

SAIL DRIVES

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SAIL DRIVES

SAIL DRIVE MODELS

The models that include sail drive are listed below:

- SD20
- SD60

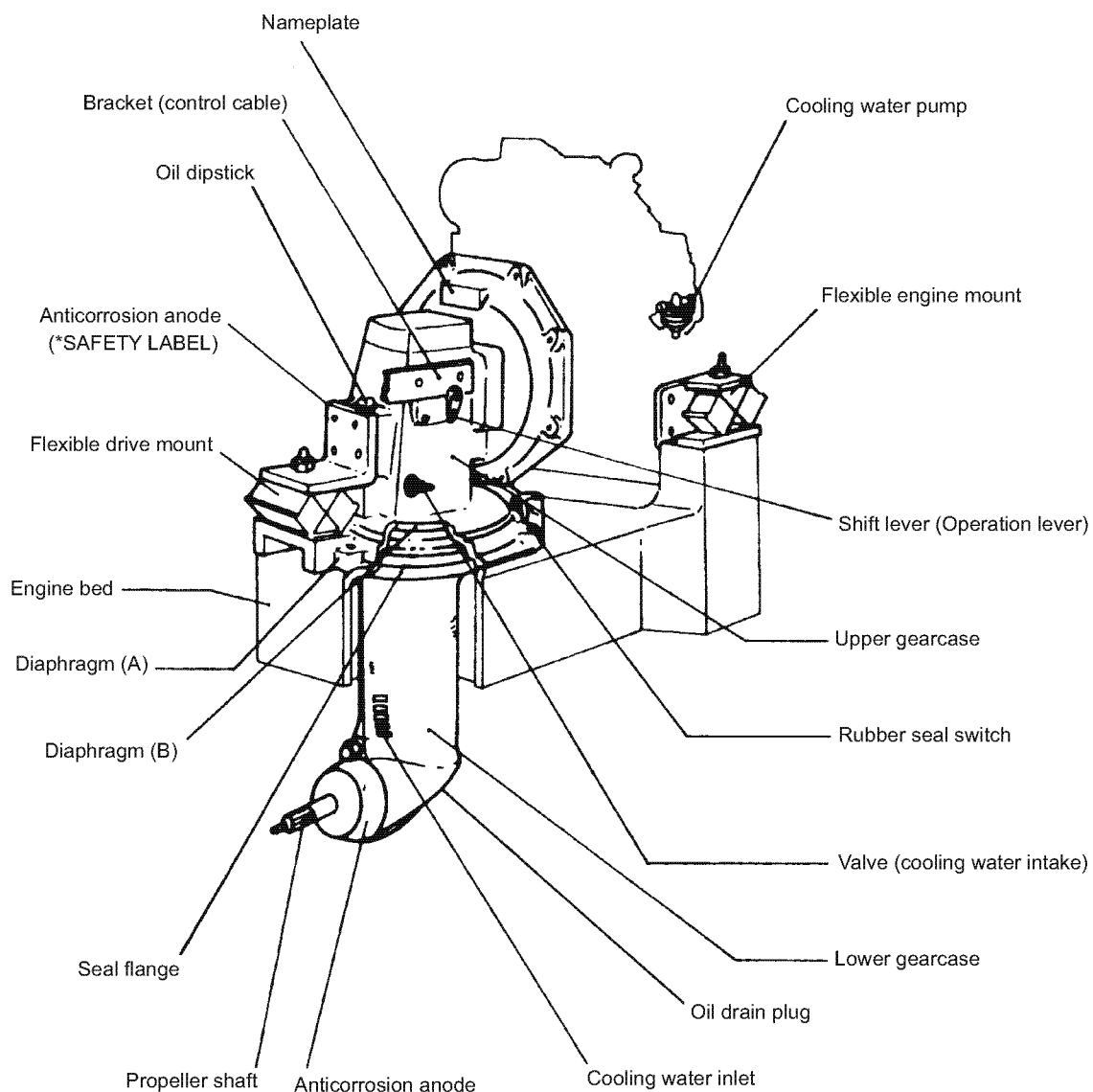
Engines and sail-drive combinations are available as follows:

Engine model	Sail-drive model
1GM10C	SD20
2YM15	
3YM20	
3YM30(E)	
3JH5E	SD60
4JH5E	
4JH4-TE	

SAIL DRIVE SPECIFICATIONS

Model		SD20	SD60-5	SD60-4
Clutch type		Mechanical dog clutch	Mechanical multiple friction disc clutch	
Direction of rotation	Input shaft	Counterclockwise viewed from stern		
	Propeller shaft	Counterclockwise viewed from stern	Counterclockwise or clockwise viewed from stern	
Reduction ratio	Ahead	2.64	2.23 or 2.49	
	Astern	2.64	2.23 or 2.49	
Propeller speed/engine speed (at maximum output)		1364/3600 min ⁻¹	1345 or 1205/3000 min ⁻¹	1435 or 1285/3200 min ⁻¹
Lubrication system		Oil bath type		
Lubrication oil capacity	Standard unit	2.2 ℓ (2.3 qt)	2.8 ℓ (3.0 qt)	
	Long-reach unit	2.5 ℓ (2.6 qt) with extension 80 mm	3.0 ℓ (3.2 qt) with extension 75 mm	
Dry weight	Standard unit	30 kg (66.1 lb)	43.6 kg (96.1 lb)	45.1 kg (99.4 lb)
	Long-reach unit	33.4 kg (73.6 lb)	48.2 kg (106.3 lb)	49.7 kg (109.6 lb)
Remote control device	Control head cable	Single control lever, travel 70 mm (2.75 in.) MORSE 33C (or equivalent)		
Applicable engine model (maximum output at crankshaft) kW (hp)/min ⁻¹		1GM10C: 6.7 (9.1)/3600	3JH5E 28.7 (39.0)/3000	4JH4-TE: 55.2 (75.1)/3200
		2YM15: 10.0 (13.6)/3600	4JH5E 39.6 (53.8)/3000	—
		3YM20: 15.3 (20.8)/3600	—	—
		3YM30 (E): 21.3 (29.0)/3600	—	—

SAIL DRIVE COMPONENTS



***SAFETY LABEL**



K0003997

Figure 1

The Yanmar sail-drive is delivered separately from the engine. When installing the unit, be sure to check that accessories and parts necessary for engine installation are correct. Parts and accessories included in the same package as the sail drive are as follows:

■ Sail drive (SD20 and 60) part list

Parts name	Quantity/ unit	Remarks
Amplifier and wire harness	1	Rubber seal switch
Rubber protection	1	Drive unit and hull
Bolts with washer M8 × 30	8	Mounting flange (SD20)
Bolts with washer M8 × 18	8	Mounting flange (SD60-5)
Bolts with washer M10 × 28	10	Mounting flange (SD60-4)
Spring washer	8	Mounting flange (SD20)

■ Cooling water hose piping

1. Attach the end of the cooling water hose to the seacock on the upper case inside the sail drive and secure it with a hose clamp.
2. Attach the other end of the hose to the cooling water pump on the engine side and secure it with a hose clamp.

Note: The cooling water hoses and hose clamps should be locally ordered by customers. Determine the setting position of the seawater strainer and select the hoses with appropriate length.

Cut the hose to the proper length for installation.

NOTICE

Do not make the hose too long and avoid bending the piping. Yanmar recommends the use of a reinforced hose such as the spiral steel type hose to prevent the hose from squashing by the negative pressure while absorbing water.

Model SD20

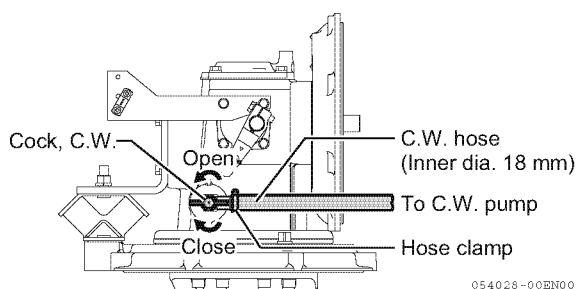


Figure 2

Model SD60

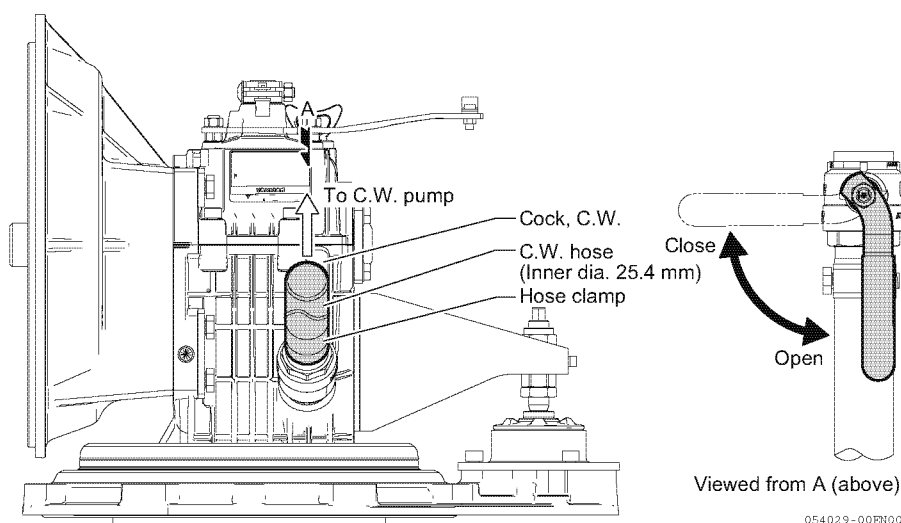


Figure 3

GALVANIC CORROSION

Galvanic corrosion results whenever two or more dissimilar metals (like those found on the sail-drive) are submerged in a conductive solution, such as saltwater, polluted water or water with a high mineral content because a chemical reaction takes place causing electrical current to flow between the metals. The electrical current flow causes the metal that is most chemically active, or anodic, to erode. If not controlled, galvanic corrosion may corrode Sail-Drive 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 sail-drive 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)*1.

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

- the number, size and location of sacrificial anodes on the sail-drive and vessel;
- the marina environment, such as stray current in the water, fresh or salt water and use and isolation of shore power;
- improper application of marine paint or antifouling paint;
- failure to repaint damaged areas; and
- how the vessel is bonded.

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

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

NOTICE

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

NOTICE

Failure to use the correct anode material may result in inadequate protection and excessive corrosion of underwater drive system components. Use only zinc or aluminum anodes in brackish and saltwater applications. In freshwater applications, use aluminum or magnesium anodes for best results. Never use magnesium anodes in brackish or salt water, 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

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

NOTICE

If the AC shore power ground is not isolated from the boat ground, 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.

Underwater Drive Coating

The lower gear case coating may be damaged when 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 it is believed that an object was hit that may have caused damage. Repair and repaint damaged areas immediately.

Observe the following precautions when applying antifouling or marine paint to the sail-drive lower gear case:

- Always follow the paint/coating manufacturer's directions for surface preparation and application.
- Always use a high quality primer and topcoat paint specifically designed for aluminum outboards, sail-drives or stern-drives.
- Never paint the sacrificial anodes installed on the sail-drive.
- Never paint the sail-drive with a material that contains copper or tin.
- Never paint over drain holes, sacrificial anodes, or other items specified by the sacrificial anode manufacturer.

Contact your authorized Yanmar Marine dealer or distributor for assistance.

NOTICE

Galvanic corrosion damage, normal maintenance and consumable parts are not covered by the Yanmar Limited Warranty.

PROPELLER SHAFT AND NUT

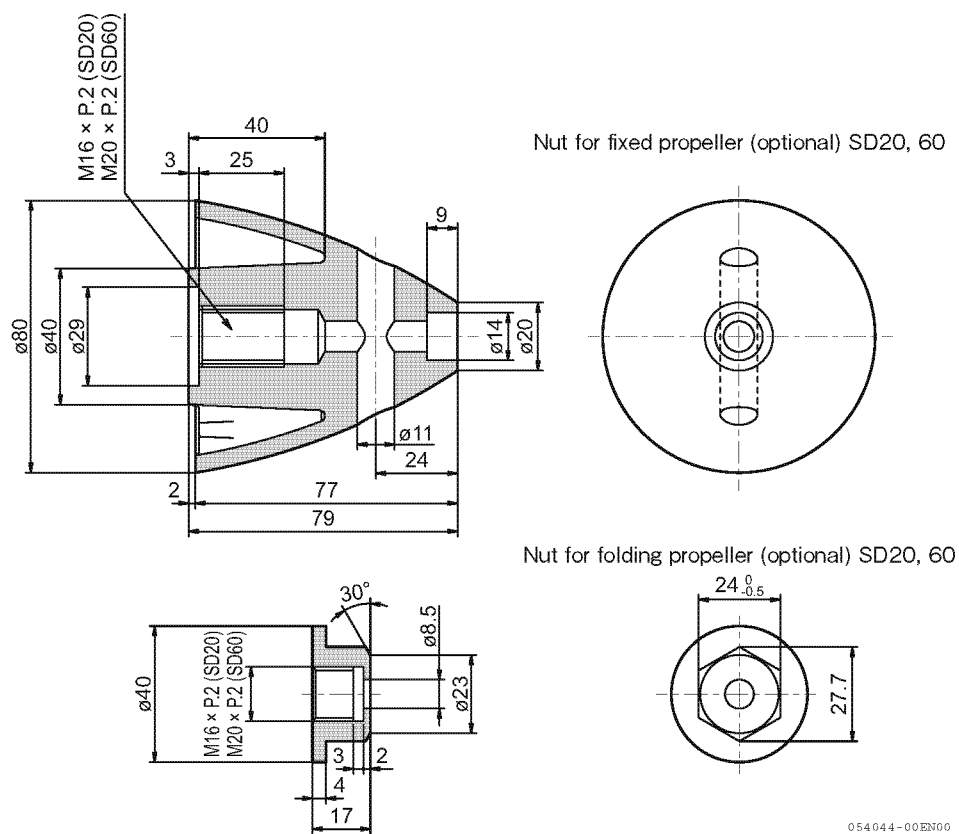
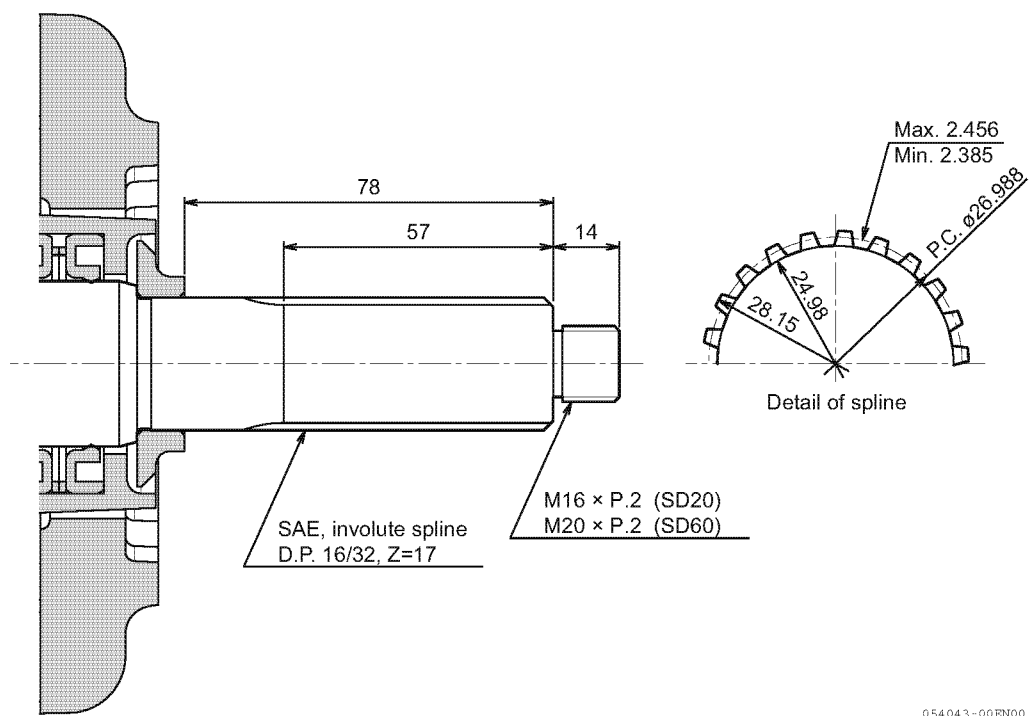


Figure 4

■ Engine bed

SD20

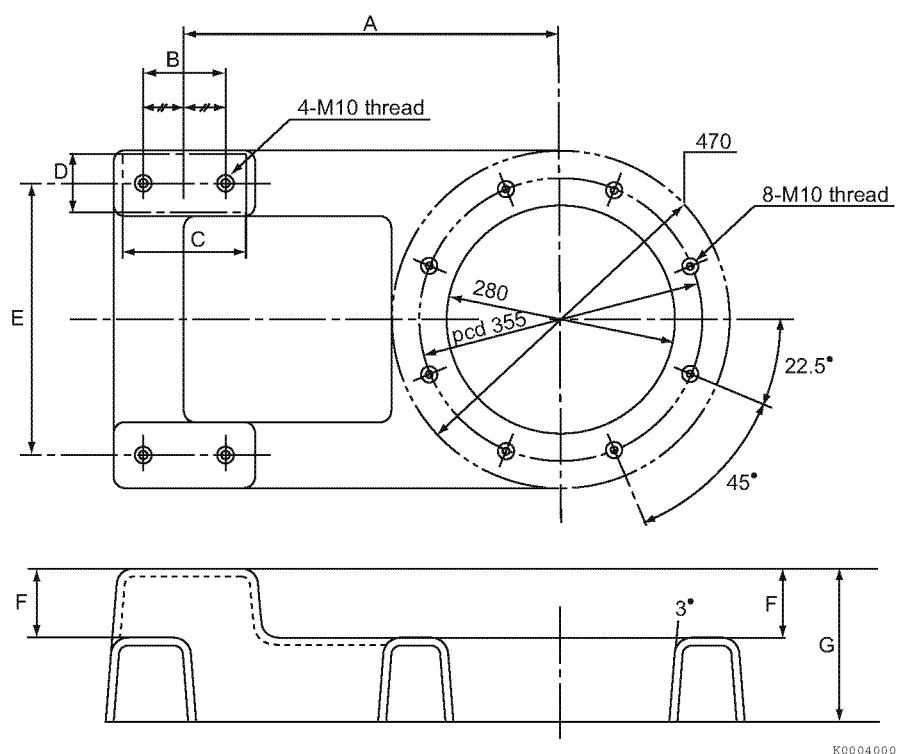


Figure 5

■ Engine bed dimension

Applicable model		A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)
SD20	1GM10C	371.5 ± 0.5	128	160	50	370	110	255
	2YM15	371.5 ± 0.5	174	206	60	370	110	255
	3YM20	449.5 ± 0.5	174	206	60	370	110	255
	3YM30(E)	468.5 ± 0.5	174	206	60	370	110	255

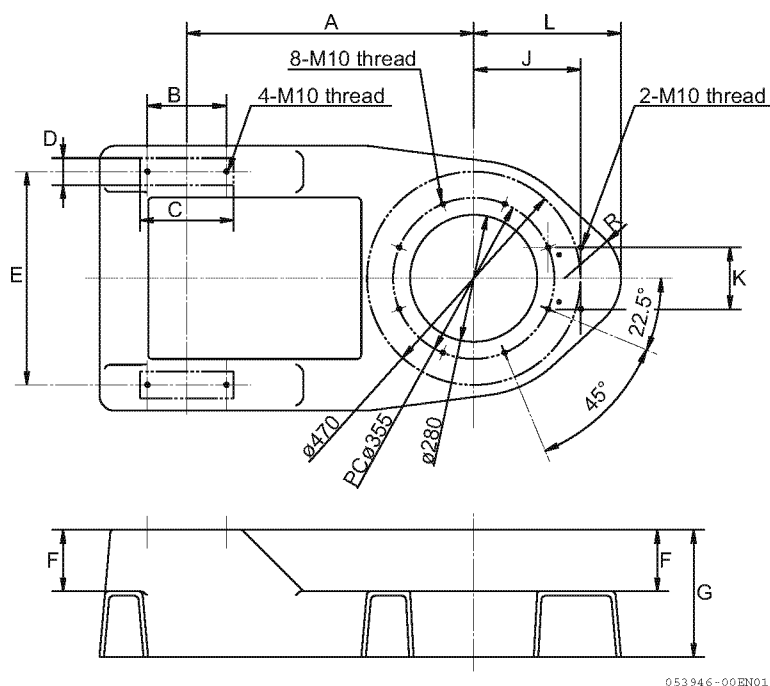


Figure 6

■ Engine bed dimension

Applicable model		A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	J (mm)	K (mm)	R (mm)	L (mm)
SD60	3JH5E	538 ± 0.5	174	215	50	420	136	281	236	136	115	287
	4JH5E	632 ± 0.5	174	215	50	470	135	280	236	136	115	287
	4JH4-TE	668 ± 0.5	174	215	50	470	135	280	236	136	115	287

■ Long-reach unit (extension kits) optional parts

It is recommended that the tip clearance between the propeller and the hull to be 10 % or more of the propeller diameter.

For installation in hulls with a high engine bed, the SD20 and SD60 have optional extension kits.

Optional extension kits:

- 80 mm (3.15 in.) for SD20
- 75 mm (2.95 in.) for SD60

SD20 long-reach unit

Unit: mm (in.)

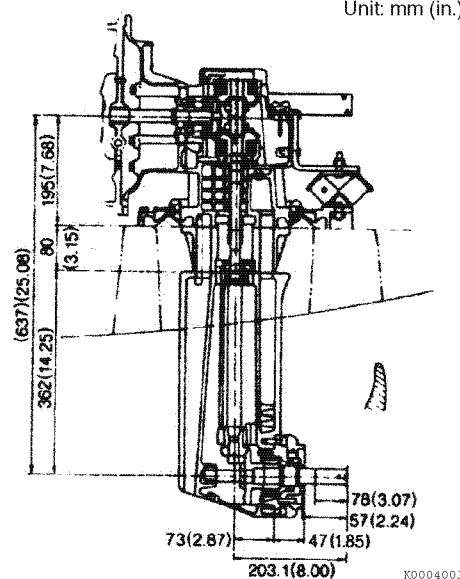


Figure 7

SD20

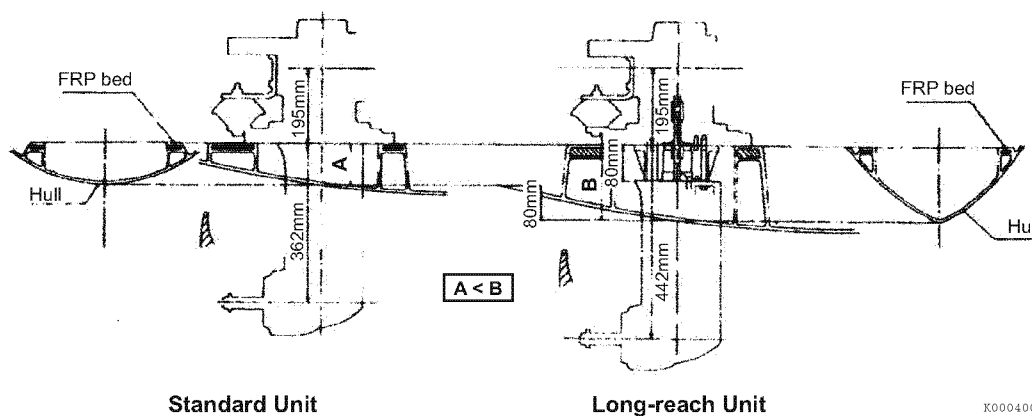


Figure 8

SD60

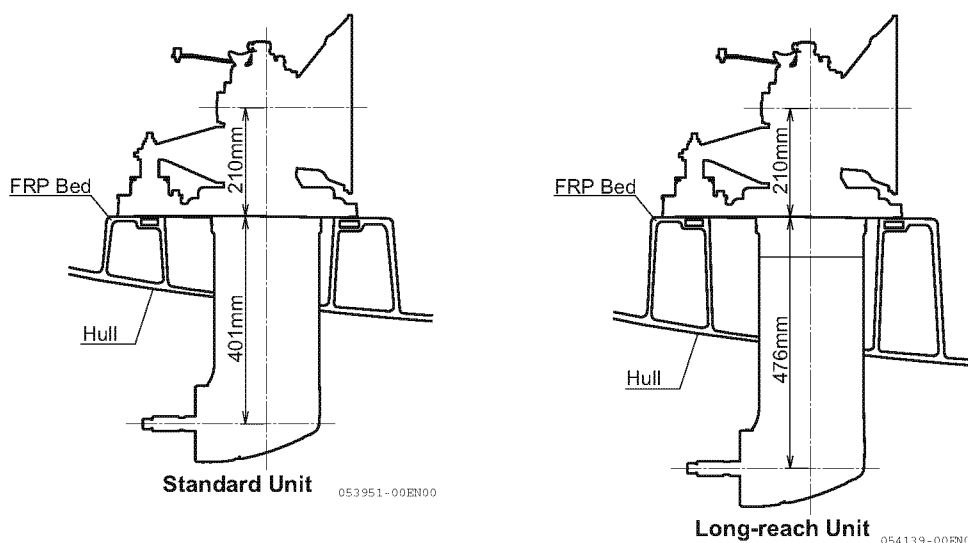


Figure 9

SD20, SD60 INSTALLATION

1. Put engine bed in hull bottom.

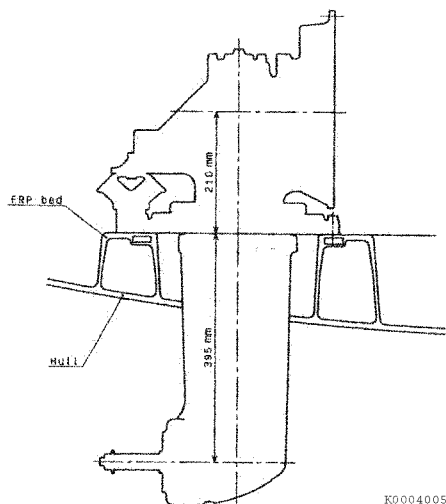


Figure 10

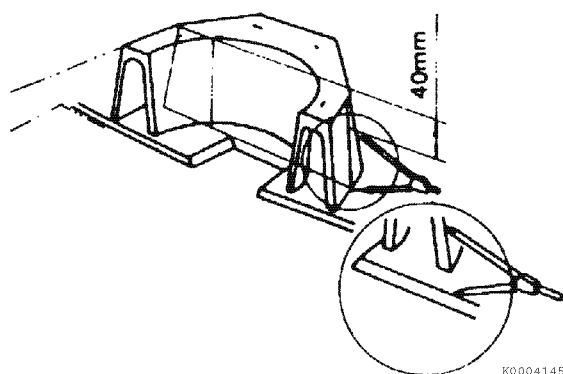


Figure 11

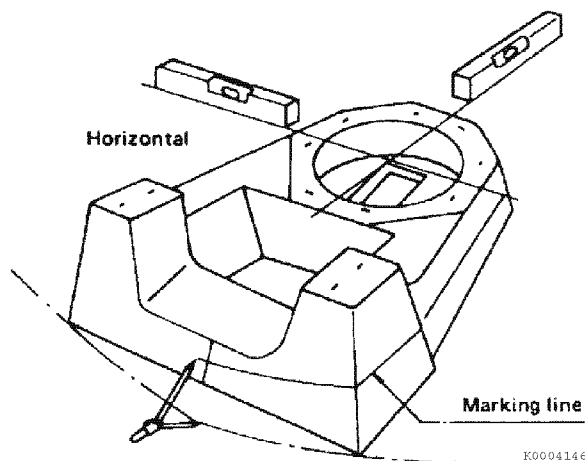


Figure 12

2. Level the engine bed fore and aft and port-to-starboard, and ensure it is centered along the keel.
3. Mark the bottom of the hull around all outer and inner surfaces of the engine bed.
4. Use a compass to scribe a cutting line around the entire engine bed. Start at a point 40 mm (1.57 in.) down from the drive mounting surface.

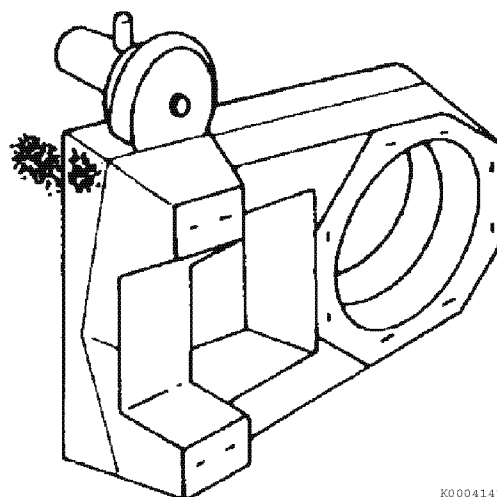


Figure 13

5. Remove the engine bed and cut along the line (Figure 13).

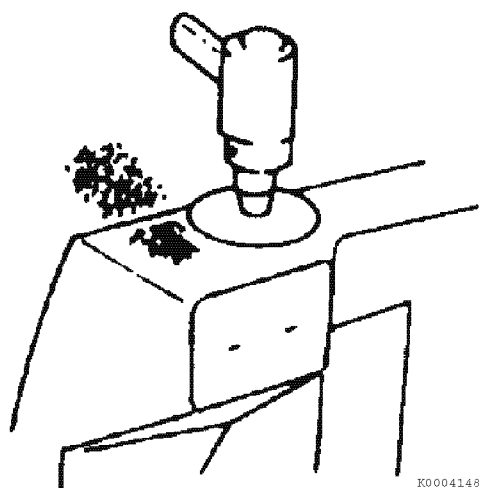


Figure 14

6. Grind the areas where fiberglass will be used to fasten bed to hull bottom to ensure a good bond (Figure 14).

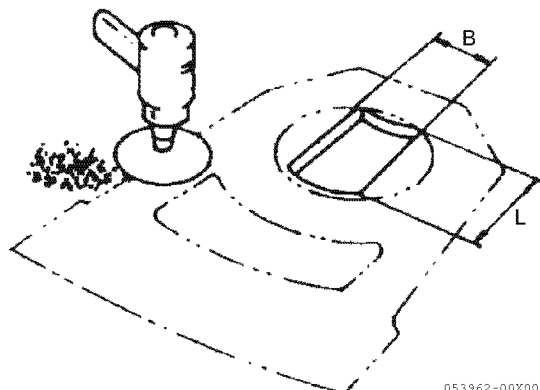


Figure 15

7. Cut a hole through the hull bottom (Figure 15).
 $L \times B$
 SD20: 230 mm \times 115 mm (9.06 \times 4.53 in.)
 SD60: 245 mm \times 180 mm (9.65 \times 7.09 in.)

Note: The sizes of the holes are described as reference values, which does not provide any guarantees of the Installability for all boats.

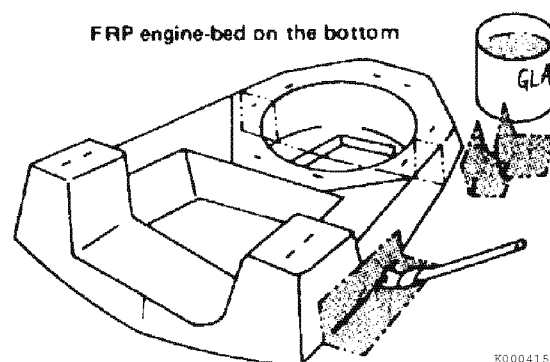


Figure 16

8. Secure the engine bed to the hull bottom using fiberglass fabric and resin (Figure 16).

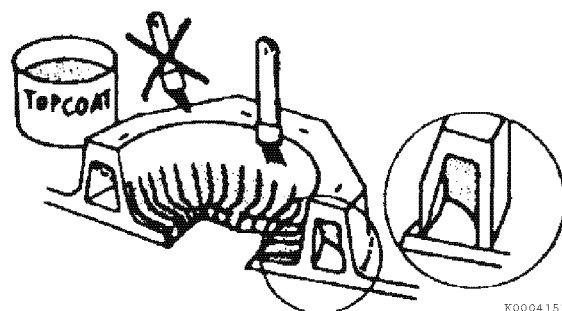


Figure 17

9. Apply a layer of glass fabric and resin to completely seal the cavity around the sail drive installation hole (Figure 17).

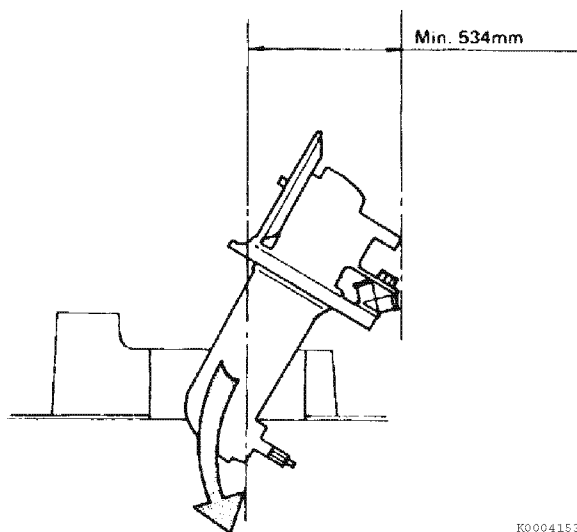


Figure 18

NOTICE

Cover the rough edges of the hole with a soft material to protect the drive unit surface from damage during installation.

10. When the resin has cured, carefully pass the sail drive through the hull bottom (**Figure 18**). Loosely install the attaching hardware but do not tighten at this time.

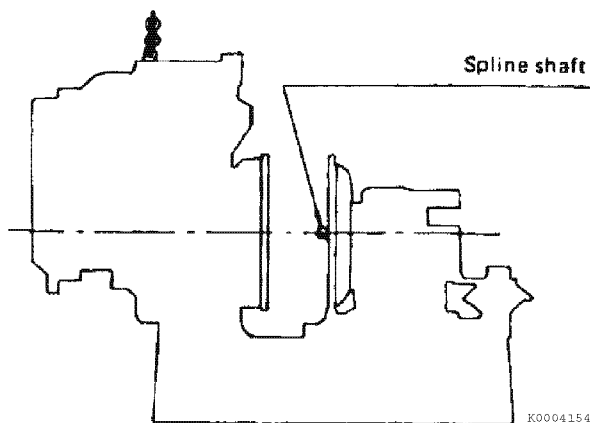


Figure 19

11. Lightly grease the splines and install the engine, being careful to engage the splined shaft as the assemblies are moved together (**Figure 19**).

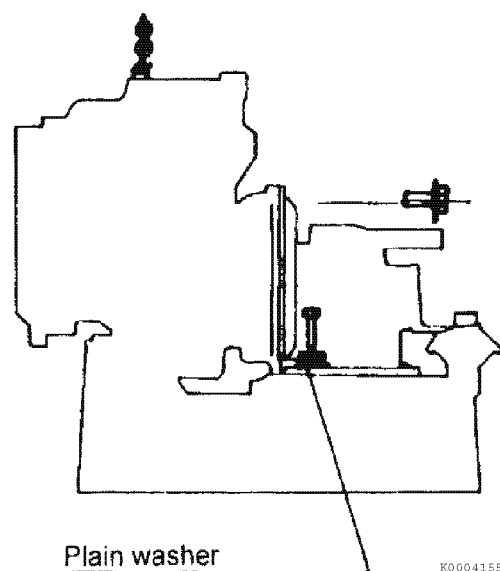
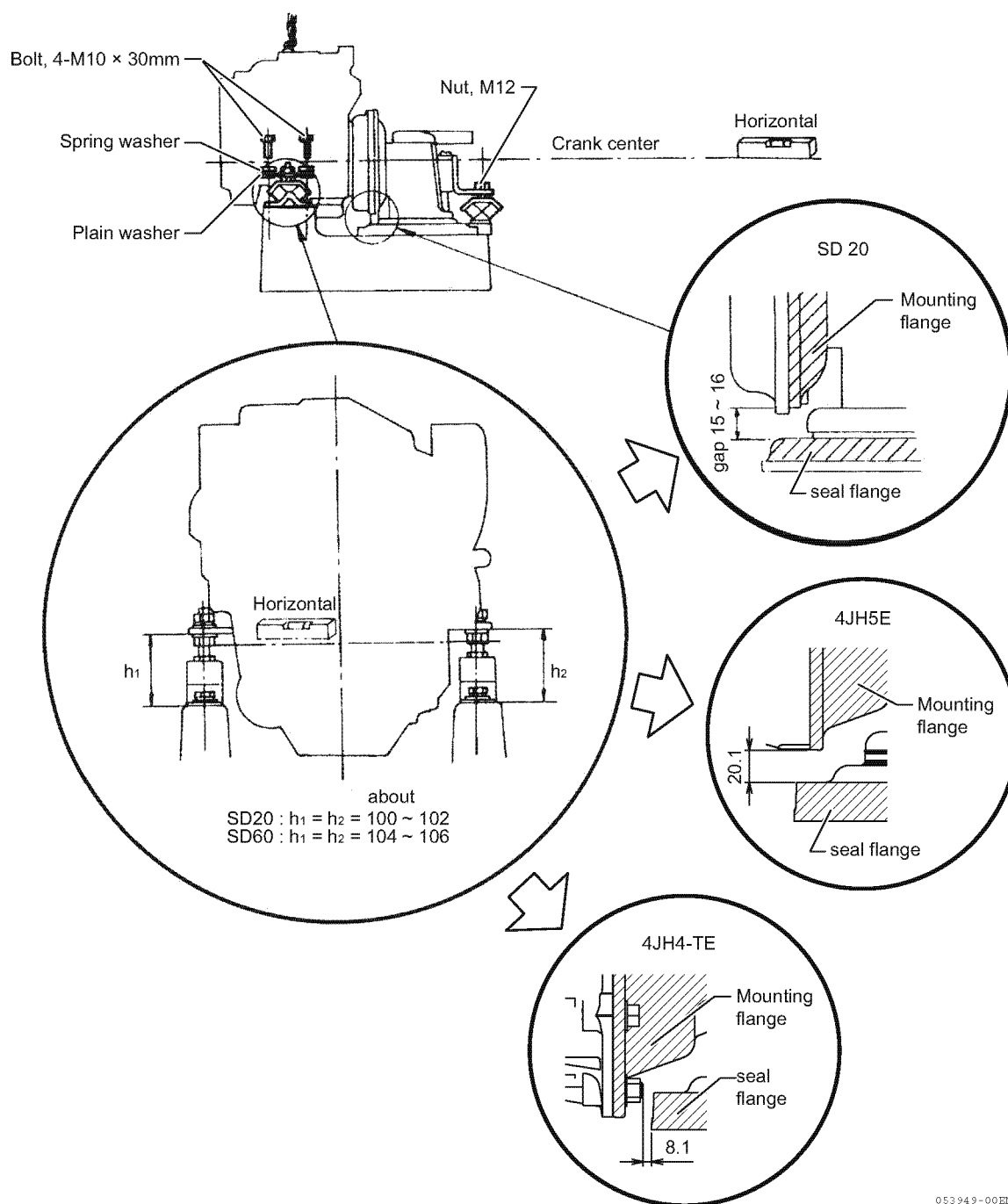


Figure 20

12. Install the attaching hardware and tighten to specification (**Figure 20**). See *Flexible Mounting* on page SD-21.



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Figure 21

13. Adjust the jack-nuts (SD20) or insert the plain washers (SD60) on the engine mounts until the engine and drive are horizontal in all directions (Figure 21).

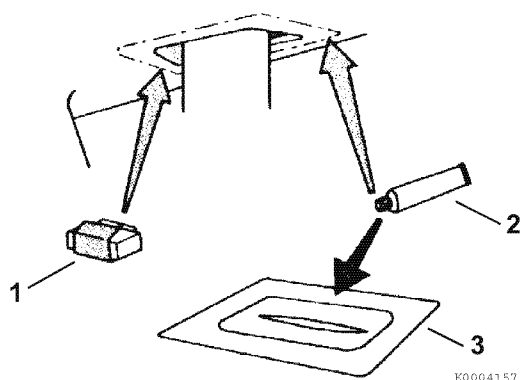


Figure 22

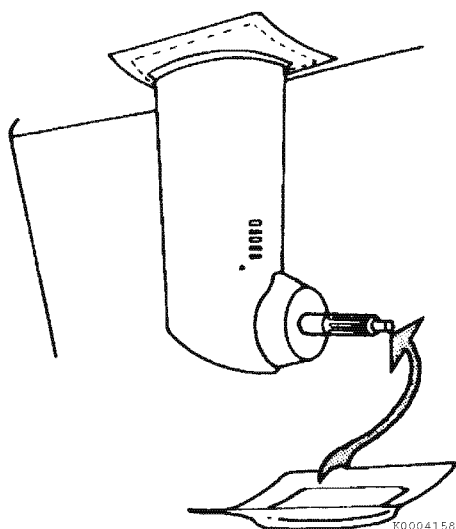


Figure 23

14. Clean the lower shield mounting area with sandpaper (1, Figure 22) to ensure a good bond.

15. Apply a suitable adhesive (2, Figure 22) to the rubber gasket (3, Figure 22) and secure in place (Figure 23).
16. Allow the adhesive to thoroughly dry and then check the rubber gasket to be sure it is securely and permanently bonded to the hull.

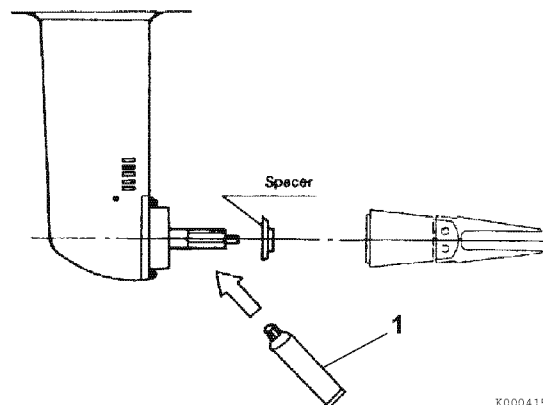


Figure 24

NOTICE

Never install a propeller without a rubber hub. Damage to the propeller shaft, bearings, and gears of the drive unit may result in the case of impact with an underwater object.

Note: Functionality may decrease if non-standard hardware is used, such as a line cutter in place of the spacer.

17. Apply grease (1, Figure 24) to the propeller shaft.
18. If installing a folding-blade propeller, refer to the propeller manufacturer's documentation for proper installation.

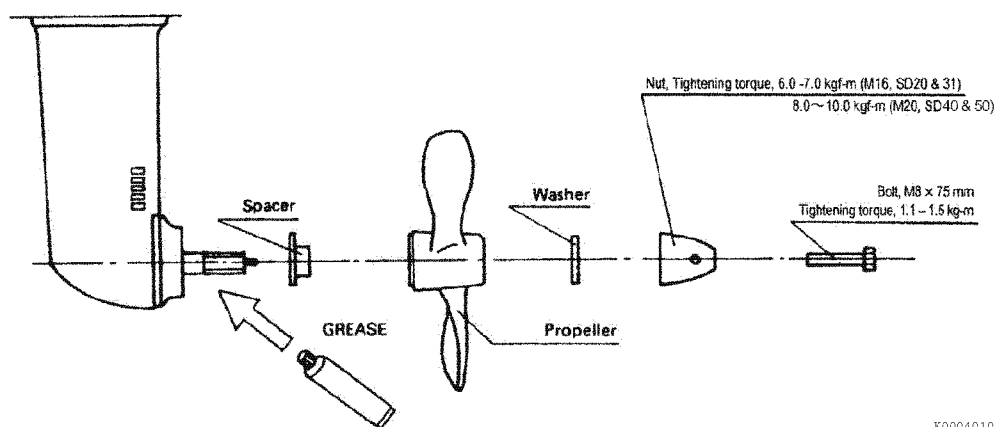


Figure 25

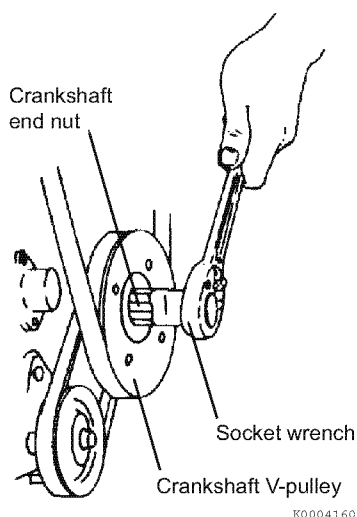


Figure 26

Note: To prevent the propeller shaft from turning while tightening the center bolt, use a socket wrench on the crankshaft V-pulley.

19. If installing a fixed-blade propeller, tighten the nut to specification. Engage the shift lever in forward gear and hold the crankshaft using a socket wrench (**Figure 26**).
20. Tighten the M8 × 75 center bolt to specification.

Item	Model	Torque
M8 bolt	—	1.1 to 1.5 kgf·m (95 to 130 in.-lb)
M10 bolt	—	2.6 to 3.0 kgf·m (226 to 260 in.-lb)
Fixed-blade propeller nut	SD20	6.0 to 7.0 kgf·m (43 to 51 ft-lb)
	SD60	8.0 to 10.0 kgf·m (58 to 72 ft-lb)

For details of propeller installation, refer to the propeller installation manual provided by the manufacturer.

NOTICE

When selecting a propeller, ensure it has a rubber hub so as to reduce shock torque and galvanic corrosion. Propellers may be 2, 3 or 4 blade, and can be of fixed, folding or feathering design. The propeller must conform to the specifications in *Propeller limitation for Yanmar sail drives on page SD-18*.

NOTICE

Use the propeller specified in this manual. The failure caused by the use of a propeller that is not specified in this manual, or a propeller that does not increase the engine speed to the rated speed, may void the engine or sail-drive warranty coverage even before the warranty is expired.

SAIL DRIVES

■ Propeller limitation for Yanmar sail drives

Always use a propeller with a rubber bushing to reduce damage to the inner parts when installing the sail drive. The use of a propeller without a rubber bushing may void the engine or sail-drive warranty coverage even before the warranty is expired.

SD20 model:

- Maximum allowable diameter of propeller:
See page *SD-19*.
- Maximum allowable shock torque:
< 145 N·m (107 ft-lb)
- Maximum allowable moment of inertia (kgm²) in relation to static torsional spring constant (N·m/degree). See **Figure 27**.

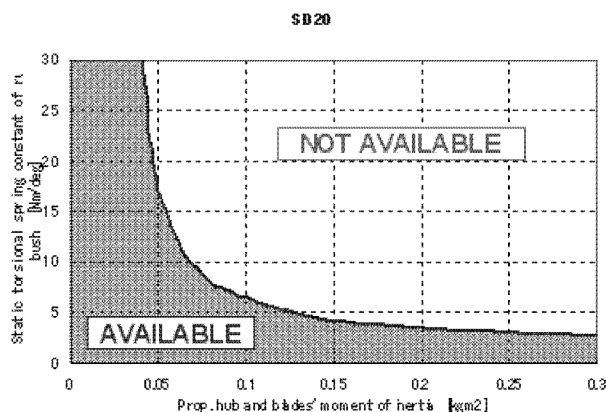


Figure 27

SD60 models:

- Maximum allowable diameter of propeller:
See page *SD-19*.
- Maximum allowable moment of inertia: 0.25 kgm²

Calculation method:

$$I \text{ (kg·m}^2\text{)} = m_1 \cdot R_1^2 + m_2 \cdot R_2^2 + m_3 \cdot R_3^2 + \dots$$

m_1 (kg); Weight of hub including all accessories

m_2 (kg); Weight of blade 1

m_3 (kg); Weight of blade 2

R_1 (m); Distance from prop center to hub's center of gravity

R_2 (m); Distance from prop center to prop blade 1's center of gravity

R_3 (m); Distance from prop center to prop blade 2's center of gravity

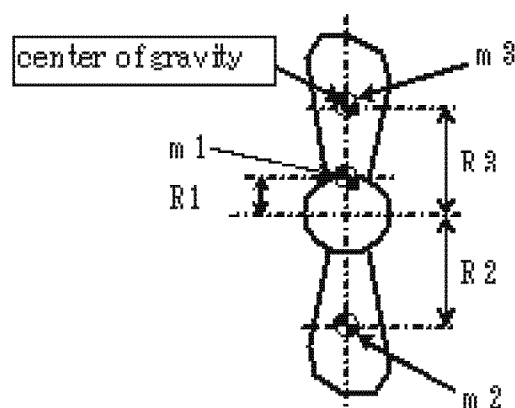


Figure 28

Allowable Propeller Size (Maximum)

Engine model	Sail-drive model	Folding type diameter	2 or 3-blades fixed type diameter
1GM10C	SD20	14 in.	14 in.
2YM15		14.5 in.	15 in.
3YM20		15 in.	16 in.
3YM30(E)		16 in.	16.5 in.
3JH5E	SD60	21 in.	21 in.
4JH5E		21 in.	21 in.
4JH4-TE		21 in.	21 in.

NOTICE

Precautions for matching the propeller:

- Be sure to confirm matching of the propeller in a sea trial.
- The match point for mechanically controlled engines is 100 min⁻¹ (rpm) above maximum output rpm at wide open throttle. This is the target value. See the Propeller Matching section in Marine Installation Manual Volume 1 for details.
- Do not use a propeller with the inertia that is larger than the value specified in allowable moment of inertia table on page *SD-18*.
- The use of a propeller without a rubber bushing, or a propeller with the inertia that is larger than the value specified in allowable moment of inertia, may void the engine or sail-drive warranty coverage even before the warranty is expired.

Reverse Installation Procedure (SD60 Only)

The SD60 can only be installed in the reverse configuration. The oil channel and rubber plug are not needed for these models.

The sail-drive may be installed in the standard or reverse 180° configuration (**Figure 29**). To reverse the installation, use the following procedure:

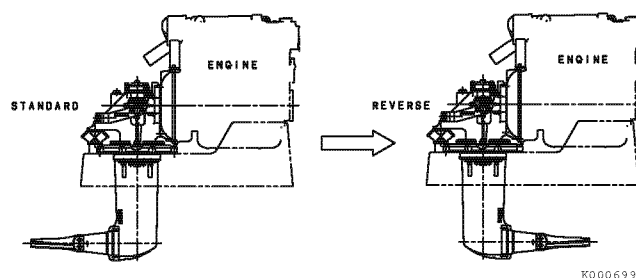


Figure 29

Note: Installation can only be made at 0° or 180°. No installation at any intermediate angle is allowed.

■ Rotation (180°) of the lower leg assembly, from “Z” to “C” configuration

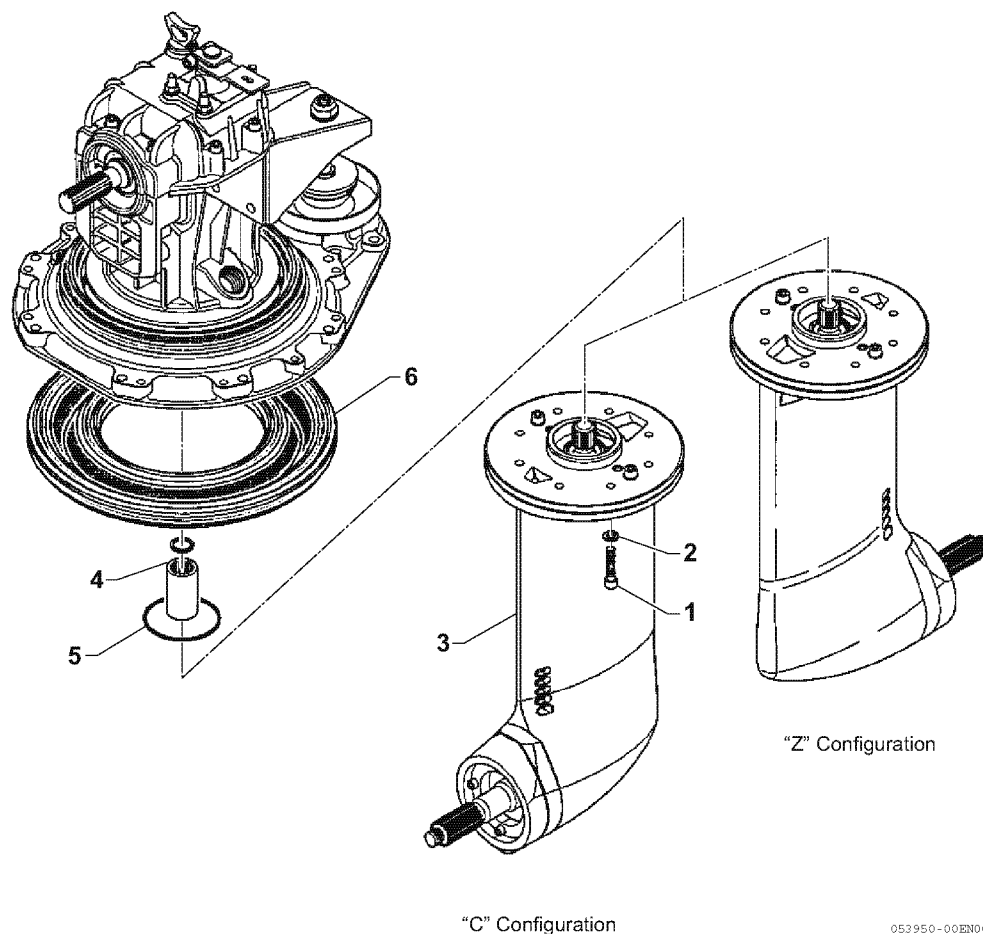


Figure 30

The connection between the upper gear housing and the lower leg housing is made by means of eight screws M8 × 40 (1, Figure 30).

The rotation of the lower leg housing is easily made:

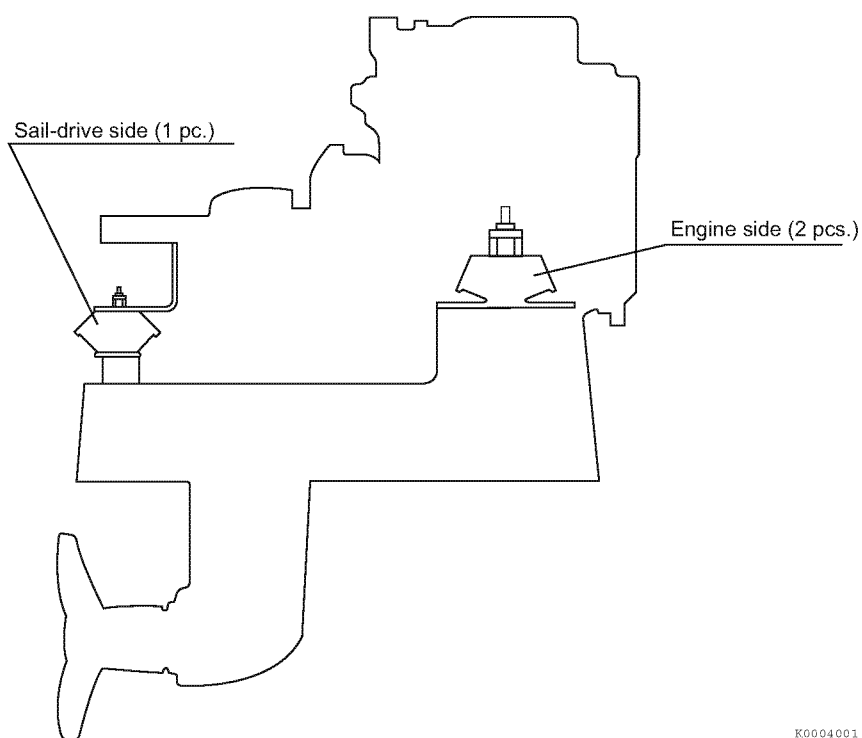
1. Remove all the lower connection screws M8 × 40, 8 pcs, (1, Figure 30) together with the relative washers (2, Figure 30) below the division line of the drive.
2. Split the drive.
3. Rotate the lower leg housing 180° (3, Figure 30).
4. Put the lower leg housing and the upper gear housing together.
5. Apply MOLYCOTE G-n PLUS to the screws M8 × 40, 8 pcs (1, Figure 30).
6. The spline sleeve (4, Figure 30) is put in vertical position, thus it can fall down.
7. Be sure that the O-ring (5, Figure 30) that seals the head with the leg stays attached to the leg when taking it out. Pay attention not to damage the O-ring when putting the leg in the new position.
8. When extracting the leg, the rubber seal (6, Figure 30), of the entire sail drive, gets loose. Pay attention not to damage this rubber when put the leg back in position.
9. When putting the leg in the new position, be smooth and use manual adjustment of the propeller shaft in order to easily made the teeth of the spline sleeve.

CAUTION

In the reversing operation pay attention to four points:

Flexible Mounting

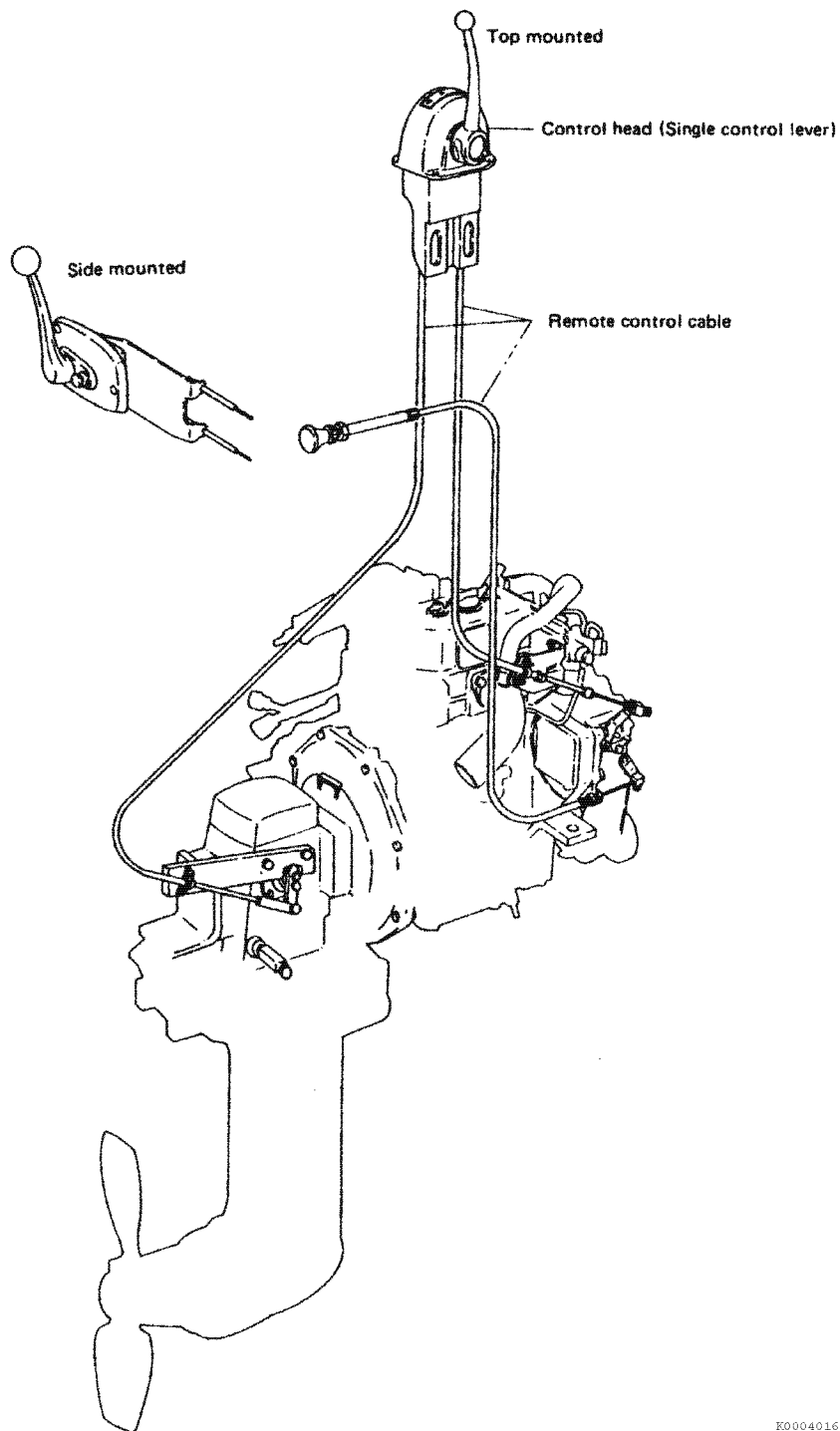
Applicable model	Model	Engine side (2 pieces) mount, ID mark	Sail drive side (1 piece) mount, ID mark
SD20	1GM10C	50	130
	2YM15	100	150
	3YM20	100	230
	3YM30(E)	100	230
SD60	3JH5E	200	Round shape mount supplied with sail drive
	4JH5E	250	
	4JH4-TE	300	



K0004001

Figure 31

INSTALLING REMOTE CONTROL SYSTEM



K0004016

Figure 32

NOTICE

- Do not use a two-lever control head. Use a single-lever control head to prevent high-speed engagement from occurring.
- If the clutch is engaged while using a two-lever control head and the rotating speed of the engine is high the shaft and gears of the sail drive will be damaged.

■ Connecting the remote control cable

Connect the cable (MORSE 33C or equivalent) with a spring joint or pivot. Crank the engine slowly, and while shifting the control lever of the control head through NEUTRAL - ASTERN - AHEAD - NEUTRAL, confirm the following:

1. Are the lever engagements to ASTERN and AHEAD smooth?
2. Does the stopper work at both ASTERN and AHEAD?
3. When the stopper is working, does the shaft of the spring joint project or is it indented at the ASTERN position? The spring joint absorbs shock on ASTERN and AHEAD engagement; adjust the cable connection so that the projected distance and the indented distance of the spring joint shaft are the same for SD20.

NOTICE

- For the control head, use a single control lever with a 70 mm (2.75 in.) travel wire.
- If the cable is not connected correctly, additional strength is required to engage and disengage the operation lever, and insufficient engagement of the lever or malfunctioning of the stopper may occur.

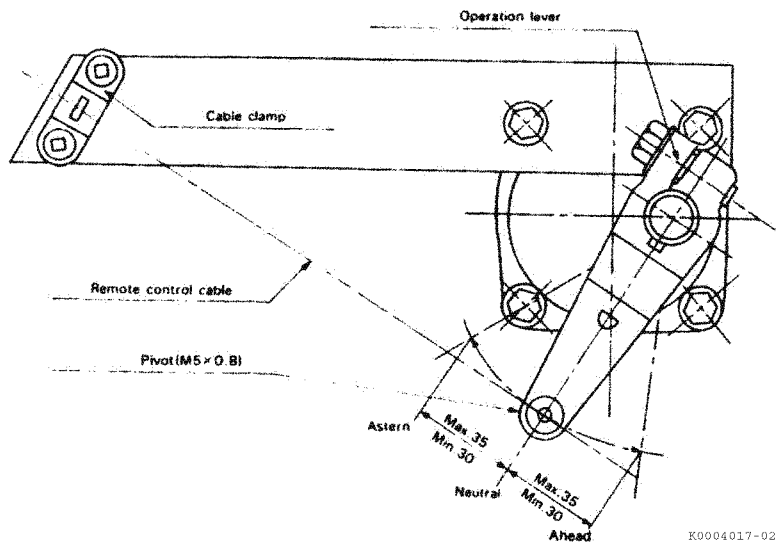
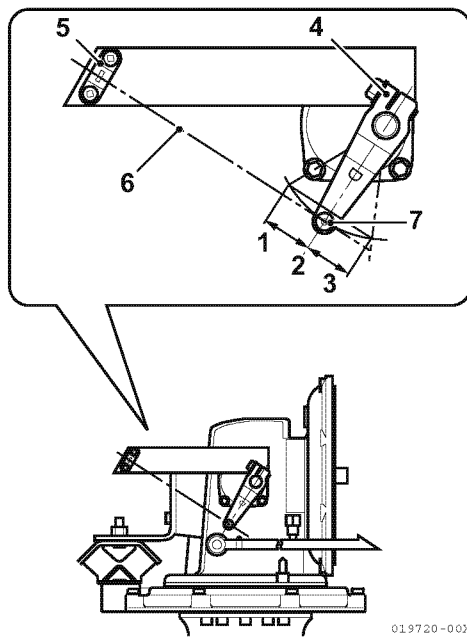


Figure 33



- 1 – Astern
- 2 – Neutral
- 3 – Ahead
- 4 – Operation lever

- 5 – Cable clamp
- 6 – Remote control cable
- 7 – Pivot

Figure 34

■ SD60

Models SD60 allow for rerouting of cables by directing the cable clamp up by 90° (**B, Figure 35**). The standard direction is as shown in (**A, Figure 35**), but reroute the cables, if necessary, to facilitate cable routing in accordance with the mounting position of the control head.

Figure 35 shows configuration as shipped from the factory.

To change the direction of the cable clamp:

1. Remove two M8 bolts and spring washer.
2. Rotate the cable clamp up by 90°.
3. Reinstall the two M8 bolts and spring washer as shown. Tighten to 1.5 ± 0.1 kgf-m, 14.7 ± 0.1 N-m (130 ± 8.7 in.-lb).
4. Remove split pin at the back of the pivot on the shift lever and install the pivot from position (A) (**A, Figure 35**) to position (B) (**B, Figure 35**).

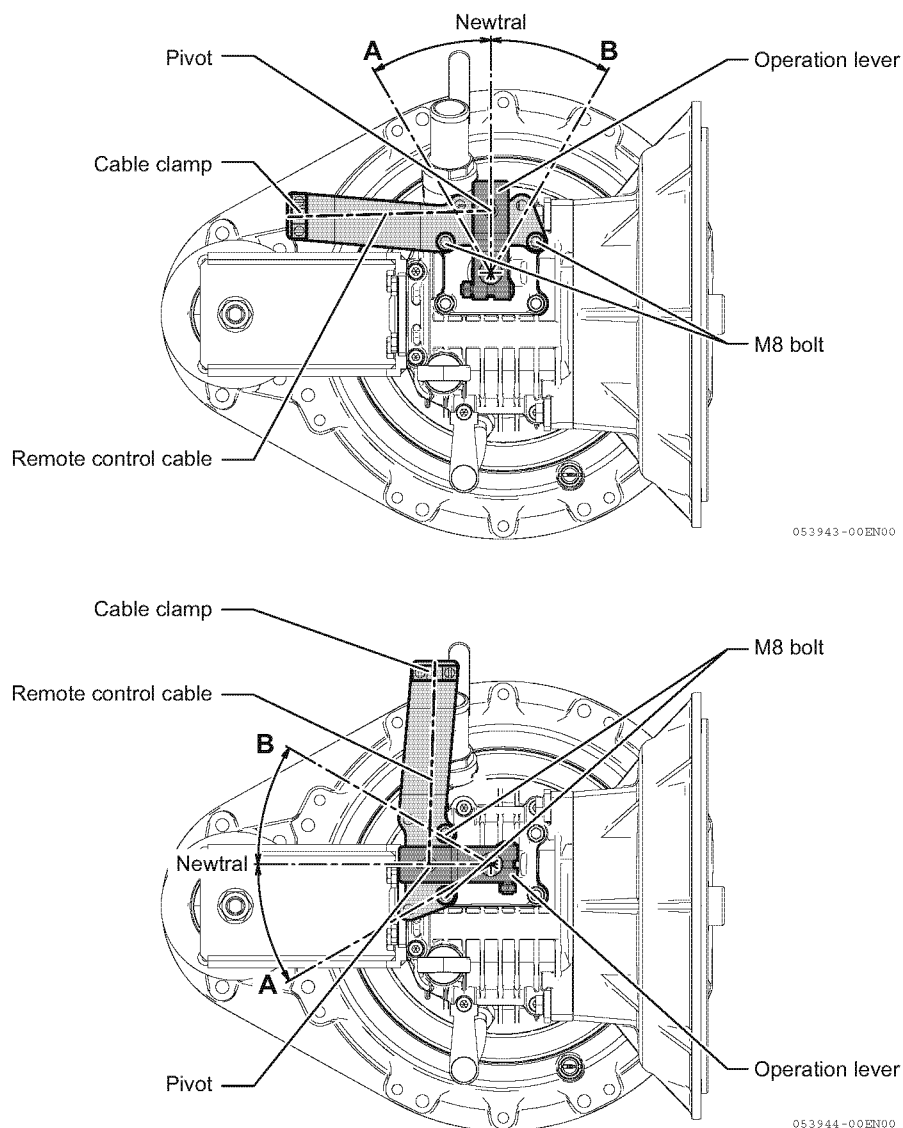
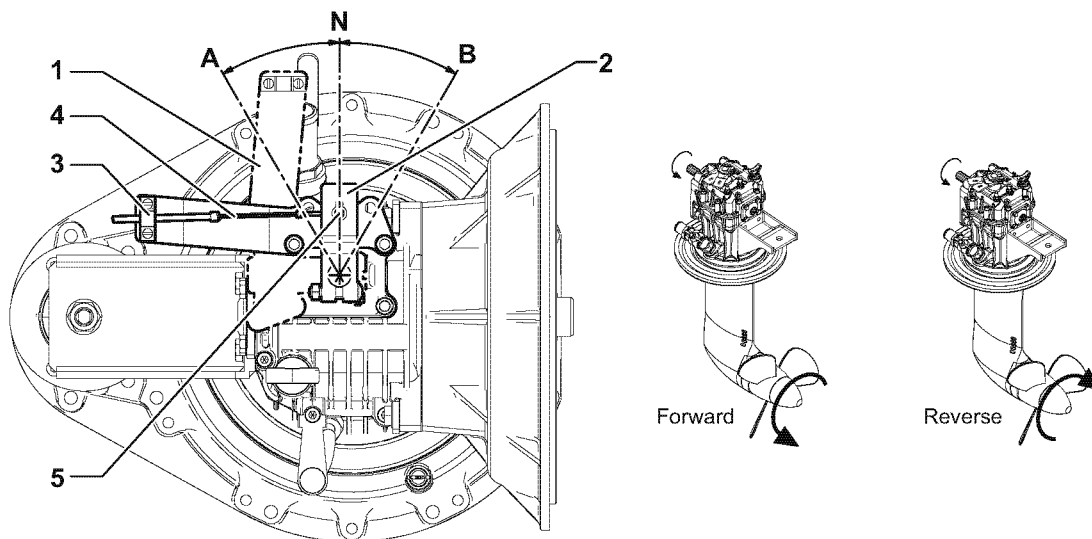


Figure 35

SAIL DRIVES

Direction of rotation

- Shifting to "A"
= Propeller rotation; Same direction as engine crankshaft
- Shifting to "B"
= Propeller rotation; Opposite direction from the engine crankshaft



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- 1 – Mounting plate at 90° angle
- 2 – Operation lever
- 3 – Cable clamp

- 4 – Remote control cable
- 5 – Pivot

Figure 36

Gear shift operation

⚠ CAUTION

Make certain that control rod or cable is easily movable.

1. Lever travel:

Minimum travel of gear shift lever (O - A = O - B) must be 35 mm (1.3/8 in.) for outer pivot point and 30 mm (1.3/16 in.) for inner pivot point.

2. Lever position: In neutral position perpendicular to control rod or cable. Gear shift lever can be fixed in any position by means of clamping screw. Minimum distance between gear shift lever and cover 0.5 mm (0.02 in.). Opening or loosening of cover requires renewed adjustment (by specialized personnel only).

3. Regular checks are required to ensure the strict observance of item 1 and 2 above.

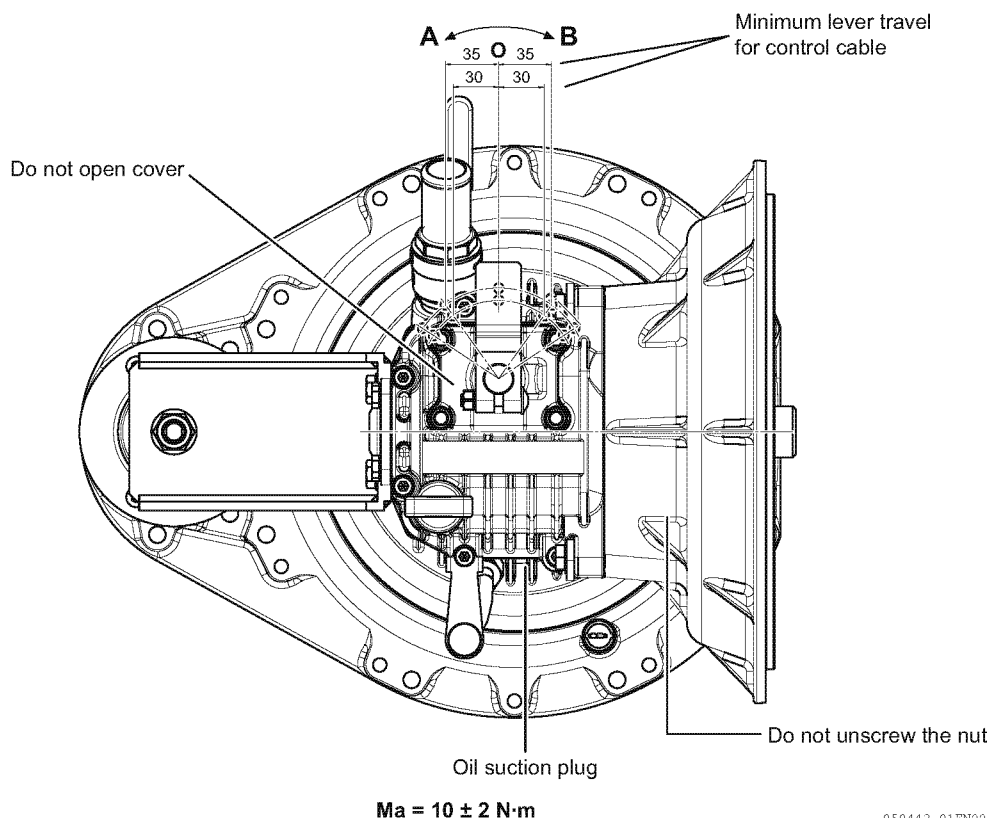


Figure 37

SAIL DRIVES

■ Electrical wiring

1. For the sail drive rubber seal switch, connect the black, white and red wires on the engine side.
2. Connect the amplifier coupler between the wire harness coupler and extension cable coupler on the engine side.

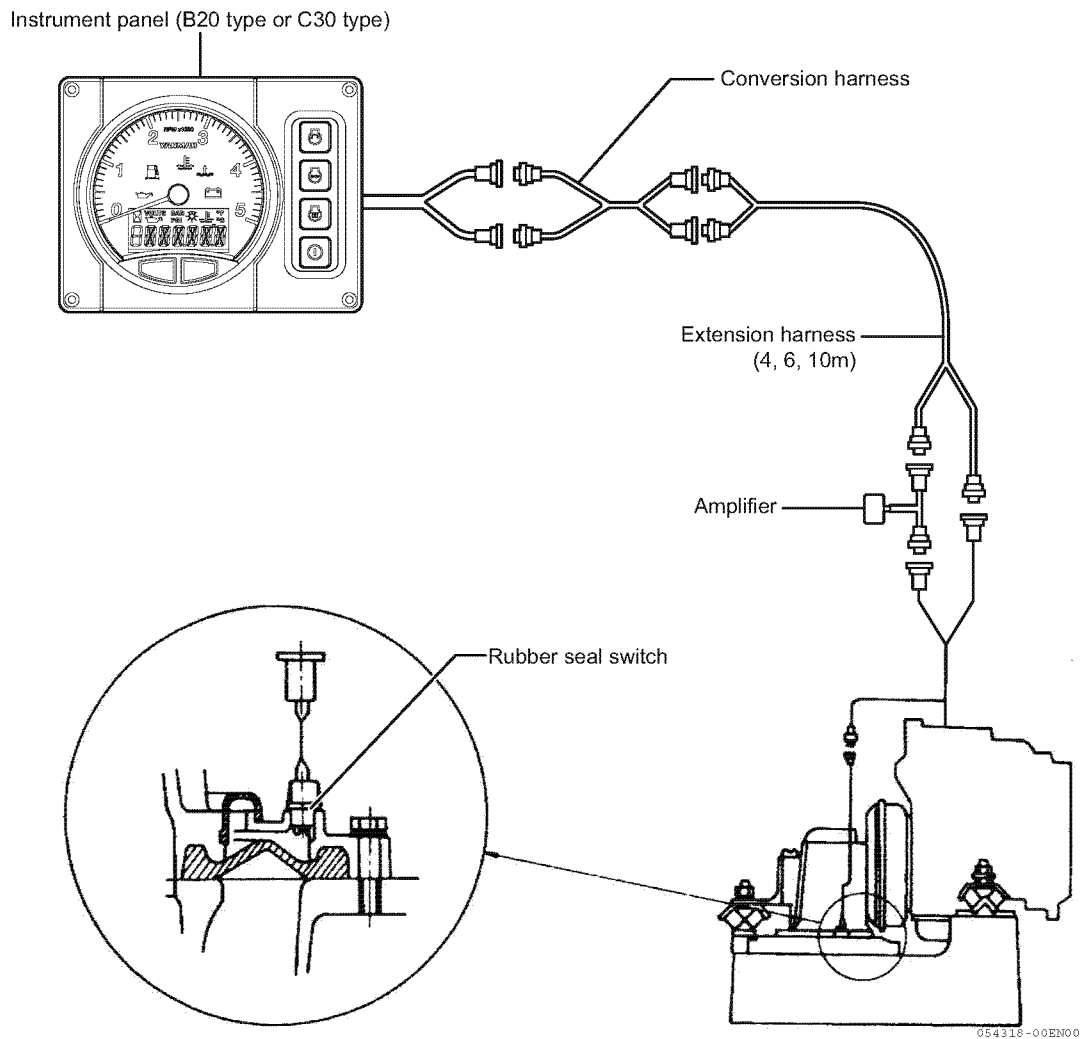


Figure 38

LUBRICATING OIL

The choice of lubricating oil is very important. If an unsuitable oil is used, or an oil change is neglected, it may result in damage and reduce the life of the sail-drive. When selecting a lubricating oil, use one of the following:

Engine series	GM, YM				JH3, JH4, JH5		
Engine model	1GM10	2YM15	3YM20	3YM30(E)	3JH5E	4JH5E	4JH4-TE
Sail-drive model	SD20				SD60		
Lubricating oil for the sail-drive	API CD or greater and SAE 10W30	API GL4 or GL5 and SAE 80W90 or 90			API CD or higher and SAE 15W40		

■ For SD20 (except if coupled with the 1GM10C)

Supplier	Brand name	API service	SAE No.
SHELL	Shell Spilax oil EP 90	GL-4	90
SHELL	Shell Spilax oil HD 90	GL-5	90
CALTEX	Multipurpose thuban EP	GL-4/GL-59	90
MOBIL	Mobilub HD 80W-90	GL-5	80W-90
ESSO	Esso gear oil GP 90	GL-4	90
ESSO	Esso gear oil GX 90	GL-5	90

SAIL DRIVES

Filling with Lubricating Oil - SD20 and SD60

Sail-drive model	SD20	SD60
Standard unit	2.2 l (2.3 qt)	2.8 l (3.0 qt)
Long-reach unit	2.5 l (2.6 qt) with extension 80 mm	3.0 l (3.2 qt) with extension 75 mm

NOTICE

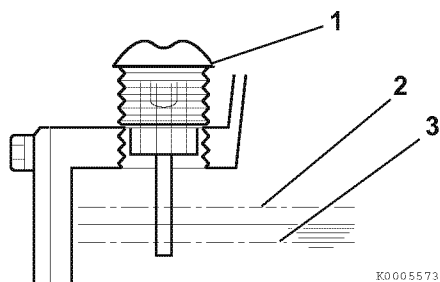
The lubricating oil capacity of the standard unit is different from that of the long-reach unit.

1. Remove the dipstick (yellow cap). Fill with approved 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 39). The oil level should reach the upper mark on the dipstick (2, Figure 39).

NOTICE

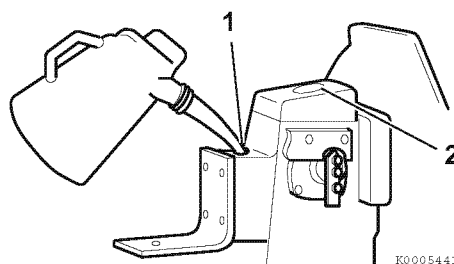
Check the oil level 15 minutes after adding the specified quantity of oil.

■ SD20



- 1 – Dipstick
- 2 – Upper limit
- 3 – Lower limit

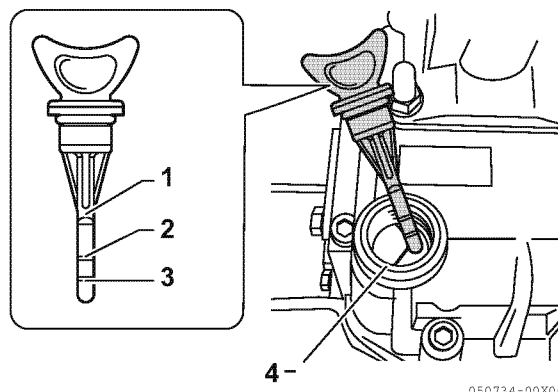
Figure 39



- 1 – Oil supply port
- 2 – Oil capacity nameplate

Figure 40

■ SD60



- 1 – Dipstick
- 2 – Maximum
- 3 – Minimum
- 4 – Upper edge of threaded hole

Figure 41

YANMAR CO., LTD.

■ Marine Operations Division

Application Engineering Dept.

5-3-1, Tsukaguchi-honmachi, Amagasaki

Hyogo, 661-0001, Japan

Phone: +81-6-6428-3168 Fax: +81-6-6421-2201

Overseas Office

■ Yanmar Europe B.V. (YEU)

Brugplein 11, 1332 BS Almere-de Vaart, Netherlands

Phone: +31-36-5493200 Fax: +31-36-5493209

■ Yanmar Asia (Singapore) Corporation Pte Ltd. (YASC)

4 Tuas Lane, Singapore 638613

Phone: +65-6595-4200 Fax: +65-6862-5189

■ Yanmar America Corporation (YA)

101 International Parkway

Adairsville, GA 30103, U.S.A.

Phone: +1-770-877-9894 Fax: +1-770-877-9009

■ Yanmar Engine (Shanghai). Co., Ltd.

10F, E-Block POLY PLAZA, No.18 Dongfang Road

Pudong Shanghai, CHINA P.R.C. 200120

Phone: +86-21-6880-5090 Fax: +86-21-6880-8090

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