

Document Title: Inching pedal, function check	Function Group: 413	Information Type: Service Information	Date: 2014/12/22
Profile: GRD, G976 [GB]			

Inching pedal, function check

Op nbr 413-019

1. After repair work has been completed in any inching pedal related system, an inching pedal function check must be performed as described below:
 1. Lift and support the rear of the machine so the rear tandem wheels are off the ground.
 2. Start the machine and depress the inching pedal. Select F1 gear and repeatedly check the operation to verify the function.
 3. Stop the wheels using the service brakes and place the shifter in the Park (P) position. Shut down the engine.
 4. Check for fault codes.

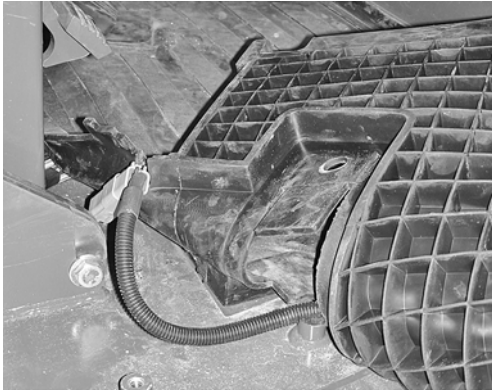
Document Title: Inching pedal, replacing	Function Group: 413	Information Type: Service Information	Date: 2014/12/22
Profile: GRD, G976 [GB]			

Inching pedal, replacing

Op nbr 413-018

Removing

1. Place the machine in the service position. Refer to [191 Service position](#)
2. Remove the two bolts securing the inching pedal to the cab floor.
3. Pull the base of the pedal through the hole in the floor mat.
4. Pull back the front left corner of the floor mat to gain access to the inching pedal wiring harness connector.



V1055286

Figure 1
Wiring harness location

5. Disconnect the wiring harness connector and pull the wire lead on the pedal through the hole in the floor mat.
6. Remove the inching pedal from the machine.

Installing

7. Lift the front left corner of the floor mat and route the wire lead on the pedal through the hole in the floor mat.
8. Connect the wire lead to the wiring harness connector near the pedestal mount.
9. Return the floor mat to its original position on the cab floor.
10. Install the base of pedal through the hole in the floor mat.
11. Secure the pedal to the floor with two mounting bolts.
12. Lift the floor mat and position the wiring harness along the grooves in the underside of the floor mat.
13. Start the machine to ensure proper operation of the inching pedal.
14. Place the machine back in service.

Document Title: Type HTE840 transmission, description and operation	Function Group: 420	Information Type: Service Information	Date: 2014/12/22
Profile: GRD, G976 [GB]			

Type HTE840 transmission, description and operation

The Volvo HTE840 transmission has a countershaft, direct drive, full powershift design. It is specially developed for grading applications as an eight speed forward and four speed reverse transmission.

A wide ratio spread between first and eighth gear allows for an even increase in road speed with each upshift. Gear ratios are made possible by seven hydraulically controlled clutch packs mounted onto four of the transmission's five shafts. Hydraulic oil flow is distributed to various clutch pack combinations by externally mounted collector caps and drilled passages in the clutch shafts. Pulse Width Modulated (PWM) solenoid valves on the collector caps are activated and controlled by the vehicle ECU (electronic control unit). The V-ECU utilizes a constant self diagnostic program that monitors electronic malfunctions as well as clutch pack slippage. A series of error messages and codes on the conetric display report malfunctions to the operator.

A gear type hydraulic pump which is externally mounted on the transmission, draws oil through a suction screen in the transmission oil sump and supplies oil to the brake booster and transmission circuit.

Oil flow supplied to the transmission circuit goes first through the transmission oil filter. After passing through the filter, the oil flow is divided to the accessory circuit and the transmission control circuit. The accessory circuit supplies oil to the differential lock, the blade lift system lock pin and parking brake.

A pressure regulating valve block is mounted on the transmission to control the transmission main pressure, oil cooler bypass and lubrication oil pressure.

The size of the clutch packs, along with the number of friction discs and separator plates varies, according to the torque loading of the clutch pack. To provide power flow through the transmission, three of seven clutch packs must be locked up (engaged).

All the gears in the transmission are helical cut type, to ensure quiet operation throughout the whole speed range.

Clutch shafts

The clutch shaft assemblies are supported in the transmission housing using a well proven design. The shafts are equipped with tapered roller bearings in both ends. Adjustment of the end float is done by placing shims under the collector cap.

Input shaft	Clutches A and B
Intermediate shaft	Clutches C and D
Second intermediate	No clutches
Output shaft	Clutches H and L
Reverse shaft	Clutch R

A clutch consists of a set of friction discs with internal splined teeth mounted onto a hub which is splined to the shaft. The clutch also contains a set of steel reaction plates. These reaction plates are retained in a drum and gear assembly by means of external tags.

The gear and drum assembly is mounted on tapered roller bearings to enable it to rotate independently of the shaft. The discs and plates are alternated in the clutch pack, starting and ending with a friction disc. By squeezing these discs and plates together between the clutch piston and the backing plate, the gear is locked to the shaft and rotates with it. To perform this function, pressurized oil is used on the backside of the clutch piston. The PWM solenoid valve, located on the collector cap for the shaft, controls the flow of oil to the chamber behind the clutch piston.

Modulation

To optimize smooth gear engagement, the PWM solenoid valves are used for each clutch pack. These solenoids are mounted on the collector caps in the end of each shaft. There is pressure build up during clutch engagement and pressure reduction in the disengagement phase. The time for clutch engagement (modulation) varies between 0.1 - 0.7 seconds. Engagement time is dependent on load conditions and is controlled by the V-ECU. A, B and R clutches are also connected to the inching function. This means that modulation on these clutches is done automatically by the V-ECU or manually by the

operator.

Inching

Inching helps the operator achieve superior control over gear selection and machine speed. Clutches A, B and R can be modulated manually using the inching pedal. This pedal sends an electrical signal to the V-ECU and a current to the PWM solenoids. SA, SB and SR is related to the pedal angle. In case the conronic monitoring system finds a clutch pack slipping, the nominal clutch pressure of 1.35 MPa (13.5 bar, 196 psi) is raised up to a maximum system pressure of 1.6 MPa (16 bar, 232 psi).

Document Title: Type HTE1160 transmission, description and operation	Function Group: 420	Information Type: Service Information	Date: 2014/12/22
Profile: GRD, G976 [GB]			

Type HTE1160 transmission, description and operation

The Volvo HTE1160 transmission has a countershaft, direct drive full powershift design. It is specially developed for grading applications as an eleven speed forward and six speed reverse transmission.

A wide ratio spread between first and eleventh gear allows for an even increase in road speed with each upshift. Gear ratios are made possible by eight hydraulically controlled clutch packs mounted onto the five shafts of the transmission. Hydraulic oil flow is distributed to various clutch pack combinations by externally mounted collector caps and drilled passages in the clutch shafts. Pulse Width Modulated (PWM) solenoid valves on the collector caps are activated and controlled by the Vehicle-ECU (V-ECU) electronic control unit. The V-ECU utilizes a constant self diagnostic program that monitors electrical malfunctions as well as clutch pack slippage. A series of error messages and codes on the conronic display report malfunctions to the operator.

A gear type hydraulic pump is externally mounted on the transmission and draws oil through a suction screen in the transmission oil sump. It also supplies oil to the brake booster circuit and the transmission circuit. Oil flow supplied to the transmission circuit first passes through the transmission oil filter. After the filter, the oil flow is divided to the accessory circuit and the transmission control circuit. The accessory circuit supplies oil to the differential lock, lock pin cylinder and parking brake.

The pressure regulating valve block is mounted on the transmission to control the main pressure , oil cooler bypass and lubrication oil pressure.

The size of the clutch packs, along with the number of friction discs and separator plates varies according to the torque loading of the clutch pack. To provide power flow through the transmission, three of seven clutch packs must be engaged.

All the gears in the transmission are helical cut type to achieve quiet operation throughout the entire speed range.

Clutch shafts

The clutch shaft assemblies are supported in the transmission housing. The shafts are equipped with tapered roller bearings in both ends. The adjustment of the end float is done with shims under the collector cap.

Input shaft	Clutches A and B
Intermediate shaft	Clutch D
Second intermediate	Clutches E and F
Output shaft	Clutches H and L
Reverse shaft	Clutch R

A clutch consists of a set of friction discs with internal spline teeth mounted onto a hub which is splined to the shaft. A set of reaction plates are retained in a gear and drum assembly.

The gear and drum assembly is mounted on tapered roller bearings to enable it to rotate independently of the shaft. The discs and plates are alternated in the clutch pack starting and ending with a friction disc. By squeezing these discs and plates together between the clutch piston and the backing plate, the gear is locked to the shaft and rotates with it. To perform this function, pressurized oil is used on the back side of the clutch piston.

Modulation

To optimize smooth gear engagement, the PWM solenoid valves are used for each clutch pack. The PWM solenoid valve located on the collector cap for the clutch shaft, controls the flow of oil to the chamber behind the clutch piston. The time for clutch engagement (modulation) varies between 0.1 - 0.7 seconds. Engagement time is dependent of load conditions and is controlled by the V-ECU.

A, B and R clutches are also connected to the inching function. That means that modulation on these clutches is done automatically by the V-ECU or manually by the operator.

Inching

To give the operator superior control over gear selection and machine speed, clutches A, B and R can be modulated manually using the inching pedal. This pedal sends an electrical signal to the V-ECU. A current is sent out to the PWM solenoids (SA, SB, SR) which is related to the angle of the pedal.

Slippage control

In the event that the conronic monitoring system finds a clutch pack slipping, the nominal clutch pressure 1.35 MPa (13.5 bar, 196 psi) is raised up to maximum system pressure of 1.6 MPa (16 bar, 232 psi).

Document Title: Transmission, changing oil and filter	Function Group: 420	Information Type: Service Information	Date: 2014/12/22
Profile: GRD, G976 [GB]			

Transmission, changing oil and filter

Op nbr 173-061

1. Place the machine in the [191 Service position](#).
2. Remove the transmission guard. Refer to [715 Transmission guard, removing](#).
3. Using a lifting strap, position and secure the hydraulic hoses on the left side of the transmission away from the drain plug and suction hose.

NOTICE

4. **Always handle oils and other environmentally hazardous fluids in an environmentally safe manner.**

Place a suitable container underneath the transmission drain plug. Remove the drain plug and drain the oil from the transmission.

NOTE!

Oil capacity of the transmission is 60.2 l (15.9 US gal).

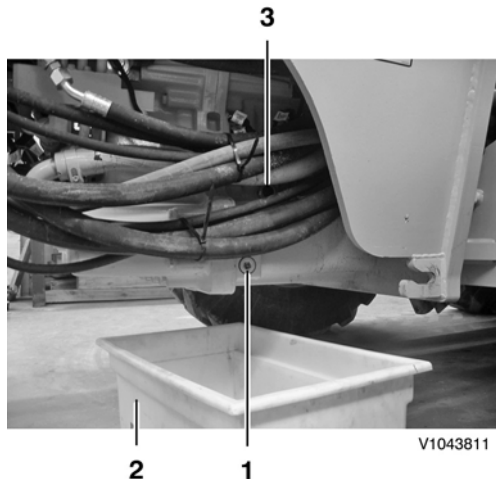


Figure 1
Transmission oil drain plug location

1. Transmission oil drain plug
 2. Container
 3. Oil level sight glass
5. Remove the magnetic drain plug from the transmission and remove any metallic particles that may be present.
 6. Re-install the drain plug.
 7. Remove the transmission filter.
 8. Apply a thin film of new oil to the gasket on the new filter. Re-install the filter.

9. Loosen the hose clamp and remove the suction line from the suction tube.
10. Remove the retaining bolts securing the suction tube to the transmission case. Remove the suction tube from the transmission.



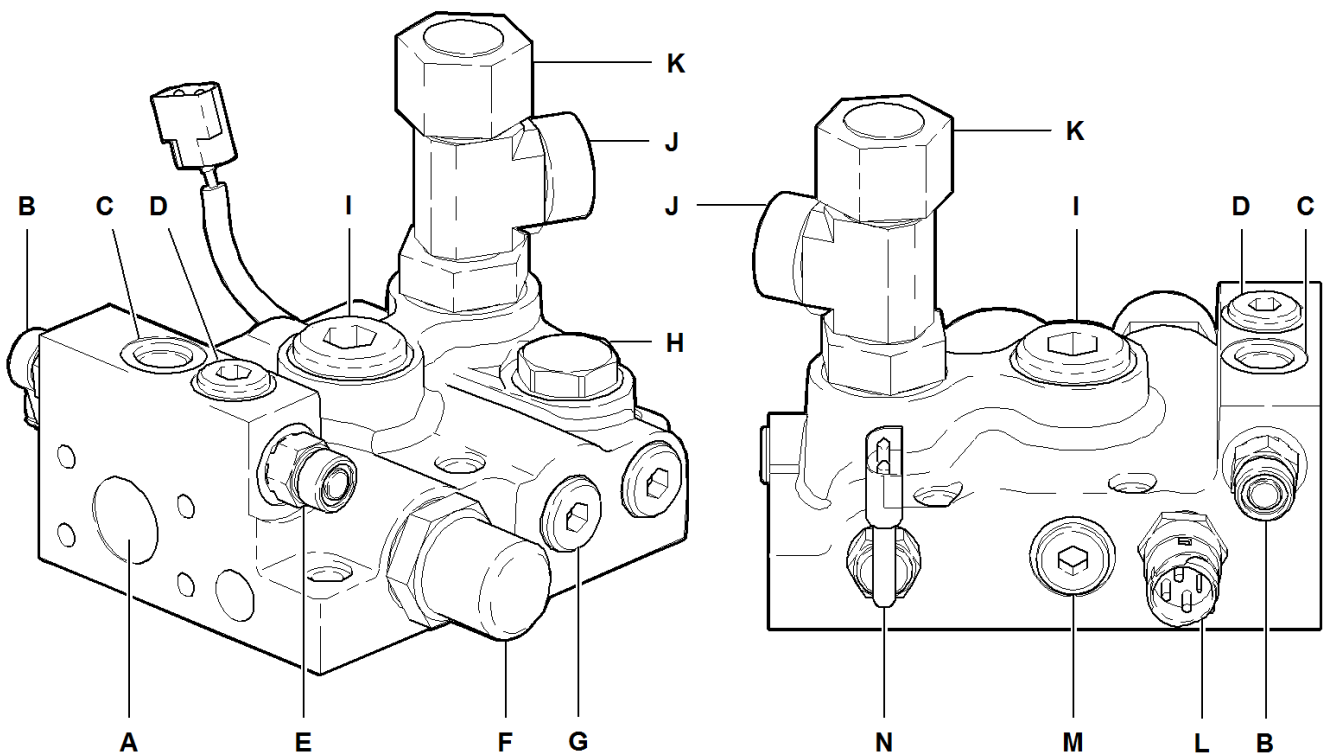
Figure 2
Removing the suction tube

1. O-ring
11. Clean the strainer on the end of the suction tube.
12. Replace the O-ring on the suction tube flange and re-install in the transmission case.
13. Re-install the suction line onto the suction tube and secure with the hose clamp.
14. **NOTICE**
Always handle oils and other environmentally hazardous fluids in an environmentally safe manner.
Re-fill the transmission with new transmission fluid, as necessary.
15. Start the machine and inspect for any leaks.
16. Re-install the transmission guard. Refer to [715 Transmission guard, installing](#).
17. Place the machine back in service.

Document Title: Transmission control HTE840/HTE1160, description and operation	Function Group: 421	Information Type: Service Information	Date: 2014/12/22
Profile: GRD, G976 [GB]			

Transmission control HTE840/HTE1160, description and operation

A pressure regulator valve block is mounted on the transmission. A gear type hydraulic pump, which is externally mounted on the transmission supplies oil to the valve, oil cooler bypass valve and a lubrication pressure backup valve. It supplies oil pressure to all of the clutch shafts. It also has a pressure sensor and a temperature sensor.



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Figure 1

- A. Pump inlet (from transmission oil filter)
- B. To R and A-B clutch shafts
- C. To C-D and E-F clutch shafts
- D. Auxiliary outlet
- E. To H-L clutch shaft
- F. Main pressure relief valve 1.6 MPa (16 bar, 232 psi)
- G. Oil cooler bypass valve 1 MPa (6 bar, 85 psi)
- H. Lubrication pressure backup valve 0.2 MPa (2 bar, 35 psi)
- I. To transmission oil cooler
- J. To lubrication manifold
- K. From transmission oil cooler
- L. Pressure sensor
- M. From brake booster (return)
- N. Temperature sensor

HTE840 Transmission solenoids

Clutch pack	Solenoid
A	PWM4205
B	PWM4206
C	PWM4207
D	PWM4208
H	PWM4210
L	PWM4211
R	PWM4212

Solenoid combinations - HTE840

Gear	Forward	Reverse
F1/R1	A-C-L	R-C-L
F2	B-C-L	
F3/R2	A-D-L	R-D-L
F4	B-D-L	
F5/R3	A-C-H	R-C-H
F6	B-C-H	
F7/R4	A-D-H	R-D-H
F8	B-D-H	

HTE1160 Transmission solenoids

Clutch pack	Solenoid
A	PWM4205
B	PWM4206
D	PWM4208
E	PWM4209
F	PWM4207
H	PWM4210
L	PWM4211
R	PWM4212

Solenoid combinations - HTE1160

Gear	Forward	Reverse
F1/R1	A-E-L	R-E-L
F2	B-E-L	
F3/R2	A-D-L	R-D-L
F4	B-D-L	
F5/R3	A-F-L	R-F-L
F6	B-F-L	
F7/R4	B-E-H	R-E-H
F8	A-D-H	
F9/R5	B-D-H	R-D-H
F10	A-F-H	
F11/R6	B-F-H	R-F-H

Document Title: Transmission hydraulic system, description and operation	Function Group: 421	Information Type: Service Information	Date: 2014/12/22
Profile: GRD, G976 [GB]			

Transmission hydraulic system, description and operation

A gear type hydraulic pump, which is externally mounted on the transmission draws oil through a suction screen in the transmission oil sump. The transmission pump supplies oil to the brake booster circuit and the transmission circuit. Oil flow supplied to the transmission circuit first goes through the transmission oil filter. Once oil passes through the oil filter, it is divided and sent through the combination valve and transmission control circuit. The combination valve supplies oil to the differential lock, the lock pin cylinder and the parking brake.

A pressure regulating valve block is mounted on the transmission to control the transmission main pressure, oil cooler bypass and the lubrication oil pressure.

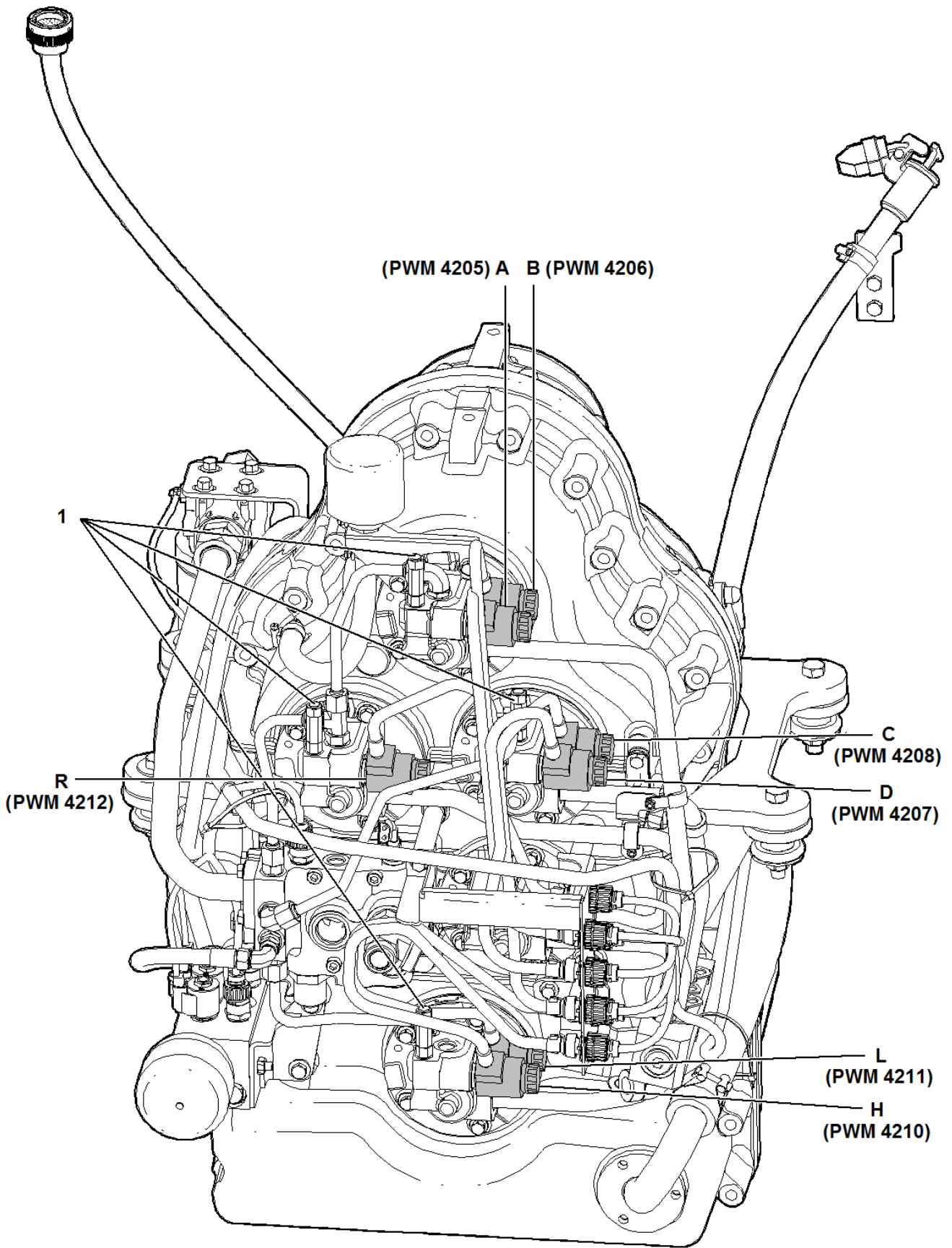
Document Title: Transmission, component locations	Function Group: 421	Information Type: Service Information	Date: 2014/12/22
Profile: GRD, G976 [GB]			

Transmission, component locations

HTE840

Gear		Clutch							
		A	B	C	D	H	L	R	Lube
Forward	1	•		•			•		
	2		•	•			•		
	3	•			•		•		
	4		•		•		•		
	5	•		•		•			
	6		•	•		•			
	7	•			•	•			
	8		•		•	•			
Neutral									
Reverse	-1			•			•	•	
	-2				•		•	•	
	-3			•		•		•	
	-4				•	•		•	

1. Lower the moldboard and all attachments, block all wheels and apply the service brake.
2. Transmission oil must be at operating temperature.
3. Install gauges in the test ports.
4. Run the engine at minimum engine speed. Depress the inching clutch and select first gear, forward mode.
5. Record the pressure in the appropriate boxes for all clutches.
6. Repeat steps 4 and 5 with the engine at maximum speed.
7. Repeat steps 4 through 6 for each successive gear.
8. The difference between the maximum speed and idle speed pressures for any one clutch should not exceed 69 kPa (0.7 bar, 10 psi).
9. Check the lube pressures against the specifications. Refer to [030 Transmission, specifications \(HTE840\)](#).



V1056094

Figure 1
HTE840 transmission component locations

1. Attenuator in the test port locations

HTE840 transmission solenoids

Clutch pack	Solenoid
A	PWM4205
B	PWM4206
C	PWM4207
D	PWM4208
H	PWM4210
L	PWM4211
R	PWM4212

HTE840 — solenoid combinations

Gear	Forward	Reverse
F1/R1	A-C-L	R-C-L
F2	B-C-L	
F3/R2	A-D-L	R-D-L
F4	B-D-L	
F5/R3	A-C-H	R-C-H
F6	B-C-H	
F7/R4	A-D-H	R-D-H
F8	B-D-H	

Document Title: Transmission, check oil pressure	Function Group: 421	Information Type: Service Information	Date: 2014/12/22
Profile: GRD, G976 [GB]			

Transmission, check oil pressure

Op nbr 421-002

[11666052 Pressure gauge](#)

936445 Testing nipple

936446 Testing nipple

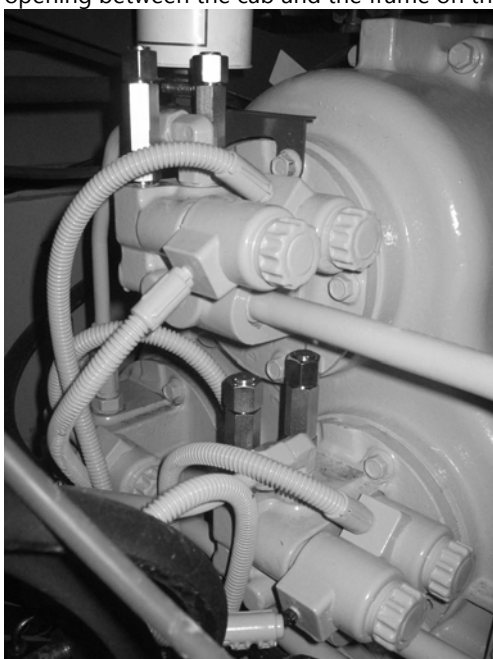
1. Park the machine on a firm level surface. Refer to the first 5 steps for placing the machine in the [191 Service position](#), but do not shut off the battery disconnect switch or allow the machine to cool down fully.

NOTE!

The engine, transmission and hydraulic systems should be at normal working temperature during the testing procedure.

Time for removing installed options such as cab skirts or lower front wipers, are not included in this procedure.

2. If the machine cannot be road tested to obtain the pressure readings, it will be necessary to raise the rear of the machine and support the tandem drive wheels elevated off the ground. This will allow you to engage the transmission and run the machine at the normal working temperatures while recording the working pressures. Refer to the Safety Section in the Service Manual and the instructions for: [191 Safety when lifting and supporting complete machine](#), [191 Safety rules when servicing](#).
3. Locate the test port attenuator nipples on the upper left side of the transmission. Access is gained through the opening between the cab and the frame on the left of the machine.



V1043767

Figure 1
Test ports — attenuator locations

4. Remove one of the attenuator nipples and install an appropriate size testing nipple into the valve block.



V1043768

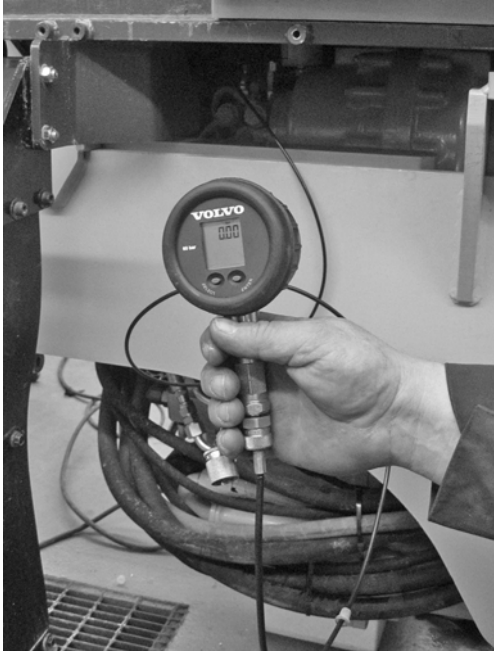
Figure 2
Test nipple with hose to gauge

NOTE!

Use nipple 936445 if connecting directly into the valve block.

Use nipple 936446 if connecting into the attenuator nipple.

5. Connect the Test Gauge 11666052 to the test nipple with the hose supplied with the gauge.

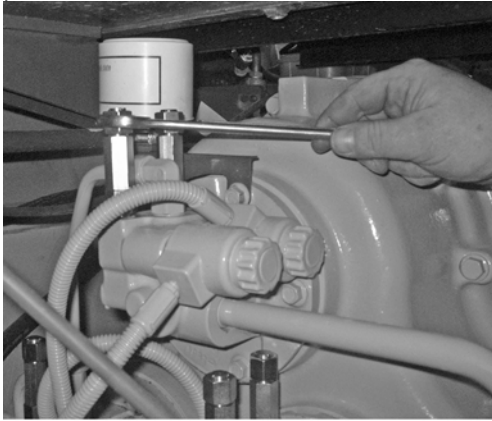


V1043769

Figure 3
Volvo pressure test gauge

6. Enter the cab and signal your intention to restart the machine.
When all bystanders are clear of the area around the tandem drive wheels, restart the machine and engage and differential lock.
7. Engage the transmission and run the machine at the normal working temperature in the specified gear while recording the working pressures at the test port according to the specification table.

8. Shut down the machine. Remove the test gauge nipple and hose line, then reinstall the attenuator into the test port.



V1043770

Figure 4
Attenuator installation

9. Repeat the procedure (steps 3 to 8) and record the pressure readings at all necessary test ports.
10. When testing is completed, carefully lower the machine to the ground and place it back into service.

Document Title: Transmission, removing	Function Group: 421	Information Type: Service Information	Date: 2014/12/22
Profile: GRD, G976 [GB]			

Transmission, removing

Op nbr 421-070

Lifting eye bolts (16 mm)

1. Place the machine in the [191 Service position](#).
2. Remove the cab. Refer to [818 Cab, removing](#).
3. Remove the transmission guard. Refer to [715 Transmission guard, removing](#).
4. Drain the hydraulic oil from the transmission. Refer to [173 Transmission, changing oil and filter](#).

WARNING

Only use lifting devices with adequate capacity.

5. Install lifting eye bolts (16 mm) into the top of the transmission using chains and a safe lifting device.



V1039473

Figure 1
Lifting eye bolts and transmission

6. Disconnect the feed and return hose to the brake booster. Swing the brake linkage out of the way. Plug and cap the hoses to prevent contamination.

Thank you very much for reading.

This is part of the demo page.

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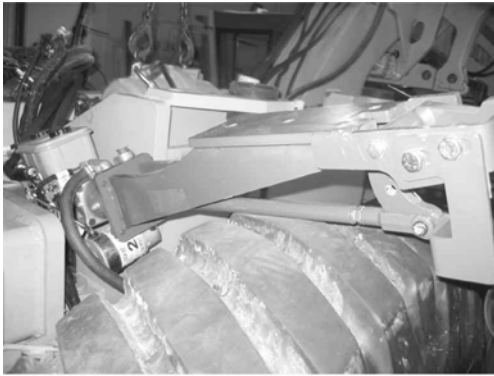
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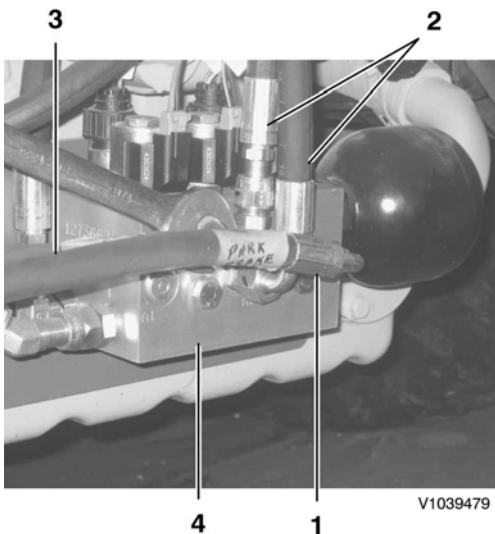
V1039475

Figure 2
Swinging the brake linkage out of the way

NOTE!

Do not disconnect the brake lines.

7. Remove the driveshaft bolts retaining the upper driveshaft to the transmission yoke and collapse the driveshaft.
 8. Remove the cushion bolts retaining the transmission on both sides of the machine. Refer to [426 Rubber cushion, changing](#).
 9. Remove the lower driveshaft. Refer to [451 Drive shaft, removing](#).
- NOTE!**
 Mark all hydraulic hoses for identification.
10. Disconnect the parking brake, blade lock cylinder and differential lock hydraulic hoses from the combination valve located on the front of the transmission. Cap and plug the hoses to prevent contamination.



V1039479

Figure 3

1. Parking brake hydraulic hose
2. Blade lock hydraulic hose
3. Differential lock hydraulic hose
4. Transmission combination valve

11. Disconnect the two cooler hydraulic hoses at the pressure regulator valve. Cap and plug the hoses to prevent contamination.

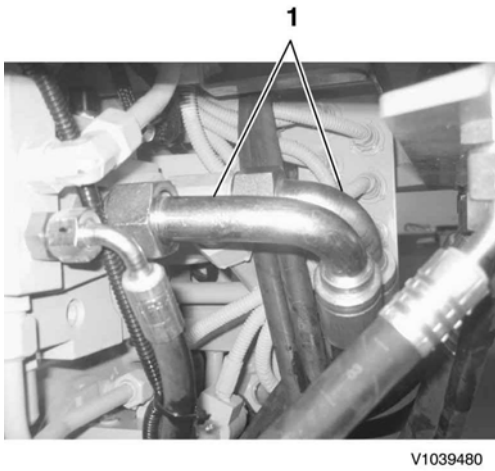


Figure 4

1. Hydraulic hoses - cooler
12. Disconnect the transmission lubrication hydraulic hose at the transmission manifold. Cap and plug the hose to prevent contamination.

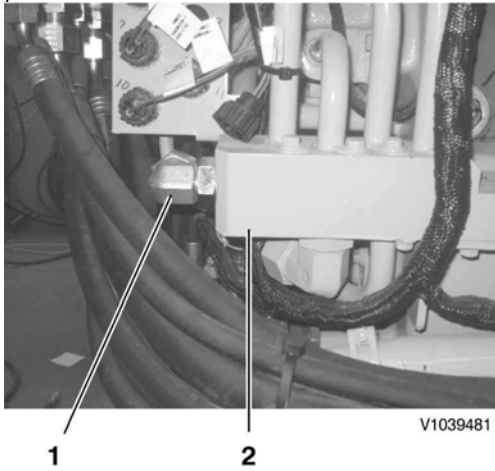


Figure 5

1. Hydraulic hose - transmission lubrication
 2. Transmission manifold
13. Disconnect the pump drive drain hydraulic hose. Cap and plug the hose to prevent contamination.

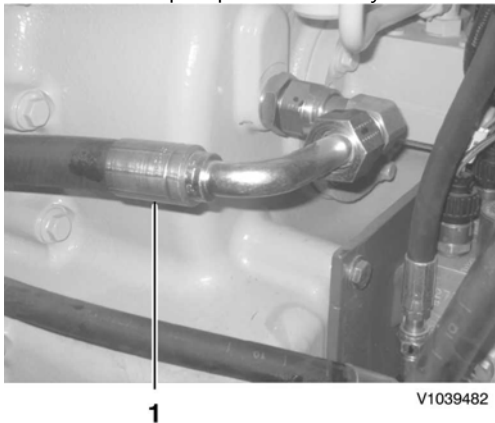


Figure 6