

Installation

Sterndrive Gasoline Engines

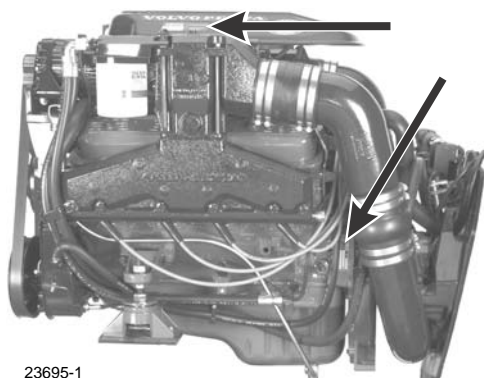
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Sterndrive Engines:	V6-200, 225
	V8-270, 300, 320
Transom Shields:	TSK, TSK-AC, TSK-OX
Sterndrives:	SX, DPS, DPS-OX

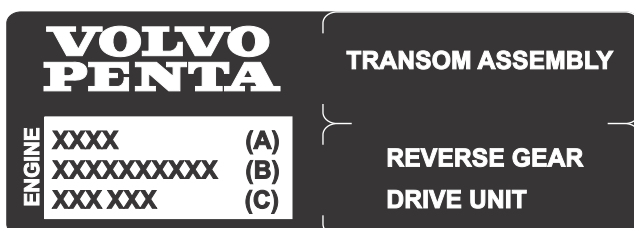
Model Identification

This installation manual applies to the products listed in the following tables. The unit that you are installing may be identified from the product model identification plates and/or decals that are placed in various locations to identify Volvo Penta engines, transmissions, transom shields, and drives.

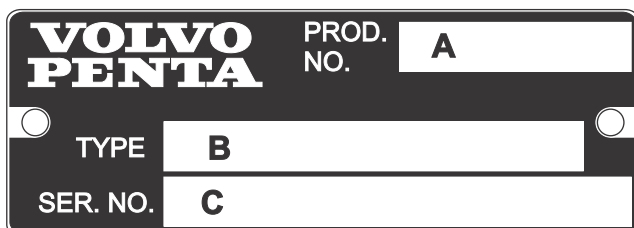
All sterndrive system components must be matched for either single or dual engine installations. Failure to properly match engine, transmission, transom shield, and drive unit will result in poor boat performance, and risk damage to engine and drive because of incorrect drive gear ratio.



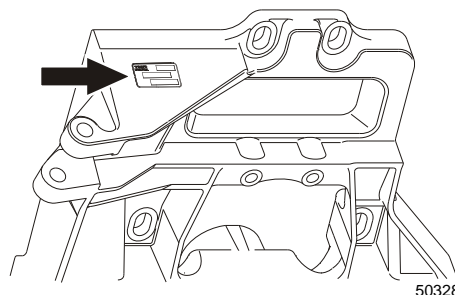
For all other engines, the model identification plate or decal is located either on the port side of the engine cover and/or next to the flywheel housing.



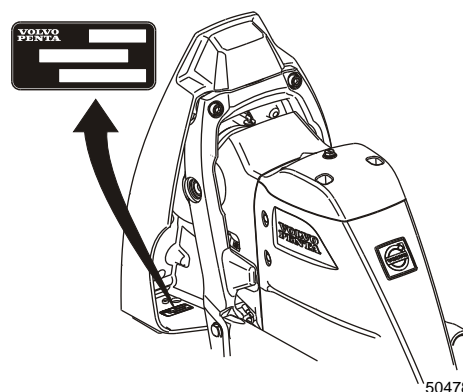
The engine decal is located on the engine cover.



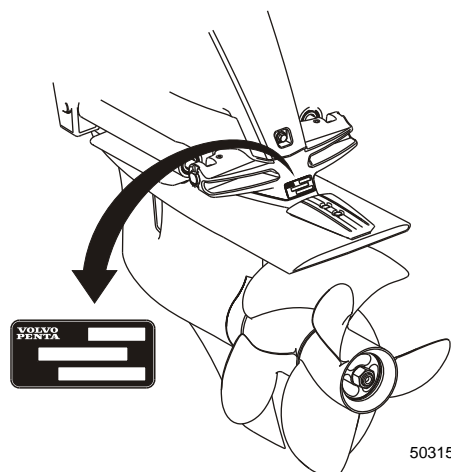
The engine data plate (hard tag) is located on the port side engine block just forward of the flywheel housing.



The XP transom shield identification plate is located on the inner transom plate, above the steering ram.



The SX-A transom identification plate is located on the lower left of the outer transom plate.



The identification plate for the SX-A/DPS-A sterndrives are located on the rear of the upper gear, just above the parting line between the upper and lower gear housing.

The *Engines, Transom Shields, & Drives* table provides a list of engines and the transom shields and drives that are compatible with each engine. **Selections that are in bold text denote standard packages.** Selections in regular text denote nonstandard or optional packages.

You may mix and match any combination of engines, transom shields and drives, as long as you select from the boxes immediately to the right of the box containing the engine model designation.

For example, a V8-270-B engine **1** may be used with a TSK transom shield **2** (standard) and a DPS drive with a 1.78:1 gear ratio **3** (nonstandard).

V8-270-B (40869481)	TSK-B-52 (21849410)	DPS-B (21766684)	(1.95:1)
	TSK-B-AC-52 (21849413)	DPS-B (21615542)	(1.78:1)

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NOTE! Any non-approved combinations of components is not an acceptable use of Volvo Penta products and will void the warranty on the products. You must use the combinations provided by these tables when selecting the product packages.

Legend of Symbols Used in Tables

Following is a list of symbols used to denote special information related to available products.

- † Limited trim to 42°
- †† Limited trim to 32°
- ‡ Active Corrosion Protection
- + High Altitude, Over 3,500 ft. (1066 m)
- ++ High Altitude, Over 5,000 ft. (1524 m)
- +++ Special Applications Only
- SX 1.51 allowed **only** on V8-320 boats faster than 45 MPH.
- * Optional Drive
- ^a Not SAV certified for Lake Constance

Engines, Transom Shields, & Drives				
Engine Model (Spec #)	TSK Model (Spec #)	Drive Model	Spec #	(Gear Ratio)
V6-200-A (40869407)	TSK-B-52 (21849410) TSK-B-42 (21849411) † TSK-B-32 (21849412) †† TSK-B-AC-52 (21849413) ‡ TSK-B-AC-42 (21849414) ‡‡ TSK-B-AC-32 (21849415) ‡‡‡	SX-A	3883601	(1.60:1)
		SX-A	3883602	(1.66:1)
		SX-A	3883623	(1.79:1)
		SX-A	3883604	(1.89:1)+
		SX-A	3883603	(1.97:1)+
		DPS-B	21766684	(1.95:1)
		DPS-B	21766685	(2.14:1)+++
		DPS-B	21615545	(2.32:1)
V6-225-A (40869408)	TSK-B-52 (21849410) TSK-B-42 (21849411) † TSK-B-32 (21849412) †† TSK-B-AC-52 (21849413) ‡ TSK-B-AC-42 (21849414) ‡‡ TSK-B-AC-32 (21849415) ‡‡‡	SX-A	3883601	(1.60:1)
		SX-A	3883602	(1.66:1)
		SX-A	3883623	(1.79:1)
		SX-A	3883604	(1.89:1)+
		SX-A	3883603	(1.97:1)+
		DPS-B	21766684	(1.95:1)
		DPS-B	21766685	(2.14:1)+++
		DPS-B	21615545	(2.32:1)
V6-225-E-A (40869409) (EVC-E2)	TSK-B-52 (21849410) TSK-B-42 (21849411) † TSK-B-32 (21849412) †† TSK-B-AC-52 (21849413) ‡ TSK-B-AC-42 (21849414) ‡‡ TSK-B-AC-32 (21849415) ‡‡‡	SX-A	3883601	(1.60:1)
		SX-A	3883602	(1.66:1)
		SX-A	3883623	(1.79:1)
		SX-A	3883604	(1.89:1)+
		SX-A	3883603	(1.97:1)+
		DPS-B	21766684	(1.95:1)
		DPS-B	21766685	(2.14:1)+++
		DPS-B	21615545	(2.32:1)
V8-270-B (40869481)	TSK-B-52 (21849410) TSK-B-42 (21849411) † TSK-B-32 (21849412) †† TSK-B-AC-52 (21849413) ‡ TSK-B-AC-42 (21849414) ‡‡ TSK-B-AC-32 (21849415) ‡‡‡	SX-A	3883600	(1.51:1)
		SX-A	3883601	(1.60:1)
		SX-A	3883602	(1.66:1)+
		SX-A	3883623	(1.79:1)+
		DPS-B	21615542	(1.78:1)
		DPS-B	21766684	(1.95:1)
		DPS-B	21766685	(2.14:1)+++
		DPS-B	21615545	(2.32:1)++
	TSK-B-OX-52 (21849416) TSK-B-OX-42 (21849417) TSK-B-OX-32 (21849418)	DPS-B OX	21615549	(1.78:1)
		DPS-B1 OX	22104470	(1.95:1)
		DPS-B1 OX	22104457	(2.14:1)
		DPS-B1 OX	22090414	(2.32:1)

Engines, Transom Shields, & Drives (Continued)				
Engine Model (Spec #)	TSK Model (Spec #)	Drive Model	Spec #	(Gear Ratio)
V8-270-E-B (40869482) (EVC-E2)	TSK-B-52 (21849410) TSK-B-42 (21849411) † TSK-B-32 (21849412) ††	SX-A	3883600	(1.51:1)
		SX-A	3883601	(1.60:1)
		SX-A	3883602	(1.66:1)+
		SX-A	3883623	(1.79:1)+
	TSK-B-AC-52 (21849413)‡ TSK-B-AC-42 (21849414)‡† TSK-B-AC-32 (21849415)‡††	DPS-B	21615542	(1.78:1)
		DPS-B	21766684	(1.95:1)
		DPS-B	21766685	(2.14:1)+++
		DPS-B	21615545	(2.32:1)++
	TSK-B-OX-52 (21849416) TSK-B-OX-42 (21849417) TSK-B-OX-32 (21849418)	DPS-B OX	21615549	(1.78:1)
		DPS-B1 OX	22104470	(1.95:1)
		DPS-B1 OX	22104457	(2.14:1)
		DPS-B1 OX	22090414	(2.32:1)
V8-300-B (40869485)	TSK-B-52 (21849410) TSK-B-42 (21849411) † TSK-B-32 (21849412) ††	SX-A	3883600	(1.51:1)
		SX-A	3883601	(1.60:1)++
		DPS-B	21615542	(1.78:1)
		DPS-B	21766684	(1.95:1)
	TSK-B-AC-52 (21849413)‡ TSK-B-AC-42 (21849414)‡† TSK-B-AC-32 (21849415)‡††	DPS-B	21766685	(2.14:1)+++
		DPS-B	21615545	(2.32:1)++
		DPS-B OX	21615549	(1.78:1)
		DPS-B1 OX	22104470	(1.95:1)
	TSK-B-OX-52 (21849416) TSK-B-OX-42 (21849417) TSK-B-OX-32 (21849418)	DPS-B1 OX	22104457	(2.14:1)
		DPS-B1 OX	22090414	(2.32:1)
V8-300-E-B (40869486) (EVC-E2)	TSK-B-52 (21849410) TSK-B-42 (21849411) † TSK-B-32 (21849412) ††	SX-A	3883600	(1.51:1)
		SX-A	3883601	(1.60:1)++
		DPS-B	21615542	(1.78:1)
		DPS-B	21766684	(1.95:1)
	TSK-B-AC-52 (21849413)‡ TSK-B-AC-42 (21849414)‡† TSK-B-AC-32 (21849415)‡††	DPS-B	21766685	(2.14:1)+++
		DPS-B	21615545	(2.32:1)++
		DPS-B OX	21615549	(1.78:1)
		DPS-B1 OX	22104470	(1.95:1)
	TSK-B-OX-52 (21849416) TSK-B-OX-42 (21849417) TSK-B-OX-32 (21849418)	DPS-B1 OX	22104457	(2.14:1)
		DPS-B1 OX	22090414	(2.32:1)
V8-320-B (40869487)	TSK-B-52 (21849410) TSK-B-42 (21849411) † TSK-B-32 (21849412) ††	SX-A	3883600	(1.51:1)
		SX-A	3883601	(1.60:1)++
		DPS-B	21615542	(1.78:1)
		DPS-B	21766684	(1.95:1)
	TSK-B-AC-52 (21849413)‡ TSK-B-AC-42 (21849414)‡† TSK-B-AC-32 (21849415)‡††	DPS-B	21766685	(2.14:1)+++
		DPS-B	21615545	(2.32:1)++
		DPS-B OX	21615549	(1.78:1)
		DPS-B1 OX	22104470	(1.95:1)
	TSK-B-OX-52 (21849416) TSK-B-OX-42 (21849417) TSK-B-OX-32 (21849418)	DPS-B1 OX	22104457	(2.14:1)
		DPS-B1 OX	22090414	(2.32:1)

Engines, Transom Shields, & Drives (Continued)

Engine Model (Spec #)	TSK Model (Spec #)	Drive Model	Spec #	(Gear Ratio)
V8-320-E-B (40869488) (EVC-E2)	TSK-B-AC-52 (21849413)‡ TSK-B-AC-42 (21849414)‡‡ TSK-B-AC-32 (21849415)‡‡‡ TSK-B-OX-52 (21849416) TSK-B-OX-42 (21849417) TSK-B-OX-32 (21849418)	SX-A	3883600	(1.51:1)
		SX-A	3883601	(1.60:1)++
		DPS-B	21615542	(1.78:1)
		DPS-B	21766684	(1.95:1)
		DPS-B	21766685	(2.14:1)+++
		DPS-B	21615545	(2.32:1)++
		DPS-B OX	21615549	(1.78:1)
		DPS-B1 OX	22104470	(1.95:1)
		DPS-B1 OX	22104457	(2.14:1)
		DPS-B1 OX	22090414	(2.32:1)

Emission related installation instructions

Starting January 1st, 2010, Volvo Penta of the Americas is required by the United States Environmental Protection Agency (EPA) to publish the following emission related information for installing Volvo Penta Gasoline engines in pleasure boats intended for use in the United States.

Failing to follow these instructions when installing a certified engine in a vessel violates federal law (40 CFR 1068.105(b)), subject to fines or other penalties as described in the Clean Air Act.

Instructions needed to properly install the exhaust system are found in *Exhaust Pipe Installation* in the *Engine* section of this installation manual.

Evaporative emissions - the installer and/or vessel manufacturer must meet the requirements of §1045.112 and 40 CFR part 1060.

If you install the engine in a way that makes the engine's emission control information label hard to read during normal engine maintenance, you must place a duplicate label on the vessel, as described in 40 CFR 1068.105.

Safety Information

Read this chapter carefully. It concerns your safety. This section describes how safety information is presented in this installation manual and on the engine. It also gives a general account of basic safety precautions to be taken when installing the engine, transom shield kit, and sterndrive.




Check that you have the correct installation manual before you read on.



This symbol is used in the book and on the engine to make you aware of safety information. Always read these safety precautions very carefully.

Incorrectly performed operations could result in personal injury, damage to property, or harm the engine. Read the installation manual carefully before proceeding with any of the procedures described. If anything is unclear, please contact your Volvo Penta dealer representative for assistance.

In the installation manual warning texts have the following priority:

-  **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.
- NOTE!** Used to draw your attention to important information that will facilitate work or procedures.

General Information

This manual contains information you need to install an engine, transom shield kit, and sterndrive safely. Check that you have the correct manual for the engine application you are installing.

If you do not understand or are uncertain about any operation or information in this installation manual, please contact Volvo Penta dealer representative for assistance.

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 workshop practices and proper accident prevention measures!

Warning Symbols Used in this Manual

Following is a list of symbols used in this manual as a quick reference visual warning of the dangers and risks associated with carrying out certain activities.



High Pressure: Fluid or gas may be ejected under a great deal of pressure causing damage to metals, fabrics, or human tissue.



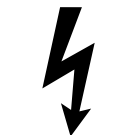
Corrosive: Fluids, gases, or solids that can damage metals, fabrics, or human tissue through decay.



Toxic: Gases or other airborne corrosives that can damage human tissue, cause ill health, or endanger life.



Poisonous: Fluids, gases, or solids that, through a chemical reaction, can damage metals, fabrics, or human tissue.



Electrical: Danger of electrical discharge or shock which can cause burns or other serious injury.



Flammable: Fluids, gases, or solids that can—depending upon the degree of confinement—burn or explode upon ignition.



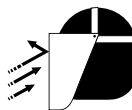
Explosive: Fluids, gases, or solids that can—depending upon the degree of confinement—burn or explode upon ignition.



Fan Belts: Loose clothing, hair, fingers or a dropped tool can be caught in revolving belts and cause serious personal injury.



Rotating Fan: Loose clothing, hair, fingers or a dropped tool can be caught in rotating parts and cause serious personal injury.



Face Mask: Highly recommended that you wear a face shield, goggles, and/or respirator to protect face, eyes, and/or lungs.



Face Wash: Wash affected body area immediately using plenty of soap and water and seek medical assistance as necessary.



Gloves: Highly recommended that you wear protective gloves while engaging in activities that may harm your hands.



Hot Surface: Hot objects, (engine block, exhaust manifold, starter element, etc.) can cause burns and other serious injury.



No Smoking: By smoking in areas where these signs are posted, you risk starting a fire or causing an explosion.



No Open Flames: By using an open flame in areas where these signs are posted, you risk starting a fire or causing an explosion.

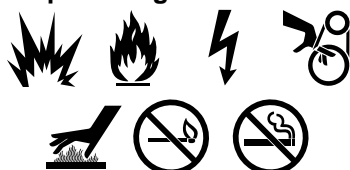
Safety Precautions (Maintenance and Service)

The following sections summarize the risks associated with carrying out certain activities while installing the engine, transom shield kit, and sterndrive, as well as the safety precautions you should always observe while engaged in these activities. **Never carry out any of the procedures described in this installation manual if you are unsure of how it should be done; contact your Volvo Penta dealer representative for assistance.**

Engine Decals

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

Stop the Engine



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

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

Approaching or working on an engine that is running is dangerous. Loose clothing, hair, fingers or a dropped tool can be caught in the rotating parts of the engine and cause serious personal injury.

If work must be carried out on an operating engine, always be extremely cautious around moving or hot parts.

Cleaning the Engine



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

Lifting the Engine



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.

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. Never carry out work on an engine suspended on a hoist.

Before Starting the Engine



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

⚠ DANGER! To prevent a possible explosion hazard, operate the engine compartment/ bilge 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 so as to disperse any gasoline fumes that may be present. Leave the hatch open until after the engine is running.

Fire and Explosion

Fuel and Lubrication Oil



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

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

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

Do not smoke when filling fuel, oil, or while in the proximity of a filling station or in the engine room.

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.

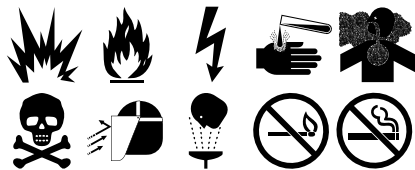
Non-Original Components



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.

Batteries



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

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

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

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

Starting Fluid (Ether)



Never use starting fluid (Ether) or similar agents to start an engine. This may cause an explosion in the inlet manifold.

Hot Surfaces and Fluids



There is always a risk of burns when working with a hot engine. Beware of hot surfaces (for example: the exhaust pipe and manifold, oil pan, starter element, hot coolant, and hot oil in oil lines and hoses).

Always turn off the engine 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.

Carbon Monoxide Poisoning



Only start the engine in a well-ventilated area. If operating the engine in an enclosed space, ensure that there is proper ventilation in order to remove exhaust gases and crankcase ventilation emissions from the working area. Please see *Station Wagon Effect & Carbon Monoxide* on page 11 for additional information.

Chemicals



Most chemicals such as anti-freeze, rust-proofing agents, inhibiting oils, degreasing agents, etc., are hazardous to your health. Read and follow the instructions on the packaging.

Some chemicals such as inhibiting oil are flammable and toxic if breathed. Ensure good ventilation and use a protective mask when spraying.

Read and follow the instructions on the packaging. Store chemicals and other hazardous materials out of the reach of children. To protect the environment please dispose of used or leftover chemicals at a properly designated disposal site for destruction.

Cooling System



There is a risk of flooding when working on the seawater system. Turn off the engine and close the sea cock (where installed) before starting work on the system.

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.

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

Lubrication System



Hot oil can cause burns. Avoid skin contact with hot oil. Ensure that the lubrication system is not under pressure before commencing work on it. Never start or operate the engine with the oil filler cap removed; hot oil could spray out.

Fuel System



Always use protective gloves when tracing leaks. Liquids ejected under pressure can penetrate body tissue and cause serious injury. There is also a danger of blood poisoning.

Always cover the alternator if it is located under the fuel filter. The alternator can be damaged by spilled fuel.

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.

Electrical System



Always stop the engine and break the current using the main switches before working on the electrical system. Isolate shore current to the engine block heater, battery charger, or accessories mounted on the engine.

Refuelling



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

Always use fuel recommended by Volvo Penta. The use of lower quality fuels can damage the engine.

Do not Start the Engine



Do not start or run the engine with a suspected fuel or LPG leak in the boat, nor when you are close to or in a discharge of explosive media, etc. There is risk of fire and/or explosion in explosive surroundings.

Station Wagon Effect & Carbon Monoxide



When a boat is moving forward, it will cause a certain vacuum to form behind the boat. In unfortunate circumstances, the suction from this vacuum—called “station wagon” effect—can be so great that the exhaust gases from the boat are drawn into the cockpit or cabin, causing carbon monoxide poisoning.

This problem is most prevalent on boats with sheer, broad transoms and high superstructures. In certain conditions, however, this suction can be a problem on other boats (e.g., when running with the cover up). Other factors that can increase the effect of the suction are wind conditions, load distribution, swells, trim, open hatches and portholes, and so on.

Most modern boats, however, are designed in such a way that this problem is very rare. If suction should arise anyway, open forward hatches or portholes. Try changing speed, trim, or load distribution instead. Try disassembling, opening, or in any other way changing the setup of the cover as well.

If you suspect that the boat exhibits this “station wagon” effect, please contact your Volvo Penta dealer representative for help in achieving the best solution for the boat.

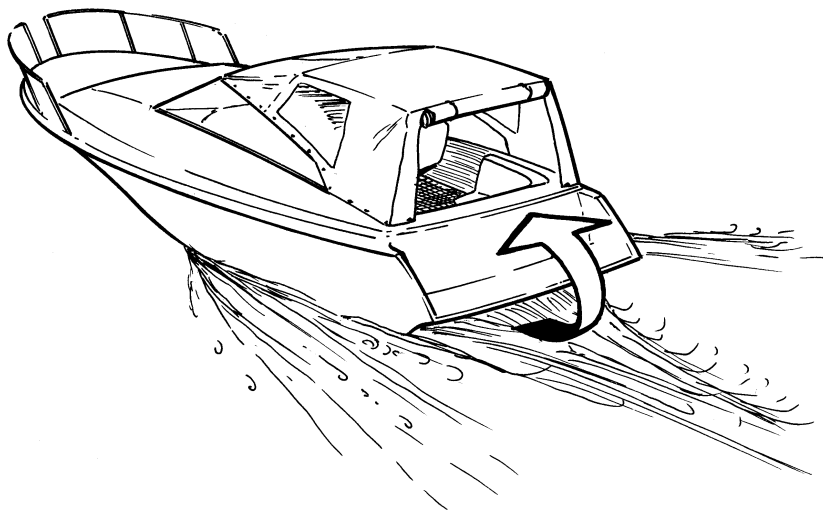
⚠ WARNING! Do not run the engine while there are people located on or near the swim platform and transom.

⚠ DANGER! DO NOT tow anyone using water sports equipment (such as skis and inner tubes) closer than twenty feet (20') from the boat. DO NOT, under any circumstances, allow people to “body surf” using the swim platform as a means of being pulled along.

Travelling at slow or idle speeds may cause carbon monoxide to accumulate in and around the boat, especially if there is a tailwind.

Carbon monoxide accumulation is particularly likely when running the engine while docked. Be sure to minimize the amount of time spent at the dock while the engine is running.

NOTE! We recommend that you install a good quality carbon monoxide detector aboard the boat, in accordance with ABYC recommended practices.



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About this Manual

This installation manual covers Volvo Penta equipment manufactured by Volvo Penta to be used on Volvo Penta products. Any use other than those specified in these instructions may give unpredictable results. These instructions provide the installer with the necessary information to make a single or dual engine installation of a Volvo Penta sterndrive.

In addition to this manual, publication 7748456 *Installation EVC-C Gas* or *Installation Poster EVC-C Gas* 7748450, are required for EVC installations.

Proper preparation is extremely helpful for efficient service work. A clean work area at the start of the job will minimize tools and parts becoming misplaced. Before you start work, gather all tools, instruments, and parts needed for the job. Interrupting a job to locate special tools or repair kits causes needless delay.

⚠ CAUTION! Using an installation procedure or tool that is not recommended in this manual may jeopardize the installers's and/or user's safety. If you are unsure about an installation procedure or you wish to use a procedure other than those provided in this manual, please contact your Volvo Penta dealer representative to discuss alternative methods. Any damage to the engine, transom shield, and drive as a result of non-recommended installation practices will not be covered under the Volvo Penta warranty.

This sterndrive marine propulsion system, as manufactured, meets or exceeds all applicable U.S. Federal Regulations covering recreational boats as required under Title 46 of the United States Code enacted by Public Law 98-89, August 26, 1983. The requirements under this Code encompass all recreational boats to be sold in the United States, Guam, Puerto Rico, the Virgin Islands, American Samoa, the District of Columbia, the Northern Mariana Islands, and any other territories or possessions of the United States.

Three technical booklets of special importance to help boat manufacturers understand and comply with these U.S. Federal Regulations are:

- Electrical System Compliance Guideline, AD/A-049-638
- Fuel System Compliance Guideline, AD/A-047-767
- Ventilation System Compliance Guideline, AD/A-114-507

These and other technical publications are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, Virginia 22161; (703) 487-4650

Telephone NTIS to obtain a quotation coding and cost of publication. This information must be included with your booklet order.

Service Policy

Whether within or following the warranty period, Volvo Penta has a constant interest in its products.

It is Volvo Penta's policy to provide dealers with service knowledge so they can give professional service demanded by today's consumer. The Volvo Penta service schools, frequent mailing of service bulletins, letters and promotions, special tools, and these instructions represent Volvo Penta's efforts in giving consumers the best and most prompt service possible. If a service question does not appear to be answered in these instructions, you are invited to call, write, or e-mail the Volvo Penta Service Department for additional help. Always be sure to give complete information, including engine model and serial number.

Be sure you are familiar with Volvo Penta's warranty. If you have any questions, call, write, or e-mail the Volvo Penta Service Department. If other than genuine Volvo Penta parts and components are used, Volvo Penta may refuse subsequent warranty claims involving that engine.

When a brand-name product or particular tool is specified, another item may be used. However, the substitute must have equivalent characteristics, including type, strength, and material. You must determine if incorrect substitution could result in product malfunction and personal injury to anyone. To avoid hazards, any equivalent products used must meet all U.S. Coast Guard Safety Regulations and ABYC standards.

Volvo Penta has specially-designed tools to simplify some disassembly and assembly operations. These special tools are listed in this instruction. All Volvo Penta special tools may be ordered from Volvo Penta Parts Order.

Warranty Responsibility

NOTE! It is the responsibility of the boat manufacturer, dealer, or engine installer to position and install the sterndrive and engine properly. An installation that permits water to enter the engine through the exhaust manifold(s) will not be covered by warranty unless damage is due to defective part(s).

References, Illustrations and Specifications

Volvo Penta reserves the right to make changes at any time, without notice, to specifications, models, and procedures. Also, we retain the right to change any specifications or parts at any time without incurring any obligation to equip same models manufactured prior to date of such change. All information, illustrations, and specifications contained in these instructions are based on the latest information available at the time of printing.

Photographs and illustrations used in this instruction may not depict actual models or equipment. The continuing accuracy of this installation instruction cannot be guaranteed.

Use the general torque specification for all fasteners unless otherwise specified in the instructions.

Carefully observe the safety alert symbols provided in the chapter entitled *Warning Symbols Used in this Manual* on page 6 for dangers, warnings, and cautions. They alert installers and operators of possible dangers or important information contained in this manual.

Warnings alone do not eliminate hazards, nor are they a substitute for safe boat handling and proper accident prevention measures!

Transom Cutout

Prepare for Installation

Follow these steps in the order listed to perform a complete installation of a Volvo Penta transom shield assembly:

1. Prepare for installation
2. Locate transom centerline
3. Locate transom baseline and X-dimension
4. Drill and cut transom
5. Ensure transom core material is free of voids
6. Finish transom cutout area

Read installation instructions completely, and collect all tools, instruments, and parts needed for the job before you start work.

Special Tools

- Transom Drill Fixture Part No. 3851081
- OR
- Paper Transom Template Part No. 7746008

Tools

- Portal align drilling fixture
- ¼ in. drill bit 12 in. long
- Electric drill with ½ in. (12 mm) chuck
- Drill bits
- 11/32 in. (8.73 mm)
- 9/16 in. (14.28 mm)
- Electric reciprocating saw or sabre saw (e.g. Sawzall)
- Hole saw
- 1 in. (25.5 mm)
- 1-¾ in. (45 mm)
- Combination level/protractor
- Carpenter's square
- Protractor
- Drift punch
- Hammer

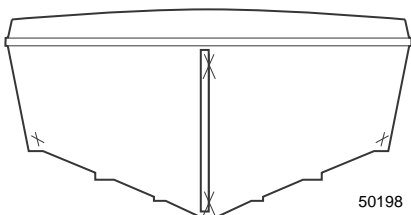
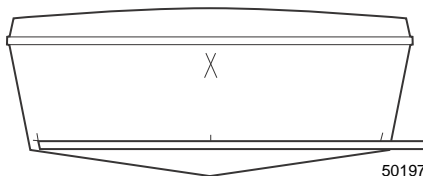
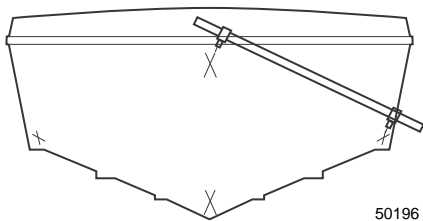
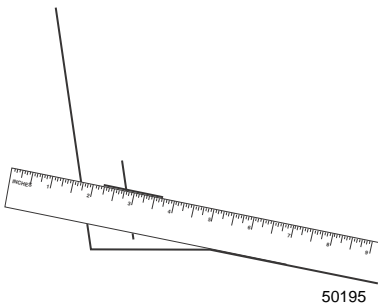
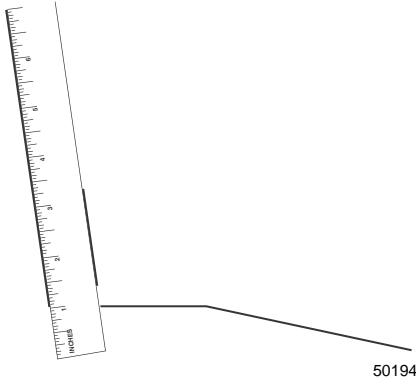
Transom Dimension Limits

Before beginning the installation, it is the installer's responsibility to determine that the boat transom meets the following requirements:

- Maximum transom thickness: 2-¼ in. (57 mm)
- Minimum transom thickness: 1-¾ in. (44 mm)

- Inside transom area must be flat within 1/8 in. (3.17 mm)
- Outside transom area must be flat within 1/16 in. (1.57 mm)
- Inside and outside transom area must be parallel within $\pm 1/8$ in. (3.17 mm)

Locate Transom Centerline



1. Draw a line parallel to the boat side at the port and starboard chines.

2. Draw an intersecting line parallel to the boat bottom at the port and starboard chines. Lightly mark the points of intersection. These points will be the center of the arcs drawn to find the transom centerline.

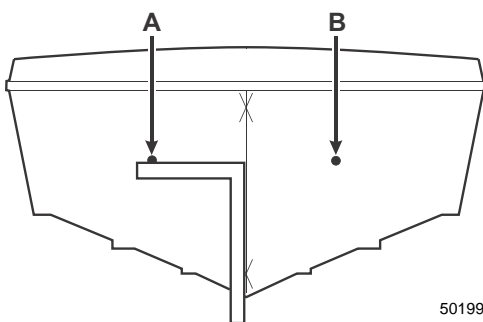
NOTE! The vertical centerline of the transom is most accurately found by using a beam compass. A workable beam compass may be made by clamping a pivot point and a pencil to a bar. A stiff wire with loops at each end for pivot point and pencil will also work, if used carefully.

3. Strike an arc at the top of the transom from one chine point and an intersecting arc from the other chine point without changing beam compass length. The exact same radius must be used to strike both arcs to locate the upper transom center point accurately. Repeat the procedure to locate the lower transom center point, with a different radius if necessary.
4. If the boat bottom is flat or a very shallow "V," a lower center point may be found by measuring across the transom from chine point to chine point and marking the midpoint on the transom.
5. Draw a straight vertical line through the upper and lower center points. This transom center-line will be used for the transom shield center-line on single engine installations and as a reference line on twin engine installations. For single engine transom layout, continue on to *Locate Transom Baseline and X-Dimension* on page 17.

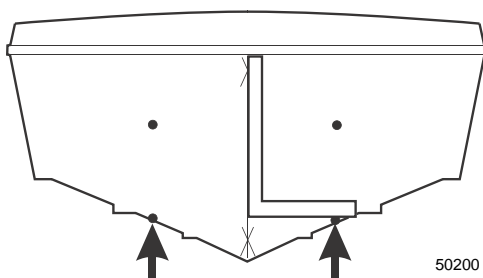
Twin Engine Installation

NOTE! The minimum engine centerline distance for twin engine installation determines the transom shield centerline and engine spacing. Use the following chart for all centerline dimensions.

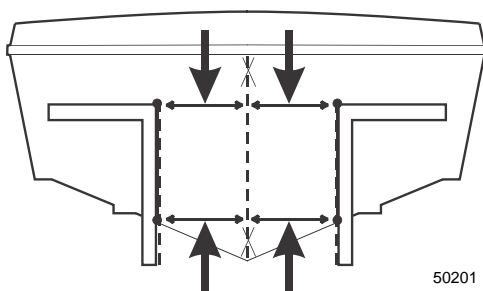
<i>Engine Centerline Spacing</i>		
Engine	Recommended	Minimum
V6	29.25 in. (743 mm)	26.5 in. (673 mm)
V8	35.40 in. (890 mm)	32.3 in. (820 mm)
V8 with joystick steering	36 in. (914 mm)	36 in. (914 mm)



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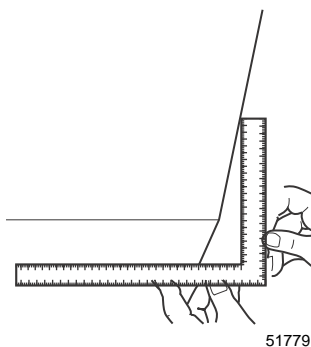
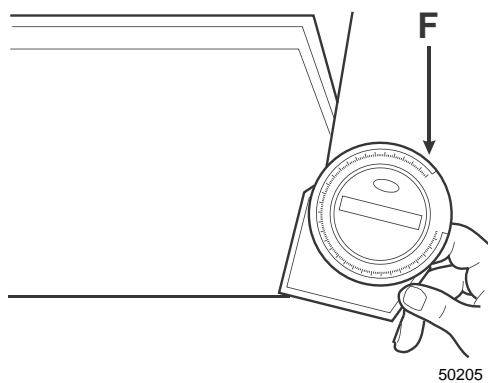
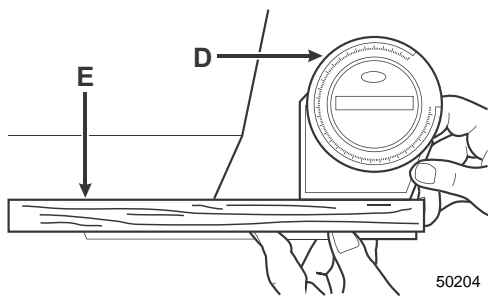
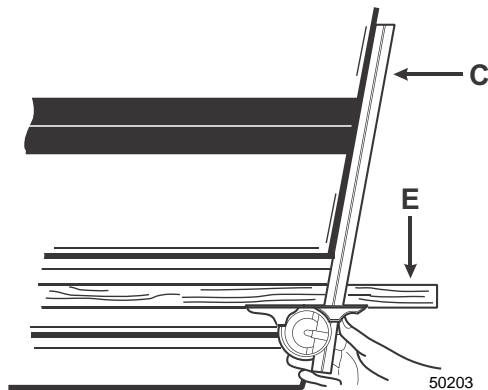
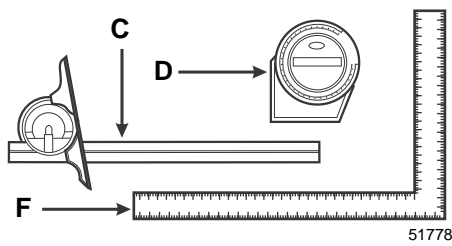


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1. Use a carpenter's square to mark the transom. Place a mark **A** at $\frac{1}{2}$ of the selected engine centerline distance to port of the transom centerline. Place a second mark **B** at $\frac{1}{2}$ of the selected engine centerline distance to starboard of the transom centerline.
2. Make similar measurements from the transom centerline near the bottom of the boat to locate the bottom points.
3. Use a carpenter's square or straight edge to connect both port and starboard transom shield centerline marks. Check the distance at both top and bottom to ensure the transom shield centerlines are equal distance from transom centerline used as a reference.

Locate Transom Baseline and X-Dimension

NOTE! The transom baseline is the horizontal centerline for the transom shield fixture and template. Boat transom angle and anti-ventilation plate height need to be known to determine the transom baseline position on the transom. The X-dimension is the distance from the hull bottom to the intersection of the transom baseline (crankshaft centerline) and vertical centerline.



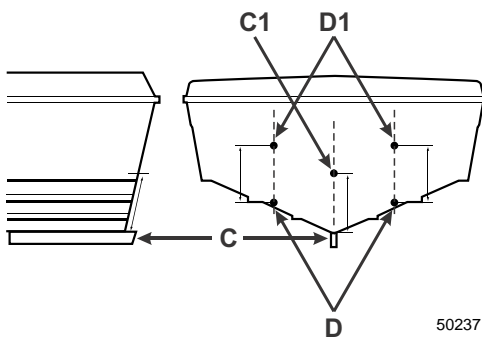
1. The boat's transom angle can be measured with several different protractors or shop devices. Two commonly used protractors are the machinist's adjustable protractor **C** and the universal plumb and level protractor **D**. Both of these protractors can be obtained locally and should be used to determine the transom angle of the boat. A third method uses a common framing square **F** available at most local hardware stores.

A. Machinist's Adjustable Protractor: Place a 4 ft. (1.2 m) straight edge **E** against the boat bottom or pad near the center of the transom. Do not place the straight edge on the keel. Place the protractor's movable turret against the straight edge. Adjust the protractor's straight edge **C** to fit the transom angle. Measure the transom angle directly from the protractor in number of degrees from perpendicular. Record the actual transom angle of the boat for later reference in selecting the X-dimension.

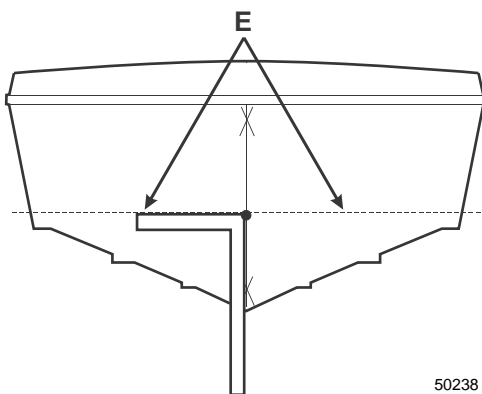
B. Universal Plumb and Level Protractor: Place a 4 ft. (1.2 m) straight edge **E** on the boat bottom or pad near the center of the transom. Do not place the straight edge on the keel if the boat has one. Place the protractor **D** on the straight edge. Level it by raising or lowering the front of the boat.

With the boat in a level position, place the protractor against the transom. Record the transom angle reading **F** for later reference in selecting the X-dimension.

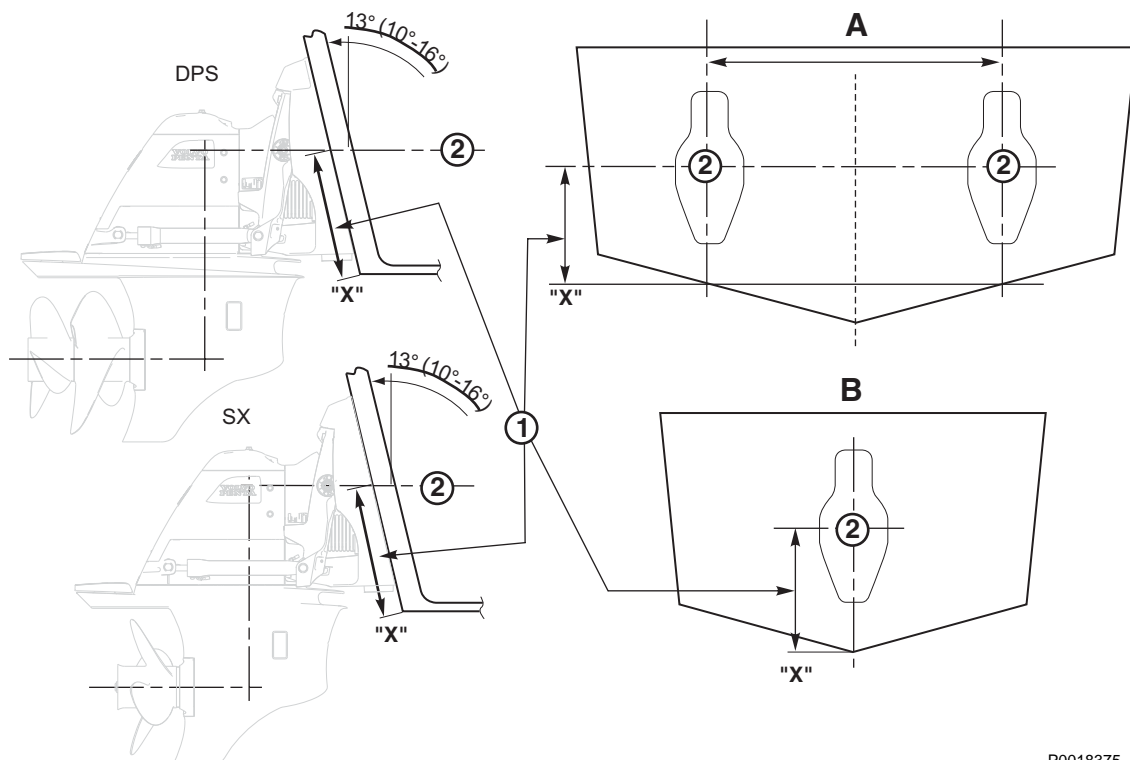
C. Framing Square: A standard framing square can be used, put the long edge along the boat bottom, the 14" side up the transom. Take measurement where transom intersects long edge of square, $\frac{1}{4}" = \text{degree}$



- Place a 4 ft. (1.2 m) straight edge **C** along bottom of boat at transom shield vertical centerline **C1** for single engine installations, or at **D** for twin engine installations. Measure the dimension selected from the chart, from top of straight edge **C**. Follow the transom angle to get an accurate measurement. Place a mark **D1** on the transom. This will become the transom shield horizontal baseline.



- Use a carpenter's square to extend the transom shield baseline (X-dimension) to port and starboard perpendicular to the vertical center-line.



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A. Dual Installation: Refer to installation drawings for minimum center distance.

B. Single Installation:

- Measure "X" along slant of transom.
- Center line of the engine.

The figures in the chart on this page will give an anti-ventilation plate height of $\frac{3}{4}$ in. above the boat bottom for a SX and DPS models. These dimension will give the optimum installation height for most applications. If changes are necessary, adjustment must be made using the $\frac{3}{4}$ in. figure for SX and DPS models as a reference point. The angle of the transom must also be known before starting.

If the optimum location of the anti-ventilation plate in relation to the boat bottom is unknown, use the following chart as a guide.

Transom Angle	X-Dimension	
Degrees	Inches	mm
10°	13-13/16	351
11°	13-55/64	352
12°	13-15/16	354
13°	13-31/32	355
14°	14-1/64	356
15°	14-3/32	358
16°	14-11/64	360

NOTE! Above figures to be used in conjunction with the specific engine installation drawing.

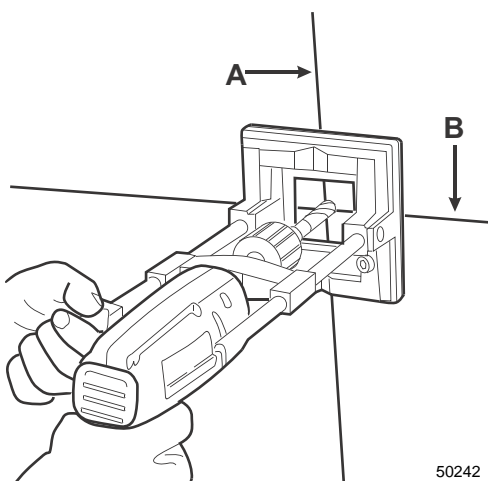
Drill and Cut Transom

Two devices and procedures can be used to drill and cut the boat transom; you may use either method.

- **Procedure A:** Transom Drill Fixture Part No. 3851081 see below. A metal fixture is used to cut out transom.
- **Procedure B:** Transom Template Part No. 7746008. A paper template is used to cut out transom. Refer to *Procedure B: Transom Template* on page 24.

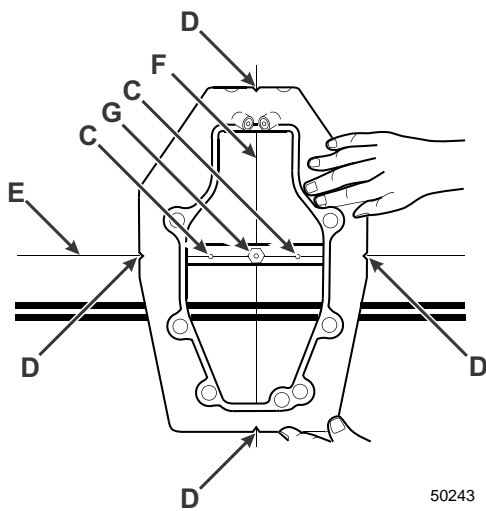
NOTE! Twin engine installations require two holes be cut in the transom. Either procedure for marking and cutting the hole will work, but must be done twice, once for each hole. A new paper template must be used for the second cutout if Procedure "B" is used.

Procedure A: Transom Drill Fixture

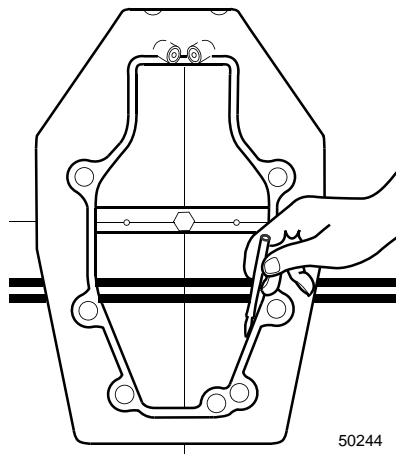


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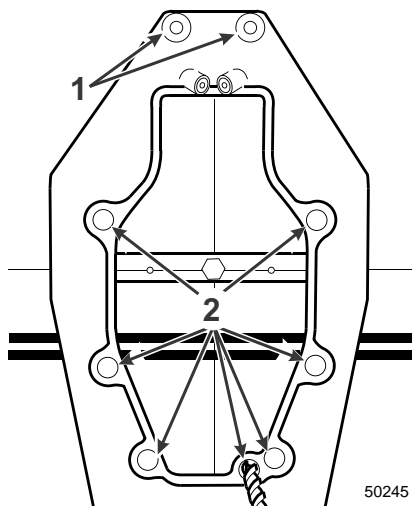
1. Center punch transom at the intersection of the transom shield baseline **B** (X-dimension) and vertical centerline **A**. Use a Portalign drill guide to ensure drilling a perpendicular hole through the transom. Drill a $\frac{9}{16}$ in. (14 mm) hole at the center punch point.



2. Align notches **D** of drill fixture with vertical centerline **F** and transom shield baseline **E** (X-dimension). Secure drill fixture to transom with ½ in. (13 mm) bolt, flat washers, and nut supplied with drill fixture **G**. Install a wood screw in either one of the two small holes **C** to keep the transom fixture from rotating.



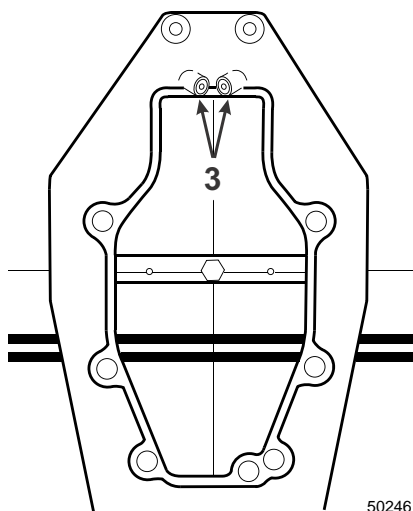
3. Mark transom cutout area using the drill fixture as a guide.



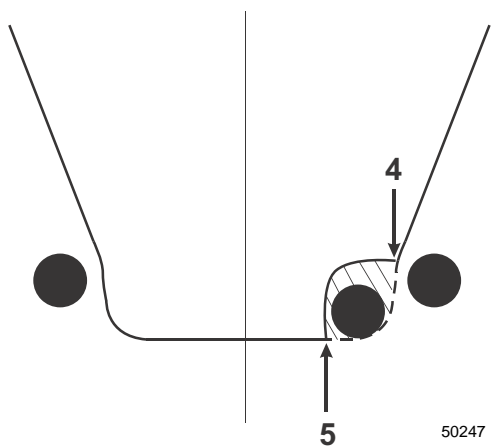
4. Drill 9/16 in. (14.3 mm) holes at location **1** and **2**.
5. Remove drill fixture from transom.

Transom Cutout

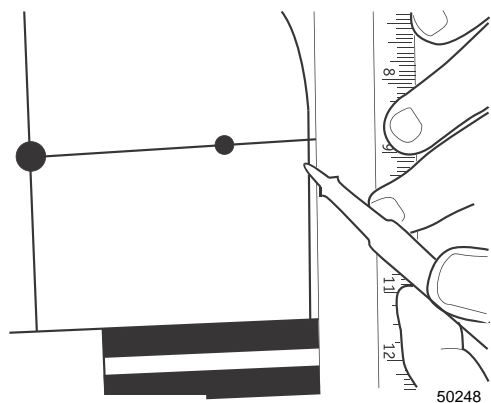
- Using the long aviation drill bit, drill two ¼ in. (6.4 mm) guide holes at location **3**.



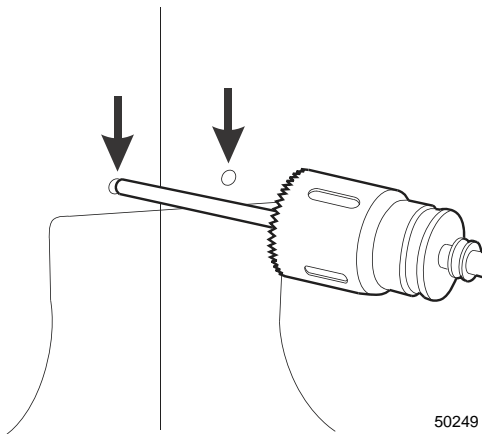
- Draw a dotted line around outside edge of saw pilot hole, and connect points **4** and **5**. This corner of lower transom cutout (shaded area) must be removed when making transom cutout.



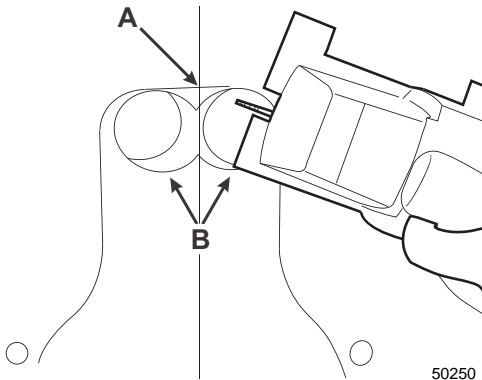
- Draw a line connecting vertical lines on both sides of cutout.



9. Remove drill bit from 1- $\frac{3}{4}$ in. (45 mm) hole saw. Replace drill bit with a 6 in. (15.2 cm) long, $\frac{1}{4}$ in. (6.4 mm) pilot rod (drill rod). Cut two 1- $\frac{3}{4}$ in. (45 mm) holes following the guide holes.



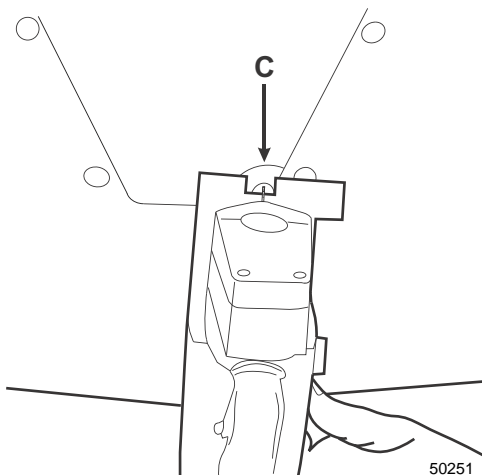
10. Use a straight edge to mark a horizontal line **A** across the top of the 1- $\frac{3}{4}$ in. (45 mm) holes **B**.



11. Cut transom following marked cutout.

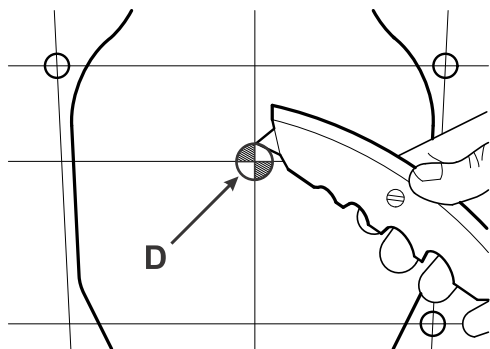
12. Use either a drilled 1- $\frac{3}{4}$ in. (45 mm) hole or inner 9/16 in. (14 mm) hole **C** as a starting point. Keep blade perpendicular (90°) to transom. Proceed to *Finish Transom Cutout Area* on page 28.

NOTE! Cutting on the marked line is important. Cutting too far inside will make the transom shield difficult to install. Cutting too far outside will weaken the transom shield stud mounting holes.



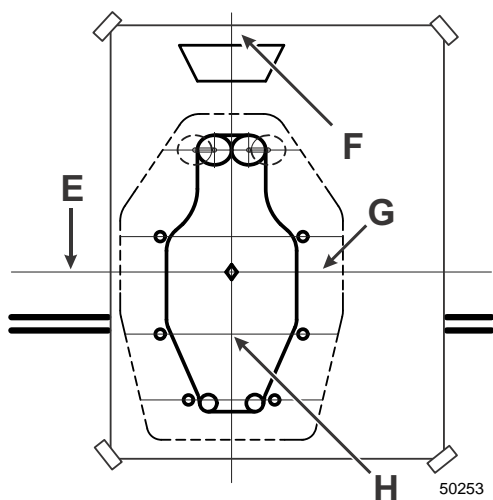
Procedure B: Transom Template

1. Carefully cut out center **D** of template.



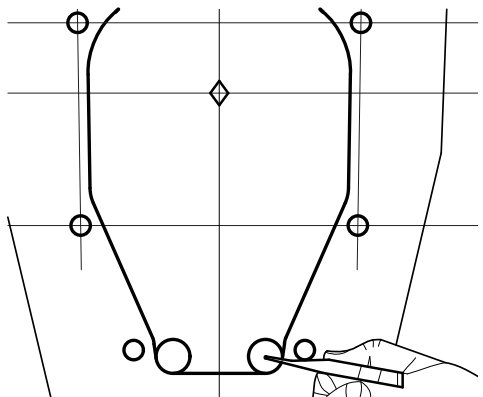
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2. Position the transom template on the boat transom. Align the template centerlines **F** and **G** with the vertical centerline **H** and the transom shield baseline **E** (X-dimension) marked on the boat transom. Tape template securely to transom.



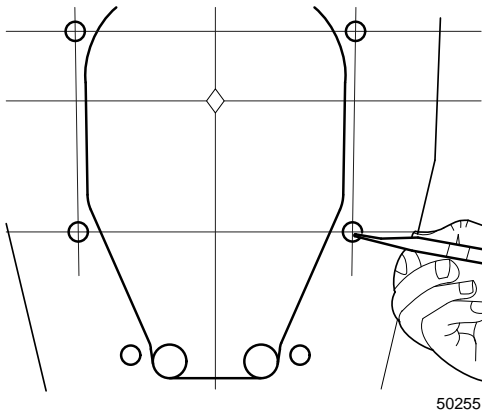
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3. Center punch lower template holes.

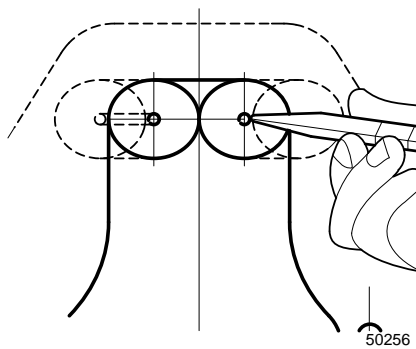


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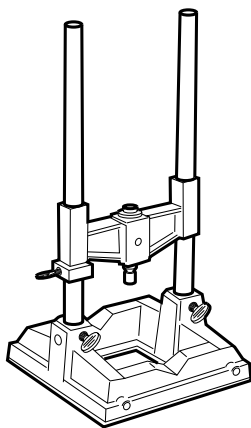
4. Center punch bolt holes.



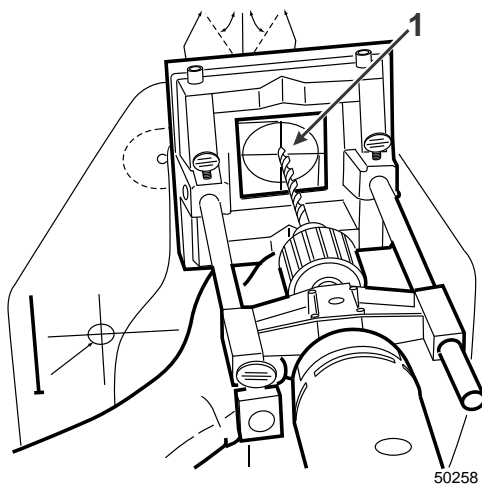
5. Center punch tiller arm cutout holes.

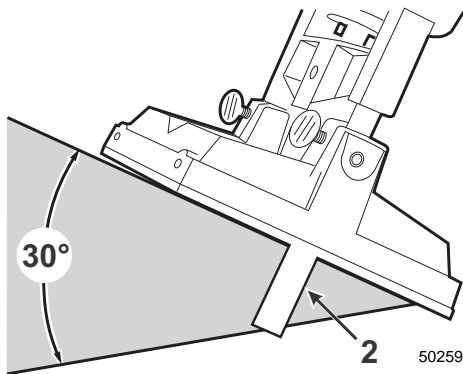


6. Use a Portalign drill fixture or equivalent to drill the two 60° holes and the remaining 90° holes through the transom.

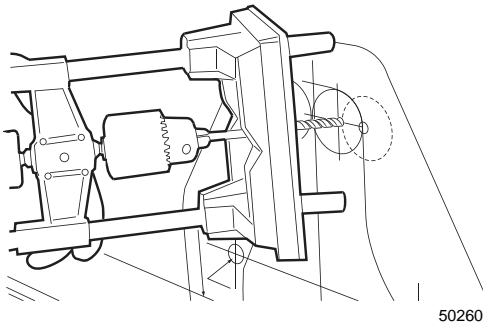


7. Attach a power drill to the drilling fixture. Drill two ¼ in. (6.4 mm) pilot holes at location 1 to a depth of 3/8 in. (9 mm) perpendicular to transom for the two 60° steering clearance holes. This will prevent the drill from "walking" when drilling at a 60° angle.

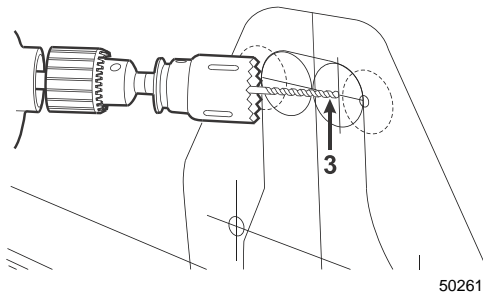




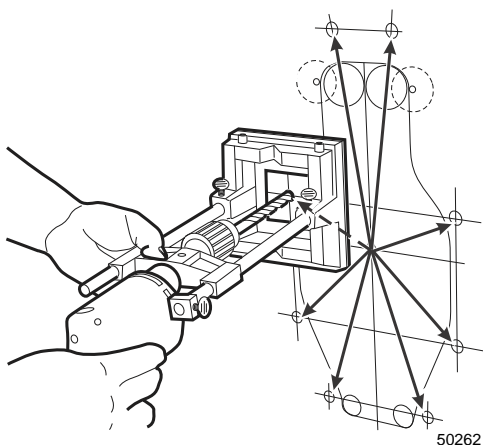
8. Adjust rods **2** to attain a 60° angle to the transom, using a 30° triangle.



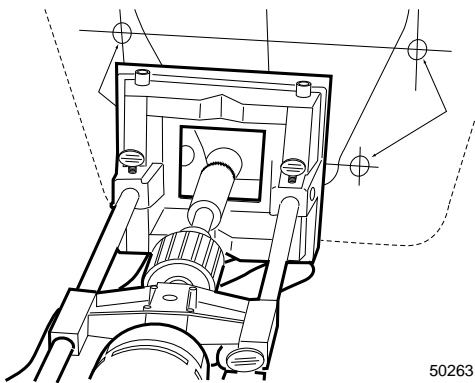
9. Drill the two 60° angle ¼ in. (6.4 mm) guide holes at the pilot holes drilled in **Step 7**.



10. Remove drill bit from 1-¾ in. (45 mm) hole saw and replace with a 6 in. (15.2 cm) long, ¼ in. (6.4 mm) pilot rod (drill rod) **3**. Follow the guide holes with the pilot rod and cut two 1-¾ in. (45 mm) holes.

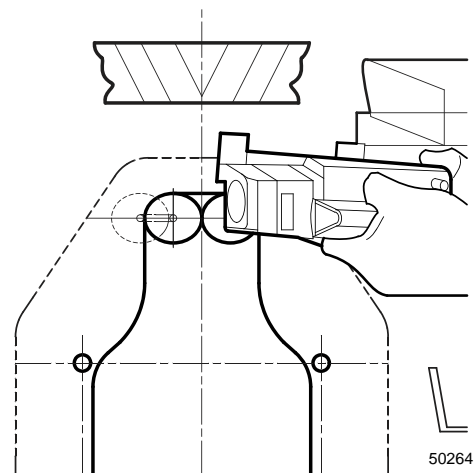


11. Drill eight perpendicular holes using a 9/16 in. (14.3 mm) drill bit.



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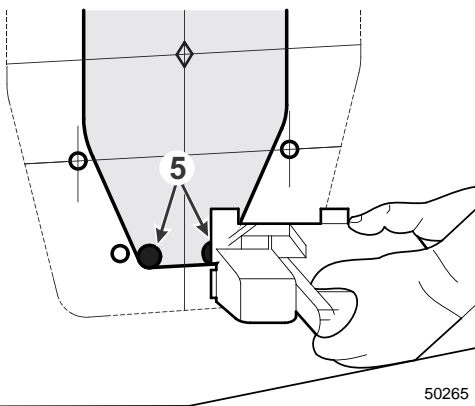
12. Drill two 1 in. (25 mm) holes at bottom of transom template for starter holes to cut out transom.



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13. Cut transom following shaded area of template. Use a drilled 1- $\frac{3}{4}$ in. (45 mm) hole as a starting point. Keep blade perpendicular (90°) to transom at all times.

NOTE! Cutting on the marked line is important. Cutting too far inside will make the transom shield difficult to install. Cutting too far outside will weaken the transom shield stud mounting holes.

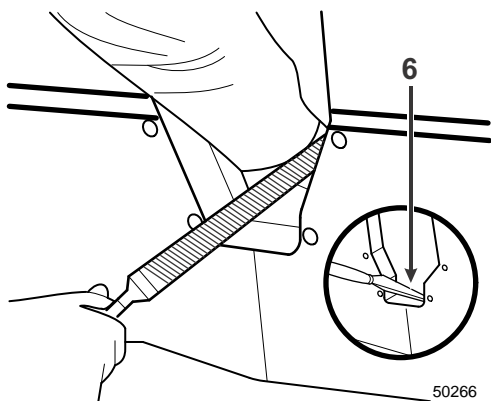


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Or, use a 1 in. (25 mm) hole as a starting point. Keep blade perpendicular (90°) to transom at all times.

NOTE! Cutting on the marked line is important. Cutting too far inside will make the transom shield difficult to install. Cutting too far outside will weaken the transom shield stud mounting holes.

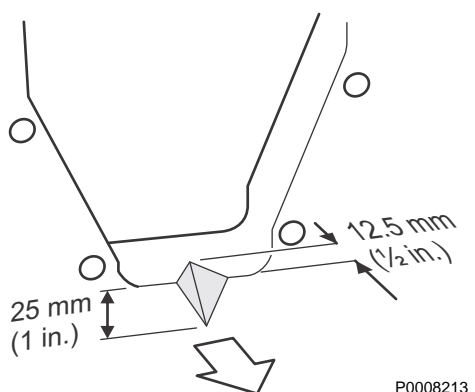
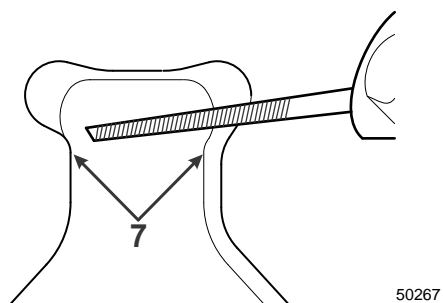
Finish Transom Cutout Area



1. Clean and file off all rough saw blade marks. Chamfer bottom inside edge of cutout **6** to clear exhaust pipe on boats with the maximum transom thickness of 2-¼ in. (57 mm).

NOTE! Fill any voids in the transom with milled fibreglass and resin that is compatible with the transom filler material.

2. Round off sharp corners **7** of steering arm area.



3. Cut or file a channel ½ in. X 1 in. (12.5 mm X 25 mm) on inside edge of cutout to drain trapped water into the bilge. This will keep the transom dry and free from rot.



4. Seal transom opening with gelcoat or equivalent to prevent water absorption and deterioration of transom.

SX-A/DPS-A Transom Shield

Installing the Transom Shield

Proper installation is important for the safe, reliable operation of all mechanical products. In these instructions we recommend and describe effective procedures you should follow when installing Volvo Penta sterndrive products. ABYC standards should always be used as general guidelines when installing equipment in a boat. Some of these methods require the use of tools especially designed for this purpose. These tools should be used whenever recommended.

Prepare for Installation

Follow these steps in the order listed to perform a complete installation of a Volvo Penta transom shield assembly:

1. Prepare for installation
2. Test static water line height before first use
3. Steering system recommendations
4. External power steering recommendations
5. Model identification
6. Install transom shield assembly
7. Install trim/tilt assembly

NOTE! Read installation instructions completely, and collect all tools, instruments, and parts needed for the job before you start work.

Tools

- Wrenches and sockets, ¼ in. to 1-1/8 in.
- Combination level/protractor
- Torque wrench
- Screwdrivers
- Carpenter's square
- Protractor
- Drift punch
- Hammer
- Pliers set

Sealants and Lubricants

- Volvo Penta water resistant grease Part No. 828250
- White sealing compound for drives Part No. 1141570

Model Identification

All sterndrive system components must be matched for either single or dual engine installations. The engine, transom shield, and drive unit model numbers must correspond according to the Model Matrix shipped with the Sterndrive.

NOTE! Failure to properly match engine and drive unit will result in poor boat performance, and risk damage to engine and drive because of incorrect drive gear ratio. For additional information, see *Gear Ratio Selection* on page 2.

Drive Trim Limits

Transom Shield trim limits must be matched to the boat to assure proper clearance of drive to swim platform. Use the transom shield with the correct trim limits for the particular application. For additional information, see *Engines, Transom Shields, & Drives* on page 3.

Static Water Line

Determine if the engine meets the static water line height requirements after the engine and drive unit have been installed in the boat. The boat must be in water with its recommended load capacity distributed aboard.

NOTE! The static water line height must be tested before the engine is started for the first time. This will prevent the ingestion of water into the engine and resultant damage.


To determine the static water line height, follow the instructions in *Static Water Line* on page 89.


NOTE! An installation that permits water to enter the engine through the exhaust manifold(s) will not be covered by warranty, unless damage is due to defective part(s).

Steering System

Recommendations

Duoprop® and SX equipped, dual engine installation boats with a top speed of 60-70 MPH (96-112 Kph), a combination of internal and external tie bars are recommended.

 **WARNING!** Boats equipped with Sterndrive Joystick Steering are limited to 60 MPH (96 Kph). Travelling at speeds more than 60 MPH (96 Kph) in boats equipped with Sterndrive Joystick Steering could result in loss of control of the boat and result in personal injury and damage to the boat.

 **CAUTION!** An external tie bar must never be used as the only tie bar, but must always be combined with an internal tie bar. Loss of steering may result in injury and property damage.

External Power Steering

Recommendations

External power steering is required for boats with a top speed of more than 70 MPH or any application where the boat and sterndrive may occasionally come out of the water.

Install Transom Shield Assembly

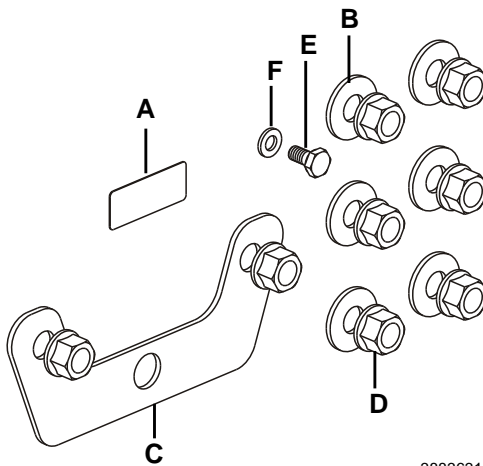
NOTE! The transom shield comes in three configurations, a full tilt, and two limited tilt configurations of 32 and 42 degrees trim limit. If the boat is equipped with a swim platform or some other type of overhang located on the transom, be sure you have the correct transom shield before installation. Failure to ensure clearance between the sterndrive and swim platform could result in damage to the sterndrive and the platform.

1. Remove protective packing.

NOTE! Do not remove tie straps from trim/tilt cylinders at this time. They will be removed before installation of the drive unit.

2. Check contents of transom shield hardware kit:

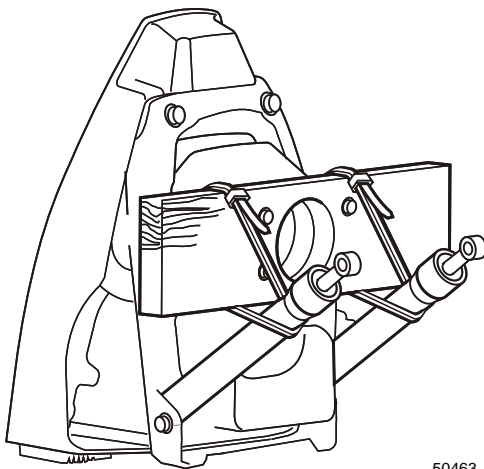
- A. Serial number decal - to be placed on engine decal
- B. Washers (6) - inner transom plate
- C. Bearing Plate
- D. Lock Nuts (8) - inner transom plate
- E. Screw - ground strap
- F. Washer - ground strap



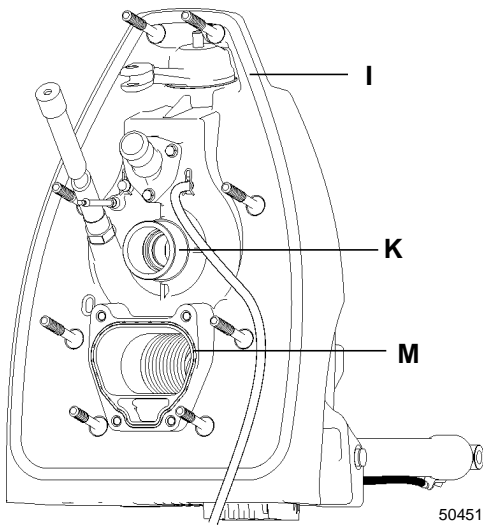
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3. Cut tie straps retaining the hoses and wires.

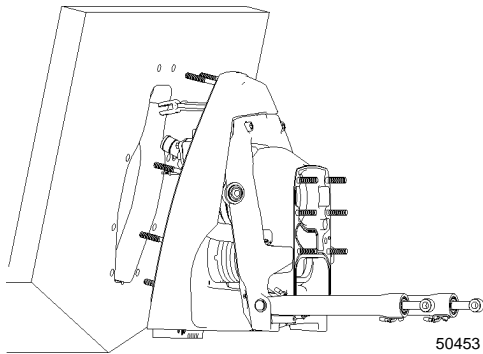
NOTE! Do not cut the tie straps holding the cylinders to the shipping block at this time.



50463

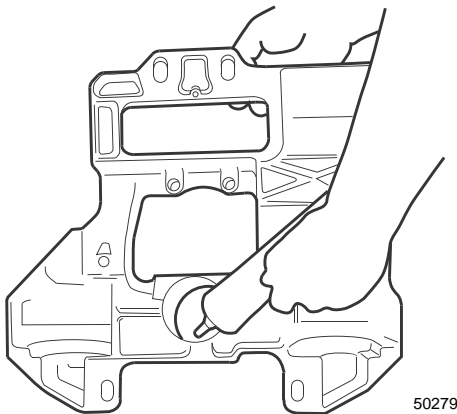


4. Make sure the outer transom seal **I** and exhaust outlet seal **M**, are properly seated in their grooves. Check the transom shield alignment tube **K** for nicks or burrs that would make installation difficult.

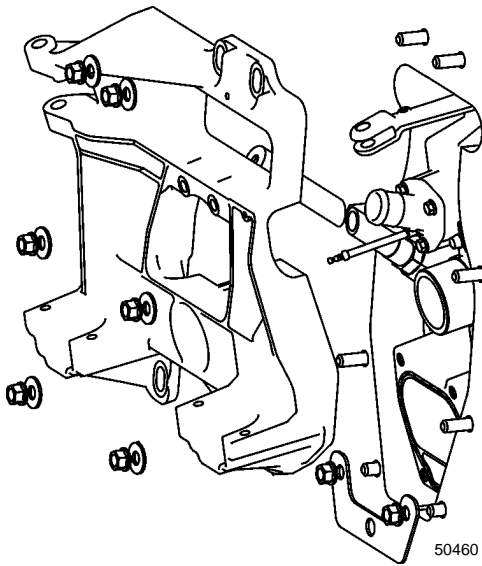


5. Install outer transom shield into transom cutout. Guide studs through drilled holes in transom.

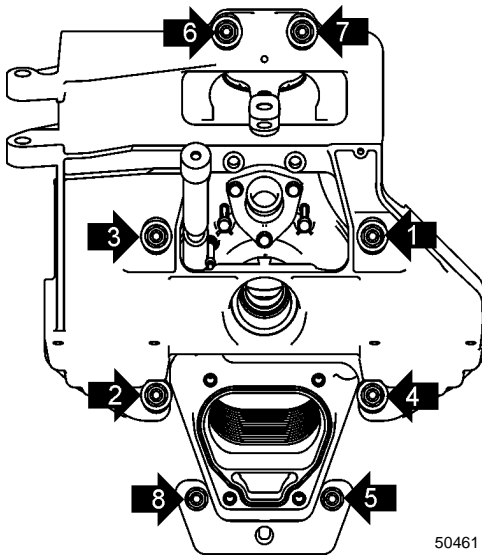
NOTE! Ensure the wires and speedometer hose are not caught under the transom seal. Failure to follow this instruction will result damage to wires and seal. This may result in water leaking into the boat.



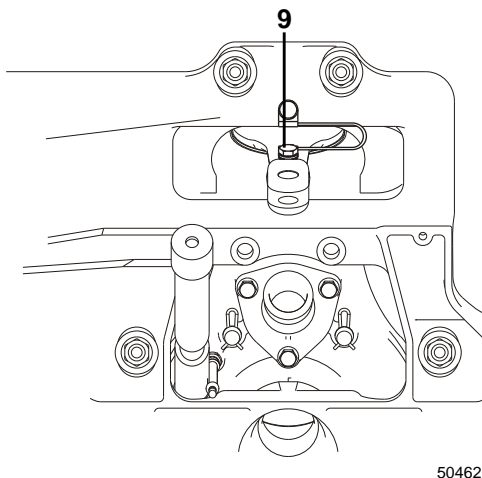
6. Apply a light coat of Volvo Penta water resistant grease Part No. 828250-1 to inner transom plate alignment sleeve. Apply white sealing compound for drives to all transom shield studs.



7. Install inner transom plate over steering arm and water tube.
8. Install nuts and washers on studs. Do not tighten at this time.
9. Install the bearing plate and nuts on the two lower transom shield studs.



10. Tighten the eight lock nuts in two steps in a crossing pattern, as shown. Tighten to 20–25 ft. lb. (27–34 Nm). Recheck all nuts again to be certain any nuts have not loosened during the process.



11. Attach inner transom plate ground strap to steering arm with washer and screw 9.

Engine

Installing the Engine

Proper installation is important for the safe, reliable operation of all mechanical products. In these instructions we recommend and describe effective procedures you should follow when installing Volvo Penta sterndrive products. Some of these methods require the use of tools especially designed for this purpose. These tools should be used whenever recommended.

Follow these steps in the order listed to perform a complete installation of a Volvo Penta engine assembly:

1. Prepare for installation
2. Test static water line height after launching
3. Locate forward engine mount holes
4. Install steering cylinder or tube
5. Exhaust pipe installation
6. Install drain plugs
7. Remove engine from pallet
8. Install battery cables
9. Determine shift and throttle cable lengths
10. Shift cable installation
11. Install and align engines
12. Install cables and hoses
13. Install power steering lines

Prepare for Installation

Read installation instructions completely and collect all tools, instruments, and parts needed for the job before you start work.

Regular Tools

- Wrenches and sockets, ¼ in. to 1 in.
- Drill Motor with ½ in. (12 mm) chuck
- Drill bits:
 - 11/32 in. (8.73 mm)
 - ½ in. (13 mm)
- Torque wrench 150 ft/lb capacity
- Screwdrivers
- Drift punch
- Hammer
- Pliers set
- Hoist and sling with a minimum capacity rating of 2,000 lb. (680 kg)

Required Tools and Equipment

Special Tools

- Engine Mount Drill Fixture Part No. 3588569
- Alignment Tool, Part No. 3851083
- Universal Drive Handle Part No. 3850609

Additional Equipment Required

- Steering wheel, helm, and cable¹
- Remote control, throttle, & shift cables
- Fuel system
- Instrument/trim harness assembly
- Emergency stop switch
- Battery cables

Sealants and Lubricants

- Volvo Penta water resistant grease Part No. 828250
- Volvo Penta white sealing compound for drives Part No. 1141570

Static Water Line

Determine if the engine meets the static water line height requirements after the engine and drive unit have been installed in the boat. The boat must be in water with its recommended load capacity distributed aboard.

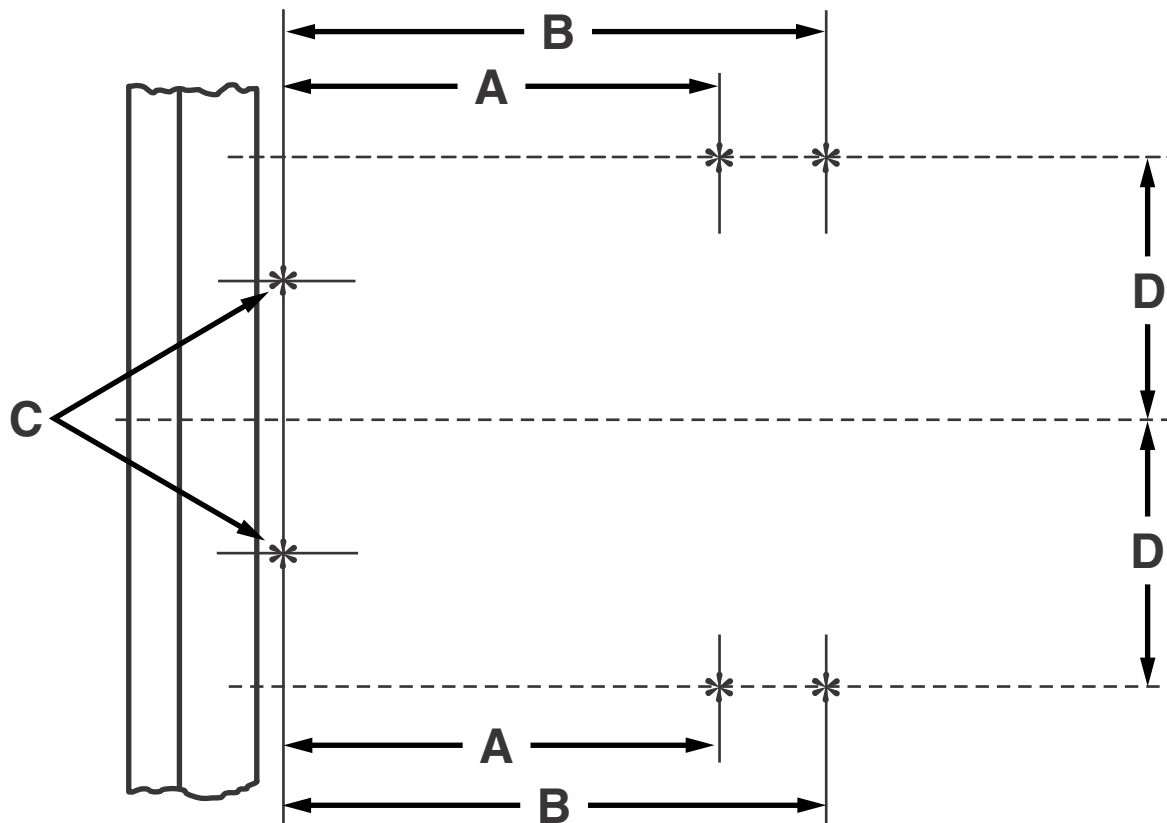
NOTE! The static water line height must be tested before the engine is started for the first time. This will prevent the ingestion of water into the engine and resultant damage.

To determine the static water line height, follow the instructions in *Static Water Line* on page 89.

NOTE! An installation that permits water to enter the engine through the exhaust manifold(s) will not be covered by warranty, unless damage is due to defective part(s).

1. Sterndrive Joystick steering and EVC equipped engines do not require this equipment or utilize EVC specific equipment.

Locate Forward Engine Mount Holes



23273

1. On the drawing below, select the letter that corresponds to the engine model being installed, for the location of the forward engine mount pads. The dimension locates the center of the forward engine mount pads.

A. V6 models: 16¼ in. (41.3 cm)

B. V8 models: 20¾ in. (52.7 cm)

C. Rear engine mount positions

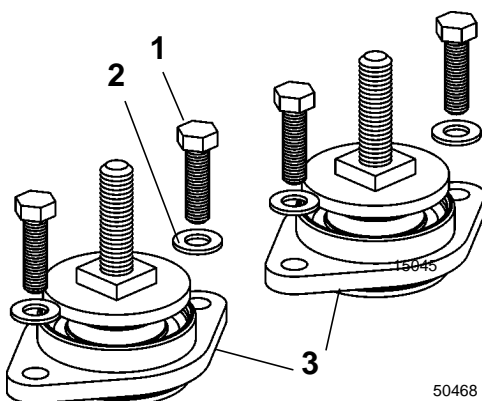
D. V6 and V8 front mount center line is 11¼ in. (28.6 cm) to port and starboard of the engine center line.

2. Check rear engine mounts and hardware:

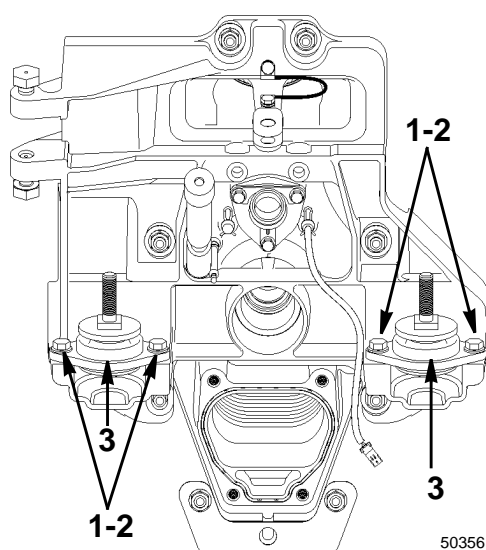
1. Mounting Screw (4)

2. Washer (4)

3. Rear Engine Mount (2)

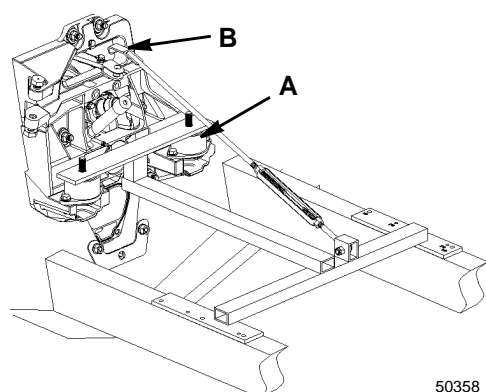


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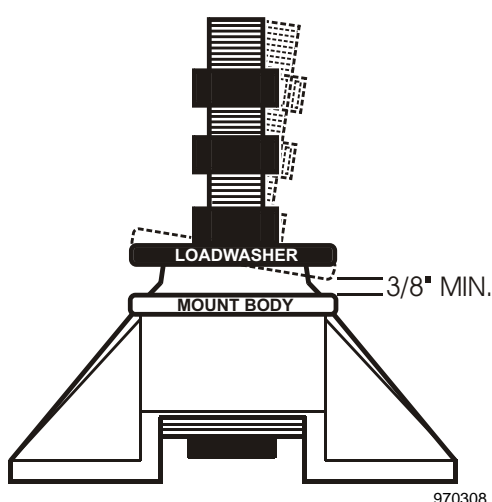
3. Secure rear engine mounts **3** to transom bracket with washers **2** and screws **1**. Tighten screws to 20–25 ft. lb. (27–34 Nm).

NOTE! Transom shields shipped with the engine in a blue plastic crate have engine mounts reassembled from the factory.



The engine mount drill fixture Part No. 3588569 has two functions:

- Locate or check the engine front mount pad height and angle.
 - Locate front engine mount pilot holes.
4. Install drill fixture on rear engine mounts **A**. Center the steering arm. Attach height finger **B** onto inner transom plate at the lower edge of the steering arm opening.

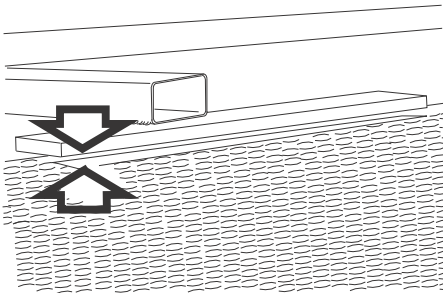


The front engine mount must be perpendicular to the boat's stringers or mounting pads so that the front engine mounts can absorb engine vibrations properly. Make sure that the clearance (gap) between the load washer and the body of the mount is even on all sides. There is a slight tolerance in this gap to compensate for transom angle and stringer installation. The stringer system should be installed parallel to the boat bottom. The engine package is designed so that, on a boat with a 13° transom angle and the stringers installed parallel to the boat bottom, the front engine mounts will have zero (0) deflection. This means that the gap between the load washer and the mount body will be of equal distance on all sides. The mount is allowed an amount of deflection to compensate for different transom angles and the stringer installation. With the maximum deviation allowed, the minimum distance between the load washer and the mount body is 9.5mm (3/8"). The adjustment of the engine mount should be in the lower half of the adjusting stud.

If the clearance does not fall within the minimum distance, you must modify the stringers or install angled shims (spacers) between the stringers and the front mounts. Shims should be made of a material (e.g., aluminium) that will not rot, shrink, crack, break, or in any other way change its size or shape.

If the clearance does not fall within the minimum distance, you must modify the stringers or install angled shims (spacers) between the stringers and the front mounts. Shims should be made of a material (e.g., aluminium) that will not rot, shrink, crack, break, or in any other way change its size or shape.

5. Position engine mount pads $\frac{1}{4}$ in. (6.35 mm) below bottom of drill fixture feet. Mark and secure pads to boat.

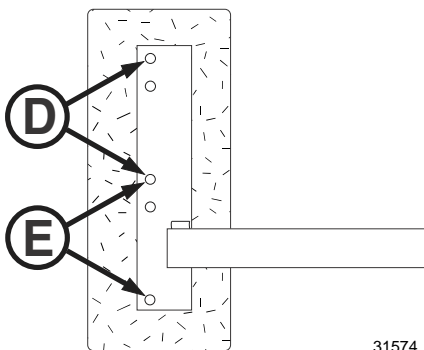


18145

6. Select correct guide holes for the engine being installed. Drill four $\frac{11}{32}$ -in. (8.73 mm) pilot holes to a depth of $2\frac{1}{2}$ in. (63 mm).

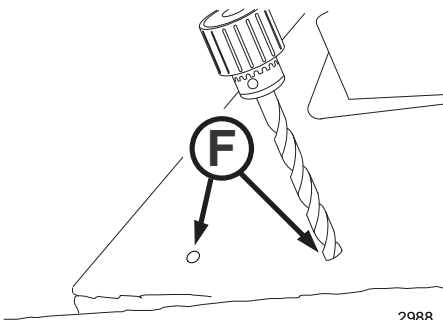
D. V6 models

E. V8 models



31574

7. Remove engine mount drill fixture from inner transom plate. Drill a $\frac{1}{2}$ -in. (13 mm) diameter counter bore hole, not to exceed $\frac{1}{2}$ in. (13 mm) in depth, through each pilot hole F.



2988

Steering Cylinder Installation

If the installation will be using Sterndrive Joystick steering, please refer to the *Installation DPS Joystick Electronic Steering Poster* P/N 47704052.

The sterndrive must be coupled to a mechanical push-pull cable steering system. The boat's steering system is important for control of the boat. It is also critical to the safety of persons in the boat or in its general area.

We recommend that the installer follow the American Boat and Yacht Council's Safety Standards P-17 and P-22 for all aspects of the

steering system to ensure that each component meets the minimum requirements.

To obtain a copy of the current ABYC Standards P-17 and P-22, use the following contact information:

American Boat and Yacht Council

3069 Solomon's Island Road

Edgewater, MD 21037 U.S.A.

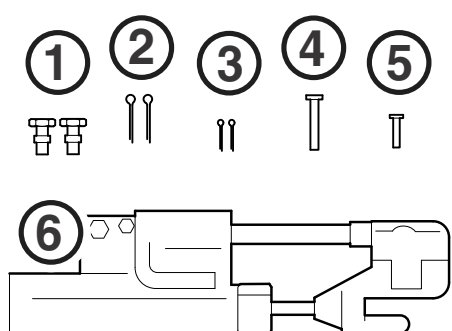
Phone: 410/956-1050

Fax: 410/956-2737

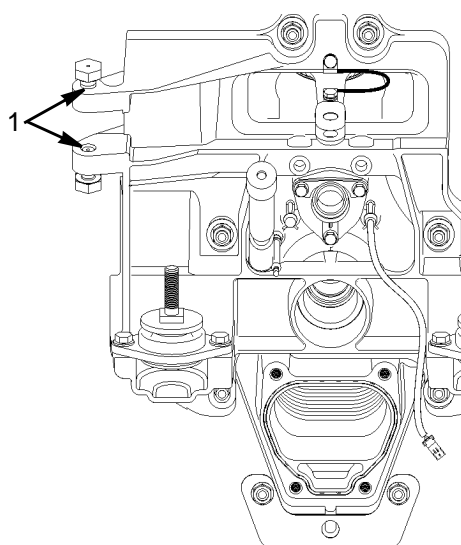
Internet: <http://www.abycinc.org>

The helm, steering wheel, and steering cable should be installed following the steering system manufacturer's installation instructions and specifications.

NOTE! Accessibility may require the steering cable be installed prior to installation of the power steering cylinder. Make this determination before proceeding. If this is the case, make the necessary modifications to the following procedures.



33995

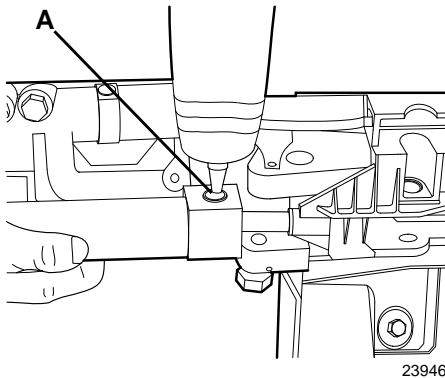


50356

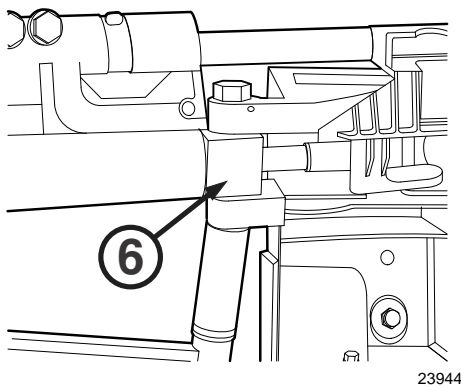
1. Remove power steering box from engine box shelf and check contents of kit:

1. Bolts (2)
2. Large Cotter Pins (2)
3. Small Cotter Pins (2)
4. Long Pin (1)
5. Short Pin (1)
6. Cylinder Assembly (1)

2. Install anchor bolts 1 flush with the inside of the inner transom plate.

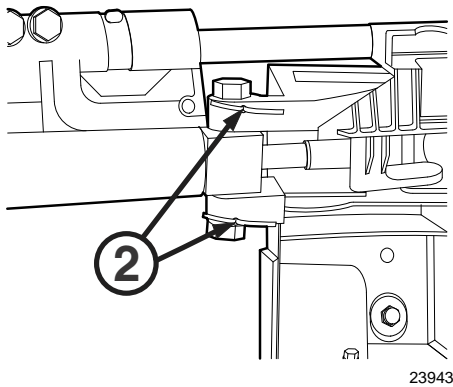


3. Apply Volvo Penta water resistant grease Part No. 828250 to both bushings **A** of steering cylinder.

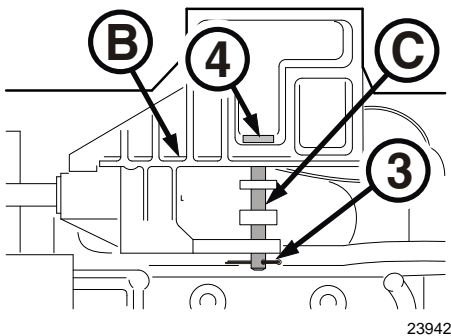


4. Install steering cylinder assembly **6** into inner transom plate. Align bushings of steering cylinder with anchor bolts. As the anchor bolts are tightened, make sure they are guided into the bushings. Tighten both anchor bolts to 40–45 ft. lb. (54–61 Nm).

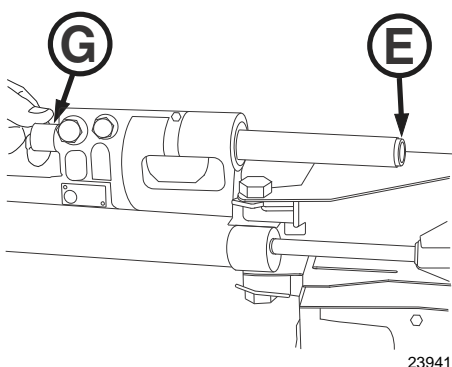
NOTE! If anchor bolts do not align with steering cylinder mounting holes, the mounting bosses on transom plate will break when bolts are tightened.



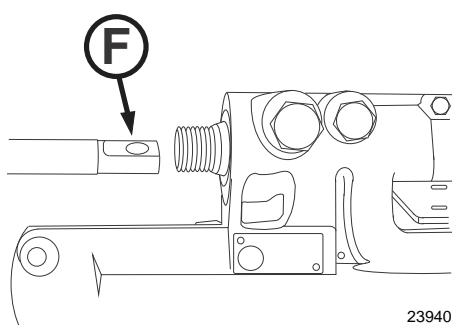
5. Install large cotter pins **2** through holes in transom plate from front side. Spread prongs of cotter pins to secure anchor bolts.



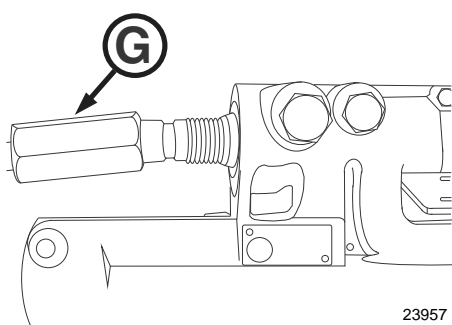
6. Apply Volvo Penta water resistant grease Part No. 828250 to large pin **4**. Pull hydraulic arm assembly **B** over steering arm. Align holes **C** and install large pin from top of arm. Install small cotter pin **3**.
7. **Spread prongs of cotter pin to secure large pin.**



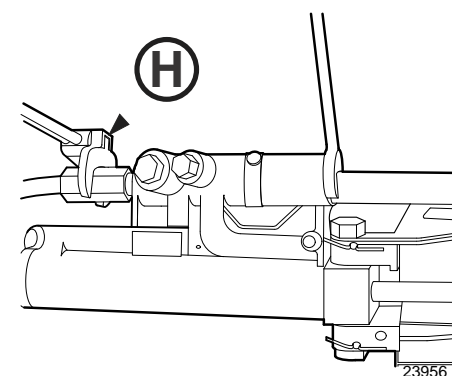
8. Remove both protective plastic plugs **G** and **E** from steering tube.



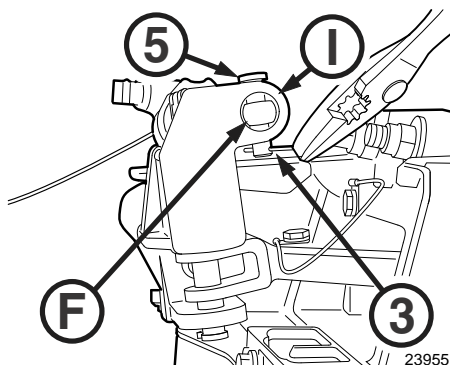
9. Turn the steering wheel to fully extend the steering cable ram **F**. Lubricate the full length of the steering ram with Volvo Penta water resistant grease Part No. 828250.
10. Retract steering ram and install into steering tube.



11. Hold anchor nut **G** back on cable casing to seat steering cable in end of steering tube.
12. Push steering cable against end of steering tube. Thread anchor nut onto tube until anchor nut bottoms on end of steering tube.



13. Hold the steering tube with a wrench. Attach a 1-1/8 in. crowfoot **H** to a torque wrench at a 90° angle. Tighten the steering cable anchor nut to the cable manufacturers specification.



14. Turn steering wheel to extend ram. Align hole of steering cable ram **F** with hole of hydraulic arm assembly **I**. Apply Volvo Penta water resistant grease Part No. 828250 to small pin **5**. Install pin from top of arm through cable hole. Install cotter pin **3**. **Spread prongs of cotter pin to secure small pin.**

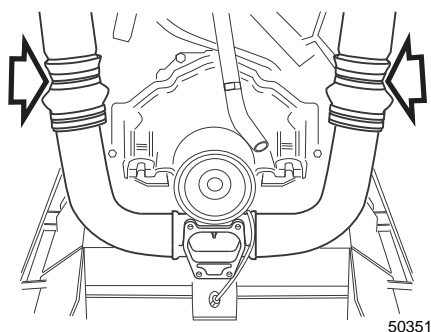
15. Continue on to the section entitled *Exhaust Pipe Installation* on page 42.

Exhaust Pipe Installation

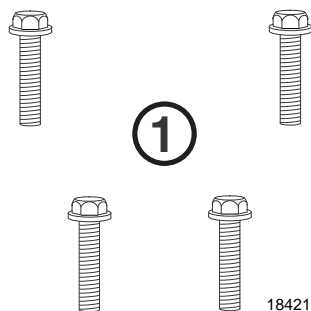
1. Remove plastic top, box and supports from engine and pallet.

NOTE! All Volvo Penta sterndrive models meet state and local laws for noise pollution when they leave the factory. Modification of the exhaust system such that it affects the noise level of the engine is the responsibility of the person modifying the system.

NOTE! Volvo Penta has a through transom exhaust elbow adapter for the catalyst exhaust system.



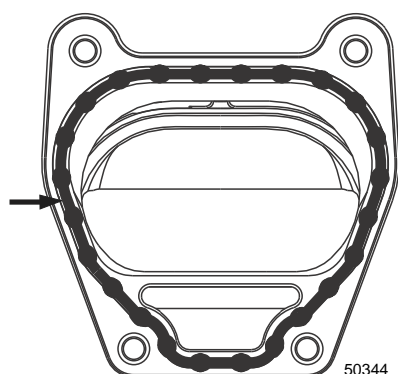
2. Loosen two upper hose clamps on each end of exhaust pipe. For ease of removing exhaust pipe, spray under upper (loose) end of hoses with water. Cut tie strap securing the exhaust pipe to the plastic pallet, and pull exhaust pipe off engine.



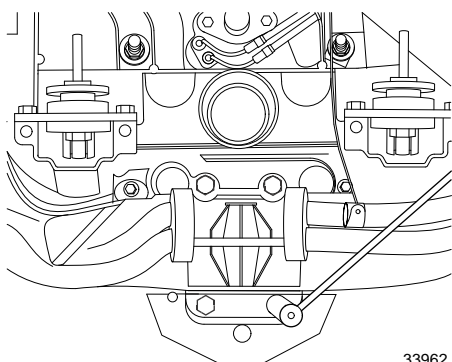
3. Check exhaust pipe mounting screws:

Exhaust Pipe (1)

Mounting Screws (4)



4. The exhaust seal is held in place by several knobs moulded into the exhaust seal on the transom shields. No adhesives or sealers are needed to hold the seal in place. Inspect the exhaust seal of transom shield to be certain it is within its groove.



5. Position bottom of exhaust pipe against bottom of exhaust seal. Hold pipe against exhaust opening without disturbing the seal, then install and tighten the four screws to 20–25 ft. lb. (27–34 Nm).

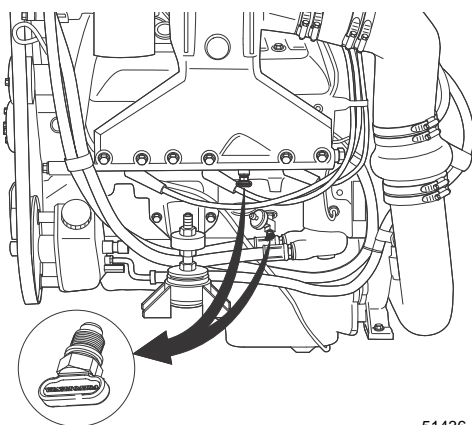
Install Engine Drain Plugs

All drain plugs, drain caps, hose clamps, and the positive **B+** battery cable protective cover are enclosed in a bag. If the engine is going to be water tested, grease and install the drain plugs and drain caps while engine is resting on the pallet.

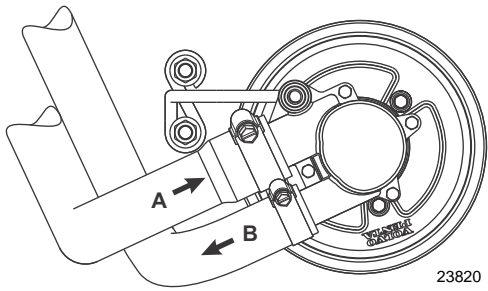
If lower water hose has been removed from the fuel cell, reinstall and secure with hose clamp.

Install drain plugs into port and starboard engine block, and onto exhaust manifold drain locations.

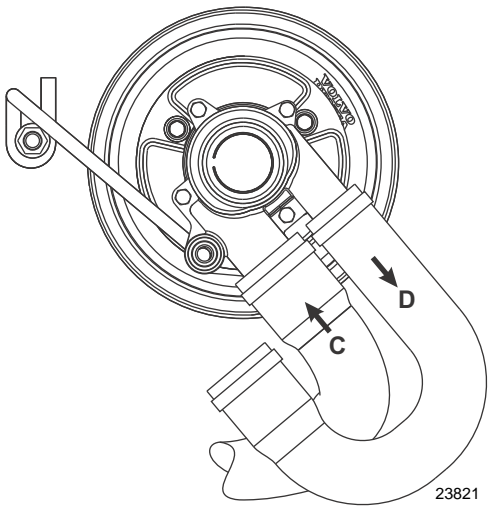
NOTE! Before shipping engine, after it has been water tested, remove the drain plugs and raw water pump hoses, drain all water from the engine and manifolds. Enclose drain plugs and hose clamps in a separate bag and attach them to the steering wheel or engine for shipment.



Connecting Raw Water Pump Hoses



23820



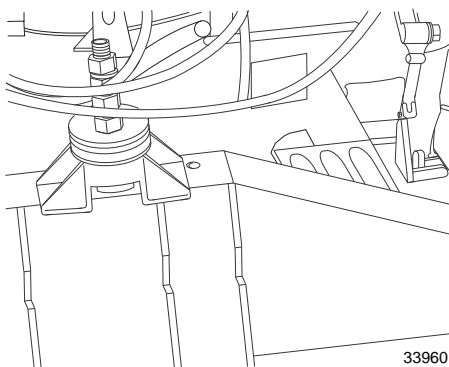
23821

1. On raw water cooled engines, install the lower raw water pump hose connection **B** to the thermostat housing hose. Connect the upper hose connection **A** to the transom shield.

2. On closed cooling system engines, install the upper raw water pump hose connection **D** to the heat exchanger return. Connect the lower hose connection **C** to the transom shield.

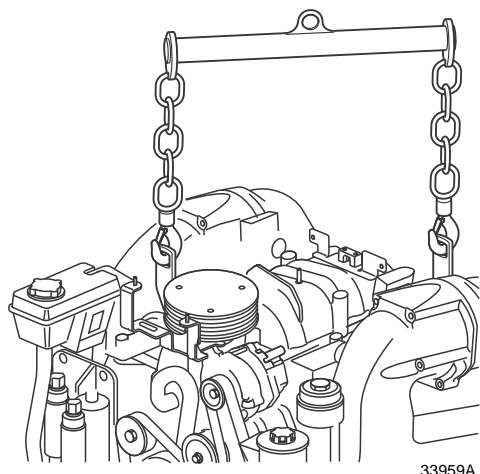
NOTE! If hoses are connected incorrectly, the engine will be severely damaged.

Remove Engine from Pallet



33960

1. Remove locking pins securing engine to pallet.

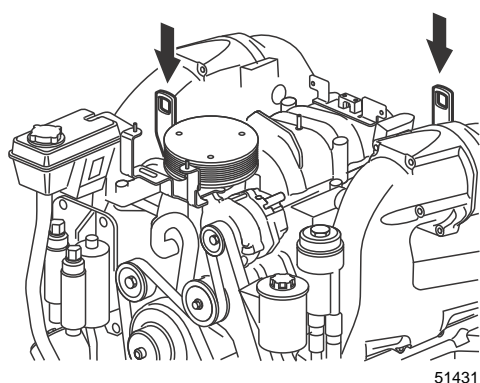


2. Use a spreader bar and hoist with a minimum capacity of 2,000 lb. (746 kg). Attach hoist to lifting brackets of engine.

NOTE! A spreader bar **must** be used to prevent engine damage while hoisting the engine.

Warning! Do not use the alignment eye attached to the thermostat housing as a lifting eye to suspend the engine during installation. The alignment eye will not support the weight of the engine.

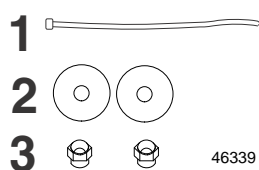
Lifting



The engine cover must be removed for access to the engine lifting eyes. The forward lifting eye is adjacent to the outboard starboard position of the thermostat housing. The aft lifting eye is port side rear of the cylinder head. These lifting eyes should be used for engine suspension during installation. The alignment eye, attached to the thermostat housing, is only intended to help manoeuvre the engine during the alignment procedure.

3. Lift and level engine.

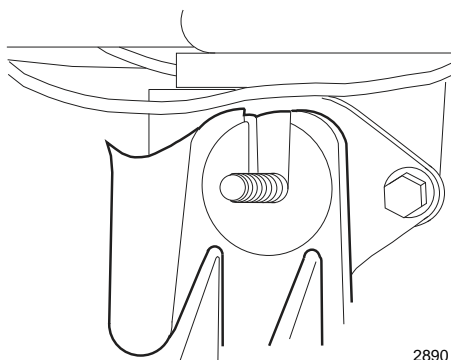
Install and Align Engine

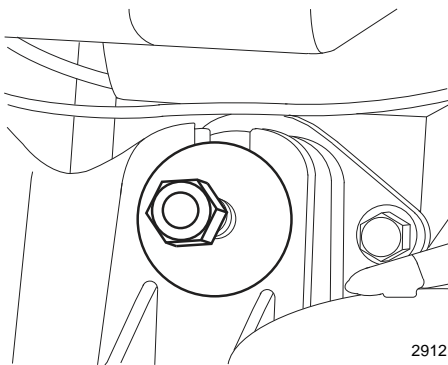


1. Check engine mount hardware:

1. Tie Strap (1)
2. Rear Mount Flat Washer (2)
3. Rear Mount Locknut (2)

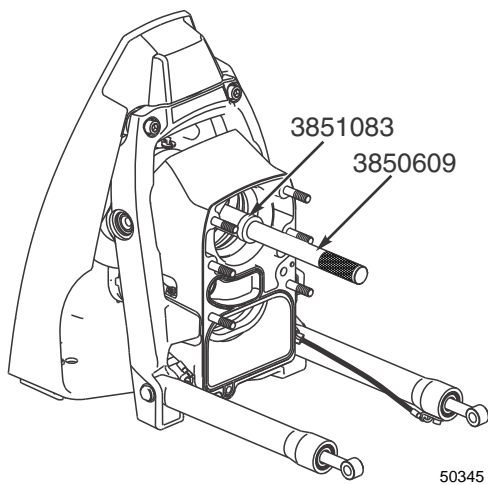
2. Lower engine onto rear engine mounts.





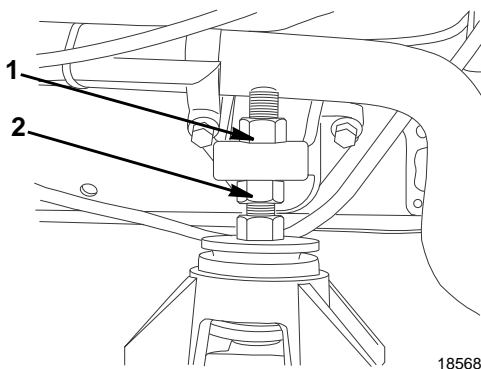
3. Install flat washer **2** into recess of engine bracket and secure to mount with a locknut **3**. Coat the threads of the engine mount with Volvo Penta sealing compound Part No. 1141570. Tighten locknut to 28–30 ft. lb. (38–41 Nm).

NOTE! **DO NOT** use an impact type power wrench to tighten the rear engine mounting nuts. Thread damage will occur and make nut removal difficult.



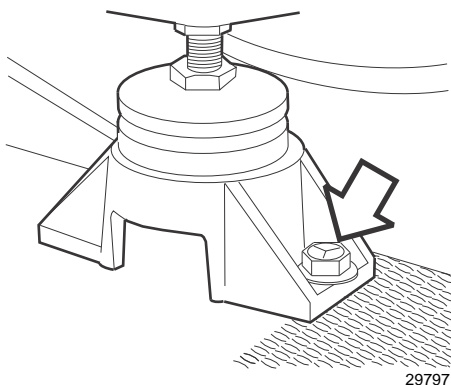
4. Correct engine alignment is essential to engine drive train. Use Alignment Tool Part No. 3851083 with Universal Handle Part No. 3850609 to test engine alignment. Slide alignment tool through driveshaft gimbal bearing. Reposition the engine until alignment tool engages engine coupler. If the alignment tool binds going into engine coupler, the engine must be adjusted “up” or “down,” or “side-to-side,” as required, until alignment tool slides in and out of engine coupler with ease.

NOTE! After alignment has been completed, do not disturb engine position.



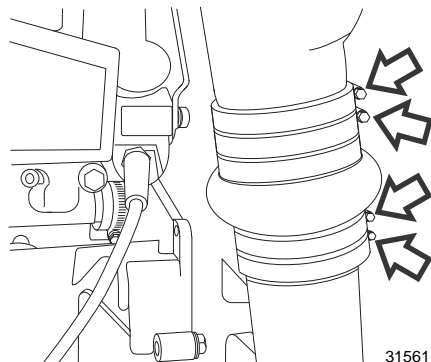
5. Loosen middle nut on engine mount stud(s) **2**. Adjust the front engine mounts until they rest on the boat's mounting pad(s).
6. While holding middle nut with an open end wrench, tighten the upper nut **1** to 100–120 ft. lb. (135–165 Nm).

After mounts have been properly adjusted and tightened, fully release engine from hoist. Recheck engine alignment as described in **Step 4**, and make further adjustments if necessary.



7. Use four ½ in. x 3 in. (12.7 mm x 76.2 mm) lag screws and four ½ in. (12.7 mm) flat washers (not included with engine) if mounting on fiberglass or wood. Use similar sized nuts, bolts and washers if mounting on metal. Slide flat washers onto forward mount lag screws. Apply a coating of a high quality marine caulk to the threads of the lag screws. Install and tighten each screw until the hex head and washer make firm contact with the engine mount.
8. Tighten each lag screw an additional ¼ to ½ turn to ensure each is engaged securely. Lag screw thread engagement must be secure. **Failure to have secure thread engagement could cause engine to come loose.**

Install Cables and Hoses



For EVC installations, refer to the appropriate installation poster for the version of EVC being installed.

NOTE! Refer to ABYC standard 8.15.8 for minimum clearances from exhaust system for all electrical cables and connections.

Slide exhaust hoses up onto exhaust elbows. Exhaust bellows must be installed on exhaust elbow far enough to allow the two hose clamps to firmly grip exhaust elbow. Position all hose clamps between ribs of exhaust hoses and tighten securely.

NOTE! DO NOT install hose clamps in expanded area of hoses. Cooling system water flow will be restricted, and engine damage due to overheating will occur if the clamps are improperly installed.

Battery Cables

Correctly sized and constructed battery cables are needed to maintain proper voltage in the starting and other circuits. Voltage drop in the complete starter circuit, between the battery positive terminal and the starter solenoid can not exceed 0.6 volts. Total cable length of all positive and negative cables in the circuit combined with the following information determines the correct cable conductor size. If a battery switch or other device is connected between the battery and the starter, the length of all cables used to connect the components are added together. Cable lengths are the running/routed lengths, not the straight line lengths between the components.

Battery cables over 18' must be sized for a maximum voltage drop of 3%. Sterndrive Joystick Steering system have additional battery requirements. Please refer to the appropriate Sterndrive Joystick installation poster for additional battery requirements.

SDJS isolated starting batteries

ACR and VSR spec's. 15 amp maximum load on engine starting batteries

Total cable length is combined with the circuit load and the cable's insulation temperature rating to determine the correct conductor size. The tables below provide **minimum conductor and insulation temperature requirements** for the amp loads indicated and total **cable lengths up to 18 feet (5.5m)**.

4.3L, 5.0L, and 5.7L Gas Engines, 150 amp starter load

4 AWG if insulation temperature rating is 125°C

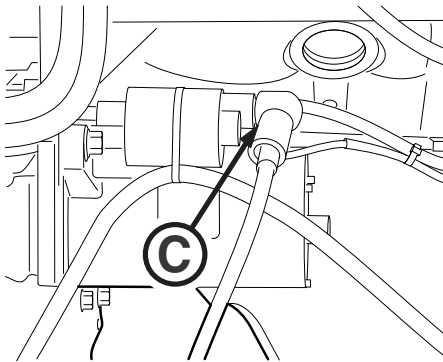
2 AWG if insulation temperature rating is 105°C

1 AWG if insulation temperature rating is 80°C

0 AWG if insulation temperature rating is 75°C

For total cable lengths over 18 feet the cable size and temperature rating must be calculated using ABYC E11.

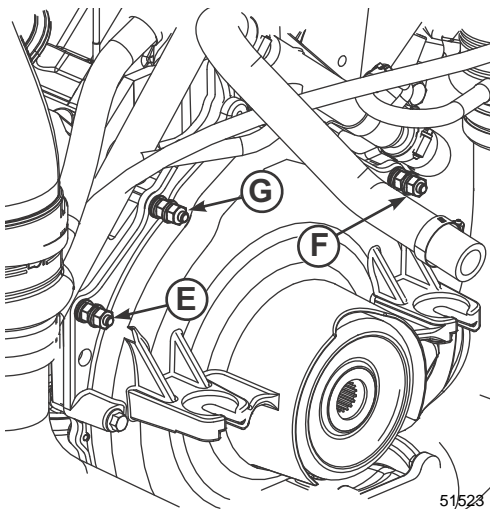
Negative (ground) cables must be the same size and rating as the positive cables in the same circuit.



29809

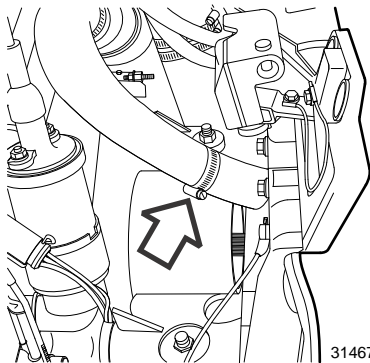
1. Determine distance from engine to battery and select battery cables of the correct gauge wire. Do not use aluminium battery cables; each battery cable must be a copper-stranded conductor.
2. Install the red positive **B+** battery cable to starter solenoid terminal, and secure with lock washer and nut. Position protective cover over terminal **C**.

NOTE! Do not over tighten the solenoid terminal. This may damage the starter solenoid housing.



51523

Install inner transom plate ground wire to engine ground stud and secure with lock washer and nut **E**. Connect the battery ground cable to engine ground **F**. Volvo Penta has provided a third grounding stud for accessories **G**.

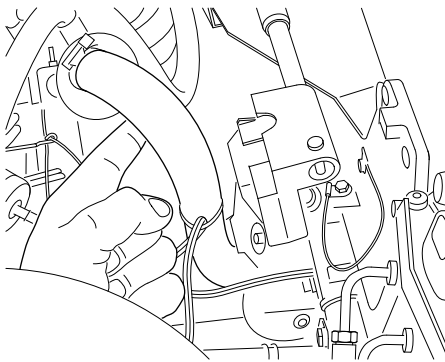


31467

3. Loosen water inlet hose clamp and slide back onto hose. Lightly lubricate inside of water inlet hose with soapy water and install onto inlet tube. Position the clamp **F** on inlet hose and tighten securely.

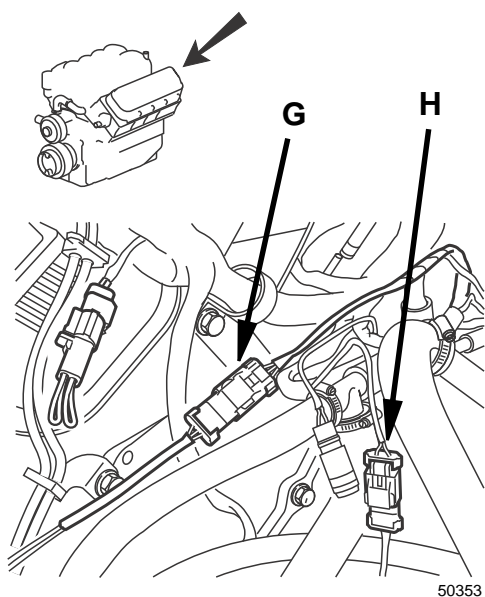


CAUTION! Ensure the water inlet hose from the transom shield to the oil cooler is positioned away from the steering mechanism or steering control could be lost.

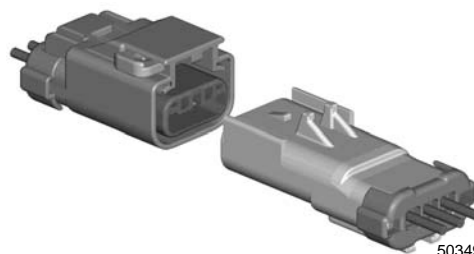


24207

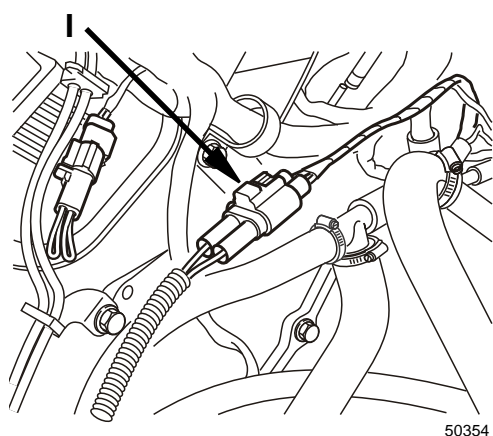
NOTE! If inlet hose is not installed properly, underside of hose may collapse. This would restrict water flow to the engine and cause overheating. Check underside of hose for proper installation and adjust hose as required. Tighten hose clamp securely.



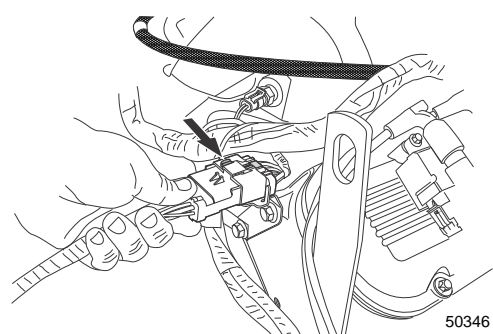
4. Push the gray connector of trim/tilt sender into the gray connector of engine harness **G** and slide the connector lock closed to lock connectors together. Push the black connector of trim control into the black connector of engine harness **H** and slide the connector lock closed to lock connectors together. Secure the wires to water inlet hose with tie strap.



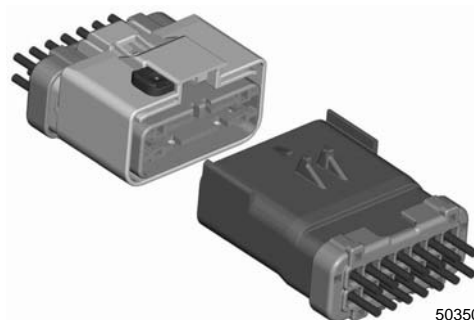
NOTE! Be sure the cables are routed away from the steering and exhaust to prevent cutting, chafing or burning.



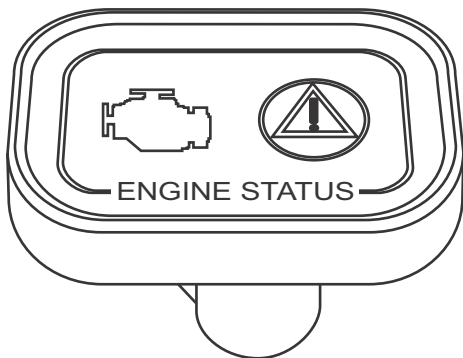
5. Connect the plastic two-wire plug of trim/tilt motor with engine harness receptacle **I**, push together and lock.



6. Align terminals of 14 pin plug and receptacle and press together until a snap is heard. Slide connector lock to right to make sure connectors are locked together.



Engine Status Panel

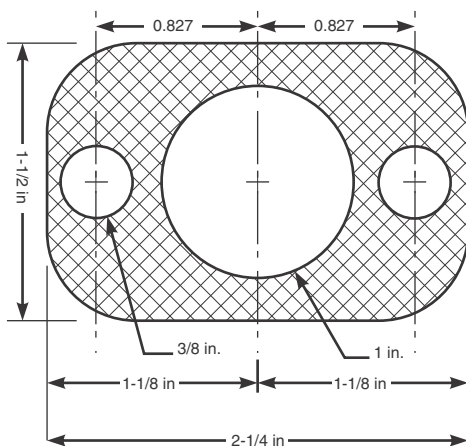


The EPA requires a status panel under 40CFR §1045.130(b)(5) and the California Air Resource Board (C.A.R.B.) require an aural or visual notification for the operator of a vessel of exhaust emission related malfunctions.

Volvo Penta engines equipped with catalyst exhaust are shipped with an engine status panel. Installation of this panel will satisfy EPA and C.A.R.B. requirements.

NOTE! Engine Status Panel functions are integrated into the EVC display or in the EVC remote control on EVC equipped engines. EVC equipped engines do not require an Engine Status Panel. Please refer to the EVC installation poster for EVC installations.

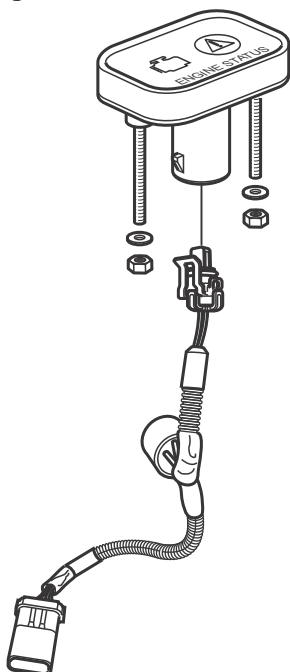
Drill Template



Find a location on the instrument panel that is readily visible under normal lighting conditions, but in no way impede the function of any visual distress signalling device, fog signal, or navigation light.

To mount the engine status panel, locate an area 1.5 X 2.25 inches and layout the drill template on the dashboard where there is space available. Drill a 1 in. hole for the connector and two 3/8 in holes for the mounting studs.

Installing the Panel



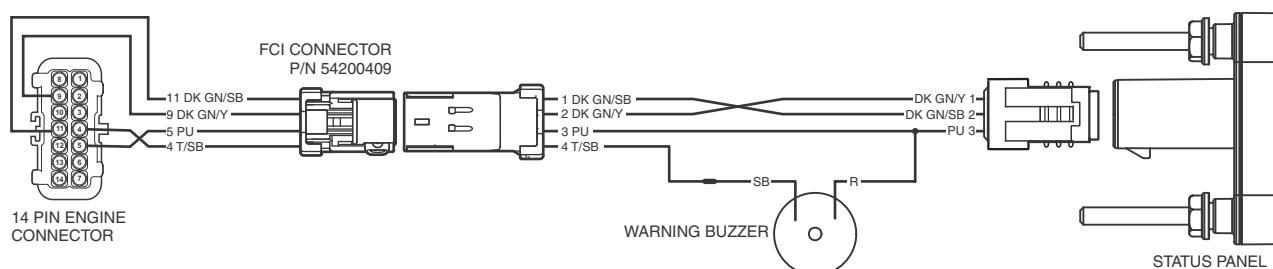
After drilling the dashboard, install the panel with the nuts and washers provided.

Connect the panel with the connector harness provided in the kit.

Connect the status panel harness to the engine extension harness that connects the engine to the instruments.

NOTE! Volvo Penta supplies an adapter harness with the status panel connector integrated (P/N 21200148). If not using a Volvo Penta extension harness with the integrated status panel connector, an FCI connector P/N 54200409 may be used to connect the status panel at the instrument panel. Wire the connector according to the wiring diagram, See *Drill Template* on page 50.

Engine Status Panel Wiring



Fuel System

NOTE! U.S. Coast Guard regulations require installation of an anti-siphon valve in any installation in which any portion of the fuel supply line is below the top of the fuel tank. An adequately sized anti-siphon valve must be used to prevent fuel flow restriction.



DANGER! Use only fuel hoses approved for marine use, and make certain all fuel line connections are leak free. Fuel leakage can result in fire or explosion. Make sure fuel line is routed properly to prevent damage from belts and pulleys.

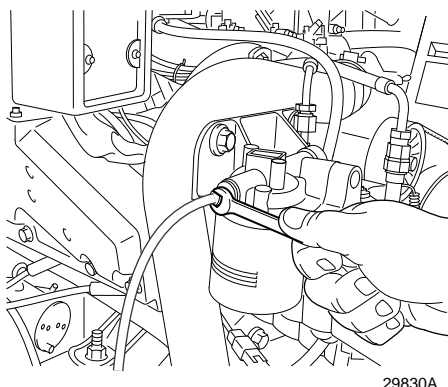
CALIFORNIA WARNING

The boat manufacturer must use Low-permeation fuel line hose on any boat to be sold in California. "Low-permeation fuel line hose" as defined by California means a fuel line hose that does not exceed 15.0 grams per square meter per day permeation rate on CE10 fuel at 23°C, as tested per SAE J1527. Fuel line hose subject to these specifications consist of the line connecting the fuel tank to the engine, but does not include the fuel connections on the engine.

Volvo Penta recommends the use of Low-permeation fuel line hose on all installations whenever possible.

1. The fuel supply hose to the engine requires a minimum inside diameter of 3/8 in. (10 mm). Remove protective plug from fuel inlet of the fuel cell filter/pump assembly. Install 3/8 in. x 1/4 in. NPTF fitting, using pipe sealant on threads. Torque boat fuel line fitting to 11–18 ft. lb. (15–25 Nm).

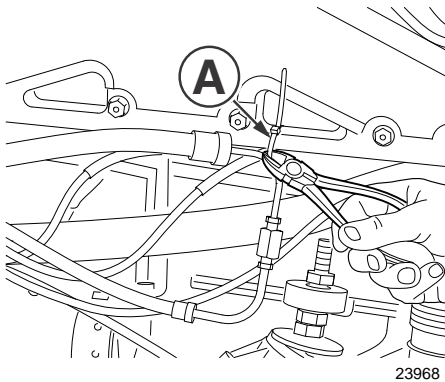
NOTE! Do not use a reducer fitting. Fuel line diameter must be no less than 3/8 in. in size. Restricting the fuel flow by using a smaller diameter hose or fitting may starve the engine of fuel, leading to engine damage.



Power Steering Lines

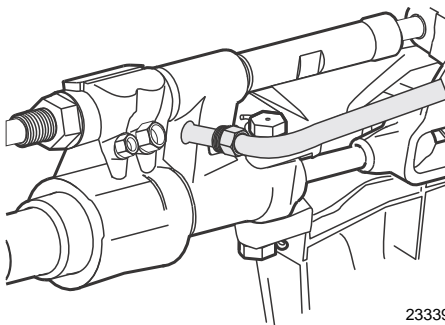
This operation applies to Single Engine or Starboard Engine of Dual Installations.

Sterndrive Joystick Steering system installation is covered in a separate installation poster.

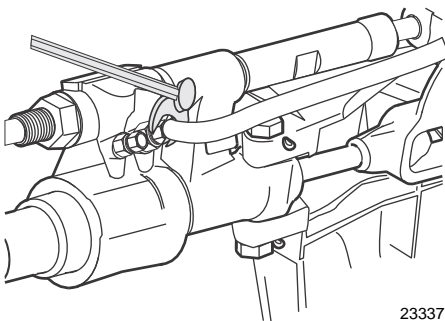


1. Cut tie strap (A) retaining hydraulic hoses and coupler.

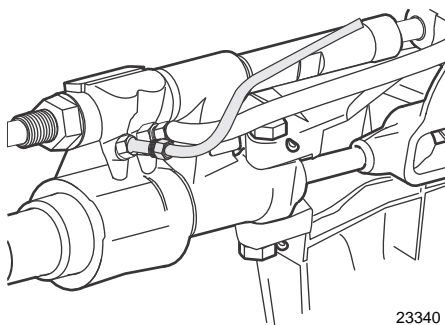
NOTE! Route the power steering hoses away from steering arm, exhaust pipes or belts that may chafe or entangle the hoses. Be sure the hoses are secured so they cannot get tangled in the steering mechanism and cause a loss of steering. Refer to ABYC standard 3.9.5 to maintain minimum clearance from exhaust system components.



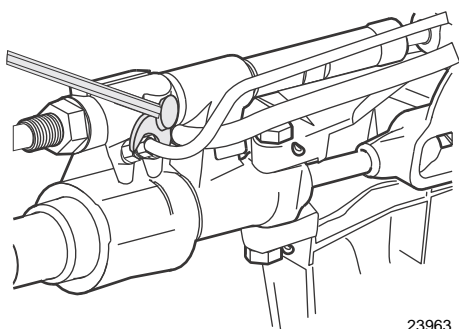
2. Remove the large hose fitting from the hose coupler. Remove the large protective plastic cover from the steering cylinder connector. Attach the large hose fitting to the actuator.



3. Use an 11/16 crow foot wrench at right angle on a torque wrench, tighten large hose fitting to 15–17 ft. lb. (20–23 Nm).



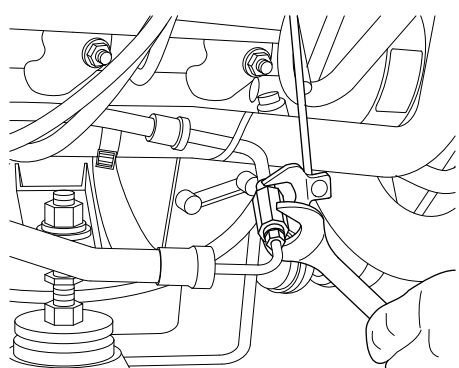
4. Remove the small hose fitting from coupler. Remove the small protective plastic cover from steering cylinder. Attach the small hose fitting to the actuator.



23963

5. Use a 9/16 inch crow foot wrench at right angle on the torque wrench, tighten the small hose fitting to 10–12 ft. lb. (14–16 Nm).

Port Engine of Dual Installations Only



31472

Do not cut strap supporting both steering hoses. Do not remove power steering pump belt. Make sure that the hoses are clear of belts and pulleys and properly secured with the tie strap. Tighten small hose fitting to 10–12 ft. lb. (13.6-16.3 Nm). Tighten large hose fitting to 15–17 ft. lb. (20,3-23 Nm).

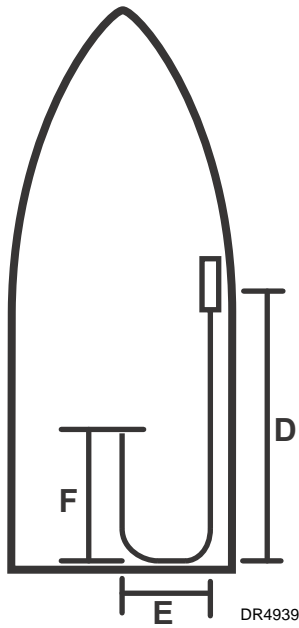
NOTE! If engine is run or tested, refill power steering reservoir with power steering fluid supplied with engine. If engine is not run or tested, ship fluid with the boat.

Controls

NOTE! This manual covers non-EVC installations. For installation on EVC controls and functions, refer to the EVC Installation Manual.

Throttle Cable Lengths

Measure the proposed route of the remote control shift and throttle cables. All bends must have a radius greater than 6 inches (15.2 cm).



1. Add **D + E + F** plus 4 in. (10.1 cm), (**F** is to center of throttle arm pin). Round up to next cable length.

NOTE! Remote control shift and throttle cables must be SAE type cables. When removing shift and throttle cables from the packing box, **DO NOT** bend the cables tighter than a 6 inch radius.

2. Check installation of throttle cable. Throttle cable should “PULL” to open and “PUSH” to close.

Throttle Cable Travel

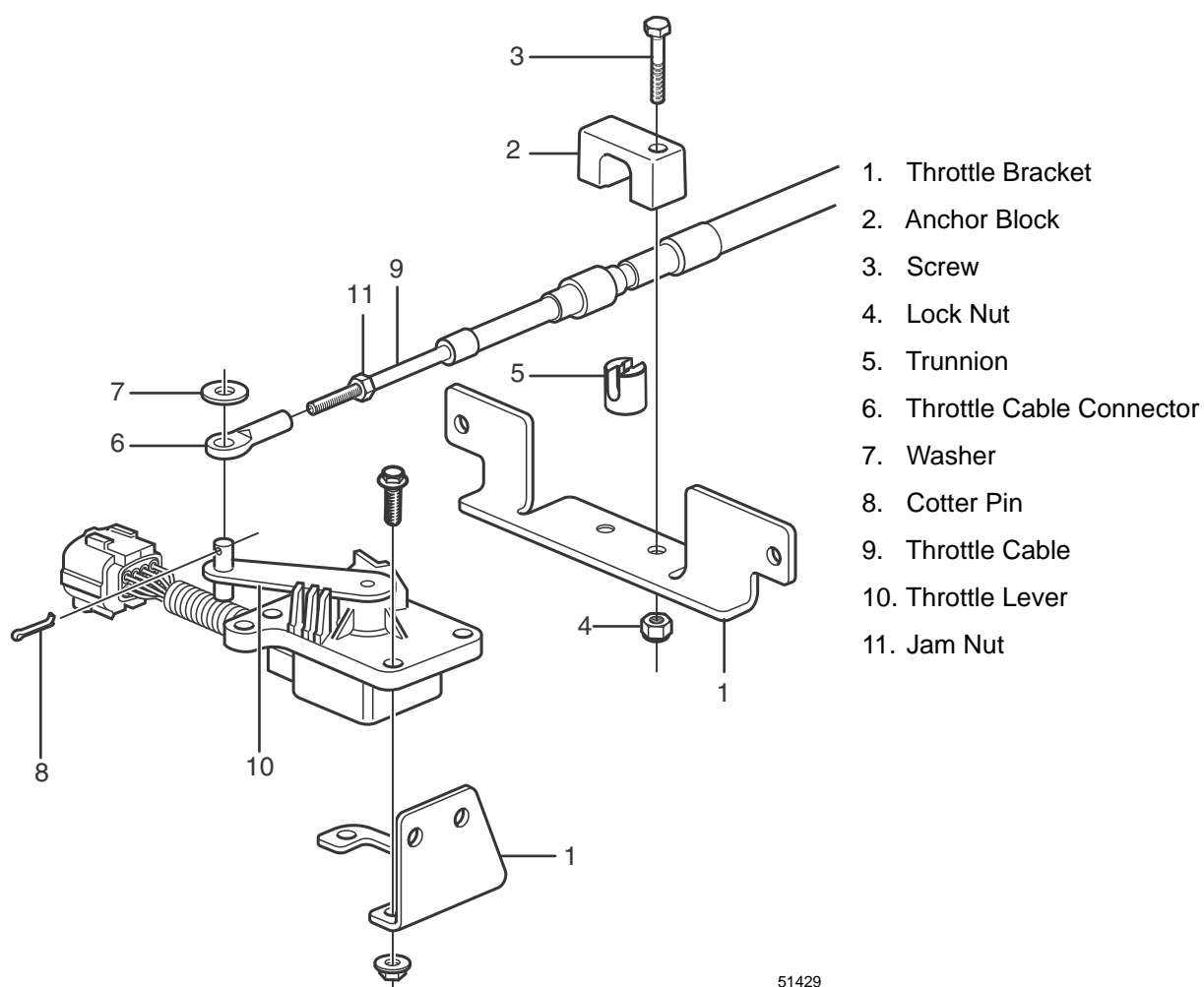
The throttle cable must comply with SAE standard for cable throw. The recommended cable throw for throttle is 2½ in. (63.5 mm). The minimum throttle cable throw is 2 in (50.8 mm) and maximum is 3 in (76.2 mm).

Throttle Cable Installation

Preparing to Install Throttle Cable

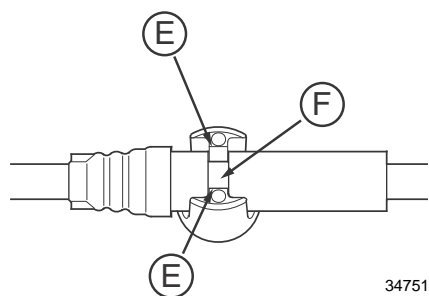
1. Move remote control handle to the NEUTRAL detent position.
2. Turn propeller shaft and shift into the forward gear detent position, and then pull HALFWAY BACK towards NEUTRAL. This positions the control for proper throttle cable adjustment. Failure to follow this procedure can bind the shift linkage in the control, and produce “hard shifting.”

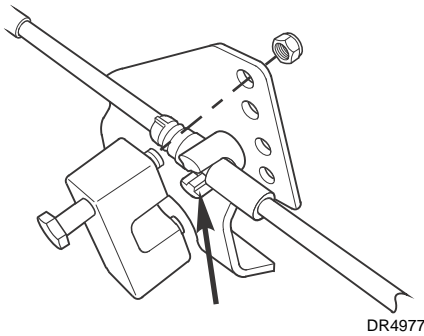
The following images illustrate—by each engine type—the relationship of all the components. Use these illustrations as you carry out the instructions in the section entitled *Installing the Throttle Cable Trunion and Holding Block* on page 55.



Installing the Throttle Cable Trunnion and Holding Block

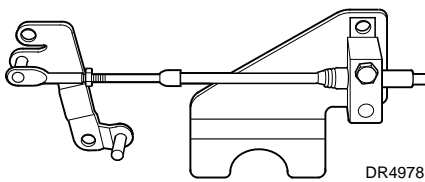
1. Align internal bosses of trunnion **E** with throttle cable groove **F**.





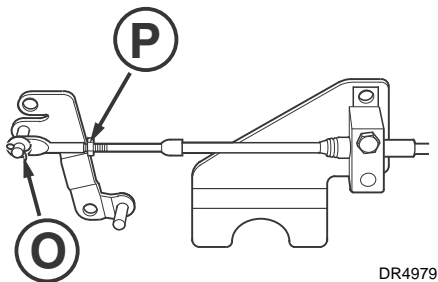
2. Press trunnion on throttle cable until seated.
3. Install open end of trunnion in anchor block. Install bolt in anchor block and position throttle cable assembly in selected set of holes on throttle bracket. Lock nut must be against the anchor bracket; tighten it securely.

CAUTION! When connecting the throttle cable to the Throttle Control Position (TCP) sensor for the electronic throttle, the throttle arm must be fully closed at idle. If the throttle arm is not in the fully closed position at idle, the ECM will sense a fault in the TCP sensor and will not allow the engine to start. Align the cable end with the pin on the throttle lever with light pressure against the idle stop



4. Install throttle cable connector **O** onto the throttle cable **9**. Pull connector forward to remove all end play from remote control throttle cable, then turn the connector in until hole aligns with the throttle lever **10**.

CAUTION! Throttle cable connector must have a minimum of 9 full turns or 1/4 in. of throttle cable thread engagement. If throttle arm connector hole cannot be adjusted to align with the throttle arm, check for proper cable installation in the remote control box.



5. Install connector onto throttle arm. Install washer **O** and cotter pin **P**, and spread prongs of cotter pin. Tighten the jam nut **13** against the connector.

Engine Ventilation

Engine Combustion Air Inlet Size Requirements

NOTE! The engine consumes a certain amount of air for the combustion process, which requires a certain minimum area for the air flow. The area can be calculated using one of the following formulas:

For Gasoline Engines Only

Area (sq. inches) = 0.16 x engine power output in HP.

For Metric Calculations

Area (cm²) = 1.38 x engine power output in kW.

The value applies for unrestricted intake and up to 3.3 feet of duct length with only one 90° bend. The bending radius should be at least twice the diameter.

If longer ducts or more bends are used, the area is corrected by multiplying the coefficient from the table below.

Number of bends	Feet (meters) of duct length				
	3.3 (1)	6.6 (2)	9.8 (3)	13.1 (4)	16.4 (5)
1	1	1.04	1.09	1.13	1.2
2	1.39	1.41	1.43	1.45	1.49
3	— 1	1.7	1.72	1.74	1.78

1. Do not make more than 2 bends in a hose of 3.3 foot (1 meter) lengths.

Engine Compartment Ventilation Requirements

NOTE! To keep the engine compartment/room temperature down to permitted values, a great deal of the radiant heat must be transported out of the engine compartment/room.

The same dimension must be chosen for the inlet and outlet ducts to achieve low flow speeds and noise levels.

The area for the inlet air can be calculated using the one of the following formulas:

For Gasoline Engines Only

Area (sq. inches) = 0.19 x engine power output in HP

For Metric Calculations

Area (cm²) = 1.65 x engine power output in kW

Maximum engine room pressure differential must not exceed 1.37 Kpa, 13.7 millibars, or 4.5" water column at Wide Open Throttle. Engine intake air temperature must not be more than 30°F above ambient temperature.

If either of these criteria is not met, engine room ventilation must be increased

NOTE! All engine horsepower ratings are at 77°F. For every 9°F increase, the engine will reduce power by 1%.

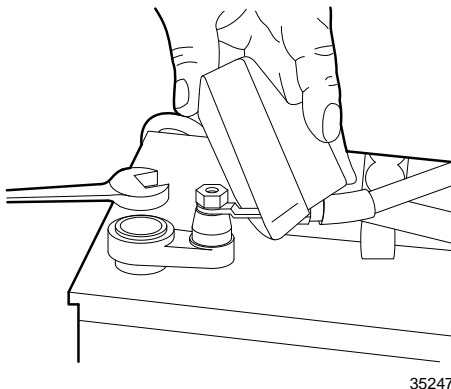
Battery Requirements

⚠ CAUTION! Batteries should be handled with care. If electrolyte contacts any part of the body, immediately flush the exposed area with water and seek medical attention as soon as possible.

NOTE! Read and understand the information supplied with your battery **before** you begin installation. Batteries must be heavy-duty marine construction and either vented/refillable or maintenance-free, with a CCA or INCA rating.

Use a 12 volt battery having a minimum rating of 650 Cold Cranking Amps at 0°F (-18° C), and a 165 minute reserve capacity rating at 80°F (27° C). Applications equipped with Sterndrive Joystick Steering systems require 750 CCA regardless of engine size.

Battery Connections



35247

NOTE! Use bolts or nuts to secure battery cables to the battery terminals. Do not use wing nuts, even if they were supplied with the battery. Wing nuts do not provide a secure connection for battery cables. Loose connections could cause permanent damage to electrical components. An internal star lock washer must be used with either a nut or screw to secure battery cables to the battery.

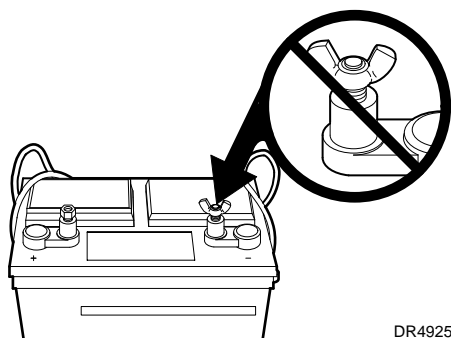
NOTE! Service electrical components only while the engine is not running. Be careful when identifying positive and negative battery cables and terminals. If you touch the wrong terminal with a battery cable, even briefly, the engine's electrical system could be damaged.

NOTE! The key switch must be in the "OFF" position to safeguard against permanent damage to electrical components while connecting or disconnecting the battery cables.

Connect the **B+** starter solenoid cable to the positive **B+** battery terminal. Position protective cover over terminal. This will provide current to the entire engine and instrument panel electrical system.

⚠ CAUTION! The battery terminal connections must always be insulated. Install protective covers if the battery mounting system does not cover the connections.

NOTE! Connect the engine ground cable to the negative battery terminal. The engine electrical system will be operable when this connection is made.



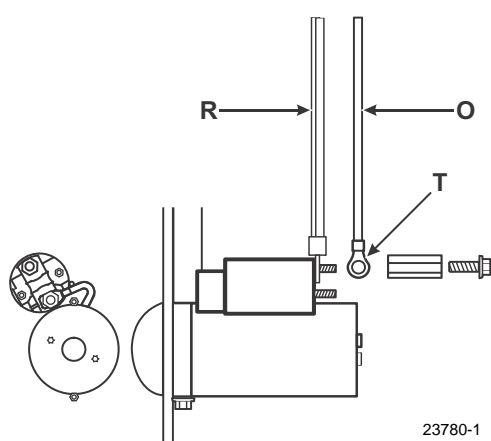
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Battery Isolators

Correct Installation of Battery Isolators

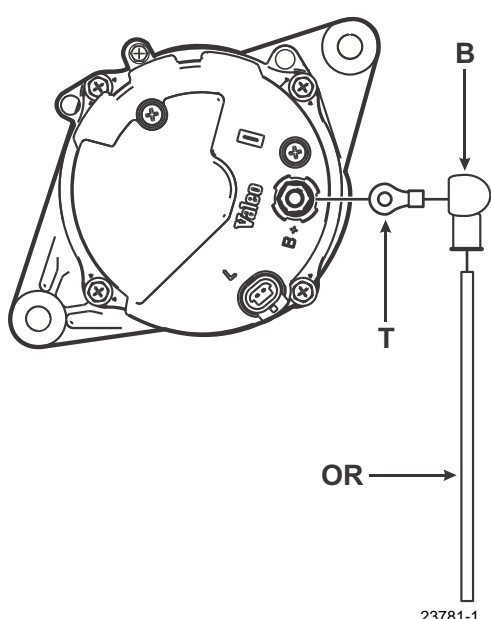
Disconnect alternator from engine harness.

⚠ CAUTION! Disconnect all power to the engine before proceeding



1. At starter, remove ring terminal/orange wire **O** from the connection point on solenoid.
2. Remove ring terminal **T** from wire by cutting it.
3. Seal cut end of wire with electrical tape or liquid tape. Tape or tie strap the wire **O** to engine harness.

NOTE! Do not remove red **R** or other wires.



4. At rear of alternator, remove ring terminal/orange wire/boot **O** from the **B+** terminal.
5. Remove ring terminal **T** and boot **B** from wire by cutting it. Save boot.
6. Cut and seal end of wire with electrical tape or liquid tape. Tape or tie strap the wire **O** to engine harness.

Alternator and wire **O** are now disconnected from the engine harness.

Connecting Alternator to Isolator

NOTE! The alternator output wire assembly, which carries alternator output to the isolator, is critical to correct operation of the charging system. The wire must meet all current ABYC specifications regarding materials, attaching terminals, and routing and protecting the wire.

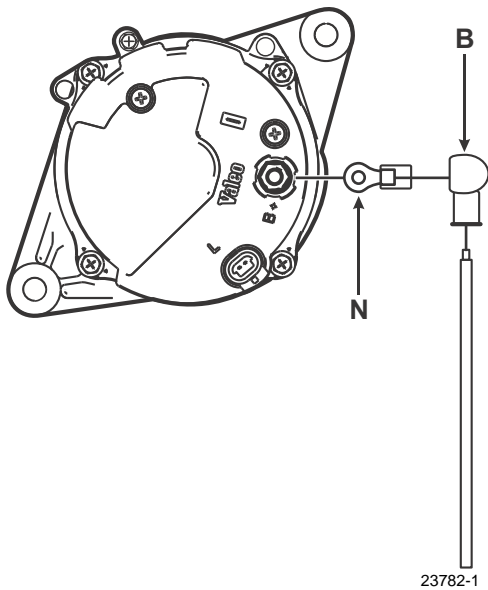
NOTE! Wire size of the output wire is critical to correct operation of the isolator and charging system. Wire size is determined by the total length of wire. The size of the output wire used in the installation must meet these ABYC standards:

0-10 ft (0 - 3m) 6 AWG

11-20 ft (3m to 6m) 4 AWG

Over 20 ft (6m) 2 AWG

NOTE! Using the correct wire size ensures that voltage drop occurs through the isolator diodes and not in the wire.



7. Place boot **B** over output wire.
8. Install a 5/16" (8mm) ring terminal **N** on output wire. To create a secure terminal, mechanically crimp the wire's conductor and add a heat shrink seal.
9. Install ring terminal/boot/wire on **B+** stud on alternator.
10. Torque the stud nut to 7–13 ft. lb. (10–17 Nm).
11. Route the wire to avoid sharp edges or other chafe points. Sheathing the wire is recommended.
12. Complete the wiring of the battery isolator per manufacturer's recommended procedures.

Prepare for Shipment

1. If the Sterndrive will not be installed before shipment, make sure the paper or plastic gimbal housing cover is in place to prevent damage during shipment. This cover is part of the packing material shipped with the transom shield and is removed when the drive unit is installed.

NOTE! Failure to properly match engine and drive unit will result in poor boat performance, and risk damage to engine and drive because of incorrect drive gear ratio.

2. If engine was water tested, and is to be stored or shipped, remove all water drain petcocks and rubber drain caps from engine. Make sure all water is removed from engine and manifolds. See *Engine Draining* on page 61.

Storage

If the boat is being placed into storage, a gasoline fuel stabilizer must be added to the tank(s) as per the manufacturers instructions. The amount of stabilizer required is determined by the quantity of fuel and the length of time it will be placed in storage.

NOTE! Do not run engine out of fuel or run the electric fuel pumps dry. Running the electric fuel pumps dry will cause fuel pump damage.

Prepare a Storage Mixture

In addition to stabilizing the fuel, it is highly desirable to have the valves and cylinders coated with a light film of oil previously accomplished through "fogging." Today's multi-port fuel injection manifolds are designed with a complex air channel design that will not allow the traditional fogging oils to be injected past the throttle plate while running. The oil will get stuck in the plenum and never reach the cylinders.

Together with the stabilizer, two-cycle motor oil can be added to a fuel mixture for stabilization purposes.

- Using an outboard motor six-gallon fuel tank, add two-cycle motor oil at a ratio of 50:1 (one pint to 6 gallons) and stabilizer at one ounce per gallon (unless stated otherwise on the manufacturer's label). Mix well.
- Disconnect boat fuel line at engine fuel pump. Attach the "storage mix" fuel tank.
- Connect a water hose to the engine flush.
- Run the engine on the "storage mixture" for approximately 5 minutes at 1500 RPM. This will ensure that all fuel system and internal engine components are thoroughly protected. Do not operate the engine above 1500 RPM as the water pump demand may exceed the supply, damaging the pump.
- Reduce the engine speed to idle and stop the engine.
- Reconnect the fuel fitting and check for fuel leaks.

Regardless of the ratio of fuel stabilizer to fuel we use, the maximum recommended storage time for gasoline, according to STA-BIL, is six months. During final assembly testing at our Lexington factory, each engine is run on a fuel mix that is stabilized.

Engine Draining

Raw Water cooled engines

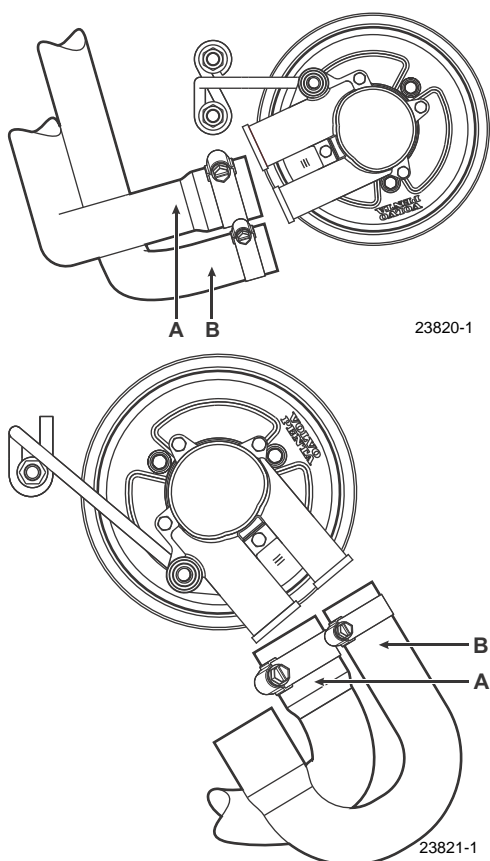
1. Remove all engine and manifold drain plugs. For locations of drain plugs See *Install Engine Drain Plugs* on page 43.

NOTE! Closed cooled engines do not require the engine block drains be removed. See *Draining Closed Cooled Engines* on page 62.

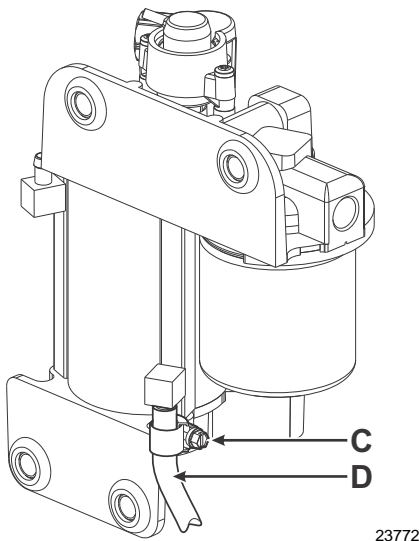
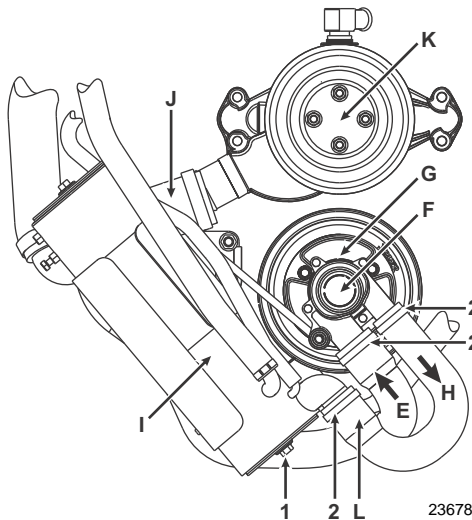
2. Remove the **Ignition** relay from the fuse and relay box so the engine will not accidentally start.

NOTE! **Relay must be removed so the engine does not start when cranked. Failure to remove relay could cause the engine to start and run without water, causing engine damage.**

3. Remove and drain hoses **A** and **B** from the raw water pump. Crank the engine for approximately 2 seconds (1 or 2 crankshaft revolutions). This will purge the water from the raw water pump.
4. Reconnect the hoses. Tighten hose clamps securely.
5. Replace the **R5** relay in the fuse and relay box.



Draining Closed Cooled Engines



Check anti-freeze protection level. If protection is adequate for the anticipated temperatures, no further service is required of the closed cooling side of the system. Proceed with the following steps to drain the raw water side of the system which is not protected from freezing.

1. With the engine turned off locate and loosen the lower drain cap from the heat exchanger (1). After water has completely drained, retighten the lower drain cap of the heat exchanger to 18-30 ft. lb. (25-41 Nm).
2. Note the hose orientation on the raw water pump (G). Loosen the hose clamps (2) and remove the hoses (E, H, & L) from the raw water pump and heat exchanger. Crank the engine briefly, (1 or 2 crankshaft revolutions) but do not start the engine, to clear the water from the pump. Reinstall the hoses and secure the clamps in the same orientation as removed.
3. Remove drain plugs from exhaust manifolds, for locations See *Install Engine Drain Plugs* on page 43. After water is completely drained, reinstall drain plugs and tighten securely.
4. Loosen clamp (C) and remove hose (D) from fuel pump. Allow water to drain from hose.
5. Reinstall all hoses and secure all clamps in the same orientation as removed.
6. Store all fittings in bag and attach to engine. Refill power steering reservoir with power steering fluid supplied with engine. If engine is not run or tested, ship fluid with the boat.
7. Check the engine, transom shield, and drive unit for the correct model numbers before shipping the boat (see separate sheet shipped with the drive unit.)

SX & DPS Sterndrive

Installing the Sterndrive

Proper installation is important for the safe, reliable operation of all mechanical products. In these instructions we recommend and describe effective procedures you should follow when installing Volvo Penta sterndrive products. Some of these methods require the use of tools especially designed for the purpose. These tools should be used whenever recommended.

Follow the steps and procedures described in this section—in the order listed—to perform a complete installation of a Volvo Penta engine and sterndrive assembly.

1. Prepare for installation
2. Install drive unit
3. Check and adjust trim sending unit
4. Install shift cable
5. Check shift cable installation
6. Install propeller(s)

Prepare for Installation

Read installation instructions completely, and collect all tools, instruments, and parts needed for the job before you start work.

Required Special Tools

- Volvo Penta “Solo” Drive Unit Cart¹ Part No. 9990001
- Lifting Eye (½ in.- 13 threads)
- Grease Gun
- Alignment Tool Part No. 3851083
- Universal Handle Part No. 3850609
- Prop Nut Tool Kit Part No. 3862811
- 1-1/16 Socket and Torque Wrench

Sealants and Lubricants Required

- Volvo Penta Water Resistant Grease Part No. 828250
- Volvo Penta DuraPlus GL 5 Synthetic Gear Lube, Quart: Part No. 3851128, Gallon: Part No. 3851129, 5 Gallon: Part No. 3851133
- White Sealing Compound For Drives Part No. 1141570
- Volvo Penta Trim/Tilt and Power Steering Fluid Part No. 3851039

1. Although a drive unit cart is not required, we strongly recommend its use when moving the sterndrive.

Static Water Line

Determine if the engine meets the static water line height requirements after the engine and drive unit have been installed in the boat. The boat must be in water with its recommended load capacity distributed aboard.

NOTE! The static water line height must be tested before the engine is started for the first time. This will prevent the ingestion of water into the engine and resultant damage.

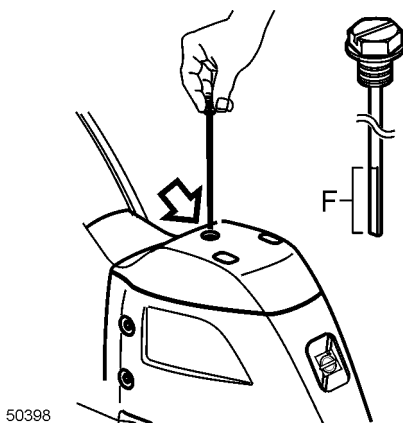
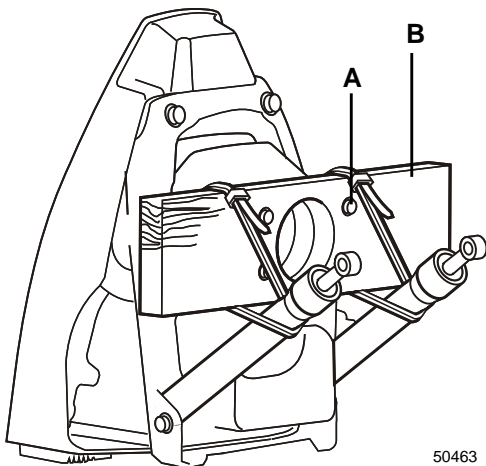
To determine the static water line height, follow the instructions in *Static Water Line* on page 89.

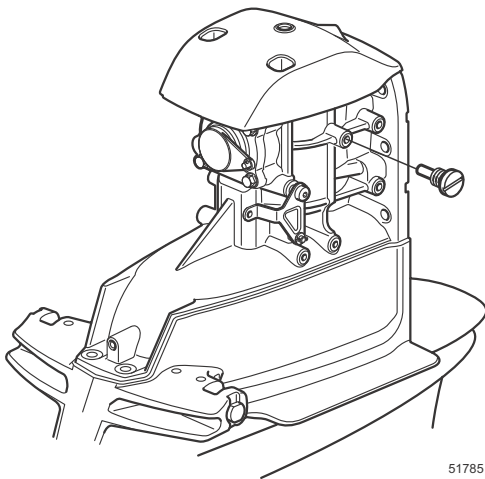
NOTE! An installation that permits water to enter the engine through the exhaust manifold(s) will not be covered by warranty, unless damage is due to defective part(s).

Preparing to Install the Drive Unit

NOTE! All sterndrive system components must be matched for either single or dual engine installations. Failure to properly match the engine and drive unit will result in poor boat performance, and risk damage to the engine and drive because of incorrect drive gear ratio.

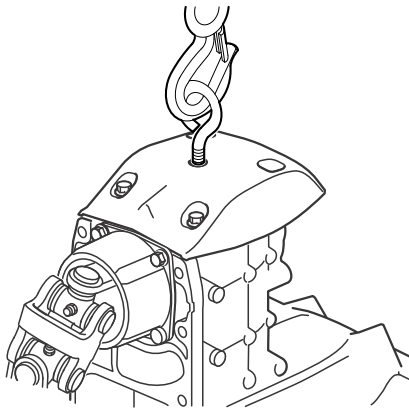
1. Support trim/tilt hydraulic cylinders before cutting tie straps to prevent damage to hydraulic lines. Remove each tie strap and carefully lower hydraulic cylinders.
2. Remove and save retaining nuts **A**. Remove and discard shipping board **B**.
3. Remove and retain oil level dipstick and gasket. Check oil level is within the FULL and ADD marks while the dipstick is removed.





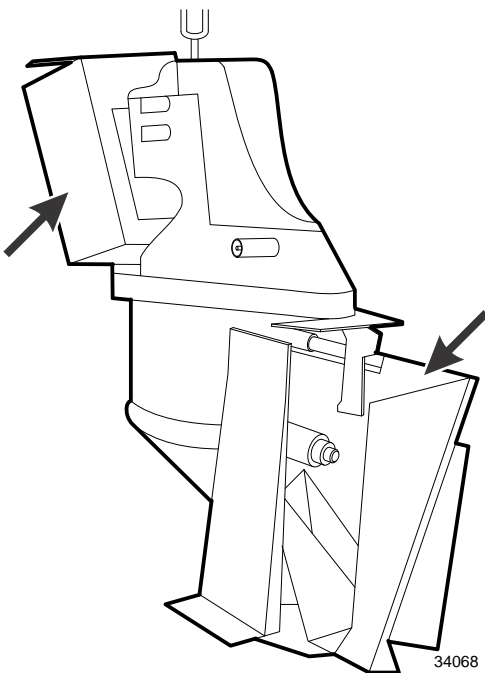
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4. If the drive oil is low, remove the oil level plug from the drive and fill the drive through the dipstick hole until oil comes out the level hole. Check that the level is between the FULL and ADD marks on the dipstick. **DO NOT** overfill.
5. When the oil level is adequate, reinstall the oil level plug.



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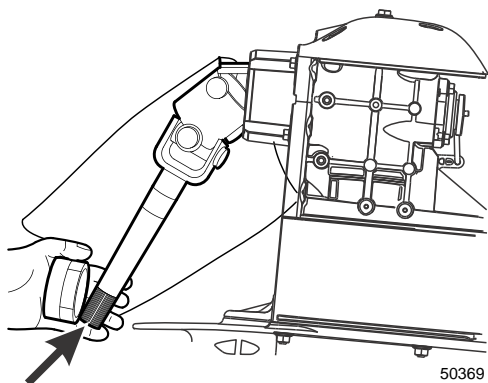
6. Thread lifting eye into oil level dipstick hole.



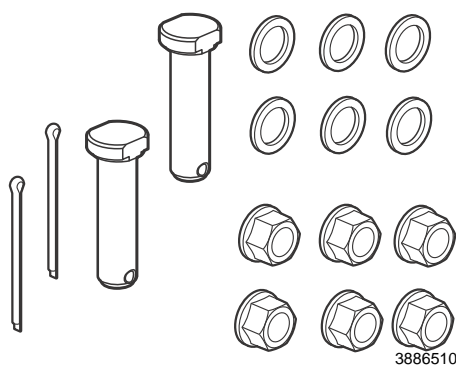
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7. Use a suitable hoist to remove drive unit from shipping carton. Remove and discard protective cardboard support from driveshaft.

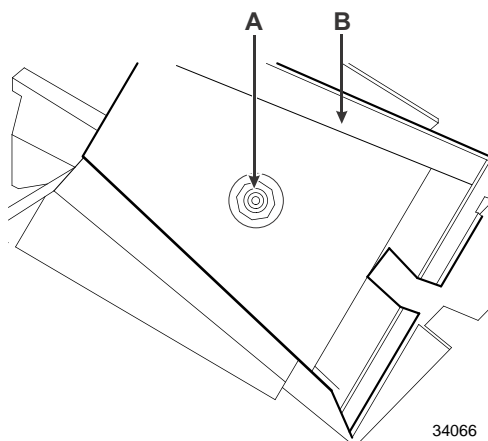
8. Remove plastic bag from greased drive shaft.



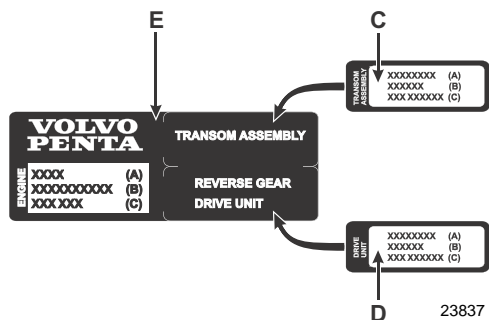
9. Check contents of the drive unit hardware kit. The six lock nuts, two trim/tilt pins and two cotter pins are for attachment of the drive unit.



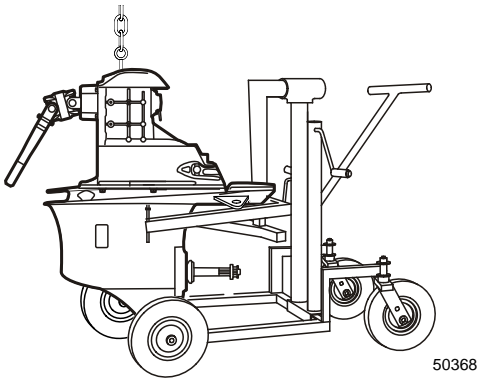
10. Remove and discard protective cardboard **B** from propeller shaft **A**, and inspect propeller mounting hardware.



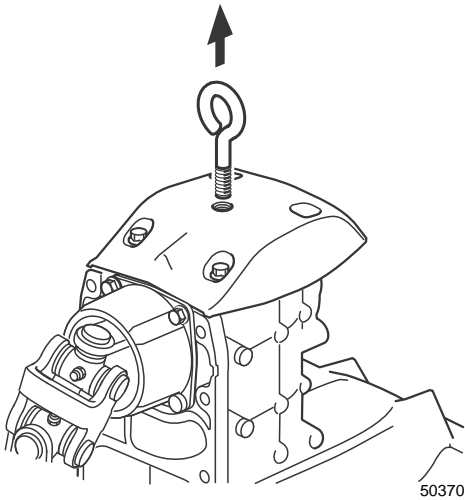
11. Remove the drive unit identification decal **D** from the bag and place it on the engine decal located on the engine cover **E**.



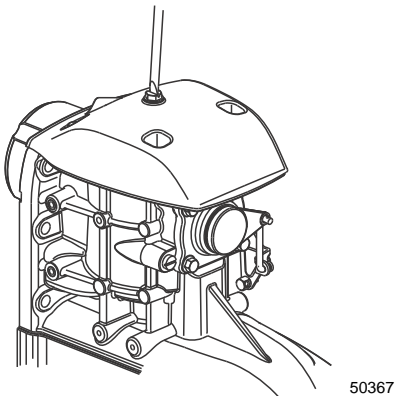
12. If the boat transom design requires the transfer of the drive unit from a hoist onto a drive unit cart, do so now.



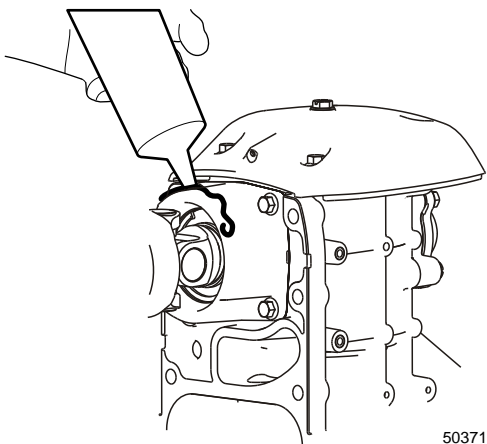
13. Remove lifting eye bolt from upper housing. Check oil level with dipstick and, if required, fill to indicator plug mark with GL 5 Synthetic Gear Lube.



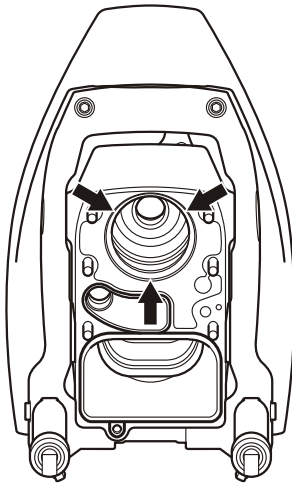
14. Reinstall oil level dipstick and gasket. Tighten oil level dipstick securely.



15. Inspect the tapered end of the bearing housing to ensure it is free of nicks and dents. Apply a light coat of Volvo Penta water resistant grease Part No. 828250 to tapered end of bearing housing. Lubricate shaft splines, O-rings, and water passage seal with grease.

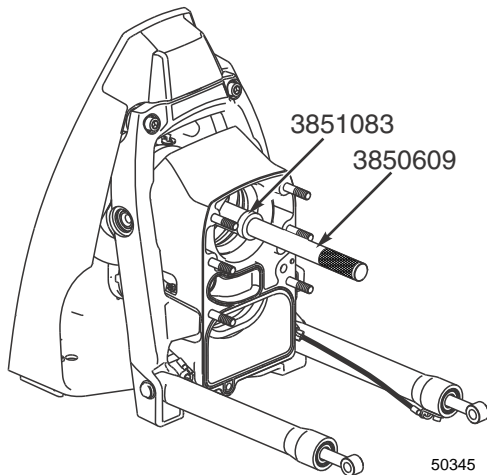


16. Inspect moulded rubber seal ring for proper fit in its groove.
Inspect and lightly lubricate U-joint bellows lip with Volvo Penta water resistant grease Part No. 828250.



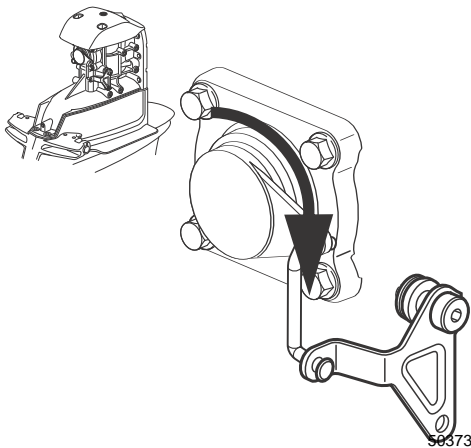
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17. Using handle Part No. 3850609, slide alignment tool Part No. 3851083 through gimbal bearing. The alignment tool must slide through the gimbal bearing and into engine coupler with ease. If the alignment tool binds going into engine coupler, the front engine mount(s) must be adjusted either "up" or "down," as required, until alignment tool slides in and out of engine coupler with ease.



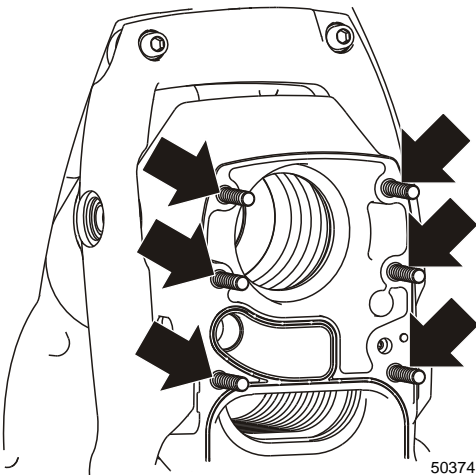
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18. Shift drive unit into gear by rotating the eccentric piston arm.

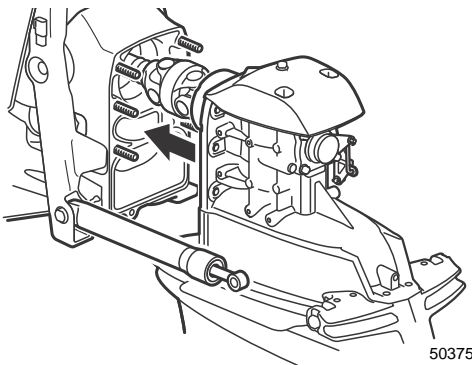


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19. Apply white sealing compound for drives or water resistant grease Part No. 828250 to the six studs.



Installing Drive Unit



1. Tilt the trim cylinders up above the upper gear splash plate.
2. Slide driveshaft through gimbal bearing.

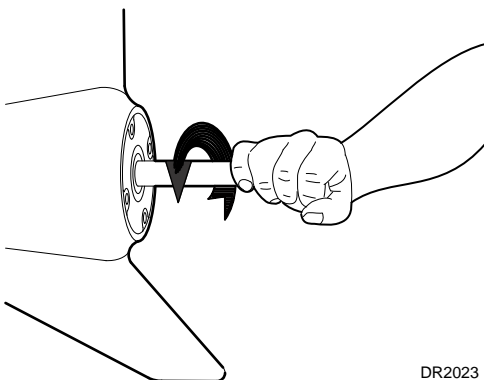
NOTE! If shift cable is installed, be careful not to damage the cable when installing the sterndrive.

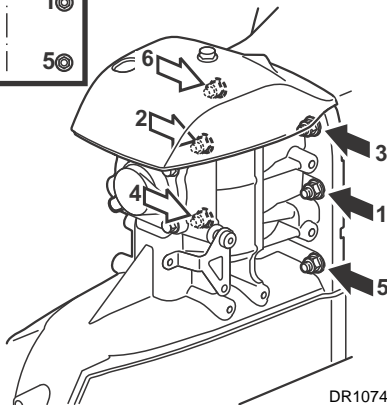
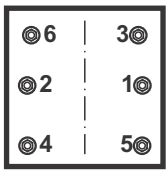
NOTE! Use caution not to damage the Drive Oil Sensor Cable when installing the Ocean X sterndrives.

3. To align the driveshaft splines, rotate propeller shaft(s) until the driveshaft splines engage the flywheel coupler. Use soft jaw pliers to rotate the propeller shaft(s) if it is difficult to turn by hand.

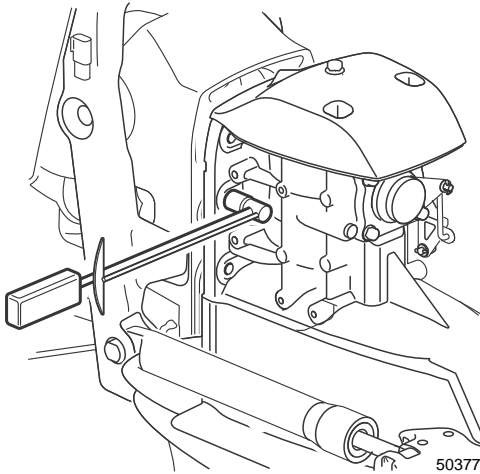


CAUTION! Wear gloves or use a shop cloth or rag to protect your hands. Propeller shaft splines may be sharp.



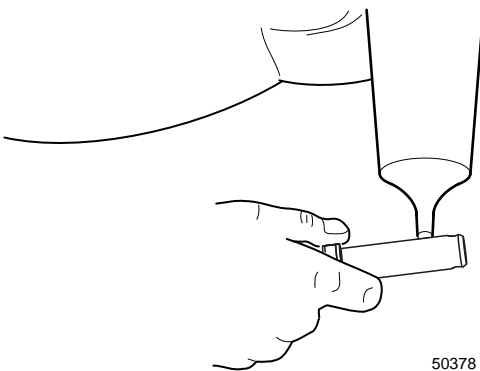


4. Slide drive unit onto the six studs until it is completely seated against the pivot housing. Install six lock nuts (three on each side).



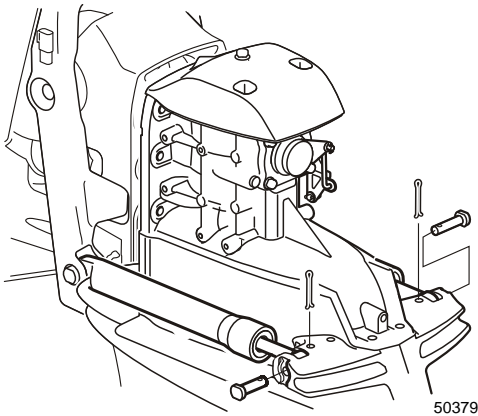
5. Tighten the nuts in two steps. Tighten nuts to an initial setting of 25 ft. lb. (34 Nm). Start with the center nut **1** and work in a crisscross pattern (**2, 3, 4, 5, 6**) to secure the drive unit to the pivot housing. Use the same crisscross pattern to tighten all six lock nuts to a final setting of 50 ft. lb. (68 Nm).

NOTE! Do not use pneumatic or electric impact type tools on drive attachment nuts. The threads of the nut and stud will be damaged.



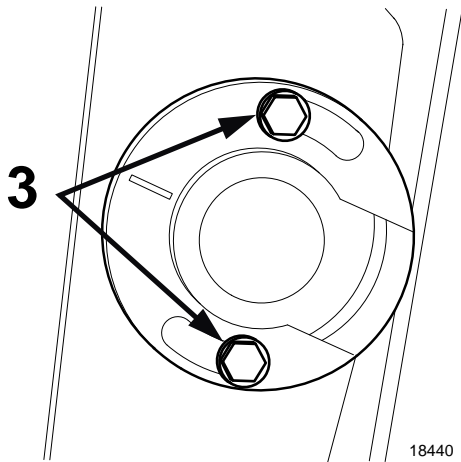
6. If a drive unit cart has been used, remove it at this time for installation of the trim/tilt cylinders.

Apply Volvo Penta water resistant grease Part No. 828250 to the trim/tilt pivot pin.

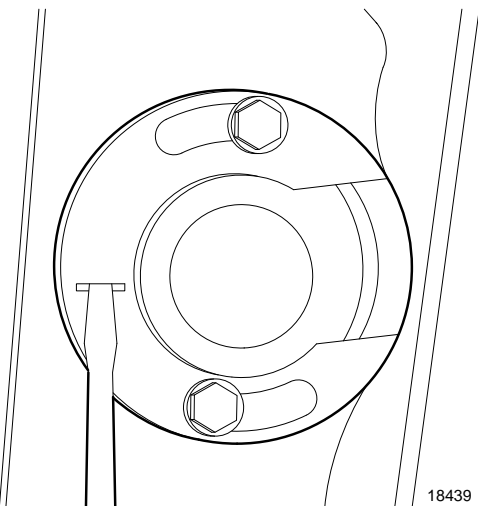


7. Align trim/tilt cylinder end with upper gear housing boss. Slide trim/tilt pivot pins into the upper gear housing.
8. Use the flats on the trim pins to align the trim pin with the cotter pin hole and install the cotter pin. Bend the cotter pin ends to lock in place.

Check and Adjust Trim Sending Unit



1. Push trim/tilt switch to the down position. Drive unit must be in a full trim-down position before adjusting the trim sending unit.
2. Loosen trim gauge sending unit screws **3** on starboard side of gimbal ring.

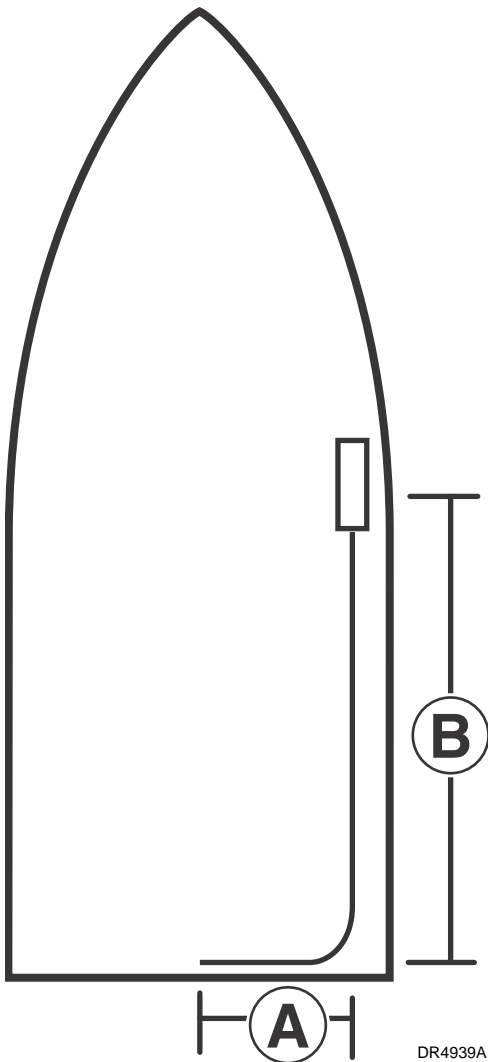


3. Rotate trim gauge sending unit as required to achieve a "full down" reading on the trim gauge.

NOTE! If you are unable to achieve a "full down" reading, check the gauge for correct operation and the sending unit for correct installation. For additional information, refer to the Workshop Manual for SX/DPS Sterndrives.

4. Tighten trim gauge sending unit screws to 24 in. lb. (2.7 Nm).

Shift Cable



Check Installation of Shift Cable

Non-EVC Applications

Check Remote Control Shift Cable Stroke

NOTE! This manual covers non-EVC installations. For installation on EVC-E2 controls and functions, refer to the EVC-E2 Installation Manual 47704235 and Installation Poster 4774051.

1. If the remote control shift and throttle cables are already installed in the remote controls, proceed to *Check Remote Control Shift Cable Stroke* below.
2. If the remote control shift cable has not been installed, the following procedure will permit you to order the correct length remote control shift cables.
3. Measure the proposed route of the remote control shift cable. All bends must have a radius greater than 6 inches (15.2 cm).

Add **A + B** plus 20 in. (50.8 cm), round up to next cable length.

NOTE! DO NOT bend the cables tighter than a 6 inch radius when removing shift and throttle cables from the packing box.

All Models:

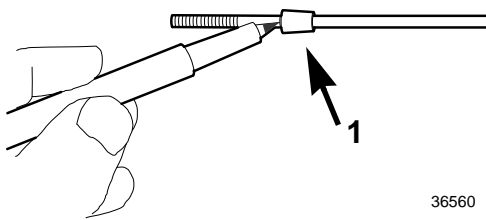
Shift cable should "PULL" for forward gear on right-hand rotation SX drives and all DPS applications.

Twin Installations, SX Models Non -EVC Only:

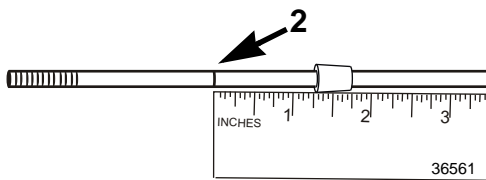
Shift cable should "PUSH" for forward gear for left-hand rotation propeller applications. This change is accomplished at the remote control.

NOTE! Check installation of throttle cable. Throttle cable should "PULL" to open and "PUSH" to close.

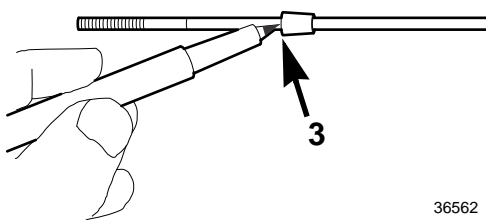
The following steps only apply to non-EVC applications. For EVC applications See *Shift Cable Installation* on page 73 and



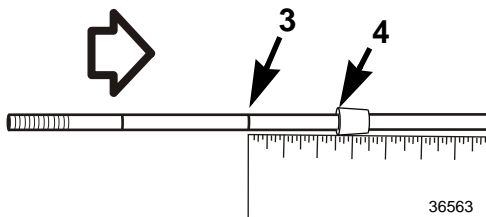
1. Move the remote control handle to the **FORWARD** position. This will retract the shift cable. Pull out the cable core wire to remove end play. Mark the cable core wire at the end of the casing **1**.



2. Return remote control shift handle to the neutral detent position. Measure and record the distance between mark and end of casing **2**.



3. Mark cable core wire at end of casing with control in the neutral detent position **3**.



4. Move the remote control handle to **REVERSE**. This will extend the shift cable to the maximum travel. Push in on cable core wire to remove end play. Measure and record the distance between mark **3** and end of casing **4**.

The distance between forward and neutral must be no less than 1¼ in. (31.8 mm) and no greater than 1⅜ in. (35.0 mm).

The distance between neutral and reverse must be no less than 1¼ in. (31.8 mm) and no greater than 1⅜ in. (35.0 mm).

NOTE! If your measurements are not within these specifications, check your remote control installation instructions. Make sure the cables are attached correctly inside the control box before continuing.

NOTE! All remote controls must meet these minimum and maximum specifications in order for the shift system to function properly.

Shift Cable Installation

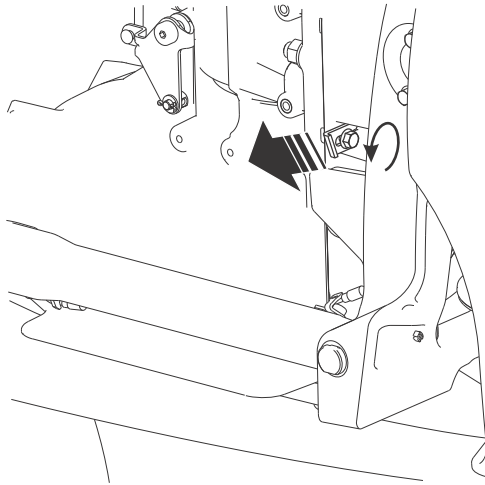
NOTE! All DPS and SX right hand rotation sterndrives should "Pull" the shift cable for forward gear. For SX left hand rotation, push for forward gear. The direction the shift cable actuates must be set in the remote control.

NOTE! Remote control shift and throttle cables must be SAE type cables. If a shift cable was previously installed in the transom shield, skip to **Step 5**.

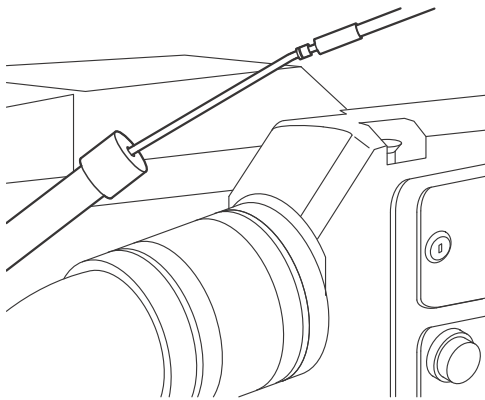
Non - EVC applications

1. If the throttle cable is attached to the throttle arm and anchor block, remove it from both. The throttle cable must be disconnected from the throttle arm prior to shift cable installation and adjustment to prevent "loading" the control box and adversely affecting shift adjustments.

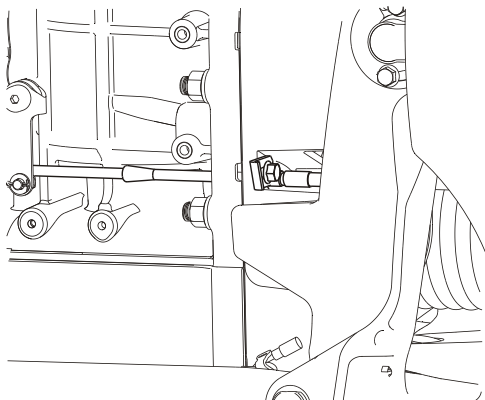
All Applications



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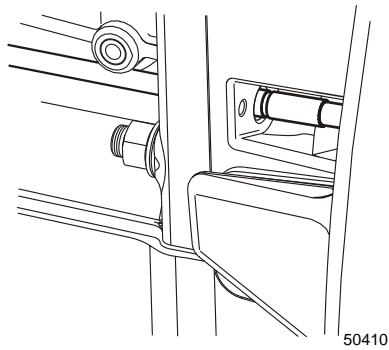


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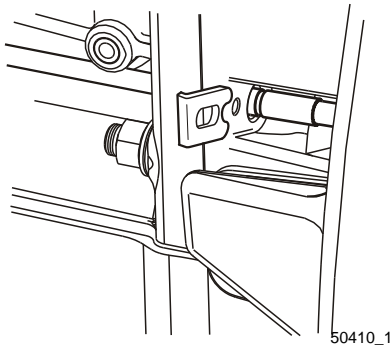
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2. Note position of small seal and large seal on the shift cable. Remove and retain jam nut, small seal, and large seal from the shift cable for reinstallation later.
3. Loosen cable anchor clamp screw. Slide cable clamp to starboard.
4. Retract inner core wire of shift cable. If the shift cable is already installed in the remote control, shift the control into forward gear. Apply a light coat of Volvo Penta water resistant grease Part No. 828250 to the end of the remote control shift cable casing. Slide shift cable through transom sleeve and connector assembly until it appears on the outside of the transom.
5. Insert shift cable through pivot housing and drive unit.
6. Reinstall the large seal and small seal onto the shift cable in the same position as removed.

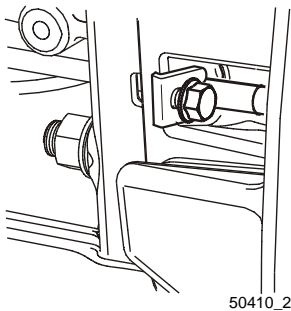


7. Align groove in shift cable housing with anchor clamp.

NOTE! Shift cable clamp and bolt are removed for illustration purposes. It is not necessary to remove the clamp and bolt for shift cable installation.



8. Slide anchor clamp in, engaging the shift cable anchor groove.



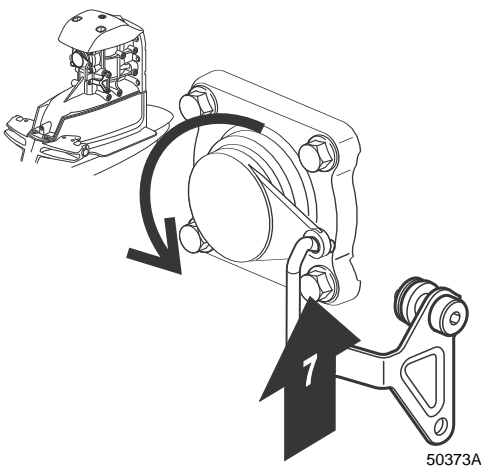
9. Torque anchor clamp screw to 62 in. lb. (7 Nm).

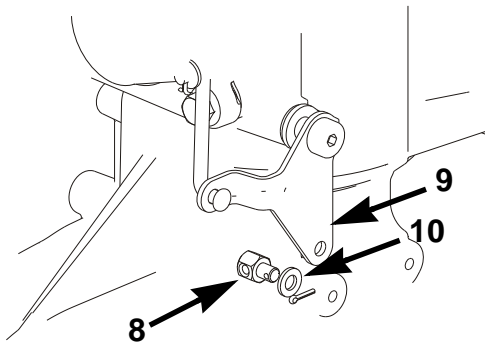


WARNING! If the shift cable anchor clamp is not completely engaged in the shift cable housing groove and the screw is not tightened, the shift cable housing will come loose and result in loss of shift control.

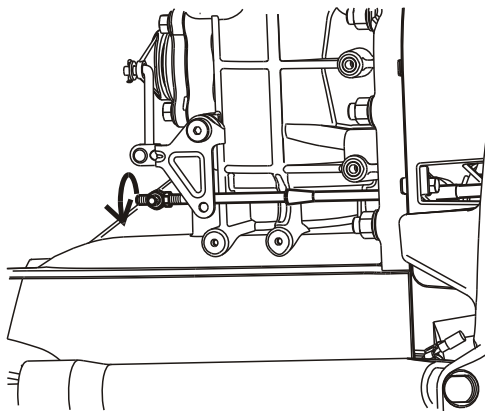
Be sure the shift cable clamp is not protruding outside of the pivot housing. If the clamp protrudes outside of the pivot housing, the clamp is not completely engaged and should not be placed into service.

10. Rotate eccentric piston arm 7 to extend bellcrank.

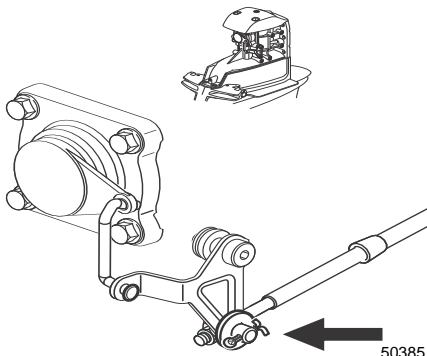




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Shift System Test

11. Remove cotter pin, flat washer, and cube **8** from bellcrank **9**.

12. If the shift cable is already installed in the remote control, move the gear shift to reverse to extend the shift cable. Thread cube halfway onto remote control cable end. Rotate shift lever back to neutral detent position, then move remote control handle to its neutral detent position. Turn cube IN or OUT until it aligns with center of bellcrank slot.

13. Install flat washer and cotter pin **10**.

14. Bend prongs of cotter pin.

15. Install jam nut and tighten securely against cube to keep cable from turning in cube.

With engine running, shift unit into forward and reverse gear several times. Ensure full forward and reverse gear engagement occurs. Boat must move in direction of selected gear (i.e., with control handle in forward, boat moves forward). Refer to the remote control manufacturer's service manual to correct any problems **before** delivery of boat.

NOTE! When shifting from neutral into forward and reverse gear, the movement of remote control handle required to obtain gear engagement should be approximately equal in both directions. If not, the shift cable trunnion has to be readjusted to obtain a centered shift stroke.

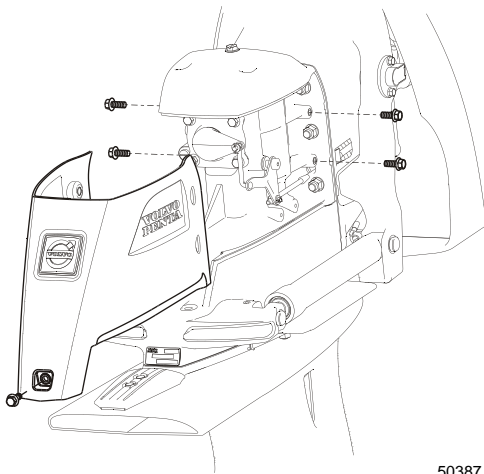
Start-in-Neutral-Only Test

CAUTION! Operate bilge blower as required by regulations before starting engine, to prevent explosion. Open engine cover or hatch before starting engine if the boat is not equipped with a blower. Leave it open until after engine has started.

NOTE! The remote control should be designed to allow starting in NEUTRAL only. If control handle is in an "in gear" position, engine should not crank. Test to make certain engine will not crank in forward or reverse gear positions, and will crank only when control handle is in neutral position.

If installing Ocean X see *OXi Drive Module* on page 86 before installing the shift cover.

1. After shift system tests are performed, and all adjustments are made, install the rear cover using the screws supplied in the parts kit.

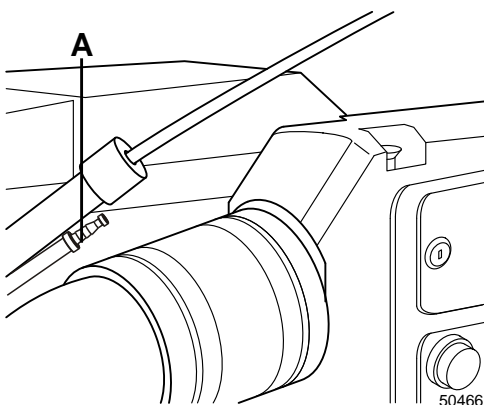


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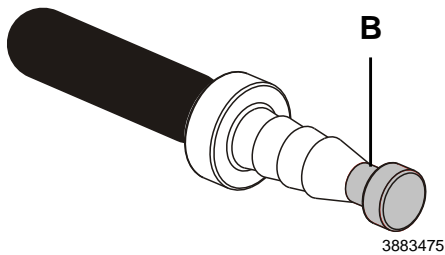
Connect Speedometer Hose

The Sterndrive comes equipped with an integral speedometer output to connect to the boat speedometer. If the boat is already equipped with a speedometer pick-up, you can choose not to connect to the sterndrive output.

1. The sterndrive speedometer output hose **A** is attached to the shift cable hose located inside the boat on the transom shield.



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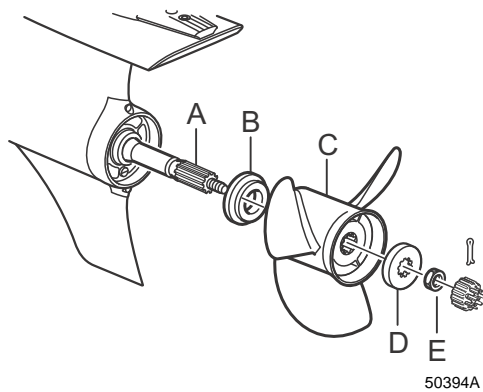
2. Cut the seal cap **A** off the end of the speedometer output hose and connect the boat speedometer hose the sterndrive speedometer output hose.

NOTE! Tie the speedometer hose away from the steering and exhaust system.

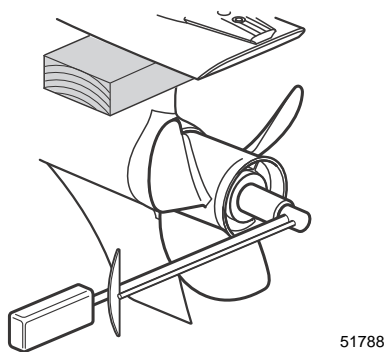
Propeller Installation

SX Models

A propeller was not shipped with your sterndrive. The correct propeller must be selected to match the engine and boat as a unit to give the best engine life, fuel economy, and performance. The boat manufacturer has performed tests to determine the optimum propeller for each boat and engine combination. Consult the boat manufacturer for their recommendations on the correct propeller to initially install.

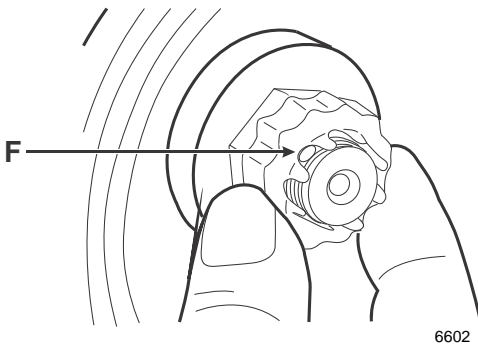


1. Coat the full length of the propeller shaft **A** with Volvo Penta water resistant grease (Part No. 828250).
2. Place thrust bushing **B** on propeller shaft with inner taper toward gearcase to match the taper on propeller shaft.
3. Slide propeller **C** onto propeller shaft, align splines, and push propeller onto thrust bushing until splines are exposed.
4. Place thrust washer **D** on propeller shaft splines.



5. Use a soft block of wood such as pine to prevent the propeller from turning while torquing the propeller nut.
6. Install and tighten the propeller nut **E** to 70-80 ft. lb. (95-108 Nm).

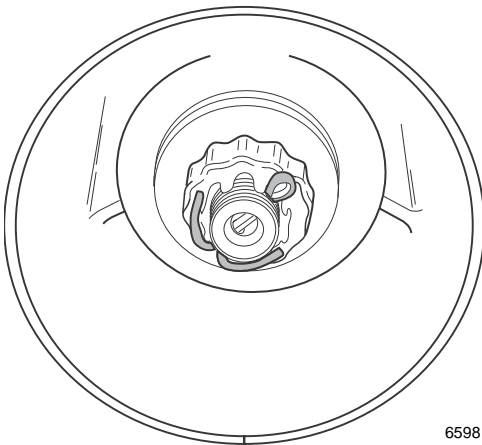
7. Index keeper **F** on propeller nut until aligned with cotter pin hole.



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8. Install cotter pin and bend prongs to secure. Use a new cotter pin if necessary.

NOTE! The propeller spacer, nut, keeper, and cotter pin must be installed as shown. Failure to install all components correctly could result in loss of the propeller when boat is operated in REVERSE.

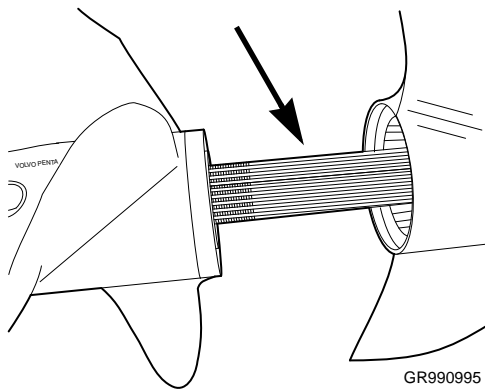


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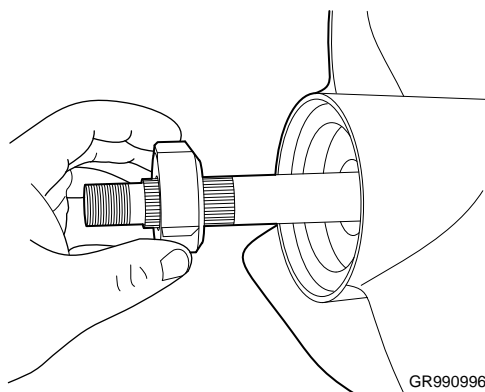
DPS Models

Propellers are not shipped with the sterndrive. The correct propellers must be selected to match the engine and boat combination to give the best engine life, fuel economy, and performance. The boat manufacturer has performed tests to determine the optimum propellers for each boat and engine combination. Consult the boat manufacturer for propeller recommendations. Tools for removing and installing the propellers are contained in Volvo Penta's propeller tool kit Part No. 3855516.

NOTE! D-series aluminium propeller sets used on Duoprop applications are not recommended for use on boat and engine combinations capable of speeds in excess of 40 MPH. F-series stainless steel propeller sets should be used in these applications. If you use D-series aluminium propeller sets, you must also use an in-trim limiter kit Part No. 3857598.

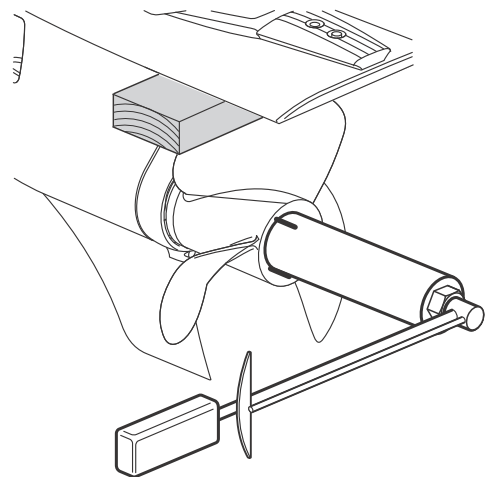


1. Coat the full length of both propeller shafts with Volvo Penta water resistant grease Part No. 828250.

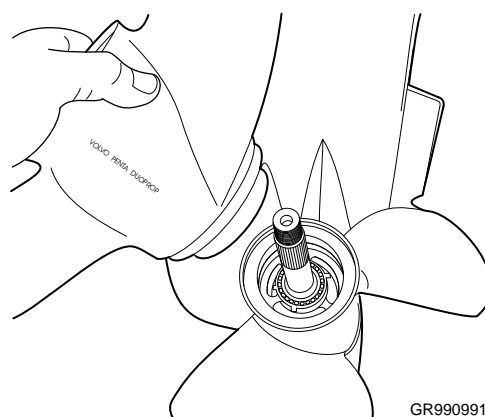


2. Install the front propeller nut, chamfered edge forward.

NOTE! Be sure the chamfered edge of the propeller nut is facing forward. Failure to install the propeller nut correctly could result in a propeller coming loose and damage to the lower unit and/or the propeller.

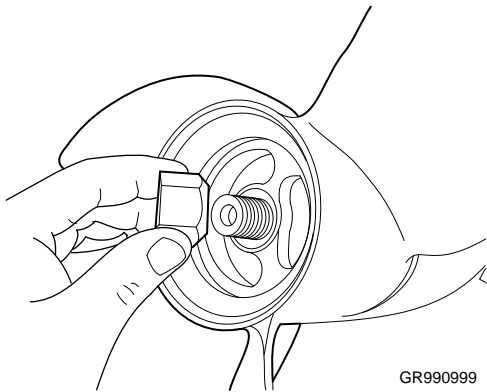


3. Use a soft block of wood such as pine to prevent the propeller from turning while torquing the propeller nut.
4. Use prop nut tool **3862797** and torque wrench. Tighten to 45 ft. lb. (60 Nm). Use propeller tool Part No. 3851615.



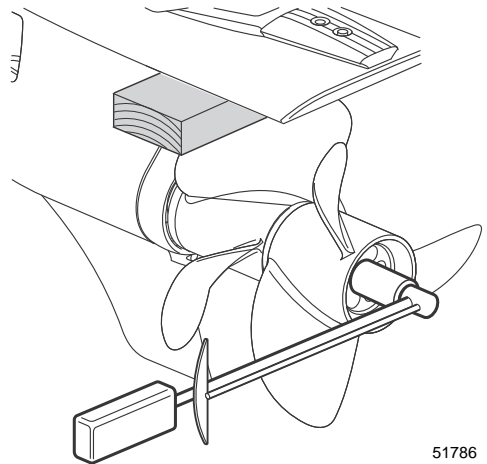
5. Install the rear propeller.

6. Install the rear propeller nut, chamfered end toward propeller.



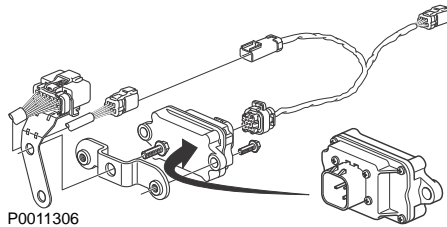
7. Use a propeller tool Part No. 3851616 or 30 mm socket and torque wrench to tighten the rear propeller nut to 50 ft. lb. (70 Nm).

NOTE! Failure to install the propellers as indicated could result in the loss of the rear propeller and damage to the lower unit.



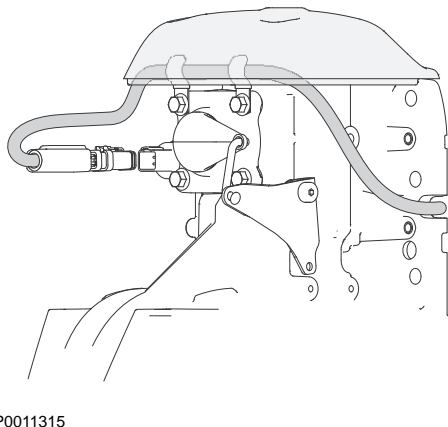
OXi Drive Module

NOTE! Some engines may already have the Drive Module installed. If the Drive Module is installed, skip steps 1 and 2.



1. Remove the top bolt of the 14 pin engine wiring harness bracket and install the Ocean X drive module bracket and tighten.
2. Install the drive module onto the bracket and tighten.
3. Connect the Ocean X wire harness to the drive module.

Connecting the Water in Drive sensor



1. Feed the Water in Drive sensor cable into the slot on the starboard side of the sterndrive when installing the sterndrive to the pivot housing.

NOTE! Be careful not to pinch the sensor cable when installing the sterndrive.

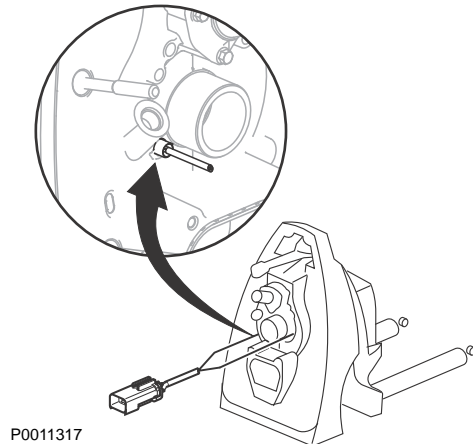
2. Route the Water in Drive sensor cable through the wire looms at the top of the shifter mechanism and connect to the sensor.



Caution! Make certain the wire harness does not interfere with the shift linkage.

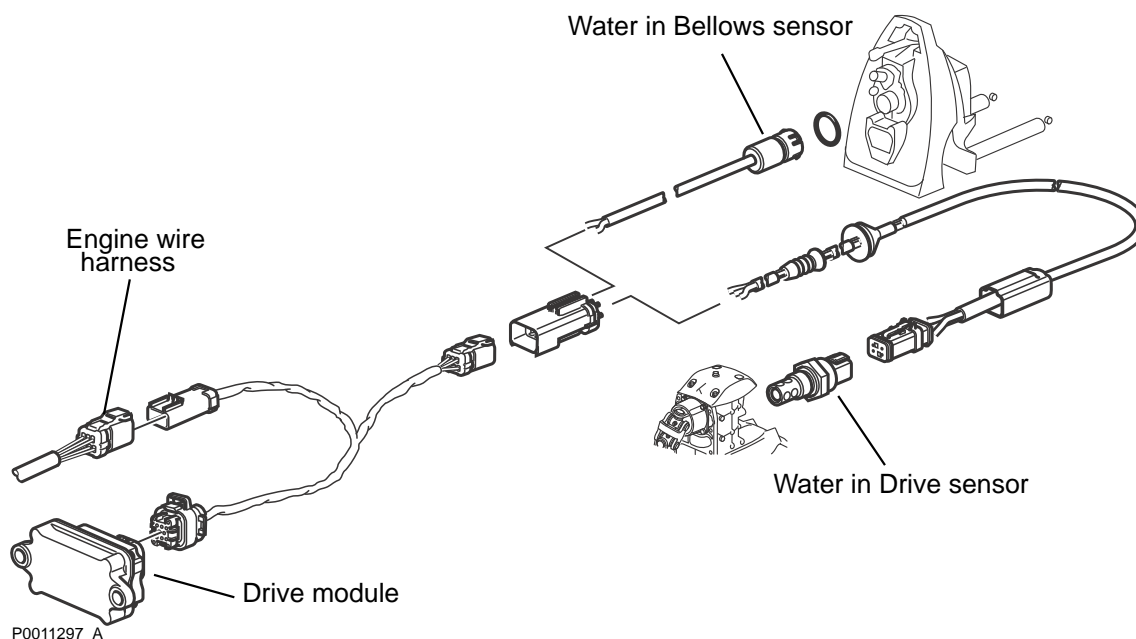
3. Slide the protective cover over the connector.

Connect Sensor Harness



1. Connect the sensor cable to the drive module harness.

NOTE! The sensor connector should come with dielectric grease installed on the connector. Check to make sure the connector has grease. If the connector needs grease, use a dielectric grease. Do not use anything other than dielectric grease.



2. Connect the drive module harness to the engine wiring harness connector. The engine wire harness connector is labelled WID/WIB.



CAUTION! Make sure the wire harness does not interfere with any steering linkage or exhaust system components.

Water in Drive Sensor Reset

The drive oil sensor must be reset whenever the drive oil is replaced.

NOTE! This procedure must be performed with the boat out of the water. If you plan to run the boat while it is out of the water, ensure that the engine has sufficient cooling water by using the flush port.

1. Ensure that the drive is trimmed to six degrees or less and that the sterndrive is as close to vertical as possible.
2. If the engine has been running, turn the engine off and allow the oil to settle for at least 30 minutes.
3. Insert the key into the ignition switch. Turn the key on but do not start the engine.
4. Slide the plastic protector on the oil sensor connector back.
5. Release on the connector and pull the plug out of the sensor and wait at least three seconds.
6. Plug the connector back in. The engine alarm will sound three beeps to acknowledge that the sensor has been reset.

NOTE! EVC equipped engines will not beep after reset.

Completing the Installation

Proper installation is important for the safe, reliable operation of all mechanical products. In these instructions we recommend and describe effective procedures you should follow when installing Volvo Penta sterndrive products. Some of these methods require the use of tools especially designed for the purpose. These tools should be used whenever recommended.

Follow the steps and procedures described in this section—in the order listed—to perform a complete installation of a Volvo Penta engine and sterndrive assembly.

1. Prepare to complete installation
2. Perform pre-delivery check
3. Test static water line height after launching
4. Check engine operation

Prepare to Complete Installation

Read installation instructions completely, and collect all tools, instruments, and parts needed for the job before you start work.

Required Tools

- Wrench Set
- Socket Set
- Tools for making adjustments while under way.

Sealants and Lubricants Required

- Volvo Penta Engine oil (<150 hours) 3847302 mineral, (>150 hours) 3847306 synthetic
- Volvo Penta GL 5 Synthetic Gear Lube, (Quart: Part No. 3851128, Gallon: Part No. 3851129, 5 Gallon: Part No. 3851133)
- Volvo Penta Trim/Tilt and Power Steering Fluid (Part No. 3851039)

Static Water Line

Determine if the engine meets the static water line height requirements after the engine and drive unit have been installed in the boat. The boat must be in water with its recommended load capacity distributed aboard.

NOTE! The static water line height must be tested before the engine is started for the first time. This will prevent the ingestion of water into the engine and resultant damage.

To determine the static water line height, follow the instructions in *Static Water Line* on page 85.

NOTE! An installation that permits water to enter the engine through the exhaust manifold(s) will not be covered by warranty, unless damage is due to defective part(s).

Static Water Line

Boat configuration for checking static water line

1. All tanks filled to capacity, fuel, and all water tanks filled to capacity, or equivalent weight in appropriate locations.
2. Load boats to maximum weight capacity, (people or equivalent) as listed on Coast Guard capacity plate, if the vessel does not require a plate, load the boat to manufacturer's maximum recommendation, or reasonable maximum load.
3. Passengers, and/or weight simulating passengers should be located reasonably on the seating areas of the vessel.

A-Bow riders should be checked with the weight distributed throughout the boat and with all seats behind the windshield occupied by people or representative weight.

B-Cruisers should be tested with passengers situated throughout the boat and with the maximum number of passengers in the cockpit.

C-If equipped with a swim platform, 400 lbs. should be relocated from the cockpit to the swim platform to simulate two passengers. Vessel

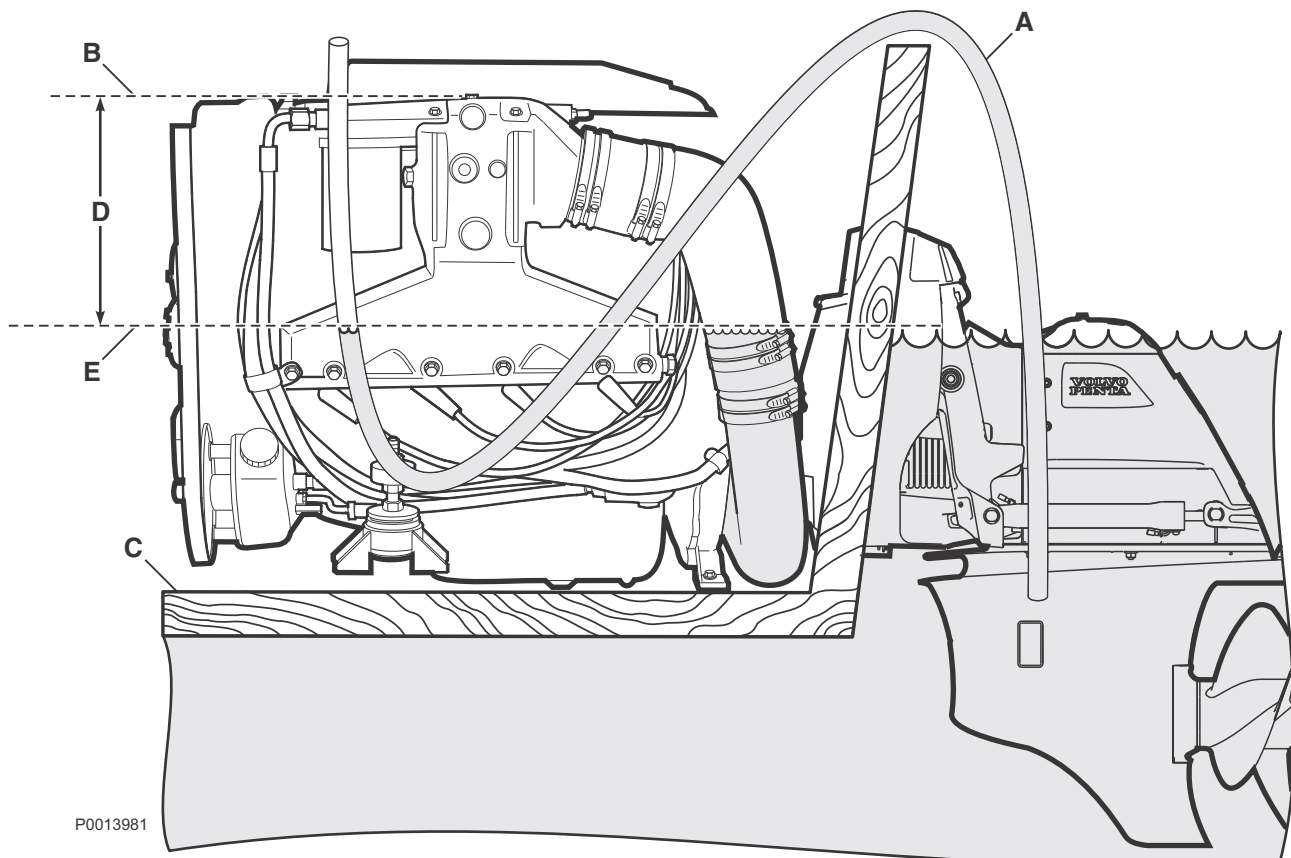
must meet SWL requirements under both conditions.

All configurations must be checked by the boat manufacturer before shipping the boats from their facility. Documentation of the each boat/engine combination will be accepted on a representative boat of each configuration.

Static Water Line Test

4. Lower a clear plastic hose **A** into the water and, once it is full of water, plug the top of the hose using your thumb or a clamp.
5. Bring plugged end of hose inside the hull **C** and hold next to—and above—the manifold **B**.
6. Release clamp pressure and slowly allow water to drain out until it has maintained a stable level.
7. Measure the vertical distance **D** from water line **E** in hose to the top of manifold **B**. Measurement **D** should not be less than 14 in. (35.6 cm).

NOTE! If the static water line does not meet these specifications, contact your Volvo Penta dealer for information on high rise extension kits.



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On-Water Tests and Adjustments

Launch boat for water test of static water line, engine, steering, trim/tilt, correct propeller, and the shift system.

Check Engine Operation

The fuel system may have to be primed prior to starting.

1. Shift into neutral. Turn key switch and crank engine for approximately 10 seconds. Return key switch to off position, then repeat the cycle until engine starts. Do not crank the engine longer than 10 seconds. This will prevent damage to the starter motor.

NOTE! The electric fuel pump used on some models cannot be run dry for longer than 20 seconds. Running the pump for longer time periods will result in pump failure.

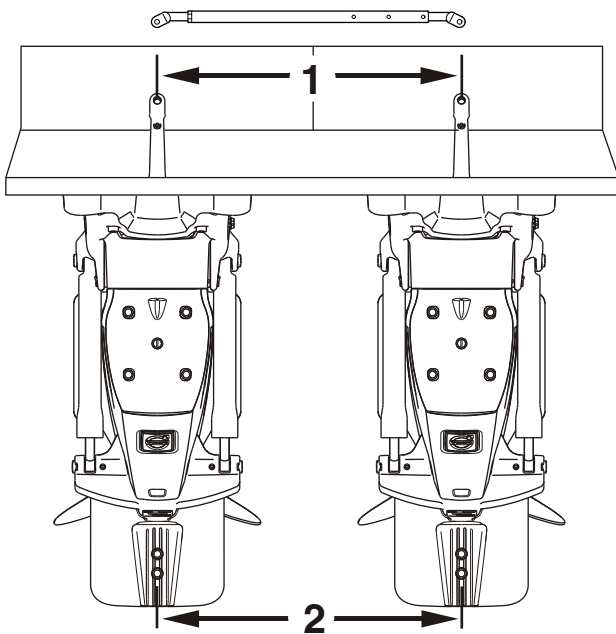
2. Check the oil pressure gauge. The gauge should indicate engine oil pressure within seconds of the engine starting. Shut the engine down if no or low pressure is indicated.
3. Check the fuel system for leaks and correct as necessary.

NOTE! Tie boat securely to dock to prevent forward or backward motion.

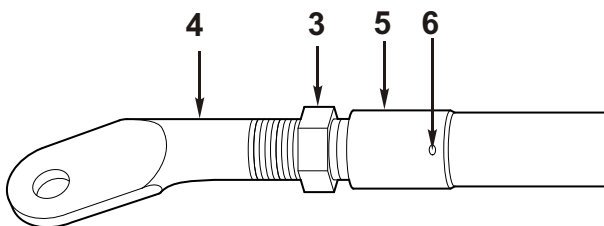
4. Check the engine water temperature gauge. The water temperature should be within a normal heat range, as shown in the table below.

5. Check the voltmeter. The voltmeter should indicate that charging and electrical systems are operating properly.
6. Check the steering operation. The steering wheel should have equal number of turns to port and starboard from centered position within 1/2 turn. Bow of boat must move in direction steering wheel is turned when moving in forward direction. Check power steering pump reservoir after engine is shut down for proper fluid level.
7. Check trim/tilt system and trim gauge operation through full up and down tilt range.
8. Check for exhaust system water/exhaust leaks.
9. Check operation of all boat accessories.

<i>Normal Engine Heat Ranges by Engine Type</i>	
Engine	Acceptable Heat Range
<i>Raw Water Cooled Engines</i>	
V6 and V8	155-178°F (68-81°C)
<i>Fresh Water Cooled Engines</i>	
V6 and V8	185-208°F (85-98°C)



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Tie Bar Adjustment

If boat handling is unstable or is an issue with the boat driver, a toe-in/toe-out condition should be created on deep V-shaped boat hulls for improved handling and performance. There is no set condition that is correct for all applications and experimentation will be required to achieve satisfactory results. A commonly used toe-in condition is one in which dimension **1** will be 3/16 in. to 1/4 in. (4.76 to 6.35 mm) **less** than engine centerline. This will give desired toe-in condition of 5/8"-7/8" between dimensions **1** and **2**. Also, a toe-out condition can be created by reversing the dimensions. Again, satisfactory results will require several changes to arrive at the most desirable handling characteristics.

1. Remove the steering tie bar from the port tiller arm.
2. Loosen the port jam nut **4** of the tie bar. Turn jam nut out 1/16 to 3/32 in. (1.59 to 2.38 mm) **5** as required, and screw in port steering tie bar end **3**. Retighten the jam nut.

CAUTION! Threads of the port tie bar must be visible through the inspection hole **6** to insure adequate thread engagement between the rod and tube. Failure to ensure proper threads engagement could result in component failure resulting in possible loss of steering control.

3. Re-attach the steering tie bar to the port tiller arm.

CAUTION! Ensure any cotter pins that were removed are in place before placing the boat into service. Failure to replace any cotter pins removed during the dismount procedure may result in loss of steering control and cause damage to equipment or injure occupants.

Pre-delivery Checklist

- ☐ Install boat drain plug.
- ☐ Install and tighten all water drain petcocks. Install exhaust manifold drain plugs. Check and tighten all hose clamps.
- ☐ Check all battery and electrical connections for tightness.
- ☐ Check engine, power steering, and drive unit oil levels.
- ☐ Fill gas tank for initial testing.
- ☐ Check all fuel line and hose connections for leaks.
- ☐ Check operation of gauges, bilge pump and blower.
- ☐ Check operation of anchor light, running lights and dash lights.
- ☐ Check trim/tilt operation.

