

OPERATOR'S MANUAL

**3.0 GS, 4.3 GL/Gi, 5.0 GL/Gi, 5.7 GS/GSi,
7.4 Gi/GSi, 8.2 GSi, DPX 385/415**

PRODUCT AND APPLICATION INFORMATION

Please complete this section for future reference.

Delivery date _____

Engine model number _____

Engine serial number _____

Drive/Transmission model _____

Drive/Transmission serial number _____

Transom shield assembly serial number _____

Boat manufacturer _____ Boat year _____

Boat model _____ Boat length _____

Hull ID number (HIN) _____

State/Province registration number _____

Propeller size _____

Selling dealer _____

Servicing dealer _____

It is very important that you obtain all serial numbers directly from serial number plates attached to product assemblies. Check page 17 for the location of product serial number plates.

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Volvo Penta reserves the right, without prior notice, to revise materials, standard equipment, specifications, models and to discontinue models. Not all models, equipment and accessories are available in all markets or countries. **Certain models and/or configurations may not be available at the time of publication. Representations made regarding these products are subject to actual use, application, and/or operating conditions, as well as proper maintenance.** The power rating data contained herein is for engines and conditions as tested and may vary within manufacturing tolerances. Engines pictured in this brochure may feature custom accessories that are not necessarily standard on production models. Horsepower ratings are in accordance with NMMA procedure.

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INTRODUCTION

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 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.

Factors that affect engine performance

Power ratings

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. When it comes to quoting and comparing ratings, it is important that there is a unified set of standards for measurement.

In September 1989, all major marine engine manufacturers agreed to quote engine power output according to a common set of conditions. These conditions are referred to as *ISO 8665*. All Volvo Penta engines meet the ISO 8665 standard. This ISO standard outlines the following fixed values or common conditions for determining the rating of the engine.

Condition	Value	Condition	Value
Sea water temperature	77° F (25° C)	Exhaust back pressure	1.45 PSI (10 kPa)
Fuel temperature	104° (40° C)	Barometric pressure	14.504 PSI (100 kPa)
Air temperature	77° F (25° C)	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.

Marine engines can be rated according to one of several power standards, but power output itself is quoted in kilowatts (KW) or horsepower (HP), for a given engine speed, usually at maximum revolutions per minute (RPM).

How load conditions affect the speed of a planing hull

The overall weight of the boat is another important factor in performance. Any increase in boat weight will slow down the boat speed, particularly on boats with planing and semiplaning hulls.

For example, a new boat tested with fuel and water tanks only half filled, and without any load, can easily drop 2 to 3 knots in speed when tested fully fuelled and loaded with all normal equipment and supplies for safe and comfortable cruising. This is because the propeller installed originally 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.

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 waterline - a problem that is often overlooked.

“Wagon-back” effect



As long as we continue to use combustion technology for engines, there will be exhaust emissions. Despite the substantial reductions achieved in modern engines, as fuel burns exhaust emissions and fumes will always be given off.

But there is also another effect. Any shear-bodied object moving forward will create a phenomenon we call “wagon-back effect.” Due

to a difference in air pressure, the airflow behind such an object will have a tendency to draw dirt and exhaust emissions back into the object. (You’ll frequently see evidence of this in the excess of road grime that is drawn back onto the rear windows of cars.) A boat with a sheer, broad transom and high superstructure creates its own wagon-back effect. This recirculating air has a tendency to draw exhaust fumes and water spray up toward the afterdeck. Often people will make the mistake of opening a ventilator or port hole in order to remove the fumes, but it has the opposite effect — more fumes are drawn in, and conditions merely become worse. In high concentrations these fumes may be hazardous. If you suspect that your boat exhibits this “wagon-back” effect, please contact your Volvo Penta dealer.

Your new boat

Every new boat has its own special characteristics. Even experienced boat owners should note carefully how a boat behaves at different speeds, weather conditions, and loads. Your boat owner's manual contains information to help you operate it with safety and pleasure. It contains details of the boat, equipment supplied or fitted, systems, and information on operation and maintenance. Please read it carefully, and familiarize yourself with your boat before using it for the first time.

We strongly recommend that you install an emergency stop switch (see page 33), regardless of the type of boat. If your boat does not have with an emergency stop switch, contact your Volvo Penta dealer, who can assist you in selecting one.

Boater's responsibilities

The operation, maintenance, and care of the Volvo Penta engine and power package as outlined in the owner's manual are the owner's responsibility. (See the *Maintenance Schedule* on page 55.) The owner must keep records of all maintenance services performed. This record of proper maintenance may be required to determine warranty coverage on certain repairs and should be transferred to each subsequent owner. If you are not sure of the proper maintenance procedures, contact the Volvo Penta Consumer Affairs Department at the address on page 85 of this document.

The operator is responsible for the correct operation of the boat and for the safety of all passengers. Make sure that all operators read this manual before operating the boat. Show your passengers the location of emergency equipment and explain how to use it. Be sure one of your passengers knows how to handle your boat in case of emergency.

Requirements for personal flotation devices (life vests, life preservers) and other safety equipment vary, depending on the type of boat and local regulations. Always comply with the regulations that apply to your boat.

Planning your trip

Everyone wants to have a problem-free and pleasant time when they take their boat out. To help you do this we have provided a pre-journey checklist below. Take extra time to check the engine and its equipment and the general maintenance of the boat.

- Get up to date charts for the planned route
- Calculate distance and fuel consumption
- Note places where you can refuel on your planned course
- Tell friends or relatives about your route (that is, file a "float plan").

Safety equipment

- Rescue and emergency items such personal flotation devices and signal rockets. Make sure all passengers know where these items are.
- Replacement parts
- Proper tools
- Fire extinguisher checked and charged

Basic safety rules of boating

- Shut off the engine when people who are in the water come near the boat.
- Propellers are inherently dangerous, and as such are potential safety hazards. Make sure that the propeller is not operating when people who are in the water come near the boat.
- Avoid standing up or shifting weight suddenly in small, lightweight boats.
- Keep your passengers seated in seats. The boat's bow, gunwale, transom, and seat backs are not intended for use as seats.

- Insist on the use of personal flotation devices by all passengers at all times.
- Know the “rules of the road” and obey them. If you are not familiar with the “rules of the road,” take the U.S. Coast Guard’s boater safety course. You may find information about boating safety at **WWW.USCGBOATING.ORG** and **WWW.CGAUX.ORG/CGAUXWEB/PUBLIC/PUBFRAME.HTM**.
- Prevent explosion and fire by maintaining your fuel delivery system in top condition. Fuel vapor is volatile; handle fuel with care.
- Keep your boat and equipment neat and in top operating condition. Carry a selection of spare parts for the engine. (Volvo Penta’s on-board kit contains a selection of essential items that a boat owner should carry at all times. See your Volvo Penta dealer.)
- **NEVER OPERATE THE BOAT IF YOU ARE UNDER THE INFLUENCE OF DRUGS OR ALCOHOL.**
- If boating waters are unfamiliar, obtain appropriate charts to avoid damage from underwater objects.

SAFETY

This owner's 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 the engine and drive: model identification, preventive maintenance recommendations, fuel and oil recommendations, and other important points. Please keep this book with your boat at all times.

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

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

Note: 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 and drive, please notify us at our address listed on page 85, 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.

This manual will alert you to certain things you should do very carefully. If you don't, you could

- hurt yourself or bystanders
- hurt the boat operator or bystanders
- damage the machinery.

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!

DANGER

Failure to comply with a danger symbol will result in serious injury or death to boat operator, boat occupants, and/or others.

WARNING

Failure to comply with a warning may result in injury or death to boat operator, boat occupants and/or others.

CAUTION

Failure to comply with a caution may result in failure or damage to the equipment.

Below is a summary of the risks and safety precautions you should always observe or carry out when operating or servicing the engine:

1. Check that the warning or information decals on the engine are always clearly visible. Replace decals that have been damaged or painted over.
2. Always turn the engine off before starting service procedures. Avoid hot surfaces and liquids in supply lines and hoses when the engine has just been turned off and is still hot.
3. To prevent a possible explosion, operate the blower as recommended by the boat manufacturer before starting the engine. If the engine compartment is not equipped with a blower, open the engine cover or hatch before starting to disperse any gasoline fumes that may be present. Leave the hatch open until after the engine is running.
4. 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.).
5. Approaching a running engine is dangerous. Loose clothing or long hair can get caught in rotating parts and cause serious personal injury.
6. If so equipped, turn off the power supply to the engine at the main switch and lock it in the *OFF* position before starting work.
7. 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.
8. If opening the filler cap or drain cock/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.
9. Stop the engine and close or block the sea water intake before carrying out operations on the engine cooling system.
10. Only start the engine in a well-ventilated area. If operating the engine in an enclosed space, make sure your work area is well ventilated.
11. Anticorrosion and antifreeze agents can be hazardous to health and to the environment. Whenever you use these agents, follow the manufacturer's instructions on the product packaging.
12. 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.
13. Hot oil can cause burns. Avoid skin contact with hot oil. Ensure that the lubrication system is not under pressure before beginning to work on it. Never start or operate the engine with the oil filler cap removed; otherwise, hot oil could spew out.
14. 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. 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.
15. 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.
16. Always use protective goggles when charging and handling batteries. Battery electrolyte contains sulfuric 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 copious amounts of water and obtain medical assistance.

17. To ensure safe handling and to avoid damaging engine components on top of the engine, use a lifting beam to raise the engine. All chains and cables should run parallel to each other and as perpendicular as possible in relation to the top of the engine. Always check that lifting equipment is in good condition and has sufficient load capacity to lift the engine and any extra equipment installed.
18. If extra equipment is installed on the engine, which alters its center of gravity, a special lifting device is required to achieve the correct balance for safe handling.
19. Never work on an engine that is suspended on a hoist.
20. Components in the electrical, ignition, and fuel systems on Volvo Penta products are designed and constructed to minimize the risk of fire and explosion. **Using non-original Volvo Penta parts that do not meet the above standards can result in fire or explosion on board.** Damage caused by using non-original Volvo Penta replacement parts will not be covered under any warranty provided by Volvo Penta.
21. Fuel filter replacement should be carried out on a cold engine to avoid the risk of fire caused by fuel spilling onto the exhaust manifold. Always cover the generator if it is located under the fuel filter. The generator can be damaged by spilled fuel.
22. Always use protective gloves when tracing leaks. Liquids ejected under pressure can penetrate body tissue and cause serious injury.
23. Always use fuel recommended by Volvo Penta. The use of lower quality fuels can damage the engine. Poor fuel quality can also lead to higher maintenance costs.
24. Never use a high-pressure washer when washing the engine.

GENERAL INFORMATION

Identification numbers



Engine model number



Transom shield model number



Drive unit model number

Immediately upon taking delivery of your new boat, have the dealer record the model and serial numbers of the engine and drive in the *Product and Application Information* space provided on the inside front cover. (These numbers are required for warranty registration, warranty service, and ordering parts.) Include the model and serial number of your boat and any auxiliary equipment. Also, make a copy and keep the copy in a safe place in the event your boat is stolen.

Owner's identification card

When you purchased your boat, the dealer was required to complete a warranty and registration form for your Volvo Penta product. The owner's portion of this form is your Owner's Identification Card. This card provides proof of ownership and is required to validate warranty, should warranty service be necessary. Warranty coverage may be delayed until the warranty and registration form is on file at Volvo Penta.

Product references, illustrations, and specifications

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of printing. Volvo Penta of the Americas, Inc. reserves the right to make changes at any time, without notice, in specifications and models; to discontinue models; to change any specifications or parts at any time without incurring any obligation to equip same on models manufactured prior to date of such change.

When reference is made in this manual to a brand name, number, product or specific tool, an equivalent product may be used in place of the product referred to unless specifically stated otherwise. To avoid hazards, equivalent products used must meet all current U.S. Coast Guard Safety Regulations and American Boat and Yacht Council (ABYC) standards.

All illustrations used in this manual may not depict actual models or equipment and are intended as representative views for reference only.

The continuing accuracy of this manual cannot be guaranteed.

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. 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 is absolutely free for Volvo Penta-related repairs. Towing is not covered by the Volvo Penta warranty. Once your warranty period has expired, there is a charge of \$50.00* U.S. per managed breakdown, plus any additional costs incurred for towing, parts, or repairs.

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



*Price subject to change without notice.

Doing your own maintenance and repairs

If you plan to do your own maintenance and repairs on your Volvo Penta products, you should purchase a set of service manuals that pertain to your particular engine and drive. Keep in mind, however, that there are certain tasks that should only be performed by your Volvo Penta dealer. He has the tools, expertise, and most current information needed to properly perform these tasks.

“Dealer-only” maintenance items are listed in the *Maintenance Schedule*, page 55.

Parts and accessories



Genuine Volvo Penta parts are the result of many hours of strenuous testing, and fulfill Volvo Penta's strict quality and safety requirements. Your authorized dealer has a complete line of (or may order) genuine Volvo Penta parts, accessories, coolants, and lubricants. When replacements are required, use only Volvo Penta genuine parts.

Purchase all Volvo Penta replacement parts, accessories, coolants, and lubricants from an authorized Volvo Penta dealer. He has needed parts in stock for routine maintenance, as well as the information needed to order special parts and accessories for you.

Only authorized Volvo Penta dealers may purchase genuine parts and accessories directly from the factory. Volvo Penta does not sell to unauthorized dealers or retail customers.

Volvo Penta dealer network

Volvo Penta has a comprehensive dealer network that offers both service and spare parts for Volvo Penta engines. These dealers have been carefully selected and trained to provide professional assistance for service and repairs. They also have the special tools and testing equipment required for maintaining a high standard of service. Volvo Penta dealers and vendors must maintain a stock of original spare parts and accessories to cover most requirements of Volvo Penta owners. When ordering a service or spare parts always quote the engine and drive/reverse gear complete type designation and serial number. You will find this information on the engine product plate and on a decal on the valve cover.

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 — he also knows you and your equipment.

For the name and location of your nearest Volvo Penta dealer, consult the Yellow Pages under **Boat Dealers**, or call **1-800-522-1959**.

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. To locate a Volvo Penta servicing dealer, check the Yellow Pages under Boat Dealers, or call 1-800-522-1959.

Volvo Penta on the Internet

The URL address for Volvo Penta of the Americas is <http://www.volvo.com>. When you reach the Volvo home page, choose the *Marine and Industrial Engines* icon.

Warranty information

Volvo Penta's warranty package can be found on page 87. Along with the warranty information you will find other checklists and reports for Volvo Penta products.

Some areas may have other warranty conditions, depending on national legislation and regulations. Information about these conditions can be obtained from Volvo Penta importers and dealers in those areas. Contact your local Volvo Penta representative for a copy.

Warranty Registration Form

The Warranty Registration Form should always be filled out and sent in by the dealer. Make sure that this has been done, since delay of warranty claims can occur if no proof of the delivery date can be provided.

2 PLUS 4™ Extended Protection

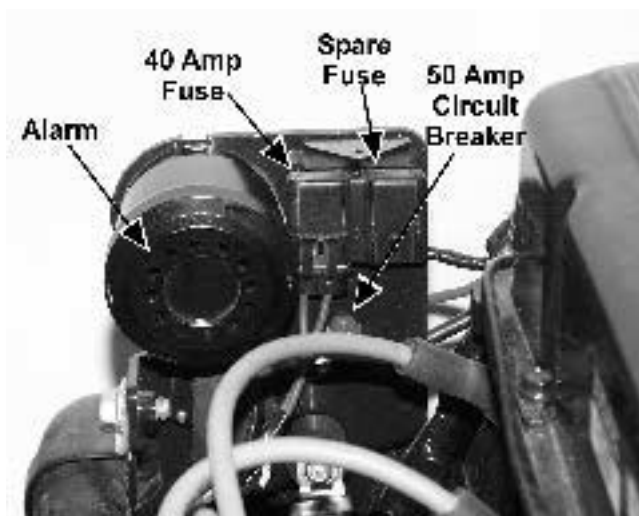


In addition to our factory warranty, owners may purchase Volvo Penta's exclusive 2 PLUS 4 Extended Protection plan, which provides additional service benefits for a total of six years of coverage. The 2 PLUS 4 program covers most repairs to Volvo Penta engines, drives, and transmissions, and is fully transferable to second owners.

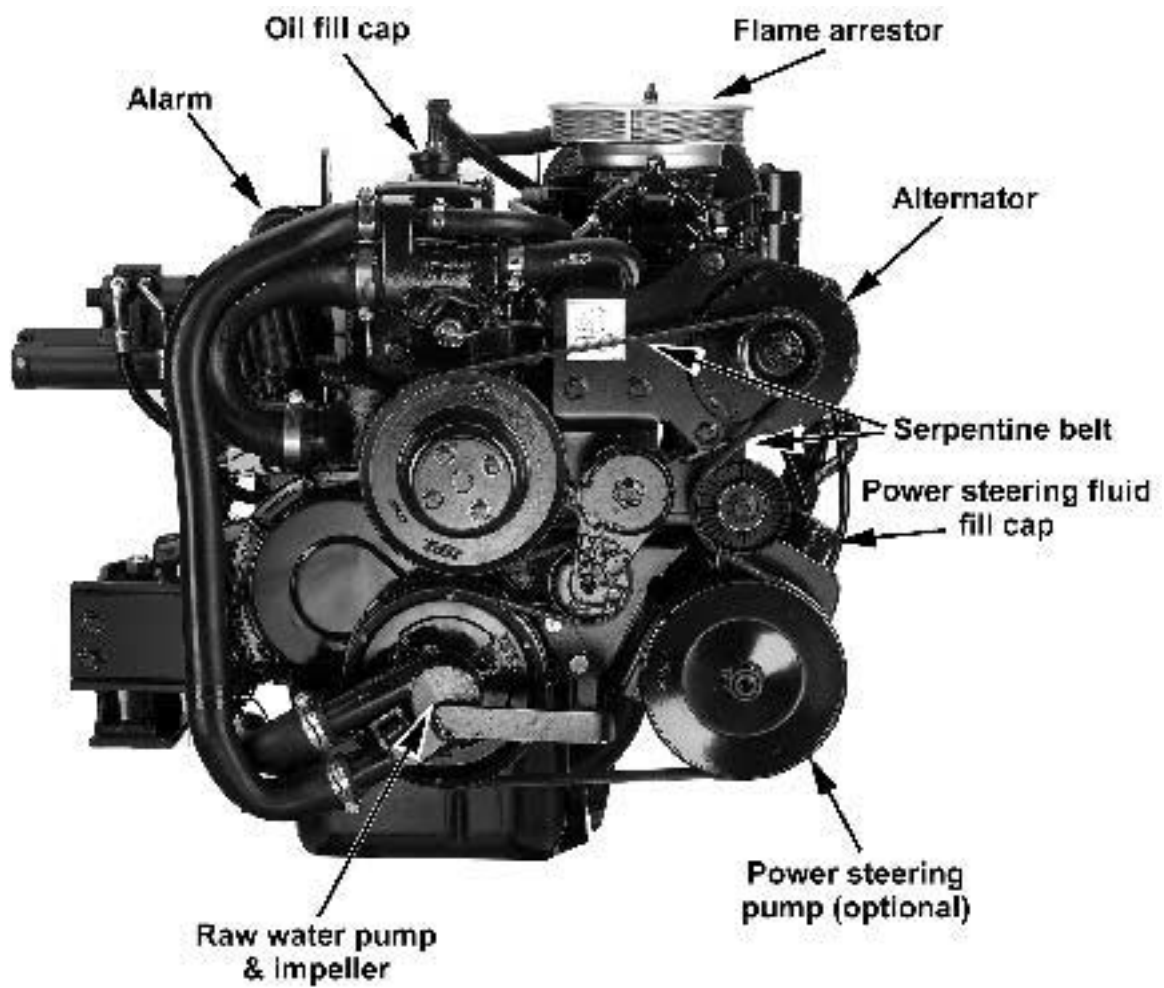
The extended protection plan provides mechanical coverage, a towing allowance, and optional accessories and trailer coverage. It covers an extensive list of repairs with only a \$25.00 deductible per repair visit. See Appendix B of this document for more information about the 2 PLUS 4 Extended Protection plan, or call 1-800-235-7549.

FEATURES

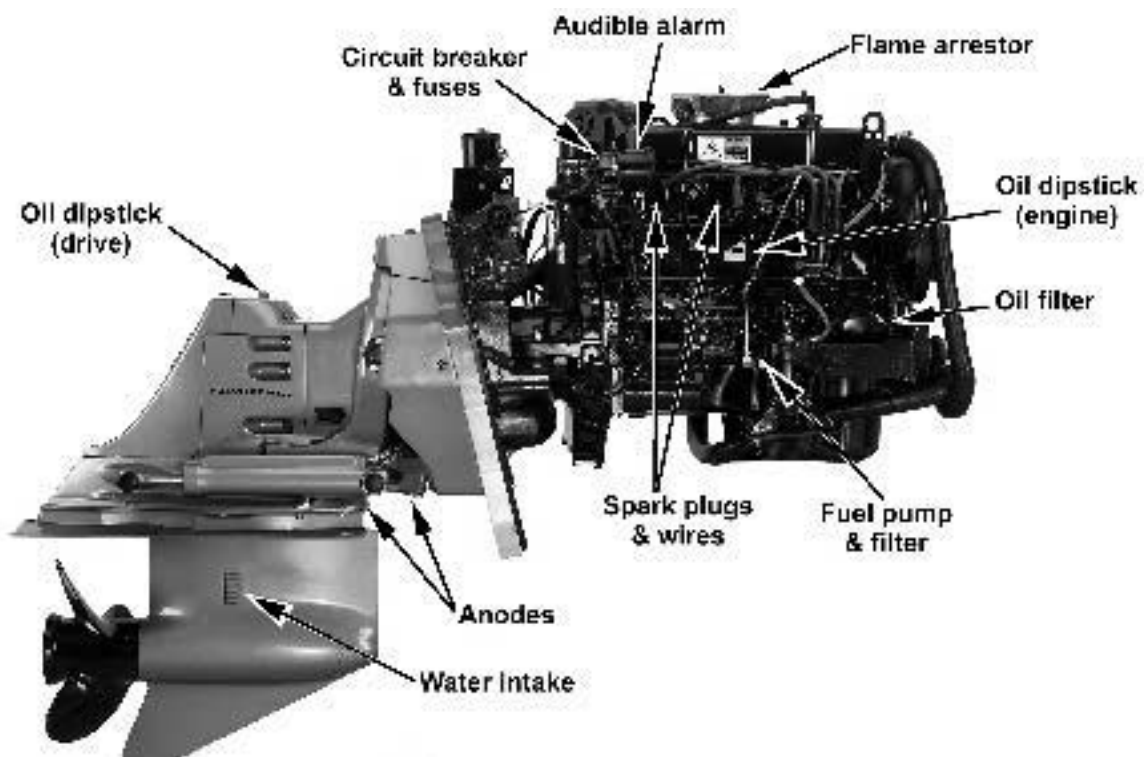
Your Volvo Penta product consists of two components: the engine and the drive. There are certain parts on each component that you, the owner, must take care of to make sure that your Volvo Penta product stays in optimum running condition. The important parts of each component are shown in the photographs on pages 22 through 31. Explanations of these parts and systems are described below; the maintenance procedures are found in the *Maintenance* section starting on page 55.



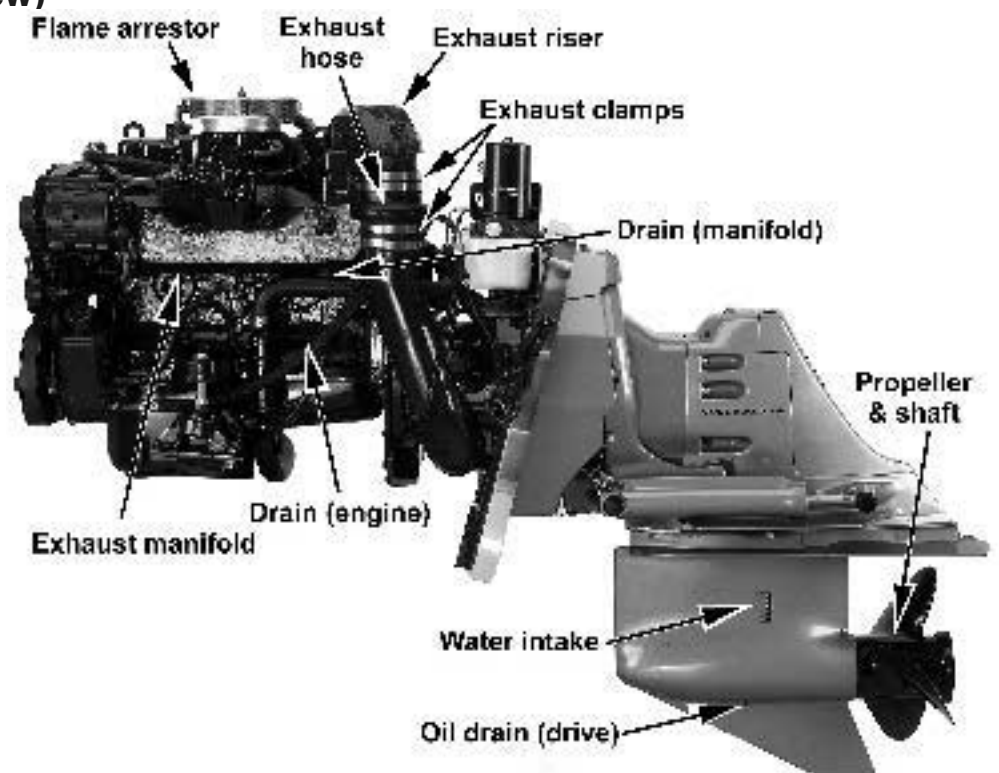
3.0 GS Alarm and Fuse Detail



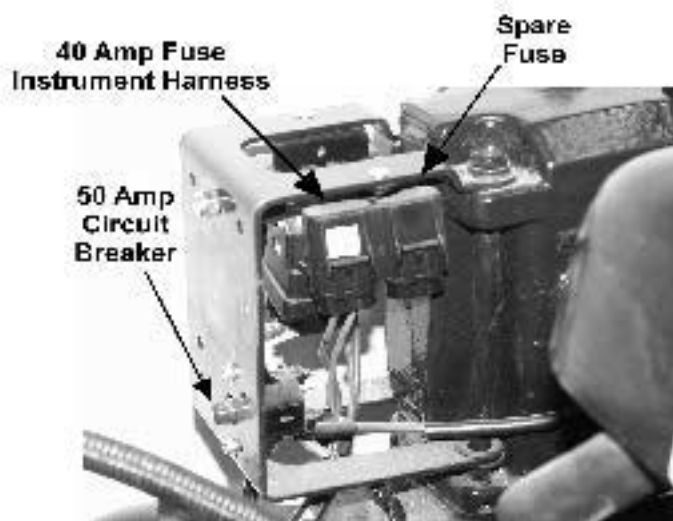
3.0 GS (front view)



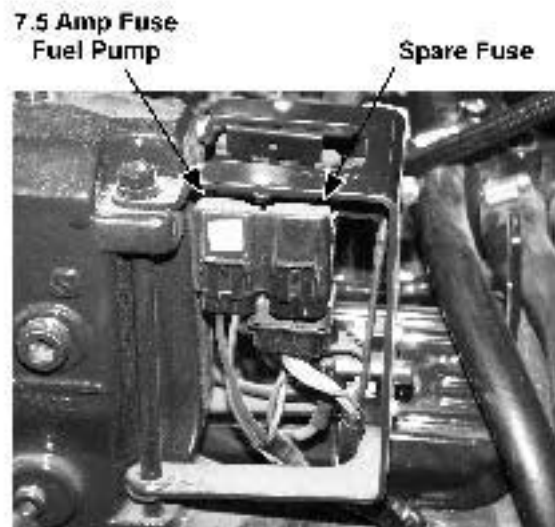
3.0 GS (starboard view)



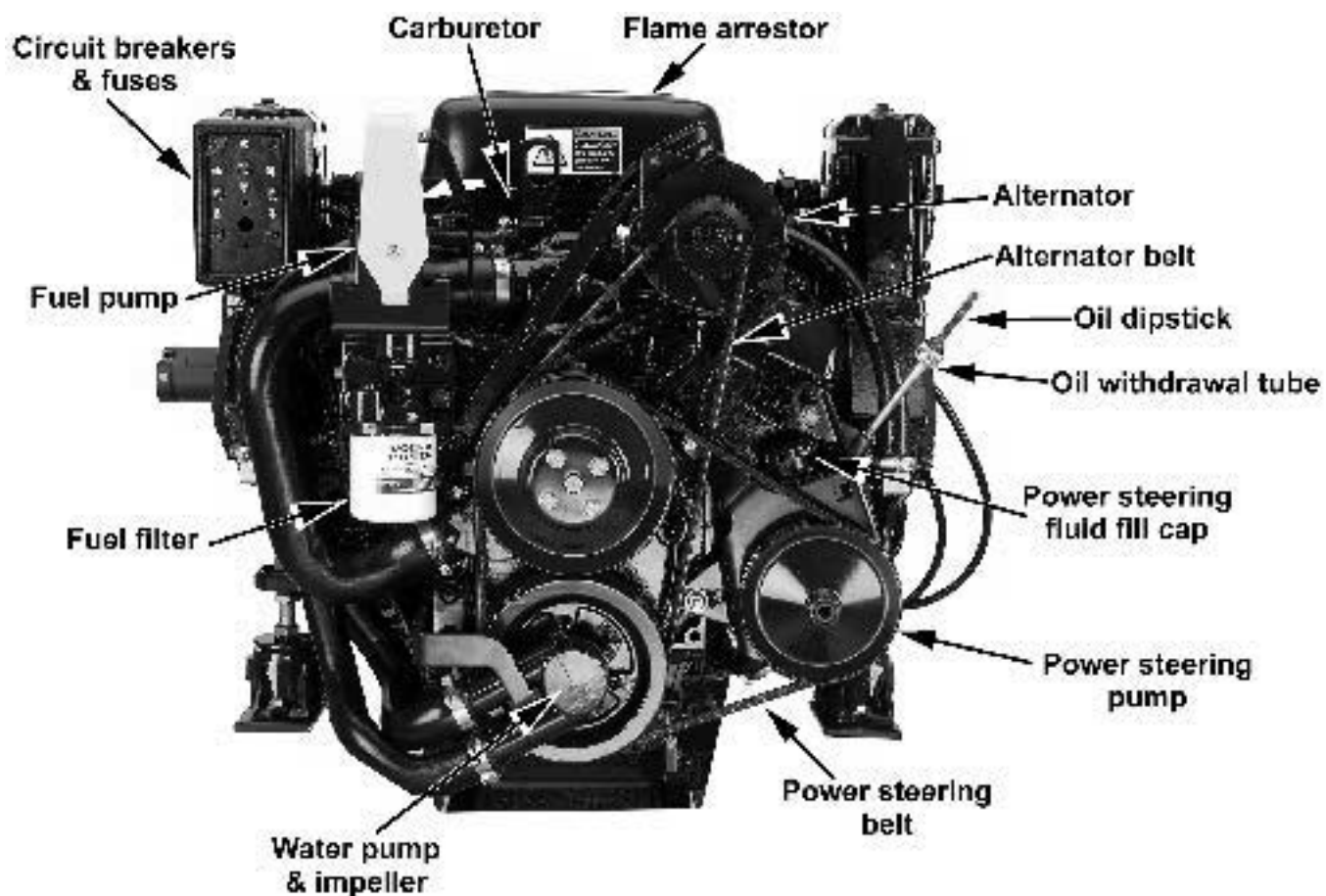
3.0 GS (port view)



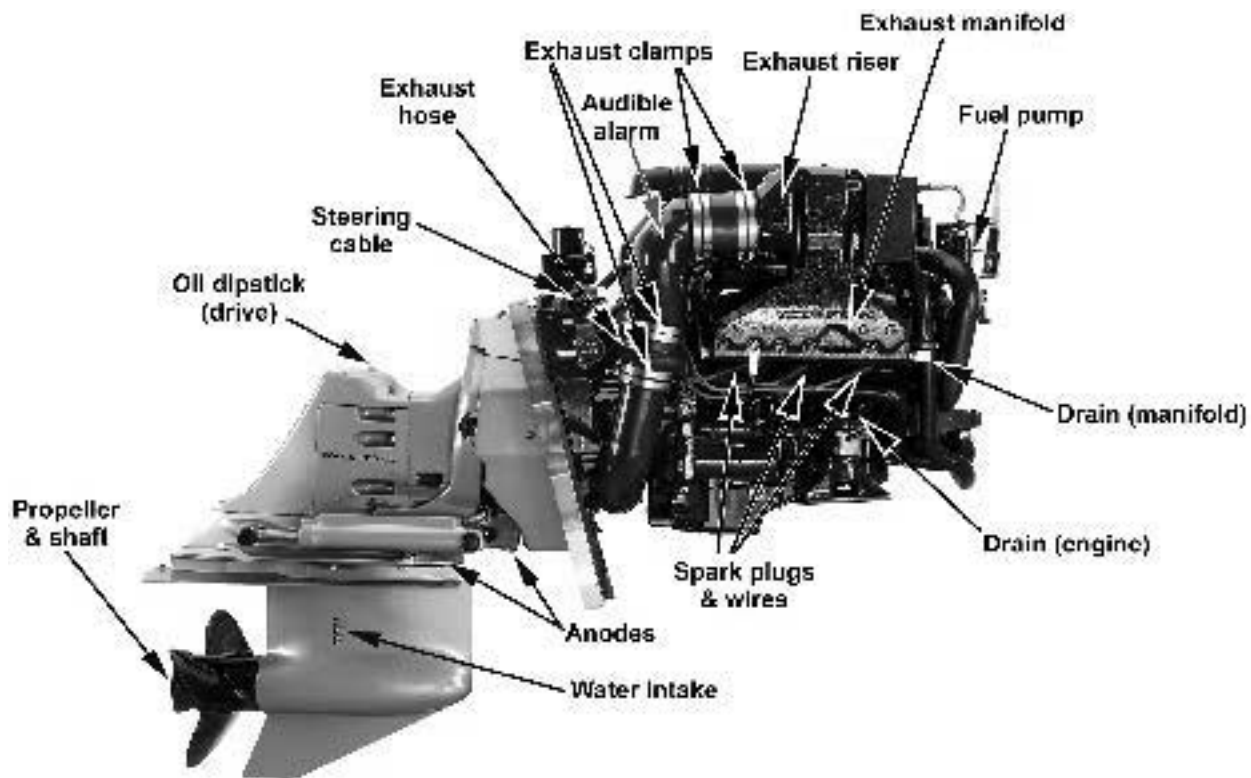
Fuses and circuit breakers (port view)



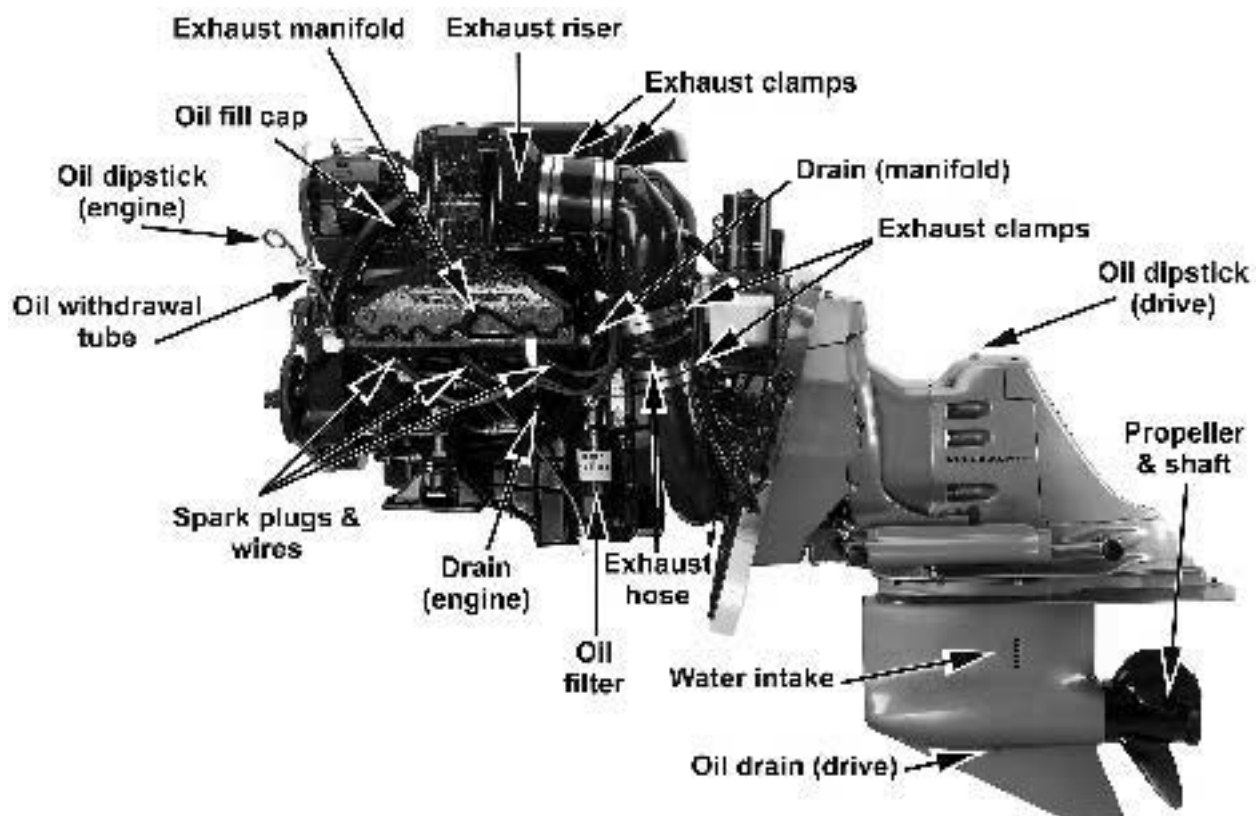
Fuses and circuit breakers (starboard view)



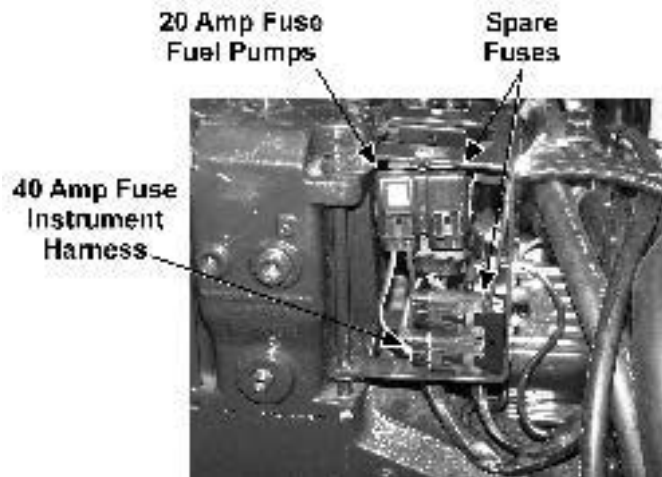
4.3 GL, 5.0 GL, 5.7 GS (front view)



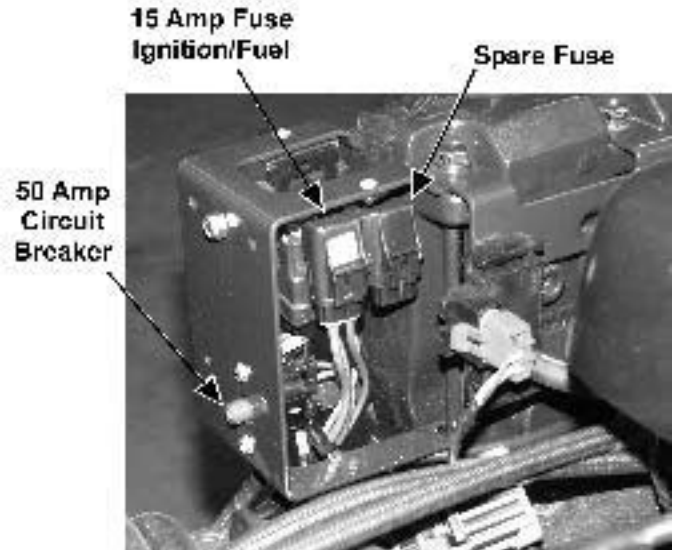
4.3 GL, 5.0 GL, 5.7 GS (starboard view)



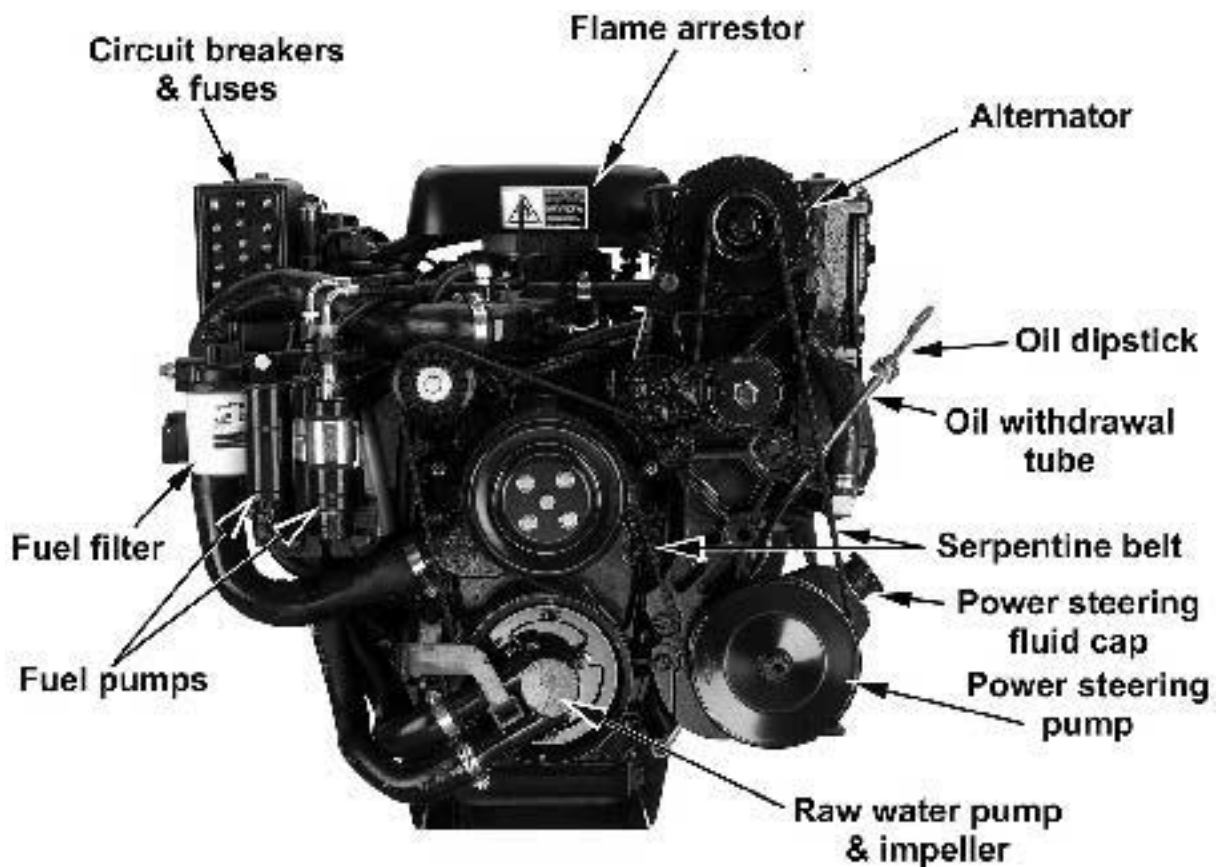
4.3 GL, 5.0 GL, 5.7 GS (port view)



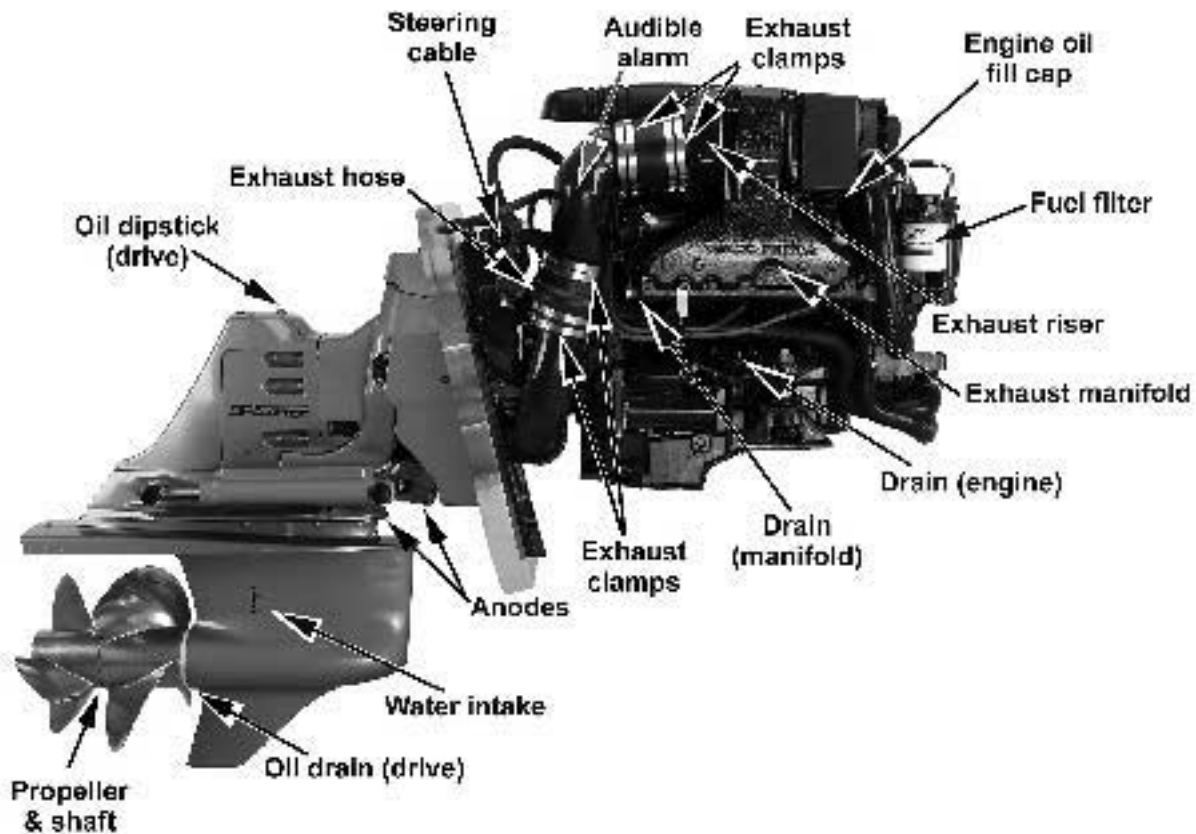
Fuses and circuit breakers
(starboard view)



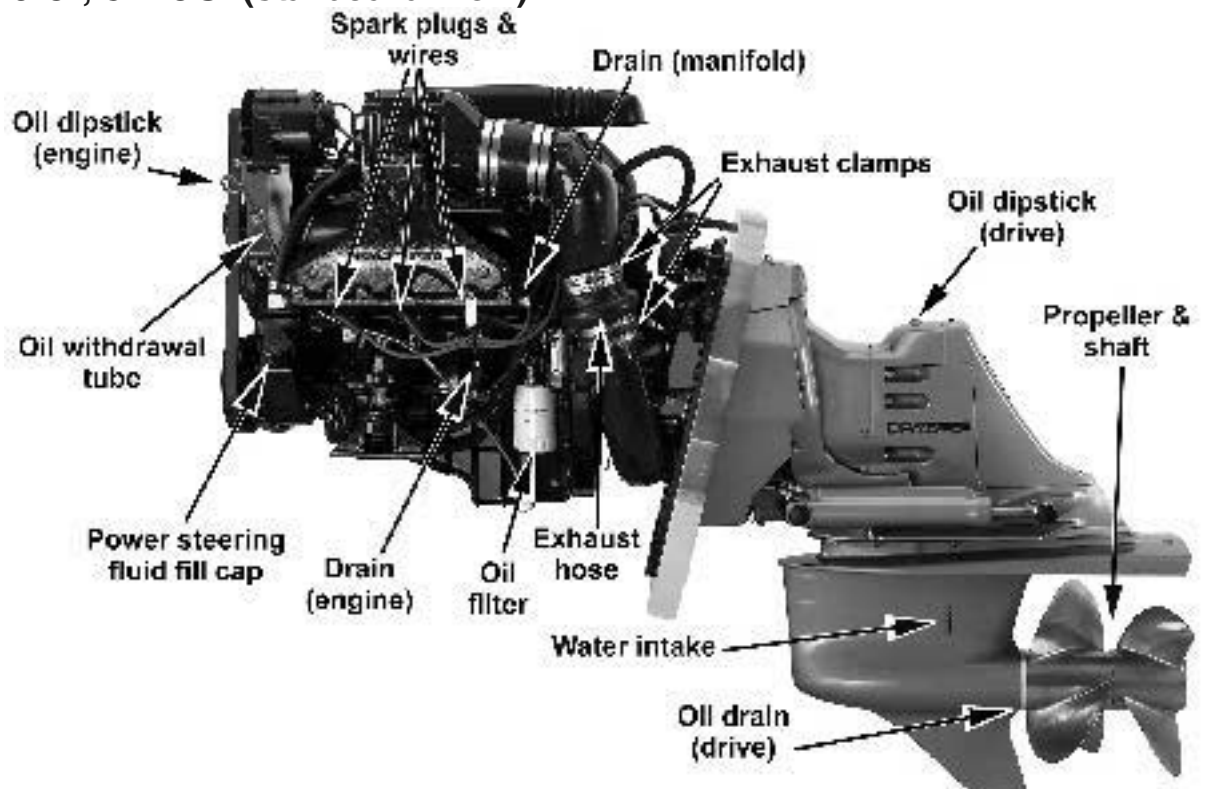
Fuses and circuit breakers
(port view)



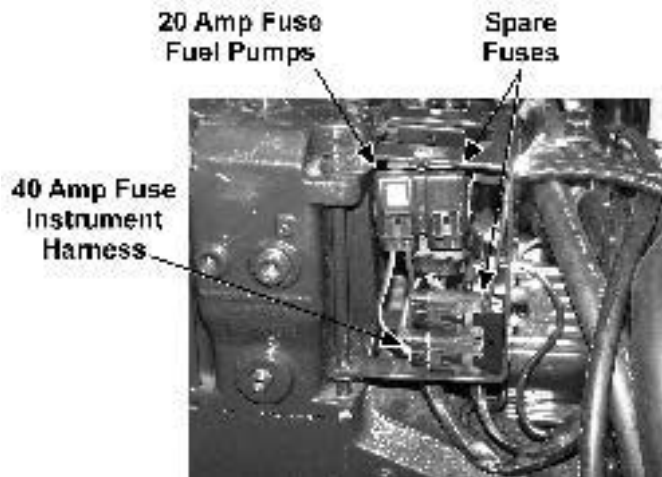
4.3 Gi, 5.0 Gi, 5.7 GSi (front view)



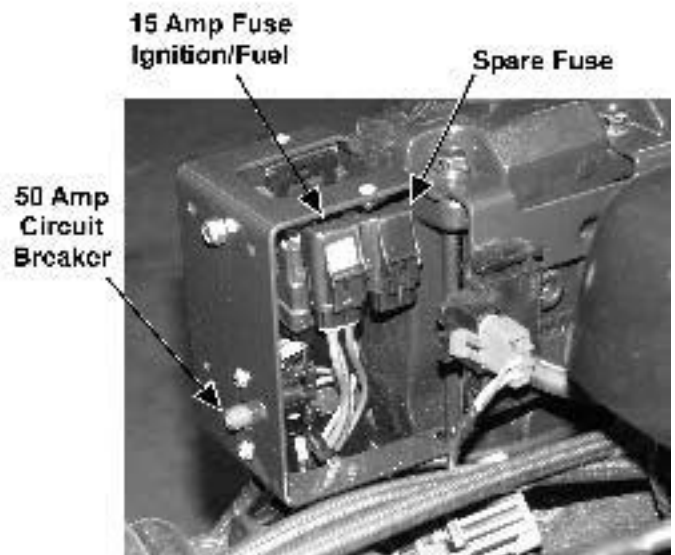
4.3 Gi, 5.0 Gi, 5.7 GSi (starboard view)



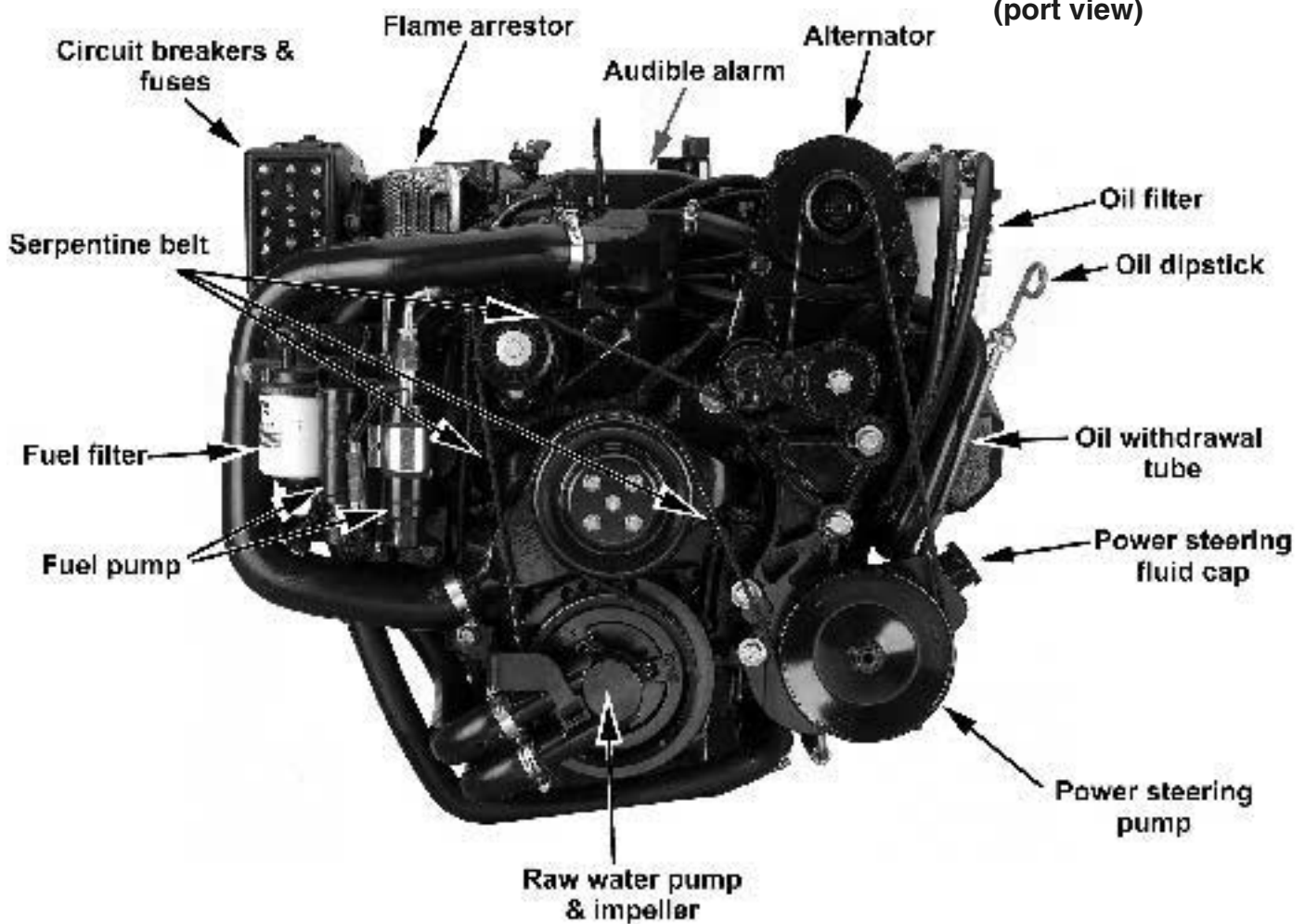
4.3 Gi, 5.0 Gi, 5.7 GSi (port view)



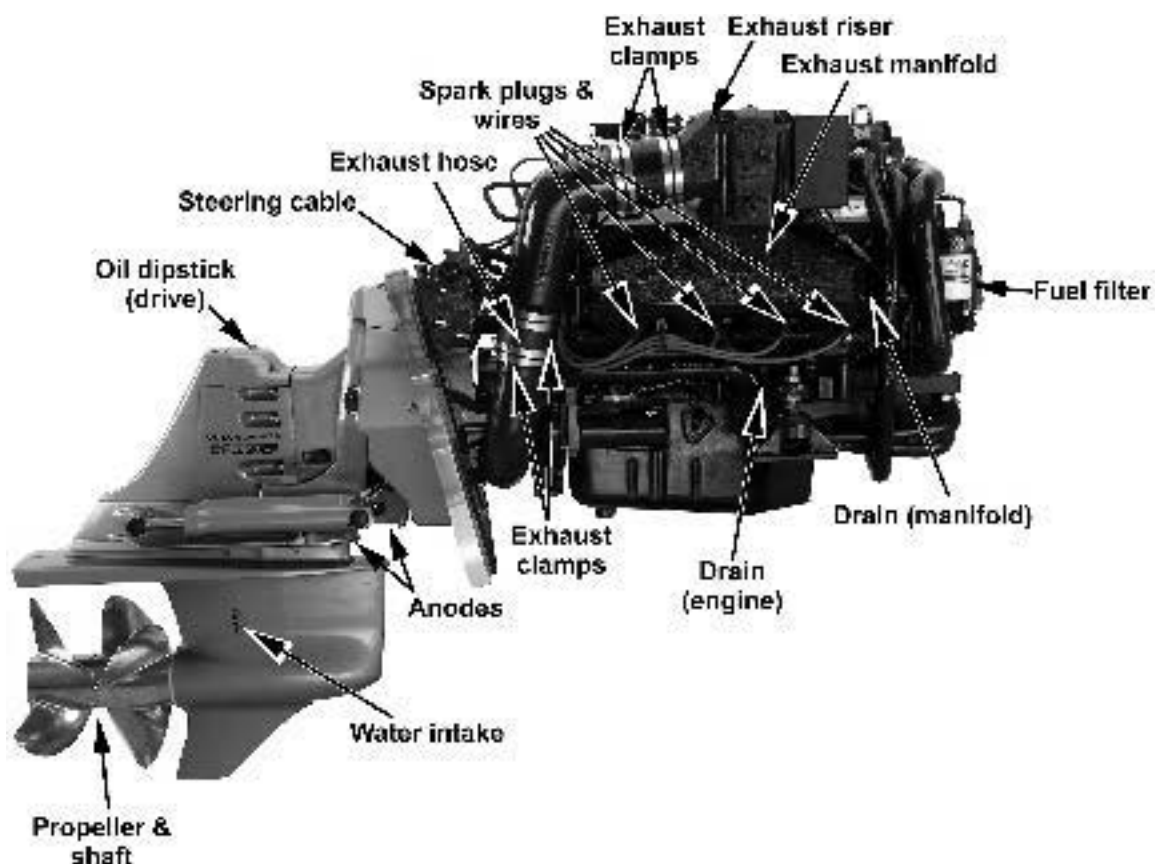
Fuses and circuit breakers
(starboard view)



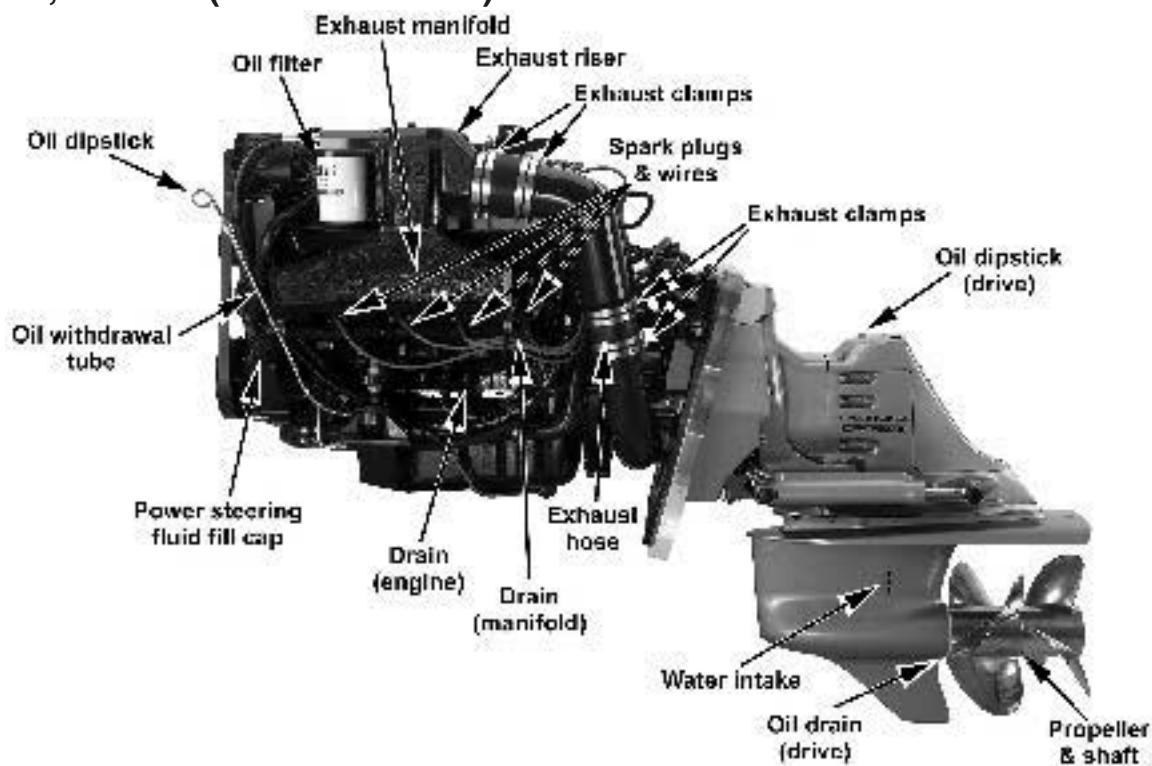
Fuses and circuit breakers
(port view)



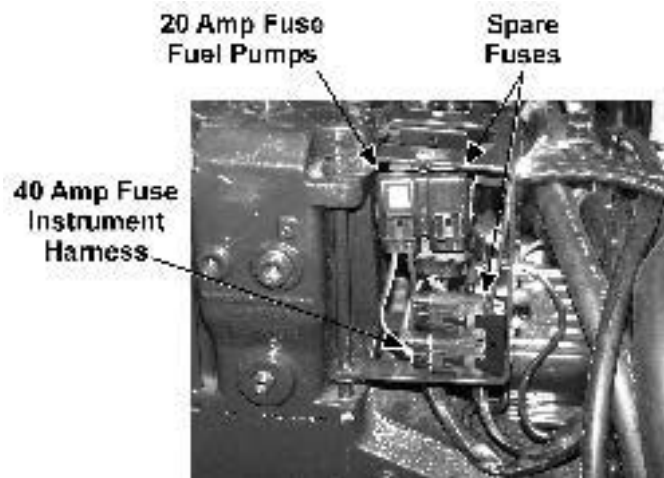
7.4 Gi, 7.4 GSi, 8.2 GSi (front view)



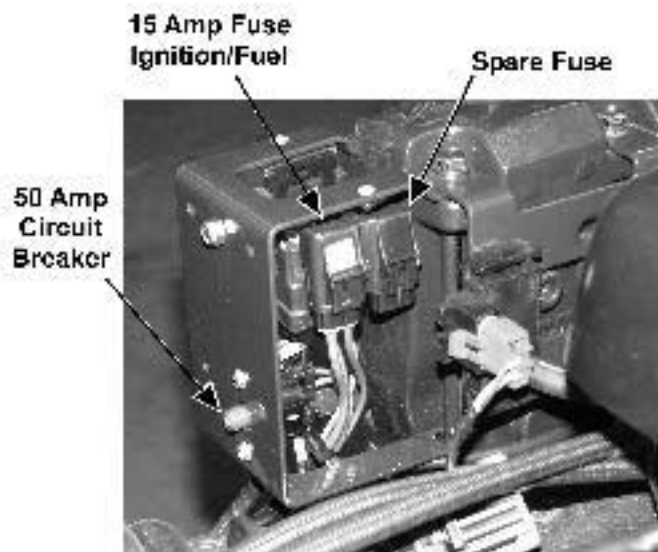
7.4 Gi, 7.4 GSi, 8.2 GSi (starboard view)



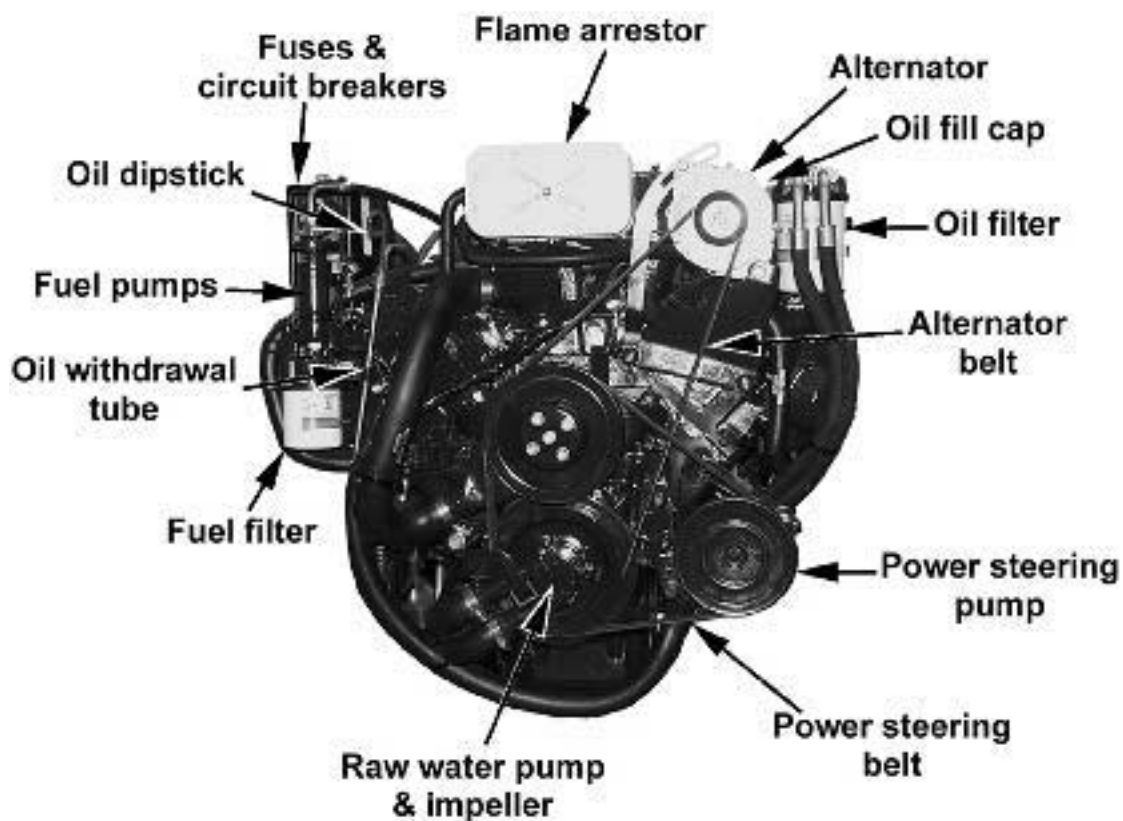
7.4 Gi, 7.4 GSi, 8.2 GSi (port view)



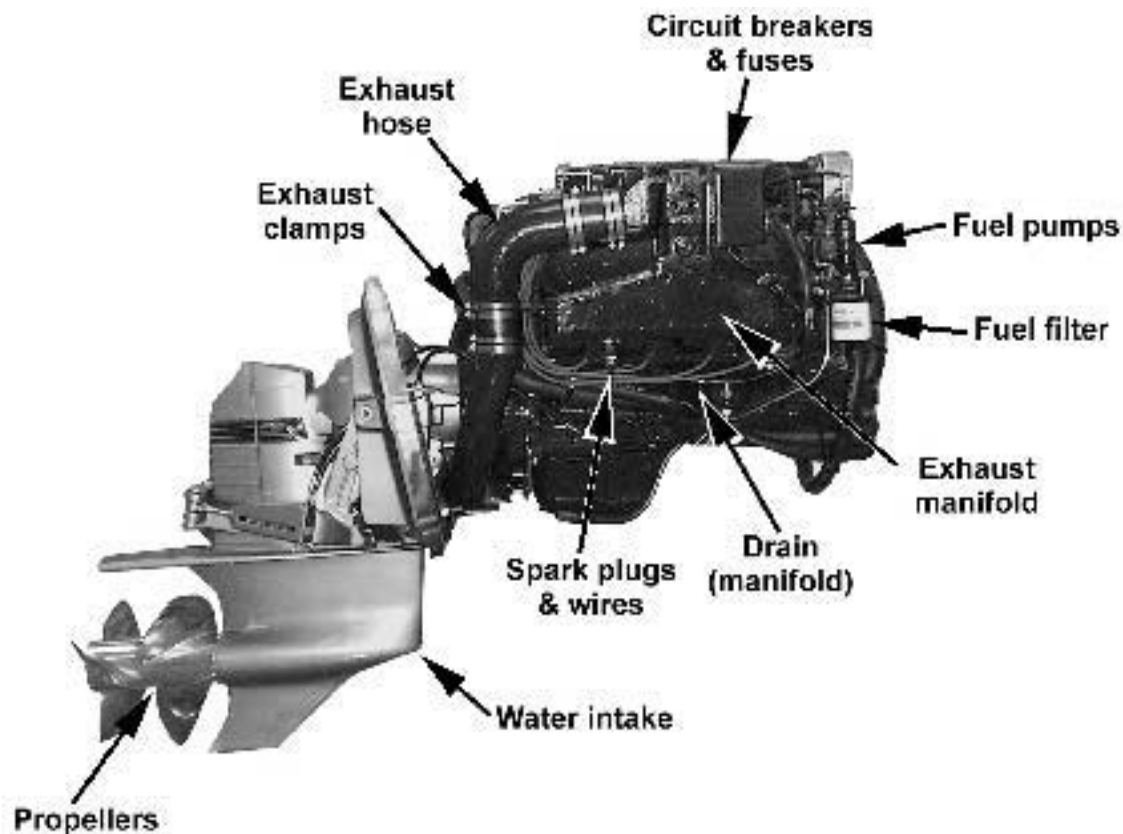
Fuses and circuit breakers
(starboard view)



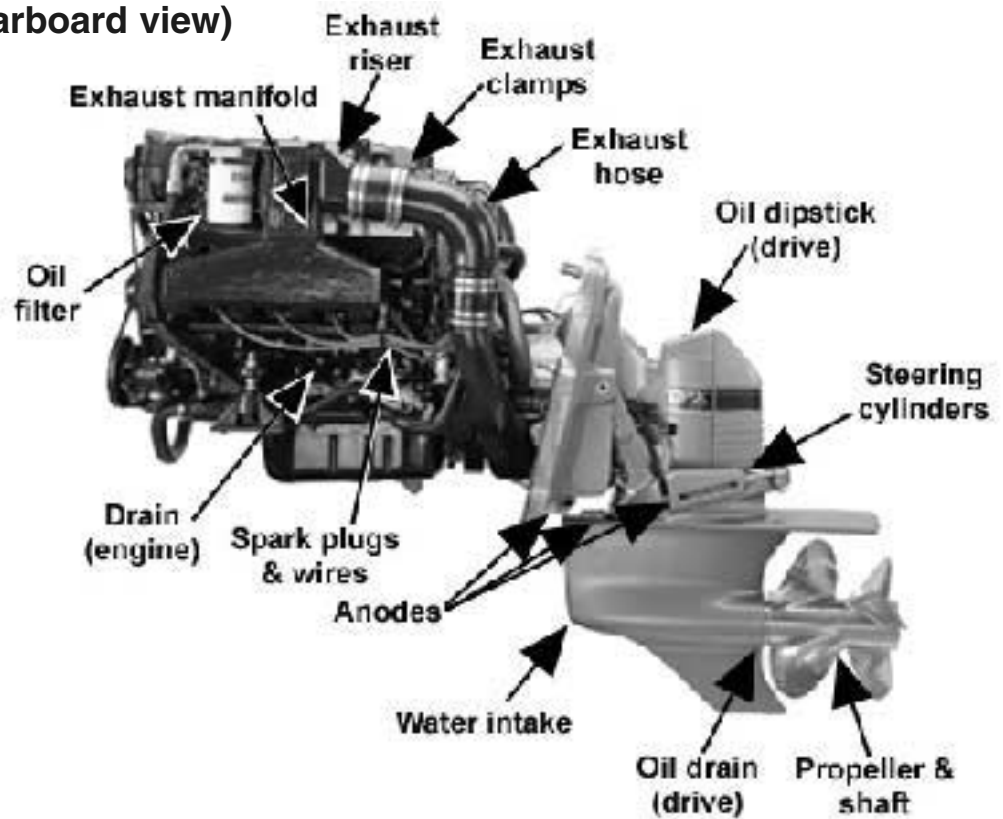
Fuses and circuit breakers
(port view)



DPX 385, 415 (front view)



DPX 385, 415 (starboard view)



DPX 385, 415 (port view)

Anodes (“sacrificial”)



Electrochemical corrosion of metal can cause very serious and expensive damage to drives, propellers, propeller shafts, rudders, keels, and other equipment fitted to your boat. To protect your investment, Volvo Penta sterndrive units are equipped with zinc anodes to provide protection against galvanic (electrochemical) corrosion. These anodes are “sacrificial,” or designed to erode away faster than the metal on the transom shield and sterndrive. (For sterndrives used only in fresh water a magnesium anode should be used.)

Use only genuine Volvo Penta zinc and magnesium anodes. Some aftermarket anodes may not meet mil-specs and are larger in size. Using aftermarket sterndrive anodes may cause cavitation bubbles due to poor fit, which may lead to propeller erosion. When you must replace the anodes, see your Volvo Penta dealer, since if additional electronic or electrical equipment is installed, each must have an individual anode or grounding device, and all grounding devices must be interconnected.

Note: If you have a stainless steel propeller, you may need additional sacrificial anodes or a Volvo Penta active corrosion protection system to handle the added corrosion potential. Your Volvo Penta dealer will help you to decide which is more appropriate for your boat.

Note: Boats that connect to an AC power source (shore power) will require protection against both galvanic and “stray current” corrosion. For the added protection needed, a galvanic isolator may be installed in the grounding, or green, wire between the boat and the shore power outlet on the dock. The isolator will block DC flow, but will permit the passage of AC flow. If you are connected to an AC power source that is not equipped with a galvanic isolator, you may need additional sacrificial anodes to handle the added corrosion potential.

Audible alarm

The audible alarm will alert you to unacceptable or dangerously low oil pressure and/or high water temperature levels.



The audible alarm is capable of producing a warning sound up to 120 decibels. Prolonged exposure to this audible alarm can cause hearing loss.

Engine systems

Important engine systems include the cooling system, fuel system, exhaust system, electrical system, lubrication system, and steering system.

Cooling system

The cooling system keeps the internal engine temperature below the boiling point of engine coolant. You will need to take care of these cooling system components:

1. Raw water pump and impeller
2. Belts (may also be involved with other engine systems)
3. Hoses and clamps

Fuel system

The fuel system stores fuel for the engine, pumps gasoline through the fuel lines to the carburetor or fuel injectors, and mixes fuel with air and sends the fuel-air mixture to the engine. You will need to take care of these fuel system components:

1. Fuel pump
2. Fuel filter
3. Fuel quality

Exhaust system

The exhaust system passes the exhaust gases from the burnt fuel-air mixture through exhaust hoses to and out the drive. You will need to take care of these exhaust system components:

1. Hoses and clamps
2. Exhaust manifold
3. Exhaust riser

Electrical system

The electrical system generates, stores, and regulates the flow of electricity needed to start the engine, fire the fuel-air mixture to run the engine, and operate any electrical accessories on your boat. You will need to take care of these electrical system components:

1. Battery and connections
2. Circuit breakers and fuses
3. Distributor cap and rotors
4. Spark plugs

Gi, GSi only

Your Volvo Penta engine features an Electronic Fuel Injection (EFI) system that uses a microprocessor (ECM) to control idle air flow, fuel, and ignition.

Note: The electronics in the ECM require protection from false signals and interference. Never mount radio transmitter antennas or sender cables near the ECM and never ground any wiring to the engine.

Lubrication system

The lubrication system circulates lubricants through your engine to keep moving parts moving freely and to reduce the friction that heats up your engine. You will need to take care of these lubrication system components:

1. Oil changes
2. Oil filter
3. Oil quality

Steering system

The steering system allows you to steer your boat in the direction you want to go. You will need to take care of these steering system components:

1. Remote control shift cable
2. Steering system cable
3. Power steering fluid

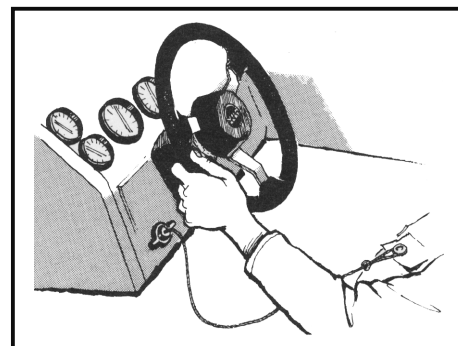
Drive components

Important drive components include the lubrication system, anodes, power trim/tilt, universal joint, and propellers.

Emergency stop switch

An emergency stop switch may be a feature of your Volvo Penta-powered boat. Volvo Penta highly recommends that you have an emergency stop switch installed in your boat. To properly use this feature, attach the lanyard securely to your clothing. **Do not attach the lanyard to clothing that will tear away before the lanyard is pulled from switch to stop the engine.** If the lanyard is too long, shorten the lanyard by knotting or looping it. **Do not cut and retie the lanyard.**

Using this switch is simple and should not interfere with normal operation of the boat. **Be very careful to avoid accidentally pulling the lanyard during normal operation: Unexpected loss of *FORWARD* motion will occur, and passengers could be thrown forward. Also, significant internal engine damage may occur.**



In an emergency situation, any occupant of the boat can restart the engine. Just press in and hold the emergency stop switch button, then follow normal starting procedures. When the button is released, the engine will stop.

WARNING

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

- The lanyard must always be free of entanglements that could hinder its operation.
- Once a month, check the switch for proper operation. With the engine running at idle in **NEUTRAL**, pull the lanyard. If the engine does not stop, have your Volvo Penta dealer repair your emergency stop switch.

Engine protection mode (EFI systems)

In a low oil pressure or engine overheat situation, the EFI system enters an engine protection mode. In these situations, normal engine operation is limited to 2500 RPM or less. Above 2500 RPM the engine will exhibit poor running characteristics. Use the oil pressure and water temperature gauges to verify a problem exists, then check the engine for proper oil level and the water inlets for obstructions. The low oil pressure/engine overheat problem must be corrected before the engine will return to normal operation.

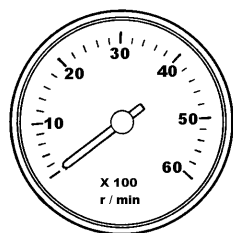
To reset the engine protection mode after the problem is corrected, shut off the engine, then restart it.

Note: If the problem continues, contact your nearest Volvo Penta dealer and have the engine checked.

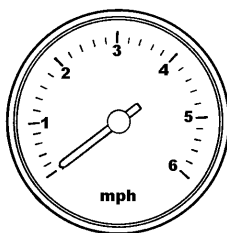
Instruments

Before operating your Volvo Penta product, familiarize yourself with the instruments supplied with your boat. (Some boats may not have Volvo Penta instruments. Read the boat's owner's manual to become familiar with the instruments used.)

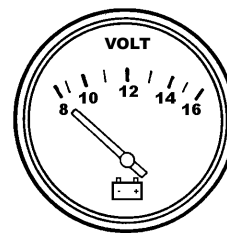
Engine instruments



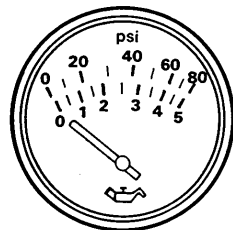
TACHOMETER –
Indicates engine revolutions per minute (RPM)



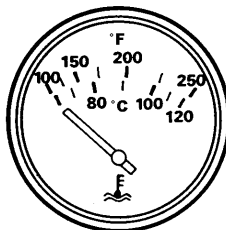
SPEEDOMETER –
Indicates boat speed in miles per hour (MPH)



VOLTMETER –
With ignition on, engine not running,
indicates battery voltage
With engine running, indicates alternator
voltage output



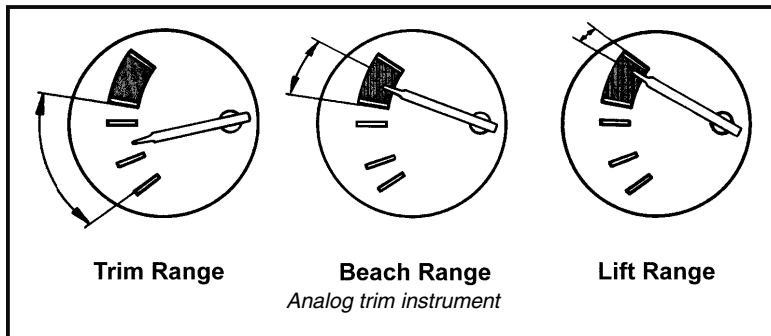
OIL PRESSURE GAUGE –
Indicates engine oil pressure



WATER TEMPERATURE GAUGE –
Indicates water temperature
in the engine's cooling system

Trim instruments

The trim instrument indicates the current trim position. Your boat may be equipped with an analog or a digital trim instrument, as shown. The SX drive has an analog trim instrument only. The DP-S drive may have either an analog or a digital trim instrument.



Analog trim instrument (SX, DP-S)

The analog trim instrument has three main ranges:

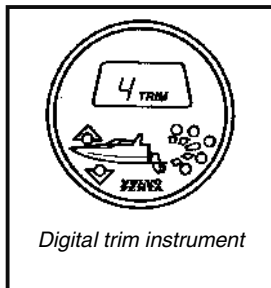
Trim range: Use trim range for maximum comfort, under normal operation, from start to maximum speed.

Beach range: Use beach range for operating at reduced speed in shallow water, where water depth is uncertain. Also use this range when you launch and take your boat out of water onto a trailer ramp.

Lift range: Use lift range for lifting the drive to its maximum angle; **however, this range cannot be used during boat operation.** Use this range when you are transporting your boat. The power trim has an automatic stop feature, which cuts off the current when the drive reaches **STOP**. (**STOP** is automatically reset when trimming down.)

⚠ CAUTION

Operating in beach range or lift range will cause significant loss of maneuverability. Operating in beach range above idle speed, or for prolonged periods of time, may cause serious drive damage.



Digital trim instrument (DP-S)

This instrument displays a figure (the angle of the drive to a stationary boat) within a range.

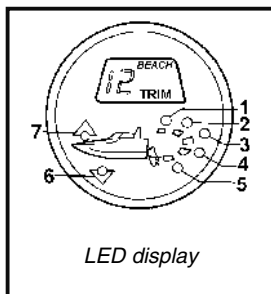
Trim range: Use trim range for maximum comfort, under normal operation, from start to maximum speed (maximum range up to 5).

Beach range: Use beach range for operating at reduced speed in shallow water, where water depth is uncertain. Also use this range when you launch and take your boat out of water onto a trailer ramp. Boat speed should always be low (range from 5 to 40).

Lift range: Flashing red warning light. Drive up completely (range from 41 to 51).

⚠ CAUTION

Operating in beach range or lift range will cause significant loss of maneuverability. Operating in beach range above idle speed, or for prolonged periods of time, may cause serious drive damage.



LED display: Certain LEDs display at certain times for the digital trim instrument:

- 1 — Flashes red within the range above 41.
- 2 — Constant red within the range of 6 to 40.
- 3 — Constant green within the range of 2 to 5.
- 4 — Constant green within the range of 0 to 2.
- 5 — Constant green in trimmed range up to 0.

- 6 — Constant yellow in maximum trimmed position up to 0; flashes yellow when above 0. (Drive moves, bow is lowered.)
7 — Constant yellow light within range of 2 to 5; flashes yellow when drive moves within trim range and bow is raised.

Trim/tilt motor protection

Always allow the trim/tilt switch to return to its center position when the drive unit reaches its maximum raised or lowered position. This precaution will prevent your trim/tilt motor from overheating.

Impact protection

The trim/tilt system provides impact protection for the drive unit. If an impact occurs, the drive will “kick up,” thereby helping to minimize drive damage. Impact damage, however, can occur in either *FORWARD* or *REVERSE* directions. You must be careful when

- You operate in *FORWARD* or *REVERSE*
- You are backing at low speeds
- You trailer your boat
- You launch your boat.

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

! CAUTION

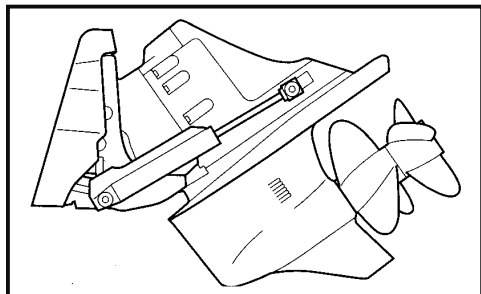
Always check your boat and engine for damage. Failure to inspect for damage may

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

When moving in *REVERSE*, there is no impact protection. Be very careful when moving in *REVERSE*. Do not exceed 2500 RPM.

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

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 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.

Propellers

Volvo Penta makes a complete line of propellers designed to match the performance of the SX, DP, and DPX sterndrives. For every combination of engine, sterndrive, hull, and application there is a Volvo Penta propeller that provides optimum performance.

Many factors influence the way a propeller performs, including hull shape, onboard weight, engine horsepower, power trim, and the way the boat is used. Ask your Volvo Penta dealer to assist you in choosing a propeller that is right for your needs.

SX sterndrive propeller choices

1. Aluminum propellers

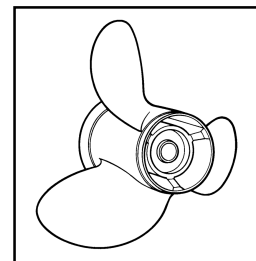
Volvo Penta's aluminum propellers are die-cast and dynamically balanced. Die cast propeller blades are thinner than sand-cast blades, which means less cavitation, greater efficiency, and longer service life. All aluminum propellers are given added protection against salt water with a special baked-on corrosion resistant paint.

2. Stainless steel propellers

SX stainless steel propellers will maximize the performance of SX-powered boats. The blade configuration and through-hub exhaust design of this propeller are important factors in the propeller's overall efficiency and performance. This is a fast planing propeller designed to give your boat better acceleration and top end speed. The blade design has a longer tip and larger diameter, which creates a better "grip" on the water.

3. High performance stainless steel propellers

This propeller has custom-cupped, high rake blades to provide better bow lift and make boats plane quick and run fast — a terrific choice for high performance boats.



Duoprop® sterndrive propeller choices

The propellers for the Duoprop drive units have application and diameter/pitch identification symbols: D0-D9, E2-E5, and F2-F9. The single number represents the diameter/pitch. The identification symbol and the front and rear identification are stamped on the end of the propeller hubs. When replacement is required, you may purchase the propellers individually, but you must make sure they are the same size and same shaft (e.g., F7 front and rear). Do not mix or split sets.

1. "D" series aluminum propellers

Volvo Penta's aluminum propellers are manufactured with a special aluminum alloy that is highly resistant to the stress and effects of salt water. The unique design of the Duoprop, with its two counter rotating propellers, is very important in achieving optimum performance.

Note: D5, D6, and D7 propellers are recommended for speeds below 40 MPH. For installations where "D" series propellers are not recommended, "F" series stainless steel propellers should be used.

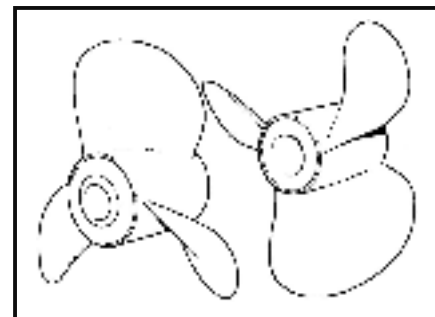
2. "F" series stainless steel propellers

A stainless steel Duoprop set is a very worthwhile upgrade from aluminum. They offer high performance through thinner blades, powerful thrust, and virtually cavitation-free running; and greater torsion strength for higher acceleration.

DPX sterndrive propeller choices

1. "E" series stainless steel propellers

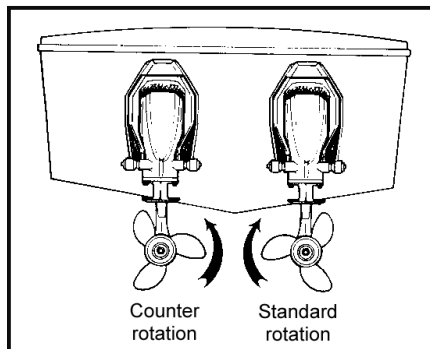
High Performance DPX Duoprop propellers offer excellent, high speed performance with the precise handling and efficiency that has made the Duoprop famous.



Drive unit, rotation, and propellers

SX drive unit

Your boat may be equipped with a single engine or twin engines. Propeller rotation is as viewed from the rear of the boat facing forward.



Single engine installation

All single engine installations are set up for right-hand rotation (standard rotation) and use right-hand propellers.

Twin engine installation

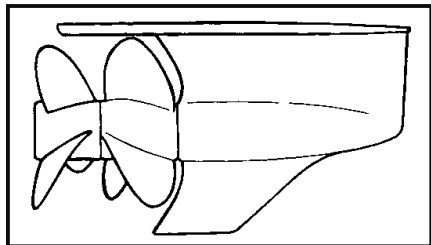
Your Volvo Penta drive unit can be set up to rotate in either direction. The propeller, propeller shaft, and vertical drive shaft are the only parts that counter-rotate. The engine always has standard rotation.

Twin engine installations should have the port drive unit set up for left-hand rotation (counter-rotation) and the starboard drive unit set up for right-hand rotation (standard rotation).

⚠ CAUTION

Some boat manufacturers may set up twin drive units so that the port drive unit set up for right-hand rotation (standard rotation) and the starboard drive unit set up for left-hand rotation (counter-rotation). If you remove the propellers and/or drive units, be very careful to attach the shift link in the same eccentric position it was in when you removed it, and make sure that the propellers are not switched.

Duoprop® drive unit

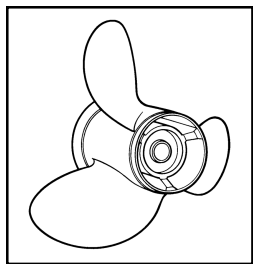


Duoprop drive units have counter-rotating propellers; it is not necessary to change drive unit rotation. The propellers operate in sets:

- The forward propeller is left-hand and rotates counter-clockwise.
- The rear propeller is right-hand and rotates clockwise.

Propellers are installed in sets. You may purchase the propellers individually, but make sure they are the same size and shaft (e.g., F7 front and rear). Do not mix or split sets.

Propeller rotation



Right-hand propellers rotate clockwise to propel a boat forward. They are considered to be **standard rotation** propellers. A drive unit set up for standard rotation must be equipped with a standard rotation propeller. (Propeller rotation is as viewed from the rear of the boat looking forward.)

Left-hand propellers rotate counterclockwise to propel a boat forward. They are considered to be **counter-rotation** propellers. A drive unit set up for counter rotation must be equipped with a counter-rotation propeller. (Propeller rotation is as viewed from the rear of the boat looking forward.)

Note: Duoprop and DPX drive units have counter-rotating propellers. See above for a more detailed description.

⚠ CAUTION

Never exchange a right-hand propeller with a left-hand propeller. This would result in your boat being propelled in reverse when the engine is operating in forward gear, and forward when the engine is operating in reverse gear.

Whenever you have the propellers serviced, shift into *FORWARD* or *REVERSE* at idle speed and determine if the boat moves in the direction indicated by the position of the control handle. If the boat moves opposite to the direction indicated by the control handle, the propellers are switched.

Your Volvo Penta sterndrive is equipped with a propeller designed to give top performance and maximum economy under all operating conditions. To obtain peak performance, the engine RPM at full throttle must fall in the specified operating range at normal load conditions at favorable/best trim settings (trim set to provide the most speed with the smoothest ride).

Engine	Full Throttle Operating Range	Engine	Full Throttle Operating Range
3.0 GS	4200 - 4600 RPM	5.7 GS	4400 - 4800 RPM
4.3 GL/GS/Gi	4200 - 4600 RPM	5.7 Gsi	4600 - 5000 RPM
5.0 GL	4400 - 4800 RPM	7.4 Gi	4200 - 4600 RPM
5.0 Gi	4600 - 5000 RPM	7.4 Gsi	4800 - 5200 RPM

- If full throttle RPM is **below** the recommended operating range, propeller(s) with **lower** pitch should be used.
- If full throttle RPM is **above** the recommended operating range, propeller(s) with **higher** pitch should be used.

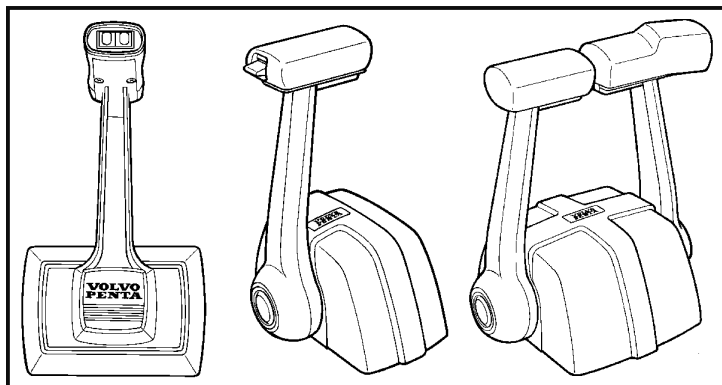
To provide your boat with the best engine life, fuel economy, and performance, select the correct propeller to allow the engine to run at full throttle in the recommended operating range. Your Volvo Penta dealer will help you to choose the correct propeller(s) for your application.

⚠ CAUTION

Replace a damaged propeller right away. Operate your boat with extreme caution if a propeller is damaged while you are boating.

Do not operate a DP model with only one propeller, as this will cause damage to propeller shafts.

Remote controls



Note: Some boats may not be equipped with Volvo Penta remote controls. If you do not have Volvo Penta controls, their operation and function may differ from Volvo Penta controls.

Volvo Penta controls have these important features:

- A single lever, which allows you to select *FORWARD* or *REVERSE*, regulate engine speed, and ensure shifting is done at low engine speed.
- A start-in-*NEUTRAL*-only feature to prevent you from starting your drive in gear.
- Concealed side mount controls have a *NEUTRAL* lock button to prevent accidental shifting. It must be squeezed to permit shifting from *NEUTRAL* to *FORWARD* or *REVERSE*. The binnacle mount controls do not have a *NEUTRAL* lock, but do have a *NEUTRAL* detent.

TRAL lock button to prevent accidental shifting. It must be squeezed to permit shifting from *NEUTRAL* to *FORWARD* or *REVERSE*. The binnacle mount controls do not have a *NEUTRAL* lock, but do have a *NEUTRAL* detent.

⚠ CAUTION

Your boat should be equipped by the manufacturer with a remote control with protection to prevent starting in gear. Use only a remote control unit with start-in-neutral-only feature. This feature can prevent injury resulting from the propeller turning unexpectedly, or the boat moving suddenly.

The shift mechanism on all Volvo Penta controls can be disengaged to allow for easier starting and engine warm-up.

Trim controls

Trimming (raising and lowering the drive) can be performed by using

- A separate control panel on the instrument panel
- A control button on the control lever
- The control buttons on the port control lever in a twin installation

The current trim position is indicated on a special trim gauge.

Operating trim controls

Control panel

The control panel has three buttons:

- The center button moves the drive trim out while it raises the boat's bow.
- The lower button moves the drive trim in while it lowers the boat's bow.
- The top button disconnects a "catch" so that the drive can be trimmed into the *BEACH* position. (Press this button and the center button at the same time.)

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 it raises the boat's bow
- Pressing the bottom half of the button moves the drive trim in while it lowers the boat's bow.

You must press a separate switch on the instrument panel to disconnect the "catch" so that the drive can be trimmed into the *BEACH* position.

Control lever with catch button (single installation)

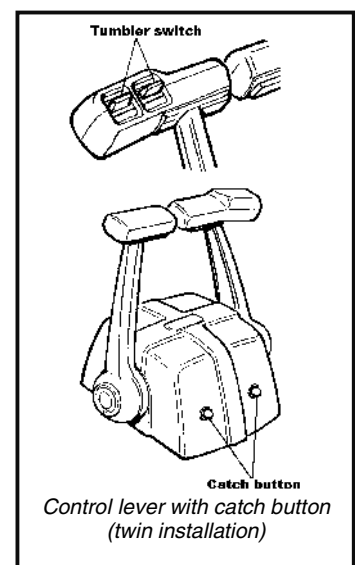
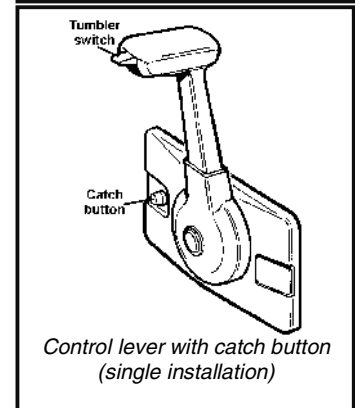
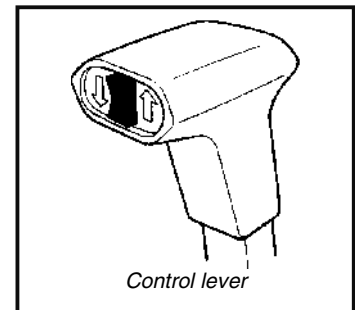
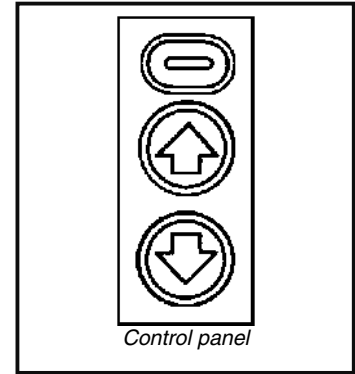
A tumbler switch on the control lever allows you to trim the drive:

- Pressing the tumbler switch up moves the drive trim out while it raises the boat's bow.
- Pressing the tumbler switch down moves the drive trim in while it lowers the boat's bow.
- The catch button disconnects a "catch" so that the drive can be trimmed into the *BEACH* position.

Control lever with catch button (twin installation)

There are two tumbler switches on the port control lever, which gives you the capability of individual adjustment of the drive trim.

- Pressing the switches up moves the drive trim out while it raises the boat's bow.
- Pressing the tumbler switches down moves the drive trim in while it lowers the



boat's bow.

- The catch buttons disconnect a “catch” so that the drive can be trimmed into the *BEACH* position.

Remote diagnostic uplink system

Your boat may be equipped with a diagnostic uplink system, which allows you to use a cellular phone to access remote communication with Volvo Action Service, a 24-hour per day customer assistance service. Your diagnostic uplink system consists of

- a cell phone handset
- a remote access panel

Setting up the diagnostic uplink system cell phone

You will hook up your cell phone to the box identified as the *Remote Diagnostics Cellular Link*:

1. Make sure the auxiliary switch powering the system is *OFF*.
2. Lift up the cover on the cellular link box.
3. Plug in the handset.
4. Turn the auxiliary switch *ON*.
5. The phone will power up as a standard cellular phone.

6. Check the access panel indicator to see the operational state, **WHICH SHOULD BE SOLID FOR NORMAL OPERATION.**

- **Solid:** Voice mode. Means that phone is operational, and system is up and running. In voice mode, you may use your cell phone as a regular telephone, or use it only as an emergency phone to access the remote diagnostic uplink capability.
- **Fast flash:** Data mode. Means that you may use your phone to send a fax via your laptop computer.
- **Slow flash:** Phone problems. Check your phone user manual for more detailed instructions.

Using the remote diagnostic uplink system

If you find that you are having a problem that requires technical assistance:

1. Call Volvo Action Service toll-free at 1-877-337-3682, then press the *SEND* button.
2. The VAS coordinator will assist you.
3. Go to data mode:
 - Press the *VOICE/DATA* button on the bulkhead panel.
 - Press the *END* button on the cell phone handset.
 - When data transfer begins, the bulkhead panel light will flash rapidly. (This may take a few seconds for the modems to establish connections.)
4. The bulkhead panel light will return to a steady *ON* condition to signal you to return to *VOICE* mode.
5. Return to voice mode:
 - Press the *SEND* button on the cell phone handset.
 - Press the *VOICE/DATA* button on the bulkhead panel after the voice/data light returns to a steady *ON* condition.
6. The VAS coordinator will discuss his findings and advise you on how to proceed.
7. Press the *END* button to terminate the phone call on the cell phone handset.
8. Switch off auxiliary power to the diagnostic uplink system.
9. Disconnect the cell phone from the bulkhead panel.

IMPORTANT

Before you operate your cell phone for the first time, you must register the phone with a cellular phone service provider. You will need to provide this information, also found on the product label on the phone itself:

- *Phone manufacturer* – Motorola
- *Phone model* – S-5690
- *Serial number* – unique to each phone

OPERATION

Engine break-in period

Note: To ensure proper lubrication during the break-in period, do not remove factory break-in oil until after the 20-hour break-in is completed. The First Service inspection should be carried out after 20 hours of operation.

CAUTION

Failure to follow engine break-in procedures can result in serious engine damage.

Never run an engine at a constant engine speed for long periods during the break-in period.

Do not run engine at a constant RPM for prolonged periods of time during the break-in period.

All Volvo Penta engines have been run for a short time during a final test at the factory. You must follow the engine break-in procedure during the first 20 hours of operation to ensure maximum performance and longest engine life.

During the break-in period, watch out for the following items during the initial engine run:

1. **Check engine oil level frequently.**

IMPORTANT

Be sure to check the oil level frequently during the first 50 hours of operation, since the oil consumption will be high until the piston rings are properly seated.

The engine may use more engine oil during the running-in period than would otherwise be normal. Check the oil level regularly and more frequently during the running-in period.

- Maintain oil level in the safe range, between the *ADD* and *FULL* marks on dipstick. Somewhat higher oil consumption is normal until the piston rings have seated.
- If you have a problem getting a good oil level reading on the dipstick, rotate the dipstick 180° in the dipstick tube.
- When adding engine oil, use Volvo Penta engine oils for gasoline engines, or a good quality oil (API Service CE/SG or better) of the same viscosity that meets General Motors Specification GM-6094-M. Use the following chart to select the SAE viscosity that matches the temperature range in which you expect to operate.

SAE Viscosity Chart

Lowest Anticipated Temperature	Recommended SAE Viscosity Oils
32° F (0° C) – above	SAE 30* SAE 20W/50 SAE 15W/50
0° F (-18° C) – 32° F (0° C)	SAE 20W-20
Below 0° F (-18° C)	SAE 10W

*SAE 30 Volvo Penta DuraPlus Synthetic Motor Oil (P/N 3851230-7) (U.S. and Canada Only)

- **Note:** To ensure proper lubrication during the break-in period, do not remove factory break-in oil until after the 20-hour break-in is completed.

2. Watch the oil pressure gauge.

- Oil pressure will rise as RPM increases, and fall as RPM decreases. In addition, cold oil will generally show higher oil pressure for any specific RPM than hot oil. Both of these conditions reflect normal engine operation.
- If the oil indicator fluctuates when the boat is turning, climbing on plane, etc., the oil pickup screen may not be covered with oil. Check the oil dipstick. If required add oil, but do not overfill. If the oil level is correct and the condition persists, ask your Volvo Penta dealer to check for possible gauge or oil pump malfunction.

3. Watch the engine temperature indicator to be sure there is proper water circulation.

IMPORTANT

Failure to follow the break-in procedure may void the engine warranty.

First two hours

1. For the **first five to ten minutes** of operation, operate the engine at a fast idle (above 1500 RPM).
2. During the **remaining first two hours** of operation, accelerate to bring the boat onto plane quickly; bring the throttle back to maintain a planing attitude.

During this period, vary the engine speed frequently by accelerating to approximately $\frac{3}{4}$ throttle for two to three minutes, then back to minimum cruising speed.

3. After the engine has reached operating temperature, momentarily reduce engine speed, then increase engine speed, to assist break-in of rings and bearings. Maintain plane to avoid excessive engine load.

IMPORTANT

For this initial two hour break-in, do not run the engine at any constant RPM for prolonged periods of time.

Next eight hours

1. During the next eight hours, continue to operate at approximately $\frac{3}{4}$ throttle or less (minimum cruising speed). Occasionally reduce throttle to idle speed for a cooling period.
2. During this eight hours of operation you may operate at full throttle for periods of less than two minutes.

Final ten hours

1. During the final ten hours of break-in, you may operate at full throttle for five to ten minutes at a time.
2. After warming the engine to operating temperature, momentarily increase engine speed.
3. Occasionally reduce engine speed to idle to provide cooling periods.

At the end of the 20 hour break-in period, drain the engine oil and replace the oil filter. Fill the crankcase with Volvo Penta's DuraPlus™ premium engine oil labeled for Service CE/SG.

First service inspection (Dealer 20-hour check)

To ensure your continued boating enjoyment, we recommend that you return your Volvo Penta product to your Volvo Penta dealer for a 20-hour check. This 20-hour check will prevent a minor problem from getting worse, and helps ensure a trouble-free boating season. When following the Volvo Penta guidelines, your dealer will service these items:

Start the engine and check that

- No leakage of fuel, oil, water, or exhaust gases occurs.
- Engine oil pressure and temperature are normal.
- All cables and controls operate correctly.
- All gauges, instruments, and alarms operate correctly.
- Steering system operates correctly.

- Engine ignition timing and idle RPM are within specifications.
- Power trim system operates correctly.

Stop the engine and

- Change engine oil and oil filter.
- Change fuel/water separator filter.
- Clean seawater strainer (if equipped).
- Check fluid levels and fluid condition in sterndrive or inboard transmission, power steering pump, and trim pump.
- Check propeller(s) and propeller(s) fasteners.
- Check condition of battery and battery cable connections.
- Check drive belt(s) tension and condition.
- Lubricate all grease fittings and linkages following service recommendations.
- Check tightness of all water, fuel, and exhaust clamps, fittings, and drain plugs.

Restart the engine and recheck that

- No leakage of fuel, oil, water, or exhaust gases occurs.
- Engine oil pressure and temperature are normal.

This is a perfect time to discuss with your Volvo Penta dealer any questions about your engine that may have arisen during the first 20 hours of operation and establish a routine preventive maintenance schedule.

In the US, Canada, and Mexico, the 20-hour check is paid for by the boat owner and performed by your Volvo Penta dealer at local rates. In other markets, warranty inspection is paid for according to the warranty policy for Importers.

Operating after break-in period

After the break-in period, the engine can be operated at any RPM from idle to full throttle. Cruising at 3600 RPM or less, however, saves fuel, reduces noise, and prolongs engine life.

Before starting

Note: Do not start the engine out of the water unless you have an optional flushing adapter. Follow the adapter manufacturer's instructions for attaching and running the engine out of water.

Familiarize yourself with the operation of the remote control supplied with your boat, then proceed as follows.



To prevent a possible explosion, operate the blower as recommended by the boat manufacturer before starting the engine. If the engine compartment is not equipped with a blower, open the engine cover or hatch before starting to disperse any gasoline fumes that may be present. Leave the hatch open until after the engine is running.

1. Start the boat's bilge blower and run for at least four (4) minutes. Frequently check boat's bilge area for gasoline fumes.
2. Check the bilge for excessive water accumulation. Always keep the bilge clean and dry.



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.

3. Open the fuel cock (if so equipped).
4. Make sure that there are no fuel, engine coolant, or oil leaks.
5. Check engine oil level.

6. Switch on the main switches (if so equipped).
7. Insert the key into the ignition switch. Turn the key one step to the right to switch on engine system voltage and instrumentation.
8. Make sure that you have enough gasoline.
9. Lower the drive unit; make sure the water intakes are submerged. (There should be no obstructions in the water near the propellers.)

Starting the engine, cold start _____

GL, GS models:

A cold engine may require priming before you can start it:

1. Turn the ignition switch *OFF*.
2. Disengage the shift mechanism.
3. Move the remote control handle to *FULL THROTTLE* (this operates the accelerator pump and primes the engine).
4. Repeat priming if necessary.
5. Return the remote control handle to *FAST IDLE*.
6. Turn the ignition switch to *START* and hold it there until the engine starts, but for no longer than 10 seconds.

Note: Too much priming may flood the engine.

Gi, GSi models:

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

If the engine floods

GL, GS models:

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

Gi, GSi models: Advance the control handle to $\frac{3}{4}$ throttle to clear a flooded engine. In this throttle position, with the engine speed below 400 RPM (cranking speed), the ECM turns off the fuel injectors so no fuel is delivered. When the throttle position is moved to full throttle or less than $\frac{3}{4}$ throttle, the ECM returns to the starting mode.

Be prepared to quickly move the control handle to *IDLE* once the engine starts. This will avoid speeding and possibly damaging the engine.



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

If you do not move the remote control handle to **IDLE** as soon as the engine starts, the engine will overspeed and could be damaged.

When you start your engine for the first time after off-season storage, always run the engine in **IDLE** for one minute to allow the water pump to prime.

Starting the engine (warm start) _____

1. Move the control handle to the *NEUTRAL* detent position.
2. Turn the key switch to *START* and hold until the engine starts, but for no longer than 10 seconds. If the engine does not start, let go momentarily, then try again.
3. As soon as the engine starts, release the key to *ON* or *RUN*.



Never leave the key in the *ON* position with the engine not running. This could damage the engine. Never turn the key to *START* when the engine is running. This could damage the engine.

If the engine floods:

GL, GS models:

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

Gi, GSi models: Advance the control handle to $\frac{3}{4}$ throttle to clear a flooded engine. In this throttle position, with the engine speed below 400 RPM (cranking speed), the ECM turns off the fuel injectors so no fuel is delivered. When the throttle position is moved to full throttle or less than $\frac{3}{4}$ throttle, the ECM returns to the starting mode.

Be prepared to quickly move the control handle to *IDLE* once the engine starts. This will avoid speeding and possibly damaging the engine.



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

Stopping the engine _____

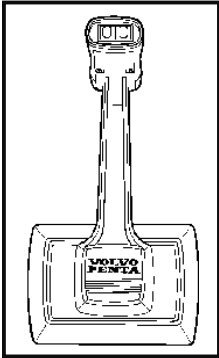
1. Move the remote control handle to *NEUTRAL*.
2. Turn ignition key to *OFF*.



Do not stop the engine at speeds above idle or “speed up” the engine while turning off the ignition. Engine damage could result.

Operating remote controls

Familiarize yourself with remote control operations before starting the engine.

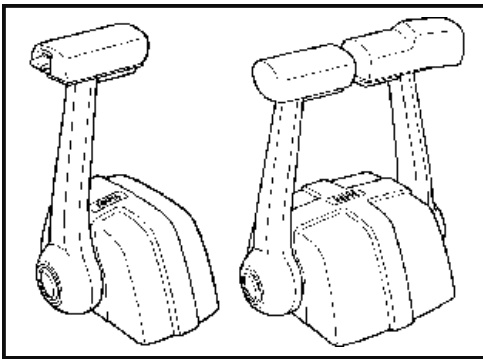


Side mount control

To disengage the shift mechanism:

1. Place the control handle in *NEUTRAL*.
2. Press both *NEUTRAL* lock button and the *SHIFT DISENGAGE* button.
3. Move control handle *FORWARD* to increase throttle.

The *NEUTRAL* lock and shift mechanism will automatically engage when the control handle is returned to *NEUTRAL*.



Top mount control

To disengage the shift mechanism:

1. Push in and hold shift disengagement button.
2. Move control handle *FORWARD* to increase throttle.

The shift mechanism will automatically engage when the control handle is returned to *NEUTRAL*.

Steering system operation

The steering system for your Volvo Penta sterndrive is operated by a steering cable connected to the helm. Restricting movement of the steering cable will limit or stop the steering system's hydraulic assist.

Do not interfere with or restrict steering cable movement through the last 90° of bend at the engine. Do not use cable retainers, clamps or tie straps. Using one or all of these could restrict the cable movement near the engine. Do not tie wiring harnesses or other control cables to the steering cable. Make sure deck combing and bulkheads allow for steering cable movement.

If the power steering system stops working, 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. 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.

Note: 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.

Some twin engine boats may have both engine power steering systems coupled together with a priority valve. This allows the use of either engine to provide power assist steering.

Power trim and tilt operation

Power trim operation

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.

To operate the trim, push and hold the switch “bow-up” or “bow-down” until the desired bow position is reached. The trim may be operated at any boat speed or at rest. Avoid operating the trim system when running in reverse. Observe the trim/tilt gauge, which indicates the bow position achieved. The upper scale (0 to 5) of the trim gauge indicates the “bow-up” positions, and lower scale (6 to 10) of the trim gauge indicates the “bow-down” positions.

Determining the proper trim

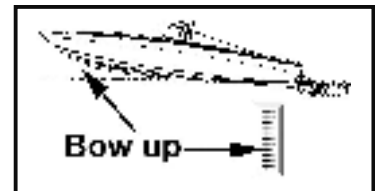
The effect of the maximum “bow-up” and “bow-down” positions will be similar for most boats. The bow position best for your operating conditions could be at any trim setting between the maximum “bow-up” and “bow-down” positions.

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. Read the following paragraphs under *Operating in “Bow-Up” Position* and *Operating in “Bow Down” Position*.

Operating in “bow-up” position

The “bow-up” 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.

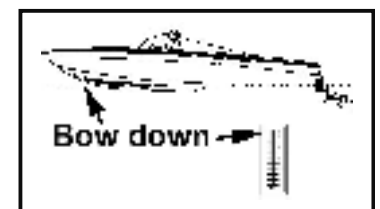


! WARNING

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.

Operating in “bow-down” position

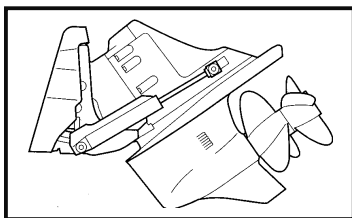
The “bow-down” position is normally used for acceleration onto plane, operating at slow planing speeds, and running against a choppy wave condition. In the fully “bow-down” position the boat may tend to self-steer. You may have to compensate with the steering wheel to keep the boat in a straight-ahead 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. The boat may tend to bow steer or spin about rapidly and possibly eject occupants.



! CAUTION

The boat trim should be adjusted to provide balanced steering as soon as possible each time you get underway. Some boat/motor/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.

Power tilt operation



Tilting is normally used for raising the drive unit to obtain clearance when beaching, launching from a trailer, or mooring. When tilting the drive unit, the boat should be at rest or at idle speed only.

The trim/tilt switch controls the tilting feature of the drive unit. When the trim/tilt switch is held in the “bow-up” position, the drive unit tilts up until the switch is released or the drive unit reaches the maximum tilt position. The trim/tilt gauge will indicate the “tilt” position whenever the drive unit is in the tilt range.

! CAUTION

Never exceed 1000 RPM when operating the drive unit in the tilted position, because it may damage the drive system. Never run the engine when the drive unit is tilted more than 30° or the drive will be damaged.

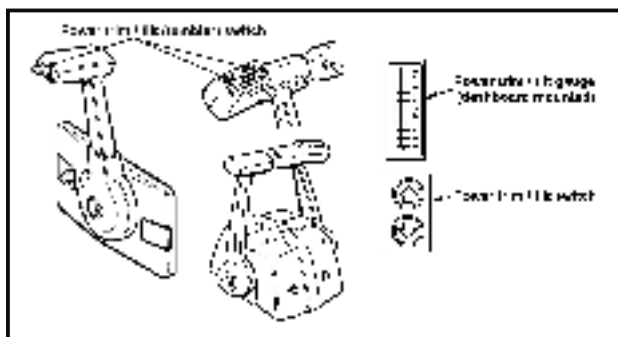
Never operate the drive unit out of water without a flushing kit attached. The water pump may be damaged or engine may overheat.

! WARNING

To avoid possible contact with the propeller, never use the drive unit as a ladder or as a lift to board the boat. Never board at the rear of the boat when the engine is running, even if the engine is operating in neutral. Personal injury could result from contact with rotating engine parts and propeller.

Any malfunction of the trim/tilt system could result in a loss of impact protection. Malfunction can also result in loss of reverse thrust capability. If malfunction occurs, see your authorized Volvo Penta dealer.

Power trim/tilt switch operation



Trimming and tilting the drive is done from a control switch mounted on the remote control or by using the switches on the dash. When using the dash mounted switches, the bottom button lowers the bow and the button n raises the bow. The switch on the remote control lever raises and lowers the drive when its upper or lower segment is pressed.

Note: Allow the trim/tilt switch to return to its center position when the drive unit reaches the maximum raised or lowered position. This will prevent your trim/tilt motor from overheating.

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 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 in-line 5-amp fuse in the remote control handle, or the 50-amp circuit breaker on the engine.

Power trim/tilt switch and gauge location

The power trim/tilt switch is located on the remote control handle or on the boat's dashboard. The trim indicator displays the drive position in the *Trim* range. With dual installations, it is permissible to individually trim the drive in *Trim* range. When the drive is in *Beach* range, 7 to 10, boat speed must be lower than planing speed. The engine must be stopped when fully tilted.

CAUTION

For twin installations, if the drives need to be trimmed or tilted, both drives must be moved at the same time (i.e., parallel) to prevent unnecessary stress on the tie rod between the drives. When trimming/tilting in parallel, both drives must be trimmed to their full forward position first. Start trimming/tilting from this position.

Note: There is no automatic stop function between the *Trim* range and *Beach* range. Check the trim indicator carefully during trim operation.

Shifting and controlling speed

IMPORTANT

Carefully check the function of all control and engine systems before leaving the dock.

1. Move the remote control handle to the *NEUTRAL* detent (idle) position. This will engage *NEUTRAL START* switch and allow engine to start. Check in front and behind boat for people or obstructions before shifting.
2. **Do not shift if engine speed is above 800 RPM.**
3. To go *FORWARD* - Actuate the *NEUTRAL* lock mechanism and move the shift handle forward. Throttle movement will begin after the *FORWARD* gear engages.
4. To go in *REVERSE* - Actuate the *NEUTRAL* lock mechanism and move the shift handle rearward. Throttle movement will begin after the *REVERSE* gear engages.
5. To go from *FORWARD* to *REVERSE*, or *REVERSE* to *FORWARD*, always pause at *NEUTRAL* and allow engine speed to return to idle. **Do not shift from *FORWARD* to *REVERSE* when the boat is planing.**
6. After shifting is completed, continue to move the control handle slowly in the desired direction to increase speed.

CAUTION

Any time you operate your boat, 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 this occurs, take the following precautions:

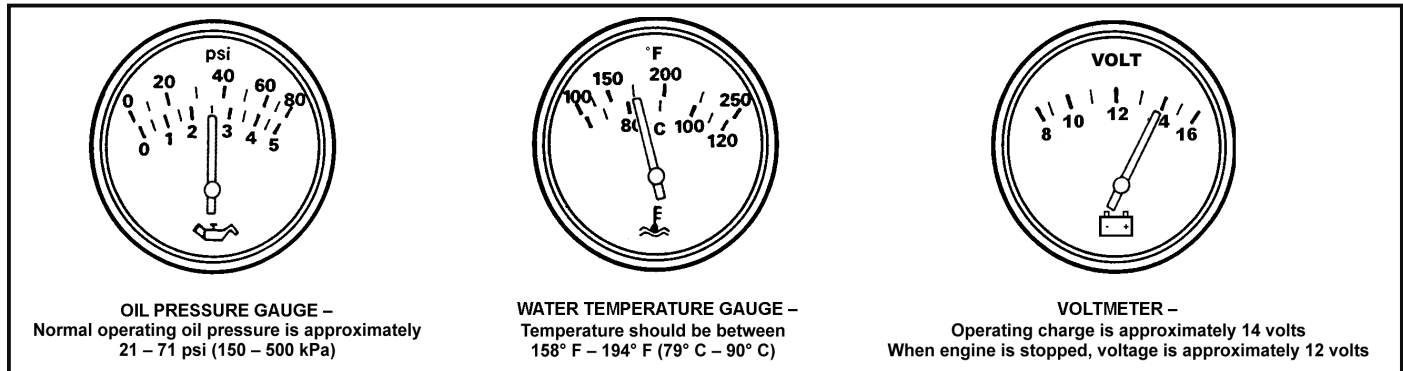
- With the engine running and the boat securely tied to the dock, shift the reverse gear into *FORWARD* and *REVERSE* to make sure there is gear engagement. Do not exceed idle RPM.
- Whenever you dock your boat, perform all docking maneuvers at slow speed. Pay special attention to other boaters. Inform passengers of potential problems and take all precautions necessary to ensure their safety.

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.

Checking instruments

Check your instruments often. Stop the boat engine if you have an abnormal reading or if your audible alarm sounds.

Normal readings are shown below.



Special boating circumstances

Engine protection mode operation (fuel injection systems)

In a low oil pressure or engine overheat situation, the EFI system enters an Engine Protection Mode. When this mode is entered, normal engine operation is limited to 2500 RPM or less. Above 2500 RPM the engine will exhibit poor running characteristics. Use the oil pressure and water temperature gauges to verify a problem exists, then check the engine crankcase for proper oil level and the water inlets for obstructions. The low oil pressure/engine overheat problem must be corrected before the engine will return to normal operation. To leave the Engine Protection Mode after the problem is corrected, turn engine off then *START* again.

Note: If the problem continues, contact your nearest Volvo Penta dealer and have the engine checked.

Shallow water operation

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

⚠ CAUTION

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.

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

When operating in shallow water, be sure the water intakes located in the lower gear unit are submerged at all times. Proceed at slow speed and lower drive unit immediately when deeper water is reached.

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.

Volvo Penta carbureted engines may require mechanical modifications. See your Volvo Penta dealer for more information.

Operating procedure for freezing temperatures

When freezing temperatures are forecast and the boat will be operated and left in the water, the drive unit must remain in the tilted down (submerged) position at all times to prevent water in the drive unit from freezing. Upon completion of engine operation, drain the engine as described in the *Maintenance* section.

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 it in polluted or salt water. This will prolong the service life of the manifolds and risers. Contact your authorized Volvo Penta dealer for an engine flushing kit that allows you to flush out the engine whether it is in or out of the water.

If your boat is moored for long periods of time, tilt the drive unit out of the water. After you remove your boat from the water, lower the drive unit to the *RUN* (down) position until the cooling system drains thoroughly.

Rinse the entire drive exterior with fresh water, then dry it and spray it with anti-corrosion spray.

Twin unit operation

When leaving or approaching the dock, or for any close maneuvering at slow speed, place the starboard engine in *NEUTRAL*, on standby, and use the port engine with the control nearest the operator. The use of one control is very effective and more convenient.

In the event that the port engine being used for maneuvering stops, you can immediately go to the starboard engine which has been on standby.



If maneuvering with an engine that has the power steering pump which stops, the power steering assist is lost. Failure to follow the above maneuvering procedure could result in a collision and personal injury.

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 the boat while operating on a single engine. The propellers are selected for the boat to operate optimally with twin engines. Operating with a single engine could cause engine damage.

Trailer your boat

Before moving your boat, check the ground clearance of the drive unit. When trailering, the drive unit may be in the up or down position. There must be at least 15 inches' (38.1 cm) clearance between the lower gear unit and the ground. If the clearance is less than 15 inches (38.1 cm), raise the drive unit.

Note: Be very careful when you back out of driveways or cross railroad tracks, so that the lower gear unit does not hit the ground.

Make sure that the boat fits the trailer properly. In many cases, loss of performance and speed is due to improper trailer support and too much tie-down pressure, which causes the boat bottom to deform. The boat should rest firmly on the trailer with maximum tie-down pressure applied at the bow and transom only.

Propeller selection

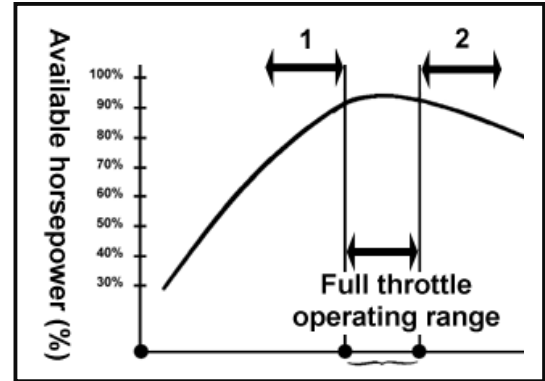
Your Volvo Penta dealer has chosen a propeller designed to deliver top performance and economy under most conditions. To obtain the maximum percentage of available horsepower, the engine RPM at full throttle should be in the specified full throttle operating range. Refer to *Specifications* on pages 95 through 100 for full throttle RPM range.

Propellers that allow full throttle operation at the upper end of the RPM range provide faster planing time for water skiing or similar activities. Propellers that place full throttle operation RPM in the middle of the range provide improved cruising fuel economy.

- If the engine's full throttle RPM with a normal load is **below the specified range** or on the low side of the range (1), use propellers with **less** pitch to **increase** the RPM.
- If the engine's full throttle RPM **exceeds the specified range** (2), use propellers with **higher** pitch to **decrease** the RPM.

Engine damage can result from incorrect propeller selection that

1. Prevents engine RPM from reaching the specified full throttle operating range (e.g., laboring engine.) Install lower pitch propeller(s).
2. Allows engine RPM above the specified full throttle operating range (e.g., overspeeding engine). Install higher pitch propeller(s).



IMPORTANT

D-series aluminum propeller sets are not recommended for use on Duoprop-equipped boat and engine combinations that are capable of speeds in excess of 43 MPH (35 knots). F-series stainless steel propeller sets should be used in these applications.

If you use D-series aluminum propeller sets, you must also use an in-trim limiter kit. See your Volvo Penta dealer.

MAINTENANCE



Volvo Penta components meet U.S. Coast Guard requirements for explosion-proof parts. To prevent fire and explosion, do not substitute automotive or other non-approved parts.

Maintenance schedule

The operation, maintenance, and care of the Volvo Penta engine and power package as outlined in the owner's manual are the owner's responsibility. The owner must keep records of all maintenance services performed. This record of proper maintenance may be required to determine warranty coverage on certain repairs and should be transferred to each subsequent owner. If you are not sure of the proper maintenance procedures, contact the Volvo Penta Consumer Affairs Department at the address on page 85 of this document.

<i>Function</i>	<i>Adjust</i>	<i>Check</i>	<i>Lubricate</i>	<i>Fill</i>	<i>Replace</i>	<i>Tighten/ Torque</i>
Weekly						
Anodes, sacrificial		•				
Cooling system, leakage		•				
Emergency stop switch, clip, and lanyard		•				
Fuel system (leakage)		•				
Oil, engine crankcase		•		•		
Oil, drive unit		•		•		
Safety equipment		•				
Shift system (operation)		•				
Steering reservoir (fluid)		•		•		
Steering system cable (operation)		•				
Monthly						
Battery and connections (water level)		•				
Emergency stop switch, clip, and lanyard		•				
Exhaust system hoses/clamps (leakage)		•				•
Every 50 operating hours						
Battery and connections (water level)		•				•
Belts: alternator, idler, power steering, water pump (4.3, 5.0 GL; 5.7 GS)		•				•
Exhaust system hoses/clamps (leakage)		•				•
Fasteners (screws, nuts, etc.)		•				•
Flame arrestor (mounting)		•				•
Fuel system (leakage)		•				
Impeller, water pump *		•				
Power steering (operation/fluid)		•		•		
Power trim/tilt (operation/fluid)		•		•		
Propeller and shaft		•	•			
Remote control shift cable (damage)		•				
Steering system cable (operation)		•	•			

* Check at 50-hour intervals; replace as necessary or once every two years, whichever comes first.

Function Once per season *	Adjust	Check	Lubricate	Fill	Replace	Tighten/ Torque
Bellows and clamps, drive unit **		•			•	
Exhaust manifold and risers		•				
Distributor cap and rotors		•				
Fuel filter, carburetor					•	
Fuel filter, engine					•	
Fuel system (leakage)		•				
Impeller, water pump **					•	
Oil, engine crankcase					•	
Oil, drive unit					•	
Oil filter (engine)					•	
Propeller and shaft		•	•			
Remote control shift cable (damage)		•				
Spark plugs					•	
Spark plug wires/boots (deterioration)		•				
Steering system cable (operation)			•			
Throttle cable (damage and operation)		•	•			
Dealer only						
Belt: serpentine (3.0 GS; all fuel-injected models)		•				
Carburetor adjustment (as needed)	•					
Engine alignment and mounting screws		•				
Exhaust manifold & risers (corrosion; blockage)		•				
Gimbal bearing			•			
PCV valve		•				
Shift system (operation)	•	•				
Universal joints			•			
Universal joint bellows		•				
Universal joint shaft splines			•			

* Once per season or every 100 operating hours, whichever comes first.

** Check at 50-hour intervals; replace as necessary or once every two years, whichever comes first.

Preparing for boating after storage (“summerization”)

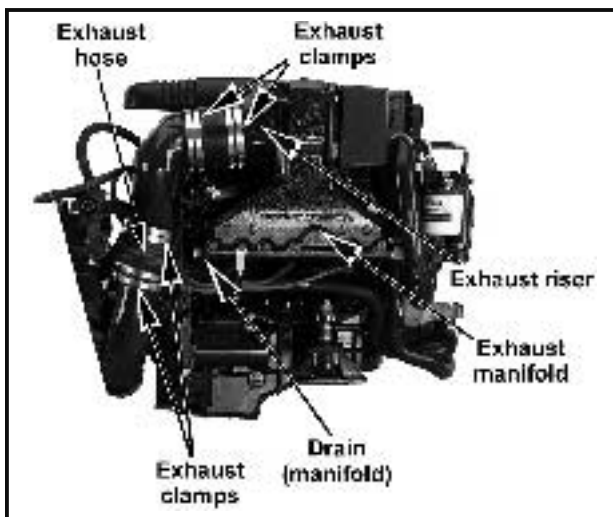
1. Replace all drain plugs.
2. Replace rubber caps and clamps or plugs.
3. Connect hoses and check their condition; tighten clamps and connections.
4. Install boat drain plug, if removed.
5. Remove distributor cap and rotor.
6. Wipe inside of distributor cap dry with a clean cloth; spray with Volvo Penta anti-corrosion spray.
7. Replace rotor and distributor cap.
8. Clean battery terminals and check battery charge.
9. With ignition switch in *OFF* position, install battery and attach battery cables.
10. Spray terminals with Volvo Penta anti-corrosion spray.
11. Open the fuel shut-off valve and check all fuel line connections for leaks.
12. Check the flame arrestor and clean if necessary.
13. Make a thorough check of boat and engine for loose or missing nuts and screws.
14. Pump the bilge dry and air out engine compartment. **Federal, state, and/or local regulations prohibit the pumping of oil into any navigable waters.**
15. Check all reservoir oil levels and fill as necessary.
16. Check drive and transom shield anodes. Clean or replace as necessary.

Off-season storage preparations (“winterization”)

Be sure to properly winterize your Volvo Penta equipment. Engine or drive damage can result from ignoring simple preventive maintenance steps during autumn. Winterizing gives you the assurance that your engine will run more reliably and economically in the springtime.

Volvo Penta recommends 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.

Exhaust system



Engine exhaust system

Periodically inspect the engine exhaust system. Check for

- Deteriorated hoses
- Burned hoses
- Loose clamps
- Evidence of water leaks
- Corrosion or blockage in the exhaust manifold and riser

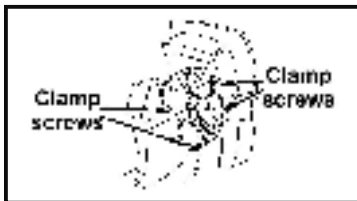
WARNING

Replace damaged or defective components, and securely tighten all clamps. Any exhaust leak must be repaired before you operate your boat. Exhaust leaks release fumes that can create hazardous conditions for operator and passengers.

Drive unit bellows

! WARNING

If you work on the drive bellows, secure the drive unit in a raised position in such a way that it cannot fall. A falling drive unit may cause serious bodily injury.



- Check the drive unit bellows for fractures and deterioration.
- Check tightness of all hose clamps.
- Check the drive unit bellows and clamps annually.
- Replace drive unit bellows and clamps every second year. You may order the bellows separately, or as part of an accessories kit. (The accessories kit also includes o-rings, oils, washers, seals, and anodes.)

- (DPX only) If hose clamps must be tightened, or hoses and clamps must be replaced, the clamp screw positions must be maintained as shown.

Fuel system

! DANGER

Gasoline is extremely flammable and highly explosive. ALWAYS turn off the engine before fueling. 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 build-up that could cause sparks and ignite fuel vapors.

Gasoline recommendations

USE ONLY UNLEADED FUEL. Maximum engine performance requires the use of lead-free gasoline with the following minimum or higher octane specification:

Inside the U.S.: (R+M)/2 (AKI) – 89

Outside the U.S.: (RON) – 93

If fuels with 89 AKI pump posted (93 RON) octane number or higher are not available, lower octane fuels (minimum 87 AKI [90 RON] octane) can be used. With the use of lower octane fuel, a slight decrease in power can be expected.

Premium fuel contains injector cleaners and other additives that protect the fuel system and provide optimum performance. Volvo Penta strongly recommends the use of premium grade fuels.

Gasoline will degrade over time. Always buy your gasoline from a reputable dealer.

! CAUTION

Engine damage resulting from the use of a lower octane gasoline than 87 AKI (90 RON) is considered misuse of the engine. Any resulting engine damage will not be covered by the warranty.

Gasoline containing alcohol

Many brands of gasoline being sold today contain alcohol. Two commonly used alcohol additives are Ethanol (ethyl alcohol) and Methanol (methyl alcohol).

See your boat's owner's manual to see if the boat's fuel system is compatible with alcohol blended fuels. If it is, your engine may be operated using gasoline blended with no more than 10% Ethanol meeting the minimum octane specification.

CAUTION

Do not use any gasoline that contains METHANOL. Serious damage will result from the continued use of fuel containing METHANOL. Any resulting engine damage will not be covered by the warranty.

If you use gasoline that contains ethanol, be aware of the following:

- The engine will operate leaner with ethanol blended fuel. This may cause engine problems such as vapor lock, low speed stall, or hard starting.
- Ethanol blended fuels attract and hold moisture. Moisture inside fuel tanks can cause corrosion of the tank material. Inspect fuel tanks at least annually. Replace fuel tanks if inspection indicates leakage or corrosion.

Detonation (spark knock)

Carbureted models: Detonation, or spark knock, in a marine engine is not necessarily audible. Overheating and continued running ("dieseling") after ignition shutoff are indications of detonation in a marine engine. If you suspect detonation or spark knock, and the engine is tuned properly, change to a higher octane fuel.

EFI models: 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 to prevent engine damage if knock is detected, and there will be a slight loss of power.

Preventing gum formation and corrosion in the fuel system

To prevent gum formation and corrosion in the fuel system, use a fuel stabilizer in the gasoline if it has been in the tank for more than two weeks. Fuel stabilizer is available from your Volvo Penta dealer.

EFI models: Some marinas sell fuel with lead additives. **Do not use leaded fuel, as it may plug the fuel injectors.**

DANGER

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

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

Failure to inspect your work could allow fuel leakage to go undetected. This could become a fire or explosion hazard. After completing service procedures, start engine and check entire fuel system for possible leaks.

To prevent fire and explosion, Volvo Penta fuel system components meet U.S. Coast Guard requirements for fuel and fuel vapor containment. Do not substitute automotive or other non-approved parts.

Carburetor (GL, GS only)

The carburetor vaporizes fuel and mixes it with air in proper quantities to suit the varying needs of the engine. Except for changing the carburetor fuel filter screen, the carburetor requires no periodic maintenance or adjustment. If operational problems occur, see your Volvo Penta dealer.

Electronic fuel injection (Gi, GSi only)

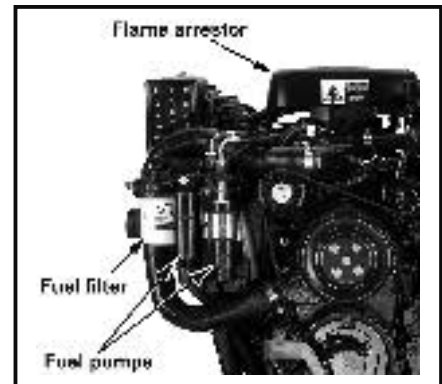
The electronic fuel injection (EFI) fuel metering system delivers the correct amount of fuel to the engine under all operating conditions. The EFI system is controlled by a microprocessor, and requires no periodic maintenance or adjustment. If operational problems occur, see your Volvo Penta dealer.

Flame arrestor

Remove the flame arrestor every 50 operating hours.

- Clean in solvent, air dry, and inspect it for damage.
- Replace if damaged.
- Reinstall flame arrestor; make sure unit is securely fastened.

To prevent fire and explosion in the engine compartment, the flame arrestor must always be in place, properly secured, and undamaged.



Electric fuel pumps

! WARNING

Check fuel pumps frequently for signs of fuel leakage. If leakage occurs, have the fuel pump serviced immediately by your Volvo Penta dealer.

EFI engines have two electric fuel pumps:

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

Both pumps are protected by a single 20-amp fuse. 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.

! CAUTION

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.

Fuel filter

All models have a fuel filter in the fuel line before the fuel pump.

IMPORTANT

Volvo Penta EFI engines require a special marine filter with a 5-10 micron filtering capability. Do not substitute any other type of filter.

! WARNING

Accumulation of water and other fuel contaminants may form corrosive compounds that can damage the fuel filter, and result in fuel leakage. For this reason, annual replacement of the fuel filter is required to avoid risk of explosion or fire.

Engine fuel filter replacement

! DANGER

The old fuel filter contains flammable fuel. Dispose of safely.

Run the bilge blower for at least five minutes to vent the engine compartment, then start the engine and check for leakage. Smell for fuel in the bilge. IF YOU CAN SMELL FUEL, TURN THE ENGINE OFF IMMEDIATELY — EXPLOSION AND FIRE ARE AN EXTREME DANGER. Clean up the bilge until fuel cannot be detected by smell.

1. Turn off the engine.
2. Unscrew fuel filter; remove and discard.
3. Lightly lubricate the gasket and inner seal on new fuel filter.
4. Screw on fuel filter and hand-tighten, following instructions on filter.
5. Clean up any spilled fuel.
6. Run the bilge blower for at least five minutes to vent the engine compartment, then start the engine and check for leakage.
7. Smell for fuel in the bilge.



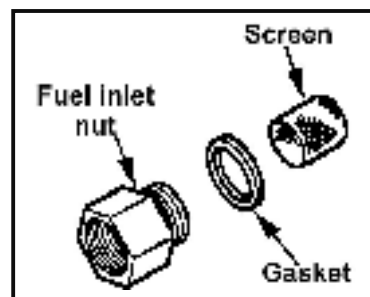
IF YOU CAN SMELL FUEL, TURN THE ENGINE OFF IMMEDIATELY — EXPLOSION AND FIRE ARE AN EXTREME DANGER.

8. Clean up the bilge until fuel cannot be detected by smell.

Note: 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.

Carburetor fuel filter replacement

1. Turn off the engine.
2. Disconnect the fuel line at the carburetor.
3. Remove the fuel inlet nut, gasket, and screen.
4. Clean the screen with solvent, then allow it to dry.
5. Reinstall the screen, gasket, and fuel inlet nut.
6. Tighten the fuel inlet nut securely.
7. Reconnect the fuel line and tighten it securely.
8. Clean up any spilled fuel.
9. Run the bilge blower for at least five minutes to vent the engine compartment, then start the engine.
10. Smell for fuel in the bilge.



IF YOU CAN SMELL FUEL, TURN THE ENGINE OFF IMMEDIATELY — EXPLOSION AND FIRE ARE AN EXTREME DANGER.

11. Clean up the bilge until fuel cannot be detected by smell.

Electrical system

The engine's electrical system features cranking, charging, ignition and trim/tilt circuits. A battery and all necessary wiring provide power.

CAUTION

If electrical connections are reversed, or wires are disconnected when the key switch is **ON** or the engine is running, sensitive electrical components may be immediately damaged. Do not turn off the main battery switch until the engine has stopped.

Battery cables

The following are the minimum specifications for stranded copper cables from the motor to the battery for all models. The maximum length is 20 feet regardless of cable diameter.

- 0 to 10 ft. (3.05 m) require a 1/0 AWG (80 MWG) cable
- 10 to 15 ft. (3.05 to 4.6 m) require a 2/0 AWG (100 MWG) cable
- 15 to 20 ft. (4.6 to 6.1 m) require a 3/0 AWG (120 MWG) cable

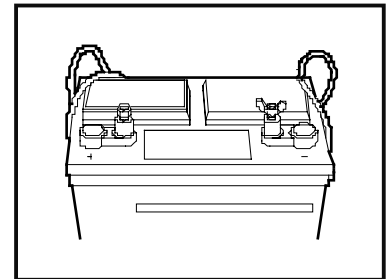
CAUTION

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

Batteries and connections

Note: Whenever you replace your battery, read and understand the information supplied with it before you begin installation.

1. The engine start battery must be a heavy duty, 12-volt, 650 CCA battery constructed for marine use.
2. All other batteries must be heavy duty and constructed for marine use. They can be either vented/refillable, maintenance-free, or deep-cycle with a CCA or INCA rating.
3. Use bolts and nuts to secure battery cables to the battery terminals. Do not use wing nuts to secure battery cables, even if they were supplied with the battery.
4. Tighten all battery connections. Loose battery connections may cause damage to the engine's electrical system.
5. Service electrical components only while the engine is off. Be careful when identifying positive and negative battery cables and terminals. If you touch the wrong terminal with a battery cable, even briefly, the motor's charging system may be damaged.



CAUTION

The battery terminal connections must always be insulated. If the battery mounting system does not cover the connections, install protective covers. This will help prevent shorting or arcing at the battery terminals.

WARNING

1. Do not expose the battery to electrical sparks or an open flame.
2. Do not use jumper cables and a booster battery to start the engine.

3. Remove the battery from the boat to recharge. Do not recharge the battery in the boat.

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

- Keep batteries dry and clean. Oxidation or dirt on the battery and battery terminals may cause short circuits, voltage drop, and discharge (especially in damp weather).
- Clean battery terminals and leads to remove oxidation.
- Tighten cable terminals tightly.
- Spray battery terminals and connections with an anti-corrosive agent, or coat them with petroleum jelly.
- Check that all other electrical connections are dry and free of oxidation, and that there are not loose connections.
- Always switch off the charging circuit before removing the battery charger connectors.
- Inspect your battery at regular intervals for specific gravity (state of charge), individual cell water level, cleanliness and tight, greased connections.
- If the battery has become discharged for no apparent reason, check all electrical system components for malfunction, or a switch left *ON*, before installing a recharged battery.
- Electrolyte levels should be 0.2 – 0.4 inches (5 – 10 mm) over the plates in the battery. Top off if necessary, using distilled water. After topping off, run the engine at fast idle for at least 30 minutes to charge the battery.

Note: Some maintenance-free batteries have special instructions. Make sure to follow them carefully.



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.

Note: It is important that the battery connections are correct. The negative battery cable must be attached to the negative terminal (–) on the battery and the engine's positive cable must be attached to the positive terminal (+) on the battery.



Failure to follow the safety precautions below may result in electrical sparks igniting fuel vapors, and thereby causing fire or explosion.

1. **Operate boat's bilge blower for at least 5 minutes. Open engine cover or hatch and check the boat's bilge area for gasoline fumes. If any fumes can be detected by smell, do not operate the boat until the source can be found, the spill cleaned up, and the cause corrected.**
2. **Do not connect cables to battery until all other electrical connections have been made.**
3. **Make sure the ignition switch is OFF before removing or installing electrical equipment, checking any electrical connections, or installing battery cables.**

See your Volvo Penta dealer for recommendations on installing multiple batteries.

Note: When replacing your battery, read and understand the information supplied with it before you begin installation.

1. Batteries must be heavy-duty and constructed for marine use. They can be either vented/refillable, maintenance-free, or deep-cycle with a CCA or MICA rating. Refer to *Specifications* on pages 95 through 100 for the correct battery sizes.
2. Use bolts and nuts to secure battery cables to the battery terminals. Do not use wing nuts to secure battery cables, even if they were supplied with the battery.
3. Loose battery connections can cause damage to the engine's electrical system.
4. Service electrical components only while the motor is not running. Be careful when identifying positive and negative battery cables and terminals. If you touch the wrong terminal with a battery cable, even briefly, the motor's charging system could be damaged.

WARNING

The battery terminal connections must always be insulated. If the battery mounting system does not cover the connections, install protective covers. This will help prevent shorting or arcing at the battery terminals.

Engine start battery

IMPORTANT

It is important that the battery connections are correct. The negative battery cable must be attached to the negative terminal (–) on the battery, and the engine's positive cable must be attached to the positive terminal (+) on the battery.

Use a 12-volt battery with the following specifications:

- a minimum 650 Cold Cranking Amp (CCA) rating at 0° F (-18° C)
- 165 minutes reserve capacity rating at 89° F (27° C).

DANGER

Fumes vented during battery charging may cause an explosion.

- **Do not expose battery to electrical sparks or an open flame.**
- **Do not use jumper cables and a booster battery to *start* engine.**
- **If the battery compartment is not properly ventilated, remove battery from boat to recharge.**

If the battery has become discharged ("dead") for no apparent reason, check all electrical system components for malfunction, or for a switch left in the ON position, before installing a recharged battery.

DANGER

Failure to follow the safety precautions below may result in electrical sparks igniting fuel vapors causing fire or explosion.

- **Operate the boat's bilge blower for at least 5 minutes. Open the engine cover or hatch and check the boat's bilge area for gasoline fumes. If any fumes can be detected by smell, do not operate the boat until you find the source, clean up the spill, and correct the cause.**
- **Do not connect cables to battery until all other electrical connections have been made.**

- **Make sure the ignition switch is *OFF* before removing or installing electrical equipment, checking any electrical connections, or installing battery cables.**

See your Volvo Penta dealer for recommendations on installing multiple batteries.

Multiple batteries and selector switch

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

A battery isolator is recommended if batteries will be switched for individual operation.

Distributor cap and rotor

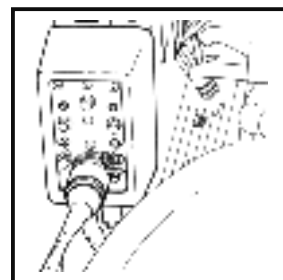
Remove, inspect and clean the distributor cap and rotor. Replace these components if worn or damaged with genuine Volvo Penta parts. No other distributor parts require service or replacement.

Be sure spark plug leads are replaced in the correct firing order (see the table below).

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, push its button to reset it.
- Replace any blown fuses.



⚠ CAUTION

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

Note: If electrical connections are reversed, or connections removed when the key switch is on or the engine is running, the electrical system may be damaged immediately.

Spark plugs

The following table provides spark plug part numbers, spark plug gap, and installation torque:

Engine Model	Spark plugs (VP part number)	Spark plug gap	Spark plug installation torque	Firing order
3.0 GS	3854399	0.045 in. (1.14 mm)	20 ft. lb. (27 N•m)	1 – 3 – 4 – 2
4.3 GL/Gi	3854399	0.045 in. (1.14 mm)	20 ft. lb. (27 N•m)	1 – 6 – 5 – 4 – 3 – 2
5.0 GL	3854399	0.035 in. (0.89 mm)	20 ft. lb. (27 N•m)	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2
5.0 Gi	3854399	0.045 in. (1.14 mm)	20 ft. lb. (27 N•m)	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2
5.7 GS	3854399	0.035 in. (0.89 mm)	20 ft. lb. (27 N•m)	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2
5.7 Gsi	3854399	0.045 in. (1.14 mm)	20 ft. lb. (27 N•m)	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2
7.4 Gi	3854399	0.045 in. (1.14 mm)	20 ft. lb. (27 N•m)	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2
7.4 Gsi; 8.2 Gsi	3854400	0.045 in. (1.14 mm)	20 ft. lb. (27 N•m)	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2
DPX 385/415	3854400	0.045 in. (1.14 mm)	20 ft. lb. (27 N•m)	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2

Before installing new spark plugs, always check for proper type and gap (see the table above). Incorrect spark plugs can cause operational problems and possible internal engine damage.

Before installing a spark plug, the spark plug seat in the cylinder head should be wiped clean. Tighten plugs to the proper torque value (see the table above). Make sure the spark plug terminals are fully seated on the spark plugs.



When spark plug leads are removed, be sure they are replaced in the correct firing order (see the table on the previous page).

! DANGER

- **Avoid abusive handling that could crack the spark plug's ceramic body. Damaged spark plugs can emit external sparks that could ignite any fuel vapors in the engine compartment.**
- **Do not operate engine if spark plug boots or high-tension leads are torn or cracked. This condition could allow external sparks which could ignite any fuel vapors in the engine compartment, and result in fire or explosion.**

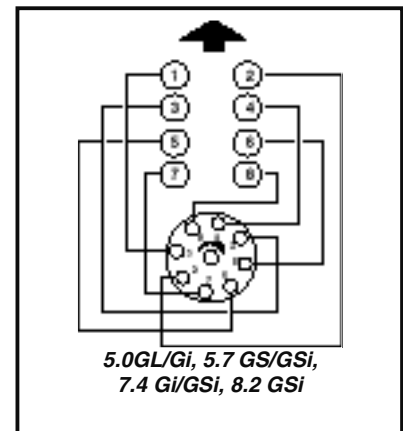
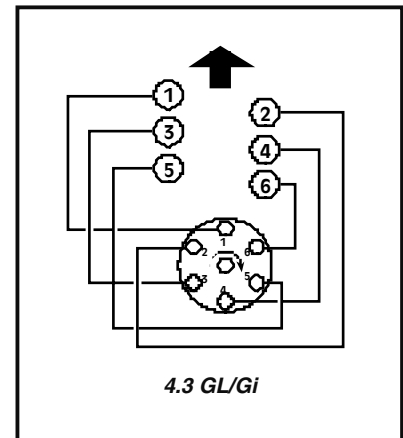
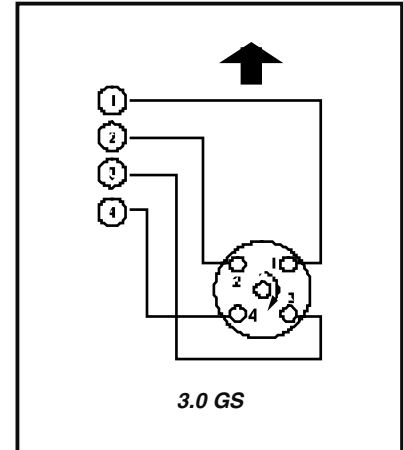
Checking and changing spark plugs

1. Twist and pull only on the spark plug wire boot (pulling on wire may cause separation of the core of the wire).
2. Remove spark plugs using a 5/8-inch spark plug socket or a 5/8-inch box wrench. Use care to avoid cracking the spark plug insulators.
3. Carefully inspect the insulators and electrodes of all spark plugs.
 - Replace any spark plug which has a cracked or broken insulator or which has loose electrodes.
 - If the insulator is worn away around the center electrode, or the electrodes are burned or worn, the spark plug is worn out and should be discarded.
 - Spark plugs that are in good condition, except for carbon or oxide deposits, should be thoroughly cleaned and gapped.

The spark plug wires are a special resistance type. The core is carbon-impregnated linen. This type wire is superior to copper core wire in its resistance to crossfire; however, it is more easily damaged than copper core. For this reason, pull on the spark plug boots to remove the spark plug wires, rather than pulling on the wire insulation. If the wire is stretched, the core may be broken with no evidence of damage on the outer insulation. If the core is broken, it will cause misfiring. In the case of wire damage, it is necessary to replace the complete wire assembly since a satisfactory repair cannot be made.

4. Clean ignition wires with a cloth moistened in kerosene, and wipe dry. Bend wires to check for brittle, cracked or loose insulation. **Defective insulation will permit misfiring, crossfiring, or spark to ground; therefore, defective wires must be replaced.**
5. If the wires are in good condition, clean any terminals that are corroded and replace any that are broken or distorted. Replace any wires with broken or deteriorated cable nipples or spark plug boots.
6. Clean spark plugs.

Spark plugs that have carbon or oxide deposits should be cleaned in a blast type spark plug cleaner. Scraping with a pointed tool will not properly remove the deposits and may damage the insulator. If spark plugs have a wet or oily deposit, dip them in a decreasing solvent and dry thoroughly with compressed air. Oily plugs will cause the cleaning compound to pack in the shell. Carefully follow the instructions of the manufacturer of the cleaner being used. Clean



each plug until the interior of shell and entire insulator is cleaned. Avoid excessive blasting.

7. Examine interior of plug in good light. Remove any cleaning compound with compressed air. If traces of carbon or oxide remain in plug, finish the cleaning with a light blasting operation. Clean firing surfaces of center and side electrodes with several strokes of a fine cut file.
8. When spark plugs have been thoroughly cleaned, carefully inspect them for cracks or other defects that may not have been visible before cleaning.
9. Use a round wire feeler gauge to check the gap between the spark plug electrodes. (Flat feeler gauges will not give a correct measurement if the electrodes are worn.) Adjust gap by bending the side electrode only. Bending the center electrode will crack the insulator. Setting the spark plug gap to any other specification in an attempt to improve idle or affect engine performance is not recommended.
10. See the diagrams for correct installation of spark plugs and wires.

For proper engine performance it is very important that the correct spark plugs be used. When installing spark plugs, make sure that the threads in the cylinder head and all surfaces on plugs and in cylinder heads are clean. Tighten spark plugs the specified amount. All engines use tapered seat plugs without gaskets.

Do not operate engine if spark plug boots or high-tension leads are torn or cracked. This condition can allow external sparks, which could ignite any fuel vapors in the engine compartment.

Spark plug wires must be arranged between the distributor cap and spark plugs in the order of firing sequence. If spark plug wires are not correctly installed, misfiring or crossfiring will result.

Belt adjustments

! WARNING

To prevent possible injury caused by someone inadvertently starting the engine, remove the ignition keys from each starting location (especially if the engine room/engine compartment cannot be seen from various remote starting positions such as a flybridge or enclosed cabin).

(3.0 GS, 4.3 Gi, 5.0 Gi, 5.7 GSi, 7.4 Gi/GSi, 8.2 GSi)

These engine models use a serpentine belt, which is a continuous-loop belt threaded through the alternator pulley, circulating pump pulley, idler pulley, and power steering pump pulley. This single belt replaces three separate belts (alternator, circulation, and power steering). At least once per year, have your Volvo Penta dealer check the serpentine belt for wear. An ideal time to have this check performed is when you have the gimbal bearings and universal joints lubricated.

(4.3 GL, 5.0 GL, 5.7 GS)

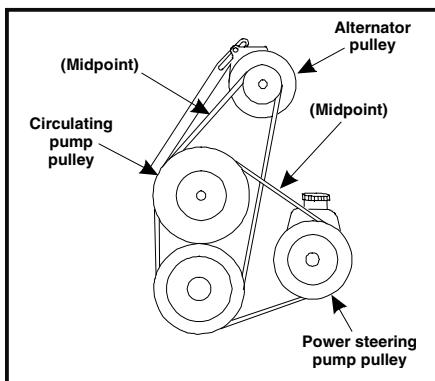
! CAUTION

The belts used for the alternator, water supply pump, and power steering pump are heavy duty. Do not replace with automotive belts.

Belt tension

1. Belt tension is determined by belt deflection.

- With the engine stopped, the belt should be tight enough so that it will deflect $\frac{1}{4}$ inch (6 mm) when pressed with a finger, or 75 ± 10 pounds (333.6 \pm 44.5 N) when using a belt tension gauge.
- If the belt is too tight, excessive belt and bearing wear can occur.
- If it is too loose, slippage can occur, resulting in belt wear, poor circulating pump alternator, and power steering operation.



2. Belt tension should be checked after 10 hours of service and every 5 hours thereafter.

Alternator belt

With engine *OFF*, check alternator belt deflection midway between the circulating pump pulley and the alternator pulley.

To increase belt tension:

1. Loosen alternator mounting screws and nuts.
2. Pivot the alternator away from the engine to increase belt tension.
3. While maintaining pressure on the alternator, retighten the top screw and bottom screw and nut.
4. Recheck belt tension.

Idler belt

Note: Improper idler belt adjustment will result in hard steering.

With engine *OFF*, check idler belt deflection midway between the circulating pump pulley and the idler pump pulley.

To increase belt tension:

1. Loosen pump mounting bracket screws.
2. With a long screwdriver, pry against a corner of the timing chain cover and tab on pump mounting bracket. Never pry against the pump reservoir or pull filler neck.
3. While maintaining pressure on the bracket, tighten the screw closest to the tab, then tighten the other screws.
4. Recheck belt tension.

Cooling system

Volvo Penta engines have a thermostat-controlled, recirculating type cooling system.

1. Cool water is drawn in through water intakes located on both sides of the lower gear case by a raw water pump mounted on the front of the engine.
2. Water is pumped to the engine and routed by the circulating water pump through the cooling system.
3. A thermostat inside the engine determines the amount of water to be taken in, recirculated, and discharged to control the engine's operating temperatures.

Engine overheating

If your engine overheats, the audible alarm will sound and a temperature gauge on your instrument panel will indicate your engine is overheating.

1. Turn off the engine.
2. Tilt the drive up and look for obstructions to the water intakes (e.g., seaweed, plastic bags).
3. Lower the drive unit.
4. Turn on the engine and run it in *NEUTRAL* at 1500 RPM.
5. Check the engine gauge to verify condition.
6. If overheating still occurs, return to shore at low RPM (to prevent excessive overheating and engine damage).
7. See your Volvo Penta dealer for service assistance.



(Gi, GSi only)

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

- Engine speed will automatically be gradually reduced to a maximum of 2500 RPM.
- The engine will operate normally only below 2500 RPM.
- The engine protection mode feature will remain activated until the engine overheating problem is corrected.

CAUTION

Do not remove the thermostat from the engine, as the engine is likely to overheat.

Draining the cooling system

CAUTION

When temperatures drop below freezing, failure to completely drain the cooling system will result in serious damage to the engine and exhaust manifolds. To assure complete drainage, probe all drain openings with a piece of wire to remove any blockage.

IMPORTANT

The following steps are very important in protecting your engine from damage in freezing conditions. If you are unsure of how to perform any of the following steps, see your Volvo Penta dealer for a complete end-of-season/winterization service. Freeze damage to the engine package is not covered by your Volvo Penta limited warranty.

- **Perform these procedures with the boat out of the water. It will prevent damage to cooling system components if temperatures drop below freezing.**
- **When draining the engine, raise or lower the bow of the boat to position the engine in a level attitude. This will provide for complete drainage of the block and manifold. If the bow of the boat is higher or lower than the stern, some water may be trapped in the block.**

Engine — raw water cooled

1. (3.0 only) Open the manifold drain cock.
(4.3, 5.0, 5.7, 7.4, 8.2, DPX 385/415 only) Remove water hose clamps and hoses from the exhaust manifold.
2. Open the engine block drain cocks.
(On 4.3 only, also open the open intake manifold drain plug located on the front face of the intake manifold, directly above the circulating pump.)
3. (4.3/5.0/7.4 Gi, 5.7 GSi, 7.4/8.2 GSi, DPX 385/415 only) Remove the water hose clamps and water hoses from the vapor separator tank.
4. After all of the water has drained out, reattach hoses/caps, tighten clamps, and close all drain cocks.

Engine — fresh water cooled (if equipped)

1. Check the coolant level and antifreeze concentration (check antifreeze manufacturer's instructions). Make sure the antifreeze's freeze point is adequate for expected temperatures.
2. Open the drain cock on the raw water side of the heat exchanger.
3. (3.0 only) Open the manifold drain cock.

(4.3, 5.0, 5.7, 7.4, 8.2, DPX 385/415 only) Remove water hose clamps and hoses/rubber caps from the exhaust manifolds.

4. After all of the water has drained out, reattach hoses/caps, tighten clamps, and close all drain cocks.

Raw water pump

1. Loosen and slide clamps back.
2. Remove hoses from the rear of water pump and drain.
3. Crank the engine no more than 2 seconds (DO NOT START) to expel any water trapped in water pump.
4. Reattach water pump hoses and tighten clamps.

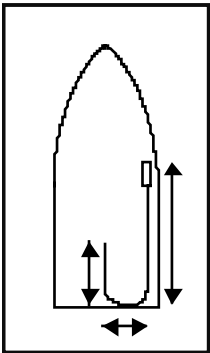
! CAUTION

Do not reverse water pump hoses. Serious engine damage may result.

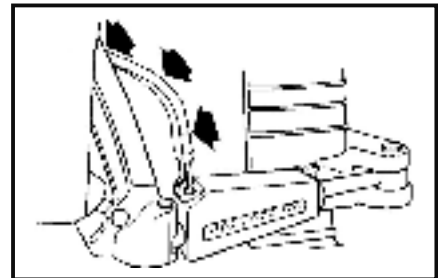
Oil cooler

Remove the lower water hose from the oil cooler. If cooler is mounted horizontally, remove either hose, loosen mounting bolt, and tip open end of cooler down to drain.

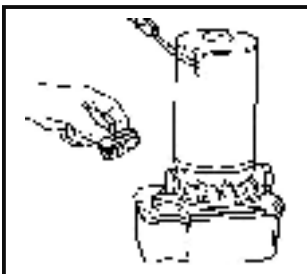
Steering system



1. Check steering and throttle cables for cracks and wear. Check all along the length of the cable, as shown in the diagram. Replace the cables if you suspect that they are not in optimum condition.
2. Check steering system hoses for cracks, leaks, and wear. Replace any hoses that you suspect are not in optimum condition.
3. (DPX only) Check steering system hydraulic hoses for cracks, leaks, and wear. Replace any hoses that you suspect are not in optimum condition.



Power trim/tilt fluid level



The power trim and tilt assembly contains an electric motor, hydraulic pump, and reservoir.

At the beginning of each boating season, check the fluid level in the reservoir:

1. With the drive unit trimmed in as far as possible, remove the fill cap.
2. Check the fluid level. It should be between the minimum and maximum marks on the reservoir. If needed, add Volvo Penta DuraPlus Power Trim/Tilt and Steering Fluid.
3. Replace the fill cap and tighten securely.

Steering reservoir fluid level

Whenever you check the engine oil, also remove the steering reservoir dipstick and check the fluid level. Wipe the dipstick and note the "hot" and "cold" fluid levels. If needed, add Volvo Penta DuraPlus Power Trim/Tilt and Steering Fluid. Do not overfill the pump reservoir.

CAUTION

Never fill the steering system with an 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.

Primary shaft spline and bearing lubrication

The primary universal joint shaft splines and bearings **must** be lubricated each year and whenever the drive unit is removed. This procedure requires the removal of the drive unit; therefore, your Volvo Penta dealer should do it. An ideal time to have this done is during the winterization process. Failure to have primary shaft splines and bearings lubricated each year may result in damage to the drive unit.

Tie rod (twin installations only)

Check the 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.

WARNING

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.

Engine and drive service

You may lubricate your Volvo Penta sterndrive yourself, or you may have your Volvo Penta dealer perform this service for you.

If you lubricate the sterndrive yourself:

- Instructions for SX drive unit lubrication are located on page 73.
- Instructions for DP drive unit lubrication are located on page 74.
- Instructions for DPX drive unit lubrication are located on page 75.

If you have your Volvo Penta dealer lubricate the sterndrive, make sure to take it to your dealer at the required intervals, as outlined in your maintenance schedule on page 55.

Lubrication system

Engine/crankcase oil

To obtain the best engine performance and engine life, Volvo Penta recommends DuraPlus™. Premium engine oil labeled for Service CE/SG, or you may use an engine oil with the recommended quality and viscosity. Engine oils are specified by API service, letter designations and SAE viscosity numbers. Refer to oil identification symbol on the container.

Initial factory fill is a high quality motor oil for API Service CE/SG. During the break-in period (20 hours), frequently check the oil level. Somewhat higher oil consumption is normal until piston rings are seated. The oil level should be maintained between the *ADD* and *FULL* marks on the dipstick. The space between the marks represents approximately one quart (one liter). For oil level dipstick location, refer to the photographs on pages 22 through 31.

See the *Specifications* on pages 95 through 100, and the *Maintenance Schedule* on page 55 for oil filter type and service intervals.

When you add or change engine oil, use Volvo Penta engine oils for gasoline engines. Use the following chart to select

the SAE viscosity that matches the temperature range in which you expect to operate.

SAE Viscosity Chart

Lowest Anticipated Temperature	Recommended SAE Viscosity Oils
32° F (0° C) – above	SAE 30* SAE 20W/50 SAE 15W/50
0° F (-18° C) – 32° F (0° C)	SAE 20W-20
Below 0° F (-18° C)	SAE 10W

*SAE 30 Volvo Penta DuraPlus Synthetic Motor Oil (P/N 3851230-7) (U.S. and Canada Only)

Use single viscosity oils in markets where available. The use of multi-viscosity oils such as 10W-30, 10W-40 is not recommended unless single viscosity oils are not available.

At the end of the break-in period (20 hours), change the crankcase oil and replace the oil filter. Refer to the *Maintenance Schedule* on page 55 for recommended oil change intervals.



Never use parts that are not recommended specifically for marine use. Substituting automotive or generally supplied parts and hardware may result in product malfunction and possible injury to the operator and/or passengers. Never use parts of unknown quality.

Checking engine oil level

Remove the dipstick. The oil level must be between the two marks on the dipstick. Add oil as necessary to maintain the proper level.

Note: Do not allow the crankcase oil level to go below the *ADD* mark, and do not fill above the *FULL* mark. Overfilling results in high operating temperatures, foaming (air in oil), loss of power, and overall reduced engine life.

Changing engine oil

Engine oil and the oil filter are important factors affecting engine life. They affect ease of starting, fuel economy, combustion chamber deposits, and engine wear. Drain and refill the engine crankcase once each season or every 100 operating hours, whichever comes first. (Also see the maintenance schedule.)

1. Run the engine to warm the crankcase oil (for easier removal).
2. Turn off the engine.
3. Remove oil dipstick, and drain the oil from the crankcase through the dipstick tube, using the special fitting provided on the tube. This special fitting is provided so that the oil does not have to be drained into the bulge.
4. Withdraw oil with a suction pump.

Note: You may purchase either a manual or an electric suction pump from any marine supply store, or from your Volvo Penta dealer.

5. Dispose of used oil according to any applicable federal, state, and local environmental regulations.
6. Replace the oil filter.
7. Remove the oil fill cap and fill the crankcase to the specified capacity with Volvo Penta DuraPlus premium engine oil.

Changing the oil filter

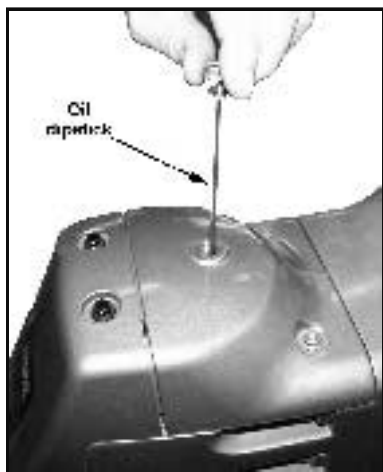
Replace the oil filter whenever the engine oil is changed. This filter is a self-contained, screw-on type.

1. To remove, unscrew filter canister counter-clockwise. Dispose of used filter according to any applicable federal, state, and local environmental regulations.
2. When attaching a new filter, be sure the gasket is lightly lubricated with motor oil.
3. Hand-tighten only.
4. Run engine and check for leaks. (Do not run engine out of water.)

Drive components

The drive unit is filled at the factory with Volvo Penta DuraPlus™ GL 5 Synthetic Gear Lube.

Drive unit lubrication



Lubricating the drive unit (SX)

Adding lubricant

Every week check the oil level in the drive unit (if possible, without removing the boat from the water).

! CAUTION

Fully thread the oil dipstick into the oil level hole in the drive unit to properly check the oil level. An improper oil level may result in serious drive unit damage.

Fully thread the dipstick into the hole, then remove and check the oil level.

Make sure that the oil level comes to the top of the flattened portion of the dipstick.

- The oil should be amber-colored.
- The oil will appear milky if any moisture is present.
- No metal flakes should appear in the oil.

If moisture or metal flakes appear in the drive unit oil, take the boat to your Volvo Penta dealer.

If the oil level is low, add only enough lubricant to bring the oil level within the full range of the dipstick.

You should completely drain and refill the drive unit at least once per season.

Draining the drive unit (SX)

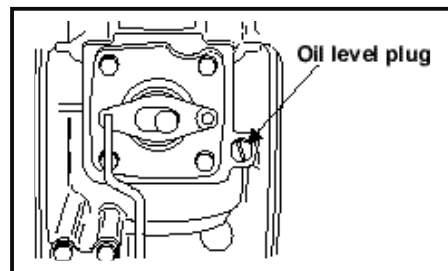
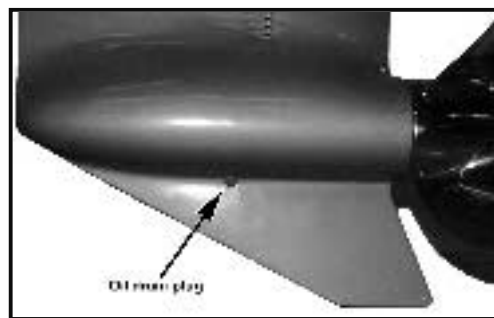
1. Place the drive unit in the *run* (down) position. Put a container under the drive unit to catch the draining oil.
2. Remove the oil drain plug and the oil level dipstick.



3. Allow the drive unit to drain completely. Dispose of used oil according to applicable environmental regulations.

Filling the drive unit (SX)

1. Remove the three screws securing the rear cover to access the oil level plug.
2. Remove the oil level plug.
3. Fill the drive unit with Volvo Penta DuraPlus GL 5



Synthetic Gear Lube. Fill through the oil drain plug location. Fill slowly to purge air. The drive unit is properly filled when the oil appears at the oil level plug hole.

4. When filled to the proper level, install the oil level dipstick and oil level plug first (to prevent excessive oil loss), then the oil drain plug.
5. Tighten oil level and drain plugs securely.
6. Install the rear cover and tighten screws securely.

If you cannot fill the drive unit through the oil drain plug, you can fill the drive by trimming it up a few degrees and filling it through the oil level plug. Reinstall the oil level plug, and place the drive in the run (down) position. Remove the dipstick and check the oil level. Reinstall the dipstick and tighten securely.

Check the oil level with the dipstick (oil must appear on the full range of the dipstick). Add oil if required through the dipstick hole. Refer to *Specifications* on pages 95 through 100 for drive unit oil capacity.

If the drive unit was filled through the oil level plug, wait 15 minutes before checking the oil level with the dipstick. Leave the dipstick loose during the waiting period. This will help ensure all air is purged from the oil cavity.

Lubricating the drive unit (DP-S)

The drive unit is filled at the factory with Volvo Penta DuraPlus GL5 Synthetic gearcase lubricant. This lubricant must be used when adding lubricant or refilling the drive unit.

Adding lubricant



Fully thread the oil dipstick into the oil level hole in the drive unit to properly check the oil level. An improper oil level may result in serious drive unit damage.

Each week, check the oil level in the drive unit (if possible, without removing the boat from the water).

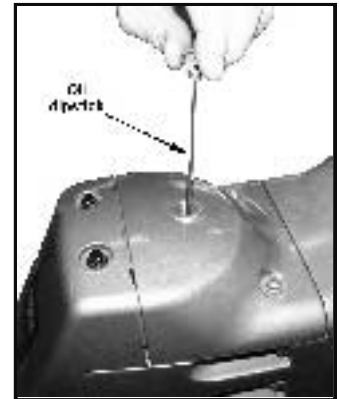
Make sure that the oil level comes to the top of the flattened portion of the dipstick.

- The oil should be amber-colored.
- The oil will appear milky if any moisture is present.
- No metal flakes should appear in the oil.

If moisture or metal flakes appear in the drive unit oil, take the boat to your Volvo Penta dealer.

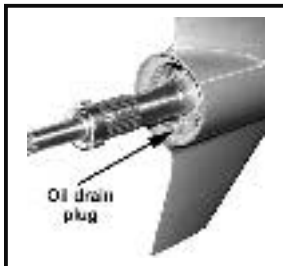
If the oil level is low, add only enough lubricant to bring the oil level within the full range of the dipstick. Improper oil level may result in serious damage to the drive unit.

You should completely drain and refill the drive unit at least once per season.



Draining the drive unit (DP-S)

1. Place drive unit in the run (down) position.
2. Remove propellers and mounting hardware.



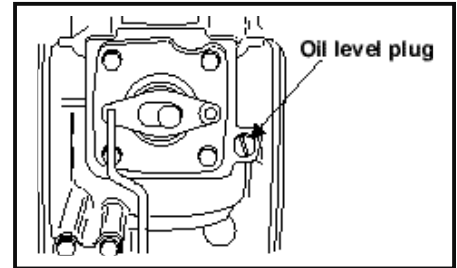
Note: Special tools are required to remove Duoprop propellers. Refer to *Propeller care* on page 77.

3. Remove the oil drain plug and the oil level dipstick.
4. Allow the drive unit to drain completely. Dispose of used oil according to applicable environmental regulations.

Filling the drive unit (DP-S)



1. Remove the three screws securing the rear cover to access the oil level plug.
2. Remove the oil level plug.
3. Fill the drive unit with Volvo Penta DuraPlus GL 5 Synthetic Gear Lube. Fill through the oil drain plug location. Fill slowly to purge air. The drive unit is properly filled when the oil appears at the oil level plug hole.
4. When filled to the proper level, install the oil level dipstick and oil level plug first to prevent excessive oil loss, then the oil drain plug.
5. Tighten the oil level and drain plugs securely.



Note: If unable to fill the drive unit through oil drain plug, fill the drive trimming it up a few degrees and filling through the oil level plug.

6. Reinstall the oil level plug, and place the drive in the run (down) position. Remove the dipstick and check the oil level. Reinstall the dipstick and tighten securely.
7. Install the propellers (refer to *Propeller care* on page 77).
8. Install the rear cover and tighten screws securely.
9. Check the oil level with the dipstick (oil must appear on the full range of dipstick). Add oil, if required, through the dipstick hole. Refer to *Specifications* on pages 95 through 100 for drive unit lubricant capacity.

Note: If the drive unit was filled through the oil level plug, wait 15 minutes before checking oil with the dipstick. This will help ensure all air is purged from the oil cavity. Leave the dipstick loose during the waiting period.

Lubricating the drive unit (DPX)

The drive unit is filled at the factory with Volvo Penta DuraPlus GL5 Synthetic gearcase lubricant. This lubricant must be used when adding lubricant or refilling the drive unit.

Adding lubricant

Each week, check the oil level in the drive unit (if possible, without removing the boat from the water).

CAUTION

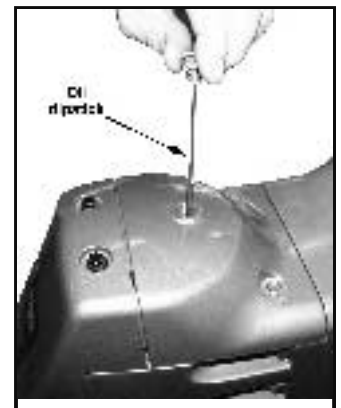
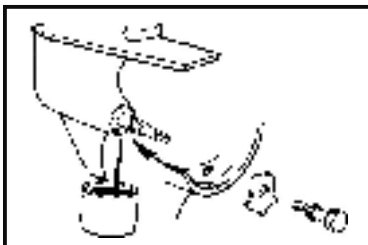
Fully thread the oil dipstick into the oil level hole in the drive unit to properly check the oil level. An improper oil level may result in serious drive unit damage.

Make sure that the oil level comes to the top of the flattened portion of the dipstick.

- The oil should be amber-colored.
- The oil will appear milky if any moisture is present.
- No metal flakes should appear in the oil.

If moisture or metal flakes appear in the drive unit oil, take the boat to your Volvo Penta dealer.

If the oil level is low, add only enough lubricant to bring the oil level within the full range of the dipstick. Improper oil level may result in serious damage to the drive unit.

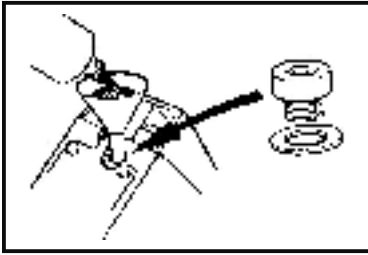


You should completely drain and refill the drive unit at least once per season.

Draining the drive unit (DPX)

1. Place the drive unit in the run (down) position and remove the dipstick.
2. Remove the propellers.
3. Remove the oil drain plug at the bottom of the propeller gear housing.

4. Allow the drive unit to drain completely, then replace the drain plug. If the oil shows signs of water, contact your Volvo Penta dealer for service assistance.



5. Dispose of used oil according to any applicable environmental regulations.

Filling the drive unit (DPX)

6. To fill the drive unit, remove the rear cover and the oil fill plug. (Refer to *Specifications* on pages 95 through 100 for drive unit oil capacity.)
7. Tilt the drive unit up.
8. Fill the drive with Volvo Penta DuraPlus GL5 Synthetic gearcase lubricant.
9. When filled to the proper level, install the oil fill plug and tighten it securely.
10. Lower the drive and check the oil level with the dipstick.
11. If necessary, add oil through the dipstick hole.

12. Make sure the fill and drain plug seals are not leaking.

13. Install the rear cover and tighten screws securely.

External lubrication points

The gimbal bearing and universal joints **must** be lubricated each year. This procedure requires the removal of the drive unit; therefore, your Volvo Penta dealer should do it. An ideal time to have this done is during the winterization process.

Failure to have the gimbal bearing and universal joints lubricated each year may result in damage to the pivot housing and drive unit.

Anodes ("sacrificial" anodes)



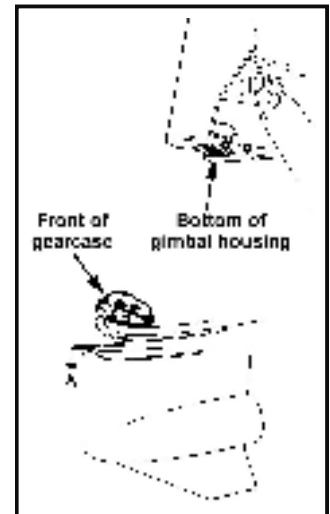
Sacrificial anodes are attached to the bottom of the gimbal housing and at the front of the gearcase above the anti-ventilation plate. (On the DPX drive only, there are additional anodes at the back of the intermediate housing, and on the steering cylinders.)

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 coarse emery

cloth or sandpaper to remove scale and oxidation to maintain their effectiveness. **Do not paint anodes, as this will destroy their effectiveness.**

When you need to replace the anodes, see your Volvo Penta dealer. The material composition of Volvo Penta anodes meets U.S. Military Specification 18001-H. If you use other anodes, make sure they have equivalent specifications or galvanic corrosion protection will be lost.

You may order the anodes separately, or as part of an accessories kit. (The accessories kit also includes o-rings, oils, washers, seals, and bellows.)



Replacing sacrificial anodes

1. Inspect anodes every 14 days, or more frequently if used in extremely salty water. If an anode is 2/3 its original size (1/3 eroded), replace it.

Note: If you use a stainless steel propeller, additional sacrificial anodes may be required to handle the added corrosion potential.

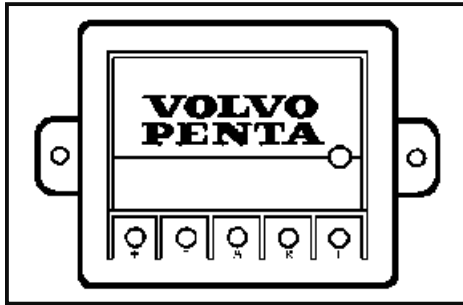
2. Remove the two screws holding the anodes onto the gearcase and/or the gimbal housing. Set the screws aside, as you will use them again.
3. Pull off the old anode.
4. Insert the new anode.

5. Secure with two screws.
6. Tighten screws to these torque specifications:
 - 12 – 14 ft. lb. (16 – 19 N•m) for the gimbal housing anode
 - 60 – 84 in. lb. (6.8 – 9.5 N•m) for the gearcase anode

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 manufacturer's recommendations.

Note: When your boating is done mostly in fresh water, Volvo Penta recommends replacing zinc anodes with magnesium anodes.

Active corrosion protection system



Your boat may be equipped with an optional Volvo Penta active corrosion protection system that greatly improves the life of the drive unit by protecting it from corrosion. 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. (This is accomplished by changing the charge of water molecules so that they do not remove electrons from the drive unit's metal parts to cause corrosion.) If you do not have an active corrosion protection system already installed, you may purchase one from your authorized Volvo Penta dealer.

The protection system's control box has a small LED indicator light that blinks once every one to five seconds to show the system is operating properly.

- If the light blinks at the rate of once every five seconds, the demand for protection is very low.
- If the light is flashing once per second, the demand for protection is high and the system is operating at maximum capacity.

The Volvo Penta active corrosion protection system is designed to adequately protect one drive unit from galvanic corrosion.

Note: 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.

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 unit and engine. If the rubber hub should begin to slip, it can be easily replaced at an authorized Volvo Penta dealer or propeller service station.

! 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.

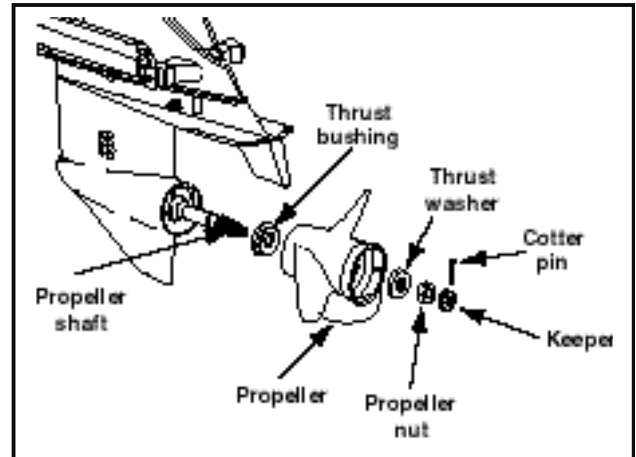
⚠ CAUTION

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

Propeller replacement — SX

Removing the propeller

1. Ignition switch must be *OFF*.
2. Make sure the remote control is in *NEUTRAL*.
3. Remove the cotter pin and keeper.
4. Shift the remote control into *FORWARD* to lock the propeller shaft.
5. Remove the propeller nut using a 1-1/16 wrench.
6. Remove the thrust washer, propeller, and thrust bushing.
7. Wipe the propeller shaft clean. Inspect for fishing line; remove if present.



Installing the propeller

⚠ CAUTION

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. Ignition switch must be *OFF*.
2. Make sure the remote control is in *NEUTRAL*.
3. Coat the full length of the propeller shaft with Volvo Penta propeller shaft grease. (Removal of the propeller will be difficult if this is not done.)
4. Place the thrust bushing on the propeller shaft with the inner taper toward the gearcase to match the taper on the propeller shaft.
5. Install the propeller onto the propeller shaft, aligning splines, and push the propeller onto the thrust bushing until the splines are exposed.
6. Install the thrust washer on propeller shaft splines.
7. Shift the remote control into *REVERSE* gear to lock the propeller shaft.
8. Install and tighten the propeller nut until it is seated against the thrust washer.
9. Loosen the nut, then turn it back against the thrust washer until finger tight. Tighten the nut an additional 1/3 to 1/2 turn.
10. Index the keeper on the propeller nut until it is aligned with the cotter pin hole.
11. Install the cotter pin and bend the ends to secure (use a new cotter pin if necessary).
12. Shift the remote control into *NEUTRAL*. The propeller should turn freely.

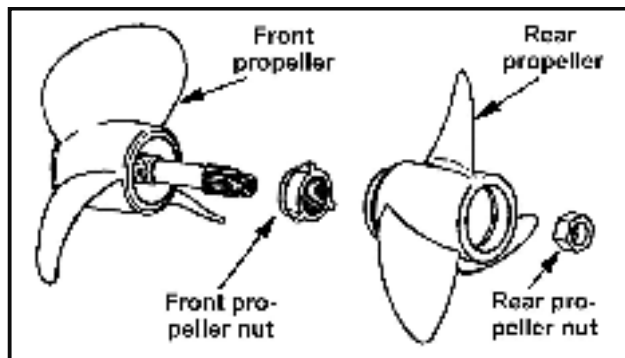
Before your next outing, use a torque wrench to tighten the propeller to 70 – 80 ft. lb. (96 – 108 N•m). The thrust washer, nut, keeper, and cotter pin must be installed as shown.

Propeller replacement — DP-S

Removing the propeller

This procedure requires you to use a special tool, Volvo Penta P/N 3855516.

1. Ignition switch must be *OFF*.
2. Make sure the remote control is in *FORWARD* to lock the propeller shaft.
3. Remove the rear propeller nut.
4. Remove the rear propeller.
5. Change the remote control position to *REVERSE* to lock the propeller shaft.
6. Remove the front propeller nut.
7. Remove the front propeller.
8. Wipe the propeller shaft clean. Inspect for fishing line; remove if present.



Installing the propeller

⚠ CAUTION

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.

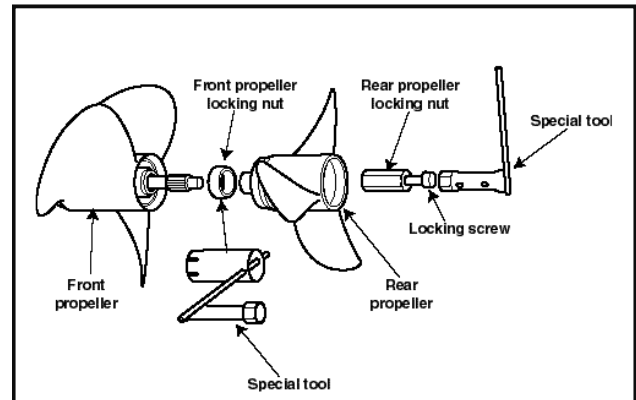
1. Ignition switch must be *OFF*.
2. Make sure the remote control is in *FORWARD*.
3. Coat the full length of the propeller shaft with Volvo Penta propeller shaft grease. (Removal of the propeller will be difficult later if this precaution is not done.)
4. Install the front propeller.
5. Install the front propeller nut and tighten it to 45 ft. lb. (60 N•m).
6. Shift the remote control into *REVERSE* to lock the propeller shaft.
7. Install the rear propeller.
8. Install the rear propeller nut and tighten it to 50 ft. lb. (70 N•m).
9. Shift the remote control into *NEUTRAL*. The propeller should turn freely.

Propeller replacement — DPX

Removing the propeller

This procedure requires you to use a special tool kit, Volvo Penta P/N 885195.

1. Ignition switch must be *OFF*.
2. Make sure the remote control is in *FORWARD* to lock the propeller shaft.
3. Use the special tool (as shown) to remove the rear locking screw. Use a 30-mm socket to remove the propeller locking nut.
4. Remove the rear propeller.
5. Shift the remote control into *REVERSE* to lock the propeller shaft.
6. Use the special tool (as shown) to remove the front locking screw.
7. Remove the front propeller.
8. Wipe the propeller shaft clean. Inspect for fishing line; remove if present.



Installing the propeller

⚠ CAUTION

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

1. Ignition switch must be *OFF*.
2. Coat the full length of both propeller shafts with Volvo Penta propeller shaft grease. (It will be difficult to remove propellers later if this precaution is not done.)
3. Make sure the remote control is in *FORWARD* to lock the propeller shaft.
4. Install the front propeller.
5. Install the front propeller locking nut. Use the special tool to tighten the nut to 37 – 52 ft. lb. (50 – 70 N•m).
6. Shift the remote control into *REVERSE* to lock the propeller shaft.
7. Install the rear propeller.
8. Install the rear propeller locking nut (use a 30-mm socket). Tighten the nut to 19 – 26 ft. lb. (25 – 35 N•m).
9. Install the locking screw. Use the special tool to tighten the nut to 52 – 59 ft. lb. (70 – 80 N•m).
10. Shift the remote control into *NEUTRAL*. The propeller should turn freely.

Boat bottom

The condition of the boat's bottom can affect your boat'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 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.

⚠ CAUTION

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

Replacement parts _____

⚠ WARNING

- Improper parts substitution can result in fire or explosion.
- Use genuine Volvo Penta parts when replacement parts needed. Volvo Penta replacement parts are designed to meet USCG requirements and ABYC standards for marine applications.
- Failure to use genuine Volvo Penta parts may result in product malfunction and possible injury to the operator and/or passengers.

In your Volvo Penta product, certain fuel and electrical system components have been designed to comply with U.S. Coast Guard regulations. 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, and related ignition parts
- Fuel pumps, relays, filter, and related parts
- Rubber caps (manifold), hoses (water and exhaust), and attaching clamps
- 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



Your Volvo Penta product was designed to operate in a marine environment. This can involve operating

- at high RPM for long periods
- in salt or brackish water
- in water laden with silt and minerals

Substituting automotive or generally supplied parts and hardware may result in product malfunction and possible injury to the operator and/or passengers. Never use parts of unknown quality. See your Volvo Penta dealer. You can depend on him to furnish expert service and Volvo Penta parts.

Bottom painting _____

If your boat is in water where marine growth is a problem, using an antifouling paint may reduce the growth rate. Be aware of laws that may limit your paint choice and its use.

- A pure Teflon®-based agent is recommended.
- Copper-based antifouling paint may be used. **Do not paint transom shield or drive with copper-based paint. If you do use copper-based paint on your boat bottom, leave a 1-inch border between the paint and the transom shield.**
- Vinyl-butyl base antifouling paint is a recommended alternative.

See your Volvo Penta dealer for an EPA-approved antifouling paint suitable for your area.

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 relubricate 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.



Delay in completing the above actions may result in extensive engine damage.

TROUBLESHOOTING CHECKLIST

The following troubleshooting checklist gives some of the most common problems and their solutions. If your problem does not appear on this checklist, please contact your Volvo Penta dealer.

WARNING

After following the “Action” described in the chart, and before cranking the engine, make sure there are no loose electrical connections that could spark. Make sure the engine compartment is free of fuel vapors. FAILURE TO DO SO MAY RESULT IN FIRE AND/OR EXPLOSION.

Sympton	Possible cause	Action
Engine cranks but won't start	No fuel in tank or gasoline shutoff valve closed	Fill tank or open valve.
	Water in fuel supply or gasoline is old.	Check fuel supply for water contamination. If gasoline is old or if water is present, drain fuel tank and flush with fresh gasoline, and change
	Fuel system problem.	See your Volvo Penta dealer.
	Emergency stop switch.	Reinstall lanyard.
Engine runs erratically	Fuel system problem.	See your Volvo Penta dealer.
	Fuel filters.	Replace filters. See your Volvo Penta dealer.
	Electrical system problem.	See your Volvo Penta dealer.
Engine vibrates	Propeller condition.	Check for damaged propellers. Check for bent propeller shaft. Look for weeds on propeller or gear case.
Loss of engine performance	Boat overloaded.	Reduce or redistribute load.
	Water in bilge.	Drain bilge according to Federal, State, and local regulations.
	Boat hull condition.	Clean boat hull.
	Incorrect fuel octane.	Fill gas tank with proper fuel.
High shift effort	Remote control box or shift cable.	See your Volvo Penta dealer.

PROBLEM RESOLUTION

Your satisfaction with our products and dealer services is vital. Volvo Penta takes pride in producing durable, reliable products, and a strong dealer network supports our efforts. If you have questions about service or your product's performance, your Volvo Penta dealer will be happy to answer them. There may be times, though, that, in spite of the best intentions, differences develop between a boat owner and a dealer. If this happens to you, Volvo Penta and your dealer will work together to pursue a reasonable resolution.

If you have a problem with your Volvo Penta product:

Maintain a written record of events (the problem, related conversations/with whom, important dates, etc.), as well as any supporting documents (invoices, work orders, etc.). Then, take the following steps:

1. Discuss the matter with the proper department manager at the dealership (e.g., Service Manager, Parts Manager, etc.). Explain exactly what caused the problem and ask what action will be taken.

If the matter remains unresolved after a reasonable amount of time:

2. Discuss the matter with the Dealer Principal (usually the owner or co-owner of the dealership). Explain what took place in step 1.

If the matter is not resolved within a reasonable amount of time:

3. Contact the Consumer Affairs Department at:

Volvo Penta of the Americas, Inc.
1300 Volvo Penta Drive
Chesapeake, VA 23320
Phone: (757) 436-5100
Fax: (757) 436-5153

Volvo Penta Canada
75 West 3rd Avenue
Vancouver, BC V5Y 3T8
Phone: (604) 872-7511
Fax: (604) 872-4606

Please be prepared to provide the following information:

- Your name, address, and daytime telephone number.
- The Volvo Penta product model and serial number for each major component in the power package (engine, transom shield, drive, or transmission). Check your owner's manual for the serial number plate location.
- Date of purchase.
- Current engine operating hours.
- Selling and/or Servicing Dealer's name.
- Description of the problem.

SPECIFICATIONS

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

3.0 GS

Battery size	12 volt with 360 Cold Cranking Amp (CCA) rating
Bore and stroke	4.00 x 3.60 inches (101.60 x 91.44 mm)
Carburetor	Adjustable idle circuit Fixed main fuel jets Electric choke
Charging system	65 amp alternator, with internal transistorized voltage regulator
Cooling system	Variable volume pump on engine Recirculating pump on engine Thermostatically controlled temperature
Cylinders (number)	4 in-line
Displacement	181 cubic inches (3.0 liters)
Firing order	1 – 3 – 4 – 2
Fuel filter (in fuel pump)	Volvo Penta P/N 3855104
Fuel filter location	Refer to photographs on pages 22 through 23.
Fuel type	Inside the U.S.: 89 octane (AKI) unleaded gasoline Outside the U.S.: 93 octane (RON) unleaded gasoline
Full throttle operating range	4200 – 4600 RPM
Idle RPM (fixed)	600 – 750 RPM in forward gear
Ignition timing	Authorized Volvo Penta dealer service only
Oil capacity	
Engine	Without filter: 3.5 quarts (3.3 liters) With filter: 4 quarts (3.8 liters)
Drive unit	Approximately 2.2 quarts (2.1 liters)
Oil filter	Volvo Penta P/N 835440
Oil filter location	Refer to photographs on pages 22 through 23.
Oil type	
Engine	DuraPlus™ Premium engine oil labeled for API service CE/SG
Drive unit	DuraPlus GL 5 synthetic gear lube
Power steering fluid	DuraPlus power steering fluid
Spark plugs	Volvo Penta P/N 3854399
Spark plug gap	0.045 inches (1.14 mm)
Spark plug installation torque	20 ft. lb. (27 N•m)

4.3 GL/Gi

Battery size	12 volt with 360 Cold Cranking Amp (CCA) rating
Bore and stroke	4.000 x 3.480 in. (101.60 x 88.39 mm)
Carburetor (GL)	Adjustable idle circuit Fixed main fuel jets Electric choke
Charging system	65 amp alternator, with internal transistorized voltage regulator
Cooling system	Variable volume pump on engine Recirculating pump on engine Thermostatically controlled temperature
Cylinders (number)	90° V-6
Displacement	262 cubic inches (4.3 liters)
Firing order	1 – 6 – 5 – 4 – 3 – 2
Fuel filter	Volvo Penta P/N 3852413
Fuel filter location	Refer to photographs on pages 24 through 27.
Fuel type	Inside the U.S.: 89 octane (AKI) unleaded gasoline Outside the U.S.: 93 octane (RON) unleaded gasoline
Full throttle operating range	4200 – 4600 RPM
Idle RPM	GL: 550 – 650 RPM in forward gear Gi: 600 RPM
Ignition timing	Authorized Volvo Penta dealer service only
Oil capacity	
Engine	Without filter: 4 quarts (3.8 liters) With filter: 4.5 quarts (4.3 liters)
Drive unit	SX: approximately 2.2 quarts (2.1 liters) DP: approximately 2.5 quarts (2.4 liters)
Oil filter	Volvo Penta P/N 841750
Oil filter location	Refer to photographs on pages 24 through 27.
Oil type	
Engine	DuraPlus™ Premium engine oil labeled for API service CE/SG
Drive unit	DuraPlus GL 5 synthetic gear lube
Power steering fluid	DuraPlus power steering fluid
Spark plugs	Volvo Penta P/N 3854399
Spark plug gap	0.045 inches (1.14 mm)
Spark plug installation torque	20 ft. lb. (27 N•m)

5.0 GL/Gi

Battery size	12 volt with 650 Cold Cranking Amp (CCA) rating
Bore and stroke	3.740 x 3.480 inches (95.00 x 88.39 mm)
Carburetor (GL)	Adjustable idle circuit Fixed main fuel jets Electric choke
Charging system	65 amp alternator, with internal transistorized voltage regulator
Cooling system	Variable volume pump on engine Recirculating pump on engine Thermostatically controlled temperature
Cylinders (number)	90° V-8
Displacement	305 cubic inches (5.0 liters)
Firing order	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2
Fuel filter	Volvo Penta P/N 3852413
Fuel filter location	Refer to photographs on pages 24 through 27.
Fuel type	Inside the U.S.: 89 octane (AKI) unleaded gasoline Outside the U.S.: 93 octane (RON) unleaded gasoline
Full throttle operating range	GL: 4400 – 4800 RPM Gi: 4600 – 5000 RPM
Idle RPM (fixed)	GL: 4400 – 4800 RPM Gi: 600 RPM
Ignition timing	Authorized Volvo Penta dealer service only
Oil capacity	
Engine	Without filter: 5 quarts (4.7 liters) With filter: 6 quarts (5.7 liters)
Drive unit	SX: approximately 2.2 quarts (2.1 liters) DP: approximately 2.5 quarts (2.4 liters)
Oil filter	Volvo Penta P/N 3850559
Oil filter location	Refer to photographs on pages 24 through 27.
Oil type	
Engine	DuraPlus™ Premium engine oil labeled for API service CE/SG
Drive unit	DuraPlus GL 5 synthetic gear lube
Power steering fluid	DuraPlus power steering fluid
Spark plugs	Volvo Penta P/N 3854399
Spark plug gap	GL – 0.35 inches (0.89 mm) Gi – 0.045 inches (1.14 mm)
Spark plug installation torque	20 ft. lb. (27 N•m)

5.7 GS/GSi

Battery size	12 volt with 650 Cold Cranking Amp (CCA) rating
Bore and stroke	4.000 x 3.480 inches (101.60 x 88.39 mm)
Carburetor (GS)	Adjustable idle circuit Fixed main fuel jets Electric choke
Charging system	65 amp alternator, with internal transistorized voltage regulator
Cooling system	Variable volume pump on engine Recirculating pump on engine Thermostatically controlled temperature
Cylinders (number)	90° V-8
Displacement	350 cubic inches (5.7 liters)
Firing order	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2
Fuel filter	Volvo Penta P/N 3852413
Fuel filter location	Refer to photographs on pages 24 through 27.
Fuel type	Inside the U.S.: 89 octane (AKI) unleaded gasoline Outside the U.S.: 93 octane (RON) unleaded gasoline
Full throttle operating range	GS: 4400 – 4800 RPM GSi: 4600 – 5000 RPM
Idle RPM (fixed)	GS: 550 – 650 RPM in forward gear GSi: 600 RPM
Ignition timing	Authorized Volvo Penta dealer service only
Oil capacity	
Engine	Without filter: 5 quarts (4.7 liters) With filter: 6 quarts (5.7 liters)
Drive unit	SX: approximately 2.2 quarts (2.1 liters) DP: approximately 2.5 quarts (2.4 liters)
Oil filter	Volvo Penta P/N 3850559
Oil filter location	Refer to photographs on pages 24 through 27.
Oil type	
Engine	DuraPlus™ Premium engine oil labeled for API service CE/SG
Drive unit	DuraPlus GL 5 synthetic gear lube
Power steering fluid	DuraPlus power steering fluid
Spark plugs	Volvo Penta P/N 3854399
Spark plug gap	GS – 0.035 inches (0.89 mm) GSi – 0.045 inches (1.14 mm)
Spark plug installation torque	20 ft. lb. (27 N•m)

7.4 Gi/GSi; 8.2 GSi

Battery size	12 volt with 650 Cold Cranking Amp (CCA) rating
Bore and stroke	4.250 x 4.000 inches (107.95 x 101.60 mm)
Charging system	65 amp alternator, with internal transistorized voltage regulator
Cooling system	Variable volume pump on engine Recirculating pump on engine Thermostatically controlled temperature
Cylinders (number)	90° V-8
Displacement	454 cubic inches (7.4 liters)
Firing order	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2
Fuel filter	Volvo Penta P/N 3852413
Fuel filter location	Refer to photographs on pages 28 through 29.
Fuel type	Inside the U.S.: 89 octane (AKI) unleaded gasoline Outside the U.S.: 93 octane (RON) unleaded gasoline
Full throttle operating range	Gi: 4200 – 4600 RPM GSi: 4800 – 5200 RPM
Idle RPM (fixed)	600 RPM
Ignition timing	Authorized Volvo Penta dealer service only
Oil capacity	
Engine	Without filter: 8 quarts (7.5 liters) With filter: 9 quarts (8.5 liters)
Drive unit	SX: approximately 2.2 quarts (2.1 liters) DP: approximately 2.5 quarts (2.4 liters)
Oil filter	Volvo Penta P/N 3850559
Oil filter location	Refer to photographs on pages 28 through 29.
Oil type	
Engine	DuraPlus™ Premium engine oil labeled for service CE/SG
Drive unit	DuraPlus GL 5 synthetic gear lube
Power steering fluid	DuraPlus power steering fluid
Spark plugs	7.4 Gi — Volvo Penta P/N 3854399 7.4, 8.2 GSi — Volvo Penta P/N 3854400
Spark plug gap	0.045 inches (1.14 mm)
Spark plug installation torque	20 ft. lb. (27 N•m)

DPX 385; DPX 415

Battery size	12 volt with 650 Cold Cranking Amp (CCA) rating
Bore and stroke	DPX 385: 4.250 x 4.000 inches (107.95 x 101.60 mm) DPX 415: 4.468 x 4.000 inches (113.49 x 101.60 mm)
Charging system	65 amp alternator, with internal transistorized voltage regulator
Cooling system	Variable volume pump on engine Recirculating pump on engine Thermostatically controlled temperature
Cylinders (number)	90° V-8
Displacement	DPX 385: 454 cubic inches (7.4 liters) DPX 415: 502 cubic inches (8.2 liters)
Firing order	1 – 8 – 4 – 3 – 6 – 5 – 7 – 2
Fuel filter	Volvo Penta P/N 3852413
Fuel filter location	Refer to photographs on pages 30 through 31.
Fuel type	Inside the U.S.: 89 octane (AKI) unleaded gasoline Outside the U.S.: 93 octane (RON) unleaded gasoline
Full throttle operating range	DPX 385: 4800 – 5200 RPM DPX 415: 4600 – 5000 RPM
Idle RPM (fixed)	600 RPM
Ignition timing	Authorized Volvo Penta dealer service only
Oil capacity	
Engine	Without filter: 8 quarts (7.5 liters) With filter: 9 quarts (8.5 liters)
Drive unit	Approximately 2.06 quarts (2.0 liters)
Oil filter	Volvo Penta P/N 3850559
Oil filter location	Refer to photographs on pages 30 through 31.
Oil type	
Engine	DuraPlus™ Premium engine oil labeled for service CE/SG
Drive unit	DuraPlus GL 5 synthetic gear lube
Power steering fluid	DuraPlus power steering fluid
Spark plugs	Volvo Penta P/N 3854400
Spark plug gap	0.045 inches (1.14 mm)
Spark plug installation torque	20 ft. lb. (27 N•m)

APPENDIX A: CERTIFIED ENGINES AND BSO NUMBERS

Certified engines

The following information concerns engines certified for European use on Lake Constance and in Switzerland.

All Volvo Penta engines and products have been developed on the basis that they should have as little an impact on the environment as possible. However, national and regional environmental legislation is different for all the markets where Volvo Penta sells its products. Sometimes legislation determines that we have to build special engines, or that the engine must be approved in advance and certified by the authorities.

The fact that the engine is certified means that Volvo Penta, as the engine manufacturer, ensures that all the engines it manufactures meet the sample engine approved for certification. Certification does not just cover requirements with respect to factory-new engines: Certified engines already in operation must also be able to meet environmental requirements. Certain requirements with respect to servicing and spare parts must be met in order that Volvo Penta as engine manufacturer will be able to assume responsibility for engines in operation.

Volvo Penta does not advise you against carrying out service yourself. In fact, Volvo Penta views it as an advantage because you have the opportunity to find out quickly whether any components are not working or are working abnormally. However, special expertise, service manuals, special tools and other suitable equipment are required in order to be able to perform some service checks. Only an authorized Volvo Penta service dealer must carry out these service checks. Always contact your Volvo Penta dealer if you are unsure of anything to do with your engine's function or maintenance.

Those of you who own or maintain a certified Volvo Penta engine must be aware of the following:

- Service intervals and maintenance by Volvo Penta must be adhered to.
- Only Volvo Penta genuine parts intended for certified engine may be used.
- An authorized Volvo Penta service dealer must always service the ignition system (ignition timing) and the fuel injection system.
- The engine must not be rebuilt or in any way modified, with the exception of the accessories and serviceable units developed for the engine by Volvo Penta.
- Changes to the installation of exhaust pipes and intake air ducts to the engine compartment (ventilation ducts) must not be implemented, as this may affect exhaust emissions.
- Unauthorized personnel must not break any seals present.

Note: Use only Volvo Penta genuine parts when you need spare parts. Using non-genuine parts means that AB Volvo Penta can no longer assume responsibility for an engine meeting the certified design. Volvo Penta will not assume any responsibility for any kind of damage or costs due to non-genuine Volvo Penta service parts being used for the product in question.

Bodensee Schifffahrts Ordnung (BSO) number

Your engine may have an assigned Bodensee Schifffahrts Ordnung (BSO) number. A BSO number is assigned to an engine model when it is certified for European use on Lake Constance and in Switzerland. There are two BSO certification decals placed on the engine, one on the starboard high-rise bracket and the other on the front of the port cylinder head to verify engine certification. These decals must be maintained so engine certification can be verified in the future.

When an emissions check is required, the plug located on either high-rise elbow can be removed for installation of a test probe.

