

OPERATION MANUAL

MARINE GEAR

**KMH60A
KMH61A**

English



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INTRODUCTION

Welcome to the world of Yanmar Marine! Yanmar Marine offers engines, drive systems and accessories for all types of boats, 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 marine gears are designed for a wide range of applications. Our parallel, down angle, saildrive and V-drive marine gears are designed to reduce the vibration and make your cruising more pleasurable.

To help you enjoy your Yanmar Marine products for many years to come, please follow these recommendations:

- Read and understand this *Operation Manual* before you operate your boat to ensure that you follow safe operating practices and maintenance procedures.
- Keep this *Operation Manual* in a convenient place for easy access.
- If this *Operation Manual* is lost or damaged, order a new one from your authorized Yanmar marine dealer or distributor.
- Make sure this manual is transferred to subsequent owners. This manual should be considered a permanent part of the boat and remain with it.
- Constant efforts are made to improve the quality and performance of Yanmar products, so some details included in this *Operation Manual* may differ slightly from your marine gear. If you have any questions about these differences, please contact your authorized Yanmar marine dealer or distributor.

INTRODUCTION

RECORD OF OWNERSHIP

Take a few moments to record the information you need when you contact Yanmar for service, parts or literature.

Marine Gear Model: _____

Marine Gear Serial No.: _____

Date Purchased: _____

Dealer: _____

Dealer Phone: _____

SAFETY

Yanmar considers safety of great importance and recommends that anyone that comes into close contact with its products, such as those who install, operate, maintain or service Yanmar products, exercise care, common sense and comply with the safety information in this manual and on the engine and marine gear's safety labels. Keep the labels 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 label attached to it, make sure you order the new part and label 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 engine and marine gear, personal property and/or the environment or cause the equipment to operate improperly.

SAFETY PRECAUTIONS

General Information

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.

Before You Operate

WARNING



- Never permit anyone to install or operate the engine or marine gear without proper training.
- Read and understand this *Operation Manual* before you operate or service the engine or marine gear to ensure that you follow safe operating practices and maintenance procedures.
- Safety signs and labels are additional reminders for safe operating and maintenance techniques.
- Contact your authorized Yanmar marine dealer or distributor for additional training.

During Operation and Maintenance

DANGER

FIRE HAZARD



- 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.
- Ensure that appropriate fire detection and extinguishing equipment are installed and checked periodically for proper operation. Check with local authorities.

DANGER

CRUSH HAZARD



- Always use lifting equipment with sufficient capacity to lift marine gear.
- Never stand under hoisted marine gear. If the hoist mechanism fails, the marine gear will fall on you, causing serious injury or death.
- Never support marine gear with equipment not designed to support the weight of the marine gear such as wooden pieces, blocks or by only using a jack.

⚠ 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.
- Diesel fuel is flammable and explosive under certain conditions.
- Never use a shop rag to catch the fuel.
- Wipe up all spills immediately.

⚠ WARNING**FIRE HAZARD**

- Avoid injury or equipment damage from fire. Undersized wiring systems can cause an electrical fire.

⚠ WARNING**ALCOHOL AND DRUG HAZARD**

- Never operate the engine while under the influence of alcohol or drugs or when feeling ill.

⚠ WARNING**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.

⚠ WARNING**ENTANGLEMENT HAZARD**

- Never leave the key in the key switch when you are servicing the engine or marine gear. Someone may accidentally start the engine and not realize you are servicing it.
- 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.
- If the vessel has more than one engine, Never service a marine gear 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.
- Avoid unexpected equipment movement. Shift the marine gear into the NEUTRAL position any time the engine is at idle.

WARNING

SEVER HAZARD



- Never service the marine gear while under tow or if the engine is running at idle speed. The propeller may rotate under these circumstances.
- 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.
- If the vessel has more than one engine, Never service a marine gear 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.
- Shift the marine gear into the NEUTRAL position only when the engine is at idle speed.
- To prevent accidental equipment movement, Never start the engine in gear.
- Before starting the engine, Always make sure that all bystanders are clear of the area. Keep children and pets away while the engine is operating.
- Avoid personal injury or equipment damage. Always remove any tools or shop rags used during maintenance from the area before operation.
- Stop the engine before you begin to service the marine gear and secure the propeller so it will not turn.

WARNING

BURN HAZARD



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

WARNING

SUDDEN MOVEMENT HAZARD

- Avoid personal injury. Always stop the engine before beginning service.
- When you install the “emergency nut” the boat will move as soon as you start the engine! Make sure the area is clear before you start the engine.

WARNING

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.

⚠ WARNING**ELECTRICAL SHOCK HAZARD**

- 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 personal injury or equipment damage. Always keep the electrical connectors and terminals clean. Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors.

⚠ CAUTION**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.

⚠ CAUTION**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.

⚠ CAUTION**FLYING OBJECT HAZARD**

- 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.

⚠ CAUTION

- Periodic maintenance prevents unexpected downtime, reduces the number of accidents due to poor machine performance and helps extend the life of the marine gear.

If any problem is noted during the visual check, the necessary corrective action should be taken before you operate the marine gear.

⚠ CAUTION

SLIPPING AND TRIPPING HAZARD



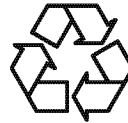
- Ensure that adequate floor space is set aside for servicing marine gear. The floor space must be flat and free of holes.
- Keep floor free of dust, mud, spilled liquids and parts to help prevent slipping and tripping.

NOTICE

It is important to perform daily checks as listed in this *Operation Manual*.

Periodic maintenance prevents unexpected downtime, reduces the number of accidents due to poor engine or marine gear performance and can help extend the life of the engine and marine gear.

NOTICE



Always be environmentally responsible.

Follow the guidelines of the EPA or other governmental agencies for the proper disposal of hazardous materials such as lubrication oil, diesel fuel and engine coolant. Consult the local authorities or reclamation facility.

NOTICE

Never dispose of hazardous materials by dumping them into a sewer, on the ground or into ground water or waterways.

NOTICE

Before operating the engine, check marine gear oil level.

NOTICE

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

NOTICE

Observe the following environmental operating conditions to maintain marine gear performance and avoid premature marine gear wear:

- Never run the marine gear if the ambient temperature is above +45 °C (+113 °F) or below -15 °C (+5 °F).
- If the ambient temperature exceeds +45 °C (+113 °F) the marine gear may overheat and cause the marine gear oil to break down.
- If the ambient temperature falls below -15 °C (+5 °F) rubber components such as gaskets and seals will harden causing premature marine gear wear and damage.
- Contact your authorized Yanmar marine dealer or distributor if the marine gear will be operated in either temperature extreme.

NOTICE

Observe the following environmental operating conditions to maintain marine gear performance and avoid premature marine gear wear:

- Avoid operating in the presence of chemical gases or fumes.
- Avoid operating in extremely dusty conditions.

NOTICE

Never attempt to modify the marine gear's design or safety features.

NOTICE

Failure to comply may impair the marine gear's safety and performance characteristics and shorten the marine gear's life. Any alterations to this marine gear may affect the warranty coverage of your marine gear.

NOTICE

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

NOTICE

If the marine gear oil temperature is too high, stop engine immediately and check the marine gear oil level and check the oil cooler for proper coolant and water flow.

NOTICE

New Marine Gear Break-In:

On the initial engine start-up, allow the engine to idle for approximately 15 minutes while you check for proper marine gear function and marine gear oil leaks.

During the break-in period, carefully observe marine gear indicators (if any) for proper marine gear function.

During the break-in period, check the marine gear oil levels frequently.

NOTICE

Never use the marine gear lifting eye to lift the engine and marine gear as an assembly. Use the engine lifting eyes to lift the engine and marine gear. Only use the marine gear lifting eye to lift the marine gear as a separate component.

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PRODUCT OVERVIEW

OVERVIEW

The KMH marine gear is a hydraulically-activated helical gear unit, developed for use in pleasure craft.

The marine gear is equipped with a disk-type reversing clutch mounted on the input shaft and the support shaft and supplied with hydraulic pressure from an oil pump.

Operation of the oil pump is dependent on the engine speed.

The marine gear is lubricated by splash and force-feed lubrication.

COMPONENT IDENTIFICATION

Note: KMH60A shown. Other models are similar.

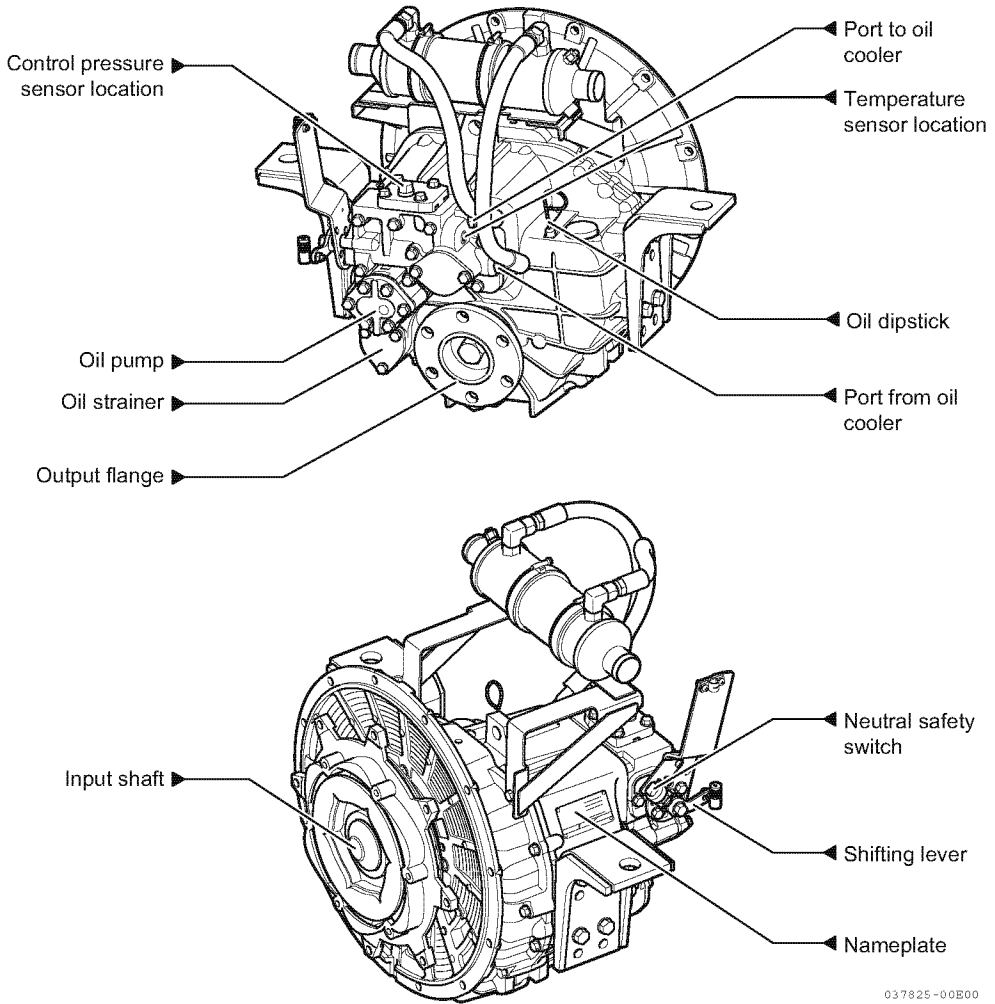


Figure 1

NOTICE

Never use the marine gear lifting eye to lift the engine and marine gear as an assembly. Use the engine lifting eyes to lift the engine and marine gear. Only use the marine gear lifting eye to lift the marine gear as a separate component.

NAMEPLATE

The nameplate is installed on the marine gear.

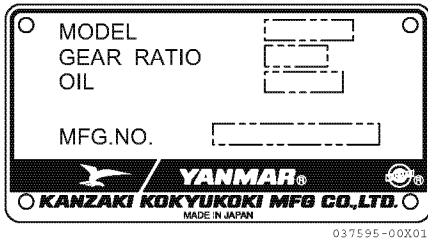
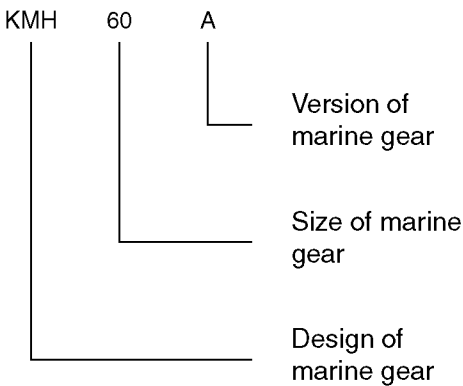


Figure 2

Significance of Marine Gear Designations



TECHNICAL DATA

When mounting the KMH marine gears, the following items should be specially noted:

- Mounting should be done by a specialist only.
- Arrange the marine gear and engine correctly.
- Align correctly with regard to engine and propeller shaft.
- Select a suitable damping coupling between the engine and the marine gear.
- Choose adequate heat exchanger.
- Mount the marine gear correctly in the boat.

	KMH60A	KMH61A
Shifting Pressure (Changes in oil temperature or input speed will affect shifting pressure.)	3.67 to 3.77 MPa (532 to 547 psi)	4.33 to 4.43 MPa (628 to 642 psi)
Maximum Input Speed	3745 min ⁻¹ (rpm)	
Oil Capacity without Heat Exchanger	2.8 L (3.0 qt)	

MARINE GEAR OPERATION

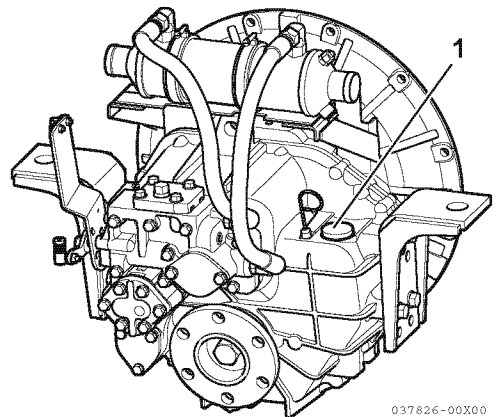
This section of the *Operation Manual* describes the procedure for performing daily checks, checking the marine gear oil level and shifting the marine gear.

Before performing any operations within this section, *review the Safety section on page 3.*

BEFORE OPERATING THE MARINE GEAR

*Note: Before operating the marine gear for the first time, be sure the plug covering the breather (1, **Figure 1**) is removed. If the breather is covered, the pressure in the marine gear may exceed the allowable operating level during operation. This will cause oil to leak from the oil seal.*

KMH60A



037826-00X00

Figure 1

DAILY CHECKS

All marine gears have been submitted to a test run before shipment.

Visual checks for leakage should be made from time to time.

Before operating the marine gear, make sure it is in good operating condition. Make sure you check the following items and have any repairs completed before you operate the marine gear.

Visual Checks

CAUTION

If any problem is noted during the visual check, the necessary corrective action should be taken before you operate the marine gear.

1. Check for oil leaks.
2. Check for damaged or missing parts.
3. Check for loose, missing or damaged fasteners.
4. Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors.

Checking Oil Level

KMH60A

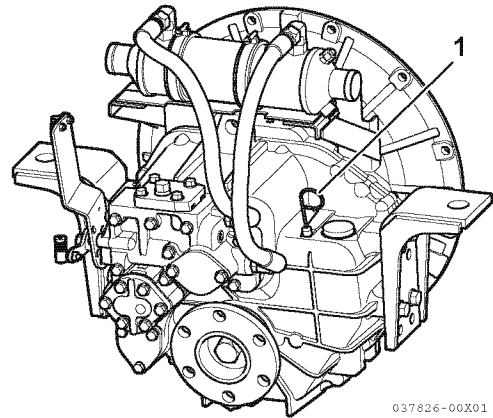


Figure 2

1. Remove dipstick (1, **Figure 2**) and wipe with clean cloth.

NOTICE

Prevent dirt and debris from contaminating marine gear oil. Carefully clean the oil plug and dipstick and the surrounding area before you remove the dipstick.

2. Fully reinsert dipstick (2, **Figure 3**) .

KMH60A

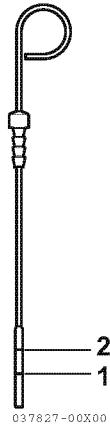


Figure 3

3. Remove the dipstick. The oil level should be between the upper (2, **Figure 3**) and lower (1, **Figure 3**) lines on dipstick.
4. Fully reinsert dipstick.
5. Move the shift lever to NEUTRAL.
6. Start the engine. Let the engine run at idle with the shift lever in the NEUTRAL position for several minutes. This will ensure the oil is distributed to all pipelines, oil cooler and marine gear oil passages.
7. Stop the engine. Wait at least 10 minutes for the oil to drain back into the sump.
8. Check the oil level. If necessary, add oil until the level reaches the upper mark on the dipstick. Check the oil level again after operating the marine gear for a short period of time.

NOTICE

Never overfill. The oil level must be between the upper and lower level marks.

Recommended Oil (Type of Oil)

- **API (American Petroleum Institute) service grade:** Class CD or higher
- **Viscosity:** SAE 30
- **Recommended oil:** Yanmar Marine Super Oil SAE 30

NOTICE

Always use the specified SAE 30 oil. Never use gear oil or ATF in KMH marine gears. Never use multi-grade oil or mix oil types.

SHIFTING THE MARINE GEAR

NOTICE

During normal operation, the marine gear should only be shifted with the engine at idle. Shifting at higher engine speed will damage the marine gear.

Mechanical Shift

The marine gear is shifted by moving the shifting lever.

Shifting Positions:

- A = Propeller rotation opposite of engine rotation
- N = NEUTRAL position
- B = Propeller rotation same as engine rotation

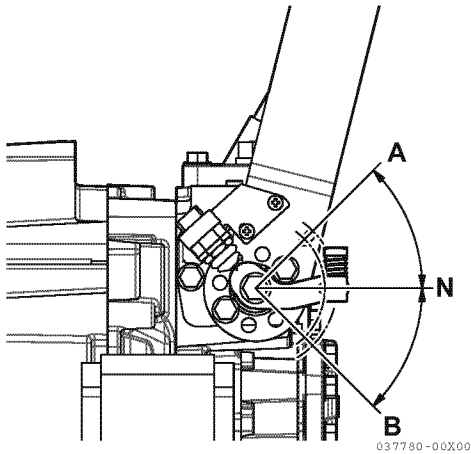


Figure 4

Operating temperature of the marine gear: 50° to 80 °C (122° to 176 °F).

A connection port for a temperature sensor has been provided. (See Component Identification on page 12.)

Electric Shift

Propeller direction

CW: Propeller rotation opposite of engine rotation.

CCW: Propeller rotation same as engine rotation.

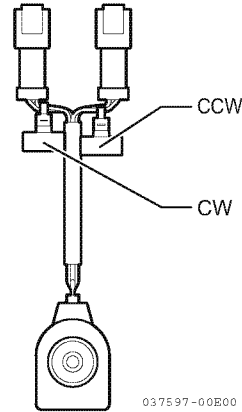


Figure 5

Viewd from Propeller Side

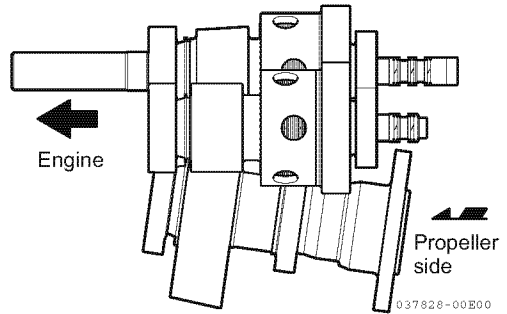
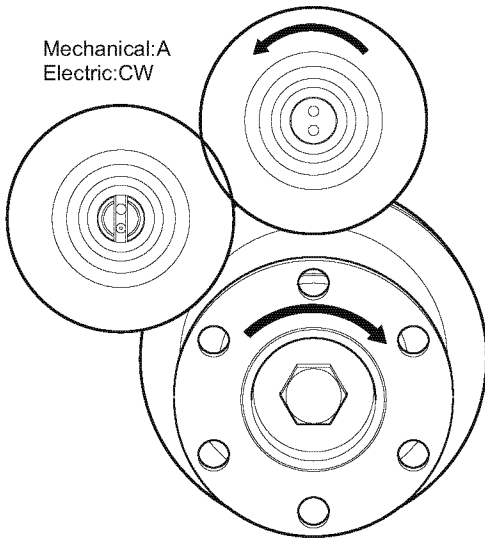


Figure 6

Emergency Operation of Electric Valve

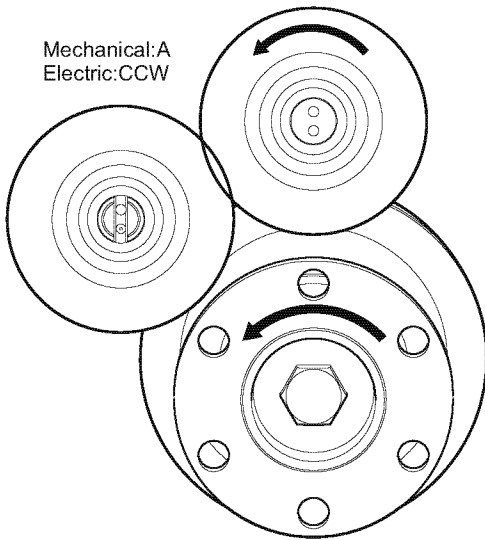
If the electric valve stops operating with the engine(s) not running, do the following:

Current Production Models



Viewed from propeller side 037829-00E00

Figure 7



Viewed from propeller side 037829-00E01

Figure 8

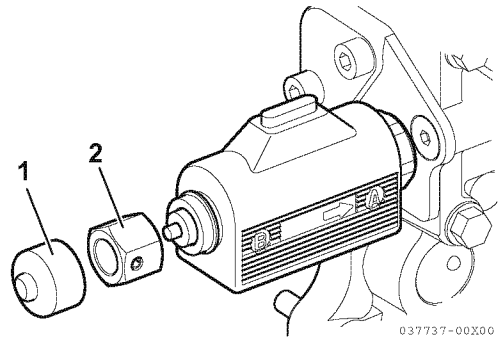


Figure 9

1. With the engine(s) not running, remove cap (1, **Figure 9**), and emergency nut (2, **Figure 9**).

CAUTION

If you have more than one engine, you cannot shift the marine gear into the "B" position after you install the "emergency nut."

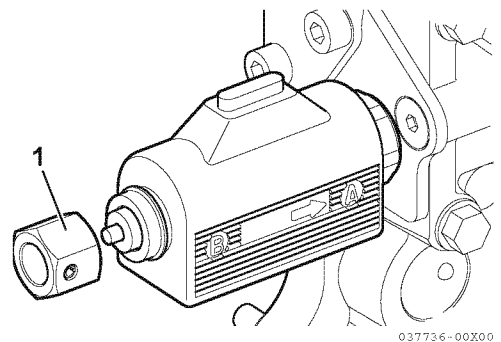


Figure 10

MARINE GEAR OPERATION

- Reverse the emergency nut (1, **Figure 10**) and thread it onto electric valve.

⚠ WARNING

When you reverse the "emergency nut" the transmission is locked in gear and the boat will move as soon as you start the engine! There is no neutral safety protection in this mode. Make sure the area is clear before you start the engine.

- In this condition, the propeller rotates in the direction of **Figure 7** at the engine start.

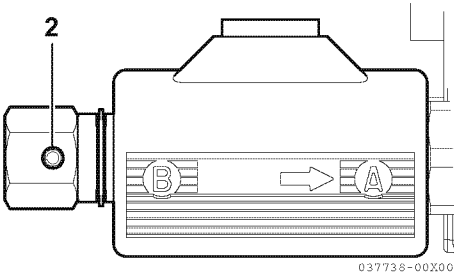
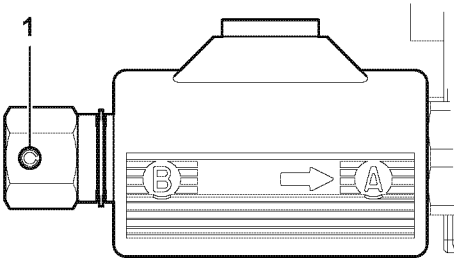


Figure 11

Note the orientation of the spring pin in the emergency nut.

- Normal operation (1, **Figure 11**)
- Emergency operation (2, **Figure 11**)

Past Production Models

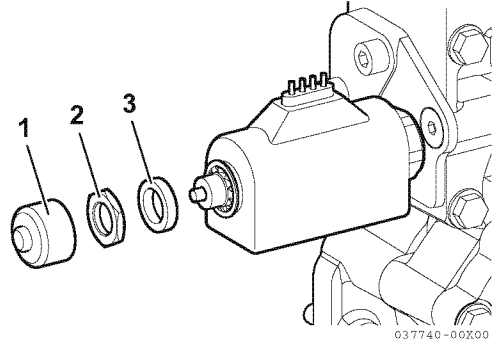


Figure 12

- With the engine(s) off, remove cap (1, **Figure 12**), nut (2, **Figure 12**) and collar (3, **Figure 12**).

⚠ CAUTION

If you have more than one engine, you cannot shift the marine gear into the "B" position after you install the "emergency nut."

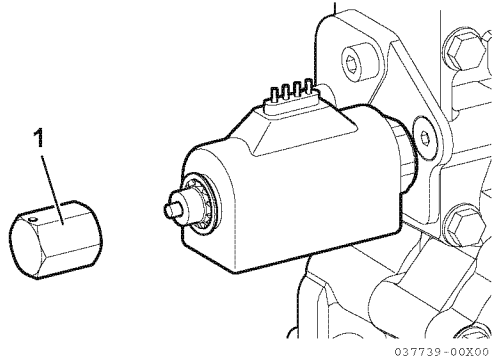


Figure 13

- Thread the emergency nut (1, **Figure 13**) onto electric valve.

▲ WARNING

When you reverse the "emergency nut" the transmission is locked in gear and the boat will move as soon as you start the engine! There is no neutral safety protection in this mode. Make sure the area is clear before you start the engine.

3. In this condition, the propeller rotates in the direction of **Figure 7** at the engine start.

TOWING OR ANCHORING

When a boat is being towed or is anchored, water current will cause the propeller to turn. (When the engine is off, the position of the shifting lever is irrelevant.) The propeller must be fixed to prevent from damage, when the propeller is turned by towing or single engine running (in the twin engine boat) for 1 hours or more.

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MAINTENANCE

This section of the *Operation Manual* describes the procedures for proper care and maintenance of the marine gear.

Before performing any operations within this section, *review the Safety section on page 3.*

TIGHTENING FASTENERS

Use the correct amount of torque when tightening fasteners. Applying excessive torque may damage the fastener or component and too little torque may cause a leak or component failure.

NOTICE



The tightening torque in the Standard Torque Chart should be applied only to the bolts with a “7” head. (JIS strength classification: 7T).

Apply 60 % torque to bolts that are not listed.

Apply 80 % torque when tightened to aluminum alloy.

TORQUE CHARTS

Standard Torque Values

	M6 x 1.0	M8 x 1.25	M10 x 1.25 or 1.5	M12 x 1.25 or 1.5	M14 x 1.5	M16 x 1.5
Cast Iron or Steel	10.8 ± 1.0 N·m	25.5 ± 2.0 N·m	49.1 ± 4.9 N·m	88.3 ± 10.0 N·m	137.2 ± 4.9 N·m	225.4 ± 10.0 N·m
	8.0 ± 0.8 ft-lb	18.8 ± 1.5 ft-lb	36.2 ± 3.6 ft-lb	65.1 ± 7.4 ft-lb	101.2 ± 3.6 ft-lb	166.2 ± 7.4 ft-lb
Aluminum	8.8 ± 1.0 N·m	20.6 ± 2.0 N·m	39.2 ± 2.0 N·m	70.6 ± 4.9 N·m	109.8 ± 4.9 N·m	180.3 ± 10.0 N·m
	6.5 ± 0.8 ft-lb	15.2 ± 1.5 ft-lb	28.9 ± 1.5 ft-lb	52.1 ± 3.6 ft-lb	81.0 ± 3.6 ft-lb	133.0 ± 7.4 ft-lb

Torque Specifications

Item	Size	Torque		Comments
Shifting Lever Bolt	M10 x 1.5	39.2 ± 2.0 N·m (347 ± 18 in.-lb)	28.9 ± 1.5 ft-lb	
Tapered Plugs	NPTF 3/8	39.2 ± 2.0 N·m (347 ± 18 in.-lb)	28.9 ± 1.5 ft-lb	
Drain Plugs	M16 x 1.5	29.4 ± 2.0 N·m (260 ± 18 in.-lb)	21.7 ± 1.5 ft-lb	
Neutral Safety Switch	M12 x 1.25	3.2 ± 0.25 N·m (28 ± 2.2 in.-lb)	2.4 ± 1.5 ft-lb	
Hose Clamps for Cooler		2.5 - 3.4 N·m (22 ± 30 in.-lb)	1.8 ± 2.5 ft-lb	
Hose for Cooler	3/4 - 16	49 ± 0.49 N·m (434 ± 43 in.-lb)	36.1 ± 0.36 ft-lb	
Transmission Assembly Bolts	M8	18.6 - 22.6 N·m (165 ± 200 in.-lb)	13.7 - 16.7 ft-lb	
	M10	37.2 - 41.2 N·m (329 ± 365 in.-lb)	27.5 - 30.4 ft-lb	
	M12	65.7 - 75.5 N·m (582 ± 668 in.-lb)	48.5 - 55.7 ft-lb	
Oil Dipstick		Hand-Tighten		

PERIODIC MAINTENANCE

CAUTION

Establish a periodic maintenance plan according to the marine gear application and make sure you perform the required periodic maintenance at intervals indicated. Failure to follow these guidelines will impair the marine gear's safety and performance characteristics, shorten the marine gear's life and may affect the warranty coverage on your marine gear. Contact your authorized Yanmar marine dealer or distributor for assistance when checking items marked with a ●.

The Importance of Periodic Maintenance

Marine gear deterioration and wear occur in proportion to the length of time the marine gear has been in service and the conditions it is subjected to during operation. Periodic maintenance prevents unexpected downtime, reduces the number of accidents due to poor machine performance and helps extend the life of the marine gear.

The Importance of Daily Checks

The Periodic Maintenance Schedule assumes that the daily checks are performed on a regular basis. Make it a habit of performing daily checks before the start of each operating day. *See Daily Checks on page 16* and refer to the *Operation Manual* for your engine.

Keep a Log of Engine Hours and Daily Checks

Keep a log of the number of hours the engine is run each day and a log of the daily checks performed. Also note the date, type of repair (e.g., replaced bearings), and parts used for any service needed between the periodic maintenance intervals. Periodic maintenance intervals are every 250 engine hours. Failure to perform periodic maintenance will shorten the life of the marine gear.

Yanmar Replacement Parts

Yanmar recommends that you use genuine Yanmar parts when replacement parts are needed. Genuine replacement parts help ensure long engine life.

Tools Required

Before you start any periodic maintenance procedure, make sure you have the tools you need to perform all of the required tasks.

Ask Your Authorized Yanmar Marine Dealer or Distributor For Help

Our professional service technicians have the expertise and skills to help you with any maintenance or service related procedures.

Daily and periodic maintenance is important to keep the marine gear in good operating condition. The following is a summary of maintenance items by periodic maintenance intervals. Periodic maintenance intervals vary depending on marine gear application and are hard to establish definitively. The following should be treated only as a general guideline.

Note: These procedures are considered normal maintenance and are performed at the owner's expense.

Periodic Maintenance Schedule

○: Check or Clean ◇: Replace ●: Contact your authorized Yanmar marine dealer or distributor

System	Item	Periodic Maintenance Interval			
		Daily	At 50 hours (1 st period)	Every 250 hour one year, whichever comes first	Every 500 hour 2 years, whichever comes first
Whole	Visual inspection of engine exterior	○ Before starting			
Lubricating System	Check the lubricating oil level and refill if necessary	○ Before starting			
	Replace the lubricating oil		◇	◇	
	Clean oil strainer		○	○	
	Replace oil filter of the electric trolling valve		◇	◇	
	Check and Clean oil cooler			●	
Electrical System	Check the wiring connectors			○	
Miscellaneous Items	Check friction/steel plates, bearings and gears. Replace them if necessary				●
	Check the damper, Replace it if necessary				●

MAINTENANCE

PERIODIC MAINTENANCE PROCEDURES

After Initial 50 Hours of Operation

Perform the following maintenance after the initial 50 hours of operation.

- Changing the Marine Gear Oil and Cleaning the Marine Gear Oil Strainer
- Changing the Electric Trolling Valve Oil Filter Element (If Equipped)

Changing the Marine Gear Oil and Cleaning the Marine Gear Oil Strainer

Optimum effectiveness of oil can only be assured if the marine gear oil is changed and the oil strainer is washed with clean oil regularly, according to the maintenance schedule.

1. Position a container under the marine gear to collect the waste oil.

KMH60A

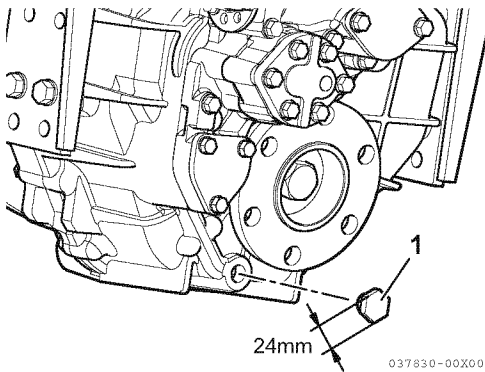


Figure 1

2. Remove the M16 drain plug (1, **Figure 1**) and seal.

3. Check the drain plug seal for damage. Replace if necessary.

KMH60A

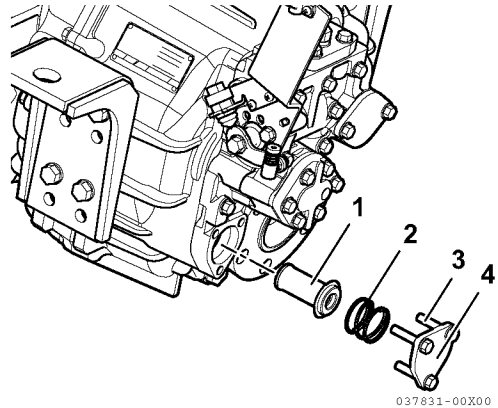
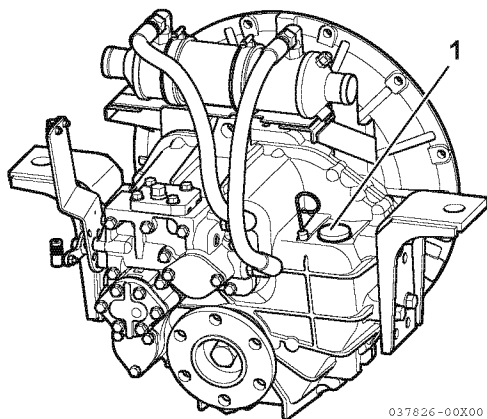


Figure 2

4. Remove three M8 x 40 bolts (3, **Figure 2**) and washers.
5. Remove the cover (4, **Figure 2**), seal, spring (2, **Figure 2**) and oil strainer (1, **Figure 2**).
6. Check the cover seal for damage. Replace if necessary.

*Note: The oil strainer (1, **Figure 2**), must be washed with clean oil whenever the oil is changed.*

7. Reinstall the oil strainer, spring, seal and cover.
8. Tighten the cover bolts to 18.6 - 20.6 N·m (13.7 - 15.2 lb-ft).



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Figure 3

9. Remove the oil cap (1, **Figure 3**). Fill with the following quantities of oil, and add the amount required for cooler and pipelines.
 - Quantities of oil:
 KMH60A/KMH61A - 2.8 L (3.0 qt)
 KMH61V - 7.5 L (7.9 qt)
 - Type of oil: *See Recommended Oil (Type of Oil) on page 17.*
10. After filling the marine gear with oil, reinstall the oil cap and hand-tighten. Over-tightening may damage the cap.
15. Check oil level. (*See Checking Oil Level on page 16*). If necessary, add oil until the level reaches the upper mark on the dipstick. Check the oil level again after operating the marine gear for a short period of time.

NOTICE

Never overfill marine gear with oil.

11. Perform a trial run after the oil change.
12. Move the shift lever to the NEUTRAL position.
13. Start the engine. Let the engine idle with the shift lever in the NEUTRAL position for several minutes. This will ensure the oil is distributed to all pipelines and the oil cooler.
14. Stop the engine. Wait at least 10 minutes for the oil to drain back into the sump.

MAINTENANCE

Changing the Electric Trolling Valve Oil Filter Element (If Equipped)

1. Remove four mounting bolts (1, **Figure 4**) from electric trolling valve (2, **Figure 4**).

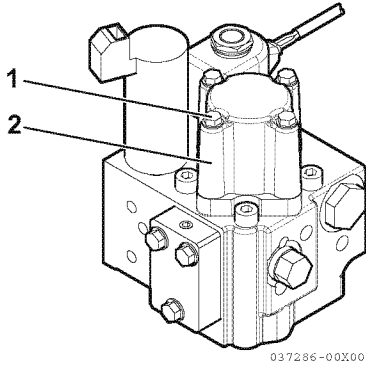


Figure 4

2. Remove filter element housing (3, **Figure 5**).

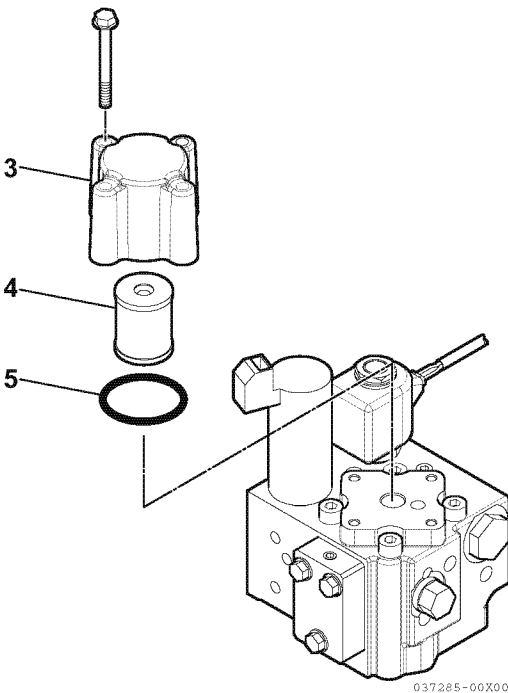


Figure 5

3. Remove filter element (4, **Figure 5**).
4. Remove and replace O-ring (5, **Figure 5**).
5. Install new filter element.
6. Install filter element housing.
7. Install four mounting bolts.

Every 250 Hours of Operation

Perform the following maintenance every 250 hours of operation or yearly, whichever comes first.

- **Changing the Marine Gear Oil and Cleaning the Marine Gear Oil Strainer**
- **Changing the Electric Trolling Valve Oil Filter Element (If Equipped)**

Changing the Marine Gear Oil and Cleaning the Marine Gear Oil Strainer

See Changing the Marine Gear Oil and Cleaning the Marine Gear Oil Strainer on page 28.

Changing the Electric Trolling Valve Oil Filter Element (If Equipped)

See Changing the Electric Trolling Valve Oil Filter Element (If Equipped) on page 30.

LONG-TERM STORAGE

If the marine gear is stored for six months or longer, oil level should be checked and the gear should be driven for 5 minutes every 6 months.

Drain seawater from the cooling system, including the gear oil cooler.

Before operating the marine gear after long-term storage, the marine gear oil must be changed. *See Changing the Marine Gear Oil and Cleaning the Marine Gear Oil Strainer on page 28.*

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TROUBLESHOOTING

TROUBLESHOOTING CHART

Before performing troubleshooting, verify that all items of the operating instructions have been complied with.

The following chart will assist in troubleshooting.

CAUTION

If any indicator fails to illuminate when the key switch is in the ON position, contact your authorized Yanmar Marine dealer or distributor for service before operating the engine and marine gear.

No.	Problem	Possible Cause	Action
1	Oil temperature	Oil level high during operation	Pump out oil until oil level is at maximum mark on dipstick.
		Oil level low	Add oil.
		Plugged or restricted heat exchanger	Replace heat exchanger and flush water system.
		Unknown	Contact your authorized Yanmar Marine dealer or distributor.
2	Oil on marine gear housing	Loose screws	Tighten to specification.
		Loose hardware	Tighten or replace.
		Loose dipstick	Tighten or replace.
		Oil level too high during operation	Pump out oil until oil level is at maximum mark on dipstick.
		Unknown	Contact your authorized Yanmar Marine dealer or distributor.
3	Oil and water mixed	Damaged heat exchanger	Contact your authorized Yanmar Marine dealer or distributor.

TROUBLESHOOTING

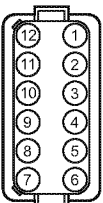
No.	Problem	Possible Cause	Action
4	Shifts hard	Selector control	Contact your authorized Yanmar Marine dealer or distributor.
		Linkage	Contact your authorized Yanmar Marine dealer or distributor.
		Unknown	Contact your authorized Yanmar Marine dealer or distributor.
5	Slow engagement	Selector control	Contact your authorized Yanmar Marine dealer or distributor.
		Low oil level	Add oil.
		Linkage	Contact your authorized Yanmar Marine dealer or distributor.
		Electric shift valve, pressure control valve or hydraulic circuit	Contact your authorized Yanmar marine dealer or distributor.
		Unknown	Contact your authorized Yanmar Marine dealer or distributor.
6	No movement of the boat	Selector control	Contact your authorized Yanmar Marine dealer or distributor.
		Improper selector position	Adjust.
		Low oil level	Add oil.
		Propeller missing	Replace.
		Propeller shaft broken	Contact your authorized Yanmar Marine dealer or distributor.
		Marine gear malfunction	Contact your authorized Yanmar Marine dealer or distributor.
		Engine malfunction	Contact your authorized Yanmar Marine dealer or distributor.
		Harness or connectors	Contact your authorized Yanmar marine dealer or distributor.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Item		Specification	
		KMH60A	KMH61A
Type		Down Angle Hydraulic	
Angle		8°	
Maximum Input Torque		960 N·m (708 ft·lb)	1070 N·m (789 ft·lb)
Maximum Input Speed		3745 min ⁻¹ (rpm)	
Reduction Ratio (F/R)		1.55/1.55	
		2.04/2.04	
		2.43/2.43	
		-	
Direction of Rotation	Input	Counterclockwise viewed from Stern	
	Output	Clockwise (Recommendation) or Counterclockwise viewed from Stern	
Shift		Mechanical or Electrical	
Lubrication		Forced Lubrication	
Oil Capacity		2.8 L (3.0 qt)	
Bellhousing Size		SAE #3	
Dry Mass		58 kg (127 lb) without Oil Cooler, Damper or Feet	

Pin No.	DESCRIPTION
1	SHIFT F(DC12V+)
2	SHIFT R(DC12V+)
3	PWM(TROLLING)
4	N/A
5	NSP LOOP
6	GND(TROLLING)
7	N/A
8	N/A
9	N/A
10	N/A
11	GND(DC12V-)
12	N/A



DT04-12PA-E005
(Deutsch)

Interface between engine & marine gear
(Electric shift & trolling)

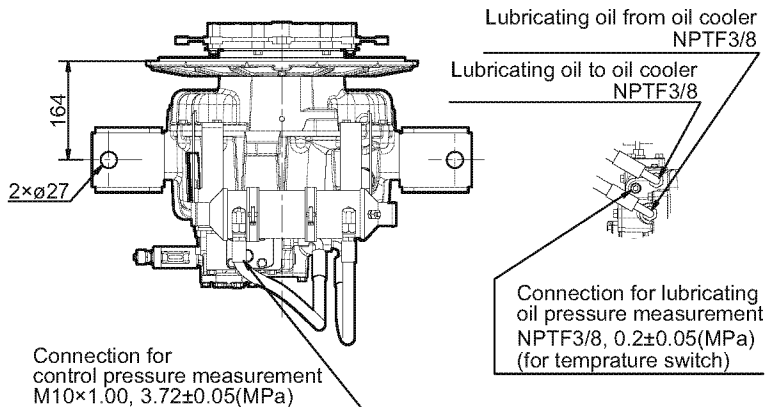
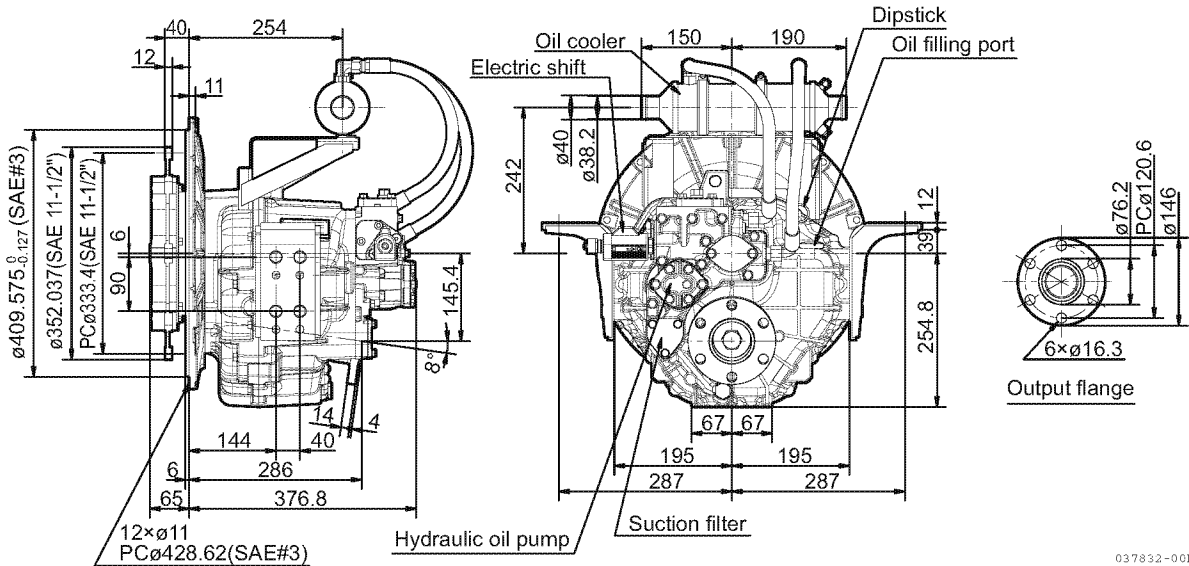


Figure 1



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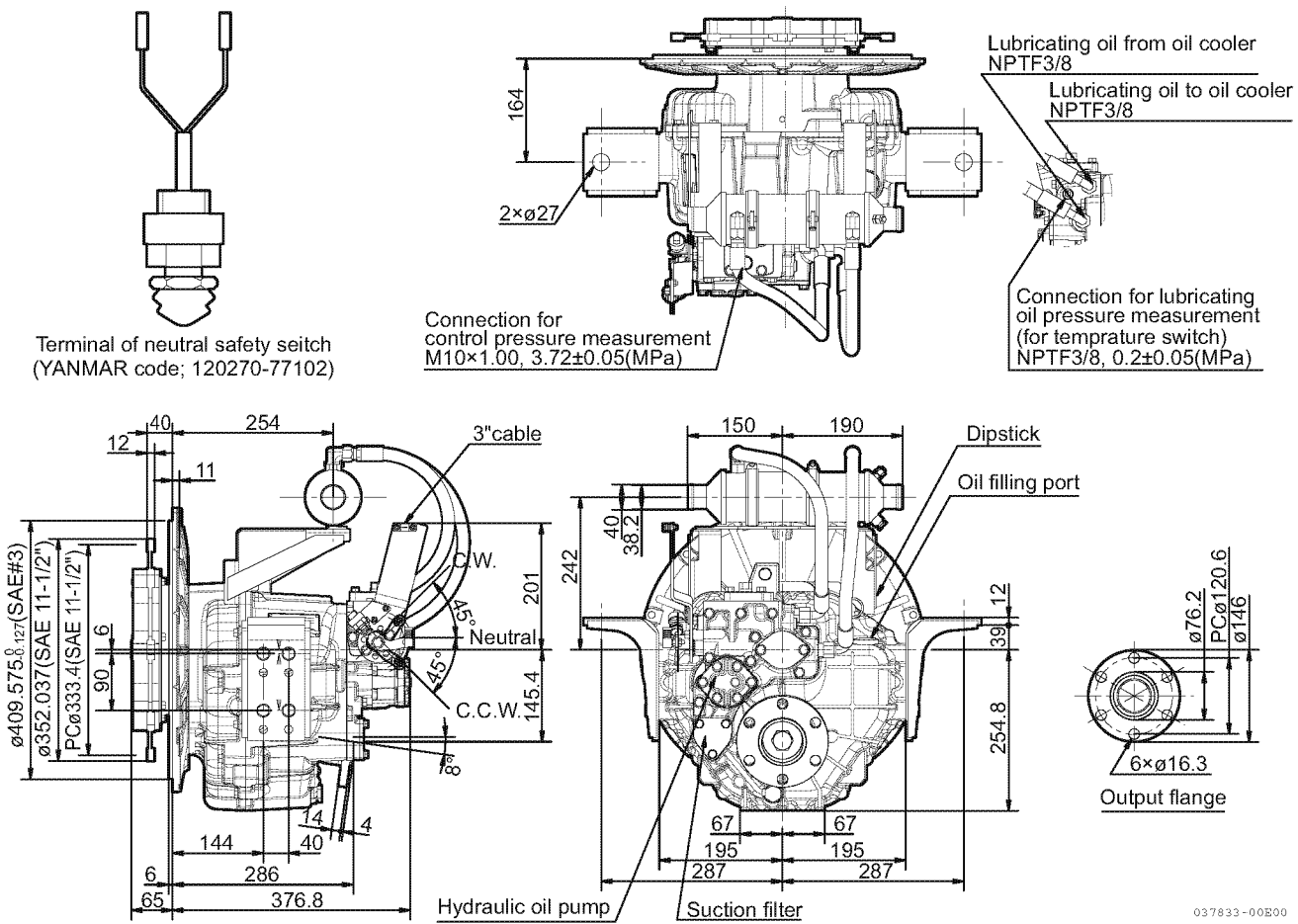
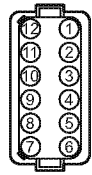


Figure 2

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Pin No.	Description
1	Shift F(DC12V+)
2	Shift R(DC12V+)
3	PWM(trolling)
4	N/A
5	NSP loop
6	GND(trolling)
7	N/A
8	N/A
9	N/A
10	N/A
11	GND(DC12V-)
12	N/A



DT04-12PA-E005 (Deutsch)

Interface between engine & marine gear (Electric shift & trolling)

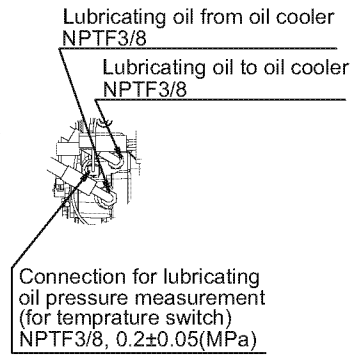
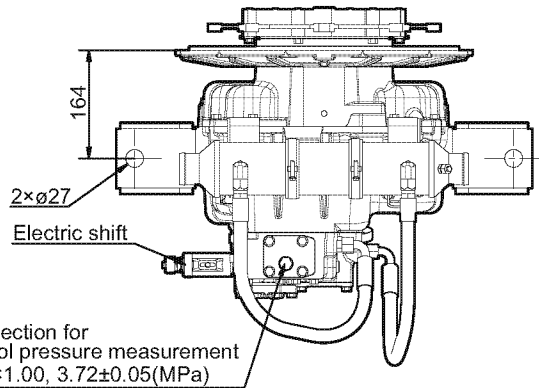
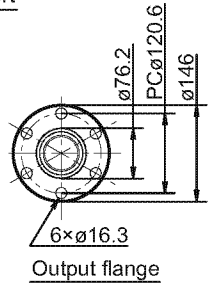
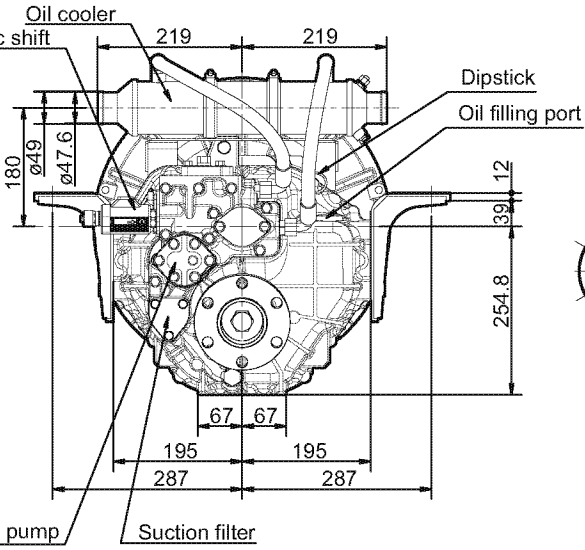
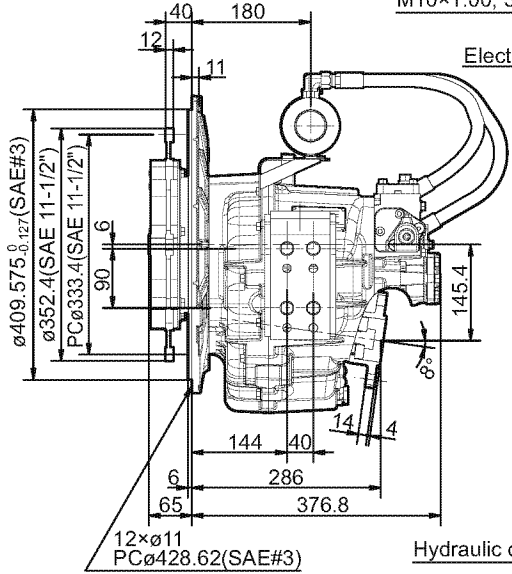
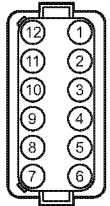


Figure 3



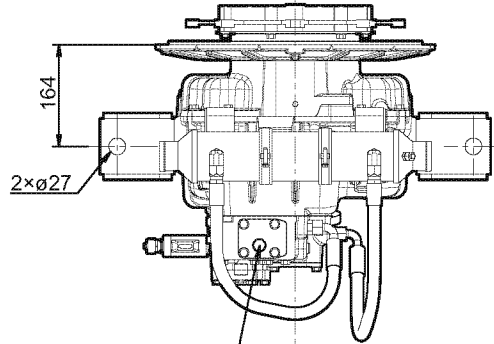
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Pin No.	DESCRIPTION
1	SHIFT F(DC12V+)
2	SHIFT R(DC12V+)
3	PWM(TROLLING)
4	N/A
5	NSP LOOP
6	GND(TROLLING)
7	N/A
8	N/A
9	N/A
10	N/A
11	GND(DC12V-)
12	N/A



DT04-12PA-E005
(Deutsch)

Interface between engine & marine gear
(Electric shift & trolling)



Connection for control pressure measurement
M10×1.00, 4.38±0.05(MPa)

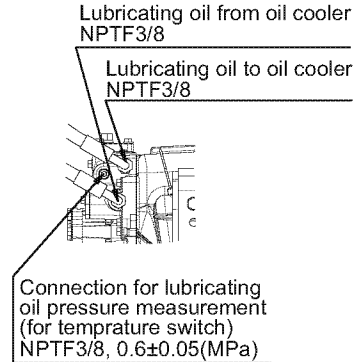
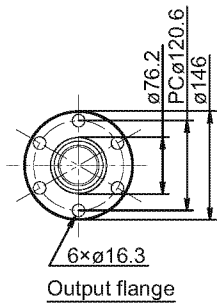
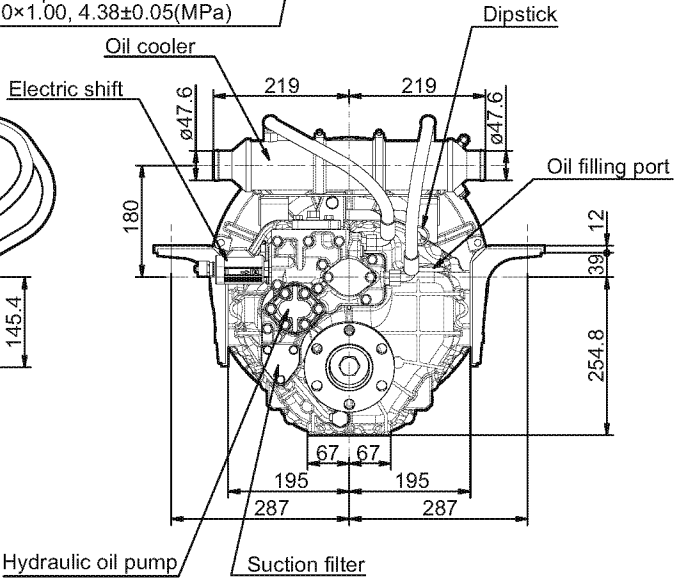
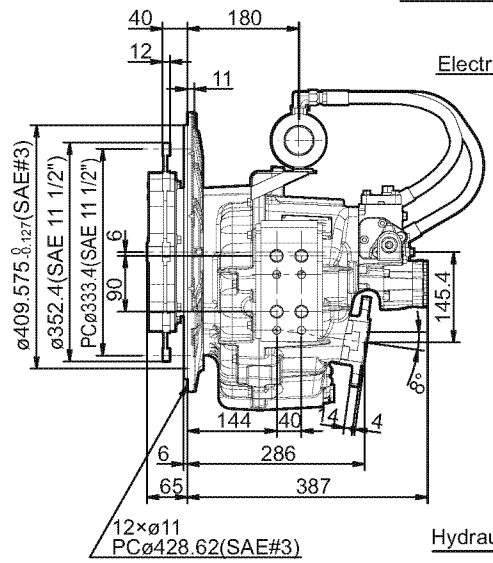


Figure 4



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OPTIONAL ACCESSORIES

The optional accessories include the following:

- ELECTRIC SHIFT VALVE
- TROLLING VALVE
- PTO SPLINE SLEEVE AND FLANGE

For installation of the optional accessories, contact your authorized YANMAR dealer or distributor.

PTO SPLINE SLEEVE AND FLANGE

By installing the PTO output port in the rear portion of the marine gear input shaft, engine power can be taken off to drive the pump, etc.. The PTO output port complies to the SAE standard (type A).

ELECTRIC SHIFT VALVE

The electric shift valve can electrically switch to forward, neutral, and reverse.

TROLLING VALVES

By decreasing the propeller speed lower than the propeller speed at the engine low idling, the trolling valve can operate the boat at low speed. The trolling valve has a mechanical trolling valve and an electric trolling valve.

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KMH60A, KMH61A

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