OPERATION MANUAL

ELECTRIC SAILDRIVE

SDe

SDe7

SDe10

SDe15

YANMAR

Disclaimers:

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OPERATION MANUAL	MODEL	SDe7, SDe10, SDe15
	CODE	0ASDE-EN0010

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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.
We design our products to respect nature. This means quieter products, with minimal vibrations, cleaner than ever. All of our products meet applicable regulations, including emissions, at the time of manufacture.

To help you enjoy your YANMAR SDe series electric saildrive for many years to come, please follow these recommendations:

- Read and understand this *Operation Manual* before you operate the machine 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 product 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 product. If you have any questions about these differences, please consult your authorized YANMAR Marine dealer or distributor.
- The specifications and components described in this manual may differ from ones installed on your boat.
  Please refer to the manual provided by the manufacturer of these components.
- Refer to the YANMAR Limited Warranty Handbook for a complete warranty description.

SOFTWARE LICENSE

This product consists of software licensed under The MIT License (MIT).

For more information, see https://github.com/aws/amazon-freertos/blob/main/LICENSE.

⚠ WARNING

This product can expose you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. Go to www.P65Warnings.ca.gov for more information.

RECORD OF OWNERSHIP

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

SDe Model: _____

SDe Serial No.: _____

Date Purchased: _____

Dealer: _____

Dealer Phone: _____

To Register Your YANMAR Electric Saildrive

1. Visit https://www.yanmar.com/marine/service/register-your-engine/ or our website: https://www.yanmar.com/marine
2. Log in the YANMAR Marine Support Portal and register your system.

To Get Multi Language Operation Manual

1. Scan the following two dimensional code.

2. Select your saildrive series.
3. Select your saildrive.
4. Select the language you want, and get the Operation Manual.

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 machine's safety decals. 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

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

Indicates a situation which can cause damage to the saildrive, 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

⚠ DANGER

- **Never permit anyone to install, service, or operate the electric saildrive without proper training.**
- **Read and understand this *Operation Manual* before you operate or service the electric saildrive to ensure that you follow safe operating practices and maintenance procedures.**
- **Read each instruction manual for the Li-ion battery and charger for their handling procedures.**
- **Safety signs and labels are additional reminders for safe operating and maintenance techniques.**
- **Consult authorized YANMAR Marine dealer or distributor for additional training.**
- **Check and follow each country's regulations to see if qualifications are required for maintenance.**

During Operation and Maintenance

⚠ DANGER

Crush Hazard!

- **Never stand under the hoisted electric saildrive or battery. If the hoist mechanism fails, the electric saildrive or battery will fall on you, causing serious injury or death.**
- **When you need to transport an electric saildrive or battery for repair, have a helper assist you to attach it to a hoist and load it onto a truck.**
- **Always use lifting equipment with sufficient capacity to lift electric saildrive or battery.**
- **Never support electric saildrive or battery with equipment not designed to support the weight of the electric saildrive or battery such as wooden pieces, blocks or by only using a jack.**

Explosion Hazard!

- **Keep the area around the Li-ion battery well-ventilated and keep sparks, open flames and any other form of ignition out of the area.**
- **Be sure to follow the precautions listed in this manual when connecting to shore power and house devices.**

⚠ WARNING

Fire Hazard!

- Undersized wiring systems can cause an electrical fire. Never use improper capacity of fuses.
- Store any equipment in a designated area away from moving parts.
- Never use the compartment with electric saildrive or Li-ion battery for storage.
- Ensure that appropriate fire detection and extinguishing equipment are installed and checked periodically for proper operation.
- Keep fire extinguishers for not only ordinary but Li-ion battery 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 and follow with national laws and local ordinances. For the electric saildrive, it is necessary to keep fire extinguishers for Li-ion battery.
- Have all fire extinguishers checked periodically for proper operation and/or readiness.

⚠ WARNING

Sever Hazard!

- Never service the electric saildrive while undertow or the system is in standby.
- 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. Keep hands, feet and tools away from all moving parts.
- Always remove any tools or shop rags used during maintenance from the area before operation.
- Always turn off the battery switch or disconnect the negative Li-ion battery cable before you begin to service the electric saildrive and secure the propeller so it will not turn.
- Never operate the electric saildrive on the land. Rotating propeller can cause severe injury or death.

Alcohol and Drug Hazard!

Never operate the electric saildrive while under the influence of alcohol or drugs or when feeling ill.

⚠ WARNING

Exposure Hazard!

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

Entanglement Hazard!

- Always turn off the battery switch (if equipped) or disconnect the negative Li-ion battery cable when you are servicing the electric saildrive. Someone may accidentally operate the electric saildrive and not realize you are servicing it.
- Never operate the electric saildrive while wearing a headset to listen to music or radio because it will be difficult to hear the warning signals.

Burn Hazard!

- Some of the motor, saildrive, controller and electric power cables surfaces become very hot during operation and shortly after shut-down. Keep hands and other body parts away from hot motor, saildrive, controller and electric power cables surfaces.
- Handle hot components with heat-resistant gloves.

⚠ WARNING

Sudden Movement Hazard!

- Always stop the electric saildrive system before beginning installing or maintenance.
- Avoid unexpected equipment movement. Turn off the electric saildrive power using the power switch on the switch panel or put the system in Neutral Mode any time the system is not used.

Electrical Shock Hazard!

- Always turn off the battery switch (if equipped) or disconnect the negative Li-ion battery cable before servicing the equipment.
- Always keep the electrical connectors and terminals clean. Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors.
- Never touch the electrical equipment with wet hands, gloves or clothes.
- Never wear clothes with metal during installing or maintenance.
- Remove bilge water and keep dry condition during installing or maintenance.
- Always pay attention to high voltage during installing, check or maintenance.
- Never attempt to repair yourself.
- Never touch non-insulated power cables, damaged wires or electrical devices.

⚠ CAUTION

Poor Lighting Hazard!

Ensure that the work area is adequately illuminated. Always install wire cages on portable safety lamps.

Tool Hazard!

Always use tools appropriate for the task at hand and use the correct size tool for loosening or tightening machine parts.

Flying Object Hazard!

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

Slipping and Tripping Hazard!

Ensure that adequate floor space is set aside for servicing electric saildrive. The floor space must be clean, flat and free of spilled liquids and debris to prevent slipping or tripping.

Battery Electrolyte Hazard!

Do not touch the electrolyte without eye and skin protection when you find the electrolyte leakage. If contact with the eyes or skin should occur, flush eyes and wash immediately with clean water.

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 electric saildrive performance and can help extend the life of the electric saildrive.

- 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. 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.
- The Li-ion battery should be processed by a recognised recycling agency. The Li-ion battery may be returned to YANMAR Marine dealer or distributor for disposal. The Li-ion battery pack must not be mixed with any domestic or industrial waste.

- When using independently procured parts, be sure to use parts that have the characteristics specified by YANMAR.
- Only use replacement parts specified. Other replacement parts may affect warranty coverage.
- Always follow the regulations of each country when storing Li-ion batteries.

NOTICE

Use only recommended batteries and chargers. Otherwise the system does not work properly. The batteries cannot be charged, resulting in damage to the battery.

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 electric saildrive's design or safety features. Failure to comply may impair the saildrive's safety and performance characteristics and shorten the saildrive's life. Any alterations to this saildrive may affect the warranty coverage of your saildrive.

LOCATION OF SAFETY LABELS

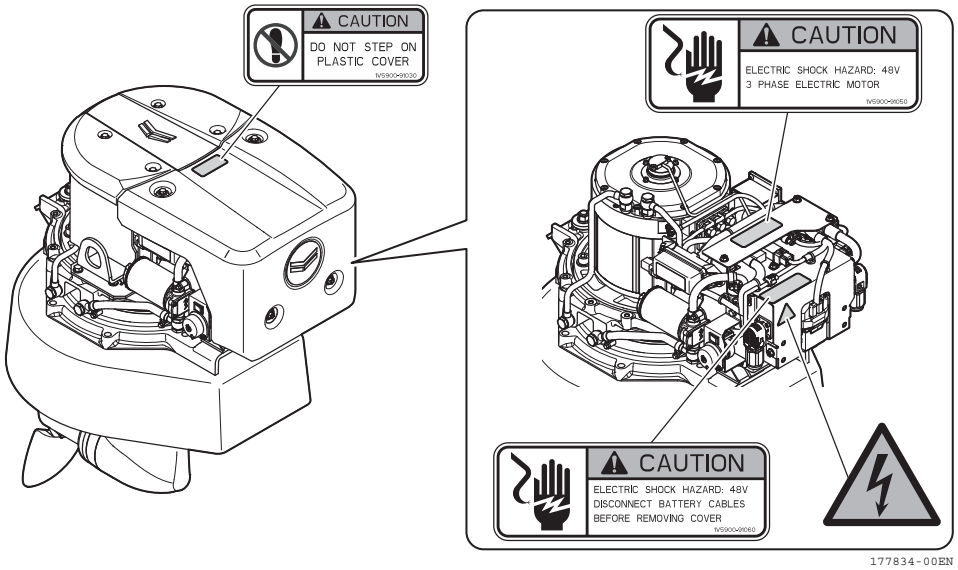

Figure 1

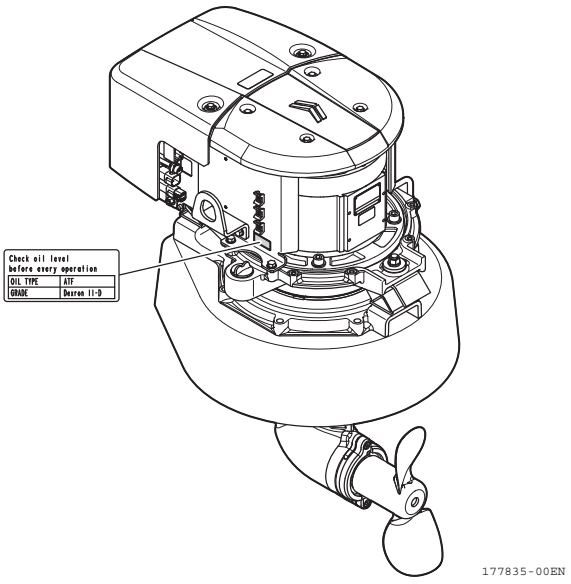

Figure 2

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PRODUCT OVERVIEW

OVERVIEW

YANMAR Electric Saildrive Features

YANMAR SDe series is an electrically driven saildrive system.
There are 3 electric motor power ratings: 7 kW, 10 kW and 15 kW. Within the specified operating conditions, the saildrive can be driven for at least 60 minutes at rated power (S2-60 min).
The motor is driven with the 48 V motor drive system and with Li-ion battery pack.

This product consists of a saildrive leg, an electric motor, a motor drive system, a Li-ion battery pack, and boat control system. Boat control system is designed to operate the SDe.

Owner/Operator Responsibilities

The operator must, and assumes all responsibility to:

- Read and understand the *Operation Manual* prior to operating the saildrive.
- Perform all safety checks as necessary to ensure safe operation.
- Comply with and follow all lubrication and maintenance instructions and recommendations.
- Have an authorized YANMAR dealer/distributor perform periodic checkups.

Conducting normal maintenance service and replacing consumable parts as necessary is the responsibility of the owner/operator and necessary to provide the best durability, performance and dependability of the saildrive while keeping your overall operating expenses to a minimum. Individual operating habits and usage may increase the frequency of performing maintenance service condition. Monitor conditions frequently to determine if the maintenance intervals suggested in the manual are frequent enough for your saildrive.

New Electric Saildrive Break-In

- On the initial saildrive operation, operate the motor to run at minimum speed for approximately 15 minutes while you checking for proper electric saildrive function and oil leakage from the saildrive.
- During the break-in period, carefully observe the saildrive seal indicator for proper electric saildrive function.
- During the break-in period, frequently check the saildrive oil levels.

Dealer/Distributor Responsibilities

In general, a dealer's responsibilities to the customer include predelivery inspection and preparation such as:

- Ensure that the boat is properly equipped.
- Prior to delivery, make certain that the YANMAR saildrive and other equipment are in proper operating condition.
- Make all necessary adjustments for maximum efficiency.
- Familiarize the customer with the on-board equipment.
- Explain and demonstrate the operation of the saildrive and boat.

GALVANIC CORROSION

Galvanic corrosion results whenever two or more dissimilar metals (like those found on the saildrive) are submerged in a conductive solution, such as seawater, polluted water or water with a high mineral content. The chemical reaction takes place due to metal submersion, and this causes 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 saildrive components.

Corrosion Control

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

However, it is essential that the owner/operator frequently monitor the anodes for wear, inspect the saildrive for corrosion and replace the anodes often enough to provide a sacrificial surface for the electrical current to attack. Galvanic isolators and isolation transformers are also available from the aftermarket (not supplied by YANMAR). The Galvanic isolator is a device that is installed in series with the (AC) grounding (GREEN) conductor of the shore-power cable to effectively block low-voltage DC galvanic current flow but permit the passage of alternating current (AC)*.

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

- the number, size and location of sacrificial anodes on the saildrive and boat.
- the marina environment, such as stray current in the water, freshwater, or seawater and use and isolation of shore power.
- improper application of marine paint or antifouling paint.
- failure to repaint damaged areas.
- how the boat is bonded.

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

* "The Boatowner's Guide to Corrosion", by Everett Collier.

NOTICE

The anode of the saildrive is designed to protect the saildrive only. Changing the material of the propeller may require additional anodes to be installed on the saildrive.

NOTICE

Failure to use the correct anode material may result in improper protection and excessive corrosion of underwater drive system components. Use only aluminum anodes in brackish and seawater applications. In freshwater applications, use aluminum or magnesium anodes for best results. Never use magnesium anodes in brackish or seawater, as they will deteriorate rapidly, which will lead to severe damage to the drive system.

If sacrificial 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

Boats 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, sacrificial 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.

SPARE FUSES

It is recommended to keep spare fuses and tools to replace them on board. After replacing a broken fuse, shut off house loads where possible and return to the nearest port for inspection without using full throttle.

UNDERWATER DRIVE COATING

The lower gear case coating may be damaged when the gear case is hit by objects in the water, or when having deposits removed from it. The underwater coating must be inspected at least once per year and when the gear case is hit by objects, and have caused damage to the gear case coating. In such case, repair and repaint the damaged area immediately. Observe the following precautions when applying antifouling or marine paint to the bottom of the boat hull:

- Always follow the paint/coating manufacturer's instructions for surface preparation and application.
- Always use a high quality primer and topcoat paint specifically designed for aluminum outboards, saildrives or stern drives.
- Never paint the sacrificial anodes installed on the saildrive.
- Never paint the saildrive with a material that contains copper or tin.
- Never paint over drain holes, sacrificial anodes, or other items specified by the sacrificial anode Manufacturer.
- Consult your authorized YANMAR Marine dealer or distributor for assistance.

NOTICE

Those parts damaged by galvanic corrosion, or parts replaced during normal maintenance, or consumable parts are not covered by the YANMAR Limited Warranty.

NAMEPLATE

The nameplate is installed on the electric saildrive.

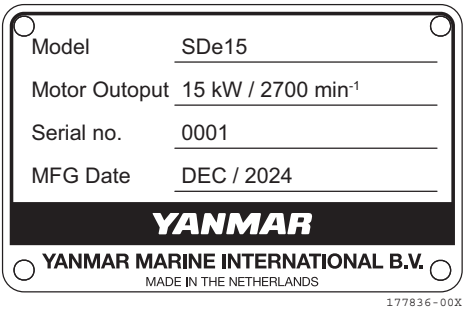
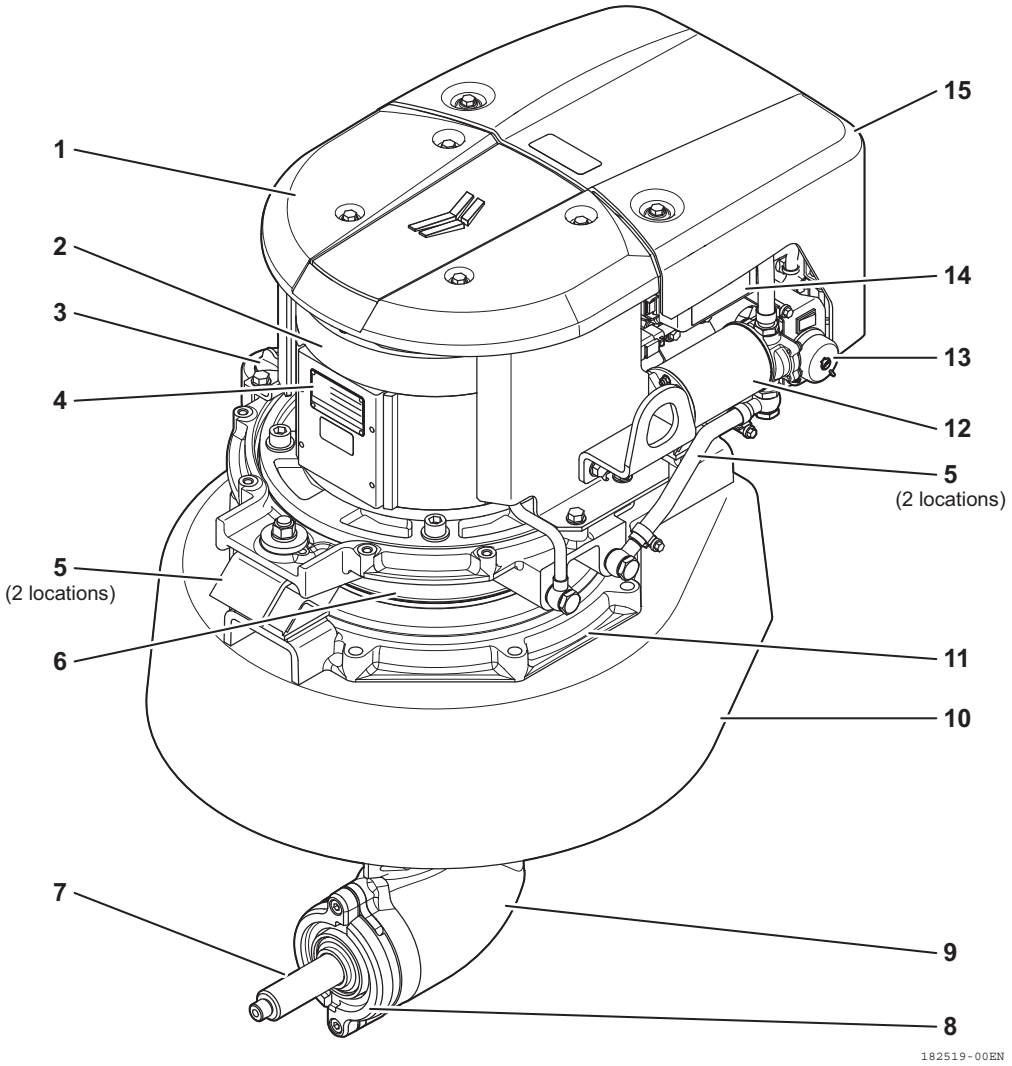


Figure 1

COMPONENT IDENTIFICATION



1 – Top cover
2 – Electric motor
3 – Dipstick
4 – Nameplate
5 – Flexible mount
6 – Diaphragm
7 – Propeller shaft
8 – Anode
9 – Saildrive leg
10 – Mounting bed
11 – Seal flange
12 – Lubricating oil pump
13 – Emergency stop button
14 – Fuse box
15 – Front cover

Figure 2

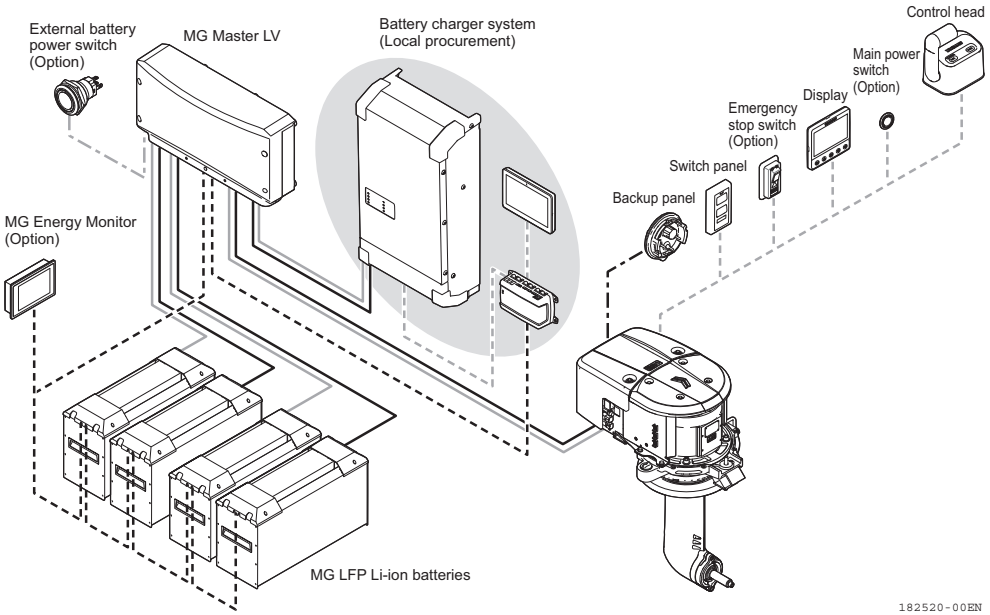

External battery
power switch
(Option)
MG Master LV
Battery charger system
(Local procurement)
Control head
Main power
switch
(Option)
Display
Emergency
stop switch
(Option)
Switch panel
Backup panel
MG Energy Monitor
(Option)
MG LFP Li-ion batteries
182520-00EN

Figure 3

FUNCTION OF MAJOR COMPONENTS

Name of component	Function
Saildrive leg	A part of a saildrive which goes down through the bottom of the boat to transmit power to the propeller. This saildrive leg is as same part as SD25.
Electric motor	Electric motor generates the propulsion power for the boat and is mounted at the top of the saildrive leg. The output power options are 3 types: 7 kW, 10 kW, and 15 kW.
Motor controller (Inside of front cover)	Motor controller controls the electric current for motor with inverter.
Lubricating oil pump	Lubricating oil pump to cool the motor and motor controller. Lubricating oil in the saildrive leg is circurated. This lubricating oil pump is also used for evacuating of oil.
Control head	Device to control the motor speed and control mode.
Display	Display to show the monitor data and status of the electric saildrive system. When a failure occurs, an alert and the failure information are displayed.
Switch panel	Panel to turn the system power on and off.
Backup panel	Panel to be used in emergency situation such as when the operating system has failure.
Main power switch (Option)	Switch that can be used to prevent the SDe control system from being powered on when the batteries are charging (theft protection).
Emergency stop switch (Option)	Switch that can stop the electric saildrive immediately in case of emergency.
External battery power switch (Option)	Switch that can turn off the battery power remotely.
MG LFP Li-ion battery	Rechargeable battery for the electric motor and electric system components on board, which includes the built-in slave battery management system (slave BMS). Battery type is LFP (Lithium Iron Phosphate).
MG Master LV	Master BMS that manages slave BMSs in the batteries to protect the batteries.
MG Energy Monitor	Display to indicate battery condition.

CONTROL SYSTEM

The SDe control system equipment consists of a control head, switch panel, display, backup panel and additional optional parts, connected by cable harnesses to the electric saildrive for remote control operation.

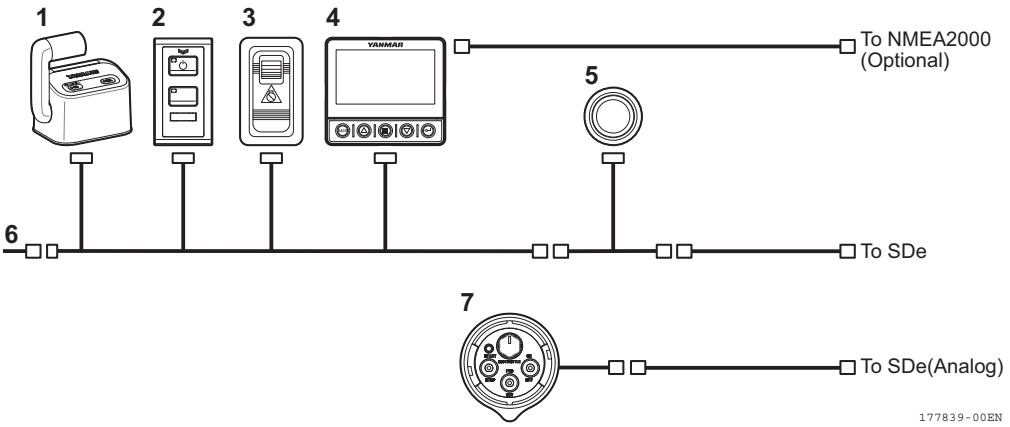


Figure 4

No.	Description
1	Control head
2	Switch panel
3	Emergency stop switch (optional)
4	Display
5	Main power switch (optional)
6	Terminal adapter
7	Backup panel

Display

The multi-function information display has the following functions.

■ Display function

Monitor data screen

This screen displays the real time motor and battery data.

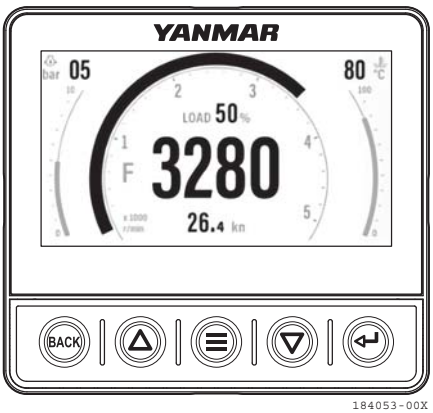


Figure 5

Alarm indicators

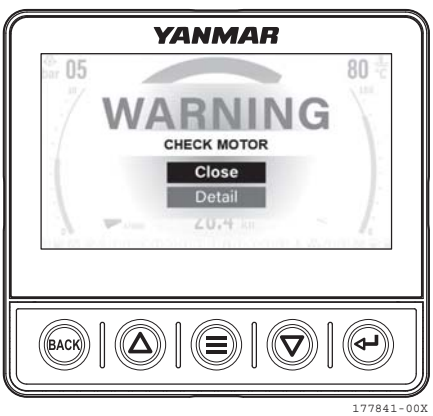


Figure 6

The alarm window appears with an audible alarm when an abnormal status occurs.

Alarm indicator functions

When the ECU detects an abnormality in the motor, motor controller, control system, or battery system, the alarm popup is displayed on the screen.
When there are multiple alarm popups, they are displayed in order of priority.

[Priority] WARNING > NOTICE
Select the “Close” or “Detail” button, and press the (↵) button to close the alarm popup. If an alarm is indicated, select “Detail” and press the (↵) button to indicate the Diagnosis Trouble Code.
(See DIAGNOSTIC TROUBLE CODE LIST on page 65.)

The following functions can be selected in “Alarm/DIAGs” in the MAIN MENU.

- Alarms: Displays warnings and notices for the operator to use the system safely and appropriately.
- DIAG codes: Confirms the details of the abnormality that occurred.
- Network nodes: Confirms the conditions of the connected ECU etc.

Display icons

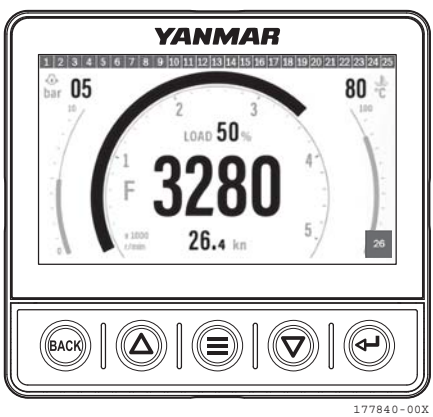


Figure 7

Display area	Display icons
13	Neutral mode
15	Maintenance time
18	Battery level low / empty / charging
24	Backup mode
25	Diag occurring

■ Operation of the display

Buttons

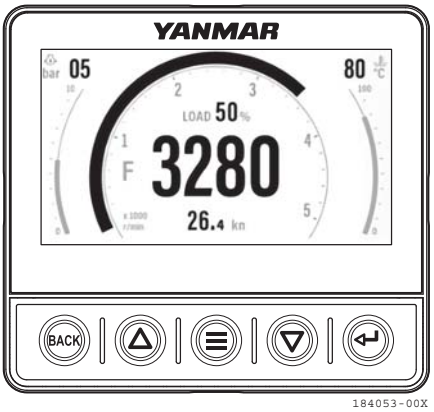


Figure 8

	Monitor screen	Main menu	Quick menu
☰	Show Main menu	Return to Monitor screen	Hide Quick menu
△ ▽	Scroll monitor pages	Scroll menu items	Scroll Quick menu items
↵	Show Quick menu	Select	Select
BACK	Toggle day/night mode	Return to previous layer / Monitor screen	Hide Quick menu

Quick menu

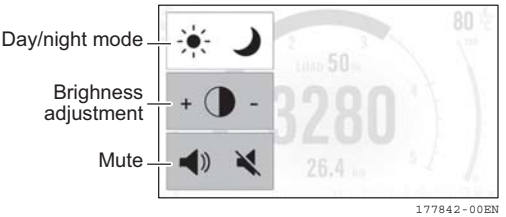


Figure 9

Day/night mode

Select to switch between day and night mode.
Night mode uses a different color scheme that is more suitable for operating in dark surroundings.

Brightness adjustment

Select to show the brightness level adjustment screen. Adjust with (△) (▽) buttons, and press (↵) button to confirm the setting.
The control head and switch panel brightness will adjust accordingly.

Note: You can also adjust the brightness level by pressing the SEL button on the control head. See INDICATOR DIMMING on page 41.

Mute

Select to mute/unmute the system. When muted, the display will not beep during key operation. When an alarm or notice popup is shown, the beeper will sound.

■ Display menu navigation

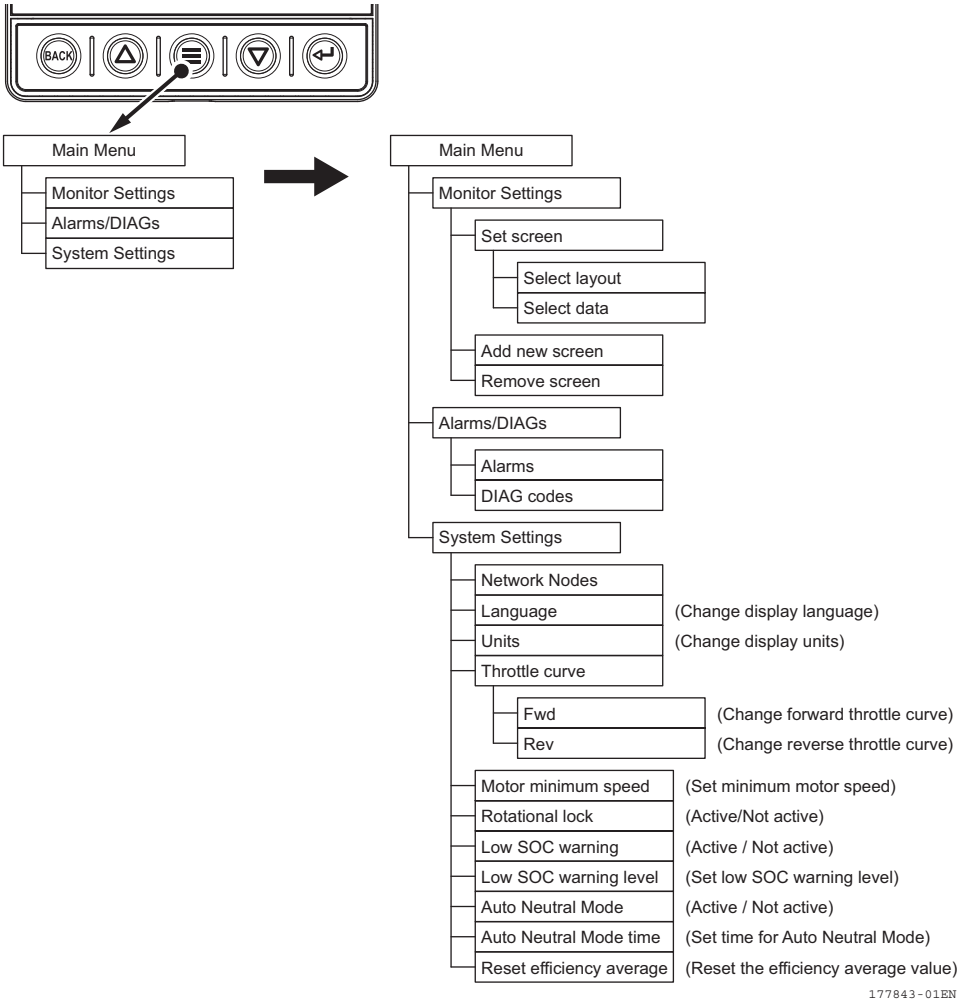


Figure 9

■ Available monitor data

Monitor settings	Set current screen	Select data			
			Motor	Motor speed	Gauge / Digital
				Motor power	Gauge / Digital
				Motor torque	Gauge / Digital
				Motor load	Gauge / Digital
				Motor temperature	Gauge / Digital
				Throttle position	Digital
				Motor operation time	Digital
			Battery	Battery consumption	Digital
				SOC	Gauge / Digital
				Battery voltage	Digital
				Battery amperage	Digital
				Battery temperature	Digital
			Boat	Range (time)	Digital
				Range (distance)*	Digital
				Boat speed*	Digital
			Eco	Battery efficiency*	Gauge / Digital
				Battery average efficiency*	Gauge / Digital

* Only available when connected to a NMEA 2000 network with GPS data (PGN129026).

NOTICE

Range (time) and Range (distance) are estimated based on the current battery status, motor power, and (in case of distance) boat speed. Use the calculated value as an estimation only since the value changes depending on the usage. Unexpected winds or currents can affect the actual range.

■ Available languages

System settings	Language	English / Spanish / French / Italian / German / Dutch / Norwegian / Portuguese

■ Available units

System settings	Units	Temperature	°C / °F
		Boat speed	knots / MPH / km/h
		Distance	NM / miles / km
		Efficiency	kWh [distance] / [distance] / kWh

MG Energy Monitor (Option)

The Li-ion battery information display has the following functions.

■ MG Energy Monitor function

Battery information screen

This screen displays real time Li-ion battery information.

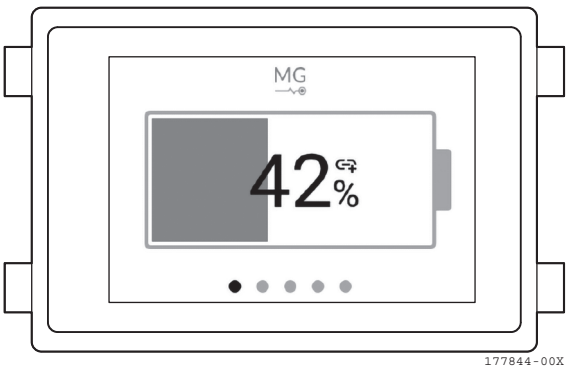


Figure 10

Alarm Indicators

Figure 11

The alarm window appears when abnormal status of Li-ion batteries or MG Master LV occurs.

COOLING SYSTEM

The motor and motor controller are cooled with lubricating oil, which is pumped up from the lower gear case of saildrive, and circurated by the lubricating oil pump.

The oil pump is active when the system temperatures are above a certain threshold. When the motor is stopped, the pump continues to circulate the oil until the system is cooled down enough.

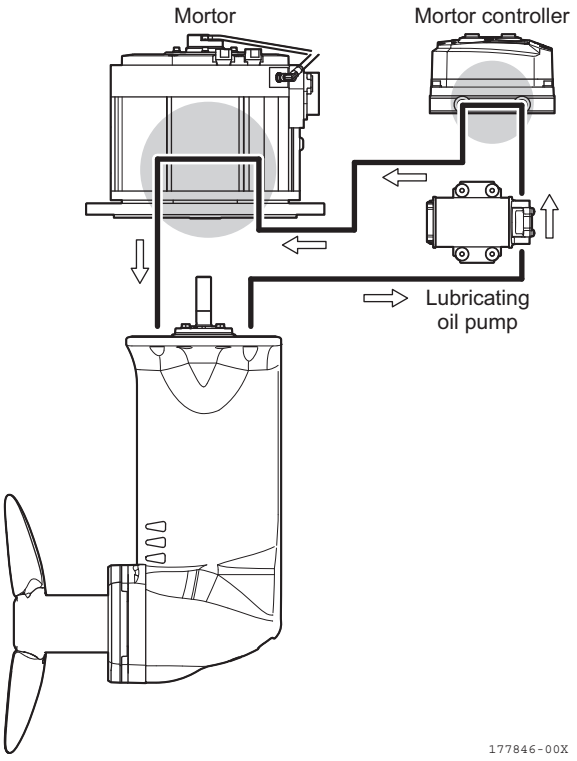


Figure 12

BATTERY CHARGER

The battery charger is a local procurement part, and is arranged by the customer or boat builder.

Recommended chargers

- Victron Multiplus II + GX device
- Victron Multiplus II GX
- Victron Quattro + GX device

NOTICE

Use only recommended chargers.
Otherwise the system might not work properly, and the batteries cannot be charged, which might result in damage to the battery.

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BEFORE YOU OPERATE

This section of the *Operation Manual* describes lubricating oil specifications and how to replenish them.

Before you operate the electric saildrive, review the *Safety* section on page *3*.

LUBRICATING OIL

The choice of lubricating oil is very important. If unsuitable oil is used, or an oil change is neglected, it may result in damage and reduce the life of the electric saildrive. When selecting lubricating oil, use lubricating oil of ATF only.

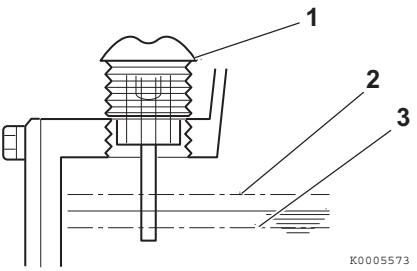
Oil type	ATF
Grade	Dexron II-D

Filling with Lubricating Oil

1. Remove the dipstick (yellow cap). Fill with specified lubricating oil.
2. Check the amount of lubricating oil by inserting the dipstick as far as possible. Do not screw the dipstick in (1, **Figure 1**). The oil level should reach the upper mark on the dipstick (2, **Figure 1**).
3. When completely changing lubricating oil, operate the cooling pump to fill the cooling system with the lubricating oil. Check the amount of lubricating oil (2, **Figure 1**) again.

NOTICE

- It takes about 10 minutes to fill up the electric saildrive with lubricating oil. Check the oil level 15 minutes after adding the specified quantity of oil.
- After lubricating oil is removed for change, some oil is also removed from the cooling circuit. Therefore,even if the amount of lubricating oil is within the normal range, the oil level decreases after operating the cooling pump since lubricating oil is circulated in the cooling system.



1 – Dipstick
2 – Upper limit
3 – Lower limit

Figure 1

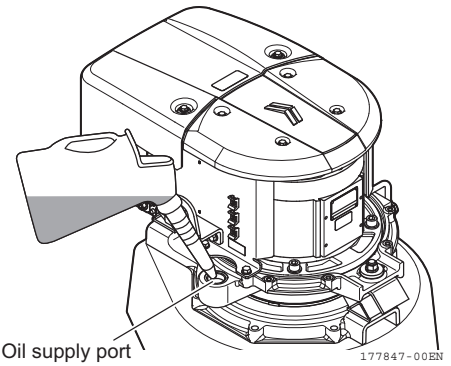


Figure 2

CHARGING LITHIUM ION BATTERY

Charge the Li-ion battery to a level sufficient for your sailing plan.

NOTICE

- If the charging level is insufficient, the motor can stop while the boat is running and there is a possibility to drift.
- Keep the Li-ion battery temperature between 0 °C and +45 °C when charging.

DAILY CHECKS

Before starting the electric saildrive, make sure that it is in good operating condition, and check the following items.

Visual Checks

1. Check for damaged or missing parts.
2. Check for loose, missing or damaged fasteners.
3. Check oil level.
   See Filling with Lubricating Oil on page 28.
4. Check the electrical harnesses for cracks, abrasions, and check for damaged or corroded connectors.
5. Check the Li-ion batteries for damage and electrolyte leakage.
6. Check the battery fixing for looseness.

Check Before Departure

1. Check the state of charge (SOC) of the Li-ion battery.
2. Confirm that the shore power cable is disconnected.

NOTICE

- If any problem is observed during the visual check, the necessary corrective action should be taken before you operate the electric saildrive.
- If the state of charge (SOC) is not sufficient, charge the Li-ion battery to a level sufficient for your sailing plan.
- If Li-ion battery is fully discharged, the battery can be damaged.

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SAILDRIVE OPERATION

Before you operate the electric saildrive, read the following safety information and review the *Safety* section on page *3*.

NOTICE

- Never run the electric saildrive if the ambient temperature is above +55 °C or below -20 °C.
  The Li-ion batteries can be damaged.
- The battery state of charge (SOC) is a reference value. The actual remaining battery capacity can be different depending on battery age, temperature and usage history.

BATTERY POWER SUPPLY AND CUTOFF

Battery Power Supply

Activate the MG Master LV for battery power supply. Press the MG Master LV power switch to turn on the MG Master LV, or press the external battery power switch (option) if it is equipped.

Battery Power Cutoff

Press the MG Master LV power switch to turn off the MG Master LV, or press the external battery power switch (option) if it is equipped.

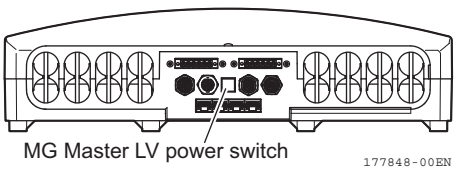

Figure 1

STARTING THE SYSTEM (POWER ON)

1. To energize the battery system, press the MG Master LV power switch or External battery power switch (option) if it is equipped.

Option

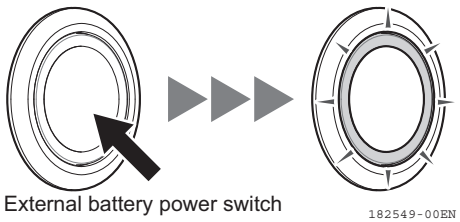

Figure 2

2. To energize the SDe system, press the main power switch (option) if it is equipped.

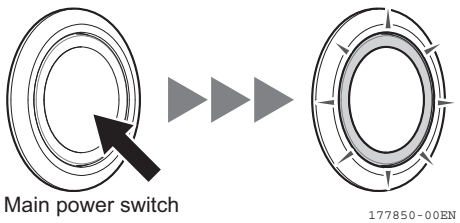

Figure 3

3. Press the power switch on the switch panel.
   The switch panel lamp comes on, and the control head “SEL” lamp turns on. Wait until the display shows the monitor data.

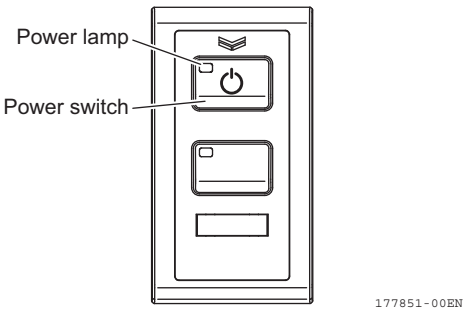

Figure 4

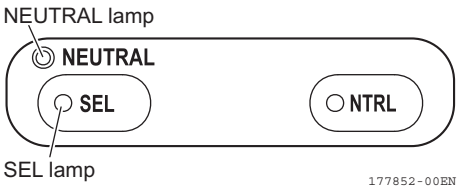

Figure 5

4. Move the control head handle to the neutral position. The “NEUTRAL” lamp comes on.

Figure 6

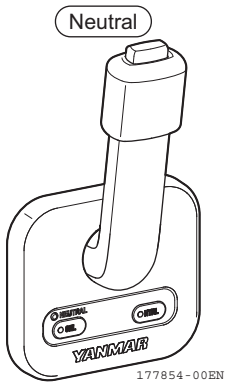

Figure 7

5. Now the motor is ready to be operated.

NOTICE

When the lever is in the neutral position, the motor stops. However, the system remains on standby, so the motor can be operated when the lever is moved from the neutral position.

SHUTTING DOWN THE SYSTEM (POWER OFF)

1. Move the control head handle to the neutral position.

Figure 8

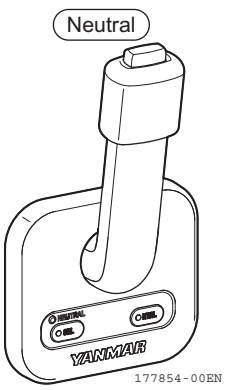

Figure 9

2. Press the power switch on the switch panel. The system goes off.

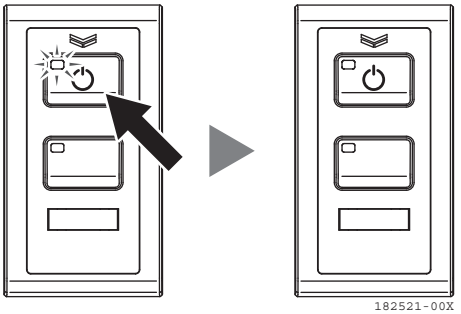

Figure 10

3. Press the main power switch (option) if it is equipped.

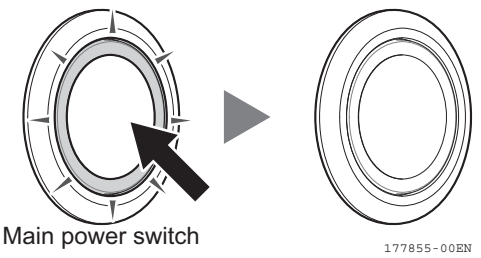

Figure 11

4. To turn off the battery system, press the MG Master LV power switch or External battery power switch (option) if it is equipped. To charge the battery, keep the battery system power ON.

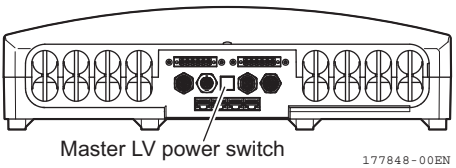

Figure 12

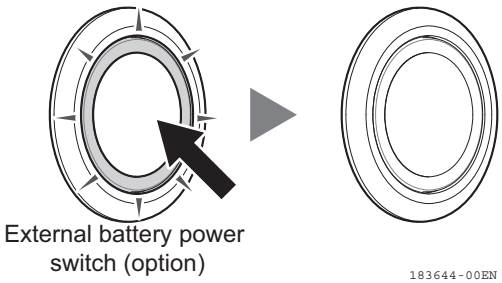

Figure 13

EMERGENCY STOP

NOTICE

- Do not use the emergency stop switch to stop the motor during normal opration. Only use the emergency stop switch to stop the motor immediately in case of an emergency.
- Unless the emergency stop is released or the safety lanyard is placed back, the motor cannot run again.

1. Press the emergency stop switch, or remove the safety lanyard to stop the motor immediately.
2. The emergency stop popup appears on the display, and the buzzer sounds.

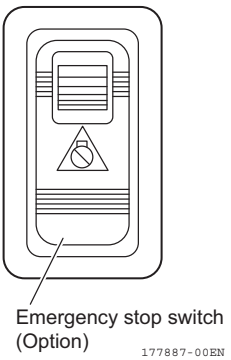

Figure 14

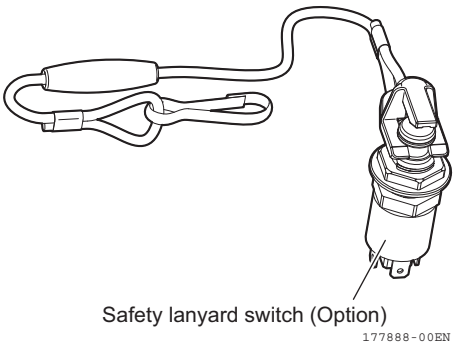

Figure 15

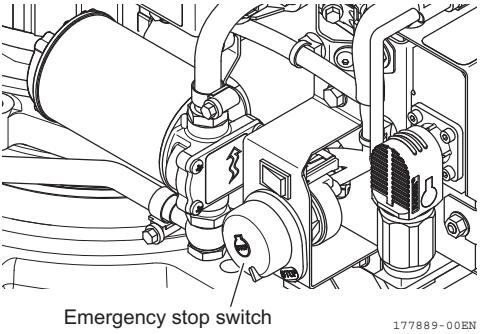

Figure 16

Display screen

Figure 17

THROTTLE CONTROL

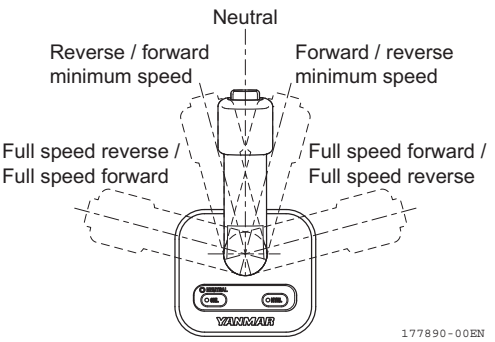

Figure 18

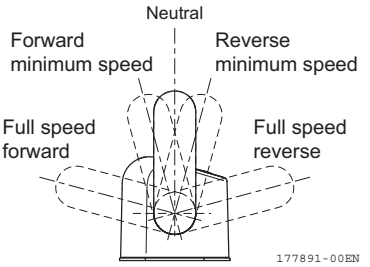

Figure 19

Neutral Position

1. Move the control head handle to the neutral position. The “NEUTRAL” lamp comes on.

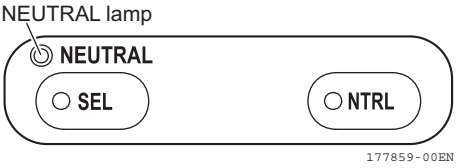

Figure 20

For the side mount control head, press the neutral lock button on top to move from the neutral position.

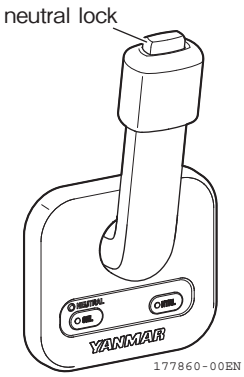

Figure 21

2. When switching between forward and reverse, move the handle slowly between the forward and reverse positions. Move the handle firmly into either the forward or reverse position.

Forward

Move the handle forward to the forward notch position. The motor moves in forward direction at minimum speed.
To increase the motor speed, move the handle forward further.

- To adjust the minimum speed, see *Motor minimum speed (Set “Motor minimum speed”) on page 43*.

Reverse

Move the handle backward to the reverse notch position. The motor goes in reverse direction at minimum speed.
To increase the motor speed, move the handle backward further.

- To adjust the minimum speed, see *Motor minimum speed (Set “Motor minimum speed”) on page 43*.

Reverse Boost

As the propellers are generally less efficient in reverse than in forward rotation, the SDe system has a reverse boost function. This means, the maximum motor speed is higher in reverse direction (3300 min^{-1}) than in forward direction (2900 min^{-1}).
The actual maximum motor speed that is reached in both directions depends on the propeller selection.

NEUTRAL MODE

Neutral Mode can help to prevent the handle from operating the motor accidentally while the system is powered on.
While in Neutral Mode, the system does not respond to movement of the control lever.

There are two ways to enter Neutral Mode, manually or automatically as indicated below.

Manual

1. Move the lever to the neutral position.
2. Press and hold the “NTRL” button for 0.5 seconds.
3. A popup will appear on the display and the lamp in the “NTRL” button comes on.
4. The system is set to Neutral Mode.

Automatic (Auto Neutral Mode)

1. When lever is in the neutral position for more than “Auto Neutral Mode Time” (default 10 min), a popup will appear on the display and the lamp in the “NTRL” button comes on.
2. The system is set to Neutral Mode.

Display screen

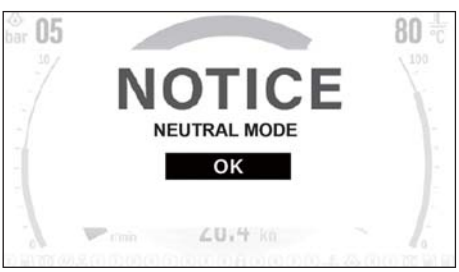

Figure 22

Press and hold the “NTRL” button for 0.5 seconds to exit Neutral Mode.

Figure 23

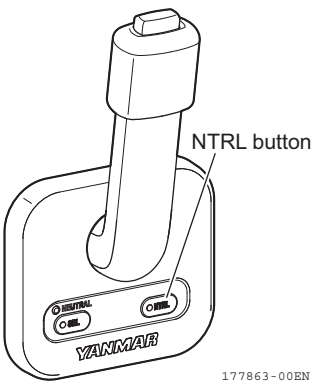

Figure 24

DISABLE AUTO NEUTRAL MODE

To turn off Auto Neutral Mode, go to Main Menu - System Settings - Auto Neutral Mode. When turned off, unexpected boat movement is possible when the system is not turned off and the lever is moved.

BACKUP PANEL OPERATION

NOTICE

Only use the backup panel in an emergency.

1. Remove the cover of the backup panel.
2. Check that the power switch on the switch panel is OFF, and that the control head handle and backup panel's shift switch are in the neutral position.
3. Press the power switch to the "ON" position on the backup panel. The popup appears on the display, and the lamp comes on. Control by the backup panel is enabled.

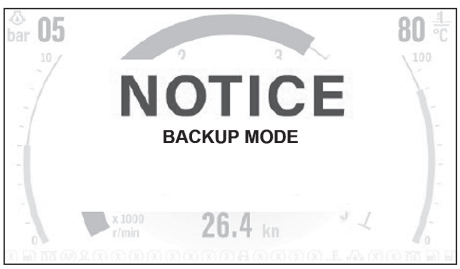

Figure 25

4. To operate the motor, use the shift switch to select rotation direction. (FWD: Forward, intermediate position of switch: Neutral, REV: Reverse)
5. Adjust the motor speed using the sub throttle control volume. (Counterclockwise: reduce the motor speed, clockwise: increase motor speed)

   Note: When controlling the throttle, first move the sub throttle volume fully counterclockwise.

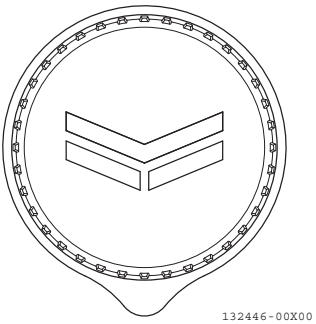

Figure 26

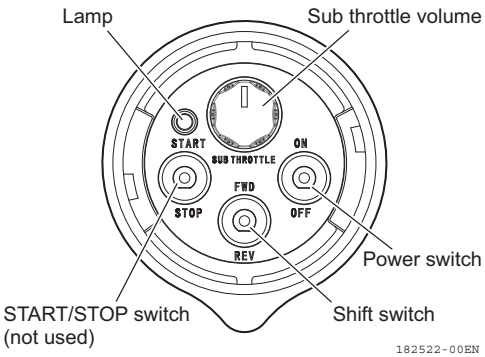

Figure 27

CONTROL HEAD OPERATION

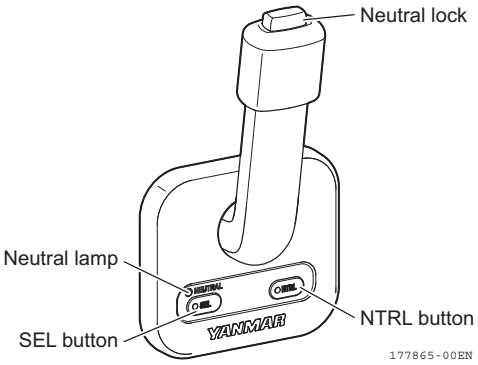

Figure 28

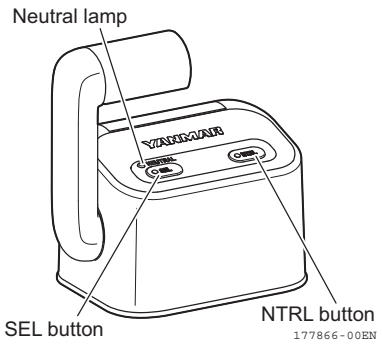

Figure 29

■ Indicator dimming

Press “SEL” button and the lamps dim.
(*See INDICATOR DIMMING on page 41*.)

■ Neutral Mode

Put the lever in the neutral position, and press the “NTRL” button. The lamp in the “NTRL” button turns on and the system is set in Neutral Mode.
Press again to exit Neutral Mode.
For details on the neutral mode function, see *NEUTRAL MODE on page 38*.

■ Neutal indication

When the lever is in the neutral position, the NEUTRAL lamp turns on.

■ Neutral lock (Only side mount control head)

Neutral lock is a safety function to prevent accidental operation of the lever.
Press the Neutral lock button to operate the lever from the neutral position.

INDICATOR DIMMING

The backlight on the SDe components can be adjusted in intensity to a more comfortable level if desired.
The dimming level is shared between all components of a station.
The lamps can be dimmed using the following two methods.

1. Dimmer with the control head “SEL” button
2. Dimmer with the display dimmer settings

Dimmer with the control head “SEL” button

1. Press the “SEL” button of the control head to decrease one level of the backlight.
2. Press “SEL” button when its on the lowest level, the brightness returns to its highest level.

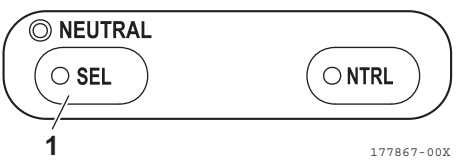

Figure 30

Dimmer with the display dimmer settings

1. Go to the brightness setting in the display quick menu.
2. Select the desired brightness level.

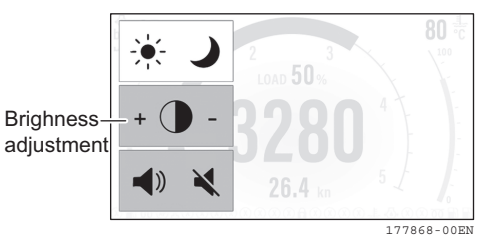

Figure 31

USER SETTINGS

Item	Default	Range
Throttle curve (fwd)	1. Standard1	1 - 8
Throttle curve (rev)	1. Standard1	1 - 8
Motor minimum speed	600 rpm	0 - 800 rpm
Rotational lock	Active	Active / Not active
Low SOC warning	Active	Active / Not active
Low SOC warning level	50%	30 - 60%
Auto Neutral Mode	Active	Active / Not active
Auto Neutral Mode time	10 min	1 - 60 min

Throttle Curve

The throttle curve is the relation between the lever position and throttle percentage of the motor.
The throttle curve can be changed to adjust the feel of the control lever by getting more or less throttle accuracy in a certain part of the lever range.

There are eight different throttle curve patterns.
A different curve can be selected for forward and reverse.
Even if the throttle curve is changed, the torque map of the motor is not changed.

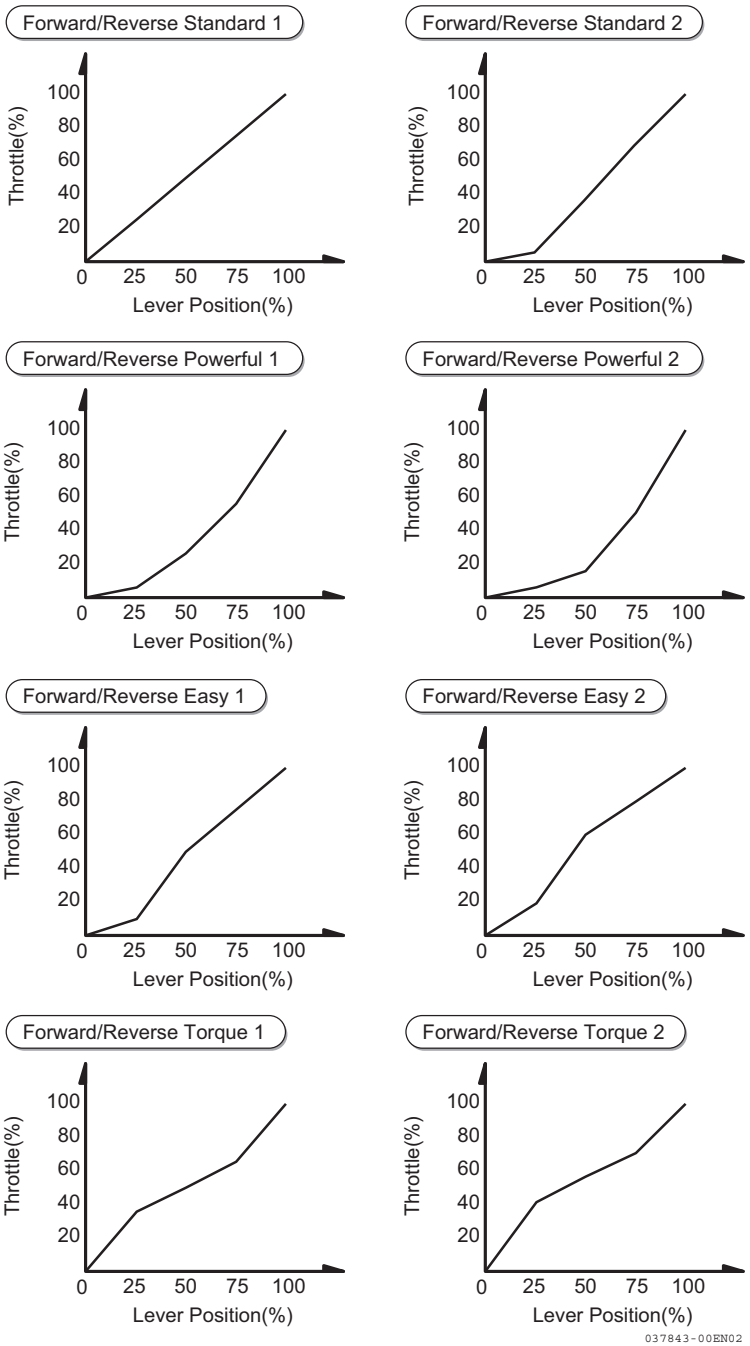
Forward/Reverse Standard 1
Forward/Reverse Standard 2
Forward/Reverse Powerful 1
Forward/Reverse Powerful 2
Forward/Reverse Easy 1
Forward/Reverse Easy 2
Forward/Reverse Torque 1
Forward/Reverse Torque 2
Throttle(%)
100
80
60
40
20
0
25
50
75
100
Lever Position(%)
037843-00EN02

Figure 32

■ Motor minimum speed (Set “Motor minimum speed”)

The motor minimum speed is the target speed of the motor when the control head is in the forward or reverse notch position (“low idle” position).

The motor minimum speed for forward and is the same.

■ Rotational lock (Active/Not active)

The rotational lock is designed to allow a folding propeller to close when the control head is in neutral position.

When the rotational lock is active, it forces the motor speed to stay at 0 rpm for a certain time after the control head reached the neutral position.

■ Low SOC warning (Active/Not active, Set “Low SOC warning level”)

The SDe control system gives a notification when the battery level is reaching low condition (20% SOC).

In addition to that, it is possible to have another low SOC warning that can be customized by the user for an early reminder of the SOC condition.

■ Auto Neutral Mode (Active/Not active, Set “Auto Neutral Mode time”)

In case of electric propulsion, there is no need to start/stop the motor. As there is no vibration or sound when the motor is in neutral, it is possible that the operator returns the control lever to neutral, and leave the system on after operation. Therefore, the control head still active.

To prevent accidental operating, Auto Neutral Mode activates Neutral Mode *(See NEUTRAL MODE on page 38)* when the control lever is in the neutral position for more than “Auto Neutral Mode time”.

AFTER YOU OPERATE THE ELECTRIC SAILDRIVE

After saildrive operation, check the state of charge (SOC) of the Li-ion battery.
When SOC is at low level, charge the Li-ion battery.

NOTICE

- If Li-ion battery is fully discharged, the battery can be damaged.
- Always turn off the SDe system power when leaving the system unattended.

When using the batteries for house load, monitor the battery state of charge by YANMAR display or by battery monitoring system to prevent the batteries reaching empty state.

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PERIODIC MAINTENANCE

Before you perform maintenance on the electric saildrive, read the following safety information and review the *Safety* section on page *3*.

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

TIGHTENING FASTENERS

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

TORQUE CHARTS

Nominal designation of screw thread	Tightening torque N·m (lb-ft)	Part name
M6	5.9 ± 1.0 (4.4 ± 0.7)	Anode
M6	8.6 ± 1.0 (6.3 ± 0.7)	Wall brackets Conductor Front cover
M8	20.4 ± 2.0 (15.0 ± 1.5)	Top cover wall
M8	10 (7.4)	MG Master LV terminators
M8	20 (14.8)	MG LFP battery poles
M10	14.0 ± 6.0 (10.3 ± 4)	Contactor
M10	39.4 ± 4.0 (29.1 ± 3)	UVW conductors
M12	47.0 ± 2.0 (34.7 ± 1.5)	Flexible mounts
M14	35.2 ± 4.0 (26.0 ± 3)	Banjo bolts

PERIODIC MAINTENANCE TABLE

○: Check or clean ◇: Replace ●: Consult your authorized YANMAR dealer or distributor

System	Item	Periodic maintenance interval						
		Daily	50 hours or after 1 month	Every 100 hours	Every 250 hours	Every year	Every 2000 hours	Every 7 years
General	Visual inspection SDe exterior	○						
Electrical system	Check wiring connectors				●			
Lubrication oil	Check oil level	Before operation ○						
	Change lubrication oil		First ◇		◇			
Anode	Inspect and replace anode			◇				
Lower gear case	Repair case coating					●		
Boat hull water-tightness	Inspect rubber diaphragm					○		◇*
Flexible mount	Inspect and/or replace the flexible mount					●		
	Replace the flexible mount						●	
Battery system	Check torque of electrical connections					●		
	Check if all communications connections are mated					●		
	Check for traces of water, oil, moisture, any other fluids or dust					●		
	Check for signs of corrosion					●		
	Clean the device					○		
	Check status with the MG Diagnostic Tool, MG Connect App or MG Energy Portal					○		

* *The diaphragms are important components that prevent the leakage of water into the boat, which could lead to the sinking of the boat. The owner/operator of the boat should always pay attention to the condition of the saildrive and especially check if it shows any irregularities.*
Such diaphragms have a shorter lifespan than the life of the boat itself and for that reason they need to be replaced once every seven (7) years. If the sensor which is located between the diaphragms signals any water ingress, the boat should immediately be brought to the nearest dock for inspection and/or replacement of the diaphragms, even if the seven (7) year period mentioned above has not expired. After the expiry of such seven (7) year period the diaphragms should be replaced and the boat should not be used with the saildrive having diaphragms older than seven (7) years.

WHEN THE BOAT IS OUT OF THE WATER, PERFORM THE FOLLOWING:

Repairing Damaged Coating

The lower gear case coating may be damaged when hit by objects in the water, or when having deposits removed from it. Never use paint containing copper or tin. This will damage the drive and void the warranty. Use a high quality primer and topcoat paint specifically designed for aluminum outboards or stern-drives. Follow the manufacturer's directions for surface preparation and application. Consult your authorized YANMAR Marine dealer or distributor for assistance.

Inspecting the Anode

See Inspecting and replacing the anode on page 50.

Inspecting the Folding Propeller

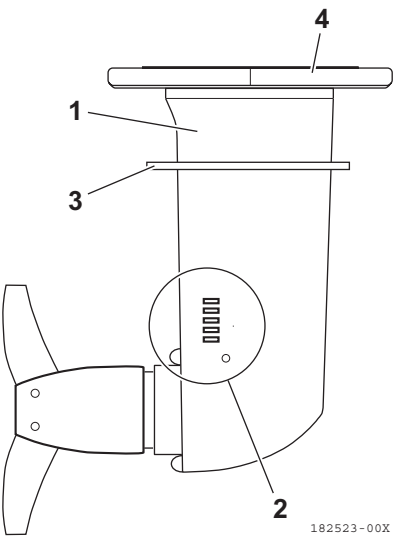
Confirm that the blade of the folding propeller opens smoothly. Inspect for wear on the blade-fixing pins, replacing them when wear is excessive. Apply seawaterproof grease to the pins in the blade gear and propeller shaft.

Check the instructions of the manufacturer of the folding propeller.

Check Protector

Before every storage period on shore check protector and replace if needed.

Note: Protector keeps sunlight away from diaphragm A.



1 – Lower gear case
2 – Seawater inlet
3 – Protector
4 – Diaphragm A

Figure 1

PERIODIC MAINTENANCE PROCEDURES

After Initial 50 Hours of Operation

Perform the following procedures after the first 50 hours of operation.

- **Draining and replacing lubricating oil**

■ Draining and replacing lubricating oil

When the boat is out of the water, drain the oil according to the following procedure.

1. Drain the lubricating oil by operating the cooling pump. *See Every 250 Hours of Operation on page 51*.

   Note: Do not remove the drain plug and dipstick.

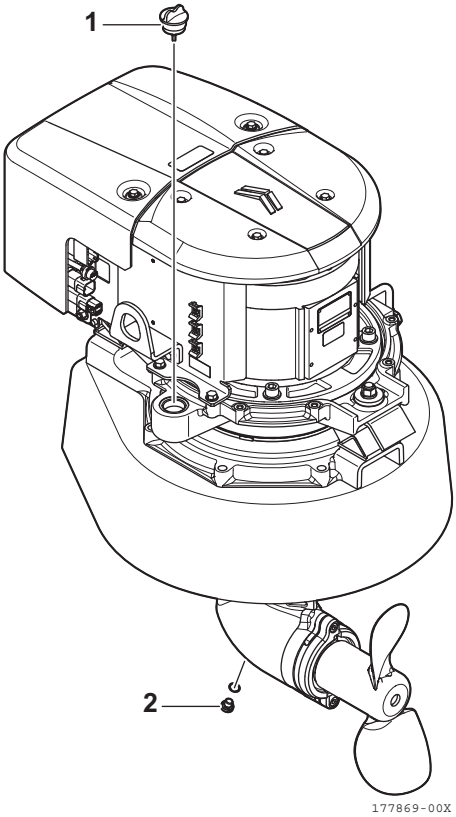
2. Remove the drain plug and dipstick to drain the remaining oil.
3. After the lubricating oil drains out, connect the rubber oil hose and install the drain plug.

⚠ CAUTION

Let the drive unit cool at least 5 minutes after operation before disconnecting the rubber hose or removing the lubricating oil drain plug. Hot oil could spurt out forcefully if the rubber hose is disconnected or the drain plug is removed from the drive unit immediately after operation.

Replacing oil

See Filling with Lubricating Oil on page 28.



1 – Dipstick
2 – Lubricating oil drain plug

Figure 2

Every 100 Hours of Operation

Perform the following maintenance every 100 hours of operation.

- **Inspecting and replacing the anode**

■ Inspecting and replacing the anode

To prevent corrosion of the saildrive body by sea or lake water, replace the anode every 100 hours of operation, once every six months or when it has reduced to half of the original volume (size).

NOTICE

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

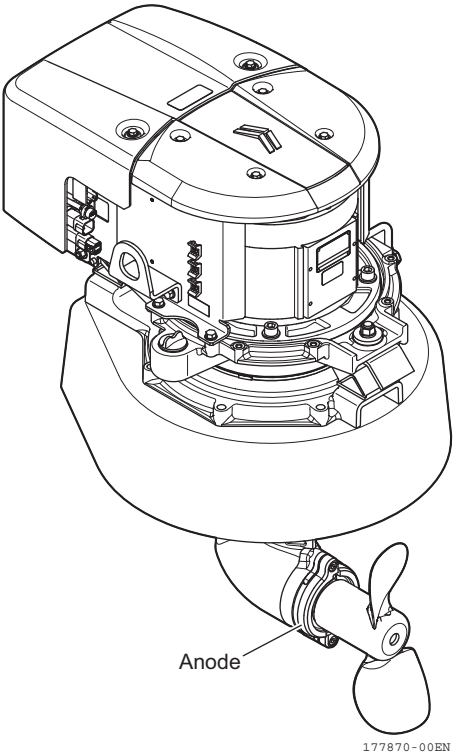


Figure 3

Every 250 Hours of Operation

Perform the following maintenance every 250 hours of operation.

- **Changing lubricating oil**

■ Changing lubricating oil

Drain lubricating oil by operating the cooling pump.

1. Loosen the hose band, and disconnect the rubber oil hose of oil pump.

   Note: Do not remove the drain plug or dipstick.

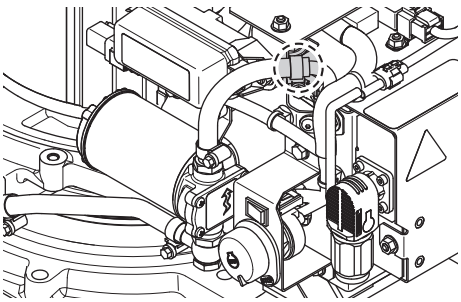


Figure 4

2. Take the end of hose into the oil container, then turn on the manual pump switch.

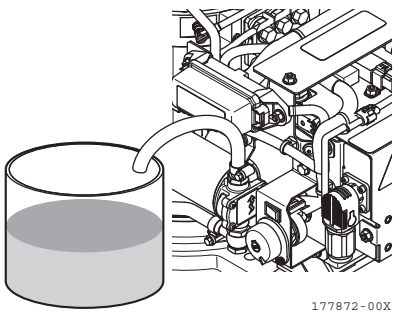


Figure 5

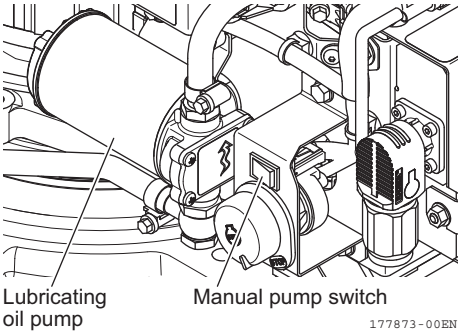


Figure 6

Note: When the manual pump switch turns on, an alarm appears on the display.

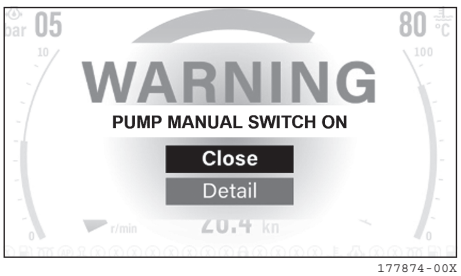


Figure 7

3. After the lubricating oil is drained, turn off the manual pump switch.
4. Connect the rubber oil hose.

Note: Lubricating oil can be drained from the drain plug when the boat is out of the water. See After Initial 50 Hours of Operation on page 49.
The procedure enables the replacement of a larger volume of lubricating oil.
Always drain oil by cooling pump first with oil drain plug installed, before draining oil by oil drain plug.

⚠ CAUTION

Let the drive unit cool at least 5 minutes after operation before disconnecting the rubber hose or removing the lubricating oil drain plug. Hot oil could spurt out forcefully if the rubber hose is disconnected or the drain plug is removed from the drive unit immediately after operation.

Replacing oil

See Filling with Lubricating Oil on page 28.

NOTICE

Lubricating oil change volume is different in each procedures.
Consider which procedure to follow depending on the dirt level of oil, oil replacement interval, and boat situation.

Note: In most cases, replacing oil by pump is sufficient.

	SDe7	SDe10	SDe15
Lubrication oil change volume by pump	1.9 L		2.0 L
Lubrication oil change volume by pump + drain plug	2.6 L		2.7 L

Every Year

Perform the following maintenance every year of operation.

- **Repairing case coating**
- **Inspecting installation/water sealing condition**
- **Inspecting and/or replacing the flexible mount**

■ Repairing case coating

See Repairing Damaged Coating on page 48.

■ Inspecting installation/water sealing condition

Rubber diaphragms (A) and (B)

The rubber diaphragms (A) and (B) of the saildrive are important parts for the hull and crew safety. Since rubber degenerates during use, be sure to inspect them when any irregularities are shown, or water ingress is signaled. The boat must be lifted onto a block for this procedure. To replace, consult your YANMAR Marine dealer.

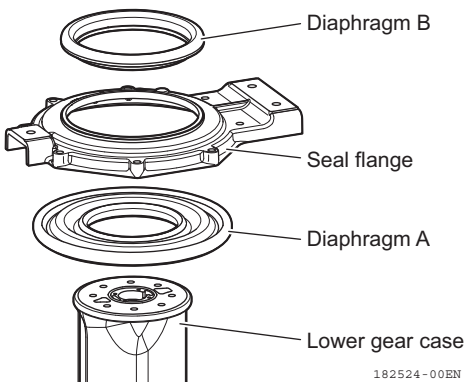


Figure 8

⚠ WARNING

Do not re-use the clamp ring.

■ Inspecting and/or replacing the flexible mount

Replace if clearance is less than 1 mm (1, **Figure 9**). See your authorized YANMAR Marine dealer or distributor for procedure.

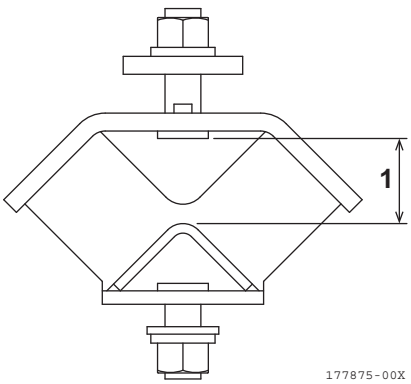


Figure 9

Every 2000 Hours of Operation

Perform the following maintenance every 2000 hours of operation.

- **Replacing the flexible mount**

■ Replacing the flexible mount

See your authorized YANMAR dealer or distributor for procedure. Flexible Mount must be replaced every 2000 hours.

Every 7 Years

Perform the following maintenance every 7 years of operation.

- **Replacing rubber diaphragm, clamp ring**

■ Replacing rubber diaphragm, clamp ring

To replace, consult your YANMAR Marine dealer.

TROUBLESHOOTING

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

If a problem occurs, stop the electric saildrive immediately. Refer to the Symptom column in the Troubleshooting Chart to identify the problem.

NOTIFICATION SCREENS

Below is an overview of the notifications that can be present on the screen.
For a detail of the WARNING notifications, see the SDe Troubleshooting Manual.

■ Neutral mode

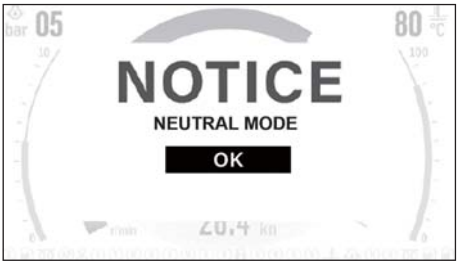


Figure 1

This notice appears when the system enters Neutral Mode (*See NEUTRAL MODE on page 38*).
The Neutral Mode is entered automatically after the control head is in neutral position for 10 minutes if Auto Neutral Mode setting is active. *See NEUTRAL MODE on page 38* how to de-activate.

■ Derate mode

Figure 2

This notice appears when the system is experiencing trouble and it determines it should not be operated at maximum power. However, operating is still possible.

Reasons to enter derate mode can be for example overheating of the motor, motor controller or battery, low SOC, etc.

If the system returns to normal operating conditions, the system will automatically return to normal operating mode.

■ Slowdown mode

Figure 3

This notice appears when the system is experiencing trouble and it determines it should stop operation. The motor will completely come to a stop.

Reasons to enter slowdown mode can be for example overheating of the motor, motor controller or battery, low SOC, etc.

If the system returns to normal operating conditions, the system will automatically return to normal operating mode.

■ Emergency stop

Figure 4

This notice appears when the emergency circuit is open. Until this is resolved, operation is not possible.

To resolve, check the E-stop line at for example:

- E-stop switch on the side of the SDe (*See COMPONENT IDENTIFICATION on page 15.*)
  Check that the E-stop switch is in the “RUN” position
- E-stop switch at the helm station
  Check that the E-stop switch is in the “OFF” position
- Safety lanyard at the helm station
  Check that the lanyard is correctly installed

■ Check display

Figure 5

This warning will appear when the display cannot communicate with the SDe motor controller.
To resolve, check all wire connections.

■ Backup mode

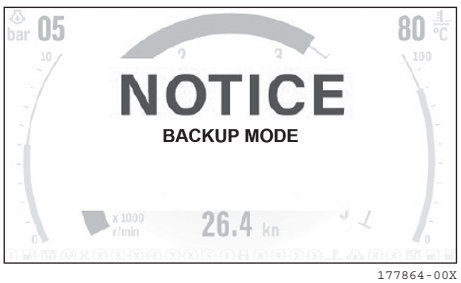


Figure 6

This notice appears when the backup panel is turned on. While the system is in backup mode, it is not possible to operate using the control head.
To exit backup mode, turn the backup panel power switch to “OFF” and reboot the system by turning off the power by the switch panel and turning the power back on by the switch panel.

■ Pump manual switch ON

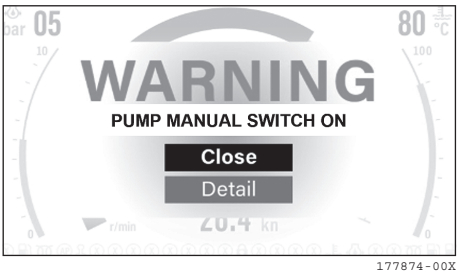


Figure 7

This warning appears when the manual pump switch is turned ON.
The manual pump switch is only needed during the oil replacement procedure.
During normal operating, the pump swith should be turned OFF.

■ Water in drive seal

Figure 8

This warning appears when the seal sensor (**Figure 9**) detects seawater entering the sail drive.

The watertight structure of SDe is dual type. Even if the rubber diaphragm A (**Figure 9**) is damaged and seawater enters, the rubber diaphragm B (**Figure 9**) prevents it from entering the vessel.

If this warning happens, stop the motor and under sail, quickly return to the nearest port for repairs.

The seal sensor is Normally Closed type. This means that also when there is a wiring fault this alarm will be triggered.

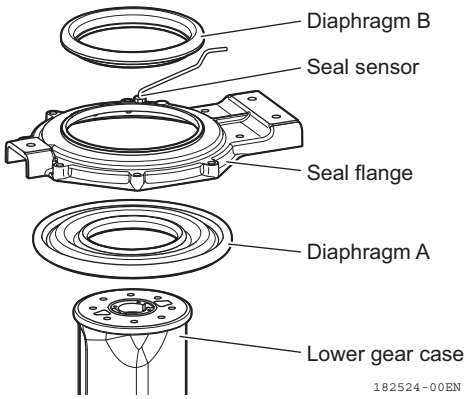


Figure 9

■ Maintenance sail drive

Figure 10

This notice appears when the maintenance timer is up. It is recommended to perform service on the SDe based on the periodic maintenance table.

The maintenance notice does not affect the operation, it is just a reminder.

To reset or disable the timer, contact a YANMAR dealer.

TROUBLESHOOTING CHART

In case of trouble, first check if all items of the installation and operating instructions have been completed. The subsequent tables will assist you in troubleshooting.

No.	Problem	Possible cause	Action
1	Sail drive does not start	No power input	• Check if BMS is turning ON. • Measure voltage between + and - battery connectors in the sail drive. • Visual inspection if BMS is closing the contactor. • Check MG diagnostic tool. • Measure voltage between + and - bars in the BMS.
		Defective main contactor	• Check connection between pins 6 and 13 of controller connector (harness side) and contactor connector. • Check if main contactor is able to close when 12 V is applied on connector.
		Low SOC / Empty battery	• Charge the battery system. • Check MG diagnostic tool.
		No 12 V supply / Voltage in 12 V circuit too low	• Measure voltage at DC-DC converter output connector (pin 5). • Check DC-DC fuse. • Check main relay on fuse box.
2	Sail drive does not run smoothly	Insufficient amount of lubricating oil	• Refill the sail drive with oil. • Check for oil leakage.
		Damaged lower leg parts	• Check for abnormal noise or vibration at the lower leg. • Check lower leg bearings. • Check lower leg gears and shafts.
		Defective controller	• Contact YANMAR dealer.
		Defective triphase connection	• Check if all conductors are connected on motor and controller. • Measure the resistance between phases (motor side): U-V, V-W, W-U.
		Defective electric motor	• Check for abnormal noise or vibration at the electric motor. • Contact YANMAR dealer.
3	Sail drive low power output	High motor temperature	• Refers to No. 5
		High motor controller temperature	• Refers to No. 7
		Defective temperature sensor	• Measure resistance between pins 1 and 2 of temperature sensor connector (motor side). • Check ground of temperature sensor connector (harness side).
		Defective controller	• Contact YANMAR dealer.
		Short circuit on power circuit	• Check MG diagnostic tool.
		Battery CAN communication error	• Check if battery CAN connector is connected to SDe. • Measure voltage in CANL (pin 5) in battery CAN connector. • Measure voltage in CANH (pin 4) in battery CAN connector. • Measure resistance between pins 4 and 5 in battery CAN connector (60 Ω). • Check the 2 terminals of the battery CAN network. • Measure the resistance between terminal's CANL and CANH pins (120 Ω).
		Defective battery system	• Refers to No. 23

No.	Problem	Possible cause	Action
4	Sail drive stops suddenly	High motor temperature	• Refers to No. 5
		High motor controller temperature	• Refers to No. 7
		Defective speed sensor	• Measure voltage on pin 1 (+5 V supply) of speed sensor connector (harness side). • Check ground of speed sensor connector (harness side).
		Defective electric motor	• Check for abnormal noise or vibration at the electric motor. • Contact YANMAR dealer.
		Defective triphase connection	• Check if all conductors are connected on motor and controller. • Measure the resistance between phases (motor side): U-V, V-W, W-U.
		No 12 V supply / Voltage in 12 V circuit too low	• Measure voltage at DC-DC converter output connector (pin 5). • Check DC-DC fuse. • Check main relay on fuse box.
		Defective controller	• Contact YANMAR dealer.
		Defective BUP	• Check pin 1 (+12 V supply) of BUP connector (harness side). • Check pin 8 (+5 V) of BUP connector (harness side). • Check ground of BUP connector (harness side). • Measure resistance between pins 8 and 10 / 9 and 10 of BUP connector (BUP side).
		CAN communication error (Control head)	• Check pin 2 (+12 V supply) of control head connector (harness side). • Check ground of control head (harness side). • Measure resistance between pins 4 and 5 in control head connector (60 Ω).
		CAN communication error	• Measure voltage in CANL (pin 3) in diagnostic connector. • Measure voltage in CANH (pin 2) in diagnostic connector. • Measure resistance between pins 2 and 3 in diagnostic connector. • Check the 2 terminals of the CAN network. • Measure the resistance between terminal's CANL and CANH pins (120 Ω).
		Defective battery system	• Refers to No. 23
5	Instrument shows. MOTOR TEMPERATURE HIGH	Insufficient amount of lubricating oil	• Refill the sail drive with oil. • Check for oil leakage.
		Defective temperature sensor	• Measure resistance between pins 1 and 2 of temperature sensor connector (motor side). • Check ground of temperature sensor connector (harness side).
		Defective oil pump	• Measure voltage on pin 1 (12 V) of oil pump connector (harness side). • Check ground of oil pump connector (harness side). • Check pump fuse. • Check pump relay's power supply and ground and its condition. • Check if pump relay is activated when manual oil switch is activated.
		Damaged lower leg parts	• Check for abnormal noise or vibration at the lower leg. • Check lower leg bearings. • Check lower leg gears and shafts.
		Defective electric motor	• Check for abnormal noise or vibration at the electric motor. • Contact YANMAR dealer.

No.	Problem	Possible cause	Action
6	Instrument shows. CHECK MOTOR	Defective speed sensor	• Measure voltage on pin 1 (+5 V supply) of speed sensor connector (harness side). • Check ground of speed sensor connector (harness side).
		Defective temperature sensor	• Measure resistance between pins 1 and 2 of temperature sensor connector (motor side). • Check ground of temperature sensor connector (harness side).
		Defective electric motor	• Check for abnormal noise or vibration at the electric motor. • Contact YANMAR dealer.
		Defective controller	• Contact YANMAR dealer.
7	Instrument shows. MOTOR CONTROLLER TEMPERATURE	Insufficient amount of lubricating oil	• Refill the sail drive with oil. • Check for oil leakage.
		Defective oil pump	• Measure voltage on pin 1 (12 V) of oil pump connector (harness side). • Check ground of oil pump connector (harness side). • Check pump relay's power supply and ground and its condition. • Check if pump relay is activated when manual oil switch is activated.
		Defective controller	• Contact YANMAR dealer.
8	Instrument shows. MOTOR CONTROLLER OVER CURRENT	Short circuit on power circuit	• Check MG diagnostic tool.
		Defective triphase connection	• Check if all conductors are connected on motor and controller. • Measure the resistance between phases (motor side): U-V, V-W, W-U.
		Defective controller	• Contact YANMAR.
9	Instrument shows. MOTOR CONTROLLER VOLTAGE HIGH	Input voltage in power circuit too high	• Measure DC voltage input at the controller contactors.
		Overcharged batteries	• Check MG diagnostic tool.
		Voltage in 12 V circuit too high	• Measure voltage at DC-DC converter output connector (pin 5).
		Defective controller	• Contact YANMAR dealer.
10	Instrument shows. MOTOR CONTROLLER VOLTAGE LOW	Input voltage in power circuit too low	• Measure DC voltage input at the controller contactors.
		Voltage in 12 V circuit too low	• Measure voltage at DC-DC converter output connector (pin 5). • Check DC-DC fuse. • Check main relay on fuse box.
		Defective controller	• Contact YANMAR dealer.
11	Instrument shows. CHECK MOTOR CONTROLLER	Defective controller	• Contact YANMAR dealer.

No.	Problem	Possible cause	Action
12	Instrument shows. CHECK SYSTEM	Disconnection in triphase conductors	• Check if all conductors are connected on motor and controller. • Measure the resistance between phases (motor side): U-V, V-W, W-U.
		Defective 5 V power supply from controller	• Measure voltage on pin 1 (+5 V supply) of speed sensor connector (harness side). • Measure voltage on pin 9 (+5 V supply) of BUP connector (harness side). • Check connection of pin 26 of controller connector (harness side) and the above pins.
		Main contactor failure	• Check power supply and ground of main contactor connector.
		Key switch relay failure	• Check key switch relay condition. • Measure voltage on pin 1 of key switch connector (harness side). • Check ground of key switch relay connector (harness side).
		Main relay failure	• Check main relay condition. • Measure voltage on pin 3 (+12 V input) of main relay connector (harness side). • Measure voltage on pin 1 (+48 V input) of main relay connector (harness side). • Check connection between pin 4 of main relay connector (harness side) and pin 2 of controller connector (harness side).
		Defective oil pump	• Measure voltage on pin 1 (12 V) of oil pump connector (harness side). • Check ground of oil pump connector (harness side). • Check pump relay's power supply and ground and its condition. • Check if pump relay is activated when manual oil switch is activated.
		No BUP power	• Measure voltage on pin 1 (+12 V supply) of BUP connector (harness side). • Check BUP DC-DC converter.
		CAN communication error (Control head)	• Check pin 2 (+12 V supply) of control head connector (harness side). • Check ground of control head (harness side). • Measure resistance between pins 4 and 5 in control head connector (60 Ω).
		CAN communication error	• Measure voltage in CANL (pin 3) in diagnostic connector. • Measure voltage in CANH (pin 2) in diagnostic connector. • Measure resistance between pins 2 and 3 in diagnostic connector. • Check the 2 terminals of the CAN network. • Measure the resistance between terminal's CANL and CANH pins (120 Ω).
		Battery CAN communication error	• Check if battery CAN connector is connected to SDe. • Measure voltage in CANL (pin 5) in battery CAN connector. • Measure voltage in CANH (pin 4) in battery CAN connector. • Measure resistance between pins 4 and 5 in battery CAN connector (60 Ω). • Check the 2 terminals of the battery CAN network. • Measure the resistance between terminal's CANL and CANH pins (120 Ω).
		Defective controller	• Contact YANMAR dealer.

No.	Problem	Possible cause	Action
13	Water in the sail drive /. Instrument shows. WATER IN DRIVE SEAL	Water leakage to the sail drive	• Check for water ingress in the sail drive diaphragm. • Inspect condition of rubber diaphragm.
		Defective seal sensor	• Measure voltage on pin 1 (+12 V supply) of seal sensor (harness side). • Check ground of seal sensor (harness side). • Check connection of pin 3 of seal sensor (sensor output) and pin number 9 of controller connector (harness side). • Check output state of sensor with presence and absence of water (sensor is NC).
14	Instrument shows. MAIN THROTTLE	Defective control head	• Check pin 2 (+12 V supply) of control head connector (harness side). • Check ground of control head (harness side). • Measure resistance between pins 4 and 5 in control head connector (60 Ω).
15	Instrument shows. SUB THROTTLE	Defective BUP	• Check pin 1 (+12 V supply) of BUP connector (harness side). • Check pin 8 (+5 V) of BUP connector (harness side). • Check ground of BUP connector (harness side). • Measure resistance between pins 8 and 10 / 9 and 10 of BUP connector (BUP side).
16	Instrument shows. BATTERY TEMPERATURE HIGH	Cell temperature too high when discharging / charging	• Check installation. • Check MG diagnostic tool.
		Air circulation problem	• Check installation. • Check MG diagnostic tool.
		Defective BMS	• Check installation. • Check MG diagnostic tool.
		Defective battery	• Check installation. • Check MG diagnostic tool.
17	Instrument shows. BATTERY TEMPERATURE LOW	Cell temperature too low when discharging / charging	• Check installation. • Check MG diagnostic tool.
		Environment temperature too low	• Check installation. • Check MG diagnostic tool.
		Defective BMS	• Check installation. • Check MG diagnostic tool.
		Defective battery	• Check installation. • Check MG diagnostic tool.
18	Instrument shows. BATTERY OVER CURRENT	Discharging / charging current too high	• Check MG diagnostic tool.
		Defective BMS	• Check MG diagnostic tool.
19	Instrument shows. BATTERY VOLTAGE HIGH	Battery cell voltage too high	• Check MG diagnostic tool.
20	Instrument shows. BATTERY VOLTAGE LOW	Battery cell voltage too low	• Charge the battery system. • Check MG diagnostic tool.
21	Instrument shows. BATTERY LEVEL LOW	State of charge (SOC) below 20%	• Charge the battery system. • Check MG diagnostic tool.
22	Instrument shows. BATTERY EMPTY	State of charge (SOC) 0%	• Charge the battery system. • Check MG diagnostic tool.

No.	Problem	Possible cause	Action
23	Instrument shows. CHECK BATTERY SYSTEM	Battery overtemperature	• Check installation. • Check MG diagnostic tool.
		BMS contactor overtemperature	• Visual inspection if BMS is closing the contactor. • Check MG diagnostic tool.
		Battery CAN communication error	• Check if battery CAN connector is connected to SDe. • Measure voltage in CANL (pin 5) in battery CAN connector. • Measure voltage in CANH (pin 4) in battery CAN connector. • Measure resistance between pins 4 and 5 in battery CAN connector (60 Ω). • Check the 2 terminals of the battery CAN network. • Measure the resistance between terminal's CANL and CANH pins (120 Ω).
		Internal 12 V / 24 V power supply problem	• Check MG diagnostic tool.
		Battery humidity high	• Check installation. • Check MG diagnostic tool.
		Discharge fuse broken	• Check fuses at MG Master LV. • Check MG diagnostic tool.
		Charge fuse broken	• Check fuses at MG Master LV. • Check MG diagnostic tool.
		Pre-charge fuse broken	• Check fuses at MG Master LV. • Check MG diagnostic tool.
		Battery temperature deviation detected by BMS	• Check MG diagnostic tool.
		Battery voltage deviation detected by BMS	• Check MG diagnostic tool.
		Battery leakage	• Check MG diagnostic tool.
		Battery terminals temperature too high	• Check MG diagnostic tool.
		Communication connection problem	• Check installation. • Check MG diagnostic tool.
		Defective BMS	• Check installation. • Check MG diagnostic tool.
		Defective battery	• Check installation. • Check MG diagnostic tool.

DIAGNOSTIC TROUBLE CODE LIST

DTC	SPN	FMI	DTC description	Display alarm	Failsafe action		Note
					Derating	Motor stop	
P1702	523811	16	Motor temperature High 1	MOTOR TEMPERATURE HIGH	○	–	
P1703	523812	0	Motor temperature High 2	MOTOR TEMPERATURE HIGH	–	○	
P1706	523815	2	Motor temperature sensor failure	CHECK MOTOR	○	–	
P1704	523813	0	Motor overspeed	CHECK MOTOR	–	○	
P1705	523814	2	Motor speed sensor failure	CHECK MOTOR	–	○	
P1707	523816	12	Motor speed gap target and actual	CHECK MOTOR	–	○	
P1708	523817	16	Controller temperature High 1	MOTOR CONTROLLER TEMPERATURE	○	–	
P1709	523818	0	Controller temperature High 2	MOTOR CONTROLLER TEMPERATURE	○	–	
P1779	523819	0	Overcurrent U/V/W	MOTOR CONTROLLER OVER CURRENT	–	○	
P1780	523823	6	Overcurrent (continuous)	MOTOR CONTROLLER OVER CURRENT	○	–	
P1781	523824	5	Disconnection U/V/W	CHECK SYSTEM	–	○	
P1782	523825	0	DC voltage High	MOTOR CONTROLLER VOLTAGE HIGH	–	○	
P1788	523827	4	DC voltage Low 1	MOTOR CONTROLLER VOLTAGE LOW	○	–	
P1783	523826	1	DC voltage Low 2	MOTOR CONTROLLER VOLTAGE LOW	–	○	
P1784	523828	1	No DC Voltage	MOTOR CONTROLLER VOLTAGE LOW	–	○	
P1785	523829	12	Cutback active	CHECK SYSTEM	○	–	Internal motor controller alarm, resulting in derating
P1786	523830	2	+5V supply voltage abnormal	CHECK SYSTEM	–	–	
P1787	523831	12	Non-volatile memory error (Read)	CHECK MOTOR CONTROLLER	–	○	
P1789	523833	12	Motor controller failure	CHECK MOTOR CONTROLLER	○	○	Internal motor controller alarm. Can result in derating or motor stop
P1978	523848	7	Contactor failure (Open/Short)	CHECK SYSTEM	–	○	
P1979	523849	7	KSI relay (Open/Short)	CHECK SYSTEM	–	–	
P1980	523850	7	Pump failure (Open/Short)	CHECK SYSTEM	–	–	
P1006	522775	0	Water in drive seal	WATER IN DRIVE SEAL	–	–	

DTC	SPN	FMI	DTC description	Display alarm	Failsafe action		Note
					Derating	Motor stop	
C1027	522042	11	Main throttle/shift sensor warning	MAIN THROTTLE	–	–	
C1028	522043	11	Main throttle/shift sensor error	MAIN THROTTLE	–	○	
P0228	29	3	BUP throttle voltage High	SUB THROTTLE	–	○	
P0220	29	4	BUP throttle voltage Low	SUB THROTTLE	–	○	
P1981	523851	12	BUP shift abnormal	SUB THROTTLE	–	○	
P1982	523852	7	BUP lamp error	SUB THROTTLE	–	–	
P1983	523853	4	No BUP power	CHECK SYSTEM	–	–	
C1208	522041	9	CAN communication error (CH)	CHECK SYSTEM	–	○	
U1226	523854	9	CAN communication error (BMS)	CHECK SYSTEM	○	–	
P1790	523834	16	Battery temperature High 1	BATTERY TEMPERATURE HIGH	○	–	
P1791	523835	0	Battery temperature High 2	BATTERY TEMPERATURE HIGH	–	○	
P1792	523836	18	Battery temperature Low 1	BATTERY TEMPERATURE LOW	○	–	
P1793	523837	1	Battery temperature Low 2	BATTERY TEMPERATURE LOW	–	○	
P1794	523838	16	Battery over current 1	BATTERY OVER CURRENT	○	–	
P1795	523839	0	Battery over current 2	BATTERY OVER CURRENT	–	○	
P1796	523840	3	Battery voltage High 1	BATTERY VOLTAGE HIGH	–	–	
P1797	523841	0	Battery voltage High 2	BATTERY VOLTAGE HIGH	–	○	
P1798	523842	4	Battery voltage Low 1	BATTERY VOLTAGE LOW	○	–	
P1799	523843	1	Battery voltage Low 2	BATTERY VOLTAGE LOW	–	○	
P1974	523844	1	Battery empty	BATTERY EMPTY	○	–	
P1975	523845	12	Check Battery system 1	CHECK BATTERY SYSTEM	○	–	
P1976	523846	12	Check Battery system 2	CHECK BATTERY SYSTEM	–	○	
P1977	523847	12	BMS not found	CHECK BATTERY SYSTEM	○	–	

LONG TERM STORAGE

If the system is not to be used for more than 1.5 months, the following measures must be taken:

- Make sure the Li-ion battery charge is between 50% and 70%.
- Turn off the power switch on the MG Master LV.
- Make sure the storage temperature is between +10 °C and +25 °C.
  If the environmental temperature cannot be maintained within this range, remove the Li-ion battery and store it.

Do not disconnect the cable between the Li-ion batteries.

If the cable between the Li-ion batteries is disconnected, check the voltage of each Li-ion battery to check if it is the same as the parallel connected batteries. When the voltage is not same between the parallel connected batteries, please consult your authorized YANMAR Marine dealer or distributor before reconnecting.

NOTICE

- Check the voltage of the stored battery module every year.
- If Li-ion battery is completely discharged, the battery can be damaged.
- When connecting the cable between the Li-ion batteries, excessive high uncontrolled current can flow between the battery modules. This can damage the batteries, and might lead to other damage or injury.
- Refer to the MG LFP Li-ion battery manual for details.

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SPECIFICATIONS

ELECTRIC SAILDRIVE

Parameter		Data		
		SDe7	SDe10	SDe15
Motor type		Liquid cooled Permanent Magnet Synchronous Motor		
Rated output power (at 2700 min^{-1}) *1,2		7 kW	10 kW	15 kW
Propeller shaft power (at 2700 min^{-1}) *3		6.8 kW	9.8 kW	14.7 kW
Nominal battery voltage		51.2 VDC		
Maximum current *4		155 A	225 A	335 A
Maximum motor speed (fwd)		2900 min^{-1}		
Maximum motor speed (rev) (Reverse Boost)		3300 min^{-1}		
Minimum motor speed (default)		0 min^{-1} (600 min^{-1})		
Motor output shaft direction		CW or CCW		
Reduction ratio		2.13		
Rated propeller speed		1361 min^{-1}		
Maximum propeller diameter		16 inch		
Propeller direction (viewed from stern)		CW or CCW		
Cooling system		ATF cooling by gear pump		
Lubrication system		Closed oil lubrication		
Lubrication oil	Type	ATF		
	Grade	Dexron II-D		
Lubrication oil capacity (effective)		3.2 (0.2) L		3.4 (0.2) L
Lubrication oil replacement volume by pump		1.9 L		2.0 L
Lubrication oil replacement volume by pump + drain plug		2.6 L		2.7 L
Dry weight *5		70 kg		78 kg

**1: Measured at motor output shaft*
**2: S2-60 rating with ambient water temperature 30 °C and ambient motor room air temperature 50 °C*
**3: Including 2% gear loss, according to ISO 8665-2*
**4: Measured at SDe power input*
**5: Including saildrive, excluding propeller*

BATTERY SYSTEM (MG ENERGY SYSTEMS)

Parameter	Data
	MG Master LV 600
Maximum current continuous	600 A
Standby mode power usage (at 52.4 V)	138 mW
Active mode power usage	8.7 W
Weight	6 kg
Operating temperature	-20 °C to +50 °C
IP rating	IP22

Parameter	Data	
	LFP230	LFP304
Technology	Lithium-Ion next generation LiFePo4	
Nominal voltage	25.6 V	
Nominal capacity	230 Ah	304 Ah
Nominal energy	5.8 kWh	7.8 kWh
Cycle Life DOD 80% *1	> 3500	> 4000
Specific energy *2	143 Wh/kg	145 Wh/kg
Weight	41 kg	54 kg
Recommended discharge current	< 115 A (< 0.5 C)	< 152 A (< 0.5 C)
Continuous discharge current	230 A (1.0 C)	304 A (1.0 C)
Recommended charge current	< 115 A (< 0.5 C)	< 152 A (< 0.5 C)
Continuous charge current	230 A (1.0 C)	304 A (1.0 C)
Operating temperature (charge)	0 to +45 °C	
Operating temperature (discharge)	-20 to +55 °C	
Recommended operating temperature	+20 to +30 °C	
Recommended storage temperature	+10 to +35 °C	
IP rating	IP30	
Short circuit current *3	6.6 kA	8.8 kA

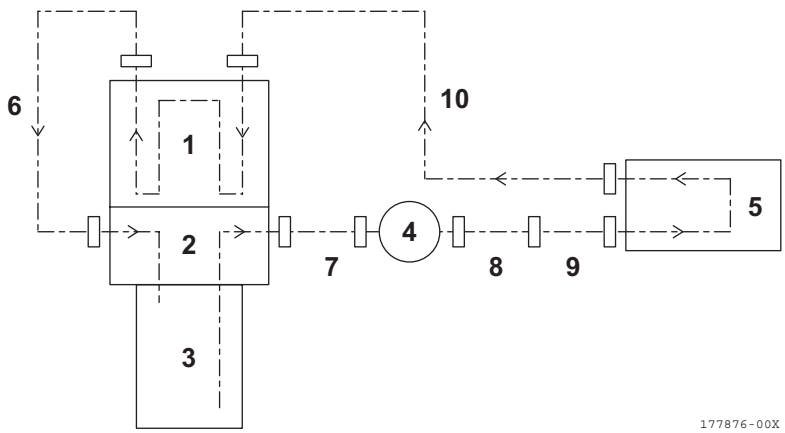
**1: End-of-Life is 70% of initial capacity at 25 °C. Cycle life depends on the battery temperature. Higher battery temperature will result in a lower number of cycles.*

**2: Including BMS and enclosure.*

**3: At 45 °C module temperature*

SYSTEM DIAGRAM

PIPING DIAGRAM



1 – Motor
2 – Saildrive adapter
3 – Saildrive
4 – Lubricating oil pump
5 – Controller cooler
6 – ø10 Steel pipe
7 – ø10 Rubber hose
8 – ø10 Rubber hose
9 – ø10 Steel pipe
10 – ø10 Steel pipe

Figure 1

EU DECLARATION OF CONFORMITY

SDe series Electric Sail Drive
This Declaration of Conformity applies to the following products within the SDe series Electric Sail Drives marked with a CE Mark, including the control system components:

SDe7
SDe10
SDe15

Manufacturer: Yanmar Marine International B.V.
Brugplein 11
1332 BS
Almere, the Netherlands

Electromagnetic Compatibility Directive 2014/30/EU

Standards Applied:

EN 60945:2002	Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results
EN IEC 61000-6-1:2019	Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity standard for residential, commercial and light-industrial environments
EN IEC 61000-6-3:2021	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for equipment in residential environments

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The Electric Sail Drives must not be put into service until the watercraft into which it is to be installed has been declared in conformity, if so required, with the relevant provision of the Directive 2013/53/EC.

This declaration of conformity is issued under the sole responsibility of the manufacturer. I declare on behalf of the product manufacturer that the electric sail drives mentioned above comply with all applicable essential requirements in the way specified.

Name and function
Gideon van Dijk, Sr Manager Development & Quality
Yanmar Marine International B.V.

Date:
14 November 2025

YANMAR MARINE INTERNATIONAL B.V.

■**Yanmar Marine International B.V.**

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As of September 1st, 2025

OPERATION MANUAL

SDe7, SDe10, SDe15

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