

Equipment Selection

How do you choose the right equipment for your boat?

Caution: Before making your final equipment selections, read the section on "Installation Tips." Installation considerations may affect specific equipment choices.

Toilets

The type of toilet selected depends largely on the boat's size and electrical power supply as well as the owner's budget.

Caution: Seacocks at seawater intake and overboard discharge through-hulls should be closed whenever the boat is not in use...regardless of the type of toilet selected.

Manually operated toilets

Advantages:

- Not dependent on power source.
- Dependable operation.
- Relative ease of installation.
- Relatively low equipment and maintenance costs.

Disadvantages:

- Users must flush waste from bowl using a manual pump.
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Electric toilets

Advantages:

- Ease of use.
- Typically macerate solid wastes, reducing the possibility of clogged waste lines.
- Macerated solid wastes are more effectively treated by disinfectants and deodorants.
- Relatively easy to interface with a Type I or II MSD for automatic treatment.

Disadvantages:

- Rely on electric power for flushing action. Manual backup, if provided, will permit system use if power is depleted or there is a malfunction.
- More complex to install; higher cost.

Vacuum toilets:

Advantages:

- Ease of use.
- Typically use less than a quart of water per flush, a real benefit for optimizing holding tank capacity.

Disadvantages:

- Require electric to operate.

While seawater is most often used for flushing, some electric and vacuum systems recommend fresh water.

Caution: Flush water plumbing must be arranged to prevent contamination of the boat's portable fresh water supply (refer to ABYC standard H-23, *Installation of Potable Water System*).

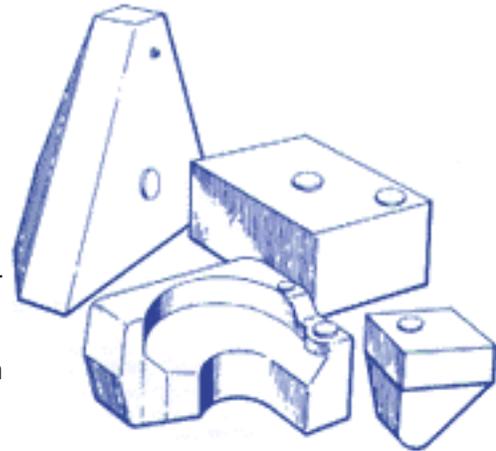
Tanks

The size of the holding tank selected should be based on the boat's intended usage (day trips, weekend or extended cruises, etc.) and the number of people using the toilet. Some experts have estimated that the average effluent (sewage and flushing water) per person per day may be as low as three gallons; in many cases it will be higher.

Leakage typically occurs at fill, pumpout and vent line connections. The more flexible the tank, the more difficult it is to maintain leak-free connections. Connection sites on a flexible tank must be reinforced to minimize the deformation of mating surfaces.

Plastic (polyethylene) tanks

are rotationally molded and, therefore, have no seams. They typically have a wall thickness of 1/8, 1/4 or 3/8 inch. Wall thickness is a key to a tank's structural rigidity and resistance to odor permeation. Odor permeation is more likely to occur in tanks with a wall thickness under 1/4". Thicker walled offer greater rigidity and permeation resistance, and are generally well worth the price differential.



Advantages:

- Readily available in a wide range of shapes and sizes.
- Generally the least expensive option.
- Provided visual indication of tank content level.

Disadvantages:

- None

Flexible tanks

Advantages:

- Can often be used when other types of tanks will not fit in the space available.

Disadvantages:

- Susceptible to permeation.
- Susceptible to leakage due to chafing and to flexing at piping connections.

Fiberglass reinforced plastic (FRP) tanks

Advantages:

- Highly resistant to permeation.
- Relatively inexpensive as a "do-it-yourself" project.
- Can be custom fit to the space available.

Disadvantages:

- Typically cost more than a plastic or flexible tank.

Metal tanks

Advantages:

- Highly resistant to permeation.
- Easy to fabricate to space available.

Disadvantages:

- Susceptible to corrosion. Sewage, additives and cleaning agents may aggravate corrosion rates.

Tank level monitors and warning systems

Federal regulations (33 CFR 159.83) require that holding tanks have a means of indicating when the tank is more than 3/4 full by volume. A translucent plastic tank can meet this requirement if its location permits easy regular access for viewing contents level. Tank level monitoring systems are fairly simple to install. These typically include a sensor installed at the top of the tank and a small remote panel with a warning light that indicates when the tank is more than 3/4 full.

Seacocks and through-hulls

Toilet intake and overboard discharge lines should be equipped with seacocks (valves) to stop the inflow of seawater in the event of a hose failure. A seacock is operated by a lever-type handle that gives clear indication whether the valve is open or closed. These seacocks should be readily accessible for maintenance and oriented so that their handles are easy to operate.

Seacocks and through-hulls are made of bronze or glass reinforced plastic. Both can be used successfully for toilet intake or overboard discharge lines. Bronze seacocks and both bronze and glass reinforced plastic ball valves may be used for toilet intake or overboard discharge lines. It's generally a good idea, however, to fit plastic valves on reinforced plastic through-hulls. Either glass reinforced plastic or bronze valves may be fitted to a bronze through-hull.

The use of gate valves, which are made of brass, should be avoided because they corrode rapidly and their stems tend to break.

Deck fittings

The federal standard for a deck fitting for pumpout is 1 1/2" inside diameter pipe thread. Most pumpout stations have adapters that will fit boats not so equipped.

The top surface of the deck fitting should be clearly and permanently labeled "Waste." Check to be certain that all of the boat's other deck fittings are labeled "Water" and "Gas" or "Diesel" as appropriate. You can ruin your whole day if you accidentally fill the waste tank with fuel or siphon out the fuel tank at the pumpout station.



Piping/hoses (intake, vent and discharge lines)

Rigid plastic (PVC) piping

comes in different thickness (strengths) known as schedules. Schedule 40, the standard for residential plumbing, works well for boats too. Structurally superior schedule 80 pipe can also be used.

Advantages:

- Highly impermeable; will not corrode.
- Resistant to chafe.
- Readily available in hardware stores with a wide range of fittings.
- Easily cut with a hacksaw; can be glued with PVC cement. Can be readily modified later if needed.
- Virtually maintenance free.

Disadvantages:

- Susceptible to damage from flexing. Provide additional support and use flexible (rubber hose) connectors to reduce potential for damage.
- Often takes longer to cut and fit rigid plastic PVC pipe in tight spaces than to run

flexible hose.

- The "nominal" size stamped on PVC piping differs considerably from the pipes actual size inside or outside diameter.
- Subject to damage from freezing if not properly winterized.

Flexible hose

Choose a hose made with one of the special compounds designed to minimize permeation of waste system odors. These are typically made of flexible PVC or rubber and labeled sanitation hose. The heavier the wall thickness, the greater the resistance to odor permeation. All waste lines should be smooth on the inside to avoid trapping waste and reinforced to prevent collapse. Rubber hose is generally more expensive, tends to have a longer service life, and is easier to stretch over fittings than flexible PVC hose.

Advantages:

- May be easier to install in tight quarters.

Disadvantages:

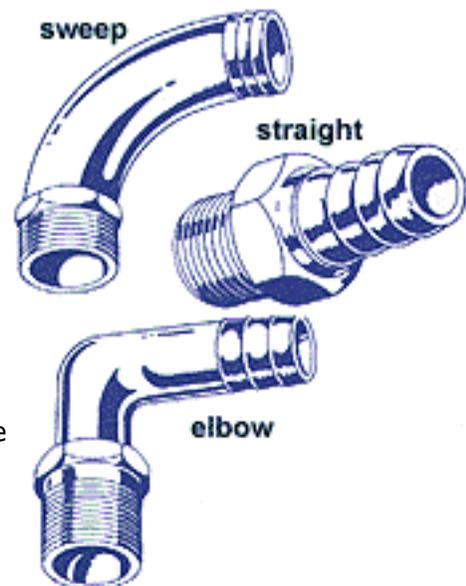
- Susceptible to permeation.

Fittings

A wide variety of fittings (adapters, couplings, elbows, t-fittings, etc.) are available for use with either rigid PVC pipe or sanitation hose. Each fitting joint creates a potential sewage catch point which may lead to a clog. When laying out the system prior to installation, use curved hose sections rather than fittings where possible. Where a fitting must be used, "sweep" fittings are preferable to "elbows".

Some lightweight spiral ribbed vacuum cleaner-type hoses will not make tight joints without a special screw-on cuff fitting. If you use this type of hose, be sure to use the required cuffs.

Plastic fittings are recommended for installation in plastic holding tanks because the coefficient of expansion is equal for the two materials. Each hose line run to a tank fitting should be restrained (e.g., with a plastic wire tie or clamp) so that it will not put a strain on the fitting and perhaps eventually cause the tank to crack.



Sealants

Sealants can be applied to the mating surface of the adapter before fitting the hose.

Caution: Using adhesive type sealants will make removal of hoses for maintenance or replacement very difficult.

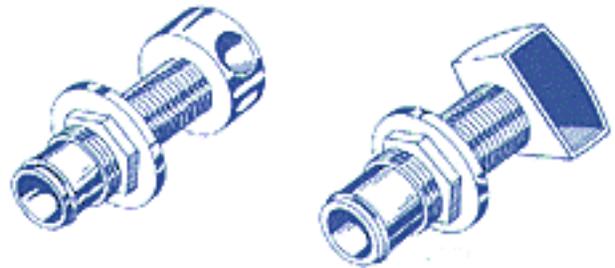
Clamps

Two hose clamps should be used at each waste system connection where space permits. Avoid clamps with nickel plated screws that are susceptible to corrosion. Look for 100% stainless steel clamps. If a clamp is non-magnetic, it is probably 100% stainless steel. If it is slightly magnetic, it may either be a lower grade of stainless steel or nickel-plated.



Vent fittings

These fittings are made of chrome plated zinc, brass, bronze, stainless steel or plastic. Overfilling the holding tank can force sewage into the tank vent line. A clogged vent line will be ineffective and can make it difficult, if not impossible, to pumpout the tank at the pumpout station. Clogged vents can also lead to overpressurizing the tank causing leakage or rupture.

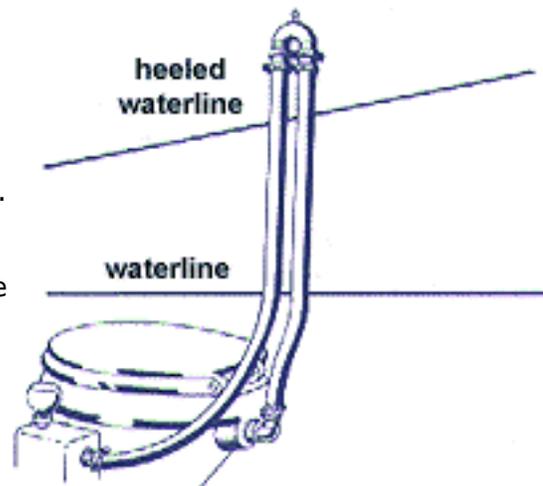


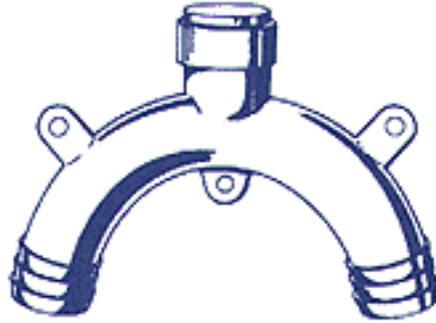
Vent line filters

A filter can be installed in the holding tank vent line to help control unpleasant odors. These filters will be most appreciated where a sewage system vent fitting is installed near the cockpit or an opening to accommodation spaces.

Siphon breaks (Vented loops)

The toilets on most boats are installed below the waterline. Any leakage past the toilet's suction or discharge valves can siphon water into the toilet, eventually sinking the boat if not discovered in time. It is, therefore, essential that a siphon break be installed on both the intake and discharge lines. A siphon break is formed by looping the line above the water level and installing a valve at the highest point so that air can be drawn into the line. As an additional safeguard, the toilet intake through-hull valve should be left in the closed position whenever the toilet is not in use.



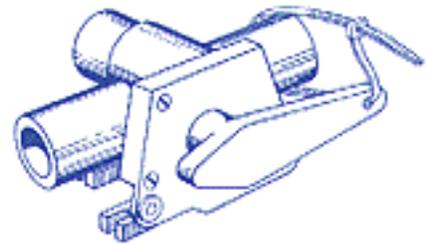


Siphon breaks are typically made of cast bronze or glass reinforced plastic, which is not affected by corrosion. A simple one-way valve at the top of the siphon break will allow air to enter the line but prevent water or sewage from escaping. Larger vent valves are less susceptible to clogging than smaller valves.

When operating within the three mile offshore limit, "Y" valves must be secured to prevent discharge of sewage overboard. Acceptable methods of securing the valve include using a padlock or a non reusable wire tie wrap, or by removal of the valve handle.

"Y" valves

"Y" valves are used to direct waste overboard, into the holding tank or to a deck pumpout fitting. Most "Y" valves used in sewage systems are made of plastic, however, bronze may also be used. Key attributes of a good "Y" valve include corrosion resistance, fully operating ports for minimal resistance to flow, ease of disassembly for maintenance, and a sturdy handle for positive stops. Make sure you can readily identify the closed position.



"Y" valves are not required at every piping junction. In the system illustrated in Fig.2, the deck pumpout fitting and the discharge through-hull valve are normally pressure tight and will typically function as selected. The advantage of using a

"Y" valve at every junction is that positive diversion of sewage flow will keep unused sections of piping from remaining unnecessarily "wet" with sewage. "Y" valves also serve as additional safeguards against accidental overboard discharge.

"Y" valves must be used at junctions where, lacking a method of positive diversion, sewage would flow both to the overboard discharge piping and to the holding tank.

Pumps

Ensure that all pumps are suited for use in sewage systems. Capacity is key to pump performance. Pumps may be made of bronze, aluminum or plastic. Bronze is frequently used in constructing rugged, high capacity pumps, while aluminum pumps are typically less expensive, but prone to corrosion. Plastic pumps are lighter and corrosion resistant, but also more likely to leak since some plastics can deform over time.

Diaphragm pumps,

Sometimes used to flush the toilet, are frequently used to pump out the holding tank. They

may be manual or electric.

Advantages:

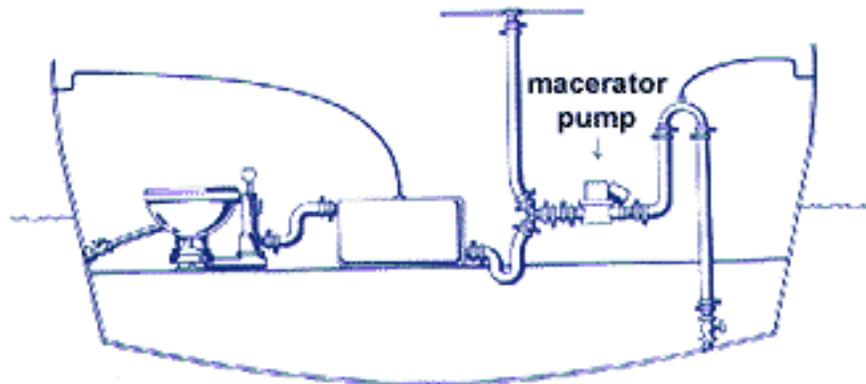
- Pass solids more readily than do piston pumps.
- Can be run dry without damage.
- Simpler design makes them less troublesome than piston pumps.

Disadvantages:

- None in waste system applications.

Macerator pumps

Are used to break up and pump wastes from many holding tanks. They may be installed inside or on top of the tank, or mounted separately. A macerator pump is not a Type I or II MSD; it does not treat sewage to reduce bacteria content.



Advantages:

- Break up solid wastes, thereby minimizing the likelihood of clogged piping downstream.
- When installed at the toilet, typically require less water for flushing than a manual pump a plus when the holding tank is being used.

Disadvantages:

- Require electrical power for operation.
- Motor, shaft seal and/or impeller may burn up if pump is run dry.

Additives

A variety of additives are available to treat toilet and marine sewage odors and/or to help break down solid wastes. These are typically injected at the toilet intake line, at the toilet itself, or at an inline sewage treatment device. The use of additives in conjunction with holding tank systems is not required. Deodorants may be desired to control odors produced by anaerobic bacteria in holding tanks.

Caution: Tanks and system fittings may deteriorate from exposure to certain additives (household bleach, caustic cleaners, etc.). Make sure you use only those additives recommended for your particular marine sewage system and ensure that they are environmentally friendly as well.

Sewage treatment equipment

Type I MSDs, which treat sewage chemically or by other means, can also be installed in-line between the toilet and holding tank. If a "Y" valve is installed after the Type I MSD, treated sewage can be pumped overboard where it is legal to do so. Otherwise, the treated effluent can be pumped into the holding tank for pumpout ashore.

Advantages:

- Treat, disinfect and deodorize sewage.
- Decreased likelihood of contact with raw sewage.

Disadvantages:

- High current draw.
- High cost relative to basic holding tank system.