SERVICE MANUAL



4 STROKE MFS 25D MFS 30D Models

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TOHATSU CORPORATION

Introduction Before reading this manual

This service manual provides information that is needed for inspection, service and repair of applicable outboard motors. For information about operation of the products that are not described in this document, refer to the owners manual. For our customers' safe and dependable use of the product for long term, it is essential to maintain the performance and quality of the outboard. To ensure this, the maintenance and service have to be done properly by service technicians with fundamental knowledge and skills. This manual is utilized so that our customers can always use their outboard motor with full satisfaction.

Safety Information

Safety Statements

The following safety statements are found throughout this manual and indicate information which, if ignored, could result in fatal safety hazards or property damage:

A DANGER

Indicates the presence of a hazard which, if ignored, will result in severe injury or death.

Indicates the presence of a hazard or an unsafe activity which, if ignored, could result in severe injury or death.

▲ CAUTION

Indicates the presence of a hazard or an unsafe activity which, if ignored, could result in minor personal injury or damage to the products or facilities.



Attention:

About this manual

Composition and use of this manual

This service manual is designed so that service persons are able to perform repairs correctly.

Understand the following matters well for efficient service and repair.

- ① Each chapter begins with the introduction of special tools that are used for the work described.
- ② Parts that are serviced in each chapter and their details are presented by using a component composition diagram.
- ③ Fastening torques are described in the component composition diagram. In the body text are critical points of the applicable work.
- ④ Pictograms indicate that there is an important work instruction for the relevant parts. It also shows the type of lubricant and its application point(s).
- (5) The component composition diagrams describe the names of the parts, the number of pieces of the parts used, size of fasteners and special notes.
- (6) Specific works are described in detail by using illustrations and adding advice on the work.



This manual uses SI unit system (International System of Units) for pressure, force (load), torque and stress. This manual newly adopts the international unit construction system (SI unit system) followed by the conventional imperial and metric systems enclosed by () and [] as described below.



* Measurements are shown using SI unit followed by conventional units (US unit) and [Japanese domestic unit].

Example : <Torque>



* The conventional unit for measurement of force uses "kgf (kilogram force)" to discriminate it from "kg (mass kilogram)" of SI unit system.

Example : <Volume> 900 cm³(30.4 fl.oz)

Example : <Length>

10 mm(0.39 in)

<Reference>

What is the SI unit system?

Although the measurement unit is standardized mostly with metric system in the world, the metric system includes different kinds of unit systems.

Though the metric system was established expecting that a single unit system would be used in the world, various physical units were established later, resulting in branching the metric system in different unit systems.

The new unit system is called "International System of Units" because it was established for the purpose of unifying the different unit systems.

Since the metric system was initially established in France, and International Bureau of Weights and Measures (IBWM) is located in Paris, General Conference of Weights and Measures (GCWM) passed a resolution of the international unit system as "Système International d'Unités (French)" that is abbreviated as "SI unit".

For example, conventional metric system uses the unit of mass (kg) and unit of force (kg or kgf) without discriminating them, but the SI unit system uses, for example, "kg" as the unit of mass, and "N" as the unit of force, aiming to apply a kind of unit for a kind of physical quantity.

Description of Pictograph

The following symbols rep	ne following symbols represent the contents of individual chapters.						
Service Information	Service Data	Inspections and Adjustments		Fuel System (Fuel Injection)			
Power Unit	Lower Unit	Bracket		Electrical System			
	Rigging	Wiring Diagrams					

The following symbols represent the contents of individual chapters.

The following symbols indicate items needed for the service.

Special Tool	×	Lubrication Oil		Engine RPM	RPM	Tightening Torque	X
Specified Electrical Value		Specified Measurement Value	Et 1	Use Limit	\oslash	Test Run Adjustment	
Specified Part							

The following symbols indicate a point to which lubrication oil, sealing agent or screw-locking agent is to be applied.

4 stroke engine oil	Gear oil	ATF DEXRON II	OBM Grease
Teflon® Grease TEFLON	Low Temperature Lithium Grease LITHIUM	Silicone Grease Oil Compound [Shinetsu Silicone] S.O.C	Bond [Konishi Bond] • G17
Bond [Konishi Bond] • G103 G103	Molybudenium Grease [SUMICO] •Molytone Grease No.1	Heat Resistant Grease •LOR # 101	Screw Locking Agent [Loctite®] • 263 (271)
Screw Locking Agent [Three Bond®] • 1322	Screw Locking Agent [Three Bond®] • 1327	Screw Locking Agent [Three Bond®] • 1342	Screw Locking Agent [Three Bond®] • 1373B
Screw Locking Agent [Three Bond®] • 1377N	Screw Locking Agent [Three Bond®] • 1401	Sealant [Loctite®] • 5910	Sealant [TOSSEAL] • 381
Sealant [Three Bond®] • 1207B	Instant Adhesive [Loctite®] • 425	Instant Adhesive [Three Bond®] • 1741 (7782)	Temporary Rubber Assembly Lubricant [Emulsion] • P-80

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1. Identification (Engine Serial Number)

The engine serial number is stamped on the swivel bracket of the outboard motor body.

- ① Model Name
- (2) Serial Number



- A Manual Tilt Model
- B Gas Assist Model, Power Tilt Model





2. Ensuring Work Safety

1) Fire Prevention

Gasoline is a hazardous material and very flammable. Do not handle gasoline near ignition source such as sparks or static electricity.



2) Ventilation

Exhaust gas or gasoline vapor is hazardous for human health. Be sure to ventilate well when working indoors.



3) Protection

Wear a pair of goggles, working gloves and safety shoes to protect human body from chemicals and oils and eyes from particles generated by grinding or polishing works.



4) Genuine Parts

Use parts and/or chemicals that are genuine or recommended. Be careful not to allow oil, grease or sealing agent to adhere to the skin. In case of exposure to such substances, wash away with soap or warm water immediately.



5) Tools

Use specified special tools to avoid damaging parts and to perform the work safely and reliably. Be sure to follow the installation procedures described in this manual and use the tightening torque specified.



6) Recommendations on service

Clean and remove foreign substances and dirt from the outboard motor body and individual parts. Apply the recommended oil or grease on rotating areas and sliding surfaces. After carrying out each work, always conduct a check to ensure smooth movement and sealing.



7) Cautions in disassembling and assembling components

- (1) Install the outboard motor securely to a dedicated stand.
- (2) Take special care not to scratch the painted surfaces or mating surfaces of the cylinder and crankcase.
- (3) Replace parts that cannot be reused such as packings, gaskets, O-rings, oil seals, spring pins or split pins with new ones after disassembly. Replace deformed snap rings with new ones.
- (4) When replacing parts, be sure to use genuine parts. For fluids such as gear oil, use genuine product.
- (5) Be sure to use special tools that are specified, and perform the works properly.
- (6) When reassembling parts, use their mating marks. For parts without mating marks, simple marking makes reassembling easier. Refer to the parts catalog too.
- (7) Clean individual parts that have been removed, and check their conditions.
- (8) When reassembling parts, pay extra attention to details such as the fitting of each part, repair limits, air tightness, clogging of oil holes for lubrication and greasing, packings, wiring, piping and so on. For components which use a lot of bolts and nuts for assembly, such as the cylinder head and crankcase, tighten all the fasteners uniformly to their specified torques clockwise in two or three stages, starting with the inner ones first followed by the outer ones. (Reverse the order when disassembling.)
- (9) When installing bearings, the flat (numbered) side should be the side in contact with the special assembly tool.
- (10) When installing oil seals, be careful not to scratch the surface of the lip that contacts the shaft, and install them in the correct direction. Apply the recommended grease on the lip before installation.
- (11) When applying liquid packing, be extra careful of the thickness and quantity. Excess liquid may ooze out if too much liquid is applied, adversely affecting the interior of the crankcase. Use adhesive after thoroughly reading the instructions.









3. Tools and Instruments

1) Test Propeller

	MFS25	MFS30
Part No.	3VS-64110-0	3VS-64110-0
Outer Diameter (a)	223 mm (8.78 in)	223 mm (8.78 in)
Width (b)	16 mm (0.63 in)	16 mm (0.63 in)
Fully Open Revolution Speed	5500 min ⁻¹ (rpm)	6000 min ⁻¹ (rpm)



2) Measuring instruments

For the following measuring instruments, use commercially available ones.

Circuit tester	(HIOKI 3000 Series: Resistance: 1 $\Omega,$ 10 $\Omega,$ 10 $k\Omega,$ AC voltage: 30 to 300 V, DC voltage: 30 V)
Vernier calipers	(M1 type, 300 mm)
Micrometer	(JIS B 7502; minimum graduation of 0.01, outer, 0 to 25 mm, 25 to 50 mm, 50 to 75 mm)
Cylinder gauge	(4 to 6 mm, 10 to 25 mm, 25 to 30 mm, 50 to 75 mm)
Ring gauge	(JIS B 7420;
Dial gauge	(JIS B 7503; minimum graduation of 0.01)
Thickness gauge	(JIS B 7524; 0.03 to 0.3 mm)
V block	(JIS B 7540)
Surface plate	(JIS B 7513; 500×500)

Dial gauge magnet base or dial gauge stand

3) Special Tools

.17		CADI-		
Bevel Gear B Nut Wrench P/N. 346-72231-0	Bevel Gear B Nut Socket P/N. 346-72232-0	Shimming Gauge P/N. 346-72250-0	Thickness Gauge P/N. 353-72251-1	
Removal/installation of	pinion nut (B gear nut)	Bevel gear B height adjustment	Measurement of gaps	
		0		
Piston Slider P/N. 3AC-72871-0	Spring Pin Tool A P/N. 345-72227-0	Spring Pin Tool B P/N. 345-72228-0	Torque Wrench P/N. 3AC-99070-0	
Installation of piston	Removal of spring pin (ø3.0)	Installation of spring pin (ø3.0)	Adjustment of valve clearance	
Oil Filter Wrench P/N. 3AC-99090-0	Piston Ring Tool P/N. 353-72249-0	Spark Tester P/N. 3F3-72540-0	Clamp Pliers P/N. 3T5-72864-0	
Removal/installation of oil filter	Removal/installation of piston rings	Spark inspection	OETIKER clamp crimper	
Valve Clearance Driver P/N. 3AC-99071-0	Tachometer P/N. 3AC-99010-0	Compression Gauge P/N. 3AC-99030-0	Vacuum/Pressure Gauge P/N. 3AC-99020-1	
Adjustment of valve clearance	Measurement of engine revolution speed	Measurement of compression pressure	Inspection of pressure	

ø34.5 x ø17.5	ø27.5 x ø15.5	ø29.5 x ø16.5	
			A COLORINA COLORINA
Oil Seal Attachment P/N. 3AC-99820-0	Oil Seal Attachment 2 P/N. 3AD-99820-0	Oil Seal Attachment 3 P/N. 3AG-99820-0	Universal Puller Plate P/N. 3AC-99750-0
Installation of oil seal on cylinder head	Installation of oil seal of propeller shaft housing	Installation of oil seal of pump case (lower)	Removal of bearing
	n ()		
Diagnosis Tool Kit P/N. 3RS-72920-0	Bearing Outer Press Kit P/N. 3B7-72739-1	BacklashMeasuring Tool Clamp P/N. 3B7-72720-0	Pressure Gauge Ass'y P/N. 3T5-72880-0
Used in diagnosing engine failures	Bevel Gear Assy (A) installation of bearing outer race	Measurement of backlash	Measurement of fuel pressure
ø51.5 x ø24.5			ø79.5 x ø51.5
Bearing Attachment P/N. 3AC-99905-0	Driver Rod P/N. 3AC-99702-0	Roller Bearing Attachment P/N. 3AC-99710-0	Center Plate P/N. 3VS-99701-0
Installation of bevel gear C ball bearing	Installation of bearing	Installation of propeller shaft housing roller bearing	Positioning of propeller shaft housing roller bearing
		Mark : BBD	- Det. Ch
Bevel Gear Bearing Installation Tool P/N. 346-72719-0	Dial Gauge Plate P/N. 3B7-72729-0	Backlash Measuring Tool Kit P/N. 3C8-72234-2	Slide Hammer Kit P/N. 3AC-99080-0
Bevel Gear Assy (A) Installation of bearing	Used to attach dial gauge when measuring backlash	Bevel gear assembly A, bevel gear B backlash measurement	Bevel Gear Assy (A) Removal of bearing outer race



4. Pre-delivery Inspection

1) Steering Handle

- \fbox{A} Check installations for clattering and play \rightarrow
- \blacksquare Adjust steering friction \rightarrow
- $\fbox{C} Check throttle grip for movement (full open/full close) \rightarrow \\ Adjust throttle friction \rightarrow \\ \end{cases}$



2) Gear Shift

Check that gear shifts from neutral (N) to forward (F) and reverse (R) smoothly.

- A Basic Tiller Handle Model
- B Multi-Function Tiller Handle Model
- C Remote Control Model







3) Engine Oil

Engine oil is removed before shipment to prevent leakage.

Fill the engine with engine oil.

4 Stroke Engine Oil:

1500 mL (1.6 US.qt) [without oil filter replacement] 1700 mL (1.8 US.qt.)

[oil filter replaced]

Use oil level gauge to check oil quantity.

4) Gear Oil

Check the quantity of gear oil.

Gear Oil:



460 mL (16 US fl.oz.)

Fill with gear oil until some of the oil spills out of the plug hole when the upper oil plug is removed.



(a) Upper Limit(b) Lower Limit



5) Fuel Line

▲ CAUTION

Since this is a 4-stroke engine model, do not use fuel mixed with engine oil. Use of fuel mixed with engine oil will cause engine trouble.

Check that the fuel tank contains a sufficient amount of gasoline and check the connection of the fuel line to see if there are any leaks.

6) Rigging

Check that the clamp bracket is fixed securely to the transom. Check the location of the anti-ventilation plate relative to the boat's bottom, and, if necessary, adjust it to prevent engine overheating and a decrease in the propulsion force.



Conduct a test run to determine the best installation height.

Anti-Ventilation Plate Position Standard Value (a): Located 0 to 25 mm (0 to 1.0 in) below boat's bottom





7) Inspection of PT Unit (EFT, EHT, EPT)

- 1. Operate the PT switch to check that the outboard motor tilts up/down smoothly.
- Operate the PT switch to check that no abnormal noise is made when tilting the outboard motor up/down.
- 3. Tilt up the outboard motor and steer fully to the right and left to check that the cables and hoses do not interfere with each other and with any part of the hull.
- 4. Check that the needle of the trim meter is pointing at the bottommost position when the outboard motor is fully tilted down.
- 5. Fully tilt up the outboard motor, lock with tilt stopper ①, and check that tilt stopper's lock mechanism functions normally.

8) Inspection of Gas Shock Absorber (EFG)

- 1. Check that the outboard motor tilts up/down smoothly.
- 2. Fully tilt up the outboard motor, lock with tilt stopper ①, and check that tilt stopper's lock mechanism functions normally.
- Tilt up the outboard motor adequately and set the lock lever (2) to the locking position to check that the manual holding mechanism of gas shock absorber (3) functions normally.

9) Inspection of Manual Tilt (MF, EF)

- 1. Check that the outboard motor tilts up/down smoothly.
- Fully tilt up the outboard motor and lock it with tilt lock lever

 to check that manual holding mechanism functions normally.







10) Inspection of Starting Switch and Stop Switch

- Press start switch ① or turn main switch key ② to the START position ⓐ to check that the engine starts.
- 2. Turn the main switch key to the OFF position (b) to check that the engine stops.
 - A Basic Tiller Handle Model
 - B Multi-function Tiller Handle Model
 - C Remote Control Model







 Press the stop switch ③ hard or pull out the lock ④ from the stop switch to check that the engine stops.

A Basic Tiller Handle ModelB Multi-Function Tiller Handle ModelC Remote Control Model



1





11) Cooling Water Check Port

Check that water is discharged from the cooling water check port (1).



12) Idling

After the engine has warmed up, use a tachometer to check that the idle revolution speed is as specified.



Idle Revolution Speed: 850 min⁻¹ (rpm)





Tachometer: P/N. 3AC-99010-0



13) Propeller Selection

<u>A</u> CAUTION Selecting a wrong propeller may cause adverse effects on the engine life, fuel consumption, etc. as well as the performance.

Select a propeller that is best-suited to type of boat and application.

Fully Open Operating RPM Range: MFS 25D: 5000 to 6000 min⁻¹ (rpm) MFS 30D: 5500 to 6500 min⁻¹ (rpm)



Propeller List					
Propeller Mark	٩)				
ropeller Mark					

Propollor Mark	(No. of Blades x	Port No		
Propener Mark	in	mm	Fait NO.	
F 8 1/4	3 x 8 x 10.2	3 x 210 x 260	346B64106-5	
9.9 x 9	9.9 x 9 3 x 9 x 9.7		3R0B64518-1	
9.9 x 10	9.9 x 10 3 x 10 x 9.7		3R0B64521-1	
9.9 x 11	3 x 11 x 9.8	3 x 279 x 249	3R0B64523-1	
9.9 x 12	3 x 12 x 9.8	3 x 305 x 249	3R0B64525-1	
9.9 x 13	3 x 13 x 9.8	3 x 330 x 249	3R0B64527-1	
14	3 x 14 x 9.9	3 x 360 x 252	349B64529-1	

14) Trim Tab

Trim Tab Angle Adjustment

After installing the outboard motor on your boat, make sure the weight of the left and right steering handle is evenly distributed at the trim angle and engine speed that you normally or frequently use. For this purpose, loosen the bolt of the trim tab, adjust it with the angle of the trim tab (1), and tighten it to the specified torque.



Trim Tab Bolt: 6 N·m (5 lb·ft) [0.6 kgf·m]



Apply OBM grease to the trim tab bolt.

Specific Example

- A If the weight of the steering handle is lighter on the left side, or if it tends to turn towards the left side, turn the trim tab in the direction of A as shown in the diagram.
- B If the weight of the steering handle is lighter on the right side, or if it tends to turn towards the right side, turn the trim tab in the direction of B as shown in the diagram.



Move the trim tab a little bit at a time and determine the best position by repeating the test several times.



Trim Tab
 Anti-Ventilation Plate

5. Break-in Operation

Break-in operation is needed for the purpose of smoothening the sliding surfaces between components such as pistons and cylinder, piston rings, piston pins, crankshaft, connecting rods, and intake and exhaust valves.

- In order to apply an appropriate load on each part during the break-in operation, run the test with the propeller mounted.
- During the break-in operation, change the revolution speed while keeping it equal to or below the specified revolution speed.

Break-in Operation...10 hours

Time C) 10 mi	nutes 2 ho	ours 3 ho	ours 10 h	ours
Break-in Operation Method	Trolling or idling	Throttle Opening 1/2 Hereinafter, approximately 3,000 min ⁻¹ (rpm)	Throttle Opening 3/4 Hereinafter, approximately 4,000 min ⁻¹ (rpm)	Throttle Opening 3/4 Approximately 4,000 min ⁻¹ (rpm)	Regular Operation
	⊽ Running at the slowest possible speed		⊽ Can be operated fully open for about 1 minute every 10 minutes	 ∇ Can be operated fully open for about 2 minute every 10 minutes 	

It is best to fluctuate the engine RPM (Target RPM or less) every 15-30 mins at each stage during the break in procedure to allow for complete break in of outboard engine.

Running the outboard at for prolonged periods such as idling or one specific RPM is detrimental to the outboard and could affect engine reliability and performance.

6. Test Run

- 1. Start the engine and check if the gear can be shifted smoothly.
- 2. After completing the warm-up operation, check the idle revolution speed.



Idle Revolution Speed: 850 min⁻¹ (rpm)

Tachometer: P/N. 3AC-99010-0

 Shift the gear to the Forward (F) position and run at the dead slow speed. (About 10 minutes)





- Run at 3,000 min⁻¹ (rpm) or half of the WOT for an initial 2 hours, then at 4,000 min⁻¹ (rpm) or 3/4 of the WOT for 1 hour.
- 5. Check that the outboard motor is not tilted up and that water does not infiltrate the boat when the gear is shifted to the Reverse (R) position.



Conduct a test run during the break-in operation.

7. Checks After Test Run

- 1. Check that no water is present in the gear oil.
- 2. Check if fuel is leaking inside the cowl.
- Check if oil or water is leaking inside the cowl and if the engine oil is contaminated by water.
- 4. After the test run, use a hose joint to wash the cooling water path inside the engine with fresh water.

- Be sure that the engine is stopped, at the cooling water path flushing. If not, the water pump may be damaged.
- Remove the stop switch lock to prevent the engine from starting.





1. Outline Dimensions

1) Engine Dimensions

Basic Tiller Handle Model



Here Tree		1 Junit	MF/EF (Manual Tilt Model)		EFG (Gas Assist Model)		EFT (Power Tilt Model)	
item	туре	Unit	mm	in	mm	in	mm	in
A		mm/in	571	22.50	571	22.50	571	22.50
В		mm/in	338	13.30	338	13.30	338	13.30
С		deg.		·	3	8	•	
	S	mm/in	763	30.05	768	30.25	777	30.60
D	L	mm/in	873	34.35	873	34.35	889	35.00
	UL	mm/in	983	38.70	978	38.50	1001	39.40
E		mm/in	578	22.75	555	21.85	555	21.85
F		mm/in	535	21.05	558	21.95	558	21.95
G		mm/in	406	15.80	381	14.80	401	15.65
н		mm/in	204	8.05	182	7.15	182	7.15
S	S	mm/in	425	16.75	425	16.75	425	16.75
1	L	mm/in	552	21.75	552	21.75	552	21.75
	UL	mm/in	679	26.75	679	26.75	679	26.75
	S	mm/in	721	28.40	721	28.40	721	28.40
J	L	mm/in	848	33.40	848	33.40	848	33.40
	UL	mm/in	975	38.40	975	38.40	975	38.40
К		mm/in	40-60	1.55-2.35	40-60	1.55-2.35	40-60	1.55-2.35
L		deg.			1	2		
М		mm/in	408	16.05	431	16.95	431	16.95
N		deg.	60		56		62	
0		mm/in	147	5.80	147	5.80	147	5.80
Р		mm/in	686	27.00	703	27.65	706	27.80
Q		mm/in	495	19.50	495	19.50	495	19.50
R		mm/in	401	15.80	401	15.80	401	15.80
Trim (Pos	Angle sition)	deg. *1	-9 to 16 (6)		-4 to 8 (4)		·	

*1: Angle from the vertical position when the transom angle is at 12°





The second se		11.5	EH (Manua	l Tilt Model)	EHT (Power Tilt Model)		
Item	Туре	Unit	mm	in	mm	in	
A		mm/in	674	26.55	674	26.55	
В		mm/in	479	18.85	479	18.85	
С		mm/in	338	13.30	338	13.30	
D		deg.		3	8	·	
	S	mm/in	763	30.05	777	30.60	
E	L	mm/in	873	34.35	889	35.00	
	UL	mm/in	983	38.70	1001	39.40	
F		mm/in	830	32.65	806	31.75	
G		mm/in	535	21.05	559	22.00	
н		mm/in	406	16.25	401	15.60	
I		mm/in	235	9.25	212	8.35	
	S	mm/in	425	16.75	425	16.75	
J	L	mm/in	552	21.75	552	21.75	
	UL	mm/in	679	26.75	679	26.75	
	S	mm/in	721	28.40	721	28.40	
к	L	mm/in	848	33.40	848	33.40	
	UL	mm/in	975	38.40	975	38.40	
L		mm/in	40-60	1.55-2.35	40-60	1.55-2.35	
М		deg.		1	2		
Ν		mm/in	408	16.05	432	17.00	
0		deg.	6	0	6	2	
Р		mm/in	147	5.80	147	5.80	
Q		mm/in	769	30.25	769	30.25	
R		mm/in	707	27.85	705	27.75	
S		mm/in	495	19.50	495	19.50	
Т		mm/in	392	15.45	392	15.45	
Trim Angle (Position)		deg. *1	-9 to 16 (6)		-4 to 8 (4)		

*1: Angle from the vertical position when the transom angle is at 12°



Remote Control Model


literee	Time	l la à	EP (Manual Tilt Model)		EPT (Power Tilt Model)	
Item	Туре	Unit	mm	in	mm	in
А		mm/in	338	13.30	338	13.30
В		mm/in	338	13.30	338	13.30
С		deg.		3	8	
	S	mm/in	763	30.05	777	30.60
D	L	mm/in	873	34.35	889	35.00
	UL	mm/in	983	38.70	1001	39.40
E		mm/in	406	15.80	401	15.60
F		mm/in	535	21.05	559	22.00
G		mm/in	197	7.75	173	6.80
н		mm/in	75	2.95	51	2.00
	S	mm/in	425	16.75	425	16.75
I	L	mm/in	552	21.75	552	21.75
	UL	mm/in	679	26.75	679	26.75
	S	mm/in	721	28.40	721	28.40
J	L	mm/in	848	33.40	848	33.40
	UL	mm/in	975	38.40	975	38.40
к		mm/in	40-60	1.55-2.35	40-60	1.55-2.35
L		deg.		1	2	
М		mm/in	408	16.05	432	17.00
N		deg.	6	60	6	2
0		mm/in	147	5.80	147	5.80
Р		mm/in	686	27.00	705	27.75
Q		mm/in	495	19.50	495	19.50
R		mm/in	389	15.30	389	15.30
Trim (Pos	Angle ition)	deg. *1	-9 to	o 16 6)	-4 t (4	o 8 4)

*1: Angle from the vertical position when the transom angle is at 12°



2) Transom Bolts

Manual Tilt Model



Gas Assist/Power Tilt Model



2. Fuel Injection System

1) ECU Fuel Feed System

The ECU uses various sensors to precisely control the injected fuel amount (time) and ignition timing.





3. Engine Lubrication System Diagram



4. Cooling Water System Diagram





5. Specifications

Item	Unit		Model	
			MFS 25D/30D	
		Basic Tiller Handle Model	Multi-Function Tiller Handle Model	Remote Control Model

Dimensions (approx.)

Overall Length		mm (in)	1113 (43.80)	1360 (53.55)	732 (28.80)	
Overall Width		mm (in)	401 (15.80)	389 (15.30)	389 (15.30)	
	S	mm (in)		1216 (47.85)		
Overall Height	L	mm (in)	1343 (52.85)			
	UL	mm (in)	1470 (57.85)			
	S	mm (in)		425 (16.75)		
Transom Height	L	mm (in)	552 (21.75)			
	UL	mm (in)	679 (26.75)			

Weight (approx.)

S	kg (lbs)	MF: 58.0 (128) / EF: 62.0 (137) EFT: 69.0 (152)	EH: 64.0 (141) EHT: 71.0 (156)	EP: 60.0 (132) EPT: 67.0 (148)
L	kg (lbs)	MF: 58.5 (129) / EF: 62.5 (138) EFG: 68.5 (151)/ EFT: 69.5 (153)	EH: 64.5 (142) EHT: 71.5 (157)	EP: 60.5 (134) EPT: 67.5 (149)
UL	kg (lbs)	EFG: 69.5 (153)/ EFT: 70.5 (155)	EHT: 72.5 (160)	EPT: 68.5 (151)

Performance

Maximum Output	kW (ps)	25D: 18.4 (25) / 30D: 22.1 (30)
Fully Open Operating RPM Range	min ⁻¹ (r/min)	25D: 5000 - 6000 / 30D: 5500 - 6500
Full-throttle Fuel Consumption	L (gal.)/hr	25D: 8.8 (2.30) / 30D: 10.3 (2.70)
Idling (Neutral [N])	min⁻¹(r/min)	850
Dead Slow (Forward [F])	min ⁻¹ (r/min)	850

Power Unit

Engine Type		4-stroke		
No. of Cylinders		3		
Piston Displacement	ml (cu.in)	500 (30.5)		
Valve System		OHC		
Bore x Stroke	mm (in)	61 x 57 (2.40 x 2.25)		
Compression Ratio		10.2		
Shift Operation System		Manual system	Remote Control System	
Starting System		Electric & Recoil		
Lubrication System		Pressurized Feeding Type (Wet Sump)		
Cooling System		Forced Water Cooling		
Exhaust System		Through-the-prop Exhaust		
Ignition System		Flywheel Magneto CD Ignitio	n	
Ignition Timing		25D: ATDC3° - BTDC24° / 30D: ATDC3° - BTDC28°		
Spark Plug		Equivalent to NGK DCPR6E		
Alternator Output		12 V - 17.5 A		
Fuel Feed System		Fuel Injection		

Item	Unit		Model	
			MFS 25D/30D	
		Basic Tiller Handle Model	Multi-Function Tiller Handle Model	Remote Control Model

Fuel & Oil

Тур	e of Fuel			Unleaded Regular Gasoline: R+M/2: 87 or higher / RON: 91 or higher
Fue	el Tank Capacity		L (US gal.)	25 (6.6)
Fue	el Priming System			ECU (Electronic Control Unit)
Fue	el Pumping System			Diaphragm pump (Plunger Type), Electric Fuel Pump
	Туре			4 Stroke Engine (Motor) Oil
Eng	Engine Grade		API	SH, SJ, SL
line			SAE	10W-30, 10W-40
Qi	Quantity (when oil filter is replaced)		ml (US qt)	1700 (1.8)
	Туре			Tohatsu Gear Oil
Gea		*1	API	GL-5
	*1	SAE	#80-90	
	Quantity		ml (US fl.oz.)	460 (16)

Lower Unit

Gear Shift		F - N - R
Gear Ratio (Reduction Ratio)		26:12 (2.17)
Type of Gears		Bevel Gear
Clutch Model Type		Dog Clutch Type
Propeller Shaft Driving		Spline
Propeller Rotation Direction		Clockwise when viewed from the stern in the Forward (F) position
Propeller (Standard)	Marking	P8, P9, P10, P11, P12, P13, P14

Bracket

No. of Trim Steps		Steps	Manual Tilt: 6 / Gas Assist, Power Tilt: 4
Trim Angle (Transom 12°)	*2	Degrees °	Manual Tilt: -9 to 16
Shallow Running Angle	*2	Degrees °	Manual Tilt: 22
Max. Tilt Angle	*2	Degrees °	Manual Tilt: 60 / Gas Assist: 56 / Power Tilt: 62
Steering Angle	*3	Degrees °	76
Max. Allowable Transom Thickness		mm (in)	40-60 (1.55- 2.35)

*1 Both API and SAE requirements shall be met.

*2 Angle from the vertical position when the transom angle is at 12°.

*3 Full Steering Angle Range to Starboard and Port



	Unit		Model	
Item			MFS 25D/30D	
		Basic Tiller Handle Model	Multi-Function Tiller Handle Model	Remote Control Model

Warning System

Warning System Operation Check	*1	Warning buzzer sounds (for 1 second only), and lamp is lit (for 1 second).
Engine temp. abnormally high	*2	Engine speed is controlled at 2,800 min ⁻¹ (rpm) or less (Low Speed ESG). Warning lamp is lit, and warning buzzer sounds continuously.
Engine Oil Pressure Low	*2	Engine speed is controlled at 2,800 min ⁻¹ (rpm) or less (Low Speed ESG). Warning lamp is lit, and warning buzzer sounds continuously.
Engine speed exceeds maximum allowable RPM		Engine speed is controlled at 6,700 min ⁻¹ (rpm) or less for the MFS30D and 6,200 min ⁻¹ (rpm) or less (High Speed ESG) for the MFS25D. Warning lamp is lit, and warning buzzer sounds continuously.
Engine temperature sensor or T-Map sensor is defective, or the sensor circuit is disconnected.	*2	Engine speed is controlled at 2,800 min ⁻¹ (rpm) or less (Low Speed ESG). Warning lamp flashes, and warning buzzer sounds Intermittently.

*1 When key is turned ON for the remote control model and multi-function tiller handle model. On basic tiller handle model, the buzzer and lamp (LED) operate at starting (when the recoil starter or starter motor operates).

*2 Stop the engine once to cancel the warning.

2



6. Maintenance Data

	Description	Item	Standard Value				
Engine Parts	Engine	Compression pressure (reference value) Note) After warming up, remove all the spark plugs and injector connectors, then take measurements with the throttle fully opened.	With Decompression: 0.50 MPa Without Decompression: 1.40 MPa				
		Valve Clearance	IN: 0.10 - 0.15 mm (0.0040 - 0.0060 in)				
			EX: 0.20 - 0.24 mm (0.0080 - 0.0094 in)				
		Valve Stem Outer Diameter	IN: φ5.48 mm (0.2157 in)				
			EX: φ5.46 mm (0.2150 in)				
		Valve Stem Runout	-				
	valve (IIVEX)	Valva Guida Innar Diamatar	IN: φ5.51 mm (0.2169 in)				
			EX: φ5.51 mm (0.2169 in)				
		Clearance Between Valve Stem and Guide	IN: 0.008 - 0.040 mm (0.0003 - 0.0016 in)				
			EX: 0.025 - 0.057 mm (0.001 - 0.0022 in)				
		Valve Seat Contact Width	IN: 1.0 mm (0.04 in)				
			EX: 1.0 mm (0.04 in)				
	Valve Spring	Free Spring Length	IN: 32.85 mm (1.2933 in)				
			EX: 32.85 mm (1.2933 in)				
Engine Parts	Rocker Arm	Rocker Arm Inner Diameter	φ13.01 mm (0.5122 in)				
		Rocker Arm Shaft Outer Diameter (Arm Sliding Part)	φ12.99 mm (0.5114 in)				
		Clearance Between Rocker Arm and Shaft	0.006 - 0.035 mm (0.0002 - 0.0014 in)				
		Maximum outer diameter Outer diameter at 10 mm (0.3937 in) above the lower end of the piston skirt At right angle to the piston pin	φ60.960 mm (2.4000 in)				
	Picton	Clearance Between Piston Diameter and Cylinder Inner Diameter	0.020 - 0.055 mm (0.0008 - 0.0022 in)				
		Adhesion of Carbon on Piston Crown and Ring Groove	-				
		Clearance Potycon Pieton Ping and Ping	Top Ring: 0.03 - 0.08 mm (0.0012 - 0.0031 in)				
		Groove	Second Ring: 0.02 - 0.06 mm (0.0008 - 0.0024 in)				
			Oil Ring: 0.03 - 0.13 mm (0.0012 - 0.0051 in)				
		Piston Pin Hole Inner Diameter	φ16.002 - 16.008 mm (0.6300 - 0.6302 in)				
	Piston Pin	Pin Outer Diameter	φ16.000 mm (0.6299 in)				
		Clearance Between Piston Pin and Pin Hole	0.002 - 0.012 mm (0.0001 - 0.0005 in)				
		Ring End Gap Note) Measure the Ring End Gap at the	Top Ring: 0.13 - 0.25 mm (0.0051 - 0.0098 in)				
	Piston Ring	bottom of the cylinder bore where there	Second Ring: 0.35 - 0.50 mm (0.0138 - 0.0197 in)				
		gauge.	Oil Ring: 0.20 - 0.70 mm (0.0079 - 0.0276 in)				
	Culinder Head	Cam Bearing Inner Diameter	Upper section: \$\phi18.000 - 18.025 mm (0.7087 - 0.7096 in) #1 - #2: \$\phi32.070 - 33.000 mm (1.2626 - 1.2992 in) #2 - #3: \$\phi3.5 mm (1.3189 in) or more (no contact) #3 - oil pump: 33.500 - 33.550 mm (1.3189 - 1.3209 in)				
	Cymruci ricau	Distortion or Damage on Mating Surface	Distortion: 0.05 mm (0.002 in) or less				
		Carbon Adhesion in Combustion Chamber	-				
		Cooling Water Passage Clogged	-				

Functional Limit	Action To Be Taken
-	Check if rotating parts, sliding parts and sealing parts cause compression leakage.
-	Adjust to specified range
IN: φ5.46 mm (0.2150 in)	- Benlace if less than specified limit
EX: φ5.44 mm (0.2142 in)	
IN: 0.05 mm (0.0020 in)	Replace if more than specified limit
EX: 0.03 mm (0.0012 in)	· · · · · · · · · · · · · · · · · · ·
IN: φ5.55 mm (0.2185 in)	Replace if more than specified limit
EX: \$5.57 mm (0.2193 in)	
IN: 0.070 mm (0.0028 in)	Replace if more than specified limit
EX: 0.100 mm (0.0039 in)	
IN: 2.0 mm (0.0787 in)	Correct or replace if more than specified limit
EX: 2.0 mm (0.0787 in)	
IN: 31.5 mm (1.2402 in)	Replace if less than specified limit
EX: 31.5 mm (1.2402 in)	
φ13.05 mm (0.5138 in)	Replace if more than specified limit
φ12.94 mm (0.5094 in)	Replace if ress than specified limit
0.060 mm (0.0024 m)	
φ60.900 mm (2.3976 in)	Replace if less than specified limit
0.15 mm (0.0059 in)	Replace if more than specified limit
-	Clean to remove. Replace with a new one if the stains cannot be fully removed even after cleaning.
0.10 mm (0.0039 in)	Replace if the gap is over the specified limit
0.09 mm (0.0035 in)	Replace the oil ring at the same time when replacing the top or
0.15 mm (0.0059 in)	second ring.
φ16.012 mm (0.6304 in)	Replace if more than specified limit
φ15.970 mm (0.6287 in)	Replace if less than the specified value
0.040 mm (0.0016 in)	Replace if more than specified limit
0.50 mm (0.0197 in)	Replace if the gap is over the specified limit
0.70 mm (0.0276 in)	Replace the oil ring at the same time when replacing the top or second ring
0.90 mm (0.0354 in)	coord mg.
Upper section: φ18.050 mm (0.7106 in) #1 - #2: φ33.050 mm (1.3012 in) #2 - #3: φ33.5 mm (1.3189 in) or more (no contact) #3 - oil pump: 33.600 mm (1.3228 in)	Replace if more than specified limit
Distortion: 0.1 mm (0.0039 in) or when the sealing performance may be affected.	Resurface by laying a #240 - 400 waterproof abrasive paper on the surface plate. Use #600 for finish.
-	Clean to remove
-	Clean to remove



	Description	Item	Standard Value
		Cylinder Liner Inner Diameter Use a cylinder gauge etc. to measure the inner diameter	φ61.00 mm (2.4016 in)
	Cylinder Block	Seizure, Cylinder Liner Damage or Wear	-
Cr Engine Parts Engine Parts		Distortion or Damage on Mating Surface	Distortion: 0.05 mm (0.002 in) or less
		Deposition in Water Jacket	-
		Small End Inner Diameter	φ16.010 - 16.021 mm (0.6303 - 0.6307 in)
	Connecting	Big End Oil Clearance	0.015 - 0.041 mm (0.0006 - 0.0016 in)
	nou	Big End Side Clearance	0.10 - 0.25 mm (0.0039 - 0.0098 in)
		Center Deflection (measure with support of journal at both ends)	Both sides and the center section must be less than 0.03 mm (0.0012 in).
		Main Journal Outer Diameter	φ33.988 - 33.996 mm (1.3381 - 1.3384 in)
	Crankshaft	Crank pin outer diameter	φ28.972 - 28.985 mm (1.1406 - 1.1411 in)
		Main Journal Oil Clearance	0.012 - 0.044 mm (0.0005 - 0.0017 in)
		Main Journal Thrust Clearance	0.05 - 0.15 mm (0.0020 - 0.0059 in)
		Cam Height	IN: 23.63 mm (0.9303 in)
			EX: 23.80 mm (0.9370 in)
	Cam Shaft	Bearing Outer Diameter	Pulley Side 17.925 - 17.940 mm (0.7057 - 0.7063 in)
			#1 - #2 32.91 - 32.92 mm (1.2957 - 1.2961 in)
			Oil Pump Side 15.925 - 15.940 mm (0.6270 - 0.6276 in)
		Cam Shaft Runout	-
	Timing Belt	External Appearance	-
		Housing Maximum Diameter	40.74 mm (1.6039 in)
		Rotor Minimum Diameter	40.53 mm (1.5957 in)
		Housing Maximum Size	15.07 mm (0.5933 in)
		Rotor Minimum Size	14.96 mm (0.5890 in)
		Pump Body Inner Diameter (Maximum Diameter)	40.74 mm (1.6039 in)
	Oil Pump	Clearance between Outer Rotor and Body (Maximum Clearance)	0.21 mm (0.0083 in)
		Outer Rotor Height (Minimum Height)	14.96 mm (0.5890 in)
		Clearance between Sides of Rotor and Body (Maximum Clearance)	0.11 mm (0.0043 in)
		Clearance between Outer and Inner Rotors (Maximum Clearance)	0.16 mm (0.0063 in)
Fu	Fuel Rail	O-ring Wear and Damage	-
Engine Parts Cy Cy Co Ro Fuel-Related Parts Parts	Fuel Regulator	Fuel Pressure	250 kPa
elat	Vapor Sonarctor	Sealing Ring Wear and Damage	-
ed		Float	-

Functional Limit	Action To Be Taken
φ61.06 mm (2.4039 in)	Replace if more than specified limit
 Difference of 0.06 mm (0.0024 in) between the most worn out area and least worn out area of the liner inner diameter (Roundness 0.06) Taper limit 0.08 mm (0.0031 in) Measurement position: From the cylinder mating surface (1) 6 mm (0.2362 in) (2) 38 mm (1.4961 in) (3) 76 mm (2.9921in) 	Replace if the difference between the most worn out area and least worn out area of the liner inner diameter is above the specified value. Replace if there are deep scratches etc. on the sliding surface with the piston, which cannot be repaired with #400 to 600 water- resistant paper.
Distortion: 0.1 mm (0.0039 in) or when the sealing performance may be affected.	Resurface by laying a #240 - 400 waterproof abrasive paper on the surface plate. Use #600 for finish.
φ16.040 mm (0.6315 in)	Clean to remove Replace if more than specified limit
0.060 mm (0.0224 m)	Replace if more than specified limit
0.03 mm (0.0012 in)	Replace if more than specified limit
ф33.97 mm (1.3374 in)	Replace if less than specified limit
φ28.94 mm (1.1394 in)	Replace if less than specified limit
0.060 mm (0.0024 in)	Replace if more than specified limit
0.60 mm (0.0236 in)	Replace if more than specified limit
IN: 23.5 mm (0.9252 in)	Replace if less than specified limit
EX: 23.5 mm (0.9252 in)	Replace if less than specified limit
Pulley Side 17.91 mm (0.7051 in)	Replace if less than specified limit
#1 - #2 32.85 mm (1.2933 in)	Replace if less than specified limit
Oil Pump Side 15.91 mm (0.6264 in)	Replace if less than specified limit
0.05 mm (0.002 in)	Replace if more than specified limit
Wear, Damage, Elongation	Replace depending on the condition.
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
Parts that are worn out or damaged	Replace with new part
-	Replace if out of standard value
Parts that are worn out or damaged	Replace with new part
Parts that have deteriorated and parts where fuel has gotten inside	Replace with new part



	Description	Item	Standard Value
Electrical Parts	Spark Plug	Plug Type	DCPR6E (NGK)
		Spark Gap	0.8 - 0.9 mm (0.030 - 0.035 in)
		Primary Coil Resistance	0.20±0.03 Ω (20°C)
	Ignition Coil	Casandan (Cail Dasiatanas	4.1±0.82 kΩ (20°C)
		Secondary Coll Resistance	9.1 ± 2.0 k Ω (with spark plug cap)
Electrical Parts Power Tilt		Alternator (MAX)	12V–210W
	Magneto	Power Concration Performance	1000 r/min, 14 V, 6 A or more
	(Alternator)		5000 r/min, 14 V, 15 A or more
		Charge Coil Resistance (Between W-W-W Lines)	0.34 Ω±20% (20°C)
		Measuring the Resistance Between Terminals	11.50 - 12.5 Ω (20°C)
	Fuel Injector	Operating Check	-
m	EED	Wear and damage of seals and grommets	-
lec		Operating Check	-
tric	Crank Position	Clearance with Encoder Ring (Flywheel)	0.8 mm (0.0315 in) ± 0.2 mm (0.0079 in)
al F	Sensor	Pulser Coil Resistance (Between Terminals)	185 Ω± 20% (20°C)
art	T.P.S	Measuring the Resistance Between Terminals	5 kΩ± 30%
S	ISC Valve Measuring the Resistance Between T		24.3 ± 3 Ω (20°C)
1 5 1 1 1 1 5	Engine Temperature	Measuring the Resistance Between Terminals	4.24 - 4.86 kΩ (4 - 6°C)
	Sensor		1.90 - 2.10 kΩ (24 - 26°C)
	T- MAP Sensor	Measuring the Resistance Between Terminals	6.0±0.6 kΩ (0°C)
			0.282 - 0.388 kΩ (80°C)
	Rectifier	Measuring the Resistance Between Terminals	Refer to the tester check table in Chapter 8.
		Output	12 V 0.7 kW
	Starter Motor	Brush Length	13.9 - 14.2 mm (0.5472 - 0.5591 in)
		Commutator Undercut	1.0 - 1.2 mm (0.0394 - 0.0472 in)
-		Commutator Outer Diameter	28.2 - 28.5 (1.1102 - 1.1024 in)
		Rated Voltage	12 V (DC)
	Starter Solenoid	Excitation Current	4 A or less
		Exciter Coil Resistance	4.4 Ω± 10% (20°C)
	Fuse	Capacity	20 A x 1
		Relief Valve Opening Pressure (UP Side)	13.8 - 18.4 MPa
		Relief Valve Opening Pressure (DN Side)	6.5 - 9.6 MPa
	Relief Valve Valve Opening	Spool Check Valve Opening Pressure: Upper Chamber Side	0.2 MPa
_	Pressure	Oil Capacity	263 ml
Power		Specified Oil	Hydraulic oil of equivalent or higher standard than DEXRON (ATF etc.)
Tilt		Rated Voltage	12 V (DC)
		Continuous Run	60 sec
	Motor	Output	130 W
		Direction of Revolution	Forward / Reverse
		Circuit Breaker Type	Bimetal Type
		Circuit Breaker Activation / Deactivation	20 sec or more at 25 A (25°C)/within 30 sec (25°C)

Functional Limit	Action To Be Taken
	Clean and remove the carbon stains or damage
-	Replace if the electrode is worn out significantly
Spark gap 1.2 mm (0.045 in)	Replace if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
-	-
-	-
-	-
-	Replace if out of standard value
-	
Parts that do not make a "clicking" sound when a voltage of 12 V is applied on the terminals	Replace with new part
Parts that are worn out or damaged	
Checking the operation sound or the valve in the fuel rail section	Replace with new part
	Re-adjust if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
	Poplace if out of standard value
9.5 mm (0.3740 in)	
0.7 mm (0.0276 in)	Benlace if out of standard value
28 mm (1 1024 in)	
-	
-	Replace if out of standard value
-	
Burn out	Replace with new part after eliminating the cause of the disconnection
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-



	Description	Item	Standard Value
		Piston Diameter	φ32 mm (1.2598 in)
	Culinder	Piston Rod Diameter	φ12.5 mm (0.4921 in)
Power Tilt Cooling System Parts Lower Parts Other	Cymaer	Stroke	140 mm (5.5118 in)
owe		Shock Absorber Valve Opening Pressure	14.4 - 20.5 MPa
Ϋ́Τ		Rated Voltage	12 V (DC)
iŧ	PT Solenoid	Continuous Run	60 sec
	(UP/DN)	Excitation Current	4 A or less
Power Tilt Cooling System Parts Lower Parts Other Other		Exciter Coil Resistance	85Ω ± 10%
Power Tilt Cooling System Parts Pur Gui	Thermostat	Valve Operation Starting Temperature (Submerged)	60±2 °C
	mermostat	Valve Full Open Temperature (Submerged)	75°C
		Valve Full Open Lift (Submerged)	3 mm (0.1181 in) or more
	Pump Impeller	Wear, Crack	-
	Pump Case Liner	Wear	-
ts	Guide Plate	Wear	-
Power Tilt Cooling System Parts Cooling System Part		Bearing Wear and Damage	-
	Propeller Shaft	Oil Seal Wear and Damage	-
		Center Deflection	-
		Pinion (B Gear) Height	0.6 - 0.64 mm (0.0236 - 0.0252 in)
	Bevel Gear	Forward Gear - Pinion Backlash (between A and B Gears)	Gauge reading: 0.33 - 0.54 mm (0.013 - 0.0213 in)
		Reverse Gear (C Gear) Washer Thickness	1.5 mm (0.0591 in)
		Spline (Upper) Base Tangent Length, 3 Gears	7.9 mm (0.311 in)
	Drive Shaft	Bearing Wear and Damage	-
	Brive Shalt	Oil Seal Wear and Damage	-
		Center Deflection	-
ower Parts	Propeller	Wear, Bend, Crack, Break	-
	Oil Seal Parts	Wear, Damage	-
Power Tilt Cooling System Parts Lower Parts Other	Anodes	Wear Cylinder head: 2 pieces Swivel bracket: 1 piece Clamp bracket L: piece Clamp bracket R: 1 piece Lower mount bracket: piece Gear case (trim tab): 1 piece Power tilt: 1 piece	-

Functional Limit	Action To Be Taken
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
Any opening under ambient temperature	Replace if out of specified range
Less than 3 mm (0.1181 in)	Replace if less than specified limit
Wear, crack or damage on tips and upper and lower surface lips	Replace pump case liner and guide plate as a set.
-	Replace if severely worn
-	Replace if severely worn
-	Replace depending on the condition.
0.4 mm (0.0157 in)	Replace if more than specified limit
0.05 mm (0.0020 in)	Replace if more than specified limit
-	Adjust to specified range
-	Adjust to specified range
1.35 mm (0.0531 in)	Replace if less than specified limit
7.5 mm (0.2953 in) or less	Replace depending on the condition.
-	Replace depending on the condition.
0.4 mm (0.0157 in)	Replace if more than specified limit
0.5 mm (0.0197 in)	Replace if more than specified limit
-	Replace depending on the condition.
When the lips are deteriorated, degraded or damaged, or when the tightening margin is reduced to 0.5 mm (0.0197 in) due to wear	Replace with new part
-	Replace if severely worn out



7. Tightening Torque Data

	Factored Commonweater	M/warah A		Type of	Tigl	que		
	Fastened Components	wrench A	Screw B X Pitch	Fastener	N⋅m	lb · ft	kgf · m	
					First ⁻	Ib · ft kgf · m Ightening Torque 7.4 1.0 22 3.0 Tightening Torque 3.0 22 3.0 Tightening Torque 4.4 0.6 0.74 13 1.8 5.2 0.7 13 1.8 5.2 0.7 13 1.8 8.1 1.1 13 1.8 3.0 0.4 5.9 0.8 6.6 0.9 t Tightening Torque 7.4 17.33 2.35 t Tightening Torque 4.4 0.6 0.9 4.4 0.6 md Tightening Torque 4.4 0.6 0.9 4.1		
		10	M0 x 1 05		of ierN·mlb·ftkgf·mFirst Tightening Torque107.41.0Second Tightening Torque30223.0First Tightening Torque64.40.6Second Tightening Torque107.41.0al18131.875.20.7al18131.8118.11.1al18131.8143.00.4al18131.815118.11.1al18131.8164.43.00.4al85.90.896.60.9107.41.0Second Tightening Torque23.517.3323.517.332.35First Tightening Torque10.523.517.332.35First Tightening Torque64.40.6Second Tightening Torque107.41.070527.064.40.6Second Tightening Torque107.41.070527.064.40.6Second Tightening Torque107.41.070527.064.40.6Second Tightening Torque0.2107.41.070527.084.1			
Cylinder Head Cylinder Block Crankcase Crankshaft Intake Manifold Starter Motor Engine Short Block Drive Shaft Housing Swivel Bracket		12	IVI8 X 1.25		Second Tightening Torque			
	Cylinder Head Mounting Bolt			Polt	30	22	3.0	
	(Cylinder Block - Cylinder Head)			DOIL	First ⁻	Tightening T	orque	
		10	Me v 1 0		6	4.4	0.6	
Cylinder Head		10			Second	d Tightening	Torque	
					10	7.4	1.0	
	Spark Plug	16	M12 x 1.25	Special	18	13	1.8	
	Tappet Adjustment Nut	10	M6 x 0.75	Nut	7	5.2	0.7	
	Anode Plug	10	M16 x 1.5	Special	18	13	1.8	
	Driven Pulley Bolt		M6 x 1.0	Pre-coated Bolt	11	8.1	1.1	
	Oil Filter	nents Wrench A Screw B x Pitch Fastener N · m D · ft g Boit er Head) 12 M8 x 1.25 Boit First Tightening 30 22 10 M6 x 1.0 Boit 6 4.4 Secord Tightenin 6 4.4 Secord Tightenin 10 7.4 10 M6 x 1.0 Special 18 13 10 M6 x 0.75 Nut 7 5.2 10 M6 x 1.0 Special 18 13 10 M6 x 1.0 Special 18 13 nsor 12 M8 x 1.25 Boit 4 3.0 24 PT1/8 Special 18 13 nsor 12 M8 x 1.25 Boit 4 3.0 23.5 17.33 Special 18 13 nsor 12 M8 x 1.25 Boit 4 3.0 23.5 17.33 Special 18 13 nsor 10 M6 x 1.0		13	1.8			
	Engine Temperature Sensor	12	M8 x 1.25	Bolt	4	3.0	0.4	
	Oil Pressure Switch	24	PT1/8	Special	8	5.9	0.8	
	Exhaust Cover Mounting Bolt		M6 x 1.0	Bolt	9	6.6	0.9	
					First	Tightening T	orque	
Cylinder Block	Crankcase Mounting Bolt (Cylinder Block - Crankcase)	12	M8 x 1.25 M6 x 1.0	Bolt	10	7.4	1.0	
Crankcase					Second	d Tightening	Torque	
					23.5	17.33	2.35	
				Bolt	First	Tightening T	orque	
					6	4.4	0.6	
					Second	d Tightening	Torque	
					11.5	8.48	1.15	
	Connecting Rod Bolt	10	M6x1.0		First	Tightening T	orque	
				Bolt	6	4.4	0.6	
Cylinder Block Crankcase Cran (Cyli Crankshaft Conr Crankshaft Flyw Timir ISC					Second	d Tightening	Torque	
					10	7.4	1.0	
	Flywheel Bolt	Interm Interm						
	Timing Pulley Nut	36	M30 × 1.5	Nut	N · m lb · ft kgf · m First Tightening Torque 30 22 3.0 Second Tightening Torque 6 4.4 0.6 Second Tightening Torque 6 4.4 0.6 Second Tightening Torque 10 7.4 1.0 18 13 1.8 13 7 5.2 0.7 18 11 8.13 1.8 7 5.2 0.7 18 13 1.8 11 8.1 1.1 18 13 1.8 11 8.1 1.1 18 13 1.8 10 7.4 1.0 Second Tightening Torque 23.5 17.33 First Tightening Torque 23.5 17.33 First Tightening Torque 6 4.4 0.6 9 6.6 Second Tightening Torque 1.0 1.0 11.5 8.48 1.15 First Tightening To			
	ISC Stay Mounting Screw	-	6 x 12	Tapping Screw	6	4.4	0.6	
Intake Manifold	MAP Sensor	-	5 x 16	Tapping Screw	2	1.5	0.2	
	Silencer Cover Mounting Screw	-	5 x 16	Tapping Screw	5.5	4.1	0.55	
	Throttle Body Assy	10	M6 x 1.0	Bolt	9	6.6	0.9	
Starter Motor	Starter Cable Mounting Nut		M6 x 1.0	Nut	5.5	4.0	0.55	
					First	Tightening T	orque	
Engine Short Block	Power Unit Installation Bolt	10	M8 x 1 25	Bolt	15	11	1.5	
				2011	Second	d Tightening	Torque	
					30	22	3.0	
	Mount Rubber (Upper)	14	M10 x 1.25	Bolt, Nylon Nut	27	20	2.7	
Drive Shaft Housing	Mount Rubber (Lower)	14	M10 x 1.25	Bolt, Nylon Nut	27	20	2.7	
	Oil Drain Plug	16	M14 x 1.5	Bolt	24	18	2.4	
Swivel Bracket	Co-Pilot Handle	13	M8 x 1.25	Nylon Nut	5	3.7	0.5	
Sinton Bracket	Tilt Stopper Mounting Bolt		M10 x 1.25	Bolt	27	20	2.7	

	Fastanad Componenta	Wronch A		Type of	Tightening Torque			
	Fastened Components	wrench A	Screw B X Pitch	Fastener	N·m	lb ⋅ ft	kgf∙m	
Clamp Bracket	Tilt Tube	32	7/8-14 UNF-2B	Nylon Nut	24	18	2.4	
PT Assy	Manual Valve	-	M12	Special	1.8	1.3	0.18	
	Bevel Gear B Nut	17	M12 x 1.0	Nut	35	26	3.5	
Goor Cooo	Propeller Nut	19	M12 x 1.5	Nut	25	18	2.5	
Gear Case	Oil Plug	-	M8 x 1.25	Special	4	3.0	0.4	
	Extension Housing Mounting Bolt		M8 x 1.25	Bolt	19	1.4	1.9	
Steering Bracket	Steering Shaft Arm		M10 x 1.25	Bolt	43	32.4	4.4	
Tiller Handle Cover	Buzzer/Push Switch Holding Plate Mounting Screw	-	6 x 12	Tapping Screw	3.5	2.6	0.35	
	Installation of Main Switch Assy		M16 x 1.5	Resin nut	3.5	2.6	0.35	
	Installation of Stop Switch		M16 x 1.5	Resin nut	3.5	2.6	0.35	
Tiller Handle	Tiller Handle Cover Mounting Screw	-	M5 x 0.8	Cross-head screw	1.5	1.1	0.15	

	Eastaned Components	Wrench A - 8 10 13 17 -	Sorow B x Ditab	Type of	Tightening Torque			
	Pastened Components	wrench A	Screw B X Plich	Fastener	N·m	lb · ft	kgf · m	
	M4	-	M4x0.7	Bolt, Nut	1.5	1.1	0.15	
	M5	8	M5x0.8 Bolt, Nut		3	2.2	0.3	
	M6	10	M6x1.0 Bolt, Nut		6	5	0.6	
	M8	13	M8x1.25	Bolt, Nut	13	10	1.3	
Standard Tightening	M10	17	M10x1.25	Bolt, Nut	27	20	2.7	
	M4	-	M4x0.7	Screw	1.5	1.1	0.15	
	M5	-	M5x0.8	Screw	2.5	1.8	0.25	
	M6	-	M6x1.0	Screw	3.5	2.5	0.35	
	M8	-	M8x1.25	Screw	4.5	3.3	0.5	





8. Sealant Application Locations

		1 (n -		(m	(n	(n -	(m		(0	(0	(0
		ligh	-ow	Nido	Nido	High scre	ligh	Anti-	Sea	Sea	Sea
		w lo	-stre			v lc	w lo	v lo	ling	ling	ling
		eng	sngt	strer	strer	eng	eng	age	Age	Age	Age
		lig th	ng a	ngth ng a	ngth ng a	ig th	lig a	, An g ag	n t	nt	n t
	<	gen	gent	gent	gent	gent	gent	lent			
		–	-	-	-	-	-	st			
			Three	Three	Three	Three	Three	Three		Three	
		Loctite	Bond	Bond	Bond	Bond	Bond	Bond	Loctite	Bond	Tosseal
	Location of Use	263	1342	1327	1322	1373B	1377N	1401	5910	1207B	381
		(271)									
	Cam Shaft										
	Oil Seal (Cam Shaft)										
	Driven Pulley Bolt										
	Rocker Arm										
	Lifter	ļ		ļ							
	Rocker Arm Spring										
Cylinder Head	Rocker Arm Shaft										
	Valve (INT, EX)										
	Valve Spring										
	Valve Spring Seat										
	Retainer • Cotter										
	Valve Stem Seal (INT, EX)										
	Adjusting Screw										
	Oil Pump										
	O-Ring (Anode Plug)			İ.							
	Head Bolt										
Anode Plug Assv	Screw										
Exhaust Cover Assv	Rectifier Complete Gasket	1									
	O-Bing (Filler Cap)										
	Evel Pump										
Cylinder Head Cover	Q-Bing (Eucl Pump)										
	Serow (Proother Chamber Cover)										
	Cylinder Liner										
	Dieton										
	Pieton Ping										
	Piston Ring										
	Piston Pin										
	Connecting Rod										
	Connecting Rod Bolt										
	Crankshaft	1		1							
Cylinder Block	Crankshaft Metal Bearing										
Grankcase	Oil Seal (Crankshaft Upper, Lower)	1									
	Cylinder Block, Crankcase Mating Surface										
	Oil Filter Bolt		•								
	Oil Filter										
	Cylinder Block										
	(Surface in Contact with the Oil Filter)										
	Plug										

Instant Glue	Instant Glue	Bond	Bond	Rubber Lubricating Oil (insertion aiding agent)	Heat-Resistant Grease	Cold-Resistant Lithium Grease	Water-Resistant Grease	Teflon Grease	Silicone Grease	Molytone Grease	4st Engine Oil	Tohatsu Genuine Gea	Power Torque Fluid	Silicone Sealant			
Loctite	Three Bond	Konishi	Konishi	Emulsion	Oil Center Research	(Chuo Yul	ka	Shinetsu Silicone	Sumico		Oi		Three Bond	Remarks		
425	1741 (7782)	G17	G103	P-80	LOR #101	Cen tax L2	FM- 531	LM- 902	KS-64	Molytone Grease No.1			ATF	5211			
															Cam Unit		
															Bearing		
															Lip		
															Outer Surface, Press Fit		
															Thread		
															Bearing, Roller, Sliding Part		
							1				•				Entire Surface		
															Entire Surface		
											-						
															Cheft Stom Hood		
											-						
											•						
											•						
											•				Entire Surface		
											•				Lip and Inside		
															Entire Surface		
															Pour 2 cc from the suction inlet		
															O-Ring		
															Thread, Seat Surface		
															Thread		
															Thread		
															Entire Surface		
															Plunger Tip		
							1								Outer Face		
															Thread		
											•				Inner Wall		
											•				Ring Grooves. Outer Face. Piston Pin Hole		
											•				Entire Surface		
															Outer Face		
															Small End Inner Diameter		
											•				Seet Underbeed Lower Cylindrical Section		
											•				Thread		
											٠				Sliding Face, Thrust Face		
															Only for Bearing, Remove Grease of Outside.		
															Lip		
															Apply in a semicircle at a range 5mm (0.20 in) from the insertion side.		
							1				٠				O-Ring		
											•				Apply a thin coat on the mating surface in contact with the O-ring.		
											•				Blank plug of the oil drip tray		



		High-strength screw locking agent	Low-strength screw locking agent	Middle-strength screw locking agent	Middle-strength screw locking agent	High-strength screw locking agent	High-strength screw locking agent	Anti-leakage, Anti-rust screw locking agent	Sealing Agent	Sealing Agent	Sealing Agent
		Loctite	Three Bond	Three Bond	Three Bond	Three Bond	Three Bond	Three Bond	Loctite	Three Bond	Tosseal
	Location of Use	263 (271)	1342	1327	1322	1373B	1377N	1401	5910	1207B	381
	Bolt (Holding Plate)										
Fuel Dell	O-Ring (Injector)										
Fuel Rail	Seal Ring										
	Valve										
	Map Sensor										
Intake Manifold	Throttle Body Assy										
	Plug Cap										
	Spark Plug	1									
Electrical Parts	Oil Pressure Switch			•							
	Starter Motor										
Electrical Bracket	Rubber Mount										
	Collar										
VST Front Assembly	Rubber Mount										
VST FIOR ASSEMDLY	Collar										
Engine Short Block	Bolt (Power Unit Mounting)										
	Oil Seal										
	Water Pipe Seal (Upper)										
Drive Shaft Housing	Water Pipe Auxiliary Mount										
Drive Shart Housing	Bolt (for Mounting the Idle Exhaust Port Cover)										
	Engine Basement Seal										
	Installation of the Engine										
Extension Housing	Bolt (for Installing the Extension Housing)		٠								
	Drive Shaft (Crank Side Spline)										
Drive Shaft	Nut (Bevel Gear B)										
	Taper Roller Bearing										
	Bolt (Gear Case)										
	Bolt (Pump Case)										
	Pump Case Liner										
	Water Pipe Seal										
Goar Caso	O-Ring (Pump Case Lower)										
	Oil Seal (Pump Case Lower)										
	Cam Rod										
	Bolt (Trim Tab)										
	Roller Bearing	L									

Instant Glue	Instant Glue	Bond	Bond	Rubber Lubricating Oil (insertion aiding agent)	Heat-Resistant Grease	Cold-Resistant Lithium Grease	Water-Resistant Grease	Teflon Grease	Silicone Grease	Molytone Grease	4st Engine Oil	Tohatsu Genuine Gea	Power Torque Fluid	Silicone Sealant	
Loctite	Three Bond	Konishi	Konishi	Emulsion	Oil Center Research	(Chuo Yuł	ka	Shinetsu Silicone	Sumico		Oii		Three Bond	Remarks
425	1741 (7782)	G17	G103	P-80	LOR #101	Cen tax L2	FM- 531	LM- 902	KS-64	Molytone Grease No.1			ATF	5211	
															Entire Surface
															Entire Surface
															Entire Surface
															Thread
															O-Ring
<u> </u>							1								High Tension Cord
															Plug Cap End
									-						Taper screw section (side to mount the block)
<u> </u>															Terminals HEX section
															Thin cost to ninion part
								•			•				Outer face: 4st oil, inner face: lefton grease
											•				
											•				
															Thread
	•														Thread
															Thread
															Thread
															Crankshaft Side Spline
															Thread
															Outer Surface, Press Fit
															Thread
															Thread
															Impeller Sliding Area
															Inner Side
															Entire Surface
															Lip
															Outer Surface, Press Fit
															Clutch Section, Gear Case Mating Section
															Entire Surface
															Outer Surface, Press Fit



		High-strength screw locking agent	Low-strength screw locking agent	Middle-strength screw locking agent	Middle-strength screw locking agent	High-strength screw locking agent	High-strength screw locking agent	Anti-leakage, Anti-rust screw locking agent	Sealing Agent	Sealing Agent	Sealing Agent
		Loctite	Three Bond	Three Bond	Three Bond	Three Bond	Three Bond	Three Bond	Loctite	Three Bond	Tosseal
	Location of Use	263 (271)	1342	1327	1322	1373B	1377N	1401	5910	1207B	381
	Propeller Shaft										
	Clutch										
Dua na llan Ohaff	Ball										
Propener Shan	Snap										
	Push Rod										
	Pin										
	Spring										
	O-ring										
	Oil Seal										
Propeller Shaft Housing	Ball Bearing										
	Roller Bearing										
	Bolt (Housing)										
	Shift Lever (Shift Lever Shaft Assy)										
	Link Rod Assy (Throttle)										
	Collar (Throttle Drum Assy)										
	Throttle Arm										
	Shift Arm										
Throttle Shift	Remote Control Cable										
	Bolt (Detent Spring)										
	Bolt (for Mounting the Shift Arm)										
	Bolt (for Mounting the Shift Arm Bracket)										
	Bolt (for Mounting the Holder/Clutch Cable Clip Bracket)									<u> </u>	
	Bolt (for Mounting the Cable Clip)										
	Nut (Throttle Rod)										
Clamp Bracket	Clamp Screw							-		L	
	Pin (for Mounting the Manual Reverse Lock Spring)										
	Grease Fitting										
	Friction Spring										
	Setting Piece										
	Bolt (Setting Plate)										
Bracket	Collar (Tilt Stopper)		-							L	
	Bolt (Co-pilot Plate)		•								
	Pivot Bolt (Reverse Lock)		•								
	Tilt Stopper Grip		-								
	Tilt Stopper (Shaft)									L	
	Steering Shaft										
L		1	1					L			

Instant Glue	Instant Glue	Bond	Bond	Rubber Lubricating Oil (insertion aiding agent)	Heat-Resistant Grease	Cold-Resistant Lithium Grease	Water-Resistant Grease	Teflon Grease	Silicone Grease	Molytone Grease	4st Engine Oil	Tohatsu Genuine Gea	Power Torque Fluid	Silicone Sealant	
Loctite	Three Bond	Konishi	Konishi	Emulsion	Oil Center Research	С	∺huo Yuł	a	Shinetsu Silicone	Sumico		Q		Three Bond	Remarks
425	1741 (7782)	G17	G103	P-80	LOR #101	Cen tax L2	FM- 531	LM- 902	KS-64	Molytone Grease No.1			ATF	5211	
															Propeller Side Spline
															Range from clutch side tip to pressure-welded section
															Spline Section
															Entire Surface
															Entire Surface
															Entire Surface
															Entire Surface
															Entire Surface
															Entire Surface
															Lip
															Outer Surface, Press Fit
															Outer Surface. Press Fit
<u> </u>															Outer Surface, Press Fit
															Thread
															Sliding Face
															Sliding Face (Ball Joint Section)
<u> </u>															
															Sliding Face
															Sliding Face
						•									(Apply while it is extended.)
															Thread
															Thread
															Thread
															Thread
															Thread
															Thread
															Press Fit
															Grease injection after completing the bracket assembly
															Entire Surface
_															Entire Surface
															Thread
															Inner and Outer Faces
															Thread
															Thread
															Bonding
															Sliding Face
															Shaft Section



		High-strength screw locking agent	Low-strength screw locking agent	Middle-strength screw locking agent	Middle-strength screw locking agent	High-strength screw locking agent	High-strength screw locking agent	Anti-leakage, Anti-rust screw locking agent	Sealing Agent	Sealing Agent	Sealing Agent
		Loctite	Three Bond	Three Bond	Three Bond	Three Bond	Three Bond	Three Bond	Loctite	Three Bond	Tosseal
	Location of Use	263 (271)	1342	1327	1322	1373B	1377N	1401	5910	1207B	381
	Bushing (Steering Shaft)										
	Bushing (Swivel Shaft)										
Breeket	Bushing (Cylinder Pin Upper, Lower)										
Drackel	O-Ring (Steering Bracket)										
	Swivel Bracket Shaft										
	Bushing (Swivel Bracket Shaft)										
	Cylinder Pin (Upper, Lower)										
ртт	Cylinder Pin Bush (Upper, Lower)										
	PTT Fluid										
	O-ring										
	Shift Lever Rod Grommet										
Bottom Cowl	Shift Rod Grommet										
	Bolt (Fuel Connector)										
	Grip Inner										
	Bolt (for Holding the Handle Shaft)										
	Handle Grip Section										
Basic Tiller Handle	Handle Steering Bracket Delivery Side										
	Steering Bracket Bushing										
	Stud (for Mounting the Steering Bracket)										
	Stop Switch										
	Shift Lever Section										
Nipples, Sealing Plugs											
Reuse Pre-coated Bolts											

Instant Glue	Instant Glue	Bond	Bond	Rubber Lubricating Oil (insertion aiding agent)	Heat-Resistant Grease	Cold-Resistant Lithium Grease	Water-Resistant Grease	Teflon Grease	Silicone Grease	Molytone Grease	4st Engine Oil	Tohatsu Genuine Gea	Power Torque Fluid	Silicone Sealant	
Loctite	Three Bond	Konishi	Konishi	Emulsion	Oil Center Research	с	huo Yul	ka	Shinetsu Silicone	Sumico		Q		Three Bond	Remarks
425	1741 (7782)	G17	G103	P-80	LOR #101	Cen tax L2	FM- 531	LM- 902	KS-64	Molytone Grease No.1			ATF	5211	
															Outer Face, Inner Face
															Outer Face, Inner Face
															Outer Face, Inner Face
															Entire Surface
															Sliding Face
															Sliding Face
															Sliding Face
															Sliding Face
															Inner Lip
															Inner Lip
															Thread
															Sliding Face
															Thread
															Sliding Face
															Sliding Face
															Entire Surface
															Thread
															Thread
															Entire Surface
															Press Fit
															Thread



Maintenance



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1. Special Tools

EB											
Oil Filter Wrench P/N. 3AC-99090-0	Spring Pin Tool A P/N. 345-72227-0	Flywheel Puller Kit P/N. 3T1-72211-4									
Removal/installation of oil filter	Removal of spring pin (ø3.0)	Removal/installation of flywheel									
Thickness Gauge P/N. 353-72251-1	Compression Gauge P/N. 3AC-99030-0	Valve Clearance Driver P/N. 3AC-99071-0	Torque Wrench P/N. 3AC-99070-0								
Measurement of gaps	Measurement of compression pressure	Adjustment of valve clearance	Adjustment of valve clearance								
Tophermature											
Tachometer P/N. 3AC-99010-0											
Measurement of engine revolution speed											

2. Inspection Schedule

			Insp	ection inter	vals			
	Inspection parts	First 20 hours or 1 month	Every 50 hours or 3 months	Every 100 hours or 6 months	Every 200 hours or 1 year	Every 400 hours or 2 years	Inspection procedure	Remarks
	Fuel Filter			0			Check, Clean or Replace if Necessary	
	Fuel Filter (Vapor Separator)					0	Check, Clean or Replace if Necessary	
First	High Pressure Fuel Hose	0	0				Check/Replace if Necessary	
Svstem	Fuel Tank	0	0				Check and Clean	
-,	Fuel Tank Cap	0	0				Check/Replace if Necessary	
	Fuel Pump					0	Check/Replace if Necessary	
	Fuel Pressure				0		Check	
	Hose	0	0				Check/Replace if Necessary	
Ignition System	Spark Plug			0			Check and Clean	Gap 0.8 to 0.9 mm (0.030 to 0.035 in)
- Cyotom	Spark Plug Cap/ High Tension Cord	0		0			Check, Clean or Replace if Necessary	
	Starter Rope	0	0				Check Wear/Replace if Necessary	
Starting	Starter Motor				0		Inspect (Pinion)	
System	Battery & Cable Connections	0	0				Check Fluid Quantity/Check Terminal	
	Engine Oil	Replace		Replace			Replace	When oil filter is replaced: Approx. 1.7 L (1.8 US qt.) Without replacement: Approx. 1.5 L (1.6 US qt.)
Engine	Oil Filter (4 stroke)	Replace			Replace		Replace	
	Valve Clearance				0		Check and Adjustment	
	Timing Belt				0		Check/Replace if Necessary	
	Compression Pressure				0		Check	
	Thermostat				0		Check/Replace if Necessary	
	Propeller	0	0				Check/Replace if Necessary	
	Split Pin	0	0				Check/Replace if Necessary	
Lower Unit	Gear Oil	Replace	0	Replace			Check and replace	Approx. 460 mL (16 US fl.oz)
	Water Strainer	0	0				Check	
	Water Pump Impeller		0		Replace		Check/Replace if Necessary	
	Water Pump Housing					0	Check/Replace if Necessary	
	Throttle Cable			0			Check/Replace if Necessary	
Shift	Throttle Link	0	0				Check and Adjustment	
Throttle	Shift Cable		0				Check/Replace if Necessary	
	Shift Link	0	0				Check and Adjustment	
Power Tilt		0		0			Check/Replenish	
Warning Syste	m		0				Check	
Stop Switch		0	0				Check	
Meters		0	0				Check	
Bolt, Nut		0	0				Retighten	
Sliding Part/Rotation Part		0	0				Apply Grease	
Grease Nipple		0	0				Pump in Grease	
External Appe	arance	0	0				Check	
Anode (Engine	e)			0			Check/Replace if Necessary	
Anode (Lower	/Bracket)		0				Check/Replace if Necessary	
Top Cowl/Latc	h				0		Check and Adjustment	



3. Inspection Items

1) Inspection of Top Cowl

Push the top cowl with both hands to check the rattling and tightening condition.



2) Fuel System

Inspection of Fuel Hose

Check the fuel system piping for fuel leak, dirt, deterioration and damage, and replace or repair parts if necessary.





3) Inspection of Fuel Tank

Remove the four screws from the fuel tank (1), remove the fuel pick up elbow (2), and clean the filter (3). Remove dirt and water from the fuel tank if any.



② Fuel Pick Up Elbow③ Filter

4) Inspection of Fuel Filter

CAUTION

If the red float ① in the fuel filter is floating, water has entered. Loosen the drain valve ② and squeeze the primer valve several times to drain the water.
Be careful not to spill fuel when removing the cup ③.

Check the filter ④ for any dirt or buildup of fuel varnish or debris, and the cup for any cracks or contamination by foreign matter. Wash the cup with gasoline, and replace the filter if necessary.





(5) O-ring Do not reuse.



5) Replacement of Engine Oil

Oil Level 1.



(1) Oil Level Gauge (a) Upper Limit (b) Lower Limit

2. **Oil Specification**

Recommended Engine Oil:

Tohatsu 4-Stroke Engine Oil **Recommended Engine Oil Grade:** API: SH, SJ, SL SAE: 10W-30, 10W-40 **Quantity of Engine Oil:** (When oil filter is replaced) : 1.7 L (1.8 US qt.) (When oil filter is not replaced): 1.5 L (1.6 US qt.)

Use oil with a viscosity that is suitable for the ambient air temperature of the operating region.



© Engine Oil

(d) Outside Air Temperature

З. **Oil Replacement Procedure**

> The engine and engine oil are hot immediately after the engine stops. Work after the engine has sufficiently cooled down.

▲ CAUTION

Engine oil that is contaminated by dirt or water can significantly shorten the lives of the rotating and sliding parts of the engine.

Replacement of Engine Oil:

1. Stop the engine and keep the outboard motor standing upright.



If the outboard motor is tilted, the accurate amount of engine oil cannot be poured in.

- 2. Remove the top cowl, then remove the oil filler cap 1).
- 3. Place drain oil pan below drain bolt 2.
- 4. Remove the drain bolt to drain away the oil.





• Apply engine oil on the sealing areas of the engine oil drain bolt.

• Use a new gasket.

Engine Oil Drain Bolt:

24 N \cdot m (18 lb \cdot ft) [2.4 kgf \cdot m]

- Pour the specified amount of new engine oil into the oil inlet ③ while checking the amount using the oil level gauge ④.
- Install the oil filler cap (1) as well as the oil level gauge and start the engine to warm up for 5 minutes.
- 7. Check if there are any oil leaks and stop the engine.

6) Replacement of Oil Filter

- 1. Drain engine oil.
- Remove the yellow plug ① of the oil drip tray under the oil filter and attach the hose to the nipple of the tray (hose inner diameter: 12.0 to 12.7 mm). Set a drain oil pan on the opposite side of the hose.
- 3. Using the oil filter wrench, which is a special tool, turn the oil filter counterclockwise to remove it.

Oil Filter Wrench (2): P/N. 3AC-99090-0



Replace the oil filter after 5 minutes or more after stopping the engine.

4. Install the oil filter and tighten it to the specified torque using the oil filter wrench.



Apply a thin coat of engine oil on the O-ring of the oil filter before installing it.

Oil Filter: 18 N ⋅ m (13 lb ⋅ ft) [1.8 kgf ⋅ m]

5. Completely wipe off the spilled oil and attach the plug of the oil drip tray.











6. Pour engine oil into the oil inlet ③.

Recommended Engine Oil:									
Tohatsu 4-Stroke Engine Oil									
Recommended Engine Oil Grade:									
API: SH, SJ, SL									
SAE: 10W-30, 10W-40									
Quantity of Engine Oil:									
(When oil filter is replaced) : 1.7 L (1.8 US qt.) (When oil filter is not replaced): 1.5 L (1.6 US qt.)									

- Install the oil filler cap (4) and oil level gauge (5), and start the engine to warm up for 5 minutes.
- 8. Check if there are any oil leaks and stop the engine.



5 Oil Level Gauge $% \fbox{5}$ (MAX) 5 Lower Limit (MIN) 5
7) Inspection of Gear Oil Quantity

- 1. Tilt down the outboard motor to make it vertical.
- 2. Remove the upper oil plug ① and check the level of the gear oil in the gear case.



Fill with gear oil until some of the oil spills out of the plug hole when the oil plug is removed.

3. Replenish the gear oil to the specified level if it is insufficient.

Recommended Gear Oil:



Tohatsu Gear Oil **Recommended Gear Oil Grade:** API: GL-5 SAE: #80 - 90



If the shortage is large, replenish through the lower oil plug hole.

4. Install the upper oil plug.

8) Inspection of Water Pump

When working with the outboard motor in the tilt up position, be sure to lock it with the tilt stopper.

- Ŀ
- The power unit does not need to be removed from the outboard motor to inspect the water pump.
- When removing the lower unit from the outboard motor, tilt up the outboard motor to make the work easier.
- 1. Shift the gear into forward (F).
- 2. Remove the retainer (1) and spring pin (2), then disconnect the shift rod and cam rod.



• Use the spring ping tool ③ to remove the spring pin.

• The spring pin cannot be reused once it is removed.

Spring Pin Tool A ③: P/N. 345-72227-0



② Gasket Do not reuse.



3. Remove the lower unit installation bolts and pull down the lower unit assembly (3) to remove it.



- 4. Remove the pump upper case ④.
- 5. Remove the impeller (5) and check it.
- Check the pump case (upper) to see if there is any deformation. Replace if necessary.
- 7. Check the impeller and pump case liner (6) for any cracks and wear. Replace if necessary.



- 8. Check key ⑦ and drive shaft groove ⓐ for wear. Replace if necessary.
- 9. Reinstall the removed component. Refer to Chapter 6 for details.



9) Replacement of Gear Oil

- 1. Tilt up the outboard motor a little as shown.
- Place the drain oil pan below the lower oil plug (1), remove the lower oil plug, and then remove the upper oil plug (2) to drain away the oil.



Remove the lower oil plug first when draining.

- Check the viscosity and the gear oil to see if there are any metal particles or discoloration (clouding). Check the lower unit internal components if necessary.
- 4. Tilt down the outboard motor to the vertical position, and fill with gear oil (via an oil tube or pump) through the lower plug hole until gear oil starts to spill out from the upper oil plug hole (a) and no air bubbles remain.

Recommended Gear Oil: Tohatsu Gear Oil Recommended Gear Oil Grade: API: GL-5 SAE: #80 - 90 Quantity of Gear Oil: 460 ml (16 US fl.oz.)



- Use the lower plug hole when filling with gear oil. The upper hole cannot be used because air cannot be purged and oil cannot be supplied.
- Be sure to tilt the outboard motor to the vertical position or otherwise the specified quantity cannot be filled.



③ Gasket Do not reuse.





5. Install a new gasket and upper oil plug, then install a new gasket and the lower oil plug immediately.



Install the upper oil plug first when refilling ends.

Oil Plug: 4 N ⋅ m (3.0 lb ⋅ ft) [0.4 kgf ⋅ m] Maintenance

10) Inspection of Gear Case (for leakage)

- 1. Drain the gear oil.
- 2. Remove the upper oil plug ① and connect a commercially available leakage tester to the hole.



 Apply the specified pressure to the gear case, and check if the pressure can be held for 10 seconds.

Do not subject the gear case to a pressure over the specified value.

Doing so can cause damage to the oil seal.

Specified Gear Case Holding Pressure: 0.05 MPa (7 psi) [0.5 kgf/cm²]

- When the propeller shaft is rotated while maintaining the pressure, it is easier to locate air leaks due to the oil seal lip being worn out.
 - Depressurize the gear case and cover the oil plug area with a piece of rag before disconnecting the leakage tester.
- 4. If the specified pressure cannot be maintained, check the oil seals of the drive shaft and propeller shaft and the O-ring of the shift shaft for any damage.

11) Inspection of Timing Belt

- 1. Remove the starter lock cable ① and recoil starter ② (3 bolts).



2. Disconnect the vent hose (3) and remove the belt cover (4).

3. Check the timing belt inner and outer surfaces for cracks, damage, and wear while rotating the flywheel clockwise with your hands. Replace if necessary.







12) Replacement of Timing Belt

- 1. Remove the recoil starter and belt cover.
- $2. \quad \ \ \text{Remove the starter pulley }).$

3. Using the flywheel puller kit ②, loosen the flywheel bolt and remove it.



Flywheel Puller Kit (2): P/N. 3T1-72211-4







4. Using the flywheel puller kit ② as shown in the figure on the right, remove the flywheel ③ and key.



Screw the puller onto the end of the crankshaft until the flywheel is disengaged from the tapered section of the crankshaft.



② Flywheel Puller Kit
 ③ Flywheel Puller Plate
 ⑤ Flywheel Puller Plate
 ⓒ Spacer

③ Flywheel



▲ CAUTION

To prevent damage to the engine and special tools, tighten the flywheel puller set bolts evenly and keep the flywheel puller parallel to the flywheel while working.



5. Disconnect the alternator assembly coupler and remove the alternator assembly ④.



- 6. Disconnect the pulse coil connector (5) and remove the fuse holder (6), battery cable (7), and ground lead wire (8).
- 7. Remove the coil bracket assembly (9).



Turn the drive pulley 10 in the clockwise direction, and 8. align the " \blacktriangle " mark (d) of the drive pulley with the " \blacktriangle " mark (e) of the cylinder block. Then, make sure that the " $\bullet I$ " mark (f) of the driven pulley (f) and the "▲" mark (g) of the cylinder head align.



The No.1 cylinder should be at the top dead center of the compression stroke.

Crank Shaft Holder: P/N. 3BJ-72815-0



9. Remove the timing belt 12.



Remove the timing belt from the driven pulley side, and then remove it.

▲ CAUTION

Do not turn the drive pulley (crank shaft) or driven pulley with the timing belt removed. Doing so can make the pistons and valves interfere with each other, possibly resulting in damage to these parts.



Maintenance

 Make sure that the "●I" mark ① of the driven pulley ① and the "▲" mark ③ of the cylinder head align.

 Make sure that the "▲" mark ⓓ of the drive pulley ⑩ and the "▲" mark ⓔ of the cylinder block align.





12. Install a new timing belt (13).

- Be careful not to damage the timing belt while installing.
- Do not twist the timing belt, turn it inside out, or bend it sharply as it may be damaged.
- Be careful not to allow oil or grease to stain the timing belt.



Install the timing belt with the part no. at the top.Install the timing belt from the drive pulley side, and then install it.

 Turn the crankshaft full rotations in the clockwise direction, and check that the matching marks of the pulleys are aligned.



Check that the crankshaft turns smoothly.

- - Make sure that the "OI" mark (f) of the driven pulley and the "A" mark (g) of the cylinder head align.





- 14. Install the coil bracket assembly (9).
- Install the ground lead wire (a), battery cable (7) as well as fuse holder (6) and connect the pulser coil connector (5).





16. Install the alternator assembly ④ and connect the alternator assembly coupler.

17. Install the key in the crankshaft, then install the flywheel ③, washer, and flywheel bolt.



- Degrease the tapered sections of the crankshaft and flywheel.
- Align the positions of the key and key groove of the flywheel to install the flywheel.
- Use the flywheel puller kit (2) to tighten the flywheel bolt to the specified torque.



- 19. Install the starter pulley (1).
- 20. Install the belt cover and coil starter.





Maintenance

13) Inspection of Spark Plugs

1. Remove the plug caps (1), then remove the spark plugs (2).



- 2. Use a spark plug cleaner or wire brush to clean the spark plug electrodes ③. Replace if necessary.
- Check the electrode for any corrosion or excessive buildup of carbon, and the washer ④ for any damage. Replace if necessary.



4. Check the gap (a) of the spark plug. Replace if it is over the specified value. Adjust the gap if it is less than specified value.



5. Install the spark plug, tighten it fully by hand, then use a plug wrench to further tighten it to the specified torque.







14) Inspection of Compression Pressure

- 1. Start the engine to warm up for 5 minutes, then stop the engine.
- 2. Shift the gear into the Neutral (N) position.
- 3. Remove lock plate (stop switch lanyard) from stop switch.

▲ CAUTION

Remove lock plate (stop switch lanyard) from stop switch before measuring compression pressure. This will prevent engine from accidental starting.

4. Remove all plug caps and then all spark plugs.

Clean the areas around the spark plugs on the cylinder before removing the spark plugs to prevent dirt from entering the cylinder.

5. Install the compression gauge (1) into the plug hole.

Compression Gauge (1: P/N. 3AC-99030-0

 Fully open the throttle and crank the engine until the compression gauge indication stabilizes, then measure the compression pressure.



Compression Pressure (Reference): at 500 r/min with decompresser : 0.50 MPa (73 psi) [5.1 kgf/cm³] without decompresser: 1.40 MPa (203 psi) [14.3 kgf/cm³]

- Compression pressure is greatly affected by the cranking speed, and normally varies by about 10% to 20%.
- For remote control model: Remove the cable joint and fully open the throttle cam with your hand, then measure the compression pressure.
- If the compression pressure is below the specified value or varies a lot among the cylinders, pour a small amount of engine oil into the cylinders and perform the compression test again.



 If the compression pressure increases after the above measure, check the pistons and piston rings for wear. Replace if necessary.

 If the compression pressure does not increase after the above measure, check the valve clearances, valves, valve seats, cylinder sleeves, cylinder head gasket and cylinder head. Adjust or replace if necessary.









A Basic Tiller Handle Model
 B Multi-Function Tiller Handle Model
 C Remote Control Model



15) Inspection and Adjustment of Valve

Clearance

- Perform inspection and adjustment of valve clearances when engine is cold.
 - Be sure to perform inspection and adjustment of valve clearances while the cylinder head bolt is tightened.
 - The No.1 cylinder should be at the top dead center of the compression stroke.
- 1. Remove the starter lock cable, recoil starter, belt cover, and spark plug.
- 2. Remove the cylinder head cover.
- 3. Turn the flywheel in the clockwise direction to align the "●I" mark ⓐ of the driven pulley ① with the "▲" mark ⓑ of the cylinder head.
- 4. Inspect and adjust the air intake and exhaust valve clearance of the #1 cylinder.
 - Insert a thickness gauge between the end of the valve ② and adjustment screw ③ ⓒ and check the valve clearance.
 - Loosen the lock nut ④ if the clearance is outside the specified range.
 - · Adjust the valve clearance with the adjustment screw.
 - · Tighten the lock nuts.
 - · Check the valve clearance.

Valve Clearance:

Intake valve : 0.10-0.15 mm (0.0040-0.0060 in) Exhaust valve: 0.20-0.24 mm (0.0080-0.0095 in)

- When loosening or tightening the lock nut, fasten the adjustment screw with the valve clearance driver (5).
 - Be sure to use the torque wrench 6.



Valve Clearance Driver (5): P/N. 3AC-99071-0 Torque Wrench (6): P/N. 3AC-99070-0 Thickness Gauge (7): P/N. 353-72251-1

- Turn the flywheel in the clockwise direction to align the "III" mark of the driven pulley ① with the "▲" mark ⓑ of the cylinder head.
- 6. Check and adjust No. 3 cylinder's valve clearances in the same procedure as No. 1 cylinder.
- Turn the flywheel in the clockwise direction to align the "II" mark of the driven pulley ① with the "▲" mark ⓑ of the cylinder head.
- 8. Check and adjust No. 2 cylinder's valve clearances in the same procedure as No. 1 cylinder.



① Driven Pulley





(5) Valve Clearance Driver (Concaved Tip, Square, Width Between Two Opposing Sides: 3 mm)

(6) Torque Wrench (10 mm tip wrench)

⑦ Thickness Gauge

1. Set the throttle grip to its fully closed position.

- Adjust the throttle cable ③ and tighten the nut ④ so that the stopper ③ of the throttle drum ① contacts the stopper ⑤ of the throttle cable bracket ②.
 - Adjust cable tension so that the cable moves approximately 2 to 3 mm when pushed lightly with a finger.
- 3. Set the throttle grip to its fully open position.

Check that the stopper (c) of the throttle drum contacts the stopper (d) of the throttle cable bracket (2).
 If not contacting, adjust the throttle cable (5) and tighten the nut (6).





(a)

 $(\mathbf{1})$

(b)

0





 Install the throttle link ⑦ on the throttle drum. Check that the stopper (e) of the throttle valve contacts the stopper (f) of the throttle body ⑧.

If not contacting, check standard length of throttle link.

6. Turn the throttle grip to its fully open and fully closed positions several times to check.



Shift operations cannot be carried out unless the throttle is fully closed. Operating it incorrectly may cause damage.

- 1. Remove the top cowl and remove the stay cover (1).
- 2. Turn the shift lever (2) to the neutral position.







3. Remove cable joint (3).

5

5. Adjust the screw-in amount of the cable joint ③ so that the hole of the cable joint is aligned with the throttle arm and shift arm pin ⓐ.

Turn the shift arm ④ to the Forward (F), Neutral (N)

or Reverse (R) position, then turn it to the Neutral (N)

position after confirming the position.

4.

⚠ WARNING

Screw in a minimum of 10 mm (0.39 in) of the cable joint.

- The cable joint is shipped together with the outboard motor in the packing box.
- When adjusting the cable joint, adjust it with the cable fully pushed in.

6. Tighten the nut (5) and install the cable joint on the pin before securing it with a washer and R pin (6).

 Operate the shift lever (2) and check whether it moves to the Forward (F), Neutral (N) and Reverse (R) positions.



Ν

(4)

(a)





Maintenance

8. Set the throttle grip to its fully open position and check that the stopper ⓒ of the throttle arm contacts with the projection ⓓ on the crankcase.

Next, check that the throttle body on the outboard motor side is fully closed when the throttle grip is returned to its original position. If the throttle valve is not fully closed, readjust the cable joint ③ position on the outboard motor side and reinstall it.

9. Check if the throttle valve operates smoothly, and repeat Steps 1 to 8 where necessary.





10. Install the stay cover 1 and then install the top cowl.



18) Adjustment of Shift · Throttle Cable (Remote Control Model)

▲ CAUTION

Shift operations cannot be carried out unless the throttle is fully closed. Operating it unreasonably may cause damage.

- 1. Remove the top cowl and remove the stay cover ①.
- 2. Set the control lever (2) to the neutral position.





3. Remove cable joint ③.

4. Turn the shift arm ④ to the Forward (F), Neutral (N) or Reverse (R) position, then turn it to the Neutral (N) position after confirming the position.





Maintenance

5. Adjust the screw-in amount of the cable joint so that the hole of the cable joint ③ is aligned with the throttle arm and shift arm ④ pin ⓐ.

Screw in a minimum of 10 mm (0.39 in) $\textcircled{}_{\mathrm{b}}$ of the cable joint.



- The cable joint is shipped together with the outboard motor in the packing box.
- When adjusting the cable joint, adjust it with the cable fully pushed in.





6. Tighten the nut (5) and install the cable joint on the pin before securing it with a washer and R pin (6).







Lower the control lever (2) to the Forward (F) side until the engine stops (at approx. 32°) and check that the outboard motor shifts in. Lower the lever further and check that the stopper (c) of the throttle arm contacts with the projection (d) on the crankcase.

Next, check that the throttle valve is fully closed when the control lever is returned to the neutral position (N). If the throttle valve is not fully closed, readjust the position of the cable joint ③ on the outboard motor side and reinstall it.

9. Check if the throttle valve operates smoothly, and repeat Steps 2 to 7 where necessary.





10. Install the stay cover (1) and then install the top cowl.





19) Inspection of Shift Lever Gear

Operations

Shift the gear from neutral (N) to forward (F) or reverse (R) and check that the gear changes smoothly. Adjust the position of the shift arm (1) and the joint position of the shift rod as well as the cam rod if necessary.

- 1. Remove the cable joint.
- 2. Remove the shift rod joint retainer (2).
- Remove the spring pin then disconnect the shift rod. Remove the shift rod joint ③.



- Use the spring pin tool A 4 to remove it.

• The spring pin cannot be reused once it is removed.



Spring Pin Tool A ④: P/N. 345-72227-0

4. Set the shift arm to the forward position.







- Align the cam rod (5) to the forward position, turn the shift rod joint so that the hole for the shift rod and the part to insert the shift rod (6) are at the same position (a).
- 6. Attach the spring pin then install the shift rod joint retainer.



Apply a thin coat of water-resistant grease on the shift rod joint retainer.

 Adjust the length so that the position of the hole of the cable joint (7) aligns with the pin of the throttle arm and shift arm. (Multi-Function Tiller Handle Control Model, Remote Control Model)

Screw in a minimum of 10 mm (0.39 in) $\textcircled{}_{\mathrm{O}}$ of the cable joint.



When adjusting the cable joint, adjust it with the cable fully pushed in.

- 8. Connect the cable joint, attach the washer and R pin (8), and tighten the lock nut (9). (Multi-Function Tiller Handle Control Model, Remote Control Model)
- 9. Check if the gear shifts smoothly, and repeat Steps 2 to 6 where necessary.

20) Inspection of PT Unit Operation

1. Tilt up and down the outboard motor several times to check that the manual tilt operates smoothly throughout the entire range. Check the PT fluid level where necessary. Refer to "Inspection of PT Fluid Quantity" described in the next page.

> Check that the PT motor produces a smooth rotating sound.

2. Fully tilt up the outboard motor and support it with the tilt stopper (1) to check whether the locking mechanism of the tilt stopper is working normally.

- 21) Inspection of Gas Shock Absorber Operation
- 1. Tilt up and down the outboard motor several times to check that the manual tilt operates smoothly throughout the entire range.
- 2. Fully tilt up the outboard motor and support it with the tilt stopper (1) to check whether the locking mechanism of the tilt stopper is working normally.











Maintenance

 Tilt up the outboard motor adequately and set the lock lever ② to the locking position to check that the manual holding mechanism of gas shock absorber ③ functions normally.

If any problem is found as a result of the inspection, replace the gas shock absorber. The gas shock absorber cannot be disassembled.



22) Inspection of Manual Tilt Operations

- 1. Tilt up and down the outboard motor several times to check that the manual tilt operates smoothly throughout the entire range.
- 2. Fully tilt up the outboard motor and support it with the tilt stopper to check whether the locking mechanism of the stopper is working normally.



23) Inspection of PT Fluid Quantity

1. Fully tilt up the outboard motor and support it with the tilt stopper ①.

Be sure to lock the outboard motor with the tilt stopper after it is fully tilted up. Leaving the outboard motor without locking it is dangerous as it may suddenly lower due to a reduction of PT hydraulic pressure.

2. Remove the reserve tank cap (2) and check the quantity of PT fluid contained in the tank.

Check the PT fluid level with the outboard motor fully tilted up. Removing the reserve tank cap at halfway position can cause expulsion of PT fluid, which is dangerous, and can also result in inaccurate fluid level reading.



Fill with PT fluid until some of the fluid spills out of the oil filler hole when the cap is removed.





3. If the PT fluid level is insufficient, replenish the PT fluid to the prescribed level.



4. Attach the reserve tank cap and tighten it to the specified torque.



24) Inspection of Idle Speed

- 1. Start the engine and run for 5 minutes to warm up.
- 2. Check the idle speed using a tachometer or diagnostic tool.



Idle Revolution Speed: 850 min⁻¹ (rpm)



25) Inspection of Ignition Timing

Adjustment method: Automatic control. No adjustment required.

Run the engine and use a timing light to check the ignition timing.

11 timing marks are found on the side of the flywheel (TDC0°, ATDC5°, 10°, BTDC5°, 10°, 15°, 20°, 25°, 30°, 35°, 40°), so the ignition timing is read from the mark in the center of the starter case window.



Model	Range of Ignition Angle	Engine Starting	Idling
MFS25D	ATDC3° - BTDC24°	BTDC5°	ATDC3°
MFS30D	ATDC3° - BTDC28°	BTDC 5°	ATDC3°



26) Inspection of Anodes

CAUTION

Do not coat the anode or trim tab with oil, grease or paint, or their anti-galvanic corrosion function will not work normally.

When it is necessary to disassemble the outboard motor to inspect the anode, refer to the disassembly procedure described in this manual.

Inspection of Exterior

- Check the anode and trim tab for buildup of scale and staining by grease and oil. Clean or replace if necessary.
- 2. Replace the anode and/or trim tab if they are corroded excessively.

Inspection of Conductivity

If the anode is not getting smaller, there is a possibility that conductivity is not being maintained correctly. Follow the procedure below to check the anode.

- 1. Check the grounding of the outboard motor and conductivity of the anode surface with a tester.
- If the resistance is very small or none at all, it means that the anode is installed correctly.
 If the resistance is large, remove the mounting bolts and after cleaning the screw thread and screw hole, install and inspect the anode again.



For the cooling water passage anode (cylindrical shape), check the conductivity between the ground of the outboard motor and anode bracket.



27) Replacement of Anodes

Anodes protect the outboard motor from galvanic corrosion (corrosion of metal due to very weak electric current).

Anodes are used in the gear case, mount rubber (lower), swivel bracket, clamp bracket, PT unit assy, and power unit.

Replace an anode if the size is reduced to 2/3 that of a new one.

· Do not coat the anodes with oil or paint.

 Since the area around the anode installation bolts will be corroded more than the other areas, be sure to retighten the bolts at every inspection.

28) Replacement of Cooling Water Passage Anode (Cylindrical Shape)

1. Remove the screw ① from the anode plug, then remove the anode ②.



- Clean the screw locking agent remaining on the screw thread of the screw tip and clean each contact surface of the anode plug.
- 3. Install a new anode ③ in the anode plug and tighten the screw to the specified torque.



• Install the anode with the smaller diameter end facing the screw.

• Apply a screw locking agent (ThreeBond 1342) to the screw.

X

Anode Screw: 2.5 N · m (1.84 lb · ft) [0.25 kgf · m]

4. Install a new O-ring ④ and install the anode plug on the outboard motor.



Apply a thin coat of water-resistant grease on the O-ring.



Anode Plug: 18 N · m (13 lb · ft) [1.8 kgf · m]



④ O-ring Do not reuse.



29) Inspection of Propeller

1. Check the propeller blades and splines for cracks, damage, wear, and corrosion. Replace if necessary.



30) Inspection of Thermostat

1. Remove the thermostat cover ① and gasket ②, then remove the thermostat ③.



- 2. Hang the thermostat in a vessel containing water.
- 3. Put thermometer in the water, and warm up water to measure valve opening temperature.





Valve Opening Temperature:

60°C (140°F) (The valve starts to open.)

 Measure valve lift of thermostat when prescribed temperature has been reached. Replace if it is less than the specified value.



5. Install the thermostat, new gasket, and thermostat cover.



Thermostat Cover Bolt : 9 N·m (6.6 lb·ft) [0.9 kgf·m]





Check the water strainer (1) for clogging. Clean if 1. necessary.

- 2. Place the outboard motor in the water and start the engine.
- 3. Check that cooling water is discharged from cooling water check port 2. If not, check the water pump and cooling water passage in the engine.

32) Inspection of Cooling Water Pressure

- 1. Measure the cooling water pressure with putting a T-fitting for pilot tube of pressure gauge on the cooling water hose between the fuel cooler and cooling water check port.
- 2. Start the engine and check the water pressure at each engine speed.

Engine

Rotation

min⁻¹ (rpm)	kPa	psi	kgf/cm ²
850	15	2.18	0.153
1500	30	4.35	0.306
3000	60	8.7	0.612
5000	70	10.15	0.714
6000	70	10.15	0.714



Shown water pressure values are reference.

Water Pressure (Reference)

З. Check the water pump and cooling water passages inside the engine if the water pressure is very low.





(2)

2 Drive Shaft Housing Nipple ③ Water Check Port



3





33) Flushing with Water

Exhaust gas contains carbon monoxide, which may result in gas poisoning. Do not start the engine with the outboard motor placed in an enclosed area such as a boat house etc.

Touching a rotating propeller may lead to injury.

Be sure to remove the propeller before running the engine on land.

Flushing with water using the gear case flushing device

- 1. With the propeller and thrust holder removed, seal the sub-water inlet ① with a tape ② to prevent air from being sucked into the water pump.
- 2. Attach the gear case flushing device ③ to the water strainer ④ area.
- 3. Insert the water hose into the gear case flushing device and turn on water supply.
- 4. Set gear shift to neutral (N) and start engine.
- 5. Check that the cooling water check port discharges water, and run engine for 3 to 5 minutes at idle speed.
- 6. Stop the engine and water supply, then remove gear case flushing device and tape and install the thrust holder and propeller.

Flushing with water using a hose joint

- 1. Tilt down the outboard motor.
- 2. Remove the flushing connector cap ① from the outboard motor, and screw in the hose joint ②.
- Connect a water hose to the hose joint. Turn on the water and adjust the flow. Continue flushing the outboard motor for 3 to 5 minutes.

▲ CAUTION

Do not operate the engine.

- 4. Remove hose joint.
- 5. Check for damage or crack in the seal ③ and O-ring ④, then install flushing connector cap.

Cooling water leaks may lead to the engine overheating.

Be sure to reattach the flushing connector cap.









34) Inspection of Battery

- Inspect the electrolyte level. If it is lower than the "LOW" mark (a), add distilled water until the level is between the "UP" and "LOW" marks.
- 2. Measure the specific gravity of the electrolyte. Fully charge the battery if the specific gravity is less than the specified value.

⚠ WARNING

The battery produces highly inflammable hydrogen gas.

- Charge the battery in a well-ventilated place.
- Do not allow smoking when handling or charging battery. Keep the battery away from sparks and fire.

Do not charge the battery when the electrolyte drops below the specified level. The battery may deteriorate faster, or it may result in a failure or accident.
Do not subject the battery to impact.

The battery electrolyte contains sulfuric acid and is extremely dangerous as it can cause burns if it contacts the eyes or skin. Wear protective glasses when working near the battery or when handling the battery. Always take the following precautions when handling the battery to prevent accidents.

- Read the instruction manual of the battery and the operating precautions carefully.
- Keep the battery and electrolyte out of the reach of children.
- Be extra careful so as not to let the electrolyte adhere to your body.

First Aid in Emergency (if electrolyte adheres to the body)

- Flush well with fresh water if adhered to skin. If gets in eye, flush well with fresh water for 15 minutes, and have doctor's evaluation immediately.
- First Aid in Emergency (if swallowed)
- Drink lots of water or milk, and seek medical treatment immediately.
 - Many types of batteries are available, which differ depending on the manufacturer. If you have any doubts or questions, refer to the manual attached to the battery as well.
 - When removing the battery, disconnect the negative lead first followed by the positive lead.

Recommended Battery:

12V 64AH/5HR

(Below freezing temperature: 12V 70AH/20HR, 512CCA)

S S

Specific Gravity of Electrolyte: 1.280 (at 20°C)







35) Grease points

Apply water proof grease to the parts shown below or pour it via grease nipples.



Fuel System (Fuel Injection)



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1. Special Tools

			A CONTRACT OF CONTRACT.
	Vacuum/Pressure Gauge P/N. 3AC-99020-1	Pressure Gauge Assembly P/N. 3T5-72880-0	Tachometer P/N. 3AC-99010-0
Inspection of pressure		Measurement of fuel pressure	Measurement of engine revolution speed

2. Piping Arrangement Diagram Fuel Hose, Vent Hose, Breather Hose, Cooling Water Hose



Ref. No.	Parts Name
1	Fuel Hose (Fuel Connector \rightarrow Fuel Filter)
2	Fuel Hose (Fuel Filter → Fuel Pump)
3	Fuel Hose (Fuel Pump \rightarrow Vapor Separator)
(4)	Breather Hose (Cylinder Head \rightarrow Intake Silencer)
5	Breather Hose (Cylinder Head \rightarrow Cylinder Block)
6	Cooling Water Hose (Engine Base \rightarrow Fuel Cooler)
\bigcirc	Cooling Water Hose (Fuel Cooler \rightarrow Cooling Water Check Port)
8	High Pressure Fuel Hose (Vapor Separator \rightarrow Fuel Rail)

3. Parts Layout

Intake Manifold



Ref. No.	Parts Name	Q'ty	Remarks
1	Intake Manifold	1	
2	Gasket	1	Do not reuse.
3	Throttle Body Assy	1	
4	Bolt	2	
5	Gasket	1	Do not reuse.
6	Intake Silencer Assy	1	
7	Bolt	2	
8	Fuel Rail	1	
9	O-ring 1.9-9.8	2	Do not reuse.
10	Valve Assy (Pressure Check)	1	
11	Сар	1	
12	Nipple	1	
13	Holding Plate	1	
14	Bolt	1	
15	Fuel Injector Assy	3	
16	Seal Ring	3	Do not reuse.
17	Bolt	2	
18	MAP Sensor	1	
19	Tapping Screw	2	
20	Intake Silencer Cover	1	
21	Air Filter	1	
22	Tapping Screw	4	
23	ISC Valve	1	
24	Washer	1	
25	Nut	1	
26	Band	1	
27	Tapping Screw	1	
28	Hose	1	8-12_L=45
29	Hose	1	8-12_L=205_40
30	Intake Manifold Gasket	3	Do not reuse.
31	Bracket	1	
32	Bolt	1	
33	Bolt	6	
34	Vent Hose W/Protector	1	
35	Vent Hose W/Protector	1	
36	Band	2	
37	ISC Valve Stay	1	
38	Vent Hose W/Protector	1	



Fuel System


Ref. No.	Parts Name	Q'ty	Remarks
1	Vapor Separator Assy	1	
2	Cover	1	
3	Seal	1	
4	Screw	4	
5	Drain Screw	1	
6	Gasket	1	Do not reuse.
7	Float Valve Assy	1	
8	Float Arm Pin	1	
9	Float	1	
10	Grommet	1	
11	Filter (Inlet)	1	
12	Holder	1	
13	Fuel Feed Pump	1	
14	O-ring	1	Do not reuse.
15	O-ring	1	Do not reuse.
16	O-ring	1	Do not reuse.
17	Fuel Regulator	1	
18	Screw	1	
19	VST Connector	1	
20	Clip	1	
21	Screw	4	
22	Washer 6-16-1.5	2	
23	Rubber Mount	2	
24	Collar	2	
25	Bolt	2	
26	Plate	1	
27	Fuel Filter Assy	1	
28	Cup	1	
29	Filter	1	
30	O-ring	1	Do not reuse.
31	O-ring	1	Do not reuse.
32	Drain Valve	1	
33	Seal	1	Do not reuse.
34	Float	1	
35	Bolt	1	
36	Fuel Filter Holder	1	
37	Fuel Pump Assy	1	
38	O-ring 3.5-25.7	1	Do not reuse.
39	Bolt	2	
40-1	Fuel Hose	1	
40-2	Fuel Hose W/Protector	1	



Ref. No.	Parts Name	Q'ty	Remarks
41	Сlip Ф9.4	2	
42	Сlip Ф9.4	2	
43-1	Fuel Hose W/Protector	1	
43-2	Fuel Hose W/Protector	1	
44	Water Hose	1	
45	Water Hose	1	
46-1	Fuel Hose W/Protector	1	
46-2	Fuel Hose W/Protector	1	
47	Сlip Ф9.4	2	
48	Fuel Hose W/Protector	1	
49	Clamp Φ16.8	2	
50	Сlip Ф9.4	1	
51	Adapter Cord	1	L=200
52-1	Fuel Hose W/Protector	1	
52-2	Fuel Hose W/Protector	1	
53	Fuel Hose Joint	1	
54	Plug	1	
55	Band	1	Do not reuse.



Magneto



	1		
Ref. No.	Parts Name	Q'ty	Remarks
1	Flywheel W/Gear	1	
2-1	Alternator Assy	1	
2-2	Alternator Assy	1	
3	Key 13.4-5-4	1	
4	Bolt	1	
5	Washer	1	13-26-3.2
6	Bolt	3	
7	Starter Pulley	1	
8	Bolt	3	
9	Coil Bracket	1	
10	Bolt	4	
11	Pulsar Coil	1	
12	Pulsar Coil	1	
13	Bolt	4	
14	Starter Lock Cable Bracket	1	
15	Bolt	1	
16	Cable Terminal Holder	1	
17	Bolt	2	
18	Fuse Holder Bracket	1	
19	Screw	2	
20	Bracket	1	
21	Bolt	2	
22	Ignition Coil W/R-cap	3	
23	Plug Cap W/Resistance	1	
24	Bolt	3	
25	Dowel Pin 6-12	2	
26	ECU Cord Assy	1	
27	Plug	1	
28	Plug	1	
29	Cable Terminal Plug	1	
30	Fuse 20A	1	
31	Cap (Y)	1	
32	Grommet	1	
33	ECU Cord Assy	1	
34	Bolt	2	
35	Band	2	
36	Band	2	
37	Band	1	Do not reuse.
38	Bolt	1	
39	Plug	1	



Electrical Parts



Ref. No.	Parts Name	Q'ty	Remarks
1	Oil Pressure Switch	1	
2	Rectifier Complete	1	
3	Cover	1	
4	Bolt	2	
5	Starter Motor Assy	1	
6	Pinion Assy	1	
7	Washer	1	
8	Brush Holder Assy	1	
9	Screw	2	
10	Bushing 2	1	
11	O-ring	1	Do not reuse.
12	Bushing 1	1	
13	Washer	2	
14	Spring Washer	2	
15	Nut	2	
16	Bolt	2	
17	Spring Washer	2	
18	Washer	2	
19	Bolt	2	
20	Starter Motor Band	1	
21	Damper	1	
22	Bolt	2	
23	Battery Cable L=2500	1	
24	Terminal Cap	1	
25	Terminal Cap	1	
26	Starter Cable	1	
27	Terminal Cap	1	
28	Bolt	1	
29	Electric Bracket	1	
30	Starter Solenoid	1	
31	Bolt	2	
32	Bolt	1	
33	Bolt	1	
34	Plate	1	
35	Mount	1	
36	Relay	2	
37	Clip	2	
38	Adapter Cord	1	
39	Rubber Mount	3	
40	Collar	3	



Ref. No.	Parts Name	Q'ty	Remarks
41	Bolt		
42	Washer	5	6-16-1.5
43	Rubber Mount	2	
44	Collar	2	
45	Plate	1	
46	Bolt	2	
47	Plate	1	
49	Band	3	
50	Engine Temp Sensor	1	
51-1	ECU Assy (25DO)	1	
51-2	2 ECU Assy (30DO) 3 ECU Assy (25)	1	
51-3		1	
51-4	ECU Assy (30)	1	
52	Bolt	1	
53	Washer	2	6-16-1.5
54	Spacer	1	6.2-9-27
55	Bolt	1	
56	Band	1	Do not reuse.
57	Band	1	Do not reuse.
58	Band	2	Do not reuse.
59	Band	1	
60	Bolt	1	
61	Bolt	1	



Fuel Tank



Ref. No.	Parts Name	Q'ty	Remarks
1	Primer Bulb Assy		
2	Joint Assy (Inlet) Joint Assy (Outlet)		
3			
4	Primer Bulb	1	
5	Clamp	2	
6	Hose	1	
7	Hose Fuel Connector		
8			
9	Fuel Connector	1	
10	Clamp	4	
11	Primer Bulb Assy W/Band	1	
12	Band	1	Do not reuse.
13	Fuel Tank Assy 25L	1	
15	Tank Filler Cap Gasket	1	Do not reuse.
16	Quick-Connector (Male)	1	
17	Fuel Pick-Up Assy W/Gauge	1	
18	Screw	4	
19	Washer	4	
20	Gasket	1	Do not reuse.

Fuel System (Fuel Injection)

4. ECU System

(1) Configuration of ECU System

The ECU uses various sensors to precisely control the injected fuel amount and ignition timing.



① Fuel Tank

Individual sensors detect the engine operating conditions and sends signals regarding the information to the ECU.

1. Pulser Coil [Crank Position Sensor]

Pulser coils function as crank position sensors. As the flywheel rotates, two pulser coils sense the flywheel's crank position in 120° and sends a crank position signal to the ECU.

The ECU uses this signal to confirm the fuel injection amount and ignition timing.

 T-MAP (Manifold Pressure and Temperature) Sensor The T-MAP sensor is located on the upper area of the intake manifold to detect the intake manifold inner pressure (intake vacuum pressure) and intake air temperature and send the signal to the ECU.
 The ECU uses this signal to confirm the fuel injection

The ECU uses this signal to confirm the fuel injection amount and ignition timing.



3. Engine Temperature Sensor

The engine temperature sensor located in the upper part of the engine cylinder measures the block temperature of the cooling water passage passing through the engine which is controlled by a thermostat, and sends a signal to the ECU.

The ECU uses this information to correct the fuel injection.

4. Throttle Position Sensor (TPS)

The throttle position sensor is located on top of the throttle body, and is connected to the throttle shaft. The throttle position sensor sends throttle opening angle information to the ECU.

The ECU uses this information for fuel injection compensation, ignition timing compensation, idling control and ISC control.





5. Oil Pressure Switch

The oil pressure switch is located on the port side of the engine block, protruding into the oil passage. The oil pressure switch sends an oil pressure low signal to the ECU.

The ECU activates the low speed ESG and warning lamp based on this information.



2) Actuators

The actuator receives signals from the ECU to control the air/fuel ratio, ignition advance angle and idle revolution speed.

1. ISC (Idle Speed Control) Valve

ISC is also referred to as IAC (Idle Air Control). The ISC valve is a solenoid valve with a built-in spring that is operated electrically to control the air intake quantity that bypasses the closed throttle valve. The opening of the ISC valve varies between 0% to 100% to control the following three functions according to signals from the ECU.

- 1. Increase the idle revolution speed during engine warmup by increasing the air intake when starting the engine.
- 2. Control the idle revolution speed according to varying engine load and operating conditions.
- Prevent the engine from stalling by increasing the air intake (bypass) to function as a dash pot when the throttle is closed quickly e.g. during sudden deceleration etc.
- 2. Fuel Injector

The fuel injector is a solenoid valve with a built-in spring that is operated electrically to feed fuel into the intake manifold passage. Electricity is supplied from the ECU to the injector, and high pressure fuel is injected by the ECU closing the ground circuit and lifting the solenoid. The fuel injector closes to stop injecting fuel when the ECU opens the ground circuit.

3. Fuel Feed Pump (FFP)

Refer to the description of the vapor separator in Chapter 4.





If the ECU (Engine Control Unit) fails, the engine stops.

The ECU provides the following functions.

- 1. Calculates the most suitable fuel injection amount and ignition timing based on the engine revolution speed, throttle position, intake vacuum, intake air temperature and engine temperature.
- 2. Controls the fuel injectors, ignition coils and ISC (Idle Speed Control) valve.
- 3. Controls the warning lamp (LED).
- 4. Controls the engine low speed ESG function.
- 5. Controls the engine high speed ESG function.
- 6. Memorizes engine operation information.

Monitoring and failure diagnosis can be carried out using a PC on which TOHATSU DIAGNOSTICS (software) is installed and diagnostics harness.

(2) Control System

The ECU (Electronic Control Unit) is installed in the cylinder block via a bracket. Data received from sensors such as pulser coil, T-MAP (Manifold Pressure, Manifold Temperature) sensor and engine temperature sensor are processed in a computer to drive the actuators (fuel injectors, ISC valves, etc.) and control the fuel injection amount and ignition timing according to the operating conditions then.

The principal control items are as follows.

Control Item	Control Description
Ignition Timing	Sets the most suitable ignition timing according to the current operating conditions.
Fuel Injection Amount	Sets the most suitable fuel injection amount according to the current operating conditions.
ISC	Stabilizes the engine revolution speed during idling or low speed running by actuating
(Idle Speed Control)	the ISC valve to control the air flow in the bypass passage.
Fuel Feed Pump	Controls the actuation of the fuel feed pump (FFP).
Tachometer	Outputs the tachometer actuation pulses.
	Per Crankshaft Rotation (6 Pulses) (12 Poles)
Warning Buzzer*1	Emits a warning sound when an error is detected.
	Only for 0.5 seconds after starting: Indicates that system operation is normal and there
	is no problem.
	 Continuous sound: When engine high speed ESG is "ON"
	When the engine temperature is abnormally high (85°C or higher)
	When engine oil pressure is abnormally low
	Intermittent sound: When water temperature sensor or T-Map (Manifold Pressure)
	sensor is defective or sensor circuit is disconnected.
Warning Lamp (LED)	The lamp lights or flashes when an error is detected.
(The tachometer warning	Lit only for 5 seconds after starting: Indicates that system operation is normal and there
lamp synchronizes	is no problem.
and lights or flashes	Lit : When engine high speed ESG is "ON"
accordingly.)	When the engine temperature is abnormally high (95°C or higher)
	When engine oil pressure is abnormally low
	• Flashing: Failure of the engine temperature sensor or T-MAP (manifold pressure, intake
	air temperature) sensor is defective or circuit disconnection
Memorizing operational	Manages the following engine operation information:
data	Engine operating hours
	Maximum water temperature record (Maximum water temperature and time of occurrence)
	Engine high speed ESG operation record
	Engine low speed ESG operation record
	Malfunction records

*1: Only for Remote Control Models

Fuel System (Fuel Injection)

(3) Fuel Injection Control

The ECU calculates the intake air quantity based on the engine revolution speed and intake manifold pressure (intake vacuum pressure) to determine the fuel injection amount.

During engine startup, warm-up, acceleration/deceleration, and idling, the ECU performs correction control based on information from the sensors.



1) Fuel Injection Timing

Fuel injection timing at starting and during normal operation are described in the following table.

Cylinder No.	Reference Signal	Injection Timing (with reference to individual cylinders)
1	#1 Crank Angle Signal	BTDC 365° and BTDC 5°
2	#2 Crank Angle Signal	BTDC 365° and BTDC 5°
3	#3 Crank Angle Signal	BTDC 365° and BTDC 5°

Remarks: 1) No. of fuel injections : Once per revolution of each cylinder (around the end of the compression and exhaust strokes)

2) Injection sequence : $\#1 \rightarrow \#2 \rightarrow \#3 \rightarrow \#1 \rightarrow \#2 \rightarrow \#3 \rightarrow \#1$ (for every 120° of the crank angle)

3) Combustion sequence : $\#1 \rightarrow \#3 \rightarrow \#2 \rightarrow \#1$ (for every 240° of the crank angle)

4) Injection timing diagram is shown below.



Injection Timing Diagram

2) Start Up Fuel Mapping

When the engine is started (cranked), the amount of fuel injected by each cylinder is increased from the normal quantity to improve the starting performance.

In addition, the block temperature and other information is obtained from the various sensors and corrected to the optimum condition.

3) Acceleration Fuel Mapping

When the change in the throttle opening exceeds a certain set value, the ECU determines that the engine revolution speed is being increased and so it increases the fuel injection amount.

4) Deceleration Fuel Mapping

When the change in the throttle opening exceeds a certain set value, the ECU determines that the engine revolution speed is being decreased and so it decreases the fuel injection amount.

5) Correction Based On Intake Air Temperature

The ECU adjusts and corrects the fuel injection amount relative to the manifold intake air temperature, which differs greatly depending on the outboard motor operating conditions and whether the engine is cold or warm.

6) Engine Temperature Correction

Similar to the correction upon startup, the block temperature and other information is obtained from the various sensors and corrected to the optimum condition.

(4) Control of Fuel Feed Pump (FFP)

During normal operation : ECU performs on/off control for fuel feed pump (FFP) by using output signal from its pump control circuit.

At starting : Pump control circuit outputs a signal to the pump (FFP), and power is supplied to the DC motor to drive the pump (FFP).

When stopped : Power supply to the motor is shut off and the pump (FFP) stops.

(5) Control of Tachometer

ECU performs on/off control for tachometer by using pulse input signal (On-off signal).

Pulse output rate is 6 pulses per crank revolution (12 poles).

When using accessory tachometer, set selector switch to 12 P (poles).



(6) Warning Buzzer and Lamp (LED), and Control of Engine Revolution Speed

Warning System

When an abnormality occurs on the engine, warning buzzer sounds and warning lamp (LED) is lit or blinks. In such case, engine speed is controlled but engine is not stopped.

1) Location of Warning Buzzer and Lamp (LED)

- · Warning buzzer: In the remote control box for remote control model. (only for remote control model)
- Warning lamp (LED): In the tachometer or on the tiller handle.
- Remarks: The lamp of the tachometer (option) with warning lamp operates synchronously with the lamp (LED) of the engine side.

2) Waring Notification, Abnormality and Action to be taken

Warning Indicators					
Buzzer	Lamp (LED)	Low speed ESG	High speed ESG	Description of faults or notice	
1 second only	ON: 1 Sec.			Normal operating check of the system at the starting (*1)	
Continuous sound (*2)	ON (*2)	ON (*2)		Engine temp. abnormally high	(1)
Continuous sound (*2)	ON (*2)	ON (*2)		Low engine oil pressure	(2)
Continuous sound	ON		ON	Engine speed exceeds maximum allowable RPM	(3)
Beep (*2)	Flashing (*2)	ON (*2)		Engine temp sensor or T-MAP (manifold pressure, intake air temperature) sensor is malfunction or short circuit.	(4)

Remarks) *1: When key is turned ON for the Remote Control Model and Multi-Function Tiller Handle Model On the Basic Tiller Handle Model, the buzzer and lamp (LED) are activated at starting (when the recoil starter or starter motor operates).

*2: To cancel the warning display, stop the engine once.

Note) When engine low speed ESG goes on, the speed is controlled at 2,800 min⁻¹ (rpm) or lower.

Continuous operation in this state should be avoided.

When engine high speed ESG goes on, the engine speed is controlled at the following level or lower.

Continuous operation in this state should be avoided.

30PS: 6,700 min⁻¹ (rpm) 25PS: 6,200 min⁻¹ (rpm)

Action to be taken (1): Move promptly to a safe location, set the throttle speed to low, set the shift to the Neutral (N) position, check that cooling water is discharged from the cooling water check port, and stop the engine. Remove any dirt, plastic sheets, etc. stuck around the lower unit. If no cooling water is discharged from the cooling water check port, check each part of the outboard motor.

- (2) : Move immediately to a safe location and stop the engine.Check the engine oil level and replenish the oil if the engine oil level is below the specified level.If the engine oil level is within the specified range, check each part.
- (3) : Return the throttle to medium speed or lower, move promptly to a safe location, and stop the engine.
 Check the propeller blades to see if they are bent or damaged.
 Check each part if the condition does not improve even after the propeller is replaced with a new one.
- (4): Go to the nearest port immediately and check each part after stopping the engine.

5. Ignition System

For ignition system, CD ignition system is adopted, and ECU's electronic ignition timing control system controls the timing to the most suitable state according to current operating conditions.

As engine is started, electric current is generated in the exciter coil of alternator. Which is input to ECU's regulator to feed power needed for operations of ignition coil, fuel injector and fuel feed pump (FFP).



(1) Configuration of Ignition System

The ignition system consists of mainly the following components.

- (1) Sensors and switches that transmit the engine operating status to the ECU
- (2) ECU to perform electronic control
- (3) Ignition coils and spark plugs that operate in accordance with the controls determined by the ECU

The following 6 components are included in the sensors and switches in (1).

- Pulser coil
- Throttle Position Sensor (TPS)
- Engine Temperature Sensor
- T-MAP Sensor
- Oil Pressure Switch

- Crank position [Crank Position Sensor]
- Throttle opening angle
- Temperature of Cooling Water (Crankcase)
- Intake air vacuum pressure and temperature
- Reduction of hydraulic pressure



(2) Ignition Control

The ECU's microcomputer is pre-programmed with optimal ignition timings according to the condition of the engine. The ECU obtains information about the engine operating status such as the revolution speed, throttle opening, manifold pressure (air intake vacuum pressure), cooling water temperature etc. based on the signals from the abovementioned sensors to ignite the fuel at the optimal ignition timing.

1) Ignition Timing Control

Ignition timing control is classified into two types, the first type by correcting the ignition timing during normal operation, and the second type by fixing the ignition advance angle (at engine startup or when an error occurs). In either case, ECU corrects ignition time or fixes it to the base.

- The basic ignition timing is determined by the engine revolution speed and manifold pressure (intake air vacuum pressure).
- Signals that are used for correction of ignition timing includes cooling water temperature, manifold intake air temperature, change of pressure at acceleration/deceleration under atmospheric pressure, and engine revolution speed.
- Ignition timing is fixed to the base at acceleration, deceleration, when high speed ESG is on, low speed ESG is on, or when hydraulic pressure is reduced.

2) Ignition and Combustion Order

No. of Ignitions: Once per revolution of each cylinder (around the end of the compression and exhaust strokes) Ignition sequence: $#1 \rightarrow #2 \rightarrow #3 \rightarrow #1 \rightarrow #2 \rightarrow #3 \rightarrow #1$ (for every 120° of the crank angle) Combustion sequence: $#1 \rightarrow #3 \rightarrow #2 \rightarrow #1$ (for every 240° of the crank angle)

3) Ignition Timing

The ignition timing is set as described below.

Model	Range of Ignition Angle	Engine Starting	Idling
MFS25D	ATDC3°- BTDC24°	BTDC5°	ATDC3°
MFS30D	ATDC3°- BTDC28°	BTDC5°	ATDC3°

4) Operations

- At Engine Starting and During Warm-up
 - Ignition timing is fixed at BTDC5° at engine startup.

The input signal and the engine temperature, manifold intake air temperature, engine speed and atmospheric pressure, on the basis of the programs stored in the ECU, the microcomputer determines the ignition timing after starting.

· During idling and low speed running

When the ECU receives the manifold pressure (intake air vacuum pressure) signal and input signal from the pulser coil (engine revolution speed signal), it controls the ignition timing so that the idling and low speed revolution speeds stabilize.

During normal operation

Microcomputer determines ignition timing in accordance with ECU's program by using cooling water temperature, manifold intake air temperature, atmospheric pressure and engine revolution speed as input signals. The maximum advance angle during normal operation is as shown below. MFS25D: BTDC24°, MFS30D: BTDC28°

During acceleration/Deceleration

When engine revolution speed changes much and is reduced below (or exceed) a setting value, ECU determines that engine is accelerating (or decelerating), and microcomputer determines the ignition timing based on the program installed in ECU.

During engine over-revolution

When the engine revolution speed exceeds the maximum allowable value (MFS25D: 6200 min⁻¹ (rpm), MFS30D: 6700 min⁻¹ (rpm)), the ECU stops feeding fuel to control the revolution based on pulser coil signals. This is the state that engine high speed ESG is "ON".

• Engine low speed ESG is "ON".

When any of the following state has been detected, engine revolution speed is controlled to 2,800r/min to prevent or reduce engine damage. This is the state that engine low speed ESG is "ON".

- Engine is overheating.: The engine temperature sensor detects 95°C or higher.
- Engine hydraulic pressure is low.: Oil pressure switch is ON (40 kPa (5.8 psi) [0.4 kg/cm²] or less) is detected.

(3) Fuel Feed System

Fuel pump ④ (low pressure mechanical type) draws fuel from fuel tank, and feeds it to fuel feed pump ⑥ (FFP) located in the vapor separator ⑤ through fuel connector ② and fuel filter ③.

Highly pressurized fuel, fed into fuel rail (8) and fuel injector, and then, injected into intake manifold.

Excessive fuel that is not used by fuel injector passes through fuel regulator ⑦, and circulated in the vapor separator ⑤ to keep fuel pressure constant.

Stabilization of fuel pressure is performed by the fuel regulator built into the vapor separator.





Fuel System (Fuel Injection)

6. Components of Fuel Feed System

1) Fuel Pump [Low Pressure Mechanical Pump]

The fuel pump is a diaphragm pump that is operated mechanically by the camshaft.



(a) IN: Fuel from Filter/Tank

(b) OUT: Fuel Outlet to Vapor Separator

2) Vapor Separator

Vapor separator feeds only liquid fuel for internal fuel feed pump (FFP) ① (electrical high pressure pump). Fuel that is fed from fuel pump (low pressure mechanical pump) is sent to upper part of vapor separator, where it is controlled with needle valve ②/float ③ assy. Removes trash and fuel filter (suction side) ④ Fuel filter (discharge side) ⑤ when passing through the Fuel Feed Pump (FFP). High pressure fuel from fuel feed pump (FFP) is fed to fuel rail and fuel injector. Excessive fuel is returned to the chamber by a fuel regulator ⑥ that is built into the vapor separator. In addition, a fuel cooler is mounted in the vapor separator to suppress an increase in the fuel temperature.



3) Fuel Regulator

The fuel regulator located inside the vapor separator serves to keep the fuel pressure constant.

The fuel regulator consists of a check valve to actuate the valve/seat, returning the excess fuel (b) (pressurized) to the vapor separator when the pressure exceeds a certain value.

Excess fuel is returned to the vapor separator through an internal pipe below the fuel level to prevent it from bubbling.





(a) High Pressure Fuel from Fuel Feed Pump(b) Excessive fuel returns to vapor separator.

4) Fuel Cooler

A fuel cooler (heat exchanger) is built into the vapor separator to cool the fuel in the vapor separator, which also uses the cooling water of the engine. By removing heat from the fuel, this serves to protect from fuel vapor lock and fuel feed pump (FFP) from wear. Cooling water delivered from the water pump is divided into two passages by the engine base, one inside the engine and the other to the fuel cooler. Cooling water from the engine base enters from the cooling water inlet (a) of the fuel cooler and comes out from the cooling water outlet (b) before being discharged to the cooling water check port.





7. Outline of Fuel Injection System

1) Air Intake System

The air intake system consists of components including the intake manifold ① (air intake passage to cylinders that are linked to a common air chamber), throttle position sensor ②, throttle body/shutter ③, ISC (idle speed control) valve ④, and T-MAP (manifold pressure and temperature) sensor ⑤.

The fuel rail and fuel injector are installed in the intake manifold



- 1 Intake Manifold
- (2) Throttle Position Sensor
- ③ Throttle Body/Shutter
- ④ ISC (Idle Speed Control) Valve
- (5) T-MAP (Manifold Pressure and Temperature) Sensor

8. Inspection Items

1) Inspection of Fuel Supply System

Check the fuel system piping for fuel leak, dirt, deterioration and damage, and replace or repair parts if necessary.





2) Inspection of Filter

 Check if there is any dirt in fuel filter ①, or if there is any fuel varnish, debris, deposits and contamination by foreign matter or water in the fuel filter cup ②, or if there are any cracks. Wash the fuel filter cup ② with gasoline, and replace the filter ① where necessary.



When removing the fuel filter cup, use a rag to catch any fuel so there is no spillage.

2. Cleaning of Fuel Tank Filter

Remove the fuel pick up elbow (5) of the fuel tank (4) counterclockwise to remove the part, and clean the filter (6).

Cleaning of Fuel Tank ④
 Clean the fuel tank ④ if there is any dirt or water.







④ Fuel Tank ⑤ Fuel Pick Up Elbow⑥ Filter



 Cleaning Fuel Feed Pump (FFP) Filter
 Remove the fuel filter (suction side) ⑦ from the fuel feed pump (FFP) in the vapor separator and clean it.



3) Inspection of Fuel Pump

- 1. Remove the fuel hoses (2 pcs.) from the fuel pump.
- 2. Connect the vacuum/pressure gauge to the inlet of the fuel pump.
- 3. Close the fuel pump outlet with your finger and apply the specified pressure. Make sure there are no air leaks.



4.

Vacuum/Pressure Gauge: P/N. 3AC-99020-1



With the outlet closed, apply the specified vacuum

pressure to check that there are no air leaks.

Specified vacuum pressure: -0.03 MPa (-4 psi) [-0.3 kgf/cm²]





- 5. Connect the vacuum/pressure gauge to the outlet of the fuel pump.
- 6. Apply the specified pressure to make sure that there are no air leaks. Replace if necessary.





4) Inspection of Fuel Connector

- 1. Check fuel connector for crack and damage.
- Connect vacuum/pressure gauge to outlet of fuel connector.
- Apply the specified pressure, and check if the pressure is maintained for 10 seconds. Replace if necessary.



Vacuum/Pressure Gauge: P/N. 3AC-99020-1



Specified Pressure: 0.029 MPa (4 psi) [0.3 kgf/cm²]





Fuel System (Fuel Injection)

5) Measurement of Fuel Pressure

- 1. Remove the cap (1).
- 2. Connect the pressure gauge (2) as shown in the figure.

- Before measurement, check that the pressure relief valve is fully closed.
- Before connecting the pressure gauge, cover the connection between the pressure gauge and valve with a clean and dry cloth to prevent fuel from leaking.
- Connect the pressure gauge securely.

Pressure Gauge Assembly: P/N. 3T5-72880-0

- Start the engine, run it for 5 minutes to warm up, and then measure the fuel pressure. If the pressure is below specified value, check high pressure fuel passage and vapor separator.

- Before measurement, be sure to check that the pressure relief valve is fully closed.
- Do not open the pressure relief valve during measurement. Opening the valve allows fuel to spew out, possibly causing fire.
- After measurement, cover hose tip with rag, and open pressure relief valve to drain fuel from discharge hose and the instrument.
- Before storing pressure gauge, fully close pressure relief valve.

Fuel Pressure (Reference value): 250± 5 kPa (35.5 ±0.724 psi) [2.5 ±0.05 kg/cm²] (at 10 L/h)

- To measure the fuel pressure without operating the engine on a basic tiller handle model (manual start model), remove the lock plate of the engine stop switch and pull the recoil starter 4 to 5 times to measure the fuel pressure.
 - Turn the key switch to ON (3 seconds operation) to measure the fuel pressure without running the engine on a multi-function tiller handle model or remote control model.

6) Draining Fuel

- 1. Remove the cap (1).
- Connect the pressure gauge assembly ② as shown in the figure, place a vessel below the pressure relief hose, and open the pressure relief valve ③ to release the fuel pressure.

Be sure to reduce the fuel pressure in the high pressure fuel passage before servicing the fuel passage and/or vapor separator. Performing the service without releasing the pressure causes compressed fuel to be injected, possibly causing a hazard.

3. Place a vessel below vapor separator drain hose, and loosen drain screw ④ to drain fuel from vapor separator drain hose.







7) Disassembly of Vapor Separator

Be sure to reduce the fuel pressure in the high pressure fuel passage before servicing the fuel passage and/or vapor separator. Performing the service without releasing the pressure causes compressed fuel to be injected, possibly causing a hazard.

1. Remove the float chamber of the vapor separator.



2. Remove the needle valve (1), float pin (2), and float.



8) Inspection of Vapor Separator

- 1. Check the needle valve for bend and wear. Replace if necessary.
- 2. Check the float for deformation. Replace if necessary.
- 3. Check the filter for dirt and clogging. Clean if necessary.
- 4. Reinstall the needle valve, float and float pin, and check that the parts moves smoothly.
- Check the float height (b) as shown. Replace the float or needle valve if the height is out of the specified range.



Do not press the needle valve with the float.



Float Height (b): 15.2 mm (0.598 in)

9) Reassembly of Vapor Separator

- 1. Attach the float chamber to the vapor separator.
- 2. Reassemble all parts that were removed.



Check that the hose is reconnected correctly.







Fuel System (Fuel Injection)

10) Inspection of ISC (Idle Speed Control)

 Use the diagnosis system to check operation of the ISC (Idle Speed Control) valve. The value may be significantly higher than the reference value when there is abnormality in the engine.



ISC Duty Ratio:

10-30% (after warming-up, idle speed 850 min⁻¹ (rpm))

 Disconnect hose at intake silencer side of ISC valve, close the hole from which the hose was disconnected with a finger to check if engine speed is reduced. Replace the ISC valve if not.

11) Inspection of Idle Speed

- 1. Start the engine and run for 5 minutes to warm up.
- 2. Check the idle speed.



Tachometer: P/N. 3AC-99010-0

RPM

Idle Revolution Speed: 850 min⁻¹ (rpm)





Power Unit

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Power Unit

1. Special Tools

Compression Gauge P/N. 3AC-99030-0	Torque Wrench P/N. 3AC-99070-0	Valve Clearance Driver P/N. 3AC-99071-0	Crank Shaft Holder P/N. 3BJ-72815-0		
Measuring compression pressure	Adjusting valve clearance	Adjusting valve clearance	Holding crankshaft		
		ø34.5 x ø17.5			
Flywheel P/N. 3T1	Puller Kit -72211-4	Oil Seal Attachment P/N. 3AC-99820-0	Oil Filter Wrench P/N. 3AC-99090-0		
Removing and ir	nstalling flywheel	Installing cylinder head oil seal	Removing and installing oil filter		
Piston Slider P/N. 3AC-72871-0	Piston Ring Tool P/N. 353-72249-0				
Installing piston	Removing and installing piston ring				

2. Parts Layout

Engine



Ref. No.	Part Name	Q'ty	Remarks	Ref. No.	Part Name	Q'ty	R
1	Recoil Starter	1		10	Cable Clip	1	
2	Belt Cover	1		11	Grommet (Lower)	1	
3	Starter Pulley	1		12	Shift Rod	1	
4	Power Unit	1		13	Engine Base Gasket	1	Do not reuse.
5	Oil Level Gauge	1		14	Dowel Pin	2	
6	Shift Lever Rod	1	Basic Tiller Model	15	Oil Strainer	1	
7	Cover	1		16	Bolt	6	M8
8	Stay Cover	1		17	Apron	1	
9	Grommet (Upper)	1					

Remarks

Power Unit

Magneto


Ref. No.	Parts Name	Q'ty	Remarks
1	Flywheel W/Gear	1	
2-1	Alternator Assy	1	
2-2	Alternator Assy	1	
3	Key 13.4-5-4	1	
4	Bolt	1	
5	Washer	1	13-26-3.2
6	Bolt	3	
7	Starter Pulley	1	
8	Bolt	3	
9	Coil Bracket	1	
10	Bolt	4	
11	Pulsar Coil	1	
12	Pulsar Coil	1	
13	Bolt	4	
14	Starter Lock Cable Bracket	1	
15	Bolt	1	
16	Cable Terminal Holder	1	
17	Bolt	2	
18	Fuse Holder Bracket	1	
19	Screw	2	
20	Bracket	1	
21	Bolt	2	
22	Ignition Coil W/R-cap	3	
23	Plug Cap W/Resistance	1	
24	Bolt	3	
25	Dowel Pin 6-12	2	
26-1	ECU Cord Assy	1	
26-2	ECU Cord Assy	1	
27	Plug	1	
28	Plug	1	
29-1	Cable Terminal Plug	1	
29-2	Cable Terminal Plug	1	
29-3	Cable Terminal Plug	1	
30-1	Fuse 20A	2	
30-2	Fuse	2	20A
31-1	Cap (Y)	1	
31-2	Cap (Y)	1	
32-1	Grommet	1	
32-2	Grommet	1	
32-3	Grommet	1	
33	ECU Cord Assy	1	
34	Bolt	2	
35	Band	2	
36	Band	2	
37	Band	1	Do not reuse.
38	Bolt	1	
39	Plug	1	

Intake Manifold



Ref. No.	Parts Name	Q'ty	Remarks
1	Intake Manifold	1	
2	Gasket	1	Do not reuse.
3	Throttle Body Assy	1	
4	Bolt	2	
5	Gasket	1	Do not reuse.
6	Intake Silencer Assy	1	
7	Bolt	2	
8	Fuel Rail	1	
9	O-ring 1.9-9.8	2	Do not reuse.
10	Valve Assy (Pressure Check)	1	
11	Сар	1	
12	Nipple	1	
13	Holding Plate	1	
14	Bolt	1	
15	Fuel Injector Assy	3	
16	Seal Ring	3	Do not reuse.
17	Bolt	2	
18	MAP Sensor	1	
19	Tapping Screw	2	
20	Intake Silencer Cover	1	
21	Air Filter	1	
22	Tapping Screw	4	
23	ISC Valve	1	
24	Washer	1	
25	Nut	1	
26	Band	1	
27	Tapping Screw	1	
28	Hose	1	8-12_L=45
29	Hose	1	8-12_L=205_40
30	Intake Manifold Gasket	3	Do not reuse.
31	Bracket	1	
32	Bolt	1	
33	Bolt	6	
34	Vent Hose W/Protector	1	
35	Vent Hose W/Protector	1	
36	Band	2	
37	ISC Valve Stay	1	
38	Vent Hose W/Protector	1	

Fuel System



Ref. No.	Parts Name	Q'ty	Remarks
1	Vapor Separator Assy	1	
2	Cover	1	
3	Seal	1	
4	Screw	4	
5	Drain Screw	1	
6	Gasket	1	Do not reuse.
7	Float Valve Assy	1	
8	Float Arm Pin	1	
9	Float	1	
10	Grommet	1	
11	Filter (Inlet)	1	
12	Holder	1	
13	Fuel Feed Pump	1	
14	O-ring	1	Do not reuse.
15	O-ring	1	Do not reuse.
16	O-ring	1	Do not reuse.
17	Fuel Regulator	1	
18	Screw	1	
19	VST Connector	1	
20	Clip	1	
21	Screw	4	
22	Washer 6-16-1.5	2	
23	Rubber Mount	2	
24	Collar	2	
25	Bolt	2	
26	Plate	1	
27	Fuel Filter Assy	1	
28	Cup	1	
29	Filter	1	
30	O-ring	1	Do not reuse.
31	O-ring	1	Do not reuse.
32	Drain Valve	1	
33	Seal	1	Do not reuse.
34	Float	1	
35	Bolt	1	
36	Fuel Filter Holder	1	
37	Fuel Pump Assy	1	
38	O-ring 3.5-25.7	1	Do not reuse.
39	Bolt	2	
40-1	Fuel Hose	1	
40-2	Fuel Hose W/Protector	1	



Ref. No.	Parts Name	Q'ty	Remarks
41	Сір Ф9.4	2	
42	Сlip Ф9.4	2	
43-1	Fuel Hose W/Protector	1	
43-2	Fuel Hose W/Protector	1	
44	Water Hose	1	
45	Water Hose	1	
46-1	Fuel Hose W/Protector	1	
46-2	Fuel Hose W/Protector	1	
47	Сlip Ф9.4	2	
48	Fuel Hose W/Protector	1	
49	Clamp Φ16.8	2	
50	Clip Φ9.4	1	
51	Adapter Cord	1	L=200
52-1	Fuel Hose W/Protector	1	
52-2	Fuel Hose W/Protector	1	
53	Fuel Hose Joint	1	
54	Plug	1	
55	Band	1	Do not reuse.

Electrical Parts



Ref. No.	Parts Name	Q'ty	Remarks
1	Oil Pressure Switch	1	
2	Rectifier Complete	1	
3	Cover	1	
4-1	Bolt	2	
4-2	Bolt	2	
5	Starter Motor Assy	1	
6	Pinion Assy	1	
7	Washer	1	
8	Brush Holder Assy	1	
9	Screw	2	
10	Bushing 2	1	
11	Q-ring	1	Do not reuse.
12	Bushing 1	1	
13	Washer	2	
14	Spring Washer	2	
15	Nut	2	
16	Bolt	2	
17	Spring Washer	2	
18	Washer	2	
10	Bolt	2	
20	Starter Motor Band	1	
20		1	
21		2	
22	Bottom Coble L 2500	- 2	
23	Ballery Cable L=2500	1	
24			
25		1	
26	Starter Gable	1	
2/	Terminal Cap	1	
28-1	Bolt	1	
28-2	Bolt	1	
29-1	Electric Bracket	1	
29-2	Electric Bracket	1	
30-1	Starter Solenoid	1	
30-2	Starter Solenoid	1	
31-1	Bolt	2	
31-2	Bolt	2	
32	Bolt	1	
33	Bolt	1	
34	Plate	1	
35-1	Mount	1	
35-2	Mount	1	
36	Relay	2	
37	Clip	2	
38	Adapter Cord	1	
39-1	Rubber Mount	3	
39-2	Rubber Mount	3	
40-1	Collar	3	
40-2	Collar	3	



			1
Ref. No.	Parts Name	Q'ty	Remarks
41	Bolt	5	
42	Washer	5	6-16-1.5
43	Rubber Mount	2	
44	Collar	2	
45	Plate	1	
46	Bolt	2	
47	Plate	1	
49	Band	3	
50	Engine Temp Sensor	1	
51-1	ECU Assy (25DO)	1	
51-2	ECU Assy (30DO)	1	
51-3	ECU Assy (25)	1	
51-4	ECU Assy (30)	1	
52	Bolt	1	
53	Washer	2	6-16-1.5
54	Spacer	1	6.2-9-27
55	Bolt	1	
56	Band	1	Do not reuse.
57	Band	1	Do not reuse.
58	Band	2	Do not reuse.
59	Band	1	
60	Bolt	1	
61	Bolt	1	

Pulley & Timing Belt



-			
Ref. No.	Part Name	Q'ty	Remarks
1	Drive Pulley	1	
2	Key 10-3.7-3	1	
3	Belt Guide	1	
4	Nut	1	
5	Driven Pulley	1	
6	Key 10-3.7-3	1	
7	Washer 6.5-19-3.2	1	
8	Pre-Coated Bolt 6-20	1	
9	Timing Belt	1	

Cylinder Head & Oil Pump



Ref. No.	Part Name	Q'ty	Remarks
1	Cylinder Head Complete	1	
2	Cylinder Head Assy	1	
3	Camshaft Assy	1	
4	Oil Seal 18-35-8	1	Do not reuse.
5	Rocker Arm	6	
6	Adjusting Screw	6	
7	Adjusting Nut	6	
8	Rocker Arm Shaft	1	
9	Rocker Shaft Spring	3	
10	Washer 13.2-21.8-2	3	
11	Collar	2	
12	Valve Spring	6	
13	Valve Spring Seat	6	
14	Intake Valve Stem Seal	3	Gray Do not reuse.
15	Exhaust Valve Stem Seal	3	Green Do not reuse.
16	Oil Pump Assy	1	
17	Bolt	3	
18	Oil Pump Gasket	1	Do not reuse.
19	Intake Valve	3	
20	Exhaust Valve	3	
21	Retainer	6	
22	Cotter	12	
23	Lifter	1	
24	Collar	3	
25	Anode Plug Assy	2	
26	Anode Plug	1	
27	O-ring 1.9-13	1	Do not reuse.
28	Anode	1	
29	Screw	1	
30	Cylinder Head Bolt 8-60	8	
31	Bolt	3	
32	Washer	3	
33	Dowel Pin 6-12	2	
34	Cylinder Head Cover Assy	1	
35	Cylinder Head Cover Gasket	1	Do not reuse.
36	Bolt	6	
37	Breather Chamber Cover	1	
38	Screw	5	
39	Oil Filler Cap	1	
40	O-ring 3.1-24.4	1	



Ref. No.	Part Name	Q'ty	Remarks
41	Spark Plug (DCPR6E)	3	
42	Breather Hose	1	Φ12-415
43	Breather Hose W/Protector	1	
44	Cylinder Head Gasket	1	Do not reuse.
45	Washer	8	
46	Intake Valve Kit	1	
47	Intake Valve	1	
48	Retainer	1	
49	Cotter	2	
50	Exhaust Valve Kit	1	
51	Exhaust Valve	1	
52	Retainer	1	
53	Cotter	2	

Cylinder & Crankcase



Ref. No.	Part Name	Q'ty	Remarks
1	Cyl Block & Crankcase Assy	1	
2	Dowel Pin 6-12	2	
3	Oil Filter Bolt	1	
4	Bolt	8	M8-70-P1.25
5	Bolt	8	
6	Washer	8	
7	Oil Drip Tray	1	
8	Plug	1	Φ11
9	Collar	1	
10	Bolt	1	
11	Washer	2	
12	Thermostat	1	
13	Thermostat Cap	1	
14	Thermostat Cap Gasket	1	Do not reuse.
15	Bolt	2	L=35mm
16	Exhaust Cover (Outer)	1	
17	Exhaust Cover Gasket	1	Do not reuse.
18	Bolt	7	L=25mm
19	Washer	7	
20	Engine Basement Gasket	1	Do not reuse.
21	Oil Strainer Assy	1	
22	Pipe	1	L=200
23	Band	2	Do not reuse.
24	Nipple	1	
25	Bolt	2	
26	Hanger	1	
27	Bolt	1	
28	Oil Level Gauge	1	
29	Band	1	Do not reuse.
30	Oil Filter	1	
31	Rectifier Complete Gasket		Do not reuse.
32	Water Jacket Insert (L)	1	

Piston & Crankshaft





Ref. No.	Part Name	Q'ty	Remarks
1	Crankshaft Assy	1	
2-1	Plain Shaft Bearing 34-37-15	8	
2-2	Plain Shaft Bearing 34-37-15	8	
3	Oil Seal 36-50-7	1	Do not reuse.
4	Oil Seal 32-44-9	1	Do not reuse.
5	Connecting Rod Assy	3	
6	Connecting Rod Bolt	2	
7	Piston Repair Kit	3	
8	Piston	1	
9	Piston Pin	1	
10	Piston Pin Clip	2	Do not reuse.
11	Piston Ring Set	3	
12	Piston Ring	1	
13	Piston Ring	1	
14	Piston Ring-Oil	1	

Top Cowl



Ref. No.	Part Name	Q'ty	Remarks
1	Top Cowl Assy	1	
2	Top Cowl Sub-Assy	1	
3	Top Cowl Seal	1	
4	Side Decal	2	
5	Logo Decal	1	
6-1	Rear Decal (25)	1	
6-2	Rear Decal (30)	1	
7	Simpliq Decal	1	
8	Caution Decal (A)	1	
9	Caution Decal	1	

Recoil Starter



Ref. No.	Part Name	Q'ty	Remarks
1	Recoil Starter Assy	1	
2	Bushing	1	
3	Starter Spring	1	
4	Reel	1	
5	Ratchet	1	
6	E-Ring d=10	1	Do not reuse.
7	Return Spring	1	
8	Return Spring	1	
9	Friction Plate	1	
10	Tapping Screw	1	
11	Starter Rope Ф5-1800	1	
12	Starter Handle	1	
13	Rope Anchor	1	
14	Starter Lock	1	
15	Starter Lock Spring	1	
16	Friction Spring	1	
17	Starter Lock Cam Spring	1	
18	Seal	1	
19	Starter Lock Wire	1	
20	Starter Seal	1	
21	Pre-Coated Bolt 6-20	3	
22	Washer 6-16-1.5	3	
23	Belt Cover	1	
24	Grommet 13-2	2	
25-1	Caution Decal (B)	1	
25-2	Caution Decal (B)	1	for EU
26	Caution Decal (Sigp)	1	for US

3. Inspection Items

1) Inspection of Compression Pressure

1. Refer to "Inspection of Compression Pressure" in Chapter 3.



Compression Pressure (reference value): At 500 min⁻¹ (rpm) With decompressor: 0.50 MPa (73 psi) [5.1 kgf/cm²] Without decompressor: 1.40 MPa (203 psi) [14.3 kgf/cm²]

2) Inspection of Oil Pressure

- 1. Place a rag below the oil pressure switch.
- 2. Disconnect the oil pressure switch lead wire ①, and then remove the oil pressure switch ②.

If the removed lead wire is grounded on the body, a low oil pressure error will occur.

 Connect the oil pressure gauge ③ (sold commercially) to the switch hole.



- 4. Start and run the engine for 5 minutes to warm up the engine at the idling revolution speed.
- Measure the oil pressure. If the pressure is below the specified value, check the oil pump, oil leakage, and oil strainer.



Oil Pressure (Reference value):

At 850 min⁻¹ (rpm): 0.21 MPa (30.5 psi) [2.1 kgf/cm²] At 4000 min⁻¹ (rpm): 0.24 MPa (34.8 psi) [2.4 kgf/cm²]

6. Install the oil pressure switch and tighten to the specified torque.



Apply a screw locking agent (ThreeBond 1327) to the screw thread (a) of the oil pressure switch.

Oil Pressure Switch: 8 N · m (5.9 lb · ft) [0.8 kgf · m]

7. Install the oil pressure switch lead wire.



Oil Pressure Switch Screw: 1.6 N · m (1.2 lb · ft) [0.16 kgf · m]







3) Inspection of Valve Clearance

1. Refer to "Inspection and Adjustment of Valve Clearance" in Chapter 3.



2.

3.

4.

rod (5).

Valve Clearance (when engine is cold): Intake Side: 0.10–0.15 mm (0.0040–0.0060 in) Exhaust Side: 0.20–0.24 mm (0.0080–0.0095 in)

4) Removal of Power Unit

1. Remove the oil level gauge (1).



Remove the shift lever rod ④ (Basic Tiller Model) and shift

Remove the cover (3).

(1)





5. Remove the battery cable (6). (Electric Starter Model)









6. Disconnect the indicator lamp connector 7.

 Disconnect the PT switch coupler (8) and PT motor coupler (9). (Power Tilt Model)

8. Disconnect the fuel hose (1).

Remove the cooling water hose (vapor separator - cooling water check port) (1).

10. Disconnect the vent hose 12, cooling water hose (drive shaft housing - vapor separator) (3), and vapor separator drain hose 14.

11. Remove the power unit installation bolts.



Loosen the power unit installation bolts in the order shown in the diagram.





A Starboard B Port



12. Remove the starter lock cable (5), and remove the recoil starter (6) (3 bolts).

13. Disconnect the vent hoses (\overline{p}) , and remove the belt cover (\overline{B}) .







14. Remove the starter pulley (19.



15. Hoist and remove the power unit.



 Install the eye bolt (20) in the screw hole for installing the starter pulley.

- When hoisting the power unit, do so carefully while checking if the wires and hoses are caught by other parts.
- Keep the power unit level by 2-point suspension and lift straight upward as illustrated.
- When removing the power unit, check the oil strainer hose routing.



Eye Bolt 20:

Commercially available item (M6)

16. Remove the nipple ①, engine base gasket ②, and dowel pin ③ from the power unit.





5) Removal of Oil Strainer

1. Remove the oil strainer (2) from the oil strainer hose (1).



Before removing the oil strainer hose, note the arrangement of the hose.



6) Inspection of Oil Strainer

1. Check the oil strainer for dirt and clogging. Clean or replace if necessary.

7) Removal of Flywheel

1. Use the flywheel puller kit 1 to loosen the flywheel bolt and remove the flywheel bolt.



Flywheel Puller Kit (1): P/N. 3T1-72211-4



2. Use the flywheel puller kit to remove the flywheel (2) and key.



Screw the puller onto the crankshaft end until the flywheel is disengaged from the tapered portion of the crankshaft.



① Flywheel Puller Kit ⓐ Flywheel Puller Plate

b Flywheel Puller Plate © Spacer 2 Flywheel



To prevent damage to the engine and special tools, tighten the flywheel puller set bolts evenly and keep the flywheel puller plate parallel to the flywheel while working.



 Disconnect the alternator assy couplers, and remove the alternator assy ③.



- Disconnect the pulser coil connectors ④, and remove the fuse holder ⑤, battery cable ⑥, and ground lead wires ⑦.
- 5. Remove the coil bracket assy (8).



8) Installation of Flywheel

- 1. Install the coil bracket assy ①.
- Install the ground lead wires (2), battery cable (3), and fuse holder (4), and connect the pulser coil connectors (5).



(6)

3. Install the alternator assy (6), and connect the alternator assy coupler.

4. Install the key in the crankshaft, and then install the flywheel ⑦, washer and flywheel bolt.

5



5. Use the flywheel puller kit (8) to tighten the flywheel bolt to the specified torque.

Flywheel Puller Kit (8): P/N. 3T1-72211-4

Flywheel Bolt: 70 N ⋅ m (52 lb ⋅ ft) [7.0 kgf ⋅ m]



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6. Install the starter pulley (9).

7.



- Install the recoil starter (2), and install the starter lock cable (1).

Install the belt cover 0, and connect the vent hoses 1.

9) Removal of Timing Belt and Pulley

 Turn the drive pulley ① in the clockwise direction, and align the "▲" mark ③ of the drive pulley with the "▲" mark (b) of the cylinder block. Check that the "●I" mark ⓒ of the driven pulley ② and the "▲" mark ⓓ of the cylinder head are aligned.



The No.1 cylinder should be at the top dead center of the compression stroke.

Crankshaft Holder: P/N. 3BJ-72815-0



Install the key ③ of the flywheel and the crankshaft holder
 ④ in the crankshaft.

When installing the crankshaft holder, align the key groove of the crankshaft holder with the key.



- 3. Loosen the nut (5) of the drive pulley while immobilizing the crankshaft holder.
 - Use two 36 mm wrenches for this step. (Spanner wrench and socket wrench)
 - When loosening the nut of the drive pulley, be sure that the drive pulley does not turn.
 - Keep the timing belt engaged as a means of precaution.
- 4. Loosen the bolt (6) of the driven pulley while immobilizing the crankshaft holder, and remove the bolt and washer of the driven pulley.



When loosening the driven pulley bolt, be careful not to turn the driven pulley.





5. Remove the timing belt \bigcirc .



Remove the timing belt from the driven pulley ② side.



- 6. Remove the driven pulley 2.
- Remove the nut (5) of the drive pulley, the belt guide (8), the drive pulley (9), and the key (10).



10) Inspection of Timing Belt

- 1. Check the timing belt for cracks, damage, and wear on both faces. Replace if necessary.
- 2. Check the drive pulley and the driven pulley for cracks, damage, and wear. Replace if necessary.


11) Installation of Pulley and Timing Belt

Do not turn the drive pulley or the driven pulley with the timing belt removed. Doing so can make pistons and valves interfere with each other, possibly resulting in damages to these parts.

Install the key ①, the drive pulley ②, the belt guide
 ③, and the nut ④ of the drive pulley. Tightening to the specified torque is performed later.



Degrease the drive pulley mounting area of the crankshaft and the inner side of the drive pulley.
Align the positions of the key and key groove of the drive pulley to install the drive pulley.



 Make sure that the "▲" mark (a) of the drive pulley is aligned with the "▲" mark (b) of the cylinder block.

This position is the compression top dead center of the No. 1 cylinder.

Install the driven pulley (5) and check that the "●I" mark (c) of the driven pulley is aligned with the "▲" mark (d) of the cylinder head.



Align the positions of the key and key groove of the driven pulley to install the driven pulley.





4. Install the timing belt 6.

- Be careful not to damage the timing belt during installation.
- Do not twist, turn inside out, or sharply bend the timing belt. Doing so may cause damage.
- Be careful not to allow oil or grease to adhere to the timing belt.



• Install the timing belt with the part number at the top.

• Install the timing belt to the drive pulley and then to the driven pulley.





When installing the crankshaft holder, align the groove of the crankshaft holder with the key.

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Crankshaft Holder (8): P/N. 3BJ-72815-0

6. Tighten the bolt (9) of the driven pulley to the specified torque while immobilizing the crankshaft holder.



• Apply a screw locking agent (ThreeBond 1342) to the thread area of the bolt.

• When tightening the driven pulley bolt, be careful not to turn the driven pulley.



Driven Pulley Bolt (9): 11 N · m (8 lb · ft) [1.1 kgf · m]

 Tighten the nut ④ of the drive pulley to the specified torque while immobilizing the crankshaft holder.



Drive Pulley Nut ④: 64 N ⋅ m (47 lb ⋅ ft) [6.4 kgf ⋅ m]









8. Turn the crankshaft two full rotations in the clockwise direction, and check that the alignment marks of the pulleys are aligned.



Check that the crankshaft turns smoothly.

- Make sure the "▲" mark ⓐ of the drive pulley is aligned with the "▲" mark ⓑ of the cylinder block.
- Check that the "●I" mark ⓒ of the driven pulley is aligned with the "▲" mark ⓓ of the cylinder head.



12) Removal of Air Intake System & Fuel System

1. Remove the clamp (1) securing the fuel hose.

- 2. Remove the band (2) and the band (3) securing the wire harness.
- Disconnect the breather hose ④ and the breather hose ⑤ (cylinder head side).



 $(\mathbf{1})$





4. Disconnect vent hose 6.

5. Disconnect the injector couplers \overline{O} .

6. Disconnect the fuel feed pump coupler (8) of the vapor separator.

Disconnect the ISC coupler (9), the T-MAP sensor coupler (10), and the throttle position sensor coupler (11).









- 8. Remove the throttle link (2) (throttle valve side).
 - A Basic Tiller Handle Model
 - B Multi-Function Tiller Handle Model, Remote Control Model





9. Remove the fuel filter (3) from the plate.

10. Remove the fuel pump (1) from the head cover.

11. Remove the intake manifold assy (5).





13) Removal of Electrical System Parts

Power Unit

1. Remove the air intake system parts and fuel system parts.

Refer to the section on removing the air intake system & fuel system (5-43)

 Remove the flywheel, alternator assy, and coil bracket assy.



Refer to the section on removing the flywheel (5-35)

3. Remove the band ① securing the wire harness.

4. Disconnect the neutral switch connector (2) and the starter solenoid lead wire (3).

- 5. Remove the spark plug caps ④.
- 6. Disconnect the ignition coil couplers (5).
- 7. Remove the ignition coil bracket assy (6) and the ground lead wire.
- 8. Remove the ground lead wire \overline{O} .
- 9. Disconnect the engine temperature sensor coupler (8).









- 10. Remove the ground lead wire (9) and the PT relay plate (10). (Power Tilt Model)
- 11. Disconnect the rectifier coupler (1). (Electric Starter Model)
- 12. Remove the ground lead wire 2.

13. Remove the ground lead wire (1) (Power Tilt Model) and oil pressure switch lead wire (4).

14. Remove the bolts (5 locations), and remove the electrical box (6.

15. Remove the oil pressure switch \bigcirc .

5



(13)



16. Remove the rectifier (18. (Electric Starter Model)





17. Remove the neutral switch (19. (Electric Starter Model)

18. Remove the starter motor (2). (Electric Starter Model)

14) Removal of Cylinder Head Assy

- 1. Remove the flywheel. (Refer to the section on removing the flywheel. 5-35)
- 2. Remove the timing belt and the driven pulley. (Refer to the section on removing the timing belt and pulley. 5-39)
- Remove the air intake system parts and fuel system parts. (Refer to the section on removing the air intake system & fuel system. 5-43)
- 4. Remove the band ① securing the wire harness.

- Remove the spark plug caps and ignition coil couplers, and remove the ignition coil bracket assy (2).
- 6. Remove the ground lead wire ③.
- 7. Remove the spark plug.
- 8. Remove the PT relay plate ④. (Power Tilt Model)









9. Remove the cylinder head cover (5).



10. Remove the cylinder head bolts in the order shown in the diagram, and remove the cylinder head assy.



Do not scratch or damage the mating surfaces of the cylinder head and cylinder block.



The water jacket insert is on the port side of the 3rd cylinder. Note that it is easy to fall off.

15) Disassembly of Cylinder Head Assy

- 1. Loosen the rocker arm lock nuts, and loosen the adjusting screws as much as possible.
- 2. Remove the oil pump assembly (1).
- Remove the rocker arm shaft (2), rocker arm (3), collars (4), springs (5), washers (6), and lifter (7).



Pull out while pressing down on other parts.







4. Remove the camshaft (8).



- 5. Remove the oil seal (9).
- Compress the valve spring (1) by using the compressor (1), remove the cotter (2), and then remove the valve spring and valve (1).



- Valves, valve springs, and other power unit related parts should be arranged in the order they are removed.
- Use an attachment having an inner diameter of 16.5 mm (0.650 in).
- If the valve spring compressor is not used, place the cylinder head on a folded rag to prevent valve damage.



Valve Spring Compressor (1): Commercially available item

16) Inspection of Valve Spring

1. Measure the free length (a) of the valve spring. Replace if less than the specified value.



Valve Spring Free Length (a): Standard Value 32.85 mm (1.29 in) Functional Limit:

31.5 mm (1.24 in)







-1

17) Inspection of Valve

- 1. Check the valve for dents and wear on the face. Replace if necessary.
- 2. Measure the valve stem outer diameter (a). Replace if less than the specified value.



Valve Stem Outer Diameter (a): Standard Value Intake Side: 5.48 mm (0.2157 in) Exhaust Side: 5.46 mm (0.2150 in)

Functional Limit:

Intake Side: 5.46 mm (0.2150 in) Exhaust Side: 5.44 mm (0.2142 in)

3. Measure the valve stem runout. Replace if greater than the specified value.



Valve Stem Runout Limit: Intake Side: 0.05 mm (0.0020 in) Exhaust Side: 0.03 mm (0.0012 in)





18) Inspection of Valve Guide



Before inspecting the valve guide, check that the valve stem outer diameter is within the specified limit.

1. Measure the valve guide inner diameter (a). Replace the cylinder head if greater than the specified value.



Valve Guide Inner Diameter (a): Standard Value Intake/Exhaust Side: 5.51 mm (0.2169 in) Functional Limit:

Intake Side: 5.55 mm (0.02185 in)

Exhaust Side: 5.57 mm (0.02193 in)

 Calculate the clearance between the valve guide and valve stem as described below. Replace the cylinder head and/or valve if greater than the specified value.



Functional Limit

Intake Side: 0.070 mm (0.00276 in) Exhaust Side: 0.100 mm (0.00394 in)





19) Inspection of Valve Seat

- 1. Remove the carbon built up on the valve.
- 2. Evenly apply a thin coat of red lead to the valve seat.
- 3. Use a valve lapper (commercially available) to push the valve onto the valve seat lightly as shown in the diagram.
- 4. Measure the valve seat contact width (a) of the valve face stained with red lead. Correct the valve seat if the contact area is above or below the center or the contact area of the valve seat is greater than the specified limit.



Intake/Exhaust Side: 2.0 mm (0.08 in)







20) Correction of Valve Seat

1. Use a valve seat cutter (commercially available) to correct the valve seat.



- Use a 45° seat cutter to grind the valve seat surface until it becomes smooth while rotating the cutter in the clockwise direction.
 - Be careful not to over-grind the valve seat. Rotate the valve seat cutter while pressing it down evenly.





(a) Carbon build-up or uneven surface



b Width before correction

- 4. Use a 60° seat cutter to adjust the contact position at the lower end of the valve seat.

Use a 30° seat cutter to adjust the contact position at the

upper end of the valve seat.

3.

 Use a 45° seat cutter to adjust the contact width (C) of the valve seat to the specified value.



- If the valve seat contact area is located in the center and the area is too wide, adjust the contact width to the specified value by cutting the upper and lower ends using 30° and 60° seat cutters respectively.
- (b) Width before correction(c) Specified width



b Width before correction

7. If the valve seat contact area is too narrow and located nearer to the valve face upper end, use a 30° seat cutter to cut the upper end. If necessary, use a 45° seat cutter to adjust the contact width of the valve seat to the specified value.



- (b) Width before correction
- 8. If the valve seat contact area is too narrow and located nearer to the valve face lower end, use a 60° seat cutter to cut the lower end. If necessary, use a 45° seat cutter to adjust the contact width of the valve seat to the specified value.



(b) Width before correction

 Apply a thin coat of an abrasive compound to the entire valve seat contact area, and rub and polish the valve seat while knocking and turning the valve with a valve lapper (commercially available).

Perform the work by taking care not to allow the abrasive compound to adhere to the valve stem and valve guide.



- Use a finer abrasive compound to finish.
- When changing the abrasive compound to a finer one, remove the present one completely.
- After completion of lapping, wipe off the compound and then clean.
- 10. After the work, remove the compound completely from the cylinder head and valve.
- 11. Check the valve seat contact width ©.



Valve Seat Contact Width ©: Standard Value 1.0 mm (0.04 in)





21) Inspection of Rocker Arm and Rocker Arm Shaft

- 1. Check the rocker arm, rocker arm shaft, and rocker arm contact area (a) for wear. Replace if necessary.
- Measure the rocker arm inner diameter (b) and rocker arm shaft outer diameter (c). Calculate the oil clearance (d) (d) = (b) (c)). Replace if other than the specified value.





(D) = (b) – (C)

22) Inspection of Camshaft

1. Measure the cam height. Replace if less than the specified value.

2	Cam Height (a): Standard Value		
	Exhaust Side: 23.80 mm (0.9370 in)		
6	Functional Limit: Cam Height (a)		
0	Functional Limit: Cam Height ⓐ Intake Side: 23.5 mm (0.9252 in)		

2. Measure the camshaft runout. Replace if greater than the specified value.



Camshaft Runout Limit: 0.05 mm (0.0020 in)





З. Measure the camshaft journal outer diameters (b) and (c). Replace the camshaft if less than the specified value.



Measure the cylinder head journal inner diameter (d) 4. and oil pump journal inner diameter (e). Calculate the oil clearances. The values are (d) - (b) and (e) - (c). Replace the camshaft, cylinder head, or oil pump if greater than the



If the oil clearance exceeds the functional limit, replace the cylinder head, camshaft, or oil pump, or all of them as a set, and check that the clearance is within the specified range.





23) Inspection of Cylinder Head

- 1. Remove the carbon build-up of the combustion chamber, and check for deterioration, corrosion of mating surfaces, etc.
- Use a straight edge ① and thickness gauge ② to check the distortion of the cylinder head in the directions shown in the diagram. Replace if greater than the specified value.



Cylinder Head Distortion Limit: 0.1 mm (0.004 in)



24) Inspection of Oil Pump

- Use a micrometer, cylinder gauge, depth gauge, and thickness gauge to measure the dimensions shown below. Replace the oil pump if other than the specified value.
- Push the plunger piston and check that it moves smoothly. If it cannot be pushed or does not return, replace the oil pump.
 - Pump body
 Outer rotor
 Inner rotor
 Plunger piston
 Shaft
 Pin
 Plunger spring
 Gasket
 Oil pump cover







25) Installation of Valve

1. Install the valve spring seat ① and new valve stem seal ② onto the valve guide.



• Apply 4-stroke engine oil to the valve spring seat and valve stem seal.

- Install the gray valve stem seal on the air intake side and the green valve stem seal on the exhaust side.
- Install the valve ③, valve spring ④, and retainer ⑤ in the order shown in the diagram, then install the valve spring compressor ⑥.



Valve Spring Compressor (6): Commercially available item

- Use an attachment of 16.5 mm (0.650 in).
- Apply 4-stroke engine oil to the valve stem area, valve spring, retainer, and cotter ⑦. (No oil should be adhered to the valve bevel.)
- When installing the valve spring, the side with the white paint (roughly wound side) should be facing upward (retainer side). (The side with the narrower spring pitch should be facing downward)
- 3. With the valve spring compressed, use a narrow flathead screwdriver with a small amount of grease at the tip to install the cotter.







4. Tap the retainer lightly with a plastic hammer to fasten the cotter securely.



26) Installation of Camshaft

 Apply 4-stroke engine oil onto the outer circumference of the new oil seal ① and install the camshaft with the oil attachment ②.



Oil Seal Attachment (2): P/N. 3AC-99820-0

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Apply cold-resistant grease to the lip of the oil seal before installing the camshaft.





 Apply a sufficient amount of 4-stroke engine oil to the cam ridges, lifters, and journals of the camshaft ③ and install it to the cylinder head from the direction shown in the diagram.



Do not apply 4-stroke engine oil to the driven pulley installation area (a).

27) Installation of Rocker Arm Shaft

1. Apply a sufficient amount of 4-stroke engine oil to the cam ridges of the camshaft and the outer circumferential surface of the rocker arm shaft.





Install the rocker arms ②, collars ③, springs ④, washers
 (5), lifter ⑥, and collars ⑦ while inserting the rocker arm shaft ① into the cylinder head.



Install the lifter in the direction shown in the diagram.

 Apply 4-stroke engine oil to the rocker arm shaft outer periphery, rocker arms, adjusting screws, adjusting nuts, collars, springs, washers, and lifter.



28) Installation of Oil Pump

1. Supply approximately 2 ml of 4-stroke engine oil to the oil passage (a).



2. Install the gasket and oil pump ①.



• Align the camshaft pin (c) to the notch (b) on the oil pump drive shaft.

• Apply 4-stroke engine oil to the insertion area (d) of the oil pump.



29) Installation of Cylinder Head Assy



The No.1 cylinder should be at the top dead center of the compression stroke.

- After temporarily assembling the driven pulley, align the "●I" mark (a) of the pulley (1) to the "▲" mark (b) of the cylinder head.
- Check that the "▲" mark ⓒ of the drive pulley ② is aligned with the "▲" mark ⓓ of the cylinder block.



Make sure that the water jacket insert on the port side of the 3rd cylinder on the cylinder block side has not fallen off.

 Install the cylinder head assy with the new gasket, and tighten the bolts in the order shown in two steps to the specified torgue.

- Do not reuse the cylinder head gasket. Be sure to replace with the new one.
- Do not turn the drive pulley or the driven pulley with the timing belt removed. Doing so can make the pistons and valves interfere with each other, possibly resulting in damage to these parts.

 Apply 4-stroke engine oil to the threaded sections and seats of the cylinder head bolts and to both sides of the washers (1-8).

- Install the washers so that the pressed curve is on top (the bolt side).
- First, tighten the M8 bolts and then the M6 bolts, each in two steps to the specified torque.
- After installing the cylinder head, install the timing belt and check the valve clearance. Refer to the corresponding section (P3-19).









4. Install the cylinder head cover gasket and cylinder head cover.



Apply 4-stroke engine oil to the cylinder head cover gasket.

5. Install the PT relay plate ③. (Power Tilt Model)





- 7. Install the ground lead wire ④.
- 8. Install the ignition coil bracket assy (5) and install the ignition coil couplers and spark plug caps.



• Tighten the ground lead wire together with the ignition coil bracket assy installation bolt.

- Apply silicone grease to the spark plug insertion area of each spark plug cap.
- 9. Secure the wire harness with a band (6).
- Install the various parts of the air intake system and fuel system. (Refer to the section on installing the air intake system & fuel system. 5-81)
- 11 Install the timing belt and driven pulley. (Refer to the section on installing the pulley and timing belt. 5-41)
- 12. Install the flywheel. (Refer to the section on installing the flywheel. 5-37)









4.

16

1. Loosen the bolts in the order shown in the diagram, and remove the thermostat cover ①, the exhaust cover ②, and the bolts.

Remove the oil filter (3) and the oil filter drip tray (4). 2.





Wipe off spilled oil completely.

Loosen the crankcase bolts in several steps in the order

shown in the diagram and remove the crankcase. $\hfill 1$ to

Oil Filter Wrench: P/N. 3AC-99090-0

3. Remove the shift lever shaft (5).





5

3

(4)



- Remove the connecting rod bolts (6) and connecting rod cap (7), and then remove the crankshaft (8) and oil seals.
- 6. Remove the metal bearings from the cylinder block and crankcase.
- Remove the connecting rods and piston assemblies from the cylinder block.
 - Removed bearings should be arranged in the order they are removed.
 - Mark individual pistons with the number (a) corresponding to their cylinders.
 - Connecting rods and caps should be arranged as pairs in the order they are removed. Removed parts should be arranged so that they can be reassembled in their original positions and orientations.
 - Do not reuse piston pin clips. Be sure to replace with new ones.
- 8. Remove the piston pin clip (9) and piston pin, and then remove the piston.





31) Inspection of Cylinder Block

1. Check if there are any scratches on the mating surfaces of the cylinder block and cylinder head.

Repair or replace the cylinder block if there are any scratches that may affect the sealing performance.

To carry out repairs, lay #240-400 water-resistant sandpaper on top of the surface plate, shape the surface, and then use #600 sandpaper for the final finishing.

2. Use a straight edge ① and thickness gauge ② to check the distortion of the cylinder in the directions shown in the diagram.

Repair or replace the cylinder block if greater than the specified value.



Functional Limit: 0.1 mm (0.0039 in)





32) Inspection of Piston Outer Diameter

1. Measure the piston outer diameter between the specified points. Replace if less than the specified value.



(a)

33) Inspection of Cylinder Inner Diameter

Measure the cylinder inner diameters (D1 to D6) at 1. measurement points (a), (b) and (c), taking measurements of D1, D3, and D5 (d) in the direction of the crankshaft and taking measurements of D2, D4, and D6 (e) in the direction of the crank web.



Cylinder Inner Diameters (D1 to D6): **Standard Value** 61.00 mm (2.4016 in) **Functional Limit:** 61.06 mm (2.4039 in)

- The cylinder inner diameter should be measured at the sections where the wear is the largest.
 - · Clean the cylinder if necessary.
- 2. Calculate the taper limit as shown below. Replace the cylinder block if greater than the specified value.



3. Calculate the out-of-roundness limit as described below. Replace the cylinder block if greater than the specified value.





(a) 6 mm (0.2362 in) (b) 38 mm (1.4961 in) © 76 mm (2.9921 in)

(d) Crankshaft direction Crank web direction

34) Inspection of Piston Clearance

1. If the piston clearance is greater than the specified limit, replace the cylinder block, or replace the piston and piston rings as a set, or replace all of them.



Piston Clearance (Cylinder inner diameter – Piston outer diameter):

0.020 to 0.055 mm (0.00079 to 0.00217 in)

Functional Limit:

0.150 mm (0.00591 in)

35) Inspection of Piston Ring Side Clearance

1. Measure the piston ring side clearance. Replace the piston and piston rings as a set if greater than the specified value.



Piston Ring Side Clearance:

Top Ring (a): 0.03 to 0.08 mm (0.0012 to 0.0031 in) Second Ring (b): 0.02 to 0.06 mm (0.0008 to 0.0024 in) Oil Ring (c): 0.03 to 0.13 mm (0.0012 to 0.0051 in)

Functional Limit

Top Ring (a): 0.10 mm (0.0039 in) Second Ring (b): 0.09 mm (0.0035 in) Oil Ring (c): 0.15 mm (0.0059 in)

36) Inspection of Piston Rings

- Push the piston ring ① into the ring gauge parallel to the top edge. Measure the cylinder bore at the top or bottom sections where there is little wear.
- 2. If a ring gauge is not available, push the piston ring into the cylinder with the piston crown in a parallel manner.
- 3. Measure the piston ring end gap (a). Replace if greater than the specified value.



Piston Ring End Gap (a):

Top Ring: 0.13 to 0.25 mm (0.0051 to 0.0098 in) Second Ring: 0.35 to 0.50 mm (0.0138 to 0.0197 in) Oil Ring: 0.20 to 0.70 mm (0.0079 to 0.0276 in)



Functional Limit:

Top ring: 0.50 mm (0.0197 in) Second Ring: 0.70 mm (0.0276 in) Oil Ring: 0.90 mm (0.0354 in)



Replace the oil ring when the top ring or second ring is replaced.





37) Inspection of Piston Pins

1. Measure the piston pin outer diameter. Replace the piston pin if less than the specified value.



Piston Pin Outer Diameter: Standard Value 16.00 mm (0.62992 in) Functional Limit: 15.97 mm (0.62874 in)

2. Measure the piston pin hole inner diameter (a). Replace the piston if greater than the specified value.



Piston Pin Hole ⓐ Inner Diameter: Standard Value 16.002 to 16.008 mm (0.6300 to 0.6302 in) Functional Limit: 16.012 mm (0.6304 in)

 Calculate the clearance between the piston pin and pin hole. Replace the piston pin or piston if greater than the specified value.



Functional Limit: 0.040 mm (0.00157 in)

38) Inspection of Connecting Rod Small End Inner Diameter

 Measure the connecting rod small end inner diameter (a). Replace the connecting rod if greater than the specified value.



16.040 mm (0.6315 in)

39) Inspection of Connecting Rod Big End Side Clearance

 Measure the connecting rod big end side clearance (a). Replace the connecting rod or crankshaft or both if greater than the specified value.



Connecting Rod Big End Side Clearance (a): 0.10 to 0.25 mm (0.0039 to 0.0098 in) Functional Limit:

0.60 mm (0.0236 in)









40) Inspection of Crankshaft

1. Measure the crankshaft journal outer diameters (a) and crank pin outer diameters (b). Replace the crankshaft if less than the specified limit.



Crankshaft Journal Outer Diameter (a): Standard Value 33.988 to 33.996 mm (1.3381 to 1.3384 in) Crank Pin Outer Diameter (b): Standard Value 28.972 to 28.985 mm (1.1406 to 1.1411 in)

Functional Limit

Crankshaft Journal Outer Diameter (a): Replace if 33.97 mm (1.3374 in) or less Crank Pin Outer Diameter (b): Replace if 28.94 mm (1.1394 in) or less





 Measure the crankshaft runout. Replace the crankshaft if greater than the specified value.



Crankshaft Runout Limit: 0.03 mm (0.0012 in)



3. Side Clearance



Side Clearance: 0.05 - 0.15 mm (0.0020 - 0.0059 in)

Functional Limit:

0.6 mm (0.0236 in)

If the side clearance is out of the specified range, measure the crankshaft width (c) and cylinder block width (d), and

replace the part having a width out of the specified range.



Crankshaft Width ⓒ: Standard Value 17.05 - 17.10 mm (0.6713 - 0.6732 in) Cylinder Block Width ⓓ: Standard Value 16.95 - 17.00 mm (0.6673 - 0.6693 in)



41) Inspection of Crank Pin Oil Clearance

- 1. Clean the connecting rod and metal bearings. Re-install the metal bearings.
- 2. Install the piston (1) to the connecting rod (2).



- Install the piston so that the piston "O" mark (a) and connecting rod "UP" mark (b) are located at the positions shown in the diagram.
- The piston should be installed without piston rings.
- З. Place the mark (a) of the piston on the flywheel side (C), set the connecting rod assy in the piston slider (3), and install the assy in the cylinder.



- Before installing, apply molybdenum grease and then 4-stroke engine oil to the piston outer surface, and then apply 4-stroke engine oil to the piston slider.
- · Clean and remove piston carbon.



- Install the crankshaft on the cylinder block. 4.
- 5. Place the Plastigauge (4) in each crank pin (5) so that it is parallel to the crankshaft.



Do not place the Plastigauge on the oil hole of the crank pin.

Install the connecting rod and connecting rod cap (6) in the 6. crank pin.



- · Be sure that each cap is installed on its original connecting rod.
- Check that the "UP" mark on the connecting rod cap is facing the crankshaft flywheel side.
- Tighten the connecting rod bolts in two steps to the 7. specified torque.



Do not move the connecting rod and crankshaft until the oil clearance measurement is completed.



Connecting Rod Bolts:

First Tightening Torque: 6 N·m (4 lb·ft) [0.6 kgf·m] Second Tightening Torque: 10 N·m (7 lb·ft) [1.0 kgf·m]









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Remove the connecting rod cap (6) and measure the width of the crushed Plastigauge (4) on each crank pin (5).
 Replace the connecting rod (2) or crankshaft if greater than the specified value.



Crank Pin Oil Clearance:

0.015 – 0.041 mm (0.0006 – 0.0016 in)

Functional Limit:

0.060 mm (0.00236 in)

42) Inspection of Crankshaft Main Journal Oil Clearance

- 1. Clean the bearings, crankshaft main journals, and bearing mounting surfaces of the crankcase and cylinder block.
- Place the cylinder block on a workbench with the cylinder head side facing downward.
- Install the bearings ① and crankshaft ② in the cylinder block ③.



• Be sure that each bearing is installed in its original location.

- Align the protrusion (a) on the bearings to the groove (b) on the cylinder block to install them.
- 4. Place a Plastigauge ④ in each crankshaft main journal so that it is parallel with the crankshaft.



Do not place the Plastigauge on the oil hole of the crankshaft main journal.

5. Install the bearings in the crankcase.



- Install the bearings with their protrusions fitted into the crankcase grooves.
- 6. Install the crankcase in the cylinder block.
- 7. Tighten the crankcase bolts in two steps to the specified torque in the order shown in the diagram.











 Loosen the bolts in the reverse order in several steps. Remove the crankcase and measure the width of the crushed Plastigauge on each main journal. Replace the bearings if greater than the specified limit.



Crankshaft Main Journal Oil Clearance: 0.012 to 0.044 mm (0.00047 to 0.00173 in)

Functional Limit:

0.060 mm (0.00236 in)



If the clearance is less than the specified value, check that the inner diameter codes are as shown below.



43) Inner Diameter of Cylinder/Crankcase Bearing Holder (Inner Diameter Codes)

The top part of the cylinder is marked with the inner diameter codes (a) to indicate the inner diameters of each bearing holder. The inner diameter codes indicate the following two types of bearings. Check the code and select the bearing accordingly.

Inner diameter code ⓐ	Standard value	Bearing color
A	37.000 to 37.008 mm (1.45669 to 1.45701 in)	Blue
В	37.008 to 37.016 mm (1.45701 to 1.45732 in)	Red



The inner diameter codes A and B indicate the size of each bearing section.

44) Thickness of Metal Bearing (Color of Inner Diameter Code)

The bearings are painted in a color (a) that indicates their thickness. The colors indicate the following two types of bearings. Use the proper bearings.

[Color (Inner Diameter Code)]	Thickness	
Blue	1.488 to 1.494 mm (0.05858 to 0.05882 in)	
Red	1.494 to 1.500 mm (0.05882 to 0.05906 in)	





45) Installation of Piston and

Connecting Rod

 Install the connecting rod (2), piston pin (3) and piston pin clips (4) in the piston (1).



• Align the connecting rod "UP" mark (a) and piston "O" mark (b) to the positions shown in the diagram.

- Be sure to use new piston pin clips, and place the clip gap away from the piston pin groove ⓒ as shown.
- Be sure to install each connecting rod cap to its original connecting rod.
- Apply 4-stroke engine oil to the piston pin hole, piston pin outer periphery, and connecting rod small end inner diameter.
- 2. Place the expander (5) (#4) into the oil ring groove and check that the ring ends meet each other correctly as shown in the diagram.
- Install by sliding the end of the upper side rail (#3) to the left by 90° from the gap in the expander (#4) while pressing down on the expander (#4) gap with your thumb.
- 4. Similarly, place the lower side rail (#5) into the groove by shifting it 90° to the right from the gap.
- Install the second ring (#2 taper) and top ring (#1) in the piston. Install the top ring (#1) and second ring (#2) so that the respective manufacturer marks (d) (T) are on top.

Piston Ring Tool: P/N. 353-72249-0

6. Install the piston rings so that their gaps are away from each other as shown in the diagram on the right.

▲ CAUTION

Be careful not to scratch the piston surface and damage the rings.

- Install the piston rings so that their gaps are away from the thrust direction of the piston and the direction of the piston pin.
 - After installing the piston rings, check that they move smoothly.









- Set the piston into the piston slider (6) with the piston "O" mark on the flywheel side (e), and install it in the cylinder.
 - Before installing, apply molybdenum grease and then 4-stroke engine oil to the piston outer surface, and then apply engine oil to the piston ring and the piston slider.
 - Clean and remove piston carbon.

Piston Slider (6): P/N. 3AC-72871-0

- Degrease the metal bearing holder surface of the cylinder and bearing contact surface (X) (f).
- 9. Install one side of the bearing ⑦ in the cylinder block ⑧ and connecting rod.



- Be sure that each bearing is installed in its original location.
- Align the protrusion (9) on the bearings to the groove (h) on the cylinder block to install them.
- 10. Apply (O) 4-stroke engine oil to the bearings and crankshaft ().
- 11. Install the crankshaft (9) and oil seals (10) and (11) in the cylinder block as shown in the diagram.



Apply cold-resistant grease on the lip of the oil seal before installing it.







12. Install the connecting rod cap ⁽¹⁾/₍₂₎ on the connecting rod, and tighten the connecting rod bolts ⁽³⁾/₍₃₎ to the specified torque in two steps.



Connecting Rod Bolts (3):

First Tightening Torque: 6 N·m (4 lb·ft) [0.6 kgf·m] Second Tightening Torque: 10 N·m (7 lb·ft) [1.0 kgf·m]



- Be sure to install each connecting rod cap to its original connecting rod.
- Install the connecting rod cap with the mark "UP" facing the direction shown in the diagram.
- Apply 4-stroke engine oil to the threaded areas and seats of the connecting rod bolts.



46) Assembly of Cylinder Block

1. Degrease the bearing holder surface of the crankcase and the bearing contact surface, and install one side of the bearing in the crankcase.



• Be sure that each bearing is installed in its original location.

- Install the bearings with their protrusions fitted into the crankcase grooves.
- Degrease the bearing holder surfaces of the crankcase journal bearings and the contact surfaces of the bearings.
- 2. Apply 4-stroke engine oil to the bearings.
- 3. Apply a sealing agent to the mating surface (one side) of the crankcase.



• Degrease the mating surfaces of the cylinder and crankcase.

- Be careful not to allow the sealing agent to adhere to the bearings.
- Apply the sealing agent (Loctite 5910) to the inner side of the mating surface (one side) of the crankcase as shown in the diagram, taking care to ensure that no excess agent protrudes out.
- Apply the sealing agent (Loctite 5910) uniformly at a thickness of approximately 2 mm (0.08 in) so that it does not run out in the middle.




- 4. Install the crankcase in the cylinder block.
- Tighten the crankcase bolts, first the M8 bolts and then the M6 bolts, to about half of the specified torque in the order shown.

Then tighten to the specified torque in the order of M8 bolts and M6 bolts.





- 6. Install the oil filter drip tray (1) and oil filter (2).
 - Apply a thin coat of 4-stroke engine oil to the contact area (a) of the oil filter O-ring.
 - Pour a small amount of 4-stroke engine oil into the oil passage (b) of the oil filter bolt.
 - Apply a thin coat of 4-stroke engine oil to the oil filter O-ring.

Oil Filter Wrench: P/N. 3AC-99090-0

Oil Filter: 18 N ⋅ m (13 lb ⋅ ft) [1.8 kgf ⋅ m]

·····

 Install the exhaust cover gasket ③, exhaust cover ④, thermostat ⑤, thermostat gasket ⑥, and thermostat cover ⑦.



• Use a new gasket.

• Tighten the exhaust cover bolts in the order shown in the diagram.

Exhaust Cover Bolt: 9 N · m (7 lb · ft) [0.9 kgf · m]







8. Install the shift lever shaft (8).



- Apply cold-resistant lithium grease to the shift lever shaft and shift lever shaft installation area.
 Apply a screw locking agent (ThreeBond 1342) to the bolts.
- 9. Install the cylinder head.



For the installation procedure, refer to "Installation of Cylinder Head."

10. Install the pulley and timing belt.



For the installation procedure, refer to "Installation of Pulley and Timing Belt."

47) Installation of Electrical System Parts

1. Install the starter motor ①. (Electric Starter Model)



Apply a thin coat of water-resistant grease to the pinion area.

2. Install the neutral switch ② and tighten to the specified torque. (Electric Starter Model)



Neutral Switch: 3.5 N ⋅ m (2.6 lb ⋅ ft) [0.35 kgf ⋅ m]



(8)



3. Install the rectifier (3). (Electric Starter Model)



Apply water-resistant grease to the rectifier gasket.



4. Install the oil pressure switch ④ and tighten to the specified torque.



Apply a screw locking agent (ThreeBond 1327) to the threaded area of the oil pressure switch.

Oil Pressure Switch: 8 N · m (5.9 lb · ft) [0.8 kgf · m]

Install the electrical box (5) and install the bolts (6) (5 locations).





6. Install the oil pressure switch lead wire ⑦ and the ground lead wire ⑧ (Power Tilt Model).



Oil Pressure Switch Screw: 1.6 N · m (1.2 lb · ft) [0.16 kgf · m]



Apply silicone grease on the oil pressure switch lead wire screw.

- 7. Install the ground lead wire (9).
- 8. Connect the rectifier coupler (1). (Electric Starter Model)





Power Unit

9. Install the PT relay plate (1) and the ground lead wire (2). (Power Tilt Model)



10. Connect the engine temperature sensor coupler (13).



- 11. Install the ground lead wire (4).
- 12. Install the ignition coil bracket assy (15).



Tighten the ignition coil ground lead wires together with the bolt (6).

- 13. Connect the ignition coil couplers \bigcirc .
- 14. Connect the spark plug caps (18).



Apply silicone grease to the spark plug insertion area of each spark plug cap.

15. Connect the starter solenoid lead wire (19) and neutral switch connector (20).



Starter Solenoid Lead Wire Nut: 4.8 N · m (3.5 lb · ft) [0.48 kgf · m]





16. Secure the wire harness with a band 1.



17. Install the coil bracket assy, alternator assy, and flywheel.



Refer to the section on installing the flywheel (5-37)

18. Install the parts of the air intake system and fuel system.



Refer to the section on installing the air intake system & fuel system (5-81)

48) Installation of Air Intake System & Fuel System

1. Install the intake manifold assy ①.



Apply 4-stroke engine oil to the intake manifold gasket.

2. Install the fuel pump (2) in the head cover.



• Apply 4-stroke engine oil to the O-ring and plunger tip of the fuel pump.

• Install the fuel pump in the direction shown in the diagram.





Power Unit

3. Install the fuel filter ③.



The fuel filter should be level with the engine when installed.



4. Install the throttle link ④.



Apply cold-resistant lithium grease to the throttle link installation area of the throttle valve.

- A Basic Tiller Handle Model
- B Multi-Function Tiller Handle Model, Remote Control Model





 Connect the throttle position sensor coupler (5), T-MAP sensor coupler (6), and ISC coupler (7).





7. Connect the injector couplers (9).

Install the belt cover, and connect the vent hoses 10. 8.

9. Connect the breather hose 1 and the breather hose 2.

10. Secure the wire harness with a band (13), and secure the wire harness and pulser coil connector with a band (4).

11. Secure the fuel hose with the clamp (15).

5-83



(15)







(9

49) Installation of Oil Strainer

Power Unit

1. Install the oil strainer ① to the hose, and install the hose to the nipple.



50) Installing the Power Unit

- Clean the mating surface of the power unit, and install a new gasket ① and nipple ②.
- 2. Install the dowel pin (3).



3. Hoist and install the power unit.



4. Install the power unit installation bolts and tighten them to the specified torque in two steps in the order shown in the diagram.



Apply water-resistant grease to the power unit installation bolts.

Power Unit Installation Bolt: First Tightening Torque: 15 N·m (11 lb·ft) [1.5 kgf·m] Second Tightening Torque: 30 N·m (22 lb·ft) [3.0 kgf·m]



A S B P



 Connect the vapor separator drain hose ④, cooling water hose (drive shaft housing - vapor separator) ⑤, and the vent hose ⑥.

 Connect the cooling water hose (vapor separator - cooling water check port) ⑦. 5





7. Connect the fuel hose (8).

Power Unit

 Connect the PT motor couplers (9) and PT switch coupler (10). (Power Tilt Model)









9. Connect the indicator lamp connectors (1).

10. Install the battery cable (2). (Electric Starter Model)

11. Install the shift rod (13) and shift lever rod (14) (Basic Tiller Model).

12. Install the cover (15).

13. Install the apron 16.



Install the apron with the front side extended.



(18)

14. Install the starter lock cable ⑦, and install the recoil starter(18) (three bolts).

- 5

15. Install the oil level gauge (19).

16. Fill with the specified amount of engine oil.



51) Removal of Recoil Starter

Power Unit

Adjustment of Starter Lock Cable

- 1. Shift the gear into neutral (N).
- 2. Check that the maximum diameter of the slide ① aligns with the neutral start mark ②.



Slide
 Neutral start mark



- 3. If not, adjust the lower side of the cable.
- 4. Perform a shift operation to check that the recoil starter is locked in a position other than neutral (N).

52) Disassembly of Recoil Starter

- 1. Disconnect the upper starter lock cable.
- 2. Remove the bolts, and then the recoil starter and belt cover.
- Place the rope into the groove of the reel (1) and gently turn the reel clockwise to release the tension of the starter spring.



When replacing the rope only, do so at this time. The rope can be replaced without disassembling the recoil.





1) Reel

- 4. Remove the starter shaft screw (2) and then the friction plate (3) and spring (4).
- 5. Take out the reel carefully.

6. Remove the E-ring (5), and remove the ratchet (7), ratchet guide (8), and return spring (9).





(5) E-ring(6) Reel(7) Ratchet

⑧ Ratchet Guide⑨ Return Spring

-1

pring

7. Remove the starter spring 1.



It is not necessary to remove the starter spring from the starter case if replacement is not necessary. The starter spring can be inspected without removal from the starter case.



1 Starter Spring

53) Inspection of Recoil Starter

- 1. Check the ratchet, starter lock, and all springs. Replace if any deformation, wear, or damage is found.
- 2. Check the reel and starter case. Replace if any crack or damage is found.
- Check the starter rope. Replace if any wear, unraveling, or damage is found.

Power Unit

54) Installation of Recoil Starter

Assembly is performed in the reverse order of disassembly, but the following points should be noted.

- When setting the starter spring into the starter case, face the starter spring outer edge hook to the right and set it into the peripheral cut of the starter case.
- \bullet Pass the starter rope through the rope guide (1).
- When installing the reel into the starter case, set the protrusion of the reel in the inner hook of the starter spring.
- Parts to which cold-resistant lithium grease is applied
 - · Starter Spring
 - · Reel Center Hole
 - · Ratchet
 - · Starter Lock
 - · Friction Plate
- Apply "ThreeBond 1342" to the starter shaft screw, and tighten the screw to the specified torque.



Starter Shaft Screw: 6 N · m (4 lb · ft) [0.6 kgf · m]

- When applying tension to the starter spring, turn the reel 4 to 5 times in the direction in which the reel rotates when pulling out the rope (left rotation).
- After installing the recoil starter to the outboard motor, perform a shift operation to check that the starter is locked in a position other than neutral (N).



① Rope Guide



(2) Friction Spring

③ Friction Plate

(4) Starter Shaft Screw





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1. Special Tools

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Spring Pin Tool A P/N. 345-72227-0	Spring Pin Tool B P/N. 345-72228-0	Bevel Gear B Nut Wrench P/N. 346-72231-0	Bevel Gear B Nut Socket P/N. 346-72232-0
Removing spring pin	Installing spring pin	Removing and instal	ling bevel gear B nut
	ø79.5 x ø51.5		
Thickness Gauge P/N. 353-72251-1	Center Plate P/N. 3VS-99701-0	Driver Rod P/N. 3AC-99702-0	Roller Bearing Attachment P/N. 3AC-99710-0
Measuring gaps	Positioning propeller shaft housing roller bearing	Installing and removing bearing and oil seal	Installing propeller shaft housing roller bearing
ø51.5 x ø24.5	ø27.5 x ø15.5	ø29.5 x ø16.5	3BJ-72732-0
Bearing Attachment P/N. 3AC-99905-0	Oil Seal Attachment P/N. 3AD-99820-0	Oil Seal Attachment P/N. 3AG-99820-0	Bearing Outer Press Kit P/N. 3B7-72739-1
Installing bevel gear C ball bearing	Installing oil seal of propeller shaft housing	Installing pump case (lower) oil seal	Bevel Gear Assy A Installing bearing outer race
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Backlash Measuring Tool Clamp P/N. 3B7-72720-0	Dial Gauge Plate P/N. 3B7-72729-0	Shimming Gauge P/N. 346-72250-0	Backlash Measuring Tool Kit P/N. 3C8-72234-2
Measuring backlash	For installing dial gauge during backlash measurement	Adjusting height of bevel gear B	Measuring bevel gear assy A, bevel gear B backlash

STATE STATE		- Det.	
Universal Puller Plate P/N. 3AC-99750-0	Bevel Gear Bearing Installation Tool P/N. 346-72719-0	Slide Hammer Kit P/N. 3AC-99080-0	Roller Bearing Press Kit P/N. 3AC-72900-3
Removing bearing	Bevel Gear Assy A Installing bearing	Bevel Gear Assy A Removing bearing outer race	Installing and removing gear case roller bearing

2. Parts Layout

Gear Case (Drive Shaft)



Ref. No.	Part Name	Q'ty	Remarks
1	Gear Case Assy	1	
2	Roller Bearing	1	
3	Plug	2	
4	Gasket	2	Do not reuse.
5	Trim Tab	1	
6	Bolt	1	
7	Water Strainer	1	
8	Screw	1	
9	Water Strainer	2	
10	Screw	1	
11	Nylon Nut	1	
12	Nut	1	
13	Bevel Gear B	1	
14	Drive Shaft Spring Guide	1	
15	Drive Shaft Spring	1	
16-1	Drive Shaft (S)	1	
16-2	Drive Shaft (L)	1	
16-3	Drive Shaft (UL)	1	
17	Кеу	1	
18	Tapered Roller Bearing	1	
19-1	Shim 35-41.9-0.1	1	
19-2	Shim 35-41.9-0.15	1	
19-3	Shim 35-41.9-0.3	1	
19-4	Shim 35-41.9-0.5	1	
20	Oil Seal 17-30-9	1	Do not reuse.
21	Pump Case Gasket (Lower)	1	Do not reuse.
22	Pump Case (Lower)	1	
23	Dowel Pin 4-10	2	
24	Water Seal Rubber	1	
25	Water Seal Plate	1	
26	Bolt	2	
27	Guide Plate Gasket	1	Do not reuse.
28	Water Pump Guide Plate	1	
29	Pump Case Gasket	1	Do not reuse.
30	Water Pump Impeller	1	
31	Pump Case Liner	1	
32	Pump Case (Upper)	1	
33	Bolt	4	
34	O-ring 2.4-5.8	2	Do not reuse.
35-1	Cam Rod (S)	1	
35-2	Cam Rod (L)	1	
35-3	Cam Rod (UL)	1	
36	Spring Pin 3-12	2	Do not reuse.
37	Clutch Cam	1	
38	Water Pipe Auxiliary Mount	1	
39	Lock Plate	1	
40	Water Pipe Seal (Upper)	1	



Ref. No.	Part Name	Q'ty	Remarks
41-1	Water Pipe (S)	1	
41-2	Water Pipe (L)	1	
41-3	Water Pipe (UL)	1	
42	Water Pipe Seal (Lower)	1	
43	Bolt	4	
44	Washer	4	

Gear Case (Propeller Shaft)



Ref. No.	Part Name	Q'ty	Remarks
1	Tapered Roller Bearing 30205	1	
2-1	Shim 26.5-34.8-0.1	1	
2-2	Shim 26.5-34.8-0.15	1	
3	Bevel Gear Assy (A)	1	
4	Push Rod	1	
5	Ball 3/8	1	
6	Spring Retainer	1	
7	Snap	1	
8	Pin	1	
9	Clutch	1	
10	Spring	1	
11	Propeller Shaft	1	
12	Washer Bevel Gear C 18-24-1.5	1	
13	Bevel Gear C	1	
14	Propeller Shaft Housing Assy	1	
15	O-ring 3-62.5	1	Do not reuse.
16	Ball Bearing 6205	1	Do not reuse.
17	Roller Bearing 18-25-2.5	1	Do not reuse.
18	Oil Seal 18-28-8	2	Do not reuse.
19-1	Propeller Assy (8)	1	
19-2	Propeller Assy (9)	1	
19-3	Propeller Assy (10)	1	
19-4	Propeller Assy (11)	1	
19-5	Propeller Assy (12)	1	
19-6	Propeller Assy (13)	1	
19-7	Propeller Assy (14)	1	
20	Bolt	2	
21	Washer	2	
22	Propeller Hardware Kit	1	
23	Thrust Holder	1	
24	Washer 12.5-32-2.5	1	
25	Propeller Nut	1	
26	Split Pin 3-22	1	Do not reuse.

3. Inspection Items

1) Draining Gear Oil

1. Drain the gear oil. Refer to "Replacement of Gear Oil" in Chapter 3.



• Drain all gear oil, and check for metal particles in the drained oil.

- Check the gear oil color. A white or cream color may indicate that the gear oil is contaminated by water.
- Take note of the points above and use them as a reference to check the disassembly and to check for damage to the gear, oil seals, gaskets, etc.



- Before removing or installing the propeller, be sure to disconnect the battery cables from the battery, then remove the stop switch lock plate.
- When removing or installing the propeller, do not handle the propeller with your bare hands.
- Put a wooden block or similar object between the anti-ventilation plate and propeller when removing or installing the propeller.
- 1. Shift the gear into forward (F).



 Put a wood block or the like between the anti-ventilation plate and propeller ④ to prevent the propeller ④ from accidental rotation. Pull out the split pin ①, loosen the propeller nut ②, and then remove the propeller ④.



Split Pin
 Propeller Nut
 Washer
 Propeller
 Thrust Holder

3) Removal of Lower Unit

🗥 WARNING

When working with the outboard motor in the tilt up position, be sure to lock it with the tilt stopper.



- Removal of the lower unit does not require the power unit to be removed from the outboard motor.
- When removing the lower unit from the outboard motor, tilt up the outboard motor to make the work easier.
- 1. Shift the gear into Forward (F) to pull up the shift rod.
- 2. Remove the shift rod joint retainer (1).
- Remove the spring pin and disconnect the shift rod. Remove the shift rod joint (2).



Use the spring pin tool A ③ to remove it.
Do not reuse the removed spring pin.

Spring Pin Tool A ③: P/N. 345-72227-0





4. Remove the lower unit installation bolts (four), and pull down the lower unit assy.

Hold the lower unit during removal to prevent the unit from dropping onto the floor.



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4) Removal of Water Pump and Cam Rod

1. Loosen the installation bolts in the pump case (upper), and remove the pump case (upper) ①-②-③-④.





5



2. Remove the water pump impeller key (5).

3. Loosen the installation bolt in the pump case (lower) and remove the pump case gasket (6), guide plate (7), guide plate gasket (8), and pump case (lower) (9).

When removing the pump case (lower), insert flathead screwdrivers into the groove of the case, and pry slowly to separate the pump case (lower).



- Check the pump case liner ① and guide plate ② for deformation and wear. Replace if necessary.
- 2. Check the pump impeller ③ for cracks, damage, and wear.

Replace if necessary.

• The impeller may have glossy or melted areas if rotated with insufficient water.

- Even if the impeller shows no surface abnormality, the impeller rubber may be separated from the impeller center hub.
- If the guide plate has a groove of 0.5 mm or greater due to wear by the impeller, replace it.
- Check the impeller key ④ and key groove for wear. Replace if necessary.

6) Inspection of Water Pipe

- Remove the water pipe ① from the drive shaft housing. Refer to "Disassembly of Drive Shaft" in Chapter 7.
- 2. Check the water pipe ① for corrosion, deformation, and clogging.







7) Disassembly of Water Pump Case (Lower)

1. Remove the oil seal.



Be careful not to damage the oil seal press fit surface.



Do not reuse.

8) Assembly of Water Pump Case (Lower)

1. Install and press fit the oil seal (1) by pressing.



• Apply gear oil to the oil seal circumference (a) before installing the oil seal.

Apply lithium grease to the oil seal lip (b).



Driver Rod (2): P/N. 3AC-99702-0 Oil Seal Attachment (3): P/N. 3AG-99820-0





9) Disassembly of Cam Rod

1. Remove the clutch cam (1).



Spring Pin Tool A ② (ø3.0): P/N. 345-72227-0



10) Inspection of Clutch Cam

1. Check the part for wear and damage. Replace if necessary.



Check especially for wear on the surface (a) that contacts the clutch push rod and flaws on the circumference (b).



11) Assembly of Clutch Cam

1. Attach the clutch cam (2) to the cam rod (1).



Spring Pin Tool B ③ (ø3.0): P/N. 345-72228-0



④ Spring Pin Do not reuse.

2. Install the spring pin ④.





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12) Removal of Propeller Shaft Housing Assy

1. Remove the propeller shaft assy.

Use a plastic hammer to remove the assy if it cannot be removed by inserting a flathead screwdriver or the like.



 Hold the propeller shaft and fully pull out the propeller shaft housing assy.



When pulling out the propeller shaft housing assy, remove the clutch push rod together with the housing assy, being careful not to let it fall.



13) Disassembly of Propeller Shaft Housing Assy

Do not reuse a removed bearing.

the bevel gear C and propeller shaft housing.

Universal Puller Plate: P/N. 3AC-99750-0

Tighten the universal puller plate to create a gap between





2. Remove the bevel gear C by putting two flathead screwdrivers into the gap to pry the gap open.

1.

3. Use a commercially available bearing puller to remove the ball bearing.



Before removal, check the bearing for play or deflection. Replace if necessary.



4. Remove the oil seal ①.



Do not scratch the housing when removing the oil seal.



5. Remove the roller bearing (2).



Driver Rod ④: P/N. 3AC-99702-0



2 Roller Bearing Do not reuse.

14) Inspection of Propeller Shaft Housing

1. Clean the propeller shaft housing, and check it for cracks or damage.

Replace if necessary.



- Check the teeth and dog sections of the bevel gear C for cracks and abnormal wear. Replace if necessary.
- 3. Check the bearing for abnormalities.



15) Assembly of Propeller Shaft Housing

1. Use a press to install a new roller bearing in the propeller shaft housing to the specified depth.



Assemble the roller bearing with the manufacturer mark (a) on the bevel gear C side.
Gently screw in the roller bearing attachment (1) by hand, making sure a gap does not occur between the attachment and the driver rod (2).

 Roller Bearing Attachment ①: P/N. 3AC-99710-0
 Driver Rod ②: P/N. 3AC-99702-0
 Center Plate ③: P/N. 3VS-99701-0

> Assembled Depth (b): 14 ± 0.2 mm (0.5512 ± 0.0079 in)



2. Install the oil seal (1).



Driver Rod (2): P/N. 3AC-99702-0 Oil Seal Attachment (3): P/N. 3AD-99820-0

- Install the oil seal with the mark facing the tool side.
 - Clean the oil seal installation face and apply gear oil before installation.
 - Apply lithium grease to the lip of the oil seal after installation.





① Oil Seal Do not reuse.



3. Install the ball bearing (4).

Use the C gear bearing press tool (5) to assemble a new bearing to the propeller shaft housing.



• Clean the bearing installation surface and apply gear oil before installation.

• Install the bearing with the mark facing the tool side.



C Gear Bearing Press Tool (5): P/N. 3AC-99905-0 **Driver Rod** (6): P/N. 3AC-99702-0





④ Ball Bearing Do not reuse.

4. Assemble the bevel gear C 7 to the bearing using a press and an appropriate mandrel.



• Clean the bearing installation surface of the bevel gear C and apply gear oil before installation.

• Use a mandrel that contacts the inner face of the bevel gear (not the clutch face).





④ Bearing Do not reuse.

16) Disassembly of Propeller Shaft Assy

1. Remove the push rod (1) and ball (2).

- Insert a flathead screwdriver into one end of the clutch pin snap ③, and remove the snap from the clutch groove while winding it.



③ Clutch Pin Snap Do not reuse.

Pull out the clutch pin ④, and remove the spring retainer
 ⑤ and clutch spring ⑥ while referring to the diagram.



4. After removing the clutch spring and spring retainer, remove the clutch ⑦ from the propeller shaft.





17) Inspection of Propeller Shaft Assy

- 1. Check the propeller shaft for bends, wear, and damage. Replace if necessary.
- 2. Measure the propeller shaft runout.



3. Check the clutch dogs (b) and push rod (c) for cracks and wear.

Replace if necessary.



(a) Support Points


18) Assembly of Propeller Shaft Assy

Attach the spring ①, spring retainer ②, push rod ③, ball
 ④, clutch ⑤, and clutch pin ⑥ to the propeller shaft.

• Attach the clutch with the groove side (a) facing the push rod side.

- Attach the clutch pin while applying preload to the push rod.
- Be careful not to allow the push rod to fly out by spring tension.





⑦ Clutch Pin Snap Do not reuse.





- 2. Attach a new clutch pin snap ⑦ by using a flathead screwdriver to turn the snap.
 - When attaching the clutch pin snap, do not apply excessive force to the snap. Doing so may cause the snap to expand during the operation of the engine, severely damaging the gear and/or other parts.
 - This can also be done by using the following tool.
- 3. After assembly, check that clutch can be operated smoothly, taking care not to allow the push rod to drop out.



⑦ Clutch Pin Snap Do not reuse.

19) Removal of Bevel Gear Assy A

- Place your hand inside the gear case and remove the bearing ① and bevel gear assembly A ②.

• The bevel gear assy A can be removed by pinching the assy in the gear case with your fingers and pulling it out from your thumb side while lifting it up slightly.

• Remove the assy without hitting the bevel gear B.





20) Disassembly of Bevel Gear Assy A

1. Use a universal puller plate to create a gap between the ball bearing and forward gear.

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Universal Puller Plate: P/N. 3AC-99750-0



 Insert two flathead screwdrivers into the gap and pry out the bevel gear assy A from the bearing.



Before removal, check the bearing for play or deflection. Replace if necessary.



21) Inspection of Bevel Gear Assy A

 Check the bevel gear assy A teeth and clutch claws for cracks, damage, or wear. Replace if necessary.



22) Assembly of Bevel Gear Assy A

- Install the shim ① removed during disassembly and install the taper roller bearing ② using a press.
- Replace the shim with a new one of the same thickness if any deformation or damage is found.
- Apply gear oil to the contact surface of the taper roller bearing when installing the taper roller bearing.



Bevel Gear A Bearing Installation Tool ③: P/N. 346-72719-0





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23) Removal of Drive Shaft

 Remove the bevel gear B nut ①, and remove the bevel gear B ② and drive shaft.



• Degrease the bevel gear B nut completely so that the nut wrench does not slip on the nut.

- Loosen the nut by rotating the bevel gear B nut socket ③ in a counterclockwise direction with a wrench. Cover the bevel gear B nut wrench ④ with a rag or the like to prevent it from hitting the gear case directly.
- This work can be made easier when the opening of the gear case on the propeller shaft side is faced upward and fixed horizontally with a vice or other holder.

Bevel Gear B Nut Socket ③: P/N. 346-72232-0 Bevel Gear B Nut Wrench ④: P/N. 346-72231-0





- 2. Pull out the drive shaft from the gear case.
 - When removing the drive shaft, be careful not to damage the shim on the bearing outer race or lose the part.
 - Replace the shim with a new one of the same thickness if any deformation or damage is found.



3. Remove the drive shaft spring guide (5).



24) Disassembly of Drive Shaft

- 1. Remove the shim (1) and outer race (2).
- 2. Remove the drive shaft spring (3).
- 3. Use the universal puller plate (4) to remove the taper roller bearing (5) with a press.

A CAUTION

Do not reuse the removed bearing. Be sure to replace it with a new one.

· Check the bearing for play or deflection before removal, and replace if necessary.

• When applying the universal puller plate to the bearing, hook the tip of the puller claw onto the inner race of the bearing correctly.

Universal Puller Plate (4): P/N. 3AC-99750-0

25) Inspection of Drive Shaft

Measure the drive shaft runout.

Runout Limit:

0.5 mm (0.020 in)

Replace if necessary.

Check the drive shaft for bends and wear.



(5) Taper Roller Bearing Do not reuse.



(5) Taper Roller Bearing Do not reuse.





1.

2.

26) Inspection of Bevel Gear B

 Check the teeth and spline of the bevel gear B for cracks, damage, and wear. Replace if necessary.



27) Assembly of Drive Shaft

 Use a press and an appropriate pipe to install the taper roller bearing (1).

Before installing the taper roller bearing, clean and then apply gear oil to the drive shaft installation surface.



Do not press the drive shaft thread (a) directly. Place a protector (suitable steel plate) on

the tip of the shaft.





① Taper Roller Bearing Do not reuse.

Duter Diameter: 26.9 mm (1.06 in)
 Inner Diameter: 20 mm (0.79 in)

2. Install the drive shaft spring 2.



With the small diameter side of the spring down, align the end turn with the groove on the lower side.



28) Disassembly of Gear Case

1. Use the tools below to remove the roller bearing (f).



A CAUTION

When installing the flange ② and guide ③, be sure that the "F" mark is in the forward direction.



1 Roller Bearing



 Remove the outer race (6) of the taper roller bearing. Place the slide hammer inside the gear case, hook the claws of the slide hammer onto the outer race to secure the hammer, and slide the hammer to pull out the outer race.



Slide Hammer Kit: P/N. 3AC-99080-0

Check the positions of the insertion grooves at the rear of the outer race position and insert the claws of the slide hammer into them.



6 Outer Race Do not reuse.

29) Inspection of Gear Case

- 1. Check the skeg (a) and torpedo-like area (b) for cracks and other damage.
 - Replace if necessary.



30) Assembly of Gear Case

▲ CAUTION

When the gear case, bevel gear assy A gear, or bearing is replaced, measure the backlash and select and install a proper shim.

Refer to Chapter 6, "Shim Adjustment."

Use the tools below to install the bearing outer (1). 1.

> Roller Bearing Outer Press Kit 2: P/N. 3B7-72739-1 **Bearing Outer Press Plate** ③: P/N. 3BJ-72732-0

3



4. Apply gear oil to the external face of the outer race, and position the outer race in the center of the housing with the marked face of the race facing the inside of the housing.



apply gear oil.

5. Press the end of the rod to press-fit the outer race in the housing securely using a press.



2.

3.

6. Install the roller bearing ④ using the tools below.



Roller Bearing Press Kit: P/N. 3AC-72900-3 Roller Bearing Outer Press Flange (5): P/N. 3AC-72900-2 Roller Bearing Outer Press Guide (6): P/N. 3AC-72765-2 Roller Bearing Press Rod (7): P/N. 3RS-72769-0 Roller Bearing Press (8): P/N. 3VS-72770-0

▲ CAUTION

- When installing the guide (6) and flange (5), be sure that the "F" mark is in the forward direction.
- Install the bearing with the marked side facing upward.
 - When installing the roller bearing, clean the installation surface of the bearing and apply gear oil before insertion.
 - Do not reuse the roller bearing. Use a new bearing.

Installation Depth (a):

165.5 - 165.8 mm (6.516 - 6.528 in)



④ Roller Bearing Do not reuse.



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31) Assembly of Bevel Gear B

1. Install the drive shaft spring guide (1) and drive shaft (2).



Apply gear oil to the bearing section of the drive shaft.





- Install the bevel gear B (3) and tighten the bevel gear B nut
 (4) to the specified torque.
 - Tighten the nut by rotating the drive shaft socket (5) in the clockwise direction with a wrench. Cover the bevel gear B nut wrench (6) with a rag or the like to prevent it from hitting the gear case directly.
 - This work can be made easier when the opening of the gear case of the propeller shaft side is faced upward and fixed horizontally with a vice or other holder.
 - Degrease the tapered section of the bevel gear B mounting on the drive shaft and the threaded section of the gear nut completely.
 - Apply ThreeBond 1373B to the threaded section when tightening the bevel gear B nut.



Bevel Gear B Nut ④: 35 N·m (26 lb·ft) [3.5 kgf·m]

Bevel Gear B Nut Socket (5): P/N. 346-72232-0 Bevel Gear B Nut Wrench (6): P/N. 346-72231-0

3. Install the bevel gear assy A.



Install the bevel gear assy A while pulling the drive shaft in the direction shown in the diagram.





32) Bevel Gear B Height Measurement and Shim Selection

When the gear case, drive shaft, or oil seal housing assy is replaced, measure the height of bevel gear **B** and the backlash between the gears and adjust the shim.

When measuring the backlash of each gear, first measure 1. the height of the bevel gear B of the drive shaft, then adjust the value accordingly.

Following "Assembly of Bevel Gear B 1 to 3" and "Installation of Pump Case 1 to 3" in Chapter 6, install the parts up to the pump case (lower) (1).



Remove the bevel gear assy A.

2. To make it easy to adjust the shim, face the opening of the gear case on the propeller shaft side upward and fix the case horizontally with a holder.

Insert a shimming gauge (2) into the gear case, and measure the gap (a) between the shimming gauge and the bevel gear B (3).

⚠ CAUTION

- The shimming gauge (2) should contact the taper surface of the outer race (4) of the taper roller bearing.
- Pull up the drive shaft to eliminate the backlash during measurement.



Measure the gap between the shimming gauge (2) and the edge of the bevel gear B with a thickness gauge.



Shimming Gauge (2): P/N. 346-72250-0 Thickness Gauge: P/N. 353-72251-1







④ Bearing Outer Race

 Add and adjust the shim (5) to the lower side of the pump case lower (1) so that the gap (a) is within the specified range.



Bevel Gear B Height (a): 0.60 - 0.64 mm (0.0236 - 0.0252 in)



Type of Shim		
Thickness	Part No.	
0.1 mm	346-64081-0	
0.15 mm	346-64082-0	
0.3 mm	346-64083-0	
0.5 mm	346-64084-0	



33) Backlash Measurement Between Bevel Gear Assy A and Bevel Gear B and Shim Selection

 Backlash Measuring Tool Kit: P/N. 3C8-72234-2
 Measuring Tool Set Piece ③: P/N. 346-72245-1
 Backlash Measuring Tool Clamp ⑨: P/N. 3B7-72720-0
 Dial Gauge Plate ⑧: P/N. 3B7-72729-0



(9)

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(4)

Shaft
 O-ring
 Collar

④ Plate

(5) Cone Disk Spring(6) Nut x 2

⑦ Washer x 6

(7)

(a)



Measure the backlash between the bevel gear assy A and the bevel gear B with the propeller shaft housing, propeller shaft, and reverse (C) gear removed from the gear case.

- 2. Install the backlash measuring tool kit ① to ⑦ and tighten with the bolts.
- 3. Install the dial gauge plate (8) with the bolts and washers.



Use commercially available bolts (M6) and washers (t = 4.5 mm).

- 4. Put two nuts (M10) (6) on the screw-side rear end of the shaft (1), and screw the nuts onto the shaft with a wrench. When the drive shaft starts to rotate as the nuts are turned, screw the nuts an additional 45 degrees. Secure the shaft in this state.
- 5. Secure the clamp (9) to the drive shaft with a bolt. Preload the bearing by turning the drive shaft several times while pulling it up in the direction shown by the arrow to give it a good fit. Use a dial gauge to read the backlash at the notch location.



Sizes of Adjusting Shims: For Bevel Gear B Side: 0.1, 0.15, 0.3, 0.5 mm



(a)

(2)

3

 Perform shim adjustment as necessary based on the gauge value obtained. The table shows the relation between dial gauge readings and shim adjustments.



 Values in this table indicate dial gauge readings obtained when using the special tool.
 Change the gear engagement position and measure the backlash again.

 After the adjustment, remove the backlash measuring tool, and turn the drive shaft while pulling it up to see if it turns smoothly.

If not, reduce the shim thickness by 0.05 mm and adjust the backlash again.



If the engagement of the bevel gear assy A and bevel gear B is imperfect, they may produce abnormal noise when turning the drive shaft while pulling it up. In such case, reduce the shim thickness by 0.05 mm.



Keep the following matters in mind when taking the measurement.

- The shaft ① securing the bevel gear assy A is tightened so that, even if the drive shaft is lightly turned, it will not turn more than the backlash.
- The drive shaft bearing is secured only at the pump case (lower). The clamp (9) should be attached as close to the pump case (lower) as possible.
- Although the measurement with dial gauge is taken by rotating the drive shaft while lifting it up with the gear case and dial gauge secured, make sure play does not occur with other parts (runout of the drive shaft, play between the drive shaft and bearing), etc., during measurement.

Gauge value (mm)	Adjusting shim amount (mm)
0.00 - 0.13	-0.1
0.14 - 0.34	-0.05
0.35 - 0.57	0
0.58 - 0.78	0.05
0.79 - 1.01	0.1
1.02 - 1.23	0.15
1.24 - 1.46	0.2
1.47 - 1.69	0.25
1.70 - 1.92	0.3
1.93 – 2.00	0.35

Type of Shim		
Thickness	Part No.	
0.1 mm (0.0039 in)	369-64081-1	
0.15 mm (0.0059 in)	369-64082-1	



34) Installation of Pump Case

- 1. Install the adjusted shim ①.
- 2. Install the O-ring (2), cam rod (3), and bolts (4) to the pump case (lower).



- Apply OBM grease to the O-ring of the pump case (lower).
- Pay attention to the orientation of the cam rod.Apply ThreeBond 1342 to the threads of the
- pump case lower installation bolts.



- 3. Install the gasket (5) and pump case (lower) (6) to the gear case.
- 4. Install the dowel pin ⑦ to the pump case (lower), and install the pump case guide plate gasket (18), pump case guide plate (29), pump case gasket (10), water seal rubber (11), and water seal rubber plate (12).



Do not forget to install the water seal rubber and the water seal plate. Failure to install these parts results in a risk of insufficient cooling water.

5. Install the water pump impeller key (13) to the drive shaft, align the position with the key groove on the water pump impeller (14) side, and install the impeller.





Attach the water pump liner (5) to the pump case (upper)
 (6).

▲ CAUTION

Align the protrusion (a) of the pump liner with the recessed area (b) of the pump case (upper) (6).



Apply OBM grease to the inner side of the water pump liner.





 Insert and install the pump case (upper) (6) and gasket (one) into the pump case (lower) (6) from the upper end of the drive shaft.

When installing the pump case (upper) (6), install the case while turning the drive shaft (2) clockwise so that the impeller blades are not reverse to the direction of engine rotation.



8. Attach the water pipe seal (7).



Apply OBM grease thinly on the inside ⓒ of the water pipe seal so that the water pipe can be inserted smoothly.

35) Installation of Propeller Shaft Housing Assy

1. Install the O-ring (2) to the propeller shaft housing (1).



Apply gear oil to the O-ring.

- Install the clutch push rod ④, ball ⑤, and washer ⑥ that was removed during disassembly to the propeller shaft ③.
- Install the propeller shaft to the propeller shaft housing ①, and install the assembly to the gear case.



 Install the propeller shaft housing to the gear case securely, and tighten the installation bolts after confirming that the O-ring is set in the case properly.

• Apply ThreeBond 1342 to the threads of the propeller shaft housing installation bolts.







② O-ring Do not reuse.

36) Inspection of Gear Case (for Leakage)

- 1. Drain the gear oil.
- 2. Remove the upper oil plug ① and connect a commercially available leakage tester to the hole.



3. Apply the specified pressure to the gear case, and check if the pressure is maintained for 10 seconds.



Do not apply pressure to the gear case over the specified value. Doing so can cause damage to the oil seal.

Specified Gear Case Maintained Pressure: 50 kPa (7 psi) [0.5 kgf/cm²]

- Rotating the shaft while maintaining the pressure makes it easier to find leakage caused by the wear of the oil seal lip.
 - Depressurize the gear case and then cover the oil plug area with a rag before disconnecting the leakage tester from the gear case.
- If the specified pressure cannot be maintained, check the oil seals of the drive shaft and propeller shaft and the O-rings of each area for damage.

37) Installation of Lower Unit

- Tilt up the outboard motor and lock it with the tilt stopper. 1.
- 2. Set the shift rod ① to the up position (forward position).



- · Apply a thin coat of TEFLON grease to the spline of the drive shaft before installation.
- · Apply a thin coat of OBM grease to the water pipe seal rubber.
- . Tilting the outboard motor up makes it easier to install the lower unit.
- · When installing the lower unit, insert the water pipe into the seal rubber properly.





З. Insert the lower unit assy into the drive shaft housing. Align the position of the water pipe and the water pipe seal 2.



4. Tighten the lower unit assy installation bolts to the specified torque.



Lower Unit Bolt:







- 5. Install the shift rod joint, and connect the shift rod using a new spring pin.
 - Double-check that the shift rod is fully raised. In addition, check that the shift lever is in the forward (F) position. (Shift lever is in contact with stopper)

If the joint is not tightened in the correct position, shifting in and out may become difficult.

• Install the spring pin with the opening facing up or down.

Spring Pin Tool ③: P/N. 345-72228-0







6. Install the shift rod joint retainer ④.



Apply water-resistant grease on the shift rod joint retainer.



7. Attach the propeller and tighten the propeller nut ④ to the specified torque.

- Before removing or installing the propeller, be sure to disconnect the battery cables from the battery and remove the stop switch lock plate.
- When removing or installing the propeller, do not handle the propeller with your bare hands.
- Put a wooden block or similar object between the anti-ventilation plate and propeller when removing or installing the propeller.



Propeller Nut ④:

23 - 25 N \cdot m (16.9 - 18.4 lb \cdot ft) [2.3 - 2.5 kgf \cdot m]

8. Attach the split pin (5).

If the propeller shaft pin hole and propeller nut pin groove do not align, tighten the nut further until they align.

9. Fill the gear case with gear oil to the specified level. Refer to "Replacement of Gear Oil" in Chapter 3.



(5) Split Pin Do not reuse.



T Bracket

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1. PT Wiring Diagram and Layout





2. Parts Layout Drive Shaft Housing



Ref. No.	Part Name	Q'ty	Remarks
1-1	Drive Shaft Housing Assy (S)	1	
1-2	Drive Shaft Housing Assy (S)	1	
1-3	Drive Shaft Housing Assy (L)	1	
1-4	Drive Shaft Housing Assy (L)	1	
2	Oil Seal	1	Do not reuse.
3	Dowel Pin 6-16	2	
4	Drain Bolt	1	
5	Washer	1	Do not reuse.
6	Flushing Connector Cap	1	
7	Seal Ring	1	
8	Engine Basement Seal	1	
9	Bolt	1	
10	Grommet	1	
11	Sub-Water Inlet Hose Plug	1	
12	Bolt 8-P1.25	6	
13	Idle Exhaust Port Gasket	2	Do not reuse.
14	Idle Exhaust Plate	1	
15	Idle Exhaust Port Cover	1	
16	Nipple	1	
17	Apron Stay	1	
18	Bolt	7	
19	Grommet	1	
20	Bolt	2	
21	Shoulder Bolt	1	
22	Apron	1	
23	Screw	4	
24	Extension Housing	1	
25	Bolt	1	
26	Nut	1	
27	Bolt	4	
28	Washer 8.1-16-1.5	4	
29	Storage Decal	1	



Bracket (Manual Tilt)



Ref. No.	Part Name	Q'ty	Remarks
1	Clamp Bracket (R)	1	
2	Clamp Bracket (L)	1	
3	Anode	1	
4	Bolt	1	
5	Co-Pilot Decal	1	
6	Swivel Bracket Shaft Assy	1	
7	Cap Nut	2	
8	Bushing	2	
9	Nylon Nut 7/8-14	1	
10	Distance Piece	1	
11	Nut	2	
12	Washer	4	
13	Thrust Rod	1	
14	Thrust Rod Spring	1	
15	Swivel Bracket Assy	1	
16	Grease Fitting	3	
17	Nylon Nut 8-P1.25	1	
18	Washer	1	
19	Friction Lever	1	
20	Washer 8.1-20-0.8	1	
21	Bolt	1	
22	Disc	2	
23	Bolt	2	
24	Plate	1	
25	Friction Lever Bracket	1	
26	Steering Shaft Assy	1	
27	Rubber Mount (Lower)	1	
28	Mount Bracket	1	
29	Bolt	4	
30	Damper (Lower)	1	
31	Bolt	4	
32	Washer 13-34-3	2	
33	Damper 21-36-5	2	
34	Washer	4	
35	Nylon Nut 10-P1,25	4	
36	Anode	1	
37	Bolt	1	
38	Bolt Cover	2	
39	Bolt	2	
40	Thrust Plate (Upper) 21-50-2	1	
41	Bushing 30-36-41	2	
42	O-ring 3.5-29.7	1	Do not reuse.
43	Thrust Plate (Lower)	1	
44	Damper (Upper)	2	
45	Rubber Mount (Upper)	2	



Ref. No.	Part Name	Q'ty	Remarks
46	Bolt	4	
47	Damper (Upper)	1	
48	Carrying Handle	1	
49	Tilt Stopper	1	
50	Spring Pin	1	
51	Bushing 10.2-12-29.5	1	
52	Setting Plate	1	
53	Bolt	2	
54	Setting Piece	1	
55	Friction Spring	1	
56	Anode	1	
57	Bolt	1	
58	Reverse Lock Arm	1	
59	Reverse Lock Rod	1	
60	Split Pin 2-12	1	
61	Reverse Lock	2	
62	Shoulder Bolt	2	
63	Reverse Lock Spring (L)	2	
64	Washer 6-16-1.5	2	
65	Reverse Lock Lever	1	
66	Reverse Lock Link	1	
67	Reverse Lock Lever Spring	1	
68	Shoulder Bolt 6-8	1	
69	Washer	1	
70	Bushing 8.1-20	1	
71	Washer 8.5-18-1.6	1	
72	Washer 6-16-1.5	1	
73	Clamp Screw Kit	2	
74	Clamp Screw Assy	1	
75	Clamp Screw	1	
76	Clamp Screw Handle	1	
77	Spring Pin	1	
78	Clamp Screw Pad	1	
79	E-Ring d=5	1	Do not reuse.
80	Rigging Bolt Set	1	
81	Bolt	2	
82	Washer	4	
83	Nylon Nut 8-P1.25	2	



Bracket (PT · Gas Assist)



Ref. No.	Part Name	Q'ty	Remarks
1	Clamp Bracket (PTT-R)	1	
2	Clamp Bracket (PTT-L)	1	
3	Swivel Bracket Shaft Assy	1	
4	Bushing	2	
5	PTT Thrust Rod	1	
6	Snap Pin	1	
7	Swivel Bracket Assy	1	
8	Collar 10.2-12-12	2	
9	Tilt Stopper Spring	1	
10-1	Tilt Stopper Kit	1	For PT model
10-2	Tilt Stopper Kit	1	For Gas assist model
11	Tilt Stopper Grip	1	
12	Spring Pin 3.5-16	1	Do not reuse.
13	PT Assy	1	
14	Cylinder Pin (Upper)	1	
15	Bolt	1	
16	Washer 6.5-23-1.5	1	
17	Bushing 13-16-40	1	
18	Bushing 13-17-19.5	1	
19	Bushing	1	
20	Bushing 18-24-22	5	
21	Cylinder Pin (Lower)	1	
22	Washer 18.2-34-1	2	
23	C-ring d=18	2	
24	Gas Shock Absorber	1	
25	Collar	1	
26	Reverse Lock Lever	1	
27	Bolt 6-35	1	
28	Washer	2	
29	Nut	1	
30	Anode	1	
31	Bolt	1	
32	Anode	2	
33	Bolt	2	
34	Clamp 6.5-14L	1	
35	Screw	1	
36	Clamp Screw Kit	2	
37	Clamp Screw (PTT)	1	
38	Clamp Screw Pad	1	
39	E-ring d=5	1	Do not reuse.
40	Rigging Bolt Set	1	
41	Bolt 12-105 P1.25	4	
42	Washer 13-34-3	4	
43	Washer	4	
44	Nvlon Nut 12-P1.25	4	
45	Band Lead Wire 300	1	Do not reuse.



Power Tilt



Ref. No.	Part Name	Q'ty	Remarks
1	Manual Valve Assy	1	
2	Seal Set	1	
3	O-ring 2.4-9.8	1	Do not reuse.
4	C-ring	1	Do not reuse.
5	Joint	1	
6	Nut	1	
7	Dust Seal	1	
8	O-ring 2.4-12.3	1	Do not reuse.
9	Cylinder	1	
10	Inner Tube	1	
11	Piston Rod Assy	1	
12	O-ring 2-28.5	1	Do not reuse.
13	Free Piston	1	
14	Back-Up Ring	1	
15	O-ring 2.4-27.7	1	Do not reuse.
16	O-ring 2-43.5	1	Do not reuse.
17	O-ring 2-34.5	1	Do not reuse.
18	Seal Washer	1	
19	Valve Seat	1	
20	O-ring 1.5-6.5	1	Do not reuse.
21	Ball	1	
22	Spring Seat	1	
23	Spring	1	
24	O-ring 1.5-6.5	2	Do not reuse.
25	Pump	1	
26	Bolt	3	
27	Coupling	1	
28	Motor Assy	1	
29	O-ring 2-62.5	1	Do not reuse.
30	O-ring 2.4-66.6	1	Do not reuse.
31	Reserve Tank	1	
32	Bolt	2	
33	Сар	1	
34	O-ring 1.9-9.8	1	Do not reuse.



Tiller Handle



Ref. No.	Part Name	Q'ty	Remarks
1	Tiller Handle Assy	1	
2	Plastic Rivet 6.5	1	
3	Stud	1	
4	Grip	1	
5	Throttle Shaft	1	
6	Throttle Shaft Damper	1	
7	Bushing 14-15.8-7	1	
8	Screw	1	
9	Throttle Shaft Support	1	
10	Screw	1	
11	Friction Piece	1	
12	Adjusting Nut	1	
13	Spring	1	
14	Bolt	1	
15	Bracket	1	
16	Screw	1	
17	Stop Switch Decal	1	
18	Throttle Decal	1	
19	Tiller Handle Cover	1	
20	Grommet 17-2.7	1	
21	Main Switch Assy	1	
22	Grommet	1	
23	Grommet	1	
24	Cord Assy	1	
25	Stop Switch Lanyard Assy	1	
26	Cable Holder	1	
27	Plate	1	
28	Tapping Screw	3	M6-18
29	Screw	3	
30	Idle Change Decal	1	
31	Start Decal	1	
32	Bushing	1	
33	Bushing	1	
34	Washer	1	
35	Cover	1	
36	Nut	1	
37	Washer	1	
38	Throttle Wire	2	
39	Steering Bracket	1	
40	Grease Fitting	1	
41	Bolt	1	
42	Bolt	1	
43	Washer	2	
44	Shift Decal	1	
45	Shift Lever	1	


Ref. No.	Part Name	Q'ty	Remarks
46	Collar 6.5-10.5-10	1	
47	Washer 6.5-21-1	1	
48	Bolt	1	
49	Shift Lever Rod	1	
50	Washer	1	
51	Wave Washer	1	
52	Protector	1	
53	Washer	1	6.5-30-1



Multi-Function Tiller Handle



Ref. No.	Part Name	Q'ty	Remarks
1	Tiller Handle Kit	1	
2	Throttle Wire	1	
3	Shift Cable	1	
4	Stop Switch Assy	1	
5	Stop Switch Lanyard Assy	1	
6	Main Switch Assy	1	
7-1	Main Switch Key No.943	1	
7-2	Main Switch Key No.944	1	
7-3	Main Switch Key No.945	1	
8	Main Switch Key Covering Cap	1	
9	Main Switch Cap (Waterproof)	1	
10	Grommet	1	
11	Throttle Decal	1	
12	Shift Decal	1	
13	Stop Switch Decal	1	
14	Instruction Decal	1	
15	Tiller Handle Cover	1	
16	Grommet	1	
17	Cord Assy	1	
18	Grip Parts Kit	1	
19	Throttle Shaft Kit	1	
20	Throttle Link Assy	1	
21	Shift Unit Assy	1	
22	Shift Lever Kit	1	
23	Cable Bracket Kit	1	
24	Buzzer Kit	1	
25	Throttle Friction Assy	1	
26	Screw Set	1	
27	Steering Bracket	1	
28	Spacer	1	
29	Spacer	1	
30	Screw	2	
31	Stud 10-45P1.25	2	
32	Nylon Nut 10-P1.25	2	
33	Washer	2	
34	Bolt 10-80 P1.25	1	
35	Conical Spring Washer 10.5-21-2.3	2	
36	Spacer 10.5-23-9	1	
37	Bushing 10.5-12.7-13.5	2	
38	Washer	4	
39	Lock Nut 10-P1.25	1	
40	Plate	1	



Ref. No.	Part Name	Q'ty	Remarks
41	Bolt	2	
42	Friction Lever	1	
43	Bolt	1	
44	Friction Lever Bracket	1	
45	Disc	2	
46	Nylon Nut 8-P1.25	1	
47	Washer	1	
48	Cap Nut	2	
49	Washer 8.1-20-0,8	1	



Bottom Cowl



Ref. No.	Part Name	Q'ty	Remarks
1	Bottom Cowl	1	
2	Mount 8.5-14-2.5	8	
3	Spacer 6.2-9-15.7	4	
4	Bolt	4	
5	Washer 6.5-21-1	4	
6	Nipple	1	
7	Pilot Lamp Assy	1	
8	Gasket	1	
9	PTT Switch Assy Bracket	1	
10	Bolt	2	
11	Grommet	1	
12	PTT Switch Assy	1	
13	Remote Cont Cable Stay Cover	1	
14	Bolt	2	
15	Cowl Latch Assy	1	
16	Bolt	1	
17	Washer 6.5-23-1.5	1	
18	Grommet	1	
19	Grommet 40-18-3	1	
20	Cable Terminal Holder Cover	1	
21	Hook	3	
22	Grommet 13.2	3	
23	Grommet	1	
24	Grommet	1	
25	Grommet 22-3	1	
26	Fuel Connector (Male)	1	
27	Bolt	1	
28	Bolt	1	
29	Nut	1	
30	Fuel Connector Protector	1	
31	Grommet	1	
32	Grommet	1	
33	Cable Clip	1	
34	Bolt	1	
35	Drain Plug (Engine Basement)	2	
36	Warning Decal	1	
37	Seal	2	



Shift



Ref. No.	Part Name	Q'ty	Remarks
1	Shift Lever Shaft Assy	1	
2	Neutral Switch	1	
3	Neutral Switch Actuator	1	
4	Neutral Switch Bracket	1	
5	Bolt	2	
6	Holder	1	
7	Bolt	2	
8	Holder	1	
9	Bolt	2	
10	Shift Detent Spring	2	
11	Shift Detent Supporter	1	
12	Bolt	1	
13	Throttle Drum Assy	1	
14	Bolt	1	
15	Washer 6-16-1.5	2	
16	Collar 6.5-10.5-9.3	1	
17	Throttle Wire Bracket	1	
18	Bolt	2	
19	Link Rod Assy (Throttle)	1	
20	Snap Pin d=6	1	
21	Shift Rod	1	
22	Grommet 17-3	1	
23	Shift Rod Joint	1	
24	Spring Pin 3-12	1	Do not reuse.
25	Shift Rod Joint Retainer	1	



Remote Control





Ref. No.	Part Name	Q'ty	Remarks
1	Shift Lever Rod	1	
2	Washer 8.5-19-1,6	2	
3	Snap Pin d=8	2	
4	Shift Arm	1	
5	Cable Joint	2	
6	Shift Arm Bracket	1	
7	Bolt	2	
8	Bolt	1	
9	Washer 6.5-21-1	2	
10	Collar 6.5-10.5-9.3	1	
11	Link Rod Assy (Throttle)	1	
12	Throttle Arm	1	
13	Washer 6.5-21-1	2	
14	Snap Pin d=8	2	
15	Drag Link Assy	1	
16	Nylon Nut 3/8-24UNF	2	
17	Washer 9.6-18-2	3	
18	Seal Ring	1	
19	Spacer	1	9.6-19-19
20	Bolt 3/8-45	1	
21	Steering Hook Plate	1	
22	Bolt	2	
23	Washer	2	
24	Washer 8.5-18-1.6	2	



3. Inspection Items

1) Inspection of Throttle Cable and Shift Cable

- 1. Check the operation of the throttle cable and shift cable.
- Remove the tiller handle cover and check the cable inner wire and outer wire for bending or damage. Replace if necessary.
- Operate the throttle fully closed and fully opened to check whether the throttle drum is fully closed or fully opened.

2) Installation of Tiller Handle

1. Attach the cables to the throttle shaft ① as shown in the diagram.



 Install the throttle shaft ① with the cable attached to the tiller handle. Pay attention to the installation position of the throttle friction ②.



Apply screw locking agent (ThreeBond 1342) to the throttle shaft screw ③.



 Install the bushings ④ and washer ⑤ to the steering bracket ⑥.



4. Attach the tiller handle assy to the steering bracket (6) and tighten the nut (7) to the specified torque.



• Apply a screw locking agent (ThreeBond 1342) to the section (a) of the stud bolt (8).

- Attach the section (a) of the stud bolt to the tiller handle side.
- Arrange the throttle cable as shown.





- 5. Install the cable (9) of the inner wire (b) that stretches when the throttle grip is set to the fully closed position.
- 6. Next, install the other cable (1) (of the inner wire (b) that stretches when the throttle grip is set to the fully open position).
- Adjust the position of the lock nuts (1) of the throttle cable so that the throttle grip can reach the fully open and fully close positions.



(10)

Adjust the cable tension so that the cable moves approximately 1 mm when pushed lightly with a finger.

3) Adjustment of Friction Lever

\Lambda WARNING

- The friction lever is not for locking the steering handle in place. Do not release your hands from the handle while operating the outboard motor.
- The weight of the steering handle exerts a direct impact on the operation of the outboard motor. Never tighten the adjusting nut too tightly as this may lead to an accident.
- 1. Install the friction plate and tiller handle assy.



- 2. Move the friction lever to the left to slide it to the tightening position.
- 3. Tighten the nylon nut ① until the steering operation becomes heavy.



Tighten the nylon nut (1) to approximately 5 N \cdot m (4 lb \cdot ft) [0.5 kgf \cdot m] and check the steering operation.

 Move the friction lever to the right to slide it to the release position to check that the outboard motor can be moved smoothly. If not, repeat steps 2 to 4 to make fine adjustments.



To prevent the nylon nut from falling, tighten the bolt until 1 ridge (a) of the screw thread can be seen above the nylon nut upper end.







4) Removal of Drive Shaft Housing

- 1. Prepare a waste oil receptacle under the drain hole, remove the drain bolt, and drain the oil completely. Refer to Chapter 3.
- 2. Remove the bolt 1 and remove the bolt cover 2.
- 3. Remove the lower mount nut (3) and bolt (4).





4. Remove the upper rubber mount nuts (5).



5. Remove the drive shaft housing (6) and the damper from the clamp bracket assy.



Be careful not to drop the drive shaft housing during removal from the clamp bracket.



 Remove the upper rubber mount installation bolts ① and remove the rubber mounts ② and the dampers ③ from the drive shaft housing.

 Check the rubber mounts ② and dampers ③ for abnormalities such as cracks and fissures. Replace if any abnormality is found.

- 3. Remove the idle exhaust port cover bolt, then remove the idle exhaust port cover ④, gasket ⑤, and plate ⑥.
 - orde

Loosen the idle exhaust port cover bolts in the order shown in the diagram.

4. Check the idle exhaust port cover and interior for sludge, cracks, fissures, or other abnormalities.



2



4

5

6



 Remove the bolt ⑦, and then remove the water pipe ⑧ from the drive shaft housing. Check the water pipe seal ⑨ for abnormalities such as cracks.

Bracket



6) Assembly of Drive Shaft Housing

1. Install the water pipe seal ① onto the water pipe, and the assembly into the drive shaft housing.



Do not apply grease when installing the water pipe seal onto the water pipe.

- 2. Tighten the bolt (2) and secure the water pipe.
- Attach the new gasket ③, plate ④, and idle exhaust port cover ⑤, and tighten the idle exhaust port cover bolts in the order shown in the diagram.



Apply screw locking agent (ThreeBond 1342) to the bolts.



Idle Exhaust Cover Bolt: 6 N · m (4 lb · ft) [0.6 kgf · m]

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4. Install the upper rubber mounts 6 and dampers 7 onto the drive shaft housing and tighten the bolts (8).



Install the dampers in the orientations shown in the diagram.

Upper Rubber Mount Bolt: 13 N \cdot m (9 lb \cdot ft) [1.3 kgf \cdot m]



7) Installation of Drive Shaft Housing Assy

Attach the damper (2) to the lower rubber mount (1), then 1. attach the drive shaft housing to the clamp bracket assy.



Correctly align the bolt hole position of the damper when installing.



2. Tighten the upper mount nuts (3) to the specified torque.



Upper Mount Nut ③: 27 N · m (20 lb · ft) [2.7 kgf · m]



3. Install the lower mount bolt (4) and lower mount nut (5).



Lower Mount Nut (5): 27 N · m (20 lb · ft) [2.7 kgf · m]





4. Install the bolt cover 6.



8) Removal of Steering Shaft

 Remove the drive shaft housing assy by referring to Chapter 7, "Removal of Drive Shaft Housing."



2. Remove the mount bracket (1) and lower rubber mount (2).



 Remove the friction plate bolts ③. (Basic Tiller Handle / Multi-Function Tiller Handle Models only)



4. Pull out the steering shaft ④ from the swivel bracket assy to remove.



Remove the washer and then remove the O-ring and collar from the steering bracket.

5. Check the individual parts.



9) Installation of Steering Shaft

- Attach the thrust plate (1) and bushing (2) to the steering 1. shaft.
- 2. Stand the swivel bracket assy vertically, and insert the steering shaft into the swivel bracket assy.
- З. Attach the bushing (3), new O-ring (4), and thrust plate (5) to the swivel bracket.



- · Push the bushing by using a flathead screw driver until it stops.
- · Insert the O-ring until it contacts the bushing.
- · Securely install the bushing and O-ring in the swivel bracket.



Install the lower rubber mount (6) and mount bracket (7). 4.







5. Pour OBM grease into the bushing (a) through the grease nipple (8) until it overflows.



A Manual Tilt Model B Power Tilt Model, Gas Assist Model





 Install the friction plate bolts (9) and adjust the friction lever. (Basic Tiller Handle / Multi-Function Tiller Handle Models only)

Apply screw locking agent (ThreeBond 1342) to the thread area of the friction plate bolts.

10) Disassembly of Clamp Bracket (Power Tilt Model, Gas Assist Model)

- 1. Remove the drive shaft housing, steering shaft, and friction lever before beginning this procedure.
- 2. Loosen the swivel bracket shaft ① and the nut ②.
- 3. Remove the pin (3) and thrust rod (4).

A Power Tilt Model B Gas Assist Model

- 4. Remove the C-ring ⑤, and then remove the cylinder pin (lower) ⑥.
- Pull out the swivel bracket shaft, and remove the clamp bracket (7) from the swivel bracket (8).
- Check the swivel bracket shaft and other parts for abnormality, and replace if necessary.











11) Installation of Clamp Bracket (Power Tilt Model, Gas Assist Model)

1. Install the clamp bracket in the reverse order of removal.



Nylon Nut: 24 N · m (17 lb · ft) [2.4 kgf · m]

2. Pour grease into the bushings (a) through the grease nipples (1) until it overflows.





12) Disassembly of Clamp Bracket (Manual Tilt Model)

- 1. Remove the thrust rod ① from the clamp bracket ②.
- 2. Remove the distance piece nut ③.
- Loosen and remove the nut of the swivel bracket shaft ④.
 Pull out the swivel bracket shaft and remove the clamp bracket ⑤ from the swivel bracket ⑥.
- 4. Remove the distance piece \bigcirc .





4. Check the swivel bracket shaft and other parts for abnormality, and replace if necessary.



13) Installation of Clamp Bracket (Manual Tilt Model)

1. Install the clamp bracket in the reverse order of removal.



2. Install the thrust rod ③.







14) Removal of PT Unit / Gas Shock Absorber

1. Fully tilt up the outboard motor and lock it with the tilt stopper (1).

- Leaving the outboard motor up without locking may lead to accidental descent due to the reduction of PT unit hydraulic pressure. Be sure to lock the motor with the stopper when the outboard motor is tilted up.
- When removing and installing the PT unit without removing the power unit, suspend and support the outboard motor with a hoist. Failure to do so may result in the outboard motor falling, which is dangerous.
 - If the PT unit does not operate, loosen the manual valve and lift up the outboard motor manually.
 - When the manual valve is loosened, be sure to tighten it to the specified torque after tilting up the outboard motor.

Manual Valve: 1.8 N · m (1.4 lb · ft) [0.18 kgf · m]

- 2. Remove the thrust rod (2).
- Remove the bolt ③, then remove the cylinder pin (upper)
 ④.
- Perform the tilt down operation and slightly retract the tilt rod.
- 5. Disconnect the PT motor lead wires from the PT solenoid.
- Remove the screw (5) and clamp (6), and pull out the PT motor lead wires.
- Remove the C-ring ⑦, then remove the cylinder pin (lower) ⑧.



- 8. Remove the PT unit (9) or gas shock absorber (10).
- 9. Remove the bushings (1), (12), (13), and (14).







15) Removal of PT Motor

1. Remove the reserve tank (2), PT motor (3), and O-rings (4) and (5) from the PT unit (1).

A CAUTION

- When removing the PT motor (reserve tank), the tilt rod should be fully extended to prevent fluid from spurting out due to internal pressure.
- Do not push down the tilt rod with the PT motor removed from the PT unit. Doing so will cause fluid to spurt out from inside the PT unit.



- 2. Remove the two screws (6), and then remove the yoke assy (8) from the brush holder (7).
- 3. Remove the armature (9) and O-ring (10) from the brush holder.





16) Inspection of PT Motor

 Measure the length of the brush. Replace the motor assy if the specified value or less.



Brush Wear Limit (a): 6 mm (0.236 in)

 Check the electrical conductivity of the brush and circuit breaker.

Replace the motor assy if there is no electrical conductivity.

- Do not pull the PT motor lead wires out of the brush holder.
- Do not press the bimetal (b) with a strong force as this will affect the operation of the circuit breaker.
- 3. Measure the diameter of the commutator.

Replace the motor assy if the specified value or less.

Commutator Diameter Limit ©: 18.5 mm (0.728 in)

4. Check the conductivity of the armature.

Replace the motor assy if outside the specified value.

	Conductivity of Armature						
Ľ	Commutator Section	Conductivity					
	Commutator Section (d) –	No conductivity					
	Armature Core Section (e)						
	Commutator Section (d) –						
	Armature Shaft Section (f)	NO CONDUCTIVITY					

5. Check the brush holder for cracks or damage, and replace the motor assy if necessary.









17) Assembly of PT Motor

- Unlock the brush spring, push the brushes into the brush holders, and install the armature. Lock the brush spring.
- 2. Check the O-ring and replace if necessary.



3. Install the yoke assy to the motor base.



Cover the end of the armature shaft with a clean cloth, hold the shaft with a pair of pliers, and carefully install the armature so that it does not get detached from the brushes.

4. Align the knock and tighten the screw.







18) Removal of PT Pump and Valve

▲ CAUTION

- When removing the PT motor (reserve tank), the tilt rod should be fully extended to prevent fluid from spurting out due to internal pressure.
- Do not push down the tilt rod with the PT motor removed from the PT unit. Doing so will cause fluid to spurt out from inside the PT unit.

WARNING

Contamination of the hydraulic system can result in damage to the components and circuits, possibly resulting in serious damage to the product.

Do not use rags or the like for inspecting and servicing parts.

Failure to do so may cause the hydraulic circuit to be clogged.

Remove the oil feed plug before beginning the work.

Keep the parts individually in plastic bags during disassembly.

- 1. Remove the PT unit ① from the outboard motor.
- 2. Remove the PT motor assy from the PT unit.
- 3. Remove the manual valve ② from the PT unit, then remove the PT pump assy ③.
- 4. Remove the valve ④ from the PT pump assy.



19) Inspection of PT Pump and Valve

- Clean and then check the piston and ball for damage and wear. Replace the PT pump if necessary.
- Check the drive gear and driven gear for damage and wear. Replace the PT pump if necessary.
- Check the valve for damage and clogging. Replace if necessary.

20) Removal of Tilt Cylinder

- 1. Retract the tilt rod.
- 2. Sandwich the PT unit ① from both sides with wood or aluminum plates ⓐ and secure with a vice.
- 3. Secure the joint (2), loosen the nut (3) with a wrench, and remove the joint (2) and nut (3).
- 4. Using a 36-mm deep socket wrench, loosen the tilt cylinder ④, extend the tilt rod, then remove the tilt cylinder ④.

The tilt cylinder is loosened with the tilt rod retracted, and then removed in its most extended position.

- 5. Drain the PT fluid.
- Remove the inner tube assy (including the inner tube (5), tilt rod assy (6), and free piston (7) from the tilt cylinder (4).
- Remove the tilt rod assy (6) and free piston (7) from the inner tube (5).







21) Inspection of Tilt Cylinder

- Check the inside and outside walls of the tilt cylinder ① and inner tube ② for scratches and damage. Replace if necessary.
- 2. Check the tilt rod assy ③ and free piston ④ for scratches and damage on the surface. Replace if necessary.
- Check the tilt rod (3) for bending and excessive corrosion. For light rust, polish with 400 to 600 grit sandpaper or replace as needed.



Tilt cylinder dust seals and O-rings are not reusable. Be sure to replace with new ones.





22) Inspection of Valve

1. Check the check valve and valve of the tilt rod assy ① for dirt or deposits. Clean if necessary.



23) Installation of PT Pump and Motor

- 1. Sandwich the PT unit ① from both sides with wood or aluminum plates and secure with a vice.
- Install the valve (2) and PT pump assy (3), and tighten the bolt (4) to the specified torque.



3. Install the manual valve (5) and tighten to the specified torque.

Manual Valve: 1.8 N · m (1.4 lb · ft) [0.18 kgf · m]

4. As shown in the diagram, supply PT fluid to near the upper surface of the pump chamber.



Recommended PT Fluid: ATF DEXRON III





 Install new O-rings (6) and (7), the coupling (8), PT motor assembly (9), and reserve tank (10), and tighten the bolt (11) to the specified torque.



Reserve Tank Bolt: 4.5 N · m (3.3 lb · ft) [0.46 kgf · m]



24) Assembly of Tilt Cylinder

- 1. Install a new O-ring (1) to the tilt cylinder (2).
- 2. Install a new dust seal (3) to the tilt cylinder (2).



- Install the free piston ④, piston rod assy ⑤, and new O-rings ⑥ and ⑦ to the inner tube ⑧.
- 4. Install the inner tube assy to the tilt cylinder ①.









5. Refill the PT fluid to the first level from the bottom of the tilt cylinder installation area.



Recommended PT Fluid: ATF DEXRON III

Insert the assembly of the tilt cylinder ①, tilt rod ⑤, inner tube ⑧, free piston ④, and O-ring into the PT unit ⑨.



7. Install the tilt cylinder ① and tighten to the specified torque.



Tilt Cylinder End Screw: 155 N·m (112 lb·ft) [15.5 kgf·m]



 Install the nut (1) and joint (1) to the tilt rod assy (5) and tighten to the specified torque.

 \searrow

Joint, Nut, Tilt Rod: 35 N·m (18 lb·ft) [3.5 kgf·m]



 With the tilt rod (5) fully extended, replenish the PT fluid to the specified level.



Recommended PT Fluid: ATF DEXRON III

10. Install the cap 2 and tighten to the specified torque.



Reserve Tank Cap: 1.5 N ⋅ m (1.1 lb ⋅ ft) [0.15 kgf ⋅ m]



25) Installation of PT Unit / Gas Shock Absorber

1. Fully tilt up the outboard motor and lock it with the tilt stopper ①.

- Be sure to lock the outboard motor with the tilt stopper after it is tilted up. Leaving the outboard motor up without locking may lead to accidental descent due to the reduction of PT unit hydraulic pressure, which is dangerous.
- When removing and installing the PT unit without removing the power unit, suspend and support the outboard motor with a hoist. The outboard motor may fall, which is dangerous.



- 2. Install the bushings (2), (3), (4), and (5) in their original positions.
- Install the PT unit (6) or gas shock absorber (7), then install the cylinder shaft (lower) (8).



Keep the tilt rod slightly retracted.

- 4. Attach the C-ring (9).
- 5. Connect the tilt rod to the battery and apply current to fully extend the tilt rod.
- 6. Install the cylinder shaft (upper) (10), and tighten the bolt (11).
- Pass the PT motor lead wire through the hole and secure it with the clamp (2) and screw (3).
- 8. Install the thrust rod (4).



Bracket

26) Air-Purging of PT Unit

(With Outboard Motor Installed)

- Fully tilt up the outboard motor and lock it with the tilt stopper ①.
- 2. Remove the cap (2) and check the amount of fluid in the reserve tank.
- 3. Turn the manual valve counterclockwise until it is full.
- 4. Manually tilt up the outboard motor until it is full and lower it under its own weight.
- 5. Turn the manual valve clockwise until it is full.



- 6. Let stand for 5 minutes to allow the PT fluid to stabilize.
- Operate the PT switch to check that the outboard motor tilts up fully.



When not tilted up to full tilt, loosen the manual valve and tilt up manually and lock with the tilt stopper.

8. Lock the outboard motor with the tilt stopper ①.

\Lambda WARNING

Be sure to lock the outboard motor with the tilt stopper after tilting up the motor. Leaving the outboard motor up without locking may lead to accidental descent due to the reduction of PT unit hydraulic pressure, which is dangerous.

9. Remove the cap (2) and check the amount of fluid in the reserve tank.

Check the fluid level with the outboard motor fully tilted up. When the reserve tank cap is removed at the halfway position, it is not possible to check the specified amount of fluid, and the PT fluid may start to spray out, which is dangerous.



The specified amount of fluid is about the amount that overflows from the level hole when the cap is removed.







10. If the amount of PT fluid is insufficient, replenish the PT fluid to the specified level.



Recommended PT Fluid: ATF DEXRON III

11. Install the reserve tank cap and tighten to the specified torque.



Reserve Tank Cap: 1.5 N·m (1.1 lb·ft) [0.15 kgf·m]

12. Repeat steps 5 through 12 until the PT fluid reaches the specified level.



27) Inspection of PT Solenoid

Check the resistance values of the PT solenoid (up side)

 and the PT solenoid (down side) ②. Replace the PT solenoid if other than the specified value.



Resistance Between Terminals (Terminal (a) – Terminal (b)): 76.5 - 93.5 k Ω (20°C) [68°F]





28) Inspection of PT Switch

1. Check the electrical conductivity of the PT switch. Replace if other than the specified value.

	Lead Wires								
للن	Switch Position	h Position Sky Blue (Sb)		Pink (P)					
UP (Tilt Up)		0	———————————————————————————————————————						
	Free								
	DOWN (Tilt Down)		0	—0					




8

Electrical System

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1. Special Tools

Vacuum/Pressure Gauge P/N. 3AC-99020-1	Spark Tester P/N. 3F3-72540-0
Inspecting pressure	Inspecting ignition

2. Electrical Component Layout Port Side View



- ① Fuse (20A) (except for MF model)
- ② Starter solenoid (except for MF model)
- ③ ECU
- ④ PT relay (UP Side) (EFT, EPT)
- ⑤ PT relay (DOWN Side) (EFT, EPT)
- 6 Engine temperature sensor
- ⑦ Ignition coil
- $(\ensuremath{\underline{8}}\xspace)$ Oil pressure switch
- (9) Rectifier (except for MF model)

8

Bow Side View



- ① Pulser coil
- (2) Exciter coil/charge coil (charge coil except for MF model)
- (3) Throttle position sensor
- ④ Starter motor (except for MF model)

Starboard Side View



- ① Fuel injector
- ② ISC valve
- ③ T-MAP sensor
- ④ Neutral switch (except for MF model)
- 5 Vapor separator

Housing Cover (Front)



① Warning lamp

② Main switch

③ Stop switch



1 Stop switch

- (2) Start switch (for EF, EFT model)
- ③ Trolling control switch
- ④ PT switch (for EFT model)

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3.Parts Layout

Magneto



Ref. No.	Parts Name	Q'ty	Remarks
1	Flywheel W/Gear	1	
2-1	Alternator Assy	1	
2-2	Alternator Assy	1	
3	Key 13.4-5-4	1	
4	Bolt	1	
5	Washer	1	13-26-3.2
6	Bolt	3	
7	Starter Pulley	1	
8	Bolt	3	
9	Coil Bracket	1	
10	Bolt	4	
11	Pulsar Coil	1	
12	Pulsar Coil	1	
13	Bolt	4	
14	Starter Lock Cable Bracket	1	
15	Bolt	1	
16	Cable Terminal Holder	1	
17	Bolt	2	
18	Fuse Holder Bracket	1	
19	Screw	2	
20	Bracket	1	
21	Bolt	2	
22	Ignition Coil W/R-cap	3	
23	Plug Cap W/Resistance	1	
24	Bolt	3	
25	Dowel Pin 6-12	2	
26-1	ECU Cord Assy	1	
26-2	ECU Cord Assy	1	
27	Plug	1	
28	Plug	1	
29-1	Cable Terminal Plug	1	
29-2	Cable Terminal Plug	1	
29-3	Cable Terminal Plug	1	
30-1	Fuse 20A	2	
30-2	Fuse	2	20A
31-1	Сар (Ү)	1	
31-2	Сар (Ү)	1	
32-1	Grommet	1	
32-2	Grommet	1	
32-3	Grommet	1	
33	ECU Cord Assy	1	
34	Bolt	2	
35	Band	2	
36	Band	2	
37	Band	1	Do not reuse.
38	Bolt	1	
39	Plug	1	

Electrical Parts



Ref. No.	Parts Name	Q'ty	Remarks
1	Oil Pressure Switch	1	
2	Rectifier Complete	1	
3	Cover	1	
4-1	Bolt	2	
4-2	Bolt	2	
5	Starter Motor Assy	1	
6	Pinion Assy	1	
7	Washer	1	
8	Brush Holder Assy	1	
9	Screw	2	
10	Bushing 2	1	
11	O-ring	1	Do not reuse.
12	Bushing 1	1	
13	Washer	2	
14	Spring Washer	2	
15	Nut	2	
16	Rolt	2	
17	Spring Wacher	2	
10	Washer	2	
10		2	
19	Buit	2	
20			
21		1	
22		2	
23	Battery Cable L=2500	1	
24	Terminal Cap	1	
25	Terminal Cap	1	
26	Starter Cable	1	
27	Terminal Cap	1	
28-1	Bolt	1	
28-2	Bolt	1	
29-1	Electric Bracket	1	
29-2	Electric Bracket	1	
30-1	Starter Solenoid	1	
30-2	Starter Solenoid	1	
31-1	Bolt	2	
31-2	Bolt	2	
32	Bolt	1	
33	Bolt	1	
34	Plate	1	
35-1	Mount	1	
35-2	Mount	1	
36	Relay	2	
37	Clip	2	
38	Adapter Cord	1	
39-1	Rubber Mount	3	
39-2	Rubber Mount	3	
40-1	Collar	3	
40-2	Collar	3	



Ref. No.	Parts Name	Q'ty	Remarks
41	Bolt	5	
42	Washer	5	6-16-1.5
43	Rubber Mount	2	
44	Collar	2	
45	Plate	1	
46	Bolt	2	
47	Plate	1	
49	Band	3	
50	Engine Temp Sensor	1	
51-1	ECU Assy (25DO)	1	
51-2	ECU Assy (30DO)	1	
51-3	ECU Assy (25)	1	
51-4	ECU Assy (30)	1	
52	Bolt	1	
53	Washer	2	6-16-1.5
54	Spacer	1	6.2-9-27
55	Bolt	1	
56	Band	1	Do not reuse.
57	Band	1	Do not reuse.
58	Band	2	Do not reuse.
59	Band	1	
60	Bolt	1	
61	Bolt	1	

8

Intake Manifold



Ref. No.	Parts Name	Q'ty	Remarks
1	Intake Manifold	1	
2	Gasket	1	Do not reuse.
3	Throttle Body Assy	1	
4	Bolt	2	
5	Gasket	1	Do not reuse.
6	Intake Silencer Assy	1	
7	Bolt	2	
8	Fuel Rail	1	
9	O-ring 1.9-9.8	2	Do not reuse.
10	Valve Assy (Pressure Check)	1	
11	Сар	1	
12	Nipple	1	
13	Holding Plate	1	
14	Bolt	1	
15	Fuel Injector Assy	3	
16	Seal Ring	3	Do not reuse.
17	Bolt	2	
18	MAP Sensor	1	
19	Tapping Screw	2	
20	Intake Silencer Cover	1	
21	Air Filter	1	
22	Tapping Screw	4	
23	ISC Valve	1	
24	Washer	1	
25	Nut	1	
26	Band	1	
27	Tapping Screw	1	
28	Hose	1	8-12_L=45
29	Hose	1	8-12_L=205_40
30	Intake Manifold Gasket	3	Do not reuse.
31	Bracket	1	
32	Bolt	1	
33	Bolt	6	
34	Vent Hose W/Protector	1	
35	Vent Hose W/Protector	1	
36	Band	2	
37	ISC Valve Stay	1	
38	Vent Hose W/Protector	1	

Fuel System



Ref. No.	Parts Name	Q'ty	Remarks
1	Vapor Separator Assy	1	
2	Cover	1	
3	Seal	1	
4	Screw	4	
5	Drain Screw	1	
6	Gasket	1	Do not reuse.
7	Float Valve Assy	1	
8	Float Arm Pin	1	
9	Float	1	
10	Grommet	1	
11	Filter (Inlet)	1	
12	Holder	1	
13	Fuel Feed Pump	1	
14	O-ring	1	Do not reuse.
15	O-ring	1	Do not reuse.
16	O-ring	1	Do not reuse.
17	Fuel Regulator	1	
18	Screw	1	
19	VST Connector	1	
20	Clip	1	
21	Screw	4	
22	Washer 6-16-1.5	2	
23	Rubber Mount	2	
24	Collar	2	
25	Bolt	2	
26	Plate	1	
27	Fuel Filter Assy	1	
28	Сир	1	
29	Filter	1	
30	O-ring	1	Do not reuse.
31	O-ring	1	Do not reuse.
32	Drain Valve	1	
33	Seal	1	Do not reuse.
34	Float	1	
35	Bolt	1	
36	Fuel Filter Holder	1	
37	Fuel Pump Assy	1	
38	O-ring 3.5-25.7	1	Do not reuse.
39	Bolt	2	
40-1	Fuel Hose	1	
40-2	Fuel Hose W/Protector	1	



Ref.	Parts Name	Q'ty	Remarks
INO.			
41	Сір Ф9.4	2	
42	Clip Φ9.4	2	
43-1	Fuel Hose W/Protector	1	
43-2	Fuel Hose W/Protector	1	
44	Water Hose	1	
45	Water Hose	1	
46-1	Fuel Hose W/Protector	1	
46-2	Fuel Hose W/Protector	1	
47	Сlip Ф9.4	2	
48	Fuel Hose W/Protector	1	
49	Clamp Φ16.8	2	
50	Сlip Ф9.4	1	
51	Adapter Cord	1	L=200
52-1	Fuel Hose W/Protector	1	
52-2	Fuel Hose W/Protector	1	
53	Fuel Hose Joint	1	
54	Plug	1	
55	Band	1	Do not reuse.

4. The Ignition System and the Ignition Control System

1) Inspection of the Ignition Spark

\Lambda WARNING

- When testing, install the electrode cap properly so as to prevent leaks and contact with the wiring of the spark tester, and perform the test carefully.
- Keep flammable gas, fuel, and oils away, because testing generates sparks.
- 1. Disconnect the plug cap from the spark plug.
- 2. Connect the plug cap to a spark tester.
- Connect the spark tester clip to the spark plug tip electrode.



Spark Performance:

10 mm (0.4 in) or greater

4. Start the engine and check the spark. Check the ignition system if the sparks are weak.



- This test can be conducted without removing the part.
- The ignition coil operation test can be conducted using the "Running (Drop) Test" of the diagnosis system.



2) Inspection of the Plug Cap



Remove the part to test it as a separate unit.

- 1. Disconnect the plug cap from the spark plug.
- 2. Remove the plug cap from the high tension cable.
- Measure the plug cap resistance. Replace it if the value is not as specified.

Plug Cap Resistance: 3.0 to 7.0 k Ω



3) Inspection of the Ignition Coil

- 1. Disconnect the ignition coil coupler.
- 2. Measure the ignition coil resistance. Replace it if the value is not as specified.



This test can be conducted without removing the part.



- Install the plug cap on the high tension cable by turning it clockwise.
- 4. Connect the plug cap to the spark plug.

4) Inspection of the Exciter Coil and ECU Charge Coil

- Disconnect the exciter coil coupler and ECU charge coil (6 pin).
- Measure the exciter coil resistance. Replace it if the value is not as specified.



This test can be conducted without removing the part.



ECU Charge Coil Resistance:

Between White (W) and White (W) terminals 1.12 to 1.68 Ω (at 20°C) Exciter Coil Resistance: Black (B) to Red (R) or Blue (L)

11.36 to 17.04 Ω (at 20°C)





5) Inspection of the Pulser Coils

- 1. Disconnect the #1 pulser coil connector ① on the starboard side.
- Measure the resistance of the #1 pulser coil. Replace it if the value is not as specified.
- 3. Disconnect the #2 pulser coil coupler ② (1 pin) on the port side and test the #2 pulser coil in the same way as #1.



This test can be conducted without removing the part.



Pulser Coil Resistance (Reference Value): #1

Between Red (R) and Black (B) terminals 148 to 222 Ω (at 20°C) (Reference Value): #2

Between Red/Yellow (R/Y) and Block Ground. 148 to 222 Ω (at 20°C)



① #1 Pulser coil (1 pin)



2 #2 Pulser coil (1 pin)

6) Adjustment of the Pulser Coil Air Gap

 Loosen the mounting screws of the pulser coil ① and insert the thickness gauge into the gap ⓐ between the pulser coil and the encoder ring ③ on the flywheel ②.



Pulser Coil Air Gap: ⓐ 0.6 to 1.0 mm (0.024 to 0.039 in)

2. Tighten the mounting screws of the pulser coil.







7) Inspection of the Oil Pressure Switch



Remove the part to test it as a separate unit.

- 1. Remove the oil pressure switch ①.
- 2. Check the conductivity of the oil pressure switch. Replace it if it is not conductive.
- Connect the vacuum/pressure gauge to the oil pressure switch.



Vacuum/Pressure Gauge: P/N. 3AC-99020-1

- 4. Apply pressure slowly with the vacuum/pressure gauge.
- 5. Check that the oil pressure switch is not conductive at the specified pressure. Replace it if it is conductive.



Oil Pressure Switch Pressure: 0.029 to 0.049 MPa (4.2 to 7.1 PSI) [0.3 to 0.5 kgf/cm²]

6. Reinstall the oil pressure switch and tighten to the specified torque.



Apply a screw locking agent (ThreeBond 1327) on the threaded section of the oil pressure switch and apply silicone grease on the screw of oil pressure switch lead wire.



Oil Pressure Switch: 8 N·m (6 lb·ft) [0.8 kgf·m]







8) Inspection of the Engine

Temperature Sensor



Remove the part to test it as a separate unit.

- 1. Remove the engine temperature sensor ① from the engine.
- Place the engine temperature sensor in a vessel containing water and slowly heat the water. To measure the resistance at low temperatures, place the sensor in ice water, refrigerator, etc. to cool the sensor.
- Measure the engine temperature sensor resistance. Replace it if the value is not as specified.







9) Inspection of the Neutral Switch (Except for MF)



This test can be conducted without removing the part.

1. Check the conductivity of the neutral switch. Replace it if it is not conductive.

	Switch Position	Lead Wire Color	
ĽIJ	SWITCH FUSITION	Green (G)	Green (G)
	Free (a)		
	Pushed (shift in) (b)	0	0





10) Inspection of the Start Switch (EF, EFT)

1. Check the electrical conductivity of the start switch and replace it if it is not conductive.



This test can be conducted without removing the part.

Switch Position	Lead W	ire Color
Switch Position	Green (G)	Red (R)
Free: OFF		
Pushed: ON	0	O



11)Inspection of the Main (Key) Switch

- 1. Remove the main switch from the multi-tiller handle or the remote controller.
- 2. Check the conductivity of the key switch and replace it if it is not conductive.



Remove the part to test it as a separate unit.

Remote Control Model:

	Switch	L	ead					
	Position	В	Br	R	R	G	L	
	OFF	0	0					
	ON			\bigcirc	Ю			
	START			\bigcirc	0	0		
PUSH	ON			0	0		-0	Variable Idle

Tiller Handle Model:

	Switch	L	ead					
	Position	В	Br	R	R	G	L	
	OFF	0	Ю					
	ON			0	Ю			
	START			\bigcirc	$\left \circ \right $	Θ		
PUSH	START			0-	0	0	-0	
PUSH	ON			0	-0-		-0	Variable Idle





12) Inspection of the Stop Switch (Except for MF)

1. Check the conductivity of the stop switch and replace it if it is not conductive.

	Switch Desition	Lead Wire Color					
Ľ.	Switch Position	Brown (Br)	Black (B)				
	Bemove lock a	0	O				
	Install lock (b)						
	Press switch ©	0	0				



5. The Fuel Control System 1) Inspection of the Injector

1. Measure the injector resistance.



- This test can be conducted without removing the part.
- The injector operation test can be conducted using the "Engine Shut-down Test" or "Engine Running Test" of the diagnosis system.

Injector Resistance (Reference Value): (at 25°C) 11.50 to 12.50 Ω





2) Inspection of the ISC Valve

Measure the resistance between the ISC valve terminals

 (1).



ISC Valve Resistance (Reference Value): (at 20°C) 21.30 to 27.30 Ω



The ISC valve operation test can be conducted using the "Engine Shut-down Test" or "Engine Running Test" of the diagnosis system.







3) Inspection of the T-MAP Sensor



The MAP (manifold pressure) sensor and MAT (intake air temperature) sensor are integrated in this sensor.

Inspection of the MAT Sensor

- 1. Measure the ambient temperature.
- Connect a computer to the outboard motor and use the diagnosis system to display "Air Temperature (Intake Air Temperature)."
- Replace the T-MAP sensor if the difference between the ambient temperature and "Air Temperature (Intake Air Temperature)" is greater than ±5°C.



Inspect the MAT sensor when the engine is cold.

 Measure the MAT sensor resistance. Replace the T-MAP sensor if the value is not as specified.



This test can be conducted without removing the part.



Inspection of the MAP Sensor

1. Measure the MAP sensor resistance. Replace the T-MAP sensor if the value is not as specified.



4) Inspection of the Fuel Feed Pump (FFP)

- 1. Turn the key switch to "ON" and check the operation of the fuel feed pump (FFP) ①.
- 2. Check for the operating sound of the fuel feed pump (FFP). If it cannot be heard, check the electrical system.



This test can be conducted without removing the component.









5) Inspection of the Throttle Position Sensor (TPS)

1. Check the throttle position sensor resistance. Replace the entire throttle body if the value is not as specified.



Resistance Between Terminals: 3.5 to $6.5 \text{ k}\Omega$ or less

2. Apply a voltage of 5 V between Vta ① and E2 ② and check the change in voltage between ② and Vc ③.



The TPS output is proportional to the degree the main valve is open, from fully closed to fully open.





6. The Starting System (Except for MF)

1) Inspection of the Fuse

1. Check the conductivity of the fuse. Replace it if it is not conductive.



A flat, compact blade fuse is used.

2) Inspection of the Starter Solenoid

- 1. Connect the lead wires of the tester to the terminals of the starter solenoid.
- 2. Connect the green (G) lead wire to the battery's positive terminal.
- Connect the black (B) lead wire to the battery's negative terminal.
- 4. Check the conductivity between the terminals of the starter solenoid. Replace it if it is not conductive.
- Remove the green (G) or the black (B) lead wire from a battery terminal and check that there is no conductivity between the terminals of the starter solenoid. Replace it if it is conductive.



① Fuse box





3) Disassembly of the Starter Motor

- Mark the starter motor body and the cap with a locating mark (for ease of reassembly).
- 2. Slide the pinion stopper ① downward as shown and remove the clip ②.



Use a small flathead screwdriver to remove the clutch. Be careful not to cut your hand, because the clip is secured firmly.

3. Remove the bolt and disassemble the starter motor.





4) Inspection of the Starter Motor Pinion

- Check the pinion teeth for cracks and wear. Replace it if necessary.
- Secure the clutch (2) and turn only the pinion to check that the pinion (1) moves smoothly in one direction. Replace it if necessary.

Turn the pinion counterclockwise and check that it rotates smoothly. Also, check that the pinion locks when it is turned clockwise.

5) Inspection of the Armature

1. Check the commutator ① for dirt. Clean it using sand paper No. 600 or compressed air, if necessary.





 Measure the outer diameter of the commutator ①. Replace the starter motor assembly if the value is below the specified value.



 Measure the undercut (a) of the commutator (1). Replace the starter motor assembly if the value is below the specified value.



Commutator Undercut: Standard Value 1.0 to 1.2 mm (0.039 to 0.047 in)

Wear Limit (a): 0.7 mm (0.027 in)

4. Check the conductivity of the armature ②. Replace the starter motor assembly if the value is not as specified.

Armature Conductivity:	
b Between commutator segments 3 and 3	Conductive
© Between segment and armature core	Not conductive
(d) Between segment and armature shaft	Not conductive

6) Inspection of the Brush

 Measure the brush length. Replace the brush holder assembly if the brush length is shorter than the specified value.



 Check the conductivity of the brush holder assembly. Replace it if the value is not as specified.

Conductivity Between Brushes							
Between Brush ① and Brush ②	Not conductive						
Between brushes ①② and Ground	Not conductive						













7) Starter Motor Operation Test

1. Assemble the starter motor and, before and after installing it in the power unit, apply an electric current between the positive and negative points to confirm that it is working normally.



Be careful of fire, because the operating test generates sparks.

7. The Charging System (Except for MF) 1) Inspection of the Charge Coil

- 1. Remove the wire band ① on the cable from the charge coil, located on the rectifier.
- 2. Disconnect the charge coil cable connector ② and measure the resistance.



This test can be conducted without removing the part.

Charge Coil Resistance: Reference Value (at 20°C) Between Yellow (Y) terminal and Yellow (Y) or Green (G) terminal 0.27 to 0.41 Ω

2) Inspection of the Rectifier

- Check the wire harness for any disconnections or problems with the terminal connection.
- Check the conductivity of each part according to the following table. The values in () are reference values.
- Disconnect all connections and measure as a separate unit.



This test can be conducted without removing the part.

Rectifier Tester Check Table "ON" means conductive, and "OFF" means not conductive.

	Positive tester lead wire											
		White (W)	Black (B)	Yellow (Y)	Yellow (Y)	Yellow (Y)						
Nega	White (W)		OFF	OFF	OFF	OFF						
tive tes	Black (B)	ON (4.9 kΩ)		ON (2.5 kΩ)	ON (2.5 kΩ)	ON (2.5 kΩ)						
ter lead	Yellow (Y)	ΟΝ (4.0 kΩ)	ON (2.5 kΩ)		ΟΝ (5.0 kΩ)	ΟΝ (5.0 kΩ)						
d wire	Yellow (Y)	ΟΝ (4.0 kΩ)	ON (2.5 kΩ)	ΟΝ (5.0 kΩ)		ΟΝ (5.0 kΩ)						
	Yellow (Y)	ΟΝ (4.0 kΩ)	ON (2.5 kΩ)	ΟΝ (5.0 kΩ)	ΟΝ (5.0 kΩ)							





Measurement conditions

Circuit tester to be used: HIOKI3030 Range to be used: 1kΩ

- Permissible error of resistance is $\pm 20\%$
- Note) ① HIOKI HITESTER MODEL 3030 was used for this measurement. Using another tester can result in an abnormal resistance value and an inaccurate test.
 - (2) Disconnect all connections and measure as a separate unit.
 - 3 Any movement of the tester needle is displayed as "ON" and indicates that it is conductive.
 - (4) "CON" display is a characteristic of the condenser in which the needle moves once and then returns to stabilize at the value shown in ().
 - (5) The value in () is the value when the "1kΩ" range is used. Because the unit contains diodes, this value varies widely depending on the type and state of the tester (such as the internal power supply) and the range.

8. ECU Coupler

- Check the wire harness for any disconnections or problems with the terminal connection.
- The location of each terminal number is shown in the diagram to the right.
- The name and lead wire color of each terminal number are shown in the table below.

Terminal	Name	Lea	d Wire (Color)
A1	Injector Power Supply (12 V)	L	Blue
A2	Exciter Coil H	R	Red
A3	Stop Switch	Br	Brown
A4	Fuel Feed Pump (FFP) U	B/W	Black/White
A5	Oil Pressure Switch	Br/W	Brown/White
A6	Fuel Feed Pump (FFP) V	B/Y	Black/Yellow
A7	TPS	L/W	Blue/White
A8	Engine Temperature Sensor	G/Y	Green/Yellow
A9	Tachometer Lamp	Lg	Light Green
A10	Warning Lamp	Lg	Light Green
A11	Warning Buzzer	Y	Yellow
A12	Tachometer	W	White
A13	T-MAP Sensor (MAP)	G/Or	Green/Orange
A14	T-MAP Sensor (MAT)	G/W	Green/White
A15	#1 Pulser Coil (-)	В	Black
A16	ISC Valve	G/R	Green/Red
A17	Injector Power Supply (12 V)	R/W	Red/White
A18	ECU Charge Coil V	W	White
A19	ECU Charge Coil U	W	White
A20	ECU Charge Coil W	W	White
A21	Trolling Speed Control	L	Blue
A22	Fuel Feed Pump (FFP) W	B/G	Black/Yellow
A23	Exciter Coil M(-)	В	Black
A24	Exciter Coil L	L	Blue
A25	#1 Ignition Coil	B/W	Black/White
A26	#2 Ignition Coil	B/Y	Black/Yellow
A27	#3 Ignition Coil	B/G	Black/Green
A28	Ground	В	Black
A29	#1 Injector	Lg/R	Light Green/Red
A30	#2 Injector	Lg/B	Light Green/Black
A31	#3 Injector	Lg	Light Green
A32	#1 Pulser Coil	R	Red
A33	#2 Pulser Coil	R/Y	Red/Yellow
A34	Ground (Sensor)	B/L	Black/Blue



1819202122232425262728293031323334

ECU A connector

Terminal	Name	Lead Wire (Color)			
B1	CAN (H)	W	White		
B2	Diagnosis (-)	В	Black		
B3	Blank				
B4	Diagnosis	Y	Yellow		
B5	Diagnosis	W	White		
B6	Blank				
B7	Blank				
B8	Blank				
B9	Blank				
B10	CAN (L)	L	Blue		
B11	ECU Power Supply	R	Red		
B12	Diagnosis Communication Power Supply (5 V)	R/W	Red/White		
B13	Blank				
B14	Blank				
B15	Blank				
B16	Blank				
B17	Blank				
B18	Blank				



ECU B Connector



Troubleshooting



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℗K Troubleshooting

1. Troubleshooting List

* Low speed ESG is activated

	Engine will not start	Engine stalls immediately after starting	Defective idling	Defective acceleration	Engine revolution speed is high (High speed ESG is activated)	Engine revolution speed is low (* Low speed ESG is activated)	Boat speed is insufficient, or revolution speed is insufficient	Engine is overheated	Battery is not charging	Starter motor will not operate	Power tilt will not operate	Warning lamp is lit	Warning lamp is flashing	Warning buzzer is activated	Probable Cause
	•														Fuel tank is empty
	•	•					•								Connection of the fuel system is incomplete
	•														Fuel system is taking in air or is clogged
Fue	•														Fuel pipe is twisted or damaged
and															Air vent screw of the fuel tank is not open
d Lubr	•	•	•	•		•	•								Fuel filter, fuel pump, vapor separator, or injector is clogged
icati															Performance of the fuel pump or vapor separator has dropped
ion															Gasoline is of poor quality
Syst															Fuel is not fed under pressure by the primer valve or primer valve is clogged
lem															Engine oil is of poor quality
ß															Excessive engine oil (is generating exhaust smoke)
						•*						•*		•*	Insufficient Engine oil (activated the oil pressure switch)
						•*						•*		•*	Defective Oil pump (activated the oil pressure switch)
						•*	•			•			•*	•*	Electrical parts are defective, wiring is disconnected, contact is poor, grounding is poor
															Specified spark plug is not being used
															Spark plug is dirty or worn
		•					•								Ignition is poor (ignition system is defective)
															Stop switch short-circuited
Ele															Stop switch is not locked or not fully inserted
ctric															Rectifier is defective
al Sys	•								•	•	•				Battery life is up, charge is insufficient, electrolyte level is low, battery terminal is loose or corroded
tem															Fuse is blown
															Shift lever is not in the neutral (N) position
															Key switch or starter switch is defective
															Starter motor or starter solenoid is defective
															Power tilt switch or power tilt relay is defective
															Power tilt fluid has air contamination
0															Compression pressure is insufficient
Imo															Valve timing is incorrect (belt is stretched, belt is installed incorrectly)
ores															Valve clearance is insufficient
sion															Intake or exhaust valve seat sealing is defective
n Sy															Piston, piston ring, or cylinder is excessively worn
sten															Carbon has built up in the combustion chamber
з															Spark plug is loose
						•*						•*		•*	Cooling water is insufficient, pump is defective, or is clogged
		•				•*	•					•*		•*	Thermostat operation is defective
						•*						•*		•*	Anti-ventilation plate is damaged
0															Mismatched propeller is being used
the															Propeller is damaged or deformed
															Thrust rod position is incorrect
															Load position is unbalanced
															Transom is too high or too low
															Throttle opening is insufficient
Before working on the engine, check the installation condition of the hull, rigging and engine, and make sure the fuel is normal and the battery is fully charged. For mechanical troubleshooting, refer to the relevant troubleshooting section in this chapter. For checking and servicing the outboard motor, refer to the service procedures described in this manual to perform the work safely.

Power Unit



℗K Troubleshooting





⑦K Troubleshooting







OK Troubleshooting





Troubleshooting



Fuel System



OK Troubleshooting





ØK Troubleshooting









PT Unit



℗ĸ Troubleshooting





Diagnosis

An electronically controlled engine can be connected to a PC to diagnose the status of the engine.

Information that can be viewed include self-diagnosis, malfunction records, and status during operation.

The operation of individual electronic components of the engine can be viewed to determine the malfunction.

To use the diagnosis tool kit, the software must be installed.

For how to install the software and how to use the diagnosis tool kit, refer to documents included with download of diagnostic program.







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1. Service Information

The installer shall ensure the work environment is safe by paying adequate attention to factors including fire prevention and ventilation so as not to cause injuries or damage the product.

2. Service Data

1) Boat Mounting Restriction

Be careful not to overload the boat or mount an engine with an output that is too large for the boat. A plate indicating the maximum permissible output and seating capacity set by the manufacturer according to specific standards is displayed on the boat. If you have any doubts or questions, consult your dealer or the boat manufacturer.

WARNING

Never mount an outboard motor exceeding the maximum output set by the boat manufacturer as the following problems may occur.

- The boat may become uncontrollable.
- The design buoyancy characteristics of the boat may change by mounting an excessive weight on the transom.

• In particular, cracks or damage may occur in the boat around the transom area.

An overpowered boat may cause serious injuries, death, or damage to the boat.

2) Mounting Dimensions

Transom Opening Smallest Dimension: (a) 1-engine mounted 696 mm (27.40 in) 2-engine mounted 1256 mm (49.45 in)

Minimum engine centerline distance when 2 engines are mounted: (b) 560 mm (22.05 in)

> When the mounting height of the outboard motor is too high, the engine may overheat or the components of the gear case may be damaged.





3) Transom Dimensions

Manual Tilt Model



Gas-Assist/Power Tilt Model



Permissible transom board thickness: 40 to 60 mm (1.55 to 2.35 in)



(a):The transom height is the height from the bottom of the boat hull to the top of transom board.



4) Lifting Up the Outboard Motor

Use an engine hanger.



5) Installation of the Outboard Motor

 Install the outboard motor so that the interval ⓒ between the anti-ventilation plate ⓐ and the hull bottom ⓑ is 0 to 25 mm (0 to 1 in).



If the mounting height of the outboard motor is too high, the following may occur.

 Air may be sucked in through the cooling water inlet port, and overheating may occur easily.
 Steering performance deteriorates.

3)When planing, or when the load is heavy, the propeller tends to idle easily.

2. Attach an outboard motor mounting template to the boat transom.



Adjust the centerline of the template accurately to the center of the boat transom.





3. Power Tilt/Gas-Assist Type

Mark the mount holes and drill 4 holes with a diameter of 12.5 mm (0.49 in).

Manual Tilt Type

Decide the mounting location and firmly tighten the clamp screw handle. Mark the mount holes and drill 2 holes with a diameter of 9.0 mm (0.35 in).



To align correctly with the positions of the holes in the outboard motor's transom bracket, make holes that are perpendicular to the transom.

- 4. Refer to "Installation Dimensions" and install the outboard motor at the recommended height.
- 5. Secure the outboard motor with the enclosed mounting bolts and nuts as shown in the diagram.
 - A Power Tilt/Gas-Assist Type
 - (1): Bolt 12 x 105 mm (0.47 x 4.13 in), (4pcs)
 - (2): Flat washer large (4pcs)
 - ③: Nylon nut (4pcs)
 - (4): Flat washer small (4pcs)
 - (5): Marine sealing agent: Apply, avoiding the threaded section of the bolt.





- B Manual Tilt Type
- (1): Bolt 8 x 85 mm (0.31 x 3.35 in), (2pcs)
- (2): Nylon nut (2pcs)
- ③: Flat washer (4pcs)
- (4): Clamp screw





3. Fuel System

It is recommended to install an additional fuel/water separator on the boat to effectively remove water and foreign substances contained in the fuel. If a fuel/water separator of a wrong size is added to the fuel system, this may restrict the fuel and lead to the engine stalling or being damaged due to fuel starvation. Use of a valve fitting of a wrong size may also cause similar problems.

	2
--	---

Recommended Fuel/Water Separator Size: Flow Rate: 50 L/H (13 GPH) or more Filter Rating: 10 Micron

1) Fuel

Avoid using old gasoline or gasoline contaminated with debris, sand, mud, and other impurities during and after the break-in operation of the engine.

Do not use a mixture of gasoline and oil as fuel in this engine.

2) Engine Oil

- 1. Engine needs to be vertical position.
- 2. Remove the top cowl, then remove the oil filler cap (1).
- Supply engine oil from the oil filler hole (2).
 While supplying, check the level with the oil gauge (3).



4. Fill oil until the middle between (a) and (b), reinstall filler cap and install the top cowl.





③ Oil level gauge ④ Upper limit (MAX) ⓑ Lower limit (MIN)

3) Installation of the Fuel Tank

<Portable Fuel Tank>

Take into consideration the length of the fuel hose of the engine in selecting an appropriate position on the boat to secure the tank.

<Stationary Fuel Tank>

Install the electrical ground, anti-siphon protection, ventilation etc. in accordance with standards.

4. Connections to the Outboard Motor

1) Steering Cable

Cable installed on the starboard side

- 1. Apply a thin coat of grease over the entire cable end.
- 2. Insert the steering cable into the tilt tube.





3. Tighten the nut to the specified torque.



Be sure to install the drag link seal ring ①.
Do not overtighten the drag link seal ring or it may deform and the telescopic shaft of steering cable will not be sealed properly.





2) Drag Link

- 1. Install the drag link as shown in the diagram.
 - Be sure to use a special bolt ①, nylon nuts ②, washers ③, and a spacer ④ to install the drag link connecting the engine and the steering cable. Do not replace these bolts and nuts with ordinary bolts and nuts (non-locking type) as the drag link may get loose or detached due to vibration etc.
 - Do not reuse nylon nut ②. Be sure to replace them with new ones.

WARNING

If the drag link becomes detached, it may result in the boat making a sharp turn. As a result, the passengers may be ejected out of the boat, resulting in serious injuries or even death.



Bolt ①: 27 N·m (20 lb·ft) [2.7 kgf·m] Nylon nut ②: Tighten until contact is made, then loosen 1/4 of a turn.

Washer ③

Spacer ④



2 Nylon nut Do not reuse



2 Nylon nut Do not reuse

Fix the rear panel securely with 2 screws.

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6.

(b)

(4

Screw about 11 mm (0.43 in) of the enclosed terminal 2. eye ④ into the threaded section at the end of the remote control cable (3) and secure it with a nut (5). Then, apply grease on the mounting hole (b) of the terminal eye end.

Insert the outer groove (C) of the remote control cable for

arm (7) and secure it with the E-ring (9).

5. Remote Control Components

Loosen the screws (1) on the rear panel and remove the

1) Installation of the Remote Control **Cable (Remote Controller Side)**

1.

З.

4.

rear panel (2).

(a) Approx. 11 mm (0.43 in)

3`



(6) Remote control cable for the shift ⑦ Shift arm

æ

(11)

- 5. Follow the same procedure as the remote control cable for the shift to install the remote control cable for the throttle (1) in the throttle arm (2).
- the shift (6) into the clamp groove of the housing. Next, insert the terminal eye into the pin (8) at the end of the shift Insert the enclosed grommet (1) into the clamp groove.





(6)



2) Installation of the Remote Control Cable (Engine Side) Remote Control Model

1. Release the latch attaching the bottom cowl and remove the top cowl.



(1)

2)

Remove the remote control stay cover ① and the grommet (upper) ②.

3. Remove the cable clip ③.

4. Remove the cover ④.

5. Screw about 12 mm (0.47 in) of the cable joint into the end of the remote control cable.







 The shift cable is the one with the end that moves first when the control lever (5) is lowered (approx.32°) to the forward (F) side (a) until it stops.



b Approx. 32°c Neutral position



 Pass the main harness ⑦ through the grommet (lower) ⑥ and attach the cable clip ③.



⑦ Main harness⑧ Battery cable⑨ Fuel hose



Pass the shift cable (1) and the throttle cable (1) through the grommet (upper) (2) and place the unit temporarily onto the grommet (lower).

8.

9. With the control lever (5) on the remote control box at the neutral position, check that the free acceleration lever (12) is at the fully closed position.

Rigging

- Operate the shift arm (3) to the forward (F), neutral (N), and reverse (R) positions to confirm the positions, then set it to the neutral (N) position.
- Adjust the screw-in amount of the cable joint (4) so that its holes are aligned with the pins (b) of the throttle arm and the shift arm.

The cable joint should be screwed in at least 10 mm.

• The cable joint is shipped in the outboard motor packing box.

• When adjusting the cable joint, secure it with the cable fully pushed in.







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10-13

case when the lever is lowered further. If the control lever is in the fully open position but the stopper on the throttle arm is not in contact with the protrusion on the crank case, adjust the

screw-in amount of the cable joint.

16. Check that the throttle body on the outboard motor side is fully closed when the control lever is returned to the neutral (N) position.

12. Tighten nuts (5), then install the cable joint on the pins and secure them with the washers and snap pins (6).

14. Operate the control lever and check that it moves to the forward (F), neutral (N), and reverse (R) positions.

15. Check that the outboard motor shifts in when the control lever is lowered to the forward (F) side until it stops once (approx. 32°) and that the stopper (f) on the throttle

13. Install the remote control stay cover ①.

If the throttle body is not fully closed when the control lever is in the neutral (N) position, adjust the screw-in amount of the cable joint.











Rigging

Check that the throttle operates smoothly and repeat steps
 9 to 16 as necessary.



18. Reconnect the main harness connectors 1.

▲ CAUTION

Do not disconnect a main harness while the engine is in operation.



19. Install the cover (4).



6. Lower Unit

1) Installation of the Propeller

⚠ WARNING

- Before removing or installing the propeller, be sure to disconnect the battery cables from the battery and remove the stop switch lock plate.
- When removing or installing the propeller, do not handle the propeller with your bare hands.
- Insert a piece of wood or a similar object between the anti-ventilation plate and the propeller when removing or installing the propeller.
- 1. Set the shift lever to the neutral (N) position.
- 2. Apply water-resistant grease on the propeller shaft.
- Install the propeller on the propeller shaft as shown in the diagram.
- 4. Insert a piece of wood between the anti-ventilation plate and the propeller and tighten the nut to the specified torque.

Propeller nut: 25 N·m (18 lb·ft) [2.5 kgf·m]

5. Insert a split pin into the nut and bend it.



① Propeller

- ② Thrust holder
- ③ Washer
- ④ Nut
- (5) Split pin

If the propeller shaft pin hole and the propeller nut pin groove are not aligned, tighten the nut further until the hole and the groove are aligned.



7. Meters

1) Installation of Meters

When installing meters, select a place on the dashboard (1) where the operator can see them easily and they are not exposed to water spray.

The meters can be installed on dashboards (1) that are 2 to 11 mm (0.08 to 0.43 in) thick. If the thickness exceeds 11 mm (0.43 in), cut the fitting plate (2) to size so that the meters can be installed.

Installation angle

When installing meters, install them at a mounting angle (a) between 50° and 80°.

Installation opening

To install the meters, make holes of the following sizes on the dashboard.

- Tachometer ③ and speedometer
 Installation hole ⓑ: φ86 mm (3.39 in)
- Trim meter ④
 Installation hole ⓒ: φ53 mm (2.09 in)





• Tachometer Settings Set the selector (5) on the back of the meter to "12P."



▲ CAUTION

If you do not use the meter on the remote control model, install Cable terminal plug (6) (3VS-76037-0) prevent from a short circuit.



8. The Electrical System

1) Battery Capacity

12 V 64 Ah/5 HR or higher 12 V 70 Ah/20 HR or higher 512 CCA or higher

2) Installation of the Battery

Recommend connecting only the engine battery cables to the starting battery.

- Battery should be stored in battery storage box and secured to hull to prevent it from falling due to rolling or pitching or any shock in the place where it is protected from water spray.
- When connecting battery cables, connect positive cable (red) ① first and then negative cable (black) ②. (Reverse the order when disconnecting.)

Positive cable is the one with red tube on the terminal end.

- Before using battery, thoroughly read warning label.
- Do not disconnect battery cable during engine operation.

▲ CAUTION

Do not use a wing/butterfly nut for installing the battery cable.

A wing/butterfly nut tends to get loose easily, resulting in electrical failures. Recommend to fasten with correct hex-

nut and if washer is needed possibly locking washer or star washer to prevent accidental loosening of nuts.







3) Wiring Diagram of the Remote Controller and Meters



A Side mount remote control head

(a) Connection to the circuit for boat lights

Lead W	/ire (Color)	No.	Part Name
В	Black	1	Remote Control Head Assembly (RC12F)
L	Blue	2	Tachometer
Lg	Light Green	3	Trim Meter
R	Red	4	Meter Lead Wire $L = 2,000$ (6.5 ft)
W	White	5	Extension Cable (Trim Sensor) L = 6,000 (19.5 ft)
Y	Yellow	6	Trim Sensor L = 1,700 (5.5 ft)


B Top/flush mount remote control head

(a) Connection to the circuit for boat lights

Lead Wire (Color)				
В	Black			
G	Green			
L	Blue			
Lg	Light Green			
R	Red			
W	White			
Y	Yellow			
Y/R	Yellow/Red			

No.	Part Name
1	Remote Control Head Assembly (Top/Flush)
2	Tachometer
3	Trim Meter
4	Main Switch Panel
5	Buzzer
6	Meter Lead Wire $L = 2,000$ (6.5 ft)
\bigcirc	Extension Cable (Trim Sensor) L = 6,000 (19.5 ft)
8	Trim Sensor L = 1,700 (5.5 ft)

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9. Installation of the Trim

Sensor

1. Tilt the engine up fully and secure it with the tilt stopper.

- Do not insert your hand or finger between the outboard motor and the clamp bracket while working.
- When attaching or detaching the PT unit without removing the power unit, suspend and support the outboard motor with a hoist etc. If not, it may be dangerous as the outboard motor may fall down.





2. Pass the trim sensor wiring through the hole in the clamp bracket and attach the trim sensor to the clamp bracket using 2 bolts.

The trim sensor is easier to install if it is held in place with a tie wrap.











3. Install the clamp and the grommet.

4. Draw the trim sensor harness into the engine through the hole in the bottom cowl.

Rigging



2

5. Remove the remote control stay cover ① and the grommet (upper) ②.

6. Remove the cable clip ③.

- Pass the trim sensor wiring through the hole (a) of the grommet (lower) (4).
 - (b) Main harness
 - © Battery cable
 - (d) Fuel hose
- 8. Install the cable clip ③.





9. Pass the shift cable (5) and the throttle cable (6) through the grommet (upper) (2) and place the unit onto the grommet (lower).



10. Install the remote control stay cover (1).



10



Wiring Diagram



Wiring Chart11-2MFS25/30D MF(Basic Tiller Handle Type)Electric Circuit11-5MFS25/30D EF/EFT11-6(Basic Tiller Handle Type)11-6Electric Circuit11-6MFS25/30D EH/EHT(Multi-Function Tiller Handle Type)Electric Circuit11-7

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Wiring Chart

NO.	Name	Remarks	ECU	Lead Wire Color				ECU
1	Magneto							
	Fristen Osti		A2	R	Red	В	Black	A23
2	Exciter Coll		A24	L	Blue			
3	Pulser Coil	#1	A32	R	Red	В	Black	A15
4	Pulser Coil	#2	A33	R/Y	Red/Yellow	В	Black	Ground
-	FOU Charge Cail		A18	W	White	W	White	A19
) ^S			A20	W	White			
6	Charge Coil		-	Y	Yellow	Y	Yellow	-
			-	G	Green			
			-	Y	Yellow	В	Black	Ground
7	Rectifier/Regulator		-	Y	Yellow	W	White	-
			-	Y	Yellow			
8	Exhaust Cover	Ground	Ground	В	Black	В	Black	Ground
9	Coil Bracket	Ground	Ground	В	Black			
10	Fuse	20A	-	R	Red	R	Red	-
11	Starter Solenoid		-	G	Green	В	Black	Ground
12	Starter Motor		-	G	Green	В	Black	-
13	Battery		-	R	Red	В	Black	-
14	PT Solenoid	UP Side / PT Model	-	Sb	Sky Blue	В	Black	Ground
15	PT Solenoid	DOWN Side / PT Model	-	Р	Pink	В	Black	Ground
16	Cylinder Block (Port Side)	Ground	Ground	В	Black	В	Black	Ground
17	PT Motor	PT Model	-	L	Blue	G	Green	-
10	PT Switch (Bottom Cowl)	PT Model	-	Р	Pink	R	Red	-
			-	Sb	Sky Blue			
19	Neutral Switch		-	G	Green	G	Green	-
20	Cylinder Head Cover	Ground	Ground	В	Black	В	Black	Ground
			Ground	В	Black			
21	Ignition Coil	#1	A25	W	White	В	Black	Ground
22	Ignition Coil	#2	A26	W	White	В	Black	Ground
23	Ignition Coil	#3	A27	W	White	В	Black	Ground
24	Idle Speed Control Valve	ISC Valve	A1	L	Blue	G/R	Green/Red	A16
25	Fuel Feed Pump	FFP	A4	B/W	Black/White	B/Y	Black/Yellow	A6
			A22	B/G	Black/Green			
26	Fuel Injector	#1	A29	Lg/R	Light Green/Red	L	Blue	A1
27	Fuel Injector	#2	A30	Lg/B	Light Green/Black	L	Blue	A1
28	Fuel Injector	#3	A31	Lg	Light Green	L	Blue	A1
29	T-MAP Sensor	MAP: A13	A17	R/W	Red/White	B/L	Black/Blue	A34
23		MAT: A14	A13	G/Or	Green/Orange	G/W	Green/White	A14
30	Throttle Position Sensor	TPS	A17	R/W	Red/White	B/L	Black/Blue	A34
			A7	L/W	Blue/White			
31	Engine Temperature Sensor	E-WTS	A8	G/Y	Green/Yellow	B/L	Black/Blue	A34
32	Oil Pressure Lamp (LED)		A1	W/R (L)	White/Red (Blue)	Lg	Light Green	A10
33	Oil Pressure Switch		A5	B/W	Black/White		Ground	-
34	ECU Connector A	With Main Harness	-	-				-
35	ECU Connector B	With Main Harness	-	-				-
36	ECU		-		-		1	-
37	CAN Communication Connector		B10	L	Blue	W	White	B1

NO.	Name	Remarks	ECU	Lead Wire Color				ECU
38	Service Connector	Diagnosis Port	B11	R	Red	R/W	Red/White	B12
			B5	W	White	Y	Yellow	B4
			B2	В	Black			
39	Resistance			R/W	Red/White	R/W	Red/White	
40	Fuse	Option, 10A	-	В	Black	В	Black	-
41	Battery	Option	-	B/W	Black/White	В	Black	-
42	Interface Unit	Option	-	-				
43	USB conversion	Option	-	-				
44	PC	Option	-	-				-
45	Meter Lamp Switch	Option	-	R	Red	L	Blue	-
46	Trim Sensor	Option	-	Р	Pink	В	Black	-
47	Volt Meter	Option	-	L	Blue	R	Red	-
			-	В	Black	В	Black	-
48	Fuel Level Sensor	Option	-	Р	Pink	В	Black	Ground
40	Eucl Motor	Ontion	-	L	Blue	R	Red	-
49	Fuel Meter	Option	-	Р	Pink	В	Black	-
50	Hour Meter	Option	-	R	Red	В	Black	-
51	Speed Motor	Ontion	-	L	Blue	R	Red	-
51	Speed Meter	Οριίοπ	-	R	Red	В	Black	-
52	Water Pressure Meter	Option	-	L	Blue	В	Black	-
	Trim Meter	Option	-	L	Blue	R	Red	-
53			-	Р	Pink	В	Black	-
			-	В	Black			
	Tachometer	Remote Control Model 1-lamp Tachometer	-	L	Blue	В	Black	-
54			A12	W	White	Y	Yellow	-
			-	R	Red	Lg	Light Green	A9
55	PT Switch Circuit	PT Model	-	-			-	
56	PT Switch	PT Model	-	Р	Pink	R	Red	-
			-	Sb	Sky Blue			
57	Main Switch Circuit	Except for Basic Tiller Handle Model	-	-			-	
58	Warning Buzzer Circuit		-	-				
59	Neutral Switch Circuit	Remote Control Model	-	-				-
	Main Switch	Except for Basic Tiller Handle Model	-	G	Green	L	Blue	A21
60			-	R	Red	R	Red	-
			-	В	Black	Br	Brown	A3
61	Stop Switch		A3	Br	Brown	В	Black	-
62	Warning Buzzer		A11	Y	Yellow	R	Red	-
63	Neutral Switch	Remote Control Model	-	G	Green	G	Green	-
64	Stop Switch Circuit	Remote Control Model	-		-			-
65	Starter Switch	Basic Tiller Handle Model	-	G	Green	R	Red	-
66	Trolling Speed Control	Basic Tiller Handle Model	A21	L	Blue	R	Red	-
67	Tachometer	Option	A12	W	White			



MFS25/30D MF (Basic Tiller Handle Type) Electric Circuit



MFS25/30D EF/EFT (Basic Tiller Handle Type) Electric Circuit



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MFS25/30D EH/EHT (Multi-Function Tiller Handle Type) Electric Circuit



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MFS25/30D EP/EPT (Side Mount Remote Control Type/Analog Meter) Electric Circuit



MFS25/30D EP/EPT (Top Mount Remote Control Type/Analog Meter) Electric Circuit



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SERVICE MANUAL

4 STROKE MFS 25D MFS 30D Models

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