

Heads and hosetails

Holding tanks, electric versus manual heads, and stamping out unwanted smells – Ali Wood gets some advice on sea toilets

With our PBO Project Boat *Maximus* now safely afloat in Chichester Marina, my thoughts turned to the jobs that needed doing before the two-day delivery trip to Poole.

It was also the end of the school summer holidays and trips to the boat were accompanied by three impatient children wanting to climb trees or swim in the harbour. DIY time was limited.

Top of my list was getting the hoses connected to the heads and galley sink. The corroded seacocks had already been replaced with TruDesign composite ones, but we'd run out of time to actually fit the hoses. While the seacocks were closed – and cable-ties protected them from curious little hands – as a double-measure I wanted the hoses fitted to the heads before we set sail. I don't know if this was so much a safety issue as my own worries. The seacocks were, of course, exceptionally robust, but I just didn't like the idea of them being our only defence against sinking.

Admittedly, now would be a good time to fit a holding tank, but we'd just come out of lockdown which, coupled with Brexit, meant prolonged delivery times for marine equipment. For now, I decided to simply refurbish the heads and replace the hoses, and fit a holding tank later.

To my enormous relief, PBO contributor Gilbert Park came to the rescue. Living in nearby Emsworth, and being handy with a spanner and a camera, he offered to help me out. I also sought advice from Richard Call of water tech company Xylem, who distribute Jabsco toilets, and Ashley Marles of Lee Sanitation.

Choosing hoses

"Some people try to clean hoses, but it's a waste of time," advises Richard. "They're not expensive; buy new ones. Best practice is to double-clip either end, so if one clip fails the other holds it in place. Hoses harden over time, which is why you can't re-use old ones – the ends are so hard they won't compress with jubilee clips."

The standard solution is white convoluted hose in 3/4in (inlet) and 1 1/2in (outlet) sizes. Note, hoses are still measured in imperial sizes for diameter. Some people also opt for clear hoses, so if they become blocked you can see the blockage. Another alternative is a low-odour or no-smell hose. These have



Keeping the workings accessible in the heads means an easier fix if things go wrong

Stephen Chung/Alamy

impermeable layering. They look like standard hoses, but they stop smelly air molecules getting through.

"A lot of people don't realise that the eggy smell you get from boat toilets is just the air permeating through the hoses," explains Richard. "It fools them. They spend ages looking for leaks, thinking the hose must be broken but air molecules are smaller than water molecules so they can still pass through the body of the hose."

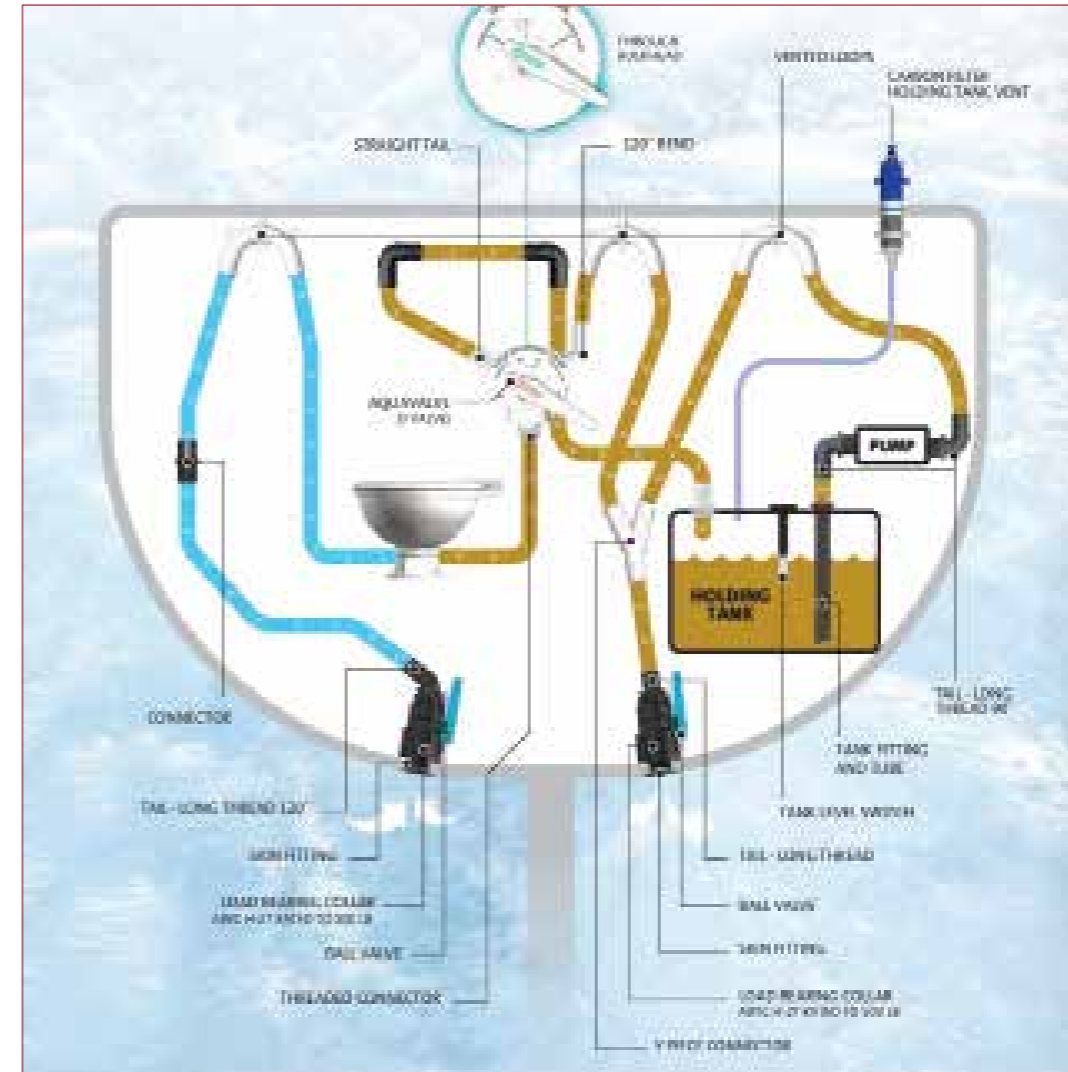
This is particularly true with raw-water or hand-pumped toilets, where the algae gets trapped in the pipes and releases hydrogen sulphide as it breaks down. The smell doesn't permeate right away, but over time, as the layer of hose breaks down with the UV, the odour escapes.

Dynamic and static waterlines

Richard points out there are a couple of things you need to know before fitting a

swan neck or 'vented loop' (the 180° pipe fitting that stops the entry of water). The first is the static waterline – the waterline as you know it when you look out of the porthole. The second is the dynamic waterline, which is when you're heeled over on the same tack as the toilet. You'll be below the waterline now as the whole side of the boat is underwater. To prevent syphoning – the water coming back out the bowl – you need to have the swan neck/anti-syphon loop at least 20cm above the dynamic waterline.

"Some people argue they don't need the swan neck on the outlet because there's a non-return valve on the toilet," says Richard. "However, that's not designed to withstand water pressure on the outside. Another common error is to put the non-return valve on the inlet in the wrong place. If you do this the toilet won't work. You need the valves in between the seacock and the toilet because that will stop the siphon."



LEFT This system diagram from TruDesign shows all the parts used in a comprehensive heads system, using any marine toilet with pump, whereby the outlet can be directed straight over the side or to a holding tank, using TruDesign's lockable diverter valve. The key part not shown is a deck pump-out option, which would require another diverter valve downstream of the pump-out pump, with options to go to the skin fitting below the waterline or to the deck fitting

Holding tanks

Leisure boat sewage discharge is, quite literally, a drop in the ocean compared to the damage done by companies such as Southern Water, who were fined £90m last summer for illegally discharging sewage on 7,000 occasions. However, as the RYA points out, it's important we know how to deal with waste responsibly, and consider the effects on the environment. There are three types of sewage: black water (toilet waste, containing harmful bacteria and viruses), grey water (from sinks, showers and washing machines), and bilge water (often contaminated with oil and fuel).

The Recreational Craft Directive (RCD) requires all new vessels to have provision for a black water holding tank; grey water can discharge directly into the sea.

There are currently no regulations (apart from some harbour bylaws) for small vessels when it comes to sewage pollution, but the RYA advises holding tanks should be emptied either at a pump-out station or three miles offshore, where it will quickly be dispersed by wave action and currents. Vessels without holding tanks should avoid discharging in poor tidal flushing areas such as

estuaries, inland waterways and crowded anchorages.

When cruising abroad, however, Richard warns that many European countries have tighter controls. They may send an inspector onboard who will want to know that you have some holding tank form of storing and locking off waste.

Holding tank options

The simplest way to fit a holding tank is to have an outlet in the bottom of the tank so that when offshore you can discharge overboard. Another option would be to have a deck fitting and, rather than discharge overboard, use a marina pump-out station.

Then there's the option to do both. You'll need to control the process with seacocks and will need extra valves to make sure that when you do the pump out, you don't empty the holding tank and then continue to suck seawater water back in through an open valve.

Where to fit a holding tank

A holding tank can be mounted where you like. Some people opt for a wall-hung one on a bulkhead, others place it in a

locker. The closer to the toilet the better, as the plumbing will be simpler and you'll have a lot less hose. If the tank is above the waterline then that also reduces the complexity of the installation. You can pump directly into the tank and that drains away to the seacock. If it's below the waterline you'll need more pumps.

How long can a holding tank store waste?

There's no limit as to how long a holding tank can store waste. It simply comes down to the size of the tank which, in a small boat, can hold anything from 60lt to 300lt of waste. Ashley Marles advises that an electric toilet uses around 7lt per flush, whereas a manual, hand-pumped toilet, just 1-2lt, so the latter will fill a holding tank more slowly.

Portable potty?

Another popular option, seen in canal boats and caravans – and sometimes boats laid up ashore – is a portable loo-type contraption. PBO's engine expert Stu Davies has one for when he stays on his boat in a Portugal boatyard. It's an installed toilet with a self-sealing

cassette, which you take out and empty. "They're not so popular with coastal sailors principally because, back in the day, the seals weren't as great as they should be and the tank volume isn't great," says Richard. "Usually it's no more than 10-20lt, which, of course, isn't a problem if you have a chemical disposal point, where you can empty it each day."

Keeping it clean

"Please don't use household chemicals in a boat toilet," says Richard. "Not only are they harmful to the environment, but they use bleach, which will attack the seals in the valve, and the seals and rubbers inside the pump. Over a short time, they're damaged, and you pump away like fury, and nothing works."

Jabsco produces Toilet Fresh, a non-chemical toilet cleaner, and also Odourlos for holding tanks, which uses enzymes to break down waste, tissue and odours. "You put a small cupful into the holding tank and they wander around munching the bad guys without harming the environment," says Richard.

Electric vs manual toilets

Manual toilets remain Jabsco's biggest seller, but increasingly boatbuilders are fitting electric as standard. Hallberg-Rassys, for example, will have one manual, one electric.

"For a bluewater boat, people like the idea of having a self-contained manual toilet that will still work if the electrics fail," says Richard. "For the more general market, there is a slow but continual drift towards electric toilets. The difference is basically it's a much neater installation, more like the toilet at home."

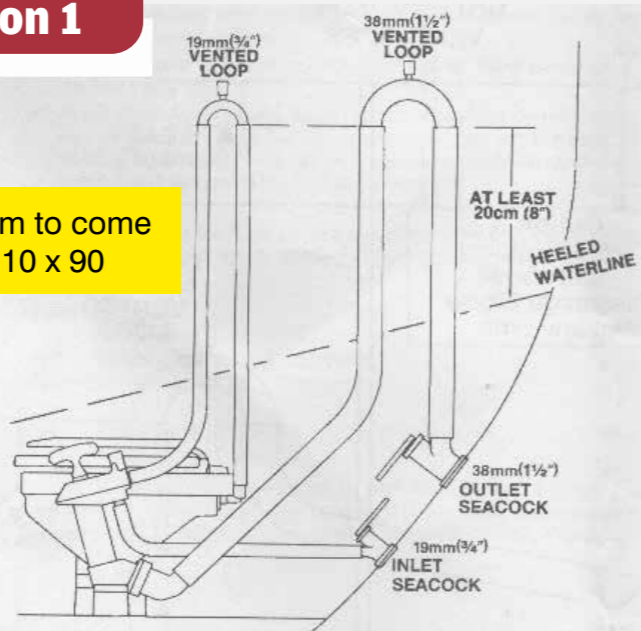
Electric toilets use fresh water to flush, not raw water, but cost is a major factor. You're talking about a jump from £150 for a hand-pumped toilet to between £600 and £800 for electric. Power draw is also quite high.

"We put big motors on and so do a lot of competitors," says Richard. "You need to know when you push the button it flushes first time. While the draw is quite high, the battery use is low as the toilet only flushes for 10 seconds. For a boat with a decent charging system it's not something to worry about."

However, if you run out of power, you're also left without a working toilet.

Option 1

diagram to come W110 x 90



A toilet below the heeled waterline that discharges straight into the sea. Two vented loops are needed to stop the risk of water siphoning into the boat through the toilet. Note that the vented loop on the inlet is sited between the pump and the bowl. If fitted between the sea water inlet and the pump you will not be able to pump water in – the vent will only let you pump in air

Maximus's toilet

In *Maximus's* survey, our marine surveyor Ben Sutcliffe-Davies noted that the Jabsco sea toilet was 'secure and in good condition.' The intake fittings needed replacement and that the one swan neck loop was low, and fitted to the discharge only, to try and prevent back flooding of the bowl when at sea. Ben advised that both intake and discharge should have higher swan necks with anti-siphon valves.

I read the original Jabsco manual which reinforced the importance of having double hose-clips with the message that an innocent thing like a loo could actually sink the boat if not installed correctly.

"If the toilet is connected to any through-hull fittings and the pipework becomes disconnected, either from a through-hull fitting or seacock, or from the toilet or any secondary valve, water may flood in and cause the craft to sink... the ends of all flexible hoses fitted directly or indirectly between the toilet and any through-hull fitting that may possibly be below the waterline at ANY time, must be

secured to the hose tails using two stainless steel worm-drive hose clips."

I sent photos of *Maximus's* toilet to Ashley Marles at Lee Sanitation, and discussed a few options with him. While I ultimately opted to keep the original loo and pump out system, it was useful to find out the costs of fitting a holding tank and going electric.

Option 1 Refurbish current toilet, £116

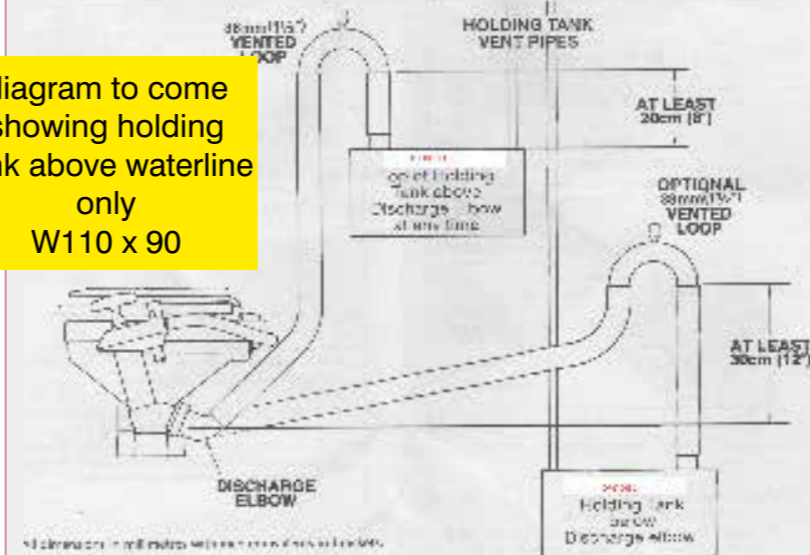
The most straightforward and cheapest option was to keep the existing toilet, replace the pipes and fit two swan necks higher up, with anti-siphon valves. This was the option we chose.

Option 2 Fit a holding tank, £548 (with new toilet +£190)

A holding tank for *Maximus* would also require a new pump assembly for the Jabsco toilet. The toilet would need to be below the waterline, using raw water for supply, and discharging to a 40lt

Option 2

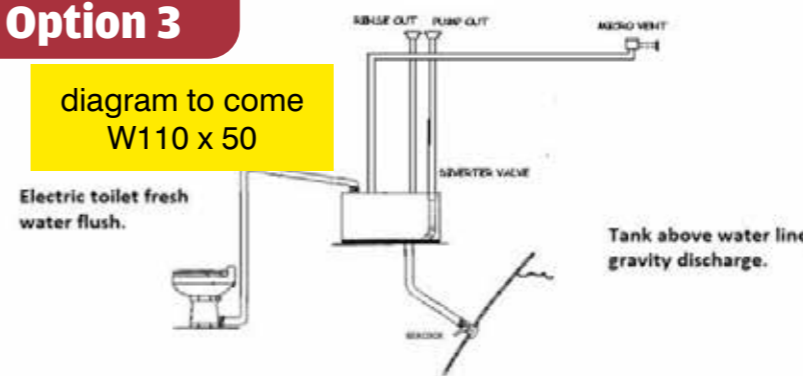
diagram to come showing holding tank above waterline only W110 x 90



Loo below the waterline with a holding tank above the waterline. This was the preferred option for *Maximus* but availability of parts and lack of time did not allow it to be fitted at this stage

Option 3

diagram to come W110 x 50



The luxury option: fitment of an electric flush toilet with a holding tank above the waterline and both gravity discharge to sea and shoreside pump-out capabilities

wall-mounted holding tank above the waterline (40 x 25 x 55cm, £381), which would allow the tank to be gravity discharged to the seacock. The tank comes with a fitting kit (including hosetails, diptube and uniseals) which needs to be fitted in the top of the tank at the time of installation. The pump assembly, including pump-out deck fitting, rinse-out deck fitting, Microvent filter and breather fitting, tank level indicator and vented loop for the inlet, comes to £167. If we replaced the toilet too that would be an additional £190.

Option 3 New electric toilet and fit holding tank, £829

Electric toilets use a freshwater flush so would need to be connected to the boat's

water pressure system that also feeds the taps. There needs to be a minimum 1.7bar pressure to supply the toilet with sufficient water. This discharges to the holding tank above the waterline, allowing the tank to be emptied by gravity. A new Sanimarin SN31 Toilet 12V would cost £662, plus £167 for the pump assembly (details as per option 2).

The tank would be above the waterline in level and heeled positions. Ashley advised that when measuring up we need to allow 15cm above the tank for the fittings and 15cm below for the gravity discharge outlet.

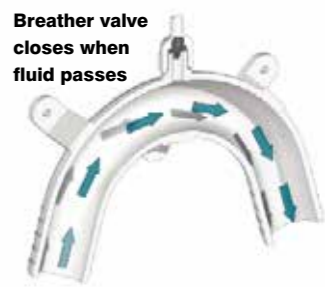
He also warned that the Microvent filter – which is essential for removing smells from the holding tank (see right) – must not get wet, so extra care is needed for installation on a sailing boat.

How vented loops work

TruDesign's New Zealand-made high strength nylon composite vented loops (also called swan necks or goose necks) prevent water siphoning from underwater skin fittings back into a vessel, thereby guarding against accidental flooding and sinking.

In a heads system vented loops are used wherever seawater could find its way from a seacock back into the boat, either inlet or outlet. They can also be used in genset or small engine inlet cooling water systems. The simple one-way breather valve at the top of the vented loop allows air to enter the line when not in use, thereby preventing siphoning, and yet seals when water or waste passes through the loop.

Breather valve closes when fluid passes



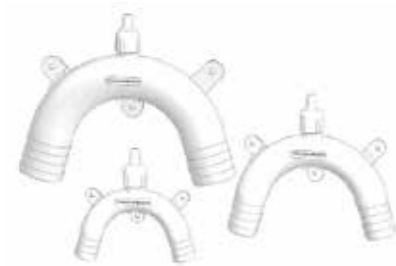
Why holding tanks need an air filter

Activated carbon filters contain absorptive carbon granules which are used to remove odours and gases from air streams, such as those found in holding tanks.

Holding tanks need breathers, but these are problematic unless the tank is fed with odour camouflaging chemicals, which hinder the natural biodegrading process.

Furthermore, water authorities don't like the use of chemicals which can damage water treatment plants when discharged into the sewer system from boats or caravans.

With an activated carbon filter, such as Microvent, the tank can be used without harmful chemicals. The filter can be installed almost anywhere and is designed to connect with the breather plumbing from any angle.



The heads needed an additional vented loop, like this one by TruDesign



Fitting kit that comes with a holding tank



A wall mounted holding tank – this one holds 80lt and costs around £460

PROJECT BOAT RESTORATION

Refurbishing the heads on *Maximus*

Gilbert Park replaces hoses on the PBO Project boat



With seacocks previously installed in the Maxi 84, it was time to connect the hoses. The first thing to decide was what sort of installation.

As Ali explains on preceding pages, there's more than one way to do this. All options require the sea water inlet. The simplest option has the waste going straight out to sea, but this setup can't be used in harbour for obvious reasons, and preferably should only be used at least three miles out to sea.

The ideal option is to fit a holding tank, but this is considerably more expensive and wasn't available to us at the time. More expensive still would have been to fit an electric loo with a holding tank above the waterline for easy emptying in dock or at sea.

A consideration for all systems is that on *Maximus* part of the toilet is on or just below the waterline with the boat in harbour. At sea, with the boat heeled over and perhaps digging the bow in it will be well below the waterline. The risk then is that the tubes, already full of water (from use) may siphon water into the toilet and from there into the boat.

To prevent this vented loops must be installed into the input and output lines. These U-shaped tubes have a one-way valve on the top that lets air in (breaking the siphon potential), but seals off with any positive pressure allowing fluids to pass freely in the right direction.

Unfortunately, supply chain difficulties meant tails for the seacocks were in short



With new pipework and a serviced pump the old Jabsco heads was good to go

supply and time was limited to connect everything up so I had to find ways around not being able to change the tails. For the two basins I had to fit reducing spigots so I could connect them up.

Tools and hose

There are some important points when installing pipework of this type. Use good quality smooth bore, spiral reinforced flexible hose. Don't skimp on this, both for safety reasons and also because cheaper

tubing may become permeable allowing smells to come out. If you have old tubing and wonder if it needs replacing, take a damp (not wet) piece of cloth and rub it along the pipework. If it smells, replace the tubing. If not, consider replacing it anyway if it's old as it might fail. Replacing the heads tubing during your cruise spoils the day!

Three inexpensive tools, although not essential, will make the job easier. A pipe cutter will make sure the cut is square and



Gentle heat from a hot air gun makes pipework more malleable and easier to fit



Anti siphon vented loop



A pipe cutter makes clean, straight cuts a breeze



Galley sink pipework and drainage

clean, while a hot air gun aids removing the old pipes and softening the new

Getting at the hose clamp screws can be difficult. A flexible socket makes it much easier. Usually, the socket is reversible allowing for different sizes of screw.

The tubing may be a tight fit on the spigots. Water on the joints may be sufficient to allow it to slide on. Oil and other lubricants are not recommended as they can damage the tubing. I've found the hot air gun the best solution to warm

the tubing making it an easy fit. I don't recommend a naked flame as you may inadvertently weaken or even burn through part of the tubing. Putting the tube into hot water supplies both heat and lubrication and may be useful away from the dock.

Double clamps

All connections should have double hose clamps, preferably with the screw parts 180° apart. This allows an overlap at these points so pressure can be applied evenly. All clamps should be made from 316 stainless steel in their entirety. Some clamps sold online have the strap made of stainless steel but the worm gear made



LEFT Replacement pump for a Jabsco heads

of mild steel which, of course, will corrode with time.

Once installed, fit small bits of rubber, plastic or tape over the tail ends of the clamps to prevent injuries as they can be sharp. One very important point is safety – wear gloves when near the fittings for the toilet as well as eye protection. I put all my tools in a bucket as I used them to keep them separate from all the others and to remind me to disinfect them. Bugs can live for a long time in old tubing.

For the full article on servicing a toilet pump see [\[bitly link to be supplied\]](#) by Chris



FROM LEFT Previous heads set-up; new TruDesign composite seacocks, two for the toilet one for the sink; new pipework all fitted



Seacock for the sink outlet

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