

OPERATOR'S MANUAL

8.1L
SX-A, DPS-A

CALIFORNIA PROPOSITION 65 WARNING

Engine exhaust, some of its constituents, and a broad range of engine parts are known to the State of California to cause cancer, birth defects, and other reproductive harm. Additionally, lubricants, fuels, and other fluids used in engines—including any waste created through the wearing of engine parts—contain or produce chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Battery posts, terminals, and related accessories contain lead and lead compounds. Wash your hands after handling. Used engine oil contains chemicals that have caused cancer in laboratory animals. Always protect your skin by washing thoroughly with soap and water.

Content

Foreword	2
Safety Information	4
Introduction	12
Instruments and Controls	14
Optional	21
Starting	23
Operation	30
Engine Shutdown	46
In Case of Emergency	51
Troubleshooting	53
Maintenance Schedule	70
Maintenance	75
Storage	91
Technical Data	94
Operator's Manual Order	108
Alphabetical index	109

Foreword

Models

<i>This manual applies to the following engines:</i>		
Engine Displacement	Model	Spec. No.
8.1L	8.1Gi-J	3869411



Welcome Aboard

Congratulations on choosing a new boat equipped with a Volvo Penta marine engine. Volvo Penta has been building marine engines since 1907. Quality, operating reliability, and innovation have made Volvo Penta a world leader in the marine engine industry. From engineering design and manufacturing to support activities in Parts, Service, and Sales, high standards have been set to ensure your pride and satisfaction as the owner of a Volvo Penta product.

As an owner of a Volvo Penta marine engine, we would also like to welcome you to a worldwide network of dealers and service workshops to assist you with technical advice, service requirements and replacement parts. Please contact your nearest authorized Volvo Penta dealer for assistance.

We wish you many pleasant voyages.

Our Core Values: Quality, Safety, Environmental Care

The values and qualities that Volvo Penta expresses are what make the company unique. From the very beginning, safety and quality have stood at the heart of the development of all of our products, processes, and services. It is on these values and qualities that the Volvo Penta corporate identity, brand position and legal status have been founded. Today's core values of quality, safety, and care for the environment remain central to Volvo Penta. They express what we believe in as a company and will ultimately help us to survive.

Quality is a value that traditionally referred to product quality but now encompasses all aspects of our products and services. In today's competitive environment, Volvo Penta's quality commitment extends beyond industrial craftsmanship and engineering ingenuity to embrace care for the customer throughout the life of the product.

Safety will always be our most distinguishing core value. Historically embedded in the quality of all Volvo products, it also encompasses personal, family, business, and environmental values.

Environmental Care in all operations, from design to production, distribution, service, and recycling, is an integral part of the Volvo quality commitment towards customers, employees, and the community. By embracing the environment as a core value, Volvo demonstrates its understanding of the environmental impact its products have upon nature and the shared urban and rural surroundings.

Volvo Penta continually commits a considerable part of its development resources toward minimizing the environmental impact of its products. Examples of areas where we are always looking for improvements are exhaust emissions, noise levels, and fuel consumption.

Regardless of whether your Volvo Penta engine is installed in a boat used for pleasure or commercial operation, incorrect operation or improper maintenance of the engine will result in disturbance or damage to the environment.

In this owner's manual there are a number of service procedures, which, if not followed, will lead to an increase in the engine's impact on the environment, and on running costs and a reduction in service life. Always observe recommended service intervals and make a habit of checking that the engine is operating normally every time you use it. Contact an authorized Volvo Penta dealer if you cannot correct the fault yourself.

Remember that most chemicals used on boats are harmful to the environment if used incorrectly. Volvo Penta recommends the use of biodegradable degreasing agents for all cleaning. Always dispose of engine and transmission oil waste, old paint, degreasing agents and cleaning residue etc. at proper disposal areas so that they do not harm the environment.

Adapt speed and distance during your boat trips so that swell and noise generated by the boat do not disturb or harm wildlife, moored boats, docks, etc. Wherever you land or cruise, please show consideration and always leave the areas you visit as you would like to find them yourself.

Safety Information

General Safety Information

Read this chapter carefully. It concerns your safety. This section describes how safety information is presented in the operator's manual and on the engine. It also gives a general account of basic safety precautions to be taken when operating the boat and maintaining the engine.

Check that you have the correct operator's manual before you read on. If this is not the case please contact your Volvo Penta dealer.



This symbol is used in the book and on engines to make you aware of safety information. Always read safety precautions very carefully. Incorrectly performed operations could result in personal injury, property damage, or engine damage. Read this manual carefully before operating or servicing the engine. If anything is unclear, please contact your Volvo Penta dealer for assistance.

In the operator's manual warning texts have the following priority:

DANGER!

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING!

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION!

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

NOTICE! Used to address practices not related to personal injury. Special attention should be used to prevent incorrect assembly, disassembly, or use. Failure to comply with a notice may result in equipment failure or damage.

This manual contains information you need to operate your boat, engine, and drive safely. Check that you have the correct manual for your engine and drive.

This manual also contains a considerable amount of information concerning model identification, preventive maintenance recommendations, fuel and oil recommendations, and other important points. Please keep this book with your boat at all times.

It is important that this manual stays with the boat when it is sold. Important safety information must be passed on to the new owner. The service information provided in the manual gives the owner important information about maintaining the engine and sterndrive.

If you do not understand or are uncertain about any operation or information in this owner's manual, please contact your Volvo Penta dealer. Your dealer will be able to help you with an explanation or will demonstrate the operation.

Federal law requires manufacturers to notify owners in the event that a safety related defect is discovered on any of their products. If you are not the original owner of this engine, please notify us at our address or through an authorized Volvo Penta dealer about the change in ownership. This is the only way we will be able to contact you if necessary.

Carefully observe the safety alert symbols shown for dangers, warnings, and cautions. They warn you of possible dangers or important information contained in this manual. However, warnings alone do not eliminate hazards, nor are they a substitute for safe boat handling and proper accident prevention measures!

Maintenance

Performing maintenance on the engine can be a dangerous undertaking. We strongly recommend that you consult your dealer. Find the correct information in the following publications: this operator's manual, any applicable *Do it Yourself* manual, and any applicable workshop manuals.

Engine Decals

Check that the warning decals on the engine are always clearly visible. Replace decals that have been damaged or painted over.

Fire and Explosion

Fueling

When refueling there is always a danger of fire and explosion. Smoking is forbidden and the engine must be switched off. Never overfill the tank. Close the fuel tank filler cap properly.

DANGER!

Gasoline is extremely flammable and highly explosive. Always turn off the engine before refueling. Do not smoke or allow open flames or sparks near the boat when adding fuel. When filling the gas tank, ground the tank to the source of gasoline by holding the hose nozzle firmly against the side of the deck filler plate, or ground it in some other manner. This action prevents static electricity buildup that could cause sparks and ignite fuel vapors.

DANGER!

Fuel leakage can contribute to a fire and/or explosion. Frequently inspect non-metallic parts of the engine's fuel system and replace if excessive stiffness, deterioration, or fuel leakage is found.

DANGER!

To prevent fire and explosion, perform all service procedures with the engine turned OFF.

DANGER!

Failure to inspect your work may allow fuel leakage to go undetected. This could become a fire or explosion hazard.

Batteries

Never allow an open flame or electric sparks near the battery or batteries. Never smoke in proximity to the batteries. The batteries give off hydrogen gas during charging which, when mixed with air, can form an explosive gas. This gas is easily ignited and highly volatile.

Operate the boat's bilge blower for at least 5 minutes prior to servicing battery. Always ventilate the battery storage area before carrying out any procedures involving batteries.

Serpentine Belt and Pulley System

CAUTION!

Working around the serpentine belt and pulley system can be dangerous. To prevent possible injury caused by pinching, crushing or entanglement, always observe these precautionary measure when working around the engine:

- Ensure that the engine cannot be started by removing the ignition keys from each starting location. This hazard is especially likely to occur if the engine room or engine compartment cannot be seen from various remote starting positions such as a flybridge or enclosed cabin.
- If work permits, disconnect the batteries.
- At each starting location, always post a sign stating that work on the engine is in progress.

Hot Surfaces and Fluids

There is always a risk of burns when working with a hot engine. Beware of hot surfaces.

Chemicals

If you are using any chemicals on your boat, read all labels and warnings carefully. Always pay special attention to safety related information and follow the manufacturer's instructions.

Safety Precautions While Operating the Boat

Your New Boat

Read the operator's manuals and other information supplied with your new boat. Learn to operate the engine, controls and other equipment safely and correctly. If this is your first boat or it is a boat type with which you are unfamiliar, we recommend that you practice controlling the boat away from other vessels, docks, shallow areas, and other obstacles.

Remember that the person driving a boat is legally required to know and follow the current rules regarding traffic and safety at sea. Make sure you know the rules that apply to you and the waters in which you are boating by contacting the relevant authorities or organization. We strongly recommend you take a course in seamanship. You may contact your local boating organization to find a suitable course.

Basic Safety Rules of Boating

Always be sure to observe the following minimum precautions while boating:

- Insist on the use of personal flotation devices by all passengers at all times.
- NEVER OPERATE THE BOAT IF YOU ARE UNDER THE INFLUENCE OF DRUGS OR ALCOHOL.
- If boating in waters that are unfamiliar, obtain appropriate charts to avoid damage from underwater objects.

We recommend that you contact your local boating organization for more detailed information on safety afloat.

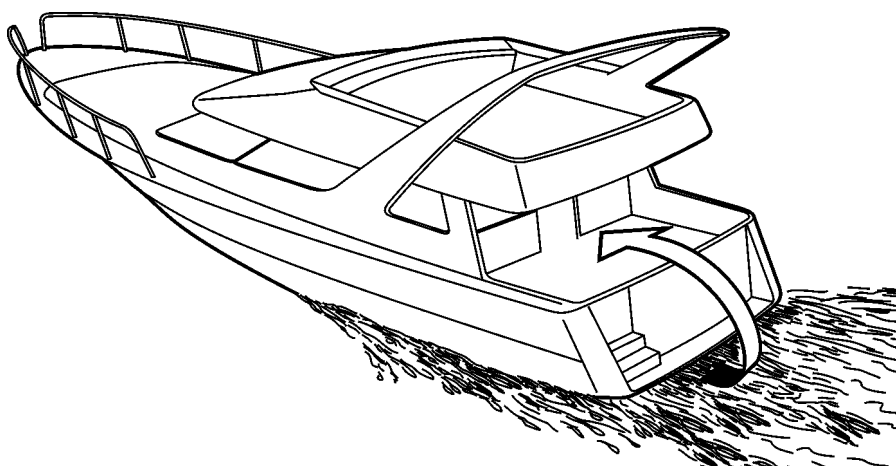
Carbon Monoxide

DANGER!

Do not run the engine while there are people located on or near the swim platform and transom.

DANGER!

Do not tow anyone using water sports equipment (such as skis and inner tubes) closer than twenty feet (6 meters) from the boat. Do not, under any circumstances, allow people to “body surf” using the swim platform as a means of being pulled along.



22770

For your safety, we recommend that you install a good quality marine carbon monoxide detector aboard your boat, in accordance with ABYC recommended practices.

The remainder of this chapter (information regarding carbon monoxide and respective illustrations) are provided courtesy of the American Boat and Yacht Council.

Properties and Characteristics of Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless, and tasteless gas that weighs about the same as air. It cannot be expected to rise or fall like some other gases because it will distribute itself throughout the space. Do not rely on the sense of smell or sight of other gases to detect CO as it diffuses in the air much more rapidly than easily detectable vapors, (i.e., visible and aromatic vapors).

What Makes Carbon Monoxide?

Carbon monoxide is produced any time a material containing carbon burns. Examples include, but are not limited to, gasoline, natural gas, oil, propane, coal, or wood. Some common sources of CO are internal combustion engines and open flame appliances such as:

- Gas propulsion engines
- Auxiliary gas engines (gensets)
- Cooking ranges
- Central heating plants
- Space heaters
- Water heaters
- Fireplaces
- Charcoal grills

The carbon monoxide component of diesel exhaust is extremely low relative to the carbon monoxide level found in gasoline engine exhaust.

How is a Person Affected by Carbon Monoxide?

Carbon monoxide is absorbed by the lungs and reacts with blood hemoglobin to form carboxyhemoglobin, which reduces the oxygen carrying capacity of the blood. The result is a lack of oxygen for the tissues, with subsequent tissue death and, if exposure is prolonged, death of the individual.

Carbon monoxide in high concentrations can be fatal in a matter of minutes. Lower concentrations must not be ignored because the effects of exposure to CO are cumulative and can be just as lethal.

Symptoms of CO Poisoning – The sequence of symptoms listed generally reflects the order of occurrence in most people; however, there are many variables that affect this order of symptom manifestation. One or more of the following symptoms can signal the adverse effect of CO accumulation:

- | | |
|----------------------------------|--------------------|
| 1. Watery and itchy eyes | 10. Drowsiness |
| 2. Flushed appearance | 11. Incoherence |
| 3. Throbbing temples | 12. Slurred speech |
| 4. Inattentiveness | 13. Nausea |
| 5. Inability to think coherently | 14. Dizziness |
| 6. Loss of physical coordination | 15. Fatigue |
| 7. Ringing in the ears | 16. Vomiting |
| 8. Tightness across the chest | 17. Collapse |
| 9. Headache | 18. Convulsions |

Emergency Treatment for CO Poisoning – CO toxicity is a life-threatening emergency that requires immediate attention. Following is a list of actions that should be carried out if CO poisoning is suspected. Proceed with caution. Keep in mind that the victim may be in an area of high CO concentration and take care when entering.

- | | |
|---|---|
| • Evaluate the situation and ventilate the area if possible. | • Contact medical help. If the victim is not breathing, perform rescue breathing or approved cardiopulmonary resuscitation (CPR), as appropriate, until medical help arrives. Prompt action can make the difference between life and death. |
| • Evacuate the area and move affected person(s) to a fresh air environment. | • Investigate the source of CO and take corrective action. |
| • Observe the victim(s). | |
| • Administer oxygen, if available. | |

Marine CO Detection Systems

Even with the best of boat design and construction, and scrupulous attention to inspection, operation, and maintenance of boat systems, hazardous levels of CO may, under certain conditions, be present in interior spaces and exterior areas. Vigilant observation of passengers for CO sickness symptoms should be supplemented by marine CO detection devices in any enclosed accommodation spaces. Detection devices should be marked with "Marine Carbon Monoxide Detector" or "A-24."

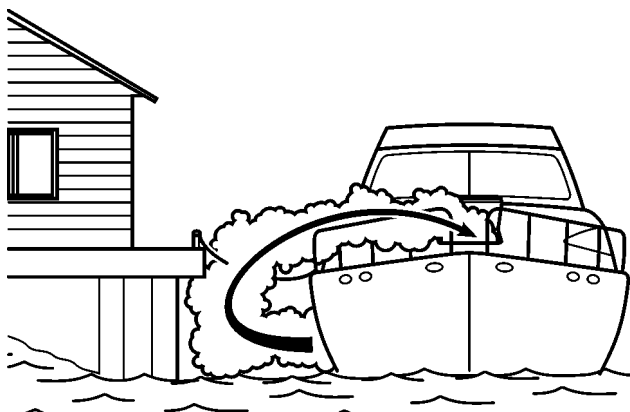
What to do When the Alarm Sounds

Actuation of a CO alarm indicates the presence of Carbon Monoxide (CO) which can kill you. If alarm sounds, take the following actions as appropriate:

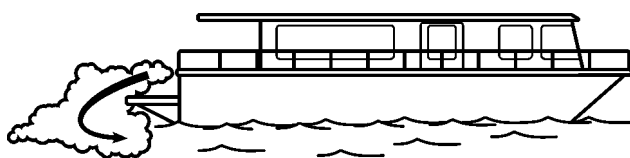
- | | |
|--|--|
| • Shut off sources of CO such as engines (if safe to do so), generators, and open flame stoves. | • Provide fresh air through actions such as opening port lights, hatches, and doors. |
| • Look for sources of CO that may be from other boats and take appropriate steps, which may include moving your boat to a safe area. | • If anyone is exhibiting signs of CO poisoning, move them to fresh air and seek medical assistance. |

Boat Operation

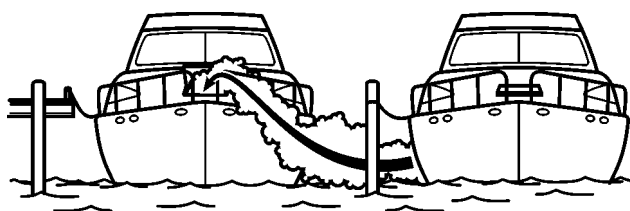
Don't run engine(s) or auxiliary generator(s) on boats with enclosed accommodation compartments unless the boat is equipped with a functioning marine carbon monoxide detector that complies with 2ABYC A-24, *Carbon Monoxide Detection Systems on Boats*.



51613



51614



51615

Stationary Operation

A boat operator should be aware that dangerous concentrations of CO can accumulate when propulsion engines and/or an auxiliary generator is operated while the boat is stationary. This is especially true when rafted or moored in a confined area such as boat-houses, or when in close proximity to seawalls or other boats.

The risk from CO is greatly increased when there is little or no wind present.

Keep engine room hatches and doors closed when operating engine(s) and/or generator set(s).

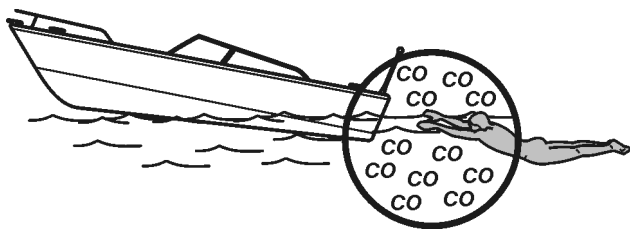
Pay attention to prevailing conditions and provide for ventilation to induce fresh air and minimize exhaust re-entry.

When the propulsion engine or generator is running, CO is produced and may remain in the vicinity of the exhaust outlet. CO accumulation may remain entrapped for some time after the engine or generator is turned off.

- Do not occupy aft lounging area(s) or swim platform,
- Do not swim under or around swim platform,
- Do not swim in the vicinity of exhaust outlet(s).

Since carbon monoxide production is greater when engines are cold versus when they are warm, a boat operator should minimize the time spent on getting underway. In order to minimize CO buildup, do not warm up or run propulsion engine(s) for extended periods while the vessel is stationary.

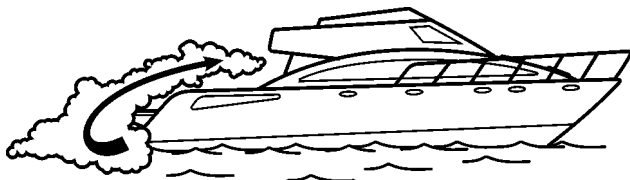
A boat operator should be aware that carbon monoxide is emitted from any boat's exhaust. Boats moored close together can affect each other. Operation, mooring, and anchoring in an area where other boats' engines or generators are running may put your boat in an atmosphere containing CO, even if your boat's engine(s) is(are) not running. Boat operators need to be aware of the effect of their boat on other boats in the area. Of prime concern is the operation of an auxiliary generator where boats are moored alongside each other. Be aware of the effect your exhaust may have on other boats and be aware that the operation of other boats' equipment may affect the carbon monoxide concentration on your boat.



51616

Underway Operation

Do not sit on, occupy or hang on any stern appendages (e.g., swim platforms, boarding ladders, etc.) while underway. Do not body surf, commonly known as “teak surfing” or “platform dragging,” in the wake of the boat. Do not tow persons in close proximity to the stern of the boat.

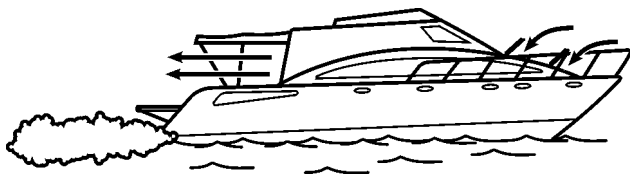


51617

Backdrafting (Station Wagon Effect)

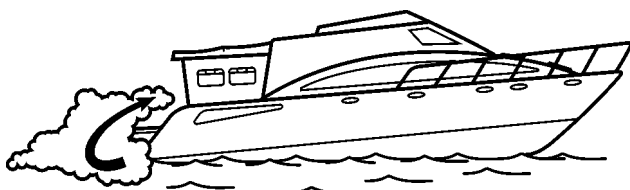
Backdrafting is caused by air movement over or around a boat creating a low pressure or suction area around the stern that can increase CO level on the boat. Backdrafting can be affected by relative wind direction, boat speed, and boat trim angle. At certain speeds and under certain operating conditions the low pressure area may form in other regions and permit carbon monoxide to enter the hull through openings that are not at the back of the boat.

Other factors during boat operation which may affect carbon monoxide concentration include:

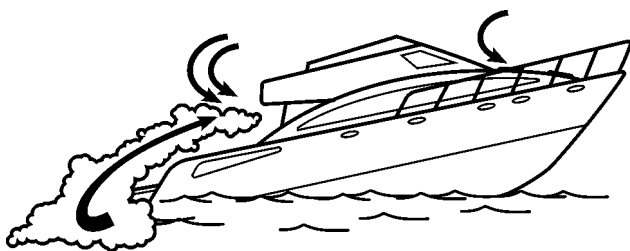


51618

- Adding or removing canvas may raise or lower CO levels. Image #51618 illustrates desired air-flow through the boat. As shown in image #51619, certain canvas configurations, such as side curtains and position of hatches, can increase backdrafting.

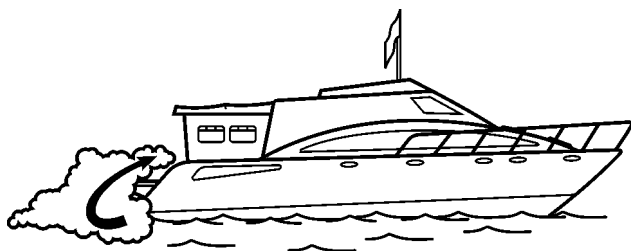


51619



51620

- Intentional or unintentional excessive trim angle (e.g., high bow angle or excessively unequal distribution of weight) may raise the CO level and should be avoided (see image #51620).



51621

- Opening and closing ports, hatches, doors, and windows may raise or lower CO levels on board a boat. When airflow is moving forward inside the boat, CO may be entering the boat.
- Operating a boat at slow speeds with a following wind should be avoided. Consider changing direction, adjusting speed, or both (see image #51621).
- Be aware that cockpit and deck drains can be a source of CO ingress into boats, especially boats with cockpits or decks enclosed with canvas or permanent boat structures.
- Altitude and Sea Conditions – Operation at altitudes greater than 5,000 ft (1500m) contributes to inefficient engine performance and may require adjustments to ignition systems, fuel systems, or changing the propeller's size or gear ratio. Failure to make adjustments to ignition systems and/or fuel systems for altitude conditions may cause an increase in CO. Reduced power resulting from increased altitude may require adjustments to propeller size. Heavy seas or out of trim conditions tend to load engines, resulting in reduced performance and increased CO production.
- Portable Generator Sets – Do not use this equipment on boats. Gasoline powered portable generator sets produce CO. These sets discharge their exhaust products in locations which can lead to an increase in the accumulation of carbon monoxide in enclosed accommodation spaces.

Maintenance

Engine Performance – Efficient engine performance is vital to minimizing CO production. Efficient engine performance can be ensured through regular maintenance. Refer to the *Maintenance Schedule* and *Maintenance* sections of this manual for instructions on keeping your engine and sterndrive in good condition.

NOTICE! Be sure to see your Volvo Penta dealer for regular inspections.

Introduction

Warranty Information

Volvo Penta's warranty information can be found in the accompanying warranty booklets. One manual applies to the North American Market while the second applies to all other markets. Along with the warranty information you will find other checklists and reports for Volvo Penta products.

Please contact your Volvo Penta dealer if you have not received a copy of your warranty booklet and a customer copy of the warranty card.

Owner's Identification Card

When you purchased your boat, the dealer was required to register your power package with Volvo Penta. Your dealer should provide you with proof of ownership in the form of an Owner's Registration Card or a print-out of the Volvo Penta computer on-line registration screen. This provides proof of ownership and is required to validate warranty, should warranty service become necessary.

Warranty coverage may be delayed until the warranty and registration form is on file at Volvo Penta. Please refer to your warranty manual for additional information.

Keep your owner's identification card with you at all times; this will facilitate finding parts and providing service when you visit any Volvo Penta authorized dealer.

Volvo Action Service (VAS)

Volvo Action Service (VAS) is a consumer breakdown service available 24 hours each day, 365 days per year. If your engine breaks down, the VAS coordinator will quickly locate your nearest dealer. If you need a tow, parts, or mechanic, the VAS coordinator will make all arrangements necessary to get you back underway as soon as possible. A service charge may apply in some situations.

Membership to Volvo Action Service is provided automatically to all Volvo Penta engine owners. As long as your Volvo Penta engine is under factory warranty, this service covers Volvo Penta-related repairs. Refer to the accompanying warranty literature for detailed information regarding coverage.

If you have a question about Volvo Action Service, or need additional information, please call toll-free 1-877-33-PENTA.

Volvo Penta Dealer Network

The Volvo Penta worldwide network of authorized dealers is at your service. They are specialists in Volvo Penta products and have the accessories, genuine Volvo Penta parts, test equipment, and tools necessary for high quality service and repair work.

Always take your Volvo Penta product to an authorized Volvo Penta servicing dealer for repair. Our dealers have the knowledge, factory-trained technicians, and special tools to take care of any necessary repairs. Ideally, take your product back to your selling dealer as they are familiar with you and your equipment.

Toll-free Dealer Locator Service

If you are away from your home waters, take your Volvo Penta product to the nearest Volvo Penta servicing dealer. For the name and location of your nearest Volvo Penta dealer, consult the telephone directory under Boat Dealers, search the dealer locator on the internet, or call 1-800-522-1959.

Volvo Penta on the Internet

Whether you're trying to replace a lost operator's manual, searching for updated service information about your engine, looking for parts information, or simply attempting to locate the nearest authorized Volvo Penta dealer, Volvo Penta on the Internet is the web site to visit. Additionally, you will find a wealth of information related to our company and all the new and innovative products we have to offer.

The URL address for Volvo Penta of the Americas is:

<http://www.volvopenta.com>

Consumer Affairs Department

The Volvo Penta Consumer Affairs Department may be contacted through the following address and phone numbers:

Volvo Penta of the Americas
1300 Volvo Penta Drive
Chesapeake, Virginia 23320, USA
Phone: (757) 436-5100

Instruments and Controls

This section describes the Volvo Penta instrumentation/controls and their functions.

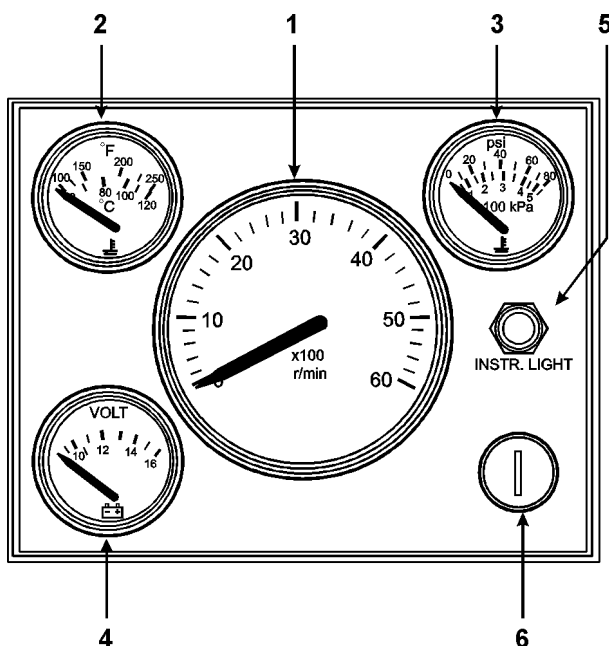
NOTICE! If you want to supplement the instrumentation, your boat is equipped with instruments not described here, or you are not sure about their functionality, please contact your Volvo Penta dealer or boat dealer.

Gauges

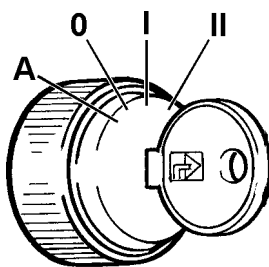
The following section contains a general description of the instrument panel. Please note that instrument panels are installed by the boat builder and will vary depending on the model installed. Commonly, instrument panels are equipped with a tachometer, temperature gauge, oil pressure gauge, voltmeter, instrument panel lighting switch, and an ignition switch.

Instrument panels can also be supplemented with extra Volvo Penta instruments such as: synchronization tachometers, fuel gauge, fresh water gauge, clock, speedometer, or rudder indicator.

The instrument panel and/or gauges depicted below are sample representations only.



21179



21181

1. **Tachometer**—Shows the engine RPM. Multiply this value by 100 or 1000 (depending on model) for revolutions per minute. Integral “Hours run” meter (optional and separately installed) displays the engine’s operating time in hours and tenths of an hour.
2. **Temperature Gauge**—Indicates engine temperature. Normal operating temperatures are listed in the section entitled *Technical Data*.
3. **Oil Pressure Gauge**—Indicates the engine oil pressure. Normal operating oil pressures are listed in the section entitled *Technical Data*. Lower oil pressure is normal and should be expected at idle after a sustained cruise.
4. **Voltmeter**—Indicates the charge voltage from the alternator which should normally be approximately 14 Volts. With the engine stopped and the switch on, battery voltage is normally indicated as 12 Volts.
5. **Instrument Lighting**—Turns gauge lights on or off (varies, depending on product manufacturer).
6. **Ignition Switch**—The ignition switch has three positions (varies, depending on product manufacturer):
 - A Accessories: Power is provided to run accessories. Ignition is OFF and engine is OFF.
 - O The key can be inserted or removed.
 - I RUN: Ignition is ON and engine is OFF. System voltage connected.
 - II START position (momentary). The starter motor is engaged and starting the engine.

NOTICE! For additional information, please read the starting instructions in the section entitled *Starting*.

Volvo Penta ignition keys are marked with a code for use when ordering extra keys. Record the code so that replacement keys can be ordered. Keep the code in a safe place where unauthorized persons do not have access to it.

Power Trim

Your Volvo Penta sterndrive is equipped with a power trim/tilt system as standard equipment. Power trim is operated using the buttons on the power trim switch or on the control lever(s). The power trim/tilt allows you to change the angle of the drive unit from the helm. Changing the angle of the drive unit in relation to the boat bottom is called trimming. Trimming provides the following benefits:

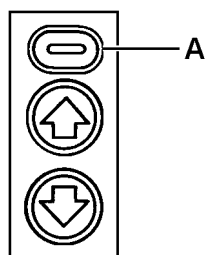
- Improves acceleration to planing.
- Keeps the boat on plane at reduced throttle settings.
- Improves fuel economy.
- Provides smoother and/or drier ride in choppy water conditions.
- Increases maximum speed.

If you do not wish to use this feature, you may leave the drive unit trimmed to the position that works best for you.

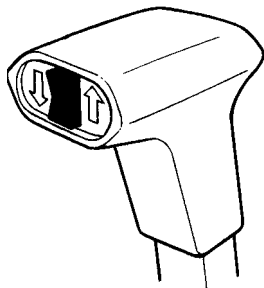
NOTICE! Avoid over-trimming the drive system as this can have a severely adverse effect on the steering of the boat.

NOTICE! When planing, avoid running with the drive fully trimmed for long periods. Apart from excessive fuel consumption, this can cause cavity damage to the propeller(s).

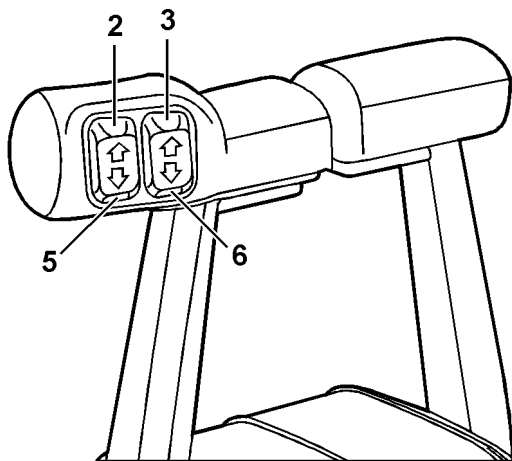
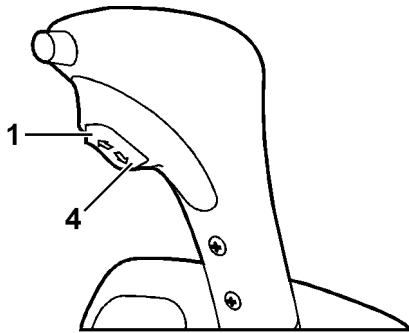
NOTICE! The trim release button **A** is used whenever switching to Beach Range or Tilt Range. Press this button whenever you will be tilting the drive above Trim Range. For additional information, please refer to *Trim Ranges*.



22766-2



22767-2



51280

Power Trim Buttons

The buttons on the power trim control panel are used for both single and twin engine installations.

For twin engine installations, the power trim control panel can be used to make individual or simultaneous adjustments to the drives.

By trimming out the drive away from the transom, the height of the bow will be "raised" in relation to the horizontal axis, while trimming in the drive will "lower" the bow of the boat.

In single engine installations, the drive can be operated by pressing button **1** or button **4**.

In twin engine installations, both drives can be operated simultaneously by pressing buttons **2 & 3** or buttons **5 & 6**.

Trimming out the Drive

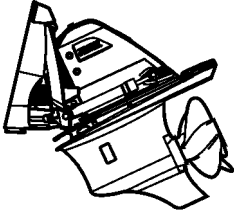
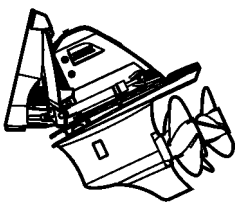
Press button **1** on the control panel or the trim button(s) on the control lever to raise the bow of the boat (drive trimmed out).

The drives can be operated separately by pressing button **2** on the control panel for the port drive and button **3** for the starboard drive.

Trimming in the Drive

Press button **4** on the control panel or the trim button(s) on the control lever to lower the bow of the boat (drive trimmed in).

The drives can be operated separately by pressing button **5** on the control panel for the port drive and button **6** for the starboard drive.

	
Trim Angle -5° PTA	Trim Angle -5° PTA
Trim Angle 13° PTA	Trim Angle 8° PTA
Trim Angle 13° PTA	Trim Angle 8° PTA
Trim Angle 30° PTA	Trim Angle 30° PTA
Trim Angle +30° PTA	Trim Angle +30° PTA

51281a

Trim Ranges

In order to utilize the information gained from the trim instrument, it is essential to know about the different trim ranges and their uses. There are three trim ranges as described below.

Trim Range

Trim range, for a drive with a single prop, is any angle⁽¹⁾ between -5° and 13°. For a drive with twin props, it is any angle between -5° and 8°. This range is used to obtain the best comfort at all running speeds (from start to maximum speed).

Beach Range

Beach range, for a drive with a single prop, is any angle between 13° and 30°. For a drive with twin props, it is any angle between 8° and 30°. This range is used for running at reduced speed in shallow water or where water depth is uncertain.

NOTICE! Maximum safe engine speed when running in beach range is 1000 rpm. Make sure the drive's coolant inlet is never trimmed out of the water.

Tilt Range

Tilt range, for either single- or dual-prop drive, is any angle over 30°. It is used to lift the drive to maximum height, **but not when the engine is running**. This range is used for trailing or putting the boat on the trailer. Power trim has an automatic stop that cuts the power when its end limit has been reached. The stop is reset automatically when activating down trimming.

CAUTION!

Operating in beach range or tilt range will cause significant loss of maneuverability.

NOTICE! Use the trim release button whenever switching to Beach Range or Tilt Range. For additional information, please refer to *Power Trim*.

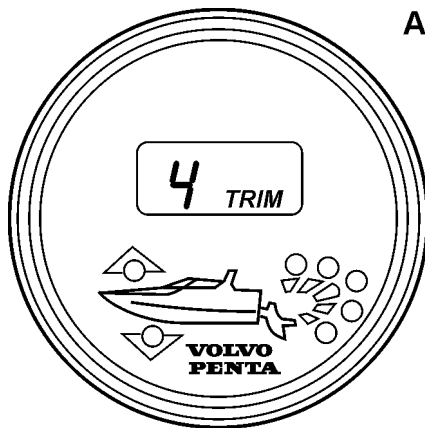
1. The number corresponds to the drive angle in relation to the horizontal (stationary boat). The lowest value shows that the drive is at max trim in and the highest value that the drive is raised to max. Note that the lowest value can vary from boat to boat depending on the angle of the transom.

Power Trim Instrument and Displays

Digital Instrument

The digital instrument **A** shows the trim angle in digits and the trim range (TRIM) and beach range (BEACH) in letters.

For an explanation of trim ranges, please refer to *Trim Ranges* in the previous section.



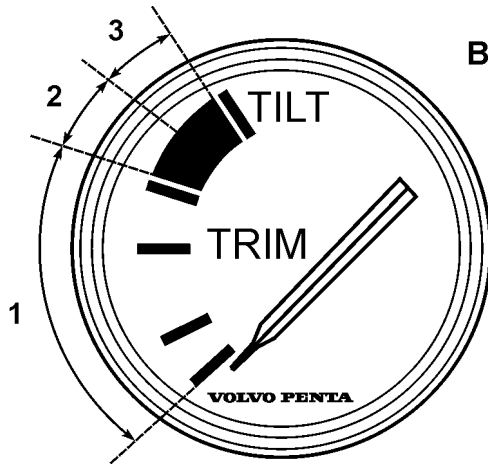
51726

Analog Instrument

The analog trim instrument **B** shows the current position of the drive. This instrument has three ranges:

1. Trim range
2. Beach range
3. Tilt range

For an explanation of trim ranges, please refer to *Trim Ranges* in the previous section.

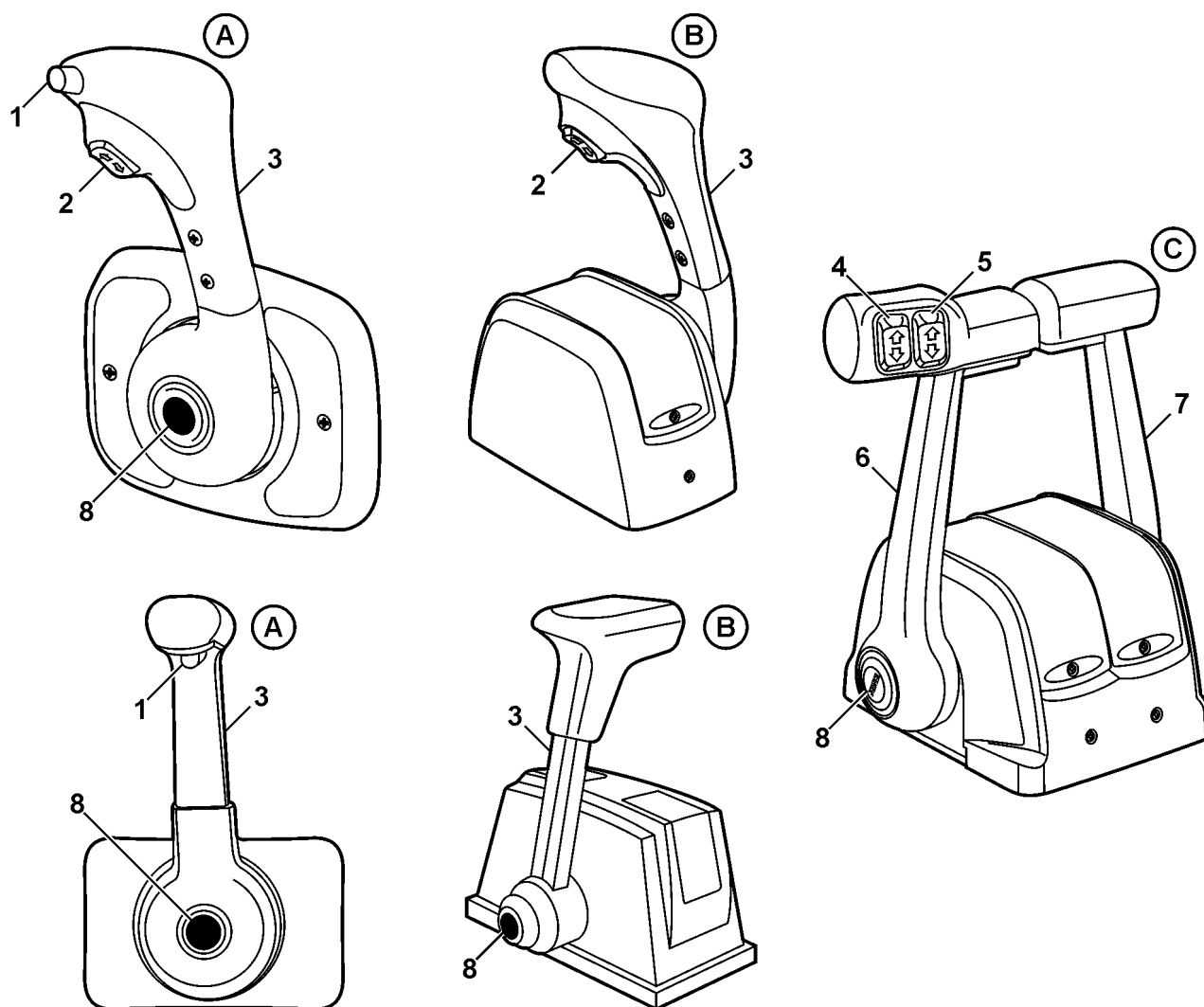


51727

Controls

Volvo Penta controls are available in single side-mount **A**, top-mount **B**, or twin top-mount **C** configurations. The control levers have an adjustable friction brake and a neutral position switch to ensure that the engine cannot be started when the drive is in gear.

Your boat may be equipped with remote controls other than those described below. If Volvo Penta controls are not used, ask your dealer for operating instructions for the remote control used in your boat since operation and function may differ from Volvo Penta remote controls.



51260-b

1. Neutral Interlock Button
2. Trim/Tilt Button
3. Engine Throttle Control Lever
4. Port Trim/Tilt Button

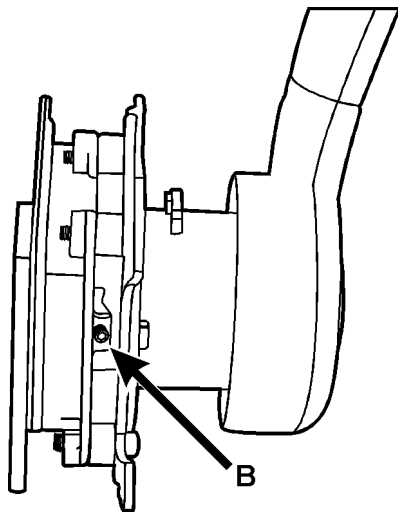
5. Starboard Trim/Tilt Button
6. Port Engine Throttle Control Lever
7. Starboard Engine Throttle Control Lever
8. Gear Shift Release

Friction Brake

Generally, the remote control has a friction brake, which can be adjusted as necessary, to provide lighter or heavier lever action. If you are using a Volvo Penta shift control and you wish to make adjustments to the friction brake, follow the instructions below to make the necessary changes.

NOTICE! Each manufacturer has a particular method for making adjustments to the friction brake. For specific directions on how to adjust a non-Volvo Penta friction brake, please refer to your manufacturer's manual.

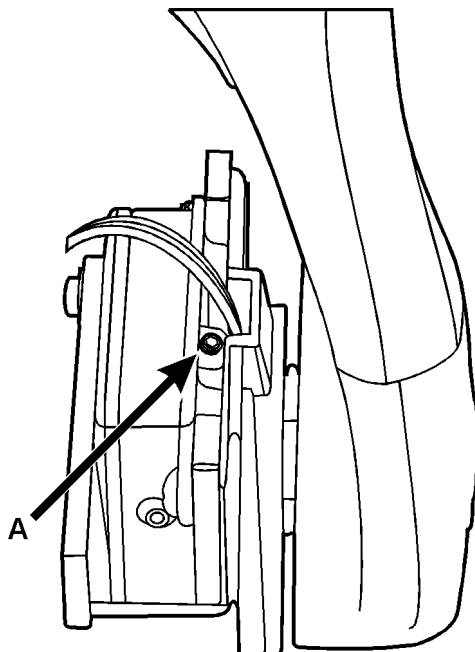
NOTICE! The brake must only be adjusted when the control lever is in the throttle range. Do not adjust the friction with the control in neutral.



51263

Side Mount Remote Controls

1. Make sure the engine is turned off by removing the key from the ignition switch.
2. Remove the plastic cover that shields the remote control mechanism.
3. Place the control lever in reverse (just beyond the reverse detent position) and adjust the throttle brake screw to prevent throttle creep.
4. Turn the tension screw **B** clockwise to increase drag and counter-clockwise to decrease drag on the control arm.
5. Reinstall the plastic cover and remote control lever.



51262

Top Mount Remote Controls

1. Make sure the engine is turned off by removing the key from the ignition switch.
2. Remove the plastic cover that shields the remote control mechanism.
3. For single lever controls, move the throttle to the forward position. For dual lever controls, move the port side lever forward and the starboard side lever into reverse.
4. Turn the tension screw **A** clockwise to increase drag and counter-clockwise to decrease drag on the control arm.
5. Reinstall the plastic cover and remote control lever.

Other Instruments

See your Volvo Penta dealer for additional accessories specifically designed for your Volvo Penta product.

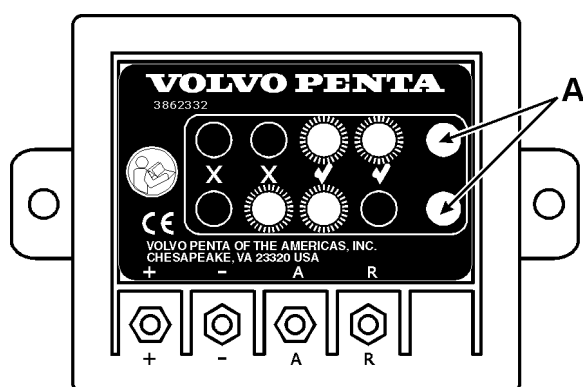
Optional

ACP

Active Corrosion Protection System

Your boat may be equipped with a Volvo Penta active corrosion protection system (APCS). This system operates with very little current drain from the boat's electrical system. It keeps the voltage potential in the area around the drive unit in a range that is not corrosive to aluminum. If you do not have an active corrosion protection system already installed, you may purchase one from your authorized Volvo Penta dealer.

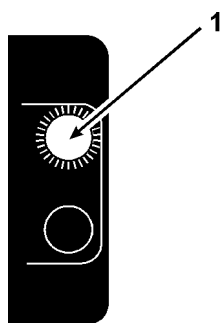
NOTICE! APCS is designed for salt water applications only; using the system in fresh water—while harmless—will not protect your sterndrive from corrosion. If you will be operating your boat in fresh water exclusively, you must install magnesium anodes to adequately protect your sterndrive.



22251

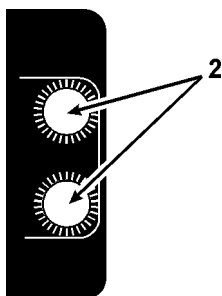
The protection system's control box has both red and green LED indicator lights **A**. The lights will indicate the amount of protection that the unit is providing to protect the sterndrive and transom shield.

NOTICE! The active corrosion protection system is designed to adequately protect one drive unit from galvanic corrosion under normal operating conditions. This system will not provide protection from stray currents emitted by a malfunctioning AC power source on your boat, the pier, or other boats in close proximity to yours. Although the zinc sacrificial anodes will last much longer with this system, they must still be cleaned and checked for material condition periodically.



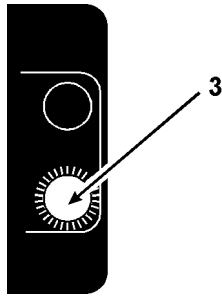
22863-1

1. The green LED **1** indicates the unit is adequately protected.



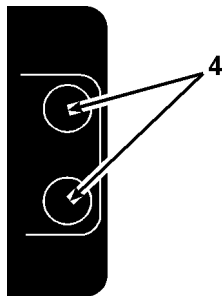
22863-2

2. If the green and red LEDs **2** are illuminated, the drive is protected but the system is drawing power (between 3 to 150 mA) to protect the drive unit. Check the conditions and solutions listed below.



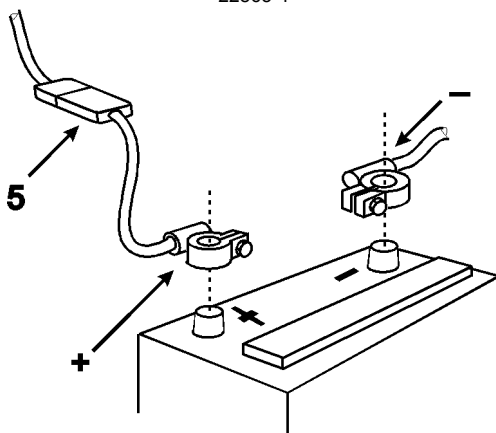
22863-3

3. If only the red LED **3** is illuminated, the drive is not adequately protected and may have one of the following conditions:
- Water too severely contaminated or polluted. Install additional anode on the transom and bond to the grounding system.
 - Too much unpainted metal on the drive or transom shield. Clean and paint exposed metal on drive and transom shield. Please see the section entitled *Painting the Drive* and/or refer to the *Do it Yourself* Manual for paint repair procedures.
 - Corroded, missing, or painted anodes. Service or replace anode as required.
 - Stray current from shore power or surrounding boats. Disconnect shore power, wait 8 hours and recheck. If still present, temporarily relocate boat to another area away from the marina and check again.
 - Loose or corroded terminals on the electronic unit or battery. Clean and tighten connectors.
 - Copper bottom paint used and is in contact with the transom shield. Remove paint and ensure there is a 25mm (1 in.) border between transom shield and bottom paint.



22863-4

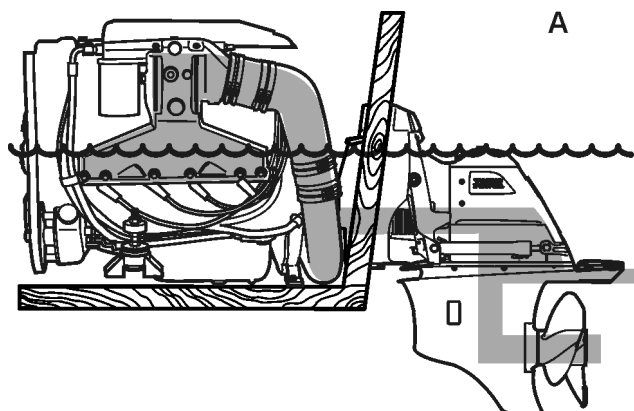
4. If no LEDs are illuminated **4**, the unit is not receiving power. Check the following conditions:
- Dead battery. Check battery condition and charge as necessary.
 - Loose connection or corroded terminals on the electronic control unit or battery. Clean and tighten the connectors.
 - Blown fuse. Replace defective fuse. The fuse **5** is located near the battery connectors.
 - Broken anode or reference sensor unit. Replace damaged unit. Follow the installation instructions included with the replacement unit, or see your authorized Volvo Penta dealer for service.



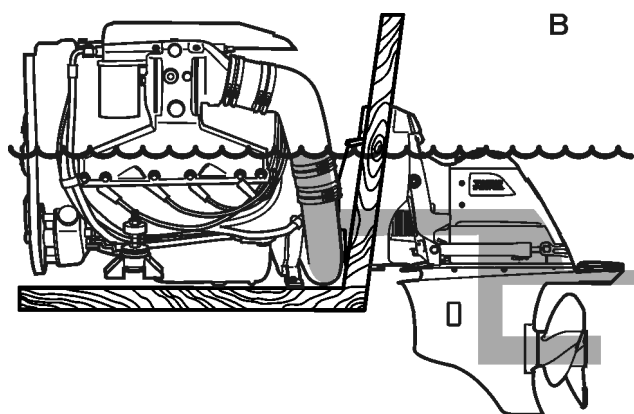
22826

If any of the malfunction conditions continue to exist after completing the steps above, see your authorized Volvo Penta dealer for further service.

Starting



51633



51634

Static Water Line

Static water line is a measurement of the water level in the boat engine's exhaust system. The exhaust passages of a sterndrive propulsion system are open to the water surrounding the boat **A**. When the engine is not running, the water level in the exhaust system will settle at the same level as the surrounding water **B**. If this water level is too high, water will enter the engine through the exhaust manifolds; this is called water ingestion.

The static water line should be correct when you purchase a new boat. Your boat was designed and constructed so that, under normal load and use conditions, the water level would not be high enough for water to enter the engine. This is accomplished with exhaust riser height and the height of the engine in the hull. If you add weight to your boat, the boat and engine exhaust will sit lower in the water. This raises the water level in the exhaust. If you add too much weight, the water level will be high enough to allow water ingestion.

NOTICE! Water ingestion damage from over-loading is not covered by warranty.

Consider the static water line of your boat before adding equipment such as generators, appliances, coolers and other heavy items. Do not store un-needed gear on your boat. Overloading with passengers also causes problems with the static water line. Load distribution, especially when concentrated in the stern of the boat, can raise the static water line.

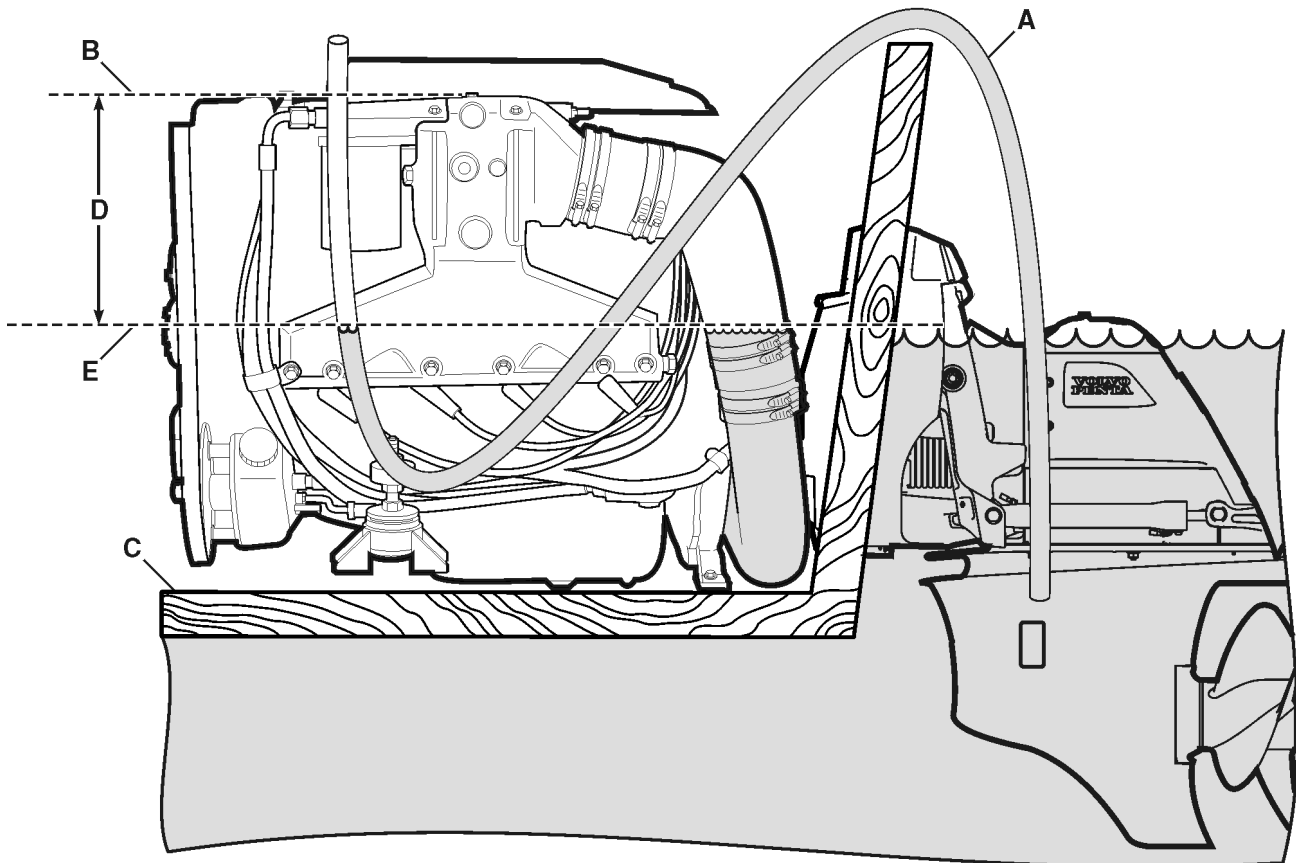
NOTICE! Never exceed the weight limit posted by the boat manufacturer. Never overload the stern of the boat as this may cause the engine to be lowered below the minimum safe static water line height.

If you have added weight to your boat and suspect there may be problems with the static water line, perform the following test before operating the boat.

Static Water Line Test

Static water line is the difference between sea water level **E** and top of the riser **B** on the engine.

1. Load the boat to maximum capacity and distribute weight as you would for normal boating conditions.
2. Lower a clear plastic hose **A** into the water and, once it is full of water, plug the top of the hose using your thumb or a clamp.
3. Bring plugged end of hose inside the hull **C** and hold next to—and above—the manifold **B**.
4. Release clamp pressure and slowly allow water to drain out until it has maintained a stable level.
5. Measure the vertical distance **D** from water line **E** in hose to the top of manifold **B**. Measurement **D** should not be less than 14 in. (35.6 cm).
6. If the static water line does not meet these specifications, contact your Volvo Penta dealer for information on high rise extension kits. Make sure one is installed before the engine is started for the first time.



51623

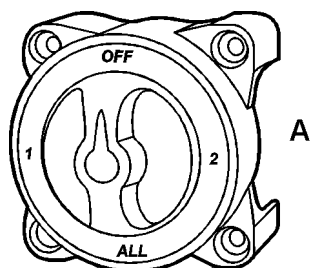
Before Starting

Before you attempt to start your engine, be sure to perform the inspection items provided in the daily checklist located in the chapter entitled *Maintenance Schedule*.

WARNING!

To prevent a possible explosion hazard, operate the engine compartment bilge blower as recommended by the boat manufacturer before starting the engine. Do not operate the engine without a fully functioning bilge blower.

- To prevent a possible explosion or fire, make a habit of checking the engine and engine compartment visually before operating the boat (before the engine is started) and after operating the boat (after the engine has been stopped). Also, smell for the presence of gasoline fumes.
- Only start the engine in a well-ventilated area. If operating the engine in an enclosed space, ensure that there is proper ventilation in order to remove exhaust gases from the area. Please see *Carbon Monoxide* in the section entitled *Safety Information* for additional details.
- Do not start the engine out of the water unless you have connected a hose with running water to the engine flushing port (see *Engine Flush* in the section entitled *After Engine Shutdown* for instructions).
- Never use start spray or similar agents to start an engine. This may cause an explosion in the inlet manifold.
- Thoroughly familiarize yourself with operation of remote control supplied with your boat before proceeding.



51421

1. Turn main battery switch **A** to start battery.

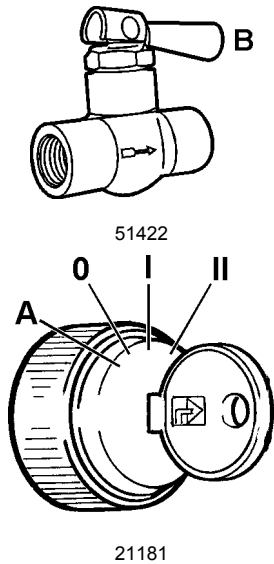
NOTICE! If your boat is equipped with multiple batteries and a selector switch, after starting, the engine should be operated with the selector switch set to the ALL position. This will provide charging system output to all batteries.

2. Start the boat's bilge blower and run as recommended by the boat manufacturer. Frequently check boat's bilge area for gasoline fumes.

3. Check the bilge for excessive water accumulation. Always keep the bilge clean and dry.

NOTICE! The water level in the boat's bilge will increase when you operate your boat at a high incline before you reach planing speed. Excessive water in the bilge can cause engine damage.

4. Open the fuel cock **B**. Also, ensure that the sea cock is open—if so equipped.

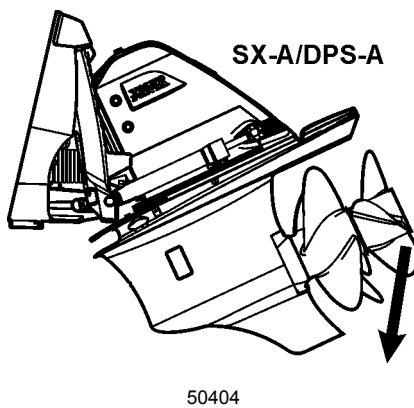


5. Insert the key into the ignition switch **O**. Turn the key one step to the right **I** to switch on engine system voltage and instrumentation.

6. Make sure that the fuel gauge is operating and that you have enough gasoline.

NOTICE! Do not run engine out of fuel or run the electric fuel pumps dry more than 20 seconds. Running the electric fuel pumps dry will damage the fuel pumps.

7. Lower the drive unit to normal run position; make sure the water intakes are submerged. There should be no obstructions in the water near the propellers.



NOTICE! If possible, check the drive oil level.

Starting the Engine

Audible Alarm

If an audible alarm⁽²⁾ has been installed on your boat, it will perform a brief self-test when the ignition key is turned to the RUN position. Following is a description of how the alarm performs the self test.

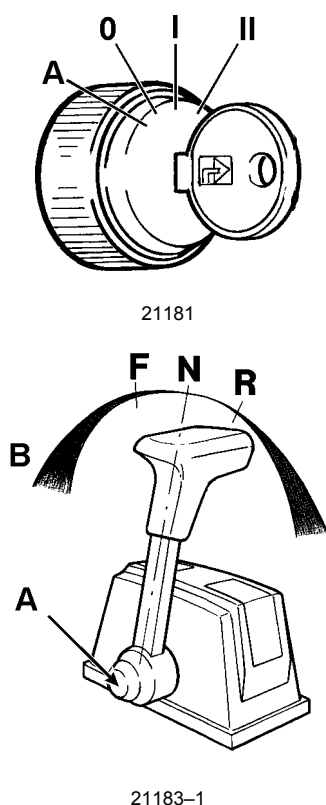
EFI Engines – When the ignition switch is turned to RUN (key on, engine off), the alarm emits three short beeps to indicate that the ECM is performing a check of the sensors. If there are any problems detected by the ECM, the alarm will sound; otherwise, it will remain off.

Carbureted Engines – When the ignition switch is turned to RUN (key on, engine off), the alarm emits a constant tone. The alarm remains operational until the key is either turned to OFF or the engine is started up.

Starting the Engine (Cold Start)

GL Models

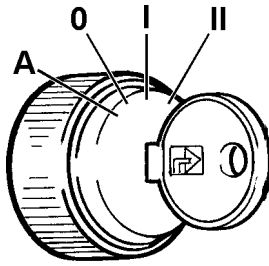
A cold engine may require priming before you can start it. To prime the engine:



1. Turn the ignition switch OFF 0.
2. Disengage the drive mechanism by pressing the gear shift release button A.
3. Depress the throttle lock and move the control lever to FULL THROTTLE B in order to activate the accelerator pump and prime the engine.
4. Return the remote control handle to a fast idle position (about 1000 RPMs).
5. Turn the ignition switch to START II and hold it there until the engine starts, but for no longer than 10 seconds.
6. Once the engine starts, keep the throttle at a fast idle (about 1000 RPMs) for 30 seconds before returning to NEUTRAL.
7. Repeat priming if necessary.

NOTICE! Too much priming may flood the engine. If the engine fails to start after a few attempts, there may be a problem that needs to be addressed. See your authorized Volvo Penta dealer for service.

2. While Volvo Penta provides an audible alarm with every engine, its installation is determined by the manufacturer of your boat. If your boat does not have an audible alarm available, we strongly recommend that you contact your dealer to have one installed.



21181

Fuel Injected Models

1. Move the control handle to the NEUTRAL detent position.
2. Turn the ignition switch to START II and hold, for no longer than ten seconds or until engine starts. If the engine does not start, let go momentarily, then try again.
3. As soon as engine starts, release key to ON or RUN I.

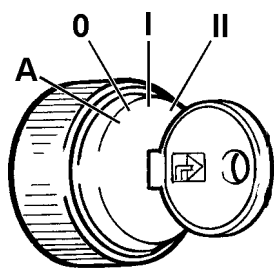
Starting the Engine (Warm Start)

All Models

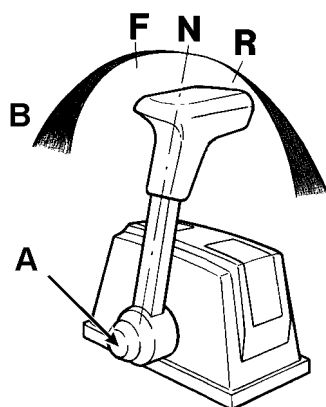
1. Move the control handle to the NEUTRAL detent position.
2. Turn the ignition switch to START II and hold, for no longer than ten seconds or until engine starts. If the engine does not start, let go momentarily, then try again.
3. As soon as engine starts, release key to ON or RUN I.

NOTICE! Never leave the key in the ON I position with the engine not running. Never turn the key to START II when the engine is running. Either situation could damage the engine.

NOTICE! If the engine floods during a warm start, simply follow the directions provided in the following section to restart the engine.



21181



21183-1

Flooded Engine

GL Models

To clear a flooded engine:

1. Disengage the shift mechanism by pressing gear shift release **A**.
2. Move the remote control lever to FULL THROTTLE **B**.
3. Turn the key switch to START **II**.
4. As soon as the engine starts:
 - Return the remote control handle to IDLE.
 - Turn the key to ON or RUN **I**.
 - Move the remote control handle to FAST IDLE to warm up the engine. Do not exceed 1000 RPM.

NOTICE! Immediately after engine start-up, look at all instruments. If any readings are abnormal, stop the engine and determine the cause.

Fuel Injected Models

To clear a flooded engine:

1. Advance the remote control lever to the FULL THROTTLE **B** position.

NOTICE! Be prepared to quickly move the control handle to IDLE once the engine starts. This will avoid over-speeding and possibly damaging the engine.
2. Turn the ignition switch to START **II**. If the engine does not start, then try again.

In this throttle position, with the engine speed below 400 RPM (cranking speed), the ECM shuts off the fuel injectors so no fuel is delivered.
3. Move the throttle back to the neutral position to return to normal operating mode.

NOTICE! Immediately after engine start-up, look at all instruments. If any readings are abnormal, stop the engine and determine the cause.

Operation

This manual covers a wide range of instruments and controls, many of which will not be equipped on all boats. The types of instruments and controls installed on your boat is determined by the boat manufacturer. This manual provides information about equipment manufactured by Volvo Penta. If you have non Volvo Penta equipment installed on your boat or if the Volvo Penta equipment installed is not covered in this manual, please refer to any additional documentation that came with your boat.

DANGER!

Never allow an open flame or electric sparks near the battery or batteries. Never smoke in proximity to the batteries. The batteries give off hydrogen gas during charging which, when mixed with air, can form an explosive gas. This gas is easily ignited and highly volatile.

WARNING!

Never use the drive unit as a ladder or as a lift to board the boat. Personal injury could result from contact with propellers.

WARNING!

Never board at the rear of the boat when the engine is running, even if the drive is in neutral. Personal injury could result from contact with propellers.

WARNING!

Check that nobody is in the water before engaging ahead or astern. Never drive in or near areas where people could be in the water.

CAUTION!

Be sure you have read and understand everything in the section entitled "Before Starting" prior to continuing with this section.

CAUTION!

Avoid violent and unexpected changes in course and gear engagement. This could cause someone on the boat to lose their balance and fall over or overboard.

CAUTION!

Avoid trimming the sterndrive too much as steering will be severely reduced.

Replacement Parts and Tools Checklist

For your safety and to ensure minimal interruption of your cruising pleasure, we strongly recommend that you carry the following spare parts and tools aboard your boat.

- | | |
|--|---|
| <input type="checkbox"/> Extra propeller & prop hardware | <input type="checkbox"/> Thermostat & gaskets |
| <input type="checkbox"/> Impeller & glycerine | <input type="checkbox"/> Cap & rotor |
| <input type="checkbox"/> Fuel filters | <input type="checkbox"/> Electrical & duct tape |
| <input type="checkbox"/> Engine oil & oil filters | <input type="checkbox"/> Hose clamps |
| <input type="checkbox"/> Fuses | <input type="checkbox"/> Tools, for any possible repairs while underway |
| <input type="checkbox"/> Ignition, starter, and fuel pump relays | |

Reading the Instruments

NOTICE! Check instruments regularly. Stop the engine if there is an abnormal reading or if the engine alarm sounds.

NOTICE! If oil pressure is too low: Stop the engine immediately and investigate. Operating the engine with oil pressure too low will damage the engine.

NOTICE! If engine coolant or exhaust temperature is too high: Idle the engine, shift to reverse and then to forward. Idle the engine for 2 to 3 minutes and shut off the engine if the temperature does not decrease. Investigate and correct the malfunction. Operating an engine with temperatures too high will damage the engine.

Alarms

Under a variety of conditions, an alarm will sound to warn you that there is a problem with your engine(s) or sterndrive(s) ⁽³⁾. Common engine and sterndrive malfunctions include, but are not limited to, the following situations:

- Low engine oil pressure
- Engine overheating
- Water in drive oil or low drive oil level (OceanX only)
- Water in drive bellows (OceanX only)

Alarms sound in order to provide you with an audible warning that your engine or drive has a problem.

NOTICE! Continuing to run the engine without correcting the cause of the problem may result in engine damage or equipment failure.

Any engine or drive damage that occurs or is worsened due to ignoring an alarm may not be covered by your warranty.

For a detailed explanation of the problems mentioned above and the steps to take to deal with them, please refer to the chapter entitled *Troubleshooting*.

3. While Volvo Penta provides an audible alarm with every engine, its installation is determined by the manufacturer of your boat. If your boat does not have an audible alarm available, we strongly recommend that you contact your dealer to have one installed.

Maneuvering

Power Trim/Tilt

Your Volvo Penta sterndrive is equipped with a power trim/tilt system as standard equipment. The power trim/tilt allows you to change the angle of the drive unit from the helm. Changing the angle of the drive unit in relation to the boat bottom is called trimming. Trimming provides these benefits:

- Improves acceleration to planing.
- Keeps boat on plane at reduced throttle settings.
- Improves fuel economy.
- Provides smoother/drier ride in choppy water.
- Increases maximum speed.

The power trim is normally used before you accelerate onto plane, after you reach the desired RPM or boat speed, and when there is a change in water or boating conditions. Locate passengers and equipment in the boat so that the weight is balanced fore and aft, and side to side. Trimming will not cancel an unbalanced load.

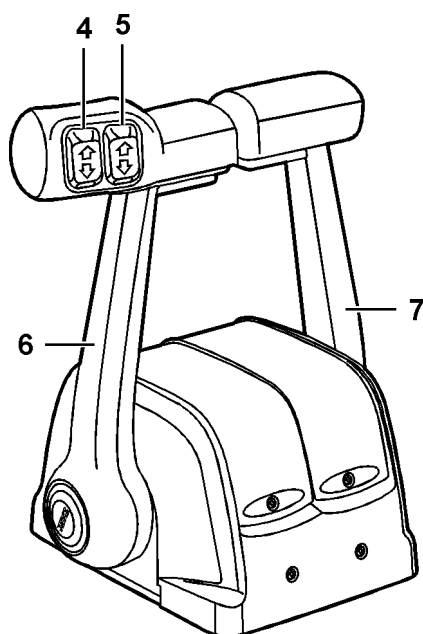
The trim may be operated at any boat speed or at rest. Avoid operating the trim system when running in reverse.

Operating Trim Controls

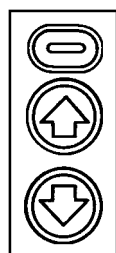
Control Lever

The control button on the control lever has two functions:

- Pressing the top half of the button moves the drive trim out while raising the boat's bow.
- Pressing the bottom half of the button moves the drive trim in while lowering the boat's bow.



51267



22766-1

Trim Switch

Trimming (raising and lowering the drive) can be performed by using the trim switch located on the instrument panel.

- Center button: Moves the drive trim out while raising the boat's bow.
- The lower button moves the drive trim in while lowering the boat's bow.
- The top button (optional) disconnects a "catch" so that the drive can be trimmed into the BEACH and TILT positions. (Press this button and the center button at the same time.)

Determining the Proper Trim

The effect of the maximum “bow-up” and “bow-down” positions will be similar for most boats. The bow position best for your operating conditions could be at any trim setting between the maximum “bow-up” and “bow-down” positions.

The boat will be properly trimmed when the trim angle provides the best boat performance for your operating conditions. On models without power steering, the trim position that provides a balanced steering load is desirable.

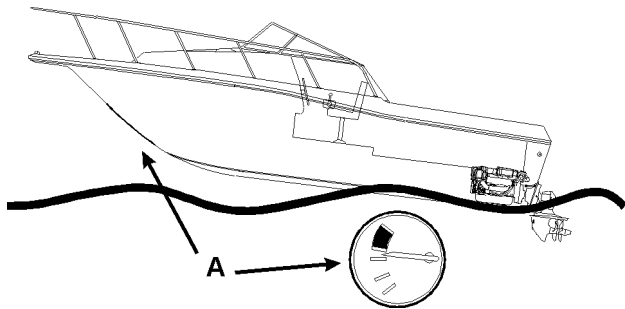
To familiarize yourself with the power trim, make test runs at slower speeds and at various trim positions to see the effect of trimming. Note the time it takes for the boat to plane. Watch the tachometer and speedometer readings and the ride action of the boat.

Operating in “Bow-up” Position

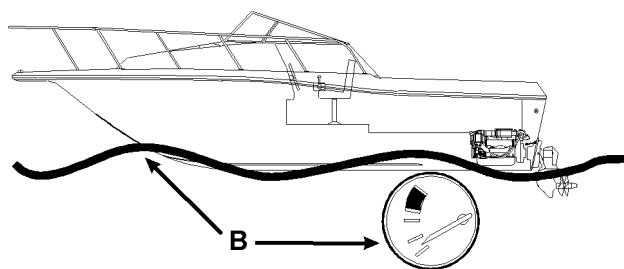
The “bow-up” **A** position is normally used for cruising, running with a choppy wave condition, or running at full speed. In a full “bow-up” position the boat may tend to self-steer. You may have to compensate with the steering wheel to keep the boat in a straight-ahead path. In this position the boat’s bow will tend to raise clear of the water. Excessive “bow-up” trim will cause propeller ventilation resulting in propeller slippage. Engine RPM will also increase, but boat speed will not increase and may even drop.

CAUTION!

Use caution when operating in rough water or crossing another boat’s wake. Excessive “bow-up” trim may result in the boat’s bow rising rapidly and possibly throwing the boat’s occupants into the water.



22796



22797

Operating in “Bow-down” Position

The “bow-down” **B** position is normally used for acceleration onto plane, operating at slow planing speeds, and running against a choppy wave condition. In the fully “bow-down” position the boat may tend to self-steer. You may have to compensate with the steering wheel to keep the boat in a straight-ahead path. In this position the boat’s bow will tend to go deeper into the water. If the boat is operated at high speed and/or against high waves, the bow of the boat will plow into the water.



CAUTION!

The boat may tend to bow steer or spin about rapidly and possibly eject occupants.

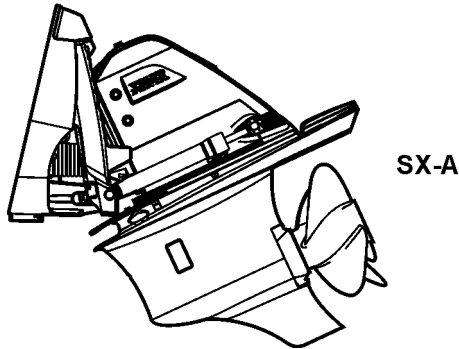
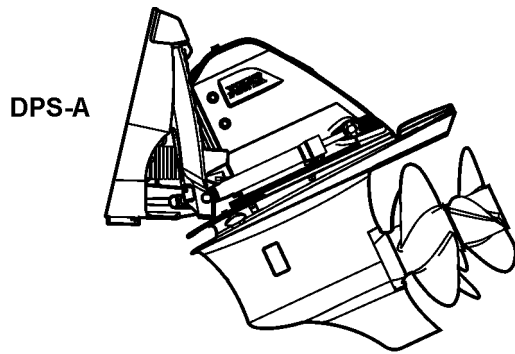
The boat trim should be adjusted to provide balanced steering as soon as possible each time you get underway. Some boat, engine, and propeller combinations may encounter boat instability and/or high steering torque when operated at or near the limits of the “bow-up” or “bow-down” positions. Boat stability and steering torque can also vary due to changing water conditions. If you experience boat instability and/or high steering torque, see your Volvo Penta dealer to correct these conditions.

Trim/Tilt Motor Protection

The trim/tilt system provides impact protection in the trim/tilt cylinders. If an impact occurs while in forward motion, the cylinders will allow the drive to “kick up,” thereby helping to minimize drive damage. However, impact damage can occur in either FORWARD or REVERSE directions.

The trim/tilt motor is protected from overheating by an internal thermal overload switch. If the electric motor stops while tilting, release the switch and refer to the section entitled *Troubleshooting: Trim/Tilt Motor Protection*.

NOTICE! When backing-up in **REVERSE**, there is no impact protection. Be very careful when backing-up in REVERSE. Do not exceed 2500 RPM.



50406

You must be careful when:

- You operate in FORWARD or REVERSE.
- You are backing up.
- You trailer your boat.
- You launch your boat.

NOTICE! Impact damage is more likely to occur when you are in a turn where side loads are placed on the drive unit.

If you strike a solid object:

- Throttle back and shut off the engine immediately.
- Closely inspect the boat and drive unit (especially the transom shield assembly that contains steering system components).
- Check the engine compartment for water leakage.

If there is damage, operate the boat at low RPM and take it to a Volvo Penta dealer for inspection. Operating a damaged unit could cause additional damage and could become very costly to repair. Have necessary repairs made immediately. Only operate your boat if absolutely necessary.

NOTICE! Always check your boat and engine for damage. Failure to inspect for damage may:

- Result in sudden loss of steering control.
- Adversely affect your boat's capability to resist high-speed impacts.

Engine	Max Cruising RPM
3.0GLP	3150-3450
4.3GL	3150-3450
4.3GXi	3300-3600
5.0GXi	3450-3750
5.7Gi-300	3450-3750
5.7GXi	3450-3900
8.1Gi	3150-3450
8.1GXi	3450-3750

51780

Cruising Speed

Volvo Penta recommends the cruising speeds in the chart at left, based on 75% of maximum RPM at wide open throttle (WOT). Operating the engine at WOT for extended periods should be avoided since it is both uneconomical and reduces engine life.

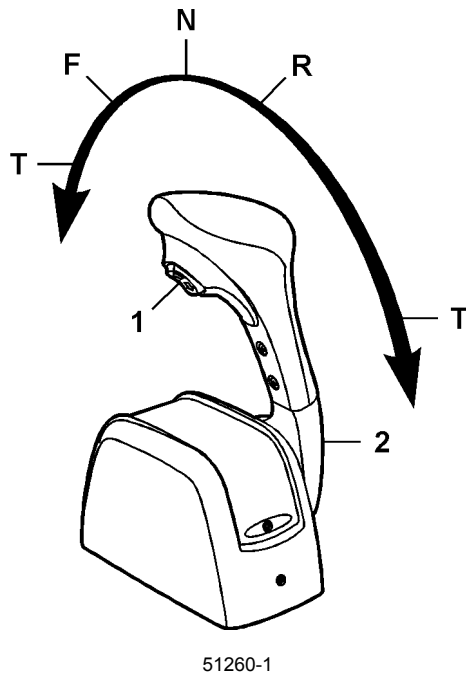
NOTICE! The engine should reach maximum RPM at WOT. If the engine exceeds maximum RPM or can not reach maximum RPM, especially for extended periods, engine damage may occur. This type of damage is not covered by warranty. See the section entitled *Technical Data* for full throttle operating ranges.

The engine should not be operated at RPMs above the WOT range (see *Technical Data*). If the engine is routinely exceeding the WOT maximum RPM or is frequently at limited RPM range (controlled by engine computer) the boat should be taken to the dealer to check for proper propeller size. If the engine will not reach the WOT range, the boat may be overloaded or over-propped and should be taken to the dealer for correction.

Disengaging the Shift Function

The gear shift can be disengaged so that the control lever affects only the engine speed. Please refer to *Controls* in the section entitled *Instruments and Controls* to see the location of the gear shift release.

To disengage the shift from gear, move the control lever to the neutral position, press the gear shift release button, then move the throttle control into—or past—idle.



Single Control Lever Operation

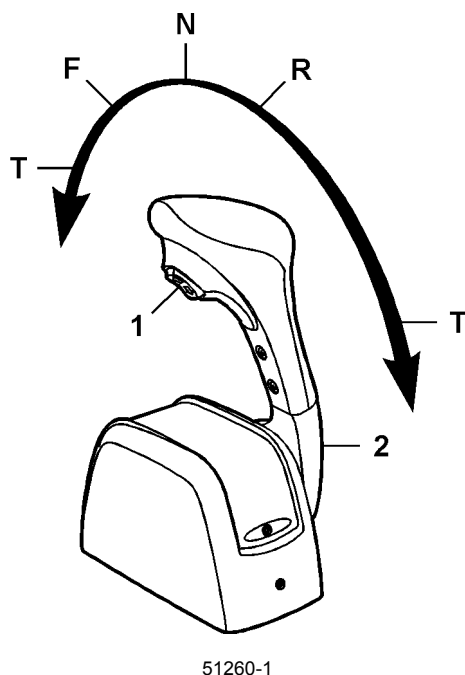
Both the gear shift release and engine speed control are operated using the single lever **2**.

- N** Neutral position (drive is disengaged and the engine runs at idle speed).
- F** Drive/forward gear engaged for forward movement (ahead).
- R** Drive/reverse gear engaged for backward movement (astern).
- T** Throttle/engine speed control.

NOTICE! The engine can be started only if the drive is in neutral.

Shifting from Neutral

To move the remote control lever from the neutral detent position, simply move the control lever in the desired direction.



Shifting and Speed Control

WARNING!

Never abruptly change speed. Sudden changes in speed may cause passengers to be thrown about in the boat.

CAUTION!

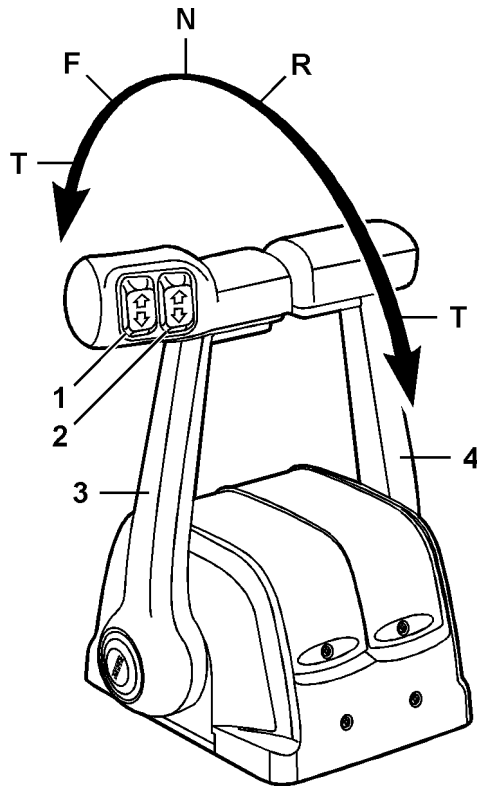
Any time the boat is operated, be aware of changes in shift system operation. A sudden increase in shift effort at the remote control handle, or other abnormal operation, indicates a possible problem in the shift system. If you suspect there is a problem, see your Volvo Penta dealer as soon as possible for proper diagnosis and required service or adjustment. Continued operation could result in damage to the shift mechanism and loss of shift and throttle control that could result in personal injury.

NOTICE! Do not shift gears if engine speed is above 800 RPM. Do not shift from forward to reverse when boat is planing. There is a danger that water will get into the engine and cause serious damage, while causing serious damage to the drive.

NOTICE! Verify proper functionality of all control and engine systems before leaving the dock.

- Move control handle(s) to the neutral detent position **N**. Check in front and behind boat for people or obstructions before shifting.
- To go from forward to reverse, or reverse to forward, always pause at neutral **N** and allow engine speed to return to idle.
- After shifting is completed, continue to move the control handle slowly in the desired direction to increase speed.
- To go forward: Move the control handle forward from neutral detent to forward gear engagement detent position **F**. Throttle movement will begin after the detent position for forward gear engagement. After the throttle is activated, continue to move the control handle slowly in the desired direction to increase speed.
- To go in reverse: Move the control handle backward until you reach the detent position for reverse gear engagement **R**. Throttle movement will begin after reverse gear engagement. After the throttle is activated, continue to move the control handle slowly in the desired direction to increase speed.

If your boat is equipped with a non-Volvo Penta remote control system, ask your dealer how to properly operate it.



51259-1

Twin Unit Maneuvering

When leaving or approaching the dock, or for any close maneuvering at slow speed, place the port engine control lever **3** in neutral **N** (on standby) and use the starboard engine. The use of one control is very effective and more convenient. In the event that the starboard engine (which is being used for maneuvering) stops, you can immediately go to the port engine (which has been on standby).

NOTICE! Both engines must be running during close maneuvering or at slow speeds. If only one engine is running, water may be forced back through the underwater exhaust outlet and cause serious engine damage. Do not attempt to plane boat while operating on a single engine; operating with a single engine at full throttle could cause engine or transmission damage.

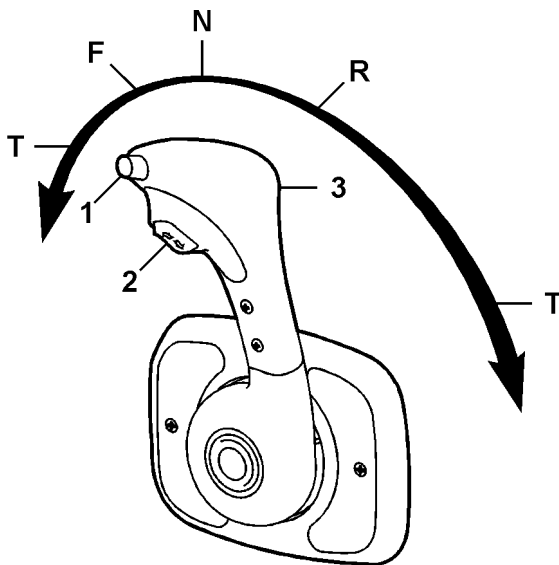
Neutral Interlock Button

The neutral interlock button **1**, available on the side-mount control only, prevents accidentally moving the throttle out of neutral. This button must be depressed to shift the throttle out of neutral.

To move the control lever away from neutral:

1. With the control handle in NEUTRAL, depress the neutral interlock button **1**.
2. While keeping the button pressed, move control handle out of neutral in the desired direction. Once the throttle is out of the neutral position, you may release the button.

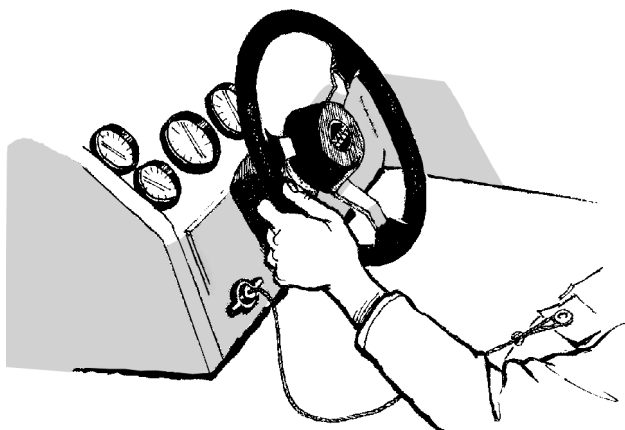
The neutral interlock will automatically re-engage when the control handle is returned to the NEUTRAL position.



51266a

Steering System Operation

While directional control of a boat's steering system operates much like that of an automobile, a boat's responsiveness and maneuverability is very different from that of a car. Avoid high-speed maneuvers until you become accustomed to driving your boat. Keep in mind that a boat is never as maneuverable when moving in reverse as it is when travelling forward.



21182

If the power steering system stops working, the steering wheel will still function but it will feel harder to steer. If this condition occurs, look for possible causes and fix them if possible. If the power steering system cannot be corrected on board, proceed at a reduced speed. You will be able to steer the boat, but with increased effort. See your authorized Volvo Penta dealer as soon as possible to correct your power steering system.

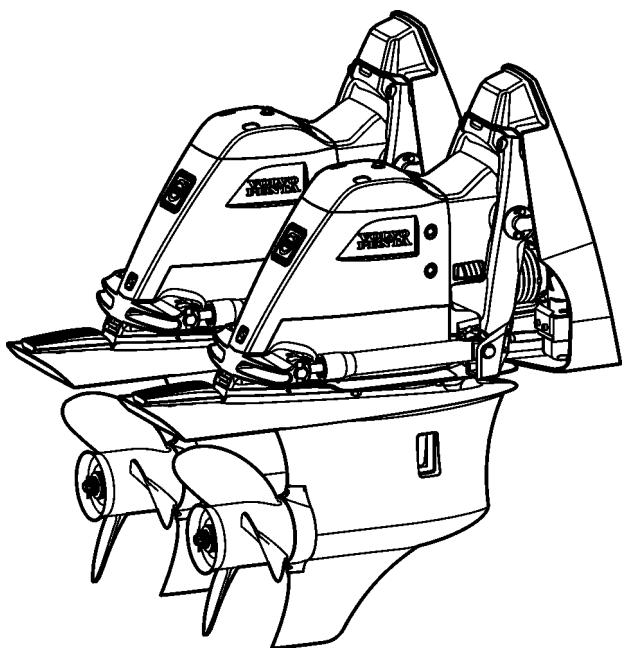
At slow speeds (no wake), your boat may tend to wander due to wind and current. This is normal and may be overcome by anticipating bow direction and correcting with steering wheel. A slightly higher throttle and trim setting may also lessen the tendency to "wander." Changing weight distribution, aft to forward, can also affect slow speed steering.

Twin Unit Steering

Twin engine boats may have only one engine with a fully operational power steering system. That power steering system is on the starboard engine; therefore, when operating on a single engine use the starboard engine.

Using a port engine that does not have a functional power steering system will cause an increased effort in steering control, due to absence of power assist.

NOTICE! Both engines must be running during close maneuvering or at slow speeds. If only one engine is running, water may be forced back through the underwater exhaust outlet and cause serious engine damage. Do not attempt to plane boat while operating on a single engine; operating with a single engine at full throttle could cause engine or transmission damage.



50405

Steering with Control Levers

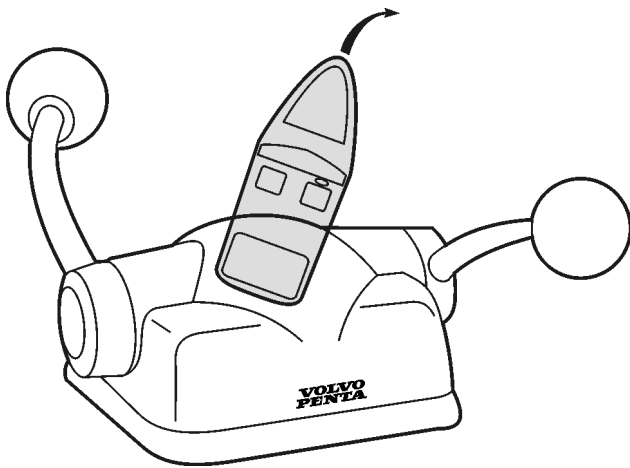
Rotating the Boat

NOTICE! Do not use this procedure if steering faults exist on one or both drives. This procedure requires that both sets of engines and drives are in working order.

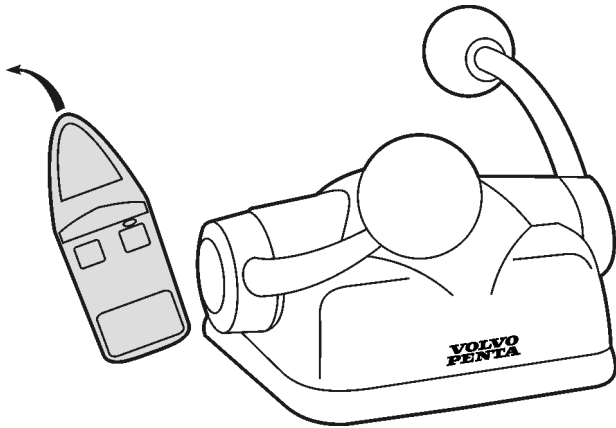
Move one control lever into forward gear and the other control lever into reverse gear.

Use a suitable engine speed for maneuvering. The direction of rotation is determined by the lever which is moved into reverse. If the boat is to be moved to starboard, the starboard control lever should be moved into reverse.

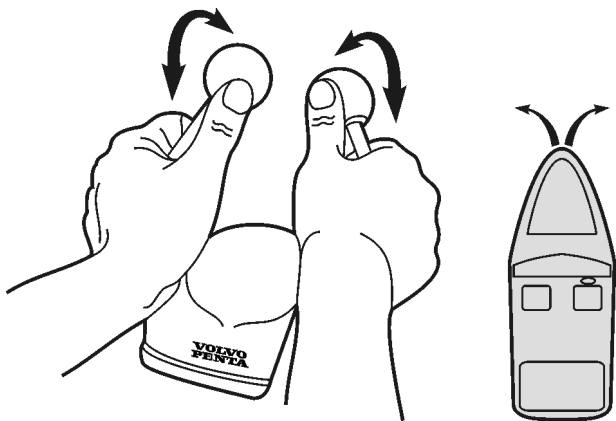
NOTICE! Both engines must be running during close maneuvering, while changing gears, or when traveling at slow speeds. If only one engine is running, water may be forced back through the underwater exhaust outlet and cause serious engine damage.



51310a



51311a



51312

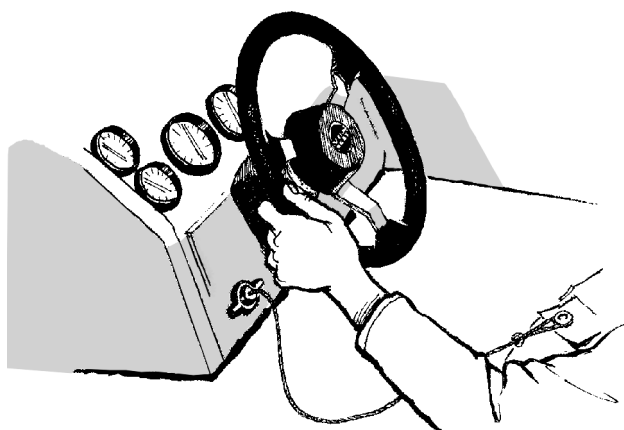
Steering the Boat

Put the control levers into forward gear. Use a suitable engine speed for maneuvering.

The direction of the steering is determined by the use of the control levers. If the boat is to be moved to port, reduce speed on port engine. For immediate reaction, move the port control lever in reverse and then back again to forward.

Operation Break

Emergency Stop Switch



21182

An emergency stop switch, also called a safety breaker, may be a feature of your boat. Use of this switch is highly recommended. To properly use this feature, attach the lanyard to clothing that will **NOT** tear away before the lanyard is pulled from the switch to stop the engine. If the lanyard is too long, shorten it by knotting or looping it. **DO NOT** cut and re-tie the lanyard.

The emergency stop switch can only be effective when in good working order. Observe the following:

- Lanyard must always be free of entanglements that could hinder its operation.
- Once a month, check the switch for proper operation. **With engine running at idle speed**, pull lanyard. If engine does not stop, see your dealer for repairs.

NOTICE! When testing the emergency stop switch, do so at engine idle speed only. Activating the emergency stop switch at any speed above idle will allow water to be ingested into the engine, causing serious engine damage.

Using this switch is simple and should not interfere with normal operation of the boat.

CAUTION!

Care must be taken to avoid accidentally pulling the lanyard during boat operation. Unexpected loss of forward motion will occur which could cause occupants to be thrown forward.

In an emergency situation, any occupant of the boat may attempt to restart the engine by pressing in and holding the emergency stop switch button, followed by normal starting procedures. When the button is released, the engine will stop.

If your boat is not equipped with an emergency stop switch and it falls into one of the following categories, installation of an emergency stop switch is recommended.

- High performance sport boats
- Small runabouts
- Boats with sensitive steering
- Boats where the distance from the top of the gunwale down to the driver's seat is less than one foot (30 cm).

Contact your Volvo Penta dealer for installation of an emergency stop switch.

Special Boating Conditions

The following section covers scenarios that are considered special boating situations. When using the boat in the following situations, there are some special procedures to take into consideration in order to keep the engine, transmission, drive, and propeller in top working condition.

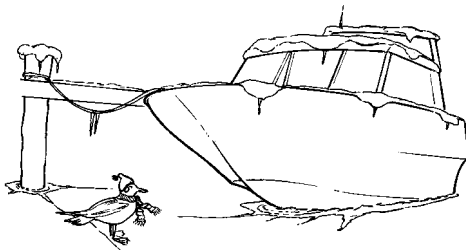
Operating in Freezing Temperatures

The engine and drive are cooled using raw (sea) water. Even freshwater (closed cooling) engines use raw water for cooling purposes. When the air and water temperatures drop low enough, any water trapped in your engine or drive will freeze. Freezing water and ice expand. This expansion could cause parts of the engine and drive containing water to crack. Always be sure to drain any trapped water from your engine and drive if temperatures are expected to drop low enough to cause freezing.

NOTICE! When temperatures drop below freezing, failure to completely drain the cooling system will result in serious damage to the engine and exhaust manifolds.

NOTICE! Freeze damage to the engine package is not covered by your Volvo Penta limited warranty.

Upon completion of engine operation, drain the engine as described in *Draining the Engine* in the chapter entitled *Engine Shutdown*.



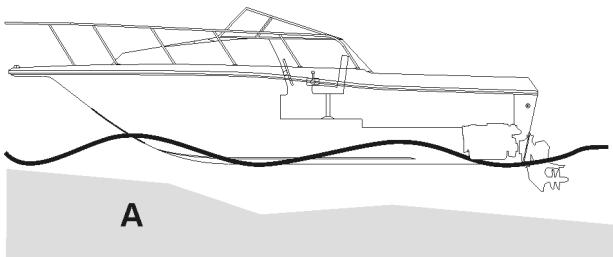
21199

Shallow Water Operation

You may tilt the drive unit to reduce the draft for shallow water running **A** as long as you do not exceed 1000 RPM. Exceeding 1000 RPM at high trim/tilt is not necessary. It will only increase the boat wake and will not increase boat speed appreciably.

NOTICE! Exceeding 1000 RPM with the drive unit tilted could damage drive train components. This type of damage is not covered by warranty. Never attempt to plane the boat or exceed 1000 rpm with the drive unit in a partially tilted position. Always return to the trim range as soon as possible to avoid damage to drive train.

NOTICE! Be very careful when operating in shallow water; the intakes may pick up mud, sand, underwater vegetation, or other submerged debris. This may lead to overheating and engine damage.



22798



22799

High Altitude Operation

Volvo Penta EFI engines have programmed altitude compensation; however, there may be a slight performance loss at altitudes above 5000 feet due to lower air density. If you are boating above 5000 feet for a short time, a lower pitch propeller will restore some of the lost performance. Long term use above altitudes of 5000 ft. may require a change in gear ratio which is not covered under the Volvo Penta Limited Warranty.

Salt Water Operation

You can use your Volvo Penta sterndrive in either fresh or salt water.

We recommend that you use fresh water to flush out the engine and drive after you use your boat in polluted or salt water. This will prolong the service life of the engine and sterndrive. For additional information, see the section entitled *After Engine Shutdown: Engine Flush*.

High Performance Boat Operation

High performance is not only defined by engine size, but by a combination of engine power (horsepower), hull design, and the size of the boat. Your new engine(s) produce a high power output. Depending on the boat type, the top speed may be much higher than what you are accustomed to.

High speed operation requires an experienced operator who has mastered handling of high performance boats. It is advisable that you learn the boat's behavior before you take passengers on board. Inform your passengers about your boat's characteristics and the maneuvers you intend to do. Use the boat's performance with due consideration and care!

When operating at high speeds, remember that other boaters may not realize the speed at which you are travelling, especially when you close in on another boat from astern or from ahead. Always keep a good distance to allow for the unexpected! Always be prepared for what other boaters may do unexpectedly. High speed driving requires the driver to give a high degree of attention to boat operation and surrounding conditions.

A boat travelling at a speed of approximately 70 M.P.H. (60 knots) covers about 101 feet (30 meters) in 1 second. The faster you go the quicker things will happen. High speed driving requires a lot of water and a good distance from possible hazards! Always allow for adequate reaction time. Always reduce speed when visibility is reduced for whatever reason.

When driving, make sure that all passengers are safely seated. Emphasize this especially if you have a larger, high performance cabin cruiser where one normally moves about during operation. Reduce speed considerably, or stop completely if someone needs to move about the boat.

The driver should always use the emergency stop switch! The emergency stop switch lanyard which is securely connected to the driver, immediately shuts off the engine(s) should the driver be thrown from the driving position. Even if the risk of being thrown overboard is practically nonexistent in your type of boat, the risk of the driver falling and being dazed in rough seas can be even greater.

Remember, even when the engine(s) is stopped in a high performance boat that is planing, it will travel approximately 325 feet (100 meters) before dropping through the planing threshold and stopping!

Engine Shutdown

Before Engine Shutdown

WARNING!

Never abruptly change speed. Sudden changes in speed may cause passengers to be thrown about in the boat.

Power Tilt Operation

Tilting is normally used for raising the drive unit to obtain clearance when beaching or launching from a trailer.

NOTICE! Never exceed 1000 RPM when operating the drive unit in the tilted position; doing so may cause loss of steering control or damage the drive system.

NOTICE! Never RUN the engine when the drive unit is tilted more than 30° or the drive will be damaged.

Stop the Engine

1. Move the remote control lever to NEUTRAL **N**.
2. Let engine return to idle.
3. Turn ignition key to OFF **0**.

NOTICE! Do not stop the engine at speeds above idle or “speed up” the engine while turning off the ignition. Do not stop the engine while in gear or while the boat is moving. Engine damage could result from water being sucked back up through the exhaust ports.

NOTICE! Always keep the drive tilted in the down position when the drive is not in use, **except when trailering**.

After Engine Shutdown

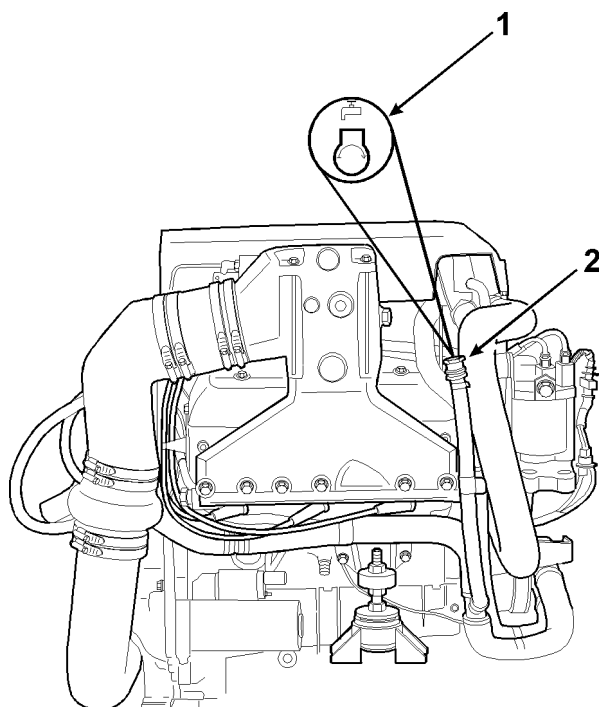
NOTICE! Drain the engine if freezing temperatures are expected. For details on draining the engine, please refer to the section entitled *Draining Raw Water Cooled Engines* or *Draining Raw Water Side of Closed Cooling System Engines*.

Engine Flush

Volvo Penta engines incorporate an engine flushing port designed to flush the engine with fresh water while the engine is running. Flushing the engine with fresh water after each use will increase the longevity of components.

NOTICE! If flushing the engine with the boat in the water, do not run higher than idle speed or sea water may be drawn in with the fresh water.

NOTICE! When flushing the engine with the boat in the water, fresh water pressure must be 17 psi (117 kPa) or greater.

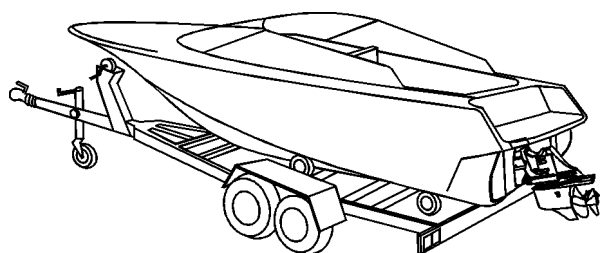


22347

1. If the engine is running, shut it down.
2. Remove the blue plastic cap from the hose that is clamped to the starboard side of the engine. It is marked with the running engine flush symbol 1.
3. Connect a water hose from a fresh water source to the flush connector on the engine 2.
4. Turn water on full and start the engine.
5. Let engine idle until engine temperature stabilizes at its normal operating range. This will allow the thermostat to open and ensure the fresh water circulates throughout the engine.
6. After engine is flushed, shut down the engine.
7. Disconnect water hose and reinstall the cap.

NOTICE! When re-installing the blue cap on the fresh water flush hose, tighten it by hand, then tighten 1/4 turn using a wrench. If the cap is too loose, air may be sucked in, causing the engine to overheat, resulting in damage.

Trailer Your Boat



22800

1. Before loading your boat on the trailer, tilt the drive unit up.
2. After your boat is on the trailer, completely lower the drive unit until the drive drains thoroughly.
3. Rinse the entire drive exterior with fresh water.

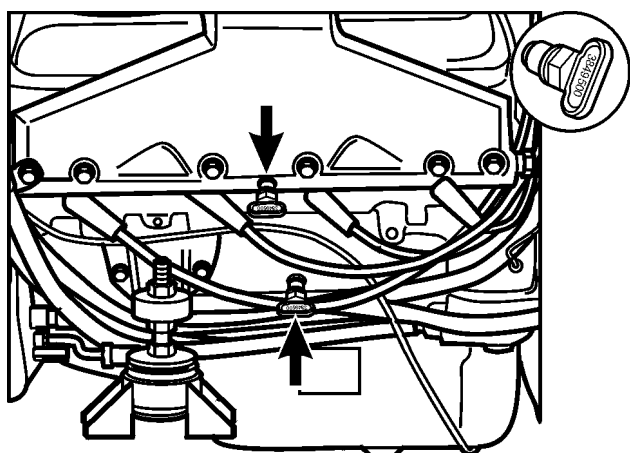
NOTICE! Before moving the trailer, tilt the drive as high as possible and secure it in place.

NOTICE! Be very careful of high or low spots when backing up or crossing railroad tracks; there is a possibility that the sterndrive may hit the ground.

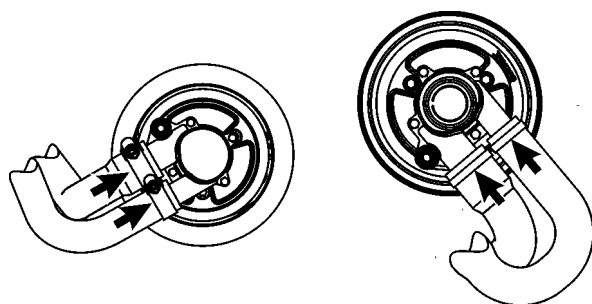
4. When you have reached your destination, if the boat will be stored on the trailer, the drive should be tilted down.

Draining the Engine

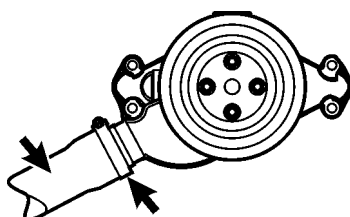
Draining Raw Water Cooled Engines



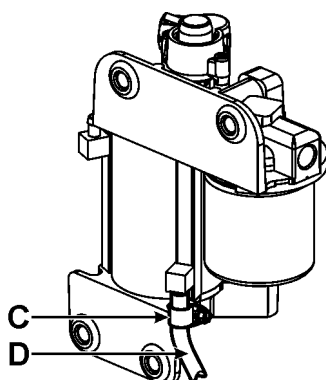
22848-f



51534



51604



23772

1. With the engine turned off, locate and open all drains located on both sides of the engine. Raw water drains are blue, hardened plastic plugs.

NOTICE! Be sure that all water is drained from the engine. If no water drains, use a piece of wire to clear any obstructions from the drain holes.

NOTICE! If possible, when draining the engine, raise or lower the bow of the boat to keep the engine level. This will provide for complete drainage of the block and manifold. If the engine is not level, some water may remain trapped.

NOTICE! When draining the starboard manifold, take care to direct the drained water away from the starter to prevent water damage to the starter.

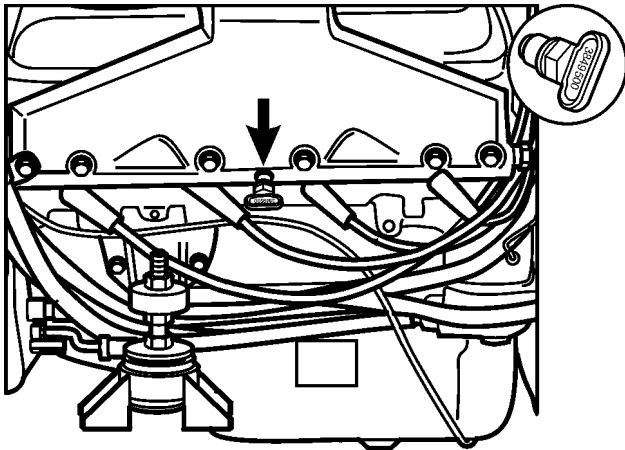
2. After the water has completely drained, reinstall the drain plugs and tighten securely.
3. Loosen the hose clamps and remove the hoses from the raw water pump.

4. Loosen the hose clamp on the large diameter hose and remove it from the circulation pump.

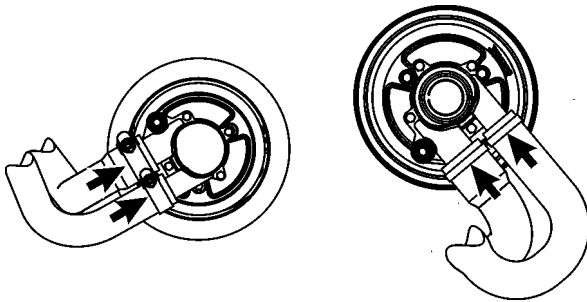
5. Loosen clamp **C** and remove hose **D** from fuel pump. Allow water to drain from hose.

Reinstall all hoses and secure all clamps in the same orientation as removed.

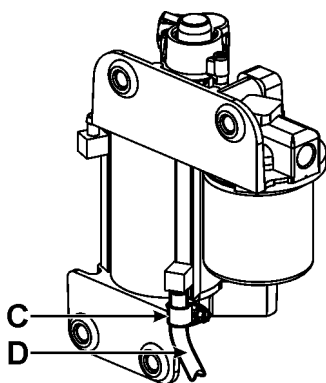
Draining Raw Water Side of Closed Cooling System Engines



22848-g



51534



23772

1. With the engine turned off, locate and open all drains located on the manifolds on both sides of the engine. **Do not drain engine block!**

NOTICE! Be sure that all water is drained from the manifolds. If no water drains, use a piece of wire to clear any obstructions from the drain holes.

NOTICE! If possible, when draining the manifolds, raise or lower the bow of the boat to keep the engine level. This will provide for complete drainage of the manifold. If the engine is not level, some water may remain trapped.

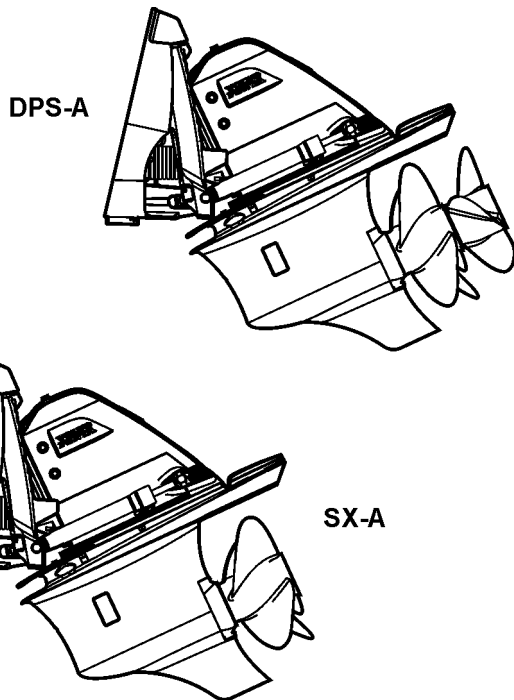
NOTICE! When draining the starboard manifold, take care to direct the drained water away from the starter to prevent water damage to the starter.

2. After the water has completely drained, reinstall the drain plugs and tighten securely.
3. Loosen the hose clamps and remove the hoses from the raw water pump.

4. Loosen the heat exchanger drain cap (located on the bottom of the heat exchanger) and allow water to drain. After water has stopped draining, reinstall the drain cap.
5. Loosen clamp **C** and remove hose **D** from fuel pump. Allow water to drain from hose.

Reinstall all hoses and secure all clamps in the same orientation as removed.

In Case of Emergency



50406

Running Aground

The trim/tilt system provides impact protection in the trim/tilt cylinders. If an impact occurs while in forward motion, the cylinders will allow the drive to “kick up,” thereby helping to minimize drive damage. However, impact damage can occur in either FORWARD or REVERSE directions.

NOTICE! When backing-up in REVERSE, there is no impact protection. Be very careful when backing-up and never exceed 2500 RPM.

If an impact occurs, check that the drive and propeller remain undamaged and that the drive does not vibrate. If there is damage or vibration, the boat should be driven slowly (if possible) to an area where it can be removed from the water for inspection.

Lift the boat ashore. Check the drive oil level and quality. If the oil is milky-white, water has entered the drive and it must be inspected by an authorized Volvo Penta workshop. Replace the propeller if it is damaged.

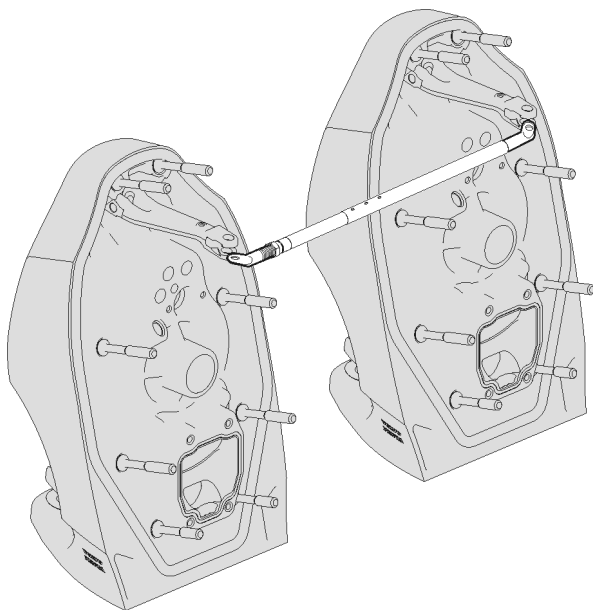
To prevent galvanic corrosion, any paint damage on the drive and propeller should be repaired before launching the boat again.

Tie Rod (Twin Engines Only)

Check the tie rod connecting the drive units, particularly if you hit an obstacle. If the tie rod is bent, loose, or damaged, have it serviced immediately by your Volvo Penta dealer. In the meantime, operate your boat at slow speeds only.

CAUTION!

The tie bar is an integral part of the steering system and is a vital safety part. A damaged tie rod may hinder steering operation or render it completely ineffective. Always replace a damaged tie bar. Never try to straighten or weld a damaged tie rod.



22853

Starting Using Auxiliary Batteries

DANGER!

Never allow an open flame or electric sparks near the battery or batteries. Never smoke in proximity to the batteries. The batteries give off hydrogen gas during charging which, when mixed with air, can form an explosive gas. This gas is easily ignited and highly volatile.

DANGER!

Never interchange the positive and negative poles on the batteries. Risk of arcing and explosion.

DANGER!

Battery electrolyte is a corrosive acid and should be handled with care. If you spill or splash electrolyte on any part of the body, immediately flush the exposed area with liberal amounts of water and seek medical attention as soon as possible.

1. Check that the auxiliary battery has the same voltage as the engine system voltage.
2. Connect the red positive cable to the plus (+) terminal on the discharged battery and then to the plus terminal on the auxiliary battery.
3. Connect the black start cable to the negative (–) terminal on the auxiliary battery and to a place a little distance away from the discharged battery (e.g. the starter motor's negative terminal).

DANGER!

The black jumper cable (–) must never come in contact with the positive connection on the starter motor. Risk of arcing and explosion.

4. Start the engine and let it run at fast idle for approximately 10 minutes to charge the batteries. Make sure there is no extra equipment connected to the electrical system.

Troubleshooting

Engine Troubleshooting Guides

The following troubleshooting guide is provided to help you isolate a malfunction of one or more of your boat's systems. After determining which systems are affected by the malfunction, refer to the individual system troubleshooting charts to isolate the specific cause.

This guide was written to help you trace the symptoms of the trouble to the source, without having to read through and prove every possibility. Much of the information here will be familiar to well informed mechanics.

Also, many factors will seem insignificant but when you think of it, usually the toughest problem to troubleshoot is caused by the smallest error. The greatest aid to solving a service problem is information. Start gathering information and keep a detailed record of the symptoms of the malfunction. Keep a record of pertinent facts, such as:

- When did this trouble start?
- How was the boat loaded?
- Did the trouble occur suddenly or did it become apparent gradually?

Whether servicing the boat's systems yourself or having your product serviced by a certified Volvo Penta dealer, you will need this record of information to identify potential causes of the malfunction.

Analyze this information and try to match it to similar situations you have experienced in the past. Keep in mind the fundamental rules:

- COMPRESSION - Mixture inducted into cylinder and compressed.
- SPARK - Proper intensity at the proper time.
- FUEL - Proper mixture of air and fuel.
- EXHAUST - Clear of any obstructions.

Engine Will Not Crank

Starter Circuit – Check:

- The control lever must be in neutral.
- Emergency stop switch.
- Battery switch turned off.
- Battery condition: weak, dead, sulfated, bad cells.
- Battery cables—for loose or corroded connections.
- Circuit breakers and/or fuses.
- Ignition relay.
- Shorted or open ignition switch.
- Wiring, from battery to ignition switch.
- Starter relay.
- Starter motor and solenoid—for shorts, grounds, or open circuits.
- Starter assist solenoid.
- Call for assistance or see Volvo Penta authorized dealer.

Engine Cranks, But Will Not Start

Ignition Circuit – Check:

- Primary circuit wiring, from ignition switch to ignition coil/ignition module.
- Secondary circuit wiring, from coil to spark plug.
- Spark plugs—for proper gap, fouling, burned electrodes, or cracked/dirty insulator.
- Low battery voltage.
- Call for assistance or see Volvo Penta authorized dealer.

Fuel System – Check:

- Fuel level.
- Fuel shutoff and multiple tank valves are open and operating properly.
- External fuel filter canister clogged.
- Carburetor accelerator pump.
- Quantity and condition of fuel in boat tank.
- Operation and flow capacity of boat anti-siphon valve.
- Fuel tank vent is unrestricted.
- Fuel tank pick-up screen is clean.
- Correct diameter/unrestricted boat fuel lines.
- Fuel pump relay and circuit breaker operation.
- Call for assistance or see Volvo Penta authorized dealer.

Hard Starting – Cold Engine

Check:

- Fuel lines for obstructions.
- For debris inside fuel tank.
- For clean fuel filter.
- Water in fuel.
- Fuel quality deterioration.
- Fuel system—for leaks, dirt, or obstructions.
- Carburetor choke operation and adjustment.
- Carburetor accelerator pump.
- Ignition system.
- Call for assistance or see Volvo Penta authorized dealer.

Hard Starting – Hot Engine

Is this a New Condition? Check:

- Quality of fuel – octane (E10 max).
- Spark plugs.
- Water in fuel.
- Carburetor choke operation and adjustment.
- Condition of battery and cables.
- Starter motor—for overheat damage.
- Call for assistance or see Volvo Penta authorized dealer.

Did Engine Refuse to Start after Being Run? Check:

- Ignition system primary circuit.
- Ignition coil(s) and/or ignition module.
- Flooded engine.
- Call for assistance or see Volvo Penta authorized dealer.

Engine Runs Rough

If At Slow Speed – Check:

- Idle speed and idle mixture.
- Spark plugs.
- Fuel pump pressure.
- Water or contaminants in fuel.
- Manifold vacuum leak.
- Call for assistance or see Volvo Penta authorized dealer.

If At High Speed – Check:

- Air leak on suction side of fuel system.
- Too low octane fuel.
- E20 or E85 fuel.
- Ignition system secondary circuit.
- External fuel filters.
- Water or contaminants in fuel, or water in cylinders.
- Call for assistance or see Volvo Penta authorized dealer.

Engine Noises and Vibrations

Valves (Hydraulic Lifters) – Check:

- Oil quality (dirt or water in oil).
- Oil quantity.
- Oil type and weight.
- Call for assistance or see Volvo Penta authorized dealer.

Ignition System (Ping or Knock) – Check:

- Improper tuning (see dealer).
- Cap and rotor for corrosion (see *Do It Yourself* manual).
- Proper octane fuel is used.
- Call for assistance or see Volvo Penta authorized dealer.

Cooling System – Check:

- Supply pump.
- Loose belts and/or pulleys.
- See section entitled *Cooling System*.
- Call for assistance or see Volvo Penta authorized dealer.

Mountings – Check:

- Loose, broken, or worn engine mounts.
- Loose lag screws holding mounts to stringer.
- Call for assistance or see Volvo Penta authorized dealer.

Alternator – Check:

- Loose pulley (see dealer).
- Noise from bearings (see dealer).
- Call for assistance or see Volvo Penta authorized dealer.

Sterndrive – Check:

- Failed U-joints or gimbal bearing (see dealer).
- Damaged internal drive components (see dealer).
- Worn, bent, or broken propeller hub or blades (refer to the section entitled *Propeller Replacement*).
- Call for assistance or see Volvo Penta authorized dealer.

Engine Overheats

Check:

- Drive water intakes blocked. Tilt the drive up and look for obstructions to the water intakes (e.g., seaweed, plastic bags, etc.).
- Check cap on running engine flush port to ensure it is securely in place.
- Raw water pump impeller damaged or blocked. For additional information, see *Maintenance: Impeller: Checking & Replacing*. Do not do this unless you have tools and parts on hand.
- Supply pump, circulating pump, and belt(s).
- Thermostat.
- Sending unit operation and wiring circuit.
- Water supply hoses (loose clamps or holes in hoses).
- Air leaks on suction side of supply pump.
- Water leaks on pressure side of supply pump.
- If equipped with a heat exchanger, check to be sure that it is free of debris.
- Call for assistance or see Volvo Penta authorized dealer.

Engine Dies Out

- Refer to the section entitled *Engine Protection Mode*.

Loss of Fuel or Out of Fuel – Check:

- Fuel level in tank.
- Water or debris in fuel.
- Plugged fuel filter.
- Fuel pickup tube and screen blockage.
- Fuel tank vent blockage.
- Air leak on suction side of fuel system.
- Fuel leak on pressure side of fuel system.

DANGER!

Be extremely careful around fuel leaks. Never expose fuel or fuel vapors to sources which could cause ignition, resulting in a fire or explosion.

- Fuel pump operational.
- Call for assistance or see Volvo Penta authorized dealer.

Loss Of Ignition – Check:

- Spark plug wires.
- Ignition switch wires.
- Circuit breakers and relays.
- Wiring between engine and dash.
- Call for assistance or see Volvo Penta authorized dealer.

Engine Stops Or Dies Out Due To Seizure – Check:

- Call for assistance or see Volvo Penta authorized dealer.

Engine Won't Reach Operating RPM

- Refer to the section entitled *Engine Protection Mode*.

Check:

- Boat overloaded or load improperly placed.
- Marine growth on hull and drive (refer to the section entitled *Boat Bottom*).
- Fuel type or octane.
- Propeller: Damaged blades or slipping hub (refer to the section entitled *Propeller Replacement*).
- Wrong propeller (refer to the section entitled *Propeller Replacement*).
- Crankcase oil volume.
- Operating at high altitude.
- Restricted carburetor air intake.
- Restricted exhaust outlets in engine, transom bracket, or drive.
- Fuel pump.
- Engine overheating.
- Ignition system operation.
- Remote control cables and linkage for proper attachment and travel.
- Call for assistance or see Volvo Penta authorized dealer.

Low Oil Pressure or Engine Knock

Engine Components – Check:

- Oil quality (dirt or water in oil).
- Oil quantity.
- Oil type and weight.
- Call for assistance or see Volvo Penta authorized dealer.

Low Battery Voltage After Short Storage

To Charge:

- Check all battery and starter cable connections to ensure they are clean and tight.
- Use a fully charged battery to jump start the engine. Refer to *Starting Using Auxilliary Batteries* in section entitled *In Case of Emergency*.
- Recharge starter battery.
- Check battery condition; replace if necessary.

To Prevent:

- All electrical accessories including ignition circuit are turned off.
- Turn battery switch off and disconnect main battery negative cable from battery.
- If problem persists, call for assistance or see Volvo Penta authorized dealer.

Less than Optimal Performance

A great number of environmental factors, such as barometric pressure, ambient temperature, humidity, the quality of fuel, and exhaust back pressure can affect engine performance. All Volvo Penta engines are tested and certified using the following fixed values or common conditions for determining the rating of the engine.

Condition	Value
Air temperature	25°C (77°F)
Barometric pressure	100 kPa (14.504 PSI)
Relative humidity	30%

A gasoline engine operates with very little surplus air. When conditions deviate from the standard values, the result can be a loss of power at full load. It can also cause a rise in exhaust emissions due to incomplete fuel combustion.

Hull Weight

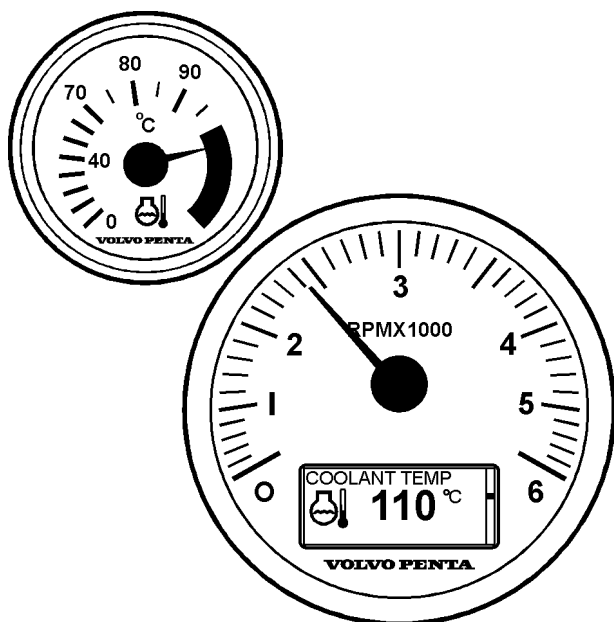
The overall weight of the boat is an important factor in performance. Any increase in boat weight will slow down the boat speed, particularly on boats with planing and semi-planing hulls. To minimize this problem, eliminate all excess weight from the boat.

In considering the influence of weight, it is worth remembering that fiberglass boats absorb a significant amount of water into their hulls while left afloat for any length of time and so become progressively heavier.

Another negative influence on boat performance is marine growth beneath the water line—a problem that is often overlooked.

The propeller originally installed is frequently one that is designed to give maximum speed when the boat is new. For this reason, it is often advisable to reduce the propeller pitch by as much as an inch or more in order to counter the effects of the increase in overall weight encountered in normal cruising, particularly in hotter climates. Although this will reduce top speed somewhat, overall ride conditions will improve and you should achieve greatly enhanced acceleration.

If you feel that your boat performance has declined over time, we recommend that you visit an authorized Volvo Penta dealer to discuss the issue. Your dealer can assist you with selecting the correct propeller size, gear ratio, and horsepower for your boat, based on your current operating conditions.



51279c

Engine Protection Mode

In a low oil pressure or engine overheat situation, the engine will trigger the Engine Protection Mode (EPM). In such cases, if an acoustic alarm has been installed with your engine, it will sound to notify you of a malfunction⁽⁴⁾.

If the engine triggers protection mode, its speed (RPMs) may be reduced or it may shut down, depending on the engine equipment and circumstances.

Under most conditions, engine operation is limited to 2500 RPMs or less⁽⁵⁾. When the engine enters EPM, there will be a temporary reduction in power until the problem is resolved. **We strongly urge you to bring the engine to idle to investigate the problem.** If the acoustic alarm stops sounding, the malfunction has been cleared and the engine may now be operated normally.

Use the oil pressure and water temperature gauges to verify a problem exists, then inspect the engine crankcase for proper oil level and check the water inlets for obstructions. The low oil pressure/engine overheat problem must be corrected before the engine will return to normal operation.

To reset the Engine Protection Mode after the problem is corrected, reduce engine speed to idle, allow the engine to cool, and then continue with normal operation.

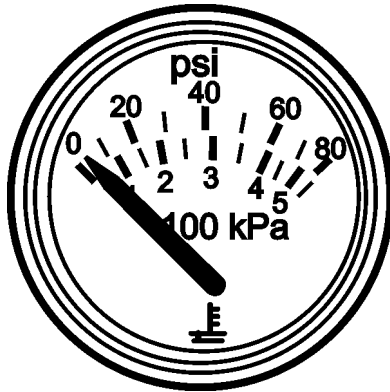
If you are unable to locate and resolve the problem, you may be able to continue operating the engine at above idle speed, keeping in mind that the acoustic alarm will continue sounding and the engine speed will remain at a reduced level.

NOTICE! Continuing to run the engine, with EPM active and without correcting the cause of the problem, may result in engine damage or equipment failure which may not be covered by your warranty.

If the problem continues, contact your Volvo Penta dealer and have the engine inspected.

4. While Volvo Penta provides an audible alarm with every engine, its installation is determined by the manufacturer of your boat. If your boat does not have an audible alarm available, we strongly recommend that you contact your dealer to have one installed.

5. For mild engine overheating, engine speed reduction will be 3500 RPMs.



51749

Low Oil Pressure

If your engine's oil pressure drops too low, the acoustic alarm will sound a constant tone, warning you that there is a problem. The engine will also enter protection mode and engine RPMs will be reduced. There are three common reasons for oil pressure dropping too low:

- High oil level
- Low oil level
- Increased engine temperature

If the alarm sounds and the oil pressure gauge indicates low pressure, reduce engine speed (RPMs) to idle and investigate the problem.

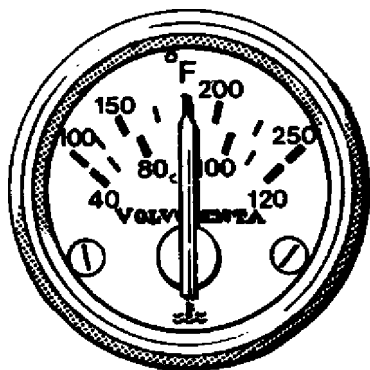
NOTICE! Ignoring a low engine oil pressure situation can cause engine damage and/or equipment failure which may not be covered by your warranty.

If safe to do so, shut off the engine and allow oil to settle for five minutes. Use the dipstick to check engine crankcase oil level. If there is too much oil, siphon out the excess until it reaches recommended levels. **If you are unable to remove oil from the engine, make way at reduced speed only.**

If there is not enough oil, add more until it reaches recommended levels. **If you are unable to add oil to the engine, make way at reduced speed only.**

If the oil level is not the problem or the alarm continues to sound after adjusting the oil level, check to see if there are any additional problems such as engine overheating. See the next section for additional information.

If the problem persists, contact your Volvo Penta dealer and have the engine inspected.



21195-1

Engine Overheating (EFI Engines)

If the engine overheats at high speeds, the engine protection mode will activate and:

- Engine speed will be automatically reduced to approximately 2500 or 3500 RPM, depending on the severity of overheating. Mild overheating results in a speed reduction to 3500 RPM. If an engine alarm has been installed, an audible warning horn will sound for 1/2 second every 5 seconds. More severe overheating results in a speed reduction to 2500 RPM. If an engine alarm has been installed, an audible warning horn will sound once per second.
- The engine protection mode will remain active until the engine has been reduced to idle and the overheating problem has been corrected. For additional information, see *Engine Protection Mode*.

To determine possible causes for overheating:

- Look for obstructions to the water intakes (e.g., seaweed, plastic bags, etc.)
- Check impeller
- If fresh water cooled, check coolant level
- Check all water supply hoses for leaks

NOTICE! Ignoring an overheating situation can cause engine damage and/or equipment failure which may not be covered by your warranty.

If the situation persists, contact your Volvo Penta dealer for assistance.

Water in Bellows

OceanX (OXi) drives are equipped with a sensor that detects water intrusion in the bellows. If water is detected inside the bellows, an alarm horn will sound for one second every sixty seconds. If this alarm sounds, please contact your dealer for repairs as soon as possible.

Water in Oil and Oil Level

OceanX (OXi) drives are equipped with an oil level sensor that also detects water intrusion in the drive. If the oil level in the drive is low or water is detected in the oil, an alarm horn will sound for one second every sixty seconds. If this alarm sounds, check the level and quality of the oil in the drive.

For instructions on checking the level, please refer to *Lubrication System: Checking Engine Oil Level* in the chapter entitled *Technical Data*. If the oil level is low, add the necessary amount.

To check the quality of the oil, siphon off a small amount of oil from the drive. Check to see if the oil has

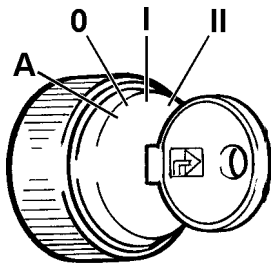
a milky or translucent white appearance. If the oil has water in it, it will appear milky.

If the alarm persists after checking the oil level and quality, please contact your dealer for repairs as soon as possible.

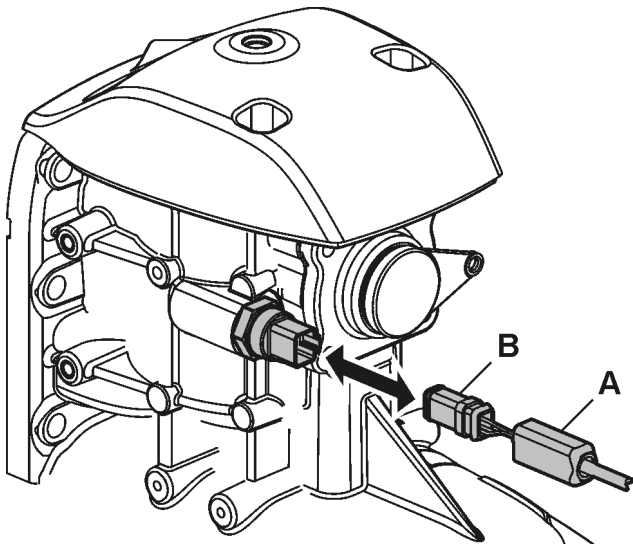
Oil Sensor Reset

Whenever the drive oil is replaced, the drive oil sensor must be reset. If your dealer changed the oil in the drive, the sensor should already have been reset. However, if you changed the drive oil yourself, or if the dealer forgot to reset the sensor, the alarm may sound. If this occurs, you can reset the sensor yourself by using the following steps:

NOTICE! This procedure must be carried out with the boat out of the water. If you plan to run the boat while it is out of the water, ensure that the engine has sufficient cooling water by using the flush port. For additional information, please see *After Engine Shutdown: Engine Flush* in the chapter entitled *Engine Shutdown*.



21181



51735

1. Ensure that the drive is trimmed to six degrees or below and that the cavitation plate is as close to level as possible.
2. Turn the engine off and allow the oil to settle for at least 30 minutes.
3. Remove the gear shift cover using a 12mm socket to loosen and remove the five screws holding it in place.
4. Insert the key into the ignition switch **O**. Turn the key one step to the right **I** to switch on engine system voltage and instrumentation. **Do not start the engine.**
5. Move the plastic protector **A** on the oil sensor connector **B**.
6. Press the release on the connector and pull the plug out of the sensor. Wait at least three seconds.
7. Plug the connector back in. The engine alarm will sound three beeps to acknowledge that the sensor has been reset.
8. Replace the cover and torque all screws to 13–17 ft. lb. (17–23 Nm).

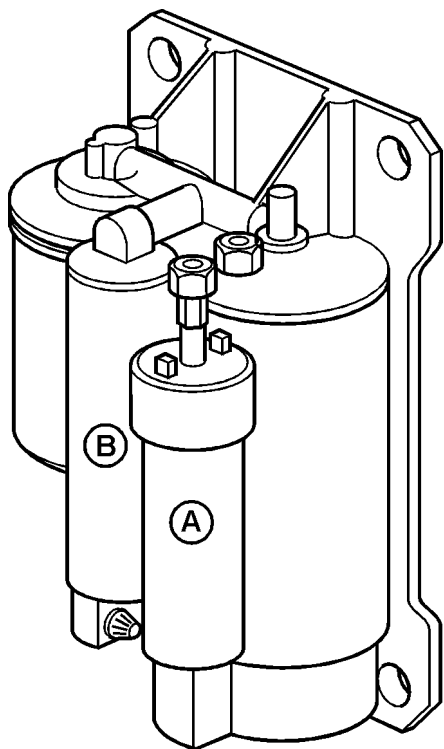
Electric Fuel Pumps

EFI engines have two electric fuel pumps:

- A high-pressure pump **A** to supply the fuel injectors.
- A low-pressure pump **B** to bring fuel from the boat tank to the engine.

Both pumps are protected by a single 20-amp fuse and relays. The pumps will operate only when the engine is cranking or running. If a pump does not function, check the fuses and replace them if necessary. See your Volvo Penta dealer if further service is required.

NOTICE! A loud whining noise at idle may be due to a restricted fuel filter causing a noisy fuel pump. Operating the engine with a restricted filter may damage the pressure regulator or fuel pumps. See your Volvo Penta dealer if the pump makes an unusual noise.



22825-a

Circuit Breakers and Fuses

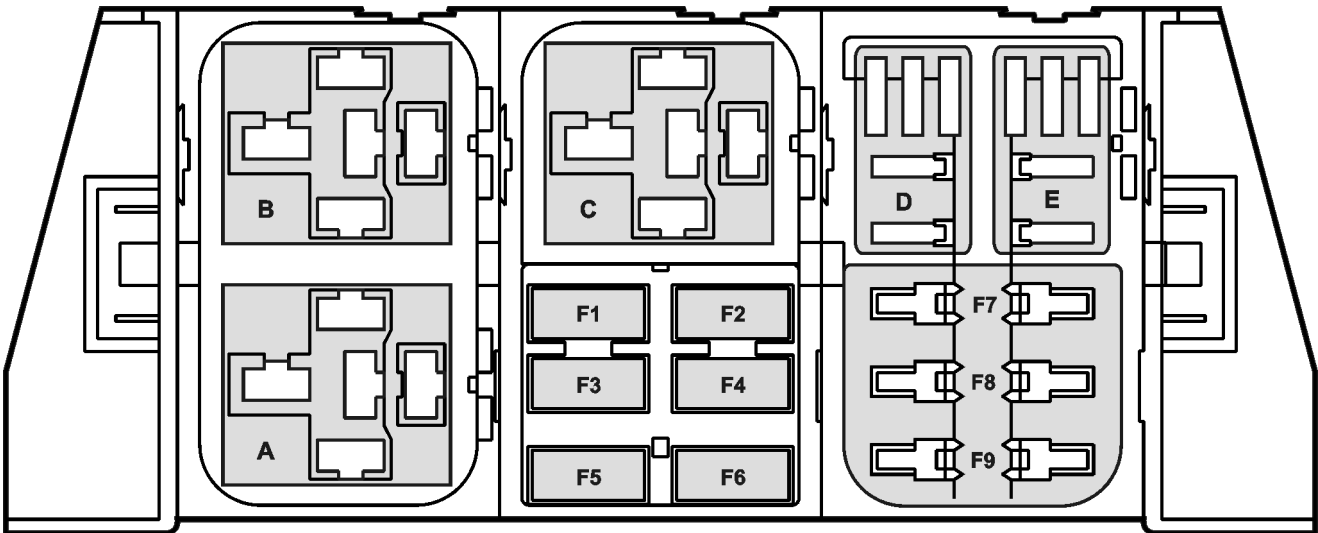
The engine and boat's electrical system is protected against current overload by a circuit breaker and fuses.

- If the circuit breaker trips, press button to reset.
- Replace any blown fuses.

NOTICE! Circuit breakers or fuses that repeatedly fail indicate a problem that requires immediate attention. See your Volvo Penta dealer.

Fuse and Relay Box Layout

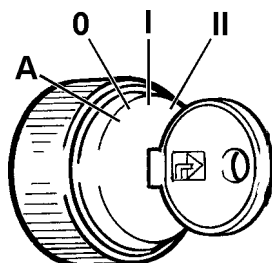
Several spare fuses and relays are located on the inside of the fuse and relay box cover. In case of malfunctioning or faulty fuses and relays, use the spares provided.



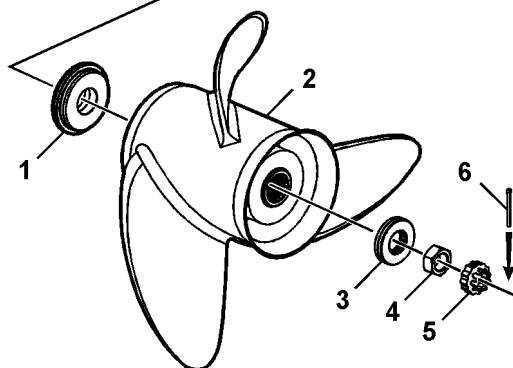
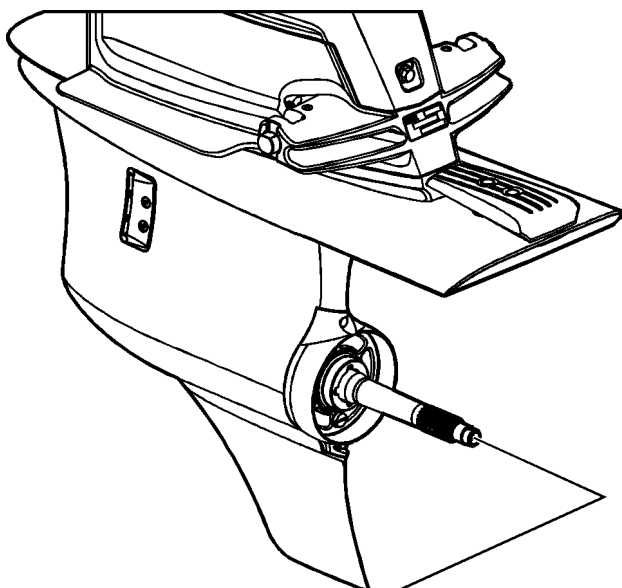
23672

A	Trim Down Relay	F3	20 Amp Fuse (Fuel Pump)
B	Trim Up Relay	F4	15 Amp Fuse (Ignition)
C	Starter Relay	F5	5 Amp Fuse (Vessel Switch)
D	Fuel Pump Relay	F6	20 Amp Fuse (ECM)
E	Ignition Relay	F7	40 Amp Fuse (Instrument Panel)
F1	15 Amp Fuse (Diagnostic Connector)	F8	40 Amp Circuit Breaker (Trim Pump)
F2	10 Amp Fuse (Trim Control)	F9	20 Amp Fuse (Starter)

NOTICE! This “get home” (emergency) procedure will require you to have tools and spare prop(s) and nuts on hand.



21181



22864-a

Propeller Replacement

Removing the SX-A Propeller

1. Turn ignition switch to RUN I (key on, engine off).
2. Tilt drive up.
3. Turn ignition switch off 0 and remove key.
4. Shift remote control into FORWARD to lock prop shaft.
5. Remove cotter pin 6 and keeper 5.
6. Remove prop nut 4 using a 1-1/16 wrench.
7. Remove thrust washer 3 and prop 2. Ensure that thrust bushing 1 is not stuck on prop.
8. Clean prop shaft. Inspect for fishing line or other debris which could ruin the seals; remove if present.

Installing the SX-A Propeller

NOTICE! Failure to install all components could result in loss of propeller and damage to drive unit next time the boat is operated.

1. Ignition switch must be OFF.
2. Make sure remote control is in NEUTRAL.
3. Coat full length of prop shaft and inside of prop hub with Volvo Penta prop shaft grease; removal of prop will be difficult if this is not done.
4. Ensure thrust bushing 1 is on prop shaft with inner taper toward gearcase to match taper on prop shaft.
5. Install the prop 2 onto the prop shaft, aligning splines, and push prop onto thrust bushing until splines are exposed.
6. Install thrust washer 3 on prop shaft splines.
7. Shift remote control into REVERSE gear to lock prop shaft.
8. Install and tighten prop nut 4 until it is seated against thrust washer.
9. Loosen nut, then turn it back against thrust washer until finger tight. Tighten nut an additional 1/3 to 1/2 turn.

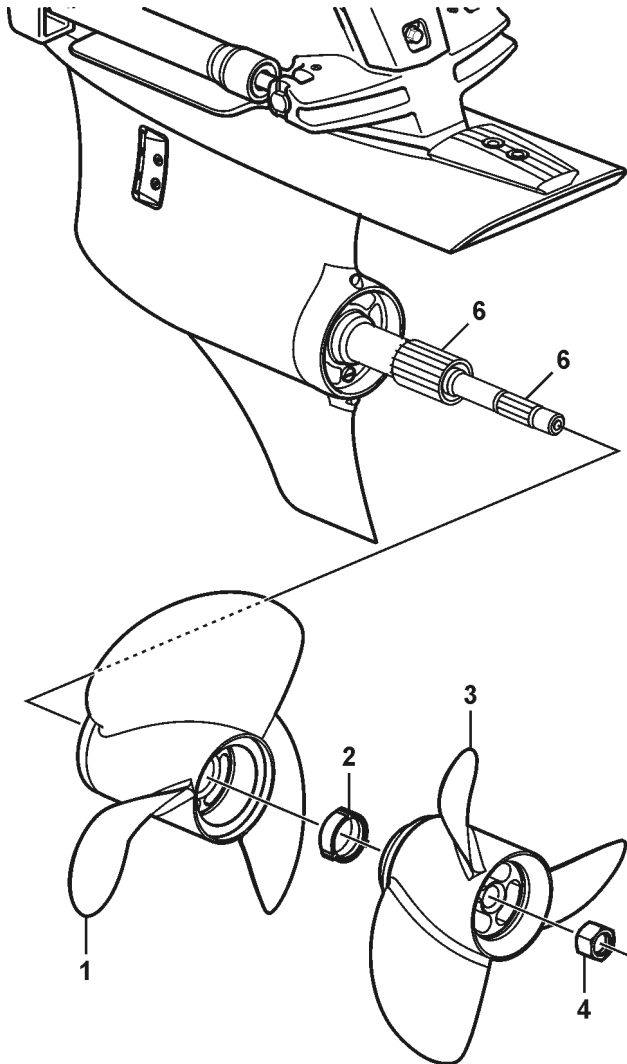
NOTICE! Before your next outing, use a torque wrench to tighten the propeller nut to 70 – 80 ft. lb. (96 – 108 Nm).

10. Index keeper 5 on prop nut until it is aligned with cotter pin hole.
11. Install cotter pin 6 and bend ends to secure; use a new cotter pin if necessary.
12. Shift remote control into NEUTRAL. The prop should turn freely.

Removing the DPS-A Propeller

NOTICE! This “get home” (emergency) procedure will require you to have tools and spare prop(s) and nuts on hand.

Special tool P/N 3862797 is needed to remove the front propeller nut on DPS-A drives.



1. Turn ignition switch to RUN (key on, engine off).
2. Tilt drive up.
3. Turn ignition switch off and remove key.
4. Use propeller tool (P/N 3862808) or 30 mm socket and ratchet to remove rear propeller nut 4.

Use a block of soft wood 5 between the cavitation plate and the front propeller, to stop the propeller shafts from turning, so the nut can be loosened.

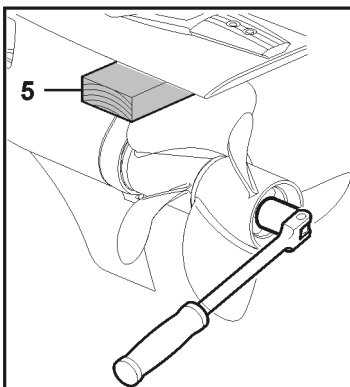
NOTICE! Blades of aluminum propellers may bend when using the wood to stop the shafts from turning. Proceed slowly and check for bending blades. If propellers appear to bend, refer to the *Do It Yourself* manual for an alternate procedure or contact your dealer.

5. Remove rear propeller 3.
6. Use propeller tool (P/N 3862797) and ratchet to remove front propeller nut 2.
7. Remove front propeller 1.

NOTICE! Propeller may be stuck to shaft. Tap the forward edge of the propeller blades **LIGHTLY** with a **NON-METALLIC** hammer. If the propeller still can not be removed, contact your dealer.

Regular removal of the propellers and re-greasing the splines of the shafts 6 and hubs helps reduce the chances of the propeller sticking.

8. Clean the propeller shafts. Inspect for fishing line or other debris; remove if present.
9. Inspect shaft seals; correct if leaking (see dealer). If reinstalling the propellers, clean the splines in the hubs (inside).



51775

Installing the DPS-A Propeller

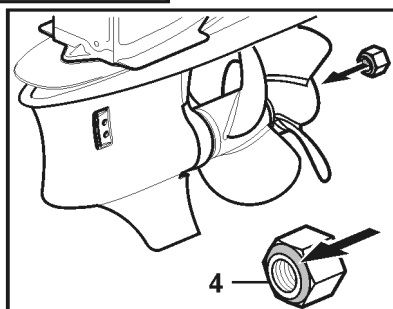
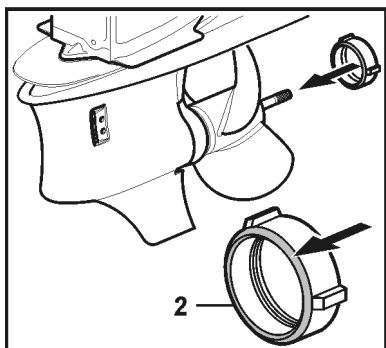
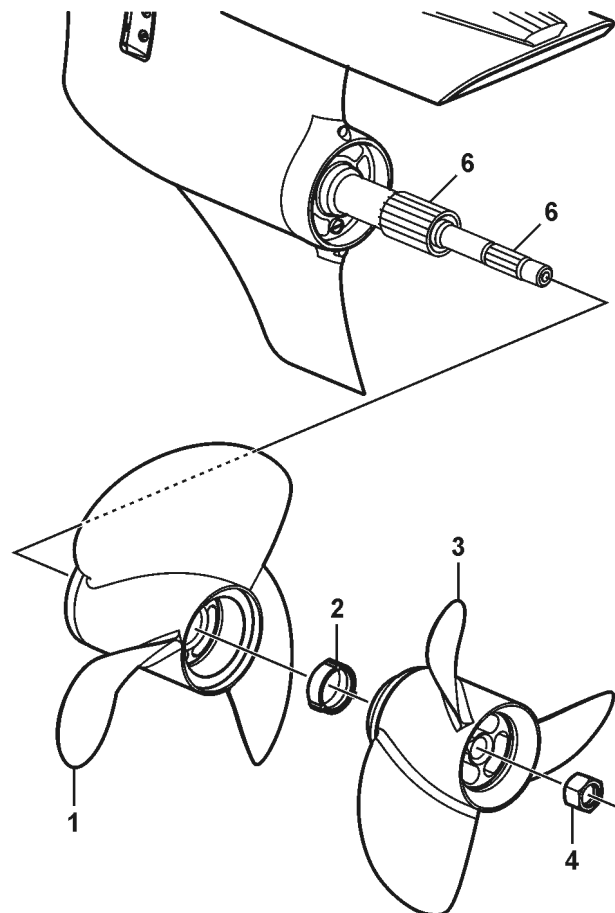
NOTICE! Failure to install all components could result in loss of the propeller and damage to the drive unit the next time the boat is operated.

1. Turn ignition switch off and remove key.
2. Coat the full length of both shafts with grease (P/N 828250). Future removal of the propellers will be difficult if this is not done.
3. Install the front propeller 1.
4. Install the front propeller nut 2, chamfered edge forward. Use propeller nut tool (P/N 3862797) and torque wrench to torque the nut to 45 ft. lb. (60 Nm).

NOTICE! Be sure the chamfered edges of the propeller nuts are facing forward. Failure to install the propeller nuts correctly could result in propellers coming loose and damage to the lower unit and/or propellers.

5. Install the rear propeller 3.
6. Install the rear propeller nut 4, chamfered edge forward. Use a 30 mm socket and torque wrench to torque the nut to 50 ft. lb. (70 Nm).
7. With the remote control in neutral position, both propellers should turn freely.

NOTICE! Failure to install the propellers as indicated could result in a propeller coming loose and damage to the lower unit and/or propeller.



51776

Boat Bottom

The condition of the boat's bottom can affect your engine's performance. Marine growth, present in fresh water as well as salt water, will reduce boat speed. A boat bottom with evidence of marine growth can cause a reduction in top speed of 20 percent or more. Periodically clean the bottom of your boat following the manufacturer's recommendations. Bottom painting may also be desirable.

Engine Submersion

1. Remove the engine from the water as quickly as possible.
2. Contact your local Volvo Penta dealer for service.
 - Your dealer will need to drain all water from the engine and immediately lubricate all internal parts.
 - All electrical devices must also be dried and inspected for water damage.
3. Frequently check engine compartment for gasoline fumes and excessive water accumulation. In addition, make sure that the water depth in the bilge is kept well below the flywheel housing.

NOTICE! Delay in completing the above actions will result in extensive engine damage.

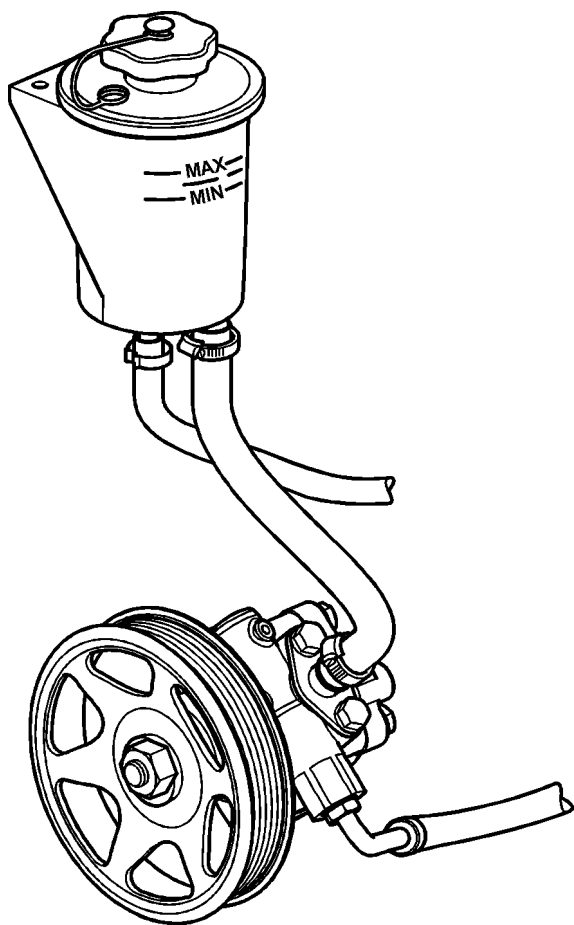
Trim/Tilt Motor Protection

If the electric motor stops while tilting, release the switch and allow the overload switch to cool and automatically reset itself. When the overload switch has reset, tilting may be resumed. Make sure the drive unit is not being restrained, causing the motor to overheat. If the electric motor still does not operate, check the 40-amp circuit breaker located in the fuse box.

Steering

If you experience difficulty steering the boat, check for the following possible problems:

- Check the fluid level in the power steering pump reservoir. The level must be between the “Min” and “Max” lines.
- Check that all hose clamps on the power steering system are securely tightened.
- Check all fittings to ensure they are securely tightened.
- Check all hoses and fittings for leaks/pinches.



51215

Maintenance Schedule

Owner's Responsibility

Marine engines and power packages are used in a harsh environment and operate at much higher loads than automotive engines. These circumstances necessitate a higher level of diligence when operating and maintaining marine engines. Volvo Penta products are designed to operate efficiently and to provide reliable and durable power in the marine environment. However, to ensure continued operating efficiency, a boat owner or operator must check, monitor, and maintain the power components as specified in this manual. An owner or operator has the responsibility to ensure that all daily and monthly checks are performed and that all scheduled maintenance is done. Please see the checklists and maintenance schedules in this chapter.

The operation, maintenance, and care of the Volvo Penta engine and power package, as outlined in this manual, are an owner's responsibility. The owner must keep records of all maintenance and service performed. This record of proper maintenance may be required to determine warranty coverage. If the boat is sold, these records should be transferred to the new owner.

Emissions Control Components

The sterndrive emission control system is governed by a separate warranty statement set forth in your warranty booklet. Volvo Penta recommends that you retain all receipts covering maintenance on the emissions control system, but Volvo Penta cannot deny warranty coverage on the emissions control system solely for the lack of receipts or your failure to ensure the performance of all scheduled maintenance. However, Volvo Penta may deny you warranty coverage for your emission control system if failure results from abuse, neglect, improper maintenance, or unapproved modifications.

If emission control system repair is required during the warranty period, you are responsible for presenting your sterndrive engine to a Volvo Penta authorized dealer as soon as the problem exists. The warranty repairs will be completed using genuine Volvo Penta parts in a reasonable period of time without charge. After expiration of the emission control system warranty, you may present your sterndrive engine to a repair shop or person of your choosing to maintain, replace, or repair emission control devices and systems.

Safety and Preventative Maintenance Checklists

The following checklists provide the preventative maintenance program for the engine and power package; successful preventative maintenance is a key element of safe boat operation. Preventative maintenance, combined with regular completion of the service work in the maintenance schedule, can reduce boat down-time and significantly reduce the chance of expensive engine repairs in the future. Checklists should be completed, by the boat owner or operator, at the intervals indicated. If an owner is unsure about how to check these items, (s)he should contact a Volvo Penta dealer for assistance with the checklists. Small corrections such as filling fluids, tightening hardware, and similar procedures can be done by the owner. If more complex problems or component failures are discovered, the owner should contact a Volvo Penta dealer to correct the problem.

DANGER!

Explosion hazard! Never operate an engine/boat with a suspected or actual fuel leak.

CAUTION!

If any items fail the checks (inspections), correct the failed items before using the boat/engine.

Owner's Checklist						
Check Before Each Use	Check/Correct	Fill/Lube	Adjust/Tighten	Clean	Change/Replace	✓
Engine						
Cooling System – Check coolant level ⁽¹⁾ ; check system for leaks	•		•			<input type="checkbox"/>
Engine Oil	•	•				<input type="checkbox"/>
Fuel Pump and System – Check for leaks	•					<input type="checkbox"/>
Sterndrive						
Anodes – Check, replace if eroded more than 30%	•					<input type="checkbox"/>
Power Trim/Tilt – Check for proper operation	•					<input type="checkbox"/>
Miscellaneous						
Emergency Stop Switch – Check clip and lanyard	•					<input type="checkbox"/>
Power Steering – Check for proper operation; check hoses and components for leaks	•					<input type="checkbox"/>
Power Steering Fluid – Check level	•	•				<input type="checkbox"/>
Remote Control and Shift System – Check for proper operation	•		•			<input type="checkbox"/>

1) Fresh water cooled versions

Owner's Checklist						
Check Each Month ⁽¹⁾	Check/Correct	Fill/Lube	Adjust/Tighten	Clean	Change/Replace	✓
Batteries and Connections – Batteries hold charge; connections clean and tight	•		•			<input type="checkbox"/>
Drive Unit Oil	•	•				<input type="checkbox"/>
Exhaust Hoses and Bellows – Check for damage, leaks, and loose clamps	•		•			<input type="checkbox"/>
Bellows, U-joint, and Exhaust – Check for wear, leaks, and loose clamps	•		•			<input type="checkbox"/>
Propshaft, Propeller, and Hub – Check for damage, corrosion; lubricate shaft, splines	•	•		•		<input type="checkbox"/>

1) Check/correct these items every month, when the boat is in use (not winterized or in storage)

Scheduled Maintenance

We recommend you contact an authorized Volvo Penta service dealer when your power package is due for scheduled maintenance. Procedures in the maintenance schedules may require lifting devices, special tools, electronic diagnostic instruments, or specialized training that are not typically available to the owner. Dealers have the training, tools, and service expertise needed to safely, correctly, and efficiently service your power package. Also, dealers are familiar with current environmental regulations and will recycle or dispose of used fluids and materials in a manner that is least harmful to the environment.

During the service visits, discuss with your dealer any questions or issues that you may have regarding your engine or power package. Advise the dealer of anything unusual that you have noticed about your boat or engine. This check can identify small problems before they become more serious. The dealer will use the following checklists to perform the scheduled maintenance. Many items on the list are also included in the daily and monthly checks to be done by the owner (see above). The dealer will conduct a more thorough check of these items to deter future problems.

If any items fail the checks, the dealer should correct them as needed. Scheduled maintenance and any corrective work performed are part of normal maintenance and, as such, are not part of warranty. Exceptions may occur, based on what the dealer finds during the service work.

Always insist that your dealer use genuine Volvo Penta parts, oils, and lubricants when servicing your engine. See *Technical Data*.

In markets outside the United States: All service specified by the maintenance schedules for the first year **must** be performed and documented by an authorized Volvo Penta dealer to be eligible for the Extended Protection Service Plan.

Hour Meter

Accurate knowledge of engine operating hours is critical for tracking engine/drive maintenance and service needs. Many boats have an hour meter mounted at the helm or near the engine; use this meter to determine when maintenance or service is due. If you do not have an hour meter, we strongly recommend that you contact a dealer to have one installed on your boat. If you do not have an hour meter, keep a manual log of the time the engine is operated.

Whenever "hours" or "engine hours" are listed in the following maintenance schedules, the reference is to engine operating hours, as recorded by the hour meter, EVC system (if applicable), or manual log.

Maintenance Schedule

If you operate your engine **50 hours or less per year** perform the items required in the Maintenance Schedule once per year. If you operate your engine more than 50 hours per year, the required items should be performed every 100 hours.

NOTICE! For engines operated over 50 hours during the first year, the engine oil and filter must be changed at 50 hours. The oil and filter are changed again at 100 hours and then afterwards according to the Maintenance Schedule.

If the boat is placed in storage during the off-season (winterized), the service should be coordinated with the service activities needed to prepare the boat for storage or for use after the storage period. See the chapter entitled *Storage*. Change the engine oil, filter, and drive oil as part of preparation for storage (winterization). The impeller should be replaced after storage.

Annual Service or Every 100 Hours	Check/ Correct	Fill/ Lube	Adjust/ Tighten	Clean	Change/ Replace	✓
Engine						
Check for Campaigns or Recalls – Dealer to check serial number on Partner Network	•					<input type="checkbox"/>
Serpentine Belt – Wear, tension	•					<input type="checkbox"/>
PCV Valve ⁽¹⁾ – Check	•					<input type="checkbox"/>
Oil and Filter ⁽²⁾⁽³⁾⁽⁴⁾ – Change					•	<input type="checkbox"/>
Fuel Pump and System – Check for leaks	•					<input type="checkbox"/>
Flame Arrestor – Properly secured	•			•		<input type="checkbox"/>
Fuel Filter – Replace					•	<input type="checkbox"/>
Exhaust Hoses and Bellows – Check for damage, leaks, loose clamps	•		•			<input type="checkbox"/>
Exhaust Manifolds, Risers, Pipes – Check for corrosion, damage, leaks	•					<input type="checkbox"/>
Cooling System – Check coolant level ⁽⁵⁾ ; check system for leaks	•		•			<input type="checkbox"/>
Sea Water Pump – Replace impeller, check housing	•				•	<input type="checkbox"/>
Spark Plugs – 3.0L only					•	<input type="checkbox"/>
Spark Plugs (V6/V8) – Replace every third year ⁽⁶⁾					•	<input type="checkbox"/>
Distributor Cap and Rotor – Check for corrosion	•					<input type="checkbox"/>
Engine Computer – Check and clear codes	•					<input type="checkbox"/>

1) 3.0L, 5.0L, 5.7L

2) **Must** use mineral oil for the first 50 hours, see *Scheduled Oil Service* in the chapter entitled *Technical Data*.

3) Change oil/filter at least annually, regardless of oil type (mineral or synthetic).

4) Engine oil change interval can be increased to 200 hours if full synthetic oil is used, see *Scheduled Oil Service* in the chapter entitled *Technical Data*.

5) Fresh water cooled versions.

6) **Must** use genuine Volvo Penta parts for 3 year change; change is every year for other plugs.

Annual Service or Every 100 Hours (Continued)	Check/ Correct	Fill/ Lube	Adjust/ Tighten	Clean	Change/ Replace	✓
Sterndrive						
Anodes – Visual inspection; replace if eroded more than 30%	•					<input type="checkbox"/>
Bellows, U-joint, and Exhaust – Check for wear, damage; replace every second year	•				•	<input type="checkbox"/>
Propshaft, Propeller, and Hub – Check for damage, corrosion; lubricate shaft, splines	•	•		•		<input type="checkbox"/>
Power Trim/Tilt – Check for proper operation	•					<input type="checkbox"/>
U-joint Shaft Splines ⁽¹⁾ – Lubricate	•	•				<input type="checkbox"/>
U-joint, Gimbal Bearing – Check for wear, corrosion	•					<input type="checkbox"/>
Gear Oil – Change					•	<input type="checkbox"/>
Miscellaneous						
Batteries and Connections – Batteries hold charge, connections clean and tight	•		•			<input type="checkbox"/>
Engine Alignment – Check	•					<input type="checkbox"/>
General Inspection – All engine and drive hardware; clamps, screws, nuts, etc.	•		•			<input type="checkbox"/>
Power Steering – Check for proper operation, check hoses and components for leaks	•					<input type="checkbox"/>
Power Steering Fluid – Check level	•	•				<input type="checkbox"/>
Steering System Cable(s) – Check for proper operation, lubricate		•				<input type="checkbox"/>
Remote Control and Shift System – Check for proper operation	•		•			<input type="checkbox"/>

1) The drive must be removed for this step. This is a good time to check and/or replace both bellows.

Maintenance

Doing Your Own Maintenance and Repairs

The following sections provide basic periodic maintenance procedures. Repair and advanced maintenance procedures are covered in the *Do it Yourself* manual. If you intend to carry out any maintenance on your equipment, we urge you to be thoroughly familiar with the procedures described in this manual. **Always read and follow the safety warnings provided in this manual.**

If you are uncertain about any procedures described in the manual or you would like to purchase a workshop or *Do it Yourself* manual, please contact your Volvo Penta dealer or visit Volvo Penta on the Internet. Keep in mind, however, that there are certain tasks which should only be performed by your Volvo Penta dealer. The dealer has the tools, expertise, and most current information needed to properly perform these tasks. **Never carry out any work on the engine if you are unsure of how it should be done. Instead, contact your Volvo Penta dealer for help.**

Replacement Parts

Always insist that your dealer use genuine Volvo Penta parts, oils, and lubricants when servicing your engine and power package. Genuine Volvo Penta parts have been designed and approved to meet the safety requirements and heavy demands of marine engines. Volvo Penta replacement parts are designed to meet all applicable legal requirements and industry standards for marine applications.

WARNING!

Do not use automotive or other non-marine parts on your Volvo Penta engine. Non-marine electrical and fuel parts do not meet USCG and other requirements for explosion prevention in gasoline fueled boats. Use of non-marine parts may result in onboard explosions.

In your Volvo Penta product, certain fuel and electrical system components have been designed to comply with U.S. Coast Guard and other regulations for explosion prevention. Parts or components that comply with these regulations are designed so they will not emit fuel vapors or cause ignition of fuel vapors in the engine compartment. To prevent explosion or fire, do not substitute automotive or general hardware parts for the following:

- **Circuit breakers, alternator, and related wiring.**
- **Starter and related wiring.**
- **Distributor, distributor cap, spark plugs, high tension leads (spark plug wires), and related ignition parts.**
- **Fuel pumps, relays, filter, and related parts.**
- **Fuel injector O-rings, injector fuel line pressure relief valve and caps, fuel reservoir vent hose and cover gasket, high pressure fuel pump mounting O-rings, fuel pressure regulator, and fuel rails.**

NOTICE! Do not use automotive or other non-marine parts on your Volvo Penta engine. Non-marine parts may not be designed for the high loads, harsh environment, and durability requirements of a marine engine. Non-marine parts may fail prematurely, disabling the engine. Engine or power package failure caused by the use of non-marine parts is not covered by warranty.

Substituting automotive or generally supplied parts and hardware may result in product malfunction. Never use parts of unknown quality. See your Volvo Penta dealer for replacement parts. You can depend on your dealer to furnish expert service and genuine Volvo Penta parts.

Volvo Penta engine oils and transmission lubricants are formulated with the correct lubrication qualities and corrosion inhibitors needed for marine applications. Use of these oils and lubricants ensures proper operation and protection of your engine and sterndrive. See your Volvo Penta dealer for genuine oils and lubricants.

Stop the Engine Before Service

Stop the engine before opening or removing engine hatches. Unless otherwise specified all maintenance and service must be carried out with the engine stopped.

Always stop the engine and turn off the main battery switch(es) before working on the electrical system. Disconnect and remove any shore power connections to the boat.

To prevent accidentally starting the engine, remove the ignition key, turn off the power supply to the engine at the main switches, and lock them in the OFF position, or disconnect the battery cables from the battery before starting work. Put up a warning sign in the control position that work on the engine is being carried out.

Approaching or working on an engine that is running is dangerous. Loose clothing, hair, fingers or a dropped tool can be caught in the rotating parts of the engine and cause serious personal injury. We recommend that all servicing with the engine running be undertaken by an authorized Volvo Penta workshop.

Starting the Engine After Service

Reinstall all protective parts removed during service operations before starting the engine. Make a point of familiarizing yourself with other risk factors, such as rotating parts and hot surfaces (exhaust manifold, starter, etc.). Check that no tools or other items have been left on the engine.

Fire and Explosion

Fuel and Lubrication Oil

All fuels, most lubricants, and many chemicals are flammable. Read and follow the instructions on the packaging.

When carrying out work on the fuel system make sure the engine is cold. A fuel spill onto a hot surface or electrical components can cause a fire.

Store fuel soaked rags and other flammable material so that there is no danger of them catching fire. Fuel soaked rags can self-ignite under certain conditions.

Certain engine oils are flammable. Some of them are also dangerous if inhaled. Whenever you use these agents, follow the manufacturer's instructions on the product packaging. Ensure that ventilation in the work place is good. Use a protective mask when spraying.

Batteries

Incorrect connection of the battery can cause a spark, which would be sufficient to cause an explosion. Do not disturb battery connections when starting the engine (spark risk) and do not lean over batteries.

Always ensure that the positive and negative battery leads are correctly installed on the corresponding terminal posts. Incorrect installation can result in serious damage to electrical equipment.

Always use protective goggles or a face mask when charging and handling batteries. Battery electrolyte contains sulphuric acid, which is highly corrosive. If battery electrolyte comes into contact with unprotected skin, wash it off immediately using plenty of water and soap. If battery acid comes in contact with the eyes, immediately flush with an abundant amount of water and obtain medical assistance.

Hot Surfaces and Fluids

Avoid hot surfaces and liquids in supply lines and hoses when the engine has just been turned off and is still hot.

Hot oil can cause burns. Avoid skin contact with hot oil. Never start or operate the engine with the oil filler cap removed; hot oil could spray out.

Cooling System



CAUTION!

Avoid opening the filler cap for engine coolant system (freshwater cooled engines) when the engine is still hot. Steam or hot coolant can spray out as system pressure is lost.



CAUTION!

If opening the filler cap or drain/venting cock, or removing a plug or engine coolant line from a hot engine, open the filler cap slowly and release coolant system pressure gradually; otherwise, steam or hot coolant can spray out. Note that the coolant may still be hot and can cause burns.

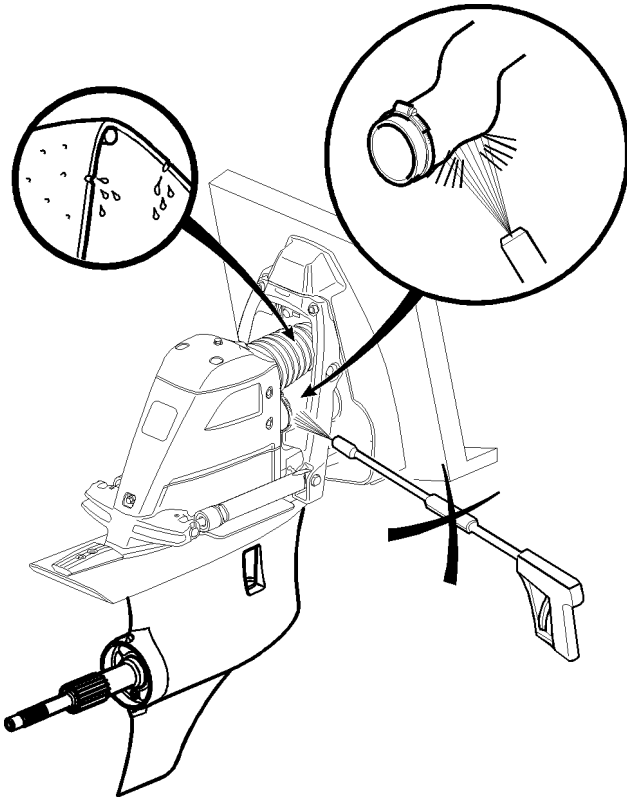
Accidents

Statistics show that poor maintenance of boats and engines and a lack of safety equipment are often the main causes of accidents at sea. Ensure that your boat is maintained in accordance with the relevant user's documentation and that the necessary safety equipment is on-board and is serviceable.

Washing the Engine

Never use a high-pressure washer when washing the engine.

NOTICE! When washing the drive unit, do not use a pressure washer. Using a pressure washer will damage the water intake hose and the drive bellows.



51423

Certified Engines

If you own an engine certified for any area where exhaust emissions are regulated by law, the following is important:

Certification means that an engine type is inspected and approved by the authorities. The engine manufacturer guarantees that all engines manufactured of that type correspond to the certified engine.

This places special requirements for maintenance and service as follows:

- The maintenance and service intervals recommended by Volvo Penta must be observed.
- Only genuine Volvo Penta replacement parts may be used.
- The servicing of ignition, timing, and fuel injection systems must always be carried out by an authorized Volvo Penta workshop.
- The engine must not be modified in any way except with accessories and service kits approved by Volvo Penta.
- No modifications to the exhaust pipes and air supply ducts for the engine may be undertaken.
- Seals may only be broken by authorized personnel.

Otherwise the general instructions contained in this *Operator's Manual* concerning operation, service, and maintenance must be followed.

NOTICE! Late or inadequate maintenance/service or the use of spare parts other than Volvo Penta original spare parts will invalidate Volvo Penta's responsibility for the engine specification being in accordance with the certified variant.

Volvo Penta accepts no responsibility or liability for any damage or costs arising due to the above.

Engine, General

Serpentine Belt

CAUTION!

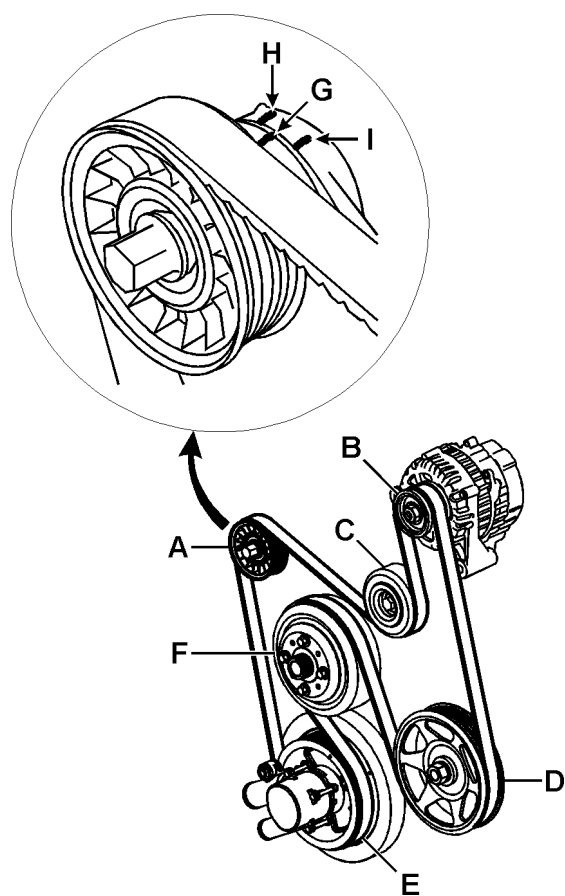
The serpentine belt and pulley system have pinch points that can cause injury. If the engine is running, keep fingers away from the belt and all pulleys. Also be aware of loose clothing and keep away from the belt and all pulleys.

All engines use a serpentine belt, which is a continuous-loop belt threaded through the automatic belt tensioner **A**, alternator pulley **B**, idler pulley **C**, power steering pump pulley **D**, raw water pump pulley **E**, and circulating pump pulley **F**.

Check the indicators, located on the automatic tensioner housing, to determine the amount of tension loss. When tick marks **G** and **H** coincide, it's time to replace the serpentine belt. As long as mark **G** is between marks **H** and **I**, the belt has adequate tension on it.

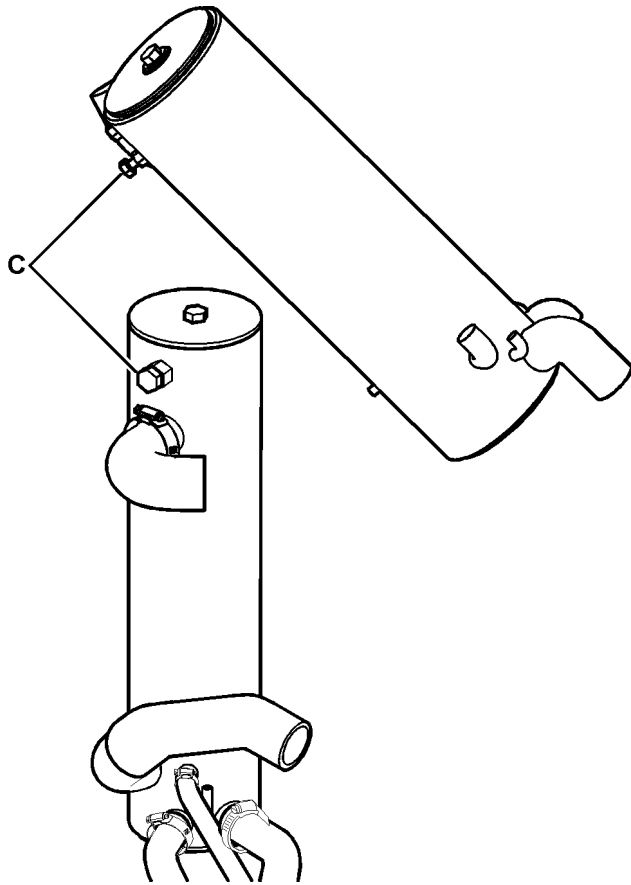
Also check the serpentine belt for:

- Regularly spaced cracks
- Regularly spaced missing chunks
- Dry rot
- Exposed cords or excessive fraying
- Oil or grease



51535

If you suspect the belt needs replacing, please refer to the *Do it Yourself* manual for the procedure or take your boat to a Volvo Penta dealer.



51427

Sacrificial Anode

Sacrificial anodes are attached near the upper edge of the heat exchanger.

Anodes are slowly eroded away by galvanic action and require inspection. Additionally, anodes that are subjected to frequent wetting and drying require periodic scraping with sandpaper to remove scale and oxidation to maintain their effectiveness. Do not paint anodes, as this will destroy their effectiveness.

When you need to purchase new anodes, see your Volvo Penta dealer. The material composition of Volvo Penta anodes meets U.S. Military Specification 18001-H. Some after-market anodes may not meet mil-specs.

Inspecting Heat Exchanger Anodes

Engines with closed cooling systems have anodes located at the top of the heat exchanger. This anode **C** resembles a bolt and may be removed and replaced using a 3/4 inch (19mm) wrench. When installing, tighten the anode all the way by hand, then turn an additional quarter turn using a wrench.

Engine Alignment

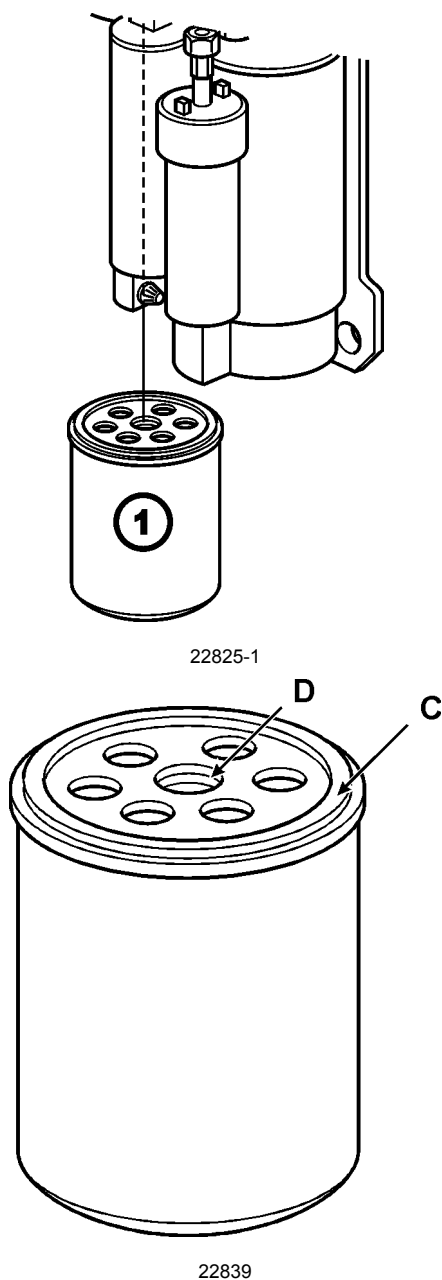
Because of the special tools required, a Volvo Penta dealer must do the engine alignment. This should be done during off-season storage preparations.

NOTICE! Failure to periodically check engine alignment may result in premature failure of the engine coupler.

Fuel System

Before you begin this procedure, be sure you have the following on hand:

- Fuel Filter
- Wrench
- Oil
- Container and absorbant rags for catching fuel spills



1. If possible, remove all passengers from the boat. If this is not feasible, ensure that all passengers are above-decks and away from confined compartments.
2. Start the engine and check for leakage.
3. Turn off the engine and remove the key.

DANGER!

Turn off the main battery switch to prevent stray sparks. Eliminate all sources of spark.

4. Unscrew fuel filter and remove.
NOTICE! Be prepared to catch any excess fuel that may spill from fuel pump or filter.
5. Using clean engine oil, lightly lubricate the gasket **C** and inner seal **D** on the new fuel filter.
6. Screw on fuel filter and hand-tighten.

7. Clean up any spilled fuel.
If possible, remove the old fuel filter, containers, and absorbant rags from the boat. Dispose of safely and according to local environmental regulations.

8. Turn on the main battery switch.
9. Run the bilge blower for at least five minutes to vent the engine compartment.
10. Start the engine and check for leakage.

DANGER!

If you detect fuel leakage, turn the engine off immediately - EXPLOSION AND FIRE ARE AN EXTREME DANGER.

11. If leakage occurs, repeat **Steps 3–10** until leakage stops.
12. If necessary, re-clean the bilge area.

Fuel Storage

If the boat will not be used for two months or longer, the boat and engine must be prepared for this storage period.

Both the fuel in the tank(s) and the engine must be treated. The fuel must be treated with fuel stabilizer. Add stabilizer according to the manufacturer's instructions.

Engine and fuel system internal components should be coated with a light film of oil to prevent corrosion. The *Fuel Storage Mixture* procedure (see next page) introduces the oil through the fuel system, protecting both the fuel system and engine during storage. This procedure applies to all gas engines, carburetted or fuel injected.

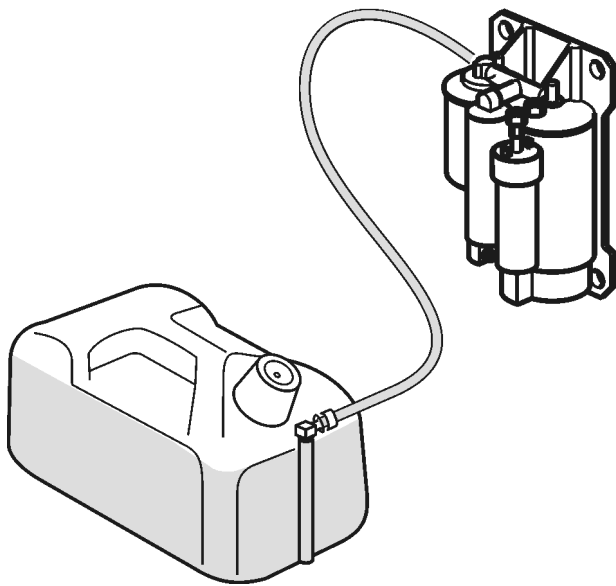
Fuel Storage Mixture

Prepare the storage mixture using a six-gallon portable fuel tank. Add:

- One pint two-cycle motor oil.
- Fuel stabilizer, per manufacturer's instructions.
- Six gallons fresh fuel (50:1 ratio to two-cycle oil).

DANGER!

Fuel and vapors will be present during procedure, which can result in an explosion; provide ventilation and eliminate all sources of spark or flame.



51773

1. Disconnect the fuel line at the inlet fitting of the engine's fuel pump. Connect a line from the portable tank (with storage mixture) to the fuel pump inlet.

CAUTION!

Engine must be run to complete process. Take precautions to ensure safety and prevent engine damage:

- Run engine with drive out of gear and in full trim down position.
 - Boat must be properly supported.
 - Flush engine with fresh water while engine is running. The engine must have adequate cooling water; always monitor engine temperature gauge when running engine with boat out of water.
 - Do not run fuel pumps dry.
2. Run the engine on the storage mixture for five minutes at 1500 RPM. This will ensure that all fuel system and internal engine components are protected.
 3. Reduce the engine speed to idle and stop the engine.
 4. Reconnect the boat fuel line to the fuel inlet fitting and check for fuel leaks. Do not start engine.

DANGER!

Failure to inspect your work may allow fuel leakage to go undetected. This could become a fire or explosion hazard.

Cooling System

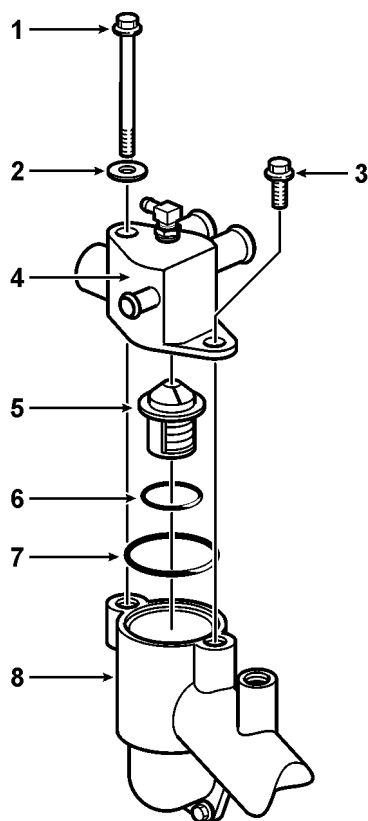
NOTICE! Do not run the engine without the thermostat as the engine is likely to overheat.

For instructions on replacing the engine thermostat on closed cooling engines, please see the *Do It Yourself* manual.

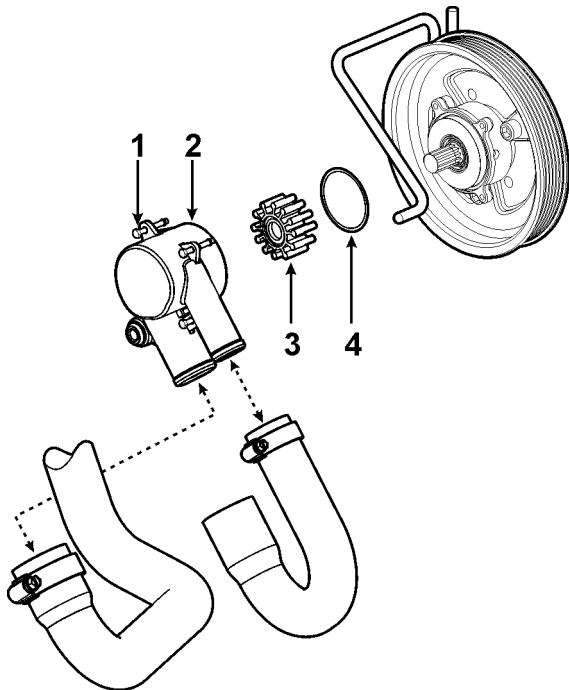
Replacing the Engine Thermostat

Raw Water Cooled

1. Loosen and remove long bolt 1, washer 2, and short bolt 3; save for reuse.
2. Remove thermostat housing 4.
3. Remove thermostat 5, small O-ring 6, and large O-ring 7, from cross-over pipe housing 8. Discard thermostat. Inspect O-rings and, if damaged, replace.
4. Place new thermostat and O-rings into the groove in the cross-over pipe housing.
5. Replace upper thermostat housing.
6. Install bolts and washer and torque to 18–30 ft. lb. (25–41 Nm).



50538



23675

Impeller: Checking & Replacing

NOTICE! If you have a seacock installed, close it now to prevent any possible water intrusion; otherwise, plug the intake hose with a suitable stopper to prevent water entry.

NOTICE! Always carry a spare impeller on board.

1. Remove the hose clamps and hoses from pump.
2. Loosen the four screws **1** and remove the housing **2**.
3. Inspect the impeller **3**. If there are cracks, signs of burning or melting on the edges, or any other visible defects, the impeller must be replaced. Inspect the O-ring **4** for nicks, cuts, and wear. Replace as necessary.
4. Lubricate the pump housing with non-petroleum based lubricant, suitable for rubber, such as glycerine. If you have purchased the Volvo Penta impeller kit, a packet of glycerine is included.
5. Reinstall the impeller. Reinstall the housing. Tighten bolts to 19–24 in. lb. (2.2–2.8 Nm).
6. Reinstall the hoses and hose clamps.

If you closed the seacock, be sure to reopen it before restarting the engine.

Electrical System

Battery Maintenance and Replacement

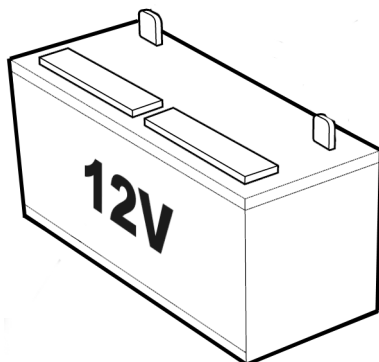
DANGER!

Never allow an open flame or electric sparks near the battery or batteries. Never smoke in proximity to the batteries. The batteries give off hydrogen gas during charging which, when mixed with air, can form an explosive gas. This gas is easily ignited and highly volatile.

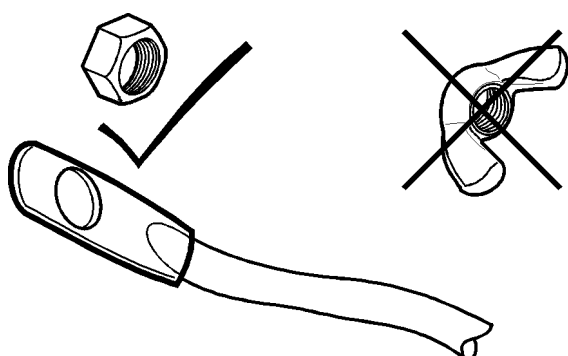
WARNING!

Battery electrolyte is a corrosive acid and should be handled with care. If you spill or splash electrolyte on any part of the body, immediately flush the exposed area with liberal amounts of water and seek medical attention as soon as possible.

NOTICE! Marine batteries should always be mounted in approved marine battery boxes with covers. Always make sure the battery is secured and the cover is firmly shut.



22827



22840

NOTICE! Do not disconnect the batteries with the engine running as sensitive electrical components may be immediately damaged.

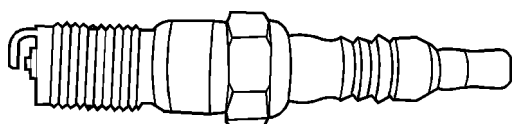
NOTICE! Do not use wing nuts to secure battery cables, even if they were supplied with the battery; use a lock nut instead.

NOTICE! Some maintenance-free batteries have special care instructions. Make sure to follow the battery manufacturers instructions carefully.

NOTICE! When replacing your battery, read and understand the information supplied with it before you begin installation. Also, read the safety section of this manual before carrying out any of these procedures.

The service life of your battery depends largely on how it is maintained.

- Keep batteries and battery terminals dry and clean. Oxidation or dirt on the battery and battery terminals may cause short circuits, voltage drops, and discharges (especially in damp weather).
- Tighten all battery connections. Loose battery connections may cause damage to the engine's electrical system.



23172-e

Spark Plugs

Your engine comes equipped with high quality spark plugs that require infrequent maintenance. Please see *Maintenance Schedule* for replacement frequency.

WARNING!

Ensure that plug wires are in good condition to avoid sparking. Sparking could potentially cause a fire or explosion.

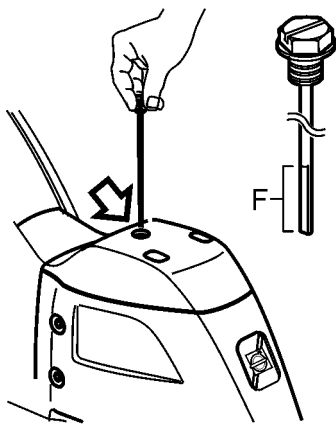
Please refer to your *Do it Yourself* manual for replacement procedures.

Drive

Checking the Drive Unit Lubricant

NOTICE! Improper oil level, under- or overfilled, will result in serious internal sterndrive damage.

Check lubricant (oil) level in sterndrive at each usage. Oil level and condition checks are the best ways to catch sterndrive problems before serious damage occurs.



50398

1. Screw dipstick fully into hole, then remove.
2. Check oil level on dipstick. Oil should show on flat portion **F** of dipstick.

If oil level is low, add small amounts through dipstick opening until oil is at proper level.

If level is too high, remove until oil is at proper level. See *Do It Yourself* manual.

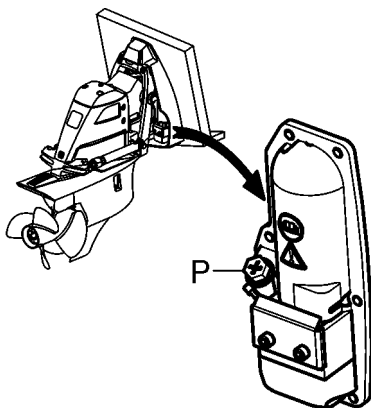
3. Check O-ring on dipstick for wear or nicks. Replace if needed. Tighten dipstick to 48–72 in. lb. (5.4–8.1 Nm).

During oil level check, inspect oil for signs of water intrusion. The oil should be amber in color. Milky looking oil indicates water mixed with the oil. Also check for metal or other debris in oil. If moisture or metal flakes appear in the drive unit oil, take the boat to your Volvo Penta dealer.

Power Trim/Tilt-Fluid

The trim/tilt assembly is a closed hydraulic system that includes the trim pump assembly, trim cylinders and hydraulic lines. No regular oil level check is required unless trim system performance is poor.

If system performance is poor, refer to the *Do it Yourself* manual or consult your Volvo Penta dealer.



50408

Pitot Tube (Speedometer Port)

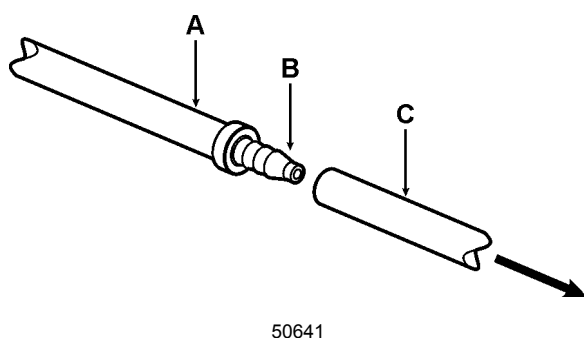
The pitot tube, located at the leading edge of the lower unit, provides pressure input for the speedometer. If the pitot tube becomes clogged (e.g. the boat runs aground or the sterndrive drags through silt as the boat is loaded onto the trailer), the speedometer may stop functioning. There are two methods for clearing debris from the pitot tube:

Method 1

Use a six inch length of stiff wire of 1/8 in. (3 mm) thickness or a wire coat hanger to push any debris in the pitot tube into the drive cavity.

Method 2

Use compressed air to clear the pitot tube.



50641

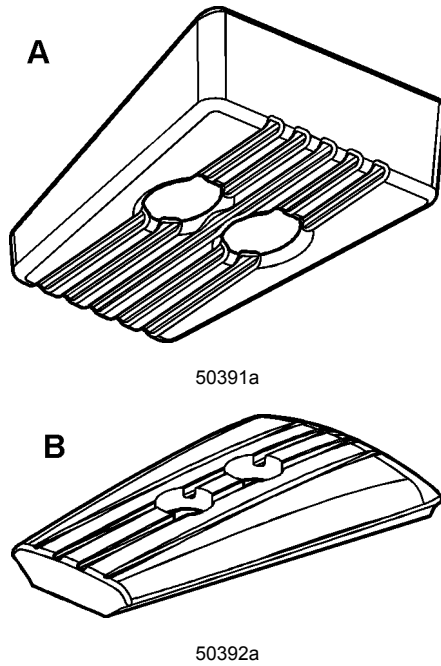
1. The pitot tube hose **A** is attached to the shift cable hose located inside the transom shield, just behind the engine. Once you have located the pitot tube hose, remove the speedometer hose **C** from the plastic barb fitting **B**.
2. Attach the hose from an air compressor to the barb fitting.
3. Have someone assist you by placing a rag in front of the pitot tube at the leading edge of the lower unit.
4. Blow air, pressurized to **no more than** 116 PSI (800 kPa), into the pitot tube hose until your assistant can feel the air exiting the pitot tube.

CAUTION!

Do not place bare hand(s) in front of the pitot tube to check for air flow as debris may be ejected forcefully enough to cause an injury.

NOTICE! Do not exceed 116 PSI (800 kPa) as this may damage the drive.

5. Reattach the speedometer hose to the barb fitting on the pitot tube hose.



Sacrificial Anode

Sacrificial anodes are attached to the bottom of the gimbal housing **A** and at the rear of the sterndrive, above the anti-ventilation plate **B**.

Anodes are slowly eroded away by galvanic action and require inspection. Additionally, anodes that are subjected to frequent wetting and drying require periodic scraping with sandpaper to remove scale and oxidation to maintain their effectiveness. Do not paint anodes, as this will destroy their effectiveness.

When you need to purchase new anodes, see your Volvo Penta dealer. The material composition of Volvo Penta anodes meets U.S. Military Specification 18001-H. Some after-market anodes may not meet mil-specs.

Inspecting Drive Anodes

The amount of erosion from the drive anode is a good indication of the condition of the transom shield anode.

Inspect anodes (see *Maintenance Schedule* for frequency). If an anode is 2/3 its original size (1/3 eroded), replace it.

If additional electronic or electrical equipment is installed, each item should have an individual anode or grounding device and all grounding devices must be interconnected. Follow equipment manufacturers recommendations.

Anode Replacement Information

NOTICE! Your Volvo Penta product has been shipped with Aluminum anodes. The table below provides replacement information and also specifies which anodes should be used, depending on water conditions.

Anode	Material	Part No.	Water Condition
Transom Shield	Zinc	3888817	Salty
Sterndrive	Zinc	3888814	Salty
Transom Shield	Aluminum	3888816	Brackish
Sterndrive	Aluminum	3888813	Brackish
Transom Shield	Magnesium	3888818	Fresh
Sterndrive	Magnesium	3888815	Fresh

Painting the Drive

The sterndrive and transom shield require a unique paint repair procedure. Please refer to the *Do it Yourself* manual or see your Volvo Penta dealer for additional information regarding painting the drive.

Anti-fouling Paint: Drive and Transom Shield

When using anti-fouling paint on the drive or transom shield, be sure to observe the following:

- Copper paints must not be used.
- Use paints specifically designed for aluminum sterndrives.
- Procedure should be carried out by a qualified technician at an authorized Volvo Penta dealership due to environmental concerns.

NOTICE! If you do use copper-based paint on your boat bottom, leave a 1-inch border between the paint and the transom shield. **Failure to follow this instruction will result in severe corrosion of the transom shield and drive system.**

Propeller

Propeller Care

A damaged or unbalanced propeller will cause excessive vibration and a loss of boat speed. Under these conditions, stop the engine and check the propeller for damage. If the propeller appears damaged, have it checked by your Volvo Penta dealer. Always carry a spare propeller and replace the damaged propeller as soon as possible.

A rubber hub in the propeller is the shock absorber that minimizes damage to drive units and engines. If the rubber hub should begin to slip, it can be easily replaced at an authorized Volvo Penta dealer or propeller shop.

⚠ WARNING!

Protect your hands from the sharp edges of the propeller blades. Wear gloves whenever you remove or replace a propeller. Do not attempt to hold propellers by hand when you remove or install propellers and propeller nuts. Serious injury could result.

NOTICE! Never continuously run with a damaged propeller. Running with a damaged propeller can result in drive unit and engine damage.

NOTICE! Propellers must be removed and the shaft re-greased according to the frequency provided in the maintenance schedule or removal (in emergency situations while in the water) will be very difficult or impossible. Please refer to the section entitled *Troubleshooting: Propeller Replacement* for additional information.

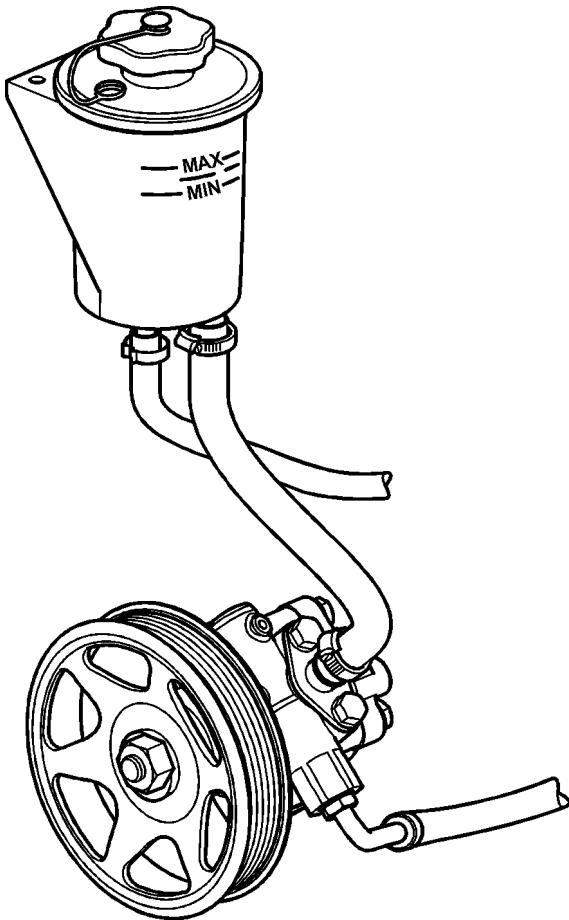
Steering

Power Steering Reservoir Fluid Level

Whenever you check the engine oil, also check the steering reservoir fluid level. The fluid level must be above the "Min" line and below the "Max" line. If needed, add Volvo Penta Power Trim/Tilt and Steering Fluid. Do not overfill the pump reservoir.

NOTICE! Never fill the steering system with oil of unknown quality. Non-recommended oil may cause steering operation impairment or component damage.

Do not allow contaminants to enter the reservoir when checking or filling the oil level.



51215

Storage

Laying Up (Winterization)

Be sure that your Volvo Penta equipment is properly prepared for long or short term storage. Engine or drive damage can result if some simple maintenance steps are overlooked prior to storage. Winterizing gives you the assurance that your engine will be protected during storage and will run more reliably when you put your boat back in the water.

Short Term Storage

Up to two months:

- ☐ Flush engine with fresh water.
- ☐ **Raw Water Cooled Engines Only:** Drain raw water from manifolds and engine block. See information on draining the engine in the section entitled *Engine Shutdown: Draining Raw Water Cooled Engines*.
- ☐ **Closed Cooling Engines Only:** Drain raw water from manifolds. **Do not drain the engine block!** See information on draining the engine in the section entitled *Engine Shutdown: Draining Raw Water Side of Closed Cooling System Engines*.
- ☐ Store battery as recommended by manufacturer.
- ☐ Add fuel stabilizer; please refer to *Ethanol-Blended Fuels (E10)* in the chapter entitled *Technical Data*.

Long Term Storage

For long term storage (more than two months), we recommend that you have your Volvo Penta dealer “winterize” your engine and drive. Your dealer will provide the proper servicing and maintenance to ensure that your equipment is treated and stored properly.

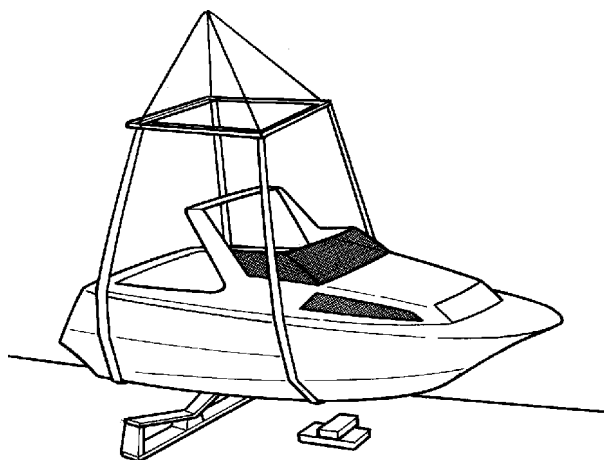
NOTICE! We recommend that you go to an authorized Volvo Penta dealer for these procedures; however, if you wish to do the work yourself, please refer to the *Do It Yourself* manual.

Should you decide to winterize the engine and drive yourself, carry out the following procedures, **in the order in which they are listed below:**

- ☐ Remove drive to inspect bellows for water.
- ☐ Check engine alignment.
- ☐ Lubricate shift cables.
- ☐ Replace engine oil and oil filter.
- ☐ Replace drive oil.
- ☐ Fuel system treatment as described in *Fuel System* in the chapter entitled *Maintenance*. **Please be sure to read the entire procedure in *Fuel System* and *Fuel Storage Mixture* before continuing.**
- ☐ **Raw Water Cooled Engines Only:** Drain raw water from manifolds and engine block. See information on draining the engine in the section entitled *Engine Shutdown: Draining Raw Water Cooled Engines*.
- ☐ **Closed Cooling Engines Only:** Drain and replace engine coolant. Drain raw water from manifolds. See information on draining the engine in the section entitled *Engine Shutdown: Draining Raw Water Side of Closed Cooling System Engines*.
- ☐ Spray engine with anti-corrosion spray.
- ☐ Remove propellers and store in a dry location.
- ☐ Store battery as recommended by manufacturer.

Bringing Out of Storage

When launching your boat for the first time or when starting out a new season, always carry out the steps provided in the following checklist:



21201

- ☐ Reinstall all engine drain plugs.
- ☐ Reconnect any hoses removed for storage.
- ☐ Check condition of hoses; tighten clamps and connections.
- ☐ Install boat drain plug, if removed.
- ☐ Remove and inspect distributor cap and rotor. Replace distributor with a new one, if necessary.
- ☐ Clean battery terminals and connections.
- ☐ Check battery for correct charge.
- ☐ With ignition switch and/or battery switch in OFF position, install battery and attach battery cables.
- ☐ Open the fuel shut-off valve and check fuel system for leaks.
- ☐ Check the flame arrestor and clean if necessary (please see the *Do it Yourself* manual for additional information).
- ☐ Pump the bilge dry and air out engine compartment. Federal, state, and/or local regulations prohibit the pumping of oil into any navigable waters.
- ☐ Check all oil and fluid levels and fill as necessary.
- ☐ Check drive, transom shield, and heat exchanger anodes. Clean or replace as necessary.
- ☐ If oil and filter were not changed for storage, do it now.
- ☐ If sterndrive oil was not changed for storage, do it now.
- ☐ If the impeller was removed for storage, reinstall it now. If the impeller is due for replacement, install a new one now.

Technical Data

Engines

Disclaimer

Volvo Penta of the Americas reserves the right to make changes in weight, construction, materials, or specifications without notice or obligation.

ENGINE	
Displacement	496 Cu. In. (8.1 liters)
Firing order	1 – 8 – 7 – 2 – 6 – 5 – 4 – 3
Idle RPM (Fixed)	600 RPM in forward gear
Full throttle range	4200 – 4600 RPM

FUEL SYSTEM	
Fuel injection	Port injection
Fuel pumps	Electric
Fuel filter	Volvo Penta, water separating, spin-on filter
Fuel type	See <i>Gasoline Requirements</i> in this section

ELECTRICAL SYSTEM	
Charging system	12 volt 75 amp alternator, with internal transistorized voltage regulator
Battery size	12 volt with 650 Cold Cranking Amp (CCA) rating (135 minute reserve capacity) Do not use a deep cycle battery as the start battery

IGNITION SYSTEM	
Distributorless	Crankshaft and camshaft triggered ignition sensors
Spark plugs	See Tune-up and Color Code Decal on engine cover or Parts Catalog
Spark plug gap	0.060 inches (1.50 mm)
Spark plug installation torque	20 ft. lb. (27 Nm)

COOLING SYSTEM	
Thermostat	160°F (71°C)
Thermostat (F-Series)	170°F (77°C) – closed cooling heat exchanger mounted on engine
Coolant type	Fresh water cooled: Ethylene Glycol

OIL FILTER	
Engine oil filter	Volvo Penta, replaceable paper element

OIL CAPACITY	
NOTICE! Overfilling the oil can cause engine and/or sterndrive damage. We urge you to use the dipstick to check the oil level whenever you are changing or topping up the oil.	
Engine with filter	6.5 quarts (6.2 liters)
Drive unit	See <i>Sterndrive: Drive Components</i> in this section

OIL TYPE	
Engine	See <i>Engine Oil Specifications</i> in this section
Drive unit	See <i>Sterndrive: Drive Components</i> in this section
Power steering fluid U.S.	Volvo Penta power steering fluid
Power steering fluid non-U.S.	ATF oil Dexron 2 or higher classification

Lubrication System

Engine Oil Specifications

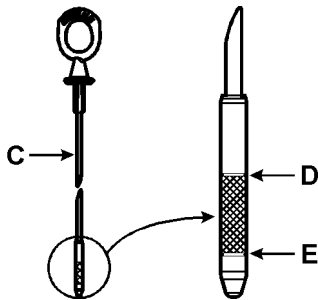
Whenever oil is added to the engine, Volvo Penta strongly recommends the use of our gasoline engine oils. These oils are engineered to meet all of the requirements of your engine and are formulated specifically for marine engines. The oils are available at Volvo Penta dealers. **If the Volvo Penta oils are not available**, use a high quality oil that meets API SM and/or ILSAC GF-4 specifications. Viscosity should be SAE 5W30 **or higher** (examples; 10W30, 10W40, 15W50). Straight 30W oil is also acceptable if it meets the API SM and/or ILSAC GF-4 specifications. Do not use 0W30 or any W20 oils (example 5W20).



51584

Checking Engine Oil Level

The oil level must be between the two level marks on the dipstick **C**. If the engine is not in a horizontal position, the oil level on the dipstick will not be accurate. If the oil level is checked with a cold engine, the oil level on the dipstick could be above the actual level. If the oil level is checked directly after shutting the engine off the oil level on the dipstick will be low. To get an accurate oil level reading on the dipstick:

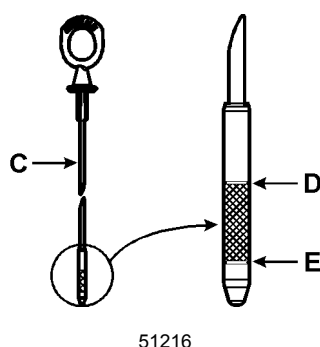


51216

1. Run the engine to normal operating temperature, then shut it off and wait at least 5 minutes.
2. Remove the dipstick and check the oil level.

NOTICE! Gas engines require a precise oil fill level to operate correctly.

- Overfilling results in high operating temperatures, foaming (air in oil), loss of power, and overall reduced engine life.
- Information has been provided in Operators Manuals, Workshop Manuals and other publications that provide crankcase capacities for these engines. This information is provided as a guideline for ordering parts and planning service work.
- To ensure the engine oil is filled to the correct level, the level must always be checked on the dipstick. This includes re-filling the crankcase as part of changing the engine oil.



Adding Oil if Low

Adding Oil During Break-in Period

NOTICE! All oil used for oil changes or added between changes must meet the *Engine Oil Specifications*.

During the engine break-in period, until the piston rings have seated, somewhat higher oil consumption is normal. Check the oil level before each trip during the break-in period. Please see *Engine Break-in: Gasoline Engines*, PN 47700022.

Maintain oil level between **E** (add) and **D** (full) on the dipstick. If oil is added during break-in, use Volvo Penta mineral oil for gasoline engines; if unavailable, use a mineral oil that meets the *Engine Oil Specifications*.

Adding Oil After Break-in Period

Check the oil level frequently (see *Maintenance Schedule* for minimum intervals). Frequent oil level checks are a good strategy to ensure long engine life. Oil level checks help identify engine service issues such as leaks and excessive oil consumption before they become serious.

Maintain oil level between **E** (add) and **D** (full) on the dipstick. If oil is added, use an approved Volvo Penta oil for gasoline engines; if unavailable, use a high quality oil that meets the *Engine Oil Specifications*.

NOTICE! Mineral oil is required for the first 50 hours.

Scheduled Oil Service

NOTICE! All oil used for oil changes or added between changes must meet the *Engine Oil Specifications*.

For a schedule of oil change intervals, please refer to the chapter entitled *Maintenance Schedule*.

NOTICE! Mineral oil is required for the first 50 hours.

After the first 50 hours, **synthetic** oil can be used in the engine. If Volvo Penta synthetic oil for gasoline engines is used, the change interval is every year or every 200 hours, whichever occurs first. When an engine has been run on synthetic oil, our recommendation is to continue with synthetic oil; **do not** change back to mineral oil. Oil added between changes must be synthetic oil.

Always change the oil filter every time the oil is changed.

Fuel System

General Warnings

DANGER!

Gasoline is extremely flammable and highly explosive. Always turn off the engine before refueling. Do not smoke or allow open flames or sparks near the boat when adding fuel. When filling the gas tank, ground the tank to the source of gasoline by holding the hose nozzle firmly against the side of the deck filler plate, or ground it in some other manner. This action prevents static electricity buildup that could cause sparks and ignite fuel vapors.

DANGER!

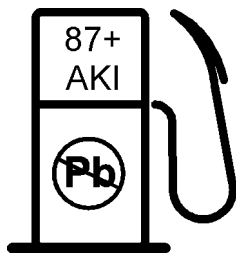
Fuel leakage can contribute to a fire and/or explosion. Frequently inspect non-metallic parts of the engine's fuel system and replace if excessive stiffness, deterioration, or fuel leakage is found.

DANGER!

To prevent fire and explosion, perform all service procedures with the engine turned OFF.

DANGER!

Failure to inspect your work may allow fuel leakage to go undetected. This could become a fire or explosion hazard.



22823

Gasoline Requirements

Octane

Use unleaded gasoline with the following minimum octane rating:

- In the U.S.: (R+M)/2 (AKI) - 87
- Outside the U.S.: (RON) - 90

NOTICE! Engine damage resulting from the use of lower octane gasoline (below 87 AKI or 90 RON) is considered misuse of the engine and is not covered by the warranty.

All Volvo Penta gasoline engines are engineered to operate on AKI 87 (RON 90) octane fuel. Mid-grade and premium fuels contain injector cleaners and other additives that protect the fuel system and provide improved performance. EFI engines may obtain an increase in power from higher octane fuels.



51585

Ethanol-Blended Fuels (E10)

Gasoline is distributed, in the United States and other markets, containing ethanol. Volvo Penta gasoline engines may be operated using gasoline blended with no more than 10% ethanol and that meets the minimum octane specification. 10% ethanol-blended fuel is also commonly referred to as "E10."

NOTICE! Do not use ethanol blends greater than 10%, especially E85 (85% ethanol). Volvo Penta engines are not designed to run on high percentages of ethanol. Loss of performance will occur. Engine damage may also occur; damage caused by fuel with too high a percentage of ethanol is not covered by the warranty.

Because of the high content of alcohol in the blend, users of ethanol-blended fuels must take additional care in the maintenance of their fuel systems. The effects vary depending on the fuel tank material. Most boats have fuel tanks constructed of aluminum, stainless steel, or composites. Since ethanol-blended fuels attract and hold moisture, ethanol content can contribute to corrosion of the tank material in aluminum fuel tanks. Corrosion material can clog fuel filters and damage injectors, carburetors, and other fuel system components. Stainless steel and composite fuel tank materials are not affected by ethanol-blended fuels. However, ethanol-blended fuel can act as a solvent, loosening and washing old deposits or contaminants into the fuel system.

NOTICE! Fuel system or engine damage caused by contamination from water, foreign particles, sludge, or gums entering or forming in the fuel system is not covered by the warranty.

Volvo Penta gasoline engines are equipped with a water separating fuel filter (see *Engine Fuel Filter Replacement* in the section entitled *Maintenance*). The use of an additional water separating fuel filter between the fuel tank and the engine is recommended. The filter must be approved for gasoline inboard installations and be installed in accordance with US Coast Guard regulations and ABYC standards. The filter must be rated for use with gasoline and have a minimum rating of 50 gallons (189 liters) per hour.

Water separating fuel filters should be checked frequently for water and contaminants in accordance with the filter manufacturer's recommended service intervals. Check and/or replace the filters when engine performance is poor (see the section entitled *Engine Troubleshooting Guides*). Carry spare filters and needed tools and supplies to change filters when boating.

The use of a commercially available fuel stabilizer such as STA-BIL® is recommended when storing ethanol-blended fuels for more than 2 weeks. Avoid extended storage of ethanol-blended fuels whenever possible.

Methanol

Do not use any gasoline containing methanol in Volvo Penta engines.

Serious engine damage may result from the continued use of fuel containing methanol. Any resulting engine damage is not covered by the warranty.

Electronic Fuel Injection

The electronic fuel injection (EFI) fuel metering system delivers the correct amount of fuel to the engine under all operating conditions. The EFI system is controlled by a microprocessor, and requires no periodic maintenance or adjustment. If operational problems occur, see your Volvo Penta dealer.

Detonation (Spark Knock)

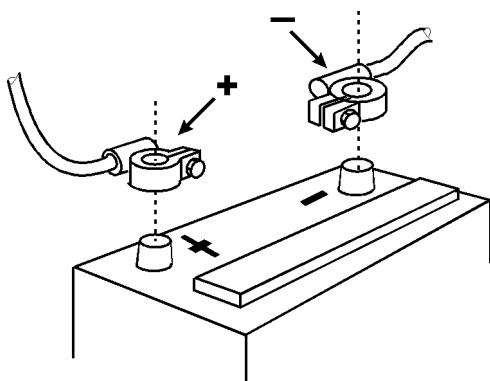
Detonation, or spark knock, is continually monitored by the electronic fuel injection (EFI) system. The EFI's computer (ECM) will automatically alter spark advance to help prevent engine damage if knock is detected, and there will be a slight loss of power.

Electrical System

Battery Cables

When replacing battery cables, always use multi-strand copper cables of the same gauge (or better) as those already installed in your boat by the boat builder. If you are unsure of the gauge to be used, consult your dealer. The maximum length is 20 feet per cable, regardless of diameter.

NOTICE! Do not use aluminum core battery cables. Failure to use battery cables of recommended gauge and material could result in poor starting and electrical component damage.



22826-a

Battery

Battery Requirements: Replace the battery with one that has the same (or better) cold cranking amps and reserve capacity as the battery installed in your boat by the boat builder. If you are unsure of the battery to be used, consult your dealer.

NOTICE! Failure to use a battery of recommended specifications could result in poor starting and electrical component damage.

NOTICE! Do not use deep cycle batteries to start the engine. A deep cycle battery, while it may have enough cold cranking amps (CCA), does not have enough voltage to power the ECM and will cause problems with the engine.

Please refer to applicable engine-related data at the beginning of this chapter for a specification of minimal requirements.

Sterndrive

Drive Components

The drive unit is filled at the factory with Volvo Penta Synthetic Gear Oil. Change lubricant as specified in *Maintenance Schedule*. Use Volvo Penta SAE 75W/90 API service GL 5 synthetic gearcase lubricant.

NOTICE! Whenever you are changing or topping up the oil, **always** check the oil level using the dipstick.

Sterndrive Oil Capacity

All SX-A Models: 2.80 quarts (2.65 liters)

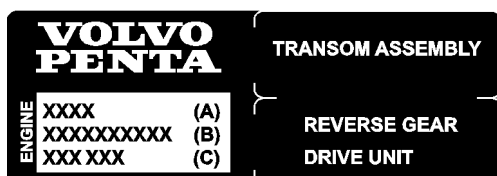
All DPS-A Models: 2.59 quarts (2.45 liters)

NOTICE! If your drive is equipped with a Drive Spacer, you will need to add more oil than the recommended amount.

Identification Numbers

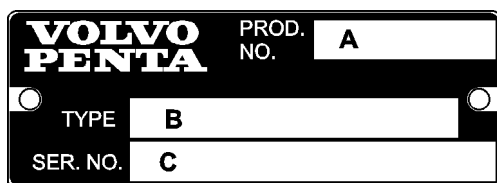
Informational Decals and Identification Plates

The following images provide graphical representations of various engine decals. The areas described are general locations and are intended to be guides only. Engine models and configurations do vary and, depending on the amount of space available, the exact locations of engine decals tend to vary also.



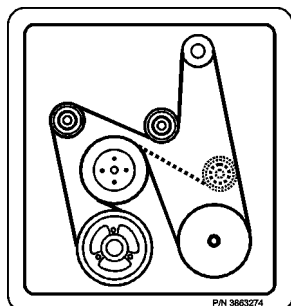
22772

The engine decal is located on the engine cover.



22774

The engine plate is typically located on the port side of the engine flywheel housing, slightly below and aft of the exhaust manifold.



3863274

The label depicting the serpentine belt configuration is typically mounted on a flat surface located on the front of the alternator/automatic tensioner bracket.



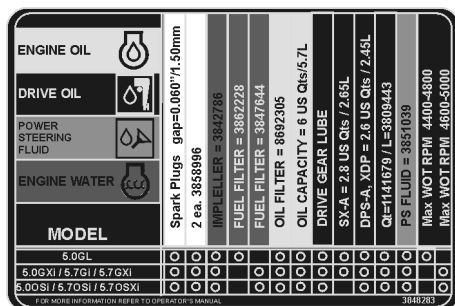
22773-a

The California Emission sticker is located on the engine cover.



The Emission Control Information sticker is located on the flat outside face (port side of engine) of the alternator support bracket.

22776-a



The tune-up and color code decal is located on the engine cover.

22775

Identification Numbers

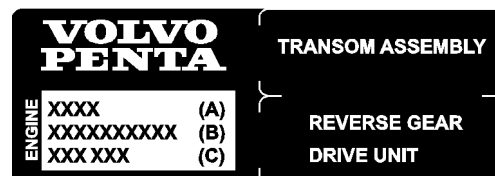
Always provide the engine, transom shield, and drive identification numbers when ordering service or replacement components. The engine identification numbers are on informational decals located in the spots described on the previous page. Make a note of the information on the lines provided below. Make a copy of this page and store the information so that it is available in event of the boat being stolen.

Engine - Decal

Product Designation (A)

Specification No. (B)

Serial No. (C)



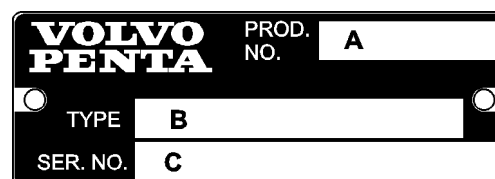
22772-1

Engine - Plate

Product No. (A)

Type (B)

Serial No. (C)



22774-1

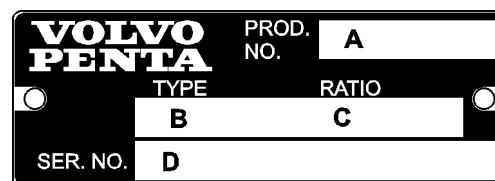
Transom Shield Plate

Product No. (A)

Type (B)

Ratio (C)

Serial No. (D)



22778-1

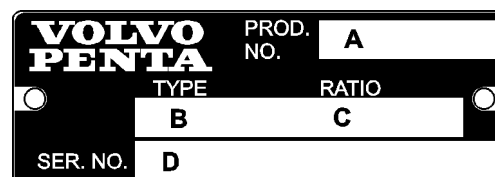
Drive

Product No. (A)

Type (B)

Ratio (C)

Serial No. (D)



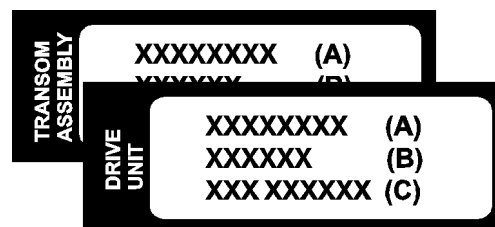
22778-1

Transom Assembly & Drive Unit Stickers

Product Designation (A)/.....

Specification No. (B)/.....

Serial No. (C)/.....



22780-1

The Transom Assembly & Drive Unit Stickers shown above should be located on the Engine Decal. Your Volvo Penta dealer will have attached these stickers at the time that the transom assembly and drive unit were mounted on your boat and attached to the engine.

Declaration of Conformity

Recreational Craft Propulsion Engines

Declaration of Conformity for Recreational Craft Propulsion Engines with the sound and exhaust emission requirements of Directive 94/25/EC as amended by 2003/44/EC

NOTICE! This Declaration of Conformity does not apply to boats using through-hull exhaust systems.

Engine Manufacturer: Volvo Penta of the Americas, 1300 Volvo Penta Drive, Chesapeake, VA 23320, USA

Body for exhaust emission assessment

International Marine Certification Institute
Rue Abbé Cuypres 3, B-1040 Brussels, Belgium
ID Number: 0609

Modules used for exhaust emission assessment

B
EC Type Examination according to Annex VII

Body for sound emission assessment

International Marine Certification Institute
Rue Abbé Cuypres 3, B-1040 Brussels, Belgium
ID Number: 0609

Module used for sound emission assessment

Aa
International production control
Test according to Annex VI

Other Community Directives applied: EMC 89/336/EEC

Description of engines and essential requirements: 4-stroke gasoline with stern drive & integral exhaust.

Engine model(s) covered by this declaration

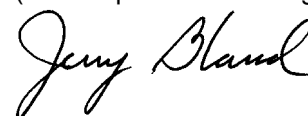
Engine Model(s)	Specification	Nominal Power	Exhaust: EC Type Certificate Number	Sound: EC Type Certificate Number
8.1 Gi	3869411	280 kW	EXVOL005	SDVOL013
8.1 GXi	3869415	313 kW	EXVOL005	SDVOL013

Essential Requirements	Standards Used	Other Normative Documents Used
Annex I.B – Exhaust Emissions		
Engine identification	Volvo Penta std	Annex I.B.1
Exhaust emission requirements	EN ISO 8178-1:1996	Annex I.B.2
Durability	Volvo Penta std	Annex I.B.3
Operator's manual	ISO 10240:2004	Annex I.B.4
Annex I.C – Noise Emissions		
Sound emission levels	EN ISO 14509:2000/prA1:2004	Annex I.C.1
Operator's manual	ISO 10240:2004	Annex I.C.2
EMC Directive	89/336/EEC	

This declaration of conformity is issued under the sole responsibility of the manufacturer. I declare on behalf of the engine manufacturer that the engine(s) mentioned above comply(ies) with all applicable essential requirements in the way specified and is in conformity with the type for which above mentioned EC type examination certificate(s) has been issued.

Name and function: Jerry Bland, Vice President of Engineering
(identification of the person empowered to sign on behalf of the engine manufacturer or his authorised representative)

Signature and title:
(or an equivalent marking)



Date and place of issue (yr/month/day): 2007/04/24 – Chesapeake, VA, USA

Operator's Manual Order

This Operator's Manual may be ordered in a different language free of charge up to 12 months after delivery, via internet.

Please refer to the link below. On the web page, type in the publication number found in the bottom of this page (7–8 digits).

<http://vppneuapps.volvo.com/manual/coupon/>

If internet access isn't possible, please contact your Volvo Penta dealer.

All order information is stored internally at AB Volvo Penta and will not be shared with third parties.

Alphabetical index

Accidents	77	Identification Numbers	103, 105
ACP.....	21	Impeller: Checking & Replacing.....	84
Active Corrosion Protection System.....	21	Informational Decals and Identification Plates.....	103
Adding Oil if Low.....	97	Laying Up (Winterization)	91
Alarms.....	31	Less than Optimal Performance.....	58
Audible Alarm.....	27	Long Term Storage.....	92
Basic Safety Rules of Boating	6	Low Oil Pressure.....	60
Battery.....	101	Lubrication System.....	96
Battery Cables.....	101	Maneuvering	32
Battery Maintenance and Replacement.....	84	Models.....	2
Before Engine Shutdown.....	46	Oil Sensor Reset	62
Before Starting.....	25	Operating in Freezing Temperatures.....	44
Bringing Out of Storage.....	93	Operating Trim Controls.....	33
Carbon Monoxide	7	Operation Break.....	43
Certified Engines.....	78	Other Instruments.....	20
Checking Engine Oil Level.....	96	Owner's Identification Card.....	12
Checking the Drive Unit Lubricant.....	86	Owner's Responsibility.....	70
Circuit Breakers and Fuses.....	64	Pitot Tube (Speedometer Port)	87
Consumer Affairs Department.....	13	Power Steering Reservoir Fluid Level.....	90
Controls.....	19	Power Tilt Operation.....	46
Cruising Speed.....	37	Power Trim.....	15
Declaration of Conformity	106	Power Trim Buttons.....	16
Determining the Proper Trim.....	34	Power Trim Instrument and Displays.....	18
Detonation (Spark Knock).....	100	Power Trim/Tilt.....	32
Disclaimer.....	94	Power Trim/Tilt-Fluid.....	86
Disengaging the Shift Function.....	37	Propeller.....	89
Doing Your Own Maintenance and Repairs.....	75	Propeller Care.....	89
Draining Raw Water Cooled Engines.....	49	Reading the Instruments	31
Draining Raw Water Side of Closed Cooling System Engines.....	50	Recreational Craft Propulsion Engines.....	106
Drive.....	86	Replacement Parts and Tools Checklist.....	30
Drive Components.....	102	Replacing the Engine Thermostat.....	83
Electric Fuel Pumps	63	Running Aground.....	51
Electrical System.....	84, 101	Sacrificial Anode	80, 88
Electronic Fuel Injection.....	100	Safety and Preventative Maintenance Check- lists.....	70
Emergency Stop Switch.....	43	Safety Precautions While Operating the Boat.....	6
Emissions Control Components.....	70	Salt Water Operation.....	45
Engine Alignment.....	80	Scheduled Maintenance.....	72
Engine Flush.....	47	Serpentine Belt.....	79
Engine Overheating (EFI Engines).....	61	Shallow Water Operation.....	44
Engine Submersion.....	68	Shifting and Speed Control.....	39
Engine Troubleshooting Guides.....	53	Short Term Storage.....	91
Engine, General.....	79	Single Control Lever Operation.....	38
Engines.....	94	Spark Plugs.....	85
Flooded Engine	29	Special Boating Conditions.....	44
Friction Brake.....	20	Starting the Engine.....	27
Fuel Storage.....	82	Starting the Engine (Cold Start).....	27
Fuel System.....	81, 98	Starting the Engine (Warm Start).....	28
Gauges	14	Starting the Engine After Service.....	76
General Safety Information.....	4	Starting Using Auxiliary Batteries.....	52
General Warnings.....	98	Static Water Line.....	23
High Altitude Operation	45	Static Water Line Test.....	24
High Performance Boat Operation.....	45	Steering.....	69, 90
Hour Meter.....	72	Steering System Operation.....	41
Hull Weight.....	58	Steering with Control Levers.....	42
		Stop the Engine.....	46

Stop the Engine Before Service.....	76
Tie Rod (Twin Engines Only)	51
Trailer Your Boat.....	48
Trim/Tilt Motor Protection.....	36, 68
Twin Unit Maneuvering.....	40
Twin Unit Steering.....	41
Volvo Action Service (VAS)	12
Volvo Penta Dealer Network.....	13
Volvo Penta on the Internet.....	13
Warranty Information	12
Washing the Engine.....	78
Water in Bellows.....	61
Water in Oil and Oil Level.....	61

VPA 47701899 English 12-2010

