| Document Title: **Description, complete machine** | Function Group: **000** | Information Type: **Service Information** | Date: **2014/12/24** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Description, complete machine

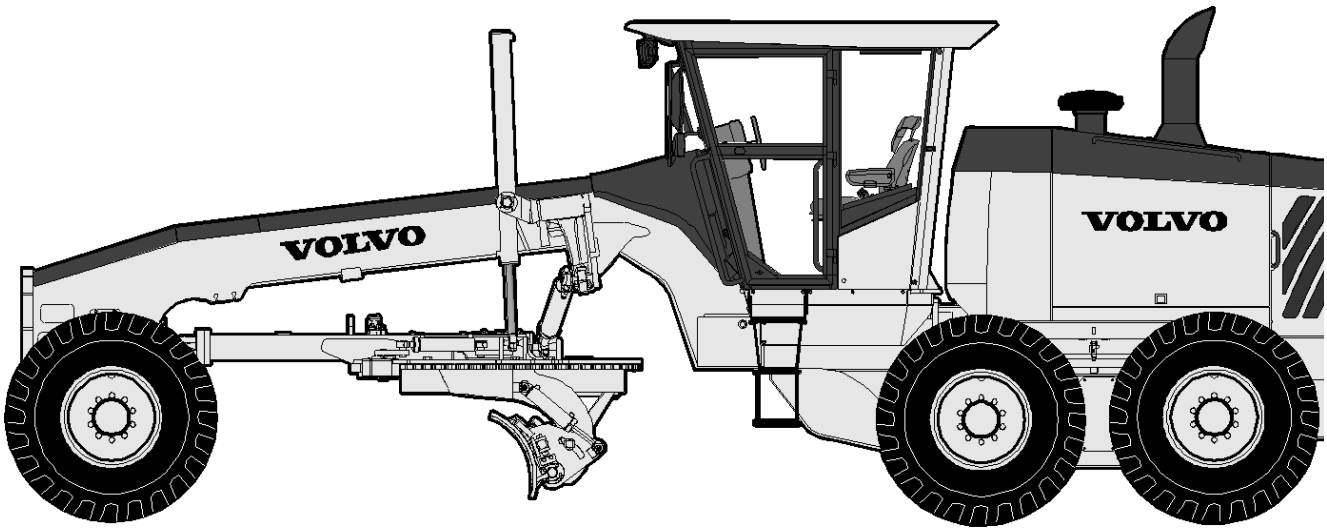



**Figure 1**
**G900 General, side view**

### Intended use

The machine is intended to be used under normal conditions for the operations described in the Operator's Manual. If it is used for other purposes or in potentially dangerous environments, for example, an explosive atmosphere, areas with dust containing asbestos, etc., special safety regulations must be followed and the machine must be equipped for such use. Contact the manufacturer / dealer for further information.

### Engine

#### G930, G940, G946, G960

G930 Volvo D7EGCE3, G940 Volvo D7EGBE3, G946 and G960 Volvo D7EGAE3. A 7.2 litre (439 in3) six cylinder, four stroke, direct-injection, low-emission engine which is turbocharged with charge air cooling of the air to air type. Common rail fuel system and IEGR (internal exhaust gas recirculation) are controlled by the engine electronic control unit (E-ECU) software. The engine has wet, replaceable cylinder liners and two valves per cylinder with replaceable valve guides and valve seat inserts. The accelerator position is transferred electrically from the accelerator pedal to the control unit (E-ECU). All models have VHP (Variable horsepower).

#### G970, G976, G990

G970 Volvo D9BGAE3, G976 and G990 Volvo D9BGBE3. A 9.4 litre (574 in3) six cylinder, four stroke, direct-injection, low-emission engine which is turbocharged with charge air cooling of the air to air type. Overhead camshaft and unit injectors and IEGR (internal exhaust gas recirculation) are controlled by the engine electronic control unit (E-ECU) software. The engine has wet, replaceable cylinder liners and two valves per cylinder with replaceable valve guides and valve seat inserts. The accelerator position is transferred electrically from the accelerator pedal to the control unit (E-ECU). All models have VHP (Variable horsepower).

### VHP

All Volvo grader models have engines that provide three different power levels depending on the gear selected by the operator.

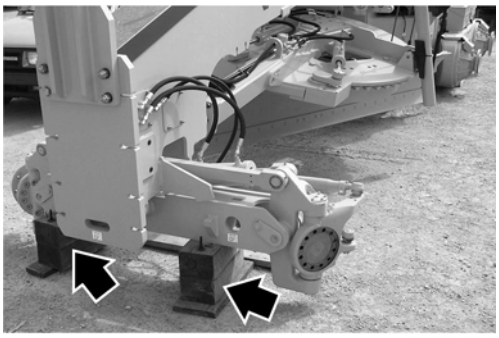
| VHP engine power | Transmission gear |
|---|---|

A spreader bar should be used to prevent damage to the rear cowling when lifting.

V1047434

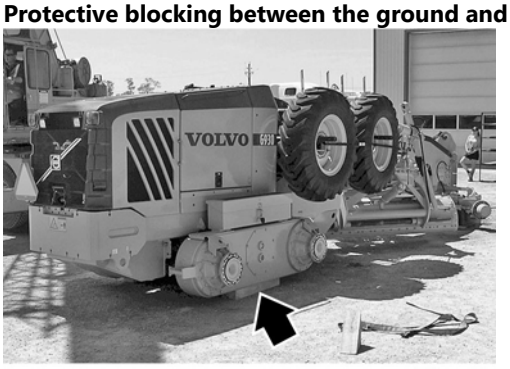
**Figure 5**
**Using a spreader bar to lift the rear of the machine**

8. Place the machine on the ground with protective blocks under the front axle and under the tandems.
   **NOTE!**
   Be sure that the work surface is firm and as level as possible. Be sure that the area around the machine is clear of obstacles that could pose as a hazard to workers or interfere with the re-assembly.



V1047435

**Figure 6**
**Protective blocking between the ground and the front axle**




V1047436

**Figure 7**
**Protective blocking between the ground and the tandems**

9. Using a suitable lifting crane, remove the tyre container from the cab mounts.
   **NOTE!**
   Be sure not to damage the rear cowling.

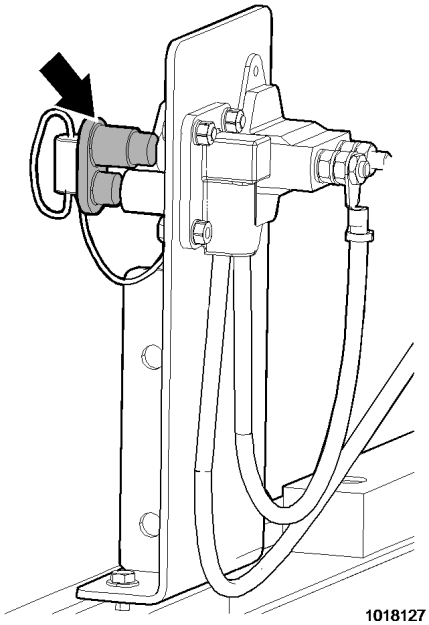



**Figure 1**
**Remote battery boost connector receptacle and cap**

6. Start the engine from the cab with the ignition key, according to the “Starting engine” procedure in the Operator's Manual.
7. When the engine has started, first disconnect the jumper cable from the remote receptacle. Then remove the jumper cable from the booster battery.
8. Reinstall the cap on the remote receptacle. Close the engine compartment door.


V1040291

**Figure 2**
**Front frame support**

**Lifting and supporting rear axle.**

Operate the blade lift cylinders to lift the machine from the ground or use appropriate jacks.
Secure the machine with one stand under each end of the tandem of the wheel to be removed.


V1040288

**Figure 3**
**Tandem support**

Secure the machine under the frame if the tandem or axle is to be removed.
Make sure it is positioned correctly and has safe ground support for the expected load.


V1040289

**Figure 4**
**Rear frame support**

**NOTE!**
Never position jacks or stands under the fuel tank or engine.

VOLVO

Construction Equipment

**Service Information**

| Document Title: **Environmentally hazardous fluids** | Function Group: **191** | Information Type: **Service Information** | Date: **2014/12/24** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Environmentally hazardous fluids

Pay attention to leakage of fuel, oils and other fluids from the machine that may contaminate the environment.

**Take appropriate actions to seal the leak immediately and decontaminate contaminated ground as soon as possible.**See191 Decontamination

**Oils and fuels**

**When emptying/draining** oils and fuels, take appropriate actions so that unnecessary spills are avoided. In places where containers for draining cannot be used, use a pump or hose for safe handling.

**Air conditioning**

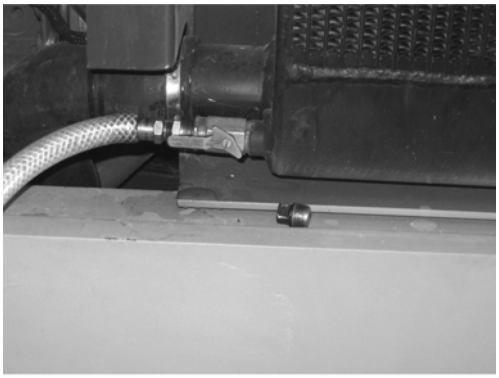
Refrigerant R134a contains substances that affect the greenhouse effect and may never be released into the open air.

Service personnel who work with refrigerants must know the laws/rules that apply in the local country but also international rules.

Special training is recommended for all service work on the air conditioning. Many countries require certification from an authority for such work. See also 191 Safety when working with air conditioning refrigerant

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

5. Connect a drain hose to the nipple. Drain the engine coolant into a suitable container. Refer to 260 Cooling system, volume (Models G930 - G940).



V1039700

**Figure 2**
**Draining the engine coolant**

**WARNING**

**Hot oil and hot engine coolant can cause severe burns!**

6. Drain the engine oil. Refer to 210 Engine D7, volume.

**WARNING**

**Only use lifting devices with adequate capacity.**

7. Attach a safe lifting device to the engine hood assembly. Refer to 821 Engine hood, removing.
   **NOTE!**
   Be sure to seal all charge air tubes as soon as they are removed from the machine.

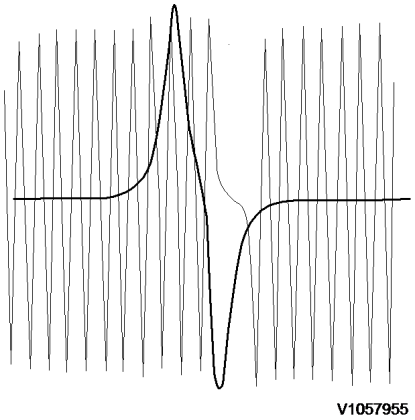



**Figure 5**
**Example of incorrect signal**
In this case, the signal for the flywheel sensor is mirror-imaged

4. Check the voltage across the camshaft sensor.
   To ensure reliable start and operation of the engine, the voltage across the sensors shall be according to 302 MID 128 SID 21 Engine position.
   If the signal is too low:

   - Check that the sensor is correctly installed and adjusted.
   - Remove the sensor and check that it is not damaged.
     If the sensor is damaged, rotate the crankshaft and check if the camshaft gear has any damage that has caused damage to the sensor.

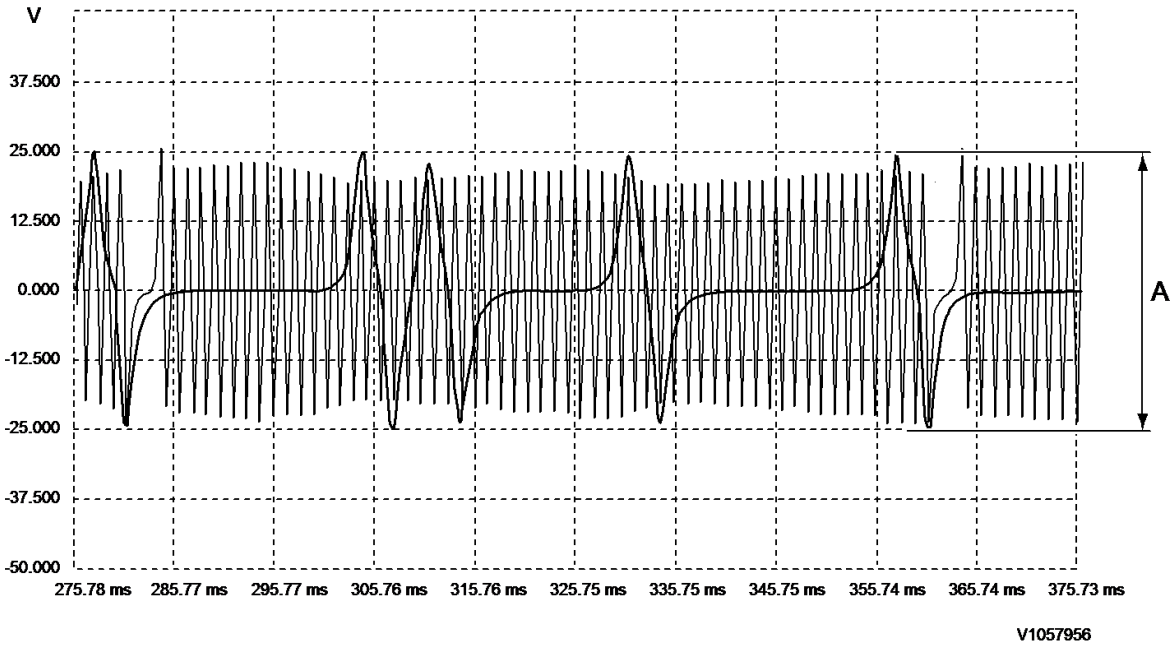



**Figure 6**

A. Signal voltage camshaft sensor (V)

5. Check the voltage across the flywheel sensor.
   To ensure reliable start and operation of the engine, the voltage across the sensors shall be according to 302 MID 128 SID 22 Timing sensor, crank.
   If the signal is too low:

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Cylinder liner, description** | **213** | **Service Information** | **2014/12/24** |
| Profile: **GRD, G970 [GB]** | | | |

# Cylinder liner, description

**D9B**

The D9B uses wet, replaceable cylinder liners.
A collar at the top of the liner fits into the cylinder block counter bore providing a precise alignment of the liner to cylinder bore. The top surface of the liner collar has a convex contour for improved sealing of combustion pressures.
The seal at the upper part of the cylinder lining is provided by an EDPM rubber seal positioned directly under the liner collar. This provides improved cooling of the upper liner area as there is increased space for coolant circulation.
The two lower rings are positioned in groves that are machined into the liner. The upper sealing ring is black (for coolant sealing), the lower sealing ring (for sealing of oil) is made from a different material and is violet colored.

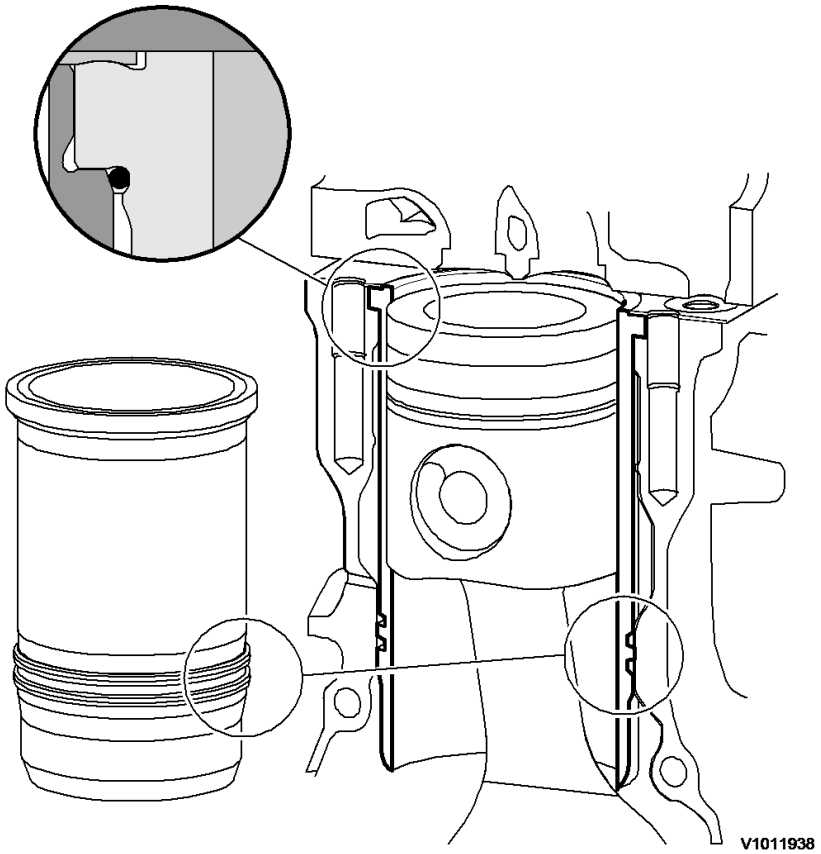



**Figure 1**

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Engine timing gear, description** | **215** | **Service Information** | **2014/12/24** |
| Profile: **GRD, G970 [GB]** | | | |

# Engine timing gear, description

**D9B**

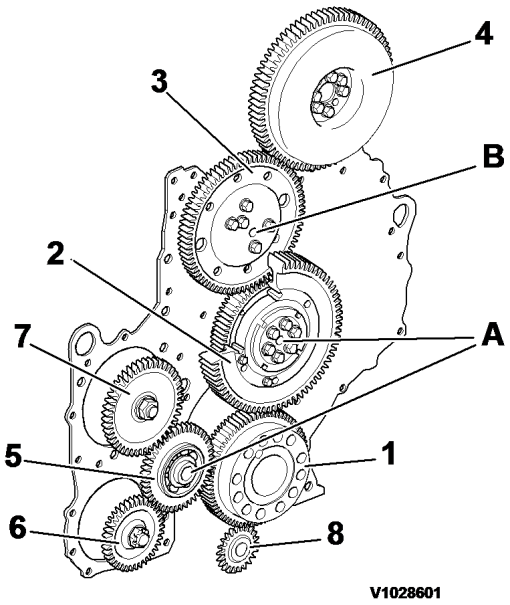



**Figure 1**
**Engine timing gear**

1. Gear, crankshaft
2. Transfer gear, double
3. Transfer gear, adjustable
4. Camshaft gear, incl. vibration damper
5. Transfer gear
6. Drive gear, fuel feed pump
7. Drive gear, air compressor
8. Drive gear, lubrication oil pump

A. Guide sleeves
B. Guide pin

The engines timing gears are located at the rear end of the engine ( flywheel end ) as opposed to some other Volvo engines which have them at the front.

The advantages with the timing gear at the rear are, among others, lower noise level and fewer parts, for example, the flywheel housing is also used as timing gear casing.

The timing gear plate is made of 6 mm (0.24 in) thick steel sheet metal which is secured to the cylinder block with two guide sleeves (A) and a guide pin (B). All gears are bevelled and nitride-hardened.

**Belt transmission**

The belt transmission on D9 is located at the front of the engine and is divided between two drive belts of the type Poly-V.

The drive belt drives the cooling fan and the coolant pump , while the belt tensioner keeps the belt tight. The idler roller gives the belt greater contact surface against the coolant pump's belt pulley.

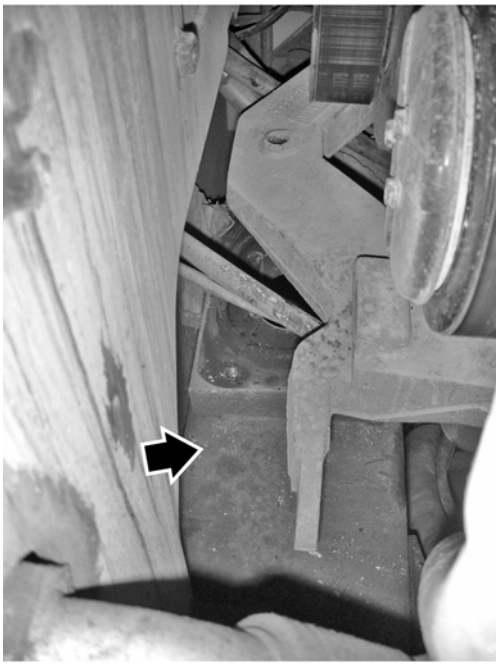



**Figure 4**
**Frame bracket with rubber cushion removed**

9. Remove the rubber cushion from the machine.

10. Position a new rubber cushion onto the frame bracket and secure with the mounting bolts and spacers. Torque-tighten to specification.


**Figure 5**
**Frame bracket with rubber cushion installed**

11. Lower the engine ensuring that the alignment pin on the rubber cushion is centered within the hole on the engine mounting bracket.

12. Reinstall bolts and washers to secure the rubber cushion to the engine mounting bracket. Torque-tighten to specification.

13. Remove the lifting device from the engine lifting bracket.


**Figure 2**
**Tank support**

7. Remove the three bolts holding the tank.
8. Lower the tank and remove it.

## Cleaning the tank

9. Remove the fuel level sender and o-ring first by turning it counterclockwise and lifting it out. Remove access cover with gasket.
   **NOTE!**
   The level sender has a level magnet. It is important to check the magnet for metal debris.

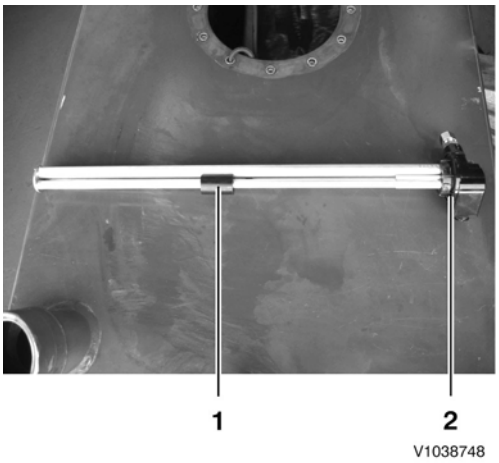



**Figure 3**
**Level sender**

1. O-ring
2. Level magnet

10. Clean the tank with a rag or clean solvent. Make sure that the tank is dry.
11. Install inspection cover with gasket. Tighten the bolts.
12. Install the o-ring on the sender and install the fuel level sender by turning it clockwise.

VOLVO

Construction Equipment

**Service Information**

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Air cleaner, installing** | **256** | **Service Information** | **2014/12/24** |
| Profile: **GRD, G970 [GB]** | | | |

# Air cleaner, installing

**Op nbr 256-011**

1. Lift the air cleaner housing into position and rest on top of the engine valve cover. **Weight 17 kg (37 lbs)**.
2. Place a board between the air cleaner housing and engine valve cover.
3. Raise the right side of the air cleaner housing into the bracket cradle. Secure the air cleaner housing into position by sliding the band onto the bracket.
4. Tighten the band securing the air cleaner housing to the bracket while leaving adequate clearance for the air cleaner housing to rotate freely.
5. Raise the left side of the air cleaner housing into the bracket cradle. Secure the air cleaner housing into position by sliding the band onto the bracket.
6. Tighten the band securing the air cleaner housing to the bracket while leaving adequate clearance for the air cleaner housing to rotate freely.
7. Install the intake stack onto the air cleaner housing and secure with band.
   **NOTE!**
   It may be necessary to slide or rotate the air cleaner housing to align the intake stack with the air cleaner housing.
8. Complete tightening the band on the left side securing the air cleaner housing to the bracket.
9. Reinstall the aspirator hose onto the air cleaner housing. Secure using the clamp. Reconnect the wire connector to the fuel filter restriction sensor (D9).
10. Complete tightening the band on the right side securing the air cleaner housing to the bracket.
11. Remove the cover from the turbo charger air intake port. Reinstall the air intake hose onto the turbo charger and air cleaner housing and secure using the clamps. Reconnect the wire connector on the air filter restriction sensor.
12. Close the left and right engine side doors.
13. Place the machine back in service.

When the engine is cold, the thermostat keeps the entrance to the radiator closed. The coolant is led through a bypass line directly back to the coolant pump.

As the engine heats, the volume of wax increases and the thermostat gradually opens the passage to the radiator while the bypass line closes.

| Document Title: **Maximum fan speed, checking** | Function Group: **263** | Information Type: **Service Information** | Date: **2014/12/24** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Maximum fan speed, checking

**Op nbr 263-016**

80872138 Tachometer

The speed of the cooling fan pump must be tested periodically to ensure that it is operating at the recommended maximum speed. A fan which is running below recommended speed may cause overheating of the cooling elements. An over speeding fan will also cause excessive noise levels.

**WARNING**

**Risk of burns! Use protective work gloves.**

1. Place the machine in an articulated service position for easier access.


**Figure 1**
**Machine articulated with right side open.**

2. Start and warm the engine. Allow it to idle.

3. Remove the top and right side hydraulic oil tank covers. Refer to 821 Engine hood, removing.

4. Disconnect the wiring harness at the fan pump controller. This will cause the fan to run at maximum speed.

VOLVO
Construction Equipment

**Service Information**

| Document Title: **Electronic control system, description** | Function Group: **300** | Information Type: **Service Information** | Date: **2015/1/4 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Electronic control system, description

**Vehicle electronics, general**

The machine electronics contain three units that communicate with each other via two data links. Each control unit processes values from sensors and operating controls, which help to control components so that proper function is maintained.

The control units in the system include the instrument control unit I-ECU, the vehicle control unit V-ECU and the engine control unit E-ECU.

The vehicle electronics facilitates trouble shooting through an extensive diagnostic system. The operator is informed of the location of the malfunction with a warning light, together with a text message.
VCADS Pro can be connected via the service socket located in the electrical distribution box behind the operator's seat.

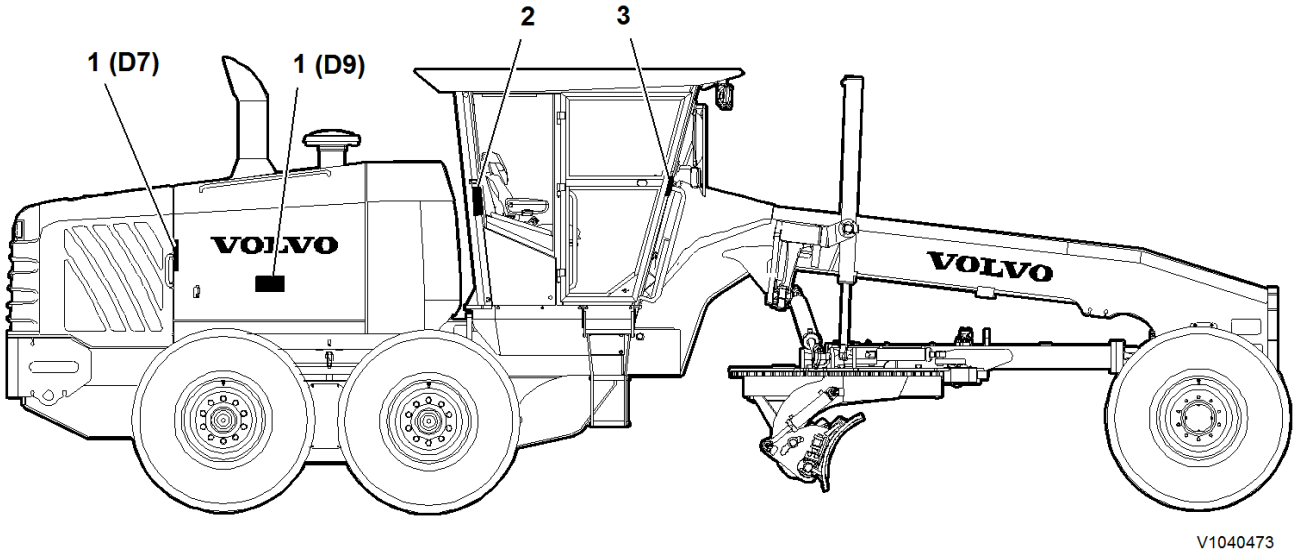



**Figure 1**
**Position of control units**

1. Engine control unit E-ECU
2. Vehicle control unit V-ECU
3. Instrument control unit I-ECU

**The instrument control unit I-ECU** is located in the instrument panel and contains software for presenting operator information on the display panel, including warnings and control lights. The control unit receives information from the other control units via the data bus.

**The engine control unit E-ECU** contains software for controlling engine functions. The control unit receives information from the engine sensors as well as the data bus. The control unit also sends information to the other control units via the data buses.

**The vehicle control unit V-ECU** is located near the electrical distribution box behind the operator's seat and contains software for controlling transmission operation, AWD system operation as well as many other systems. The vehicle control unit is connected to the other control units by the data bus.

**Communication** for programming, changing parameters, reading error codes, testing and checking components, etc, takes place using VCADS Pro.

VOLVO

Construction Equipment

**Service Information**

| Document Title: **V2006.2.0, change specification** | Function Group: **300** | Information Type: **Service Information** | Date: **2015/1/4 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# V2006.2.0, change specification

It is possible to update the following machines to the new software version:

| Machine | Serial no. Goderich |
|---|---|
| G930 | 39300 — 39470 |
| G940 | 39300 — 39470 |
| G946 | 39300 — 39470 |
| G960 | 39300 — 39470 |
| G970 | 39300 — 39470 |
| G976 | 39300 — 39470 |
| G990 | 39300 — 39470 |

**Software update:**

**I-ECU**

- D7 Engine hourmeter function in Contronic display did not increment time correctly.
- Portuguese and Turkish languages added to I-ECU.

**V-ECU**

- VECU software changed to implement transmission shift control improvements.

**Hardware update:**

**E-ECU**

- New D9 E-ECU with improved ventilation.

| Document Title: **V2008.3.0, change specification** | Function Group: **300** | Information Type: **Service Information** | Date: **2015/1/4 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# V2008.3.0, change specification

It is possible to update the following machines to the new software version:

| Machine | Serial no. Goderich | Serial no. Pederneiras |
|---|---|---|
| G930 | 39300 — 42466 | 501000 — 501265 |
| G940 | 39300 — 42466 | 502200 — 502511 |
| G946 | 39300 — 42466 | |
| G960 | 39300 — 42466 | 505000 — 505029 |
| G970 | 39300 — 42466 | |
| G976 | 39300 — 42466 | |
| G990 | 39300 — 42466 | 508000 — 508003 |

**Software update:**

**I-ECU**

- The reversing fan display text was revised so "No Fan Installed" is displayed when the reversing fan is not installed on the machine. Some previous software versions "OFF" was displayed when the reversing fan option was not installed.
- The error message for all PWM solenoids was revised so the FMI codes were removed from the display message. The FMI codes are available when an error code is read using VCADS Pro.

**V-ECU**

- Additional engine over-speed protection functionality has been added. The new function prevents manual transmission downshifts which will result in an engine over-speed condition.
- Creep mode for AWD machines was revised so it will function when the transmission mode switch is in Auto.
- The control logic for error codes PSID 36 Secondary Steering solenoid and PSID 89 Brake booster solenoid was corrected so non-error conditions do not display as an error when checked using VCADS Pro.

**W-ECU**

- Software version change which only affects other business lines.

VOLVO

Construction Equipment

**Service Information**

| Document Title: **Description of table for software functions** | Function Group: **301** | Information Type: **Service Information** | Date: **2015/1/4 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Description of table for software functions

| **Input signals** | **Conditions for output functions** | **Output functions** |
|---|---|---|
| **1**<br>○ Charge-air-temperature, SE2507 | **2**<br>○ Charge air temperature > 90°C (194°F) | **3**<br>○ Amber central warning light **illuminated**<br>○ Warning message displayed: **WARNING High Temp. Charge Air** |
| **4**<br>○ Circuit Monitoring: Charge-air-temperature, SE2507 | **5**<br>○ Charge air temperature, signal outside limits<br>ERROR detected if signal<br>voltage < .5 volts<br>voltage > 4.5 volts | **6**<br>○ Amber central warning light **illuminated**<br>○ ERROR message displayed **ERROR Monitoring Charge Air Temp.** |

**Description of information in table**

1. Component identification.
2. Condition for obtaining output display. All conditions must be fulfilled.
3. Control units resulting output action when conditions are fulfilled.
4. Circuit monitoring of relevant component for error/malfunction detection.
5. Component error conditions.
6. ECU actions when error condition present.

| Document Title: **Engine coolant level** | Function Group: **301** | Information Type: **Service Information** | Date: **2015/1/4 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Engine coolant level

**Function**

This function monitors coolant level in the expansion tank and informs the operator if the level is too low.

| **Input signals** | **Conditions for output functions** | **Output functions** |
|---|---|---|
| Coolant level SE2603 | Coolant level sensor SE2603 status<br>**Low coolant level** | Red central warning lamp<br>**Flashes**<br>Warning text displayed:<br>**Low engine coolant level**<br>Buzzer energized |

| | | |
|---|---|---|
| | SW5201 service brake<br>**Applied**<br>SE4101/4102 inching pedal position<br>**Applied (Auto mode only)**<br>SE4201 transmission shifter position<br>**Out of forward gear (Auto mode)** | |
| **Circuit monitoring**<br>SW2706 throttle mode, auto/hold<br>SW2708 throttle control, increase/ decrease | Loss of voltage input from both circuits 27C and 27H simultaneously | Amber central warning light<br>**Flashes**<br>Error text displayed<br>**Accelerator set SW2706-11** |
| | Activation of throttle control increase/ decrease simultaneously | Amber central warning light<br>**Flashes**<br>Error text displayed<br>**Accelerator set SW2708-11** |

More than one document matches chosen profile

- Inching

  Product Line: GRD
  Model Variant: G970 (Volvo)
  Site: Goderich
  Serial number start: 39300
  Serial number stop: 41319
  Software release start: V2006.1.0
  Software release stop: V2007.4.0

- Inching

  Product Line: GRD
  Model Variant: G970 (Volvo)
  Site: Goderich
  Serial number start: 41320
  Serial number stop: 59999
  Software release start: V2007.5.0

More than one document matches chosen profile

- Manual mode

  Product Line: GRD
  Model Variant: G970 (Volvo)
  Site: Goderich
  Serial number start: 39300
  Serial number stop: 41319
  Software release start: V2006.1.0
  Software release stop: V2007.4.0

- Manual mode

  Product Line: GRD
  Model Variant: G970 (Volvo)
  Site: Goderich
  Serial number start: 41320
  Serial number stop: 59999
  Software release start: V2007.5.0

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Transmission Stall Protection** | **301** | **Service Information** | **2015/1/4 0** |
| Profile: **GRD, G970 [GB]** | | | |

# Transmission Stall Protection

**Function**

This function protects transmission clutches by eliminating clutch slippage as a result of low transmission pump pressure caused by low engine r/min. The transmission stall protection shuts down the engine if engine speed drops below 450 r/min and the transmission gear status is, forward or reverse.

| **Input signals** | **Conditions for output functions** | **Output functions** |
|---|---|---|
| Engine speed<br>Transmission shifter position SE4201<br>Engine run status Off - On<br>Ignition key SW3301 position | Engine run status<br>**ON**<br>Ignition key position<br>**Run**<br>Engine speed **< 450 r/min**<br>Transmission shifter position SE4201<br>**Forward / Reverse** | Engine shut down<br>Within 1 sec. |

| | |
|---|---|
| **Circuit fault**<br>Machine speed | **Flashes**<br>Error text displayed<br>**Park brake pressure sensor SE5501-XX**<br>**XX = 03 high voltage**<br>**XX = 04 low voltage** |

| Document Title: **VCADS Pro, 17012-3 - Error Codes** | Function Group: **301** | Information Type: **Service Information** | Date: **2015/1/4 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# VCADS Pro, 17012-3 - Error Codes

**This is generally the most important and frequently used function within VCADS Pro.**

This is a function where the user can check what faults the ECUs have detected and recorded.

**NOTE!**
Just because an error message is displayed on the contronic display in the cab it does not necessarily mean that the fault has been recorded by the ECU. Different faults are displayed in different manners.

When you click on an instance, VCADS Pro shows:

- MID: which ECU detected the error
- PID/PPID/SID/PSID: problem area that you want to look up in the Service Manual
- FMI: type of failure (example: open circuit)
- First occurrence
- Last occurrence
- Time: number of hours the machine has on it

This CAN give exacting details about what has failed in the circuit and provide a clear place to refer in the Service Manual for further support.

**How to read all error codes**
This is the default setting that when begun (by pressing the "start" button) will connect to the various ECUs to read and display all recorded error codes.

- Select the top option "Read error codes" in field (1).
- Select the control units from which the error codes will be read by clicking the button "MID filter" (2). A dialogue box will open. Select the check boxes for the control units from which the error codes will be read.
- Click the "start" button (3). The error codes are read off.
- Click the "print" button to print directly. All information displayed to the user from the Error Code operation can be printed out later from the job card.
- New errors occurring while viewing the error code tables will automatically be displayed in the field (4). Click the "stop" button to stop the session and go to the "Error Reporter" tab.

**Deleting error codes**

- Select the middle option "Erase error codes" (5).
- Click the "start" button. All the error codes are deleted.

**NOTE!**
The spacebar can be used instead of the Start button.

**Clearing only one error code**
This is a useful feature in VCADS Pro that increases the flexibility of the tool. By selecting an error code and erasing only that error code, you leave the rest of the history for other faults detected.
Use this for increased accuracy when fault tracing to eliminate potential problems systematically.

**Error code information**

- Highlight an error code in the list (4).
- Information about the selected error code is displayed (6).
- If there is a camera in the column (7), it means that Error Reporter information is available for the error code. Double click the line or go in under the "Error Reporter" tab to see these.

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**Service Information**

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **VCADS Pro, 28407-3 - Sensor values, monitoring** | **301** | **Service Information** | **2015/1/4 0** |
| Profile: **GRD, G970 [GB]** | | | |

# VCADS Pro, 28407-3 - Sensor values, monitoring

This operation give an overview of engine related system information.

Systems this operation measures:

- Fuel pressure
- Charge air temperature
- Air filter restriction
- Oil pressure, engine
- Oil temperature, engine
- Oil level, engine
- Coolant temperature
- Coolant level
- Atmospheric pressure
- Engine speed
- Water in fuel
- Induction air temperature
- Fuel rail pressure, D7
- Boost pressure
- Crank house pressure, D9

**Instructions for program operation**

- Ensure that VCADS Pro is running on the computer, that the computer is connected to the data link connector on the machine and that a jobcard has been started. (To start a jobcard select the "identify" button).
- Double click "28407-3 - Sensor values, monitoring" which can be found under the section "2 – Engine, engine mounting and equipment".
- Click the "start" button to carry out the operation.
- Follow the on-screen prompts and instructions on the left side of the screen.

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**Service Information**

| Document Title: **VCADS Pro, MID 128, programming E-ECU** | Function Group: **301** | Information Type: **Service Information** | Date: **2015/1/4 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# VCADS Pro, MID 128, programming E-ECU

**Op nbr 200-009**

88890180 Interface

### 28423-3 – MID 128 ECU, programming

If the machine ECU is off site or not near an internet connection, the technician will need to download the software first before travelling to the machine. Be sure to read the whole operation first.

1. Start up the VCADS Pro computer.
2. Start up VCADS Pro and supply the password.
3. Turn on “Intermediate storage” by clicking Tools/Intermediate storage.
   **NOTE!**
   Look for the lap top icon in bottom right of the screen that indicates the intermediate storage is turned on.
4. Order the software for the machine by clicking on “Tools” and “Administrate software”.
5. Fill out the “Administrate software” form and choose “1 Replace control unit” action.
   **NOTE!**
   “Chassis ID” refers to machine model and serial number.
6. Click on “Send order”.
   **NOTE!**
   This step will require an internet connection.
7. When prompted, accept the billing charges and enter the “Static” or “Digipass” password.
8. Turn on the battery disconnect switch. Turn the key to the Running (I) position without cranking the engine.
9. Plug in the adapter connecting the machine to the lap top using the adapter cable (special tool number 88890020 or 9998555).
10. Create a new job card by clicking “File” then “Identify” following the screen prompts.
11. Program the ECU by selecting the operation “28423–3 MID 128 ECU, programming” and follow the on screen instructions.
    **NOTE!**
    If the ECU isn't being changed, disregard the VCADS Pro prompt.
12. Check for error codes. Refer to operation “17012–3 Error codes”.

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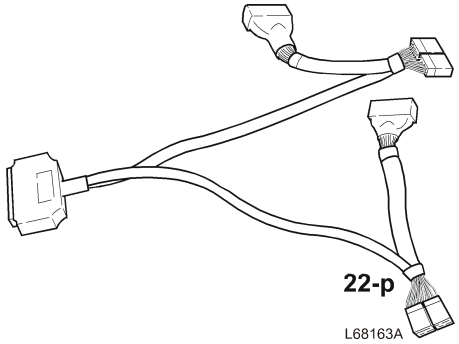
**Service Information**

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Adapter cable 999 8533** | **302** | **Service Information** | **2014/12/29** |
| Profile: **GRD, G970 [GB]** | | | |

# Adapter cable 999 8533




Description: Adapter cable

Part no. 999 8533

Specification: 22-pin adapter cable for testing instrument control unit (I-ECU) connector I2.

| Document Title: **Conditions when checking** | Function Group: **302** | Information Type: **Service Information** | Date: **2014/12/29** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Conditions when checking

The following checks (measurements) are mostly described using symbols, in order to clarify the conditions and to reduce reading time. The symbols are described below.

**NOTICE**

**When checking components, i.e. relays and solenoid valves controlled by a control unit, certain conditions must be fulfilled.**

**NOTICE**

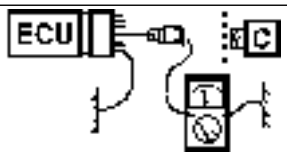
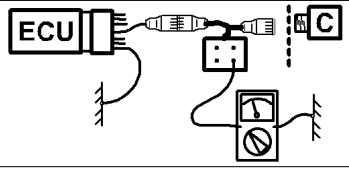
**To avoid changing functioning components, check the connectors with regards to loose connections and oxidation.**

### General symbols

| Symbol | Description | Symbol | Description |
|---|---|---|---|
|  | Battery disconnect switch in position **Off**. |  | Ignition in position **0, 1,** or **3**. |
|  | Resistance measurement |  | Engine at idle speed, ignition in position 1. |
|  | Voltage measurement |  | Ground connection |
|  | Component | | |

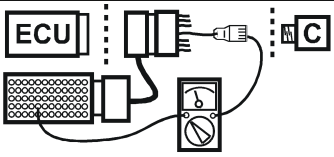
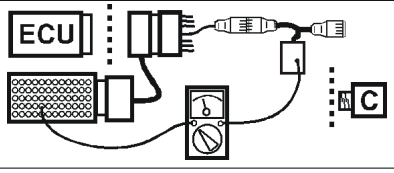
### Measuring control unit and cable harness, symbols

Measuring through cable harness to ECU. Component disconnected.

| Symbol | Description | Symbol | Description |
|---|---|---|---|
|  | Measuring in connector without adapter. |  | Measuring with 4-pin adapter is recommended. |

### Measuring cable harness, symbols

Measuring cable harness only. Component and ECU disconnected.

| Symbol | Description | Symbol | Description |
|---|---|---|---|
|  | Measuring with breakout box without adapter. |  | Measuring with breakout box and 4-pin adapter is recommended. |

### Measuring component/cable harness, symbols

Measuring cable harness and component. ECU disconnected.

| Document Title: **MID 128 PPID 55 ECU temperature** | Function Group: **302** | Information Type: **Service Information** | Date: **2014/12/29** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# MID 128 PPID 55 ECU temperature

| **Component E-ECU** | |
|---|---|
| **Function** | Measures E-ECU internal temperature. |
| **References** | ○ Component location diagram |

| **Malfunction detection condition** |
|---|
| Detected if engine control unit (E-ECU) registers an open or short circuit of the internal sensor. |

| **Type of error/ malfunction** | **Symptom** | **Possible cause** |
|---|---|---|
| FMI 4 | ○ Error text displayed<br>○ Amber central warning lamp **FLASHES** | ○ Internal fault in E-ECU |
| FMI 5 | ○ Error text displayed<br>○ Amber central warning lamp **FLASHES** | ○ Internal fault in E-ECU |

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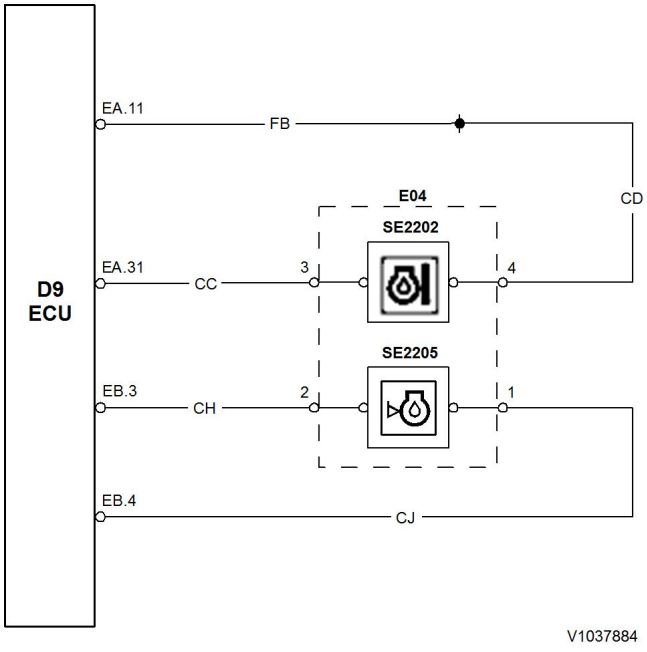
**Service Information**

| Document Title: **MID 128 PID 98 Engine oil level** | Function Group: **302** | Information Type: **Service Information** | Date: **2014/12/29** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# MID 128 PID 98 Engine oil level

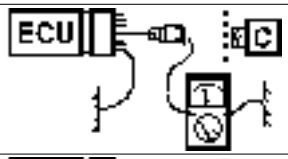
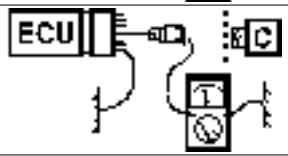
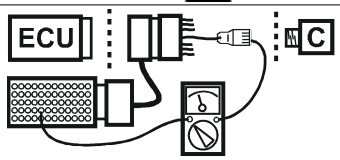
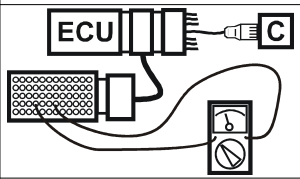
| **Component: SE2205 Oil level sensor** | | |
|---|---|---|
| **Function** | The engine oil level sensor is located inside at the bottom of the engine oil sump and measures the level of the engine oil. The sensor is combined with SE2202 engine oil temperature sensor. The oil level sensor measures engine oil level with the use of a hot wire sensor. Changes in oil level affect resistance of the hot wire, this results in changes in the amount of current flow. Note: Oil level is only checked before engine start. |  |
| **References** | ○ 370 Wiring diagram 5<br>○ 370 Component list 11: Sensors<br>○ 301 Engine Oil Level | |
| **Tools** | ○ 302 Multimeter 8889 0074<br>○ 302 Adapter cable 999 0014<br>○ 302 Extension cable 999 0062<br>○ 302 Multi-pin breaker box 999 8699 | EB.03, ground<br>EB.04, signal |

| **Malfunction detection condition** |
|---|
| Detected if engine control unit (E-ECU) registers no current flow or excessive current flow at EB.04. |

**SAE code MID 128 PID 098**

| **Type of error/ malfunction** | **Symptom** | **Possible cause** |
|---|---|---|
| FMI 1 | ○ Engine oil level display indicates low level | ○ The engine oil level is below minimum limits.<br>○ Leakage |

| | | |
|---|---|---|
| FMI 3 | ○ Error text displayed<br>○ Amber central warning lamp **FLASHES**<br>○ Power loss | ○ Feed or signal cable short circuited to voltage.<br>○ Ground cable open circuit.<br>○ Defective sensor |
| FMI 5 | ○ Error text displayed<br>○ Amber central warning lamp **FLASHES**<br>○ Power loss | ○ Feed or signal cable open circuited or short circuited to ground.<br>○ Defective sensor<br>○ Poor electrical connection (Pin tension, damage, moisture or corrosion) |

| **Testing** | **Measuring Point** | **Correct Values** | **Condition** | **Test method** |
|---|---|---|---|---|
| Control unit/cable harness: | Ground cable<br>1 – | ≈ 0 Ω |  |  |
| | Feed cable<br>3 – | ≈ 5 V |  |  |
| | Signal cable<br>4 - EA22 | ≈ 0 Ω |  |  |
| Subsystem | EA11 – EA22 | (see graph below) |  |  |

**SE2508 Sensor Graph**

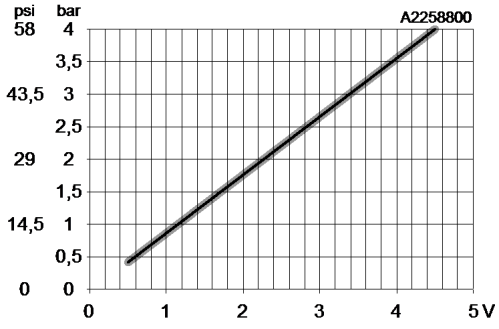



**Figure 1**
**SE2508 sensor graph**

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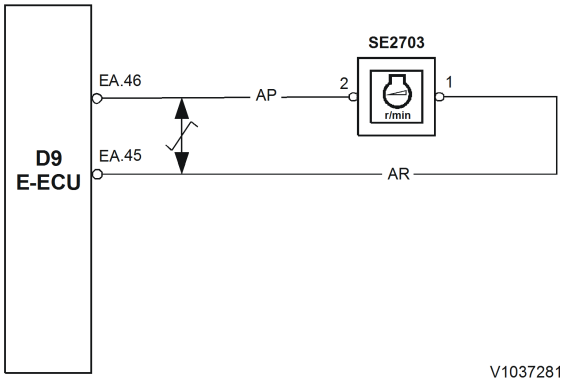
**Service Information**

| Document Title: **MID 128 SID 21 Engine position** | Function Group: **302** | Information Type: **Service Information** | Date: **2014/12/29** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# MID 128 SID 21 Engine position

| **Component: SE2703 Sensor camshaft speed** | |
|---|---|
| **Function** | The sensor consists of a permanent magnet surrounded by a coil of wire. It reads the rotation speed and position of the camshaft. The sensor produces an AC signal voltage whose frequency varies with engine speed. |
| **References** | ○ 370 Wiring diagram 5<br>○ 370 Component list 11: Sensors |
| **Tools** | ○ 302 Multimeter 8889 0074<br>○ 302 Adapter cable 999 0014<br>○ 302 Extension cable 999 0062<br>○ 302 Extension cable 999 0062 |




EA45, frequency (+)
EA46, frequency (-)

| **Malfunction detection condition** |
|---|
| Detected if engine control unit (E–ECU) registers missing sensor signal or if the signal has an abnormal frequency. |

**SAE code MID 128 SID 021**

| **Type of error/ malfunction** | **Symptom** | **Possible cause** |
|---|---|---|
| FMI 2 | ○ Error text displayed<br>○ Amber central warning lamp **FLASHES**<br>○ Fuel consumption is increased | ○ Bad correlation between crankshaft and camshaft sensors.<br>○ Phase error. |
| FMI 3 | ○ Error text displayed<br>○ Amber central warning lamp **FLASHES**<br>○ Engine start time will increase | ○ Missing signal from cam sensor.<br>○ Signal cable short circuited to ground or higher voltage.<br>○ Defective sensor. |
| FMI 8 | ○ Error text displayed<br>○ Amber central warning lamp **FLASHES**<br>○ Engine start time will increase | ○ Disturbances on signal cable.<br>○ Incorrectly mounted sensor (wrong distance to ring gear). |

| **Testing** | **Measuring Point** | **Correct Values** | **Condition** | **Test method** |
|---|---|---|---|---|

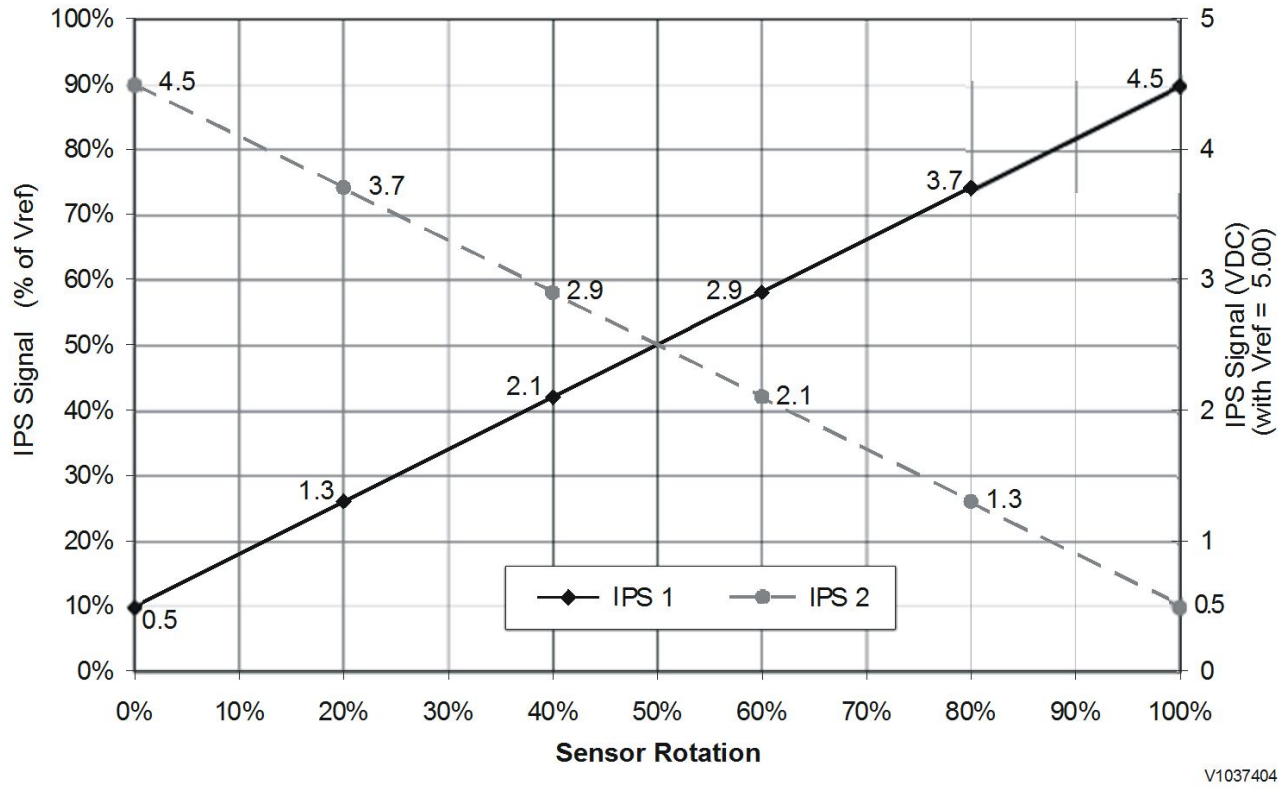



**Figure 1**
**IPS Signal vs. Sensor Angle**

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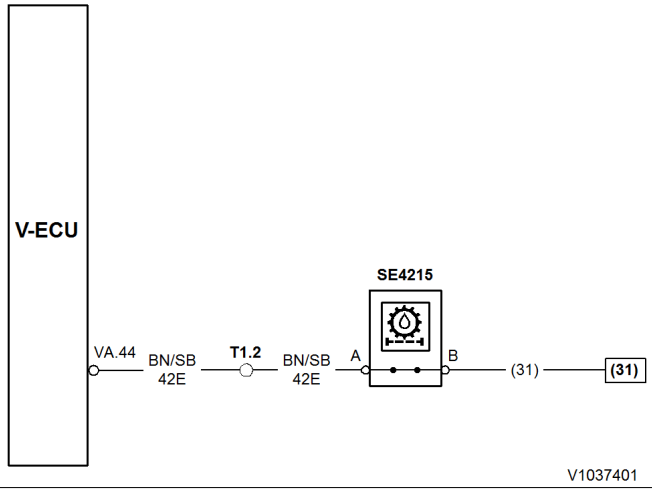
**Service Information**

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Transmission diagnosis - SE4215 Sensor, transmission filter restriction** | **302** | **Service Information** | **2014/12/29** |
| Profile: **GRD, G970 [GB]** | | | |

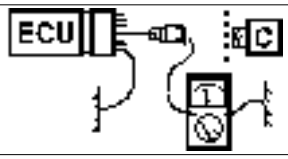
# Transmission diagnosis - SE4215 Sensor, transmission filter restriction

| **Component: SE4215 transmission filter restriction** | | |
|---|---|---|
| **Function** | The transmission oil filter restriction sensor is a normally closed switch. The sensor monitors pressure differential between the inlet and outlet of the filter and informs the operator when a filter restriction occurs. |  |
| **References** | ○ 370 Wiring diagram 18<br>364 Connectors, configuration<br>○ 301 Transmission oil filter bypass indicator<br>○ | |
| **Tools** | ○ 302 Multimeter 8889 0074<br>○ 302 Adapter cable 999 3893<br>○ 302 Extension cable 999 0062<br>302 Multi-pin breaker box 999 8699<br>○ | VA.44 signal<br>31. ground through sensor housing |

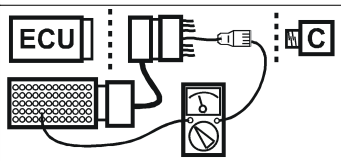
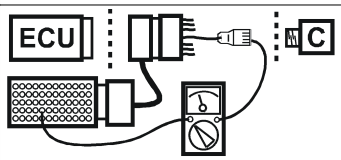
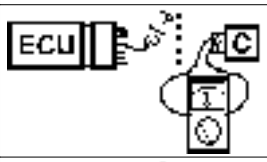
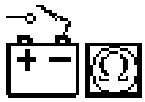
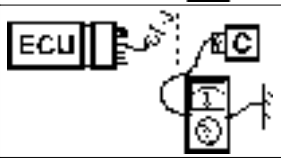


| **Malfunction detection condition** |
|---|
| Detected if vehicle control unit (V-ECU) detects a filter bypass signal when the engine is off. |

| **Type of error/ malfunction** | **Symptom** | **Possible cause** |
|---|---|---|
| FMI 11 | ○ Error text displayed<br>○ Amber central warning lamp **FLASHES** | ○ Sensor defective.<br>○ Sensor feed cable short circuited to ground. |

| **Testing** | **Measuring Point** | **Correct Values** | **Condition** | **Test method** |
|---|---|---|---|---|
| Cable harness & component | Signal cable<br>VA.44 - | ≈ 0.8 bat. V |  |  |

| | | |
|---|---|---|
| FMI 5 | ○ Error text displayed<br>○ Amber central warning lamp **FLASHES** | ○ Cable harness or component open circuit. |
| FMI 6 | ○ Error text displayed<br>○ Amber central warning lamp **FLASHES** | ○ Cable harness or component short circuit. |

| **Testing** | **Measuring Point** | **Correct Values** | **Condition** | **Test method** |
|---|---|---|---|---|
| Cable harness & component | Signal cable<br>VB.25 - (-) | ≈ 0 Ω |  |  |
| | Signal cable<br>VB.27 – (+) | ≈ 0 Ω |  |  |
| Component | (+) – (-) | ≈ 1050 ± 100 Ω |  |  |
| | (+) –<br>(-) – | ≈ ∞ Ω |  |  |

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**Service Information**

| Document Title: **V-ECU diagnosis - SE2702/ SE2704 Sensor, accelerator pedal position** | Function Group: **302** | Information Type: **Service Information** | Date: **2014/12/29** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

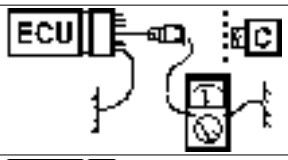
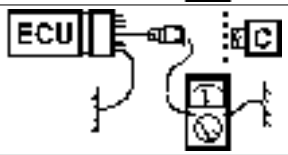
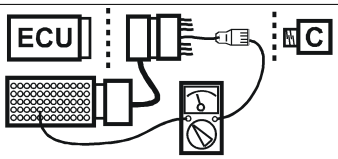
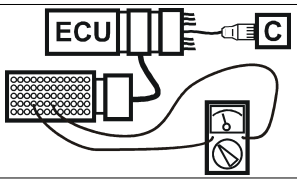
Go back to Index Page

# V-ECU diagnosis - SE2702/SE2704 Sensor, accelerator pedal position

| **Component: SE2702/SE2704 accelerator pedal position sensor** | |  |
|---|---|---|
| **Function** | The accelerator pedal uses two sensors SE2702 and SE2704 which monitor and transmit the desired accelerator position to the V-ECU. Two sensors are used to ensure reliability in the system. Each sensor is scaled differently. The V-ECU only requires information from one sensor, the other serves as a fail safe. | |
| **References** | ○ Schematic 7<br>○ Component location diagram<br>○ VCADS Pro, 27102-8<br>○ Software description | |
| **Tools** | ○ 9812519 Multimeter<br>○ 9993893 Break out harness<br>○ 9990062 Cable<br>○ 9998699 Adapter | VA.26 signal<br>VA.27 signal<br>VA.55 5V feed<br>VA.56 5V feed<br>VA.24 ground<br>VA.25 ground |

| **Malfunction detection condition** |
|---|
| Detected if vehicle control unit (V-ECU) registers that voltage on signal circuit exceeds 4.75 volts or is below 0.25 volts. The V-ECU compares the two sensors to each other and recognizes a skewed or miss scaled sensor. When the voltage differs by 10 percent or more from expected voltage, an error is detected. |

| **Type of error/ malfunction** | **Symptom** | **Possible cause** |
|---|---|---|

| Testing | Measuring Point | Correct Values | Condition | Test method |
|---|---|---|---|---|
| Control unit/cable harness: | Ground cable<br>4 – | ≈ 0 Ω |  |  |
| | Feed cable<br>1 – | ≈ 5 V |  |  |
| | Signal cable<br>2 – VA.54 | ≈ 0 Ω |  |  |
| Subsystem | VA.25 – VA.54 | ≈ 0.5 V (engine switched off) As per chart |  |  |

**SE5501 Sensor Graph**

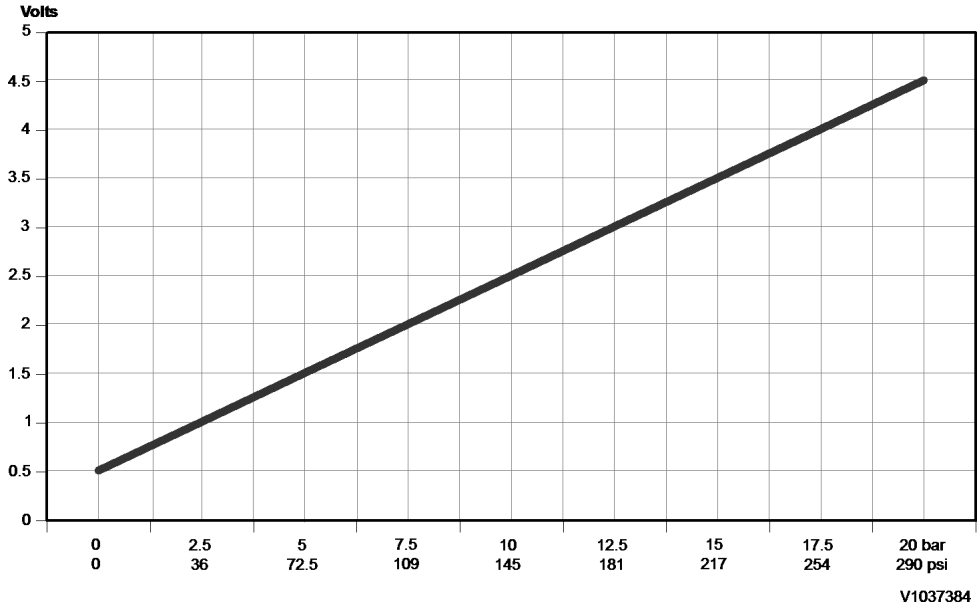
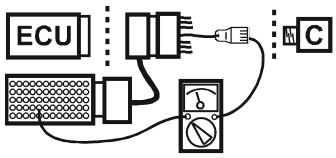
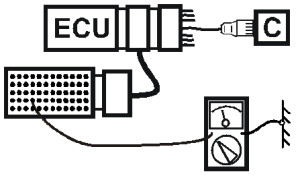
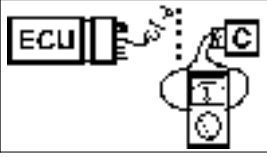
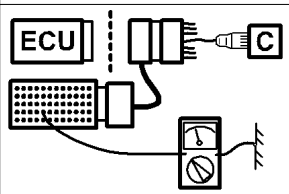
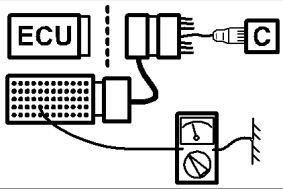
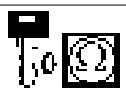
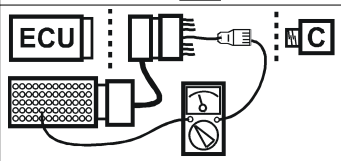
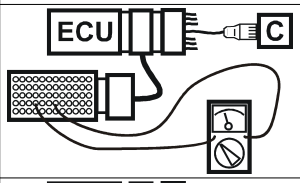
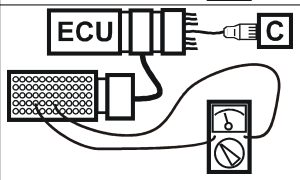
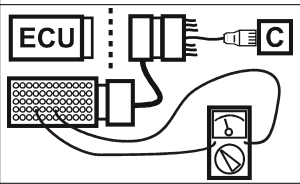
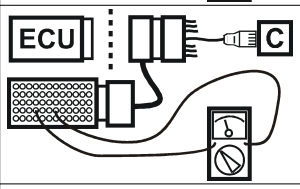
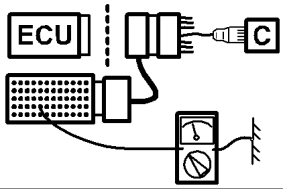



**Figure 1**
**SE5501 voltage signal versus pressure**

| | | | | |
|---|---|---|---|---|
| | Feed cable<br>VB.59 - 2 | ≈ 0 Ω |  |  |
| | Feed cable<br>VB.59 - ⏚ | ≈ bat. V<br>During engine starting |  |  |
| Component | 1 - 2 | ≈ 29.4 Ω at 20 °C |  |  |

| | |
|---|---|
| ○ On / mode / non float<br>○ On / mode / float | to voltage<br>○ Defective control lever switch<br>○ Poor electrical connection (pin tension, damage, moisture or corrosion) |
| Auxiliary enable switch lamps flashing with auxiliary hydraulic switch in:<br>○ On / mode / non float<br>○ On / mode / float | Open circuit in the PWM solenoid circuit after a successful start up<br>Poor electrical connection (pin tension, damage, moisture or corrosion) |

| **Testing** | **Measuring Point** | **Correct Values** | **Condition** | **Test method** |
|---|---|---|---|---|
| Control unit/ cable harness | Feed cable<br>HEC.02 | ≈ 12 V |  |  |
| | Ground cable<br>HEC.01 | ≈ 0 Ω |  |  |
| Switch / cable harness | Cable harness<br>HEC.03 – 2<br>HEC.12 – 1<br>HEC.19 – 3<br>HEC.20 – 3<br>HEC.21 – 3 | ≈ 0 Ω |  |  |
| | Feed cable<br>HEC.03 – HEC.12 | ≈ 5 V |  |  |
| | Signal Cable<br>HEC.19 – HEC.12<br>HEC.20 – HEC.12<br>HEC.21 – HEC.12 | ≈ 0.5 V<br>lower<br>≈ 2.5 V<br>neutral<br>≈ 4.5 V<br>raise |  |  |
| PWM solenoids and cable harness | PWM9101<br>PWM9102<br>PWM9103<br>PWM9104<br>PWM9105 | ≈ 4.75 Ω at 20°C |  |  |
| | PWM9121<br>PWM9122<br>PWM9123<br>PWM9124<br>PWM9125 | ≈ 10.5 Ω at 20°C |  |  |
| | PWM9101<br>PWM9102<br>PWM9103<br>PWM9104<br>PWM9105 | ≈ ∞ |  |  |

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Alternator, description** | **320** | **Service Information** | **2015/1/4 0** |
| Profile: **GRD, G970 [GB]** | | | |

# Alternator, description

The alternator is an 80 A alternating current generator with a normal charge voltage of 28.3 V and a built-in charge regulator.
Machines that have been equipped with a large number of components using electric power, for example, extra work lights, can be equipped with an 110 A alternator as an alternative.
When the engine is turned off, the batteries normally give a voltage of approx. 24 – 26 V, depending on their state of charge.
When the engine is running, the batteries are normally charged by the alternator, since the alternators output voltage is higher than the battery voltage.

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Direction indicator; turn signal description** | **361** | **Service Information** | **2015/1/4 0** |
| Profile: **GRD, G970 [GB]** | | | |

# Direction indicator; turn signal description

The operator activates the directional indicator/turn signal from inside the cab. The signal lights can be located at the front of the machine and at the rear. At the front, they are found in the headlight housing on the light bar. At the rear, they are found in the housing for the brake lights and tail lights.
European model machines have their turn signal indicators in the headlight housing at the front of the machine. The rear turning signals are mounted on the end of arms attached to the radiator enclosure instead of the standard rear location.

With the ignition switch in position I, voltage is supplied form relay RE8704 through fuse 7 and the flasher RF3601 to the turn signal switch SW3605.
With the turn signal switch is in LH turn position, voltage is supplied to both the LH front and rear turn signal bulbs. The lamps go on immediately. They begin to flash when the current flow causes the flasher to repeatedly open and close the circuit. The I-ECU receives a pulsing voltage signal from the flasher RF3601, for turn signal indicator operation.
With the turn signal switch is in RH turn position, voltage is supplied to both the RH front and rear turn signal bulbs. The lamps go on immediately. They begin to flash when the current flow causes the flasher to repeatedly open and close the circuit. The I-ECU receives a pulsing voltage signal from the flasher RF3601, for turn signal indicator operation.

Proper maintenance and operation of the wipers are important to ensure operator visibility for safe operation of the machine at all times.

7. When testing and adjustments are completed and the wipers have been switched off (in the parked position), turn on the battery disconnect switch.

10. Re-install the cab headliner, storage compartments, plastic cover trim, interior rear view mirrors, or any other interior components that were removed in order to gain access to the wiper motor and linkages.
    **NOTE!**
    Be sure to re-connect all wiring harnesses to all standard or optional components (as equipped) such as the interior dome lights or defroster fans.

    Secure the headliner, trim and other components in position with the appropriate fasteners and screws. Tighten all fasteners to specification.

11. Place the machine back into service.

| | | | | |
|---|---|---|---|---|
| 46 | Not used (AWD) | | Orange | |
| 47 | Not used (AWD) | | Brown | |
| 48–49 | Not used | | | |
| 50 | Not used (AWD) | | Orange | |
| 51 | Not used (AWD) | | Brown | |
| 52 | Not used (AWD) | | Blue | |
| 53 | Not used (AWD) | | White | |
| 54 | Not used (AWD) | | Orange/white | |
| 55 | Not used (AWD) | | Brown/white | |
| 56 | 22 | Brake booster activation | Yellow/green | 6A |
| 57 | 22 | Park brake solenoid MA5501 feed | Yellow/white | 55A |
| 58 | 3 | Start relay RE3302 activation | Blue | 28 |
| 59 | 7 | Fan control solenoid MA2603 feed | Orange/brown | 26D |
| 60 | 7 | Fan reverse solenoid MA2602 feed | Orange/white | 26C |
| 61 | 24 | AC On / V-ECU Output | Orange/white | 87I |
| 62–63 | Not used | | | |
| 64 | 26 | Hydraulic unload solenoid MA9111 feed | Violet/yellow | 91U |
| 65–66 | Not used | | | |
| 67 | 23 | MO6401Secondary Steering relay feed | Grey/blue | 64 |
| 68 | 19 | Differential lock solenoid MA4601 feed | Violet/white | 46A |
| 69 | 18 | Backup warning/light relay feed | Blue/white | 10B |
| 70 | 19 | Differential lock indicator signal | Violet | 46I |

| Document Title: **Explanation of wiring diagrams** | Function Group: **370** | Information Type: **Service Information** | Date: **2015/1/4 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Explanation of wiring diagrams

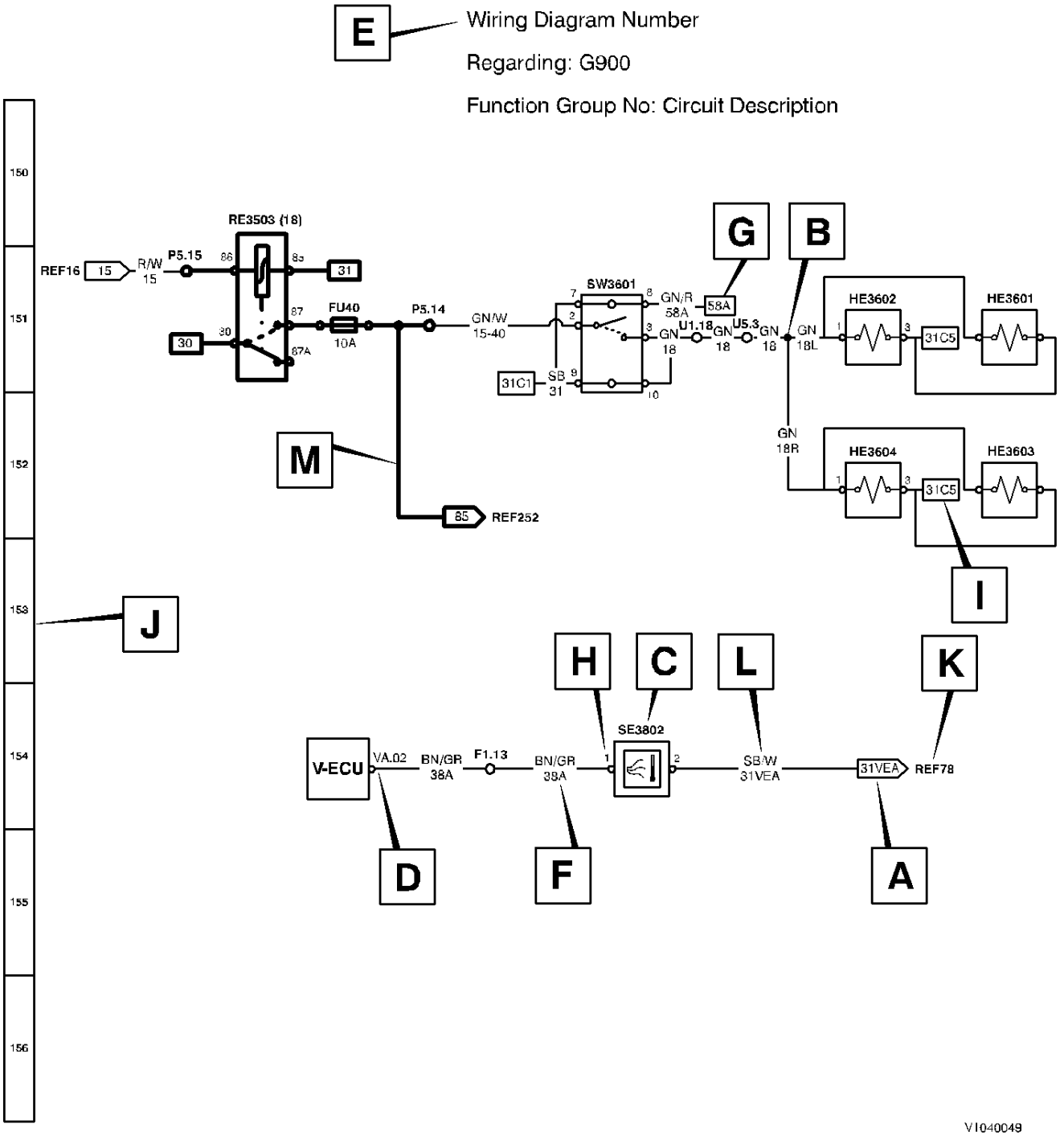



**Figure 1**
**Explanation of wiring diagrams**

**Fuse locations with converter installation**

| Designation | Rating | Function | Wiring diagram |
|---|---|---|---|
| FH3–1 | 7.5 (30 amp converter)<br>10 (60 amp converter) | 12 V power outlet PO3902 | 17 |
| FH3–2 | 7.5 (30 amp converter)<br>15 (60 amp converter) | Accessory power connection | 17 |
| FH3–3 | 7.5 (30 amp converter)<br>15 (60 amp converter) | Accessory power connection | 17 |
| FH3–4 | 7.5 (30 amp converter)<br>15 (60 amp converter) | Accessory power connection | 17 |

**Fuse locations in engine compartment**

| Designation | AMP Rating | Function | Wiring diagram |
|---|---|---|---|
| FH4 | 5 | Engine preheating indicator lamp circuit | 3 |

| Document Title: **Component list 9: Relays** | Function Group: **370** | Information Type: **Service Information** | Date: **2015/1/4 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

Go back to Index Page

# Component list 9: Relays

Refer to component location diagrams for relay locations

**Relays on circuit board**

| Position | Designation | Function | Wiring diagram |
|---|---|---|---|
| RE 1 | RE3701 | Electronic components supply | 1 |
| RE 2 | RE3702 | Vehicle ECU (V-ECU) | 2 |
| RE 3 | RE3502 | Rear & Side work lights | 11 |
| RE 4 | RE3602 | Wipers/washers | 16 |
| RE 5 | RE3512 | Cab headlights | 8 |
| RE 6 | RE3501 | Front work lights | 11 |
| RE 7 | RE3507 | Moldboard work lights | 12 |
| RE 8 | RE9101 | Auxiliary hydraulics | 28, 29 |
| RE 9 | RE8701 | HVAC climate control | 24 |
| RE 10 | RE3703 | Instrument ECU (I-ECU) | 2 |
| RE 11 | RE3705 | Engine ECU (E-ECU) | 2 |
| RE 12 | RE8704 | Defroster fan/air mix/ direction flasher | 24 |
| RE 13 | RE | Spare | 27 |
| RE 14 | RE | Spare | 27 |
| RE 15 | RE3510 | Front headlights | 8 |
| RE 16 | RE4201 | Back-up alarm/Lights | 18 |
| RE 17 | RE8501 | Seat air suspension | 25 |
| RE 18 | RE3503 | Heated mirrors, heated seat | 15 |
| RE 19 | RE5201 | Brake booster motor | 22 |
| RE 20 | RE3505 | Front headlights, high/low beam | 8 |
| RE 21 | RE3506 | Cab headlights, high/low beam | 8 |
| RE 22 | RE3302 | Start control | 3 |
| RE 23 | RE3902 | 24/12 converter | 17 |

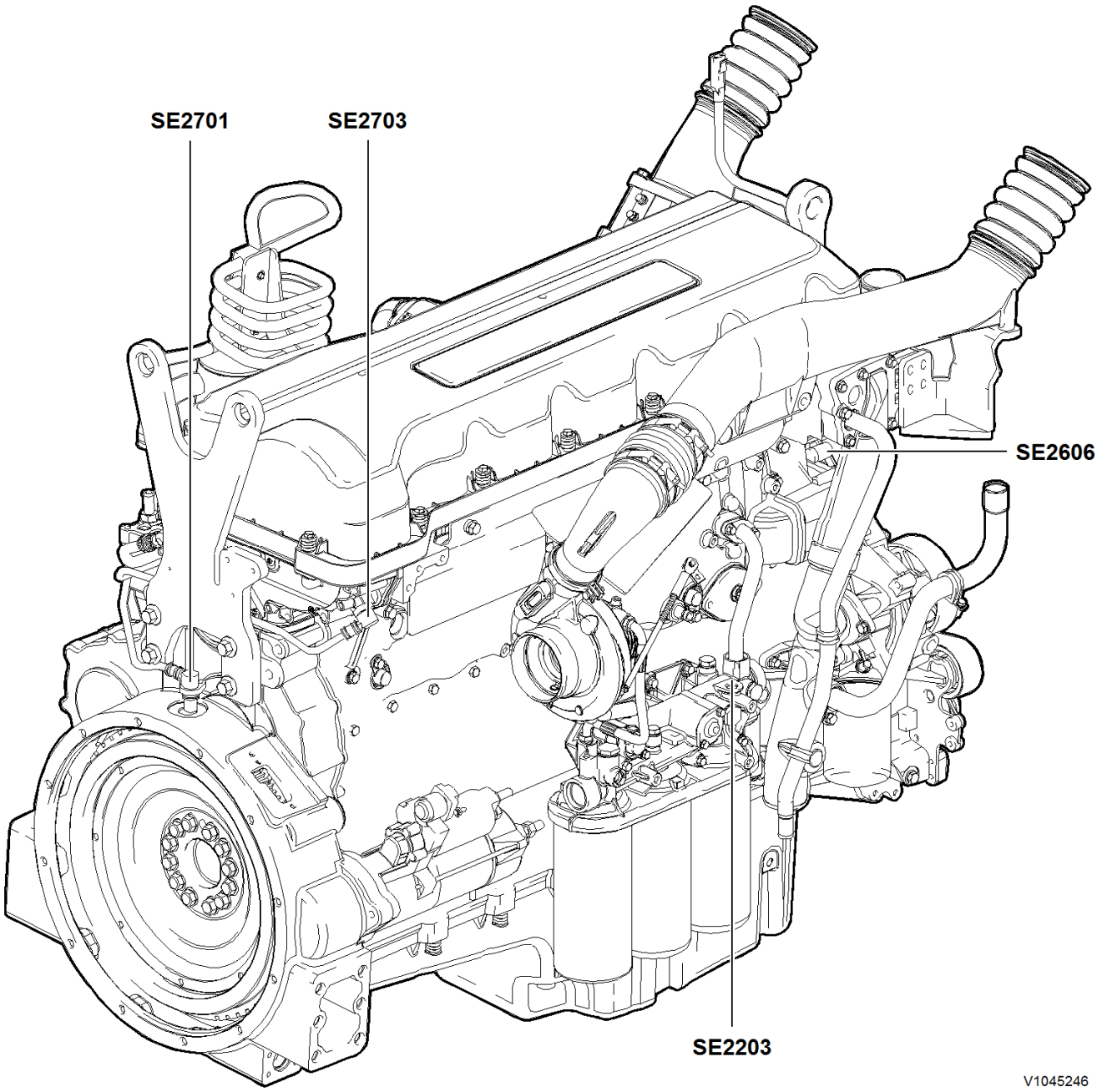



**Figure 2**
**D9B sensor locations**

More than one document matches chosen profile

- Wiring diagram 2 Feeds V-ECU, I-ECU

  Product Line: GRD
  Model Variant: G970 (Volvo)
  Site: Goderich
  Serial number start: 39300
  Serial number stop: 40921

- Wiring diagram 2 Feeds V-ECU, I-ECU

  Product Line: GRD
  Model Variant: G970 (Volvo)
  Site: Goderich
  Serial number start: 40922
  Serial number stop: 59999

VOLVO

Construction Equipment

**Service Information**

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Wiring diagram 9** | **370** | **Service Information** | **2015/1/4 0** |
| Profile: **GRD, G970 [GB]** | | | |

# Wiring diagram 9

**Function group 3: radio, 12V convertor, turn signals, hazard**

VOLVO
Construction Equipment

**Service Information**

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Wiring diagram 26** | **370** | **Service Information** | **2015/1/4 0** |
| Profile: **GRD, G970 [GB]** | | | |

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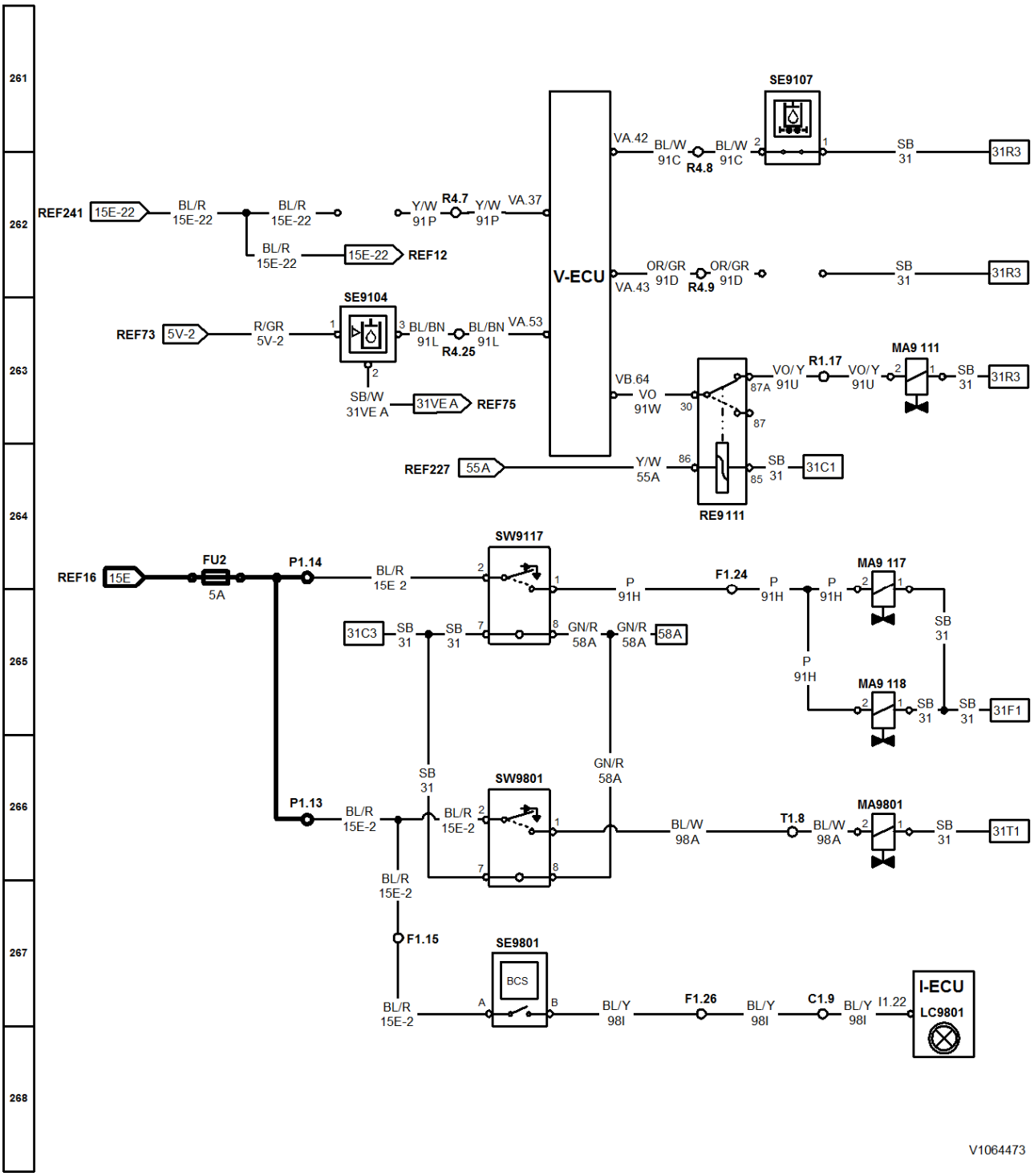
# Wiring diagram 26

**Function group 9 D9 engine, non AWD model: BCS lock cylinder, hydraulic unload**




V1064473

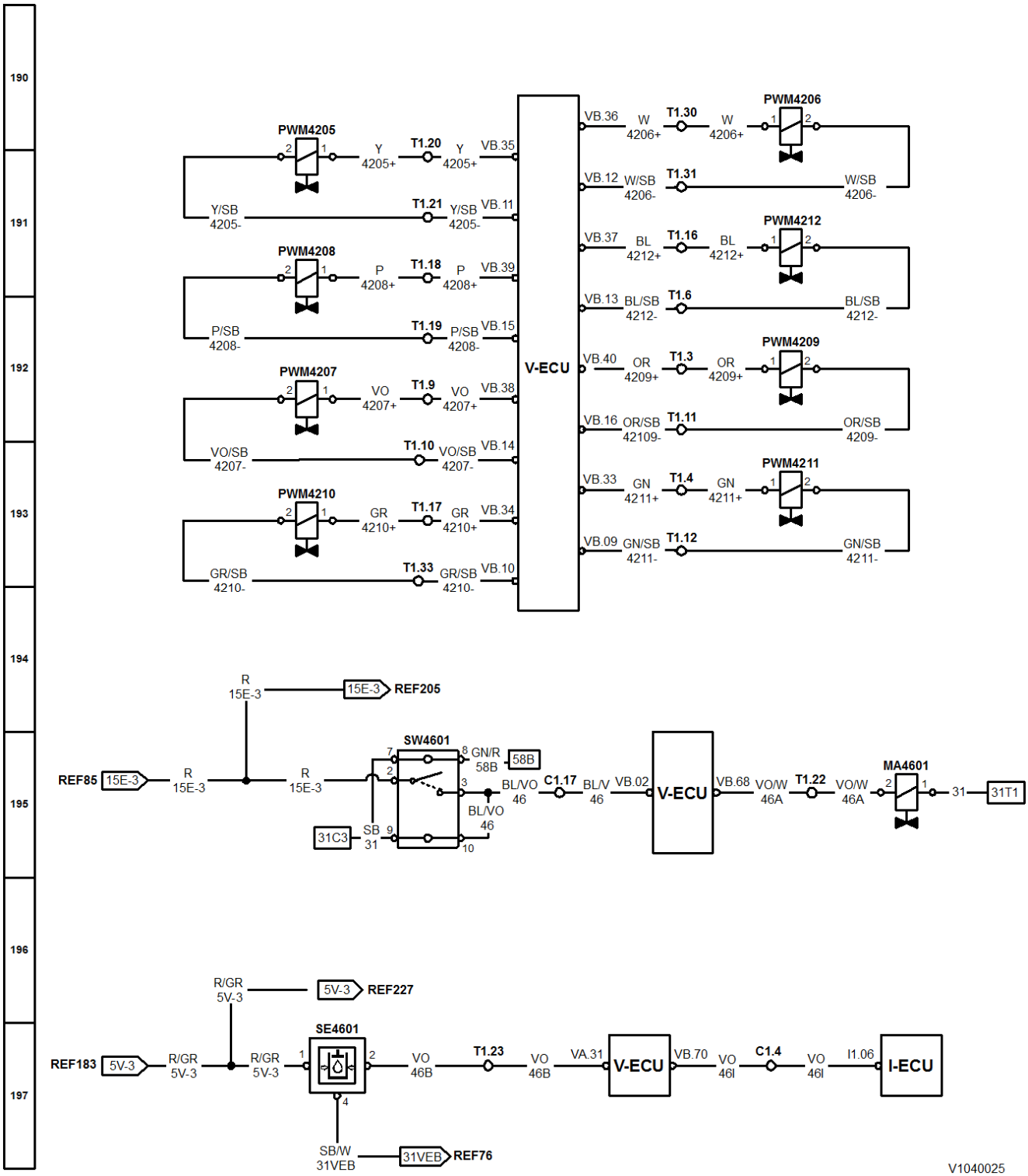
VOLVO
Construction Equipment

**Service Information**

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Wiring diagram 19** | **370** | **Service Information** | **2015/1/4 0** |
| Profile: **GRD, G970 [GB]** | | | |

# Wiring diagram 19

**Function group 4: transmission solenoids, differential lock**



VOLVO
Construction Equipment

Service Information

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Wiring diagram 25** | **370** | **Service Information** | **2015/1/4 0** |
| Profile: **GRD, G970 [GB]** | | | |

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# Wiring diagram 25

**Function group 8: heated seat, defrost fan**

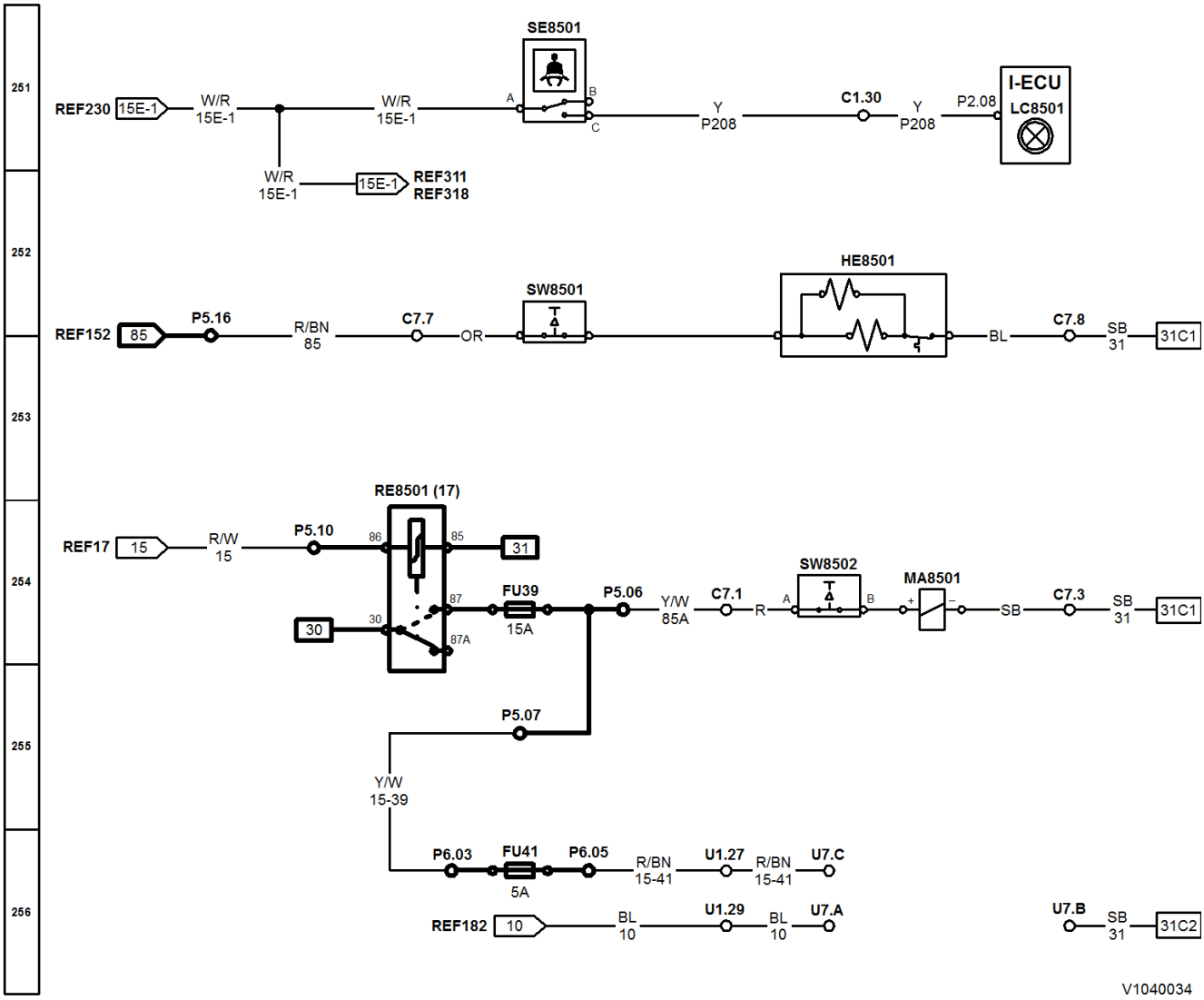



**Figure 1**
**Wiring diagram 25**

**Figure 1**
**Wiring diagram 29**

VOLVO
Construction Equipment

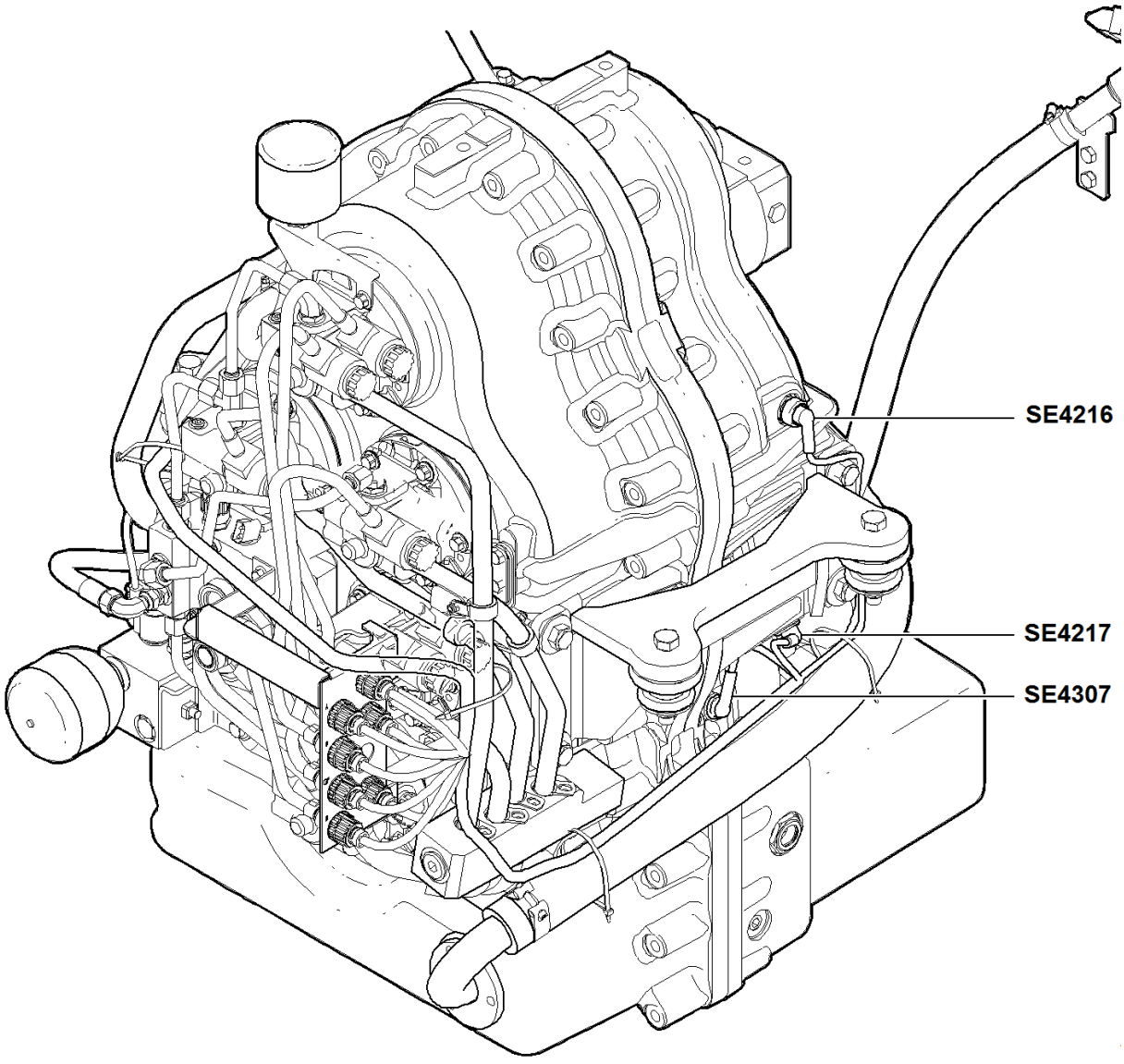
**Service Information**

| Document Title: **Transmission sensor and connection, checking** | Function Group: **386** | Information Type: **Service Information** | Date: **2015/1/4 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Transmission sensor and connection, checking

**Op nbr 386-009**

1. Place the machine in the service position. Refer to 191 Service position
2. Remove the transmission guard. Refer to 715 Transmission guard, removing.
3. Disconnect the speed sensor in question.
4. With the machine not running, enter the cab and turn the ignition key to the (II) position. **Do not start the engine.**
5. Read the error message displayed on the centre instrument panel display unit and compare it to the transmission speed sensor diagram to ensure that the connections match the sensor.



VOLVO
Construction Equipment

Service Information

| Document Title: **Type HTE840 transmission, description and operation** | Function Group: **420** | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [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 contronic 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 (modulaton) 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

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

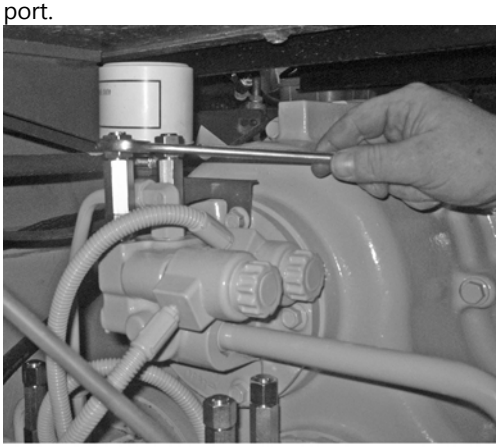



**Figure 4**
**Attenuator installation**

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 pressure sensor, replacing** | Function Group: **421** | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Transmission pressure sensor, replacing

**Op nbr 421-026**

## Removing

1. Place the machine in the 191 Service position.
2. Lower the transmission guard. Refer to 715 Transmission guard, removing.
3. Disconnect the wiring harness from the pressure sensor SE4214.

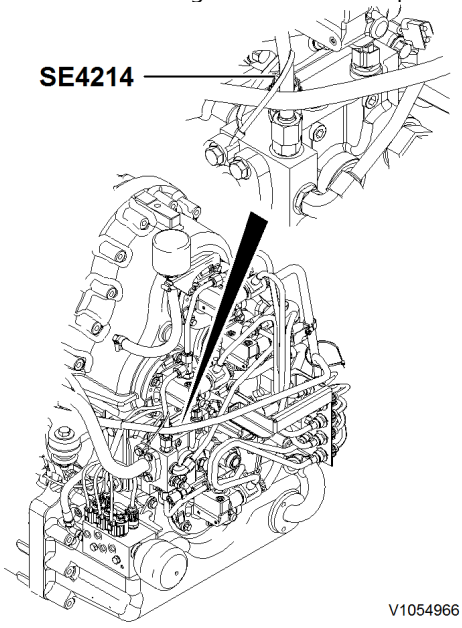



**Figure 1**
**Transmission pressure sensor location**

4. Create a special wrench e tool measuring 152 mm (6 in.).

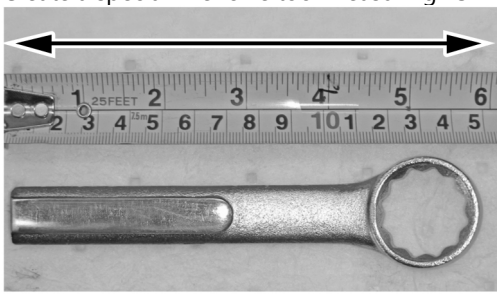



**Figure 2**
**Special wrench e tool**

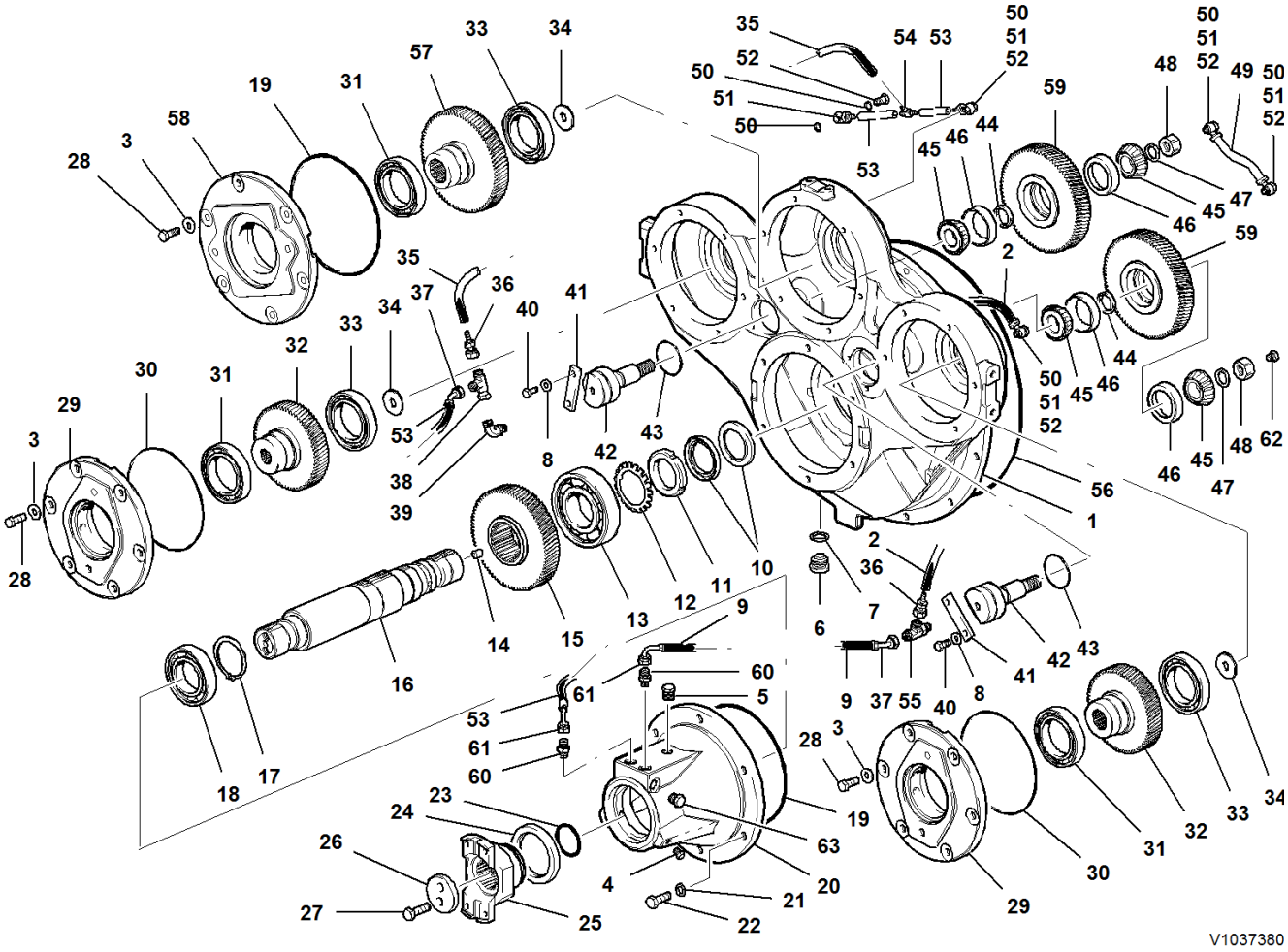



**Figure 3**
**Pump drive assembly - AWD models G946 and G976**

1. Housing
2. Hose
3. Washer
4. Plug
5. Plug
6. Magnetic plug
7. Plane gasket
8. Washer
9. Hose
10. Seal
11. Round nut
12. Lock washer
13. Ball bearing
14. Set screw
15. Gear
16. Shaft
17. Retaining ring
18. Ball bearing
19. O-ring
20. Housing
21. Washer
22. Hexagon screw
23. O-ring
24. Sealing ring
25. Yoke

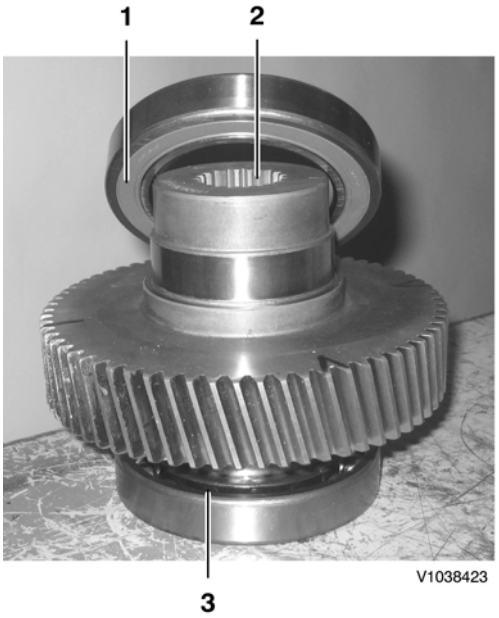



**Figure 13**
**Pump Gear**

1. Seal
2. Splines
3. No seal

22. Install the retaining ring to the output shaft. Install the gear on the shaft. Press on the bearing and add a new lock washer. Tighten the locknut. Lock the nut in a slot.

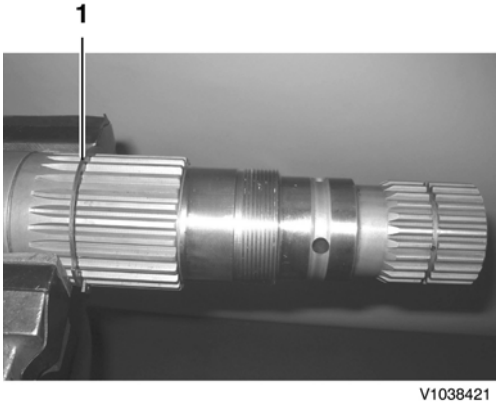



**Figure 14**
**Output shaft**

1. Retaining ring

23. Press the bearing on the other side of the shaft.

24. Reinstall the baffle in the housing.

3. Place the machine in the service position. Refer to 191 Service position.

4. Remove the bolts from the hydraulic tank cover support member. Remove the two bolts on the right side of the machine retaining the driveshaft cover.

5. Remove two bolts from each end of the driveshaft.
   **NOTE!**
   Turn the driveshaft 180° in order to remove the remaining bolts.

6. Remove the driveshaft. **Weight 20 kg (44 lbs)**

| Document Title: **Universal joint, replacing** | Function Group: **451** | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Universal joint, replacing

**Op nbr 451-033**

1. Remove the complete lower and midship driveshaft assemblies with the U-joints and pillow block bearing assembly from the machine.
   Refer to 451 Drive shaft, removing
   Place the assembly on a clean workbench.


**Figure 1**
**Lower front driveshaft assembly**

2. Insert a prybar through the universal joint and remove the four patch bolts.


**Figure 2**
**Prybar inserted through U-joint**

3. Remove the universal joint from the end of the lower driveshaft.

VOLVO
Construction Equipment

**Service Information**

| Document Title: **Tandem drive chain, installation** | Function Group: **463** | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Tandem drive chain, installation

**Op nbr 463-059**

## Rear tandem drive chain installation

**WARNING**

**Only use lifting devices with adequate capacity.**

1. Install the new rear tandem drive chain through the inspection cover onto the teeth of the brake sprockets and the center tandem drive sprocket.
2. Once the chain has been placed on the teeth of the sprockets, install the connector link and cotter pins at the rear inspection cover position.
   **NOTE!**
   If the front tandem drive chain needs to be replaced, refer to 463 Tandem drive chain, installation.
3. Apply a bead of sealant to the open faces on the tandem case. Apply sealant to the bolts.
4. Reinstall one inspection cover and one brake line shield on the tandem case. Reinstall the tandem drive sprocket access cover.
5. Reconnect the brake lines and clamps. Reinstall the brake line shield.
6. Through the remaining inspection cover, fill the tandem case with clean oil. Refer to 463 Tandems, volume (Models G930 - G976), 463 Tandems, volume (Model G990) and 160 Recommended lubricants, oils.
7. Reinstall the battery box and batteries, if servicing the left side of the machine. Refer to 311 Batteries, replacing.
8. Once both tandem drives are connected, back off the parking brake bolts to 31 mm. Reengage to the 191 Service position.
9. Bleed the parking brake and service brakes. Refer to 517 Brake system, bleeding.
10. Place the machine back in service.

**1000 kg, 2300 lbs)**

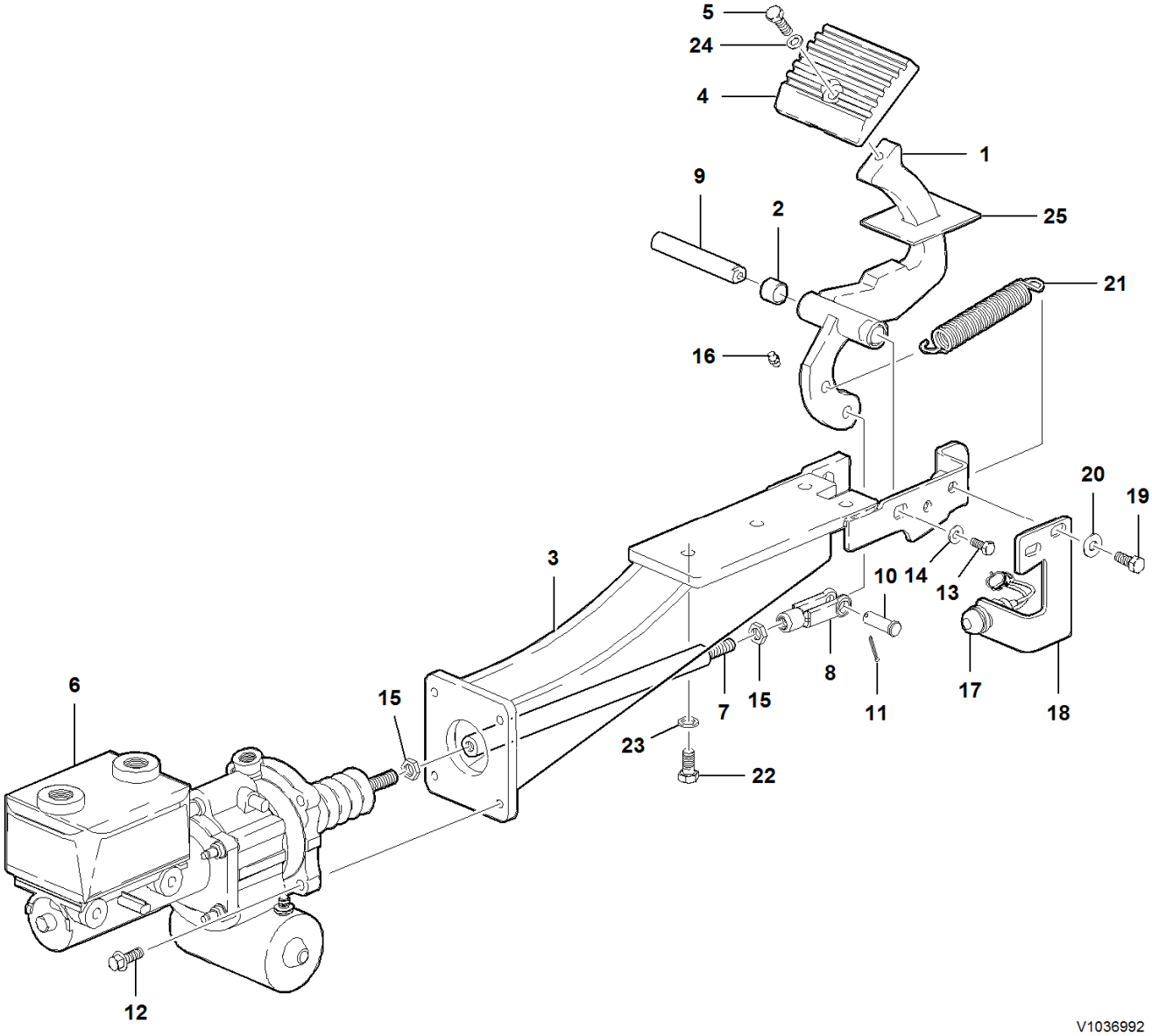



**Figure 1**

1. Brake pedal
2. Bearing
3. Bracket
4. Brake pad
5. Hexagon screw
6. Master cylinder
7. Rod
8. Clevis
9. Shaft
10. Clevis pin
11. Cotter pin
12. Flange screw
13. Hexagon screw
14. Washer
15. Hexagon nut
16. Nipple
17. Switch
18. Bracket
19. Hexagon screw

**Figure 8**

12. Place the brake housing (with the large opening down) on a sturdy, level work surface. **Weight 91 kg (200 lbs).** Use a rubber tipped air nozzle to carefully apply shop air pressure until the piston releases from the bore.

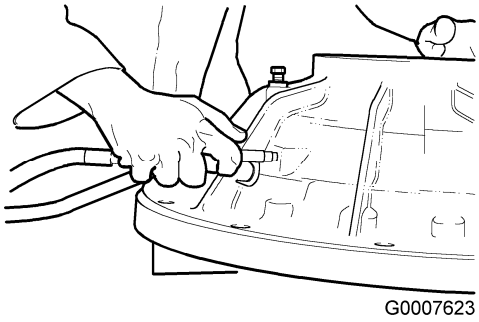



**Figure 9**

13. Remove and discard the O-rings (9) and back-up rings (8 and 10) from the piston (11).

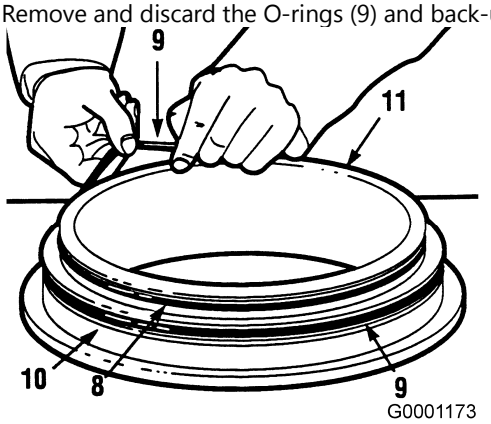



**Figure 10**

14. Place the housing in a hydraulic press. Remove the outboard bearing cup. Place the bearing cup to one side for cleaning and inspection.

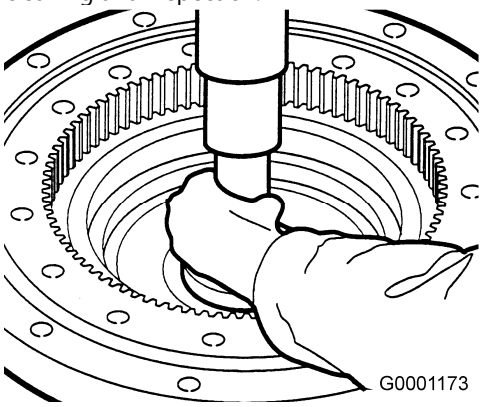



**Figure 11**

15. Remove the adjusting pin. Remove and discard the O-ring.

**Figure 4**

8. Install the back-up plate on the brake housing and tap into place with a plastic mallet. **Weight 35 kg (77 lbs)**
   Install the retaining bolts and washers.
   Torque-tighten the bolts in a diagonal pattern to **136 Nm (100 lbf ft)**.

9. Lubricate the inboard bearing cone and install on the axle shaft (1). This should be a slide fit.

10. Use a safe lifting device to install the driven sprocket on the axle shaft. This should be a slide fit. Make sure the sprocket flange is in the correct orientation. **Weight 36 kg (80 lbs)**.

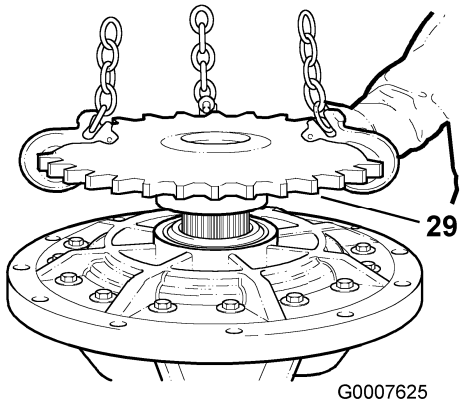



**Figure 5**

11. Install the retainer plate without shims.
    Install the bolts and **torque-tighten to 54 Nm (40 lbf ft)**.
    Rotate the housing (7) during the tightening process to seat the bearings properly. It may be necessary to retighten the bolts several times.
    Remove the bolts and retainer plate. DO NOT turn the housing. The bearings are now set at zero preload.

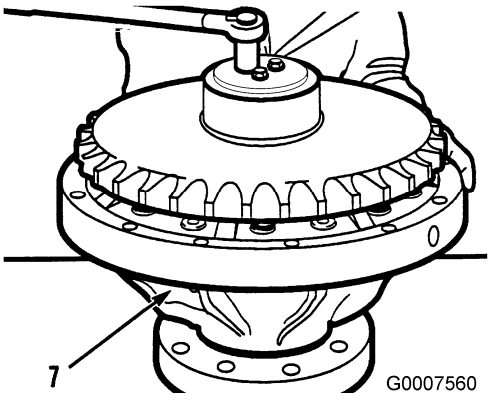



**Figure 6**

12. Measure the distance from the step in the driven sprocket to the end of the axle shaft. Record the measurement.
    Repeat the procedure in three separate places.
    Calculate the average of the three measurements.
    Subtract the following:
    0,225 0,025 mm (0.009 0.001 in.) models G930 to G976 0,275 0,025 mm (0.011 0.001 in.) model G990 from the average measurement and make up a shim pack (23) to this thickness.
    Check shim pack thickness with a micrometer.

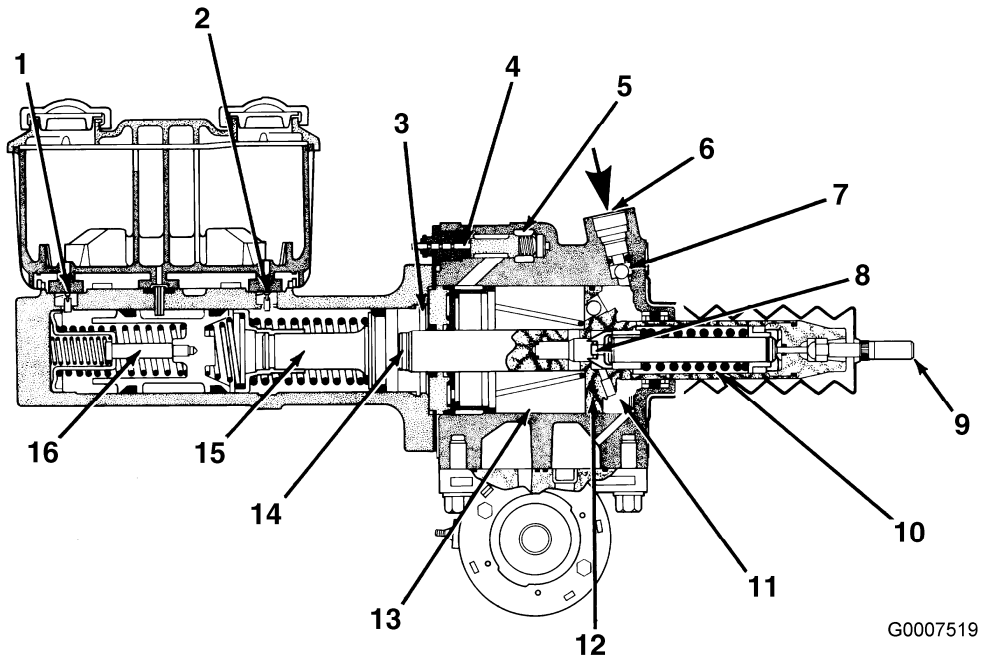



**Figure 6**
**Engine running – Maximum brake application**

1. Secondary compensating valve (seated)
2. Primary compensating valve (seated)
3. Atmospheric pressure
4. Flow switch (open)
5. Fluid return
6. Fluid flow
7. Inlet check ball
8. Pressure valve (almost totally closed)
9. Brake pedal push rod (fully applied)
10. Pressure regulator spring
11. High pressure chamber
12. Power piston
13. Low pressure chamber
14. Output push rod (maximum output force)
15. Primary piston
16. Secondary piston

**Hydraulic boost malfunction – Normal brake application**

System function when brake boost is demanded and there is no hydraulic fluid flow due to engine shut down or some other condition that interrupts fluid flow:

1. The booster inlet check valve closes as a result of no fluid flow entering the booster assembly.
2. The flow switch closes since there is no flow to keep it open. This completes the electric circuit to the electric motor pump mounted on the bottom of the power booster housing.
3. The electric motor pump supplies system fluid at a somewhat lower pressure for power braking assist. Therefore, increased pedal effort is required to stop the machine within a specified distance. The brake system is faulty if the brake warning lamp and alarm energize.
   The brake system must be repaired by a qualified service technician. **DO NOT** drive the grader.
4. The brake master cylinder operates as described in **Engine running - normal brake application**, above.

| Document Title: **Brake master cylinder, assembling** | Function Group: **521** | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Brake master cylinder, assembling

**Op nbr 521-015**

1. Lubricate the brake master cylinder body bore, primary and secondary piston assemblies and all parts in the repair kit.
   **NOTE!**
   Use only mineral oil. **DO NOT** use hydraulic fluid.

2. Install and compress the large diameter of the primary piston return spring into the primary piston actuator.

3. Install the piston stop pin and relieve the compression applied to the spring.

4. Place the secondary piston return spring into secondary piston actuator.

   **WARNING**

   **Spring tension.**

   Danger of objects released under spring compression. Serious injury can result. Wear appropriate face and hand protection.

5. Carefully install the secondary piston assembly, spring end first. Carefully install the primary piston assembly, spring end first. Using the same compression tool, depress both piston assemblies approximately 25 mm (1 in.). Spring compression load is between 41 and 59 kg (90 and 130 lb). Take care not to scratch the bore surface.

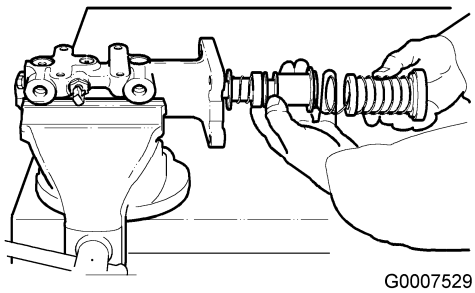



**Figure 1**

6. Install a new snap ring into the body bore. Remove the spring compression tool.

7. Install two new compensating valve seals into their recesses in the reservoir. Install a new piston stop O-ring.

8. Install new O-rings on the pressure differential piston, lubricate and install with plastic insert.

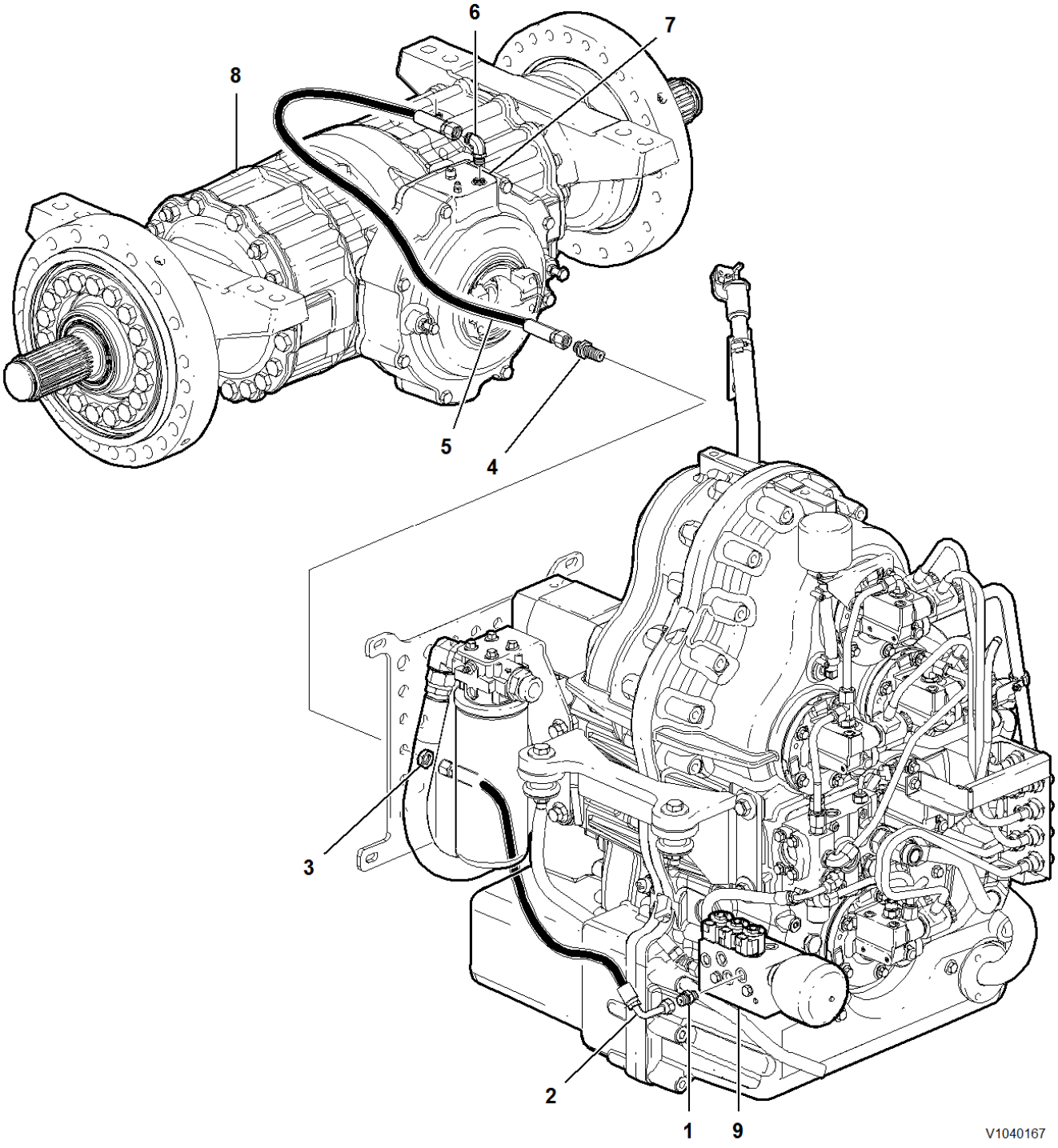



**Figure 2**
**Parking brake hydraulic circuit**

1. Nipple
2. Hydraulic hose
3. Lock nut
4. Nipple
5. Hydraulic hose
6. Elbow nipple
7. Parking brake
8. Final drive axle

V1040395

**Figure 2**
**Transmission jack underneath the front axle frame**

7. Mark the locations of all hydraulic hoses. Remove them from the bulkhead fittings on the side of the frame. Cap and plug all hydraulic hoses and fittings to prevent contamination.

8. Remove the retaining rings from both ends of the tie bar and remove it from the axle frame.

9. From the rear of the axle, remove the hexagon screw from the center pivot pin. From the front of the axle, position a large bar through the lower cut out on the nose plate and on to the end of the center pivot pin. Make sure that the axle is supported and drive the center pivot pin out.

V1040396

**Figure 3**
**Removing the retaining bolt from the center pin**

10. Lower the axle frame out and away from the machine.

| Document Title:<br>**Tie bar, installing** | Function Group:<br>**622** | Information Type:<br>**Service Information** | Date:<br>**2015/1/6 0** |
|---|---|---|---|
| Profile:<br>**GRD, G970 [GB]** | | | |

# Tie bar, installing

**Op nbr 622-063**

Drift

1. Secure the tie bar in a vise. Use a hammer and appropriate drift to install the bearings. Install new retaining rings.
2. Before installing the tie bar onto the front axle, clean and lubricate the tie bar pins.

   **WARNING**

   **Only use lifting devices with adequate capacity.**
3. Install the tie bar onto the front axle. Install the retaining rings.
4. Take the machine out of the service position.

10. Rotate the gas shock so the upper lug will be in line with the mounting lug on the rear support beam.

11. Apply a drop of thread locker to the threads just above the actuator head and tighten the lock nut. .
    **NOTE!**
    Be sure that the thread locker does not enter the actuator head, as this will affect proper pedal function

12. Insert the gas shock assembly into the pedestal.

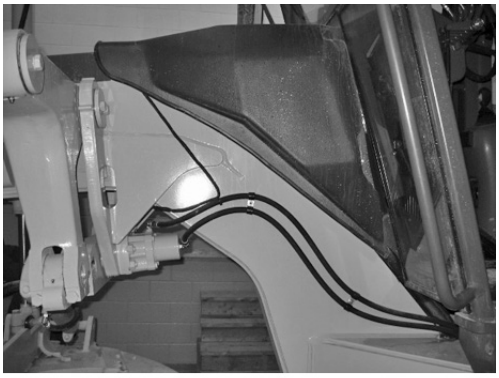
13. Secure the lower lug of the gas shock assembly to the pedestal with the screw, spacer and lock nut.

14. Install the pedal pad on the lever.

15. Tilt the pedestal fully forward towards the front of the machine. Secure the upper lug of the gas shock to the rear support beam with the screw, washer and lock nut.

16. Re-install the control rods to the levers.

17. Place the machine back in service.



V1044016

**Figure 3**
**Cover installed**

6. After work has been carried out on a safety-related system, a function check should be performed to meet the requirements in ISO 15998.
   Perform the steering system function check. Refer to 600 Steering system, function check.

7. Place the machine back into service.

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**Service Information**

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Secondary steering circuit hydraulic diagram** | **647** | **Service Information** | **2015/1/6 0** |
| Profile: **GRD, G970 [GB]** | | | |

# Secondary steering circuit hydraulic diagram

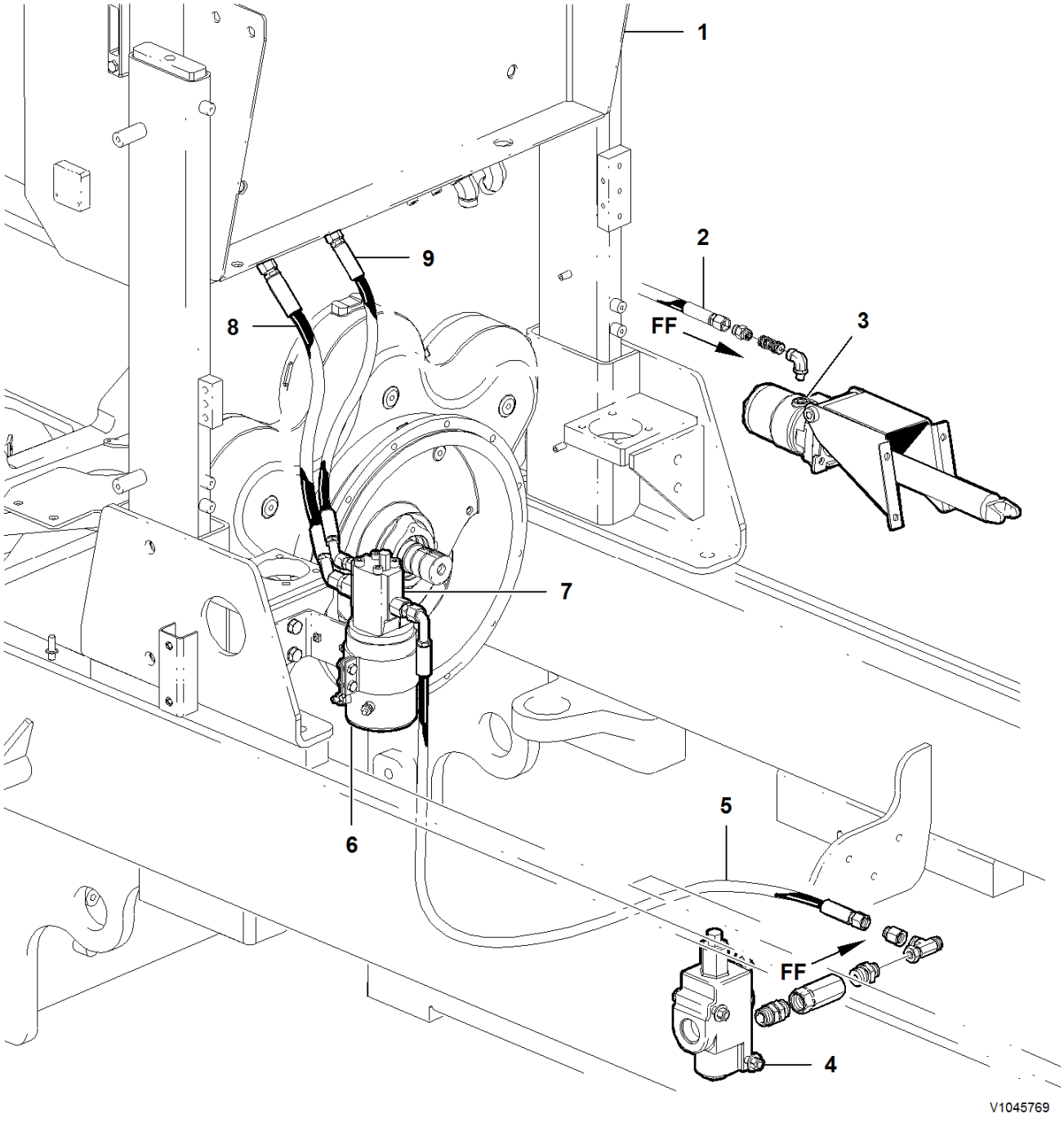


**Figure 1**
**Secondary steering circuit hydraulic diagram — D9 engine**

FF = Free Flow

Thank you for your purchase.
Have a nice day.

| Document Title: **Articulation Indicator - Setup and Adjustment** | Function Group: **742** | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Articulation Indicator - Setup and Adjustment

**Op nbr 742-054**

1. Place the machine on a flat surface ensuring that the front and rear frames are in alignment with each other. To ensure proper alignment, install the articulation lock pins.
   **NOTE!**
   It should be possible to lift either articulation lock pin out freely.

2. Place the machine in the 191 Service position.

3. Tilt the pedestal fully forward toward the operator's seat. Remove the screws securing the lower pedestal cover to the cab. Remove the pedestal cover.

4. Adjust the upper and lower nut securing the control cable to the bracket until the indicator corresponds with the center mark of the articulation gauge.
   **NOTE!**
   If there is not enough travel up or down to adjust the articulation indicator to correspond with the center mark on the gauge, the center instrument cover must be removed. Adjust the position of the ball joint on the control cable.

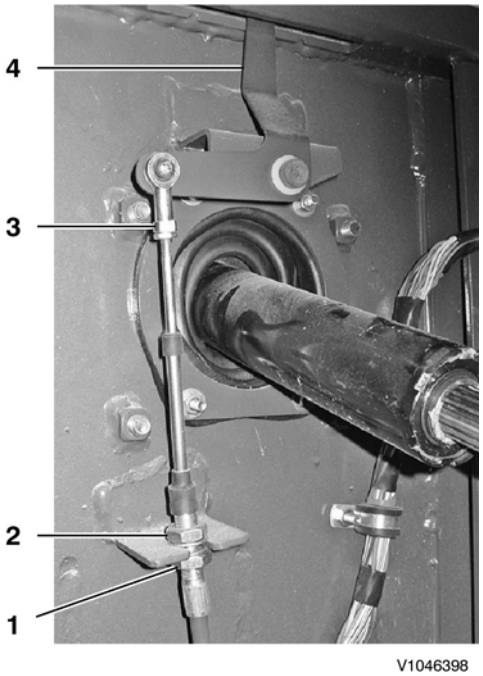


**Figure 1**
**Articulation indicator adjustments**

1. Lower adjustment nut
2. Upper adjustment nut
3. Adjustment nut at the ball joint
4. Articulation indicator

Thank you for your purchase.
Have a nice day.

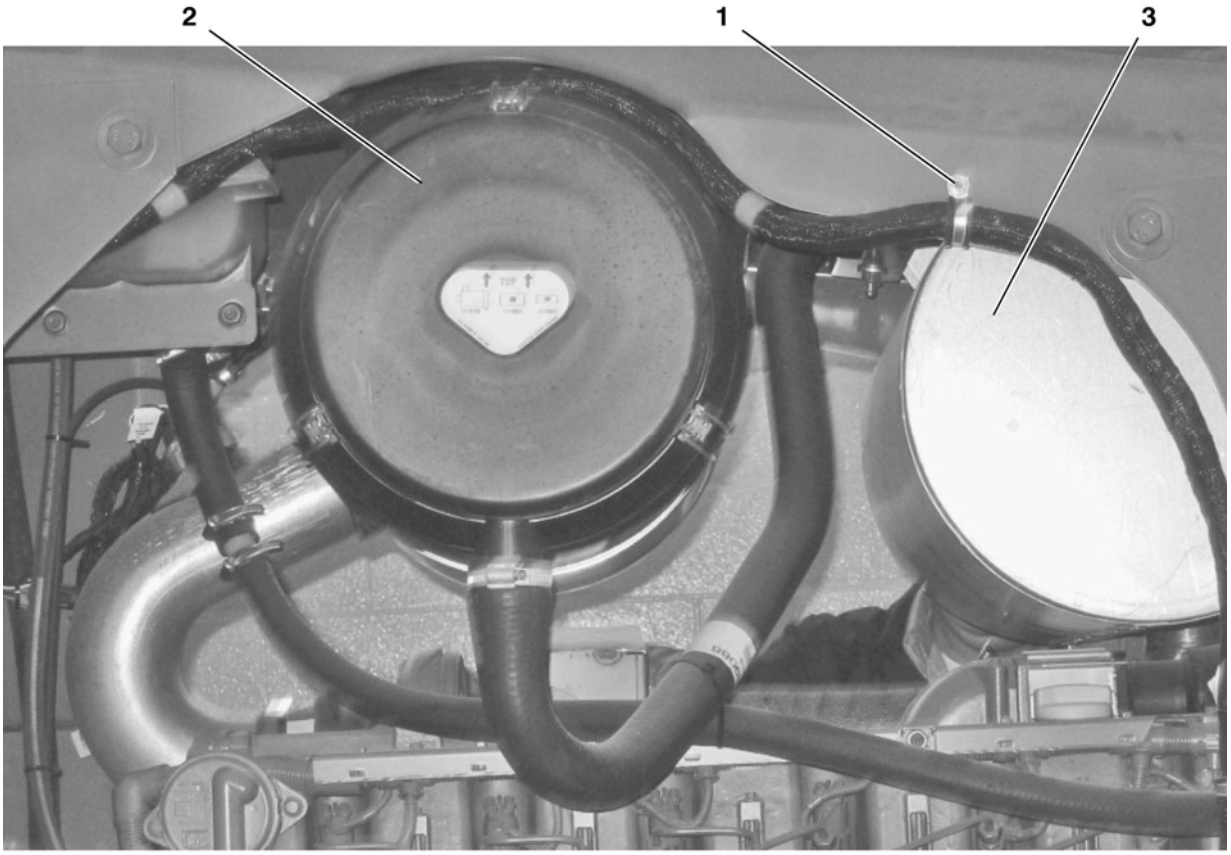


**Figure 9**
**Left side view of engine**

1. Wiring harness clip
2. Air cleaner
3. Muffler

12. Attach four nuts and bolts to the hinges for lifting purposes. Attach two, 2m straps to the hinges and bolts on both sides of the engine hood assembly.

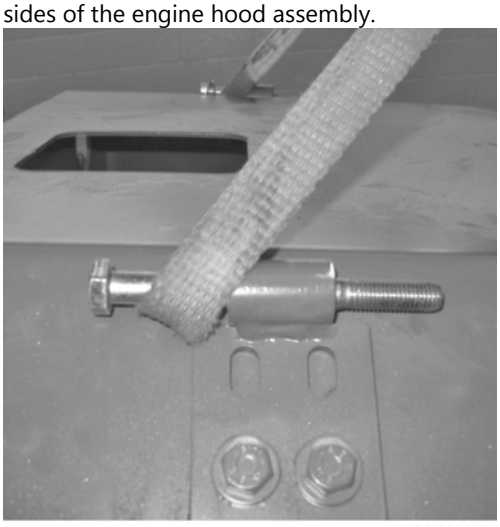


**Figure 10**

13. Remove the eight bolts that attach the top engine hood assembly to the engine hood frame and lift. **Weight 136 kg (299 lbs)**
**NOTE!**

| Document Title: **Front headliner, removal** | Function Group: **851** | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Front headliner, removal

**Op nbr 851-003**

1. Place the machine in the 191 Service position.
2. Remove and discard the plastic rivets securing the center headliner.
3. Lower the center headliner and disconnect the dome light wiring connectors.
4. Remove the center headliner from the cab.
5. Remove the plastic bezels for the left and right side upper compartments.
6. Remove the plastic rivets securing the front headliner.
7. Lower the headliner to gain access to the front speaker wires. Disconnect the wires.
8. Remove the headliner from the cab.

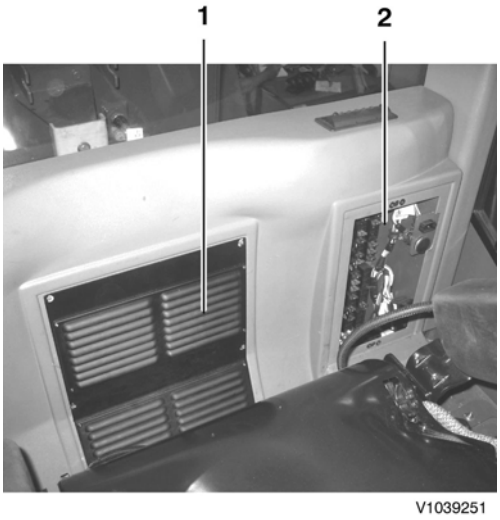


**Figure 6**
**Back wall**

1. Air intake grille panel
2. Fuse access panel

10. Remove the bolts for the heater assembly and let the assembly drop down on the steel bar.

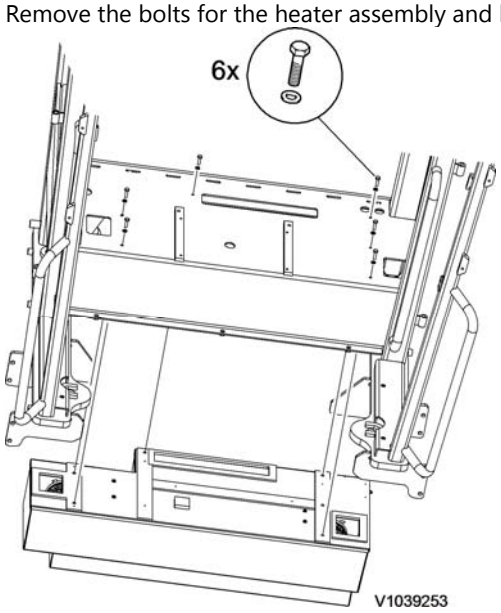


**Figure 7**

**WARNING**

**Only use lifting devices with adequate capacity.**

11. Slide out and remove the heater assembly with a lifting strap. **Weight 46 kg (102 lbs)**.

| Document Title: **Heat control valve, replacing** | Function Group: **873** | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Heat control valve, replacing

**Op nbr 873-008**

1. Place the machine in service position. Refer to 191 Service position.

2. Turn the battery disconnect switch to the "OFF" position.

   **WARNING**

   **Before removing the radiator cap, stop the engine and let it cool down sufficiently. When removing it, turn it slowly to release the pressure.**

3. Drain the coolant or use a hose pinching tool on the heater hoses.
   Remove the expansion tank pressure cap. Add a 3/8" nipple to the draining valve.
   **NOTE!**
   Be sure that the valve does not turn.

   **NOTICE**

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

4. Connect a drain hose to the nipple. Drain the engine coolant into a suitable container. Refer to 260 Cooling system, volume (Models G930 - G940).

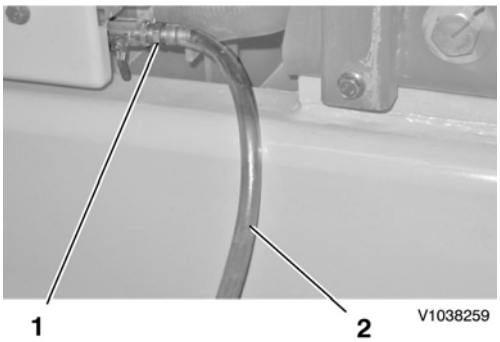


**Figure 1**

1. Nipple
2. Drain hose

5. Release the spring clamps from the lower heater hoses. Disconnect the electrical connector from the water valve. Remove the hoses and the valve.

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Service Information

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Cooling unit, leak detection** | **874** | **Service Information** | **2015/1/6 0** |
| Profile: **GRD, G970 [GB]** | | | |

# Cooling unit, leak detection

**Op nbr 874-009**

9812517 Leak detector AC

**WARNING**

**Always wear protective gloves and use safety glasses for all work with refrigerant. Risk of frostbite.**

The A/C system on Volvo G900 model graders contains fluorescent dye to make it easier to check for leaks. A leak can be seen using the ultraviolet inspection light and the supplied glasses. When a leak is found, the dye will glow a bright greenish color when viewed through the glasses and illuminated by the ultraviolet light.

**NOTE!**
The supplied glasses must be worn to be able to see any leaks.

1. Direct the inspection light at the components included in the AC-system, as well as its pipes and couplings.

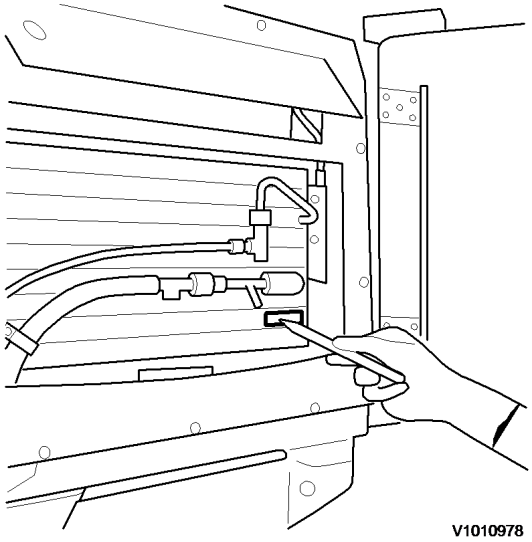


**Figure 1**

**Removing fluorescent paint**

When the leak has been fixed, it is important to clean the area around the leak. Use water and then wipe dry. Then check with an inspection light and glasses that no paint remains.

**NOTE!**
It may not be possible to detect very small leaks using the inspection light and the fluorescent substance.

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Construction Equipment

**Service Information**

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Lap Seat Belts** | **884** | **Service Information** | **2015/1/6 0** |
| Profile: **GRD, G970 [GB]** | | | |

# Lap Seat Belts

The seat belt is an integral feature of the ROPS protection. The seat belt helps to keep the operator inside the cab and ride down the crash forces more gradually during a roll over or impact accident.
Replace any seat belts that are cut or damaged. When replacing a seat belt, use only service replacement parts.

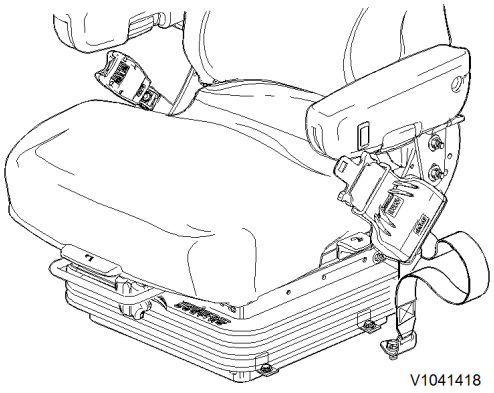


**Figure 1**
**Seat belt**

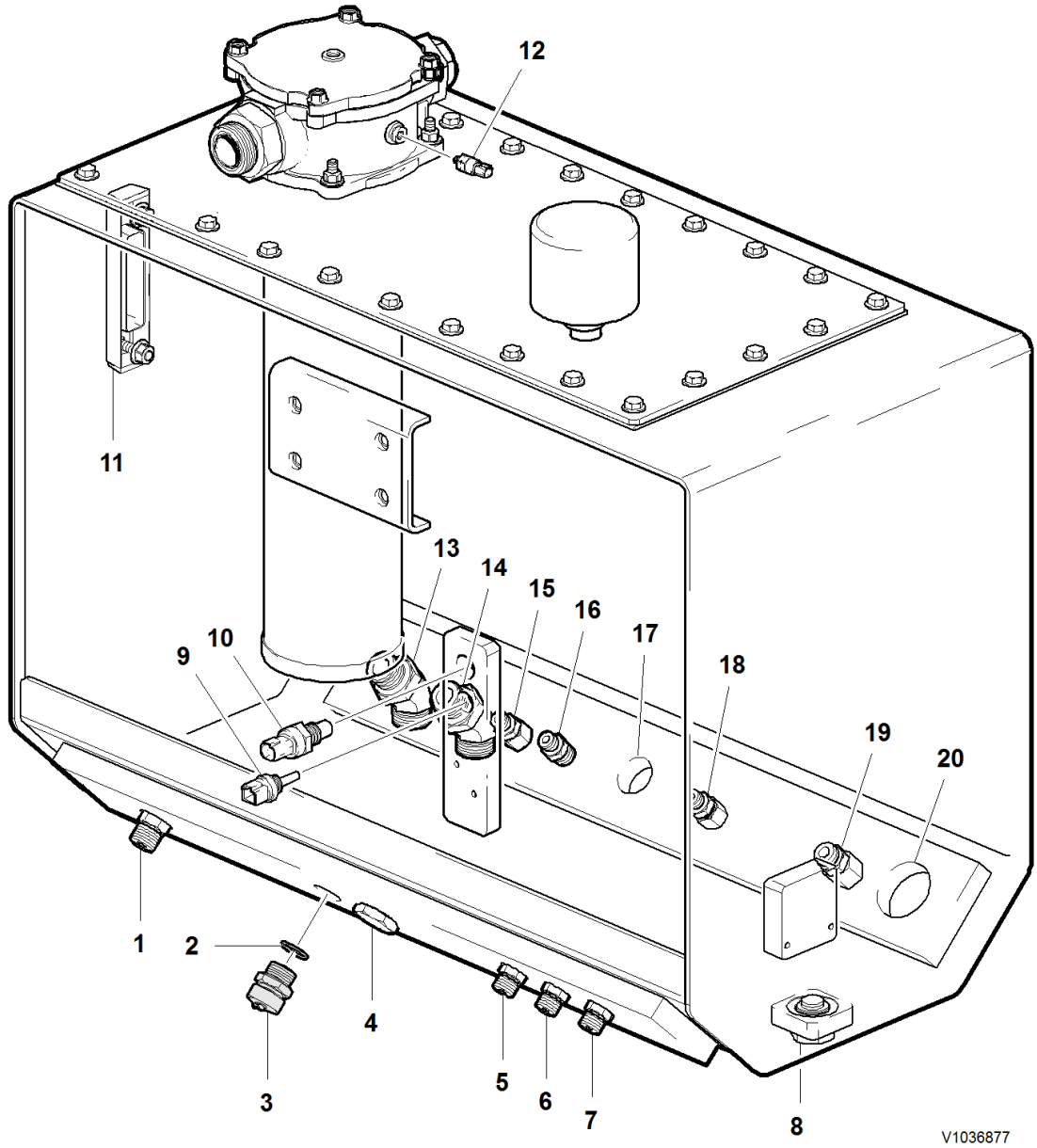


**Figure 1**

1. Fan pump drain
2. Copper washer
3. Drain valve
4. Plug for optional heater
5. Front auxiliary drain
6. Priority flow valve drain — T port
7. Load sense line relief valve drain (port 2)
8. Magnetic plug
9. Oil temperature sensor
10. Oil level switch
11. Oil level inspection glass
12. Pressure sensor
13. Steering and implement pump drain
14. Fan valve return — T port
15. Rear auxiliary drain
16. Fan motor drain line
17. Fan pump suction
18. Secondary steering return line

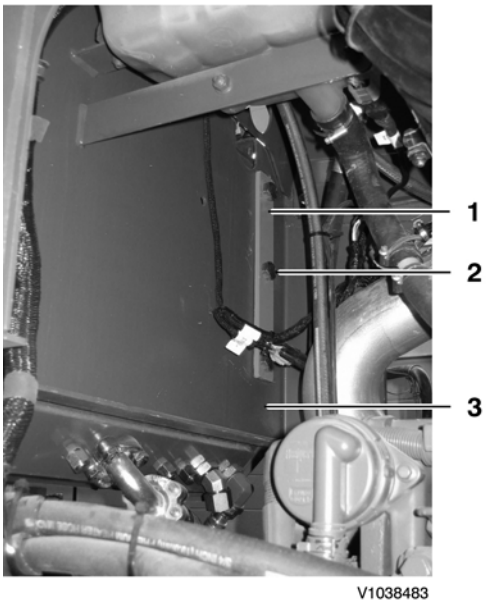


**Figure 7**
**Rear view of hydraulic oil tank mounting**

1. Backing plate
2. Bolt
3. Engine compartment bulkhead

10. Carefully lift the hydraulic oil tank away from the machine and set it aside.

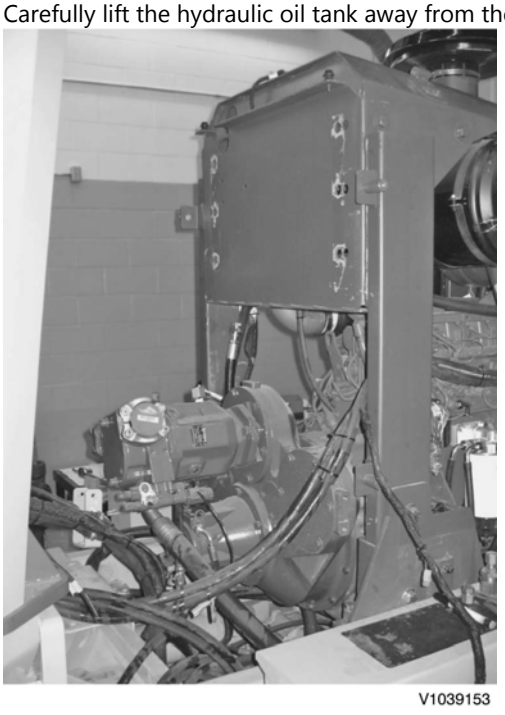


**Figure 8**
**Hydraulic oil tank removed**

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Construction Equipment

**Service Information**

| Document Title: **Oil cooler line bypass valve (check valve), replacing** | Function Group: **911** | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Oil cooler line bypass valve (check valve), replacing

**Op nbr 911-033**

11666052 Pressure gauge

Hand pump

Vacuum pump

## Removing

1. Place the machine in the 191 Service position.
2. Connect a suitable vacuum pumpto the hydraulic oil tank.
3. Mark the orientation of the check valve. Disconnect and plug the two hoses at both ends of the valve.

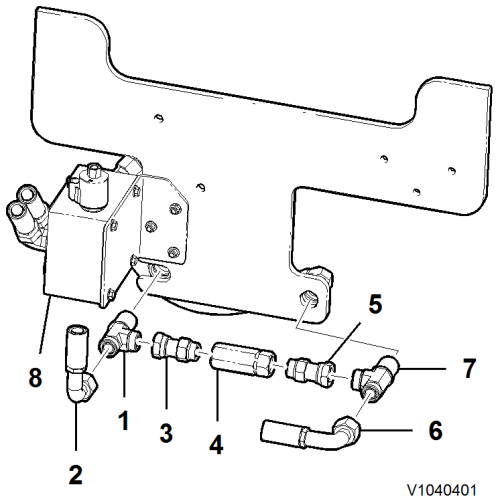



**Figure 1**

1. T-nipple
2. Hydraulic hose (from hydraulic oil cooler)
3. Fitting
4. Check valve
5. Fitting
6. Hydraulic hose (to hydraulic oil cooler)
7. T-nipple
8. Fan valve

4. Remove the mounting clamp and check valve.
5. Turn off the vacuum pump.

4. Start the engine. Using the throttle hold switch on the side console instrument panel, set the engine to run at 1500 r/min.

5. Remove the electrical connector from the rear of the fan pump control.

6. Slowly close the needle valve on the flow meter until the pressure reads 14 MPa (138 bar, 2000 psi). The flow should read 50l/min. (13.2 gpm; ±1%) If pump flow is below 44 l/min. (11.6 gpm), the pump must be repaired or replaced.

7. Shut off the engine. Remove the flow meter and reconnect the hydraulic hoses and the electrical connector.

The steering and implement pump uses a voltage driven solenoid. When the steering and implement pump is energized, it will destroke to its minimum pressure setting at 1 MPa (10 bar) (150 psi).

When the engine starter motor is turned to the **ON** position (engine cranking), the vehicle ECU will unload both the steering and implement and cooling pumps. It will also shift the fan control valve to the closed position.

VOLVO
Construction Equipment

Service Information

| Document Title: | Function Group: | Information Type: | Date: |
|---|---|---|---|
| **Hydraulic Cylinder Overhaul Procedure** | **912** | **Service Information** | **2015/1/6 0** |
| Profile: **GRD, G970 [GB]** | | | |

# Hydraulic Cylinder Overhaul Procedure

**Op nbr 912-112**

88830005 Wrench
88830006 Wrench
88830007 Wrench
88830008 Wrench
88830009 Wrench

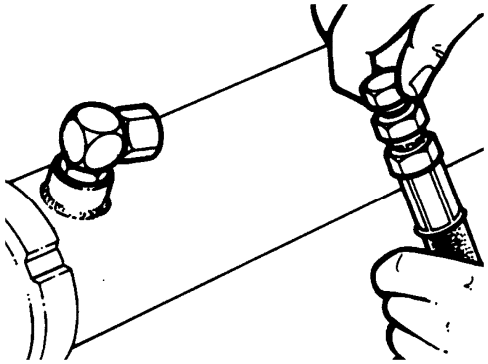

G0007383

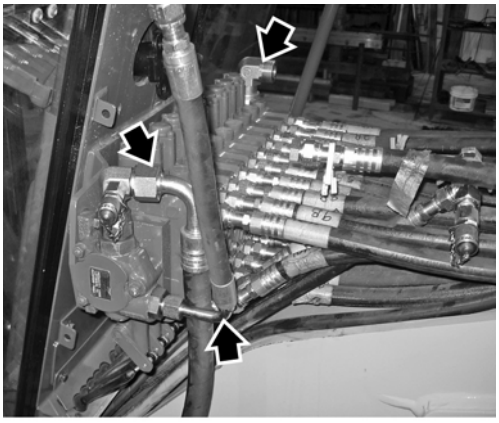
**Figure 1**

1. Place the machine in the 191 Service position.

   **WARNING**

   **Loosen carefully. There may be hot/high-pressure oil in the line.**

2. Relieve all hydraulic pressure. Take care with hydraulic circuits that contain lock valves. Disconnect the hydraulic hoses. Immediately plug the open ports and fittings to prevent contamination. Remove the cylinder from the machine.



V1044335

**Figure 5**
**10 bank valve, main hoses**

**NOTICE**

**When a hose has been disconnected, plug both the hose and the connection immediately. The hoses should be marked for correct connection.**

8. Mark each of the valve sections by number from one to ten. Identify each of the twenty hydraulic hoses by marking or tagging each hose according to the valve section it is connected to (example: 1A, 1B, 2A, 2B etc.), then disconnect the hoses from the front of the ten bank valve sections.

V1044336

**Figure 6**
**10 bank hoses, remove & cap**

**NOTICE**

**Plug hoses and connections immediately.**

**NOTICE**

**Collect draining oil.**

**NOTICE**

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

9. Before removing the mounting bolts for the ten bank directional flow valve, attach a suitable lifting device around both ends of the valve. Adjust the lifting device equally on both ends to support the weight of the valve in its current position.

Install new seals from the seal kit into the valve body.

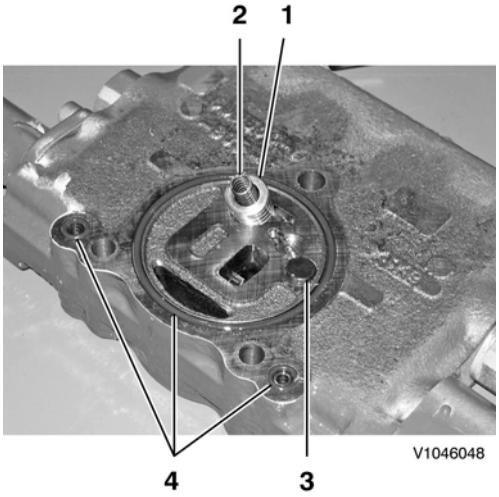



**Figure 15**
**Valve section assembly & seals**

1. Section compensator valve spool
2. Spring
3. Shuttle disc
4. Valve section seal rings (included in seal kit)

The reconditioned valve section is now ready for reassembly into the proper position in the ten bank directional flow valve assembly.
Refer to 912 Directional control valve, reconditioning.

N. Priority CF to steering control unit
O. Ten bank to return line filter
P. Parking brake
Q. Auxiliary
R. Shuttle valve to steering load sense
S. Priority EF to ten bank pressure
T. Auxiliary
U. Differential lock
V. Transmission return
W. Auxiliary
X. Auxiliary front — two bank drain
Y. Transmission pressure

**Figure 2**
**Lifting the steering and implement pump**

3. Carefully align the splines on the pump drive shaft with the gear inside the pump drive. Push the pump into drive until the mounting flange and O-ring is fully seated into the drive housing.

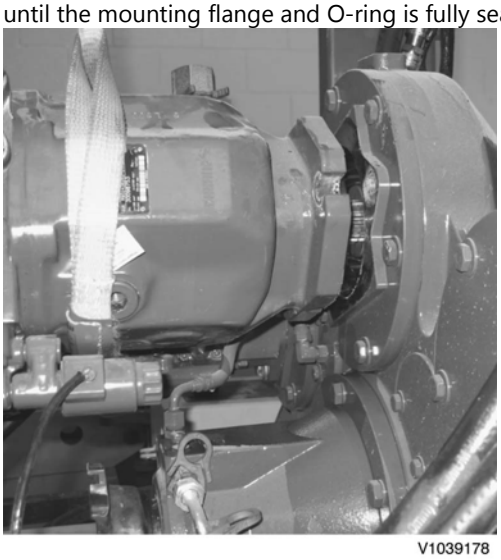



**Figure 3**
**Aligning the pump drive splines**

4. Install the mounting bolts and washers. Torque to specification and remove the lifting strap.

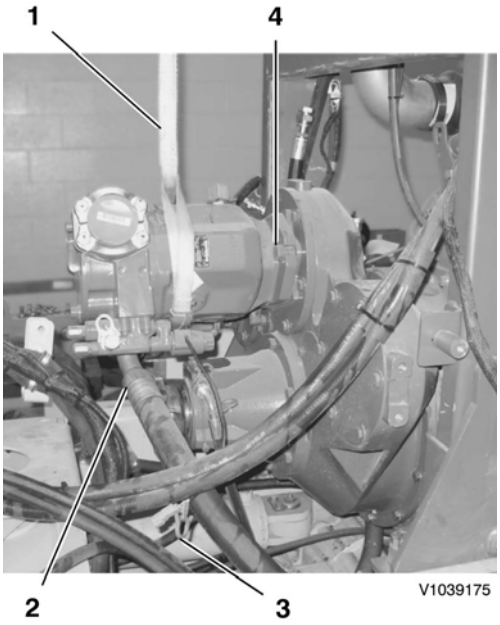



**Figure 4**
**Installing the steering and implement pump**

1. Lifting strap
2. Hydraulic hose to priority flow valve
3. Wiring harness connector
4. Mounting bolt

5. Remove the cap plugs from the bottom port in the steering and implement pump. Inspect the O-rings on the hose connectors and replace if necessary. Reattach the hose from the priority flow valve to the steering and implement pump.

| | | |
|---|---|---|
| Auxiliary valve section — port B | X | X |
| Auxiliary valve — float activated | X | X |

**Hydraulic control module**

The hydraulic control module operates on 12 volts and can operate up to three auxiliary valve sections, with one section able to operate in float position. In machines configured with more than three auxiliary outlets, a second hydraulic control module is required. The hydraulic control modules are stand alone and as such, do not communicate with any other electronic control units in the machine.

**Enable/float switch**

The enable/float switch is mounted in the center pedestal and is used to activate the auxiliary hydraulic system. Two switch options are available; float and non float.

The non float switch is a two position switch and provides an electrical ground input to the auxiliary hydraulic control module. When the switch is in the OFF position, the system cannot be engaged.

The switch with the float option is a three position switch. When the switch is in the center position, it is in the OFF position. When the upper end of the switch is depressed, the auxiliary hydraulic system is enabled. When the lower end of the switch is depressed, the auxiliary hydraulic system is enabled with float available on one hydraulic section.

To enable float, depress the float enable switch in the float position. Activate the float control lever to the lower direction more than 90 percent for greater than 0.5 seconds. This allows the hydraulic function to float.

To disable the float, move the float enable switch to the OFF or non float position. The float is also disabled when the float control lever is moved in the raised position more than 70 percent for greater than 0.5 seconds.

| Document Title: **Ripper, installation** | Function Group: **926** | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Ripper, installation

**Op nbr 926-082**

1. Install the support arch. Refer to 926 Support arch, installation.

2. Secure the ripper box to the ripper frame before lifting it up into place in order to prevent the ripper shanks from falling.

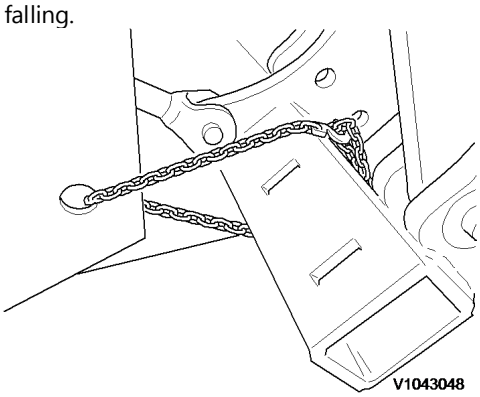



**Figure 1**
**Securing the ripper box to the ripper frame**

**WARNING**

**Only use lifting devices with adequate capacity.**

3. Lift the ripper assembly into place using a safe lifting device and spreader bar. Line the ripper up and mount it to the frame of the machine using the necessary bolts, washers and nuts. **Weight 1002 kg (2209 lbs)**. Torque the bolts to specification, in sequence.

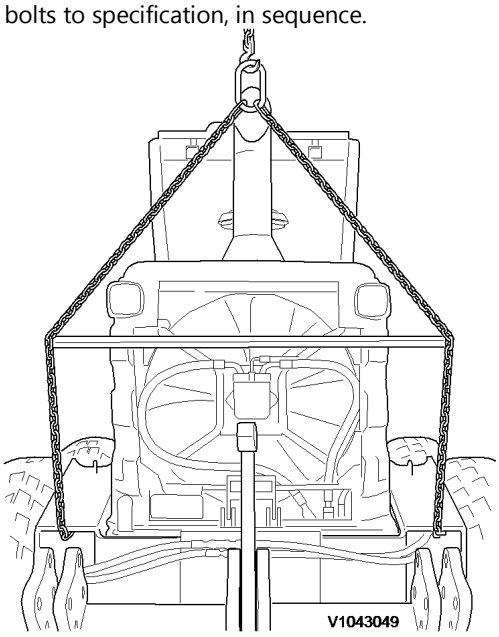



**Figure 2**

| Document Title: **Blade lift cylinder, removing** | Function Group: | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Blade lift cylinder, removing

**Op nbr 981-081**

Lifting strap

1. Place the machine in the 191 Service position.

   **WARNING**

   **Only use lifting devices with adequate capacity.**

2. Attach a suitable lifting strap to support the blade lift cylinder.

3. Place a mark on the rod end and cap for proper orientation upon reassembly.

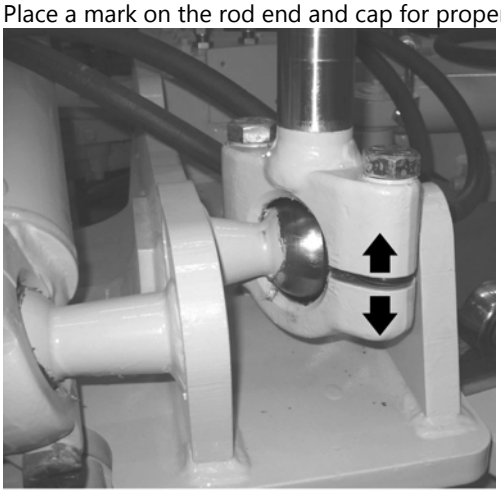



**Figure 1**
**Marking the rod end and cap**

4. Loosen and remove the cylinder rod cap. Note the positions of the shims.

5. Start the engine and fully retract the cylinder rod.

6. Tag, remove, plug and cap the hydraulic hoses and cylinder ports to prevent contamination.

7. Remove the four bolts on each side of the cylinder trunions.

8. Install two bolts to act as pullers. Pull out both trunion caps.


**Figure 2**

1. Hexagon screw
2. Half clamp
3. Accumulator
4. Mounting plate

5. Remove the solenoid valve from the accumulator.

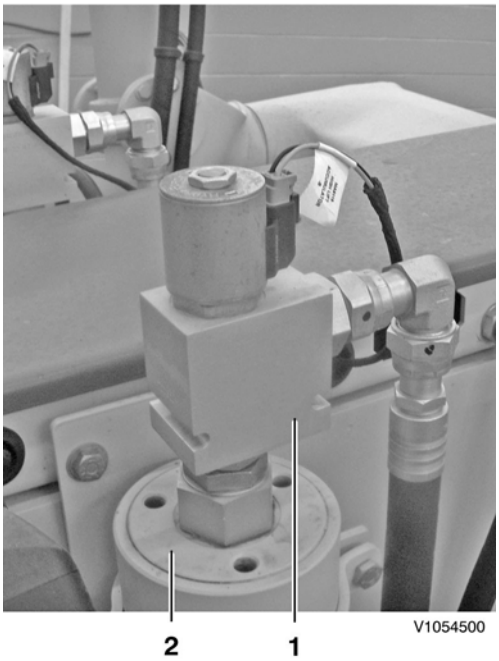
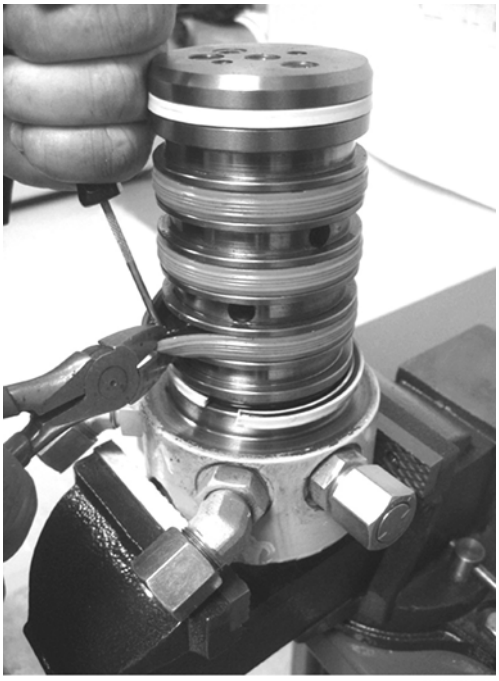



**Figure 3**

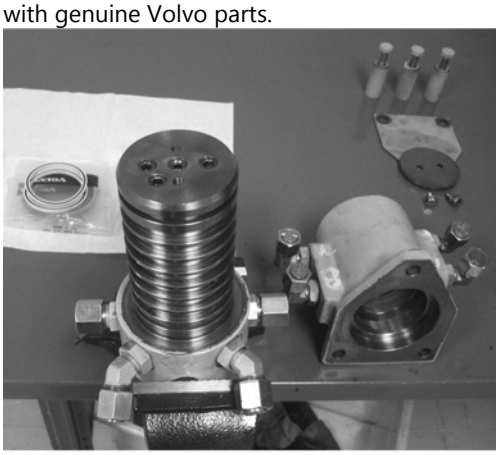
1. Solenoid valve



V1043494

**Figure 6**

7. Thoroughly clean the spool and housing using moisture-free compressed air. Lint-free, uncontaminated wiping rags can also be used. Ensure all oil passages are unblocked.
   Inspect each part for scoring, wear or pitting. If there is any evidence of damage or wear, replace all defective items with genuine Volvo parts.



V1043495

**Figure 7**

8. After cleaning and inspection, lubricate the spool with system oil and prepare the parts for reassembly with a new seal kit.

| Document Title: **Circle Turn Valve Overhaul Procedure** | Function Group: | Information Type: **Service Information** | Date: **2015/1/6 0** |
|---|---|---|---|
| Profile: **GRD, G970 [GB]** | | | |

# Circle Turn Valve Overhaul Procedure

**Op nbr 912-104**

1. Fully retract the left-hand cylinder so that a straight line intersects all three pivot points. Ensure the right-hand cylinder and crank is towards the drawbar. Position the cylinder so that the anchor stud, crank stud and crank center line form an approximate 90° angle. This set-up is crucial to the outcome of the overhaul procedure.

2. Adjust the front guide plate until there is a 1,0 – 2,0 mm (0.040 in. – 0.080 in.) backlash between the drive pinions and circle teeth. The circle turn valve pinion should have approximately the same backlash. Mark the spool position to the body using a marker. Refer to 9815 Circle Timing.