

21F
121F
221F
321F
Tier4
Compact Wheel Loader

SERVICE MANUAL

Part number 47768535B

English

April 2015

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CASE
CONSTRUCTION

CLICK HERE TO **DOWNLOAD** THE COMPLETE MANUAL

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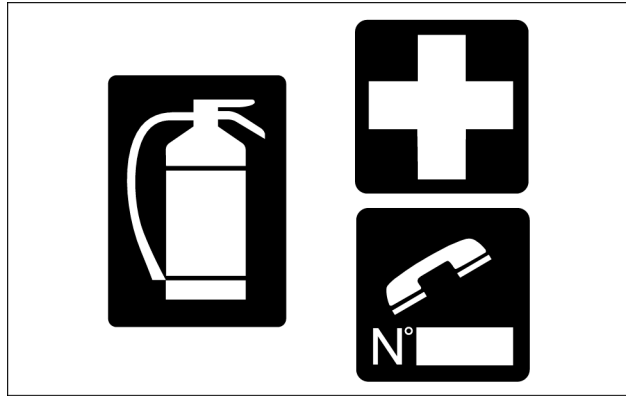


- Please note: If there is no response to CLICKING the link, please download this PDF first and then click on it.

CLICK HERE TO **DOWNLOAD** THE COMPLETE MANUAL

Emergency

Be prepared for emergencies. Always keep a fire extinguisher and first aid kit readily available. Ensure that the fire extinguisher is serviced in accordance with the manufacturer's instructions.



SMIL12WEX0174AA 3

Equipment

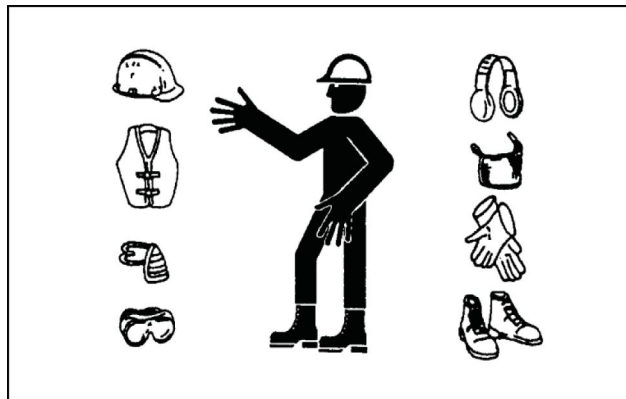
Wear close fitting clothing and safety equipment appropriate for the job:

- Safety helmet
- Safety shoes
- Heavy gloves
- Reflective clothing
- Wet weather clothing

If working conditions require, the following personal safety equipment should be on hand:

- Respirators (or dust proof masks)
- Ear plugs or acoustic ears protections
- Goggles with lateral shield or masks for eyes protection

Do not wear rings, wristwatches, jewels, unbuttoned or flapping clothing such as ties, torn clothes, scarves, open jackets or shirts with open zips which could get caught into moving parts.



TUL12WEX2008AA 4

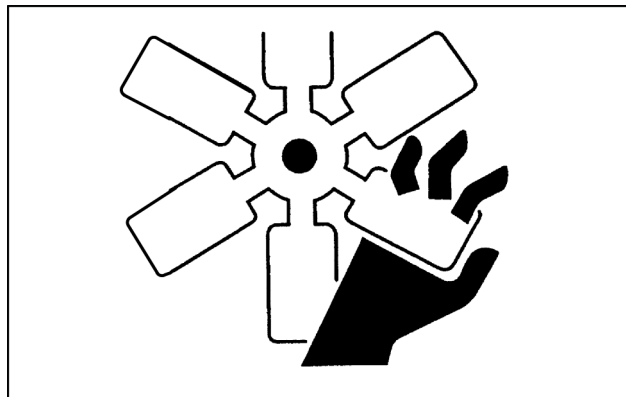
Engine - Radiator

Never leave the engine running in enclosed spaces without proper ventilation which is able to evacuate toxic exhaust gases. Keep the exhaust manifold and tube free from combustible materials.

Do not refuel with the engine running, especially if hot, as this increases fire hazard in case of fuel spillage.

Never attempt to check or adjust the belts when the engine is running.

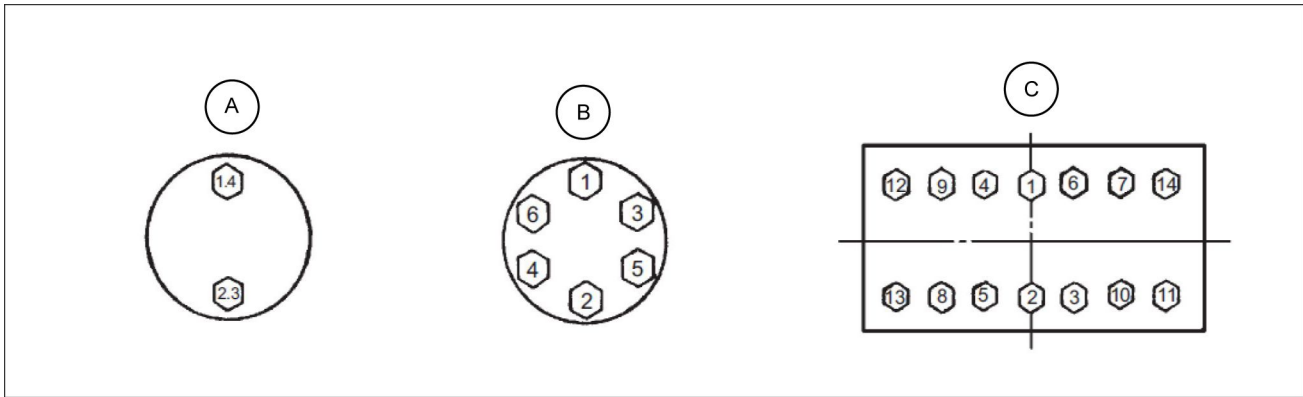
Never lubricate the machine with the engine running.



TUL12WEX2009AA 5

Bolt tightening order

When tightening two or more bolts, tighten them alternately, as shown, to ensure even tightening.



SMIL13CEX0149EA 2

- A Equally tighten upper and lower alternately
- B Tighten diagonally
- C Tighten from center and diagonally

Other cautions to be exercised

PARTS LIABLE TO DEGRADE

Rubber products, such as, hydraulic hoses, O-rings, and oil seals deteriorate with time; replace them at regular intervals or at overhauls.

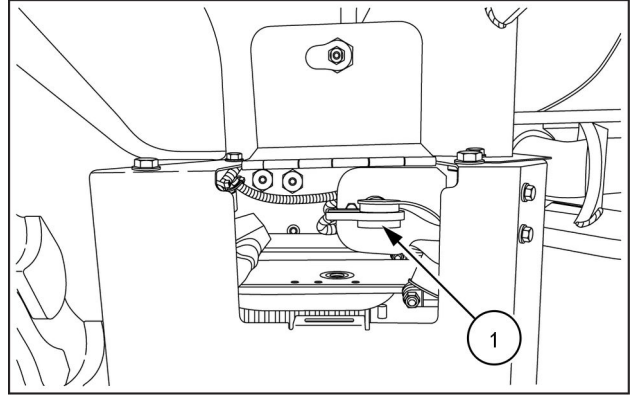
PARTS REQUIRING REGULAR REPLACEMENT

Out of critical hoses that are necessary to secure safety, we designate Very Important Parts (V.I.P) and recommend that they should be replaced regularly.

INSPECTION AND REPLACEMENT OF OILS AND GREASES

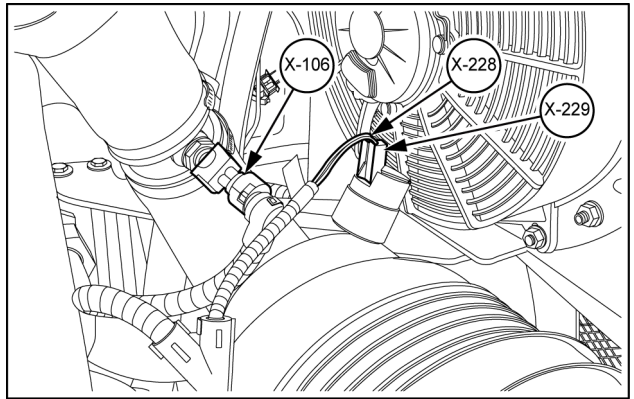
In performing maintenance, it is necessary for the user to familiarize himself with how to handle the machine safely, cautions to be exercised and inspection/lubrication procedures. Refer to the Operators Manuals as well.

- Put the battery main switch **(1)** in the OFF position.



LEIL14CWL0017AA 4

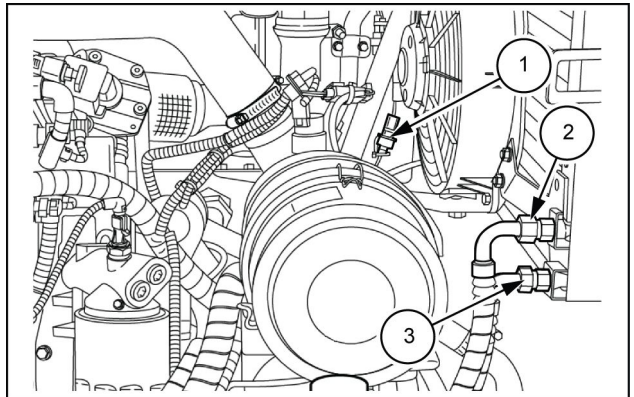
- Disconnect the wiring harness (X-228) and (X-229) from the engine air filter. Disconnect the wiring harness (X-106) from the air temperature sensor.



LEIL14CWL0171AB 5

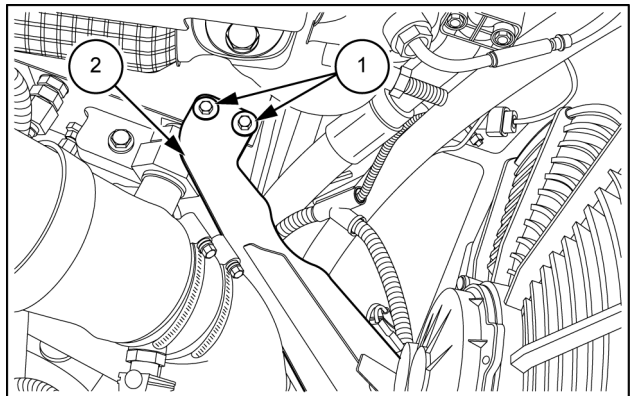
Versions with air conditioning

- Drain the air conditioning system and disconnect the fan electrical connector **(1)**. Tag and disconnect the condenser hoses **(2)** and **(3)**.



LEIL14CWL0159A 6

- Remove the two lower bolts **(1)** of the condenser bracket **(2)**.



LEIL14CWL0160AB 7

Engine - Install

⚠ WARNING

Hot liquid under pressure!

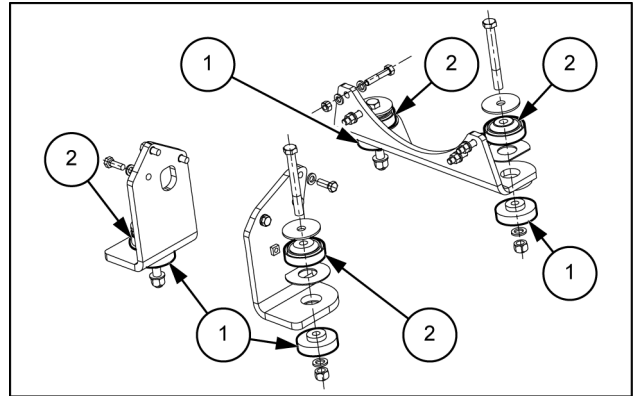
Never remove the filler cap or the recovery tank cap while the engine is running or the coolant is hot. Let the system cool. Turn the filler cap to the first notch and allow any pressure to escape, and then remove the filler cap. Loosen the recovery tank cap slowly to allow any pressure to escape. Failure to comply could result in death or serious injury.

W0296A

NOTE: Emission sensors mounted in the exhaust stream are sensitive to extreme vibrations. Use of tools that generate extreme vibrations, such as impact wrenches and hammers, will result in damage to emission sensors. Avoid using these tools during any service procedure in close proximity of emission sensors. If the use of these tools cannot be avoided, remove the sensors using extreme prior to performing any service procedure.

1. Inspect the engine mounts. If the engine rubber isolators require replacement, remove and discard the isolators (1) and (2). Install new rubber isolator (2), then rubber isolator (1).

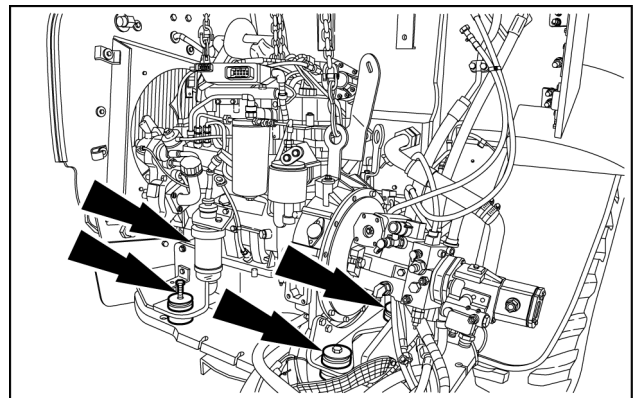
Make sure that the tightening torque of the fixing screws of the brackets to the engine is **118 - 133 N·m (87 - 98 lb ft)**.



LEIL14CWL0393AB 1

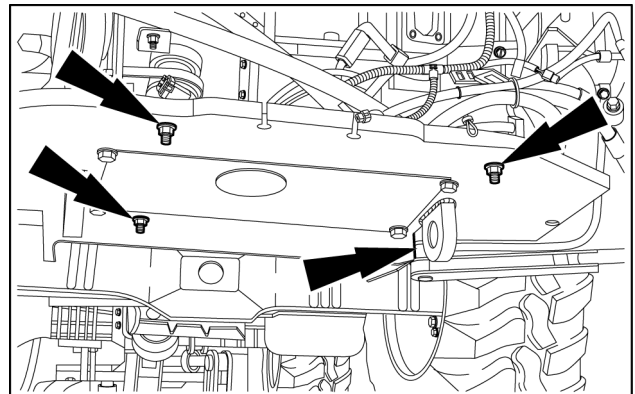
2. Attach suitable lifting device to the engine and slowly move it into position over the rear chassis. Be sure all harness connections and hoses are out of the way or positioned correctly for reconnecting, before lowering engine.

Install the silent blocks (arrows) on the engine.



LEIL14CWL0235AB 2

3. Tighten the mounting bolts of the engine to a torque of **244 - 298 N·m (180 - 220 lb ft)**.



LEIL14CWL0394AB 3

Index

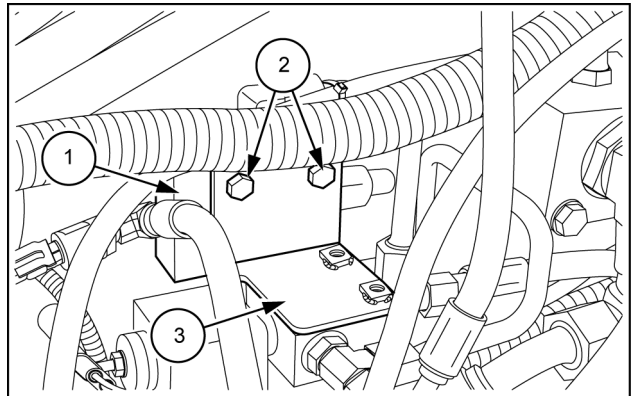
Engine - 10

Engine and crankcase - 001

Engine - Install	16
Engine - Remove	3

Inching valve - Remove

1. The inching valve **(1)** is positioned on the right side (under the cab).
Disconnect the inlet hose, the piloting hose and the tank hose from the inching valve **(1)**.
Remove the screws **(2)** fixing plate **(3)** and remove the inching valve **(1)**.



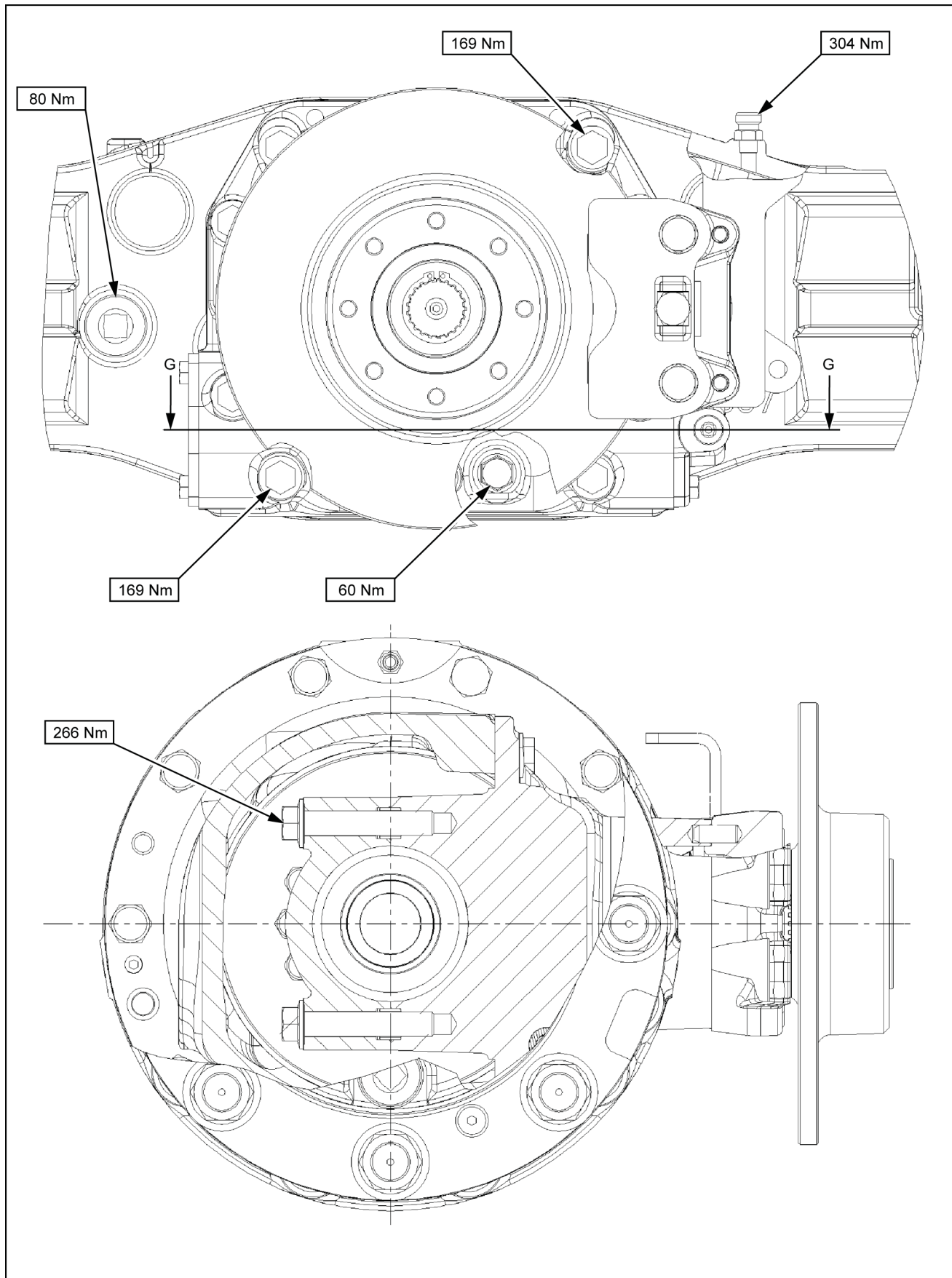
LEIL14CWL0760AB 1

Contents

Front axle system - 25

[25.100] Powered front axle	25.1
[25.102] Front bevel gear set and differential	25.2
[25.108] Final drive hub, steering knuckles, and shafts	25.3

Front axle system - Powered front axle



LEIL14CWL0284HB 6

Contents

Front axle system - 25

Front bevel gear set and differential - 102

FUNCTIONAL DATA

Differential	
Component identification - Differential support	3
Component identification	4
Component identification	5
Limited slip differential	
Component identification	6
Differential lock	
Component identification	7
Axle pinion	
Component identification	8

SERVICE

Bevel gear set and differential carrier	
Check	9
Differential	
Disassemble - Differential support	10
Assemble - Differential support	12
Disassemble	16
Assemble	17
Disassemble	18
Assemble	19
Limited slip differential	
Disassemble	21
Assemble	24
Differential lock	
Disassemble	28
Assemble	29
Axle pinion	
Disassemble	30
Assemble	32

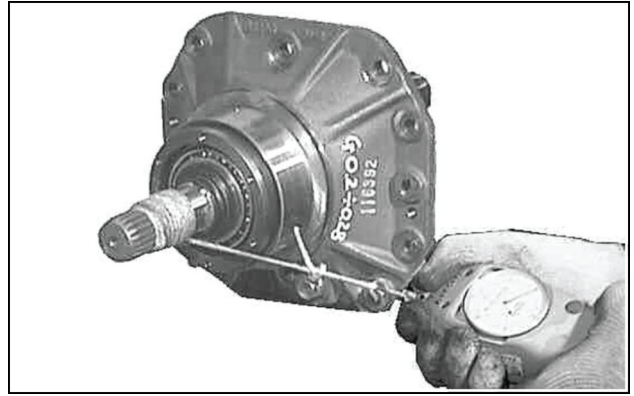
Once the pinion-ring gear backlash has been adjusted, measure the total preload (**T**) of the bearings (pinion-ring gear system), using a dynamometer whose cord is wound on the pinion end. The measured value should be within the following range:

$$T = (P + 3.1) \div (P + 4.7) \text{ daN}$$

$$T = (P + 6.96) \div (P + 10.56) \text{ lbf}$$

where P is the effectively measured pinion preload.

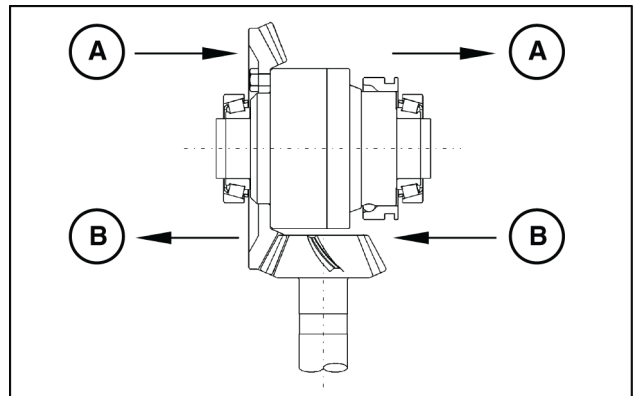
NOTICE: all pre-loads must be measured without seal ring.



LEPH12WHL0326AA 9

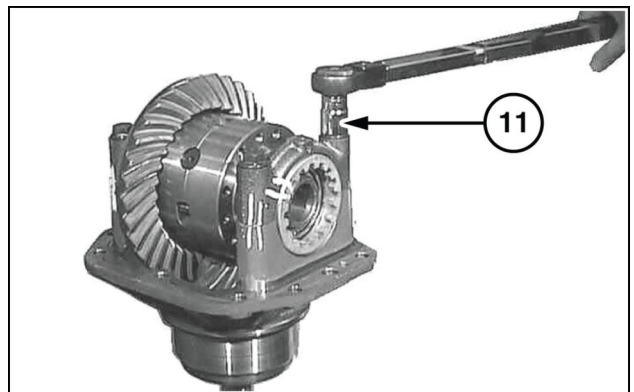
If the measurement is not within the requested range, accurately check the assembly of each single component and operate on the adjusting ring nuts (**3**) and (**7**) of the differential support:

- If the total preload is lower than the given range, screw in both ring nuts (**3**) and (**7**) by the same measure, keeping the value of the pinion-ring gear (**A**) backlash unchanged.
- If the total preload is higher than the given range, loosen both ring nuts (**3**) and (**7**) by the same measure, keeping the value of the pinion-ring gear (**B**) backlash unchanged.



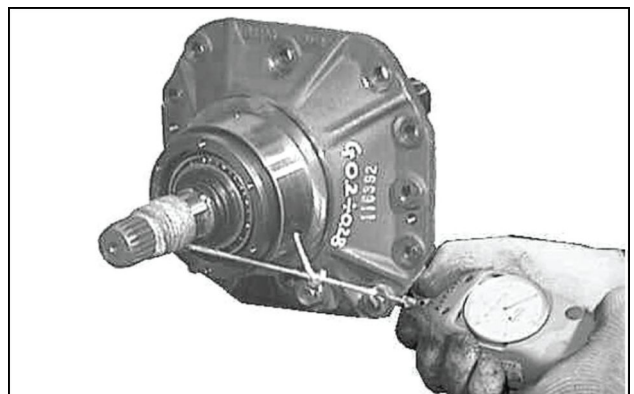
LEL112WHL0327AB 10

Once the adjustment is complete, screw in and tighten the screws (**11**) to the prescribed torque of **266 N·m (196.19 lb ft)**.



LEPH12WHL0328AB 11

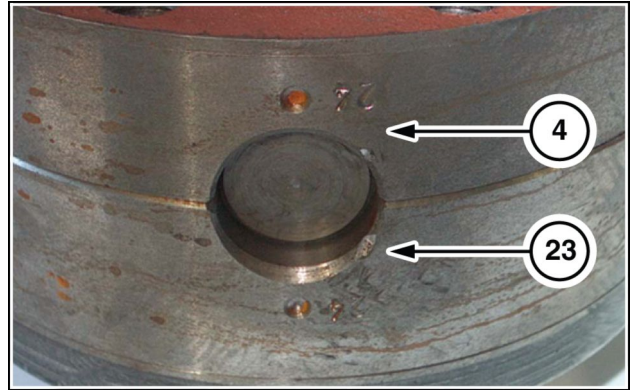
Check total preload of bearings.



LEPH12WHL0326AA 12

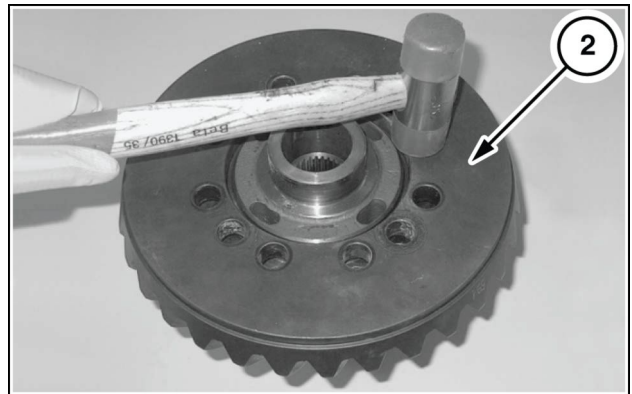
Assemble the two differential half boxes (4) and (23).

NOTICE: Carefully check that the reference marks of both differential half boxes are aligned.



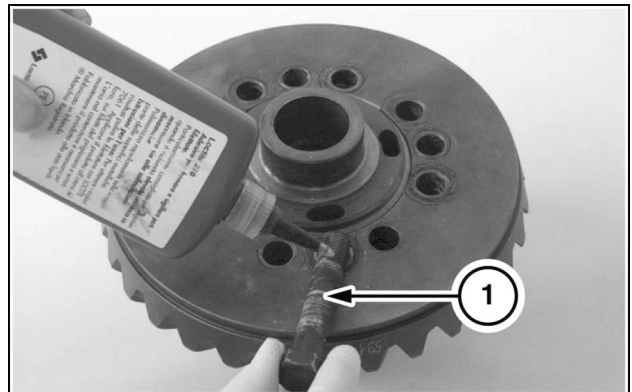
LEPH12WHL0339AB 9

Assemble the ring gear (2) by using a hammer.



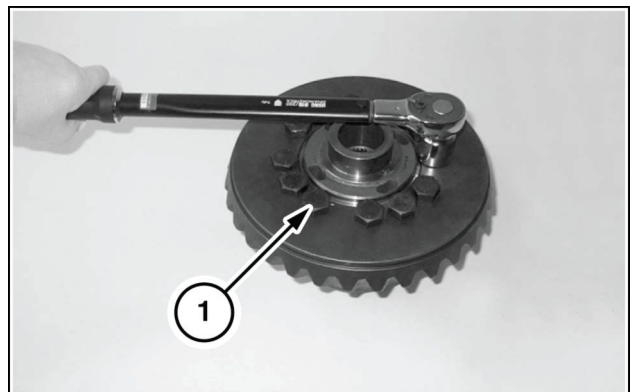
LEPH12WHL0349AB 10

Apply some LOCTITE® 242® on the thread of the screws (1).



LEPH12WHL0350AB 11

Tighten the screws (1) to 95 N·m (70.07 lb ft).



LEPH12WHL0351AB 12

Contents

Front axle system - 25

Final drive hub, steering knuckles, and shafts - 108

FUNCTIONAL DATA

Axle shaft	
Component identification (*)	3
Component identification (*)	4
Planetary drive and hub	
Component identification (*)	6
Component identification (*)	7
Wheel hub	
Component identification - Wheel hub without brakes (*)	8
Component identification - Wheel hub (with brakes)	9

SERVICE

Axle shaft	
Disassemble (*)	10
Assemble (*)	12
Disassemble (*)	14
Assemble (*)	18
Planetary drive and hub	
Disassemble (*)	22
Assemble (*)	24
Disassemble (*)	26
Assemble (*)	28
Wheel hub	
Disassemble - Wheel hub without brakes (*)	30
Assemble - Wheel hub without brakes (*)	35
Disassemble - Wheel hub with brakes	39
Assemble - Wheel hub with brakes	42

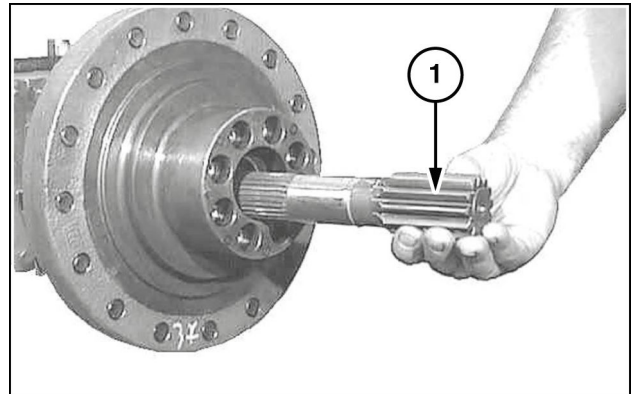
(*) See content for specific models

Axle shaft - Disassemble

221F HS	NA --- WE
221F STD	NA --- WE
321F HS	NA --- WE
321F STD	NA --- WE

Standard and High speed

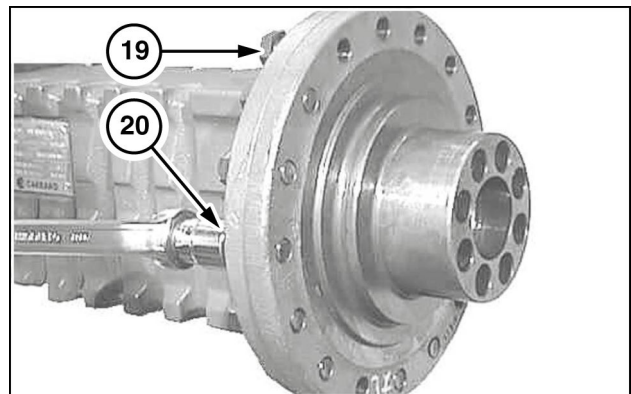
Extract the short half axle (1).



LEPH12WHL0251FB 1

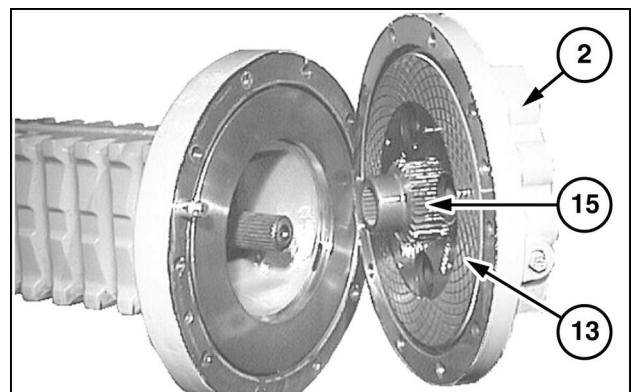
Loosen and remove the breather valve (20).
Loosen and remove the screws (19).

NOTICE: Do not drop the wheel shaft and, if necessary, hold it by means of a rope.



LEPH12WHL0264AB 2

Remove the wheel shaft (2) paying attention not to drop the brake disc (13) and the gear (15).

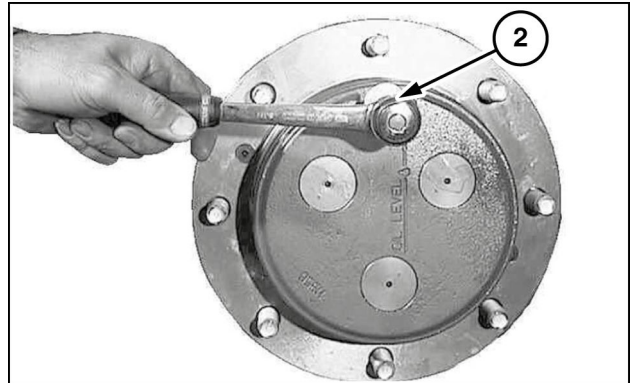


LEPH12WHL0265AB 3

Planetary drive and hub - Disassemble

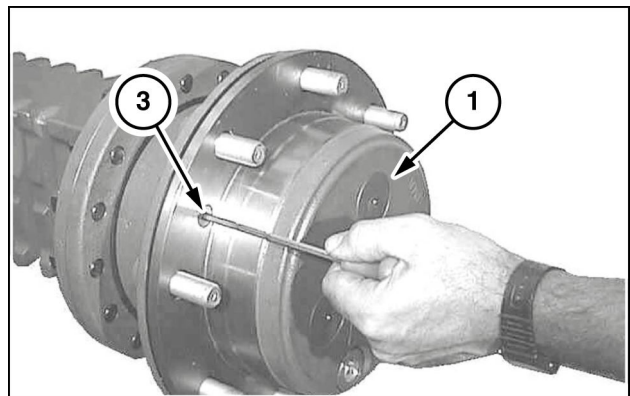
221F HS	NA --- WE
221F STD	NA --- WE
321F HS	NA --- WE
321F STD	NA --- WE

Unscrew and remove the plug **(2)**.
Drain the oil completely from the reduction gear.



LEPH12WHL0202AB 1

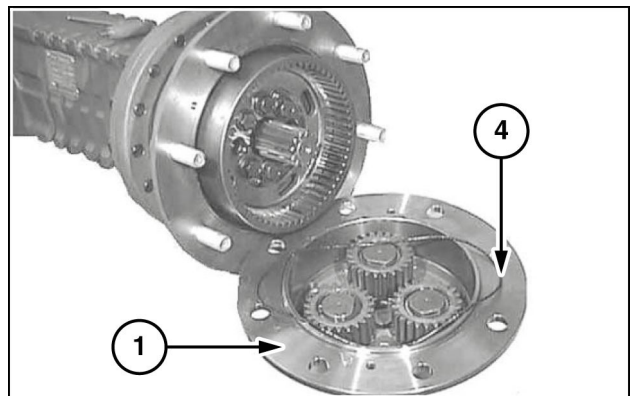
Unscrew and remove the screws **(3)** of the planetary carrier cover **(1)**.



LEPH12WHL0203AB 2

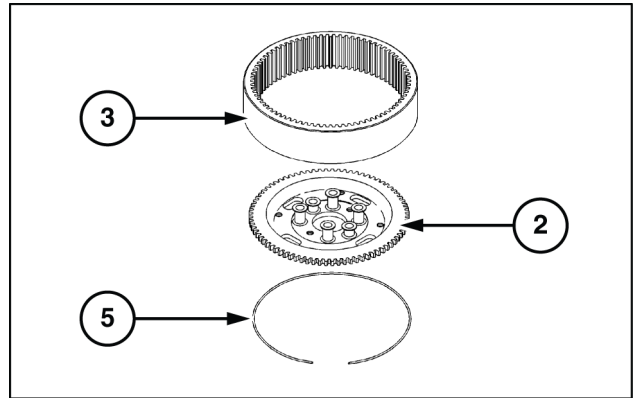
Remove the planetary carrier cover **(1)** and collect the relevant O-ring **(4)**.

Position the planetary gear carrier **(1)** onto a workbench and check its wear conditions.



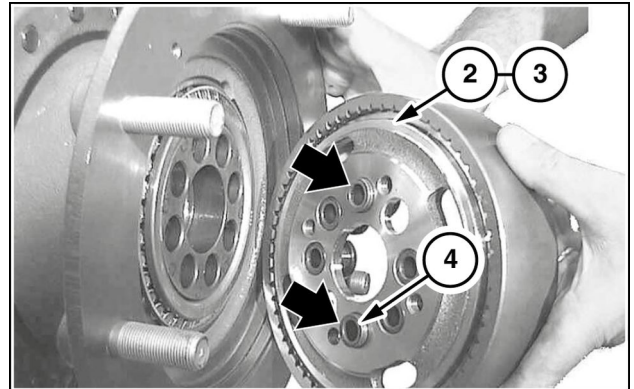
LEPH12WHL0213AB 3

Preassemble the ring gear carrier (2) and the ring gear (3) with the snap ring (5).



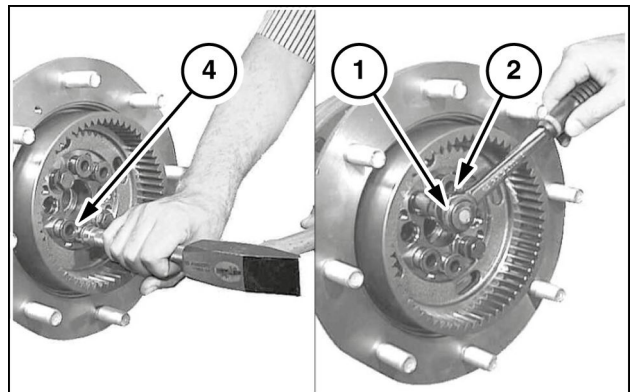
LEPH12WHL0244AB 12

Assemble the ring gear carrier assembly (2) and the ring gear (3) on the wheel hub using the two projecting bushings (4) as dowel pins.



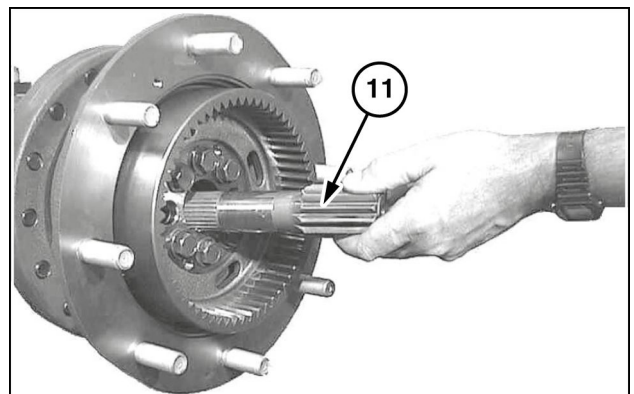
LEPH12WHL0245AB 13

Assemble the bushings (4) and completely insert them. Apply some **LOCTITE® 242®** on the thread of the screws (1). Screw in the screws (1) and tighten them to the prescribed torque of **120 N·m (88.51 lb ft)**.



LEPH12WHL0246AB 14

Install the short half axle (11).



LEPH12WHL0247AB 15

Contents

Rear axle system - 27

Powered rear axle - 100

TECHNICAL DATA

Powered rear axle	
General specification	3
Dimension	9
Torque	10

FUNCTIONAL DATA

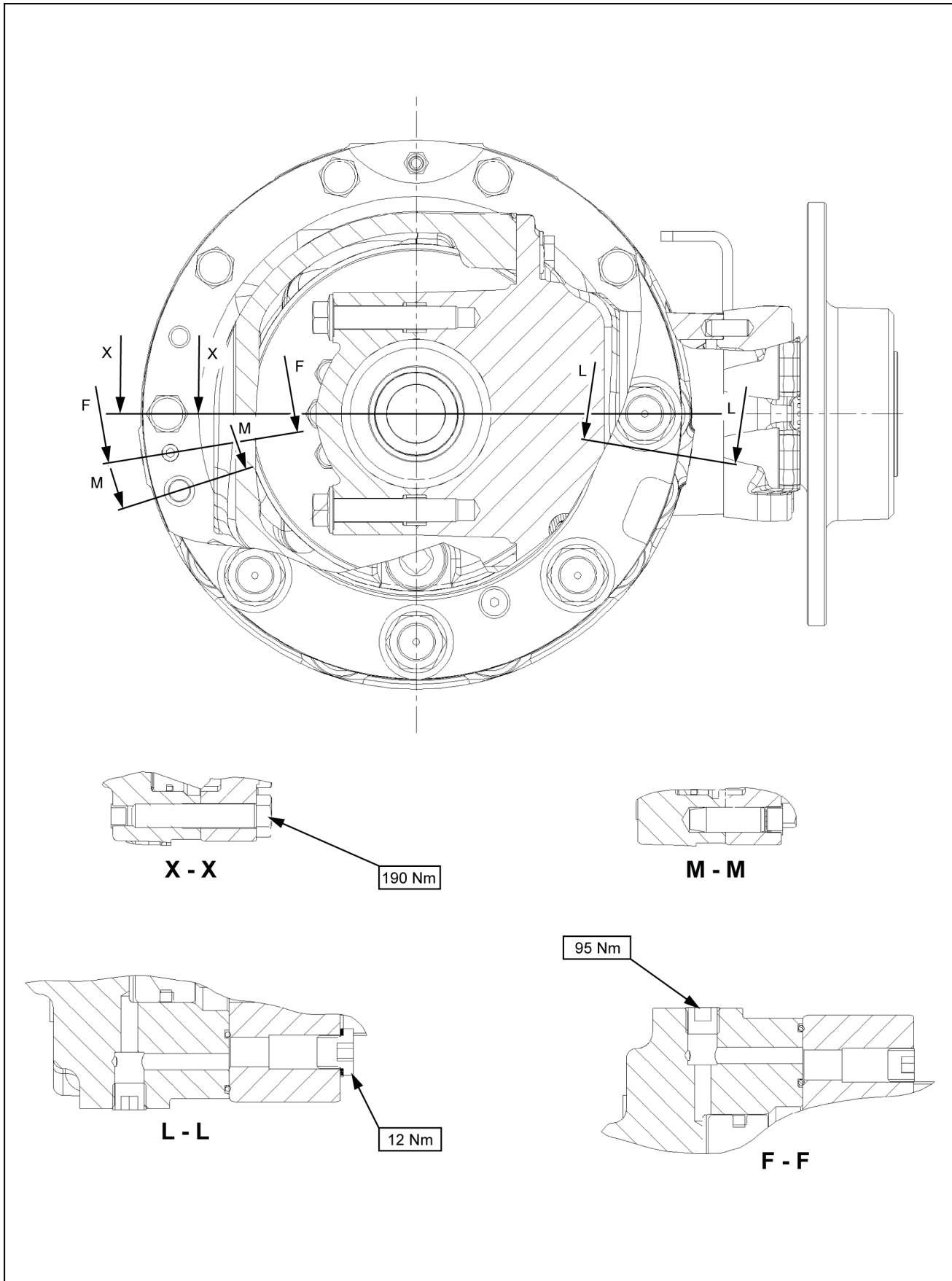
Powered rear axle	
Component localization	22
Transmission housing	
Component identification - Transmission TB 172 (*)	24
Component identification - Motor flange and RPM sensor	25
Component identification - Transmission TB138.5 "high speed" (*)	26

SERVICE

Powered rear axle	
Service instruction - Motor TB138.5 "high speed" (*)	29
Disassemble - Motor TB 138.5 "High Speed" (*)	30
Assemble - Motor TB 138.5 "High speed" (*)	32
Remove	34
Install	37
Transmission housing	
Disassemble - Motor flange and RPM sensor	40
Assemble - Motor flange and RPM sensor	41
Disassemble - Transmission TB 172 (*)	42
Assemble - Transmission TB 172 (*)	45
Disassemble - Transmission TB 138.5 "High Speed" (*)	49
Assemble - Transmission TB 138.5 "High Speed" (*)	58

(*) See content for specific models

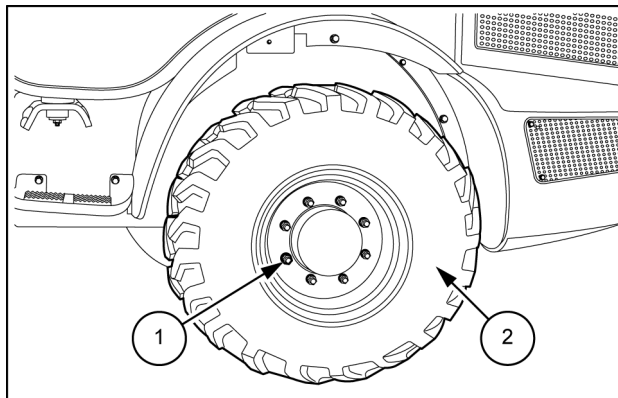
For axle with 4 planetary epicyclic reduction gear (221F HS, 321F HS)



Transmission housing - Component identification - Transmission TB138.5 "high speed"

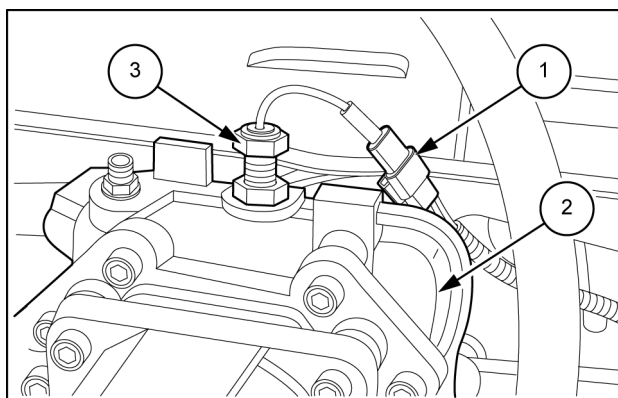
221F HS	NA --- WE
321F HS	NA --- WE

5. Install the two rear wheels **(2)**.
Tighten the nuts **(1)** from both sides and install the cups.
Remove the hydraulic jack.



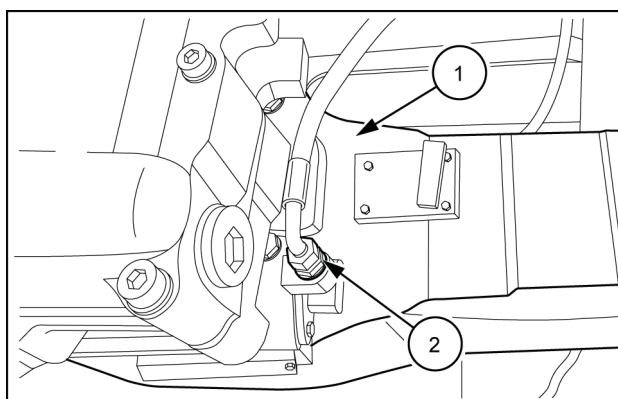
LEIL14CWL0377AB 5

6. Connect the gearbox speed sensor connector **(1)**.
NOTE: the speed sensor **(3)** has not been removed from the gearbox **(2)**.



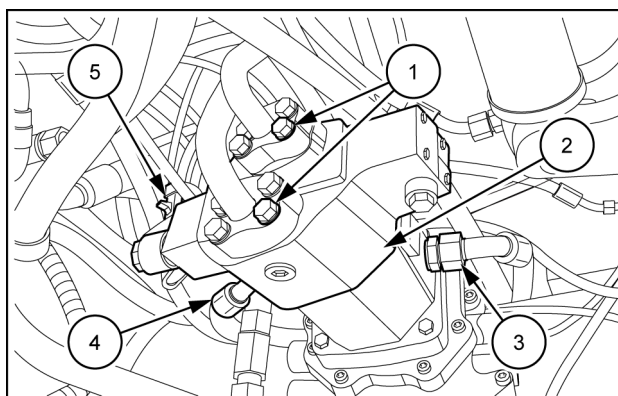
LEIL14CWL0392AB 6

7. Connect the differential lock hose to the rear axle **(1)** and tighten the fitting **(2)**.



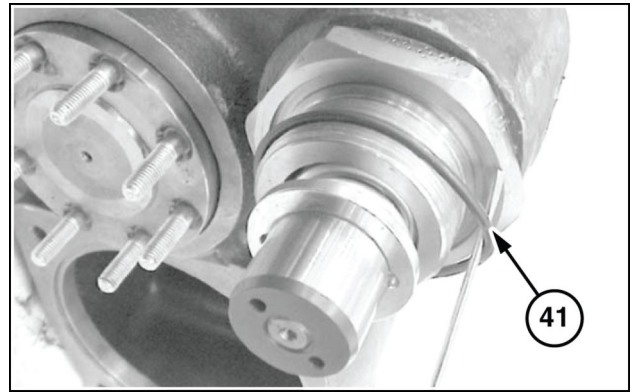
LEIL14CWL0381AB 7

8. Connect the pipes **(1)** of the forward and reverse to the hydraulic motor **(2)**.
Connect the hoses **(3)** and **(4)** to the hydraulic motor **(2)**.
Connect the solenoid valve connector **(5)**.



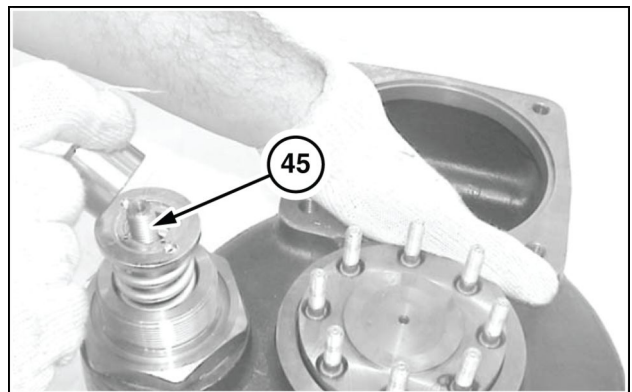
LEIL14CWL0380AB 8

Remove the O-ring (41).



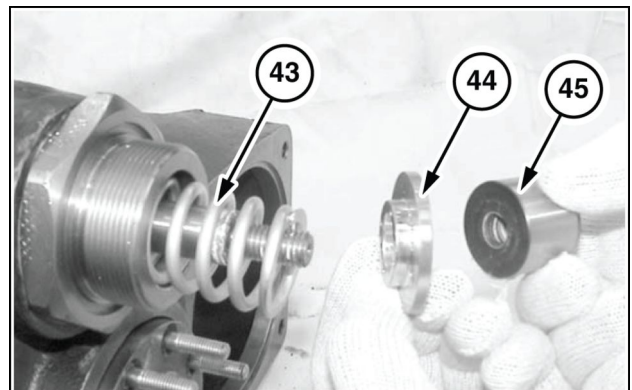
LEPH12WHL0060AB 4

Unscrew the piston (45) using the wrench 380002244.



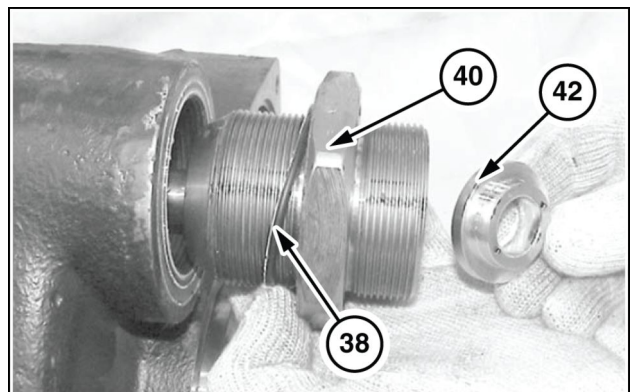
LEPH12WHL0061AB 5

Remove the piston (45), the spring seat (44) and the spring (43).



LEPH12WHL0062AB 6

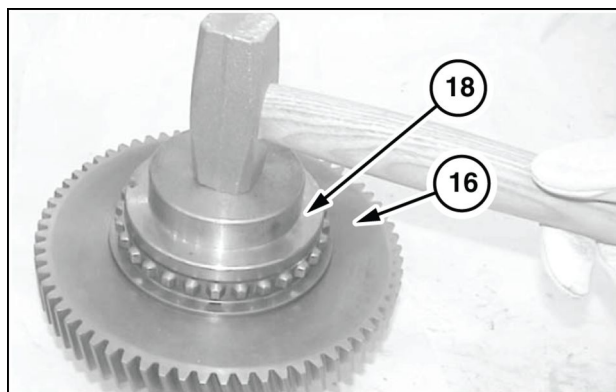
Remove the spring seat (42). Loosen and remove the fitting (40) and the O-ring (38).



LEPH12WHL0063AB 7

Assemble the bearing (18) on the gear (16) using the driver 380002241 and a hammer.

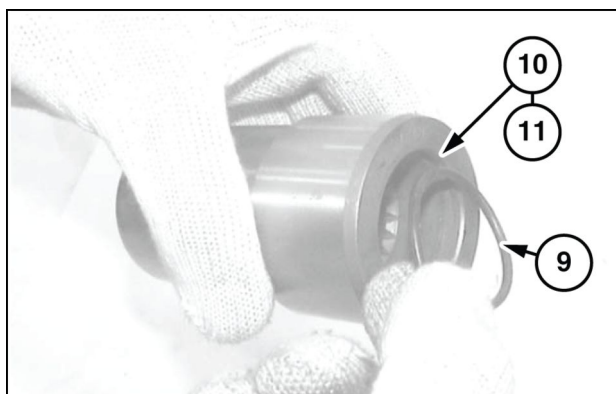
NOTE: the driver must be used with the handle 380002211. Wear protective gloves.



LEPH12WHL0705AB 16

Check that the elastic ring (11) is already assembled on the splined sleeve (10).

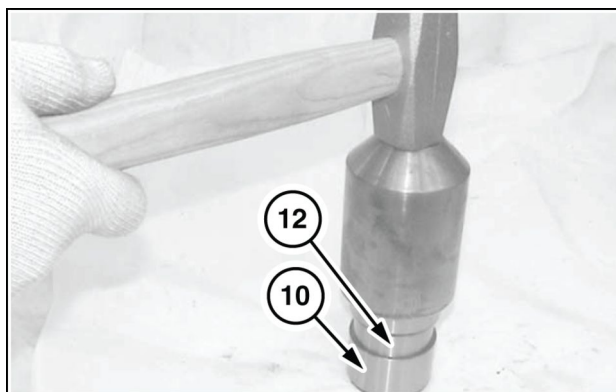
Install the O-ring (9) on the splined sleeve (10).



LEPH12WHL0075AB 17

Install the bearing (12) on the splined sleeve (10) using the driver 380002240 and a hammer.

NOTE: the driver must be used with the handle 380002211. Wear protective gloves.

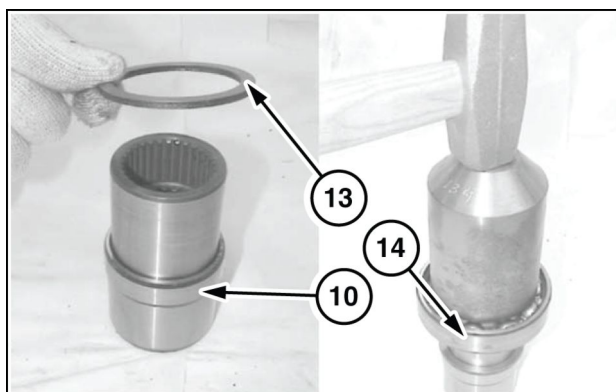


LEPH12WHL0706AB 18

Insert the shim (13).

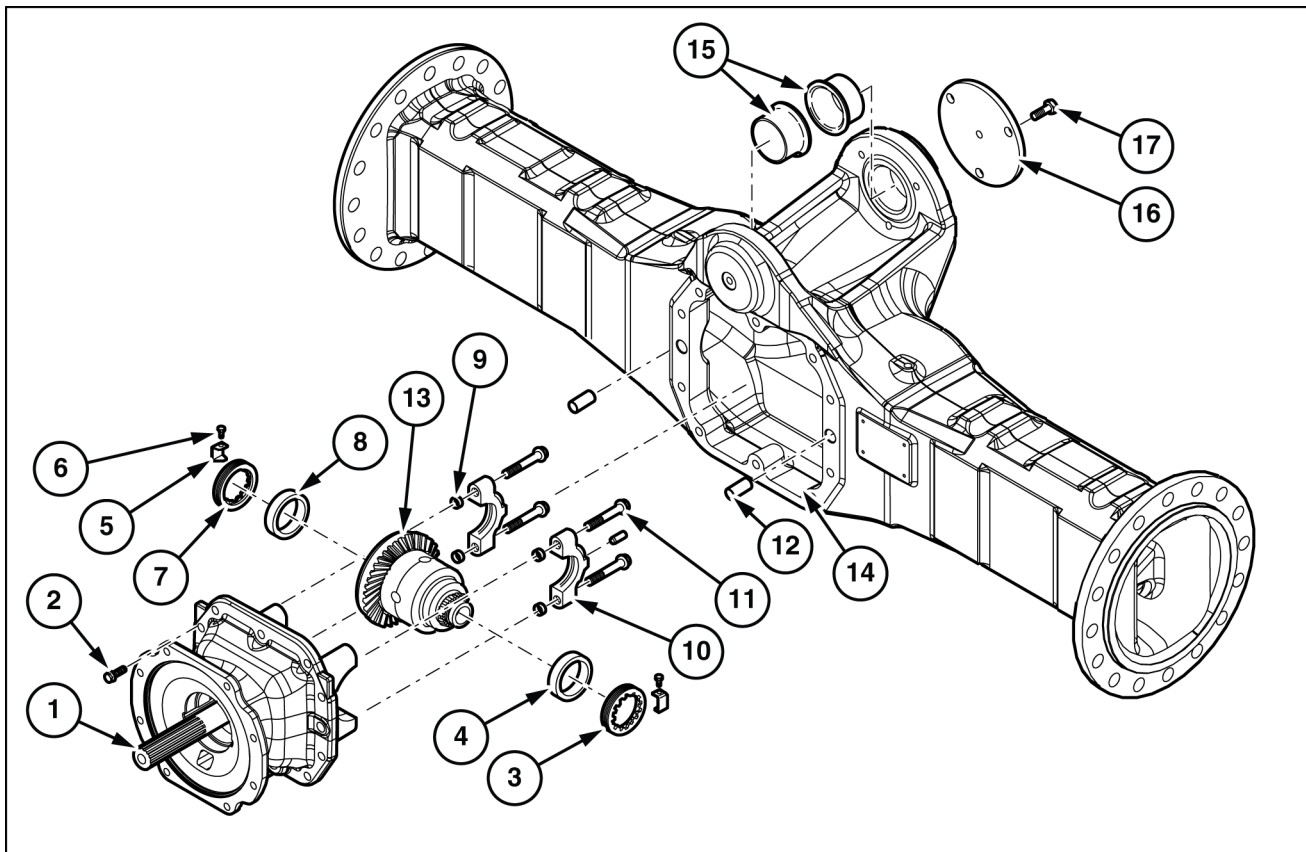
Install the bearing (14) on the splined sleeve (10) using the driver 380002240 and a hammer.

NOTE: the driver must be used with the handle 380002211. Wear protective gloves.



LEPH12WHL0707AB 19

Differential - Component identification - Differential support



LEL112WHL0194FB 1

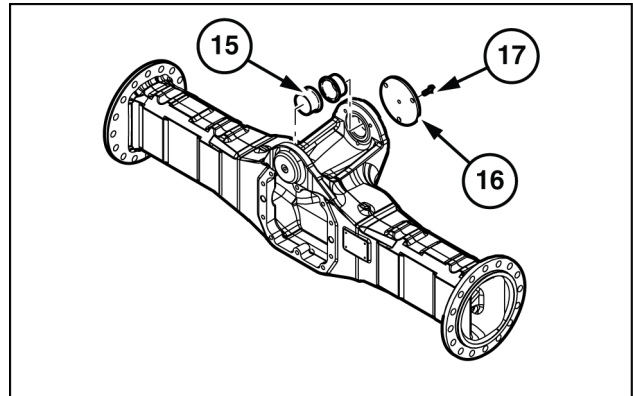
- | | |
|----------------------|---------------------------|
| 1. Support | 10. Half collar |
| 2. Screw | 11. Screw |
| 3. Ring nut | 12. Pin |
| 4. Bearing | 13. Differential assembly |
| 5. Ring nut retainer | 14. Axle housing |
| 6. Screw | 15. Bushing |
| 7. Ring nut | 16. Cover |
| 8. Bearing | 17. Screw |
| 9. Bushing | |

Differential - Disassemble - Differential support

Unscrew and remove the screws (17) of the cover (16).
Remove the bushings (15) from the axle beam only if the wear conditions require it.

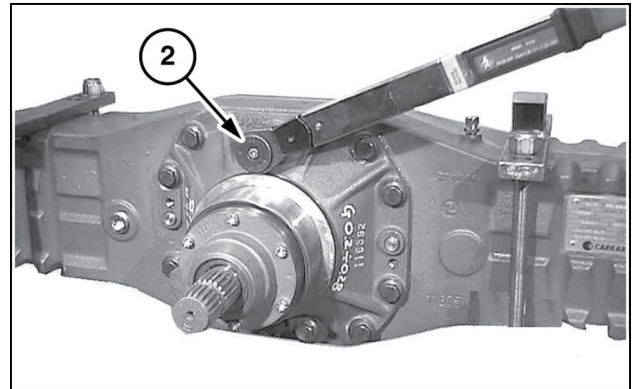
NOTE: this is a destructive operation for the bushings.

NOTICE: do not damage the bushings seat.



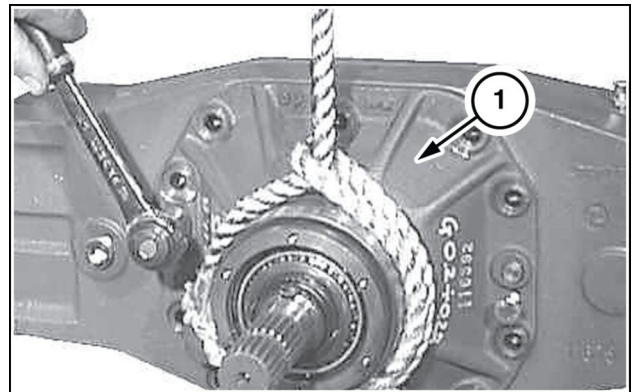
LEL12WHL0195AB 1

Drain the oil completely from the differential. Loosen and remove the screws (2).



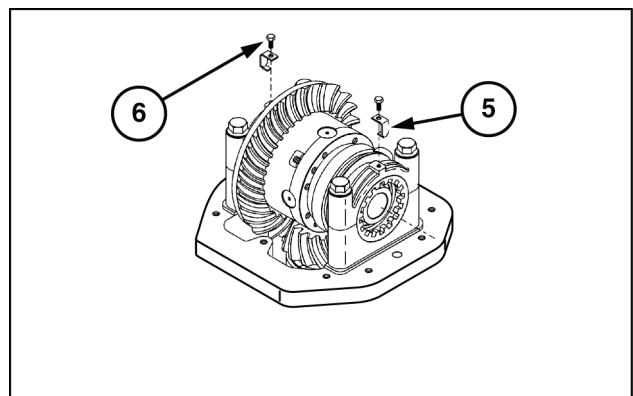
LEPH12WHL0196AB 2

To extract the differential support (1), tighten two screws in the threaded holes of the differential support.
Then hold the differential support (1) with a rope or other appropriate means and remove it.



LEPH12WHL0197AB 3

Loosen and remove the screws (6) to extract the 2 ring nut retainers (5).



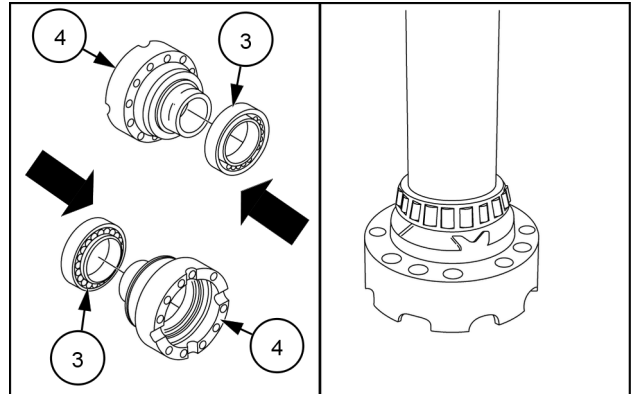
LEL12WHL0198AB 4

Differential - Assemble

100% lock differential

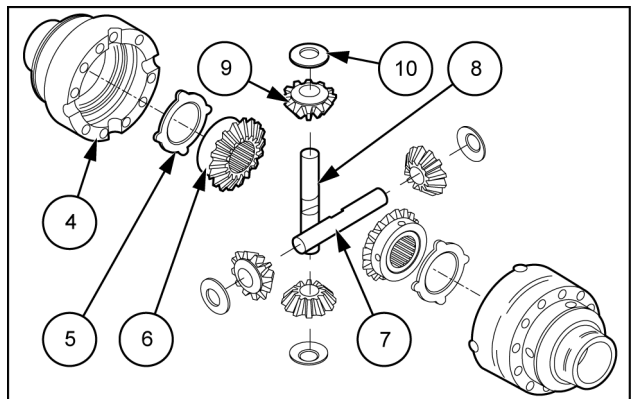
1. Assemble the bearing cones (3) on the half housing (4), using the driver 380002216 and a hammer.

NOTE: the driver must be used with the handle 380002211. Wear protective gloves.



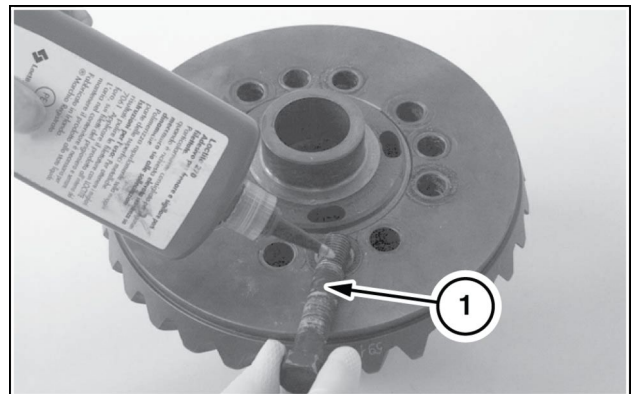
LEIL14CWL0298AA 1

2. Position a half housing (4) on a workbench and assemble all inner components: locking differential counter discs (5), sun gears (6), spider (7) and (8), spider gears (9), thrust washers (10). See parts position shown in figure. Join the two half boxes, aligning the reference marks made upon them.



LEIL14CWL0299AB 2

3. Place the bevel gear on the differential housing. Apply sealant on the threads and tighten the bolts (1) to the requested torque.

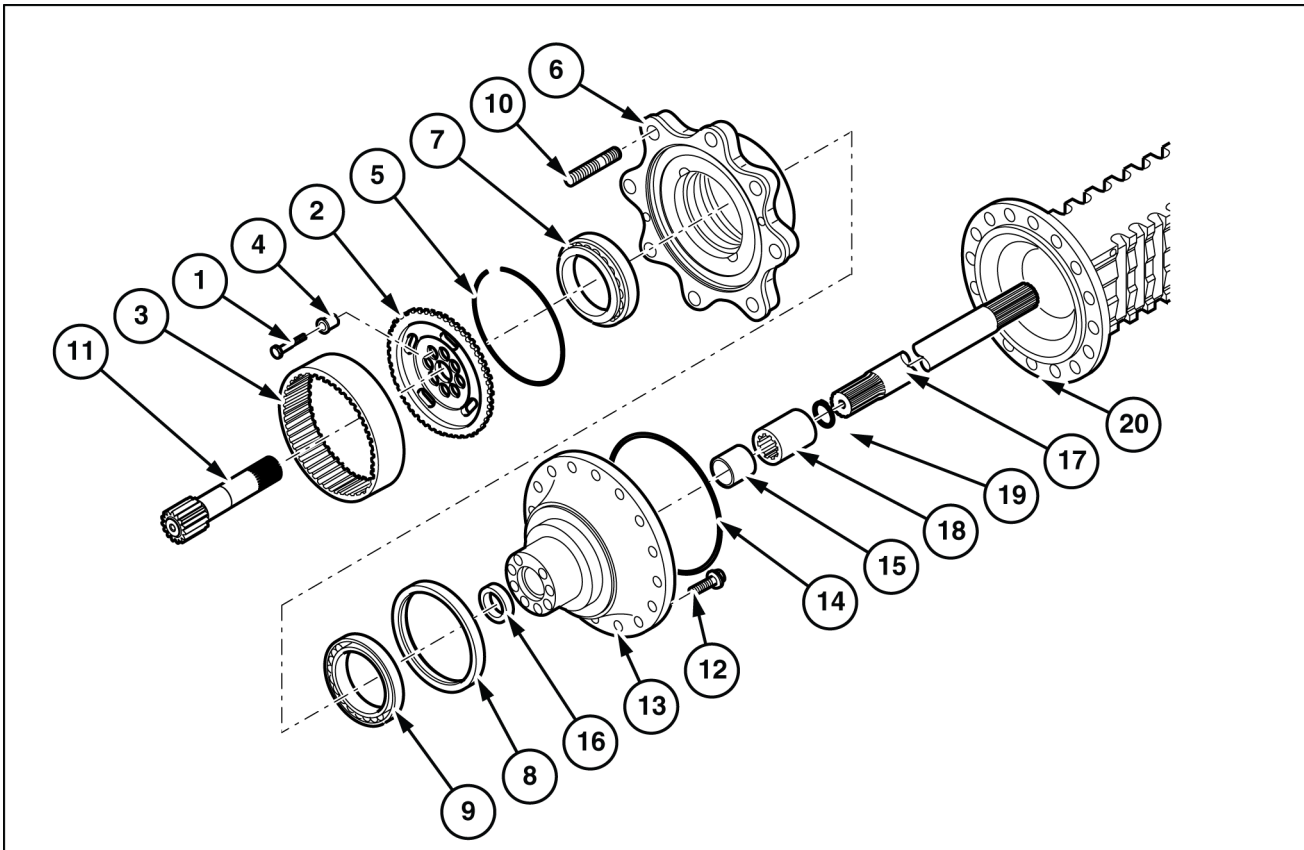


LEPH12WHL0534AB 3

Problem	Possible Cause	Correction
	Different rotation radius of the tires	If one tire has a smaller radius, it will cause partial wheel slipping when force is applied. The other tire with bigger radius will have to support all the work. Replace the tire or adjust pressure to have same radius on both tires.
	Bent axle beam	Replace the axle beam
	Incorrect use of the product	See the vehicle producer's instructions once again
Break towards the external end of the ring gear tooth	Excessive gear load compared to the one expected	Replace bevel gear Carefully observe the recommended operations for the adjustment of ring gear and pinion backlash and for tooth mark detection
	Gear adjustment wrong (excessive backlash)	Replace bevel gear Carefully observe the recommended operations for the adjustment of ring gear and pinion backlash and for tooth mark detection
	Pinion nut loose	Replace bevel gear Carefully observe the recommended operations for the adjustment of ring gear and pinion backlash and for tooth mark detection
Bent axle beam body	Machine overloaded	Replace the axle beam body
	Damaged vehicle	Replace the axle beam body
	Crash load	Replace the axle beam body
Ring gear teeth or pinion teeth damaged or scored	Insufficient oil	Replace bevel gear Replace worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring gear Use proper lubricant, fill up to right level and replace at recommended intervals
	Contaminated oil	Replace bevel gear Replace worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring gear Use proper lubricant, fill up to right level and replace at recommended intervals
	Incorrect oil or with poor additives	Replace bevel gear Replace worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring gear Use proper lubricant, fill up to right level and replace at recommended intervals
	Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring gear	Replace bevel gear Replace worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring gear Use proper lubricant, fill up to right level and replace at recommended intervals
Break towards the internal end of the ring gear tooth	Crash load	Replace bevel gear Carefully observe the recommended operations for the adjustment of ring gear and pinion backlash and for tooth mark detection

Wheel hub - Component identification

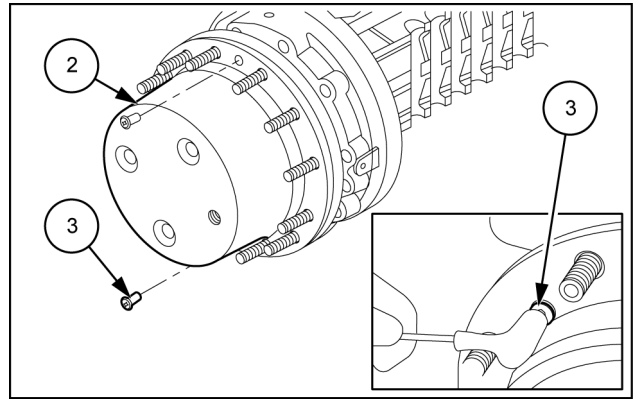
121F XT	NA --- WE
121F ZB	NA --- WE
21F XT	NA --- WE
21F ZB	NA --- WE



LEL112WHL0217FB 1

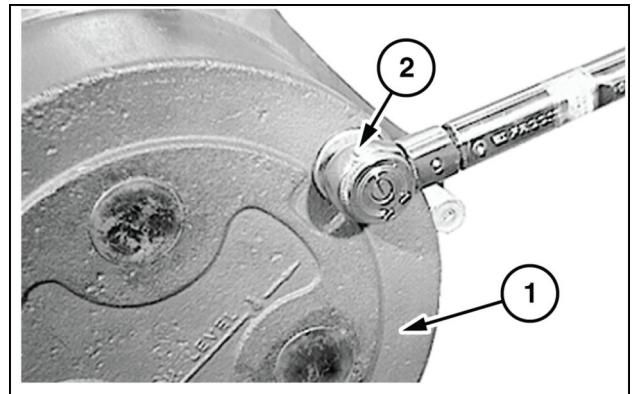
- | | |
|----------------------|---------------------|
| 1. Screw | 11. Short half axle |
| 2. Ring gear carrier | 12. Screw |
| 3. Ring gear | 13. Wheel shaft |
| 4. Bushing | 14. O-ring |
| 5. Snap ring | 15. Bushing |
| 6. Wheel hub | 16. Seal ring |
| 7. Bearing | 17. Long half shaft |
| 8. Seal ring | 18. Sleeve |
| 9. Bearing | 19. Elastic ring |
| 10. Stud bolt | 20. Axle beam |

5. Assemble the fastening screws (3) and tighten them to the requested torque of **25 N·m (18.44 lb ft)**.



LEIL14CWL0772AB 5

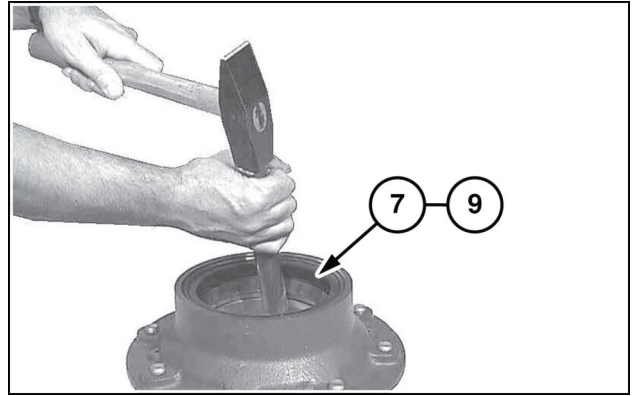
6. Top up the oil on the wheel hub.
Screw the plug (2) onto the planetary gear carrier (1) and tighten it to the prescribed torque of **60 N·m (44.25 lb ft)**.



LEPH12WHL0736AB 6

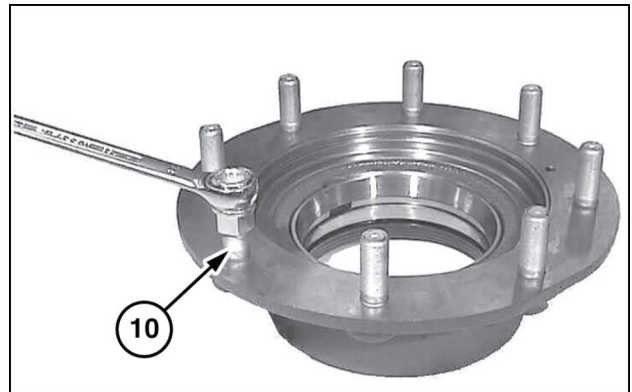
Take out the bearing cups (7) and (9) with a driver and a hammer.

NOTE: wear protective gloves.



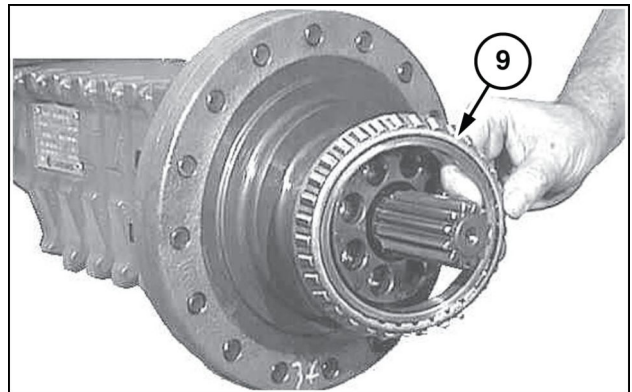
LEPH12WHL0169AB 8

To unscrew and replace the worn stud bolts (10) of the wheel hub, use a nut and a locknut. Warm up the screwed part, if necessary.



LEPH12WHL0170AB 9

Remove the bearing (9).

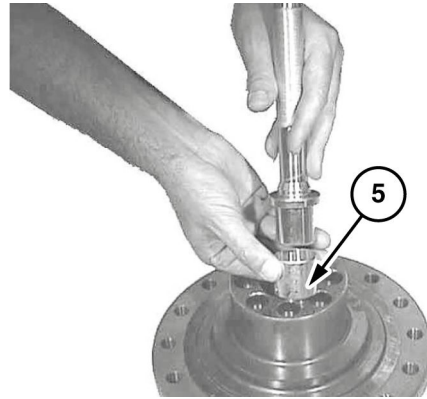


LEPH12WHL0171AB 10

Axle shaft - Assemble

Install the bushing (5) onto the wheel shaft using a driver and a hammer.

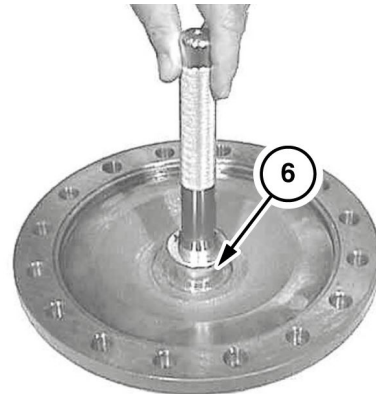
NOTE: the driver must be used with the handle 380002211. Wear protective gloves.



LEPH12WHL0257AB 1

Turn the wheel shaft upside down and install the seal ring (6) using the driver 380002221 and a hammer.

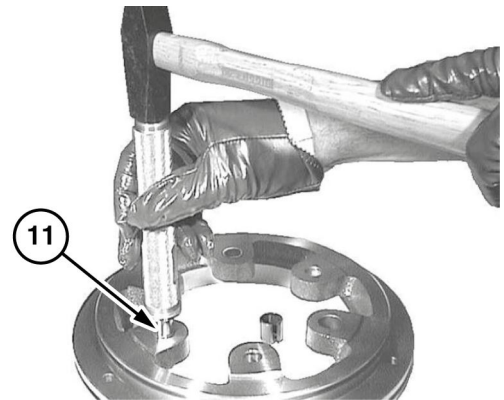
NOTE: the driver must be used with the handle 380002211. Wear protective gloves.



LEPH12WHL0258AB 2

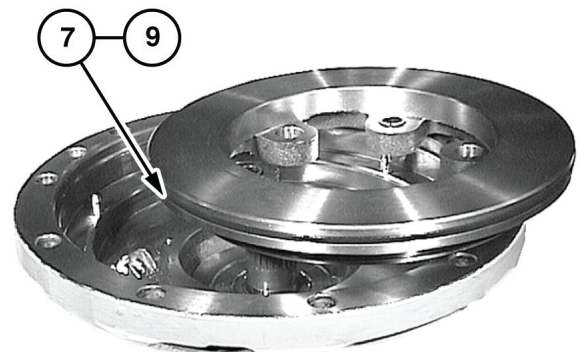
Assemble the split pin of the self-adjust kit (11) in the brake piston using the driver 380002232 and a hammer.

NOTE: the driver must be used with the handle 380002211. Wear protective gloves.



LEPH12WHL0274AB 3

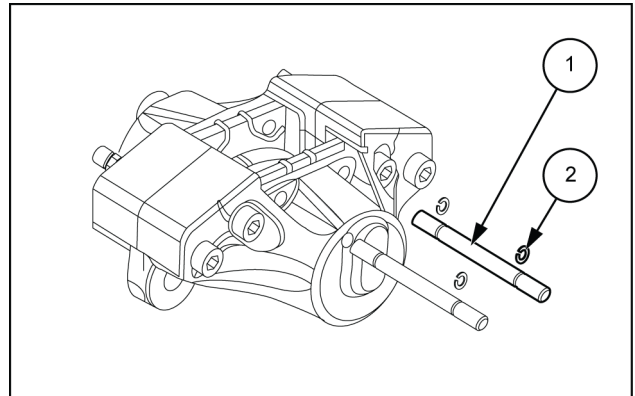
Clean the piston and the O-ring seat.
Grease the O-ring seat.
Grease and install the O-rings (7) and (9).



LEPH12WHL0301AB 4

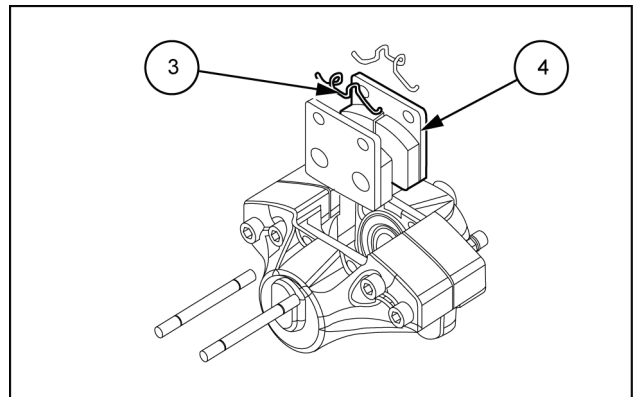
Brake caliper - Disassemble

1. Remove the pins (1) with the rings (2) using an hammer and a driver.



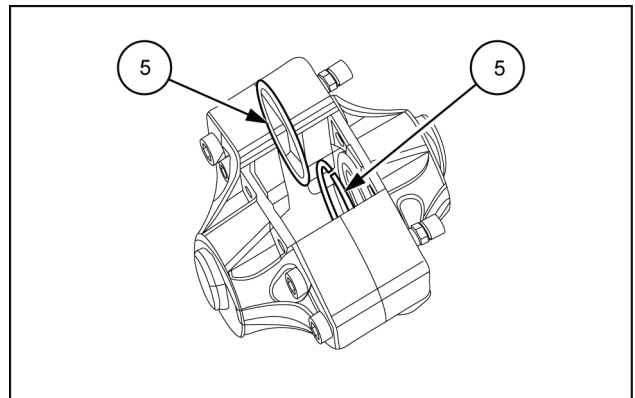
LEIL14CWL0359AB 1

2. Remove spring (3) and brake pads (4).



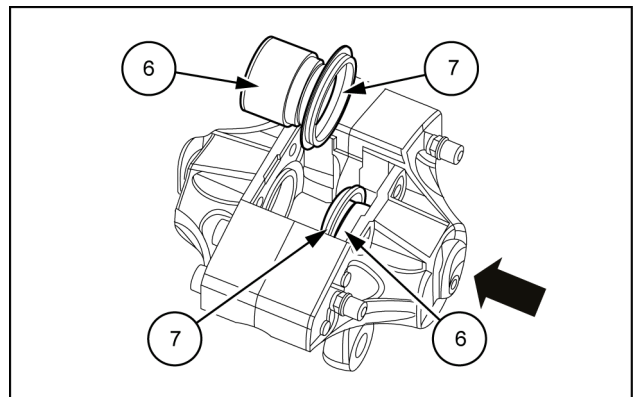
LEIL14CWL0360AB 2

3. Remove O-rings (5).



LEIL14CWL0361AB 3

4. Eject pistons (6) with the dust boots (7) by gradually inlet compressed air through the brake port.



LEIL14CWL0362AB 4

Index

Brakes and controls - 33

Parking brake or parking lock - 110

Parking brake caliper - Check	7
Parking brake caliper - Service instruction	3



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Index

Hydraulic systems - 35

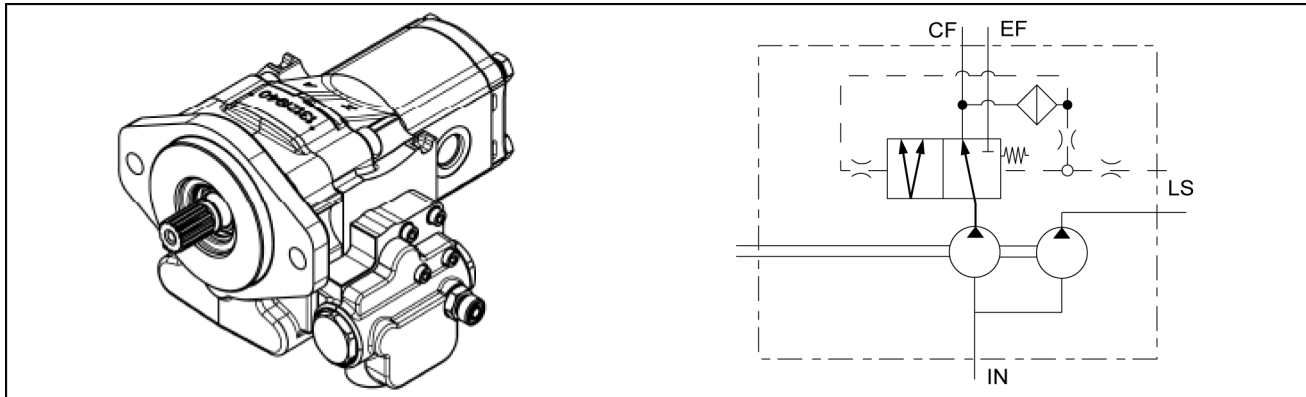
Hydraulic systems - 000

Hydraulic systems - Hydraulic schematic frame 02 (*)	6
Hydraulic systems - Hydraulic schematic frame 01 (*)	4
Hydraulic systems - Troubleshooting	9

(*) See content for specific models

Pump - General specification - Tandem gear pump

221F HS	NA --- WE
221F STD	NA --- WE
321F HS	NA --- WE
321F STD	NA --- WE



LEIL14CWL0208FA 1

		I PUMP	II PUMP
Direction of rotation (looking on drive shaft)		Clockwise	
Displacement		34.58 cm³/rev (2.11 in³/rev)	19.09 cm³/rev (1.16 in³/rev)
Inlet pressure range for pump		0.7 - 3 bar (10.1 - 43.5 psi)	
Max continuous pressure	P1	250 bar (3625 psi)	200 bar (2900 psi)
Max intermittent pressure	P2	280 bar (4060 psi)	220 bar (3190 psi)
Max peak pressure	P3	300 bar (4350 psi)	240 bar (3480 psi)
Speed	Min. P1	500 RPM	
	Max P1	3000 RPM	
Min temperature		-25 °C (-77 °F)	
Max temperature	Continuous	+110 °C (+230 °F)	
	Peak	+125 °C (+257 °F)	
Stand-by pressure LS valve		19 bar (276 psi)	
Weight		18.324 kg (40.398 lb)	

Unlocking

To tow the machine, it is necessary to short-circuit (unlock) the hydraulic system of the travel motor, otherwise the transmission and the wheels remain locked.

Loosen the locknut **(2)** from 1 ½ to 2 turns.

Hold the locknut with a wrench and screw in the setscrew **(1)** with another wrench, until this one locks the locknut **(2)**. Tighten the nut again.

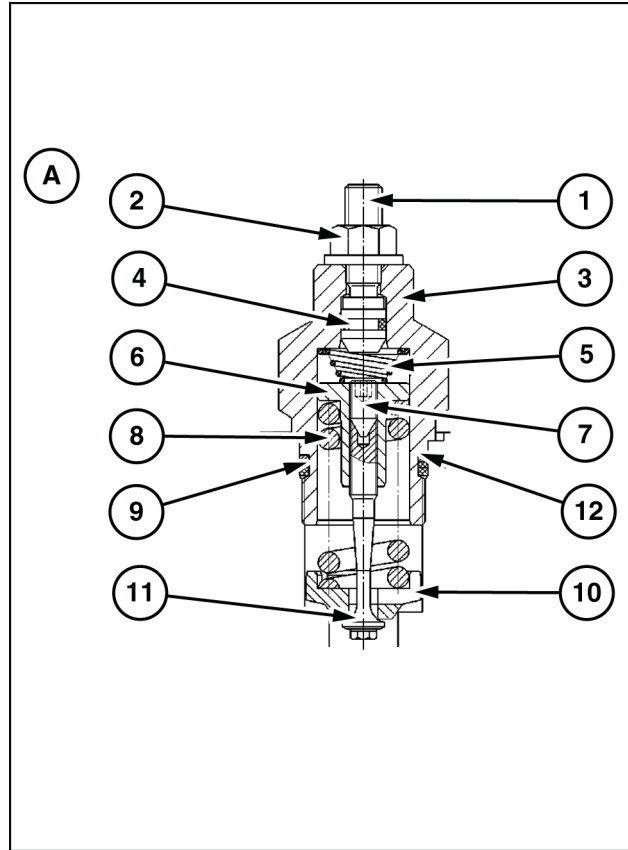
Once towing is complete, loosen the locknut **(2)**.

Loosen the setscrew **(1)** up to the retainer and tighten the locknut **(2)**.

NOTICE: do not operate against the high pressure relief valves **(A)** longer than 5 s, because they could get damaged due to high temperature.

The high pressure relief valves **(A)** do not usually need any adjustment. If anyway the high pressure relief value has to be adjusted, disassemble the valve and loosen the stud screw **(7)**. Then proceed with pressure adjustment by means of the piston **(11)**. Once the adjustment is complete (1 turn corresponds to about **44 bar (638 psi)**), tighten the stud bolt **(7)** again and reassemble the valve on the pump casing.

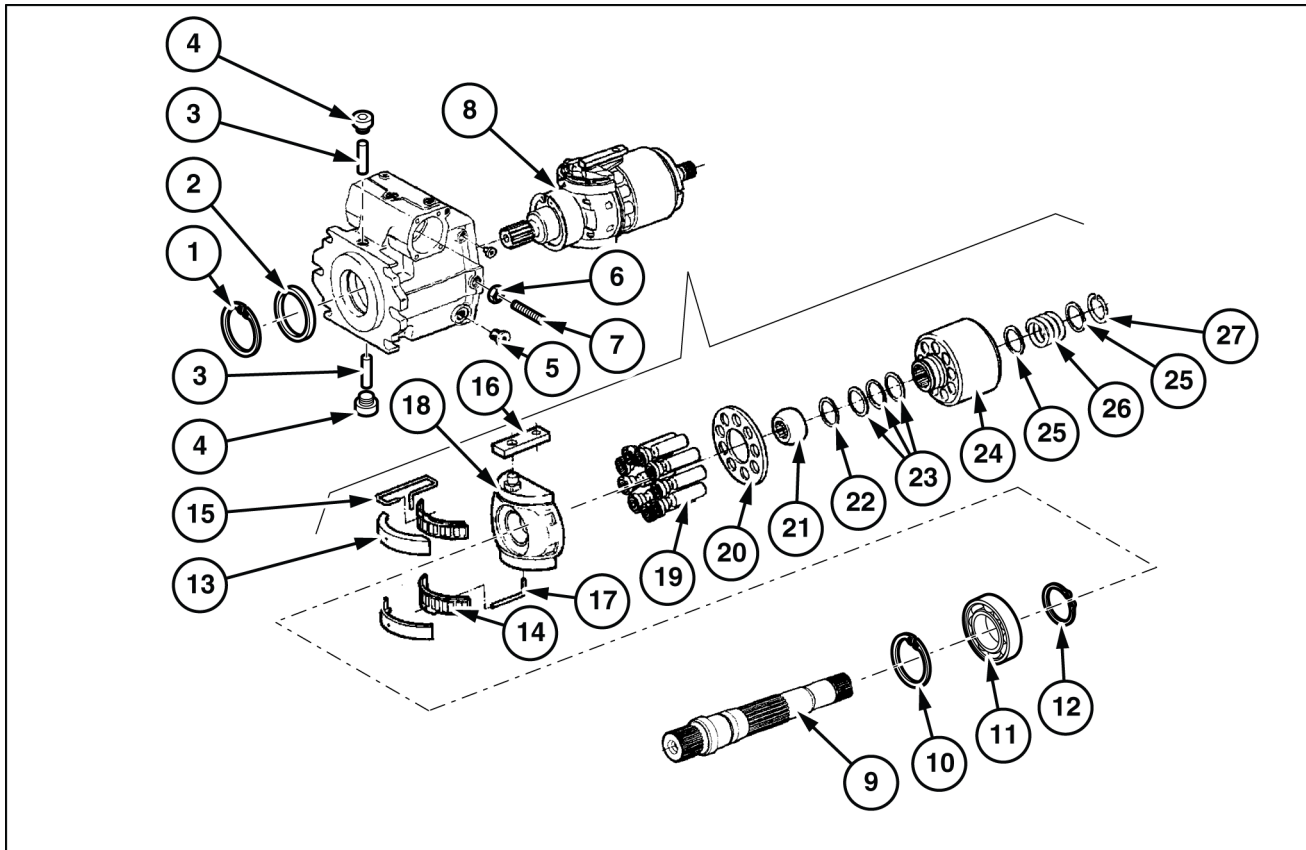
NOTE: after the assembly check the pressure again.



LEL112WHL0428BB 3

1. Setscrew
2. Locknut
3. Valve body
4. O-ring
5. Spring
6. Distance sleeve
7. Stud screw
8. Spring
9. Seal ring
10. Spring seat
11. Little piston
12. Ring

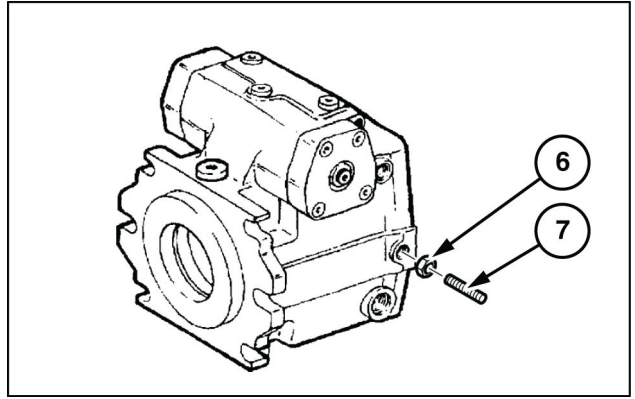
Pump - Component identification - Complete rotary assembly



LEL12WHL0291FC 1

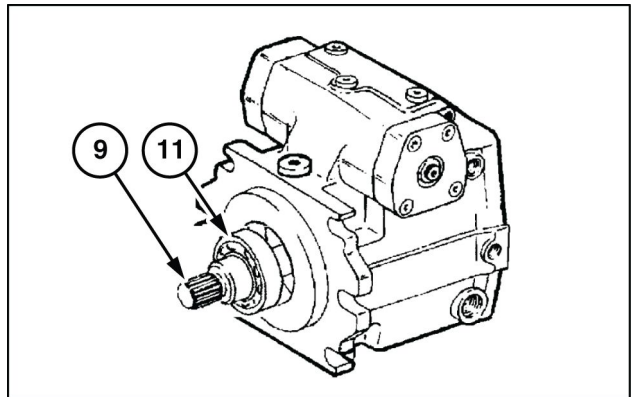
- | | |
|--------------------|---------------------------|
| 1. Elastic ring | 15. Retainer |
| 2. Seal ring | 16. Plate |
| 3. Pin | 17. Retainer |
| 4. Plug | 18. Swash plate |
| 5. Plug | 19. Pistons |
| 6. Locknut | 20. Pistons holding plate |
| 7. Setscrew | 21. Articulated joint |
| 8. Rotary assembly | 22. Washer |
| 9. Shaft | 23. Belleville washers |
| 10. Elastic ring | 24. Cylinder |
| 11. Bearing | 25. Washer |
| 12. Elastic ring | 26. Spring |
| 13. Bearing cup | 27. Elastic ring |
| 14. Bearing | |

Screw in the locknuts **(6)** and the setscrews **(7)** using the seating values marked during disassembly.



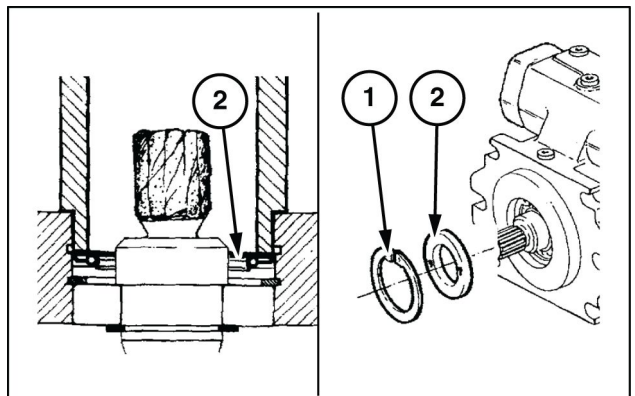
LELI12WHL0613AB 5

Assemble the shaft **(9)** complete with the bearing **(11)**.



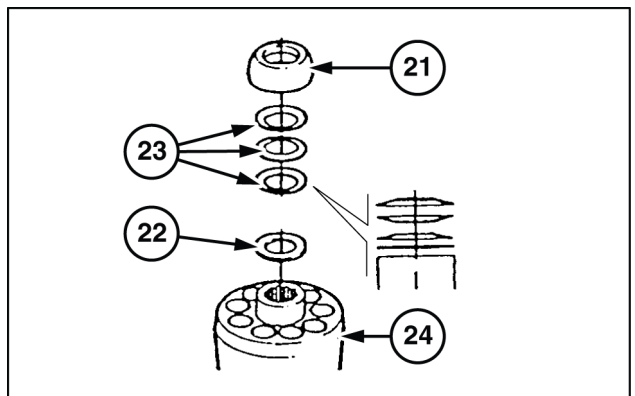
LELI12WHL0614AB 6

Assemble the seal ring **(2)**.
Press-in shaft seal with bush to stop.
Assemble the elastic ring **(1)**.



LELI12WHL0615AB 7

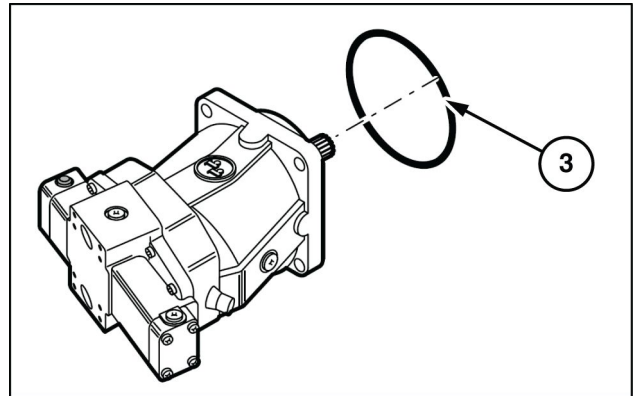
Assemble the articulated joint **(21)**, the belleville washers **(23)** and the washer **(22)** on the cylinder **(24)**.



LELI12WHL0616AB 8

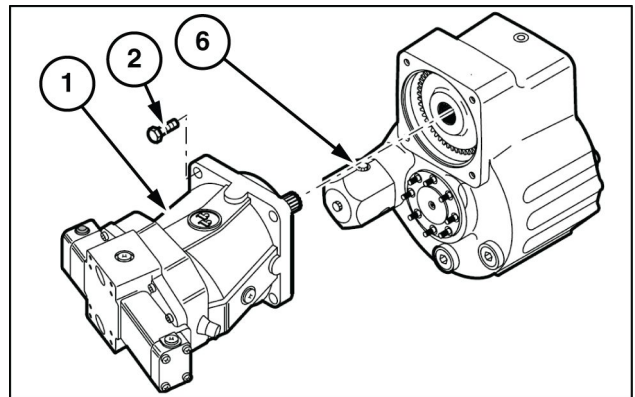
Travel motor - Install

1. Install the new O-ring (3).



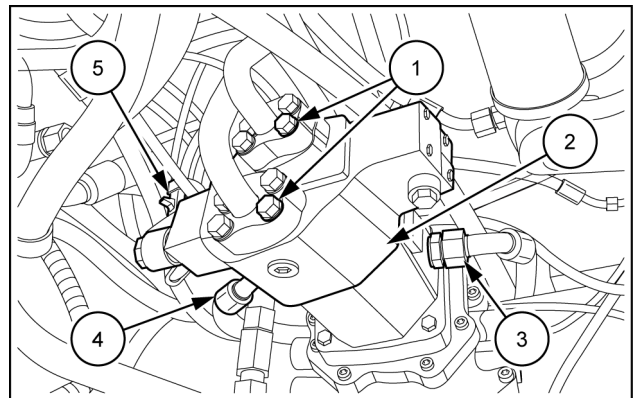
LEL112WHL0022AB 1

2. Install the travel motor (1) onto the transmission box (6) and fasten it with the screws (2).
Tighten the screws (2) to **280 N·m (206.52 lb ft)**.



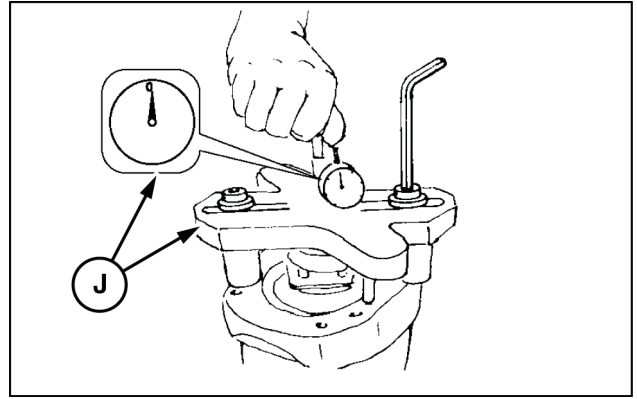
LEL112WHL0021AB 2

3. Connect the pipes (1) of the forward and reverse to the travel motor (2).
Connect the hoses (3) and (4) to the travel motor (2).
Connect the solenoid valve connector (5).

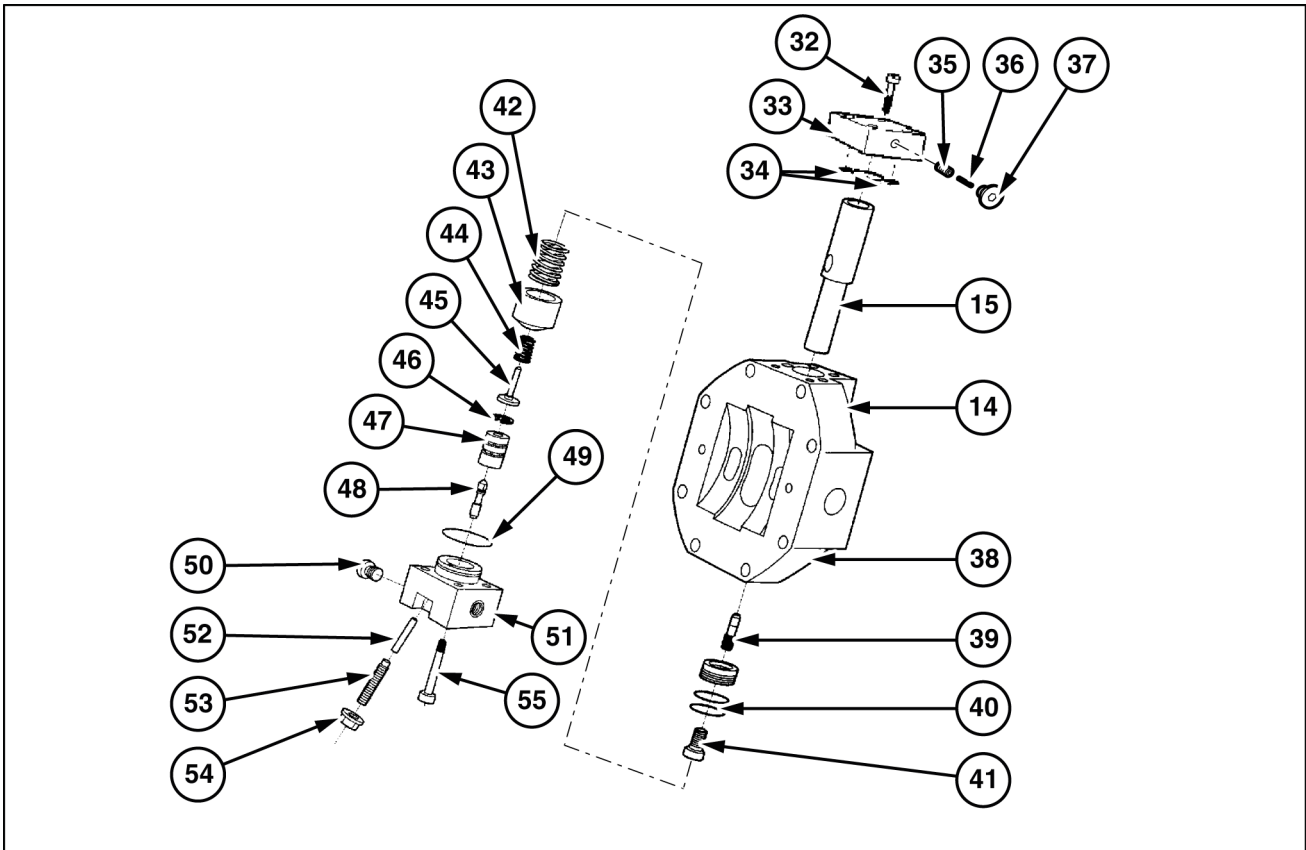


LEL114CWL0390AB 3

12. Check and/or determine values X using the measuring gauge (J).



LEL112WHL0678AB 12

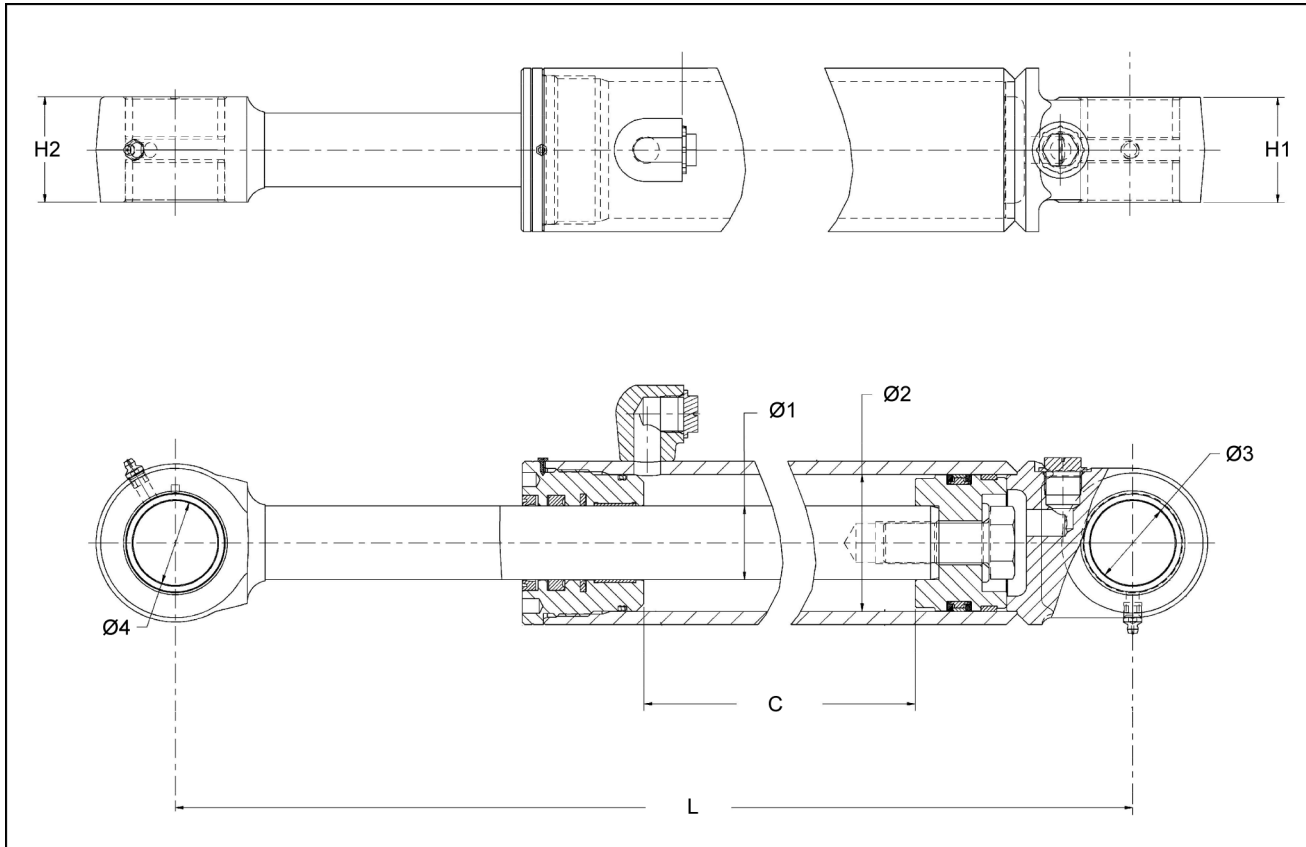


LEL112WHL0679FB 13

13. Assemble the regulator assembly.

21F Z-bar - 121F Z-bar Models

Ø1	Rod	44.46 mm (1.75 in)
Ø2	Bore	82.6 mm (3.3 in)
Ø3	Bottom connection	51 mm (2.0 in)
Ø4	Rod connection	51 mm (2.0 in)
L	Completely retracted	904.5 mm (35.6 in)
C	Stroke	491.5 mm (19.4 in)
H1		63.5 mm (2.5 in)
H2		63.5 mm (2.5 in)



LEIL14CWL0214FA 2

Contents

Frames and ballasting - 39

[39.140] Ballasts and supports	39.1
--------------------------------------	------

Contents

Steering - 41

Steering control - 101

TECHNICAL DATA

Steering control	
General specification	3

FUNCTIONAL DATA

Steering control	
Dynamic description	4
Steering column	
Exploded view	6

SERVICE

Steering column	
Remove	8
Install	11

Index

Steering - 41

Steering control - 101

Steering column - Exploded view	6
Steering column - Install	11
Steering column - Remove	8
Steering control - Dynamic description	4
Steering control - General specification	3

Contents

Steering - 41

Cylinders - 216

TECHNICAL DATA

Steering cylinder	
Dimension	3

SERVICE

Steering cylinder	
Remove	4
Install	6

Contents

Electrical systems - 55

Electrical system - 000

FUNCTIONAL DATA

Electrical system

Electrical schematic sheet 01 - Main cab harness	4
Electrical schematic sheet 02 - Cab roof harness	18
Electrical schematic sheet 03 - Frame harness (*)	22
Electrical schematic sheet 03 - Frame harness (*)	28
Electrical schematic sheet 04 - Engine and transmission harness (*)	34
Electrical schematic sheet 04 - Engine and transmission harness	40
Electrical schematic sheet 05 - Travel light harness	46
Electrical schematic sheet 06 - Harness of right-hand travel light and horn	48
Electrical schematic sheet 07 - Arm harness	50
Electrical schematic sheet 08 - Cable of battery and main ECU relay	52
Electrical schematic sheet 09 - Cable of battery and master disconnect switch	54
Electrical schematic sheet 09 - Cable of battery and master disconnect switch	56
Electrical schematic sheet 11 - Ground strap	58
Electrical schematic sheet 13 - Cable of starter motor and master disconnect switch (*)	60
Electrical schematic sheet 13 -Cable of starter motor and master disconnect switch (*)	62
Electrical schematic sheet 15 - Battery cable	64
Electrical schematic sheet 16 - Battery cable	66
Electrical schematic sheet 17 - Hand brake jumper harness	68
Electrical schematic sheet 18 - Work lights jumper harness	70
Electrical schematic sheet 19 - Beacon light jumper harness	72
Electrical schematic sheet 21 - Telematics jumper harness	74
Electrical schematic sheet 22 - Harness of front auxiliary electrical system	76
Electrical schematic sheet 23 - Frame harness of front auxiliary electrical system	78
Electrical schematic sheet 24 - Arm harness of front auxiliary electrical system	80

(*) See content for specific models

ITEM	DESCRIPTION	CODE COMPONENT	SHEET
99	High flow	X-030	13
100	High flow knob	X-024	15
101	Quick coupler switch	X-036	13
102	Heatshrink	SP-GND1	9
103	Creep speed ON/OFF	X-031	14
104	Creep speed +/- switch	X-044	14
105	Heatshrink	SP-LED1	20
106	Hand throttle knob	X-023	15
107	ACC relay	X-009	2
108	ACC relay	X-008	2
109	ACC relay	X-010	2
110	Fuse	X-245	6
111	Fuse	X-244	6
112	Diagnostics	X-029	22
113	Diagnostic connector	X-077	23
114	Heatshrink	SP-006	3
115	Heatshrink	SP-063	3
116	UCM (Unit Control Module) CN4B	X-04B	3-12-13- 14-15
117	UCM (Unit Control Module) CCN4A	X-04A	3-12-14- 15
118	Heatshrink	SP-051	22
119	Heatshrink	SP-038	18
120	Heatshrink	SP-045	23
121	Heatshrink	SP-044	23

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ITEM	DESCRIPTION	CODE COMPONENT	SHEET
35	Frame-cab interface connector	X-300S	3-5-12- 13-14- 15-17- 20
36	Brake pressure sensor	X-038	14
37	Pump displacement solenoid	X-082	15
38	Heatshrink	SP-020	14 39
39	Heatshrink	SP-028	14
40	Handle pressure sensor RTD (Return To Dig)	X-302	14
41	Heatshrink	SP-023	9
42	Handle floating down pressure sensor (A)	X-303	14
43	Heatshrink	SP-047	9
44	Handle floating down pressure sensor (B)	X-304	14
45	High flow activation solenoid	X-070	15
46	High flow solenoid	X-080	13

ITEM	DESCRIPTION	CODE COMPONENT	SHEET
32	Air conditioning clutch	X-226	24
33	Intermediate connector 2	X-110	10
34	Intermediate connector 1	X-109	10-11
35	Engine intake air filter	X-228	16
36	Engine intake air filter	X-229	16
37	Air temperature sensor	X-106	11
38	Forward solenoid	X-087	15
39	Reverse solenoid	X-086	15
40	Heatshrink	SP-074	8
41	Rear right road light	X-054	17
42	Heatshrink	SP-034	8
43	Heatshrink	SP-030	17
44	Filter pressure switch	X-227	24
45	Back up alarm	X-064	20
46	Water in fuel	X-105	11
47	Rear left road light	X-053	17

Electrical system - Electrical schematic sheet 07 - Arm harness

ITEM	DESCRIPTION	CODE COMPONENT	SHEET
1	Arm jumper	X-400P	12
2	Quick coupler selection valve	X-093	12
3	3rd/4th selection solenoid	X-094	12

Electrical system - Electrical schematic sheet 13 -Cable of starter motor and master disconnect switch

121F XT	NA --- WE
121F ZB	NA --- WE
21F XT	NA --- WE
21F ZB	NA --- WE

ITEM	DESCRIPTION	CODE COMPONENT	SHEET
1	Starter motor	X-062	2
2	Master disconnect switch	X-205	2

Electrical system - Electrical schematic sheet 21 - Telematics jumper harness

ITEM	DESCRIPTION	CODE COMPONENT	SHEET
1	CAB interconnect	X-076P	22
2	To telematics unit	X-076S	22

Contents

Electrical systems - 55

Harnesses and connectors - 100

TECHNICAL DATA

Harnesses and connectors	
General specification	4

FUNCTIONAL DATA

Harnesses and connectors	
Electrical schematic sheet 02	6
Electrical schematic sheet 03	8
Electrical schematic sheet 04	10
Electrical schematic sheet 05	12
Electrical schematic sheet 06	14
Electrical schematic sheet 07	16
Electrical schematic sheet 08	19
Electrical schematic sheet 09	23
Electrical schematic sheet 10	26
Electrical schematic sheet 11	28
Electrical schematic sheet 12	30
Electrical schematic sheet 13	32
Electrical schematic sheet 14	34
Electrical schematic sheet 15	36
Electrical schematic sheet 16	38
Electrical schematic sheet 17	40
Electrical schematic sheet 18	42
Electrical schematic sheet 19	44
Electrical schematic sheet 20	46
Electrical schematic sheet 21	48
Electrical schematic sheet 22	50
Electrical schematic sheet 23	52
Electrical schematic sheet 24	54
Electrical schematic sheet 25	56
Electrical schematic sheet 26	58
Wire connectors	
Component identification	61
Fuse and relay box	

Harnesses and connectors - Electrical schematic sheet 06**Power distribution, fuse module, X-003**

Location	Component	Code component
8	Block junction	W-001
8	Fuse front work lighs (15 A)	F-041
8	Fuse rear work lights (15 A)	F-042
8	Fuse H2O control unit (5 A)	F-043
8	Fuse autoradio (3 A)	F-044
8	Fuse A/C & fan motor switch (25 A)	F-045
8	Fuse front wiper motor (15 A)	F-046
8	Fuse rear wiper motor (10 A)	F-047
8	Fuse low beam head lights (15 A)	F-048
8	Fuse high beam head lights (15 A)	F-049
8	Fuse not used (5 A)	F-050
13	Fuse 4th speed blower (40 A)	F-065
8	Fuse module (Z-007)	Z-007

Harnesses and connectors - Electrical schematic sheet 10

Engine control, engine control unit

Location	Component	Code component
15	Boost pressure (HP)	B-002
15	Coolant temperature sensor (F)	B-017
15	EGR PIERBURG	B-022
15	Electric valve (WG)	Y-051
9	Engine control unit	A-013
15	Exhaust gas pressure sensor (P3)	B-019
2	Fuel metering unit(X)	Y-050
2	Fuel temperature sensor (A)	B-018
2	Increment speed sensor (B)	B-014
2	Injector electric valve (Cyl 1)	Y-046
2	Injector electric valve (Cyl 2)	Y-047
2	Injector electric valve (Cyl 3)	Y-048
2	Injector electric valve (Cyl 4)	Y-049
2	Oil pressure switch (V)	B-055
2	Rail pressure sensor (RD)	B-013
2	Segment speed sensor (C)	B-016
15	Turbo temperature sensor (SN)	B-006
15	TVA Dellorto	B-021

Harnesses and connectors - Electrical schematic sheet 16**Analog-Digital Instrument Cluster lowline, instrument cluster**

Location	Component	Code component
12	Brake fluid level	S-012
3	Display navigation ENTER/HOME	S-020
3	Display navigation UP/DOWN	S-021
14	Engine intake air filter	S-017
3	Fuel level sender	S-031
8	Instrument cluster	A-002

Harnesses and connectors - Electrical schematic sheet 22**GPS system, telematics and air seat**

Location	Component	Code component
15	Diagnostics	X-029
8	Seat air suspension	S-029
8	Telematics (GPS)	A-008

Electrical systems - Harnesses and connectors

NAME	COMPONENT	DESCRIPTION	SHEET
X-049	X-049(E-004)	LEFT HAND REAR WORK LIGHT	18
X-050	X-050(E-003)	RIGHT HAND REAR WORK LIGHT	18
X-051	E-009	RIGHT HAND FRONT LIGHT	17
X-052	E-010	LEFT HAND FRONT LIGHT	17
X-053	E-011	LEFT HAND REAR LIGHT	17
X-054	E-012	RIGHT HAND REAR LIGHT	17
X-055	E-005	BEACON SOCKET	18
X-055P	X-055P(E-005)	JUMPER BEACON SOCKET	18
X-055S	X-055S(E-005)	JUMPER BEACON SOCKET	18
X-056	M-005	FAN CONDENSER	24
X-057	S-003	BEACON LIGHT SWITCH	18
X-058A	E-006	DOME LAMP	18
X-058B	E-006	DOME LAMP GROUND	18
X-059	J-007	CIGAR LIGHTER	20
X-060	J-007	CIGAR LIGHTER (BACK LIGHT)	20
X-061	M-001	STARTER MOTOR SOLENOID	2
X-062	M-001	STARTER MOTOR 30	2
X-063	M-001	STARTER MOTOR 30	2
X-064	H-0A1	BACKUP ALARM	20
X-065A	H-006	HORN	20
X-065B	H-006	HORN	20
X-066	Z-002	FRONT AND REAR WIPER SWITCH	19
X-068	M-002	FRONT WIPER MOTOR	19
X-069	M-003	REAR WIPER MOTOR	19
X-070	Y-021	HIGH FLOW ACTIVATION SOLENOID	15
X-071	A-002	ADIC Lowline (Instruement Cluster) CN-01	16
X-072	A-002	ADIC Lowline (Instrument Cluster) CN-02	16
X-073	M-004	WIPER WASHER MOTOR	19
X-074	S-021	DISPLAY NAVIGATION UP/DOWN	16
X-075	S-020	DISPLAY NAVIGATION ENTER/HOME	16
X-076	X-076 (A-008)	TELEMATICS	22
X-076P	X-076P (A-008)	JUMPER TELEMATICS	22
X-076S	A-008	TELEMATICS	22
X-077	X-077	DIAGNOSTIC CONNECTOR	23
X-078	A-013	ECU CONN 1	10
X-079	A-013	ECU CONN 2	10
X-080	Y-006	HIGH FLOW VALVE	13
X-081	Y-007	RTD (RETURN TO DIG) VALVE	13
X-082	Y-013	PUMP DISPLACEMENT	15
X-083	Y-10	DIFFERENTIAL LOCK SOLENOID	15
X-084	Y-011	1ST GEAR VALVE	13
X-085	Y-017	2ND GEAR VALVE	13
X-086	Y-002	REVERSE SOLENOID	15
X-087	Y-001	FORWARD SOLENOID	15
X-088	Y-012	TURTLE/RABBIT SOLENOID	15
X-089	Y-004	Y21.6 SOLENOID (DIRECTION CONTROL)	15
X-090A	Y-009	RIDE CONTROL SOLENOID A	13

Contents

Electrical systems - 55

Front axle control system - 045

TECHNICAL DATA

Differential lock solenoid General specification	3
---	---

SERVICE

Differential lock solenoid Replace - Differential lock control valve	4
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Connector CN2 (X-072)

PIN	ITEM	FUNCTION	SIGNAL
CN2-1	-	+5V	Not used
CN2-2	-	SW-1 (wake up)	Not used
CN2-3	23	Engine Intake Air Filter	INP. Negative
CN2-4	-	SW-3 / [CAN_B-L]	Not used
CN2-5	-	SW-4	Not used
CN2-6	10	Main High Beam Lamp	INP. Positive
CN2-7	-	SW-6	Not used
CN2-8	-	SW-7 (wake up)	Not used
CN2-9	6	Turn Left	INP. Positive
CN2-10	19	Turn Right	INP. Positive
CN2-11	-	SW-15	Not used
CN2-12	-	SW-16	Not used
CN2-13	26	D+ Alternator Charging	OUT.Neg./INP Pos.
CN2-14	-	[Battery] / +5V	Not used
CN2-15	-	Power GND	Ground
CN2-16	-	SW-22	Not used
CN2-17	-	Cranking Detection	INP. Positive
CN2-18	16	Brake Fluid Level	INP. Positive
CN2-19	11	Side Lights	INP. Positive
CN2-20	-	Battery Power Supply Voltage (+12VP)	INP. Positive
CN2-21	-	+12V Switched Power Supply	INP. Positive
CN2-22	-	LIN	Not Used
CN2-23	9	Front Work Lamps	INP. Positive
CN2-24	-	[SW-33] / FQ-1	Not used
CN2-25	-	[SW-34] / FQ-2	Not used
CN2-26	8	Rear Work Lamps	INP. Positive

3870-CAN message not received from Vehicle Controller	410
3899-Info: Engine temperature exceeded pre-warn level	411
3900-Info: Engine temperature exceeded warn level	412
3906-Injector: Number of injections is limited by quantity balance of high pressure pump	413
3910-Fuel metering unit: Error check for loose contact between metering unit and ECU	414
3915-Pressure Relief Valve: Averaged rail pressure is outside the expected range with open PRV ..	415
3916-Pressure Relief Valve: Open time of PRV for wear out monitoring had exceeded maximum value	416
3978-Signal range check for flow resistance of the diesel particulate filter - high (Level 2 of PFI Overloaded)	417
3979-Signal range check for flow resistance of the diesel particulate filter - very high (Level 3 of PFI Overloaded)	418
4351-Power supply fault on Quick Coupler Solenoid (HSD) [UCM]	419
4352-Short circuit to battery on Quick coupler solenoid (HSD) [UCM]	420
4353-Open circuit on Quick coupler solenoid (HSD) [UCM].....	421
4354-Short circuit to ground on Quick coupler solenoid (HSD) [UCM]	422
4355-Low current on Quick coupler solenoid (HSD) [UCM]	423
4411-Power supply fault on High Flow solenoid (HSD) [UCM]	424
4412-Short circuit to battery on High flow solenoid (PWM) [UCM]	425
4413-Open circuit on High flow solenoid (PWM) [UCM]	426
4414-Short circuit to ground on High Flow solenoid (PWM) [UCM].....	427
4415-Low current on High Flow solenoid (PWM) [UCM].....	428
4421-Power supply fault on High Flow unlock solenoid (HSD) [UCM]	429
4422-Short circuit to battery on High Flow unlock solenoid (HSD) [UCM].....	430
4423-Open circuit on High Flow unlock solenoid (HSD) [UCM]	431
4424-Short circuit to ground on High Flow unlock solenoid (HSD) [UCM].....	432
4425-Low current on High Flow solenoid (PWM) [UCM].....	433
4429-Flow knob signal value out of range [UCM].....	434
4431-Power supply fault on High Flow LED (CMB) [UCM].....	435
4432-Short circuit to battery on High Flow LED (CMB) [UCM].....	436
4433-Open circuit on High Flow LED (CMB) [UCM]	437
4434-Short circuit to ground on High Flow LED (CMB) [UCM].....	438
4435-Low current on High Flow LED (CMB) [UCM].....	439
4451-Power supply fault on 3rd/4th switching solenoid (HSD) [UCM]	440
4452-Short circuit to battery on 3rd/4th switching solenoid (HSD) [UCM]	441
4453-Open circuit on 3rd/4th switching solenoid (HSD) [UCM]	442
4454-Short circuit to ground on 3rd/4th switching solenoid (HSD) [UCM]	443
4455-Low current on 3rd/4th switching solenoid (HSD) [UCM]	444
4461-Power supply fault on 3rd function solenoid (PWM/HSD) [UCM]	445
4462-Short circuit to battery on 3rd function solenoid (PWM/HSD) [UCM]	446
4463-Open circuit on 3rd switching solenoid (PWM/HSD) [UCM].....	447
4464-Short circuit to ground on 3rd switching solenoid (PWM/HSD) [UCM]	449
4465-Low current on 3rd Function Solenoid (PWM/HSD) [UCM]	451

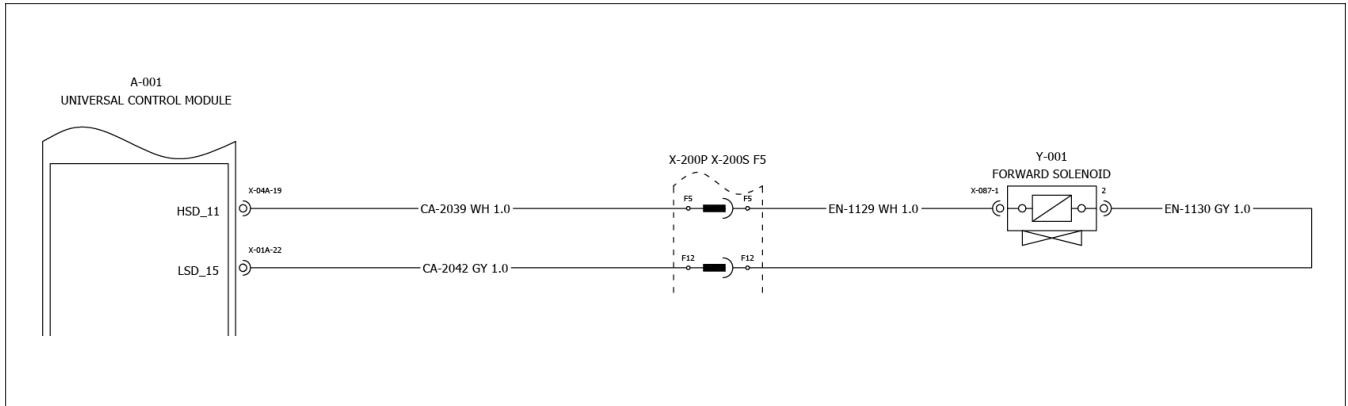
2755-Low current on Forward solenoid (HSD)

Context:

UCM has detected a low current on the Forward supply line.

Solution:

1. Check the connections X-0419 and X-01A-22 of UCM.
2. Check the connection X-200-F-05-12.
3. Check the connection X-087-1-2 (valve).
4. Check the solenoid valve Y-001.



LEIL15CWL0003EA 1

2783-Open circuit on Reverse Solenoid (LSD)

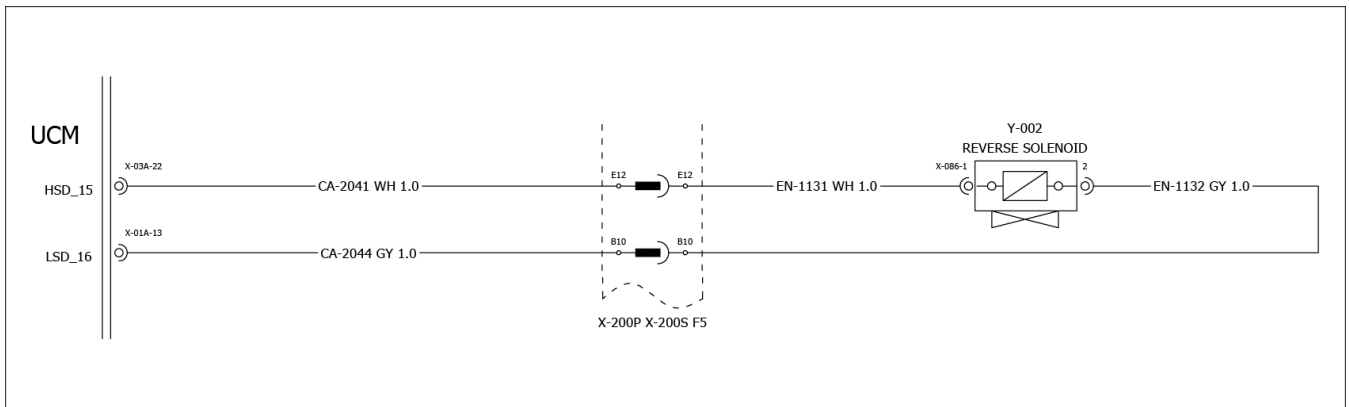
Control Module : UCM

Context:

UCM has detected the open circuit on Reverse solenoid supply line.

Solution:

1. Check the connection X-03A-22 of UCM.
2. Check the connection X-200-E12/B10.
3. Check if the connection X-086-1-2 of solenoid Y-002 (valve).
4. Check the connections: X-01A-13 of UCM.



LEIL15CWL0009EA 1

2811-Power supply fault on 1st gear solenoid (HSD)

Control Module : UCM

Context:

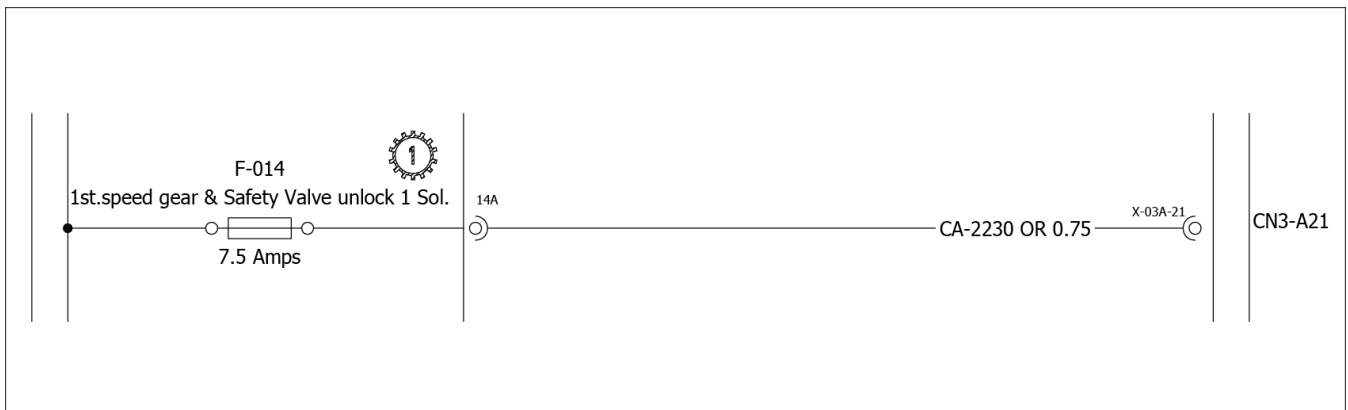
The error code on HSD Power supply is linked to the error code on relevant Power rail. The error can be displayed after the execution of the remedial action for the power rail fault, if reset with key cycle is not performed.

Possible failure modes:

1. Faulty fuse F-014 (**7.5 A**).

Solution:

1. Replace the fuse F-014 (**7.5 A**) on the Fuse module.



LEIL15CWL0013EA 1

2833-Open circuit on 1st Gear solenoid (LSD)

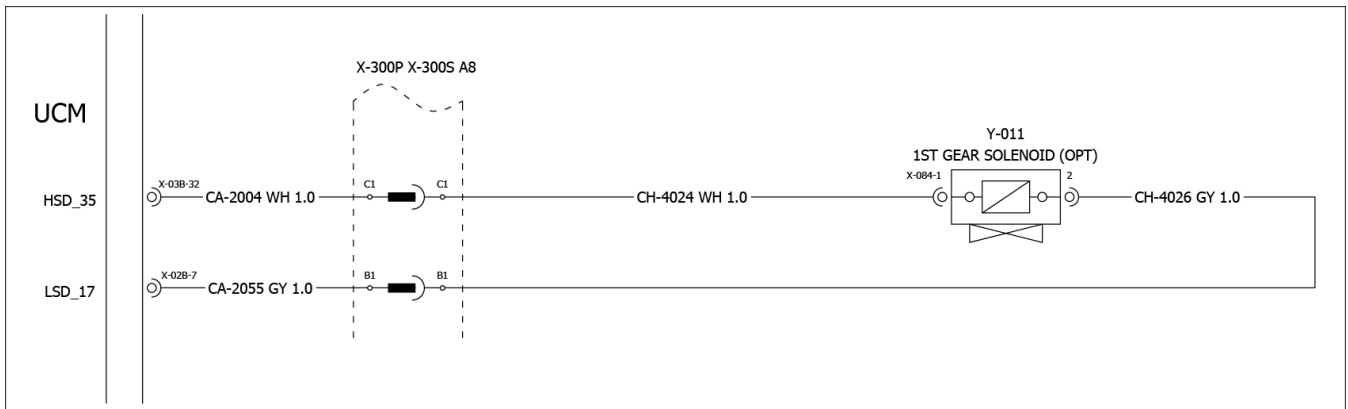
Control Module : UCM

Context:

UCM has detected the open circuit on the 1st Gear solenoid supply line.

Solution:

1. Check the connection X-01A-24 of UCM.
2. Check the connection X-300-C1/B1.
3. Check the connection X-084-1-2 of solenoid Y-011 (valve).
4. Check the connection X-02B-7 of UCM.



LEIL15CWL0014EA 1

2863-Open circuit on 2nd Gear LED (CMB)

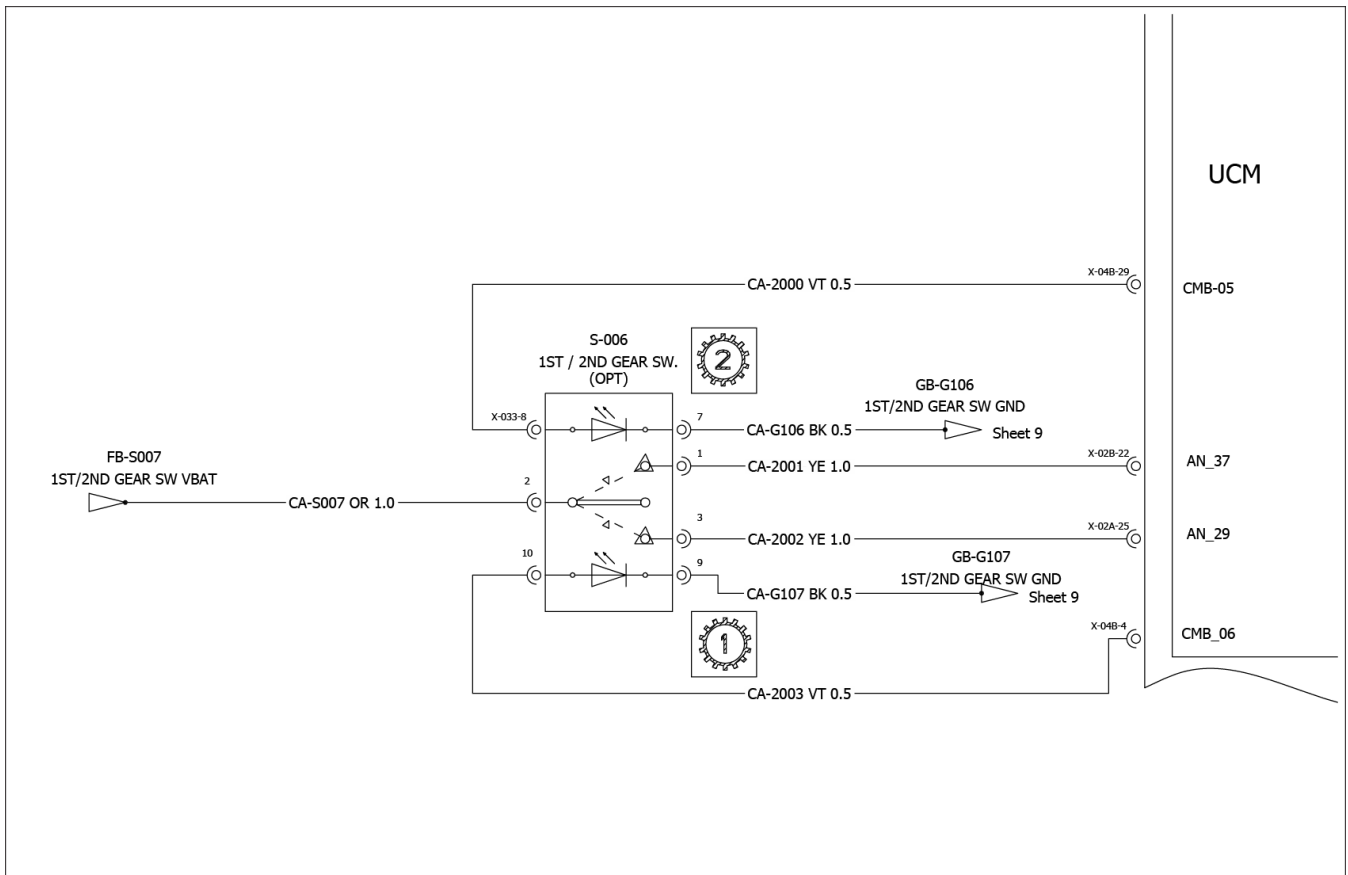
Control Module : UCM

Context:

UCM has detected an open circuit on the 2nd Gear LED supply line.

Solution:

1. Check the pin X-033-10 of the switch S-006.
2. Check the pin X-04B-4 of the UCM.
3. Check the connection between X-033-10 and X-04B-29 (wire CA-2003).



LEIL15CWL0018FA 1

2884-Short circuit to ground on inching solenoid (PWM/HSD)

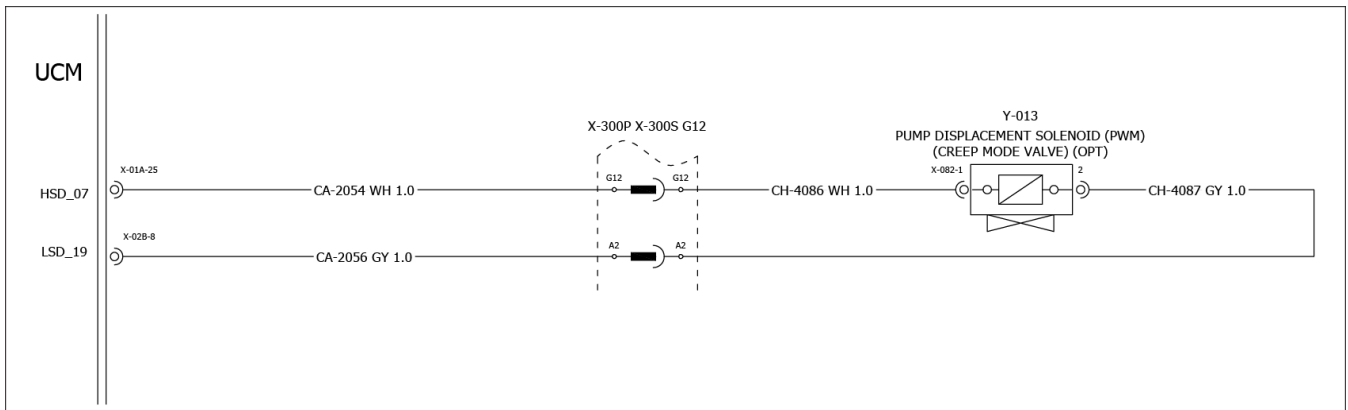
Control Module : UCM

Context:

UCM has detected a short circuit to ground on the inching solenoid supply line.

Solution:

1. Check if the connection X-01A-25 of UCM is shorted to ground.
2. Check if the connection X-300-G12 is shorted to ground.
3. Check if the connection X-082-1 of the solenoid valve Y-013 is shorted to ground.



LEIL15CWL0021EA 1

3011-Air intake temperature sensor signal below minimum range

Context:

The Engine Control Unit (ECU) generated an error from a fault associated with the air intake temperature sensor. The boost pressure sensor is an integrated sensing device used to sense both temperature and pressure. This fault is related to the temperature sensing function of the device. This error could result from a signal out of range or a signal that is either erratic or intermittent.

Cause:

The air intake temperature sensor signal to the ECU is out of range of the lower threshold limit.

Possible failure modes:

1. Faulty electrical wiring or connection.
2. Faulty sensor.
3. Faulty ECU.

Solution:

1. Verify that the fault code is active.

Connect the Electronic Service Tool to the service tool connector.

To check for fault codes: Start and operate the machine.

A. The fault code is not recorded again. OK to return the machine to service.

B. Fault code 3011 is recorded again. Go to step 2.

2. Verify that the wiring and connectors are free of damage.

Inspect the ECU and the air intake temperature sensor connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the ECU to the air intake temperature sensor. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.

A. The connectors are secure and the harness is free of damage. Go to step 3.

B. The connectors or the harness has damage. Repair or replace the harness or connectors as required. Return to step 1 to confirm elimination of fault.

3. Measure the sensor supply voltage.

Turn the ignition switch OFF.

Disconnect the boost pressure/ air temperature sensor from the engine harness.

Turn the ignition switch ON.

Measure the voltage between the boost pressure sensor connector pin 3 and pin 1. The voltage should be approximately **5 V**. Wiggle the harness during measurement to reveal an intermittent condition.

A. The voltage is between **4.5 V** and **5.5 V**. Go to step 4.

B. The voltage is less than **4.5 V**. There is a problem in the voltage supply to the sensor. Repair as required. Return to step 1 to confirm elimination of the fault.

4. Measure the resistance of the signal wires to chassis ground.

Turn the ignition switch OFF.

Disconnect the boost pressure/ air temperature sensor from the engine harness.

3063-Cylinder 1 - Injector Cable Short Circuit (High Side To Ground)

NOTE: *this diagnostic procedure requires a good quality multi-meter to be able to take accurate resistance measurements. The meter should be able to measure to a resolution of 0.1 Ω. Some of the measurements required to be taken, could be as low as 0.4 Ω (typical injector solenoid coil resistance is 0.4 - 0.5 Ω) and any inaccuracies in the DMM could cause a technician to take the wrong diagnostic path.*

Context:

The engine control unit (ECU) has determined that a short circuit exists in the high side injector circuit for cylinder 1. A power stage component energizes the unit injection system transistors and simultaneously observes the current flow in the high-side and low-side switching branch by sensing resistors. If there is a deviation from the expected current flow the component detects specific errors and reports them to the ECU. This error message is then rearranged so it holds information on performed injections, errors of cylinders on the same bank, bank specific errors and cylinder specific errors. The rearranged error message is then compared to applicable error patterns and if there is a match the failure corresponding to the matched pattern is output. If an error message doesn't match any pattern the defect is treated as an unclassifiable error. Monitoring is performed once per camshaft revolution. This error is the result of a short circuit of the high side to the low side or ground over 3 camshaft revolutions. As a result of this error an individual cylinder or bank is shut off, based on parameters established in the ECU. Certain parameters, as currently applied, are permanent (without a healing possibility, once tested by switching on the component to see if the defect is still present). and others evoke an irreversible or reversible shut off of the engine to be executed.

Cause:

The Engine Control Unit (ECU) has determined that there is a fault associated with the current monitoring of the injector output power driver stage.

Possible failure modes:

1. Faulty cylinder 1 solenoid windings.
2. Faulty electrical wiring, short high side to low side or ground (damaged wiring harness).
3. Faulty ECU, ECU hardware or software.

Solution:

1. Verify this error code is still present and in an active state.
 - A. If the error is still present and active, continue with step 2.
 - B. If the error is no longer present or is in an inactive state, continue with step 8.
2. Carefully disconnect the engine cylinder harness from the ECU at ECU cylinder harness connector 3. Use a multi-meter to check the resistance, on the cylinder harness side of connector 3, between pins 4 and 13. There should be 0.4 - 0.5 Ω.
 - A. If the resistance was within range, leave ECU cylinder connector 3 disconnected and continue with step 3.
 - B. If the resistance was lower than range minimum, continue with step 6.
3. Use a multi-meter to check for continuity, on the ECU cylinder harness side of connector 3, from pin 4 to chassis ground and pin 13 to chassis ground. There should not be continuity.
 - A. If there was continuity on either or both pins to chassis ground, continue with step 4
 - B. If there was no continuity on either pin to chassis ground, the ECU may have failed. Try reloading the ECU software and if the fault reoccurs, replace the ECU.
4. Disconnect the engine cylinder harness from the injector (valve) cover at connector VC1. Use a multi-meter to check for continuity, on the injector (valve) cover side of connector VC1 from pin A to chassis ground and pin B to chassis ground. There should not be continuity.
 - A. If there was continuity on either or both pins to chassis ground, leave connector VC1 disconnected and continue with step 5.

Note:

The engine will be running off the Camshaft speed sensor during the single ended test, if it isn't already (based on the fault code type). The engine can also be very hard to start when running exclusively off the Camshaft speed sensor. The ECU needs to see a few revolutions of the camshaft to be able to use this information to start the engine.

The Crankshaft speed sensor and the Camshaft speed sensor are exactly the same. These sensors may be swapped in this diagnostic procedure to determine the functionality of the Crankshaft speed sensor. A new set of error codes may be generated by the ECU if the sensors are swapped.

Test Type	From	To	Expected Results
1. Voltage (AC) - Single ended connection at low RPM (1000 - 1100 RPM)	Crankshaft speed sensor connector DG6 Incr, (Pin 1)	Crankshaft speed sensor connector DG6 Incr, (Pin 2)	Approx. 16 - 18 V (AC)
2. Voltage (AC) - Single ended connection at high RPM (2000 - 2200 RPM)	Crankshaft speed sensor connector DG6 Incr, (Pin 1)	Crankshaft speed sensor connector DG6 Incr, (Pin 2)	Approx. 32 - 34 V (AC)
3. Voltage (AC) - In-line connection at low RPM (1000 - 1100 RPM)	Crankshaft speed sensor connector DG6 Incr, (Pin 1)	Crankshaft speed sensor connector DG6 Incr, (Pin 2)	Approx. 10 - 12 V (AC)
4. Voltage (AC) - In-line connection at high RPM (2000 - 2200 RPM)	Crankshaft speed sensor connector DG6 Incr, (Pin 1)	Crankshaft speed sensor connector DG6 Incr, (Pin 2)	Approx. 14 - 17 V (AC)

- A. If the voltage test was successful, proceed to step **6**.
- B. If the voltage test was not successful for any of the single ended connections, replace the sensor.
- C. If the voltages encountered during testing are low and the sensor was replaced on a prior diagnostic procedure of this type, ensure the Crankshaft speed sensor is installed properly.
- D. If the voltage test was successful for the single ended connections and not for any of the in-line connections, leave the connector disconnected and proceed to step **5**.

5. Operation: Check for Faulty Wiring.
Vehicle status: Key Off Engine Off.

Perform continuity tests between connector DG6 Incr and connector 2 on ECU engine harness. Flex harness during test to check for any intermittent operation. See test table below.

Important Note: Check and verify that the Vehicle Status is correct. Potential ECU damage could result when removing main ECU connectors if this is not followed.

Test Type	From	To	Expected Results
1. Continuity	Crankshaft speed sensor connector DG6 Incr, (Pin: 1)	ECU engine harness connector 2, (Pin: 23)	Approx. 0 - 0.10 Ω
2. Continuity	Crankshaft speed sensor connector DG6 Incr, (Pin: 2)	ECU engine harness connector 2, (Pin: 19)	Approx. 0 - 0.10 Ω
3. Short Circuit	ECU engine harness connector 2, (Pin: 23)	ECU engine harness connector 2, (Pin: 19)	Open Circuit

- A. If continuity/shorts test is successful, go to step **6**.
- B. If continuity/shorts test is unsuccessful, find and repair the damaged section(s) of the wiring harness.

6. Operation: Check for ECU Voltages and Ground Continuity.
Vehicle Status (when removing connector 1): Key Off Engine Off.
Vehicle Status (when performing test) Key On Engine Off.
Vehicle Status (when replacing connector 1): Key Off Engine Off.

Using the product schematics for a reference, remove connector 1 from the ECU and check for voltage and continuity at the appropriate pins defined in the test table below.

6. Operation: Crankshaft speed sensor alignment.
Vehicle Status: Key Off Engine Off.

Check proper mechanical alignment and tooth spacing of the Crankshaft speed sensor. The spacing between the trigger teeth and the sensor is critical for proper voltage output. Make sure that the sensor is seated properly (flush with mounting flange). After the sensor alignment is complete, check to see if this fault code has cleared.

A. If this fault code is still present and has not cleared, Replace Crankshaft speed sensor, being careful to ensure the sensor's mechanical alignment and tooth spacing is correct and the sensor is seated properly.

B. If this fault code is still present and has not cleared, proceed to step **13**.

7. Operation: Check Camshaft speed sensor Output Voltage and Harness Wiring.

Perform both (2) electrical tests defined below:

1) AC output voltage test for Camshaft speed sensor:

Vehicle Status: Key Off Engine Off (test setup)

Vehicle Status: Key On Engine On (during test)

Remove Camshaft speed sensor connector DG6 Segm and connect the Coolant/Fuel Temp Sensor test lead in-line with the sensor and the engine wiring harness. Make sure that the signal polarity is not swapped during the connection process. Start the engine and measure the (AC) voltage using a multi-meter across the breakout alligator clips from the Coolant/Fuel Temp Sensor test lead. Use the table below to determine test parameters and the measurement results.

Test Type	From	To	Expected Results
1. Voltage (AC) - In-line connection at low RPM (1000 - 1100 RPM)	Camshaft speed sensor connector DG6 Segm, (Pin 1)	Camshaft speed sensor connector DG6 Segm, (Pin 2)	Approx. - 1.5 - 2.8 V (AC)
2. Voltage (AC) - In-line connection at high RPM (2000 - 2200 RPM)	Camshaft speed sensor connector DG6 Segm, (Pin 1)	Camshaft speed sensor connector DG6 Segm, (Pin 2)	Approx. - 3 - 4.5 V (AC)

2) Harness wiring continuity/shorts electrical test (Camshaft speed sensor).

Vehicle Status: Key Off Engine Off.

Remove and perform continuity tests between Camshaft speed sensor connector DG6 Segm and ECU engine harness connector. Flex harness during test to check for any intermittent operation. See test table below.

Important Note: Check and verify that the Vehicle Status is correct. Potential ECU damage could result when removing main ECU connectors if this is not followed.

Test Type	From	To	Expected Results
1. Continuity	Camshaft speed sensor connector DG6 Segm (Pin: 1)	ECU engine harness connector 2, (Pin: 10)	Approx. 0 - 0.1 Ω
2. Continuity	Camshaft speed sensor connector DG6 Segm (Pin: 2)	ECU engine harness connector 2, (Pin: 9)	Approx. 0 - 0.1 Ω
3. Short Circuit	ECU engine harness connector 2 (Pin: 10)	ECU engine harness connector 2, (Pin: 9)	Open Circuit

A. If both electrical tests are successful, proceed to step **10**.

B. If harness wiring continuity/shorts test was not unsuccessful, find and repair the damaged section(s) of the wiring harness.

C. If the voltage test was not successful and the continuity/shorts test was successful, proceed to step **8**.

8. Operation: Camshaft Position (CMP), Engine camshaft RPM B-07, sensor Alignment.

3137-Metering Unit - Open Load

Context:

The engine control unit (ECU) has determined that an open circuit condition exists in the Pump control valve (Metering Unit - High Pressure Pump Regulator solenoid/valve) circuit. The metering unit of the fuel high pressure pump regulates the pressure in the common rail. The metering unit is controlled by both main relay 1 high side and a low side power stages (main relay 1 is an electronic control circuit within the ECU used to provide fixed and variable control signals to devices external to the ECU). The monitoring at low side is stopped if a short circuit to ground at the high side (main relay 1) is detected or it is switched off for some reason. Failure detection of an over current condition is only possible if the low side power stage is switched on and the open circuit condition only if it is switched off. With the current settings, the monitoring is shut off during after-run. This error is the result of the power stage hardware report of an 'open load' in the metering unit longer than 200 milliseconds.

Cause:

Pump control valve circuit is open.

Possible failure modes:

1. Faulty Pump control valve, open solenoid coil.
2. Faulty circuit, open conductor.
3. Faulty ECU, hardware or software.

Solution:

1. Disconnect the ECU cylinder connector from the ECU at connector X-078. Use a multi-meter to check the resistance on the Engine Injector harness side of connector X-078, from pin 60 to pin 15. There should be approximately **3.2 Ω**.
 - A. If there is approximately **3.2 Ω**, check for other ECU errors and follow those troubleshooting procedures.
 - B. If there is a high resistance reading, leave connector X-078 disconnected and continue with step 2.
2. Disconnect the Engine Injector harness from the pump control valve at connector ZME. Use a multi-meter to check the resistance of the pump control valve solenoid coil. There should be approximately **3.2 Ω**.
 - A. If there is approximately **3.2 Ω**, leave connector ZME disconnected and continue with step 3.
 - B. If there is a high resistance reading, replace the Pump control valve solenoid.
3. Use a multi-meter to check for continuity from the Engine Injector harness side of connector ZME, pin 1 to the Engine Injector harness side of connector X-078, pin 15. There should be continuity.
 - A. If there is continuity, leave the connectors disconnected and continue with step 4
 - B. If there is no continuity, locate and repair the break in the wire.
4. Use a multi-meter to check for continuity from the Engine Injector harness side of connector ZME, pin 2 to the Engine Injector harness side of connector X-078, pin 60. There should be continuity.
 - A. If there is continuity, try reloading the ECU software and if the error reoccurs, replace the ECU.
 - B. If there is no continuity, locate and repair the break in the wire.

3177-Engine overspeed detected

Context:

- An unacceptably high engine speed may arise in the event of a fault in the Engine Control Unit (ECU) or under certain operating states like downhill travel. In this case the failure should not indicate a fault but simply informs about a "misuse" of the engine.
- No action is necessary, unless this fault occurs repeatedly. Check for ECU fault codes. If there are fault codes present, proceed to that troubleshooting procedure.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while monitoring the Display.
 - A. If damage is found or other than normal display readings are indicated, repair the damage discovered during the inspection or locate and repair the other than normal display condition and verify that the error has been resolved.
 - B. If no damage or other than normal display readings are indicated, erase the fault code and continue operation.

3241-Engine controller EEPROM - Default value used

Context:

The Engine Control Unit (ECU) has detected that substitute values for the Electrically Erasable Programmable Read-Only Memory (EEPROM) are used. If a failure is detected, this fault sets and should reset immediately if the EEPROM operates correctly. This failure can be the result of wrong programming / flashing of the ECU or an internal defect.

Cause:

The ECU has detected an internal fault.

Possible failure modes:

1. Faulty software.
2. Faulty ECU.

Solution:

1. Verify the fault is still active and present.
 - A. If the fault is still active, try to update the ECU software with the proper data set. If the fault still is present, replace the ECU.
 - B. If the fault is not present, the fault may be intermittent. Check for an intermittent fault. If no faults are found, clear the fault code. Return the machine to service.

There should be continuity.

- A. If there is no continuity, there is an open circuit in the wiring harness. Locate and repair faulty wiring.
- B. If there is continuity, try updating the ECU software. If the fault code is still present, replace the ECU.

3305-Cannot maintain rail pressure above the minimum pressure of 200 Bar

Context:

The engine control unit (ECU) has determined that the Fuel Rail/System Pressure is too low. The rail pressure is monitored by various fault paths during active pressure control by the metering unit. The fault path at hand detects if the rail pressure has fallen below a minimum pressure threshold. The monitoring is only active if the high pressure governor is operating in closed loop control and the monitoring has not been inhibited by other faults. If the rail pressure is below the engine speed dependent limit from a curve, established by the ECU, over 2.5 seconds this error will occur. This error is the result of a leak in the high or low pressure side of the fuel rail system. On the high pressure side check for worn or stuck open injector, worn high pressure pump or leaking pressure relief valve. On the low pressure side check for low fuel pressure before or after the gear pump, clogged fuel filter or leakage.

3362-Torque to Quantity Map - Not Plausible

Context:

The engine control unit (ECU) has detected an error. This failure can be the result of wrong programming / flashing of the ECU or an internal defect. Try to flash the ECU correctly with the proper data set. If the error persists, replace the ECU.

Disconnect the Electric Valve connector.

Measure the resistance through the electric valve pin 1 to chassis ground. The resistance should be greater than **20000 Ω**.

A. The resistance is greater than **20000 Ω**. Go to Step **5**.

B. The resistance is less than **20000 Ω**. There is an internal short to chassis ground. Temporarily replace the Electric Valve and retest. Return to Step **1** to confirm elimination of the fault.

5. Measure the resistance through the signal wire.

Turn the ignition switch OFF.

Disconnect the Electric Valve connector.

Disconnect the ECU connector X-078.

Measure the resistance from the ECU connector X-078 pin 4 to chassis ground. The resistance should be greater than **20000 Ω**. Wiggle the wire during measurement to reveal an intermittent condition.

A. The resistance is greater than **20000 Ω**. Temporarily replace the ECU and retest. Return to Step **1** to confirm elimination of the fault.

B. The resistance is less than **10 Ω**. There is a short circuit in the signal wire to chassis ground. Repair or replace the wire as required. Return to Step **1** to confirm elimination of fault.

Disconnect the glow plug connector.

Measure the resistance between the glow plug and chassis ground. The chassis ground connection must be clean and free of paint, oil and dirt. The resistance should be approximately **1 Ω** .

- A. The resistance is approximately **1 Ω** . There is a problem in the wiring to the glow plug. Repair or replace as required. Return to step **1** to confirm elimination of the fault.
- B. The resistance is less than **0.75 Ω** . Temporarily replace the glow plug and retest. Return to step **1** to confirm elimination of the fault.
- C. The resistance is greater than **20000 Ω** . There is an open circuit in the glow plug. Temporarily replace the glow plug and retest. Return to step **1** to confirm elimination of the fault.

3434-Diesel Particulate Filter (DPF) inducement most severe derating level

Context:

Legislations require special measures to induce proper functionality of the Exhaust Gas Recirculation (EGR) system. The EGR system related faults are monitored and trigger different warnings and reactions. The inducement starts with a driver warning, then a torque reduction follow. If the fault is not fixed, a creep mode with a strongly reduced maximum vehicle speed is activated. A failure which will trigger an inducement is Diesel Particulate Filter 'DPF inducement'. If at least one error belonging to 'DPF inducement' group is set and the engine is running, the timer for inducement level 3 (more severe torque reduction) is increased. When timer exceeds **4 h** and at least one error belonging to the triggered group is active, level 3 for "DPF inducement" group is set.

Cause:

The Engine Control Unit (ECU) has detected a fault with the diesel particulate filter (DPF) and inducement level, due to 'DPF inducement' has been activated.

Possible failure modes:

1. DPF system failure.

Solution:

1. Check for other fault codes relating the to the DPF system.
 - A. If other DPF fault codes are present, continue with troubleshooting other active EGR fault codes.
 - B. If other fault codes are not present, clear fault code and return machine to service.

3656-Torque limitation, Engine protection: Torque limitation caused by particulate filter

Context:

This is an information fault code only. The fault code is logged and indicates that engine torque has been limited due to a restriction in the particulate filter. Troubleshoot the fault codes that cause the reduction in power.

3672-Short circuit to ground on Out2 error for H-bridge

Context:

The ECU had detected a short circuit to minus battery or chassis ground on Out2 error for H-bridge.

Cause:

The EGR valve drive circuit or wiring is shorted to minus battery or chassis ground.

Possible failure modes:

1. Wiring shorted to minus battery or chassis ground.
2. Faulty ECU.

Solution:

1. Verify that the fault code is active.

Connect the Electronic Service Tool to the service tool connector.

To check for fault codes: Start and operate the machine.

A. The fault code is not recorded again. OK to return the machine to service.

B. Fault code 3672 is recorded again. Go to step 2.

2. Verify that the wiring and connectors are free of damage.

Inspect the ECU and the EGR valve. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the ECU to the EGR valve. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.

A. The connectors are secure and the harness is free of damage. Go to step 3.

B. The connectors or the harness has damage. Repair or replace the harness or connectors as required. Return to step 1 to confirm elimination of fault.

3. Measure the resistance of the harness to chassis ground.

Turn the ignition switch OFF.

Disconnect the EGR valve connector. Disconnect the ECU connector.

Measure the resistance between ECU connector X-078 pin 50 and chassis ground. The resistance should be greater than **20000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between ECU connector X-078 pin 35 and chassis ground. The resistance should be greater than **20000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

A. The resistance is greater than **20000 Ω**. Go to step 4.

B. The resistance is less than **20000 Ω**. There is a short circuit to chassis ground in the wiring harness. Repair or replace the harness as required. Return to step 1 to confirm elimination of the fault.

4. Measure the resistance of the valve to chassis ground.

Turn the ignition switch OFF.

Disconnect the EGR valve connector.

Measure the resistance between the EGR valve, motor plus pin and chassis ground. The resistance should be greater than **20000 Ω**.

3688-Water sensor in the fuel filter: WIF sensor check is failed

Context:

The Engine Control Unit (ECU) has senses when the fuel filter water tank is full. The fuel filter separates any water from the fuel, and collects it in a special tank.

Cause:

The water in fuel sensor check has failed.

Possible failure modes:

1. Faulty wiring harness.
2. Faulty sensor.

Solution:

1. Check the fault is still present and in an active state.
 - A. If fault is still present and active, continue with Step 2.
 - B. If fault is no longer present or inactive, check for intermittent fault.
2. Verify the wiring harness and connectors are not damaged.

Inspect the wiring harness from the ECU to the water in fuel sensor.

Check that the wiring harness is free of damage, corrosion, abrasion and incorrect attachment.

- A. If the connectors are secure and the wiring harness is free of damage, the sensor has failed. Replace the sensor.
- B. If damage is found to the wiring harness or connectors, repair or replace as required.

3705-Injector adjustment programming: check of missing injector adjustment value programming

Context:

This fault has been generated due to the injector programming being incorrect. This failure can be the result of wrong programming / flashing of the ECU or an internal defect. Using the Electronic Service Tool (EST), Easy-Engine software, check the injector code matches the injector code used for that cylinder. Reprogram the engine control unit (ECU) to the proper injector code. Try to flash the ECU correctly with the proper data set. If the error persists, replace the ECU.

3714-Lambda sensor: Fault code to indicate SRC High error for O2 calibration

Context:

The oxygen signal measured during calibration must be lower than **0.2 V**.

Cause:

The oxygen signal is greater than **0.2 V** during calibration.

Possible failure modes:

1. Faulty electrical wiring or connection.
2. Faulty oxygen sensor.
3. Problems with injection system or EGR.
4. Faulty control unit or software.

Solution:

1. Verify the fault code is still present and in an active state.
 - A. If the fault is no longer active or present, check for an intermittent fault.
 - B. If the fault is still present and active, continue with step 2.
2. Place the ignition switch in the OFF position. Disconnect the engine harness from the oxygen sensor at connector X-104. Inspect all connectors, pins, and wiring harness for broken connectors, corrosion, bent pins or wire breaks.
 - A. If any damage is found, repair or replace connections, pins, or wiring.
 - B. If no damage is found, reconnect the wiring harness to the sensor. Continue with step 3.
3. Test the oxygen sensor for proper operation. Run the machine for approximately **10.0 min** to allow the sensor to warm up. Place the machine off. Use a back probe pin to connect the positive multi-meter lead to connector X-104 pin 3 on the oxygen sensor. Place the negative lead to chassis ground. Have someone start the machine. Rev the engine and monitor the voltage. The voltage range should vary between **0.1 - 0.9 V**.
 - A. If the voltage is not in range the sensor has failed. Replace the sensor.
 - B. If the sensor is in range, continue with step 4.
4. Check the wiring harness for any short or open circuits. Disconnect the engine harness from the oxygen sensor at connector X-104 and the ECU at connector X-079. Using a multi-meter to test the wiring harness, refer to the table below for test results.

Test Type	From	To	Result
Continuity	X-104 pin 3	X-079 pin 7	Continuity
Continuity	X-104 pin 1	X-079 pin 64	Continuity
Continuity	X-104 pin 5	X-079 pin 86	Continuity
Continuity	X-104 pin 2	X-079 pin 85	Continuity
Continuity	X-104 pin 6	X-079 pin 63	Continuity
Short Circuit	X-104 pin 4	X-104 pin 3	No continuity
		X-104 pin 1	
		X-104 pin 5	
		X-104 pin 2	
		X-104 pin 6	

- A. If any of the above tests fail. Locate and repair damaged wiring harness.
 - B. If the all the above test are correct, continue with step 5.
5. Check the injection system for any leaks or damages.

3727-Low oil viscosity

Context:

This fault is the result of the oil viscosity breaking down below a first threshold. Once this fault is present, it remains active until the oil is changed. Change the engine oil, and clear any fault codes present.

3746-Power stages, Injector: OS timeout in shutoff path test. Failure setting the alarm task period.

Context:

The Engine Control Unit (ECU) has detected a processing error during ECU start up. Try to flash the ECU correctly with the proper data set. If the error persists, replace the ECU.

3759-Level 2 Monitoring: Diagnosis of current path limitation forced by Engine Control Unit (ECU) monitoring level 2

Context:

The Engine Control Unit (ECU) has detected an internal fault with the torque request.

Cause:

The calculated engine torque is greater than the acceptable engine torque.

Possible failure modes:

1. Faulty ECU.

Solution:

1. Verify the fault is still active and present.
 - A. If the fault is still active, try to update the ECU software with the proper data set. If the fault is still present, replace the ECU.
 - B. If the fault is not present, the fault may be intermittent. Check for an intermittent fault. If no faults are found, clear the fault code. Return the machine to service.

3770-ECU internal: Diagnostic fault check to report 'WDA/ABE active' due to unknown reason

Context:

The Engine Control Unit (ECU) has detected an internal failure. Try to flash the ECU correctly with the proper data set. If the error persists, replace the ECU.

3808-Fuel Metering Unit: set point of metering unit in idle mode not plausible

Context:

This fault is a result of a leak on the high or low pressure side of the high side pressure pump. Check for worn or stuck open injector, worn high pressure pump or leaking pressure control valve. Check for low fuel pressure before or after the gear pump, clogged fuel filter or leakage, or faulty fuel pump.

3822-Short circuit to battery on Out2 error for H-bridge

Context:

Short circuit to battery on Out2 error for H-bridge. The ECU had detected a short circuit to an external power source.

Cause:

The TVA valve drive circuit is shorted to positive battery.

Possible failure modes:

1. Wiring shorted to positive battery source.
2. Faulty ECU.

Solution:

1. Verify that the fault code is active.

Connect the Electronic Service Tool to the service tool connector.

To check for fault code: Start and operate the machine.

A. Fault code 3822 is not recorded again. OK to return the machine to service.

B. Fault code 3822 is active and recorded again. Go to step 2.

2. Verify that the wiring and connectors are free of damage.

Inspect the ECU and the TVA valve. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the ECU to the TVA valve. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.

A. The connectors are secure and the harness is free of damage. Go to step 3.

B. The connectors or the harness has damage. Repair or replace the harness or connectors as required. Return to step 1 to confirm elimination of fault.

3. Measure the voltage through the wiring harness

Turn the ignition switch OFF.

Disconnect the TVA valve connector. Disconnect the ECU connector.

Turn the ignition switch ON.

Measure the voltage from ECU connector X-078 pin 49 to chassis ground. The voltage should be less than **0.5 V**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the voltage from ECU connector X-078 pin 34 to chassis ground. The voltage should be less than **0.5 V**. Wiggle the harness during measurement to reveal an intermittent condition.

A. The voltage is less than **0.5 V**. Temporarily replace the ECU and retest. Return to step 1 to confirm elimination of the fault.

B. The voltage is greater than **0.5 V**. There is a short circuit to another voltage source. Repair or replace the harness as required. Return to step 1 to confirm elimination of the fault.

3839-Oxidation catalyst upstream temperature shorted to low source

Context:

The engine control unit (ECU) has detected the exhaust gas temperature sensor #1 sensed voltage is less than **0.0 V**.

Cause:

The exhaust gas temperature sensor #1 signal is shorted to a ground source.

Possible failure modes:

1. Faulty electrical wiring.
2. Faulty sensor.
3. Faulty control unit.

Solution:

1. Verify that the fault code is active.

Connect the Electronic Service Tool to the service tool connector.

To check for fault code: Start and operate machine.

A. Fault is not recorded again. OK to return the machine to service.

B. Fault code 3839 is recorded again. Go to step **2**.

2. Verify that the wiring and connectors are free of damage.

Inspect the ECU and the exhaust gas temperature sensor connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the ECU to the exhaust gas temperature sensors. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.

A. The connectors are secure and the harness is free of damage. Go to step **3**.

B. The connectors or the harness has damage. Repair or replace the harness or connectors as required. Return to step **1** to confirm elimination of fault.

3. Measure the resistance between the signal wires.

Turn the key switch OFF

Disconnect ECU connector X-079. Disconnect the temperature sensor #1 connector.

Measure the resistance between ECU connector X-079 pin 79 to X-079 pin 80. The resistance should be greater than **20000 Ω** Wiggle the harness during measurement to reveal an intermittent condition.

A. The resistance is greater than **20000 Ω**. Go to step **4**.

B. The resistance is less than **20000 Ω** there is a short circuit between the sensor wires. Repair or replace the wires as required. Return to step **1** to confirm elimination of fault.

4. Measure the resistance of the signal wire to chassis ground.

Turn the ignition switch OFF.

Disconnect ECU connector X-079. Disconnect the temperature sensor #1 connector.

Measure the resistance between ECU connector X-079 pin 80 to chassis ground. The resistance should be greater than **20000 Ω** Wiggle the harness during measurement to reveal an intermittent condition.

3848-Zero fuel calibration by lambda (ZFL) : DFC reporting error state on comparing energizing time to min value injector 1

Context:

This fault has been generated due to the injector (cylinder 1, 2, 3 or 4) programming being incorrect. This failure can be the result of wrong programming / flashing of the ECU or an internal defect of the injector. Using the Electronic Service Tool (EST), Easy-Engine software, check the injector code matches the injector code used for that cylinder. Reprogram the engine control unit (ECU) to the proper injector code. Try to flash the ECU correctly with the proper data set. If the error persists, replace the injector.

3979-Signal range check for flow resistance of the diesel particulate filter - very high (Level 3 of PFI Overloaded)

Context:

When filter regeneration is insufficient, due too prolonged city driving cycle (low exhaust temperatures) or DOC is damaged (no feed gas produced), the filter flow resistance can increase above critical values.

Possible failure modes:

1. Filter is overloaded, the flow resistance is too high.

Solution:

1. Check delta pressure sensor on filter.
2. Perform filter regeneration or clean the filter.
3. Check presence and condition of DOC.

4422-Short circuit to battery on High Flow unlock solenoid (HSD)

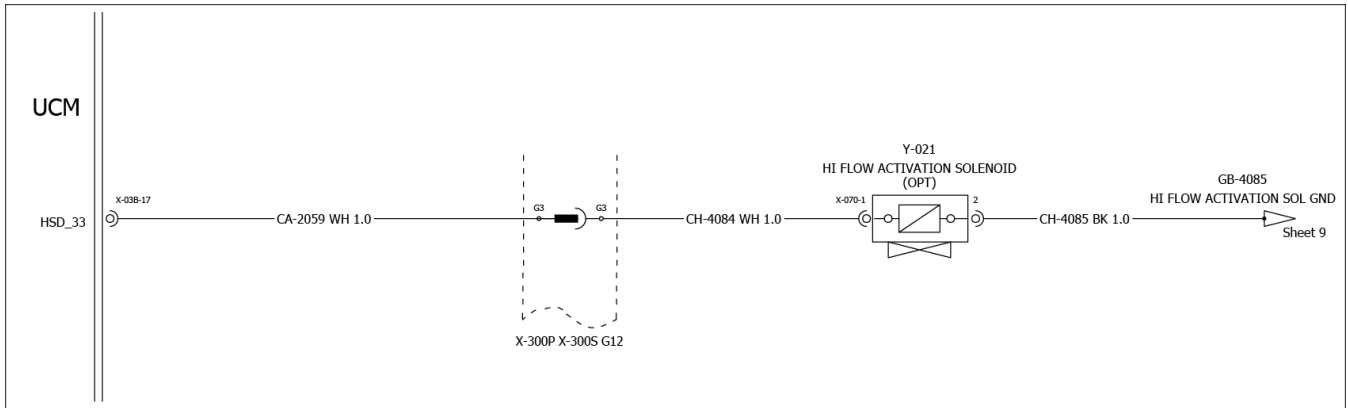
Control Module : UCM

Context:

UCM has detected a short circuit on High flow unlock supply line.

Solution:

1. Check the supply line of the solenoid Y-021 to verify where is located the short circuit to battery.



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- A. Check the pin X-03B-17 of UCM.
- B. Check the pin X-200-G3
- C. Check the pins X-070-1 and X-070-2 of the solenoid valve Y-021.

4453-Open circuit on 3rd/4th switching solenoid (HSD)

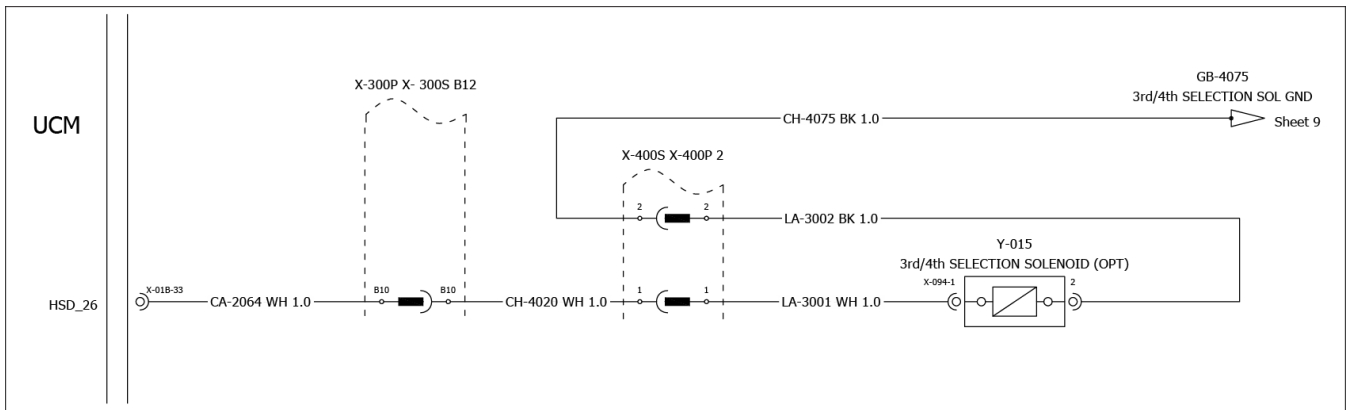
Control Module : UCM

Context:

UCM has detected an open circuit on 3rd/4th switching solenoid supply line.

Solution:

1. Verify configuration/variant setting alignment.
2. Verify the presence of the electrical connections of 3rd/4th selection solenoid.
3. Check the connection X-01B-33 of UCM.
4. Check the connection X-300-B10.
5. Check the connection X-400-1.
6. Check the valve connections X-094-1 and X-094-2.
7. Check if the solenoid of the valve is opened.
8. Check the ground connection.



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