Document Title:	Function Group:	Information Type:	Date:
Power transmission, description	**400**	**Service Information**	**2014/3/13**
Profile: **PIP, PL3005D [GB]**			

Power transmission, description

The excavator's power transmission is a generic name of all components that transmit motive force to perform the various functions of the excavator.

The mechanical power from the engine transmitted via the pump coupling is converted to hydraulic power by the main pumps. Hydraulic power from the main pump goes to the travel motors, swing motor and hydraulic cylinders via the main control valve, where it is converted back to mechanical power, that actuates the travel action, swing action and attachments.

The reduction gears of the planetary mechanisms convert the high speed rotation of the hydraulic motor into low speed, high torque rotating force, at the track unit / sprocket for travel, and at the swing unit / ring gear for swing.

The center passage 360° rotating unit allows high pressure hydraulic flow from the main control valve to the track motors. The unit rotates with the superstructure without twisting hoses therefore oil flow is not obstructed by swing.

VOLVO
Construction Equipment

Service Information

Document Title: **Function description**	Function Group:	Information Type: **Service Information**	Date: **2014/3/13**
Profile: **PIP, PL3005D [GB]**			

Function description

The track unit is operated by hydraulic power from the main pump and servo pump. The engine power transmitted via the pump coupling is converted from mechanical power to hydraulic power. When the engine is running, the travel system is ready to be operated; the remote control valve pedal controls the main control valve travel spool via servo hydraulic power to change track motor rotational direction.

Hydraulic diagrams. See 990 Hydraulic diagram.

Function track unit (Forward)

- The pedal remote control valve is pushed forward.
- The swash plate angle increases and the main control valve spool is moved from left to right by servo hydraulic circuit.
- Then the hydraulic motor is operated by main hydraulic power and the motor shaft transmits power through the reduction gears.
- The reduction gears of the planetary mechanism convert the high speed rotation of the hydraulic motor shaft into low speed high torque rotation at the track unit for forward travel.

Function track unit (Reverse)

- The pedal remote control valve is pushed backward.
- The swash plate angle increases and the main control valve travel spool is moved from right to left by the servo hydraulic circuit.
- Then the hydraulic motor is operated by main hydraulic power and the motor shaft transmits power through the reduction gears.
- The reduction gears of the planetary mechanism convert the high speed rotation of the hydraulic motor shaft into low speed high torque rotation at the track unit for reverse travel.

Gearbox, torque flow

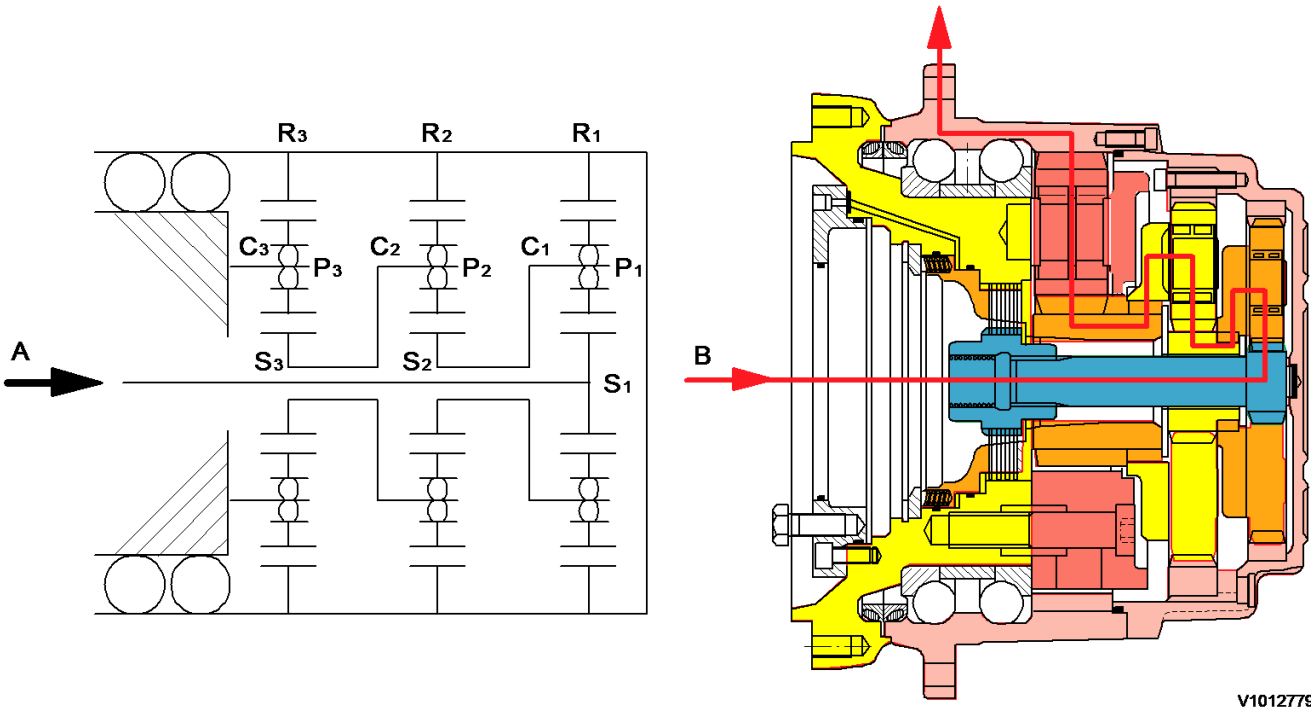


Figure 1
Gearbox, torque flow

A	Input (Hydraulic motor output)
B	Torque flow

The input rotation of the hydraulic motor is transmitted to No. 1 sun gear (S1) and this drives No.1 planetary gears (P1). The No. 1 planetary gears (P1) drive No. 1 ring gear (R1) with the same force as the meshing tangential force with No. 1 sun gear (S1), and also No. 1 carrier (C1) with the same force as the meshing reaction force. In other words, No. 1 planetary gears (P1) revolve rotating. This rotation of No. 1 carrier (C1) becomes the output of the 1st stage, and is transmitted directly to No. 2 sun gear (S2). (No. 1 carrier is spline–coupled with No. 2 sun gear.)
Similarly the revolution of No.2 planetary gears (P2) are transmitted through No. 2 carrier (C2) to No.3 sun gear (S3). Since No. 3 carrier (C3) supporting No.3 planetary gears (P3) are fixed, No. 3 planetary gears (P3) do not revolve, but rotates to drive No. 3 ring gears (R3).
Therefore, the rotating case is driven by the overall driving torque of No. 1, 2 and 3 ring gears. This reduction ratio is expressed as shown below:

$$i = \frac{(Z_{S1} + Z_{r1})(Z_{S2} + Z_{r2})(Z_{S3} + Z_{r3})}{Z_{S1} \cdot Z_{S2} \cdot Z_{S3}} - 1$$

V1012776

where, Z: =Number of teeth of each gear
The direction of rotation is reverse to that of the input shaft

Document Title: **Track gearbox, description**	Function Group:	Information Type: **Service Information**	Date: **2014/3/13**
Profile: **PIP, PL3005D [GB]**			

Track gearbox, description

Track gearbox consists of three stage planetary mechanism that converts the high speed rotation of the hydraulic motor, into low speed, high torque rotating force at the sprocket hub.

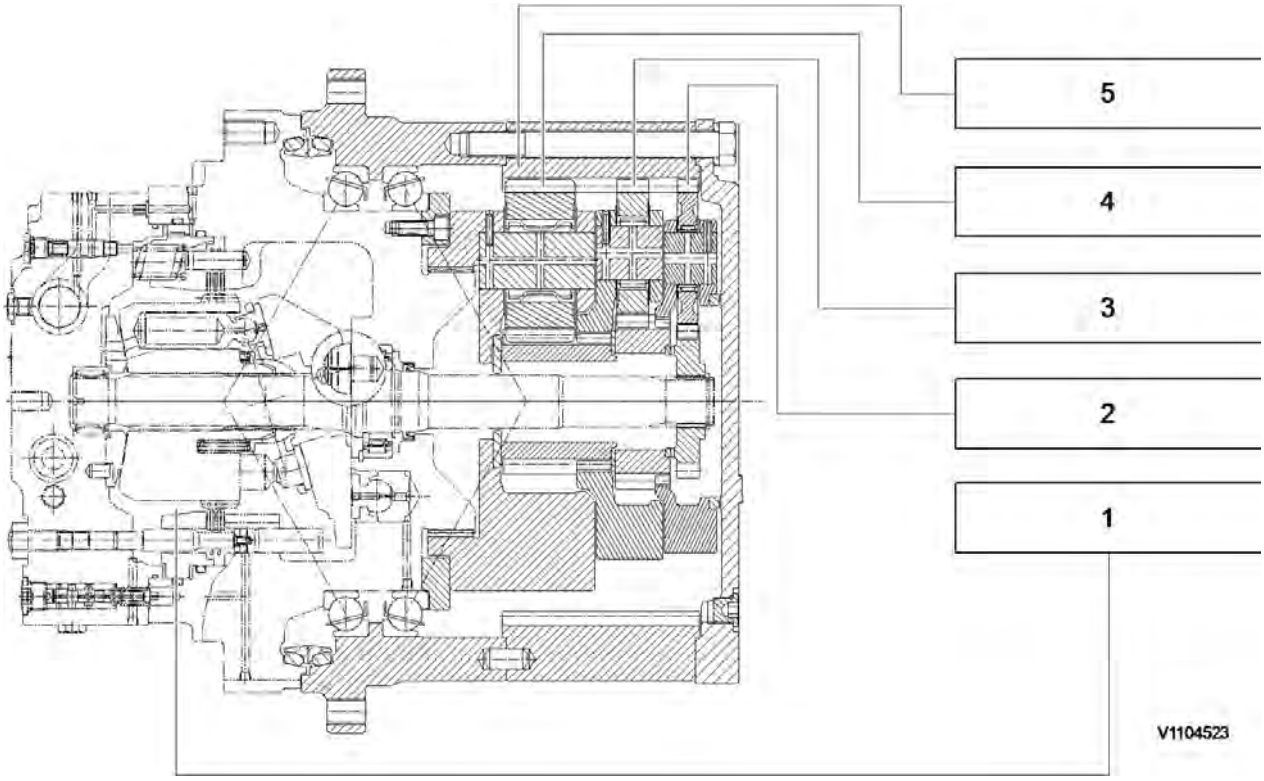


Figure 1
2 stage planetary gearbox

1. Track motor
2. No.1 carrier assembly
3. No.2 carrier assembly
4. No.3 carrier assembly
5. Ring gear

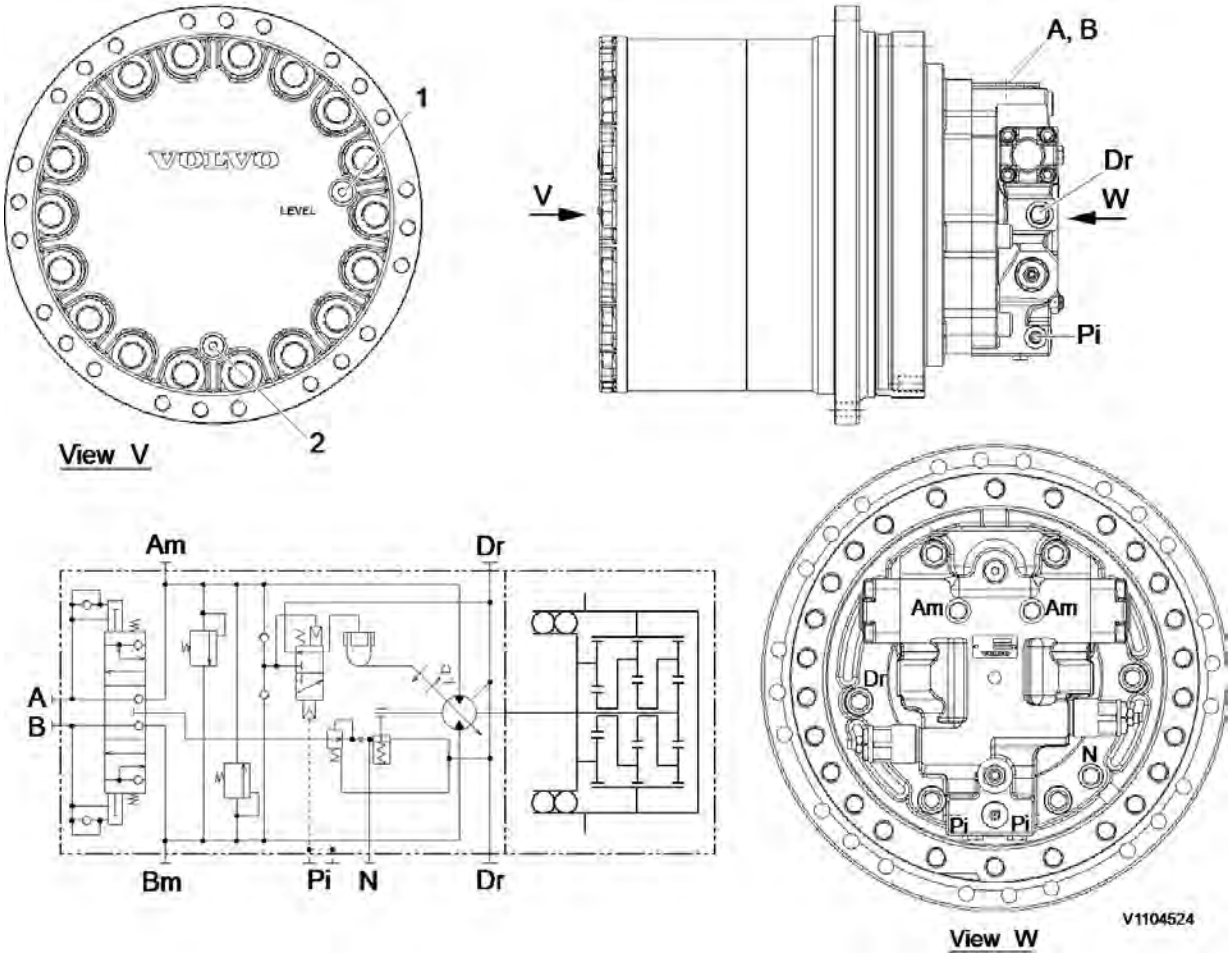


Figure 2
Port connections

1. Oil filling port (PF 1/2): 59 Nm (6.0 kgf m) (44 lbf ft)
2. Oil drain port (PF 1/2): 59 Nm (6.0 kgf m) (44 lbf ft)

Port connections

Port symbol	Port size	Port
A, B	ø25	Oil supply (return)
Am, Bm	9/16-18 UNF-2B	Pressure measurement port
Pi	9/16-18 UNF-2B	Displacement change pilot port
N	9/16-18 UNF-2B	Port for manual release of brake
Dr	7/8-14 UNF-2B	Motor drain

Rotational direction

View from Vaxis	Inlet port	Outlet port
Clockwise	B	A
Counterclockwise	A	B

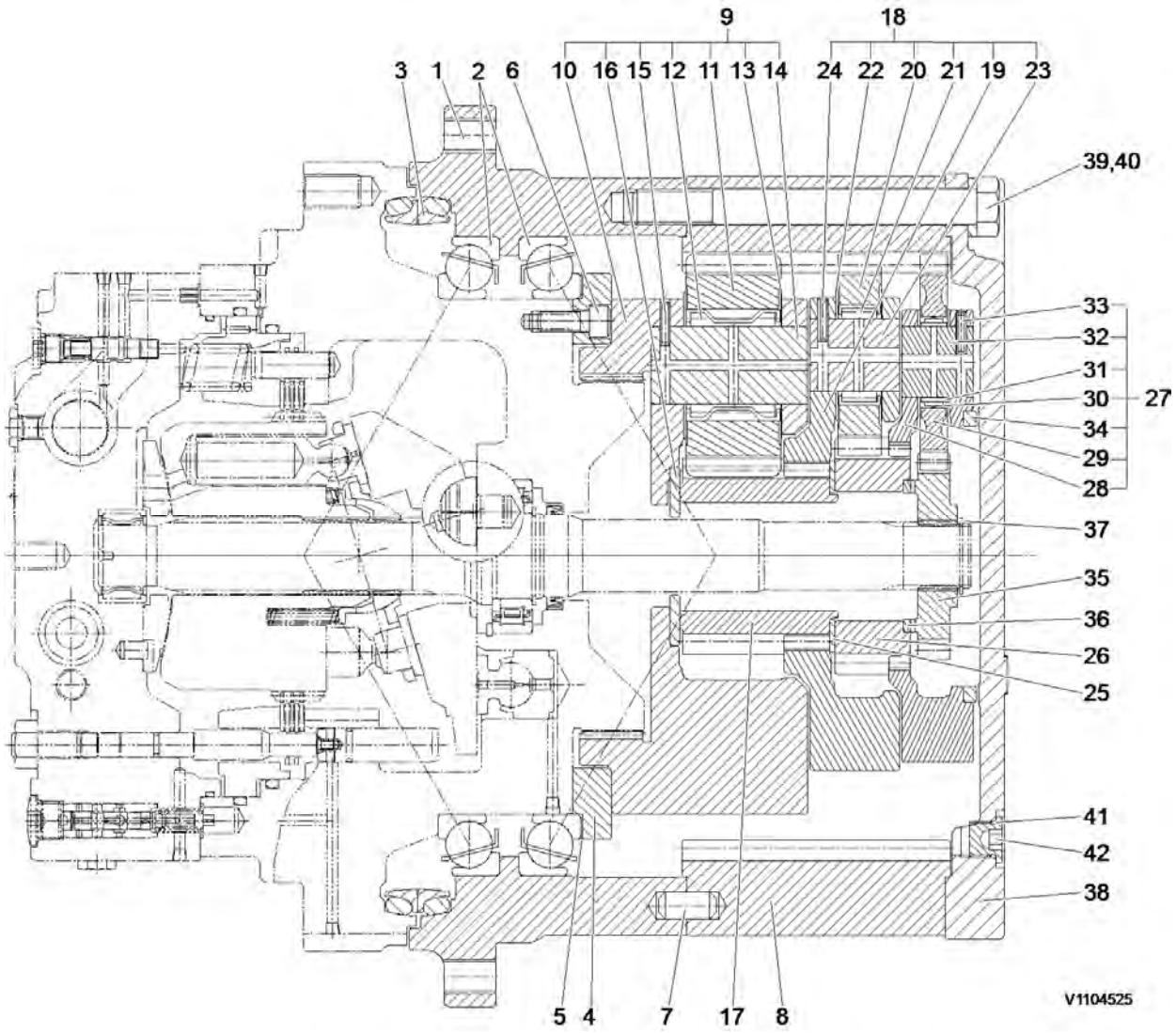


Figure 3
Track gearbox, sectional view

1	Housing	15	Spring pin	29	No.1 planetary gear
2	Main bearing	16	Thrust ring	30	Needle bearing
3	Floating seal	17	No.3 sun gear	31	Thrust washer
4	Retainer	18	No.2 carrier assy	32	No.1 pin
5	Shim	19	No.2 carrier	33	Spring pin
6	Screw: 122.5 12 Nm (12.5 kgf m) (90.6 lbf ft)	20	No.2 planetary gear	34	Thrust ring
7	Parallel pin	21	Needle bearing	35	No.1 sun gear
8	Ring gear	22	Thrust washer	36	Thrust ring
9	No.3 carrier assy	23	No.2 pin	37	Retaining ring C type
10	No.3 carrier	24	Spring pin	38	Cover
11	No.3 planetary gear	25	Thrust plate	39	Spring washer
12	Needle bearing	26	No.2 sun gear	40	Screw: 520 Nm (53 kgf m) (385 lbf ft)
13	Thrust washer	27	No.1 carrier assy	41	O-ring
14	Thrust pin	28	No.1 carrier	42	Plug

The power transmitted from the hydraulic motor output shaft is transmitted to the No.1 sun gear → No.1 carrier → No.2 sun

gear → No.2 planetary gear → No.2 carrier → No.3 sun gear → No.3 planetary gear → ring gear.

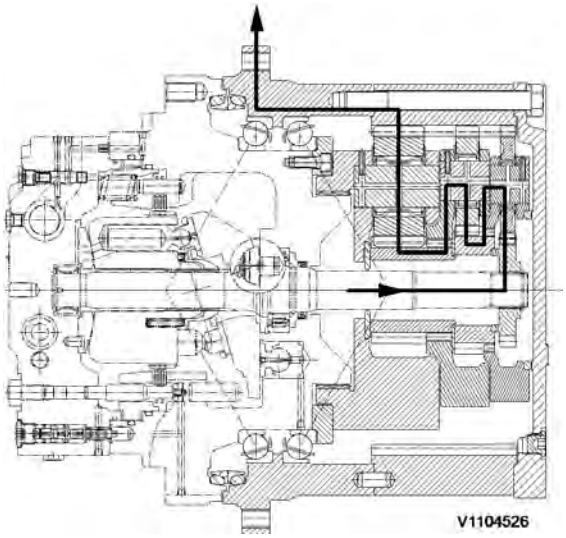


Figure 4
Track gearbox, torque flow

At this time, the reduction ratio of reduction gear is as follows:

(1) Reduction ratio

$i = [(Zs1 + Zr) \cdot (Zs2 + Zr) \cdot (Zs3 + Zr) / (Zs1 \cdot Zs2 \cdot Zs3)] - 1$

- Zs1 = No. of 1st sun gear tooth
- Zs2 = No. of 2nd sun gear tooth
- Zs3 = No. of 3rd sun gear tooth
- Zr = No. of ring gear tooth

VOLVO
Construction Equipment

Service Information

Document Title: **Track gearbox, maintenance standard**	Function Group:	Information Type: **Service Information**	Date: **2014/3/13**
Profile: **PIP, PL3005D [GB]**			

Track gearbox, maintenance standard

The parts are precision finished and must be handled carefully.
Keep the parts of carrier assembly together, do not mix the bearings, gears, pins and thrust washers.

Seals

Replace the seals and O-rings, although they appear not damaged.

Part replacement criteria

Replace all parts that appear damaged or are not within the allowable value.
Replace some parts in sets, i.e. gears, bearings, pins and thrust washers.

Part replacement criteria

No.	Part	Condition	Allowable value
8 11 17 20 26 29 35	Ring gear No.3 planetary gear No.3 sun gear No.2 planetary gear No.2 sun gear No.1 planetary gear No.1 sun gear	The tooth surface is pitted or non uniformly worn. The gear is cracked.	Area rate: within 5%
12 21 30	No.1 Needle bearing No.2 Needle bearing No.3 Needle bearing Angular bearing	Pitting/flaking of the balls, rollers or races. Hard to rotate by hand.	
3	Floating Seal	Rust or damage on sliding face. O-ring distorted or damaged.	
32 23 14	No.3 pin No.2 pin No.1 pin	The pin is cracked, galled or pitted.	
22 25	Thrust washer Thrust plate	Excessively worn on the face area.	

Installation

- Check that the mating mount surfaces are clean.
- Check that the motor is positioned correctly in the frame.
- If the gearbox to frame fit is tight, draw the assembly into the frame evenly with the mounting screws.
- Tighten the screws in a crisscross pattern in several stages to the specified torque. See 700 Undercarriage, tightening torque.
- Apply these same precautions when mounting the sprocket.

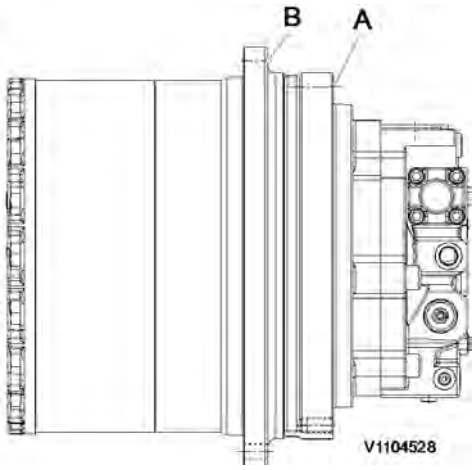


Figure 1
Mounting location

A. Main body mounted area
B. Sprocket mounted area

NOTE!
The screws must be 10.9 KS strength classification or above.

Lubricating oil

NOTICE

Prior to operating the travel function, fill the gearbox with the specified oil to the correct level.

NOTE!
Gear oil specification

Use a gear oil equivalent to one of the following two criteria. API classification GL-4 or GL-5 and SAE 90.

Gear oil replacement period
See operators manual

- First (initial) oil replacement: 500 operating hours
- Subsequent oil replacement: 2000 operating hours
- After maintenance (initial): 500 operating hours

NOTE!
Regardless of the operating hours the gear oil must be replaced at least once per year.

NOTE!
Do not mix different types, classifications or brands of oil.

NOTE!
Drain the gear oil while it is still warm to flush out any contaminants.

Gear oil replacement procedure

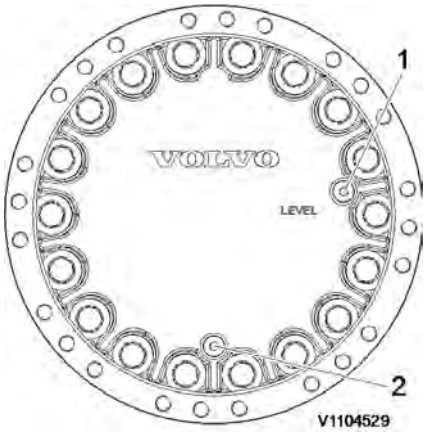


Figure 2
Oil replacement location

1. Oil filling port
2. Oil drain port

- Rotate the gearbox until the drain plug is the lowest position on the ground.
- Remove the 2 plugs and drain the oil into a suitable container.
- Ensure that the drain plug O-ring is not damaged, then install the plug with specified tightening torque.
- Refill the xx liter gear oil through the fill port. See 4311 Track gearbox, specifications.
- Ensure that the O-ring on each plug is not damaged, then install the plugs with specified tightening torque. See 4311 Track gearbox, description.

Operating checks

- Check the oil level prior to operating the travel function.
- Check for oil leakage on the gearbox assembly.
- Check for loose mounting screws.
- Check for abnormal sound or vibration while rotating.
- Check for any abnormal temperature increase after operating for a short time.

WARNING

The temperature of the case is high just after running. Use a thermometer to measure. Do not touch directly by hand to prevent a burn injury.

NOTE!
The temperature of the case must be lower than 90 °C, during continuous operation.

Remove air in the track motor before operating.

1. Check that the gearbox axis is horizontal. Rotate the gearbox housing until the drain plug is on the bottom of the vertical axis of the end cover.
   The gearbox is supplied with oil plugs (draining, filling and level) equipped with an hole that allows the air to bleed.
   NOTE!
   Remove the oil plugs with care. When the gearbox is warm, the air inside can be pressurized and this can cause their strongly expulsion towards the worker.
2. Loose with caution the plugs (2~3 rounds) counterclockwise.
3. Clean the plug to be sure that the air bleed hole is not obstructed.
4. Wait a few seconds to allow the pressurized air to bleed from the gearbox.
5. Remove the plugs and let the oil flow in a large enough container; in order to facilitate the draining must be oil still warm.
6. Wait a few minutes until all the oil is drained and then proceed to screw on the plugs.

7. Proceed with the oil fill-up following the procedures given.

NOTE!
Never mix mineral oils with synthetic oils and vice versa.

Do not dispose of the oil in the natural environment but be careful to eliminate it in compliance with the relative rules and regulations that govern locally.

Tightening torque plug. See track gearbox, description.

General tools
General tools

No.	Description	Size	Quantity
1	Socket wrench	30 mm (1.18 inch)	1
2	L wrench & Hexagon wrench socket	10 mm (0.39 inch)	1
3	Torque wrench	Torque wrench with a tightening torque range containing 60 Nm, 125 Nm and 530 Nm	1
4	Eye bolt	M10 (For carrier) M12 (For ring gear & motor) M20 (For housing) PF1/2 (For cover)	2 2 2 2
5	Plastic hammer	Approximately L = 300 ~ 500 mm (11.8 ~ 19.7 inch)	1
6	Depth gauge (Vernier calliper)	Range approximately 300 mm (11.8 inch) Minimum scale 0.01 mm (0.00039 inch)	1

Special tool
Special tool

No.	Description	Part number	Quantity
1	Shim thickness measuring gage	14633156 Drift	1
2	Floating seal assembly jig	14633155 Drift	1

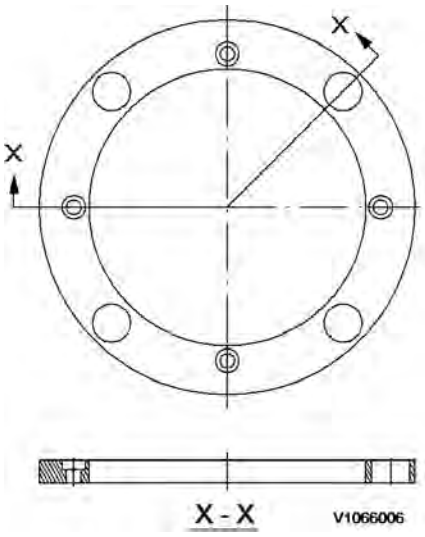


Figure 4
Shim thickness measuring tool

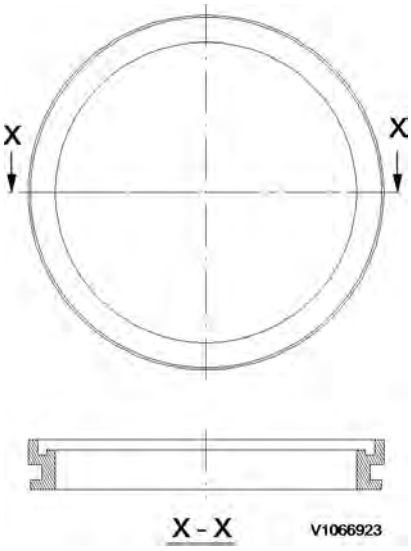


Figure 5
Floating seal assembly jig

Track gearbox, troubleshooting

Gearbox does not rotate.	Motor overloaded.	Reduce the load.
	Gearbox is damaged.	Replace the gearbox.
Oil leakage from mating joint surfaces.	Liquid gasket improperly applied.	Disassembly and re-apply.
	Mating surface damaged.	Repair or replace.
	Loosen screws.	Tighten to specified torque.
	Loosen plug.	Tighten to specified torque.
Casing leakage.	Cracks or pin holes.	Replace the housing.
	Cover damaged.	Replace the cover.

Track gearbox, troubleshooting

Floating seal leakage.	Sliding surface worn.	Replace the floating seal

		assembly.
	O-ring distorted.	
Abnormal operating temperature.	Insufficient gear oil.	Refill to specified level.
	Gear or bearing damaged.	Replace the gearbox.
	Hydraulic and gear oil mixed.	Replace the motor oil seal.
Abnormal operating sound.	Gearbox is damaged.	Replace the gearbox.

VOLVO
Construction Equipment

Service Information

Document Title: **Function description**	Function Group:	Information Type: **Service Information**	Date: **2014/3/13**
Profile: **PIP, PL3005D [GB]**			

Function description

The swing system consists of swing motor (3), swing gearbox (4) and swing ring gear (6).
. The oil supplied from main pump (1) passes through control valve (2) to rotate swing motor (3). The turning force of the motor is transmitted through gearbox (4), pinion (5) and swing ring gear (6), making the superstructure revolve.

Function swing unit (move left)

- The remote control valve lever is moved to the left side.
- The swash plate angle is increased and the main control valve swing spool is moved from left to right by the servo hydraulic circuit.
- Then the hydraulic motor is operated by main hydraulic power and the motor shaft transmits power through the reduction gears.
- The swing gearbox pinion meshes with the internal gear of the swing ring inner race and drives it to rotate the superstructure left.

Function swing unit (move right)

- The remote control valve lever is moved to the right side.
- The swash plate angle is increased and the main control valve swing spool is moved from right to left by the servo hydraulic circuit.
- Then the hydraulic motor is operated by main hydraulic power and the motor shaft transmits power through the reduction gears.
- The swing gearbox pinion meshes with the internal gear of the swing ring inner race and drives it to rotate the superstructure right.

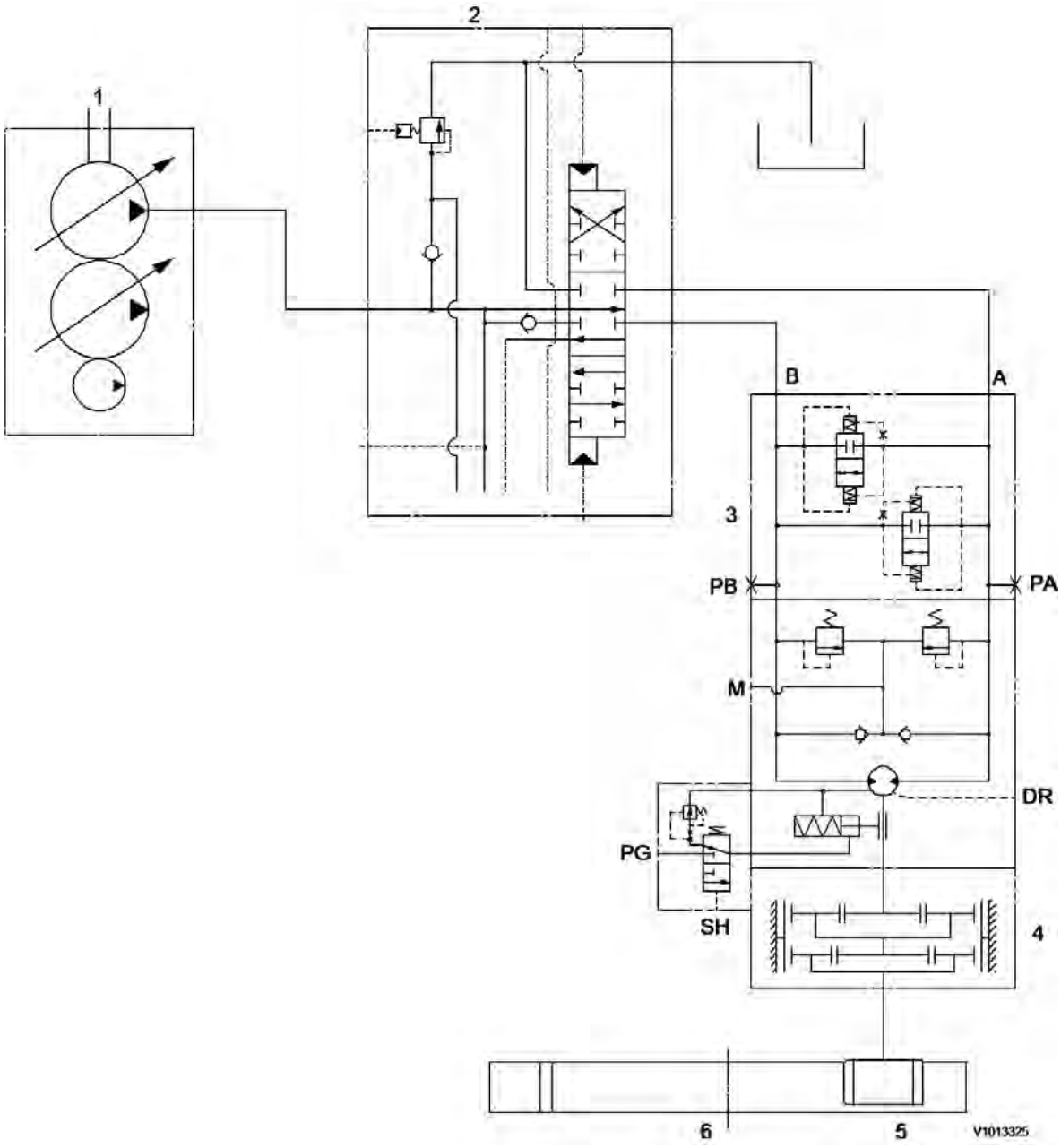


Figure 1
Swing motor

1. Main pump
2. Control valve
3. Hydraulic motor
4. Gearbox
5. Pinion gear
6. Swing ring gear

Gearbox, torque flow

The 2–stage planetary gear reduction assembly converts the high speed / low torque output of the hydraulic motor to low speed / high torque output, which is transmitted via the reduction drive shaft pinion gear to the swing ring inner circumference gear to rotate the superstructure.

Operation

Power supplied to the output shaft of the hydraulic motor is transmitted to the 2nd sun gear through the splines of the 1st sun gear , the 1st planetary gear , the 1st pin and the 1st carrier . In the same way, power is transmitted to output shaft through the splines of the 2nd planetary gear , the 2nd pin and the 2nd carrier.

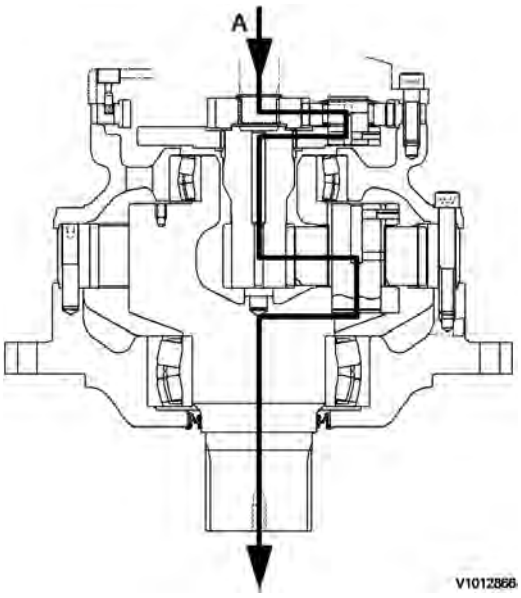


Figure 2
Swing gearbox

A. Torque flow

At this time, the reduction ratio of reduction gear is as follows :

- 1st reduction ratio
  i1 = (Zr1 / ZS1) + 1
  i1 : 1st reduction ratio
  ZS1 : No. of gear teeth of the 1st sun gear
  Zr1 : No. of tooth of the 1st ring gear
- 2nd reduction ratio
  i2 = (Zr2 / ZS2) + 1
  i2 : 2nd reduction ratio
  ZS2 : No. of gear teeth of the 2nd sun gear
  Zr2 : No. of gear teeth of the 2nd ring gear
  Accordingly the total reduction ratio of reduction gear is as follows :
  i = i1 × i2
  = (Zr1 / ZS1 + 1) × (Zr2 / ZS2 + 1)
  i : Total reduction ratio

Document Title: **Swing gearbox, description**	Function Group:	Information Type: **Service Information**	Date: **2014/3/13**
Profile: **PIP, PL3005D [GB]**			

Swing gearbox, description

Swing gearbox consists of the driving shaft as a group including the 1st carrier assembly, the 2nd carrier assembly and the 1st and 2nd sun gear, the housing supporting the driving shaft, and the ring gear including the planetary gear.

Swing gearbox, sectional view

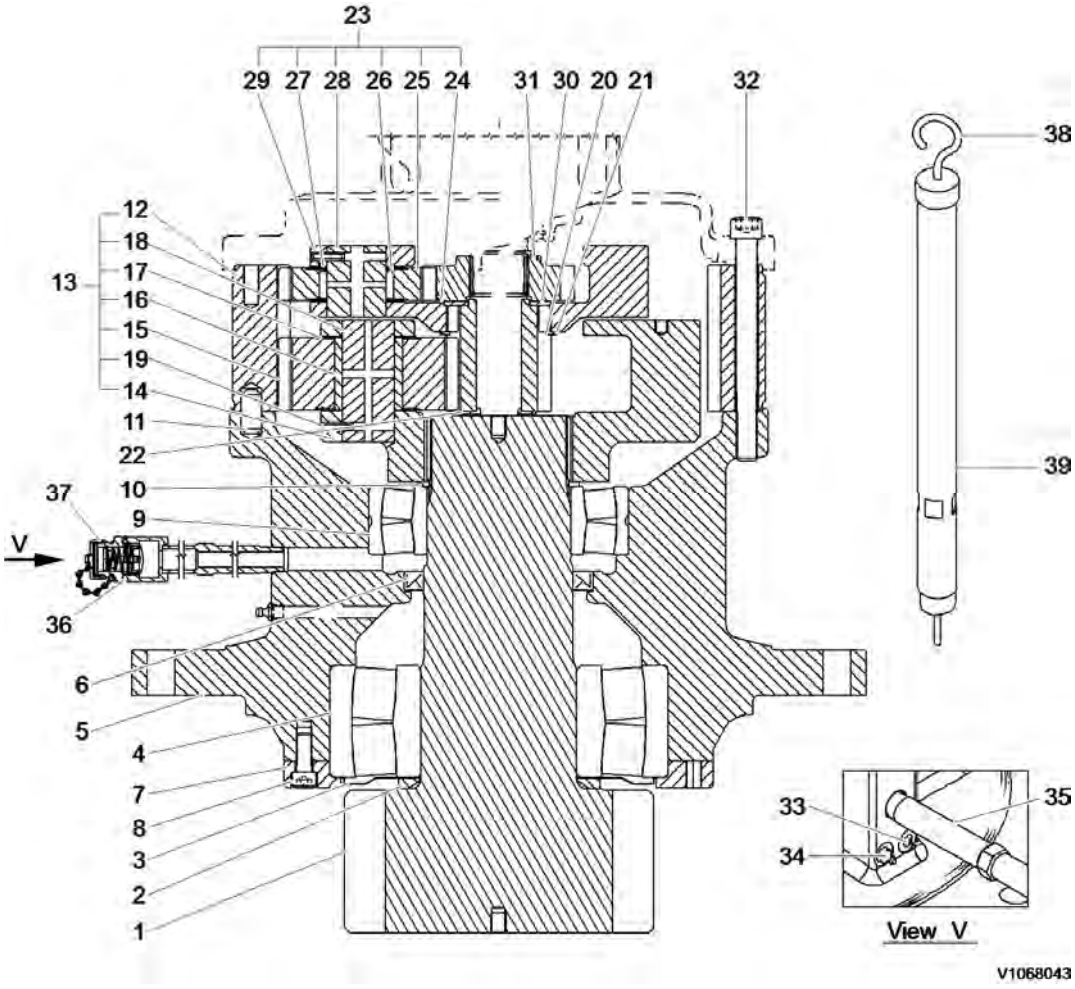


Figure 1
Swing gearbox, sectional view

NOTE!
There is no necessity for filling grease to grease port or change grease. (But, when disassembling the gear box, change the grease).

1	Shaft	14	Carrier_No 2	27	Wash_thrust
2	Collar	15	Gear_planetary No.2	28	Pin_No.1
3	Ring_nilos	16	Bushing	29	Spring pin
4	Bearing_spherical	17	Washer_Thrust	30	Thrust plate
5	Case	18	Pin_No 2	31	Gear_sun No.1

6	Seal_oil	19	Spring pin	32	Screw_hex socket dacro
7	Cover	20	Gear_sun No.2	33	Plug_Hydraylic
8	Screws_hex socket	21	Ring_retaining C type	34	Nipple_grease
9	Bearing_spherical	22	Ring_thrust	35	Pipe_drain
10	Ring_retaining C type	23	Carrier_assembly No.1	36	Gasket_copper
11	Pin_parallel	24	Carrier_No.1	37	Valve_drain
12	Gear_ring	25	Gear_planetary No.1	38	Level gauge
13	Carrier_assembly No.2	26	Needle_bearing	39	Pipe

Tightening torque, Nm (kgf m) (lbf ft)
No. 8 screws: 130.4 ±12.7 (13.3 ±1.3) (96 ±9.4)
No. 32 screws: 353 ±35.3 (36 ±3.6) (259.9 ±25.9)
No. 33 plug, 34 grease nipple: 14.7 ±1.5 (1.5 ±0.15) (10.8 ±1.1)
No. 35 drain pipe: 49 ±4.9 (5 ±0.5) (36.1 ±3.6)
No. 37 drain valve: 44.1 ±4.4 (4.5 ±0.45) (32.5 ±3.2)
No. 39 pipe: 70.6 ±6.9 (7.2 ±0.7) (51.9 ±5.1)

Function

The 2–stage planetary gear reduction assembly converts the high speed/low torque output of the hydraulic motor to low speed/high torque output, which is transmitted via the reduction drive shaft pinion gear to the swing ring inner circumference gear to rotate the superstructure.

Operation

Power supplied to the output shaft of the hydraulic motor is transmitted to the 2nd sun gear (20) through the splines of the gear_sun No.1 (31), planetary gear_No.1 (25), pin_No.1 (28) and carrier_No.1 (24). In the same way, power is transmitted to output shaft (1) through the splines of the planetary gear_no.2 (15), the pin_No.2 (18) and the carrier_No.2 (14).

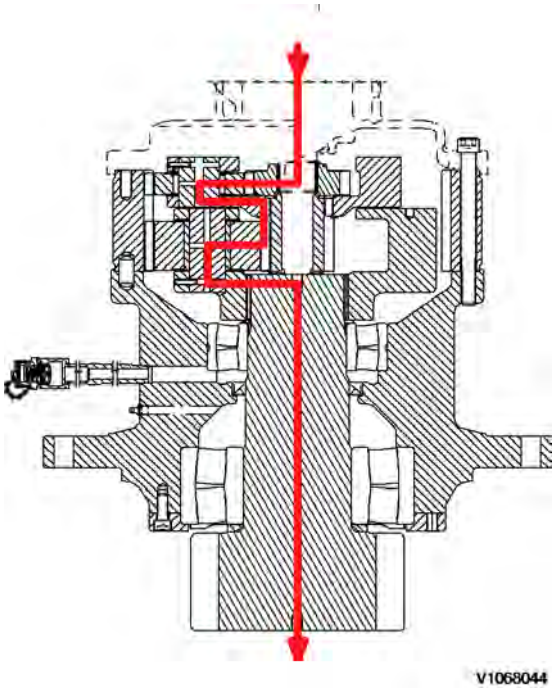


Figure 2
Swing gearbox, operation

A. Torque flow

At this time, the reduction ratio of reduction gear is as follows :

- 1st reduction ratio
  i1 = (Zr / ZS1) + 1
  i1 = 1st reduction ratio

ZS1 = No. of gear teeth of the 1st sun gear
Zr = No. of teeth of ring gear

- 2nd reduction ratio
  i2 = (Zr / ZS2) + 1
  i2 = 2nd reduction ratio
  ZS2 = No. of gear teeth of the 2nd sun gear
  Accordingly the total reduction ratio of reduction gear is as follows:
  i = i1 × i2
  = (Zr / ZS1 + 1) × (Zr / ZS2 + 1)
  i = Total reduction ratio

Document Title: **Track unit, replacing**	Function Group:	Information Type: **Service Information**	Date: **2014/3/13**
Profile: **PIP, PL3005D [GB]**			

Track unit, replacing

Op nbr 431-127

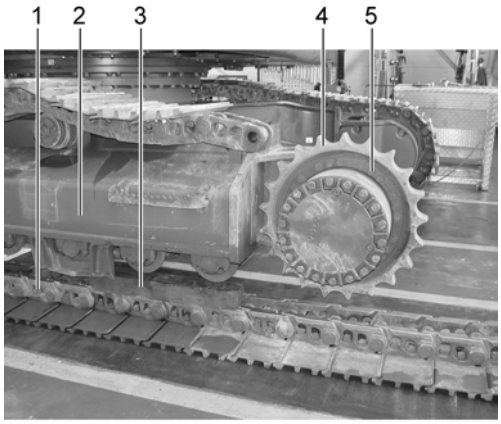
1. 

Figure 1
Removal, sprocket

1. Link
2. Track frame
3. Block
4. Sprocket
5. Screws

Park the machine in the service position D. See 091 Service positions.
Remove the track shoes over the master pin and remove the pin to split the track chain. Insert a bar into the track link to guide the track assembly. Rotate the track backward to remove the track chain from the drive sprocket. See7753 Track chain assembly, removing to remove the master pin and the track chain.

2. Lift up the track frame and insert block between track frame and link to support the undercarriage.

3. Remove the screws from sprocket.

4. Hold sprocket with the hoist and remove the sprocket from the track unit carefully.

- Stop the engine, and remove the residual pressure inside the hydraulic line by operating the control lever smoothly 3-4 times with the ignition switch at "ON" position. Turn the ignition switch to "OFF" position.

NOTE!
Remove the residual pressure inside the hydraulic tank by pressing the air breather on the hydraulic tank.

NOTE!
After disconnecting the hose, install a plug to prevent oil leakage and contamination.

5. Remove the track motor cover.

6. Remove the track motor high pressure hoses.