

**YANMAR**

SERVICE MANUAL

**STERN-DRIVE**

**ZT350  
ZT370**

California  
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.

California  
Proposition 65 Warning

Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the state of California to cause cancer and reproductive harm.  
Wash hands after handling.

This Service Manual has been developed for the exclusive use of service and repair professionals such as Yanmar authorized Distributors and Yanmar authorized Dealers. It is written with these professionals in mind and may not contain the necessary detail or safety statements that may be required for a non-professional to perform the service or repair properly and/or safely. Please contact an authorized Yanmar repair or service professional before working on your Yanmar product.

**Disclaimers:**

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SERVICE MANUAL	Model	ZT350, ZT370
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## ***Section 1***

# **INTRODUCTION**

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This manual gives specific instructions for the proper repair of Yanmar ZT350/370 series marine stern drive units.

Please follow the procedures carefully to ensure quality service.

Yanmar recommends that you read this *Service Manual* completely before starting repairs.

Along with standard tools, Yanmar recommends the use of special tools necessary to perform repairs correctly.

Yanmar products are continuously undergoing improvement. This *Service Manual* has been checked carefully in order to avoid errors. However, Yanmar is not liable for any misrepresentations, errors of description or omissions. Contact the regional headquarters for any questions you have regarding this *Service Manual*.

# INTRODUCTION

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## REVISION HISTORY

This manual is a living document. Periodic manual revisions are published to document product improvements and changes. This practice ensures the manual has the most current information.

As manual revisions become necessary, individual pages are prepared and sent to those who need the information. If a page, or number of pages should be replaced, the replacement information is sent along with a revised Revision Control Table. Discard the older, obsolete information.

At times, the revision involves inserting additional pages in one or more sections. Replace the Revision Control Table and insert the new pages.

This method of revision control represents the most cost-effective solution to providing current, updated information as needed.

### Revision Control Table

<b>Revision Date Revision Number</b>	<b>New Page Numbers Involved</b>	<b>Remarks</b>	<b>Initiating Dept.</b>
MAR 2011	All	Initial release	

## Section 2

# SAFETY

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Yanmar is concerned for your safety and the condition of your marine stern drive. Safety statements are one of the primary ways to call your attention to the potential hazards associated with Yanmar Marine stern drives. Follow the precautions listed throughout the manual before operation, during operation and during periodic maintenance procedures for your safety, the safety of others and to protect the performance of your marine stern drive. Keep the decals from becoming dirty or torn and replace them if they are lost or damaged. Also, if a part needs to be replaced that has a decal attached to it, make sure to order the new part and decal at the same time.



This safety alert symbol appears with most safety statements. It means attention, become alert, your safety is involved! Please read and abide by the message that follows the safety alert symbol.

### **DANGER**

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

### **WARNING**

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

### **CAUTION**

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

### **NOTICE**

**NOTICE** indicates a situation which can cause damage to the machine, personal property and/or the environment or cause the equipment to operate improperly.

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## SAFETY PRECAUTIONS

There is no substitute for common sense and careful practices. Improper practices or carelessness can cause burns, cuts, mutilation, asphyxiation, other bodily injury or death. This information contains general safety precautions and guidelines that must be followed to reduce risk to personal safety. Special safety precautions are listed in specific procedures. Read and understand all of the safety precautions before operating or performing repairs or maintenance.

### DANGER



Never permit anyone to install or operate the stern drive without proper training.

- Read and understand this *Service Manual* before operating or servicing the stern drive to ensure that safe operating practices and maintenance procedures are followed.
- Safety signs and decals are additional reminders for safe operating and maintenance techniques.
- Contact your Yanmar RHQ for additional training.

### DANGER

#### CRUSH HAZARD



- When attaching a stern drive to a repair stand, be sure to use a stand of adequate capacity to safely support the stern drive to be repaired, and that it is securely attached to the stern drive.
- Never stand under a hoisted stern drive. If the hoist mechanism fails, the stern drive will fall on you.
- Always secure the stern drive solidly to prevent the stern drive from falling during maintenance.
- Always use lifting equipment with sufficient capacity to lift the stern drive.
- Never support the stern drive with equipment not designed to support the weight of the stern drive such as wooden pieces, blocks or by only using a jack.

### WARNING

#### FIRE AND EXPLOSION HAZARD



- While the engine is running or the battery is charging, hydrogen gas is being produced and can be easily ignited. Keep the area around the battery well-ventilated and keep sparks, open flame and any other form of ignition out of the area.
- Wipe up all spills immediately.
- Have appropriate safety equipment available. Have all fire extinguishers checked periodically for proper operation and/or readiness.
- Always read and follow safety-related precautions found on containers of hazardous substances like parts cleaners, primers, sealants and sealant removers.

### WARNING

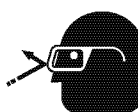
#### ENTANGLEMENT HAZARD



- Never leave the key in the key switch when servicing the stern drive. Attach a “Do Not Operate” tag near the key switch while performing maintenance on the equipment.
- Always stop the engine before beginning service.

### WARNING

#### FLYING OBJECT HAZARD



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



**⚠ WARNING****SEVER HAZARD**

- Never wear jewelry, unbuttoned cuffs, ties or loose-fitting clothing and always tie long hair back when working near moving/rotating parts. Keep hands, feet and tools away from all moving parts.
- Never use your hand to hold the propeller when loosening the nut. Put a wood block between the antiventilation plate and the propeller blade to prevent the propeller from turning.

**⚠ WARNING****ELECTRICAL HAZARD**

Make welding repairs safely.



- Always turn off the battery switch (if equipped) or disconnect the negative (-) battery cable and the leads to the alternator when welding on the equipment.
- Remove the multi-pin connector to the engine control unit. Connect the weld clamp to the component to be welded and as close as possible to the welding point.
- Never connect the weld clamp to the stern drive or in a manner which would allow current to pass through a mounting bracket.
- When welding is complete, reconnect the leads to the alternator and engine control unit prior to reconnecting the batteries.
- Never turn off the battery switch (if equipped) or short the battery cables during operation. Damage to the electrical system will result.
- Always keep the electrical connectors and terminals clean. Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors.

**⚠ WARNING****EXHAUST HAZARD**

All internal combustion engines create carbon monoxide gas during operation and special precautions are required to avoid carbon monoxide poisoning.

- Never block windows, vents or other means of ventilation if the engine is operating in an enclosed area.
- Always ensure that all connections are tightened to specifications after repair is made to the exhaust system.

**⚠ WARNING****BURN HAZARD**

Some of the engine and stern drive surfaces become very hot during operation and shortly after shutdown.

- Keep hands and other body parts away from hot surfaces.
- Handle hot components with heat-resistant gloves.

**⚠ WARNING****LIFTING HAZARD**

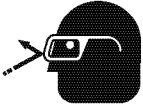
- Additional equipment is necessary to lift the stern drive. Always use lifting equipment with sufficient capacity to lift the stern drive.
- If transport is needed for stern drive repair, have a helper assist in attaching it to a hoist or stand and loading it onto a truck.

**⚠ WARNING****ALCOHOL AND DRUG HAZARD**

Never operate the engine or stern drive while under the influence of alcohol, drugs or when ill.

## **⚠ WARNING**

### **EXPOSURE HAZARD**



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

## **⚠ WARNING**

### **TOOL HAZARD**

Always remove any tools or shop rags used during maintenance from the area before operation.

## **⚠ WARNING**

### **SUDDEN MOVEMENT HAZARD**

To prevent accidental startup, complete the following before installing or removing the propeller:

- Put the remote control in the NEUTRAL position.
- Put the main battery switch in the OFF position and remove the ignition key.
- To prevent accidental equipment movement, Never start the engine in gear.
- Always turn off the battery switch (if equipped) or disconnect the negative (-) battery cable before servicing the equipment.

## **⚠ CAUTION**

### **POOR LIGHTING HAZARD**

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

## **⚠ CAUTION**

### **TOOL HAZARD**

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

## **⚠ CAUTION**

### **FLYING OBJECT HAZARD**

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

## **⚠ CAUTION**

### **SLIPPING AND TRIPPING HAZARD**

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

## **⚠ CAUTION**

### **LOSS OF CONTROL HAZARD**

Never grease the steering cable while extended. Hydraulic lock could occur and cause loss of steering control.

**NOTICE**

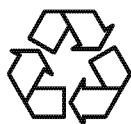
Any part which is found defective as a result of inspection or any part whose measured value does not satisfy the standard or limit must be replaced.

**NOTICE**

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

**NOTICE**

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

**NOTICE**

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

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

**NOTICE**

If any indicator illuminates during engine operation, stop the engine immediately. Determine the cause and repair the problem before continuing to operate the engine.

**NOTICE**

Only use the stern drive oil specified. Other gear oils may affect warranty coverage, cause internal components to seize and/or shorten stern drive life.

**NOTICE**

Never mix different types of stern drive oil. This may adversely affect the lubricating properties of the oil.

**NOTICE**

Never attempt to modify the stern drive's design or safety features. Failure to comply may impair the stern drive's safety and performance characteristics and shorten the stern drive's life. Any alterations to this stern drive may affect the warranty coverage of the stern drive.

**NOTICE**

Always keep the stern drive oil level at the upper full level of the oil reservoir. Do not overfill with oil. Oil level in the oil reservoir will rise and fall during stern drive operation; Always check the level when the stern drive is cool and the engine is shut down.

**NOTICE**

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

**NOTICE**

Anytime the boat is left in the water and the engine is not running, the drive must be left in the fully down position. This will keep the anodes in the water and will keep the exhaust pipe engaged with the exhaust port of the drive.

**NOTICE**

Always keep the power trim pump oil level at the upper full level of the oil reservoir. Do not overfill with oil. Always check the oil level with stern drive in the full DOWN/TRIM-IN position.

**NOTICE**

Never attempt to change propellers until after determining the average load and individual requirements.

**NOTICE**

Never paint the anodes or Y-CaPS electrode. Painting these components will render them ineffective as galvanic corrosion inhibitors.

**NOTICE**

If the AC shore power ground is not isolated from the boat ground, the Y-CaPS and anodes may be unable to neutralize the increased galvanic potential. Corrosion damage that results from the improper system design or application is not covered by the Yanmar Limited Warranty.

**NOTICE**

Any part which is found defective as a result of inspection or any part whose measured value does not satisfy the standard or limit must be replaced.

## **SAFETY**

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### ***NOTICE***

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

### ***NOTICE***

Replace anodes if eroded 50 percent or more.

### ***NOTICE***

If any water drains from the oil fill/drain hole, or if it appears milky, the stern drive may be leaking and should be checked immediately.

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## Section 3

# GENERAL SERVICE INFORMATION

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### RESPONSIBILITIES

#### Owner/Operator Responsibilities

The operator must, and assumes all responsibility to:

- Read and understand the *Operation Manual* prior to operating the stern drive;
- Perform all safety checks as necessary to ensure safe operation; and
- Comply with and follow all lubrication and maintenance instructions and recommendations.

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

#### **NOTICE**

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

#### Dealer/Distributor Responsibilities

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

- Ensure that the vessel is properly equipped.
- Prior to delivery, make certain that the Yanmar stern drive and other equipment are in proper operating condition.
- Make all necessary adjustments for maximum efficiency.
- Familiarize the customer with the onboard equipment.
- Explain and demonstrate the operation of the stern drive and vessel.

# GENERAL SERVICE INFORMATION

## SPECIFICATIONS

Stern Drive Model		ZT350		ZT370
Applicable Engine	Yanmar	4/6BY Series	6LP Series	8LV Series
	Reduction Ratio	1.65	1.65	1.65
		1.78	1.78	1.78
		1.97	–	–
		2.18	–	–
Maximum Input Speed		4500 min <sup>-1</sup> (rpm)		
Direction of Rotation (view from stern)	Input	C.C.W.		
	Front Propeller	C.C.W.		
	Rear Propeller	C.W.		
Dimension	Steering Angle	2 × 30 degrees		
	Tilt Angle	51 degrees		
	Trim Zone	-6 to 10 degrees		
Propeller	Diameter × Pitch (3 blade)	Counter Rotating Double Propeller		
		Front Propeller	Rear Propeller	
		400.1 × 508 mm (15 - 3/4 × 20 in.)	362.0 mm × 508 mm (14 - 1/4 × 20 in.)	
		400.1 × 558.8 mm (15 - 3/4 × 22 in.)	362.0 mm × 558.8 mm (14 - 1/4 × 22 in.)	
		400.1 × 609.6 mm (15 - 3/4 × 24 in.)	362.0 mm × 609.6 mm (14 - 1/4 × 24 in.)	
		400.1 × 660.4 mm (15 - 3/4 × 26 in.)	362.0 mm × 660.4 mm (14 - 1/4 × 26 in.)	
		400.1 × 711.2 mm (15 - 3/4 × 28 in.) 362.0 mm × 711.2 mm (14 - 1/4 × 28 in.)		
		Allowable propeller diameter: MAX. 406.4 mm (16 in.)		
Oil	Stern Drive Unit	GL-5 (SAE 80W90)	Quick Silver High Performance Gear Oil	
		2.5 ℓ (84.5 oz)		
	Power Steering System	Dextron III Automatic transmission fluid		
	Tilt/Trim System	Dextron III Automatic transmission fluid		
Clutch System		Hydraulic multi-friction disc type with hydraulic pump		
Shift Type		Mechanical shift or Electrical shift with solenoid		
Power Steering System		Mechanical cable operated hydraulic power assist		
Tilt/Trim System		Electric motor drive hydraulic power operation		
Anti-Corrosion System	Y-CaPS	Electronic control cathodic protection		
Mass (Weight)	Dry Condition	100 kg (220.5 lb)		



## IDENTIFICATION

The following information describes the identification nameplate location and related information of the Yanmar ZT350/370 stern drive series.

### Transom Assembly

The transom assembly nameplate is located on the top of the transom bracket assembly (Figure 3-1).

### Transom Assembly Nameplate

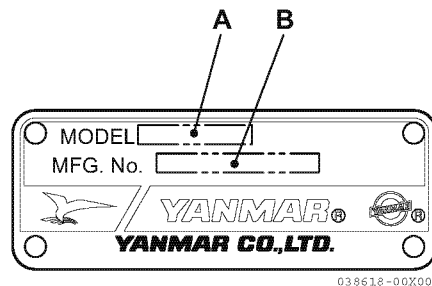


Figure 3-2

Stamp Position	Stamp Character	Remarks
A	ZT350 or ZT370	Model Type
B	○○○○○○	Serial Number (6 figure)

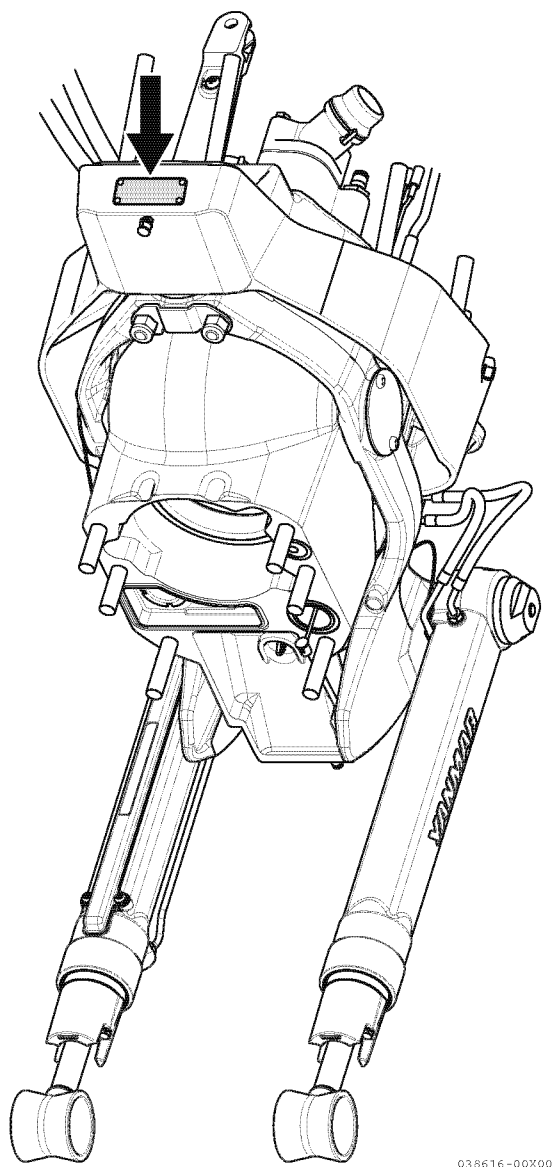


Figure 3-1

# GENERAL SERVICE INFORMATION

## Stern Drive Assembly

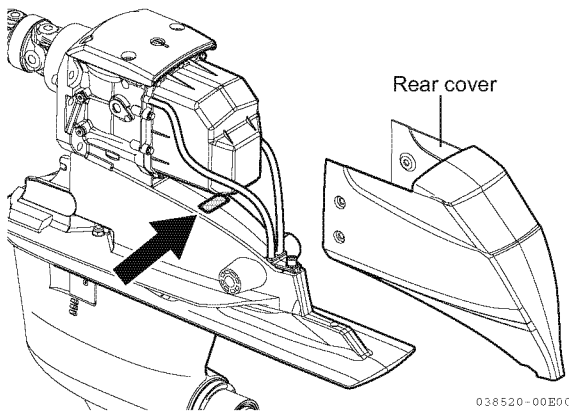
### ■ Gear Ratio Identification

Gear ratio is identified on the driveshaft housing. It is important to note the ratio of the drive unit before proceeding with any repairs.

This will be true for new or unused drive units. A drive unit could have had the gear ratio changed for high altitude, which would void out any application of the chart below. The gear ratio then would have to be determined by counting the teeth on the drive gear and the driven gear in the driveshaft housing and using the following chart for reference.

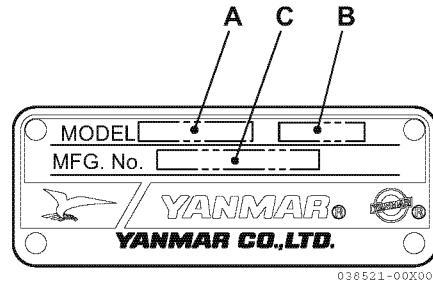
Number of Gear Teeth				
Gear Ratio	Upper Gear		Lower Gear	
	Drive	Driven	Drive	Driven
1.65	24	28	17	24
1.78			17	26
1.97			16	27
2.18			15	28

The stern drive assembly gear ratio identification nameplate (**Figure 3-3**) is located on the outer aft driveshaft housing. The driveshaft housing cover must be removed to read the nameplate.



**Figure 3-3**

## Stern Drive Assembly Nameplate



**Figure 3-4**

Stamp Position	Stamp Character				Remarks
A	ZT350 or ZT370				Model Type Gear Ratio
B	1.65	1.78	1.97	2.18	
C	○○○○○○				Serial Number (6 figure)

## TIGHTENING TORQUES FOR STANDARD BOLTS AND NUTS

### Tightening Fasteners

Use the correct amount of torque when tightening fasteners. Applying excessive torque may damage the fastener or component and not enough torque may cause a leak or component failure.

### General Tightening Torque

Size	Tightening Torque
M5	3 - 4 N·m (26 - 35 lb-in.)
M6	5 - 7 N·m (44 - 62 lb-in.)
M8	13 - 17 N·m (115 - 150 lb-in.)
M10	28 - 32 N·m (21 - 24 lb-ft)

Size	Tightening Torque
M12	43 - 47 N·m (31 - 34 lb-ft)
R1/8	9 - 11 N·m (80 - 97 lb-in.)
R1	60 - 70 N·m (44 - 51 lb-ft)

### Special Tightening Torques

#### ■ Transom Assembly

Size	Tightening Torque	Description
M6	5 - 7 N·m (44 - 62 lb-in.)	Connector bolt for engine water
M10	60 - 70 N·m (44 - 51 lb-ft)	Steering lever bolt
M10	45 - 55 N·m (33 - 40 lb-ft)	Nut for U-bolt of Gimbal ring
M12	55 - 65 N·m (40 - 48 lb-ft)	Nut to set stern drive assembly
M16	130 - 140 N·m (96 - 103 lb-ft)	Hinge bolt (Gimbal ring)
10 - 32UNF	3 - 4 N·m (26 - 35 lb-in.)	Trim cylinder anode bolt
1/4 - 20UNC	5 - 7 N·m (44 - 62 lb-in.)	Bolt for pipe plate of trim cylinder
3/4 - 16UNF	33 - 37 N·m (24 - 27 lb-ft)	Power steering pivot bolt
10 - 24UNF	3 - 4 N·m (26 - 35 lb-in.)	Trim sender bolt
3/8 - 24UNF	16 - 17 N·m (141 - 150 lb-in.)	Trim cylinder hose
7/16 - 24UNS	20 - 24 N·m (177 - 212 lb-in.)	Trim pump hose

#### ■ Stern Drive Assembly

Size	Tightening Torque	Description
M8	5 - 7 N·m (44 - 62 lb-in.)	Rear cover bolt
M10	13 - 17 N·m (115 - 150 lb-in.)	Drain plug, Vent plug
M10	33 - 37 N·m (24 - 28 lb-ft)	Nut to set Driveshaft housing and Gear housing
M20	190 - 210 N·m (140 - 154 lb-ft)	Universal joint nut
M35	190 - 210 N·m (140 - 154 lb-ft)	Upper gear B nut
M90	130 - 140 N·m (96 - 103 lb-ft)	Upper gear B Retainer
M16	43 - 47 N·m (31 - 34 lb-ft)	Lower pinion nut
M45	190 - 210 N·m (140 - 154 lb-ft)	Lower gear B nut
M113	190 - 210 N·m (140 - 154 lb-ft)	Bearing carrier
1 - 14UNS	75 - 85 N·m (55 - 62 lb-ft)	Propeller nut inner
2 1/8 - 16UNS	130 - 140 N·m (96 - 103 lb-ft)	Propeller nut outer

# GENERAL SERVICE INFORMATION

## Torque Conversion Chart

### ■ Universal Joint Nut

Torque Wrench Length: L in mm (Inches)	Torque Wrench Reading in N·m (lb-ft) to Achieve 200 N·m (148 lb-ft)
381 (15)	155 (114)
406 (16)	157 (116)
432 (17)	159 (117)
457 (18)	161 (118)
483 (19)	162 (120)
508 (20)	164 (121)
533 (21)	165 (122)
559 (22)	167 (123)
584 (23)	168 (124)
610 (24)	169 (125)
635 (25)	170 (125)
660 (26)	171 (126)
686 (27)	172 (127)
711 (28)	173 (127)
737 (29)	174 (128)
762 (30)	174 (129)
787 (31)	175 (129)
813 (32)	176 (130)
838 (33)	176 (130)
864 (34)	177 (131)
889 (35)	178 (131)
914 (36)	178 (131)

Torque Wrench P/N 196350-92310

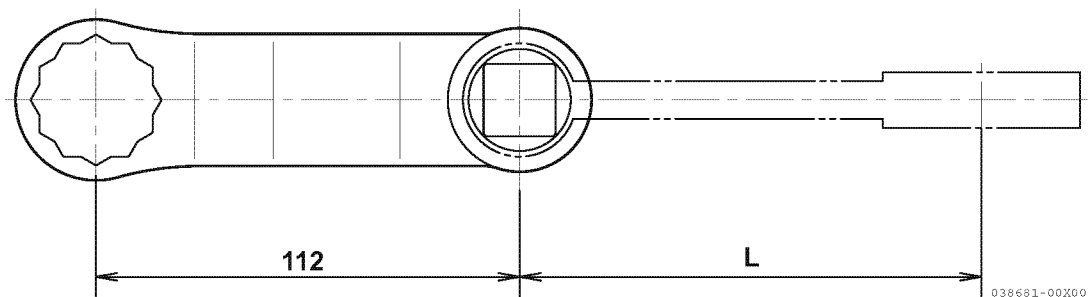


Figure 3-5

■ Bearing Carrier

Torque Wrench Length: L in mm (Inches)	Torque Wrench Reading in N·m (lb-ft) to Achieve 200 N·m (148 lb-ft)
381 (15)	164 (121)
406 (16)	165 (122)
432 (17)	167 (123)
457 (18)	169 (124)
483 (19)	170 (125)
508 (20)	171 (126)
533 (21)	173 (127)
559 (22)	174 (128)
584 (23)	175 (129)
610 (24)	176 (129)
635 (25)	176 (130)
660 (26)	177 (131)
686 (27)	178 (131)
711 (28)	179 (132)
737 (29)	179 (132)
762 (30)	180 (133)
787 (31)	181 (133)
813 (32)	181 (134)
838 (33)	182 (134)
864 (34)	182 (134)
889 (35)	183 (135)
914 (36)	183 (135)

Torque Wrench P/N 196350-92170

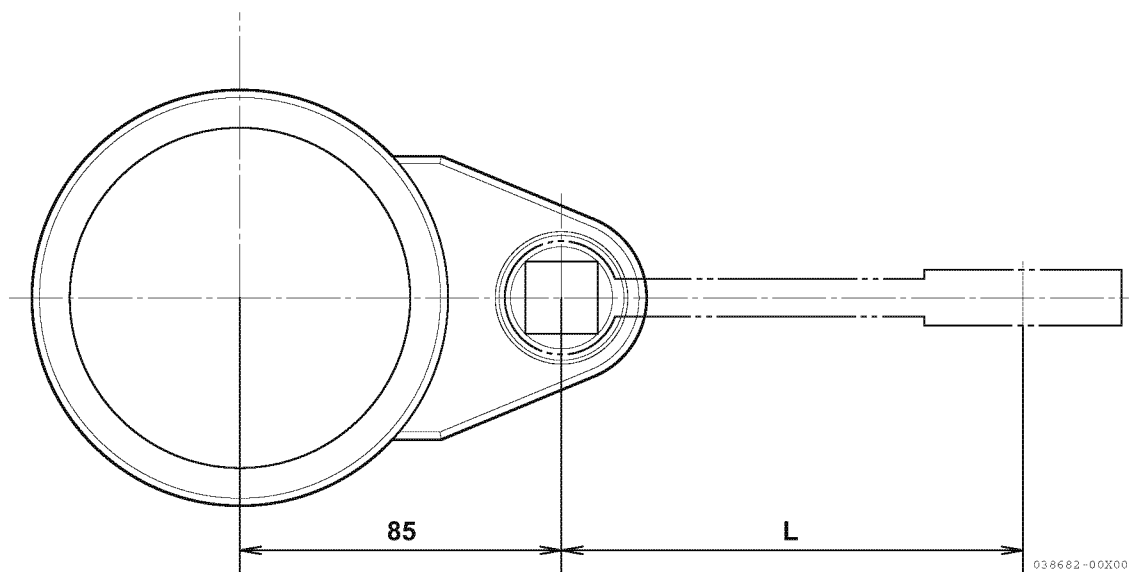


Figure 3-6

# GENERAL SERVICE INFORMATION

## ■ Propeller Nut - Outer

Torque Wrench Length: L in mm (Inches)	Torque Wrench Reading in N·m (lb-ft) to Achieve 135 N·m (100 lb-ft)
381 (15)	97 (71)
406 (16)	99 (73)
432 (17)	100 (74)
457 (18)	102 (75)
483 (19)	103 (76)
508 (20)	104 (77)
533 (21)	105 (78)
559 (22)	106 (79)
584 (23)	107 (79)
610 (24)	108 (80)
635 (25)	109 (81)
660 (26)	110 (81)
686 (27)	111 (82)
711 (28)	111 (82)
737 (29)	112 (83)
762 (30)	113 (83)
787 (31)	113 (84)
813 (32)	114 (84)
838 (33)	115 (84)
864 (34)	115 (85)
889 (35)	116 (85)
914 (36)	116 (86)

Torque Wrench P/N 196350-92180

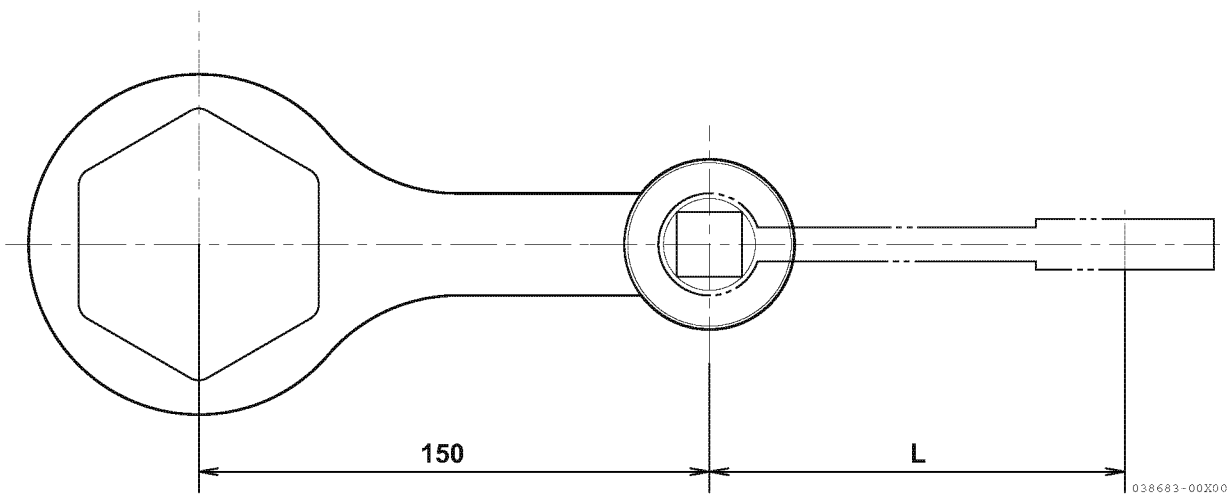


Figure 3-7

■ Tilt-Up - Limit Spacer

Torque Wrench Length: L in mm (Inches)	Torque Wrench Reading in N·m (lb-ft) to Achieve 60 N·m (44 lb-ft)
381 (15)	41 (30)
406 (16)	42 (31)
432 (17)	42 (31)
457 (18)	43 (32)
483 (19)	44 (32)
508 (20)	44 (33)
533 (21)	45 (33)
559 (22)	45 (33)
584 (23)	46 (34)
610 (24)	46 (34)
635 (25)	47 (34)
660 (26)	47 (35)
686 (27)	48 (35)
711 (28)	48 (35)
737 (29)	48 (36)
762 (30)	49 (36)
787 (31)	49 (36)
813 (32)	49 (36)
838 (33)	49 (36)
864 (34)	50 (37)
889 (35)	50 (37)
914 (36)	50 (37)

Torque Wrench P/N 196350-92320

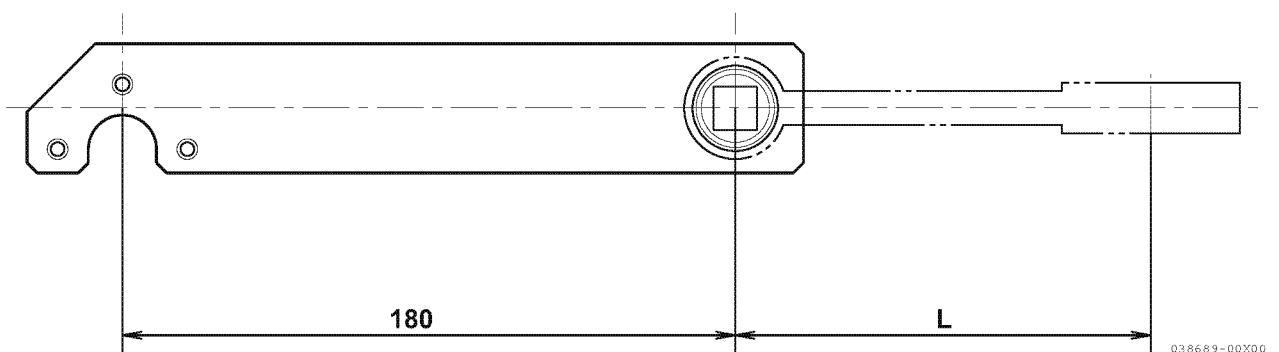


Figure 3-8

### Hose Clamps

#### **NOTICE**

Never reuse or retighten hose clamps.  
Always install new hose clamps.

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Size	Specification
5 mm Hex Head	1.0 to 1.5 N·m (8.9 to 13 lb-in.)
6 mm Hex Head	2.5 to 3.5 N·m (22 to 31 lb-in.)



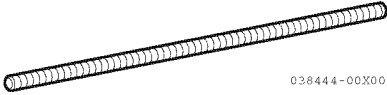
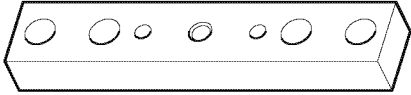
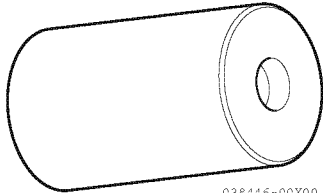
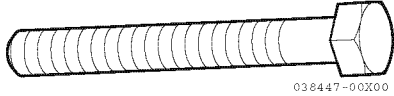
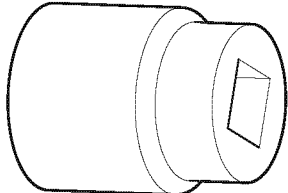
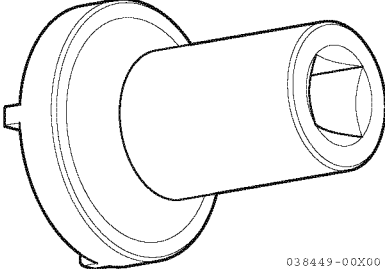
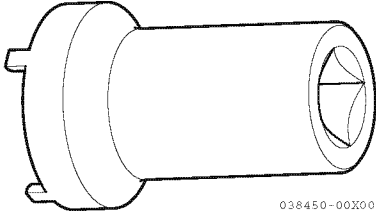
**LUBRICANTS, SEALERS AND ADHESIVES**

Description	Example
Lithium grease with PTFE	Crtec Co.: Lithium EP Grease with PTFE Arexons: System GLT2 Grasso AL PTFE - MI 500 or Equivalent
Multi-purpose heavy-duty type lithium grease (NLGI #2)	Valvoline: Multi-Purpose Grease/gm or Equivalent
Urea grease water resistant type (NLGI #2)	Rykon: Premium Grease EP
Liquid gasket for seawater resistance	Three Bond® 1101 or Equivalent
Liquid gasket	Three Bond® 1215 or Equivalent
Thread locking (high-strength type, Anaerobic sealant)	Three Bond® 1305, Loxal: 86-53 or Equivalent
Thread locking (mid-strength type, Anaerobic sealant)	Three Bond® 1324N or Equivalent
Thread locking (low-strength type, Anaerobic sealant)	Three Bond® 1344N or Equivalent
Adhesives for rubber	Three Bond® 1521, Loxal Instant 32 or Equivalent

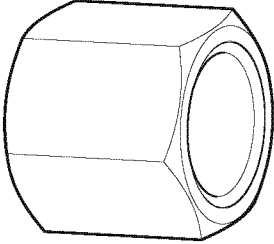
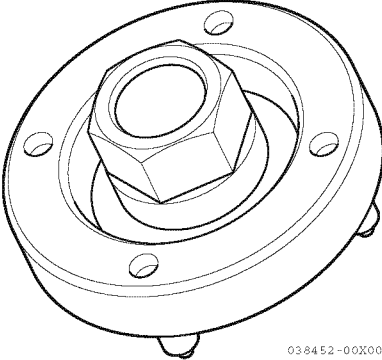
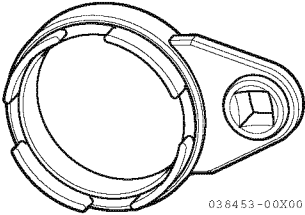
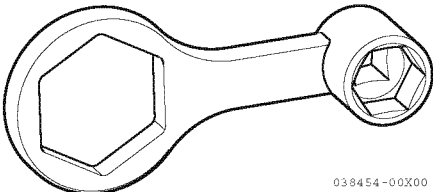
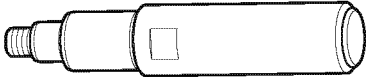
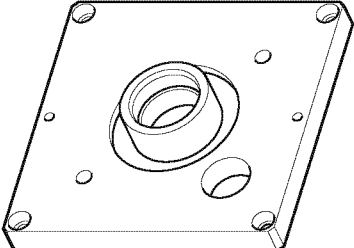
## GENERAL SERVICE INFORMATION

### SPECIAL SERVICE TOOLS

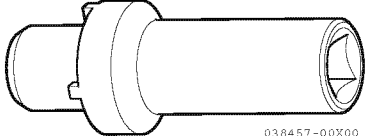
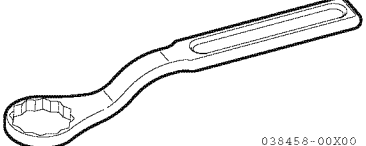
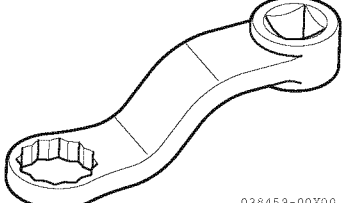

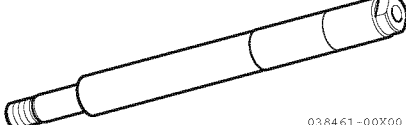
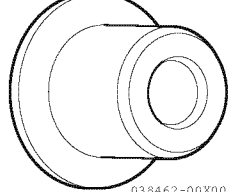
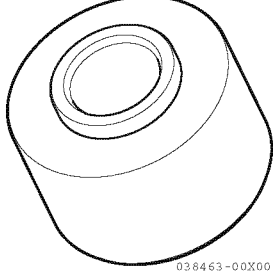
Note: Contact Yanmar America or refer the ZT350/370 parts catalog for additional information on special tools and special tool kits.

No.	Tool Name	Part Number	Illustration
1	Threaded Rod, M16 × 600	177524-09220	
2	ARM	177524-09230	
3	Tool, 35/43	196320-92690	
4	Bolt, M12 × 100	196320-92700	
5	Socket, 36	196340-92400	
6	Socket (BRG Nut)	196350-92100	
7	Socket (Prop Shaft)	196350-92110	

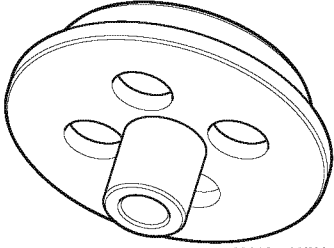



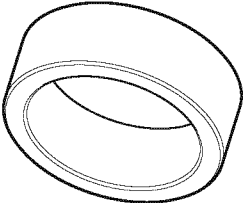
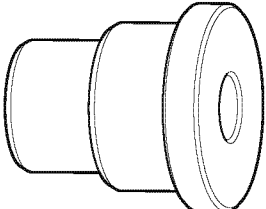
## GENERAL SERVICE INFORMATION

No.	Tool Name	Part Number	Illustration
8	Socket, S PLINE (D/S)	196350-92130	 <p style="text-align: right; font-size: small;">038451-00X00</p>
9	Wrenchs CMP	196350-92140	 <p style="text-align: right; font-size: small;">038452-00X00</p>
10	Wrenchs (B Carrier)	196350-92170	 <p style="text-align: right; font-size: small;">038453-00X00</p>
11	Wrenchs (Prop Nut)	196350-92180	 <p style="text-align: right; font-size: small;">038454-00X00</p>
12	Handle (Gear)	196350-92190	 <p style="text-align: right; font-size: small;">038455-00X00</p>
13	Base (Prop Shaft)	196350-92200	 <p style="text-align: right; font-size: small;">038456-00X00</p>

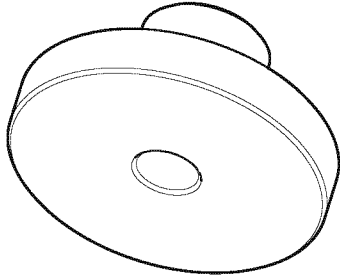
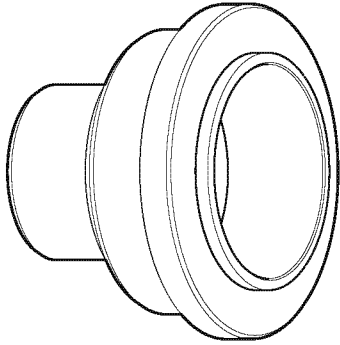
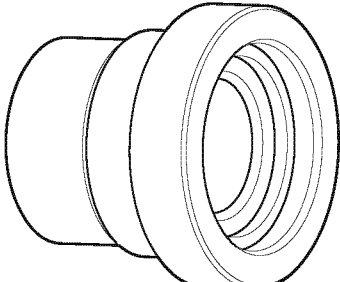
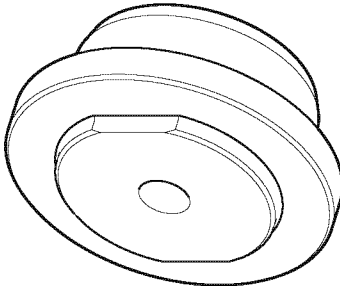
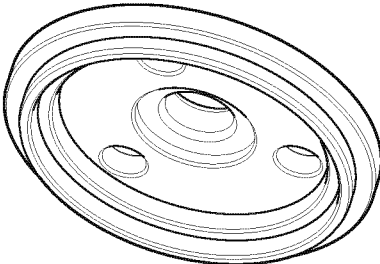
# GENERAL SERVICE INFORMATION

No.	Tool Name	Part Number	Illustration
14	Socket CMP (Insert)	196350-92220	 <p>038457-00X00</p>
15	Wrenchs 30 (UJ)	196350-92300	 <p>038458-00X00</p>
16	Wrenchs 30 (UJ)	196350-92310	 <p>038459-00X00</p>
17	Wrenchs (CYL End)	196350-92320	 <p>038460-00X00</p>
18	Shaft (Needle BRG)	196350-92360	 <p>038461-00X00</p>
19	Guide (Needle BRG)	196350-92370	 <p>038462-00X00</p>
20	Base (Needle BRG)	196350-92380	 <p>038463-00X00</p>

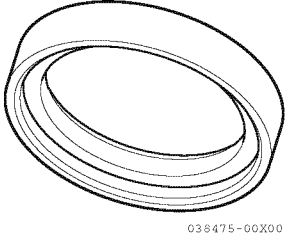
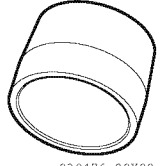
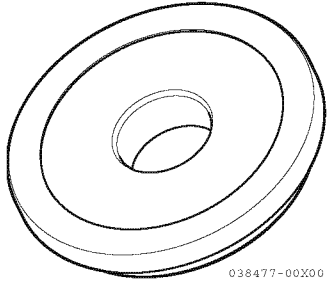
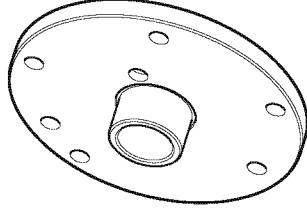

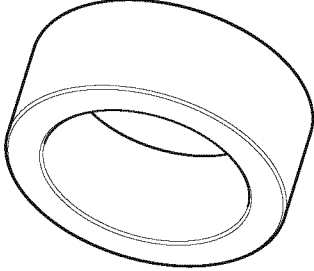
## GENERAL SERVICE INFORMATION

No.	Tool Name	Part Number	Illustration
21	Sleeve (UJ Bellows)	196350-92390	 <p style="text-align: right; font-size: small;">038464-00X00</p>
22	BRG (Gear B, Upper)	196350-92400	 <p style="text-align: right; font-size: small;">038465-00X00</p>
23	BRG (Driveshaft)	196350-92410	 <p style="text-align: right; font-size: small;">038466-00X00</p>
24	Ring (Driveshaft)	196350-92420	 <p style="text-align: right; font-size: small;">038467-00X00</p>
25	Needle (BRG Carrier)	196350-92430	 <p style="text-align: right; font-size: small;">038468-00X00</p>
26	Needle (Prop Shaft)	196350-92440	 <p style="text-align: right; font-size: small;">038469-00X00</p>

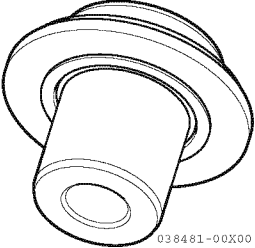
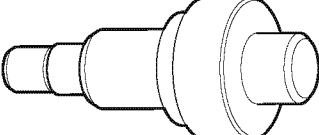

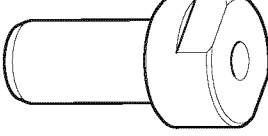
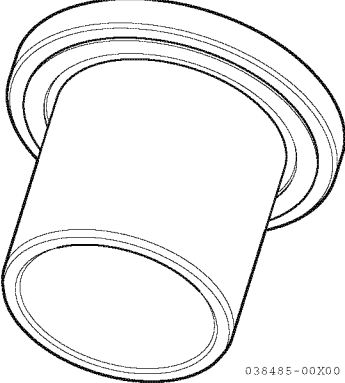
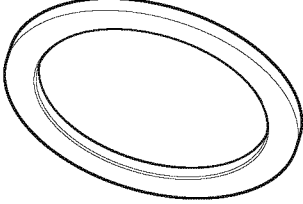
# GENERAL SERVICE INFORMATION

No.	Tool Name	Part Number	Illustration
27	Guide (Unit BRG)	196350-92450	 <p style="text-align: right; font-size: small;">038470-00X00</p>
28	Bearing (BRG-H)	196350-92470	 <p style="text-align: right; font-size: small;">038471-00X00</p>
29	Base (BRG Housing)	196350-92480	 <p style="text-align: right; font-size: small;">038472-00X00</p>
30	BRG (G/H Gear A)	196350-92500	 <p style="text-align: right; font-size: small;">038473-00X00</p>
31	Guide (G/H Gear A)	196350-92520	 <p style="text-align: right; font-size: small;">038474-00X00</p>

# GENERAL SERVICE INFORMATION

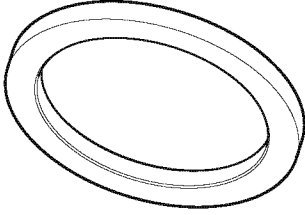
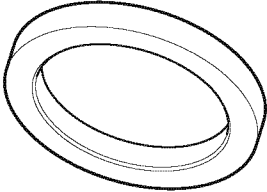
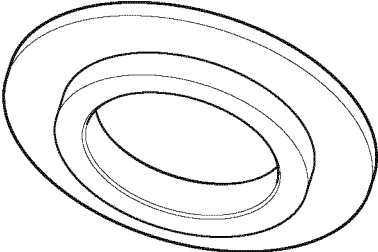
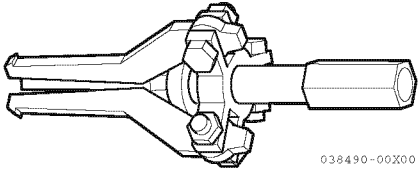


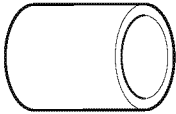
No.	Tool Name	Part Number	Illustration
32	Ring (Clutch Shaft)	196350-92550	
33	Guide (Clutch Shaft)	196350-92560	
34	Base (Clutch Shaft)	196350-92570	
35	Clutch Shaft	196350-92600	
36	Driveshaft	196350-92610	
37	Base (Front Cover)	196350-92720	

# GENERAL SERVICE INFORMATION

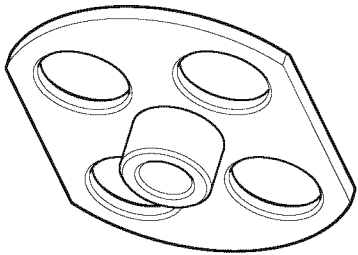
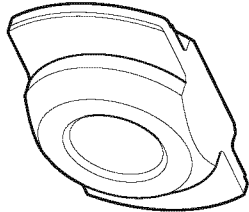
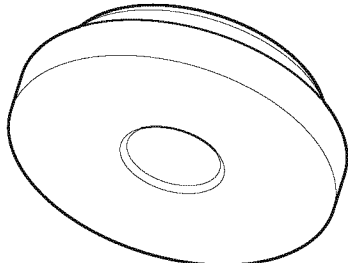
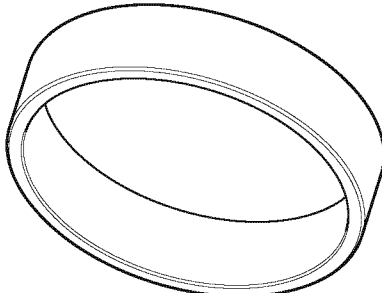
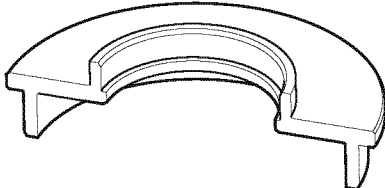
No.	Tool Name	Part Number	Illustration
38	Seal (Gimbal & Front)	196350-92700	 <p>038481-00X00</p>
39	Bushing (Steer Shaft)	196350-92710	 <p>038482-00X00</p>
40	Ring (Steering)	196350-92720	 <p>038483-00X00</p>
41	Bushing (Gimbal Ring)	196350-92730	 <p>038484-00X00</p>
42	Seal (BRG Carrier)	196350-92740	 <p>038485-00X00</p>
43	Ring1 (BRG Carrier)	196350-92750	 <p>038486-00X00</p>



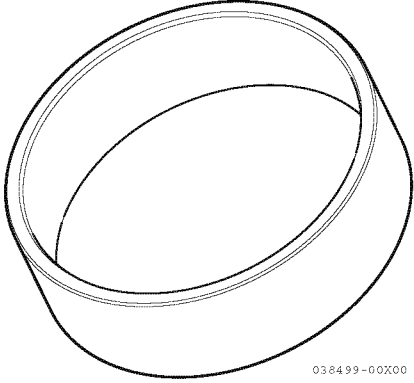
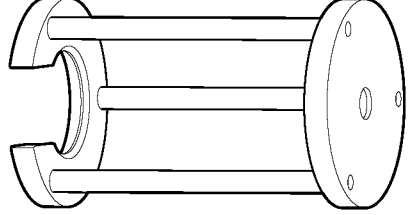

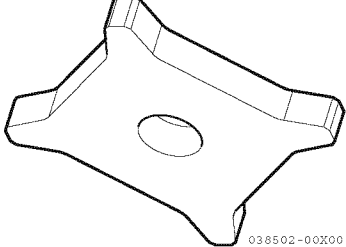
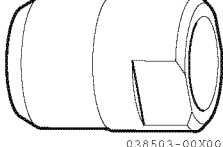
# GENERAL SERVICE INFORMATION

No.	Tool Name	Part Number	Illustration
44	Ring2 (BRG Carrier)	196350-92760	 <p style="text-align: right; font-size: small;">038487-00X00</p>
45	Ring1 (P/S Outer)	196350-92790	 <p style="text-align: right; font-size: small;">038488-00X00</p>
46	Ring2 (P/S Outer)	196350-92800	 <p style="text-align: right; font-size: small;">038489-00X00</p>
47	BRG Cup Remover	196350-92810	 <p style="text-align: right; font-size: small;">038490-00X00</p>
48	Shaft (BRG)	196350-92820	 <p style="text-align: right; font-size: small;">038491-00X00</p>
49	Bushing (Steering Shaft)	196350-92830	 <p style="text-align: right; font-size: small;">038492-00X00</p>
50	Bushing (Gimbal Ring)	196350-92840	 <p style="text-align: right; font-size: small;">038493-00X00</p>

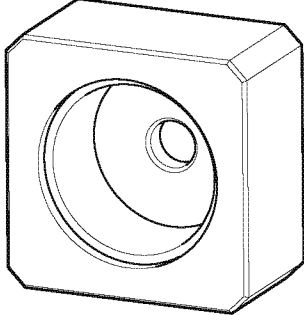

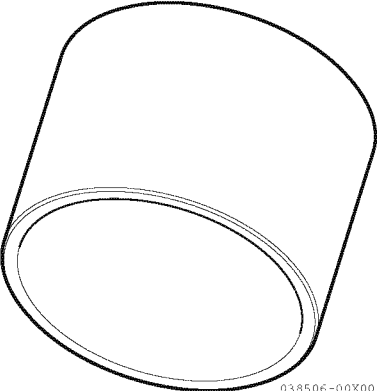
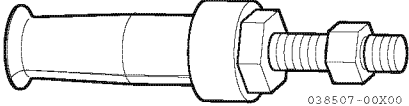
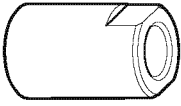

# GENERAL SERVICE INFORMATION

No.	Tool Name	Part Number	Illustration
51	Plate (Ring)	196350-92850	 <p>038494-00X00</p>
52	BRG (Front Cover)	196350-92860	 <p>038495-00X00</p>
53	Bearing (BRG HSG)	196350-92870	 <p>038496-00X00</p>
54	Base (Bearing)	196350-92880	 <p>038497-00X00</p>
55	BRG (Upper Gear B)	196350-92890	 <p>038498-00X00</p>

# GENERAL SERVICE INFORMATION

No.	Tool Name	Part Number	Illustration
56	Base (Upper Gear B)	196350-92900	 <p style="text-align: right; font-size: small;">038499-00X00</p>
57	Pusher (Spring)	196350-92910	 <p style="text-align: right; font-size: small;">038500-00X00</p>
58	Needle BRG (D/S)	196350-92920	 <p style="text-align: right; font-size: small;">038501-00X00</p>
59	Needle (BRG Carrier)	196350-92930	 <p style="text-align: right; font-size: small;">038502-00X00</p>
60	Needle (P/S Outer)	196350-92940	 <p style="text-align: right; font-size: small;">038503-00X00</p>

# GENERAL SERVICE INFORMATION

No.	Tool Name	Part Number	Illustration
61	Guide (P/S Outer)	196350-92950	 <p>038504-00X00</p>
62	Bolt (12 × 135)	196350-92960	 <p>038505-00X00</p>
63	Base (Bearing HSG)	196350-92970	 <p>038506-00X00</p>
64	Puller 5	196350-92980	 <p>038507-00X00</p>
65	Joint (Puller 5)	196350-92990	 <p>038508-00X00</p>
66	Alignment Shaft	196350-92010	 <p>039102-00X00</p>

## ABBREVIATIONS AND SYMBOLS

### Abbreviations

<b>A</b>	ampere
<b>AC</b>	alternating current
<b>ACEA</b>	Association des Constructeurs Européens d'Automobilies
<b>Ah</b>	ampere-hour
<b>API</b>	American Petroleum Institute
<b>ARB</b>	Air Resources Board
<b>ATDC</b>	after top dead center
<b>BTDC</b>	before top dead center
<b>°C</b>	Celsius
<b>CARB</b>	California Air Resources Board
<b>CCA</b>	cold cranking amp
<b>cm</b>	centimeter
<b>cm<sup>3</sup></b>	cubic centimeter
<b>cm<sup>3</sup>/min</b>	cubic centimeter per minute
<b>cu. in.</b>	cubic inch
<b>DC</b>	direct current
<b>DI</b>	direct injection
<b>DVA</b>	direct volt adapter
<b>EPA</b>	Environmental Protection Agency
<b>ESG</b>	electronic speed governor
<b>°F</b>	degree Fahrenheit
<b>fl oz</b>	fluid ounce (U.S.)
<b>fl oz/min</b>	fluid ounce (U.S.) per minute
<b>ft</b>	foot
<b>ft-lb</b>	foot pound*
<b>ft-lbf/min</b>	foot pound force per minute
<b>g</b>	gram
<b>gal/hr</b>	gallon (U.S.) per hour
<b>gal</b>	gallon (U.S.)
<b>GL</b>	gear lubricant
<b>hp</b>	horsepower (metric)
<b>hrs</b>	hours
<b>I.D.</b>	inside diameter
<b>IDI</b>	indirect injection
<b>in.</b>	inch
<b>in.-lb</b>	inch pound**
<b>JASO</b>	Japanese Automobile Standards Organization
<b>kg</b>	kilogram
<b>kgf/cm<sup>2</sup></b>	kilogram force per square centimeter

<b>kgf-m</b>	kilogram force meter
<b>km</b>	kilometers
<b>kPa</b>	kilopascal
<b>kW</b>	kilowatt
<b>ℓ</b>	liter
<b>ℓ/hr</b>	liter per hour
<b>lb</b>	pound
<b>lbf</b>	pound-force
<b>lb-ft</b>	pound foot (Tightening Torque)
<b>lb-in.</b>	pound inch (Tightening Torque)
<b>min</b>	minute
<b>mL</b>	milliliter
<b>mm</b>	millimeter
<b>MPa</b>	megapascal
<b>mV</b>	millivolt
<b>N</b>	newton
<b>N-m</b>	newton meter
<b>No.</b>	number
<b>O.D.</b>	outside diameter
<b>oz</b>	ounce
<b>PS</b>	horsepower (Deutsch)
<b>psi</b>	pound per square inch
<b>qt</b>	quart (U.S.)
<b>rpm</b>	revolutions per minute
<b>SAE</b>	Society of Automotive Engineers
<b>sec</b>	second
<b>t</b>	short ton 2000 lb
<b>TBN</b>	Total Base Number
<b>TDC</b>	top dead center
<b>V</b>	volt
<b>VAC</b>	volt alternating current
<b>VDC</b>	volt direct current
<b>W</b>	watt
<b>WOT</b>	Wide-Open Throttle

### Symbols

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

\* Work torque such as engine torque

\*\* Work torque such as starter motor torque

# GENERAL SERVICE INFORMATION

## UNIT CONVERSIONS

### Unit Prefixes

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

### Units of Length

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

### Units of Volume

gal (U.S.)	×	3.78540	= ℓ
qt (U.S.)	×	0.94635	= ℓ
cu in	×	0.01639	= ℓ
cu in	×	16.38700	= ml
fl oz (U.S.)	×	0.02957	= ℓ
fl oz (U.S.)	×	29.57000	= ml
cm <sup>3</sup>	×	1.00000	= ml
cm <sup>3</sup>	×	0.03382	= fl oz (U.S.)

### Units of Mass

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

### Units of Force

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

### Units of Torque

lb-ft	×	1.3558	= N·m
lb-ft	×	0.1383	= kgf·m
lb-in.	×	0.1130	= N·m
lb-in.	×	0.0115	= kgf·m
kgf·m	×	7.2330	= lb-ft
kgf·m	×	86.8000	= lb-in.
kgf·m	×	9.8070	= N·m
N·m	×	0.7376	= lb-ft
N·m	×	8.8510	= lb-in.
N·m	×	0.1020	= kgf·m

### Units of Pressure

psi	×	0.0689	= bar
psi	×	6.8950	= kPa
psi	×	0.0703	= kgf/cm <sup>2</sup>
bar	×	14.5030	= psi
bar	×	100.0000	= kPa
bar	×	29.5300	= in Hg (60 °F)
kPa	×	0.1450	= psi
kPa	×	0.0100	= bar
kPa	×	0.0102	= kgf/cm <sup>2</sup>
kgf/cm <sup>2</sup>	×	98.0700	= psi
kgf/cm <sup>2</sup>	×	0.9807	= bar
kgf/cm <sup>2</sup>	×	14.2200	= kPa
in. Hg (60°)	×	0.0333	= bar
in. Hg (60°)	×	3.3770	= kPa
in. Hg (60°)	×	0.0344	= kgf/cm <sup>2</sup>
psi	×	0.0689	= bar

### Units of Power

hp (metric or PS)	×	0.9863201	= hp SAE
hp (metric or PS)	×	0.7354988	= kW
hp SAE	×	1.0138697	= hp (metric or PS)
hp SAE	×	0.7456999	= kW
kW	×	1.3596216	= hp (metric or PS)
kW	×	1.3410221	= hp SAE

### Units of Temperature

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$$

$$^{\circ}\text{C} = 0.556 \times (^{\circ}\text{F} - 32)$$

## Section 4

# MAINTENANCE

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## SAFETY PRECAUTIONS

Before servicing the stern drive, review *Safety on page 2-1*.

## INTRODUCTION

This section of the *Service Manual* describes the procedures for proper care and maintenance of the stern drive.

## MAINTENANCE

# CHECKING, FILLING AND CHANGING STERN DRIVE OIL

## Checking Stern Drive Oil Reservoir Level

Model	Description	Where Used
ZT350	GL-5 Hypoid Gear Oil	Oil Reservoir
ZT370	Quick Silver High Performance Gear Oil	

### NOTICE

Only use GL-5 rated gear oil. Use of incorrect gear oil will cause premature clutch wear and stern drive damage.

### NOTICE

The oil level in the reservoir may be incorrectly indicated if air becomes trapped in the oil. The air separator (2, **Figure 4-1**) must be properly installed between the stern drive and the oil reservoir (1, **Figure 4-1**) to prevent air from being trapped in the oil.

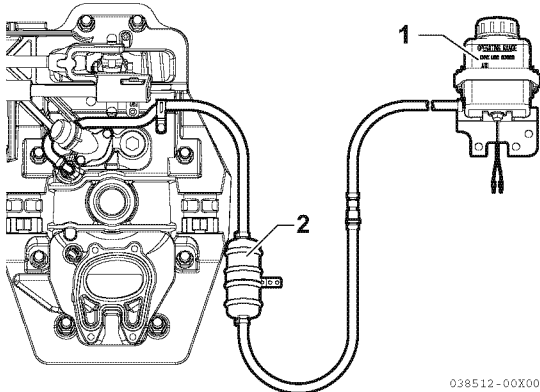


Figure 4-1

### NOTICE

The oil valve screw (1, **Figure 4-2**) and (1, **Figure 4-3**) must be open during normal operation and before checking the stern drive oil level. Open the oil valve screw (approximately 2 turns).

### NOTICE

If the oil reservoir hose is kinked or the air separator is restricted, the reservoir will not function properly and damage to the drive unit will occur. Ensure oil flows freely from the oil reservoir to the stern drive.

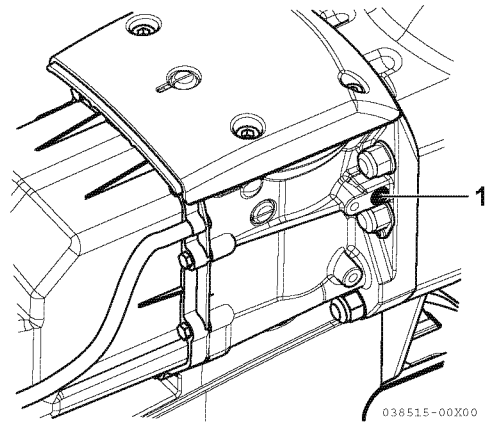


Figure 4-2

Note: If the oil valve screw nut turns when turning the oil valve screw, hold the nut with a wrench while turning the valve screw. Do not allow the valve screw nut to turn.

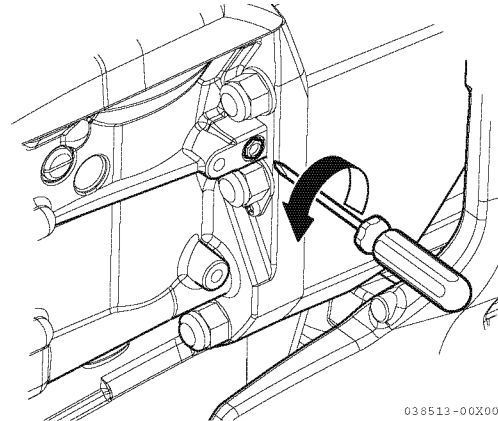


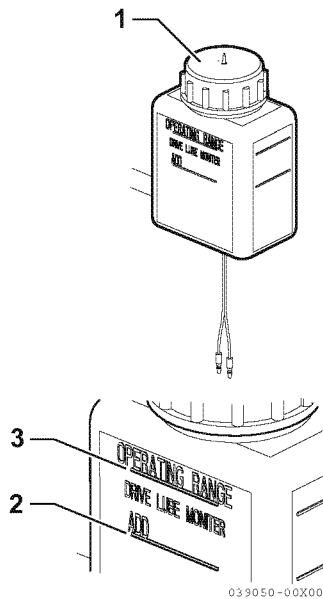
Figure 4-3

### NOTICE

Oil level in the oil reservoir will rise and fall during stern drive operation; Always check the level when the stern drive is cool and the engine is shut down.

1. Check the stern drive reservoir oil level (**Figure 4-4**). Keep the oil level at or near the OPERATING RANGE (full) line (3, **Figure 4-4**) on the oil reservoir (1, **Figure 4-4**).

- The oil level is low if it is below the ADD line (2, **Figure 4-4**) on the oil reservoir (1, **Figure 4-4**). Fill as needed with the specified oil. See *Filling Stern Drive Oil Reservoir* on page 4-6.



**Figure 4-4**

**NOTICE**

If any water is visible at the bottom of the oil reservoir or appears at the oil fill/drain plug and/or if oil appears discolored, check the stern drive assembly for water leaks and repair as needed.

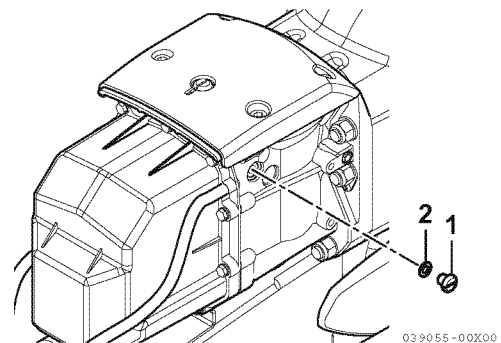
**Checking Stern Drive Oil Level**

**NOTICE**

The oil valve screw must be open during normal operation and before checking the stern drive oil level. Open the oil valve screw (approximately 2 turns).

Check the stern drive oil level as follows:

- Remove the oil vent plug (1, **Figure 4-5**) and gasket (2, **Figure 4-5**).



**Figure 4-5**

- If necessary, add oil until an air-free stream of oil flows from the oil vent hole.
- Install the oil vent plug and gasket. Torque the oil vent plug.

Oil Vent Plug Torque	
N·m	lb·ft
15	11

# MAINTENANCE

## Filling Stern Drive Oil Reservoir

### NOTICE

If the oil reservoir hose is kinked or the air separator is restricted, the reservoir will not function properly and damage to the drive unit will occur. Ensure oil flows freely from the oil reservoir to the stern drive.

See *Changing Stern Drive Oil* on page 4-6 when filling the entire stern drive.

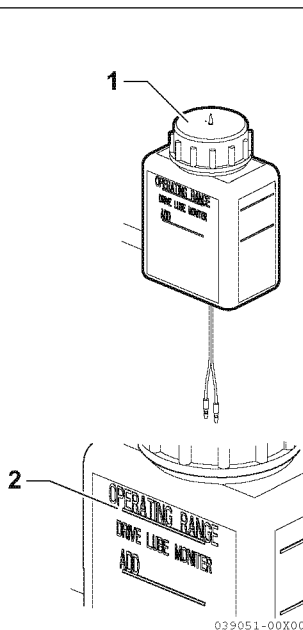
### NOTICE

If more than 60 ml (2 fl oz) of gear oil is required to fill the reservoir, a seal may be leaking. Check the stern drive for leaks and repair as needed.

1. Remove the oil reservoir cap (1, **Figure 4-6**).
2. Fill the oil reservoir to the OPERATING RANGE (2, **Figure 4-6**) (full) line with specified fluid.

### NOTICE

Do not overfill.



**Figure 4-6**

Model	Description	Where Used
ZT350	GL-5 Hypoid Gear Oil	Oil Reservoir
ZT370	Quick Silver High Performance Gear Oil	

3. When replacing the cap, ensure that the rubber gasket is inside the oil reservoir cap and install the cap. Do not over-tighten.

## Changing Stern Drive Oil

### NOTICE

The oil valve screw must be open during normal operation. Open the oil valve screw (approximately 2 turns).

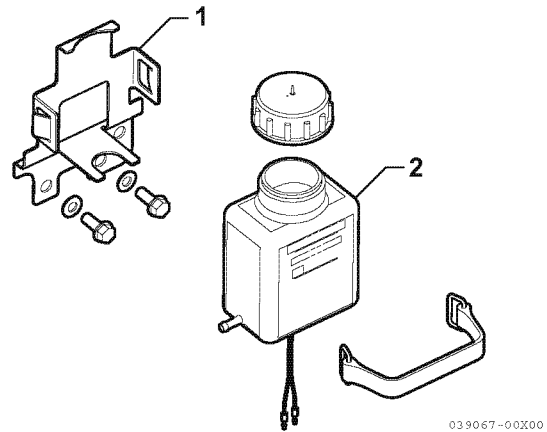
*Note: The stern drive oil must be changed and the oil filter cleaned or changed every 100 hours.*

### NOTICE

Always be environmentally responsible.

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

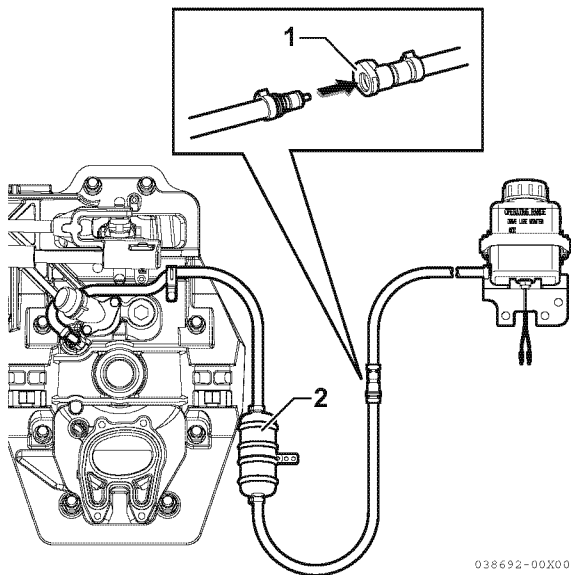
1. Disconnect the oil hose and remove the oil reservoir from the retaining strap.



**Figure 4-7**

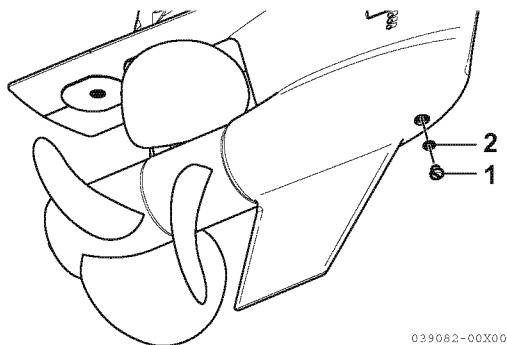
2. Empty the oil into a container large enough to hold the drained gear oil.
3. Install the oil reservoir (2, **Figure 4-7**) in the bracket (1, **Figure 4-7**) and connect the oil hose.

4. Connect the oil reservoir hose connector (1, **Figure 4-8**). Ensure the oil hose and air separator (2, **Figure 4-8**) hose connections are tight.



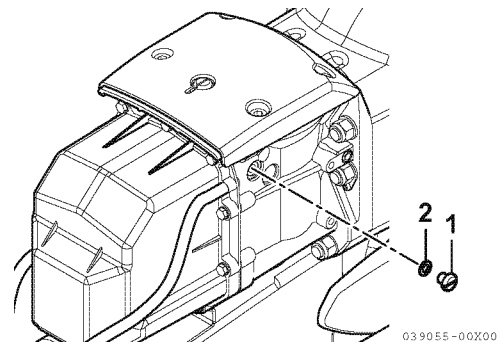
**Figure 4-8**

5. Place the stern drive in full trim limit OUT position.
6. Remove the oil fill/drain plug (1, **Figure 4-9**) and gasket (2, **Figure 4-9**).
7. Drain the oil.



**Figure 4-9**

8. Remove the oil vent plug (1, **Figure 4-10**) and gasket (2, **Figure 4-10**). Allow the oil to drain completely.

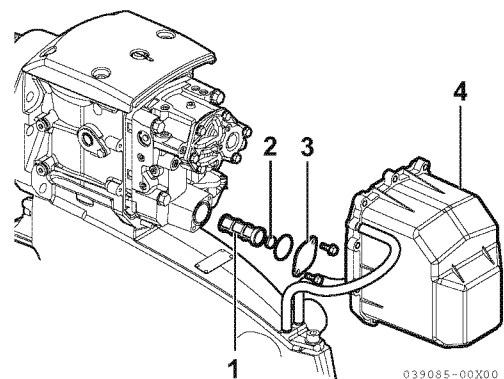


**Figure 4-10**

## NOTICE

If any water drains from the oil fill/drain hole, or if it appears milky, the stern drive may be leaking and should be checked immediately.

9. Remove the case plate cover (4, **Figure 4-11**), filter cover (3, **Figure 4-11**), magnet (2, **Figure 4-11**) and filter (1, **Figure 4-11**). Clean or replace the filter and magnet.



**Figure 4-11**

10. Lower the stern drive so that the propeller shaft is level. Fill the stern drive through the oil fill/drain hole with the specified oil until an air-free stream of oil flows from the filter opening. Install the filter, magnet, filter cover and case plate cover.

# MAINTENANCE

- Continue to fill the stern drive with oil through the oil fill/drain hole until an air-free stream of oil flows from the oil vent hole.

## NOTICE

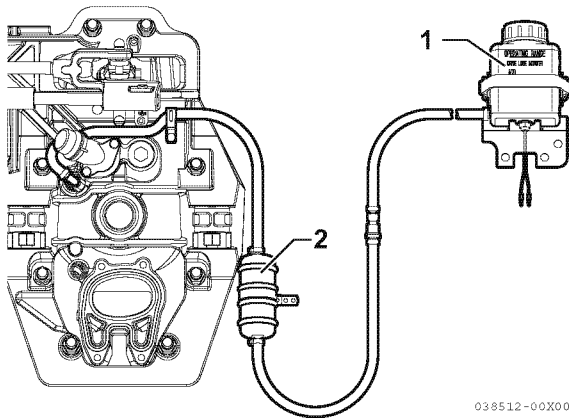
Do not pump gear oil into the oil reservoir circuit from the oil fill/drain plug. This will raise the internal pressure of the drive unit too high, causing damage to the oil seal.

- Install the oil vent plug and gasket. Torque the oil vent plug.

Oil Vent Plug Torque	
N·m	lb-ft
15	11

## NOTICE

The oil level in the reservoir may be incorrectly indicated if air becomes trapped in the oil. The air separator (2, **Figure 4-12**) must be properly installed between the stern drive and the oil reservoir (1, **Figure 4-12**) to prevent air from being trapped in the oil.



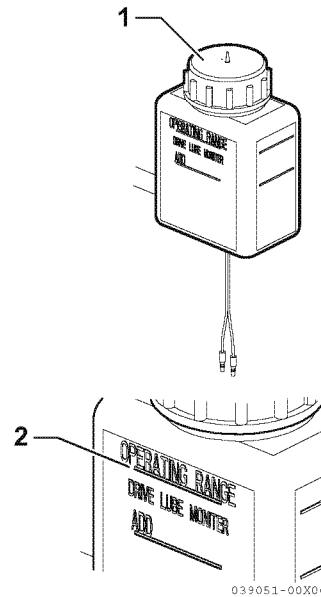
**Figure 4-12**

- Remove the oil reservoir cap (1, **Figure 4-13**) and fill the oil reservoir so that the oil level is to the operating range line (2, **Figure 4-13**).

## NOTICE

Never overfill.

Model	Description	Capacity
ZT350	GL-5 Hypoid Gear Oil	2,500 mL (85 oz)
ZT370	Quick Silver High Performance Gear Oil	



**Figure 4-13**

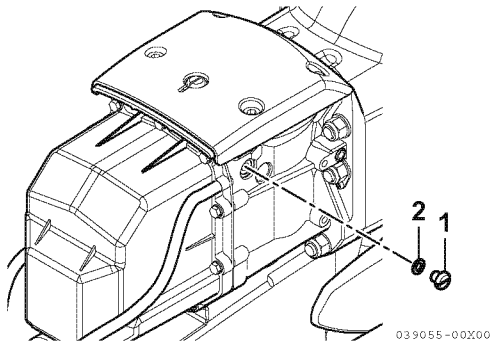
- Ensure that the rubber gasket is inside the cap and install the cap. Never over-tighten.
- Remove the pump from the oil fill/drain hole. Quickly install the gasket and oil fill/drain plug. Torque the oil fill/drain plug.

Oil Fill/Drain Plug Torque	
N·m	lb-ft
15	11

- Check the oil level in the oil reservoir after running the drive.

17. Check the stern drive oil level within one week of the first use as follows:

1. Remove the oil vent plug (1, **Figure 4-14**) and gasket (2, **Figure 4-14**).



**Figure 4-14**

2. If necessary, add oil until an air-free stream of oil flows from the oil vent hole.
3. Install the oil vent plug and gasket. Torque the oil vent plug.

**NOTICE**

Oil level in the oil reservoir will rise and fall during stern drive operation; Always check the level when the stern drive is cool and the engine is shut down.

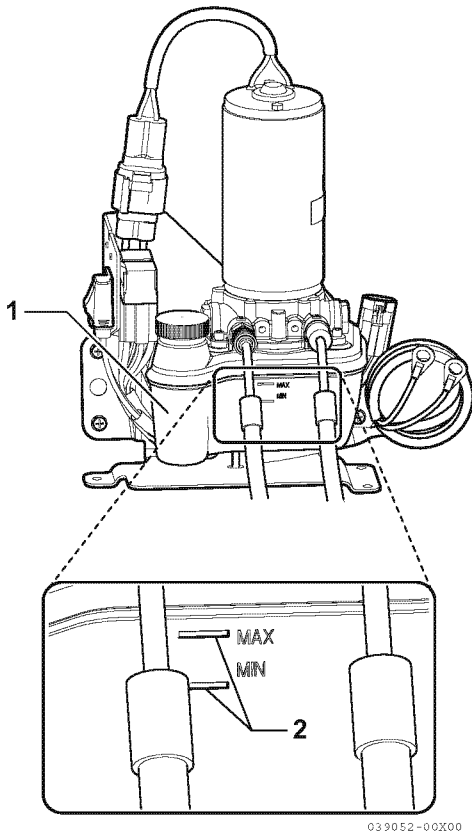
# CHECKING AND FILLING POWER TRIM PUMP FLUID

## Checking Power Trim Pump Fluid

**NOTICE**

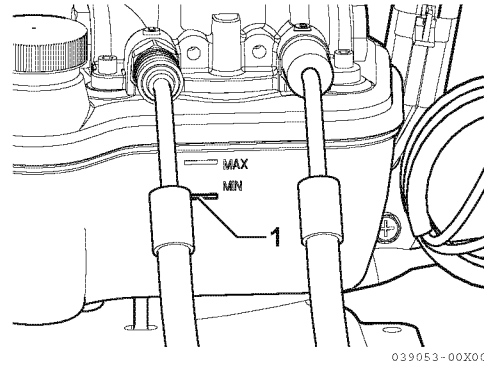
Always check the oil level with stern drive in the full DOWN/TRIM-IN position.

1. Place the stern drive in full DOWN/TRIM-IN position.
2. Observe the oil level in the reservoir. The oil level should be maintained within the MIN and MAX lines (2, **Figure 4-15**) on the reservoir (1, **Figure 4-15**).



**Figure 4-15**

3. The oil level is low if it is below the MIN line (1, **Figure 4-16**) on the reservoir. Fill as necessary with the specified fluid. See *Filling Power Trim Pump Fluid* on page 4-10.



**Figure 4-16**

## Filling Power Trim Pump Fluid

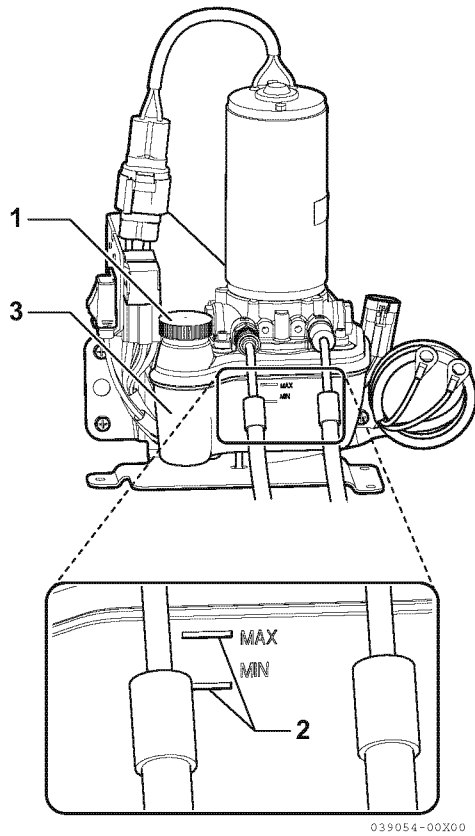
*Note: The power trim fluid does not require changing unless it becomes contaminated with water or debris.*

1. Place the stern drive in the full DOWN/TRIM-IN position.
2. Unscrew and remove the fill cap assembly (1, **Figure 4-17**) from the reservoir (3, **Figure 4-17**).

Description	Where Used
Dextron 3 Automatic Transmission Fluid	Power Trim Pump



3. Add oil to bring the oil level to within the MIN and MAX lines on the reservoir (2, **Figure 4-17**).



**Figure 4-17**

4. Install the fill cap assembly.

## MAINTENANCE

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### PERIODIC MAINTENANCE

#### **NOTICE**

Establish a periodic maintenance plan according to the stern drive application and make sure to perform the required periodic maintenance at the intervals indicated. Failure to follow these guidelines will impair the stern drive's safety and performance characteristics, shorten the stern drive's life and may affect the stern drive warranty coverage.

---

#### **The Importance of Periodic Maintenance**

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

#### **Performing Periodic Maintenance**

#### **⚠ WARNING**

#### **EXHAUST HAZARD**

Never block windows, vents, or other means of ventilation if the engine is operating in an enclosed area. All internal combustion engines create carbon monoxide gas during operation. Accumulation of this gas within an enclosure could cause illness or even death.

---

#### **The Importance of Daily Checks**

The Periodic Maintenance Schedule assumes that daily checks are performed on a regular basis. Make a habit of performing daily checks before the start of each operating day.

#### **Yanmar Replacement Parts**

Yanmar recommends using genuine Yanmar parts when replacement parts are necessary. Genuine replacement parts help ensure long life.

#### **Tools Required**

Before starting any periodic maintenance procedure, make sure to have the tools needed to perform all of the required tasks on hand.

PERIODIC MAINTENANCE TABLE

○: User-maintenance   ◇: Parts replacement   ●: Shop-inspection

System Item	Daily	Weekly	Every 50 Hours	Every 100 Hours	Every 250 Hours	Every Year
Check the Stern Drive Oil Level (Reservoir), Fill if Necessary	Before Operation ○					
Check the Trim Pump Oil Level, Fill if Necessary	Before Operation ○					
Check the Power Steering Fluid, Fill if Necessary	Before Operation ○					
Check the Water Inlets for Debris or Marine Growth, Clean if Necessary		○				
Check the Seawater Inlet Hole, Clean if Necessary		○				
Inspect the Anodes and Replace if 50 percent eroded		○				
Replenish the Oil In Stern Drive		First Time Only ○				
Lubricate the Propeller Shaft and Retorque the Nut <sup>*</sup>				○		
Touch-Up the Stern Drive Paint and Spray with Corrosion Guard					○	○
Change the Stern Drive Oil			First Time Only ○		○	○
Retorque the Gimbal Ring to Steering Shaft Connection				○		○
Inspect the Bellows and the Clamps				○		○
Check the Engine Alignment				●		●
Lubricate the Unit Bearing (Gimbal Housing) and the Steering Shaft Bushing				○		○
Lubricate the Engine Coupler <sup>**</sup>			○	○		○
Check the Circuit for Loose or Damaged Connections				○		○
Test the Y-CaPS Output on ZT350/370				○		○
Check the Steering System for Loose, Missing or Damaged Parts and Lubricate				○		○
Check the Remote Control for Loose, Missing or Damaged Parts				○		○
Lubricate the Shift Cables and Linkages				○		○
Retorque the Rear Engine Mounts					○	○

\* If operating in only freshwater, this maintenance may be extended to every four months.

\*\* Lubricate engine coupler every 50 hours if operated at idle for prolonged periods of time.

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

### GENERAL INSPECTION

Inspect the stern drive at regular intervals to help maintain top operating performance and correct potential problems before they occur.

Check for loose, damaged or missing parts, hoses and clamps. Tighten or replace as needed.

Check the electrical connections and leads for damage and corrosion.

Remove and inspect the propeller. If it is badly nicked, bent or cracked replace the propeller.

Repair nicks and corrosion damage on stern drive exterior finish. Never use paint containing copper or tin. This will damage the stern drive and void the warranty. Use a high quality primer and topcoat paint specifically designed for aluminum outboards or stern drives. Follow the manufacturer's directions for surface preparation and application.

### PERIODIC MAINTENANCE PROCEDURES

#### Weekly

Perform the following procedures on a weekly basis.

- **Checking the Water Inlets**
- **Checking the Seawater Inlet Hole**
- **Inspecting the Anodes**
- **Checking the Oil Level**

#### ■ **Checking the Water Inlets**

Check the water inlets for debris or marine growth. Clean if necessary.

#### ■ **Checking the Seawater Inlet Hole**

Check the seawater inlet hole. Clean if necessary.

#### ■ **Inspecting the Anodes**

Inspect the anodes and replace if 50 % corroded.  
*See Corrosion Control Parts Diagram on page 13-4.*

#### ■ **Checking the Oil Level**

*See Checking, Filling and Changing Stern Drive Oil on page 4-4.*

**After Initial 50 Hours of Operation**

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

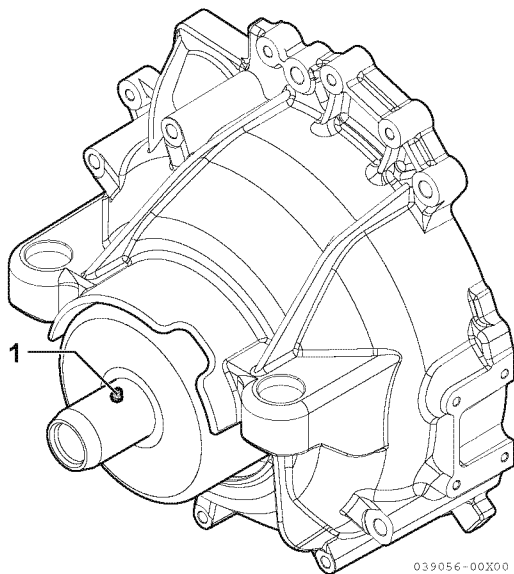
- Lubricating the Engine Coupler
- Changing the Stern Drive Oil

**■ Lubricating the Engine Coupler**

Lubricate the engine coupler every 50 hours if operated at idle for prolonged periods of time.

*Note: The stern drive may be equipped with a sealed engine coupler. The sealed coupler and shaft splines can be lubricated without removing the stern drive.*

Apply approximately 8 to 10 pumps of grease to the engine coupler grease fitting (1, **Figure 4-18**) to lubricate the engine coupler splines through the grease fittings, if equipped. Use a typical hand-operated grease gun to apply the grease.



**Figure 4-18**

Description	Where Used
Multi-Purpose Heavy-Duty Type Lithium Grease, NLGI #2	Coupler

*Note: Lubricate the coupler every 50 hours if the vessel is operated at idle for prolonged periods of time.*

**■ Changing the Stern Drive Oil**

See *Changing Stern Drive Oil* on page 4-6.

**Every 50 Hours of Operation**

Perform the following maintenance every 50 hours of operation.

- Lubricate the Engine Coupler

**■ Lubricate the Engine Coupler**

Lubricate the engine coupler every 50 hours if operated at idle for prolonged periods of time. See *Lubricating the Engine Coupler* on page 4-15.

## Every 100 Hours of Operation

Perform the following maintenance every 100 hours of operation.

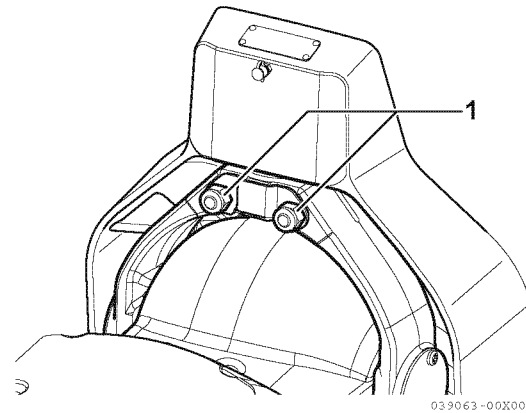
- Lubricating the Propeller Shaft and Retorquing the Nut
- Retorquing the Gimbal Ring to Steering Shaft Connection
- Inspecting the Bellows and the Clamps
- Checking the Engine Alignment
- Lubricating the Steering Shaft Bushing
- Lubricating the Unit Bearing (Gimbal Housing)
- Lubricating the Engine Coupler
- Checking the Electrical Circuit for Loose or Damaged Connections
- Testing the Y-CaPS Unit Output
- Checking the Steering System for Loose, Missing or Damaged Parts
- Lubricating the Drive Unit and Universal Joint Shaft Splines and O-Rings
- Torquing the Rear Engine Mount Bolts
- Checking the Remote Control for Loose, Missing or Damaged Parts
- Lubricating the Shift Cable and the Linkages

### ■ Lubricating the Propeller Shaft and Retorquing the Nut

If operating in only fresh water, this maintenance may be extended to every four months. See *Propeller Installation* on page 12-6.

### ■ Retorquing the Gimbal Ring to Steering Shaft Connection

Torque the gimbal ring locknuts (1, **Figure 4-19**) for the steering shaft connection.



**Figure 4-19**

Gimbal Ring Locknut Torque	
N·m	lb-ft
50	37

### ■ Inspecting the Bellows and the Clamps

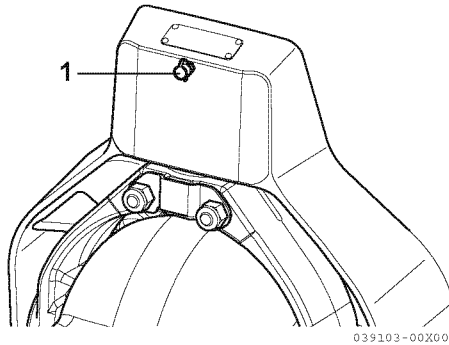
See *General Inspection* on page 4-14.

### ■ Checking the Engine Alignment

See *Stern Drive Driveshaft Alignment* on page 5-15 for engine alignment information.

**■ Lubricating the Steering Shaft Bushing**

Apply approximately 8 to 10 pumps of grease to the steering shaft bushing grease fitting (1, **Figure 4-20**). Use a typical hand-operated grease gun to apply the grease.

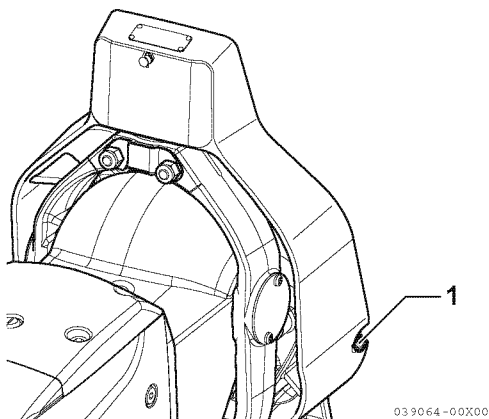


**Figure 4-20**

Description	Where Used
Urea Grease Water Resistant Type, NLGI #2	Steering Shaft Bushing

**■ Lubricating the Unit Bearing (Gimbal Housing)**

Apply approximately 8 to 10 pumps of grease to the unit bearing (gimbal housing) grease fitting (1, **Figure 4-21**) to lubricate the unit bearing (gimbal housing). Use a typical hand-operated grease gun to apply the grease.



**Figure 4-21**

Description	Where Used
Urea Grease Water Resistant Type, NLGI #2	Unit Bearing (Gimbal Housing)

**■ Lubricating the Engine Coupler**

See *Lubricating the Engine Coupler* on page 4-15.

**■ Checking the Electrical Circuits for Loose or Damaged Connections**

Check the electrical connections and leads for damage and corrosion.

**■ Testing the Y-CaPS Unit Output**

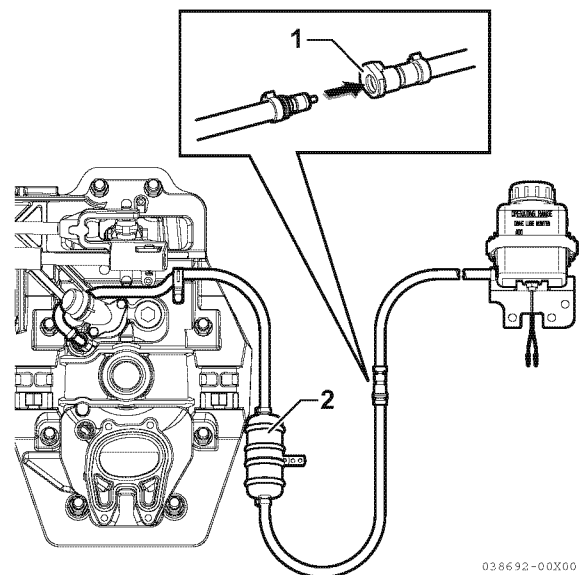
See *Yanmar Cathodic Protection System* on page 13-8.

**■ Checking the Steering System for Loose, Missing or Damaged Parts**

Check the steering system and tighten any loose parts and replace any missing or damaged parts.

**■ Lubricating the Drive Unit and Universal Joint Shaft Splines and O-Rings**

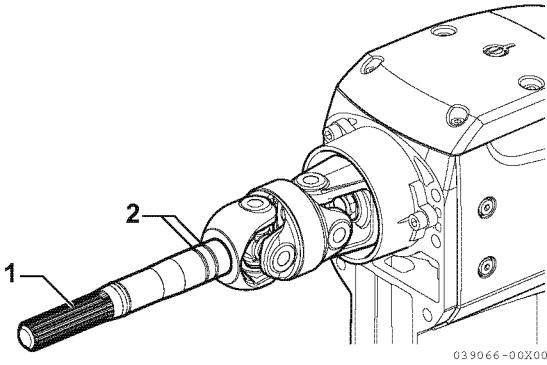
When you remove the stern drive unit from the transom assembly, you should first disconnect the oil reservoir hose (1, **Figure 4-22**) quick connect fitting. Use an approved container to catch the oil from the oil reservoir and the air separator (2, **Figure 4-22**).



**Figure 4-22**

# MAINTENANCE

Remove the drive unit and lubricate the universal joint shaft splines (1, **Figure 4-23**) and the O-rings (2, **Figure 4-23**).



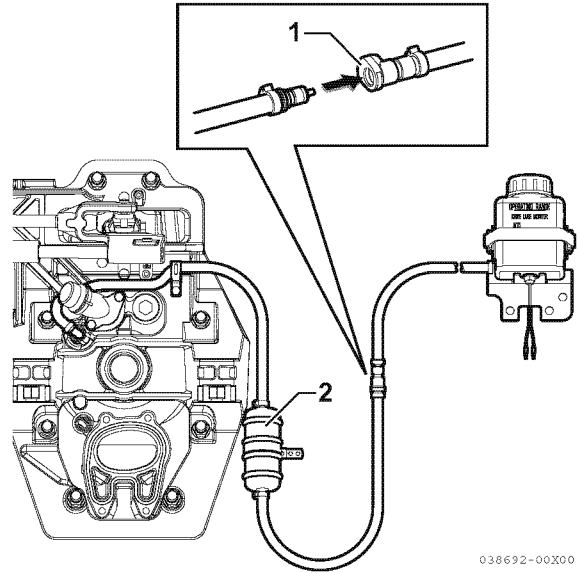
**Figure 4-23**

Description	Where Used
Multi-Purpose Heavy-Duty Type Lithium Grease, NLGI #2	Universal Joint Shaft Splines and O-Rings

Upon reassembly, reconnect the oil reservoir hose connector (1, **Figure 4-24**). Ensure the oil hose and air separator (2, **Figure 4-24**) hose connections are tight.

## NOTICE

The oil level in the reservoir may be incorrectly indicated if air becomes trapped in the oil. The air separator must be properly installed between the stern drive and the oil reservoir to prevent air from being trapped in the oil.

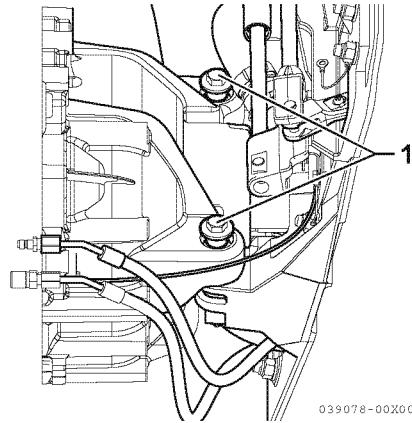


**Figure 4-24**

## ■ Torqueing the Rear Engine Mount Bolts

*Note: Refer to the Engine Installation Manual and/or Operation Manual for engine mount information.*

Torque the rear engine mount bolts (1, **Figure 4-25**).



**Figure 4-25**

Engine Rear Mount Bolt Torque	
N·m	lb-ft
45	33



**■ Checking the Remote Control for Loose, Missing or Damaged Parts**

Check the remote control for proper operation and loose or damaged hardware. Repair as needed.

**■ Lubricating the Shift Cable and the Linkages**

**▲ CAUTION**

**Loss of Control Hazard. Never grease the steering cable while extended. Hydraulic lock could occur and cause loss of steering control.**

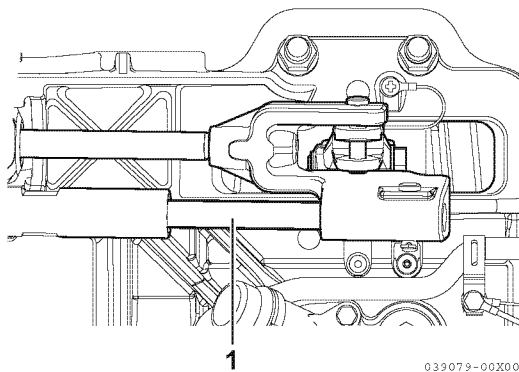
Grease the steering cable grease fitting.

1. Turn the steering wheel until the steering cable is fully retracted into the cable housing. Apply approximately three pumps of grease from a typical hand-operated grease gun.

*Note: If the steering cable does not have a grease fitting, the inner wire of the cable cannot be greased.*

Description	Where Used
Lithium Grease with PTFE	Steering Cable

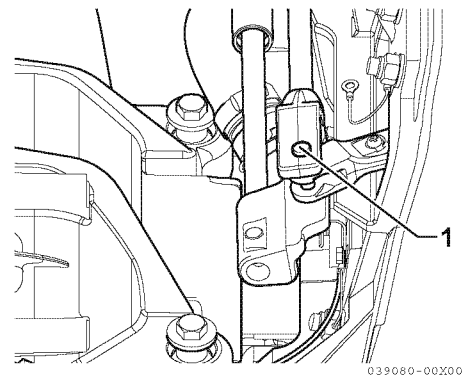
2. Turn the steering wheel until the steering cable (1, **Figure 4-26**) is fully extended. Lightly lubricate the exposed part of the cable.



**Figure 4-26**

Description	Where Used
Urea Grease Water Resistant Type, NLGI #2	Steering Cable

3. Lubricate the steering system clevis pin (1, **Figure 4-27**).



**Figure 4-27**

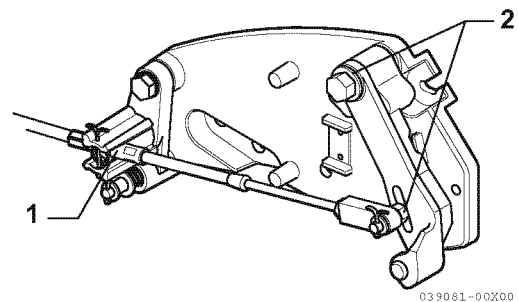
Description	Where Used
Urea Grease Water Resistant Type, NLGI #2	Clevis Pin

*Note: On dual engine vessels, lubricate the tie bar clevis pin.*

4. Before starting the engine, turn the steering wheel several times to starboard and then port to ensure that the steering system operates properly before getting underway.

**Lubricating the Shift Cable (Typical)**

Lubricate the shift cable pivot points (1, **Figure 4-28**) and the guide contact surfaces (2, **Figure 4-28**).



**Figure 4-28**

Description	Where Used
SAE 30W Engine Oil	Shift Cable Pivot Points
Lithium Grease with PTFE	Guide Contact Surfaces and Cable End

## Every 250 Hours of Operation

Perform the following maintenance every 250 hours of operation.

- **Touching Up the Stern Drive Paint and Spray with Corrosion Guard**
- **Retorquing the Rear Engine Mounts**
- **Changing the Stern Drive Oil**

### ■ **Touching Up the Stern Drive Paint and Spray with Corrosion Guard**

Corrosion damage that results from improper application of anti-fouling paint will not be covered by the warranty.

Painting vessel hull or vessel transom: Anti-fouling paint may be applied to the vessel hull and the vessel transom.

#### **NOTICE**

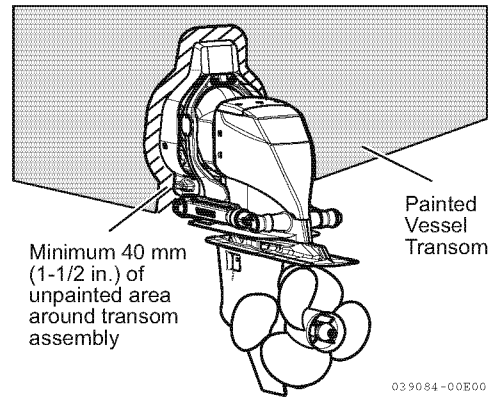
Avoid damaging the stern drive paint. Paint coverage provides corrosion protection. Always repair damaged paint areas immediately to avoid further paint damage and metal corrosion. Use a high quality primer and topcoat paint specifically designed for aluminum outboards or stern drives. Follow the manufacturer's directions for surface preparation and application.

#### **NOTICE**

Never paint the anodes or Y-CaPS electrode. Painting these components will render them ineffective as galvanic corrosion inhibitors.

#### **NOTICE**

Use copper-based paint as anti-fouling protection for the vessel hull or vessel transom, as long as it is not prohibited by law in the area where the vessel will be operated. If using copper- or tin-based anti-fouling paint, avoid an electrical interconnection between the Yanmar Product, Anodic Blocks, or Y-CaPS and the paint by allowing a minimum of 40 mm (1-1/2 in.) of UNPAINTED area on the transom of the vessel and around these items.



**Figure 4-29**

#### **NOTICE**

The drive unit and transom assembly can be painted with a good quality marine paint or an anti-fouling paint that does not contain copper or any other material that could conduct electrical current. Never paint drain holes, anodes, Y-CaPS or items specified by the vessel manufacturer.

#### **NOTICE**

Never wash the stern drive with a power washer because it can damage the coating on the reference wire and increase corrosion.

### ■ **Retorquing the Rear Engine Mounts**

*See Torqueing the Rear Engine Mount Bolts on page 4-18.*

### ■ **Changing the Stern Drive Oil**

*See Changing Stern Drive Oil on page 4-6.*

## Every Year

Perform the following maintenance every year of operation.

- Retorquing the Gimbal Ring to Steering Shaft Connection
- Inspecting the Bellows and the Clamps
- Checking the Engine Alignment
- Lubricating the Unit Bearing (Gimbal Housing)
- Lubricating the Engine Coupler
- Checking the Circuit for Loose or Damaged Connections
- Testing the Y-CaPS Unit Output
- Checking the Steering System for Loose, Missing or Damaged Parts
- Checking the Remote Control for Loose, Missing or Damaged Parts
- Lubricating the Cable and the Linkages
- Touching Up the Stern Drive Paint and Spray with Corrosion Guard
- Changing the Stern Drive Oil
- Retorquing the Rear Engine Mounts

### ■ Retorquing the Gimbal Ring to Steering Shaft Connection

See *Retorquing the Gimbal Ring to Steering Shaft Connection* on page 4-16.

### ■ Inspecting the Bellows and the Clamps

See *General Inspection* on page 4-14.

### ■ Checking the Engine Alignment

See *Stern Drive Driveshaft Alignment* on page 5-15.

### ■ Lubricating the Unit Bearing (Gimbal Housing)

See *Lubricating the Unit Bearing (Gimbal Housing)* on page 4-17.

### ■ Lubricating the Engine Coupler

See *Lubricating the Engine Coupler* on page 4-15.

### ■ Checking the Circuit for Loose or Damaged Connections

See *Checking the Electrical Circuits for Loose or Damaged Connections* on page 4-17.

### ■ Testing the Y-CaPS Unit Output

See *Yanmar Cathodic Protection System* on page 13-8.

### ■ Checking the Steering System for Loose, Missing or Damaged Parts

See *Checking the Steering System for Loose, Missing or Damaged Parts* on page 4-17.

### ■ Checking the Remote Control for Loose, Missing or Damaged Parts

Check the remote control for proper operation and loose or damaged hardware. Repair as needed.

### ■ Lubricating the Cable and the Linkages

See *Lubricating the Shift Cable (Typical)* on page 4-19.

### ■ Touching Up the Stern Drive Paint and Spray with Corrosion Guard

See *Touching Up the Stern Drive Paint and Spray with Corrosion Guard* on page 4-20.

### ■ Changing the Stern Drive Oil

See *Changing Stern Drive Oil* on page 4-6.

### ■ Retorquing the Rear Engine Mounts

See *Torqueing the Rear Engine Mount Bolts* on page 4-18.

## MAINTENANCE

### COLD WEATHER (FREEZING TEMPERATURE), SEASONAL AND EXTENDED STORAGE

#### NOTICE

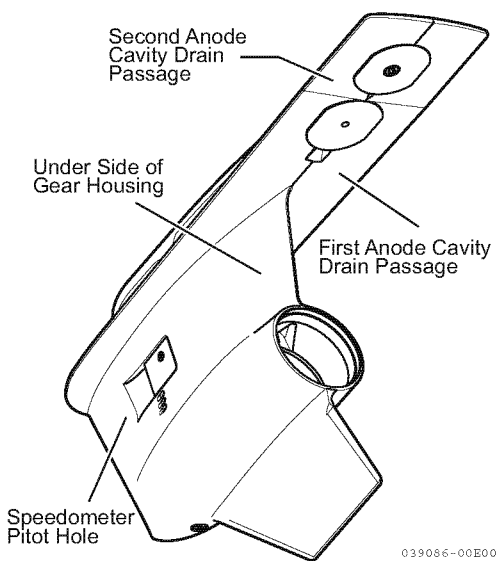
Damage caused by freezing IS NOT covered by the Yanmar Warranty.

### Stern Drive Recommissioning

1. Carefully inspect the stern drive for leaks.
2. Check the steering system, shift and throttle control for proper operation.

### Stern Drive Lay-Up

1. Use a piece of wire to check the water drain passages in the drive unit to ensure that they are open.



**Figure 4-30**

2. Change the stern drive oil. See *Changing Stern Drive Oil* on page 4-6.
3. Perform all other checks, inspections, lubrication and fluid changes.

#### NOTICE

The stern drive should be stored in the FULL DOWN/TRIM-IN position. The universal joint bellows may develop a set if the unit is stored in the raised position and may fail when the stern drive is returned to service.

Place the stern drive in the full DOWN/TRIM-IN position.

## Section 5

# STERN DRIVE

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	<b>Page</b>
Safety Precautions .....	5-3
Introduction.....	5-3
Component Identification.....	5-3
Stern Drive Removal from Transom Assembly .....	5-4
Stern Drive Installation to Transom Assembly .....	5-9
Stern Drive Driveshaft Alignment .....	5-15
Driveshaft Housing and Gear Housing Disassembly .....	5-17
Driveshaft Housing and Gear Housing Assembly .....	5-18

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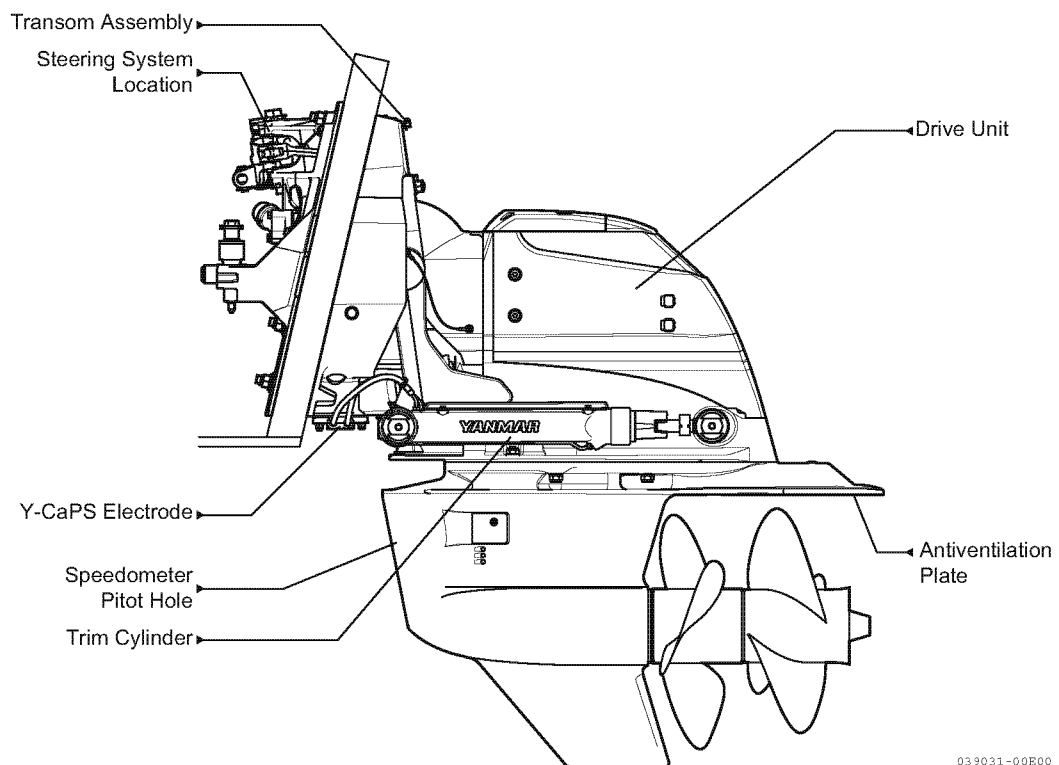
## SAFETY PRECAUTIONS

Before servicing the stern drive, review *Safety on page 2-1*.

## INTRODUCTION

This section of the *Service Manual* describes the procedures necessary to remove and install the stern drive and the procedures to separate and assemble the gear housing and driveshaft housing.

## COMPONENT IDENTIFICATION



03 9031-00E00

**Figure 5-1**

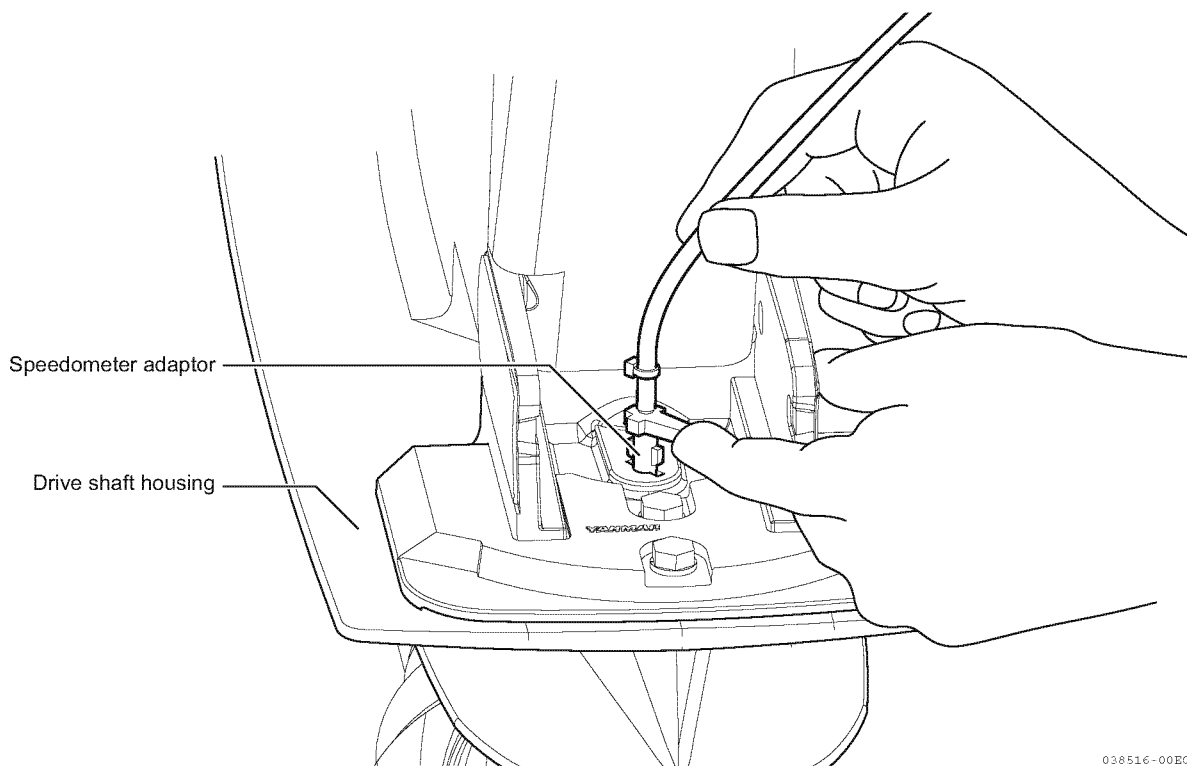
## STERN DRIVE

### STERN DRIVE REMOVAL FROM TRANSOM ASSEMBLY

Before removing the stern drive: (Speedometer Adaptor used for ZT350 only)

- Disconnect the shift harness, or shift cable from the shift plate.
- Close the oil valve.
- Disconnect the quick connector from the oil tank hose.
- Disconnect all other electrical connections, such as the YCaPS, trim limit and sender wires, etc.

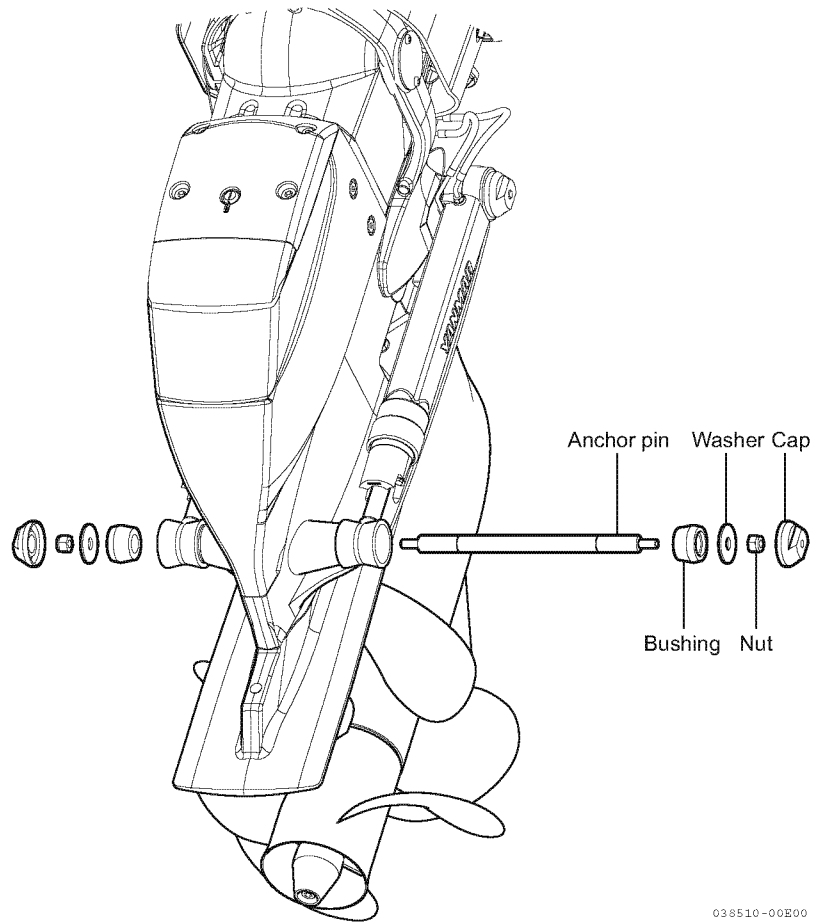
1. Remove the speedometer hose and adaptor, as shown in **Figure 5-2**.



**Figure 5-2**



2. Remove the tilt/trim cylinder anchor pin and hardware, as shown in **Figure 5-3**.

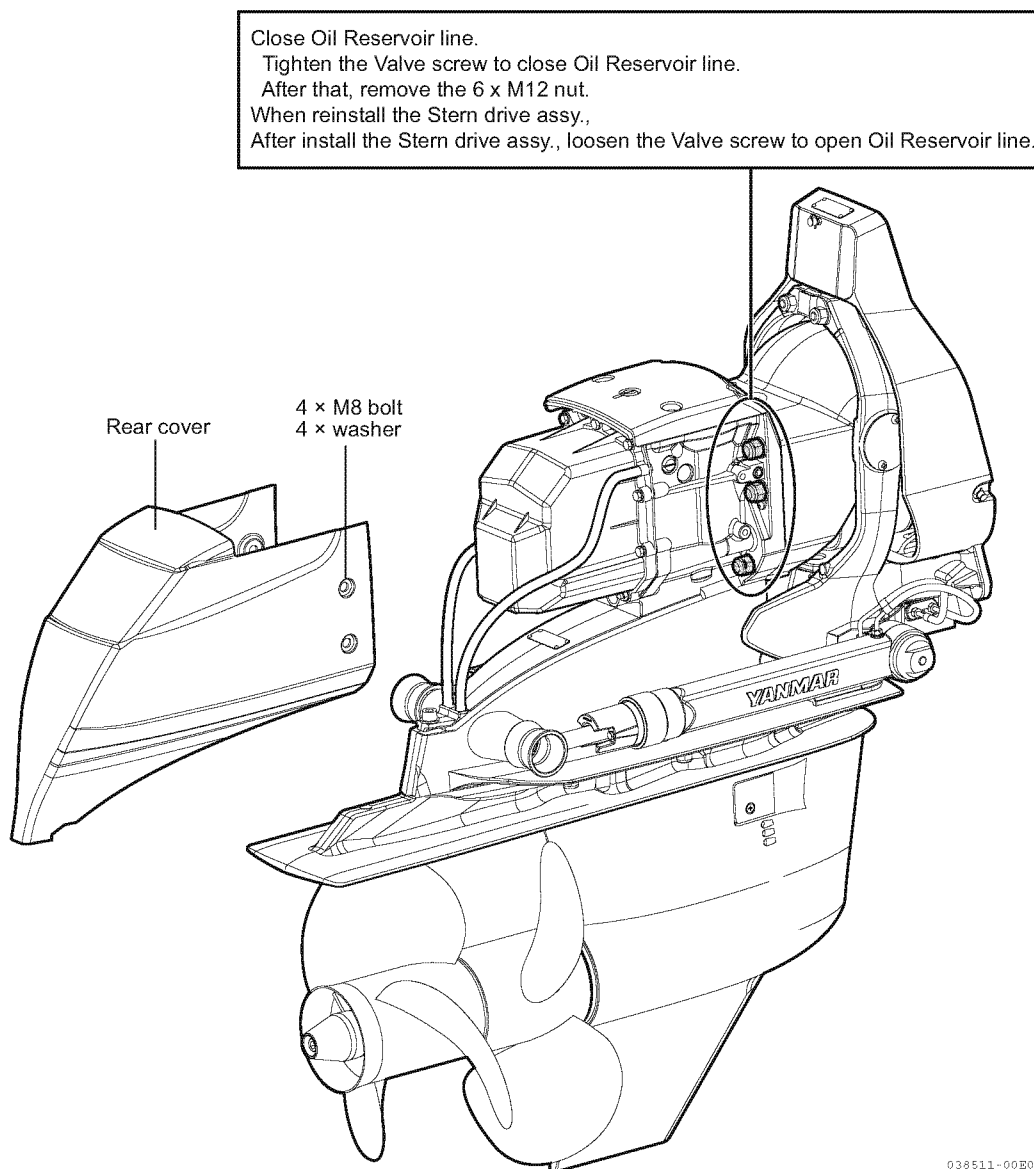


038510-00E00

**Figure 5-3**

## STERN DRIVE

3. Remove the rear cover bolts, washers and rear cover, as shown in **Figure 5-4**.



**Figure 5-4**

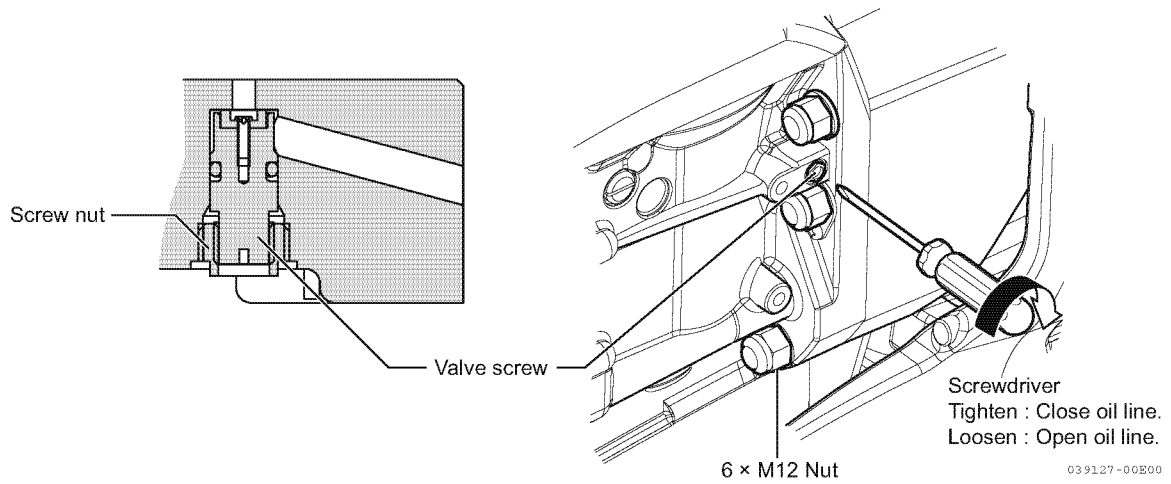
4. Tighten the valve screw to close the oil reservoir line, as shown in **Figure 5-5**. If the oil valve screw nut turns when turning the oil valve screw, hold the nut with a wrench while turning the valve screw. Do not allow the valve screw nut to turn.

### **NOTICE**

ONLY close the oil valve screw when removing the stern drive. The oil valve screw must be open during normal operation and before checking the stern drive oil level. Open the oil valve screw (approximately 2 turns).

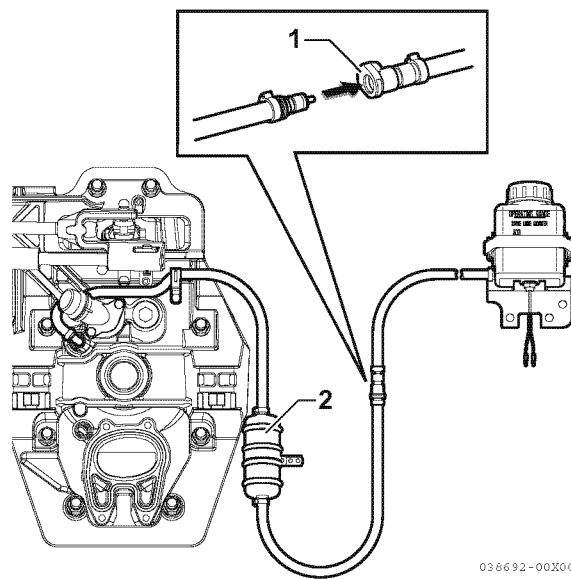
*Note: Clockwise tighten = close  
Counterclockwise loosen = open  
Avoid overtightening, hand-tighten only.*

- Remove the stern drive mounting nuts.



**Figure 5-5**

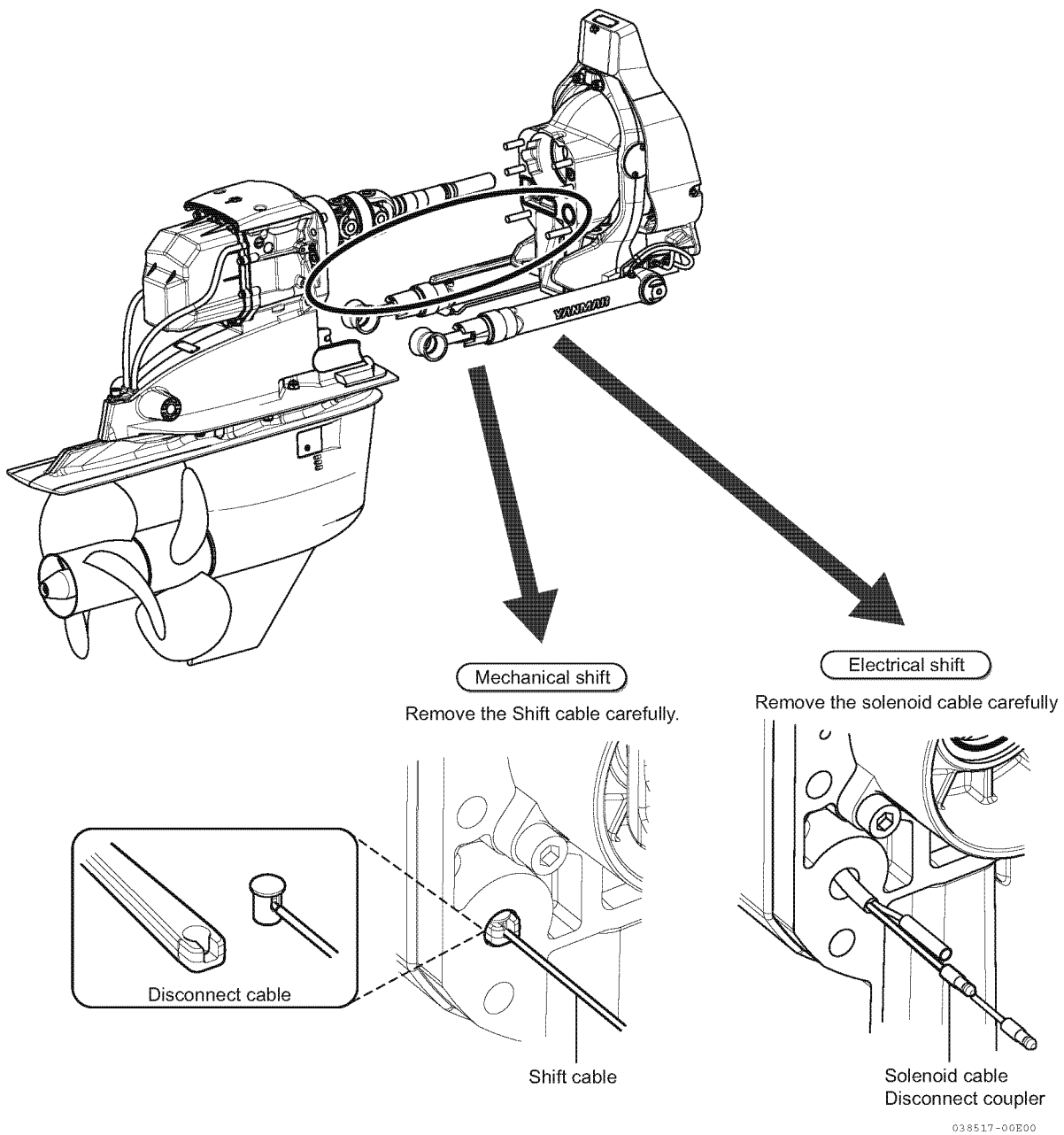
- Disconnect the oil reservoir hose connector (1, **Figure 5-6**). Drain the oil from oil reservoir and air separator (2, **Figure 5-6**) into an approved container.



**Figure 5-6**

## STERN DRIVE

7. Carefully separate the stern drive from the transom assembly, just enough to disconnect the shift cable or electrical shift leads (depending on model), as shown in **Figure 5-7**.

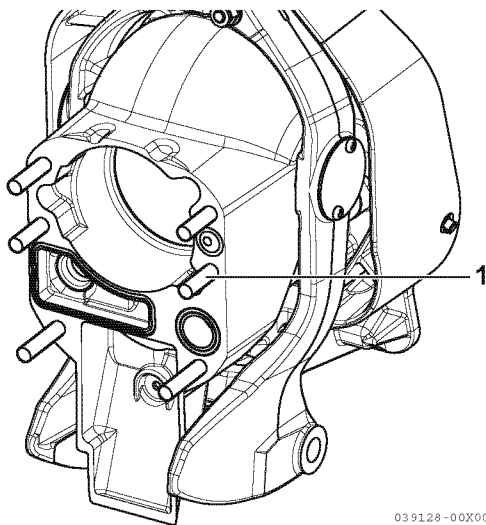


**Figure 5-7**

8. Remove the stern drive assembly and mount in a suitable bench stand.

# STERN DRIVE INSTALLATION TO TRANSOM ASSEMBLY

1. Apply lubricant to the threads of the bell housing studs (Qty.6) (1, **Figure 5-8**).



**Figure 5-8**

Lithium Grease with PTFE	
Where Used	Part Number
Bell Housing Studs	Obtain Locally

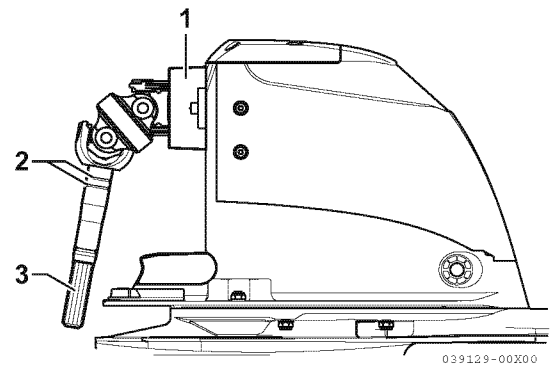
**NOTICE**

Yanmar recommends applying multipurpose, heavy-duty type grease to the drive unit pilot to help prevent corrosion.

2. Lubricate the drive unit pilot (1, **Figure 5-9**), U-joint shaft O-rings (2, **Figure 5-9**) and drive shaft splines (3, **Figure 5-9**).

**NOTICE**

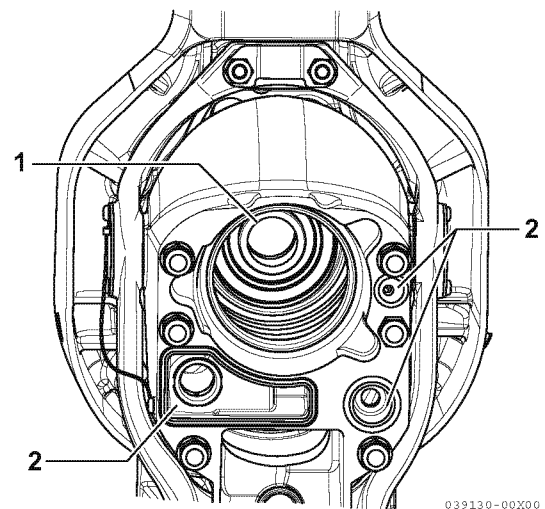
Use new U-joint shaft O-rings each time the drive unit is installed.



**Figure 5-9**

Multipurpose Heavy-Duty Type Grease NLGI #2	
Where Used	Part Number
Drive Unit Pilot	Obtain Locally
U-Joint Shaft O-Rings	
Drive Shaft Splines	

3. Ensure that the drive shaft U-joint bellows (1, **Figure 5-10**) are clean and free of debris. Apply lubricant to O-ring seals (2, **Figure 5-10**).

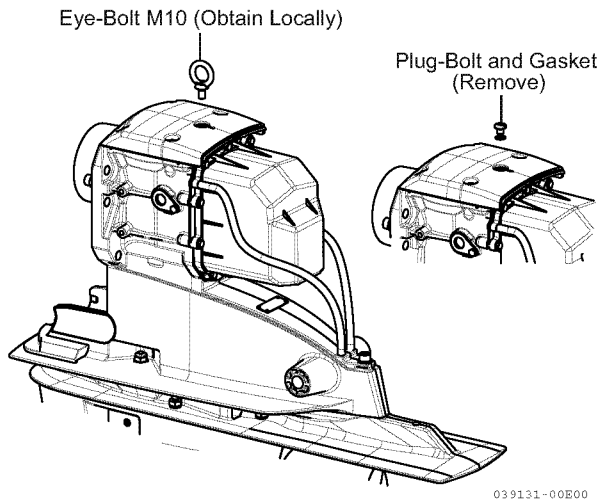


**Figure 5-10**

Lithium Grease with PTFE	
Where Used	Part Number
O-Ring Seals	Obtain Locally

## STERN DRIVE

4. Lift the drive unit by using the eye-bolt (Figure 5-11) mounted on the top cover.



**Figure 5-11**

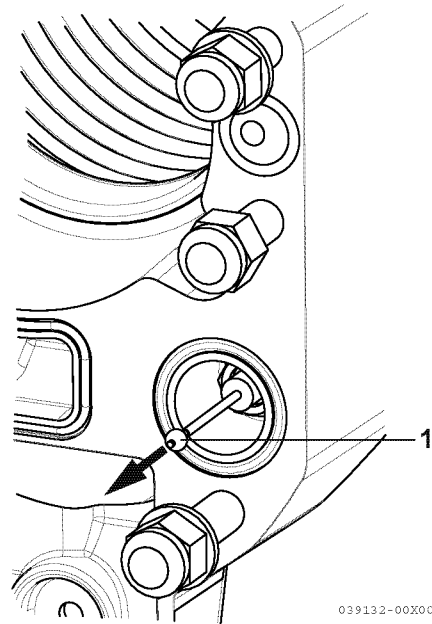
### NOTICE

As the drive unit is inserted into the bell housing, the shift cable must be connected to the jaws of the shift linkage assembly in the drive unit.

5. Connect Shift Cable:

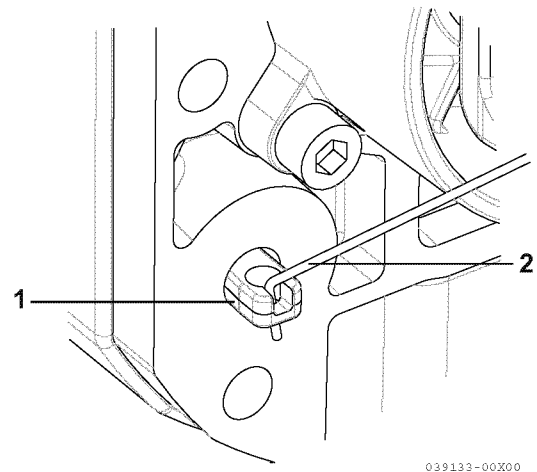
### ● Mechanical Shift Type

- 1- Pull the shift cable (1, Figure 5-12) out as far as it moves by hand.



**Figure 5-12**

- 2- Pull the slider (shift linkage) (1, Figure 5-13) out as far as it goes with a piece of wire (obtain locally) (2, Figure 5-13).



**Figure 5-13**

- 3- Follow steps 1, 2 and 3 (Figure 5-14) to connect the cable to the slider (shift linkage).

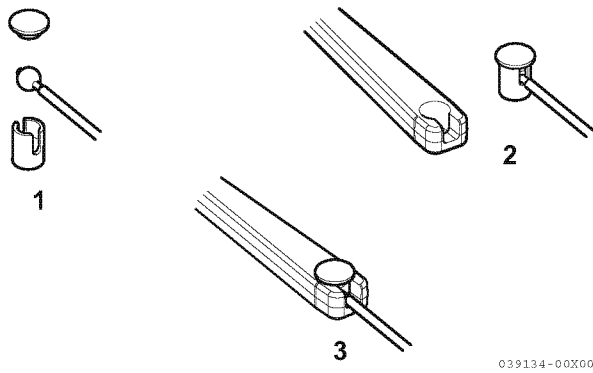


Figure 5-14

- 4- After the cable is connected, push it into the inside of the housing.

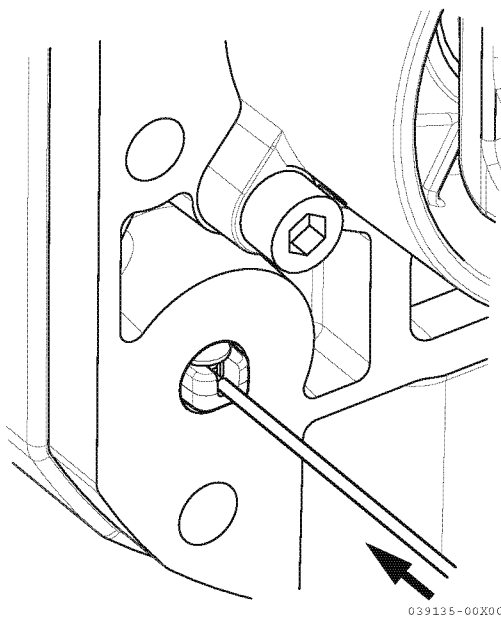


Figure 5-15

● Electric Shift Type

**NOTICE**

Do not pull the connector wire from the driveshaft housing out more than 20 mm, the connector does not expand or contract.

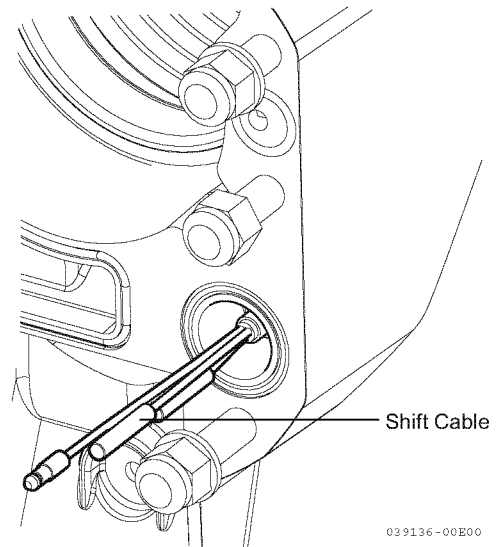


Figure 5-16

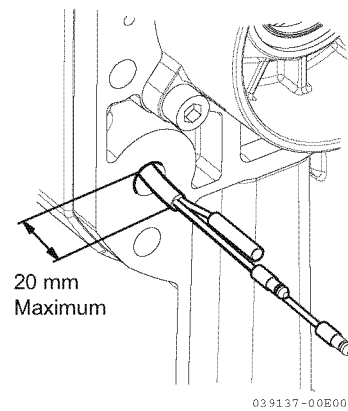
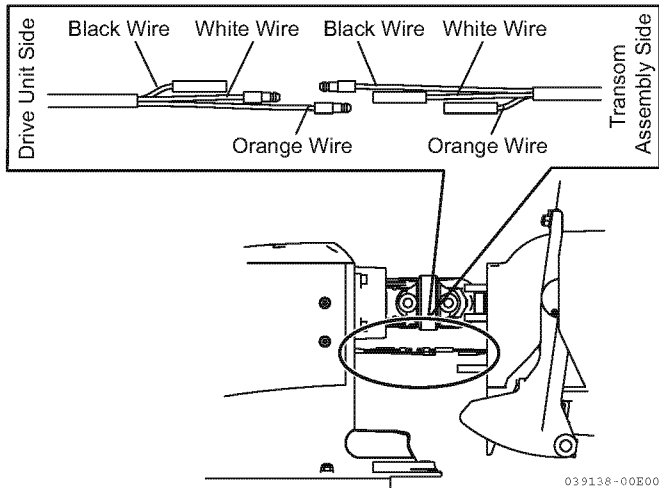


Figure 5-17

# STERN DRIVE

- 1- Connect the wires that are the same color.

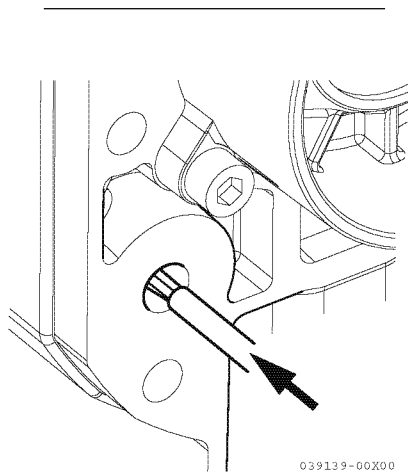


**Figure 5-18**

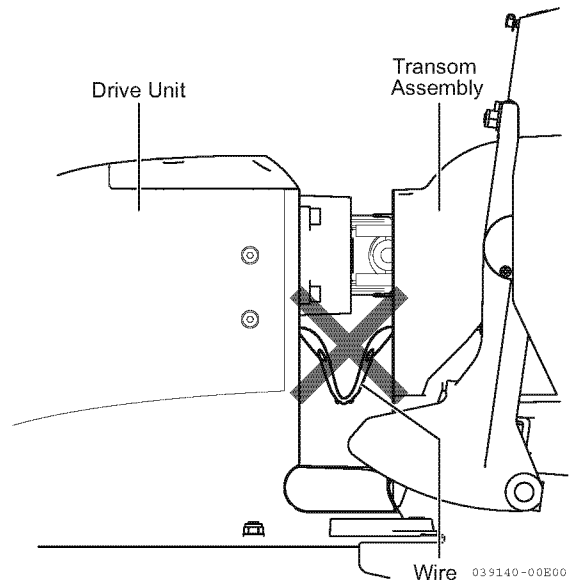
- 2- After the cable is connected, push it into the housing.

## NOTICE

Make sure the cable is not caught in the transom assembly and the drive unit.

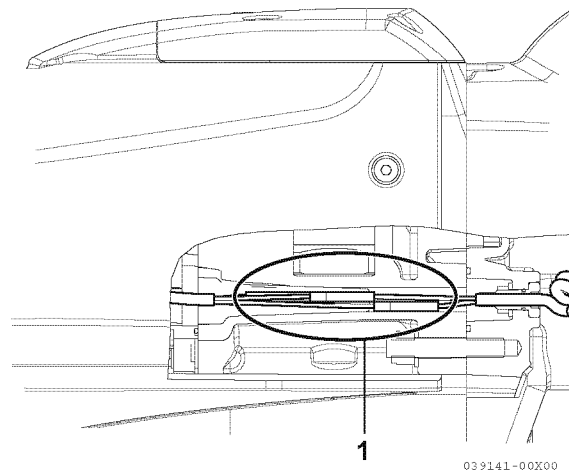


**Figure 5-19**



**Figure 5-20**

- 3- See (1, **Figure 5-21**) for location of connectors after the drive unit has been installed.



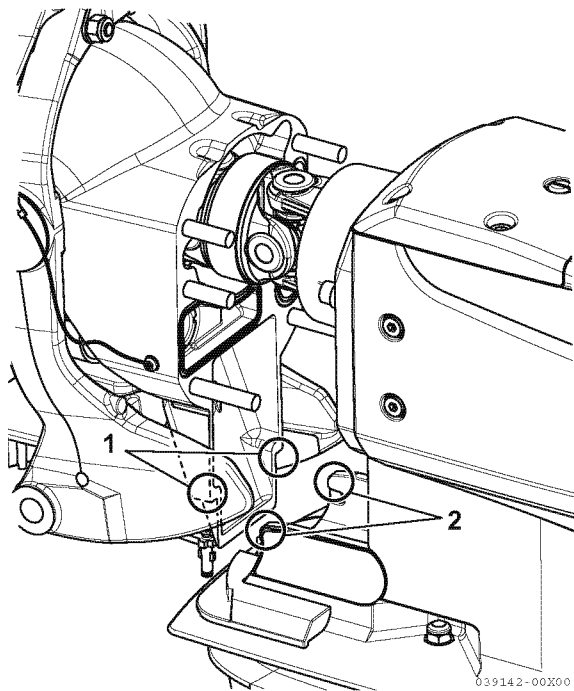
**Figure 5-21**



6. Place the drive unit in position on the bell housing and install as follows:
  - Position the trim cylinders so that they point straight back.
  - Position the drive unit so that the U-joint shaft aligns with the bell housing bore.
  - Guide the U-joint shaft through the bearing in the gimbal housing and into the engine coupler. Make sure that the slider engages the bell housing shift cable assembly.

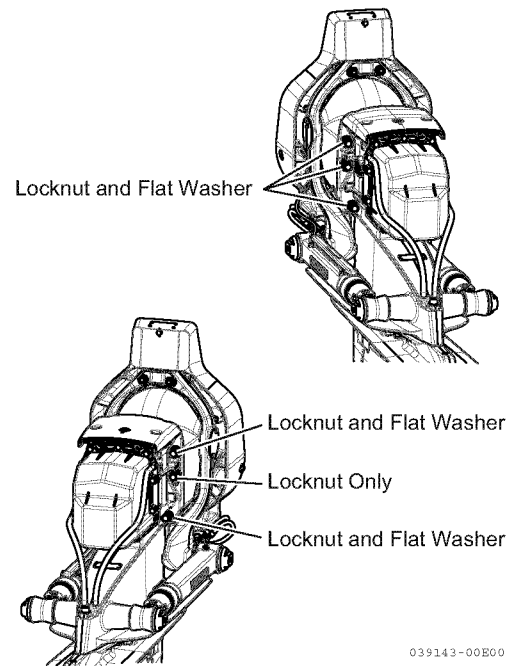
## NOTICE

Do not allow the edge of the bell housing (1, **Figure 5-22**) and the edge of the drive shaft housing (2, **Figure 5-22**) on the stern drive to contact when installing the stern drive.



**Figure 5-22**

- Slide the drive unit all the way into the bell housing.
- Secure the drive unit to the bell housing with five flat washers and six locknuts.



**Figure 5-23**

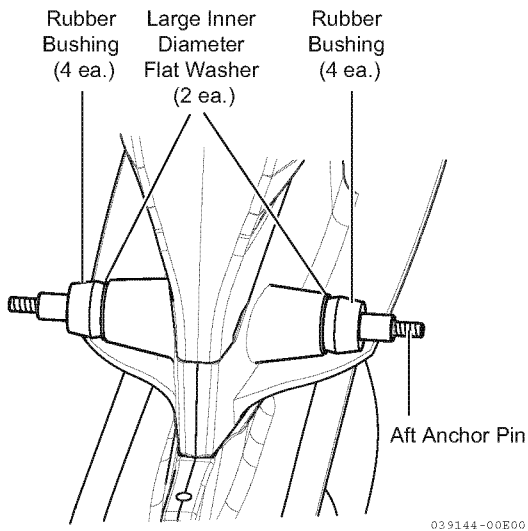
- Torque the drive unit locknuts.

Drive Unit Locknut Torque	
N·m	lb·ft
60	44

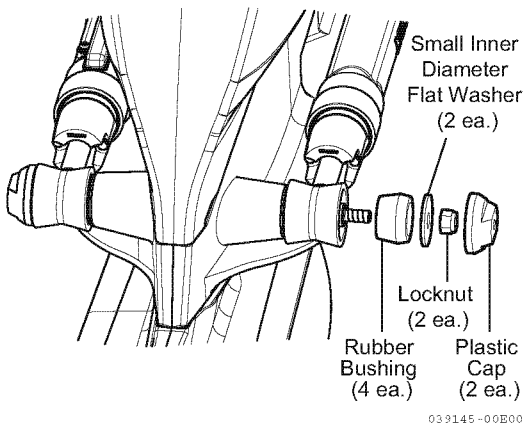
## NOTICE

Avoid damaging the stern drive paint. Paint coverage provides corrosion protection. Always repair damaged paint areas immediately to avoid further paint damage and metal corrosion.

7. Remove the eye-bolt from the top cover and replace the plug and washer to prevent corrosion.
8. Apply lubricant to all of the components (except plastic caps) during installation.
9. Install the trim cylinders on the aft end of the drive unit with the hardware as illustrated.
10. Tighten the locknuts until the washer and nut contact the shoulder on the anchor pin.
11. Install the plastic caps and hand-tighten.



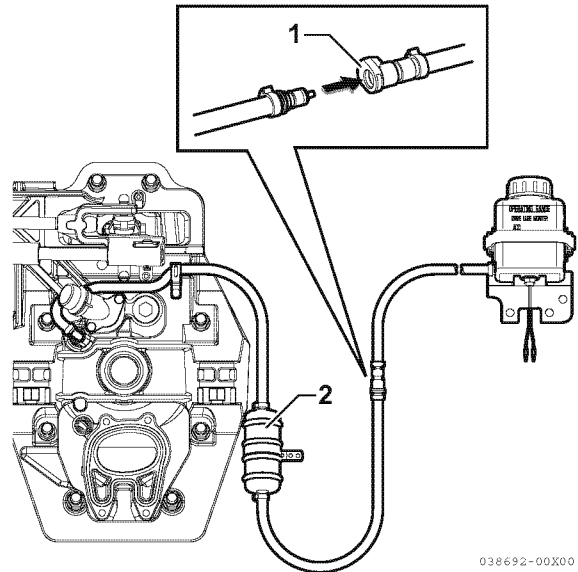
**Figure 5-24**



**Figure 5-25**

Lithium Grease with PTFE	
Where Used	Part Number
Anchor Pin Threads	Obtain Locally

12. Connect the oil reservoir hose connector (1, **Figure 5-26**). Ensure the oil hose and air separator (2, **Figure 5-26**) hose connections are tight.



**Figure 5-26**

13. Fill the oil reservoir. See *Filling Stern Drive Oil Reservoir* on page 4-6.

### NOTICE

After installation, while holding the oil valve screw jam nut, loosen the valve screw to open the oil reservoir line.

*Note: Clockwise tighten = close  
Counterclockwise loosen = open  
Avoid overtightening, hand tighten only.*

### NOTICE

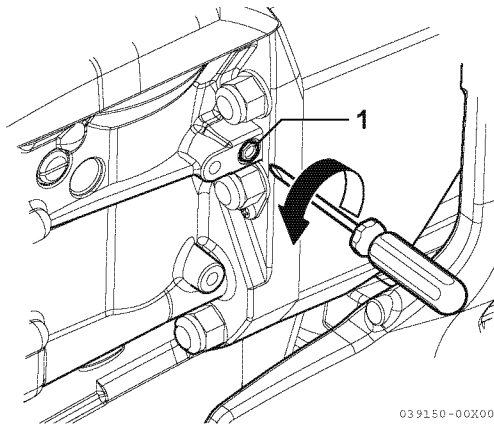
The oil valve screw (1, **Figure 5-27**) must be open during normal operation and before checking the stern drive oil level. Open the oil valve screw (approximately 2 turns).

## STERN DRIVE DRIVESHAFT ALIGNMENT

### ⚠ CAUTION

#### Tool Hazard

Avoid drive unit damage. Use the Yanmar Alignment Tool Only. Alignment tools other than the Yanmar Alignment Tool may cause damage to the gimbal bearing, the engine coupler, or both.



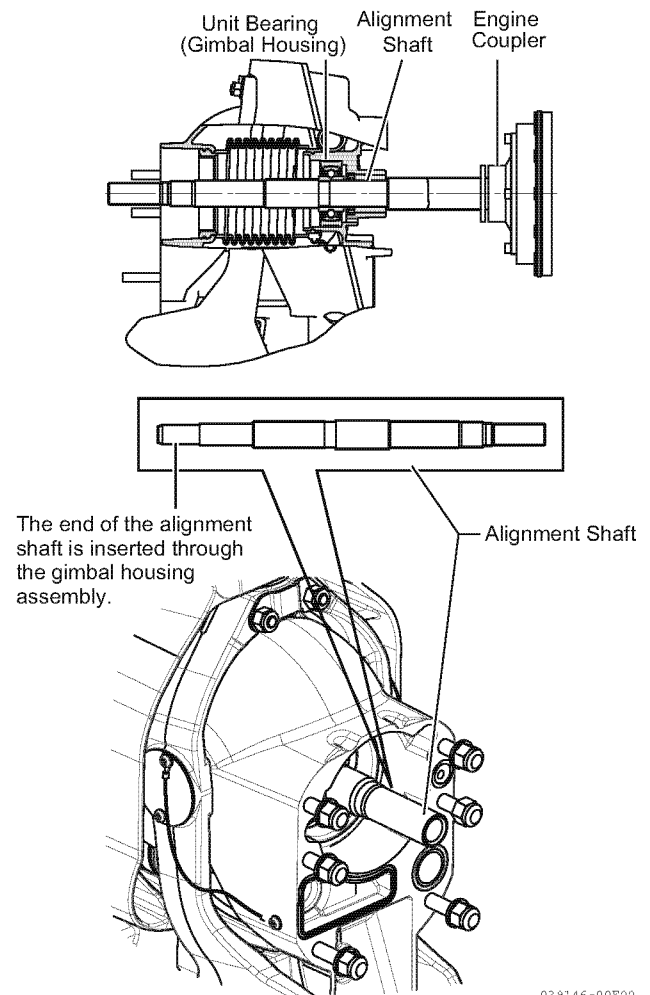
**Figure 5-27**

- After installation, check the stern drive oil level and stern drive oil reservoir level before starting the engine. See *Checking Stern Drive Oil Reservoir Level* on page 4-4 and *Checking Stern Drive Oil Level* on page 4-5.

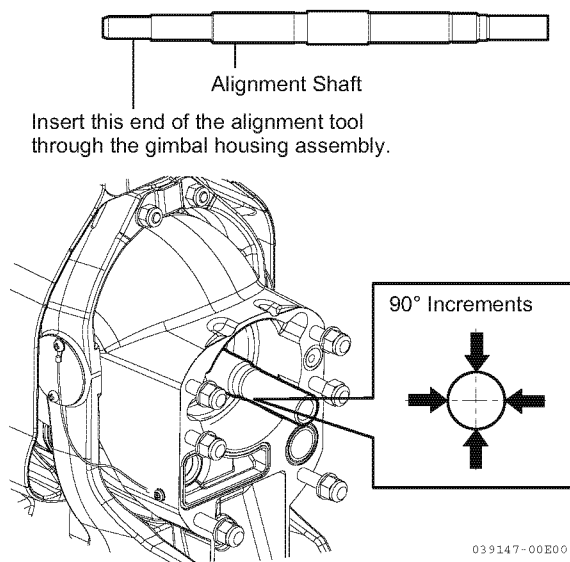
### NOTICE

Avoid damaging the stern drive paint. Paint coverage provides corrosion protection. Always repair damaged paint areas immediately to avoid further paint damage and metal corrosion. Use a high quality primer and topcoat paint specifically designed for aluminum outboards or stern drives. Follow the manufacturer's directions for surface preparation and application.

1. Attempt to insert the solid end of the Alignment Tool (Special Tool 196350-92010) through the gimbal bearing and into the engine coupler splines. If necessary, hit the sides of the Alignment Tool with a soft mallet at 90° increments to help align the gimbal bearings to the coupler.



**Figure 5-28**



**Figure 5-29**

- If the Alignment Tool does not fit, remove it and carefully adjust engine mounts as necessary.

## NOTICE

Turn both front engine mount adjustment nuts an equal amount in the direction required to align the engine.

To Adjust the Engine Up or Down:

- Loosen locknuts on mounts.
- Turn adjusting nuts as necessary.
- Temporarily tighten locknuts.

To Move the Engine to the Left or Right:

- The locknuts on mounts should be loose.
- Move the engine in the slotted mount holes as necessary, if equipped.

- Attempt to insert the solid end of the Alignment Tool through the gimbal bearing and into the engine coupler splines again.
- On models where the front engine mounts cannot be lowered enough to allow for proper engine alignment:
  - Attach a sling and lifting arm to the engine lifting eyes and adjust so that the engine is level when suspended.
  - Remove the rear engine mounting bolts and hardware.

- Use an overhead hoist to lift the engine enough to install the stainless steel washer inside the inner diameter of both fiber washers.

*Note: This will position the washer between the new engine mount and the transom mounting support, which should raise the engine slightly, resulting in additional front mount adjustment.*

- Install both rear engine mounting bolts with hardware as illustrated.
  - Set the engine on the stringers.
  - Relieve the hoist tension.
  - Disconnect the sling from the engine lifting eyes.
  - Insert the solid end of the Alignment Tool through the gimbal bearing and into the engine coupler splines.
- Repeat this process until the Alignment Tool installs easily (slides freely with two fingers) all the way into and out of engine coupler splines. Never twist the alignment tool into position.
- Torque the rear engine mount bolts.

Rear Engine Mount Bolts	
N·m	lb·ft
45	33

- Fasten the front mount assemblies to the boat stringers using appropriate hardware (per manufacturer's design specifications).
  - Torque both front mount locking nuts.
  - Recheck alignment with the Alignment Tool.

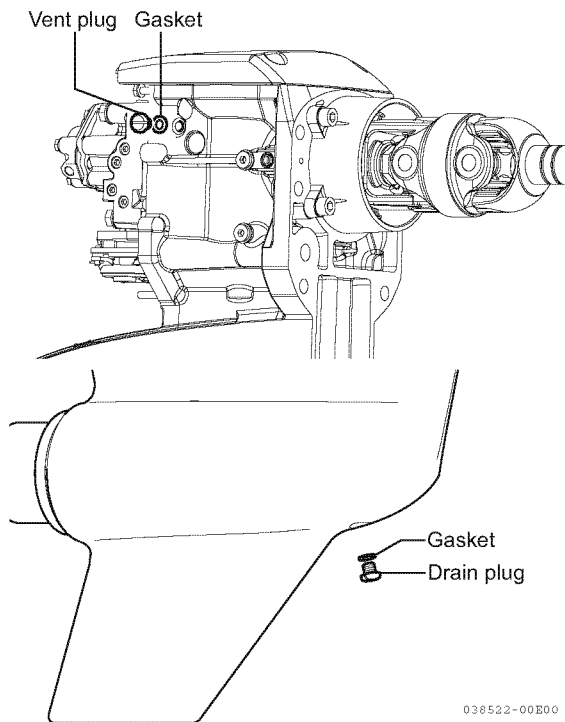
## NOTICE

The Alignment Tool must enter the coupler splines freely. If not, remove the Alignment Tool and readjust the alignment.

- Remove the Alignment Tool when alignment is complete.
- If operating in a saltwater environment, apply sealant to the threads and nuts of the engine mounting hardware to help protect against corrosion. This will allow for easier loosening in the future.
- Ensure that all hardware is properly installed.

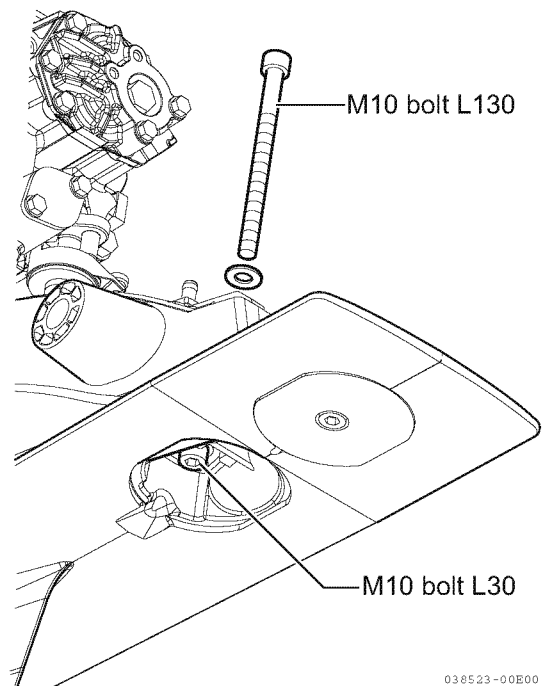
## DRIVESHAFT HOUSING AND GEAR HOUSING DISASSEMBLY

1. Mount the stern drive assembly in a suitable bench stand.
2. Remove the vent plug and gasket from the driveshaft housing and the drain plug and gasket from the gear housing.
3. Drain the oil into a suitable container.



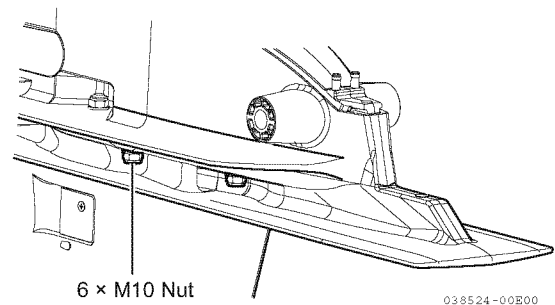
**Figure 5-30**

4. Remove the upper and lower rear mounting bolts, as shown in **Figure 5-31**.



**Figure 5-31**

5. Remove the driveshaft housing mounting nuts, as shown in **Figure 5-32**.



**Figure 5-32**

### DRIVESHAFT HOUSING AND GEAR HOUSING ASSEMBLY

Perform the driveshaft housing to gear housing assembly in the reverse order of disassembly with the following notes.

- During assembly, apply liquid gasket (seawater resistance) Three Bond® 1101 or equivalent to bolt thread.
- After installation, torque the driveshaft housing mounting nuts to 33 to 37 N·m (292 to 327 lb-in.).

## Section 6

# DRIVESHAFT HOUSING

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## DRIVESHAFT HOUSING

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### **SAFETY PRECAUTIONS**

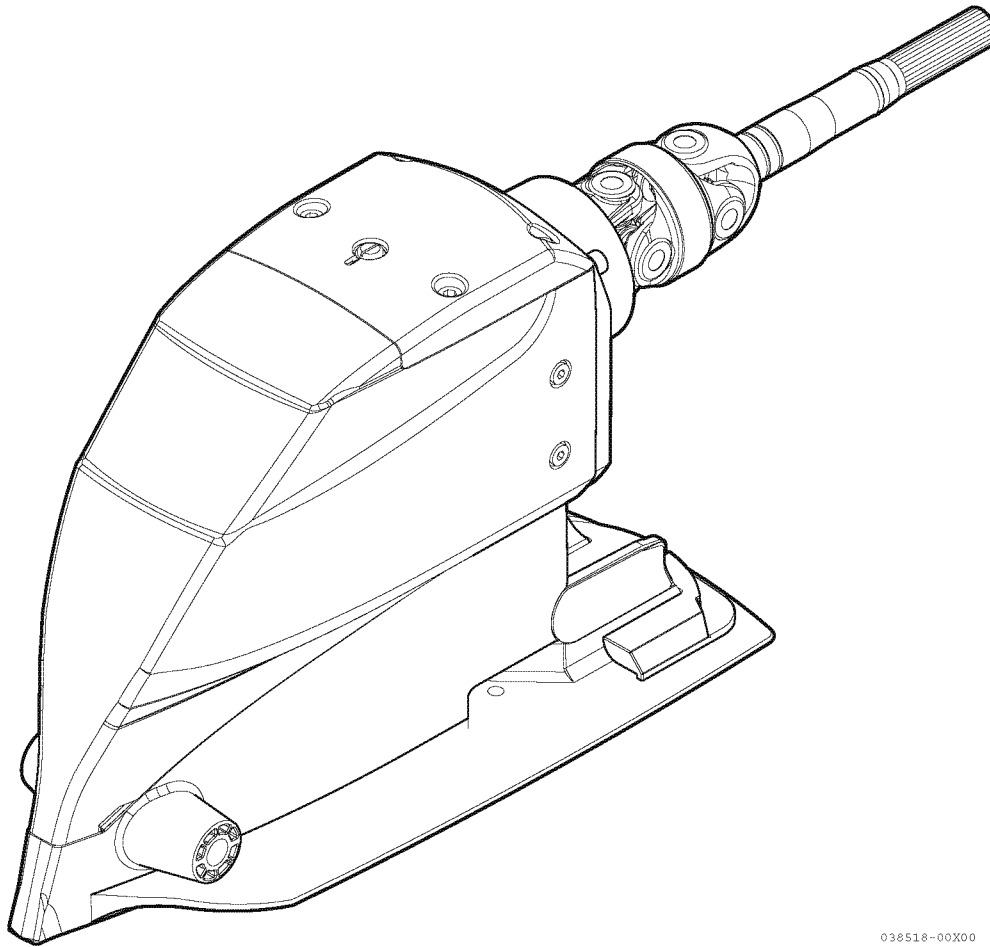
Before servicing the stern drive, review *Safety on page 2-1*.

### **INTRODUCTION**

This section of the *Service Manual* describes the procedures necessary to disassemble and assemble the driveshaft housing.

GENERAL VIEWS

External View



038518-00X00

*Figure 6-1*

Cross Section View

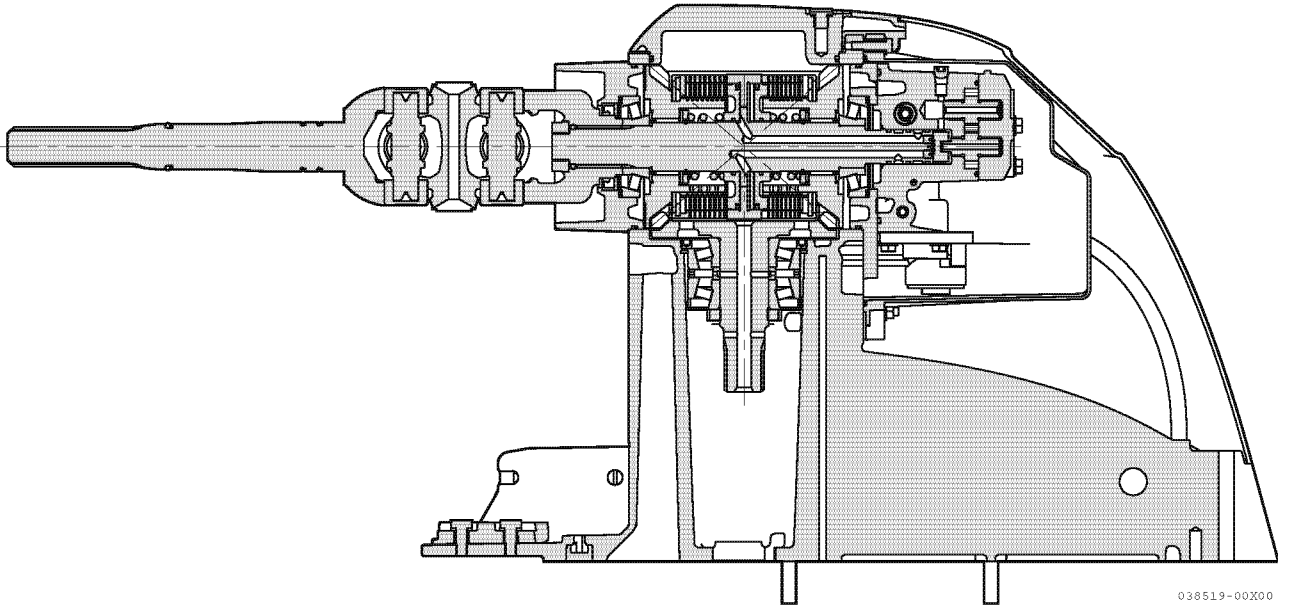
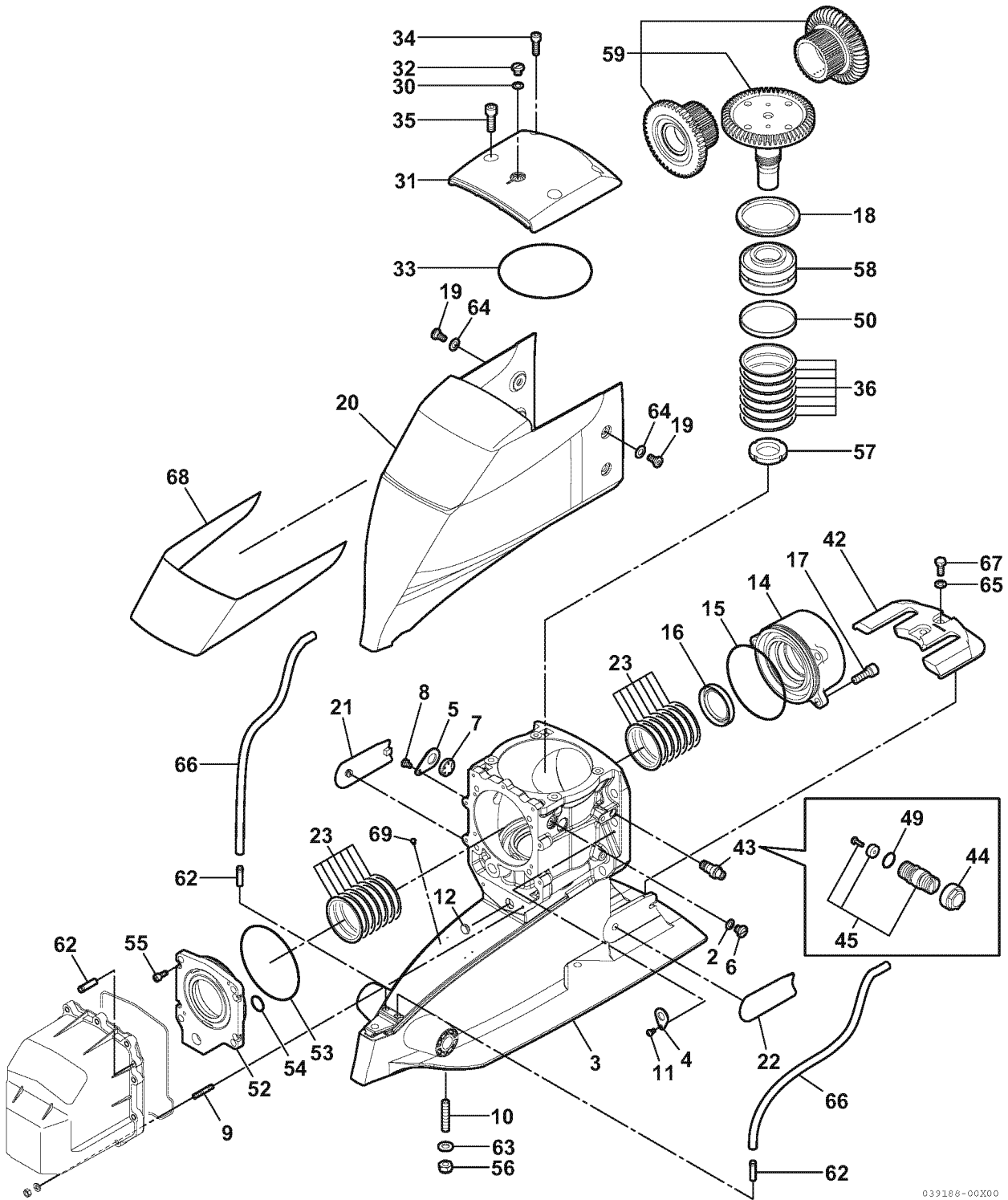


Figure 6-2

DRIVESHAFT HOUSING PART DIAGRAMS

Driveshaft Housing and Drive Gear



039188-00X00

Figure 6-3

# DRIVESHAFT HOUSING

Item	Part Number	Description	ZT350	ZT370	N/O
2	189010-01130	Gasket	1	1	
3	196350-02021	D.S. Housing	1	1	
4	196350-02100	Ground Plate	1	1	
5	196350-02320	Cover Oil Level	1	1	
6	196324-02420	Plug	1	1	
7	196312-06400	Gauge Oil Level	1	1	
8	26113-060082	Bolt M6 × 8	1	1	
9	26223-060252	Stud Bolt 6 × 25	2	2	
10	26223-100302	Stud Bolt 10 × 30	4		O
10-1	196350-12060	Stud Bolt 10 × 30	4	4	N
11	26553-050082	Screw 5 × 8	1	1	
12	27260-150000	Plug 15	1	1	
14	196350-02040	Front Cover	1	1	
15	24321-001100	O-Ring G-110	1	1	
16	24423-456209	Seal TC456029	1	1	
17	26453-100302	Bolt M10 × 30	3	3	
18	196350-02050	Retainer	1	1	
19	196350-02060	Bolt 8 × 12	4	4	
20	196350-02070	Rear Cover	1	1	
21	196350-02080	Wear Pad L	1		O
21-1	196350-02081	Wear Pad L	1	1	N
22	196350-02090	Wear Pad R	1		O
22-1	196350-02091	Wear Pad R	1	1	N
23	196311-02310	Shim Set	2	2	
30	189010-01130	Gasket	1	1	
31	196350-02300	Top Cover	1	1	
32	196324-02420	Plug	1	1	
33	24321-001300	O-Ring G-130	1		O
33-1	24321-001200	O-Ring G-120	1	1	N
34	26453-080252	Bolt M8 × 25	2	2	
35	26453-100302	Bolt M10 × 30	2	2	

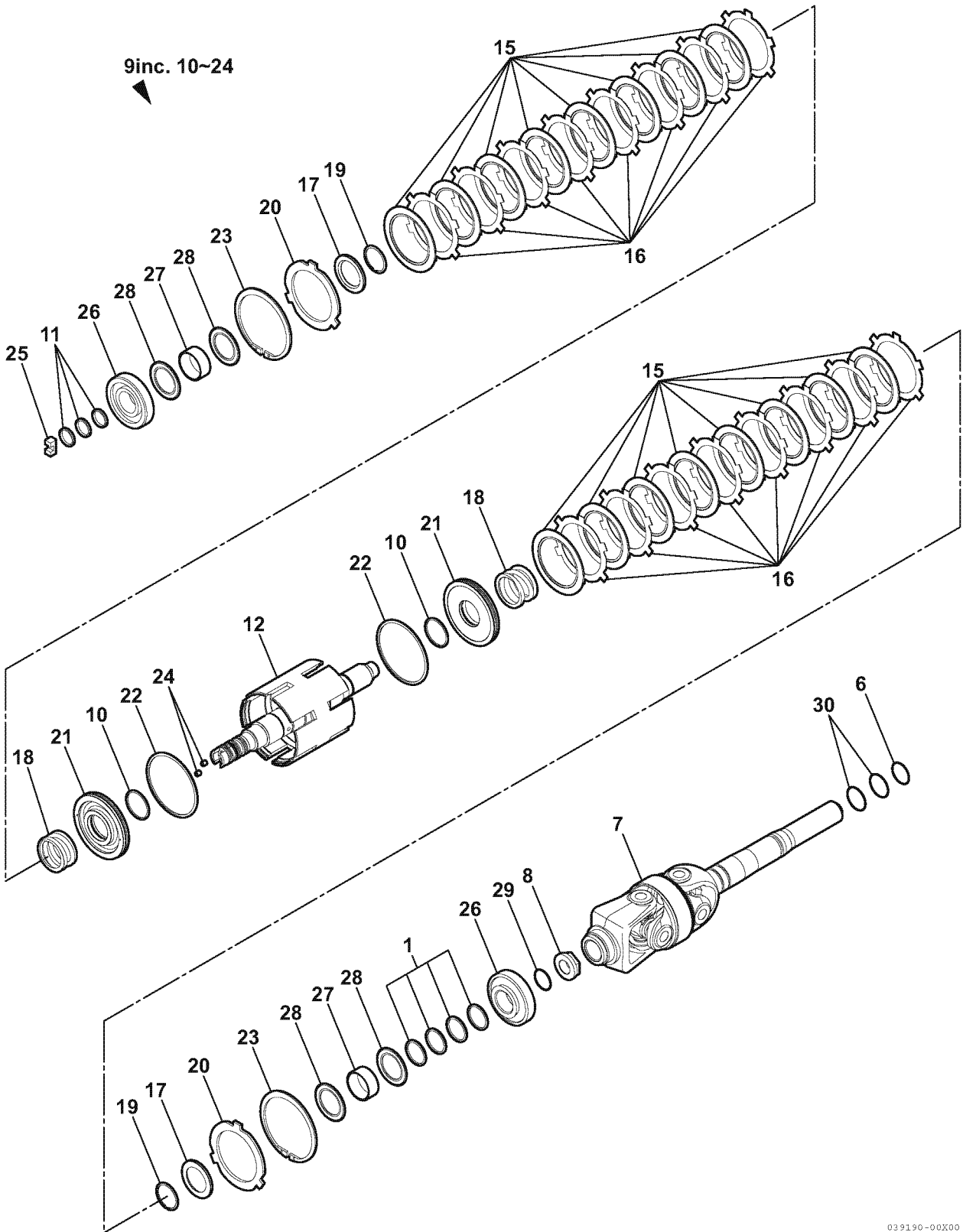
Item	Part Number	Description	ZT350	ZT370	N/O
36	196320-02320	Shim Set	1	1	
42	196350-02350	Anode D/S Housing	1	1	
43	196350-02360	Valve Screw CMP	1	1	
44	196350-02370	Screw 12	1	1	
45	196350-02390	Valve CMP	1	1	
49	24311-000060	O-Ring P-6	1	1	
50	196350-02400	Spacer 80/76.5	1	1	
52	196350-02480	Bearing Housing	1		
52-1	196350-02481	Bearing Housing	1		
52-2	196350-12480	Bearing Housing		1	N
53	24321-001100	O-Ring G-110	1	1	
54	24341-000220	O-Ring S-22	1	1	
55	26453-060142	Bolt M6 × 14	4	4	
56	196350-02590	Nylon Nut 35	4	4	
57	196350-04450	Lock Nut	1	1	
58	196350-04460	Bearing 30307DJR	1	1	
59	196350-04540	Gear Set A Upper	1		
59-1	196350-14540	Gear Set A Upper		1	
62	196350-08110	C.Water Pipe	4	4	
63	22133-100000	Washer 10	4	4	
64	22193-100003	Seal Washer 10	4	4	
65	22213-080000	Spring Washer 8	2	2	
66	23061-080400	Pipe 8 × 400	2	2	
67	26203-080202	Bolt M8 × 20	2	2	
68	196350-12610	Brand Label	1		
68-1	196350-12620	Brand Label		1	
69	196311-02060	Rivet 2 × 5	4	4	

No.	Design-change Part		Reason of Change
10-1	196350-12060	Stud Bolt 10 × 30	Only part number changed
21-1	196350-02081	Wear Pad L	Corner shape modify
22-1	196350-02091	Wear Pad R	Corner shape modify
33-1	24321-001200	O-Ring G-120	Easy install for Top-cover

No.	Design-change Part		Reason of Change
52-1	196350-02481	Bearing Housing	Cast hole to Drilling hole (3 × 5 mm dia)
52-2	196350-12480	Bearing Housing	3 × 5 mm to 1 × 2.8 mm dia hole
59-1	196350-14540	Gear Set A Upper	Oil hole position change
68-1	196350-12620	Brand Label	For ZT370

# DRIVESHAFT HOUSING

## Universal Joint and Clutch



039190-00X00

Figure 6-4

# DRIVESHAFT HOUSING

Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-04010	Shim Set 35/30	1	1	
6	196350-04070	O-Ring U/J	1	1	
7	196350-04080	Universal Joint	1	1	N
7-1	196350-04060	Universal Joint		1	N
8	196350-04090	Lock Nut	1		O
8-1	196350-04091	Lock Nut	1	1	N
9	196350-04202	Clutch Shaft Set	2		
9-1	196350-14200	Clutch Shaft Set		2	
10	177524-03631	Ring	2	2	
11	177524-03640	Ring	3	3	
12	196350-04210	Clutch Shaft CMP	1		
12-1	196350-14210	Clutch Shaft CMP		1	
16	196350-04241	Friction Disc	16	14	
17	196350-04250	Steel Plate	16		
17-1	196350-14250	Steel Plate		16	

Item	Part Number	Description	ZT350	ZT370	N/O
18	196350-04271	Spring	2	2	
19	196350-04311	Ring	2	2	
20	196350-04340	Plate	2		
20-1	196350-14340	Plate		2	
21	196350-04351	Cylinder	2	2	
22	196350-04360	Ring A	2	2	
23	22252-000950	Circlip 95	2		
23-1	196350-14280	Circlip 97		2	
24	26911-060062	Screw M6 × 6	2	2	
25	196350-04300	Joint Pump	1	1	
26	24144-303060	Bearing 30306	2		O
26-1	196350-04290	Bearing 30306CA	2	2	N
27	24161-354017	Needle Bearing	2	2	
28	24166-355202	Needle Bearing	4	4	
29	24311-000250	O-Ring P-25	1	1	
30	24356-240300	O-Ring 24030	2	2	

No.	Design-change Part		Reason of Change
7-1	196350-04060	Universal Joint	Localization
8-1	196350-04091	Lock Nut	Out Dia 36 mm to 35 mm
26-1	196350-04290	Bearing 30306CA	Higher output

# DRIVESHAFT HOUSING

## Case Plate and Shifter (Mechanical)

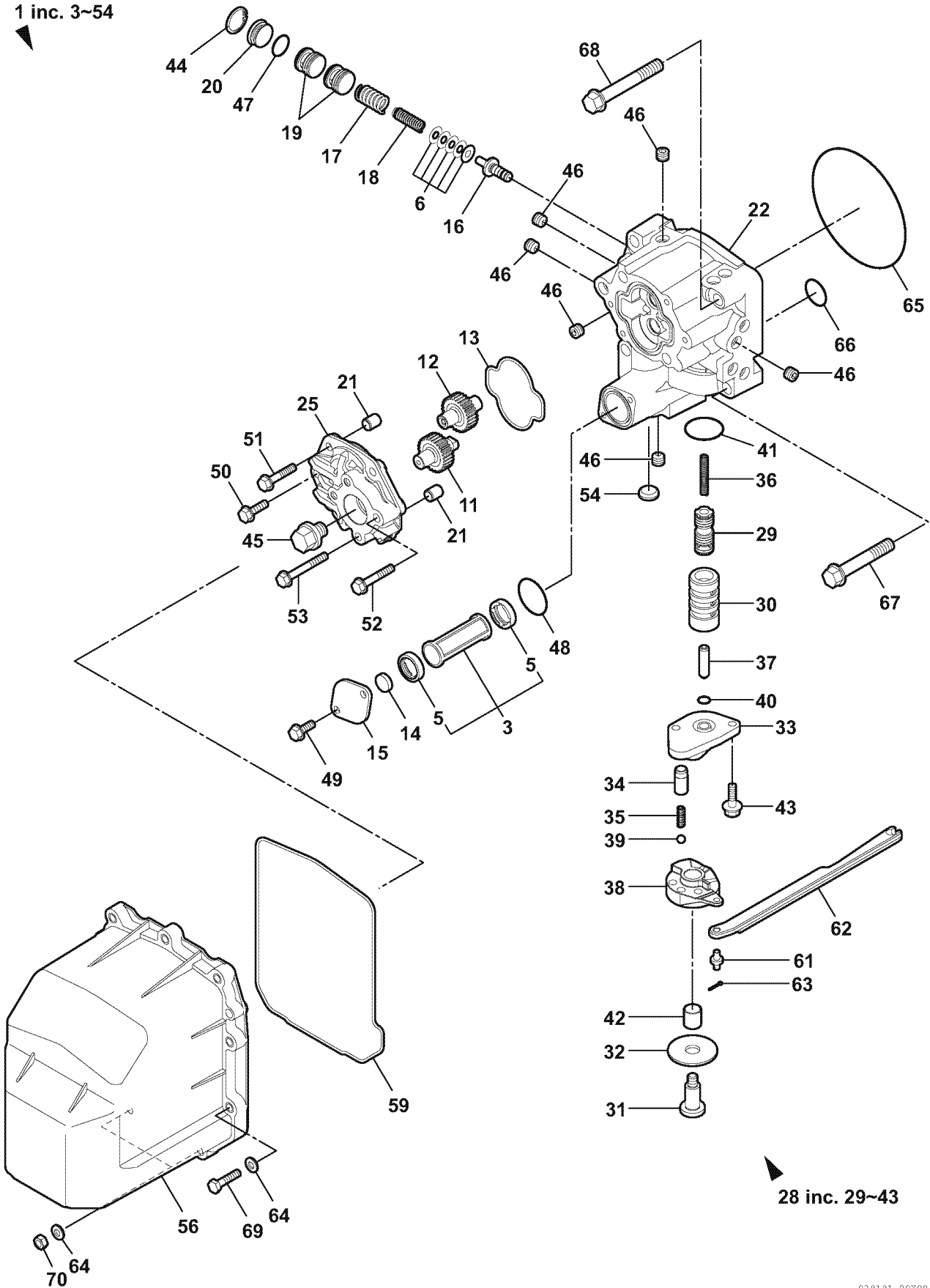


Figure 6-5



# DRIVESHAFT HOUSING

Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-02800	Case Plate Set	1		
1-1	196350-02801	Case Plate Set	1		N
1-2	196350-12711	Case Plate Set		1	
3	196350-02422	Filter Assy	1	1	
5	196350-02441	Rubber	2	2	
6	196350-02750	Shim 15/6 Assy	1	1	
11	196350-02820	HOP Drive Gear	1	1	
12	196350-02830	HOP Driven Gear	1	1	
13	196350-02850	Gasket	1	1	
14	196350-02870	Magnet	1	1	
15	196350-02880	Filter Cover	1	1	
16	196350-02900	Valve	1	1	
17	196350-02910	Spring Out	1	1	
18	196350-02920	Spring In	1	1	
19	196350-02930	Valve	2	1	
19-1	196350-12750	Valve		1	
20	196350-02940	Spacer	1	1	
21	196350-02950	Pin 10 mm	2		
21-1	196350-06010	Pin 11 mm	2	2	N
22	196350-06010	Case Plate CMP	1		
22-1	196350-06012	Case Plate CMP	1		N
22-2	196350-06071	Case Plate CMP		1	
25	196350-06020	Cover CMP	1		
25-1	196350-06021	Cover CMP	1	1	N
28	196350-06200	Valve Shift	1	1	
29	196350-06210	Valve Spool	1	1	
30	196350-06220	Sleeve	1	1	
31	196350-06250	Support	1	1	
32	196350-06260	Washer	1	1	
33	196350-06270	Spool Cover	1	1	
34	196350-06280	Spacer	1	1	
35	196350-06290	Spring	1	1	

Item	Part Number	Description	ZT350	ZT370	N/O
36	196350-06300	Spring	1	1	
37	196350-06330	Follow Pin	1	1	
38	196350-06370	Shift Lever Cam	1	1	
39	24190-080001	Ball 1/4	1	1	
40	24311-000080	O-Ring P-8	1	1	
41	24321-000300	O-Ring G-30	1	1	
42	24550-012150	Bush 12 × 15	1	1	
43	26106-060202	Bolt 6 × 20	2	2	
44	22252-000220	Circlip 22	1	1	
45	23490-120002	Plug 12	1	1	
46	23876-010000	Plug PT 1/8	14	14	
47	24311-000160	O-Ring P-16	1	1	
48	24341-000300	O-Ring S-30	1	1	
49	26106-060162	Bolt 6 × 16	2	2	
50	26106-060202	Bolt 6 × 20	3	3	
51	26106-060302	Bolt 6 × 30	1	1	
52	26106-060352	Bolt 6 × 35	1	1	
53	26106-060452	Bolt 6 × 45	1	1	
54	27243-160000	Plug 16	1	1	
56	196350-02961	Case Plate Cover	1	1	
59	196350-02990	Gasket	1	1	
61	196350-06130	Slider Pin	1	1	
62	196350-06140	Slider	1	1	
63	22417-160100	Cotter Pin	1	1	
64	22133-060000	Washer 6	9	9	
65	24321-001050	O-Ring G-105	1	1	
66	24341-000220	O-Ring S-22	1	1	
67	26106-100602	Bolt M10 × 60	2	2	
68	26106-100702	Bolt M10 × 70	2	2	
69	26113-060252	Bolt M6 × 25	7	7	
70	26713-060002	Nut M6	2	2	

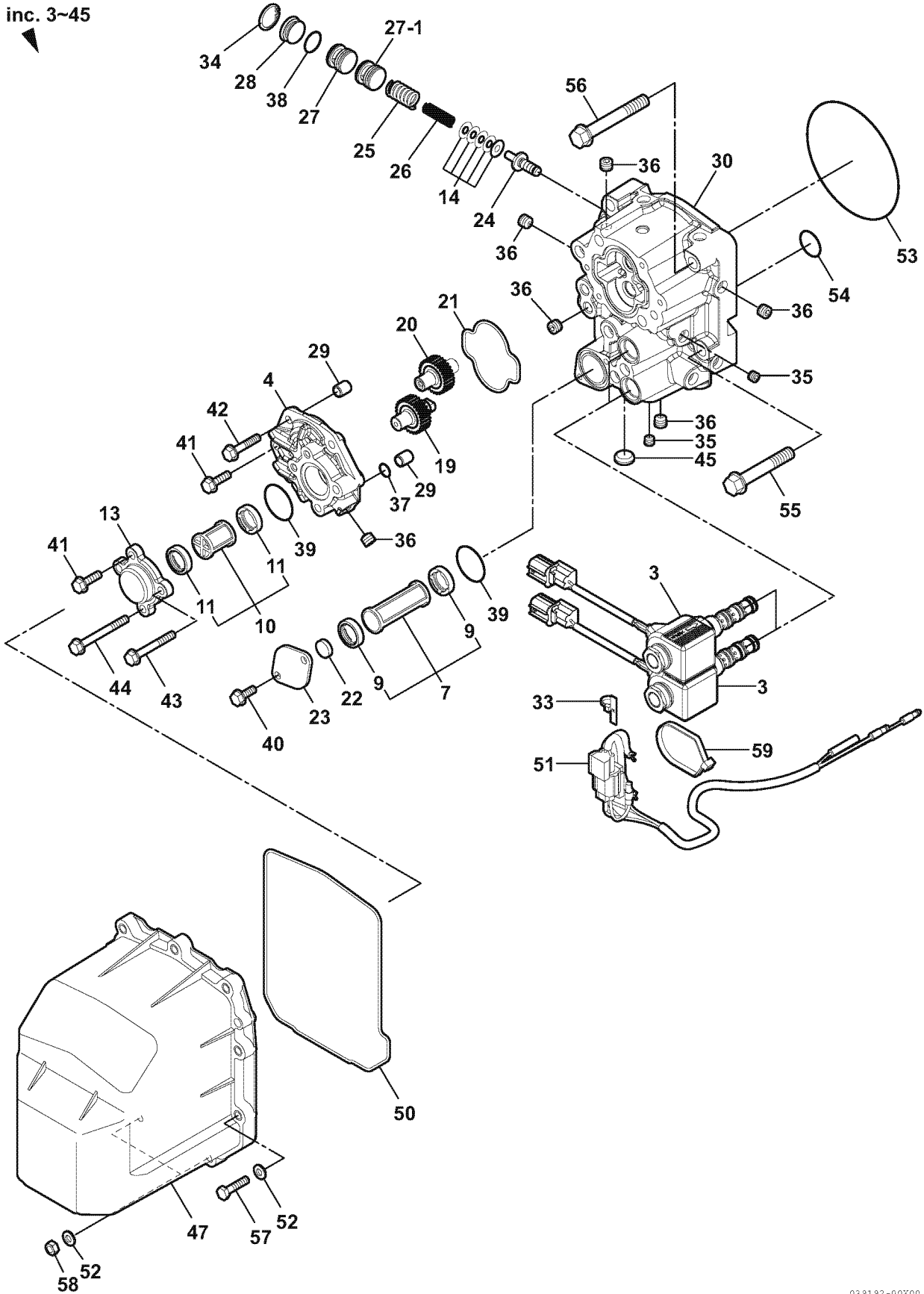
No.	Design-change Part	Reason of Change	
1-1	196350-02801	Case Plate Set	SP Guide valve
1-2	196350-12711	Case Plate Set	HO Pressure change
19-1	196350-12750	Valve	Add Guide SP
21-1	196350-06010	Pin 11 mm	Pin size 10 mm to 11 mm

No.	Design-change Part	Reason of Change	
22-1	196350-06012	Case Plate CMP	SP Guide valve
22-2	196350-06071	Case Plate CMP	HO Pressure change
25-1	196350-06021	Cover CMP	Pin size change (11 mm)

# DRIVESHAFT HOUSING

## Case Plate and Shifter (Electric)

1 inc. 3~45



039192-00X00

Figure 6-6

# DRIVESHAFT HOUSING

Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-02730	Case Plate	1		
1-1	196350-02731	Case Plate	1		N
1-2	196350-12731	Case Plate		1	
3	168136-00070	Solenoid 12 V	2	2	
4	196350-02410	Cover HOP	1		
4-1	196350-02411	Cover HOP	1	1	N
7	196350-02422	Filter Assy	1	1	
9	196350-02441	Rubber	2	2	
10	196350-02451	Filter Assy	1	1	
11	196350-02441	Rubber	2	2	
13	196350-02500	Cover Filter	1	1	
14	196350-02750	Shim 15/6	1	1	
19	196350-02820	Drive Gear	1	1	
20	196350-02830	Driven Gear	1	1	
21	196350-02850	Gasket	1	1	
22	196350-02870	Magnet	1	1	
23	196350-02880	Filter Cover	1	1	
24	196350-02900	Valve	1	1	
25	196350-02910	Spring Out	1	1	
26	196350-02920	Spring In	1	1	
27	196350-02930	Valve	2	1	
27-1	196350-12750	Valve		1	
28	196350-02940	Spacer	1	1	
29	196350-02950	Pin 10	2		
29-1	194521-41570	Pin 11	2	2	N
30	196350-06050	Case Plate CMP	1		

Item	Part Number	Description	ZT350	ZT370	N/O
30-1	196350-06052	Case Plate CMP	1		N
30-2	196350-06091	Case Plate CMP		1	
33	196350-06390	Marking Tie	1	1	
34	22252-000220	Ring 22	1	1	
35	23876-005000	Plug R005	2	2	
36	23876-010000	Plug R01	20	20	
37	24311-000100	Packing P-10	1	1	
38	24311-000160	Packing P-16	1	1	
39	24341-000300	Packing S-30	2	2	
40	26106-060162	Bolt 6 × 16	2	2	
41	26106-060202	Bolt 6 × 20	5	5	
42	26106-060302	Bolt 6 × 30	1	1	
43	26106-060452	Bolt 6 × 45	1	1	
44	26106-060552	Bolt 6 × 55	1	1	
45	27243-160000	Plug 16	1	1	
47	196350-02961	Case Plate Cover	1	1	
50	196350-02990	Gasket	1	1	
51	196350-06420	Connector	1	1	
52	22133-060000	Washer 6	9	9	
53	24321-001050	Packing G-105	1	1	
54	24341-000220	Packing S-22	1	1	
55	26106-100602	Bolt 10 × 60	2	2	
56	26106-100702	Bolt 10 × 70	2	2	
57	26113-060252	Bolt 6 × 25	7	7	
58	26713-060002	Nut 6	2	2	
59	29621-200000	Band 200	1	1	

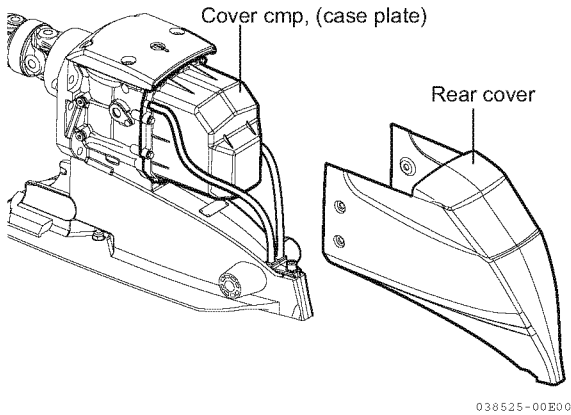
No.	Design-change Part	Reason of Change
1-1	196350-02801 Case Plate Set	SP Guide valve
1-2	196350-12711 Case Plate Set	HO Pressure change
19-1	196350-12750 Valve	Add Guide SP
21-1	196350-06010 Pin 11 mm	Pin size 10 mm to 11 mm

No.	Design-change Part	Reason of Change
22-1	196350-06012 Case Plate CMP	SP Guide valve
22-2	196350-06071 Case Plate CMP	HO Pressure change
25-1	196350-06021 Cover CMP	Pin size change (11 mm)

# DRIVESHAFT HOUSING

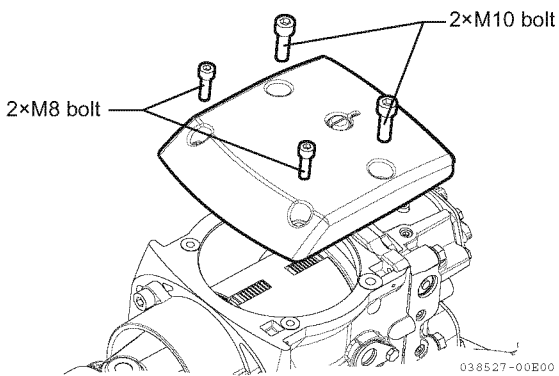
## DRIVESHAFT HOUSING DISASSEMBLY

1. Remove the rear cover bolts and washers, then remove the rear cover (**Figure 6-7**).
2. Remove the seven bolts and two M6 nuts fastening the cover CMP (case plate) and then remove the cover CMP.



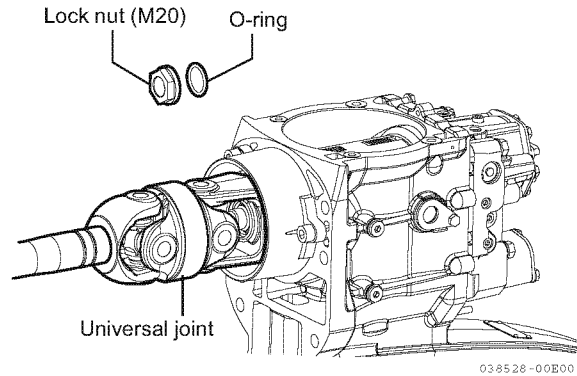
**Figure 6-7**

3. Remove the two M8 and two M10 upper cover bolts, then remove the upper cover (**Figure 6-8**).



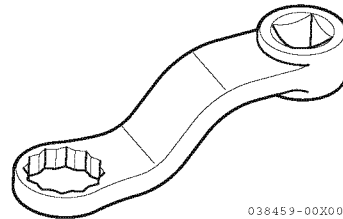
**Figure 6-8**

4. While holding the universal joint assembly, remove the universal joint M20 locknut (**Figure 6-9**) using the special tools shown in **Figure 6-10** and **Figure 6-11**, then remove the O-ring.



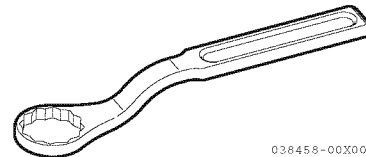
**Figure 6-9**

**Special Tool - P/N 196350-92310**



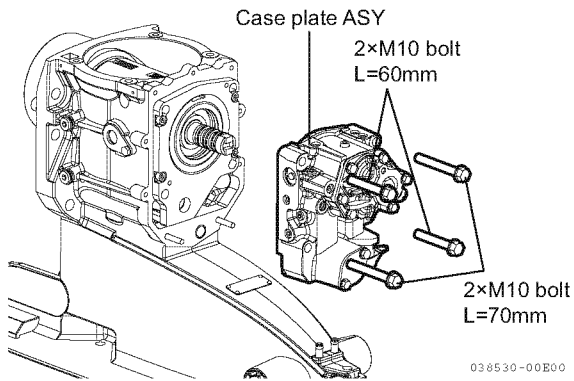
**Figure 6-10**

**Special Tool - P/N 196350-92300**



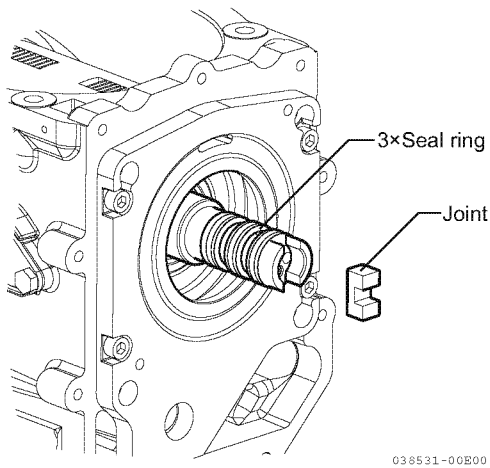
**Figure 6-11**

- Remove the four M10 case plate bolts, then remove the case plate assembly, as shown in **Figure 6-12**.



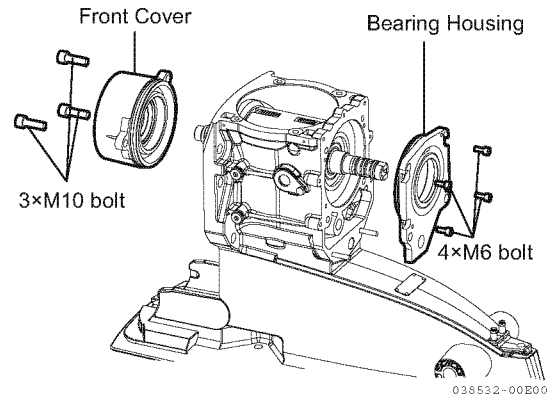
**Figure 6-12**

- Remove the pump joint and three seal rings, as shown in **Figure 6-13**.



**Figure 6-13**

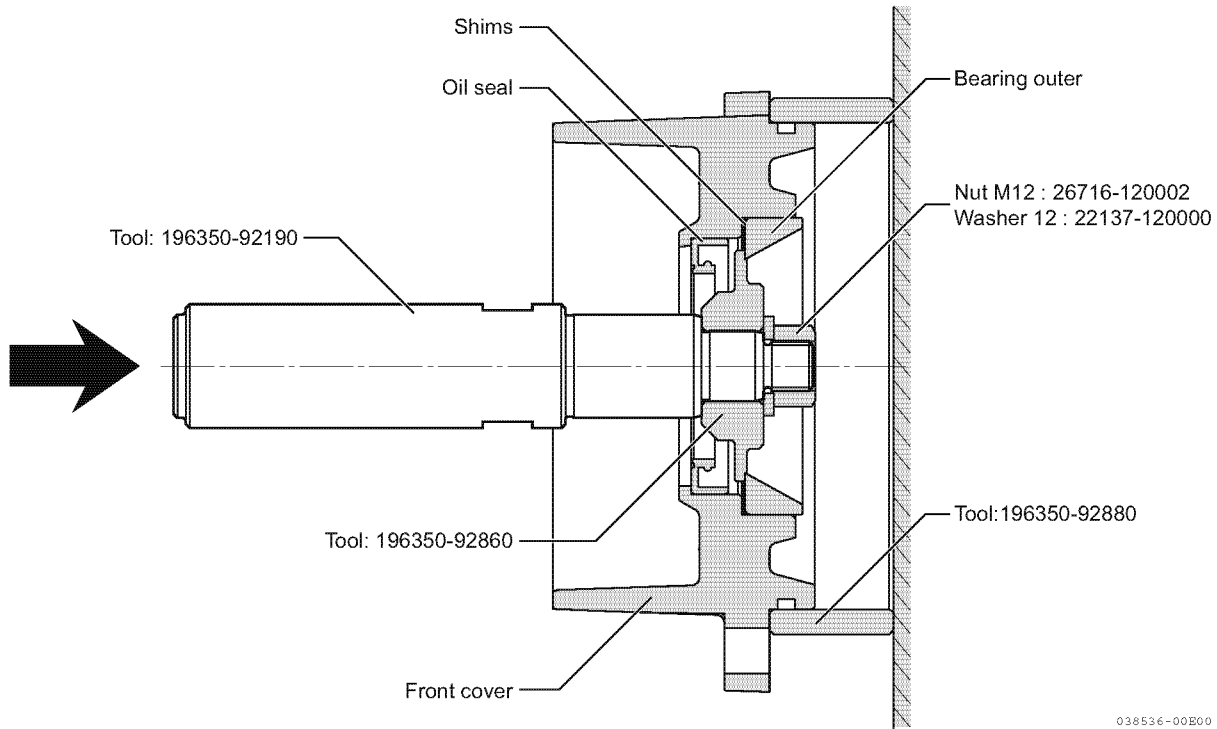
- Remove the four M6 bearing housing bolts and then remove the bearing housing, as shown in **Figure 6-14**.
- Remove the three M10 front cover bolts and then remove the front cover, as shown in **Figure 6-14**.



**Figure 6-14**

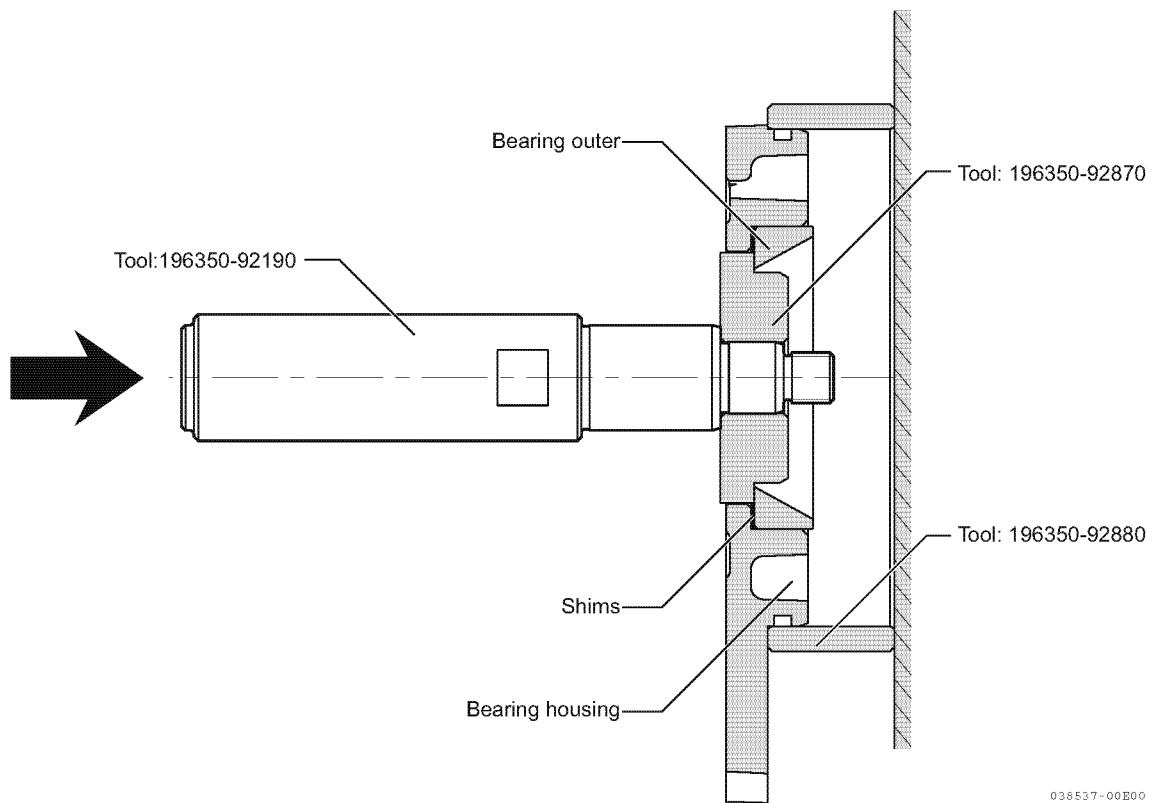
# DRIVESHAFT HOUSING

9. Remove the outer bearing from the front cover, as shown in **Figure 6-15**.



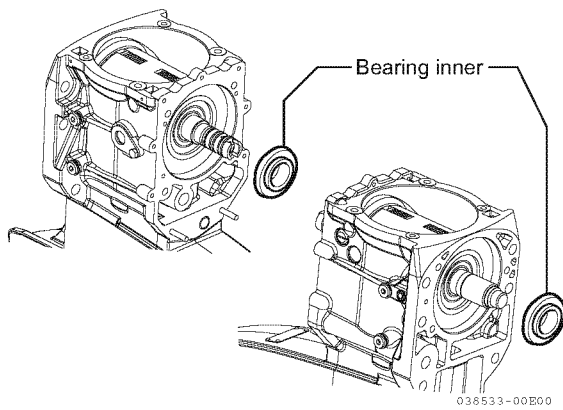
**Figure 6-15**

10. Remove the outer bearing from the bearing housing, as shown in **Figure 6-16**.



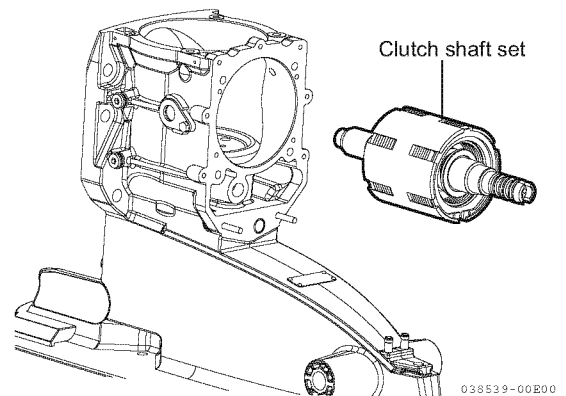
**Figure 6-16**

11. Remove both front and rear inner bearings from the clutch shaft CMP, as shown in **Figure 6-17**.



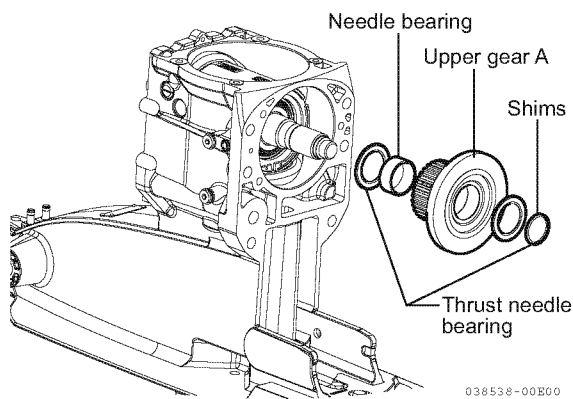
**Figure 6-17**

13. Remove the upper gear "A", needle bearing and thrust needle bearing from rear side, in the same removal manner as from the front side.
14. Remove the clutch shaft set (**Figure 6-19**).



**Figure 6-19**

12. Remove the upper gear "A", shims, needle bearing and thrust needle bearing from the front side, as shown in **Figure 6-18**.



**Figure 6-18**

## UPPER GEAR "B" CMP

### Disassembly

1. Loosen (unthread) the bearing retainer a few turns, then remove the upper gear "B" CMP, as shown in Figure 6-20.

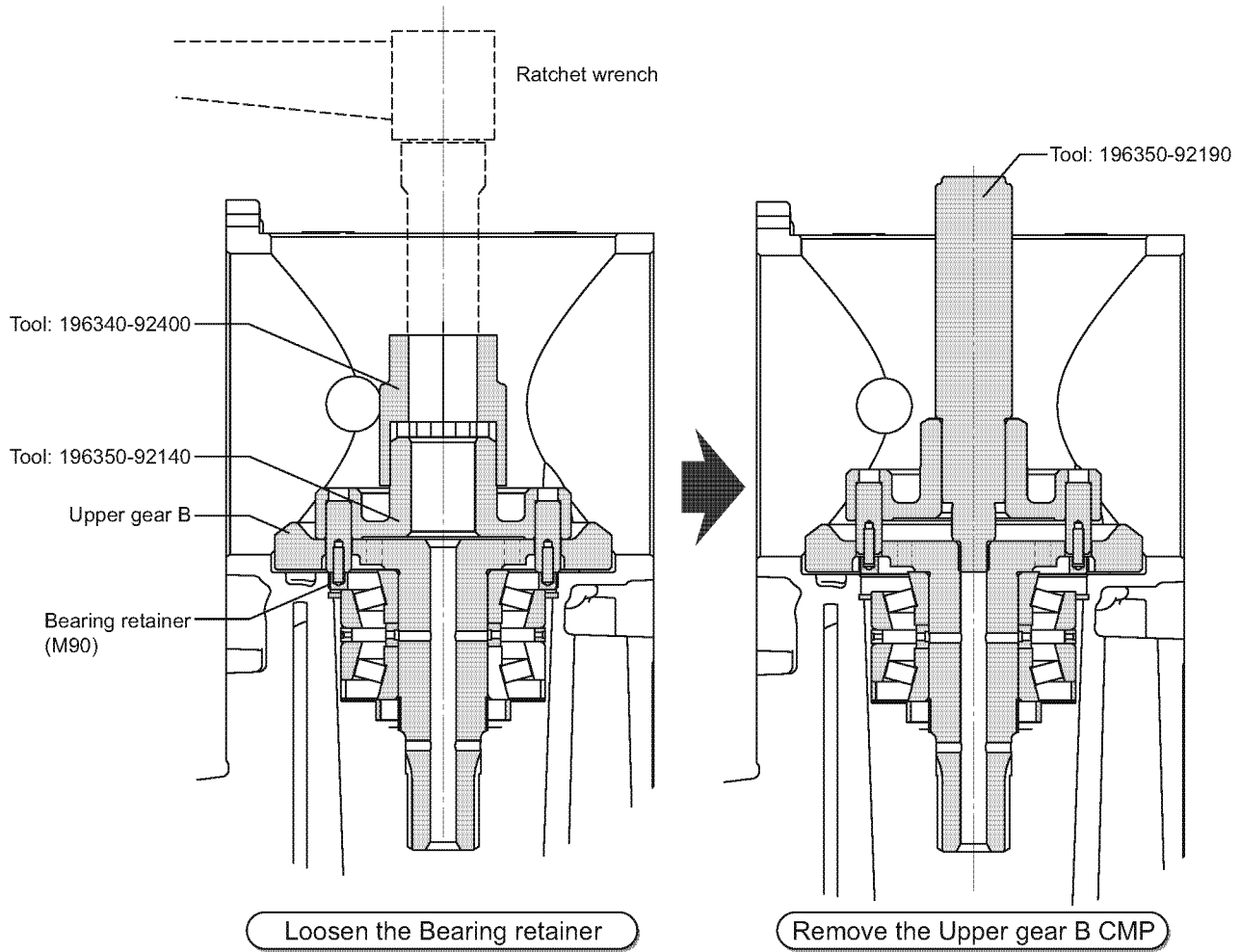
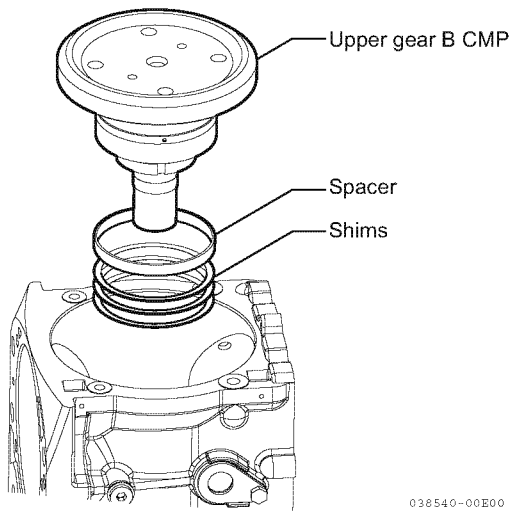


Figure 6-20



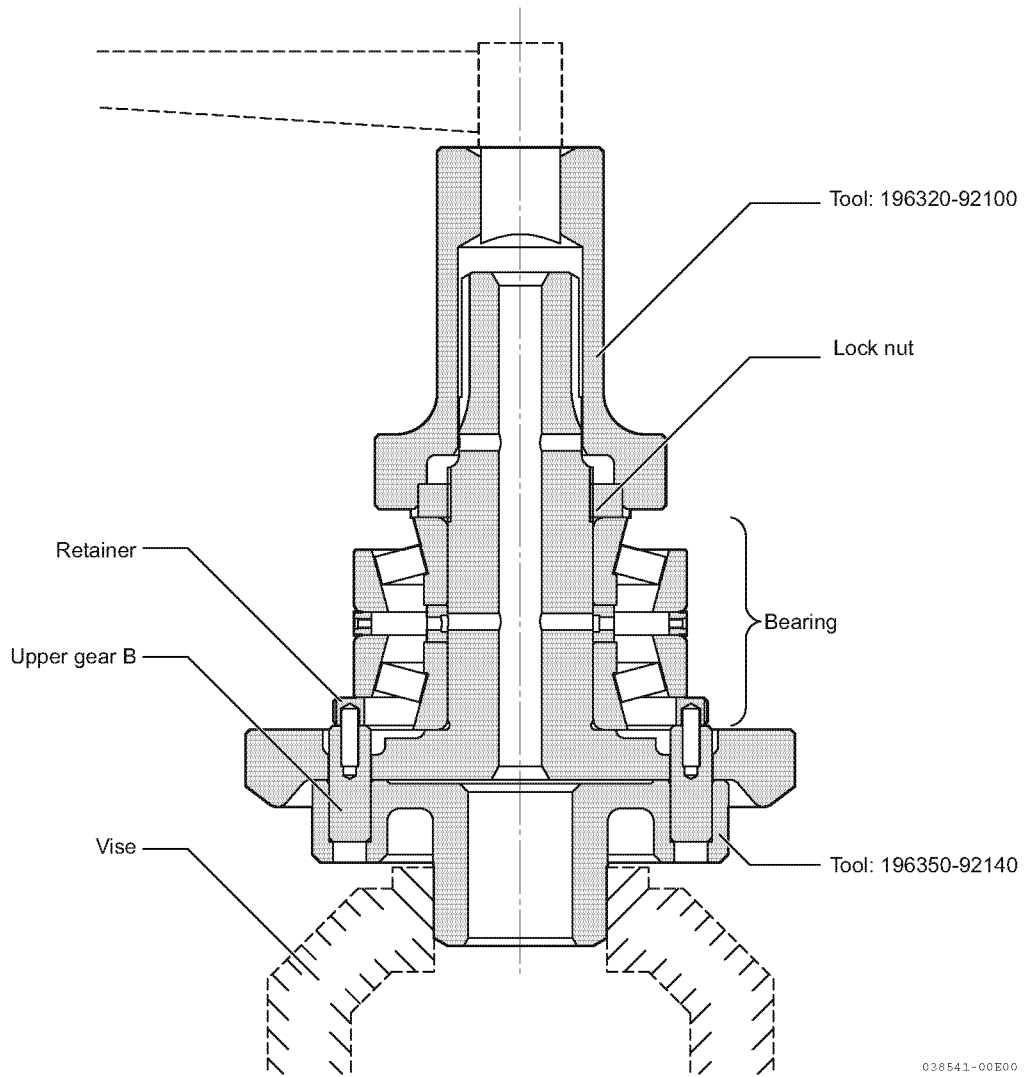
2. Remove the upper gear "B", spacer and shims, as shown in **Figure 6-21**.
3. Check and record all shim thicknesses for assembly reference.



**Figure 6-21**

# DRIVESHAFT HOUSING

4. Loosen the locknut, as shown in **Figure 6-22**.



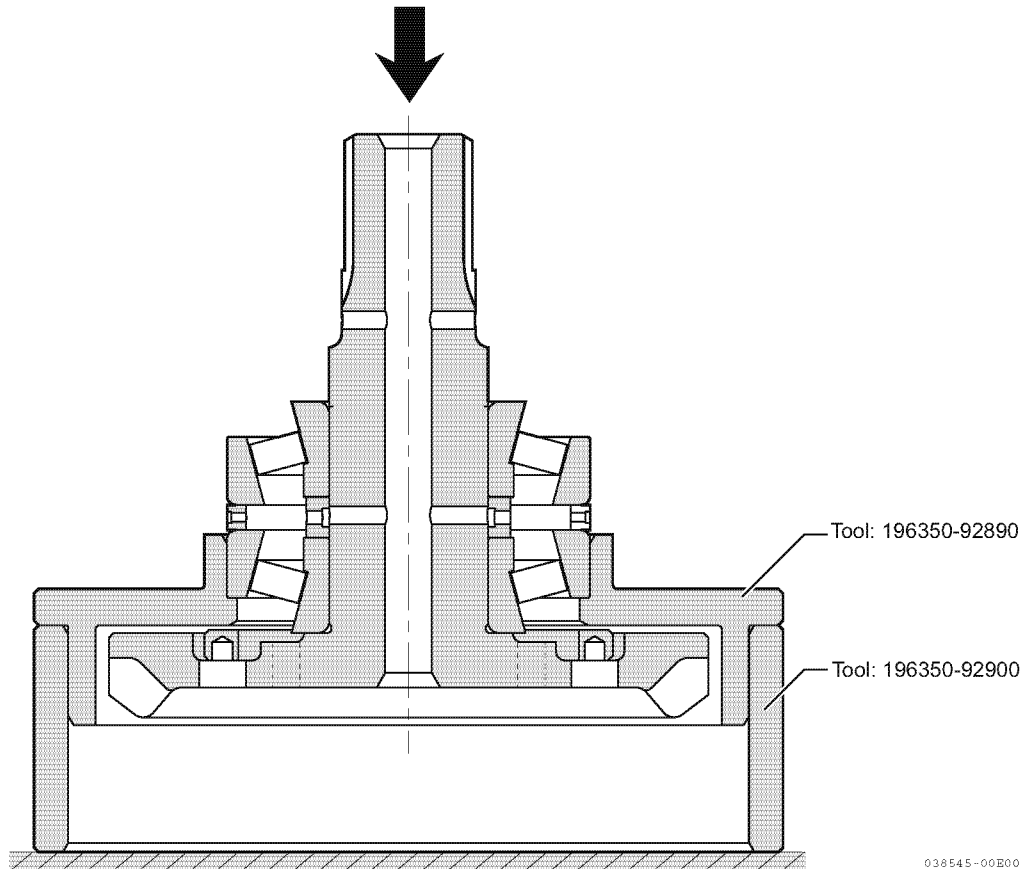
038541-00E00

**Figure 6-22**

- Remove the bearing, as shown in **Figure 6-23**.

**NOTICE**

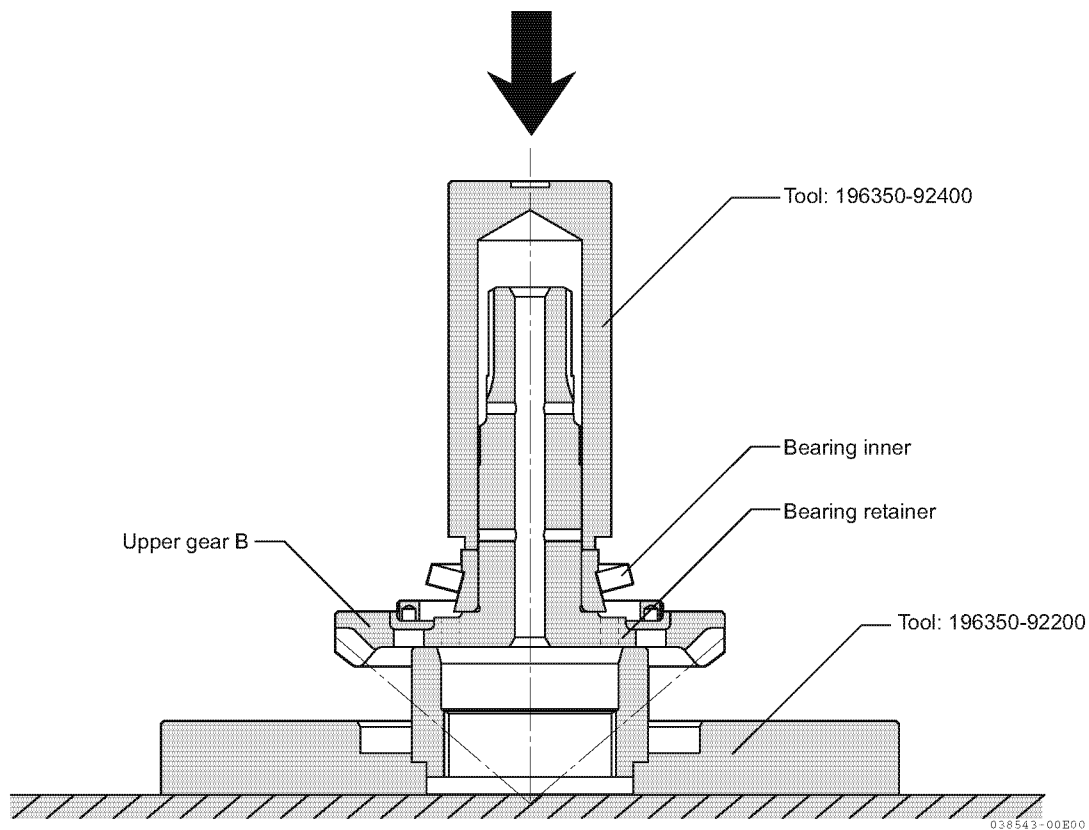
Use a press to remove bearings.  
Do not reuse old bearings.



**Figure 6-23**

## Assembly

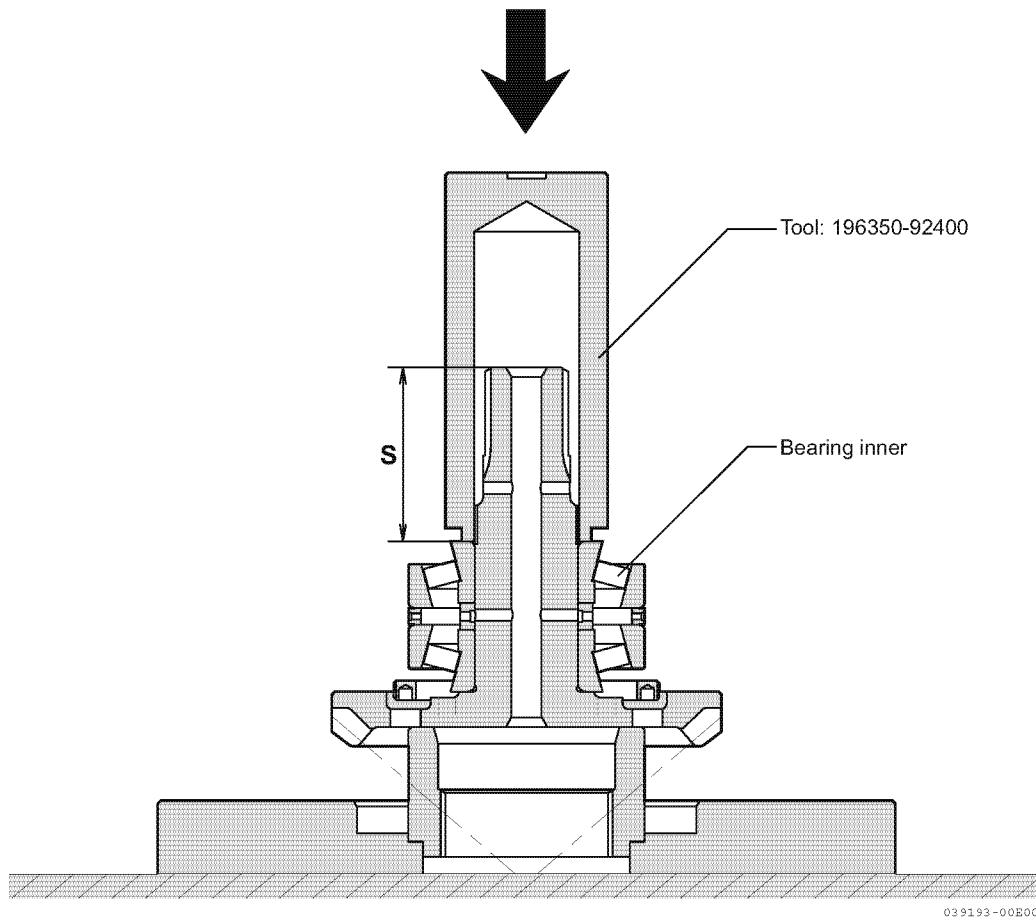
1. Install the inner bearing, as shown in **Figure 6-24**.



**Figure 6-24**

2. Install the inner bearing, as shown in **Figure 6-25**.

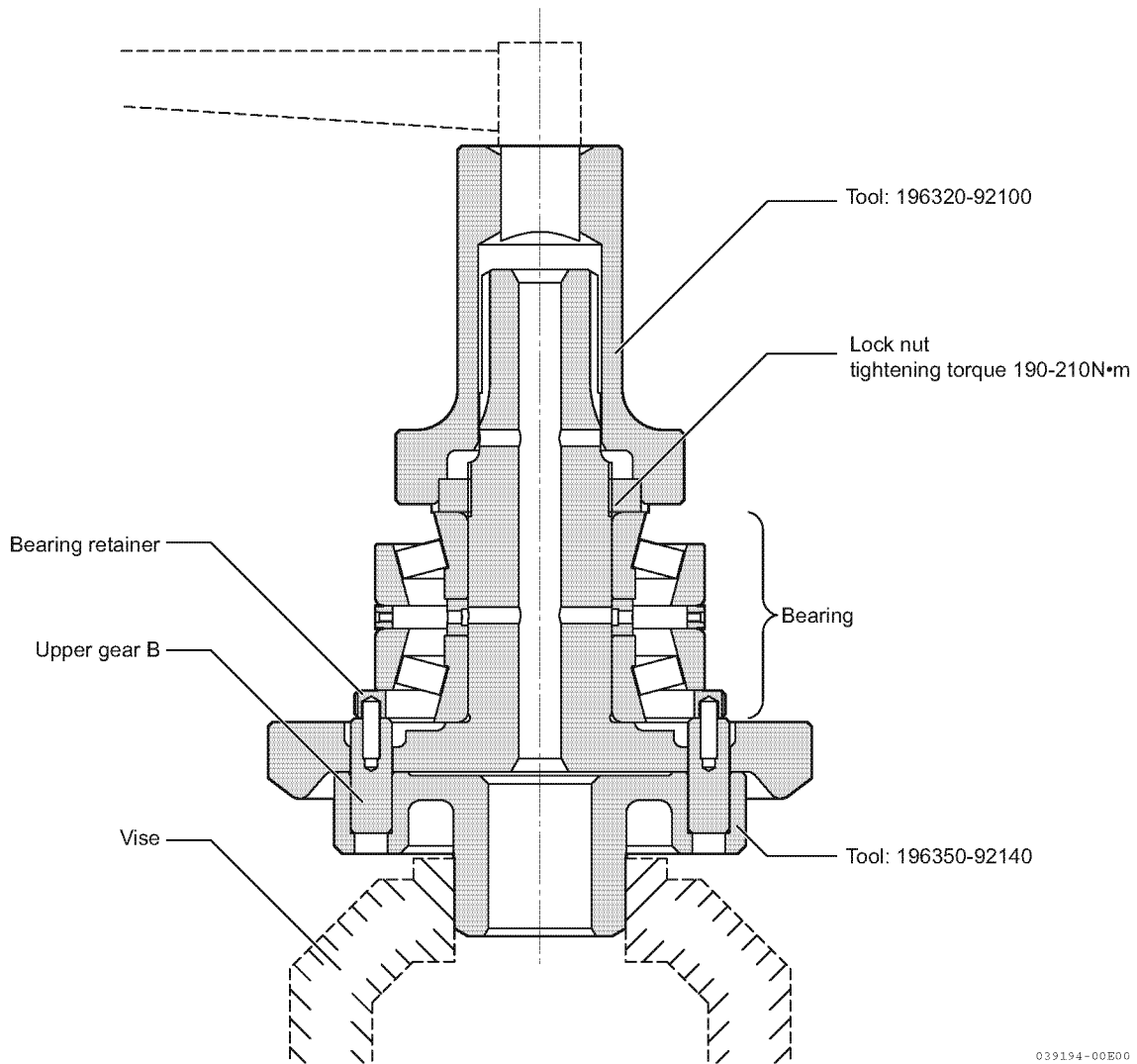
*Note: Dimension "S" = 59 mm (2.32 in.).*



**Figure 6-25**

# DRIVESHAFT HOUSING

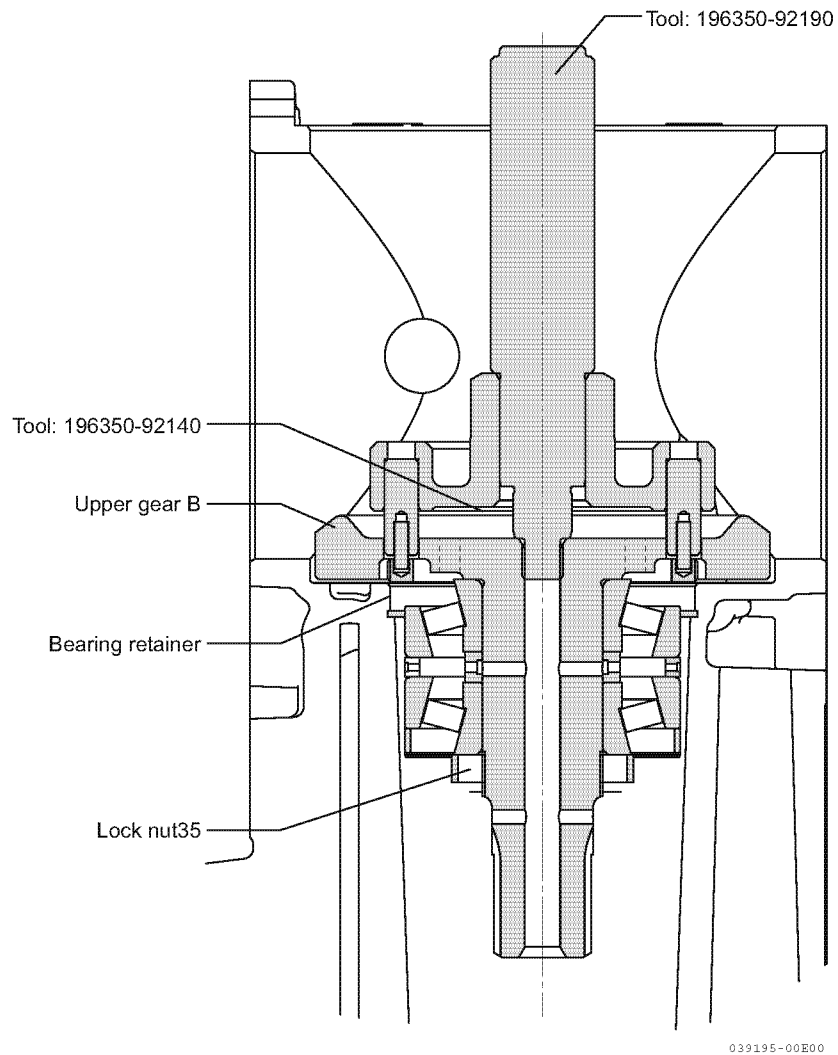
3. Install the locknut, as shown in **Figure 6-26**.



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**Figure 6-26**

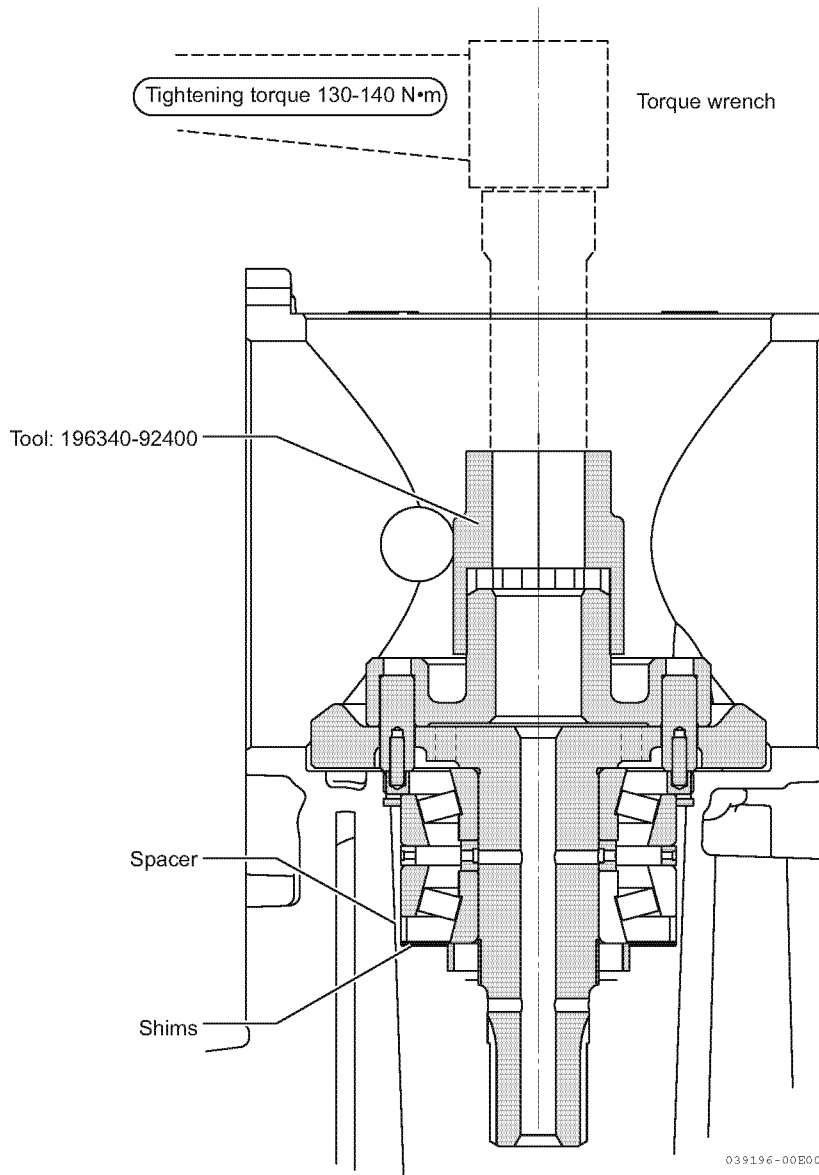
4. Set in driveshaft housing, as shown in **Figure 6-27**.



**Figure 6-27**

## DRIVESHAFT HOUSING

5. Install the shims, spacer and upper gear "B" CMP to the driveshaft housing, as shown in **Figure 6-28**. Set shim adjustment; see *Upper Gear Shim Adjustment* on page 6-39.



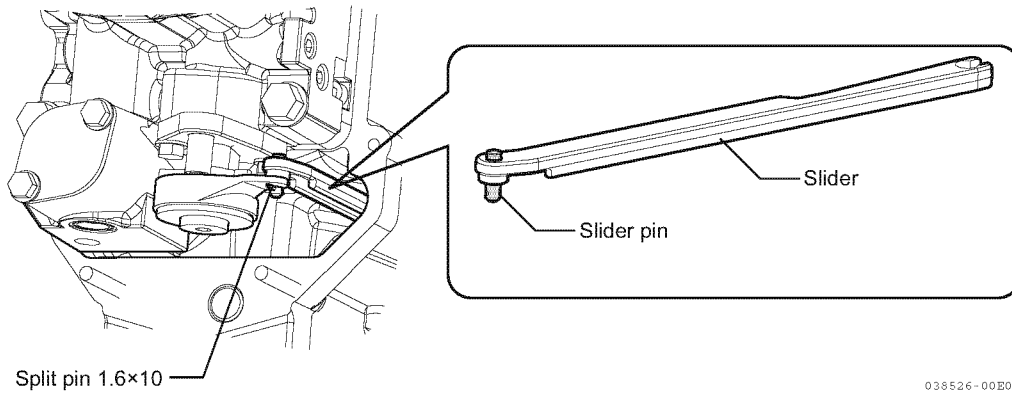
**Figure 6-28**



## CASE PLATE AND SHIFTER

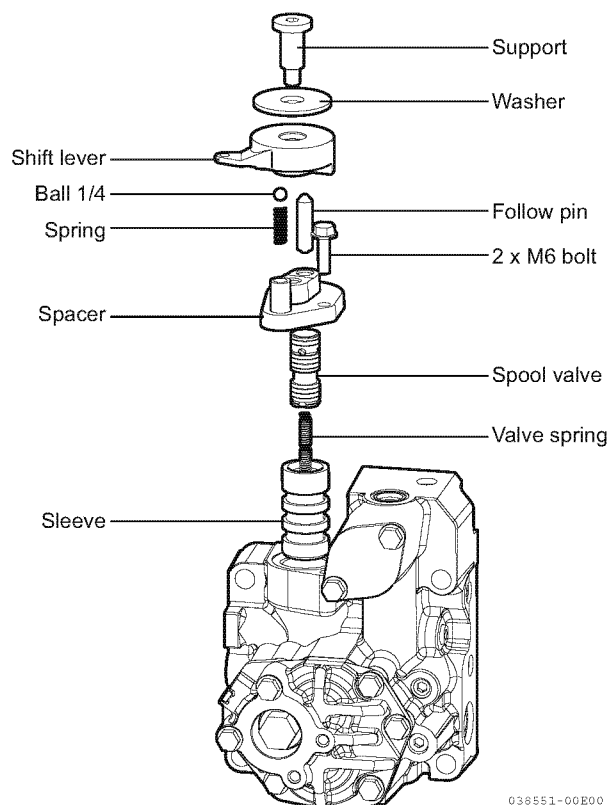
### Disassembly - Mechanical Shifter

1. Remove the split pin from the slider pin, then remove the slider, as shown in **Figure 6-29**.



**Figure 6-29**

2. Disassemble the shift valve CMP, as shown in **Figure 6-30**.

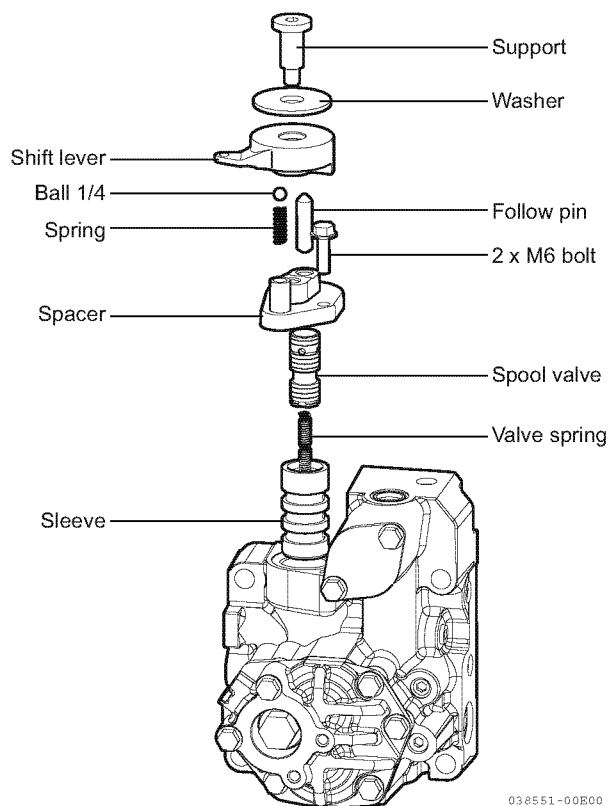


**Figure 6-30**

## Assembly - Mechanical Shifter

Assemble the shift valve CMP (**Figure 6-31**) in the reverse order of disassembly, using the following note.

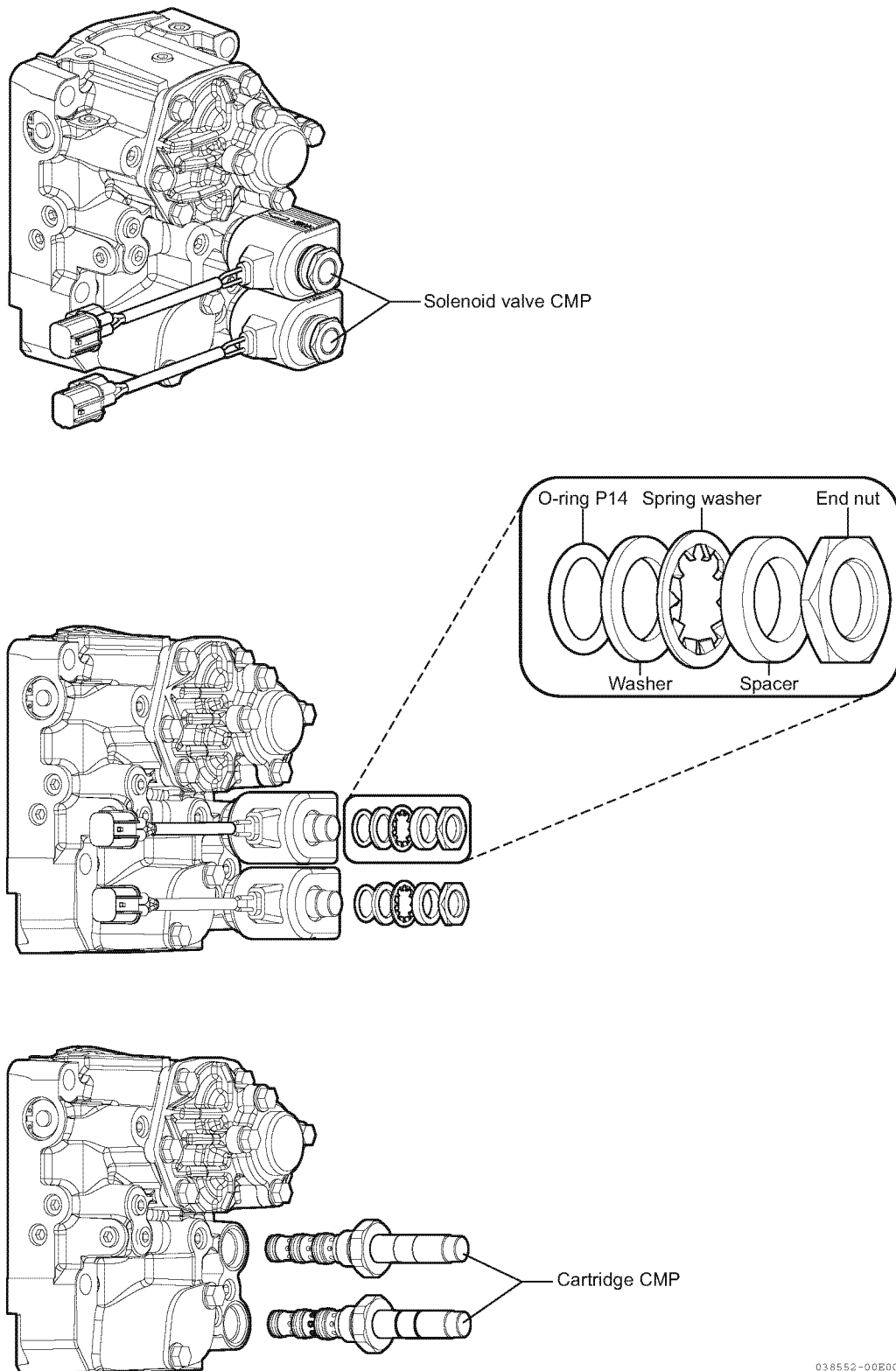
- Apply lithium grease to following parts: washer, shift lever cam, follow pin, ball 1/4, spring and O-rings.



**Figure 6-31**

### Disassembly - Electric Shifter

Remove electric shifter solenoid valves, as shown in **Figure 6-32**.



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**Figure 6-32**

## DRIVESHAFT HOUSING

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### Assembly - Electric Shifter

Assemble the electric shifter solenoid valves in the reverse order of disassembly, using the following notes.

- Apply lithium grease to O-rings.
- Tightening torque: Cartridge CMP: 15.7 - 17.7 N·m (11.6 - 13.1 ft-lb)
- Tightening torque: End nut: 5.9 - 7.9 N·m (4.4 - 5.8 ft-lb)

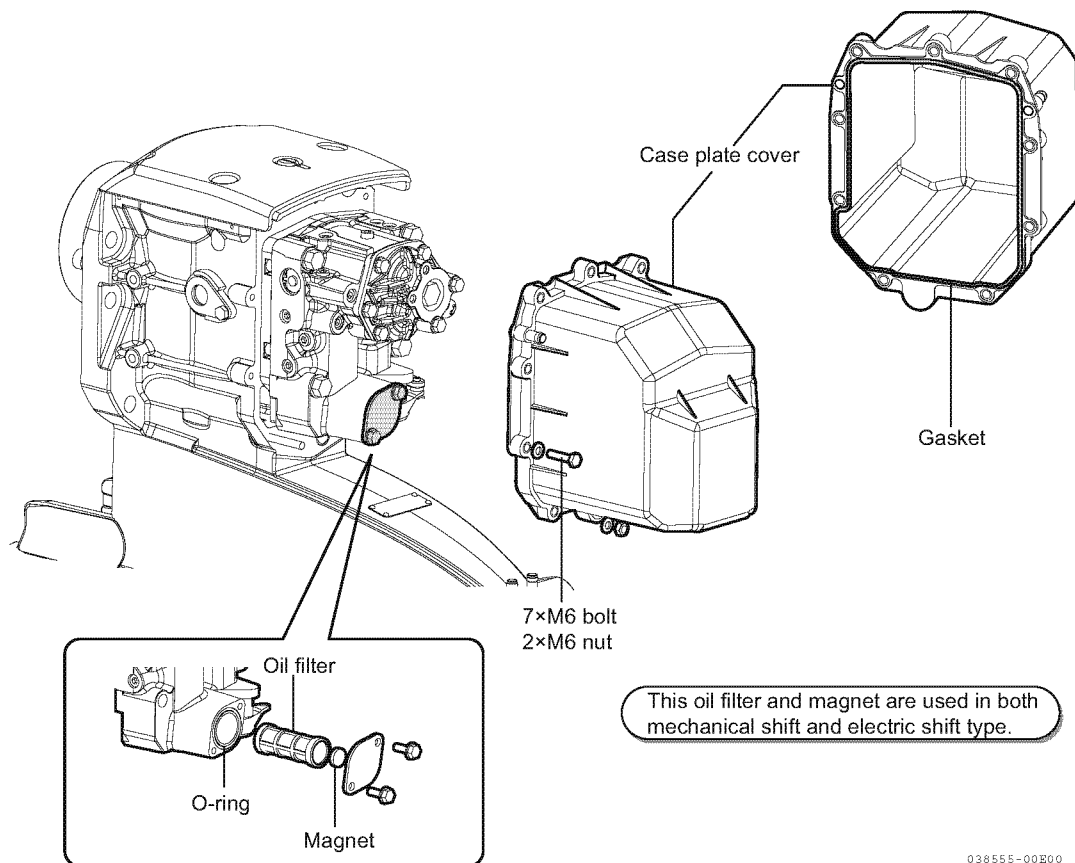
### Filter and Magnet Check

Remove the case plate cover, and check and clean the oil filter and magnet, as shown in **Figure 6-33**.

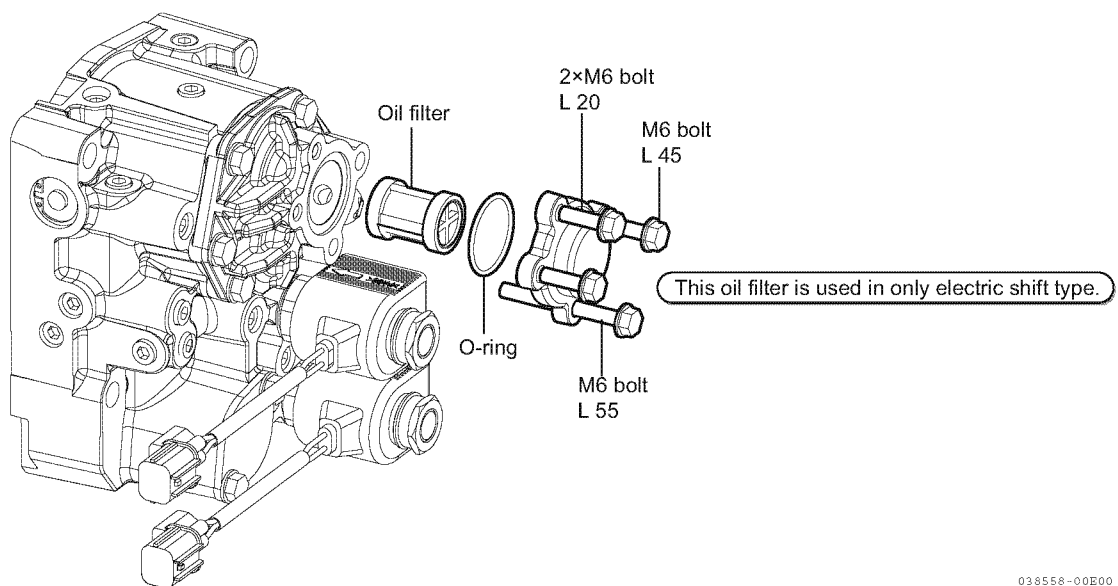
*Note: Mechanical shift: equipped with 1 oil filter and 1 magnet.*

*Electrical shift: equipped with 2 oil filters and 1 magnet.*

A periodic check is required of the filter and magnet for metal shavings. If metal shavings are found, inspection of inner parts may be required.



038555-00200

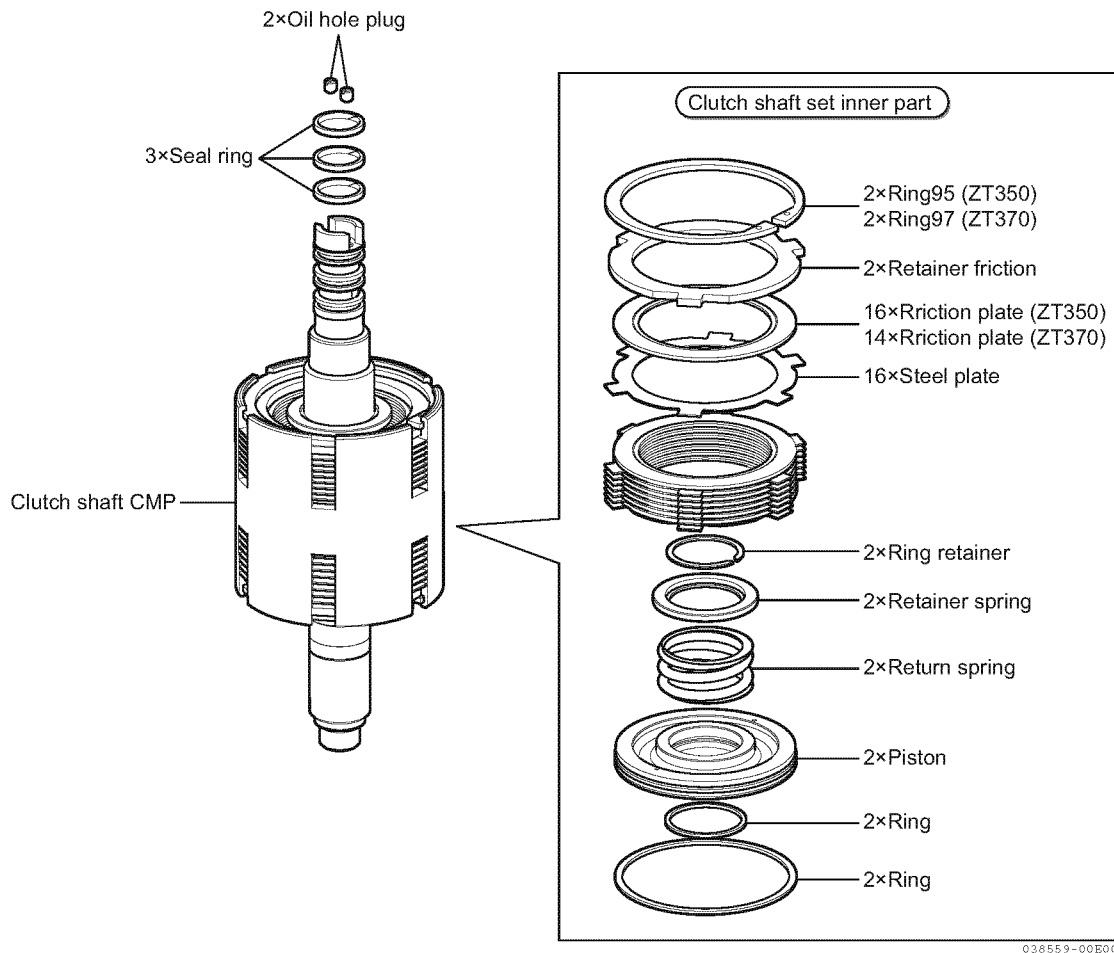


038558-00E00

**Figure 6-33**

## CLUTCH SHAFT SET DISASSEMBLY AND INSPECTION

1. During disassembly, check the following:
  - Oil hole plugs for looseness and oil leakage.
  - Seal rings for excessive wear and damage.
  - Friction and steel plates for excessive wear and damage.
2. Remove the retainer friction, friction plates and steel plates from both sides, as shown in **Figure 6-34**.
3. Remove Ring 95 (**Figure 6-34**) using a circlip opener.



**Figure 6-34**

### Ring Retainer Disassembly - Piston Removal

1. Assemble the special tools, as shown in **Figure 6-35**.
2. Press in the retainer spring and return spring by tightening special tool P/N:196320-92700.
3. Remove the ring retainer using a ring opener.
4. Remove the retainer spring, retainer return spring and piston. Low pressure shop air may be required to pressurize the piston port area to remove the piston assembly. Repeat procedure for opposite side.

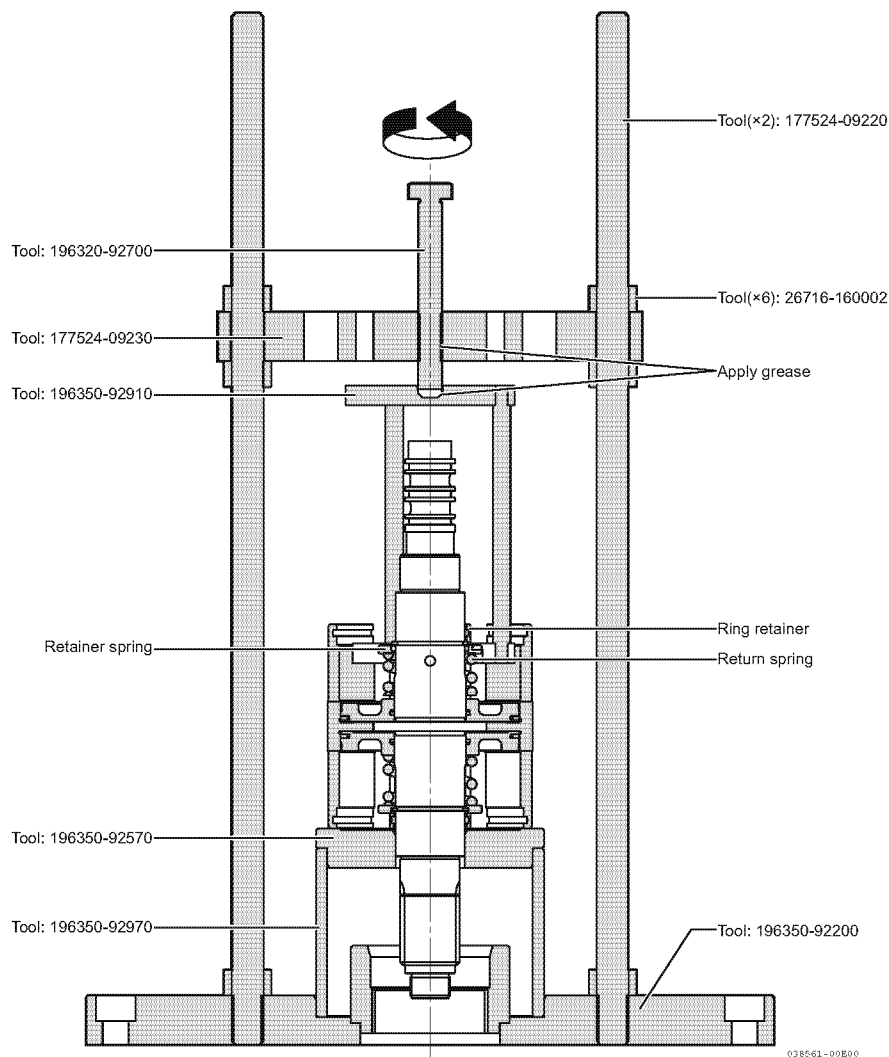
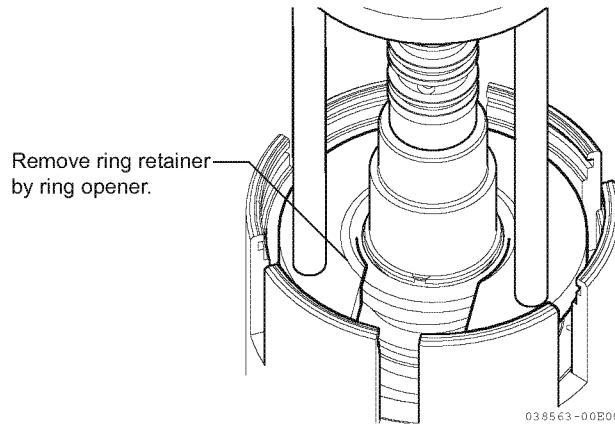


Figure 6-35

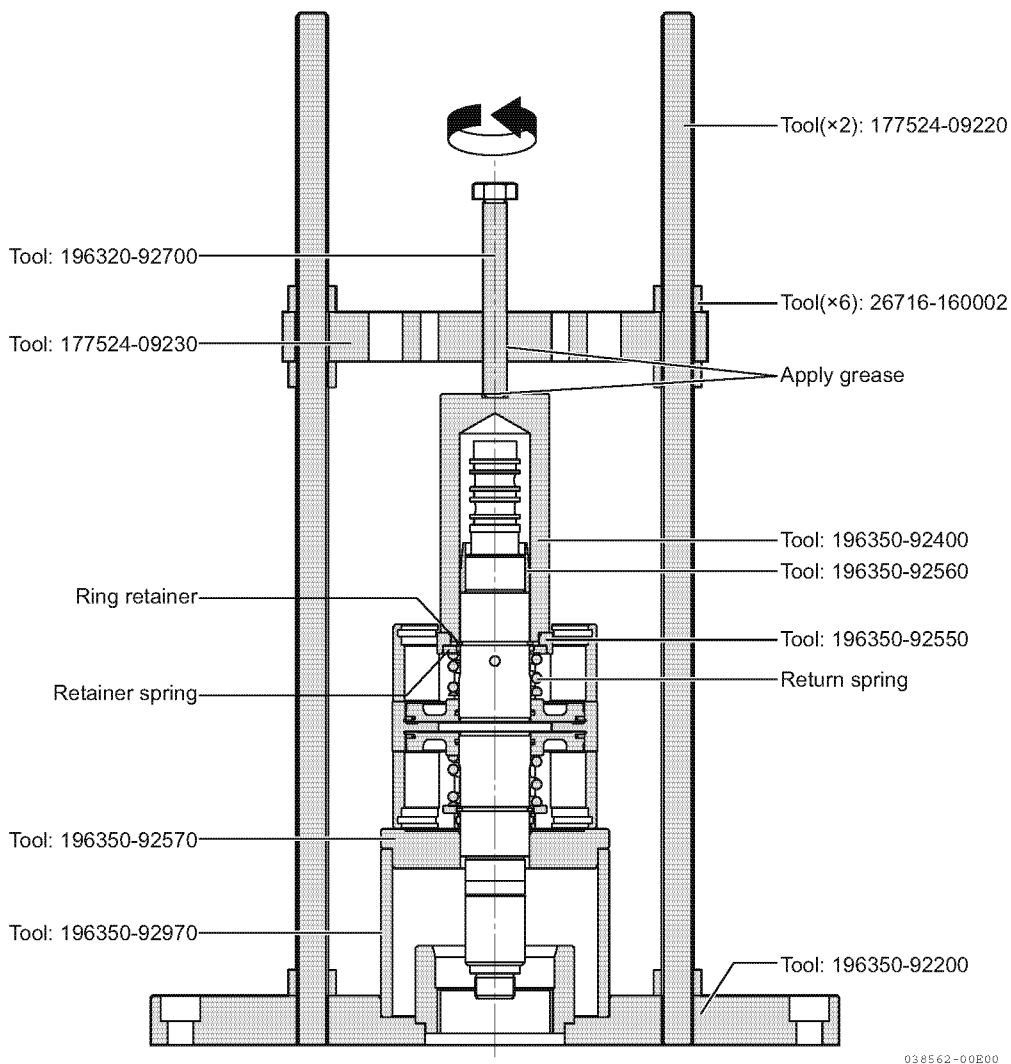
## Ring Retainer Assembly

1. Replace the seal ring and piston ring.

*Note: During assembly, apply lithium grease to seal ring, piston groove and ring. Use care when installing the piston assembly into the cylinder to not damage the piston ring. Stock shim material may be used to start the piston assembly into the cylinder.*

2. Assemble the special tools, as shown in **Figure 6-36**.
3. Press in the retainer spring and return spring by hand or use special tool P/N:196320-92700.
4. Install the ring retainer into the groove with a click. Be careful not to over-stroke, as the ring retainer can be pushed out of the groove.
5. Check that Dimension S (**Figure 6-36**) is approximately 116 mm (4.6 in.). Repeat procedure for opposite side.

*Note: Apply a mid-strength thread locking compound to the oil hole plug. Apply gear oil to the friction plate and steel plate.*



**Figure 6-36**



## DRIVESHAFT HOUSING ASSEMBLY

1. Install the clutch shaft set (Figure 6-37).

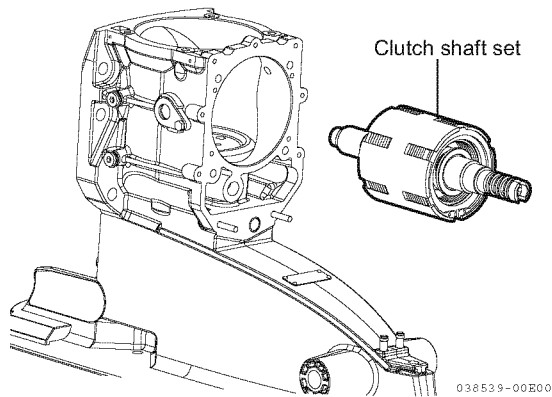


Figure 6-37

2. Install the upper gear "A", shims, needle bearing and thrust needle bearing to the front side, as shown in Figure 6-38.
3. Perform upper gear "B" shim adjustment. See *Upper Gear Shim Adjustment on page 6-39*.

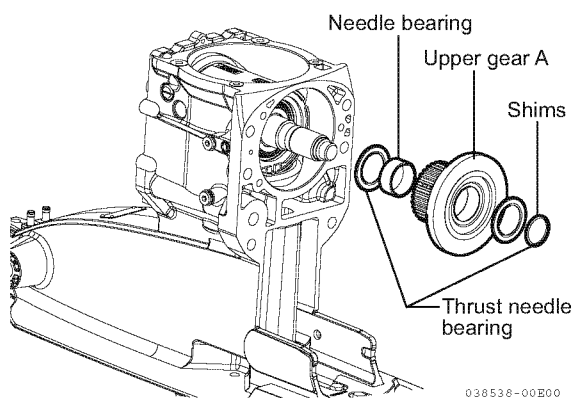


Figure 6-38

4. Install the upper gear "A", needle bearing, and thrust needle bearing to the rear side in the same manner as the front side.
5. Install the inner bearing to the clutch shaft CMP on both the front and rear sides (Figure 6-39).

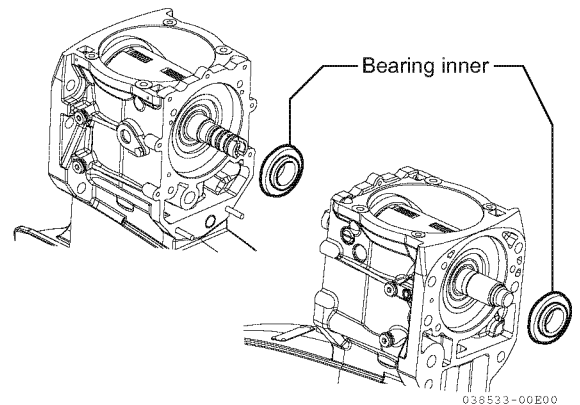


Figure 6-39

6. Install the oil seal into the front cover, as shown in Figure 6-40.

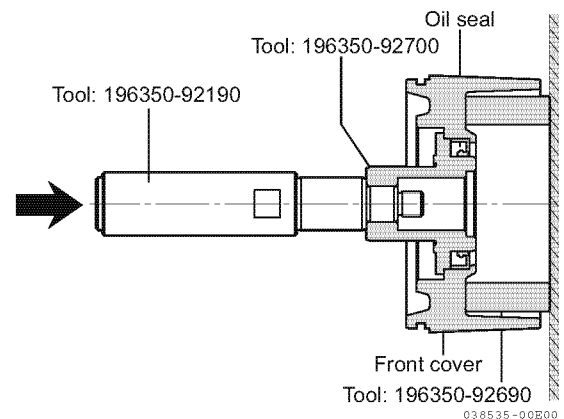
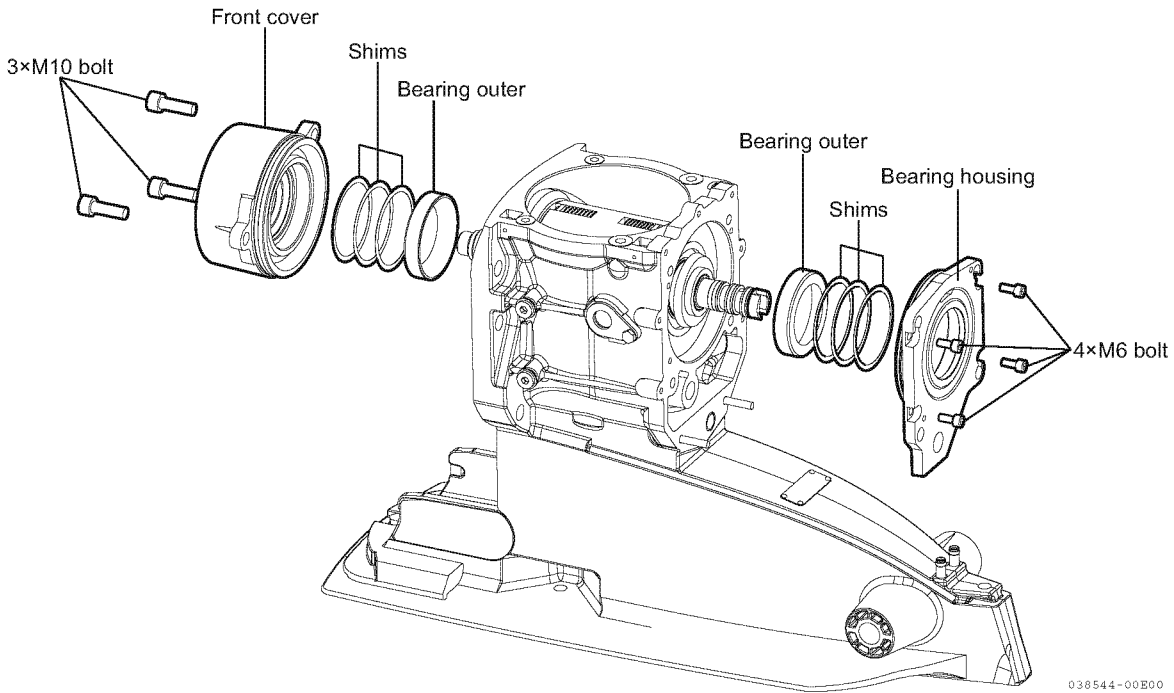


Figure 6-40

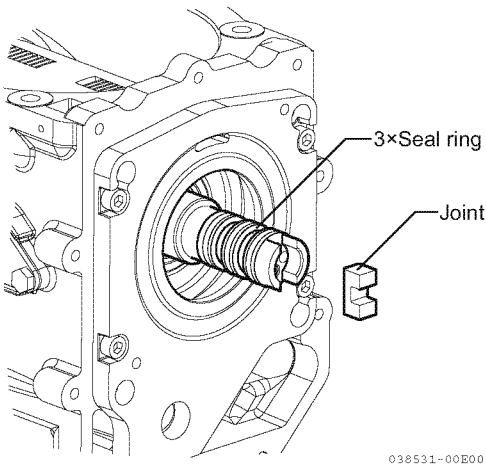
# DRIVESHAFT HOUSING

7. Install shim and outer bearing into front cover, as shown in **Figure 6-41**.
8. Install shim and outer bearing into bearing housing, as shown in **Figure 6-41**.  
*Note: Apply gear oil to the O-ring.*
9. Perform shim adjustment. See *Upper Gear Shim Adjustment* on page 6-39.

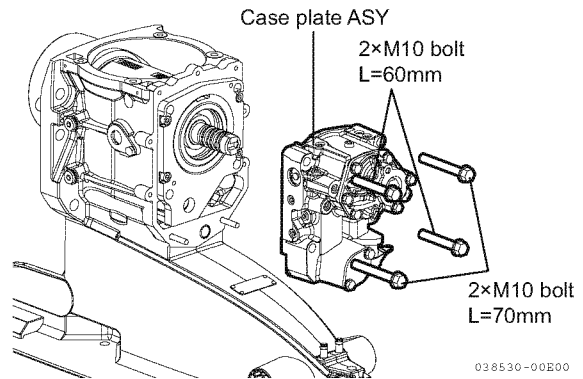


**Figure 6-41**

10. Install the three seal rings and coat with lithium grease (**Figure 6-42**).
11. Install pump joint (**Figure 6-42**).
12. Install the case plate assembly, while aligning the pump joint and pump connector in the case plate assembly, as shown in **Figure 6-43**.

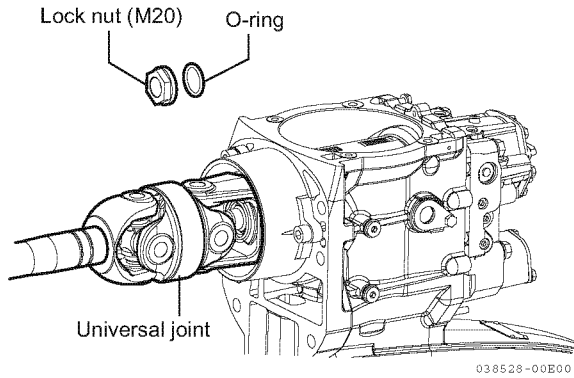


**Figure 6-42**



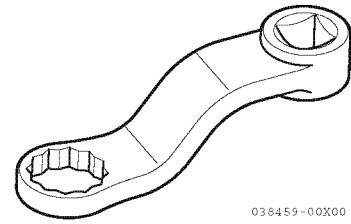
**Figure 6-43**

13. Apply lithium grease to O-ring, oil seal and spline of the universal joint, as shown in **Figure 6-47**.
14. Install the universal joint locknut O-ring and then while holding the universal joint, tighten the locknut (**Figure 6-44**) with special tools (**Figure 6-45**) and (**Figure 6-46**) to the specified tightening torque. See *Special Tightening Torques* on page 3-7.



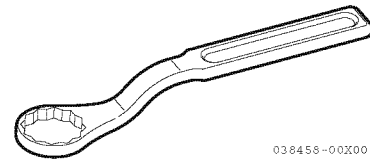
**Figure 6-44**

**Special Tool - P/N 196350-92310**

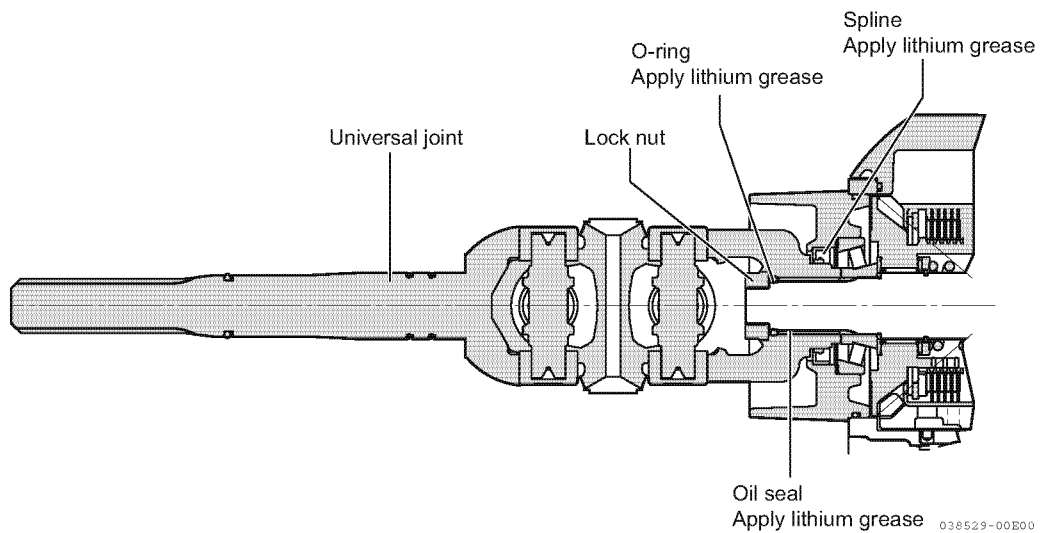


**Figure 6-45**

**Special Tool - P/N 196350-92300**



**Figure 6-46**



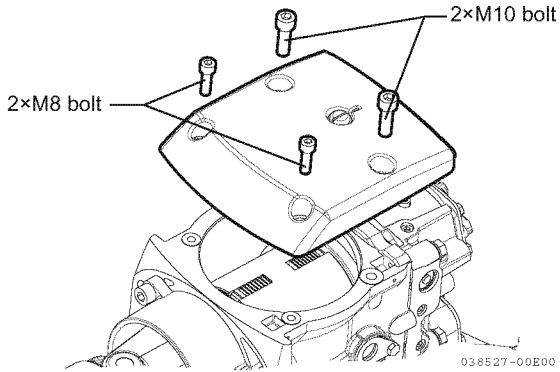
**Figure 6-47**

# DRIVESHAFT HOUSING

15. Install top cover, being careful not to cut the O-ring during installation.

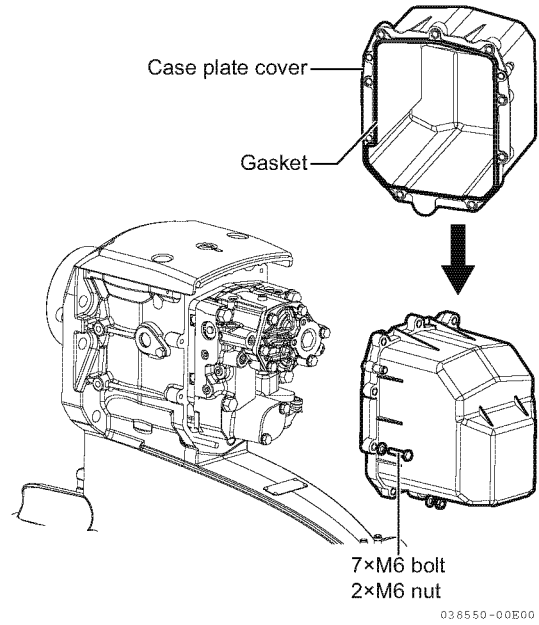
*Note: Apply gear oil to the O-ring.*

16. Apply liquid gasket Three Bond® 1215 or equivalent to bolt threads, then install and tighten bolts (**Figure 6-48**).



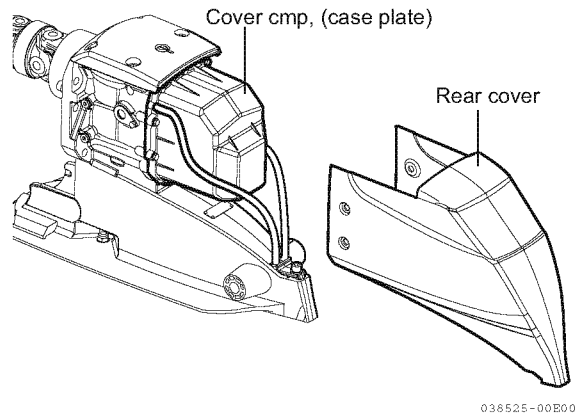
**Figure 6-48**

17. Apply lithium grease to the case plate cover gasket, then install the case plate cover and tighten bolts and nuts, as shown in **Figure 6-49**.



**Figure 6-49**

18. Install the rear cover and tighten bolts (**Figure 6-50**).



**Figure 6-50**

## UPPER GEAR SHIM ADJUSTMENT

Perform the following procedures to determine the shims needed for bearing and gear clearance of the following:

- Determine gear housing standard dimensions. See *Determine Housing Standard Dimensions on page 6-41*.
- T1 = Gear B. See *Determine T1 Shim Thickness - Gear Adjustment "B" Position on page 6-42*.
- T2 = Gear A-1. See *Determine T2 Shim Thickness - Gear Adjustment "A-1" Position on page 6-42*.
- T3 = Gear A-2. See *Determine T3 Shim Thickness - Gear Adjustment "A-2" Position on page 6-43*.
- T4 = Bearing Clearance. See *Determine T4 Shim Thickness - Bearing Clearance Adjustment on page 6-43*.
- Gear Backlash. See *Setting Gear Backlash on page 6-45*.

Use the following chart with **Figure 6-51** as reference to determine shims needed.

Symbol (see Fig. 6-51)	Description	Standard Dimension (mm)	Read, Measure or Calculate Measurement
A	Driveshaft housing vertical dimension (This dimension is stamped on driveshaft housing)	116.7 +/- 0.05	Read
C	Driveshaft housing horizontal dimension (This dimension is stamped on driveshaft housing)	85.0 +/- 0.05	Read
*1	Spacer thickness	8.0 +/- 0.05	Measure
*2	Bearing width	43.25 +/- 0.15	Measure
*3	Bearing housing depth	4.0 +/-	Measure
*4	Bearing width	20.75 +/-	Measure
*5	Clutch shaft length	133 +/-	Measure
*6	Bearing height	5.75 +/-	Calculate and measure
*7	Front cover depth	6.7 +/-	Measure
T1	Adjustment of GEAR B position	0.45	Calculate
T2	Adjustment of GEAR A-1 position	0.75	Calculate
T3	Adjustment of GEAR A-2 position	2.0	Calculate
T4	Adjustment bearing clearance	0.95	Calculate

## Shim Location

### Cross Section View

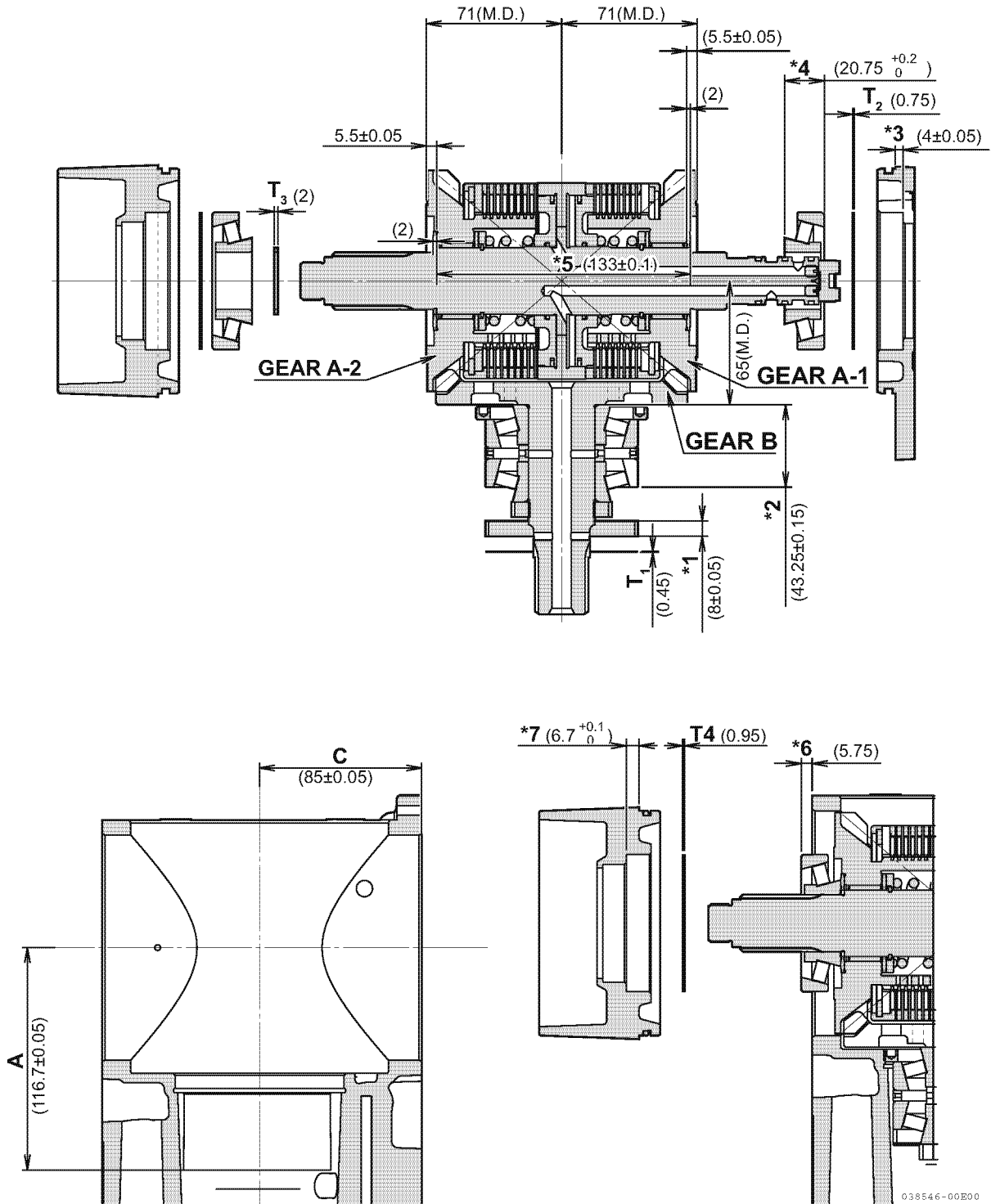
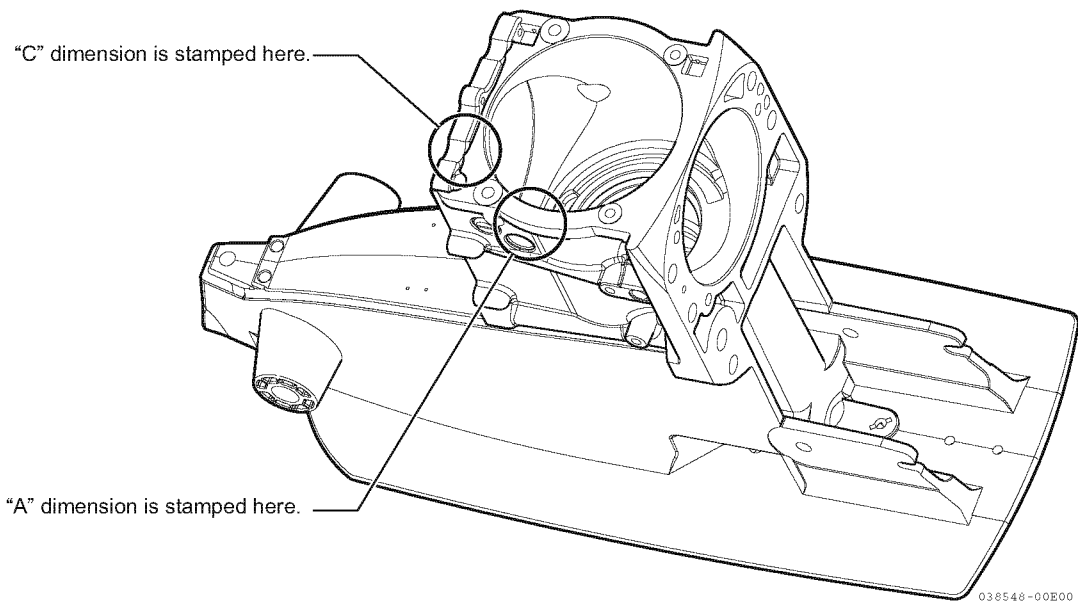


Figure 6-51

## Determine Housing Standard Dimensions

Check and record the "A" and "C" standard dimensions, as shown in **Figure 6-52**.



**Figure 6-52**

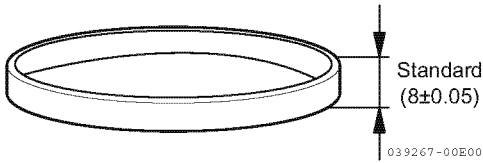
# DRIVESHAFT HOUSING

## Determine T1 Shim Thickness - Gear Adjustment "B" Position

<b>Standard Dimension "A" is 116.7 mm (4.63 in.).</b>
Confirm stamped letters on Driveshaft housing.
All dimensions are in mm
Example 1: $A + 2 = 116.72$ or $116.7 + 0.02 = 116.72$
Example 2: $A - 2 = 116.68$ or $116.7 - 0.02 = 116.68$

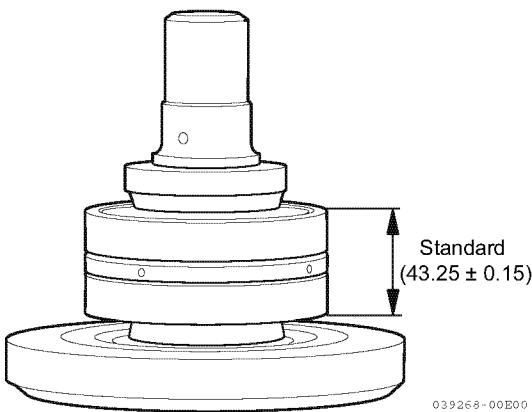
- See **Figure 6-51** for shim location.
  - All dimensions are in millimeters.
  - Illustrations may show gear teeth removed for clarity.
1. Measure and record the "\*1" and "\*2" dimensions.
  2. Calculate T1 shim thickness.  
 $T1 = A - *1 - *2 - 65$  (T1 tolerance +/- 0.025)  
 Example:  $T1 = 116.7 - 8 - 43.25 - 65 +/- 0.025 = 0.425$  to  $0.475$  (Use 0.45 mm shim thickness)

### \*1 - Spacer Thickness



**Figure 6-53**

### \*2 - Bearing Width



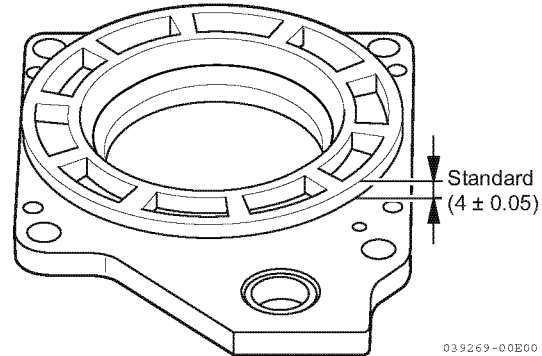
**Figure 6-54**

## Determine T2 Shim Thickness - Gear Adjustment "A-1" Position

<b>Standard Dimension "C" is 85 mm (3.35 in.).</b>
Confirm stamped letters on Driveshaft housing.
All dimensions are in mm
Example 1: $C + 2 = 85.02$ or $85 + 0.02 = 85.02$
Example 2: $C - 2 = 84.98$ or $85 - 0.02 = 84.98$

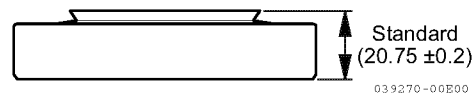
- See **Figure 6-51** for shim location.
  - All dimensions are in millimeters.
1. Measure and record the "\*3" and "\*4" dimension.
  2. Calculate T2 shim thickness.  
 $T2 = C + *3 - *4 - 67.5$  (T2 tolerance +/- 0.025)  
*Note: It is not necessary to install the O-ring into the bearing housing while adjusting shims.*  
 Example:  $T2 = (85 + 4 - 20.75 - 67.5 +/- 0.025 = 0.725$  to  $0.775$  (Use 0.75 mm shim thickness)

### \*3 - Bearing Housing Depth



**Figure 6-55**

### \*4 - Bearing Width



**Figure 6-56**



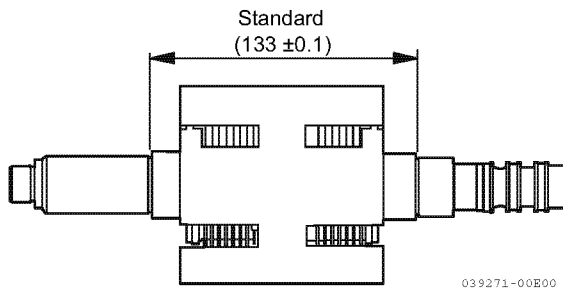
## Determine T3 Shim Thickness - Gear Adjustment "A-2" Position

- See **Figure 6-51** for shim location.
  - All dimensions are in millimeters.
1. Measure and record the "\*5" dimension.
  2. Calculate T3 shim thickness.

$$T3 = 135 - *5 \text{ (T3 tolerance } \pm 0.05)$$

Example:  $T3 = (135.0 - 133.0 \pm 0.05 = 1.95 \text{ to } 2.05)$  (Use 2.0 mm shim thickness)

### \*5 - Clutch Shaft Length



**Figure 6-57**

## Determine T4 Shim Thickness - Bearing Clearance Adjustment

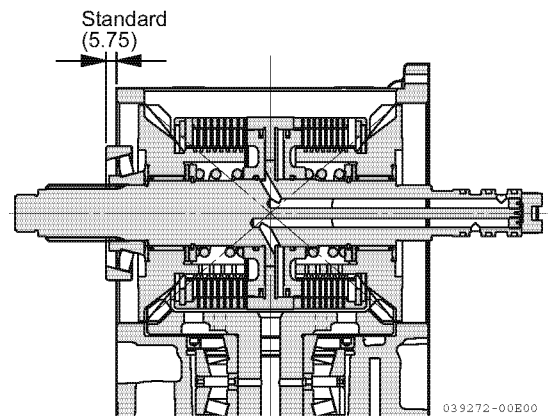
- See **Figure 6-51** for shim location.
  - All dimensions are in millimeters.
1. Measure and record the "\*6" and "\*7" dimension. See *Measuring the \*6 Dimension on page 6-44.*
  2. Calculate T4 shim thickness.

$$T4 = *7 - *6 \text{ (T4 tolerance } \pm 0.05)$$

*Note: It is not necessary to install the O-ring into the front cover while adjusting shims.*

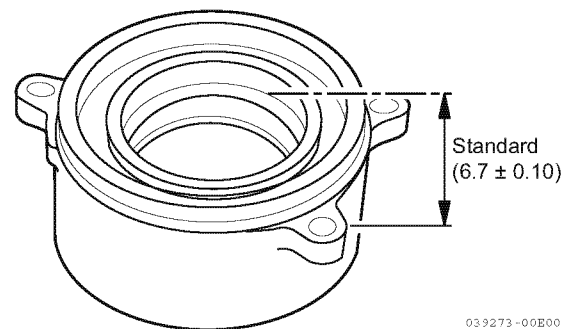
Example:  $T4 = (6.7 - 5.75) \pm 0.025 = 0.925 \text{ to } 0.975$  (Use 0.95 mm shim thickness)

### \*6 - Bearing Height



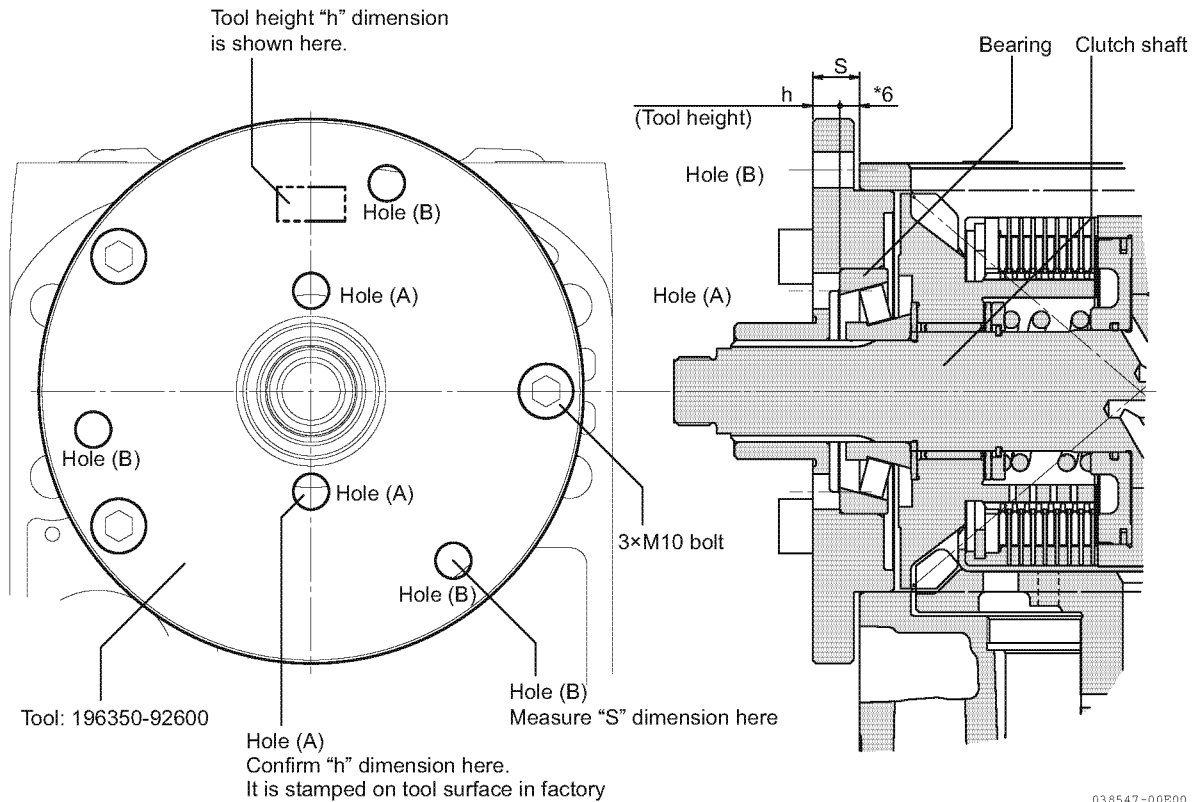
**Figure 6-58**

### \*7 - Front Cover Depth



**Figure 6-59**

## Measuring the \*6 Dimension



**Figure 6-60**

1. Install special tool P/N 196350-92600 using three M10 bolts hand tight, as shown in **Figure 6-60**.

*Note: If the clutch shaft cannot be turned by hand, loosen the three M10 bolts.*

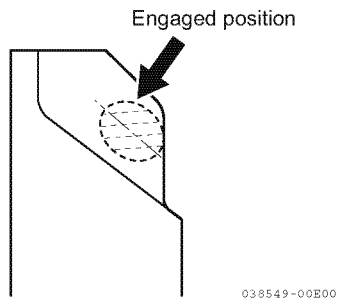
2. Measure and calculate the depth of \*6:  

$$*6 = S - h$$
 Tool height "h" dimension is stamped on special tool P/N 196350-92600.

## Setting Gear Backlash

- Gear A-1: 0.17 - 0.36 mm
- Gear A-2: 0.17 - 0.36 mm

*Note: Check the engaged position on teeth surface (Figure 6-61). Optimal gear backlash is achieved by setting equal backlash on both gears within the tolerance.*



**Figure 6-61**

- If Gear A-1 backlash > 0.36  
Increase "T2" shim thickness.
- If Gear A-1 backlash < 0.17  
Decrease "T2" shim thickness.
- If Gear A-2 backlash > 0.36  
Decrease "T3" shim thickness.
- If Gear A-2 backlash < 0.17  
Increase "T3" shim thickness.

*Note: Measure the above backlash while holding Gear "B". After determining shims, install O-ring to front cover and bearing housing.*

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*Section 7*

# **GEAR HOUSING**

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Gear Housing Part Diagrams .....	7-6
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Gear Housing Disassembly .....	7-12
Gear Housing Assembly.....	7-21
Driveshaft CMP Assembly.....	7-38
Install Driveshaft CMP and Lower Pinion Gear to Gear Housing .....	7-40
Install Inner Propeller Shaft .....	7-45

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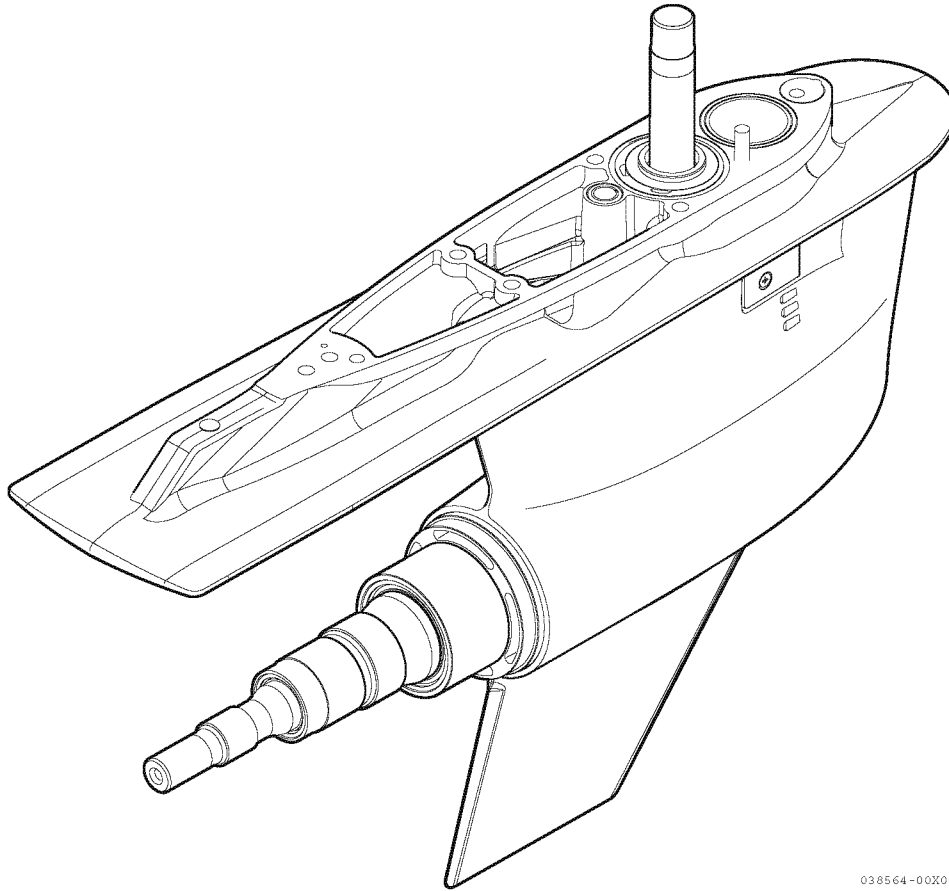
### **SAFETY PRECAUTIONS**

Before servicing the stern drive, review *Safety on page 2-1*.

### **INTRODUCTION**

This section of the *Service Manual* describes the procedures necessary to disassemble and assemble the gear housing.

External View

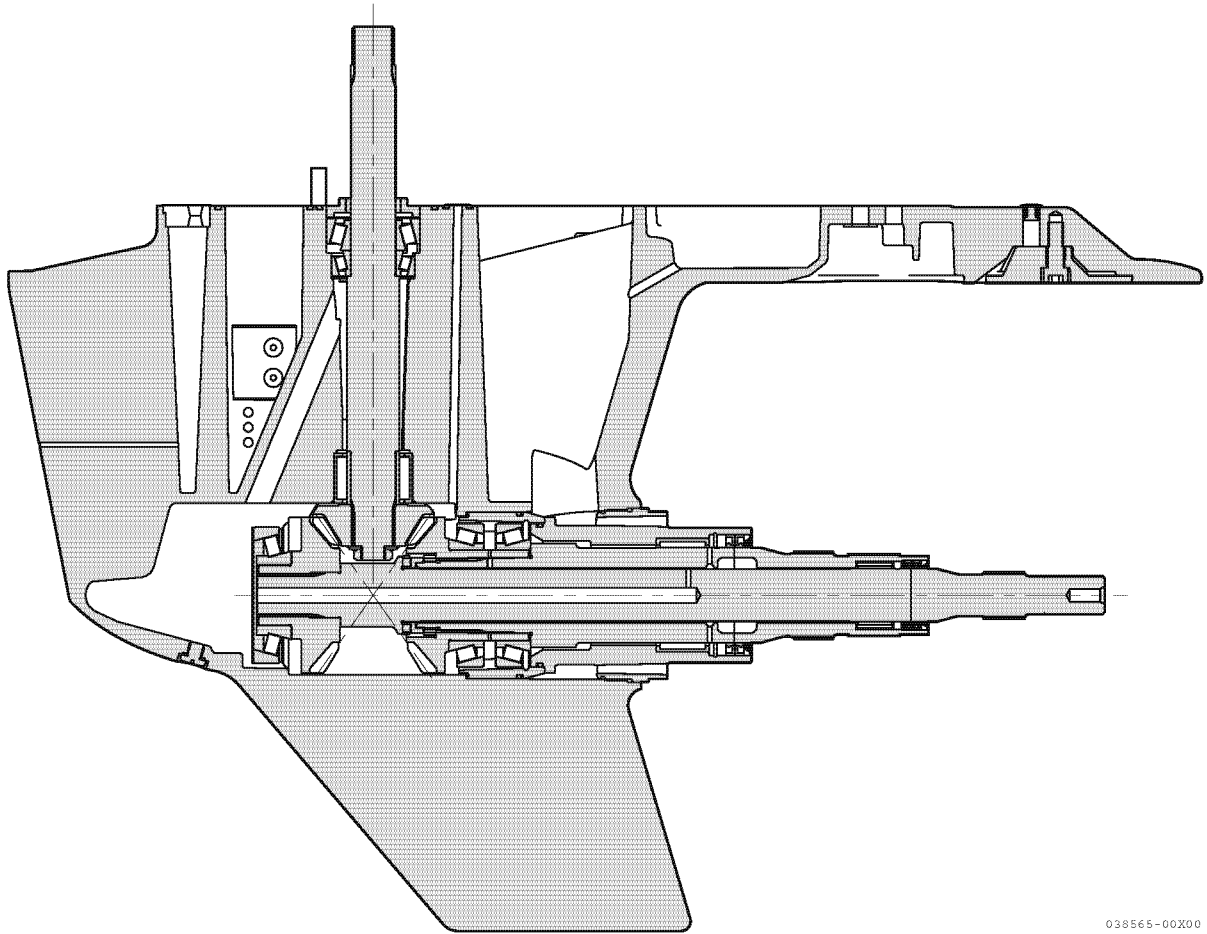


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*Figure 7-1*



Cross Section View

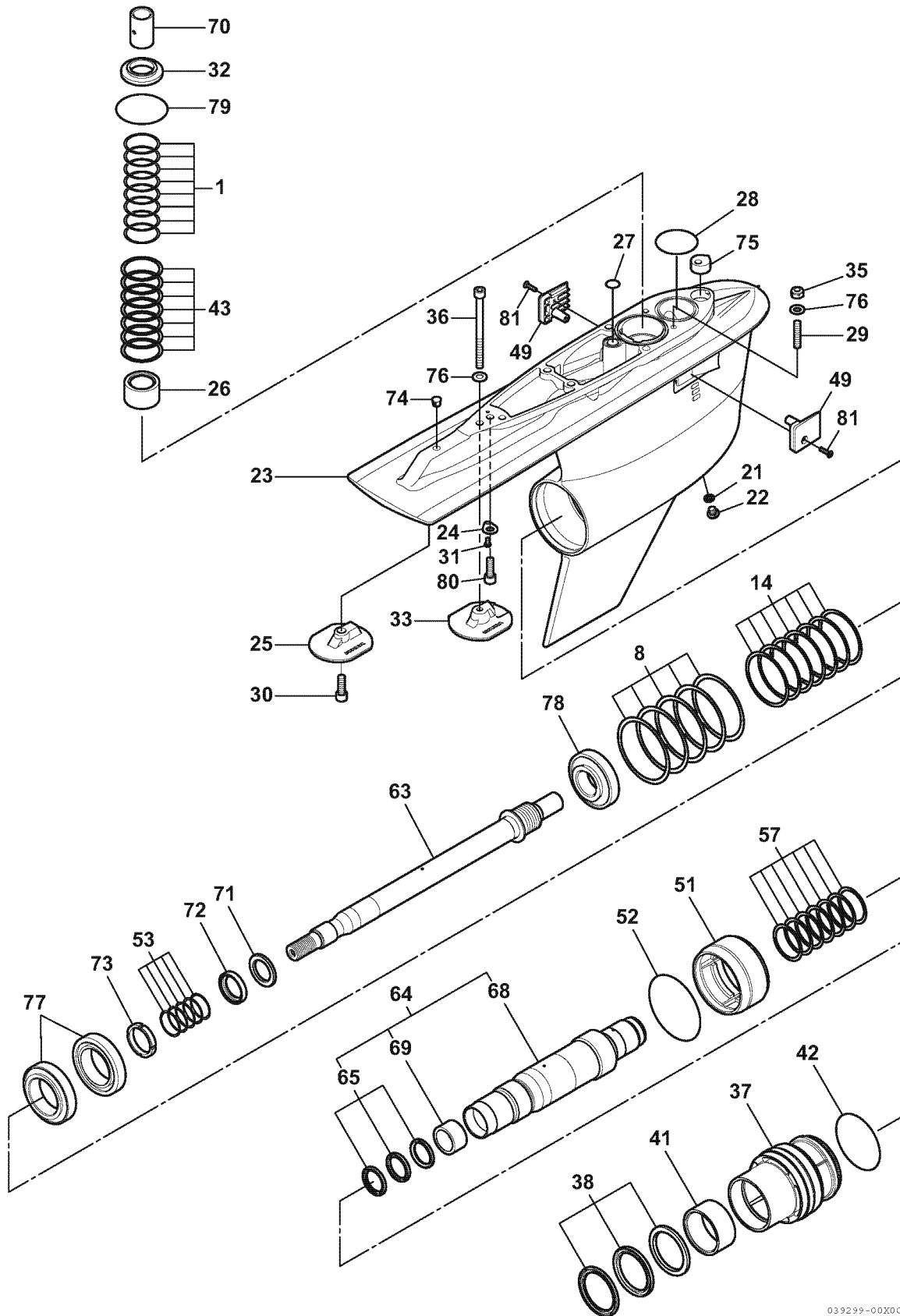


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Figure 7-2

GEAR HOUSING PART DIAGRAMS

Gear Housing Assembly



039299-00X00

Figure 7-3

## GEAR HOUSING

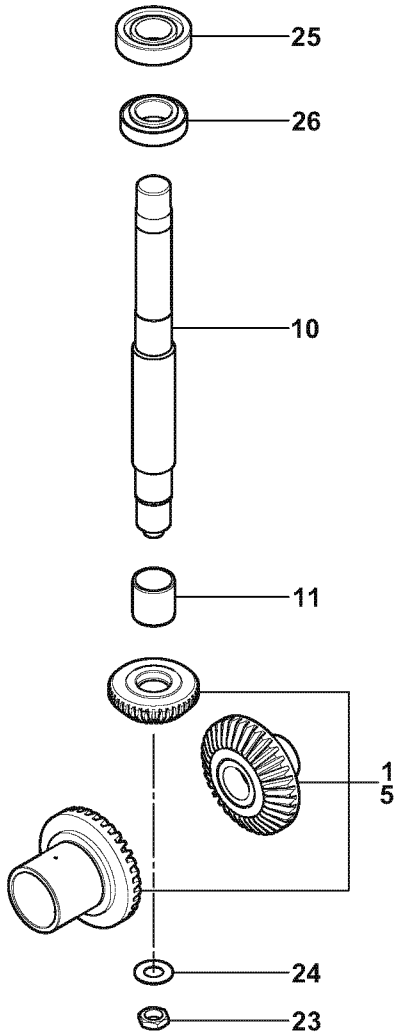
Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-02110	Shims Set 55/45	1	1	
8	196350-02240	Shims Set 110/105	1	1	
14	196327-02320	Shim Set	1	1	
21	189010-01130	Gasket	1	1	
22	196324-02420	Plug	1	1	
23	196350-02521	Gear Housing	1	1	
24	196350-02540	Ground Plate	1	1	
25	196350-02570	Anode Plate B	1	1	
26	196350-04420	N.Bearing 355233	1	1	
27	24311-000180	O-Ring P-18	1	1	
28	24321-000600	O-Ring G-60	1	1	
29	26223-100252	Stud Bolt M10 × 25	2	2	
30	26453-100302	Bolt M10 × 30	1	1	
31	26553-050102	Screw M5 × 10	1	1	
32	196350-02530	Spacer	1	1	
33	196350-02550	Anode Plate A	1	1	
34	196350-02560	Bolt 10 × 30	1	1	
35	196350-02590	Nylon Nut 10	2	2	
37	196350-02611	Bearing Carrier	1	1	
38	196350-02620	Oil Seal Outer	1	1	
41	196350-04430	N.Bearing 637535	1	1	
42	24321-000900	O-Ring G-90	1	1	

Item	Part Number	Description	ZT350	ZT370	N/O
43	196320-02650	Shim Set	1	1	
49	196350-02650	Slit Suction	2	2	
51	196350-02720	BRG Housing	1	1	
52	24321-001050	O-Ring G-105	1	1	
53	196350-04100	Shim Set 43/36	1	1	
57	196350-04140	Shim Set 60/50	1	1	
63	196350-04510	Shaft Inner	1	1	
64	196350-04520	Shaft Outer CMP	1	1	
65	196350-02670	Oil Seal Inner	1	1	
68	196350-04530	Shaft Outer	1	1	
69	24162-354525	Needle Bearing	1	1	
70	196350-04871	Spline Sleeve	1	1	
71	196350-04880	Bearing 81107	1	1	
72	196350-04890	Bushing	1	1	
73	196350-04900	Lock Nut M45 × 1.5	1	1	
74	196350-12810	Hole Plug 11	1	1	
75	196350-12820	Seal	1	1	
76	22133-100000	Washer 10	3	3	
77	24142-320120	Bearing 32012H	2	2	
78	24144-303080	Roller Bearing	1	1	
79	24321-000750	O-Ring G-75	1	1	
80	26453-100302	Bolt M10 × 30	1	1	
81	26573-050202	Screw 5 × 20	2	2	

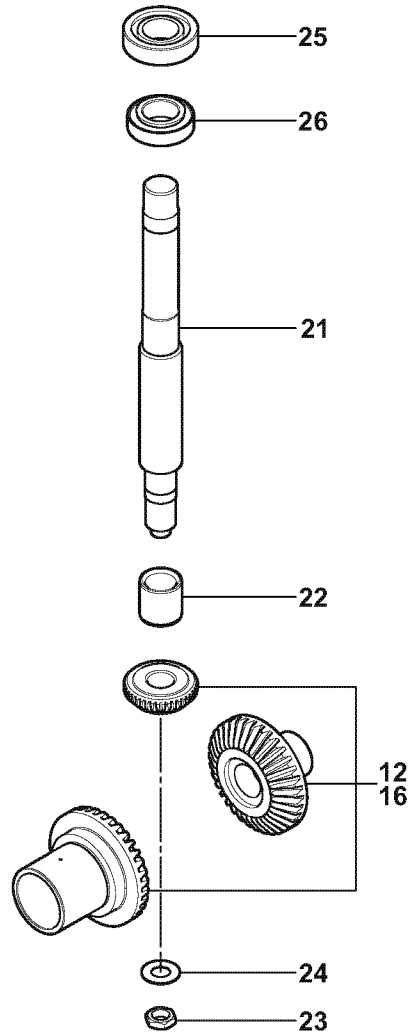
# GEAR HOUSING

## Driveshaft and Gears

I=1.65  
I=1.78



I=1.97  
I=2.18



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Figure 7-4

Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-04610	Gear Assy 17/24	1	1	
5	196350-04660	Gear Assy 17/26	1	1	
10	196350-04850	Drive Shaft	1	1	
11	196350-04860	Ring Inner 303535	1	1	
12	196350-04710	Gear Assy 16/27	1	1	
16	196350-04760	Gear Assy 15/28	1	1	

Item	Part Number	Description	ZT350	ZT370	N/O
21	196350-04820	Drive Shaft	1	1	
22	196350-04830	Ring Inner 263535	1	1	
23	196350-04910	Nut 16	1	1	
24	196350-04920	Coned Disc SP	1	1	
25	196350-04930	Bearing 32206	1	1	
26	24141-320060	Roller Bearing	1	1	

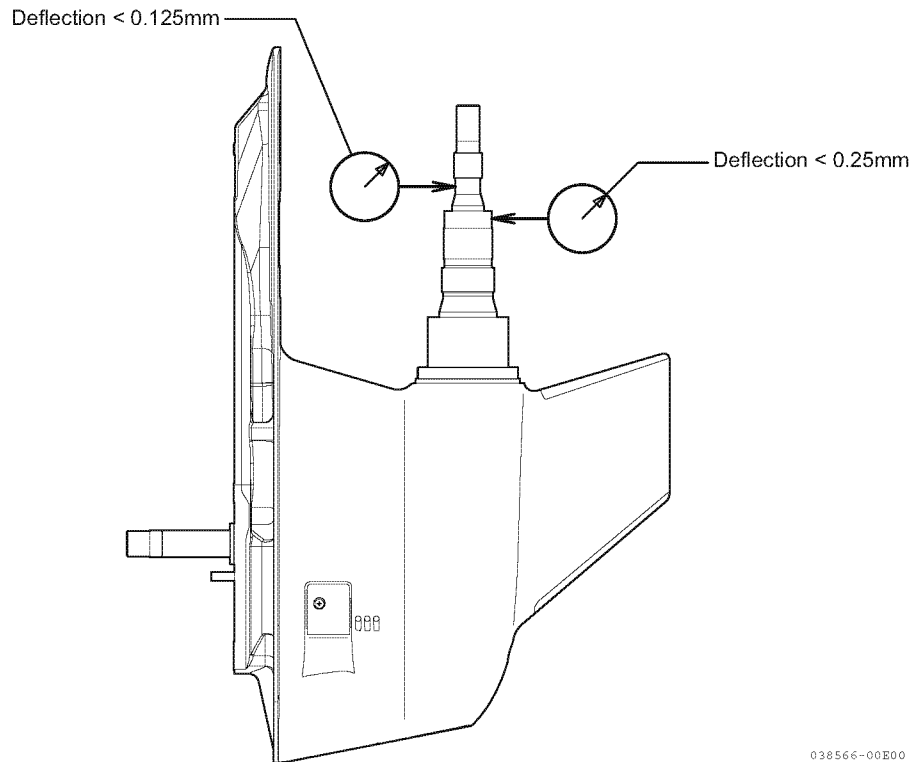
### NOTICE

Gear sets of different ratios are available. There are two different driveshafts available depending on the gear ratio used. Be aware of dimensional differences in these parts when changing these parts and when servicing these parts.

## DISASSEMBLY AND INSPECTION

Before disassembly, check the deflection and backlash.

1. Check the deflection or the bend of the propeller shaft by turning propeller shaft, as shown in **Figure 7-5**.

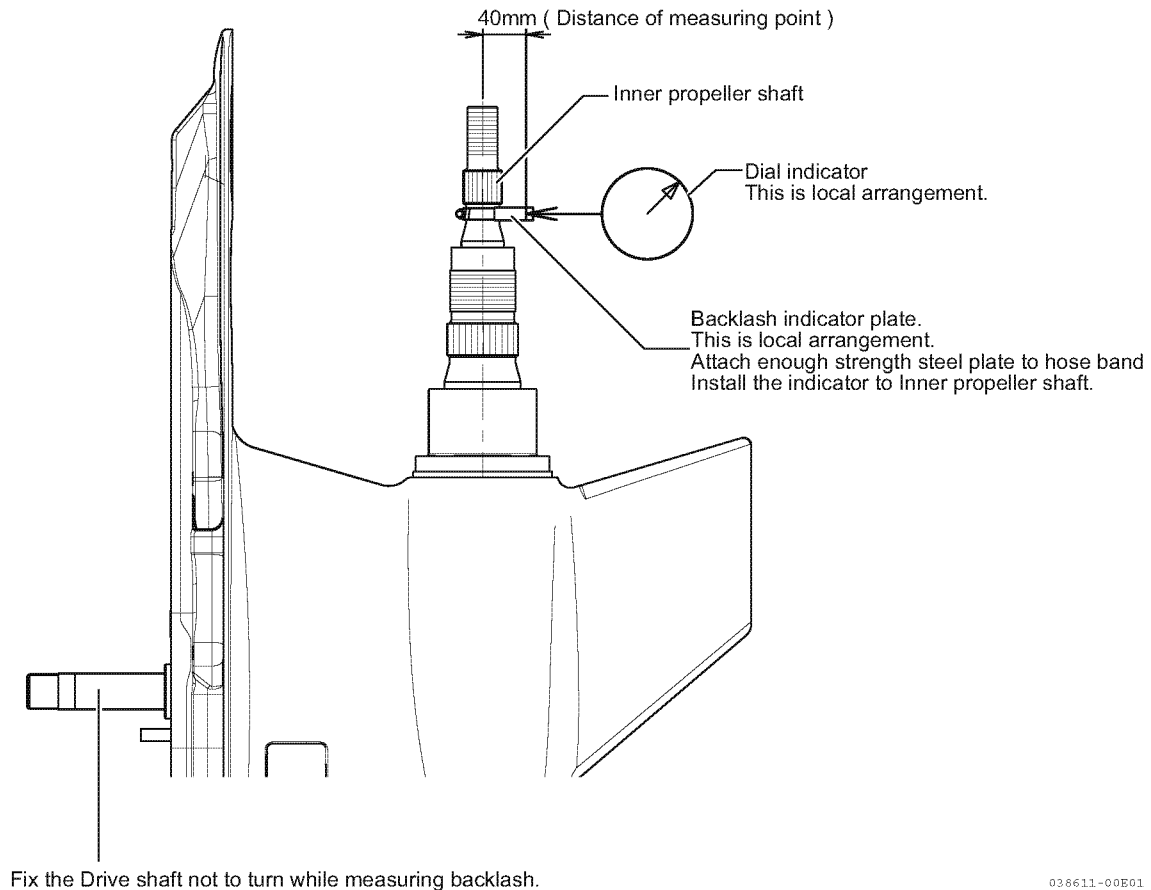


**Figure 7-5**

## GEAR HOUSING

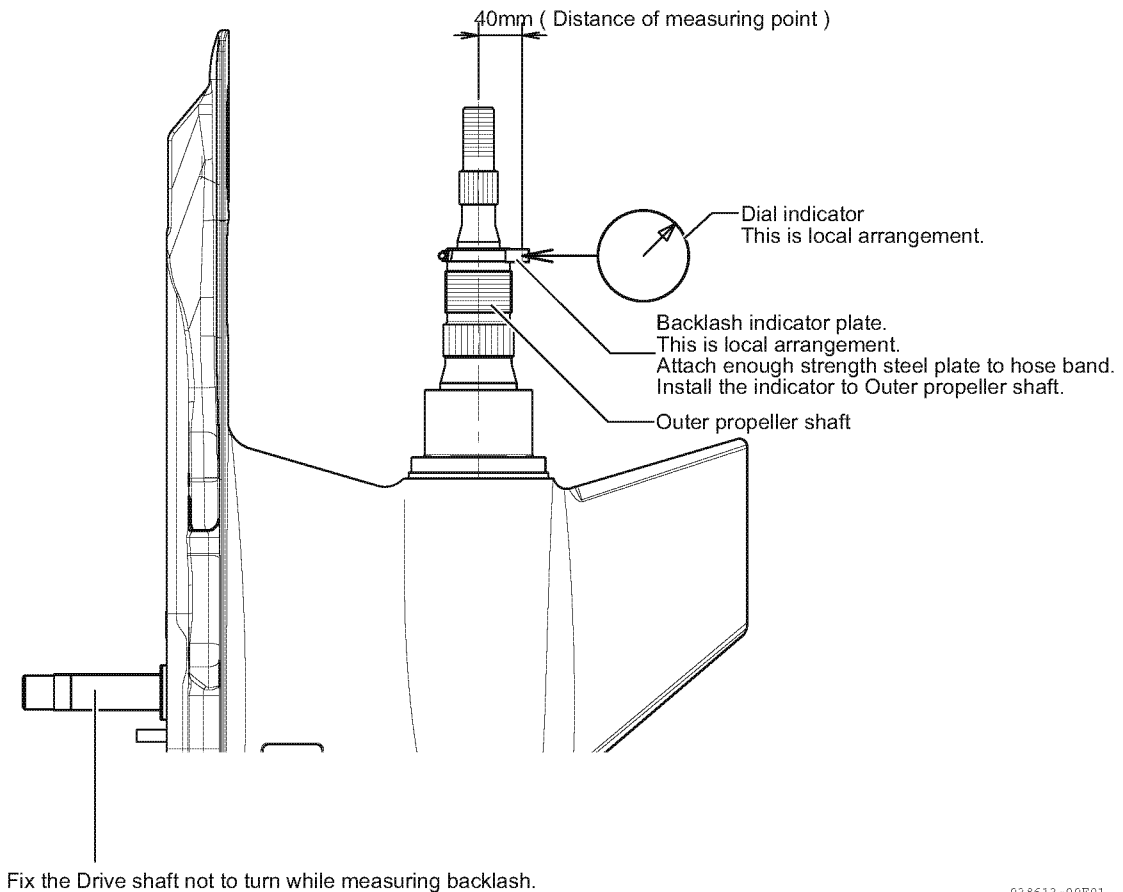
2. Check backlash between lower pinion gear and lower gear "A", as shown in **Figure 7-6**.

- Backlash: 0.16 to 0.32 mm
- Use a suitable tool (obtain locally) to lock the driveshaft in place, while checking backlash.
- Use a suitable tool as a backlash indicator plate (obtain locally) to attach to the propeller shaft. The dial indicator measurement point must be 40 mm from the center of the propeller shaft; deviation will result in incorrect backlash measurement.



**Figure 7-6**

3. Check backlash between lower pinion gear and lower gear "B", as shown in **Figure 7-7**.
  - Backlash: 0.16 to 0.32 mm
  - Use a suitable tool (obtain locally) to lock the driveshaft in place, while checking backlash.
  - Use a suitable tool as a backlash indicator plate (obtain locally) to attach to the propeller shaft. The dial indicator measurement point must be 40 mm from the center of the propeller shaft; deviation will result in incorrect backlash measurement.



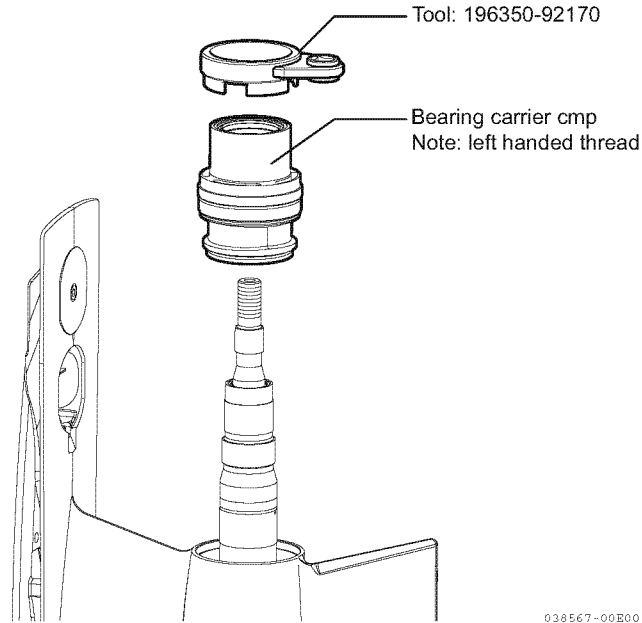
**Figure 7-7**

# GEAR HOUSING

## Gear Housing Disassembly

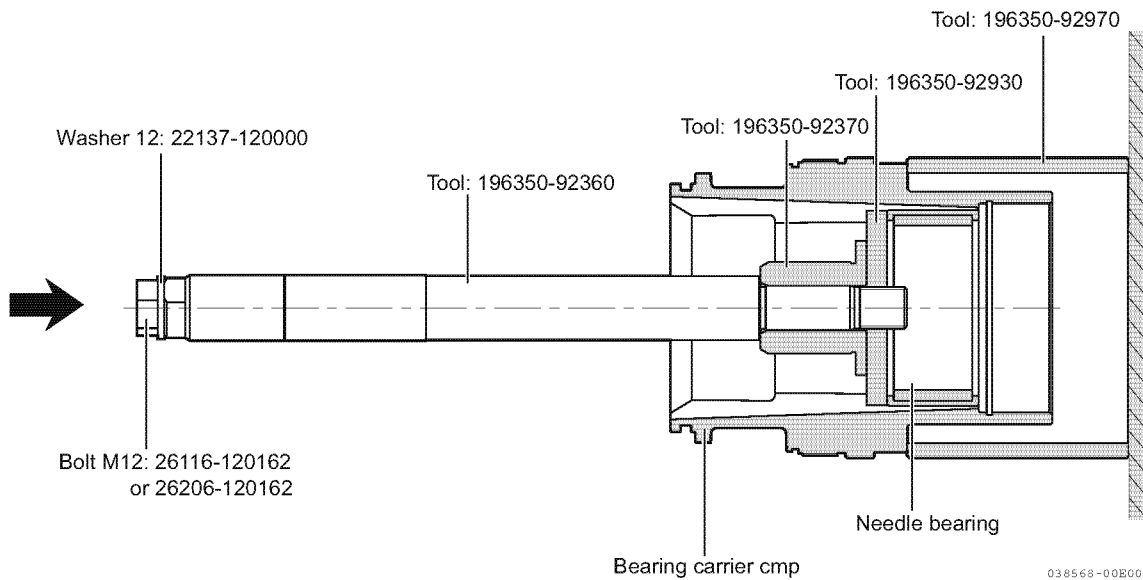
1. Remove bearing carrier CMP, as shown in **Figure 7-8**.

*Note: It may be necessary to strike the bearing carrier removal tool with a suitable tool, to loosen the bearing carrier. Use caution to avoid damaging parts.*



**Figure 7-8**

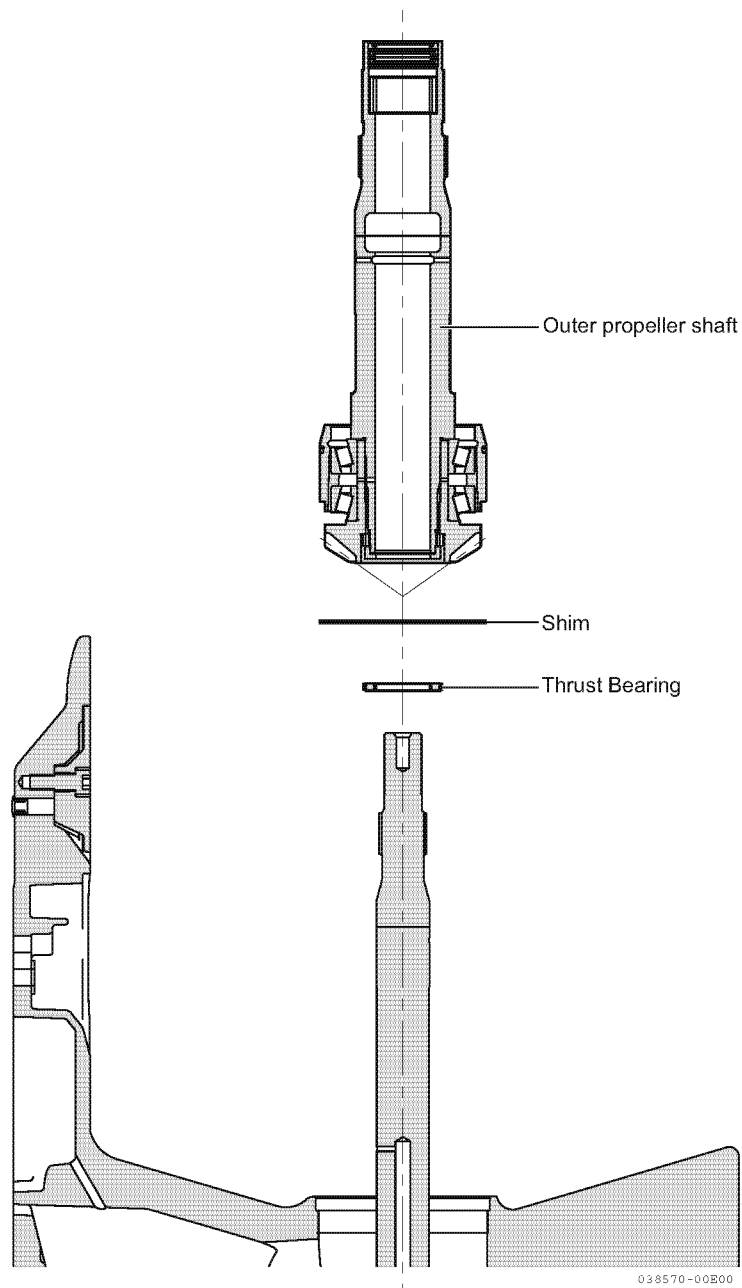
2. Disassemble the bearing carrier CMP, as shown in **Figure 7-9**, then remove the needle bearing.



**Figure 7-9**



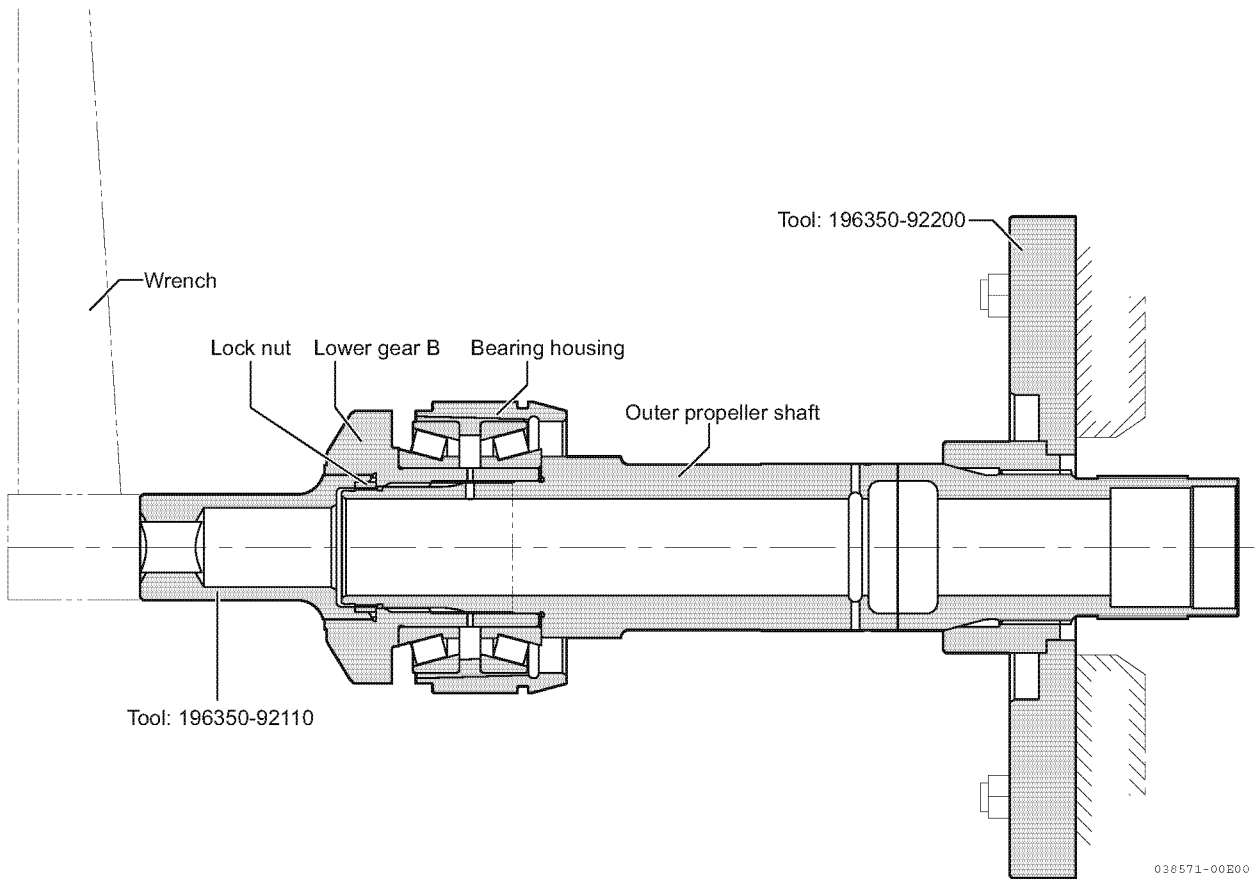
3. Remove the outer propeller shaft CMP, as shown in **Figure 7-10**.
4. Check and record the shim thickness.



**Figure 7-10**

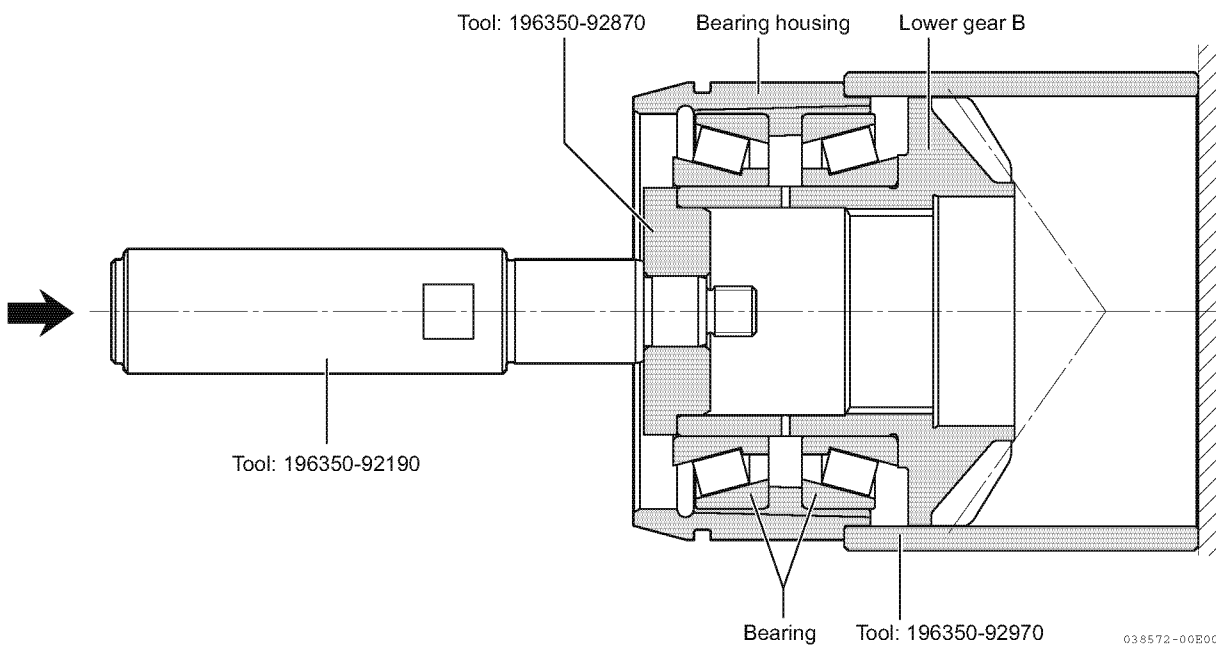
# GEAR HOUSING

5. Disassemble the outer propeller shaft CMP, by removing the locknut, as shown in **Figure 7-11**.



**Figure 7-11**

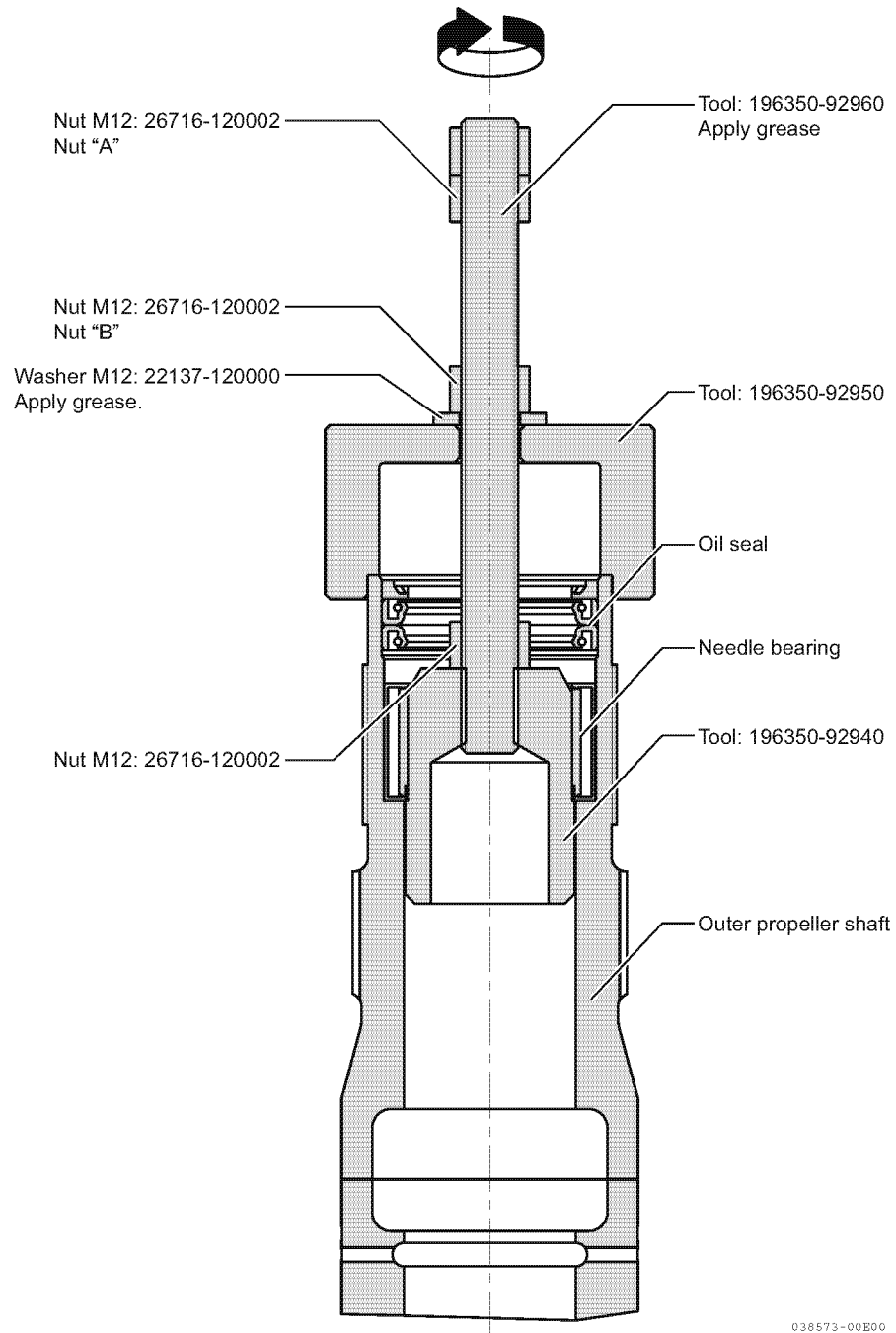
6. Remove the bearings from the bearing housing, as shown in **Figure 7-12**.



**Figure 7-12**

7. Remove the needle bearing and the oil seal from the outer propeller shaft CMP.
8. To remove, hold nut "A" with a wrench while tightening nut "B", as shown in **Figure 7-13**.

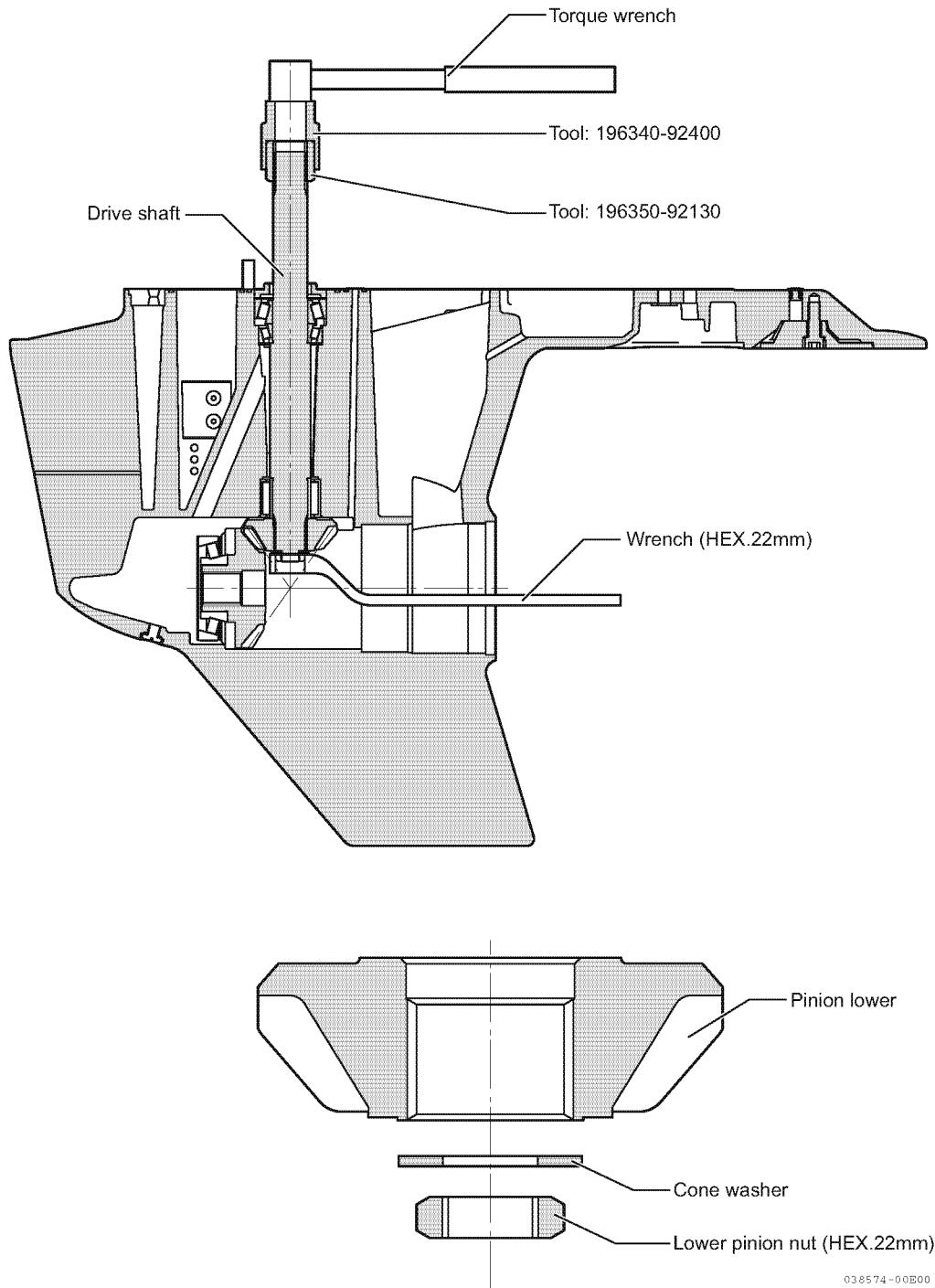
*Note: Discard needle bearing and oil seal.*



**Figure 7-13**

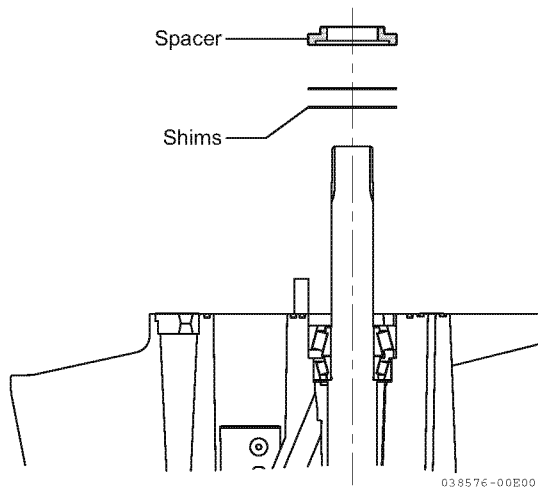
# GEAR HOUSING

9. While holding the lower pinion nut using a 22 mm hex wrench, loosen the lower pinion nut, as shown in Figure 7-14.



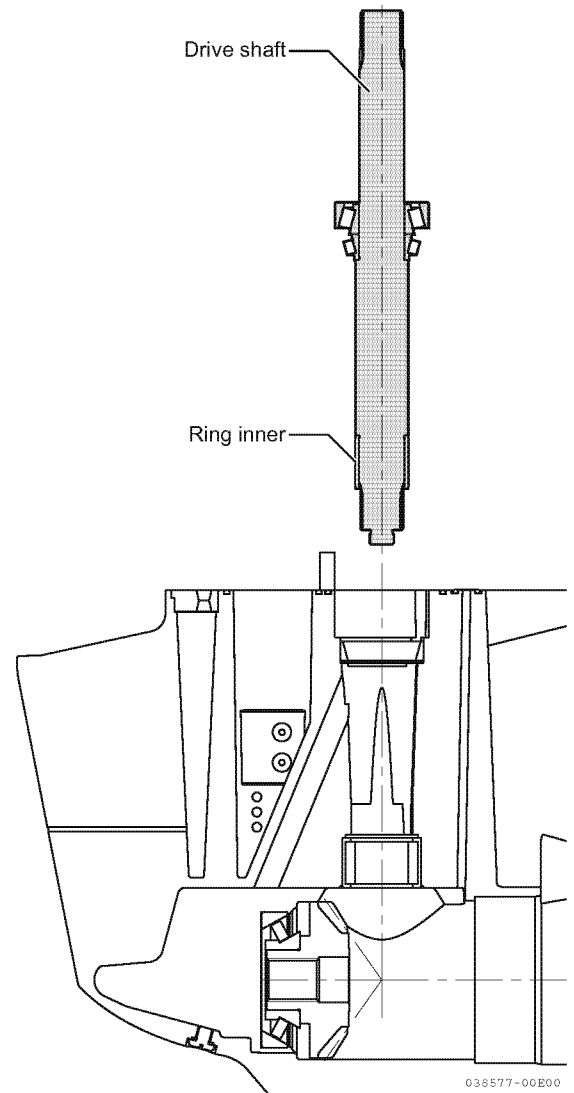
**Figure 7-14**

10. Remove the spacer and shims from gear housing, as shown in **Figure 7-15**.
11. Check and record the shim thickness.



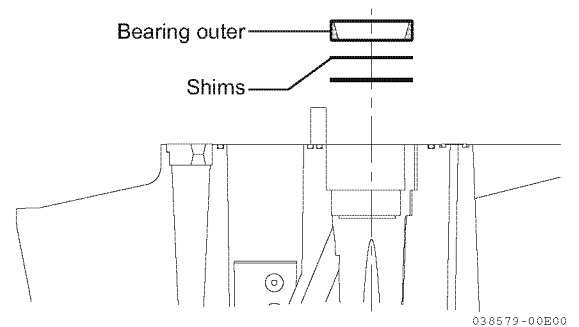
**Figure 7-15**

12. Remove the driveshaft, as shown in **Figure 7-16**.



**Figure 7-16**

13. Remove the bearing outer and shims, as shown in **Figure 7-17**.
14. Check and record the shim thicknesses.

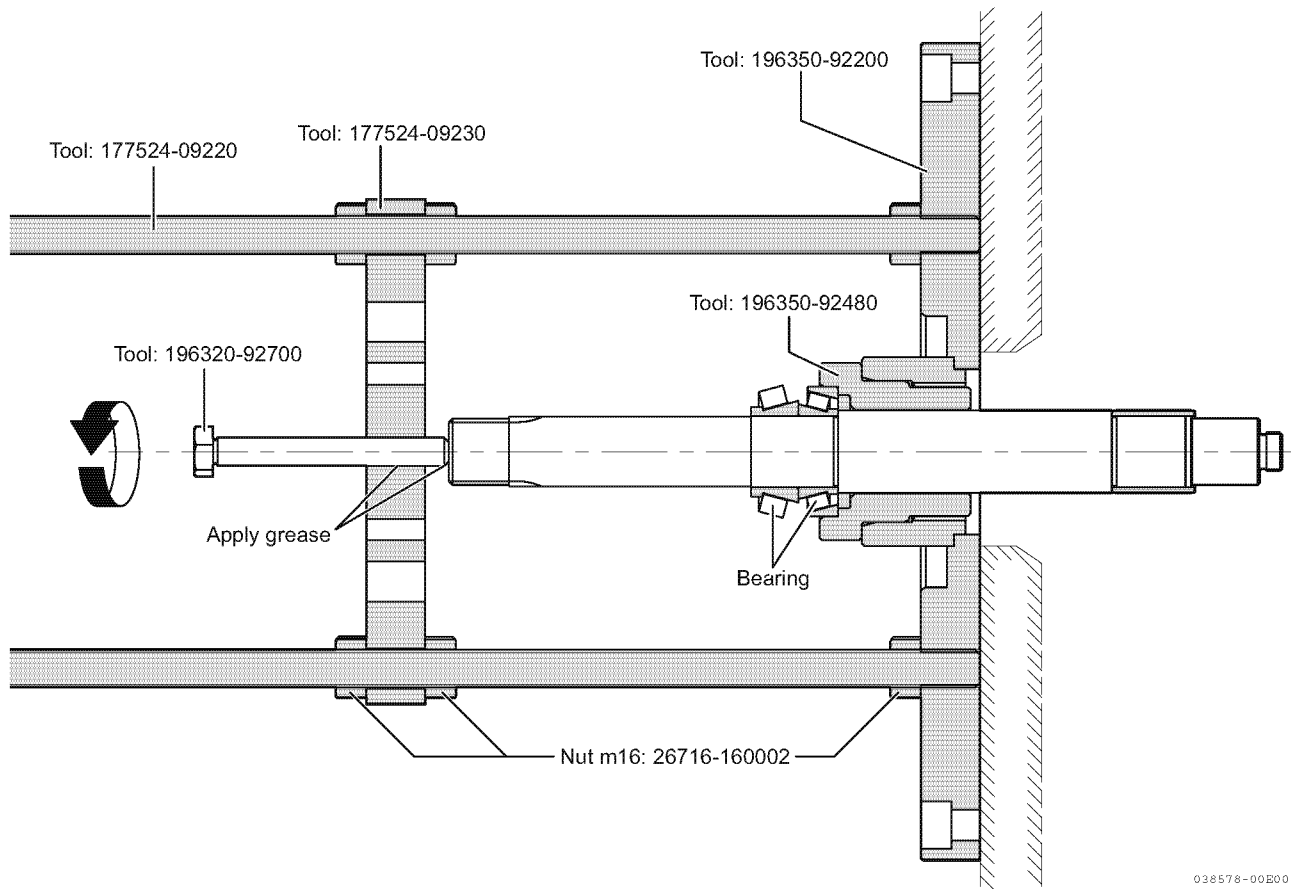


**Figure 7-17**

# GEAR HOUSING

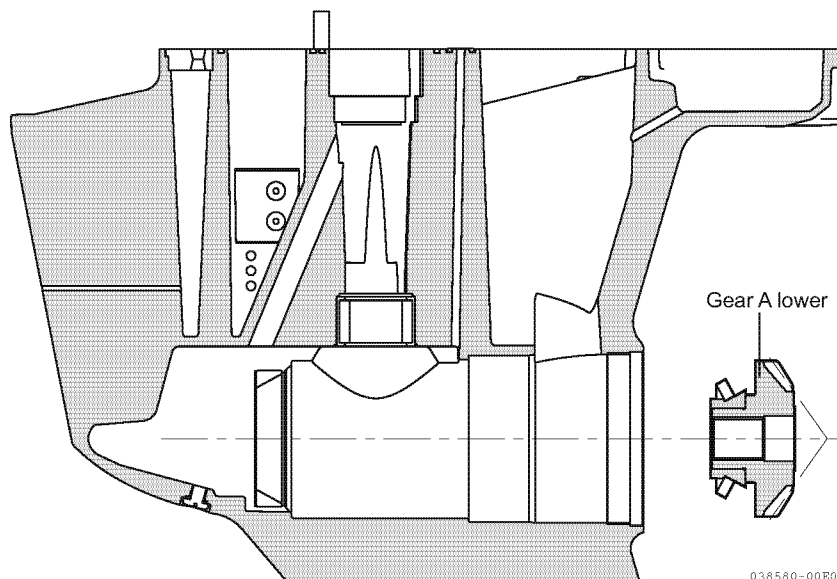
15. Remove the bearings from the driveshaft CMP, as shown in **Figure 7-18**.

*Note: Do not damage the spline area of driveshaft.*



**Figure 7-18**

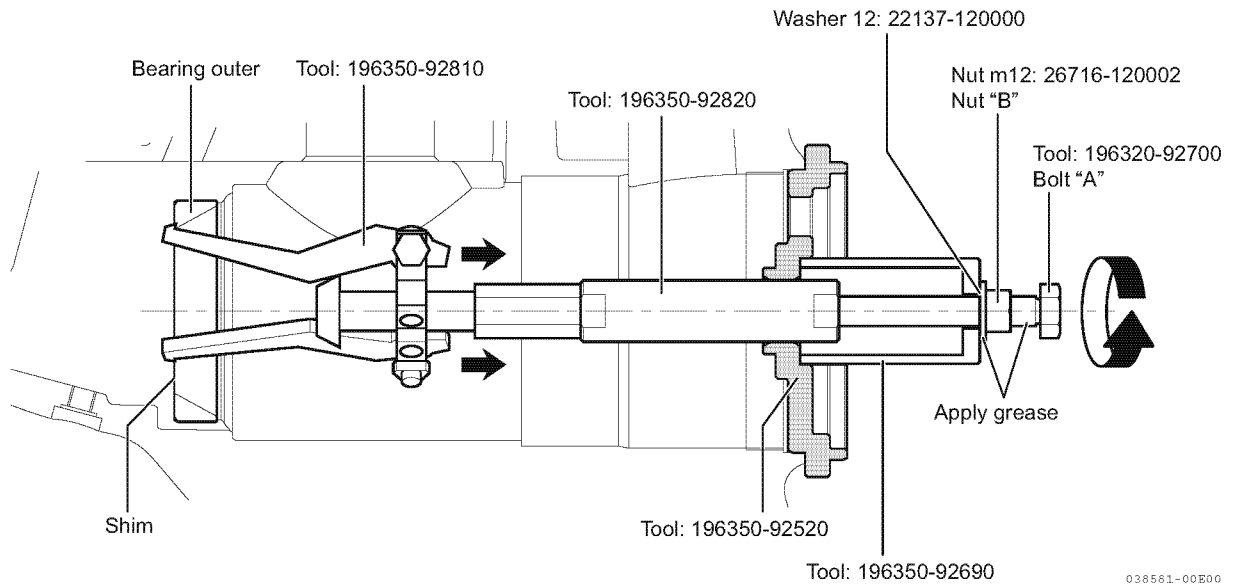
16. Remove the gear "A" lower, as shown in **Figure 7-19**.



**Figure 7-19**

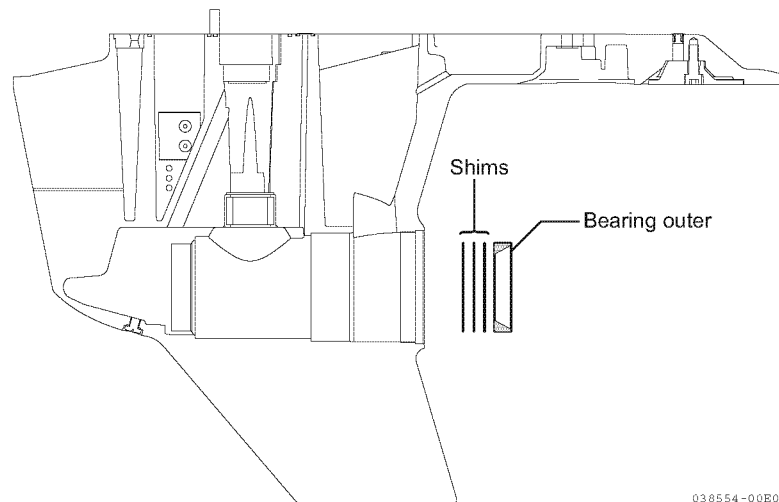
17. Remove the bearing outer and shims, as shown in **Figure 7-20**.

18. To remove, hold bolt "A" with a wrench while tightening Nut "B".



**Figure 7-20**

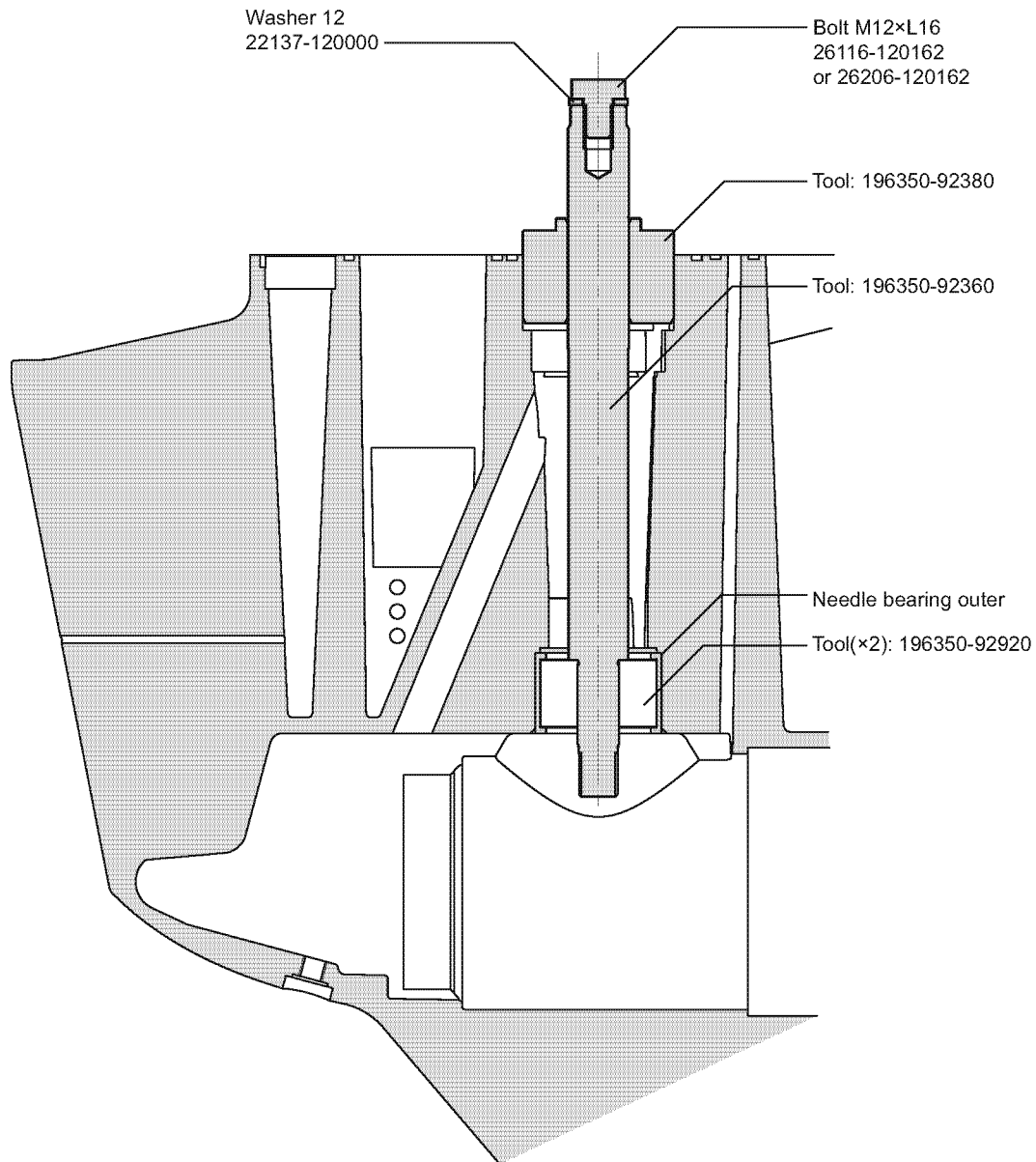
19. Check and record the shim thicknesses.



**Figure 7-21**

## GEAR HOUSING

20. Remove the needle bearing outer from gear housing, as shown in **Figure 7-22**.



**Figure 7-22**

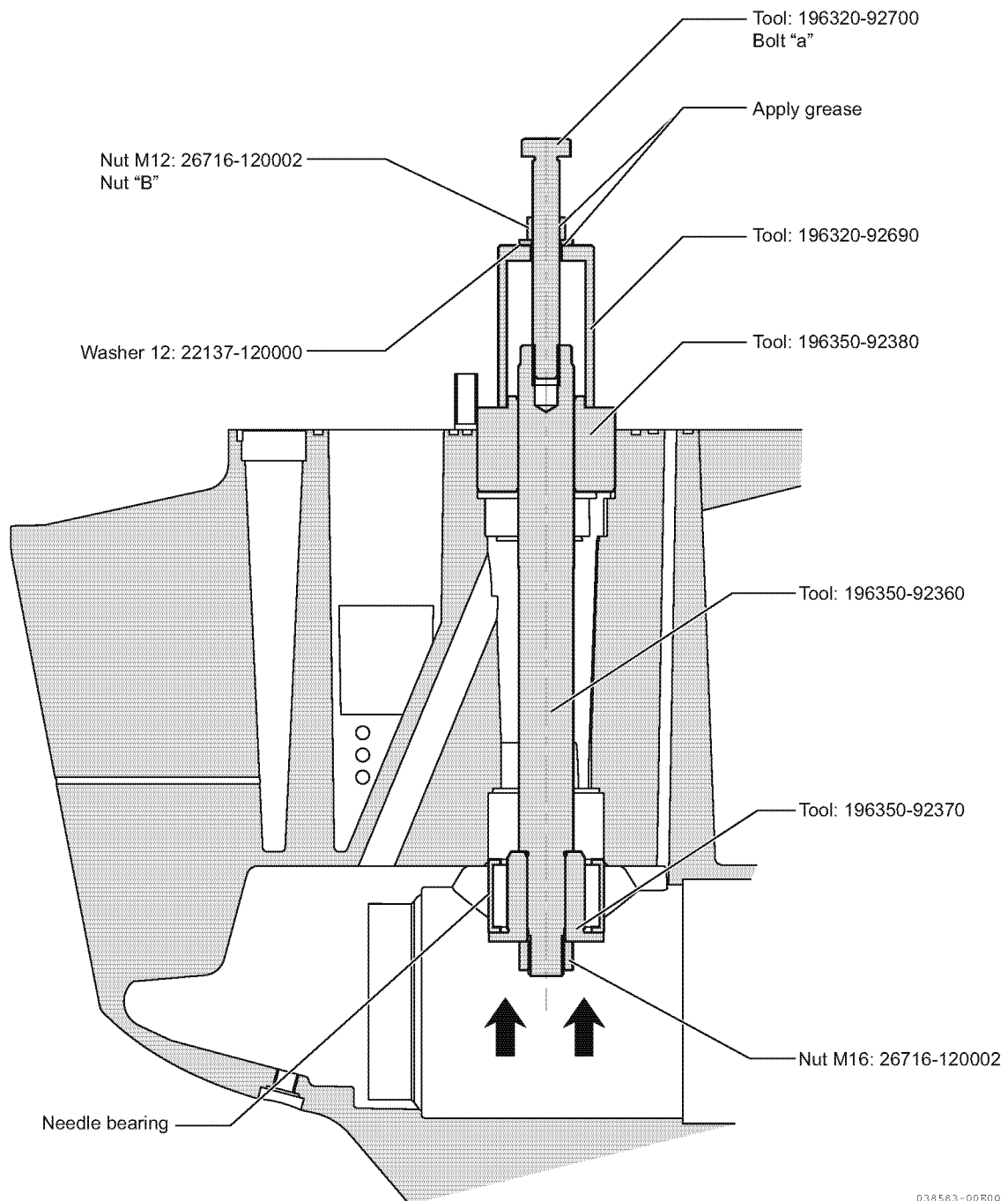


## GEAR HOUSING ASSEMBLY

1. Install the needle bearing into the gear housing, as shown in **Figure 7-23**.

*Note: Apply lithium grease to hold the needle bearing in the gear housing.*

2. To install, hold bolt "A" with a wrench while tightening nut "B".

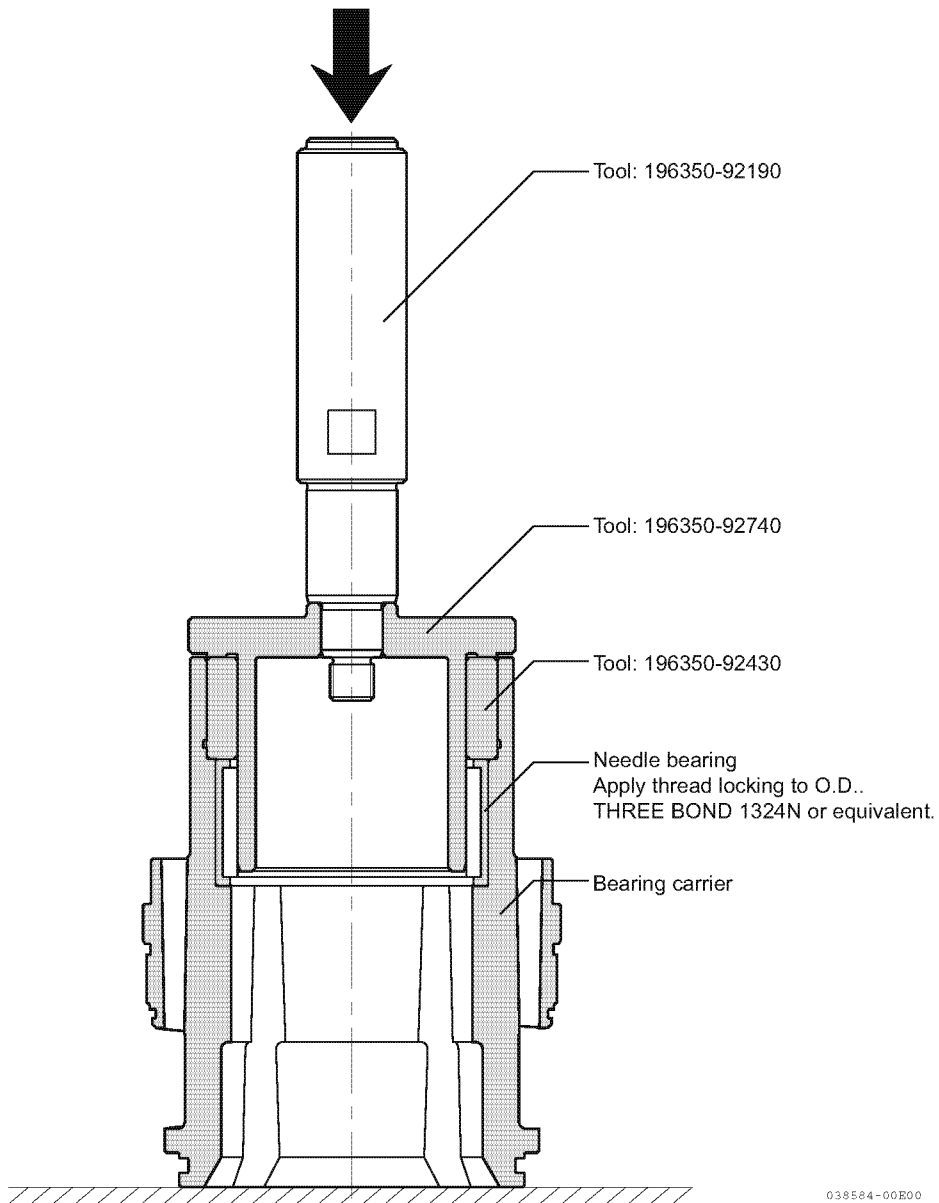


**Figure 7-23**

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## GEAR HOUSING

3. Apply thread locking mid-strength type Three Bond® 1324N or equivalent to the O.D. of the needle bearing and install the needle bearing into the bearing carrier, as shown in **Figure 7-24**.



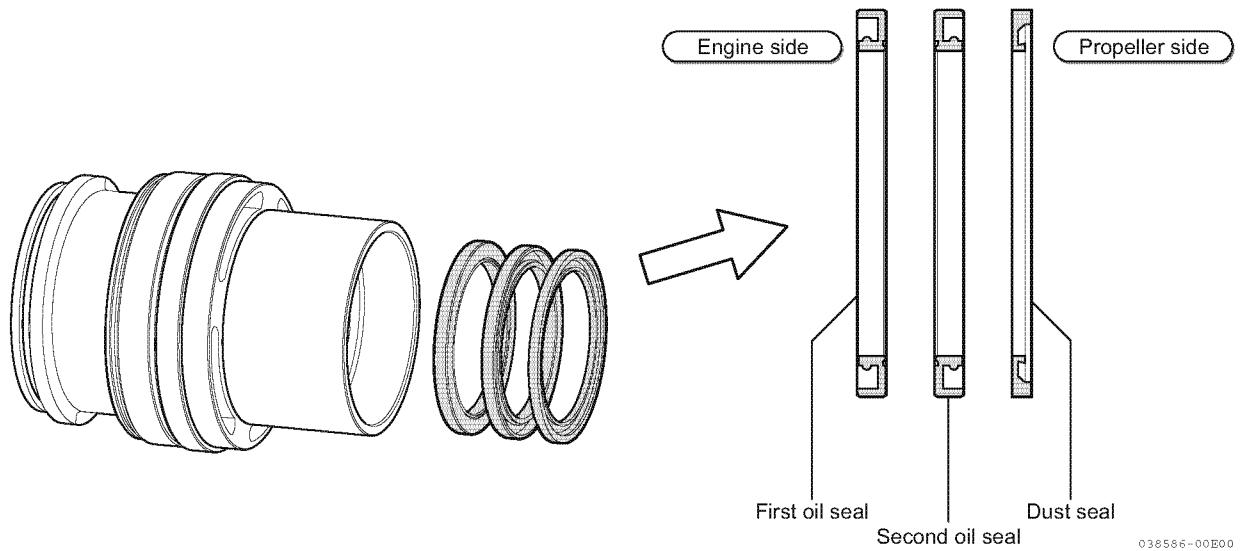
**Figure 7-24**

4. Apply thread locking high-strength type Three Bond® 1305 or equivalent to the O.D. of the oil seal, then install the first oil seal into the bearing carrier, as shown in **Figure 7-26**.

*Note: Install oil seal in the correct direction, as shown in **Figure 7-25**.*

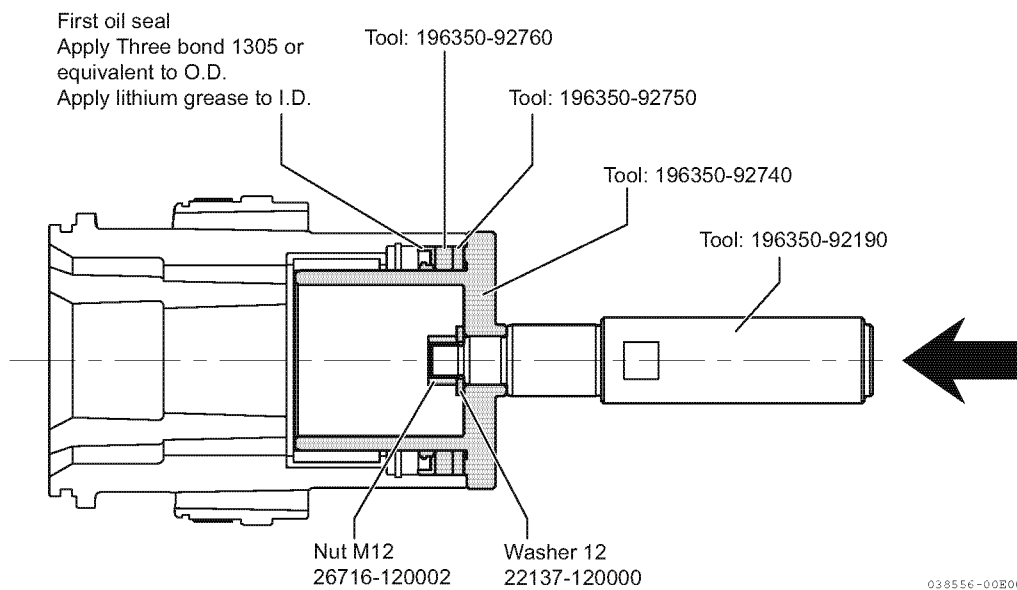
5. Apply lithium grease to I.D. of the oil seal after installation.

### Direction of Oil Seal and Dust Seal



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**Figure 7-25**



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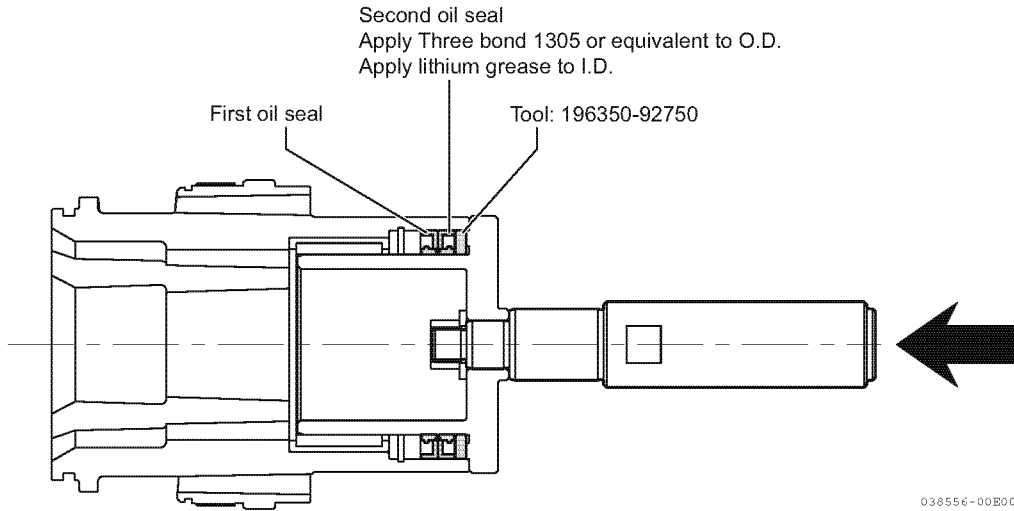
**Figure 7-26**

# GEAR HOUSING

6. Apply thread locking high-strength type Three Bond® 1305 or equivalent to the O.D. of the oil seal, then install the second oil seal into the bearing carrier, as shown in **Figure 7-27**.

*Note: Install oil seal in the correct direction, as shown in **Figure 7-25**.*

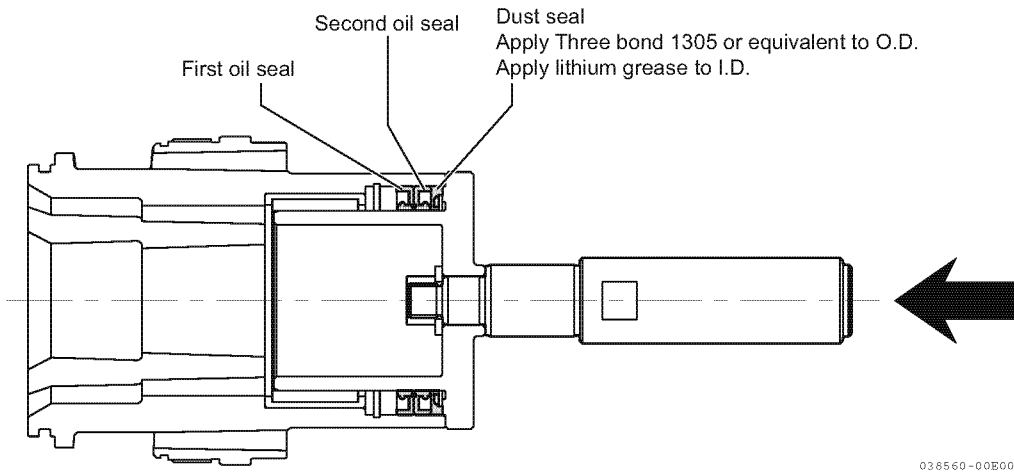
7. Apply lithium grease to I.D. of the oil seal after installation.



**Figure 7-27**

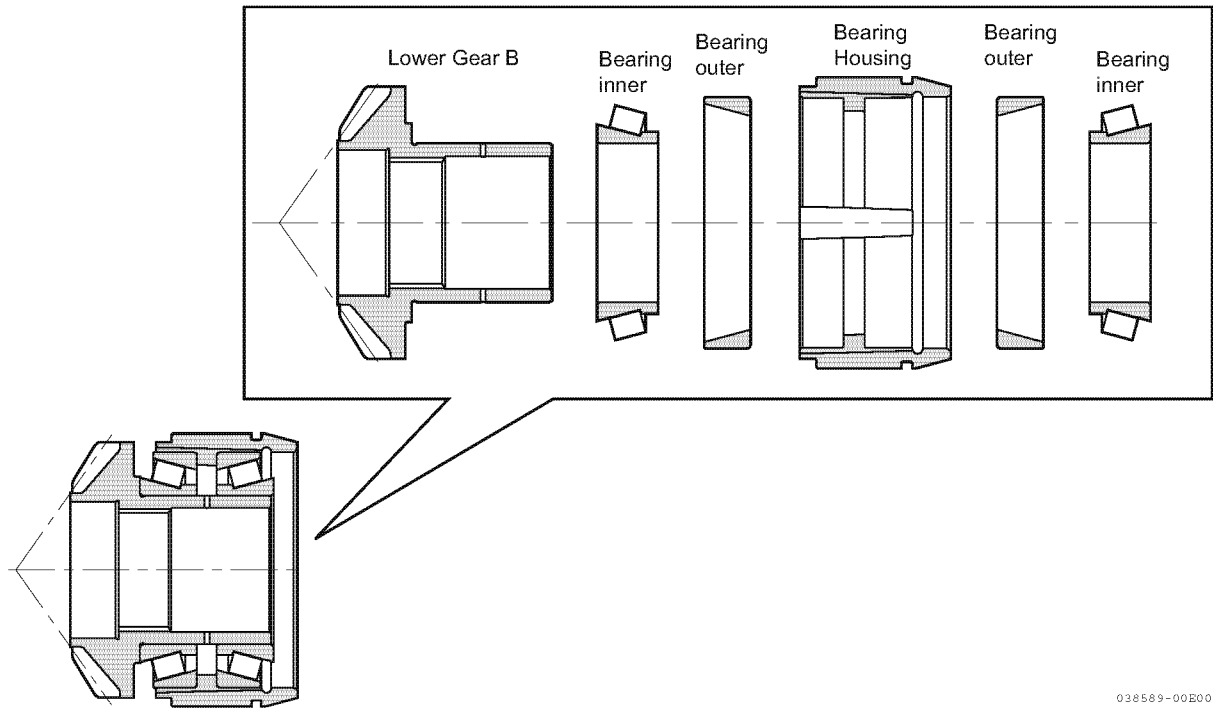
8. Apply thread locking high-strength type Three Bond® 1305 or equivalent to the O.D. of the dust seal, then install the dust seal into the bearing carrier, as shown in **Figure 7-28**.

*Note: Install oil seal in the correct direction, as shown in **Figure 7-25**. If the dust seal is installed incorrectly, water may leak into the gear case or lubrication oil may leak out.*



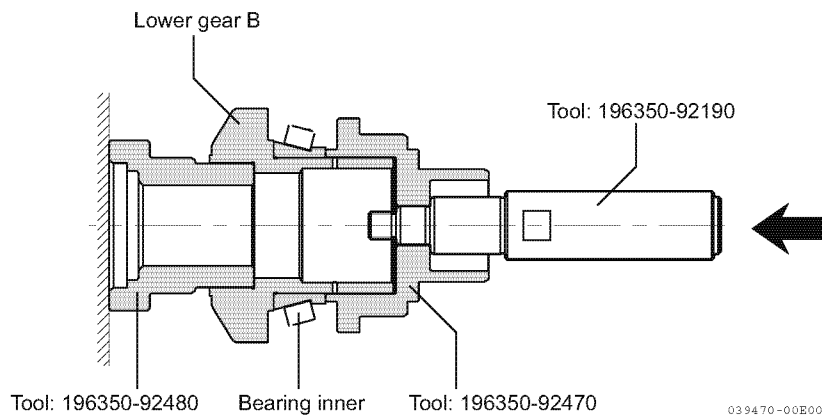
**Figure 7-28**

9. Lower gear "B" CMP assembly is shown in **Figure 7-29**.



**Figure 7-29**

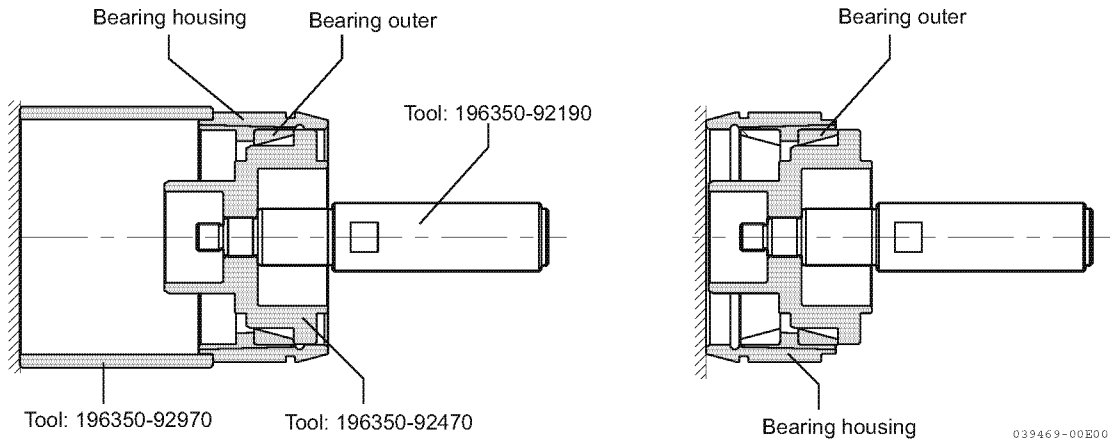
10. Install the bearing inner to the lower gear "B", as shown in **Figure 7-30**.



**Figure 7-30**

# GEAR HOUSING

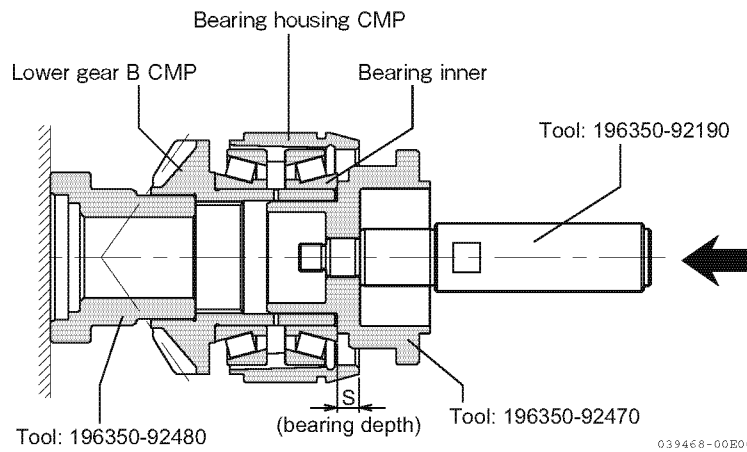
11. Install the bearing outer to both sides of the bearing housing, as shown in **Figure 7-31**.



**Figure 7-31**

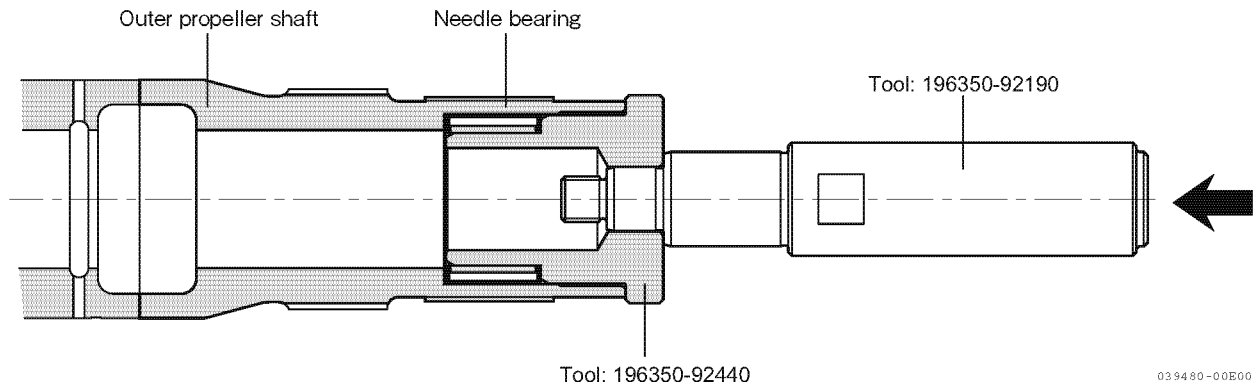
12. Install the bearing housing CMP and bearing inner to the lower gear "B" CMP, as shown in **Figure 7-32**.

- "S" dimension (bearing depth): 9.5 mm (0.37 in.)



**Figure 7-32**

13. Install the needle bearing to the outer propeller shaft, as shown in **Figure 7-33**.



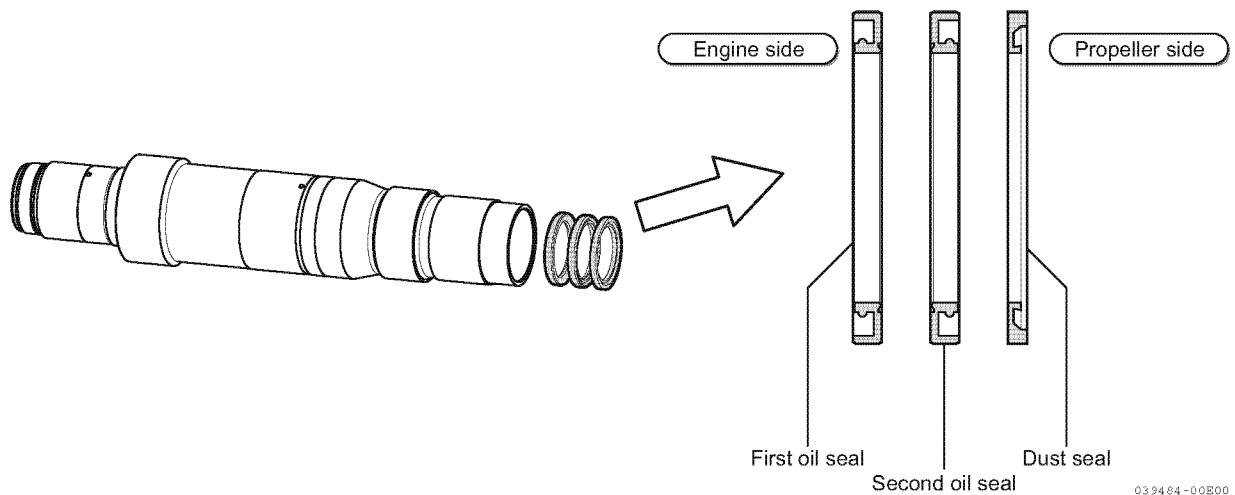
**Figure 7-33**

14. Apply thread locking high-strength type Three Bond® 1305 or equivalent to the O.D. of the oil seal and install the first seal into the outer propeller shaft, as shown in **Figure 7-35**.

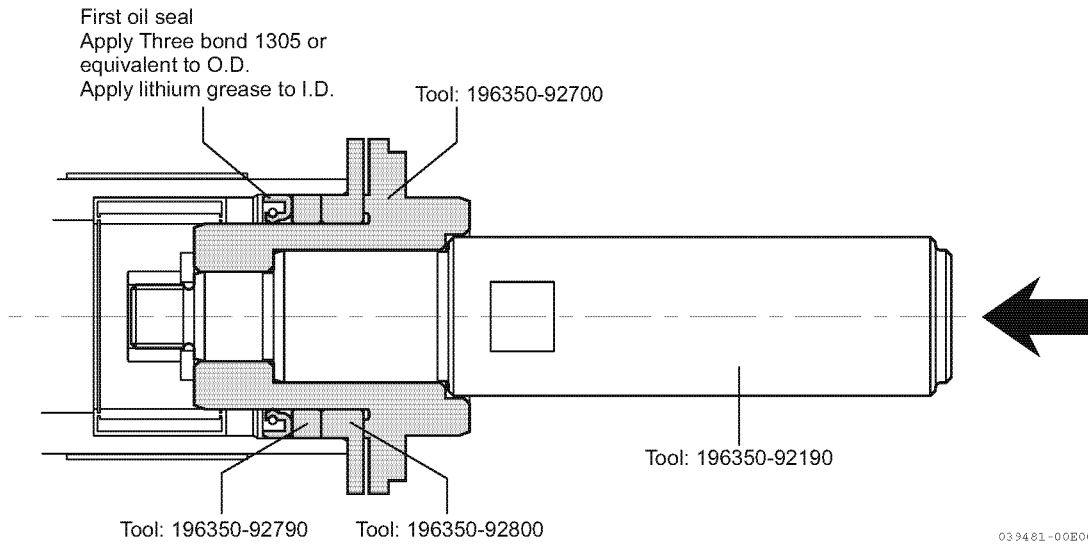
*Note: Install oil seal in the correct direction, as shown in **Figure 7-34**.*

15. Apply lithium grease to I.D. oil seal after installation.

**Direction of oil seal and dust seal**



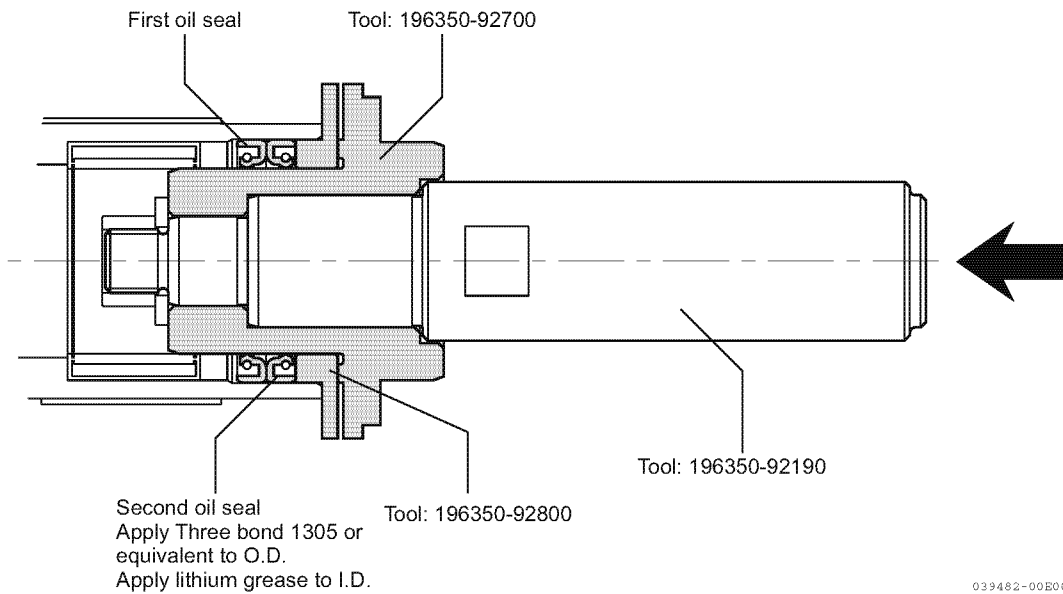
**Figure 7-34**



**Figure 7-35**

16. Apply thread locking high-strength type Three Bond® 1305 or equivalent to the O.D. of the oil seal and install the second seal into the outer propeller shaft, as shown in **Figure 7-36**.

*Note: Install oil seal in the correct direction, as shown in **Figure 7-34**.*

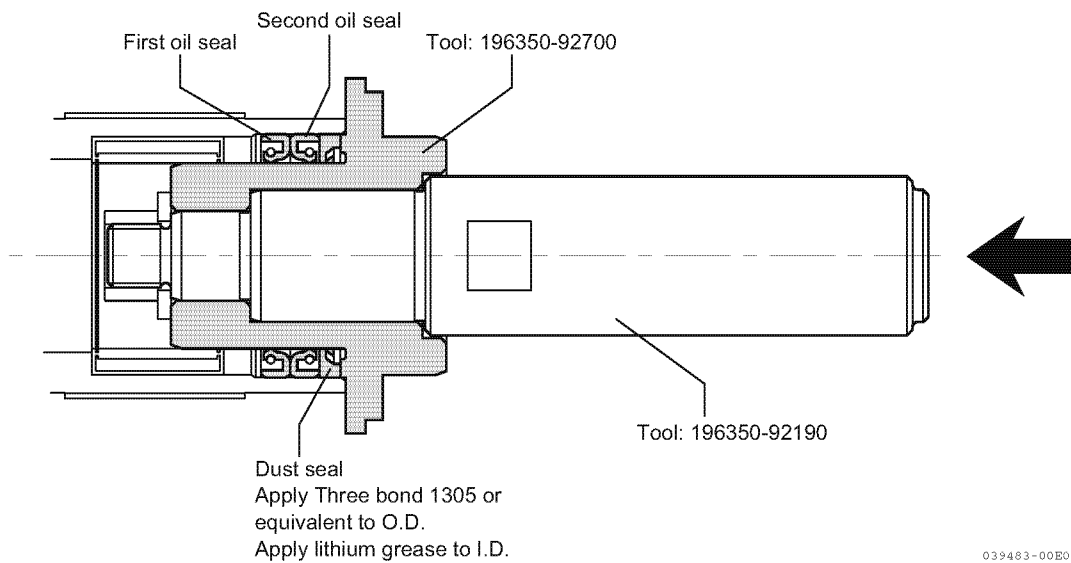


**Figure 7-36**



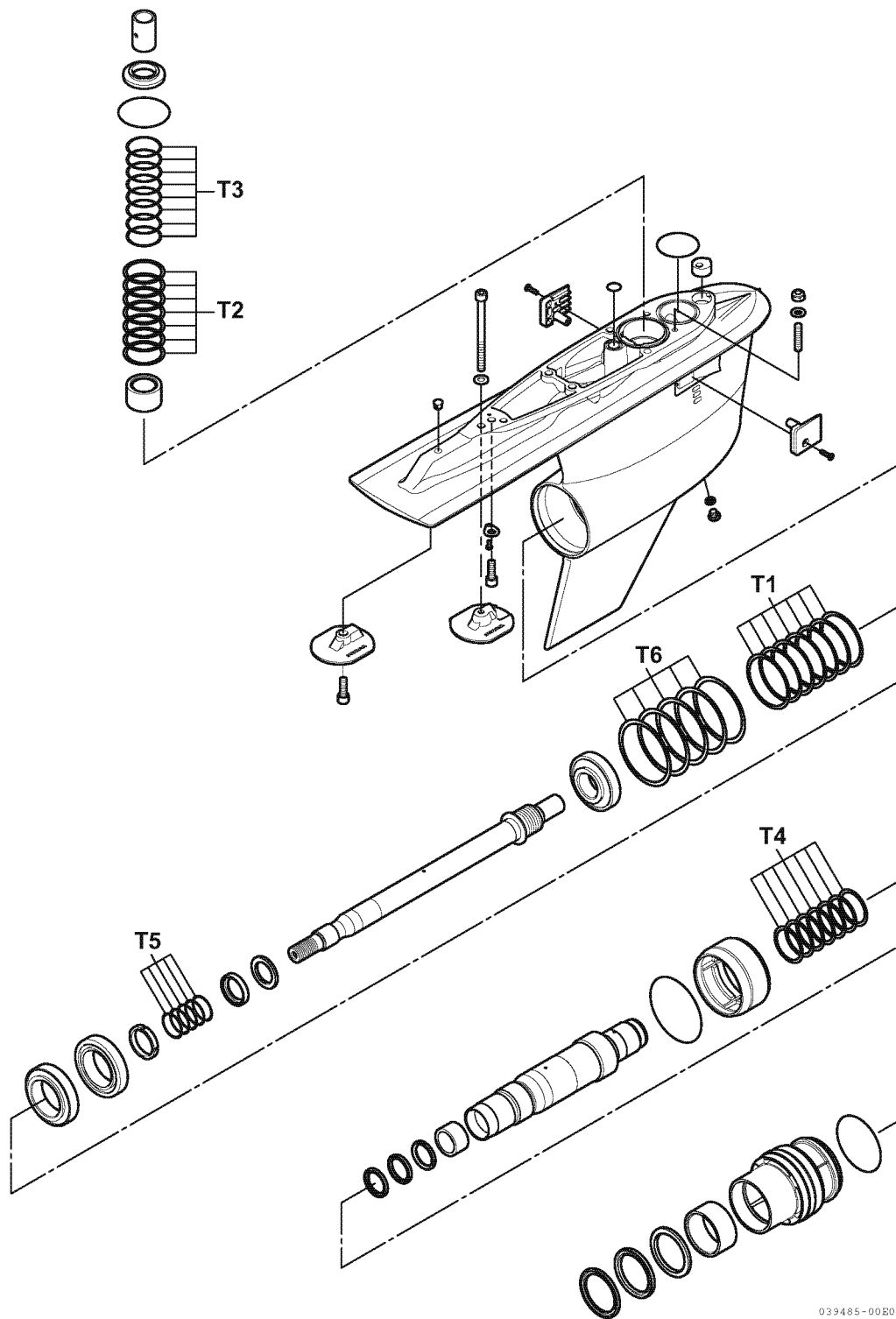
17. Apply thread locking high-strength type Three Bond® 1305 or equivalent to the O.D. of the dust seal and install the dust seal into the outer propeller shaft, as shown in **Figure 7-37**.

*Note: Install oil seal in the correct direction, as shown in **Figure 7-34**. If the dust seal is installed incorrectly, water may leak into the gear case or lubrication oil may leak out.*



**Figure 7-37**

## Shim Location



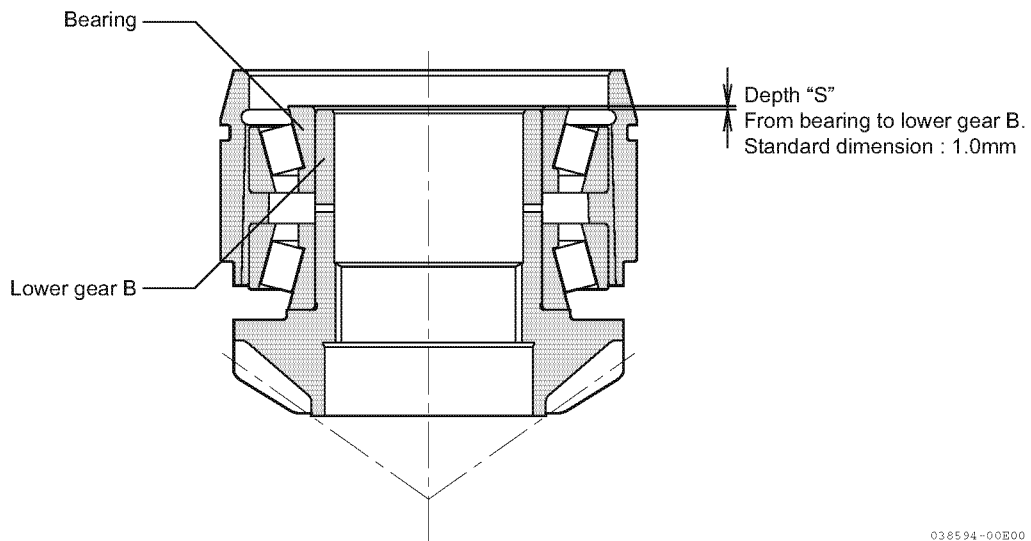
039485-00B00

Figure 7-38

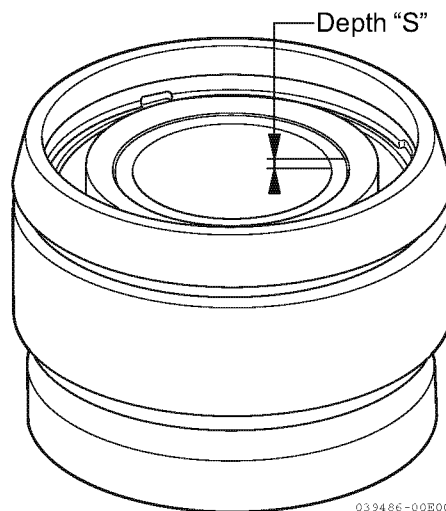
18. Find shim thickness "T4", as shown in **Figure 7-39**.

- For shim location, see **Figure 7-38**.
- Shim thickness "T4" = Depth "S" + 0.05 mm ("T4" tolerance +/- 0.025)

Example:  $T4 = 1.0 \pm 0.025 + 0.05$  (Use 1.05 mm shim)



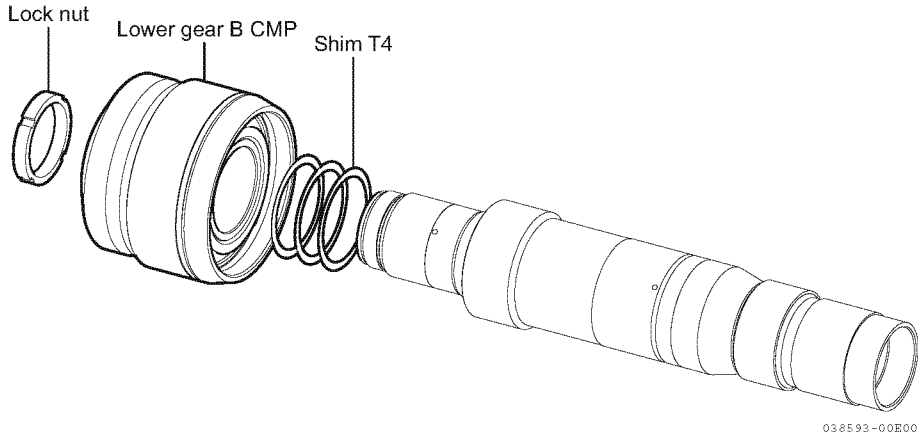
**Figure 7-39**



**Figure 7-40**

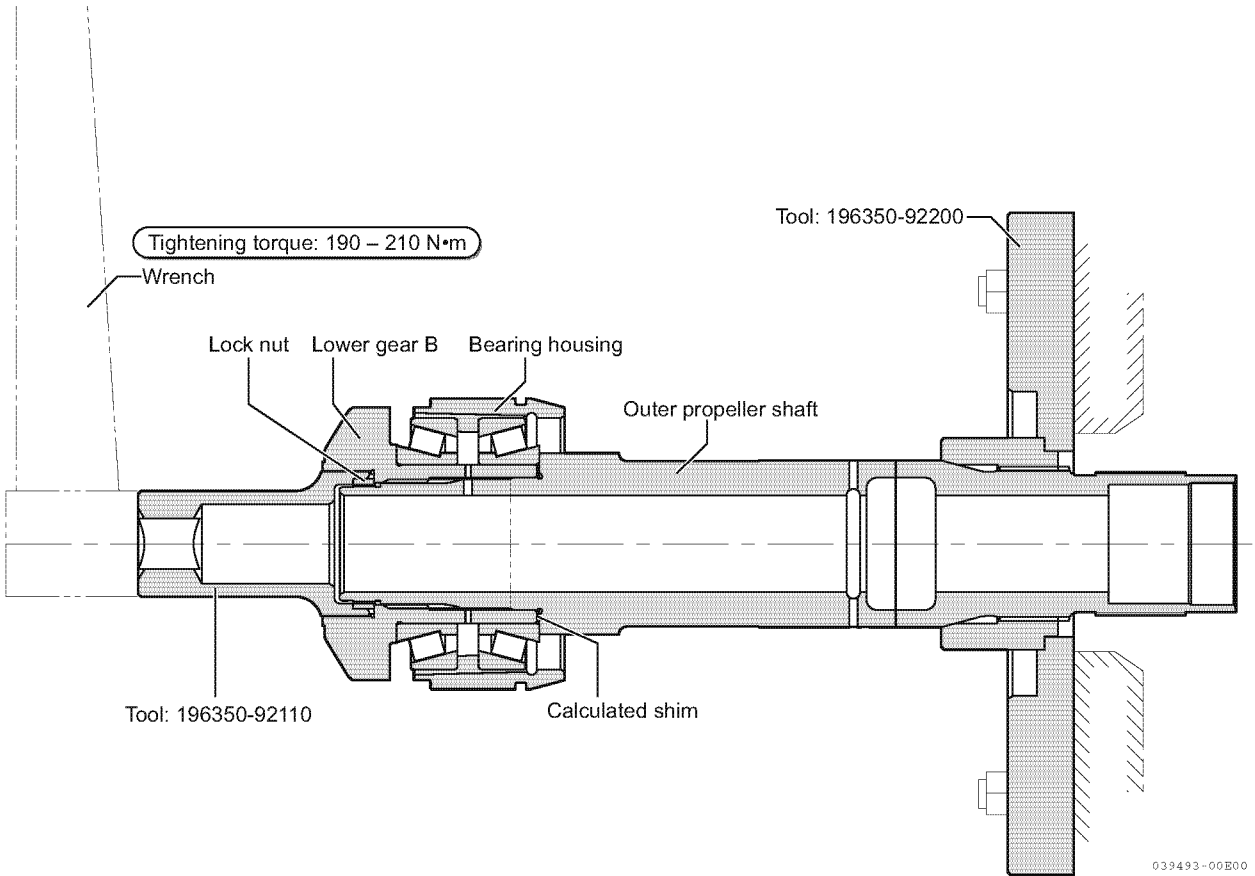
# GEAR HOUSING

19. Install shim, lower gear “B” CMP and locknut to outer propeller shaft, as shown in **Figure 7-41**.



**Figure 7-41**

20. Using a new locknut, install as shown in **Figure 7-42**.



**Figure 7-42**

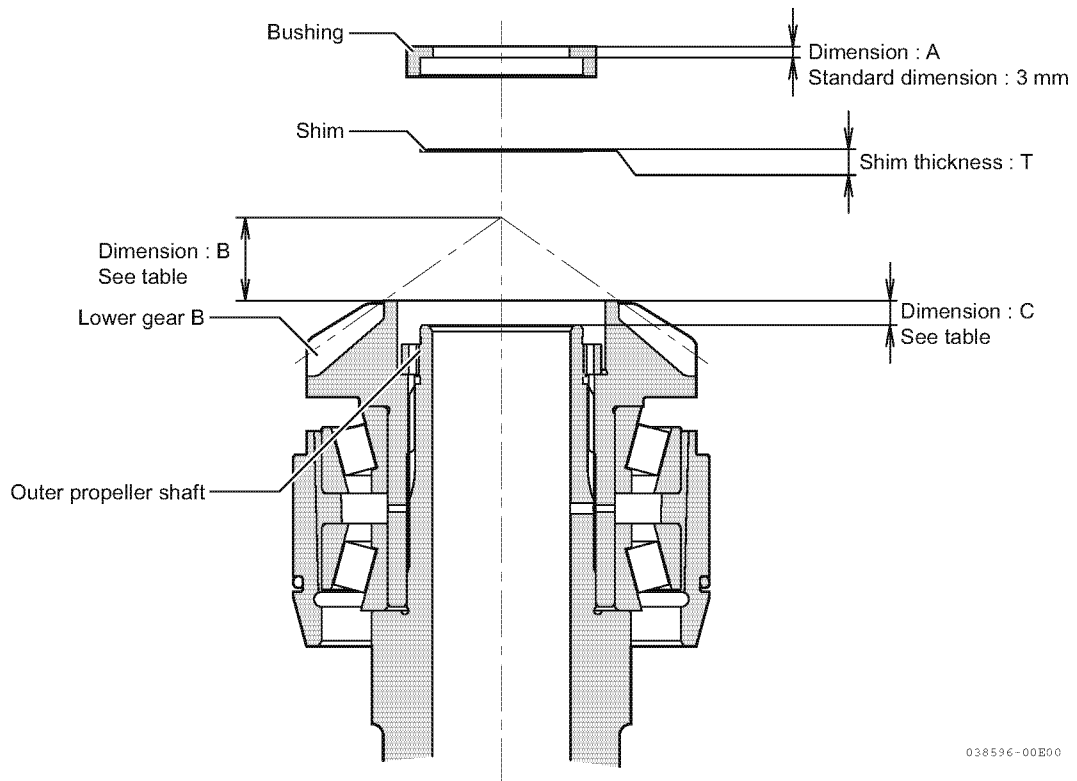
21. To find shim thickness “T5”, measure dimensions “A”, “C” and “D”.

- For shim location, see **Figure 7-38**.

22. Calculate shim thickness “T5” = B + C – (D – 21.5) – 5 – 0.3 – A (“T5” tolerance +/- 0.05).

Example: T5 = 16.2 + 22 – 41 + 6.5 – 3 +/- 0.05 = 0.65 to 0.75 (Use 0.7 mm shim)

*Note: Lightly coat bushing outside surface with Three Bond® upon final assembly.*

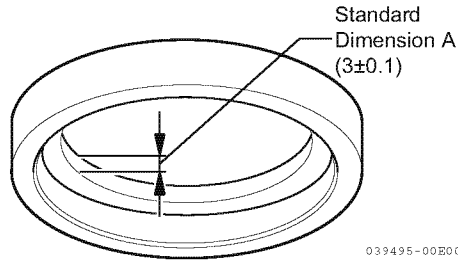


**Figure 7-43**

Standard Dimension “B”, “C” mm				
	Reduction ratio (Lower gear B teeth number)			
	1.65 (24)	1.78 (26)	1.97 (27)	2.18 (28)
Dimension “B”	22	21	19	17
Dimension “C”	6.5	7.5	9.5	11.5

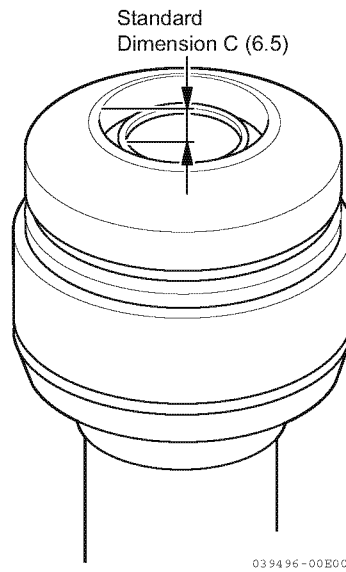
# GEAR HOUSING

23. Measure dimension "A", as shown in **Figure 7-44**.



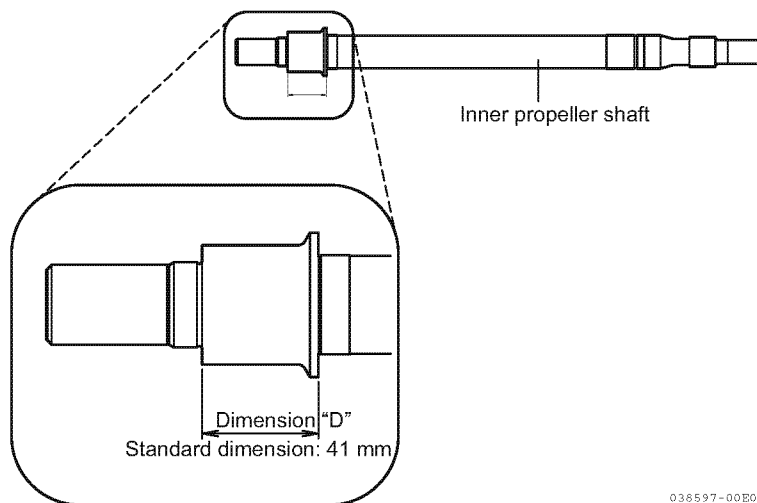
**Figure 7-44**

24. Measure dimension "C", as shown in **Figure 7-45**.



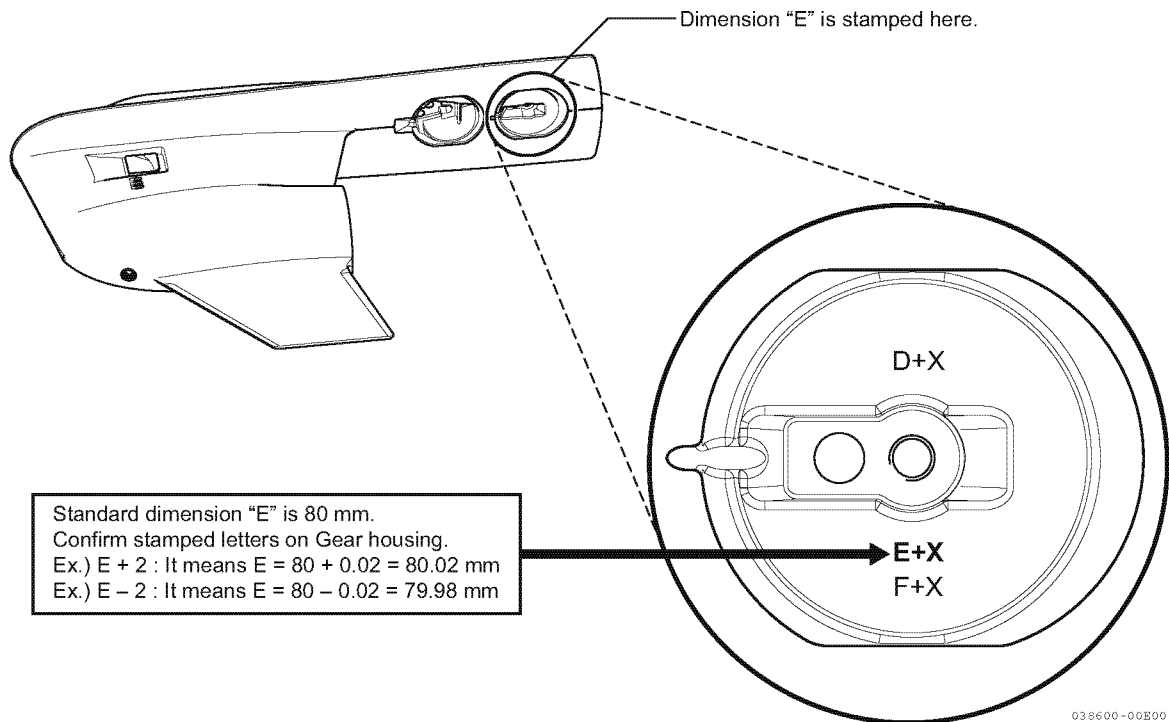
**Figure 7-45**

25. Measure dimension "D", as shown in **Figure 7-46**.



**Figure 7-46**

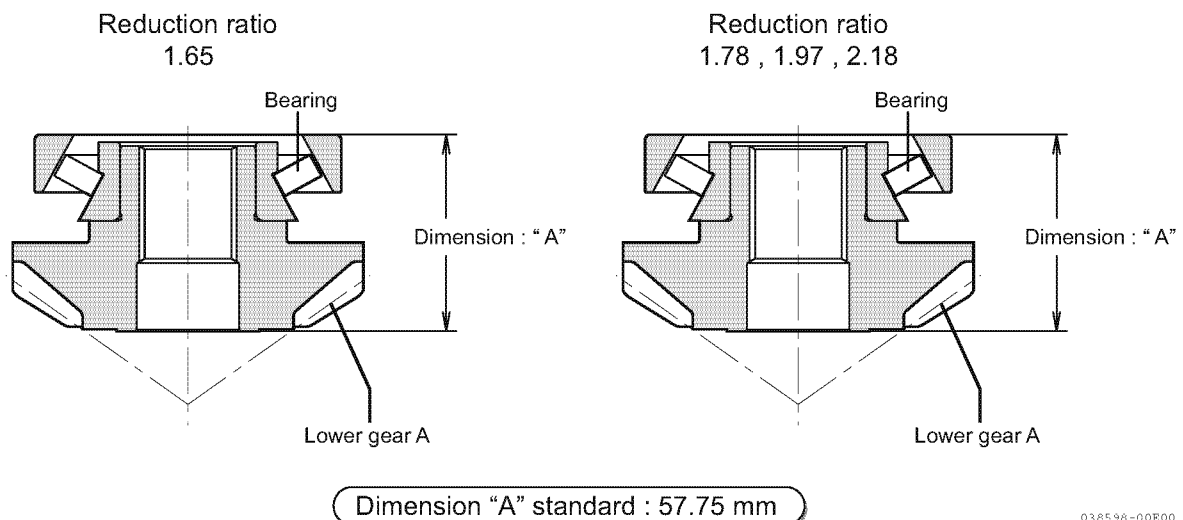
26. Find shim thickness “T1” as follows.
- For shim location, see **Figure 7-38**.
27. Confirm dimension “E”, as shown in **Figure 7-47**.



**Figure 7-47**

28. Measure dimension “A”, as shown in **Figure 7-48**.
- Dimension “A” standard: 57.75 mm (2.27 in.)
29. Adjust shim thickness “T1”, as shown in **Figure 7-48**.
- Shim thickness “T1” = E - A - 21.5 (“T1” tolerance +/- 0.025)
  - Example: T1 = (80 - 57.75 - 21.5) +/- 0.025 = 0.725 to 0.775 (Use 0.75 mm shim)

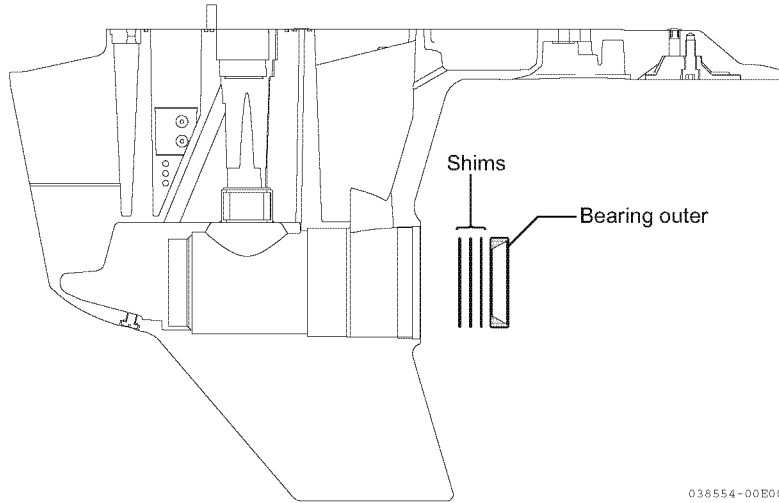
**Measure dimension “A”**



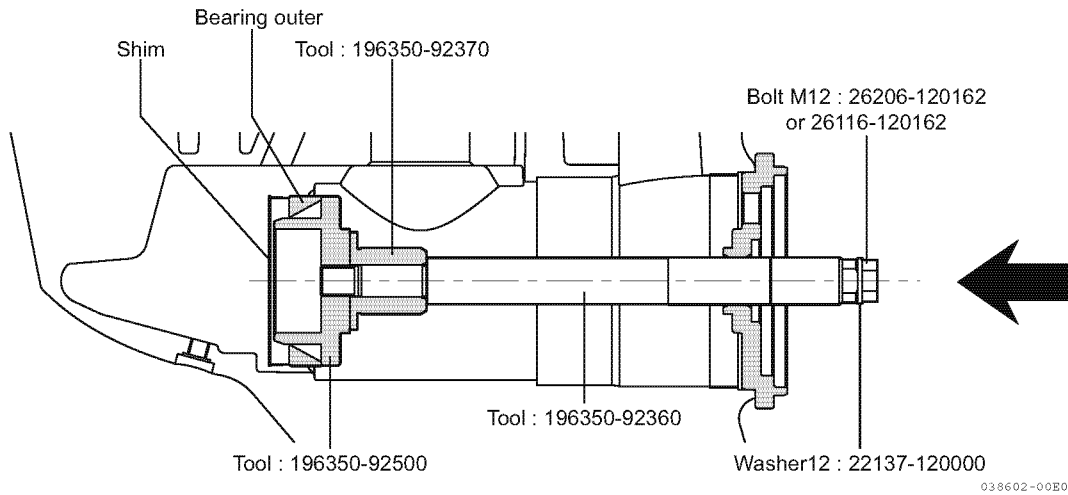
**Figure 7-48**

# GEAR HOUSING

30. Install the shim and bearing outer to the gear housing, as shown in **Figure 7-49** and **Figure 7-50**.



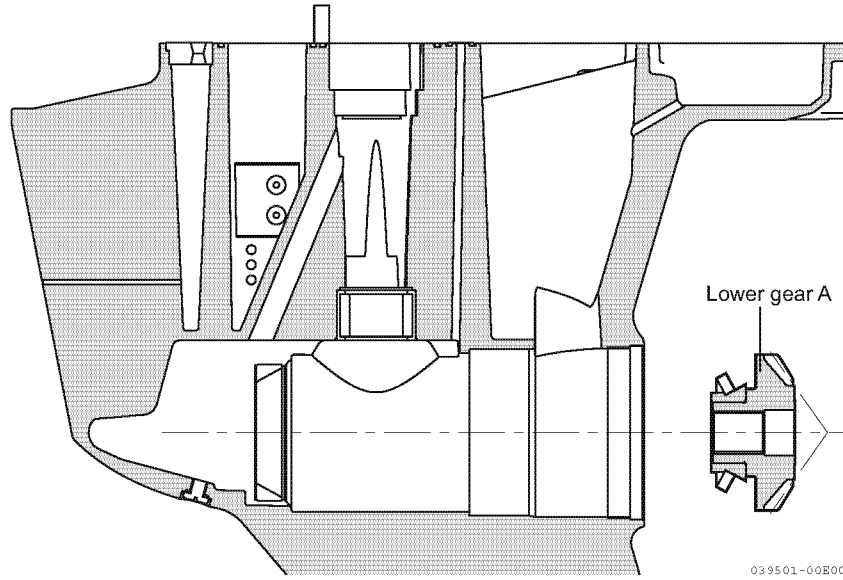
**Figure 7-49**



**Figure 7-50**



31. Install lower gear "A" to gear housing, as shown in **Figure 7-51**.



**Figure 7-51**

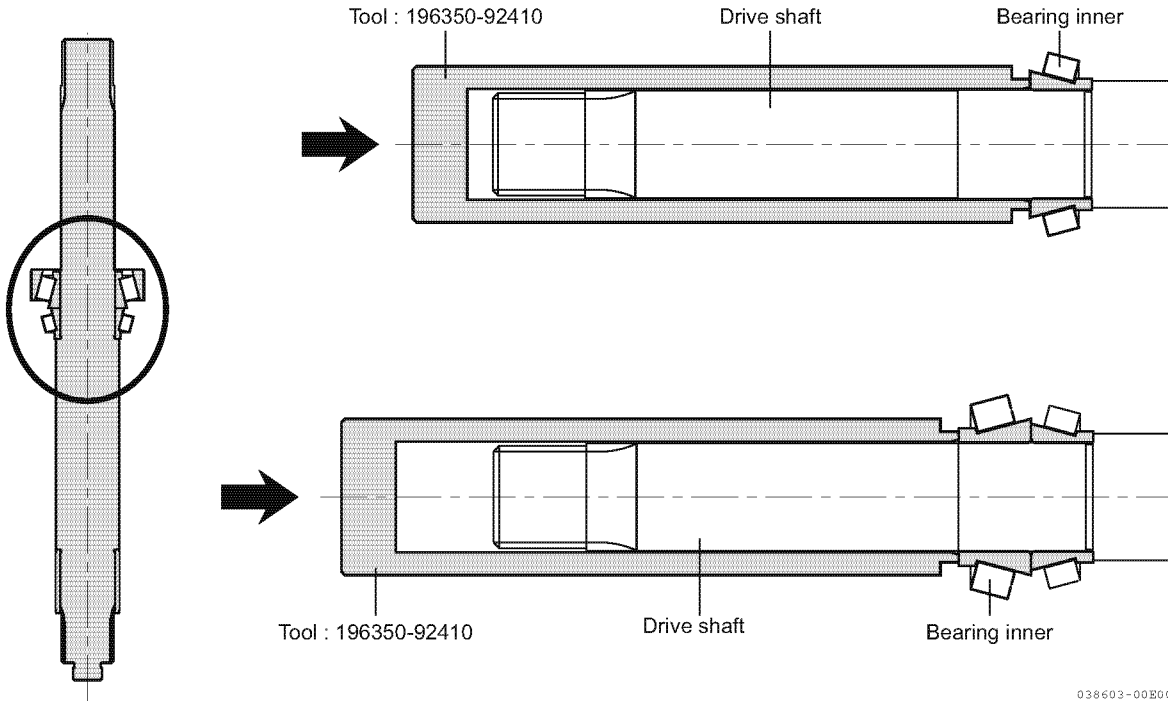
# GEAR HOUSING

## Driveshaft CMP Assembly

### NOTICE

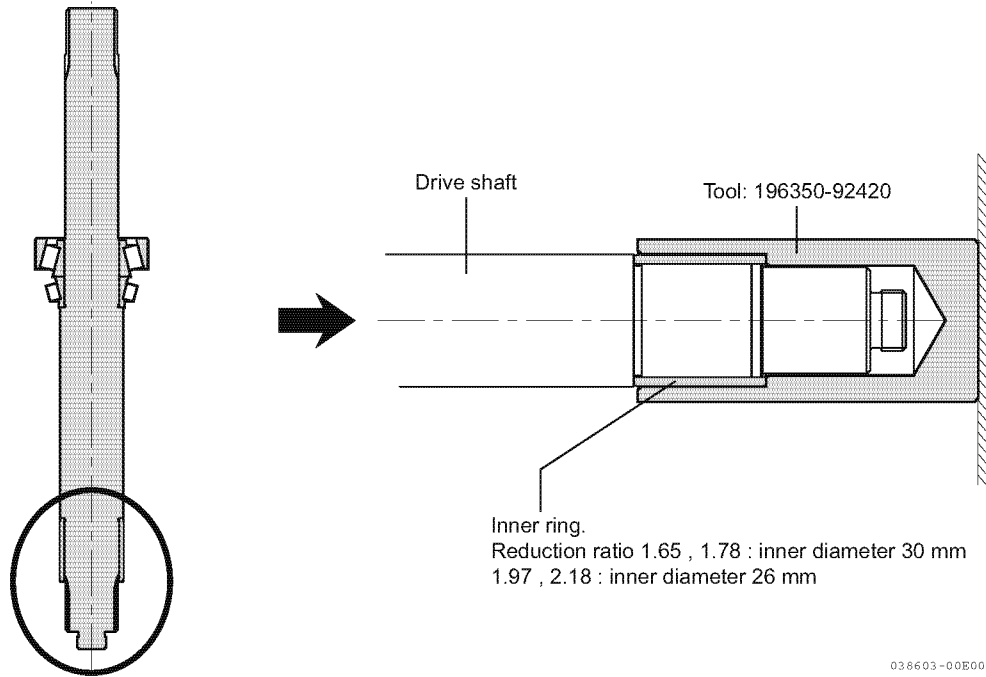
Gear sets of different ratios are available. There are two different driveshafts available depending on the gear ratio used. Be aware of dimensional differences in these parts when changing these parts and when servicing these parts.

1. Install bearing inner to driveshaft, as shown in **Figure 7-52**.



**Figure 7-52**

2. Install inner ring to driveshaft, as shown in **Figure 7-53**.



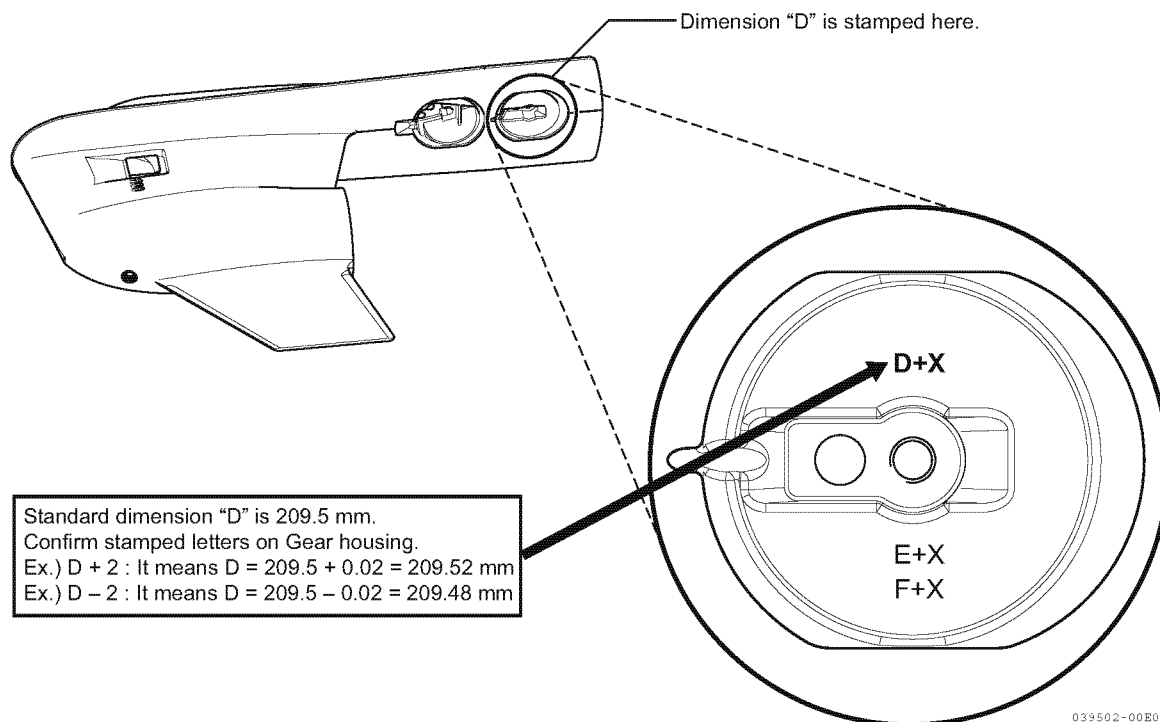
038603-00500

**Figure 7-53**

## GEAR HOUSING

### Install Driveshaft CMP and Lower Pinion Gear to Gear Housing

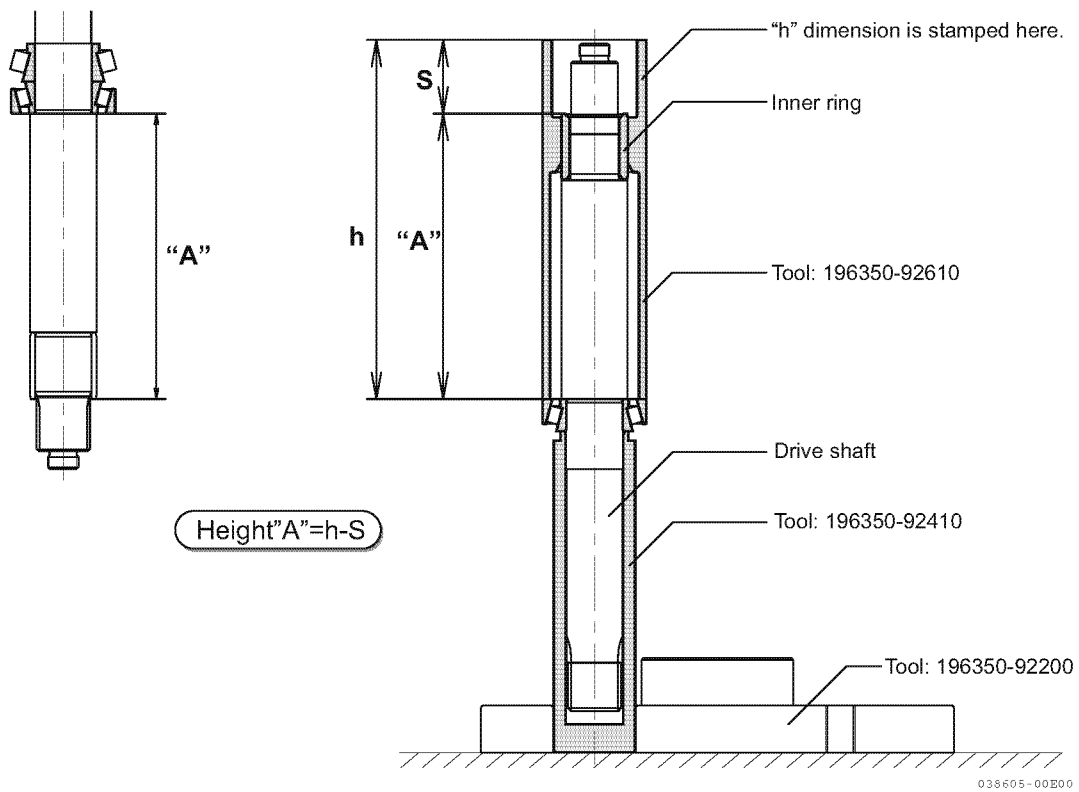
1. Find shim thickness "T2" as follows.
  - For shim location, see **Figure 7-38**.
2. Confirm dimension "D", as shown in **Figure 7-54**.



**Figure 7-54**

3. Measure height dimension "A" of driveshaft CMP, as shown in **Figure 7-55**.

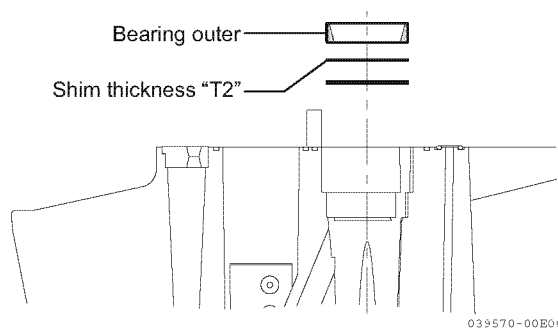
- Height "A" = h - S



**Figure 7-55**

4. Adjust shim thickness "T2", as shown in **Figure 7-56**.

- Shim thickness "T2" = A + 60.0 - D ("T2" tolerance +/- 0.025)
- Example: T2 = (151 + 60 - 209.5) +/- 0.025 = 1.475 to 1.525 (Use 1.5 mm shim)

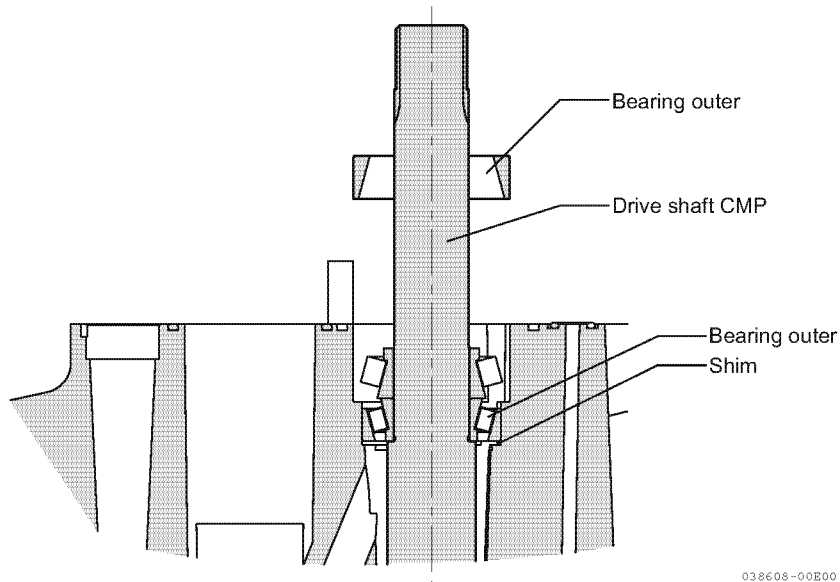


**Figure 7-56**

## GEAR HOUSING

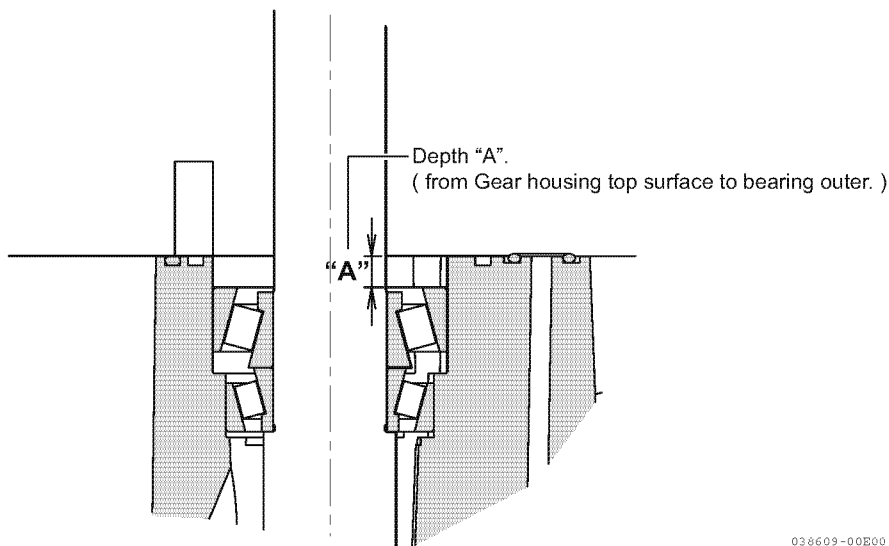
5. Find shim thickness T3 as follows.
  - For shim location see **Figure 7-38**.
6. Install shim, bearing outer, driveshaft CMP and bearing outer to gear housing, as shown in **Figure 7-57**.

*Note: Bearing outer (Figure 7-57) is loose fit.*



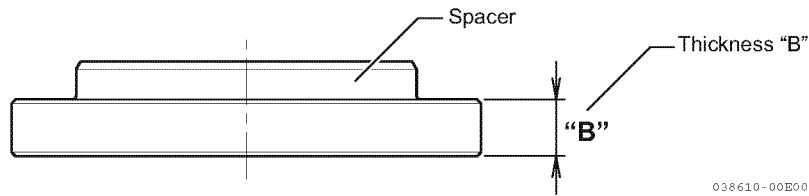
**Figure 7-57**

7. Measure depth "A", as shown in **Figure 7-58**.



**Figure 7-58**

8. Measure spacer thickness "B", as shown in **Figure 7-59**.



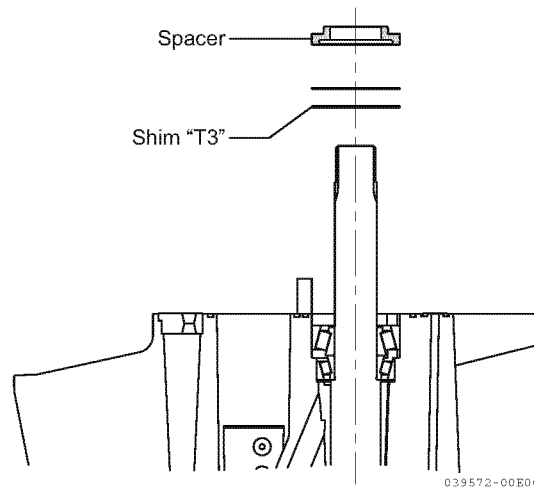
**Figure 7-59**

9. Calculate shim thickness "T3".

- Shim thickness "T3" = A - B ("T3" tolerance – 0.025/- 0.075)
- Example:  $T3 = 8.25 - (7.5 \text{ tolerance} - 0.025/- 0.075) = 0.675 \text{ to } 0.725$  (Use 0.7 mm shim)

*Note: Spacer must be flush with the surface of the housing upon final assembly.*

10. Install shim and spacer to gear housing, as shown in **Figure 7-60**.



**Figure 7-60**

# GEAR HOUSING

11. Using a new pinion nut, install and tighten the lower pinion gear to driveshaft CMP, as shown in Figure 7-61.

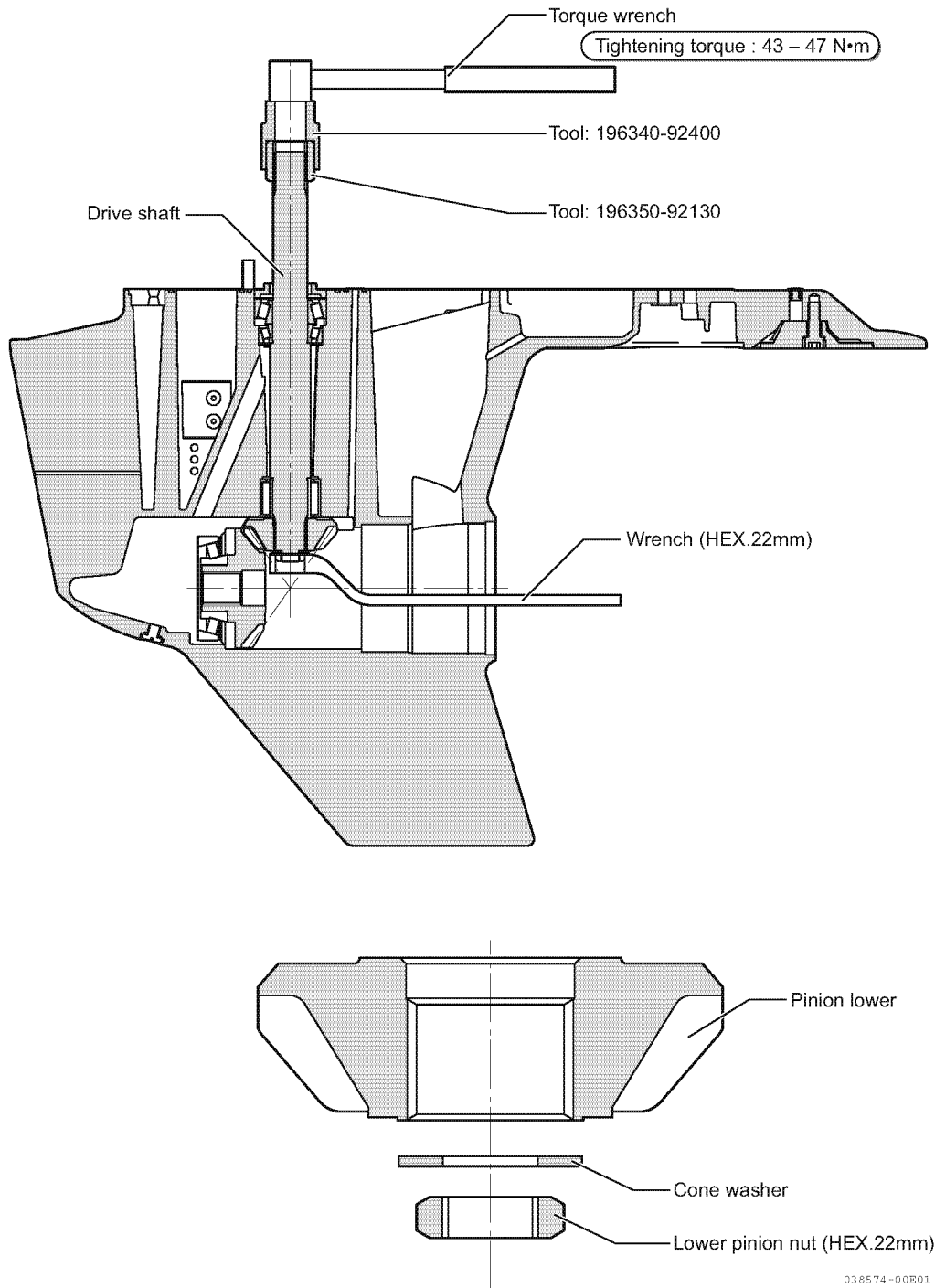
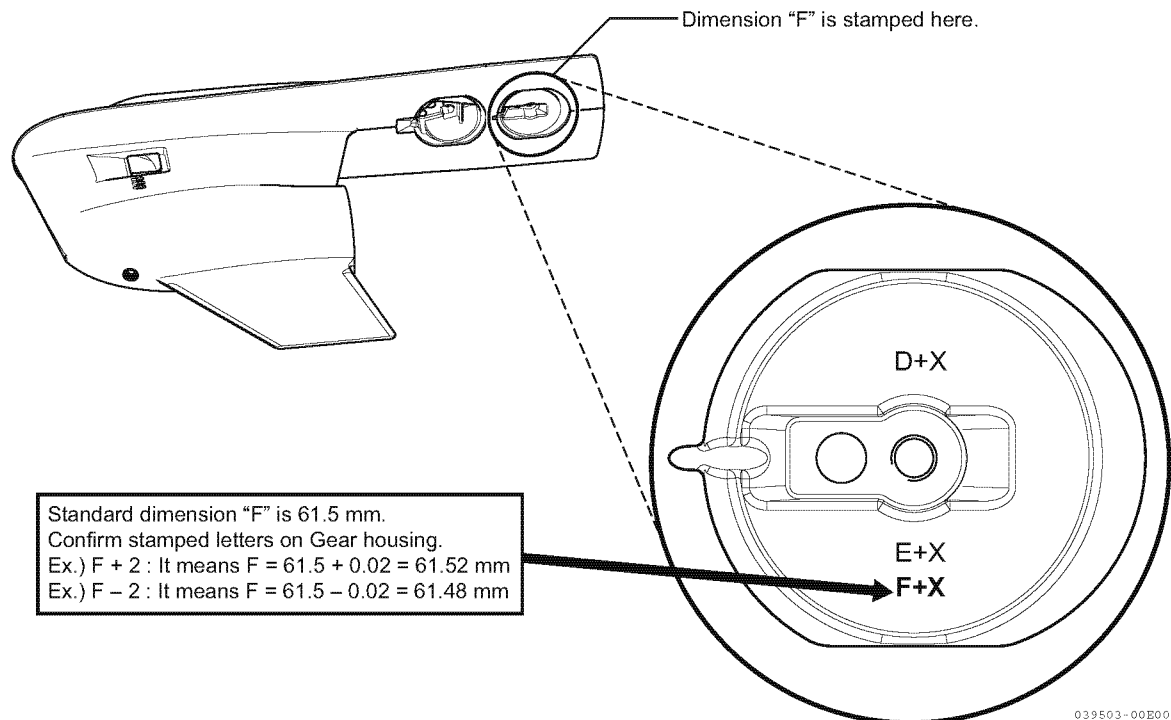


Figure 7-61



## Install Inner Propeller Shaft

1. Find shim thickness "T6" as follows.
  - For shim location, see **Figure 7-38**.
2. Confirm dimension "F", as shown in **Figure 7-62**.



**Figure 7-62**

# GEAR HOUSING

3. Measure dimensions "A" and "B".

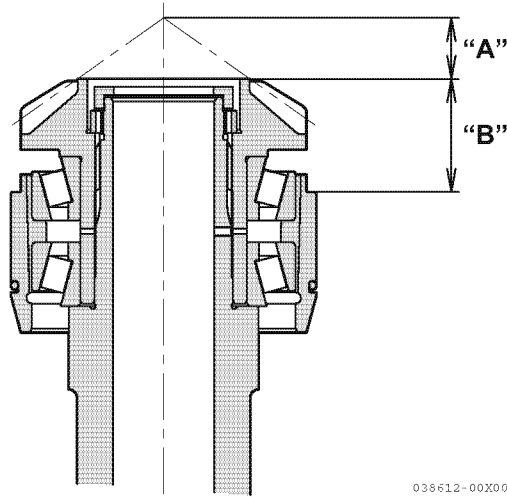


Figure 7-63

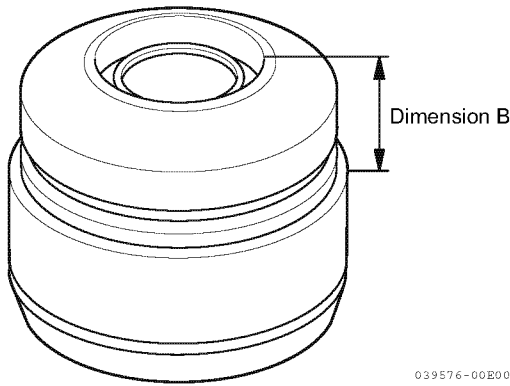
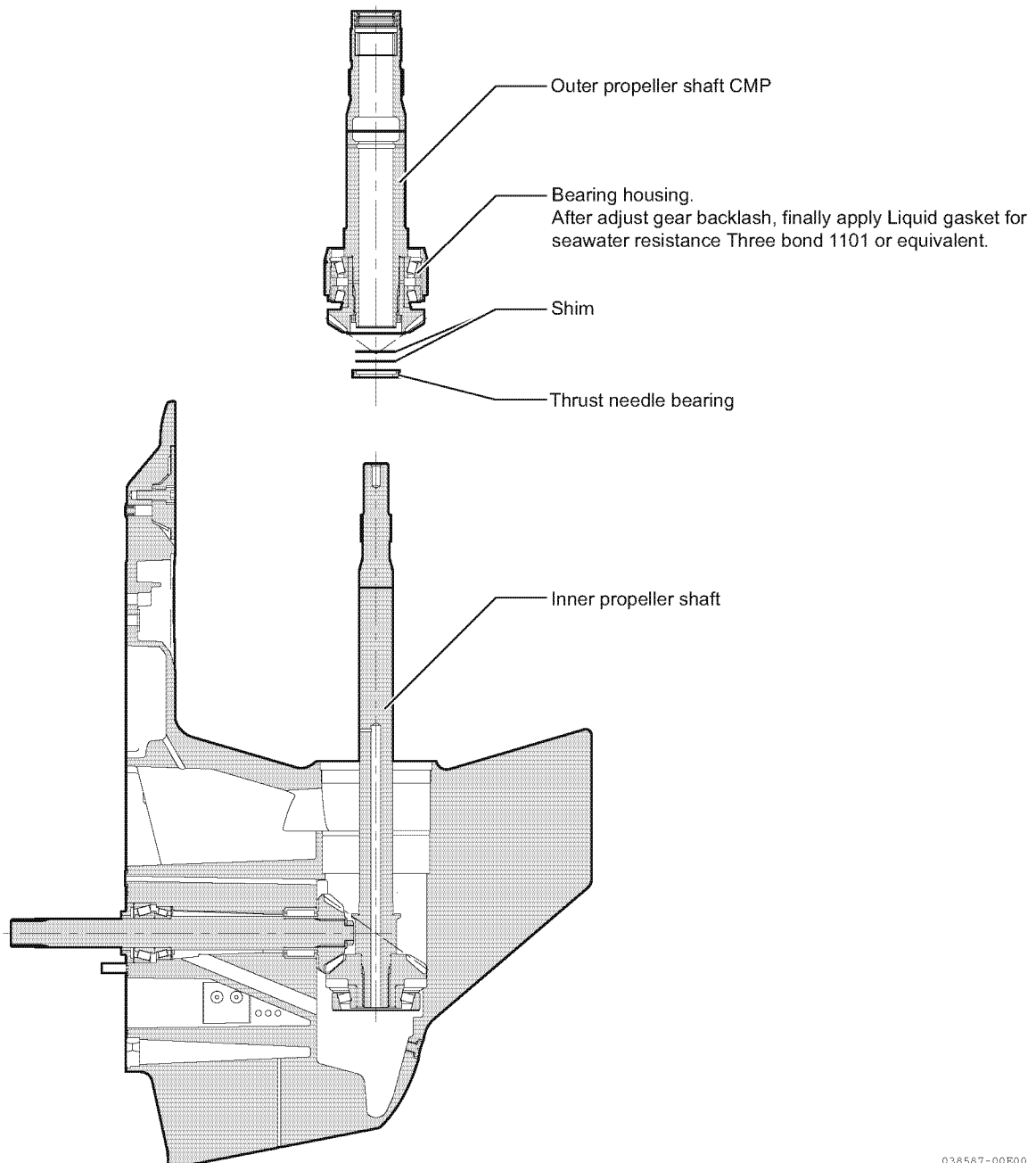


Figure 7-64

Standard Dimension "A", "B" mm (in.)				
	Reduction ratio (Lower gear B teeth number)			
	1.65 (24)	1.78 (26)	1.97 (27)	2.18 (28)
Dimension "A"	22 (0.87)	21 (0.83)	19 (0.75)	17 (0.67)
Dimension "B"	40.8 (1.61)	41.8 (1.65)	43.8 (1.72)	45.8 (1.80)

4. Calculate shim thickness "T6".
  - Shim thickness "T6" =  $A + B - F$  ("T6" tolerance +/- 0.05)
  - Example:  $T6 = 22 + 40.8 - 61.5 \pm 0.05 = 1.25 \text{ to } 1.35$  (Use 1.3 mm shim)
5. Apply Three Bond<sup>®</sup> 1101 or equivalent liquid gasket for seawater resistance to bearing housing outer surface, as shown in **Figure 7-65**.
6. Install inner propeller shaft, thrust needle bearing, shim and outer propeller shaft CMP to gear housing.

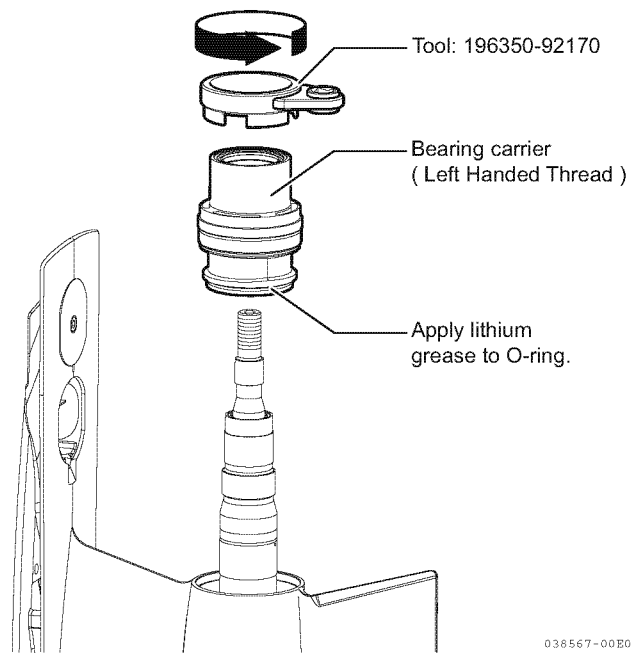


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**Figure 7-65**

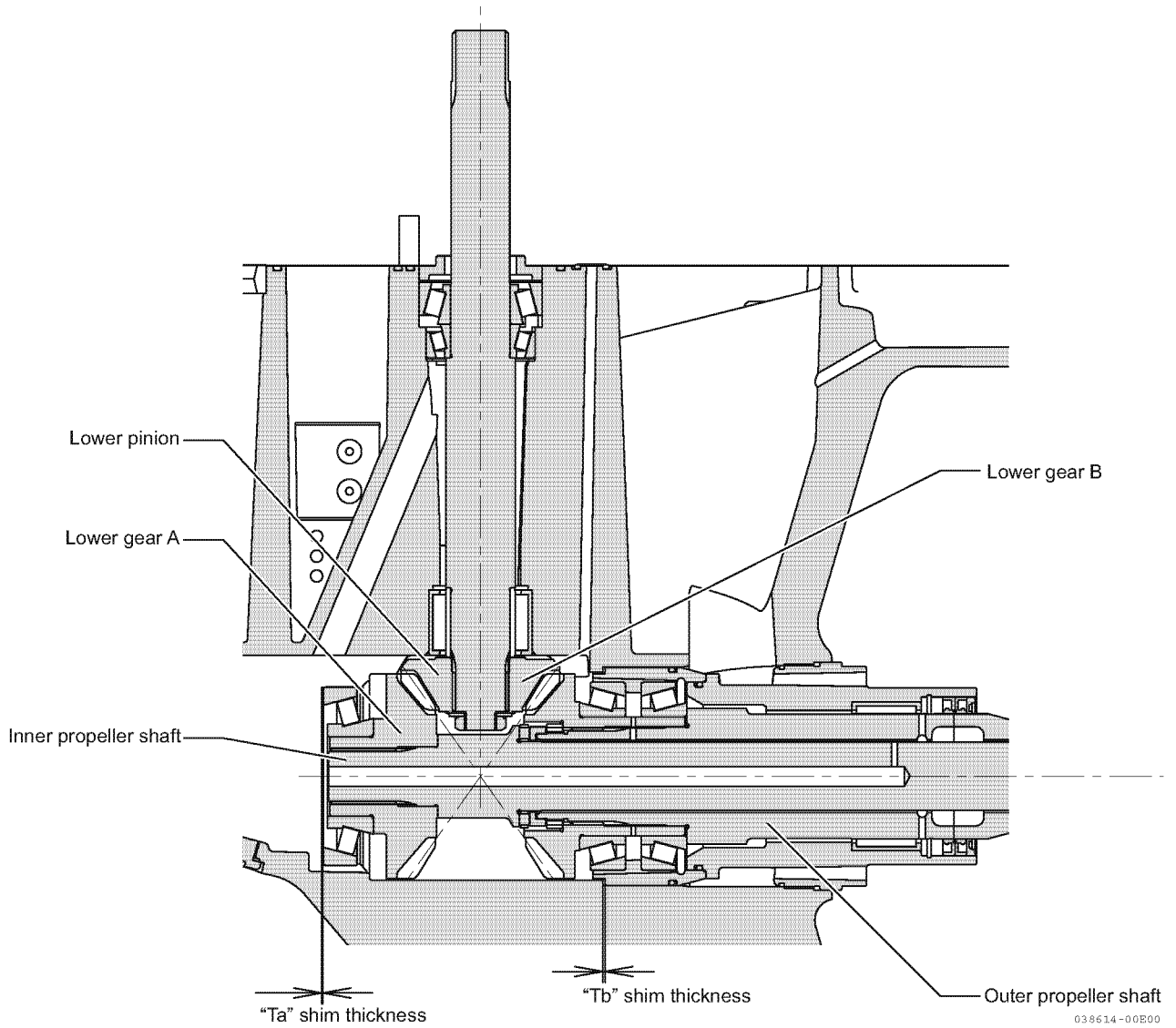
## GEAR HOUSING

7. Install bearing carrier to gear housing, as shown in **Figure 7-66**. See *Bearing Carrier* on page 3-9 for tightening torques.



**Figure 7-66**

8. Check gear backlash as follows.

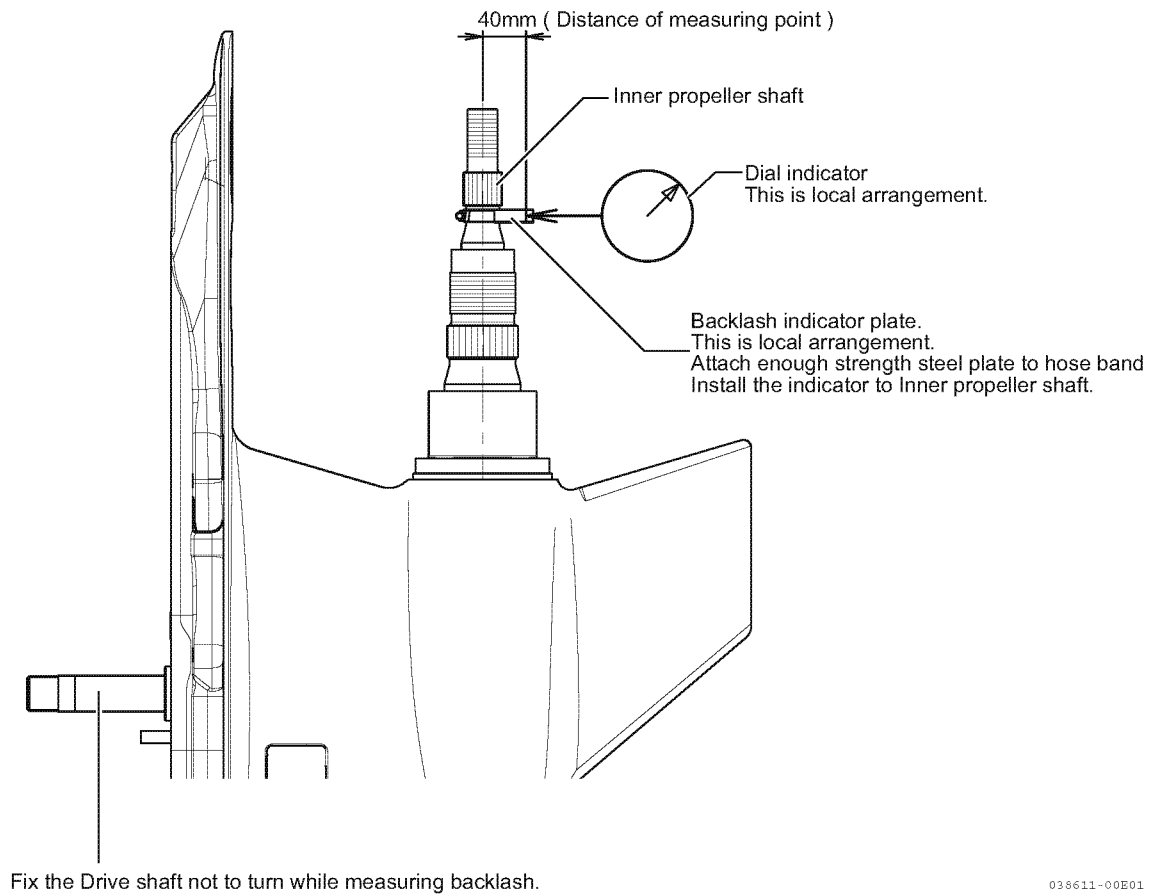


**Figure 7-67**

## GEAR HOUSING

9. Check backlash between lower pinion gear and lower gear "A", as shown in **Figure 7-68**.

- Backlash: 0.16 to 0.32 mm

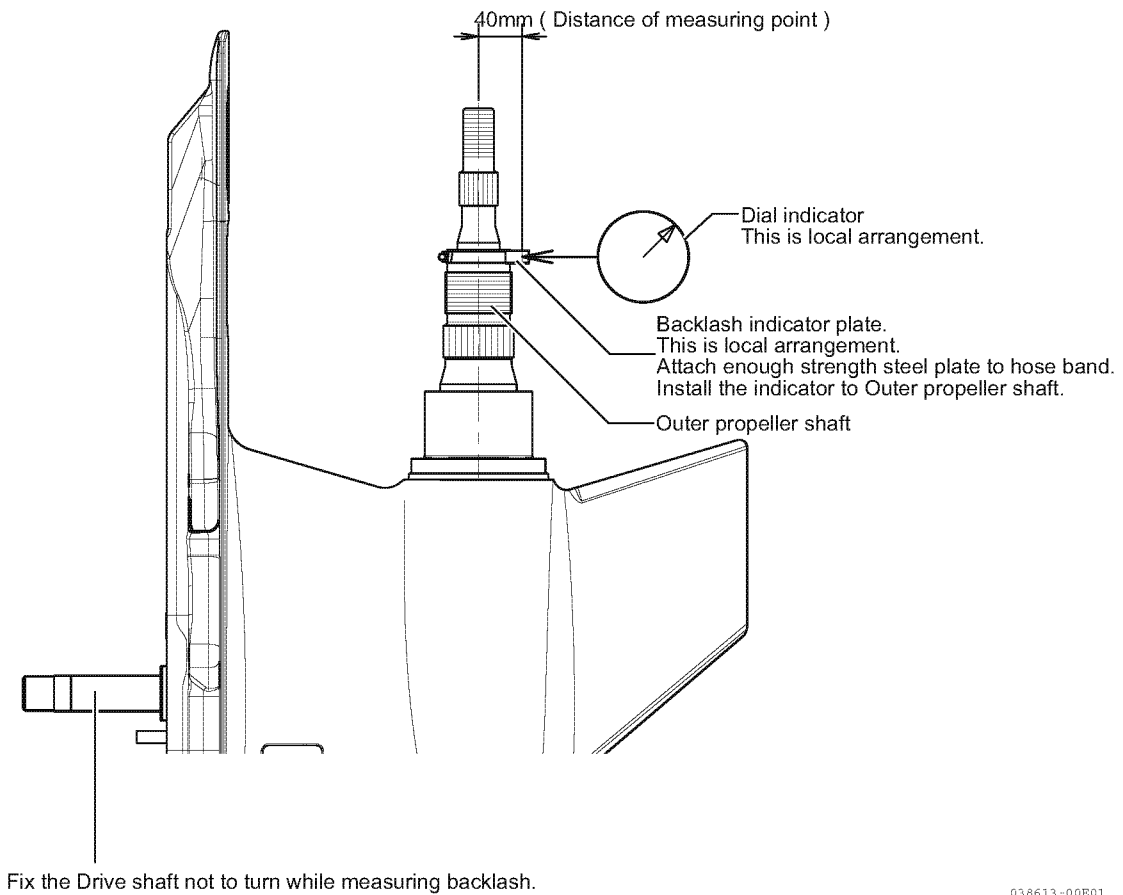


**Figure 7-68**

- If lower pinion gear and lower gear "A" backlash > 0.32 increase "Ta" shim thickness (**Figure 7-67**).
- If lower pinion gear and lower gear "A" backlash < 0.16 decrease "Ta" shim thickness (**Figure 7-67**).

10. Check backlash between lower pinion gear and lower gear "B", as shown in **Figure 7-69**.

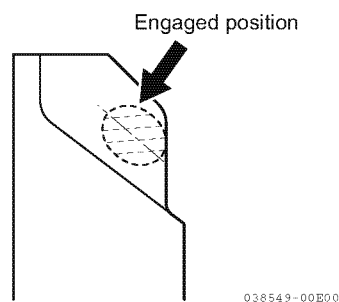
- Backlash: 0.16 to 0.32 mm



**Figure 7-69**

- If lower pinion gear and lower gear "B" backlash > 0.32 increase "Tb" shim thickness (**Figure 7-67**).
- If lower pinion gear and lower gear "B" backlash < 0.16 decrease "Tb" shim thickness (**Figure 7-67**).

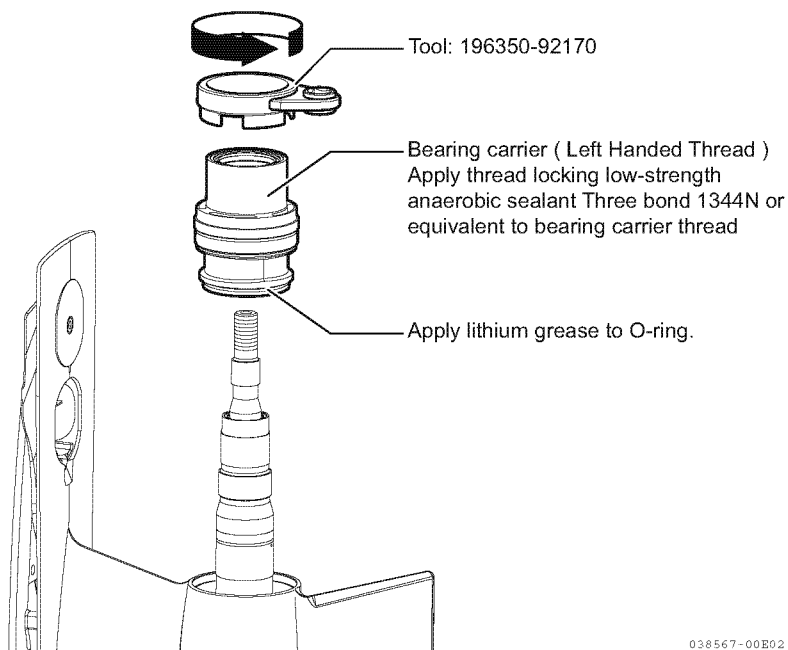
11. Check the engaged position on teeth surface, as shown in **Figure 7-70** (lower pinion, lower gear "A", lower gear "B").



**Figure 7-70**

## GEAR HOUSING

12. After adjustment of gear backlash, loosen the bearing carrier.
13. Apply thread locking low-strength anaerobic sealant Three Bond® 1344N or equivalent to bearing carrier thread, as shown in **Figure 7-71**.
14. Reinstall the bearing carrier with specified tightening torque. *See Bearing Carrier on page 3-9 for tightening torques.*



**Figure 7-71**



*Section 8*

# **TRANSOM ASSEMBLY**

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### **SAFETY PRECAUTIONS**

Before servicing the stern drive, review *Safety on page 2-1*.

### **INTRODUCTION**

This section of the *Service Manual* describes the procedures necessary to disassemble and assemble the transom assembly.

GENERAL VIEWS

External View

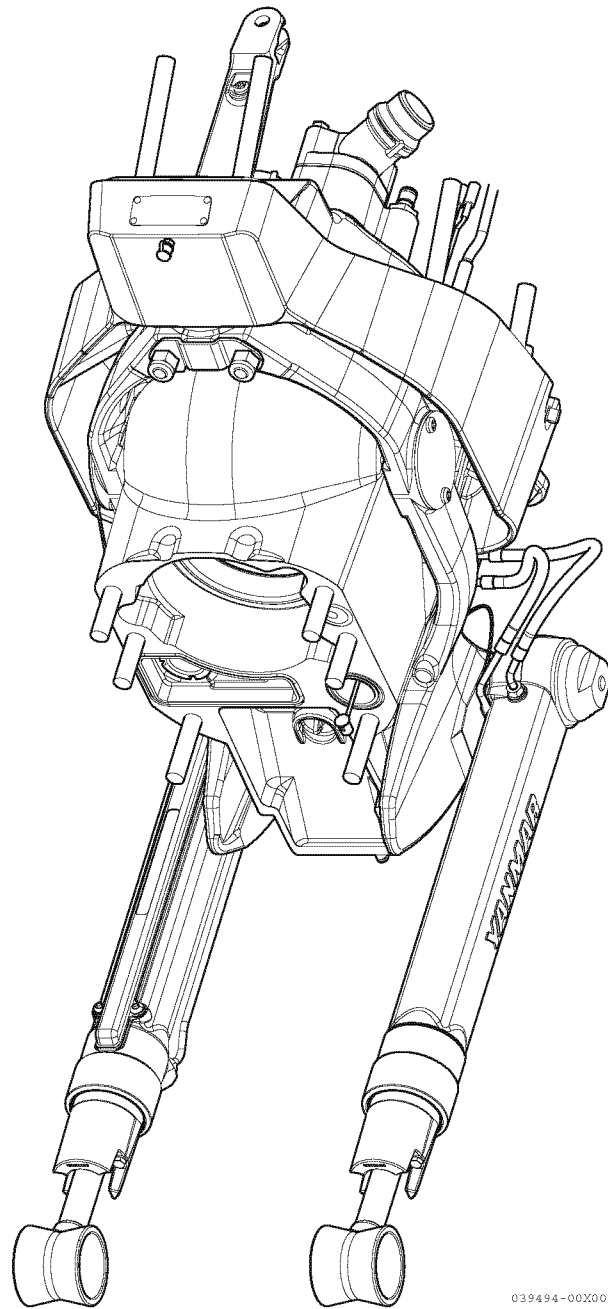


Figure 8-1

Cross Section View

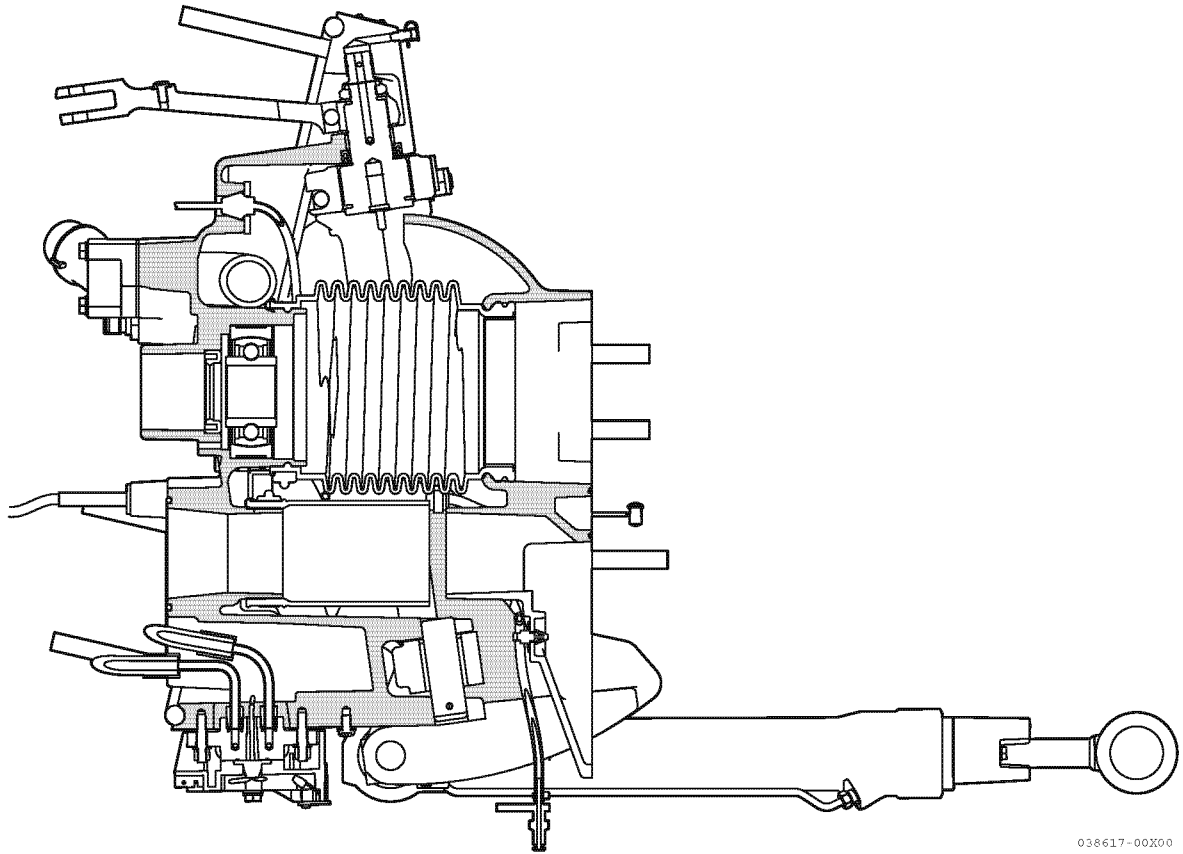
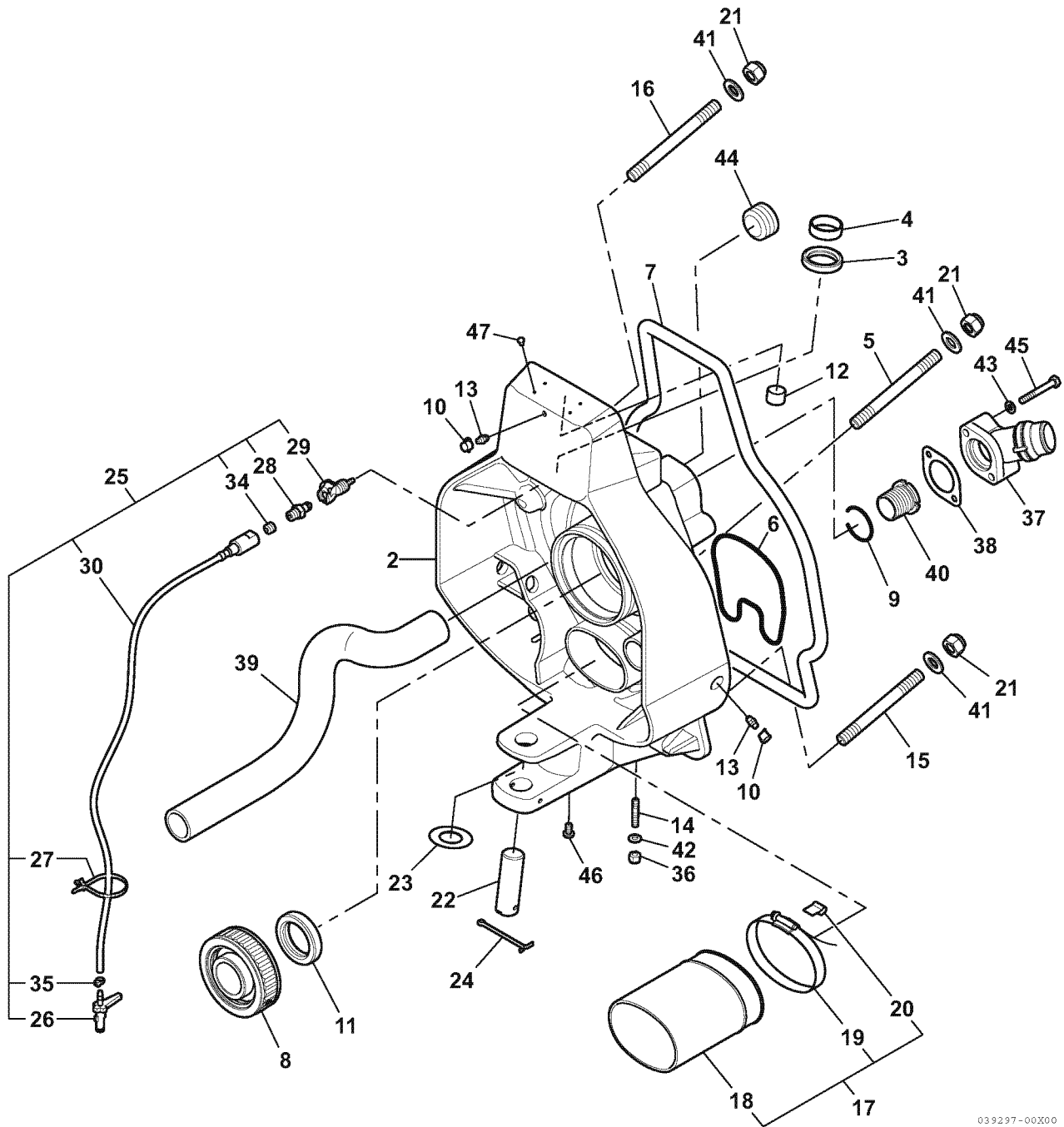


Figure 8-2

TRANSOM ASSEMBLY PART DIAGRAMS

Gimbal Housing



039297-00X00

Figure 8-3

# TRANSOM ASSEMBLY

Item	Part Number	Description	ZT350	ZT370	N/O
2	196350-01120	Gimbal Housing	1	1	
3	196350-01130	Dry Bearing 28 × 10	1	1	
4	196350-01140	Seal 284008	1	1	
5	196350-01150	Stud Bolt 12 × 100	2	2	
6	196350-01160	O-Ring	1	1	
7	196350-01170	Rubber Seal	1	1	
8	196350-04410	Unit Bearing CMP	1	1	
9	196350-07320	Ring 35	1	1	
10	189010-39600	Cap	2	2	
11	24411-355511	Seal SC355511	1	1	
12	24550-016120	Bush 16 × 12 Dry	1	1	
13	24764-060000	Nipple MT6 × 1	1	1	
14	26223-060202	Stud 6 × 20	2	2	
15	26226-120902	Stud M12 × 90	4	4	
16	26226-121002	Stud 12 × 100	2	2	
17	196350-01180	Bellows CMP	1	1	
18	196350-01190	Bellows Exhaust	1	1	
19	196350-01200	Clamp Hose 80	1	1	
20	196350-02210	Clip Grounding	1	1	
21	196350-01280	Nylon Nut 12	8	8	
22	196350-03200	Swivel Pin	1	1	

Item	Part Number	Description	ZT350	ZT370	N/O
23	196350-03210	Washer	1	1	
24	196350-03220	Cotter Pin 6	1	1	
25	196350-03700	Speed Meter CMP	1		O
25-1	23873-010000	Plug R01	1	1	N
26	196350-03710	Adaptor	1		O
27	196350-03730	Cable Band	1		O
28	196350-03740	Fitting Male	1		O
29	196350-03750	Fitting Female	1		O
30	196350-03760	Hose CMP	1		O
34	23873-010000	Plug R01	1		O
35	29621-100001	Band 100	1		O
36	196324-06900	Nut 6	2	2	
37	196350-07241	Connector	1	1	
38	196350-07251	Gasket	1	1	
39	196350-07261	Water Hose	1	1	
40	196350-07310	Insert	1	1	
41	22137-120000	Washer 12	8	8	
42	22213-060000	Spring Washer 6	2	2	
43	22217-060000	Spring Washer 6	2	2	
44	23873-100000	Plug PT1	1	1	
45	26116-060452	Bolt M6 × 45	2	2	
46	26553-060102	Screw 6 × 10	1	1	
47	196311-02060	Rivet 2 × 5	4	4	

No.	Design-change Part	Reason of Change
25	196350-03700 Speed Meter CMP	Eliminate
26	196350-03710 Adaptor	Eliminate
27	196350-03730 Cable Band	Eliminate
28	196350-03740 Fitting Male	Eliminate

No.	Design-change Part	Reason of Change
29	196350-03750 Fitting Female	Eliminate
30	196350-03760 Hose CMP	Eliminate
34	23873-010000 Plug R01	Eliminate
35	29621-100001 Band 100	Eliminate

# TRANSOM ASSEMBLY

## Gimbal Ring and Steering Lever

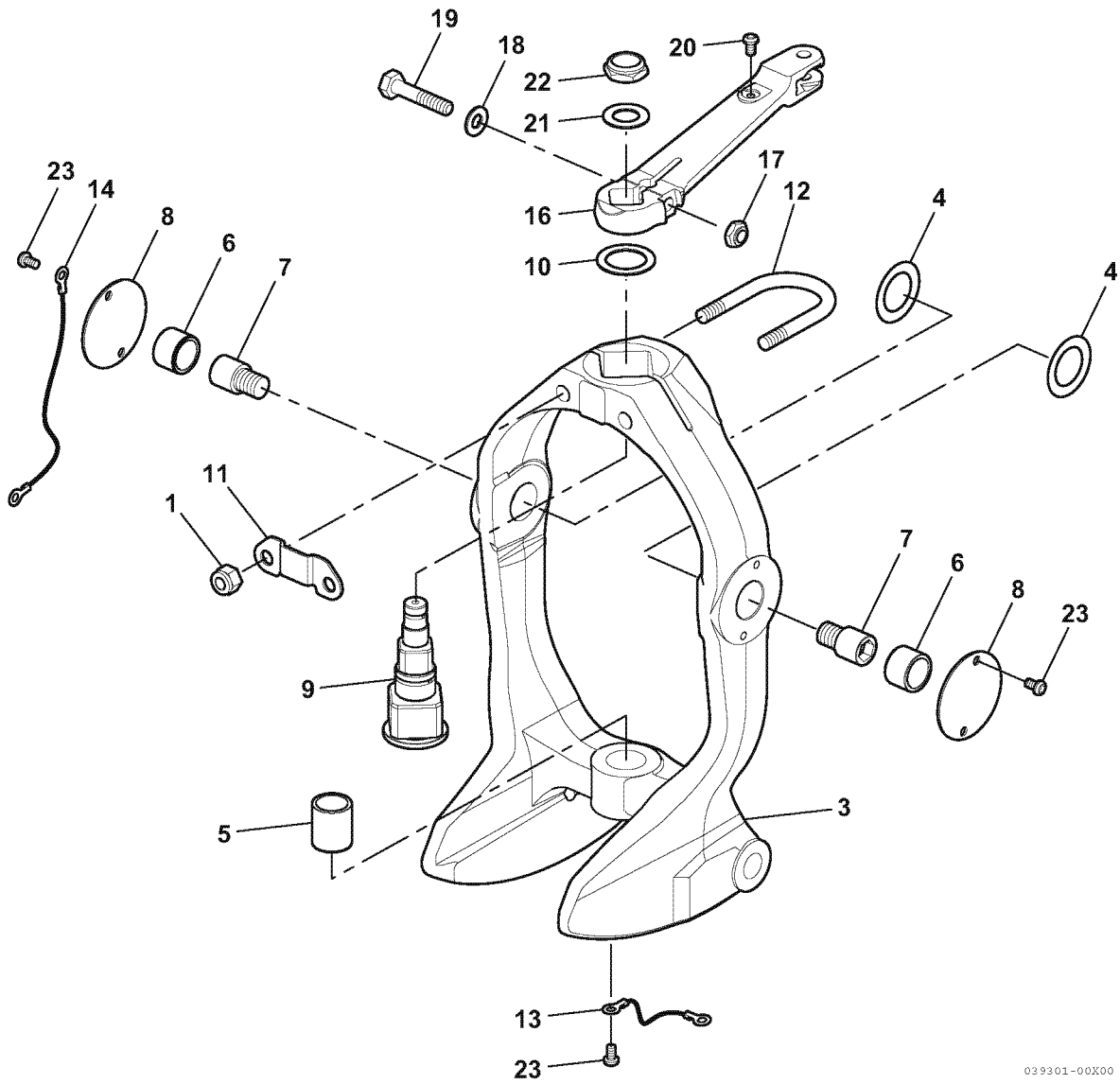


Figure 8-4

039301-00X00



## TRANSOM ASSEMBLY

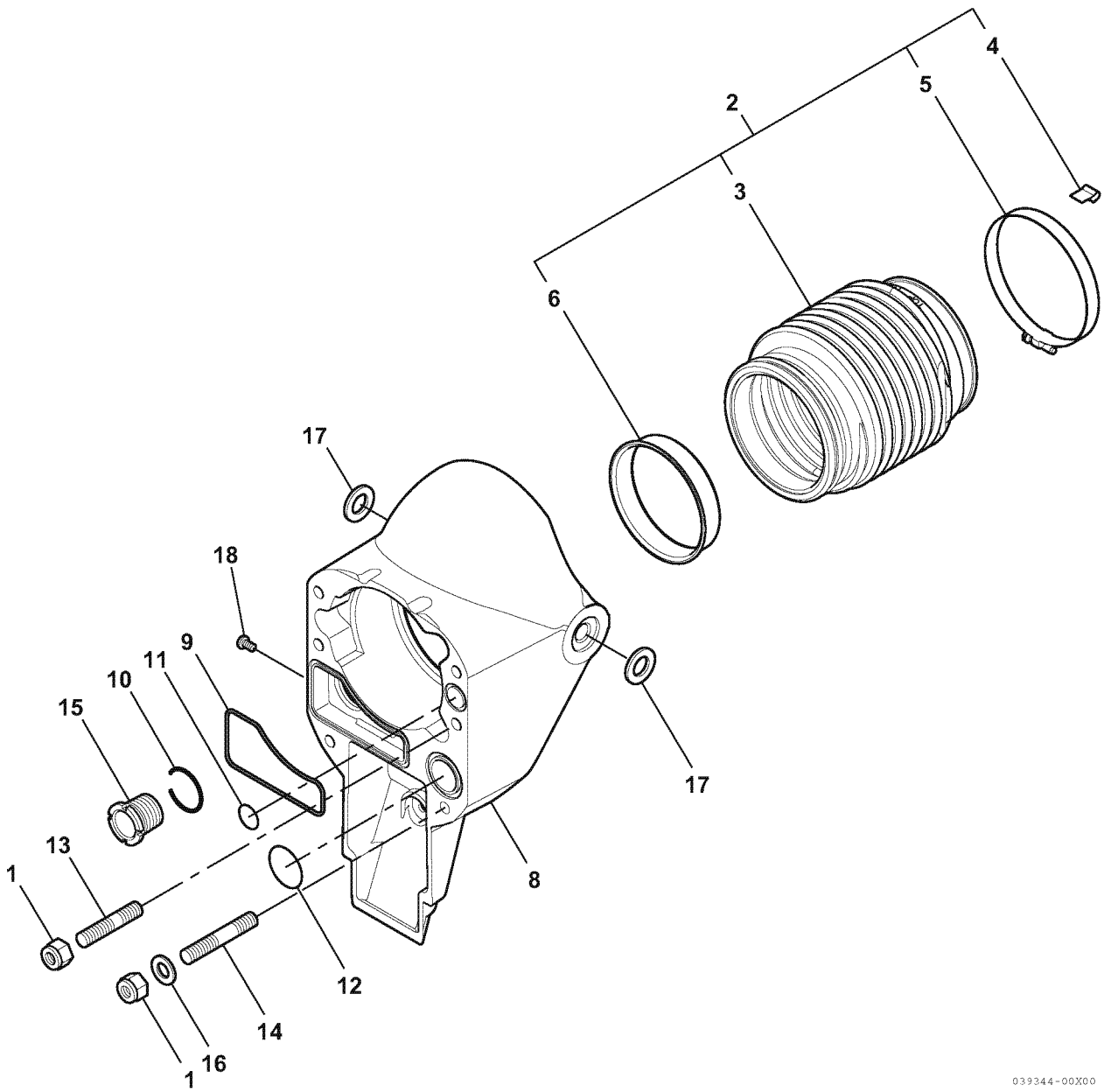
Item	Part Number	Description	ZT350	ZT370	N/O
1	196323-01380	Nut	2	2	
3	196350-03020	Gimbal Ring	1	1	
4	196350-03040	Washer	2	2	
5	196350-03230	Bush Swivel	1	1	
6	196350-03250	Bush Hinge	2	2	
7	196350-03060	Hinge Screw	2	2	O
7-1	196350-03061	Hinge Screw	2	2	N
8	196350-03070	Plate	2	2	
9	196350-03080	Steering Shaft	1	1	
10	196350-03090	Washer D29	1	1	
11	196350-03150	Bracket	1	1	

Item	Part Number	Description	ZT350	ZT370	N/O
12	196350-03160	U-Bolt	1	1	
13	196350-03900	Cord Ground TA	1	1	
14	196350-03950	Cord Ground CA	1	1	
16	196350-05210	Steering Lever	1	1	
17	196350-05240	U-Bolt	1	1	
18	22137-100000	Washer 10	1	1	
19	26076-100502	Bolt M10 × 50	1	1	
20	26553-060102	Screw 6 × 10	1	1	
21	196350-05220	Washer D19	1	1	
22	196350-05230	Nylon Nut 18	1	1	
23	26553-060102	Screw 6 × 10	5	5	

No.	Design-change Part		Reason of Change
7-1	196350-03061	Hinge Screw	Length 20 mm to 17.8 mm

# TRANSOM ASSEMBLY

## Bell Housing



039344-00X00

**Figure 8-5**

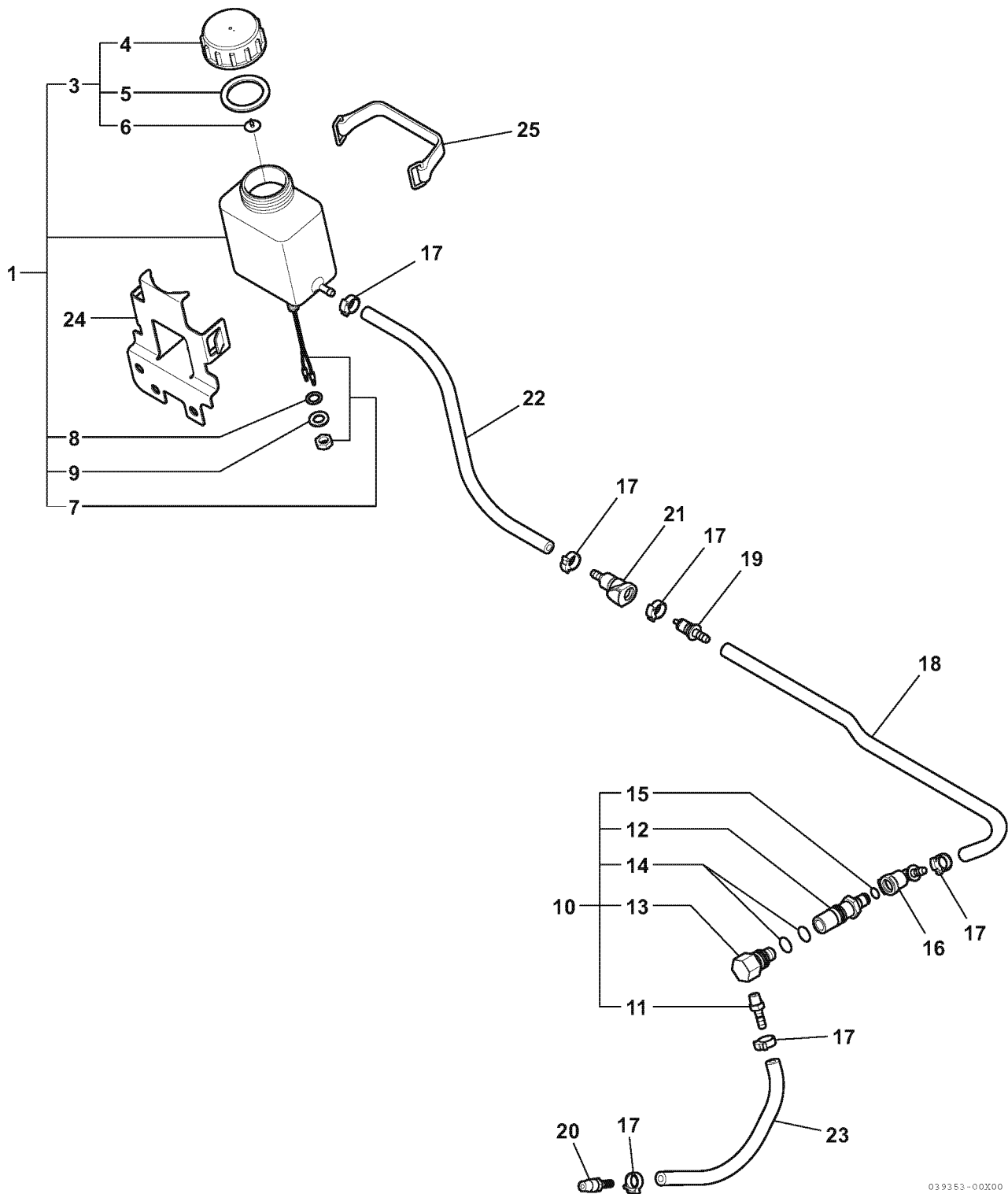
## TRANSOM ASSEMBLY

Item	Part Number	Description	ZT350	ZT370	N/O
1	196340-02040	Nut	6	6	
2	196350-02190	Bellows Set	1	1	
3	196350-02200	Bellows CMP	1	1	
4	196350-02210	Clip Ground	1	1	
5	196350-02220	Clamp Hose 127	1	1	
6	196350-02230	Sleeve Bellows	1	1	
8	196350-03320	Bell Housing	1	1	
9	196350-03340	Gasket	1	1	
10	196350-07320	Ring 35	1	1	

Item	Part Number	Description	ZT350	ZT370	N/O
11	24311-000200	O-Ring P-20	1	1	
12	24321-000350	O-Ring G-35	1	1	
13	26223-120382	Stud Bolt 12 × 38	4	4	
14	26223-120502	Stud Bolt 12 × 50	2	2	
15	196350-07310	Insert	1	1	
16	22133-120000	Washer 12	5	5	
17	22133-160000	Washer 16	2	2	
18	26553-060102	Screw 6 × 10	1	1	

# TRANSOM ASSEMBLY

## Oil Reservoir CMP



039353-00X00

Figure 8-6

## TRANSOM ASSEMBLY

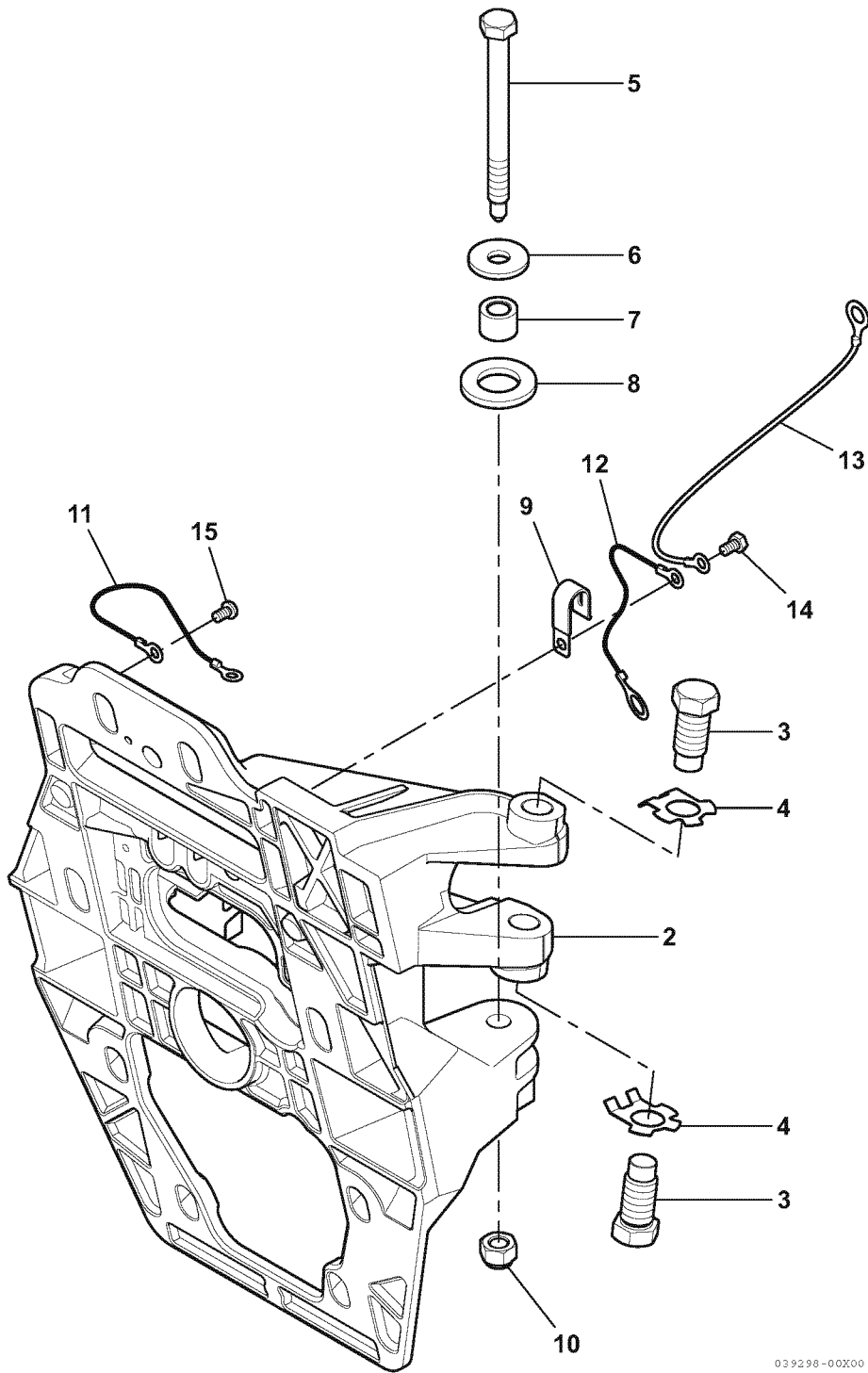
Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-07001	Oil Reservoir CMP	1	1	
3	196350-07021	Cap CMP	1	1	
4	196350-07030	Cap	1	1	
5	196350-07040	PK	1	1	
6	196350-07051	Valve	1	1	
7	196350-07060	Level Gauge CMP	1	1	
8	196350-07070	PK 15/10	1	1	
9	22117-100000	Washer 10	1	1	
10	196350-07100	Fitting CMP	1	1	
11	196350-07110	Connector	1	1	
12	196350-07120	Fitting A	1	1	
13	196350-07130	Fitting B	1	1	

Item	Part Number	Description	ZT350	ZT370	N/O
14	24311-000140	O-Ring P-14	2	2	
15	24341-000090	O-Ring S-9	1	1	
16	196350-07140	Quick Connector	1	1	
17	196350-07150	Nylon Clamp	6	6	
18	196350-07160	Hose A	1	1	
19	196350-07170	Fitting Male	1	1	
20	196350-07180	Connector	1	1	
21	196350-07190	Connector Female	1	1	
22	196350-07210	Hose B	1	1	
23	196350-07220	Hose C	1	1	
24	196350-07780	Bracket	1	1	
25	196350-07790	Strap	1	1	

*Note: Contact the Yanmar Parts Department for air separator part number information.*

# TRANSOM ASSEMBLY

## Transom Plate



039298-00X00

Figure 8-7

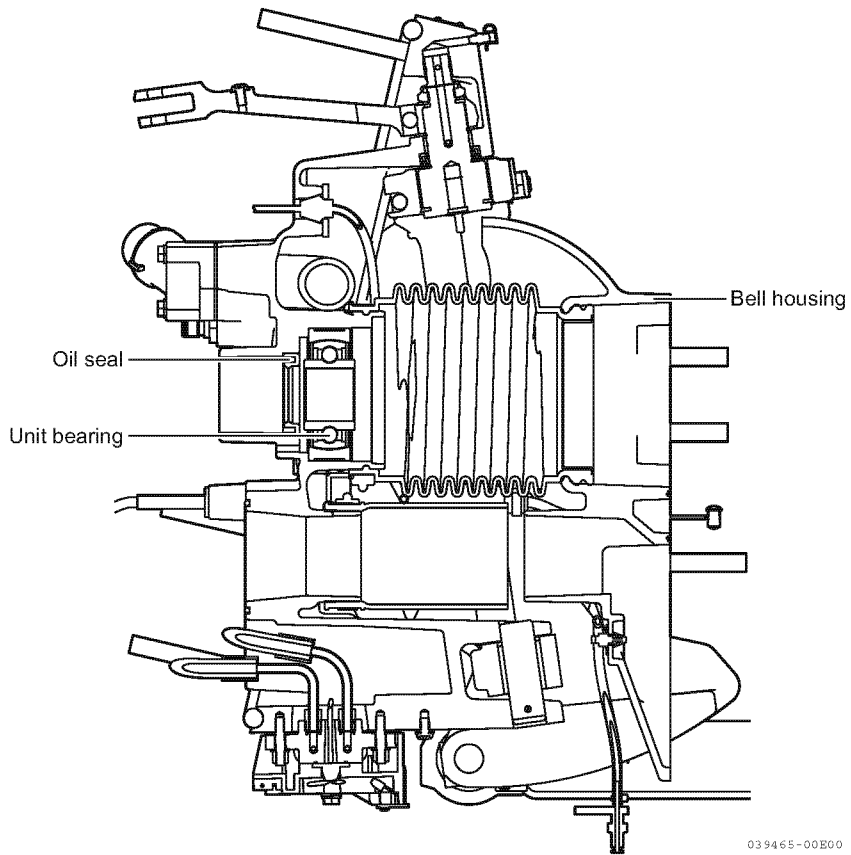
## TRANSOM ASSEMBLY

Item	Part Number	Description	ZT350	ZT370	N/O
2	196350-01020	Transom Plate	1	1	
3	196350-34150	Pivot Bolt	2		O
3-1	196350-34151	Pivot Bolt	2	2	N
4	196350-34160	Washer	2	2	
5	196350-01030	Bolt M12	2	2	
6	196350-01040	Washer	2	2	
7	196350-01050	Sleeve 12	2	2	
8	196350-01060	Washer	2	2	

Item	Part Number	Description	ZT350	ZT370	N/O
9	196350-01070	J Clip	1	1	
10	196350-01280	Nylon Nut 12	2	2	
11	196350-03900	Cord Ground TA	1	1	
12	196350-03910	Cord Ground TB	1	1	
13	196350-03920	Cord Ground TC	1		O
13-1	196350-03921	Cord Ground TC	1	1	N
14	26113-060102	Bolt M6 × 10	1	1	
15	26553-060102	Screw 6 × 10	1	1	

No.	Design-change Part		Reason of Change
3-1	196350-34151	Pivot Bolt	Material SUS304 to SUS410
13-1	196350-03921	Cord Ground TC	Length 350 mm to 380 mm

GIMBAL HOUSING DISASSEMBLY

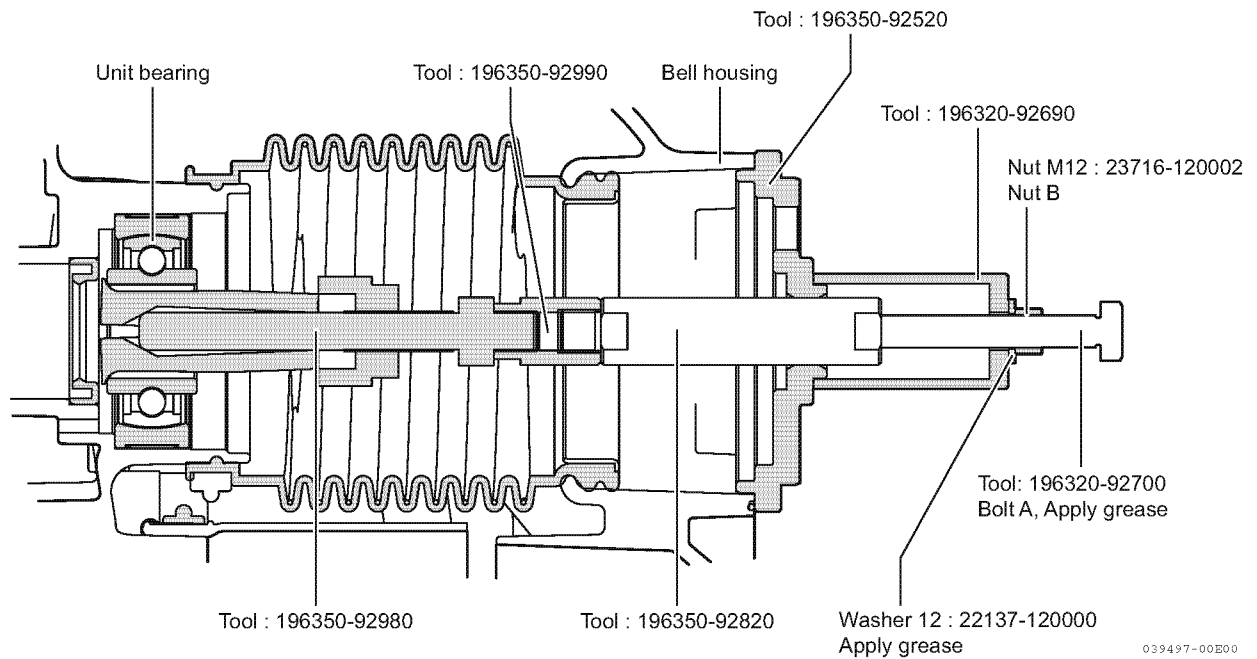


*Figure 8-8*



If the unit bearing is to be replaced or disassembled, use the special tools as shown in **Figure 8-9** to remove the unit bearing before disassembling the bell housing.

1. Remove the unit bearing before disassembling the bell housing by holding bolt "A" using a wrench while tightening nut "B".



**Figure 8-9**

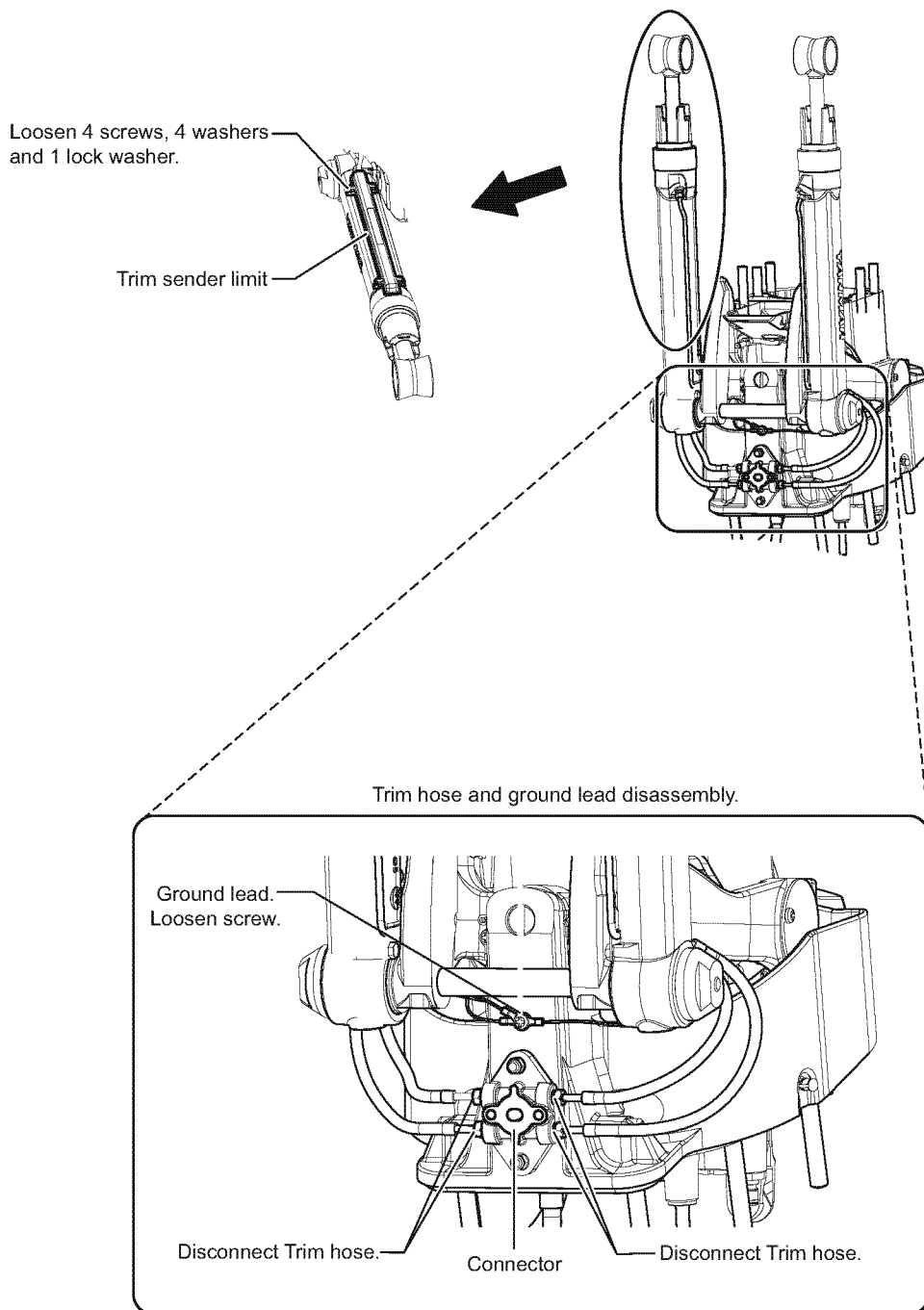
## TRANSOM ASSEMBLY

2. Remove the trim hoses, electrical ground lead and then the trim cylinders, as shown in **Figure 8-10**.

**⚠ WARNING**

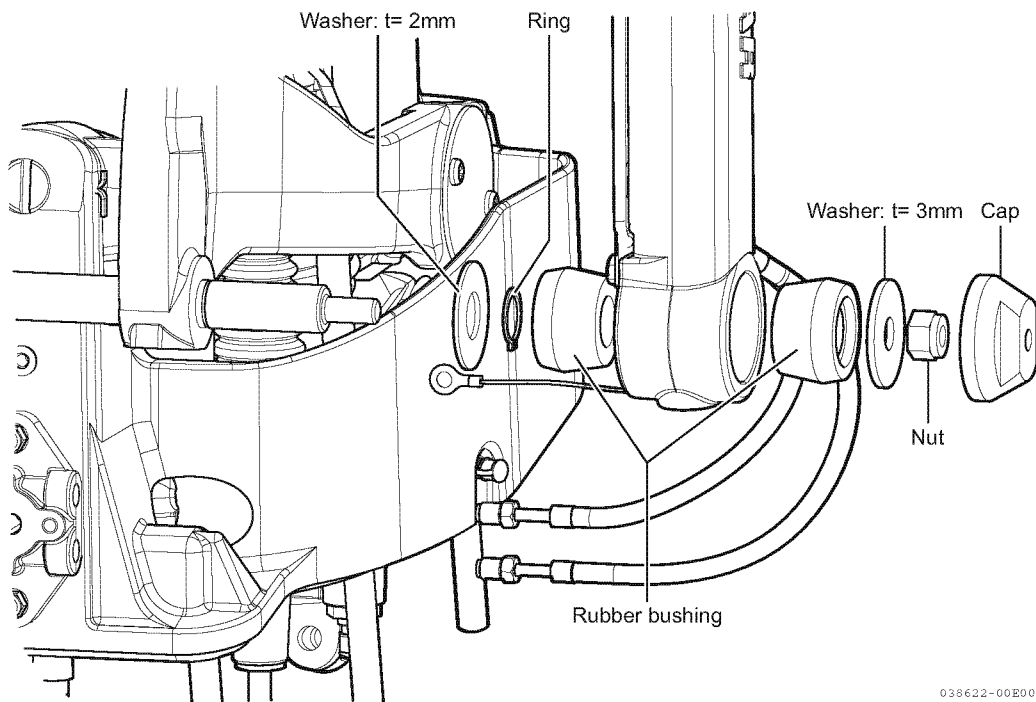
### EXPOSURE HAZARD

Wear safety glasses when loosening the trim hoses.



**Figure 8-10**

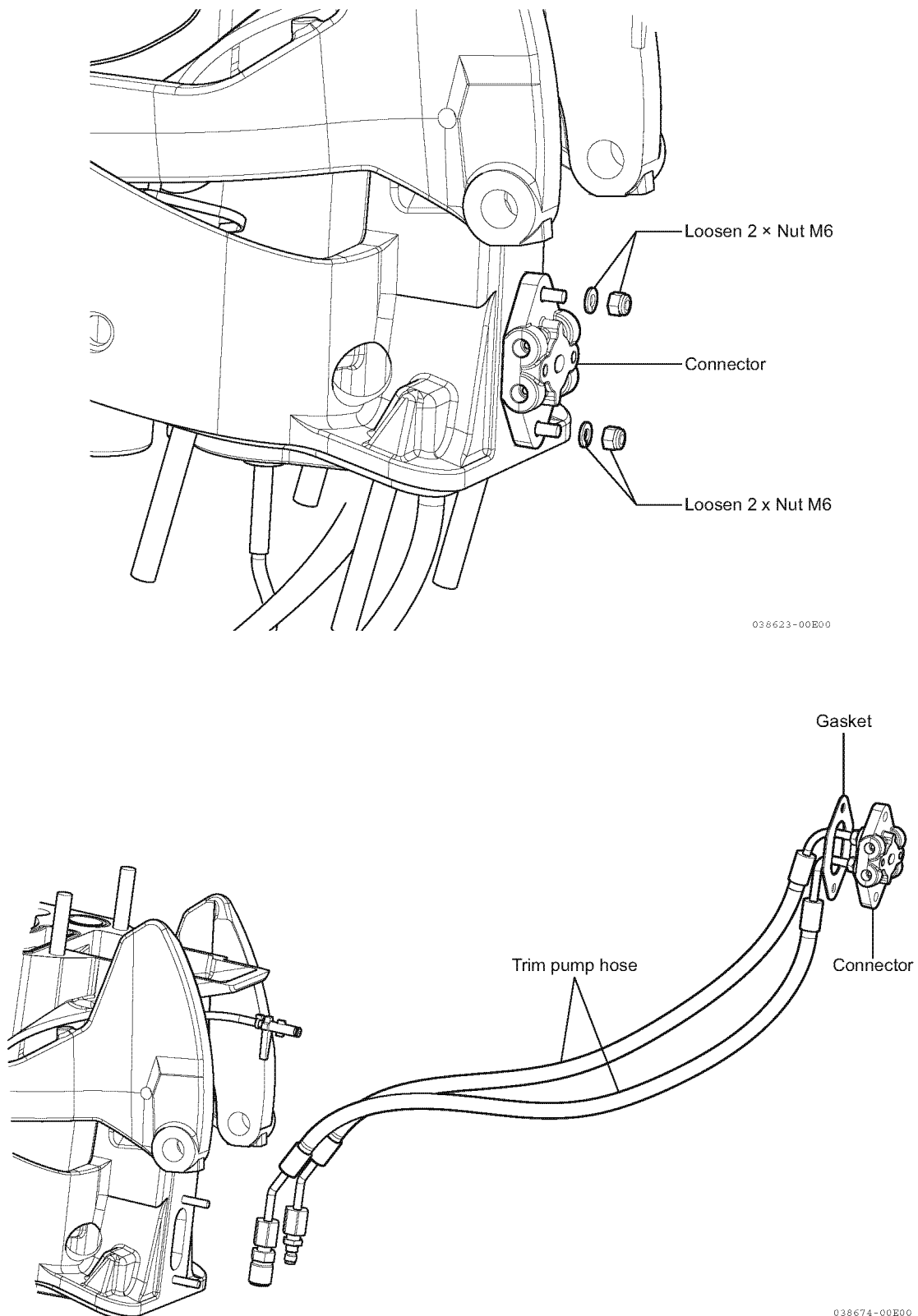
3. Remove the cap, nut, washer, rubber bushing, ring and washer, as shown in Figure 8-11.



**Figure 8-11**

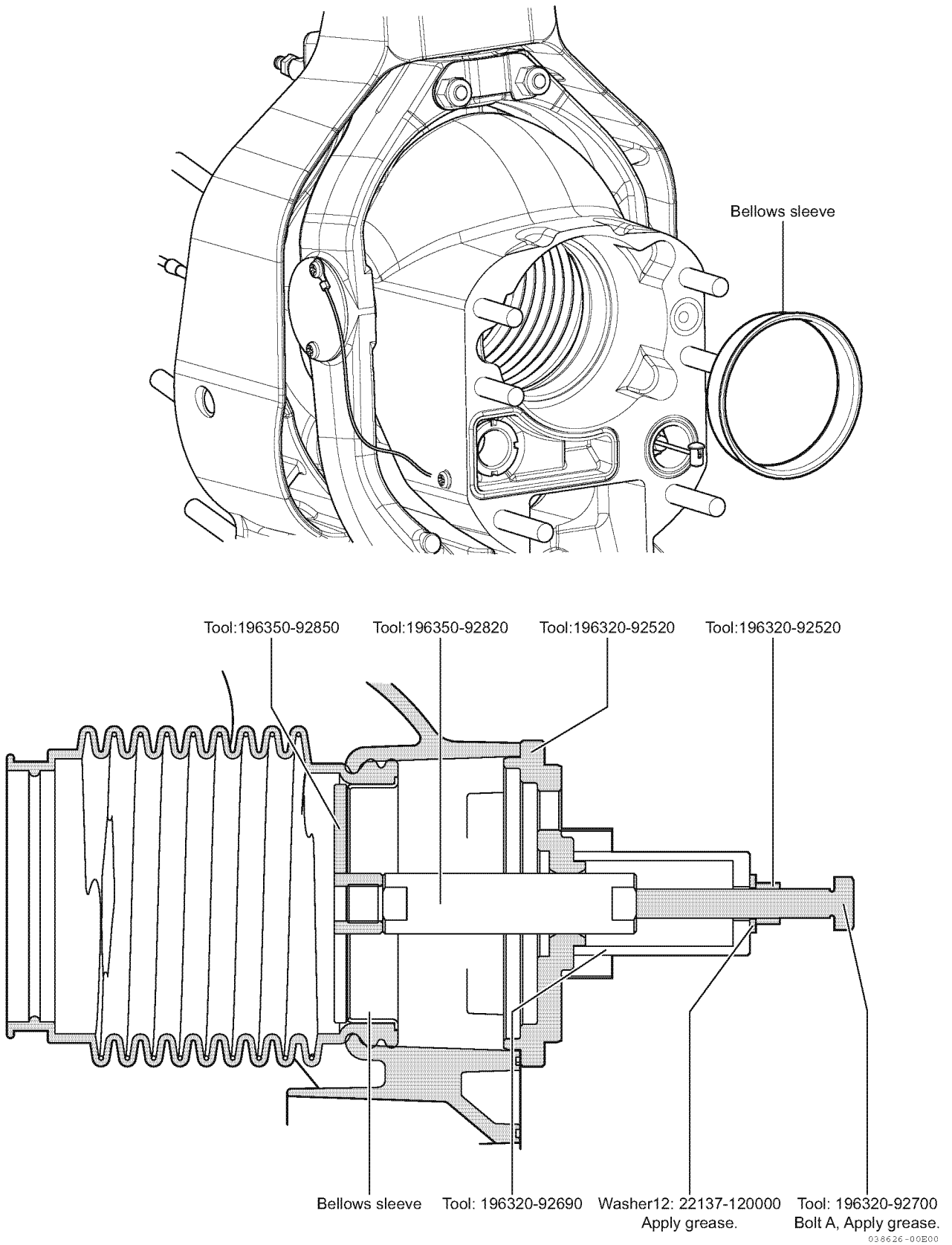
# TRANSOM ASSEMBLY

4. Remove the connector and gasket, as shown in **Figure 8-12**.



**Figure 8-12**

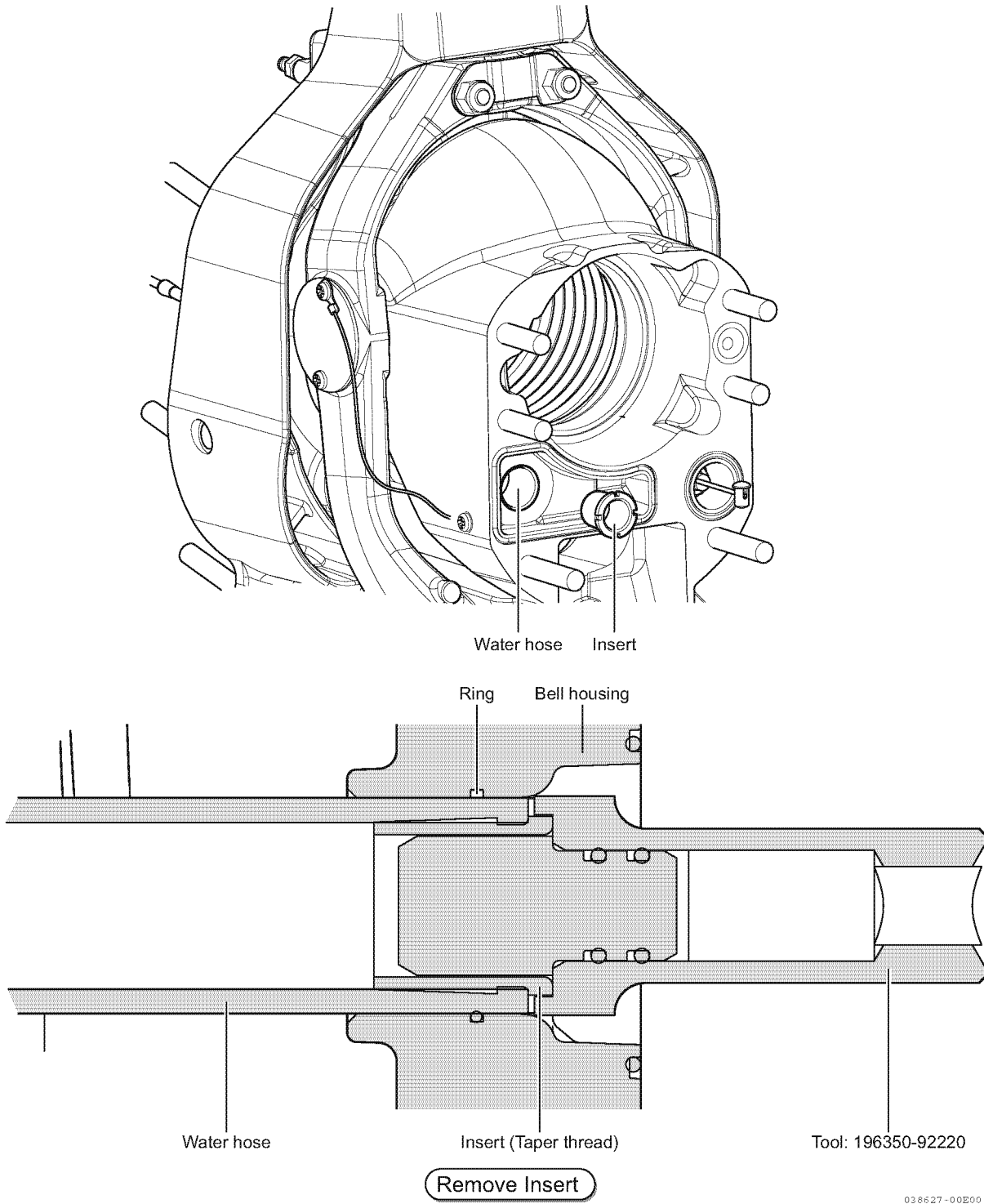
- Remove the bellows sleeve from the bell housing by holding bolt "A" with a wrench while tightening nut "B", as shown in **Figure 8-13**.



**Figure 8-13**

# TRANSOM ASSEMBLY

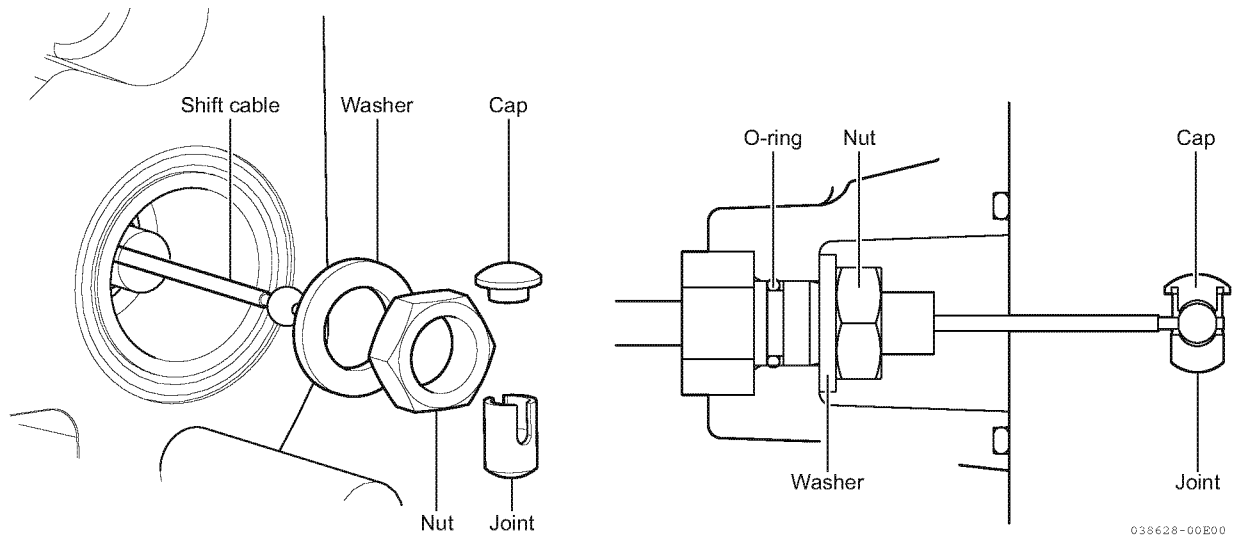
6. Remove the insert from the water hose, as shown in **Figure 8-14**.



**Figure 8-14**

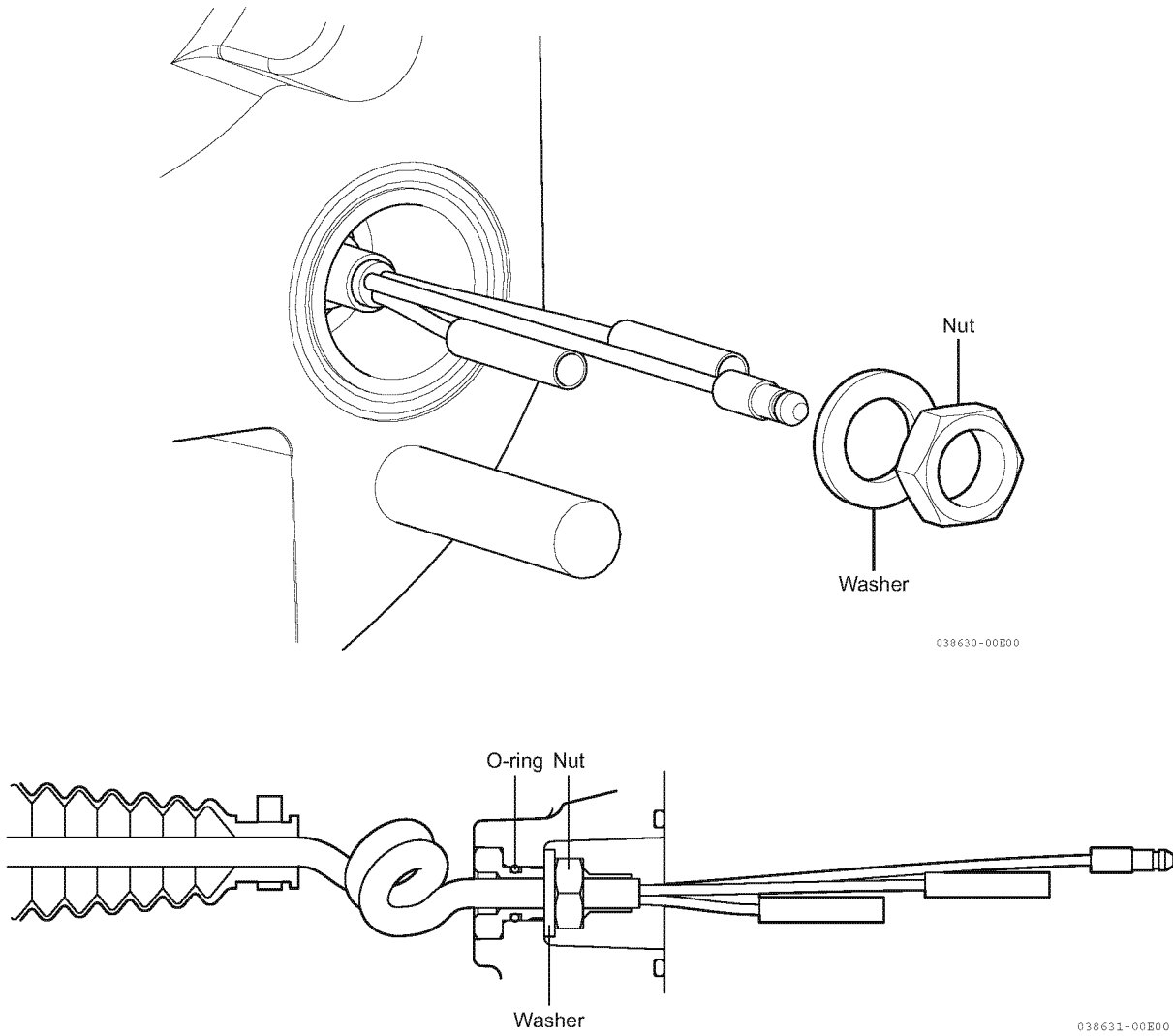
7. Disassemble the shift cable end, as shown in **Figure 8-15** and **Figure 8-16**.

## Mechanical Shift



**Figure 8-15**

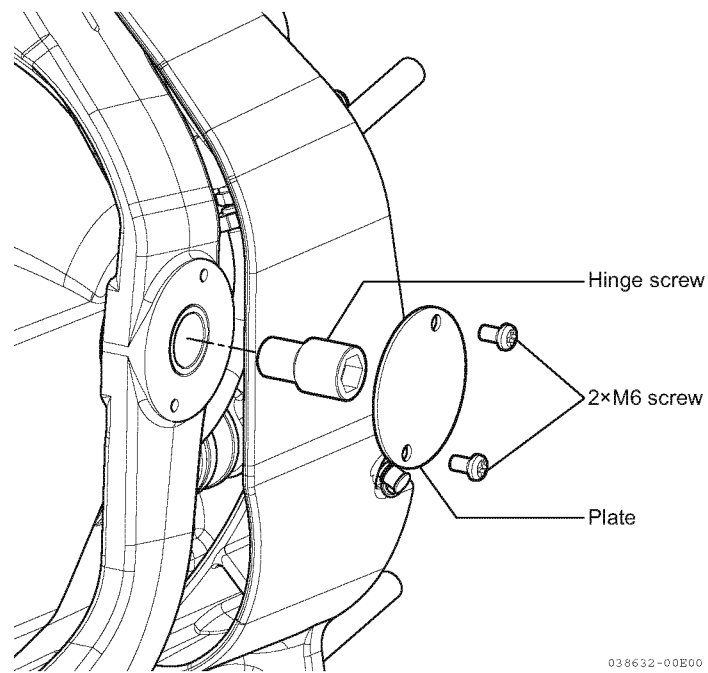
## Electric Shift



**Figure 8-16**



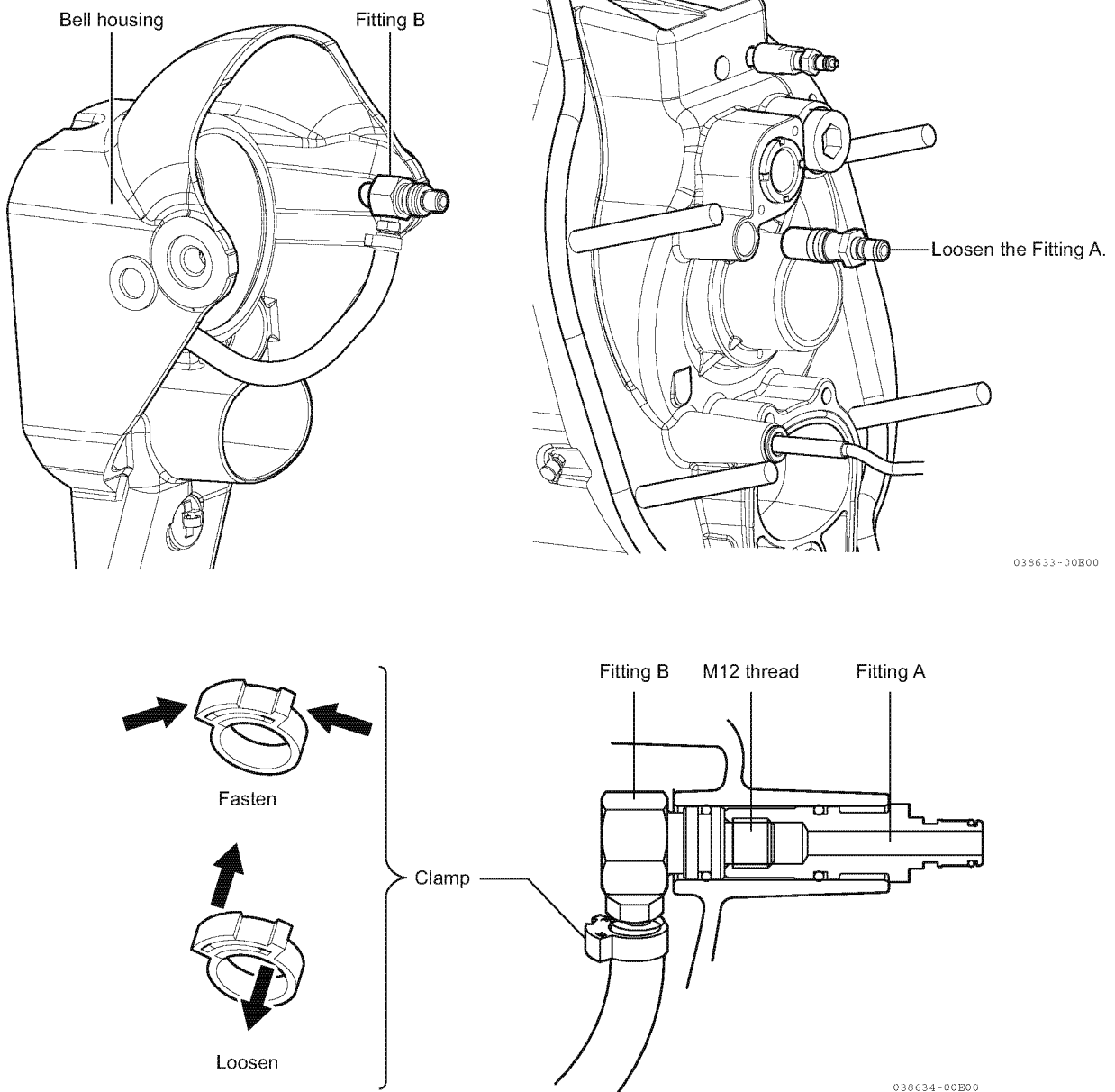
8. Remove the plate and hinge screw, as shown in **Figure 8-17**.



**Figure 8-17**

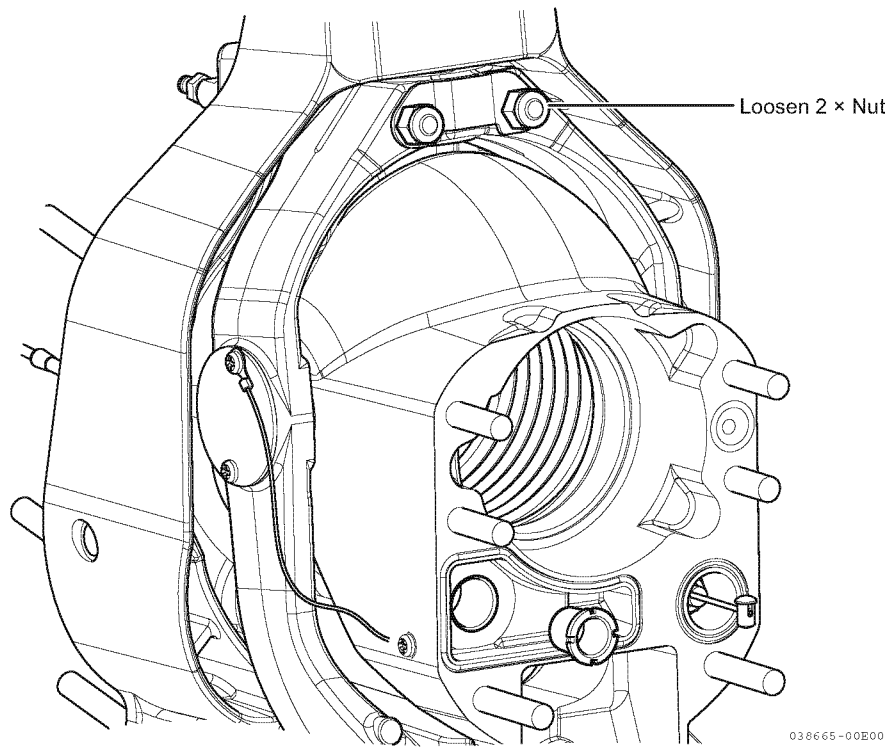
# TRANSOM ASSEMBLY

9. Loosen fitting "A", then remove the bell housing, as shown in **Figure 8-18**.



**Figure 8-18**

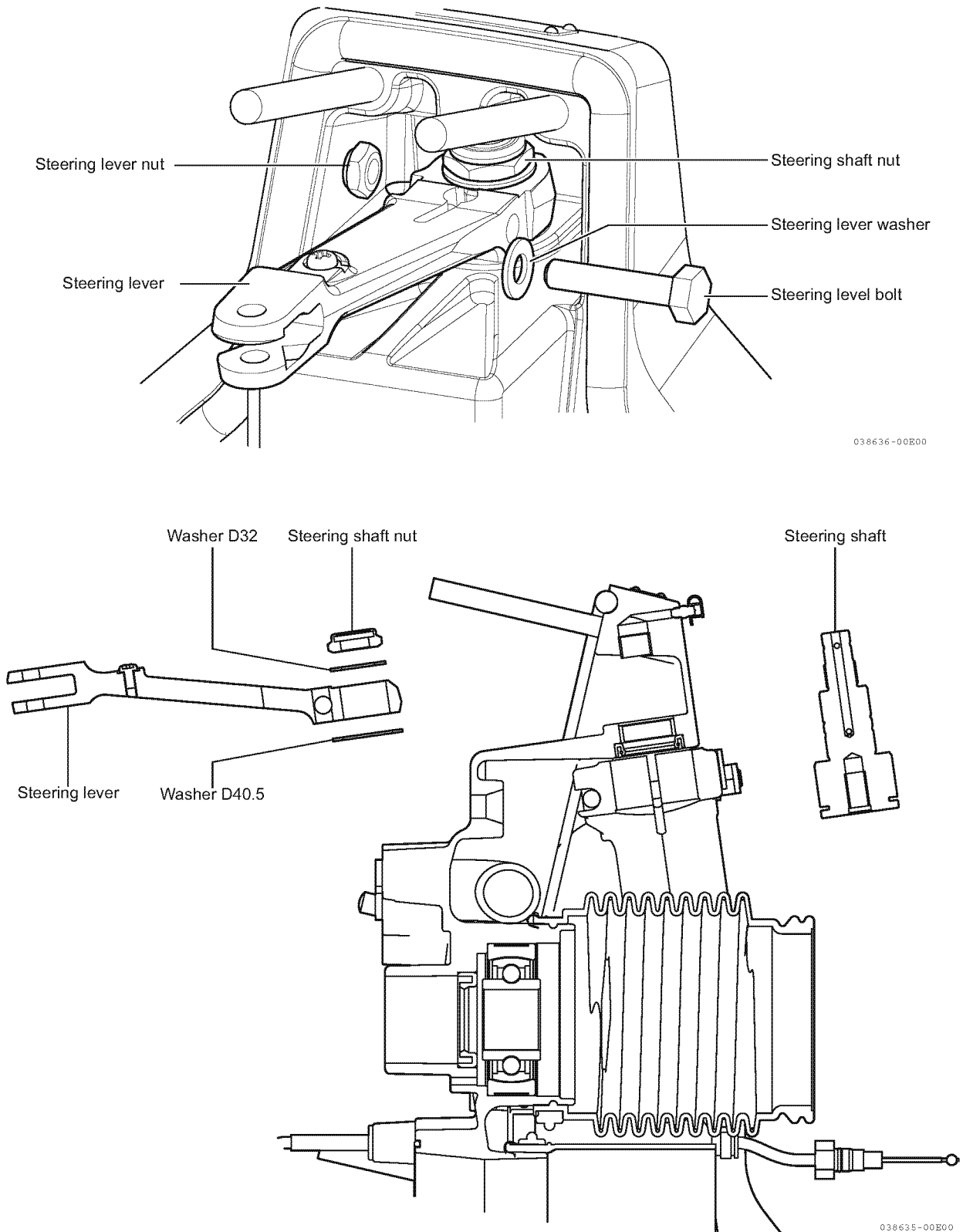
10. Loosen the two nuts on gimbal ring, as shown in **Figure 8-19**.



**Figure 8-19**

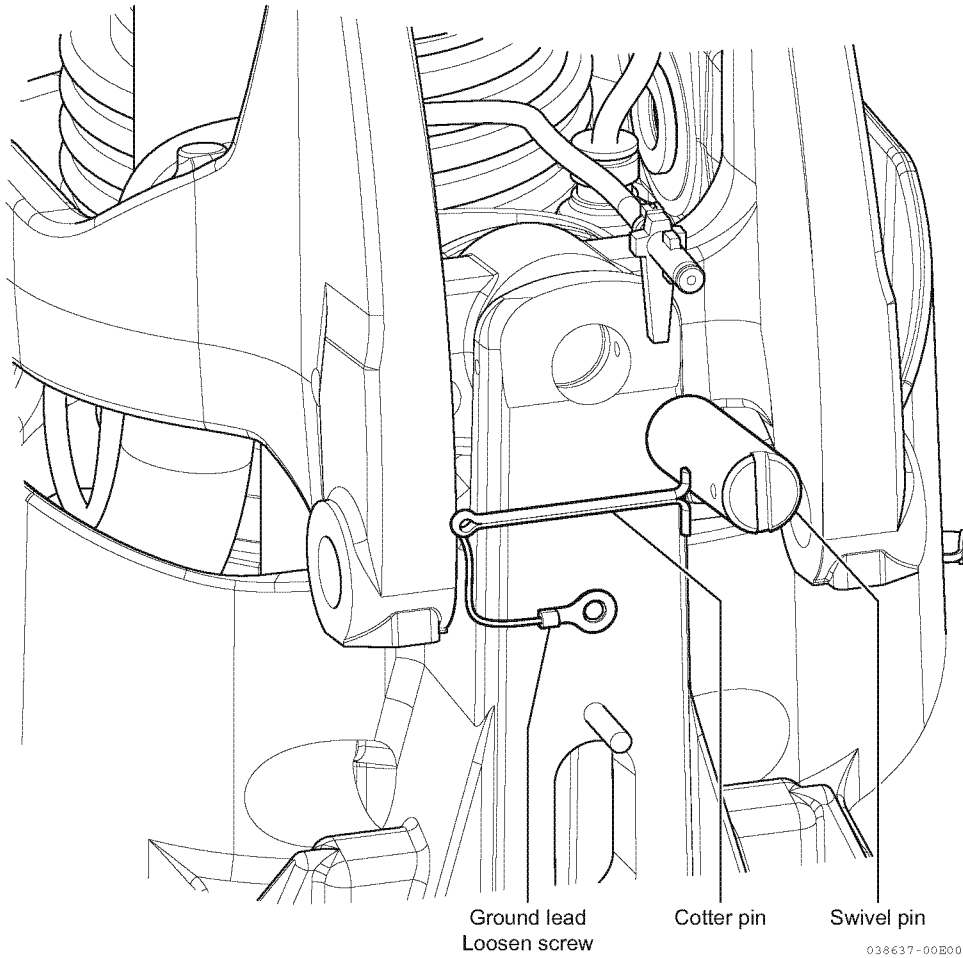
# TRANSOM ASSEMBLY

11. Loosen the steering shaft nut and steering lever bolt and then remove the steering lever and shaft, as shown in **Figure 8-20**.



**Figure 8-20**

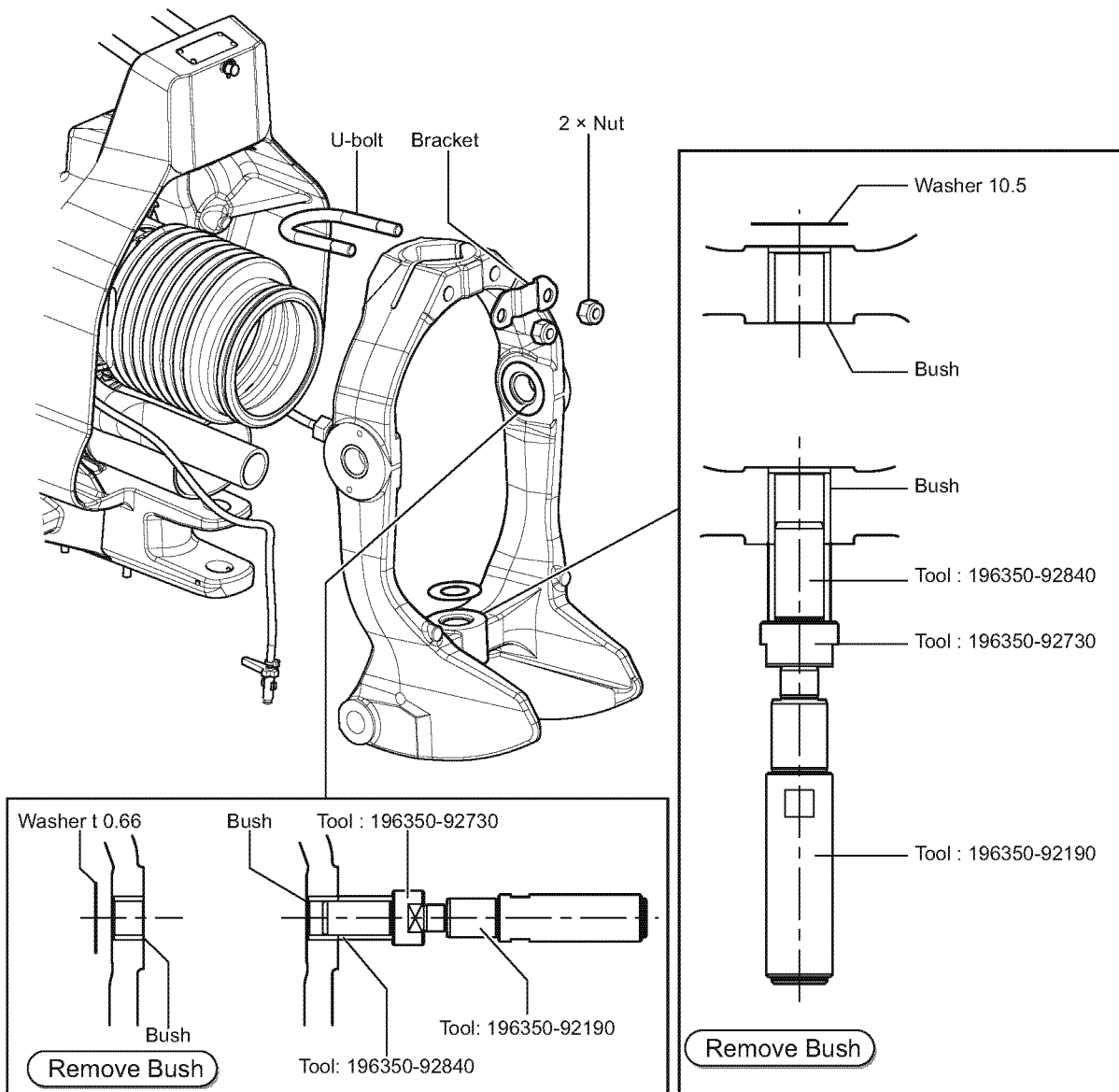
12. Remove the electrical ground lead and cotter pin, as shown in **Figure 8-21**.



**Figure 8-21**

# TRANSOM ASSEMBLY

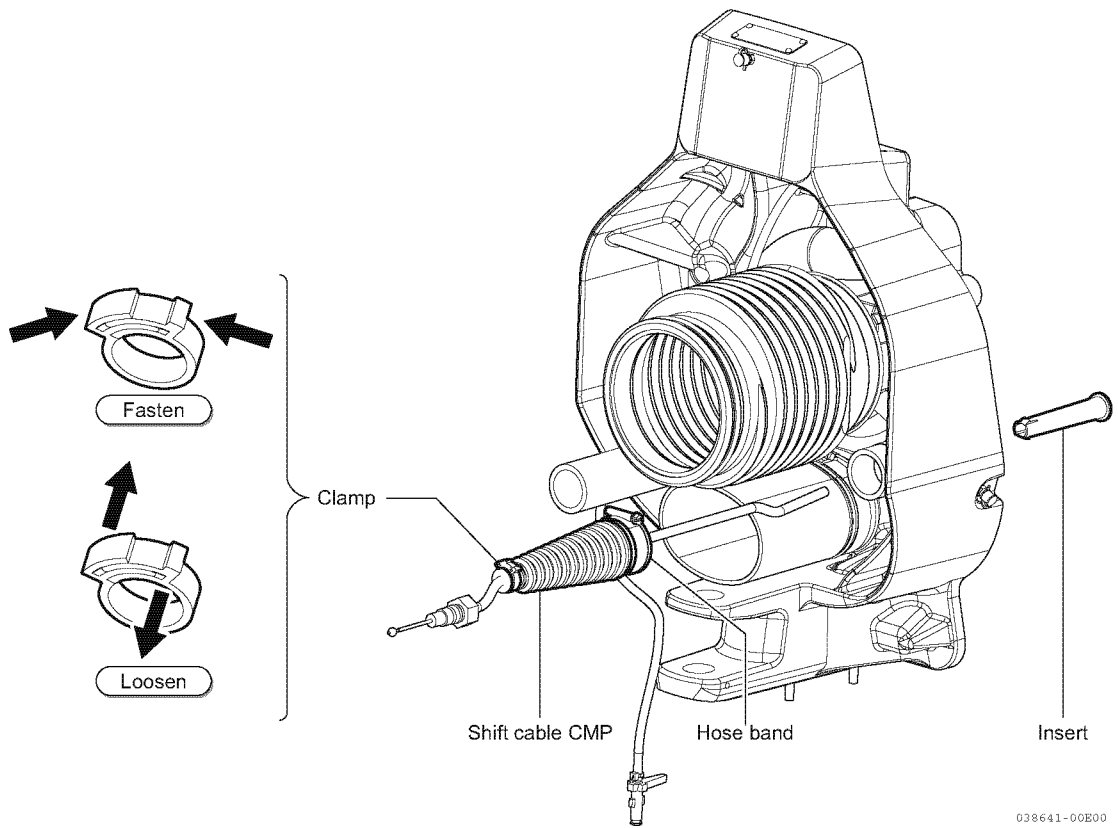
13. Disassemble the gimbal ring, as shown in **Figure 8-22**.



**Figure 8-22**

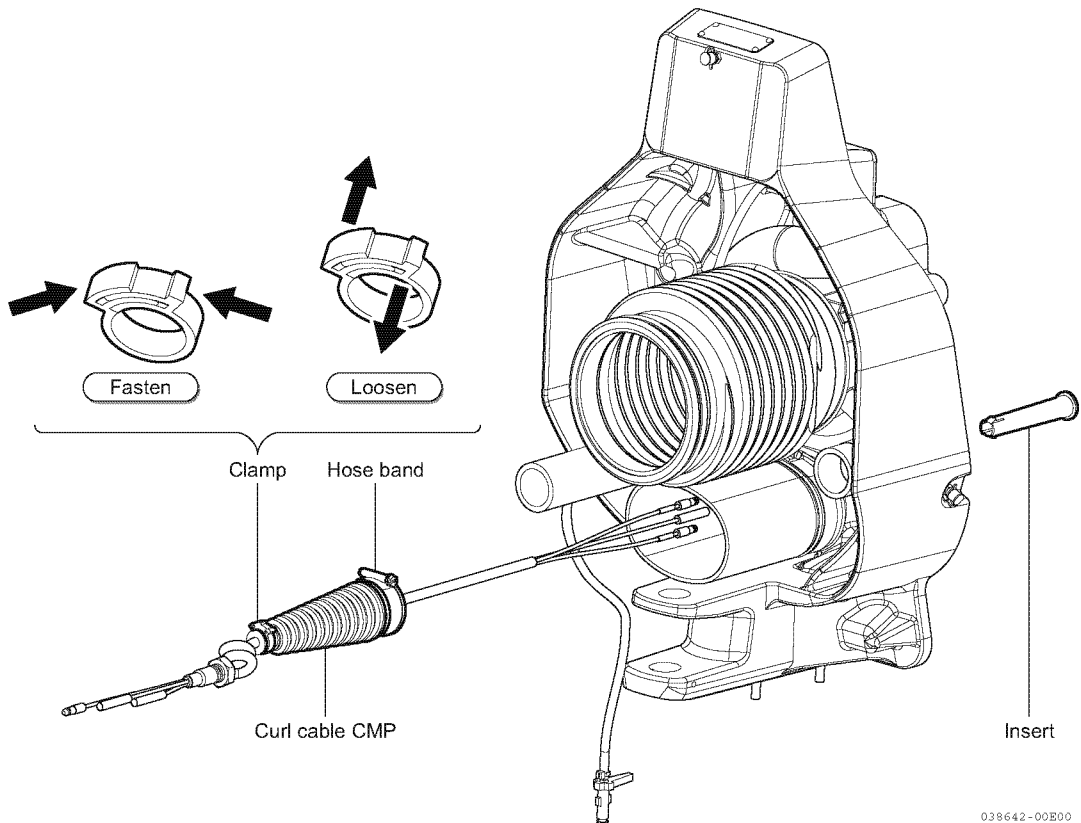
14. Disassemble the shift cable CMP, as shown in **Figure 8-23** and **Figure 8-24**.

**Mechanical Shift**



**Figure 8-23**

**Electric Shift**

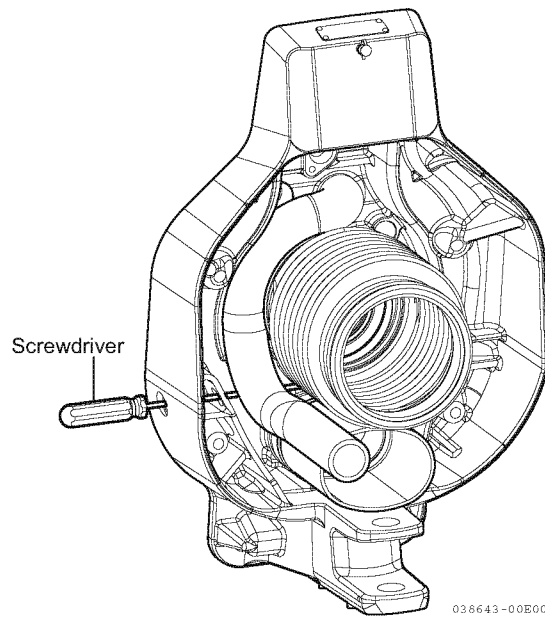


**Figure 8-24**

## TRANSOM ASSEMBLY

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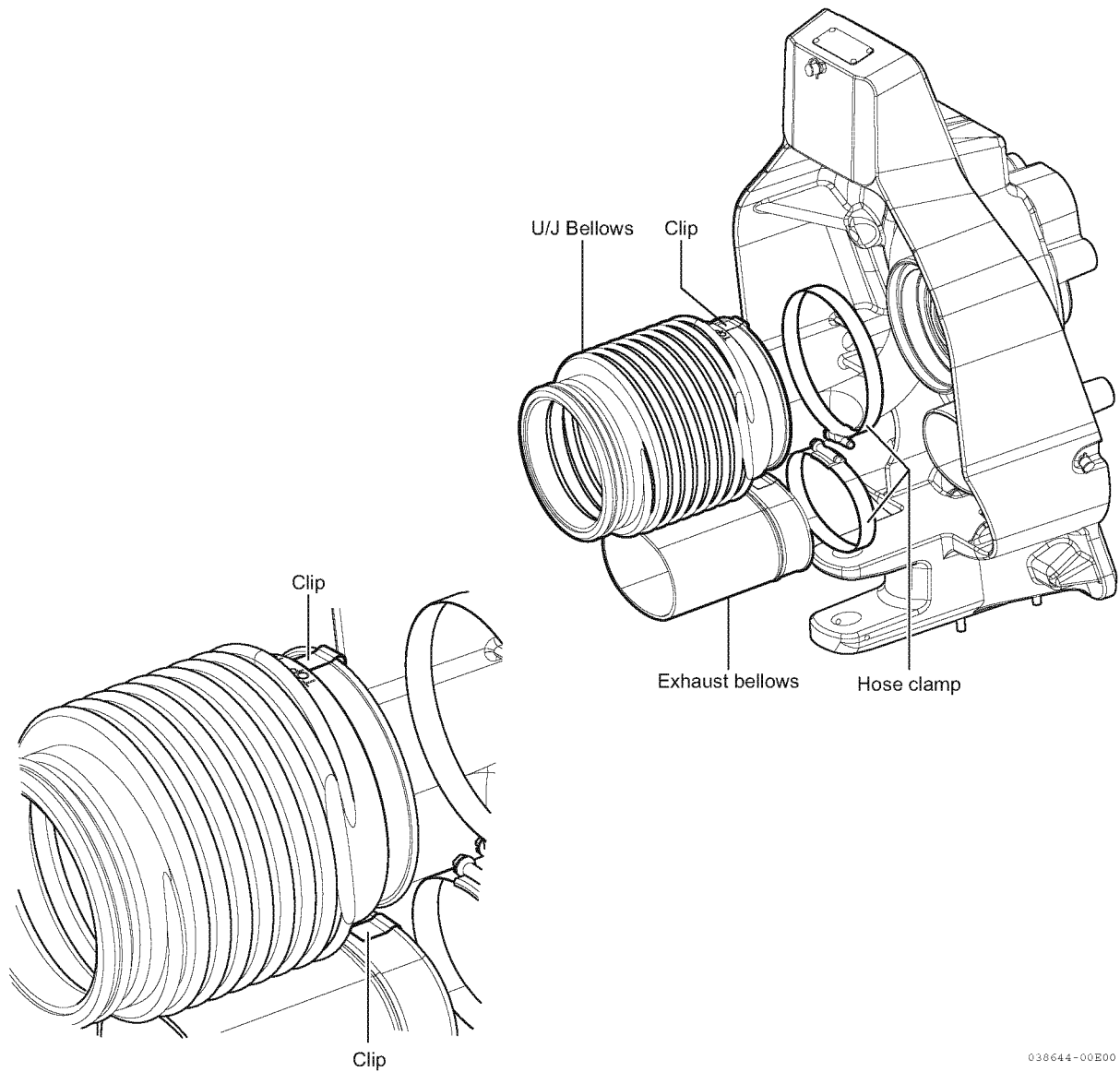
15. Loosen the hose clamp using a screwdriver, as shown in **Figure 8-25**.



**Figure 8-25**



16. Remove the hose clamp, U/J bellows and exhaust bellows, as shown in **Figure 8-26**.

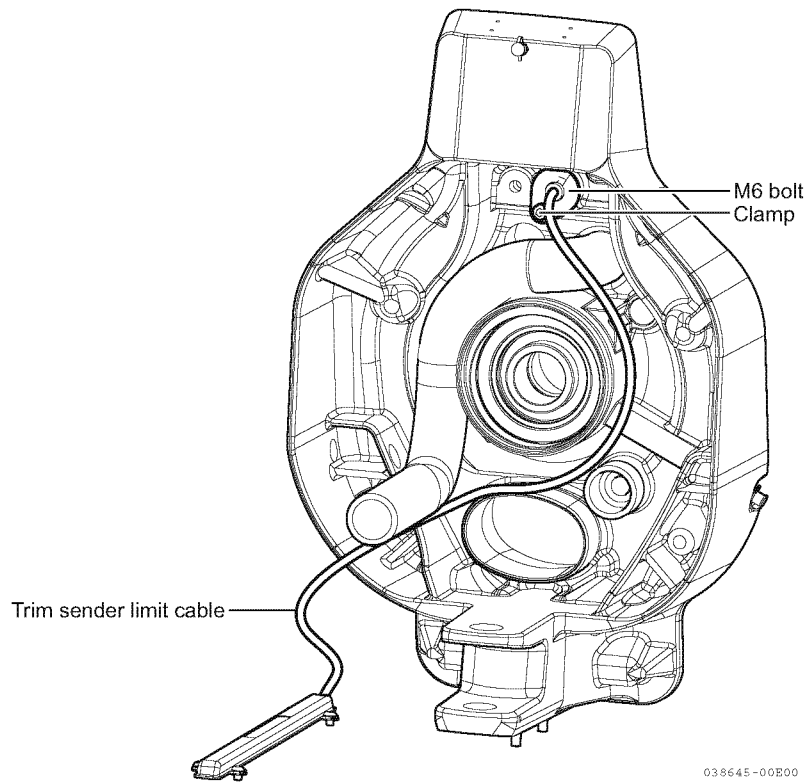


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**Figure 8-26**

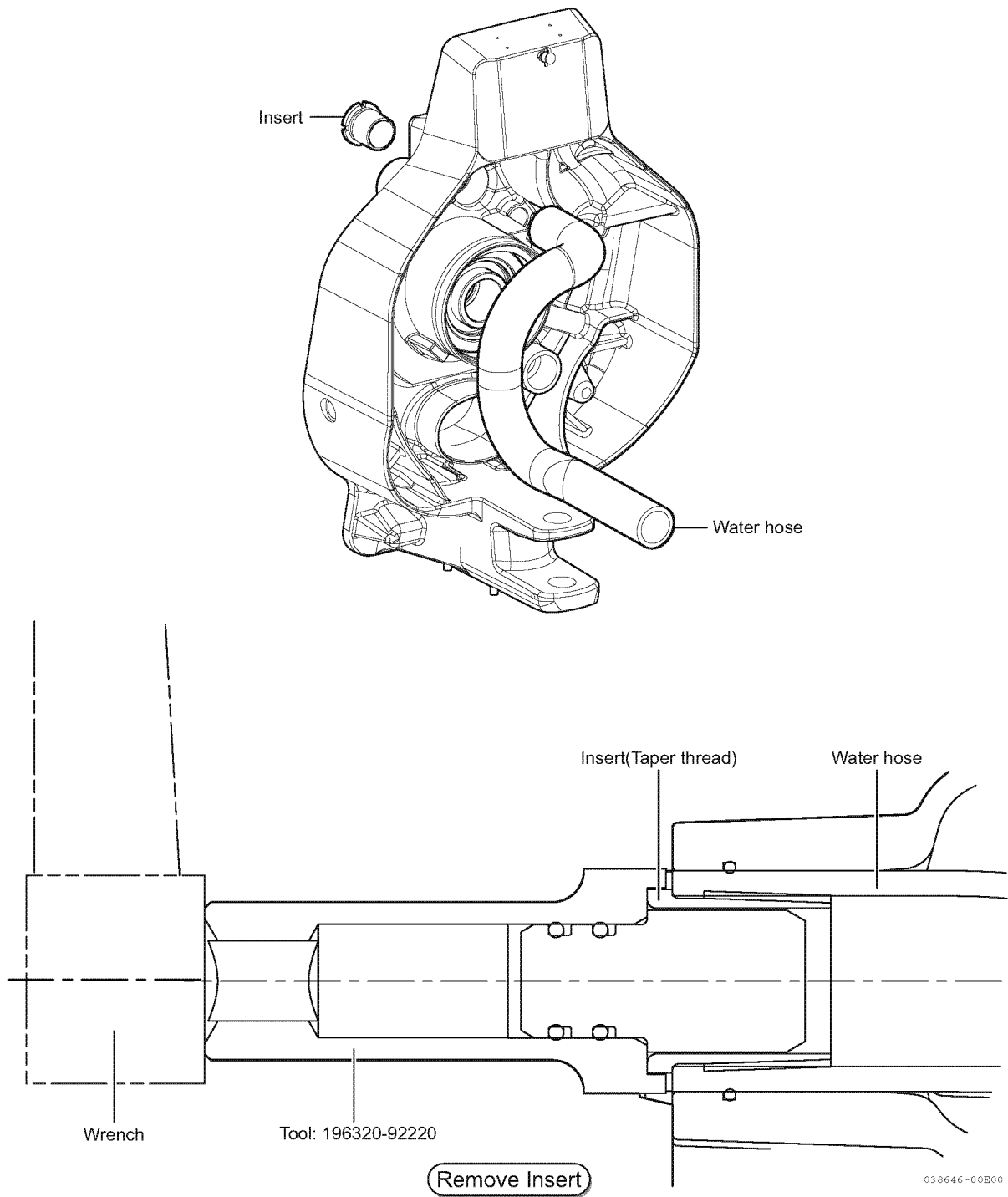
## TRANSOM ASSEMBLY

17. Loosen the M6 bolt and remove the trim sender limit cable, as shown in **Figure 8-27**.



**Figure 8-27**

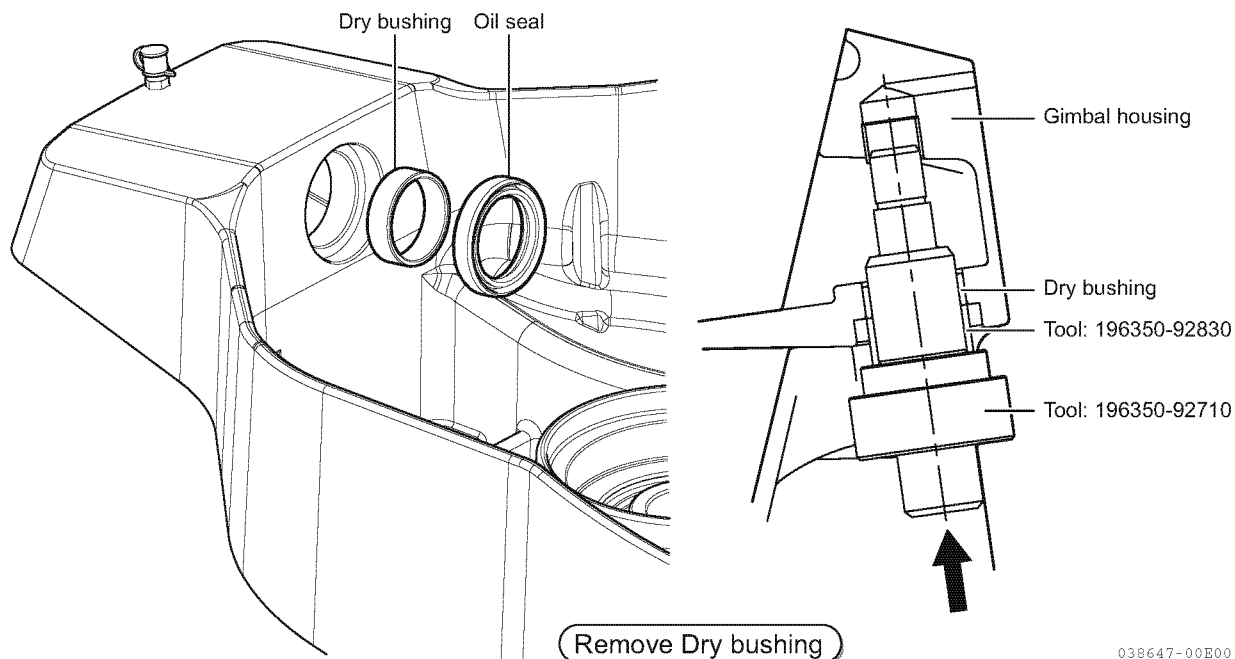
18. Remove the insert and water hose, as shown in **Figure 8-28**.



**Figure 8-28**

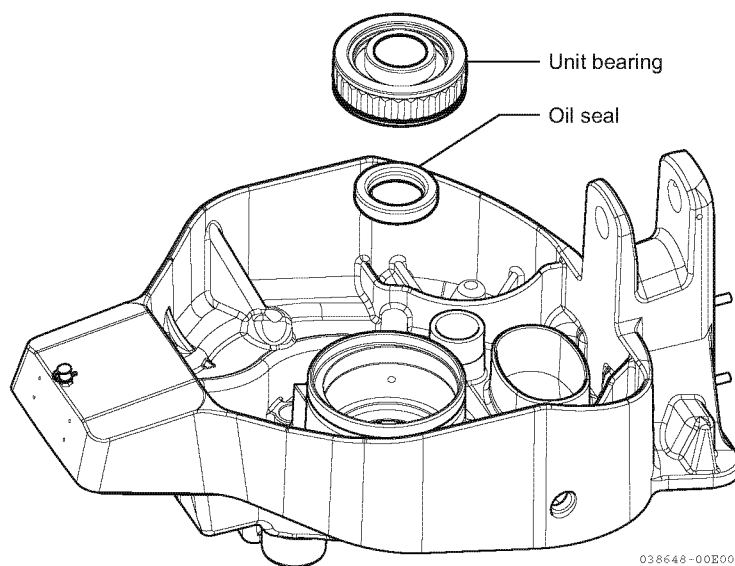
## TRANSOM ASSEMBLY

19. Remove the oil seal and dry bushing from the steering shaft, as shown in **Figure 8-29**.



**Figure 8-29**

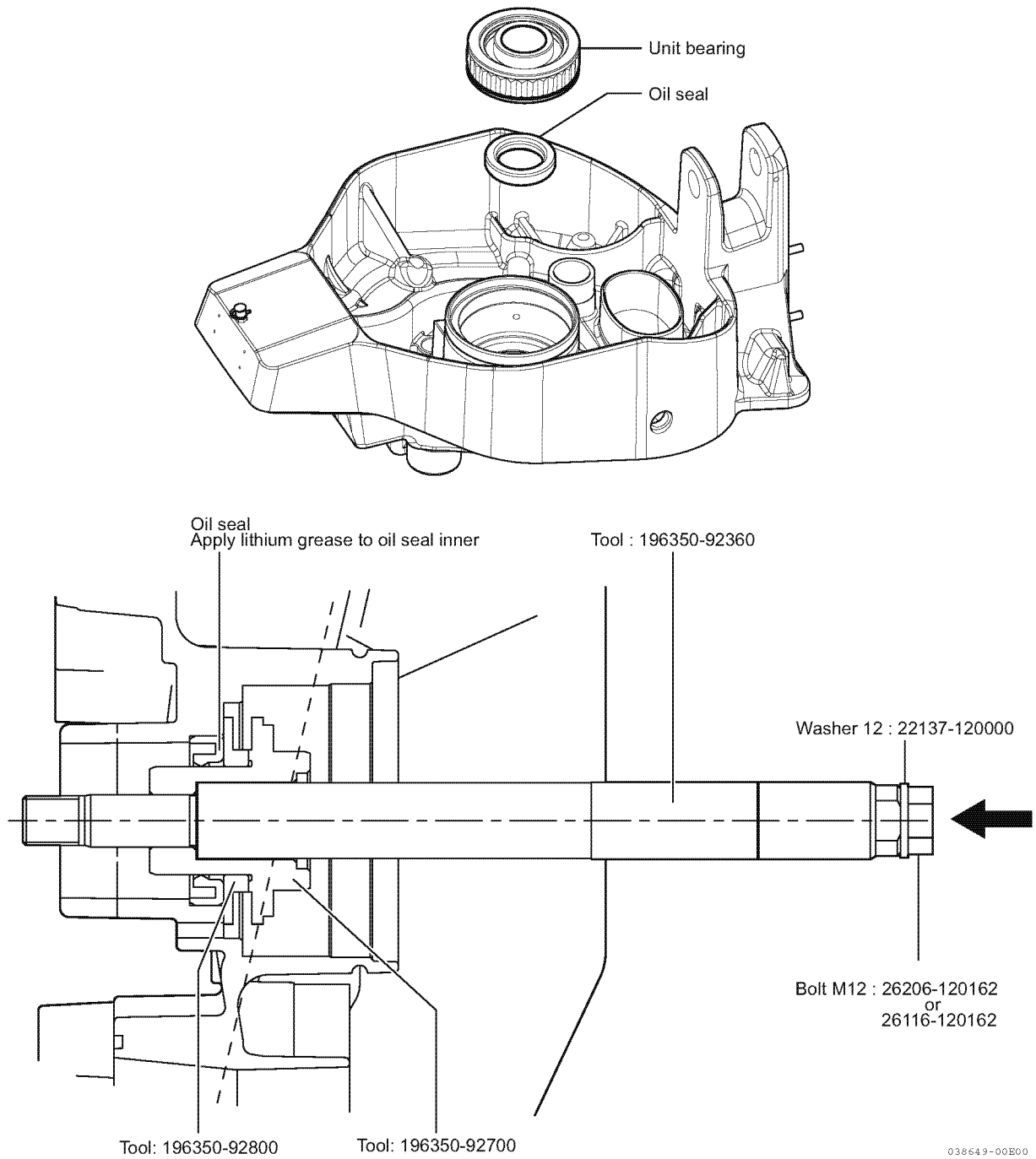
20. Remove the unit bearing and oil seal. For additional information, see **Figure 8-9** on page 8-17.



**Figure 8-30**

# GIMBAL HOUSING ASSEMBLY

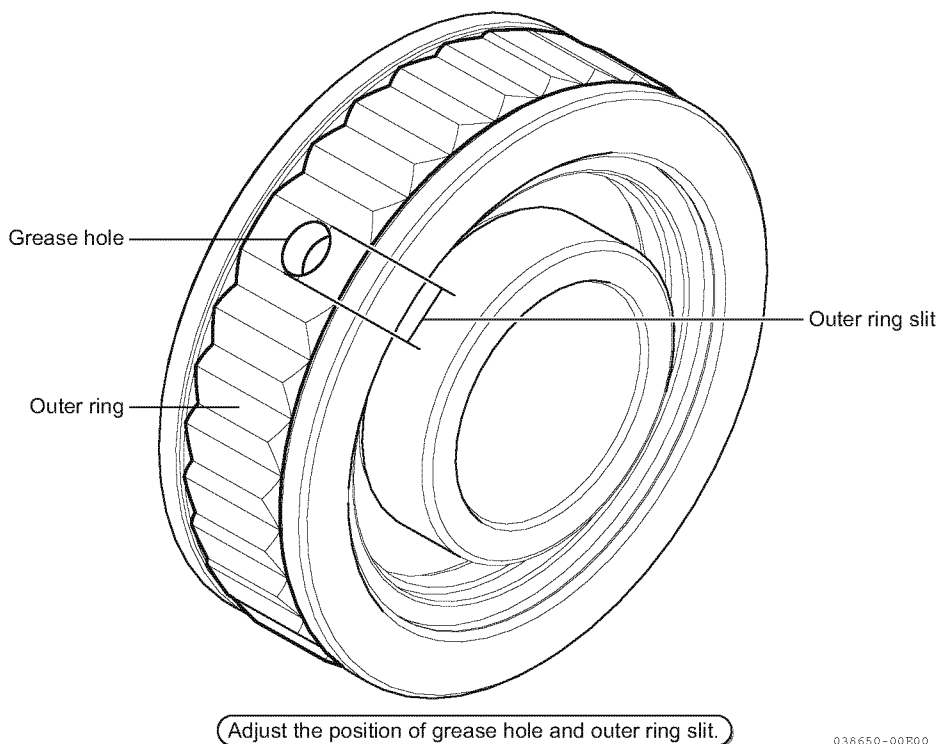
1. Install the oil seal, as shown in Figure 8-31.



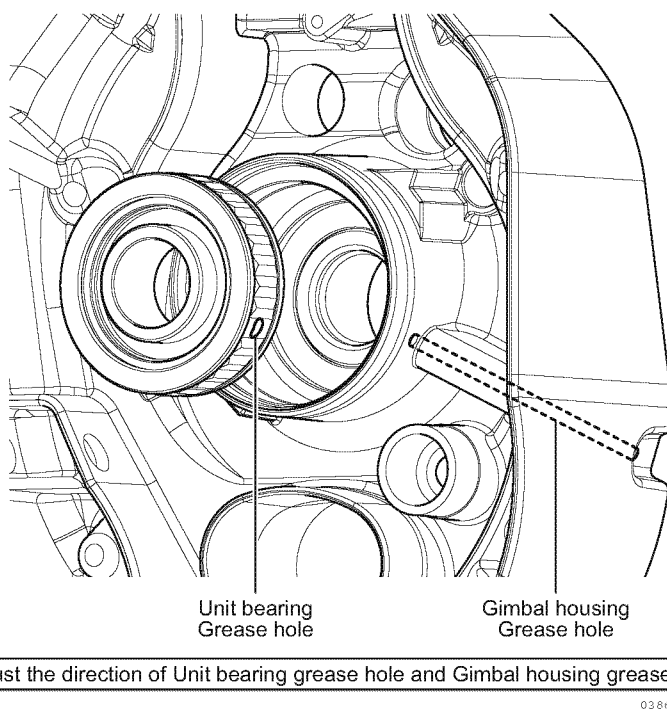
**Figure 8-31**

## TRANSOM ASSEMBLY

2. Before installing the unit bearing, adjust the position of grease hole and outer ring slit, as shown in **Figure 8-32** and **Figure 8-33**.

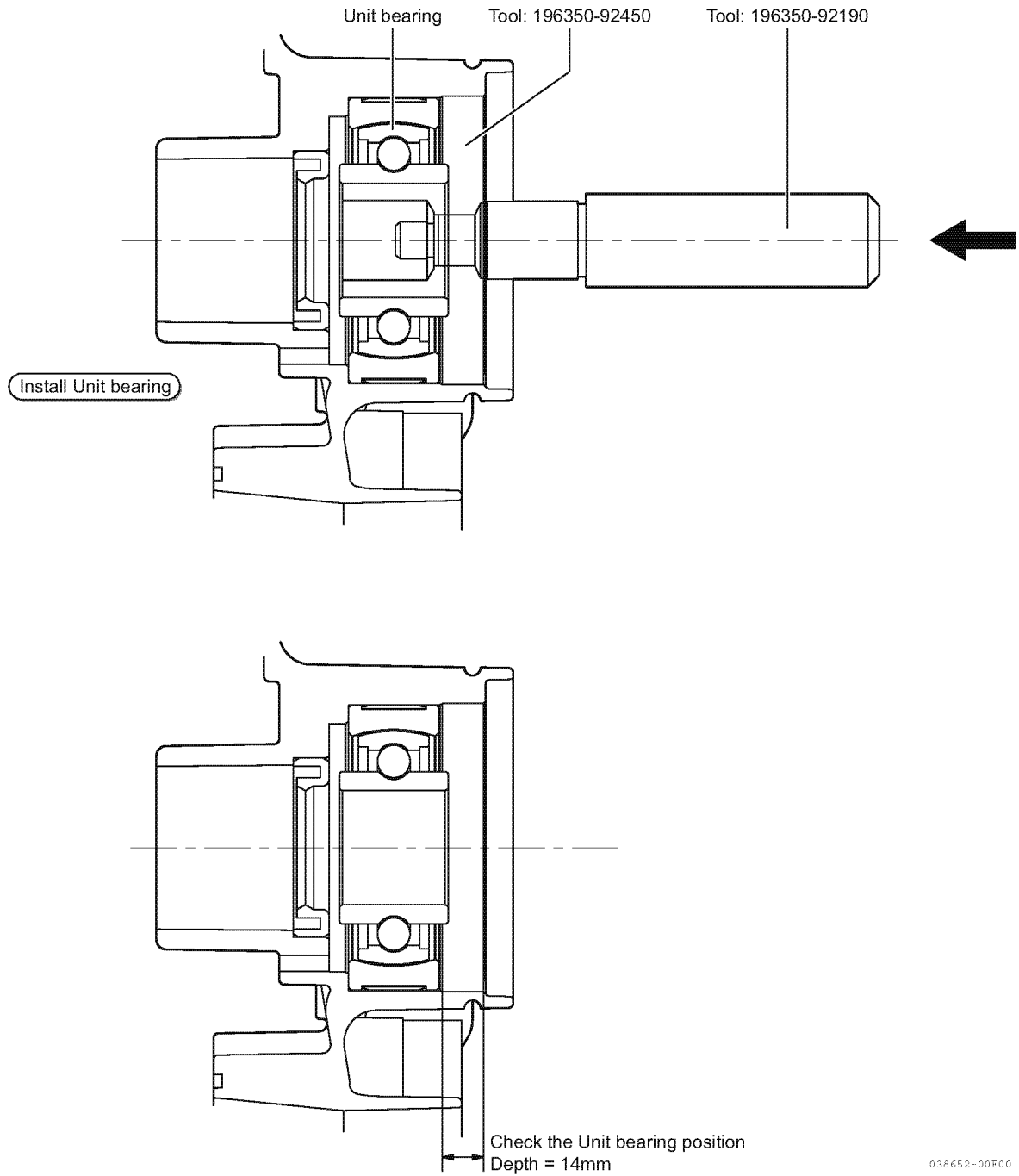


**Figure 8-32**



**Figure 8-33**

3. Align the unit bearing grease hole and gimbal housing grease hole during installation, as shown in **Figure 8-34**.
4. Check the unit bearing depth after installation, as shown in **Figure 8-34**.

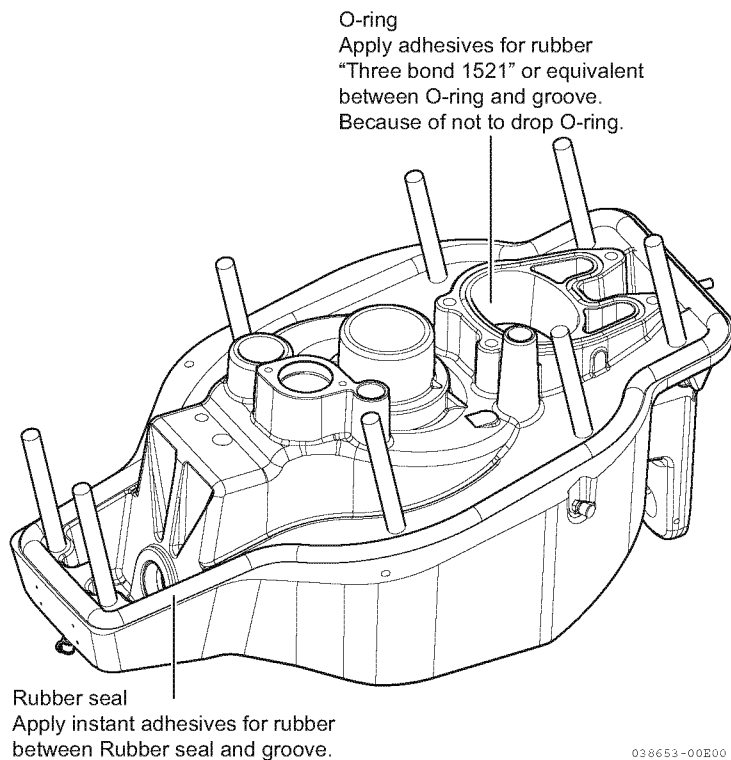


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**Figure 8-34**

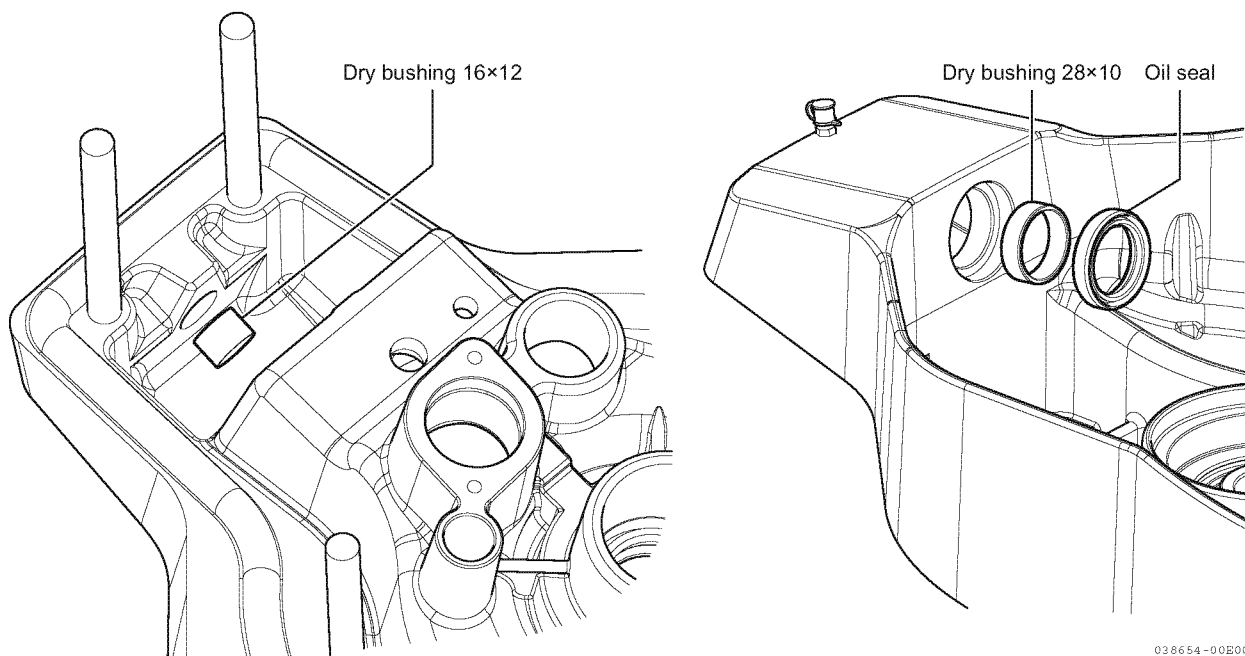
## TRANSOM ASSEMBLY

5. Install the rubber seal and O-ring, as shown in **Figure 8-35**.



**Figure 8-35**

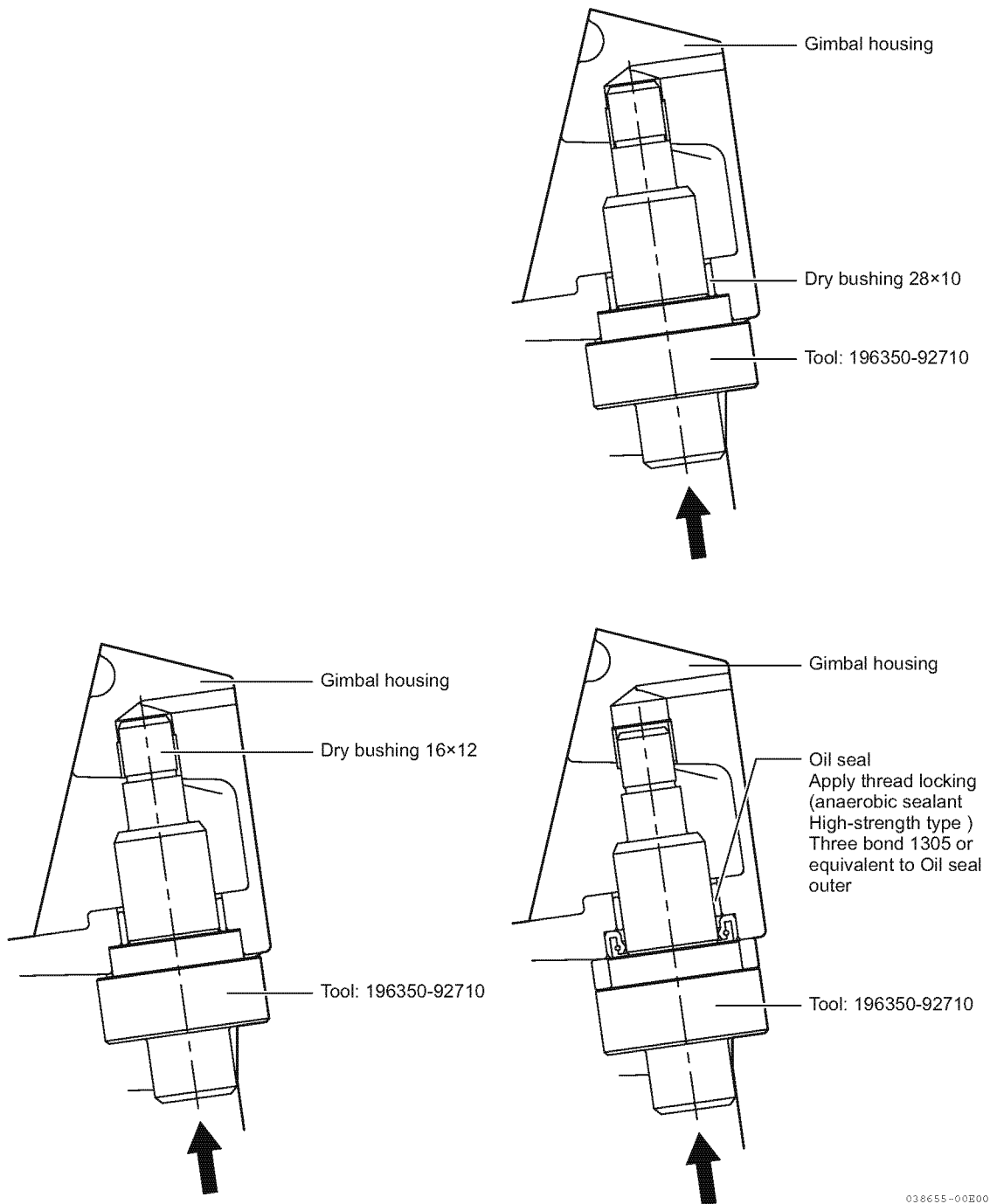
6. Install the dry bushing and oil seal for the steering shaft, as shown in **Figure 8-36**.



**Figure 8-36**



7. Install dry bushing 28 × 10 before dry bushing 16 × 12, as shown in **Figure 8-37**, then install the oil seal.

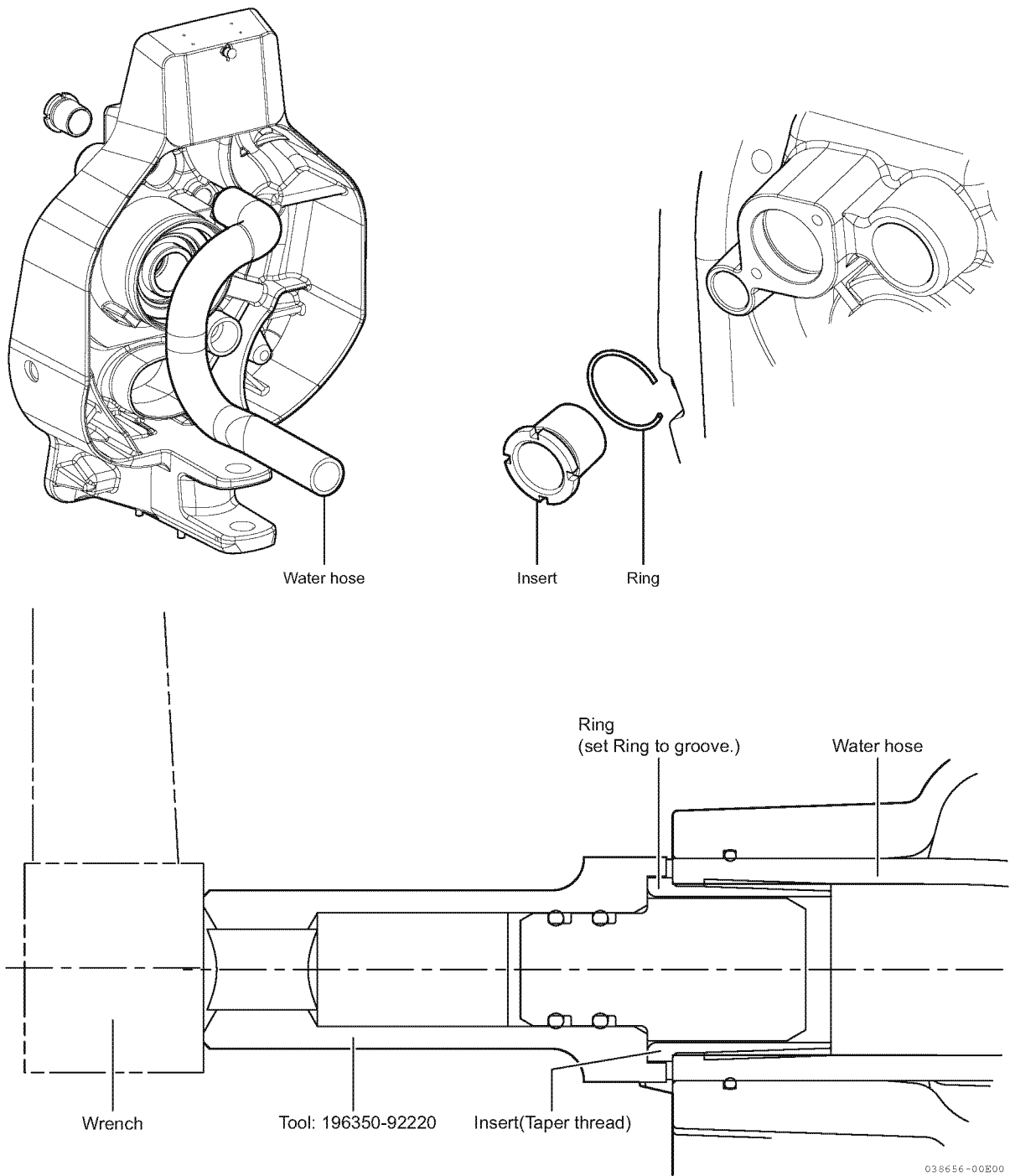


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**Figure 8-37**

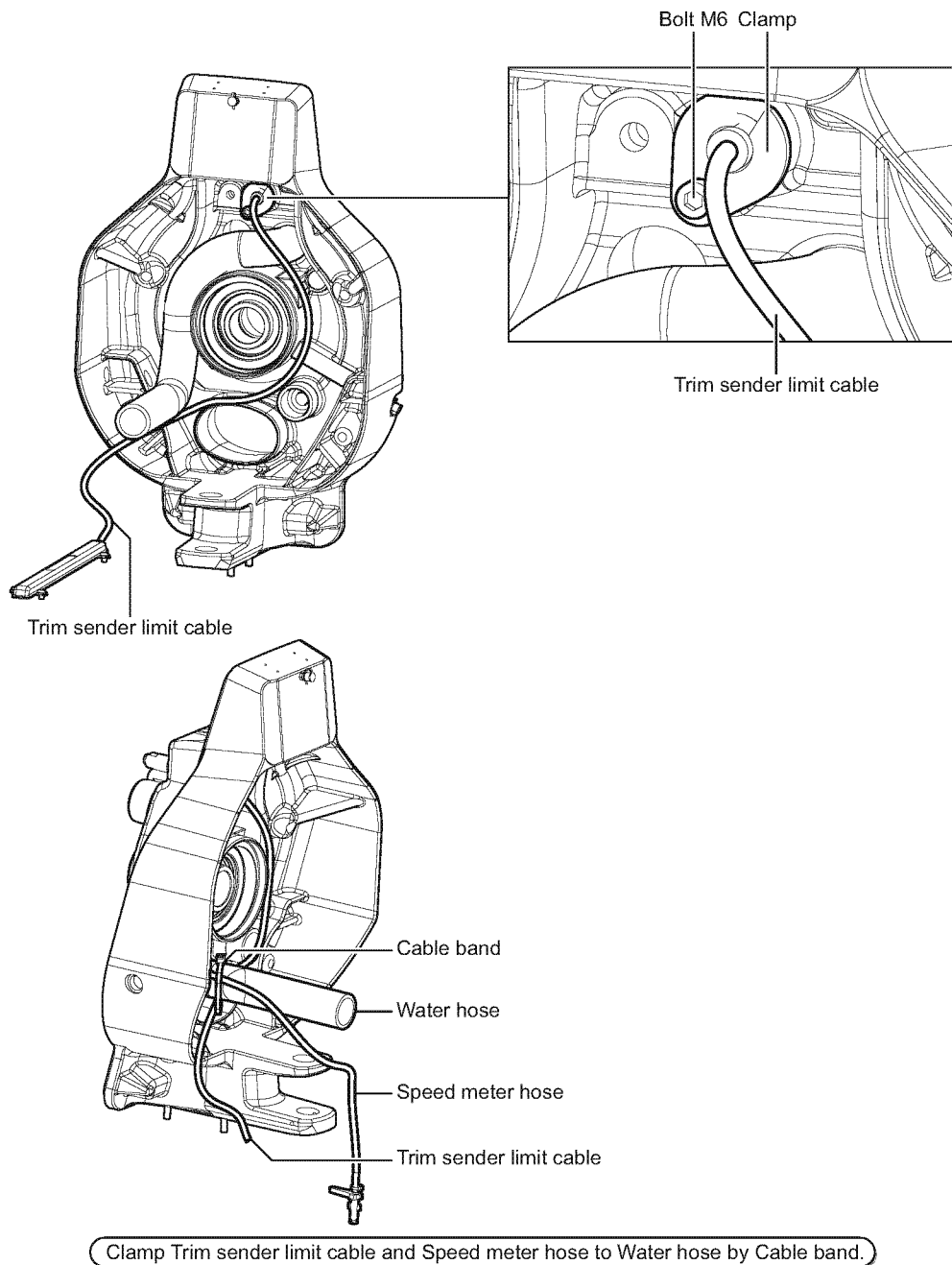
# TRANSOM ASSEMBLY

8. Install the water hose, insert and ring to the gimbal housing, as shown in **Figure 8-38**.



**Figure 8-38**

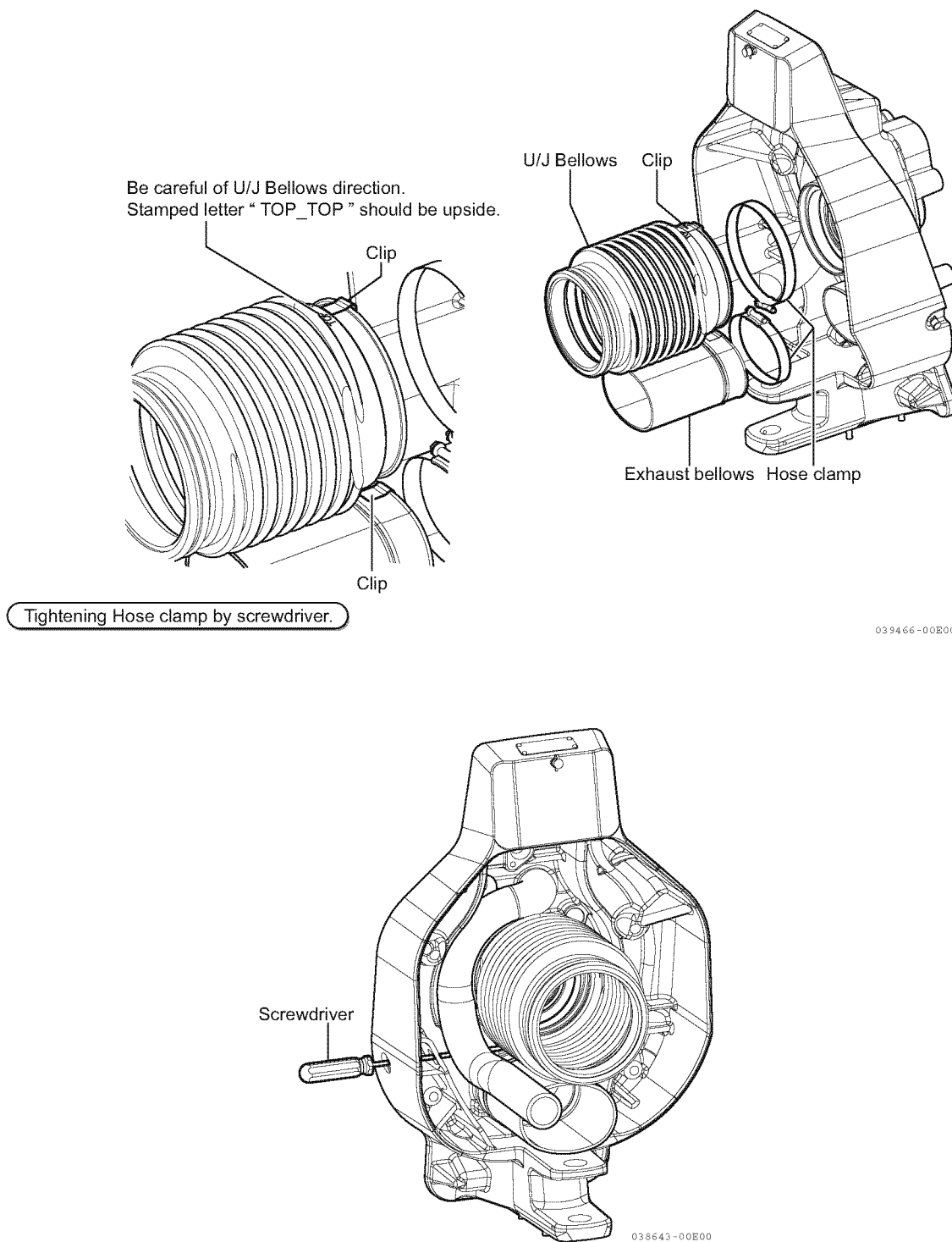
9. Install the trim sender limit cable to the gimbal housing, as shown in **Figure 8-39**.



**Figure 8-39**

## TRANSOM ASSEMBLY

10. Install and secure the U/J bellows and exhaust bellows with clips and tighten the hose clamp, as shown in **Figure 8-40**.
11. Apply adhesive Three Bond® 1521 or equivalent between the U/J bellows and gimbal housing and between the exhaust bellows and gimbal housing.

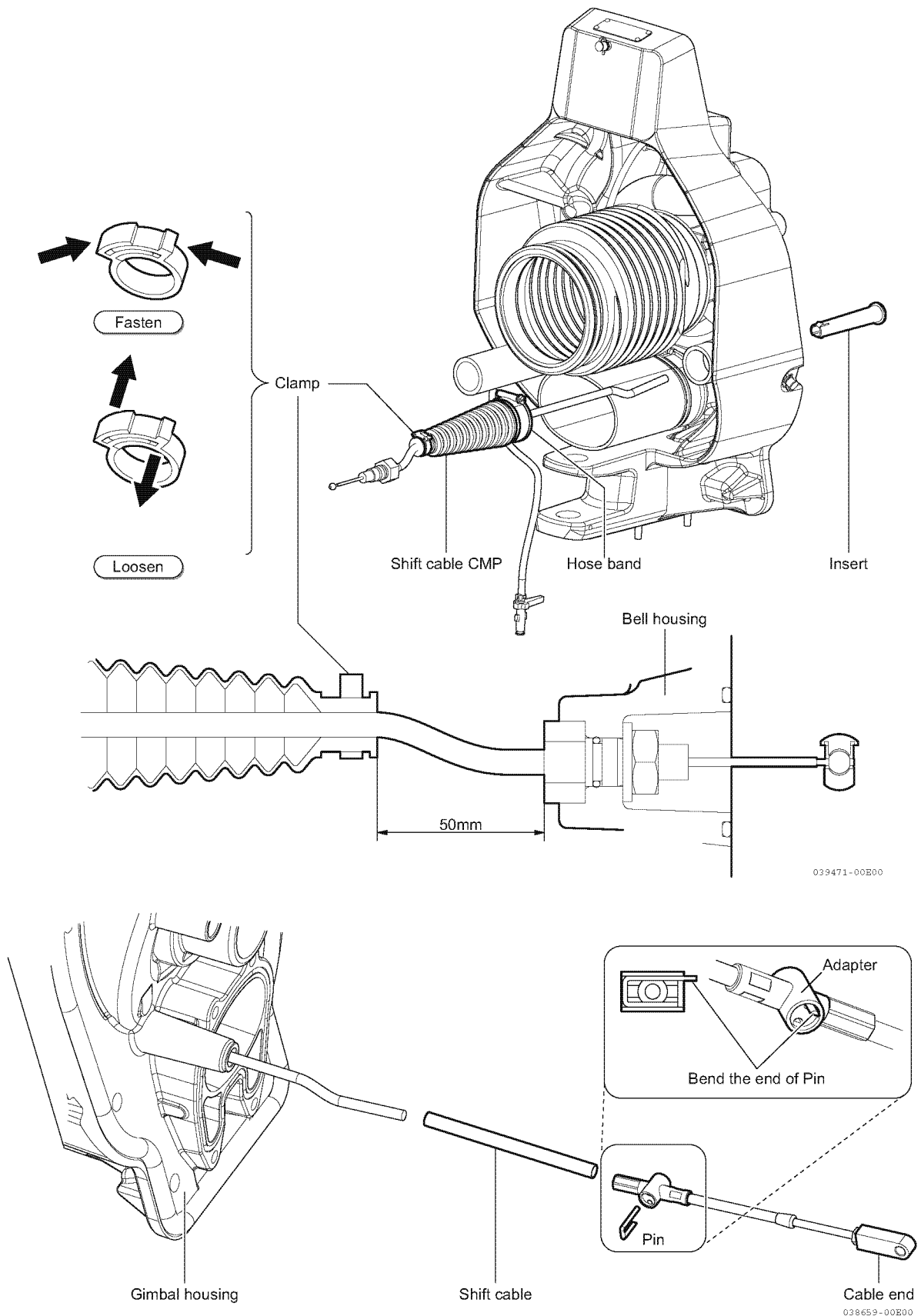


**Figure 8-40**

12. Install shift cable CMP, as shown in **Figure 8-41** and **Figure 8-42**.

- Mechanical shift - Before installing the insert into the gimbal housing, pass the shift cable CMP through the insert, then install adapter and cable end to shift cable.

## Mechanical Shift



**Figure 8-41**

# TRANSOM ASSEMBLY

- Electric shift - Before installing the insert into the gimbal housing, pass the curl cable CMP through the insert, then connect the curl cable to the joint cable.

## Electric Shift

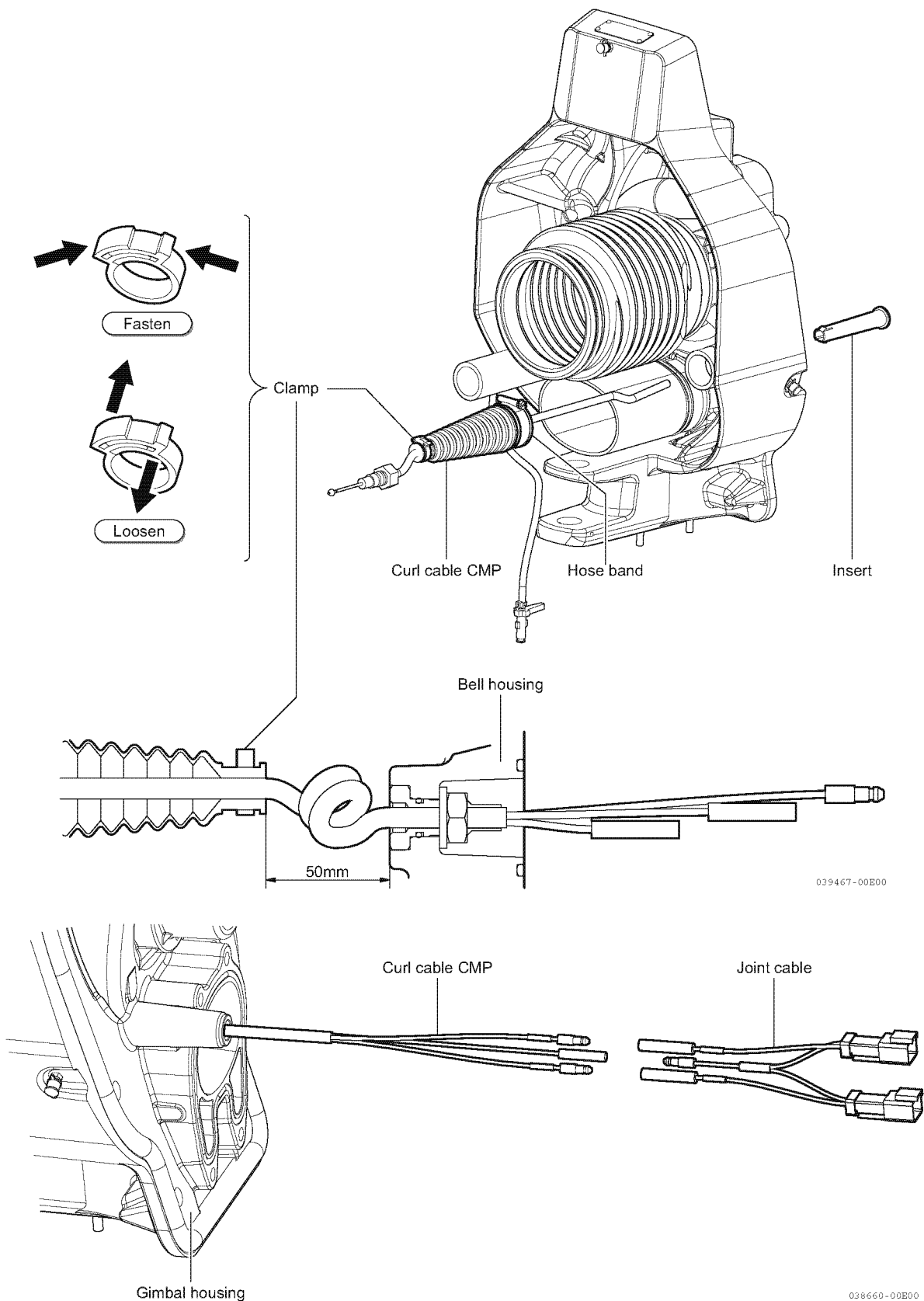
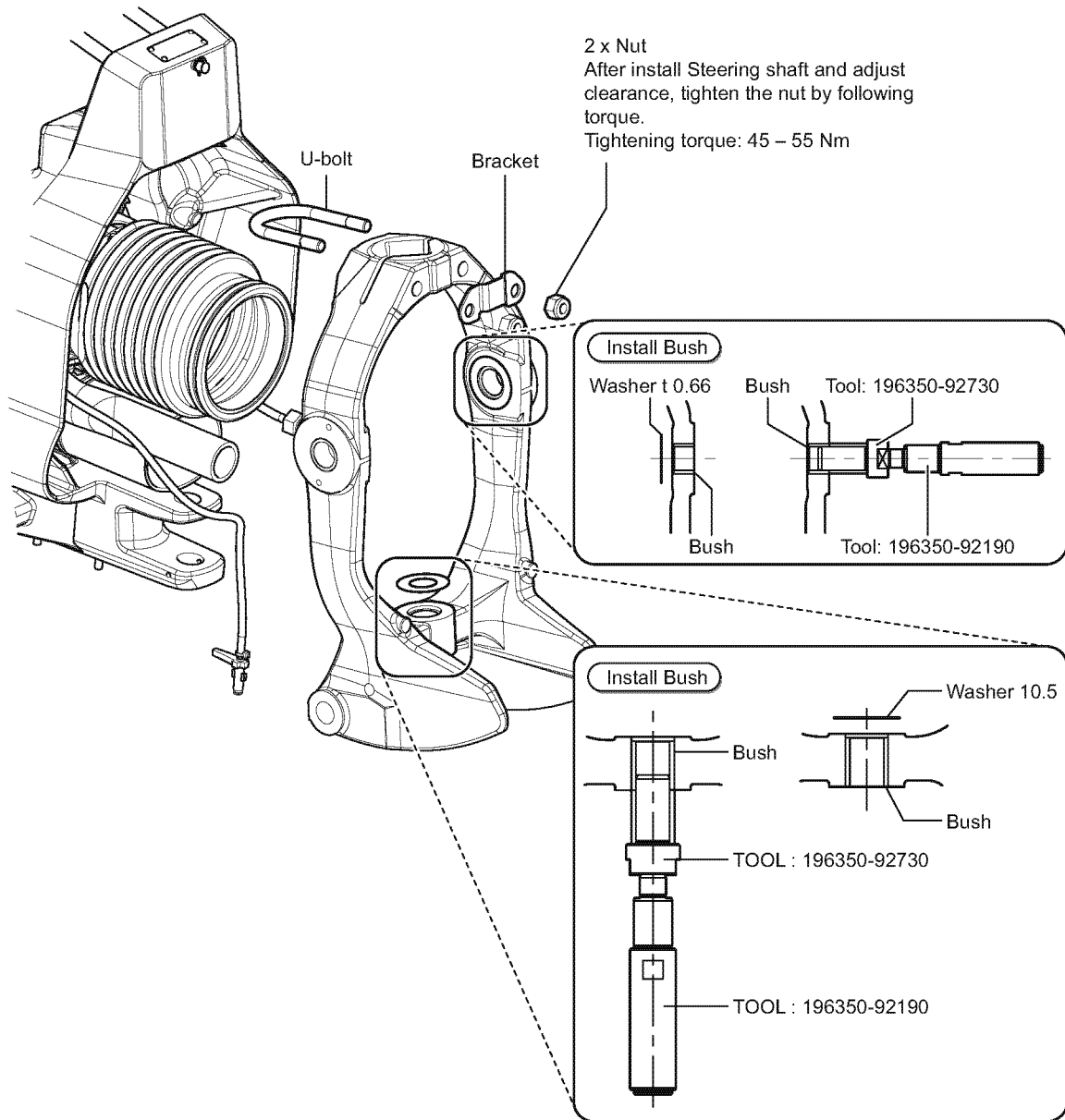


Figure 8-42

13. Install gimbal ring, as shown in Figure 8-43.

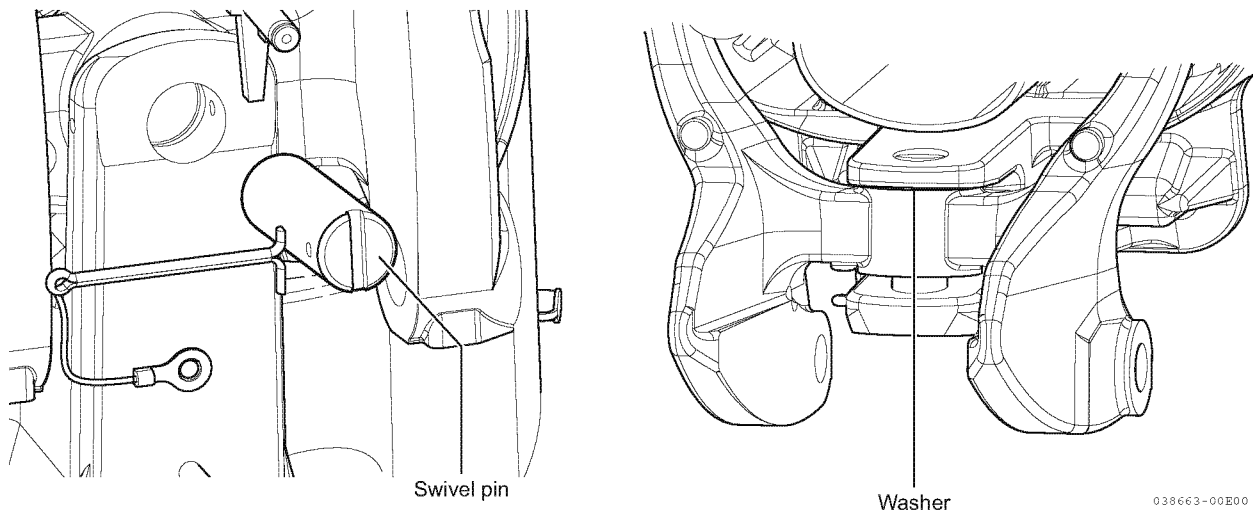


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Figure 8-43

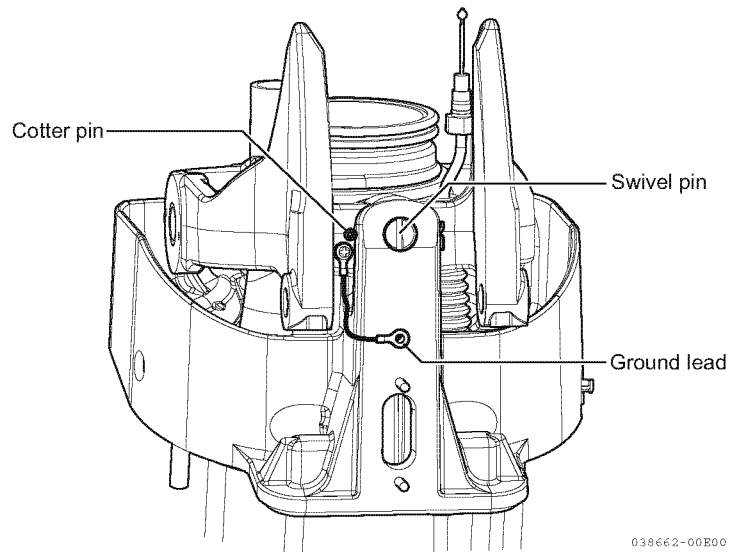
## TRANSOM ASSEMBLY

14. Install the swivel pin and washer, as shown in **Figure 8-44**.



**Figure 8-44**

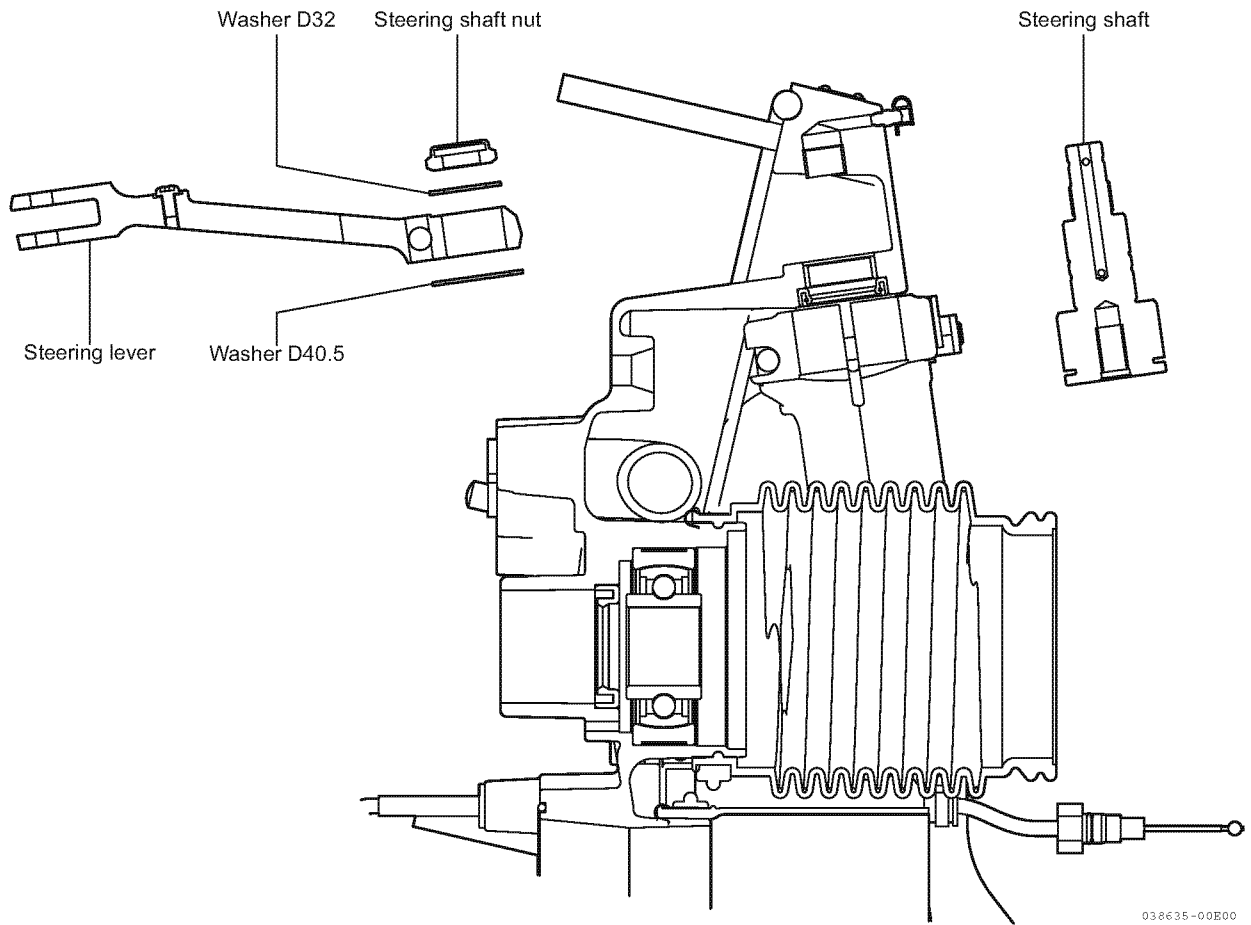
15. Install cotter pin and electrical ground cable, as shown in **Figure 8-45**.



**Figure 8-45**

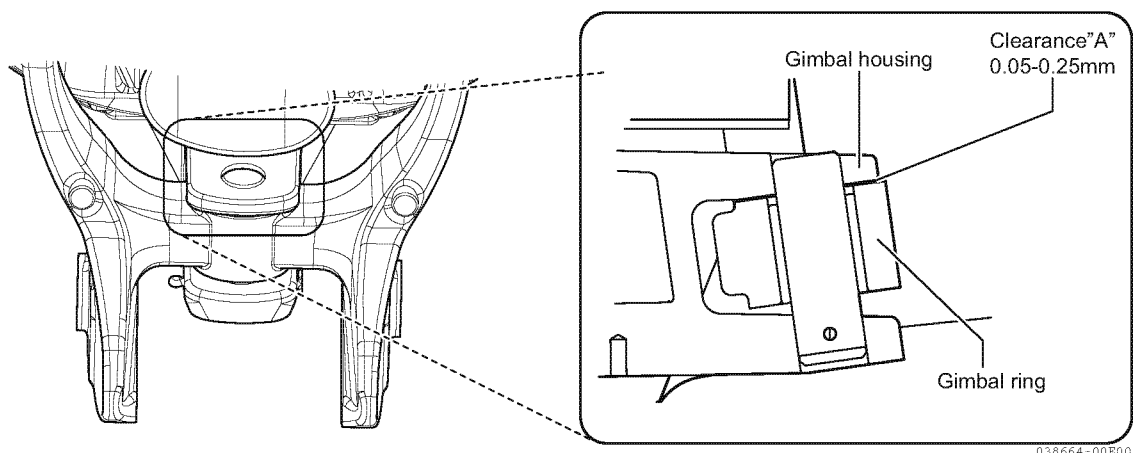


16. Install the steering shaft, steering lever, washer and steering nut, as shown in **Figure 8-46**.



**Figure 8-46**

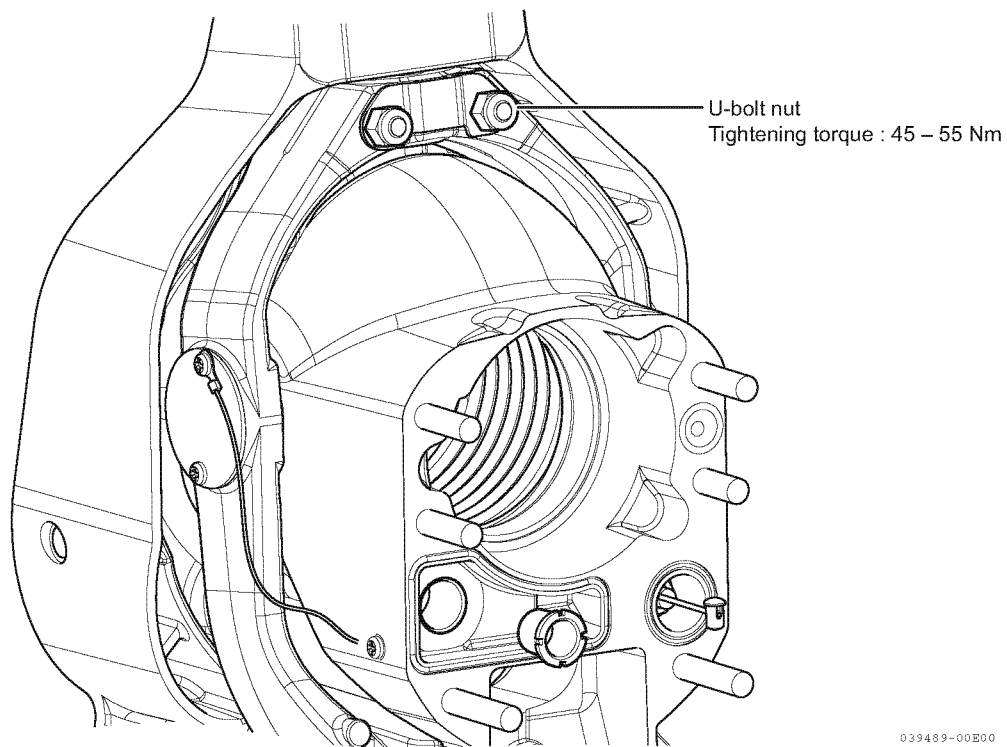
17. Tighten or loosen the steering shaft nut to adjust clearance "A" to 0.05 to 0.25 mm, as shown in **Figure 8-47**.



**Figure 8-47**

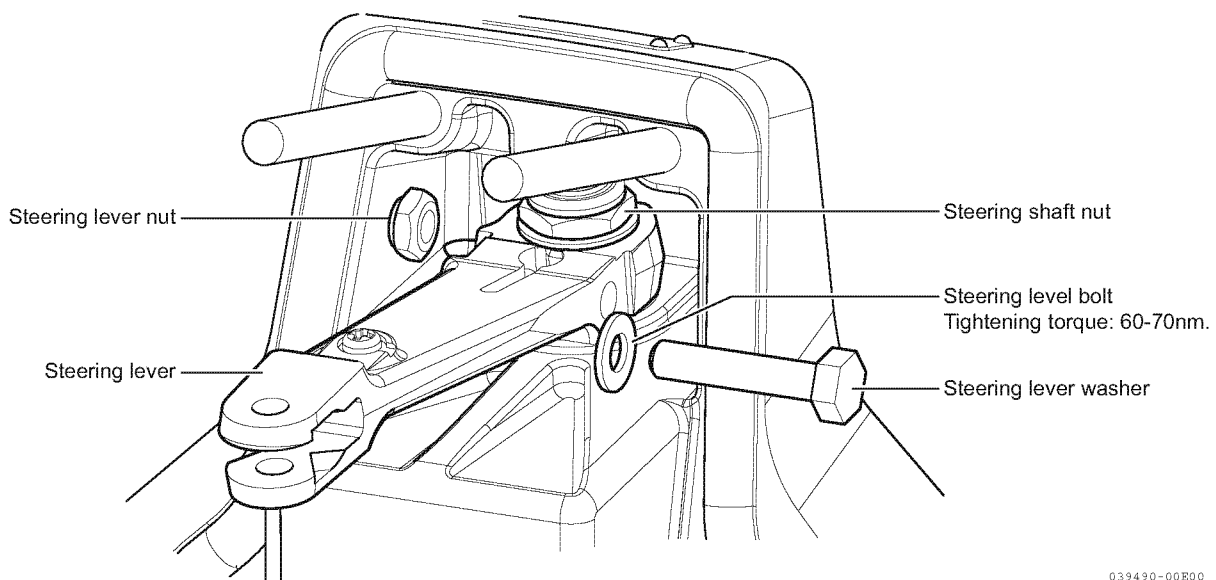
## TRANSOM ASSEMBLY

18. Tighten the U-bolt nut, as shown in **Figure 8-48**.



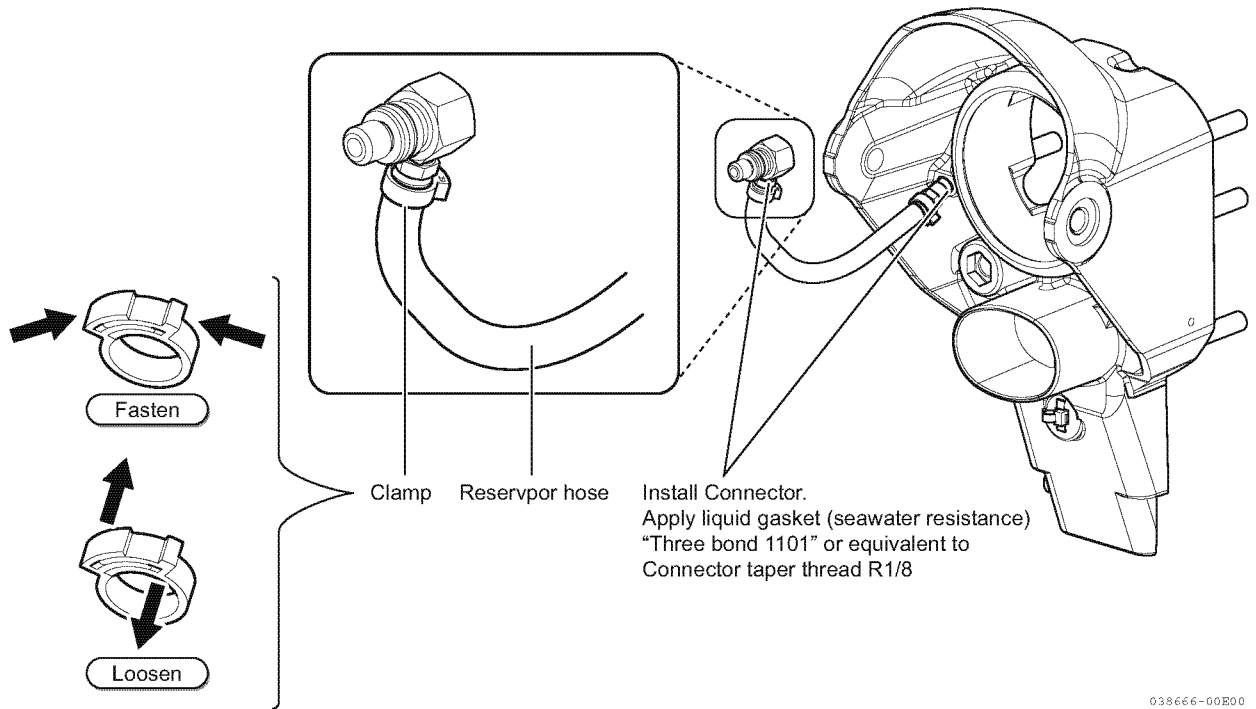
**Figure 8-48**

19. Install steering lever nut, steering lever washer and steering lever bolt, as shown in **Figure 8-49**.



**Figure 8-49**

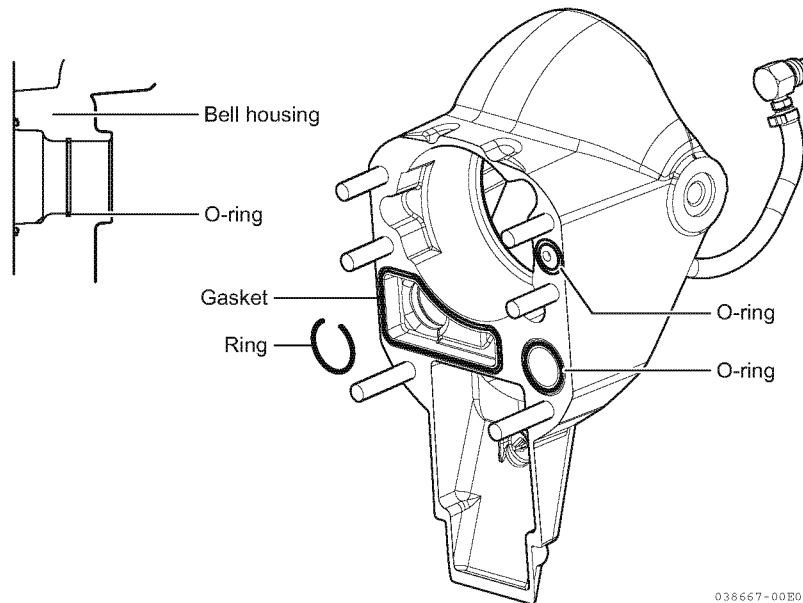
20. Install the reservoir hose to the bell housing, as shown in **Figure 8-50**.



**Figure 8-50**

21. Install O-rings, gasket and ring to the bell housing, as shown in **Figure 8-51**.

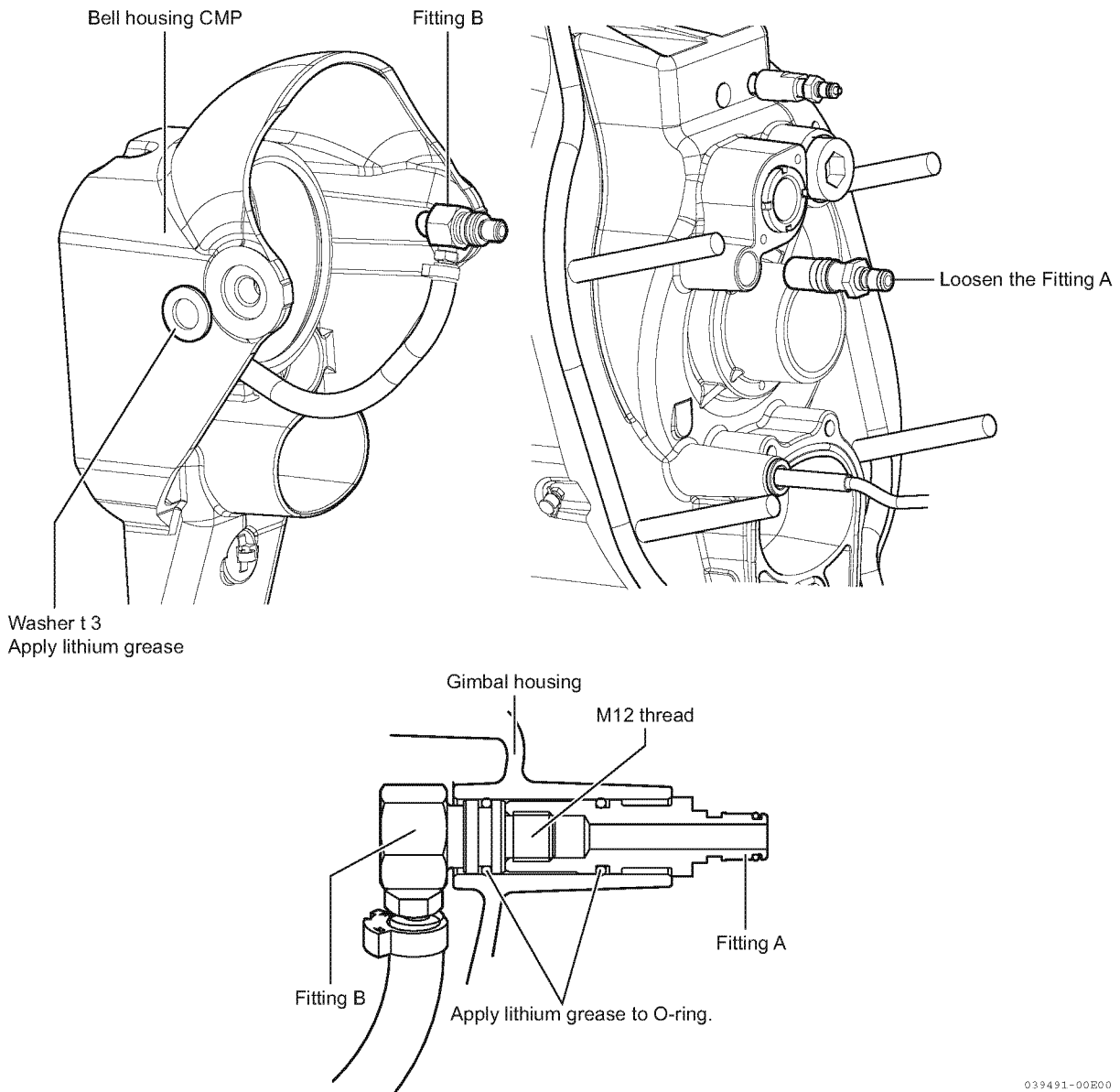
22. Apply adhesive Three Bond® 1521 or equivalent between the O-ring and groove and gasket and groove.



**Figure 8-51**

# TRANSOM ASSEMBLY

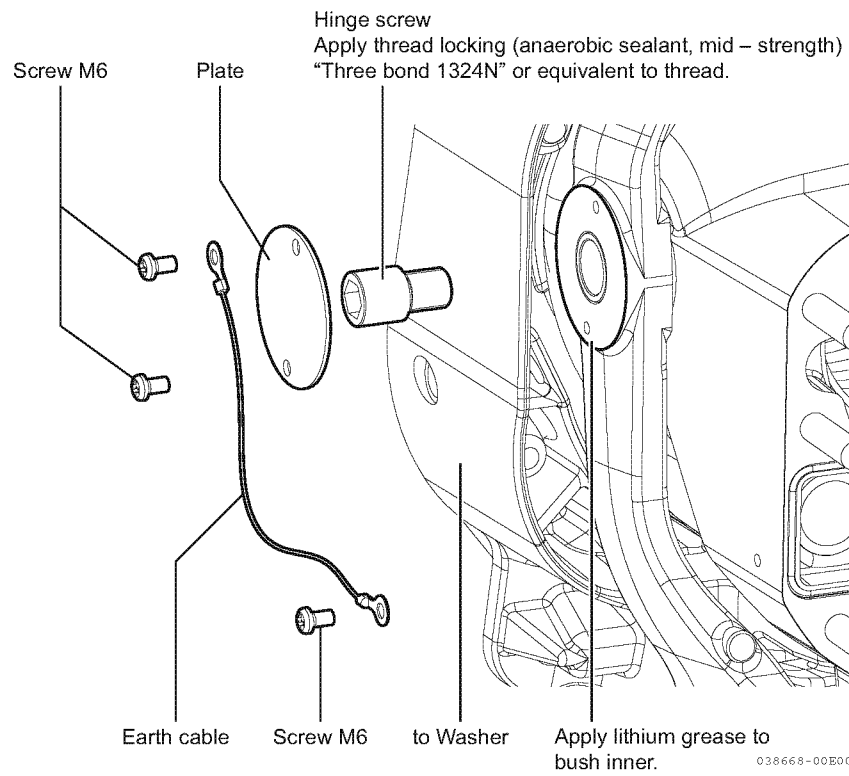
23. Connect fitting "B" to fitting "A" through the gimbal housing, as shown in **Figure 8-52**.



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**Figure 8-52**

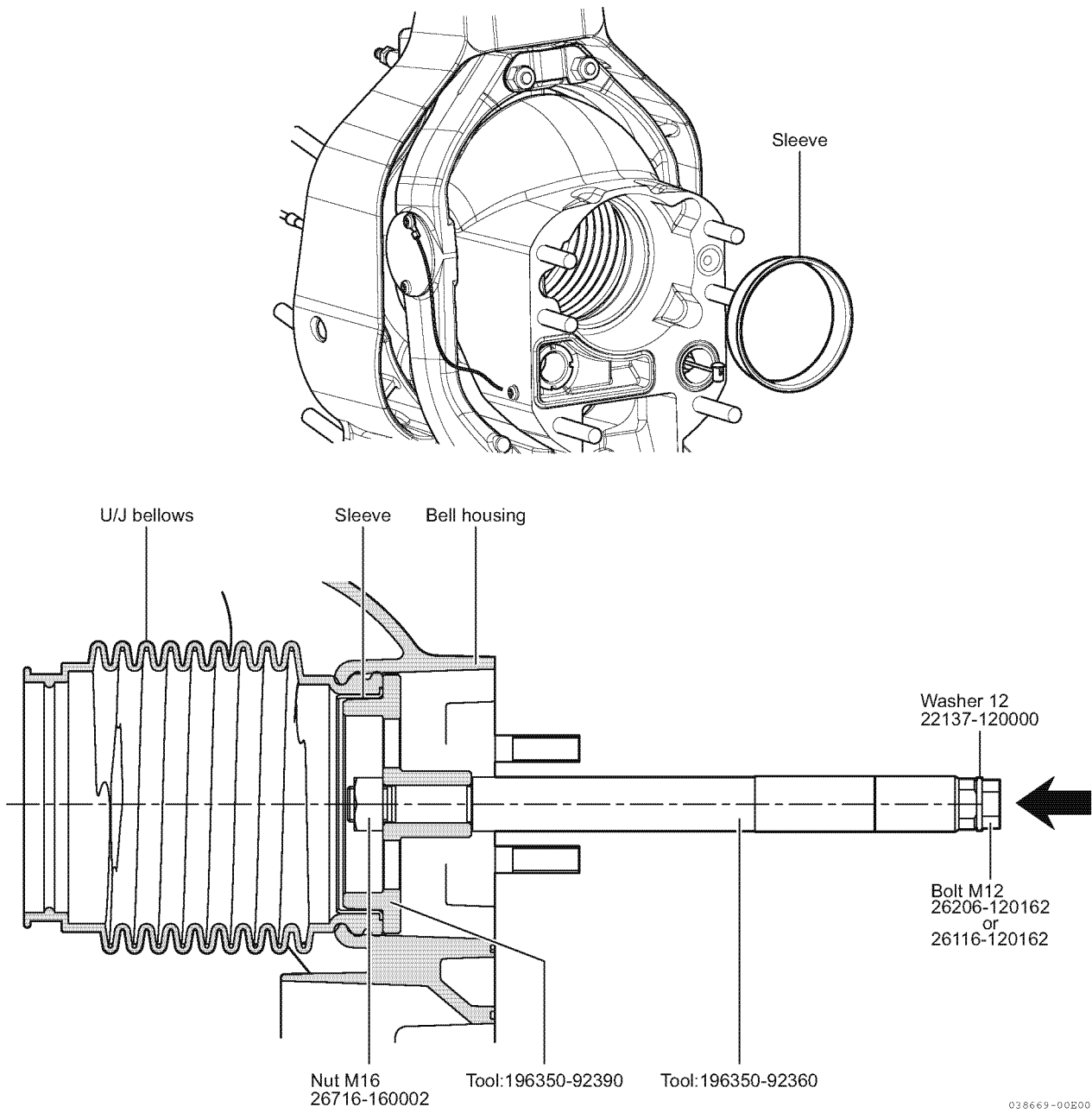
24. Install the hinge screw, as shown in **Figure 8-53**.



**Figure 8-53**

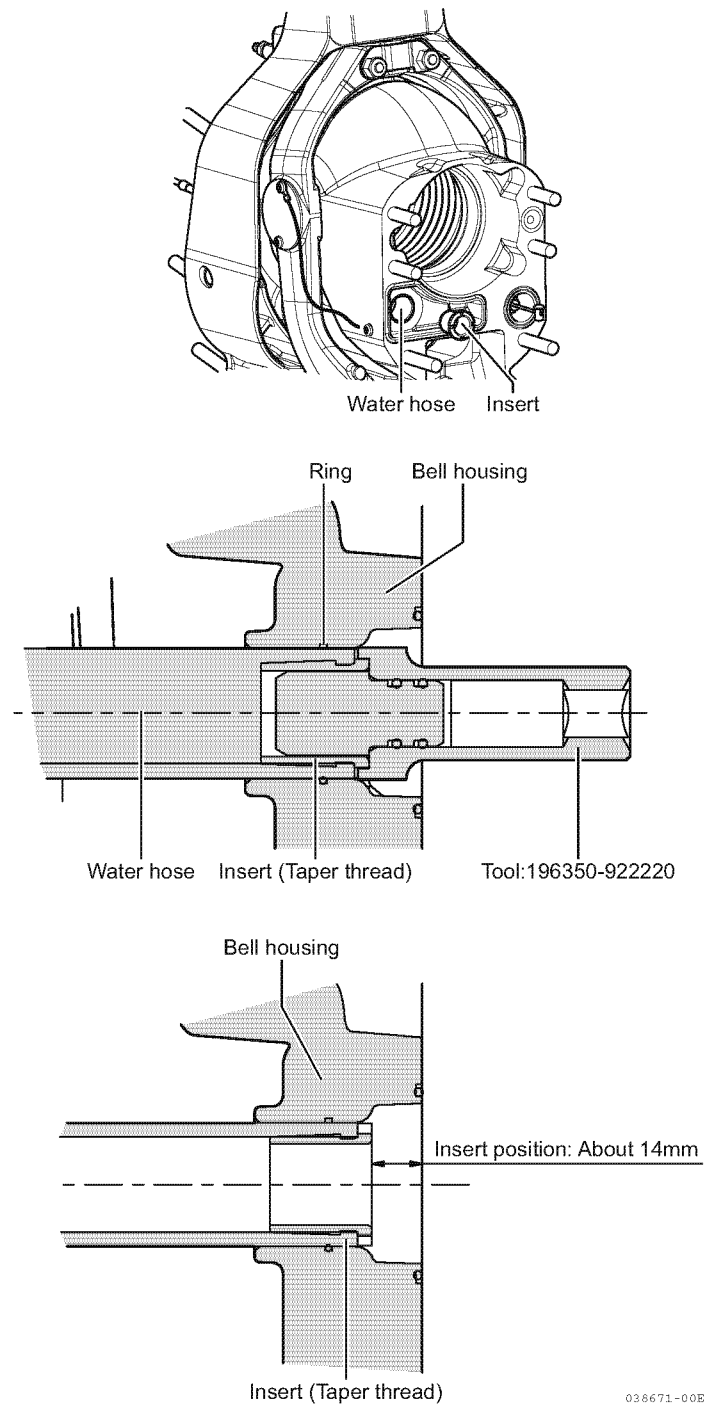
# TRANSOM ASSEMBLY

25. Install the sleeve to the U/J bellows, as shown in **Figure 8-54**.



**Figure 8-54**

26. Install the insert into the water hose, as shown in **Figure 8-55**.

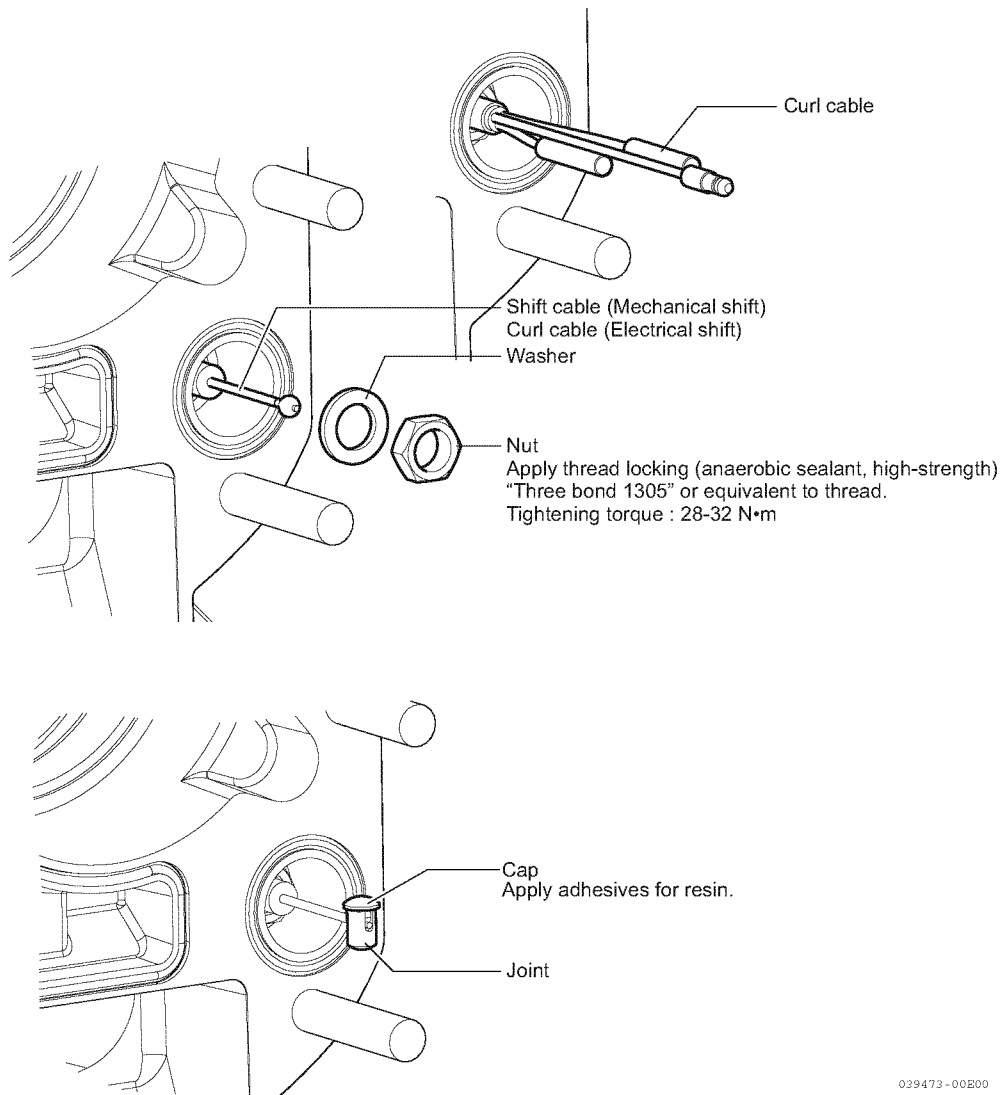


**Figure 8-55**

## TRANSOM ASSEMBLY

27. Install the washer and nut to the shift cable (mechanical shift models only), as shown in **Figure 8-56**.

*Note: Electric shift models - Install curl cable as shown in **Figure 8-56**.*

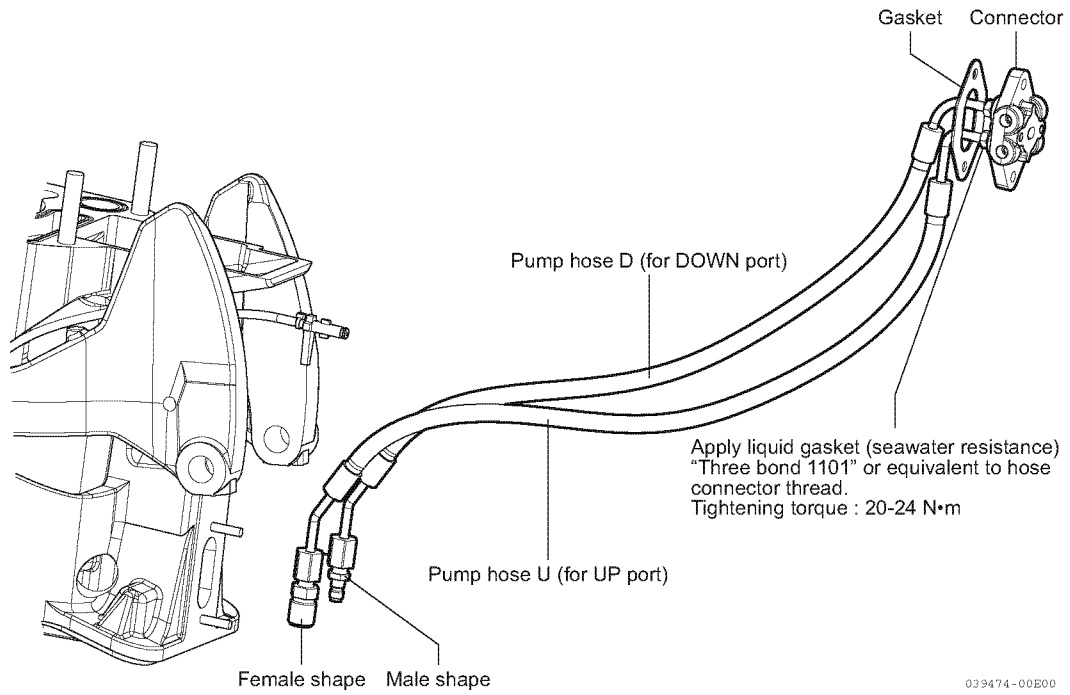


**Figure 8-56**

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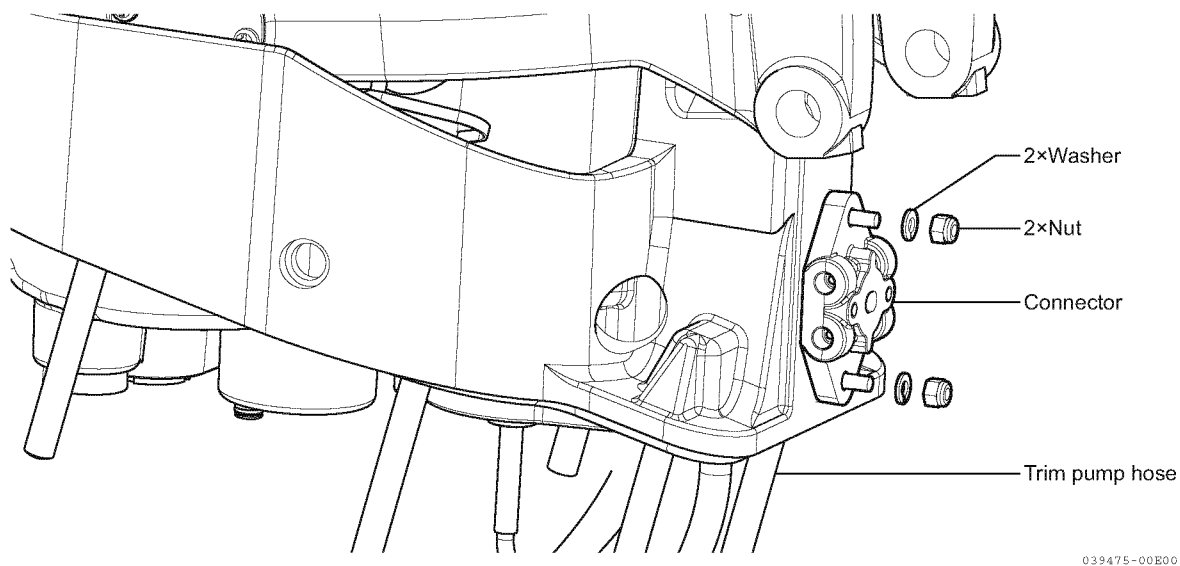
28. Install the trim hose gasket and pump hoses "U" and "D" to the connector, as shown in **Figure 8-57**.



**Figure 8-57**

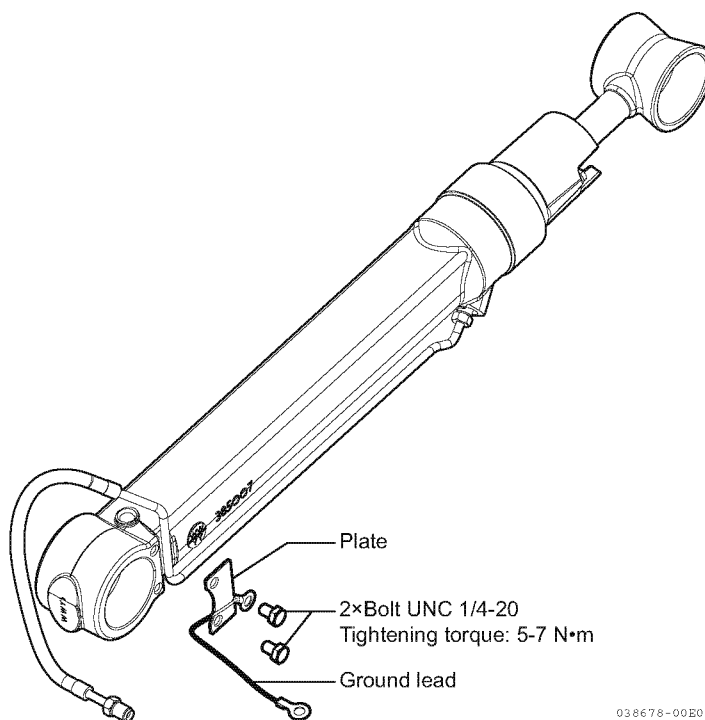
## TRANSOM ASSEMBLY

29. Install the connector, washers and nuts to the gimbal housing, as shown in **Figure 8-58**.



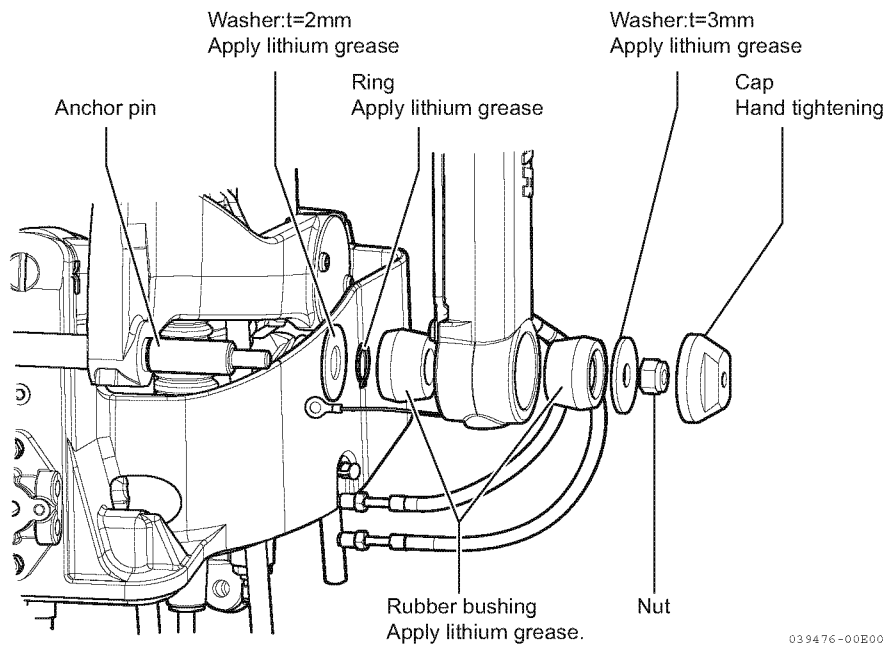
**Figure 8-58**

30. Install the plate and electrical ground lead to both trim cylinders, as shown in **Figure 8-59**.



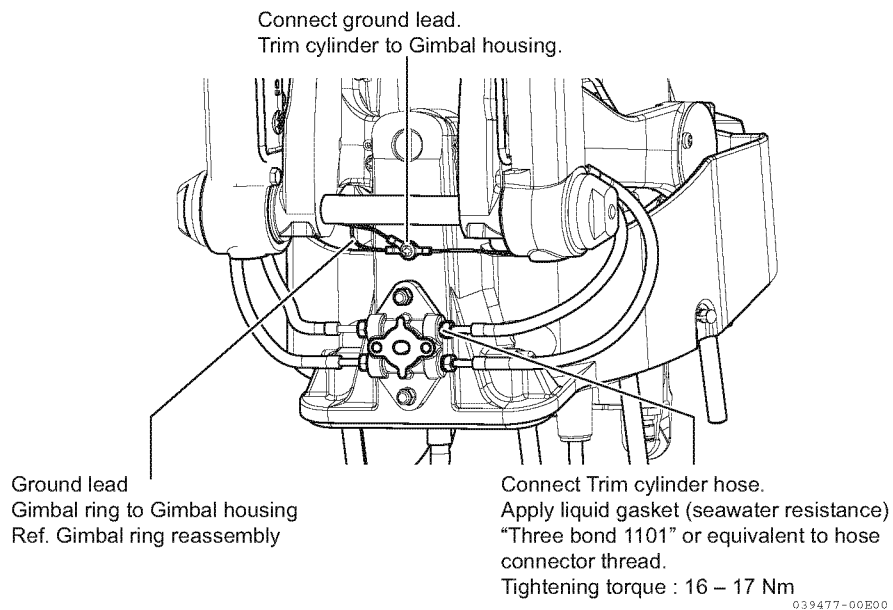
**Figure 8-59**

31. Install the trim cylinders to the gimbal housing, as shown in **Figure 8-60**.



**Figure 8-60**

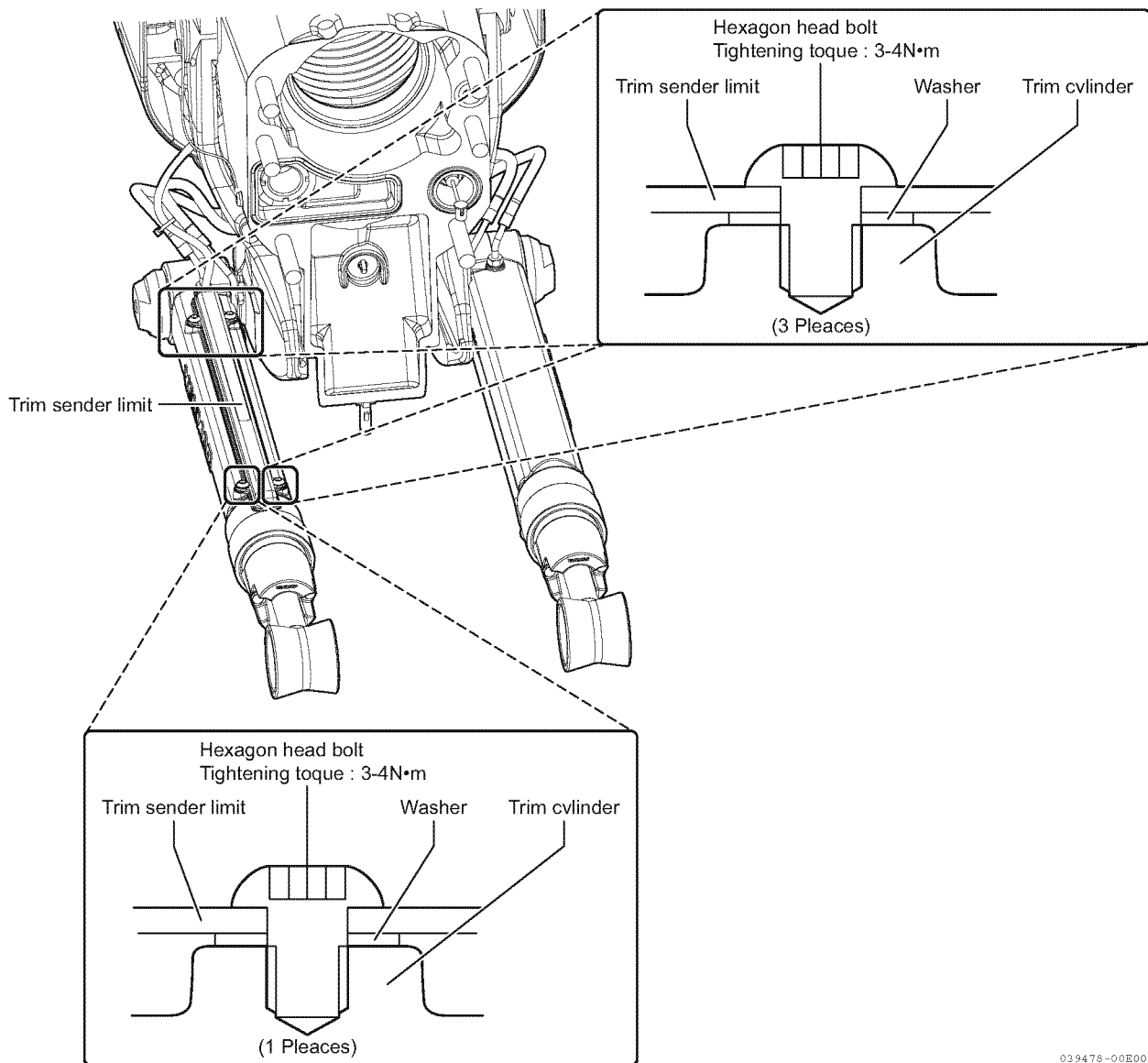
32. Connect the trim hose connector and electrical ground lead, as shown in **Figure 8-61**.



**Figure 8-61**

# TRANSOM ASSEMBLY

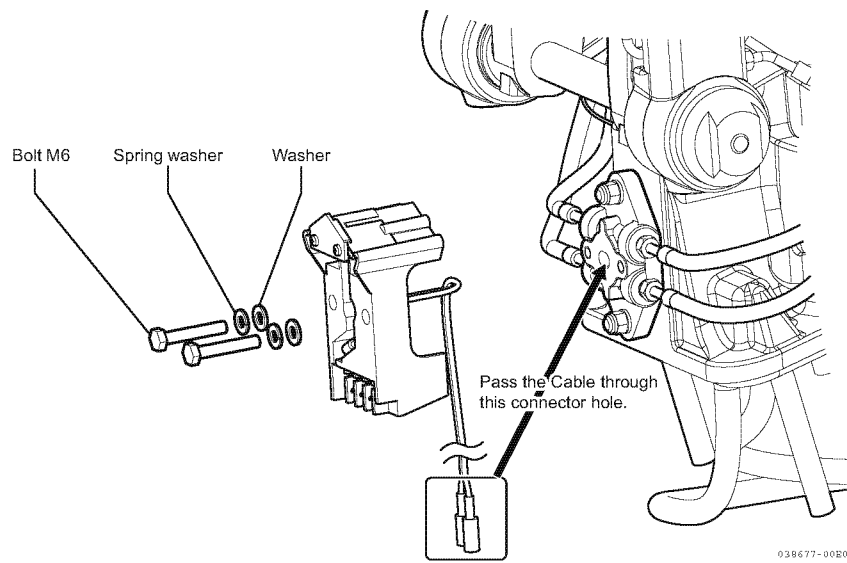
33. Install trim sender limit, as shown in **Figure 8-62**.



039478-00B00

**Figure 8-62**

34. Install the electrode CMP (Y-CaPS), as shown in **Figure 8-63**.



**Figure 8-63**

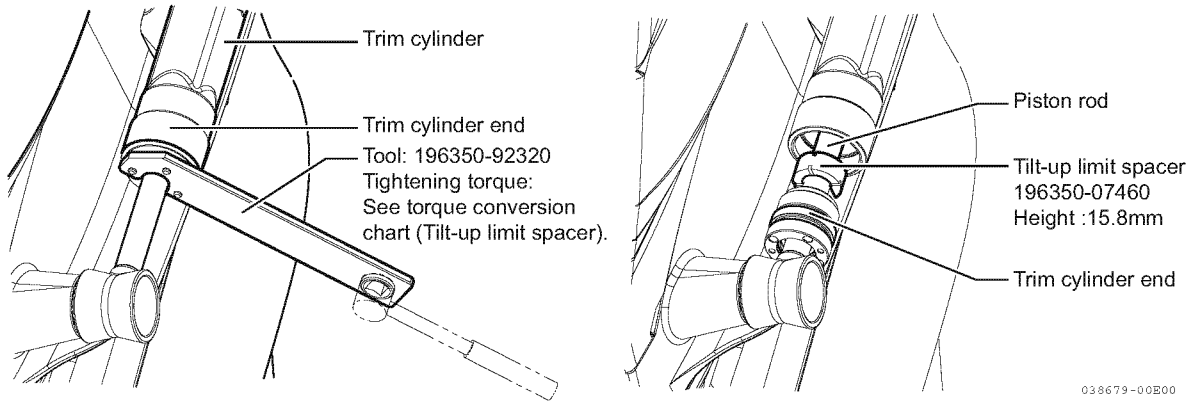
# TRANSOM ASSEMBLY

## TILT-UP LIMIT SPACER

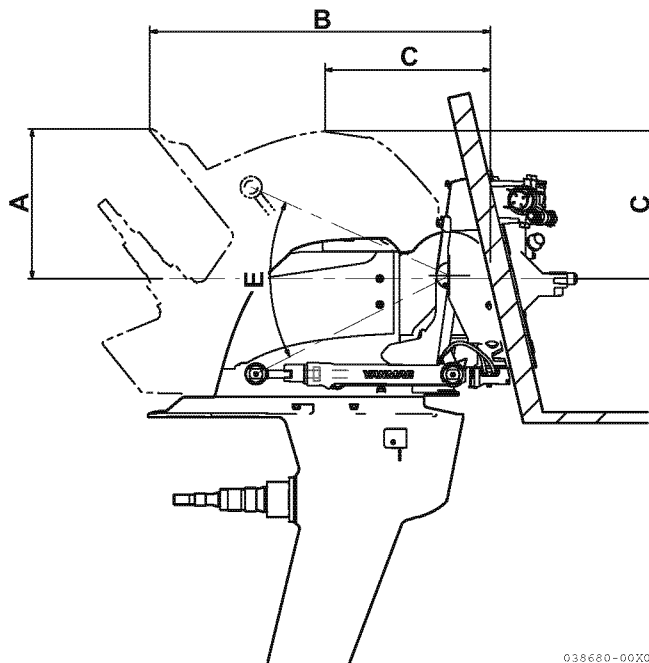
For additional information on the trim-in limiter, see *Trim-In Limiter* on page 11-12.

Adjust the tilt-up angle by installing the tilt-up limit spacer to the trim cylinder, as shown in **Figure 8-64**.

*Note: This part is not installed as shipped from Yanmar. If used, it should be installed in each cylinder.*



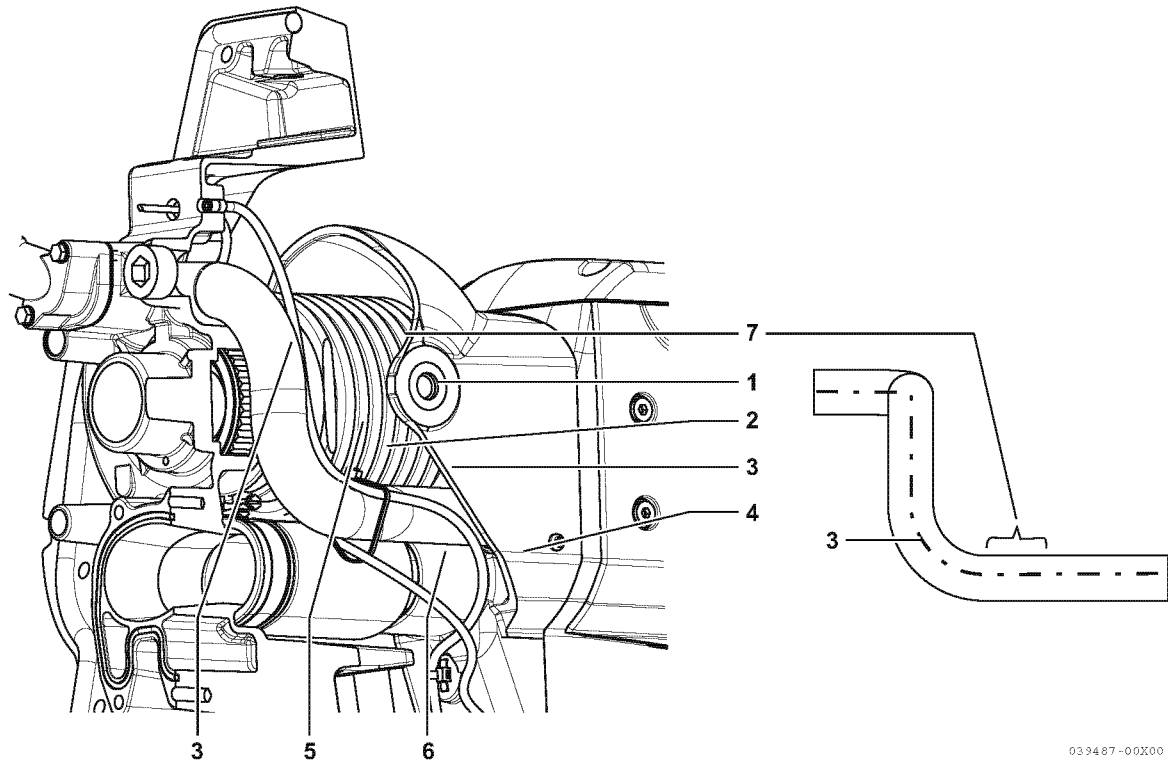
Tilt-up Limit Spacer (Pieces/Each Trim Cylinder)	A (mm)	B (mm)	C (mm)	D (mm)	E (Degrees)
0 (Standard)	375	851	370	413	51
1 (Loose Part)	308	881	341	443	46
2 (Option)	244	902	316	359	41.3
3 (Option)	180	825	286	280	36.7



**Figure 8-64**

## SPEEDOMETER CONNECTION

Figure 8-65 shows the speedometer hose piping.



039487-00X00

- |                         |                     |
|-------------------------|---------------------|
| 1 - Speedometer Hose    | 5 - Cable Band A    |
| 2 - Trim Sender Wire    | 6 - Cable Band B    |
| 3 - Engine Cooling Hose | 7 - Straight Area   |
| 4 - Bell Housing        | 8 - Exhaust Opening |

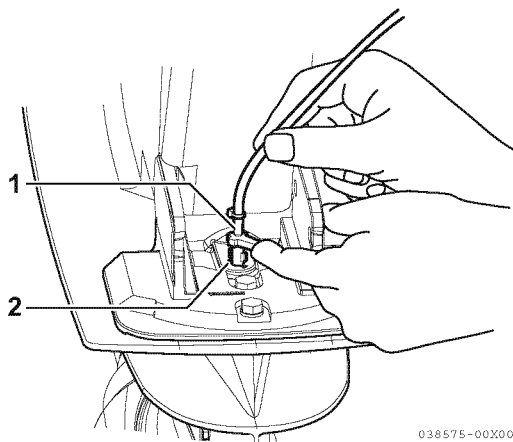
**Figure 8-65**

## TRANSOM ASSEMBLY

Cable band A (5, **Figure 8-65**) attaches the speedometer hose (1, **Figure 8-65**) and the trim sender wire (2, **Figure 8-65**) to the engine cooling hose (3, **Figure 8-65**). The fixed place is the straight area (7, **Figure 8-65**) of the engine cooling hose. The speedometer hose passes the port side of the engine cooling hose, and it passes the port side of the exhaust opening (8, **Figure 8-65**).

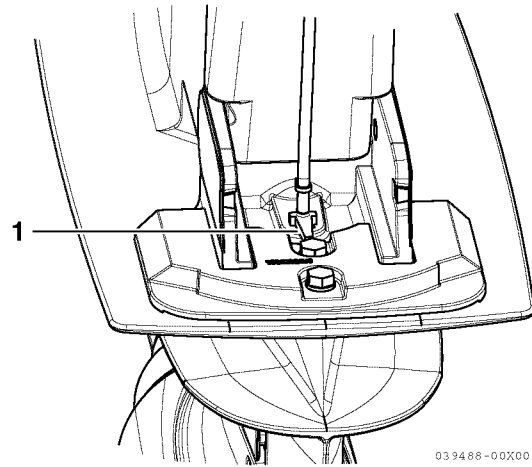
Cable band B (6, **Figure 8-65**) attaches the speedometer hose to the bell housing (4, **Figure 8-65**).

1. Raise the drive unit to gain access to the area between the gimbal housing and the drive unit, immediately on top of the transom end of the antiventilation plate.
2. Insert the speedometer tube fitting (1, **Figure 8-66**) into the opening (2, **Figure 8-66**) on the topside of the ventilation plate in position as illustrated.



**Figure 8-66**

3. With the fitting fully seated, turn the handle (1, **Figure 8-67**) to the left to a tightly seated position.



**Figure 8-67**



## Section 9

# SHIFT CABLE

---

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### **SAFETY PRECAUTIONS**

Before servicing the stern drive, review *Safety on page 2-1*.

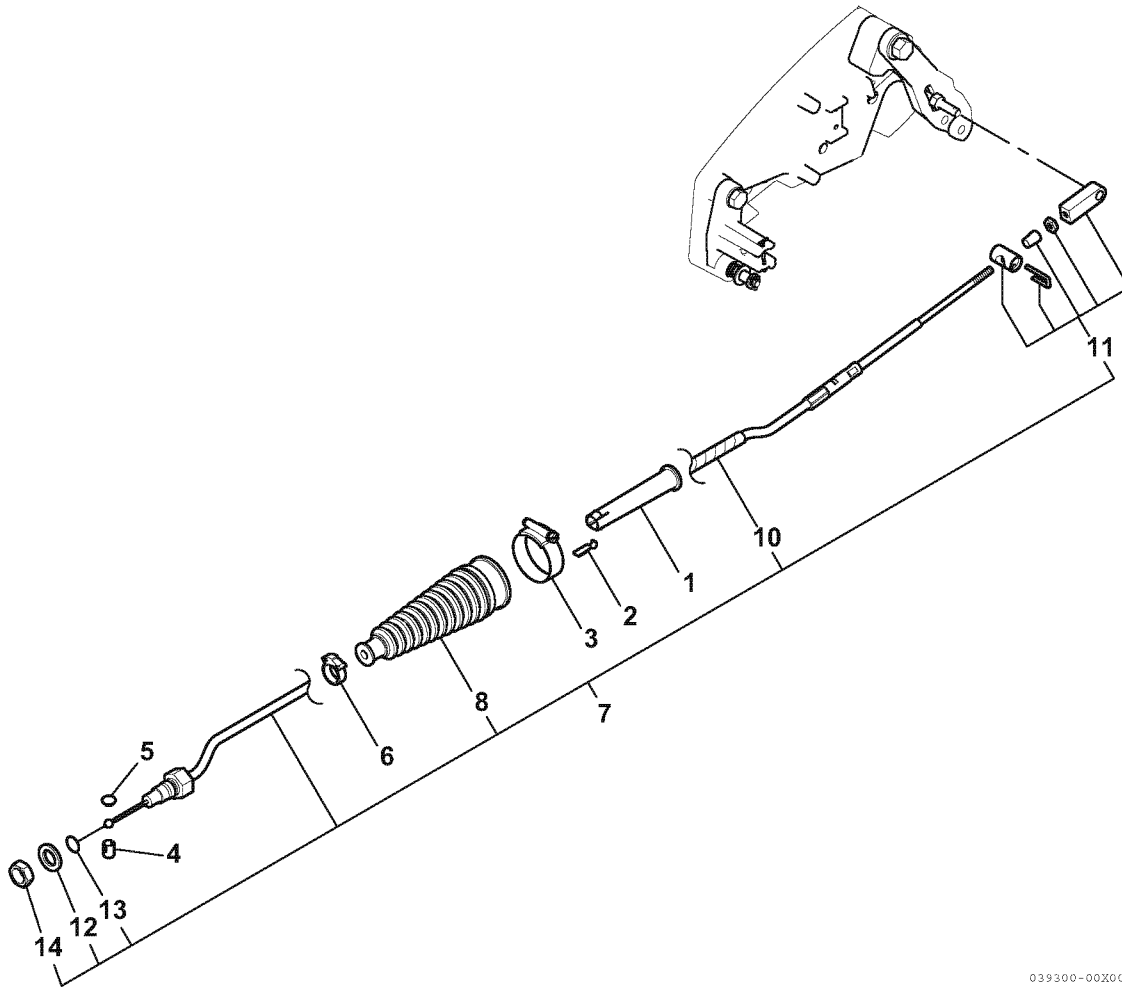
### **INTRODUCTION**

This section of the *Service Manual* describes the procedures necessary to replace and adjust the shift control cable.

# SHIFT CABLE

## CONTROL CABLES

### Mechanical Shift Cable Parts Diagram



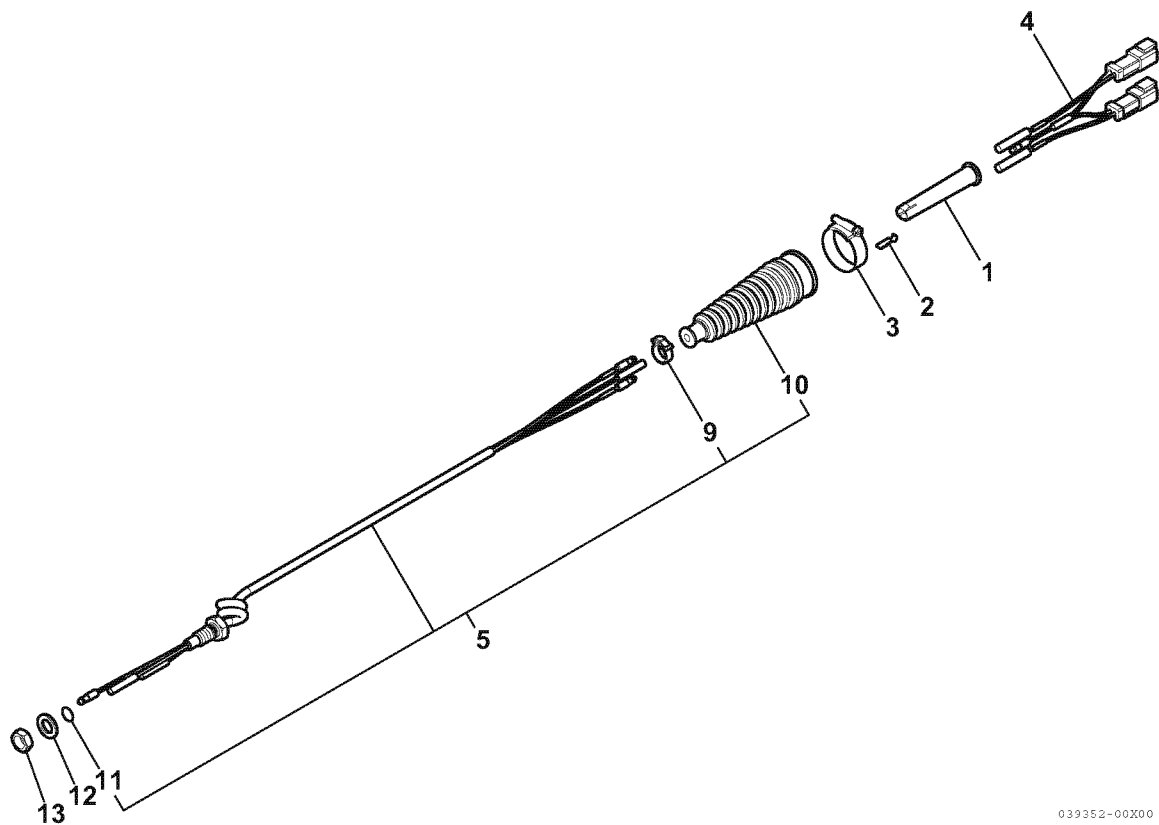
039300-00200

Figure 9-1

Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-01080	Insert	1	1	
2	196350-01260	Clip Grounding	1	1	
3	196350-01270	Clamp Hose 48	1	1	
4	196350-06100	Slider Joint	1	1	
5	196350-06110	Slider Cap	1	1	
6	196350-34110	Nylon Clamp	1	1	
7	196350-34200	Shift Cable CMP	1	1	

Item	Part Number	Description	ZT350	ZT370	N/O
8	196350-34100	Bellows	1	1	
10	196350-34220	Spiral Tube	1	1	
11	196350-34250	Attachment Kit	1	1	
12	22117-120000	Washer 12	1	1	
13	24311-000100	Packing	1	1	
14	26776-120002	Nut 12	1	1	

Electric Shift Cable Parts Diagram



039352-00X00

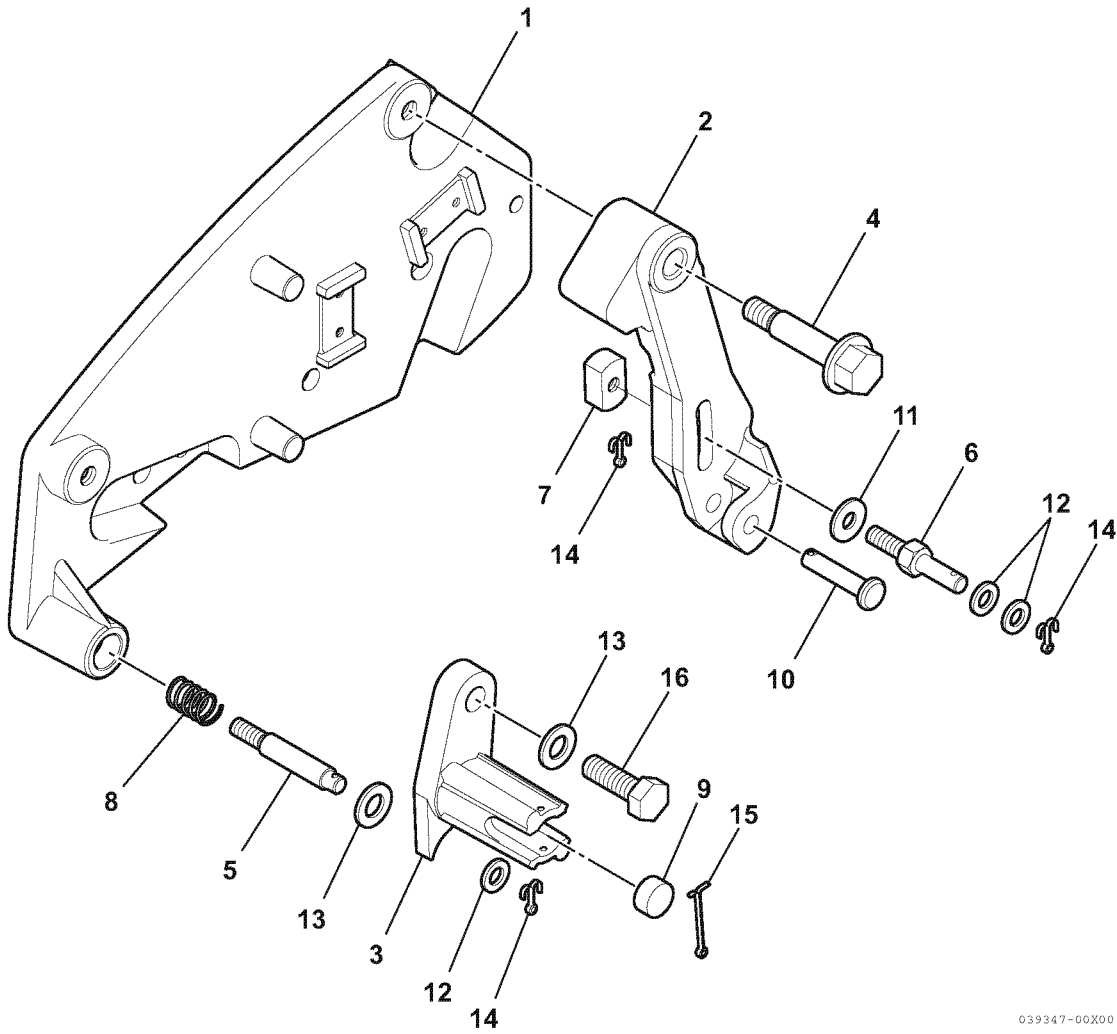
Figure 9-2

Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-01080	Insert	1	1	
2	196350-01260	Clip Grounding	1	1	
3	196350-01270	Clamp Hose 48	1	1	
4	196350-06380	Joint Cable	1	1	
5	196350-06400	Curl Cable CMP	1	1	

Item	Part Number	Description	ZT350	ZT370	N/O
9	196350-34110	Nylon Clamp	1	1	
10	196350-34100	Bellows	1	1	
11	24311-000100	Packing P-10	1	1	
12	22117-120000	Washer 12	1	1	
13	26776-120002	Nut 12	1	1	

# SHIFT CABLE

## Shift Plate Parts Diagram



039347-00X00

Figure 9-3

Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-06500	Shift Plate	1	1	
2	196350-06510	Shift Lever	1	1	
3	196350-06520	Support	1	1	
4	196350-06540	Bolt M8 × 45	1	1	
5	196350-06550	Pivot Bolt A	1	1	
6	196350-06560	Pivot Bolt B	1	1	
7	196350-06570	Nut 6	1	1	
8	196350-06580	Spring	1	1	

Item	Part Number	Description	ZT350	ZT370	N/O
9	196350-06590	Sponge	1	1	
10	196350-06600	Pin	1	1	
11	196350-06610	Washer	1	1	
12	22113-060000	Washer 6	3	3	
13	22113-080000	Washer 8	2	2	
14	22413-200160	Cotter Pin	3	3	
15	22413-200320	Pin 2 × 32	1	1	
16	26203-080252	Bolt M8 × 25	1	1	

## Control Cable Travel

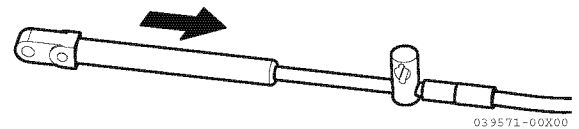
Yanmar recommends using a Teleflex remote control and cables to ensure proper shift and throttle operation. If a control other than Yanmar - Teleflex is used, a shift control cable must be (at the shift plate end) 70 mm (2-3/4 in.) to 77 mm (3-1/32 in.) with a 50 to 70 N (11 to 16 lb) load applied to the cable end.

## Verify Propeller Rotation with Mechanical Shift System

### NOTICE

Use this method to verify the correct propeller rotation (right-hand or left-hand) for this drive unit.

The front propeller on the drive unit is always left-hand rotation and the rear propeller is always right-hand rotation. The shift cable end guide must move in the direction shown in **Figure 9-4** when the control lever is placed in the FORWARD gear position.



**Figure 9-4**

### NOTICE

Route the cable away from sharp bends and moving parts. Never fasten items to the shift cables.

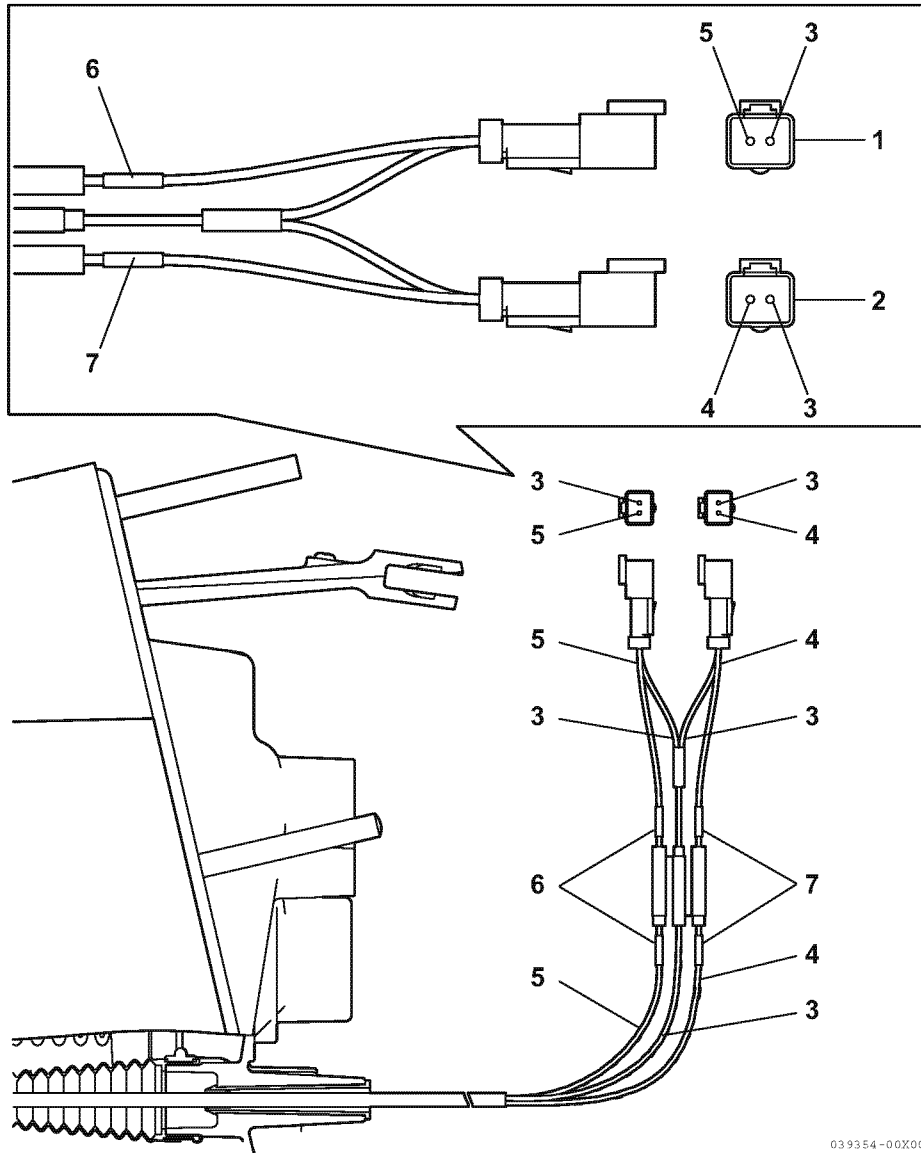
# SHIFT CABLE

## SHIFT CABLE INSTALLATION AND ADJUSTMENT

Additional shift cable installation and removal information is provided in the procedures within *Transom Assembly* on page 8-1.

### Shift Cable Installation for Electric Shift Type

Connect the shift cable to the control system and the engine. Please refer to the manual of the control system and the engine.



- 1 - FORWARD Connector (female): DEUTSCH DT04-2P-CE03 1060-16-0622 W2P
- 2 - REVERSE Connector (female): DEUTSCH DT04-2P-CE03 1060-16-0622 W2P
- 3 - Black: for Earth Signal (negative)

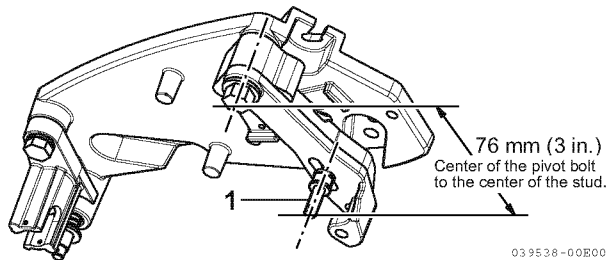
- 4 - White: for REVERSE Signal
- 5 - Orange: for FORWARD Signal
- 6 - Name Tag: FORWARD
- 7 - Name Tag: REVERSE

**Figure 9-5**



## Shift Cable Installation for Mechanical Shift Type

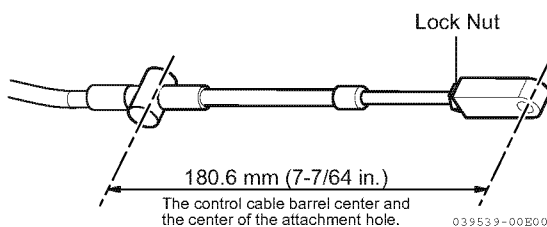
1. Install the shift cable into the remote control. Refer to the appropriate instructions that come with the system you are using.
2. Loosen the stud (1, **Figure 9-6**) and move it to the dimension as shown in the illustration below. Tighten the stud.



**Figure 9-6**

## Setting the Cable Length

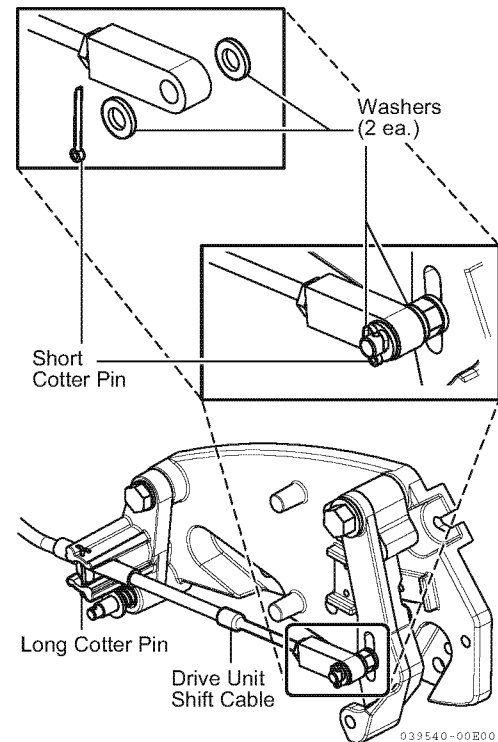
Find the NEUTRAL position at the shift cable for the drive unit. Measure the distance between the control cable barrel center and the center of the attachment hole of the cable end. Adjust it at the screw of the attachment if necessary, and then lock the nut. This distance should be 180.6 mm (7-7/64 in.).



**Figure 9-7**

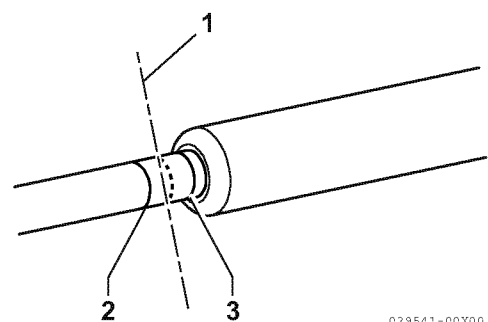
## Installing the Drive Unit Shift Cable

1. Insert the cotter pins from the top. Spread the ends of the cotter pins fully.



**Figure 9-8**

2. Locate the center of the remote control and control cable play (backlash):
  - 1- Shift the remote control to NEUTRAL.
  - 2- Push in on the control cable end with enough pressure to remove play, and mark position 2 on tube (**Figure 9-9**).
  - 3- Pull out on the control cable end with enough pressure to remove play and mark position 3 on tube (**Figure 9-9**).
  - 4- Measure the distance between marks 2 and 3 and mark position 1 halfway between marks 2 and 3 (**Figure 9-9**).



**Figure 9-9**

# SHIFT CABLE

## Adjusting the Shift Control Cable

### NOTICE

Keep center mark 1 aligned with sleeve end face when making the following adjustment (Figure 9-9).

1. Temporarily install the shift control cable end guide (4, Figure 9-10) into the shift lever and insert the clevis pin (5, Figure 9-10).
2. Adjust the shift control cable barrel (2, Figure 9-10) so that the hole in the barrel centers with the vertical centerline of the stud (1, Figure 9-10). Ensure that the backlash center (3, Figure 9-10) mark is aligned with the edge of the control cable end guide.

### NOTICE

Never attempt to install or remove the shift control cable barrel from the stud without first removing the end guide clevis pin from the shift lever and removing the cable. Attempting to bend the shift control cable to install or remove the barrel will put undue stress on the cable end guide and shift lever. Damage to both could occur.

3. Remove the shift control cable end guide from the shift lever by removing the clevis pin.

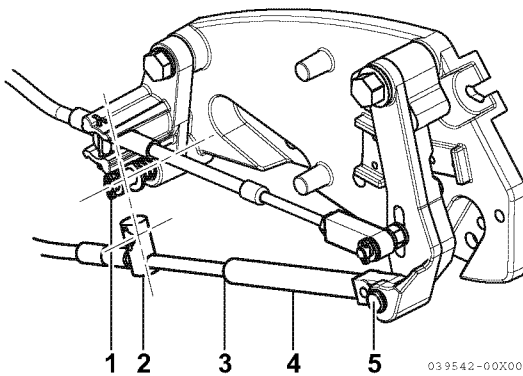


Figure 9-10

4. Install the shift control cable.
5. Install the washers (1, Figure 9-11) and cotter pin (2, Figure 9-11) to secure the barrel. Spread the ends of the cotter pin.
6. Install the clevis pin (4, Figure 9-11).
7. Install the cotter pin (3, Figure 9-11) into the clevis pin. Spread the ends of the cotter pin.

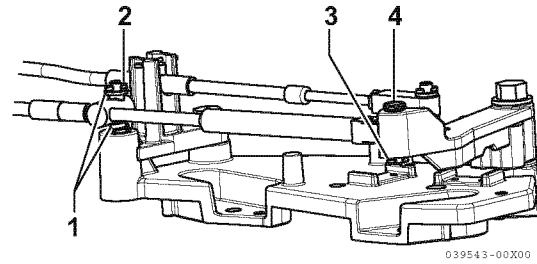


Figure 9-11

8. Shift the remote control lever into the FORWARD position.
9. Measure the distance between the shift control cable barrel center and the shift lever stud center (Figure 9-12). This distance should be  $155.6 \pm 1.5$  mm ( $6\text{-}1/8 \pm 1/16$  in.).
10. If the distance does not satisfy the dimension, loosen the shift lever stud (Figure 9-12) and slide the stud up or down until the distance is within the stated the dimension. When the adjustment is correct, tighten the stud.

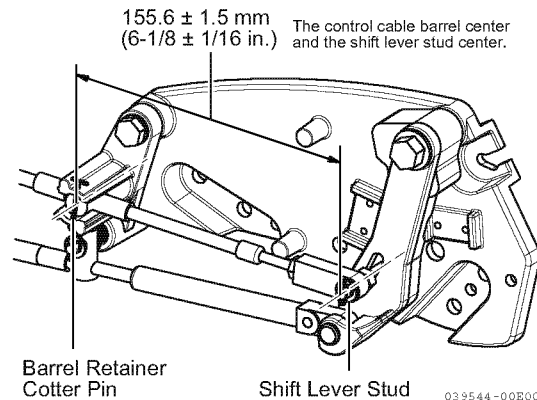
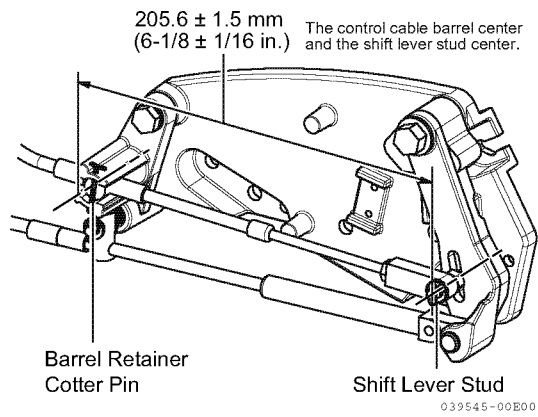


Figure 9-12

11. Shift the remote control into REVERSE.
12. Measure the distance between the control cable barrel center and the shift lever stud center (Figure 9-13). This distance should be  $205.6 \pm 1.5$  mm ( $8\text{-}3/32 \pm 1/16$  in.).
13. If the distance does not satisfy the dimension, loosen the shift lever stud (Figure 9-13) and slide the stud up or down, until the distance is within the stated dimension.
14. When the adjustment is correct, tighten the stud.



**Figure 9-13**

15. Ensure that all of the cotter pins are secure and that the ends of the cotter pins are spread completely.
16. Lubricate the shift cable pivot points.

SAE 30W Engine Oil	
Where Used	Part Number
Shift Cable Pivot Points	Obtain Locally

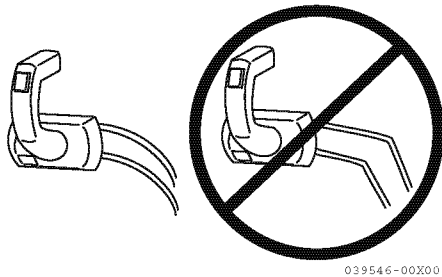
# SHIFT CABLE

## Troubleshooting Shift Problems

For additional shifting troubleshooting information, see *Troubleshooting and Testing on page 14-1*.

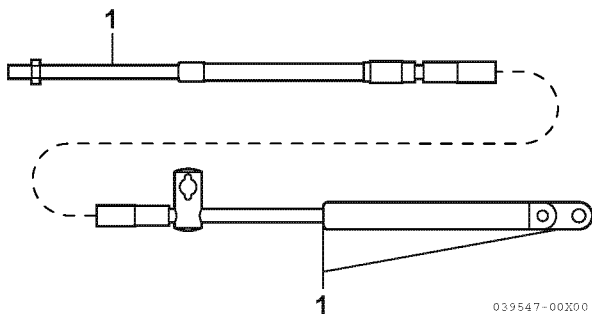
*Note: Use the following information to troubleshoot hard shifting or rough shifting into forward gear.*

1. Check that the control box cables have enough clearance to operate. This is necessary because the cables move up and down when the shift handle is moved. If the control box is mounted too far back toward any fiberglass structure, the cables will be interfered with. This will cause very hard shifting.



**Figure 9-14**

2. Route the shift cable from the control box through the side gunnel of the hull without inducing any extremely sharp bends (**Figure 9-14**) to prevent stiff shifting.
3. Before installing the shift cable into the control box, extend the stainless rod eye end of the cable and coat it with lubricant (1, **Figure 9-15**). Move it back and forth to allow even distribution of the lubricant.



**Figure 9-15**

Lithium Grease with PTFE	
Where Used	Part Number
Shift Cable End	Obtain Locally

4. Never strap or clamp the control cables to any other cables or rigid structure within 1000 mm (3 ft) of the control box. Make sure there are no kinks in the cable.
5. Ensure that there is enough clearance for cable movement when the control box is installed in the side panel. The cables must have room to move up and down when the control handle is shifted into either FORWARD or REVERSE.
6. Ensure that the intermediate shift cable is not damaged; this will cause improper and/or stiff shifting.
7. Never fasten the shift cable with straps or clamps to any other cable within 1500 mm (5 ft) of the shift plate.
8. Avoid over-tightening the shift cable to the transom with any type of plastic clips or fasteners within 1500 mm (5 ft) of the shift plate.
9. Do not over-tighten the throttle or shift cable attaching nuts at the engine end. Barrel and cable end must be free to rotate on the mounting stud.

*Note: Lubricate attaching points with engine oil.*

SAE 30W Engine Oil	
Where Used	Part Number
Shift Cable Pivot Points	Obtain Locally

10. The drive unit shift cable must be routed to allow sufficient length for connection to shift plate.

*Note: Make a final check of the adjustments with the boat in the water and with the engine running.*

## Section 10

# STEERING

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External Power Steering with an External Tie Bar.....	10-12

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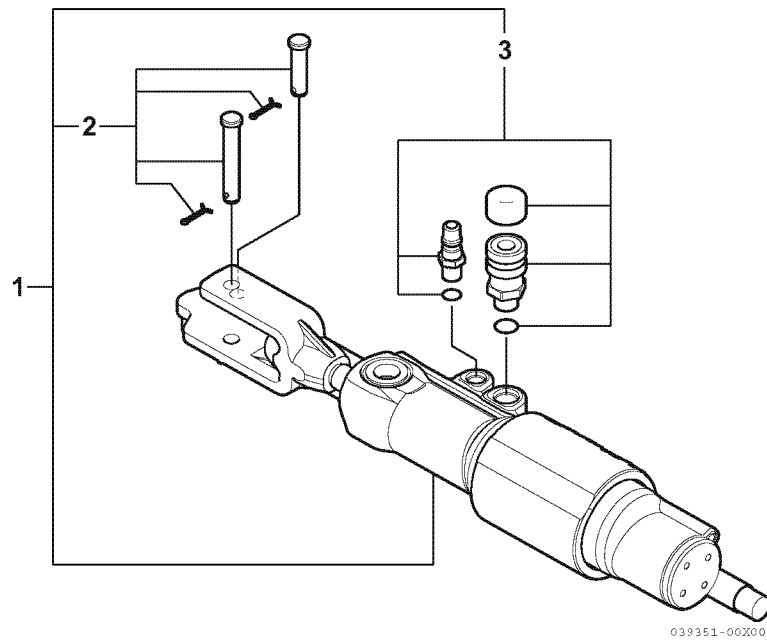
## SAFETY PRECAUTIONS

Before servicing the stern drive, review *Safety on page 2-1*.

## INTRODUCTION

This section of the *Service Manual* describes the procedures necessary to replace and adjust the steering cable and replace the power steering unit.

## POWER STEERING UNIT PARTS DIAGRAM



**Figure 10-1**

Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-34010	Power Steering Assy	1	1	
2	196350-34020	Hardware Kit	1	1	
3	196350-34030	Fitting Kit	1	1	



## STEERING CABLE SPECIFICATIONS

The stern drive is equipped with the steering cable guide preset for cables with end dimensions that comply with ABYC standards, as outlined in the NMMA certification handbook. Yanmar recommends using a steering cable with a self-locking coupler nut. There must also be a means of locking it to the guide tube as specified in the ABYC requirements.

Use an external locking device if using a steering cable that does not have a self-locking coupler nut.

### WARNING

#### **LOSS OF CONTROL HAZARD**

**Failure to use a steering cable locking device could cause a loss of steering.**

### **NOTICE**

Power steering units only - If the steering cable is installed with improper dimensions, it may cause severe damage to the transom assembly and/or steering system. Never attempt to adjust the cable guide tube on the power steering unit, as the guide tube and locknut have been torqued (with Loctite®) at the factory, and an attempt to loosen nut or tube may result in damage to tube.

Ensure that the steering cable is the correct length, particularly when installed in larger boats.

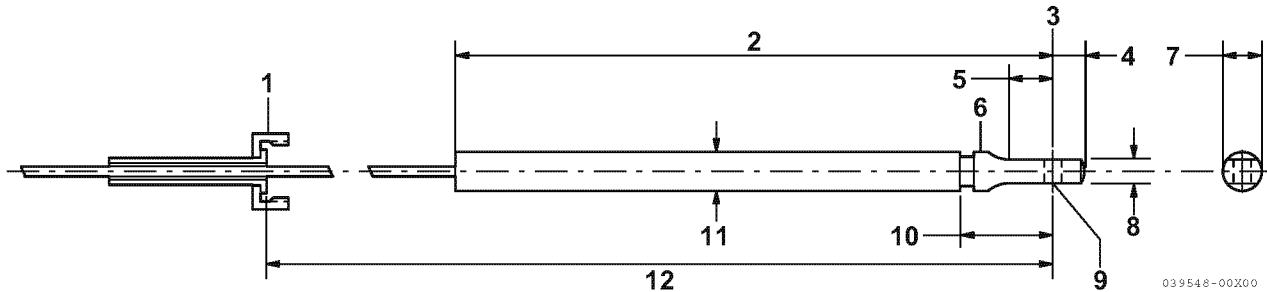
Route the cable so it does not go around any sharp bends. Remove and avoid any kinks or loops when mounting the cable.

## STEERING

Use the following illustration to determine the cable end dimension when the power steering cable is fully extended.

### NOTICE

Power steering pump lugging (squealing) in a hard right turn (against the lock) may mean that the steering cable has been installed using incorrect dimensions.



- 1 - Coupler/Nut - 7/8 UNF - 28 Thread
- 2 - 298 mm (11-3/4 in.) Minimum
- 3 - Interface Point
- 4 - 12.7 mm (1/2 in.) Maximum
- 5 - 10.7 mm (27/64 in.) Minimum Flat
- 6 - 3.1 mm (7/64 in.) Minimum Radius
- 7 - 15.9 mm (5/8 in.) Maximum Diameter End Fitting
- 8 - 9.5 mm (3/8 in.)
- 9 - 9.8 mm (3/8 in.) Diameter Through Hole (chamfered each side)

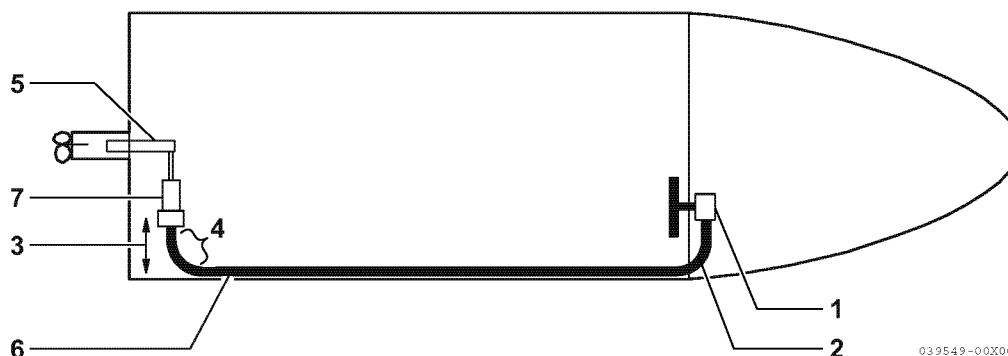
- 10 - 1-3/8 in. (34.9 mm) Maximum
- 11 - 15.9 mm (5/8 in.) Diameter Tube
- 12 - Cable Travel:
  - Mid-Travel Position - 429 mm (16-7/8 in.)
  - Total travel to be 203 mm (8 in.) minimum to 228 mm (9 in.) maximum.
  - Travel each side of mid-travel position - 102 mm (4 in.) minimum, 114 mm (4-1/2 in.) maximum.

**Figure 10-2**

## INSTALLATION OF STEERING CABLE

When installing the steering cable (6, **Figure 10-3**) between the rotary or rack helm (1, **Figure 10-3**) and the steering lever of the stern drive (5, **Figure 10-3**), use the following specifications:

- Never exceed a 20 cm (8 in.) radius bend in the cable (2, **Figure 10-3**).
- Keep +/- 25 mm (1 in.) free motion of cable and power steering valve (3, **Figure 10-3**) and be sure to prevent any interferences with other objects.
- Never tie down or clamp the steering cable within 90 cm (3 ft) of the power steering cylinder (4, **Figure 10-3**).



- |   |                             |
|---|-----------------------------|
| 1 - Rotary or Rack Helm   | 5 - Steering Lever          |
| 2 - Minimum 20 cm (8 in.) bend radius   | 6 - Steering Cable          |
| 3 - +/- 25 mm (1 in.) free motion of cable housing and power steering valve     | 7 - Power Steering Cylinder |
| 4 - Never tie down or clamp within 90 cm (3 ft) of the power steering cylinder. |                             |

**Figure 10-3**

### **⚠ WARNING**

#### **LOSS OF CONTROL HAZARD**

**Loss of Control Hazard.** Be sure the steering cable is correctly installed. Verify that all cable bends, free motion of cable housing and restraints of the cable are within specifications. Incorrect installation of the steering cable could result in erratic or loss of steering.

## CONNECTING STEERING CABLES

1. Coat the steering cable end with a liberal amount of lubricant.
2. Install the steering cable and secure with hardware as shown in **Figure 10-4**.

### NOTICE

The flat surfaces of the spool barrel cable guide tube (2, **Figure 10-4**) must be positioned horizontally to prevent feedback in the steering system.

3. Use a wrench to hold the flat surfaces of the spool barrel cable guide tube horizontally.
4. Torque the coupler nut. Ensure that the flat surfaces are still aligned horizontally after torque is applied to the coupler nut.

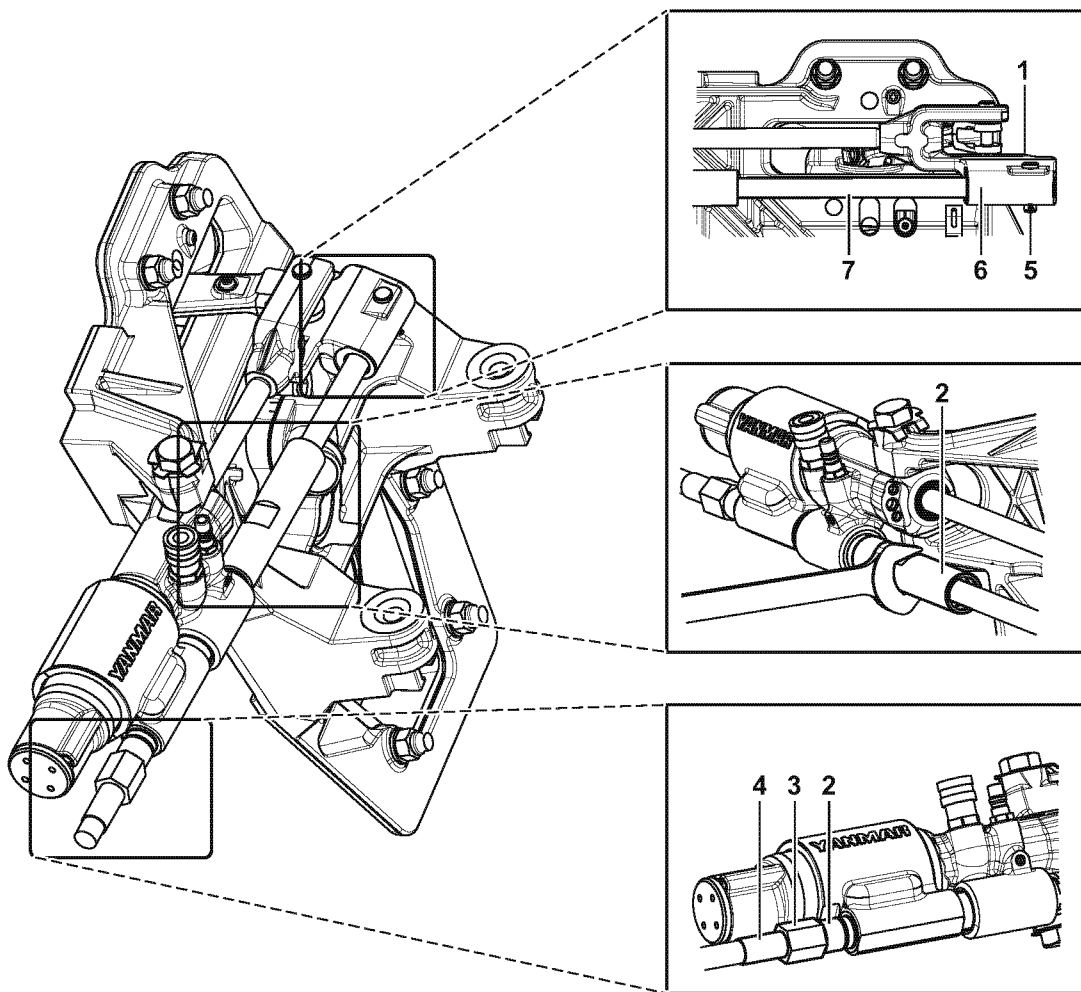
#### UREA Grease Water Resistant Type NLGI #2

Where Used

Steering Cable End

#### Cable Coupler Nut Torque

N·m	lb·ft
45	33



039550-00X00

- 1 - Clevis Pin
- 2 - Spool Barrel Cable Guide Tube
- 3 - Cable Coupler Nut
- 4 - Steering Cable

- 5 - Cotter Pin
- 6 - Clevis
- 7 - Steering Cable End

**Figure 10-4**

## POWER STEERING UNIT INSTALLATION

1. Inspect the bushings for debris.
2. Lubricate the power steering bushings (1, **Figure 10-5**).

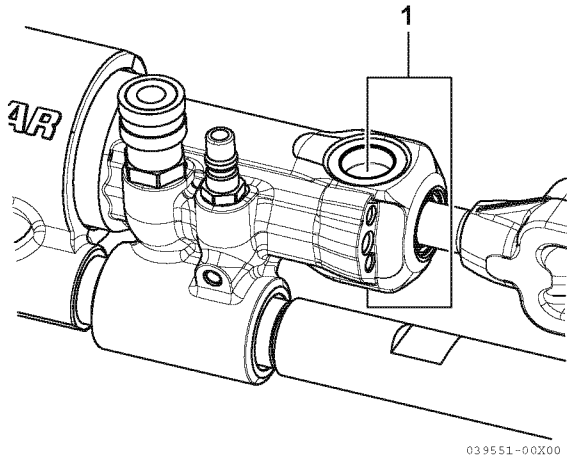


Figure 10-5

UREA Grease Water Resistant Type NLGI #2	
Where Used	Part Number
Power Steering Bushings	Obtain Locally

3. Remove the upper and lower pivot bolts (1, **Figure 10-6**) and lubricate the threads liberally.

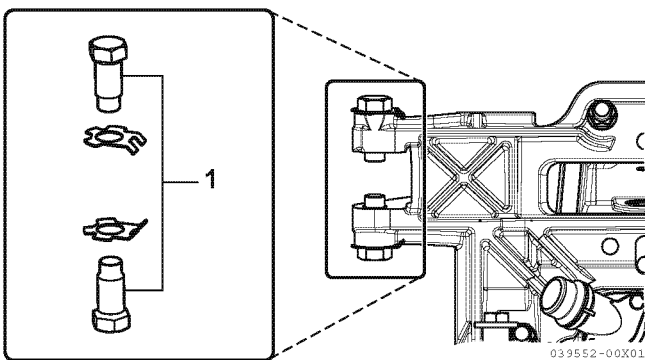


Figure 10-6

UREA Grease Water Resistant Type NLGI #2	
Where Used	Part Number
Upper and Lower Pivot Bolts	Obtain Locally

4. Position the steering assembly so that the pivot bolts will fit in the bushings in the power steering cylinder.

5. Install the upper and lower pivot bolts along with the lock tab washers (1, **Figure 10-7**). Ensure that the lock tab washer tabs straddle the ridge (2, **Figure 10-7**) on the inner transom plate.

The upper pivot bolt and tab washer is shown (lower is similar).

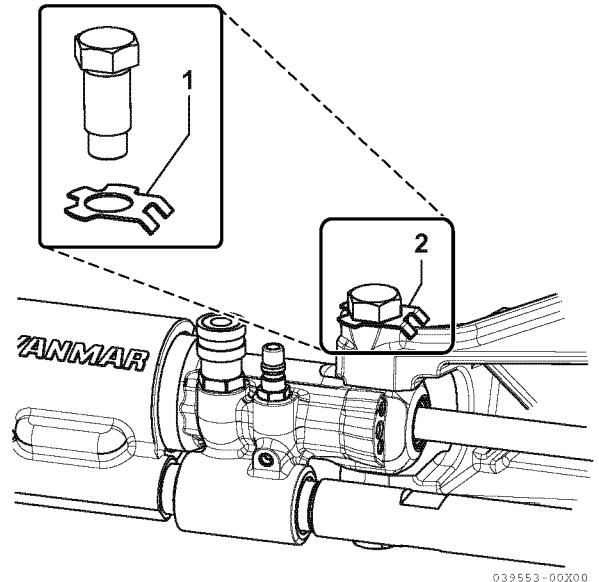


Figure 10-7

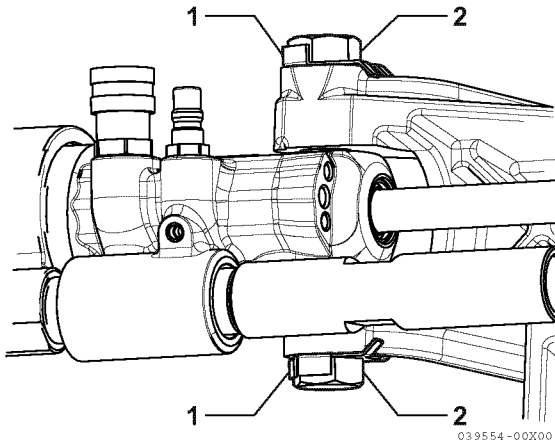
6. Turn the pivot bolts all the way in by hand. Ensure that the steering assembly pivots freely.
7. Torque the pivot bolts.

Upper and Lower Pivot Bolt Torque	
N·m	lb·ft
35	26

## STEERING

8. Bend the locking washer tabs (1, **Figure 10-8**) against the corresponding flats on the bolt heads.

*Note: It may be necessary to tighten the pivot bolts (2, **Figure 10-7**) a little more to align the flats on bolt head with the tabs on the washer.*



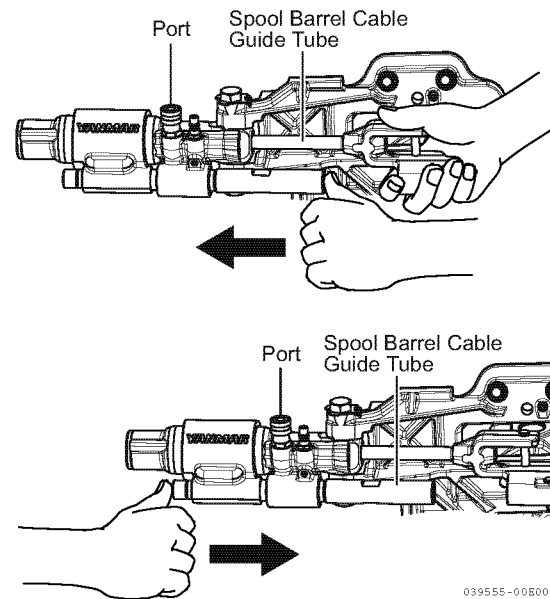
**Figure 10-8**

9. Move the spool barrel cable guide tube in the directions shown in **Figure 10-9**. It will be less difficult to pull it out or push it in during the following installation steps.

### **⚠ WARNING**

#### **EXPOSURE HAZARD**

Moving the spool barrel cable guide tube with the hoses disconnected will leak fluid from the ports. Wear eye protection to avoid injury.



**Figure 10-9**

10. Connect the clevis to the steering lever.
11. Lubricate the clevis pin. Spread both ends of the clevis pin.

*Note: Insert the clevis pin from the top and rotate the pin to ensure that the cotter pin hole is as shown in **Figure 10-10**.*

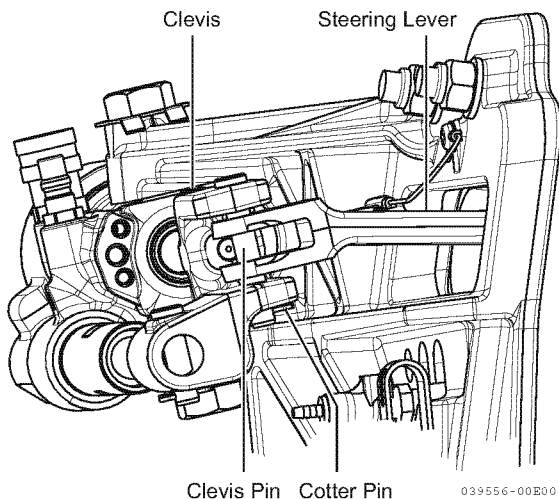
## POWER STEERING HOSE INSTALLATION

**⚠ WARNING**

**LOSS OF CONTROL HAZARD**

To avoid injury or property damage route the hydraulic hoses to avoid extreme heat, stress on the hose fittings and/or hose kinks, or a loss of steering control may occur.

1. Attach both hydraulic hose fittings to the steering control valve.
2. Ensure that the quick connect fittings are securely engaged.
3. Position the hoses as illustrated.

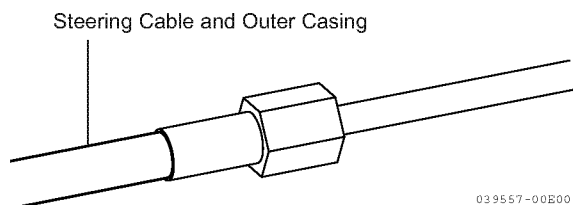


**Figure 10-10**

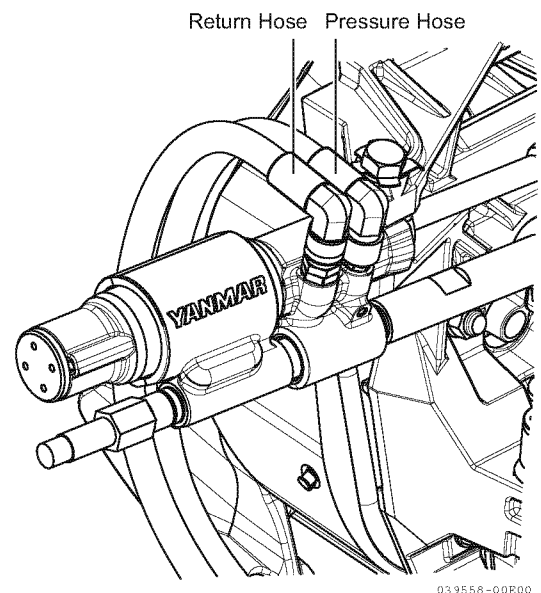
<b>UREA Grease Water Resistant Type NLGI #2</b>
Where Used
Clevis Pin

**NOTICE**

The steering cable and outer casing must move freely for the steering system to function properly. Never fasten any items to the steering cable and/or the outer casing.



**Figure 10-11**



**Figure 10-12**

**NOTICE**

Never let the hose come in contact with the steering system components, the engine coupler, the U-joint shaft or the drive shaft. Secure the hoses to avoid contact with hot or moving components.

### STEERING TIE BAR CONSIDERATIONS

#### NOTICE

The use of multiple stern drives requires a careful consideration of the type of steering system that should be used. Contact your Yanmar dealer or distributor for additional information on tie bars.

#### ⚠ WARNING

##### **LOSS OF CONTROL HAZARD**

**Failure to observe the recommended tie bar arrangements could result in serious damage to the steering and/or power trim system components. This damage could adversely affect boat control.**

*Note: For dual installations, the power steering unit can be mounted on the port or starboard transom assembly. Measure the exact distance between stern drive centerlines. Use a proper tie bar.*

#### Internal Tie Bar Only

Internal tie bars are only recommended for vessels that operate at speeds up to 50 knots (58 mph).

Internal tie bars are a direct connection between the slave stern drive and the stern drive that is directly connected to the factory power steering output. This internal tie bar is available in a variety of lengths from Yanmar. Contact your Yanmar dealer or distributor.

#### Internal and External Tie Bar

This system is recommended for vessels that operate at speeds from 50 to 60 knots (60 to 70 mph) or for the benefit of reduced steering backlash.

Usually, external tie bars are attached at the aft power trim cylinder bosses, but if one drive is trimmed differently than the other, undue stress on the system is introduced. For this reason, dual trim control equipment should be installed to limit the tilt differential between the two drives to 20°.

#### NOTICE

When using an internal power steering system, Yanmar does not recommend the use of an external tie bar by itself. This can cause excessive loads on the steering components and may result in an increase of the play in boat steering.

#### External Power Steering with an External Tie Bar

This system is recommended for vessels that operate at speeds of 70 knots (80 mph) or greater, 1

or for the ultimate in reduced steering backlash. This system does not use an internal tie bar, but requires dual trim control equipment.



## Section 11

# POWER TRIM SYSTEM

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Trim-In Limiter .....	11-12

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### **SAFETY PRECAUTIONS**

Before servicing the stern drive, review *Safety on page 2-1*.

### **INTRODUCTION**

This section of the *Service Manual* describes the procedures necessary to replace the power trim pump.

POWER TRIM PUMP PARTS DIAGRAM

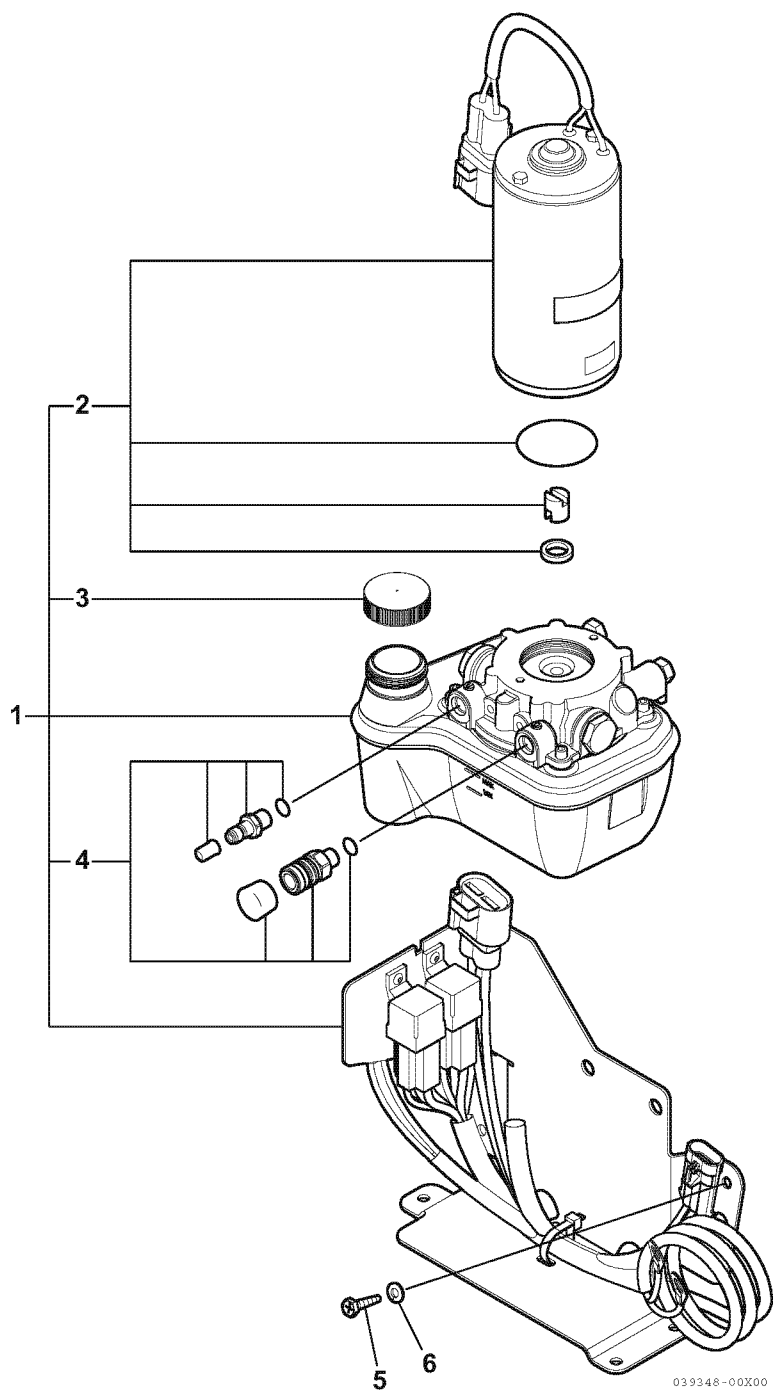
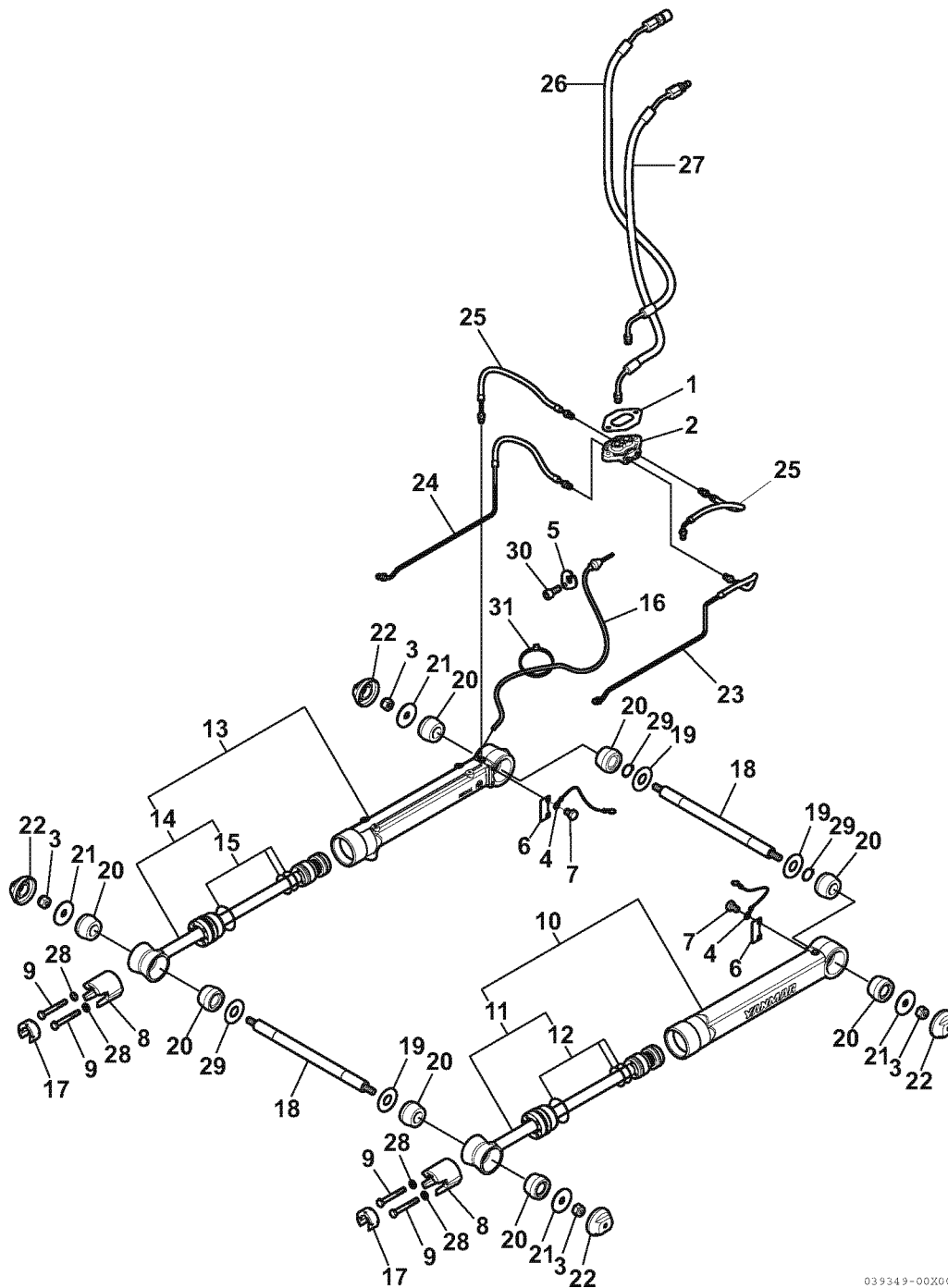


Figure 11-1

<b>Item</b>	<b>Part Number</b>	<b>Description</b>	<b>ZT350</b>	<b>ZT370</b>	<b>N/O</b>
1	196350-07800	Trim Pump Assy	1	1	
2	196350-07810	Motor Replace Kit	1	1	
3	196350-07820	Pump Replace Kit	1	1	
4	196350-07840	Fitting Kit	1	1	
5	106350-07830	Tapping Bolt 6	4	4	
6	22213-060000	Spring Washer 6	4	4	

POWER TRIM CYLINDERS PARTS DIAGRAM



039349-00X00

Figure 11-2

## POWER TRIM SYSTEM

Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-01290	Gasket	1	1	
2	196350-01300	Connector	1	1	
3	196350-01380	Nut	4	4	
4	196350-03950	Cord Ground CA	2	2	
5	196350-06910	Clamp	1	1	
6	196350-07330	Plate	2	2	
7	196350-07340	Bolt UNC1/4-20	4	4	
8	196350-07340	Anode	2	2	
9	196350-07370	Bolt UNCF10-32	4	4	
10	196350-07400	Cylinder R	1	1	
11	196350-07480	Kit R Cyl.	1	1	
12	196350-07470	Kit Trim Cyl. Seal	1	1	
13	196350-07440	Cylinder L	1	1	
14	196350-07410	Kit L Cyl.	1	1	
15	196350-07470	Kit Trim Cyl. Seal	1	1	
16	196350-07450	Trim Sender Unit	1	1	

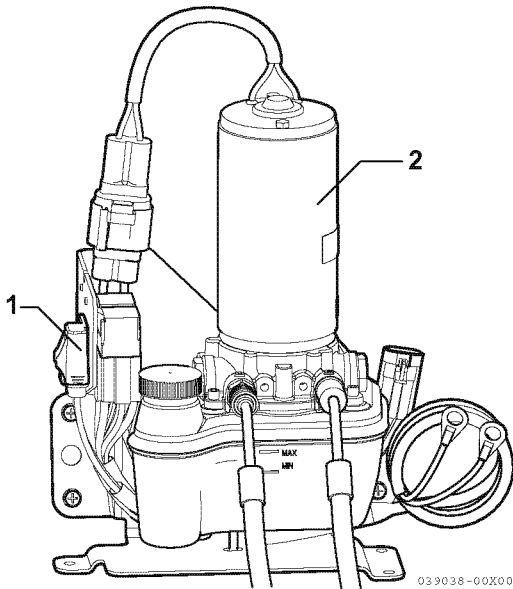
Item	Part Number	Description	ZT350	ZT370	N/O
17	196350-07460	Spacer	2	2	
18	196350-07510	Pin	2	2	
19	196350-07520	Washer 2	4	4	
20	196350-07530	Bushing	8	8	
21	196350-07540	Washer 3	4	4	
22	196350-07551	Cap	4	4	
23	196350-07560	Hose Cylinder R	1		O
23-1	196350-07561	Hose Cylinder R	1	1	N
24	196350-07570	Hose Cylinder L	1		O
24-1	196350-07571	Hose Cylinder L	1	1	N
25	196350-07600	Hose Cylinder	2		O
25-1	196350-07601	Hose Cylinder	2	2	N
26	196350-07620	Hose U Pump	1	1	
27	196350-07660	Hose D Pump	1	1	
28	22213-050000	Spring Washer 5	4	4	
29	22243-000190	Ring 19	2	2	
30	26453-060142	Bolt M6 × 14	1	1	
31	29621-200000	Brand 200	1	1	

No.	Design-change Part	Reason of Change
23-1	196350-07561	Hose Cylinder R Material change
24-1	196350-07571	Hose Cylinder L Material change
25-1	196350-07601	Hose Cylinder Material change

## POWER TRIM SYSTEM

### POWER TRIM SYSTEM

The power trim pump's electrical system is protected by either a 1A in-line fuse (1, **Figure 11-3**) or an auto-reset circuit breaker (2, **Figure 11-3**) located within the trim motor. In the event of an electrical overload, the fuse will blow out or the circuit breaker will shut off. Correct the cause of the electrical overload before operating the trim system.



**Figure 11-3**

### POWER TRIM PUMP FLUID

#### **NOTICE**

Use only Dextron III automatic transmission fluid (ATF) in the power trim system.

#### **NOTICE**

Never operate the power trim system without fluid or the pump will be damaged.

For procedures on checking and filling power trim fluid, see *Checking and Filling Power Trim Pump Fluid* on page 4-10.

### POWER TRIM CYLINDERS

For information on the removal and installation of the power trim cylinders, see procedures within *Transom Assembly* on page 8-1.

For power trim cylinder part diagram information, see *Power Trim Cylinders Parts Diagram* on page 11-6.



# POWER TRIM TROUBLESHOOTING

The following wiring diagram is provided for troubleshooting the power trim electrical system. For additional power trim troubleshooting information, see *Power Trim System Troubleshooting* on page 14-10.

## Power Trim Wiring Diagram

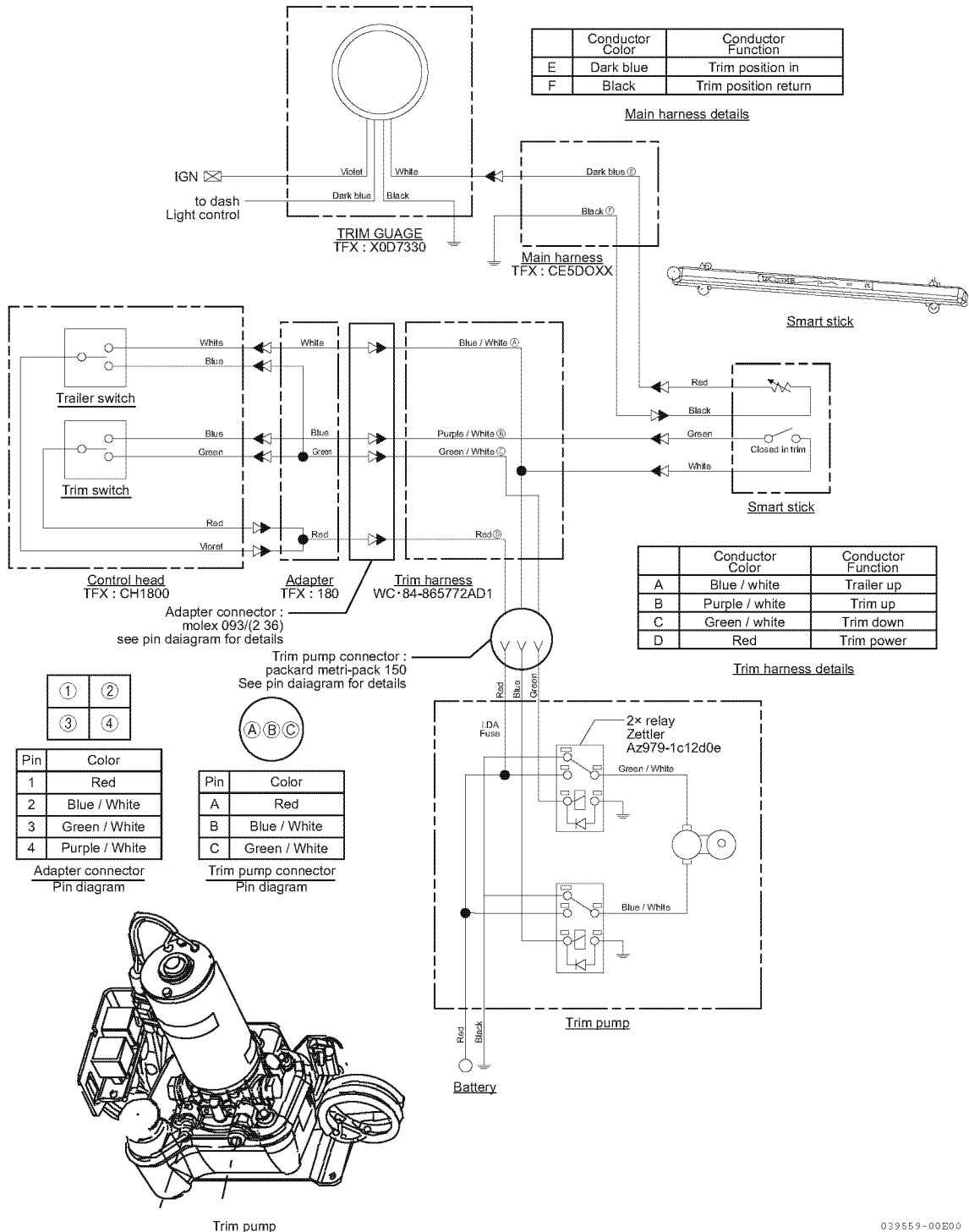


Figure 11-4

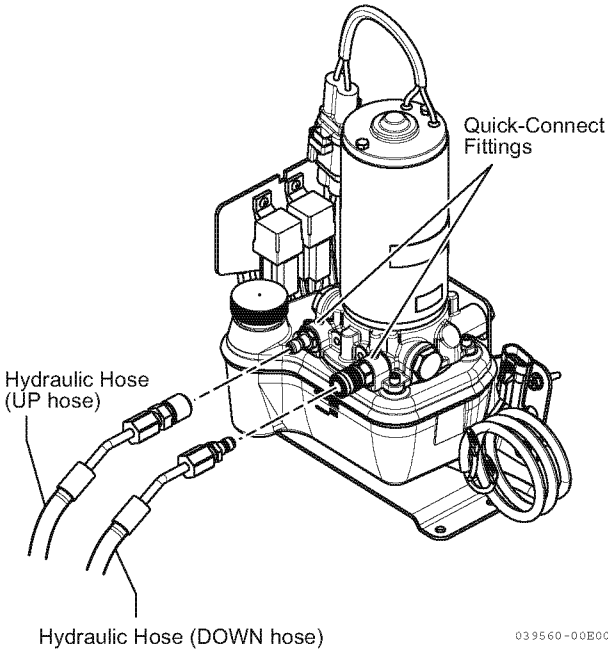
# POWER TRIM SYSTEM

## POWER TRIM PUMP INSTALLATION

Mount the pump in the selected position.

*Note: Make hydraulic connections as quickly as possible to prevent oil from leaking out of the system.*

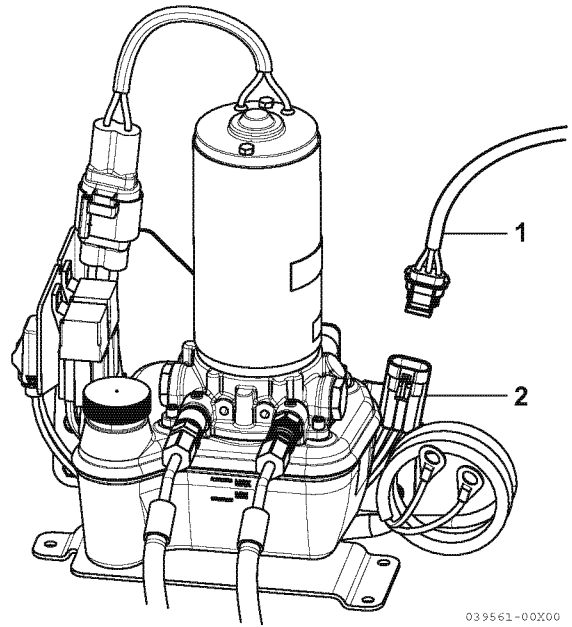
1. Connect the hydraulic hoses to the trim pump. Ensure that the quick-connect fittings completely seat when connecting the hoses.



**Figure 11-5**

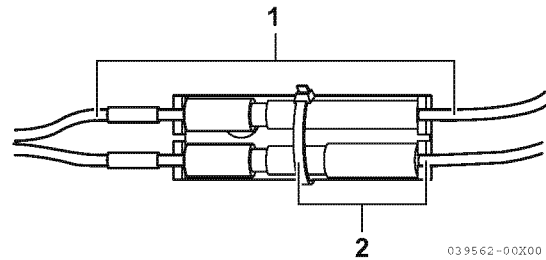
*Note: If used, connect the adapter harness for the remote control trim pump to the pump. The adapter harness uses a "PACKARD METRI-PACK 150" series 3-pin connector.*

2. Connect the power trim pump control harness (1, Figure 11-6) to the trim pump connector (2, Figure 11-6).



**Figure 11-6**

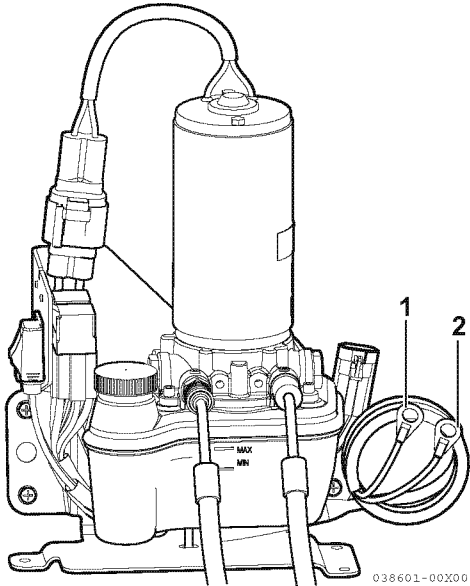
3. Connect the trim limit switch wires (1, Figure 11-7) and secure with a wire retainer and tie strap (obtain locally) (2, Figure 11-7).



**Figure 11-7**

*Note: The engine electrical system is negative (-) ground.*

4. Connect the power trim pump RED (+) battery cable (1, **Figure 11-8**) to the positive (+) battery terminal.
5. Connect the power trim pump BLACK (-) battery cable (2, **Figure 11-8**) to the negative (-) battery terminal.



**Figure 11-8**

6. Ensure that all battery terminal connections are tight.
7. Spray the battery terminal connections with a sealant to help retard corrosion.

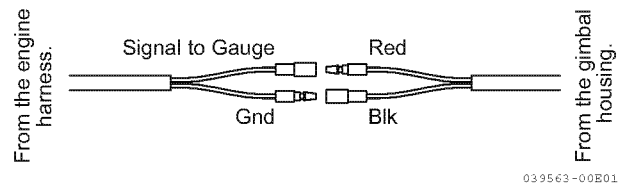
## TRIM POSITION SENDER CONNECTION

For additional information on the trim-in limiter, see page 8-60.

Connect the trim position sender leads from the gimbal housing to the leads from the engine harness. (Refer to the appropriate Engine and Control System Installation Manual.)

Engine	Shift	Signal	GND
4/6BY2	Classic	Dark BLUE	BLACK
	Unlimited	BLUE	BLACK
6LPA2	Mechanical	BROWN/WHITE	BLACK

*Note: Confirm wiring colors when connecting wires. If connections are incorrect, the trim gauge will not work.*



**Figure 11-9**

*Note: Refer to the appropriate Engine and Control System Installation Manual.*

## TRIM-IN LIMITER

For additional information on the trim-in limiter, see *Tilt-Up Limit Spacer* on page 8-62.

### **WARNING**

#### **LOSS OF CONTROL HAZARD**

Only qualified personnel should install and evaluate the effectiveness of the trim-in limiter. The vessel is required to be tested at trim-in range and several different speed settings. If an undesirable handling characteristic occurs when the drive unit is trimmed in at higher speeds, the trim-in range should be adjusted by using a trim-in limiter. Wider trim-in ranges and higher speeds may cause handling problems on some vessels that could result in personal injury.

The stern-lift will cause certain vessels (predominantly heavy, deep-V hulls) to list toward the port or starboard side during full power speeds with the stern drive set to full trim-in. The vessel will not roll over completely, but the list can often be significant enough to unseat the operator and/or passengers. This creates an unsafe situation.

This condition is primarily a result of vessel design and can only be reduced with thorough performance testing by the manufacturer (OEM) of the vessel. However, shifting hull weight to the stern may be helpful in controlling this tendency.

To help reduce the effect of stern-lift, a trim-in limiter is available for the Yanmar ZT350/370 stern drive, as a service part.

The trim-in limiter reduces stern-lift by preventing the stern drive unit from reaching the last few degrees of full trim under. While this device should reduce the rolling tendency, it may not eliminate the tendency entirely. The use of a trim-in limiter, and the evaluation of its effectiveness, can only be determined by trial and error adjustments and is ultimately the responsibility of the boat manufacturer.

## Section 12

# PROPELLERS

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Propeller and Propeller Accessory Parts Diagrams .....	12-4
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Removing Propellers .....	12-10

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## SAFETY PRECAUTIONS

Before servicing the stern drive, review *Safety on page 2-1*.

## INTRODUCTION

This section of the *Service Manual* describes the procedures necessary to remove and install the propellers.

## PROPELLER SELECTION

The propeller converts the engine's power into the thrust needed to propel the vessel. Careful selection of your propeller is very important to proper vessel operation. Propellers are identified by two numbers, such as 15.75 × 20 left-hand and stainless steel propeller. In the number sequence, the first number is the diameter of the propeller and the second is the pitch. Left-hand is counterclockwise rotation for front propeller. Right-hand is clockwise rotation for rear propeller.

Pitch is the angle of the blades expressed in the theoretical distance a propeller travels in each revolution. If for example the pitch is 20, each revolution of the propeller pushes the vessel 20 in. (508 mm) through the water. A 28 pitch is considered "higher" pitched and a 20 pitch propeller is considered "lower" pitched. A smaller pitch propeller should be selected for water skiing or for heavy loads.

Keep these guidelines in mind when selecting a propeller:

### NOTICE

Never attempt to change propellers until after determining the average load and individual requirements.

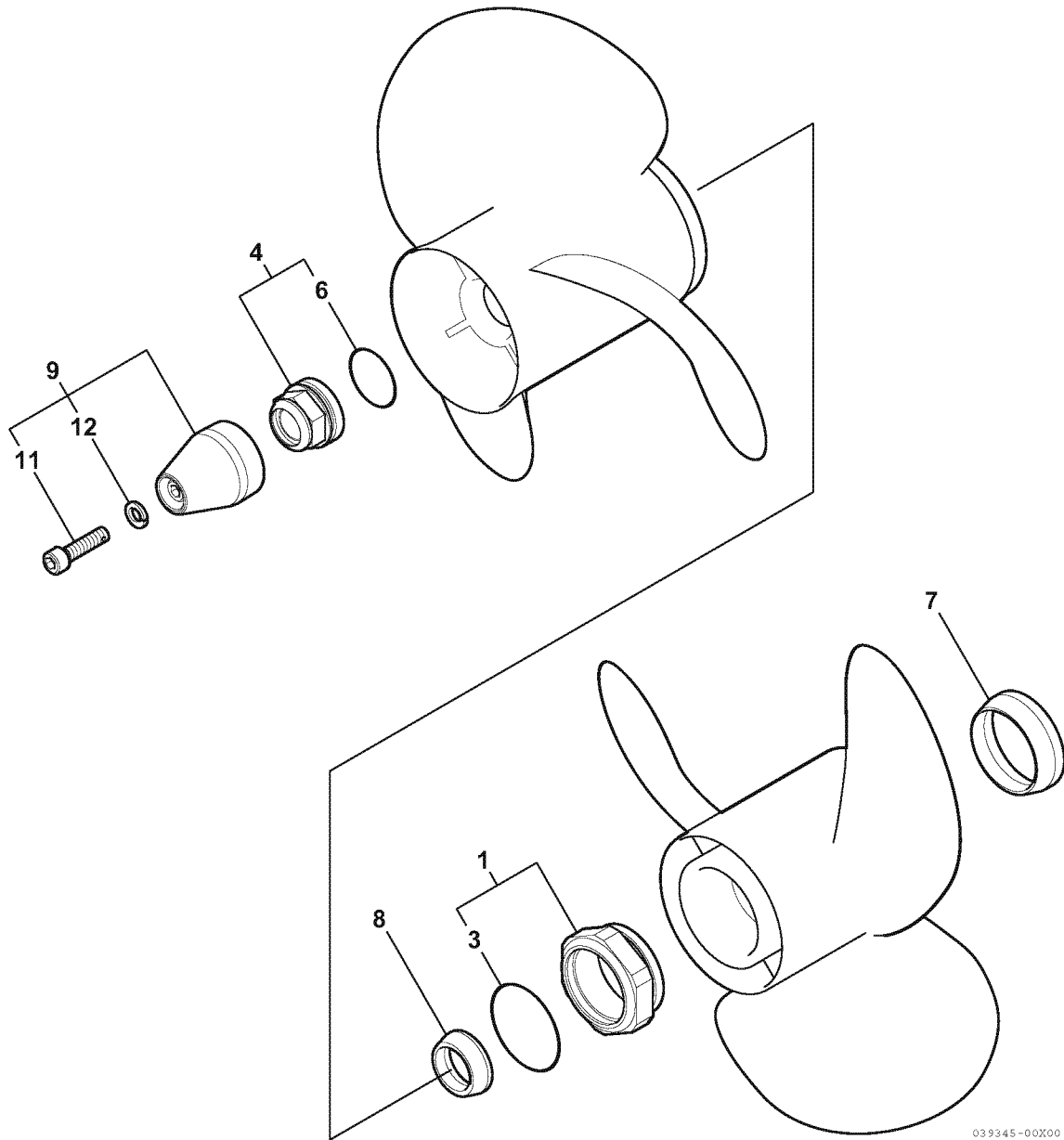
Engine rpm must be within the recommended operating range.

Problems associated with propellers include ventilation, cavitation and blow-out.

# PROPELLERS

## Propeller and Propeller Accessory Parts Diagrams

### ■ Propeller and Propeller Accessories



039345-00X00

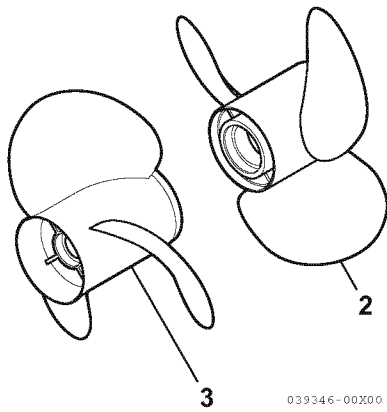
**Figure 12-1**

Item	Part Number	Description	Quantity
1	196350-09000	Prop Nut Front CMP	1
3	24321-000600	O-Ring G-60	1
4	196350-09020	Prop Nut Rear CMP	1
6	24321-000400	O-Ring G-40	1
7	196350-09050	Thrust Hub Front	1

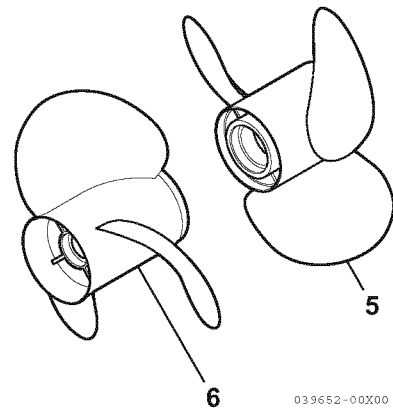
Item	Part Number	Description	Quantity
8	196350-09060	Thrust Hub Rear	1
9	196350-09900	Anode	1
11	196350-09920	Bolt M10 x 40	1
12	22213-100000	Spring Washer 10	1



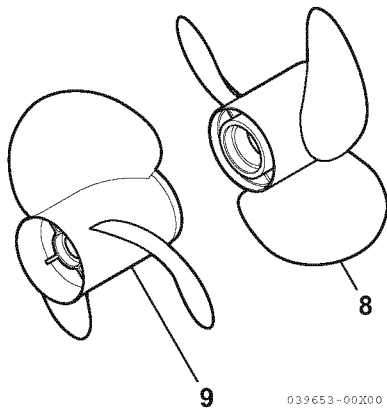
Propeller pitch 20 inch



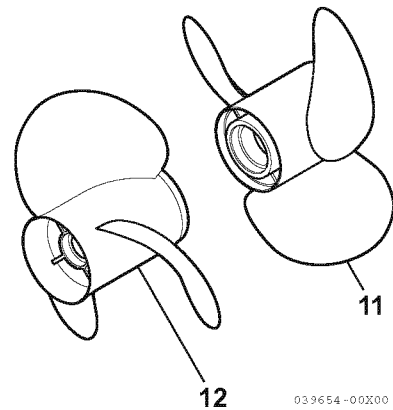
Propeller pitch 22 inch



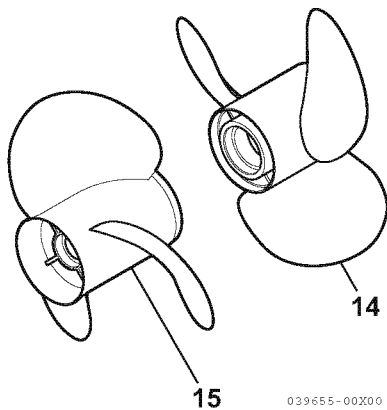
Propeller pitch 24 inch



Propeller pitch 26 inch



Propeller pitch 28 inch



Item	Part Number	Description	Quantity
2	196350-09400	Prop 20 LH	1
3	196350-09700	Prop 20 RH	1
5	196350-09420	Prop 22 LH	1
6	196350-09720	Prop 22 RH	1
8	196350-09440	Prop 24 LH	1

Item	Part Number	Description	Quantity
9	196350-09740	Prop 24 RH	1
11	196350-09460	Prop 26 LH	1
12	196350-09760	Prop 26 RH	1
14	196350-09480	Prop 28 LH	1
15	196350-09780	Prop 28 RH	1

# PROPELLERS

## PROPELLER INSTALLATION

### **⚠ WARNING**

#### **SUDDEN MOVEMENT HAZARD**

To prevent accidental startup, complete the following before installing or removing the propeller:

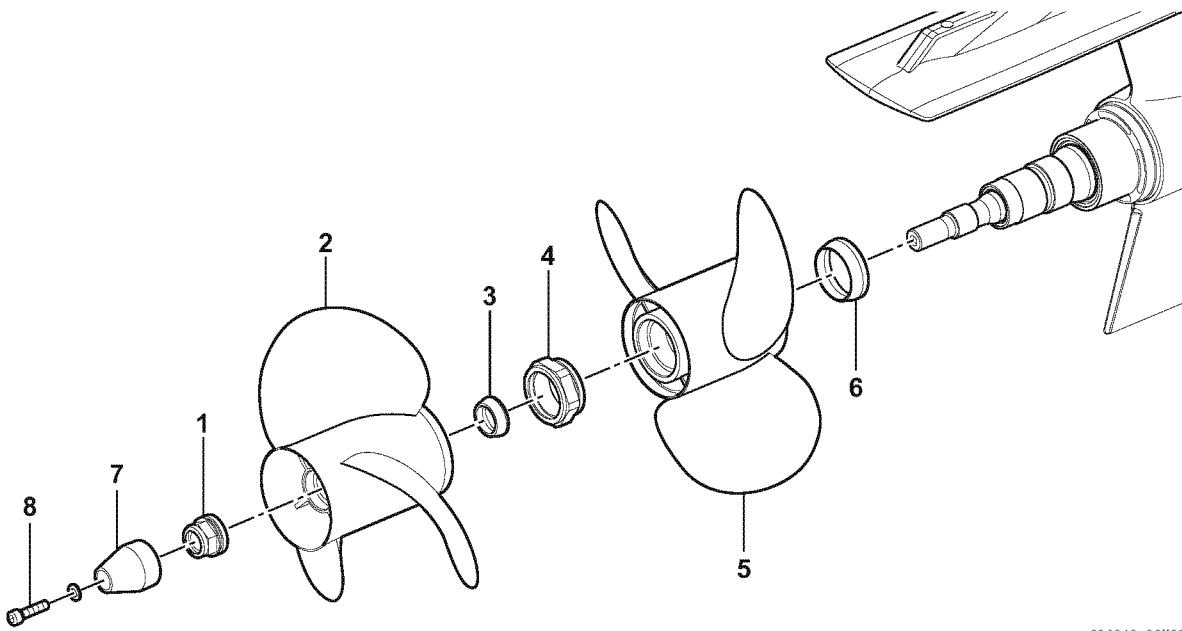
- Position the remote control in the **NEUTRAL** position.
- Position the main battery switch to the **OFF** position and remove the ignition key.

### **⚠ WARNING**

#### **SEVER HAZARD**

Never use your hand to hold the propeller when loosening the nut. Put a wood block between the antiventilation plate and the propeller blade to prevent the propeller from turning.

When installing or removing the propeller nut, place a block of wood as shown in **Figure 12-4** to prevent the propeller from turning. Use special tool, as shown in **Figure 12-3**.



039040-00X00

- 1 - Rear Propeller Nut
- 2 - Rear Propeller
- 3 - Rear Propeller Thrust Hub
- 4 - Front Propeller Nut

- 5 - Front Propeller
- 6 - Front Propeller Thrust Hub
- 7 - Propeller Shaft Anode
- 8 - Propeller Shaft Anode Bolt and Washer

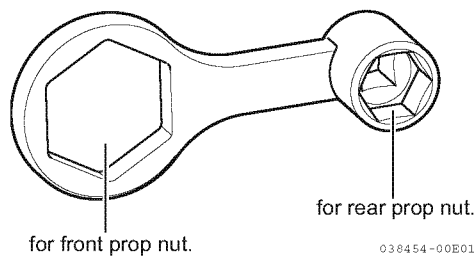
**Figure 12-2**

1. Apply a liberal coat of lubricant to the propeller shaft. Recommended lubricants are shown in the table below.

Description	Where Used
Urea Grease Water Resistant Type, NLGI #2	Propeller Shaft
Lithium Grease with PTFE	

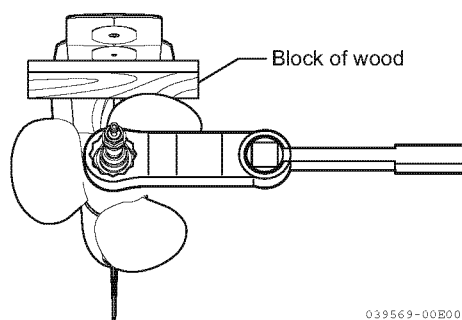
2. Slide the forward thrust hub onto the propeller shaft with the tapered side toward the propeller hub (toward end of propeller shaft).
3. Align the splines and place the propeller on the propeller shaft.
4. Using a block of wood (**Figure 12-4**) to hold the propeller, install and torque the front propeller nut, using special tool as shown in **Figure 12-3**. Check the propeller nut torque at least every 20 hours. See **Figure 12-5** for additional information.

**TOOL: 196350-92180**



**Figure 12-3**

Front Propeller Nut Torque	
N·m	lb-ft
135	99



**Figure 12-4**

5. Slide the aft thrust hub onto the propeller shaft, with the tapered side toward the propeller hub (toward end of shaft).

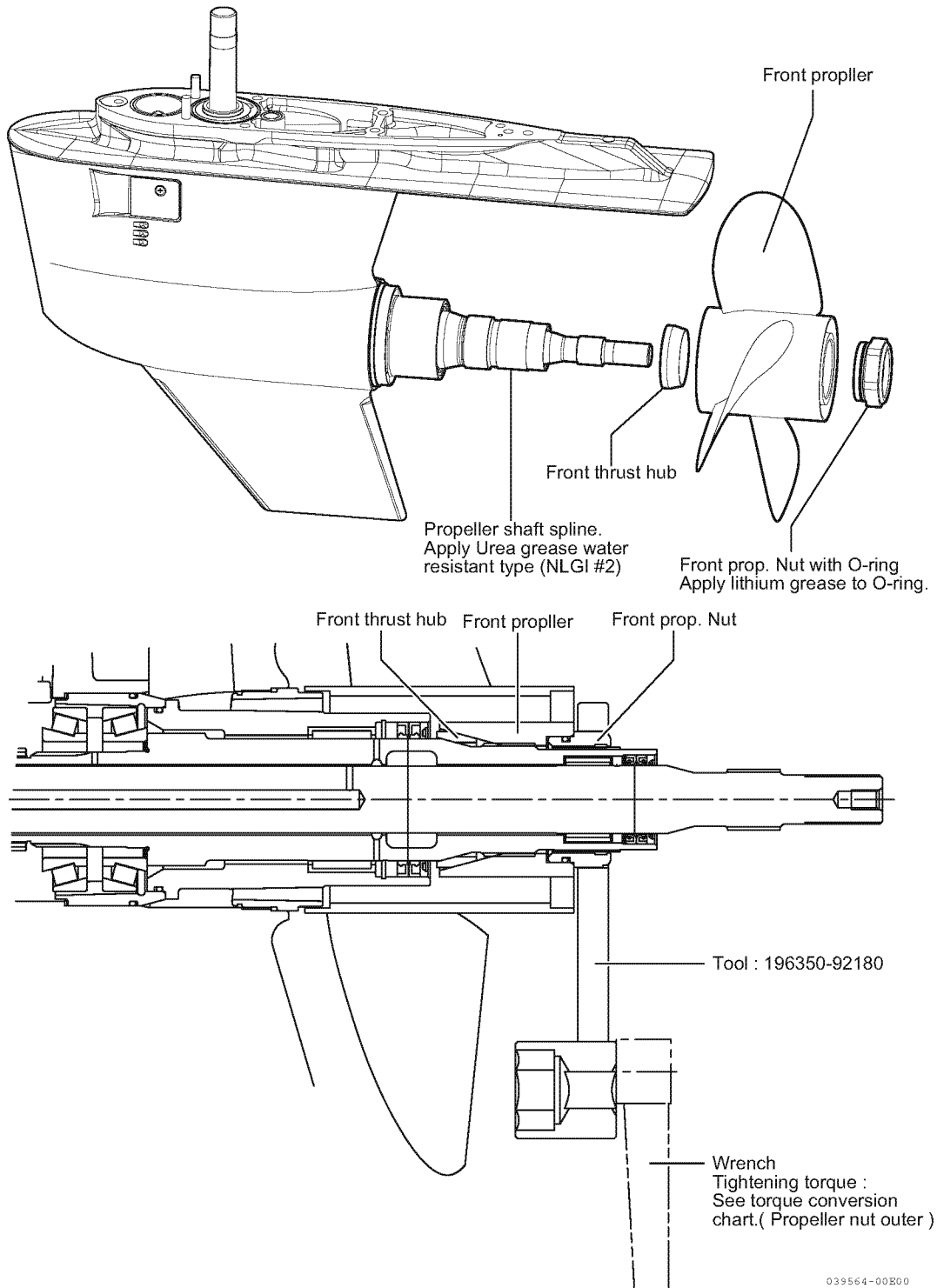
6. Align the splines and place the propeller on the propeller shaft.
7. Install and torque the rear propeller nut, using special tool as shown in **Figure 12-3**. Check the propeller nut torque at least every 20 hours. See **Figure 12-6** for additional information.

Rear Propeller Nut Torque	
N·m	lb-ft
80	59

8. Install the propeller shaft anode bolt with a washer. Torque the bolt.

Propeller Shaft Anode Bolt Torque	
N·m	lb-ft
30	22

## Front Propeller Installation



**Figure 12-5**

Rear Propeller Installation

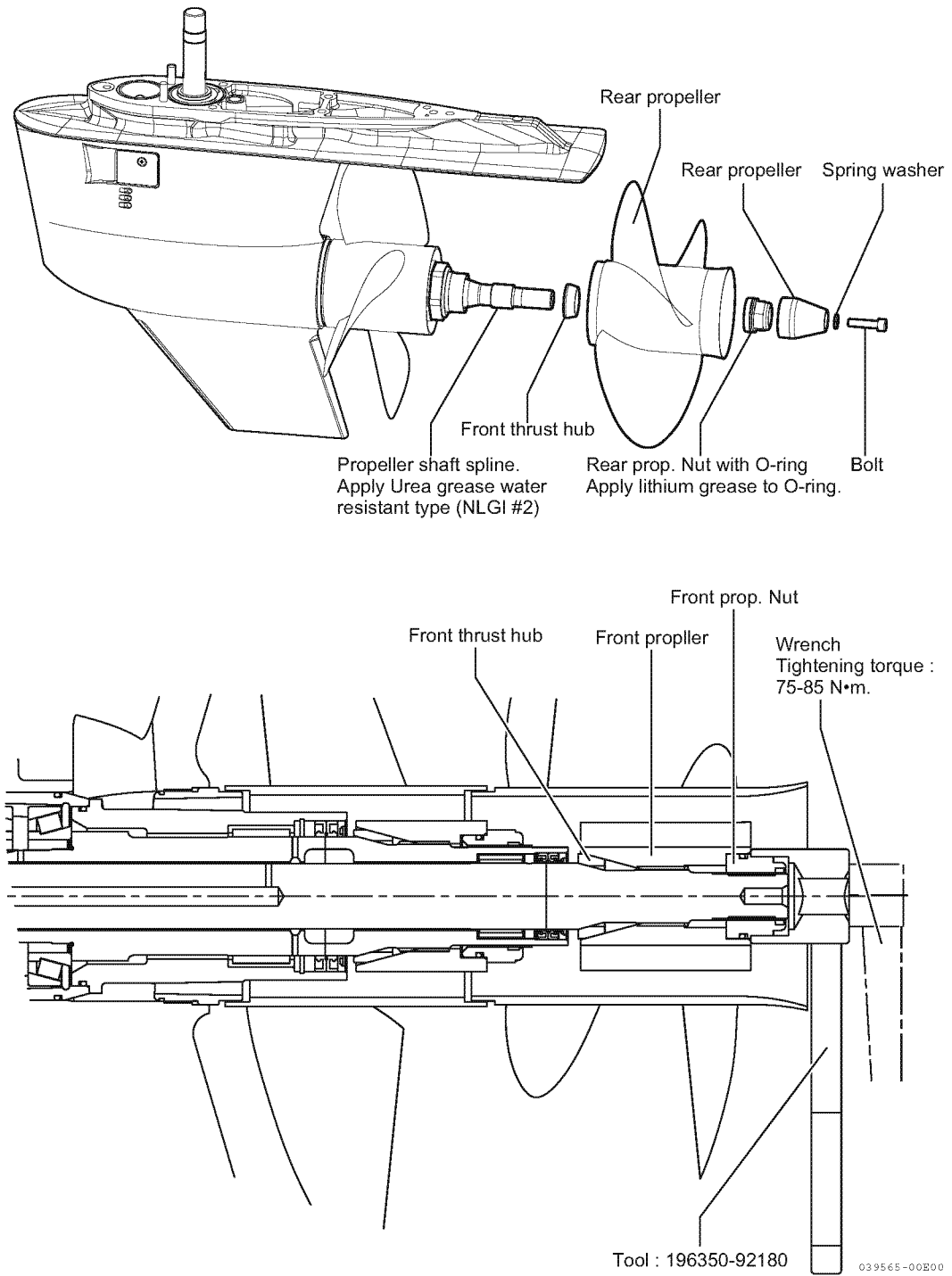


Figure 12-6

## REMOVING PROPELLERS

### WARNING

#### **SUDDEN MOVEMENT HAZARD**

To prevent accidental startup, complete the following before installing or removing the propeller:

- Position the remote control in the **NEUTRAL** position.
- Position the main battery switch to the **OFF** position and remove the ignition key.

### WARNING

#### **SEVER HAZARD**

- Never use your hand to hold the propeller when loosening the nut. Put a wood block between the antiventilation plate and the propeller blade to prevent the propeller from turning.
- **Sever Hazard.** The remote control must be in **NEUTRAL** and the starter key removed from the switch before removing and/or installing the propeller.

1. Place a wood block (**Figure 12-4**) between the propeller blades and the antiventilation plate to prevent rotation.
2. Using special tool as shown in **Figure 12-3**, turn the rear propeller nut counterclockwise to remove the nut.
3. Slide the propeller and the thrust hub off the propeller shaft.
4. Using special tool as shown in **Figure 12-3**, turn the front propeller nut counterclockwise to remove the nut.
5. Slide the propeller and the thrust hub off the propeller shaft.

*Section 13*

# **CORROSION PROTECTION**

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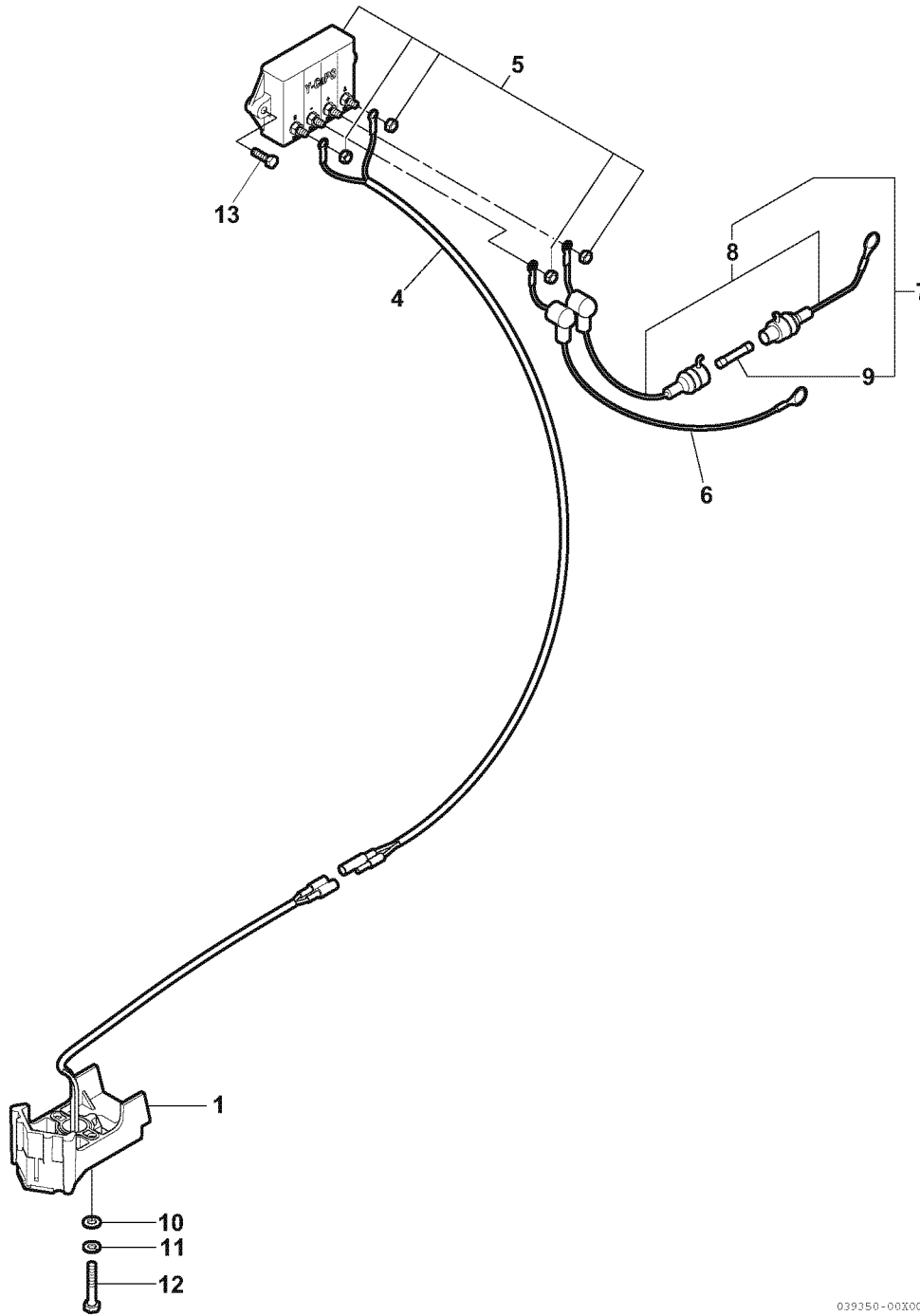
### **SAFETY PRECAUTIONS**

Before servicing the stern drive, review the *Safety Section on page 2-1*.

### **INTRODUCTION**

This section of the *Service Manual* describes the affects of corrosion and the corrosion protection systems used on the stern drive unit.

CORROSION CONTROL PARTS DIAGRAM



039350-00X00

Figure 13-1

Item	Part Number	Description	ZT350	ZT370	N/O
1	196350-01400	Electrode CMP	1	1	
4	196350-01410	Harness	1	1	
5	196350-01420	Controller	1	1	
6	196350-01430	Cable Black	1	1	
7	196350-01480	Cable-Fuse CMP	1	1	
8	196350-01440	Cable Red	1	1	

Item	Part Number	Description	ZT350	ZT370	N/O
9	196350-01450	Fuse 20 A	1	1	
10	22133-060000	Washer 6	2	2	
11	22213-060000	Spring Washer 6	2	2	
12	26113-060352	Bolt M6 × 35	2	2	
13	26116-050162	Bolt M5 × 16	2	2	

## **GALVANIC CORROSION**

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

### **NOTICE**

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

### **NOTICE**

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

## **CORROSION CONTROL**

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

To help control the effects of galvanic corrosion, Yanmar Marine ZT350/370 stern drives come with several anodes and an electronic anticorrosion system (Y-CaPS) that protect the stern drive in moderately corrosive conditions. However, it is essential that the owner/operator frequently monitor the anodes for wear, inspect the stern drive for corrosion and replace the anodes often enough to provide a sacrificial surface for the electrical current to attack. Galvanic isolators are also available from the aftermarket (not supplied by Yanmar) to block stray current while still providing a path to ground for dangerous shock currents.

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

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

If anodes erode quickly or if signs of corrosion are evident, the owner should take immediate corrective action. Yanmar recommends consulting an engineer specializing in marine electricity and corrosion control to determine the best way to correct the rapid erosion of the anodes.

## **SHORE POWER**

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

### **NOTICE**

If the AC shore power ground is not isolated from the boat ground, the Y-CaPS and anodes may be unable to neutralize the increased galvanic potential. Corrosion damage that results from the improper system design or application is not covered by the Yanmar Limited Warranty.

## **UNDERWATER DRIVE COATING**

The lower gear housing coating may be damaged when hit by objects in the water, or when having deposits removed from it. The underwater coating must be inspected at least once per year and when it is believed that an object was hit that may have caused damage. Repair and repaint damaged areas immediately.

Observe the following precautions when applying antifouling or marine paint to the transom of the boat hull:

## CORROSION PROTECTION

- Always follow the paint/coating manufacturer's directions for surface preparation and application.
- Always use a high quality primer and topcoat paint specifically designed for aluminum outboards or stern drives.
- Never paint the anodes installed on the stern drive.
- Never paint the Y-CaPS reference electrode and/or anode.
- Never wash the stern drive with a high-pressure washer. This could damage the coating on the reference wire.
- Never paint the stern drive with a material that contains copper or tin.
- Never paint over drain holes, anodes, Y-CaPS or other items specified by the anode manufacturer.

### NOTICE

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

## ADDITIONAL PROTECTION

In addition to the corrosion protection devices, take these steps to inhibit corrosion:

### NOTICE

Avoid damaging the stern drive paint. Paint coverage provides corrosion protection. Always repair damaged paint areas immediately to avoid further paint damage and metal corrosion. Use a high-quality primer and topcoat paint specifically designed for aluminum outboards or stern drives. Follow the manufacturer's directions for surface preparation and application.

1. Paint the stern drive.
2. Spray stern drive components on the inside of the vessel annually with Corrosion Guard to protect the finish from dulling and corrosion. External stern drive components may also be sprayed.
3. Keep all lubrication points, especially the steering system, shift and throttle linkages, well-lubricated.

4. Flush the coolant system periodically, preferably after each use.

### NOTICE

Replace anodes if eroded 50 percent or more.

### NOTICE

Anytime the boat is left in the water and the engine is not running, the drive must be left in the fully down position. This will keep the anodes in the water and will keep the exhaust pipe engaged with the exhaust port of the drive.

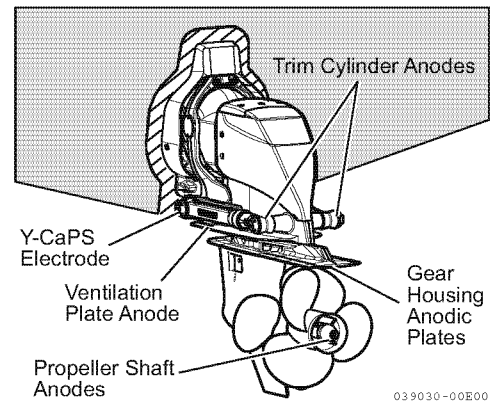
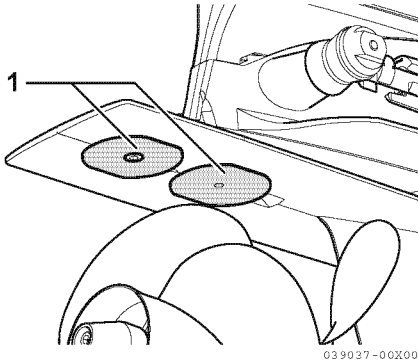


Figure 13-2

## GEAR HOUSING ANODIC PLATES

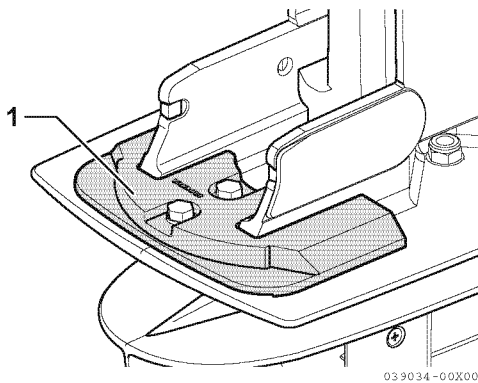
The gear housing anodic plates (1, **Figure 13-3**) are installed on the underside of the antiventilation plate.



**Figure 13-3**

## VENTILATION PLATE ANODE

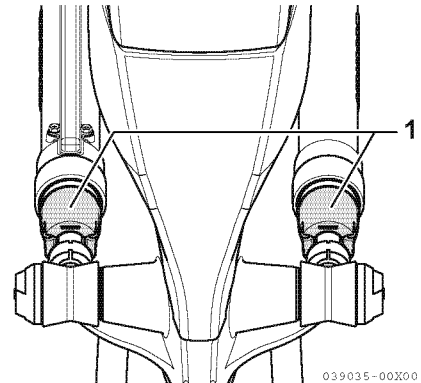
The ventilation plate anode (1, **Figure 13-4**) is installed on the front of the driveshaft housing on top of the ventilation plate.



**Figure 13-4**

## TRIM CYLINDER ANODES

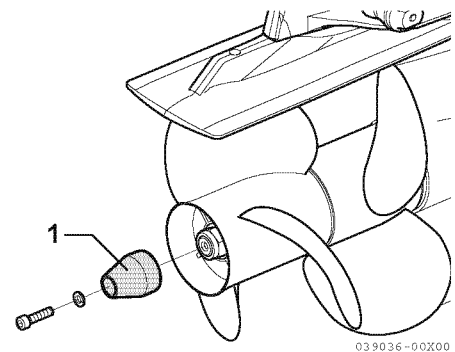
The trim cylinder anodes (1, **Figure 13-5**) are installed on each trim cylinder.



**Figure 13-5**

## PROPELLER SHAFT ANODE

The propeller shaft anode (1, **Figure 13-6**) is located behind the aft propeller.



**Figure 13-6**

## YANMAR CATHODIC PROTECTION SYSTEM

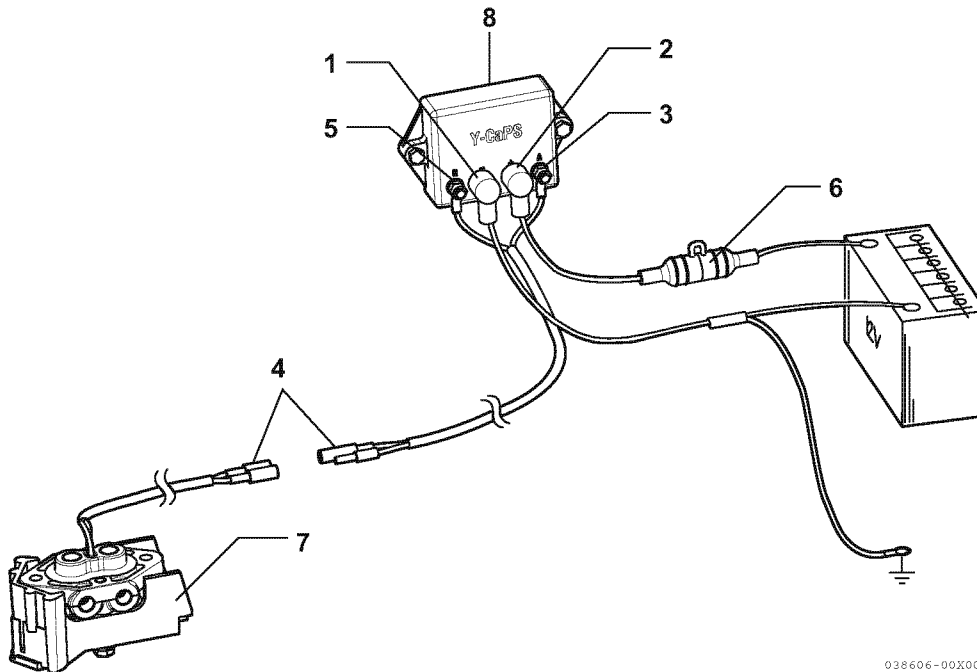
The Yanmar Cathodic Protection System (Y-CaPS) has a 20A in-line fuse (6, **Figure 13-7**) in the wire which connects to the positive (+) terminal on the controller. If the fuse blows, the system will not operate resulting in a loss of corrosion protection.

Test Y-CaPS to ensure adequate output. The test should be performed where the vessel is moored, using a reference electrode and test meter.

### NOTICE

The opposite end of the RED wire and BLACK wire must be connected directly to the battery terminals. Never connect them to a switched circuit. The Y-CaPS system must function continuously to provide proper corrosion protection.

Apply a thin coat of sealant (Liquid Type Neoprene or Silicon Sealant) to all wire connections. Obtain sealant locally.



- 1 - BLACK Wire - From the engine harness, if equipped, or to the negative (-) battery terminal.
- 2 - RED Wire - To the positive (+) battery terminal.
- 3 - YELLOW Lead - From the anode on the transom assembly.
- 4 - Y-CaPS Electrode Connector

- 5 - BROWN Wire - From the electrode on the transom assembly.
- 6 - 20A In-Line Fuse Holder
- 7 - Electrode
- 8 - Y-CaPS Controller

**Figure 13-7**

## CORROSION TROUBLESHOOTING

## Corrosion on Underwater Parts

	Cause		Remedy
1	Sacrificial anode(s) consumed.	1	Replace anode(s) when 2/3 consumed.
2	Sacrificial anode(s) not grounded to drive.	2	Remove anode(s), clean contact surface, reinstall, check continuity.
3	Loss of continuity between underwater parts and ground.	3	Provide good ground connections.
4	Paint on drive heavily abraded (exposed metal).	4	Prime and repaint.
5	Sacrificial anode(s) painted.	5	Remove paint or replace anode(s).
6	Corrosion in area of exhaust outlets (exhaust deposits can cause corrosion).	6	Remove deposits with marine or auto wax.
7	Corrosion occurring after unit removed from saltwater.	7	Wash exterior and flush interior with fresh water.
8	Poor connection between reference electrode (brown) lead or anode (yellow) lead and Y-CaPS controller.	8	Clean and/or tighten connection. Repair wiring.
9	Faulty Y-CaPS reference electrode.	9	Disconnect reference electrode lead (brown) from the controller "R" terminal. Connect the lead to positive (+) terminal of a volt meter (set on 0–2000 milli-volt scale). Connect negative (–) meter lead to negative (–) battery terminal. Note meter reading; then repeat the test with a test silver/silver chloride reference electrode held behind the drive. The same reading should be obtained in both cases. If not, replace the reference electrode.
10	Faulty Y-CaPS controller.	10	With anode and reference electrode leads connected to controller, connect a jumper wire between "R" and "–" terminals on controller. Connect positive (+) lead of volt meter (set on 0-20 scale) to "A" terminal on controller. Connect the negative (–) meter lead to the negative (–) controller terminal. Reading should be as follows: Freshwater Areas = 11.8 milli-volts Seawater Areas = 11.8 milli-volts If the reading is low, replace the controller.
11	Too much cathode (such as stainless steel).	11	Y-CaPS system overpowered by large quantity of stainless steel below the water line.
12	Y-CaPS reference electrode or anode painted.	12	Remove paint or replace anode or Y-CaPS reference electrode.
13	No power to Y-CaPS controller.	13	Connect positive (+) lead of volt meter (set on 0-20 volt scale) to positive (+) terminal on the controller and negative (–) volt meter lead to negative (–) terminal. Meter should indicate battery voltage. Clean the connection or repair wiring as required.

# CORROSION PROTECTION

## Corrosion Troubleshooting Procedure

1. Unplug shore power (if equipped).
2. Measure hull potential with silver/silver chloride reference electrode and digital volt/ohm meter.

### Readings

	Potential	Diagnosis
<b>Salt Water</b>	Below 850 milli-volts	Drive is corroding. <i>See Corrosion Troubleshooting on page 13-9.</i>
	Between 850 - 1100 millivolts	Drive is protected.
	Above 1100 milli-volts	Drive is overprotected. <i>See Corrosion Troubleshooting on page 13-9.</i>

	Potential	Diagnosis
<b>Freshwater</b>	Below 750 milli-volts	Drive is corroding. <i>See Corrosion Troubleshooting on page 13-9.</i>
	Between 750 - 1050 milli-volts	Drive is protected.
	Above 1050 milli-volts	Drive is overprotected. <i>See Corrosion Troubleshooting on page 13-9.</i>

### Corrosion Symptoms

- Paint blistering (usually on sharp edges)
- Loosely adhering white corrosion products on exposed aluminum surfaces (do not confuse these with tightly clinging calcium carbonate deposits)
- Aluminum pitting



*Section 14*

# **TROUBLESHOOTING AND TESTING**

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### SAFETY PRECAUTIONS

Before servicing the stern drive, review the *Safety Section on page 2-1*.

### INTRODUCTION

This section is a guide for performance and product troubleshooting and testing. Referrals to specific sections of this manual are made where special tests or repair procedures are to be performed.

Because of the relationship between power package components (engine and stern drive), it will be necessary, in some cases, to simultaneously refer to the appropriate Engine Service Manual for further troubleshooting information.

Effective troubleshooting is best enhanced by:

- Personal product knowledge and experience of the trained mechanic/technician.
- Allowing adequate time for testing and analysis.
- Utilizing these charts as a guide or starting point.

## TROUBLESHOOTING AND TESTING

### STERN DRIVE UNIT TROUBLESHOOTING

Stern drive unit will not slide into bell housing.

	Cause		Remedy
1	Engine not aligned.	1	Check engine alignment.
2	Gimbal bearing not properly installed.	2	Check engine alignment to determine if gimbal bearing is cocked, or improperly installed in gimbal housing.
3	Damaged universal joint shaft splines and/or engine coupler splines.	3	Inspect and replace if necessary.

Drive unit (mechanical shift type) does not shift into gear; remote control shift handle does not move.

	Cause		Remedy
1	Control box not properly assembled.	1	Properly reassemble control box.
2	Broken or damaged linkage in control box.	2	Repair linkage.
3	Controls improperly adjusted-cable end guide hitting brass barrel.	3	Adjust shift cables.

Drive unit (mechanical shift type) does not shift into gear (both forward and reverse direction); remote control shift handle moves.

	Cause		Remedy
1	Shift cables improperly adjusted.	1	Adjust shift cables.
2	Shift cables not connected.	2	Install and adjust shift cables.
3	Inner core wire broken or loose.	3	Reconnect or replace inner core wire.
4	Oil pump is damaged.	4	Replace the case plate assembly. Replace clutch shaft as necessary.
5	Contaminated oil.	5	Flush oil filter and case plate assembly with clean oil. Replace the case plate assembly if necessary.

Drive unit (mechanical shift type) does not shift into gear (forward or reverse direction) or shift into gear (another direction); remote control shift handle moves.

	Cause		Remedy
1	Shift cable broken.	1	Replace cable and adjust.
2	Shift cables improperly adjusted.	2	Adjust shift cables.
3	Cable end not connected in drive unit.	3	Remove and reinstall drive unit.
4	Remote control damaged.	4	Repair or replace remote control.
5	Internal shift mechanism in case plate assembly damaged.	5	Replace case plate assembly.
6	Friction plate(s) and/or steel plate(s) in clutch assembly are damaged.	6	Replace the friction plate(s) and/or steel plate(s). Replace clutch assembly if necessary.

## Drive unit (mechanical shift type) shifts hard.

	Cause		Remedy
1	Shift cables improperly adjusted.	1	Adjusted shift cables.
2	Damaged remote control or drive unit shift cable.	2	Replace cable(s) and adjust.
3	Shift cable too short (sharp bends) or too long (loops and long bends).	3	Select and install proper length cable.
4	Corroded shift cables.	4	Replace, adjust and check for water leakage.
5	Internal wear in remote control box.	5	Repair as needed.
6	Shift cable attaching nuts too tight (end cannot pivot).	6	Properly install nuts.
7	Shift cable pivot ends are corroded, or not lubricated.	7	Clean and lubricate.

## Drive unit (electric shift type) does not shift into gear (forward and reverse direction).

	Cause		Remedy
1	Cable loose, corroded or damaged.	1	Check cable. Replace cable as necessary.
2	Faulty solenoid.	2	Replace.
3	Oil pump is damaged.	3	Replace the case plate assembly. Replace clutch shaft as necessary.
4	Contaminated oil.	4	Flush oil filter and case plate assembly with clean oil. Replace the case plate assembly if necessary.

## Drive unit (electric shift type) does not shift into gear (forward or reverse direction) or shift into gear (another direction).

	Cause		Remedy
1	Cable loose, corroded or damaged.	1	Check cable. Replace cable as necessary.
2	Faulty solenoid.	2	Replace.
3	Internal shift mechanism in case plate assembly damaged.	3	Replace case plate assembly.
4	Friction plate(s) and/or steel plate(s) in clutch assembly are damaged.	4	Replace the friction plate(s) and/or steel plate(s). Replace clutch assembly if necessary.

## Gear Housing Noise

	Cause		Remedy
1	Metal particles in drive unit lubricant.	1	Disassemble, clean and inspect, and replace necessary components.
2	Propeller incorrectly installed.	2	Inspect mounting hardware. Install propeller correctly.
3	Propeller shaft bent.	3	Inspect and replace if necessary.
4	Incorrect gear shimming.	4	Check gear housing backlash and pinion gear height.
5	Worn or damaged gears and/or bearings caused by impact, overheating or improper shimming.	5	Disassemble, inspect, replace.

# TROUBLESHOOTING AND TESTING

## Driveshaft Housing Noise

	Cause		Remedy
1	Steering lever contacting transom cutout opening in turns.	1	Modify transom cutout.
2	Engine flywheel housing contacting inner transom plate or exhaust pipe.	2	Determine cause for interference (loose engine mounts, transom too thin, etc.) and correct as necessary.
3	Propeller with untrue or out-of-balance blades.	3	Repair or replace, as required.
4	Abnormal stern drive operation.	4	Instruct operator on proper operating technique.
5	Excessive side-to-side play in universal joint cross and bearing assemblies.	5	Replace universal joint.
6	Universal joint cross and bearing rough.	6	Replace universal joint.
7	O-rings missing or flattened out on universal joint shaft causing shaft to rattle against ID of gimbal bearing.	7	Install new O-rings.
8	Worn universal joint splines and/or engine coupler splines.	8	Remove universal joint coupling end yoke and insert into gimbal bearing and engine coupling. Rotate shaft back-and-forth. If play is excessive, replace universal joint and/or engine coupler, as necessary.
9	Engine alignment incorrect or engine coupler cocked.	9	Adjust alignment, making sure that alignment tool moves in-and-out of coupler freely. After proper alignment has been obtained, check for a cocked coupler by rotating engine coupler 1/2 turn and rechecking alignment. If proper alignment is no longer observed, coupler is cocked and must be replaced.
10	Gimbal bearing rough.	10	Replace gimbal bearing. NOTICE: Gimbal bearing and carrier must be replaced as an assembly as they are a matched set. Failure to do this may result in a loose bearing fit in carrier.
11	Loose gimbal bearing.	11	Reinstall bearing using a new tolerance, if carrier is loose in gimbal housing. If bearing is loose in carrier, bearing assembly must be replaced.
12	Gimbal bearing not fully seated in gimbal housing. Yoke moves back-and-forth in turns and may hammer against bearing if not fully seated.	12	Drive bearing assembly into place.
13	Excessive clearance between gimbal ring and gimbal housing. This could cause misalignment also may allow gimbal ring to vibrate up-and-down, in turns.	13	Check and adjust clearance.
14	Improperly installed or failed rear engine mounts. This will affect engine alignment, but usually is not detectable with engine alignment tool.	14	Check for uneven mount height, or loose or soft mounts. Make sure there is clearance between flywheel housing and fiber washer. If no clearance exist, mounts have probably sagged. Install mounts correctly or replace, as necessary.
15	Boat transom too thin. Thickness: 51 mm (2 in.) minimum 57 mm (2-1/4 in.) maximum	15	Add thickness to transom.

## TROUBLESHOOTING AND TESTING

	Cause		Remedy
16	Boat transom thickness uneven. This could affect engine to transom assembly alignment and is usually not detectable with alignment tool. Variation: 3 mm (1/8 in.) maximum	16	Repair boat as necessary.
17	Bell housing contacting gimbal ring. This would cause knocking in the fully trimmed "IN" position only.	17	Check for soft or split trim cylinder bushings, and loose or worn hinge pin bushings.
18	Stringer height uneven or transom assembly installed cocked on boat transom. This will affect engine alignment, but is usually not detectable with alignment tool.	18	Measure the distance between the engine flywheel housing and the inner transom plate on both sides. If distances are uneven, the problem may be due to uneven stringer height or a cocked transom assembly. Adjust the stringer height or relocate the transom cutout as required.
19	Weak boat transom or boat bottom that flexes under power and causes engine misalignment. This condition will usually cause engine coupler failure.	19	This condition can sometimes be detected by having someone apply force to the top of the drive unit while watching the inner transom plate. If movement can be observed, the transom is weak and must be repaired.
20	Rear engine mount attaching hardware improperly installed or missing.	20	Reinstall hardware correctly.
21	Engine mounting holes drilled off-center in inner transom plate engine supports or engine flywheel housing.	21	Make sure the holes are equally spaced fore and aft, and are equal distance from the centerline.

# TROUBLESHOOTING AND TESTING

## PERFORMANCE TROUBLESHOOTING

### Low Full-Throttle Engine rpm

	Cause		Remedy
1	Improper drive unit trim angle.	1	Properly adjust drive unit trim angle.
2	Damaged propeller.	2	Repair or replace.
3	Improper propeller pitch.	3	Water test boat using a lower pitch propeller.
4	Dirty or damaged boat bottom.	4	Clean and/or resurface boat bottom.
5	Drive installation too low on transom.	5	Contact boat manufacturer for installation specifications.
6	Permanent "hook" in boat bottom (some boats are built with a slight "hook" for correct boat performance).	6	Check for a "hook" in the boat bottom by placing a straight edge, at least 2 m (6 ft) long, under the bottom edge of the transom. If a "hook" is found, contact the boat manufacturer.
7	"Power hook" or weak boat bottom.	7	Water test boat. Boat will perform normally until hook develops at high speed; then loss of rpm and speed will occur. Contact boat manufacturer.

### High Full-Throttle Engine rpm

	Cause		Remedy
1	Propeller ventilating.	1	Determine cause for ventilation.
2	Improper propeller pitch.	2	Water test boat using a higher pitch propeller.
3	Propeller hub slipping.	3	Replace hub or replace propeller.
4	Drive installation too high on transom.	4	Contact boat manufacturer for installation specifications.
5	Engine coupler hub slipping.	5	Replace hub.

### Propeller Ventilating/Cavitating

	Cause		Remedy
1	Drive unit trimmed too high.	1	Trim drive unit "In" / "Down".
2	Incorrect propeller.	2	Install correct propeller.
3	Propeller hub slipping.	3	Replace hub.

### Poor Boat Performance and/or Poor Maneuverability - Bow too Low

	Cause		Remedy
1	Improper drive unit trim angle.	1	Properly adjust drive unit trim angle.
2	Boat is bow heavy.	2	Redistribute boat load to stern. If bow overweight is caused by permanently installed fuel tank(s), etc., contact the boat manufacturer.
3	Boat is underpowered.	3	Check horsepower to weight ratio. Contact the boat manufacturer.
4	Permanent "hook" in boat bottom (some boats are built with a slight "hook" for correct boat performance).	4	Check for a "hook" in the boat bottom a placing a straight edge, at least 2 m (6 ft) long, under the bottom edge of the transom. If a "hook" is found, contact the boat manufacturer.
5	Power hook or weak boat bottom.	5	Water test boat. Boat will perform normally until hook develops at high speed; then loss of rpm and speed will occur. Contact boat manufacturer.



## Poor Boat Performance and/or Poor Maneuverability - Bow too High

	Cause		Remedy
1	Improper drive unit trim angle.	1	Properly adjust drive unit trim angle.
2	Boat is stern heavy.	2	Redistribute boat load to bow. If stern overweight is caused by permanently installed fuel tank(s), etc., contact the boat manufacturer.
3	Propeller pitch too high.	3	Water test the boat using a lower pitch propeller.
4	Permanent "rocker" in boat bottom (some boats are built with a slight "rocker" for correct boat performance).	4	Check for a "rocker" in the boat bottom a placing a straight edge, at least 2 m (6 ft) long, under the bottom edge of the transom. If a "rocker" is found, contact the boat manufacturer.
5	Power hook or weak boat bottom.	5	Water test boat. Boat will perform normally until hook develops at high speed; then loss of rpm and speed will occur. Contact boat manufacturer.

## POWER STEERING TROUBLESHOOTING

### Hard Steering

	Cause		Remedy
1	Damaged steering cable.	1	Replace cable.
2	Steering cable too short (sharp bends) or too long (loops and long bends).	2	Select and install proper length cable.
3	Steering cable corroded or not lubricated.	3	Lubricate or replace the cable.
4	Low power steering pump fluid level.	4	Check fluid level.
5	Air in system.	5	Locate source of air in lines or fittings and repair.
6	Fluid leak.	6	Locate and correct source of leak.
7	Loose hose connections.	7	Tighten hose connections.

## TROUBLESHOOTING AND TESTING

### POWER TRIM SYSTEM TROUBLESHOOTING

Power trim pump motor will not run.

	Cause		Remedy
1	Power trim pump battery cables or wiring harness connections corroded or loose.	1	Clean and/or tighten connections.
2	Pump motor brushes stuck, corroded or worn out.	2	Replace motor assembly.
3	Water or oil in motor.	3	Replace motor assembly.

Power trim pump motor runs in the “Up” or ”Down” direction, but not in the another direction.

	Cause		Remedy
1	Loose or dirty solenoid connections.	1	Check connections and clean and/or tighten.
2	Solenoid faulty.	2	Replace trim pump assembly.

#### Power Trim Hydraulic System:

- Drive unit cannot be trimmed or trims slowly or with jerky movements.
- Drive unit will not stay in trimmed “Up” position.
- Drive unit cannot be lowered or lowers with jerky movements.

	Cause		Remedy
1	Power trim pump oil level low.	1	Check for cause of low oil level and correct. Add oil and bleed trim system.
2	Air in trim system.	2	Check for cause of entry and correct. Add oil to pump and bleed air from system.
3	Trim cylinder(s) binding.	3	Check for cause of binding (bent piston rod, scored cylinder, etc.). Repair or replace as necessary.
4	Gimbal housing-to-trim pump hydraulic hose pinched.	4	Replace hose.
5	Contaminated oil.	5	Flush system with clean oil, refill pump and bleed trim system.
6	Valve problem.	6	Replace the cylinder assembly.

## STERN DRIVE TESTING

### Test Preparations

#### **⚠ WARNING**

#### **LOSS OF CONTROL HAZARD**

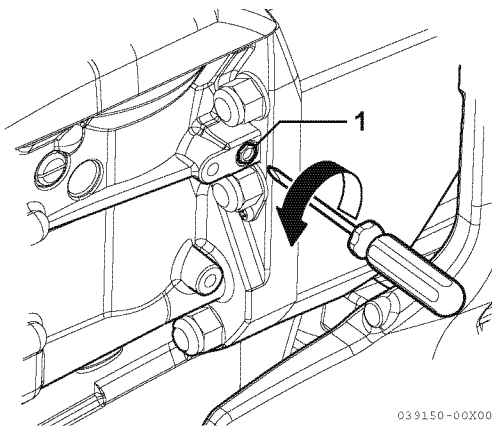
Never leave the helm unattended when performing tests with the boat in the water.

#### **NOTICE**

The oil valve screw (1, **Figure 14-1**) must be open during normal operation and before checking the stern drive oil level. Open the oil valve screw (approximately 2 turns).

#### **NOTICE**

If the oil valve screw nut turns when turning the oil valve screw, hold the nut with a wrench while turning the valve screw. Do not allow the valve screw nut to turn.



**Figure 14-1**

#### **NOTICE**

During operation, ensure that the engine seawater pump suction does not collapse the hose to the water source, causing the engine water supply to stop.

1. Ensure that there is a sufficient supply of coolant to the drive unit seawater inlet holes and/or the through-hull-seawater inlet holes.
2. Use the correct flushing attachment for the seawater pickup found on the drive unit.

#### **NOTICE**

If using a flush test device (attachment), install over the seawater intake holes and connect a water hose. Never use full water tap pressure. Also, avoid operating the engine above 1500 min<sup>-1</sup> (rpm), because the suction created could cause the water hose to collapse causing the water supply to be cut off.

3. Check all engine-related items as specified by the engine manufacturer. See the engine manufacturer's instructions.

#### **NOTICE**

The drive unit oil level in the oil reservoir will rise and fall during the drive unit operation. Always check the oil level in the reservoir when the drive unit is cool and when the engine is shut down.

4. Check the drive unit oil level in the oil reservoir.
5. Test the audio warning system, if equipped.

### Engine Operation Tests

#### **⚠ WARNING**

#### **SEVER HAZARD**

If engine is to be tested with the boat out of the water, the propeller must be removed to avoid injury.

#### **NOTICE**

Overheating from insufficient coolant will cause engine and drive unit damage. Ensure that there is sufficient water available at the water inlet holes during operation.

1. Ensure that the coolant system drain plugs and petcocks are installed and tight.
2. Ensure that the coolant system hoses are installed and clamped securely.

### Out-of-Water Testing

The following information is for engine operation tests with the boat out of the water:

#### **NOTICE**

On vessels with the drive unit seawater inlet blocked off at the gimbal housing and using a through-the-hull seawater inlet, a constant supply of coolant must be available for both the drive unit and the engine during operation.

## TROUBLESHOOTING AND TESTING

1. Install a flushing attachment over the drive unit and/or the alternate seawater inlet pickup holes.
2. Connect a hose between the flushing attachments and a water source.

### NOTICE

If using a flushing attachment (sometimes referred to as a flush test device) over the seawater inlet holes and a water hose as shown, Never use full water source pressure. Open the water source about 1/2 maximum. Never use full water pressure.

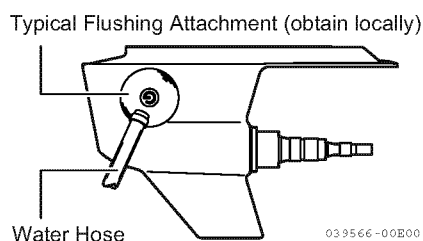


Figure 14-2

### In-Water Testing

The following information is for engine operation tests with the boat in the water.

### WARNING

#### LOSS OF CONTROL HAZARD

Never leave the helm unattended when testing the vessel in the water.

### NOTICE

The water level must be above the seawater inlet holes on the drive unit or the through-the-hull pickup.

1. On engines with a drive unit seawater inlet: The water level must be above the seawater inlet holes on the drive unit.

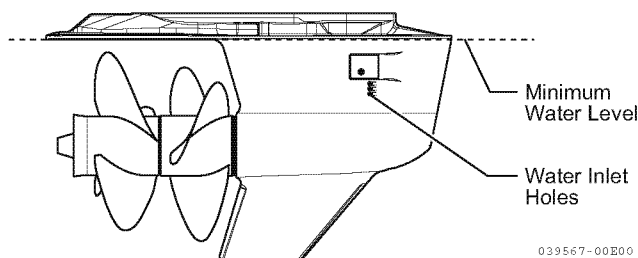


Figure 14-3

2. On engines with a through-the-hull seawater inlet: Ensure that the water level is above the seawater inlet holes on the through-the-hull seawater inlet.

### Wide Open Throttle Test

To test if the correct propeller has been installed, operate the boat with a full load onboard at wide open throttle (WOT) and check the rpm with an accurate tachometer. Engine rpm should be near top of the specified range so that engine speed will not fall below specifications under a heavy load. If the engine speed is too high, replace the propeller with a higher pitch propeller.

### Drive Unit Operational Tests

### WARNING

#### LOSS OF CONTROL HAZARD

Never leave the helm unattended when performing tests with the boat in the water.

### NOTICE

Instruments can warn of engine problems. Watch the temperature gauge on the dash to ensure that the engine does not overheat to avoid engine damage.

1. Start the engine.
2. Operate the engine at IDLE rpm until it reaches normal operating temperature.
3. Turn the steering wheel to starboard, then to port, and ensure that the drive unit turns the correct way.
4. Check the power steering system for a lugging condition (engine rpm drops and/or the power steering pump tone changes).
5. Turn the steering wheel to the left (port) until it stops and then continue to apply pressure. If the pump lugs, check the following:
  - Check for an obstruction between the gimbal ring and the gimbal housing, and all moving steering components.
  - Ensure that the steering lever is not contacting the cutout in the transom.
6. Turn the steering wheel to the right (starboard) until it stops and then continue to apply pressure. If the pump lugs, check the following:
  - Check for an obstruction between the gimbal ring and the gimbal housing, and all moving steering components.

- Ensure that the steering lever is not contacting the cutout in the transom.
7. Check steering cable end dimension with the cable FULLY EXTENDED. See *Steering Cable Specifications on page 10-5*.
  8. Turn the engine off.
  9. Lubricate the steering cable and clevis.

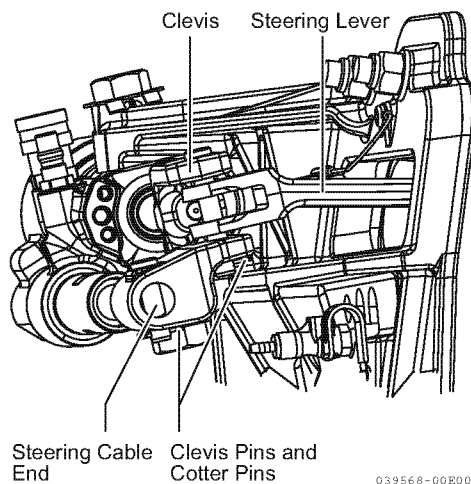
### NOTICE

Ensure that the cable end that enters the clevis is heavily lubricated.

and freeze damage to the engine and/or the drive unit.

### NOTICE

The drive unit should be stored in the FULL DOWN/IN position. The U-joint bellows may develop a set if the drive unit is stored in the raised position and may fail when the drive unit is returned to service.



**Figure 14-4**

<b>UREA Grease Water Resistant Type NLGI #2</b>	
Where Used	Part Number
Steering Cable End	Obtain Locally

10. Restart the engine and observe the drive unit. If drive unit creeps, an external tension may exist on steering cable.
11. Ensure that there is nothing attached to steering cable casing. The cable must be free to move when actuated.
12. Check the power steering pump fluid level.
13. Position the drive unit so it is straight back.
14. Turn the engine off.
15. Check the power steering fluid level and add as necessary.

### NOTICE

If the power package will not be used for an extended period of time, or will be exposed to freezing temperatures, drain the water from the drive unit. Always drain water to prevent corrosion

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