

# STEERING GEARBOX

Power Assisted System (Power Steering)

## 3. Steering Gearbox S601545

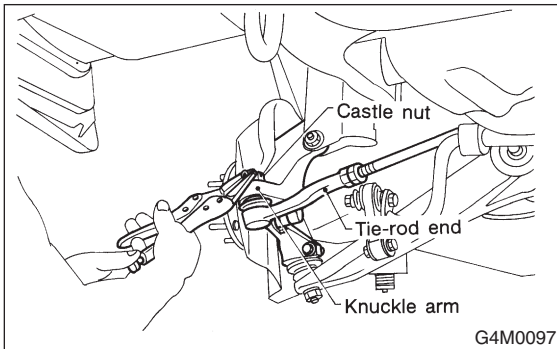
### A: REMOVAL S601545A18

- 1) Disconnect battery minus terminal.
- 2) Loosen front wheel nut.
- 3) Lift vehicle and remove front wheels.
- 4) Remove front exhaust pipe assembly.

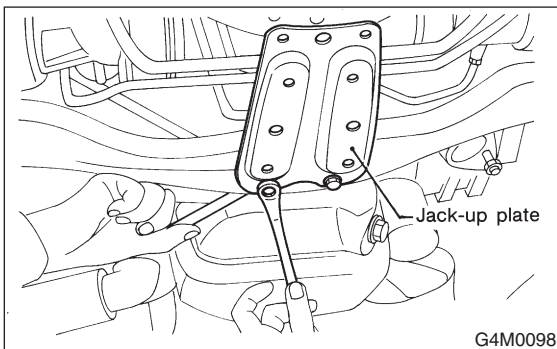
#### WARNING:

**Be careful, exhaust pipe is hot.**

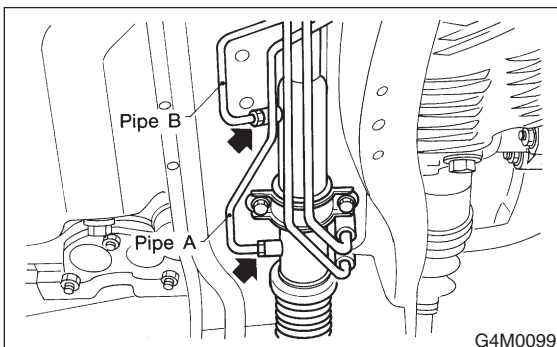
- 5) Using a puller, remove tie-rod end from knuckle arm after pulling off cotter pin and removing castle nut.



- 6) Remove jack-up plate and front stabilizer.



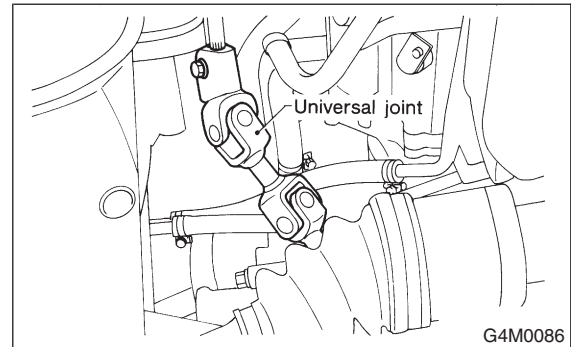
- 7) Remove one pipe joint at the center of gearbox, and connect vinyl hose to pipe and joint. Discharge fluid by turning steering wheel fully clockwise and counterclockwise. Discharge fluid similarly from the other pipe.



- 8) Remove lower side bolt of universal joint, then remove upper side bolt and lift the joint upward.

#### NOTE:

Place a mark on the joint and mating serration so that they can be re-installed at the original position.



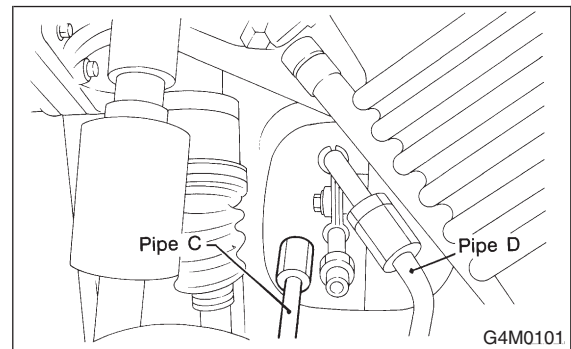
- 9) Disconnect pipes C and D from pipe of gearbox.

#### CAUTION:

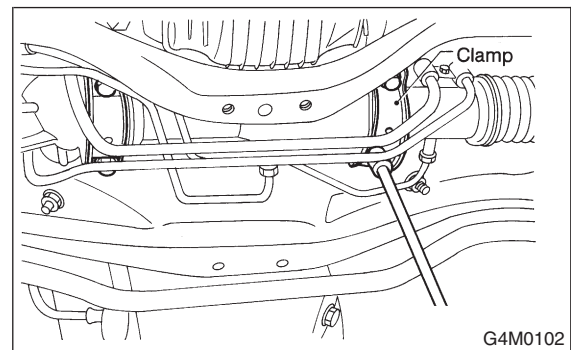
**Be careful not to damage these pipes.**

#### NOTE:

Disconnect upper pipe D first, and lower pipe C second.



- 10) Remove clamp bolts securing gearbox to crossmember, and remove gearbox.



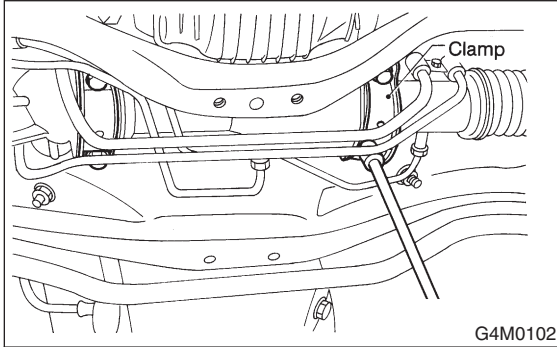
# STEERING GEARBOX

Power Assisted System (Power Steering)

## B: INSTALLATION S601545A11

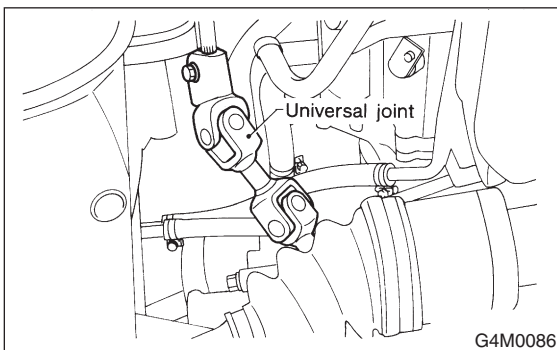
- 1) Insert gearbox into crossmember, being careful not to damage gearbox boot.
- 2) Tighten gearbox to crossmember bracket via clamp with bolt to the specified torque.

**Tightening torque:**  
**59 N·m (6.0 kgf-m, 43 ft-lb)**



- 3) How to install the joint.
  - (1) Push the long yoke of the joint, all the way into the serrated portion of the steering shaft, setting the bolt hole in the cutout.
  - (2) Then pull the short yoke all way out of the serrated portion of the gear box, setting the bolt hole in the cutout.
  - (3) Insert the bolt through the short yoke, pull the joint and confirm that the bolt is on cutout of the gearbox.
  - (4) Fasten the short yoke side with a spring washer and bolt, then fasten the long yoke side.

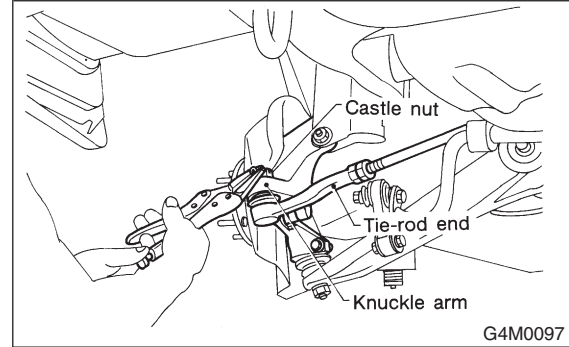
**Tightening torque:**  
**24 N·m (2.4 kgf-m, 17.4 ft-lb)**



- 4) Connect tie-rod end and knuckle arm, and tighten with castle nut. Fit cotter pin into the nut and bend the pin to lock.

**Castle nut tightening torque:**  
**Tighten to 27.0 N·m (2.75 kgf-m, 19.9 ft-lb), and tighten further within 60° until cotter pin hole is aligned with a slot in the nut.**

**CAUTION:**  
**When connecting, do not hit cap at the bottom of tie-rod end with hammer.**



- 5) Install front stabilizer to vehicle.
- 6) Install front exhaust pipe assembly.  
<Ref. to EX-7 INSTALLATION, Front Exhaust Pipe.>
- 7) Install tires.
- 8) Tighten wheel nuts to the specified torque.

**Tightening torque:**  
**88 N·m (9.0 kgf-m, 65 ft-lb)**

- 9) Connect ground cable to battery.
- 10) Pour fluid into oil tank, and bleed air.  
<Ref. to PS-51 REPLACEMENT, Power Steering Fluid.>
- 11) Check for fluid leaks.
- 12) Install jack-up plate.

**WARNING:**  
**Be careful, exhaust manifold is hot.**

- 13) Lower vehicle.
- 14) Check fluid level in oil tank.

# STEERING GEARBOX

Power Assisted System (Power Steering)

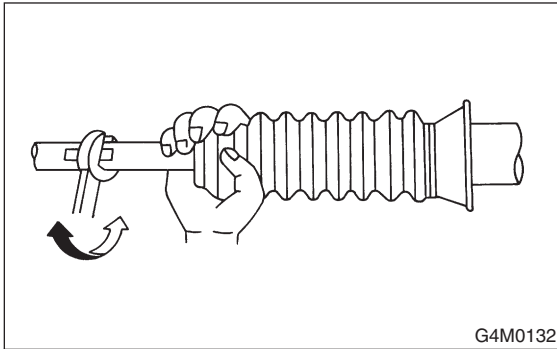
15) After adjusting toe-in and steering angle, tighten lock nut on tie-rod end.

### Tightening torque:

**83 N-m (8.5 kgf-m, 61.5 ft-lb)**

### CAUTION:

When adjusting toe-in, hold boot as shown to prevent it from being rotated or twisted. If twisted, straighten it.



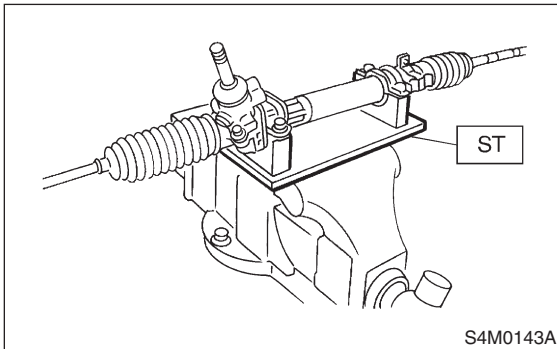
## C: DISASSEMBLY

S601545A06

- 1) Disconnect four pipes from gearbox.
  - 2) Secure gearbox removed from vehicle in vice using ST.
- ST 926200000 STAND

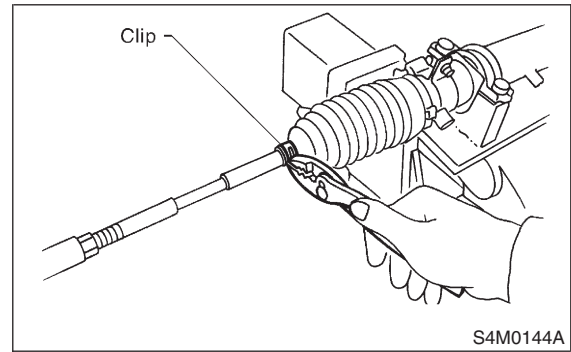
### CAUTION:

Secure the gearbox in a vice using the ST as shown. Do not attempt to secure it without this ST.

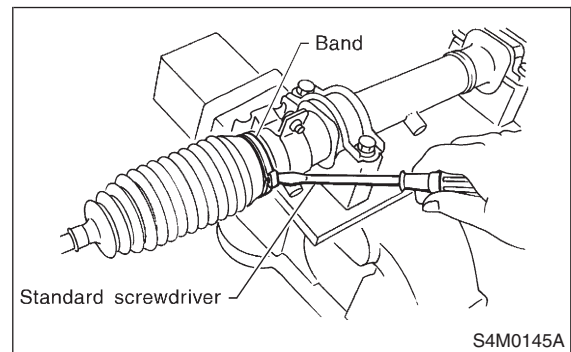


- 3) Remove tie-rod end and lock nut from gearbox.

- 4) Remove small clip from boot using pliers, and move boot to tie-rod end side.



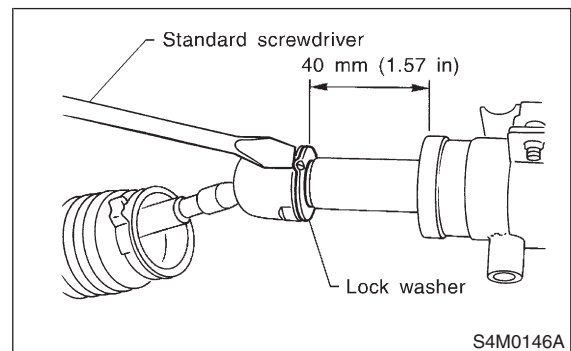
- 5) Using standard screwdriver, remove band from boot.



- 6) Extend rack approximately 40 mm (1.57 in) out. Unlock lock wire at lock washer on each side of tie-rod end using a standard screwdriver.

### CAUTION:

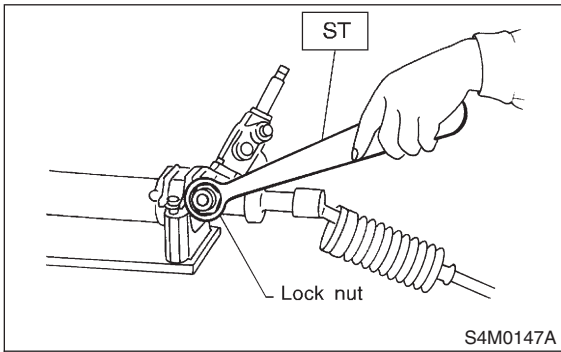
Be careful not to scratch rack surface as oil leaks may result.



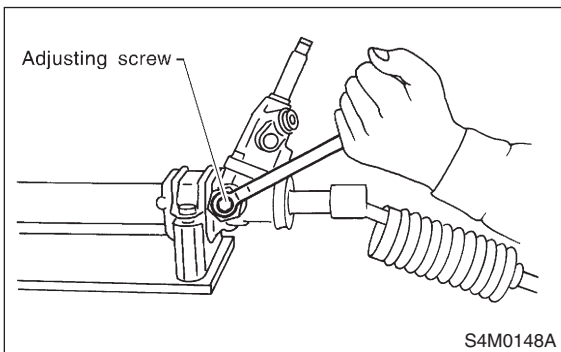
# STEERING GEARBOX

Power Assisted System (Power Steering)

- 7) Using ST, loosen lock nut.  
ST 926230000 SPANNER



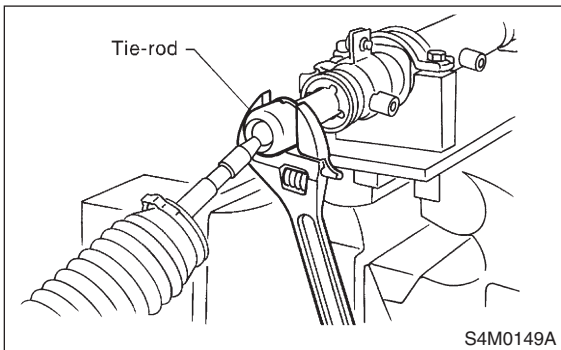
- 8) Tighten adjusting screw until it no longer tightens.



- 9) Using a wrench [32 mm (1.26 in) width across flats] or adjustable wrench, remove tie-rod.

**CAUTION:**

- Check ball joint for free play, and tie-rod for bends. Replace if necessary.
- Check dust seals used with tie-rod end ball joint for damage or deterioration. Replace if necessary.

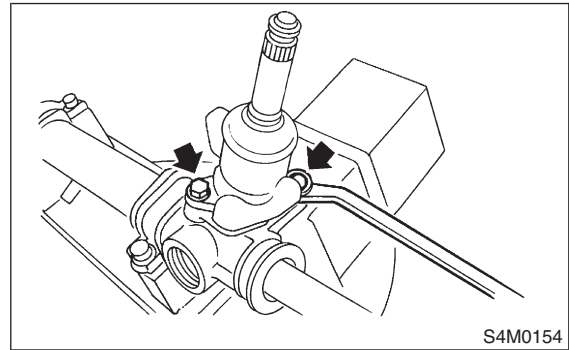


- 10) Loosen adjusting screw and remove spring and sleeve.

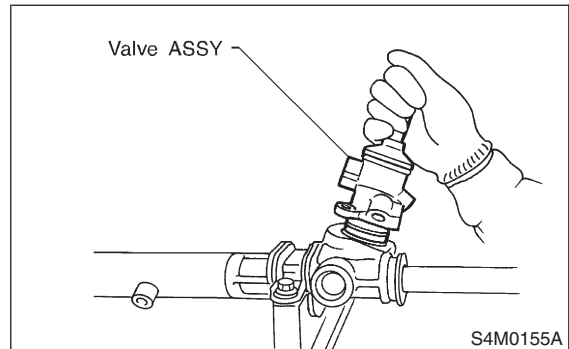
**CAUTION:**

- Replace spring and/or sleeve if damaged.

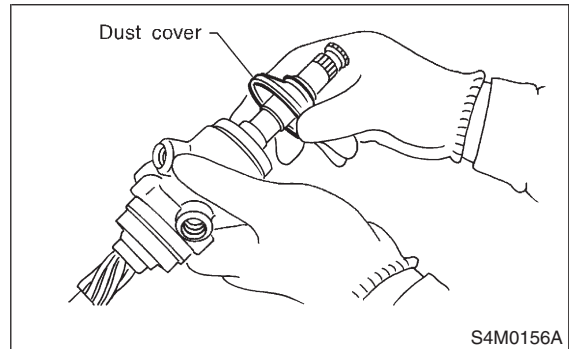
- 11) Remove two bolts securing valve assembly.



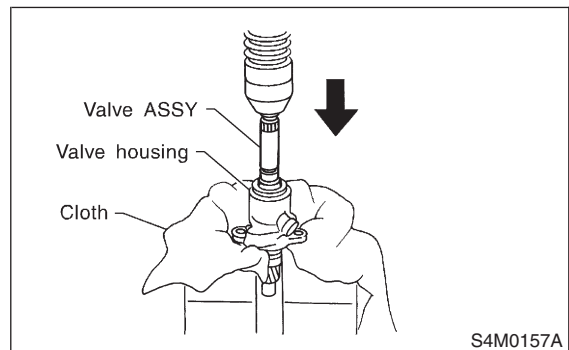
- 12) Carefully draw out input shaft and remove valve assembly.



- 13) Slide dust cover out.



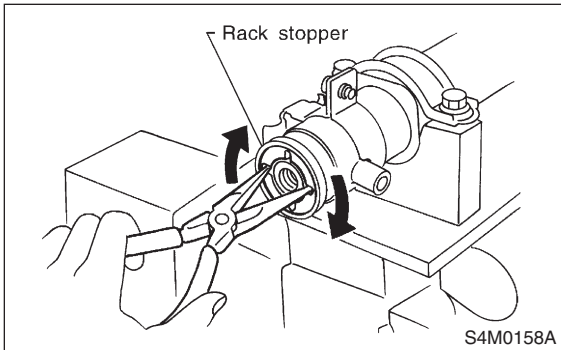
- 14) Using a press remove pinion and valve assembly from valve housing.



# STEERING GEARBOX

## Power Assisted System (Power Steering)

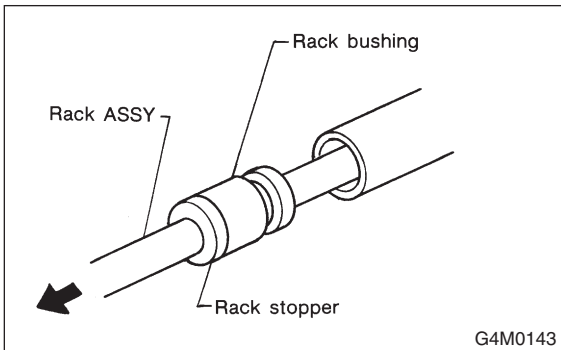
15) Using a sharp pointed pliers, rotate the rack stopper in the direction of the arrow until the end of the circlip comes out of the stopper. Rotate the circlip in the opposite direction and pull it out.



16) Pull rack assembly from cylinder side, and draw out rack bushing and rack stopper together with rack assembly.

### CAUTION:

Be careful not to contact rack to inner wall of cylinder when drawing out. Any scratch on cylinder inner wall will cause oil leakage.



17) Remove rack bushing and rack stopper from rack assembly.

### CAUTION:

Do not reuse removed rack bushing and circlip.

### D: ASSEMBLY S601545A02

### CAUTION:

Use only SUBARU genuine grease for gearbox.

**Specified grease for gearbox:**

**VALIANT GREASE M2 (Part No. 003608001)**

1) Fixing rack housing

Fix rack housing in vice using ST.

ST 926200000 STAND

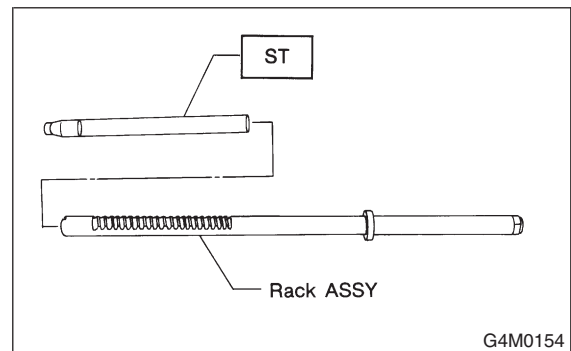
### CAUTION:

● When fixing rack housing in vice, be sure to use this special tool. Do not fix rack housing in vice using pad such as aluminum plates, etc.

● When using old rack housing, be sure to clean and remove rust before assembling. Check pinion housing bushing carefully.

2) Fit ST over toothed portion of rack assembly, and check for binding or unsmooth insertion. If any deformation is noted on flats at the end of rack, shape by using file, and wash with cleaning fluid.

ST 926390001 COVER and REMOVER



3) Apply genuine grease to teeth of thoroughly washed rack assembly, and fit ST over the toothed portion.

### CAUTION:

● Be careful not to block air passage with grease. Remove excessive grease.

● After fitting cover, check air passage hole for clogging. If clogged, open by removing grease from the hole.

● Check rack shaft for damage.

● Apply specified power steering fluid to this ST and surface of piston ring to prevent seal from being damaged.

4) Insert rack assembly into rack housing from cylinder side, and remove ST after it has passed completely through oil seal.

### NOTE:

Before inserting rack assembly, apply a coat of specified power steering fluid to surfaces of ST and rack piston.

ST 926390001 COVER AND REMOVER



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Power Assisted System (Power Steering)

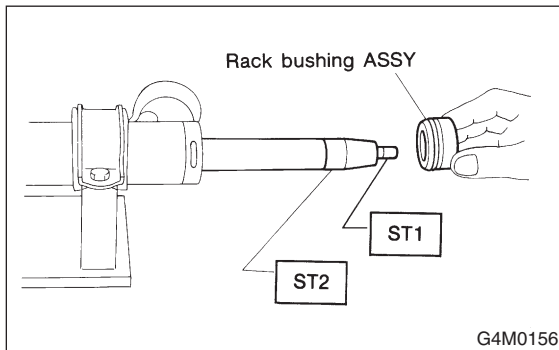
5) Fit ST1 and ST2 over the end of rack, and install rack bushing.

ST1 926400000 GUIDE

ST2 927660000 GUIDE

### CAUTION:

- If burrs, or nicks are found on this guide and rack shaft portion, remove by filing.
- Dip rack bushing in specified power steering fluid before installing, and pay attention not to damage O-ring and oil seal.



6) Insert rack stopper into cylinder tube until internal groove (on cylinder side) is aligned with external groove (on rack stopper). Turn rack stopper with ST so that rack stopper hole is seen through cylinder slits.

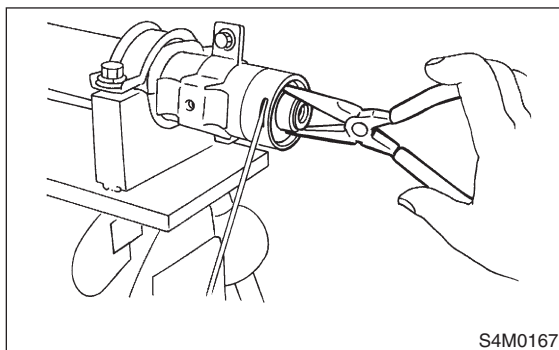
7) Insert rack stopper into rack housing, and wrap circlip using a sharp pointed pliers to secure rack stopper in position.

### CAUTION:

Be careful not to scratch rack while winding circlip.

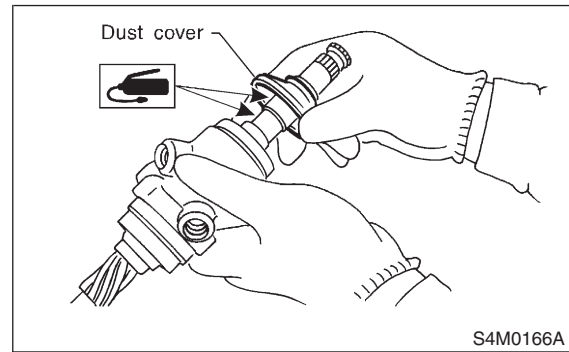
### NOTE:

Rotate wrench another 90 to 180° after the end of circlip has been wrapped in.



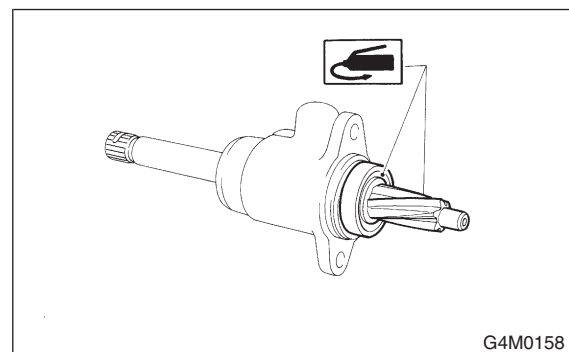
8) Fit mounting rubber onto rack housing.

9) Apply specified grease to dust cover.



10) Install dust cover on valve assembly.

11) Apply genuine grease to pinion gear and bearing of valve assembly.



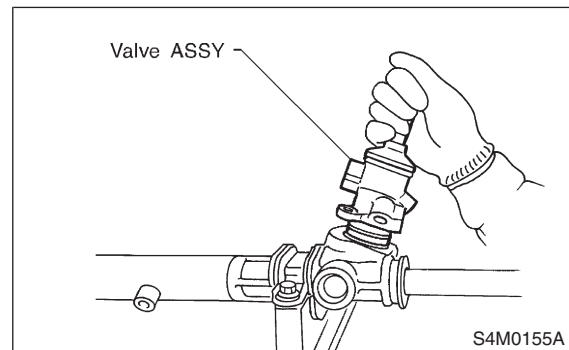
12) Install gasket on valve assembly. Insert valve assembly into place while facing rack teeth toward pinion.

### CAUTION:

Be sure to use a new gasket.

### NOTE:

Do not allow packing to be caught when installing valve assembly.



13) Tighten bolts alternately to secure valve assembly.

### Tightening torque:

25 N·m (2.5 kgf·m, 18.1 ft·lb)

### CAUTION:

Be sure to alternately tighten bolts.

14) Clean all parts and tools before reassembling.

# STEERING GEARBOX

## Power Assisted System (Power Steering)

15) Apply grease to teeth of rack so that grease applied is about as high as teeth, and also apply a thin film of grease to sliding portion of rack shaft.

### CAUTION:

- When moving rack to stroke end without tie-rod attached, prevent shocks from being applied at the end.
- Do not apply grease to threaded portion at end of rack shaft.
- Move rack shaft to stroke end two (2) or three (3) times to squeeze grease which accumulates on both ends. Remove grease to prevent it from choking air passage hole.

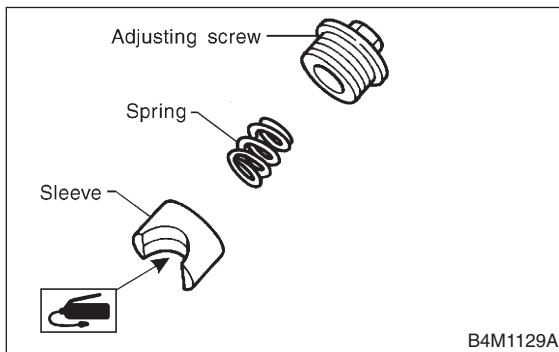
16) Apply grease to sleeve insertion hole.

17) Apply grease to dust seal insertion hole.

### CAUTION:

Apply clean grease with clean hands. If material having a sharp edge is used for applying grease, oil seal at the inside might be damaged.

18) Apply grease to sliding surface of sleeve and spring seat, then insert sleeve into pinion housing. Fit spring into sleeve screw, pack grease inside of screw, then install the screw.



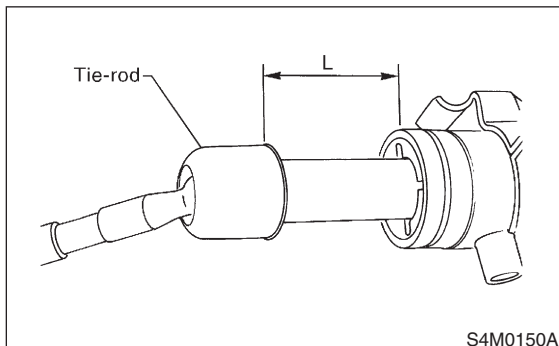
19) Install lock washers and tighten left and right tie-rods into rack ends.

### On condition

**L: Approximately 40 mm (1.57 in)**

### Tightening torque:

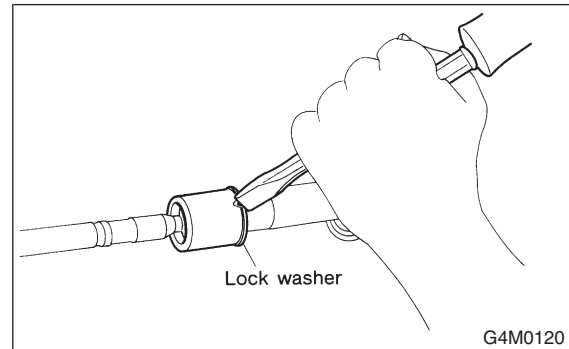
**78 N·m (8.0 kgf·m, 58 ft·lb)**



20) Bend lock washer using a chisel.

### CAUTION:

Be careful not to scratch rack when bending lock washer.

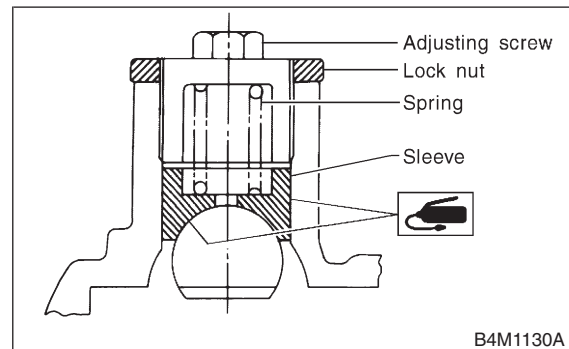


21) Rack and pinion backlash adjustment

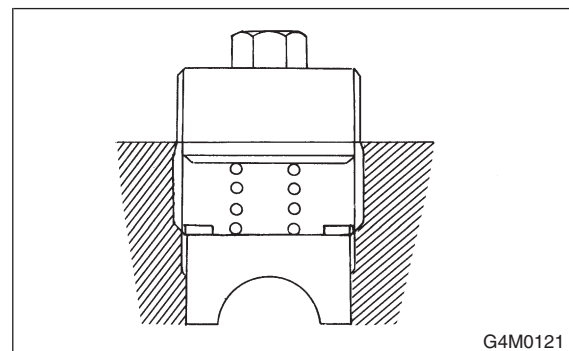
(1) Loosen adjusting screw.

(2) Rotate input shaft so that rack is in the straight ahead direction.

(3) Apply grease to sleeve.



(4) Tighten adjusting screw by two threads.



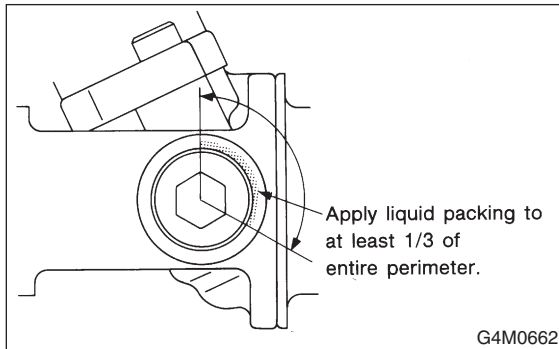
# STEERING GEARBOX

Power Assisted System (Power Steering)

(5) Apply liquid packing to at least 1/3 of entire perimeter of adjusting screw thread.

### Liquid packing:

**THREE BOND 1141**



(6) Tighten adjusting screw to 7.4 N·m (0.75 kgf-m, 5.4 ft-lb) and back off 25°.

(7) Install lock nut. While holding adjusting screw with a wrench, tighten lock nut using ST.

ST 926230000 SPANNER

### Tightening torque (Lock nut):

**39 N·m (4.0 kgf-m, 29 ft-lb)**

### NOTE:

- Hold adjusting screw with a wrench to prevent it from turning while tightening lock nut.
- Make adjustment so that steering wheel can be rotated fully from lock to lock without binding.

22) Check for service limit as per article of "Service limit". <Ref. to PS-29 INSPECTION, Steering Gearbox.> Make replacement and adjustment if necessary.

23) Install boot to housing.

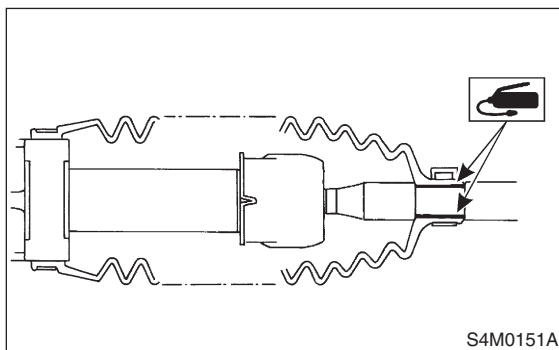
### NOTE:

- Before installing boot, be sure to apply grease to the groove of tie-rod.
- Install fitting portions of boots to the following portions in both sides of assembled steering gearbox.

The groove on gearbox

The groove on the rod

- Make sure that boot is installed without unusual inflation or deflation.



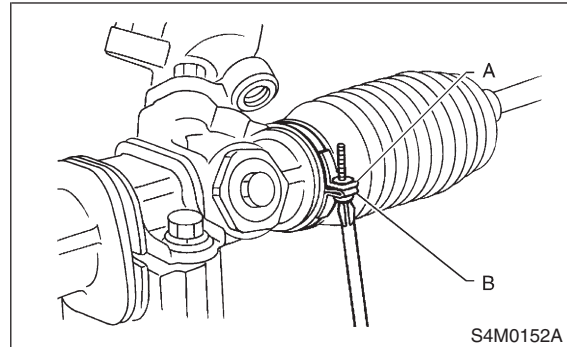
24) Using a screwdriver, tighten the screw until the ends "A" and "B" of the band come into contact with each other.

### CAUTION:

**Use a new band.**

### NOTE:

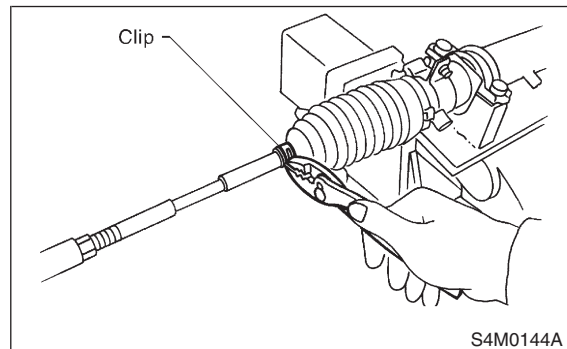
Always tighten the band from the underside of the gear box.



25) Fix boot end with clip (small).

### CAUTION:

**After installing, check boot end is positioned into groove on tie-rod.**





# STEERING GEARBOX

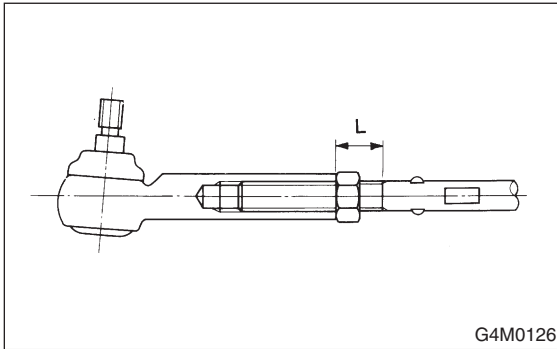
Power Assisted System (Power Steering)

26) If tie-rod end was removed, screw in lock nut and tie-rod end to screwed portion of tie-rod, and tighten lock nut temporarily in a position as shown in figure.

**Installed tie-rod length: L**  
**15 mm (0.59 in)**

NOTE:

Pay attention to difference between right and left tie-rod ends.

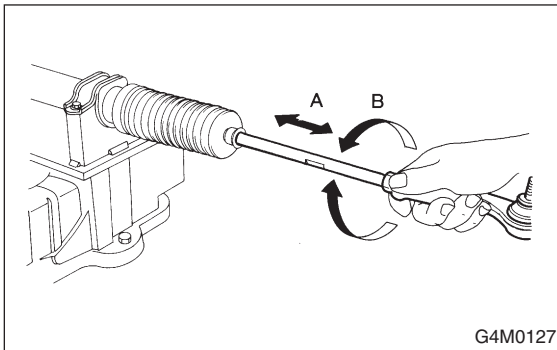


27) Inspect gearbox as follows:

“A” Holding tie-rod end, repeat lock to lock two or three times as quickly as possible.

“B” Holding tie-rod end, turn it slowly at a radius one or two times as large as possible.

After all, make sure that boot is installed in the specified position without deflation.



28) Remove gearbox from ST.

ST 926200000 STAND

29) Install four pipes on gearbox.

(1) Connect pipes A and B to four pipe joints of gearbox. Connect upper pipe B first, and lower pipe A.

**Tightening torque:**

**13 N·m (1.3 kgf·m, 9.4 ft·lb)**

(2) Connect pipes C and D to gearbox.

Connect lower pipe C first, and upper pipe D second.

**Tightening torque:**

**15 N·m (1.5 kgf·m, 10.8 ft·lb)**

# STEERING GEARBOX

Power Assisted System (Power Steering)

## E: INSPECTION S601545A10

- 1) Clean all disassembled parts, and check for wear, damage, or any other faults, then repair or replace as necessary.
- 2) When disassembling, check inside of gearbox for water. If any water is found, carefully check boot for damage, input shaft dust seal, adjusting screw and boot clips for poor sealing. If faulty, replace with new parts.

No.	Parts	Inspection	Corrective action
1	Input shaft	(1) Bend of input shaft (2) Damage on serration	If bend or damage is excessive, replace entire gearbox.
2	Dust seal	(1) Crack or damage (2) Wear	If outer wall slips, lip is worn out or damage is found, replace it with new one.
3	Rack and pinion	Poor mating of rack with pinion	(1) Adjust backlash properly. By measuring turning torque of gearbox and sliding resistance of rack, check if rack and pinion engage uniformly and smoothly with each other. (Refer to "Service limit".) (2) Keeping rack pulled out all the way so that all teeth emerge, check teeth for damage. Even if abnormality is found in either (1) or (2), replace entire gearbox.
4	Gearbox unit	(1) Bend of rack shaft (2) Bend of cylinder portion (3) Crack or damage on cast iron portion	Replace gearbox with new one.
		(4) Wear or damage on rack bush	If free play of rack shaft in radial direction is out of the specified range, replace gearbox with new one. (Refer to "Service limit".)
		(5) Wear on input shaft bearing	If free plays of input shaft in radial and axial directions are out of the specified ranges, replace gearbox with new one. (Refer to "Service limit".)
5	Boot	Crack, damage or deterioration	Replace.
6	Tie-rod	(1) Looseness of ball joint (2) Bend of tie-rod	Replace.
7	Tie-rod end	Damage or deterioration on dust seal	Replace.
8	Adjusting screw spring	Deterioration	Replace.
9	Boot clip	Deterioration	Replace.
10	Sleeve	Damage	Replace.
11	Pipes	(1) Damage to flared surface (2) Damage to flare nut (3) Damage to pipe	Replace.

# STEERING GEARBOX

Power Assisted System (Power Steering)

## 1. SERVICE LIMIT S601545A1001

Make a measurement as follows. If it exceeds the specified service limit, adjust or replace.

### NOTE:

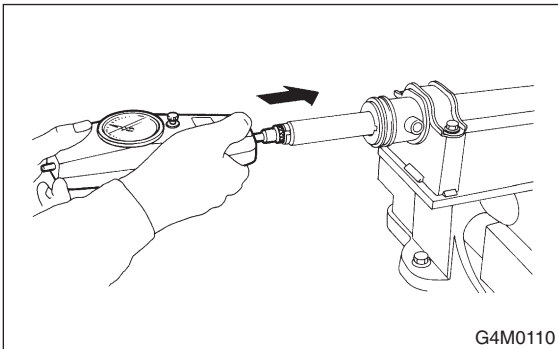
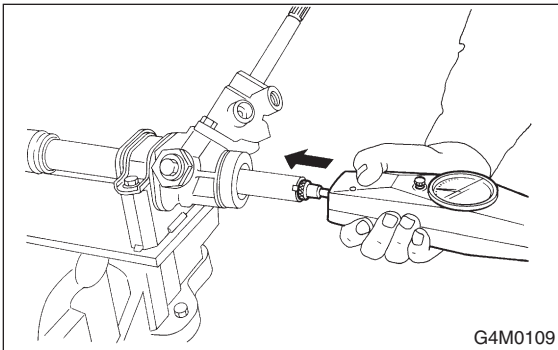
When making a measurement, vise gearbox by using ST. Never vise gearbox by inserting aluminum plates, etc. between vise and gearbox.

ST 926200000 STAND

### Sliding resistance of rack shaft:

#### Service limit

**304.0 N (31.0 kgf, 68.4 lb) or less**



## 2. RACK SHAFT PLAY IN RADIAL DIRECTION S601545A1002

### Right-turn steering:

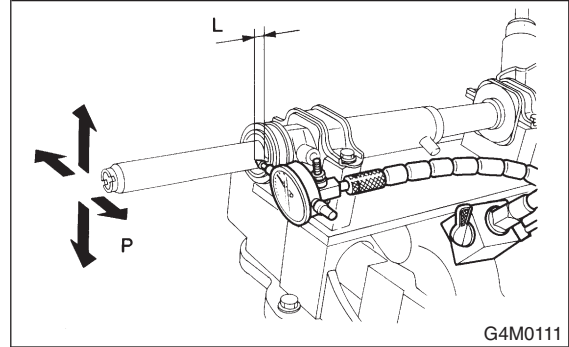
#### Service limit

**0.15 mm (0.0059 in) or less**

#### On condition

**L: 5 mm (0.20 in)**

**P: 98 N (10 kgf, 22 lb)**



### Left-turn steering:

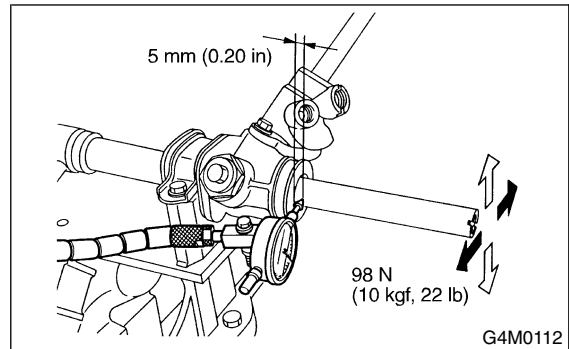
#### Service limit

**Direction** ← →

**0.15 mm (0.0059 in) or less**

**Direction** ← →

**0.15 mm (0.0059 in) or less**



# STEERING GEARBOX

Power Assisted System (Power Steering)

## 3. INPUT SHAFT PLAY S601545A1003

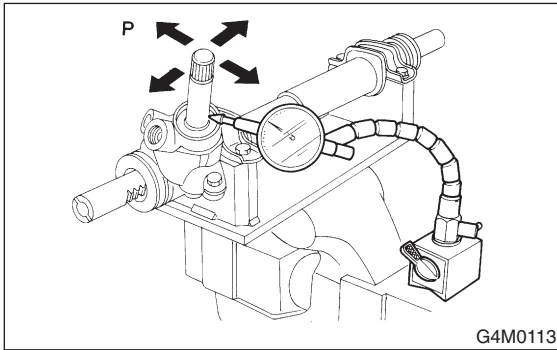
**In radial direction:**

**Service limit**

**0.18 mm (0.0071 in) or less**

**On condition**

**P: 98 N (10 kgf, 22 lb)**



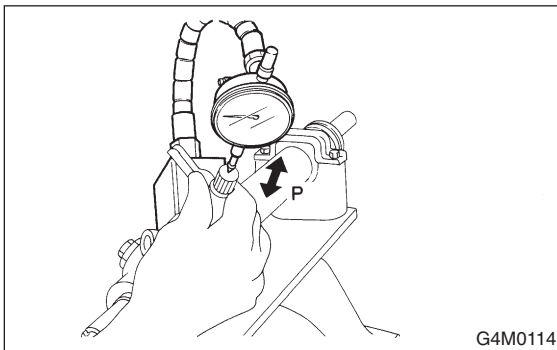
**In axial direction:**

**Service limit**

**0.1 mm (0.004 in) or less**

**On condition**

**P: 20 — 49 N (2 — 5 kgf, 4 — 11 lb)**



## 4. TURNING RESISTANCE OF GEARBOX

S601545A1004

Using ST, measure gearbox turning resistance.

ST 926230000 SPANNER

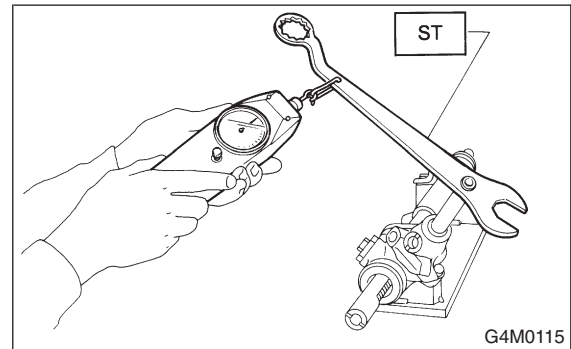
**Service limit:**

**Straight-ahead position within 30 mm (1.18 in) from rack center**

**Less than 11.18 N (1.14 kgf, 2.51 lb)**

**Maximum allowable resistance**

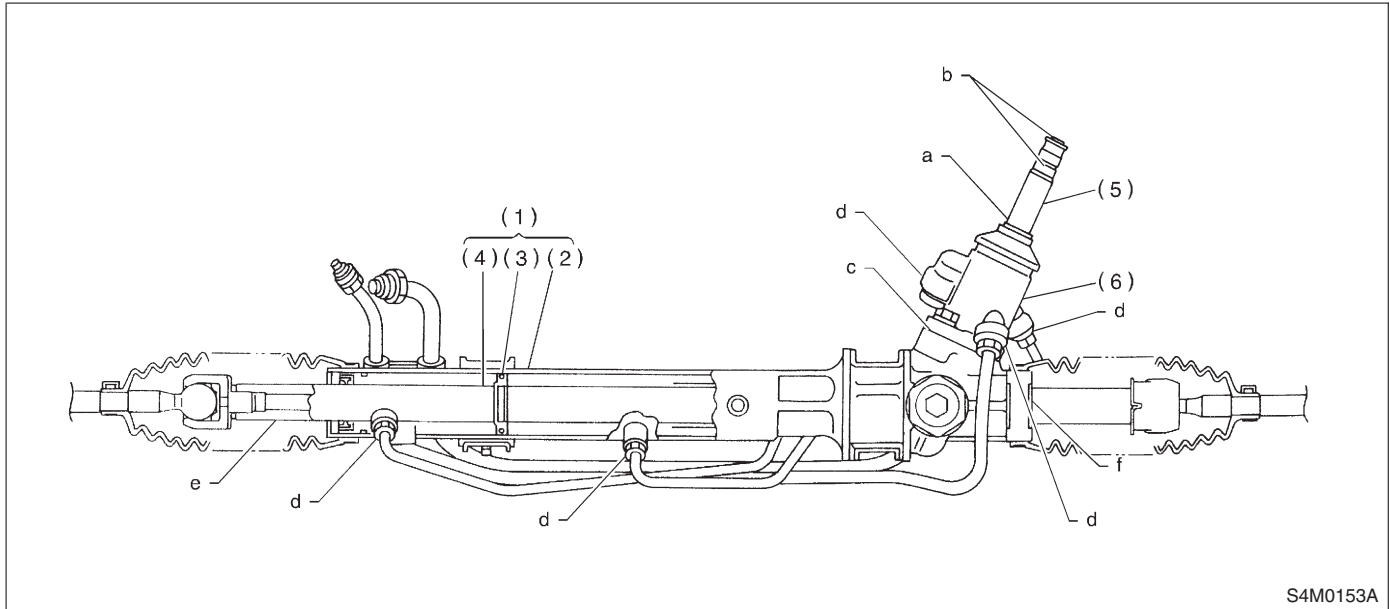
**12.7 N (1.3 kgf, 2.9 lb)**



# STEERING GEARBOX

Power Assisted System (Power Steering)

## 5. OIL LEAKING S601545A1005



S4M0153A

- |                    |                 |                   |
|--------------------|-----------------|-------------------|
| (1) Power cylinder | (3) Rack piston | (5) Input shaft   |
| (2) Cylinder       | (4) Rack axle   | (6) Valve housing |

### ● Oil leaking points

1) If leak point is other than a, b, c, or d, perform the 5th step in "Oil leak check procedure and replacement parts" before dismounting gearbox from vehicle. If gearbox is dismounted without confirming where the leak is, it must be mounted again to locate the leak point.

2) Even if the location of the leak can be easily found by observing the leaking condition, it is necessary to thoroughly remove the oil from the suspected portion and turn the steering wheel from lock to lock about 30 to 40 times with engine running, then make comparison of the suspected portion between immediately after and several hours after this operation.

3) Before starting oil leak repair work, be sure to clean the gearbox, hoses, pipes, and surrounding parts. After completing repair work, clean these areas again.

### ● Oil leak check procedure and replacement parts

#### NOTE:

Parts requiring replacement are described in the smallest unit of spare parts including damaged parts and spare parts damaged. In actual disassembly work, accidental damage as well as inevitable damage to some related parts must be taken into account, and spare parts for them must also be prepared. However, it is essential to pinpoint the cause of trouble, and limit the number of replacement parts as much as possible.

#### 1) Leakage from "a"

The oil seal is damaged. Replace valve assembly with a new one.

#### 2) Leakage from "b"

The torsion bar O-ring is damaged. Replace valve assembly with a new one.

#### 3) Leakage from "c"

The oil seal is damaged. Replace valve assembly or oil seal with a new one.

#### 4) Leakage from "d"

The pipe is damaged. Replace the faulty pipe or O-ring.

# STEERING GEARBOX

Power Assisted System (Power Steering)

5) If leak is other than a, b, c, or d, and if oil is leaking from the gearbox, move the right and left boots toward tie-rod end side, respectively, with the gearbox mounted to the vehicle, and remove oil from the surrounding portions. Then, turn the steering wheel from lock to lock 30 to 40 times with the engine running, then make comparison of the leaked portion immediately after and several hours after this operation.

(1) Leakage from "e"

The cylinder seal is damaged. Replace rack bush with a new one.

(2) Leakage from "f"

There are two possible causes. Take following step first. Remove the pipe assembly B from the valve housing, and close the circuit with ST.

ST 926420000 PLUG

Turn the steering wheel from lock to lock 30 to 40 times with the engine running, then make comparison of the leaked portion between immediately after and several hours after this operation.

## CAUTION:

● If leakage from "f" is noted again:

The oil seal of pinion and valve assembly is damaged. Replace pinion and valve assembly with a new one. Or replace the oil seal and the parts that are damaged during disassembly with new ones.

● If oil stops leaking from "f":

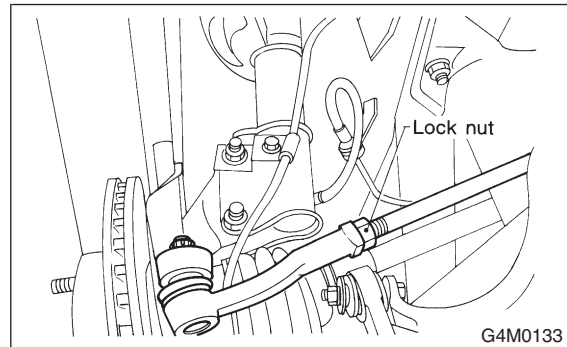
The oil seal of rack housing is damaged. Replace the oil seal and the parts that are damaged during disassembly with new ones.

## F: ADJUSTMENT S601545A01

1) Adjust front toe.

**Standard of front toe:**

**IN 3 — OUT 3 mm (IN 0.12 — OUT 0.12 in)**

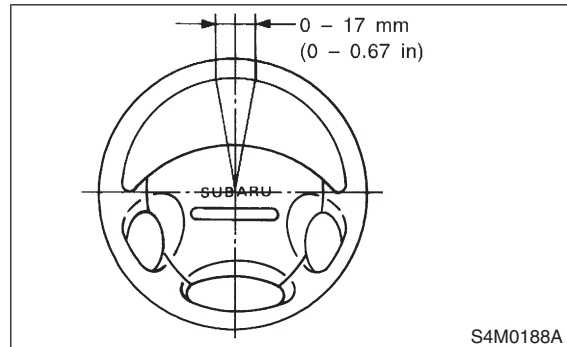


2) Adjust steering angle of wheels.

**Inner wheel:  $37.4^{\circ} \pm 1.5^{\circ}$**

**Outer wheel:  $32.5^{\circ} \pm 1.5^{\circ}$**

3) If steering wheel spokes are not horizontal when wheels are set in the straight ahead position, and error is more than  $5^{\circ}$  on the periphery of steering wheel, correctly re-install the steering wheel.



4) If steering wheel spokes are not horizontal with vehicle set in the straight ahead position after this adjustment, correct it by turning the right and left tie-rods in the same direction by the same turns.

