TOHATSU
Outboards

SERVICE MANUAL

2 Stroke
1 & 2
Cylinder
Models

TOHATSU CORPORATION
Address : 5-4,3-chome,Azusawa,Itabashi-ku,
TOKYO,174-0051 JAPAN
Phone : TOKYO (03)3966-3117
FAX : TOKYO (03)3966-2951

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No.003-21035-1
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TABLE OF CONTENTS

SECTION 1
SERVICE SAFETY

TABLE OF CONTENTS

⚠⚠ WARNING

Inadequate knowledge of safe shop practices can result in severe injury or death. Review general safety procedures and specific safety information provided for each procedure prior to beginning any repairs.

INTRODUCTION

Marine manufacturers are required to comply with special regulations and standards to ensure their products are safe and reliable for the consumer. As the marine technician, it is your responsibility to keep these products safe when performing normal rigging, repair and maintenance operations.

It is not possible to foresee all safety hazards which may occur or to include all the knowledge of an experienced technician in a single service manual. Therefore, it is assumed that those using this manual have a working knowledge of 2-cycle outboard engines and the proper technical training for servicing them.

This section discusses safe shop practices and general safety concerns relevant to the operations performed throughout this manual. Read this section carefully and follow all safety statements in this manual as they pertain to the procedures at hand. Remember, always use common sense when servicing outboard engines!

SAFETY STATEMENTS

The following safety statements are found throughout this manual and indicate information which, if ignored, could result in safety hazards or faulty service techniques:

⚠ DANGER

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

⚠⚠ WARNING

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

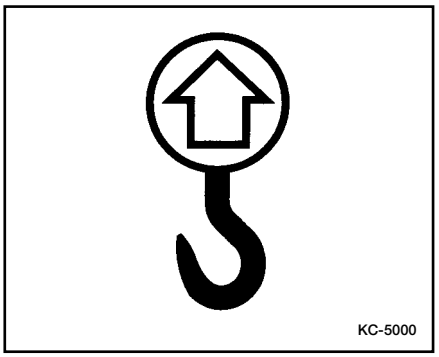
⚠ CAUTION

Indicates the presence of a hazard which, if ignored, COULD result in minor personal injury or damage to product, equipment, or other property.

NOTE

Indicates special information to facilitate the installation, operation, or maintenance of the product or further clarify information which is important but not hazard related.

SAFETY PRECAUTIONS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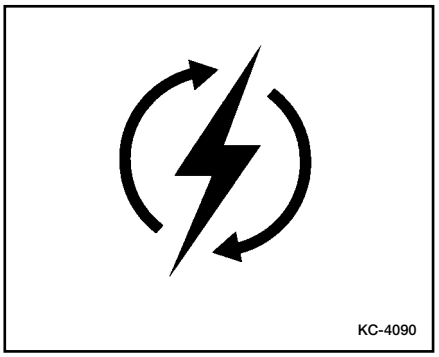
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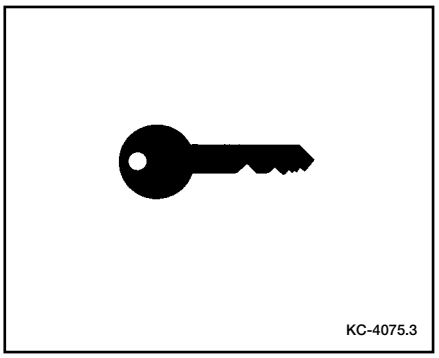
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Handling Outboard Engines

- Never disable the neutral switch start-in-gear prevention system to accommodate installation of a foot control or other option. Always test the neutral switch and emergency stop switch before returning an engine to the customer.

- Lifting devices and hardware must be of suitable capacity for the weight of the outboard engine. Some models are equipped with a fixed hanger on the powerhead. Hanger may be used to lift the complete engine or to remove the powerhead unit. Be aware the engine may swing outward when lifted by the hanger.

- Engine stands must be in good condition, of adequate size, and mounted properly to prevent unexpected shifting or collapse.

- Engine covers are guards to prevent personal contact with the spinning flywheel and high voltage components such as spark plugs and coils. Never wear jewelry or loose clothing near a running engine. Keep hands, arms and hair away from the flywheel. Never touch electrical components when the engine is running.

- Two people working on a running engine must use extreme caution and be aware of one another. Never attempt to start an engine or operate any controls, including steering, before signaling your partner.

- To prevent accidental startup during operations which may cause the flywheel to turn, always perform the following steps:

  1. Turn the ignition key to OFF and remove the key.

  2. Disable the engine ignition system.

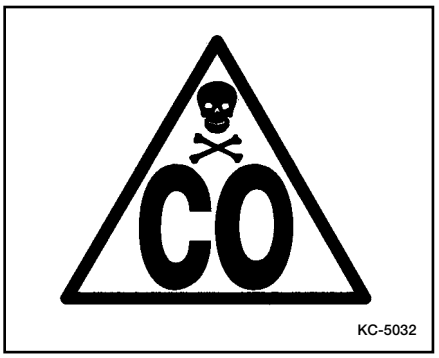
  3. Shift engine to NEUTRAL and verify propeller shaft is not in gear.

- Rotating propellers are not equipped with guards and can cause severe injury or dismemberment. Always stay clear of rotating propellers and make sure there is no possibility of engine startup before removing or installing a propeller. The propeller nut must always be tightened to torque specification prior to starting the engine.

- Avoid running the engine at high RPM. Engine speed can easily increase to excessive RPM when under a no load condition. To avoid engine damage during testing, always use the correct test propeller and keep engine speed below 2000 RPM.

- Run engines only in well ventilated areas to prevent exposure to Carbon Monoxide (CO) gas. Direct and prolonged exposure to CO wiII cause brain damage or death.

- Always wear eye protection, protective clothing, gloves and use other applicable safety equipment when work activities present the risk of personal injury.



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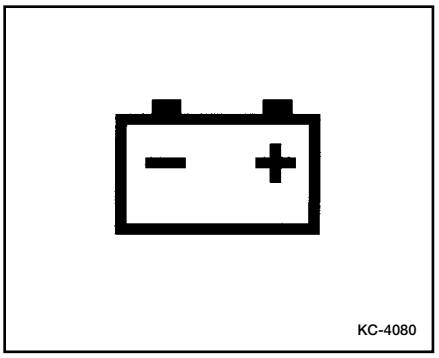
Lead Acid Batteries

- Never check battery charge by placing a metal object across the terminal posts; sparks may occur, resulting in serious burns.

- Avoid contact with battery acid. If battery acid is spilled on skin, thoroughly wash area with plenty of water. If battery acid gets into eyes, flush eyes with water for at least 15 minutes and get prompt medical attention.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- Never remove charger cables from a battery when the charger is energized; sparks and explosion are possible. To remove charger cables, follow these steps:

  1. Turn the charger to OFF.

  2. Disconnect the charger power cord from its power source.

  3. Remove the charger cables from the battery posts.


KC-5050

- Batteries emit explosive vapor through the vented caps during charging. Never charge or test batteries near sparks or flames; explosion can result. Extinguish all smoking materials and flame producing devices before charging and make sure the charging area is weII ventilated.

- Make sure battery vents are not clogged or pressure may build and cause battery to explode.

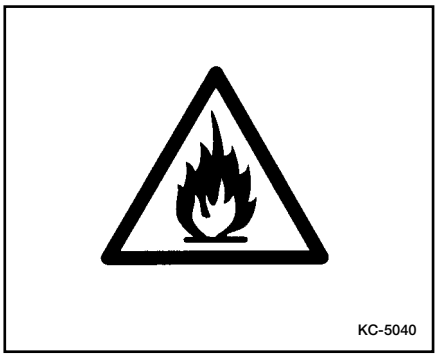
Hazardous Materials

- Gasoline vapors are highly flammable and can cause an explosion. Never smoke or allow sparks or flames nearby when handling fuel Always store gasoline in a shaded, well ventilated area in an approved safety container.

- Ventilate gasoline fumes as soon as detected. Be aware that appliance pilot lights, such as those in furnaces and water heaters, can ignite gasoline vapors and cause explosion.

- Never use gasoline as a cleaner, and always clean up fuel spills immediately and properly dispose of rags in an approved safety container.

- Read and follow the safety labels on products used around the shop. Adhesives, lubricants, solvents, and fuel additives are usually poisonous and flammable. Store and dispose of these products properly.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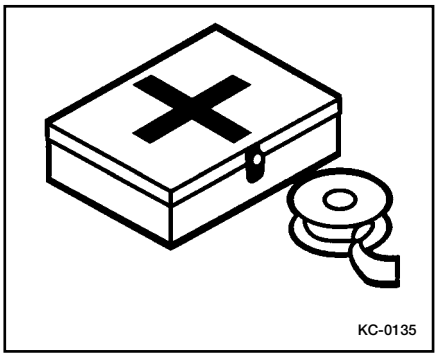
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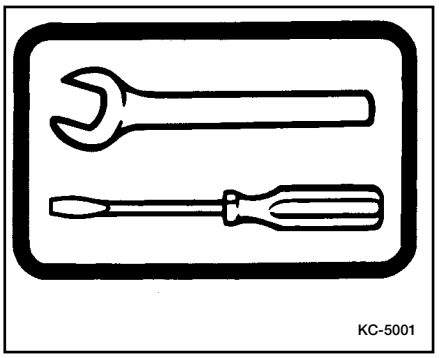
Shop Environment

- Make sure the shop and your work area are properly ventilated.

- Shops must be equipped with the proper tools and safety equipment such as fire extinguisher, eye flushing device, and first aid kit.

- Keep the shop clean and free of clutter. Clean up spills on the floor as soon as possible to prevent someone from slipping.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WORKMANSHIP STANDARDS

1. Avoid damage to the mating surfaces of crankcase and cylinder assembly. Do not use a sharp metal scraper to clean these areas.

2. Replace gaskets, O-rings, seals, cotter pins, lock nuts, and spring pins when removed during repair operations.

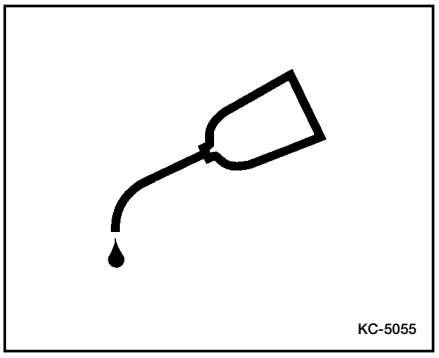
3. Use only genuine factory replacement parts and accessories.

4. Use recommended special tools when specific repairs require them.

5. Calibrate measurement tools and test equipment on a regular basis.

6. Clean all metal parts with solvent before inspection and assembly operations.

7. Use penetrating solvents when necessary to remove rusted or seized hardware.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8. Keep all removed parts separated for ease of identification during assembly.

9. Locate alignment marks on components being disassembled. If marks are not present and should be, scribe or match mark them yourself to ensure the pieces are assembled properly.

10. Follow torque sequences and specifications where they apply. First, tighten each bolt in the specified sequence. Use the same sequence to torque each bolt to final specification. Special torque specifications are listed at the beginning of each section. Standard torque specifications for common fasteners are listed in Section 3.

11. Use lubricant when assembling seals to prevent damage to the seal lips. Make sure seal lips are facing the correct direction.

12. Use the correct type and amount of sealing compound on metal to metal surfaces.

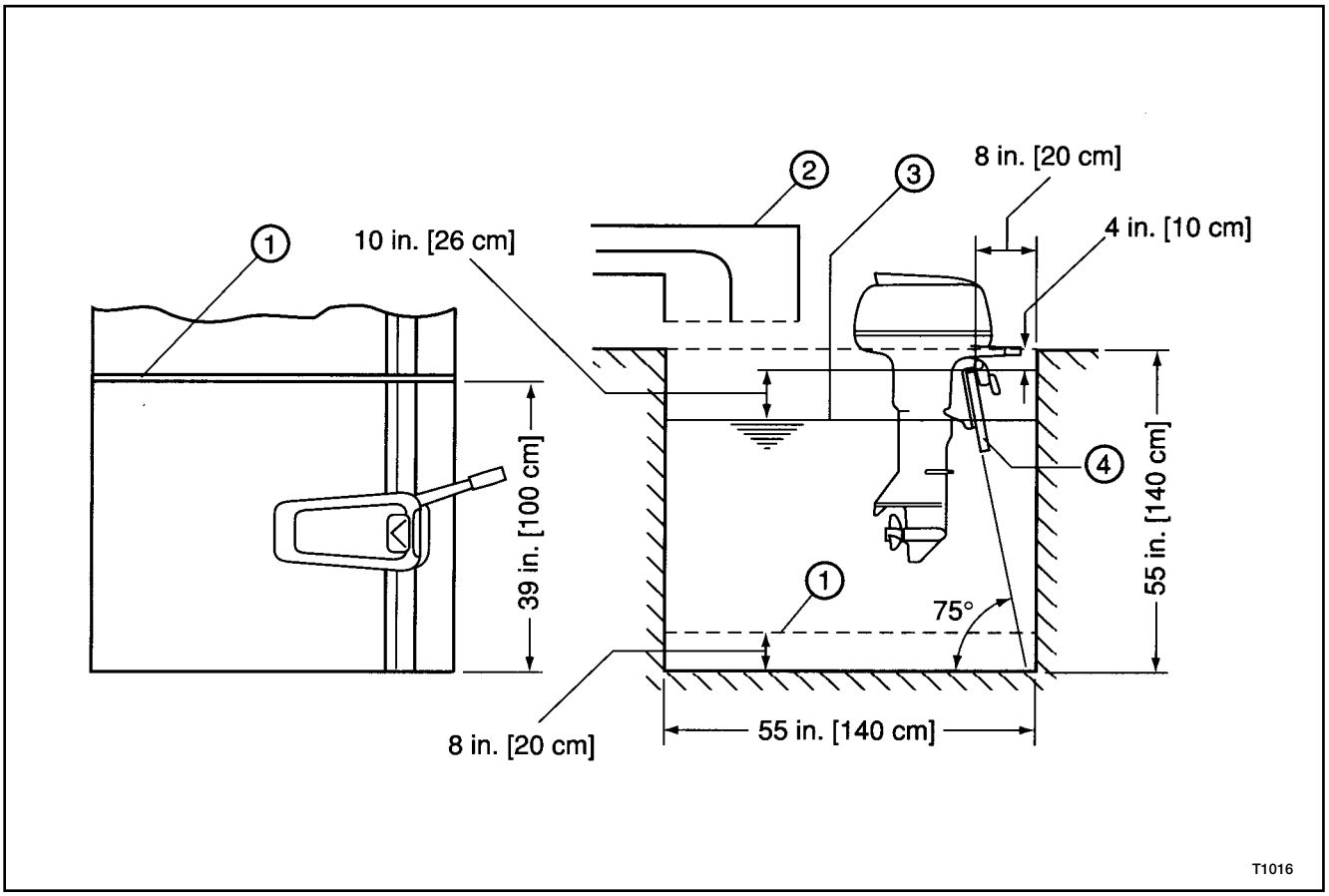
13. When using compressed air to clean or dry parts, make sure air supply is regulated not to exceed 25 psi [172 kPa /1.76 kg/cm^2].

14. Replace missing or damaged safety labels on the engine before returning it to the customer.

TEST TANK GUIDELINES

When properly setup, test tanks provide a safe and controlled environment in which to perform outboard engine adjustment and testing procedures. Test tanks must be setup to the minimum dimensions shown. If multiple engines will be installed in the tank, secure partition plate **(1)** so that the minimum dimensions are maintained for each outboard engine installed. In addition, adhere to the following guidelines to prevent engine damage:

- Continuous usage raises the water temperature in the tankwhich can lead to engine seizure. Make sure water temperature in the tank does not exceed 77°F [25°C].
- Repeated use introduces carbon into the water which can adhere to the engine cooling system and degrade its ability to cool the engine. Always replace dirty tank water at regular intervals with clean, fresh water.
- Exhaust gases produced during engine operation can collect around the engine, causing suction into the carburetors and affecting engine performance. To prevent this condition, install forced ventilation equipment **(2)** to remove gases away from the engine and work area.
- Water may splash out of the tank during testing. Maintain water level **(3)** in the tank as illustrated.
- Keep transom board **(4)** at an approximately 75° angle to the tank bottom to ensure near vertical engine position.



SECTION 2
GENERAL SERVICE INFORMATION

TABLE OF CONTENTS

SECTION 2

GENERAL PRECAUTIONS

Before performing any service work on the outboard engine, read and understand Section 1 - Service Safety.

Use only genuine factory replacement parts with equivalent characteristics such as type, material, and strength. Failure to do so may result in product malfunction and injury to the operator or passengers.

Follow the **Standard Torque Values** chart when a special torque value for a certain fastener is not listed in the **Special Torque Values** chart at the beginning of each section.

Rather than just repairing a bad part, use repair kits and overhaul kits when applicable to ensure complete and efficient repair of the complete component. Wear not readily noticed on other parts can lead to malfunction soon after the repair.

When indicated in a procedure, use manufacturer special tools. In some cases, the use of substitute tools will damage the part.

When using compressed air to clean or dry parts, make sure air supply is regulated not to exceed 25 psi [172 kPa / 1.76 kg/cm^2].

ABBREVIATIONS AND SYMBOLS

Abbreviations

A	ampere
AC	alternating current
AH	ampere-hour
approx.	approximately
API	American Petroleum Institute
ATDC	after top dead center
BTDC	before top dead center
°C	degree Celsius
CCA	cold cranking amp
cm	centimeter
cm^3	cubic centimeter
cm^3/min	cubic centimeter per minute
cu-in	cubic inch
DC	direct current
DVA	direct volt adapter
Kg-m	kilogram meter
°F	degree Fahrenheit
fl oz	fluid ounce (U.S.)
fl oz/min	fluid ounce (U.S.) per minute
ft	foot
ft-lb	foot pound
ft-lbf/min	foot pound force per minute
g	gram
gal/hr	gallon (U.S.) per hour
gal	gallon (U.S.)
GL	gear lubricant
GM	General Motors Company
HP	horsepower (U.S.)
I.D.	inside diameter
in	inch
in-lb	inch pound
kg	kilogram
kg/cm^2	kilogram per square centimeter
ESG	electronic speed governor
kPa	kilopascal
kW	kilowatt
L	liter
L/hr	liter per hour
lb	pound
mL	milliliter
mm	millimeter
mV	millivolt
N	newton
N·m	newton meter
NMMA	National Marine Manufacturers Association
No.	number
O.D.	outside diameter
oz	ounce
PS	horsepower (metric)
psi	pound per square inch
qt	quart (U.S.)
RPM	revolution per minute
SAE	Society of Automotive Engineers
sec.	second
t	short ton 2000 lb
TDC	top dead center
V	volt
VAC	volt alternating current
VDC	volt direct current
W	watt

Symbols

°	angular degree
+	plus
-	minus
±	plus or minus
Ω	ohm
µ	micro
%	percent

UNIT CONVERSIONS

Unit Prefixes

Prefix	Symbol	Power
mega	M	x 1,000,000
kilo	k	x 1,000
centi	c	x 0.01
milli	m	x 0.001
micro	µ	x 0.000001

Units of Length

mile	x	1.6090 = km
ft	x	0.3050 = m
in	x	2.5400 = cm
in	x	25.4000 = mm
km	x	0.6210 = mile
m	x	3.2810 = ft
cm	x	0.3940 = in
mm	x	0.0394 = in

Units of Volume

gal (U.S.)	x	3.78540 = L
qt (U.S.)	x	0.94635 = L
cu-in	x	0.01 639 = L
cu-in	x	16.38700 = mL
fl oz (U.S.)	x	0.02957 = L
fl oz (U.S.)	x	29.57000 = mL
cm^3	x	1.00000 = mL
cm^3	x	0.03382 = fl oz (U.S.)

Units of Mass

lb	x	0.45360 = kg
oz	x	28.35000 = g
kg	x	2.20500 = lb
g	x	0.03527 = oz

Units of Force

lbf	x	4.4480 = N
lbf	x	0.4536 = kgf
N	x	0.2248 = lbf
N	x	0.1020 = kgf
kgf	x	2.2050 = lbf
kgf	x	9.8070 = N

Units of Torque

ft-lb	x	1.3558 = N-m
ft-lb	x	0.1383 = kg-m
in-lb	x	0.1130 = N-m
in-lb	x	0.0115 = kg-m
kg-m	x	7.2330 = ft-lb
kg-m	x	86.8000 = in-lb
kg-m	x	9.8070 = N-m
N-m	x	0.7376 = ft-lb
N-m	x	8.8510 = in-lb
N-m	x	0.1020 = kg-m

Units of Pressure

psi	x	0.0689 = bar
psi	x	6.8950 = kPa
psi	x	0.0703 = kg/cm^2
bar	x	14.5030 = psi
bar	x	100.0000 = kPa
bar	x	29.5300 = in Hg (60°F)
kPa	x	0.1450 = psi
kPa	x	0.0100 = bar
kPa	x	0.0102 = kg/cm^2
kg/cm^2	x	14.2200 = psi
kg/cm^2	x	0.9807 = bar
kg/cm^2	x	98.0700 = kPa
in Hg (60°F)	x	0.0333 = bar
in Hg (60°F)	x	3.3770 = kPa
in Hg (60°F)	x	0.0344 = kg/cm^2

Units of Power

HP	x	1.01400 = PS
HP	x	745.70000 = W
HP	x	550.00000 = ft-lbf/s
PS	x	0.98630 = HP
PS	x	735.50000 = W
PS	x	542.50000 = ft-lbf/s
W	x	0.00134 = HP
W	x	0.00136 = PS
W	x	0.73760 = ft-lbf/s
kW	x	1.34100 = HP
kW	x	1.36000 = PS
kW	x	737.56000 = ft-lbf/s
ft-lbf/s	x	0.00181 = HP
ft-lbf/s	x	0.00184 = PS
ft-lbf/s	x	1.35600 = W

Units of Temperature

°F = (1.8 • °C) + 32
°C = 0.556 • (°F - 32)

SERVICE SPECIFICATIONS

Standard Torque Values

Size	Torque			
	in-lb	ft-lb	N-m	kg-m
M4	10 - 17	0.8 - 1.4	1 - 2	0.1 - 0.2
M5	26 - 35	2.2 - 2.9	3 - 4	0.3 - 0.4
M6	44 - 52	3.6 - 4.3	5 - 6	0.5 - 0.6
M8	97 - 133	8 - 11	11 - 15	1.1 - 1.5
M10	204 - 274	17 - 22	23 - 31	2.3 - 3.1

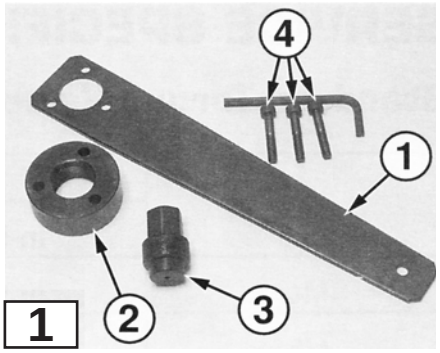
These torque values apply only when a special torque specification is not listed in the **Special Torque Values** chart at the beginning of each section.

Manufacturer Special Tools Required - 1-2 Cylinder

2.5/3.5

Tool Description	Part No.	Components
1 Flywheel Puller Assembly	309-72214-0 or 3V1-72211-0	Arm (1) Adapter (2) Pressing Bolt (3) Bolts (4)
2 Spring Pin Tool ✳	345-72227-0	Pin Punch (1)
2 Spring Pin Tool ✳	345-72228-0	Hollow Punch (2)
Tool Box	353-72254-0	

✳ : For 3.5B



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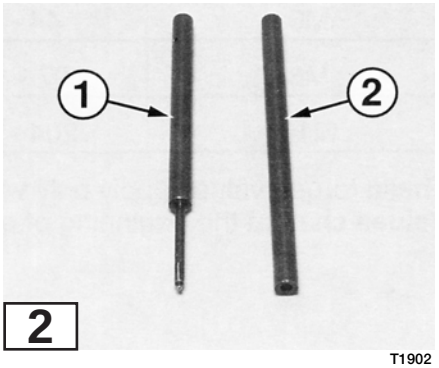

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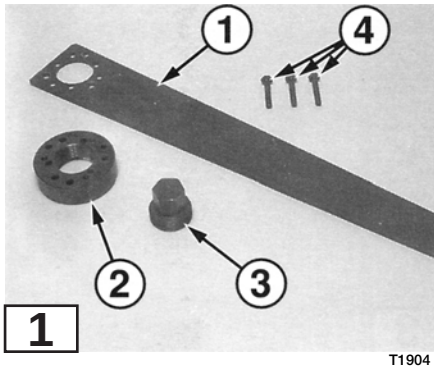

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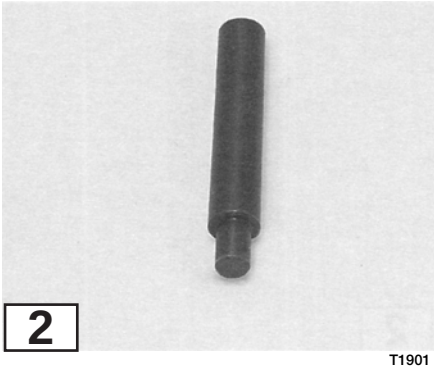

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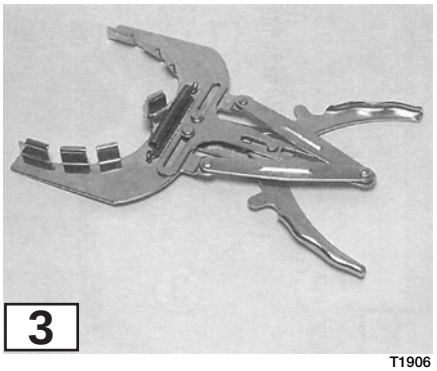

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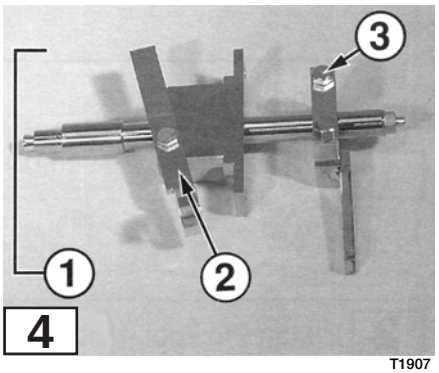
Tool Description	Part No.	Components
1 Flywheel Puller Assembly	369-72211-0	Arm ① Adapter ② Pressing Bolt ③ Bolts ④
2 Piston Pin Tool	332-72215-0	
3 Piston Ring Tool	353-72249-0	
6 Driveshaft Needle Bearing Tool Assembly	369-72900-0	
4 Backlash Measuring Tool	369-72740-0	Kit ①
4 Sub Assembly	369-72730-0	Except ② and ③
4 Arm	369-72727-0	②
4 Clamp Assembly	3B7-72720-0	③
5 Spring Pin Tool (3 mm Dia.)	345-72227-0	Pin Punch ①
5 Spring Pin Tool (3 mm Dia.)	345-72228-0	Hollow Punch ②
5 Spring Pin Tool (3.5 mm Dia.)	369-72217-0	Pin Punch ③
5 Spring Pin Tool (3.5 mm Dia.)	369-72218-0	Hollow Punch ④
Tool Box	353-72254-0	



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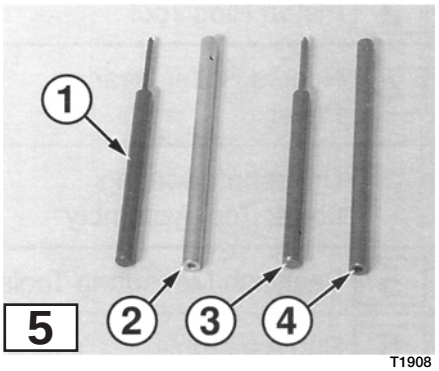

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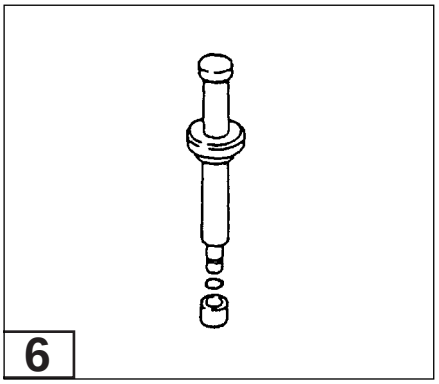

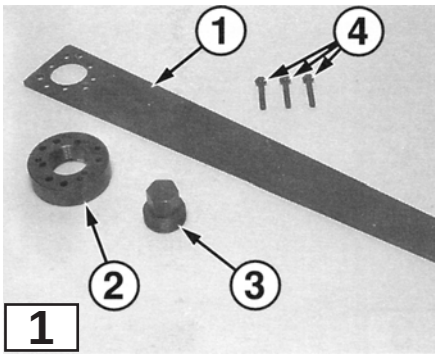

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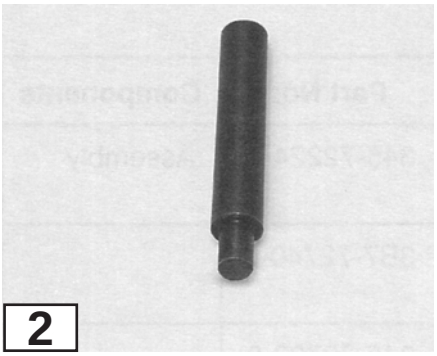

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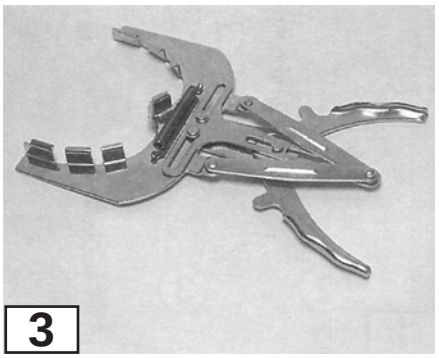

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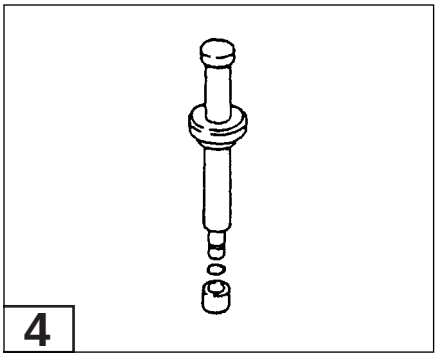
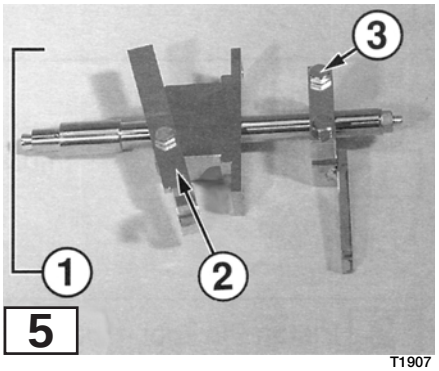
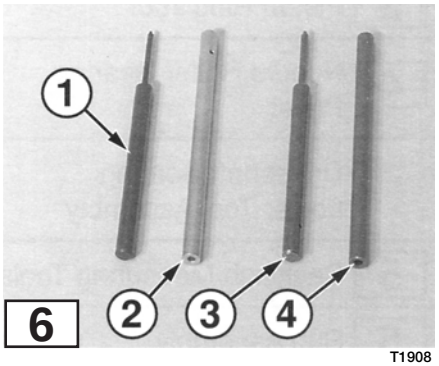
Tool Description	Part No.	Components
1 Flywheel Puller Assembly	369-72211-0	Arm ① Adapter ② pressing Bolt ③ Bolts ④
2 Piston Pin Tool	332-72215-0	
3 Piston Ring Tool	353-72249-0	
4 Driveshaft Needle Bearing Tool Assembly	3B2-72900-0	
5 Backlash Measuring Tools	369-72740-0	Kit ①
5 Sub Assembly	369-72730-0	Except ② and ③
5 Arm	3B2-72727-0	②
5 clamp Assembly	3B7-72720-0	③
6 spring Pin Tool (3 mm Dia.)	345-72227-0	Pin Punch ①
6 spring Pin Tool (3 mm Dia.)	345-72228-0	Hollow Punch ②
6 spring Pin Tool (3.5 mm Dia.)	369-72217-0	Pin Punch ③
6 spring Pin Tool (3.5 mm Dia.)	369-72218-0	Hollow Punch ④
Tool Box	353-72254-0	

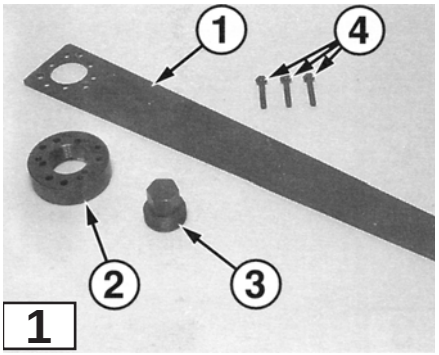




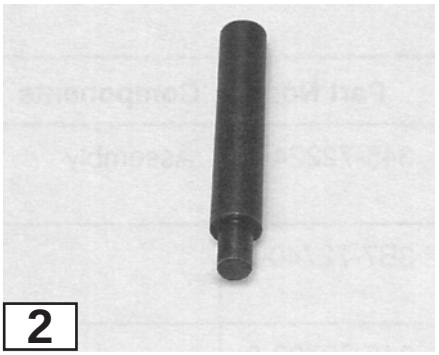
T1907



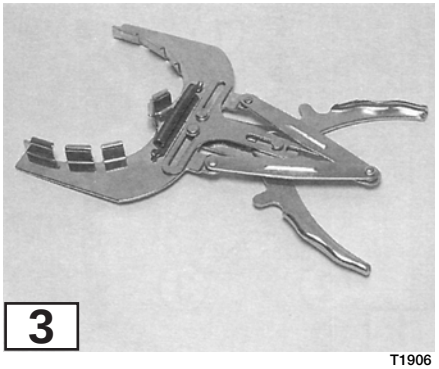
T1908



T1904



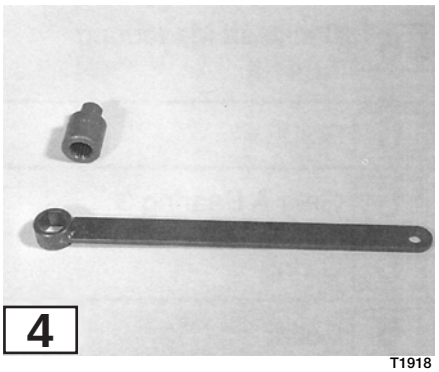
T1910



T1906

9.9/15/18

Tool Description	Part No.	Components
1 Flywheel Puller Assembly	369-72211-0	Arm ① Adapter ② pressing Bolt ③ Bolts ④
2 Piston Pin Tool	332-72215-0	
3 Piston Ring Tool	353-72249-0	
4 Wrench, Bevel Gear B Nut	346-72231-0	
4 Socket, Bevel Gear B Nut	350-72232-0	
5 Needle Roller Bearing Puller	3C8-72700-0	Kit
5 Flange A	3C8-72701-0	①
5 Shaft	346-72702-0	②
5 Shaft Stopper A	350-72704-0	③
5 Washer	346-72707-0	⑤
5 Nut, 12P=1.25	346-72706-0	⑥
5 Guide A	350-72705-0	⑦
5 Retainer A	350-72703-0	⑧
5 Flange B	346-72701-5	⑬
5 Shaft B	350-72702-5	⑭
5 Guide B	350-72705-5	⑮



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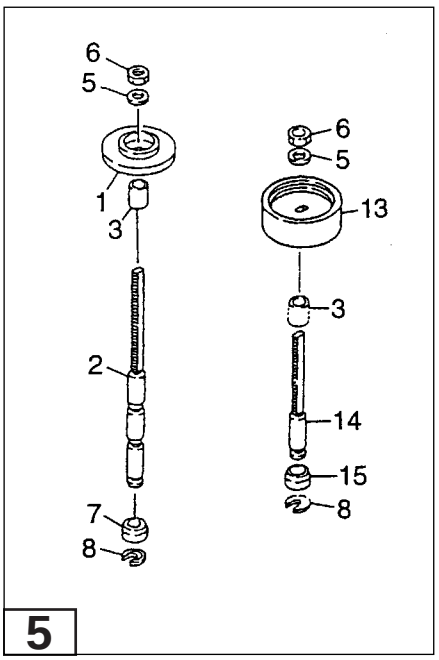
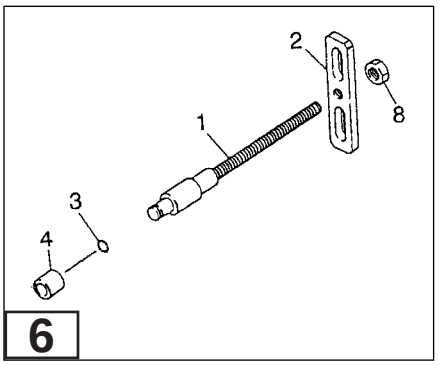
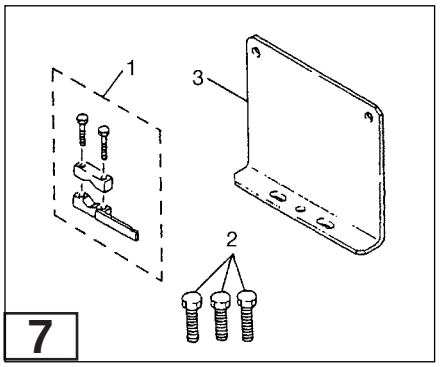
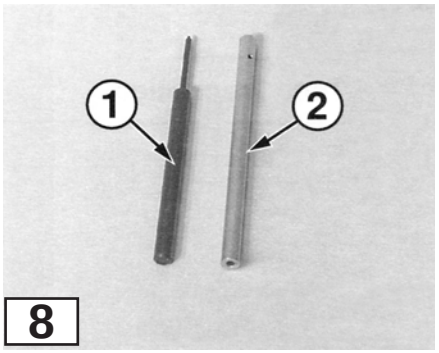


9.9/15/18 Continued

Tool Description	Part No.	Components
6 Backlash Measuring Tool Kit	3C8-72234-0	Kit
6 Shaft	345-72723-0	①
6 Plate	3A3-72724-0	②
6 O-ring	332-60002-0	③
6 Collar	350-72245-0	④
6 Nut, M10	930191-1000	⑧ , 2 nuts
7 Clamp Assembly	3B7-72720-0	①
7 Bolt, H625	910191-0625	② for lower pump case
7 Plate, Dial Gauge	3B7-72729-0	③
8 Spring Pin Tool (3 mm Dia.)	345-72227-0	Pin Punch
8 Spring Pin Tool (3 mm Dia.)	345-72228-0	Hollow Punch
9 Clutch Pin Snap Tool	350-72229-0	① = 1.85 in 47 mm
Tool Box	353-72254-0	







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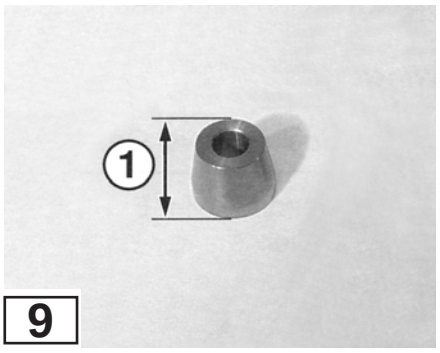

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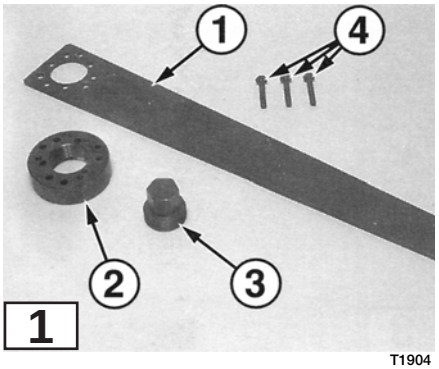
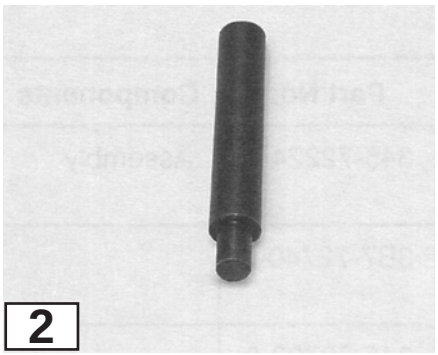


T1904



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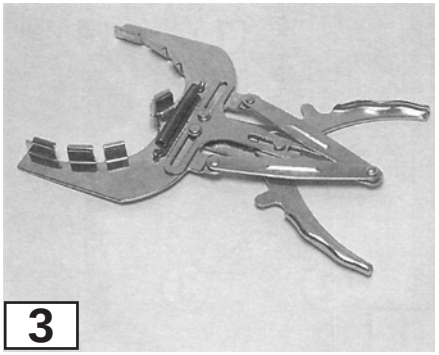
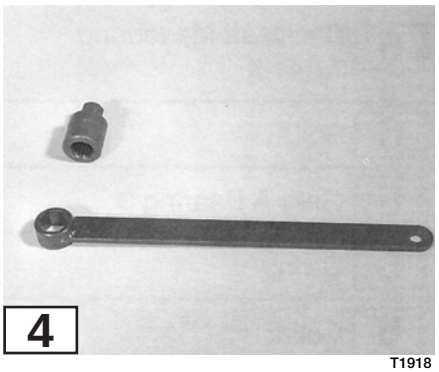


T1906

25/30

Tool Description	Part No.	Components
1 Flywheel Puller Assembly	369-72211-0	Arm ① Adapter ② Pressing Bolt ③ Bolts ④
2 Piston Pin Tool	345-72215-0	
3 Piston Ring Tool	353-72249-0	
4 Wrench, Bevel Gear B Nut	346-72231-0	Wrench
4 Socket, Bevel Gear B Nut	346-72232-0	Socket
5 Needle Roller Bearing Puller	3C8-72700-0	Kit
5 Flange A	3C8-72701-0	①
5 Shaft	346-72702-0	②
5 Shaft Stopper	346-72704-0	④
5 Washer	346-72707-0	⑤
5 Nut, 12P=1.25	346-72706-0	⑥
5 Guide A	346-72705-0	⑨
5 Retainer A	346-72703-0	⑩
5 Flange B	346-72701-5	⑬
5 Guide B	346-72705-5	⑯
5 Retainer B	346-72703-5	⑰
5 Spacer	346-72708-0	⑱



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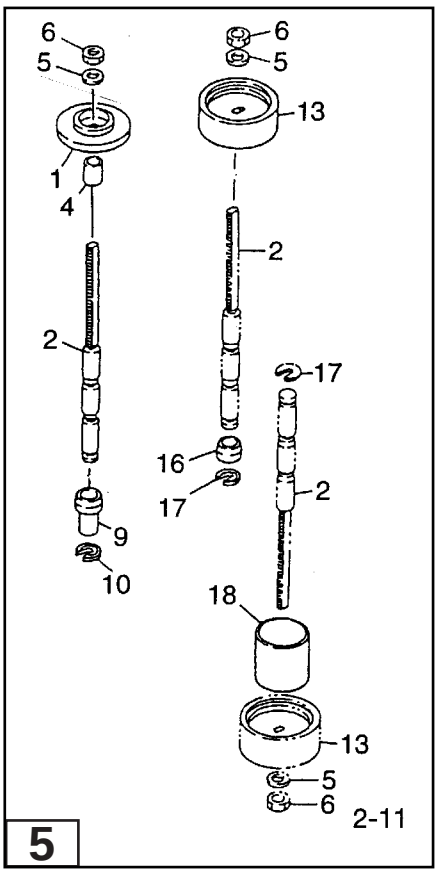
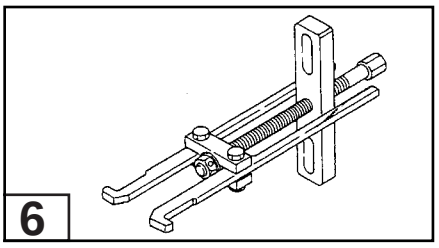
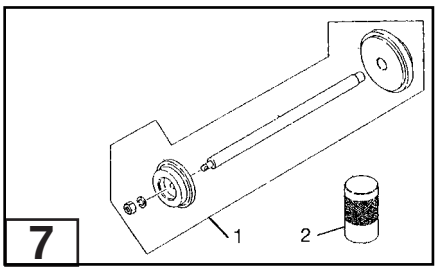
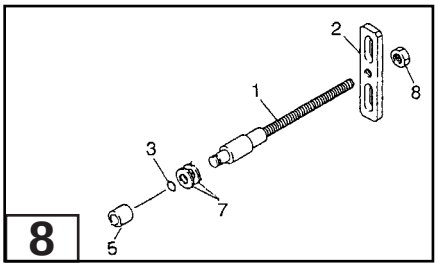


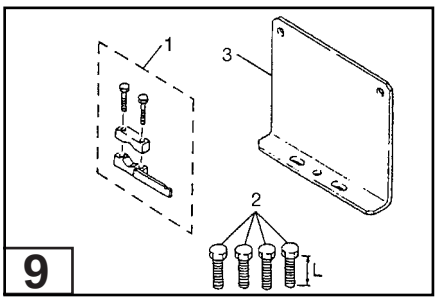
25/30 Continued

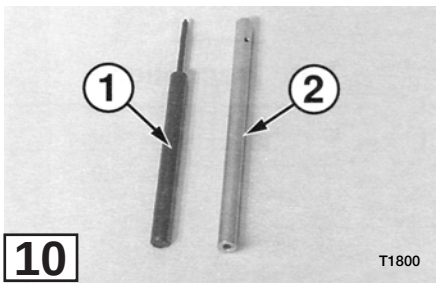
Tool Description	Part No.	Components
6 Bevel Gear Bearing Puller	3A3-72755-0	Assembly
7 Bearing Outer Press Kit	3B7-72739-0	Kit, ①
7 Bevel Gear Bering Installing Tool	346-72719-0	② , Ø 32 mm
8 Backlash Measuring Tool Kit	3C8-72234-0	Kit
8 Shaft	345-72723-0	①
8 Plate	3A3-72724-0	②
8 O-ring	332-60002-0	③
8 ColLar	346-72245-1	⑤
8 Cone Disk Spring, d=12	3B7-72734-0	⑦ , 2pcs
8 Nut, M10	930191-1000	
9 Clamp Assembly	3B7-72720-0	①
9 Bolt, H625	910191-0625	② for lower pump case
9 Dial Gauge Plate	3B7-72729-0	③
10 Spring Pin Tool A (3 mm Dia.)	345-72227-0	Pin Punch
10 Spring Pin Tool B (3 mm Dia.)	345-72228-0	Hollow Punch
11 Clutch Pin Snap Tool	346-72229-0	① = 1.97 in 50 mm
12 Shimming Gauge	346-72250-0	①
12 Thinkness Gauge	353-72251-0	②
13 Rubber Mount Puller	361-72760-0	Kit
Tool Box	353-72254-0	

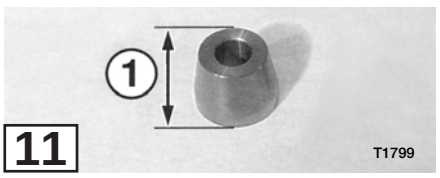


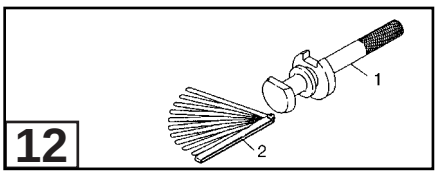


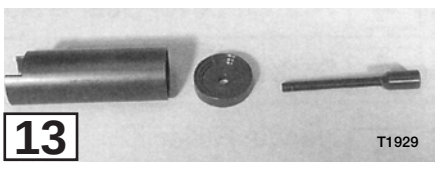


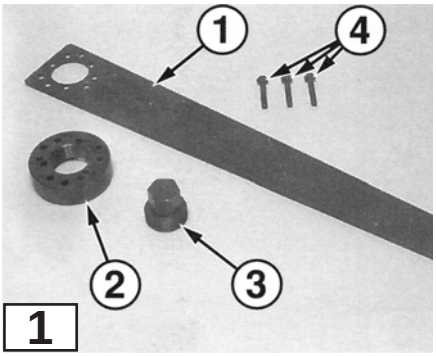




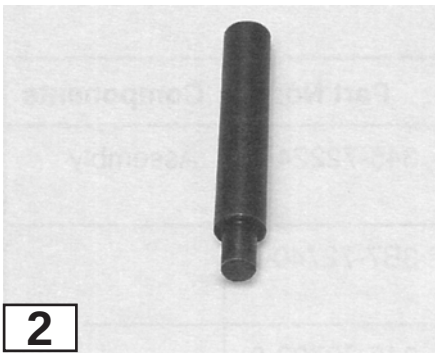




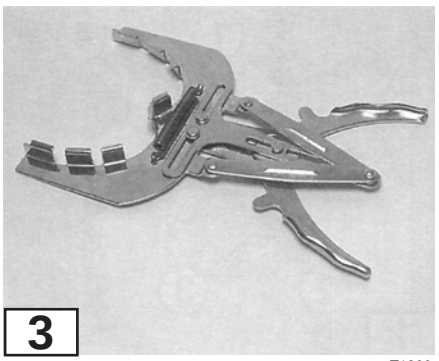




T1904



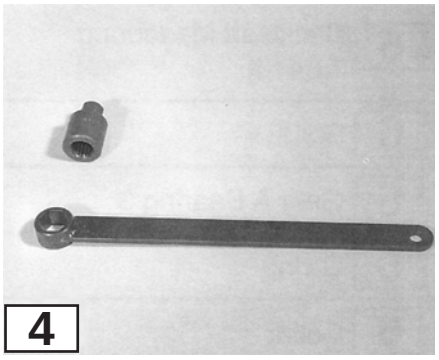
T1910



T1906

40

Tool Description	Part No.	Components
1 Flywheel Puller Assembly	369-72211-0	Arm (1) Adapter (2) Pressing Bolt (3) Bolts (4)
2 Piston Pin Tool	345-72215-0	
3 Piston Ring Tool	353-72249-0	
4 Wrench, Bevel Gear B Nut	346-72231-0	Wrench
4 Socket, Bevel Gear B Nut	345-72232-0	Socket
5 Needle Roller Bearing Puller	3C8-72700-0	Kit
5 Flange A	3C8-72701-0	(1)
5 Shaft	346-72702-0	(2)
5 Shaft Stopper A	346-72704-0	(4)
5 Washer	346-72707-0	(5)
5 Nut, 12P=1.25	346-72706-0	(6)
5 Guide A	345-72705-0	(11)
5 Retainer A	345-72703-0	(12)
5 Flange B	346-72701-5	(13)
5 Shaft Stopper B	345-72704-5	(19)
5 Guide	345-72705-5	(20)
6 Bevel Gear Bearing Puller	3A3-72755-0	Assembly



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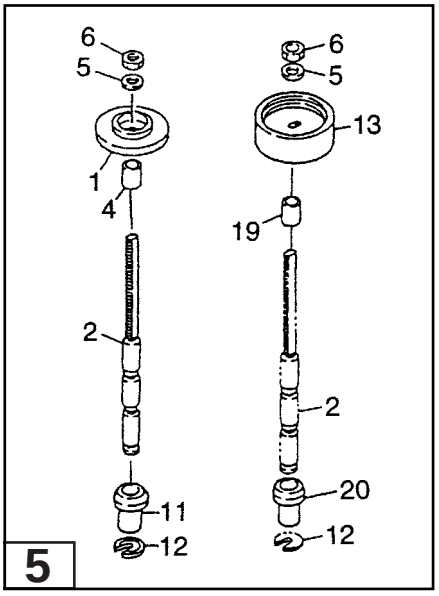
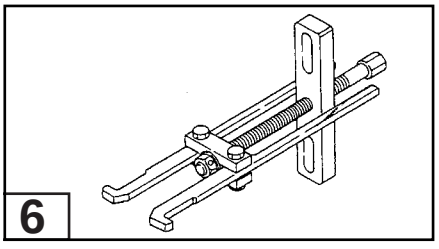
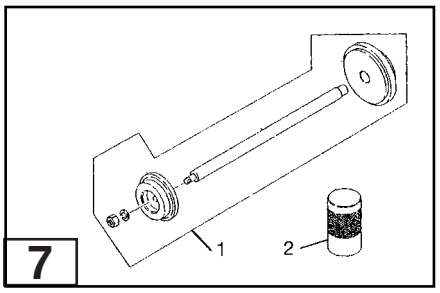
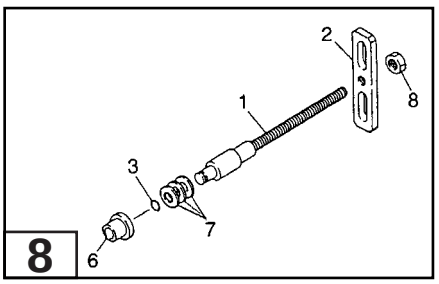


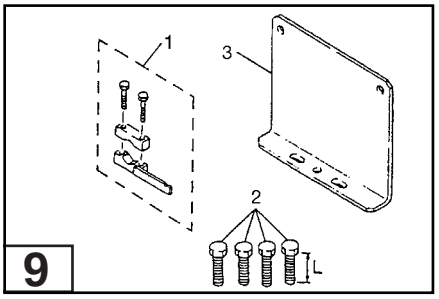


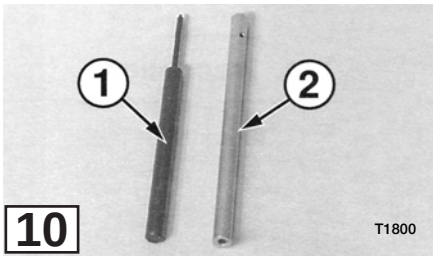
40 Continued

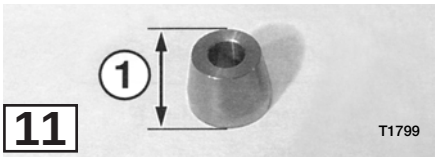
Tool Description	Part No.	Components
7 Bearing Outer Press Kit	3B7-72739-0	Kit, ①
7 Bevel Gear Bering Installing Tool	3C8-72719-0	② , Ø 42 mm
8 Backlash Measuring Tool	3C8-72234-0	Kit
8 Shaft	345-72723-0	①
8 Plate	3A3-72724-0	②
8 O-ring	332-60002-0	③
8 Collar	353-72245-1	⑥
8 Cone Disk Spring, d=12	345-72763-0	⑦ , 3 pcs
8 Nut, M10	930191-1000	⑧
9 Clamp Assembly	3B7-72720-0	①
9 Bolt, H625	910191-0625	② for lower pump case
9 Plate, Dial Gauge	3B7-72729-0	③
10 Spring Pin Tool A	345-72227-0	Pin Punch
10 Spring Pin Tool B	345-72228-0	Hollow Punch
11 Clutch Pin Snap Tool	345-72229-0	① = 2.36 in 60 mm
12 Shimming Gauge	3C8-72250-0	①
12 Thickness Gauge	353-72251-0	②
13 Rubber Mount Puller	361 -72760-0	Kit
Tool Box	353-72254-0	

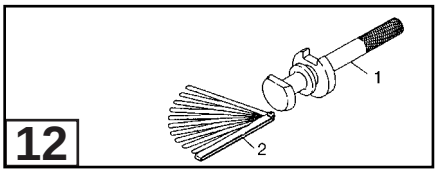


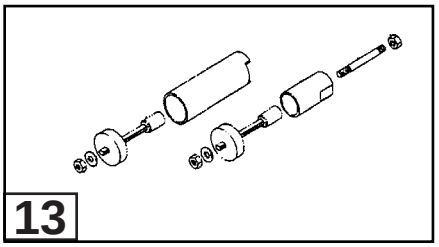












General Equipment Required

Water Pressure Gauge, 0 - 15 psi [0 - 103 kPa / 0 - 1 kg / cm^2]
Fuel Pressure Gauge, 0 - 15 psi [0 - 103 kPa / 0 - 1 kg / cm^2]
Torque Wrench, 0 - 150 in-lb [0 - 17 N·m / 0- 1.7kg-m]
Torque Wrench, 0 - 750 ft-lb [0 - 1000 N·m / 0 - 100 kg-m]
Dial Gauge, minimum scale 0.0001 in [0.01 mm]
Micrometer Set or Dial Caliper, minimum scale 0.0001 in [0.01 mm]
Telescoping Gauge, Inside Micrometer Set, or Dial Caliper, minimum scale 0.0001 in [0.01 mm]
Variable Load High Rate Discharge Tester, *Electronic Specialties® Model 700 or equivalent*
Analog Multimeter, *Electronic Specialties® Model M-530 or equivalent*
Digital Multimeter, *Electronic Specialties® Model KD 3200 or equivalent*
Digital Pulse Tachometer, 10 - 6000 RPM, *Electronic Specialties® Model 321 or equivalent*
Ammeter, 0 - 100 A
Gearcase Pressure Tester, *Stevens® S-34 or equivalent*
Gearcase Vacuum Tester, *Stevens® V-34 or equivalent*
Engine Compression Gauge, 0 - 300 psi [0 - 2000 kPa / 0 - 20 kg/cm^2]
Spark Gap Tester, *Stevens® S-13C, S-48, or equivalent*
Flexible Fuel Tubing, 1/4 in I.D. x 5 in [6 mm I.D. x 127 mm]
Flexible Fuel Tubing, 3/8 in I.D. x 5 in [9.5 mm I.D. x 127 mm]
Industrial Thermometer, minimum 300°F [150°C]
Heat-Resistant Container, *Pyrex®*
Bearing Puller
Seal Pullers
Seal Installers
Heat Gun
Hydrometer

Consumables Required

Threadlocker, *Loctite® 242*
Threadlocker, *Loctite® 243*
Gasket Dressing, *Permatex® Hylomar® Aerosol High-Temp Gasket Dressing*
Gasket Sealant, *Permatex® High Tack Gasket Sealant*
Anaerobic Gasket Maker, *Loctite® 518*
Silicone Sealant, *Permatex® Hi-Temp RTV Silicone Gasket*
Super Bond Adhesive, *Permatex® Super Glue Gel*
Cleaning Pads, *Scotch-Brite® Abrasive Pads*
Low Temperature Lithium Grease
Genuine Grease or Equivalent Friction Surface Marine Grease
Power Trim/Tilt Fluid, *Nisseki® power torque fluid or GM approved automatic transmission fluid*
Isopropyl Alcohol
Cleaning Solvent
Gasket Remover
Gear Lubricant, *Genuine gear oil or API grade GL5, SAE #80 - #90*
Engine Lubricant, *Genuine engine oil or NMMA certified TC-W3 oil*
Automotive Crankcase Oil, flashpoint above 300°F [150°C]
Battery Spray Protector, *Permatex® Battery Protector & Sealer*
Electrical Shrink Tubing, various diameters

ENGINE SPECIFICATIONS

Operation

Power

2.5	2.5 HP [1.8 kW]
3.5	3.5 HP [2.6 kW]
5	5 HP [3.7 kW]
8	8 HP [5.9 kW]
9.8	9.8 HP [7.2 kW]
9.9	9.9 HP [7.3 kW]
15	15 HP [11.0 kW]
18	18 HP [13.2 kW]
25	25 HP [18.4 kW]
30	30 HP [22.1 kW]
40	40 HP [29.4 kW]

Full Throttle RPM Range

2.5	3800 - 5200
$3.5A_2$ / $3.5B_2$	4200 - 5300
5	4500 - 5500
8	4500 - 5500
9.8	5000 - 6000
9.9	4500 - 5300
15, 18	5200 - 5800
25	5000 - 6000
30	5150 - 5850
40	5200 - 5800

Idle RPM	IN GEAR	NEUTRAL
2.5, $3.5A_2$	1100	—
$3.5B_2$	1100	1300
5	850	1000
8, 9.8	750	950
9.9, 15, 18	800	950
25, 30	900	1050
40	850	1000

Fuel Consumption at Full Throttle

2.5	0.37 g/hr [1.4 L/hr]
3.5	0.45 g/hr [1.7 L/hr]
5	0.66 g/hr [2.5 L/hr]
8	1.0 g/hr [4.3 L/hr]
9.8	1.35 g/hr [5.1 L/hr]
9.9	1.45 g/hr [5.5 L/hr]
15	1.93 g/hr [7.3 L/hr]
18	2.25 g/hr [8.5 L/hr]
25	3.30 g/hr [12.5 L/hr]
30	3.96 g/hr [15 L/hr]
40	4.49 g/hr [17 L/hr]

Test Propeller

2.5, $3.5A_2$	309-64111-0
$3.5B_2$	3F0-64111-0
5	369-64111-0
8, 9.8	3B2-64111-0
9.9, 15, 18	362-64111-0
25, 30	364-64111-5
40	348-64111-0

Powerhead

Number of Cylinders

2.5, 3.5, 5	1
8, 9.8, 9.9, 15, 18, 25, 30, 40	2

Displacement

2.5, 3.5	4.6 cu. in [74.6 cm^3]
5	6.22 cu. in [102 cm^3]
8, 9.8	10.3 cu. in [169 cm^3]
9.9, 15	15.07 cu. in [247 cm^3]
18	17.94 cu. in [294 cm^3]
25, 30	26.18 cu. in [429 cm^3]
40	30.08 cu. in [493 cm^3]

Standard Bore

2.5, 3.5	1.85 in [47 mm]
5	2.17 in [55 mm]
8, 9.8	1.97 in [50 mm]
9.9, 15	2.17 in [55 mm]
18	2.36 in [60 mm]
25, 30	2.68 in [68 mm]
40	2.76 in [70 mm]

Stroke

2.5, 3.5	1.69 in [43 mm]
5, 8, 9.8	1.69 in [43 mm]
9.9, 15, 18	2.05 in [52 mm]
25, 30	2.323 in [59 mm]
40	2.520 in [64 mm]

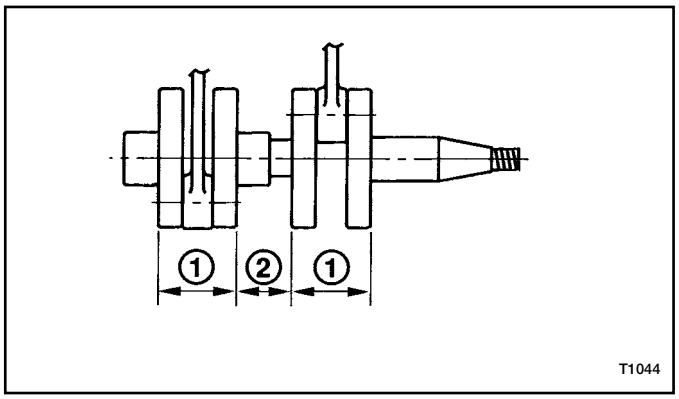
Piston Clearance

2.5, 3.5	0.0024 - 0.0035 in [0.06 - 0.09 mm]
5	0.008 - 0.020 in [0.02 - 0.05 mm]
8, 9.8	0.008 - 0.020 in [0.02 - 0.05 mm]
9.9, 15, 18	0.0020 - 0.0035 in [0.05 - 0.09 mm]
25, 30	0.0024 - 0.0039 in [0.06 - 0.10 mm]
40	0.0020 - 0.0039 in [0.05 - 0.10 mm]

Piston Ring End Gap

2.5, 3.5, 5, 8, 9.8	0.007 - 0.013 in [0.18 - 0.33 mm]
9.9, 15, 18	0.008 - 0.019 in [0.20 - 0.40 mm]
25, 30	0.013 - 0.019 in [0.33 - 0.48 mm]
40	0.008 - 0.016 in [0.20 - 0.40 mm]

Crankshaft Dimensions



Dimension ①
2.5, 3.5 .....1.417 ± 0.002 in [36 ± 0.05 mm]
5.....1.575 ± 0.002 in [40 ± 0.05 mm]
8, 9.8.....1.654 ± 0.002 in [42 ± 0.05 mm]
9.9, 15, 18.....1.890 ± 0.004 in [48 ± 0.1 mm]
25, 30.....2.047 + 0 - 0.001 in [52 + 0 - 0.02 mm]
40.....2.071 + 0 - 0.002 in [52.6 + 0 - 0.05 mm]

Dimension ②
2.5, 3.5.....N/A
5.....N/A
8, 9.8.....0.984 ± 0.002 in [25 ± 0.05 mm]
9.9, 15, 18.....1.299 ± 0.002 in [33 ± 0.05 mm]
25, 30.....1.496 ± 0.002 in [38 ± 0.05 mm]
40.....1.591 ± 0.002 in [40.4 ± 0.05 mm]

Gearcase

Gear Ratio
2.5, 3.5.....13 : 24
5.....13 : 28
8, 9.8.....13 : 27
9.9, 15, 18.....13 : 24
25, 30.....12 : 23
40.....13 : 25

Lubricant ..... Genuine manufacturer gear oil or API GL5, SAE #80 - #90

Capacity
2.5A, 3.5A .....Approx. 3.0 U.S. fl oz [90 mL]
3.5B .....Approx. 6.1 U.S. fl oz [180 mL]
5.....Approx. 6.6 U.S. fl oz [195 mL]
8, 9.8.....Approx. 10.8 U.S. fl oz [320 mL]
9.9, 15, 18.....Approx. 12.5 U.S. fl oz [370 mL]
25, 30.....Approx. 9.5 U.S. fl oz [280 mL]
40.....Approx. 14.2 U.S. fl oz [420 mL]

Clutch System
2.5, 3.5A..... None (Forward gear only)
3.5B..... Dog clutch type (Forward gear and Neutral only)
5, 8, 9.8, 9.9, 15, 18, 25, 30, 40 ..... Dog clutch type (Forward-Neutral-Reverse)

Electrical System

Ignition Type..... Flywheel magneto capacitor discharge

Ignition Timing
See Ignition Timing Adjustment in Section 2

Spark Plug (with resistor)
2.5, 3.5 ..... NGK BPR6HS-10 or Champion RL87YC10
5, 8, 9.8 ..... NGK BPR7HS-10or Champion RL82YC10
9.9, 15, 18, 25, 30, 40 ..... NGK BR7HS-10 or Champion RL82C10

Spark Plug Gap
All Models ..... 0.035 - 0.039 in [0.9 - 1.0 mm]

Battery
2.5, 3.5 ..... None
5 .....None (Optional - 12V 30 - 35 AH recommended)
8, 9.8 ..... None (Optional - 12V 40 AH recommended)
9.9, 15, 18 ..... None (Optional - 12V 40 AH recommended)
25, 30 ..... None (Optional - 12V 40 AH recommended)
40 ..... None (Optional - 12V 70 AH recommended)

Engine Fuse
2.5, 3.5 ..... None
5 .....None (With Optional Battery Charger - 10A)
8, 9.8 .....None (With Optional Battery Charger or Starter - 15A)
9.9, 15, 18 .....None (With Optional Battery Charger or Starter - 15A)
25, 30, 40 .....None (With Optional Battery Charger or Starter - 15A)

Alternator
2.5, 3.5 ..... None
5 ..... None (Optional - 12V 60W)
8, 9.8 ..... None (Optional - 12V 80W)
9.9, 15, 18, 25, 30, 40 ..... 12V 80W

Charging Performance (at 1500 RPM)
N/A

Charging Performance (at 5500 RPM)
5 (Optional) ..... 4 A
8, 9.8, 9.9, 15, 18, 25, 30, 40 ..... 5 A

Number of Tachometer-to-Alternator Coil Impulses
2.5, 3.5 ..... N/A
5 2
8, 9.8, 9.9, 15, 18, 25, 30, 40 4

Alternator Coil Resistance
2.5, 3.5 ..... N/A
5 ..... 0.31 - 0.47 Ω
8, 9.8 ..... 0.24 - 0.36 Ω
9.9, 15, 18, 25, 30 ..... Y-W : 0.65 - 0.98 Ω
Y-B : 0.31 - 0.47 Ω
W-B : 0.37 - 0.55 Ω
40 ..... Y-W : 0.65 - 0.98 Ω
Y-B : 0.31 - 0.47 Ω
W-B : 0.37 - 0.55 Ω

Ignition Coil Resistance (±25%)

Primary Coil
2.5, 3.5 ..... 0.18 - 0.24 Ω
5 ..... 0.2 - 0.38 Ω
9.9, 15, 18, 25, 30, 40 ..... 0.2 - 0.3 Ω

Secondary Coil
2.5, 3.5 ..... 2.7 - 3.7 KΩ
5 ..... 3.0 - 4.4 KΩ
8, 9.8 ..... 1.95 - 3.25 KΩ
9.9, 15, 18 ..... 4.1 - 6.1 KΩ
25, 30, 40 ..... 4.1 - 6.1 KΩ

Fuel and Lubricant System

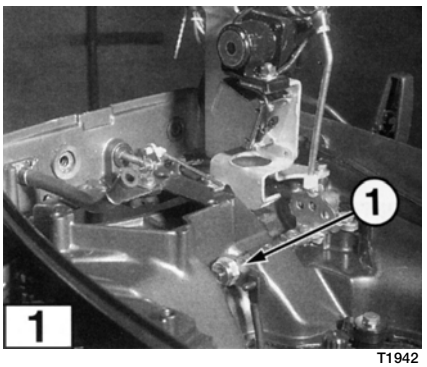
Required Fuel, Lubricant, and Mix Ratio
See Fuel System Requirements in Section 3

NOTE

A special mix ratio is required during break-in. See "Break-In" at end of this section.

Carburetor
2.5, 3.5 ..... Slide valve type carburetor, float feed
5, 8, 9.8, 9.9, 15, 18, 25, 30, 40 ..... Butterfly valve type carburetor, float feed

LUBRICATION CHART

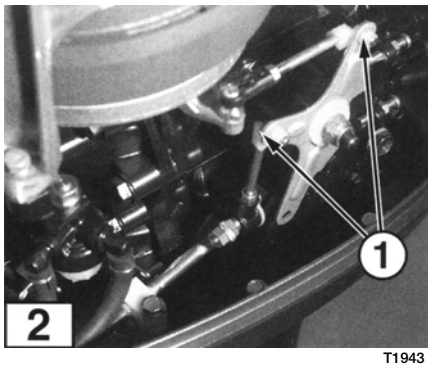


T1942

NOTE

Recommended intervals are for freshwater recreational operation. Decrease interval by 50% for salt water and severe duty (commercial) operation.

Lube Type: (1) = Low Temperature Lithium Grease
(2) = Genuine Grease or equivalent Friction Surface Marine Grease
(3) = Non-flammable solvent
(4) = Genuine Gear Oil or API Grade GL5 #80 - #90



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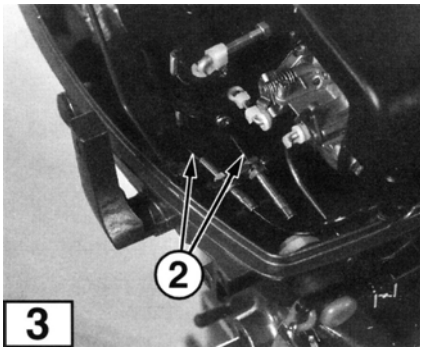

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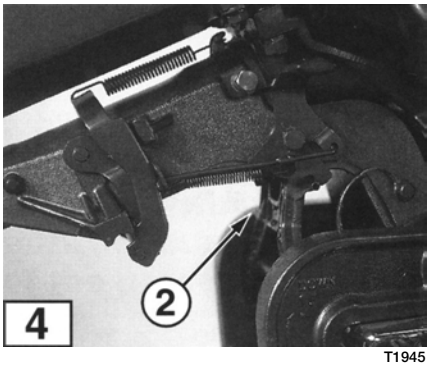

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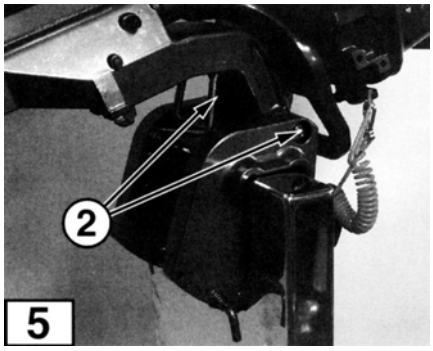

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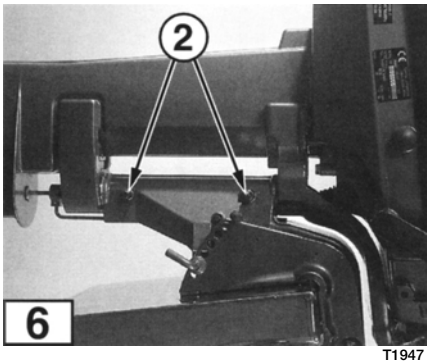

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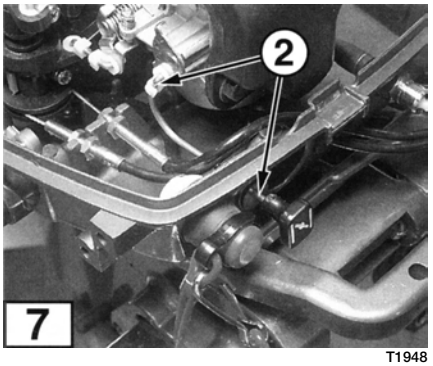
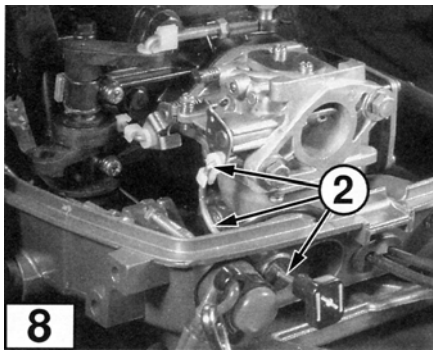


T1948

Lubrication Points and Lubricant			Engine Model						Frequency
Fig.	Location	Lube Type	2.5 3.5	5	8 9.8	9.9 15 18	25 30	40	Hours
1	Shift Lever Mechanism	(1)	•	•	•	•	•	•	50
2	Throttle Linkage	(1)				•	•	•	50
3	Throttle Cable	(2)		•	•				50
4	Tilt Stopper	(2)	•	•	•	•	•	•	50
5	Bracket Bolt	(2)	•	•	•	•	•	•	50
6	Bracket Shaft	(2)		•	•	•	•	•	50
7	Carburetor Choke Rod	(2)		•	•	•	•	•	50



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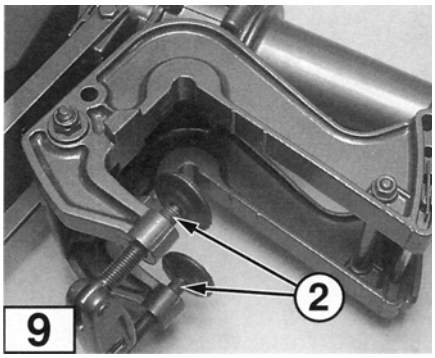

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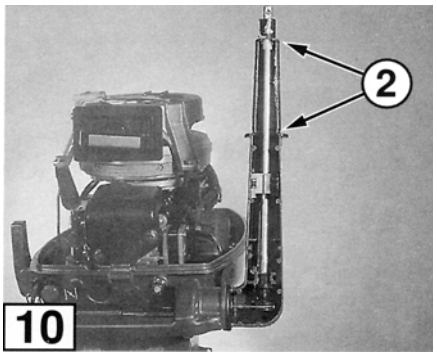

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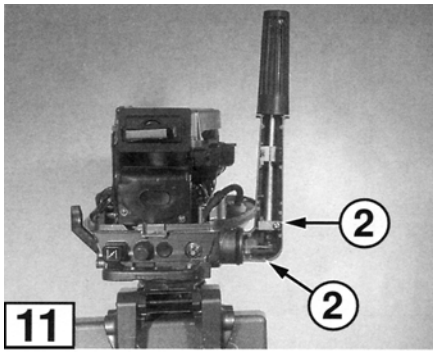

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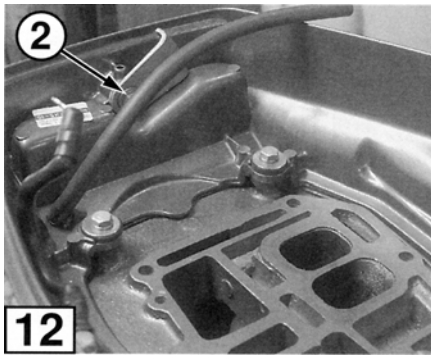

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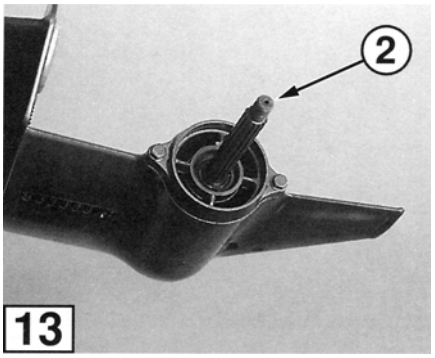

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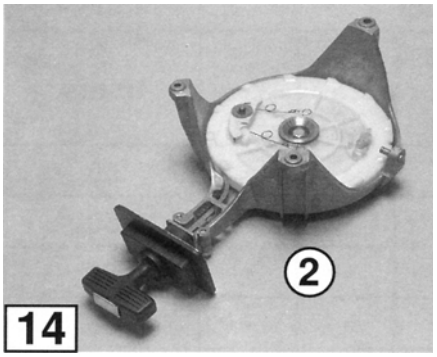

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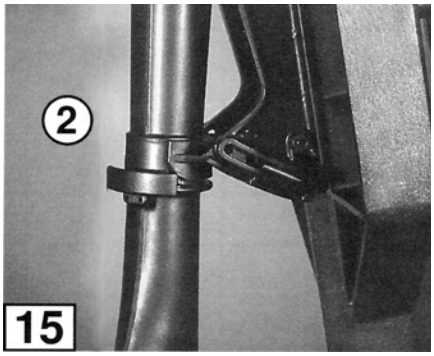

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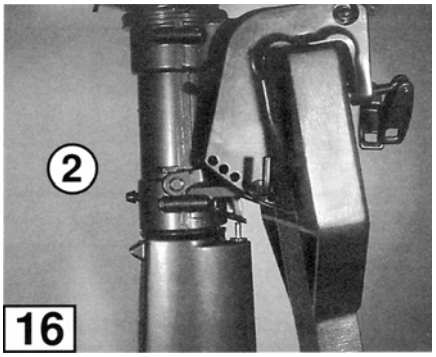
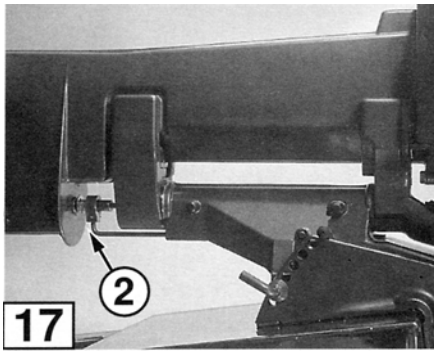


T1957

Lubrication Points and Lubricant			Engine Model						Frequency
Fig.	Location	Lube Type	2.5 3.5	5	8 9.8	9.9 15 18	25 30	40	Hours
8	Choke Mechanism	②	•	•	•	•	•	•	50
9	Clamp Screw	②	•	•	•	•	•	•	50
10	Grip	②		•	•	•	•	•	50
11	Handle	②	•	•	•	•	•	•	50
12	Hook Lever Mechanism	②		•	•	•	•	•	50
13	Propeller Shaft	②	•	•	•	•	•	•	50
14	Recoil Starter	②	•	•	•	•	•	•	50
15 16	Reverse Lock	②	•	•	•	•	•	•	50



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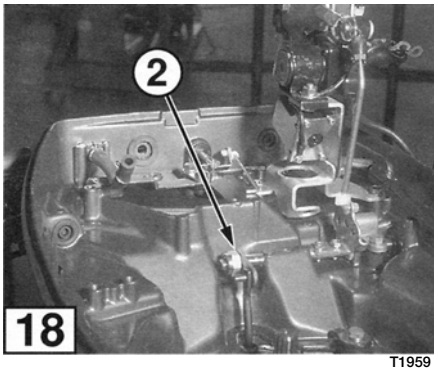

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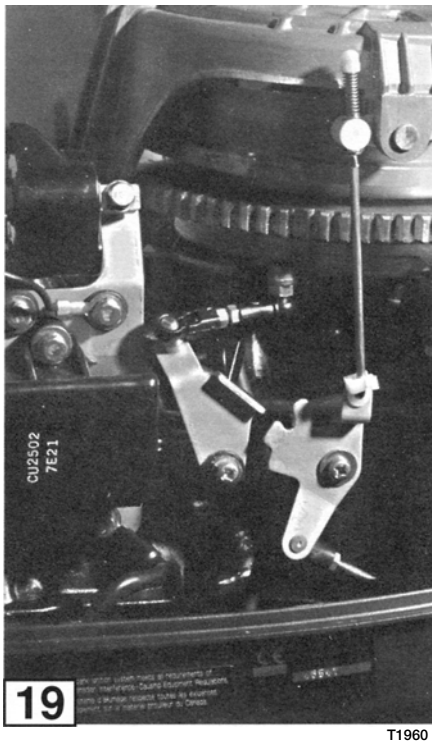

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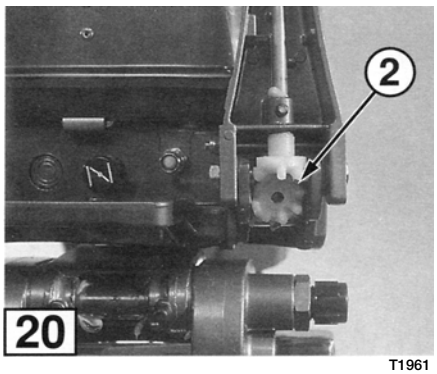

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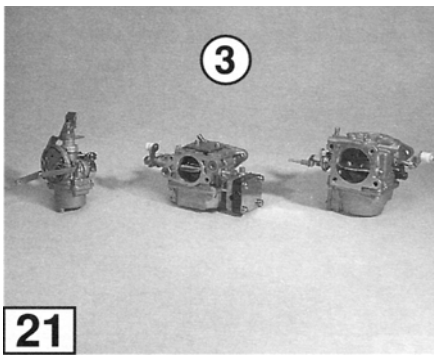
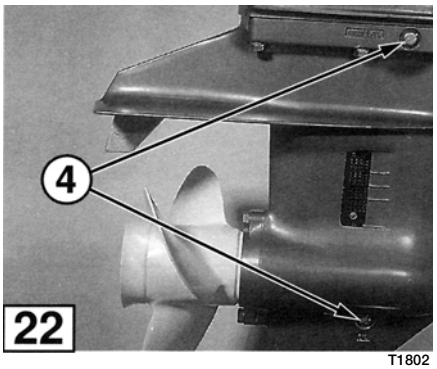


T1962

Lubrication Points and Lubricant			Engine Model						Frequency
Fig.	Location	Lube Type	2.5 3.5	5	8 9.8	9.9 15 18	25 30	40	Hours
17	Reverse Lock	②	•	•	•	•	•	•	50
18	Shift Lever Stopper	②		•	•	•	•	•	50
19	Starter Lock	②		•	•	•	•	•	50
20	Throttle Mechanism	②		•	•	•	•	•	50
21	Carburetor *(Note 1)*	③	•	•	•	•	•	•	100

Note 1: *Disassemble, remove dust and clean with air and non-flammable solvent. Completely dry all components and reassemble.*



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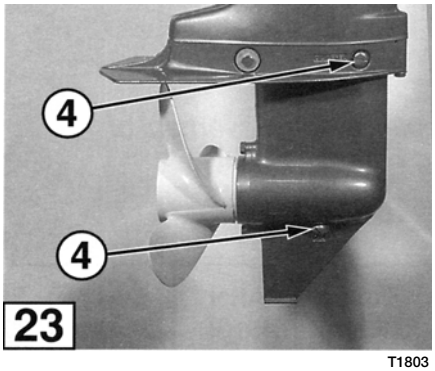

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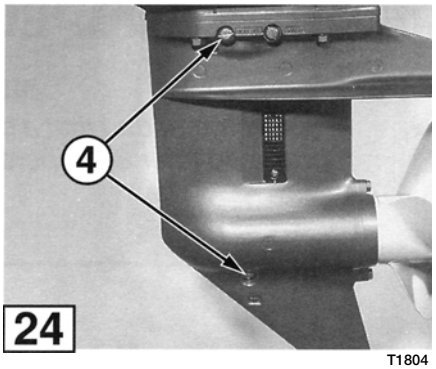


T1804

Lubrication Points and Lubricant			Engine Model						Frequency
Fig.	Location	Lube Type	2.5 3.5	5	8 9.8	9.9 15 18	25 30	40	Hours
22	First Gear Oil Change	④	•	•	•	•	•	•	10
23	Top Off Gear Oil	④	•	•	•	•	•	•	50
24	Oil Change *(Note 2)*	④	•	•	•	•	•	•	100

Note 2: *Change gearcase oil after every 100 hours of operation, and prior to prolonged storage, such as over the winter.*

SECTION 2

PERIODIC INSPECTIONS

NOTE

It is recommended that a complete engine overhaul be performed after 300 operating hours.

Item	Inspection	Before Each Use	After 1st 10 Hours 2 Days	Every 30 Hrs or 7 Days	Every 50 Hrs or 30 Days	Every 100 Hrs or 60 Days	Remarks
Fastener torque	Check the following: • Cylinder head bolts • Cylinder head cover bolts • Exhaust cover bolts • Carburetor mounting bolts • Intake manifold bolts • Crankcase bolts • Flywheel nut • Starter motor installation bolts (where applicable) • Driveshaft housing bolts • Gearcase bolts • Propeller shaft housing bolts • Propeller nut • Lower engine cover mounting bolts • Engine mounting bolts		•		•		Torque to specification.
Gearcase	• Check oil level and add oil as required. • Check for water or metallic matter in gear oil.			•			See Lubrication Chart in this section.
Spark Plugs	• Check plug gap. • Remove carbon deposits.		•		•		Replace plugs when electrodes are worn.
Carbure-tors	• Disassemble and clean. • Check float valve for wear.					•	Replace worn parts as required.
Fuel Tank, Pick-up Tube, Filters, and Fuel Pump	• Disassemble, clean, and inspect. • Check for leakage. • Check for cracks.		•		•		
Fuel and Recircula-tion Hoses	• Clean and inspect • Check all hose clips.					•	Replace hoses every 2 years.

Item	Inspection	Before Each Use	After 1st 10 Hours 2 Days	Every 30 Hrs or 7 Days	Every 50 Hrs or 30 Days	Every 100 Hrs or 60 Days	Remarks
Engine Compression	• Check with compression gauge				•		Obtain normal operating temperature and check at full throttle.
Water Pump	• Check for wear and damage.				•		Replace impeller every 200 hours (12 months).
Cooling and Exhaust Components	Remove dirt and deposits from the following: • Water pump and impeller • Water pipe • Thermostat • Exhaust cover • Exhaust pipe • Engine base • Reverse gas passage					•	
Power head Cleaning	Inspect and remove carbon deposits from the following: • Cylinder head • Pistons • Rings • Inner exhaust cover • Outer exhaust cover						Check every 200 hours (12 months).
Electrical Wiring	• Check for loose connections • Inspect wires and insulation for damage		•			•	
Ignition Timing and Carburetor Adjustment	• Check and adjust timing • Adjust linkage.		•			•	See Synchronization and Linkage Adjust ments in this section.
Throttle and Choke Valve Linkage	Inspect for the following: • Loose ball joints and lock nuts • Bent link rods • Loose rod snaps		•	•			

Item	Inspection	Before Each Use	After 1st 10 Hours 2 Days	Every 30 Hrs or 7 Days	Every 50 Hrs or 30 Days	Every 100 Hrs or 60 Days	Remarks
Sacrificial Anodes	• Inspect amount of erosion. • Test for proper installation.				•		Replace when anode has been reduced to 2/3 its original size (1/3 eroded). See Anodes - Inspection and Testing in this section.
Water Intake Screens	• Check for blockages.	•					Remove and clean as required.
Operational Checks	Check function and condition of the following: • Water discharge from check ports • Tiller or remote steering controls • Manual or remote clutch engagement • Main switch key • Emergency stop switch • Drag link and hardware	•					

BREAK-IN PROCEDURE

⚠ CAUTION

Failure to follow the Break-In Procedure in Owner's Manual and special fuel mixture requirements for break-in may lead to serious engine damage and shortened engine life.

To prevent serious engine damage and ensure long engine life, new engines, used engines with new powerhead, used engines with newly rebuilt powerhead, and engines coming out of storage must be run for a period of 10 hours in accordance with the break-in procedure.

⚠ CAUTION

After break-in has been successfully completed fuel tank should be filled with a 50:1 ratio gas/oil premix.

First 10 Minutes (0 - 0.16 Hours)

- Fill the fuel tank with a 25:1 gasoline to oil premix.
- Operatethe engine at minimum idle speed **ONLY**.
- Verify a steady stream of water from the cooling water check port and idle port on the engine, indicating the water pump is functioning properly.

Next 50 Minutes (0.16 to 1 Hour)

- **DO NOT** operate the engine above 1/2 throttle.
- **DO NOT** maintain a constant throttle setting. Vary engine speed from 1/4 to 1/2 throttle every 15 minutes.

NOTE

For boats which come onto plane easily, use full throttle to quickly accelerate onto plane; then immediately reduce throttle to 1/2 and maintain this speed.

Next Hour (1 to 2 Hours)

- Use full throttle to quickly accelerate boat onto plane; then immediately reduce throttle to 3/4 and maintain this speed.
- At intervals, run engine at 3/4 throttle for 1 - 10 minutes; then return to 1/2 throttle for a cooling period.
- Vary engine speed every 15 minutes.
- Check for water discharge from cooling water check ports.

Next Eight Hours (2 to 10 Hours)

- Run engine at 3/4 throttle.
- For short periods of time, run engine at full throttle and then reduce speed back to 3/4 throttle. As this part of the break-in period progresses, open to full throttle for longer and longer periods of time, but never longer than 5 minutes.
- Vary engine speed every 15 minutes.
- **DO NOT** exceed the Full Throttle RPM Range of the engine. See Engine Specifications in this section.

After Break-in

- Retorque cylinder head bolts to specification after engine has been run and cylinder head has cooled to the touch.
- Empty fuel tank and replenish with a 50:1 gasoline/oil mixture.

TUNE-UP PROCEDURE

⚠⚠ WARNING

Deteriorated or damaged parts identified during engine tune-up must be replaced in order to maintain safe engine operation.

1. Inspect engine for leaks, missing, loose or damaged parts, or other visible defects.

2. Remove each spark plug and check for fouling, cracks in ceramic, and incorrect gap. Replace plugs if needed.

3. Check engine compression. Refer to Cylinder Compression -Test in Section 4.

4. Check all wiring, connectors, and clamps for damage. Replace parts as needed.

5. Replace fuel filter and inspect carburetor. Check fuel hoses for deterioration. Replace as needed.

6. Check for proper clutch engagement and make shift linkage adjustments as needed.

Model	Adjustment Part
2.5A/3.5A	-
3.5B	Shift rod joint : Cam rod position with shift rod
5	Shift rod joint : Cam rod position with shift rod
8/9.8	Shift lever stopper : Position onto Shift rod lever
9.9/15/18	Shift lever stopper : Position onto Shift rod lever
25/30	Shift lever stopper holder : Position onto Shift lever stopper plate
40	Shift lever stopper holder : Position onto Shift lever stopper plate

7. Check for proper operation of the reverse lock mechanism.

8. Adjust the engine ignition timing and carburetor. See Synchronization and Linkage Adjustments, this section.

9. Remove propeller and inspect propeller shaft oil seal for leakage. Inspect propeller, thrust washer, and other propeller shaft hardware for damage. Replace as needed.

10. Drain and refill the gearcase with specified gear oil. See Engine Specifications in this section.

11. Lubricate all engine components as specified in the Lubrication Chart, this section.

12. Verify that all bolts and screws are torqued to specification by applying a torque wrench to each.

13. Run engine in test tank with proper test propeller and check for the following:

- Abnormal engine noise.
- Improper clutch operation.
- Little or no cooling water discharge from check port and idle port.
- Fuel leaks from mating surfaces of crankcase.
- Fuel leaks from mounting surface of intake manifold.
- Cooling water leaks from mating surfaces of cylinder head.
- Cooling water leaks from engine mounting surfaces.
- Cooling water leaks from exhaust cover mounting surfaces.
- Improper idle RPM and stability.
- Defective stop switch.

EMERGENCY STOP SWITCH AND LANYARD

The emergency stop switch and lanyard should be inspected and tested after servicing outboard. The operator should perform Emergency Stop function test with the boat in the water prior to leaving the launch area.

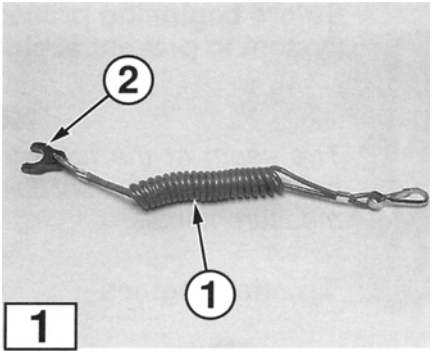
⚠⚠ WARNING

Do not attempt to repair worn or faulty stop switch and lanyard. Replace only with genuine parts. Do not substitute.

Inspection

1. Inspect lanyard **(1)** for cuts or fraying, lock clip **(2)** for cracks.

2. Inspect stop switch assembly **(3)** for signs of wear and make sure the switch has adequate spring tension to hold the lanyard lock clip in place.



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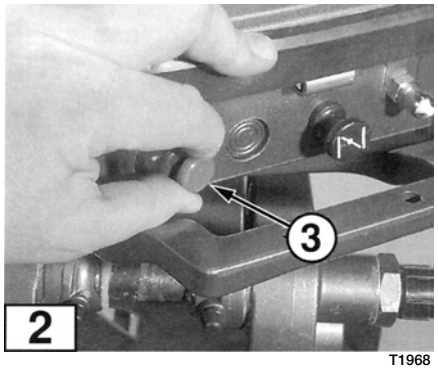


T1968

Stop Switch Test

1. Attach the lanyard lock clip to the stop switch.

2. Start the engine.

3. With engine running, pull the lanyard to disengage the lock clip. Engine should stop running.

NOTE

The stop switch also operates as a push-button switch with the lanyard left attached.

4. Repeat the test but do not remove the lanyard. Press down firmly and hold the stop switch until engine stops running.

If engine continues to run in either test, the stop switch or wiring are faulty and must be replaced before engine is operated.

SYNCHRONIZATION AND LINKAGE ADJUSTMENTS

To ensure consistent engine idling and smooth operation throughout the full RPM range, it is important that each procedure be performed exactly as written and in the following sequence:

1. Ignition Timing Adjustment

2. Carburetor Synchronization

⚠⚠ WARNING

Before beginning procedures, disable the ignition system to prevent accidental engine startup

NOTE

The seam at the mating surfaces of the crankcase halves is the alignment point for all ignition timing degree measurements.

Single Cylinder Engines

2.5 / 3.5 / 5 Engines

The timing of these engines is inspected by locating the timing marks which are on top of the flywheel. You can not adjust the timing.

Twin Cylinder Engines

A. 8/9.8 Engines
Because of a unique multi-cylinder ignition system, timing of the ignition is only necessary when the powerhead is disassembled and reassembled. This procedure is fairly simple as the only purpose is to ensure that the coil plate rotates in the proper direction.

B. 9.9/15/18 Engines
9.9/15/18 engines have timing marks on the side of the coil plate which must be aligned to the seam of the mating surfaces of the crankcase.

C. 25/30 Engines
Similar to 9.9/15/18 Engines.

D. 40 Engines
Similar to 9.9/15/18 Engines.

Ignition Timing Adjustment

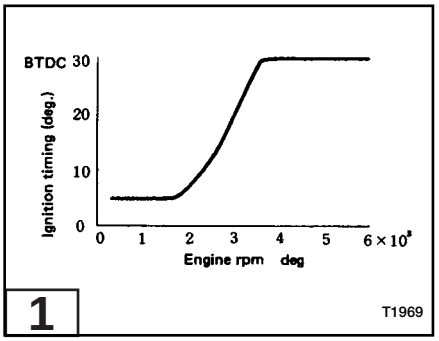
2.5 and 3.5 Models

Throttle Setting	Full Open		Full Closed (In Gear)	
Engine	Match Mark	Target RPM	Match Mark	Target RPM
2.5A	BTDC 20°	3800 - 5200	BTDC 20°	—
3.5A	BTDC 20°	4200 - 5300	BTDC 20°	—
3.5B	BTDC 20°	4200 - 5300	BTDC 20°	1100

5 Models

Throttle Setting	Full Open		Full Closed (In Gear)	
Engine	**Match Mark**	**Target RPM**	**Match Mark**	**Target RPM**
5	BTDC 30°	4500 - 5500	BTDC 5°	850

The magneto of the 5 engine uses an “electrical lead angle” where ignition timing is advanced as engine RPM increases.

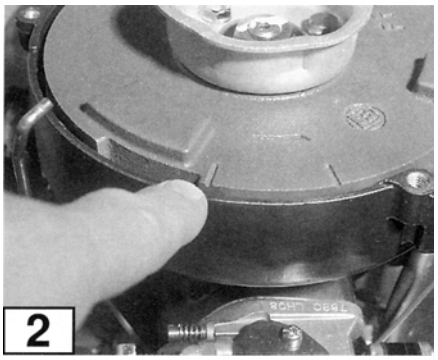


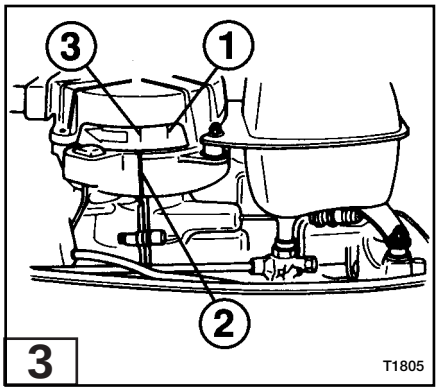
1 1. Start engine and check ignition timing using a timing light.

2 **3** 2. Two marking lines are cast on top of the flywheel, topand lead angle: BTDC 30°.

Item	Description
1	Top Marking
2	Matching Surface of Crankcase
3	Full Lead Angle Marking

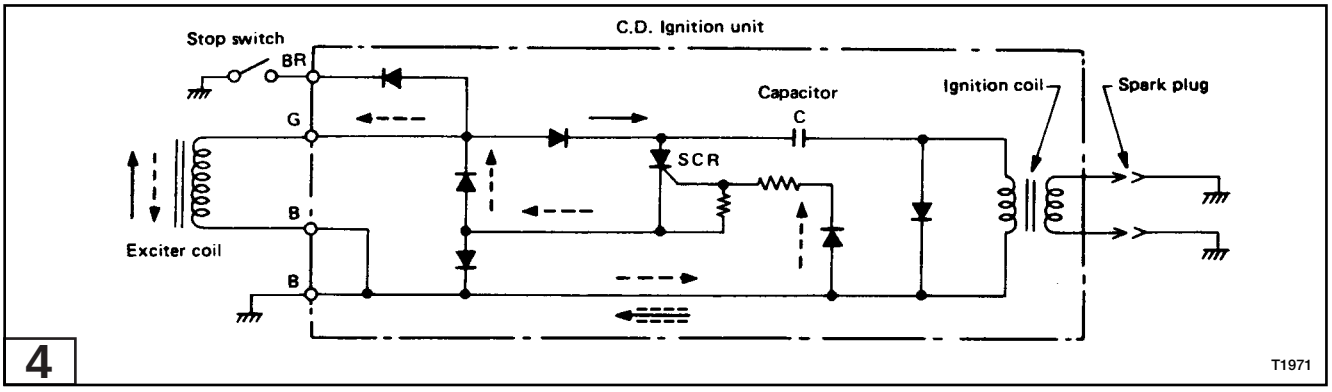
3. Check the matching surface of the crankcase.





8/9.8 Models

Throttle Setting	Full Open		Full Closed (In Gear)	
Engine	**Match Mark**	**Target RPM**	**Match Mark**	**Target RPM**
8	BTDC 22°	4500 - 5500	ATDC 1.5°	750
9.8	BTDC 26°	5000 - 6000	BTDC 2.5°	750



4 The 8 and 9.8 engines are different electronically from other one and two cylinder engines. The 8 and 9.8 engines incorporate an electronic switch (Thyristor SCR (*Silicon Controlled Rectifier*)) which is actuated by signal voltage to provide stable, high performance secondary sparking.

The magneto is a simultaneous, multi-cylinder ignition type and would, if allowed, cause ignition in both cylinders at the same time. Ignition however occurs only on the compression stroke side (TDC side). Ignition is caused in only one cylinder at each spark timing. The other cylinder is not ignited, although sparking is caused in both cylinders at the same time.

The timing is adjusted only after the powerhead has been disassembled and reassembled. Timing is controlled by the position of the advancer link rod which is adjusted so that the coil plate turns counterclockwise to contact with the stopper when the throttle valve is closed fully when the advancer lever is moved.

8/9.8 Adjustment Procedure

1. Move the advancer lever with a finger to fully open the carburetor throttle valve. At this time, adjust the length of pole joint cap of the advancer link rod so that the coil plate stopper hits the projection of the set plate lower as the coil plate rotates to the left.

2. Assemble the throttle cable into the throttle drum and attach the nut to the throttle cable holder of the motor cover lower. At this time, be careful that the cable is not attached to a wrong location.

3. Adjust the nut of the throttle cable that was attached to the throttle cable holder so that the coil plate of the magneto rotates to the left at the position where the handle grip stops when it is turned to the left and hits the coil plate stopper, and then the coil plate of the magneto rotates to the right at the position where the handle grip stops when it is turned to the right and hits the coil plate stopper.

Model 9.9/15/18, 25/30 and 40

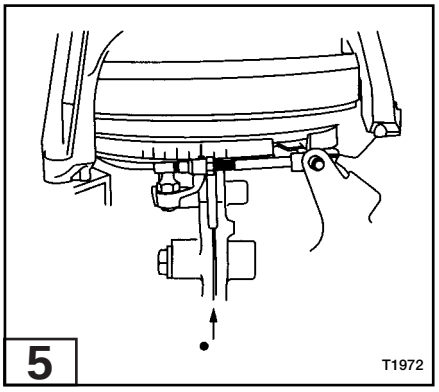
Throttle Setting	Full Open		Full Closed (In Gear)	
Engine	**Match Mark**	**Target RPM**	**Match Mark**	**Target RPM**
9.9D	BTDC 22°	4500 - 5300	ATDC 3°	800
$9.9D_2$	BTDC 20°	4500 - 5300	ATDC 3°	800
15D	BTDC 22°	4750 - 5500	ATDC 3°	800
$15D_2$	BTDC 25°	5200 - 5800	ATDC 3°	800
18E	BTDC 25°	4750 - 5500	ATDC 3°	800
$18E_2$	BTDC 25°	5200 - 5800	ATDC 3°	800
$25C_2$	BTDC 20°	4800 - 5500	ATDC 2°	900
$25C_3$	BTDC 25°	5000 - 6000	ATDC 4°	900
$30A_3$	BTDC 25°	4800 - 5500	ATDC 2°	900
$30A_4$	BTDC 25°	5150 - 5850	ATDC 4°	900
40	BTDC 25°	5200 - 5800	ATDC 2°	850

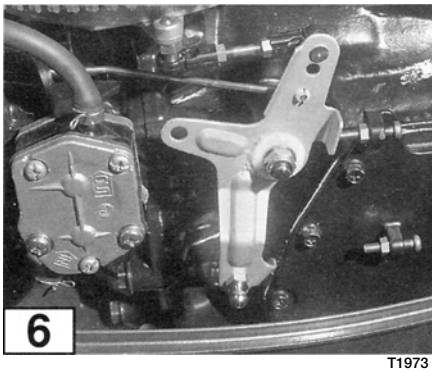
9.9/15/18, 25/30 and 40 Adjustment Procedure

1. Rotate the throttle grip to the FAST side until the throttle stops

5 2. Adjust ignition timing link so that the timing full open match mark is aligned with the fitting line (Crankcase Mating Surfaces).

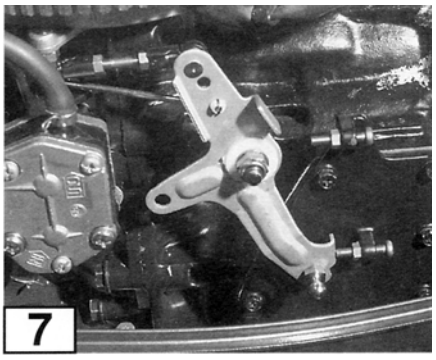
6 3. Adjust the stopper bolt so that the advancer arm touches the full open stopper bolt when throttle is fully opened.





7 4. Turn the throttle grip toward SLOW side.

5. Adjust the stopper bolt (for full close adjustment) so that it hits the stopper bolt at the position where the magneto coil plate timing mark (fully closed side) meets the ignition timing inspection line (crank case mating surface).

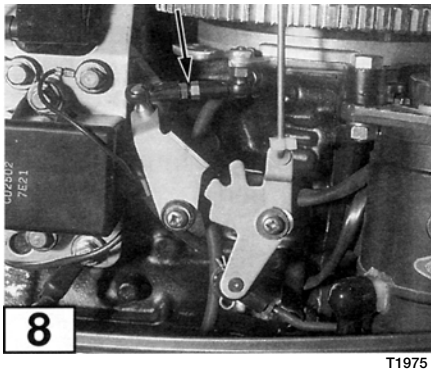


T1974

⚠ CAUTION

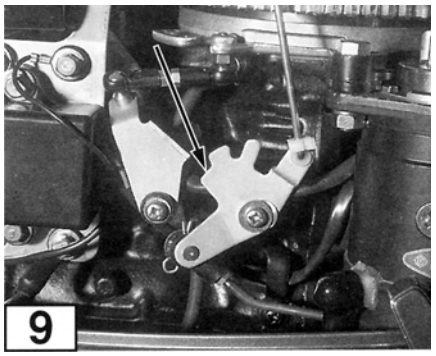
After making adjustments, check that the advancer arm moves firmly and smoothly. Tighten adjusting nut after completing adjustments.

8 6. At the neutral and reverse position, the starter lock arm and neutral stop arm controls the engine speed.



T1975

7. (9.9/15/18 HP Engines Only) Rotate the adjusting screw so that the set distance is 0.45 - 0.47 in [11.5 -12 mm].



T1976

⚠ CAUTION

Make this adjustment only after placing the gear shift lever in reverse.

8. Test gear shift lever operation in FORWARD, NEUTRAL and REVERSE.

9 9. Check that recoil starter is locked at positions other than neutral (M, EF and EP models). Turn on main switch and check that the starter motor (if so equipped) does not operate at positions other than neutral (EF and EP types only.)

CARBURETOR ADJUSTMENT

There are two types of carburetor adjustments. One applies to the 2.5/3.5 HP engines only. The remaining one and two cylinder engines use a different carburetor adjustment procedure.

2.5A/3.5A/3.5B

Idling Speed	In Neutral	In Gear
2.5A/3.5A/3.5B	Approx. 1200 RPM	Approx. 1000 RPM
$2.5A_2/3.5A_2/3.5B_2$	Approx. 1300 RPM	Approx. 1100 RPM

NOTE

The 2.5A and 3.5A may on/y be adjusted in gear.

NOTE

Adjust idling speed after engine is warmed up.

Idling Adjustment

- Turn the slow ajusting screw one turn clockwise and start engine.
- Return the throttle lever to its close position and adjust the screw until the correct speed is obtained. Turn the screw clockwise to increase speed or counterclockwise to decrease speed.

Jet Needle Adjustment

⚠ CAUTION

The 2.5/3.5 carburetor is properly adjusted when shipped from the factory. No adjustment should be made to the carburetor unless absolutely necessary.

- The jet needle is held in position by a spring clip which fits into one of four grooves on the needle. Moving the clip to a higher groove will make the mixture leaner, and moving the clip down will produce a richer mixture.

All Other Engine Carburetors

Covers: 5 Model
8/9.8 Models
9.9/15/18 Models
25/30 Models
40 Model

Idling Speed	In Neutral	In Gear	Pilot Adjusting Screw : Number of turms
5	1000 RPM	850 RPM	1 ± 1/4
8/9.8	950 RPM	750 RPM	8 : 1-3/8 ± 1/4,9.8 : 2 ± 1/4
9.9/15/18	950 RPM	800 RPM	$9.9D_2/15D_2/18E_2$: 2 ± 3/4
25/30	1050 RPM	900 RPM	$25C_3/30A_4$:1-1/4 ± 1/4
40	1000 RPM	850 RPM	1-1/4 ± 1/4

NOTE

Adjust idling speed after warm-up operation.

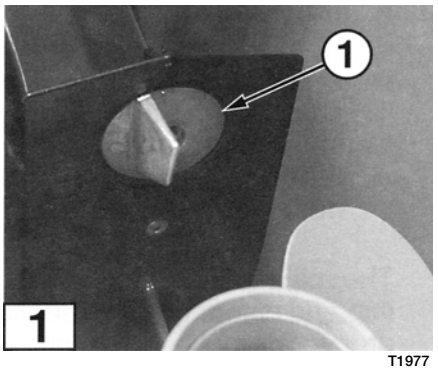
Adjustment Procedure

- Set the pilot adjusting screw to the standard reverse turns, and adjust the engine rpm by using the pilot adjusting screw and throttle stop screw while monitoring the tachometer.
- The engine rpm should reach maximum when the pilot adjusting screw is within +/- 1/4 turns of the standard position.

Replace the pilot adjusting screw if the tip is worn.

ANODES - INSPECTION AND TESTING

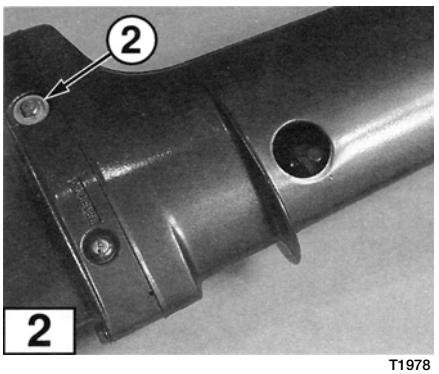
Engines are equipped with several sacrificial anodes to help protect metal parts from the effects of galvanic corrosion (electrolysis). Disintegration of the anodes indicates they are performing their function. An anodes must be replaced when it has been reduced to 2/3 its original size (1/3 eroded). Engine corrosion will increase if eroded anodes are not replaced.



T1977

⚠ CAUTION

Do not paint or coat anodes or their mounting surfaces.



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External Anodes

Anodes mounted externally on the engine should be inspected every 3 months, or more frequently if the engine is operated in salt or polluted water.

1 Inspect the sacrificial trim tab **(1)** for erosion.

2 Inspect the mid-section or lower unit anode **(2)** for erosion.

Powerhead Anode

The powerhead is protected by an anode mounted in the cylinder head or cylinder. The anode should be replaced whenever service work requires removal of the cylinder head, or when a complete overhaul of the engine is performed.

Installation Test

Use the following procedure to test for proper installation of the anode. Make sure the surface of the anode is clean before testing.

1. Calibrate an ohmmeter on high ohms scale.

2. Connect one meter lead to a ground on the powerhead and the other lead to the anode. The ohmmeter should show a low reading. If not, remove the anode and clean the surface where it was mounted. The anode and its mounting hardware should also be cleaned. Install anode and retest.

SECTION 3
FUEL SYSTEM

TABLE OF CONTENTS

SECTION 3

GENERAL PRECAUTIONS

⚠⚠ WARNING

Gasoline is extremely flammable and can explode if mishandled.

1. Before performing any service work on the fuel system, read and understand Section 1 - Service Safety.

2. Before servicing the fuel system, disable the ignition system by removing all spark plug leads to prevent accidental starting of engine.

3. Fuel leakage can contribute to a fire or explosion. After service work is complete and engine is fully assembled, always run the engine momentarily to pressurize the fuel system. Then check for leaks.

4. Never attempt to run the engine with any fuel system component removed or disconnected.

5. Check fuel hoses and other nonmetallic components for indications of damage or deterioration. Always replace components with authorized factory replacement parts suitable for fuel systems.

6. Clean up fuel spills immediately and store rags in approved containers. Keep drained fuel in approved containers for proper disposal.

7. When using compressed air to clean or dry parts, make sure the air supply is regulated not to exceed 25 psi [172 kPa / 1.76 kg/cm^2].

SERVICE SPECIFICATIONS

Special Torque Values

NOTE

Refer to Section 2 for Standard Torque Values chart.

Description	Torque in-lb N·m kg-m					
	Model					
	2.5 / 3.5	**5**	**8 / 9.8**	**9.9 / 15 / 18**	**25 / 30**	**40**
Carburetor Mounting Bolt	—	40 - 55 4.6 - 6.2 0.47 - 0.64	40 - 55 4.6 - 6.2 0.47 - 0.64	40 - 55 4.6 - 6.2 0.47 - 0.64	—	—
Air Silencer Cover Bo lt/Screw*	13.2 - 16.8 1.5 - 2.0 0.15 - 0.20	13.2 - 16.8 1.5 - 2.0 0.15 - 0.20	40 - 55 4.6 - 6.2 0.47 - 0.64	21.6 - 30.0 2.5 - 3.4 0.25 - 0.35	43.2 - 54.6 4.9 - 6.4 0.50 - 0.65	43.2 - 54.6 4.9 - 6.4 0.50 - 0.65
Inlet Manifold Mounting Bolts	—	—	43.2 - 54.6 4.9 - 6.4 0.50 - 0.65	43.2 - 54.6 4.9 - 6.4 0.50 - 0.65	43.2 - 54.6 4.9 - 6.4 0.50 - 0.65	43.2 - 54.6 4.9 - 6.4 0.50 - 0.65
Reed Valve Mounting Screw*	—	—	6.1 - 7.8 0.7 - 0.9 0.07 - 0.09	—	—	—

*Loctite #242 required

Manufacturer Special Tools Required

• None

SECTION 3

General Equipment Required

Fuel Pressure Gauge, 0 - 15 psi [0 - 1 kg/cm²]
Tee Fitting with 3/8 in O.D. barbs [9.5 mm O.D.]
Torque Wrench, 0 - 150 in-lb [0- 17 N·m/0 - 1.7kg-m]
Digital Pulse Tachometer
Flexible Fuel Tubing, 3/8 in I.D. x 5 in. [9.5 mm I.D. x 127 mm]

Consumable Supplies Required

Thread Locking Compound, *Loctite 272*
Isopropyl Alcohol
Cleaning Solvent
Lint-free Wipes

FUEL SYSTEM REQUIREMENTS

Acceptable Fuel

Any premium gasoline with pump posted octane rating over 89 (research octane rating of 91) and with no more that 10% Ethanol by volume.

Unacceptable Fuel

Gasoline with more than 5% Methanol (even if it contains co-solvents or corrosion inhibitor) or more than 10% Ethanol, regardless of the octane rating.

Fuel Storage Life

Fuel of storage should not be used after a period of 3 months.

Acceptable Lubricant

Any NMMA certified TC-W3 2-cycle outboard engine oil is acceptable for fuel tank premix applications. Do not use automotive oils which can damage the engine and shorten spark plug life.

Mix Ratios

⚠ CAUTION

A 25:1 gasoline/oil mixture is required during engine break-in. Refer to Break-In Procedure in Section 2.

Premixing

A 50:1 gasoline/oil mixture (2% oil) is required. New engines or reconditioned powerheads require a 25:1 gasoline/oil mixture (4% oil) during break-in.

SECTION 3

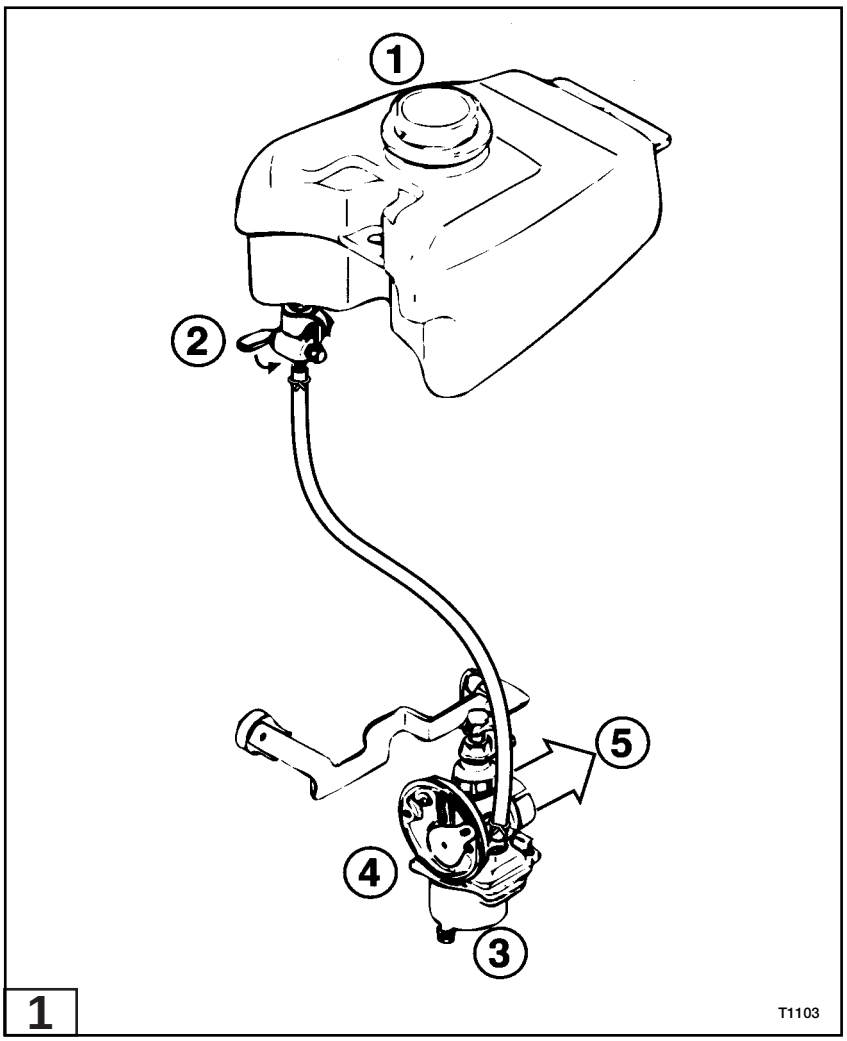
TROUBLESHOOTING

The troubleshooting chart lists common engine symptoms related to problems with the fuel system. It also indicates specific malfunctions in the fuel system which may be causing the problem so it can be isolated more effectively. Before beginning major troubleshooting operations on the fuel system, perform the following operations:

- Disconnect fuel tank hose from the engine. Connect a known good tankand hose and determine if the problem persists.
- Remove and clean the engine fuel filter assembly and replace the filter element.
- Replace filter element in the fuel tank pickup tube.

Checks \ Symptom	Hard to start or will not start	Misses at low speeds	Misses at high speeds	Poor acceleration, hesitation or coughs	Runs rough and smokes	Idles well, then slows and stops	Will not start and after fires into exhaust housing	No acceleration, low/full throttle RPM	Idles well but slows when accelerated	Runs at high speed only when hand primer is used	Engine stops suddenly	Runs noisy and knocks	Excessive fuel consumption
FUEL TANK AND FILTERS													
Empty fuel tank	•										•		
Low fuel in tank		•		•									
Fuel tank air vent closed	•					•				•	•		
Poor quality or old fuel	•	•	•		•								
Water in fuel system	•		•						•				
Fuel hose pinched or disconnected	•							•	•	•			
Restricted fuel pickup pipe or clogged pipe filter	•							•	•	•			
Faulty primer bulb	•												
Improper or faulty anti-siphon valve	•							•	•	•			
Clogged fuel filter	•							•	•	•			
Loose connector or vacuum leak	•								•				

Checks \ Symptom	Hard to start or will not start	Misses at low speed	Misses at high speed	Poor acceleration, hesitation or coughs	Runs rough and smokes	Idles well, then slows and stops	Will not start and after fires into exhaust housing	No acceleration, low/full throttle RPM	Idles well but slows when accelerated	Runs at high speed only when hand primer is used	Engine stops suddenly	Runs noisy and knocks	Excessive fuel consumption
OIL MIXTURE													
Mixture too rich (too much oil)		•			•								
Mixture too lean (not enough oil)		•				•		•	•			•	
CARBURETOR													
Carburetor out of adjustment	•	•		•	•			•	•	•			
Carburetor obstruction or faulty needle valve	•												
Restricted air flow to carburetor					•								
Faulty choke valve	•				•				•				
Carburetor and ignition timing not synchronized	•							•					
Float position too high					•								•
Float position too low				•					•	•			
Jet obstructed or defective				•					•	•			•
Carburetor gasket leakage				•									•
RECIRCULATION SYSTEM													
Puddle drain valve or hose blockage		•			•	•							
Recirculation hose misrouted		•		•									
FUEL PUMP													
Mounting gasket leakage						•				•			
Check valve sticking open or closed				•						•			
Ruptured diaphragm				•									•
INLET MANIFOLD													
Warped inlet manifold		•		•									
Manifold gasket leakage		•		•									
Faulty reed valve operation or broken valve		•		•				•					
Reed valve gasket leakage		•		•			•	•					

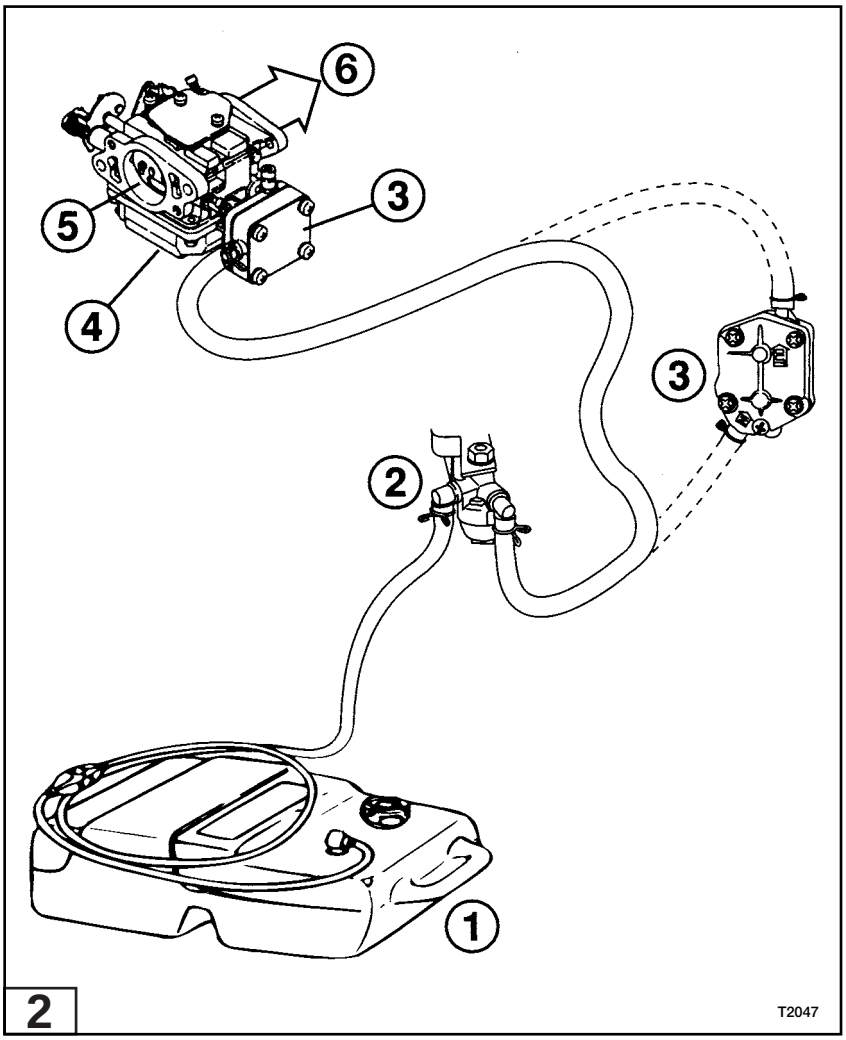


DESCRIPTION OF OPERATION

There are two types of fuel systems, models 2.5 and 3.5 use a gravity fed fuel system. Models 5 through 40 have a fuel pump.

2.5 / 3.5 Fuel Flow

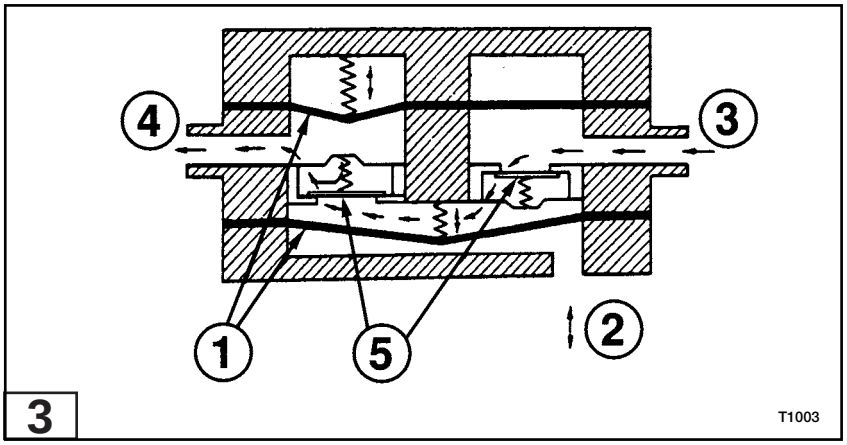
1 Prior to starting, the air vent on fuel cap **(1)** and fuel cock **(2)** must be opened. The difference in air pressure and gravity force fuel from the fuel tank to the float chamber **(3)** through the needle valve into the carburetor. When pull the recoil starter, air is sucked into the carburetor from **(4)** and mixed with fuel and then pulled into the crankcase.



2

5 - 40 Fuel Flow

2 Upon engine startup, premixed fuel is drawn from fuel tank **(1)** by vacuum pressure on the suction side of the fuel pump through the fuel filter **(2)** and, into fuel pump **(3)**. Fuel flows from the fuel pump into the carburetor float chamber **(4)**. Fuel is drawn from the float chamber into the carburetor **(5)** where it is mixed with air and pulled into the crankcase **(6)**.



3

Fuel Pump

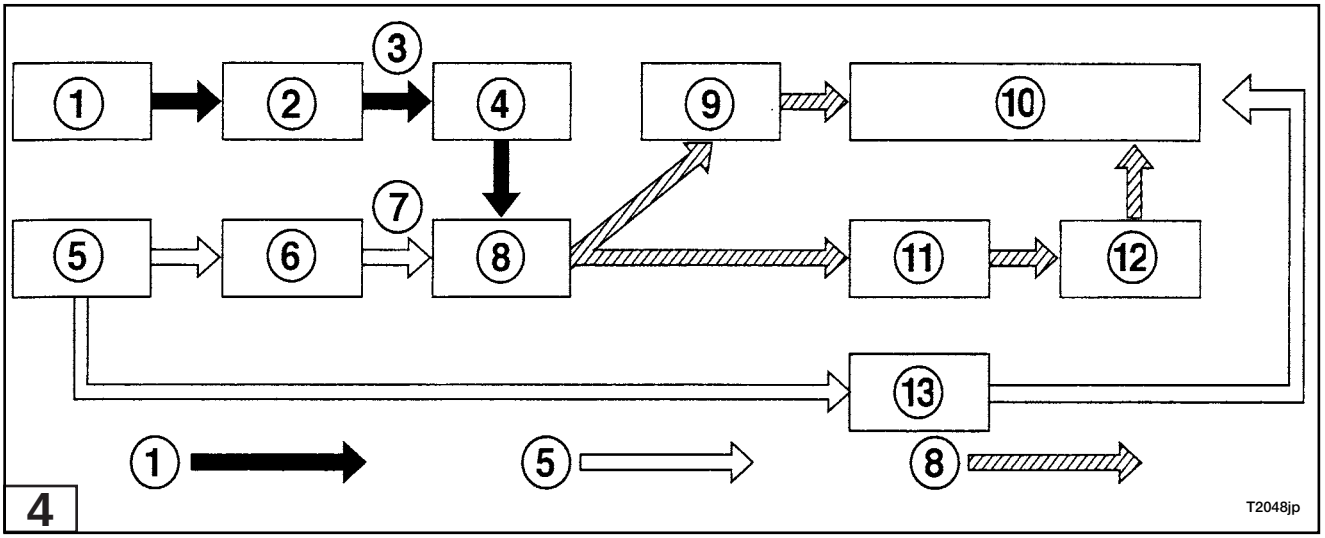
3 The fuel pump may be integral with the carburetor or mounted on the side of the crankcase and contains one or more internal diaphragms **(1)**. The diaphragms move in response to changing crankcase pressures **(2)** which draws fuel in **(3)** and pumps fuel out **(4)**. A series of check valves **(5)** in the pump ensure that fuel moves only in one direction.

Carburetors

The carburetors use a pilot system and main system to meter and deliver an atomized fuel mixture to the engine for combustion under varying operating conditions.

Pilot System

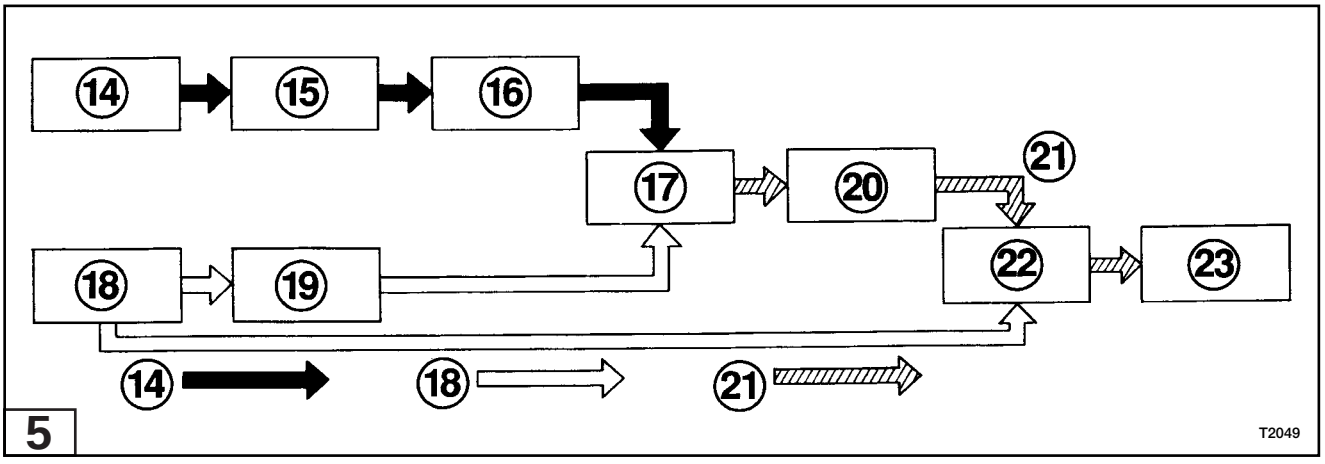
4 The pilot system is a slow speed system consisting of the slow jet, slow air jet, pilot outlet, bypass, and pilot adjusting screw. At 1/4 throttle and less, mixed fuel **(1)** enters the carburetor and flows from the carburetor float chamber **(2)** through passage **(3)** to the pilot jet **(4)**. Air **(5)** measured at the pilot air jet **(6)** is directed through passage **(7)** and combines with the existing fuel from the pilot jet to form fuel/air mixture **(8)**. After exiting bypass **(9)**, the mixture directly enters engine **(10)** or passes pilot adjustment screw **(11)** for output to the engine through pilot outlet **(12)**. Unrestricted air flow to the engine is available through venturi **(13)**.



Under idling conditions, the mixture of fuel and air is mainly output from the pilot outlet. As throttle is increased, the negative pressure applied to the pilot system increases and allows more of the mixture to flow from the bypass. When the throttle is opened further, the increase of air causes a pressure drop which allows the main system to assume full control of fuel delivery.

Main System

5 The main system in the carburetors is a high speed system consisting of the main jet, main nozzle and main air jet. As the throttle valve opens, mixed fuel **(14)** enters the carburetor and flows from the carburetor float chamber **(15)** to main jet **(16)**. The fuel is then measured and directed to the main nozzle **(17)** bleed hole where it combines with air **(18)** from the main air jet **(19)**. The increased air quantity and flow rate at venturi **(22)** allows pressure drop at the tip of main nozzle **(20)**, causing increased output of fuel/ air mixture **(21)**. The fuel mixture combines with main air at the venturi **(22)** before entering the engine **(23)**.



Recirculating

Recirculation hoses at the inlet manifold and crankcase recirculate unburned fuel for engine consumption.

SEPARATE FUEL TANK

1 Two types of separate fuel tanks are used. Smaller engines use the 3.1 gal [12 L] separate fuel tank. Larger engines use a 6.6 gal [25 L] separate fuel tank. Both tanks have filler caps with an integral fuel gauge and manual vent screw, and a fuel pick-up pipe with a hose quick connector.

Cleaning

Water or dirt in the fuel tank can cause fuel starvation and engine problems. Clean and inspect fuel tank once a year or after long time storage (more than 3 months).

1. Disconnect fuel line from fuel tank.

2. Empty remaining fuel from tank and properly dispose.

3. Fill tank 1/4 with fresh gasoline and install cap. Rigorously shake tank for 30 seconds to loosen dirt particles.

4. Empty gasoline from tank and properly dispose.

5. Inspect tank components before refilling.

Inspection

All worn, damaged, or missing parts must be replaced.

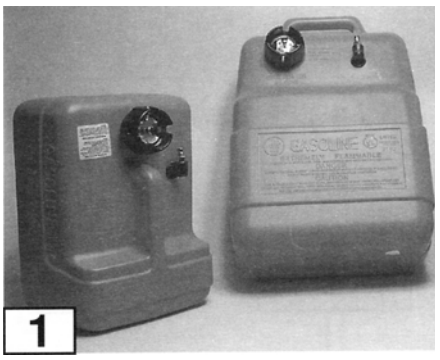
1. Inspect overall condition of tank exterior and interior. Cracked or damaged tanks must be removed from service.

2 2. Inspect the cap vent screw **(1)** and inner gasket **(2)** for cracks, vent hole blockage or deterioration. Check that float **(3)** moves freely and operates the gauge needle.

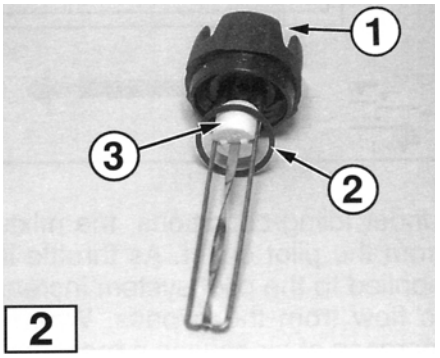
3 3. Unscrew tank pickup tube and check for cracks. Remove and inspect connector **(4)**, filter **(5)** and gasket **(6)**.

4. Reassemble and install all tank components.

5. See Fuel Hose and Primer, this section.



T1107



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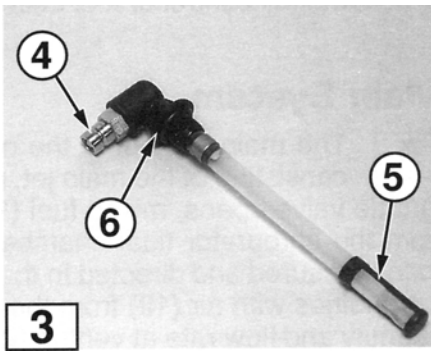
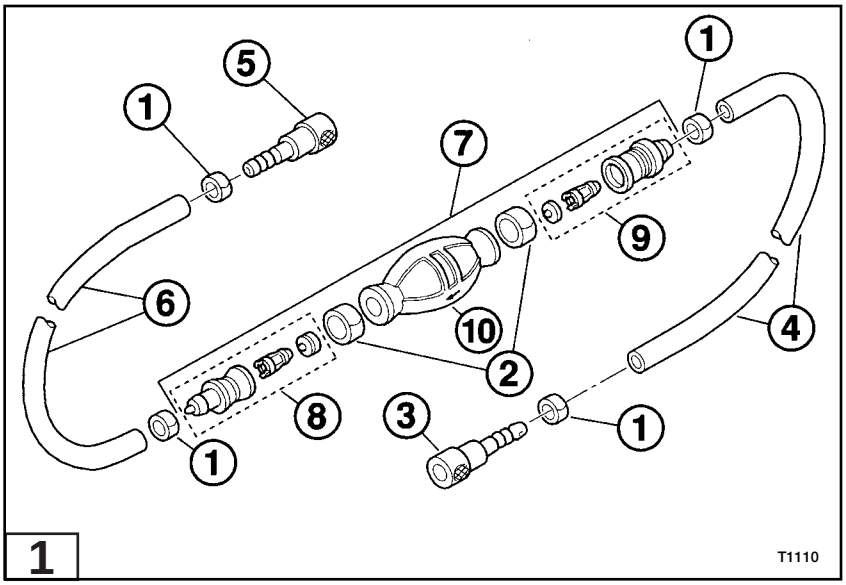


T1109

FUEL HOSE AND PRIMER



Separate fuel tanks are connected to the engines by a hose with a primer bulb. The primer bulb forces fuel into the carburetor float chamber for engine starting. Check valves on each side of the primer bulb maintain fuel flow, in one direction only, from the tank to the engine.

Disassembly

NOTE

Note direction of fuel flow as indicated by the arrow on the primer bulb.

1 1. Remove and discard hose clamps **(1)** and primer bulb clamps **(2)** as required.

1 2. Remove tank connector **(3)** and hose **(4)**.

1 3. Remove engine connector **(5)** and hose **(6)**.

1 4. Remove primer bulb assembly **(7)**. Remove check valves **(8)** and **(9)** from primer bulb **(10)**.

Cleaning and Inspection

1. Clean components using soap and water.

2. Dry all components with low pressure compressed air. Make sure all parts and passages are completely dry.

3. Inspect primer bulb and hoses for cracks and deterioration.

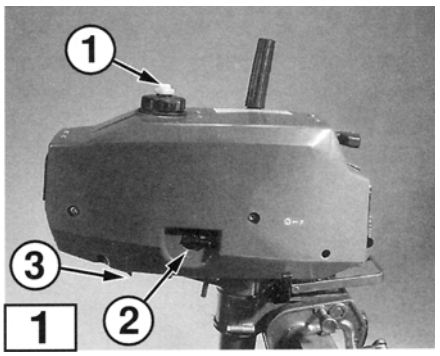
4. Inspect tank and engine quick connectors for damage and wear. Make sure check valves in quick disconnects open freely when pressed.

5. Inspect primer bulb check valves for damage.

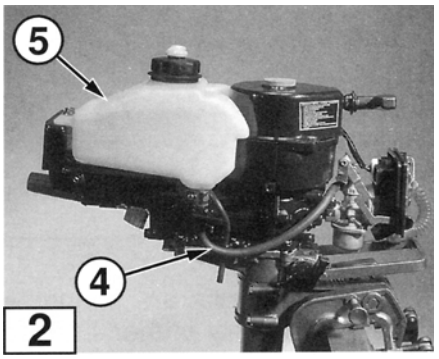
⚠ CAUTION

New hose clamps must be used in assembly. All worn or damaged parts must be replaced.

6. Reassemble all components.



T1111



T1112

INTEGRAL FUEL TANK

The 2.5 and 3.5 engines have a 0.37gal [1.4 L] integral fuel tank. The 5B model engine is provided with a 0.66 gal [2.5 L] integral fuel tank.

NOTE

The model 5BS engine has a standard 3.1 gal [12 L] separate tank.

Removal

1 1. Close air vent **(1)** and fuel cock **(2)**.

2. Remove cover.

- 2.5 and 3.5 HP Only
- Remove spark plug cover **(3)**.
- Remove screws securing right side engine cover.
- Remove screws securing left side engine cover.

2 3. Disconnect fuel line **(4)** from fuel tank **(5)**.

4. Inspect fuel tank for crack and fuel filter for damage.

5. Remove screws securing fuel tank.

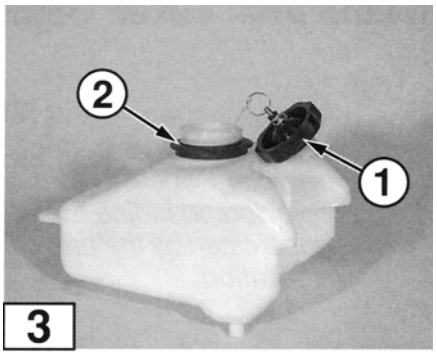
Cleaning and Inspection

All worn, damaged, or missing parts must be replaced.

1. Clean components using soap and water.

2. Dry all components with low pressure compressed air. Make sure all parts and passages are completely dry.

3. Inspect overall condition of tank exterior and interior. Cracked or damaged tanks must be removed from service.



T1113

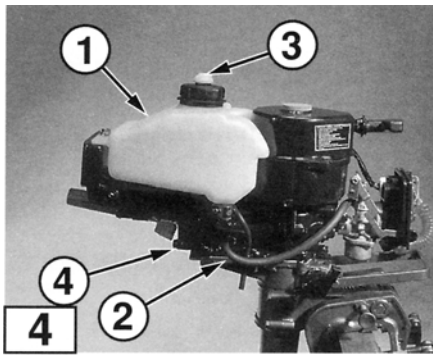
3 4. Inspect the cap **(1)** and gasket **(2)** for cracks, vent hole blockage or deterioration.

5. Inspect tank, fuel filter and fuel pump (if equipped) connections for cracks and damage.

6. Remove fuel cock and inspect filter screen for blockage. If screen cannot be cleaned, the fuel cock assembly must be replaced.

NOTE

The fuel filter in the 2.5 and 3.5 engines is located in the fuel cock. The fuel cock must be removed from fuel tank to inspect the fuel filter.



T1114

Installation

1. Install fuel cock in fuel tank.

4 2. Install fuel tank **(1)**.

4 3. Attach fuel line **(2)** to fuel tank

4 4. Fill fuel tank with fresh pre-mixed fuel. Open air vent **(3)** and fuel cock **(4)** and check for leaks.

5. Install cover.

FUEL FILTER

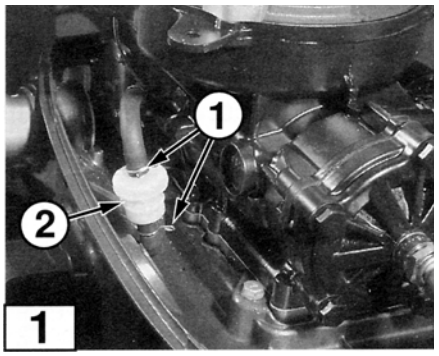
Three types of fuel filters are used:

- In-Tank Pickup Filters (see Fuel Tank, this section)
- In-Line Fuel Filters
- Bowl Type Fuel Filters

NOTE

For the 2.5, 3.5 and 5B engines, the in-tank pickup filter is the only fuel filter used. This filter is part of the fuel cock, and if clogged or damaged, it must be replaced with a new fuel cock assembly.

In-Line Fuel Filter Replacement



T1116

NOTE

In-line fuel filters cannot be serviced. Replace in-line fuel filters once a year or with each tune-up. When replacing an in-line fuel filter, note direction of fuel flow as indicated by the arrow on the filter housing for proper installation.

1

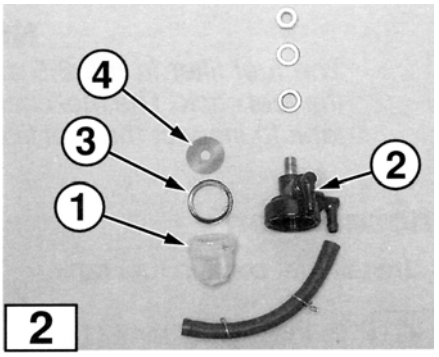
1. Loosen clips **(1)** on each side of the filter **(2)** and slide down the hose.

2. Separate the fuel filter from the hoses and discard.

3. Replace with new fuel filter.

4. Attach hoses and secure clips.

Bowl Type Fuel Filter Cleaning and Inspection



T1125

2

1. If necessary, use a wrench on the square at the bottom of the sediment bowl **(1)** to loosen the bowl. Remove the bowl from filter body **(2)**.

2

2. Remove gasket **(3)** and screen **(4)**.

3. Clean bowl and screen.

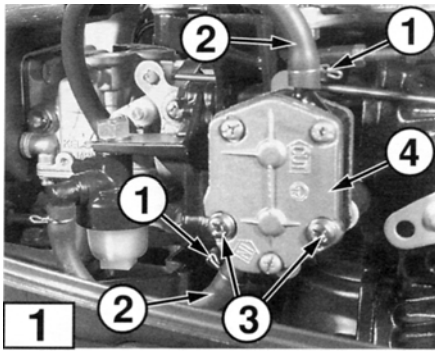
NOTE

Clean the screen with a soft brush and solvent.

4. Inspect bowl for cracks and screen for damage. Replace gasket.

5. Install screen and bowl.

FUEL PUMP



T1118

⚠ CAUTION

Before servicing the fuel pump, disconnect the fuel hose from the engine to prevent excessive fuel spillage.

NOTE

Fuel for the 2.5 and 3.5 engines is gravity fed to the carburetor. There is no fuel pump to be serviced on these engines.

Disassembly

NOTE

Match mark parts before disassembly and reference the illustrations in the Inspection procedure to ensure proper orientation of internal components.

NOTE

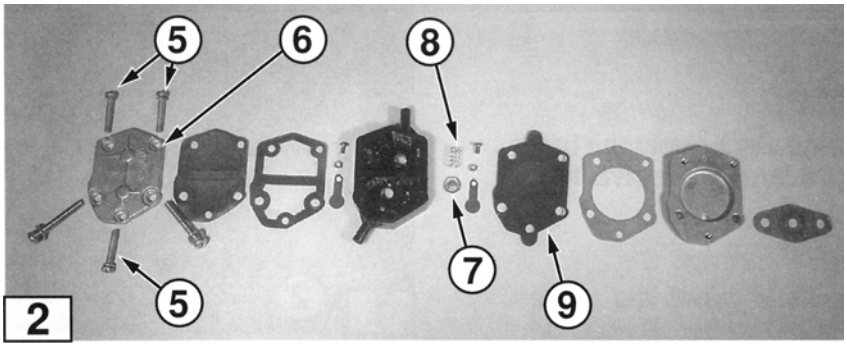
Models 5, 8, 9.8, 9.9, 15 and 18 are equipped with carburetor-mounted fuel pump. Disconnect fuel hoses from pump, remove the mounting screws and fuel pump. Gently separate the pump components and continue with Cleaning and Inspection procedures.

1 1. Expand and move clips **(1)** on fuel hose(s) **(2)**.

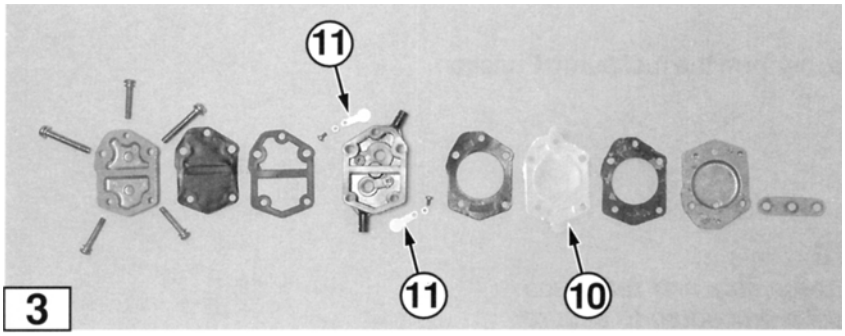
2. Disconnect fuel hoses from fuel pump.

1 3. Loosen pump mounting screws **(3)** and remove fuel pump **(4)** and gasket from crankcase.

2 4. Remove fuel pump cover screws **(5)** and cover **(6)**. Gently separate the pump components.



T1119



T1120

2 3

NOTE

*Past production models 25, 30, and 40 contained an internal guide plate **(7)** and spring **(8)** assemblies under tension. The rubber diaphragm **(9)** that required the guide plate and spring has been replaced by a resin film (white opaque) diaphragm **(10)** which no longer requires the guide plate and spring.*

4. Remove and discard all serviceable gaskets and diaphragms.

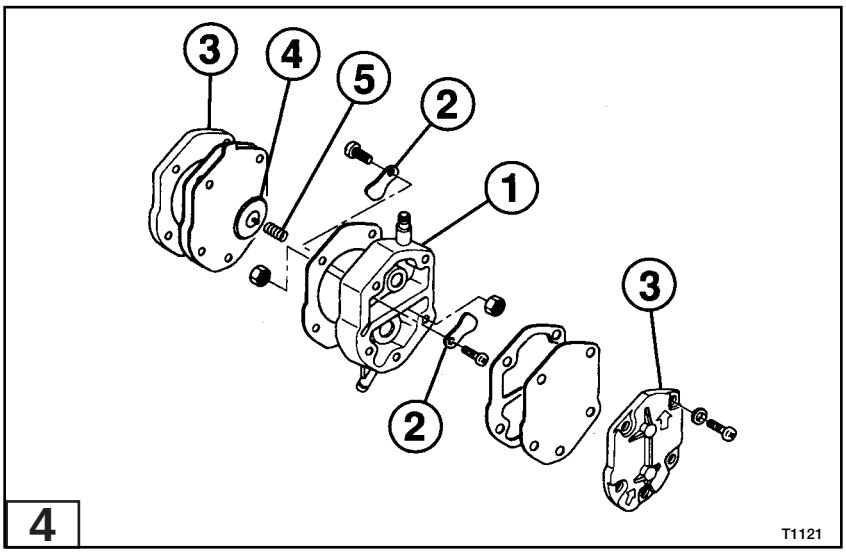
3 5. Remove all check valves **(11)** from pump body.

Cleaning

1. Clean all pump components with kerosene.

2. If necessary, clean pump mounting surface on carburetor with isopropyl alcohol. (for models 5, 8/9.8 and 9.9/15/18)

3. Dry all components with low pressure compressed air.



Inspection

4 1. Inspect pump body **(1)** for cracks.

4 2. Inspect check valves **(2)** for deformation.

4 3. Inspect pump covers **(3)** for cracks and surface deformation.

4 4. Inspect guide plate **(4)** and spring **(5)**, if equipped, for deformation and tension.

5. Inspect gasket between crankcase and fuel pump for dryness (crankcase-mounted pumps).

Assembly

1. Install all check valves in pump body.

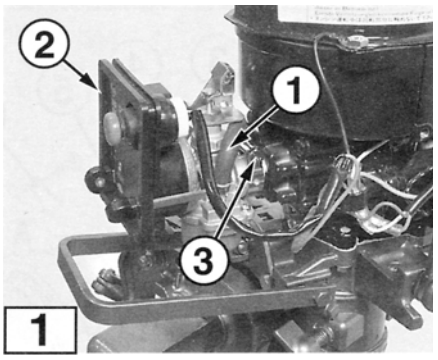
2. Fully assemble fuel pump. All serviceable gaskets and diaphragms must be replaced.

3. Install fuel pump. Use Loctite 242 on mounting screw threads.

4. Connect fuel hoses to fuel pump.

CARBURETORS

Two basic types of carburetors are used; the round slide valve type used on the 2.5 and 3.5 horsepower engines, and the butterfly valve type used on 5 horsepower and up.



T1124

Slide Carburetor Specifications

Model	Item	Specifications
2.5A / 3.5A / 3.5B	Main Jet	#92
	Jet Needle Clip Groove	2nd from bottom
$2.5A_2$ / $3.5A_2$ / $3.5B_2$	Main Jet	#86
	Jet Needle Clip Groove	2nd from bottom

Removal

1. Remove motor cover.

1 2. Turn off fuel supply fuel cock and remove fuel hose **(1)** from carburetor.

1 3. Remove carburetor cover **(2)**.

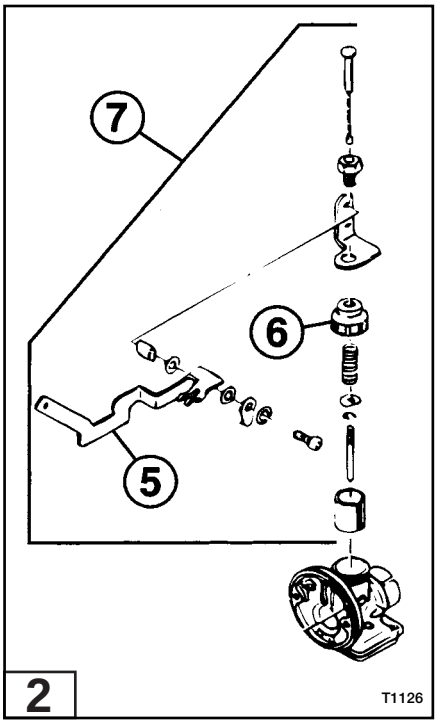
1 4. Loosen clamp bolt **(3)** and remove carburetor.

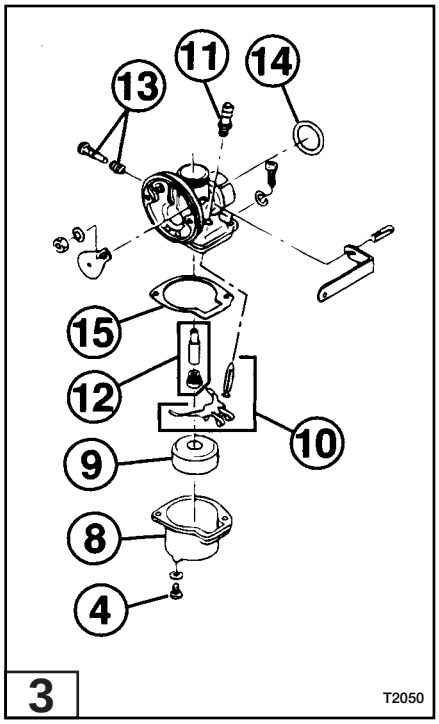
Disassembly

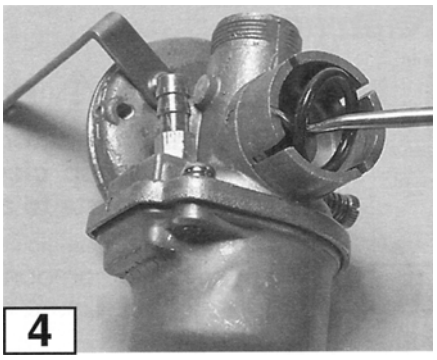
⚠ CAUTION

Use the following precautions during carburetor disassembly:

- **Use correct size screwdrivers to avoid damaging the carburetor jets.**







3 1. Remove drain screw **(4)** from float chamber and allow to drain.

2 2. Lift throttle lever **(5)** up. Unscrew cap **(6)** and remove throttle assembly **(7)**. If necessary, disassemble throttle assembly.

3 3. Remove float chamber **(8)** and float **(9)**.

3 4. Remove float valve assembly **(10)** and needle valve seat **(11)**.

3 5. Remove main jet assembly **(12)**.

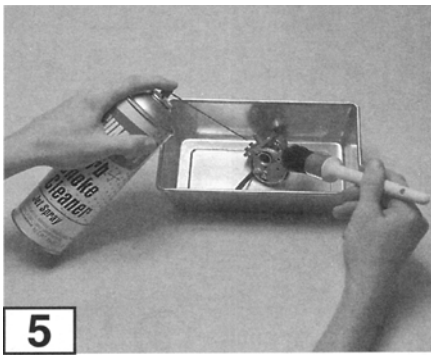
3 6. Remove throttle stop screw assembly **(13)**.

3 4 7. Remove and discard o-ring **(14)**.

Cleaning

⚠ CAUTION

DO NOT clean carburetor by submerging or soaking in a carburetor dip cleaner or hot tank. Do not expose plastic parts to any carburetor cleaner.



T1129

5 1. Clean all metal components using a mild aerosol solvent or isopropyl alcohol. Use a soft bristle brush to remove gummy deposits.

2. Clean plastic parts with warm soapy water.

3. Dry all components with low pressure compressed air. When drying passages, direct the flow of air opposite the direction of fuel flow.

4. Inspect the Carburetors, this section.

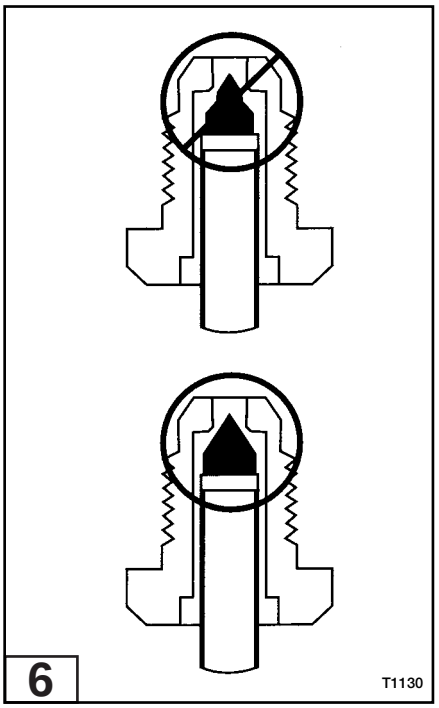
Inspection

⚠ CAUTION

DO NOT inspect passages or holes with wire or similar materials. Doing so may scratch or enlarge jet holes and alter the fuel-air ratio.

NOTE

Before inspection, all carburetor components must be cleaned. All worn or damaged parts must be replaced.



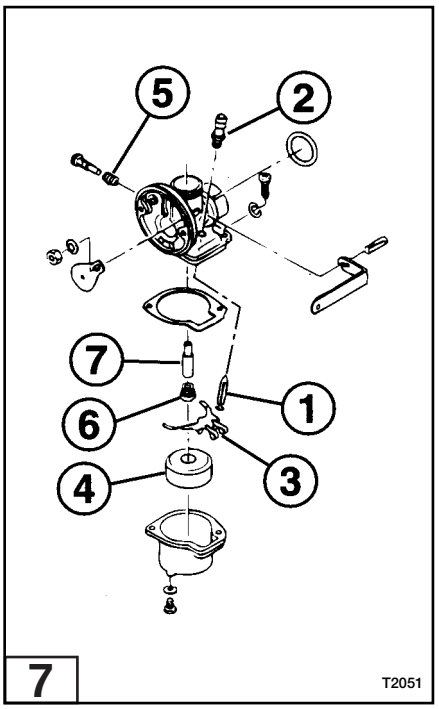
T1130

1. Inspect the following float valve components:

6 • Check tip of float valve assembly for grooves, nicks, or wear.

NOTE

The float valve assembly (needle and seat) must be replaced as an assembly.



T2051

7 • Check needle valve seat **(2)** and float hinge **(3)** for damage.
• Check float **(4)** for damage and signs of fuel saturation.

7 2. Check tension of throttle stop screw spring **(5)**.

7 3. Inspect main jet **(6)** for thread damage and blockage. Check all passages in main needie jet **(7)** are free of blockage.

8 4. Inspect the following slide valve components:

- Check throttle wire **(1)** for wear and fraying.
- Check return spring **(2)** for damage.
- Check spring receiver **(3)** for distortion.
- Check jet needle clip **(4)** for damage. Normal clip setting is second groove from bottom.

NOTE

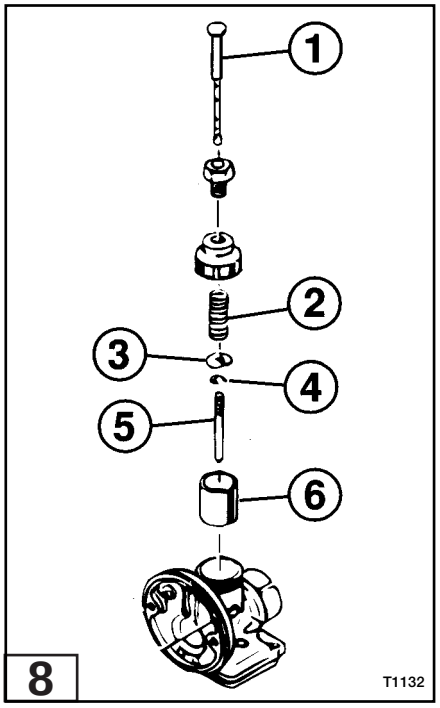
See Adjustments, this section, for information on clip settings.

- Check jet needle **(5)** for wear or distortion.
- Check slide **(6)** for nicks, scratches and wear.

5. Check all passages and holes with a syringe filled with isopropyl alcohol.

6. Inspect all gasket surfaces for damage.

7. Visually inspect the carburetor body, float chamber, drain screw, and all other parts for damage.



Assembly

⚠ CAUTION

Fuel and air passages must be kept clean. Dust, dirt, gum and varnish cause poor running and increased wear.

NOTE

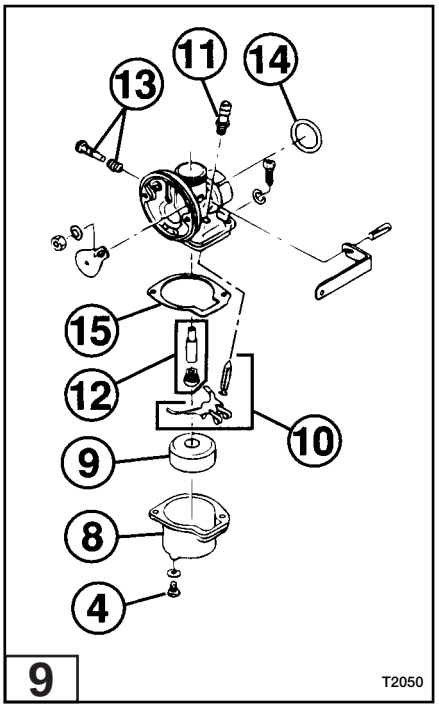
Before proceeding, be sure all components are completely clean and dry and all replacement parts match the originals.

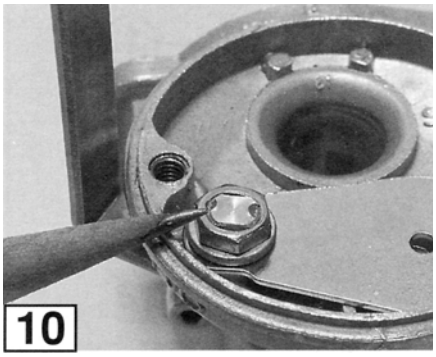
9 1. During assembly, replace o-ring **(14)** and gasket **(15)**.

2. Invert carburetor and install following components. Tighten jets securely but do not use thread locker:

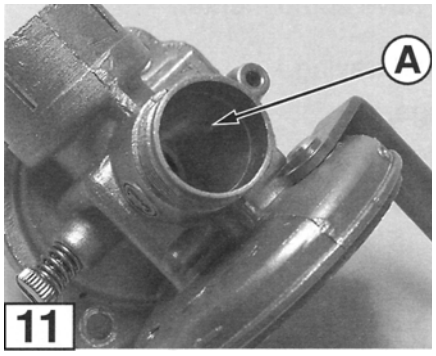
- Needle jet and main jet assembly **(12)**.
- Float valve assembly **(10)**.

9 3. Install new gasket **(15)** on carburetor body.





T1133



T1134

4. Install float chamber. Use Loctite 242 on screw threads and tighten securely.

9 5. Install drain screw **(4)** and new gasket.

9 6. Install throttle stop screw and spring **(13)**.

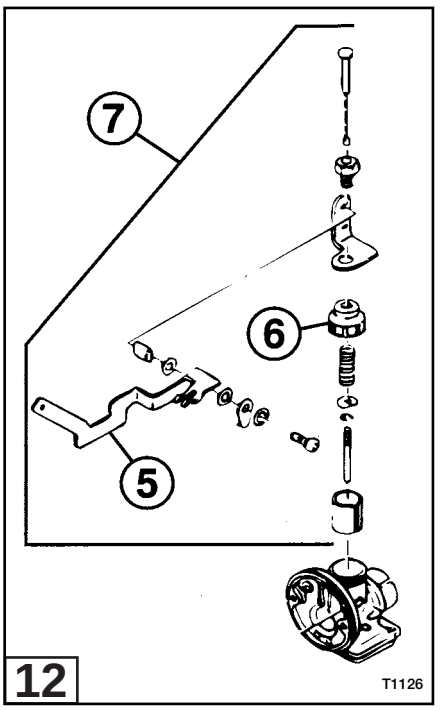
10 7. If removed, install choke assembly. Use a drift to peen end of shaft screw to prevent nut from coming loose.

8. If disassembled, assemble the throttle assembly.

11 **12** 9. Align the groove in the slide with the pin **(A)** in the slide LE bore. Carefully install slide and tighten cap **(6)** securely using fingers.

13 10. Install new o-ring.

11. Install clamp, but do not tighten.



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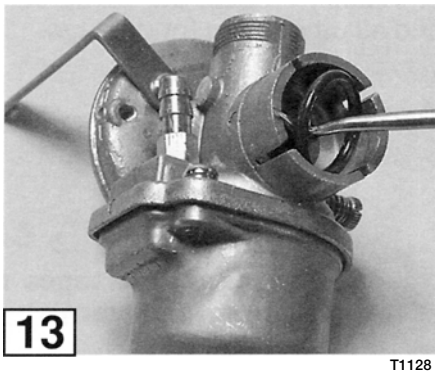

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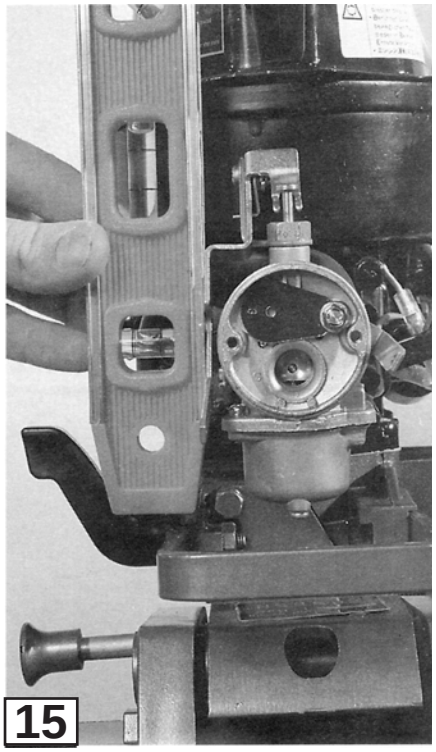

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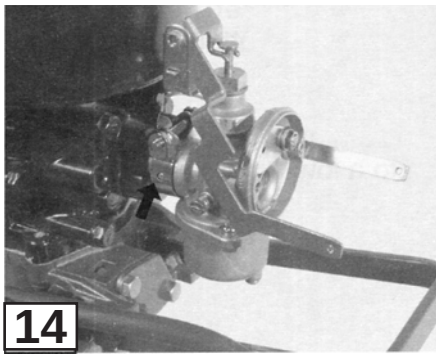

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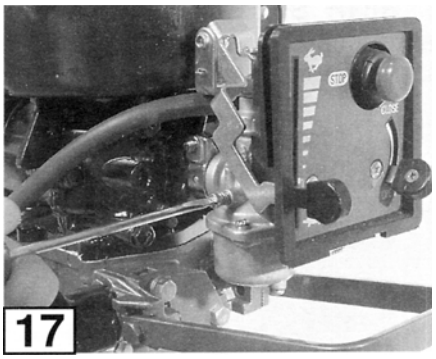

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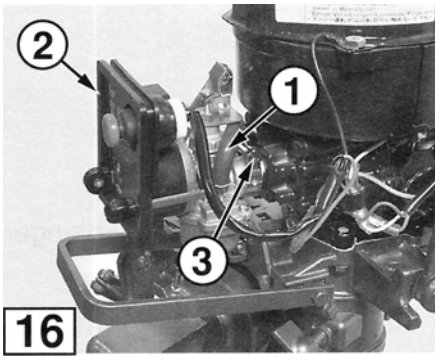


T1124

Installation

14 1. Check that the round boss on the carburetor mates with the hole in the clamp.

15 2. Position the carburetor on the crankcase inlet and push until fully seated. Make sure that the carburetor is vertical. Tighten clamp securely.

16 3. Install carburetor cover **(2)**.

16 4. Attach fuel hose **(1)**.

5. Install motor cover and open fuel cock.

Adiustments

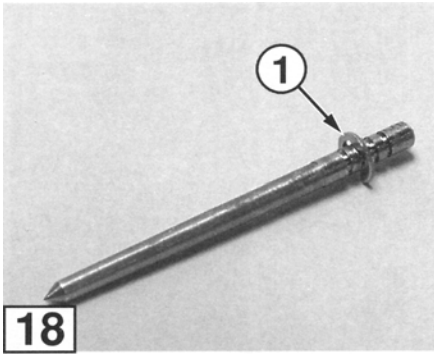
NOTE

An access hole in the motor cover allows idle adjustment with the motor cover on.

17 1. IDLE – With the throttle in the START position, turn the slow stop screw all the way in, then back-out l-1/4 turns. Start the engine and after warm-up, move the throttle all the way down to the idle position. Turn the stop screw clockwise to increase RPM, or counterclockwise to decrease RPM.

2. HIGH SPEED (1/4 to 3/4 Throttle) – The jet needle clip is factory set to the second needle groove from the bottom and does not normally need adjustment.

18 Move the jet needle clip **(1)** up to a higher groove to make the fuel-air mixture leaner or down to a lower groove to make the fuel-air mixture richer.



T1136

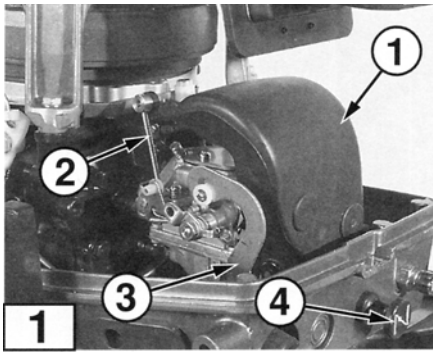
BUTTERFLY VALVE CARBURETORS

1 Removal

1. Remove the air silencer **(1)**.

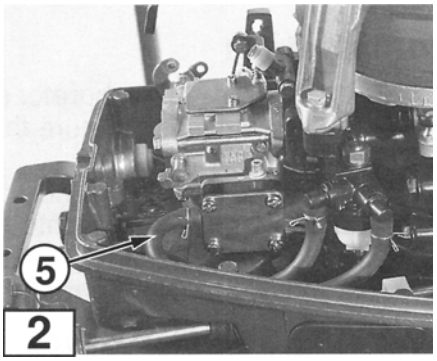
2. Remove the carburetor throttle rod **(2)** and choke linkage **(3)**.

3. Disconnect the choke knob **(4)** or choke solenoid plunger hook as required.



T1137

2 4. Remove the fuel hose **(5)**.

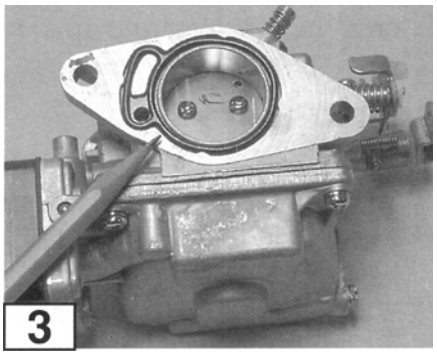


T1138

⚠ CAUTION

DO NOT pull fuel hoses off fuel fittings - push them off. If hose cannot be pushed off, carefully cut the hose along its side and peel it off to avoid damaging the fitting.

3 5. Remove carburetors and discard the carburetor base gaskets or o-ring seal.



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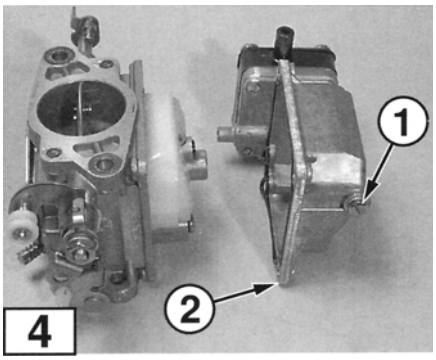

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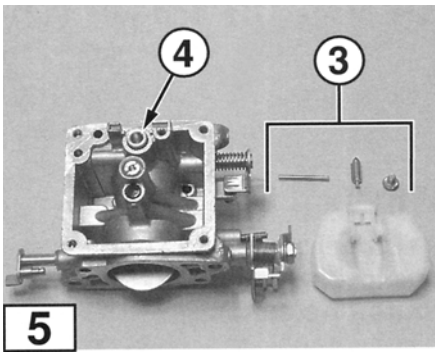

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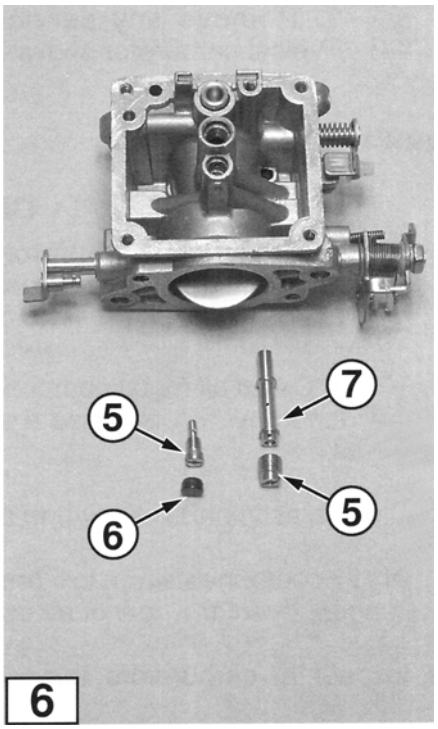

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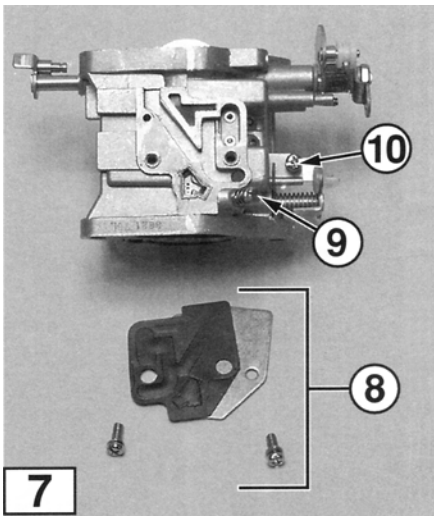


T1143

Disassembly

NOTE

5 to 18 models are equipped with integral fuel pump. To ensure proper cleaning of the carburetor, remove and service the fuel pump at this time. Refer to Fuel Pump, this section.

4 1. Remove drain screw **(1)** from float chamber **(2)** and allow to drain.

⚠ CAUTION

Use the following precautions during carburetor disassembly:

- **Use correct size screwdrivers to avoid damaging the carburetor jets.**
- **DO NOT disassemble the choke or throttle butterfly valve assembly components. They are NOT serviceable.**
- **Throttle stop screw spring has higher tension than pilot adjust screw spring. DO NOT interchange the springs.**

4 2. Remove float chamber **(2)**.

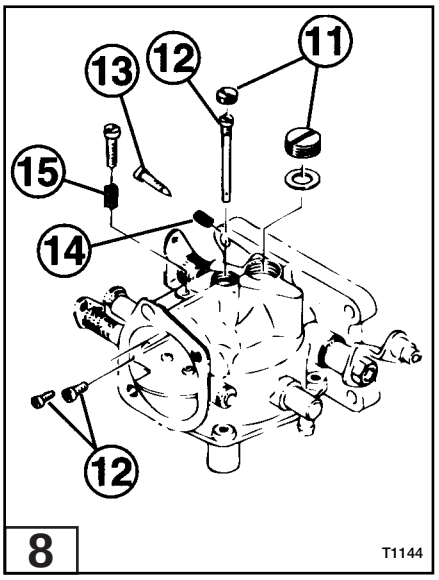
5 3. Remove float valve assembly **(3)**. If serviceable, remove needle seat **(4)**.

6 4. Remove all jets **(5)**, plugs **(6)** and nozzles **(7)** from the bottom of the carburetor.

7 5. From the top of the carburetor, remove the cover and gasket **(8)** if equipped.

7 6. Remove the pilot adjust **(9)** and throttle stop screw **(10)**.

8 7. Remove any serviceable plugs **(11)** and jets **(12)**. Typical carburetor shown.



Cleaning

⚠ CAUTION

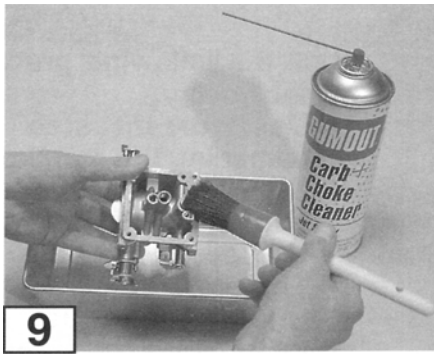
DO NOT clean carburetor by submerging or soaking in a hot tank or carburetor dip cleaner. DO NOT expose plastic parts to carburetor cleaner.

9 1. Clean all metal components using a mild aerosol solvent or isopropyl alcohol. Use a soft bristle brush to remove gummy deposits.

2. Clean plastic parts with warm soapy water.

3. Dry all components with low pressure compressed air. When drying passages, direct the flow of air opposite the direction of fuel flow.

4. Inspect the carburetors, this section.



T1145

Inspection

⚠ CAUTION

DO NOT inspect passages or holes with wire or similar materials. Doing so may scratch or enlarge jet holes and alter the fuel/air ratio.

NOTE

Before inspection, all carburetor components must be cleaned. All worn or damaged parts must be replaced.

1. Inspect the following float valve components:

10 • Check tip of float valve assembly for grooves, nicks, or wear.

NOTE

The float valve assembly (needle and seat) must be replaced as an assembly. If the seat is non-serviceable, replace the carburetor.

11 • Check float valve pin **(1)** and float chip (if applicable) for damage.

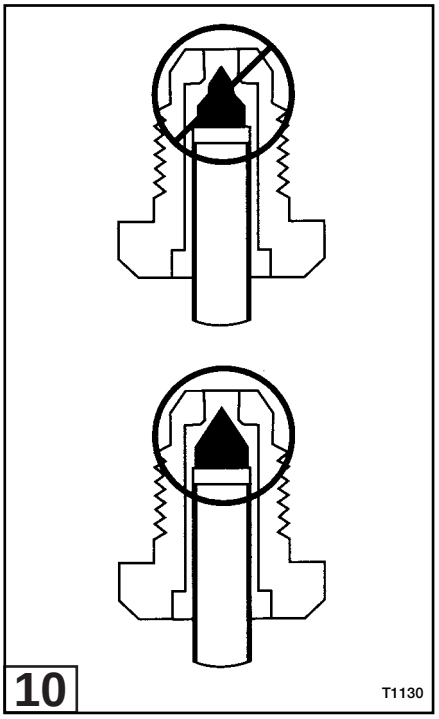
11 • Check float **(2)** for damage and signs of fuel saturation.

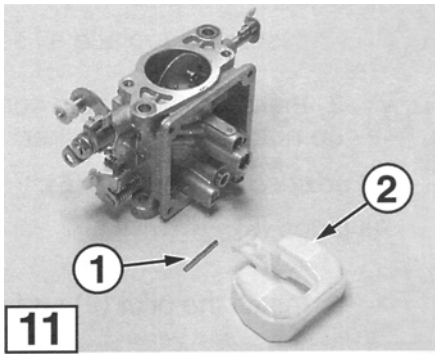
12 2. Inspect pilot adjust screw **(13)** for thread damage. Check tip for grooves, nicks, or distortion.

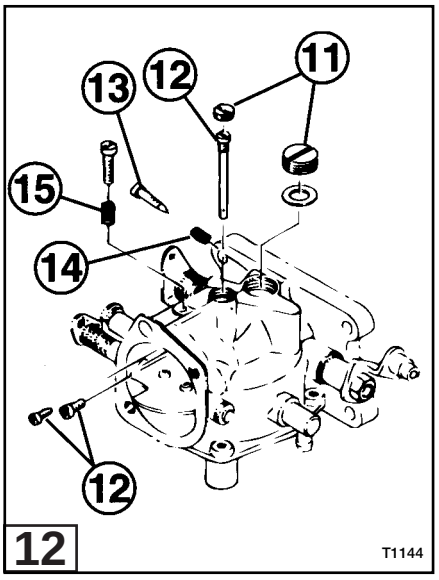
12 3. Check tension of pilot adjust screw **(14)** and throttle stop screw **(15)** springs. DO NOT interchange the springs.

12 4. Inspect all jets **(12)** for thread damage and blockage. Check all passages in main nozzle are free of blockage.

5. Check all passages and holes with a syringe filled with isopropyl alcohol.



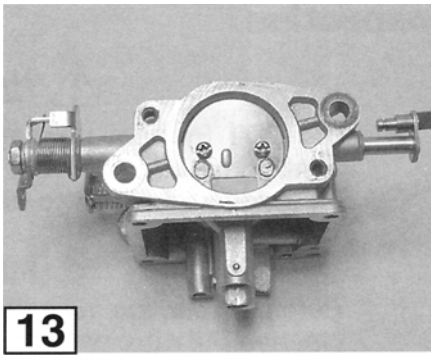




13 6. Inspect gasket surfaces for damage.

7. Check throttle shaft and choke shaft assemblies for excessive play. inspect the butterfly valves for damage and smooth operation. If assemblies are defective, the carburetor must be replaced.

8. Visually inspect the fuel fitting, carburetor cover, float chamber, drain screw, and all other screws and washers for damage.



T1147

Assembly

⚠ CAUTION

Fuel and air passages must be kept clean. Dust, dirt, gum and varnish cause poor running and increased wear.

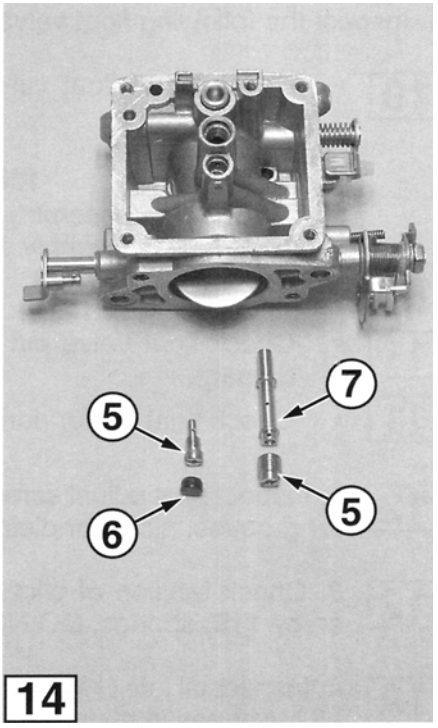
NOTE

Before proceeding, be sure all components are completely clean and dry and all replacement parts match the originals.

1. During assembly, replace all serviceable gaskets and plugs.

14 2. Install the following components. Tighten jets securely but do not use thread locker:

- All nozzles **(7)** and jets **(5)**.
- All plugs **(6)**.

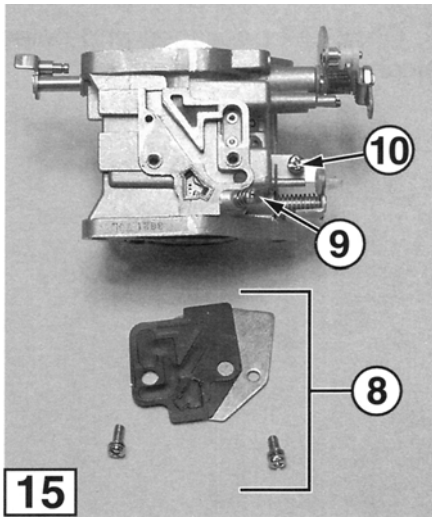


T1142

15 3. Install the pilot **(9)** and stop **(10)** screw assemblies.

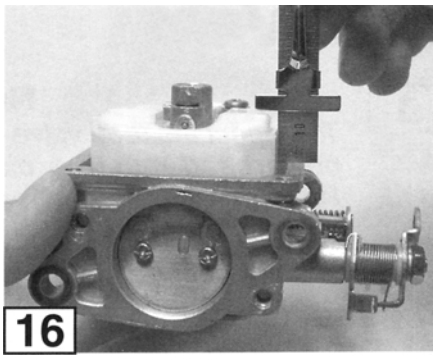
15 4. Install the cover and gasket **(8)** if equipped.

5. Install the needle seat (if removed) and float valve assembly.



T1143

16 6. Check the float height with the carburetor inverted on a flat surface. Measure the distance between the top of the float and the float chamber surface.



T1148

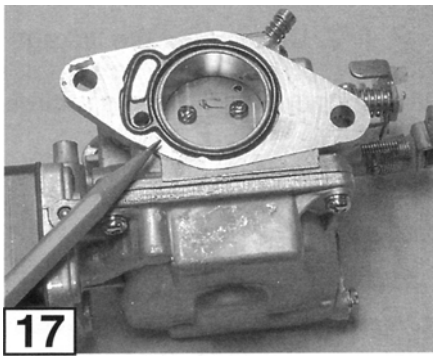
NOTE

If float height is not correct, remove the float valve assembly and make minor adjustments by slightly bending the tabs on the metal float hinge clip. Some models cannot be adjusted; replace the float and valve assembly.

7. Install new gasket or o-ring on float chamber.

8. Install float chamber. Use Loctite 242 on screw threads and tighten securely in a criss-cross pattern.

9. Install drain screw and new o-ring gasket.



T1139

Installation

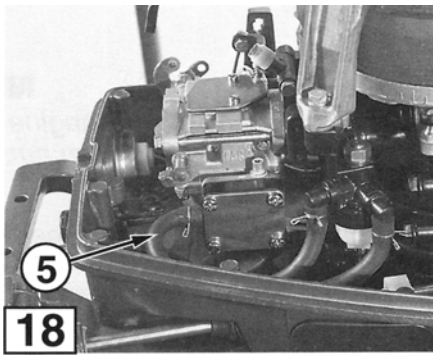
1. Clean the carburetor mounting surfaces on the intake manifold with isopropyl alcohol.

17 2. Install new carburetor base gasket dry.

3. Mount carburetor to intake manifold and torque to specification.

18 4. Install the fuel hose and clamp **(5)**.

19 5. Install the throttle and choke linkage **(2)** and **(3)** and reconnect the choke solenoid or choke knob **(4)**.

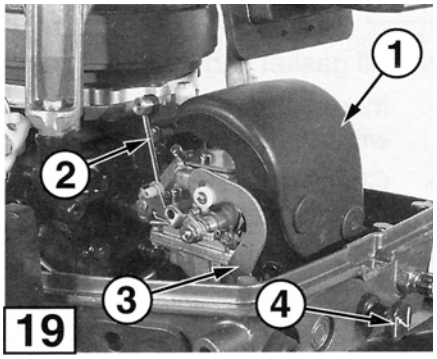


T1138

6. Run the engine momentarily to pressurize the fuel system and check for leaks.

7. Adjust the ignition timing. Refer to Synchronization and Linkage Adjustments in Section 2.

19 8. Mount air silencer **(1)** to carburetors. If gaskets are required, use new gaskets. Use Loctite 242 on mounting screw threads and torque to specification.



T1137

REED VALVE

1

NOTE

To inspect the reed valve of a one cylinder engine, the powerhead must be disassembled, Refer to the Powerhead section for removal and inspection procedures in this section.

Disassembly

1. Follow steps listed in Carburetor Removal procedure, this section.

2 2. Disconnect the linkage at the throttle cam.

3. Remove the crankcase recirculation hose from the manifold.

4. Remove recoil starter or flywheel cover as applicable, refer to Powerhead section.

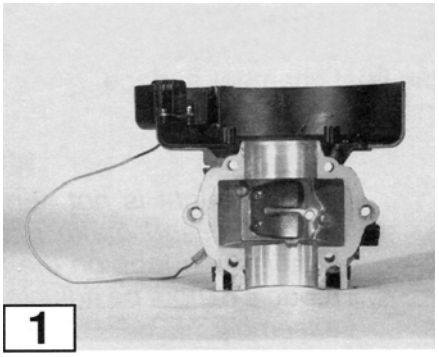
3 5. Remove the intake manifold.

6. Remove the reed valve assemblies from the manifold or lift them from the crankcase as applicable. DO NOT disassemble the reed valve assemblies. (Except 8/9.8)

Inspection

4 1. Inspect the reed valve assemblies:

- All gasket surfaces must be flat, within ± 0.003 in [0.08 mm].
- Inspect reeds **(1)** for cracks or chips. Reeds must be seated flat without any preload.
- Check tightness of reed valve stoppers **(2)**. If loose, tighten screws using Loctite 242.
- Inspect valve seat surface **(3)** for rise, wear, or damage.



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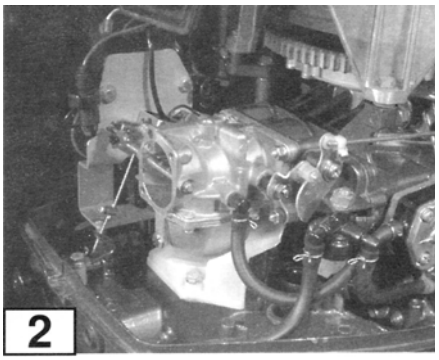

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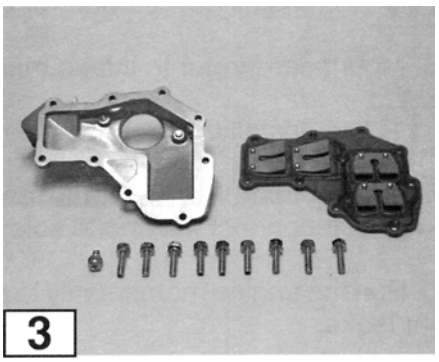
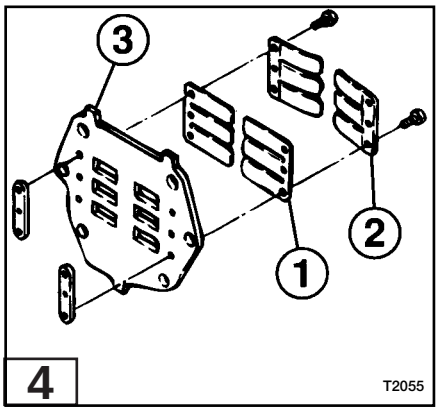


T2054

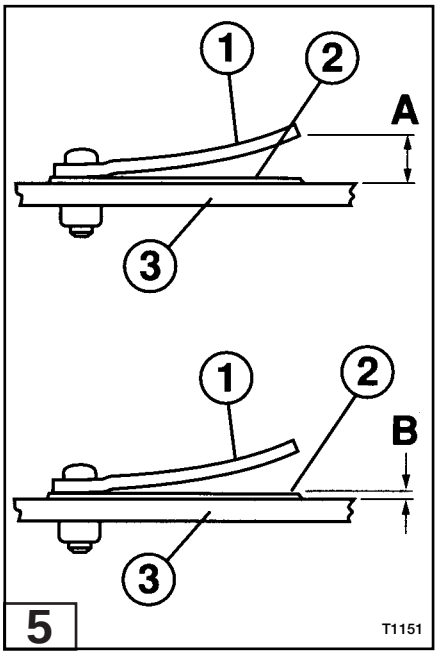


T2055

5 • Lift height of each reed valve and stopper must be within specification.

	2.5 / 3.5	5	8 / 9.8	9.9 / 15 / 18	25 / 30	40
No. Valves	2	2	6	6	8	12
Strips	1 Strip	1 Strip	2 Strips	2 Strips	4 Strips	4 Strips
Valves / Strip	2 Valves/Strip	2 Valves/Strip	3 Valves/Strip	3 Valves/Strip	2 Valves/Strip	3 Valves/Strip
A=Valve Height	0.236-0.244 in (6.0-6.2 mm)	0.236-0.244 in (6.0-6.2 mm)	0.197-0.204 in (5.0-5.2 mm)	0.236-0.244 in (6.0-6.2 mm)	0.236-0.244 in (6.0-6.2 mm)	0.236-0.244 in (6.0-6.2 mm)
B=Gap Valve End Valve Seat	0.0079 in (0.2 mm)	0.0079 in (0.2 mm)	0.0079 in (0.2 mm)	0.0079 in (0.2 mm)	0.0079 in (0.2 mm)	0.0079 in (0.2 mm)

• Inspect entire valve assembly :
If any part of the reed valve assembly is worn, damaged, or corroded, entire valve assembly must be replaced.



⚠ CAUTION

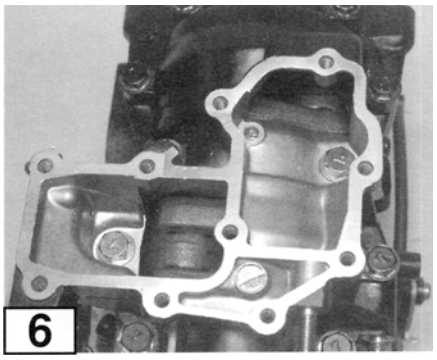
Used reeds must never be turned over and re-used. Reed could break when returned to service, causing serious powerhead damage.

2. Inspect the intake manifold:
• All gasket surfaces must be smooth and free of nicks.

6 • Check manifold surface for flatness in all directions. Mounting surface must be flat, within ± 0.004 in [0.10 mm].

NOTE

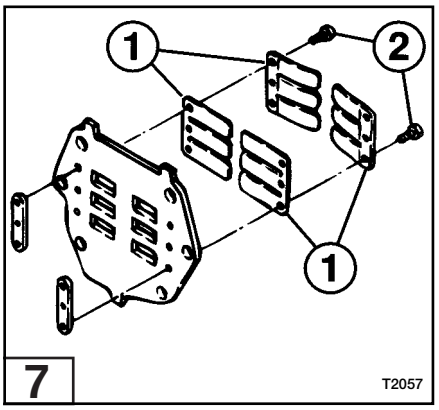
All intake manifold components must be perfectly clean before assembly. Use isopropyl alcohol. DO NOT use a carburetor cleaner or a soaking tank.



T2056

Assembly

Components must be clean and all serviceable gaskets must be replaced.



NOTE

The reed valve of the 8 and 9.8 is unique and requires special handling.

This reed valve is made of a thin 0.00787 in (0.2 mm) stainless steel and can be damaged if mishandled.

7 *When assembling the reed valve note that the two surfaces of the valve are different. Align the notches **(1)** as shown when assembling.*

*The reed valve screws **(2)** are coated with an adhesive. When installing the reed valve, tighten new reed valve screws to 6.1 - 7.8 in-lb [0.7 - 0.9 N·m, 0.07 - 0.09 kg-m]*

NEVER reinstall the used reed valve screws because the effect of the adhesive has been lost and may lead to reed valve failure during operation.

Verify that the clearance between the reed valve and the valve seat is 0.0078 in (0.2 mm) or less after assembly

7 1. Assemble the intake manifold components as illustrated:

- Install all gaskets dry.
- Torque manifold bolts evenly to specification.

2. Connect the crankcase recirculation hose to the manifold.

3. Follow steps listed in Carburetor Installation procedure, this section.

4. Connect the linkage at the throttle cam.

5. Install recoil starter or flywheel cover as applicable, refer to Powerhead section.

SECTION 4
POWERHEAD

TABLE OF CONTENTS

SECTION 4

GENERAL PRECAUTIONS

Before performing any service work on the powerhead, read and understand the Service Safety section at the beginning of this manual.

Use the manufacturer special tools as indicated during servicing of the powerhead.

Use caution when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel.

Check entire fuel system for leaks after servicing the powerhead to prevent fire or explosion.

Make sure all ignition and electrical leads are properly routed and clamped in their original positions.

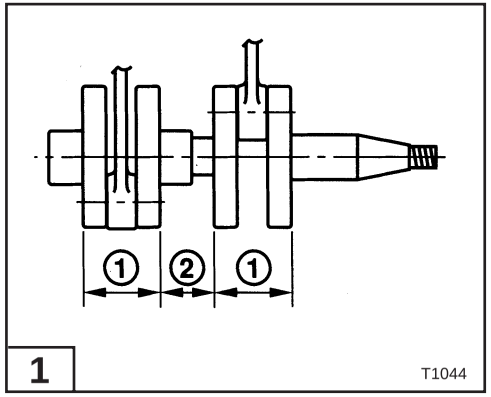
Disable the ignition system and disconnect the battery when servicing the powerhead.

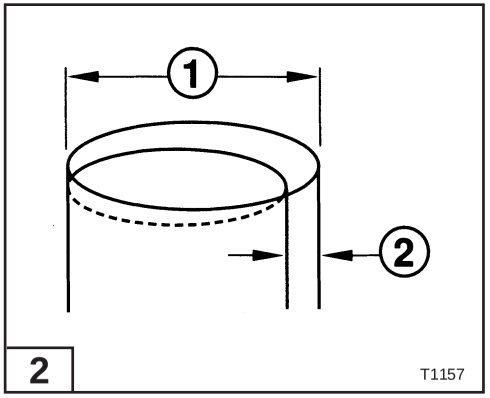
Replace locking fasteners when their locking feature becomes weak. Use only factory replacement parts.

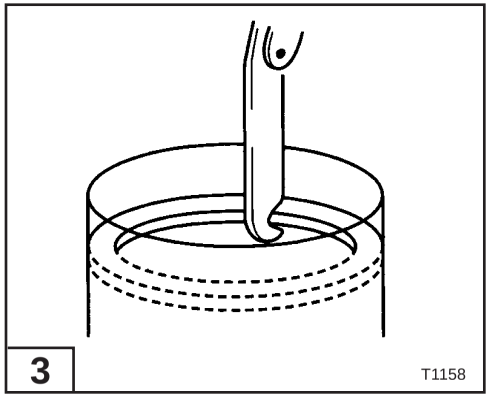
Always inspect and test the start-in-gear prevention system before returning engine to customer.

SERVICE SPECIFICATIONS (Standard Value)

Fig	Description		Unit	2.5/3.5	5	8/9.8	9.9•15/18	25/30	40
	Compression		psi kPa kg/cm²	78.2 539 5.5	78.2 539 5.5	56.9 392 4.0	113.7/106.6 784/735 8.0/7.5	109.5 755 7.7	106.6 735 7.5
	Thermostat Opening Temperature		°F °C	— —	— —	125.6 52	125.6 52	125.6 52	125.6 52
	Crankshaft (off center)		in mm	<0.002 <0.05	<0.002 <0.05	<0.002 <0.05	<0.002 <0.05	<0.002 <0.05	<0.002 <0.05
1	Crankshaft (dimensions)	①	in mm	1.417 ± 0.002 36 ± 0.05	1.575 ± 0.002 40 ± 0.05	1.654 ± 0.002 42 ± 0.05	1.890 ± 0.004 48 ± 0.10	2.047 ± 0.001 52 ± 0.02	2.071 ± 0.002 52.6 ± 0.05
		②	in mm	N/A	N/A	0.984 ± 0.002 25 ± 0.05	l.299 ± 0.002 33 ± 0.05	l.496 ± 0.002 38 ± 0.05	1.591 ± 0.002 40.4 ± 0.05
2	Cylinder Bore	①	in mm	1.850 47	2.165 55	1.969 50	2.165 55	2.677 68	2.756 70
2	Piston Clearance	②	in mm	0.0024 ~ 0.0035 0.06 ~ 0.09	0.0008 ~ 0.0020 0.02 ~ 0.05	0.0008 ~ 0.0020 0.02 ~ 0.05	0.0008 ~ 0.0035 0.05 ~ 0.09	0.0024 ~ 0.0039 0.06 ~ 0.10	0.0024 ~ 0.0039 0.05 ~ 0.10
3	Piston Ring End Cap		in mm	0.007 ~ 0.013 0.18 ~ 0.33	0.008 ~ 0.016 0.2 ~ 0.4	0.007 ~ 0.013 0.18 ~ 0.33	0.008 ~ 0.016 0.20 ~ 0.40	0.013 ~ 0.019 0.33 ~ 0.48	0.008 ~ 0.016 0.20 ~ 0.40







SERVICE SPECIFICATIONS (Continued)

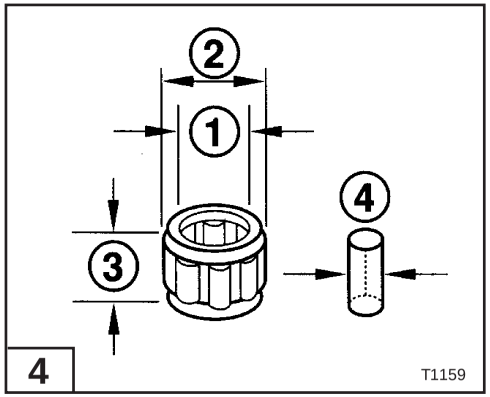


Fig	Description		Unit	2.5B/3.5B	5	8/9.8	9.9/15/18	25/30	40
4	Connecting Rod Bearing (small end)	①	in mm	0.413 10.5	0.551 14	0.551 14	0.551 14	0.669 17	0.669 17
		②	in mm	0.551 14	0.709 18	0.709 18	0.709 18	0.827 21	0.827 21
		③	in mm	0.591 15	0.787 20	0.787 20	0.787 20	1.063 27	1.063 27
		④	in mm	0.069 1.75	0.079 2	0.079 2	0.079 2	0.079 2	0.079 2
	Connecting Rod Bearing (big end)	①	in mm	0.630 16	0.787 20	0.669 17	0.787 20	0.787 20	0.984 25
		②	in mm	0.866 22	1.024 26	0.906 23	1.024 26	1.102 28	1.260 32
		③	in mm	0.472 12	0.472 12	0.551 14	0.630 16	0.709 18	0.787 20
		④	in mm	0.118 3	0.118 3	0.118 3	0.118 3	0.157 4	0.138 3.5

Manufacturer Special Tools Required

Flywheel Puller Assembly, 309-72214-0 (2.5 / 3.5 only)
Flywheel Puller Assembly, 336-72214-0 (5 - 40)
Flywheel Stripper, 3B6-72214-1
Piston Pin Tool, 332-72215-0
Piston Ring Tool, 353-72249-0
Thickness Gauge Set, 353-72251-0

General Equipment Required

Compression Gauge, 0 - 199 psi [0 - 1,350 kPa / 0 - 13.7 kg/cm²]
Water Pressure Gauge, 0 - 15 psi [0 - 98 kPa / 0 - 1 kg/cm²]
Torque Wrench, 0 - 150 in-lb [0 - 17 N-m / 0 - 1.7kg-m]
Torque Wrench, 0 - 750 ft-lb [0 - 1000 N-m / 0 - 100 kg-m]
Micrometer Set or Vernier Caliper, graduation 0.0001 in [0.01 mm], 0 - 1 in [0 - 30 mm] range
Telescoping Gauge, Inside Micrometer Set, or Vernier Caliper, graduation 0.0001 in [0.01 mm], 1.5 - 4 in [40 - 100 mm]
Dial Indicator, graduation 0.0001 in [0.01 mm], 0 - 1 in [0 - 30 mm] range
Analog Multimeter, *Electronic Specialties® Model M-530 or equivalent*
Digital Pulse Tachometer, 10 - 6000 RPM, *Electronic Specialties® Model 321 or equivalent*
Industrial Thermometer, minimum 300°F [150°C]
Heat-Resistant Container, *Pyrex®*
Bearing Puller
Seal Pullers
Seal Installer
Surface Plate, 20 x 20 in [500 x 500 mm], 0.0001 in [0.01 mm] accuracy

Consumables Required

Threadlocker, *Loctite® 242*
Threadlocker, *Loctite® 243*
Gasket Dressing, *Permatex® Hylomar® Aerosol High-Temp Gasket Dressing*
Gasket Sealant, *Permatex® High Tack Gasket Sealant*
Anaerobic Gasket Maker, *Loctite® 518*
Dielectric Lubricant, *Permatex® Dielectric Tune-Up Grease*
Cleaning Pads, *Scotch-Brite® Abrasive Pads*
Isopropyl Alcohol
Cleaning Solvent
Gasket Remover
Heat-Sensitive Markers, 125°F [52°C] and 163°F [73°C], *Markal® Thermomelt Stik*
Low Temperature Lithium Grease
Bearing Cup Grease
Engine Lubricant, *Genuine engine oil or NMMA certified TC-W3 oil*
Automotive Crankcase Oil, flashpoint above 300°F [150°C]

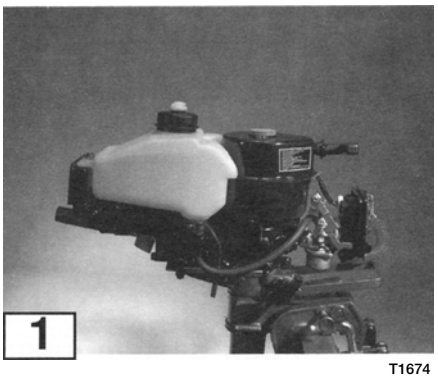
SECTION 4

TROUBLESHOOTING

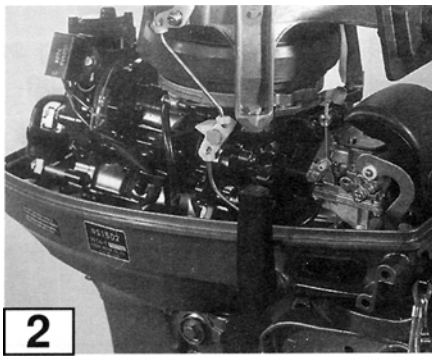
The troubleshooting chart lists common engine symptoms related to problems with the powerhead. It also indicates specific component failures which may be causing the problem so it can be isolated more effectively.

Symptom / Checks	Hard to start or will not start	Low cylinder compresslon	Runs rough or erratically	Idles poorly	No acceleration, Fails to acheive full RPM	RPM decreases	Engine overheats	Runs noisy or has excessive vibration
Poor crankcase seal	●							
Ignition timing or throttle linkage out of adjustment, see Section 2	●		●		●			
Water entering crankcase	●			●		●		
Defective thermostat					●		●	
Fouled, defective or incorrect spark plug; wrong gap setting	●		●	●		●	●	
Worn or defective cylinder, piston, rings or warped head	●	●			●			●
Blown cylinder head or engine base gasket	●	●	●	●	●	●		●
Worn connecting rod or crankshaft bearings, internal wear limits out of specification	●		●					●
Defective ignition components, see Section 7	●		●		●			
Carbon accumulation in combustion chamber	●				●	●		

DESCRIPTION OF OPERATION



T1674



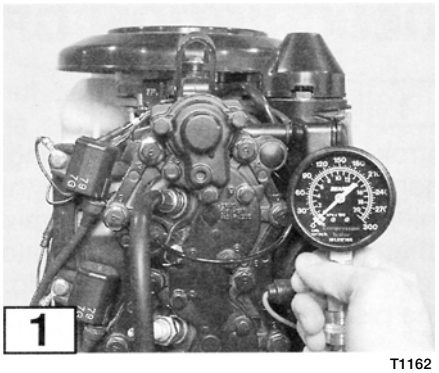
T1675

1 2 The power head of this outboard motor is a two-stroke engine (or two-stroke cycle engine). The engine completes its one cycle operation including gas mixture suction, compression, explosion and exhaust while the crankshaft rotates once i. e. the piston moves upward and then downward (two strokes).

As the piston starts to move toward top dead center (TDC), the interior of the crank case is made vacuum pressure causing the reed valve to open and the gas mixture to be taken into the crankcase. As the piston comes near the TDC, the spark plug produces the sparks to ignite the compressed gas mixture for combustion. As the fuel mixture is exploded, the piston moves toward bottom dead center (BDC) and open the exhaust port and then scavenging port. The scavenging is an action that sends the fresh gas mixture in the crankcase to the cylinder.

SECTION 4

CYLINDER COMPRESSION TEST



T1162

1. Operate engine to normal operating temperature.

2. Stop engine.

3. Disconnect the magneto leads to disable the ignition system.

⚠⚠ WARNING

Ignition system must be disabled to prevent accidental engine startup during compression test.

1 4. Remove spark plug(s) and install thread-type compression tester in spark plug hole.

5. Place throttle in fully open position and crank engine with starter through at least four compression strokes. Take reading for each cylinder and verify specified pressure is obtained:

Model	Cylinder Compression* psi [kPa / kg / cm^2]
2.5 / 3.5	78.0 [539.0 / 5.5]
5	78.0 [539.0 / 5.5]
8 / 9.8	56.9 [392.0 / 4.0]
9.9 / 15	113.7 [784.0 / 8.0]
18	106.6 [735.0 / 7.5]
25 / 30	99.6 [686.0 / 7.0]
40	106.6 [735.0 / 7.5]

* Compression variation among cylinders should not exceed 15 psi [103 kPa / 1.05 kg/cm^2] on two cylinder engines.

If variation of cylinder compression, on two cylinder engines, exceeds 15 psi [103 kPa / 1.05 kg/cm^2], check for the following:
- Scored cylinder walls.
- Piston damage.
- Head gasket damage.
- Stuck or broken piston rings.

On two cylinder models, if cylinder compression is equal, engine is difficult to start and runs poorly, check for the following:
- Scored cylinderwalls.
- Piston damage.
- Stuck or worn piston rings.

THERMOSTAT

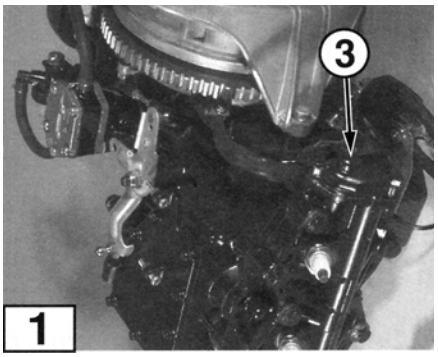
Removal

1 1. Remove thermostat cap screws. Gently tap thermostat cap **(3)** with rubber mallet to loosen and remove cap and gasket. Discard gasket.

2. Remove thermostat and inspect for obvious damage and corrosion.

3. Check pressure relief valve for proper operation.

4. Perform thermostat Function Test if thermostat is suspect.



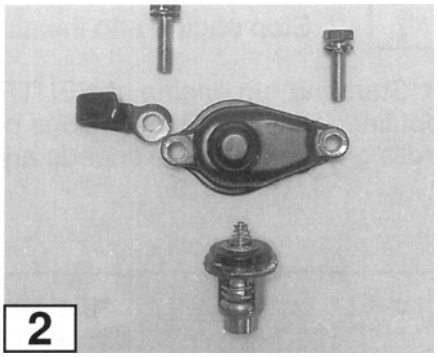
T2011

Installation

2 1. Install thermostat in cylinder head.

3 2. Lightly coat both sides of new thermostat cap gasket **(1)** with gasket sealant. Mount gasket on cap **(2)**.

3. Install thermostat cap and gasket and torque to specification.



T2012

Function Test

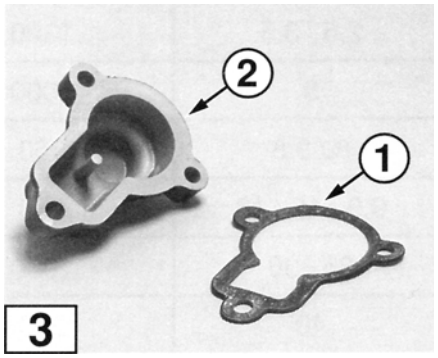
4 1. Suspend thermostat and thermometer in a heat-resistant container filled with water.

2. Slowly heat and stir the water. Verify the thermostat opens at 140°F [60°C]. If it does not open at specified temperature, replace thermostat.

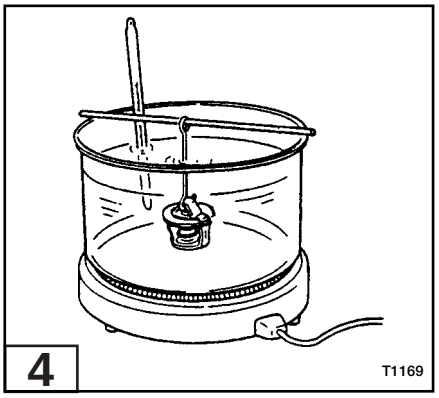
⚠⚠ WARNING

Use a heat-resistant container such as Pyrex® glassware. DO NOT allow thermostat or thermometer to rest against the glass. Items could overheat and rupture.

3. Remove thermostat and observe its closing action as it cools. If closing action is not slow and smooth, replace thermostat.

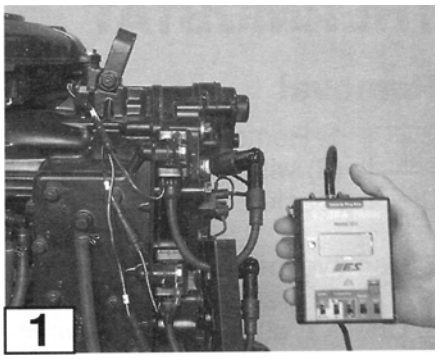


T1168



T1169

RPM PERFORMANCE TEST



T1170

⚠ CAUTION

Do not perform RPM test if engine shows signs of overheating.

Perform this test with correct test propeller installed and with the engine in a test tank.

1. Operate engine up to normal operating temperature.

2 2. Stop engine and install tachometer.

3. Start and run engine at NEUTRAL idle and verify specified RPM is obtained. If test tank conditions permit, run engine in forward gear at trolling and full throttle speeds and check for correct RPM:

Model	NEUTRAL Idle RPM	Trolling Speed RPM	Full Throttle Speed RPM
2.5 / 3.5	1300	1100	3800 - 5200 / 4200 - 5300
5	1000	850	4500 - 5500
8 / 9.8	950	750	4500 - 5500 / 5000 - 6000
9.9 / 15 / 18	950	800	4500 - 5300 / 5200 - 5800 / 5200 - 5800
25 / 30	1050	900	5000 - 6000 / 5150 - 5850
40	950	850	5200 - 5800

4. If test results vary, refer to Troubleshooting in this section.

RECOIL STARTER

⚠⚠ WARNING

The 5 - 40 engines have neutral start mechanism (start-in-gear protection) attached to the recoil starter. This feature disables the engine from starting while in gear (forward or reverse). During reassembly of the engine following repair, ensure that you DO NOT DISABLE THE START-IN-GEAR PROTECTION.

⚠⚠ WARNING

Ignition system must be disabled to prevent accidental engine startup during servicing of the recoil starter.

Removal — 5/8/9.8/9.9/15/18/25/30/40

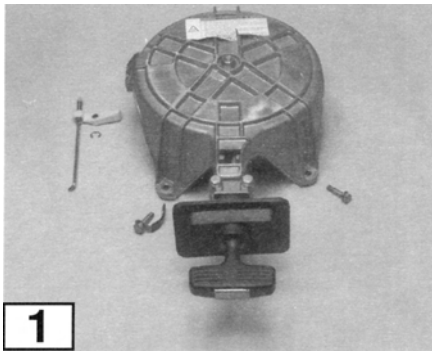
1 1. Remove the neutral start mechanism components and remove the recoil starter unit from the engine.

2 2. Rewind the reel and loosen the recoil starter spring.

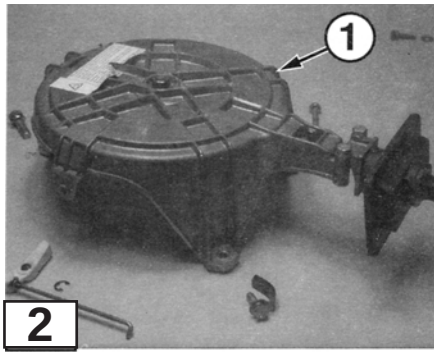
- Use a screw driver to put the starter rope in the reel notch. With the rope hooked in the notch, rotate the reel slowly to loosen the rope.

Repeat this process until the starter spring does not pull the reel.

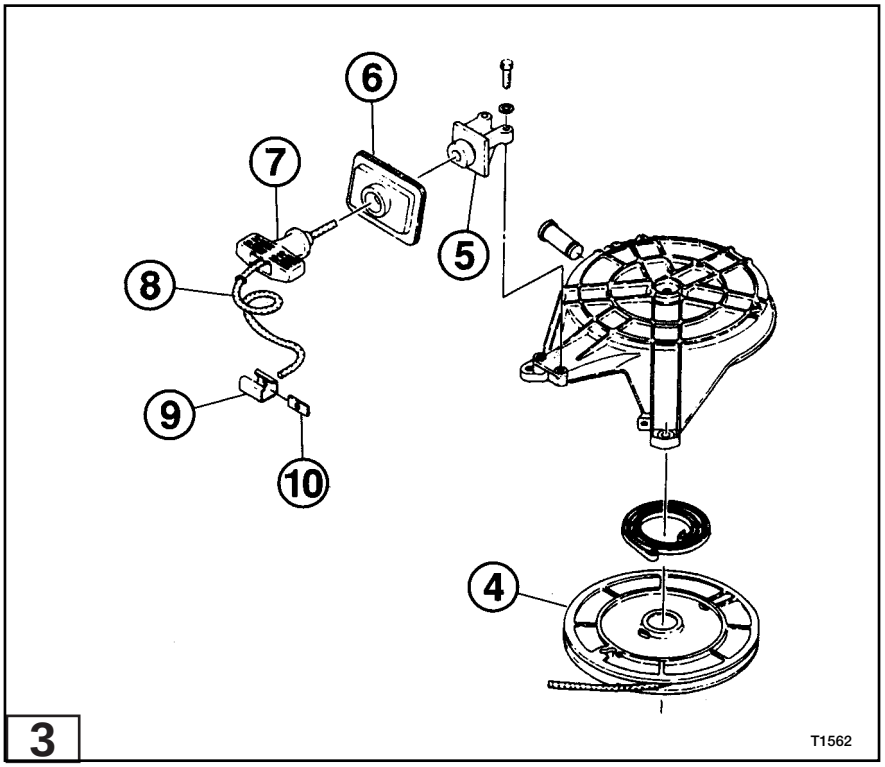
3 3. Remove the handle **(7)** from the starter rope **(8)**.



T1600



T1564



T1562

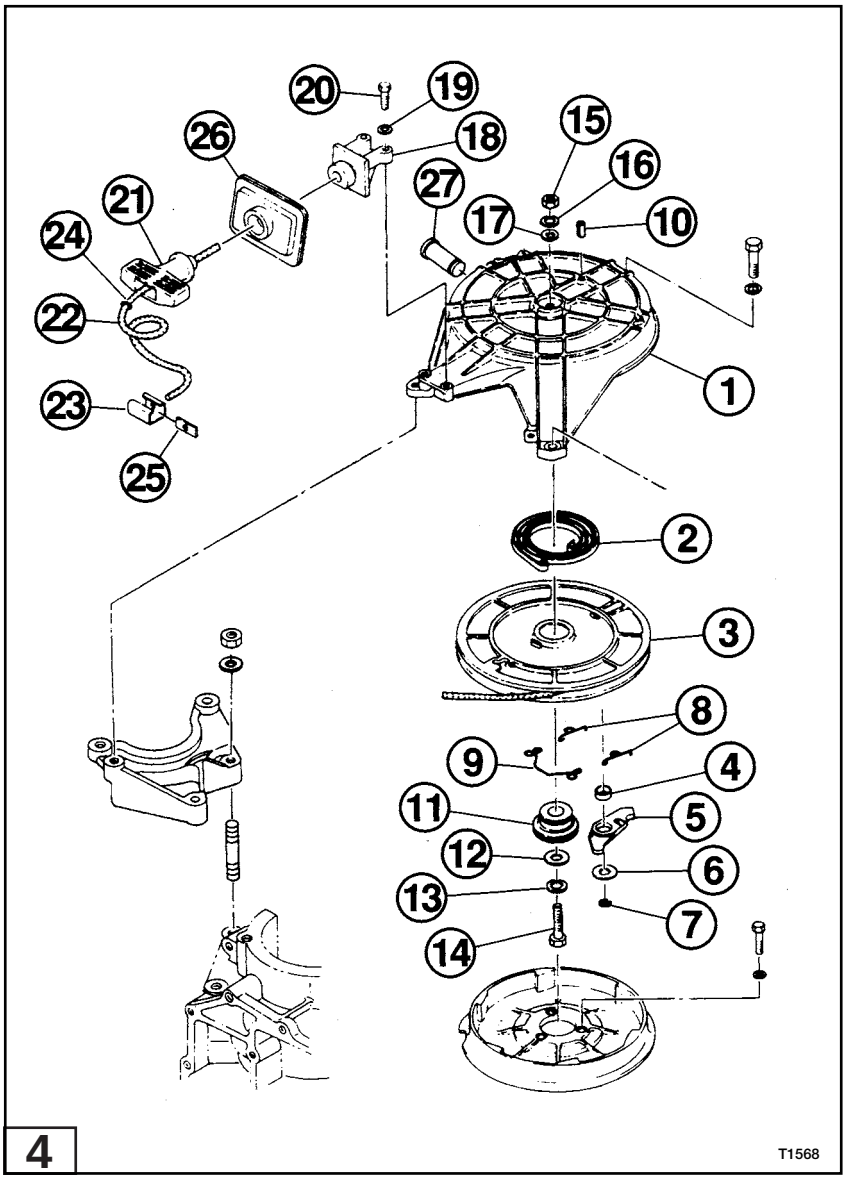
4 5 4. Remove ratchet e-ring **(7)**, ratchet **(5)**, ratchet guides A and B **(8)** and **(9)**, starter shaft bolt **(14)**, starter shaft **(11)** and finally the reel **(3)**.

NOTE

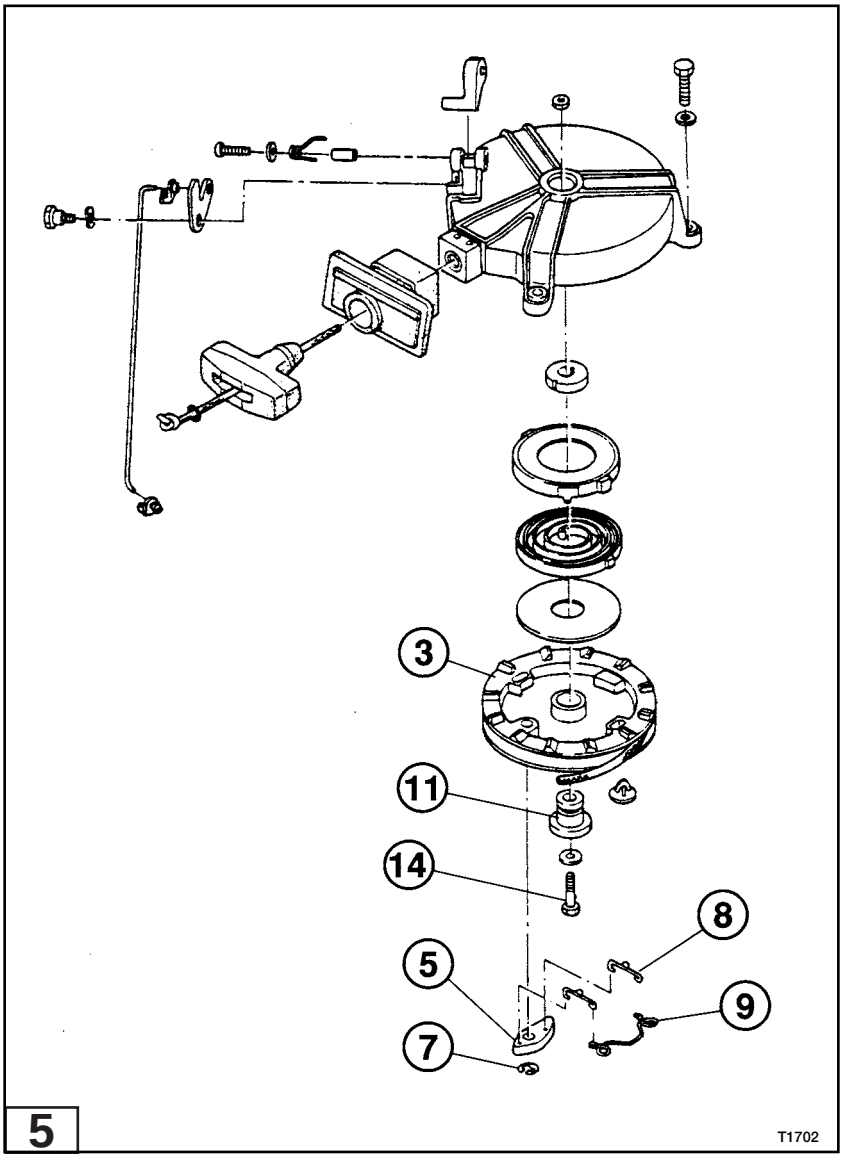
Take note of the direction in which the ratchet guides A and B are mounted. Note position as it is essential they be returned in the same orientation during reassembly.

⚠ CAUTION

Remove the starter shaft bolt after loosening the nut at the center of the starter shaft. Remove the reel with the rope wound on it so that the internal starter spring is not displaced.

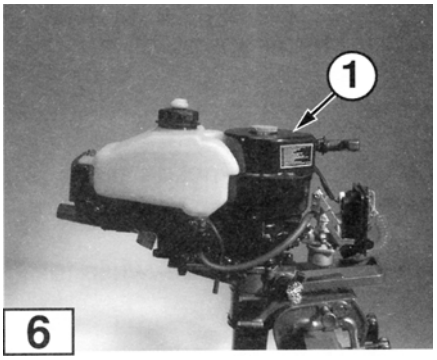


4 T1568



5

T1702



6

T1563

Removal — 2.5/3.5

⚠⚠ WARNING

The 2.5/3.5A (2) engine operates in forward gear only. When started, the propeller will turn.

The 3.5B (2) engine is equipped with a gear shift, allowing the engine to be set to NEUTRAL or FORWARD only.

Neither 2.5 or 3.5 is provided with a neutral LOCKOUT for STARTUP.

⚠⚠ WARNING

Ignition system must be disabled to prevent accidental engine startup during servicing of the recoil starter.

6 1. Remove recoil starter **(1)** from engine.

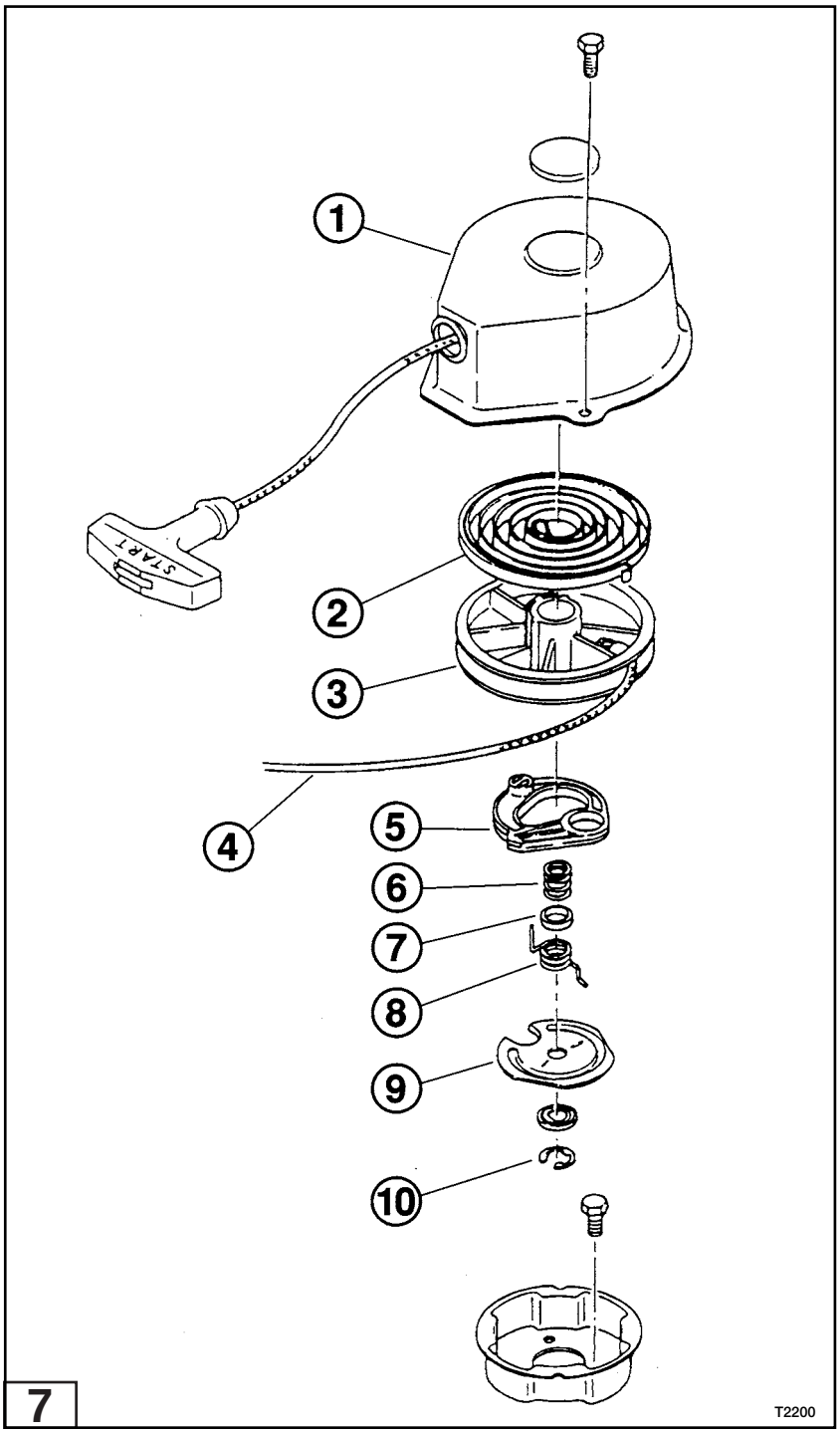
7 2. Pull out the rope a little and put it in the notch of the case.

3. While holding the starter case **(1)** and the rope **(4)**, turn the reel slowly to loosen the starter spring **(2)**.

4. Detach E-ring **(10)**.

5. Remove the friction plate **(9)**, friction spring **(6)**, ratchet **(5)** and ratchet return spring **(8)**.

6. Slowly remove reel.

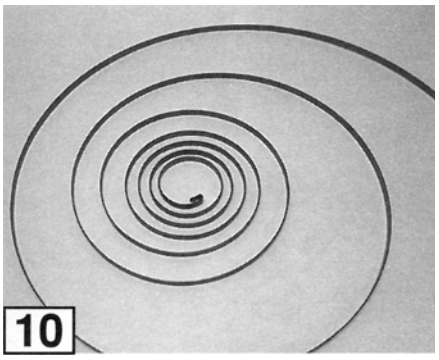


Cleaning and Inspection

All worn, damaged, or missing parts must be replaced.

1. Clean metal parts with solvent and dry with low pressure compressed air. Clean plastic parts with dry cloth.

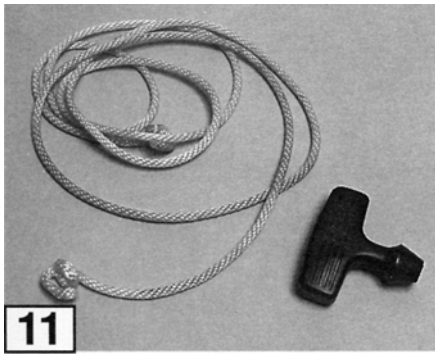
2. Inspect following components as follows:



T1187

10 Starter rewind spring for cracked or broken end loops.

- Ratchet and reel stopper springs for deformation or poor tension.
- Sliding plates, stopper components, and busing for cracks or signs of wear.
- Reel assembly for wear.
- Starter housing for sharp or rough edges which could fray starter rope.



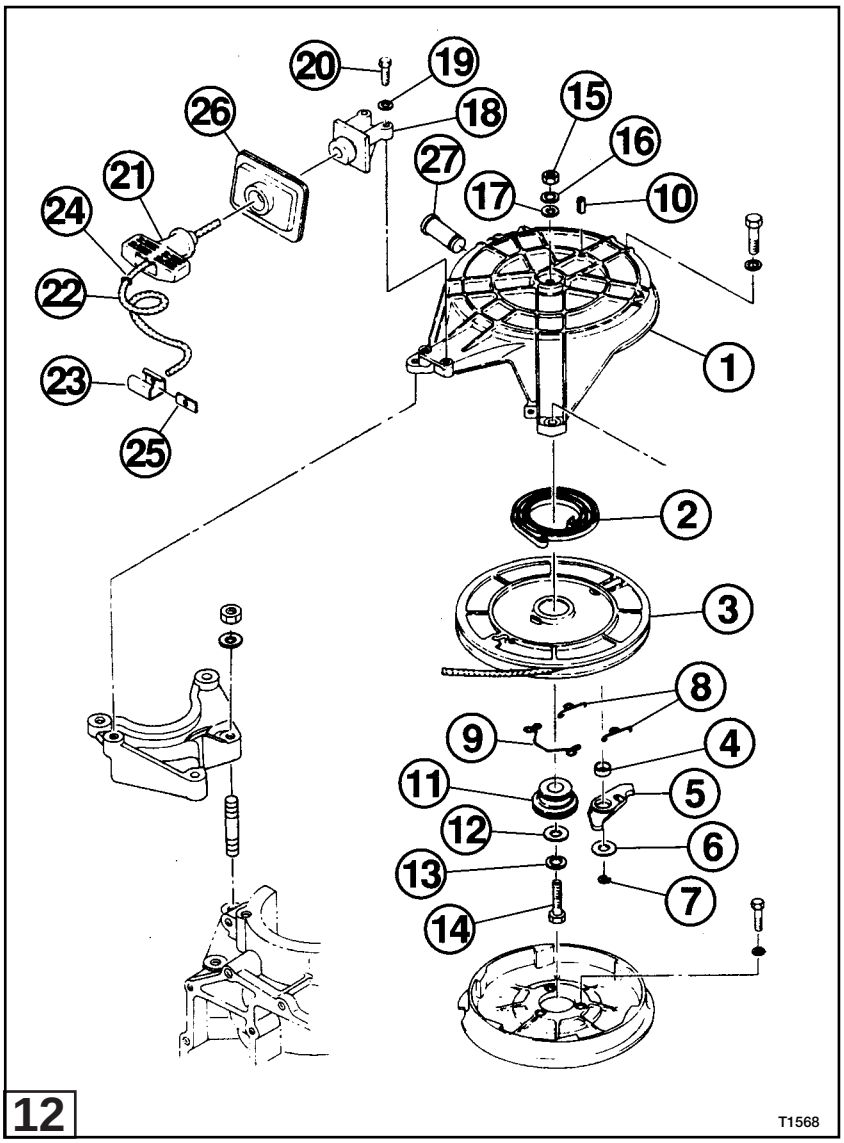
T1188

11 Starter rope for frays and rope handle for damage.

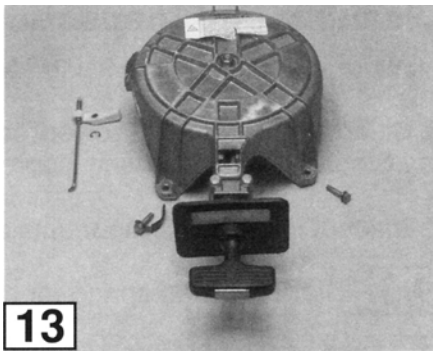
Assembly – 5/8/9.8/9.9/15/18/25/30/40

12 For assembling, use the procedure reverse to the disassembly while observing the following notes.

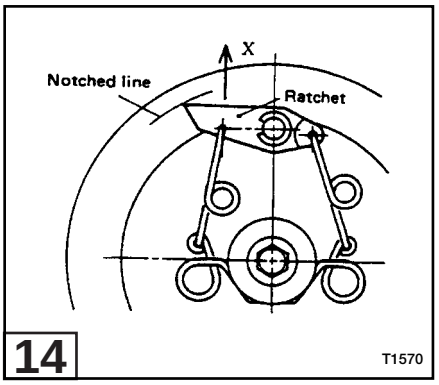
- When setting the starter spring **(2)** on the starter spring case **(1)**, direct the outer edge hook of the coil spring to the right and set it in the notch of the starter spring case outer circumference.
- When winding the starter spring **(2)**, rotate the reel **(3)** to the direction of turn (left turn) at pulling out the rope. Then, set the spring so that the reel rotates 1/4 of a turn to one and 1/4 of a turn when rope is fully pulled out.
- Apply anti-freeze grease to both ends of the starter spring **(2)** and sliding area between the starter shaft bolt **(14)** and friction plate.
- Tighten the starter shaft bolt to the specified toque.



12 T1568



13 T1600



14 T1570

13 1. Install the starter locking rod, the starter locking cam shaft and the starter handle.

14 2. Verify that the ratchet operates when the proper load is applied to the ratchet. Set ratchet face up, apply grease and measure force.

Ratchet Load Requirements	
5 / 8 / 9.8:	600 to 800 grams
9.9 / 15 / 18:	300 to 500 grams
25 / 30:	300 to 500 grams
40:	300 to 500 grams

Assembly — 2.5 / 3.5

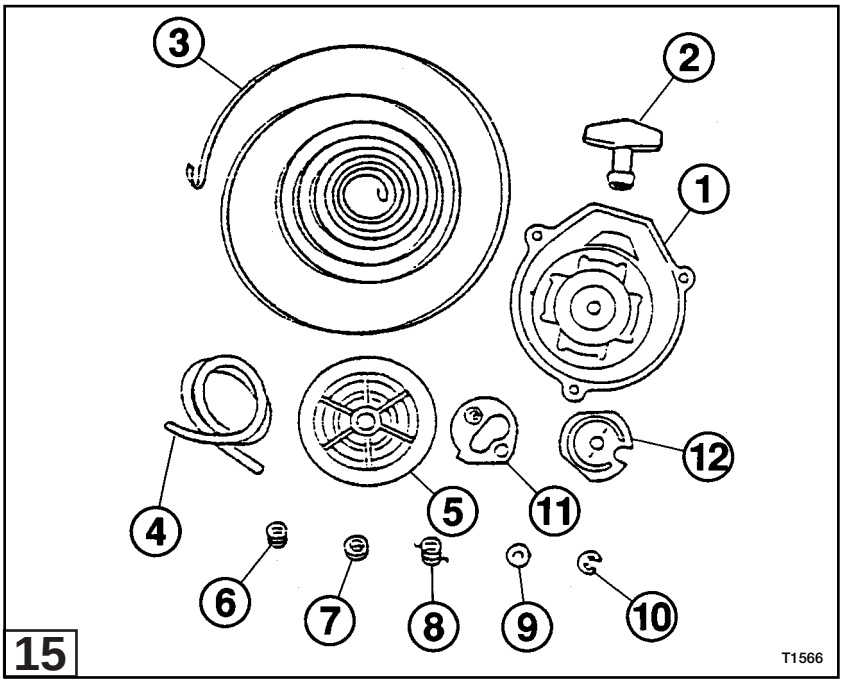
15 16 For assembling, use the procedure reverse to the disassembly while observing the following notes.

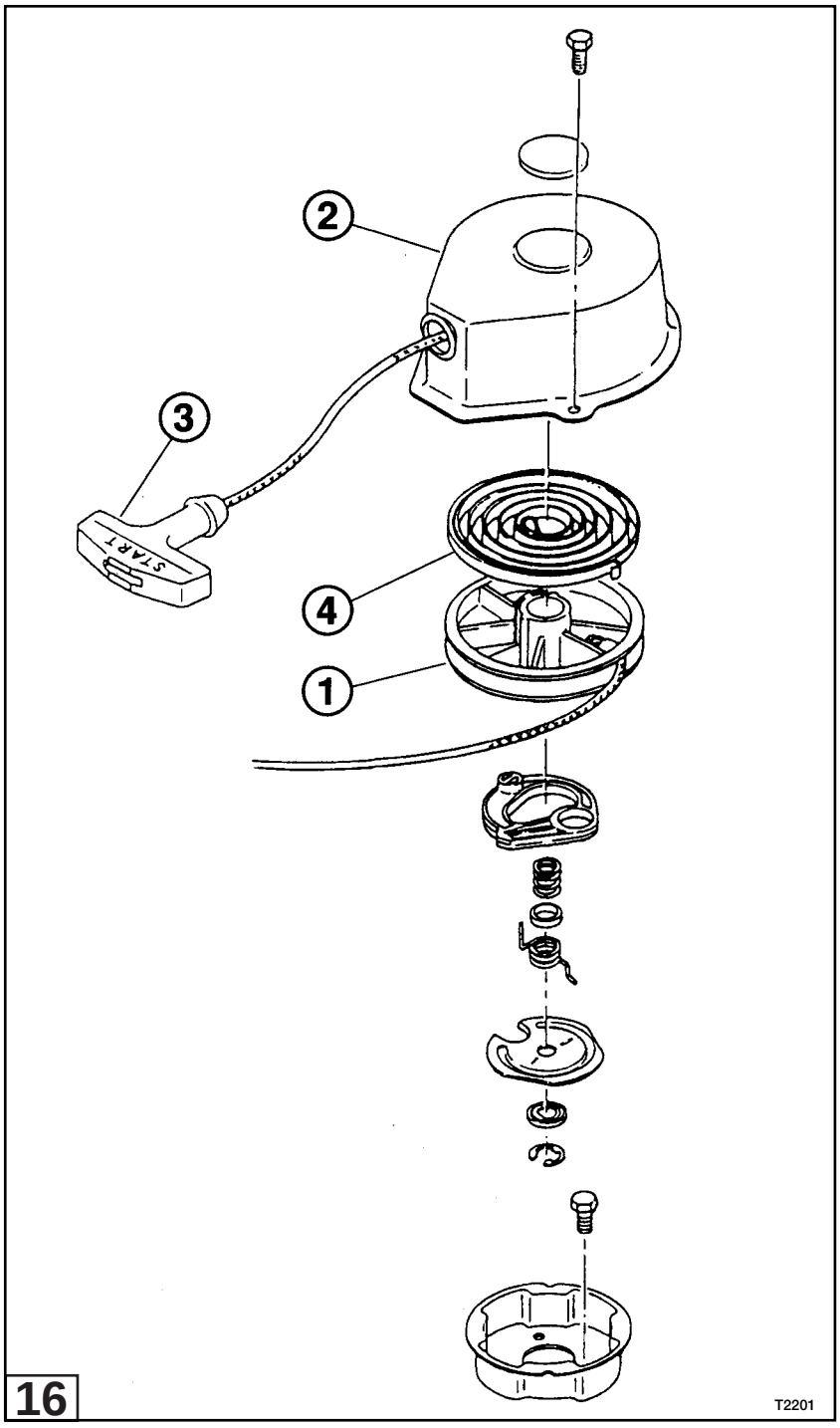
- When setting the starter spring, fix the outer end to the location when the reel is attached, and then wind it counterclockwise in the unit.
- Wind the rope counterclockwise as viewed from the reel side. Run the rope through the starter case hole, and wind the rope two times and fix the starter handle.
- When attaching the ratchet, be careful of the direction.
- Adjust the starter spring tension after completing the assembling, by putting the rope into the notch of the reel and turning it counterclockwise. Give preliminary winding of four turns.

Starter rope pulling out load:
15 to 25 N (1.5 to 2.5 kg) when pulled out by 30 cm

⚠ CAUTION

Apply cold-resistant grease to the starter guides, starter shaft, ratchet and ratchet bushing (where used) prior to installation.

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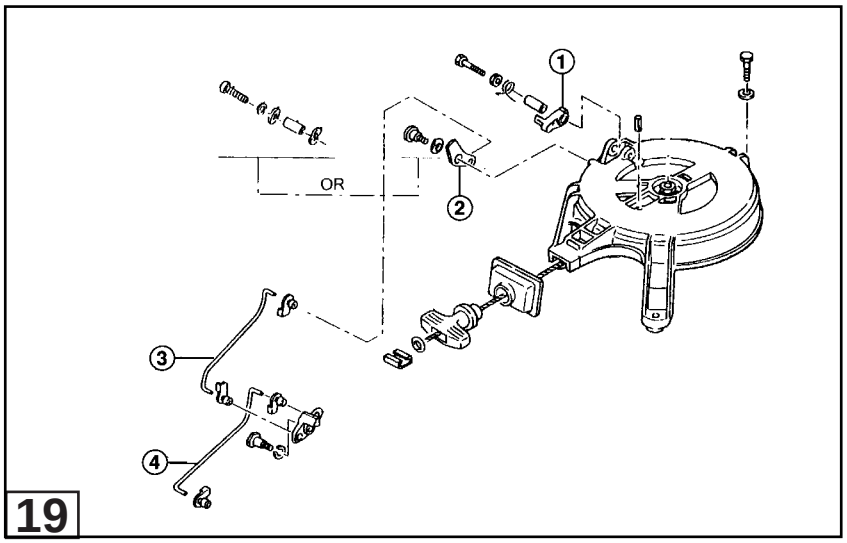
T2201



19

Installation

1. Position recoil starter on powerhead and install mounting bolts.

19 2. Make sure engine is in NEUTRAL. Install the start-in-gear protection mechanism **(1)** , **(2)** , **(3)** and **(4)**.

3. Test the operation of the start-in-gear protection mechanism.

⚠⚠ WARNING

start-in-gear protection mechanism must be installed. NEVER return engine to customer with mechanism disconnected or not functioning properly.

FLYWHEEL

NOTE

Flywheel magneto must be of a particular strength in order to run the ignition system. Flywheels seldom go bad and would only be replaced as a last resort in solving an ignition problem.

⚠ CAUTION

Flywheel is under high torque and requires the use of special tools for removal and installation. Failure to use the specified tools can result in injury or damage to the flywheel or coil plate electrical components.

⚠ CAUTION

The force needed to loosen and tighten the flywheel nut requires flywheel be removed and installed with engine mounted and secured on an engine stand.

NOTE

Reference the following specification table for flywheel Removal and Installation special tool requirements.

Flywheel Puller Part Number	Applicability
	Model
3V1-72211-0(309-72214-0)	2.5 / 3.5
369-72211-0(336-72214-1)	5 / 8 / 9.8 / 9.9 / 15 / 18 / 25 / 30 / 40

Removal

⚠⚠ WARNING

Ignition system must be disabled to prevent accidental engine startup during removal of the flywheel.

1. Remove recoil starter and starter pulley.

2. Determine the direction of rotation for removing flywheel nut by running your thumbnail along the threads of the crankshaft.

⚠ CAUTION

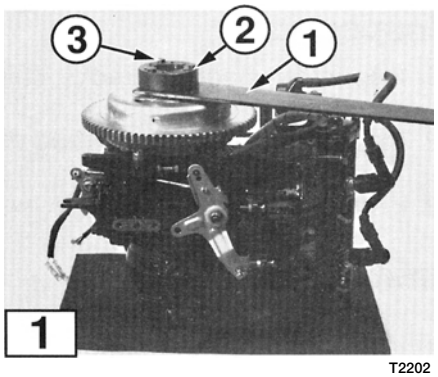
Past production models (9.9 / 15 / 18 and 40) may have reverse thread (left thread).

1 3. Install puller arm **(1)** and adapter **(2)** on flywheel using bolts **(3)**.

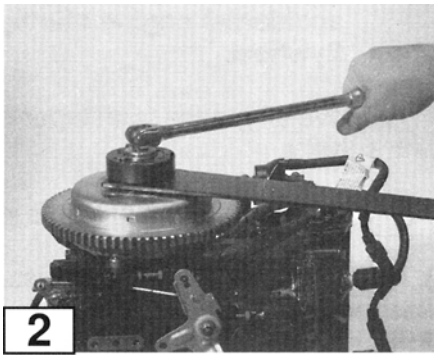
2 4. Hold arm and remove flywheel nut with a socket wrench. Make sure to turn nut in the correct direction.

3 4 5. Install pressing bolt **(6)** in adapter **(3)**.

5 6. Hold arm and tighten pressing bolt until flywheel releases.



T2202



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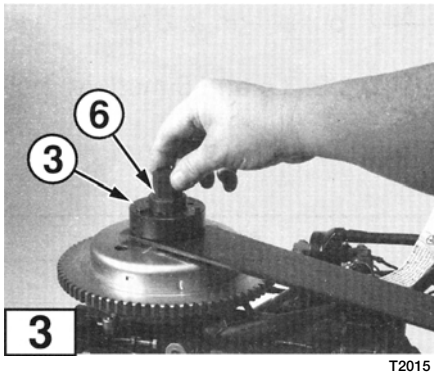

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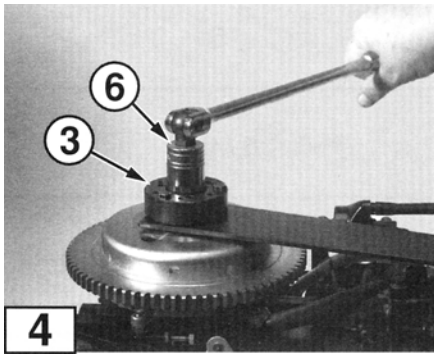

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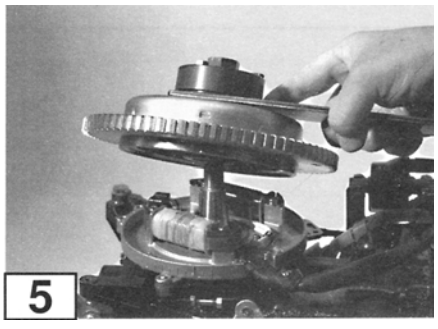


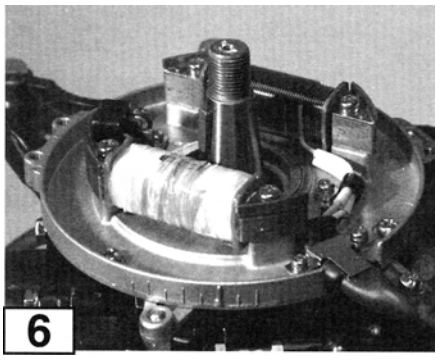
T2017

Inspection

1. Inspect flywheel for cracks, chips, and damaged taper.

2. Inspect crankshaft for thread damage and damaged taper.

3. Inspect flywheel key and keyway for damage.



T2018

Installation

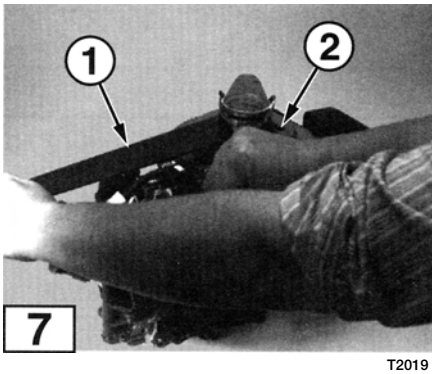
⚠⚠ WARNING

Ignition system must be disabled to prevent accidental engine startup during installation of the flywheel.

1. Remove all grease from tapered portion of flywheel and crankshaft with solvent.

6 2. Check flywheel key is inserted in crankshaft.

3. Align flywheel keyway and install on crankshaft. Install the flywheel washer.



T2019

7 4. Install puller arm **(1)** on flywheel using bolts **(2)**. Hold puller arm and torque flywheel nut to specification.

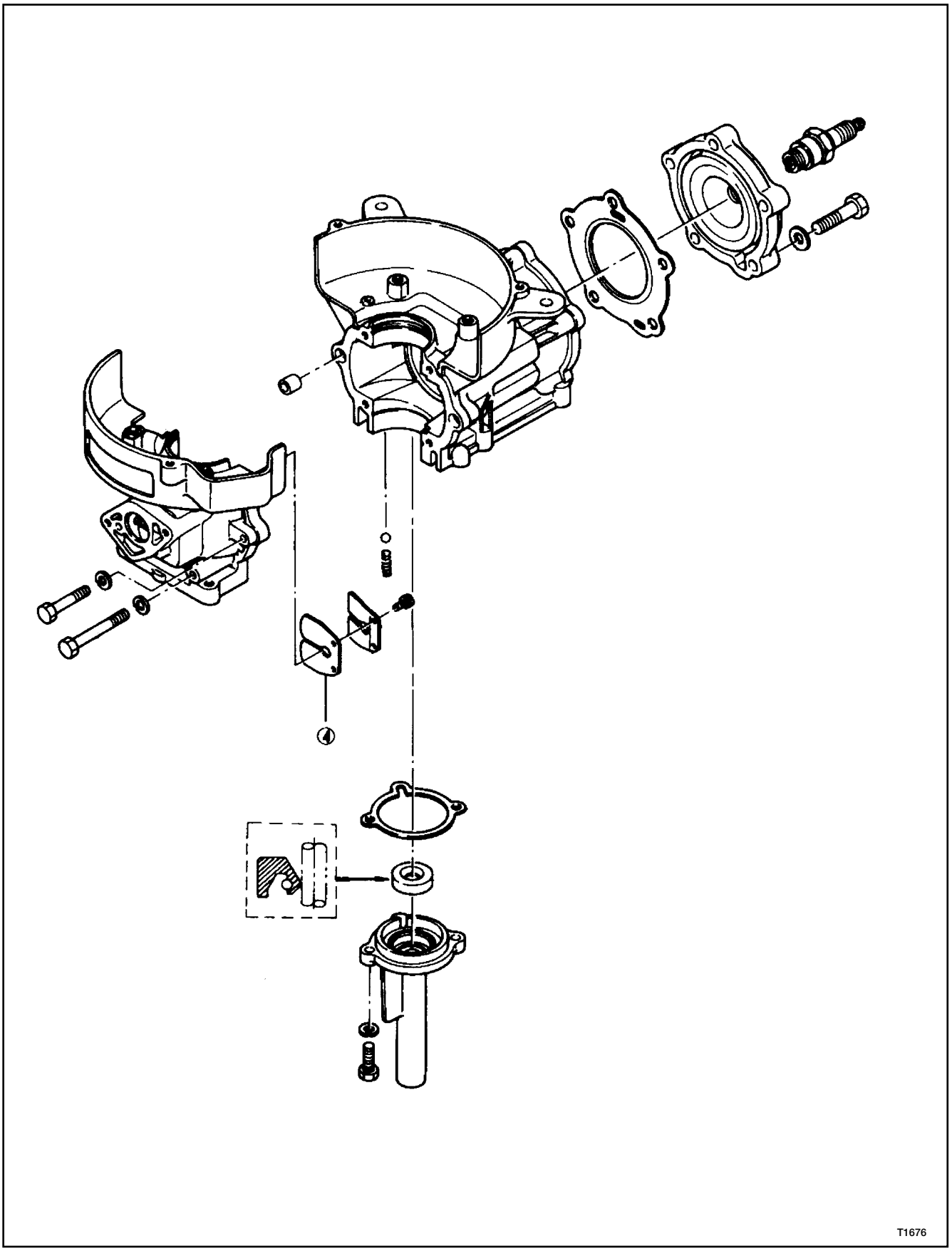
5. For 2.5, 3.5 and 5 models, install the integral fuel tank.

6. Install recoil starter.

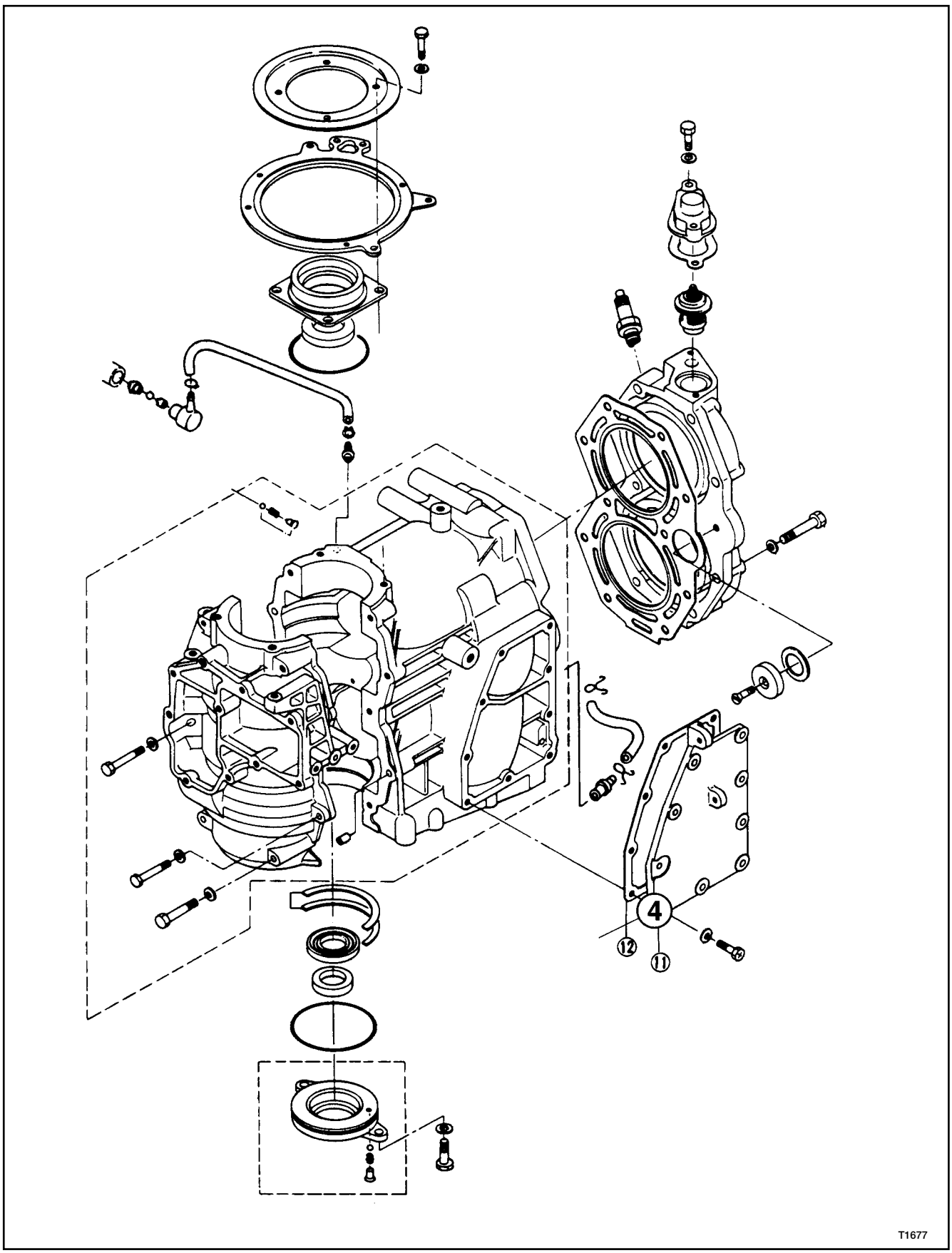
Model	Flywheel Torque
2.5 - 3.5	347 - 391 in-lb 39 - 44 N-m 4 - 4.5 kg-m
5	434 - 521 in-lb 49 - 59 N-m 5 - 6 kg-m
8 / 9.8	434 - 521 in-lb 49 - 59 N-m 5 - 6 kg-m
9.9 / 15 / 18	608 - 783 in-lb 69 - 88 N-m 7 - 9 kg-m
25 / 30	1043 - 1217 in-lb 118 - 137 N-m 12 - 14 kg-m
40	1043 - 1217 in-lb 118 - 137 N-m 12 - 14 kg-m

POWERHEAD

Typical 1-Cylinder



Typical 2-Cylinder



Removal

⚠⚠ WARNING

Ignition system must be disabled to prevent accidental engine startup during removal of the powerhead.

NOTE

If service work requires flywheel to be removed, remove flywheel before lifting powerhead from the rest of the engine. See Flywheel, this section.

NOTE

Mark the mounting location of all clamps so they can be returned to their original positions during assembly of the powerhead.

1. Disconnect the battery and fuel tank.

2. Disable the ignition system and disconnect the battery terminals on the powerhead.

3. Disconnect all electrical connections as applicable:
- Remote control or main key switch wire harness.
- Neutral safety switch.

4. Disconnect fuel INPUT hose from fuel filter.

5. Disconnect pilot water hose from exhaust cover.

6. Complete the following operations.

1 **2** Tiller Models: (as applicable)

- Remove throttle cable **(1)** and **(2)** from connection (5, 8/9.8).
- Remove link rod **(3)** from advancer arm (9.9/15/18, 25/30, 40).
- Disconnect choke knob link rod.

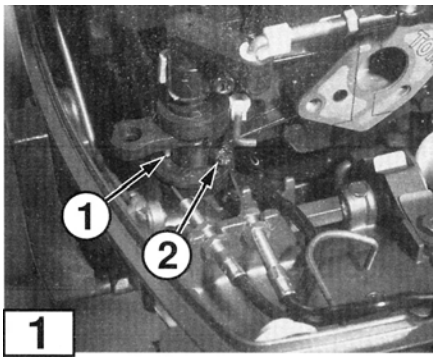
Remote control models:

- Disconnect shift cable from shift arm.
- Disconnect throttle cable from advancer arm.

3 7. Remove engine mounting bolts.

4 8. Rock engine back and forth to break seal, then remove the powerhead by lifting straight up.

5 9. Remove lower crankcase head bolts **(4)**. Insert screwdriver in pinch groove and remove lower crankcase head.



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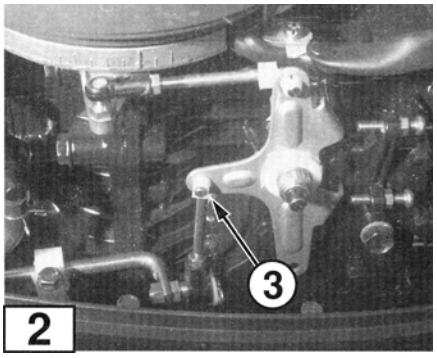

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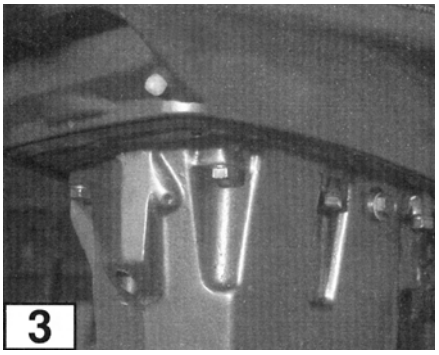

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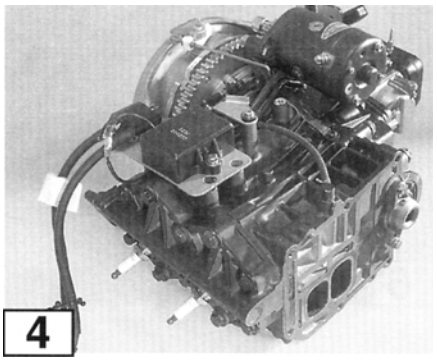
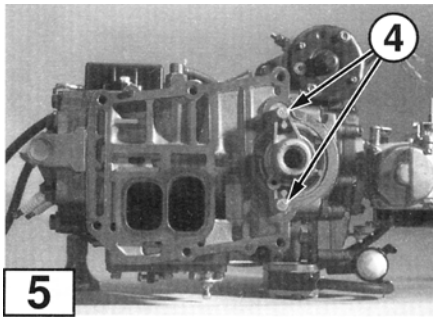


T1678



T2023

Disassembly

Preliminary

1. Remove all carburetor, ignition, and electrical components from the powerhead.

2. Remove the intake manifold and reed valves. See Intake Manifold in Section 3.

NOTE

The reed valve of the single cylinder models is attached directly to the crankcase. Therefore, it is removed after dividing the crankcase.

Cylinder Head

3. Remove and inspect the thermostat. See Thermostat, this section.

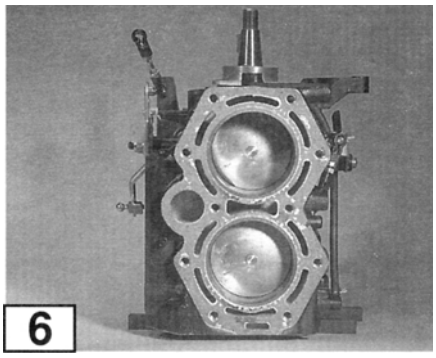
6 4. Remove the cylinder head bolts. Separate and remove cylinder head.

7

NOTE

Start with those farthest from the center of the cylinder head and work inward.

5. Using a pointed scribe, identify the heads of the cylinders for correct positioning during assembly operations.



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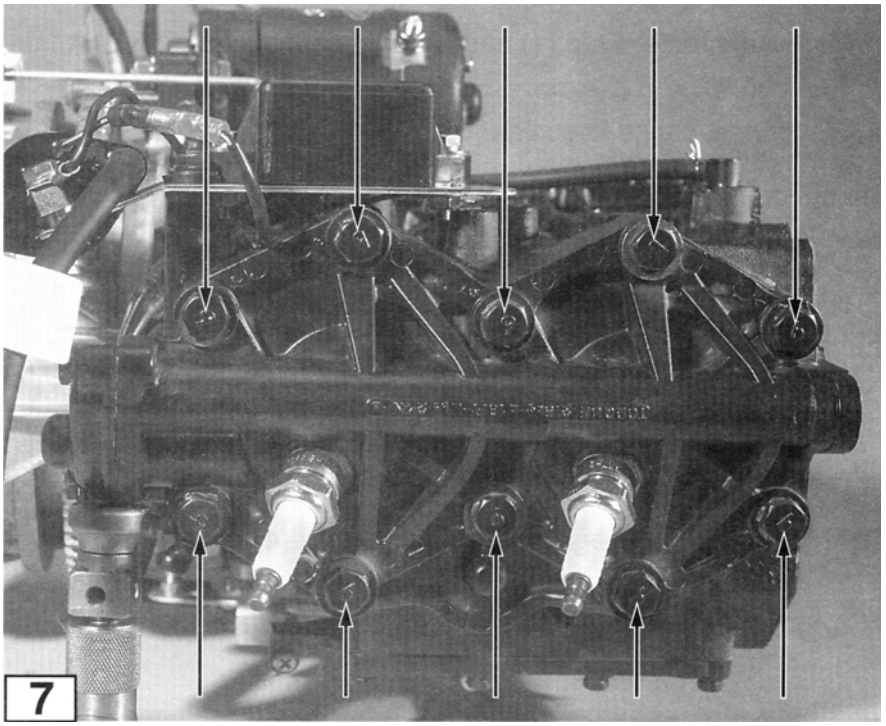

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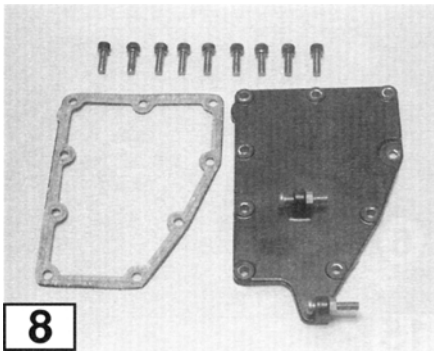

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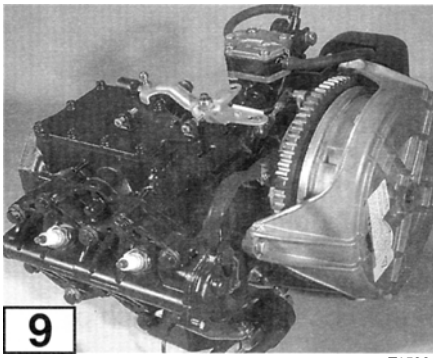
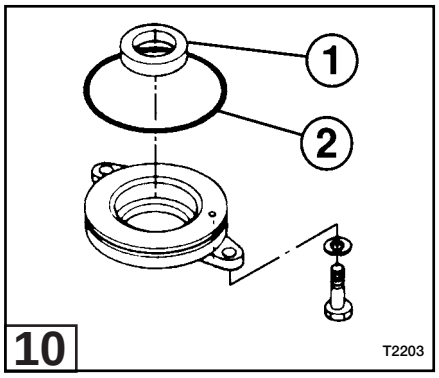


T1592



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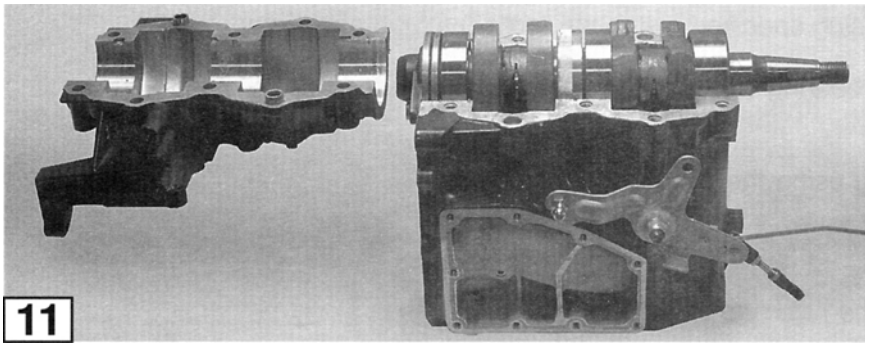
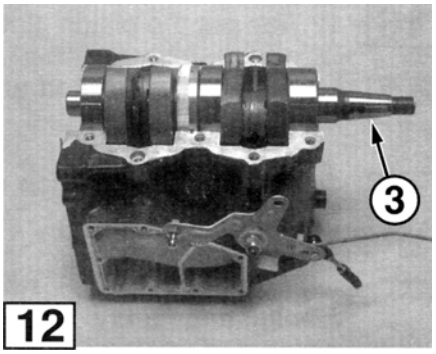


T1682



T1683

Exhaust Cover

8 9 6. Remove the exhaust cover bolts. Insert screwdrivers into pinch grooves to separate and remove outer and inner exhaust covers.

Crankcase and Crankshaft

10 7. Remove and discard oil seal **(1)** and o-ring **(2)** from lower crankcase head (or engine base or lower cowl). Use a seal puller to prevent damage to the head.

11 8. Remove the crankcase bolts and separate the crankcase from the cylinder block.

NOTE

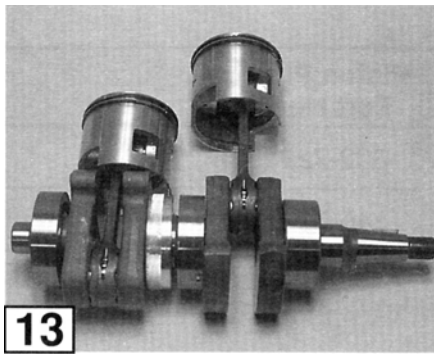
Start with the bolts farthest from the center of the crankcase and work inwald.

12 13 9. Tap the tapered portion of the crankshaft **(3)** with a rubber mallet to loosen it. Lift the crankshaft and pistons from the cylinder block and place on bench for disassembly.

14 10. Slide the upper main bearing off the crankshaft. Remove and discard bearing oil seal **(4)** and o-ring **(5)**.

NOTE

The 25/30 crankshaft has a bearing race which blocks removal of the bottom piston. Lift up and remove race to remove the crankshaft assembly.



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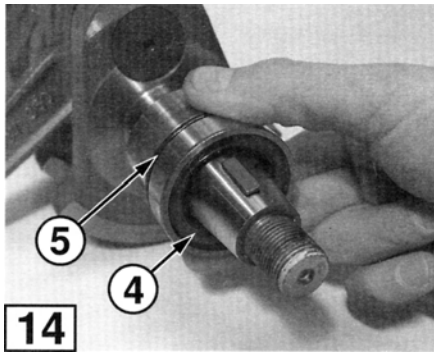
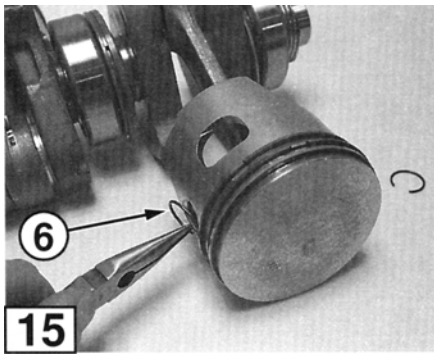


T1685

Pistons

NOTE

Pistons, rings, and connecting rod bearings are wear parts which seat with operation of the engine. Make sure these parts are marked and kept together so they can be returned to their original positions during assembly.

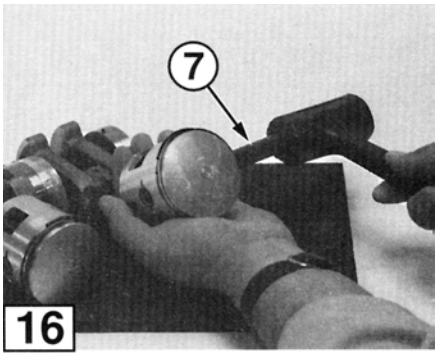


T1686

15 11. Remove piston pin clip **(6)** from both sides of each piston. Discard the clips.

16 12. Tap out the piston pins using specified piston pin tool **(7)**.

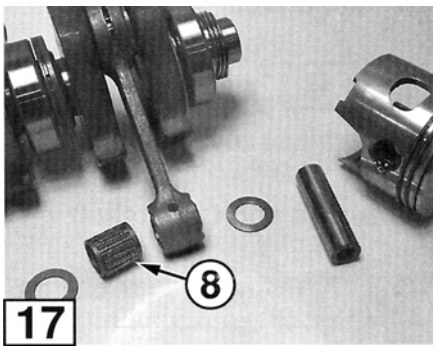
Piston Pin Tool Part Number	Applicability Model
332-72215-0	5 / 8 / 9.8 / 9.9 / 15 / 18
345-72215-0	25 / 30 / 40



T2041

17 13. Remove the piston and bearing **(8)** from the connecting rod.

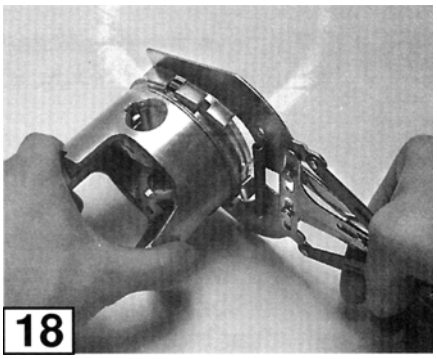
18 14. Remove each piston ring using the piston ring tool (Part No. 353-72249-0).



T1689

NOTE

Identify each ring so it can be returned to its original piston and ring groove.

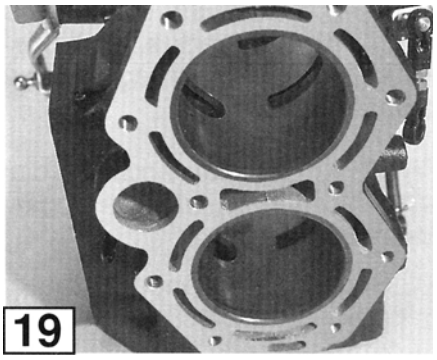


T1222

Cleaning

1. Remove all carbon accumulation from exhaust port areas and cylinder head combustion chambers.

19 2. Use gasket remover and Scotch-Brite Abrasive Pads to remove all traces of gasket and sealer from the cylinder block, crankcase, cylinder head, intake manifold, exhaust covers, and air silencer.

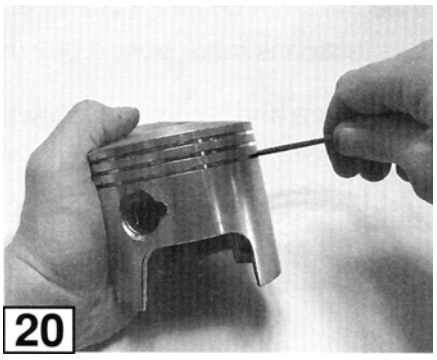


T1687

⚠ CAUTION

DO NOT use a metal scraper on gasket surfaces or the mating surfaces of the crankcase.

20 3. Remove all carbon deposits from the tops and ring grooves of the pistons.

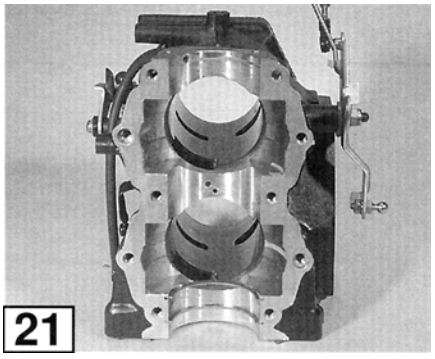


T1224

NOTE

A ring groove cleaning tool can be made by breaking an old ring and grinding an ang/e on its end. Do not damage the grooves when cleaning.

21 4. Wipe off all traces of oil and thoroughly wash the cylinder block and crankcase with warm, soapy water. Air dry the cylinder block and crankcase. Dry all holes and passages with low pressure compressed air.



T1690

5. Coat the cylinder walls with genuine engine oil or certified TC-W3 oil to protect them from corrosion.

Inspection

NOTE

Before inspection of the powerhead, all components must be perfectly clean and free of contaminants.

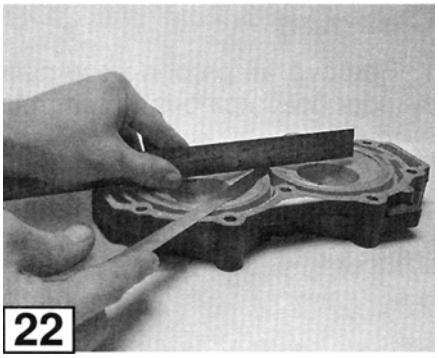
⚠ CAUTION

After the inspection, when it is found that the cylinder(s) requires re-finishing or boring, all the works have to be done in the approved machining plant. Light scuffing or burn does not require boring for removal. Use water-resistant sand paper of around #320 to remove the damages, and then use #400 and #600 to finish.

1. Visually inspect all internal components. Inspect for unusual wear patterns, heat-related discoloration of bearings, broken parts, and scuffing or damage to aluminum parts.

2. Inspect the intake manifold and reed valves. See Intake Manifold in Section 3.

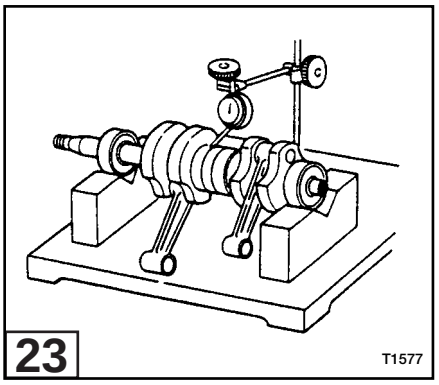
22 3. Check the cylinder head for warpage using a machinist straight edge and the thickness gauge set (Part No. 353-72251-0). If warpage exceeds 0.004 in [0.10 mm], replace the cylinder head.



23 4. Using an accurate dial indicator, measure the crankshaft deflection with the upper and lower main bearings installed. Measure as follows:

- Support both ends of the crankshaft at the main bearings in precision V-blocks or an alignment jig.
- Slowly rotate crankshaft and record measurement at each crankshaft bearing **(1)** and at both ends of the crankshaft.

If deflection is more than 0.002 in [0.05 mm], replace the crankshaft.

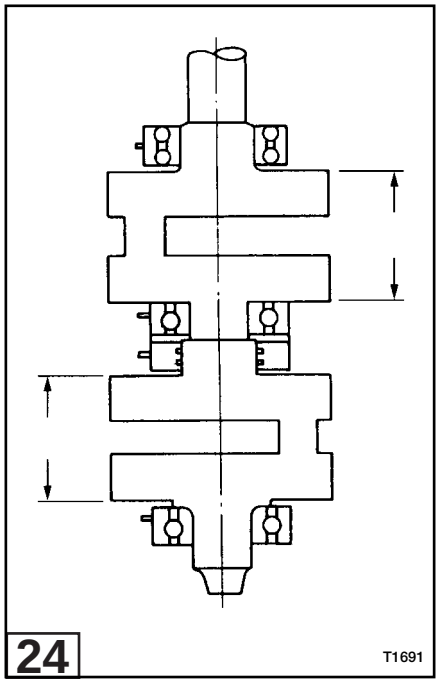


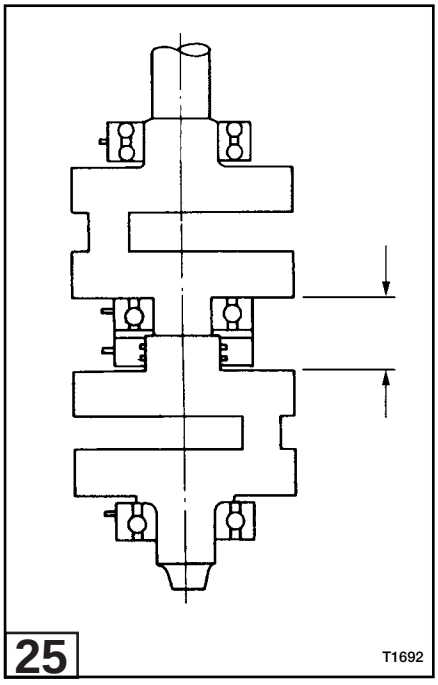
5. Measure and record the following crankshaft dimensions and check for signs of wear:

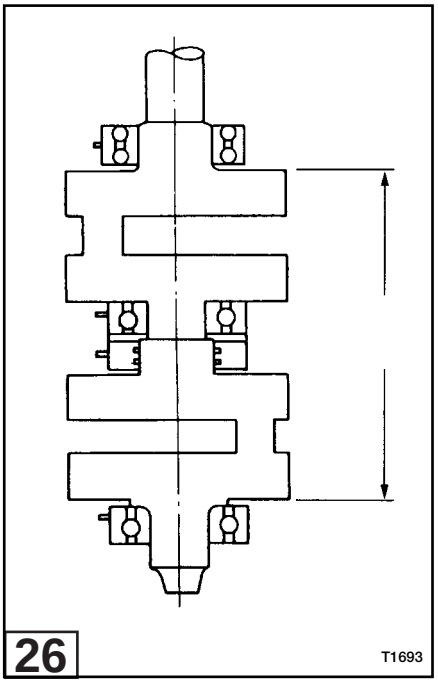
24 • Dimension 1 : Distance between the outside edges of each pair of cranks haft webs. Measure at both ends of the webs.

25 • Dimension 2: Distance between each pair of crankshaft webs.

26 • Dimension 3: Distance between the outside edges of the first and last crankshaft webs.





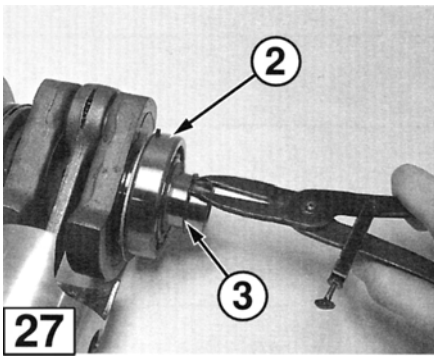


If any dimension is not within specification, replace the crankshaft assembly.

Model	Dimension 1 in [mm]	Dimension 2 in [mm]	Dimension 3 in [mm]
2.5 / 3.5	1.417 ± 0.002 [36 ± 0.05]	N/A	N/A
5	1.975 ± 0.002 [40 ± 0.05]	N/A	N/A
8 / 9.8	1.654 ± 0.002 [42 ± 0.05]	0.984 ± 0.002 [25 ± 0.05]	4.292 [109]
9.9 / 15 / 18	1.890 ± 0.004 [48 ± 0.1]	1.299 ± 0.002 [33 ± 0.05]	5.079 [129]
25 / 30	$2.047\ ^{+\ 0}_{-\ 0.001}$ $[52\ ^{+\ 0}_{-\ 0.02}\ ]$	1.496 ± 0.002 [38 ± 0.05]	5.590 [142]
40	$2.071\ ^{+\ 0}_{-\ 0.002}$ $[52.6\ ^{+\ 0}_{-\ 0.05}\ ]$	1.591 ± 0.002 [40.4 ± 0.05]	5.733 [145.6]

27 6. Check for smooth operation of all crankshaft and connecting rod bearings. Upper and lower main bearings and small end connecting rod bearings are serviceable. Wear of other parts requires replacement of the crankshaft assembly. If lower main bearing **(2)** is defective, proceed to remove the components as follows:

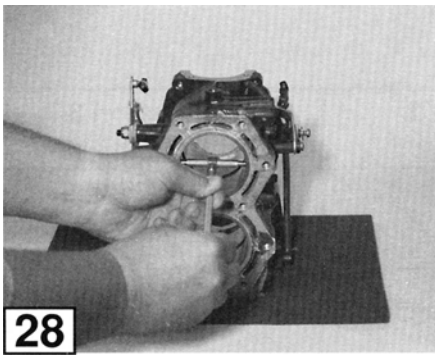
- Remove snap ring **(3)**.
- Install a universal bearing puller with bearing retainer plate and remove lower main bearing **(2)** from the crankshaft.
- See powerhead Assembly procedure for installation.



T2026

NOTE

DO NOT fully disassemble the crankshaft assembly unless further wear or damage is suspect.



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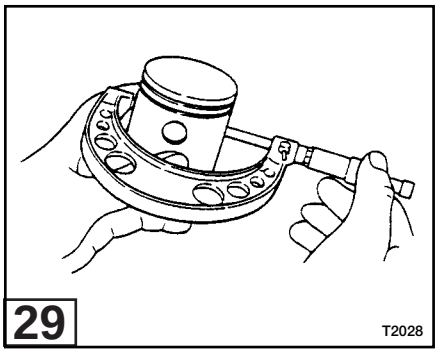
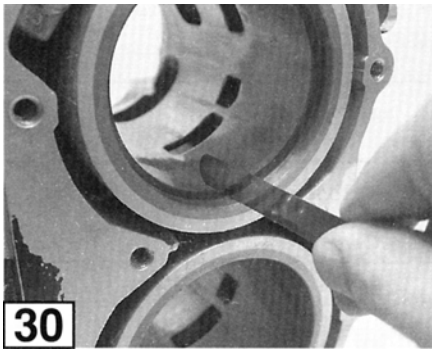


T2028



T1235

28 **29** 7. Measure and record the diameter of each cylinder bore and the outside diameter of its respective piston. Subtract the values to calculate the piston clearances. If any bore diameter or piston clearance exceeds the specified limit, the cylinder must be professionally bored oversize for use with an oversize piston.

Model	Standard Bore Diameter in [mm]	Standard Piston Clearance in [mm]	Repair Limit Piston Clearance in [mm]
2.5 / 3.5	1.85 [47]	0.0024 - 0.0035 [0.06 - 0.09]	0.006 or over [0.15 or over]
5	2.16 [55]	0.008 - 0.020 [0.02 - 0.05]	0.006 or over [0.15 or over]
8 / 9.8	1.97 [50]	0.008 - 0.020 [0.02 - 0.05]	0.006 or over [0.15 or over]
9.9 / 15	2.16 [55]	0.0020 - 0.0035 [0.05 - 0.09]	0.006 or over [0.15 or over]
18	2.36 [60]	0.0020 - 0.0035 [0.05 - 0.09]	0.006 or over [0.15 or over]
25 / 30	2.68 [68]	0.0024 - 0.0039 [0.06 - 0.10]	0.006 or over [0.15 or over]
40	2.76 [70]	0.0020 - 0.0039 [0.05 - 0.10]	0.006 or over [0.15 or over]

30 8. Complete the following inspection for new or used piston ring sets. Inspect each ring separately:

- Place ring in its respective cylinder bore.
- Use a piston to square the ring in the bore.
- Use the thickness gauge set (Part No. 353-72251-0) to measure the ring end gap.

The ring end gap must be within specification:

Model	Standard Ring End Gap in [mm]	Repair Limit Ring End Gap in [mm]
2.5 / 3.5	0.007 - 0.013 [0.18 - 0.33]	0.031 [0.8] or over
5	0.008 - 0.016 [0.20 - 0.40]	0.031 [0.8] or over
8 / 9.8	0.007 - 0.013 [0.18- 0.33]	0.031 [0.8] or over
9.9 / 15 / 18	0.008 - 0.016 [0.20 - 0.40]	0.031 [0.8] o rover
25 / 30	0.013 - 0.019 [0.33 - 0.48]	0.031 [0.8] or over
40	0.08 - 0.019 [0.33 - 0.48]	0.031 [0.8] or over

Assembly

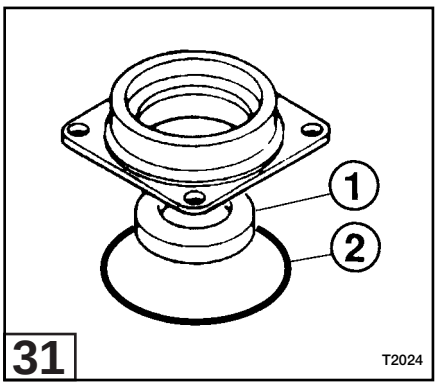
NOTE

Before assembly of the powerhead, all components must be perfectly clean and lightly coated with genuine engine oil or a NMMA certified TC-W3 oil. All serviceable gaskets and seals must be replaced.

Preliminary

31 1. Before installation, lightly coat the outside surfaces of new bearing seals and o-rings with genuine engine oil or TC-W3 oil. Apply bearing cup grease to the seal lips. Press fit the seals into place using an appropriate size seal installer to avoid damaging the seal or component.

- Install a new oil seal in lower crankcase head and a new o-ring on base of lower crankcase head (or engine base or lower cowl).
- Install new oil seal **(1)** in upper magneto base and new o-ring **(2)**.

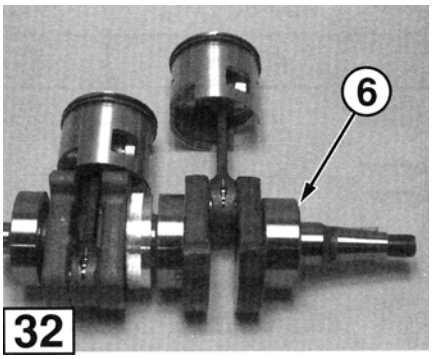


2. Coat the rotating surfaces of the crankshaft and connecting rod bearings, bearing washers, and bearing thrust plates (model 40) with genuine engine oil or TC-W3 oil.

Crankshaft

32 3. If upper main bearing was removed, slide and install the upper main bearing onto crankshaft **(6)**.

4. If lower main bearing was removed, coat lower end of crankshaft with genuine engine oil or TC-W3 oil and install the bearing.

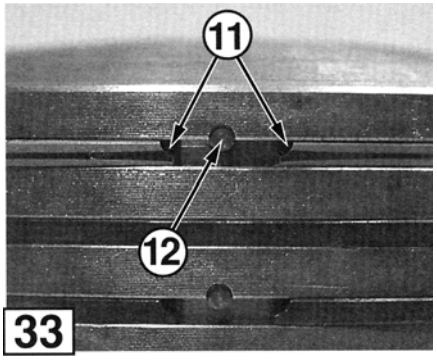


T2029

Pistons

33 5. Install each piston ring in its original groove on its original piston using the piston ring tool (Part No. 353-72249-0). Each ring must be installed so end notches **(11)** fit the contour of piston knock **(12)** when the ring is compressed.

34 6. Install each piston on its respective connecting rod as follows:

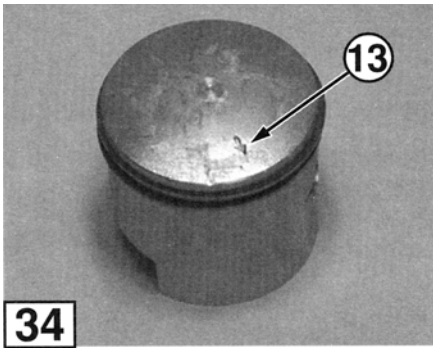


T1696

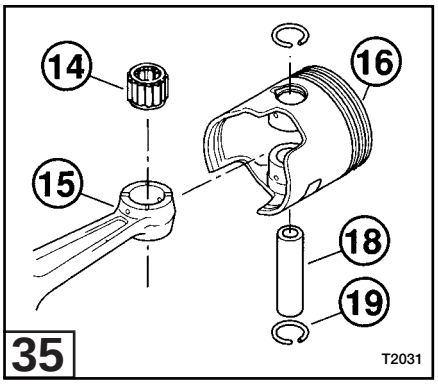
NOTE

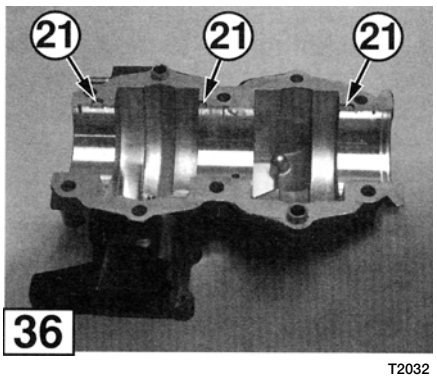
*An arrow **(13)** or the word "UP" is cast on the top of the piston. This mark is used to align the piston in a specific orientation. See chart for proper orientation.*

2.5/3.5	*Arrow (Crown Mark) points to exhaust port*
5	*"Up" mark points to flywheel*
8/9.8	*"Up" mark points to flywheel*
9.9/15/18	*"Up" mark points to flywheel*
25/30	*"Up" mark points to flywheel*
40	*"Up" mark points to flywheel*



T2030





35 Insert bearing **(14)** into small end of connecting rod **(15)**.

35 Correctly position piston **(16)** onto the connecting rod.

35 Align components so piston pin hole is not obstructed and install piston pin **(18)** using piston pin tool.

35 Install new piston pin clips **(19)**. Do not reuse old clips.

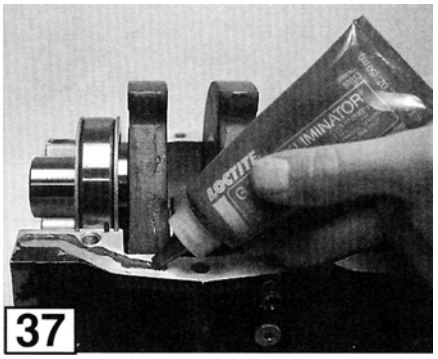
Cylinder Block and Crankcase

7. Coat the pistons, rings and cylinder walls with genuine engine oil or TC-W3 oil. Install the bearing washers or thrust plates (model 40) into cylinder block, guiding each piston into its respective cylinder. Ensure the following:

36 All main bearing knocks **(21)** are seated against the crankcase mating flange of the cylinder block.

- Bearing washers or thrust plates (model 40) are seated properly in the cylinder block.

37 8. Degrease the crankcase flange and mating surface of the cylinder block. Apply anaerobic gasket maker(Loctite 518) to the cylinder block frange. The application must cover the flange evenly and not be excessive.



T2033

9. Install crankcase on cylinder block.

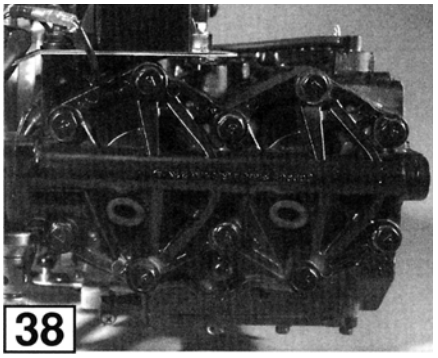
10. Install crankcase mounting bolts and torque to specification:

NOTE

Start with the bolts closest to the center of the crankcase and work outward.

Cylinder Head

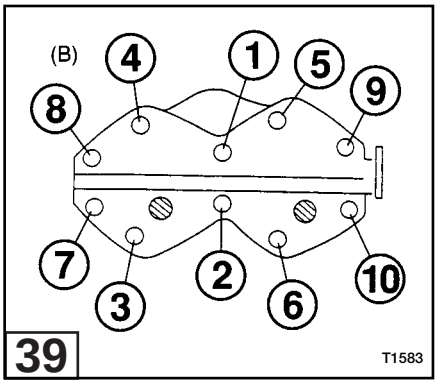
38 39 11. Head gasket dressing not required, head gaskets are coated at factory. Install cylinder head gasket.



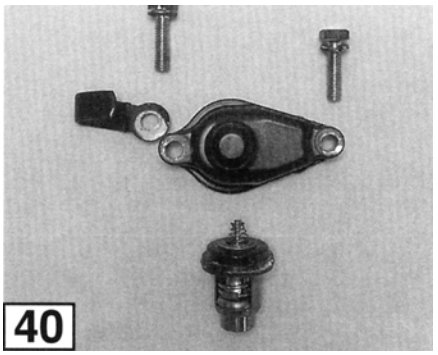
T2034

12. Install the cylinder head. Torque the bolts to specification.

40 13. Install thermostat and torque thermostat cap bolts to specification. See Thermostat, this section.



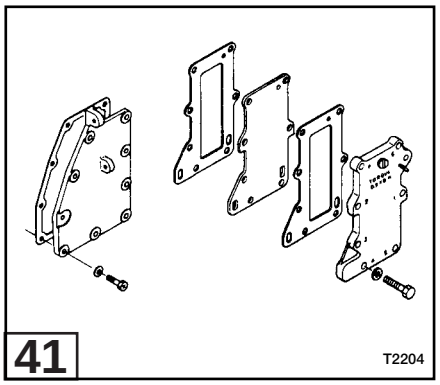
T1583



T1591

Exhaust Cover

41 14. Lightly coat both sides of new (inner and outer) exhaust cover gaskets with gasket sealant. Install gaskets and mount exhaust covers to cylinder block. Torque exhaust cover bolts to specification from lowest embossed number to highest.

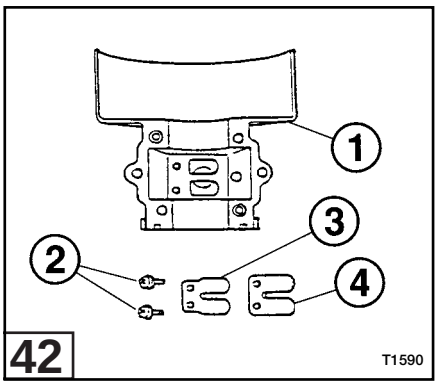


Final Assembly

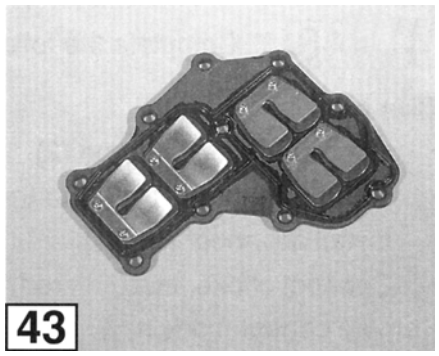
42 43 15. Install the reed valves and intake manifold. Check the reed valve and lift to verify setting. If damaged, replace with new assembly. See Reed Valve in Section 3.

16. Install all carburetion, ignition, and electrical components on the powerhead using the following guidelines. Assemble as much as possible before mounting powerhead to engine midsection.

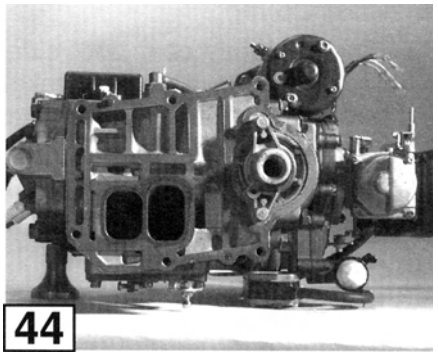
- Follow all relevant procedures and wiring diagrams in other sections of this manual.
- Torque fasteners to specification. Use Loctite 243 on the pulsar coil assembly screws.
- Lubricate powerhead components as specified. See Lubrication Chart in Section 2.
- Route and clamp all wires and hoses away from moving engine parts.
- Do not install flywheel until powerhead has been bolted to engine base.



17. Install lower crankcase head.



44 19. Apply high temperature gasket dressing to engine base gasket and install gasket on powerhead.



T2035

Installation

45 1. Degrease the engine base surface and coat driveshaft splines **(1)** with genuine engine oil or TC-W3 oil.

2. Apply high temperature gasket dressing to bottom surface of engine base gasket. Lower powerhead onto engine base, guiding the driveshaft into the lower crankcase head.

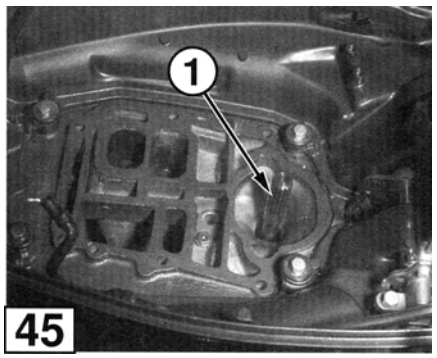
46 3. Install the engine mounting bolts and torque to specification.

4. Connect fuel INPUT hose to fuel filter.

5. Connect pilot water hose to nipple.

6. Complete the following electrical connections:
- Remote control or main key switch wire harness.
- Neutral safetyswitch.

  Reference the appropriate wiring diagram in Section 7 for electrical box connections. Leave ignition system disabled.

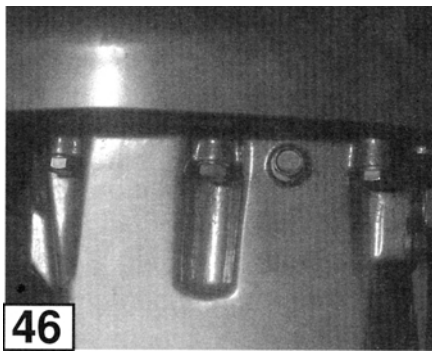


T2036

47 **48** 7. Complete the following operations.

Tiller models:
- Connect starter lock rod **(2)**.
- Secure throttle cable **(3)** to throttle cable bracket **(4)**.
- Install advancer arm **(5)**.
- Connect choke knob link rod **(6)**.

Remote control models:
- Connect shift cable to shift arm.
- Connect throttle cable to advancer arm.

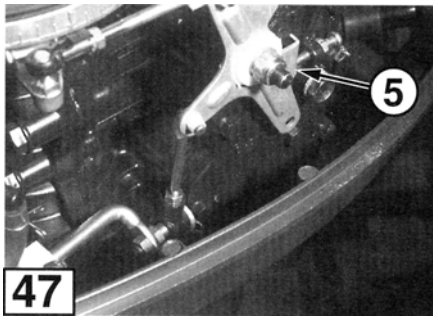


T2037

8. Install flywheel and recoil starter (if equipped). See Flywheel and Recoil Starter, this section.

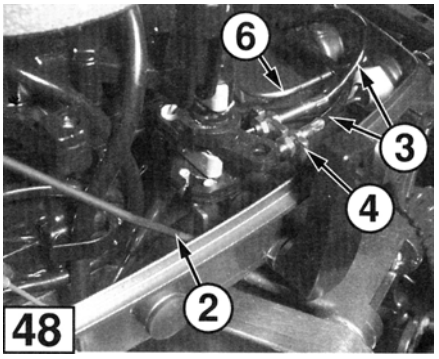
9. Perform all carburetor and ignition timing adjustments. See Synchronization and Linkage Adjustments in Section 2.

10. Perform all tune-up operations. See Tune-Up Procedure in Section 2.



T2038

11. Test and inspect all safety features of the engine and instruct operator to repeat the original break-in procedure described in Section 2 before engine is put into normal service.



T2039

SECTION 5
MIDSECTION

TABLE OF CONTENTS

SECTION 5

GENERAL PRECAUTIONS

Before performing any service work on the midsection, read and understand the Service Safety section at the beginning of this manual.

Replace locking fasteners when their locking feature becomes weak. Use only factory replacement parts.

When using compressed air to clean or dry parts, make sure air supply is regulated not to exceed 25 psi [172 kPa / 1.76 kg/cm^2].

Always inspect and test the start-in-gear prevention system before returning engine to customer.

Most service work on the midsection requires preliminary steps to remove major components. Follow all applicable procedures in other sections when indicated.

Use threadlockers and follow torque specifications as indicated to ensure shock-absorbing components remain secure after returning the engine to service.

SERVICE SPECIFICATIONS

Special Torque Values

Description	Torque in-lb (ft-lb) N-m kg-m						Threadlocker
	Model						
	2.5/3.5	5	8/9.8	9.9/15/18	25/30	40	
Engine Mounting Bolt							—
Bracket Bolt Nut (Tilt Tube Nut)		99-133 11.1-15.1 1.14-1.54	(8.6-10.8) 11.7-14.7 1.2-1.5	Type I: (10.8-14.4) 14.7-19.6 1.5-2.0 Type II: (17.4-18.1) 23.5-25.5 2.4-2.6	(17.4-18.1) 23.5-25.5 2.4-2.6	(17.4-18.1) 23.5-25.5 2.4-2.6	—
Rubber Mount Bolt - Upper				(16.6-23.1) 22.5-31.5 2.3-3.2			Loctite 242
Rubber Mount Bolt - Lower							Loctite 243
Gearcase Mounting Bolt					(17-19) 24-25 2.4-2.6		Loctite 242
Shift Lever Shaft Holder Bolt					41-55 4.6-6.3 0.47-0.64	41-55 4.6-6.3 0.47-0.64	Loctite 242
Exhaust Pipe Bolts			61-78 6.8-8.8 0.7-0.9	61-78 6.8-8.8 0.7-0.9	—	—	Loctite 242

Refer to Section 2 for Standard Torque Values chart.

Note: TYPE I = Metal Rod Type
TYPE II = Pipe Style Type

Manufacturer Special Tools Required

Spring Pin Tool, Ø3 and Ø3.5 : 345-72227-0, 345-72228-0, 369-72217-0, 369-72218-0
Rubber Mount Tool Kit-25/30 and 40 : 361-72760-0

General Equipment Required

Torque Wrench, 0-150 in-lb [0-17 N-m / 0-1.7 kg-m]
Torque Wrench, 0-145 ft-lb [0-200 N-m / 0-20 kg-m]
Dial Gauge, minimum scale 0.0001 in [0.01 mm]

SECTION 5

Consumable Supplies Required

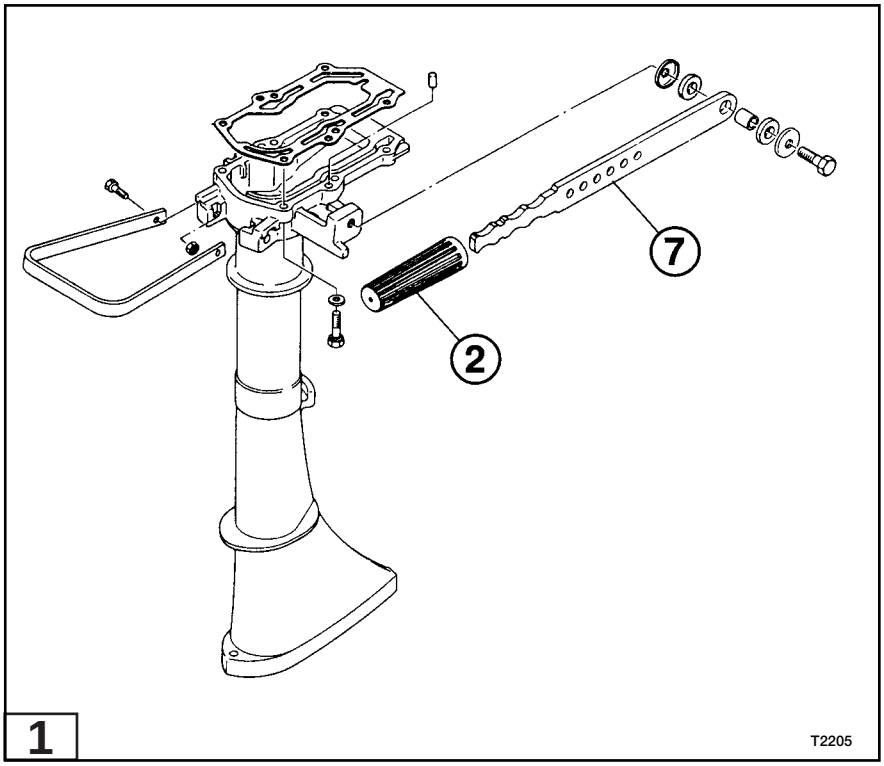
Threadlocker, *Loctite® 242*
Threadlocker, *Loctite® 243*
Gasket Dressing, *Permatex® Hylomar® Aerosol High-Temp Gasket Dressing*
Silicone Sealant, *Permatex® Hi-Temp RTV Silicone Gasket*
Super Bond Adhesive, *Permatex® Super Glue Gel*
Cleaning Pads, *Scotch-Brite® Abrasive Pads*
Isopropyl Alcohol
Cleaning Solvent
Gasket Remover
Genuine Grease or Equivalent Friction Surface Marine Grease

TILLER STEERING HANDLE

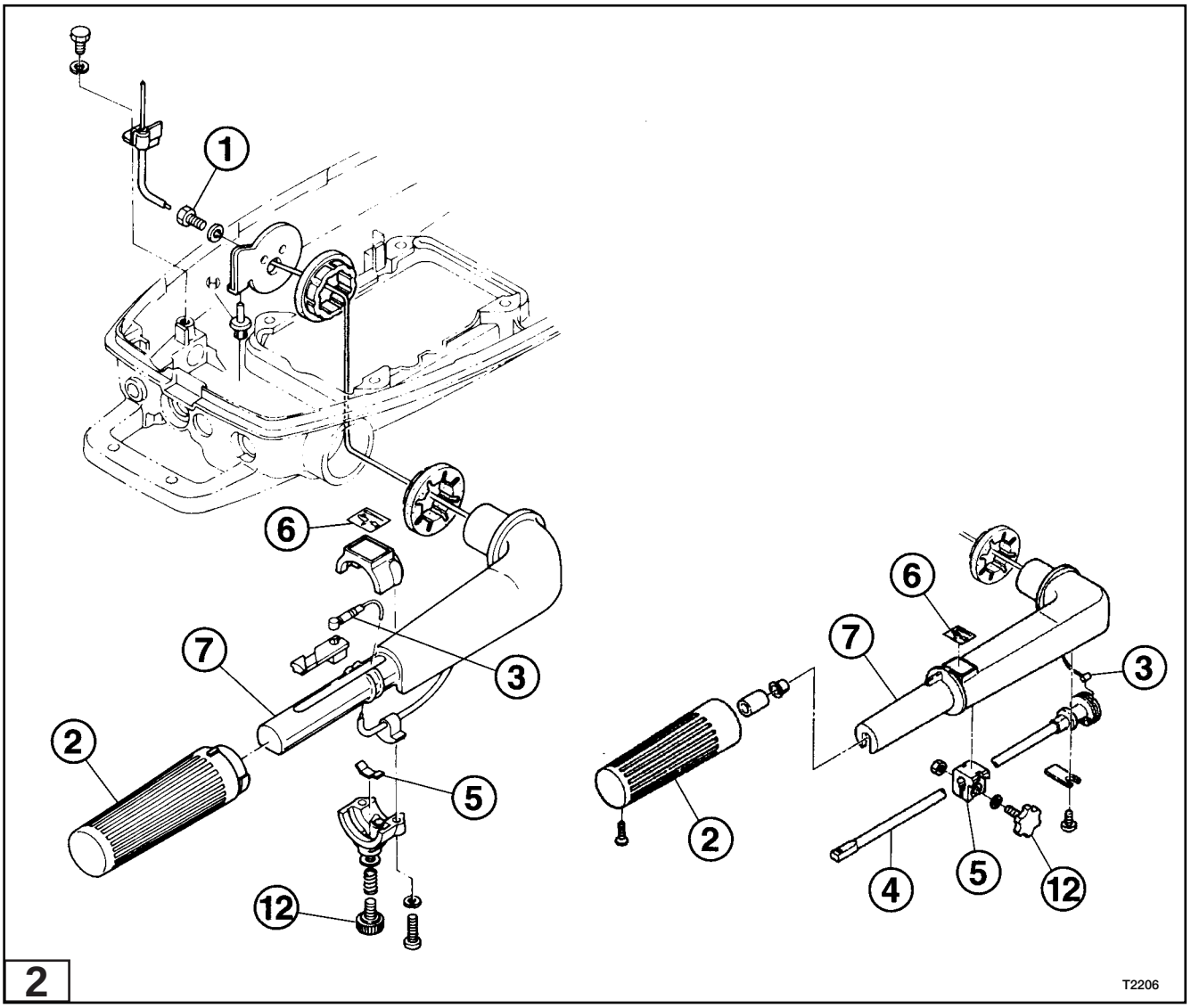
NOTE

Reference the following illustrations for all procedures.

Models 2.5/3.5



Model 5



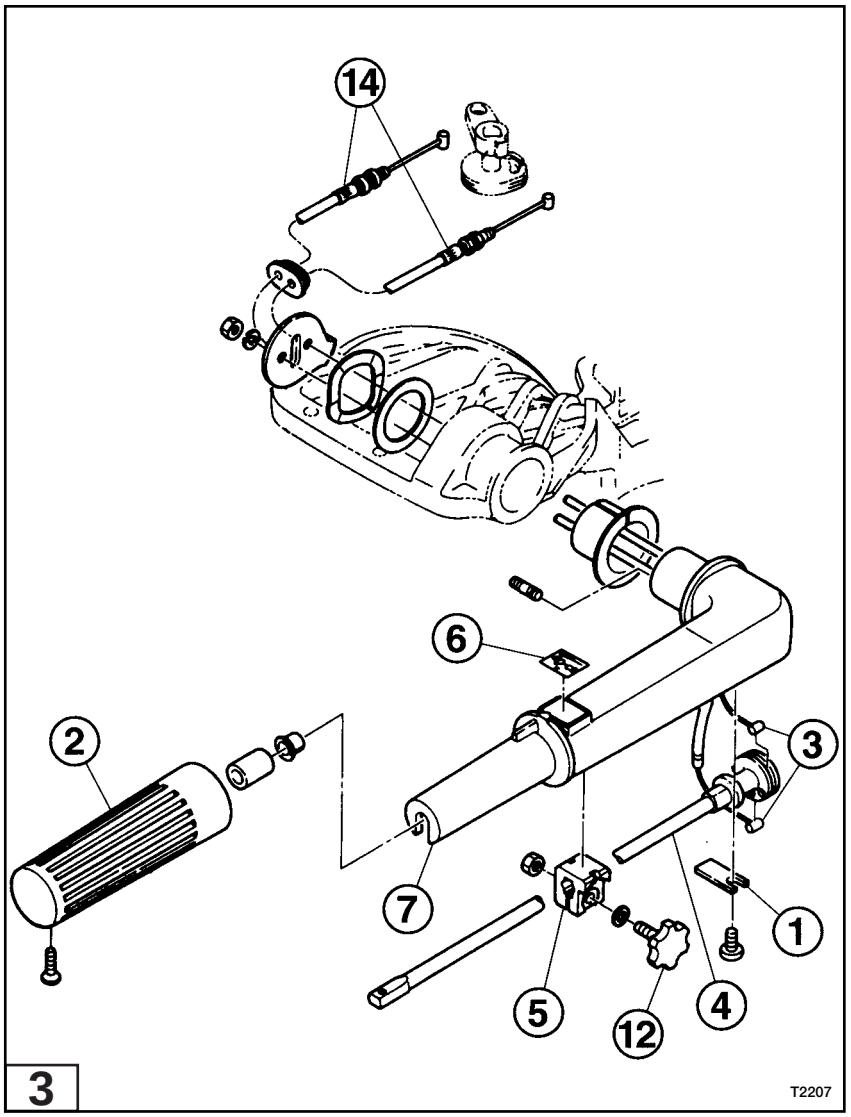
Removal

The tiller steering handle for the 2.5/3.5 engine is for steering only. For the 5 engine, the tiller arm steers and uses a single cable to control the throttle. The 8/9.8 engine tiller arm steers and uses dual cables to control the throttle. The 9.9/15/18/25/30 and 40 engine tiller arms steer, control throttle through a pinion throttle linkage, and can be set up for remote control.

1. Disconnect throttle cable(s) from carburetor(5, 8/9.8). Remove the throttle shaft from advancer arm(9.9 - 40).

1 2 3 4 2. Remove the tiller steering assembly from lower unit.

Models 8/9.8



Disassembly

1 2 3 4 1. Remove grip **(2)**.

1 2 3 4 2. Disconnect throttle cables **(3)** from throttle shaft **(4)**. Remove the throttle shaft.

3. Fully disassemble all remaining components as illustrated.

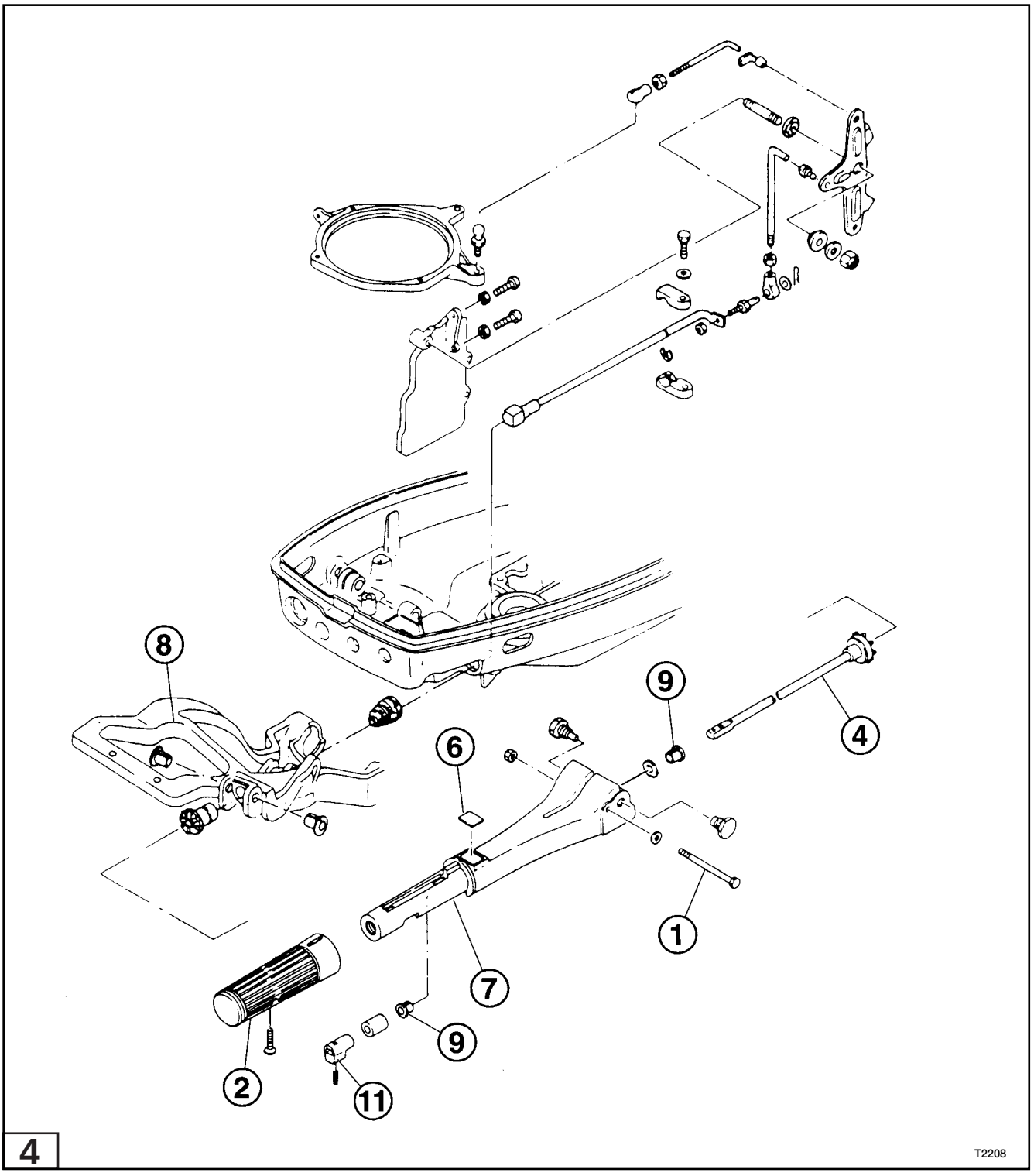
Cleaning and Inspection

All worn, damaged, or missing parts must be replaced.

1. Wipe off all excess grease from components. Thoroughly clean individual parts with mild solvent or isopropyl alcohol.

2. Dry all parts with low pressure compressed air.

Models 9.9/15/18/25/30/40



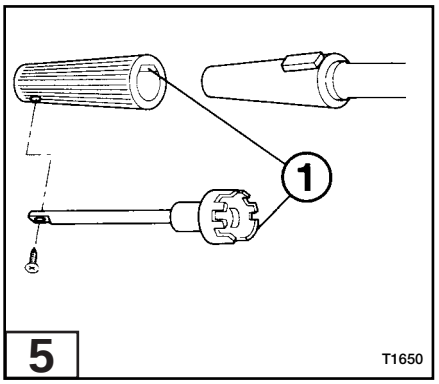
1 2 3 4 3. Inspect all plastic and rubber bushings and spacers, grip **(2)**, and friction piece **(5)** for cracks or deformation caused by wear.

4. Check all fasteners for thread damage, all washers for deformation.

2 3 4 5. Replace throttle label **(6)** if damaged or missing.

1 2 3 4 6. Verify the following components and their friction surfaces are not cracked, bent, or wom:

- Steering handle **(7)**
- Steering bracket **(8)**



1 2 7. Inspect throttle cables **(3)** for kinks, wear, cracks in the protective covering, and excessive stretch.

Assembly

2 3 4 **NOTE**

*Apply genuine grease or equivalent friction surface marine grease to bushings **(9)**, spacer **(11)**, and the grip portion of steering handle **(7)** before assembly. DO NOT lubricate friction piece **(5)**.*

1. Apply spray lubricant to the throttle cables. Work the cables back and forth to ensure full coverage under the protective covering.

2 3 4 2. Assemble all components onto throttle shaft **(4)** and connect throttle cables **(3)** to throttle shaft as required. Route opposite end of throttle cables through steering handle **(7)**.

3. Install throttle shaft in steering handle.

7 **NOTE**

*For the 9.9/15/18/25/30 and 40 models, make sure the throttle shaft is positioned **(1)** as shown during installation.*

1 2 3 4 4. Install grip **(2)**.

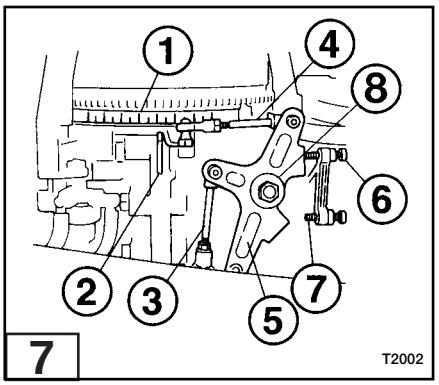
5. Fully assemble all remaining components as illustrated.

Installation

2 3 4 1. Install the tiller steering assembly.

2. Connct throttle cable(s) (or throttle shaft).

2 3 3. Adjust screw **(12)** by tightening or loosening it to obtain proper grip turning resistance.



9.9/15/18 Linkage Adjustment

7 **Adjustment of Throttle Mechanism**

Item	Description
1.	Timing Mark
2.	Ignition Timing Inspection Line
3.	Link Rod 5-65L
4.	Link Rod 5-60L
5.	Advancer Arm
6.	Stopper Bolt (Fully-open)
7.	Stopper Bolt (Fully-closed)
8.	M8 Nylon Nut

⚠ CAUTION

Make this adjustment only after fitting the power unit to the lower unit.

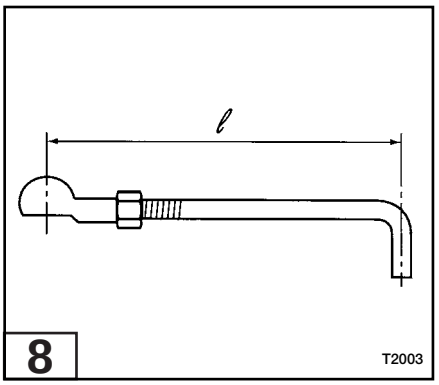
⚠ CAUTION

Apply grease on sliding parts and ball joints of the advancer arm bushing.

⚠ CAUTION

Adjust link rods 5-60L and 5-65L as shown in figure [8] prior to adjusting ignition timing.

8 Adjusting Link Rods



1. Prior to adjusting ignition timing, adjust Link Rods 5-60L and 5-65L to the following specifications depending on model being serviced:

ℓ of Link Rod	5-60L	5-65L
9.9C 9.9D $9.9D_2$ 15C 15D	2.83-2.87 in (72 - 73 mm)	2.95 in (75 mm)
$15D_2$ 18D 18E $18E_2$	2.83 - 2.87 in (72 - 73 mm)	3.07 in (78 mm)

7 Adjusting Sliding Motion of Advancer Arm

1. Using the M8 nylon nut of the advancer arm, adjust so that the throttle grip can be operated lightly and the grip does not return to its original position when you release your hand

⚠ CAUTION

After making adjustments, confirm that the advancer arm move firmly and smoothly. Always tighten the adjusting nut after adjustments

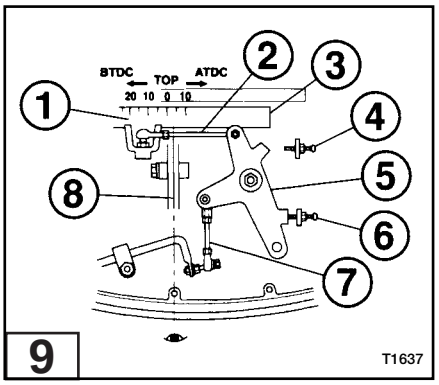
Model	Ignition Timing
9.9C & D	ATDC 3° - BTDC 22°
$9.9D_2$	ATDC 3° - BTDC 20°
15C & D	ATDC 3° - BTDC 22°
$15D_2$	ATDC 3° - BTDC 25°
18D & E	ATDC 3° - BTDC 25°
$18E_2$	ATDC 3°- BTDC 25°

7 8 Adjusting when Throttle is Fully - Open

1. Rotate the throttle grip fully toward the FAST side. (With advancer arm nearest the top stopper bolt.)

2. Adjust as shown in the preceding table using the link rod 5-65L **(3)** so that the timing mark **(1)** of the magneto coil plate and the ignition timing inspection line (crankcase mating surface) are in alignment.

3. Adjust the stopper bolts so that the advancer arm **(5)** touches the stopper bolt (fully-open adjustment).



⚠ CAUTION

Look vertically down the crankcase when adjusting the ignition timing.

NOTE

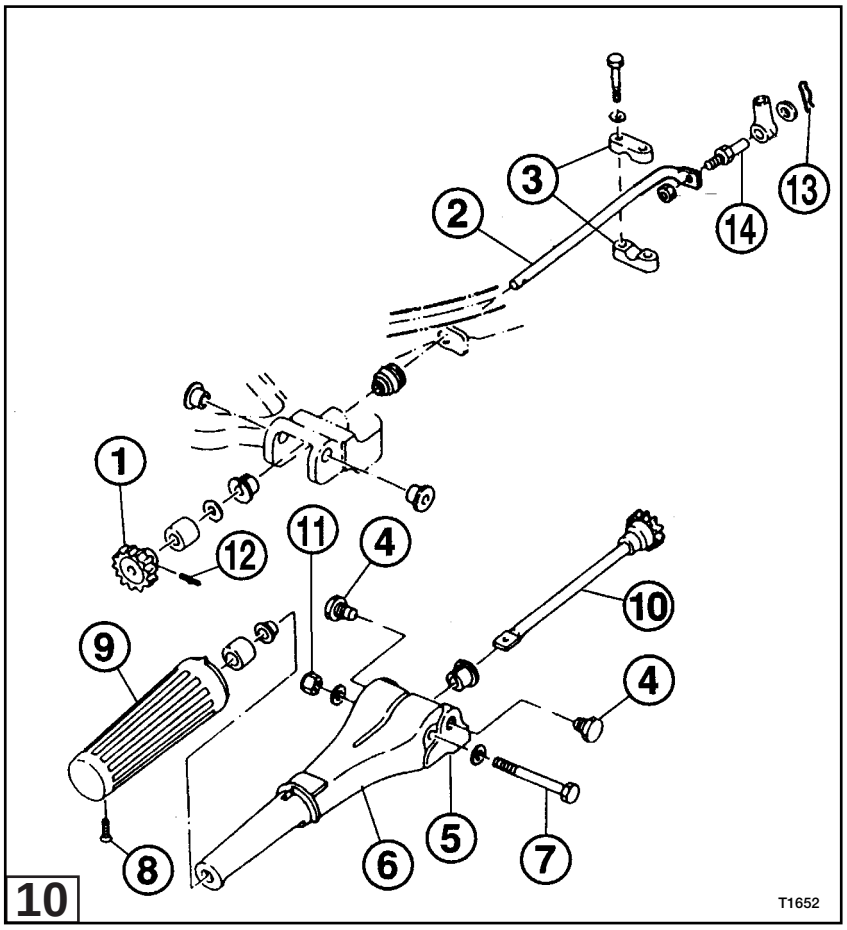
The marks engraved on the magneto coil plate are 5° apart. When the engine has been properly assembled. the longest engraved line should be 0°.

9 Adjusting when Throttle is Fully-Closed

Item	Description
1.	Timing Marks
2.	Advancer Link Rod 5-60L
3.	Magneto Coil Plate
4.	Stopper Bolt (Fully-open)
5.	Advancer Arm
6.	Stopper Bolt (Fully-closed)
7.	Link Rod 5-65L
8.	Ignition Timing Inspection Line

- Rotate the throttle grip fully toward the SLOW side. (Advancer Arm closest to lower stopper screw.)

- Adjust the stopper bolts at the position where the timing mark **(1)** 3° ATDC of the magneto coil plate and the ignition timing inspection line **(8)** (crankcase mating surface) are in alignment and the advancer arm touches the stopper bolt **(6)** (fully closed adjustment).



10

25/30/40 Twist Handle and Linkage Adjustment

Twist Handle and Linkage Disassembly

10 1. Loosen the M6 nylon nut **(11)** and remove the two handle bolts **(4)**.

10 2. Remove the handle assembly from the steering bracket.

10 3. Remove the Spring pin **(12)** from the universal pinion **(1)**.

10 4. Remove the R-pin **(13)** from the cable pin **(14)**.

10 5. Remove the throttle shaft supports **(3)**.

10 6. Remove the throttle shaft B **(2)** and the universal pinion **(1)**, and relevant parts.

10 7. Remove the handle grip mounting screw **(8)** and pull out the grip **(9)** from handle **(6)**.

10 8. Pull out the throttle shaft A **(10)**, and relevant parts.

Twist Handle and Linkage Inspection

1. Check all components for wear or cracks.

2. Lubricate all moving surfaces.

Twist Handle and Linkage Assembly

11 1. Install throttle shaft A **(10)** after applying grease.

11 2. Install grip on handle A and insert the handle grip **(9)** and mounting screw **(8)**.

3. Install Throttle Shaft B Assembly in the lower motor cover, installing the tip of inner throttle shaft in the proper orientation for the link rod.

12 4. Install the universal pinion **(3)** after coating with grease. Maintain the relationship between inner throttle shaft and the universal pinion, and inner throttle shaft and the collar as shown.

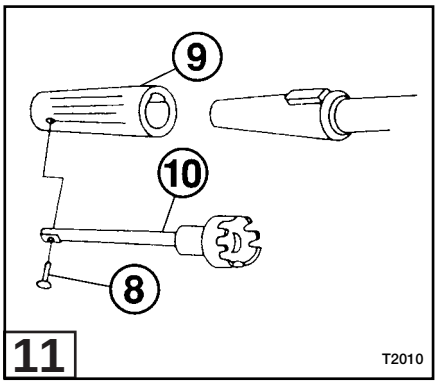
13

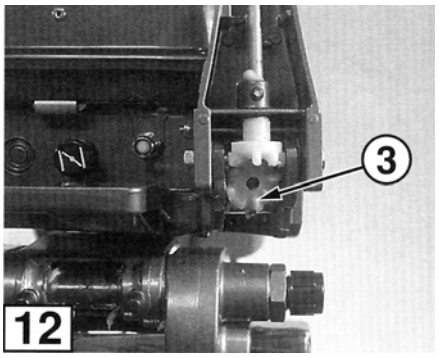
Item	Description
1.	Spring Pin
2.	Throttle Shaft B
3.	Universal Pinion

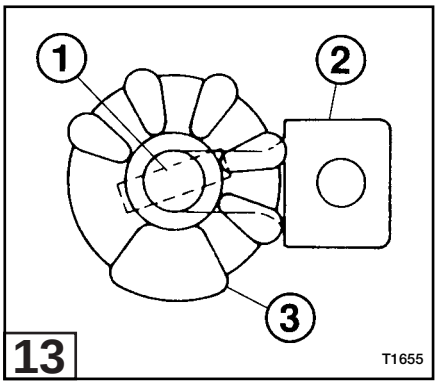
5. Assemble handle and assembly to the steering bracket.

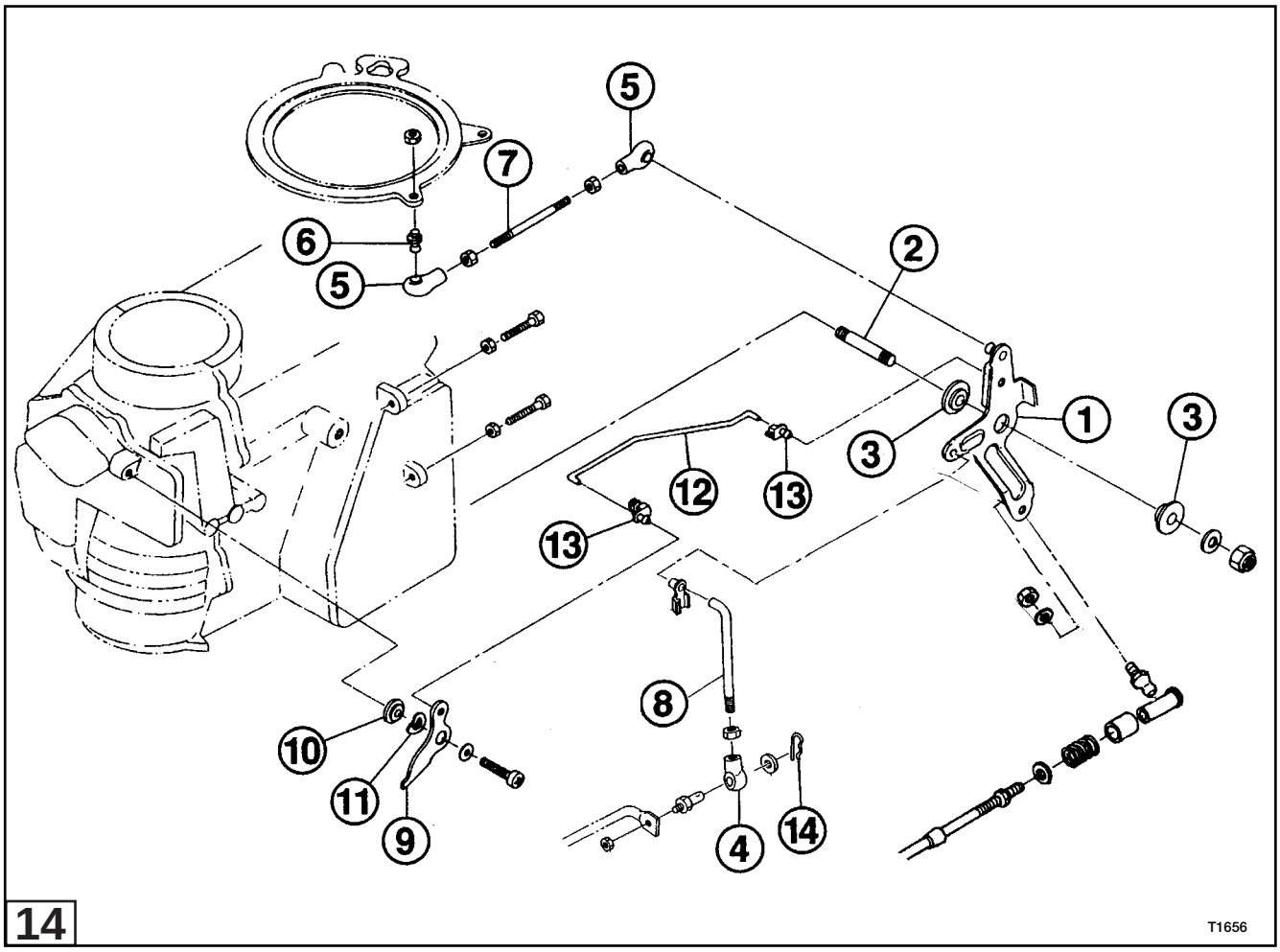
6. Tighten the handle friction bolt so that the handle does not drop from the vertical position.

7. Install the throttle shaft supports.



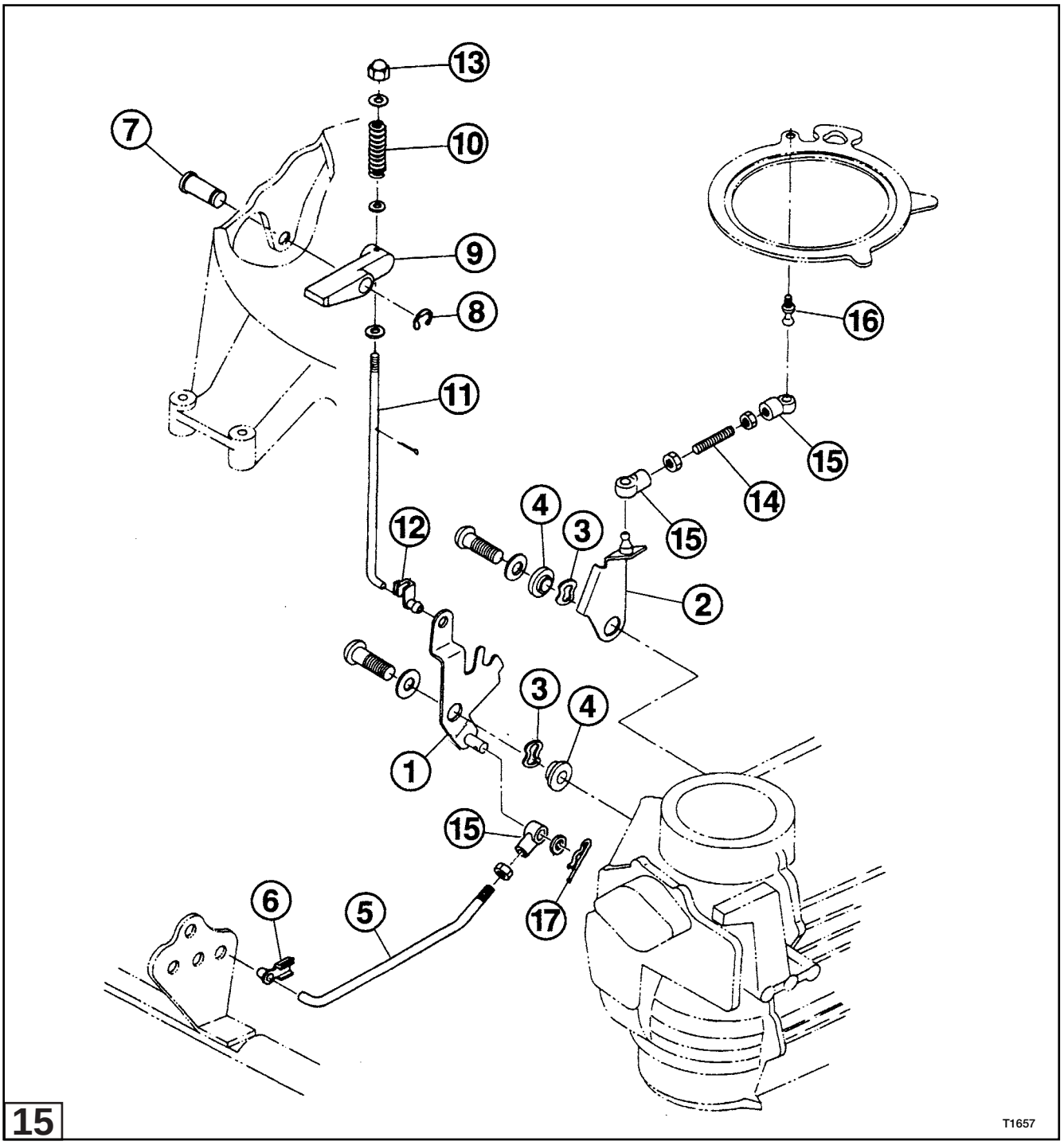






14 15 Throttle Linkage Adjustment

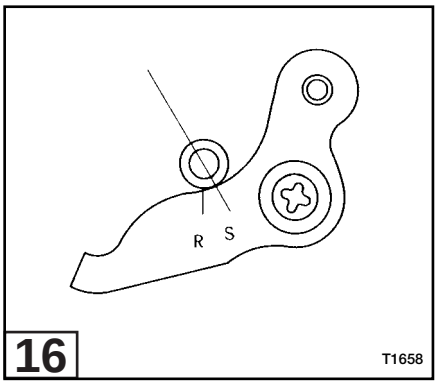
Item	Description
1.	Advancer Arm
2.	Stud Bolt
3.	Advancer Arm Bushing
4.	Ø 5 Rod Joint
5.	Ball Joint Cap
6.	Ball Joint B
7.	Advancer Link Rod, 5-50L
8.	Handle Link Rod, 5-75L
9.	Throttle Cam
10.	Throttle Cam Bushing
11.	Wave Washer
12.	Throttle Link Rod
13.	Throttle Link Rod Snap, 3.5-2
14.	R-Pin, d=8



Item	Description
1.	Starter Lock Arm
2.	Throttle Stop Arm
3.	Wave Washer
4.	Bushing
5.	Starter Lock Arm Rod
6.	Starter Lock Arm Rod Snap
7.	Starter Lock Lever Shaft
8.	Starter Lock Lever Shaft E-ring
9.	Starter Lock Lever

Item	Description
10.	Starter Lock Spring
11.	Starter Lock Rod
12.	Starter Lock Rod Snap
13.	Starter Lock Lever Cap
14.	Throttle Stop Arm Rod
15.	Ball Joint Cap
16.	Ball Joint B
17.	R-Pin, d=8

16 1. Turn the handle grip so that the collar center of the carburetor throttle lever in on the “S” marking line.

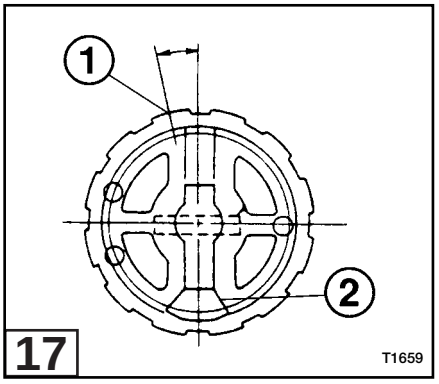


17 2. Adjust the length of the handle link rod so that the START **(1)** match mark on the handle grip is aligned to the START position on the tiller handle.

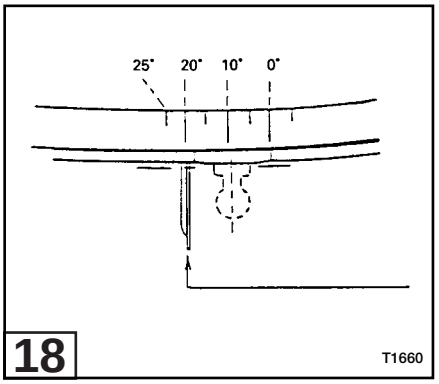
NOTE

The “R” mark is the specified opening position for reversing the engine.

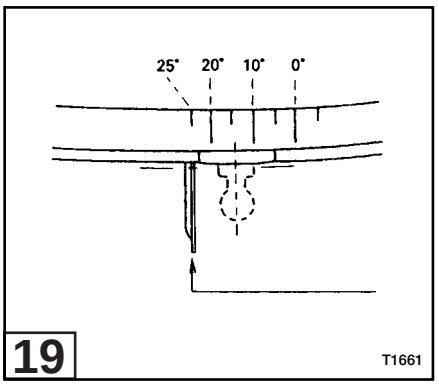
3. Set the ignition timing for when the throttle valve is fully open.

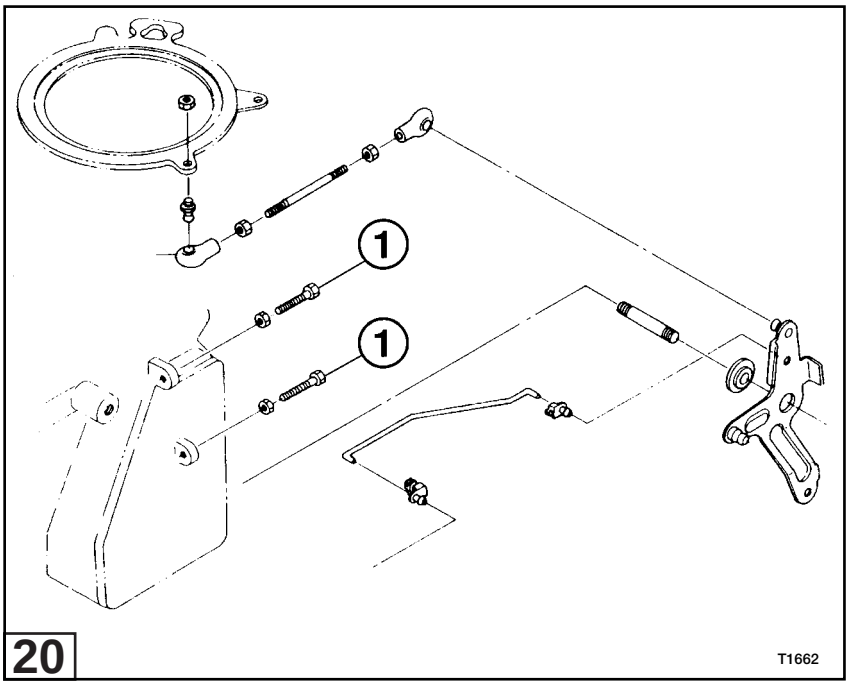


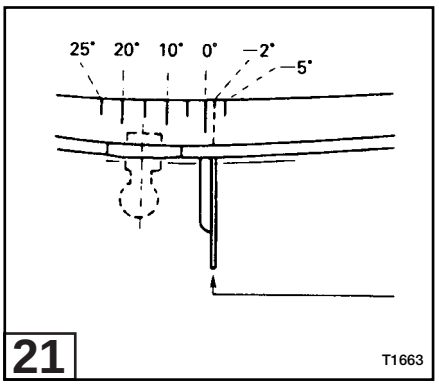
18 $25C_2$ BTDC 20°



19 $25C_3$ BTDC 25°
$30A_3$ BTDC 25°
$30A_4$ BTDC 25°
40C BTDC 25°

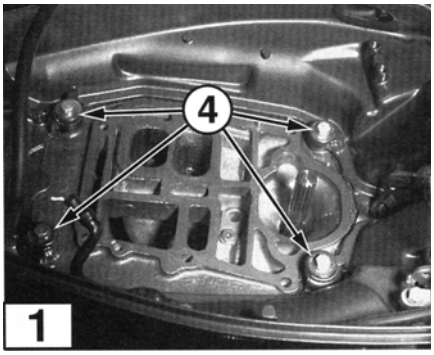




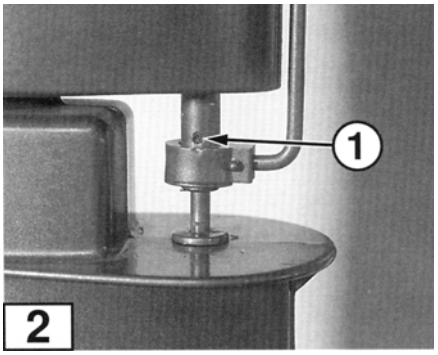


20 **21** 4. Check that the throttle valve is fully open, and the ignition timing mark at starting comes to the crankcase mating surface. Under this state, adjust the advancer arm stopper bolts **(1)** so that the advancer arm stops at the throttle valve full-open and full-close positions, and lock the bolts with a nuts.

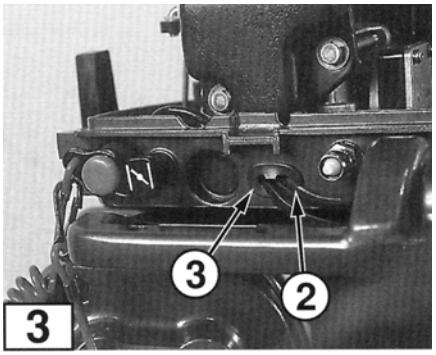
Model	Timing Setting at Start
$25C_2$	ATDC 2°
$25C_3$	ATDC 4°
$30A_3$	ATDC 2°
$30A_4$	ATDC 4°
40	ATDC 2°



T1634



T1666



T1667

LOWER ENGINE COVER

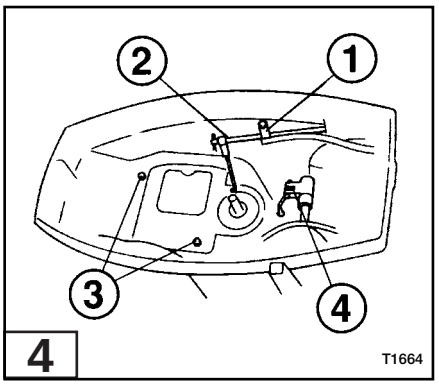
Removal

1. Remove powerhead as described in Section 4.

2. Remove control cables, electrical leads and grommets as required from lower engine cover.

1 3. Remove lower engine cover bolts **(4)**.

4. Lift cover off engine base.



T1664

8/9.8 Shift Rod and Throttle Removal

2 1. Remove spring pin **(1)** using special tool.

3 2. Remove throttle wire **(2)** and grommet **(3)**.

9.9/15/18 Throttle Shaft Removal

4 1. Remove throttle shaft support **(1)**.

4 2. Remove throttle shaft **(2)**.

25/30/40 Throttle Shaft Removal

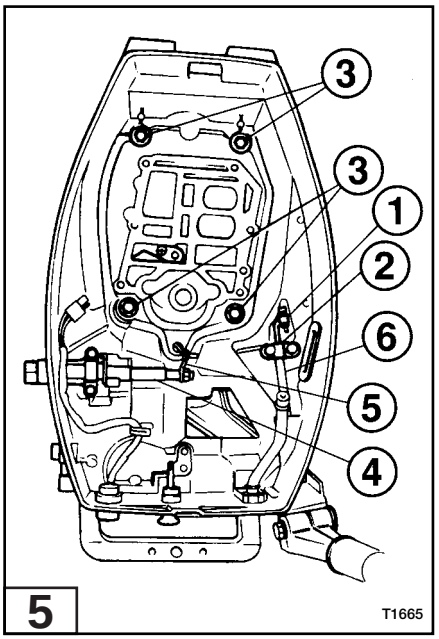
5 1. Remove throttle shaft ball joint **(1)**.

5 2. Remove upper and lower throttle shaft supports **(2)**.

5 3. Remove lower motor cover bolts **(3)**.

5 4. Raise the cover slightly and remove the shift rod **(4)** from the shift rod lever **(5)**.

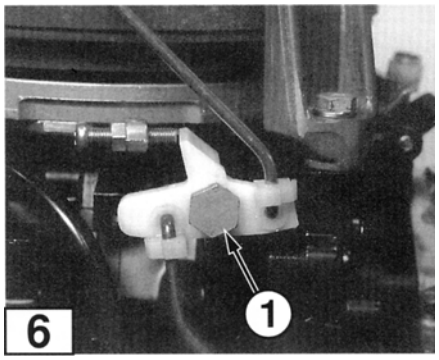
5 5. Remove the lower cover.



T1665

Installation

6 Installation is done in the reverse order of Removal. Use Loctite 242 on throttle stopper bolt **(1)** if removed.



T1668

DRIVESHAFT HOUSING

Removal

1. Remove powerhead as described in Section 4.

2. Remove tiller steering handle if equipped, this section.

3. Remove lower engine cover, this section.

4. Remove gearcase as described in Section 6.

1 5. Remove upper rubber mount nut **(1)**.

1 6. With driveshaft housing tilted fully down, remove the nut from each lower rubber mount bolt **(2)**. Do not remove the bolts.

⚠ CAUTION

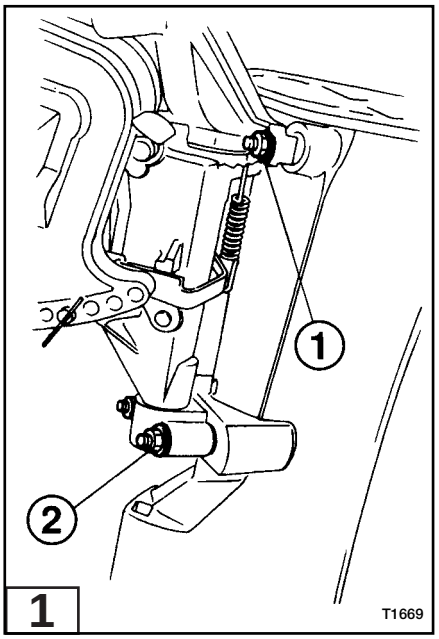
Driveshaft housing is free to fall if lower rubber mount bolts are removed.

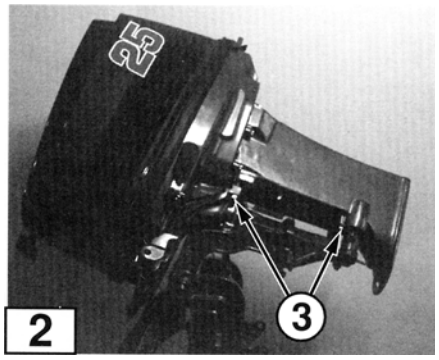
2 7. Hold driveshaft housing securely and pull lower rubber mount bolts and remove driveshaft housing. Place housing on bench for disassembly.

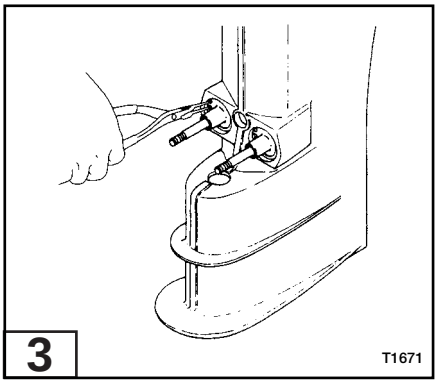
3 8. Remove the clip from the lower rubber mount and remove the upper and lower rubber mounts.

NOTE

For the 25/30 and 40 engines, use the special tool 361-72760-0 for removing the rubber mounts.





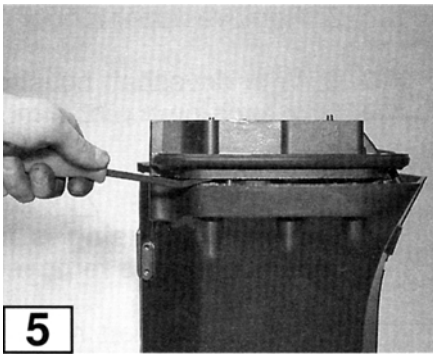


Disassembly

5

⚠ CAUTION

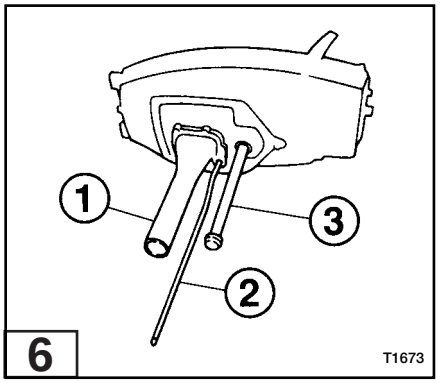
Engine base and driveshaft housing are aligned with dowel pins and may be difficult to separate. Avoid damage to the mating surfaces and gently pry sections apart if necessary ... Model 40 only.



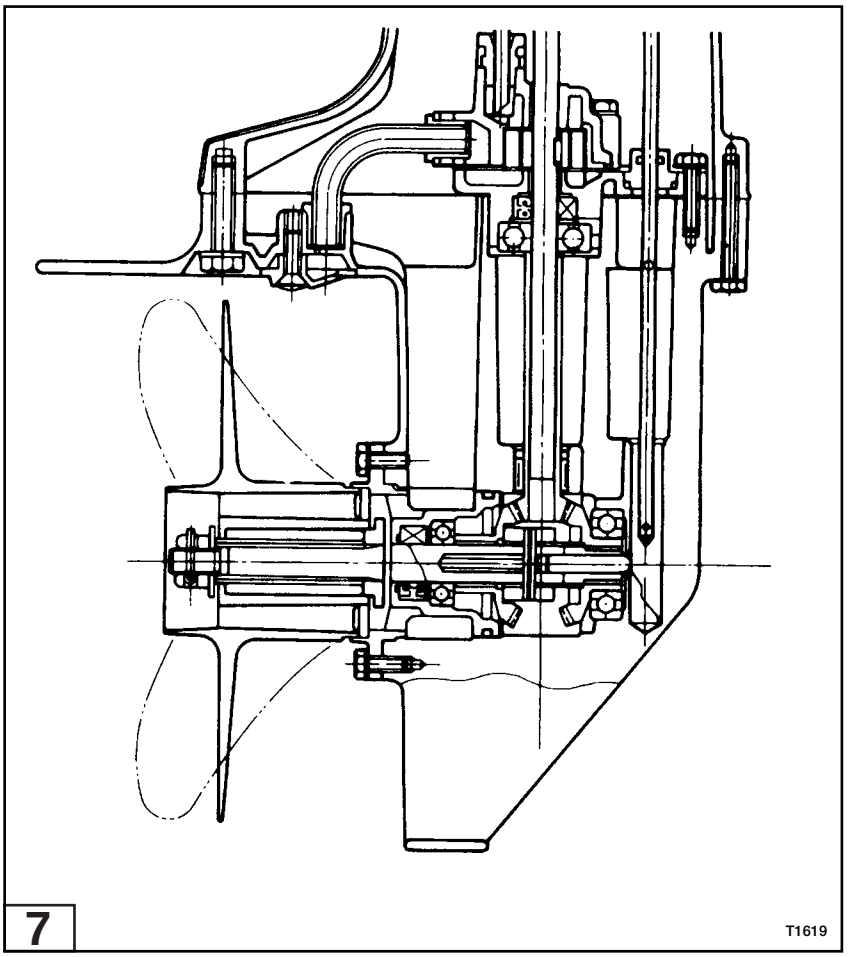
T1273

6

3. Remove exhaust pipe **(1)**, water pipe **(2)**, and guard pipe **(3)** ... Models 9.9/15/18 only.



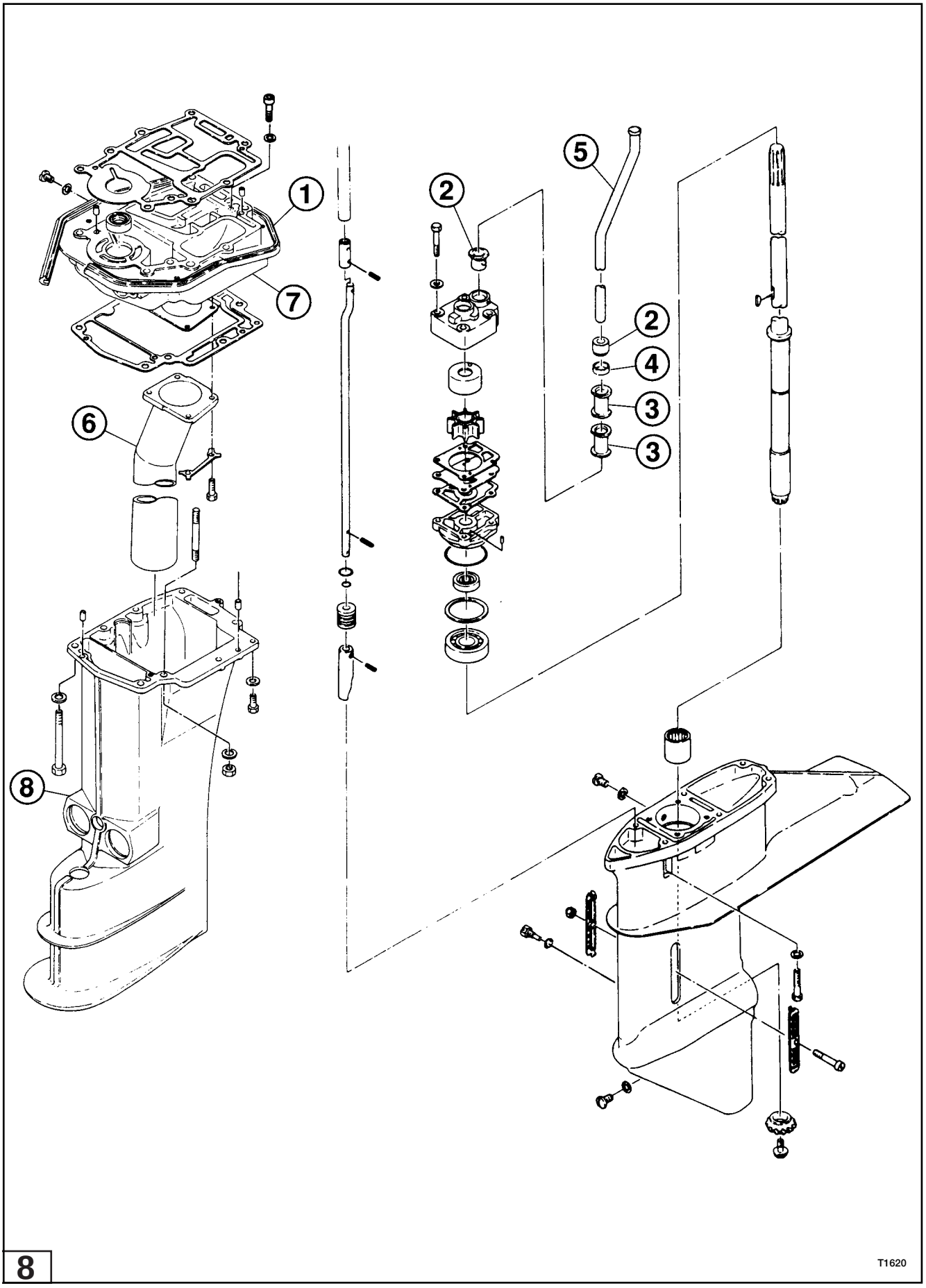
T1673



7

NOTE

The 5 engine does not have an exhaust pipe. Water is drawn through an inlet located in front of the propeller and pumped out through a tube beneath the engine.



8

T1620

Cleaning and Inspection

All worn, damaged, or missing parts must be replaced.

1. Before cleaning, examine the following rubber parts as applicable and remove if damaged, dry, or brittle:

8
- Lower cover grommets and seal ring
- Lower engine cover seal **(1)**
- Water pipe seal **(2)** locking rubber **(3)**, and rubber set ring **(4)**

Use super bond adhesive to install new rubber parts as needed on metal surfaces. Make sure metal surfaces are clean and dry before installation of rubber parts.

2. Thoroughly clean all parts including fasteners with solvent and dry with low pressure compressed air. Verify all carbon deposits, gasket adhesives, and threadlocker residue have been removed.

8 3. Inspect water pipe **(5)** for kinks or obstruction. Replace as needed.

8 4. Inspect exhaust pipe **(6)**, engine base **(7)**, and driveshaft housing **(8)** for cracks, chips, dents or other damage.

9 5. Examine the upper and lower rubber mount components for damage or signs of deterioration. Replace as needed.

Assembly

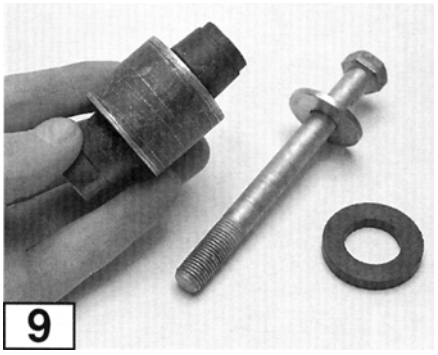
1. Verify all new rubber replacement parts have been installed on components as needed.

2. Position engine base with powerhead side facing down.

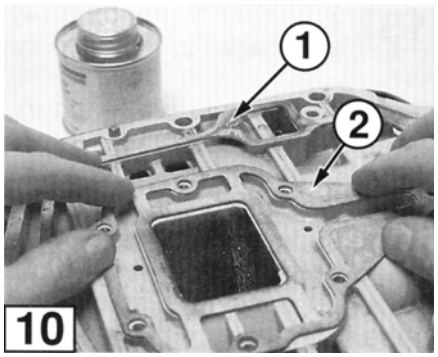
10 3. Mount new exhaust pipe gasket **(2)** on engine base **(1)**. Apply high temperature gasket dressing to both sides of gasket.

11 4. Install exhaust pipe.

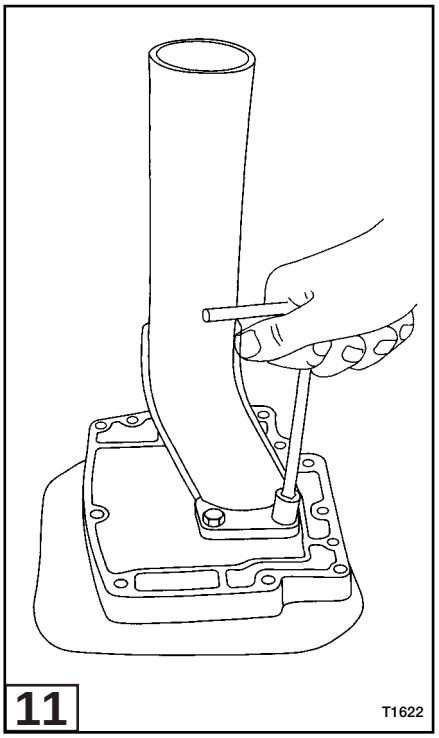
12 5. Apply genuine grease or equivalent friction surface marine grease to water pipe seal **(3)**.



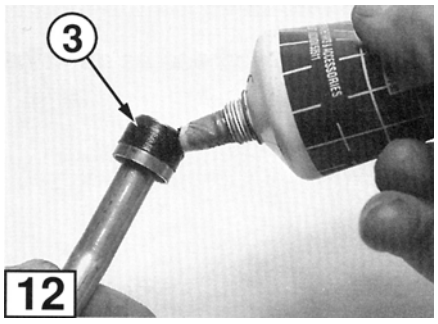
T1278



T1621



T1622



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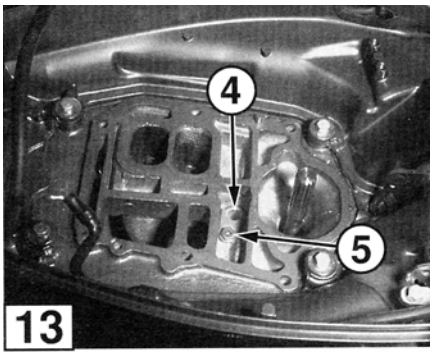


13 6. Install water pipe **(4)** in engine base **(5)** and align for installation in the driveshaft housing.

14 7. Verify knocks (where used) are installed in driveshaft housing. Apply high temperature gasket dressing to both sides of new driveshaft housing gasket and install gasket on housing.

Installation

16 1. Insert the damper cap **(1)** and damper collar **(2)** into the drive shaft housing.

2. Assemble the lower rubber mount components and install them into the drive shaft housing.

3. Apply Loctite 243 to bolt threads and torque to specification.

4. Install clip.

17 5. Assemble the upper rubber mount components and install them into the engine base.

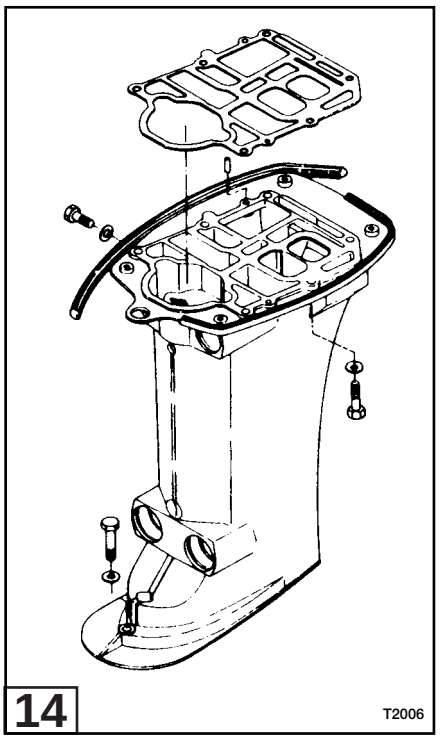
6. Apply Loctite 242 to bolt threads, install the retainer and torque to specification.

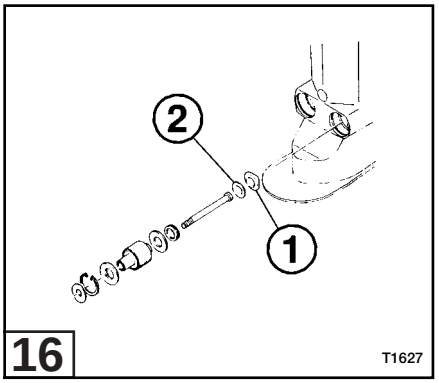
7. Install gearcase as described in Section 6.

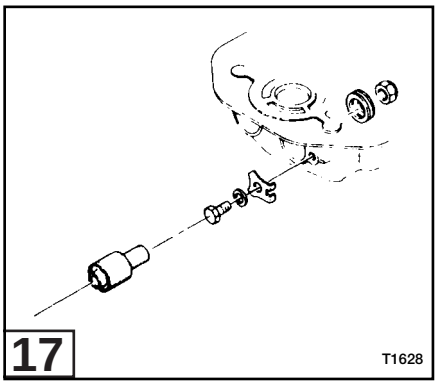
8. Install lower engine cover, this section.

9. Install tiller steering handle if equipped, this section.

10. Install powerhead as described in Section 4.







STERN AND SWIVEL BRACKETS

NOTE

The following procedures cover full disassembly of the stern and swivel bracket components with the engine mounted on an engine stand. To service only the stern brackets, suspend engine with adequate hoist and remove and install stern brackets as illustrated.

1 **Models 2.5/3.5**

2 **Model 5**

3 **Models 8/9.8**

4 **Models 9.9/15/18 Type I**

NOTE

TYPE I has a metal rod type stem bracket bolt similar to smaller engines.
TYPE II has a pipe style stem bracket bolt similar to larger engines.

5 **Models 9.9/15/18 Type II**

6 **Models 25/30/40**

Removal

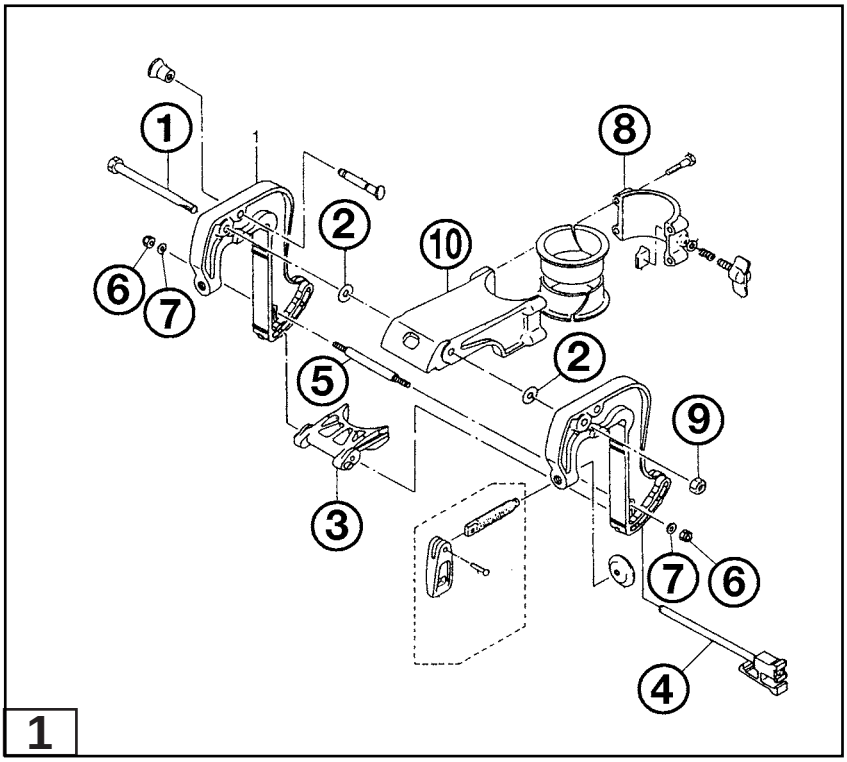
1. Remove powerhead as described in Section 4.

2. Remove tiller steering handle if equipped, this section.

3. Remove lower engine cover, this section.

4. Remove gearcase as described in Section 6.

5. Remove driveshaft housing, this section.



2.5/3.5 Stern and Swivel Bracket Disassembly

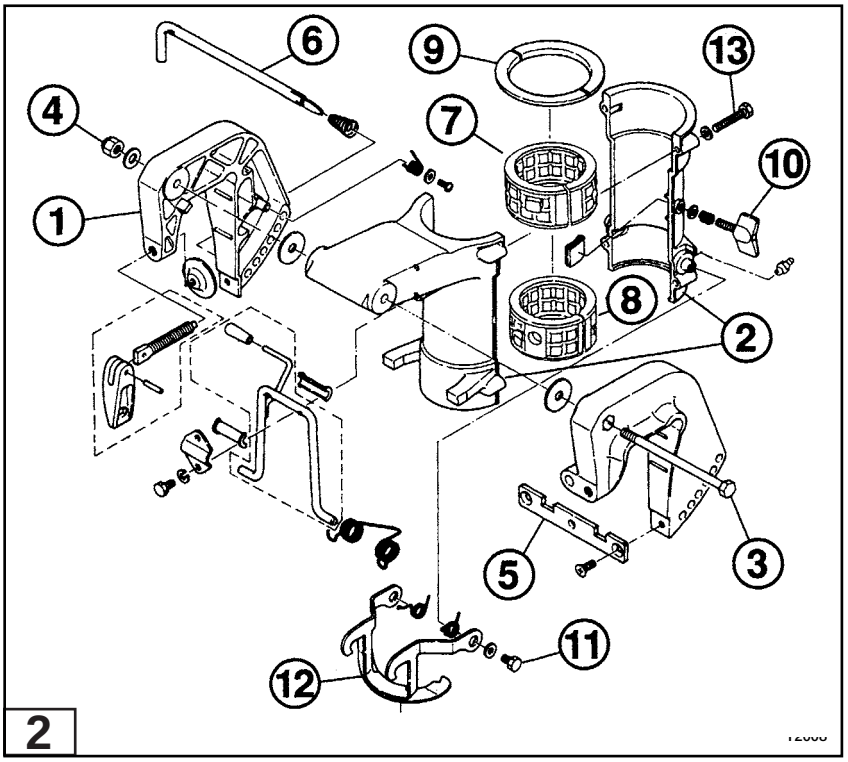
1 1. Remove the thrust rod **(4)**.

1 2. Remove stern bracket bolt, nut and washers **(1)**, **(9)**, **(2)**.

3. Remove distance shaft, nuts and washers **(5)**, **(6)**, **(7)**.

4. Remove thrust support **(3)**.

5. Separate swivel brackets **(8)**, **(10)**.



5 Stern Bracket Disassembly

2 1. Remove the reverse lock arm bolts **(11)**.

2 2. Remove reverse arm lock and springs **(12)**.

2 3. Remove swivel bracket bolts **(13)**.

4. Remove drive shaft housing.

2 5. Remove thrust plates **(9)**.

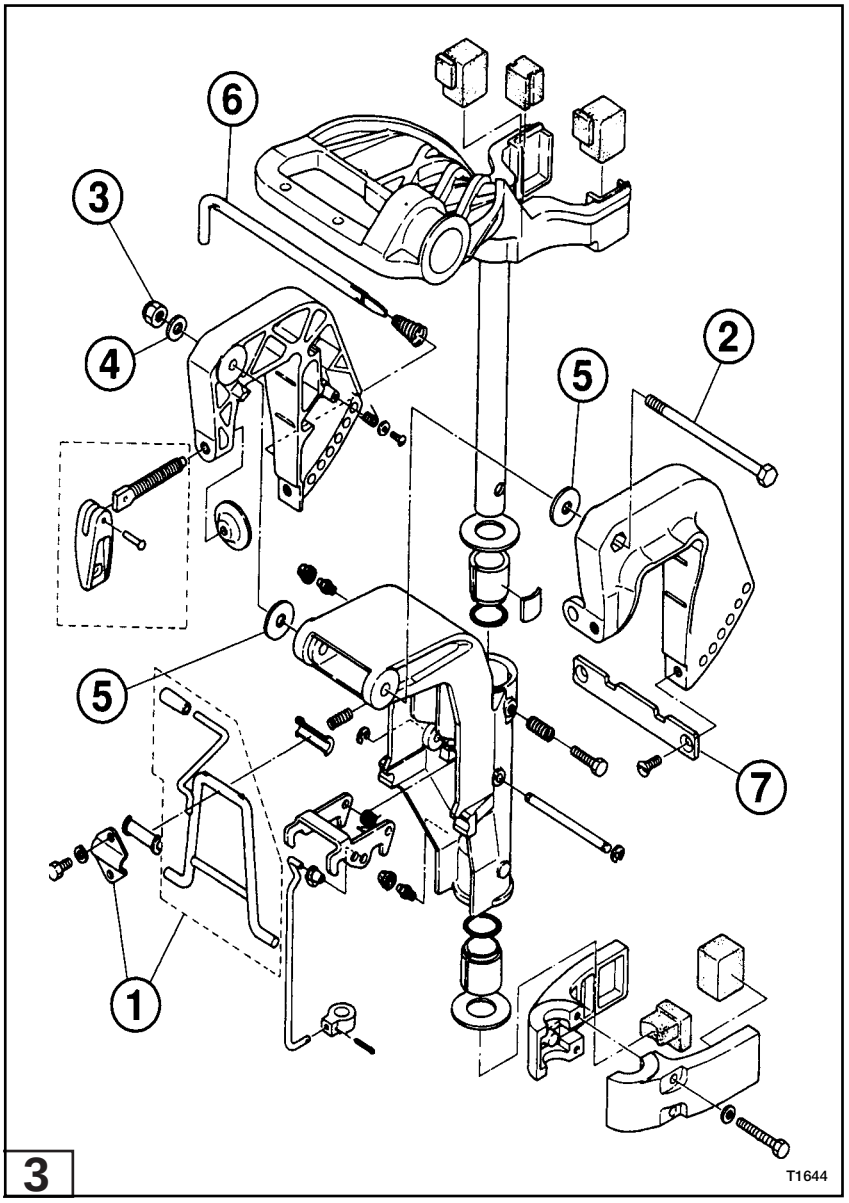
2 6. Remove both upper and lower bushings **(7)**, **(8)**.

2 7. Remove the thrust rod **(6)**.

2 8. Remove the stern bracket bolt, nut and washers **(3)**, **(4)**.

2 9. Remove the distance plate **(5).**

10. Separate the brackets.



8/9.8 Stern Bracket Disassembly

3 1. Remove tilt stop assembly **(1)**.

3 2. Remove stern bracket bolt **(2)**, nut **(3)** and washers (**4** and **5**).

3 3. Remove thrust rod **(6)**.

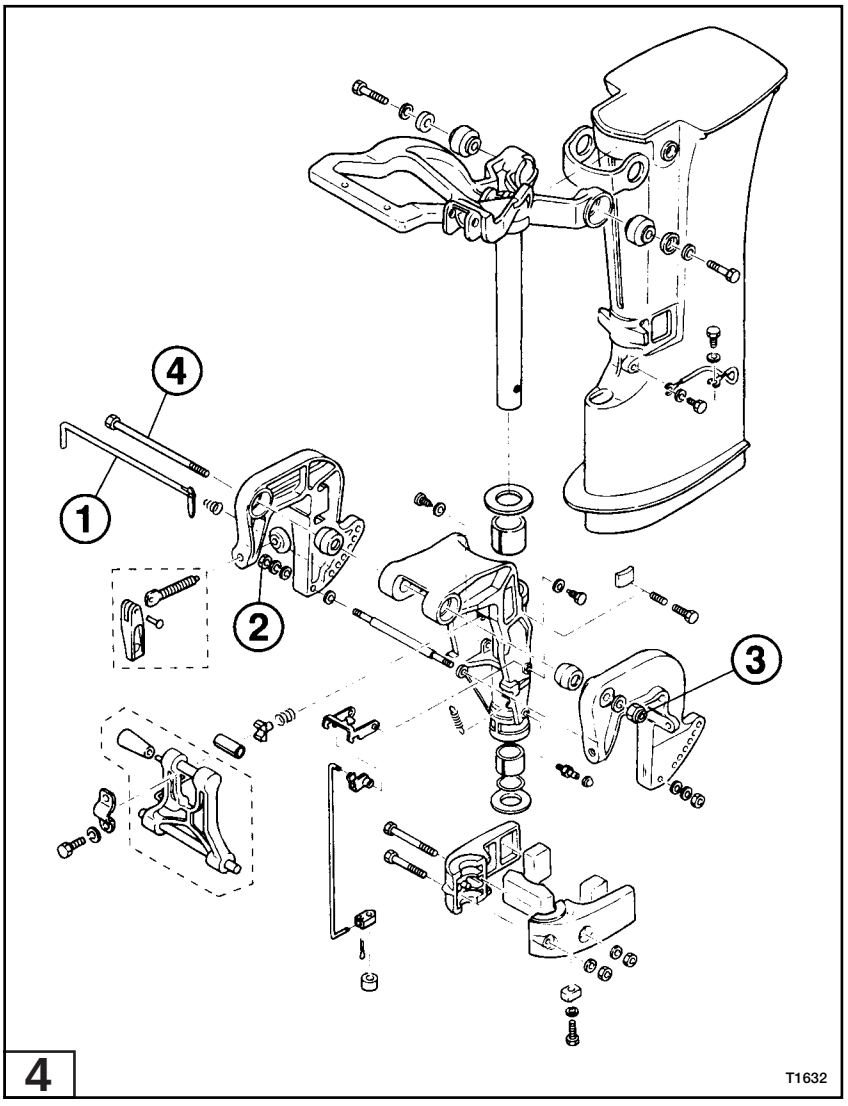
3 4. Remove distance plate **(7)**.

9.9/15/18 Stern Bracket
Disassembly

Two types of stern brackets are used on the 9.9/15/18 engines and are identified as **Type I** and **Type II**:

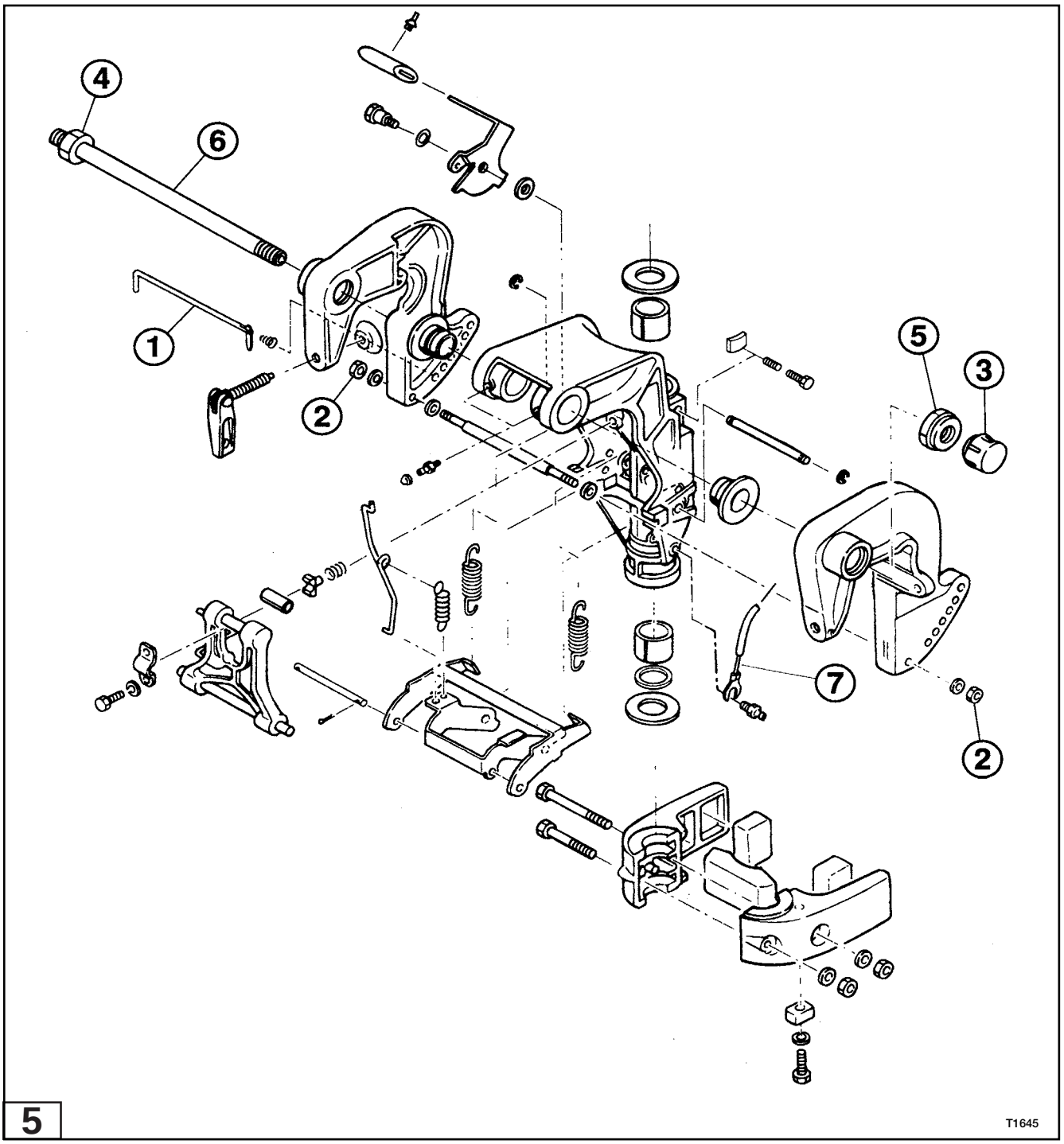
- **Type I** has a metal rod type **stern bracket bolt** similar to the smaller engines
- **Typel II** has a pipe style **stern bracket bolt** similar to larger engines

Type II stern bracket bolts have nylon caps on both ends. All Type II stern bracket bolts are the same diameter, but vary in length.



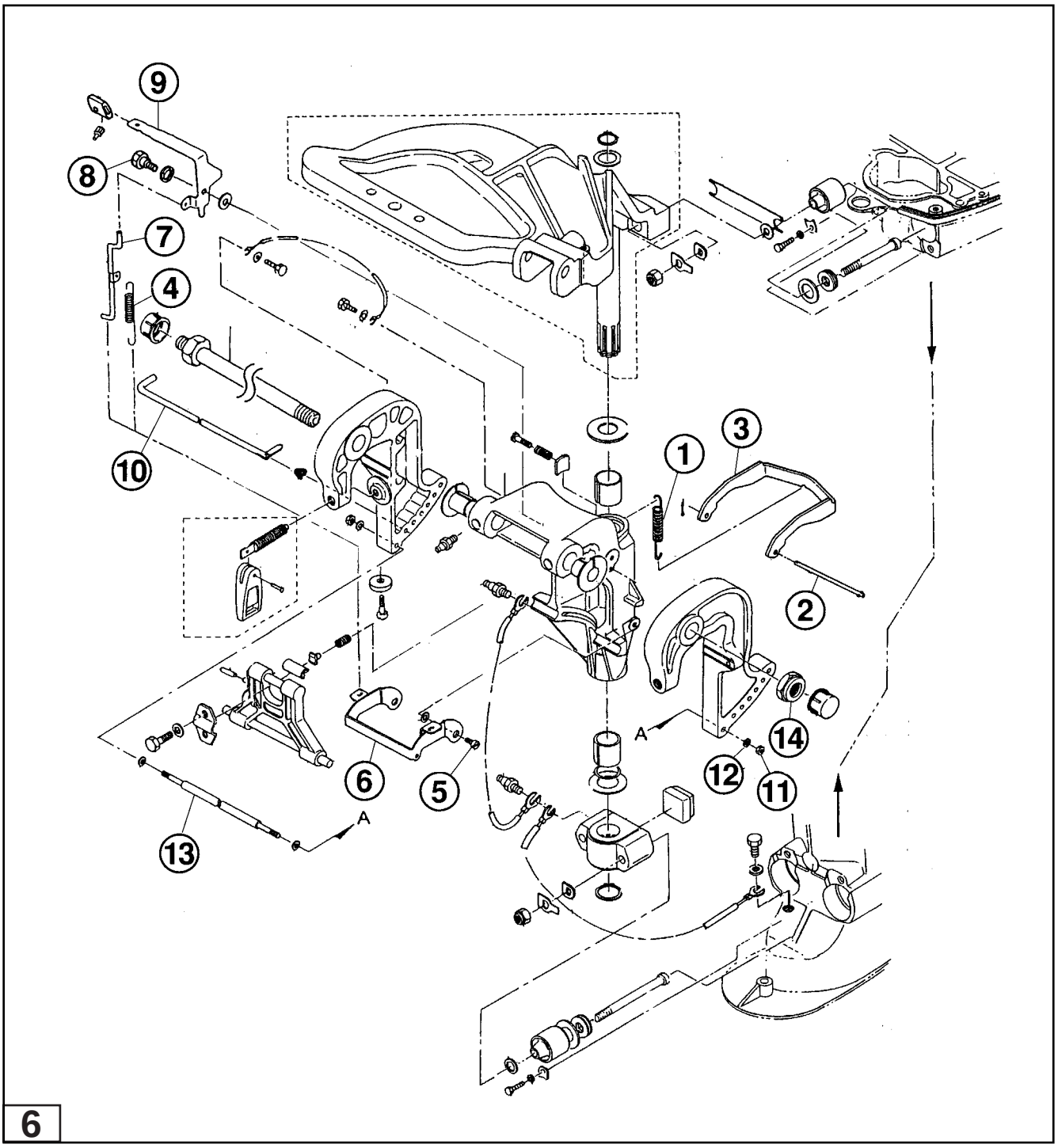
4 **Type I Stern Bracket**

1. Remove thrust rod **(1)**.
2. Remove nuts **(2)**.
3. Remove bracket nut **(3)**.
4. Remove bracket bolt **(4)**.
5. Separate the brackets.



5 Type II Stern Bracket

1. Remove thrust rod **(1)**.
2. Remove nuts **(2)**.
3. Remove pipe caps on bracket bolt **(3)**.
4. Holding bracket bolt nut **(4)** with wrench, remove bracket bolt nut **(5)**.
5. Remove bracket bolt **(6)**.
6. Remove ground wires **(7)**.
7. Separate the brackets.



6

25/30 and 40 Stern Bracket Disassembly

NOTE

Only minor variations exist between 25/30 and 40 model brackets.

6 1. Remove the reverse lock spring **(1)**.

6 2. Remove the split pin from the reverse lock rod **(2)** and remove the reverse lock rod **(2)** and reverse lock **(3)**.

6 3. Remove the reverse lock lever spring **(4)**.

6 4. Remove the reverse lock arm shafts **(5)** and remove the reverse lock arm **(6)**.

6 5. Remove the reverse lock link **(7)**.

6 6. Remove the reverse lock lever shafts **(8)** and remove the reverse lock lever **(9)**.

6 7. Remove the thrust rod **(10)**.

6 8. Remove the bracket distance piece nuts **(11)** and washer **(12)** and pull out the bracket distance piece **(13)**.

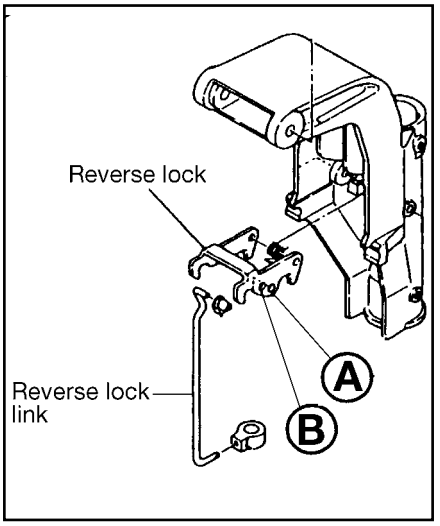
6 9. Remove the bracket nut **(14)**, and separate the brackets.

SWIVEL BRACKET AND REVERSE LOCK

The swivel bracket and reverse locks of one and two cylinder engines differ in function. The following describes features of swivel brackets and reverse locks.

Engine	Swivel Bracket	Reverse Lock
2.5/3.5	Turning Radius: 360°	Ring Inhibit
5	Turning Radius: 360°	Synchronized with shift lever (Lock only reverse position)
8/9.8	Turning Radius: 130° Port: 65° Starboard: 65°	Synchronized with shift lever (Lock only reverse position) The lock position can be adjusted by moving the reverse lock link as shown in below.
9.9/15/18	Turning Radius: 80° Port: 40° Starboard: 40°	Lock all of shifting positions. Un-locking is carried out by operating the reverse lock lever. Reference : Kit parts for synchronized with shift lever is prepared for an option.
25/30/40	Turning Radius: 80° Port: 40° Starboard: 40°	Lock all of shifting position. Un-locking is carried out by operating the reverse lock lever.

Shift position-Lock (for 8/9.8)



- The shift lever is normally locked in Reverse **(R)**. (the reverse lock link is position **A**)
- When locking the shift lever in Reverse **(R)** and Neutral **(N)**, shift the reverse lock link from **A** to **B** position.

Assembly

NOTE

Before proceeding, make sure all components have been thoroughly cleaned with solvent and allowed to dry. Inspect all parts, especially bushings, thrust washers, and upper and lower engine mounts for damage and deterioration. Replace all seals and o-rings.

NOTE

Improper arrangement of bushings and thrust washers may not prevent full assembly of the bracket components. Reference preceding illustrations to ensure correct orientation of parts.

NOTE

During assembly, apply genuine grease or equivalent friction surface marine grease to all friction parts and surfaces.

1. Install swivel bracket and springs (if applicable) while installing bracket nuts.

2. Install bracket distance piece (or plate) with bolts (or nuts).

3. Install the thrust rod.

4. Install the reverse lock lever and shaft.

5. Install the reverse lock link (if applicable, and cotter pin).

6. Install reverse lock arm and shaft.

7. Install reverse lock lever spring.

8. Install the reverse lock, cotter pin and rod.

9. Install reverse lock spring.

10. Fill all grease fittings. See Lubrication Chart in Section 2.

Installation

Installation is done in the reverse order of Removal.

SECTION 6
GEARCASE

TABLE OF CONTENTS

SECTION 6

GENERAL PRECAUTIONS

Before performing any service work on the gearcase, read and understand the Service Safety section at the beginning of this manual.

Full servicing of the gearcase requires manufacturer special tools. Follow all special tool requirements as specified. Substituting special tools with those not provided by the manufacturer may result in severe personal injury, equipment or engine damage, or faulty service work.

Perform bearing removal and installation operations exactly as specified to avoid damage to the bearing or housing during pressing operations.

Replace locking fasteners when their locking feature becomes weak.
Use only factory replacement parts.

When using compressed air to clean or dry parts, make sure air supply is regulated not to exceed 25 psi [172 kPa / 1.76 kg/cm^2].

SERVICE SPECIFICATIONS

Special Torque Values

Description	Torque in-lb (ft-lb) N-m kg-m				Threadlocker
	Model				
	2 / 3 / 5	8 / 9.8 / 9.9 / 15 / 18	25 / 30	40	
Propeller Nut	—	—	(21.7 - 28.9) 29.4 - 39.2 3.0-4.0	(21.7 - 28.9) 29.4 - 39.2 3.0-4.0	—
Pump case Bolts	41 - 55 4.6 - 6.2 0.47 - 0.64	41 - 55 4.6 - 6.2 0.47 - 0.64	41 - 55 4.6 - 6.2 0.47 - 0.64	41-55 4.6-6.2 0.47 - 0.64	Loctite 242
Bevel Gear B Nut/Bolt	—	(2l.7 - 25.3) 29.4 - 34.3 3.0 - 3.5 Nut	(21.7 - 25.3) 29.4 - 34.3 3.0 - 3.5 Nut	(17.3 - 18.8) 23.5 - 25.5 2.4 - 2.6 Bolt	—

Refer to Section 2 for Standard Torque Values chart.

SECTION 6

Manufacturer Special Tools Required

Part Name	Part Number	2.5 3.5	5	8 9.8	9.9 15 18	25 30	40
Bevel Gear A Bearing Puller Ass'y	3A3-72755-0					•	•
Bearing Outer Press Rod	3B7-72731-0					•	•
Bearing Outer Press Plate	353-72732-0						•
Bearing Outer Press Plate	346-72732-0					•	
Bearing Outer Press Guide	346-72733-0					•	•
Bevel Gear A Set Tool	346-72719-0					•	
Bevel Gear A Set Tool	3C8-72719-0						•
Backlash Measuring Tool Kit	3B7-72740-0		•	•			
Backlash Measuring -Tool Sub-Ass'y	*369-72730-0		•	•			
Backlash Measuring Tool Arm	*369-72727-0		•				
Backlash Measuring Tool Arm	*3B2-72727-0			•			
Backlash Measuring Tool Kit	3C8-72234-0				•	•	•
Measuring Tool Shaft	*345-72723-0				•	•	•
Backlash Measuring Tool Plate	*3A3-72724-0				•	•	•
O-Ring, 2-9	*332-60002-0				•	•	•
Backlash Measuring Tool Collar	*350-72245-0				•		
Backlash Measuring Tool Collar	*346-72245-1					•	
Backlash Measuring Tool Collar	*353-72245-1						•
Nut, 10P1.5	*930191-1000				•	• (2)	• (2)
Conedisk Spring, d=12	*3B7-72734-0					• (2)	• (3)
Clamp Ass'y Backlash Measur'g Tool	3B7-72720-0		•	•	•	•	•
Bolt	910191-0625				• (3)	• (4)	• (4)
Dial Gauge Plate	3B7-72729-0				•	•	•
Shimming Gauge	346-72250-0					•	
Shimming Gauge	3C8-72250-0						•
Thickness Gauge	353-72251-0					•	•

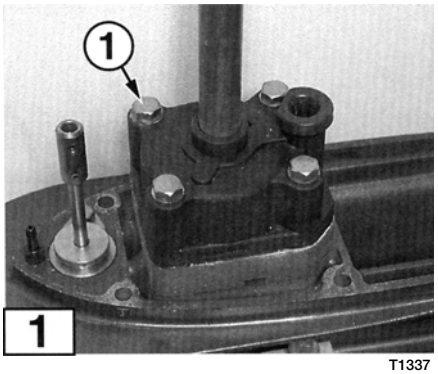
Remark: Given mark in (*) to part number shows parts for the Backlash Measuring Tool Kit.

General Equipment Required

TorqueWrench, 0- 150 in-lb[0 - 17 N-m / 0- 1.7 kg-m]
TorqueWrench, 0 - 150 ft-lb [0 - 200 N-m / 0 - 20 kg-m]
Dial Gauge, minimum scale0.0001 in [0.01 mm]
Gearcase Pressure Tester, *Stevens® S-34 or equivalent*
Gearcase Vacuum Tester, *Stevens® V-34 or equivalent*
Seal Pullers
Seal hlStallers
Heat Gun

Consumables Required

Threadlocker, *Loctite® 242*
Gasket Sealant, *Permatex® High Tack Gasket Sealant*
Anaerobic Gasket Maker, *Loctite® 518*
Silicone Spray Lubricant, *Permatex® Silicone Spray Lubricant*
Genuine Grease or Equivalent Friction Surface Marine Grease
lsopropyl Alcohol
Cleaning Solvent
Engine Lubricant, *Genuine engine oil or NMMA certified TC-W3 oil*
Gear Lubricant, *Genuine gear oil or API grade GL5, SAE #80 - #90*
Cleaning Pads, *Scotch-Brite® Abrasive Pads*
Gasket Remover



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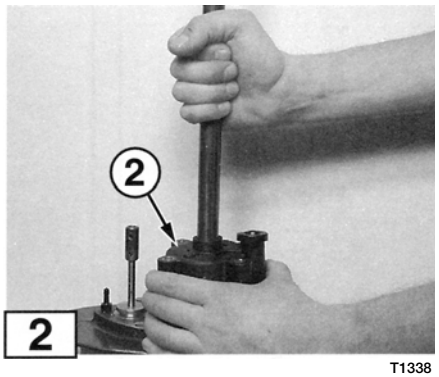

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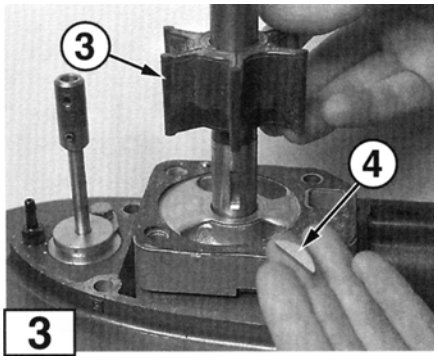

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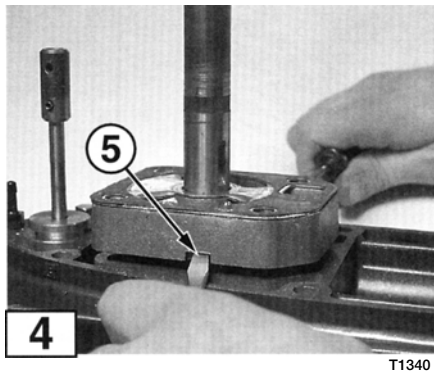


T1340

WATER PUMP

If the engine has been run without water for any length of time, the water pump should be serviced with a water pump repair kit. Use the following procedures to install the repair kit.

Removal

1. Remove the gearcase. See Gearcase, this section.

1 2. Remove water pump mounting bolts **(1)**.

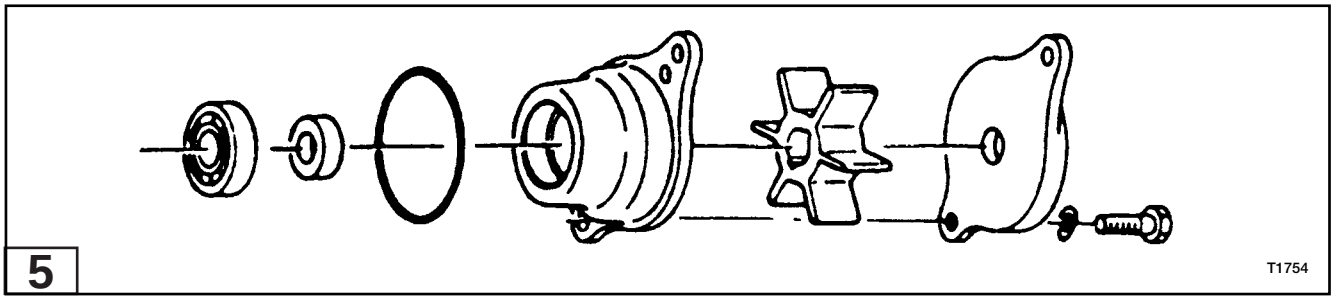
2 3. Hold upper pump case **(2)** securely and rotate driveshaft clockwise to free impeller from upper pump case.

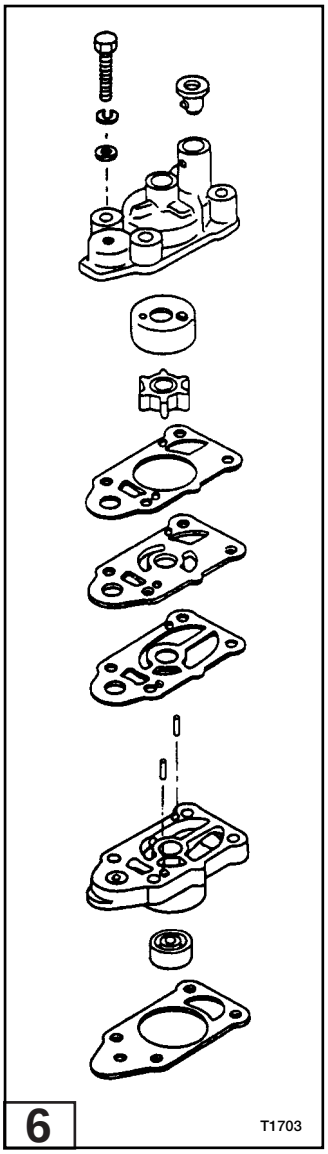
⚠ CAUTION

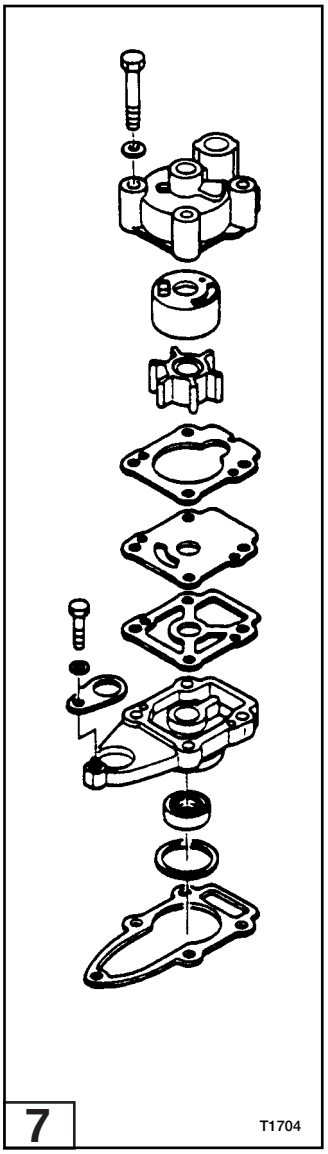
Do not rotate driveshaft counterclockwise. Doing so will bend impeller fins in wrong direction and may weaken or damage the impeller.

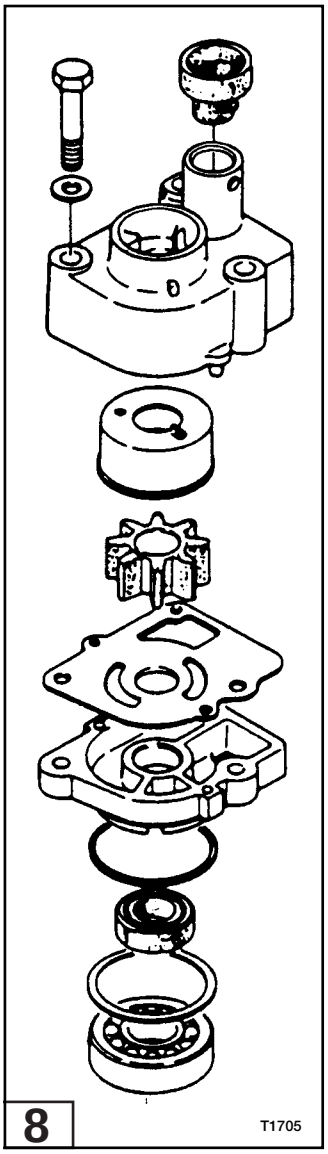
3 4. Slide upper pump case off driveshaft and remove pump impeller **(3)** and impeller key **(4)**.

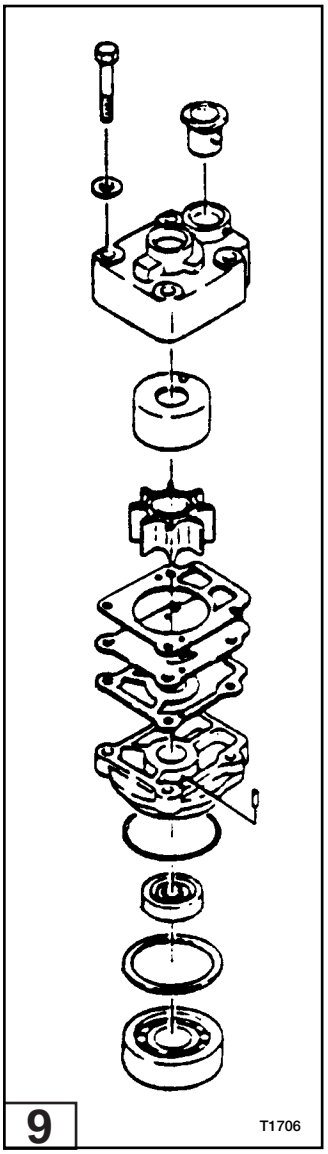
4 5. Insert a screwdriver in each lower pump case notch **(5)** and gently pry upward to remove. Slide lower pump case off driveshaft.











Disassembly and Assembly

5 6 7 8 9 1. Disassemble the water pump component as illustrated and verify the kit parts match the originals before discarding old parts.

NOTE

Lower pump case dowel pins are difficult to remove and should only be pulled out if replacement is necessary.

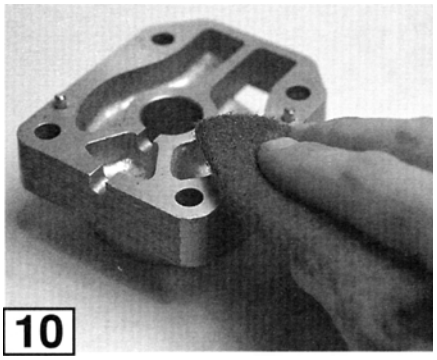
5 2.5/3.5 w/o Shift Lever

6 3.5 w/ Shift Lever

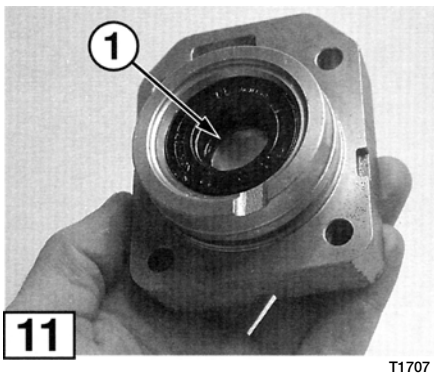
7 5, 8/9.8

8 25/30

9 40



T1344



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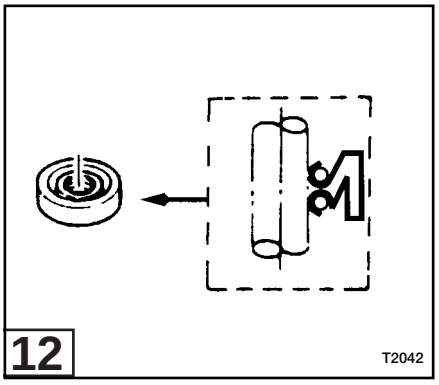


T2042

10 2. Remove all gasket residue from lower pump case with abrasive cleaning pads and gasket remover. Do not scrape the gasket surface with metal scraper. Thoroughly clean all components with isopropyl alcohol and dry with lou pressure compressed air.

3. Inspect the upper and lower pump cases for signs of melting and cracks. Replace as needed.

11 4. Examine lower pump case oil seals **(1)** for signs of damage and deterioration.

12

NOTE

If necessary to replace seals, use appropriate size seal puller and installer to avoid damaging new seals and seating surfaces in lower pump case. Apply silicone spray lubricant to seals and install so lips face direction indicated.

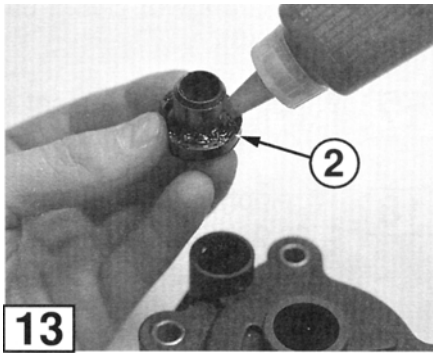
13 5. Apply anaerobic gasket maker to seating surface of water pipe lower seal **(2)**.

14 6. Install seal in upper pump case so locking tabs **(3)** align with holes **(4)**.

15 7. Slide pump case liner **(5)** partially into upper pump case housing so locking tab **(6)** is aligned with notch in housing.

NOTE

Pump case liner must be flush with flanged surface of upper pump case. If not, remove liner and re-align locking tab with notch in upper pump case housing.



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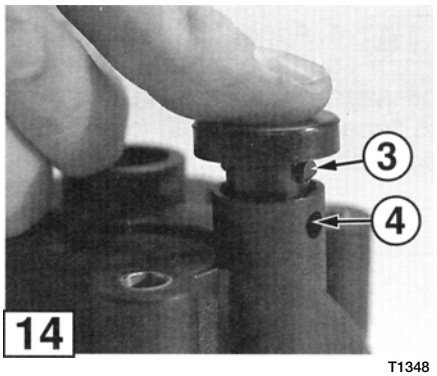

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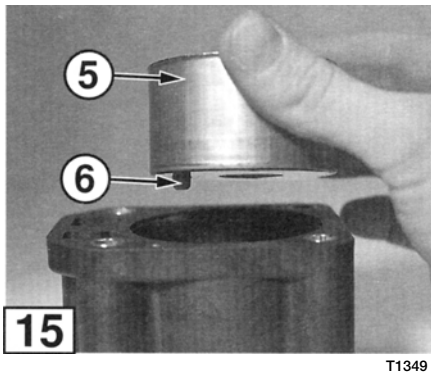

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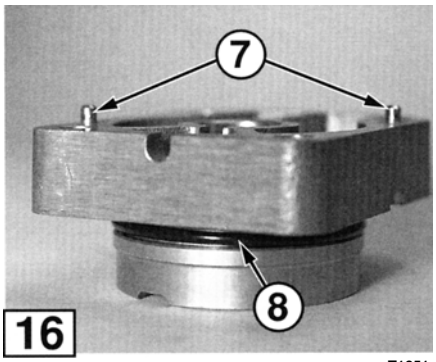

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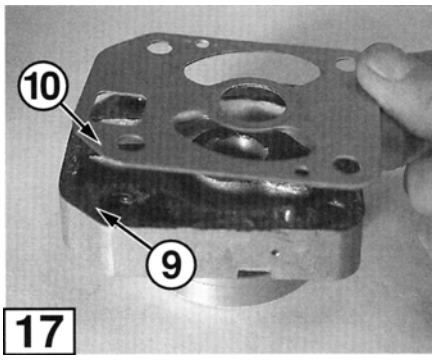

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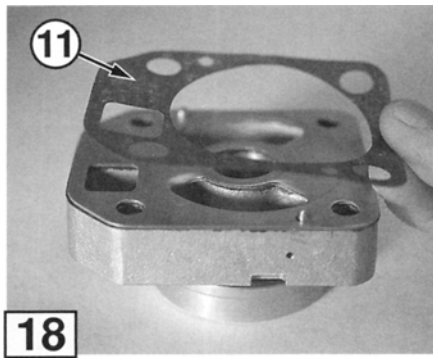
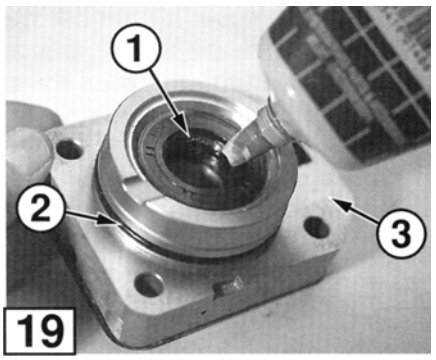


T1353

16 8. Install lower pump case dowel pins **(7)** if removed and o-ring **(8)**.

17 9. Apply gasket sealant to both sides of guide plate gasket **(9)**. Mount gasket and guide plate **(10)** on lower pump case.

18 10. Apply gasket sealant to guide plate side of upper pump case gasket **(11)**. Mount gasket on guide plate.

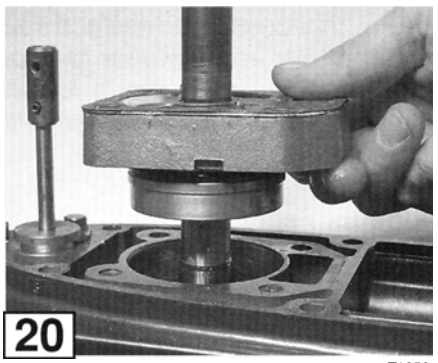


T1355

Installation

19 1. Apply a light coating of genuine grease or equivalent friction surface marine grease to the lower pump case driveshaft passage, oil seal lips **(1)**, and o-ring **(2)**. Apply an aerobic gasket maker to flanged surface **(3)** to provide adequate seal between lower pump case and gearcase.

20 2. Slide lower pump case down driveshaft and seat into position on gearcase.

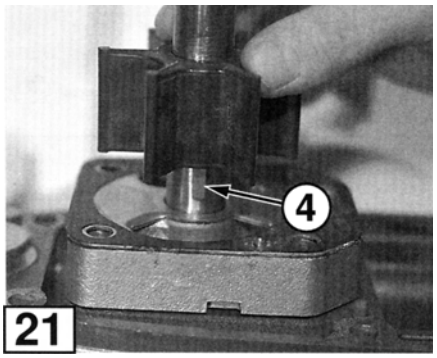


T1356

3. Slide the impeller down the driveshaft onto lower pump case.

21 4. Insert impeller key **(4)** in driveshaft and align impeller slot with key. Hold the impeller key in place and push impeller down until seated in position.

22 5. Lubricate the impeller blades with soapy water and slide upper pump case down driveshaft. Hold pump case securely and push downward while rotating driveshaft clockwise to seat the impeller.

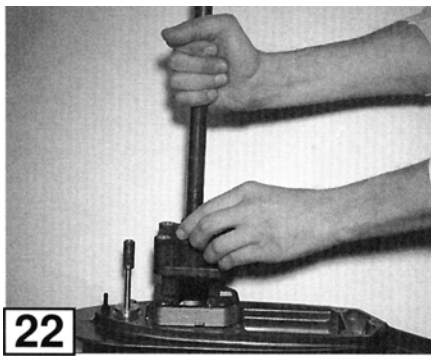


T1357

⚠ CAUTION

Do not rotate driveshaft counterclockwise. Doing so will bend impeller blades in wrong direction and may weaken or damage the impeller.

6. Ensure upper pump case is aligned and fully seated on the dowel pins. Hold the upper pump case in position and rotate driveshaft clockwise to ensure free movement.

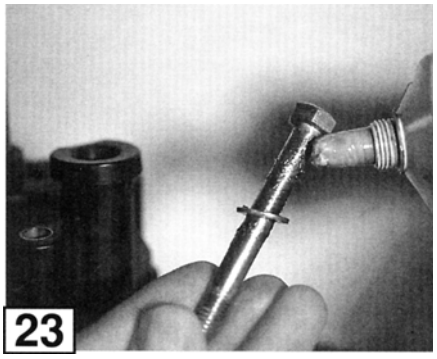


T1358

⚠ CAUTION

Make sure impeller blades are not caught or pinched between upper and lower pump cases when upper pump case is fully seated.

23 7. Apply genuine grease or equivalent friction surface marine grease to neck portion of water pump mounting bolts. Install the bolts.

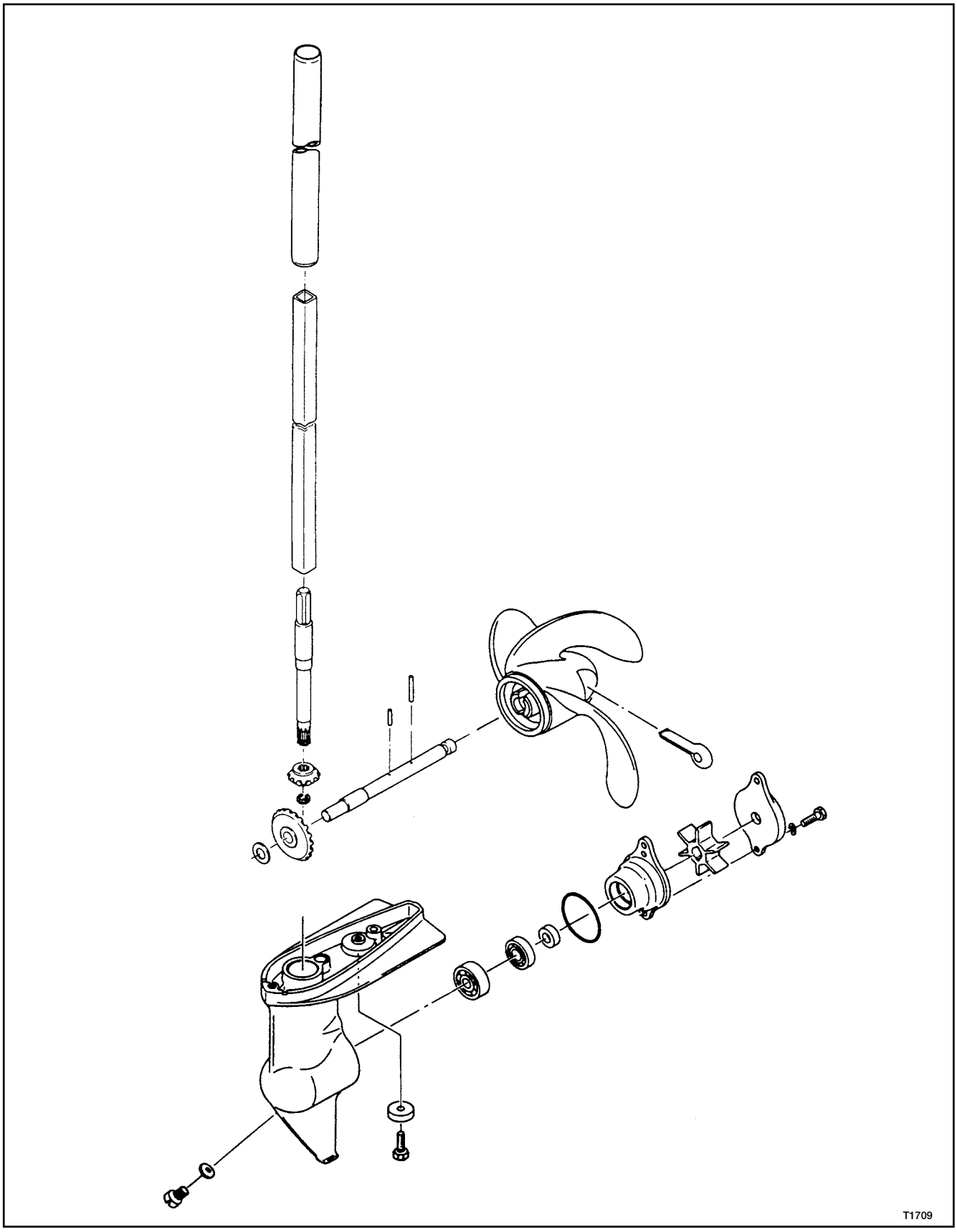


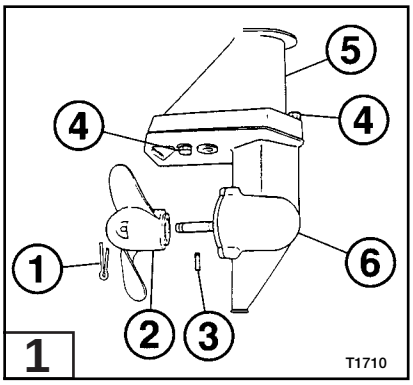
T1359

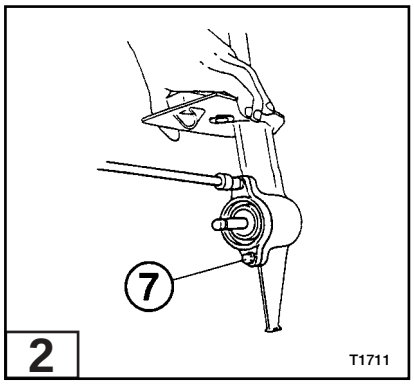
8. Install the gearcase. See Gearcase, this section.

GEARCASE

Typical Gearcase – 2.5/3.5







Removal and Disassembly

⚠⚠ WARNING

Ignition system must be disabled to prevent accidental engine start-up during removal of the gearcase.

1 1. Remove split pin **(1)**, propeller **(2)**, and shear pin **(3)**.

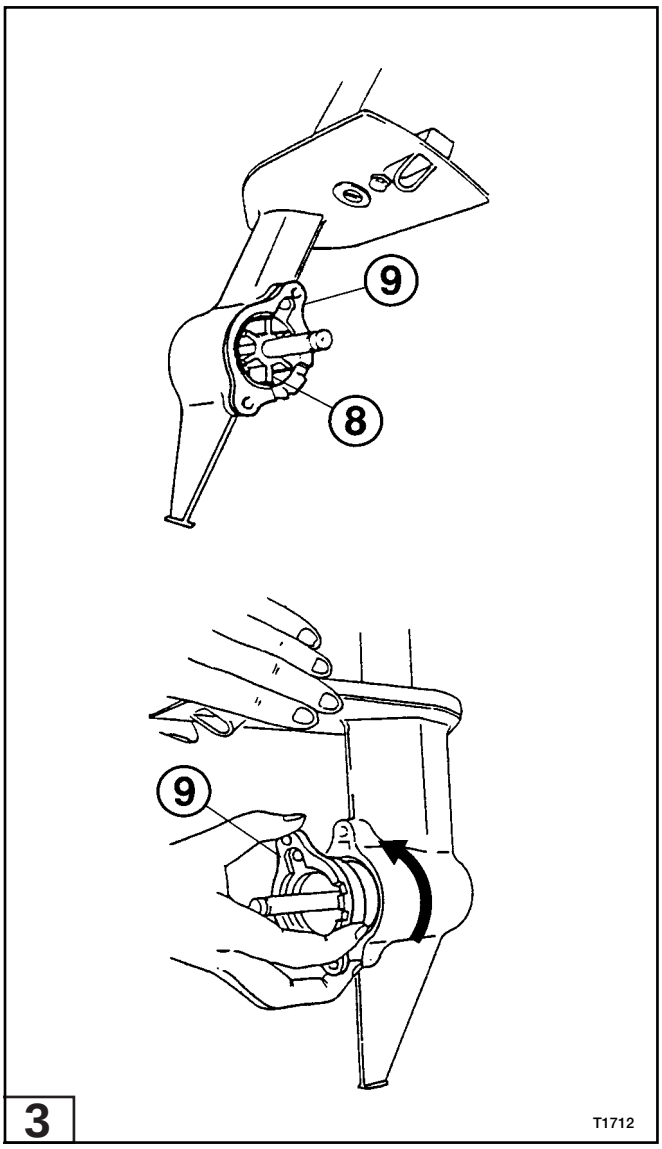
1 2. Remove gearcase bolts **(4)** and gearcase assembly **(6)** from the drive shaft housing **(5)**.

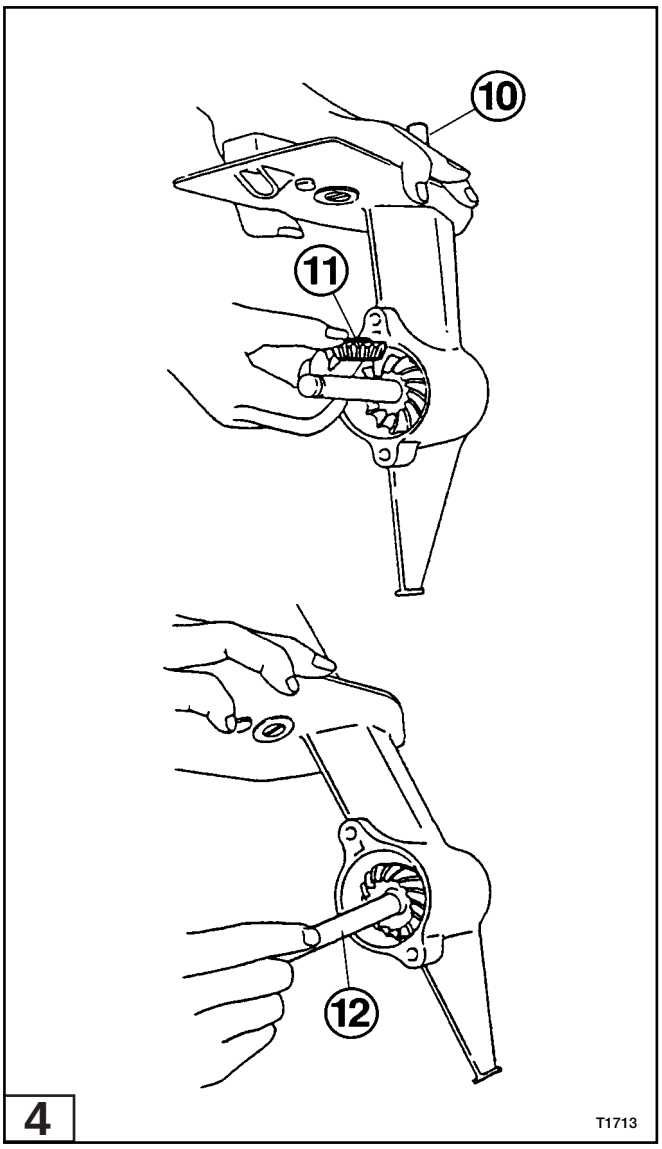
3. Drain all gearcase oil into a container and inspect the oil for metal chips.

NOTE

Small metal fragments may indicate normal wear of gears, bearings, and shafts Large metal chips usually indicate extensive internal damage. Record your observations for future reference when inspecting internal components.

2 4. Remove gearcase head bolts **(7)** and head.

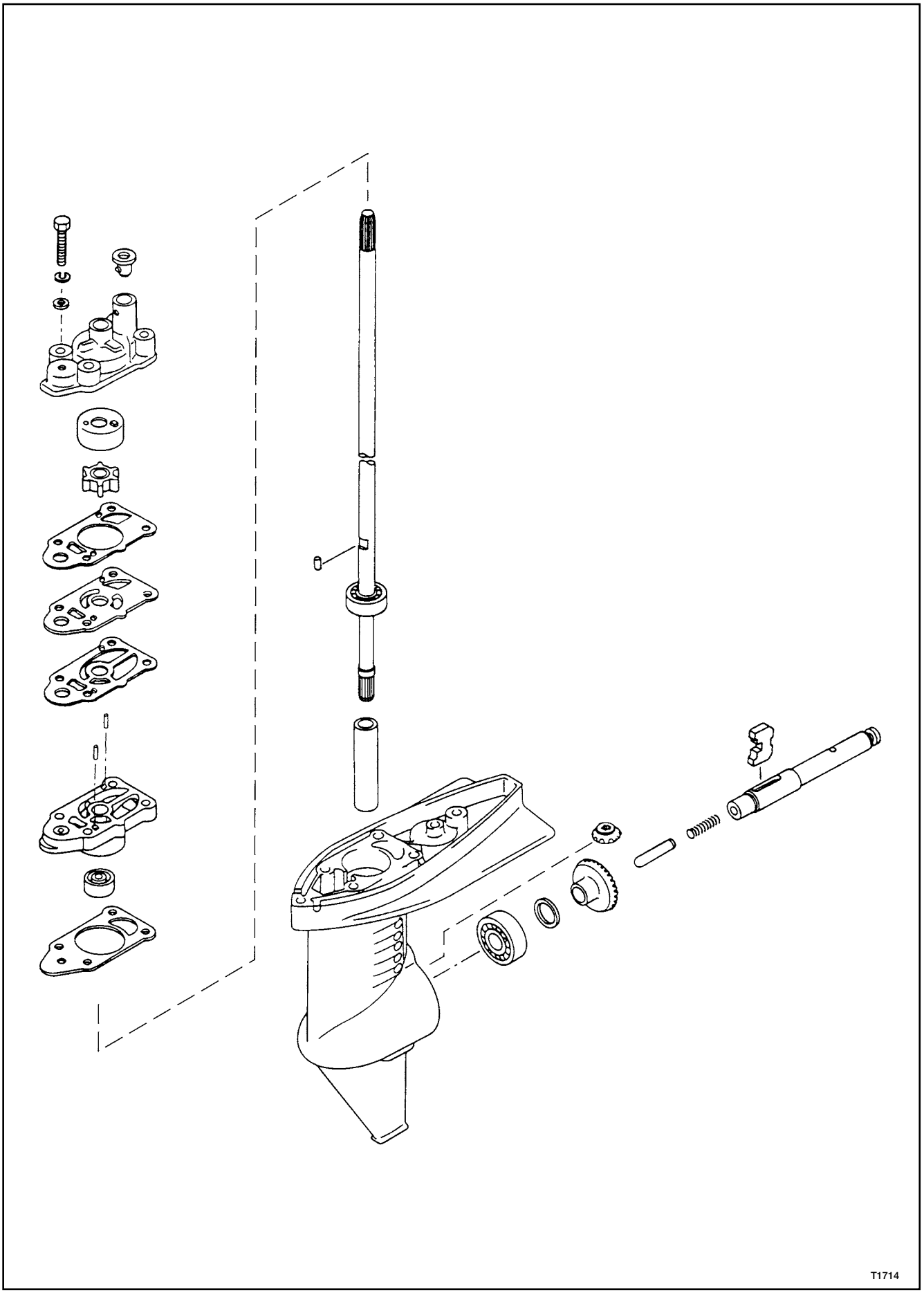


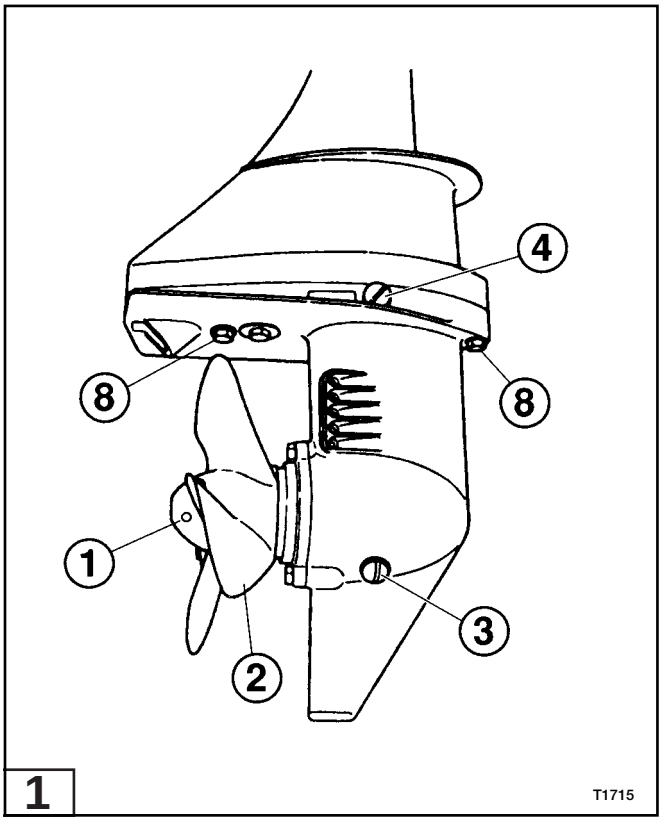


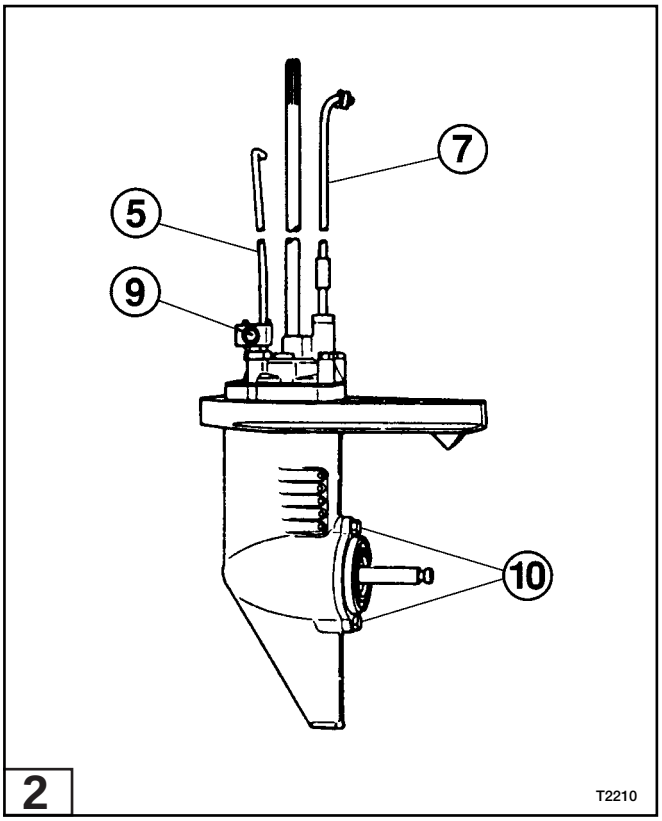
3 5. Remove the water pump impeller **(8)** and impeller key. Remove the water pump case **(9)**. Install a water pump repair kit if gearcase has been in service for any length of time. See Water Pump, this section.

4 6. Lift up the lower drive shaft **(10)** and remove bevel gear B **(11)**. Remove the propeller shaft **(12)**.

Typical Gearcase – 3.5B







Removal and Disassembly

⚠⚠ WARNING

Ignition system must be disabled to prevent accidental engine start-up during removal of the gearcase. Place engine in neutral gear.

1. Remove drive shaft housing grommet.

2 2. Loosen shift rod joint bolt **(9)**.

NOTIE

Shift rod joint bolt can only be loosened. Do not remove it from the shift rod.

1 3. Remove gearcase bolts **(8)**.

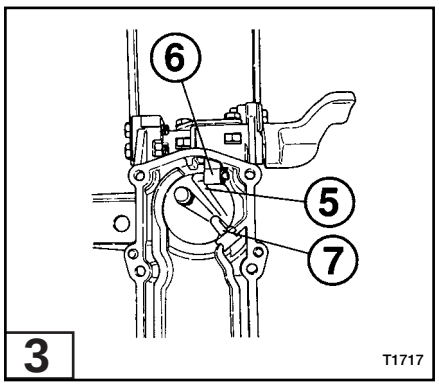
2 4. Remove gearcase assembly.

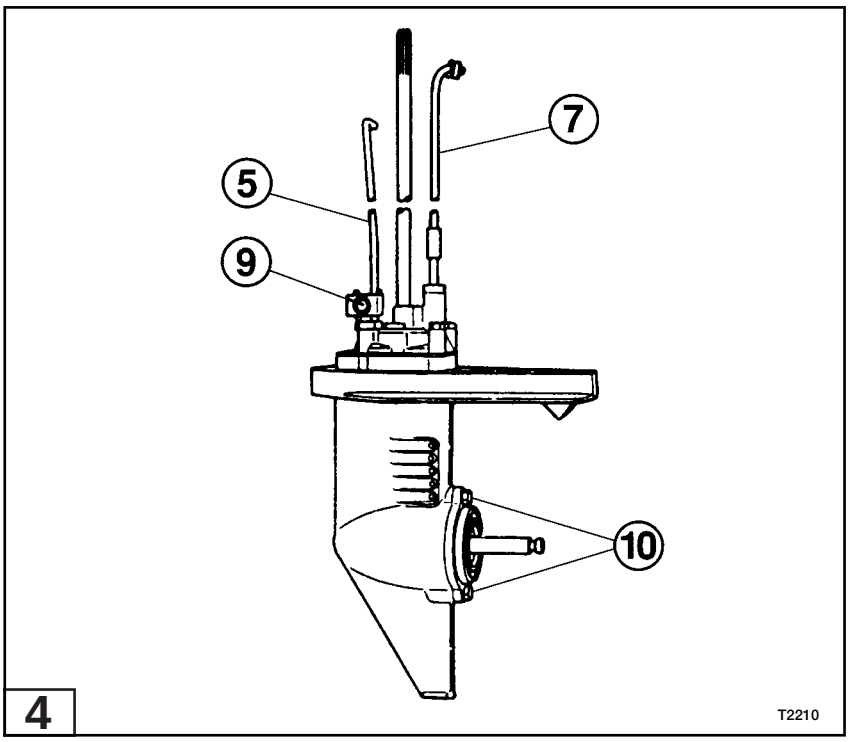
1 5. Remove split pin **(1)** and propeller **(2)**.

1 6. Drain all gearcase oil into a container by removing the lower **(3)** and upper **(4)** oil plugs. Inspect oil for metal chips.

NOTE

Small metal fragments may indicate normal wear of gears, bearings and shafts. Large metal chips usually indicate extensive internal damage. Record your observations for future reference when inspecting internal components.





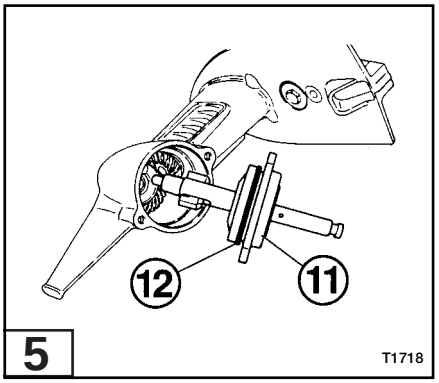
2 3 7. Remove the shift rod **(5)** from the shift rod lever **(6)**.

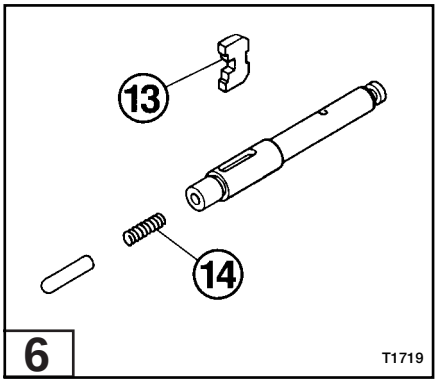
2 8. Pull up the water pipe **(7)** from the drive shaft housing.

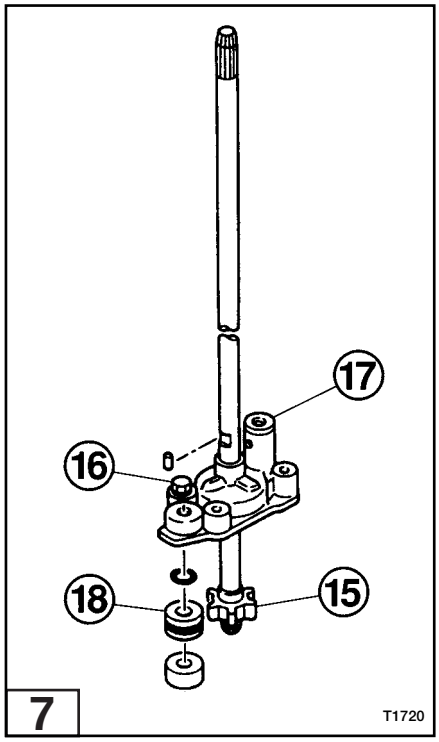
4 9. Remove the propeller shaft housing bolts **(10)**.

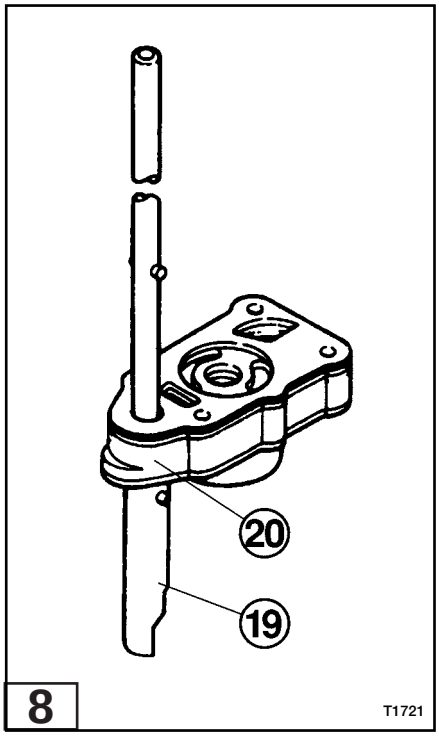
5 10. Remove the propeller shaft housing **(11)**. Note the push rod dropping and check the o-ring **(12)** for damage.

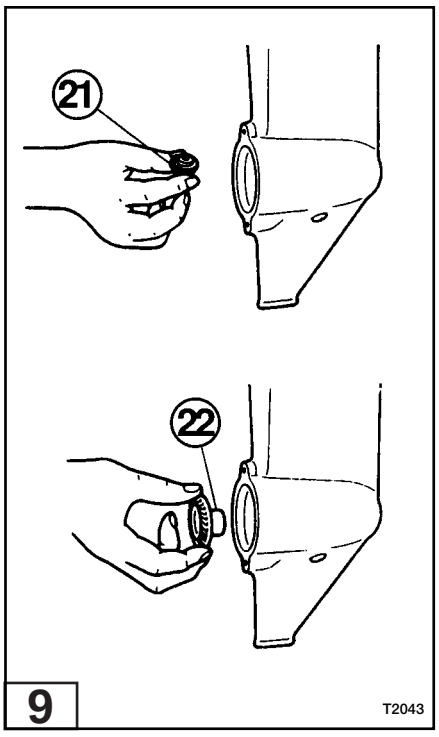
6 11. Remove the clutch **(13)**. Do not apply excessive force to the clutch spring **(14)**.











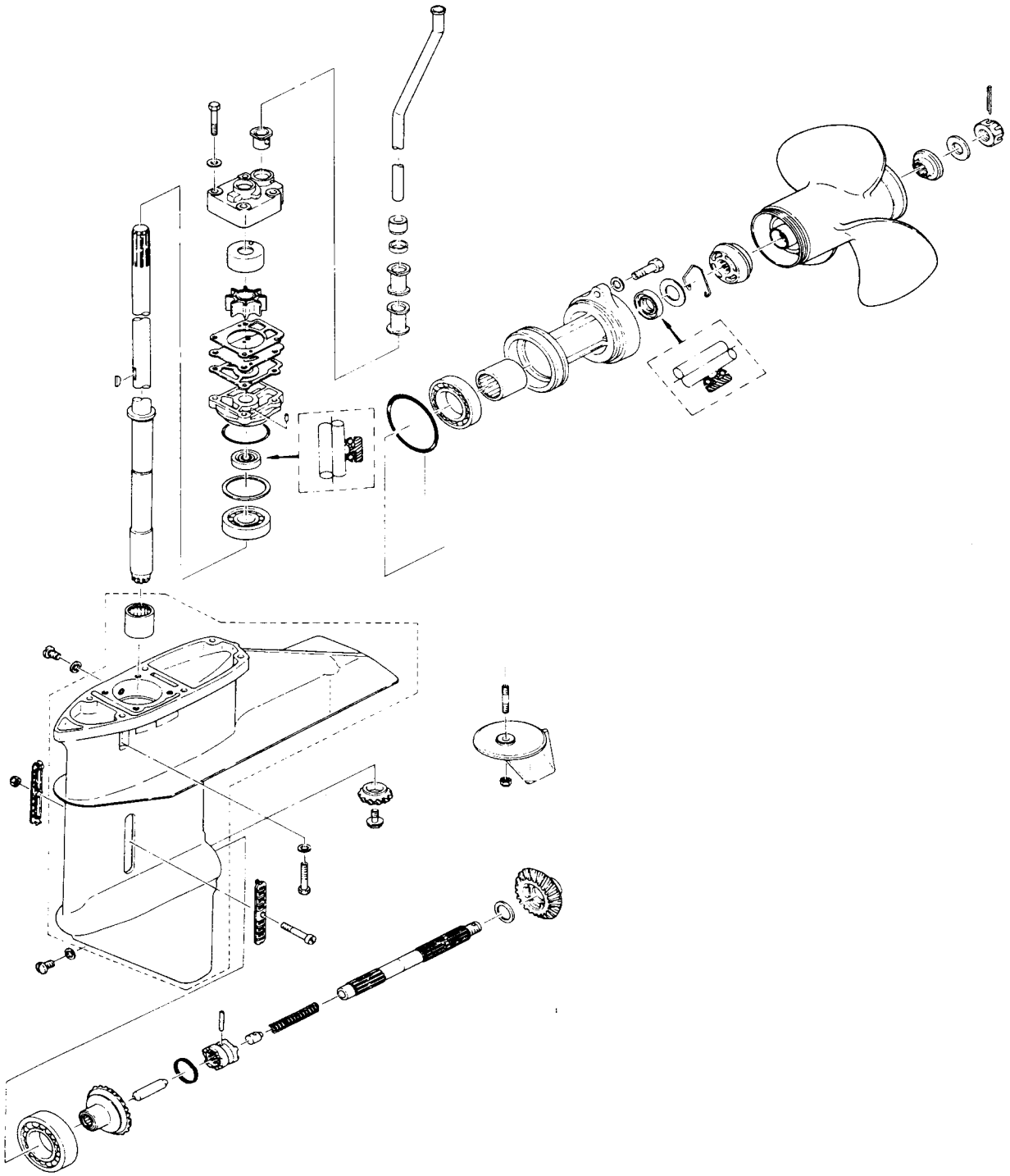
7 12. Remove the pump case bolts **(16)**. Remove the pump case **(17)** and pump impeller **(15)**.

13. Install a water pump repair kit if gearcase has been in service for any length of time. See Water Pump, this section.

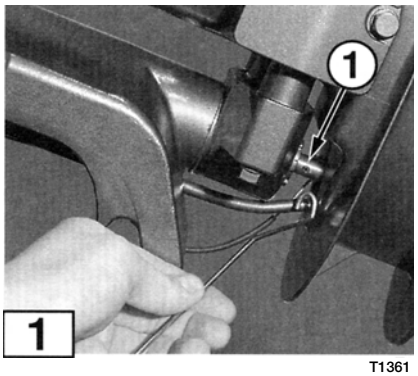
8 14. Remove the cam **(19)** and cam rod. Pull them up together with the lower pump case **(20)**.

9 15. Remove bevel gear B **(21)** and bevel gear A **(22)**.

Typical Gearcase — 8/9.8/9.9/15/18/25/30/40



T1723



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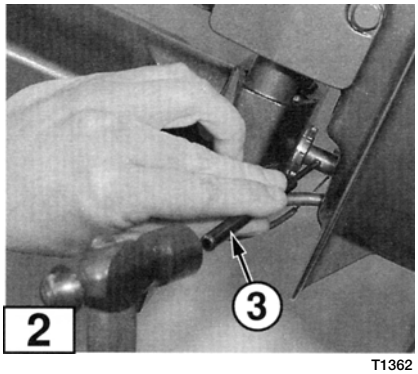


T1362

Removal

⚠⚠ WARNING

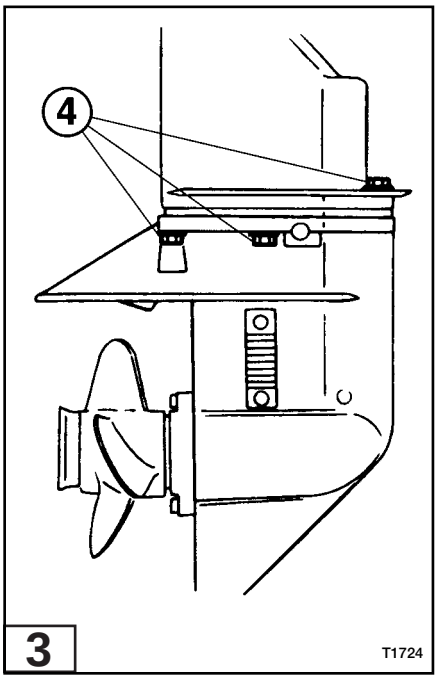
Ignition system must be disabled to prevent accidental engine start-up during removal of the gearcase.

1. 1. Place engine in FORWARD gear so shift rod joint **(1)** is accessible.

2. 2. Use spring pin tool A **(3)** (Part No. 345-72227-0) to remove upperspring pin from shift rod joint. Discard the spring pin.

3. 3. Remove gearcase mounting bolts **(4)** from both sides of gearcase.

4. 4. Separate gearcase from driveshaft housing.



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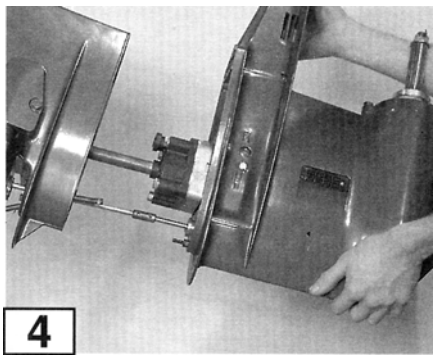

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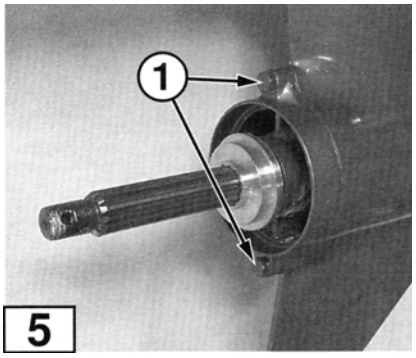

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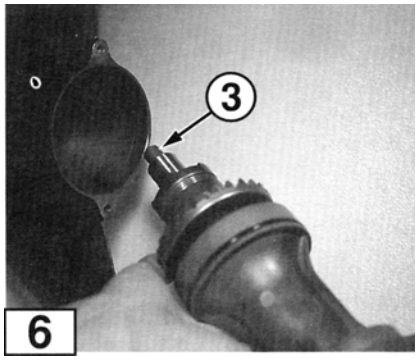

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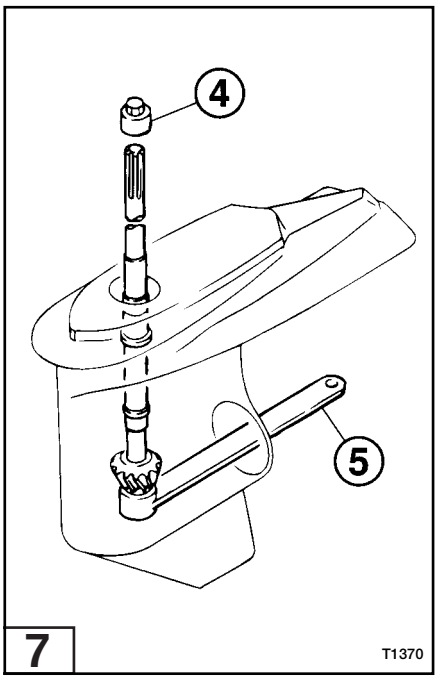


T1370

Disassembly

⚠ CAUTION

Gearcase must be secured in a suitable holding fixture during disassembly.

1. Drain all gearcase oil into a container and inspect the oil for metal chips.

NOTE

Small metal fragments may indicate normal wear of gears, bearings, and shafts. Large metal chips usually indicate extensive internal damage. Record your observations for future reference when inspecting internal components.

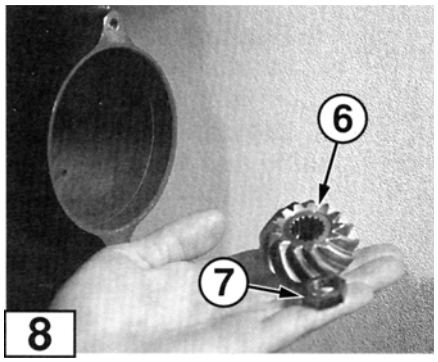
2. Remove the water pump and install a water pump repair kit if gearcase has been in service for any length of time. See Water Pump, this section.

3. Remove propeller mounting nut, washers and propeller.

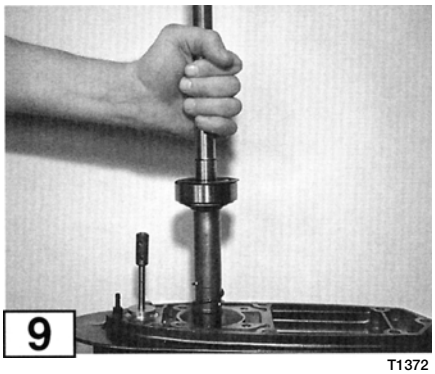
5 4. Remove propeller shaft housing bolts **(1)**.

6 5. Remove propeller shaft and housing from gearcase. Make sure clutch push rod **(3)** is also removed. The push rod and spring may "pop" out with removal. Set the assembly aside.

7 8 6. Install socket **(4)** (Part No. 9.9/15/18: 350-72232-0, 25/30: 346-72232-0, 40: 345-72232-0) and wrench **(5)** (Part No. 346-72231-0). Hold bevel gear B nut with wrench and turn driveshaft counterclockwise to loosen the nut. Remove bevel gear B **(6)** and nut **(7)** from gearcase.



T1371



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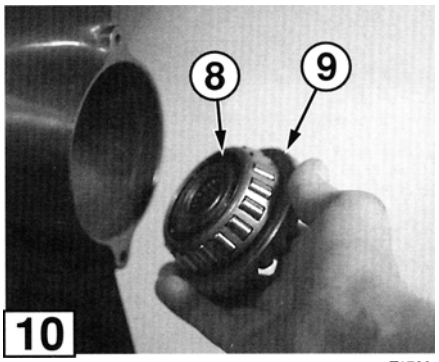

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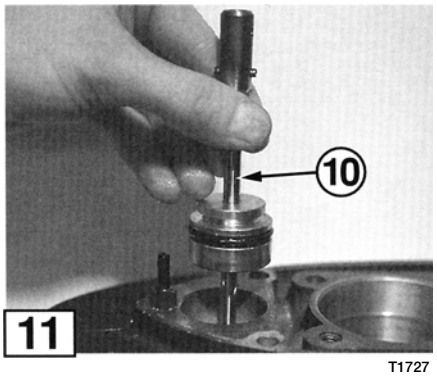


T1727

9 8. Lift the driveshaft from the gearcase and set it aside.

10 9. Reach inside gearcase and remove roller bearing **(8)** and bevel gear A **(9)**.

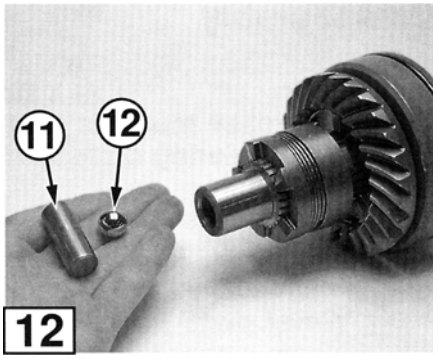
NOTE

Taper bearing for bevel gear A is only used on Model 40.

11 10. Remove the stopper and lift cam rod **(10)** from gearcase. Fullydisassemble the cam rod components, including the cam rod bushing internal and external o-rings.

12 11. Remove clutch push rod **(11)** and ball **(12)** from propeller shaft. Pull propeller shaft out of housing.

13 12. Remove washer **(13)**, bevel gear A **(14)**, and all shims **(15)** (25/30 and 40) from propeller shaft.



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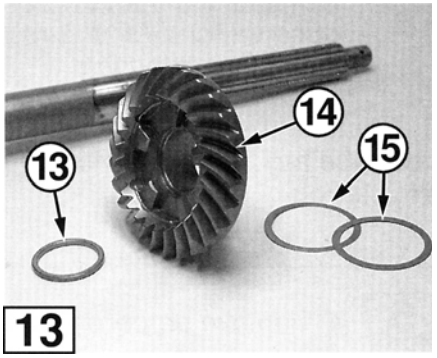

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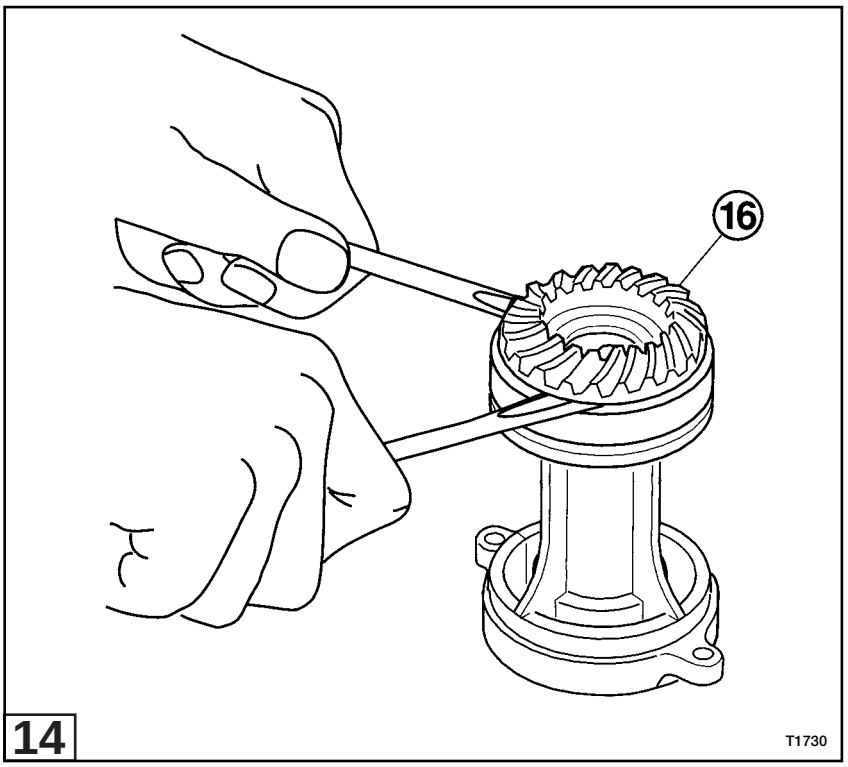
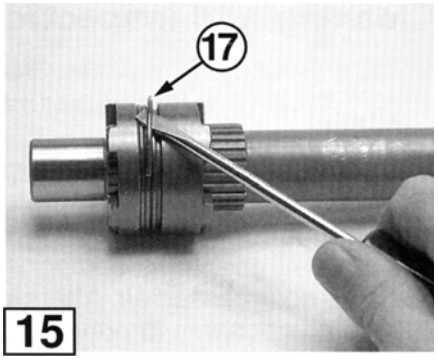
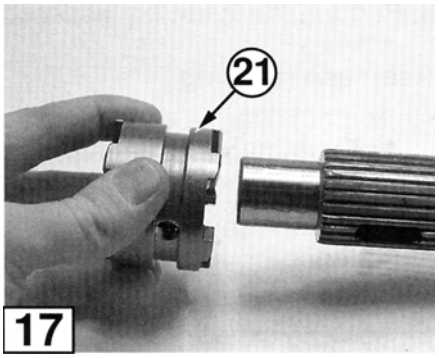
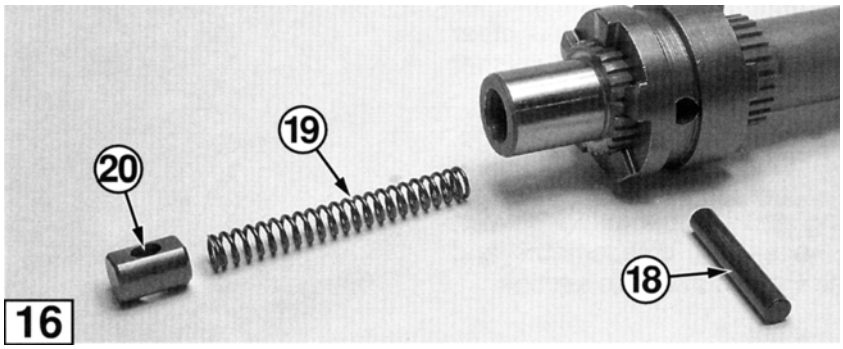








14 13. Remove bevel gear C **(16)** from the propeller shaft housing.

15 14. Insert screwdriver under one end of clutch pin snap spring **(17)**. Remove spring from groove by unwrapping it from clutch. Discard the spring.

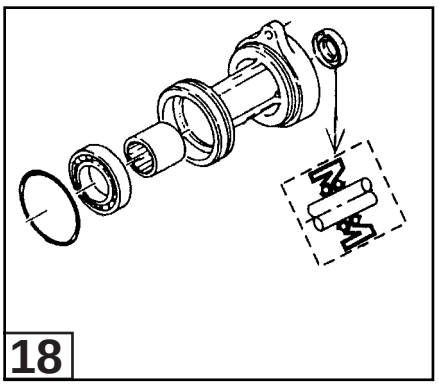
16 15. Place propeller shaft open end against bench surface and push out clutch pin **(18)**. Remove clutch spring **(19)** and spring holder **(20)**.

⚠⚠ WARNING

Wear safety glasses and DO NOT hold open end of propeller shaft towards face or body when removing clutch pin. Clutch spring and spring holder come out with great force.

17 16. Pull clutch **(21)** off propeller shaft.

Cleaning and Inspection



NOTE

All worn, damaged, and missing palls must be replaced.

1. Discard the clutch pin snap spring and all seals and o-rings that have been removed.

2. Clean all gearcase components with solvent and dry with low pressure compressed air. After cleaning, apply specified gear oil to all internal components to prevent rusting.

3. Perform the following inspections:

Gearcase Housing

- Inspect internal and external surfaces of housing for cracks and other damage. All threaded holes must be undamaged and free of corrosion and sealing agents.
- Checkthe sacrificial trim tab ford amage and erosion. See Anodes - Inspection and Testing in Section 2.
- Inspect the water intake screens for damage and blockage. If screens cannot be fully cleaned, replace them.

Propeller and Shaft

- Verify the propeller is true and free of nicks, chips, and other damage that will affect performance. Inspect the thrust washer and mounting hardware for damage.
- Check the propeller shaft threads and splines for wear and damage.

Propeller Shaft Housing

18 Examine propeller shaft housing and components for wear, damage, and deterioration. If necessary, disassemble and repair as needed. See Gearcase Repair Procedures, this section.

Driveshaft

- Check driveshaft threads and splines for wear, chips, and cracks. Severe spline wear or the appearance of spline “twisting” indicates the gearcase or exhaust housing has been distorted, possibly by impact damage.
- Bearing(s) must be free of damage, corrosion, and discoloration. Replace bearing(s) as required. See Gearcase Repair Procedures, this section.

All Internal Components

Inspect all internal components for signs of wear, chipping, pitting, distortion, and discoloration due to improper lubrication. Special attention to the following:

- Check the bevel gear A tapered roller bearing outer race. If damaged or corroded, replace both the race and the bearing. See Gearcase Repair Procedures in this section.
- Inspect clutch and gear teeth and the clutch cam for chips and signs of metal transfer. Replace parts as needed.

Assembly

⚠ CAUTION

Gearcase must be secured in a suitable holding fixture during assembly.

Assembly — 2.5 / 3.5

1. Install propeller shaft assembly.

2. Install water pump case.

3. Install pump impeller key.

4. Install pump impeller.

Assembly — 3.5B

1. Install the clutch, clutch spring and the clutch push rod to propeller shaft.

2. Install propeller shaft assembly.

3. Fix the clutch cam to the cam rod with a spring pin, and insert it into the gear case. Also, insert the drive shaft and install the lower pump case.

4. Lift the drive shaft a little and install the bevel gear B.

5. Install the pump guide plate gasket, guide plate, cam rod bush and upper pump case gasket.

6. Install the pump impeller key.

7. Install the pump impeller.

8. Install the pump case liner in the case.

9. Install the water pump case.

NOTE

When installing the water tube, apply oil to the inner circumference of the lower water pipe rubber seal.

2.5 / 3.5 only

10. Install the gear case head.

2.5 / 3.5 Only

11. Install the upper driveshaft and attach the driveshaft guard pipe

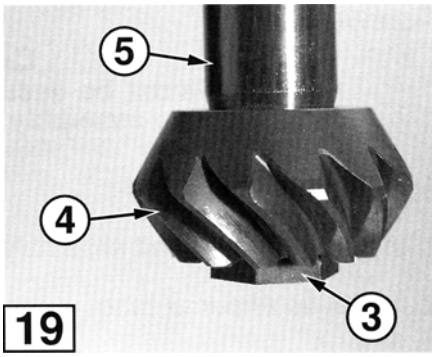
2.5 / 3.5 and 3.5B

12. Install the gear case assembly to the driveshaft housing. Tighten the gear case bolt.

3.5B Only

13. When connecting the cam rod and shift rod to each other with the shift rod joint, set the cam rod and shift rod at the neutral position.

14. Install the propeller.

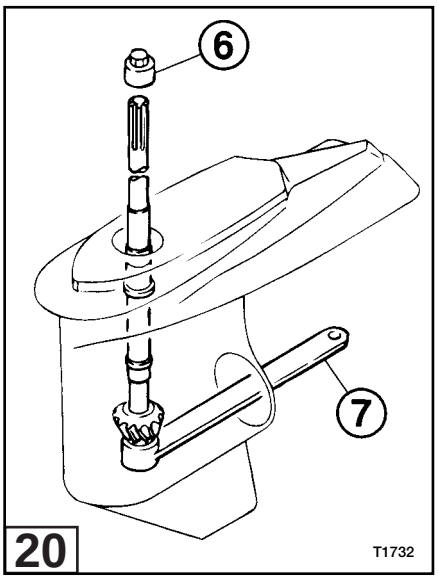


Assembly — 5 / 8 / 9.8 / 9.9 / 15 / 18 / 25 / 30 / 40

1. Install new gearcase needle bearing, bevel gear A & B roller bearing and outer race, and driveshaft bearing(s) if any of these parts were removed. See Gearcase Repair Procedures, this section.

2. Secure gearcase in holding fixture with water pump side facing upward.

19 3. Apply Loctite 242 to the thread of bevel gear B nut **(3)**. Slide bevel gear B **(4)** onto driveshaft **(5)** as shown from propeller shaft side of gearcase. Hand tighten nut **(3)** to secure the gear in place.



NOTE

Before applying Loctite 242, remove all grease from tapered portion of bevel gear B and driveshaft with solvent, and thread of driveshaft and bevel gear B nut also.

20 4. Install specified socket **(6)** (9.9/15/18 - Part No. 350-72232-0, 25/30 - Part No. 346-72232-0, 40 - Part No. 345-72232-0) and wrench **(7)** (Part No. 346-72231-0). Hold bevel gear B nut with wrench and turn driveshaft clockwise to tighten the nut. Torque bevel gear B nut to specification.

5. Perform all adjustment steps before proceeding. See Adjustments, this section.

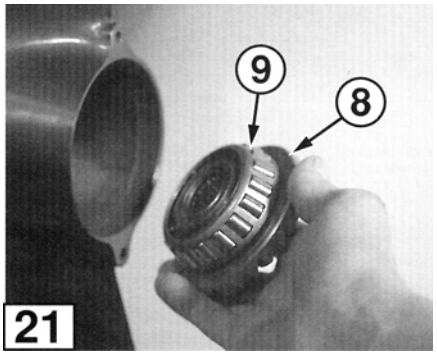
⚠ CAUTION

Failure to perform the adjustment steps may result in poor engine performance, premature wear of parts, or severe damage to gearcase components.

6. Install the water pump. See Water Pump, this section.

NOTE

Make sure all necessary adjustment shims are installed on driveshaft bearing before installing lower pump case.



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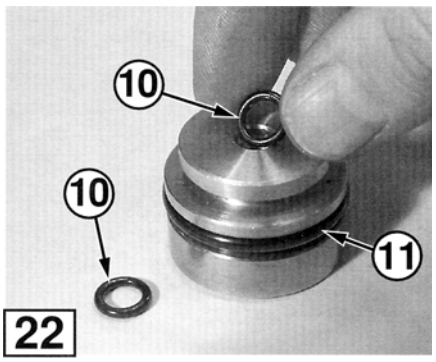

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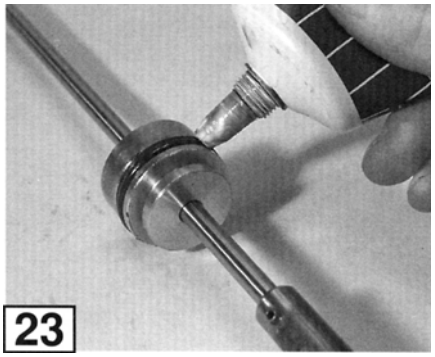


T1390

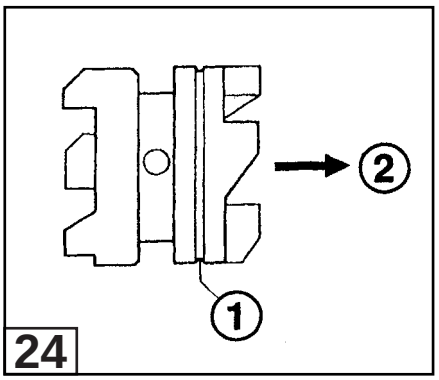
21 7. Install bevel gear A **(8)** so tapered roller bearing **(9)** is seated in outer race.

22 8. Replace cam rod bushing internal o-rings **(10)** and external o-ring **(11)**. Coat the internal o-rings and inner surface of bushing with specified gear oil. Then fully assemble the cam rod components.

23 9. Apply genuine grease or equivalent friction surface marine grease to the exterior of the cam rod bushing and o-ring.

10. Insert the cam rod into the cam rod port on the gearcase and seat the bushing. Install stopper with stopper bolt.

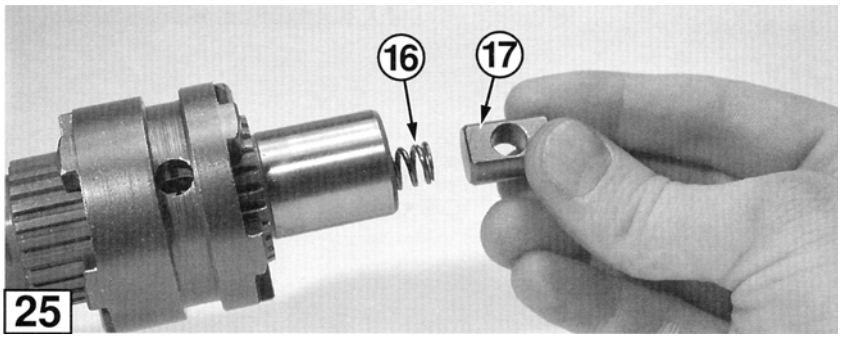
24 11. Align hole in clutch with slot in propeller shaft. Slide clutch onto shaft so the side with the groove **(1)** faces the side with bevel gear A **(2)**.



CAUTION

The clutch is not symmetrical (except 5 HP). If installed backwards, clutch and gears will be damaged.

25 12. Insert clutch spring **(16)** and install spring holder **(17)** so hole in spring holder is aligned with clutch hole.



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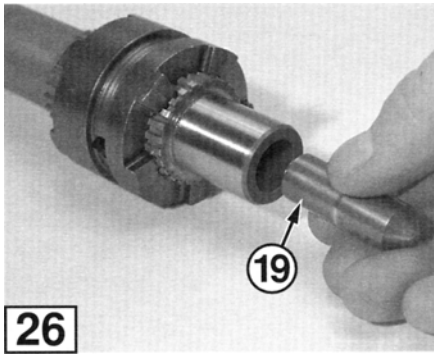
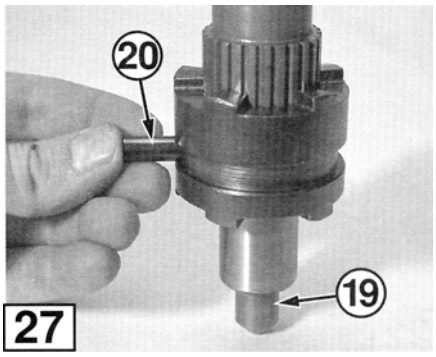


T2045



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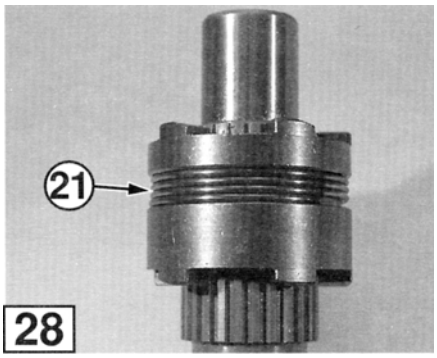


T1740

26 13. Install clutch push rod **(19)** so tapered end faces bevel gearA.

27 14. Compress the clutch spring by applying pressure to push rod **(19)**. Align the holes of the clutch and spring holder and insert clutch pin **(20)**.

⚠ CAUTION

Wear safety glasses and DO NOT hold spring end of propeller shaft towards face or body when compressing the clutch spring.

28 15. Install new clutch pin snap spring **(21)** using the clutch pin snap tool. Do not reuse old snap Spring.

Part number of clutch pin snap tool
9.9/15/18 : 350-72229-0
25/30 : 346-72229-0
40 : 345-72229-0

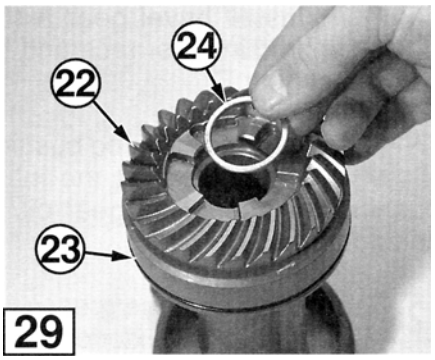
⚠ CAUTION

DO NOT reuse clutch pin snap spring (21), it must be replaced. Reusing clutch pin snap spring may cause severe damage to gears and other components.

29 16. Make sure all necessary adjustment shims are installed on bevel gear C **(22)** and install gear onto propeller shaft housing **(23)**. Install washer **(24)** onto bevel gear.

30 17. Apply genuine grease or equivalent to the propeller shaft housing o-ring and oil seal. Slide the propeller shaft into the propeller shaft housing.

31 18. Lift the cam rod to the fully UP position and verify through the gearcase opening that clutch cam beveled side **(25)** faces gearcase opening.



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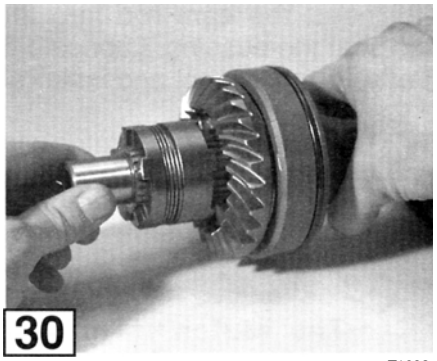

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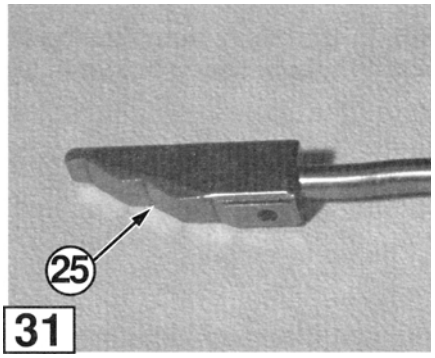

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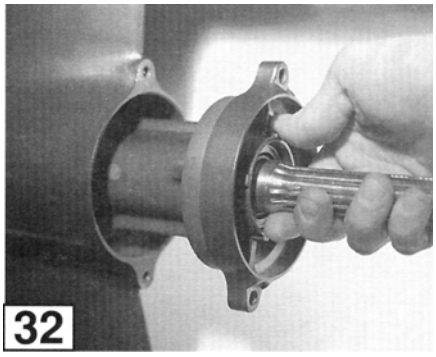
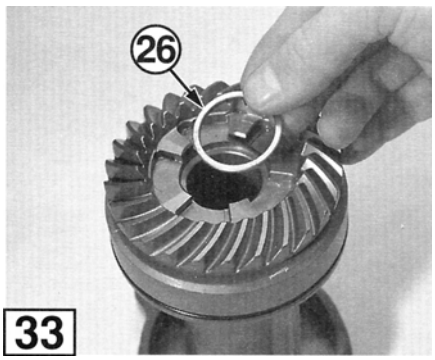
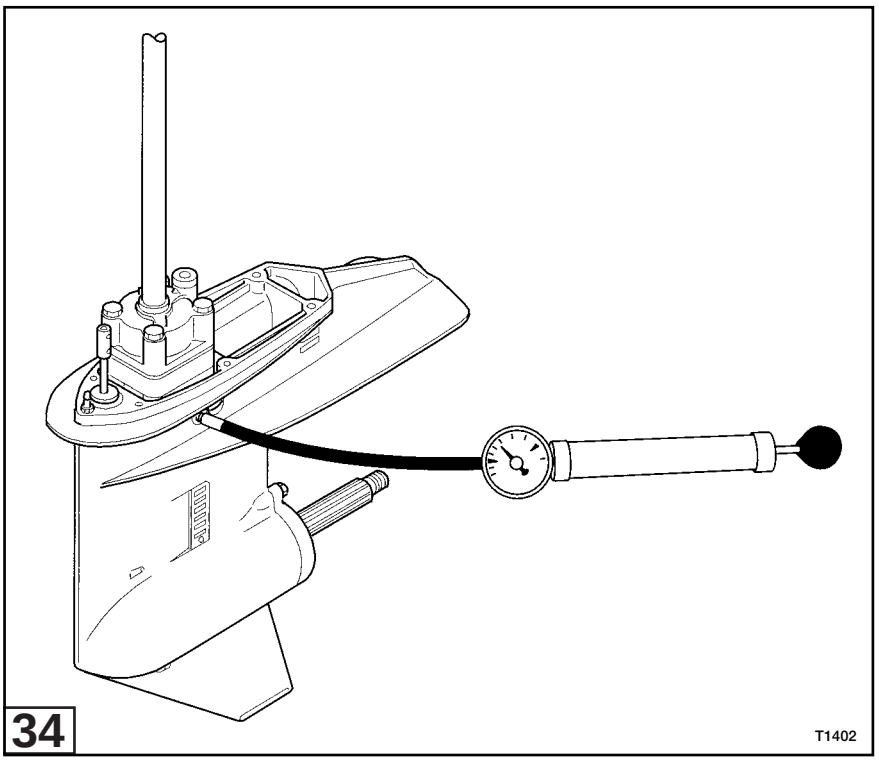


T1400



T1743



T1402

32 19. Align the clutch push rod with the clutch cam and slide the propeller shaft and housing into the gearcase opening. Push forward and rotate the propeller shaft as needed until bevel gears have engaged. Ensure the propeller shaft housing bolts are completely clean and apply Loctite 242 to the bolt threads. Install and torque the bolts evenly to prevent improper seating of the housing.

33 20. Move the cam rod to each position and rotate the driveshaft to test gearcase function in all gears. Check the propeller shaft for looseness in the forward and reverse directions. If looseness exceeds 0.016 in [0.40 mm], replace bevel gear C washer **(26)** with one of correct thickness.

NOTE

Refer to current Parts Catalog for washer availability

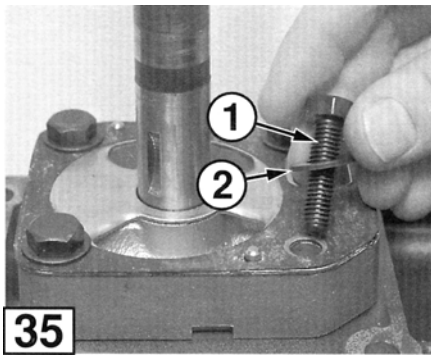
34 21. Before adding gear oil, pressure test and vacuum test the gearcase as follows:

- Remove the oil level plug and install gearcase pressure tester.
- Pump pressure tester until gauge indicates 3 - 6 psi [20 - 39 kPa / 0.2 - 0.4 kg/cm^2]. If pressure loss occurs, determine source of leakage by submerging gearcase in water. Make necessary repairs to correct the problem and retest.
- Remove the pressure tester and install gearcase vacuum tester.

- pump vacuum tester until gauge indicates 3 - 5 in [76 - 127mm] of mercury. If loss of vacuum occurs at either range, apply oil around suspected seal. If leak stops or oil is drawn in, the seal is defective and must be replaced. Make necessary repairs to correct the problem and retest.

22. Fill gearcase with specified gear lubricant. See Engine Specifications in Section 2 for gearcase capacities.

23. Apply genuine grease or equivalent to the propeller shaft and propeller mounting hardware. Install the propeller and propeller mounting hardware.



T1403

⚠ CAUTION

Make sure propeller thrust holder is installed and seated against the propeller shaft oil seal before installing propeller. If installed improperly, propeller may be pushed into gearcase housing during tightening.

Adjustments

⚠ CAUTION

DO NOT attempt gearcase adjustments without proper manufacturer special tools and adequate knowledge of gearcase setup.

NOTE

Specific assembly steps must be completed in order to perform the gearcase adjustments. If these steps have not been performed, refer to Assembly, this section.

NOTE

Unless otherwise indicated, all gearcase adjustment specifications are based on measurements obtained with manufacturer special tools.

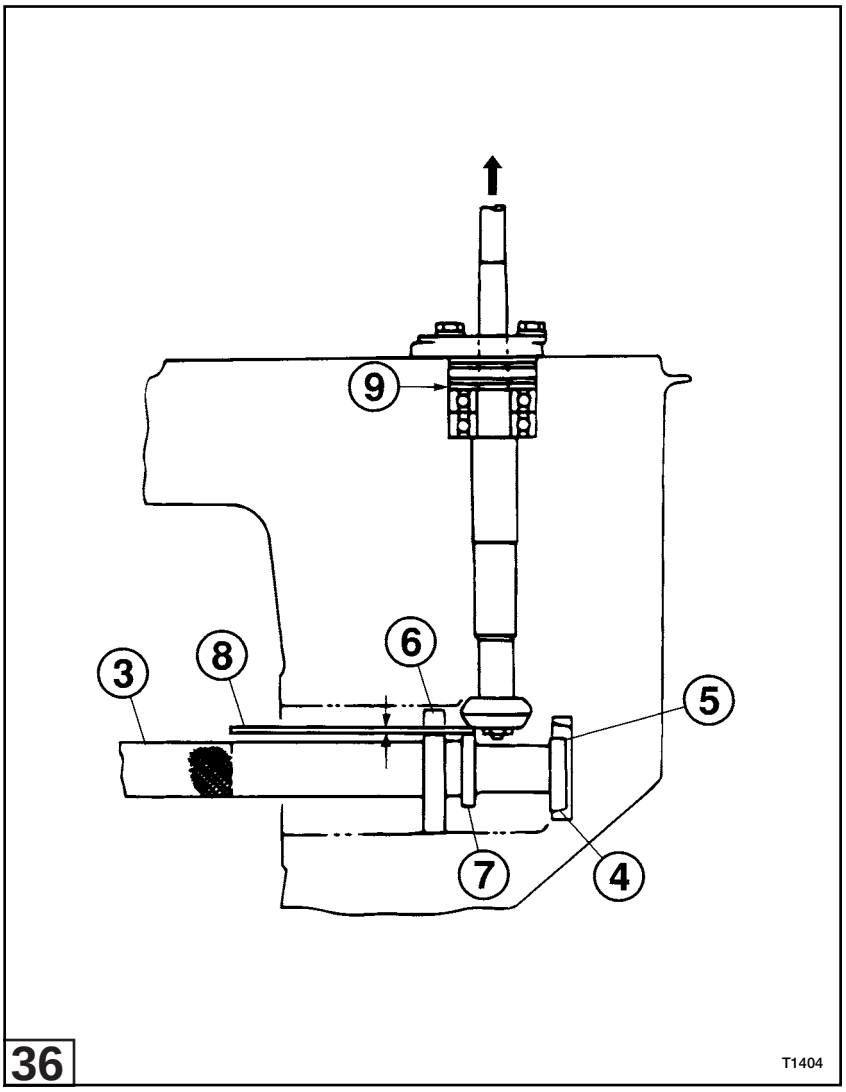
35 1. Slide lower pump case onto driveshaft and seat into position on gearcase. Secure lower pump case with bolts **(1)** and plain washers **(2)**.

Bevel Gear B Adjustment - (25/30 and 40 Only)

36 2. Insert shimming gauge **(3)** into gearcase (25/30 gauge: 346-72250-0, 40 gauge: 3C8-72250-0).

NOTE

*Correct positioning of the shimming gauge in the gearcase is critical, Make sure tapered side **(4)** is fully seated I'n bevel gearA bearing outer race with ilat side **(5)** and notch **(6)** facing upward.*



36 3. Eliminate all looseness between driveshaft and gearcase using one of the following methods:

- Lift driveshaft upward and tap down on gearcase with rubber mallet.
- Slide acompression spring (obtain locally) over driveshaft and seat onto lower pump case. Install backlash measuring tool clamp assembly (Part No. 3B7-72720-0) on driveshaft. Compress the spring and tighten the clamp to maintain the spring compression and provide constant upward pressure against driveshaft.

With all looseness eliminated, measure the gap between collar **(7)** and bevel gear B using thickness gauge set **(8)** (Part No. 353-72251-0). If gap measurement is not within 0.023 - 0.025 in [0.60 - 0.64 mm], remove the lower pump case and install correct size shim onto roller bearing outer race at location **(9)**.

NOTE

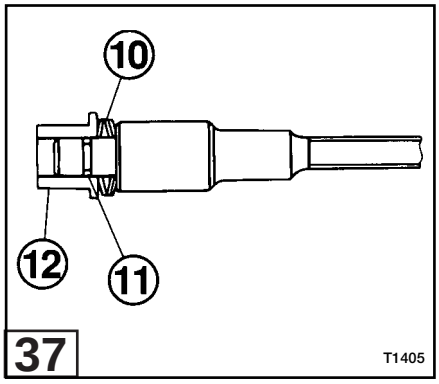
Refer to current Parts Catalog for shim availability.

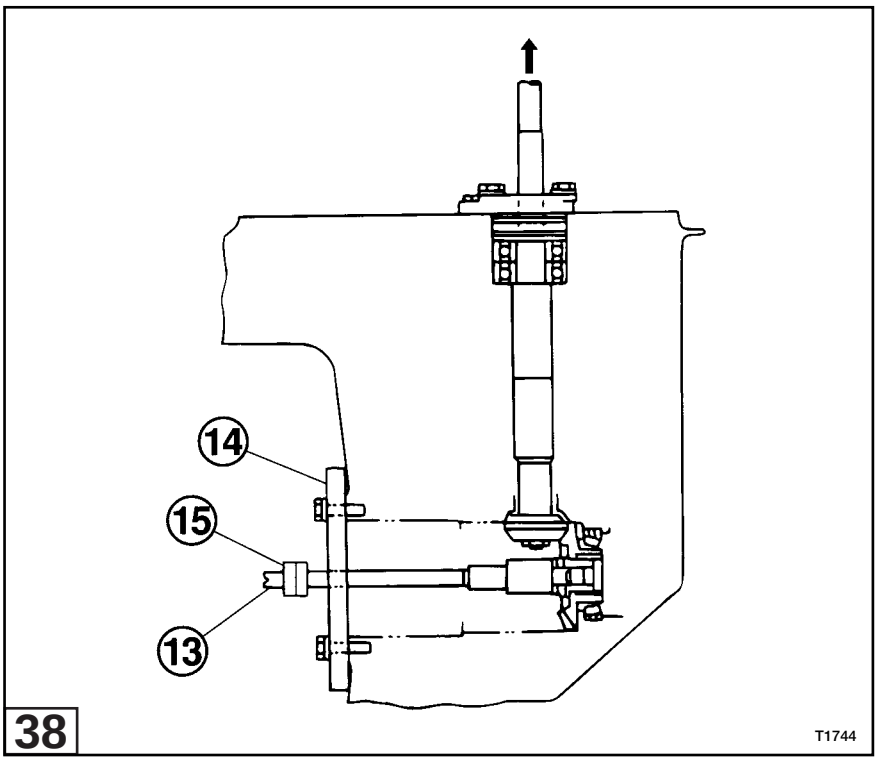
4. If shimming was necessary re-install the lower pump case before proceeding with Backlash Adjustment - Bevel Gears A and B.

Backlash Adjustment - Bevel Gears A and B

NOTE

Obtain backlash measuring tools in reference to page 6-4 table for special tool requirements.





5. With the tapered roller bearing installed, position bevel gear A in gearcase so bearing is fully seated in outer bearing race. Rotate the driveshaft to ensure gears are property meshed.

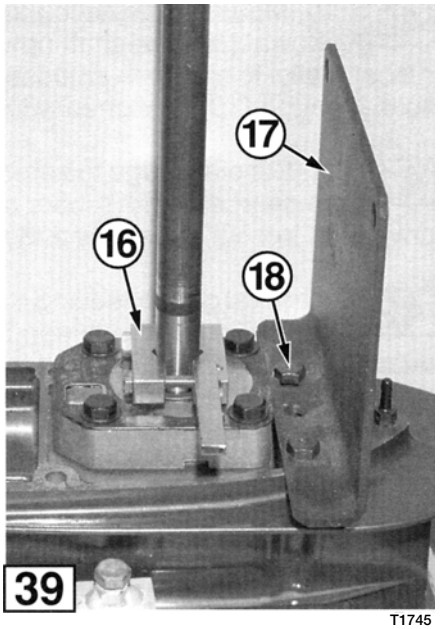
6. Assemble the following backlash tool components. Note the correct quantity and orientation of conedisk spring washers:

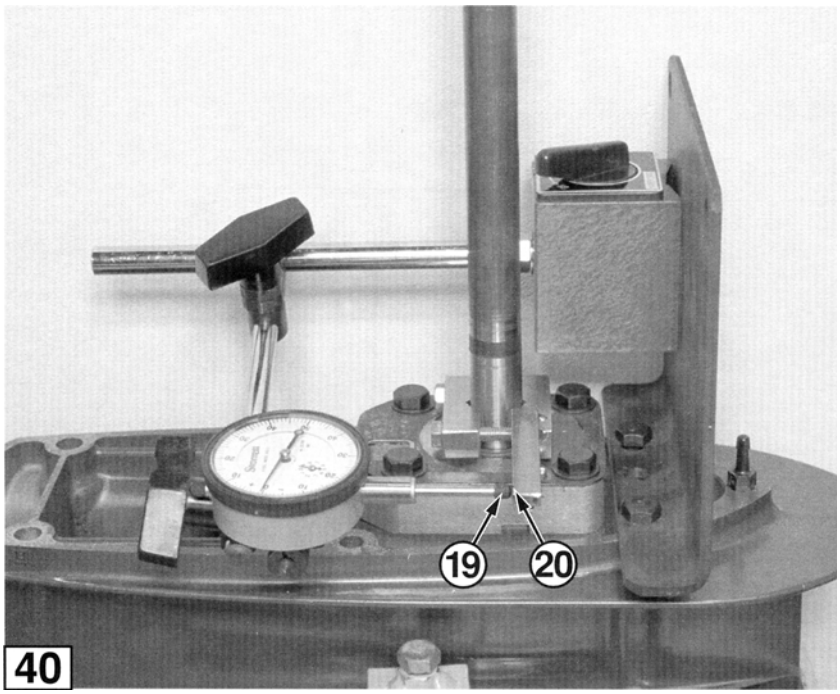
37 Assemble three conedisk spring washers **(10)**, o-ring **(11)**, and collar **(12)**.

38 7. Insert shaft **(13)** into gearcase and seat collar/guide end in bevel gear A. Install plate **(14)** using appropriate size bolts. Turn shaft nuts **(15)** onto shaft. Tighten the nuts against each other so outer nut can be used to tighten shaft **(13)**.

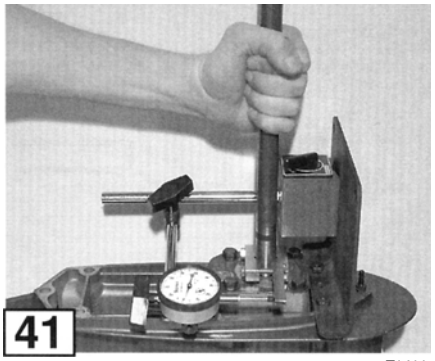
8. Look the nuts **(15)**.

39 9. Mount clamp assembly **(16)** on driveshaft as close as possible to lower pump case. Install dial gauge plate **(17)** on gearcase with appropriate size bolts **(18)**.

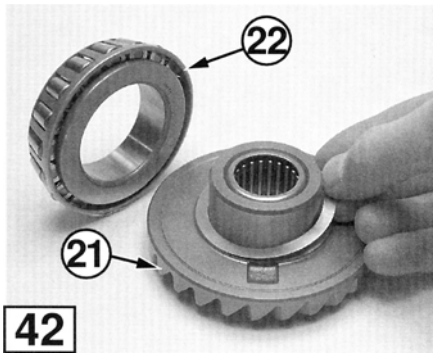




T1746



T1411



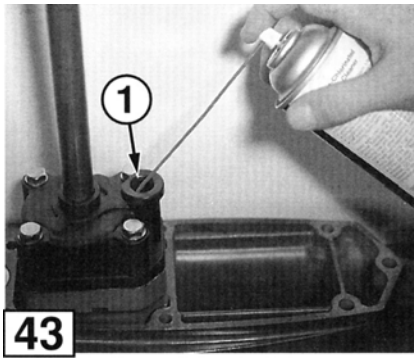
T1747

40 10. Mount a magnetic base and dial gauge (obtain locally) as shown. Lift driveshaft upward and tap down on gearcase with rubber mallet to eliminate all looseness and proceed to adjust the setup so dial gauge **(19)** is aligned with V-notch **(20)**.

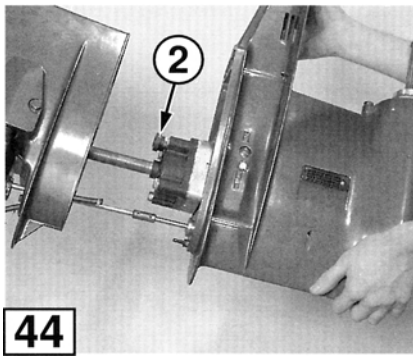
41 11. Set dial gauge to zero. Lift driveshaft upward and rotate driveshaft in both directions and record the dial gauge reading.

42 If the dial gauge reading is not within the specified range, adjust shim thickness between bevel gear A **(21)** and tapered roller bearing **(22)** in accordance with the Backlash - Shim Adjustment Table, this section. See Gearcase Repair Procedures in this section for removal and installation of the bevel gearA roller bearing.

Model	Acceptable Dial Gauge Reading	
	in	mm
3.5B	0.008 - 0.025	0.21 - 0.62
5	0.006 - 0.019	0.16 - 0.49
8 / 9.8	0.0056 - 0.0165	0.14 - 0.42
9.9 / 15 / 18	0.0147 - 0.0240	0.38 - 0.61
25 / 30	0.0130 - 0.0213	0.33 - 0.54
40	0.0236 - 0.0394	0.60 - 1.00



T1417



T1748

Installation

⚠ WARNING

Ignition system must be disabled to prevent accidental engine start-up during installation of the gearcase.

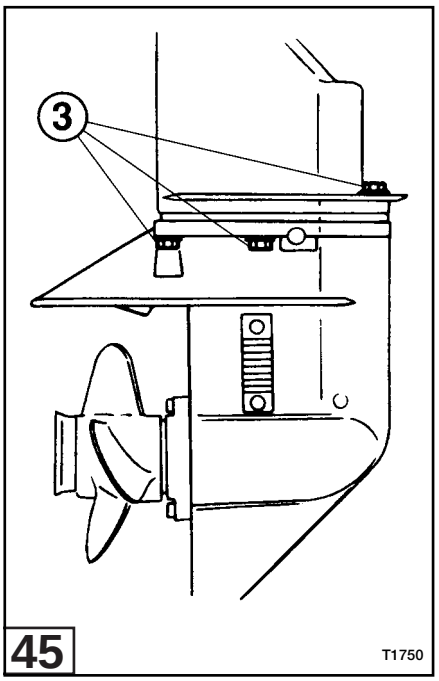
43 1. Lightly coat the driveshaft splines with genuine engine oil or TC-W3 oil and apply silicone spray lubricant to water pipe lower seal **(1)**.

44 2. Slide driveshaft into lower crankcase head. Align water pipe with lower seal **(2)** before seating gearcase on driveshaft housing.

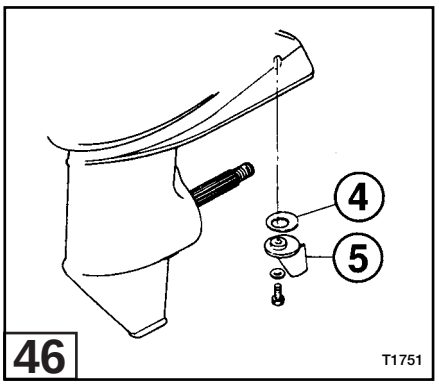
45 3. Apply Loctite 242 to threaded portion of gearcase mounting bolts. Install the gearcase mounting bolts **(3)** and torque all bolts to specification.

46 4. Inspect trim tab **(5)** and replace if corroded. Install trim tab packing **(4)** and trim tab **(5)**.

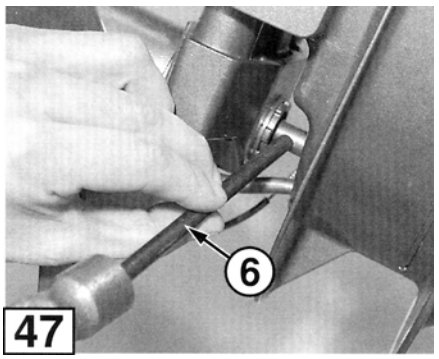
47 5. Use spring pin tool B **(6)** (Part No. 345-72228-0) to install new upper spring pin in shift rod joint. DO NOT reuse the old spring pin.



T1750



T1751



T1749

BACKLASH - SHIM ADJUSTMENT TABLE

NOTE

Refer to current Parts Catalog for shim availability.

1. Determine Dial Gauge Reading range in table that has a low end value closest to the obtained dial gauge reading.
2. Find corresponding Shim Thickness value in table.
3. Install or remove shims to increase or decrease shim thickness by the value specified.
4. Re-check the backlash measurement.

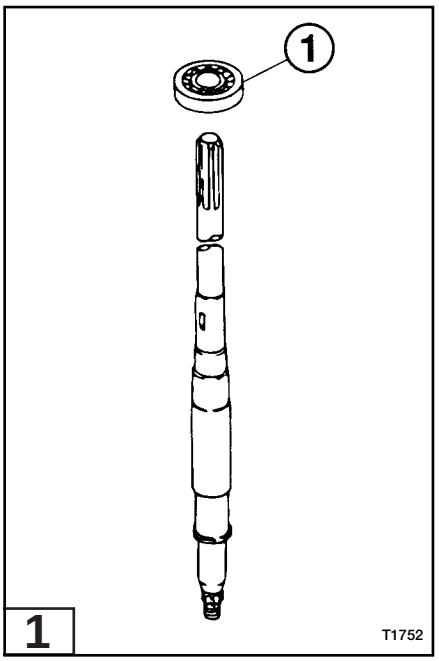
Dial Gauge Reading						Shim Thickness + Increase shim thickness - Decrease shim thickness	
5		8 / 9.8		9.9 / 15 / 18			
in	mm	in	mm	in	mm	in	mm
—	—	0 - 0.0011	1 - 0.02	—	—	-0.0059	-0.15
0-0.0063	0 - 0.15	0.0012 - 0.0055	0.03 - 0.13	0.0052 - 0.0146	0.14 - 0.37	-0.0039	-0.10
—	—	—	—	—	—	-0.0020	-0.05
0.0063 - 0.0192	0.16 - 0.49	0.0056 - 0.0165	0.14 - 0.42	0.0147 - 0.0240	0.38 - 0.61	0.0000	0.00
—	—	—	—	—	—	+0.0020	+0.05
—	—	—	—	0.0241 -0.0331	0.62 - 0.84	+0.0039	+0.10
—	—	—	—	—	—	+0.0059	+0.15
—	—	—	—	0.0332 - 0.0417	0.85 - 1.06	+0.0079	+0.20
0.0193 - 0.0208	0.50 - 0.52	0.0166 - 0.0188	0.43 - 0.47	—	—	+0.0098	+0.25
0.0209 - 0.0236	0.53 - 0.59	0.0189 - 0.0208	0.48 - 0.52	0.0418 - 0.0496	1.07 - 1.29	+0.0118	+0.30
0.0237 - 0.0259	0.60 - 0.65	0.0209 - 0.0232	0.53 - 0.58	—	—	+0.0138	+0.35
0.0260 - 0.0283	0.66 - 0.71	0.0233 - 0.0255	0.59 - 0.64	0.0497 - 0.0594	1.30 - 1.51	+0.0157	+0.40
0.0284 - 0.0307	0.72 - 0.77	0.0256 - 0.0275	0.65 - 0.69	—	—	+0.0177	+0.45
0.0308 - 0.0330	0.78 - 0.83	0.0276 - 0.0299	0.70 - 0.75	0.0595 - 0.0685	1.52 - 1.74	+0.0197	+0.50
0.0331 - 0.0354	0.84 - 0.89	0.0300 - 0.0318	0.76 - 0.80	—	—	+0.0217	+0.55
0.0355 - 0.0480	0.90 - 1.22	0.0319 - 0.0425	0.81 - 1.08	—	—	+0.0236	+0.60

= Acceptable range

Dial Gauge Reading				Shim Thickness + Increase shim thickness - Decrease shim thickness	
25 / 30		40			
in	mm	in	mm	in	mm
—	—	0 - 0.002	0.00 - 0.05	-0.0098	-0.25
—	—	0.002 - 0.006	0.06 - 0.15	-0.0079	-0.20
0 - 0.002	0.00 - 0.05	0.006 - 0.O14	0.16 - 0.35	-0.0059	-0.15
0.002 - 0.008	0.06 - 0.20	0.O14 - 0.O18	0.36 - 0.45	-0.0039	-0.10
0.008 - 0.013	0.21 - 0.32	0.O18 - 0.023	0.46 - 0.59	-0.002	-0.05
0.013 - 0.021	0.33 - 0.54	0.024 - 0.039	0.60 - 1.00	0	0.00
0.022 - 0.026	0.55 - 0.65	0.04 - 0.041	1.01 - 1.05	+0.002	+0.05
0.026 - 0.031	0.66 - 0.80	0.042 - 0.045	1.06 - 1.14	+0.0039	+0.10
0.032 - 0.037	0.81 - 0.95	0.045 - 0.047	1.15 - 1.20	+0.0059	+0.15
0.038 - 0.044	0.96 - 1.11	0.048 - 0.053	1.21 - 1.35	+0.0079	+0.20
0.044 - 0.051	1.12 - 1.30	0.054 - 0.059	1.36 - 1.50	+0.0098	+0.25
0.052 - 0.057	1.31 - 1.45	0.059 - 0.065	1.51 - 1.65	+0.0118	+0.30
0.057 - 0.063	1.46 - 1.60	0.065 - 0.071	1.66 - 1.80	+0.0138	+0.35
0.063 - 0.069	1.61 - 1.75	0.071 - 0.077	1.81 - 1.95	+0.0157	+0.40
0.069 - 0.075	1.76 - 1.90	0.077 - 0.083	1.96 - 2.10	+0.0177	+0.45
0.075 - 0.081	1.91 - 2.05	0.083 - 0.089	2.11 - 2.25	+0.0197	+0.50
0.081 - 0.089	2.06 - 2.25			+0.0217	+0.55
				+0.0236	+0.60

= Acceptable range

GEARCASE REPAIR PROCEDURES



⚠ CAUTION

DO NOT attempt gearcase repairs without proper manufacturer special tools.

Use this section when service work requires disassembly or replacement of the following gearcase components:

- Driveshaft roller bearings.
- Gearcase needle bearing.
- Propeller shaft housing needle bearing.
- Bevel gear A bearing outer race.
- Bevel gear A roller bearing.

Driveshaft Roller Bearings

1

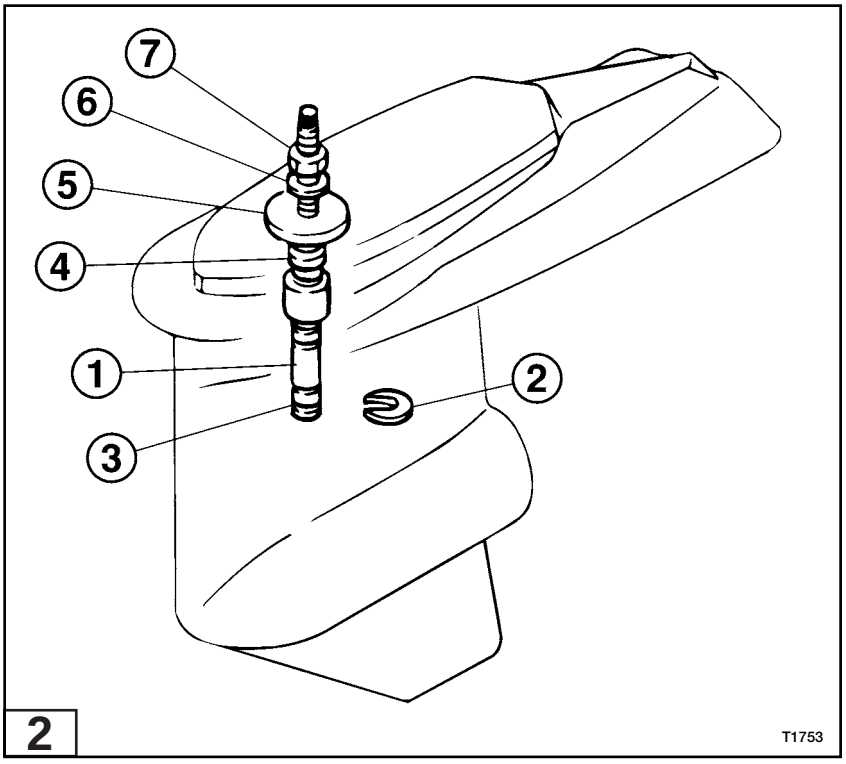
⚠ CAUTION

If it is determined after complete inspection that replacement of driveshaft roller bearing (1) is necessary, all pressing operations during removal and installation must be performed at a qualified machine shop equipped with minimum 1 ton Press.

Gearcase Needle Bearing - Models 9.9 / 15 / 18 / 25 / 30 / 40

NOTE

Obtain needle roller bearing puller kit (Part No, 3C8-72700-0).



Removal

2 1. Insert shaft **(1)** through needle bearing from water pump side of gearcase.

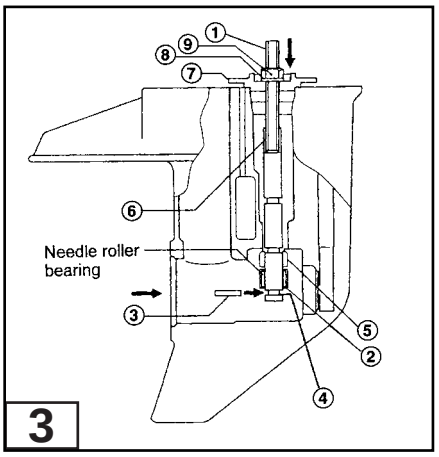
2 2. Attach retainer **(2)** from propeller shaft side of gearcase to shaft groove **(3)**. Make sure retainer is fully seated in groove with raised surface facing bearing:

2 3. Slide guide **(4)** onto shaft from water pump side of gearcase. Make sure guide is seated in bearing.

4. Install plate/flange **(5)**, washer **(6)**, and nut **(7)** onto shaft.

5. Hold end of threaded shaft with wrench and tighten nut **(7)** until bearing releases from housing.

Installation



3 1. Insert shaft **(1)** through needle bearing housing in gearcase.

3 2. Coat the new needle bearing with genuine gear oil. Slide bearing onto shaft from propeller shaft side of gearcase so bearing stamped surface **(2)** faces propeller shaft side.

⚠ CAUTION

Stamped surface of needle bearing must face propeller shaft side of gearcase or bearing could be damaged during installation.

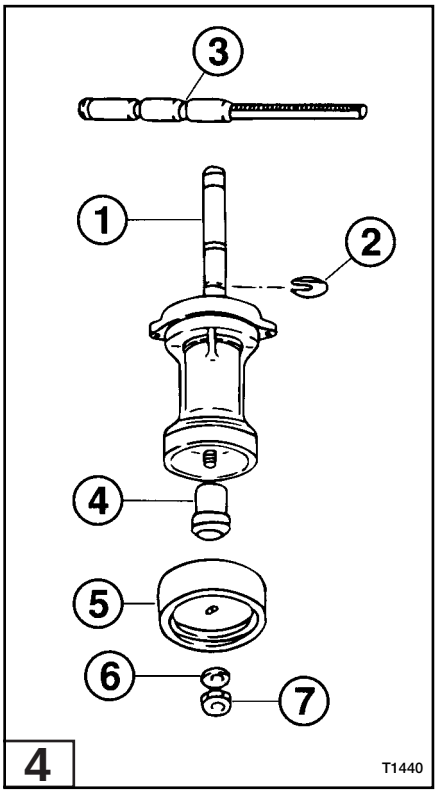
3 3. Attach retainer **(3)** from propeller shaft side of gearcase to specified shaft groove **(4)**. Make sure retainer is fully seated in groove with raised surface facing bearing.

3 4. Slide guide **(5)** onto shaft from water pump side of gearcase. Make sure guide is seated in bearing.

3 5. Install stopper **(6)**, plate/flange **(7)**, washer **(8)**, and nut **(9)** onto shaft from water pump side of gearcase.

3 6. Hold end of threaded shaft with wrench and tighten nut **(9)** until stopper **(6)** contacts plate/flange **(7)**.

7. Remove tools and verify needle bearing is fully seated in housing.



Propeller Shaft Needle Bearing

4 Removal

1. Remove oil seal from propeller shaft housing.

2. Remove roller bearing from propeller shaft housing by heating the housing with hot water.

3. Place shaft **(1)** through needle bearing.

4. Attach retainer A **(2)** to shaft groove **(3)** with raised surface of retainer facing bearing.

5. Slide guide B **(4)** and flange B **(5)** onto shaft and secure with washer **(6)** and nut **(7)**.

6. Tighten nut **(7)** until needle bearing releases from housing.

5 **Installation**

1. Attach retainer A **(2)** to shaft groove **(3)** with raised surface of retainer facing bearhg.

2. Coat new needle bearing with gear oll. Slide bearing onto shaft so bearing stamped surface faces retainer A **(2)**.

⚠ CAUTION

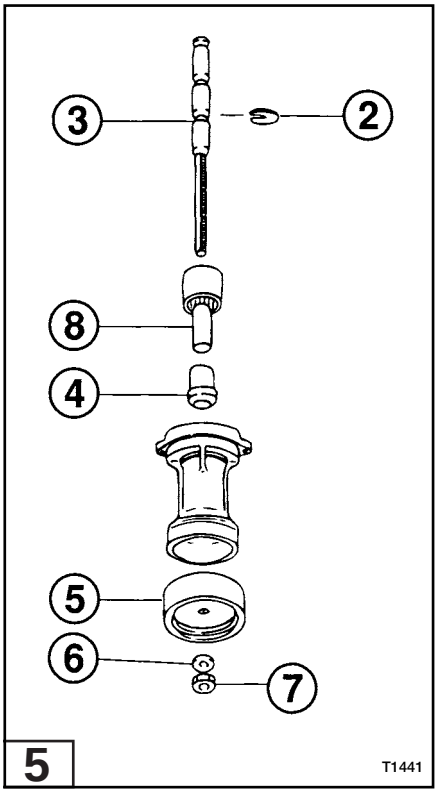
Stamped surface of needle bearing must face retainer or bearing could be damaged during installation.

3. Slide stopper B **(8)** and guide B **(4)** onto shaft and insert shaft in propeller shaft housing.

4. Slide flange B **(5)** onto shaft and secure with washer **(6)** and nut **(7)**.

5. Tighten nut **(7)** until stopper B **(8)** contacts flange B **(5)**.

6. Remove tools and verify needle bearing is fully seated in housing.



Bevel Gear A Bearing Outer Race

Removal

1. Install bevel gear A bearing puller assembly (Part No. 3A3-72755-0).

6 2. Tighten bolt (1) until bearing race releases from housing.

Installation

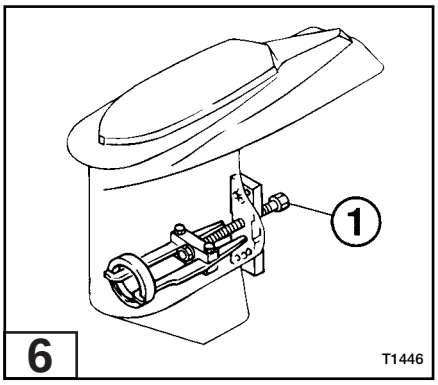
1. Secure gearcase horizontally in padded vice or other fixture so propeller shaft opening faces upward.

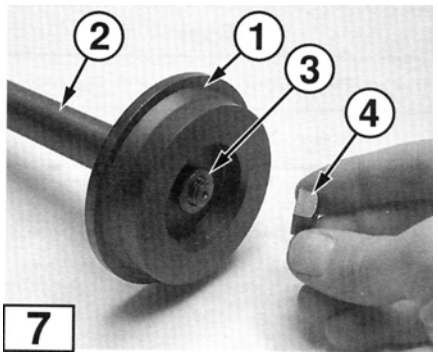
2. Verify bearing race seating surface in gearcase is clean and smooth.

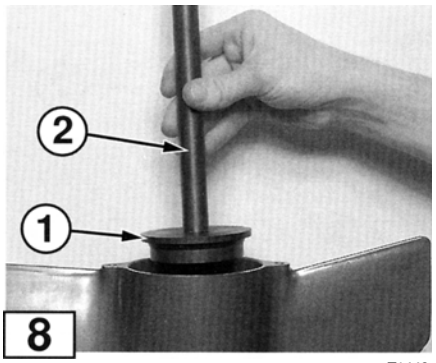
3. Apply specified gear oil to exterior of bearing race. Position race in gearcase so stamped surface faces closed end of gearcase.

7 4. Attach plate **(1)** to threaded end of rod **(2)** using spring washer **(3)** and nut **(4)**. Tighten nut with wrench.

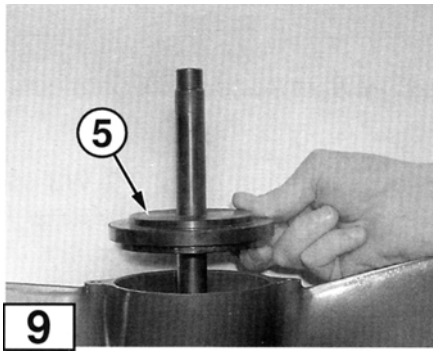
Tool	Part Number	Model
Bearing Outer Press Kit	3B7-72739-0	25 / 30 / 40



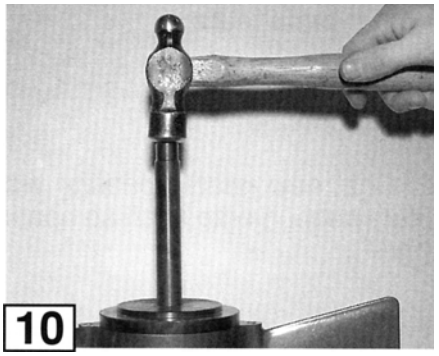




T1448



T1449

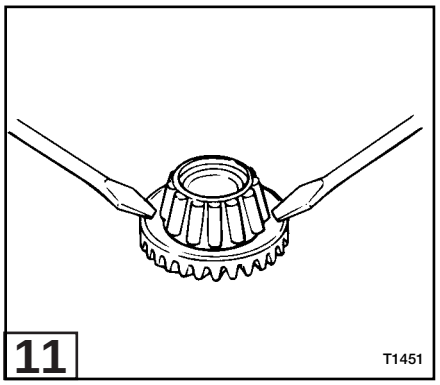


T1450

8 5. Insert rod **(2)** into gearcase so plate **(1)** is seated within the bearing race.

9 6. Slide guide **(5)** onto rod and seat into position on gearcase. Raised surface of guide must fit tightly within the circumference of the gearcase opening.

10 7. Fully seat bearing race in gearcase by hammering the rod end.



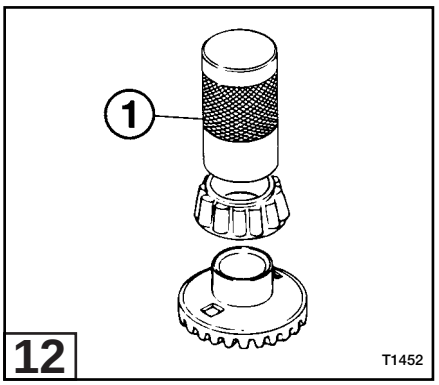
T1451

Bevel Gear A Roller Bearing

Removal and Installation

11 1. Insert screwdrivers in notches of bevel gear A and gently pry gear and bearing apart.

12 2. Use specified set tool **(1)** to press fit bearing onto bevel gear.



T1452

Tool	Part Number	Model
Set Tool, Bevel Gear A Bearing	3C8-72719-0	40
	346-72719-0	25 / 30

SECTION 7
ELECTRICAL SYSTEM

TABLE OF CONTENTS

SECTION 7

GENERAL PRECAUTIONS

Before performing any service work on the electrical system, read and understand the Service Safety section at the beginning of this manual.

Use the manufacturer and special tools as indicated during servicing of the electrical system.

Avoid electrical shock:

- Do not handle spark gap tester leads during performance testing.
- Do not touch ignition coils, exciter coil, pulser coils, or alternator coils while the engine is cranking or running.

Use the spark gap tester to prevent the engine from starting when performing static ignition performance tests.

Use caution when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

After repairs are complete, make sure all ignition and electrical leads are properly routed and clamped in their original positions.

Replace locking fasteners when their locking feature becomes weak.
Use only factory replacement parts.

Always inspect and test the start-in-gear prevention system before returning engine to customer.

SERVICE SPECIFICATIONS

Special Torque Values

Description	Torque in-lb (ft-lb) N-m kg-m				Threadlocker
	Model				
	2.5 / 3.5	**5 / 8 / 9.8**	**9.9 / 15 / 18**	**25 / 30 / 40**	
Spark Plug	(19 - 21) 25 - 29 2.6 - 3.0	(19 - 21) 25 - 29 2.6 - 3.0	(19 - 21) 25 - 29 2.6 - 3.0	(19 - 21) 25 - 29 2.6 - 3.0	—
Flywheel Nut	(29 - 33) 39 - 44 4	(36 - 43) 49 - 59 5 - 6	(51 - 65) 69 - 88 7 - 9	(87 - 101) 118 - 137 12 - 14	—

NOTE

Verify direction of flywheel nut rotation. Most are right-hand threads, however, some will have left-hand threads (past production models 9.9/15/18 and 40).

*Refer to Section 2 for Standard Torque Values chart.

Manufacturer Special Tools Required

None

SECTION 7

General Equipment Required

Analog Multimeter, *Electronic Specialties® Model M-530 or equivalent*
Digital Multimeter, *Electronic Specialties® Model KD 3200 or equivalent*
Spark Gap Tester, *Stevens® S- 13C, S-48, or equivalent*
Digital Pulse Tachometer, 10 - 6000 RPM, *Electronic Specialties® Model 321 or equivalent*
Variable Load High Rate Discharge Tester, *Electronic Specialties® Model 700 or equivalent*
Hydrometer
Heat Gun
Torque Wrench, 0 - 150 in-lb [0 - 17N-m / 0 - 1.7kg-m]

Consumables Required

Dieiectric Lubricant, *Permatex® Dielectric Tune-Up Grease*
Battery Spray Protector, *Permatex® Battery Protector and Sealer*
Low Temperature Lithium Grease
Genuine Grease or Equivalent Friction Surface Marine Grease
Threadlocker, *Loctite® 243*
lsopropyl Alcohol
Cleaning Solvent
Thermomelt Stik, 125°F [52°C] and 163°F [73°C]
Electrical Shrink Fit Tubing, various diameters

Electrical System

NOTE

Refer to Outboard Motors Service Data publication for all wiring diagrams when performing electrical testing.

Ignition Type
Flywheel Magneto Capacitor Discharge - models 2.5 / 3.5 / 5 / 8 / 9.9 / 15 / 18 / 25 / 30 / 40

Ignition Timing
degree

2.5 / **3.5:**	BTDC 20°
5:	BTDC 30° - BTDC 5°
8:	BTDC 22° - ATDC 1.5°
9.8:	BTDC 26° - BTDC 2.5°
9.9D:	BTDC 22° - ATDC 3°
9.9D$_2$:	BTDC 20° - ATDC 3°
15D:	BTDC 22° - ATDC 3°
15D$_2$:	BTDC 25° - ATDC 3°
18E:	BTDC 25° - ATDC 3°
18E$_2$:	BTDC 25° - ATDC 3°
25C$_2$:	BTDC 20° - ATDC 2°
25C$_3$:	BTDC 25° - ATDC 4°
30A$_3$:	BTDC 25° - ATDC 2°
30A$_4$:	BTDC 25° - ATDC 4°
40:	BTDC 25° - ATDC 2°

Spark Plug
With Resistor **2.5** / **3.5:** NGK BPR6HS-10 or Champion RL87YC10

With Resistor **5** / **8** / **9.8:** NGK BPR7HS-10 or Champion RL82YC10

With Resistor **9.9** / **15** / **18** / **25** / **30** / **40:** NGK BR7HS-10 or Champion RL82C10

Spark Plug Gap
in[mm]
2.5 / **3.5** / **5, 8, 9.8, 9.9, 15, 18, 25, 30, 40C:** 0.035 - 0.039 [0.9 - 1.0]

Battery
2.5, 3.5 ..... None
5 ..... None (Optional 12V 30 - 35 AH Recommended)
8, 9.8, 9.9, 15, 18, 25, 30 ..... None (Optional 12V 40 AH Recommended)
40 ..... None (Optional 12V 70 AH Recommended)

Engine Fuse
2.5, 3.5 ..... None
5 ..... None (with Optional Battery Charger - 10A)
8, 9.8, 9.9, 15, 18, 25, 30, 40 ..... None (with Optional Battery Charger - 15A)

Alternator
2.5, 3.5 ..... None
5 ..... None (Optional - 12V - 60W)
8, 9.8 ..... None (Optional - 12V - 80W)
9.9, 15, 18, 25, 30, 40 ..... 12V 80W

Charging Performance (at 1500 RPM)
N/A

Charging Performance (at 5500 RPM)
5 (Optional)..... 4A
8, 9.8 ,9.9, 15, 18 ,25 ,30 ,40 ..... 5A

Number of Tachometer to Alternator Coil Impulses
2.5, 3.5 ..... N/A
5 2
8, 9.8, 9.9, 15, 18, 25, 30, 40 4

Ignition Coil Resistance
Primary Coil
2.5/ 3.5: 0.18- 0.24 Ω
5: 0.2 - 0.38 Ω
9.9 / **15** / **18** / **25** / **30** / **40:** 0.2 - 0.3 Ω

Secondary Coil
2.5 / **3.5:** 2.7 - 3.7 KΩ
5: 3.0 - 4.4 KΩ
8 / **9.8:** 1.95 - 3.25 KΩ
9.9 / **15** / **18:** 4.1 - 6.1 KΩ
25 / **30** / **40:** 4.1 - 6.1 KΩ

CD Unit Output (Cranking)
3.5B / **5B** / **5BS** / **9.9** / **15** / **18** / **25** / **30** / **40C:** 198-220 DVA
8 / **9.8, 9.9** / **15** / **18:** 198-220 DVA

Exciter Coil Output (Cranking)
3.5B / **5B** / **5BS** / **9.9** / **15** / **18** / **25** / **30** / **40C:** 100 DVA Mim

Pulser Coil Output (Cranking)
3.5B / **5B** / **5BS** / **9.9** / **15** / **18** / **25** / **30** / **40C:** 4.75-5.0 DVA

Coil Resistance

Coil	Ω	2.5 / 3.5	5	8 / 9.8	9.9D / 15D / 18E	9.9D2 / 15D2 / 18E2	25C2 / 30A3	25C3 / 30A4	40	40new
Exciter Coil	Ω	280-420	93-140	210-350	168-252	130-195	200-300	130-195	200-300	130-195
Pulser Coil	Ω	N/A	80-117	N/A	30-46	N/A	30-46	N/A	30-46	N/A
Alternator W-Y	Ω	N/A	0.31-0.47	0.24-0.36	0.24-0.36	Y-W :0.65-0.98 Y-B :0.31-0.47 W-B:0.37-0.55	0.24-0.36	Y-W :0.65-0.98 Y-B :0.31-0.47 W-B:0.37-0.55	0.24-0.36	Y-W :0.65-0.98 Y-B :0.31-0.47 W-B:0.37-0.55

ELECTRICAL SERVICING STANDARDS

Electrical Connectors

When you replace electrical components or perform diagnostic tests, you must disconnect electrical connectors in many instances.

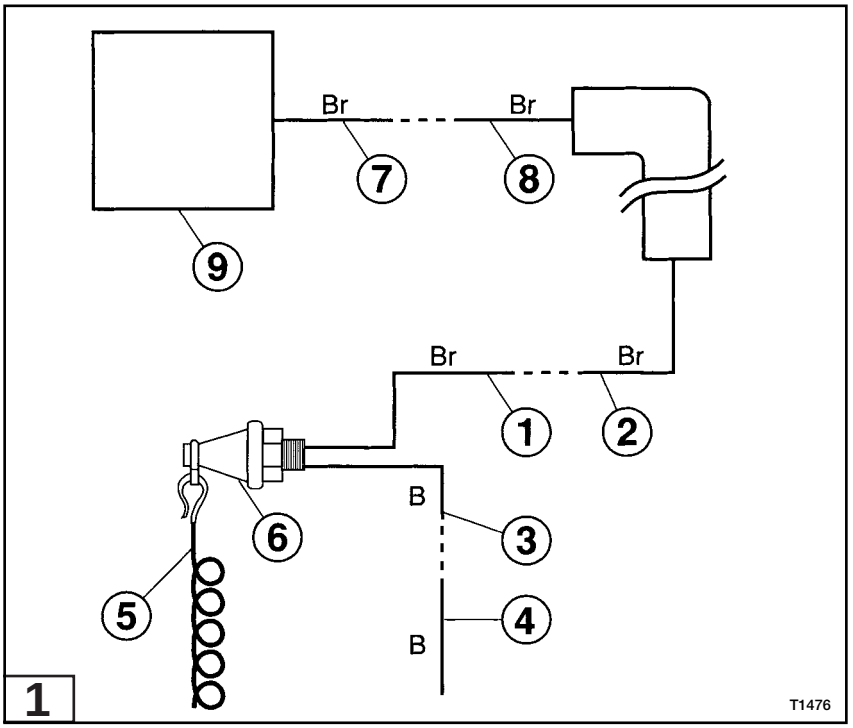
The following discussion will help you recognize connectors in electrical drawings and show you how to disconnect and connect them.

Electrical Connector Drawings

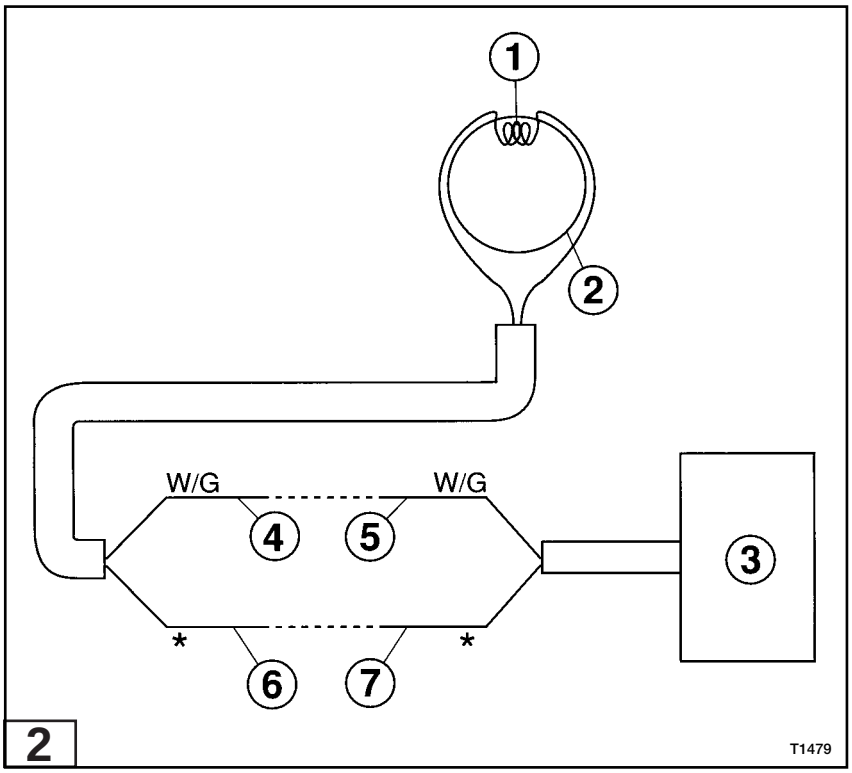
In most of the electrical drawings in this section, the physical shape of electrical connectors has been eliminated to clarify testing procedures.

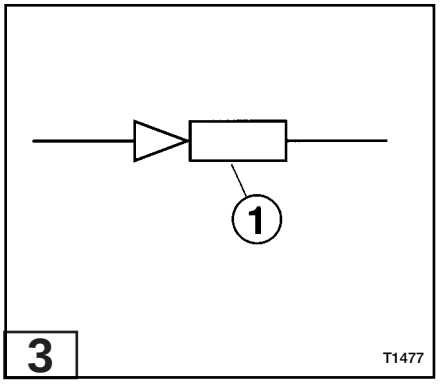
1 A typical electrical drawing illustrates several connectors. Items **(1)**, **(2)**, **(3)**, **(4)**, **(7)** and **(8)** are terminals that are located inside of electrical connectors. The dashed line between two terminals [e.g., between terminal **(7)** and **(8)**] means that they are a part of the same connector but have been disconnected for testing.

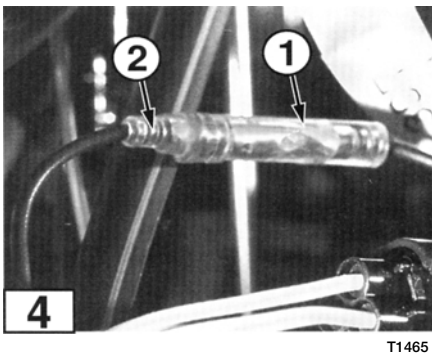
Note that Terminal **(7)** is directly connected to the CD Unit **(9)** (no connectors between the terminal and CD Unit). When you disconnect an electrical connector to test a component, it is very important that you disconnect the FIRST CONNECTOR. Terminals **(1)**, **(3)** and **(7)** are examples of how the first connector is illustrated.



1







2 Special cases are the connectors used to test components located on the coil plate assembly. For testing purposes, the first connector is located at the far end of the cable (away from the coil plate assembly).

Bullet Connectors

NOTE

3 *Bullet connectors **(1)** are shown like this in electrical drawings.*

Disconnecting Bullet Connectors

1. Carefully examine the connector to determine which end is removable and which end is fixed. Typically the insulation surrounding the removable end is tapered so it fits inside of the insulation for the fixed end.

4 2. Grasp the fixed end **(1)** of the connector and carefully pull the removable end **(2)** straight out without twisting or bending it.

NOTE

Never twist or bend bullet connectors or damage to the connectors will occur. Always PULL these connectors apart.

Electrical Cable Color Codes

Electrical cables have color coded conductors so you can locate the correct conductor during troubleshooting and repair procedures. All conductor colors are in capital letters in this manual.

Some conductors have a background color and a different color stripe that runs the length of the conductor. These conductors are designated as follows:

A/B
Where A = Background Color
B = Stripe Color

Example:
BLACK/WHITE
This conductor has a BLACK background with a WHITE stripe.

Electrical Drawings

All electrical drawings shown in this manual have been simplified to clarify the circuit that is being tested. They represent typical configurations and may not look exactly like the electrical wiring for your engine. Complete electrical schematics are provided in the Outboard Motors Service Data publication.

SECTION 7

TROUBLESHOOTING

The troubleshooting chart lists common engine symptoms related to problems with the electrical system. It also indicates specific malfunctions in the electrical system which may be causing a problem so it can be isolated more effectively. Before beginning major troubleshooting on the electrical system, perform the following operations:

- Check battery fluid level and specific gravity. Charge or replace as required. See Battery Care and Maintenance, this section.
- Check the following electrical connections and make sure they are secure and free of corrosion:
    - Battery cables
    - Starter solenoid wiring
    - Starter motor wiring (including ground connection)
    - Spark plug leads
    - Ignition circuit wiring
    - Stop circuit wiring
    - Charge circuit wiring
- Make sure shift lever or remote control lever operates freely.
- Attach lanyard to emergency stop switch, see Section 2.

Ignition System

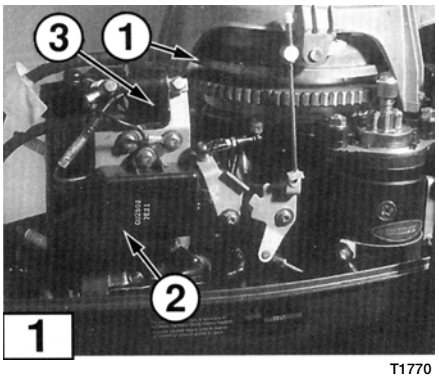
SYMPTOM / CHECKS	Cranks but will not start	Wilt not start and pops or backfi res	Starts but stops immediately	Low or high speed miss	Poor accel-eration, low top end RPM	Engine will not shut off
Faulty stop circuit - see Test 2 - stop Circuit Test, this section						●
Faulty ignition system - see Ignition System Performance Testing, this section		●		●	●	●
Faulty spark plug(s) - See Section 2	●		●	●	●	
Incorrect ignition timing or carburetor synchronization - See Section 2		●	●	●	●	

Starting System

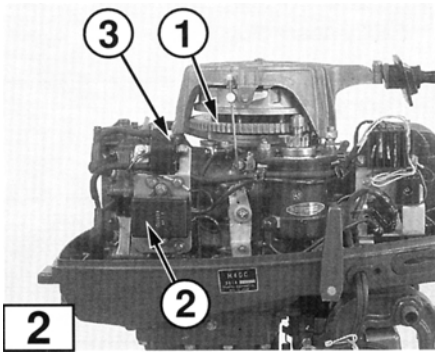
SYMPTOM / CHECKS	Will not crank
Blown fuse	●
Faulty main key switch	●
Not in Neutral, defective Neutral switch	●
Faulty battery, starter solenoid/ starter motor cable	●
Faulty starter solenoid	●
Faulty starter motor: - Faulty brushes - Damaged pinion assembly	●

Charging System

SYMPTOM / CHECKS	Battery does not maintain charge or overcharges
Blown fuse	●
Shorted or faulty alternator coil	●
Faulty recitier/regulator	●
Faulty charge circuit wiring	●



T1770

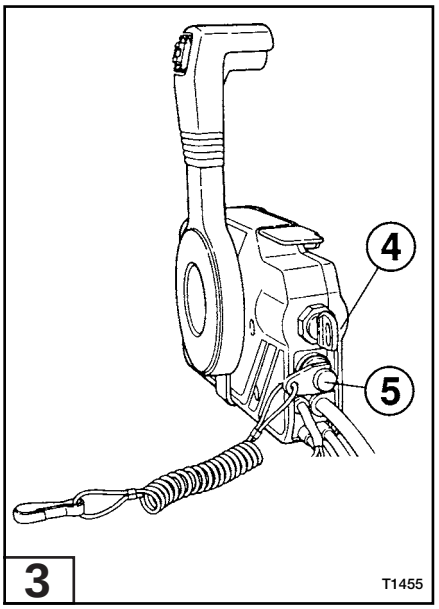


T1771

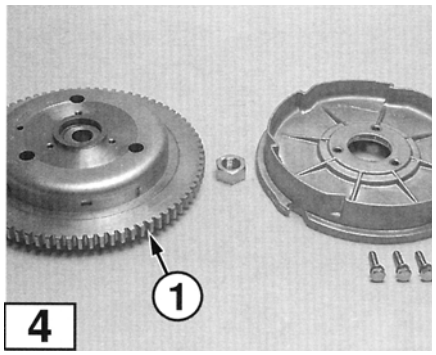
DESCRIPTION OF OPERATION

Ignition System

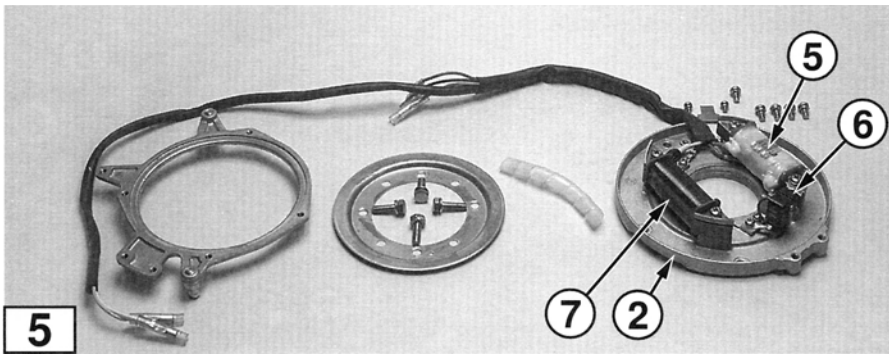
1 2 3 The ignition system consists ofthe magneto **(1)**, Capacitive Discharge (CD) unit **(2)**, ignition coil **(3)**, main key switch **(4)** and emergency stop switch **(5)**. The purpose of this system is to provide an electric spark inside each cylinder at the precise moment needed by the combustion chamber.



T1455



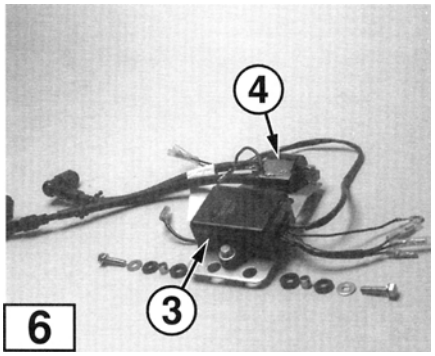
T1981



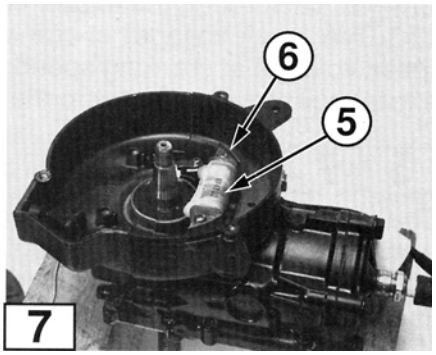
T1982

Magneto

4 5 6 7 The electrical system consists of a flywheel **(1)**, coil plate assembly **(2)**, a CD unit **(3)** and an ignition coil **(4)**. The 1/2 cylinder engines are comprised of seven basic electrical systems. The following chart demonstrates not only the differences but the similarities:



T1983



T1984

	2.5A 3.5A	2.5A(2) 3.5A(2) 3.5B(2)	5	8 9.8	9.9 15 18	25 30	40
Flywheel Magneto	•	•	•	•	•	•	
CD Unit			•	•	•	•	•
Condenser	•	•					
Contact Breaker	•						
Coil Plate	•			•	•	•	•
Exciter Coil	•	•	•	•	•	•	•
Ignition Coil	•	•	•	•	•	•	•
Pulser Coil		*	•	*	•	•	•
Alternator/Lighting Coil			Opt	Opt	•	•	•

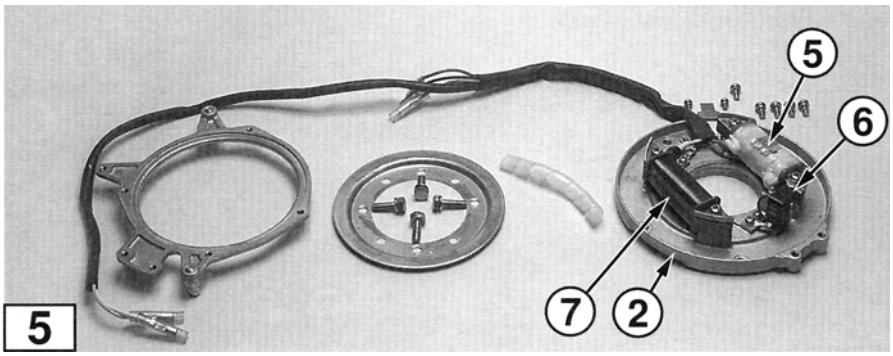
*** NOTE**

Pulser coils are not present in either the 3.5B or 8/9.8 models. 9.9D2 / 15D2/ 18E2 and 25C3 / 30A4 also.

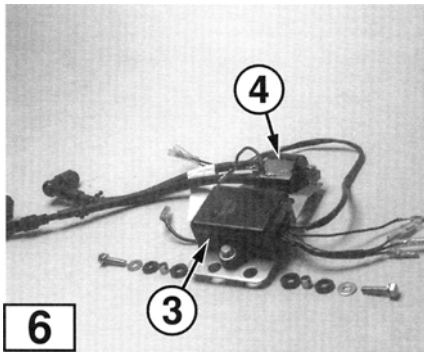
The chart demonstrates that the 2.5/3.5 non-CD engine have different components, all other engines are all basically similar. The basic units are described as follows:

4 Flywheel

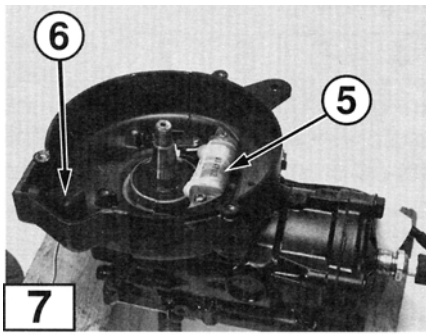
Mounted radially inside the flywheel **(1)** are a number of high performance ferrite magnets. As the flywheel rotates, the magnets pass in front of the coils (exciter / alternator) to produce voltage in the coils.



T1982



T1983



T2212

5 7 Coil Plate

The coil plate is a part to which exciter coil, pulser coil and alternator coil are attached. (2.5, 3.5 and 5 Hp models do not use the coil plate.) The coil plate is rotated for ignition advance.

5 7 Exciter Coil

The exciter coil **(5)** consists of many windings of wire wrapped around a metal lamination. Once the flywheel exceeds a minimum cranking RPM, the lines of force from the ferrite magnets contained within the flywheel cut through the exciter coil windings. This will produce about 100 DVA or over(peak voltage) at cranking speed. A minimum of 100 DVA(peak voltage) at cranking speed must be detected. The output of the exciter coil provides power to the CD Unit.

5 7 Pulser Coil

The pulser coil **(6)** consists of an iron core with numerous windings of a wire wrapped around it. The flywheel is equipped with a metallic cam called an interrupter molded into it. When the interrupter passes in close proximity to the pulser coil, the permanent magnet's lines of force collapse momentarily. At cranking speed this produces a 4.75 to 5.0 DVA signal in the coil. A minimum of 3 DVA must be detected during testing.

The output voltage from the pulser coil is used to control a small electronic switch (SCR) located inside the CD Unit. When the CD Unit receives an output from a pulser coil, it directs an output, approximately 220 DVA, to the appropriate ignition coil primary.

5 Alternator/Lighting Coil

The larger 1/2 cylinder engines (9.9-40) are provided with an alternator coil **(7)** mounted on the coil plate which may be used to power a lighting circuit and/or recharging circuit if equipped with this option. An Alternator/Lighting Coil is available as an add-on to the 5 and 8/9.8 models.

6 CD Unit

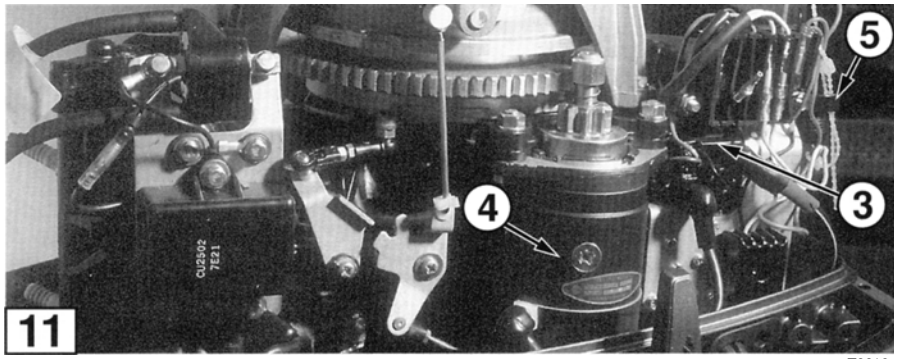
The CD Units incorporate a printed circuit board (PCB) encased in a black resin housing to protect the circuitry from water and vibration. Major components include a diode used to rectify current generated by the exciter coil, a capacitor which charges the voltage supplied, a thyristor which serves as a breaker and a zener diode used to control the thyristor. Additional components such as resistors and SCR's are also provided depending upon the model.

6 Ignition Coil

Each ignition coil **(4)** consists of two windings or wire wrapped around a compacted ferrite material. The coil has a primary and secondary terminal connection and a ground plate. Through mutual induction, the ignition coil transforms the output from the CD Unit to as much as 20,000 - 30,000 volts to fire the spark plug. The ignition coil is generally adjacent to the CD Unit and attached to its mounting bracket, with the exception of the 8/9.8 CD Unit where the ignition coil is molded as together as part of the CD Unit.

Main Key Switch and Emergency Stop Switch

The emergency stop switch is connected to the CD Unit through an engine wiring harness. When lanyard is removed from the emergency stop switch, an input to the CD Unit is grounded. This deactivates the CD Unit and the engine shuts down. If the engine is fitted with the Remote Control feature, pressing the stop switch on the Remote Control Unit will also ground the CD Unit.



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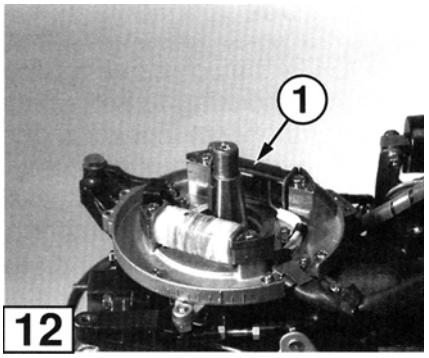
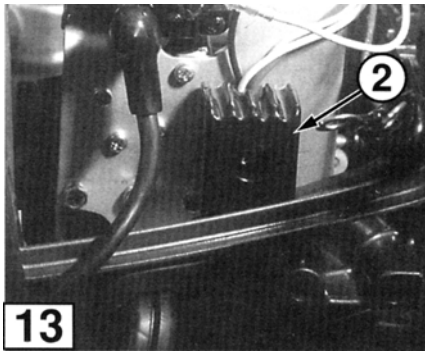


T1986

Starting System - Optional Electric Start
(8 / 9.8 / 9.9 / 15 / 18 / 25 / 30 / 40)

11 The starting system consists of the battery, main key switch, neutral start switch, starter solenoid **(3)**, starter motor **(4)** and 15 A engine fuse **(5)**. When the main key switch is in the START position, and the start contacts of the neutral start switch are closed, power is sent to the starter solenoid, energizing it. When the starter solenoid is energized, a connection between the positive terminal of the battery and the starter motor is provided. The connection between the starter motor and ground completes the circuit. The fuse opens if the coil circuit of the starter solenoid shorts or overloads.



T1987

Charging System

12 **13** The charging system consists of the alternator coil set **(1)**, rectifier **(2)**, 10 or 15 A engine fuse, and the battery. When the flywheel is turning approximately 1500 RPM or higher, the alternator coil set provides alternating current (AC) voltage to the rectifier/regulator. The rectifier transforms the AC voltage into direct current (DC) voltage.

BATTERY CARE AND MAINTENANCE

⚠⚠ WARNING

Batteries produce and explosive mixture of oxygen and hydrogen. Keep sparks or open flame away from battery.

⚠ CAUTION

Battery electrolyte is a poisonous, acidic solution. Always:

- **Wear protective gloves and safety glasses when working with battery acid.**
- **Ifspilled, clean up immediately.**
- **If skin contact occurs, immediately wash with clean water.**
- **If ineyes, flush immediately for 10 to 15 minutes using fresh water, and seek medical help immediately.**
- **If injested, do not induce vomiting. Drink large amounts of Milk of Magnesia, beaten eggs or vegetable oil. Seek medical help immediately.**

General Procedures

Inspection and Cleaning

1. Inspect battery case for damage
2. Inspect cable connectors.
3. Inspect cables.
4. Check electrolyte level.
5. Check battery Mounting.

Cleaning

1. Disconnect and remove battery.
2. Clean battery, terminals, connectors, mounting and box using a 4-1 solution of water and baking soda.
3. Flush with clear water and let dry.
4. Reinstall battery.
5. Apply battery spray protector to cables and connectors.
6. Attach and tighten cables to specifications.

Testing

1. Check electrolyte level.
2. Check specific gravity using a hydrometer.
3. Note temperature of fluid or ambient air (in celcius).
4. Calculate corrected specific gravity using the following formula:

Corrected specific gravity = MSP + (temperature - 20) x 0.0007

Where: MSP = measured specific gravity
Temperature = Temperature in degrees celcius

5. If the corrected specific gravity is less than 1.260 or differs between any two cells by more than 0.030, perform the charging capacity test.

Charging Capacity Test

⚠⚠ WARNING

Whenever recharging battery, always remove ALL filler caps.

⚠⚠ WARNING

Remove battery from boat whenever charging

⚠⚠ WARNING

When removing battery cables ALWAYS remove the negative cable first.

1. Check electrolyte levels.
2. Test specific gravity.
3. Calculate amount of discharge in ampere hours.
4. Calculate charging current.
5. Calculate time required to recharge battery.
6. Charge battery.
7. If electrolyte temp exceeds 115°F (45°C) or gassing becomes excessive, life of battery will be shortened.
8. If battery goes to 13 volts immediately upon starting charge, replace battery.
9. Good battery should start at 12 and rise to 12.5 or 13 over the period of 30 to 60 minutes.
10. If little or no gas is produced during charge, replace battery.
11. When charged, battery should measure 15-16 volts and have a specific gravity of 1.260.

Terminal Voltage Test

1. Check electrolyte level and specfic gravity.
2. Connect a Variable Load High Rate Discharge Tester to battery terminals.
3. Discharge at a rate of 3 x ampere hour rating of battery for 15 seconds.

    - 5 HP (30-35 Ampere Hour Rating) = Discharge Rate: 90 to 105
    - 8/9.8, 9.9/15/18, 25/30 (40 Ampere Hour Rating) = Discharge Rate: 120
    - 40 (70 Ampere Hour Rating) = Discharge Rate: 210

4. Measure voltage at battery terminals. If 9.6 volts or higher, battery has good output capacity. If lower than 9.6 volts, replace the battery.

Charging

(See Charging Capacity Test - this section.)

For more detailed information, see Section 7 - Electrical System-3/4 Cylinder Service Manual.

SECTION 7

IGNITION SYSTEM

⚠ CAUTION

All cranking output tests must be performed with spark plugs installed and torqued in the cylinder head. It necessary to remove the spark plugs, be sure to keep the spark gap tester away from open spark plug holes.

⚠ CAUTION

Avoid electrical shock:

- **Do not handle spark gap tester heads during performance testing.**
- **Do not touch ignition coils, exciter coil, pulser coils, or alternator coils while the engine is cranking or running.**

⚠ CAUTION

Use proper precautions when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

⚠ CAUTION

When repairs are complete, make sure all ignition and electrical leads are properly routed and champed in their original positions and the start-in-gear prevention system must be tested before returning engine to customer.

Ignition System Performance Testing

Ignition Performance Testing is divided into two sections. The first section consists of a flow chart. This chart presents the correct sequence of performing ignition system performance tests to effectively and efficiently check for problems in starting and running the engine. Follow the steps in the order listed until the problem is resolved and the ignition system meets specifications while the engine is running.

The chart references specific performance tests that must be completed to resolve each problem. These tests are described in detail in the section which follows the flow chart.

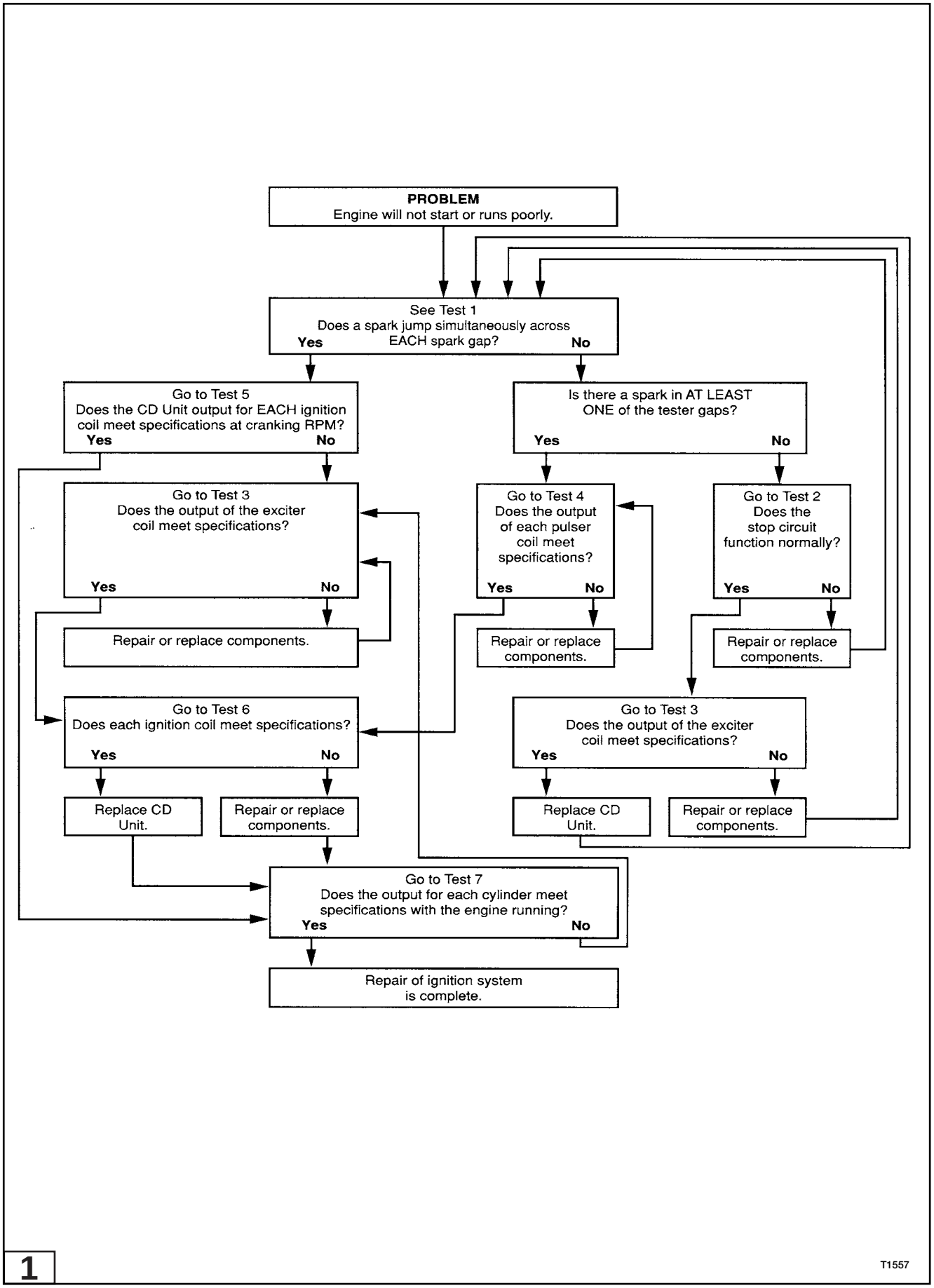
The performance tests, identified as Test 1 through Test 7, contain specific instructions for testing and servicing various ignition system components. Use this section to perform the tests correctly in accordance with the factory recommendations.

NOTE

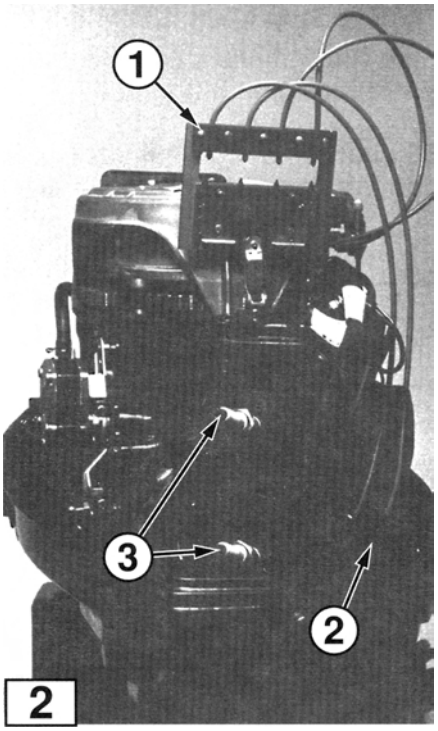
After you complete each performance test refer back to the flow chart for the next step. You must follow the flow chart until the ignition system meets specifications while the engine is running. The only way to be sure that you have uncovered and repaired all ignition system problems is to follow these procedures in a systematic fashion.

If you only have problems in stopping the engine, proceed directly to Test 2 - Stop Circuit Test.

1 Ignition System Performance Testing Flow Chart



Test 1 - Spark Test



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NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

1. Remove all spark plug leads, and spark plugs **(3)**.

2 2. Adjust spark gap tester **(1)** to 7/16 in [11 mm].

3. Connect each spark plug lead to spark gap tester **(2)**.

4. Secure spark gap tester to a clean ground on engine block.

⚠⚠ WARNING

To avoid possible shock hazard, do not handle ignition coils or spark gap tester during cranking tests.

NOTE

To prevent possible arcing of high voltage, route tester leads at least 2 in [51 mm] from any metal surface.

Ground unused test leads to a clean engine ground.

5. Attach lanyard to emergency stop switch,

6. Crank engine.

A spark should jump across the gap for each cylinder and alternate from one gap to another.

7. Reconnect all wires disconnected during test.

8. Return to Ignition System Performance Testing Flow Chart.

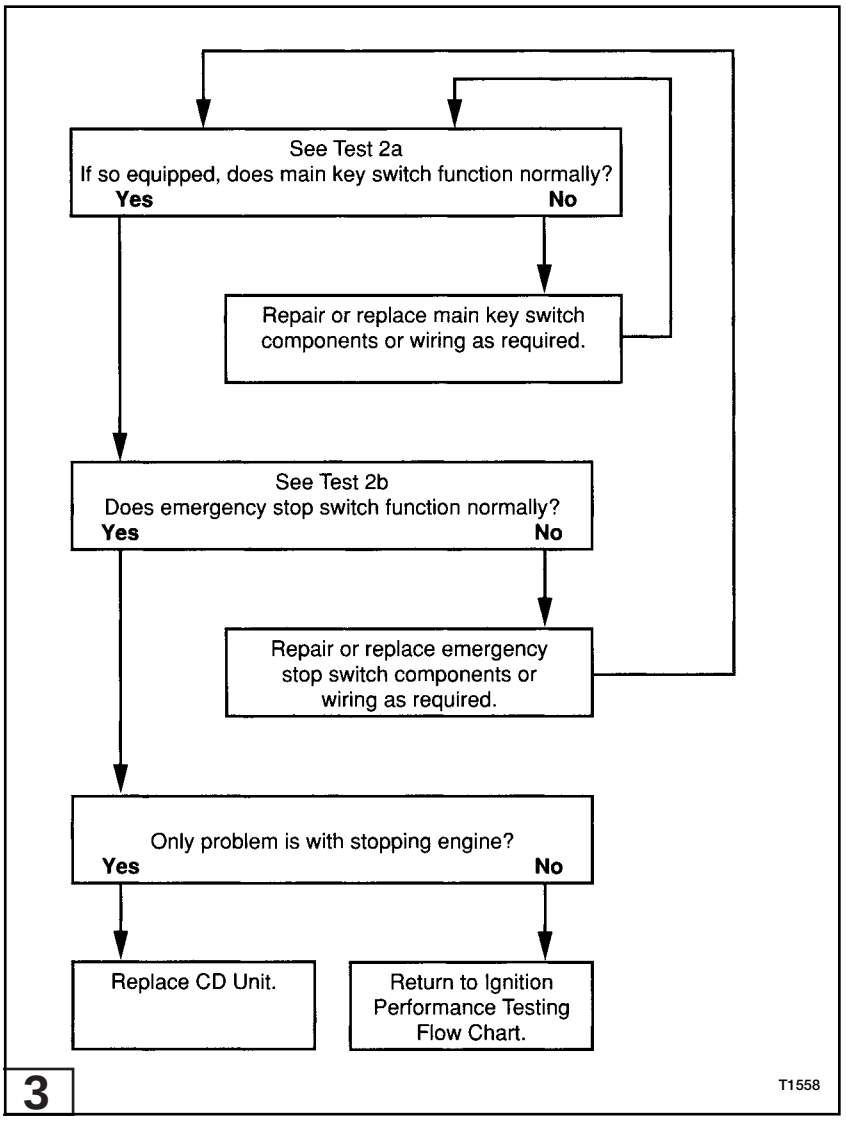
Test 2 - Stop Circuit Test

Stop circuit malfunction can cause the engine not to start or prevent it from stopping.

Several component failures can cause the stop circuit to malfunction. Use this flow chart to isolate and repair all component failures.

NOTE

3 *After you complete each stop circuit test, refer back to the flow chart for the next step.*



Test 2a - Stop Circuit Main Key Switch Test (if so equipped)

This test is used to determine whether the main key switch and connecting wiring are functioning normally.

NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils beAore conducting the following procedure.

All continuity tests must be conducted with negative lead kom battery disconnected or you may damage the meter.

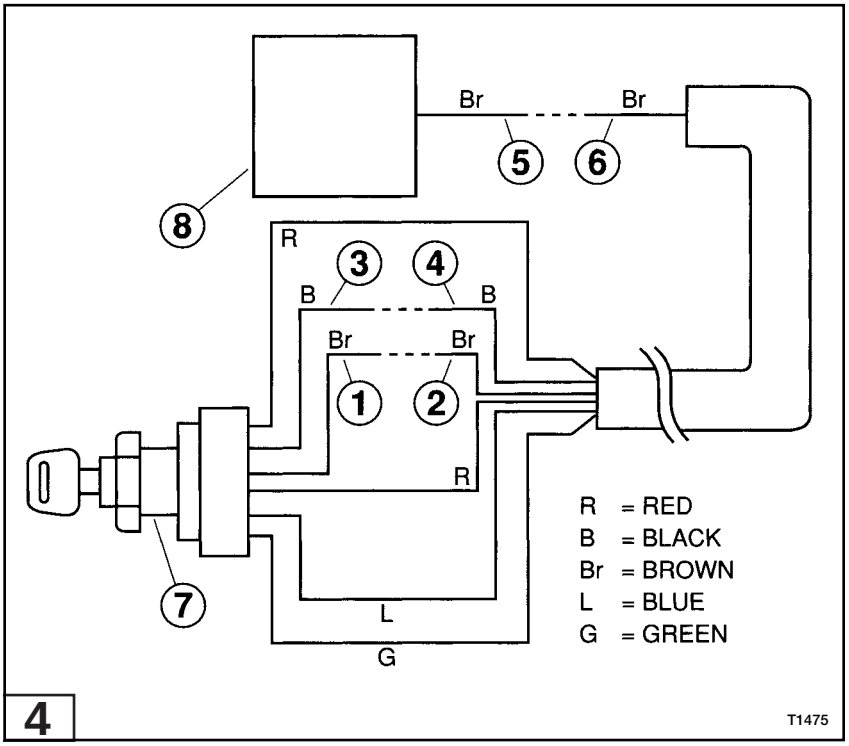
1. Remove negative lead from battery.

4 2. Disconnect main key switch terminals **(1)**, **(2)**, **(3)** and **(4)**.

4 3. Set analog multimeter to check continuity. Connect one meter lead to terminal **(1)** and the other to terminal **(3)**.

4 4. Turn main key switch **(7)** to OFF position, meter must show continuity. If not, replace main key switch.

5. Turn main key switch to ON position, meter must not show continuity. If it does, replace it.



5 6. Disconnect CD Unit **(8)** terminals **(5)** and **(6)**.

5 7. Connect one meter lead to terminal **(6)** and the other to terminal **(2)** and check continuity. If the meter does not show continuity, replace the cable.

5 8. Connect one meter lead to terminal **(6)** and the other to a clean engine ground. If the meter shows continuity, replace the cable.

9. Reconnect all wires and return to Test 2 - Stop Circuit Test flow chart.

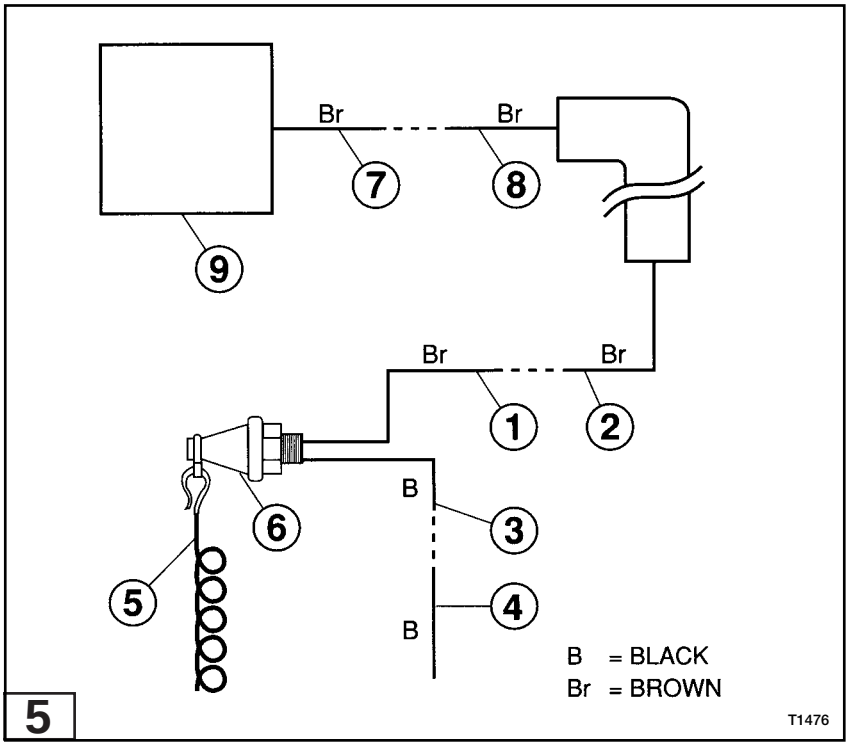
Test 2b - Stop Circuit Emergency Stop Switch Test
This test is used to determine whether the emergency stop switch and connecting wiring are functioning normally.

NOTIE

Make sure all electrical terminals are connected during this test except those that are noted in the test pro cedure.

Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

All continuity tests must be conducted with negative lead from battery disconnected or you may damage the meter.



5

1. Remove negative lead from battery.

6 2. Disconnect emergency stop switch terminals **(1)**, **(2)**, **(3)** and **(4)**.

6 3. Set analog multimeter to check continuity. Connect one meter lead to terminal **(1)** and the other to terminal **(3)**.

6 4. Attach lanyard **(5)** to emergency stop switch **(6)**, meter must not show continuity. If it does, replace emergency stop switch.

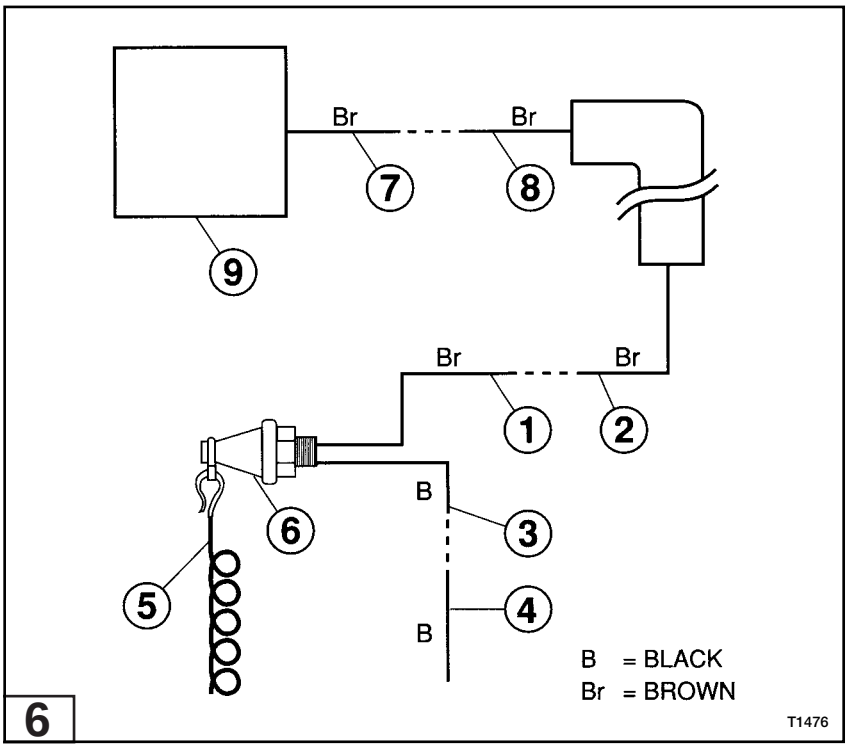
6 5. Remove lanyard **(5)** from emergency stop switch **(6)**, meter must show continuity. If not, replace emergency stop switch.

6 6. Disconnect CD Unit **(9)** terminals **(7)** and **(8)**.

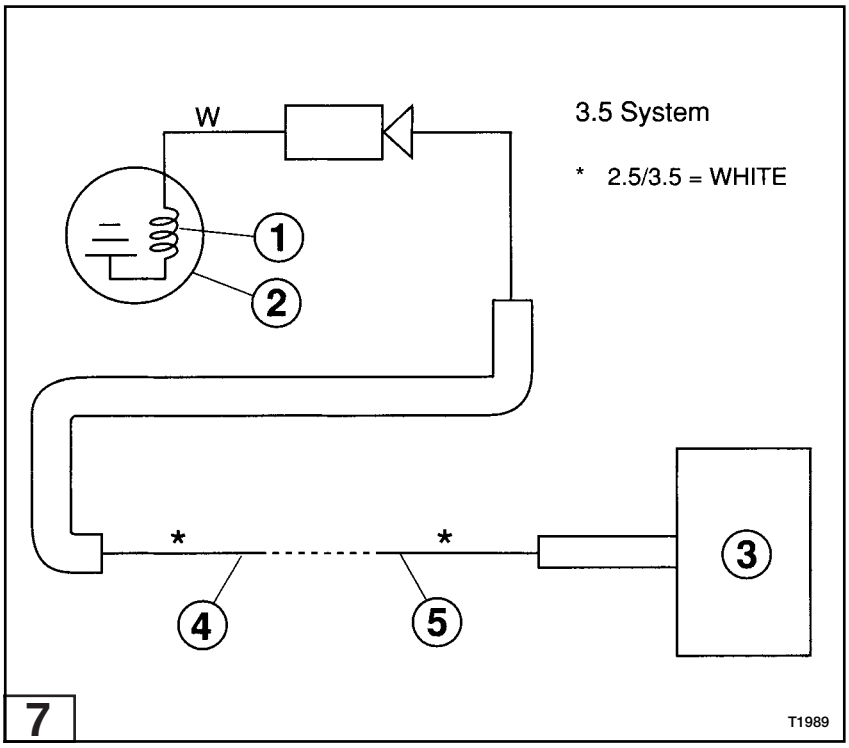
6 7. Connect one meter lead to terminal **(8)** and the other to terminal **(2)** and check continuity. If the meter does not show continuity, replace the cable.

6 8. Connect one meter lead to terminal **(8)** and the other to a clean engine ground. If the meter shows continuity, replace the cable.

9. Reconnect all wires and return to -Test 2 - Stop Circuit Test flow chart.



6



Test 3 - Exciter Coil Test

NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

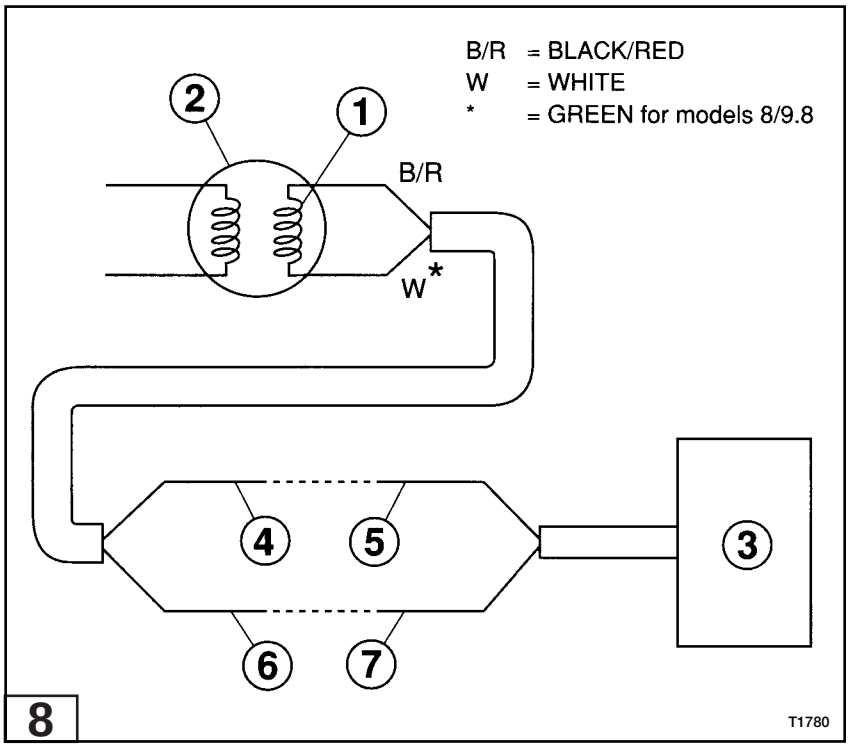
Reference the following electrical drawings for the exciter coil test. The pulser and alternator coils have been removed from both illustrations for clarity.

7 - *Models 2.5 / 3.5 / 3.5B*

8 - *Models 5 / 8 / 9.8*

9 - *Models 9.9 / 15 / 18 / 25 / 30 / 40*

Remark) Terminals 6 and 7 does not apply to models $9.9D_2$ / $15D_2$ / $18E_2$ / $25C_3$ / $30A_4$ and 40 new.



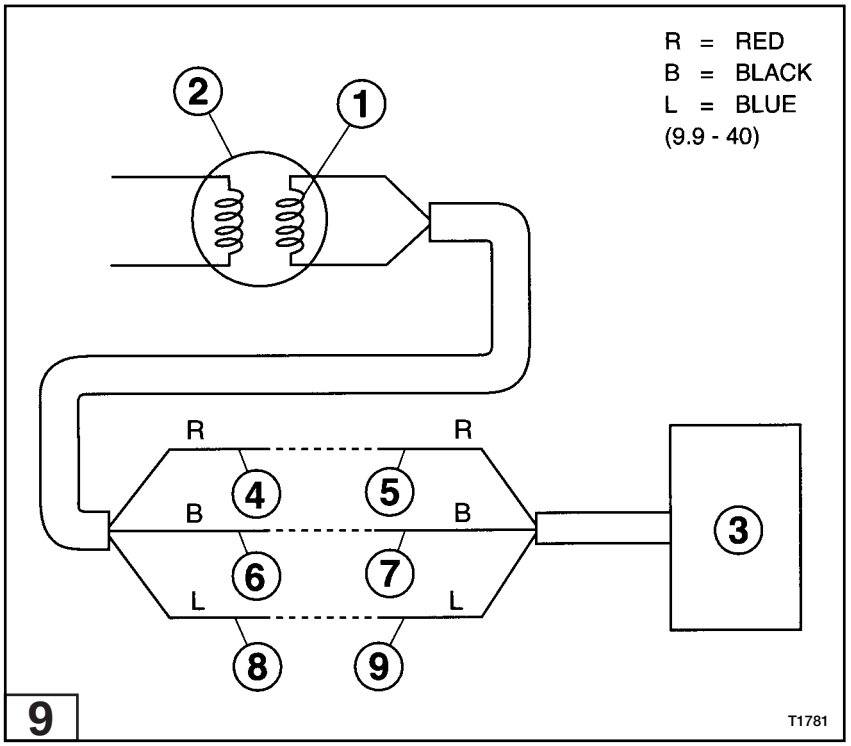
7 8 9 The exciter coil test is used to determine the output voltage, in DVA, from the exciter coil **(1)**, located on the coil plate assembly **(2)** to the CD Unit while you are cranking the engine.

1. Disconnect the following terminals:

Engine Models	Disconnect Terminals
2.5 / 3.5	4 and 5
5 / 8 / 9.8	4, 5, 6, and 7
9.9D / 15D / 18E / 25C$_2$ / 30A$_3$ / 40	4, 5, 6, 7, 8, and 9
9.9D$_2$ / 15D$_2$ / 18E$_2$ / 25C$_3$ / 30A$_4$ / 40new	4, 5, 8, and 9

2. Set the digital multimeter to ohms and connect the leads between the following terminals to read the resistance of the exciter coil:

Engine Models	Connect Multimeter Between These Terminals
2.5 / 3.5	4 and Ground
5 / 8 / 9.8	4 and 6
9.9D / 15D / 18E / 25C$_2$ / 30A$_3$ / 40	4 and 6
9.9D$_2$ / 15D$_2$ / 18E$_2$ / 25C$_3$ / 30A$_4$ / 40new	4 and 8



3. The meter should indicate the following resistance:

Engine Models	Results
2.5 / 3.5	280 - 420 Ω ± 25%
5	93 - 140 Ω ± 25%
8 / 9.8	224 - 336 Ω ± 25%
9.9D / 15D / 18E	168 - 252 Ω ± 25%
$9.9D_2$ / $15D_2$ / $18E_2$	130 - 195 Ω ± 25%
$25C_2$ / $30A_3$	200 - 300 Ω ± 25%
$25C_3$ / $30A_4$	130 - 195 Ω ± 25%
40	200 - 300 Ω ± 25%
40new	130 - 195 Ω ± 25%

4. If the resistance is not within the indicated range, replace the exciter coil set. See Ignition System Repair Procedures - Exciter Coil. After repairs are made, return to Ignition System Performance Testing Flow Chart.

If the resistance is within indicated range, proceed to the next step.

Engine Models	Connect Multimeter Between These Terminals
2.5 / 3.5 / 3.5B	• Terminal 4
5 / 8 / 9.8	• Terminal 4 • Terminal 6
9.9D / 15D / 18E / 25C$_2$ / 30A$_3$ / 40	• Terminal 4 • Terminal 6 • Terminal 8
9.9D$_2$ / 15D$_2$ / 18E$_2$ / 25C$_3$ / 30A$_4$ / 40new	• Terminal 4 • Terminal 8

7 8 9 5. Set the analog multimeter to “400” on the “DVA” scale. Connect the RED tester lead to terminal **(4)** and BLACK tester lead to terminal **(5)** for models 2.5 /3.5. Connect the RED tester lead to terminal **(6)** and BLACK tester lead to terminal **(4)** for models 5 / 8 / 9.8 / 9.9 / 15 / 18 / 25 / 30 / 40.

6. Attach lanyard to emergency stop switch.

7. Crank engine.

8. At cranking RPM, the tester should show the following results:

Engine Models	Test Results
2.5 / 3.5 / 3.5B, 5, 8 / 9.8, 9.9 / 15 / 18, 25 / 30 and 40	100 DVA Minimum

9. If the exciter coil test results are not within the acceptable range, replace the exciter coil set. See Ignition System Repair Procedures Exciter Coil.

10. Reconnect all wires disconnected during test.

11. Return to flow chart.

Test 4 - Pulser Coil Test

NOTE

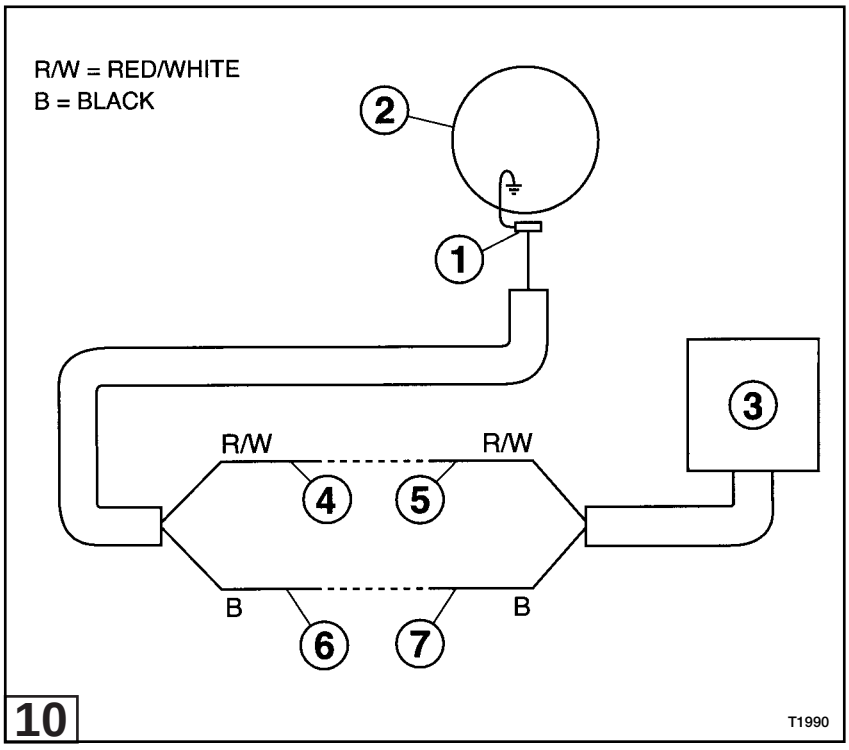
Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

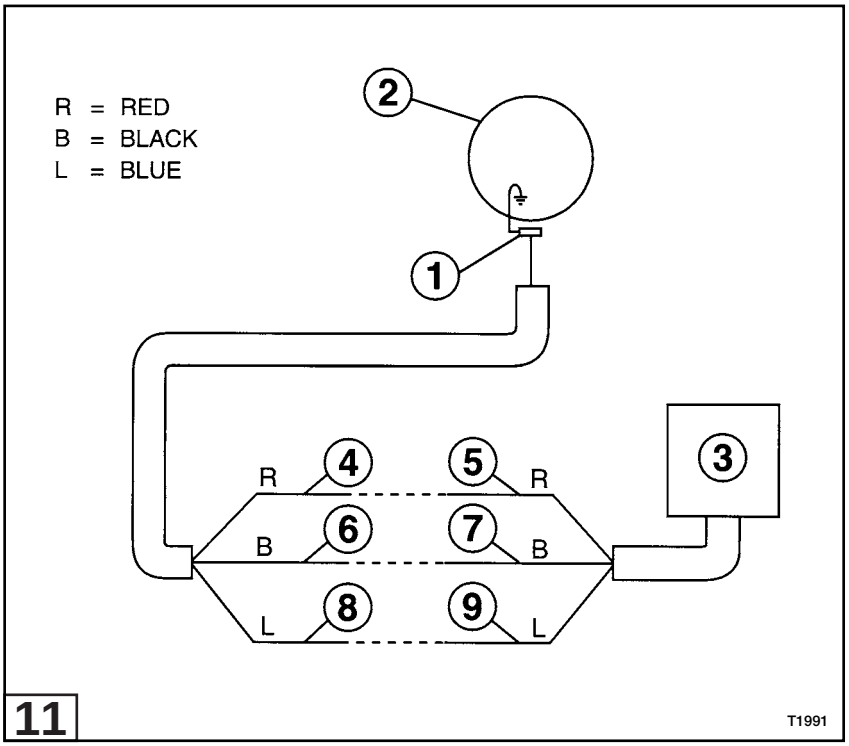
Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

Reference the following electrical drawings for the pulser coil test. The exciter and alternator coils have been removed from both illustrations for clarity.

Does not apply to models 2.5 / 3.5, 8 / 9.8, 9.9D_2 / 15D_2 / 18E_2 and 25C_3 / 30A_4.

10 - *Model 5*





11 *- Models 9.9 / 15 / 18 / 25 / 30 and 40*

10 **11** The pulser coil test is used to determine the output voltage, in DVA, from the pulser coil **(1)**, located on the coil plate assembly **(2)**, to the CD Unit **(3)** while you are cranking the engine.

1. Disconnect the following terminals:

Engine Models	Disconnect Terminals
5	4,5,6 and 7
9.9 / 15 / 18 / 25 / 30 / 40	4, 5, 6, 7, 8 and 9

2. Set the digital multimeter to ohms and connect the leads to test the resistance of the pulser coil

Engine Models	Connect Multimeter Between These Terminals
5	• 4 and 6
9.9 / 15 / 18 / 25 / 30 / 40	• 6 and 8

3. The meter should indicate the following resistance for pulser coils:

Engine Models	Results
2.5 / 3.5	N/A
5	80 - 117 Ω ± 25%
8 / 9.8	N/A
9.9D / 15D / 18E	30 - 46 Ω ± 25%
$9.9D_2$ / $15D_2$ / $18E_2$	N/A
$25C_2$ / $30A_3$	30 - 46 Ω ± 25%
$25C_3$ / $30A_4$	N/A
40	30 - 46 Ω ± 25%
40	N/A

4. If the resistance is not within the indicated range, replace the pulser coil. See Ignition System Repair Procedures - Pulser Coil. After repairs are made, return to Ignition System Performance Testing Flow Chart.

If the resistance is within the indicated range, proceed to the next step.

5. Set the analog multimeter to “20” on the “DVA” scale.

6. Insert the banana plug of the RED tester lead into the meter connection labeled “DVA” and the banana plug of the BLACK tester lead into the meter connection labeled “-COM”.

7. Set the analog multimeter to “20” on the “DVA” scale. Connect the RED and BLACK tester leads as follows to check the output voltage (DVA) of the pulser coil at cranking speed:

Engine Models	Black Lead	Red Lead
5	• Terminal 4	• Terminal 6
9.9 / 15 / 18, 25 / 30 and 40	• Terminal 6	• Terminal 8

8. Attach lanyard to emergency stop switch.

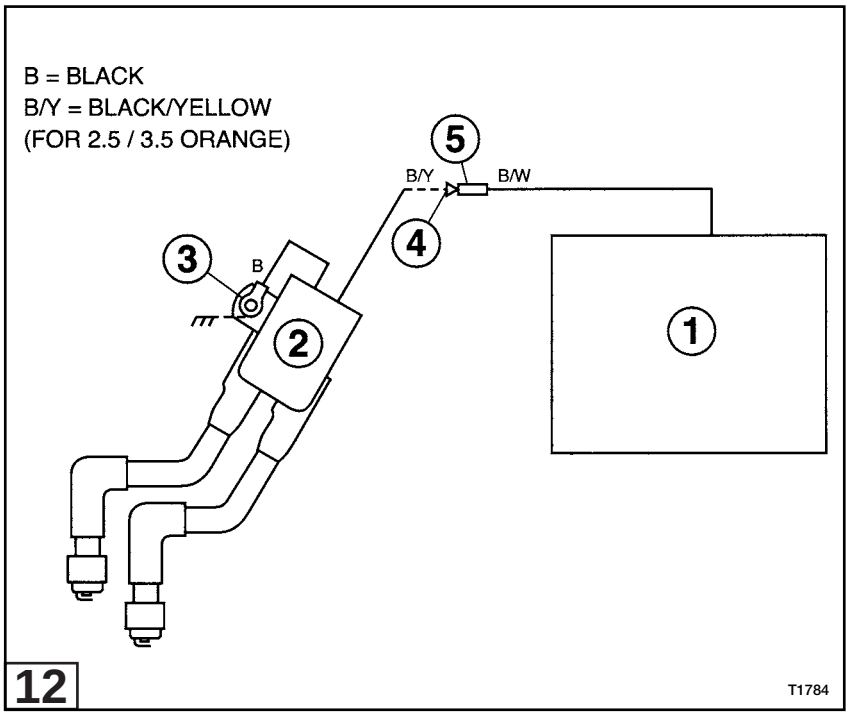
9. Crank engine.

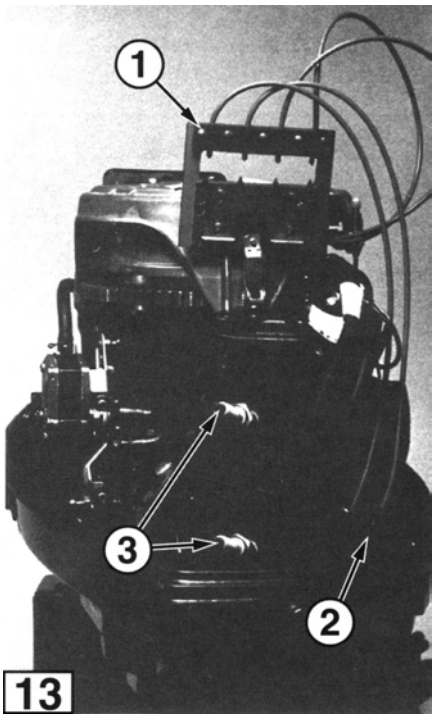
10. At cranking RPM, the tester should show the following results:

- Minimum 3.0 DVA

11. If the pulser coil test results are not within the acceptable range, replace the pulser coil set. See Ignition System Repair Procedures - Pulser Coil.

12. Reconnect all wires disconnected during test.





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Test 5 - CD Unit Output Test - Cranking RPM

NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coil before conducting the following procedure.

Reference the following electrical drawings for the CD Unit Output Test - Cranking RPM:

12 *- Models 2.5 / 3.5 / 5 / 8 / 9.8, 9.9 / 15 / 18, 25 / 30 and 40.*

12 The CD Unit Output Test - Cranking RPM is used to determine the output voltage, in DVA, from the CD Unit **(1)**, to the ignition coil **(2)** while you are cranking the engine.

1. Remove all spark plug leads, and spark plugs **(3)**.

13 2. Adjust spark gap tester **(1)** to 7/16 in [11 mm].

3. Connect each spark plug lead to spark gap tester **(2)**.

4. Secure spark gap tester to a clean ground on engine block.

⚠⚠ WARNING

To avoid possible shock hazard, do not handle ignition coils or spark gap tester during cranking tests.

NOTE

To prevent possible arcing of high voltage, route tester leads at least 2 in [51 mm] from any metal surface.

Ground unused test leads to a clean engine ground.

5. Set the tester to “400” on the “DVA” scale.

6. Insert the banana plug of the RED tester lead into the meter connection labeled “DVA” and the banana plug of the BLACK tester lead into the meter connection labeled “-COM”.

7. Connect the BLACK tester lead to terminal **(3)**.

12 8. Carefully slide the RED tester into the bullet connector [terminal **(4)**] sleeve until it makes contact with the terminal.

NOTE

*DO NOT disconnect the CD Unit output connector [terminals **(4)** and **(5)**]. Damage to the CD Unit may result.*

9. Attach lanyard to emergency stop switch.

10. Crank engine.

11. At cranking RPM, the tester should show the following result for each CD Unit output:

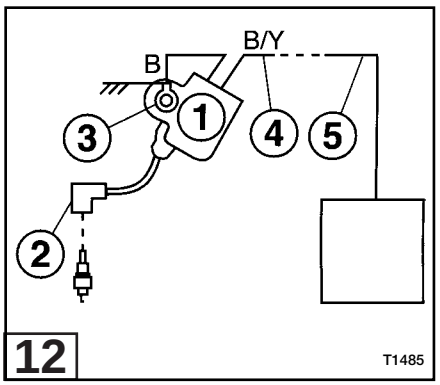
- 100 DVA Minimum.

12. If the test results for any CD Unit output is not within acceptable range, replace the CD Unit. See Ignition System Repair Procedures - CD Unit.

13. Reconnect all wires disconnected during test.

14. Return to flow chart.

Test 6 - Ignition Coil Tests



NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

14 The following tests check the resistance of the primary and secondary windings in each ignition coil **(1)**.

1. Remove spark plug lead **(2)**.

2. Set digital multimeter to ohms.

3. Disconnect terminals **(4)** and **(5)**.

4. Connect one tester lead to terminal **(3)** and the other terminal **(4)**.

5. The meter should indicate the following readings for the primary winding.

Repeat readings for each ignition coil:

Engine Models	Results
2.5 / 3.5	0.18 - 0.24 Ω ± 25%
5	0.2 - 0.38 Ω ± 25%
8 / 9.8	N/A
9.9 / 15 / 18	0.2 - 0.3 Ω ± 25%
25 / 30	0.2 - 0.3 Ω ± 25%
40	0.2 - 0.3 Ω ± 25%

6. If primary winding for any ignition coil is not within the acceptable range, replace the ignition coil. See Ignition System Repair Procedures - Ignition Coil. After repairs are made, return to Ignition System Performance Testing Flow Chart.

If the primary windings are within the acceptable range, proceed to the next step.

7. Connect one tester lead to terminal **(3)** and the other to spark plug lead (cap) [terminal **(2)**].

8. The meter should indicate the following readings for the secondary winding.

Repeat readings for each ignition coil:

Engine Models	Results
2.5 / 3.5	2.7 - 3.7 KΩ ± 25%
5	3.0 - 4.4 KΩ ± 25%
8 / 9.8	1.95 - 3.25 KΩ ± 25%
9.9 / 15 / 18	4.1 - 6.1 KΩ ± 25%
25 / 30	4.1 - 6.1 KΩ ± 25%
40	4.1 - 6.1 KΩ ± 25%

9. If secondary winding for any ignition coil is not within the acceptable range, replace the ignition coil. See Ignition System Repair Procedures - Ignition Coil. After repairs are made, return to Ignition System Performance Testing Flow Chart.

10. Reconnect all wires disconnected during test.

11. Return to flow chart.

15 Test 7 - Output Tests - Engine Running

⚠ CAUTION

The following tests must be performed with correct test propeller and with the engine in a test tank. Note that some performance problems cannot be duplicated in a test tank, in these cases the tests must be conducted with the engine mounted on a boat and operated in open water.

NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

These series of tests are designed to efficiently find faulty ignition components that can cause an engine to run poorly. Use the flow chart to systematically eliminate the possible causes to the problems.

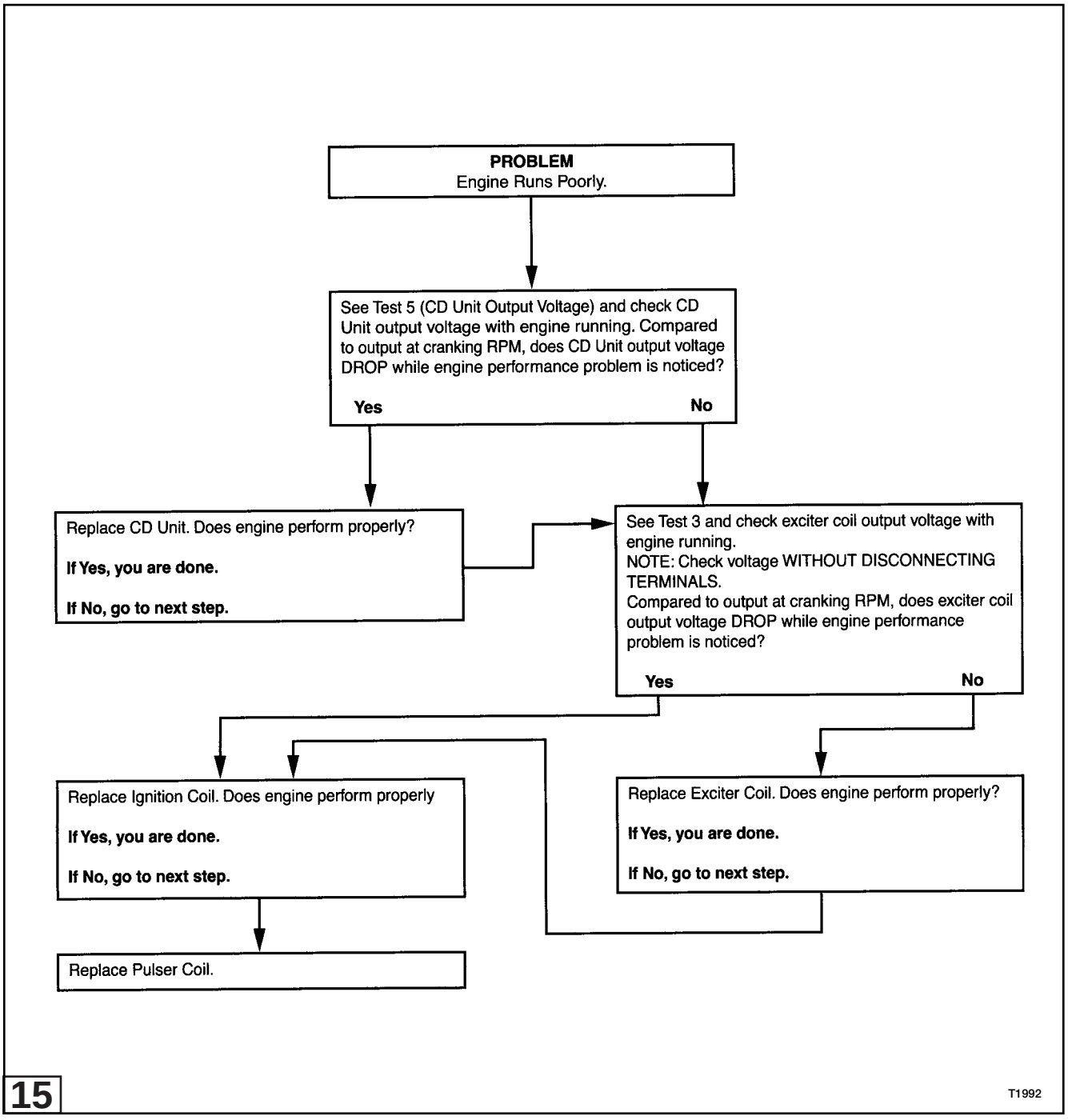
The tests assume that:

- The engine starts.
- Tune-Up Procedure has been performed, see Section 2.
- Ignition Timing and the Carburetor Synchronization Procedure has been performed, see Section 2.
- Engine is at operating temperature.
- Tests are performed with engine running in forward gear.
- Tachometer is installed.

NOTE

Some steps refer to other ignition tests. After you complete those tests, return to the flow chart for further instructions.

15 Output Tests - Engine Running - Flow Chart



IGNITION SYSTEM REPAIR PROCEDURES

1

⚠⚠ WARNING

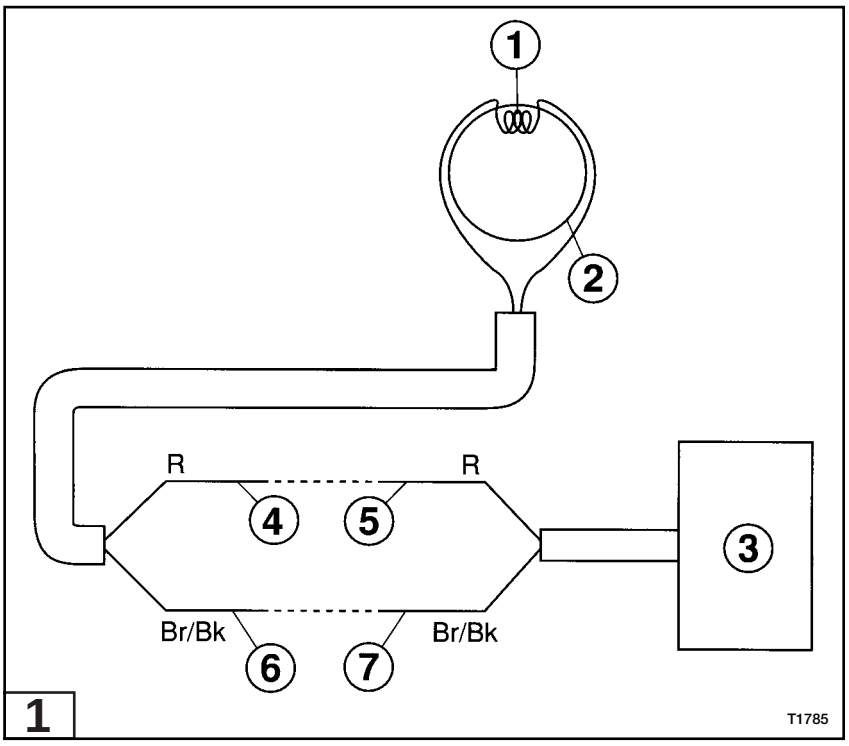
Disable ignition system, by disconnecting exciter coil terminals (4), (5), (6), (7), to prevent accidental engine startup during removal and replacement of the flywheel.

⚠ CAUTION

Flywheel is under high torque and requires the use of special tools for removal and installation. Failure to use the specified tools can result in injury or damage to the flywheel or coil plate electrical components.

⚠ CAUTION

The force needed to loosen and tighten the flywheel nut requires flywheel be removed and installed with engine mounted and secured on an engine stand.



⚠ CAUTION

Use proper precautions when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

⚠ CAUTION

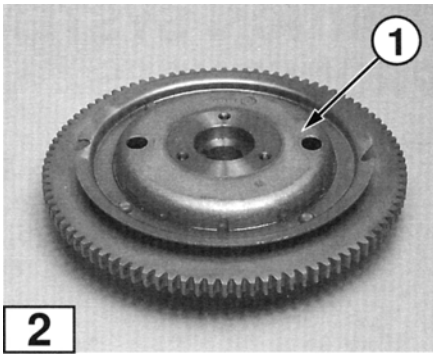
When repairs are complete, make sure all ignition and electrical leads are properly routed and clamped in their original positions and the start-in-gear prevention system must be tested before returning engine to customer.

Flywheel

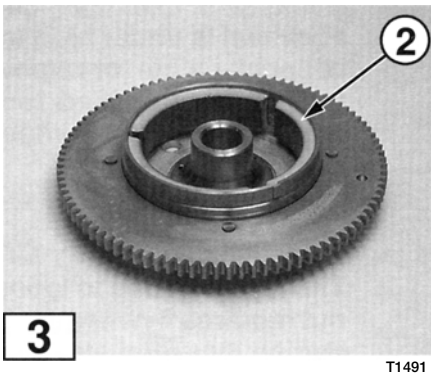
Replacing the exciter coil or coil plate assembly requires the removal of the flywheel, see Section 4, Flywheel, for the proper procedure.

NOTE

Flywheel magnets must be of a particular strength in order to run the ignition system. Weak magnets can cause low ignition voltage which may affect engine performance. Flywheels seldom go bad and would only be replaced as a last resort in solving an ignition problem.



T1490



T1491

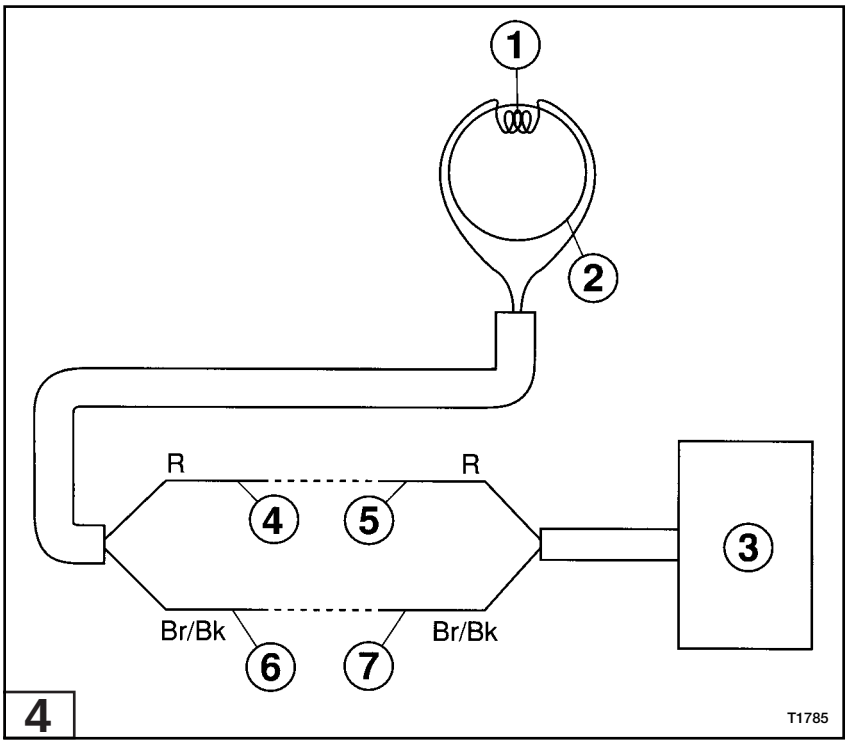
2 3 Carefully inspect flywheel **(1)** for cracks, chips, and worn taper after it is removed. Also inspect the magnets **(2)** for cracks and chips and make sure they are firmly attached to the flywheel.

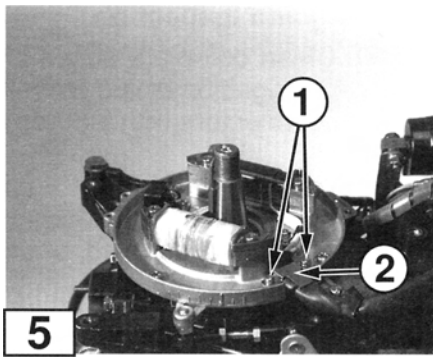
Exciter Coil

NOTE

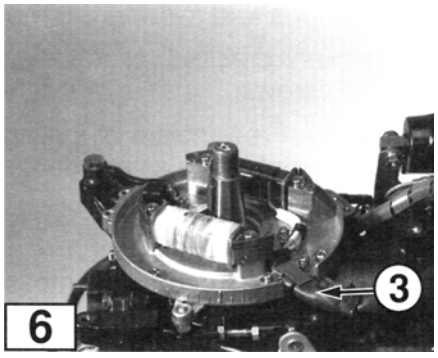
Disconnect negative battery cable from battery before removing exciter coil.

This procedure assumes exciter coil is available as a separate replaceable component. Some engine configurations might require replacement of entire coil plate assembly. Check current Parts Catalog for availability.

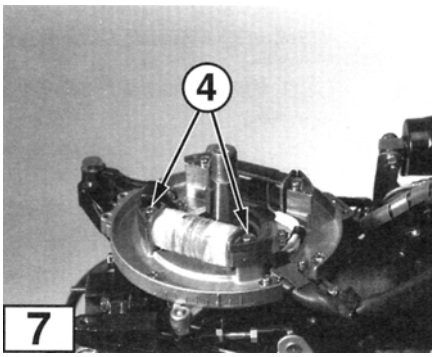




T1993



T1994



T1995

Removal

1. Remove the flywheel.

4 2. Disconnect terminals **(4)**, **(5)**, **(6)** and **(7)** for exciter coil **(1)** connectors. Note that these terminals interconnect cable from coil plate assembly **(2)** to cable from CD Unit **(3)**:

5 3. Remove coil plate assembly cable clamp screws **(1)** and cable clamp **(2)**.

6 4. For models 9.9 / 15 / 18 / 25 / 30 / 40 ONLY: Carefully slit coil plate assembly cable shield **(3)**.

NOTE

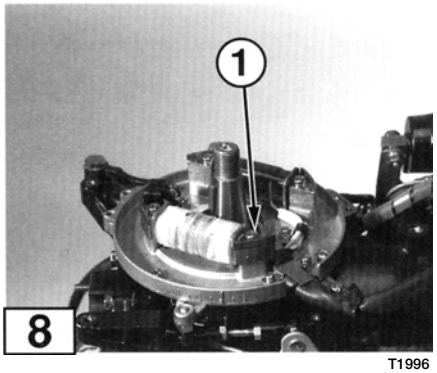
Make sure you don't cut electrical conductors inside of coll plate assembly cable when you slit cable shield.

5. For models 9.9 / 15 / 18 / 25 / 30 / 40 ONLY: Cuttiewrap.

7 6. Remove exciter coil screws **(4)** and exciter coil from the mounting bracket.

Cleaning and Inspection

8 Clean coil plate assembly, upper main bearing seal **(1)**, set ring, ignition timing link, alternator coils, pulser coils, coil leads, and coil connectors with isopropyl alcohol as required.

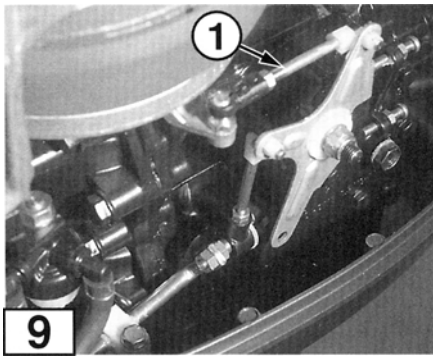


T1996

Check for the following and repair or replace as required:

- Bent, chipped, cracked, or corroded coil plate assembly.
- Coil leads for integrity, cut or cracked insulation, and damaged connectors.
- Broken or bent alternator coil Laminations damaged alternator coil windings and missing alternator coil screws.
- Broken, cracked, or misaligned pulser coils and missing pulser coil screws.

9 • Free motion of ignition timing link (1). Repair, adjust, and lubricate as needed, see Section 2.



T1786

Installation

Install in reverse order of removal.

NOTE

Use threadlocker on screw threads before installing screws.

Use a length of shrink tube to fabricate a new coil plate assembly cable shield as required. Inside diameter of shrink tubing must be large enough to pass over the largest connector.

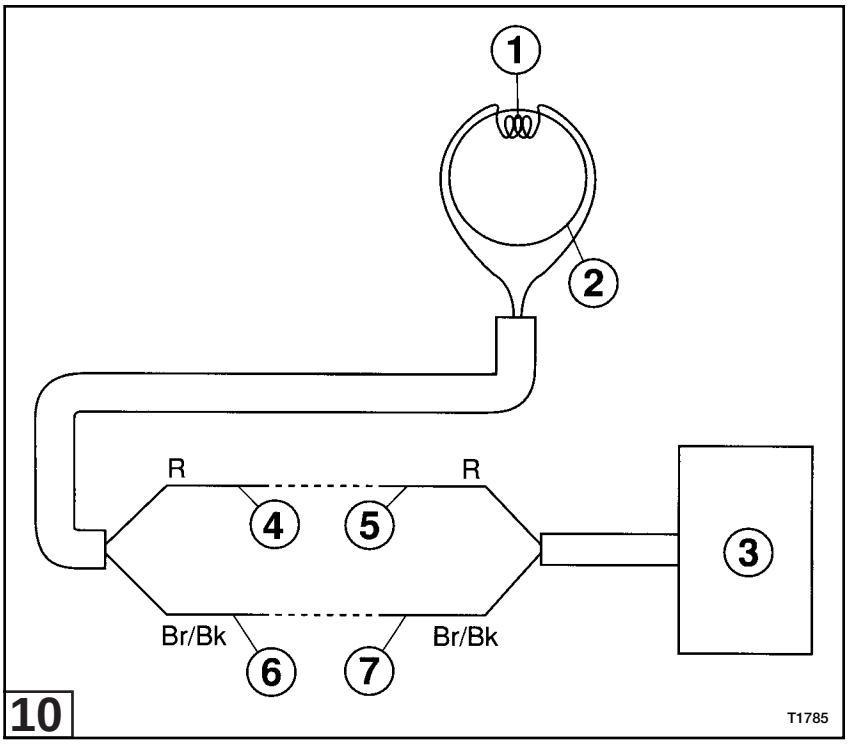
Coil Plate Assembly

Removal

l. Remove the flywheel.

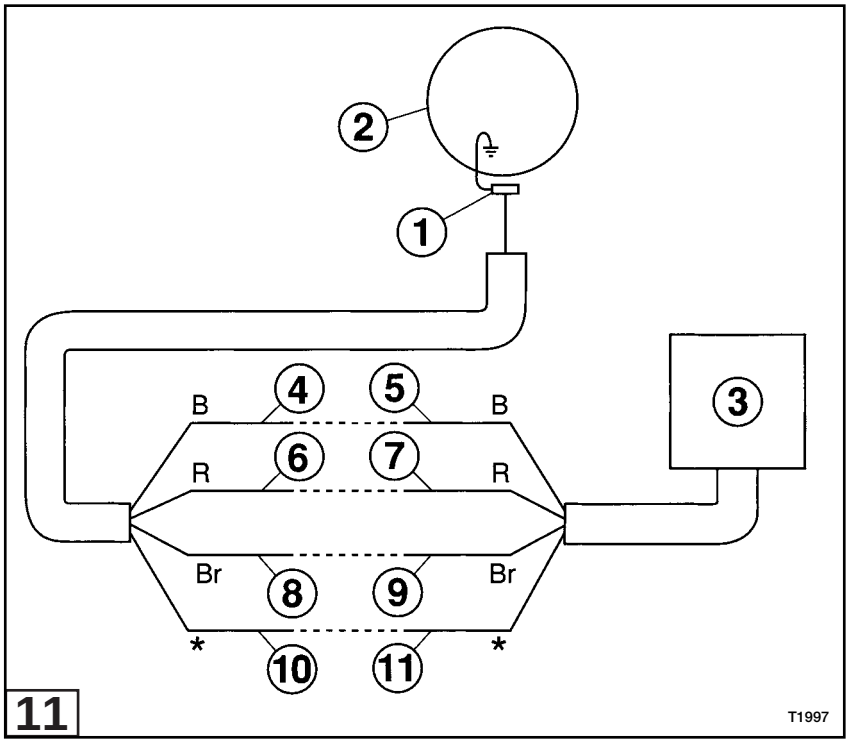
2. Disconnect the following terminals:

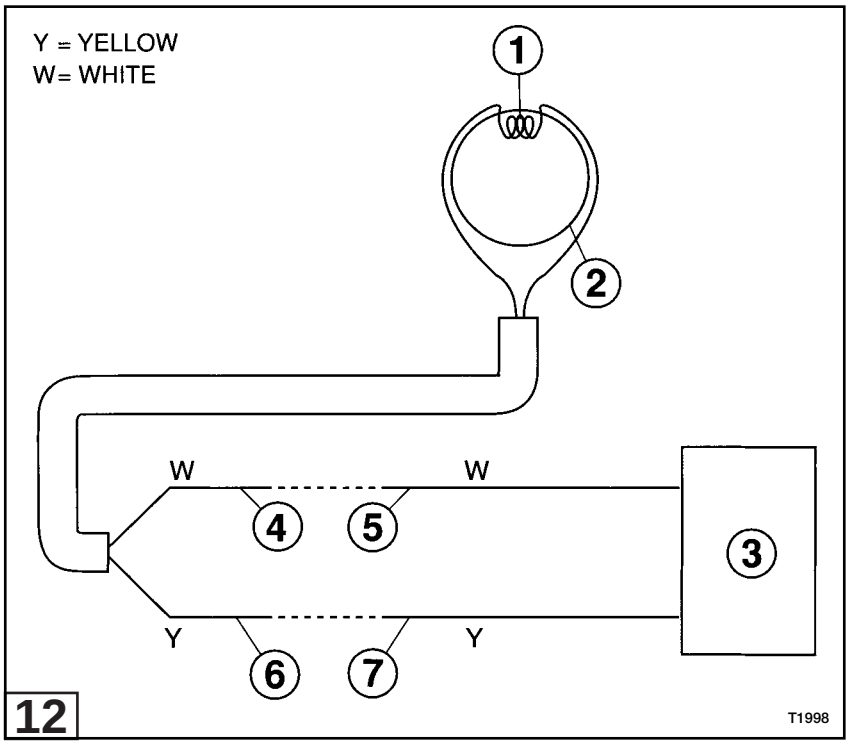
10 Exciter coil **(1)** terminals. Note that these terminals interconnect cable from coil plate assembly **(2)** to cable from CD Unit **(3)**. Disconnect terminals **(4)**, **(5)**, **(6)** and **(7)**.



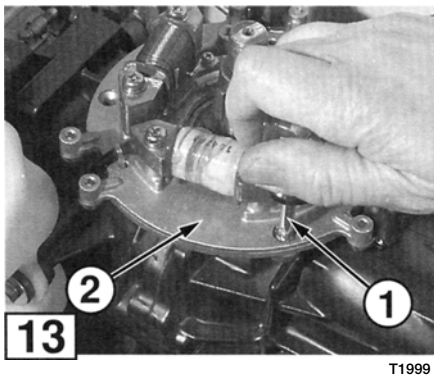
11 pulser coil **(1)** terminals. Note that these terminals interconnect cable from coil plate assembly **(2)** to cable from CD Unit **(3)**. Disconnect terminals **(4)**, **(5)**, **(6)**, **(7)**, **(8)**, **(9)**, **(10)** and **(11)**.

12 Alternator coil **(1)** terminals. Note that these terminals interconnect cable from coil plate assembly **(2)** to rectifier/ regulator **(3)**. Disconnect terminals **(4)**, **(5)**, **(6)** and **(7)**.





13 3. Remove the screws **(1)** and remove coil plate assembly **(2)** from the set ring.



T1999

Cleaning and Inspection

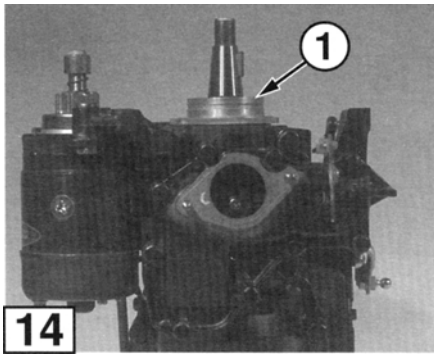
14 15 Clean upper main bearing seal **(1)**, guide plate **(2)** and set ring **(3)** with dry cloth.

Check for the following and repair or replace as required:
- Bent, chipped, cracked, or corroded guide plate.
- Broken or bent set ring.

Apply light coat of low temperature lithium grease to guide plate **(2)**.

Istallation

Install in reverse order of removal.



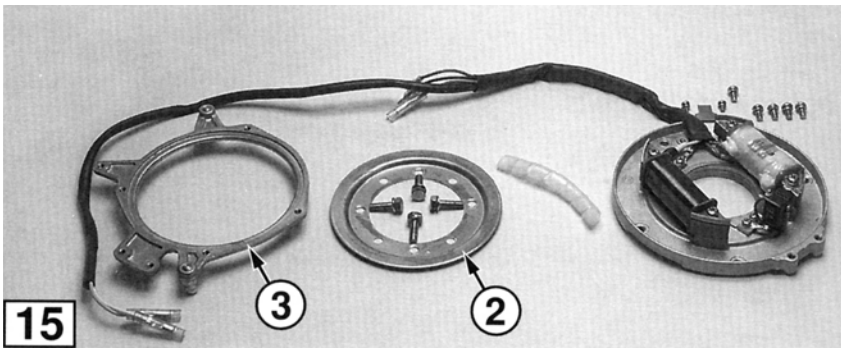
T2000

NOTE

Disconnect negative battery cable from battery before installing coil plate assembly.

Use threadlocker on screw threads before installing screws.

Apply light coat of low temperature lithium grease to the guide plate.

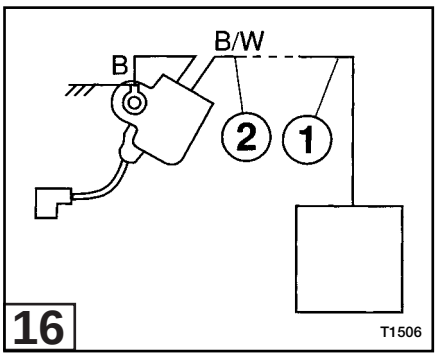


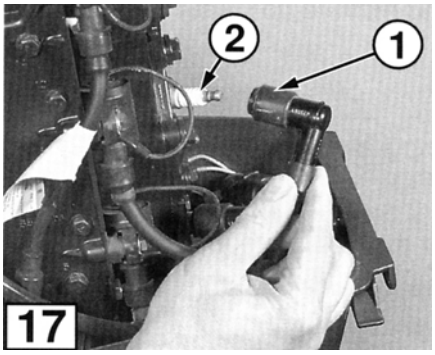
T2001

Ignition Coil

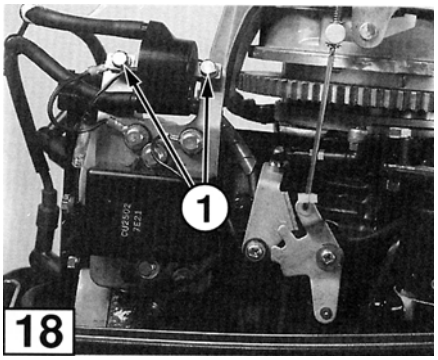
NOTE

Disconnect negative battery cable from battery before removing ignition coil.





T1507



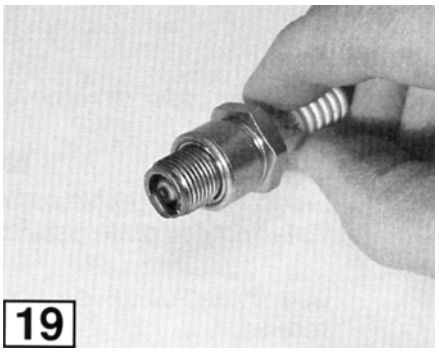
T1788

Removal

16 1. Disconnect CD Unit output lead **(1)** from ignition coil primary cable **(2)**.

17 2. Disconnect spark plug cap **(1)** from spark plug **(2)**.

18 3. Remove bolts **(1)** and remove ignition coil.



T1509

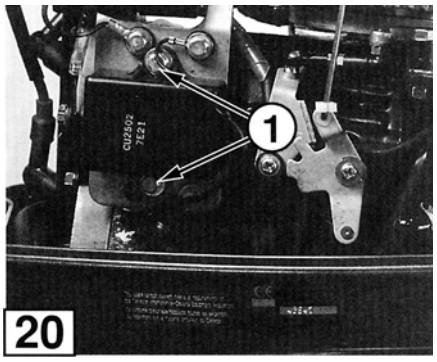
Cleaning and Inspection
Clean mounting area with isopropyl alcohol.

Check for the following and repair or replace as required:

19 Remove spark plug(s) and inspect for fouling, damaged electrodes, or damaged ceramic insulator.
CD Unit output connectors and leads for integrity, cut or cracked insulation.

Installation
Install in reverse order of removal.

CD Unit



T1789

NOTE

Disconnect negative battery cable from battery before removing CD Unit.

Removal

20 1. Remove bolts **(1)**.

2. Remove CD Unit.

Cleaning and Inspection
Examine electrical conductors and connectors.

Installation
Install in reverse order of removal.

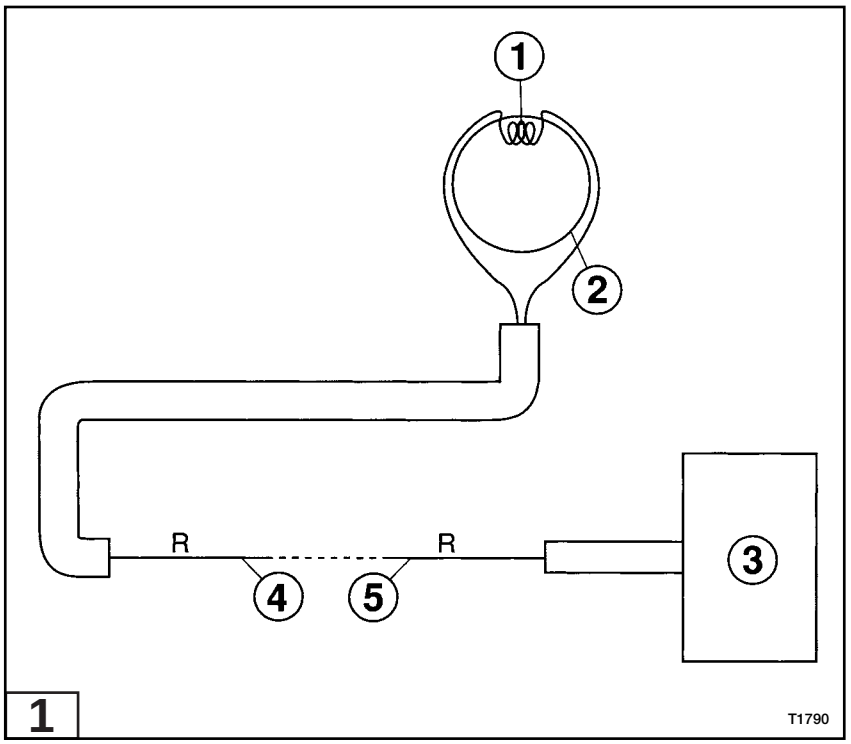
NOTE

Make sure that all electrical conductors are properly routed before you insert CD Unit to avoid pinching them.

STARTING SYSTEM

⚠⚠ WARNING

Disable ignition system, by disconnecting exciter coil terminals (4) and (5) to prevent accidental engine startup during testing of starter circuit.



⚠ CAUTION

Use proper precautions when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

⚠ CAUTION

When repairs are complete, make sure all ignition and electrical leads are properly routed and clamped in their original positions and the start-in-gear prevention system must be tested before returning engine to customer.

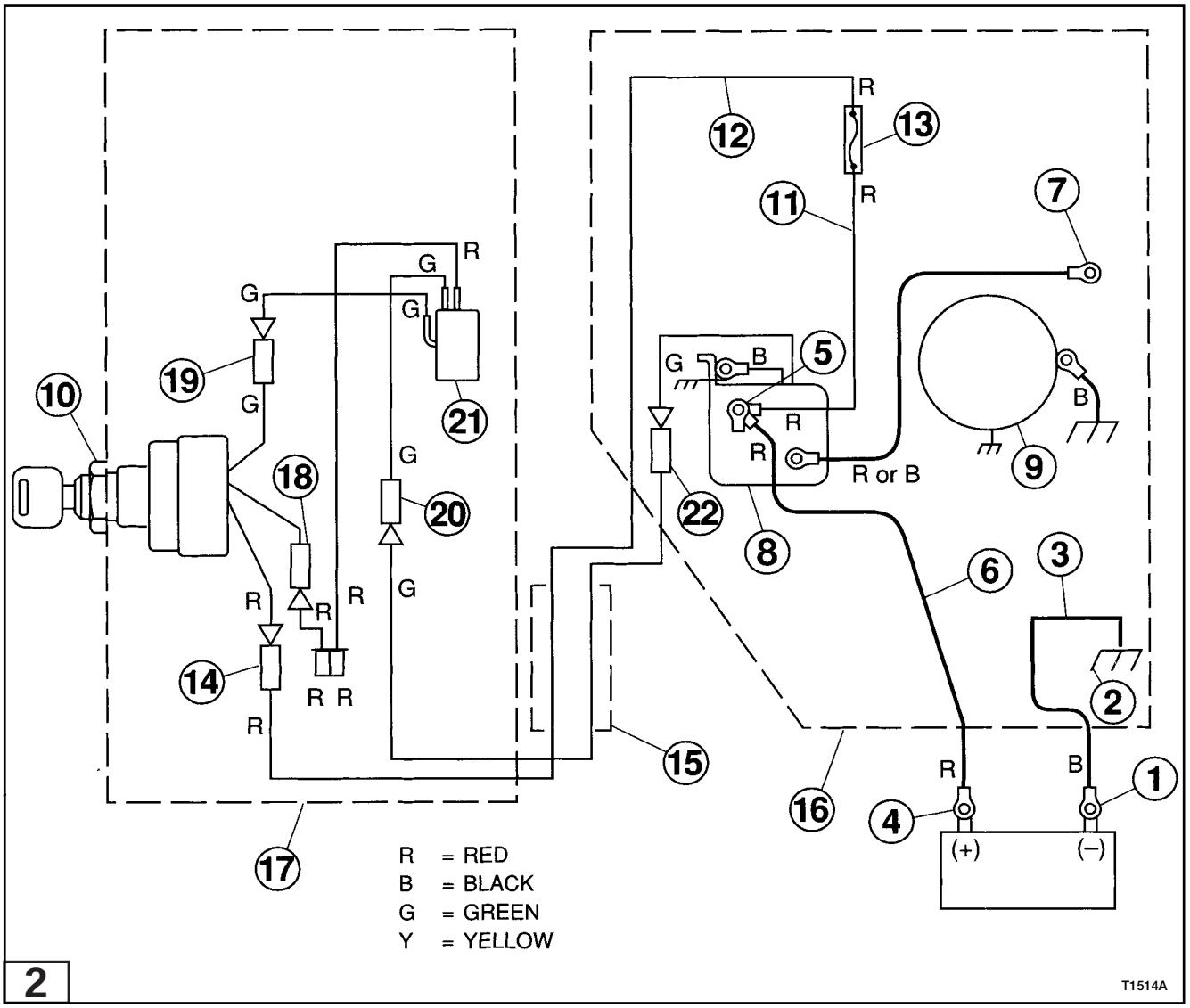
Starter System Testing

The starter system may cause three types of problems:

- The engine does not crank, see Starter Circuit Tests in this section.
- The starter motor runs but does not engage or disengage from the flywheel, see Starter Motor Test in this section.
- The starter motor will not shut off, see Starter Solenoid -Test in this section.

Before you begin testing of starting system:

- Check battery fluid level and specific gravity. Charge or replace as required. See Battery Care and Maintenance, this section.
- Check the following electrical connections and make sure they are secure and free of corrosion:
  - Batterycables and clamps.
  - Starter solenoid wiring (including ground connection).
  - Starter motor wiring (including ground connection to engine block and/or cowling).
  - Main key switch and neutral start switch cables.
- Make sure shift lever or remote control lever is in NEUTRAL and it operates freely.
- Set main key switch to OFF position unless otherwise directed in instructions,



2 3 Starter Circuit Tests

These tests are designed to quickly isolate the faulty starter circuit component if the engine does not crank.

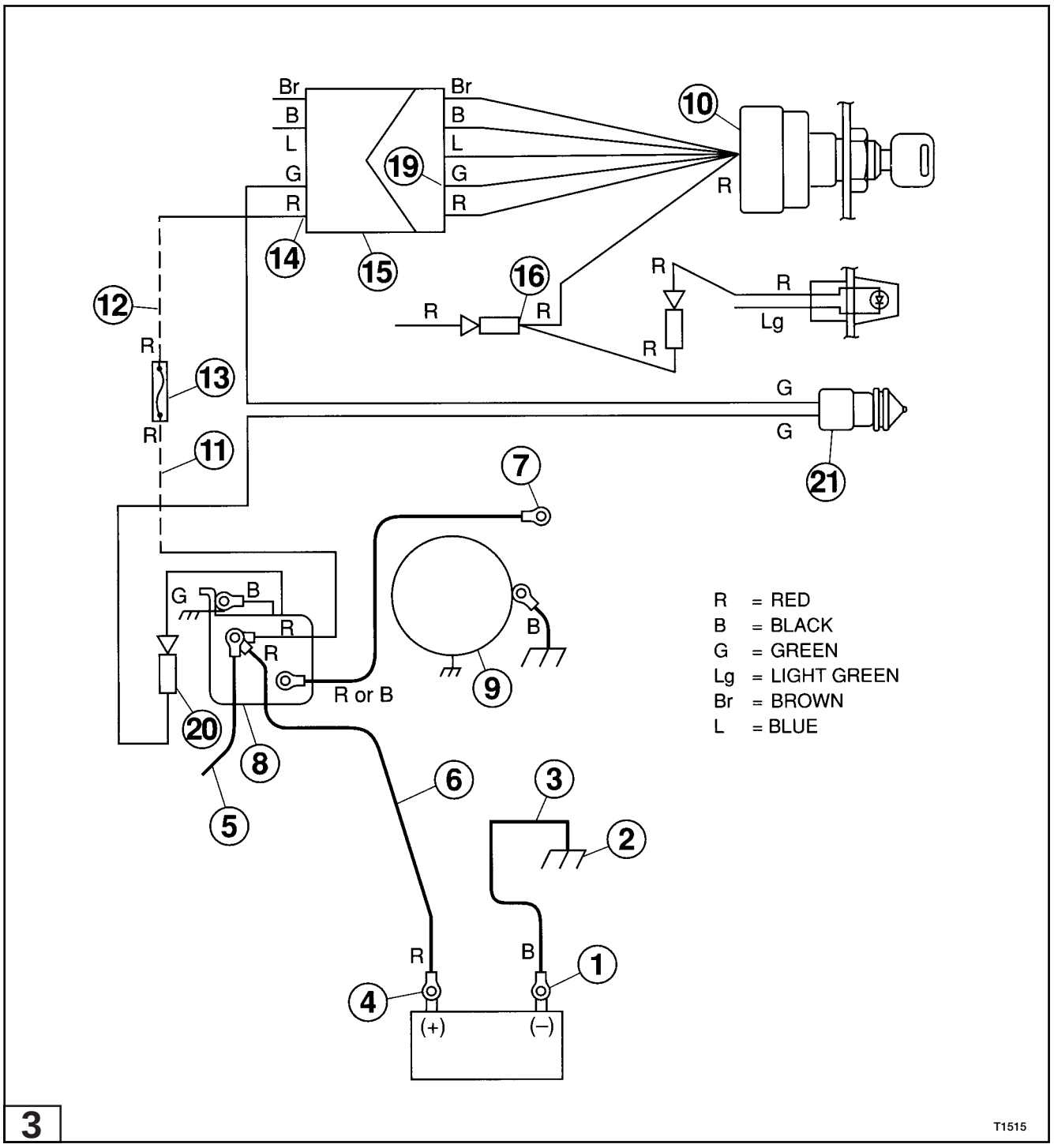
NOTE

The electrical drawings have been simplified to show only those elements necessary to test the starter circuit.

Two types of starter circuits are used and illustrated in:

2 • *Models with remote control box.*

3 • *Models without remote control box.*



1. Disconnect negative battery cable **(3)** from negative battery terminal **(1)**.

2. Set analog multimeter to check continuity. Connect one tester lead to negative battery terminal **(1)** and the other tester lead to the ground connection **(2)** for negative battery cable **(3)**.

If the meter does not indicate continuity, clean connections and/or replace negative battery cable.

If the meter indicates continuity, go to the next step.

3. Set analog multimeter to “iDCV” and set range to “20”. Connect BLACK tester lead to “- COM” and the RED tester lead to “+ VΩ”.

4. Connect BLACK tester lead to clean engine ground.

5. Connect RED tester lead to positive battery terminal **(4)**.

If meter does not indicate 11.8 to 13.2 VDC (battery voltage), see Battery Care and Maintenance, this section.

If meter indicates battery voltage go to next step.

6. Reconnect negative battery cable **(3)** to negative battery terminal **(1)**.

7. Connect RED tester lead to starter solenoid terminal **(5)**.

If meter does not indicate battery voltage, replace battery cable **(6)**.

If meter indicates battery voltage go to next step.

8. Disconnect lead **(7)** from starter solenoid **(8)** to starter motor **(9)**.

9. Connect RED tester lead to starter solenoid lead **(7)** and turn main key switch **(10)** to START position.

If meter indicates battery voltage, repair or replace starter motor, see Starter Motor Tests in this section.

If meter does not indicate battery voltage, go to next step.

10. Connect RED tester lead to connector closest to fuse holder **(11)**.

If meter does not indicate battery voltage, repair or replace cable between **(5)** and **(11)**.

If meter indicates battery voltage, go to next step.

11. Connect RED tester lead to connector closest to fuse holder **(12)**.

If meter does not indicate battery voltage, find source of overload or short and replace 15 A engine fuse **(13)**. Possible sources of short or overload:

- Short in starter circuit wiring or components, such as starter solenoid, main key switch, or neutral start switch.
- Short in charging circuit wiring or components, such as the alternator coils or rectifier/regulator.
- Short in accessories.
- Short in starter motor.

If meter indicates battery voltage, go to next step.

12. Connect RED tester lead to connector closest to main key switch **(14)**.

NOTE

*For models with remote control box - Make sure you test the correct terminal in this step. Terminal **(14)** is connected directly to the main key switch **(10)** and the RED lead that comes out of the large cable **(15)** that connects the engine compartment **(16)** to the remote control box **(17)**, DO NOT CONFUSE TERMINAL **(14)** WITH TERMINAL **(18)**.*

NOTE

*For models without remote control box - You might have to pull connector **(15)** apart and measure voltage at terminal.*

Make sure you test the correct terminal in this step.

If meter does not indicate battery voltage, repair or replace cable between **(12)** and **(14)**.

If meter indicates battery voltage, go to next step.

13. Connect RED tester lead to main key switch lead **(19)** and turn main key switch **(10)** to START position.

NOTE

*For models without remote control box - You might have to pull connector **(15)** apart and measure voltage at terminal indicated in drawing.*

If meter does not indicate battery voltage, test main key switch. Refer to Main Key Switch Test in this section.

If meter indicates battery voltage, go to next step.

14. Connect RED tester lead to neutral start switch lead **(20)** and turn main key switch **(10)** to START position.

If meter does not indicate battery voltage, test neutral start switch **(21)**. Refer to Neutral Start Switch Test in this section.

If meter indicates battery voltage, go to next step.

15. For models with remote control box ONLY - Connect RED tester lead to starter solenoid lead **(22)** and turn main key switch **(10)** to START position.

If meter does not indicate battery voltage, repair or replace cable between **(20)** and **(22)**.

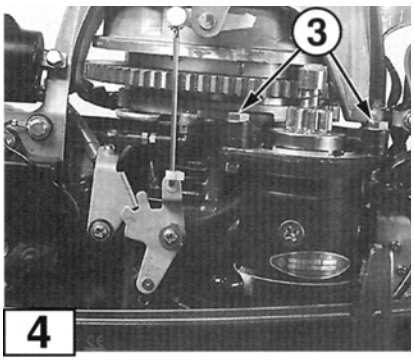
If meter indicates battery voltage, go to next step.

16. Connect RED tester lead to starter solenoid lead **(7)** and turn main key switch **(10)** to START position.

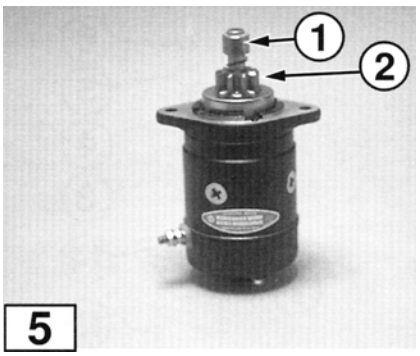
If meter does not indicate battery voltage, test starter solenoid **(8)**. Refer to Starter Solenoid Test in this section,

Starter Motor Tests

- If the engine does not crank and you completed the Starter Circuit Tests previously described, remove the starter motor and inspect the brush assembly. If the brush assembly meets specifications, replace the starter motor or have it rebuilt.
- If the starter motor runs but the starter motor does not engage or disengage from the flywheel, remove the starter motor and inspect the pinion assembly. If the pinion assembly meets specifications, inspect the flywheel for chipped or worn teeth and replace as needed.



T2214



T2215

Remove Starter Motor

NOTE

Disconnect negative battery cable from battery before removing starter motor.

4 1. Disconnect starter solenoid cable and ground cable.

2. Remove starter motor bolts **(3)**.

3. Slide starter motor out of bracket.

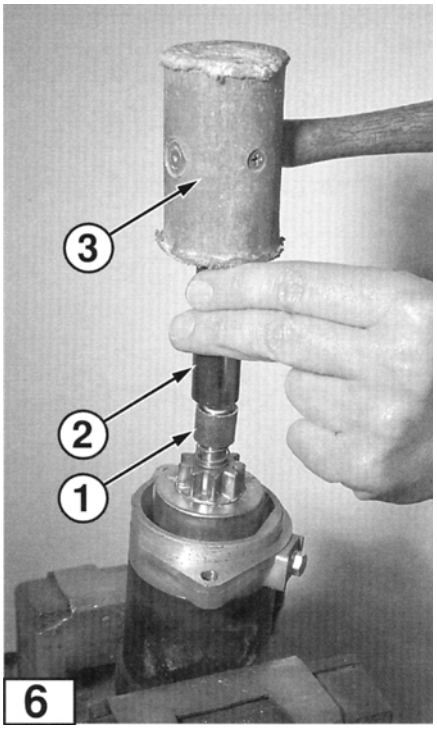
4. Clean bracket with cleaning solvent.

Inspect and Remove Pinion Assembly

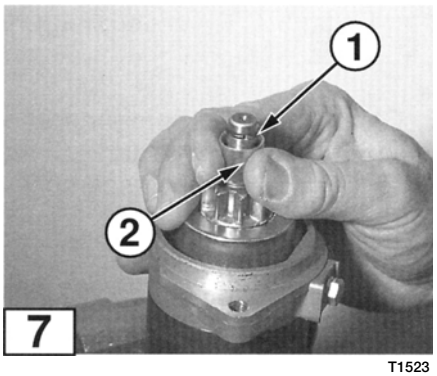
5 1. Grasp pinion collar **(1)** and wind pinion gear **(2)** in a clockwise direction. Make sure gear moves freely and returns to original position. If any binding is noted, remove and replace pinion assembly.

6 2. Release pinion collar **(1)** by tapping it with a socket **(2)** (with same outside diameter as pinion collar and clearance for motor shaft) and mallet **(3)**.

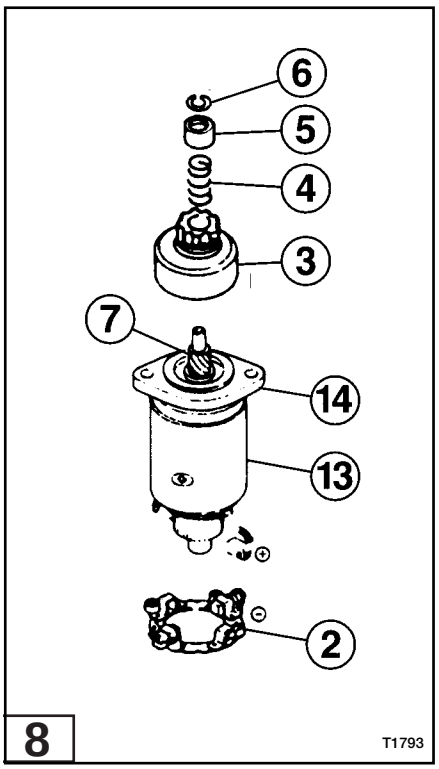
7 3. Push down on pinion collar (2) and remove locking ring **(1)**.

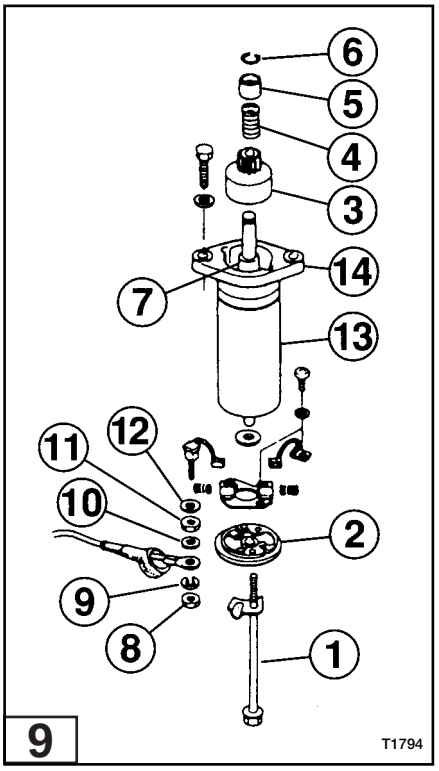


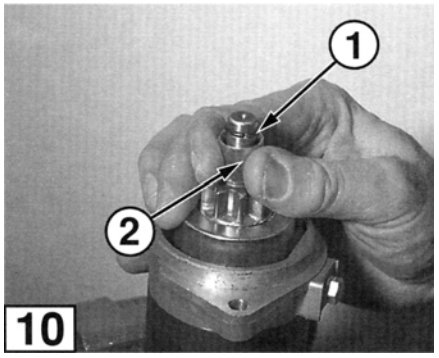
T1522

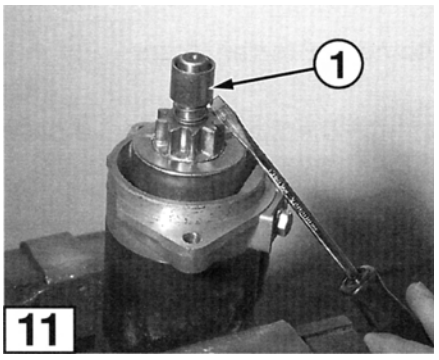


T1523









8 **9** 4. Remove pinion gear **(3)**, spring **(4)** and pinion collar **(5)**.

5. Clean removed components with cleaning solvent and examine pinion gear for wear and chipped teeth and spring for tension or distortion and replace assembly as required.

NOTE

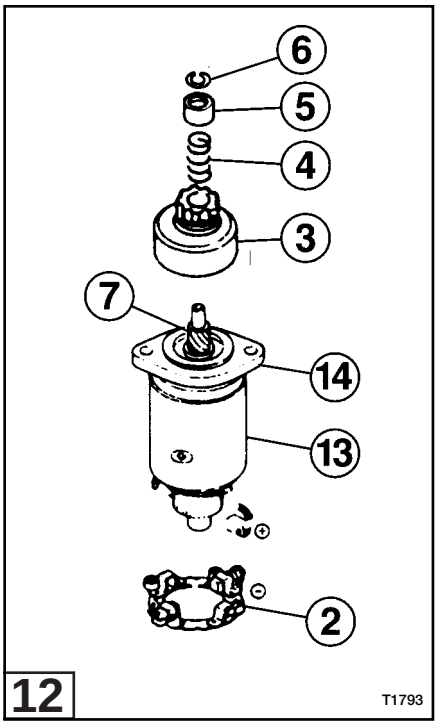
Do not allow cleaning solvent to come in contact with starter motor.

6. Apply a light coat of low temperature lithium grease to motor shaft **(7)** and slide on pinion gear **(3)**, wind counterclockwise to seat.

7. Slide spring **(4)** and pinion collar **(5)** on motor shaft **(7)**.

10 8. Push down on pinion collar **(2)** and install locking ring **(1)**.

11 9. Tap pinion collar **(1)** in place.



Disassemble Starter Motor

NOTE

Bolts for models 25 / 30 /40 may not be available as separate parts. Check current Parts Catalog for availability.

9 **12** 1. Remove bolts **(1)**.

2. Remove motor base **(2)**.

Inspect Brush Assembly

13 1. Clean starter motor terminal and hardware **(1)** with isopropyl alcohol and fine emery cloth and replace brush assembly if terminal or hardware cannot be restored to original condition.

13 **14** **15** 2. Check brushes **(2)** and **(3)** for chips, fractures, and wear. If not within specifications, replace brush assembly:

Engine Models	Original Length (a)	Repair Limit (b)
8 / 9.8 - 9.9 / 15 / 18	0.295 in [7.5 mm]	0.177 in [4.5mm]
25 / 30 - 40	0.295 in [7.5 mm]	0.177 in [4.5mm]

3. Check spring tension. If springs are weak, replace brush assembly.

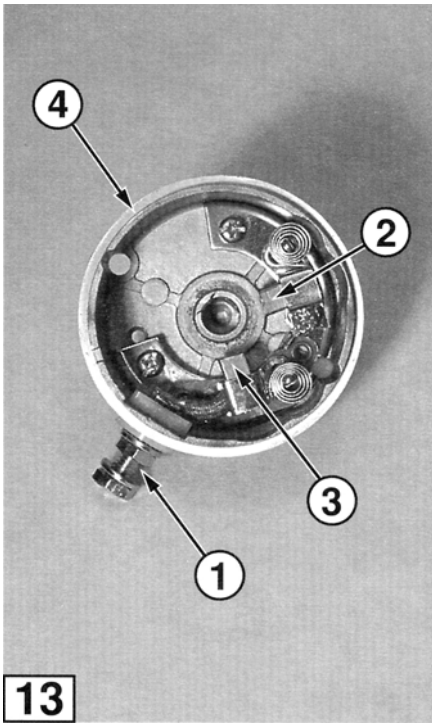
4. Check continuity with analog multimeter between:

Brush **(2)** and **(3)**. Replace brush assembly if meter indicates continuity.

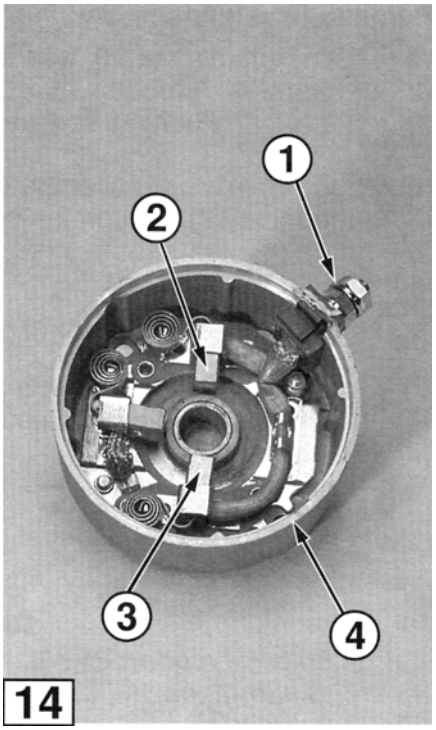
Brush **(3)** and the motor base **(4)**. Replace brush assembly if meter indicates continuity.

Brush **(3)** and the starter motor terminal **(1)**. Replace brush assembly if meter does not indicate continuity.

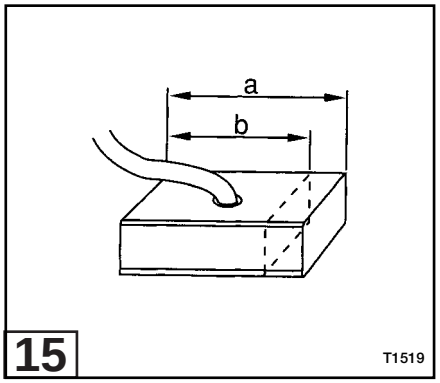
Brush **(2)** and the motor base **(4)**. Replace brush assembly if meter does not indicate continuity.



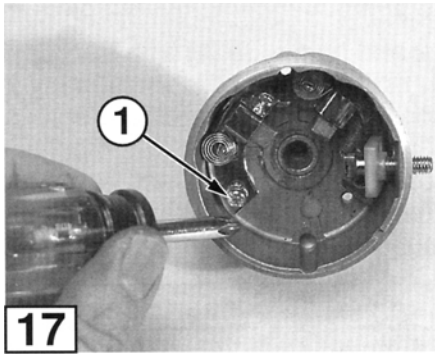
T2216



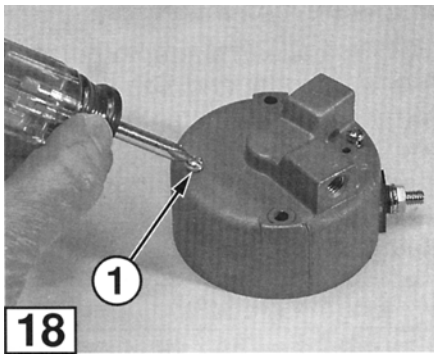
T2217



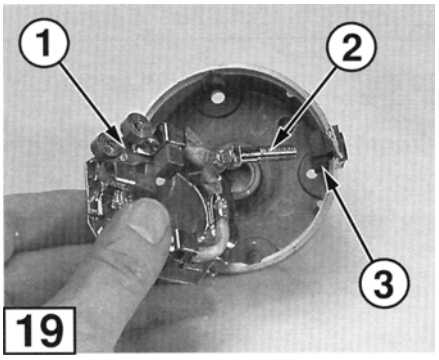
T1519



T1526



T1529



T1530

Remove Brush Assembly

17 **18** 1. Remove screws **(1)**.

19 Remove brush assembly **(1)** carefully guiding the starter motor terminal **(2)** through the bushing **(3)**.

Install Brush Assembly

20 1. Apply genuine grease to bearing cup **(1)**.

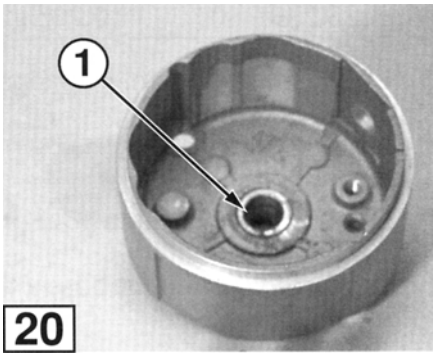
21 2. Install brush assembly **(1)**. Make sure that the starter motor terminal **(2)** is fully seated in the bushing **(3)**.

Assemble Starter Motor

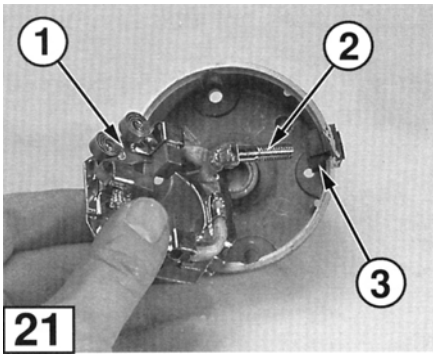
NOTE

Bolts for models 25 / 30 / 40 may not be available as separate parts. Check current Parts Catalog for availability.

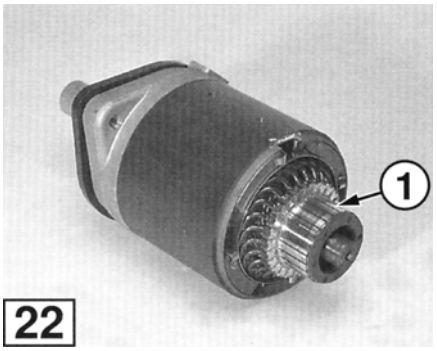
22 1. Clean commutator **(1)** with fine emery cloth.



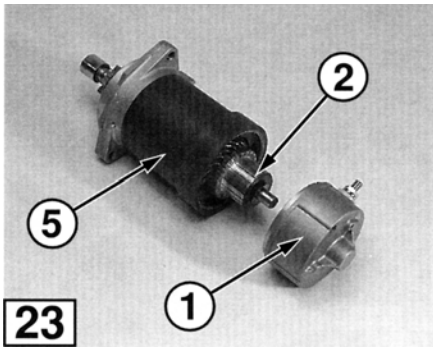
T1531



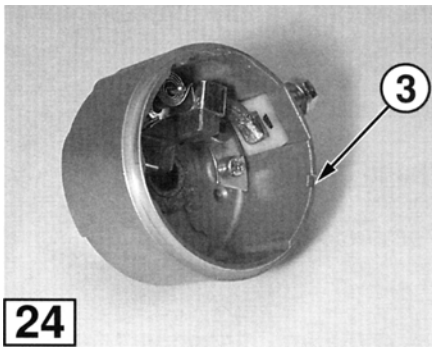
T1530



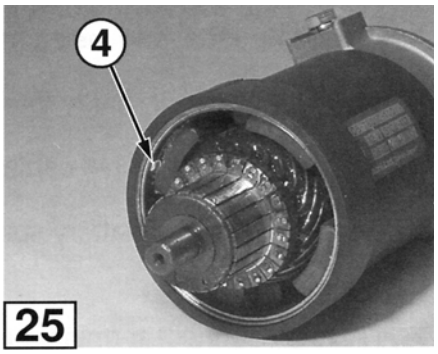
T1535



T1533



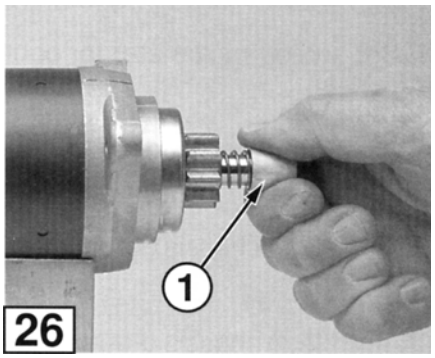
T1536



T1537

23 **24** **25** 2. Retract brushes as you slide motor base **(1)** over commutator **(2)**. Align notch **(3)** in motor base with tab **(4)** in motor body **(5)** and seat motor baseto motor body.

26 3. Grasp pinion collar **(1)** and rotate several times to make sure brushes are seated.



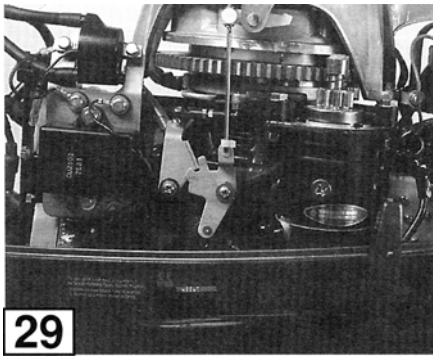
T1542

Install Starter Motor

29 1. Slide starter motor into bracket, apply threadlocker to bolt threads, and install mounting bolts.

2. Connect starter solenoid cable and ground cable.

3. Coat terminals with battery spray protector.



T1795

Starter Solenoid Test

30 1. Disconnect terminals **(4)** and **(5)** and disconnect terminal **(3)** from chassis ground.

2. Set analog multimeter for continuity. Check for continuity between terminals:

(3) and **(5)**. If meter does not show continuity, replace starter solenoid **(1)**.

(5) and clean chassis ground. If meter shows continuity, replace starter solenoid.

(3) and clean chassis ground. If meter shows continuity, replace starter solenoid.

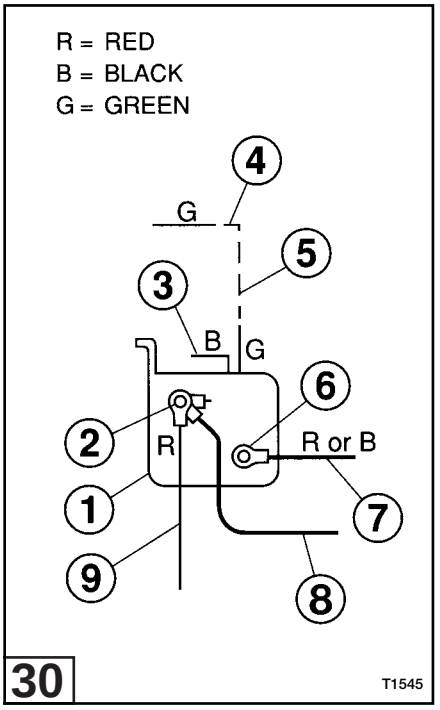
3. Disconnect positive battery lead **(8)** and RED starter switch lead **(9)** from starter terminal **(2)** and disconnect starter motor lead **(7)** from starter terminal **(6)**.

4. Check for continuity between terminals:

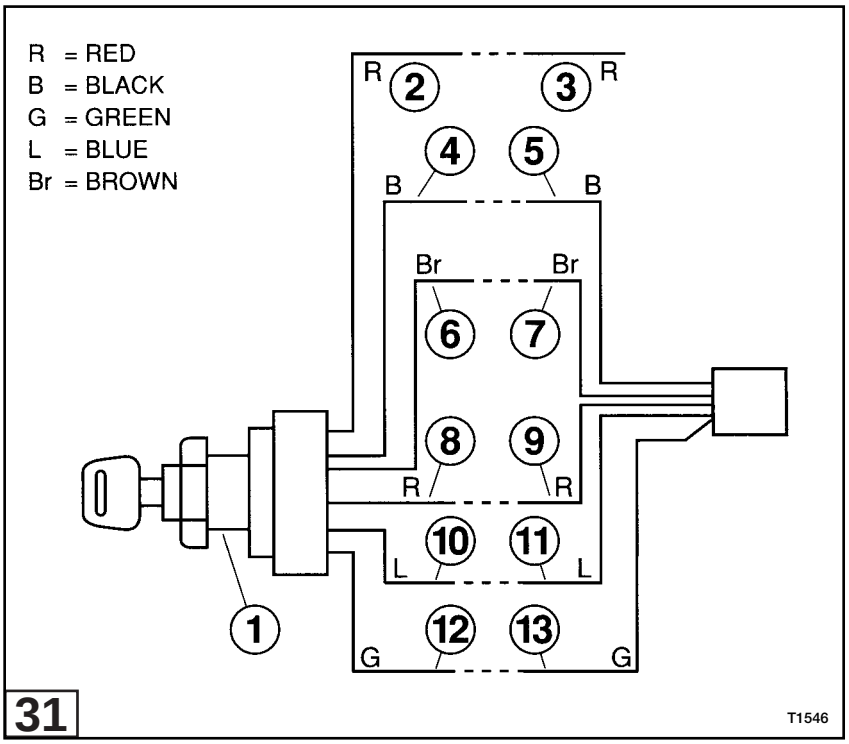
(2) and **(6)**. If meter shows continuity, replace starter solenoid.

(2) and clean chassis ground. If the meter shows continuity, replace starter solenoid.

(6) and clean chassis ground. If the meter shows continuity, replace starter solenoid.



T1545



Main Key Switch Test

31 1. Disconnect terminals **(2)**, **(3)**, **(4)**, **(5)**, **(6)**, **(7)**, **(8)**, **(9)**, **(10)**, **(11)**, **(12)** and **(13)**.

2. Set analog multimeter for continuity. With main key switch **(1)** set to OFF, ON, START, and PUSH IN positions, check for continuity between a clean chassis ground and one of these terminals (test one terminal at a time):

Terminal (2)	Terminal (4)	Terminal (6)
Terminal (8)	Terminal (10)	Terminal (12)

If meter shows continuity in any of these tests, replace main key switch.

3. With main key switch set to the OFF position, check for continuity between terminals **(4)** and **(6)**. If meter does not show continuity, replace main key switch.

Check for continuity between the following terminals, if meter shows continuity, replace main key switch.

Terminal (2) and (8)	Terminal (2) and (10)	Terminal (2) and (12)
Terminal (8) and (10)	Terminal (8) and (12)	Terminal (10) and (12)

4. With main key switch set to the ON position, check for continuity between terminals **(2)** and **(8)**. If meter does not show continuity, replace main key switch.

Check for continuity between the following terminals, if meter shows continuity, replace main key switch.

Terminal ④ and ⑥	Terminal ④ and ⑩	Terminal ④ and ⑫
Terminal ⑥ and ⑩	Terminal ⑥ and ⑫	Terminal ⑩ and ⑫

5. With main key switch set to the START position, check for continuity between terminals **(2)**, **(8)** and **(12)**. If meter does not show continuity between all three terminals, replace main key switch.

Check for continuity between the following terminals, if meter shows continuity, replace main key switch.

Terminal ④ and ⑥	Terminal ④ and ⑩	Terminal ⑥ and ⑩

6. With main key switch set to the OFF position, PUSH IN the key, check for continuity between terminals **(4)** and **(6)**. If meter does not show continuity, replace main key switch. Check for continuity between all remaining terminals, if meter shows continuity, replace main key switch.

Check for continuity between the following terminals, if meter shows continuity, replace main key switch.

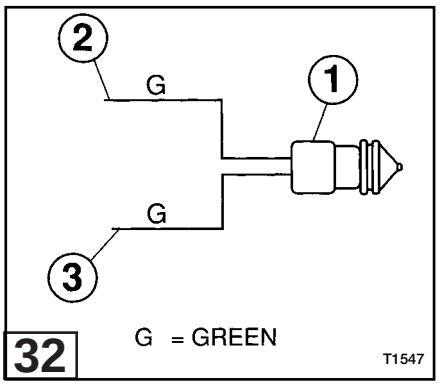
Terminal ② and ⑧	Terminal ② and ⑩	Terminal ② and ⑫
Terminal ⑧ and ⑩	Terminal ⑧ and ⑫	Terminal ⑩ and ⑫

7. With main key switch set to the ON position, PUSH IN the key, check for continuity between terminals **(2)**, **(8)** and **(10)**. If meter does not show continuity between all three terminals, replace main key switch. Check for continuity between all remaining terminals, if meter shows continuity, replace main key switch.

Check for continuity between the following terminals, if meter shows continuity, replace main key switch.

Terminal	Terminal	Terminal
(4) and (6)	(4) and (12)	(6) and (12)

8. With main key switch set to the START position, PUSH IN the key, check for continuity between terminals **(2)**, **(8)**, **(10)** and **(12)**. If meter does not show continuity, between all four terminals replace main key switch. Check for continuity between all terminals **(4)** and **(6)**, if meter shows continuity, replace main key switch.



Neutral Start Switch Test

32 1. For models without remote control box: Disconnect terminals **(2)** and **(3)**.

33 For models with remote control box: Disconnect terminals **(2)**, **(3)** and **(4)**.

2. For models without remote control box: Set analog multimeter for continuity. With shift lever set at NEUTRAL FORWARD, and REVERSE positions, check for continuity between a clean chassis ground and one of these terminals (test one terminal at a time):

Terminal (2)	Terminal (3)

32 If meter shows continuity in any of these tests, replace neutral start switch **(1)**.

33 For models with remote control box: Set analog multimeter fol continuity. With remote control lever set at NEUTRAL, FORWARD, and REVERSE positions, check for continuity between a clean chassis ground and one of these terminals (test one terminal at a time):

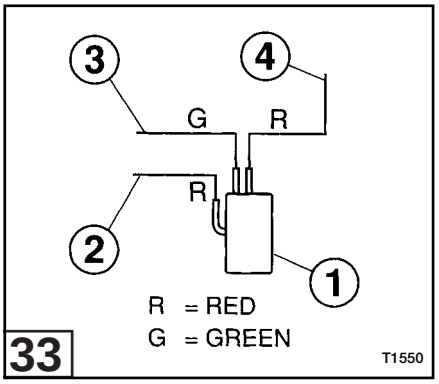
Terminal (2)	Terminal (3)	Terminal (4)

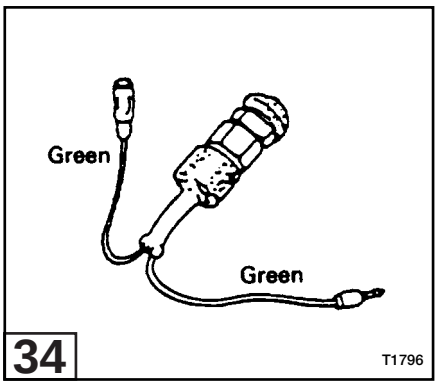
If meter shows continuity in any of these tests, replace neutral start switch.

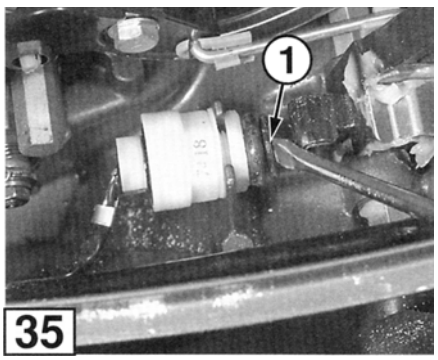
32 33 3. With shift lever set at NEUTRAL check for continuity between terminals **(2)** and **(3)**.

34 35 If meter does not show continuity, put shift lever in FORWARD gear and press in neutral start switch plunger **(1)** all the way in. If meter shows continuity, adjust, repair, or replace shift lever linkage. If meter does not show continuity, replace the neutral start switch.

33 4. For models with remote control box ONLY: With remote control lever set at FORWARD and then REVERSE, check for continuity between terminals **(3)** and **(4)**. If meter does not show continuity in either test, replace the neutral start switch.







T1549

Choke Solenoid Test

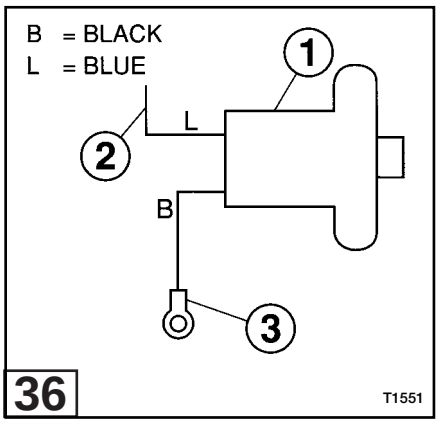
36 1. Disconnect terminals **(2)** and **(3)**.

2. Set analog multimeter for continuity. Check for continuity between a clean chassis ground and one of these terminals (test one terminal at a time):

Terminal (2)	Terminal (3)

If meter shows continuity in any of these tests, replace choke solenoid **(1)**.

3. Check for continuity between terminals **(2)** and **(3)**. If meter does not show continuity, replace choke solenoid.



CHARGING SYSTEM

⚠ CAUTION

Avoid electrical shock:

- **Do not handle spark gap tester leads during performance testing.**
- **Do not touch ignition coils, exciter coil, pulser coils, or alternator coils while the engine is cranking or running.**

⚠ CAUTION

Use proper precautions when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

⚠ CAUTION

When repairs are complete, make sure all ignition and electrical leads are properly routed and clamped in their original positions and the start-in-gear prevention system must be tested before returning engine to customer.

⚠ CAUTION

The following tests must be performed with correct test propeller and with the engine in a test tank.

If the battery fails to maintain a charge:

1. Check battery, see Battery Care and Maintenance in this section.

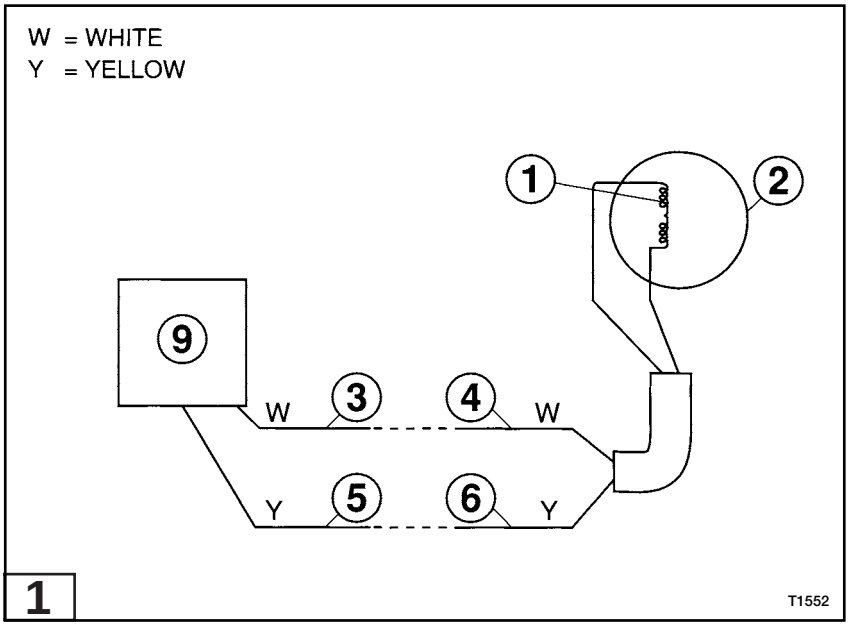
2. Check 15A (10A - 5 model only) engine fuse. If it is blown, check the following short or overload conditIons:

- Short in charging circuit wiring or components, such as the alternator coils or rectifier/regulator.
- Short in starter circuit wiring or components, such as starter solenoid, main key switch, or neutral start switch.
- Overload in starter motor.

3. Check main key switch for continuity between RED leads with switch in OFF position, see Main Key Switch Test in this section.

4. Check alternator coils, see Alternator Coil Tests in this section.

5. Check rectifier/regulator, see Rectifier/Regulator Tests in this section.



Alternator Coil Tests

NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

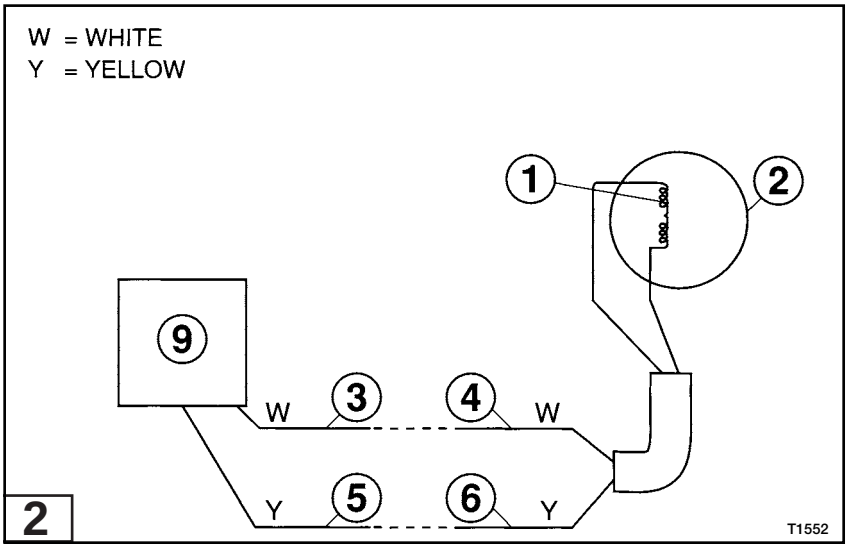
Check for continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

Reference the following electrical drawings for the alternator coil test, The pulser and exciter coils have been removed from both illustrations for clarity.

1 The alternator coil test is used to determine whether the alternator coils **(1)**, located on the coil plate assembly **(2)** are open or shorted.The output from the alternator coil goes to the rectifier/regulator **(9)**.

1 1. Disconnect terminals **(3)**, **(4)**, **(5)** and **(6)**.

1 2. Set the digital multimeter to ohms and connect the leads between terminals **(4)** and **(6)** to read the resistance of the alternator coil.



3. The meter should indicate the following resistance:

Engine Models	Results
40new	Y-W : 0.65 - 0.98 Y-B : 0.31-0.47 W-B : 0.37-0.55
40	0.24 - 0.38 Ω
25C3 / 30A4	Y-W : 0.65 - 0.98 Y-B : 0.31-0.47 W-B : 0.37-0.55
25C2 / 30A3	0.24 - 0.36 Ω
9.9D2 / 15D2 / 18E2	Y-W : 0.65 - 0.98 Y-B : 0.31-0.47 W-B : 0.37-0.55
9.9D / 15D / 18E	0.24 - 0.36 Ω
8 / 9.8	0.24 - 0.36 Ω
5	0.31 - 0.47 Ω

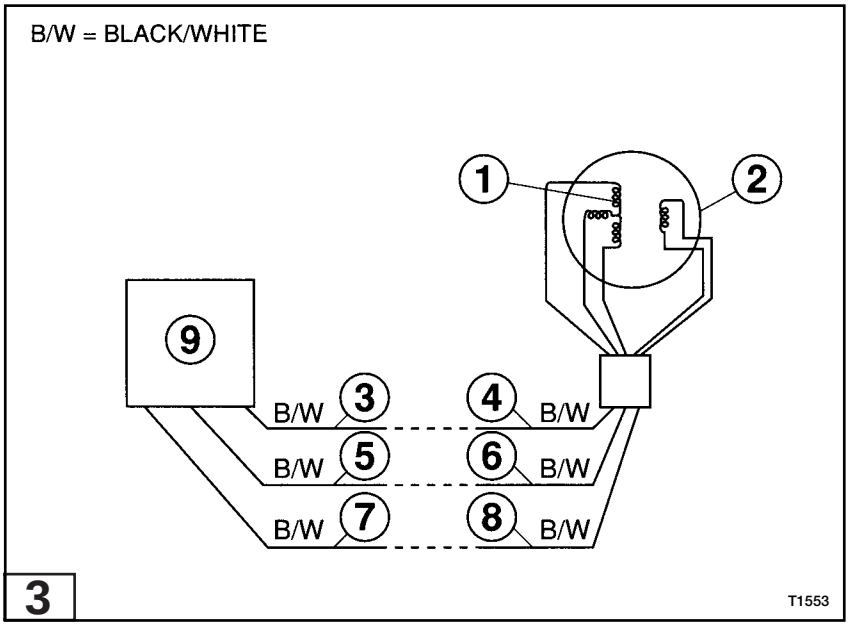
4. If the resistance is not within the indicated range, replace the alternator coils. See Charging System Repair Procedures - Alternator Coils.

If the resistance is within the indicated range, proceed to the next step.

2 **3** 5. Connect one tester head to a clean engine ground and connect the other tester lead to terminals **(4)** and **(6)** (one terminal at a time) to check for any resistance to ground:

6. If the meter indicates any resistance to ground, replace the alternator coils. See Charging System Repair Procedures - Alternator Coils.

If the meter does not indicate any resistance to ground, proceed to the next step.



7. Set the analog multimeter to “40” on the “ACV” scale.

8. Insert the banana plug of the RED tester lead into the meter connection labeled “+VΩ” and the banana plug of the BLACK tester lead into the meter connection labeled “-COM”.

3 9. Connect the BLACK tester lead to a clean engine ground and the RED tester lead to terminals **(4)** and **(6)** (one terminal at a time) to check for any voltage to ground:

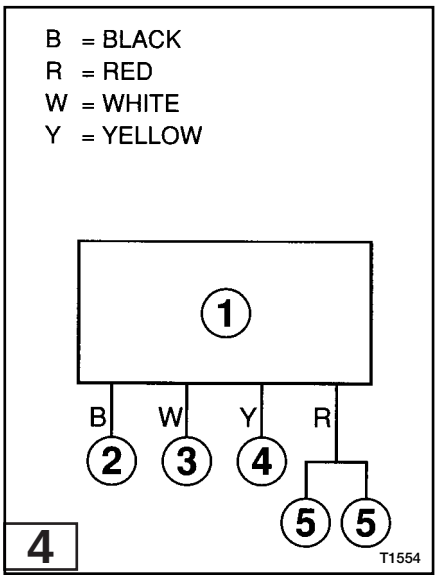
10. Start engine.

11. At idle and full throttle, if the meter indicates any voltage to ground, replace alternator coils. See Charging System Repair Procedures - Alternator Coils.

If no voltage to ground is indicated, the test is complete.

12. Reconnect alternator terminals.

Rectifier/Regulator Tests



NOTE

Make sure all electrical terminals are connected during this test except those that are noted in the test procedure.

Check ior continuity between chassis ground and the ground connection for the magneto plate, CD Unit, and ignition coils before conducting the following procedure.

Reference the following electrical drawings for the rectifier/regulator test.

4 *- Models 25 / 30 / 40.*

NOTE

Models 8 / 9.8 / 9.9 / 15 / 18 optional.

The rectifier/regulator tests check whether the rectifier/regulator **(1)** is shorted or open.

1. Disconnect terminals **(2)**, **(3)**, **(4)** and **(5)** from all other wiring:

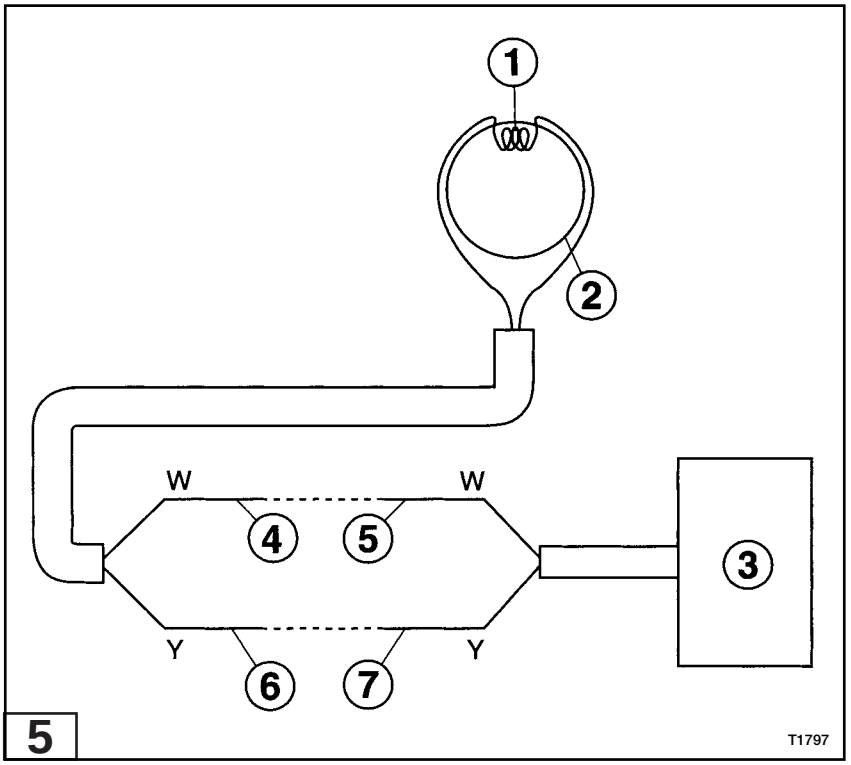
2. Set analog multimeter to check continuity.

3. Insert the banana plug of the RED tester lead into the meter connection labeled “+VΩ” and the banana plug of the BLACK tester lead into the meter connection labeled “-COM”.

4. Connect the RED and BLACK tester leads to the terminals as shown and note the results:

- Follow the tests listed in the chart starting at the TOP of each COLUMN and going DOWN.
- Follow the tests listed in the chart starting at the LEFT of each ROW and going to the RIGHT.

Replace rectifier/regulator if continuity tests are not as shown. If continuity checks are within specifications, proceed to next step.



NOTE

Continuity on chart means that the meter showed continuity (some resistance indicated by meter - exact value depends on test conditions). No Continuity on chart means that meter had no deflection.

		RED Tester Lead			
		Terminal (2)	**Terminal (3)**	**Terminal (4)**	**Terminal (5)**
BLACK Teste Lead	**Terminal (2)**	NA	Continuity	Continuity	Continuity
	Terminal (3)	NO Continuity	NA	NO Continuity	Continuity
	Terminal (4)	NO Continuity	NO Continuity	NA	Continuity
	Terminal (5)	NO Continuity	NO Continuity	NA	NA

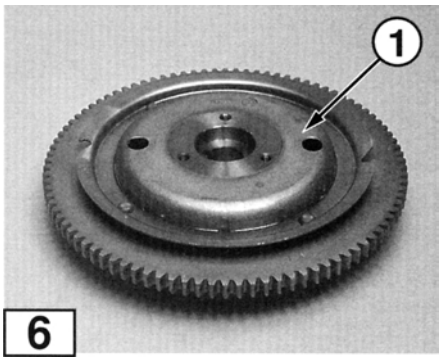
5. Connect rectifier/regulator leads.

Charging System Repair Procedupes

5

⚠⚠ WARNING

Disable ignition system, by disconnecting exciter coil terminals (4), (5), (6), (7), to prevent accidental engine startup during removal and replacement of the flywheel.



T1490

⚠ CAUTION

Flywheel is under high torque and requires the use of special tools for removal and installation. Failure to use the specified tools can result in injury or damage to the flywheel or coil plate electrical components.

⚠ CAUTION

The force needed to loosen and tighten the flywheel nut requires flywheel be removed and installed with engine mounted and secured on an engine stand.

⚠ CAUTION

Use proper precautions when performing tests with the engine cover removed. Do not wear loose clothing or jewelry. Keep hair, hands, and clothing away from the flywheel and other moving parts.

⚠ CAUTION

When repairs are complete, make sure all ignition and electrical leads are properly routed and clamped in their original positions and the start-in-gear prevention system must be tested before returning engine to customer.

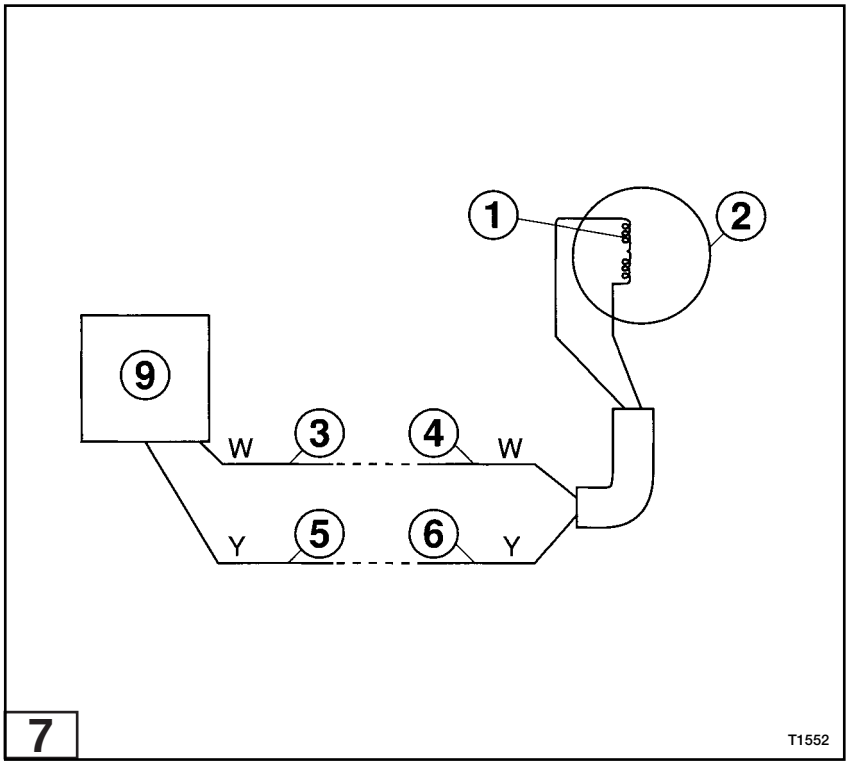
Flywheel

Replacing the exciter coil or coil plate assembly requires the removal of the flywheel, see Section 4, Flywheel, for the proper procedure.

NOTE

Flywheel magnets must be of a particular strength in order to run the ignition system. Weak magnets can cause low ignition voltage which may affect engine performance. Flywheels seldom go bad and would only be replaced as a last resort in solving an ignition problem.

6 Carefully inspect flywheel **(1)** for cracks, chips, and worn taper after it is removed. Also inspect the magnets for cracks and chips and make sure they are firmly attached to the flywheel.



Alternator Coils

NOTE

Disconnect negative battery cable from battery before removing alternator coils.

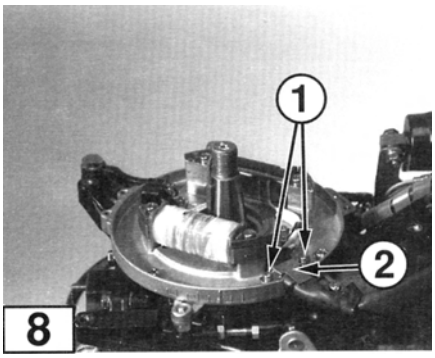
This procedure assumes alternator coils are available as a separate replaceable component. Some engine configurations might require replacement of entire coil plate assembly. Check current Parts Catalog for availability.

Removal

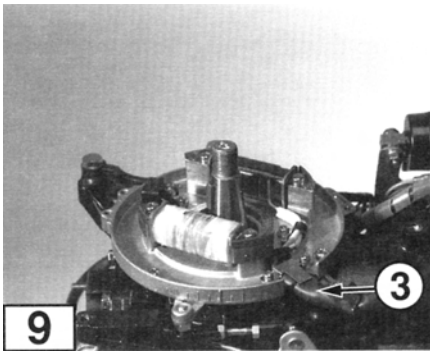
1. Remove the flywheel.

7

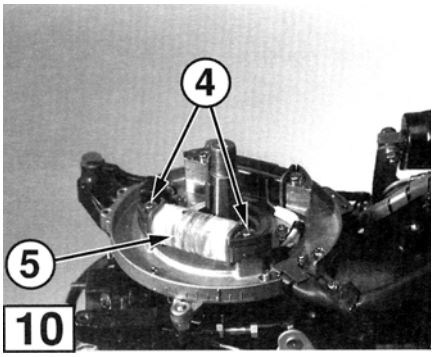
2. Disconnect terminals **(3)**, **(4)**, **(5)** and **(6)** for alternator coils **(1)**. Alternator coils are located on the coil plate assembly **(2)**.



T1993



T1994



T2218

8 3. Remove coil plate assembly cable clamp screws **(1)** and cable clamp **(2)**.

NOTE

Make sure you don't cut electrical conductors inside of coil plate assembly cable when you slit cable shield.

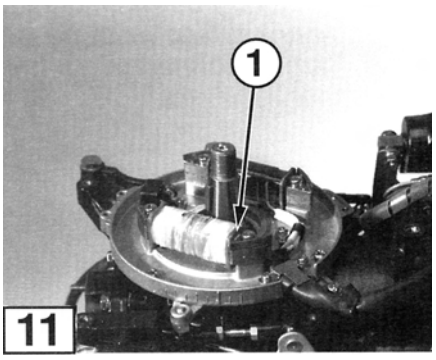
9 4. For models 9.9 / 15 / 18 / 25 / 30 / 40 ONLY: Carefully slit coil plate assembly cable shield **(1)**.

NOTE

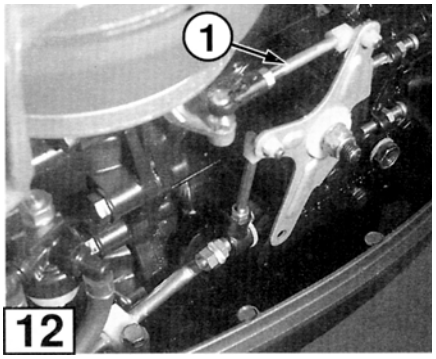
Make sure you don't cut electrical conductors inside of coil plate assembly cable when you slit cable shield.

5. For models 9.9 / 15 / 18 / 25 / 30 / 40 ONLY: Cut tie wrap.

10 6. Remove alternator coil screws **(4)** and alternator coil **(5)** from the mounting bracket.



T2219



T1798

Cleaning and Inspection

11 Clean coil plate assembly, upper main bearing housing, set ring, ignition timing link, exciter coil, pulser coil, coil leads, and coil connectors with isopropyl alcohol as required.

Check for the following and repair or replace as required:

- Bent, chipped, cracked, or corroded coil plate assembly.
- Coil leads for integrity, cut or cracked insulation, and damaged connectors.
- Broken or bent exciter coil laminations, damaged exciter coil windings, and missing exciter coil screws.
- Broken, cracked, or misaligned pulser coils and missing pulser coil screws.

12 • Free motion of ignition timing link **(1)**, Repair, adjust, and lubricate as needed. see Section 2.

Installation
Install in reverse order of removal.

NOTE

Use threadlocker on screw threads before installing screws.