YANMAR

INSTALLATION MANUAL

STERN-DRIVE

ZT370

California
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.

California
Proposition 65 Warning

Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the state of California to cause cancer and reproductive harm.
Wash hands after handling.

Disclaimers:

All information, illustrations and specifications in this manual are based on the latest information available at the time of publishing. The illustrations used in this manual are intended as representative reference views only. Moreover, because of our continuous product improvement policy, we may modify information, illustrations and/or specifications to explain and/or exemplify a product, service or maintenance improvement. We reserve the right to make any change at any time without notice. YANMAR and **YANMAR** are registered trademarks of YANMAR CO., LTD. in Japan, the United States and/or other countries.

All Rights Reserved:

INSTALLATION MANUAL	Model	ZT370
	Code No.	0FZTD-G00200

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Section 1

INTRODUCTION

WELCOME TO THE WORLD OF YANMAR MARINE!

YANMAR marine offers engines, stern-drive systems and accessories for all types of vessels, from runabouts to sailboats, and from cruisers to mega yachts. In marine leisure boating, the worldwide reputation of YANMAR marine is second to none.

YANMAR stern-drives are designed for a wide range of applications and are designed to reduce vibration and make your cruising more pleasurable.

ABOUT THIS MANUAL

This manual provides boat designers, naval architects, installers and builders with the instructions necessary to safely install YANMAR marine propulsion systems. Optimum boat and engine performance are achieved when the appropriate diesel marine engine, marine gear, propeller and accessories are selected for an application.

Accurate information is required during the engine selection and space planning processes for each lifeboat/rescue boat application. Numerous calculations are needed in determining vessel performance characteristics. Boat designers, naval architects, installers and builders use the data and formulas to provide systems that satisfactorily answer the operator's exacting requirements..

Please note that this manual does not include guidance about the safety regulations of each country. Also, the diagrams, figures and information in this manual are subject to change in accordance with technical improvements made to our engines. Engine data and optional accessories are subject to change without notice.

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Section 2

SAFETY

YANMAR is concerned for your safety and the condition of your marine engine. Safety statements are one of the primary ways to call your attention to the potential hazards associated with YANMAR marine engines. Follow the precautions listed throughout the manual before operation, during operation and during periodic maintenance procedures for your safety, the safety of others and to protect the performance of your marine engine. Keep the decals from becoming dirty or torn and replace them if they are lost or damaged. Also, if you need to replace a part that has a decal attached to it, make sure you order the new part and decal at the same time.

This safety alert symbol appears with most safety statements. It means attention, become alert, your safety is involved! Please read and abide by the message that follows the safety alert symbol.

⚠ DANGER

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

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, *could* result in death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, *could* result in minor or moderate injury.

NOTICE

NOTICE indicates a situation which can cause damage to the machine, personal property and/or the environment or cause the equipment to operate improperly.

SAFETY PRECAUTIONS

There is no substitute for common sense and careful practices. Improper practices or carelessness can cause burns, cuts, mutilation, asphyxiation, other bodily injury or death. This information contains general safety precautions and guidelines that must be followed to reduce risk to personal safety. Special safety precautions are listed in specific procedures. Read and understand all of the safety precautions before operation or performing repairs or maintenance.

⚠ DANGER

Avoid injury or equipment damage due to engine falling. Always secure the engine solidly to prevent the engine from falling during service.

- **Never permit anyone to install or operate the engine without proper training.**

- **Read and understand this manual before you operate or service the engine to ensure that you follow safe operating practices and maintenance procedures.**
- **Safety signs and labels are additional reminders for safe operating and maintenance techniques.**
- **See your authorized YANMAR marine dealer or distributor for additional training.**

⚠ WARNING

Explosion Hazard

Avoid serious personal injury or equipment damage. While the engine is running or the battery is charging, hydrogen gas is being produced and can be easily ignited. Keep the area around the battery well-ventilated and keep sparks, open flame and any other form of ignition out of the area.

Avoid serious personal injury or equipment damage. Always turn off the battery switch (if equipped) or disconnect the negative battery cable before servicing the equipment.

Avoid unexpected equipment movement. Shift the marine gear into the NEUTRAL position any time the engine is at idle.

Fire Hazard

- **Avoid personal injury or equipment damage. Have appropriate safety equipment available.**

- **Keep fire extinguishers handy in case of fire. Clearly indicate the location of the fire extinguishers with a safety sign.**
- **Ensure that the type of fire extinguishers are appropriate for material that might catch fire. Check with local authorities.**
- **Have all fire extinguishers checked periodically for proper operation and/or readiness.**
- **Post evacuation routes prominently. Periodically conduct fire drills.**

Avoid personal injury. Always read and follow safety-related precautions found on containers of hazardous substances like parts cleaners, primers, sealants and sealant removers.

Wipe up all spills immediately.

⚠ WARNING

Entanglement Hazard

Rotating parts can cause severe injury or death. Never wear jewelry, unbuttoned cuffs, ties or loose fitting clothing and always tie long hair back when working near moving/rotating parts such as the flywheel or PTO shaft. Keep hands, feet and tools away from all moving parts.

Avoid personal injury. Always stop the engine before beginning service.

Avoid personal injury. Never leave the key in the key switch when servicing the engine. Attach a "Do Not Operate" tag near the key switch while performing maintenance on the equipment.

Sever Hazard

Avoid personal injury. The propeller may rotate during towing or if the engine is running at idle speed. Never service the engine while being towed or when the engine is running.

Avoid personal injury. If the vessel has more than one engine, never service an engine if either of the engines are running. In multi-engine configurations the propeller for an engine that is shut down may rotate if any of the other engines are running.

Rotating parts can cause severe injury or death. Never operate the engine without the guards in place.

Avoid personal injury. Never operate the engine while wearing a headset to listen to music or radio because it will be difficult to hear the warning signals.

⚠ WARNING

Electrical Hazard

- Make welding repairs safely.
- Always turn off the battery switch (if equipped) or disconnect the negative battery cable and the leads to the alternator when welding on the equipment
- Remove the multi-pin connector to the engine control unit. Connect the weld clamp to the component to be welded and as close as possible to the welding point.
- Never connect the weld clamp to the engine or in a manner which would allow current to pass through a mounting bracket.
- When welding is completed, reconnect the leads to the alternator and engine control unit prior to reconnecting the batteries.

Exhaust Hazard

Avoid serious injury or death. Never block windows, vents, or other means of ventilation if the engine is operating in an enclosed area. All internal combustion engines create carbon monoxide gas during operation and special precautions are required to avoid carbon monoxide poisoning.

Burn Hazard

Avoid serious injury. Some of the engine surfaces become very hot during operation and shortly after shut-down. Keep hands and other body parts away from hot engine surfaces.

Handle hot components with heat-resistant gloves.

⚠ WARNING

Sudden Movement Hazard

Avoid personal injury or equipment damage. The engine lifting eyes are engineered to lift the weight of the marine engine only. Always use the engine lifting eyes when lifting the engine.

To prevent accidental equipment movement, never start the engine in gear.

Lifting Hazard

Avoid serious personal injury. Additional equipment is necessary to lift the marine engine and marine gear together. Always use lifting equipment with sufficient capacity to lift the marine engine.

If you need to transport an engine for repair, have a helper assist you in attaching it to a hoist and load it on a truck.

Alcohol and Drug Hazard

Never operate the engine while you are under the influence of alcohol or drugs or are feeling ill.

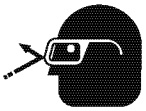
Exposure Hazard

To avoid injury, Always wear personal protective equipment including appropriate clothing, gloves, work shoes, eye and hearing protection as required by the task at hand.

Tool Hazard

Avoid personal injury or equipment damage. Always remove any tools or shop rags used during maintenance from the area before operation.

⚠ CAUTION



Avoid personal injury. Always wear eye protection when servicing the engine or when using compressed air or high-pressure water. Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.

Poor Lighting Hazard

Avoid personal injury or equipment damage. Ensure that the work area is adequately illuminated. Always install wire cages on portable safety lamps.

Tool Hazard

Avoid personal injury or equipment damage. Always use tools appropriate for the task at hand and use the correct size tool for loosening or tightening machine parts.

NOTICE

Any part which is found defective as a result of inspection or any part whose measured value does not satisfy the standard or limit must be replaced.

Always tighten components to the specified torque. Loose parts can cause equipment damage or cause it to operate improperly.

Only use replacement parts specified. Other replacement parts may affect warranty coverage.

Never attempt to modify the engine design or safety features such as defeating the engine speed limit control or the diesel fuel injection quantity control.

Modifications may impair the engine's safety and performance characteristics and shorten the engine's life. Any alterations to this engine may void its warranty. Be sure to use YANMAR genuine replacement parts.

- Always be environmentally responsible.

- Follow the guidelines of the EPA or other governmental agencies for the proper disposal of hazardous materials such as engine oil, diesel fuel and engine coolant. Consult the local authorities or reclamation facility.
- Never dispose of hazardous materials by dumping them into a sewer, on the ground or into ground water or waterways.

If any indicator illuminates during engine operation, stop the engine immediately. Determine the cause and repair the problem before you continue to operate the engine.

NOTICE

Make sure the engine is installed on a level surface. If a YANMAR marine engine is installed at an angle that exceeds the specifications stated in the YANMAR marine installation manuals, engine oil may enter the combustion chamber causing excessive engine speed, white exhaust smoke and serious engine damage. This applies to engines that run continuously or those that run for short periods of time.

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Section 3

GENERAL INFORMATION

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NOTICE TO VESSEL OEM AND EQUIPMENT INSTALLER

This Installation Manual contains safety information designed to:

- Make you aware of the hazards associated with the installation of the ZT370 stern-drive.
- Inform you of the risk of injury associated with those hazards.
- Tell you how to avoid or reduce the risk of injury.
- Prior to work, read and understand the section(s) of this manual that pertain to the job.
- Read and follow all safety warnings.

Note: See the appropriate YANMAR Technical Manual for application recommendations.

This Installation Manual has been written and published by YANMAR to assist boat manufacturers and service personnel when installing the products described herein.

It is assumed that these personnel are familiar with the installation procedures for these products, or like or similar products, manufactured by YANMAR. It is also assumed that they have been trained in the recommended installation procedures for these products, which includes the use of mechanics' hand tools and any special tools that might be required.

We could not possibly know of and advise the marine trade of all conceivable procedures or methods by which a service might be performed, or of every possible hazard and/or results of each procedure or method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a procedure or method not described by the manufacturer must first satisfy himself that neither his safety, nor the safety of the product, will be endangered by the installation or servicing procedure selected.

All information, illustrations and specifications contained in this manual are based on the latest production information available at the time of publication. However, YANMAR reserves the right to change, alter or otherwise improve the product at any time without obligation or prior notice.

Sales and Technical Assistance

The YANMAR dealer/distributor network is trained to assist with any sales or technical issues. This includes application engineering and service information.

If you have an issue with the application of our product that cannot be resolved, contact your YANMAR distributor service engineer. All requests for assistance should be directed to your local YANMAR distributor. The distributor for your area can be found by using the service locator on the YANMAR website (www.yanmarmarine.com) or by contacting YANMAR.

GENERAL SPECIFICATIONS

<table>
<tr><th colspan="2">Stern-drive model</th><th colspan="3">ZT370</th></tr>
<tr><td rowspan="5">Applicable engine</td><td>YANMAR</td><td>BY3 series</td><td>6LPA series</td><td>8LV series</td></tr>
<tr><td rowspan="4">Reduction ratio</td><td>1.65</td><td rowspan="4">1.65
1.78</td><td rowspan="4">1.65
1.78</td></tr>
<tr><td>1.78</td></tr>
<tr><td>1.97</td></tr>
<tr><td>2.18</td></tr>
<tr><td colspan="2">Maximum input speed</td><td colspan="3">4500 min^{-1} (rpm)</td></tr>
<tr><td rowspan="3">Direction of rotation (view from stern)</td><td>Input</td><td colspan="3">C.C.W.</td></tr>
<tr><td>Front propeller</td><td colspan="3">C.C.W.</td></tr>
<tr><td>Rear propeller</td><td colspan="3">C.W.</td></tr>
<tr><td rowspan="3">Dimension</td><td>Steering angle</td><td colspan="3">2 × 30 degrees</td></tr>
<tr><td>Tilt angle</td><td colspan="3">51 degrees</td></tr>
<tr><td>Trim zone</td><td colspan="3">-6 to 10 degrees</td></tr>
<tr><td rowspan="3">Propeller</td><td rowspan="3">Diameter × pitch
(3 blade)</td><td colspan="3">Counter rotating double propeller</td></tr>
<tr><td colspan="2">Front propeller</td><td>Rear propeller</td></tr>
<tr><td colspan="2">400.1 × 508 mm (15 - 3/4 × 20 in.)
400.1 × 558.8 mm (15 - 3/4 × 22 in.)
400.1 × 609.6 mm (15 - 3/4 × 24 in.)
400.1 × 660.4 mm (15 - 3/4 × 26 in.)
400.1 × 711.2 mm (15 - 3/4 × 28 in.)</td><td>362.0 mm × 508 mm (14 - 1/4 × 20 in.)
362.0 mm × 558.8 mm (14 - 1/4 × 22 in.)
362.0 mm × 609.6 mm (14 - 1/4 × 24 in.)
362.0 mm × 660.4 mm (14 - 1/4 × 26 in.)
362.0 mm × 711.2 mm (14 - 1/4 × 28 in.)</td></tr>
<tr><td colspan="3">Allowable propeller diameter: Maximum 406.4 mm (16 in.)</td></tr>
<tr><td rowspan="3">Oil</td><td>Stern-drive unit</td><td colspan="2">Quick Silver®*1 High Performance Gear Lube
or GL-5 (SAE 80W90)
2.5 ℓ (84.5 oz)</td><td>Quick Silver®*1 High Performance Gear Lube
2.5 ℓ (84.5 oz)</td></tr>
<tr><td>Power steering system</td><td colspan="3">Dextron III
Automatic transmission fluid</td></tr>
<tr><td>Tilt/trim system</td><td colspan="3">Dextron III
Automatic transmission fluid</td></tr>
<tr><td colspan="2">Clutch system</td><td colspan="3">Hydraulic multi-friction disc type with hydraulic pump</td></tr>
<tr><td colspan="2">Shift type</td><td colspan="3">Mechanical shift or electrical shift with solenoid</td></tr>
<tr><td colspan="2">Power steering system</td><td colspan="3">Mechanical cable operated hydraulic power assist</td></tr>
<tr><td colspan="2">Tilt/trim system</td><td colspan="3">Electric motor drive hydraulic power operation</td></tr>
<tr><td>Anti-corrosion system</td><td>Y-CaPS</td><td colspan="3">Electronic control cathodic protection</td></tr>
<tr><td>Mass (weight)</td><td>Dry condition</td><td colspan="3">100 kg (220.5 lb)</td></tr>
</table>

**1: Quick Silver is a registered trademark of Brunswick Corporation.*

Note: For engine/stern-drive performance, electrical, outline, piping diagrams and related information, see the engine-specific section of this Installation Manual and/or the Service Manual.

TIGHTENING TORQUES

Tightening Fasteners

Use the correct amount of torque when tightening fasteners. Applying excessive torque may damage the fastener or component and not enough torque may cause a leak or component failure.

Tightening Torques for Standard Bolts and Nuts

Use the following standard torque specifications for fasteners not listed in the table *Special Tightening Torques on page 3-5*.

Nominal diameter	Grade (lubricated)		
	8.8 or 8	10.9 or 10	12.9 or 12
M4	2.7 N·m (24 in.-lb)	3.88 N·m (34.3 in.-lb)	4.6 N·m (41 in.-lb)
M5	5.5 N·m (48.6 in.-lb)	8 N·m (71 in.-lb)	9.5 N·m (84 in.-lb)
M6	9.5 N·m (84 in.-lb)	13 N·m (115 in.-lb)	16 N·m (142 in.-lb)
M7	15 N·m (133 in.-lb)	22 N·m (195 in.-lb)	26 N·m (230 in.-lb)
M8	23 N·m (204 in.-lb)	32 N·m (24 ft-lb)	39 N·m (29 ft-lb)
M8 × 1	25 N·m (221 in.-lb)	35 N·m (26 ft-lb)	42 N·m (31 ft-lb)
M10	46 N·m (34 ft-lb)	64 N·m (47 ft-lb)	77 N·m (57 ft-lb)
M10 × 1.25	49 N·m (36 ft-lb)	68 N·m (50 ft-lb)	82 N·m (60 ft-lb)
M12	80 N·m (59 ft-lb)	110 N·m (81 ft-lb)	135 N·m (100 ft-lb)
M12 × 1.5	88 N·m (65 ft-lb)	125 N·m (92 ft-lb)	150 N·m (111 ft-lb)

Special Tightening Torques

Use the following special torque specifications for only the fasteners and applications listed. Use the standard torque specifications for all other applicable fasteners; see table *Tightening Torques for Standard Bolts and Nuts on page 3-5*.

Tightening torque	Description
45 N·m (33 lb ft)	Transom plate bolt
6 N·m (53 lb-in.)	Connector bolt (seawater)
6 N·m (53 lb-in.)	Plate bolt (seawater inlet)
30 N·m (22 lb ft)	Exhaust block-off plate bolt
35 N·m (26 lb ft)	Steering system upper and lower pivot bolt
45 N·m (33 lb ft)	Steering cable coupler nut
45 N·m (33 lb ft)	Rear engine mount bolt
60 N·m (44 lb ft)	Stern-drive unit fastener
75-85 N·m (55-62 lb-ft)	Propeller nut inner
130-140 N·m (96-103 lb-ft)	Propeller nut outer
30 N·m (22 lb ft)	Propeller shaft anode screw

Torque Conversion Charts

■ Propeller nut - outer

Use special tool P/N 196350-92180 and a standard torque wrench to torque tighten the outer propeller nut.

Note: The special tool and torque wrench must be inline when applying torque.

Torque wrench length: L in mm (inches)	Torque wrench reading in N·m (lb-ft) to achieve 135 N·m (100 lb-ft)
381 (15)	97 (71)
406 (16)	99 (73)
432 (17)	100 (74)
457 (18)	102 (75)
483 (19)	103 (76)
508 (20)	104 (77)
533 (21)	105 (78)
559 (22)	106 (79)
584 (23)	107 (79)
610 (24)	108 (80)
635 (25)	109 (81)
660 (26)	110 (81)
686 (27)	111 (82)
711 (28)	111 (82)
737 (29)	112 (83)
762 (30)	113 (83)
787 (31)	113 (84)
813 (32)	114 (84)
838 (33)	115 (84)
864 (34)	115 (85)
889 (35)	116 (85)
914 (36)	116 (86)

Torque wrench P/N 196350-92180

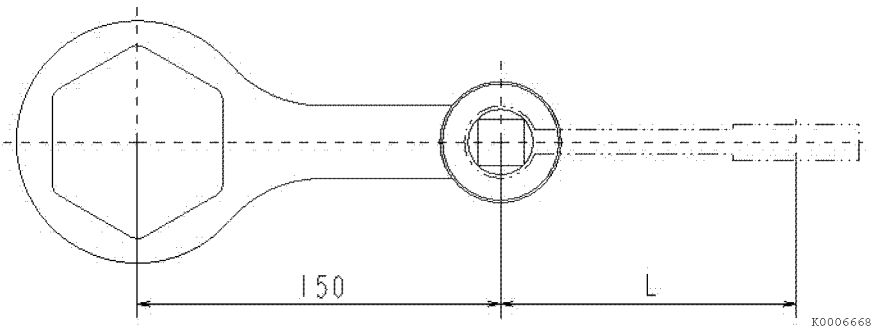


Figure 3-1

■ Tilt-up - limit spacer

Use special tool P/N 196350-92320 and a standard torque wrench to torque tighten the trim cylinder end.

Note: The special tool and torque wrench must be inline when applying torque.

Torque wrench length: L in mm (inches)	Torque wrench reading in N·m (lb-ft) to achieve 60 N·m (44 lb-ft)
381 (15)	41(30)
406 (16)	42 (31)
432 (17)	42 (31)
457 (18)	43 (32)
483 (19)	44 (32)
508 (20)	44 (33)
533 (21)	45 (33)
559 (22)	45 (33)
584 (23)	46 (34)
610 (24)	46 (34)
635 (25)	47 (34)
660 (26)	47 (35)
686 (27)	48 (35)
711 (28)	48 (35)
737 (29)	48 (36)
762 (30)	49 (36)
787 (31)	49 (36)
813 (32)	49 (36)
838 (33)	49 (36)
864 (34)	50 (37)
889 (35)	50 (37)
914 (36)	50 (37)

Torque wrench P/N 196350-92320

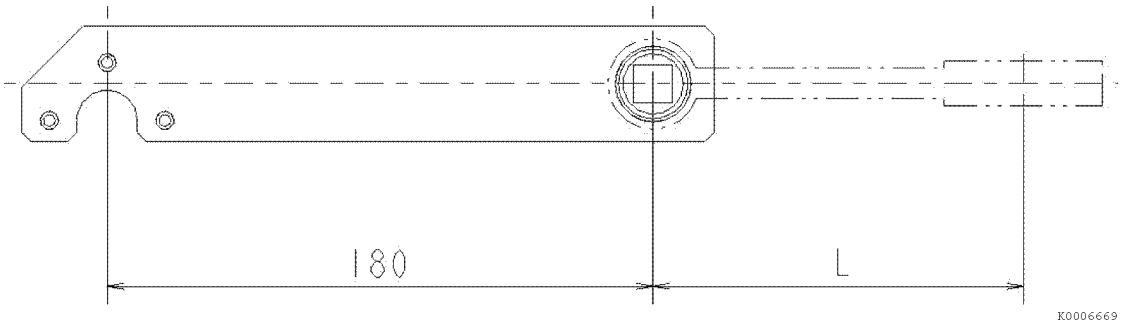


Figure 3-2

Hose Clamps

NOTICE

Never reuse or retighten hose clamps. Always install new hose clamps.

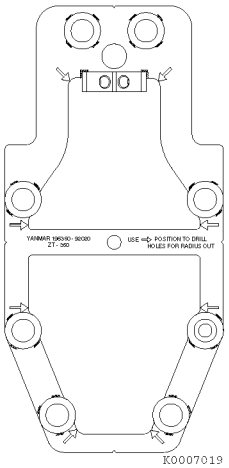
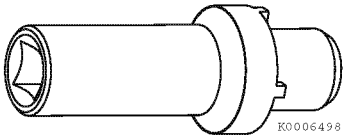
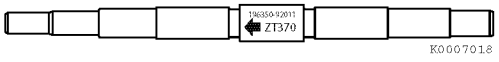
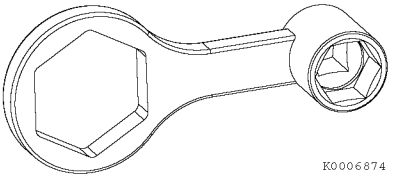
Size	Specification
5 mm Hex head	1.0 to 1.5 N·m (8.9 to 13 lb-in.)
6 mm Hex head	2.5 to 3.5 N·m (22 to 31 lb-in.)

LUBRICANTS/SEALANTS/ADHESIVES

Description	Where used	Part number
UREA grease Water resistant type NLGI #2 Ex: Rykon Premium Grease EP	Power steering bushings	Obtain locally
	Upper and lower pivot bolts	
	Clevis pin	
	Steering cable end	
	Propeller shaft splines	
	Steering cable and clevis	
Liquid type neoprene or silicon sealant	Electrical connections	
	Y-CaPS connections	
Multipurpose heavy-duty type lithium grease NLGI #2 Ex: Valvoline Multipurpose Grease/GM	Drive unit pilot	
	Universal joint shaft O-rings	
	Drive shaft splines	
	Coupler splines	
SAE 30W engine oil	Shift cable pivot points	
GL-5 hypoid gear oil	Oil reservoir*1	
Lithium grease with PTFE Ex: Cortec Co. Lithium EP Grease with PTFE	Bell housing studs	
	O-ring seals	
	Anchor pin threads	
	Shift cable	
UREA grease Water resistant type NLGI #2 Ex: Rykon Premium Grease EP	Unit bearing (gimbal housing)	
Dexron III Automatic transmission fluid	Power steering pump	
	Power trim pump	

**1: Only use GL-5 rated gear oil. Use of incorrect gear oil will cause premature clutch wear and stern-drive damage.*

SPECIAL TOOLS

Transom cutout and drill fixture (196350-92020)	Use to determine where to cut and drill the boat's transom for the stern-drive installation.	 K0007019
Hose insert tool (196350-92220)	Remove and install the hose insert into the water inlet hose.	 K0006498
Alignment shaft (196350-92011)	Align the engine and the drive unit during installation.	 K0007018
Tilt limit adjustment tool (196350-92320)	Remove and install the trim cylinder end cap.	 K0006880
Propeller nut wrench (196350-92180)	Remove and install the propeller nut.	 K0006874
Shift cable adjustment tool (119781-34090)	Adjust shift cables.	 K0007026

IDENTIFICATION

The following information describes the identification nameplate location and related information of the YANMAR ZT370 stern-drive series.

Transom Assembly

The transom assembly nameplate is located on the top of the transom bracket assembly **(Figure 3-3)**.

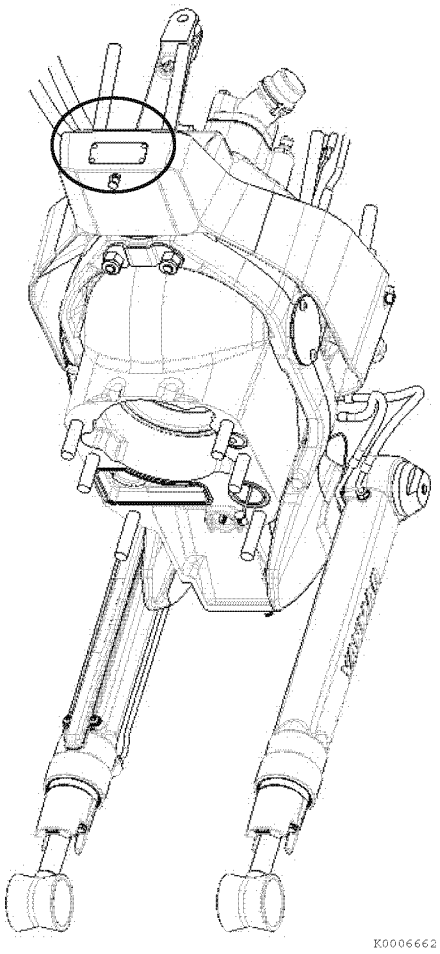


Figure 3-3

Transom assembly nameplate

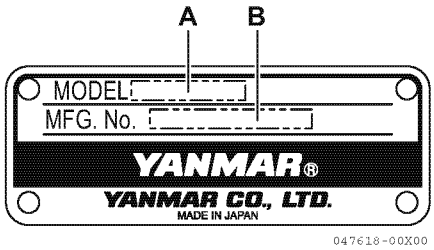


Figure 3-4

Stamp position	Stamp character	Remarks
A	ZT370	Model type
B	○○○○○○ S/#	Serial No.

Stern-Drive Assembly

■ Gear ratio identification

Gear ratio is identified on the drive shaft housing. It is important to note the ratio of the drive unit before proceeding with any repairs.

This will be true for new or unused drive units. A drive unit could have had the gear ratio changed for high altitude, which would void out any application of the chart below. The gear ratio then would have to be determined by counting the teeth on the driven gear on the propshaft in the lower gear housing and using the following chart for reference.

Number of gear teeth				
Gear ratio	Upper gear housing		Lower gear housing	
	Drive	Driven	Drive	Driven
1.65	24	28	17	24
1.78			17	26
1.97			16	27
2.18			15	28

The stern-drive assembly gear ratio identification nameplate **(Figure 3-5)** and **(Figure 3-6)** is located on the outer aft drive shaft housing. The drive shaft housing cover must be removed to read the nameplate.

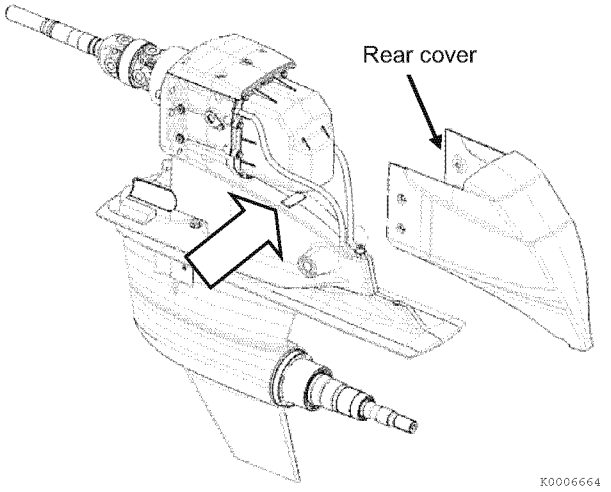


Figure 3-5

Stern-drive assembly nameplate

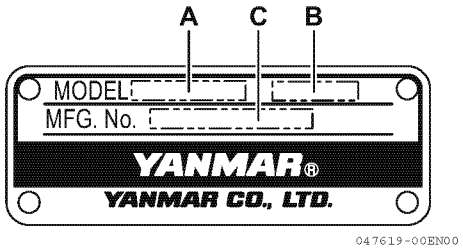


Figure 3-6

Stamp position	Stamp character				Remarks
A	ZT370				Model type
B	1.65	1.78	1.97	2.18	Gear ratio choose one from left table
C	○○○○○○ S/#				Serial No.

Section 4

VESSEL DESIGN

Page

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VESSEL DESIGN CONSIDERATIONS

⚠ WARNING

Improper Installation Hazard

Always adhere to all applicable marine regulations such as the United States Coast Guard (USCG), European Union-Recreational Craft Directive (EU-RCD), etc. and the standards they reference such as the American Boat and Yacht Council (ABYC), Society of Automotive Engineers (SAE), International Standards Organization (ISO), etc., when designing and constructing the boat and the boat components, such as the engine compartment, fuel delivery system and exhaust system.

When choosing a vessel for the installation of the ZT370 stern-drive, consider the following before installation:

- Transom thickness and angle
- Engine and drive position
- Exhaust system type

Checking Transom Thickness

■ New installation (transom thickness)

When choosing a vessel that will potentially be modified for the installation of the ZT370 stern-drive, ensure that the vessel transom meets the following criteria:

- Transom thickness should be between 51 and 57 mm (2.0 and 2.25 in.).
- The inner and outer surface of the transom should be parallel to within 2 mm (0.078 in.).
- The inner surface of the transom is flat to within 2 mm (0.078 in.).
- The outer surface of the transom is flat to within 1 mm (0.039 in.).

NOTICE

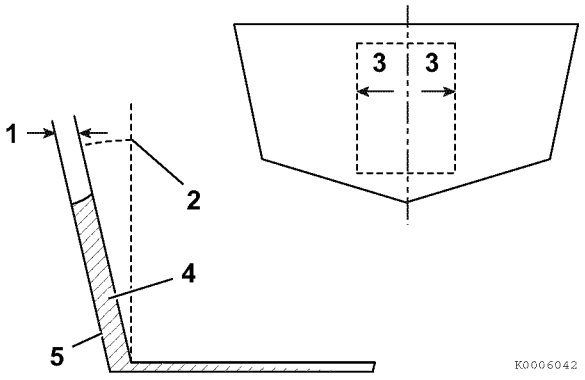
If surface flatness is not within specifications:

- Water leakage through transom can occur.
- The transom plate may crack after tightening.

- The transom angle is between 10° and 16° (13° is ideal).
- Ensure that there is enough flat surface area on the transom to apply the transom plate. This would be 203 mm (8.0 in.) on either side of the center line of the transom.

NOTICE

The dashed area **(Figure 4-1, (3))** should have a strong base. If a polyester hull is used, a wooden support base (for example plywood, not MDF) should be laminated in the polyester stern. In dual engine installations the area between the drives should have the same strength as the transom mounting area itself.



1 – Transom thickness
2 – Transom angle
3 – Transom plate coverage 203 mm (8.0 in.) from the center.
4 – Inner surface
5 – Outer surface

Figure 4-1

■ Re-power installation (transom thickness)

Ensure that the transom thickness and surface dimensions **(Figure 4-2)** and **(Figure 4-3)** conform to specifications listed previously and to the Transom Specifications chart on page *4-4*.

NOTICE

If surface flatness is not within specifications:

- Water leakage through transom can occur.
- The transom plate may crack after tightening.

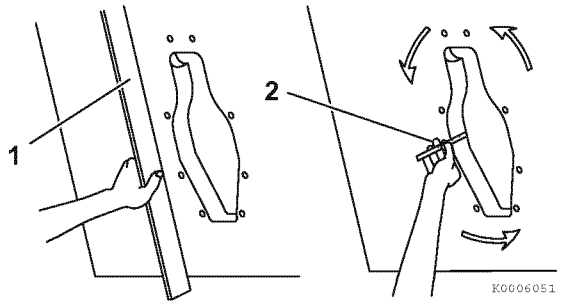
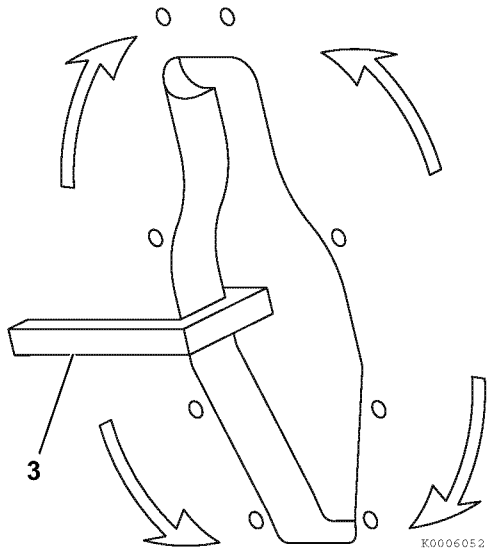


Figure 4-2



1 – Measuring transom flatness
2 – Measuring transom thickness
3 – Suitable uniform transom thickness tool

Figure 4-3

Transom specifications	
Thickness*1	Between 51and 57 mm (2 and 2 - 1/4 in.).
Parallelism*2	Inner and outer surfaces must be parallel within 3 mm (0.125 in.).
Surface plane*2	Transom surfaces in an area where transom assembly will be mounted (includes vertical as well as horizontal dimensions): Inner surface - flat within 2 mm (0.078 in.) Outer surface - flat within 1 mm (0.039 in.)
Angle	10° - 16° (13° ideal)

**1: Excessive transom thickness may cause alignment problems between the exhaust pipe (bullhorn) and high riser mixing elbow.*
**2: Measured in transom assembly mounting area.*

Vessel Engine Mount Position

The engine mount position should allow for a minimum of 6 mm (0.25 in.) of vertical adjustment on the front mounts of the engine.

Note: The mounting hardware that is incorporated with the engine usually allows for some adjustment. However, it is good practice to ensure that the engine mount points that hold the engine in the vessel are all in parallel planes.

To check if the engine mount points are in parallel planes:

1. Tie a string from the front right mount position to the left rear mount position.
2. Tie a string from the left front mount position to the right rear mount position.

The strings should touch at the point of intersection.

Selecting an Engine Exhaust System

It is important to know what type of engine exhaust system will be used with the ZT370 stern-drive.

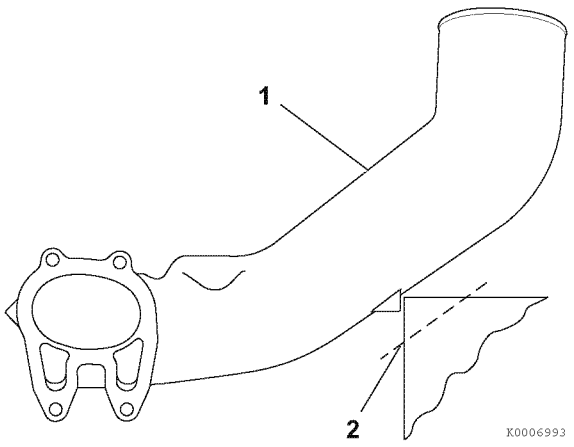
The following chart describes the parts required for each system.

Engine exhaust system	Transom exhaust	Transom exhaust bellows or tube
Through-the-transom exhaust	Exhaust cover plate	Exhaust tube
Through-the-hull exhaust		
Through-the-propeller exhaust	Engine exhaust pipe	

*Note: When the stringers are attached directly to the stern, the stringer may need to be undercut **(Figure 4-4, (2))** to allow for the installation of the bullhorn **(Figure 4-4, (1))**. There should be no interference between the bullhorn and the stringer once the engine is installed.*

NOTICE

Contact between the bullhorn and the stringer will cause damage to the bullhorn.



1 – Bullhorn
2 – Area of boat stringer to be removed

Figure 4-4

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Section 5

INSTALLING ENGINE AND DRIVE UNIT

POSITIONING THE DRIVE UNIT

Preparation before Actual Installation

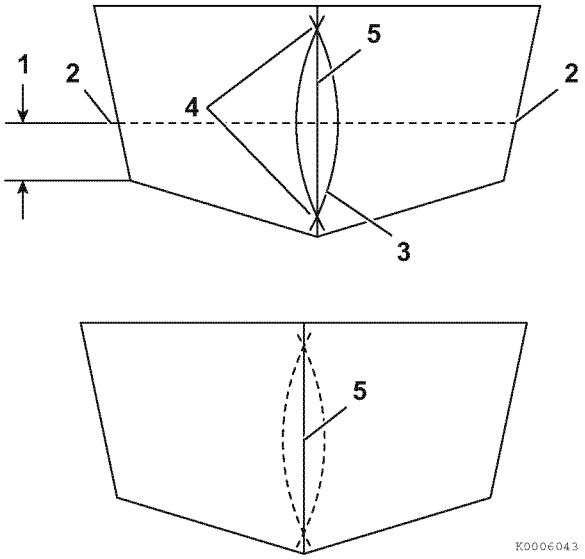
1. Check boat drawings with actual dimension:
   1- Check stringer position in boat compared to engine flex mount height and crankshaft centerline.
   2- Check if X-dimension indicated in stern-drive drawings is correctly aligned compared to stringer height.
   3- Check if stern thickness is within specifications.
2. Check flatness of inner and outside transom.
3. Check if all required installation parts are present (hoses, exhaust pipe, ZT-parts [check ZT-boxes], etc.).

Locating the Crankshaft Vertical Centerline - Single Engine Installation

If the crankshaft vertical centerline is not already marked by the vessel manufacturer, locate and mark the vertical centerline on the transom in accordance with the following steps and methods:

Use a large compass to locate the vertical centerline.

1. Mark identical locations on each side of the boat 305 mm (12.0 in.) from the bottom of the hull, take any fixed point.
2. Position the fixed end of a compass at the marks and draw arcs on the transom.
3. Draw the crankshaft vertical centerline through the intersection points of the two arcs.



1 – 305 mm (12 in.)
2 – Identical side marks
3 – Compass arc
4 – Arc intersection points
5 – Crankshaft vertical centerline

Figure 5-1

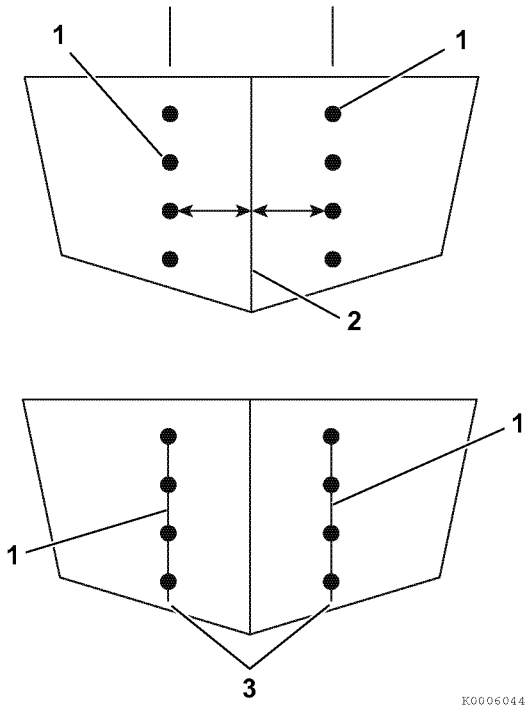
Locating the Crankshaft Vertical Centerline - Dual Engine Installation

Locate and mark the transom vertical centerline. *See Locating the Crankshaft Vertical Centerline - Single Engine Installation on page 5-3.*

NOTICE

The minimum distance between the crankshaft vertical centerlines for dual side-by-side applications is 838 mm (33.0 in.).

1. Make a set of marks equal to 1/2 the minimum distance (419 mm [16.5 in.]) on both sides of the transom vertical centerline.
2. Draw the two crankshaft vertical centerlines through the intersection of the marks.



1 – 1/2 minimum distance between the crankshaft centerlines
2 – Transom vertical centerline
3 – Dual engine crankshaft vertical centerlines

Figure 5-2

Finding the Crankshaft Horizontal Centerline (X-Dimension)

There are two general methods available for locating the horizontal centerline of the engine crankshaft. They are the "90° tool method" and the "Tape measure method." Regardless of the method used, several vessel design considerations need to be examined before an optimum determination can be made. The following suggestions are offered as a general guideline. The actual "X-dimension" should be the result of thorough design testing by the hull manufacturer.

Vessel characteristics	
Speeds between 25 Knots (29 mph) and 43 Knots (50 mph)	Use the X-dimension given in the 90° tool method.
Speeds above 43 Knots (50 mph)	Increase the X-dimension to improve performance.

Note: When the X-dimension is increased (drive higher), pulling power for skiing is decreased. Faster top speeds may be achieved, but with higher drive position, cavitation could occur. During testing process, increase the X-dimension in 13 mm (0.5 in.) increments until preferred performance is achieved.

Never increase the X-dimension by more than:

Maximum increase in X-dimension	
ZT370	25 mm (1.0 in.)

Observe the following details during the testing process:

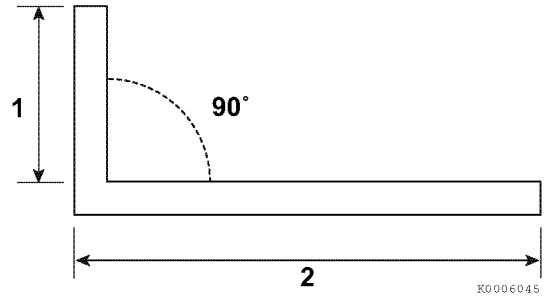
- Ensure that the water supply does not become aerated when the drive unit is raised.
- Use a clear water inlet hose or seawater filter with a transparent top to monitor the incoming water while watching the engine temperature gauge to prevent the engine from overheating.

NOTICE

Damage to YANMAR products caused by a crankshaft horizontal centerline that is too high will not be covered by YANMAR warranty.

■ The 90° tool method

Construct the 90° tool as shown in **Figure 5-3**. 16 mm (0.629 in.) plywood may be used to construct the tool.



1 – 345 mm (13.58 in.)
2 – 1.2 m (3.94 ft)

Figure 5-3

NOTICE

The 345 mm (13.58 in.) dimension should only be raised or lowered after proper testing *(see Finding the Crankshaft Horizontal Centerline (X-Dimension) on page 4).*

- To lower the drive unit - subtract from the 345 mm (13.58 in.) dimension **(Figure 5-3, (1))**.
- To raise the drive unit - add to the 345 mm (13.58 in.) dimension.

Use the 90° tool as follows:

1. Place the 90° tool along the boat bottom at the vertical centerline.
2. Locate the point at which the top of the 90° tool contacts the transom on the vertical centerline. This is the crankshaft horizontal centerline or X-dimension.
3. Draw a line perpendicular to the vertical centerline at the intersection of the crankshaft horizontal centerline.

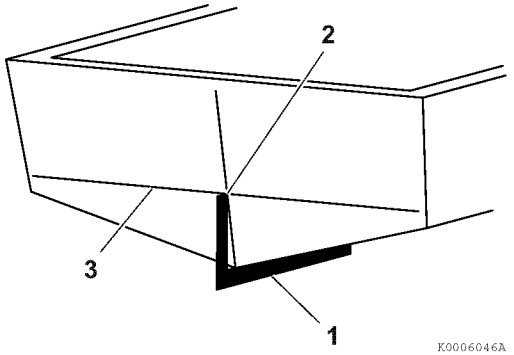
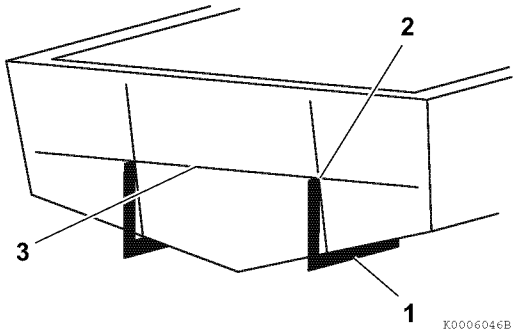


Figure 5-4



1 – 90° tool along the boat bottom at the vertical centerline
2 – Contact point
3 – Crankshaft horizontal centerline

Figure 5-5

■ The tape measure method

NOTICE

These dimensions should only be raised or lowered after proper testing *(see Finding the Crankshaft Horizontal Centerline (X-Dimension) on page 4).*

Use the following chart to determine the X-dimension.

Transom angle	X-dimension (measuring up from the keel)
16°	364 mm (14-5/16 in.)
15°	362 mm (14-1/4 in.)
14°	360 mm (14-3/16 in.)
13°	359 mm (14-1/8 in.)
12°	357 mm (14-1/16 in.)
11°	356 mm (14 in.)
10°	354 mm (13-15/16 in.)

1. On the vertical crankshaft centerline, measure up from the bottom of the vessel transom to the X-dimension selected from the chart.
2. This point is the crankshaft horizontal centerline at the X-dimension.
3. Draw a line perpendicular to the vertical centerline at the crankshaft horizontal centerline.

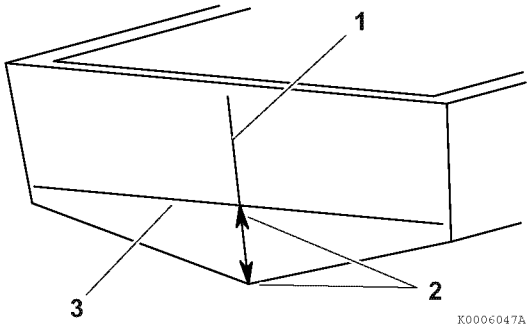
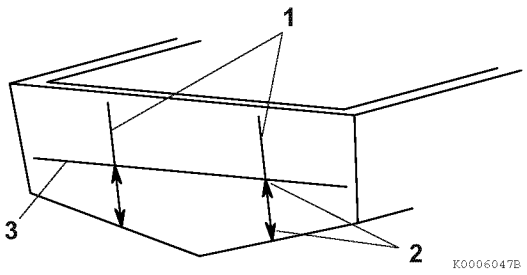


Figure 5-6



1 – Vertical centerline
2 – X-dimension that corresponds to the transom angle selected from the chart
3 – Crankshaft horizontal centerline

Figure 5-7

Cutting the Vessel Transom

Use the transom template cutout **(Figure 5-8)** or the transom cutout and drill fixture **(Figure 5-9)** to drill and cut the vessel transom. These items are available separately from YANMAR.

NOTICE

- Follow the instructions that are indicated on the template or provided with the drilling fixture.
- Ensure that the centerlines of the template or the drilling fixture align with the marks determined previously. *See Positioning the Drive Unit on page 5-3.*

■ Required tools

Required tools	
6 mm (0.236 in.) drill - long (200 mm [7.87 in.] length) shaft type	To drill pilot hole for 51 mm (2.0 in) hole saw.
6 mm (0.236 in.) guiding pin (150 mm [5.91 in.] length)	To guide the hole saw and set the tool while drilling the mounting holes.
51 mm (2.0 in) hole saw	To saw hole for steering lever area.
14 mm (0.551 in.) drill (extra long shaft, sideways guiding type, not cutting)	General use.
Powerful drill (1 kW or more)	General use.
Reciprocating saw (sabre type saw). A jigsaw may be used if larger than 750 W.	General use. Use extra long 126 mm (4.96 in.) jigsaw blades for wood if a jigsaw used.

Transom template cutout

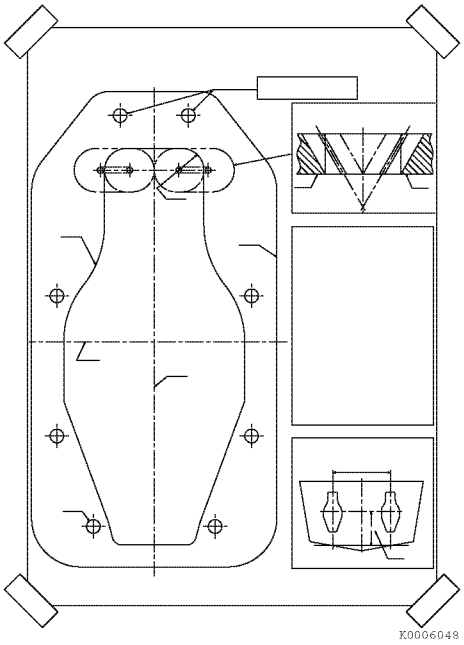


Figure 5-8

Transom cutout and drill fixture

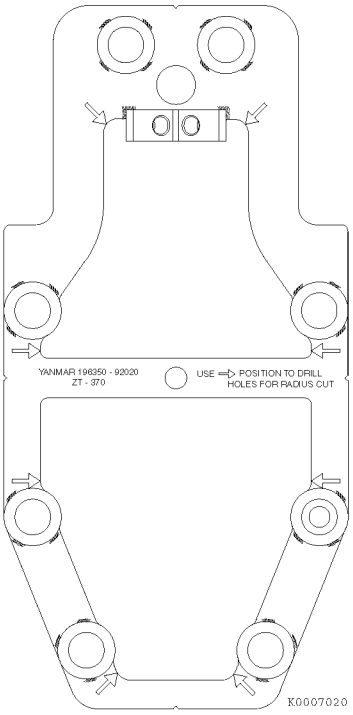


Figure 5-9

■ Marking and drilling procedure

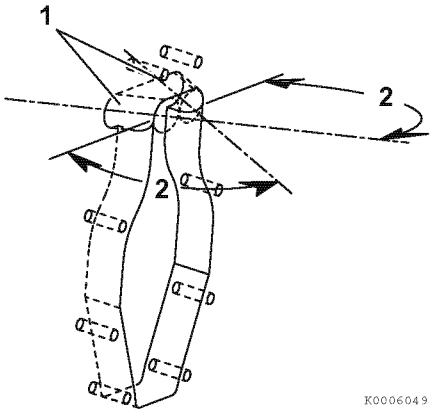
Use the following procedure to mark and drill the transom using the transom cutout and drill fixture **(Figure 5-9)**.

1. Mark the hole of the center bolt and insert the bolt and nut. Only tighten after making sure the tool is aligned with X-dimension horizontal line and vertical centerline.
2. Drill one of the two 6 mm (0.236 in.) pilot holes at a 60° angle for the hole saw guides.
3. Insert the guide pin into the 6 mm (0.236 in.) drilled hole to secure the tool during drilling.
4. Verify the tool is aligned with the vertical and horizontal guidelines.
5. Drill the second 6 mm (0.236 in.) pilot hole at a 60° angle for the hole saw guides.
6. The eight mounting holes need to be drilled at 90° to the surface of the transom. Drill one of the eight mounting holes with the 14 mm (0.551 in.) drill.
7. Secure the tool with the mounting bolt.
8. Drill the remaining seven mounting holes with the 14 mm (0.551 in.) drill.
9. Draw the cutting line at the inside of the transom cutout and drill fixture tool.
10. Mark the corners where the corner holes are to be drilled. Cut a 6 mm (0.236 in.) hole when using a jigsaw or a 14 mm (0.551 in.) hole when using a reciprocating saw.
11. Remove the bolts and the tool.
12. Ensure the cutting line is straight around the corners of the mounting bolts.
13. Drill two corner holes 6 or 14 mm (0.236 or 0.551 in.) horizontally in the corners of the exhaust pipe area.
14. Drill the other corner holes 6 or 14 mm (0.236 or 0.551 in.) in the indicated corners 90° from the surface of the transom.

15. Use a hole saw to cut the two 51 mm (2 in.) holes for the steering lever cutout.
    1- Mount the 6 mm (0.236 in.) guiding pin in the hole saw assembly.
    2- Use this hole saw assembly to drill the two 51 mm (2.0 in.) holes for the steering lever cutout.

NOTICE

If the hole saw cutout is made incorrectly, the stern-drive steering lever may come in contact with the transom causing limited steering travel.



1 – 51 mm (2.0 in.) steering lever cutout
2 – 60° from the surface of the transom

Figure 5-10

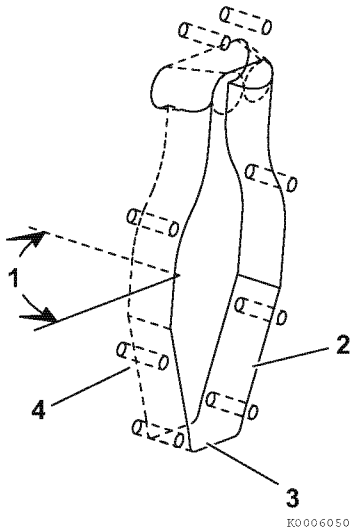
NOTICE

Use caution when cutting the transom. An incorrect cut could cause the gimbal housing or exhaust system to come in contact with the boat transom, making it difficult to mount the drive unit.

16. Use a reciprocating saw or jigsaw for cutting the hole. Cut the transom on the cut line at a 90° angle, except at the exhaust pipe bottom area:

NOTICE

At the exhaust pipe bottom area **(Figure 5-11, (3))**, the transom must be cut with a horizontal line, not at 90° to the transom surface.



1 – 90° from the surface of the transom
2 – Cut line
3 – Exhaust pipe area (cut should be horizontal, not cut at 90°)
4 – Mounting holes perpendicular (90°) to the transom surface (8 ea.)

Figure 5-11

17. Clean and smooth the inside cutting line with a file.
18. Seal the inside edge of the transom cutout opening with a sealant to prevent water absorption and deterioration of the transom.

INSTALLING THE TRANSOM ASSEMBLY

1. Insert the wires, hoses and shift cable through the corresponding openings in the inner transom plate.
2. Position the gimbal housing on the transom and hold it in place.

NOTICE

Tighten the transom assembly bolts using an X-pattern torque sequence. Tighten in small increments and go around the pattern several times until the proper torque is achieved.

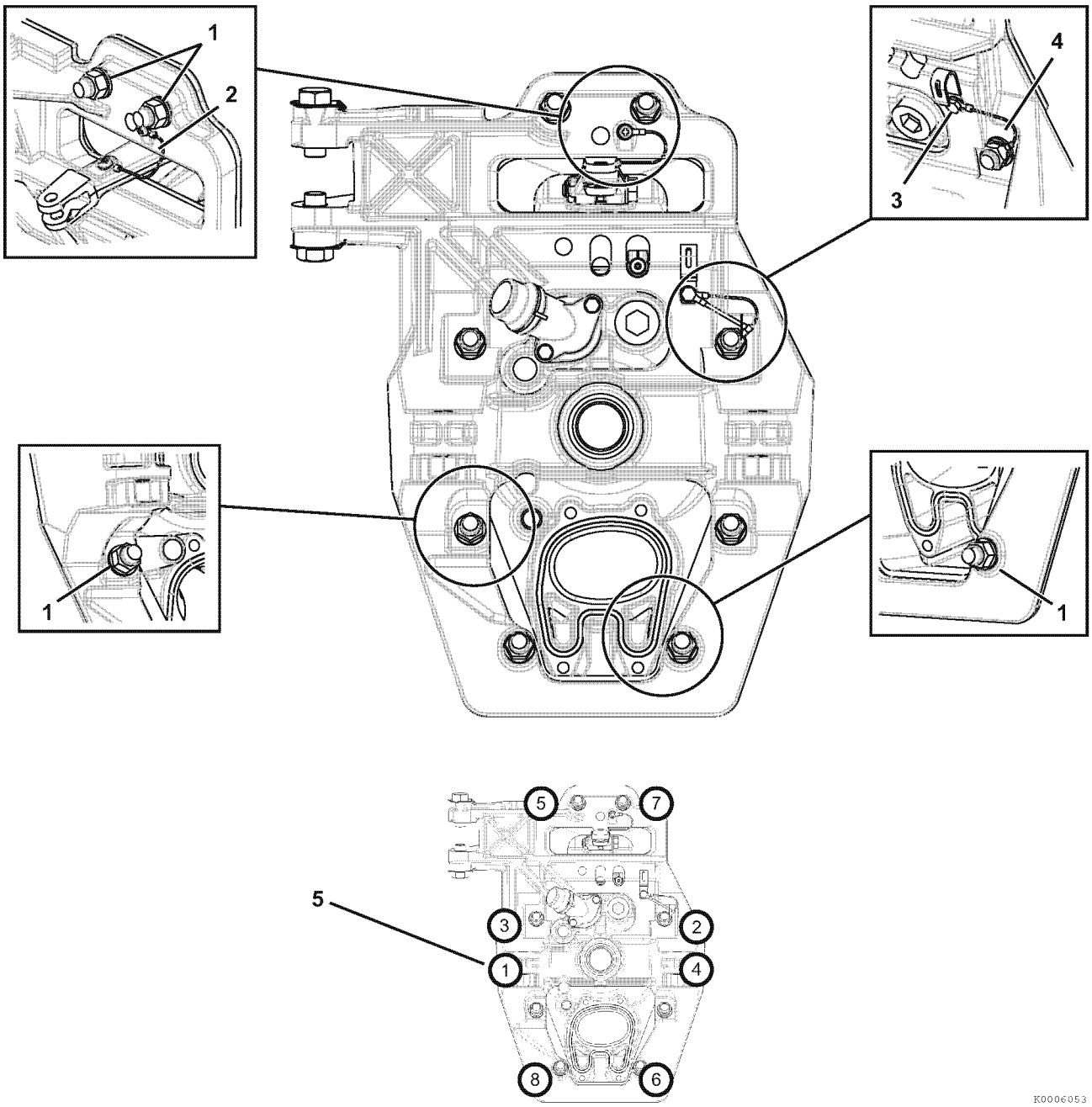
3. Secure the transom assembly with the hardware as shown in **Figure 5-12**.
4. Torque the transom plate bolts.

Transom plate bolt torque	
N·m	**lb-ft**
45	33

5. Attach the bonding wires.

NOTICE

The steering lever bonding wire must be positioned as shown in **Figure 5-12** to avoid stressing the wire when the steering lever moves.



1 – Locknuts and flat washers (8 ea.)
2 – Steering lever bonding wire
3 – Bonding wire bolt
4 – Transom plate bonding wire
5 – Torque sequence

Figure 5-12

TRANSOM ASSEMBLY AND ENGINE CONNECTION INSTALLATION INFORMATION

ZT370 Stern-Drive Applicable Engines

The ZT370 stern-drive can be coupled with following engine models.

Engine model		4BY3-180Z	6BY3-220Z	6BY3-260Z	6LPA-STZP2 6LPA-STZP3	8LV320Z	8LV350Z	8LV370Z
Stern-drive model	–	ZT370						
Maximum input speed	min^{-1} (rpm)	4000			3800	3800		
Direction of rotation (view from stern)	–	Front propeller C.C.W Rear propeller C.W.						

Specifications

The ZT370 stern-drive and applicable engine model specifications are shown below.

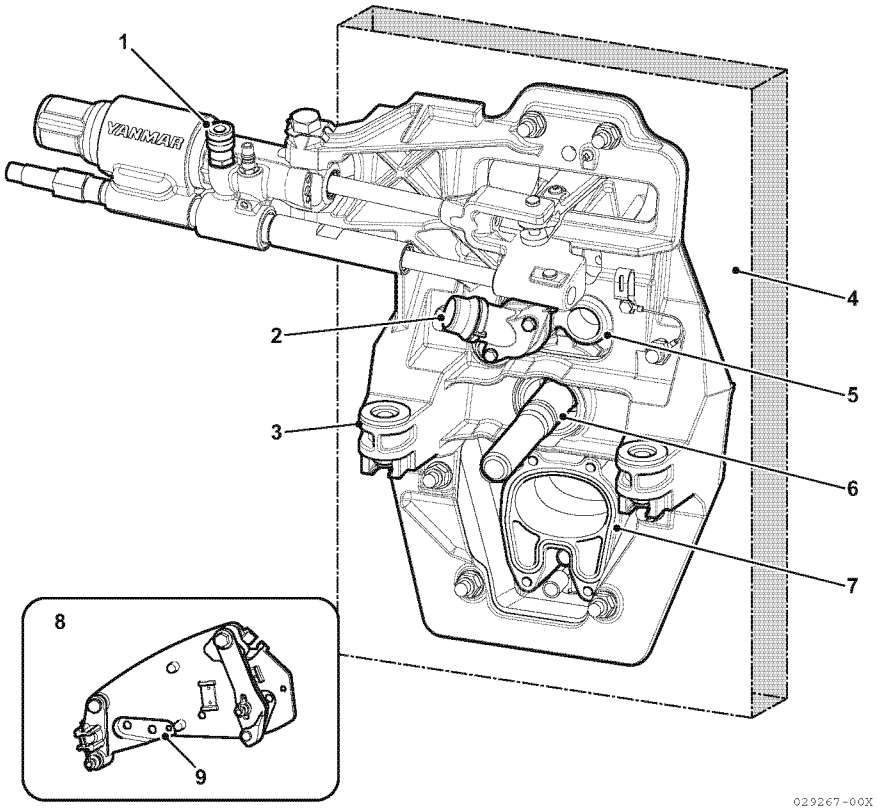
Drive model		ZT370 stern-drive			
Type	–	Stern-drive			
Clutch system	–	Hydraulic multiple friction plate			
Propeller system	–	Counterrotating propeller			
Gear ratio	–	1.65	1.78	1.97	2.18
Maximum input torque	N·m (lb-ft)	650 (479.4)		460 (339.2)	
Allowable input torque	N·m (lb-ft)	780 (575.2)		550 (405.6)	
Maximum input speed	min^{-1} (rpm)	4500			
Applicable engine model	–	4BY3-180Z, 6BY3-220Z, 6BY3-260Z, 6LPA-STZP2, 6LPA-STZP3, 8LV320Z, 8LV350Z, 8LV370Z		4BY3-180Z, 6BY3-220Z, 6BY3-260Z	
Lubricating oil	–	Quick Silver®*1 High Performance Gear Lube		Quick Silver®*1 High Performance Gear Lube or GL-5 (SAE 80W90 or 75W-90)	
Lubricating oil capacity for drive unit	ℓ (oz)	2.5 (84.5)			
Dry mass	kg (lb)	100 (220.5)			

**1: Quick Silver is a registered trademark of Brunswick Corporation.*

Applicable engine model			4BY3-180Z	6BY3-220Z	6BY3-260Z	6LPA-STZP2 6LPA-STZP3	8LV320Z	8LV350Z	8LV370Z
Type			Water cooled 4 stroke cycle diesel engine						
Number of cylinders			L4	L6		L6	V8		
Bore × stroke		mm (in.)	ø84 × 90 (3.3 × 3.5)			ø94 × 100 (3.7 × 3.9)	ø86 × 96 (3.4 × 3.8)		
Displacement		ℓ (gal)	1.995 (0.527)	2.993 (0.791)		4.164 (1.10)	4.461 (1.178)		
Fuel stop power	Power	kW (hp)	132 (177)	162 (217)	191 (256)	232 (311)	235 (320)	257 (350)	272 (370)
	Crank speed	min^{-1} (rpm)	4000			3800	3800		
	Torque	N·m (lb-ft)	316 (233)	386 (285)	457 (337)	583 (430)	591 (436)	647 (477)	684 (504)
Dry mass		kg (lb)	273 (602)	338 (745)		428 (944)	435 (960)		

Outline of Installation Parts

Outline of ZT370 stern-drive to engine installation parts shown.



1 – Hydraulic hose joint: Quick connector
2 – Water intake joint: Quick connector
3 – Engine mount: M12 bolts
4 – Transom thickness: 51 to 57 mm (2.008 to 2.244 in.)
5 – Drain port: Rc1 taper thread
6 – Input shaft spline: SAE 16/32-17t flat root
7 – Exhaust port for drive exhaust system (the flange shapes is different from Bravo® drive)
8 – Shift bracket
9 – Holes for fixed bolts: ø9 mm (M8 bolt) damper coupling installation

Figure 5-13

Coupling Installation Procedures

The following section contains coupling procedures for the ZT370 stern-drive to engines (4BY3, 6BY3, 6LPA and 8LV). For additional installation information, see *Installing the Engine on page 5-67*.

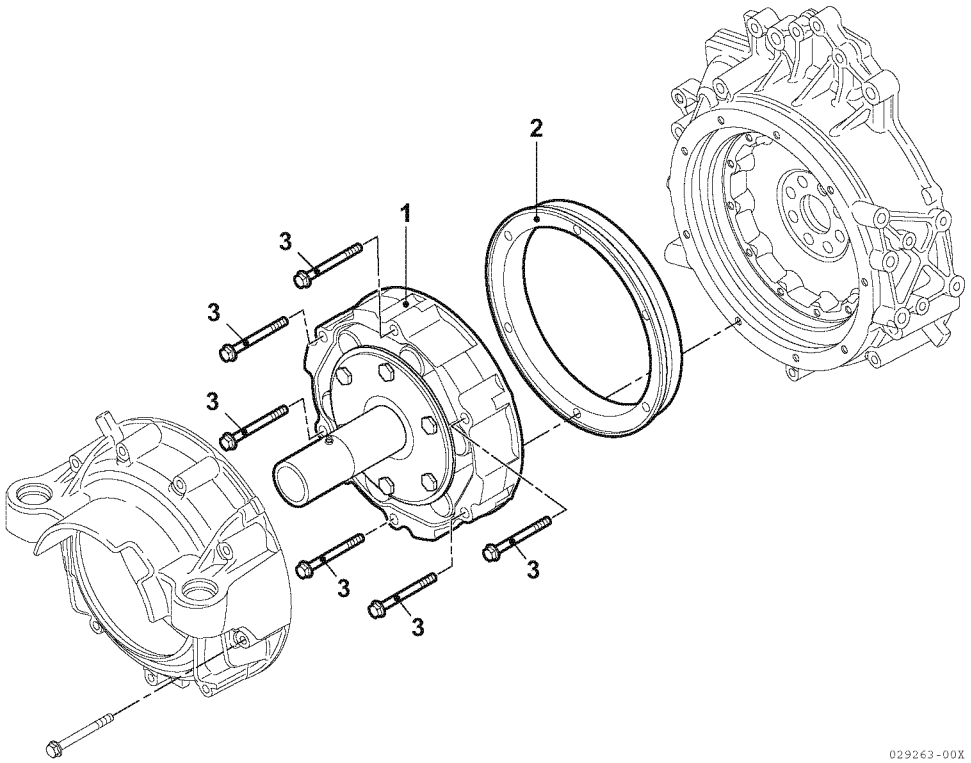
■ 4BY3-180Z damper coupling installation

Use the ZT370 stern-drive coupling.

NOTICE

Use of improper coupling may cause drive damage and/or excessive rattling noise.

Coupling assembly for ZT370 drive (engine optional parts)



1 – Coupling CF-RSD106
2 – Spacer
3 – Bolt M8 x 85, 6 pcs

Figure 5-14

Install the damper coupling to the engine flywheel.

Tighten the coupling and spacer to the engine flywheel using the M8 bolts. Torque bolts to the specified torque.

Torque (in steps)	N·m (lb-ft)
Initial	15 (11.1)
Final	23 (17.0)

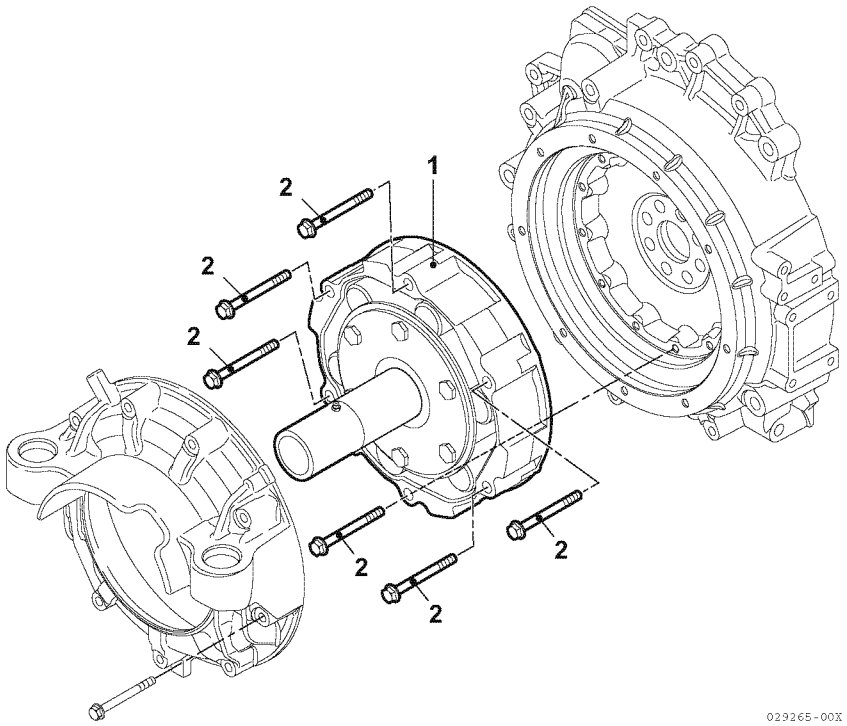
■ 6BY3-220Z and 6BY3-260Z damper coupling installation

Use the ZT370 stern-drive coupling.

NOTICE

Use of improper coupling may cause drive damage and/or excessive rattling noise.

Coupling assembly for ZT370 drive (engine optional parts)



1 – Coupling CF-RSD106

2 – Flange bolt M8 × 60, 6 pcs

Figure 5-15

Install the damper coupling to the engine flywheel.

Tighten the coupling and spacer to the engine flywheel using the M8 bolts. Torque bolts to the specified torque.

Torque (in steps)	N·m (lb-ft)
Initial	15 (11.1)
Final	23 (17.0)

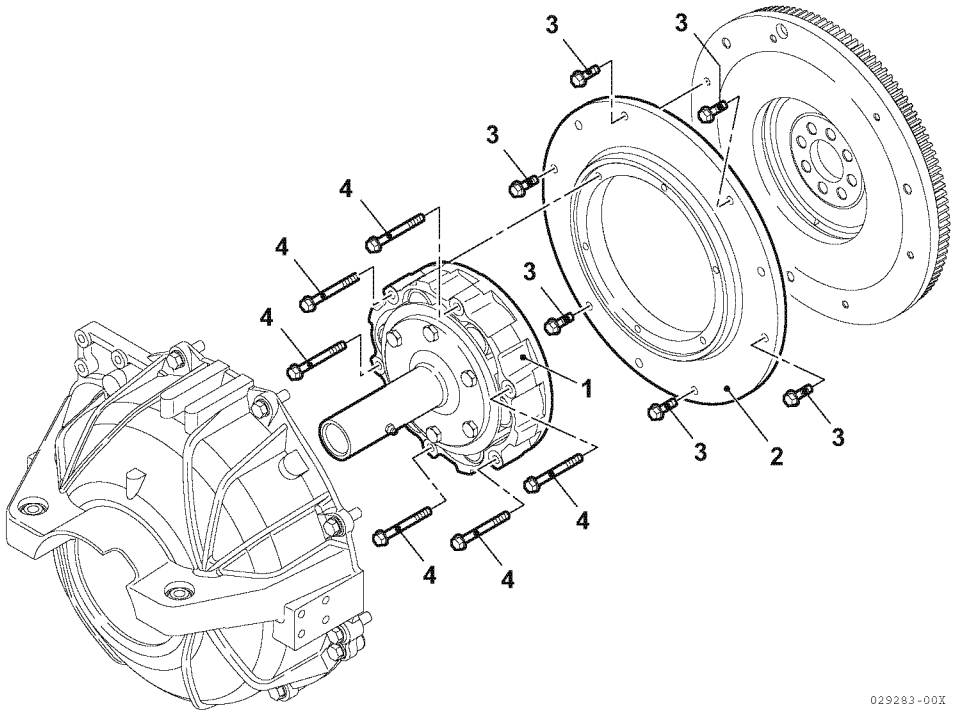
■ 6LPA-STZP2 and 6LPA-STZP3 damper coupling installation

Use the ZT370 stern-drive coupling. (CF-RSD106: S/#2415 and before)

NOTICE

Use of improper coupling may cause drive damage and/or excessive rattling noise.

Coupling assembly for ZT370 drive (engine optional parts)



1 – Coupling CF-RSD106
2 – Spacer
3 – Bolt M8 × 25, 6 pcs
4 – Bolt M8 × 70, 6 pcs

Figure 5-16

Tighten the coupling to the spacer using the M8 flange bolts. Tighten bolts to the specified torque.

Torque (in steps)	N·m (lb-ft)
Initial	15 (11.1)
Final	23 (17.0)

Tighten the coupling and spacer assembly to the engine flywheel using the M8 bolts. Tighten bolts to the specified torque.

Torque	N·m (lb-ft)
	25.5 (18.8)

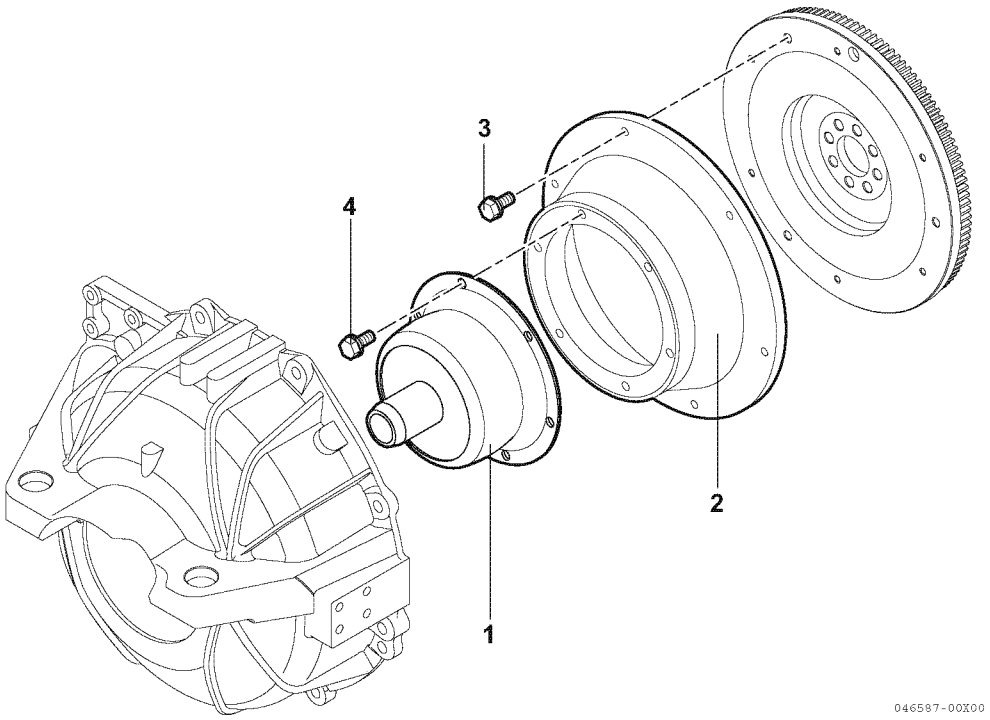
■ 6LPA-STZP2 and 6LPA-STZP3 lord coupling installation

Use the ZT370 stern-drive coupling. (LC-6000: S/#2416 and after)

NOTICE

Use of improper coupling may cause drive damage and/or excessive rattling noise.

Coupling assembly for ZT370 drive (engine optional parts)



1 – Coupling LC-6000
2 – Spacer
3 – Bolt M8 x 25, 6 pcs
4 – Bolt M10 x 30, 6 pcs

Figure 5-17

Tighten the coupling to the spacer using the M10 flange bolts. Tighten bolts to the specified torque.

Torque (in steps)	N·m (lb-ft)
	46 (34)

Tighten the coupling and spacer assembly to the engine flywheel using the M8 bolts. Tighten bolts to the specified torque.

Torque	N·m (lb-ft)
	25.5 (18.8)

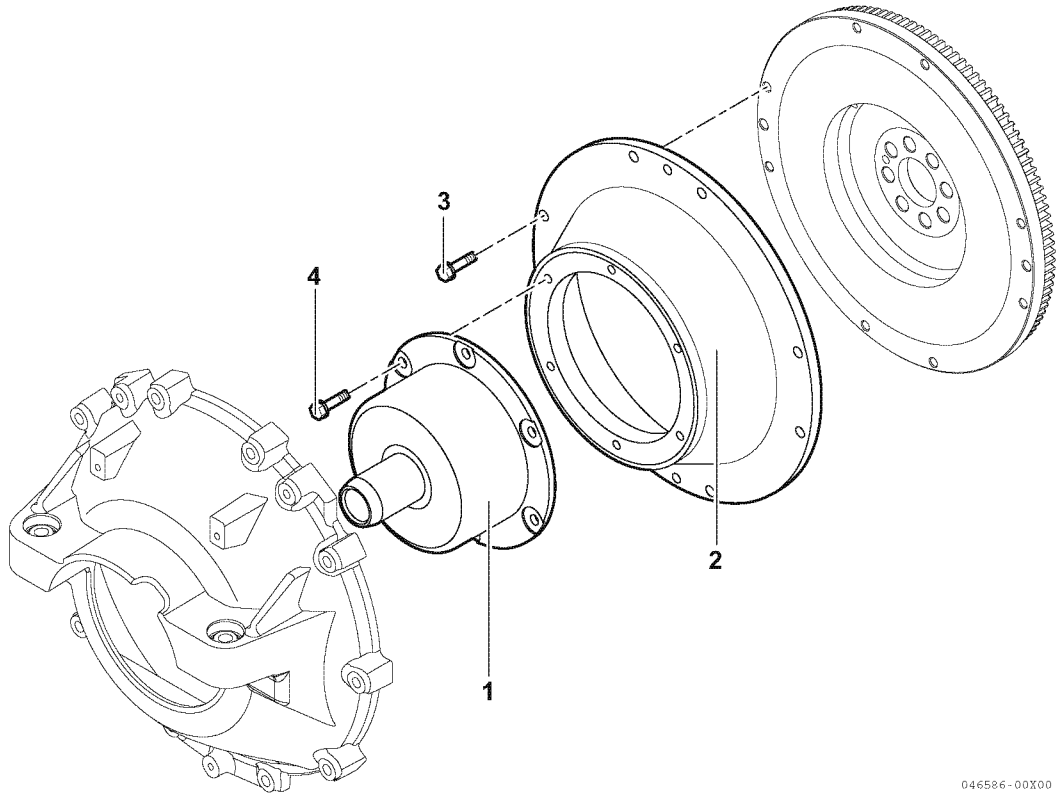
■ 8LV lord coupling installation

Use the ZT370 stern-drive coupling. (LC-6000)

NOTICE

Use of improper coupling may cause drive damage and/or excessive rattling noise.

Coupling assembly for ZT370 drive (engine optional parts)



1 – Coupling LC-6000
2 – Spacer
3 – Bolt M10 × 30, 8 pcs
4 – Bolt M10 × 30, 6 pcs

Figure 5-18

Tighten the coupling to the spacer using the M10 flange bolts. Tighten bolts to the specified torque.

Torque (in steps)	N·m (lb-ft)
	46 (34)

Tighten the coupling and spacer assembly to the engine flywheel using the M8 bolts. Tighten bolts to the specified torque.

Torque	N·m (lb-ft)
	46 (34)

Engine Cooling Seawater Hose Installation

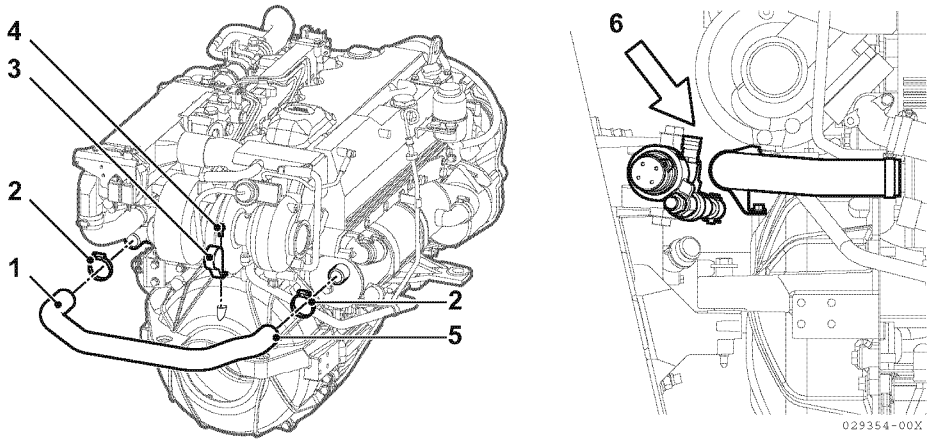
■ 6LPA-STZP2 and 6LPA-STZP3 cooling seawater hose installation

NOTICE

Depending on drive, the seawater hose may differ. Ensure the hose is matched with the drive to prevent interference **(Figure 5-19, (6))** with the power steering cylinder.

Install the cooling seawater hose between the charge air cooler and oil cooler.
Tighten the hose clips.
The marked (white) end of hose **(Figure 5-19, (5))** should be installed to the oil cooler side.
Tighten the clamps to the flywheel housing using the M8 bolt.

CSW hose assembly (engine optional parts)



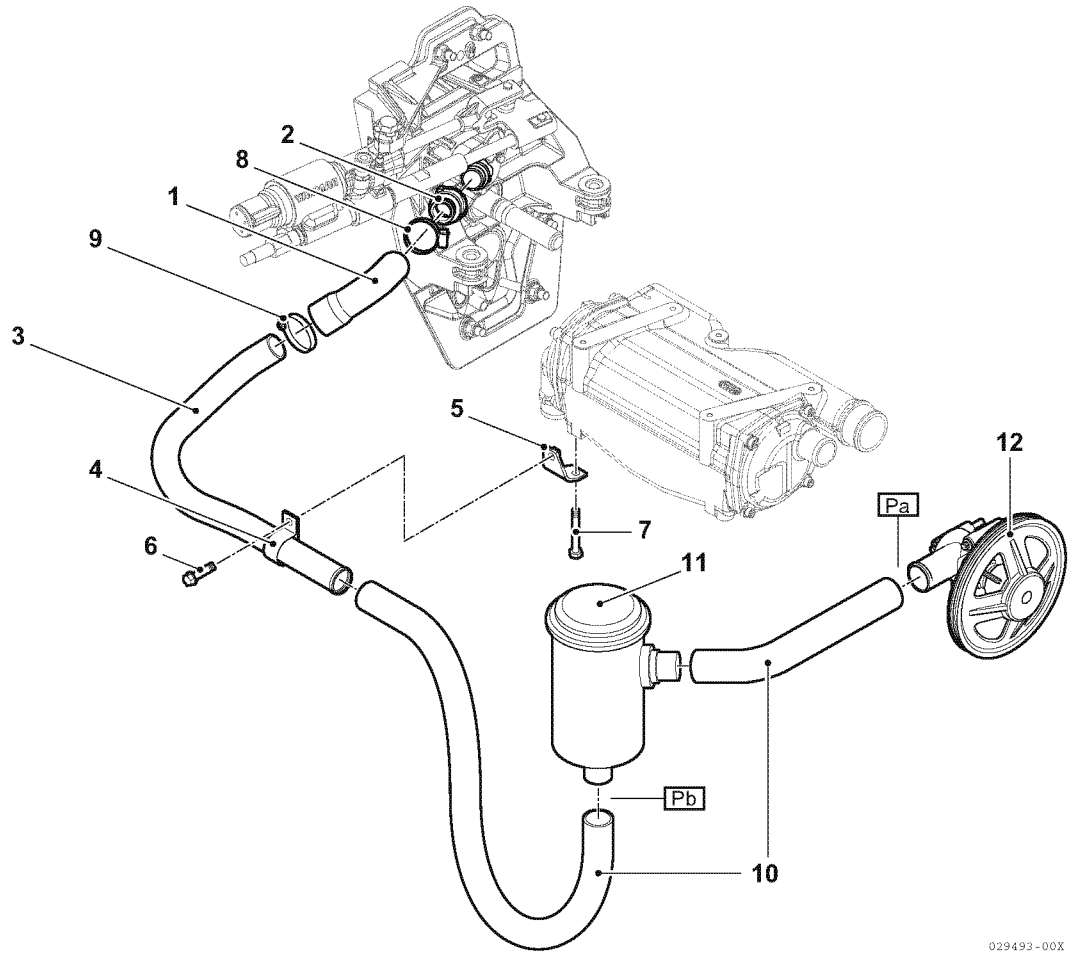
1 – CSW-T (lubrication oil cooler out)
2 – Clip, hose, 2 pcs
3 – Clamp
4 – Bolt M8 x 18
5 – Identification marking (white)
6 – Interference area

Figure 5-19

Cooling Seawater Intake (Drive Only) Installation

■ 4BY3-180Z, 6BY3-220Z and 6BY3-260Z cooling seawater intake installation

CSW drive assembly (engine optional parts)



1 – Hose, drive out
2 – Joint quick connect
3 – Pipe, CSW drive
4 – Clamp, D38
5 – Bracket, CW-T
6 – Bolt M10 x 16
7 – Bolt M10 x 65
8 – Hose clip
9 – Hose clip, 3 pcs
10 – Hose, CSW 2M
11 – Water strainer (locally supplied)
12 – Seawater pump (on engine)

Figure 5-20

NOTICE

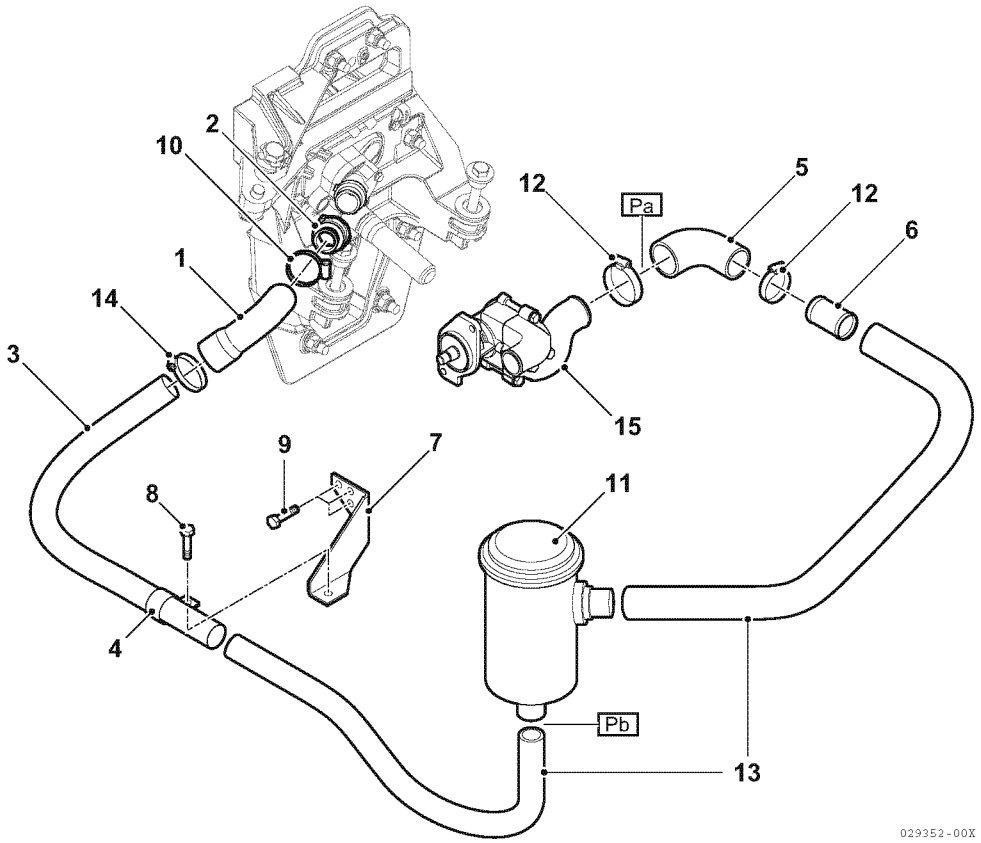
YANMAR recommends to measure the cooling seawater intake pressure (Pa and Pb) when installing a water strainer.
Pa: Cooling seawater pressure at seawater inlet
Pb: Cooling seawater pressure at water strainer

Permissible pressure before seawater pump: Pa ≥ -45 kPa (-6.53 psi) at engine speed 4000 min^{-1} (rpm)
Permissible pressure drop before and after water strainer: Pb - Pa ≤ 30 kPa (6.53 psi) at engine speed 4000 min^{-1} (rpm)

Example: VETUS FTR330 or FTR1320

■ 6LPA-STZP2 and 6LPA-STZP3 cooling seawater intake installation

CSW drive assembly (engine optional parts)



1 – Hose, drive out
2 – Joint quick connect
3 – Pipe, CSW drive
4 – Clamp, D38
5 – Hose, CSW-P-IN
6 – Pipe, CSW-P-IN
7 – Bracket, CW-T
8 – Bolt M10 × 16
9 – Bolt M10 × 22, 3 pcs
10 – Hose clip 41
11 – Water strainer (locally supplied)
12 – Hose clip 54
13 – Hose, CSW 2.5M
14 – Hose clip 48, 4 pcs
15 – Seawater pump (on engine)

Figure 5-21

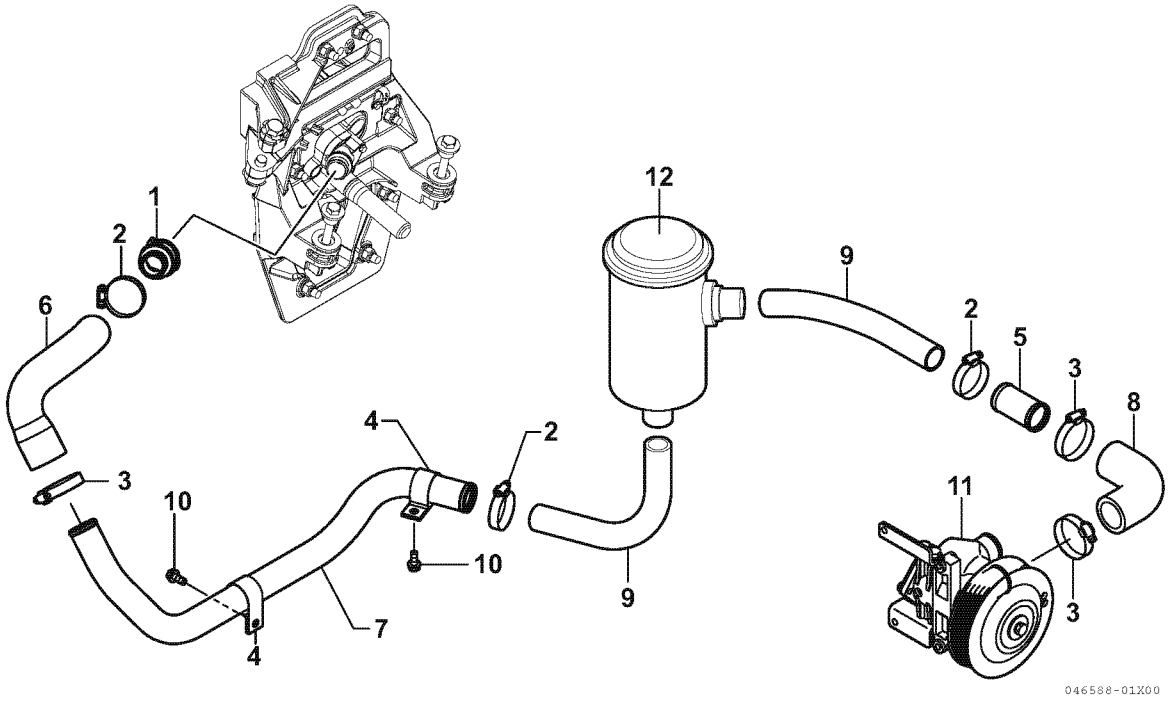
NOTICE

YANMAR recommends to measure the cooling seawater intake pressure (Pa and Pb) when installing a water strainer.
Pa: Cooling seawater pressure at seawater inlet
Pb: Cooling seawater pressure at water strainer

Permissible pressure before seawater pump: Pa ≥ -25 kPa (-3.63 psi) at engine speed 3800 min^{-1} (rpm)
Permissible pressure drop before and after water strainer: Pb - Pa ≤ 10 kPa (1.45 psi) at engine speed 3800 min^{-1} (rpm)

Example: VETUS FTR330 or FTR1320

■ 8LV320Z, 8LV350Z and 8LV370Z cooling seawater intake installation



1 – Joint
2 – Hose clip 48, 3 pcs
3 – Hose clip 54, 3 pcs
4 – Clamp, CW-T, 2 pcs
5 – Pipe, CSW-P-IN
6 – Hose, drive out
7 – Pipe, CSW drive
8 – Hose, CSW-P-IN
9 – Hose, CSW 2.5M
10 – Bolt M8 x 18, 2 pcs
11 – Seawater pump (on engine)
12 – Water strainer (locally supplied)

Figure 5-22

NOTICE

YANMAR recommends to measure the cooling seawater intake pressure (Pa and Pb) when installing a water strainer.
Pa: Cooling seawater pressure at seawater inlet
Pb: Cooling seawater pressure at water strainer

Permissible pressure before seawater pump: Pa ≥ -36 kPa (-5.22 psi) at engine speed 3800 min^{-1} (rpm)
Permissible pressure drop before and after water strainer: Pb - Pa ≤ 10 kPa (1.45 psi) at engine speed 3800 min^{-1} (rpm)

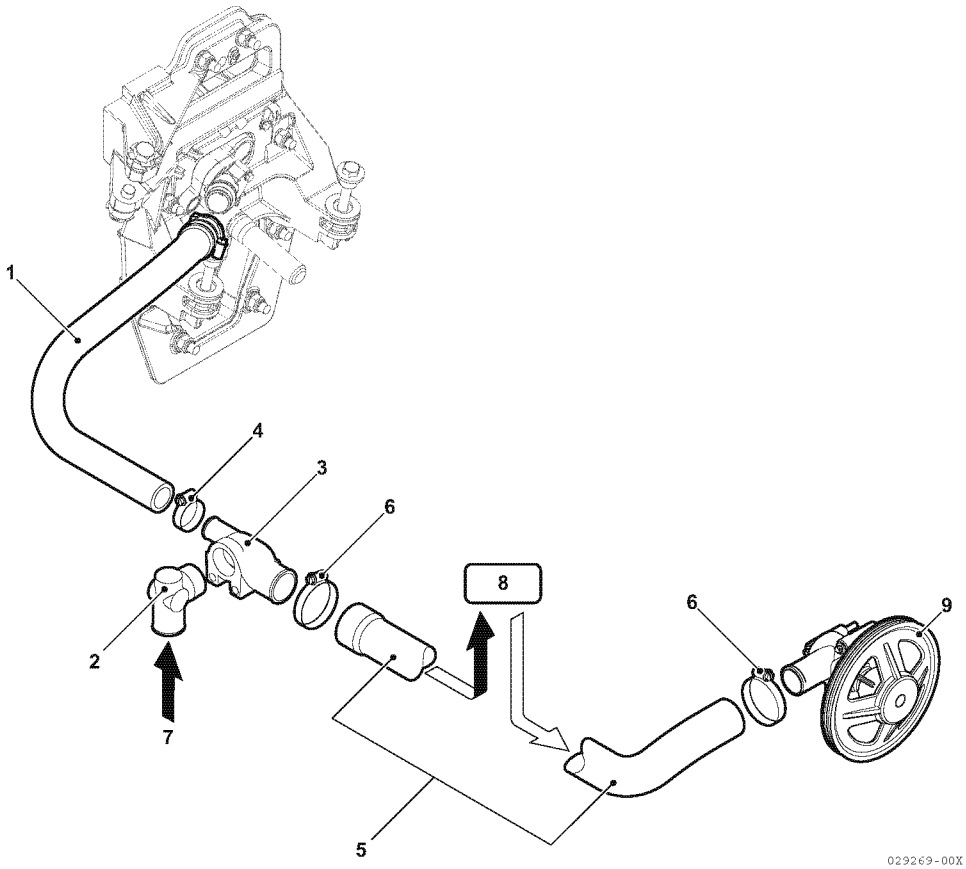
Example: VETUS FTR1320

■ 4BY3-180Z, 6BY3-220Z and 6BY3-260Z seawater intake with kingston cock installation

NOTICE

YANMAR recommends to use a 3-way joint when installing a kingston cock.

(Engine standard parts)



1 – Hose assembly, drive out
2 – Cooling joint
3 – 3-way joint
4 – Hose clamp
5 – Hose, pump IN
6 – Hose clamp
7 – From kingston cock
8 – Water strainer
9 – Seawater pump

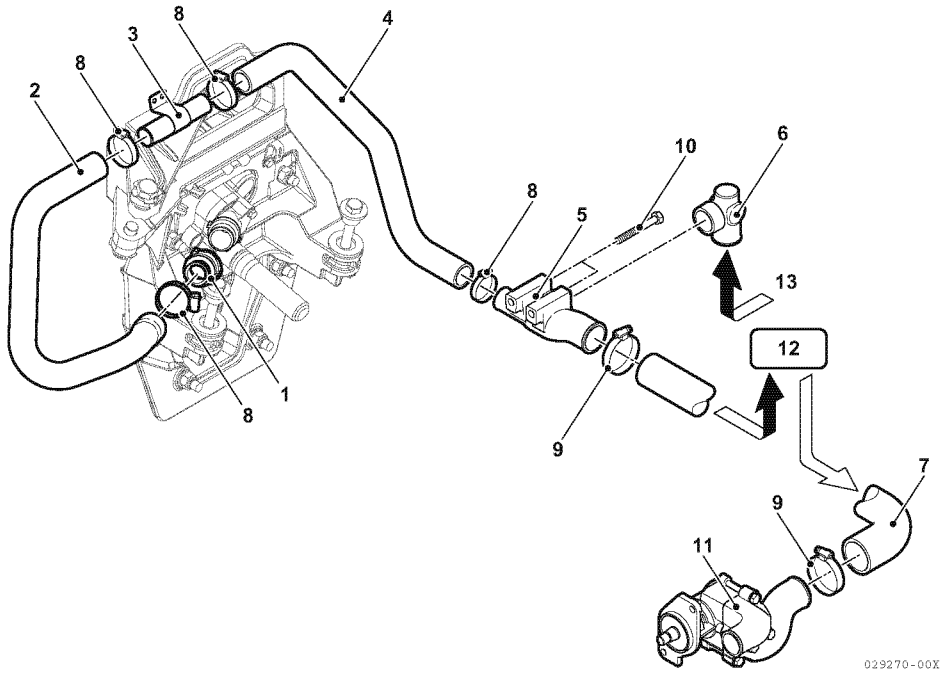
Figure 5-23

■ 6LPA-STP2 and 6LPA-STP3 seawater intake with kingston cock installation

NOTICE

To avoid excessive exhaust back pressure, YANMAR recommends the use of a 3-way joint when installing a kingston cock only when the boat has a transom exhaust. For boats with drive exhaust system, *see 6LPA-STZP2 and 6LPA-STZP3 cooling seawater intake installation on page 5-20.*

(Engine standard parts)



1 – Joint quick connect
2 – Hose, drive out
3 – Tube, drive
4 – Hose, joint IN
5 – Joint, 3-way
6 – Joint, cooling water
7 – Hose, cooling water
8 – Hose clamp
9 – Hose clamp
10 – Bolt M10 x 80 (x2)
11 – Seawater pump
12 – Water strainer
13 – From kingston cock

Figure 5-24

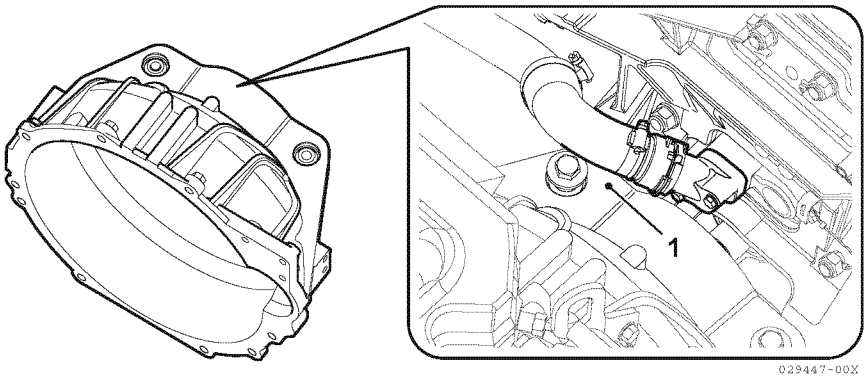
Flywheel Housing Replacement or Modification

■ 6LPA-STZP2 and 6LPA-STZP3 flywheel housing replacement or modification

NOTICE

The flywheel housing requires replacement or modification if it is the old style. The old style flywheel housing interferes with the ZT370 stern-drive seawater intake coupling. Replace the flywheel housing with a new style flywheel housing or modify (cut) as necessary to eliminate any interference.

Old type housing



1 – Interference area of seawater intake coupling

Figure 5-25

New type housing (engine standard parts)

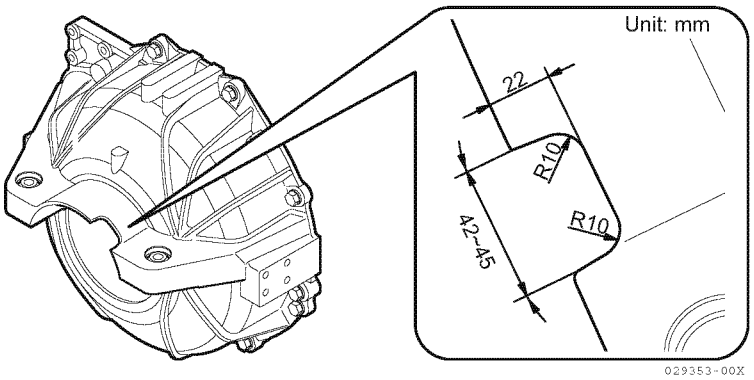


Figure 5-26

Cooling Seawater Mixing (Drive Exhaust) Installation

■ 4BY3-180Z cooling seawater mixing for drive exhaust installation

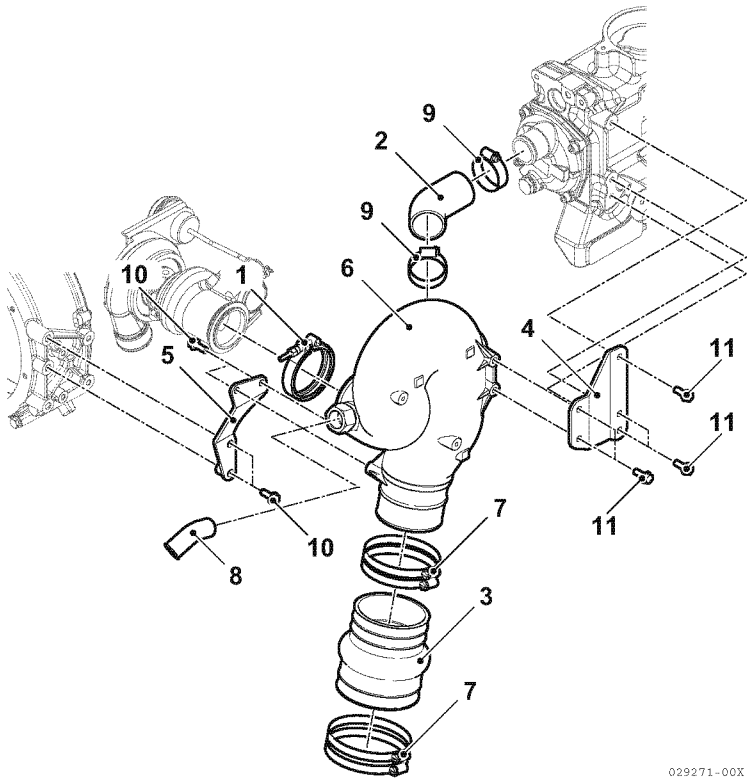
NOTICE

Always install the provided brackets (2 pieces) to prevent gas leakage from turbocharger mounting flange caused by vibration. When tightening the V-clamp, tighten first to initial torque of 4.0 N·m (2.95 lb-ft), then tap the circumference with a plastic hammer, and then tighten to 5.5 ± 0.5 N·m (3.7 ± 0.4 lb-ft).

Install the mixing elbow assembly between the exhaust port of stern-drive and the turbocharger exhaust outlet.

Install the exhaust water mixing outlet hose.

Elbow assembly - mixing R (engine standard parts)



1 – V-clamp, turbine out
2 – Hose, mixing drive
3 – Hose, exhaust pipe
4 – Bracket A, mixing
5 – Bracket B, mixing DR
6 – Elbow assembly, mixing DR
7 – Clip, hose 127 (4 qty.)
8 – Bend
9 – Clamp, hose (2 qty.)
10 – Bolt, 8 × 20 (4 qty.)
11 – Bolt, 8 × 20 (5 qty.)

Figure 5-27

■ 6BY3-220Z and 6BY3-260Z cooling seawater mixing for drive exhaust installation

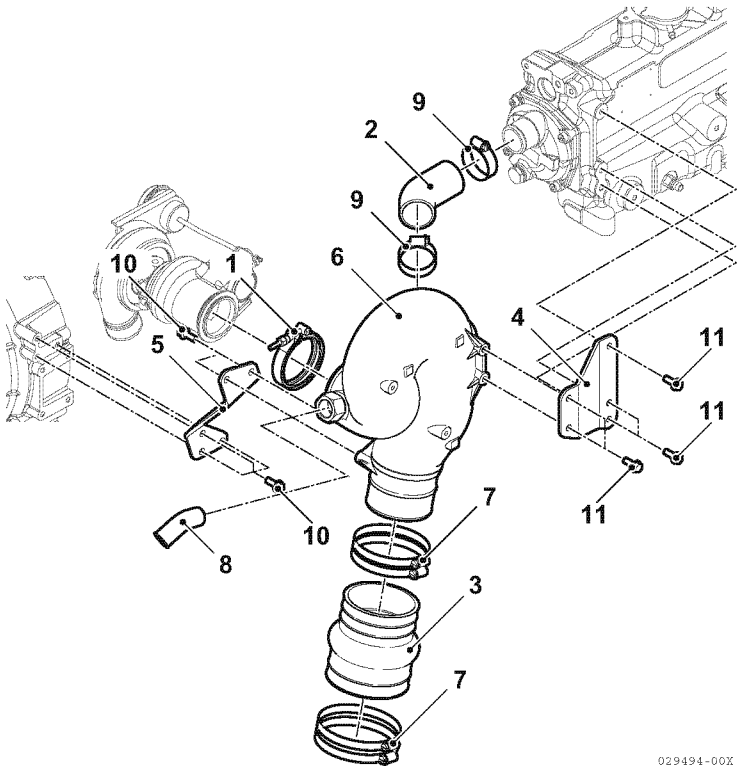
NOTICE

Always install the provided brackets (2 pieces) to prevent gas leakage from the turbocharger mounting flange caused by vibration. When tightening the V-clamp, first tighten to an initial torque of 4.0 N·m (2.95 lb-ft), then tap the circumference with a plastic hammer, and then tighten to 5.5 ± 0.5 N·m (3.7 ± 0.4 lb-ft).

Install the mixing elbow assembly between the exhaust port of the stern-drive and the turbocharger exhaust outlet.

Install the exhaust water mixing outlet hose.

Elbow assembly - mixing R (engine standard parts)



1 – V-clamp, turbine out
2 – Hose, mixing drive
3 – Hose, exhaust pipe
4 – Bracket A, mixing
5 – Bracket B, mixing DR
6 – Elbow assembly, mixing DR
7 – Clip, hose 127 (4 qty)
8 – Bend
9 – Clamp, hose (2 qty)
10 – Bolt, 8 × 20 (4 qty)
11 – Bolt, 8 × 20 (5 qty)

Figure 5-28

■ 6LPA-STZP2 and 6LPA-STZP3 cooling seawater mixing for drive exhaust installation

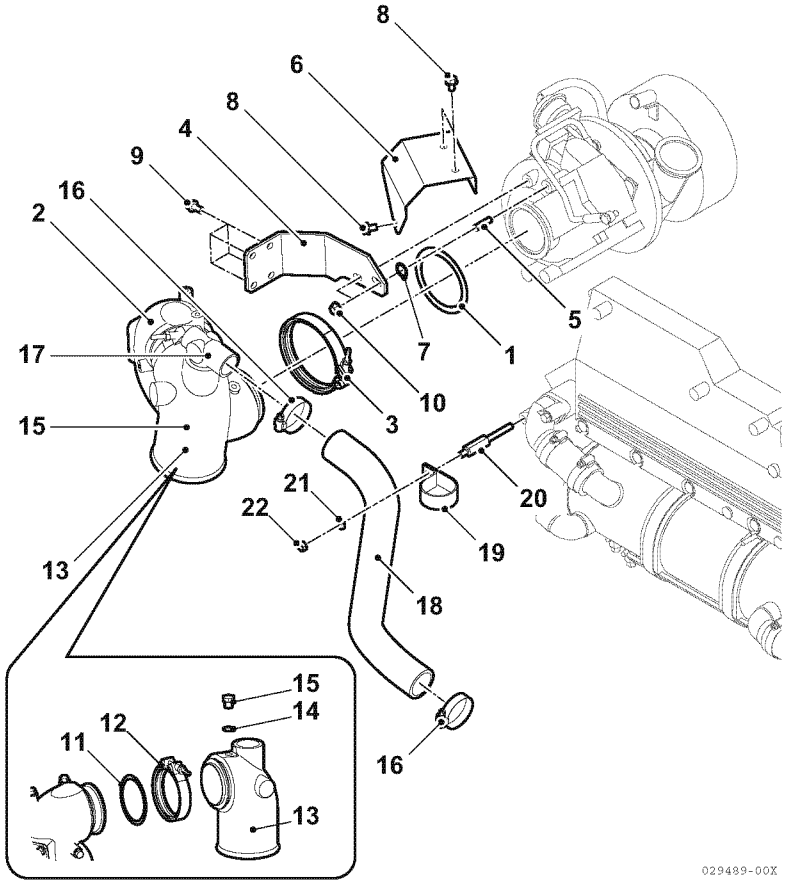
NOTICE

Always install the provided bracket to prevent gas leakage from the turbocharger mounting flange caused by vibration. When tightening the V-clamp, first tighten to an initial torque of 6 to 7 N·m (4.4 - 5.2 lb-ft), then tap the circumference with a plastic hammer, and then tighten to 9 N·m (6.6 lb-ft).

Install the mixing elbow assembly between the exhaust port of stern-drive and the turbocharger exhaust outlet.

Install the exhaust water mixing outlet hose.

Exhaust bend, water mixing elbow and cooling water pipe assembly (engine standard parts)



1 – Gasket, turbocharger
2 – Bend assembly, exhaust
3 – Band
4 – Bracket, bend
5 – Stud (2 qty)
6 – Cover, air duct
7 – Washer, M8
8 – Bolt, M8 x 12 (3 qty)
9 – Bolt, M8 x 16 (4 qty)
10 – Nut, M8 (2 qty)
11 – Gasket, turbocharger
12 – Band
13 – Elbow, mixing
14 – Gasket, 13 x 1.0 mm
15 – Plug, G 1/4 in.
16 – Clip, hose (2 qty)
17 – Joint, cooling water
18 – Hose, mixing IN
19 – Clamp
20 – Bolt, spacer mixing
21 – Washer, M8
22 – Nut, M8

Figure 5-29

■ 8LV320Z, 8LV350Z and 8LV370Z cooling seawater mixing for drive exhaust installation

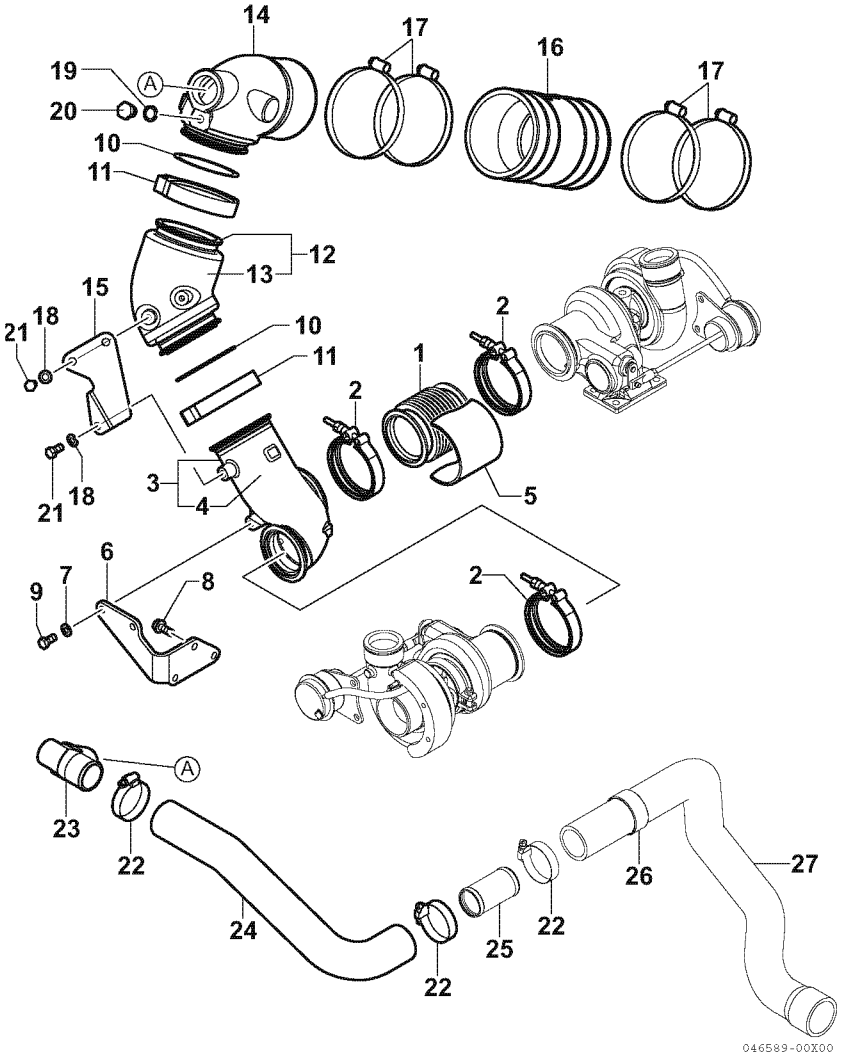
NOTICE

Always install the provided bracket to prevent gas leakage from the turbocharger mounting flange caused by vibration. When tightening the V-clamp, first tighten to an initial torque of 6 to 7 N·m (4.4 - 5.2 lb-ft), then tap the circumference with a plastic hammer, and then tighten to 9 N·m (6.6 lb-ft).

Install the mixing elbow assembly between the exhaust port of stern-drive and the turbocharger exhaust outlet.

Install the exhaust water mixing outlet hose.

Exhaust bend, water mixing elbow and cooling water pipe assembly (engine standard parts)



1 – Bellows, exhaust
2 – V-clamp, 3 pcs
3 – Bend assembly, exhaust
4 – Insulator, exhaust bend
5 – Insulator, bellows
6 – Bracket, exhaust bend
7 – Washer, M8, 2pcs
8 – Bolt, M8 x 20, 3 pcs
9 – Bolt, M8 x 16 (SUS), 2 pcs
10 – Gasket
11 – V-clamp, 2 pcs
12 – Exhaust bend CMP
13 – Heat insulator, exhaust bend
14 – Elbow, mixing
15 – Bracket, bend
16 – Joint, rubber
17 – Hose clip, 127, 4 pcs
18 – Washer, M8, 3 pcs
19 – Gasket
20 – Plug
21 – Bolt, M8 x 16 (SUS), 3 pcs
22 – Hose clip, 48, 2 pcs
23 – Bend, elbow
24 – Hose, mixing IN
25 – Pipe, seawater pump IN
26 – Band
27 – Hose, CSW ATF cooler

Figure 5-30

Exhaust Pipe to Drive Exhaust Installation

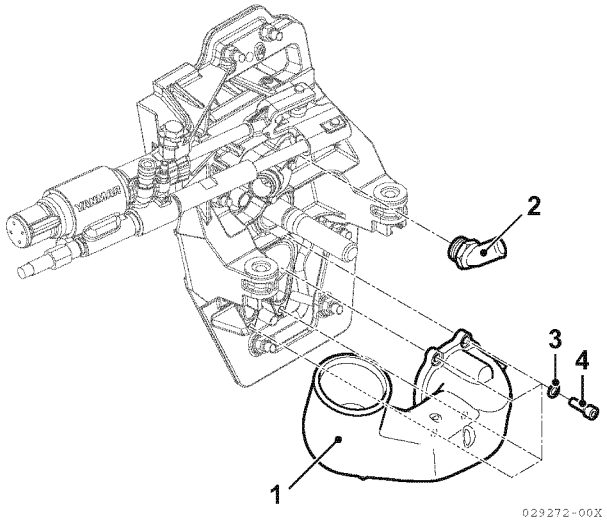
■ 4BY3-180Z, 6BY3-220Z and 6BY3-260Z exhaust pipe from stern-drive exhaust port installation

NOTICE

Use the ZT370 exhaust pipe. The shape of the exhaust pipe joint and drain bypass outlet differs from the Bravo drive.

Install the ZT370 stern-drive exhaust pipe assembly.

Exhaust pipe assembly (engine optional parts)



1 – Exhaust pipe
2 – Elbow, CSW
3 – Washer, M10 (4 qty)
4 – Bolt, M10 x 30 (4 qty)

Figure 5-31

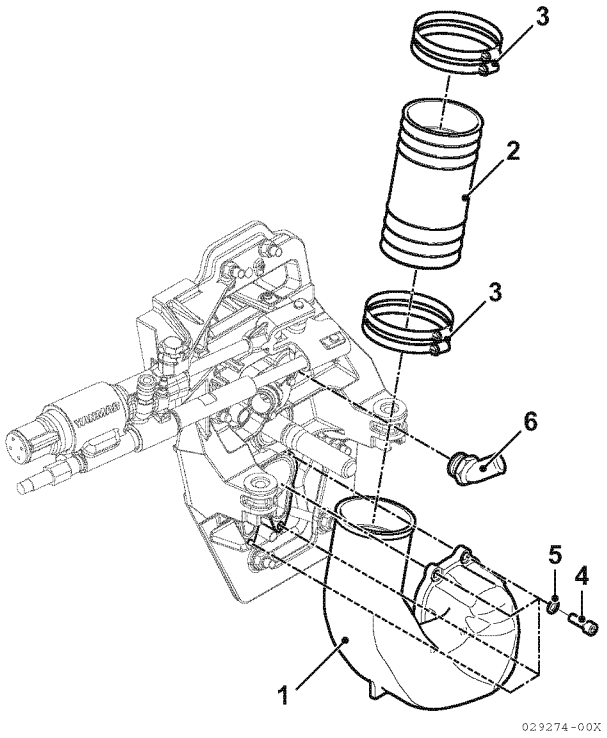
■ 6LPA-STZP2 and 6LPA-STZP3 exhaust pipe from stern-drive exhaust port installation

NOTICE

Use the ZT370 exhaust pipe. The shape of the exhaust pipe joint and drain bypass outlet differs from the Bravo drive.

Install the ZT370 stern-drive exhaust pipe assembly.

Exhaust pipe assembly (engine optional parts)



1 – Exhaust pipe
2 – Joint, rubber
3 – Clip, hose (4 qty)
4 – Bolt, M10 × 30 (4 qty)
5 – Washer, M10 (4 qty)
6 – Elbow, CSW

Figure 5-32

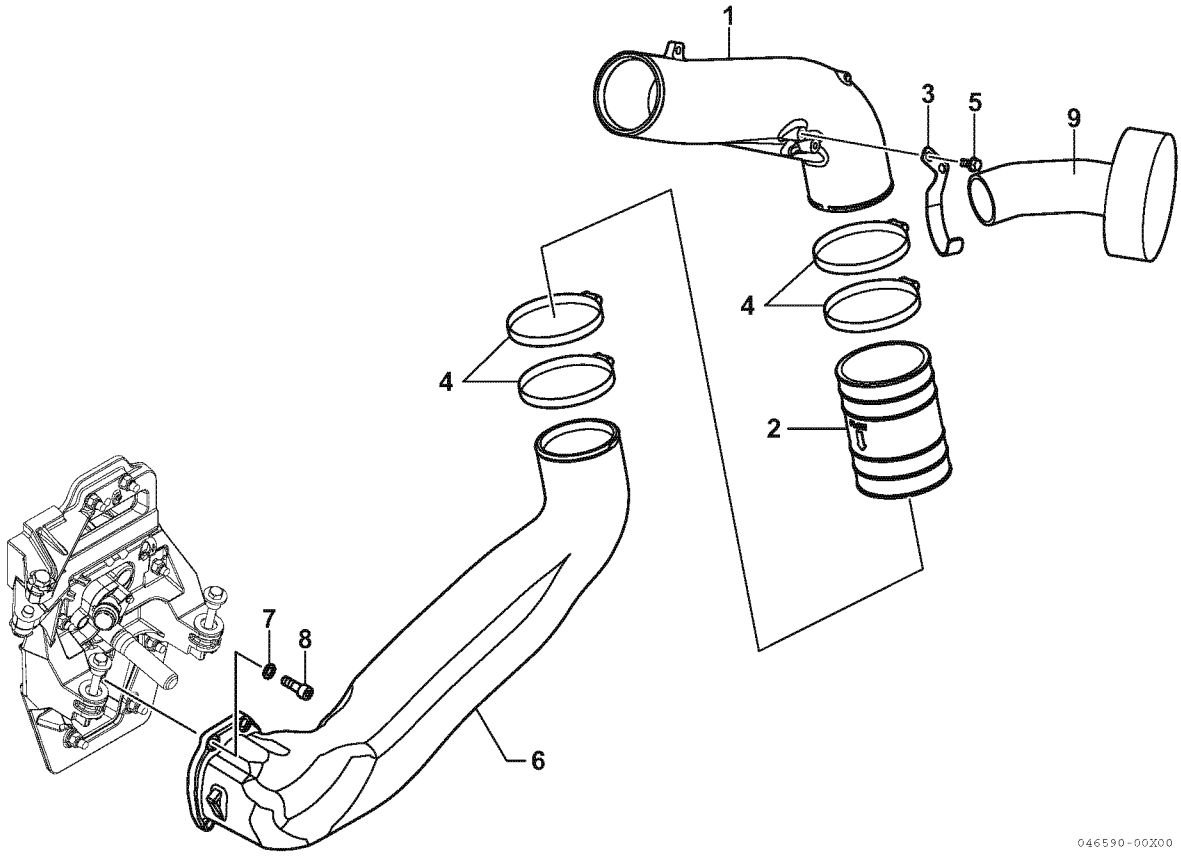
■ 8LV320Z, 8LV350Z and 8LV370Z exhaust pipe from stern-drive exhaust port installation

NOTICE

Use the ZT370 exhaust pipe. The shape of the exhaust pipe joint and drain bypass outlet differs from the Bravo drive.

Install the ZT370 stern-drive exhaust pipe assembly.

Exhaust pipe assembly (engine optional parts)



1 – Exhaust pipe, mixing
2 – Joint, rubber
3 – Support
4 – Hose clip, 48, 4 pcs
5 – Bolt, M8 x 16, 2 pcs
6 – Exhaust pipe, D
7 – Washer, M10, 4 pcs
8 – Bolt, M10 x 30, 4 pcs
9 – Rubber hose (turbocharger inlet)

Figure 5-33

*Note: Fix the rubber hose **(Figure 5-33, (9))** of the silencer with the support **(Figure 5-33, (3))** after the exhaust pipe is installed. If the rubber hose is deformed by the weight of the silencer, it may have adverse effects on the engine performance.*

Water Bypass for Drive Exhaust Installation

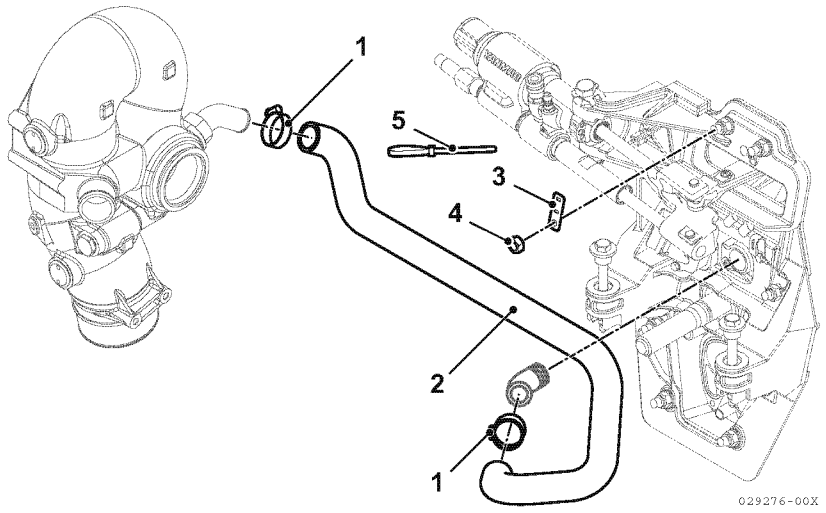
■ 4BY3-180Z, 6BY3-220Z and 6BY3-260Z water bypass from stern-drive drain port installation

NOTICE

To prevent the loss of engine power and/or excessive black exhaust smoke, always connect the drive exhaust drain bypass.

Install the ZT370 stern-drive cooling seawater exhaust bypass parts shown, when not installing tie bar.

CSW hose assembly, bypass (engine standard parts) - No tie bar



1 – Clamp, hose (2 qty)
2 – Hose, bypass
3 – Sheet, retaining
4 – Nut, ISO7/16
5 – Tie strap

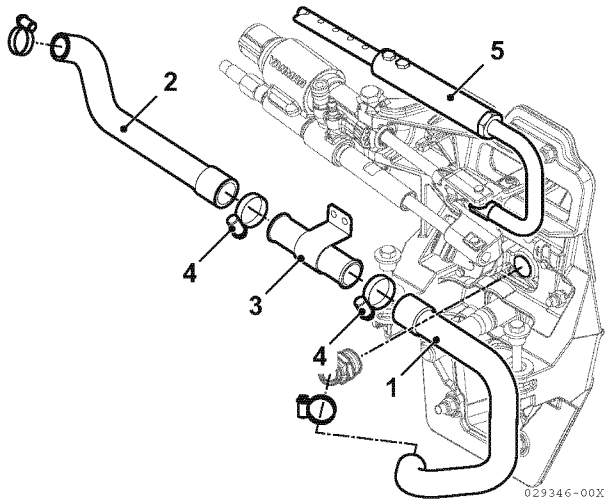
Figure 5-34

Install the ZT370 stern-drive cooling seawater exhaust bypass assembly parts shown when installing a tie bar.

NOTICE

If using an internal tie bar, hose configuration may differ to prevent interference with the tie bar.

CSW hose assembly, bypass (engine standard parts) with tie bar



1 – Hose, drive in
2 – Hose, bypass
3 – Tube, drive
4 – Clip, hose M38 (4 qty)
5 – Tie bar

Figure 5-35

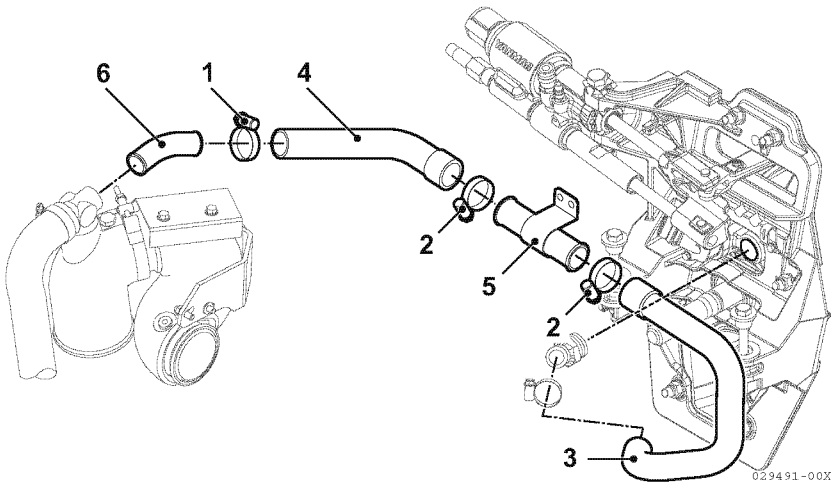
■ 6LPA-STZP2 and 6LPA-STZP3 water bypass from stern-drive drain port installation

NOTICE

To prevent the loss of engine power and/or excessive black exhaust smoke, always connect the drive exhaust drain bypass.

Install cooling seawater bypass assembly for ZT370 stern-drive exhaust.

CSW hose assembly, bypass (engine standard parts)



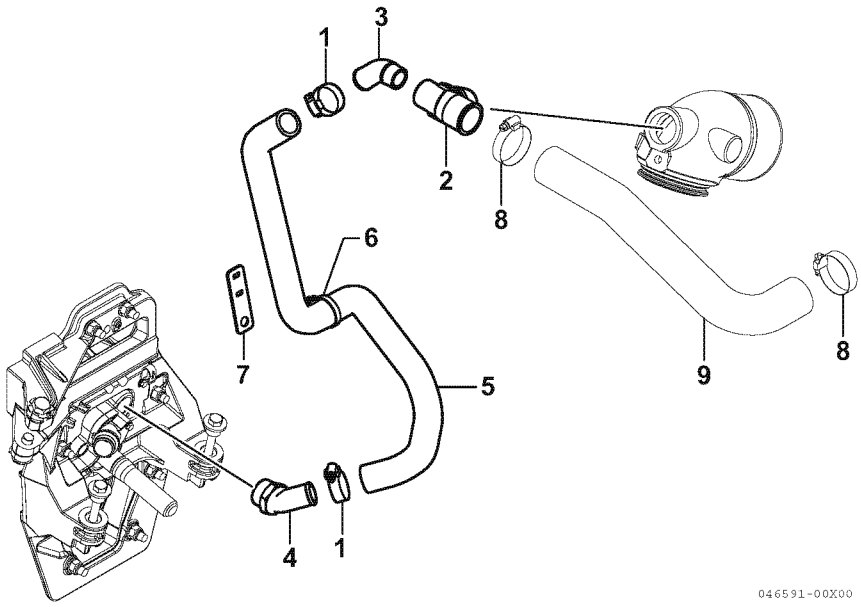
1 – Clip, hose 35 (2 qty)
2 – Clip, hose 41 (2 qty)
3 – Hose, drive in
4 – Hose, bypass
5 – Tube, drive
6 – Bend

Figure 5-36

■ 8LV320Z, 8LV350Z and 8LV370Z water bypass from stern-drive drain port installation

Install cooling seawater bypass assembly for ZT370 stern-drive exhaust.

CSW hose assembly, bypass (engine optional parts)



1 – Hose clip, 35, 2 pcs
2 – Bend, 90 elbow
3 – Joint
4 – Elbow, seawater
5 – Hose, bypass
6 – Band
7 – Retainer
8 – Hose clip, 48, 2 pcs
9 – Hose, mixing IN

Figure 5-37

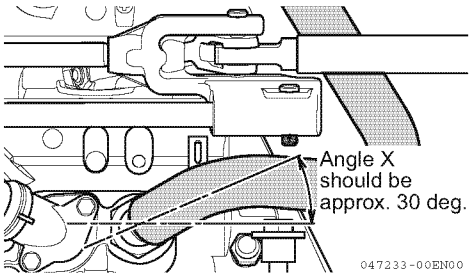


Figure 5-38

Note: Install the bypass hose at the angle of approx. 30 deg. and check the interference by steering to the right & left sides every time when installing the ZT370 drive.

Power Steering Hydraulic Oil Pipes Connection

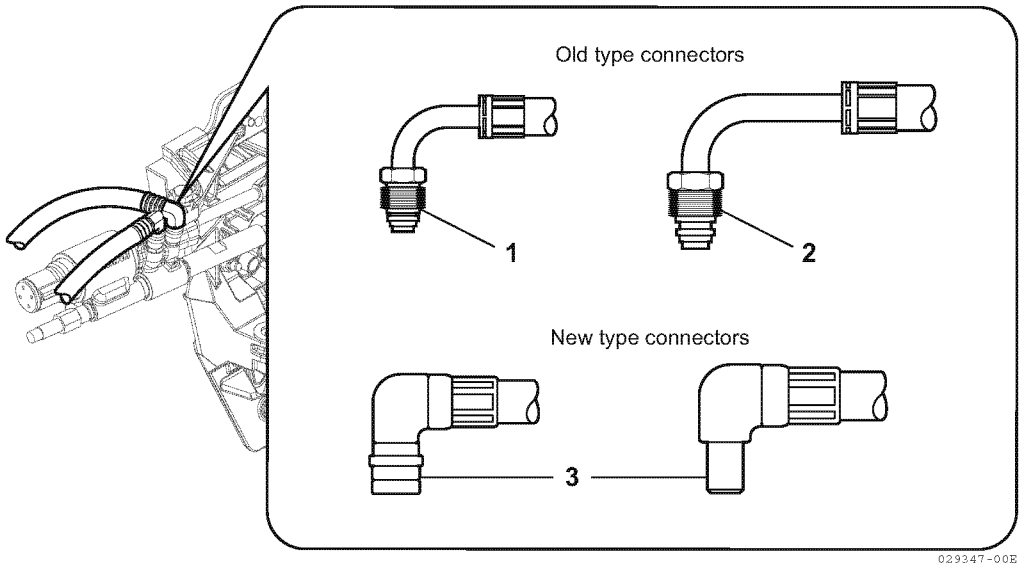
■ 6LPA-STZP2 power steering hydraulic oil pipe installation

NOTICE

If the hydraulic pipe connector on the engine side is of the older design, use this kit to convert the connection.

(Drive optional parts)

Connect the ZT370 stern-drive power steering hydraulic oil pipes.



1 – M14
2 – M16
3 – Quick connector

Figure 5-39

KIT, PAS fitting cup (drive optional parts)

Use parts shown below for older design connectors of ATF pipe.

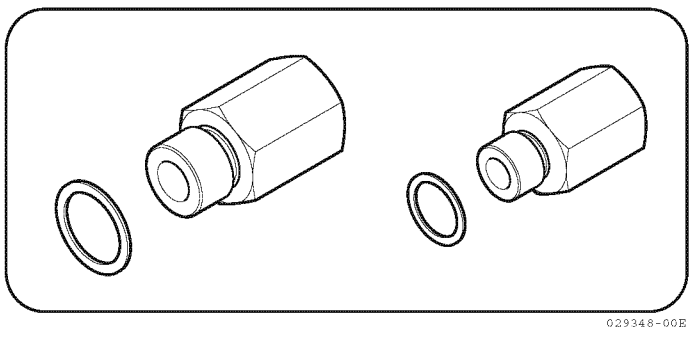


Figure 5-40

Shift Bracket Replacement

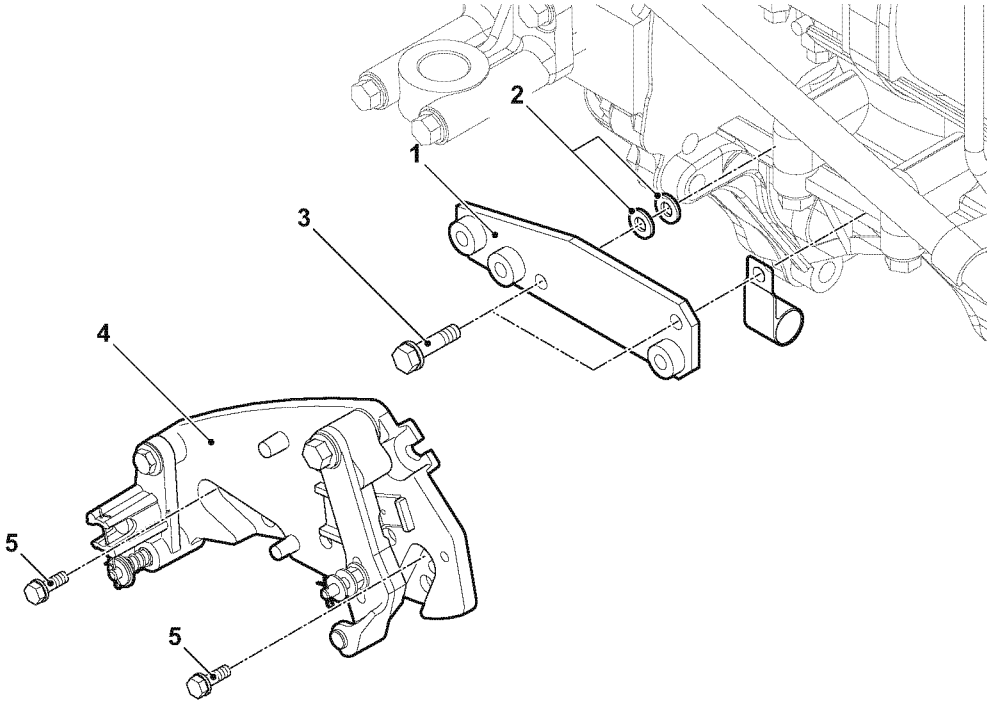
■ 6LPA-STZP2 and 6LPA-STZP3 shift bracket replacement

NOTICE

Old style shift bracket must be replaced with a new style.

Install the new shift bracket to the engine.

Shift bracket assembly (engine standard parts)

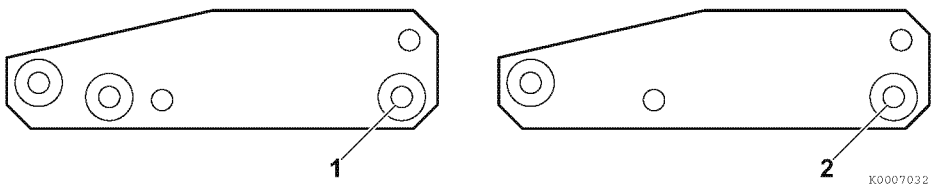


1 – Bracket, shift
2 – Washer, 8 (2 qty)
3 – Bolt, M8 x 22 (2 qty)
4 – KIT, M-shift bracket (optional)
5 – Bolt, M8 x 18 (2 qty)

Figure 5-41

The new style shift bracket uses 3 x M8 threads **(Figure 5-42, (1))**.

Different style shift brackets for Bravo and ZT370 (engine standard parts)



1 – 3 x M8 threads (new style bracket)
2 – 2 x M10 threads (older style bracket)

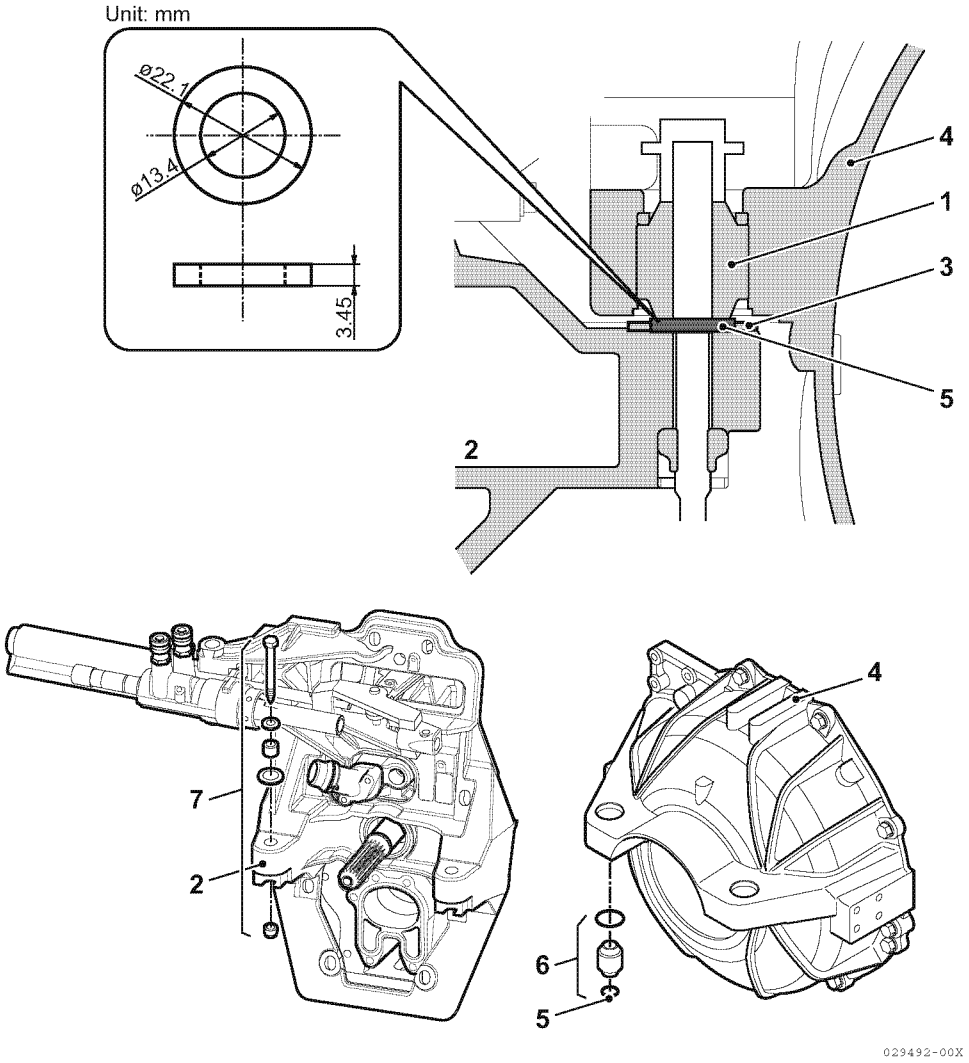
Figure 5-42

Flywheel Housing to Stern-Drive Transom Plate Spacer Installation

■ 6LPA-STZP2 and 6LPA-STZP3 spacer installation between engine flywheel housing and ZT370 stern-drive transom plate

The 6 LPA series engine up to serial number 0448 used a spacer **(Figure 5-43, (5))** between the rubber mount and the transom plate during mounting. The flywheel housing was changed and now a spacer is no longer used. The BY series and the 8LV do not use a spacer.

Engine mount



1 – Rubber mount
2 – Inner transom plate
3 – Rubber washer (act as a cushion)
4 – F.W. housing
5 – Spacer
6 – Stopper, rubber mount, and spacer (included with 6LPA engines)
7 – Bolt, washer, sleeve, rubber washer, and nut (include with drive)

Figure 5-43

Neutral Safety Switch Installation

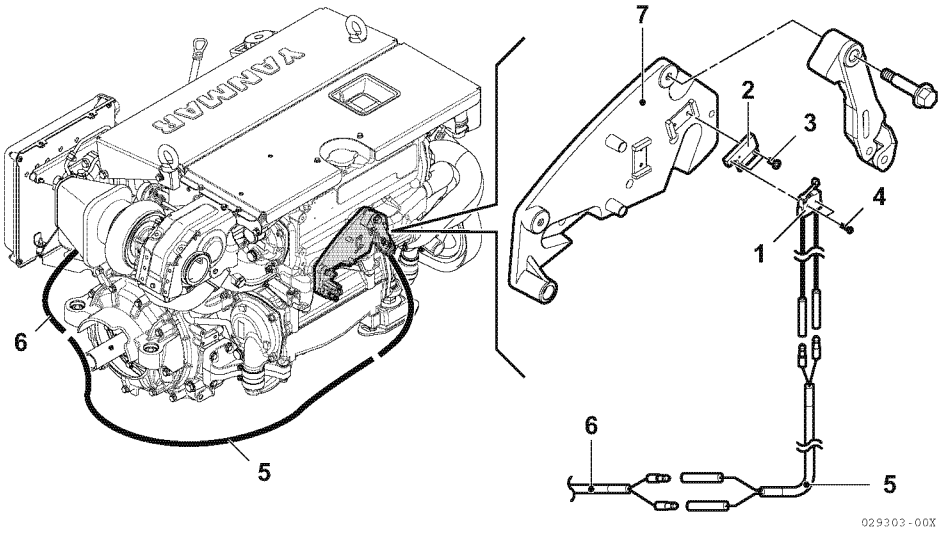
■ 4BY3-180Z, 6BY3-220Z and 6BY3-260Z neutral safety switch installation

NOTICE

Route the neutral safety switch wiring harness away from high-temperature areas of the engine.

Install the ZT370 stern-drive neutral safety switch and harness to the shift bracket. The neutral safety switch is required on the BY classic system and not required on the BY unlimited system.

Neutral safety KIT (drive optional parts)



1 – Micro switch
2 – Plate, NSP switch
3 – Screw, No. 6-32 UNC 5/16 (2 qty)
4 – Screw, M2.3 × 10 (2 qty)
5 – Cable, NSP switch
6 – Engine harness
7 – Shift bracket

Figure 5-44

The parts shown in gray are engine parts that operate at high temperature. Route the neutral safety switch wiring harness away from high temperature areas of the engine.

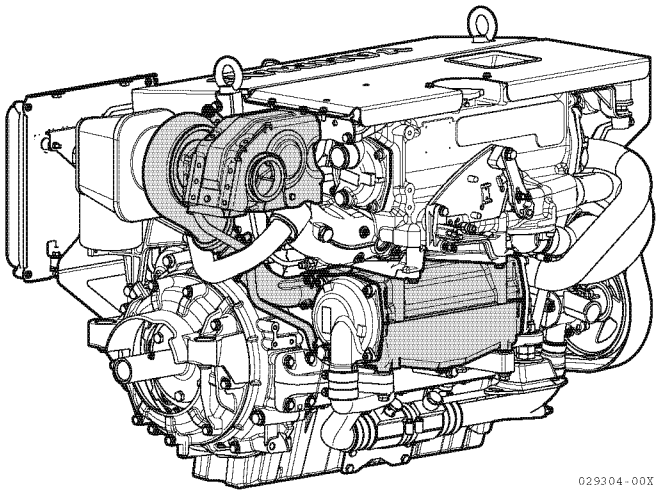
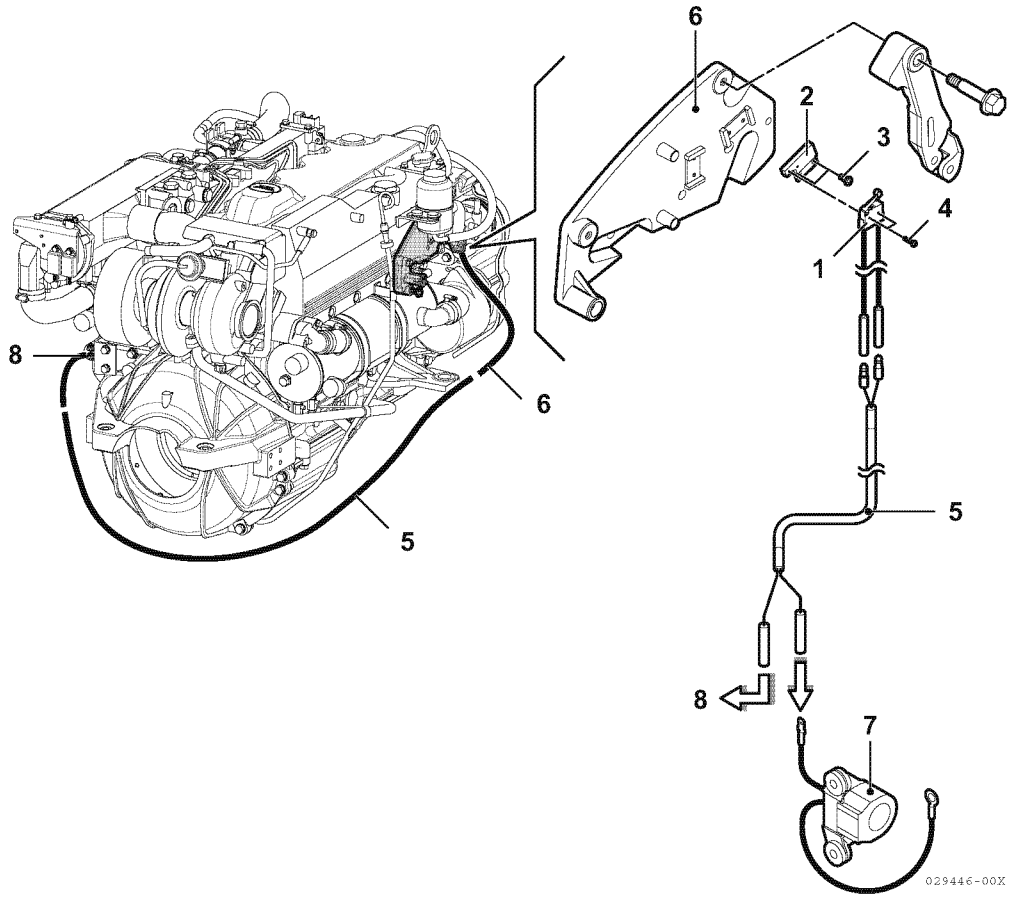


Figure 5-45

■ 6LPA-STZP2 and 6LPA-STZP3 neutral safety switch installation

Connect the neutral safety switch harness between the starter relay and the engine harness.

Neutral safety KIT (drive optional parts)



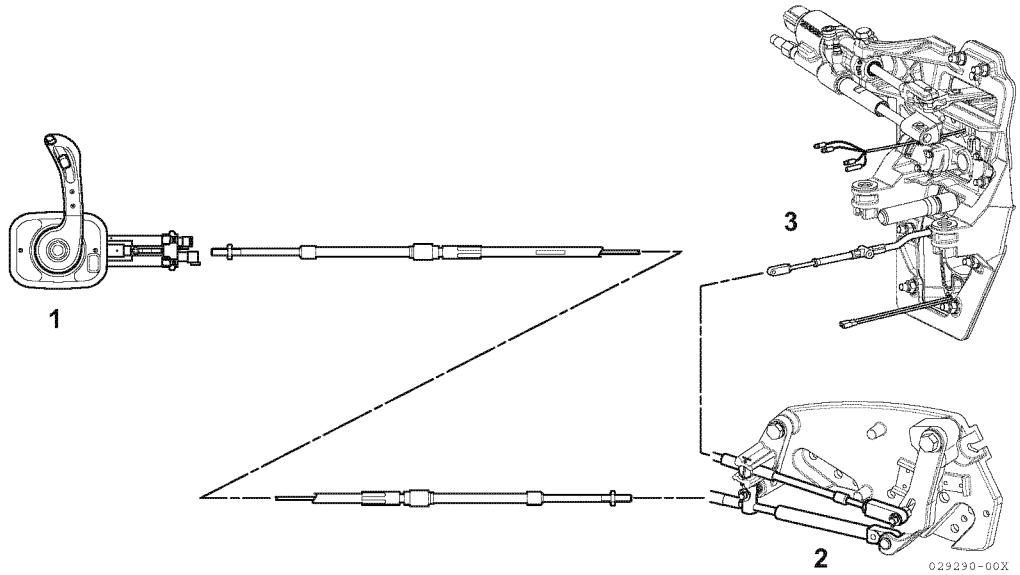
1 – Micro switch
2 – Plate, NSP switch
3 – Screw, No. 6-32 UNC 5/16 (2 qty)
4 – Screw, M2.3 × 10 (2 qty)
5 – Cable, NSP switch
6 – Shift bracket
7 – Starter relay
8 – Engine harness

Figure 5-46

Shift Cable Installation

Shift cables are available in three different lengths, 23, 26 and 31 ft. for use with 4BY3-180Z, 6BY3-220Z, 6BY3-260Z, 6LPA-STZP2 and 6LPA-STZP3 engines.

Install the shift cables from the control head to the shift bracket and drive inner transom as shown. For additional shift cable installation information, see *Shift Plate and Cable Installation and Adjustment (Mechanical Shift System) on page 5-73*.



1 – Control head
2 – Shift bracket
3 – Drive inner transom

Figure 5-47

Trim Harness Installation

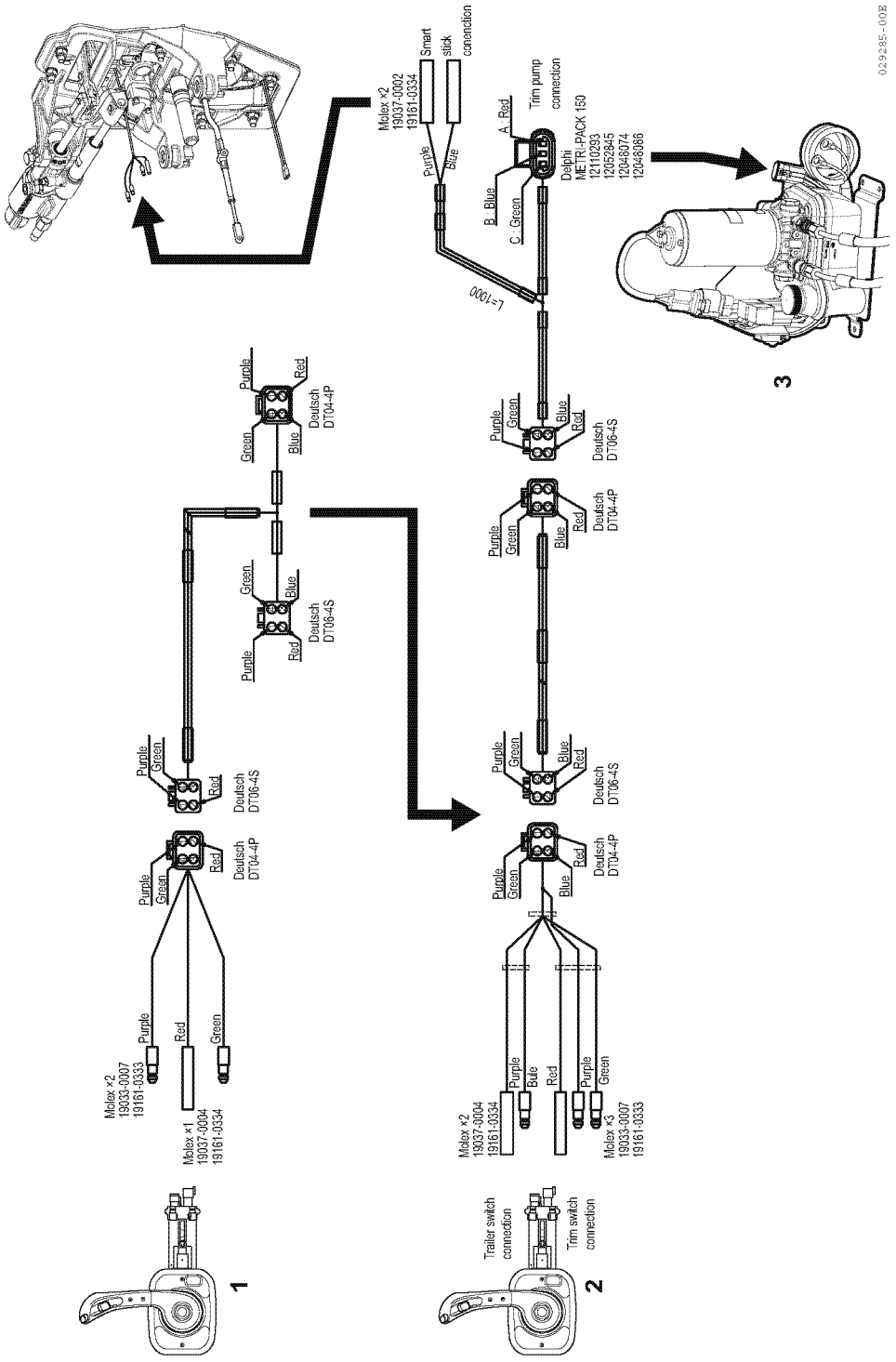
■ BY3 series, 6LPA and 8LV series trim harness installation

The trim harness CMP for the 1st station control head is available in 6 or 8 m lengths for use with shift cable lengths of 23, 26 and 31 ft.

The dual trim harness CMP for the 2nd station control head is available in 5 and 6 m lengths.

Install the trim harness between the control heads and drive inner transom as shown in **Figure 5-48**.

Refer to the Installation Manual of VCS for the 8LV series installation.



1 – Control head (at 2nd station, trim function only)
2 – Control head (at 1st station)
3 – Trim pump

Figure 5-48

Trim switch and trailer switch wire colors

Switch	Function	Control head (ex: CH18000)	Trim harness
Trim switch	Up	Blue (female)	Purple (male)
	Down	Green (female)	Green (male)
	Power	Red (male)	Red (female)
Trailer switch	Switch in	Purple (male)	Purple (female)
	Switch return	Green or white (female)	Blue (male)

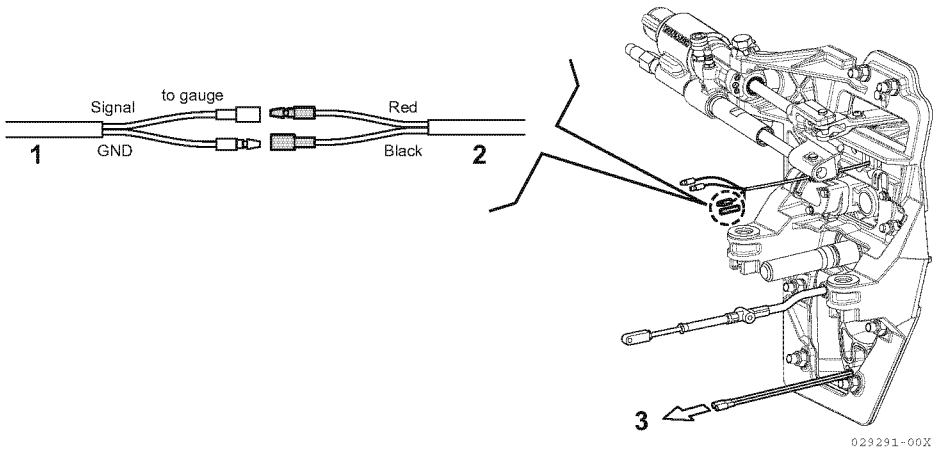
Trim harness and smart stick wire colors

Function	Trim harness	Smart stick
Switch in	Purple (female)	Green (male)
Switch return	Blue (female)	White (male)

Trim Position Sender Installation

■ BY3 series, 6LPA and 8LV series trim position sender installation

Install the wire harness between the engine and gimbal housing.



1 – From the engine harness
2 – From the gimbal housing
3 – To Y-CaPS

Figure 5-49

Wire colors for each engine harness

Harness type	Signal to gauge	Ground
BY3 with classic control system (CE500XX)	Dark blue	Black
BY3 with unlimited control system (CE50206)	Blue	Black
6LPA	Brown and white	Black
8LV	Green	Blue

NOTICE

For wiring connection to Y-CaPS, see *Y-CaPS Controller Connection on page 5-53*.

ENGINE BONDING WIRE CONNECTION

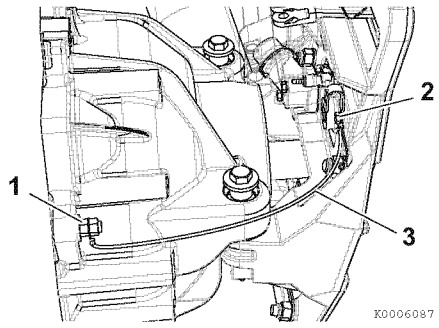
NOTICE

When routing all wire harnesses and hoses, ensure that they are routed and secured away from hot spots on the engine and away from any moving parts.

1. Connect the engine bonding wire, supplied with engine package, from the engine to the transom assembly.
2. Tighten the inner transom plate screw securely.

NOTICE

Never attach any accessory ground (-) wires to the transom plate ground point. Accessory ground wires can only be attached to the ground stud on the engine.



1 – Engine ground stud
2 – Inner transom plate grounding screw
3 – Engine bonding wire

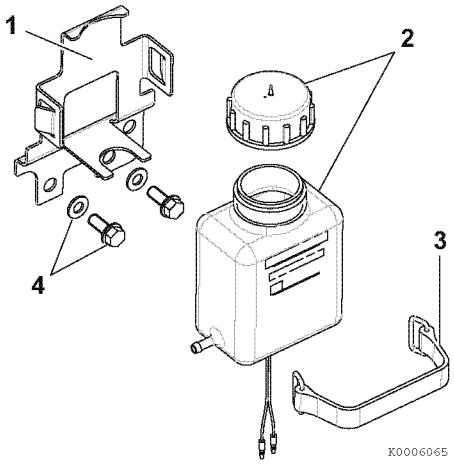
Figure 5-50

INSTALLING THE OIL RESERVOIR

NOTICE

A bracket is included to allow oil reservoir to be located on the transom. The mounting location specified must be above the steering lever on the transom assembly and above the waterline. The hose must be positioned away from moving parts such as the steering system and engine coupler.

1. Install the oil reservoir bracket in the specified location and secure with lag screws and flat washers.
2. Install the oil reservoir in the bracket. Secure the reservoir with the retaining strap.

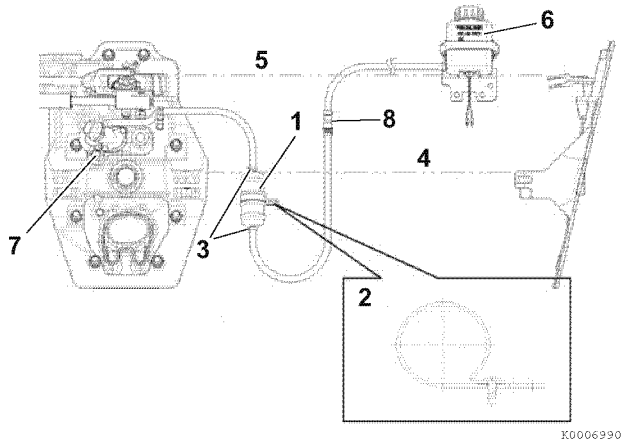


1 – Bracket (oil reservoir)
2 – Oil reservoir and cap
3 – Strap (oil reservoir)
4 – Lag screw and flat washer (obtain locally)

Figure 5-51

Installing the Air Separator Tank

Install the YANMAR-supplied air separator tank **(Figure 5-52)**. Instructions are included with the kit.

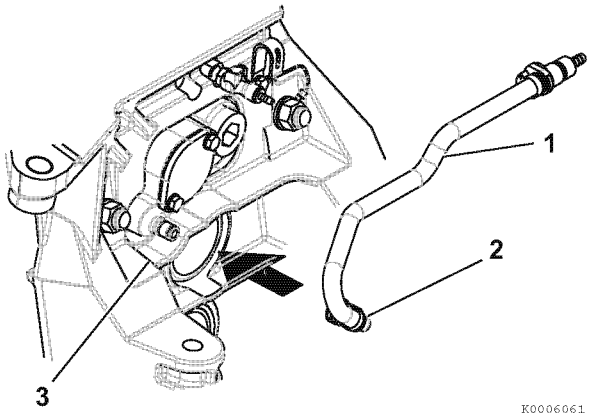


1 – Air separator tank
2 – Nylon clip
3 – Clamp (x2)
4 – Height of engine mounting foot
5 – Height of steering lever
6 – Oil reservoir tank
7 – Connector of gimbal housing
8 – Connector of hose from oil reserve tank

Figure 5-52

Connecting the Oil Reservoir Hose

1. Connect the oil reservoir hose 90° quick connector from the gimbal housing assembly to the gimbal housing fitting.



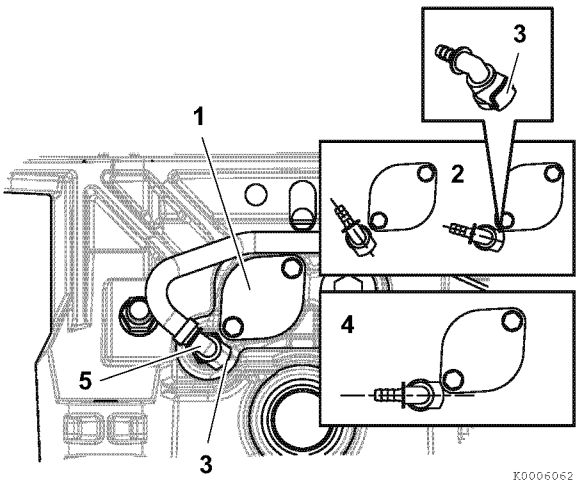
1 – Gimbal housing hose assembly
2 – 90° quick connector
3 – Gimbal housing fitting

Figure 5-53

2. Position the quick release button on the 90° hose fitting away from the seawater connector or seawater inlet plate, if equipped.

NOTICE

The release button must not contact the seawater connector or seawater inlet plate, if equipped. The quick release button on the oil reservoir 90° hose fitting may not lock fully on the gimbal housing fitting if the button is touching or depressed by the seawater connector or seawater inlet plate, if equipped. Failure to do so may result in a loose 90° fitting, loss of gear lube and drive unit damage.



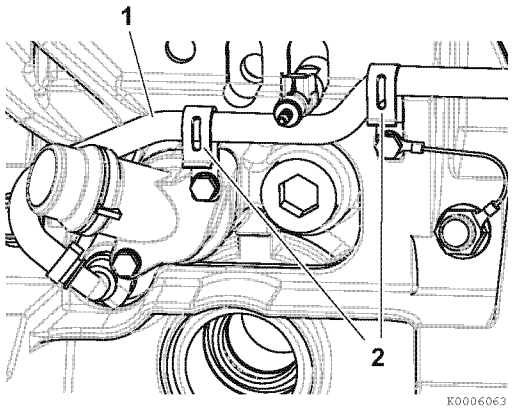
1 – Seawater inlet plate
2 – Acceptable positions
3 – Quick release button
4 – Not acceptable position
5 – 90° quick connector

Figure 5-54

NOTICE

Reservoir oil hose leakage may cause stern-drive damage. Do not allow the oil hose to contact any moving parts, such as steering system components, the engine coupler or the drive shaft. Secure the oil hose with clamps or J-clips to prevent damage.

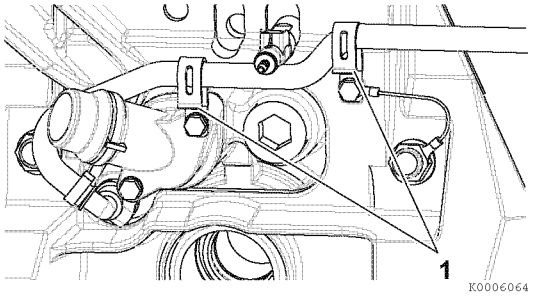
3. The oil reservoir hose assembly can be routed toward the port side of the engine.
4. Secure the hose assembly at the top side of the seawater connector or seawater inlet plate using the hose J-clip.



1 – Oil reservoir hose
2 – Hose J-clip

Figure 5-55

5. Secure the oil reservoir gimbal housing hose assembly with J-clips on the transom plate.



1 – J-clips

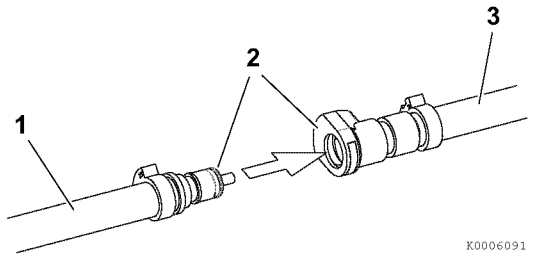
Figure 5-56

6. Temporarily position the hose out of the way until connection is completed after engine installation.

NOTICE

- If the oil reservoir hose is kinked, the reservoir will not function properly and damage to the drive unit will occur. Ensure the oil reservoir hose is not kinked when connected.
- Avoid using excessive hose length when routing the oil hose to the oil reservoir. The hose should be routed as straight and directly as possible, to avoid low spots (traps) in the system.

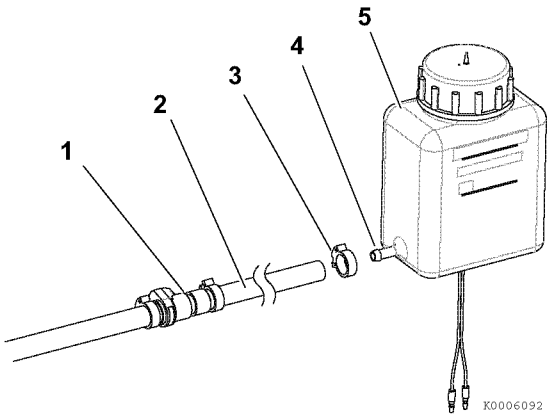
7. Install the YANMAR-supplied air separator tank. Instructions are included with the kit.
8. Locate the white oil reservoir quick connect at the rear of the engine.
9. Ensure the oil reservoir hose is mounted in the J-clip on the transom plate.



1 – Oil reservoir hose assembly
2 – Quick connect fitting (male and female quick connect fittings have check valve)
3 – Gimbal housing hose assembly

Figure 5-57

10. Connect the quick connect fitting between gimbal housing hose assembly and the oil reservoir hose assembly.



1 – Quick connect (if equipped)
2 – Oil reservoir hose
3 – Clamp
4 – Fitting
5 – Oil reservoir

Figure 5-58

11. Route the oil reservoir hose to the oil reservoir.
12. If necessary, cut the oil reservoir hose to the correct length at the oil reservoir.

NOTICE

The oil reservoir connection fitting contains a check valve. If the hose is shortened, the original check valve fitting must be reused.

13. Connect and securely clamp the oil reservoir hose to the oil reservoir fitting.

NOTICE

Never let the oil reservoir hose come in contact with the steering system components, the engine coupler or the drive shaft.

14. Secure the oil reservoir hose with cable ties.

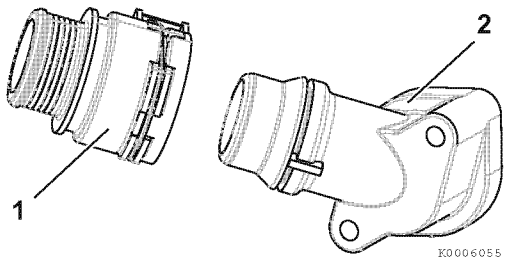
SEAWATER PICKUP INSTALLATION

Drive Unit Seawater Pickup

Seawater for engine cooling is supplied through the drive unit as standard equipment design and is also the recommended method of cooling. An alternative cooling method is also available; see *Alternate Seawater Pickup on page 5-50* for additional information.

When using the drive unit for engine cooling seawater supply, a quick connect seawater hose fitting is included in the engine loose parts.

Note: On 6LPA engine installations the bell housing will interfere with the seawater pickup and will require modification. Modification instructions are available separately.

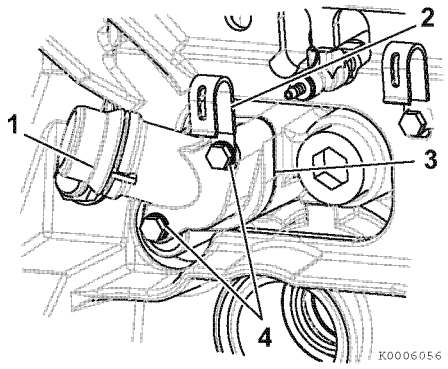


1 – Seawater hose fitting
2 – Seawater connector

Figure 5-59

1. Install the fitting connector gasket.
2. Install the seawater connector.
3. Install J-clip if oil reservoir hose assembly will be routed to the port side.
4. Install the lock washers and seawater connector bolts.
5. Torque the bolts.

Seawater inlet fitting bolt torque	
N·m	**lb-in.**
6	53



1 – Seawater connector
2 – J-clip
3 – Connector gasket
4 – Bolt and lock washer

Figure 5-60

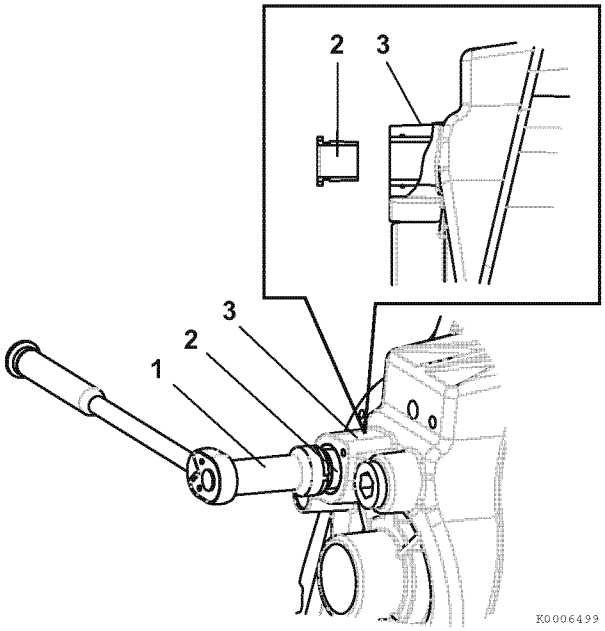
Alternate Seawater Pickup

Seawater for engine cooling can be supplied through an alternate (separate) seawater pickup and not through the drive unit. When using a separate seawater pickup, it is necessary to cover the drive unit seawater passage and to cut the water line inlet in order to circulate seawater through the drive unit for cooling. ***The hose must be cut as recommended;*** see *Modifying the Inlet Water Hose on page 5-52*.

NOTICE

- Installation of a water inlet cover plate will make it necessary to provide an alternate seawater pickup and related hardware. Depending upon application and boat configuration, a through-the-hull or through-the-transom seawater pickup must be used.
- Avoid overheating the drive unit. The drive unit water inlet holes must be allowed to flow water without being obstructed, or overheating damage to drive unit may result. Never dead-end the water hose from the bell housing.

1. Use the hose insert tool to remove the insert from the gimbal housing.

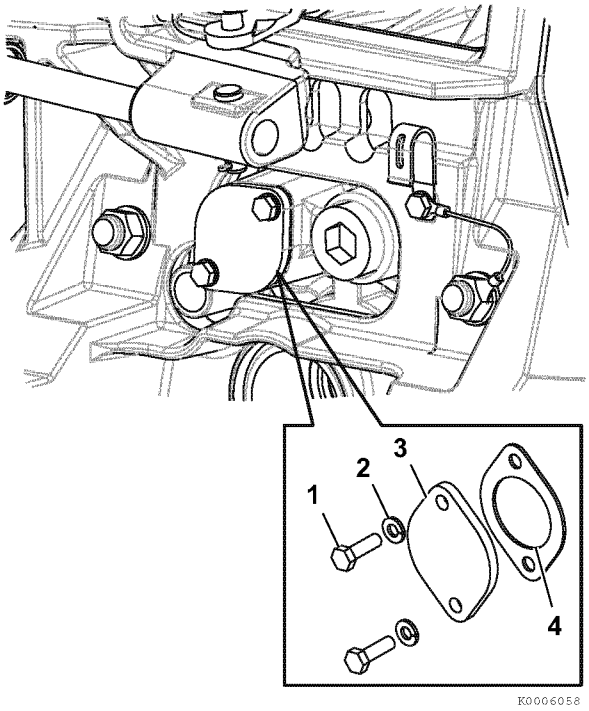


1 – Hose insert tool (P/N: 196350-92220)
2 – Insert
3 – Gimbal housing

Figure 5-61

2. Lift the drive bellows and pull the hose out from upper position.
3. Install the seawater inlet plate using a new gasket.
4. Install the lock washers and plate bolts.
5. Torque the bolts.

Seawater inlet plate bolt torque	
N·m	**lb-in.**
6	53



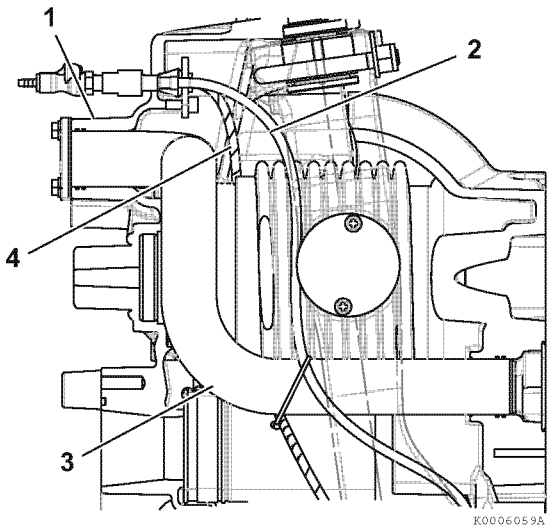
1 – Bolts
2 – Lock washer
3 – Seawater inlet plate
4 – Gasket

Figure 5-62

6. Modify and cut the inlet water hose; see *Modifying the Inlet Water Hose on page 5-52*.

Modifying the Inlet Water Hose

Note: This procedure is only required when using the alternate seawater pickup.



1 – Gimbal housing
2 – Speedometer hose
3 – Water hose
4 – Trim sender limit switch wires

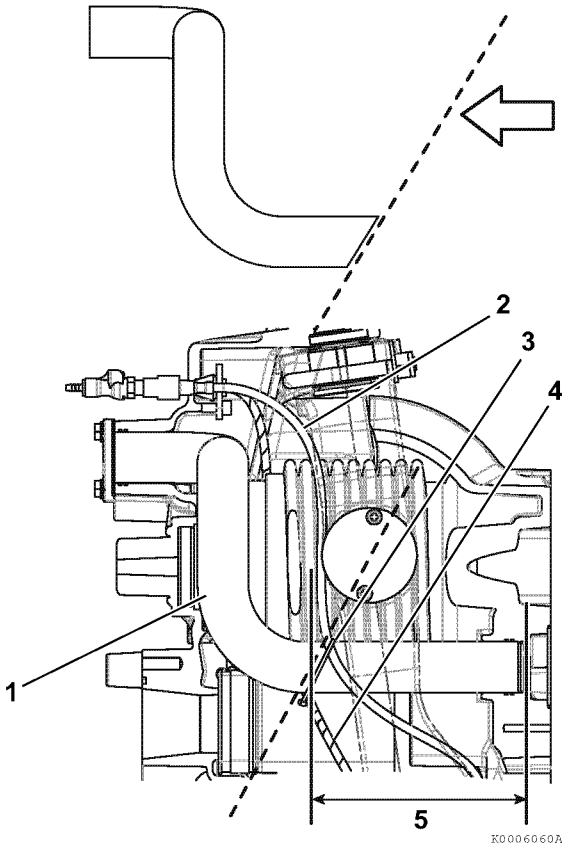
Figure 5-63

NOTICE

- Avoid water leaking into the boat. Damage to U-joint bellows could result from water entering the boat. Do not damage the U-joint bellows when removing the section of the water hose attached between the gimbal housing and bell housing.
- Move the trim sender limit switch wires and speedometer hose to avoid damaging them when cutting the inlet drive shaft water hose. The existing tie strap and clip can be reused if they are moved and repositioned after the hose is cut.

---

1. Cut completely through the inlet water hose 127 mm (5.0 in.) in front of the aft end of the hose where it is fitted into the bell housing. Do not damage the U-joint bellows.
2. Discard the loose upper hose piece.
3. Secure the trim sender limit switch wires and speedometer hose to the remaining section of water hose using the existing tie strap and clip.



1 – Water hose
2 – Speedometer hose
3 – Clip
4 – Trim sender limit switch wires
5 – Measurement: 127 mm (5.0 in.)

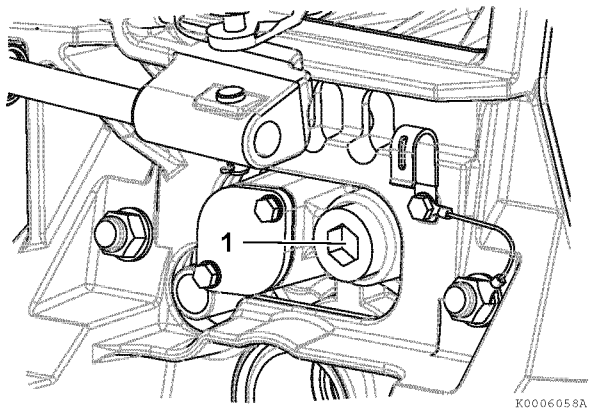
Figure 5-64

Installing the Bypass Return Seawater Plug

NOTICE

On ZT-LP models it is mandatory to bypass part of the return seawater either through the drive or through the stern fitting to avoid high back pressure.

1. Remove the hex plug.



1 – Hex plug

Figure 5-65

2. Apply sealant to the threads of the bypass hose fitting. The fitting is supplied in the ZT-LP kit.
3. Tighten the bypass hose fitting using a 150 mm (5.90 in.) bar inserted into the fitting.
4. Hand tighten securely until an upward position of 30° is reached.

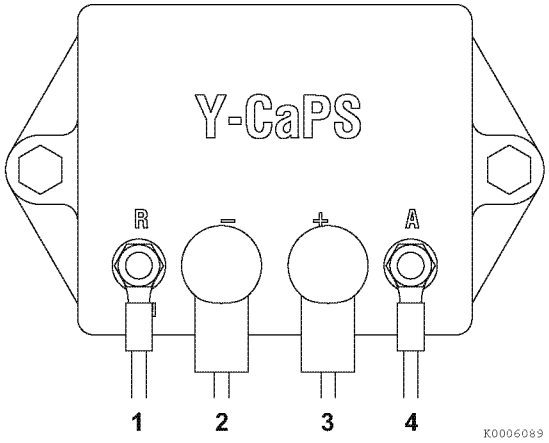
Y-CAPS CONTROLLER CONNECTION

(Cathodic protection system)

1. Connect the wires to the Y-CaPS controller assembly.

NOTICE

The opposite end of the red wire and black wire must be connected directly to the battery terminals. Never connect them to a switched circuit. The Y-CaPS system must function continuously to provide proper corrosion protection.

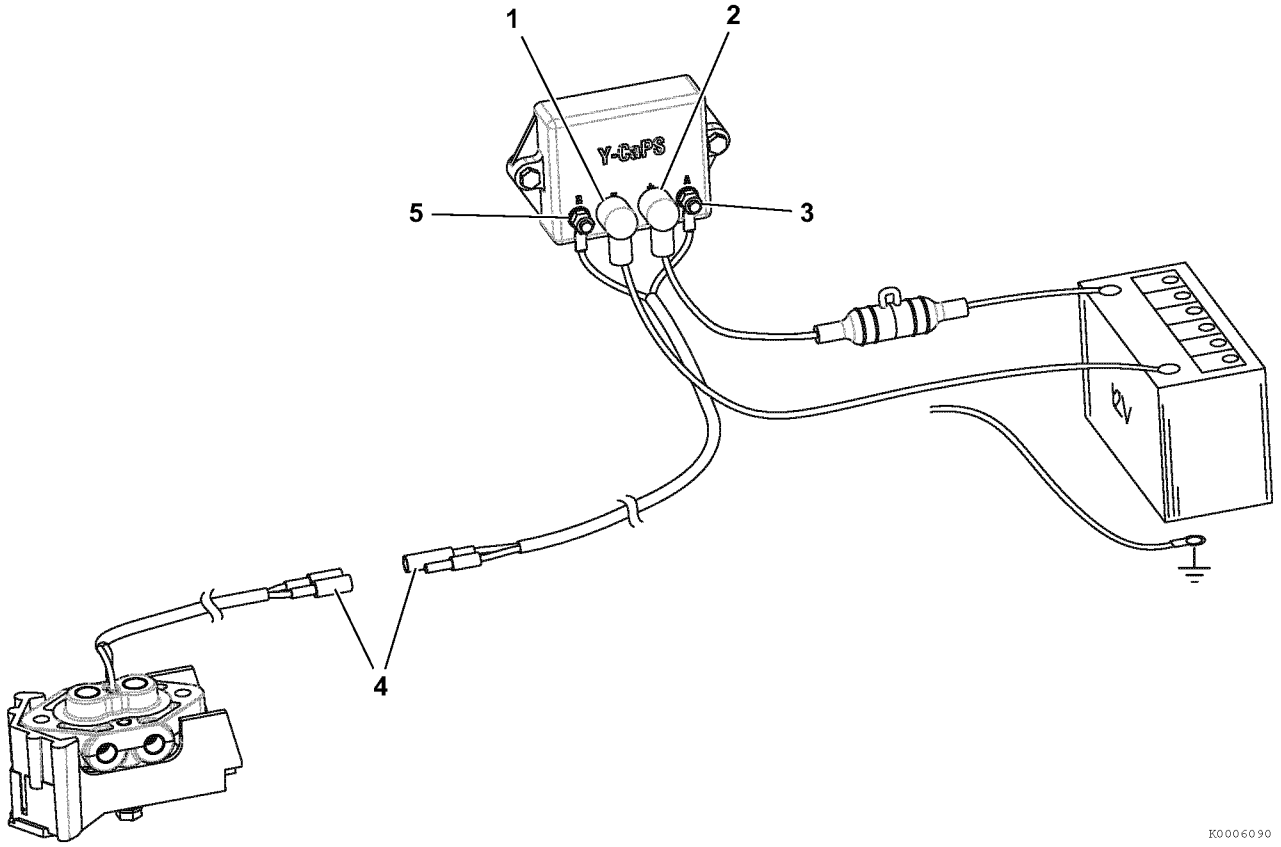


1 – Brown wire - from the electrode on the transom assembly.
2 – Black wire - from the engine harness, if equipped, or to the negative (-) battery terminal.
3 – Red wire - connect (other end) to the positive (+) battery terminal.
4 – Yellow wire - from the anode on the transom assembly.

Figure 5-66

2. Connect wires to the Y-CaPS electrode.
3. Apply a thin coat of sealant to all wire connections.

Liquid type neoprene or silicon sealant	
Where used	**Part number**
Electrical connections	Obtain locally



1 – Black wire - from the engine harness, if equipped, or to the negative (-) battery terminal.
2 – Red wire - to the positive (+) battery terminal.
3 – Yellow lead - from the anode on the transom assembly.
4 – Y-CaPS electrode connector
5 – Brown wire - from the electrode on the transom assembly.

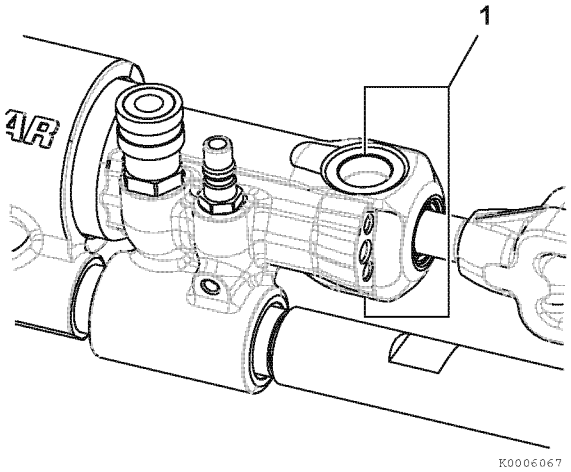
Figure 5-67

INSTALLING THE STEERING SYSTEM

Note: For dual installations the power steering unit can be mounted on the port or starboard transom assembly. Many OEM vessel manufacture's prefer starboard side power steering unit installations.

Before installation, measure the exact distance between stern-drive centerlines and always use the proper type tie bar *(see Internal and external tie bar on page 62)*.

1. Inspect the bushings for debris.
2. Lubricate the power steering bushings.

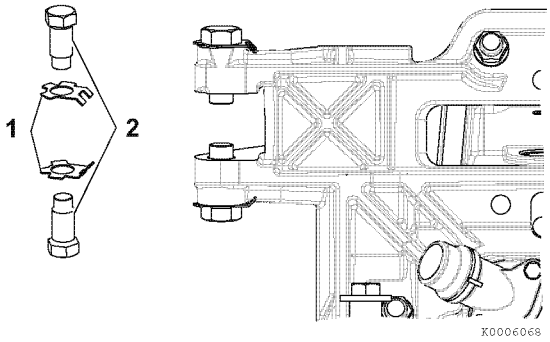


1 – Power steering bushings

Figure 5-68

UREA grease water resistant type NLGI #2	
Where used	**Part number**
Power steering bushings	Obtain locally

3. Remove the upper and lower pivot bolts and lubricate the threads liberally.

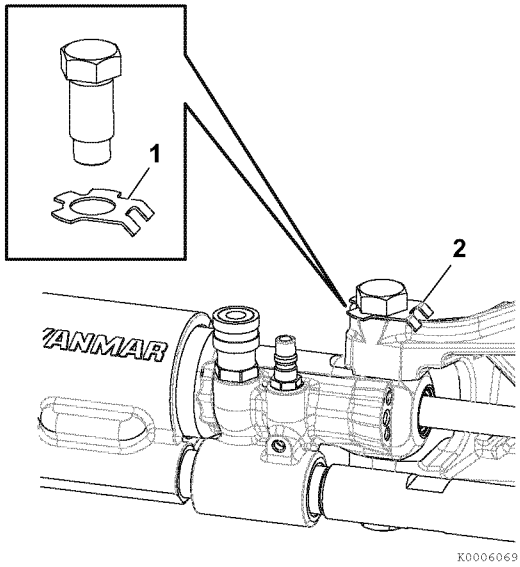


1 – Lock tab washers
2 – Upper and lower pivot bolt

Figure 5-69

UREA grease water resistant type NLGI #2	
Where used	**Part number**
Upper and lower pivot bolts	Obtain locally

4. Position the steering assembly so that the pivot bolts will fit in the bushings in the power steering cylinder.
5. Install the upper and lower pivot bolts along with the lock tab washers. Ensure that the lock tab washer tabs straddle the ridge on the inner transom plate. The upper pivot bolt and tab washer are shown in **Figure 5-70**; the lower pivot bolt and tab washer are similar.



1 – Locking washer tang
2 – Ridge

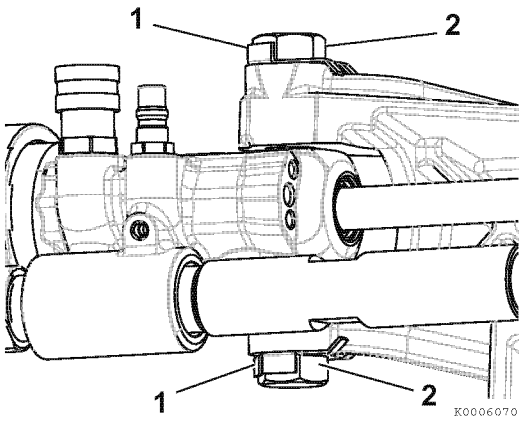
Figure 5-70

6. Turn the pivot bolts all the way in by hand. Ensure that the steering assembly pivots freely.
7. Torque the pivot bolts.

Upper and lower pivot bolt torque	
N·m	lb-ft
35	26

8. Bend the locking washer tabs against the corresponding flats on the bolt heads.

   Note: If required, slightly tighten the pivot bolts to align the flats on bolt head with the tabs on the washer.



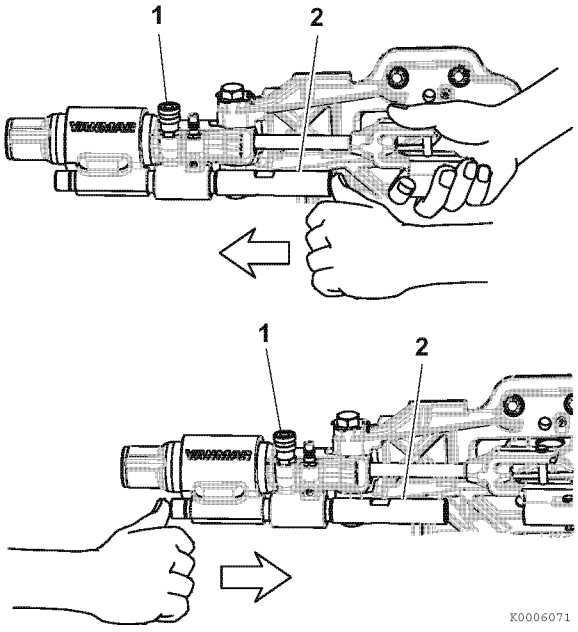
1 – Bent tab
2 – Pivot bolt

Figure 5-71

⚠ WARNING

Exposure Hazard

Moving the spool barrel cable guide tube with the hoses disconnected will leak fluid from the ports. Wear eye protection while moving the spool barrel cable guide tube in the directions shown in Figure 5-72. It will be less difficult to pull it out or push it in during the following installation steps.

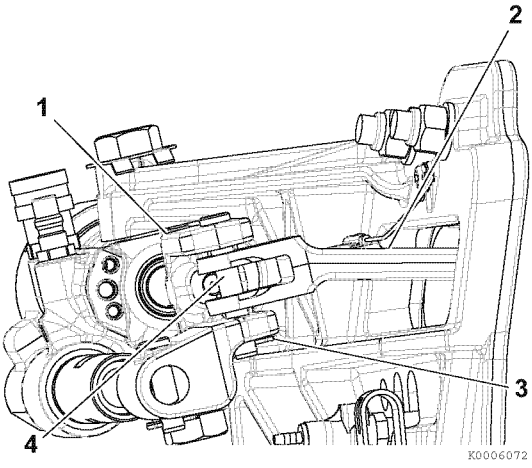


1 – Port
2 – Spool barrel cable guide tube

Figure 5-72

9. Connect the clevis to the steering lever.
10. Lubricate the clevis pin. Spread both ends of the clevis pin.

    *Note: Insert the clevis pin from the top and rotate the pin to ensure that the cotter pin hole is as shown in **Figure 5-73**.*



1 – Clevis
2 – Steering lever
3 – Cotter pin
4 – Clevis pin

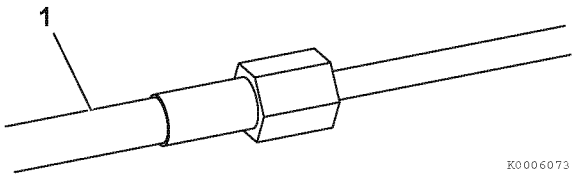
Figure 5-73

UREA grease water resistant type NLGI #2
Where used
Clevis pin

⚠ WARNING

Steering Control Hazard

The steering cable and outer casing must move freely for the steering system to function properly. Never fasten any items to the steering cable and/or the outer casing.



1 – Steering cable and outer casing

Figure 5-74

Power Steering Hoses

⚠ WARNING

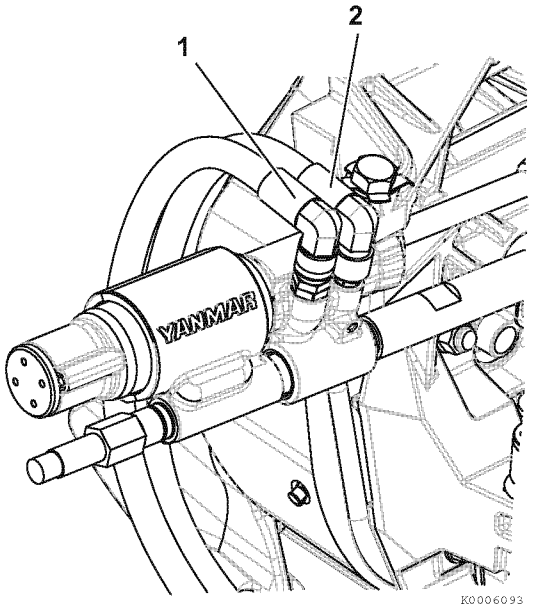
Steering Control Hazard

Route the hydraulic hoses to avoid extreme heat, stress on the hose fittings and/or hose kinks. Never let the hoses come in contact with the steering system components, the engine coupler, the U-joint shaft or the drive shaft. Secure the hoses to avoid contact with hot or moving components.

1. Attach both hydraulic hose fittings to the steering control valve.
2. Ensure that the quick connect fittings are securely engaged.

   Note: When installing the ZT370 stern-drive on a repower installation, existing hydraulic hoses may be threaded. Use adapters to connect with the quick connect fittings of ZT370.

3. Position the hoses as shown in **Figure 5-75**.



1 – Return hose
2 – Pressure hose

Figure 5-75

Steering Helm and Cable

The stern-drive is shipped with the steering cable guide preset for cables with end dimensions that comply with ABYC standards, as outlined in the NMMA certification handbook. YANMAR recommends using a steering cable with a coupler nut. There must also be a means of locking it to the guide tube as specified in the ABYC requirements.

⚠ WARNING

Steering Control Hazard

Be sure the steering cable is properly locked into place. Failure to use a steering cable locking device could cause a loss of steering control.

YANMAR recommends using the steering cable with a self-locking coupler nut.

Use an external locking device if using a steering cable that does not have a self-locking coupler nut.

Steering Cable Specifications

⚠ WARNING

Steering Control Hazard

(Power steering units only) - Be sure the steering cable is properly installed. If the steering cable is installed with improper dimensions, it may cause severe damage to the transom assembly and/or steering system.

NOTICE

Never attempt to adjust the cable guide tube on the power steering unit, as the guide tube and locknut have been torqued (with Loctite®) at the factory, and an attempt to loosen nut or tube may result in damage to tube.

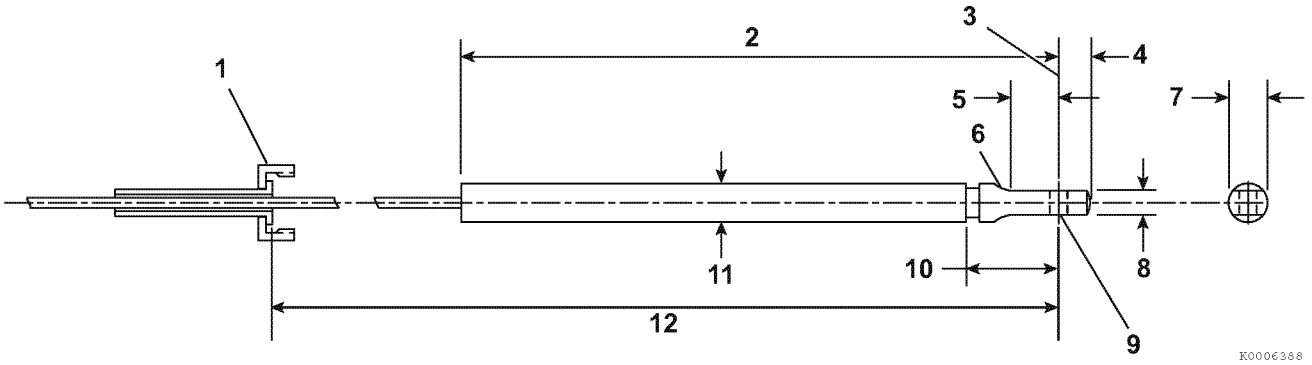
Ensure that the steering cable is the correct length, particularly when installed in larger boats.

Route the cable, avoiding any sharp bends, kinks or loops.

Use the following illustration to determine the cable end dimension when the power steering cable is fully extended.

NOTICE

Power steering pump lugging (squealing) in a hard right turn (against the lock) may mean that the steering cable has been installed using incorrect dimensions.



1 – Coupler/nut - 7/8 UNF - 28 thread
2 – 298 mm (11 - 3/4 in.) minimum
3 – Interface point
4 – 12.7 mm (1/2 in.) maximum
5 – 10.7 mm (27/64 in.) minimum flat
6 – 3.1 mm (7/64 in.) minimum radius
7 – 15.9 mm (5/8 in.) maximum diameter end fitting
8 – 9.5 mm (3/8 in.)
9 – 9.8 mm (3/8 in.) diameter through hole (chamfered each side)
10 – 1-3/8 in. (34.9 mm) maximum
11 – 15.9 mm (5/8 in.) diameter tube
12 – Cable travel:
Mid-travel position - 429 mm (16-7/8 in.)
Total travel to be 203 mm (8.0 in.) minimum to 228 mm (9.0 in.) maximum.
Travel each side of mid-travel position - 102 mm (4.0 in.) minimum, 114 mm (4-1/2 in.) maximum.

Figure 5-76

Installation of Steering Cable

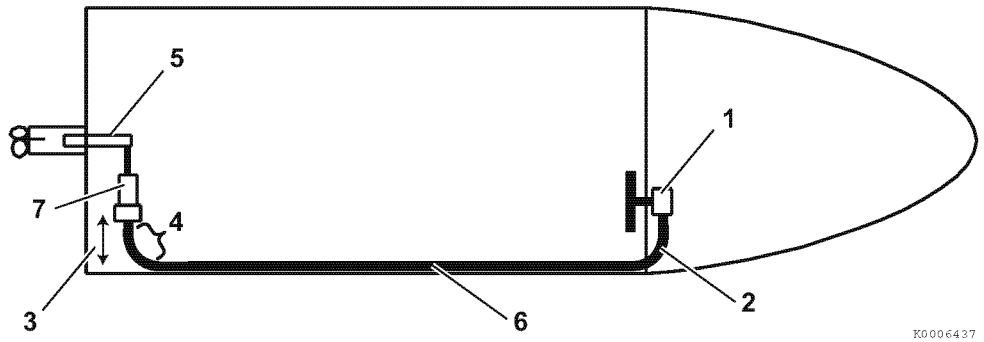
When installing the steering cable **(Figure 5-77, (6))** between the rotary or rack helm **(Figure 5-77, (1))** and the steering lever of the stern-drive **(Figure 5-77, (5))**, use the following specifications:

- Never exceed a 20 cm (8.0 in.) radius bend in the cable **(Figure 5-77, (2)).**
- Keep ±25 mm (±1.0 in.) free motion of cable and power steering valve **(Figure 5-77, (3))** and be sure to prevent any interferences with other objects.
- Never tie down or clamp the steering cable within 90 cm (3 ft) of the power steering cylinder **(Figure 5-77, (4))**.

⚠ WARNING

Steering Control Hazard

Be sure the steering cable is correctly installed. Verify that all cable bends, free motion of cable housing and restraints of the cable are within specifications. Incorrect installation of the steering cable could result in erratic steering or loss of steering control.



1 – Rotary or rack helm
2 – Minimum 20 cm (8.0 in.) bend radius
3 – Plus or minus 25 mm (1.0 in.) free motion of cable housing and power steering valve.
4 – Never tie down or clamp within 90 cm (3 ft) of the power steering cylinder.
5 – Steering lever
6 – Steering cable
7 – Power steering cylinder

Figure 5-77

Connecting the Steering Cables

1. Coat the steering cable end with a liberal amount of grease.
2. Install the steering cable and secure with hardware as shown in **Figure 5-78**.

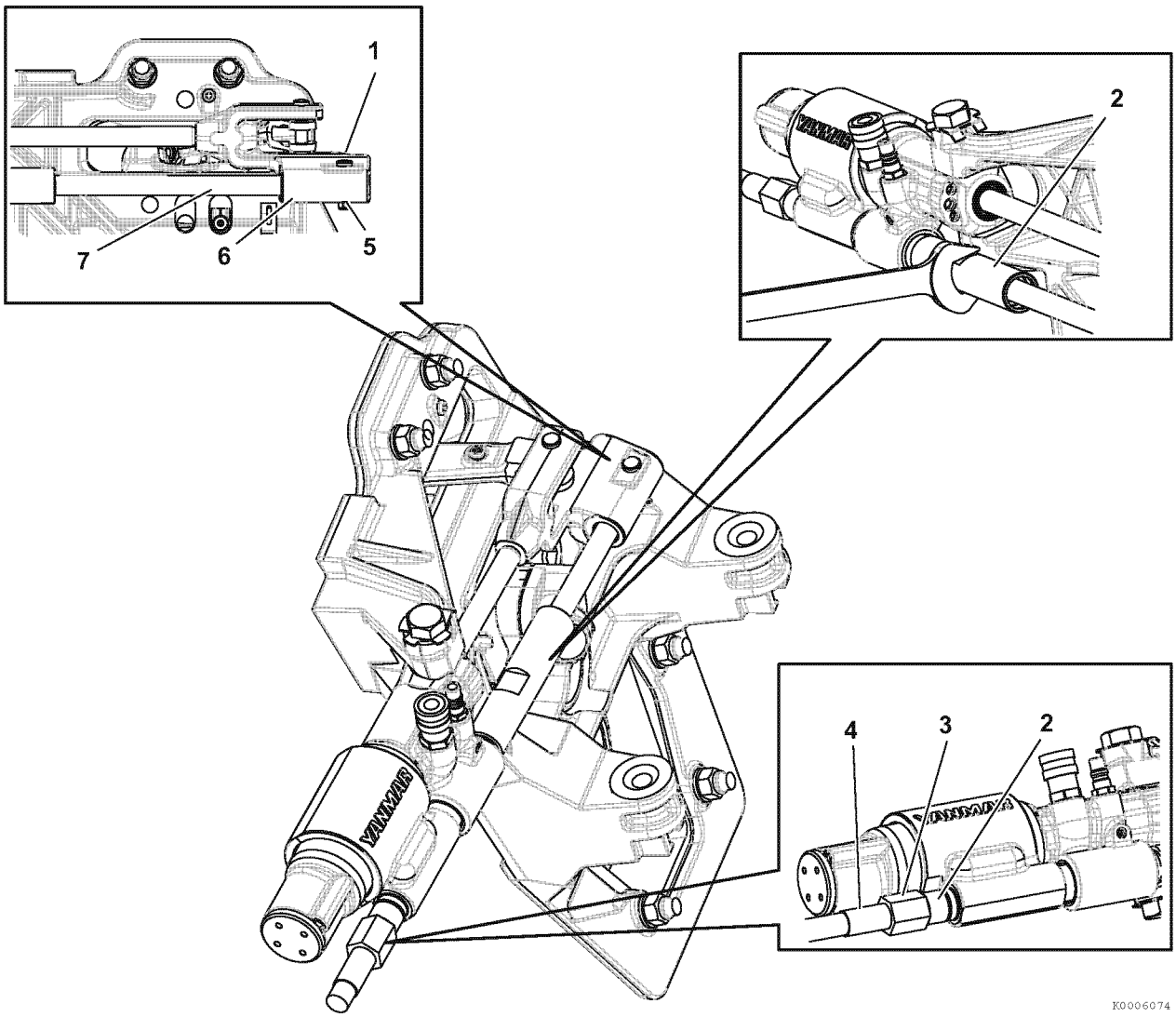
NOTICE

The flat surfaces of the spool barrel cable guide tube must be positioned horizontally to prevent feedback in the steering system.

3. Use a wrench to hold the flat surfaces of the spool barrel cable guide tube horizontally.
4. Torque the coupler nut. Ensure that the flat surfaces are still aligned horizontally after torque is applied to the coupler nut.

UREA grease water resistant type NLGI #2
Where used
Steering cable end

Cable coupler nut torque	
N·m	**lb-ft**
45	33



1 – Clevis pin
2 – Spool barrel cable guide tube
3 – Cable coupler nut
4 – Steering cable
5 – Cotter pin
6 – Clevis
7 – Steering cable end

Figure 5-78

Steering Tie Bar Considerations

⚠ WARNING

Steering Control Hazard

Be sure the tie bar is properly installed. Failure to observe the recommended tie bar arrangements could result in serious damage to the steering and/or power trim system components. This damage could cause loss of steering control.

NOTICE

The use of multiple stern-drives requires a careful consideration of the type of steering system that should be used.

■ Internal tie bar only

This system is recommended for vessels that operate at speeds up to 50 knots (58 mph).

It is a direct connection between the slave stern-drive and the stern-drive that is directly connected to the factory power steering output. This internal tie bar is available in a variety of lengths from YANMAR. For additional information, contact your YANMAR dealer or distributor.

■ Internal tie bar installation (optional)

Pre-trim adjustment

The ability to adjust pre-trim on twin drive applications allows for greater boat control and stability at higher speeds. Pre-trim effectively sets the drives closer together, compared to parallel position.

Note • *Pre-trim should be decided in relation to the shape of the V-hull.*

• *Increasing the internal tie-bar length by 1.5 cm (0.59 in.) results in the propellers moving approximately 4 cm or more closer to each other.*

• *Pre-trim is often adjusted to 1.5 to 2 cm (0.59 to 0.78 in.), as a starting point.*

■ Internal and external tie bar

⚠ WARNING

Steering Control Hazard

When using an internal power steering system, YANMAR does not recommend the use of an external tie bar by itself. This can cause excessive loads on the steering components and may result in an increase of the play in boat steering.

This system is recommended for vessels that operate at speeds from 50 to 60 knots (58 to 69 mph) or for the benefit of reduced steering backlash.

Usually, external tie bars are attached at the aft power trim cylinder bosses, but if one drive is trimmed differently than the other, undue stress on the system is introduced. For this reason, dual trim control equipment should be installed to limit the tilt differential between the two drives to 20°.

■ External power steering with an external tie bar

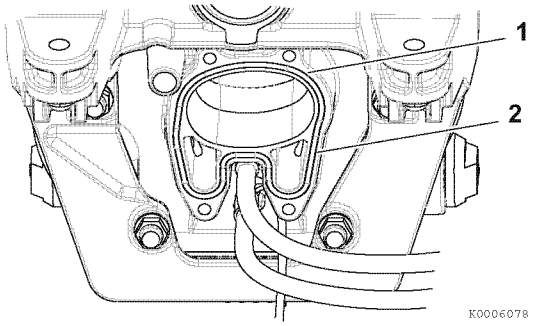
This system is recommended for vessels that operate at speeds of 70 knots (80 mph) or greater or for the ultimate in reduced steering backlash. This system does not use an internal tie bar, but requires dual trim control equipment. *See Internal and external tie bar on page 5-62.*

EXHAUST OPTIONS

Through-the-Propeller Exhaust

NOTICE

To prevent water and/or exhaust from entering the boat, the exhaust tube and the gimbal housing mating surfaces must be clean and free of nicks and scratches. The O-ring must be in good condition and properly seated in the groove.

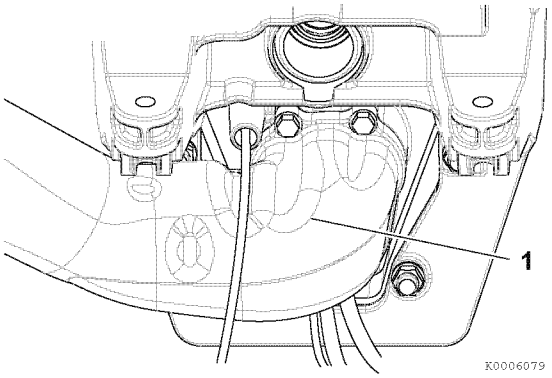


1 – Gimbal housing exhaust tube mating surface
2 – O-ring

Figure 5-79

Install the engine exhaust tube as shown in **Figure 5-80**.

Note: The engine exhaust tube (also called bullhorn) must be installed before engine installation.



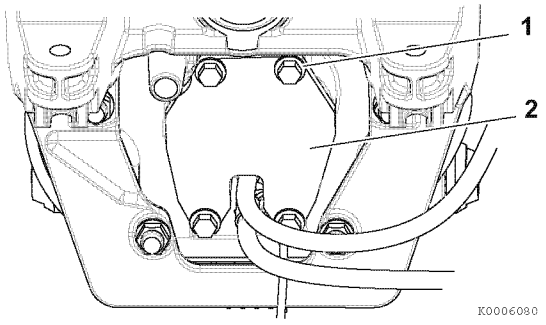
1 – Engine exhaust tube

Figure 5-80

Exhaust tube bolt torque	
N·m	**lb-ft**
30	22
Apply “blue” loctite to bolt threads	

Alternate Exhaust System

1. Install the exhaust block-off plate as shown in **Figure 5-81**, using the four bolts and lock washers.
2. Torque the cover plate bolts.



1 – Bolts and lock washers
2 – Exhaust block-off plate

Figure 5-81

Exhaust block-off plate bolt torque	
N·m	**lb-ft**
30	22
Apply “blue” loctite to bolt threads	

POWER TRIM SYSTEM

Control System

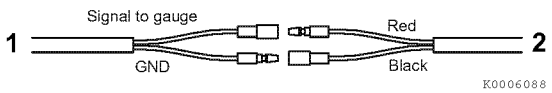
Use the appropriate control panel or in-handle trim control arrangement (Teleflex controls, etc.) with the power trim system. Install the trim control according to the instructions included with the power trim system.

Trim Position Sender Connection

Connect the trim position sender leads from the gimbal housing to the leads from the engine harness.

Engine		Shift	Signal	GND
4/6BY3	Classic	Mechanical	Dark blue	Black
	Unlimited	Electrical	Blue	Black
6LPA		Mechanical	Brown/white	Black
8LV		Electrical	Green	Blue

Confirm wiring colors when connecting wires. If connections are incorrect, the trim gauge will not work.



1 – From the engine harness. (Refer to the appropriate *Engine and Control System Installation Manual.*)
2 – From the gimbal housing.

Figure 5-82

Installing the Power Trim Pump

Select a mounting location for the trim pump that meets the following requirements:

- Within length limits of the hydraulic hoses coming from gimbal housing assembly
- Close to the battery so that the trim pump battery leads can be connected
- Easily accessible to trim pump oil fill and vent locations
- In an area where the pump will not be exposed to water

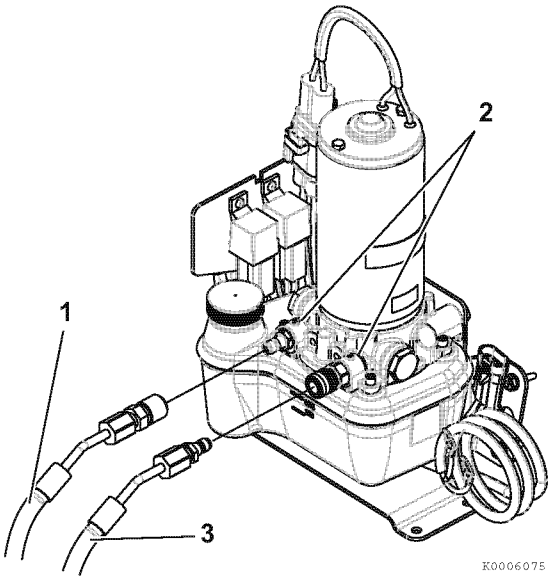
Note: The pump can be installed below waterline.

- Prevent the power assist steering cylinder from coming in contact with the trim pump when the steering wheel is turned to the limit in either direction.

1. Mount the pump in the selected position.

   Note: Make hydraulic connections as quickly as possible to prevent oil from leaking out of the system.

2. Connect the hydraulic hoses to the trim pump. Ensure that the quick connect fittings completely seat when connecting the hoses.

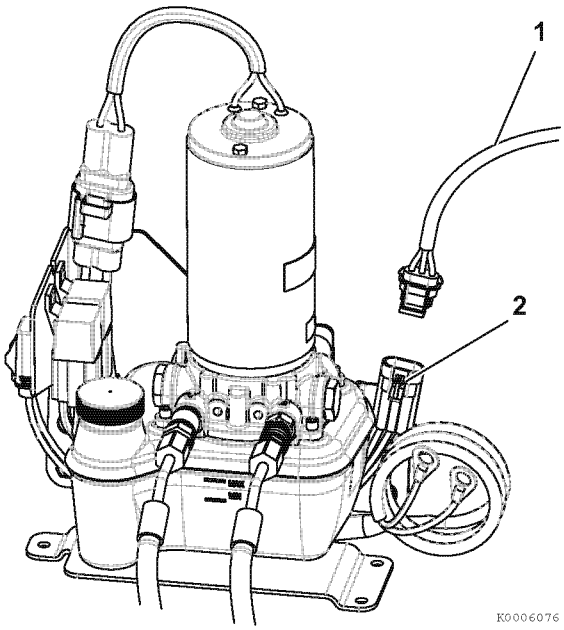


1 – Hydraulic hose (up hose)
2 – Quick connect fittings
3 – Hydraulic hose (down hose)

Figure 5-83

Note: An adapter harness may be needed to connect the remote control trim pump harness to the pump. Acquire an adapter harness that has a "PACKARD METRI-PACK 150" series 3-pin connector.

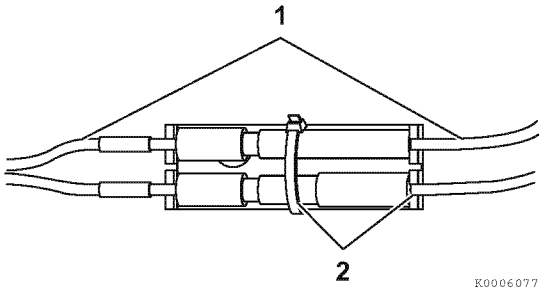
3. Connect the power trim pump control harness to the trim pump connector.



1 – Power trim pump control harness
2 – Trim pump connector

Figure 5-84

4. Connect the trim limit switch wires and secure with a wire retainer and tie strap.



1 – Trim limit switch wires
2 – Wire retainer and tie strap (obtain locally)

Figure 5-85

Power trim system wiring diagram

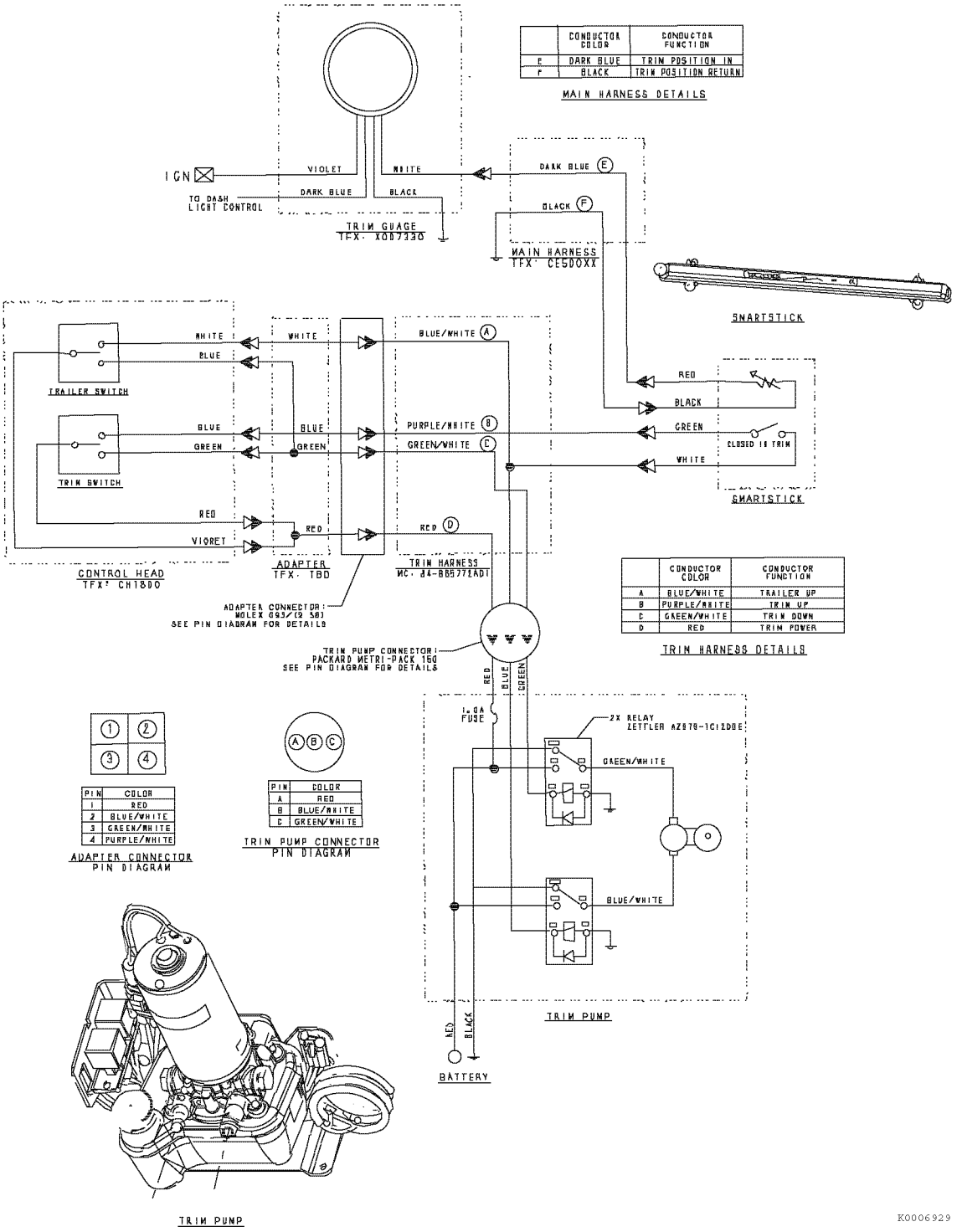


Figure 5-86

INSTALLING THE ENGINE

NOTICE

Avoid product damage caused by improper engine alignment. Improper engine alignment can be caused by mismatched flywheel housing mounts and inner transom plate mounting hardware. Ensure that the flywheel housing mounts and the inner transom plate mounting hardware, port and starboard, are the correct parts and match before installing the engine.

1. Attach a sling to the lifting eyes on the engine and adjust so that the engine is level when suspended.
2. Lift the engine into position in the boat using an overhead hoist.

⚠ WARNING

Crush Hazard

Only use a hoist with adequate lifting capacity of the engine.

⚠ WARNING

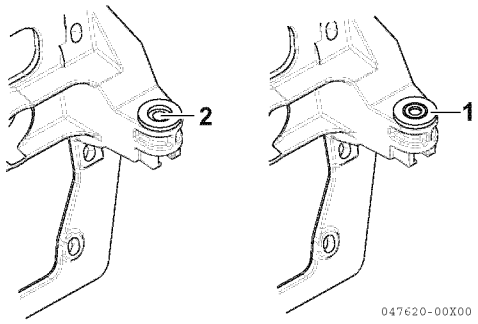
Steering Control Hazard

When lowering the engine into position, never set the engine on the shift cable. The shift cable outer casing can be crushed, causing damage to the shift cable and difficult or improper shifting.

3. Align the rear engine mounts with the inner transom plate mounts.
4. Set the engine on the front engine mounts and inner transom plate mounts. Do not relieve the hoist tension at this time.

NOTICE

Engine attaching hardware must be installed in the sequence illustrated. Install and torque rear engine mounting bolts with hardware as illustrated.

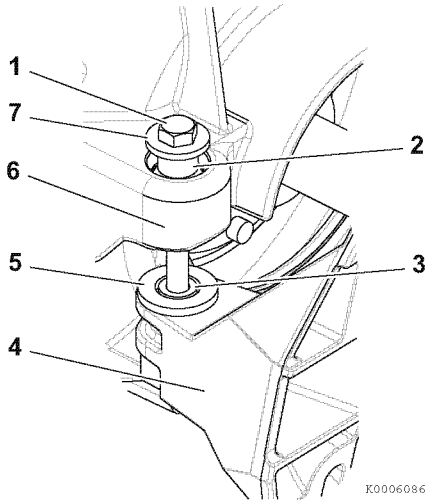


1 – Rubber washer
2 – Spacer T = 3.45 (6LPA engines only: S/#0448 and before)

Figure 5-87

Note • *The spacers (T = 3.45) between the rubber engine mounts and the transom plate are standard equipment on 6LPA series engine installations. (S/#0448 and before)*

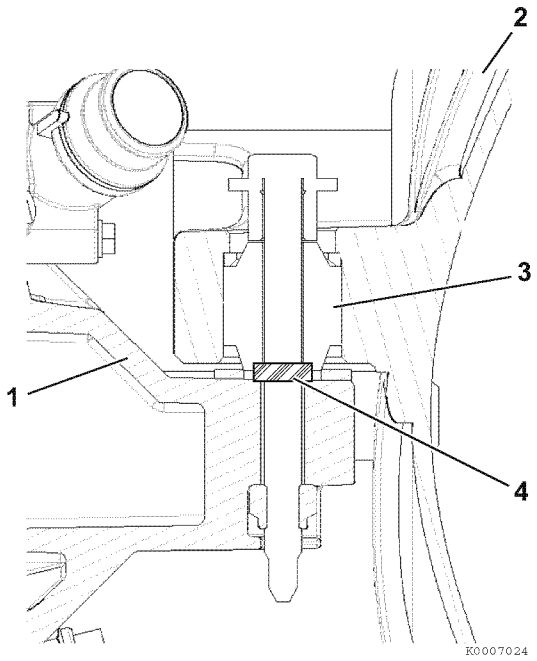
• *The spacers (T = 3.45) are not required for BY3 series and 8LV engine installations.*



1 – Bolt
2 – Spacer
3 – Spacer T = 3.45 (6LPA engines only: S/#0448 and before)
4 – Inner transom plate mount
5 – Rubber washer
6 – Rear engine mount
7 – Washer

Figure 5-88

6LPA mount installation reference



1 – Inner transom plate mount
2 – Flywheel housing
3 – Rear engine mount
4 – Spacer T = 3.45 (6LPA engines only: S/#0448 and before)

Figure 5-89

5. Adjust the front engine mounts until they rest on the boat stringers.
6. Set the engine on the stringers.
7. Relieve the hoist tension.
8. Disconnect the sling from the engine lifting eyes.

NOTICE

The finished boat stringer must allow the front engine mount a minimum of 6 mm (0.236 in.) up or down adjustment to exist after the mount is adjusted to contact the stringer. This allows for future engine alignment or adjustments. Make proper alterations to the boat stringer (structure) height to obtain the 6 mm (0.236 in.) dimension.

Aligning the Engine

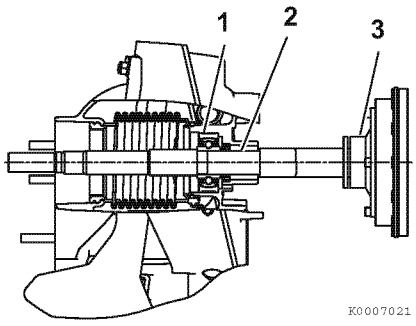
NOTICE

Avoid drive unit damage. Use the YANMAR alignment tool only. Alignment tools other than the YANMAR alignment tool may cause damage to the gimbal bearing, the engine coupler, or both.

■ Aligning gimbal bearing

NOTICE

Alignment of the gimbal bearing is important to ensure proper drive-to-engine alignment.

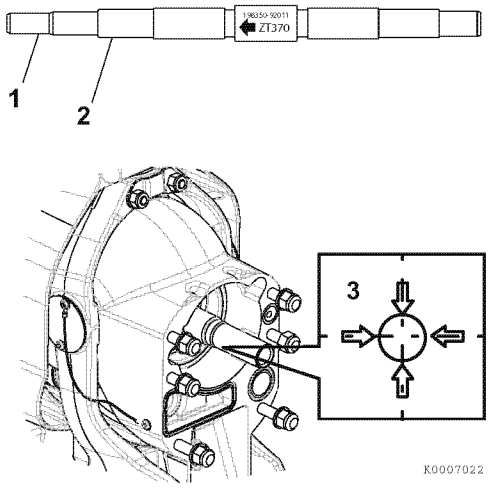


1 – Unit bearing (gimbal housing)
2 – Alignment shaft
3 – Engine coupler

Figure 5-90

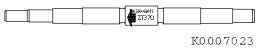
Attempt to insert the solid end of the alignment tool through the gimbal bearing and into the engine coupler splines and touch the inner end of the coupling.

If insertion is difficult, retract the tool approximately 75 mm (3.0 in.) then hit the sides of the alignment tool with a soft mallet at 90° increments to help align the gimbal bearings to the coupler. If the tool cannot be inserted, proceed to *Adjusting engine mounts on page 5-69*.

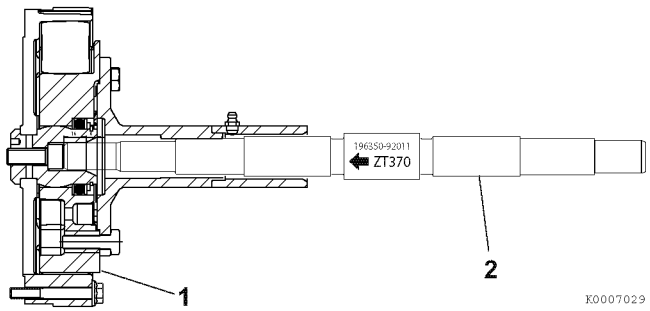


1 – Insert this end of the alignment tool through the gimbal housing assembly.
2 – Alignment shaft
3 – 90° increments

Figure 5-91

Alignment shaft (196350-92011)	Aligns the engine and the stern-drive during installation.	 K0007023

- Alignment shaft short end: Used to align BY3, 6LPA and LH series engines with MerCruiser Bravo drives, 6LPA (S/# 2416 and after) and 8LV engines with ZT370 drive (Damper coupling: LC-6000).
- Alignment shaft long end: Used to align ZT370 stern-drive with BY3 and 6LPA series (S/#2415 and before) engines equipped with ZT370 (Damper coupling: CF-RSD106).



1 – Engine coupler
2 – Alignment shaft

Figure 5-92

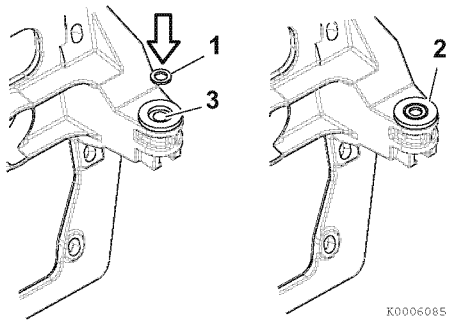
■ Adjusting engine mounts

NOTICE

Turn both front engine mount adjustment nuts an equal amount in the direction required to align the engine.

- **To adjust the engine up or down:**
  - 1- Loosen locknuts on mounts.
  - 2- Turn adjusting nuts as necessary.
  - 3- Temporarily tighten locknuts.
- **To move the engine to the left or right:**
  - 1- The locknuts on mounts should be loose.
  - 2- Move the engine in the slotted mount holes as necessary, if equipped.

1. Attempt to insert the solid end of the alignment tool through the gimbal bearing and into the engine coupler splines again.
2. On models where the front engine mounts cannot be lowered enough to allow for proper engine alignment:
   - 1- Attach a sling and lifting arm to the engine lifting eyes and adjust so that the engine is level when suspended.
   - 2- Remove the rear engine mounting bolts and hardware.
   - 3- Use an overhead hoist to lift the engine enough to install the stainless steel washer inside the inner diameter of both fiber washers.
   - 4- Inserting a 3 mm (0.118 in.) steel washer **(Figure 5-93, (1))** at the rear engine mounts will result in 20 mm (0.787 in.) extra height at the front engine mounts.



1 – Steel washer (obtain locally)
2 – Rubber washer
3 – Spacer T = 3.45 (6LPA engines only: S/#0448 and before)

Figure 5-93

Note • This will position the washer between the new engine mount and the transom mounting support, which should raise the engine slightly, resulting in additional front mount adjustment.

• The spacers (T = 3.45) between the rubber engine mounts and the transom plate are standard equipment on 6LPA series engine installations. (S/#0448 and before)

• The spacers (T = 3.45) are not required for BY3 series and 8LV engine installations. For additional information, see Installing the Engine on page 5-67.

3. When the installed engine mount brackets are positioned too high (more than 10 mm [0.393 in.] of thread is visible under engine mount brackets) on the flexible mounts, perform the following:
   1- Attach a sling and lifting arm to the engine lifting eyes and adjust until the engine is level when suspended.
   2- Adjust the flex mounts upward.
   3- Insert a shim plate under the flexible mounts. The thickness of shim plate will depend upon height adjustment.
4. Install both rear engine mounting bolts with hardware.
   1- Set the engine on the stringers.
   2- Relieve the hoist tension.
   3- Disconnect the sling from the engine lifting eyes.
   4- Insert the solid end of the alignment tool through the gimbal bearing and into the engine coupler splines.
5. Repeat this process until the alignment tool installs easily (slides freely with two fingers) all the way into and out of engine coupler splines. Never twist the alignment tool into position.
6. Torque the rear engine mount bolts.

Rear engine mount bolts	
N·m	**lb-ft**
45	33

7. Fasten the front mount assemblies to the boat stringers using appropriate hardware (follow engine mount manufacturer's installation specifications).
   1- Torque both front mount locking nuts.
   2- Recheck alignment with the alignment tool.

NOTICE

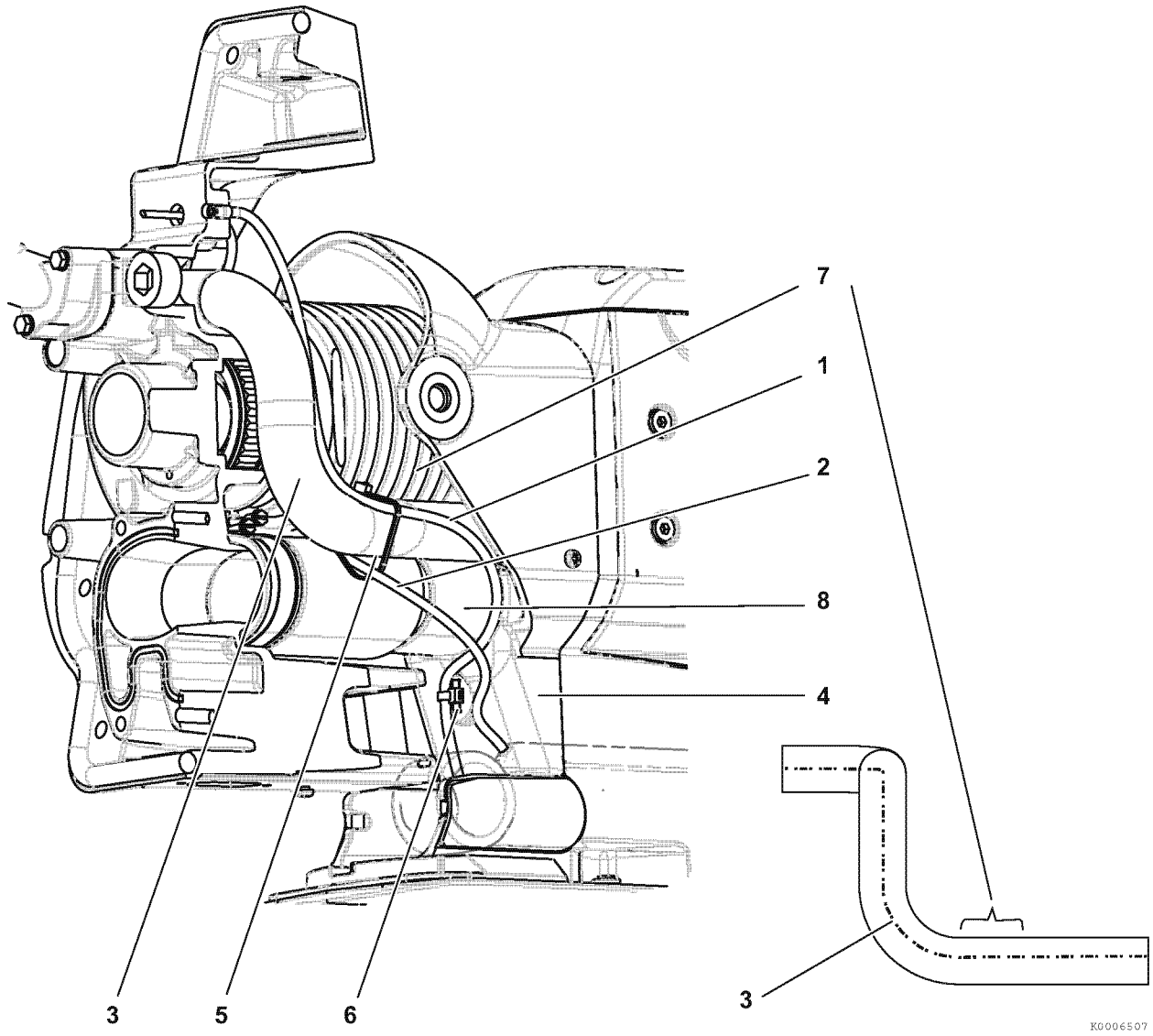
The alignment tool must enter the coupler splines freely. If not, remove the alignment tool and readjust the alignment.

   3- Remove the alignment tool when alignment is complete.
8. If operating in a saltwater environment, apply sealant to the threads and nuts of the engine mounting hardware to help protect against corrosion. This will allow for easier loosening in the future.

   Note: YANMAR recommends that the shipping hardware remain on the transom assembly during shipment if the boat will be shipped without the drive unit installed. On boats that will be shipped with the drive unit installed, fold the bell housing dust cover flap back into place and tape shut.
9. Ensure that all hardware is properly installed.

SPEEDOMETER CONNECTION

Figure 5-94 shows the speedometer hose piping.



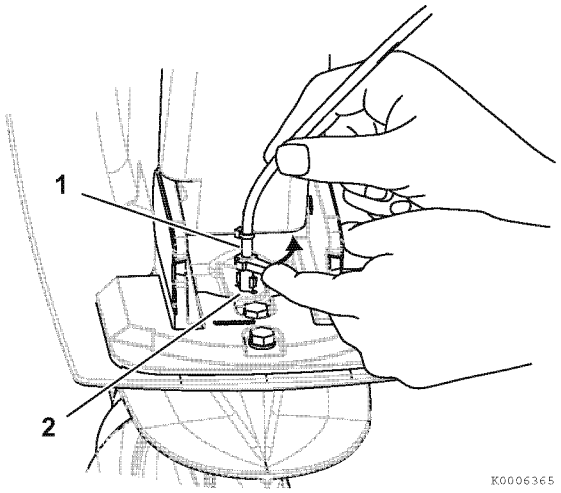
1 – Speedometer hose
2 – Trim sender wire
3 – Engine cooling hose
4 – Bell housing
5 – Cable band A*1
6 – Cable band B*2
7 – Straight area
8 – Exhaust opening

Figure 5-94

**1: This cable band attaches the speedometer hose (1) and the trim sender wire (2) to the engine cooling hose (3). the fixed place is the straight area (7) of the engine cooling hose (3). the speedometer hose passes the port side of the engine cooling hose, and it passes the port side of the exhaust opening (8).*

**2: This cable band attaches the speedometer hose (1) to the bell housing (4).*

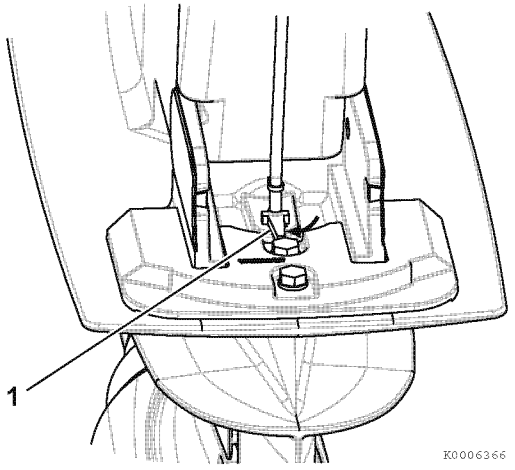
1. Raise the drive unit to gain access to the area between the gimbal housing and the drive unit, immediately on top of the transom end of the antiventilation plate.
2. Insert the speedometer tube fitting into the opening on the top side of the ventilation plate in position as illustrated.



1 – Speedometer tube fitting
2 – Opening

Figure 5-95

3. With the fitting fully seated, turn the handle to the left to a tightly seated position.



1 – Handle

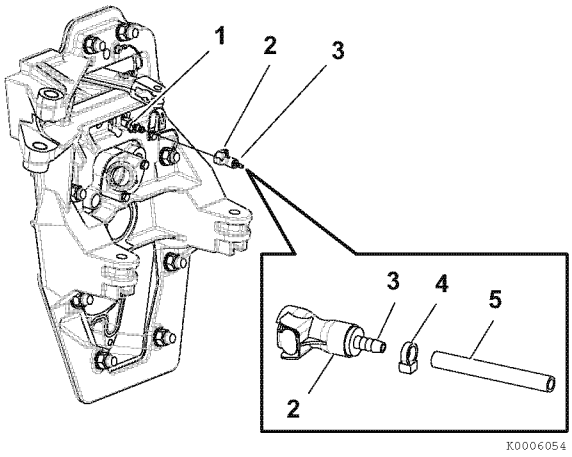
Figure 5-96

Connecting the Speedometer Pickup

NOTICE

Excess water in the bilge can damage the engine or cause the boat to sink. Never remove the plug from the speedometer pickup tube fitting unless the connection is to be used.

1. Remove the protective cap from the male quick connect.
2. Connect a 4 mm (0.157 in.) hose (not provided) from the speedometer to the barb fitting.
3. Secure the hose to the fitting with a tie strap.



1 – Male quick connect
2 – Female quick connect
3 – Barbed fitting
4 – Tie strap
5 – Hose

Figure 5-97

4. Secure the hose to the transom with the hose clip and screw.

NOTICE

Avoid water leaking into the boat. Ensure that the hose never contacts the steering system components, the engine coupler or the drive shaft. The speedometer hose is filled with water, especially during boat operation. Hose contact with moving or rotating engine parts could cause damage to the hose resulting in water leaking into boat. Never let the speedometer hose come in contact with the steering system components, the engine coupler or the drive shaft.

SHIFT PLATE AND CABLE INSTALLATION AND ADJUSTMENT (MECHANICAL SHIFT SYSTEM)

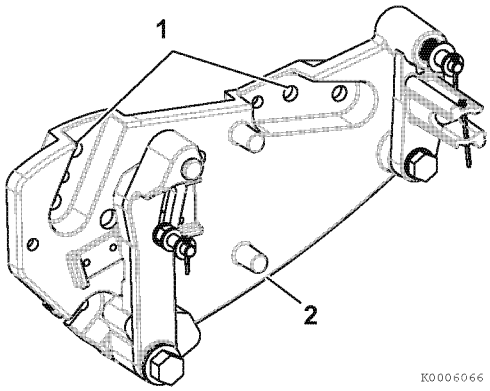
The following shift plate and cable installation and adjustment procedures are for mechanical shift type systems only. For electric shift system installation procedures, see *Shift Cable Installation (Electric Shift System) on page 5-79*.

Installing the Shift Plate

Note: The shift plate and bracket are only used with mechanical shift systems.

Install the shift plate to the inside of the transom or on the engine heat exchanger.

- The shift plate and bracket assembly must be installed to allow the connection of the drive unit shift cable.
- Never mount the assembly near moving components.
- Avoid causing sharp bends and kinks in the control cable.
- Use fasteners that are appropriate for the mounting surface to install the mounting bracket.



1 – Mounting bolt location
2 – Shift plate

Figure 5-98

Installing the Drive Unit Shift Cables

■ Verify propeller rotation

Before installing the shift cables, verify the drive unit shift cable direction and propeller rotation.

Use the following method to verify the correct propeller rotation (RH or LH) for this drive unit.

The front propeller on the drive unit is always LH rotation and the rear propeller is always RH rotation. The shift cable end guide must move in the direction as shown in **Figure 5-99**, when the control lever is placed in the FORWARD gear position.

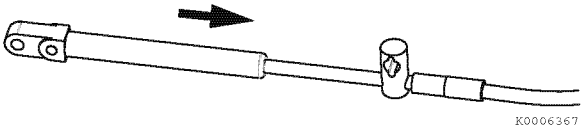


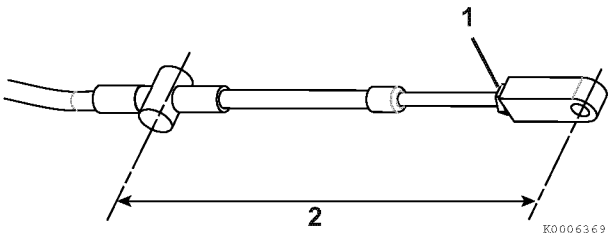
Figure 5-99

■ Verify shift cable travel

YANMAR recommends using Teleflex remote control and cables to ensure proper shift and throttle operation. If a control other than YANMAR - Teleflex is used, a shift control cable must be 70 mm (2.75 in.) to 77 mm (3.031 in.) (at the shift plate end) with a 50 to 70 N (11 to 16 lbf.) load applied to the cable end.

■ Setting drive unit shift cable length

Find the NEUTRAL position of the drive unit shift cable. Measure the distance between the control cable barrel center and the center of the attachment hole of the cable end. This distance should be 180.6 mm (7.110 in.). Adjust the cable length by loosening the cable end locknut and turning the cable end to the specified distance. Tighten the locknut after adjustment.



1 – Locknut
2 – 180.6 mm (7.110 in.) - The control cable barrel center and the center of the attachment hole.

Figure 5-100

■ Drive Unit Shift Cables Installation

⚠ WARNING

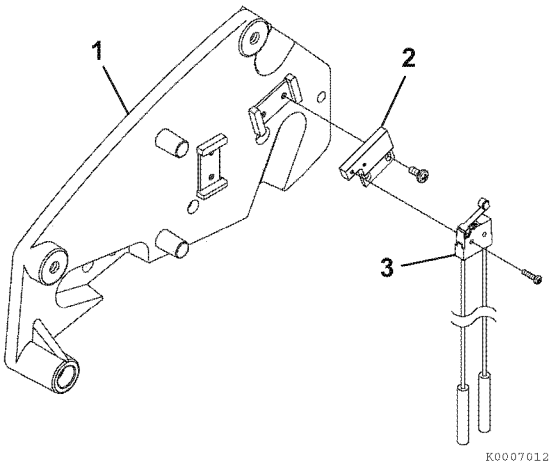
Shift Control Hazard

Route the shift cables away from sharp bends and moving parts. Never fasten items to the shift cables.

Note: Before installing the drive unit shift cable onto the shift plate, install the remote control shift cable into the remote control. See the remote control installation instructions for proper shift cable installation procedures.

1. Install the NSP (neutral safety) switch on the shift plate, as shown in **Figure 5-101**.

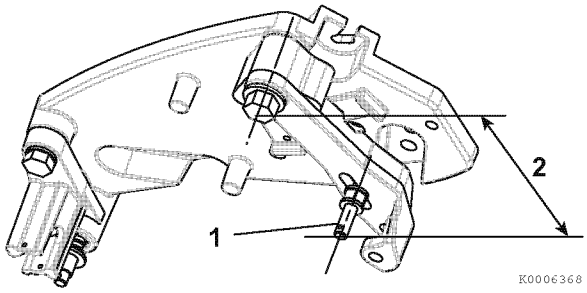
   Note: The NSP switch requires adjustment after the shift cable has been installed and adjusted. The switch adjustment procedure is provided in step 17 of this procedure.



1 – Shift plate
2 – Switch plate
3 – NSP neutral safety switch

Figure 5-101

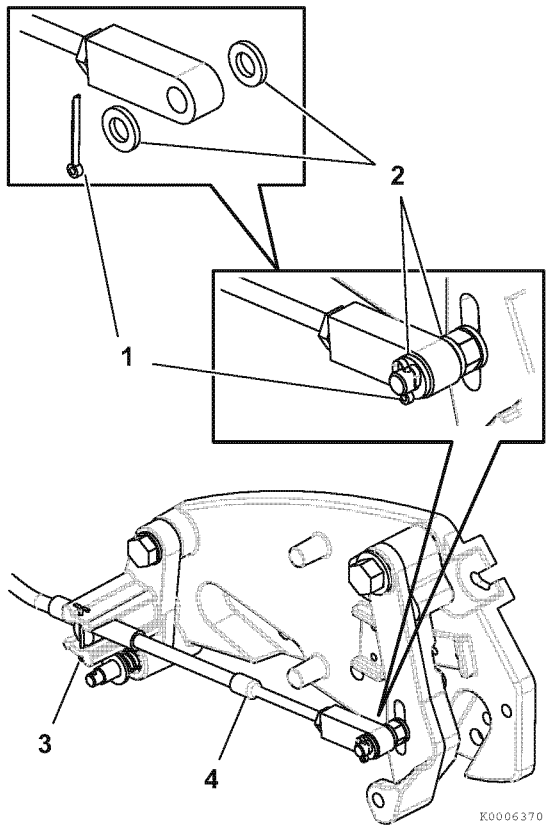
2. Loosen the stud and move it to the dimension as shown in **Figure 5-102** and then tighten the stud.



1 – Stud
2 – 70 mm (2.75 in.) - Center of the pivot bolt to the center of the stud.

Figure 5-102

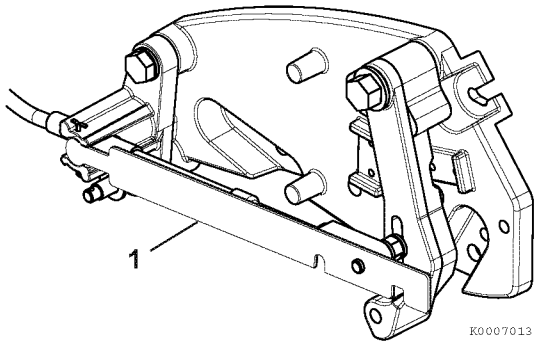
3. Install the drive unit shift cable as shown in **Figure 5-103**, inserting the cotter pins from the top. Secure the cable by spreading the ends of the cotter pins fully.



1 – Short cotter pin
2 – Washers (2 ea.)
3 – Long cotter pin
4 – Drive unit shift cable

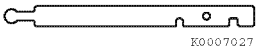
Figure 5-103

4. Install the shift cable adjustment tool as shown in **Figure 5-104**. Use tape on the barrel end to hold the tool in place.



1 – Shift cable adjustment tool (119781-34090)

Figure 5-104

Shift cable adjustment tool (119781-34090)	Adjusts shift cable length	 K0007027

5. Locate the center of the remote control and control cable play (backlash), as shown in **Figure 5-105**.
   1- Shift the remote control to NEUTRAL.
   2- Push in on the control cable end with enough pressure to remove play, and mark position 2 on tube.
   3- Pull out on the control cable end with enough pressure to remove play and mark position 3 on tube.
   4- Measure the distance between marks 2 and 3 and mark position 1 halfway between marks 2 and 3.

NOTICE

Keep center mark 1 aligned with sleeve end face when making the following adjustment.

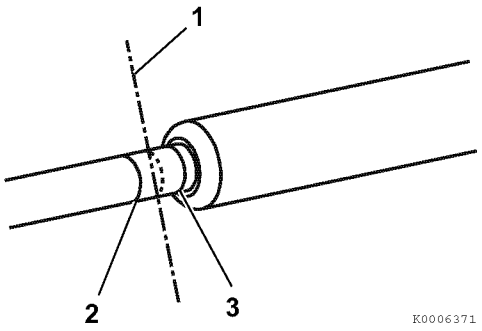


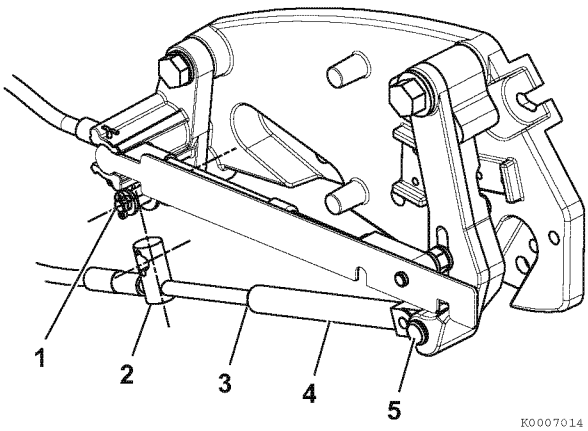
Figure 5-105

6. Adjust the remote control shift cable.
   1- Temporarily install the remote control shift cable end onto the shift lever and insert the clevis pin.
   2- Adjust the remote control shift cable barrel so that the hole in the barrel centers with the vertical centerline of the stud. Ensure that the backlash center mark is aligned with the edge of the remote control cable end guide.

NOTICE

Never attempt to install or remove the remote control shift cable barrel from the stud without first removing the end guide clevis pin from the shift lever and removing the cable. Attempting to bend the shift control cable to install or remove the barrel will put undue stress on the cable end guide and shift lever. Damage to both could occur.

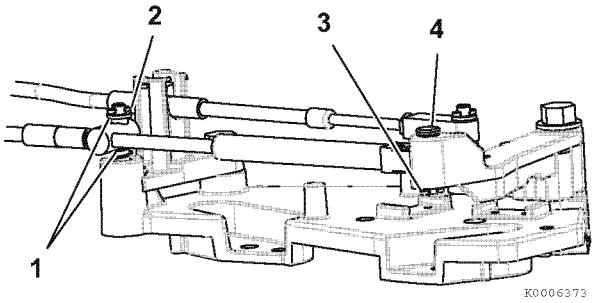
   3- Remove the remote control shift cable end guide from the shift lever by removing the clevis pin.



1 – Stud
2 – Control cable barrel
3 – Backlash center
4 – Control cable end guide
5 – Clevis pin

Figure 5-106

7. Install the remote control shift control cable.
8. Install the washer and cotter pin to secure the barrel. Spread the ends of the cotter pin.
9. Install the clevis pin.
10. Install the cotter pin into the clevis pin. Spread the ends of the cotter pin.



1 – Washers - (on both sides of barrel)
2 – Cotter pin
3 – Cotter pin (partially shown)
4 – Clevis pin

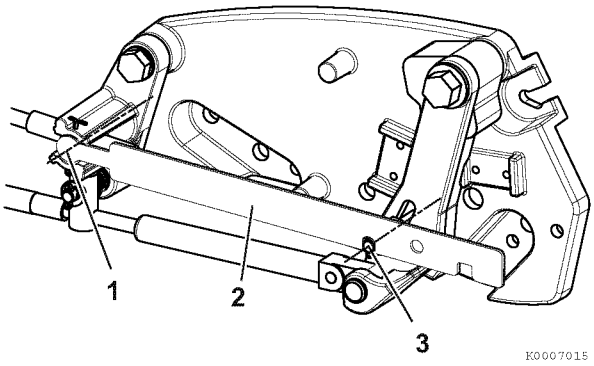
Figure 5-107

11. Remove the shift cable special adjustment tool.
12. Shift the remote control into the full FORWARD position.

13. Install the end of the shift cable adjustment tool into the barrel retainer, as shown in **Figure 5-108**. The rear slot of the tool should fit freely over the stud.

Specification	
Distance of tool from center of rear slot to center of barrel retainer end.	155.6 ± 1.5 mm (6.125 ± 0.059 in.)

Note: If the rear slot of the shift cable adjustment tool does not freely fit over the stud, loosen the shift lever stud and adjust as needed, then retighten the stud.



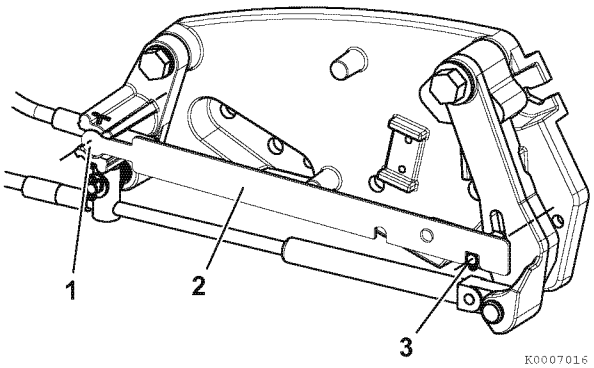
1 – Barrel retainer end
2 – Shift cable adjustment tool
3 – Shift lever stud

Figure 5-108

14. Remove the shift cable special adjustment tool.
15. Shift the remote control into full REVERSE.
16. Install the end of the shift cable adjustment tool into the barrel retainer, as shown in **Figure 5-109**. The front slot of the tool should fit freely over the stud.

Specification	
Distance of tool from center of front slot to center of barrel retainer end.	205.6 ± 1.5 mm (8.09 ± 0.059 in.)

Note: If the front slot of the shift cable adjustment tool does not freely fit over the stud, loosen the shift lever stud and adjust as needed, then retighten the stud.



1 – Barrel retainer end
2 – Shift cable adjustment tool
3 – Shift lever stud

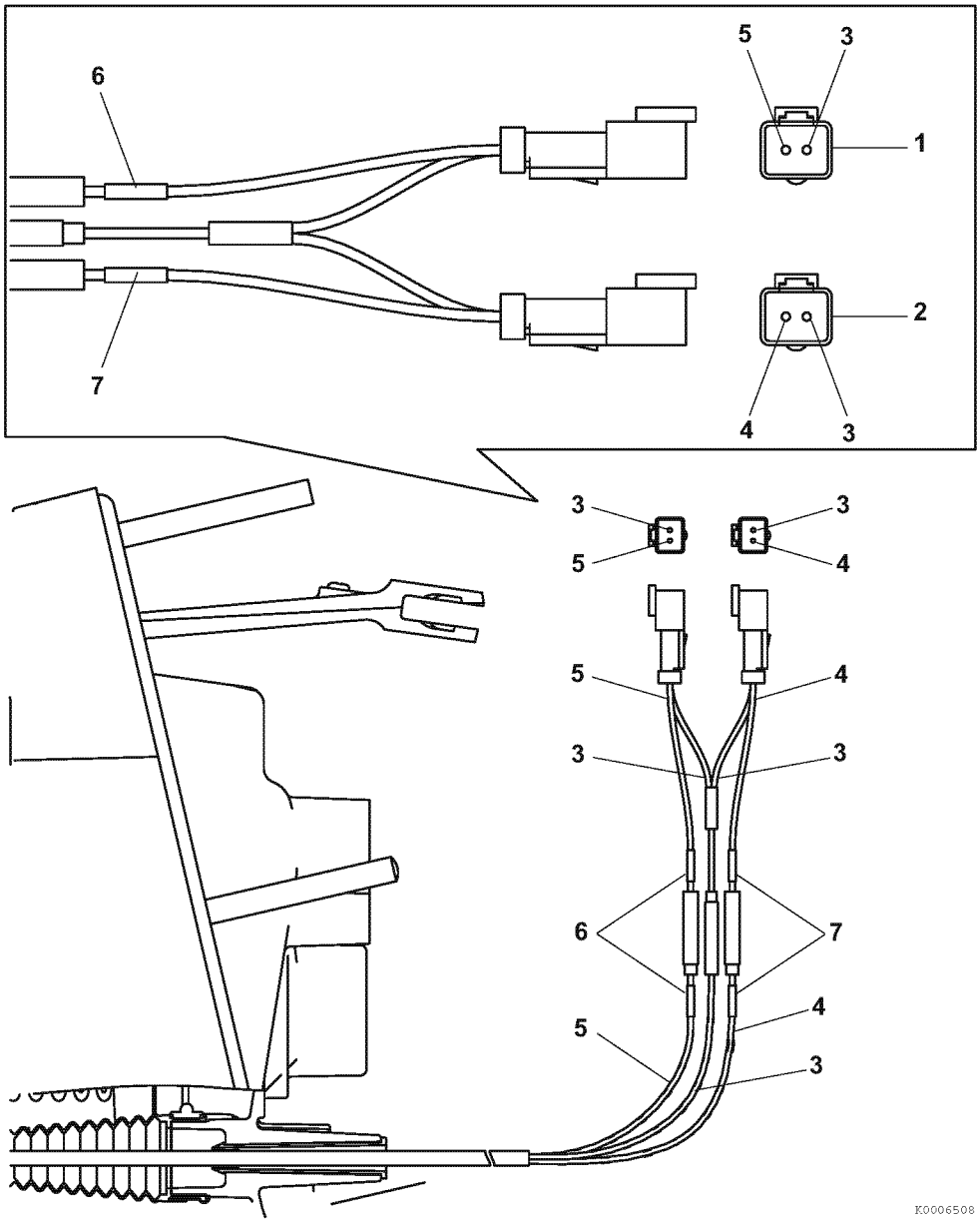
Figure 5-109

17. Adjust the NSP switch.
    1- Connect an ohmmeter to the NSP switch leads.
    2- While monitoring the ohmmeter, move the shift lever to the FORWARD, REVERSE and NEUTRAL positions. The NSP switch is properly adjusted when the switch is open only when the shift lever is in the NEUTRAL position.
    3- Adjust the switch position by loosening the switch mount screws and moving the switch in the slotted holes.
    4- After adjustment, tighten the screws and recheck the switch adjustment using the ohmmeter while moving the shift lever.
18. Connect the NSP switch leads to the engine harness.
19. Ensure that all of the cotter pins are secure and that the ends of the cotter pins are spread completely.
20. Lubricate the shift cable pivot points.

SAE 30W engine oil	
Where used	**Part number**
Shift cable pivot points	Obtain locally

SHIFT CABLE INSTALLATION (ELECTRIC SHIFT SYSTEM)

Connect the shift cable harness to the control system and engine harness. For additional information, see the OEM control system and the engine installation manuals.



1 – FORWARD connector (female):
DEUTSCH DT04-2P-CE03 1060-16-0622 W2P
2 – REVERSE connector (female):
DEUTSCH DT04-2P-CE03 1060-16-0622 W2P
3 – Black: Ground signal (negative)
4 – White: REVERSE signal
5 – Orange: FORWARD signal
6 – Name tag: FORWARD
7 – Name tag: REVERSE

Figure 5-110

TROUBLESHOOTING SHIFT PROBLEMS

Use the following information to troubleshoot hard shifting or chucking/roughing when shifting into forward gear.

1. When installing the control box into the side panel of the boat, ensure that the cables have enough clearance to operate. This is necessary because the cables move up and down when the shift handle is moved. If the control box is mounted too far back toward any fiberglass structure, the cables will be interfered with. This will cause very hard shifting.
2. Route the shift cable from the control box through the side gunnel of the hull without inducing any extremely sharp bends **(Figure 5-111)** to prevent stiff shifting.

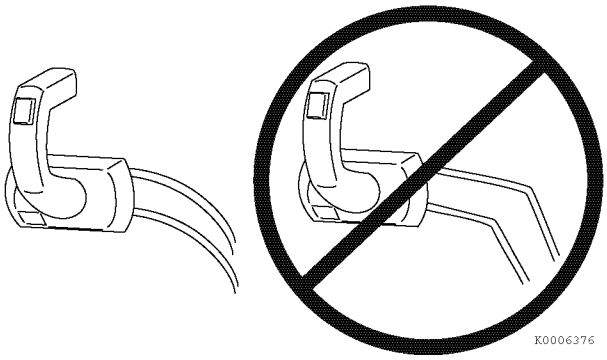
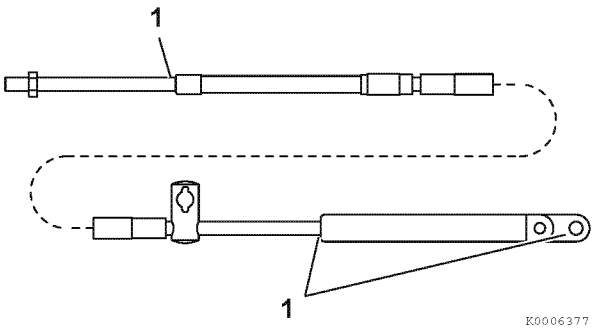


Figure 5-111

3. Before installing the shift cable into the control box, extend the stainless rod eye end of the cable and coat it with lubricant **(Figure 5-112, (1))**. Move it back and forth to allow even distribution of the lubricant.



1 – Lubrication point

Figure 5-112

Lithium grease with PTFE	
Where used	**Part number**
Shift cable end	Obtain locally

4. Never strap or clamp the control cables to any other cables or rigid structure within 1000 mm (3.0 ft) of the control box. Make sure there are no kinks in the cable.
5. Ensure that there is enough clearance for cable movement when the control box is installed in the side panel. The cables must have room to move up and down when the control handle is shifted into either FORWARD or REVERSE.
6. Ensure that the engine was not set down on the intermediate shift cable during installation; this will crush the inner cable tubing and cause improper and/or stiff shifting.
7. Never fasten the shift cable with straps or clamps to any other cable within 1500 mm (5.0 ft) of the shift plate.
8. Avoid over-tightening the shift cable to the transom with any type of plastic clips or fasteners within 1500 mm (5.0 ft) of the shift plate.
9. Do not over-tighten the throttle or shift cable attaching nuts at the engine end. Barrel and cable end must be free to rotate on the mounting stud.

   Note: Lubricate attaching points with engine oil.

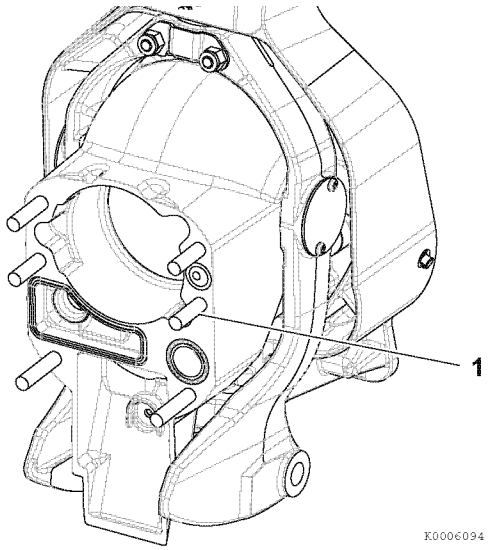
SAE 30W engine oil	
Where used	**Part number**
Shift cable pivot points	Obtain locally

10. The drive unit shift cable must be routed to allow sufficient length for connection to shift plate.

    Note: Make a final check of the adjustments with the boat in the water and with the engine running. If this cannot be done, or is not done at the manufacturing facility, make arrangements with the dealer to do this as part of the pre-delivery inspection.

INSTALLING THE DRIVE UNIT

1. Apply lubricant to the threads of the bell housing studs.



1 – Studs (6 ea.)

Figure 5-113

Lithium grease with PTFE	
Where used	**Part number**
Bell housing studs	Obtain locally

NOTICE

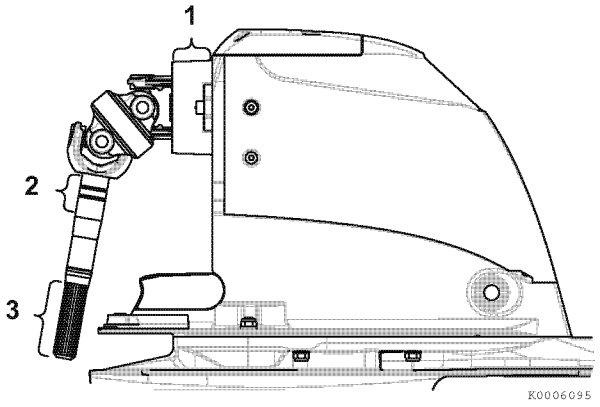
YANMAR recommends applying multipurpose, heavy-duty type grease to the drive unit pilot to help prevent corrosion.

2. Lubricate the drive unit pilot, U-joint shaft O-rings and drive shaft splines.

   Note: The purpose of the U-joint shaft O-rings is to reduce noise or rattle due to shaft vibration.

NOTICE

Use new U-joint shaft O-rings each time the drive unit is installed.



1 – Drive unit pilot
2 – O-rings
3 – Splines

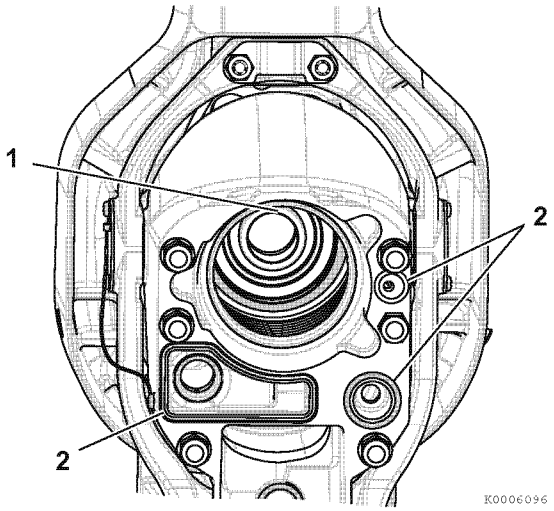
Figure 5-114

Multipurpose heavy-duty type grease NLGI #2	
Where used	**Part number**
Drive unit pilot	Obtain locally
U-joint shaft O-rings	
Drive shaft splines	

3. Ensure that the drive shaft U-joint bellows are clean and free of debris. Apply lubricant to O-ring seals.

NOTICE

Use new O-ring seals each time the drive unit is installed.

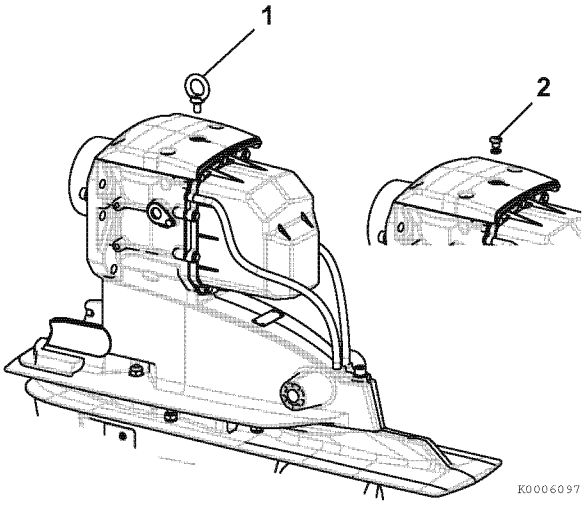


1 – U-joint bellows (clean)
2 – O-ring seals (lubricate)

Figure 5-115

Lithium grease with PTFE	
Where used	**Part number**
O-ring seals	Obtain locally

4. Lift the drive unit by using the eye-bolt mounted on the top cover.



1 – Eye-bolt M10 (obtain locally)
2 – Plug-bolt and gasket (remove)

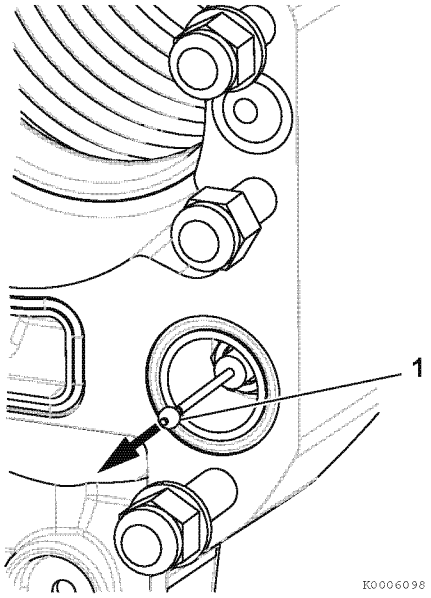
Figure 5-116

NOTICE

As the drive unit is inserted into the bell housing, the shift cable must be connected to the jaws of the shift linkage assembly in the drive unit.

Mechanical shift type

Pull the shift cable out as far as it moves by hand.



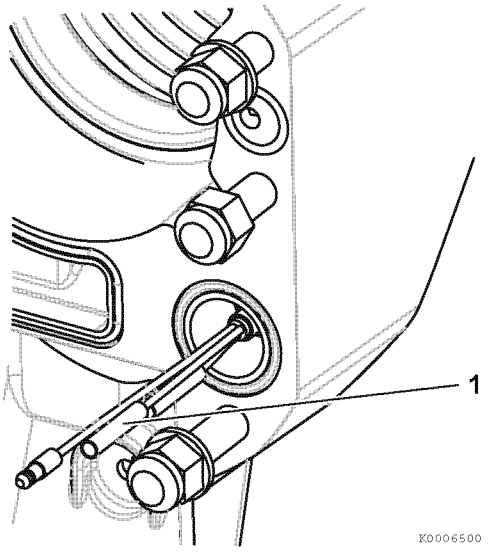
1 – Shift cable

Figure 5-117

Electric shift type

NOTICE

Do not pull the shift cable; it does not expand and contract.

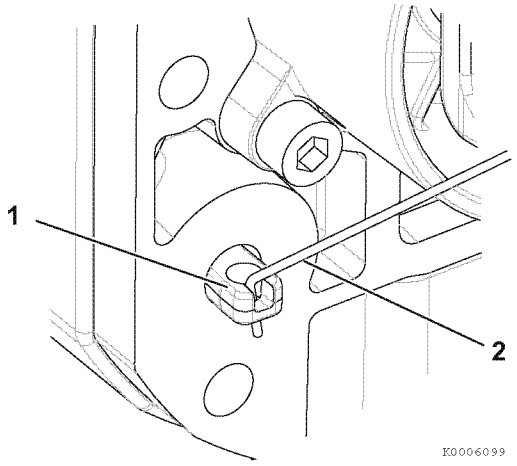


1 – Shift cable

Figure 5-118

Mechanical shift type

Pull the slider (shift linkage) out as far as possible with a piece of wire.



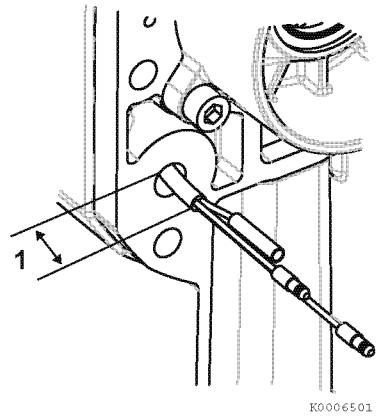
1 – Slider (shift linkage)
2 – Wire (obtain locally)

Figure 5-119

Electric shift type

NOTICE

Do not pull the connector wire from the drive shaft housing end more than 20 mm (0.79 in.).



1 – 20 mm maximum (0.79 in.)

Figure 5-120

Mechanical shift type

Follow steps 1, 2 and 3 in **Figure 5-121** to connect the cable to the slider (shift linkage).

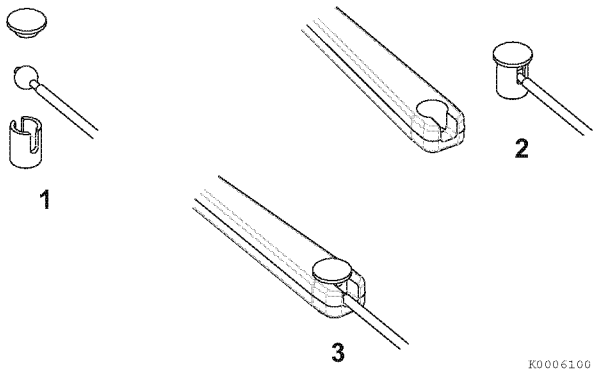
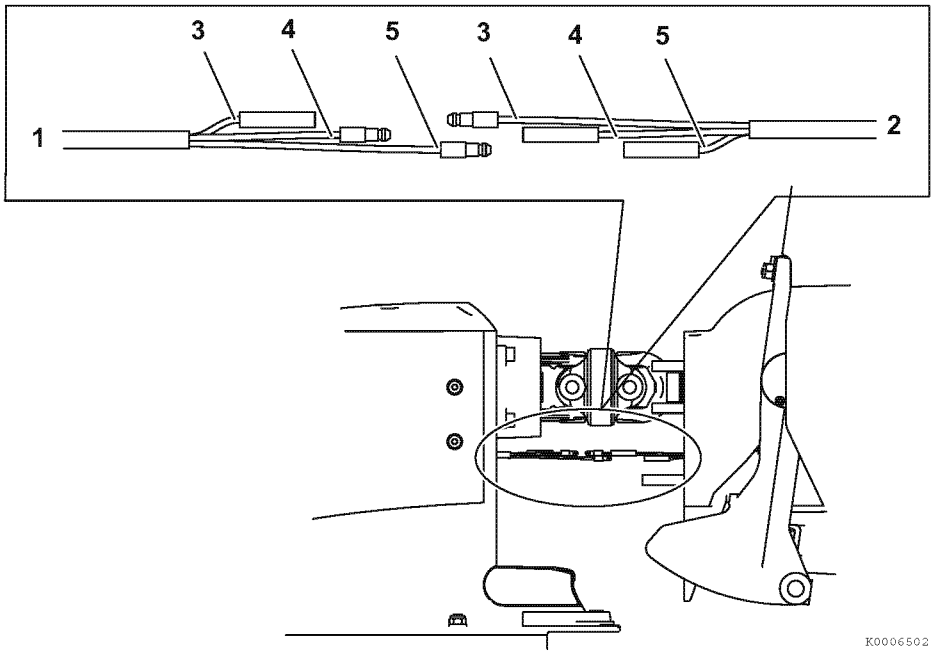


Figure 5-121

Electric Shift Type

Connect both harness wires to the same color wires of each harness.



1 – Drive unit side
2 – Transom assembly side
3 – Black wire
4 – White wire
5 – Orange wire

Figure 5-122

Mechanical shift type

After the cable is connected, push it into the inside of the housing.

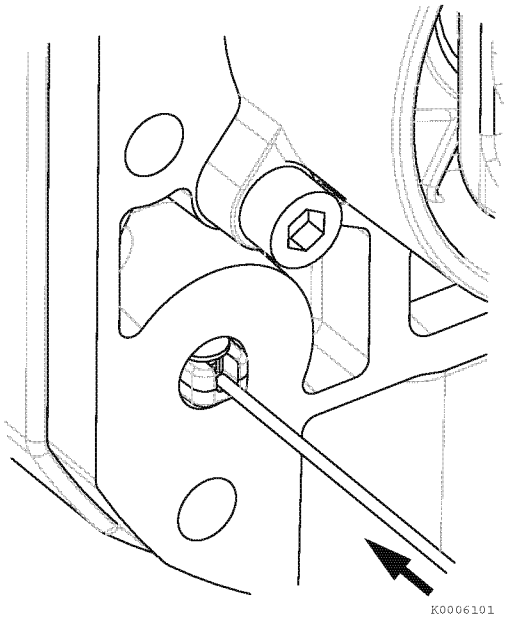


Figure 5-123

Electric shift type

After the cable is connected, push it into the housing.

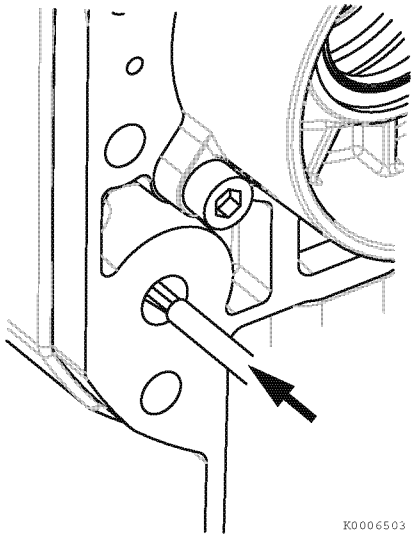
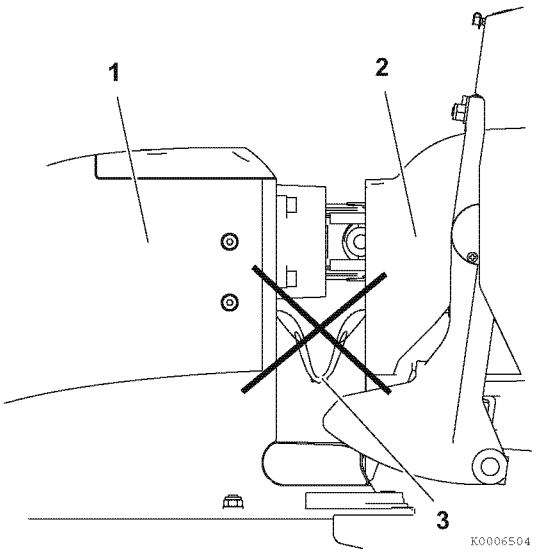


Figure 5-124

⚠ WARNING

Shift Control Hazard

Make sure the shift harness is not caught in the transom assembly and the drive unit.



1 – Drive unit
2 – Transom assembly
3 – Wire

Figure 5-125

Ensure the shift harness and connectors are positioned correctly **(Figure 5-126, (1))** to avoid being damaged after the drive unit has been installed.

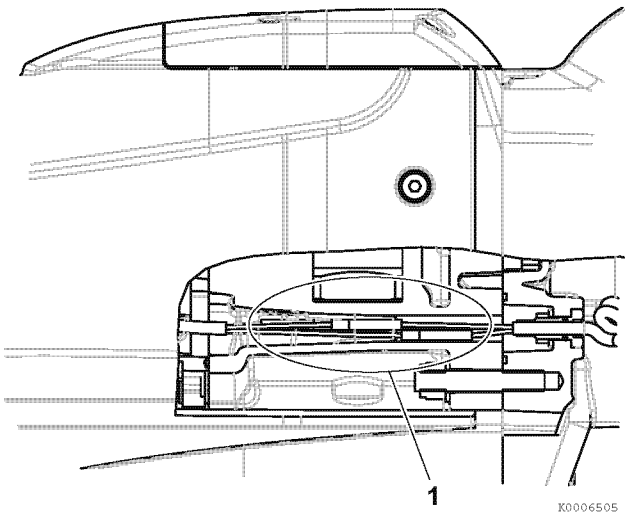


Figure 5-126

5. Place the drive unit in position on the bell housing and install as follows:
   1- Position the trim cylinders so that they point straight back.
   2- Position the drive unit so that the U-joint shaft aligns with the bell housing bore.
   3- Guide the U-joint shaft through the bearing in the gimbal housing and into the engine coupler. Make sure that the slider engages the bell housing shift cable assembly.

NOTICE

Do not allow the edge of the bell housing **(Figure 5-127, (1))** and the edge of the drive shaft housing **(Figure 5-127, (2))** on the stern-drive to contact when installing the stern-drive.

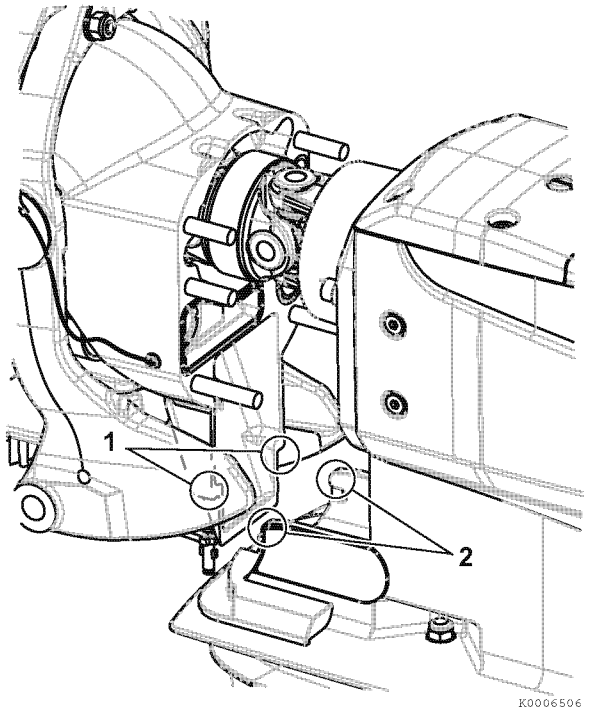
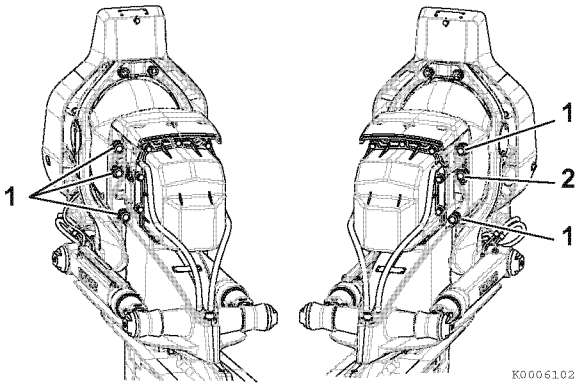


Figure 5-127

   4- Slide the drive unit all the way into the bell housing.
   5- Secure the drive unit to the bell housing with five flat washers and six locknuts.



1 – Locknut and flat washer
2 – Locknut only

Figure 5-128

   6- Torque the drive unit locknuts.

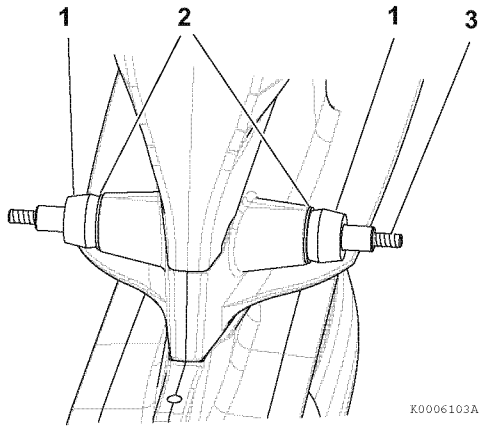
Drive unit locknut torque	
N·m	**lb-ft**
60	44

6. Remove the eye-bolt from the top cover and replace the plug and washer to prevent corrosion.
7. Apply lubricant to all of the components (except plastic caps) during installation.
8. Install the trim cylinders on the aft end of the drive unit with the hardware.
9. Tighten the locknuts until the washer and nut contact the shoulder on the anchor pin.

NOTICE

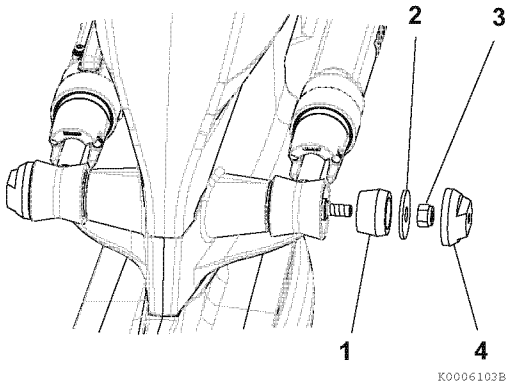
Avoid damaging the stern-drive paint. Paint coverage provides corrosion protection. Always repair damaged paint areas immediately to avoid further paint damage and metal corrosion.

10. Install the plastic caps and hand-tighten.



1 – Rubber bushing (4 ea.)
2 – Large inner diameter flat washer (2 ea.)
3 – Aft anchor pin

Figure 5-129



1 – Rubber bushing (4 ea.)
2 – Small inner diameter flat washer (2 ea.)
3 – Locknut (2 ea.)
4 – Plastic cap (2 ea.)

Figure 5-130

Lithium grease with PTFE	
Where used	**Part number**
Anchor pin threads	Obtain locally

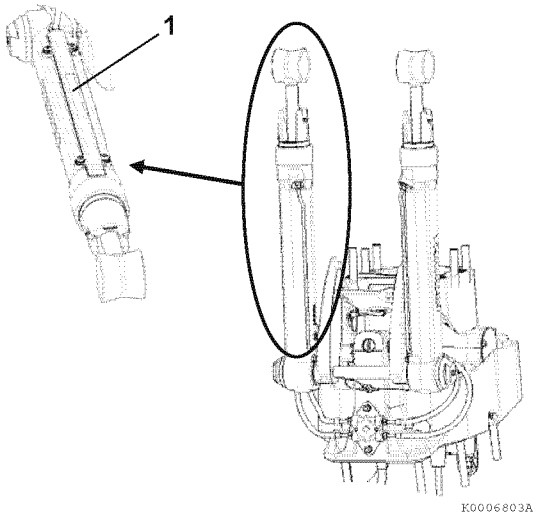
NOTICE

Check the stern-drive oil reservoir level and the stern-drive oil level. *See Check the Stern-Drive Reservoir Oil Level on page 6-5* and *Check the Stern-Drive Oil Level on page 6-7.*

TRIM AND TILT LIMITERS

Trim-In Limiter

The trim-in limiter is used to limit the negative trim (trim in/under) of the trim system. The trim-in limiter (smartstick) is an electronic sensor that senses the trim position of the stern-drive from the position of one of the trim cylinders.



1 – Trim-in limiter (smartstick)

Figure 5-131

⚠ WARNING

Steering Control Hazard

Only qualified personnel should install and evaluate the effectiveness of the trim-in limiter. The vessel is required to be tested at trim-in range and several different speed settings. If an undesirable handling characteristic occurs when the drive unit is trimmed in at higher speeds, the trim-in range should be adjusted by using a trim-in limiter. Wider trim-in ranges and higher speeds may cause handling problems on some vessels that could result in personal injury.

The stern-lift will cause certain vessels (predominantly heavy, deep-V hulls) to list toward the port or starboard side during full power speeds with the stern-drive set to full trim-in. The vessel will not roll over completely, but the list can often be significant enough to unseat the operator and/or passengers. This creates an unsafe situation.

This condition is primarily a result of vessel design and can only be reduced with thorough performance testing by the manufacturer (OEM) of the vessel. However, shifting hull weight to the stern may be helpful in controlling this tendency.

To help reduce the effect of stern-lift, a trim-in limiter is available for the YANMAR ZT370 stern-drive, as a service part.

The trim-in limiter reduces stern-lift by preventing the stern-drive unit from reaching the last few degrees of full trim under. While this device should reduce the rolling tendency, it may not eliminate the tendency entirely. The use of a trim-in limiter, and the evaluation of its effectiveness, can only be determined by trial and error adjustments and is ultimately the responsibility of the boat manufacturer.

Tilt-Up Limit Adjustment Spacer

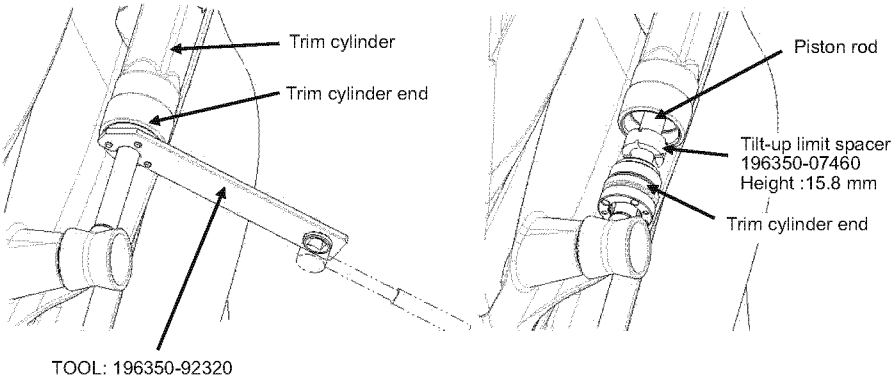
Tilt-up angle can be limited mechanically with the use of an adjustment spacer to reduce the cylinder stroke. The trim-in limiter (smartstick) is an electronic sensor used to limit negative trim (trim in/under); see *Trim-In Limiter on page 5-87* for additional information.

To adjust the tilt-up angle, install a tilt-up limit spacer into each trim cylinder, as shown in **Figure 5-132**.

Use special tool P/N 196350-92320 and a standard torque wrench to torque tighten the trim cylinder end.

Note • *The special tool and torque wrench must be inline when applying torque. See Tilt-up - limit spacer on page 3-7 for torque conversion values.*

• *Tilt-up spacers are not installed by YANMAR as original equipment. The tilt-up limit spacer includes six pieces, three for each cylinder.*



TILT-UP LIMIT SPACER (PIECES \ EACH TRIM CYLINDER)	A (mm)	A (mm)	A (mm)	A (mm)	E (DEGREES)
0 (STANDARD)	375	851	370	413	51
1 (LOOSE PART)	308	881	341	443	46
2 (OPTION)	244	902	316	359	41.3
3 (OPTION)	180	825	286	280	36.7

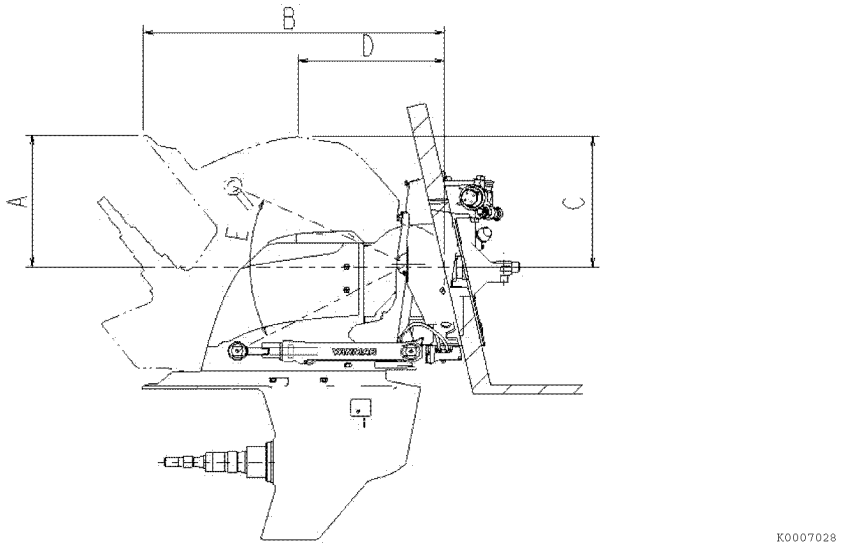


Figure 5-132

CORROSION PROTECTION

Galvanic Corrosion

Galvanic corrosion results whenever two or more dissimilar metals (like those found on the stern-drive) are submerged in a conductive solution, such as saltwater, polluted water or water with a high mineral content because a chemical reaction takes place causing electrical current to flow between the metals. The electrical current flow causes the metal that is most chemically active, or anodic, to erode. If not controlled, galvanic corrosion may corrode stern-drive components.

NOTICE

The anode of the stern-drive is only calculated for the stern-drive. Changing the material of the propeller may require additional anodes to be installed on the stern-drive.

Corrosion Control

It is the boat designer's responsibility and/or the repowering engineer's responsibility to design the proper systems and equipment to control and reduce the possibility of galvanic corrosion.

To help control the effects of galvanic corrosion, YANMAR marine ZT370 stern-drives come with several anodes and an electronic anticorrosion system (Y-CaPS) that protect the stern-drive in moderate corrosive conditions. However, it is essential that the owner/operator frequently monitor the anodes for wear, inspect the stern-drive for corrosion and replace the anodes often enough to provide a sacrificial surface for the electrical current to attack.

Galvanic isolators are also available from the aftermarket (not supplied by YANMAR) to block stray current while still providing a path to ground for dangerous shock currents.

The rate of corrosion depends on numerous factors, such as:

- The number, size and location of anodes on the stern-drive and vessel.
- The marina environment such as stray current in the water, fresh or salt water, and use and isolation of shore power.
- Improper application of marine paint or antifouling paint.
- Failure to repaint damaged areas.
- How the vessel is bonded.

Please check with the boat builder, dealer or other professional to determine if your vessel and/or stern-drive is adequately protected from galvanic corrosion.

If anodes erode quickly or if signs of corrosion are evident, the owner should take immediate corrective action. YANMAR recommends consulting an engineer specializing in marine electricity and corrosion control to determine the best way to correct the rapid erosion of the anodes.

Shore Power

Vessels that are connected to shore power require additional protection to prevent destructive low voltage galvanic currents from passing through the shore power ground wire. Galvanic isolators are available from the aftermarket (not supplied by YANMAR) to block these currents while still providing a path to ground for dangerous shock currents.

NOTICE

If the AC shore power ground is not isolated from the boat ground, the Y-CaPS and anodes may be unable to neutralize the increased galvanic potential. Corrosion damage that results from the improper system design or application is not covered by the YANMAR limited warranty.

Antifouling Paint

NOTICE

Corrosion damage that results from the improper application of marine paint or antifouling paint is not covered by the YANMAR limited warranty.

Observe the following precautions when applying antifouling or marine paint to the transom of the boat hull.

- Never paint the anodes installed on the stern-drive.
- Never paint the Y-CaPS reference electrode and/or anode.
- Never wash the stern-drive with a high-pressure washer. This could damage the coating on the reference wire.
- Never paint the stern-drive with a material that contains copper or tin.
- Never paint over drain holes, anodes, Y-CaPS or other items specified by the anode manufacturer.

Painting the Transom and Stern-Drive

Corrosion damage that results from improper application of antifouling paint will not be covered by the warranty.

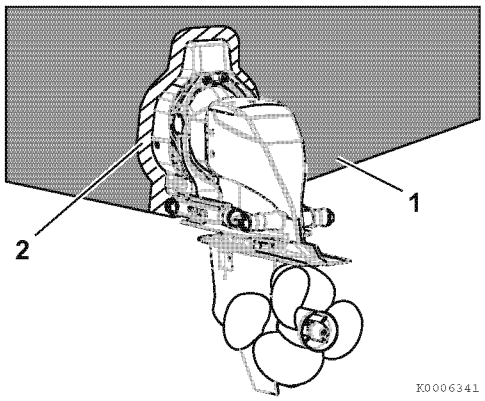
Antifouling paint may be applied to the vessel hull and the vessel transom.

NOTICE

- Avoid damaging the stern-drive paint. Paint coverage provides corrosion protection. Always repair damaged paint areas immediately to avoid further paint damage and metal corrosion.
- Never paint the anodes or Y-CaPS electrode. Painting these components will render them ineffective as galvanic corrosion inhibitors.

NOTICE

Use copper-based paint as antifouling protection for the vessel hull or vessel transom, as long as it is not prohibited by law in the area where the vessel will be operated. If using copper- or tin-based antifouling paint, avoid an electrical interconnection between the YANMAR product, anodic blocks, or Y-CaPS and the paint by allowing a minimum of 40 mm (1-1/2 in.) of unpainted area on the transom of the vessel and around these items.



1 – Painted vessel transom
2 – Minimum 40 mm (1.5 in.) of unpainted area around transom assembly.

Figure 5-133

NOTICE

- The drive unit and transom assembly can be painted with a good quality marine paint or an antifouling paint that does not contain copper or any other material that could conduct electrical current. Never paint drain holes, anodes, Y-CaPS or items specified by the vessel manufacturer.
- Never wash the stern-drive with a power washer because it can damage the coating on the reference wire and increase corrosion.

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Section 6

PRE-DELIVERY

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PRE-DELIVERY PREPARATION

NOTICE

Before starting pre-delivery read the general information and installation requirements completely.

When the drive unit installation is complete, complete these final steps to prepare the package for delivery to the customer. It is the boat manufacturer's responsibility to perform these steps, or to make arrangement with the dealer to have these procedures completed.

Power Steering Fluid

NOTICE

- Use only Dextron III automatic transmission fluid (ATF) in a power steering system.
- Never operate the engine and power steering without fluid or the pump will be damaged.

Dexron III automatic transmission fluid	
Where used	**Part number**
Power steering pump	Obtain locally

Battery Connections

NOTICE

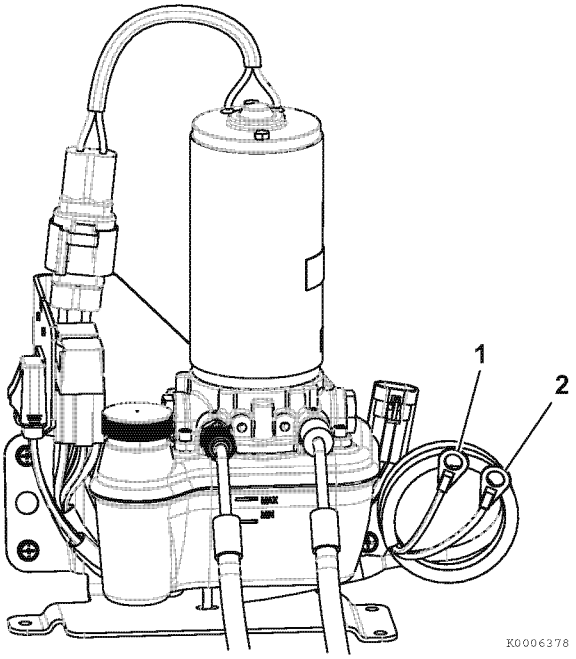
The engine electrical system is negative (-) ground.

---

1. Position the battery as close to the engine as possible.

   Note: If two or more batteries are used, connect the trim pump to the accessory battery, not the engine battery.

2. Connect the engine positive (+) battery cable (usually red) to the positive (+) battery terminal.
3. Connect the engine negative (-) battery cable (usually black) to the negative (-) battery terminal.
4. Connect the power trim pump red (+) battery cable to the positive (+) battery terminal.
5. Connect the power trim pump black (-) battery cable to the negative (-) battery terminal.



1 – Positive battery lead (red)
2 – Negative battery lead (black)

Figure 6-1

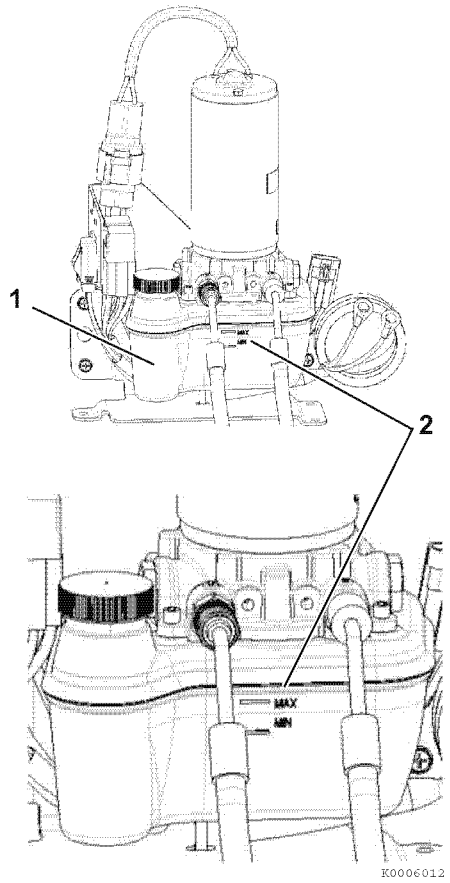
6. Ensure that all battery terminal connections are tight.
7. Spray the battery terminal connections with a sealant to help prevent corrosion.

Check the Power Trim Pump Fluid

NOTICE

Always check the oil level with stern-drive in the full DOWN/TRIM-IN position.

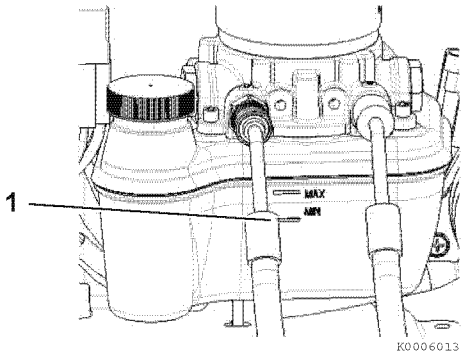
1. Place the stern-drive in full DOWN/TRIM-IN position.
2. Observe the oil level in the reservoir. The oil level should be maintained within the MIN and MAX lines on the reservoir **(Figure 6-2, (2))**.



1 – Reservoir
2 – MIN and MAX lines

Figure 6-2

3. The oil level is low if it is below the MIN line **(Figure 6-3, (1))** on the reservoir. Fill as necessary with the specified fluid. *See Fill the Power Trim Pump Fluid on page 6-4.*



1 – MIN line

Figure 6-3

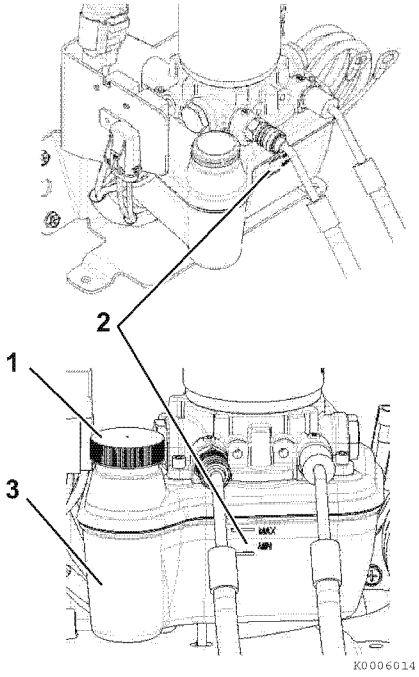
Fill the Power Trim Pump Fluid

Note: The power trim fluid does not require changing unless it becomes contaminated with water or debris. Contact your authorized YANMAR marine dealer or distributor if the power trim fluid needs to be changed.

1. Place the stern-drive in the full DOWN/TRIM-IN position.
2. Unscrew and remove the fill cap **(Figure 6-4, (1))** from the reservoir **(Figure 6-4, (3))** and fill with the specified fluid.

Dextron III automatic transmission fluid
Where used
Power trim pump

3. Add lubricant to bring the oil level to within the MIN and MAX lines on the reservoir **(Figure 6-4, (2))**.



1 – Fill cap assembly
2 – MIN and MAX lines
3 – Reservoir

Figure 6-4

4. Install the fill cap assembly.

Check the Stern-Drive Reservoir Oil Level

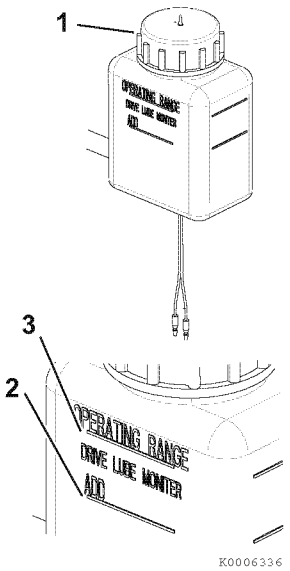
GL-5 hypoid gear oil
Where used
Oil reservoir

NOTICE

Only use GL-5 rated gear oil. Use of incorrect gear oil will cause premature clutch wear and stern-drive damage.

Note: The oil level will rise and fall during operation. Check the oil level before starting, when the engine is cold.

1. Check the stern-drive lubricating oil level **(Figure 6-5)**. Keep the oil level at or near the OPERATING RANGE (full) line on the oil reservoir.
2. The oil level is low if it is below the ADD line on the oil reservoir. Fill as needed with the specified oil. *See Fill the Stern-Drive Reservoir with Oil on page 6-6.*



1 – Oil reservoir
2 – ADD line
3 – OPERATING RANGE line

Figure 6-5

NOTICE

If any water is visible at the bottom of the oil reservoir or appears at the oil fill/drain plug, or if the oil appears discolored, contact your authorized YANMAR marine dealer or distributor immediately. Both conditions may indicate a water leak somewhere in the stern-drive.

Fill the Stern-Drive Reservoir with Oil

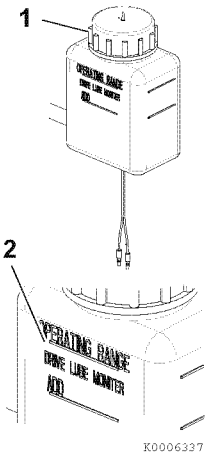
NOTICE

- If more than 60 ml (2 fl oz) of gear oil is required to fill the reservoir, a seal may be leaking. Damage to the stern-drive may occur because of lack of lubrication. Contact your authorized YANMAR marine dealer or distributor.
- Always check the stern-drive oil level in the reservoir after opening the oil valve screw. Fill with oil as required.

1. Remove the oil reservoir cap **(Figure 6-6, (1))**.
2. Fill the oil reservoir to the OPERATING RANGE **(Figure 6-6, (2))** (full) line with specified fluid.

NOTICE

Do not overfill the reservoir with oil.



1 – Oil reservoir cap
2 – OPERATING RANGE line

Figure 6-6

GL-5 hypoid gear oil
Where used
Oil reservoir

3. When replacing the cap, ensure that the rubber gasket is inside the oil reservoir cap and install the cap. Do not over-tighten.
4. Remove the oil reservoir cap and fill the reservoir with lubricant (GL-5 hypoid gear oil).
5. Recheck the oil level after the first use.
6. Connect oil tank sending unit wires to main harness.

Check the Stern-Drive Oil Level

NOTICE

The oil valve screw **(Figure 6-7, (1))** must be open during normal operation and before checking the stern-drive oil level. Open the oil valve screw (approximately 2 turns).

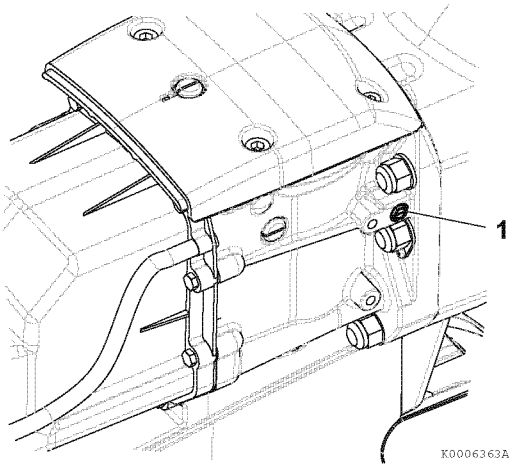


Figure 6-7

Note: If the oil valve screw nut turns when turning the oil valve screw, hold the nut with a wrench while turning the valve screw. Do not allow the valve screw nut to turn.

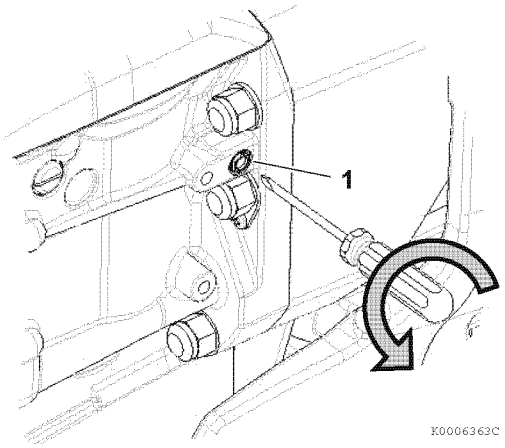
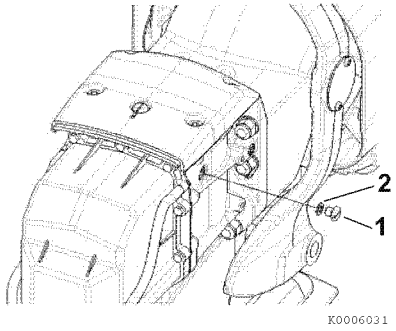


Figure 6-8

1. Remove the oil vent plug **(Figure 6-9, (1))** and gasket **(Figure 6-9, (2))**.



1 – Oil vent plug
2 – Gasket

Figure 6-9

2. If necessary, add oil until an air-free stream of oil flows from the oil vent hole.
3. Install the oil vent plug and gasket. Torque the oil vent plug.

Oil vent plug torque	
N·m	**lb-ft**
15	11

Propeller Selection

The propeller converts the engine's power into the thrust needed to propel the vessel. Careful selection of your propeller is very important to proper vessel operation. Propellers are identified by two numbers, such as 15.75 x 20 left-hand and stainless steel propeller. In the number sequence, the first number is the diameter of the propeller and the second is the pitch. Left-hand is counterclockwise rotation for front propeller. Right-hand is clockwise rotation for rear propeller.

Pitch is the angle of the blades expressed in the theoretical distance a propeller travels in each revolution. If for example the pitch is 20, each revolution of the propeller pushes the vessel 20 in. through the water. A 28 pitch is considered "higher" pitched and a 20 pitch propeller is considered "lower" pitched. A smaller pitch propeller should be selected for water skiing or for heavy loads.

For additional propeller information, see *General Specifications on page 3-4*.

Keep these guidelines in mind when selecting a propeller:

- The front and rear propeller should be the same pitch.

NOTICE

Never attempt to change propellers until after determining the average load and individual requirements. Your YANMAR dealer or distributor is most qualified to help you select a propeller.

- Engine rpm must be within the recommended OPERATING RANGE. Refer to the Engine Operator's Manual.

⚠ WARNING

Sever Hazard

To prevent accidental start-up, complete the following before installing or removing the propeller:

- **Put the remote control in the NEUTRAL position.**
- **Put the main switch to the OFF position and remove the key.**
- **Never use your hand to hold the propeller when loosening the nut. Put a wood block between the antiventilation plate and the propeller blade to prevent the propeller from turning.**

Problems associated with propellers include ventilation, cavitation and blow-out. These problems have similar symptoms and are best diagnosed by an expert. If a propeller-related problem develops, see your YANMAR marine dealer or distributor.

Installing the Propellers

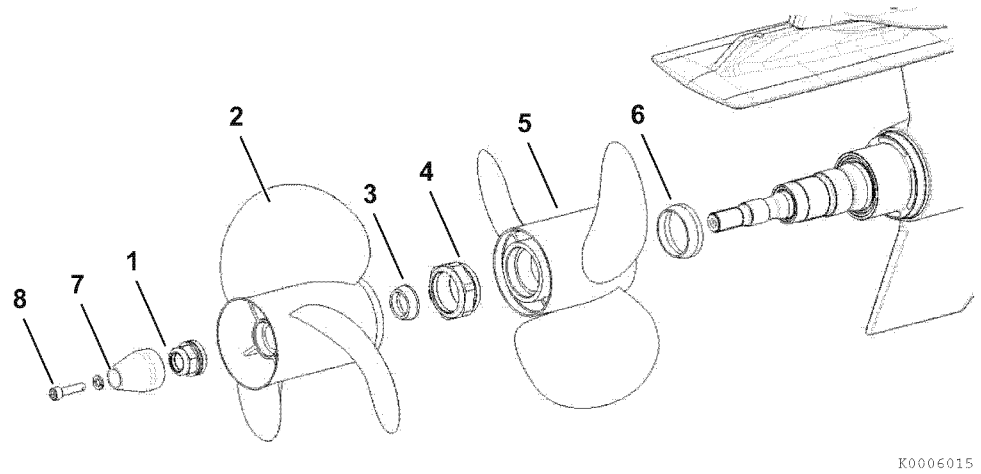
■ Propeller installation precautions

⚠ WARNING

Sever Hazard

- **A rotating propeller, especially when driven by an operating engine, can cause severe injury. Prior to installing or removing the propeller, ensure that the remote control is in the NEUTRAL position, the lanyard switch, if equipped, is in the OFF position, and the ignition switch is in the OFF position with the key removed from the switch.**
- **A rotating propeller can cause severe injury. Place a block of wood between the anti-ventilation plate and the propeller to protect hands from the propeller blades and to prevent the propeller from turning when removing and tightening the propeller nut.**

■ Propeller installation procedure



1 – Rear propeller nut
2 – Rear propeller
3 – Rear propeller thrust hub
4 – Front propeller nut
5 – Front propeller
6 – Front propeller thrust hub
7 – Propeller shaft anode
8 – Propeller shaft anode bolt and washer

Figure 6-10

1. Apply a liberal coat of lubricant to the propeller shaft. Recommended lubricants are shown in the table below.

Description	Where used
Urea grease water resistant type, NLGI #2	Propeller shaft
Lithium grease with PTFE	

2. Slide the forward thrust hub onto the propeller shaft with the tapered side toward the propeller hub (toward end of propeller shaft).
3. Align the splines and place the propeller on the propeller shaft.
4. Install and torque the front propeller nut. Check the propeller at least every 20 hours.

Front propeller nut torque	
N·m	lb-ft
135	99

5. Slide the aft thrust hub onto the propeller shaft, with the tapered side toward the propeller hub (toward end of shaft).
6. Align the splines and place the propeller on the propeller shaft.

NOTICE

- To reduce cavitation, stagger the alignment of the propellers on the shafts. The blades of the front and rear propellers should not be in the top position at the same time. When one of the front propeller blades is in the top position, the rear propeller blades should be visible between the front propeller blades after installation.
- Use special tool P/N 196350-92180 and a standard torque wrench to torque tighten the rear propeller nut.
  The special tool and torque wrench must be inline when applying torque. *See Propeller nut - outer on page 3-6* for torque conversion values.

7. Install and torque the rear propeller nut. Check the propeller at least every 20 hours.

Rear propeller nut torque	
N·m	lb-ft
80	59

8. Install the propeller shaft anode bolt with a washer. Torque the bolt.

Propeller shaft anode bolt torque	
N·m	lb-ft
30	22

NOTICE

Installation is correct when at least two threads of the propeller shaft are exposed through the propeller locknut after applying torque to the locknut. Place a block of wood between the anti-ventilation plate and the propeller when tightening the propeller nut.

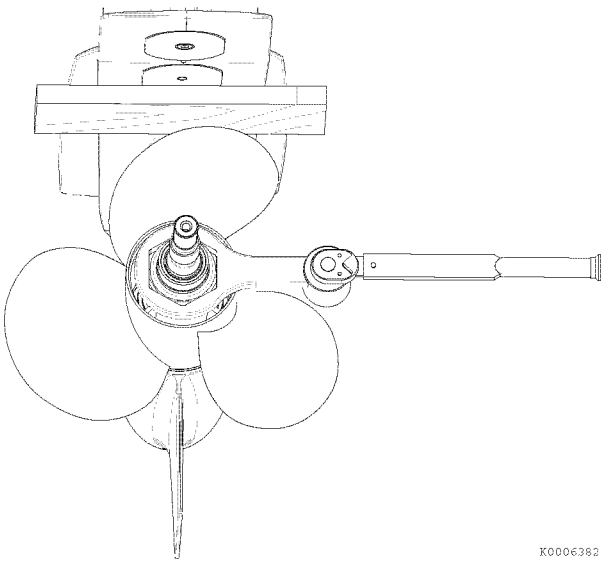


Figure 6-11

To aid in the future removal of the propeller, liberally apply lubricant on the propeller shaft splines.

UREA grease water resistant type NLGI #2	
Where used	Part number
Propeller shaft splines	Obtain locally

Removing the Propeller

⚠ WARNING

Sever Hazard

The remote control must be in NEUTRAL and the starter key removed from the switch before removing and/or installing the propeller.

1. Place a wood block between the propeller blades and the anti-ventilation plate to prevent rotation.

⚠ WARNING

Sever Hazard

Place a block of wood between the antiventilation plate and the propeller to protect hands from propeller blades and to prevent the propeller from rotating when removing the propeller nut.

2. Turn the rear propeller nut 36 mm (1.41 in.) counterclockwise to remove the nut.
3. Slide the propeller and the thrust hub off the propeller shaft.
4. Turn the front propeller nut 70 mm (2.75 in.) counterclockwise to remove the nut.
5. Slide the propeller and the thrust hub off the propeller shaft.

Test Preparations

⚠ WARNING

Steering Control Hazard

Never leave the helm unattended when performing tests with the boat in the water.

NOTICE

- The oil valve screw **(Figure 6-12, (1))** must be open during normal operation and before checking the stern-drive oil level. Open the oil valve screw (approximately two turns).
- If the oil valve screw nut turns when turning the oil valve screw, hold the nut with a wrench while turning the valve screw. Do not allow the valve screw nut to turn.

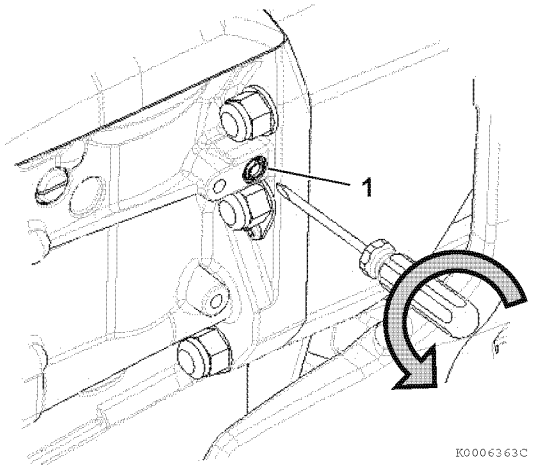


Figure 6-12

NOTICE

During operation, ensure that the engine seawater pump suction does not collapse the hose to the water source, causing the engine water supply to stop.

1. Ensure that there is a sufficient supply of coolant to the drive unit seawater inlet holes and/or the through-hull-seawater inlet holes.

2. Use the correct flushing attachment for the seawater pickup found on the drive unit.

NOTICE

If using a flush test device (attachment), install over the seawater intake holes and connect a water hose. Never use full water tap pressure. Also, avoid operating the engine above 1500 rpm, because the suction created could cause the water hose to collapse, causing the water supply to be cut off.

3. Check all engine-related items as specified by the engine manufacturer. See the engine manufacturer's instructions.

   Note: See the Operation Manual provided with your engine/vessel for operating specifications and fluid capacities.

NOTICE

The drive unit oil level in the oil reservoir will rise and fall during the drive unit operation. Always check the oil level in the reservoir when the drive unit is cool and when the engine is shut down.

4. Check the drive unit oil level in the oil reservoir.
5. Test the audio warning system, if equipped.

Engine Operation Tests

⚠ WARNING

Sever Hazard

If engine is to be tested with the boat out of the water, the propeller must be removed to avoid injury.

NOTICE

Overheating from insufficient coolant will cause engine and drive unit damage. Ensure that there is sufficient water available at the water inlet holes during operation.

1. Ensure that the coolant system drain plugs and petcocks are installed and tight.
2. Ensure that the coolant system hoses are installed and clamped securely.

Out-of-Water Testing

The following information is for engine operation tests with the boat out of the water:

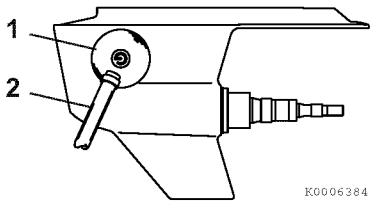
NOTICE

On vessels with the drive unit seawater inlet blocked off at the gimbal housing and using a through-the-hull seawater inlet, a constant supply of coolant must be available for both the drive unit and the engine during operation.

1. Install a flushing attachment over the drive unit and/or the alternate seawater inlet pickup holes.
2. Connect a hose between the flushing attachments and a water source.

NOTICE

If using a flushing attachment (sometimes referred to as a flush test device) over the seawater inlet holes and a water hose as shown, never use full water source pressure. Open the water source about 1/2 maximum.



1 – Typical flushing attachment (obtain locally)
2 – Water hose

Figure 6-13

See Test Preparations on page 6-11 for other checks.

In-Water Testing

The following information is for engine operation tests with the boat in the water.

⚠ WARNING

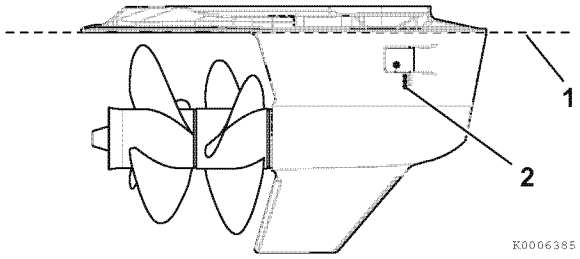
Steering Control Hazard

Never leave the helm unattended when testing the vessel in the water.

NOTICE

The water level must be above the seawater inlet holes on the drive unit or the through-the-hull pickup.

1. On engines with a drive unit seawater inlet: The water level must be above the seawater inlet holes on the drive unit.



1 – Minimum water level
2 – Water inlet holes

Figure 6-14

2. On engines with a through-the-hull seawater inlet: Ensure that the water level is above the seawater inlet holes on the through-the-hull seawater inlet.

■ Wide-Open Throttle Test

NOTICE

Follow the Engine Operation Manual to operate the engine at full throttle before the break-in period is complete.

1. To test if the correct propeller has been installed, operate the boat with a full load onboard at Wide-Open Throttle (WOT) and check the rpm with an accurate tachometer. Engine rpm should be near top of the specified range so that engine speed will not fall below specifications under a heavy load. If the engine speed is too high, replace the propeller with a higher pitch propeller.
2. *See Test Preparations on page 6-11* for other checks.

Drive Unit Operational Tests

⚠ WARNING

Steering Control Hazard

Never leave the helm unattended when performing tests with the boat in the water.

NOTICE

Instruments warn of engine problems. Watch the temperature gauge on the dash to ensure that the engine does not overheat to avoid engine damage.

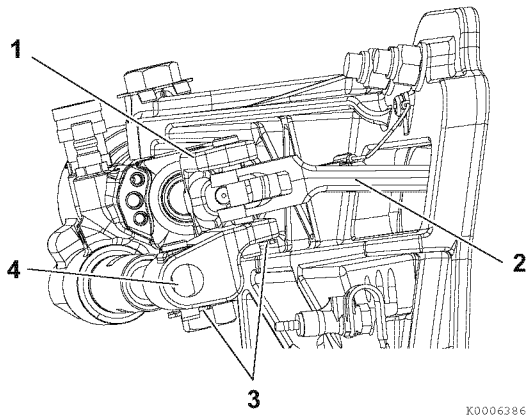
1. Refer to the Engine Operation Manual and start the engine.
2. Operate the engine at idle rpm until it reaches normal operating temperature.
3. Turn the steering wheel to starboard, then to port, and ensure that the drive unit turns the correct way.

   Note: A noisy steering pump indicates air may be trapped in the system. To correct the problem, bleed the air from the HO system.

4. Check the power steering system for a lugging condition (engine rpm drops and/or the power steering pump tone changes).
5. Turn the steering wheel to the LEFT (port) until it stops and then continue to apply pressure. If the pump lugs, check the following:
   1- Check for an obstruction between the gimbal ring and the gimbal housing, and all moving steering components.
   2- Ensure that the steering lever is not contacting the cutout in the transom. Modify the cutout if there is contact between the transom and the cutout.
6. Turn the steering wheel to the RIGHT (starboard) until it stops and then continue to apply pressure. If the pump lugs, check the following:
   1- Check for an obstruction between gimbal ring and gimbal housing, and all moving steering components.
   2- Ensure that the steering lever is not contacting the cutout in the transom. Modify the cutout if there is contact between the transom and the cutout.
7. Check the steering cable end dimension with the cable fully extended. *See Shift Plate and Cable Installation and Adjustment (Mechanical Shift System) on page 5-73* for proper steering cable dimensions.
8. Turn the engine off.
9. Lubricate the steering cable and clevis.

NOTICE

Ensure that the cable end that enters the clevis is heavily lubricated.



1 – Clevis
2 – Steering lever
3 – Clevis pins and cotter pins
4 – Steering cable end

Figure 6-15

UREA grease water resistant type NLGI #2	
Where used	**Part number**
Steering cable end	Obtain locally

10. Restart the engine and observe the drive unit. If drive unit creeps, an external tension may exist on steering cable.
11. Ensure that there is nothing attached to steering cable casing. The cable must be free to move when actuated.
12. Check the power steering pump fluid level.
13. Position the drive unit so it is straight back.
14. Turn the engine off.

15. Check the power steering fluid level and add as necessary.

NOTICE

- If the power package will not be used for an extended period of time, or will be exposed to freezing temperatures, drain the water from the drive unit. Always drain water to prevent corrosion and freeze damage to the engine and/or the drive unit. *See Y-CaPS Functionality Tests on page 6-15.*
- The drive unit should be stored in the FULL DOWN/IN position. The U-joint bellows may develop a set if the drive unit is stored in the raised position and may fail when the drive unit is returned to service.

Y-CaPS Functionality Tests

Before testing the operation of the Y-CaPS, the boat should be in the water for a minimum of 24 hours.

Verify and determine the following:

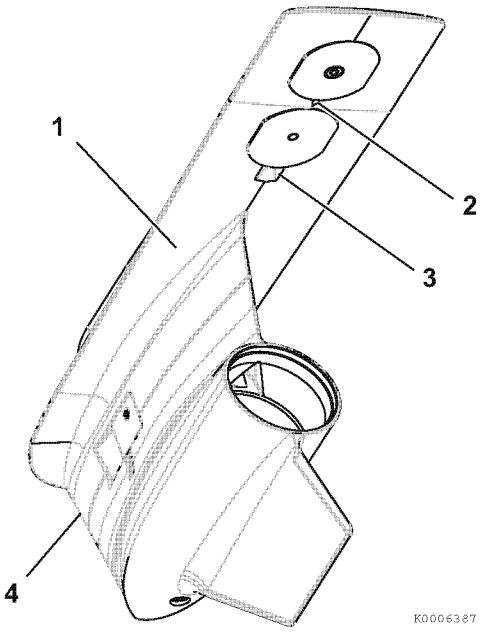
- Are galvanic protection levels adequate?
- Are additional measures required?
- Is the Y-CaPS functioning correctly?

Cold Weather (Freezing Temperature), Seasonal and Extended Storage

NOTICE

YANMAR strongly recommends that this service should be performed by an authorized YANMAR dealer/distributor. Damage caused by freezing is not covered by the YANMAR warranty.

Use a piece of wire to check the water drain passages in the drive unit to ensure that they are open.



1 – Underside of anticavitation plate
2 – First anode cavity drain passage
3 – Second anode cavity drain passage
4 – Speedometer pitot hole

Figure 6-16

NOTICE

The drive unit should be stored in the full DOWN/IN position. The U-joint bellows may develop a set if the unit is stored in the raised position and may fail when the unit is returned to service.

Store the drive unit in the full DOWN (in) position.

Removal of Stern-Drive

Before removing the stern-drive:

- Disconnect the shift harness, or shift cable, from the shift plate.
- Close the oil valve on the drive unit.
- Disconnect the quick connector from the oil tank hose.
- Disconnect all other electrical connections, such as the Y-CaPS, trim limit and sender wires, etc.

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