VacuFlush® Installer’s Guide

For Systems with Pedal Operated Vacuum Toilets
VacuFlush® System Components

SeaLand recommends that the OEM label key sanitation system components: such as vacuum generators, wye valves and directions, seacocks, etc.

VacuFlush® toilet systems are not difficult to install BUT certain steps are CRITICAL and must be followed as described. These areas are highlighted throughout this guide in RED.

For Systems with Pedal Operated Vacuum Toilets
For Systems with Pedal Operated Vacuum Toilets

VacuFlush® Principles of Operation

- Uses pressure difference between atmosphere and vacuum in the tank.
- The vacuum pump is activated by the loss of vacuum in the vacuum tank.
- Vacuum is maintained at all times. The “leak-down” time period should be approximately eight hours. (The pump should not come on within a three hour window of non-use.)
- Recharging vacuum takes less than a minute.
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</table>
Vacuum Toilets are available as all china “designer” models and “pedal operated” models.

See separate Installation Instructions for how to mount Designer Models.
Pedal operated models feature ceramic bowl and very compact plastic mounting base.

100 Series
Lowest Height
Most Compact

5000 Series
Full-sized Seat

500+ Series
Full Sized Seat
Hush Flush Seal

Three different bowl shapes:
5000 will replace the 1000 in 2007.

Pedal Operated Toilets
Critical Toilet Mounting Clearances

Location of the floor hole for the toilet discharge through floor

For Systems with Pedal Operated Vacuum Toilets
Critical Toilet Mounting Clearances

For Systems with Pedal Operated Vacuum Toilets
Pedal operated toilets are available in many different outlet configurations. Please review a SeaLand brochure for current model information.

**HINT:** If the Model Number has a zero (like 506) in the middle, the toilet discharges through the floor.

For models with 147 or 148, the connection must be a hose connection, not a glued joint.
For Systems with Pedal Operated Vacuum Toilets

Above-the-Floor Discharge - Side and Rear

These joints require SOLVENT BONDING per procedure on page 11!

90° Elbow Detail
Cannot be used with models ending in 147 or 148.

For Systems with Pedal Operated Vacuum Toilets

Section 1
For Systems with Pedal Operated Vacuum Toilets

Through-Floor Funnel Comparison

- Standard through the floor funnel
- Quick turn funnel
- Standard below the floor discharge with hose

Dimensions:
- 8 1/2" (216mm) minimum bend radius
- 2 3/4" (70mm)
- 4" (102mm)
When there is NO room, use this Quick-turn Funnel

Special Quick Turn Funnel - must be special ordered - P/N 385310550

(Can only be installed with models that use a separate floor flange funnel, like the models ending in -06 or -09.)

This joint requires PROPER HOSE CONNECTION per procedure on pages 34-36!

Limited space under the deck, despite the size of the boat.
Below-the-Floor Discharge

-08 Model Detail

This joint requires SOLVENT BONDING per procedure on page 11!
Through-floor funnels must...
• be mounted securely with 8 fasteners (not provided).
• be mounted flat against floor.
• Screw heads must be flush or lower than the top of the mounting flange on funnel.

Toilet base must be securely fastened with 4 fasteners (provided).

Bottom of the toilet base and the bottom of the through-floor funnel must be mounted on the same surface.

No gaps allowed between funnel and floor.

Follow SOLVENT BONDING per procedure per page 11 for connecting fitting to bottom of the funnel!

Use FULL scale template for cutting holes (Shipped with Owners Manual).
Solvent Bonding For Rigid Pipe & Fittings

The most important steps:

1. Use a PVC cleaner on both bonding surfaces.
2. Use a PVC cement (must contain Tetrahydrofuran) on both bonding surfaces.
3. Connect parts using a twist and hold motion until the glue is set.
4. Let joint cure for at least four hours or per instructions on the container. (Cold temperatures require longer cure times.)
The incoming water line MUST...

- Be **cold water ONLY**
- Be ½” (13mm) **MINIMUM ID**
- **Provide a MINIMUM flow of 2 gallons/min (7.6 liters/min) at the toilet.** This requires a 2.8 GPM (10.6 l/m) demand pump, or greater depending on line restrictions.
- Include a **SHUT-OFF valve** for maintenance purposes

Fresh water is highly recommended. If the choice is made to use salt or brackish flush water, SeaLand requires the use of a primary and secondary filter. The secondary filter must be 100 mesh or less.
Keep Debris Out of the Toilet

- To prevent leaks, **THE BALL SEAL MUST BE PROTECTED FROM DEBRIS.** Keep the toilet bowl covered.
- Lag bolts and/or T-bolts **MUST be securely fastened in FOUR locations**, or toilet wobble will result.

Ball seal debris is **THE MOST COMMON installation problem!!**

Leave this protective cover in place until final delivery.
For Systems with Pedal Operated Vacuum Toilets

Critical Guidelines – Toilet Installations

1. Allow proper clearances from rear and side objects (bulkheads, partitions, etc).
2. When installing a funnel, secure the funnel flat against the floor using 8 fasteners.
3. Fasten toilet securely to floor using 4 fasteners.
4. When installing a funnel, the bottom of the toilet base and the bottom of the through-floor flange must be mounted on the same surface.
5. Follow proper solvent bonding procedure for rigid PVC on page 11 when required.
6. Assure minimum incoming water supply of 2 gallons per minute (7.6 liters/min) at the toilet.
7. Keep debris out of the toilet bowl/funnel DURING INSTALLATION to avoid vacuum or water leakage through the ball seal.
Section 2: Vacuum Sources

Combination Vacuum Tank, Vacuum Pump and Holding Tank for Smaller Craft

2500 Vacuum Cassette Tank
- Requires only 1.6 cubic feet of space.
- Removable 3.6-gallon cassette tank slides into remote docking platform.
- Self-closing valve automatically seals removable cassette tank.
- Can be installed with any VacuFlush toilet.

3600 Vacuum Holding Tank
- Can be discharged dockside or overboard in unrestricted waters.
- Holding capacity of 6.5 gals. (24.6 L).

4500 Vacuum Holding Tank
- Must be installed with 150 Series toilet with pedal lock (See next page.)
- Has roughly same dimensions as VHT
- Holding capacity of approximately 9 gallons (50% more than VHT)
- Includes ¾ & FULL level indication with panel with wire harness
- Automatic shut down when full
- Integrated discharge pump mounting

For Systems with Pedal Operated Vacuum Toilets
150 Series Vacuum Toilet with Pedal Lock for installation with 4500 VHT

Allows make up air into 4500 tank during waste discharge.

1. Engage pedal lock with toe.

2. Press down on pedal and release to lock flush ball open.

3. Press down to release lock.

For Systems with Pedal Operated Vacuum Toilets
Section 2: Vacuum Sources

Vacuum Generators (Ideal for typical cruisers of all sizes)

- **New Vacuum Generator 4**: Combines Vacuum Pump and Tank into one package...VG4 has many new features.
- **Low Profile Vacuum Generator**: Low Profile fits in areas with reduced heights...less than 8-inches (20.3 cm) tall.
- **Vacuum Tank and Pump**: Separate S-series Pump and Vacuum Tanks for very compact spaces.

**NOTE**: ALL VACUUM GENERATORS ARE NOW EQUIPPED WITH NEW “WHISPER-QUIET” PUMPS.
Section 2: Vacuum Sources

Holding Tank System (HTS) with Vacuum Generator (VG)

Pre-assembled, pre-tested holding tank assemblies.
Over 165 existing tank shapes.
Tank material has 30+ year life.
Pre-formed mounting surfaces.
Molded in mounting feet ...eliminating need for strapping.
Pre-assembled pipe and hose connections.
Section 2: Vacuum Sources

M-Series Pump and Vacuum Tank for multiple vacuum toilets on a central pump.

M-series pumps can serve up to 8 toilets. Each toilet and vacuum tank is followed by a check valve and an isolation valve. Sanitation System Control Unit (SSCU) allows complete system control from one location. Available voltages are: 12-volt, 24-volt, 110-volt AC and 220-volt AC.

More on racked M-Pump systems in the Yacht System Designer Guide.
For Systems with Pedal Operated Vacuum Toilets

A. Maximum vertical height of vacuum piped from toilet outlet to vacuum source inlet is 6 feet (1.8 meters).

B. Maximum horizontal length of vacuum piped from toilet outlet to vacuum source inlet is 50 feet (15 meters).

Each toilet must have a separate vacuum generator or tank/pump.

Except M-pumps and some electrically operated toilet installations.
Suction and Lift Parameters – Pumps with W-motors

Each toilet must have a separate vacuum generator or tank/pump... except M-pump systems and some electrically operated toilet installations.

A = 50-feet (15-meters)
B = 6-feet (1.8-meters)
C₁ + C₂ = 6-feet (1.8-meters)

Note vertical loops on pressure side of pump exceeding a total of 6-feet (1.8-meters) create excessive backpressure, preventing vacuum pumps from shutting off.

NOTE: It is always more desirable to lift with vacuum by locating the vacuum generator up to 6-feet and to push up another 6-feet.

For Systems with Pedal Operated Vacuum Toilets
Key Installation Points

- Never attempt to adjust the vacuum switch in the field.

- Never test a dry vacuum generator.
For Systems with Pedal Operated Vacuum Toilets

Vacuum Pump Mounting

- Mount pump horizontally
- Mount pump at same level or lower than vacuum tank outlet. Do not mount the pump higher than the vacuum tank outlet.

Optional straight or 90° swivel quick-disconnect fittings are available for suction & discharge sides of vacuum pump.

- 307341513 – hose connector
- 307341425 – threaded fitting
- 385310728 – swivel fitting assembly
- 307341161 – elbow

Section 2
Sailboat Pump Mounting

When mounting Vacuum Pump or Vacuum Generator athwartships (at right angle to keel) on sailing vessels, compensate with a 15° incline on the discharge side.

Mounted athwartship (at right angle to keel), need 15° incline to be acceptable.

Mounted parallel with keel, no incline is needed.
Vacuum Tanks Do’s & Don’ts

- The outlet of the vacuum tank must be at the lowest level.

- The vacuum switch must be on the top when mounted vertically.

- Proper clearance must be allowed for access to the vacuum switch.

Never tamper with the vacuum switch! Vacuum levels can ONLY be adjusted at factory!
Accessibility is Important!

Do NOT do this!! Insufficient access.

- EASY access is needed to service
  - Pumps
  - Vacuum Switches
  - Tank inlet and outlet fittings
  - Vent Filters

- All pumps and tanks must have access to replace if necessary.

Vacuum Generator is located behind an appliance, difficult to access and entire unit cannot be replaced.
ALLOW ACCESS TO:

- MOTOR
- AIR PUMP BODY AND VALVES
- VACUUM SWITCHES
Critical Access Areas

ALLOW ACCESS TO:
- MOTOR
- PUMP BODY AND VALVES
- VACUUM SWITCHES
Minimizing vacuum pump noise

Avoid placing vacuum pumps under sleeping areas.
Critical Guidelines – Vacuum Sources

1. Do not exceed the maximum length between toilet outlet and vacuum source of 50 feet (15.2 meters) or the maximum height of 6 feet (1.8 meters).

2. There must be a separate vacuum source (vacuum generator) for each toilet.

3. Support the hose coming from the vacuum generator.

4. Mount pumps horizontally 15° athwartship on sailboats.

5. Vacuum tanks
   - Locate the outlet of the vacuum tank at the lowest level.
   - When mounted vertically, the vacuum switch must be at the top.
   - Never tamper with the vacuum switch settings.

6. All fittings and connections, pumps, vacuum switches, tank inlet and outlet fittings and vent filters must be readily accessible.

7. Avoid locating vacuum pumps under berths.
3. Hose and Piping Layout

Problems to be Avoided

Crushed, pinched, kinked hoses found on new boats.

- Hose is routed improperly.
- Hose forced beyond bend radius, routed too tightly.

This could be avoided by using a quick turn funnel.

For Systems with Pedal Operated Vacuum Toilets
Supporting the Vacuum Hose

The inlet and outlet hoses of the vacuum generator must not have a side load (see picture below). Support the hose, as necessary.

Do not let the hose go unsupported (up or down). It will pull the fitting out of the seal, creating a leak.
Vacuum Side Factors – General
Elbows and bends on vacuum side do not effect flushing efficiency.

90° ELBOW OR HOSE BEND
Vacuum Side Factors – General
Upward slopes as shown should be avoided.
Use Generous Bend Radii to avoid hose kinks.

<table>
<thead>
<tr>
<th>Piping Material</th>
<th>Minimum Inside Bend Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5” (38 mm) OdorSafe Hose</td>
<td>7.5” (190.5 mm)</td>
</tr>
<tr>
<td>1.5” (38 mm) Pipe Fittings</td>
<td>2.5” (64 mm)</td>
</tr>
</tbody>
</table>

All piping and fittings (including seacocks) must be 1 1/2-inch (38 mm) nominal pipe size.
Hose Run Simplification

BEFORE

• One-head system with 40 gallon holding tank
• Excessive hose runs
• Difficult to reach wye valve
• Discharge hose from holding tank always filled with sewage

AFTER

• Now a two-head system with 40-gallon holding tank on same footprint. Created by matching a SeaLand holding tank with rigid pipe fittings.
Avoid Heat Sources

Do not locate in or around hot water heater relief valves (they may leak).
For Systems with Pedal Operated Vacuum Toilets

Do Not Risk Affecting Structural Integrity
Making Hose Connections

How to use the SeaLand Hose Heater

1. Insert hose into pre-heated hose heater for 1.5 - 2.0 minutes. Do not leave the hose in the hose heater for longer than 10 minutes, hose degradation will occur.

2. Remove hose from heater. Using liquid dishwashing soap, quickly lubricate fitting and inside hose end, then push hose onto fitting. For second end, twist hose counterclockwise before placing onto fitting. This will ease installation due to natural twist (helix) of the hose.

3. Allow hose to cool to room temperature, then clamp hose to fitting with two clamps. Make sure clamp mechanisms are 180° from each other when tightened.

Never use an open flame or overheat hose end!
WHEN DOING THIS... USE THIS...

AND REMEMBER THIS...

**LITHIUM-BASED GREASE** has led to small cracks in adapters due to chemical reaction with certain PVC formulations.

**RTV (ROOM-TEMPERATURE Vulcanizing) SEALANT** inhibits ability to service system easily at a later time if needed.

**PVC CEMENT** prevents ability to service system easily at a later time if needed.

*For Systems with Pedal Operated Vacuum Toilets*
• All hose connections should be double clamped with screw mechanisms 180° apart and reversed.

• Use ONLY liquid soap and SeaLand hose heaters as aids for installing sanitation hoses.

• Connect hose only to barbless fittings sized at a diameter of 1.53 ± .015" (39 ± .4mm).

• Fully insert hose to the positive stop. If there is no stop, minimum hose insertion is 1 1/8” (29mm).

For Systems with Pedal Operated

Section 3
Wye valves create odor permeation problems by trapping waste in unused hose runs.

To avoid odor permeation problems, eliminate unnecessary runs that can trap liquids.

Use RIGID pipe for any locations of standing sewage.

Acceptable material for rigid piping is PVC.
Hose… Avoiding Malodors

Use rigid piping for standing sewage!

Before: failed hose

After: replaced with rigid standpipe
PVC Rigid Pipe

1½-inch (38mm) PVC pipe cut in 5-foot (1.5m) length for easy handling. For use with all fittings shown on next two pages.

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<thead>
<tr>
<th>Product No.</th>
<th>Description</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>307001540</td>
<td>1½-inch (38mm)</td>
<td>5-foot (1.5m)</td>
</tr>
<tr>
<td>Product No.</td>
<td>Description</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>307341085</td>
<td>Pipe Coupling</td>
<td>Connects 1½-inch (38mm) PVC pipe sections.</td>
</tr>
<tr>
<td>307341143</td>
<td>90° Bend</td>
<td>90° Ell for connecting 1½-inch (38mm) PVC pipe sections.</td>
</tr>
<tr>
<td>307341425</td>
<td>Threaded Male Adapter</td>
<td>Adapts 1½-inch (38mm) PVC pipe to 1½-inch (38mm) NPT thread.</td>
</tr>
<tr>
<td>307347286</td>
<td>45° Wye</td>
<td>Makes three way connection to 1½-inch (38mm) PVC pipe.</td>
</tr>
<tr>
<td>307341812</td>
<td>Double Bend</td>
<td>Makes three way connection of 1½-inch (38mm) PVC pipe.</td>
</tr>
<tr>
<td>307341158</td>
<td>Sanitary Tee</td>
<td>Makes three way connection of 1½-inch (38mm) PVC pipe.</td>
</tr>
<tr>
<td>307342971</td>
<td>Special Adapter for Toilet Outlet</td>
<td>Adapts VacuFlush toilet outlet to other PVC pipe connections.</td>
</tr>
<tr>
<td>307341104</td>
<td>PVC 45° Street Ell</td>
<td>Handy for custom fitting design. Adapts to all 1½-inch (38mm) PVC fittings shown here.</td>
</tr>
<tr>
<td>307341161</td>
<td>PVC 90° Street Ell</td>
<td>For tight bends. Can be used with other PVC fittings shown. 1½-inch (38mm) Hub.</td>
</tr>
<tr>
<td>Product No.</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>307230310</td>
<td>Hose Mender Kit: &lt;br&gt;Connects 1½-inch (38mm) for maintenance purposes.</td>
<td></td>
</tr>
<tr>
<td>307230311</td>
<td>90° Bend Kit: &lt;br&gt;Provides smooth sweep bend. Eliminates hose kinking in sharp bends.</td>
<td></td>
</tr>
<tr>
<td>307230312</td>
<td>Hose Adapter Kit &lt;br&gt;Connects 1½-inch (38mm) hose to 1½-inch (38mm) NPT thread.</td>
<td></td>
</tr>
<tr>
<td>307230313</td>
<td>Double Bend Kit &lt;br&gt;Connects intersecting 1½&quot;-inch (38mm) hose segments per indicated flow as shown.</td>
<td></td>
</tr>
<tr>
<td>307238798</td>
<td>WYE Kit &lt;br&gt;Connects intersecting 1½-inch (38mm) hose segments per indicated flow as shown.</td>
<td></td>
</tr>
<tr>
<td>307238802</td>
<td>Tee Kit &lt;br&gt;Connects intersecting 1½-inch (38mm) hose segments per indicated flow as shown.</td>
<td></td>
</tr>
<tr>
<td>307341113</td>
<td>Reducing Adapter &lt;br&gt;Connects 1½&quot;-inch (38mm) hose to 1-inch (25mm) hose.</td>
<td></td>
</tr>
<tr>
<td>307341513</td>
<td>Custom Hose Adapter &lt;br&gt;Can be used with all 1½-inch (38mm) PVC fittings with socket connection. Lubricated hose or cuff slides on easily.</td>
<td></td>
</tr>
<tr>
<td>307348684</td>
<td>Flexible Vinyl Couplings &lt;br&gt;Handy 3-inch (76mm) length of soft vinyl to couple 1½-inch (38mm) hose adapter fittings.</td>
<td></td>
</tr>
<tr>
<td>307238803</td>
<td>Hose Tail Piece &lt;br&gt;Connects hose to 1½-inch (38mm) MPT with swivel nut and sealing ring included.</td>
<td></td>
</tr>
</tbody>
</table>
1. Simplify the layout – eliminate unnecessary valves and hose runs.
2. Use plumbing fittings or hose with generous bend radii to avoid hose kinking.
3. Do not run hose or piping close to heat sources.
4. Avoid sharp edges where hose or pipe pass through bulkheads or panels.
5. Pre-heat hose using SeaLand Hose Heaters.
6. Follow the hose connection procedure on pages 34-36.
7. Double clamp all hose connections, rotating clamps 180°.
8. Use only RIGID PIPING for any runs containing standing sewage.
9. Follow solvent bonding procedure per page 11.
SeaLand holding tanks available in MANY configurations

Rotationally molded, polyethylene holding tanks, which have thick walls and are resistant to corrosion, are recommended.
For Systems with Pedal Operated Vacuum Toilets

Holding Tank Locations

1. The BEST location for a holding tank is at an elevation lower than the vacuum pump.

   ✓ Allow room above the tank for attaching inlet and outlet fittings, vent fittings and level indicator cap.
   ✓ All flexible hose runs should be installed to drain into the holding tank or to the seacock. If runs of standing sewage cannot be avoided, use RIGID pipe.

2. Do not pump UP, if possible!

3. Better to use vacuum source to lift sewage, not to push sewage with pump.
If the holding tank **MUST** be located above the vacuum source...

- **This stand pipe must be rigid PVC**
- Enter the holding tank from the top
- **20 ft MAX (6.1m)**
- **6.0 ft MAX (1.8m)**
- Include a maintenance valve.

SeaLand does not recommend locating the holding tank above the vacuum generator, **but in layouts with no alternatives, follow the above guidelines.**
For Systems with Pedal Operated Vacuum Toilets

Use Diptubes

- Diptubes can be added to existing SeaLand or any holding tank.
- The engineered angle on diptubes will reduce the possibility of plugging.
- Angled suction fitting also lowers the tank contents to provide maximum liquid pumpout.
- Diptubes eliminate standing liquid in the discharge hose, eliminating the possibility of odor permeation.
- Diptube connection on top of tank allows for increased tank length (A).

Conventional Discharge

Recommended Discharge

Section 4
“Problem Solver” Accessories for Holding Tanks

- **TANKSAVER** automatically allows make up air into tank. Allows use of 5/8-inch vent line.
- **SANIPUMP** with pre-wired sealed connectors are available.
- **TANKWATCH 4** is a four-level indicator with automatic shut-off when tank is full.
- **SANIGARD** in-line vent line odor filter.
- **TANKMANAGER** provides automatic discharge of sewage overboard or to holding tank.
- **SEACOCK INTERLOCK SWITCH** eliminates operator error. Prevents pump damage from operating a closed seacock.
For Systems with Pedal Operated Vacuum Toilets

Use Vent Filters

1. Always use **reinforced vent hose** to prevent kinking.
2. Do not allow a **low spot in the hose**, this will allow condensation to build up and block the hose – trapping odors.
3. Easy access must be allowed to replace the vent filters!

Vent filter is located below top of holding tank.
For Systems with Pedal Operated Vacuum Toilets

**Discharge Pumps**

The maximum vertical distance recommended on the discharge side is 10 feet (3.05 meters). This parameter does not apply to vacuum generators.

To calculate the pump discharge head, take the following two measurements and add them together:

- **X.** The vertical height from the discharge outlet of the pump to the highest point in the discharge line.
- **Y.** The distance below the waterline of the discharge thru-hull if connected directly to a seacock.

\[ X + Y = 10 \text{ feet (3.05 meters)} \]

**Maximum Total Head**

Vented loops are mandatory when the pump is or may be below the water line (due to heeling or loading).

T-pumps have left-handed threads. They will sometimes unscrew during the installation of hose to the next fitting in the discharge line.
For Systems with Pedal Operated Vacuum Toilets

**Vented Loops & Seacocks**

Vented loops are required in the overboard discharge line when the top of the toilet is below the water line.

ABYC standard requires a seacock on all through hull fittings less than 7°, as shown, above the waterline. ISO requires that any thru-hull that is capable of discharging sewage must be equipped with a seacock.
When Installing Level Indicators into Holding Tanks...

It is important for the float switches to be positioned properly at installation.

See TankWatch® Owner’s Manual, for specific instructions.
1. Do not pump up to the holding tank if possible. Use vacuum to lift sewage.
2. Rigid pipe must be used for runs where standing sewage may collect.
3. Hose runs into and out of the holding tank should be made through the top of the tank.
4. If layout must pump up, 6 feet (1.83 m) is maximum allowable head and a rigid stand pipe must be used.
5. Use diptubes to eliminate discharge lines that contain standing sewage.
6. Be sure that vent filter lines do not have low spots that trap liquid.
7. Allow easy access to replace vent filters.
8. Any probe lengths and float switches must be positioned properly at installation.
Section 5:

Critical Guidelines – Electrical System

1. Each pump (or vacuum generator) must have its own circuit breaker or fuse.
2. Always use stranded copper wire (preferably tinned).
3. Always use crimp type connectors. Do not use wire nuts (they corrode).
5. Wire size must be appropriate for run length per ABYC/ISO wiring practices.

<table>
<thead>
<tr>
<th>System</th>
<th>Voltage</th>
<th>Circuit Breaker</th>
<th>Wire Size – English (Metric)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum Pumps and Generators (with W-series Motor)</td>
<td>12 volt DC</td>
<td>10 amp Breaker</td>
<td>14 to 12 Gauge (2 to 3)</td>
</tr>
<tr>
<td></td>
<td>24 volt DC</td>
<td>5 amp Breaker</td>
<td>14 to 12 Gauge (2 to 3)</td>
</tr>
<tr>
<td>VHT 4500 without Discharge Pump</td>
<td>12 volt DC</td>
<td>5 amp Breaker</td>
<td>14 to 12 Gauge (2 to 3)</td>
</tr>
<tr>
<td>VHT 4500 with discharge pump</td>
<td>12 volt DC</td>
<td>5 amp Breaker for Vacuum Pump</td>
<td>14 to 12 Gauge (2 to 3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Separate 10 amp Breaker for Discharge Pump</td>
<td>14 to 12 Gauge (2 to 3)</td>
</tr>
<tr>
<td>VHT 3500</td>
<td>12 volt DC</td>
<td>5 amp Breaker</td>
<td>14 to 12 Gauge (2 to 3)</td>
</tr>
<tr>
<td>VHT 2500</td>
<td>12 volt DC</td>
<td>5 amp Breaker</td>
<td>14 to 12 Gauge (2 to 3)</td>
</tr>
</tbody>
</table>
Section 6: System Checkout

Before energizing the system, check the following:

✓ Key system components (vacuum generators, wye valves, seacocks, etc.) are labeled appropriately (port, starboard, forward, aft, guest, etc.).

✓ Toilet(s) mounted securely.

✓ Vacuum tank(s) mounted securely.

✓ Pump(s) mounted securely.

✓ Holding tank is vented correctly.

✓ All connections have double hose clamps installed tight and rotated 180°.

✓ No kinks or sharp bends in hose.

✓ No crushed or partially collapsed hose.

✓ Holding tank mounted securely.

✓ System must be winterized per page 56 instructions for areas with temperatures below freezing.
Power On Check

✓ Pressurize water system.
✓ Energize vacuum system.
✓ Hold flush valve open on each toilet for 30 seconds to charge vacuum pump with water. Assure that sufficient water has circulated through the system to wet pump valves before proceeding with the following test procedure.

Do not test system dry!
✓ After closing toilet flush valve, note time it takes for pump to shut off. Vacuum pump should shut off within one minute.
✓ Inspect inlet water connections on toilet(s) for leaks.
✓ Turn off power to the pump and let the system sit for eight hours. Re-establish power to the vacuum pump. If the pump turns on, there is a vacuum leak. Use the Digital Vacuum Gauge Instructions on page 57 to troubleshoot the leak.
✓ Winterize the system to prevent freeze problems by flushing the system with antifreeze or draining all water from the water valve assembly (see following page).
## Winterizing the System

### Flushing with antifreeze
1. Thoroughly flush the system with fresh water.
2. Empty the holding tank.
3. Shut off the water supply to the toilet and remove the inlet waterline.
4. Push the flush lever until all water is drained from the toilet and water valve.
5. Drain potable water tank.
6. Add antifreeze to potable water tank. The antifreeze should be pink and contain no alcohol. **DO NOT DILUTE** the antifreeze with water.
7. Reconnect the water inlet to the toilet. Flush the antifreeze through the system into the holding tank.
8. Empty the holding tank.

### Draining water from the water valve
1. Disconnect the water supply line from the water valve.
2. Depress the flush pedal to allow water to drain out of the toilet.
3. Allow all water to drain out of water valve and water inlet line.
4. Reattach water supply to the water valve.
Determine the System Leak Rate

Use SeaLand’s Digital Vacuum Gauge (P/N 318530003) to confirm the system leak rate and find the leak.

1. Be sure that water has circulated through the system and the duckbill valves are wet. Turn off water to toilet.

2. Follow the instructions included with the vacuum gauge to determine the leak rate.

Digital gauge measures vacuum in 1/100 Hg in.
Reads 8-hour leak rate in 15 minutes!

<table>
<thead>
<tr>
<th>Drop in Vacuum (15 min)</th>
<th>Extrapolated time between pump cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; .2&quot; Hg (not acceptable)</td>
<td>2.5 hours</td>
</tr>
<tr>
<td>* .15&quot; Hg (acceptable)*</td>
<td>3.3 hours</td>
</tr>
<tr>
<td>.10&quot; Hg (good)</td>
<td>5.0 hours</td>
</tr>
<tr>
<td>.05&quot; Hg (very good)</td>
<td>10.0 hours</td>
</tr>
</tbody>
</table>

* Maximum acceptable leak rate*

For Systems with Pedal Operated Vacuum Toilets
Section 7: System Troubleshooting

1. Water will not stay in the bowl.

- Is the plastic flush ball closed completely?
  - NO: See Problem number 2.
  - YES: The bowl-to-base clamp ring may be loose.
    - Check the bowl-to-base clamp ring by removing the base cover. Tighten band clamp around the base and bowl until very snug (65-inch pounds).
    - Is the water level in the bowl holding?
      - NO: Ball seal may be worn or damaged. Replace ball seal. Is the water level in the bowl holding?
      - YES: An improper seal develops around flush ball from dirt or debris collecting on underside of the ball seal. Clean flush ball and underside of ball seal for foreign objects (cleaning tool available, p/n 600344236). Is the water level in the bowl holding?
    - YES: Flush ball may be scratched or damaged. Visually inspect the flush ball for scratches and replace if needed. The water level should now hold.
For Systems with Pedal Operated Vacuum Toilets

2. Plastic flush ball will not close completely.

Frictional drag may exist between flush ball and ball seal.
*Lubricate the flush ball with silicone spray (must not contain petroleum distillates) or furniture polish.
Is the flush ball closing completely?

The flush ball may be catching on the edge of ball seal.
*Be sure that the ball seals are centered over the flush ball and in the center of the base. Reposition if necessary.
Is the flush ball closing completely?

The water valve screws may be over-tightened.
*Loosen the screws slightly.
Is the flush ball closing completely?

The spring cartridge is defective.
*Check spring tension by releasing the flush lever suddenly. If lever does not snap back, replace spring cartridge.
The flush ball should now close completely.

3. Plastic flush ball will not open.

The shaft may not be fully engaged in the spring cartridge.
*Replace the spring cartridge assembly and be sure that the shaft and spring cartridge are fully engaged upon reassembly.
The flush ball should now open.

Is the shaft is broken?

Replace the shaft.
The flush ball should now open.
4. Water does not shut off in toilet (toilet overflows).

Does the foot pedal return to normal position when activated?

YES

NO

The water valve screws or cartridge screw may be over tightened.
Loosen the screws slightly.
Has the water shut off?

NO

YES

Is the flush lever a plastic shroud over a metal lever?

YES

There may be insufficient clearance between cam strap and top of water valve.
Adjust cam strap to have .02"-.06" (0.5mm-1.5mm) clearance with top of water valve.
Has the water shut off?

NO

Debris may be lodged in the water valve seal.
Replace the water valve assembly.
Water should now be shutting off.

NO

NO

There is insufficient clearance between the cam strap and water valve assembly.
Replace the plastic foot pedal assembly.
Has the water shut off?
5. Water does not enter toilet bowl properly.

The water flow rate at the toilet may be insufficient.  
*Check the flow rate at the waterline from the back of the toilet, it needs to be 2 gpm (7.6 lpm).*  
Is the flow rate acceptable?

- **YES**
  - The water valve assembly may have a dirty/plugged screen.  
    *Remove and clean the screen located at the inlet of the water valve assembly.*  
    Is water entering the bowl properly?

- **NO**
  - The bowl may have plugged rim wash holes.  
    *Clean the holes (using a stiff wire or awl). If the flow is still unacceptable, replace the bowl.*  
    Water should now enter the bowl properly.

The water line must be ½″ (12.7mm) the entire distance from the demand water pump.  
*Check the water lines and replace where needed.*  
Is the flow rate acceptable?

- **NO**
  - The pump may not be large enough to supply the required rate.  
    *Check the pump rating it needs to be a minimum of 2.8 gpm (10.6 l/m). Replace the demand water pump with a higher rated pump if needed.*  
    The flow rate should be acceptable, is the water entering the bowl properly?
6. Cannot lift flush lever to add water to the bowl.

Is the flush lever a plastic shroud over a metal lever?

- **YES**
  - There is excessive clearance between the cam strap and water valve assembly. Adjust the cam strap clearance so it is .02"-.06" (0.5 - 1.5mm). The flush lever should now add water.

- **NO**
  - There is excessive clearance between the cam strap area of the plastic foot pedal and water valve assembly. Replace the plastic foot pedal assembly. The flush lever should now add water.

7. Water is leaking from the water valve assembly.

The water line connection may be loose and/or not seated properly. Insure that the fittings are not cross threaded and tighten. Is the assembly still leaking?

- **YES**
  - The valve body may be cracked from freeze damage or the unit may have a defective water valve or the threads may be stripped. Replace the water valve assembly. Water should no longer be leaking.
8. Water is leaking from the rear of the toilet bowl.

The vacuum breaker assembly may not fully insert into the uniseal.
*Secure the vacuum breaker connection.*
Is water still leaking from the rear of the toilet?

YES

The vacuum breaker may be leaking.
*Remove the white cap from the vacuum breaker and flush the toilet. If water leaks while flushing, this is the problem.*
*Replace the vacuum breaker assembly.*
Was this the problem?

NO

The toilet bowl may be cracked or defective.
*Replace the toilet bowl.*
Water should no longer leak from the rear of the toilet bowl.

9. Water is leaking from the toilet bowl/base connection.

The bowl-to-base clamp ring may be loose.
*Check the bowl-to-base clamp ring by removing the base cover. Tighten band clamp around the base and bowl until very snug (65 inch-pounds).*
Is the water still leaking?

YES

The ball seals may be misaligned.
*Be sure the ball seals are centered over the flush ball and in the center of the base. Reposition if necessary.*
Is the water still leaking?

YES

The internal ball seals may be worn or defective.
*Replace the ball seals.*
Water should no longer be leaking.
10. Pump is running too often between flushes (more than once every 3 hours).

Determine the system leak rate before starting per Digital Gauge Instructions.

The flush ball may be leaking.
*Leave a small amount of water in the toilet.*
Is water being sucked from the bowl?

- **YES:** See problems 1 & 2. Was this the problem?
- **NO:** Leave a small amount of water in the toilet. Is water being sucked from the bowl?

Check for a leak at the vacuum generator.
*Remove the inlet hose to the vacuum generator and insert the vacuum gauge in the inlet fitting.*
Does the vacuum leak stop?

- **YES:** Check for a leak at the vacuum generator.
  *Insert vacuum gauge in 1” opening at toilet outlet.*
  Does the vacuum leak stop?

  - **YES:** The leak is probably between the toilet and the vacuum generator.
    *Check the hose and all connections (including clamps and threaded spin nuts between the toilet and the vacuum generator). Apply solvent to plastic joints with a cotton swab. On Ecovac units, also check the screws in the discharge cup under the base.*
    Leak should be resolved.

  - **NO:** The leak is between the toilet and the vacuum generator.
    *Insert vacuum gauge in 1” opening at toilet outlet.*
    Does the vacuum leak stop?

    - **YES:** The leak is between the toilet and the vacuum generator.
      *Insert vacuum gauge in 1” opening at toilet outlet.*
      Does the vacuum leak stop?

      - **YES:** The leak is probably between the toilet and the vacuum generator.
        *Check the hose and all connections (including clamps and threaded spin nuts between the toilet and the vacuum generator). Apply solvent to plastic joints with a cotton swab. On Ecovac units, also check the screws in the discharge cup under the base.*
        Leak should be resolved.

      - **NO:** The leak is between the toilet and the vacuum generator.
        *Insert vacuum gauge in 1” opening at toilet outlet.*
        Does the vacuum leak stop?

        - **YES:** The leak is probably between the toilet and the vacuum generator.
          *Check the hose and all connections (including clamps and threaded spin nuts between the toilet and the vacuum generator). Apply solvent to plastic joints with a cotton swab. On Ecovac units, also check the screws in the discharge cup under the base.*
          Leak should be resolved.

        - **NO:** The leak is in the vacuum generator unit.
          *Check that the fitting is not side loaded at the inlet uniseal. Tighten band clamps at the vacuum switch and dip tube assembly. Check the spin nut and fitting between the pump and vacuum tank. Apply solvent to plastic joints with a cotton swab.*
          Has the leak stopped?

    - **NO:** The leak is “above” 1” orifice.
      *Check for a crack in the base or funnel and replace the appropriate item.*
      Leak should be resolved.

**Warning**

Pump starts automatically.
Turn off power before servicing.
11. **Pump will not shut off.**
Determine the system leak rate before starting per Digital Gauge Instructions.

- **Is the vacuum level greater than 10” of mercury?**
  - YES
    - Check the vacuum switch.
      - Compress the vacuum switch spring several times.
      - Does the pump shut off?
    - NO
    - Verify that the switch is functioning properly.
      - Flush the toilet three times.
      - Does the pump shut-off within one minute each time?
    - NO
    - Replace the vacuum switch.
      - Does the pump shut-off?
      - NO
      - The wiring may be improper.
        - Check the wiring per appropriate wiring diagram.
      - NO
      - The holding tank may be full or the vent line could be clogged.
        - Empty the holding tank and check the vent line for obstructions.
    - NO
  - NO
  - Problem could be at the pump.
    - Turn power off to the pump.
    - Using a digital vacuum gauge, does a leak exist (is the vacuum level dropping)?
    - YES
      - Replace the vacuum switch.
        - Does the pump shut-off?
      - NO
      - Verify that the switch is functioning properly.
        - Flush the toilet three times.
        - Does the pump shut-off within one minute each time?
      - NO
      - Replace the vacuum switch.
        - Does the pump shut-off?
      - NO
      - The wiring may be improper.
        - Check the wiring per appropriate wiring diagram.
    - NO
    - There is a leak in the system.
      - See problem #10.
    - NO
    - There could be a problem with the pump.
      - Check to see that the rod is moving (bellows are pumping),
        tighten the set screw, replace duckbill valves. Check for pinched o-rings in the pump assembly.
      - Does the pump shut off?
      - NO
      - Warning
        - Pump starts automatically. Turn off power before servicing.

For Systems with Pedal Operated Vacuum Toilets
For Systems with Pedal Operated Vacuum Toilets

12. Pump will not run.

The pump may not have power. Check circuit breaker on the main breaker. Is it tripped?

YES

Reset the circuit breaker. Operate the pump by flushing the toilet. Does the breaker trip again?

NO

NO

Be sure that the leads are connected to the “B” terminal. Check voltage at incoming lead to “B” terminal on vacuum switch. Is voltage present?

YES

Jump across “B” terminals of vacuum switch. Does the motor run?

NO

NO

Check operation of motor by connecting motor lead to known VDC power source. Does the motor run?

YES

Repair open circuit between the vacuum switch and pump.

NO

Replace the motor.

NO

Repair the open circuit between breaker and switch.

YES

There may be a plug or kink in the discharge line of the vacuum pump. Clear the discharge line of any kinks or obstructions. Does the breaker trip again?

YES

Motor may be faulty. Check amperage of the motor. If motor is pulling more than 10 amps, replace the motor.

NO

Check for debris in the pump. Remove the pump’s top closure and throw away any debris collected inside. Replace the closure. Restore power and operate the pump by flushing the toilet. (When flushing the toilet, use of additional water may alleviate this problem.) Does the breaker trip again?

NO

YES

NO

Warning
Pump starts automatically. Turn off power before servicing.

There may be a plug or kink in the discharge line of the vacuum pump. Clear the discharge line of any kinks or obstructions. Does the breaker trip again?

YES

NO

Replace the vacuum switch.

Check for a blockage or kinked hose between toilet and pump.

NO

YES

Replace the motor.

NO

Does the breaker trip again?

NO

YES

Does the breaker trip again?

NO

YES

Reset the circuit breaker. Operate the pump by flushing the toilet. Does the breaker trip again?

NO

YES

YES

YES
13. Vacuum pump runs too slowly, very hot, or blows fuses frequently.

The pump motor may be worn or defective.  
Isolate the motor from the pump and check it with a known VDC power source.  If the motor is running slow replace.  
Reassemble.  
Is the pump working properly now?

The voltage to the pump may be incorrect.  
Check the input power for proper voltage.  
Is the pump working properly now?

The improper wire size may have been used.  
The wire size is too small – check electrical diagram for proper wire size for the voltage of pump used.  
Is the pump working properly now?

There may be a plugged vent in the holding tank or discharge line.  
Disassemble and clean.  Check to be certain the seacock and in-line valves are in proper position.  Disassemble and clean discharge line.  
Is the pump working properly now?

Check for debris in the pump.  
Remove the pump's top closure and throw away any debris collected inside.  Replace the closure.  Restore power and operate the pump by flushing the toilet.  (When flushing the toilet, use of additional water may alleviate this problem.)  
The pump should now be working properly.

Warning  
Pump starts automatically.  Turn off power before servicing.
14. Toilet will not flush. (No vacuum)
Also see problem #3.

There is a blockage in the system.
Check the 1” opening at the bottom of the toilet base for a blockage and dislodge. Never use chemicals.
If the plug is not in the bottom of the base, blockages are most likely in the following locations:
  Outlet of the vacuum tank
  Inlet of the vacuum generator
  Diptube of the vacuum generator
  Inlet of the vacuum pump
  From collapsed vacuum line
  At a kink or sharp bend in a vacuum line.
Is the toilet flushing now?

There may be a problem with the pump. See problem #12.
Is the toilet flushing now?

The duckbill valves in the pump may have inverted due to a clogged discharge line or closed seacock. Replace the duckbill valves.
The toilet should now be flushing properly.

Blockages may also be caused by the following
1. Improper operation of the toilet. Make sure toilet is being operated correctly and each person using the toilet knows the correct operating procedure.
2. Flushing foreign objects down the toilet. DO NOT flush any non-dissolving items (i.e. sanitary napkins, facial tissue, paper towels, etc.) or excessive toilet tissue down toilet. Rapid-dissolving SeaLand® brand toilet tissue is best.
15. Pump leaks water internally or externally (may emit an odor).

Is the leak external?

- **YES**
  - Tighten connections or replace hose and make new connections.
  - Is water still leaking?
    - **YES**
      - Tighten intake or discharge fittings. Replace nipples or adapters if necessary.
      - Is water still leaking?
        - **YES**
          - Check for pinched o-rings in the pump assembly and replace if necessary.
          - Water should no longer be leaking.
        - **NO**
          - Check for worn, torn or punctured pump bellows or diaphragm. Replace if necessary. Water should no longer be leaking.
  - **YES**
    - Check for old style bellows clamp without ribs. Replace with new style that has ribs.
    - Is water still leaking?
      - **YES**
        - Check for worn, torn or punctured pump bellows or diaphragm. Replace if necessary. Water should no longer be leaking.
      - **NO**
        - Check for worn, torn or punctured pump bellows or diaphragm. Replace if necessary. Water should no longer be leaking.

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**Warning**

Pump starts automatically. Turn off power before servicing.