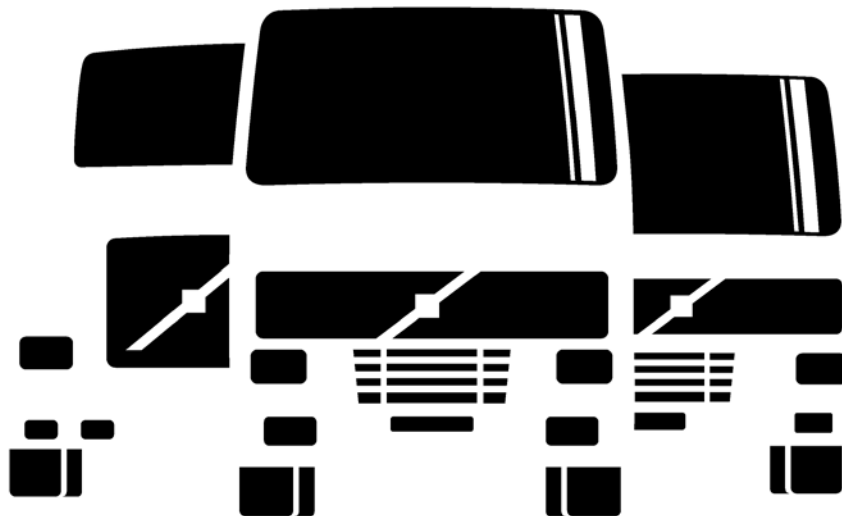


# Service Manual Trucks

Group **41**

Hydraulically Actuated Clutch  
(Including transmission removal)  
VNL, VNM



# Foreword

The descriptions and service procedures contained in this manual are based on design and method studies up to October 1996.

The products are under continuous development. Vehicles and components produced after the above date may therefore have different specifications and repair methods. When this is believed to have a significant bearing on this manual, supplementary service bulletins will be issued to cover the changes.

The new edition of this manual will update the changes.

In service procedures where the title incorporates an operation number, this is a reference to an S.R.T. (Standard Repair Time).

Service procedures which do not include an operation number in the title are for general information and no reference is made to an S.R.T.

The following levels of observations, cautions and warnings are used in this Service Documentation:

**Note:** Indicates a procedure, practice, or condition that must be followed in order to have the vehicle or component function in the manner intended.

**Caution:** Indicates an unsafe practice where damage to the product could occur.

**Warning:** Indicates an unsafe practice where personal injury or severe damage to the product could occur.

**Danger:** Indicates an unsafe practice where serious personal injury or death could occur.

**Volvo GM Heavy Truck**  
Greensboro, NC USA

**Order number: PV776-TSP24581/1**

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# General

## About this Service Information

The information and instructions contained in this Service Information pertain to the following components:

### Clutch

- Volvo 17 single plate - model CL43S-O (previously KFD117E)
- Volvo 15 double plate - model CL38D-O (previously KFD215B)
- Spicer® Easy-Pedal™ 1552 double plate, ceramic

**Note:** For more information on servicing the Volvo clutches, please refer to the Volvo Service Manual 411–600, Clutch, Pull-Type — Volvo.

### Clutch Master Cylinder

- Hydraulic master cylinder with plastic reservoir.

### Clutch Slave Cylinder

- Volvo Transmissions-Volvo air assisted hydraulic servo
- Other Transmissions-hydraulic slave cylinder

**Note:** For more clutch overhaul instructions, please refer to the Volvo Service Manual 411–600, Clutch, Pull-Type — Volvo.



# Specifications

## Clutch

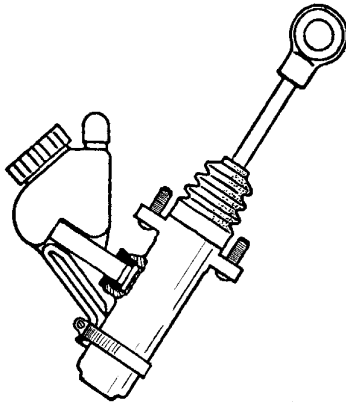
### Volvo

Model	Size mm (in.)	Max. Torque Nm (lb•ft)	Spline Size	Facing Material
CL43S-O (single plate)	430 (17)	1850 (1365)	10-SAE	organic
CL38D-O (double plate)	380 (15)	1980 (1460)	10-SAE	organic

### Spicer

Model	Size mm (in.)	Max. Torque Nm (lb•ft)	Spline Size	Facing Material
Easy-Pedal® Plus™ 1552 (double plate)	394 (15.5)	1730 (1275) 1970 (1450) 2240 (1650)	10-SAE	ceramic

## Clutch Master Cylinder



P/N 1628218 (Volvo) or  
 8076243 (Non-Volvo) ..... Non-serviceable

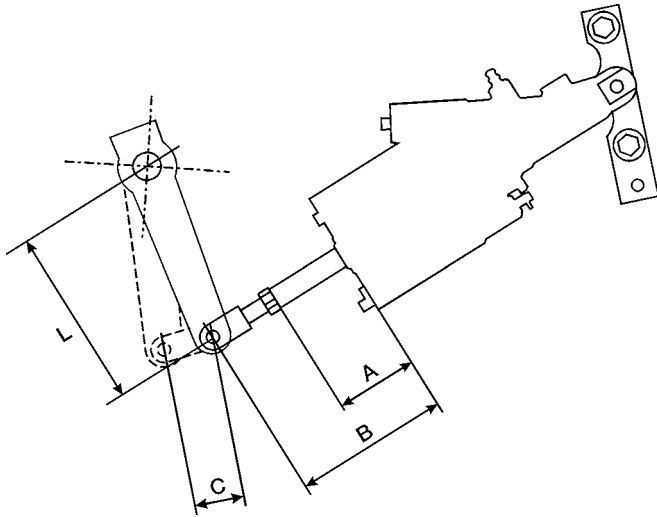
## Transmission Slave Cylinder

**Note:** Vehicles equipped with a Volvo transmission use a pneumatic/hydraulic servo for clutch operation. Vehicles

equipped with a non—Volvo transmission use a hydraulic slave cylinder.

### Volvo Transmissions

#### Volvo Clutch Servo

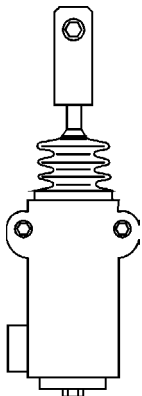


Air assisted, hydraulic cylinder ..... P/N 1521371

Measurement	CL43S-O clutch mm (in.)	CL38D-O clutch mm (in.)
Basic setting (A) .....	55 ± 1.5 (2.16 ± 0.06)	55 ± 1.5 (2.16 ± 0.06)
Measurement (B) mm (in.) .....	Max. 115 (4.53)	Max. 115 (4.53)
Stroke (C), mm (in.) .....	27-29 (1.06-1.14)	27-29 (1.06-1.14)
Lever length (L), mm (in.) .....	150 (5.9)	130 (5.12)

### Fuller or Rockwell Transmissions

#### Hydraulic Clutch Slave



Slave Cylinder, Hydraulic ..... P/N 8075008



## Hydraulic System

Clutch Fluid .....	DOT 4 (SAE J1703)
Fluid Reservoir Capacity .....	0.15 liter (0.16 qts.)
Total Hydraulic System Capacity .....	0.3 liter (0.3 qts.)

## Tightening Torques

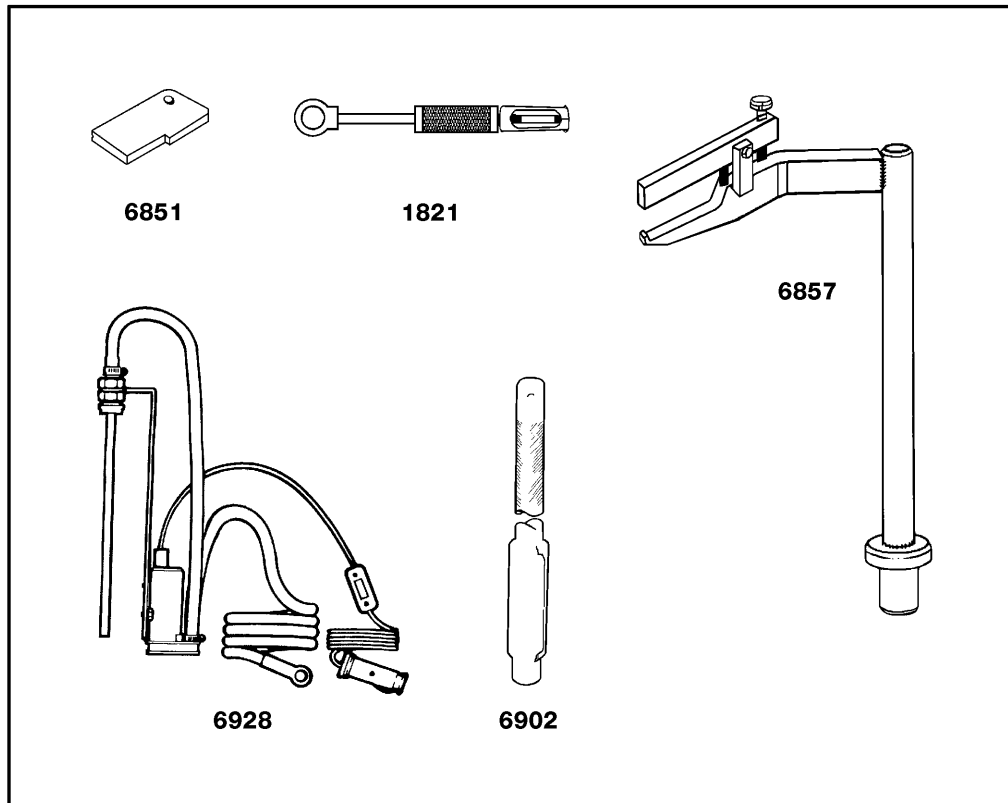
Component	Nm	(ft•lbs)
Clutch Housing to Flywheel		
CL430S-O .....	37 ± 4	(27 ± 3)
CL380D-O .....	65 ± 6	(48 ± 4)
Spicer® Easy-Pedal™ 1552 .....	60 ± 7	(45 ± 5)
Intermediate Ring - Volvo clutches		
CL380D-O .....	26 ± 2	(19 ± 1)
Clutch Servo - Volvo		
Lock nut, push rod .....	60 ± 10	(45 ± 7)
Air Connection .....	24 ± 2	(18 ± 1)
Fluid bleed nipple .....	10 ± 2	(7 ± 1)
Hydraulic connection .....	45 ± 5	(33 ± 4)
Clutch Slave Cylinder - non Volvo		
Mounting bolts .....	35	(26)
Hydraulic connection, line to fitting .....	40 ± 5	(30 ± 4)
Hydraulic connection, fitting to cylinder .....	20	(15)
Clutch Master Cylinder		
Mounting bolts .....	24 ± 4	(18 ± 3)
Hydraulic connection .....	40 ± 5	(30 ± 4)



# Tools

## Special tools

The following special tools are required for work on the Volvo VN Series Hydraulic Clutch System. The tools can be ordered from the Volvo GM Heavy Truck Corporation.



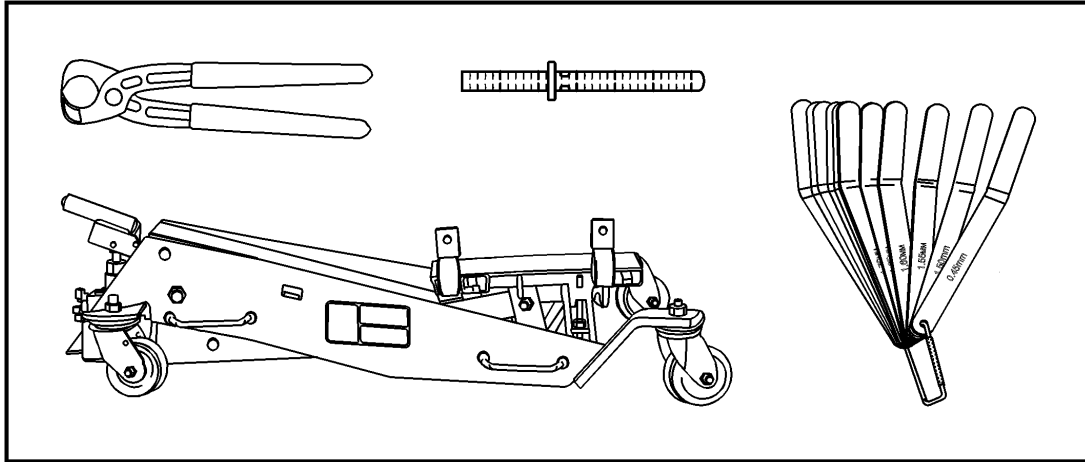
W4000833

**999 6851** Adjustment gauge  
**999 1821** Slide puller  
**999 6928** Bleeder  
**999 6902** Centering drift

**999 6857** Lifting tool  
**999 6896** Adapting fixture  
 (used with 6857)

## Other equipment

The following items are considered common shop equipment and are necessary for the repair procedures in this manual.



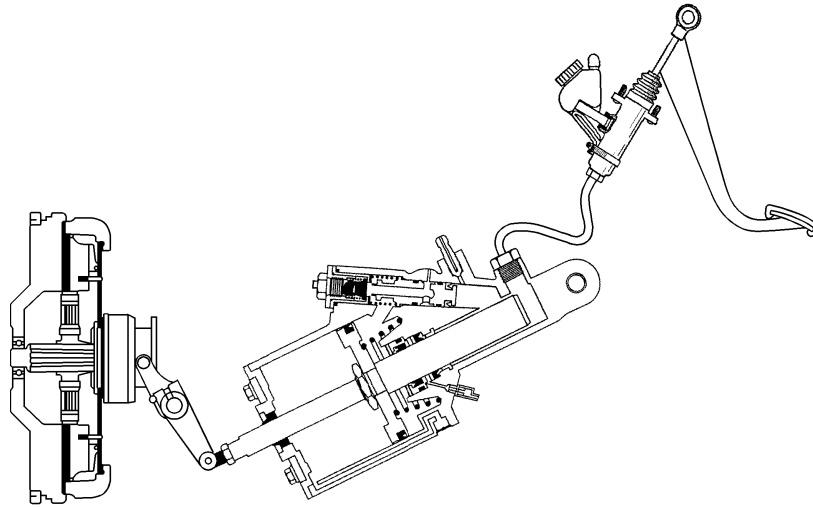
W4000817

Pinch pliers  
Transmission jack

Pocket ruler  
Feeler gauges

# Design and Function

## Clutch and Hydraulic Clutch System



W4000835

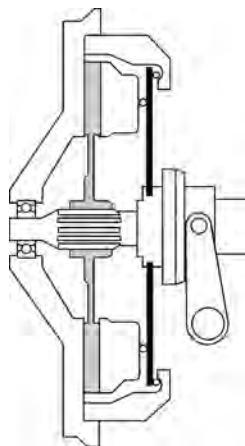
### Design

#### Volvo Clutches

The Volvo dry plate clutches are specifically matched to engine and transmission combinations. Volvo uses two types of dry plate clutches: single plate and double plate. The double plate is mainly used for heavy duty transport purposes.

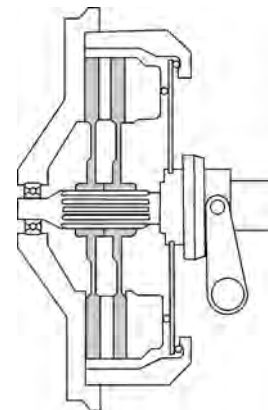
All of the clutches are of the diaphragm spring type and are controlled by an air assisted hydraulic servo.

The clutch movement (engagement, disengagement) is a result of the servo rotating the cross shaft (fork assembly). These clutches are called “pull-type” because the fork assembly pulls the release bearing rearward to disengage the clutch.



W4000821

The single plate clutch consists of a pressure plate, release bearing and one clutch disc.



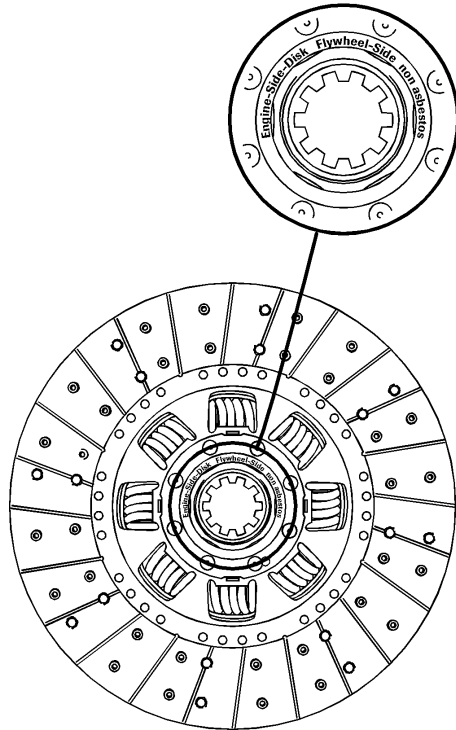
W4000822

The double plate clutch consists of a pressure plate, release bearing, intermediate pressure plate, straps, two clutch discs and four centering lugs.

**Volvo Clutch Plate(s)**

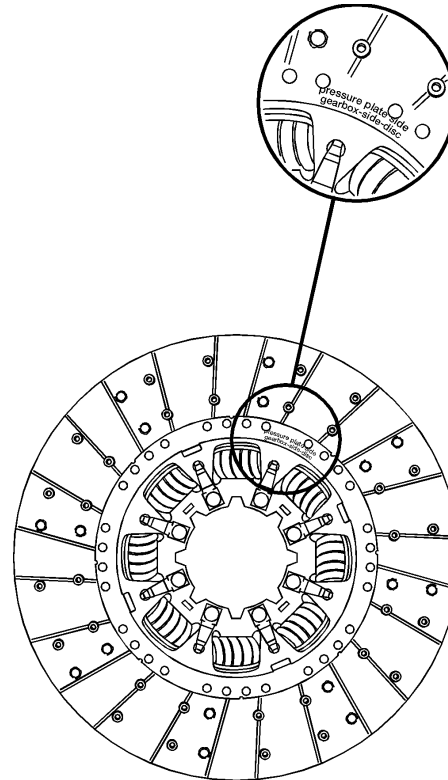
The Volvo clutch plates are dry with linings on both sides. Each clutch plate consists of a disc, damper springs, hub, and linings. The disc is connected to the hub by friction elements and damper springs to provide a smooth engagement and eliminate engine pulses.

The front plate hub is splined onto the transmission's input shaft. The rear plate is splined onto the outer diameter of the front plate hub. The linings are organic, non-asbestos material and are riveted to the disc.



W4000794

Flywheel plate

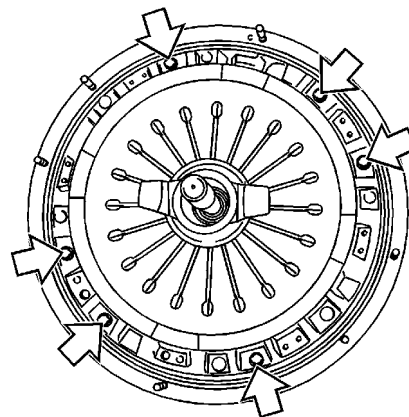


W4000795

Gearbox plate

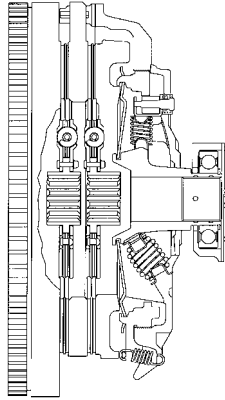
**Volvo Pressure Plate**

The pressure plate is a powerful diaphragm spring. It is mounted to the flywheel with six mounting bolts. When the clutch pedal is depressed the spring force is removed from the clutch plates and absorbed by the release bearing. The clutch plates are then disengaged and stop transmitting torque to the transmission.



W4000789

## Spicer Clutch

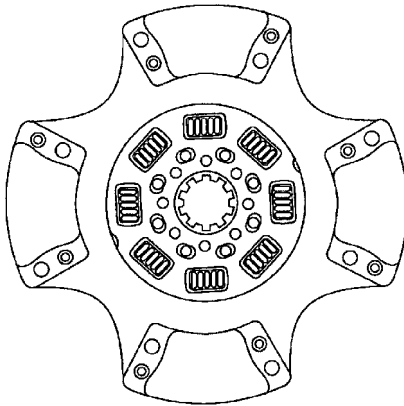


W4000831

The Spicer Easy-Pedal® Plus™ 1552 double plate clutch is a spring type clutch that is controlled by a hydraulic slave cylinder. The clutch engagement/disengagement is a result of the slave cylinder rotating the cross shaft and fork assembly.

The Spicer double plate clutch consist of a pressure plate, release bearing, intermediate plate, Positive Separator Pin™, two clutch plates and a Kwik-adjust™.

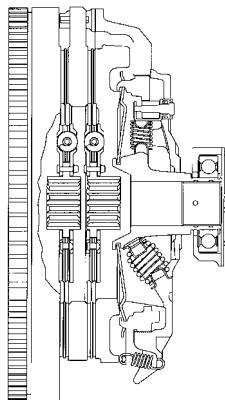
## Spicer Clutch Plates



W4000832

The Spicer clutch uses ceramic linings on both clutch plates. The plates are dampened with springs to reduce torsional vibrations.

## Spicer Pressure Plate

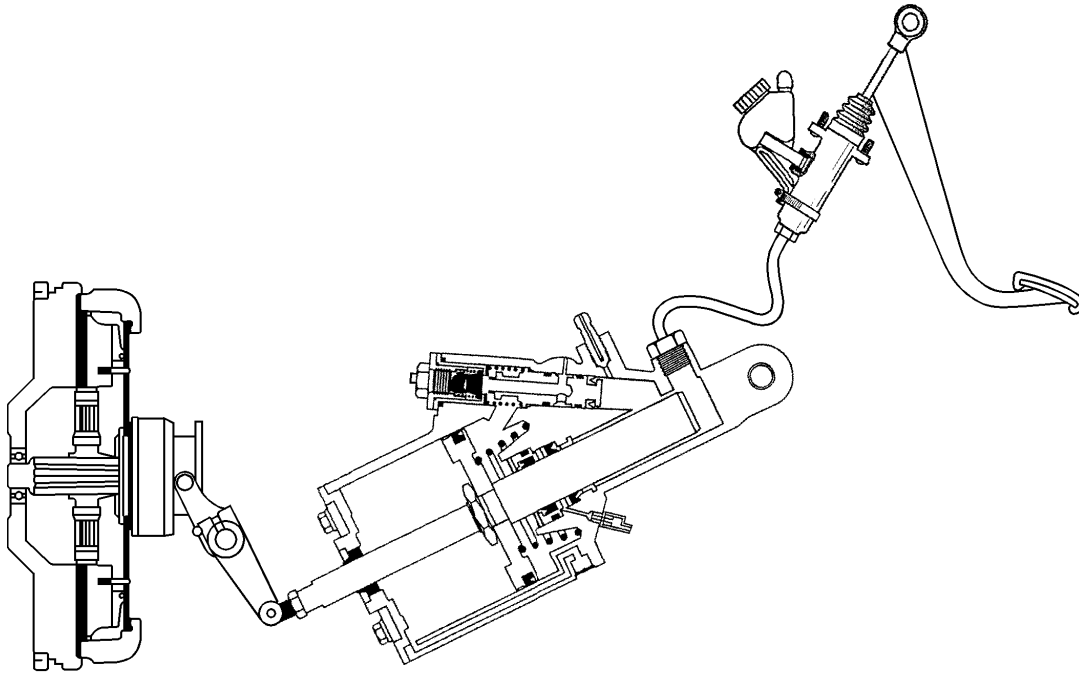


W4000831

The Spicer pressure plate is a spring type with 9 coil springs.

## Function

### Master Cylinder with Pneumatic Servo - Volvo Transmissions



The Volvo pneumatic servo operates on hydraulic pressure from the clutch master cylinder and is assisted with

air pressure. The servo consists of an air cylinder, reaction plunger, and control valve.

W4000835

### Master Cylinder

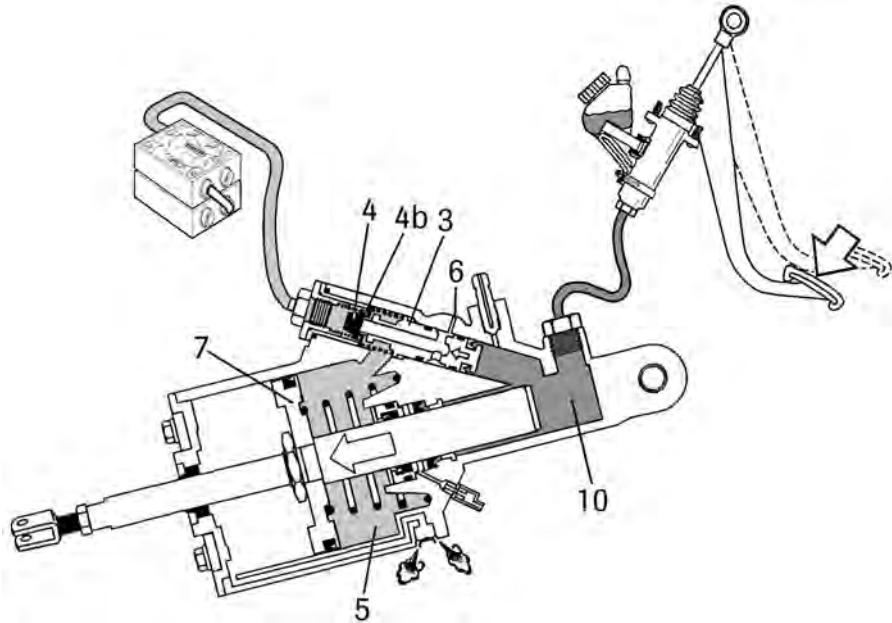


The clutch pedal activates the master cylinder. When the clutch pedal is depressed, the clutch rod moves downward pushing the plunger into the cylinder. Plunger movement into the cylinder forces the fluid through the hydraulic lines and into the clutch servo. As the plunger is forced into the cylinder, the fluid supply duct from the reservoir is closed. When the clutch pedal is released, the clutch rod and plunger return to the rest position and the fluid supply duct opens.

W4000840



**Pneumatic Servo  
Clutch engagement**

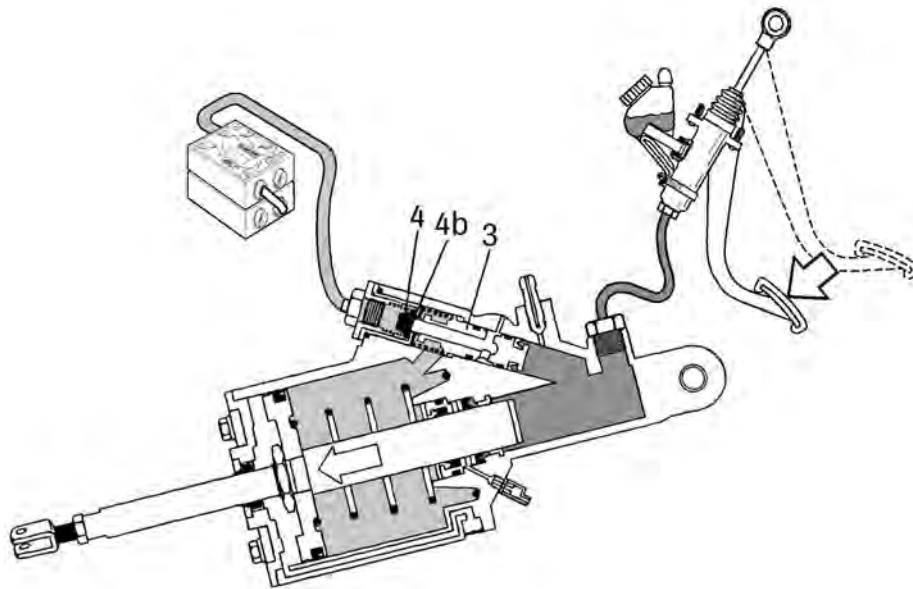


When the clutch pedal is pressed, hydraulic pressure (10) increases and the reaction piston (3) is pressed in the direction of the arrow. This movement first shuts the control valves upper seat (4b) and then the air outlet duct (6).

As the reaction piston moves further, the rubber peg (4) is pushed off its seat (4b) allowing pressurized air into the air chamber (5). As a result of the increased air pressure, the piston (7) moves in the direction of the arrow.

W4000857

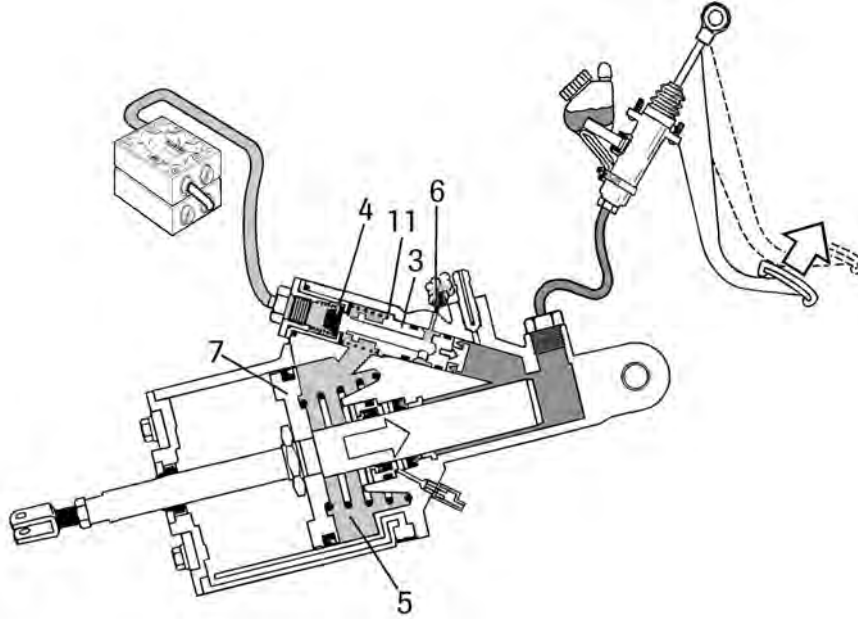
**Fully depressed**



The reduction in hydraulic pressure allows the air pressure to push back the control valve (4b) stopping the air supply. Pressure is now stabilized, the reaction piston (3) and

rubber peg (4) are held in their positions until the position of the clutch pedal is changed.

W4000858

**Released**

When the clutch pedal is released, hydraulic pressure is lowered and the pressure spring (11) presses back the reaction piston. The rubber peg (4) closes the air supply

and opens the air outlet duct (6). Air is now released from the air chamber (5) and the piston (7) is returned to its rest position by the force of the pressure plate spring.

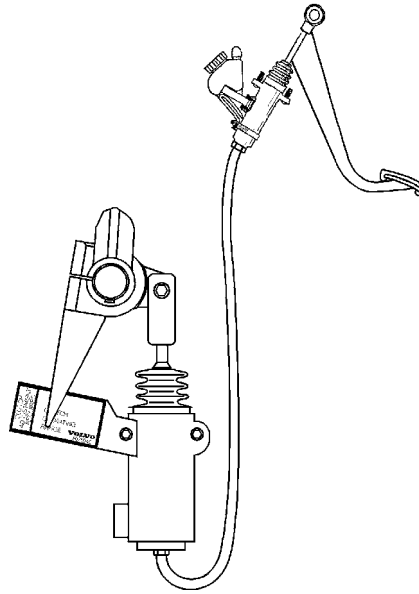
**Servo Failure**

If air pressure drops or the air system does not supply air pressure, the servo will continue to function on hydraulic pressure, however, this will require greater pedal effort.

**⚠ WARNING**

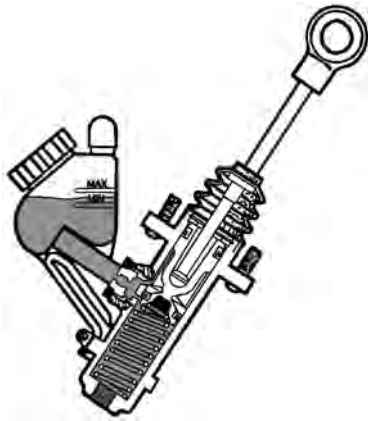
Increased pedal effort is required if servo air pressure is lost. Increased pedal effort may make the vehicle hard to control. Repair a damaged servo before driving vehicle. Driving a vehicle without servo air pressure could result in damage to the vehicle or personal injury.

## Master Cylinder with Slave Cylinder - Fuller or Rockwell Transmissions



W4000781

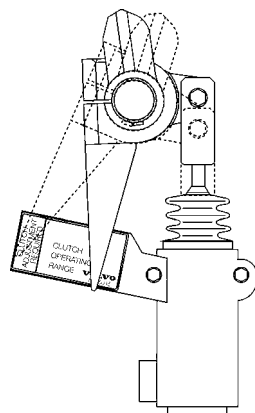
### Master Cylinder



W4000840

The clutch pedal activates the master cylinder. When the clutch pedal is depressed, the clutch rod moves downward pushing the plunger into the cylinder. Plunger movement into the cylinder forces the fluid through the hydraulic lines and into the clutch slave cylinder. As the plunger is forced into the cylinder, the fluid supply duct from the reservoir is closed. When the clutch pedal is released, the clutch rod and plunger returns to the rest position and the fluid supply duct opens.

### Slave Cylinder



W4000816

The slave cylinder is connected to the master cylinder through a steel braided hydraulic hose. The slave cylinder operates on the hydraulic pressure from the master cylinder. The adjustment indicator shows whether the clutch is properly adjusted.



# Service Procedures

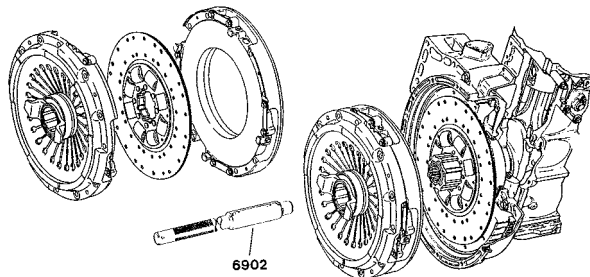
## Clutch removal

### Volvo clutch

Transmission removed from vehicle

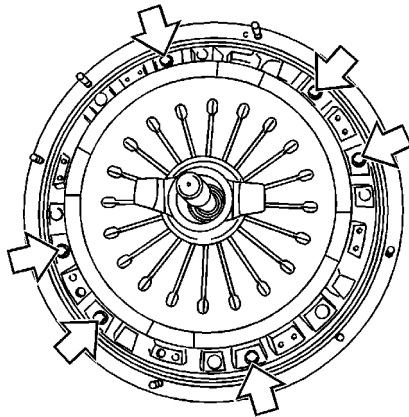
Other special equipment: 1821 Puller, 6857 Lifting tool, 6902 Centering drift

1



Install the centering drift 6902 into the clutch.

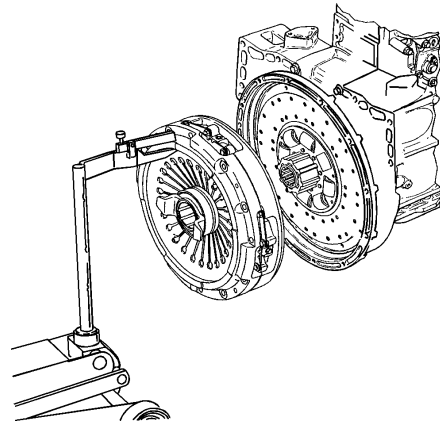
2



Loosen the pressure plate mounting bolts.

17 mm socket; ratchet

3



Using a floor jack with tool 6857, place the lifting hook of tool 6857 between the pressure plate spring and housing. Remove the clutch mounting bolts and remove the clutch from the flywheel.

4

Remove clutch from under the vehicle.

## Clutch plate changing and installation

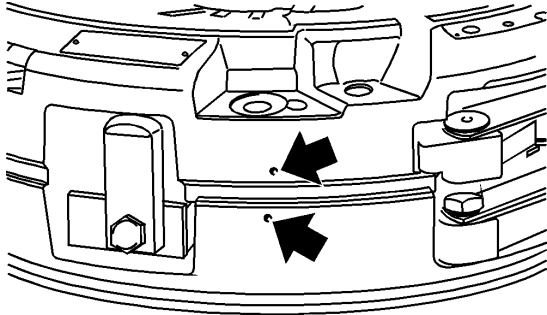
### Volvo clutch

Clutch removed from vehicle (double plate type clutch)

Part no.: 1161138 Heat resistant grease

Special tools: 6902 centering drift

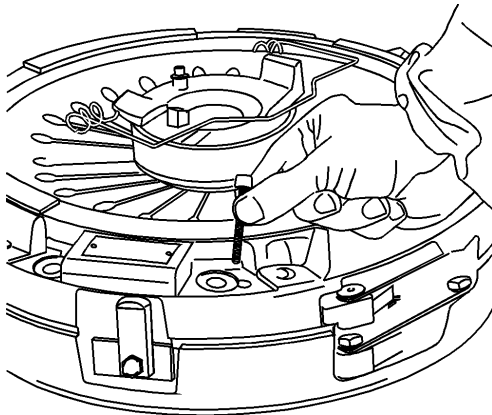
1



W4000791

Punch-mark the pressure plate housing and the intermediate plate for proper alignment.

2



W4000792

Remove the four hex head socket screws that hold together the pressure plate housing and intermediate plate. Remove the pressure plate housing and the gearbox side clutch plate.

6mm hex socket; ratchet

3

Inspect the clutch parts:

- Pressure plate housing
- Intermediate plate
- Clutch plates (engine side and gearbox side)
- Release bearing

**Note:** Refer to TSI Service Manual 411-600, Clutch, Pull-type — Volvo for additional clutch overhaul information.

4

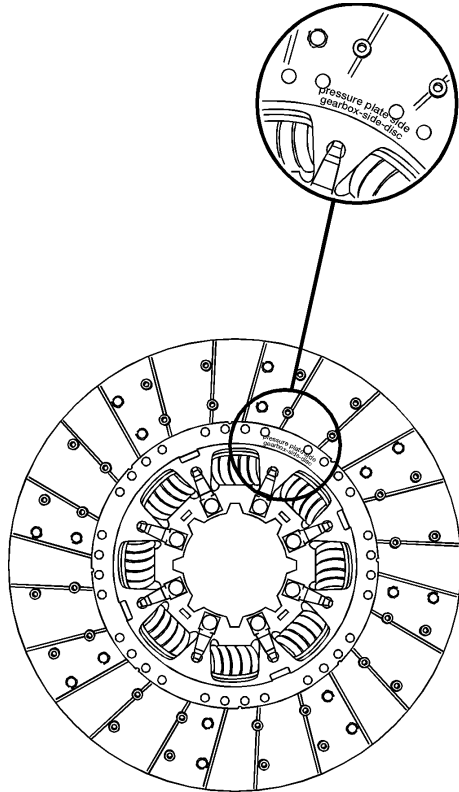
Grease input shaft spline with heat-resistant grease (p/n 1161138). Install the new engine side clutch plate on the input shaft. The side marked “Flywheel-side non asbestos” should be toward the flywheel. Pull the clutch plate backwards and forwards on the shaft to properly spread the grease.

6mm hex socket; ratchet; torque wrench

5

Remove the new engine side clutch plate from the input shaft. Remove any excess grease so it will not contaminate the clutch plates during operation.

6

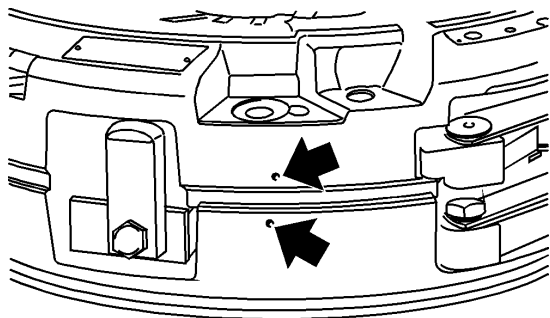


W4000795

Place the gear box side clutch plate on intermediate plate.

**Note:** The side marked “**pressure plate side**” should be toward the pressure plate housing (facing the gearbox).

7

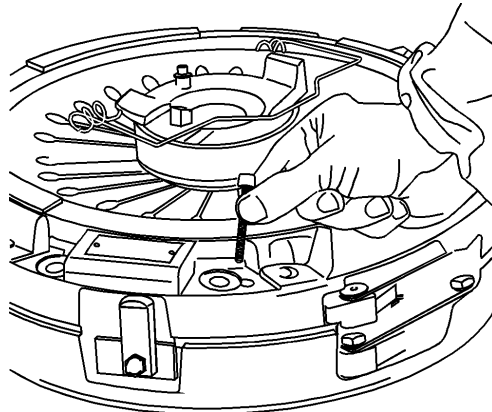


W4000791

Place the pressure plate on the intermediate plate and align the punch marks.

6mm hex socket

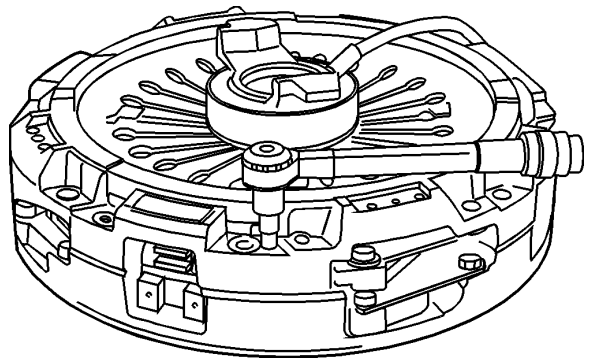
8



W4000792

Install the four hex head socket screws and tighten them evenly.

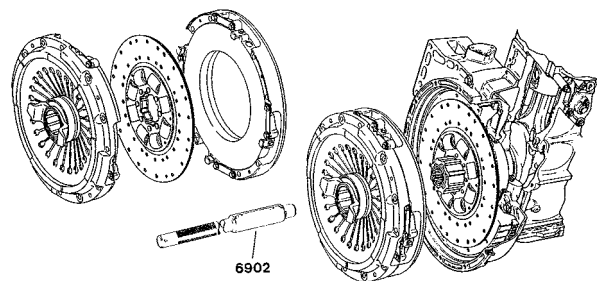
9



W4000796

Torque the hex screws to  $26 \pm 2$  Nm ( $19 \pm 1$  ft-lb).

10



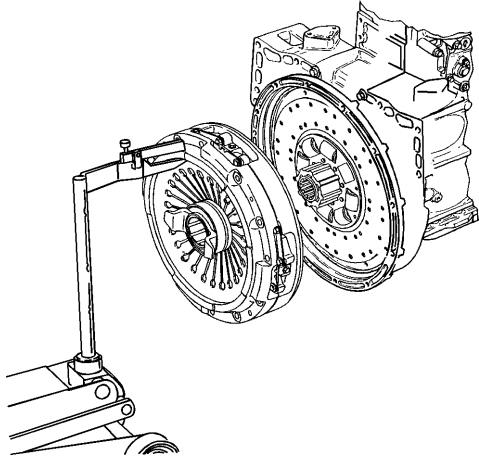
6902

T4006506

Using a floor jack with tool 6857, place the lifting hook of tool 6857 between the pressure plate spring and housing. Install the centering drift 6902 through the clutch and flywheel side clutch disc.

**Note:** “**Flywheel side**” must be facing the flywheel.

11



W4000790  
Install the clutch to the flywheel using 18 mm socket; centering drift 6902. Hand tighten bolts torque evenly to compress pressure plate. Torque the nuts to 85 Nm (63 ft-lb). 6857; 6902

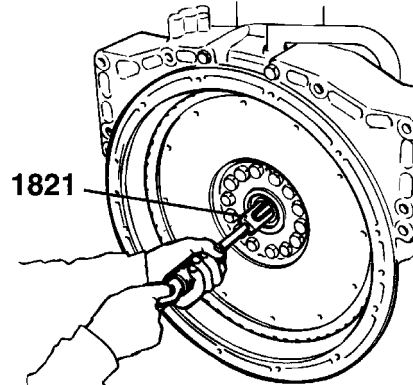
## Flywheel pilot bearing replacing

**VE D12 engine**

**Clutch removed**

**Special tools:** 1821 puller, 2564 drift, 6956 cranking tool

1

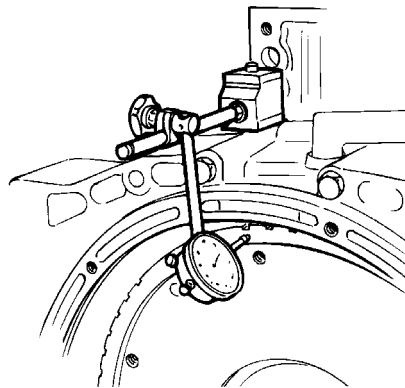


T2006733  
Remove the flywheel pilot bearing with puller 1821 tool 8121.

2

Clean the flywheel and check for damage.

3



T2006734  
Set up a dial indicator probe on the flywheel so that the probe is against the flywheel at a radius of 150 mm (5.9 in.) from the center. Set the dial indicator to zero (0). Rotate the flywheel with tool 6956. Note the reading on the dial indicator during flywheel rotation.

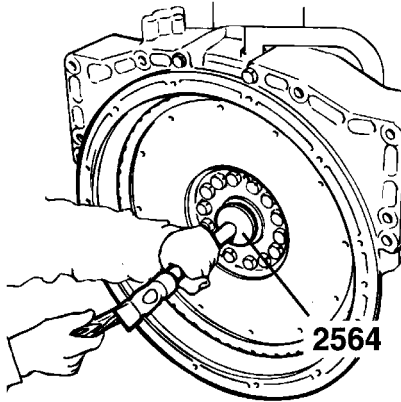


4

If the dial indicator reading exceeded 0.20 mm (0.0079 in.), remove the flywheel and inspect and clean the surface between the flywheel and the crankshaft.

**Note:** If the flywheel is out of specification after cleaning the crankshaft flange, the flywheel should be replaced. Refer to TSI Service Manual 210-600, Basic Engine, VE D12.

5

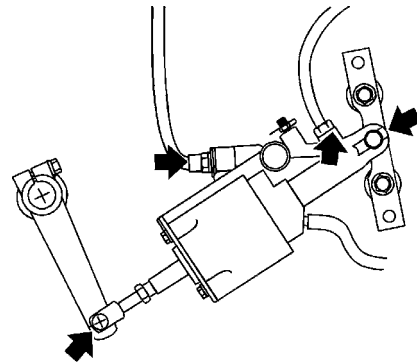


Install the new flywheel pilot bearing using drift 2564.

2564

## Volvo clutch servo removal

1

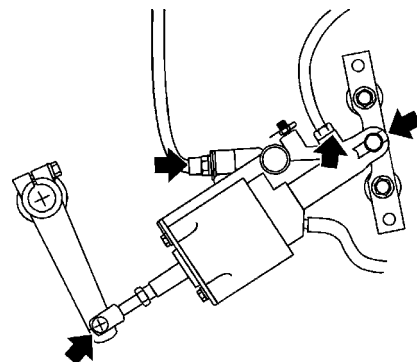


W4000867

Remove the air line to the servo cylinder. Remove the cotter pins from the front and rear clevis pins and remove both clevis pins. Lower the servo to the floor.

pliers

2



W4000867

Disconnect the vent line and the hydraulic line from the servo cylinder.

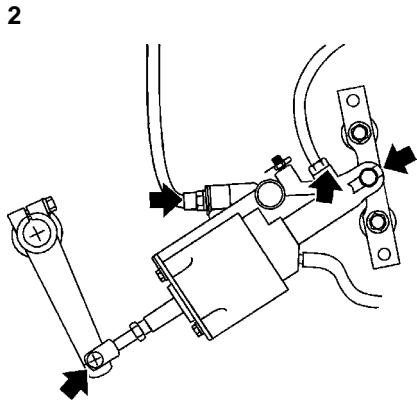
**Note:** A suitable drain pan will be needed to catch leakage from the hydraulic line.

19 mm open end wrench;  
17 mm open end wrench

## Volvo clutch servo installation

**1**  
Position the servo cylinder into place and hand tighten the hydraulic line.

**Note:** Install a new O-ring on the hydraulic line connection.



W4000867

Install the front and rear clevis pins and secure with cotter pins.

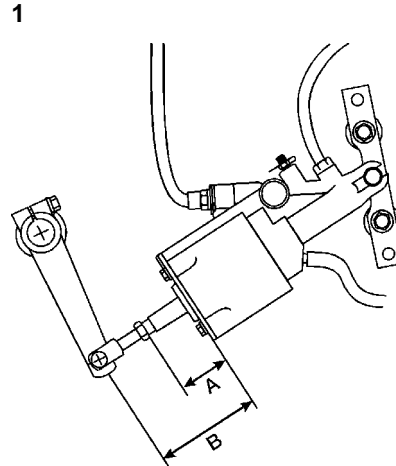
pliers

**3**  
Tighten the hydraulic line and connect the air and vent lines. Torque the hydraulic connector to 45 Nm (33 ft-lb) and the air line to 24 Nm (18 ft-lb).

19 mm open end wrench;  
17 mm open end wrench;  
17 mm crows foot socket;  
torque wrench

**4**  
Bleed the air from the servo and clutch system using the clutch bleeding procedure.

## Volvo clutch servo adjustment



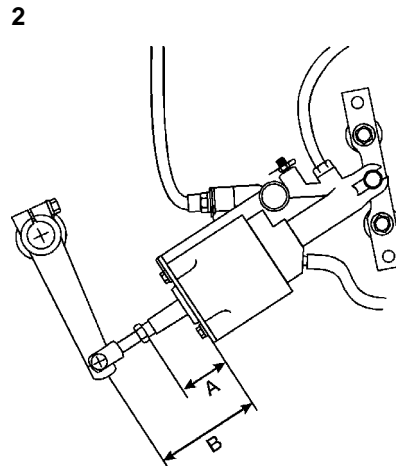
W4000824

Measure the distance "A" from the clutch servo end to the lock nut. Adjust to 55 ± 1.5 mm (2.17 ± 0.05 in.).

15 mm wrench; 19 mm wrench; ruler

### CAUTION

Improper clutch operation. If the distance above is too long, the clutch may not fully disengage. If the distance is too short, the clutch may not fully engage.



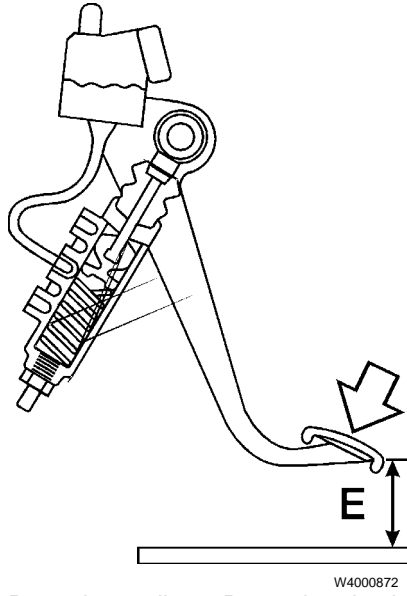
W4000824

Measure the distance "B" between the clevis pin center and the end of the clutch servo. If the distance exceeds 115 mm (4.5 in.) re-indexed the clutch arm on the cross shaft to adjust.

ruler

**Note:** Only when the clutch arm has been removed is this adjustment necessary.

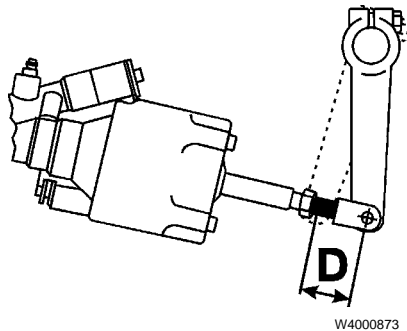
3



Pre-select splitter. Press the clutch pedal until just before the splitter shifts and measure from the upper edge of the clutch pedal to the floor (E). Press the clutch pedal until it strikes the lower stop screw and re-measure from the upper edge of the clutch pedal to the floor. The pedal movement from splitter to lower stop screw should be  $40 \pm 5$  mm ( $1.5 \pm 13/64$  in.).

ruler

4

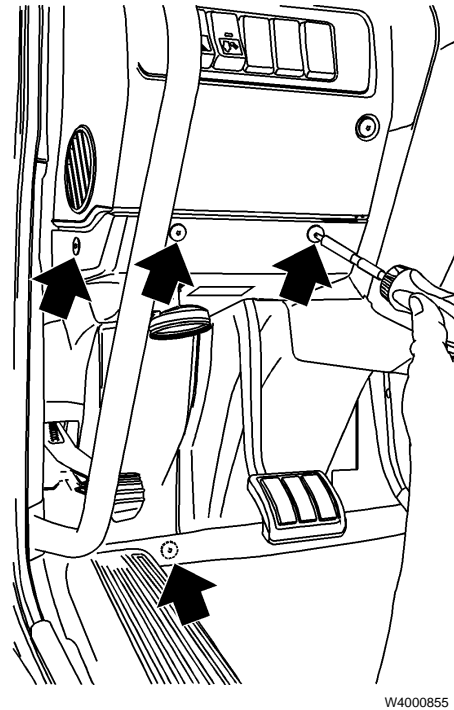


Measure the clutch servo stroke (D). Stroke should be 27–29 mm ( $1 \frac{9}{16}$ – $1 \frac{9}{64}$  in.).

ruler

## Master cylinder removal

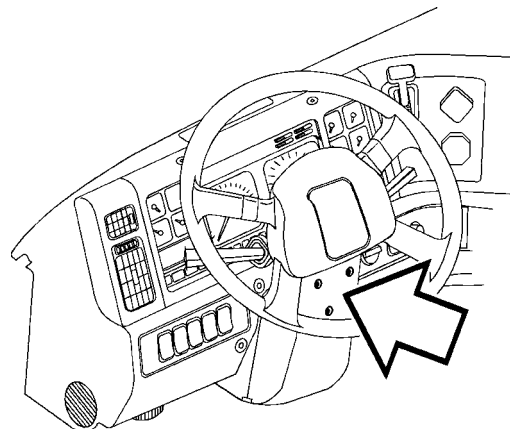
1



Pull the floor mat back and remove the plastic nuts fastening the left panel. Remove the three torx screws and the diagnostic connector. Pull the heater hose out of cover and remove the cover.

10 mm socket;  
6" extension;  
20 torx bit

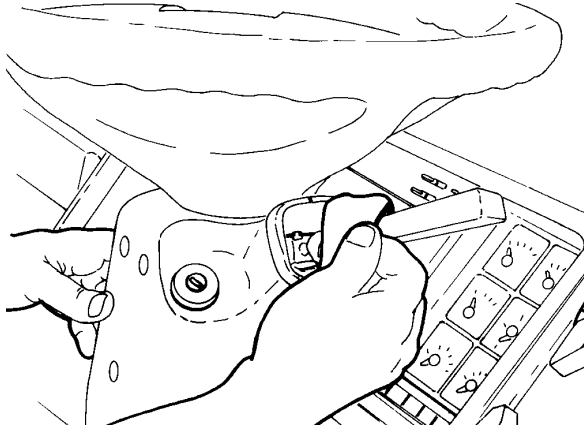
2



Remove the cover on the steering wheel column by removing the ignition key and the three torx screws.

20 torx bit; 3" extension

3



W3000654

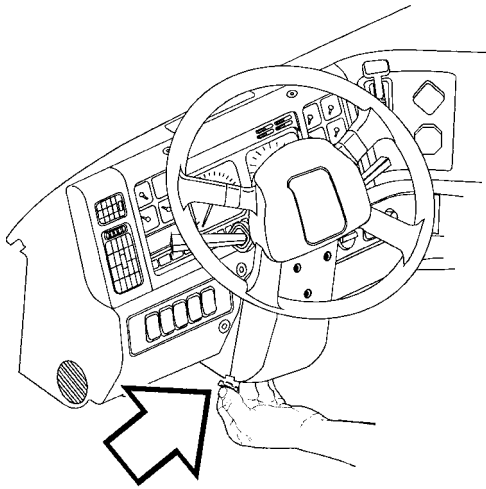
Pull the dust covers back on the turn signal and windshield wiper stalks.

4

Remove four torx screws from the center dash cover. Pull the floor mat back and remove the plastic nut.

10 mm socket;  
6" extension;  
20 torx bit

5

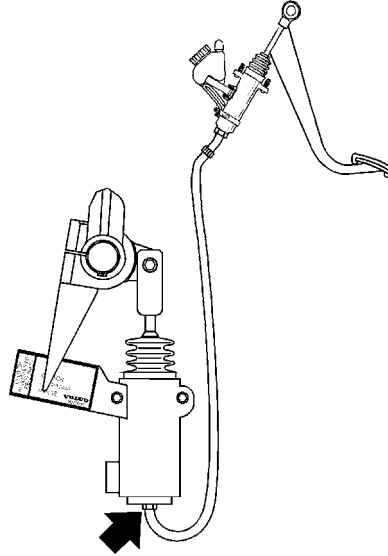


W3000655

Remove the two clips at the bottom of the steering column. Remove the cover over the lower steering column by removing the plastic rivets.

**Note:** Be careful not to damage the lower cover when removing.

6

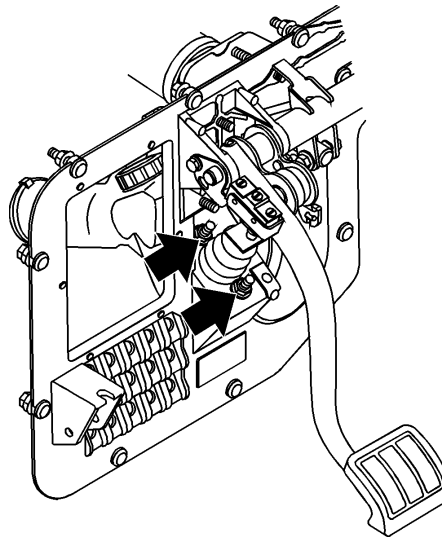


W4000851

Loosen and remove the fluid line from the slave cylinder. Drain the brake fluid into a drain pan or suitable container. Install the fluid line back onto the slave cylinder to keep contaminants out of the system.

19 mm open end wrench;  
17 mm open end wrench

7



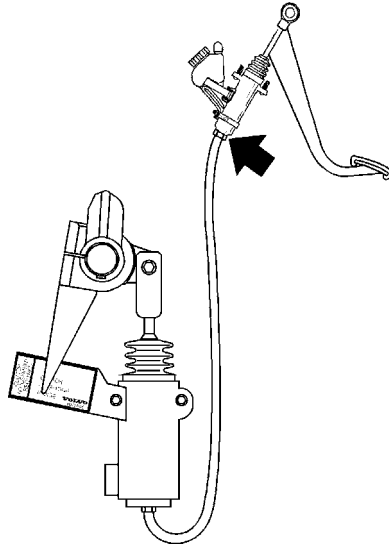
W4000819

Remove the clutch pedal return spring to access the two master cylinder mounting bolts.

13 mm deep swivel;  
ratchet; 6" extension

**Note:** Depress the clutch pedal for easier access to the mounting bolts.


8



W4000809

Remove the fluid line and remove the master cylinder from the pedal plate assembly.

**Note:** Remove O-ring between the master cylinder and the pedal plate assembly.

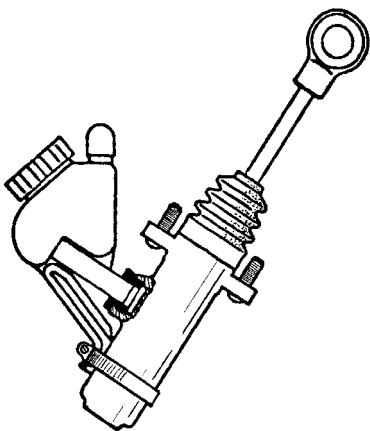
 <b>CAUTION</b>
Brake fluid can cause damage to paint and painted surfaces.

9

Remove 45 degree angle fitting from master cylinder.

17 mm open end wrench;  
12 mm open end wrench

10



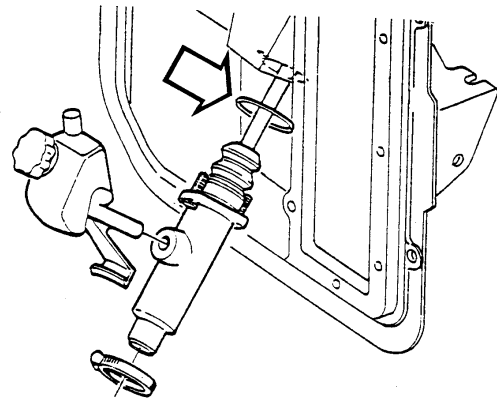
T4006730

Remove the band clamp holding the reservoir. Remove the reservoir by pulling the reservoir out of the rubber seal.

7mm socket

## Master cylinder installation

1



T4006731

Install reservoir on the master cylinder and secure with band clamp. Torque band clamp to 3 Nm (26 in-lb).

7mm socket;  
ratchet

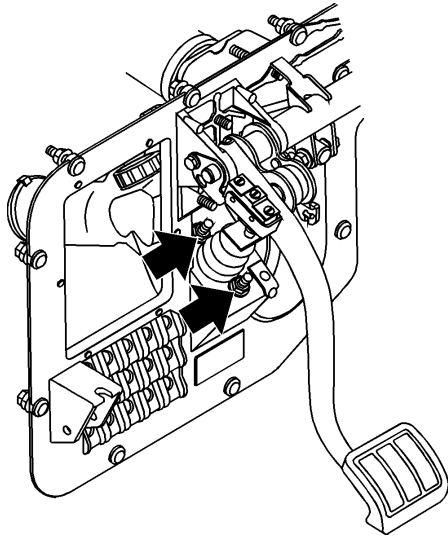
**Note:** Lubricate the mount tube on the fluid reservoir (which connects to the master cylinder's rubber seal) before the reservoir is fitted to the master cylinder. Use grease p/n 8775046 or 8708640.

2

Clean the 45 degree angle fitting and install it hand tight on the master cylinder. Use pipe sealant on the fitting.

12 mm open end wrench

3



W4000819

Install master cylinder. Make sure the O-ring is fitted around the neck of the master cylinder before the cylinder is inserted into the pedal plate assembly. Press the clutch pedal down to access the two mounting bolts. Torque mounting bolts to  $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb).

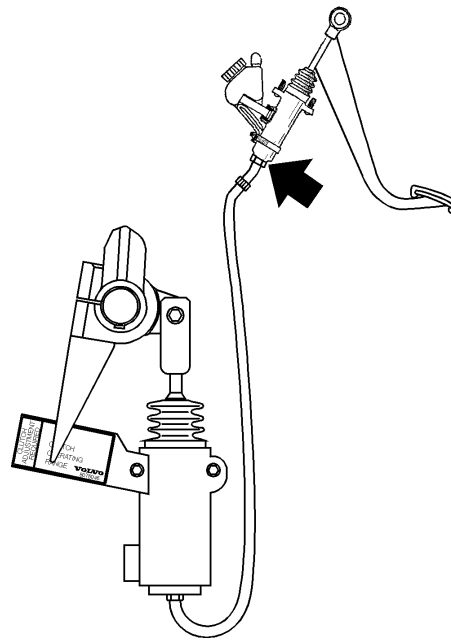
13 mm deep swivel; 6" extension; torque wrench

4

Install the clutch pedal return spring.

**Note:** Lubricate the spring end with grease p/n 8708166.

5

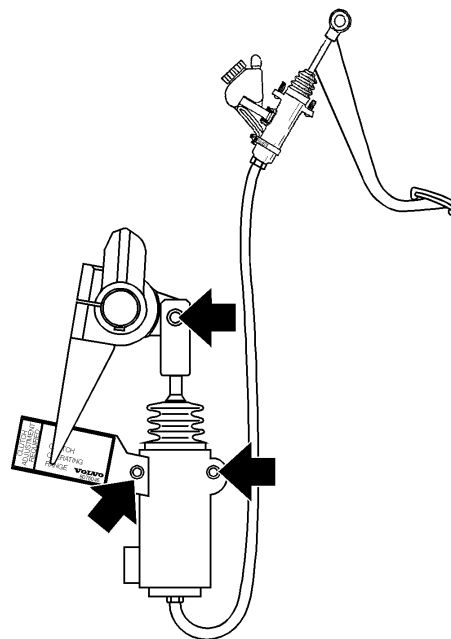


W4000850

Tighten 45 degree fitting to proper angle and install the fluid line with a new O-ring. Torque fluid line to  $40 \pm 5$  Nm ( $30 \pm 4$  ft-lb).

12 mm open end wrench; 17 mm open end wrench; 17 mm crow foot

6

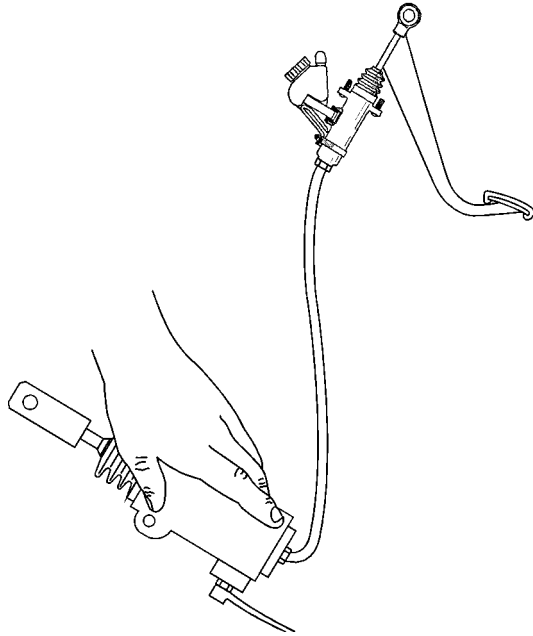


W4000870

Remove the two slave cylinder mounting bolts and the clevis pin.

12 mm socket; ratchet; pliers

7

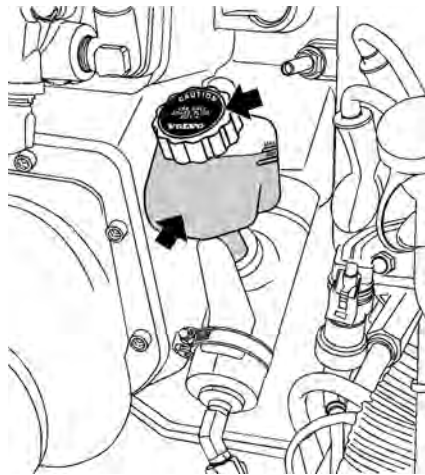


W4000810

Open the bleed screw and connect the bleed tool. Clean the reservoir filler cap area and remove the cap. Hold the slave cylinder with the bleeder screw at the lowest point and turn the bleed pump on.

10 mm wrench; bleed tool 6928

8



W4000811

Stop bleeding when the fluid is at the minimum level indicated on the side of the reservoir. Close the bleeder screw. Torque bleed screw to 10 Nm (7 ft-lb).

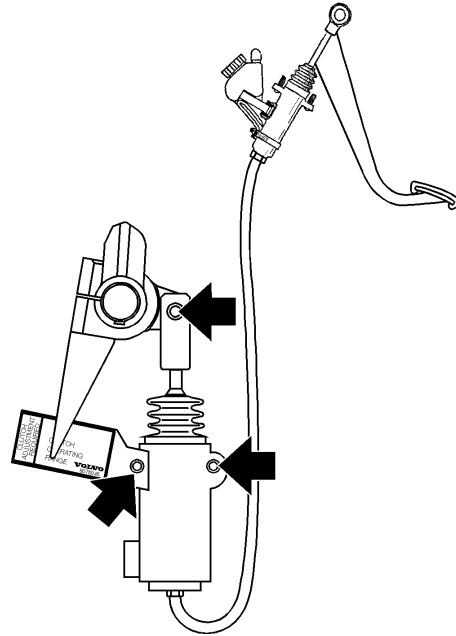
10 mm wrench

**Note:** Use clean DOT 4 fluid only.

9

Disconnect the bleeder tool and remove.

10



W4000870

Install the clevis pin and the slave cylinder mounting bolts with the operating range tag. Torque the mounting bolts to 35 Nm (26 ft-lb).

12 mm socket; pliers

11

Check for the correct operation of the clutch. Re-check fluid level.

12

Install the lower steering column cover with plastic rivets (pull floor mat back to position the cover over the studs).

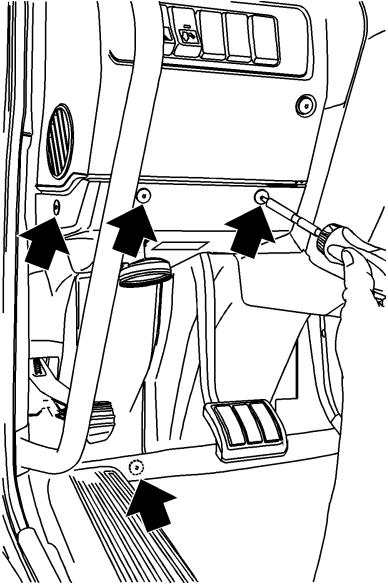
**Note:** Be careful not to damage the cover when installing.

13

Install three torx screws and the plastic nut on the center of the lower dash cover.

10 mm socket; 6" extension; 25 torx driver

14

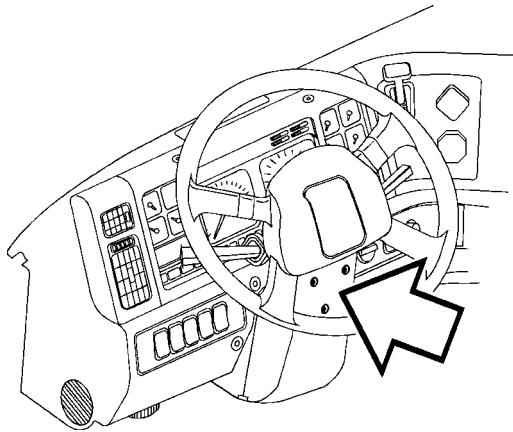


W4000855

Install the left panel. Install the diagnostic connector. Install the heater hose, three torx screws and the plastic nut.

20 torx driver;  
10 mm socket;  
6" extension;  
ratchet

15

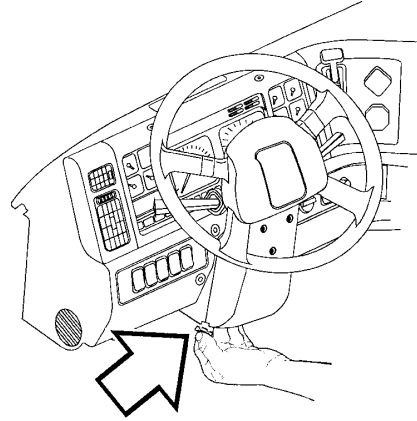


W3000648

Install the upper cover on the steering column with three torx screws.

20 torx driver

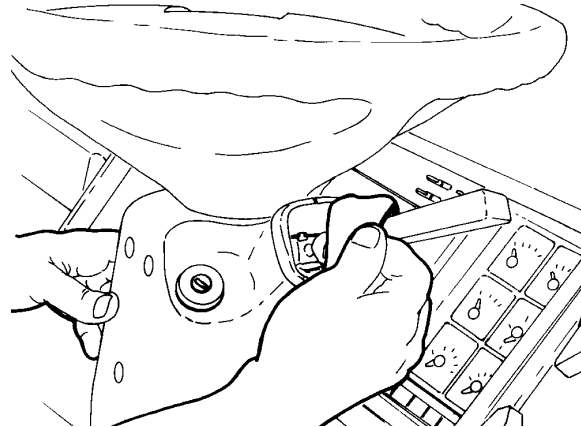
16



W3000655

Install the two clips at the bottom of the steering column cover.

17



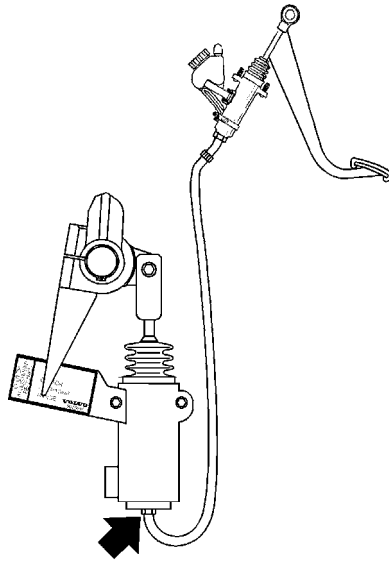
W3000654

Put the dust covers in place on the turn signal and windshield wiper switches.



## Clutch slave cylinder removal

1



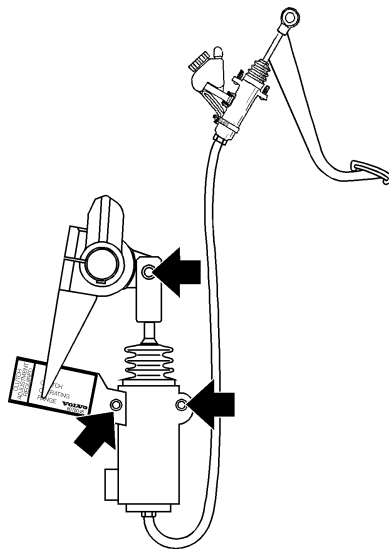
W4000851

Remove the fluid hose from the slave cylinder.

19 mm open end wrench

**Note:** Use a catch pan to drain the fluid.

2



W4000870

Remove the slave cylinder mounting bolts with the operating range indicator. Remove the clevis pin.

12 mm socket; ratchet

3

Remove the fluid hose fitting.

19 mm wrench

## Clutch slave cylinder installation

1

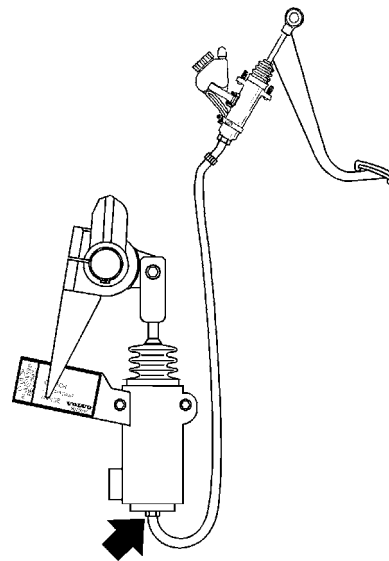
Install a new sealing washer on the fluid hose fitting and install the fitting. Torque the fitting to 20 Nm (15 ft-lb).

19 mm open end wrench; 19 mm crow foot

2

Mount the slave cylinder to the transmission temporarily with the two mounting bolts.

3



W4000851

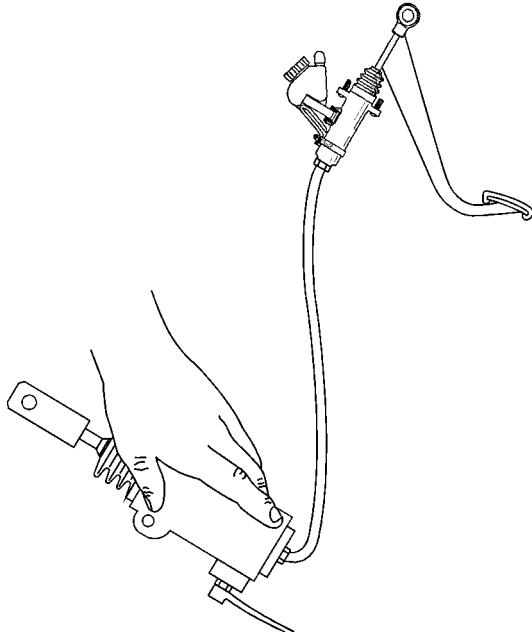
Install the fluid hose with a new O-ring. Torque the hose to  $40 \pm 5$  Nm ( $30 \pm 4$  ft-lb).

19 mm open end wrench; 17 mm open end wrench; 17 mm crow foot

4

Remove the slave cylinder for bleeding.

5

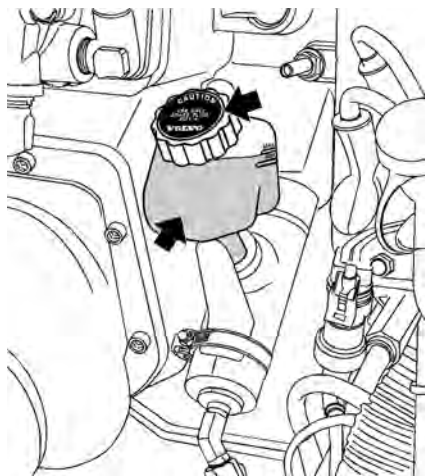


W4000810  
6928

Plug power cord into cigarette lighter. Place bleeder tool into brake fluid container. Open the bleed screw and attach the bleeder hose to the bleeder screw on the slave cylinder. Clean the reservoir filler cap area and remove the cap. Hold the slave cylinder with the bleeder screw at the lowest point and turn the bleed pump on.

**Note:** 24V motor working at half speed.

6



W4000811

Stop the bleed when the fluid is at the minimum level indicated on the side of the reservoir. Close the bleeder screw. Torque the bleeder screw to 10 Nm (7 ft-lb).

**Note:** Use DOT 4 fluid only.

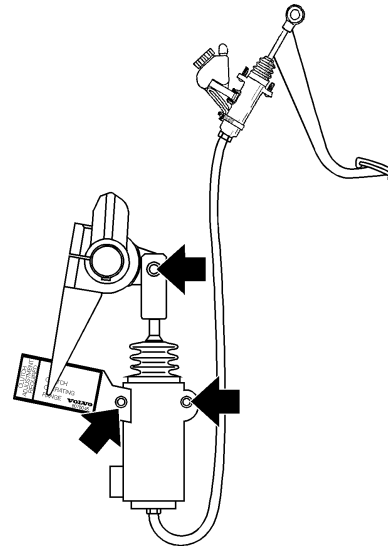
7

Disconnect the bleeder tool and remove.

8

Install clevis pin with new cotter pin.

9



W4000870

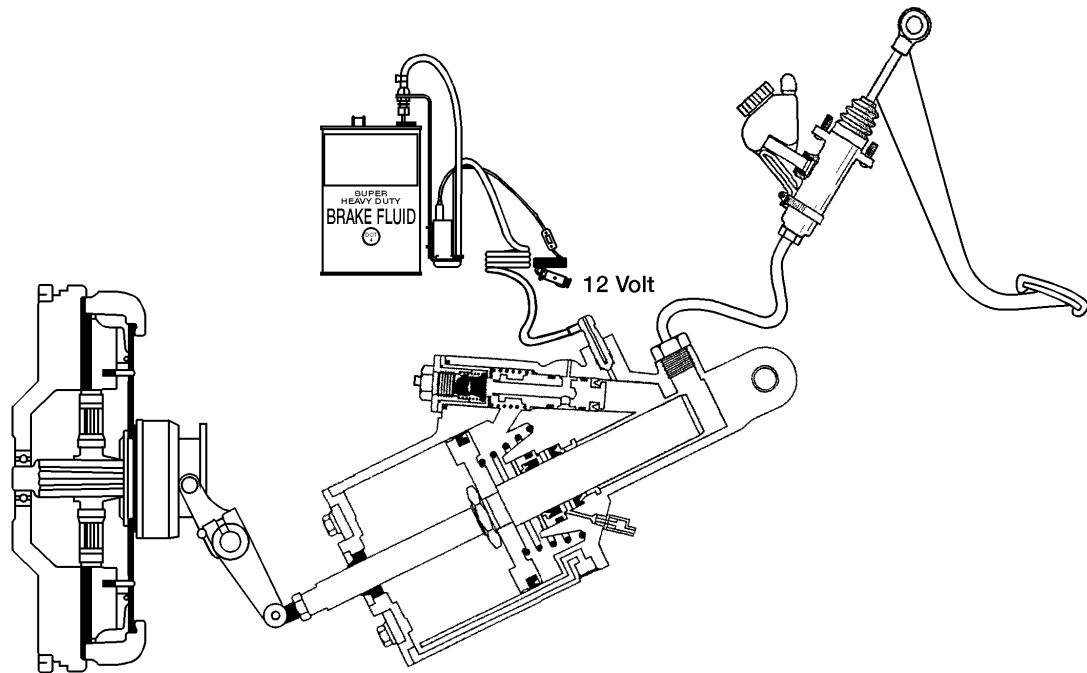
Install slave cylinder with the two mounting bolts. Be sure to install operating range indicator. Torque bolts to 35 Nm (26 ft-lb).

12 mm socket

10

Check for proper clutch operation. Re-check fluid level.

## Clutch bleeding procedure



**1**  
Place the pick-up tube in a 4 liter (one 6928 gallon) can of DOT 4 brake fluid.

**2**  
Plug the fluid pump wire into the dash cigarette lighter receptacle.

**3**  
Connect the bleed hose to the slave cylinder bleed nipple.

**4**  
Loosen the bleed nipple about one 11 mm wrench turn and use the metal "C" clamp to lock the bleeder hose onto the nipple.

**5**  
Remove the reservoir cap.

**6**  
Using the ON/OFF switch on the wire, turn ON the switch to start the pump. When the fluid has reached the level of the reservoir FULL mark, turn OFF the pump.

**Note:** Watch the fluid level in the reservoir to avoid it overspilling onto the paint.

**7**  
Close the bleeder nipple. Remove the 11 mm wrench clamp and hose. Torque the nipple to  $10 \pm 2.5$  Nm ( $7 \pm 1.8$  ft-lb).

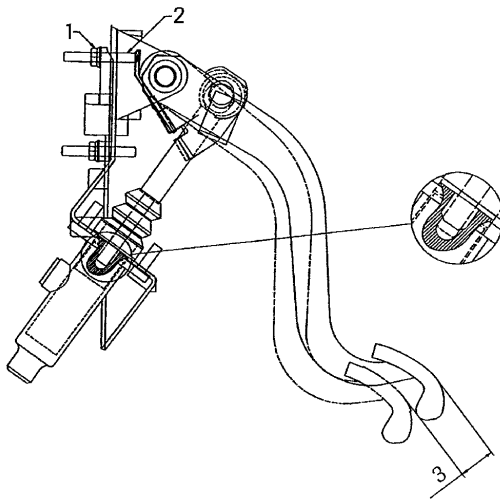
**8**  
Check the clutch operation.

**9**  
Check the fluid level and top off as necessary. Replace the cap.

W4000836

## Upper clutch pedal adjustment

1



W4000799

Measure the play (3) in the clutch pedal at the free position. Adjust the upper screw (2) until 4–8 mm (5/32–5/16 in.) play is obtained.

13 mm wrench; 4 mm Allen wrench

**Note:** Clutch pedal play is the clearance between the clutch rod and the piston in the master cylinder. Clutch adjustment does not affect pedal play.

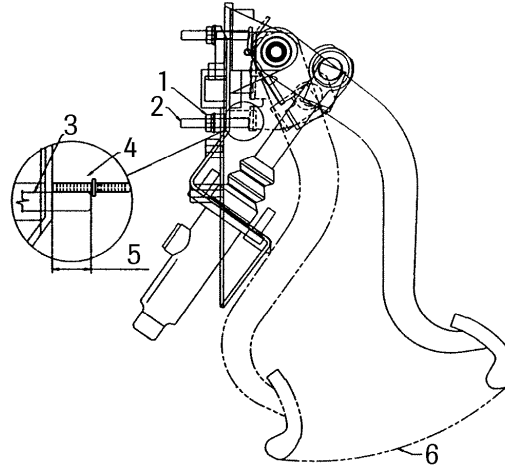
2

Torque jam nut (1) to 24 Nm (18 ft-lb).

13 mm deep socket; 10" extension; torque wrench

## Lower clutch pedal adjustment

1



W4000798

Insert the measuring instrument through the opening in the panel for the clutch pedal. Measure the amount the adjusting screw extends from the inside of the casting. Adjust the lower screw (2) until it extends 19 mm (3/4 in.) from the inside of the casting.

13 mm wrench; 4 mm Allen wrench

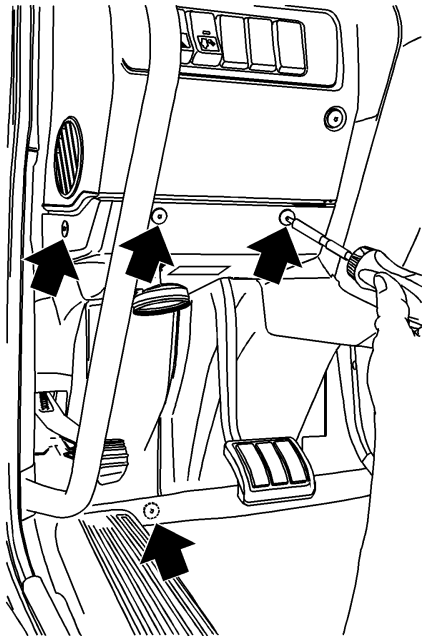
2

Torque jam nut (1) to 24 Nm.

13 mm deep socket; 10" extension; torque wrench

## Micro-switch adjustment

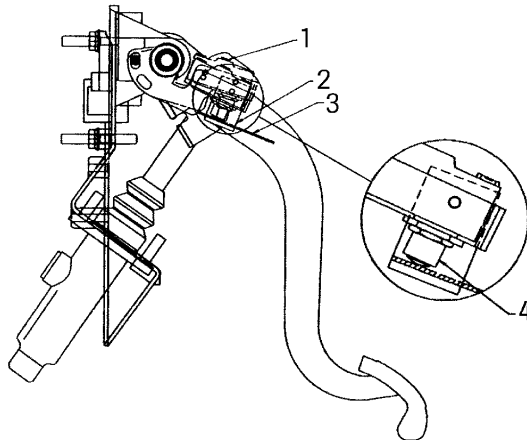
1



Remove the left side clutch pedal panel.

10 mm  
wrench; torx  
bit 25

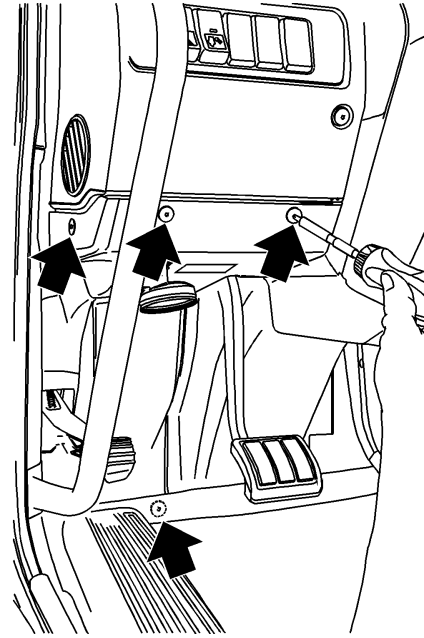
2



With the clutch pedal in the free position, place a 3 mm thick feeler gauge on top of the L-bracket. Rotate the micro switch assembly down until the switch bottoms out, then tighten the mounting screw. Torque to 10 Nm (7.5 ft-lb).

10 mm wrench

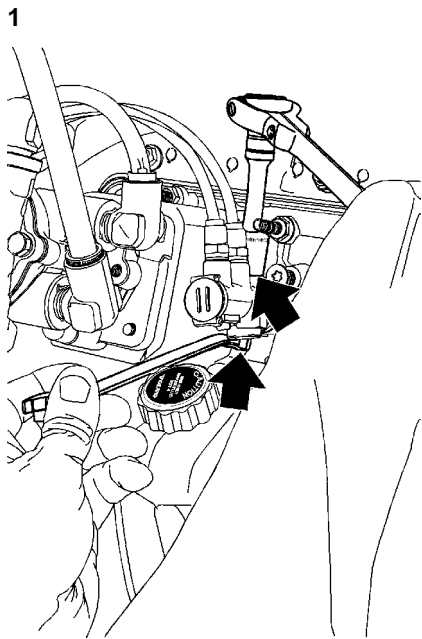
3



Install the left side clutch pedal panel.

25 torx bit

# Inhibitor valve splitter adjustment

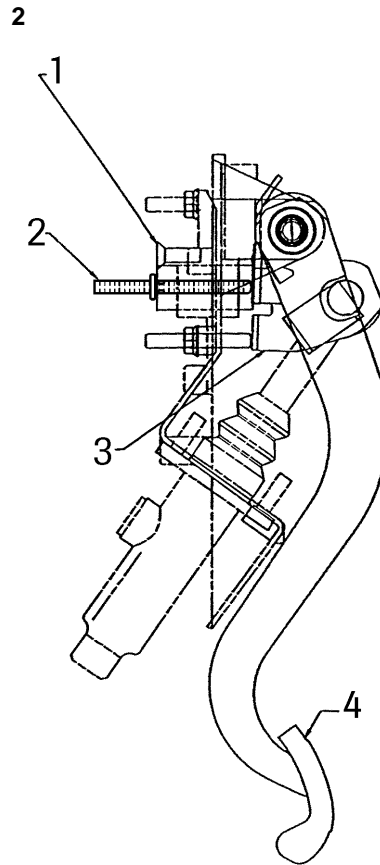


W4000818

**Note:** The lower clutch pedal adjustment must be performed before the inhibitor valve adjustment can be made.

Loosen the pinch bolt and nut. Remove the inhibitor valve.

13 mm socket;  
13 mm  
wrench;  
ratchet; 3" ex-  
tension



W4000800

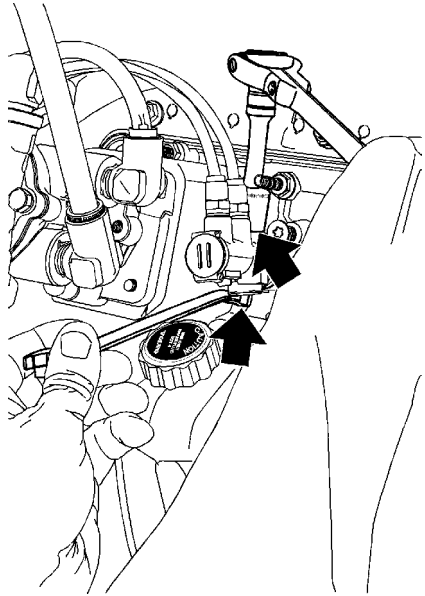
**Note:** This procedure requires two technicians.

Fully depress the clutch pedal until it contacts the stop (3) and hold it there.

**3**  
Insert a ruler into the inhibitor valve hole until it is against the clutch pedal lever. Adjust the flat head adjusting screw (1) to a distance of 53.5 mm (2.10 in.) from the flat of the screw head to the depressed clutch pedal lever.

metric ruler;  
#40 torx bit;  
ratchet

4



W4000818

Remove the ruler and slide the inhibitor valve into its bore. Slide the valve in until it bottoms against the flat head adjusting screw. Tighten pinch bolt and nut to a torque of 24 Nm (18 ft-lb).

13 mm socket;  
13 mm  
wrench;  
torque  
wrench; 3" ex-  
tension

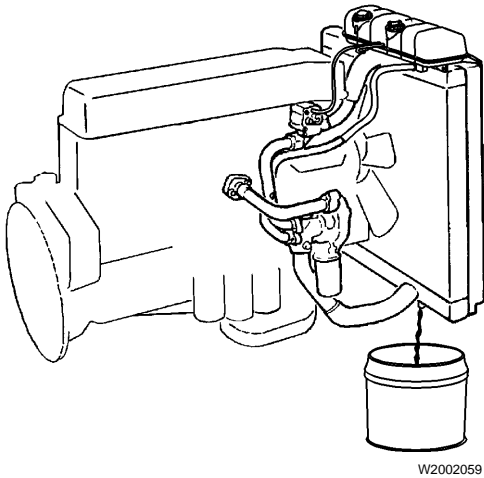
**Note:** Apply grease around the outside diameter of the valve before installation.

# Transmission removal

## Volvo transmission

Other special equipment: Transmission jack

1



W2002059

**⚠ DANGER**

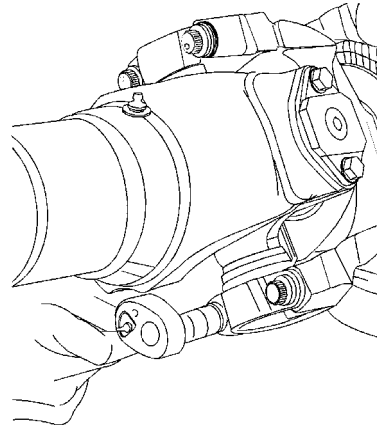
Risk of poisoning. Coolant is toxic. Do not drink coolant. Use proper eye and hand protection when handling. Keep coolant out of reach from children and animals.

**⚠ WARNING**

Risk of burns. Engine and fluids may be hot. Never remove the coolant drain plug or the expansion tank cap when the engine is hot. Allow the engine to cool before servicing.

Drain the coolant from the radiator. The drain is located on the bottom of the radiator.

2



W4000782

Disconnect the rear slip-yoke by disconnecting the U-joints (four bolts) located behind the center bearing support. 1/2" socket

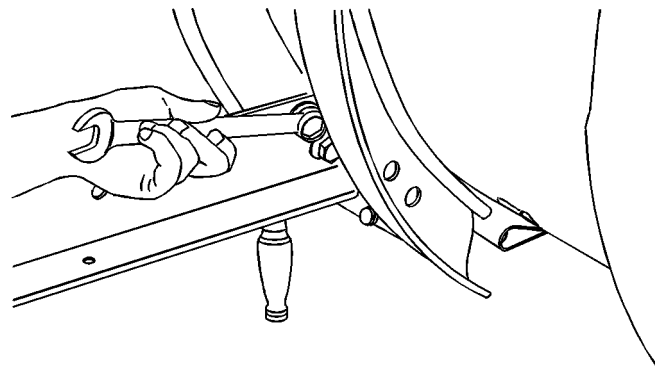
3

Disconnect the U-joint at the transmission yoke. 1/2" socket

4

Remove center bearing support (two bolts). 11/16" socket;  
5/8" wrench  
ratchet

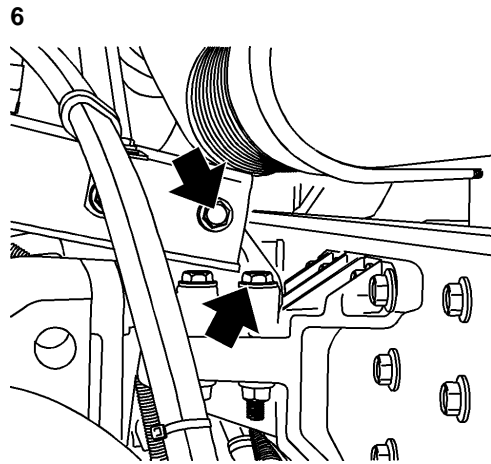
5



W4000806

Remove fuel tank brace. 18 mm socket;  
15 mm  
wrench ratchet

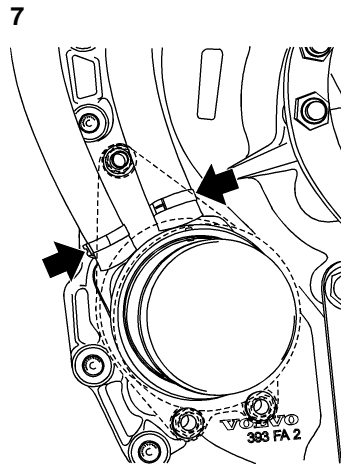




W4000807

Remove the engine cross member from the top cover of the engine nodal mounts.

18 mm socket/  
wrench; 15  
mm socket/  
wrench



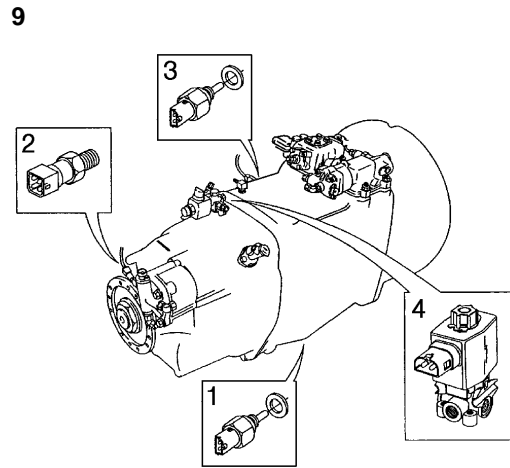
W4000783

Remove the transmission oil filter cover to access the coolant hoses. Cut the hose clamp to remove the hoses.

14 mm socket;  
side cutters

8  
Remove the coolant hose support brackets.

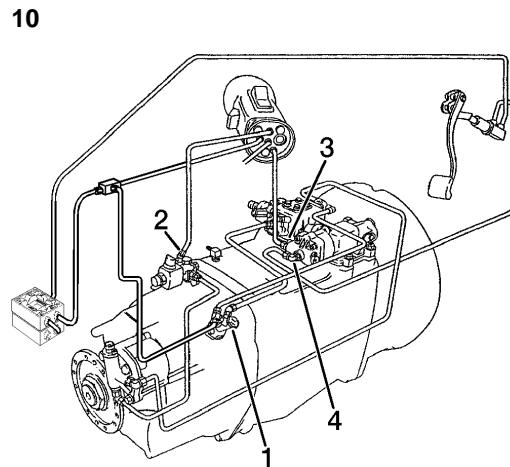
13 mm socket;  
10 mm socket;  
ratchet



W4000860

Disconnect the wire harness from the following sensors and cut the wire ties.

- 1 Transmission temperature sensor
- 2 VSS (vehicle speed sensor)
- 3 Reverse lamps sensor
- 4 Range solenoid

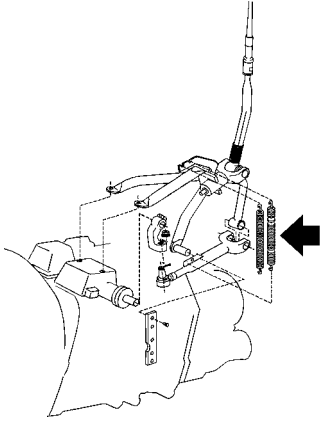


W4000861

Remove air lines (1 through 4) and "L" brackets.


3/8" open end  
wrench; 5/8"  
open end  
wrench; 18  
mm open end  
wrench

11

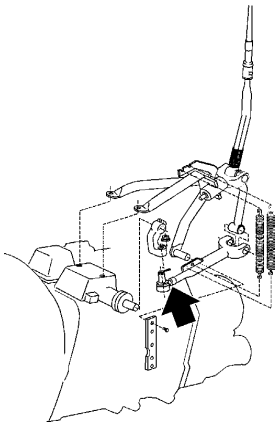


W4000846

Remove the two springs on the shifter. pry bar

 <b>WARNING</b>
<p>High spring tension. Risk of flying debris. Always use proper eye and hand protection.</p>

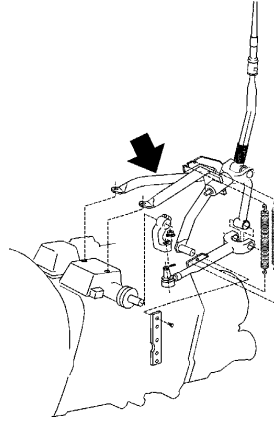
12



W4000847

Remove the cotter key at the rod end nut of the shift linkage. Remove the rod end nut. Remove the rod end from the side control lever. side cutters; 19 mm wrench

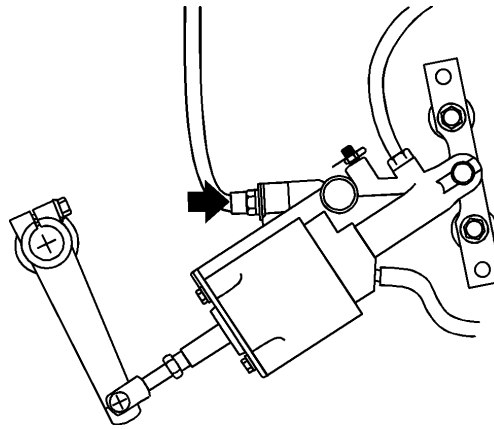
13



W4000848

Remove the shifter support assembly. Move the shifter linkage to the side, out of the way. 14 mm socket

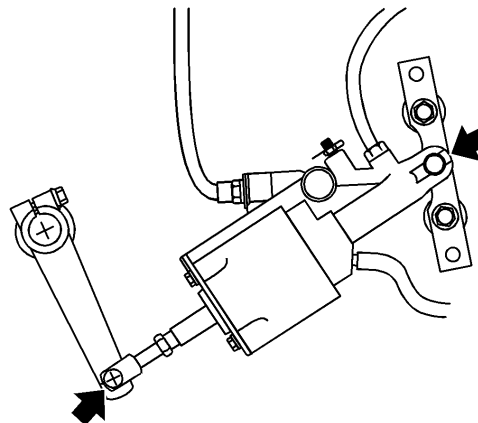
14



W4000862

Remove the servo air supply line. 5/8" open end wrench; side cutters

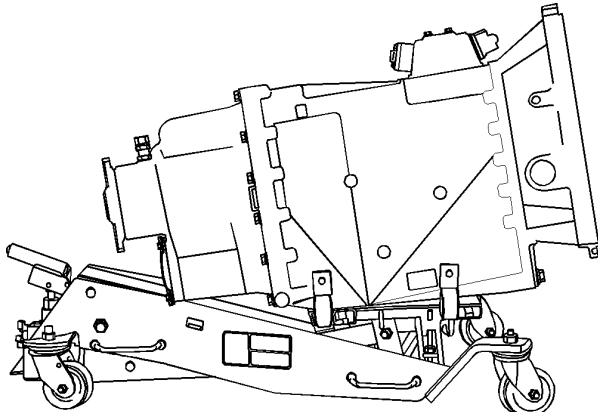
15



W4000863

Remove the two clevis pins securing the servo. Move the servo to the side, out of the way. side cutters

16

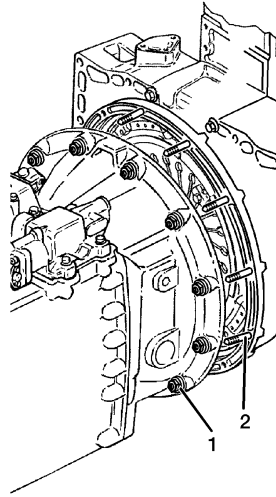


W4000788

Place a transmission jack under the transmission. Secure the transmission to the jack.

transmission jack; 18 mm socket

17



W4000828

- 1 Nut
- 2 Stud

Remove the transmission mounting bolts and remove the transmission from the engine.

18 mm socket; extension

**⚠ WARNING**

Transmission is top heavy and may be unstable. Failure to remove the transmission carefully could result in damage to the transmission and personal injury.

18

Remove the transmission from under the truck.

**Note:** In some applications it may be necessary to raise the vehicle with a floor jack and jack stands. This is for the transmission and transmission jack to be able to clear the vehicle frame.

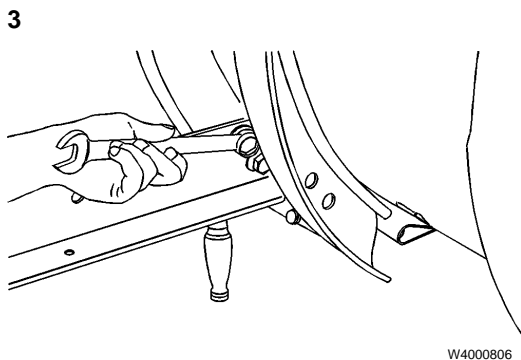
# Non-Volvo transmission

This procedure is meant to be a guide for removing non-Volvo transmissions. Refer to the transmission manufacturer's literature for more information.

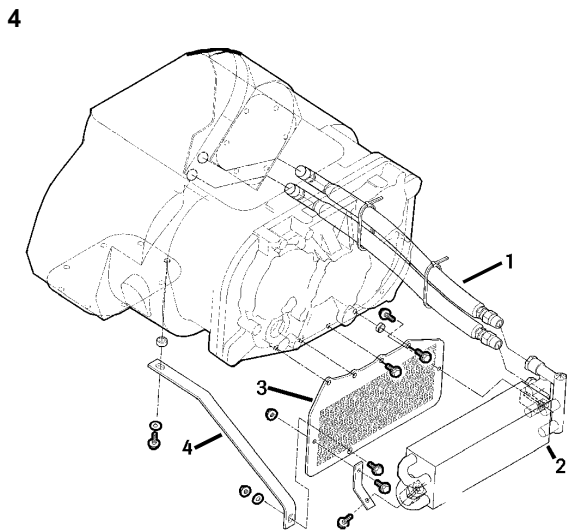
## Other special equipment: Transmission jack

**1**  
Remove the battery cable. 9/16" open end wrench

**2**  
Remove the drive shaft, center bearing and U-joint at the rear of the transmission. 1/2" 12 point socket; 15 mm socket; 18 mm wrench

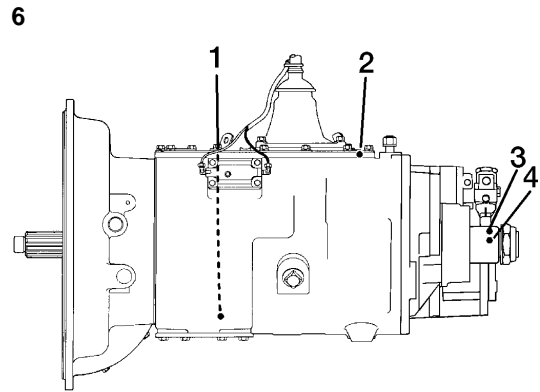


Remove the fuel tank brace. 15 mm socket; 18 mm wrench



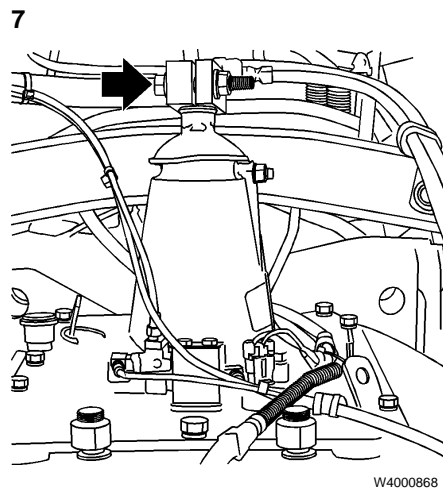
Remove the oil cooler and the oil cooler hoses at the transmission. 9/16" socket; 9/16" wrench; 5/8" wrench; 7/8" open end wrench

**5**  
Remove the necessary air lines and tie down clamps. 6 mm hex socket; 12 mm socket; side cutters



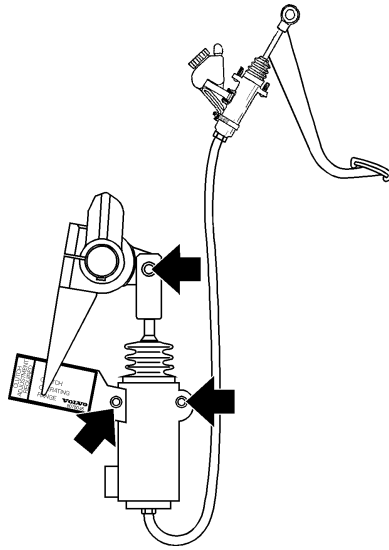
- 1 temperature sender
- 2 reverse light sender
- 3 vehicle speed sensor (ECU)
- 4 vehicle speed sender (speedometer)

Remove the wires at the sensor connectors and tie down clamps. side cutters; 9/16" socket



Remove the gear shifter lever by loosening the clamp bolt on the shift tower. 11/16" socket; 5/8" wrench

8

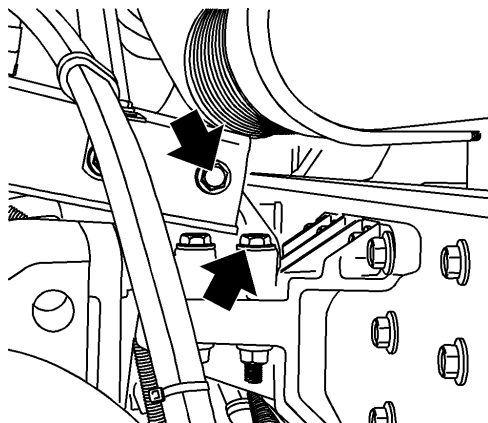


W4000870

Remove the slave cylinder by removing the clevis pin and the two mounting bolts.

12 mm socket; pliers

9



W4000807

Remove the cross member and the top half of the engine/transmission nodal mounts.

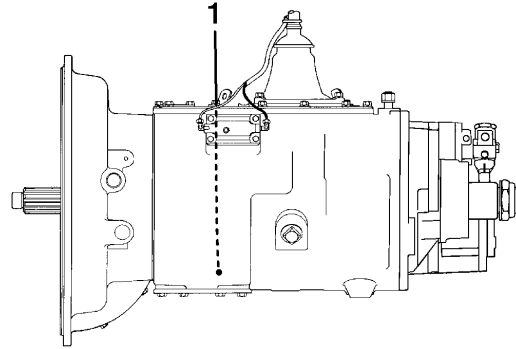
15 mm wrench/socket; 18 mm wrench/socket; extension

10

Drain gear oil into a suitable container.

1/2" drive ratchet; drain pan

11



W4000869

1 temperature sender

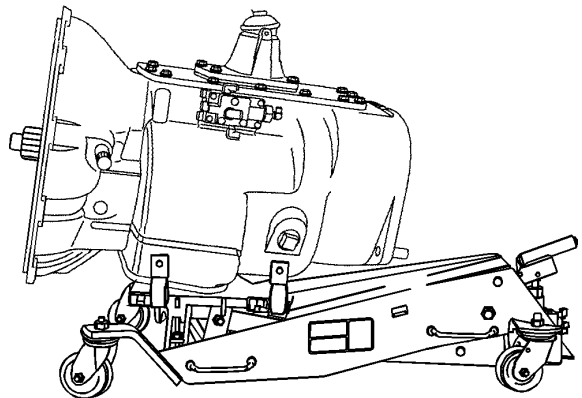
Remove the temperature sender (1) from the lower left side of the transmission.

5/16" wrench

12

Support the engine with a suitable tool.

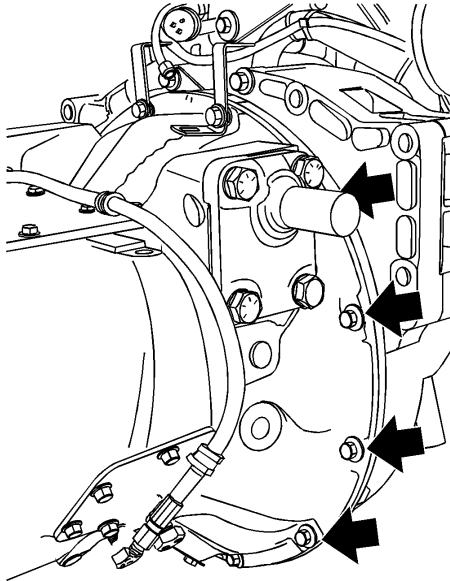
13



W4000808


Support the transmission with the transmission jack and secure the transmission to the jack.

14



W4000854

Remove the transmission mounting bolts and remove the transmission from the engine.

 <b>WARNING</b>
<p>Transmission is top heavy and may be unstable. Failure to remove the transmission carefully could result in damage to the transmission and personal injury.</p>

15

Remove the transmission from under the truck.

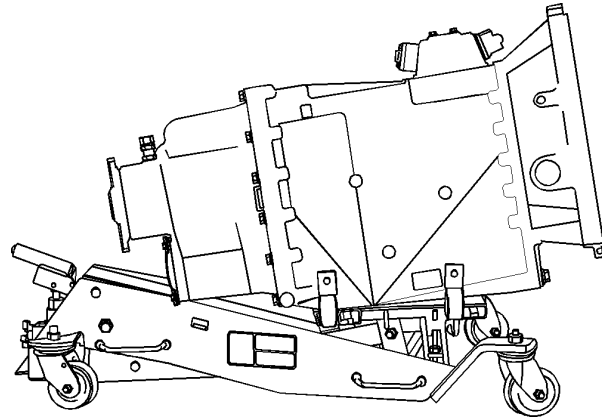
**Note:** In some applications it may be necessary to raise the vehicle with a floor jack and jack stands. This is for the transmission and transmission jack to be able to clear the vehicle frame.

## Transmission installation

### Volvo transmission

*Other special equipment: Transmission jack*

1



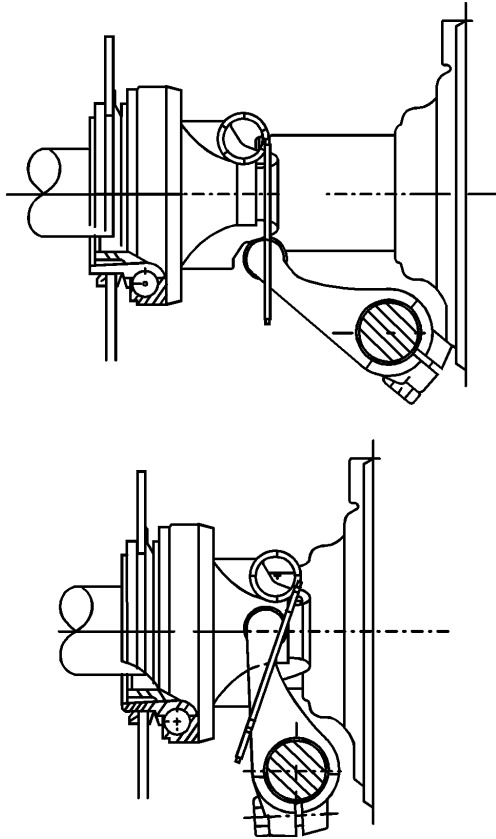
W4000788

Move the transmission under the truck. Jack the transmission into position to align the input shaft. Grease input shaft spline with high heat-resistant grease (p/n 1161138).

transmission jack; 18 mm wrench; 18 mm socket; extension

**Note:** Remove any excess grease to avoid contaminating the clutch plates.

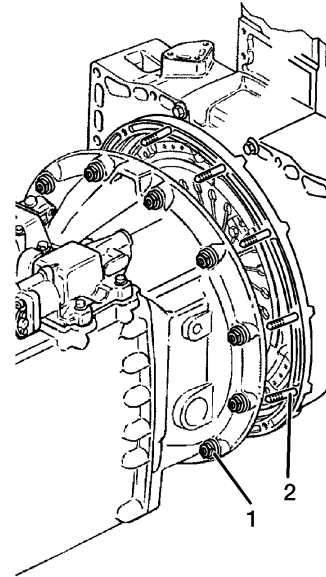
2



W4000864

Make sure the clutch fork is in the proper position for installing the transmission. The fork and spring should be behind the ears of the release bearing when the transmission is installed.

3



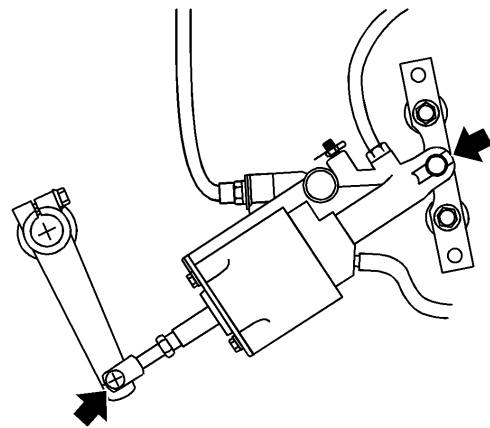
W4000828

- 1 mounting nut
- 2 stud

Install transmission mounting nuts hand tight. Remove the transmission jack. Torque transmission mounting nuts to 92 Nm (68 ft-lb).

18 mm socket; extension; torque wrench

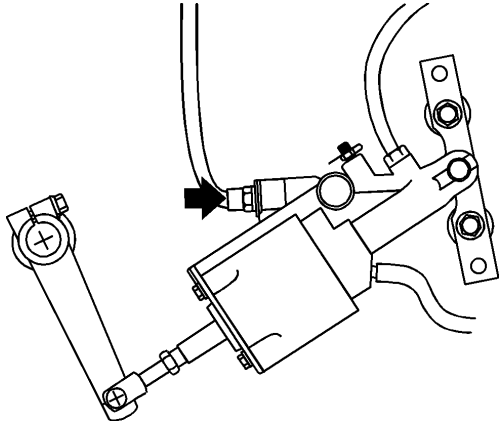
4



W4000863

Install the clutch servo clevis pins with side cutters new cotter pins.

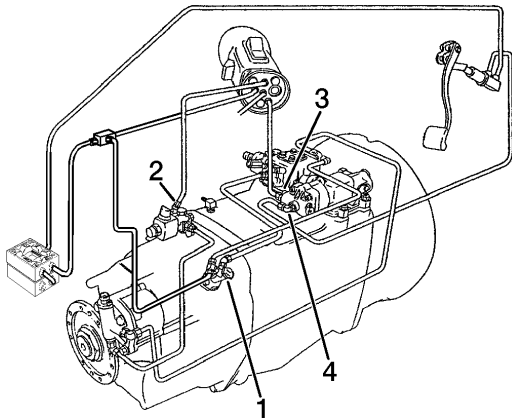
5



W4000862

Connect the servo air supply line. Torque to 24 Nm (18 ft-lb). 5/8" open wrench

6



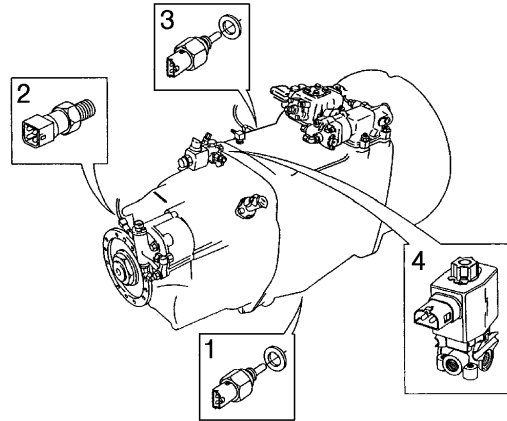
W4000861

Install the air lines to the transmission. 3/8" open end wrench; 5/8" open end wrench; 18 mm open end wrench

7

Install the shift and support assembly using the shift linkage installation procedure.

8



W4000860

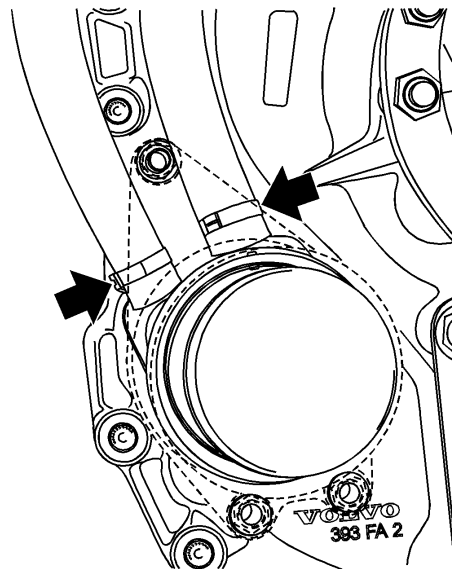
Install the wire harness and connect it to the following sensors.

- 1 Transmission temperature sensor
- 2 VSS (vehicle speed sensor)
- 3 Reverse lamps sensor
- 4 Range solenoid

9

Tie wrap the wires and air lines making sure they are properly routed. side cutters; tie wraps

10



W4000783

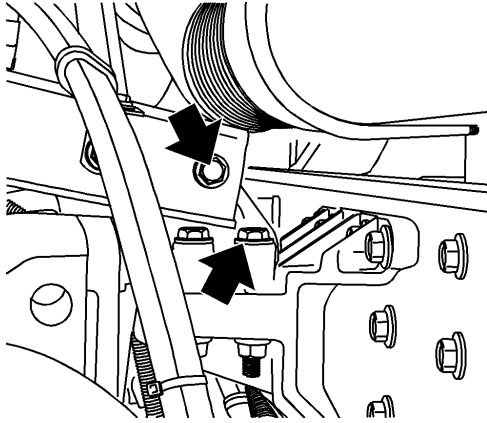
Install the transmission cooler hoses with new hose clamps. Install the oil filter cover (three bolts). 14 mm socket; extension; ratchet

11

Connect all "L" brackets for the cooler hoses. 14 mm socket; 10 mm socket; ratchet



12



W4000807

Install the engine cross member. Torque mount bolts to  $105 \pm 20$  Nm ( $78 \pm 15$  ft-lb).

15 mm socket/wrench; 18 mm socket/wrench; extension

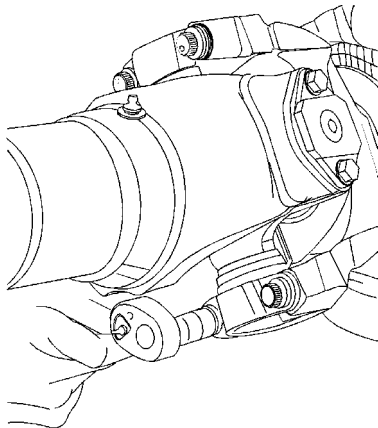
13

Connect the front section of the drive shaft to the transmission yoke and install the center bearing. Torque center bearing mount bolts to 105 Nm (78 ft-lb).

1/2" 12 point socket; 11/16" socket; 5/8" wrench

**Note:** Refer to the driveline manufacture for the proper torque of the U-joint yoke.

14



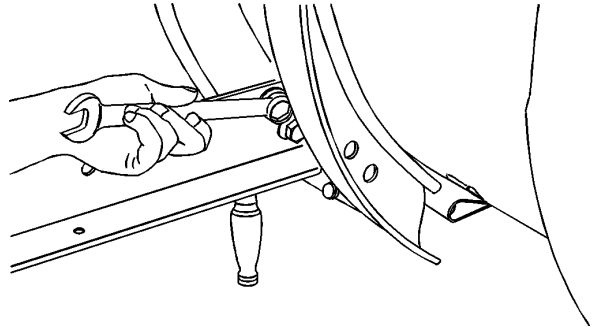
W4000782

Connect the slip yoke of the rear section to the front drive shaft.

1/2" 12 point socket; torque wrench

**Note:** Refer to the driveline manufacturer for the proper torque of the U-joint yoke.

15

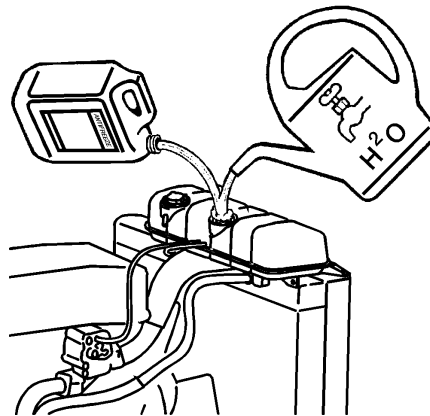


W4000806

Install fuel tank brace.

15 mm socket; 18 mm socket; ratchet; torque wrench

16



W2002058

Fill cooling system with the proper coolant mixture.

**Note:** Refer to TSI bulletin 260–600 (01) **Coolant Requirements, Volvo VE D12** for proper coolant concentration.

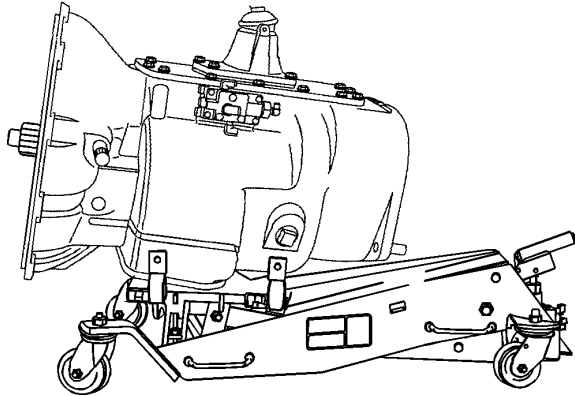
**Note:** Maximum fill rate of 2.5 gallons per minute.

# Non-Volvo transmission

This procedure is meant to be a guide for installing non-Volvo transmissions. Refer to the transmission manufacturer's literature for more information.

*Other special equipment: Transmission jack*

1



Set transmission on a transmission jack. Secure the transmission to the jack.

2

Roll the transmission under the truck and jack up the transmission.

3

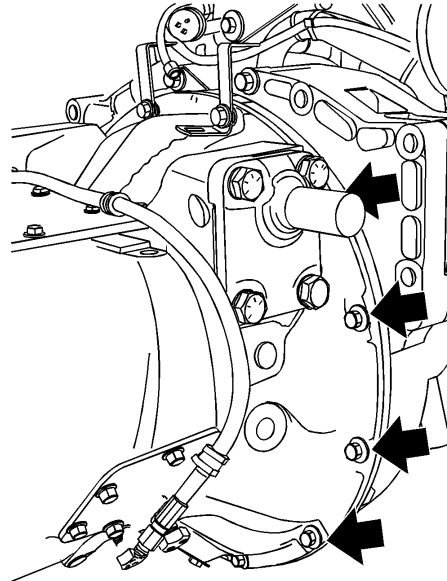
Install a new rubber bushing onto the engine/transmission nodal mount pins.

**Note:** Put anti-seize on the pin before installing rubber bushing.

4

Push the transmission forward and align the input shaft, making sure the clutch fork is positioned properly over the release bearing.

5



Install the transmission mounting bolts and torque them to 95–100 Nm (70–75 ft-lb).

5/8" socket; torque wrench

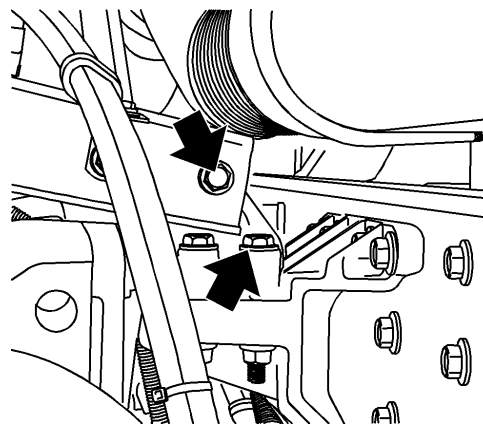
6

Remove transmission jack.

7

Remove engine support.

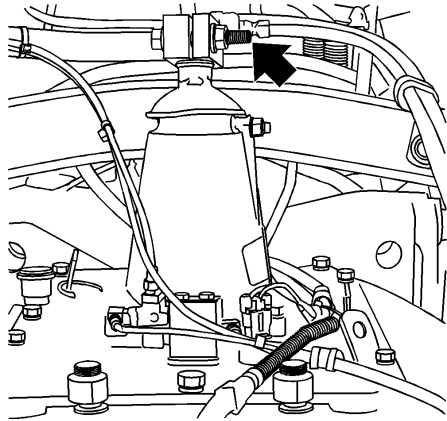
8



Install engine mount (top half) and cross member. Torque bolts to 105 ± 20 Nm (78 ± 15 ft-lb).

15 mm wrench/socket; 18 mm wrench/socket; torque wrench

9



W4000871

Install gear lever and secure with the clamp bolt. Torque bolt to  $70 \pm 15$  Nm ( $52 \pm 11$  ft-lb).

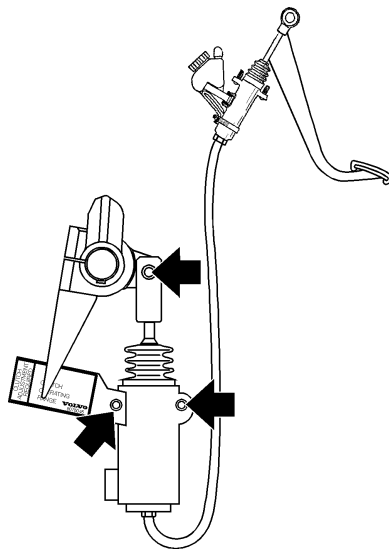
11/16" socket;  
5/8" wrench

10

Install the air lines that were removed during transmission removal.

9/16" socket

11

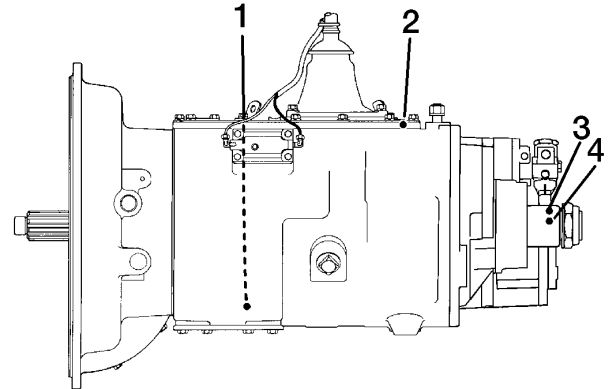


W4000870

Install clutch slave cylinder. Torque the mounting bolts to  $35 \pm 6$  Nm ( $26 \pm 6$  ft-lb). Use a new cotter pin to secure the clevis pin.

12 mm socket

12



W4000812

- 1 temperature sender
- 2 reverse light sender
- 3 vehicle speed sensor (ECU)
- 4 vehicle speed sender (speedometer)

Install temperature sender (1) and torque to 48 Nm (35 ft-lb).

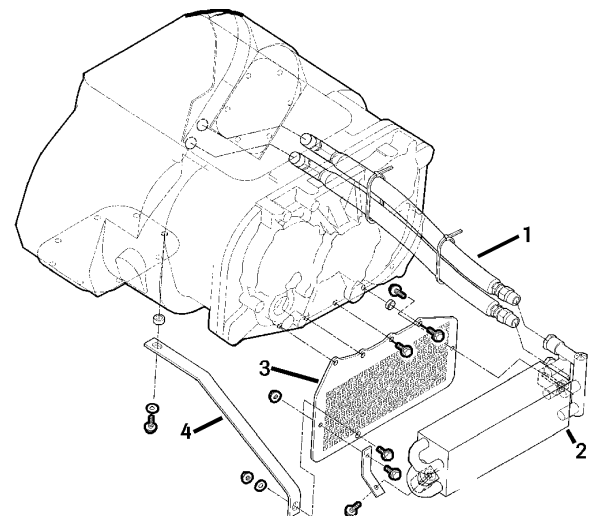
**Note:** Use pipe sealer on threads.

13

Connect the wire harness to the sensors and secure the wires with tie wraps.

9/16" socket;  
15/16" wrench

14

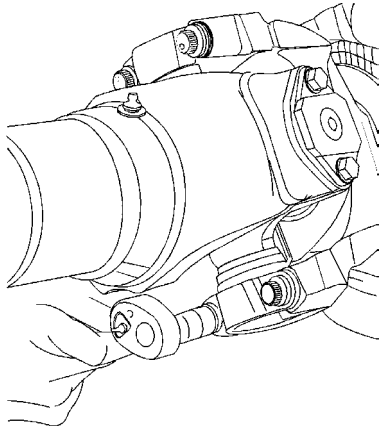


W4000802

Install the transmission oil cooler and hoses. Torque the 3/8" bolt to 48 Nm (35 ft-lb) and the 7/16" bolt to 70–85 Nm (50–65 ft-lb). Use pipe sealer on oil cooler hoses.

9/16" socket/  
wrench; 5/8"  
wrench; 7/8"  
wrench

15



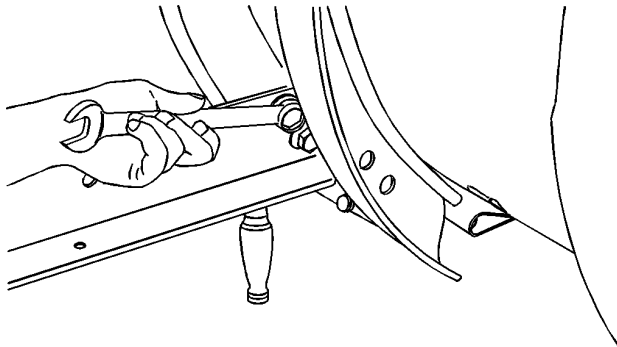
W4000782

Install the drive shaft and center bearing. Center bearing to bracket; torque to 105 Nm (78 ft-lb).

**Note:** Refer to the driveline manufacturer for the proper torque values.

1/2" 12 pt. socket; 15 mm socket; 18 mm wrench

16



W4000806

Install the fuel tank brace.

15 mm socket; 18 mm wrench

17

Fill the transmission with the manufacturer's recommended oil. Torque drain plug to 82–100 Nm (60–75 ft-lb).

9/16" wrench

18

Install the battery cable.

19

Road test the vehicle to check for oil leaks and air leaks.

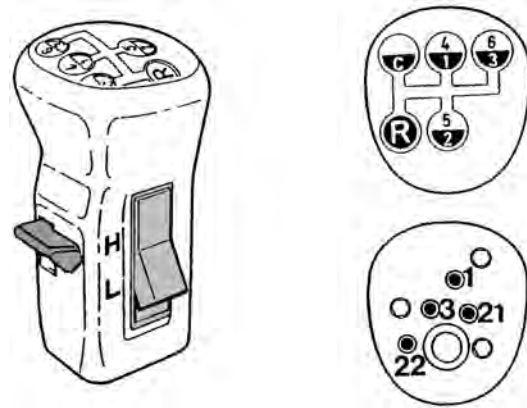
## Shift linkage removal

1

Remove the upper shift lever boot mounting bolts. Pull the upper and lower shift lever boots up on the shift lever so work be carried out through the cab floor.

12 mm socket; 6" extension

2

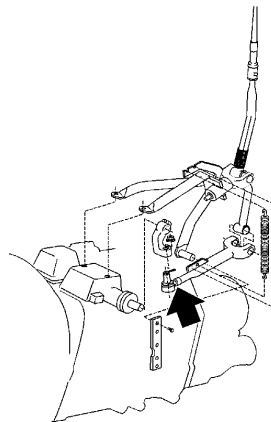


W4000849

Disconnect the air lines from the gear lever knob and cut the plastic ties.

10 mm open end wrench; 18 mm open end wrench; side cutters

3



W4000847

Remove the cotter pin and nut from the rod end assembly.

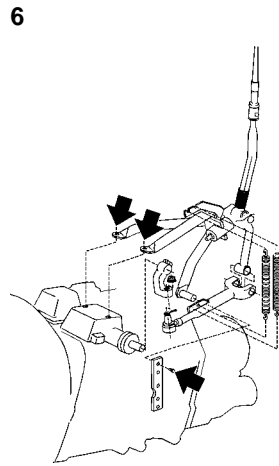
19 mm wrench; side cutters

4

Remove the rod end assembly. Pull down the rod end assembly until rod end is out of control lever. Release slowly to release spring tension. Disconnect both springs.

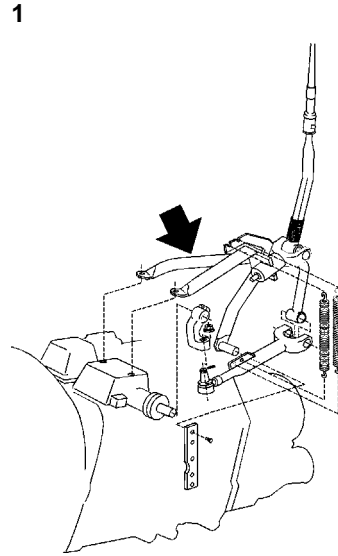
hammer; ball joint separator

**5**  
Remove the nut from the control yoke at support assembly. Lift assembly out. 19 mm socket

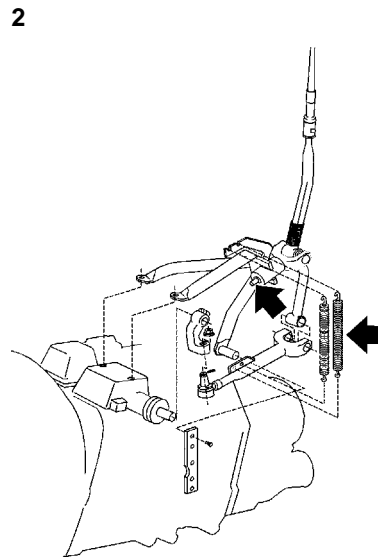


**6**  
Remove the three mounting bolts for the support assembly, then remove the assembly. 14 mm socket

## Shift linkage installation

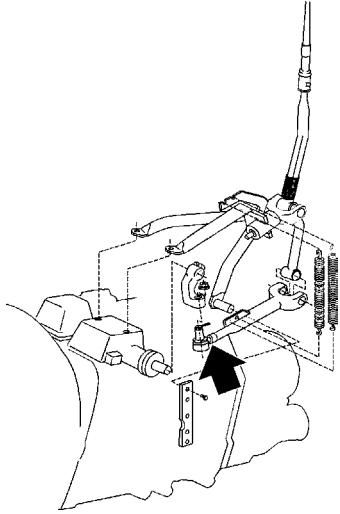


**1**  
Install the support assembly with three mounting bolts. Torque the two upper mounting bolts to  $30 \pm 5$  Nm ( $22 \pm 4$  ft-lb). Torque the lower mounting bolt to  $48 \pm 8$  Nm ( $35 \pm 6$  ft-lb). 14 mm socket; torque wrench



**2**  
Install the control assembly and nut. Connect the springs to the rod assembly. Torque the control assembly nut to  $50 \pm 10$  Nm ( $37 \pm 7$  ft-lb). 19 mm wrench; side cutter; 19 mm crow's foot; torque wrench

3

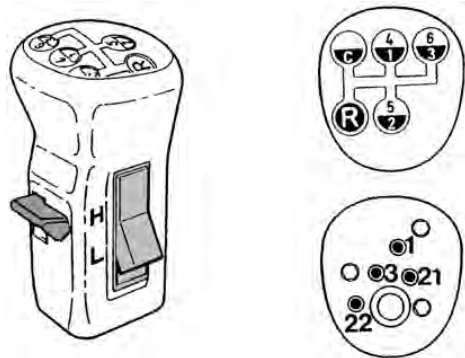


W4000847

Position the rod end into the control lever. Install the rod end nut and cotter pin. Torque the rod end nut to  $40 \pm 10$  Nm ( $30 \pm 7$  ft-lb).

19 mm socket;  
torque wrench

4



W4000849

Connect the air lines to the gear lever knob. Tie wrap the air lines.

- 1 – Purple / Supply
- 3 – Yellow / Vent
- 21 – Black / Range cylinder
- 22 – Blue / Splitter cylinder

10 mm open  
end wrench;  
18 mm open  
end wrench;  
side cutters

5

Install the upper and lower shift boots into the proper positions. Install four mounting bolts.

12 mm socket;  
6" extension;  
torque wrench

6

Road test the vehicle to check for proper shift operation and air leaks.



**VOLVO**  
**Volvo GM Heavy Truck**

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