21F
121F
221F
321F
Stage IIIB
Compact Wheel Loader

SERVICE MANUAL

Part number 47768535C
English
March 2017

CASE
CONSTRUCTION

When hydraulic oil has been swallowed, avoid vomiting, but consult a doctor or go to a hospital.

If an accident occurs, see a doctor familiar with this type of injury immediately.

Any fluid penetrating the skin must be removed within few hours to avoid serious infections.

Flammable splashes may originate because of heating near lines with fluids under pressure, resulting in serious burns. Do not weld or use torches near lines containing fluids or other flammable materials.

Lines under pressure can accidentally be pierced when the heat expands beyond the area immediately heated.

Arrange for temporary fire resistant shields to protect hoses or other components during welding or torch use.

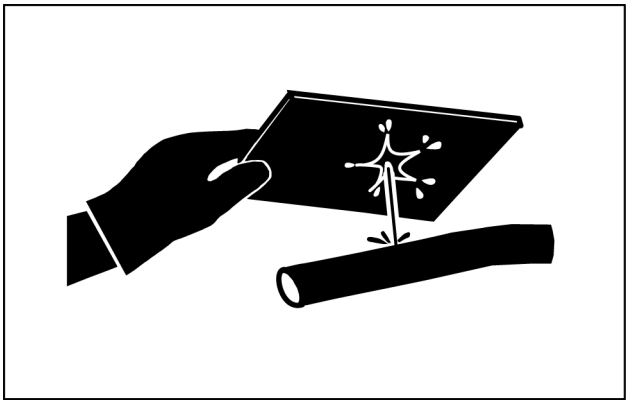
Have any visible leakage repaired immediately.

Discharged oil pollutes the environment. Soak up any oil that has spilled with a proper binding agent. Sweep up binding agent and dispose of it separately from other waste.

Never search for leakages with fingers; instead, use a piece of cardboard and always wear goggles.

Never repair a damaged line; always replace it. Replace hydraulic hoses immediately on detecting any damaged or moist areas.

Always store hydraulic oil in the original containers.



TULI12WEX2013AA 9

Hydraulic contamination

Contamination in the hydraulic system is a major cause of the malfunction of hydraulic components. Contamination is any foreign material in the hydraulic oil.

Contamination can enter the hydraulic system in several ways:

- When you drain the oil or disconnect any line
- When you disassemble a component
- From normal wear of the hydraulic components
- From damaged seals or worn seals
- From a damaged component in the hydraulic system

All hydraulic systems operate with some contamination. The design of the components in this hydraulic system permits efficient operation with a small amount of contamination. An increase in this amount of contamination can cause problems in the hydraulic system.

The following list includes some of these problems:

- Cylinder rod seals that leak
- Control valve spools that do not return to neutral
- Movement of control valve spools is difficult
- Hydraulic oil that becomes too hot
- Pump gears, housing, and other parts that wear rapidly
- Relief valves or check valves held open by dirt
- Quick failure of components that have been repaired
- Slow cycle times are slow. The machine does not have enough power.

If your machine has any of these problems, check the hydraulic oil for contamination.

There are two types of contamination: microscopic and visible.

Microscopic contamination occurs when very fine particles of foreign material are suspended in the hydraulic oil. These particles are too small to see or feel. Microscopic contamination can be found by identification of the following problems or by testing in a laboratory.

Examples of problems caused by microscopic contamination:

- Cylinder rod seals that leak
- Control valve spools that do not return to neutral
- The hydraulic system has a high operating temperature

Visible contamination is foreign material that can be found by sight, touch, or odor. Visible contamination can cause a sudden failure of components.

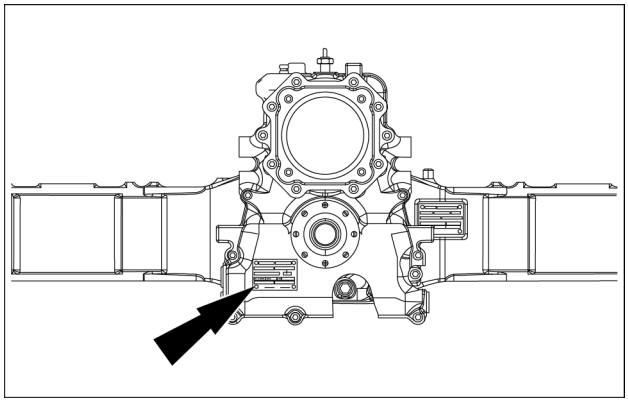
Examples of problems caused by visible contamination:

- Particles of metal or dirt in the oil
- Air in the oil
- Dark or thick oil
- Oil with an odor of burned oil
- Water in the oil

If you find contamination, use a portable filter to clean the hydraulic system.

Transmission

The serial number is on the transmission face plate.



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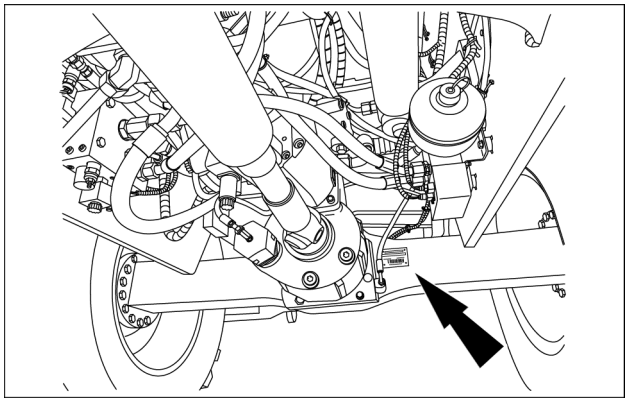
Axle

The serial number plate is on the axle cross member.



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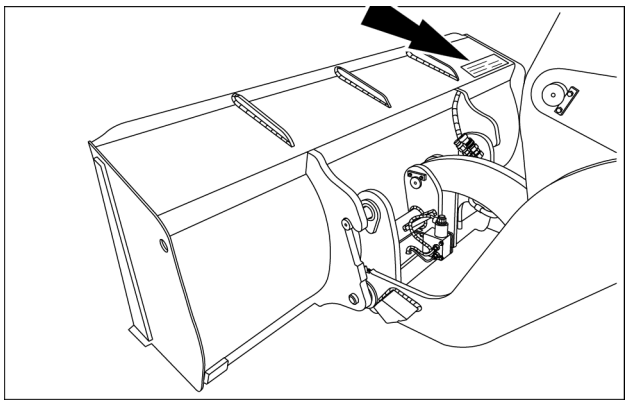
Bucket

The serial number plate is located on the right-hand side of the bucket.



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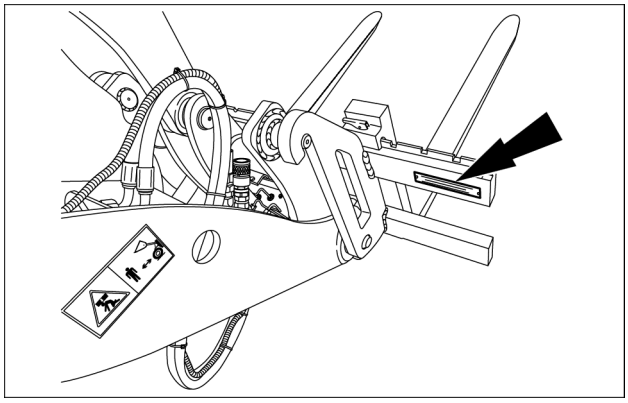
Forks

The serial number plate is located on the right-hand side of the forks.



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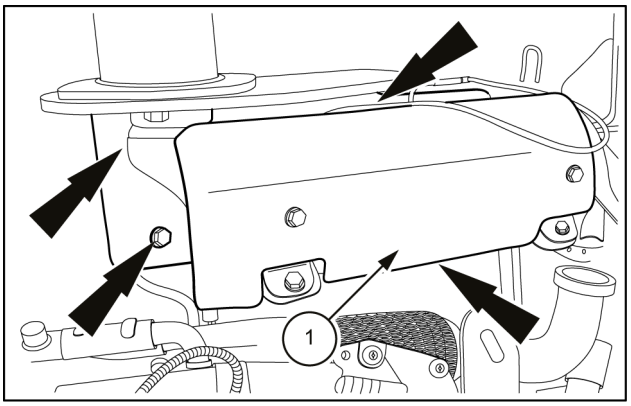
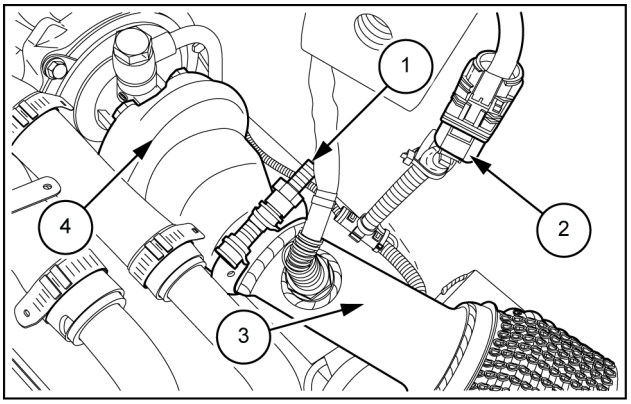
27. Remove the four screws (arrows) securing PM-Cat system **(1)** of the frame.
Remove the PM-Cat system **(1)** from the machine.
Extract, from the bottom, the exhaust stack.



LEIL14CWL0227AB 34

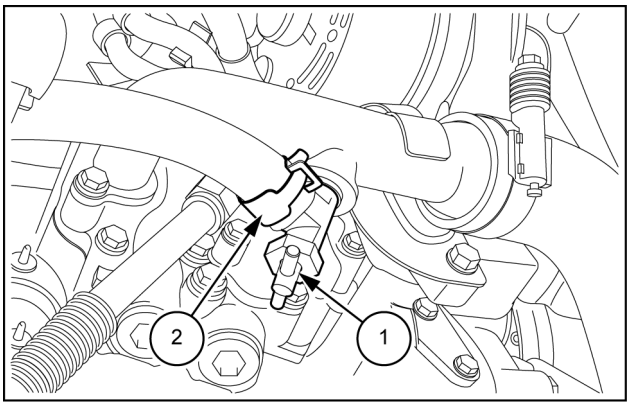
28. Disconnect the lambda probe connector **(2)**.
Loosen the clamp **(1)** and remove the compensation hose **(3)** from the turbocharger **(4)**.



LEIL14CWL0228AB 35

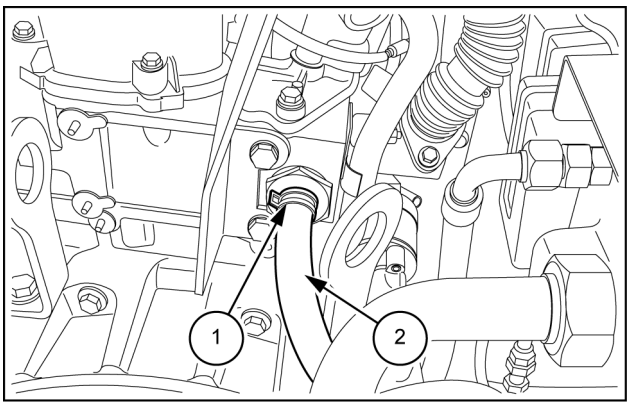
29. Acting from under the machine:
    - turn off the tap **(1)**;
    - loosen the clamp **(2)** and disconnect the cab heating hose;
    - open the tap **(1)** to drain the coolant from the engine block.

NOTE: *use a suitable container for collection of coolant and abide by all local environmental laws for proper handling and disposal.*



LEIL14CWL0229AB 36

30. From the right side of the machine, loosen the clamp **(1)** and disconnect the hose cab heating **(2)**.



LEIL14CWL0230AB 37

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Engine and crankcase - 001

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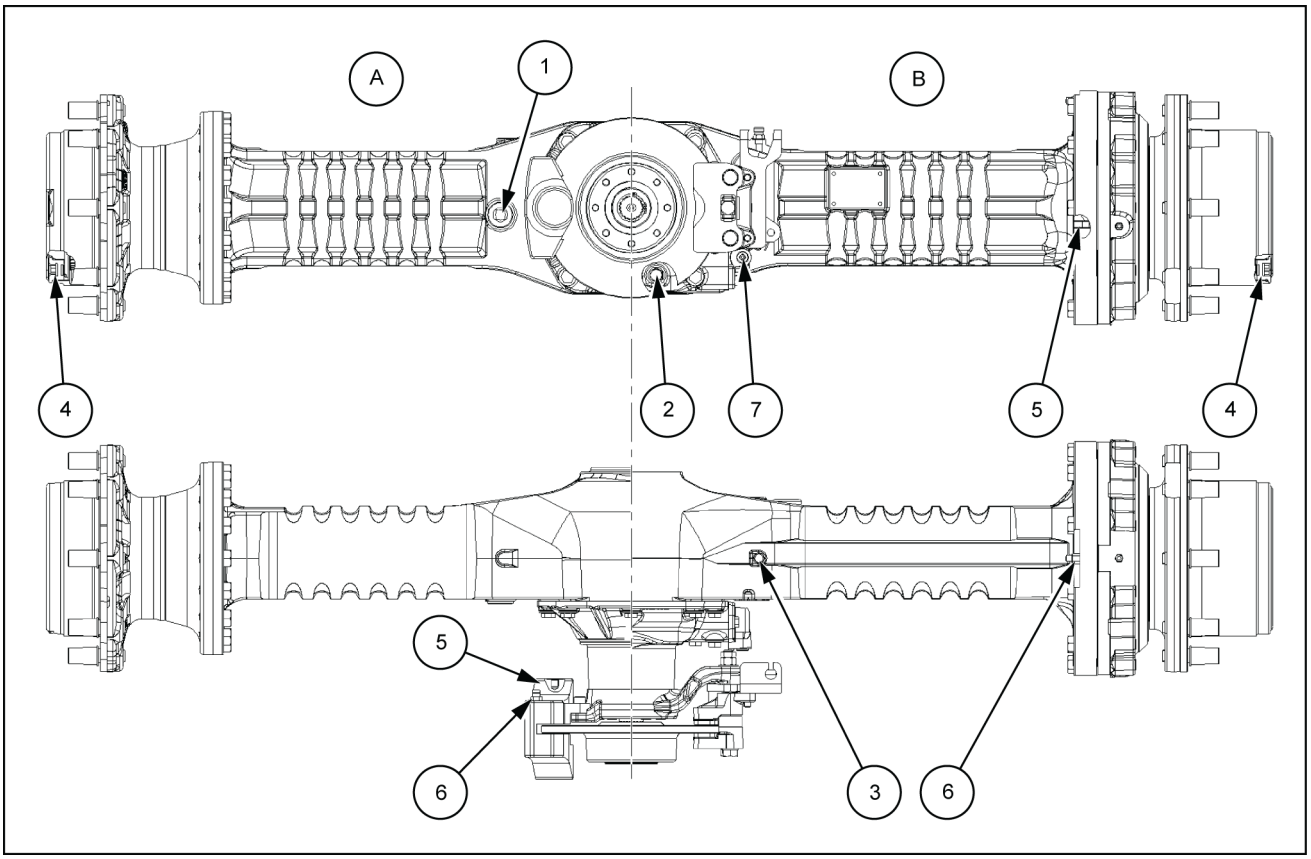
Powered front axle - Service instruction - Plugs and connection ports

A. Axle 28.16
B. Axle 28.25



LEIL14CWL0272FB 1

1. Differential oil filling and level plug
2. Differential oil drain plug
3. Oil breather
4. Fill, level and drain plug of epicyclic reduction gear oil
5. Service brake inlet port
6. Brake oil breather
7. Differential locking engagement inlet port (if present)

Contents

Front axle system - 25

Front bevel gear set and differential - 102

FUNCTIONAL DATA

SERVICE

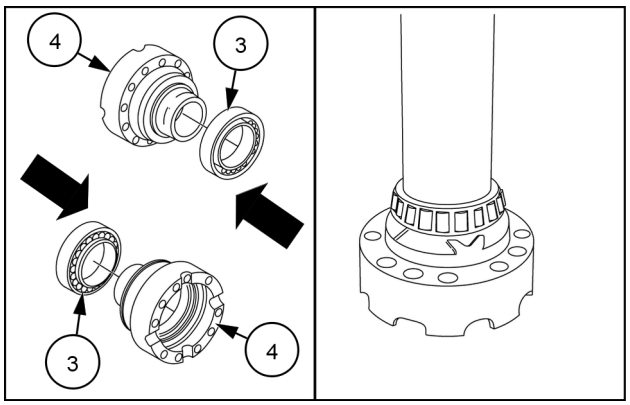
(*) See content for specific models

Differential - Assemble

Open differential

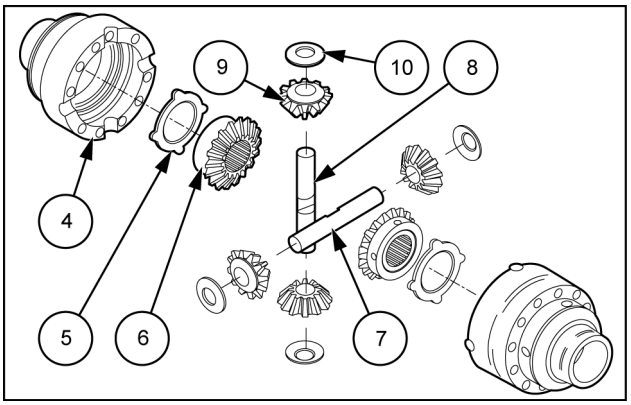
1. Assemble the bearing cones **(3)** on the half housing **(4)**, using the driver **380002216** and a hammer.

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



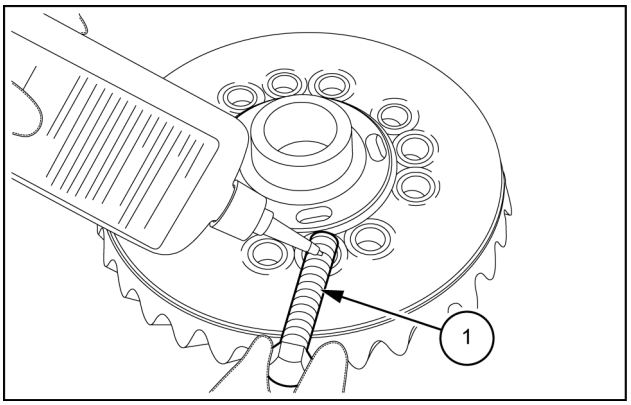
LEIL14CWL0298AA 1

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.



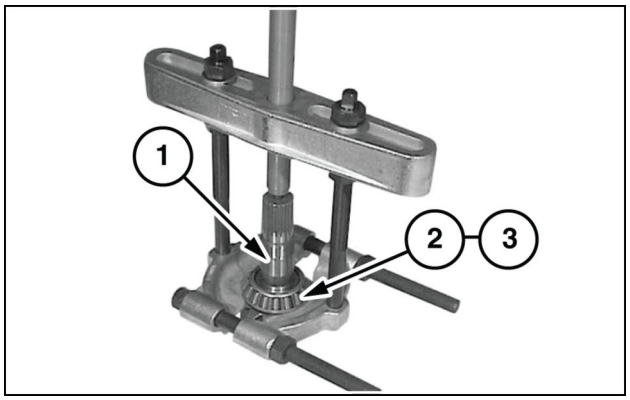
LEIL14CWL0299AB 2

3. Place the bevel gear on the differential housing.
   Apply **LOCTITE® 270** on the threads and tighten the bolts **(1)** to the requested torque.



LEIL15CWL0357AB 3

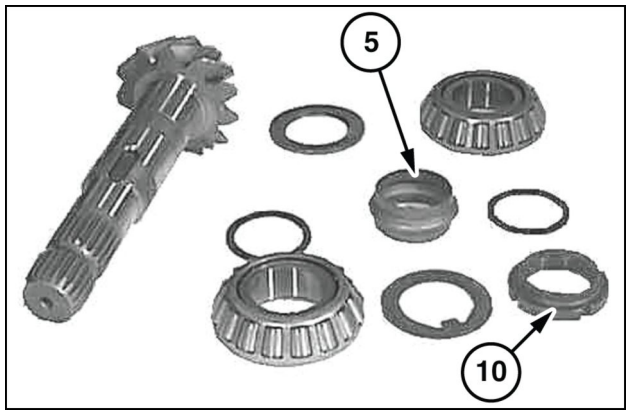
Remove the bearing **(3)** from the pinion **(1)** using a puller.
Collect the shim **(2)**.



LEPH12WHL0359AB 5

Check the conditions of all parts.

NOTICE: *the ring nut* ***(10)*** *and the spacer* ***(5)*** *must be replaced by reassembly.*

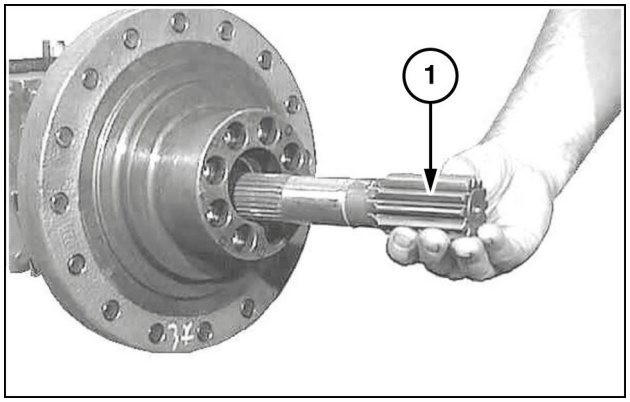


LEPH12WHL0360AB 6

Axle shaft - Disassemble

121F XT	WE
121F ZB	WE
21F XT	WE
21F ZB	WE

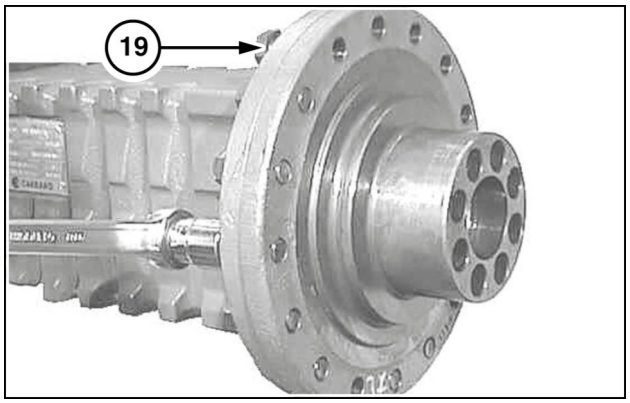
Extract the short half axle **(1)**.



LEPH12WHL0251FB 1

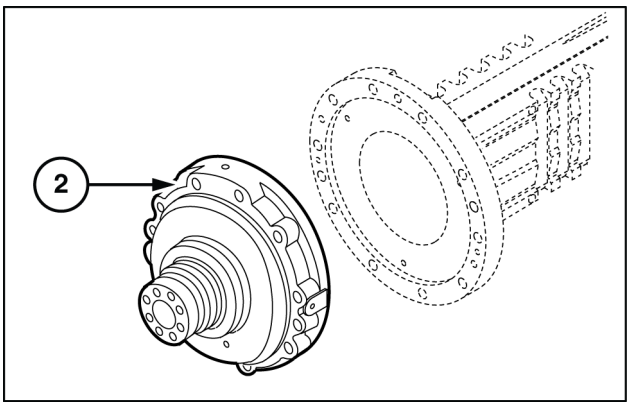
Loosen and remove the screws **(19)**.

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



LEPH12WHL0252AB 2

Remove the wheel shaft **(2)**.

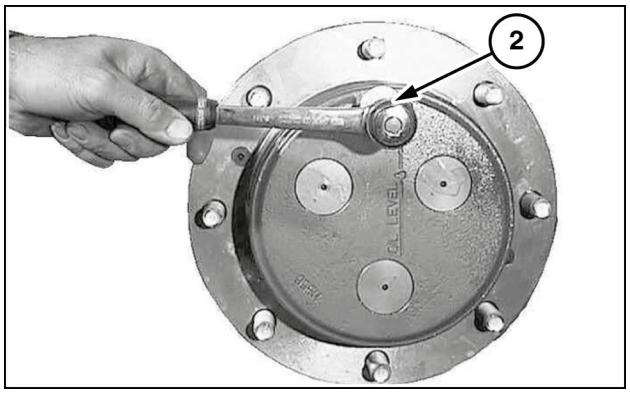


LELI12WHL0253AB 3

Planetary drive and hub - Disassemble

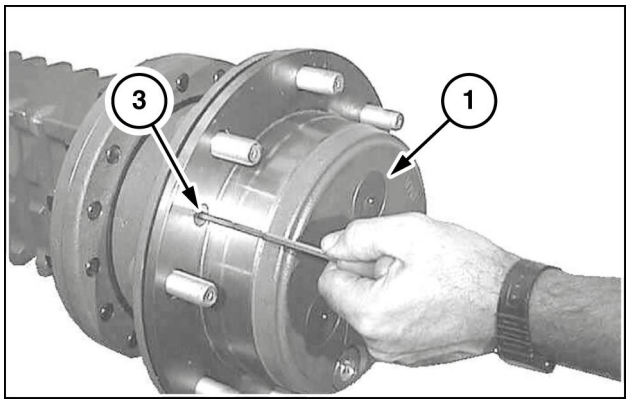
221F HS	WE
221F STD	WE
321F HS	WE
321F STD	WE

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



LEPH12WHL0202AB 1

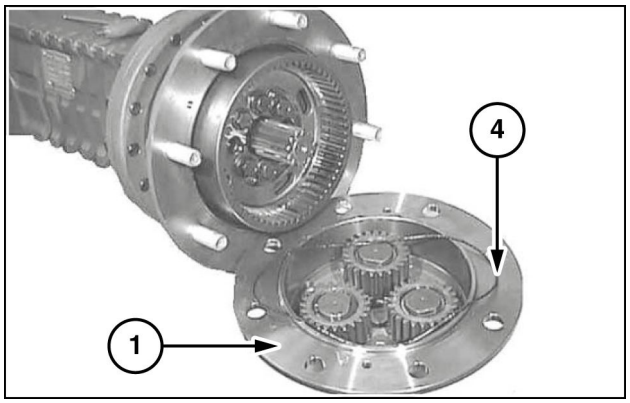
Unscrew and remove the screws **(3)** of the planetary carrier cover **(1)**.



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.

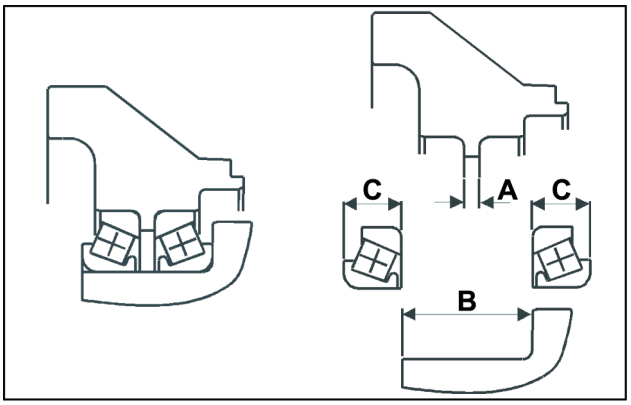


LEPH12WHL0213AB 3

Wheel hub - Assemble - Wheel hub with brakes

221F HS	WE
221F STD	WE
321F HS	WE
321F STD	WE

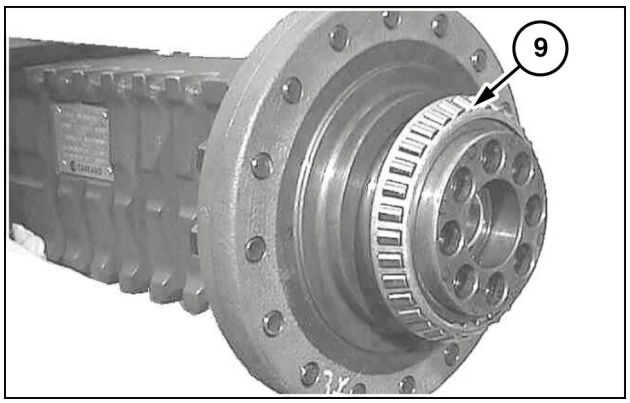
The special operation “Set Right” of the bearings does not require preload or backlash adjustment. Anyway, before assembling new components, check the indicated dimensions.
A = **08.450 – 08.500 mm** (**0.333 – 0.335 in**)
B = **54.775 – 54.825 mm** (**2.156 – 2.158 in**)
C = **23.070 – 23.172 mm** (**0.908 – 0.912 in**)



LELI12WHL0238AA 1

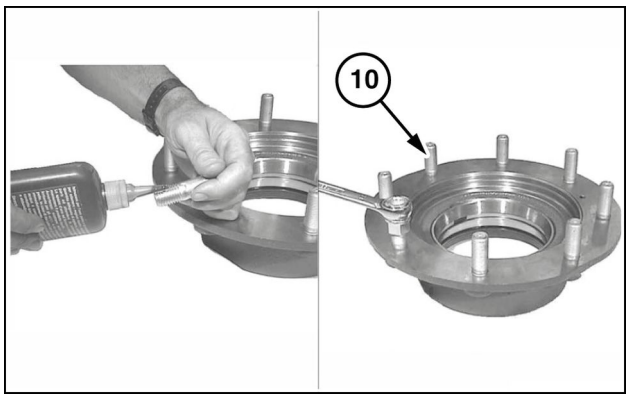
Heat the bearing **(9)** to **80 – 100 °C** (**176 – 212 °F**). Assemble the bearing on the wheel shaft.

NOTICE: *wear safety gloves.*



LEPH12WHL0239AB 2

Apply some **LOCTITE® 242®** on the stud bolt threads **(10)** and tighten them **70 N·m** (**51.63 lb ft**) using two nuts (nut and locknut).



LEPH12WHL0240AB 3

Gasket sealants

Reference	Brand and type	Technical characteristics	Strength
(A1)	**LOCTITE® 510™ SUPERBOND ® 529 ADHESIVE**	Flat surface sealing	High
(A2)	**LOCTITE® 573™ SUPERBOND ® 519 ADHESIVE**	Flat surface sealing	Low
(A3)	**LOCTITE® 518™**	Uneven surface sealing	High
(A4)	**LOCTITE® 5205**	Even surface sealing with possibility of micro movements	High
(A5)	**LOCTITE® 5188 FLANGE SEALANT**	Even and/or uneven surface sealing with possibility of micro movements	High

***NOTE: (A3)** can be used instead of **(A1)**. .*

NOTE: (A5)** can be used instead of **(A1)**, **(A2)**, **(A3)**, **(A4)

Thread parts adhesives

Reference	Brand and type	Technical characteristics	Strength
(B1)	**LOCTITE® 542™ SUPERBOND® 321 ADHESIVE**	Locking of threaded parts	Medium
(B2)	**LOCTITE® 270**	Locking of threaded parts	High
(B3)	**LOCTITE®** 986/AVX SUPERBOND® 438	Locking of threaded parts	High, special applications

Fixing parts adhesives

Reference	Brand and type	Technical characteristics	Strength
(C1)	**LOCTITE®** 402™ SUPERBOND® istant 25	Fixing adhesive	Medium bond
(C2)	**LOCTITE® 638™**	Fixing adhesive	Strong bond
(C3)	**LOCTITE® 542™ SUPERBOND® 321 ADHESIVE**	Fixing adhesive	Medium bond
(C4)	**LOCTITE® 496 INSTANT ADHESIVE** SUPERBOND® SB14	Rubber fixing adhesive	Strong bond

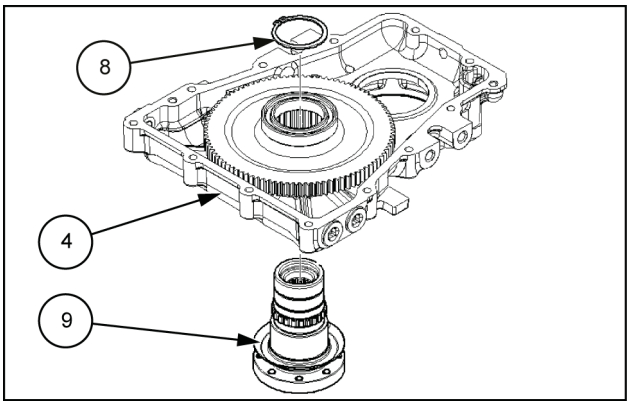
Powered rear axle - Grease

Grease in assembly

NOTICE: *lubricate the O-Rings with mineral oil (* ***SAE 90****) or Lithium grease.*

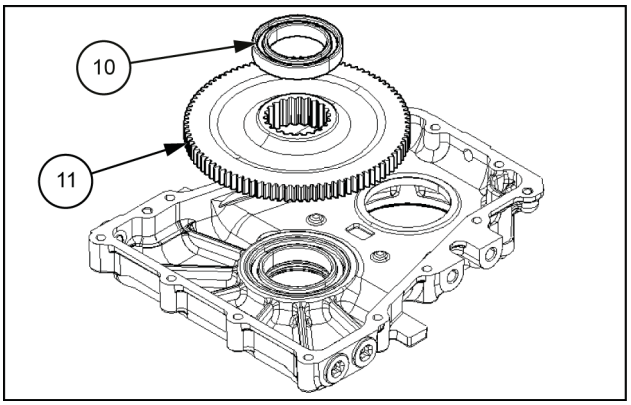
Grease application in assembly		
(X)	**TUTELA MULTI-PURPOSE EP GREASE 251H, GR-9**	Apply on the indicated surfaces

4. Remove the snap ring **(8)** and extract the shaft **(9)** from the housing **(4)**.
   If necessary, beat on the shaft end with a pad and a hammer.



LEIL14CWL0321AB 4

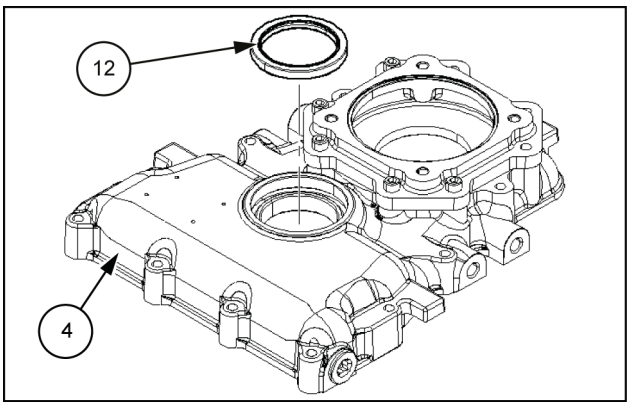
5. Remove the bearing **(10)** and the gear **(11)**.



LEIL14CWL0322AB 5

6. Remove the seal ring **(12)** from the half box **(4)**.

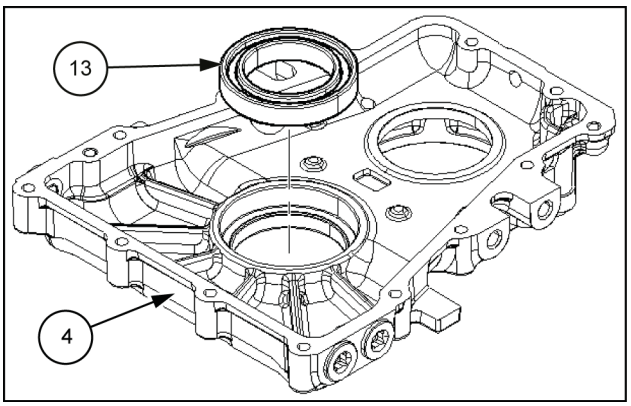
NOTE: *Destructive operation for the seal ring **(12)**; the seal ring must be replaced.*



LEIL14CWL0323AB 6

7. Remove the bearing **(13)** from the half box **(3)**.

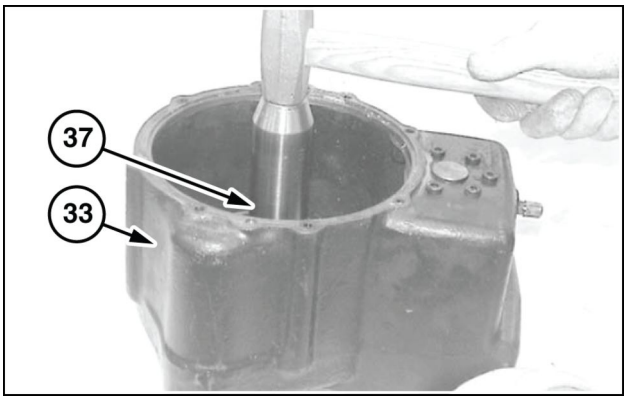
NOTE: *Use a driver and an hammer if necessary.*



LEIL14CWL0324AB 7

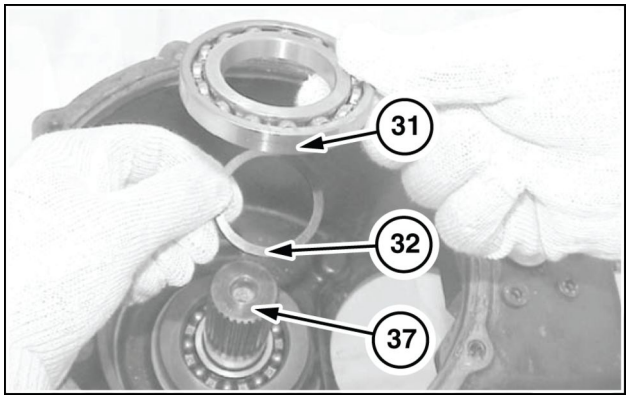
Install the shaft **(37)** on the transmission box **(33)** using the driver **380002217** and a hammer.

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



LEPH12WHL0093AB 4

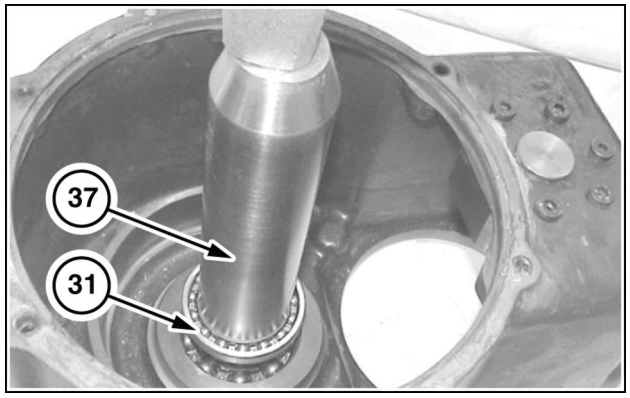
Assemble the shim **(32)** and the bearing **(31)** on the shaft **(37)**.



LEPH12WHL0094AB 5

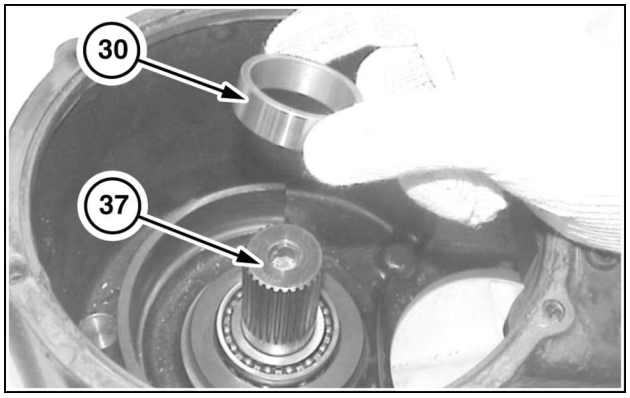
Install the bearing **(31)** on the shaft **(37)** using the driver **380002217** and a hammer.

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



LEPH12WHL0095AB 6

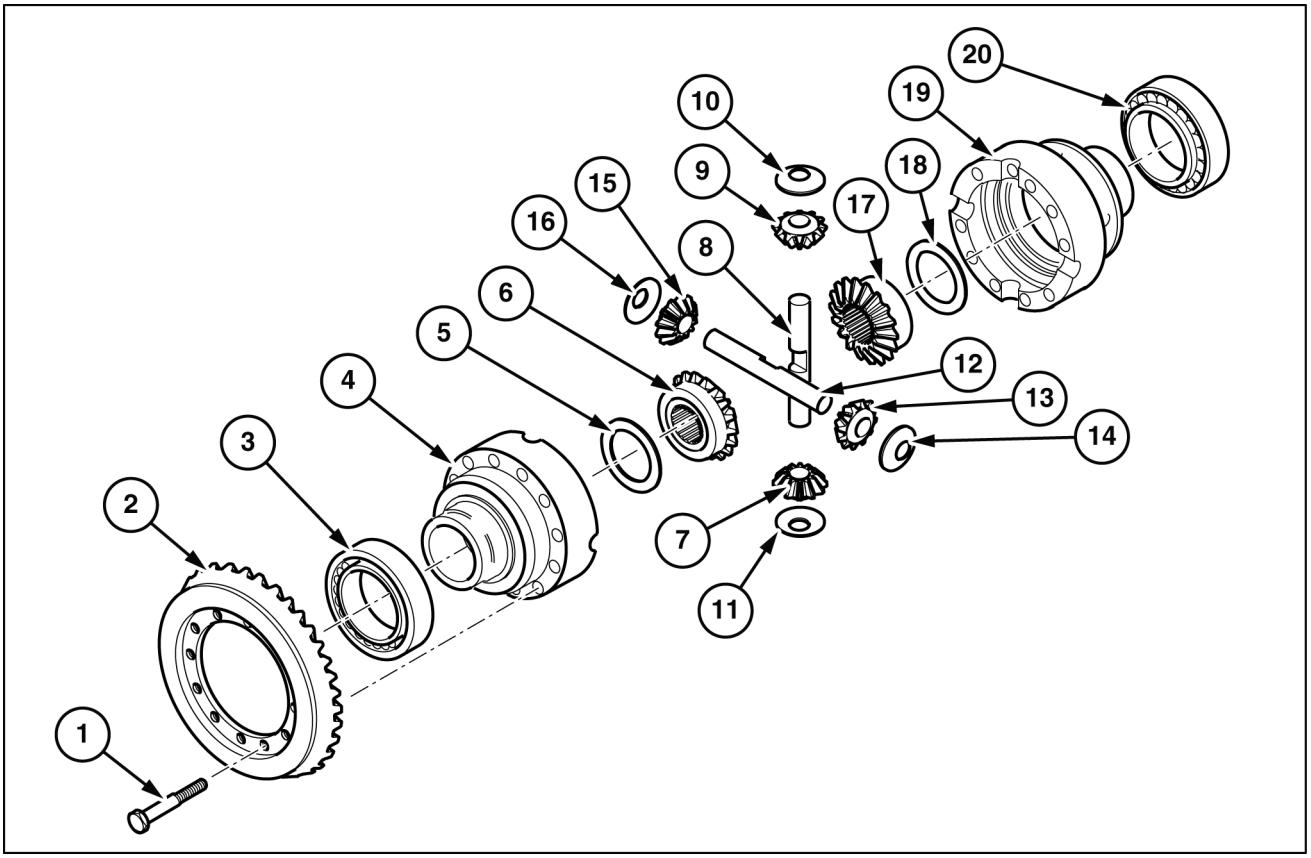
Insert the bushing **(30)** on the shaft **(37)**.



LEPH12WHL0096AB 7

Differential - Component identification

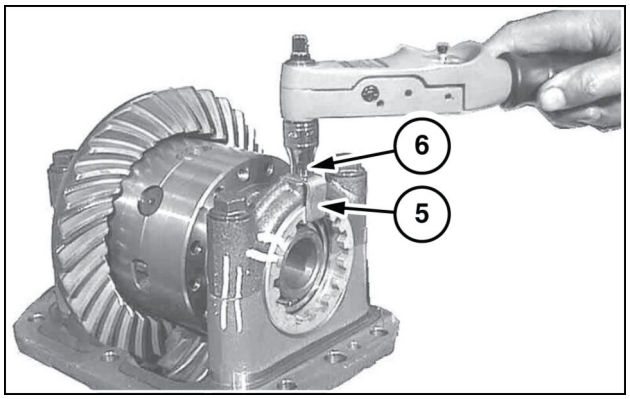
Open differential



LELI12WHL0519GB 1

1. Screw
2. Ring gear
3. Bearing
4. Half box
5. Shim
6. Gear
7. Gear
8. Shaft
9. Gear
10. Spherical washer
11. Spherical washer
12. Shaft
13. Gear
14. Spherical washer
15. Gear
16 Spherical washer
17. Gear
18. Shim
19. Half box
20. Bearing

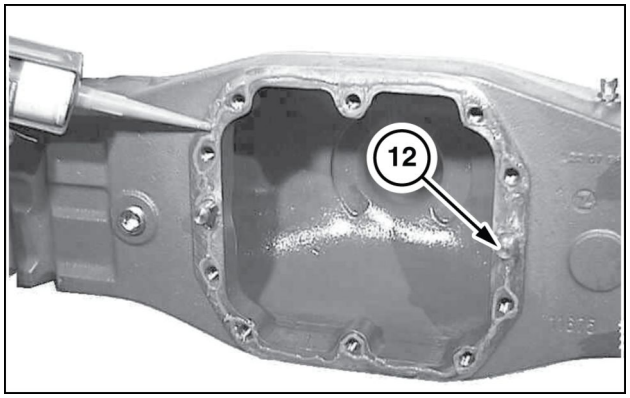
Once all the adjustment operations have been completed, assemble the ring nut retainers **(5)** and the relevant screws **(6)**, tightening them to the prescribed torque of **13 N·m** (**9.59 lb ft**).



LEPH12WHL0513AB 13

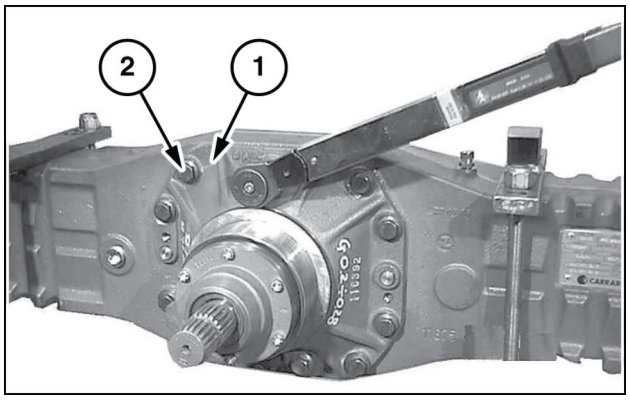
Before coupling the surfaces, make sure that they have been perfectly cleaned with appropriate detergents. Spread an adhesive film on the contact surface between the axle beam and the differential support.

NOTE: *Check that the pins **(12)** remain in their housings.*



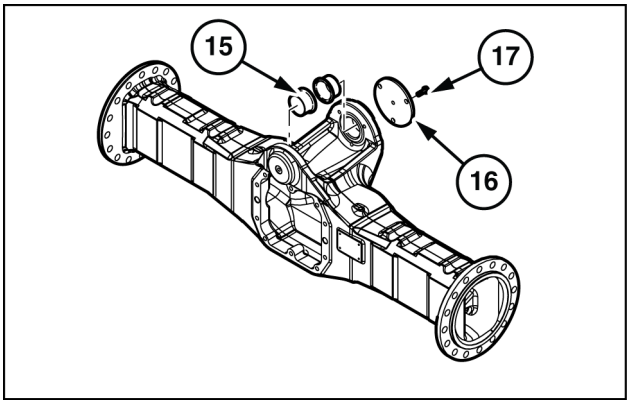
LEPH12WHL0514AB 14

Position the differential support **(1)** on the axle beam and tighten the screws **(2)** to the prescribed torque of **169 N·m** (**124.65 lb ft**).



LEPH12WHL0515AB 15

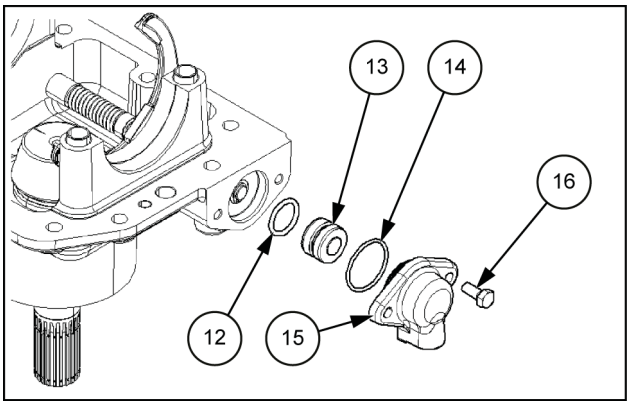
Install the new bushings **(15)** into the hole of the axle beam.
Position the cover **(16)** fastening it with the screws **(17)**.
Tighten the screws **(17)** to the prescribed torque of **50 N·m** (**36.88 lb ft**).



LELI12WHL0195AB 16

Differential lock - Disassemble

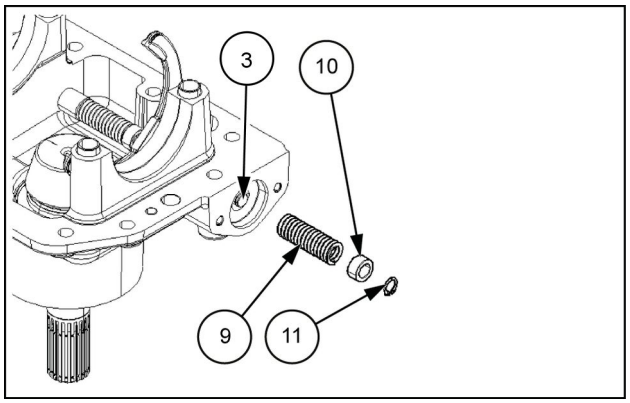
1. Remove the differential group before disassemble the differential locking device.
   Unscrew the bolts **(16)** and remove the cylinder support **(15)**.
   Collect the piston **(13)** and the O-rings **(14)** and **(12)**.



LEIL14CWL0307AB 1

2. Remove the lock ring **(11)** keeping the bushing **(10)** that it's pushing outer by the spring **(9)**.
   Remove the bushing and the spring from the control shaft **(3)**.

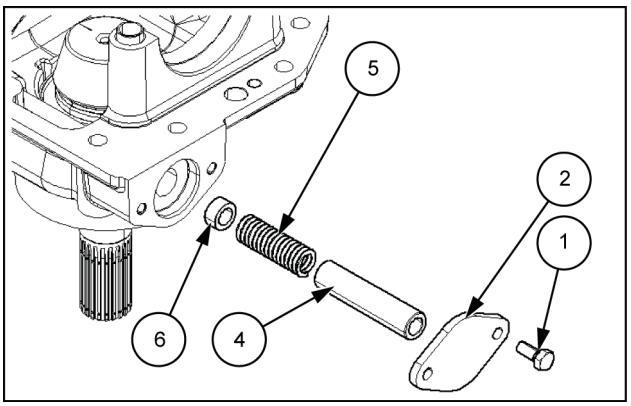
NOTICE: *possible ejection of the bush **(10)** and spring **(9)**.*



LEIL14CWL0308AB 2

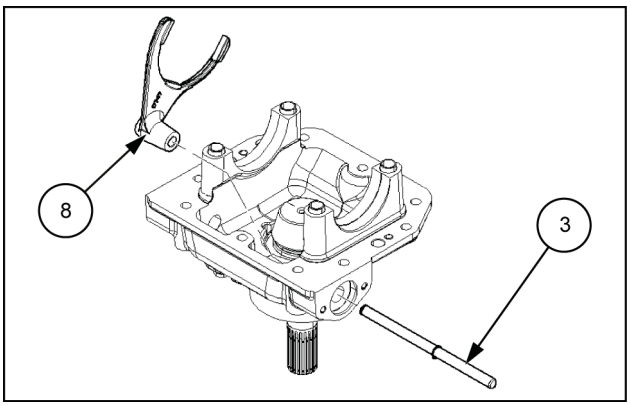
3. Remove the bolt **(1)** and the cover **(2)** keeping the bushing **(4)** that it's pushing outer by the spring **(5)**.
   Remove the bushing, the spring and spacer **(6)** from the control shaft **(3)**.

NOTICE: *possible ejection of the bush **(4)** and spring **(5)**.*



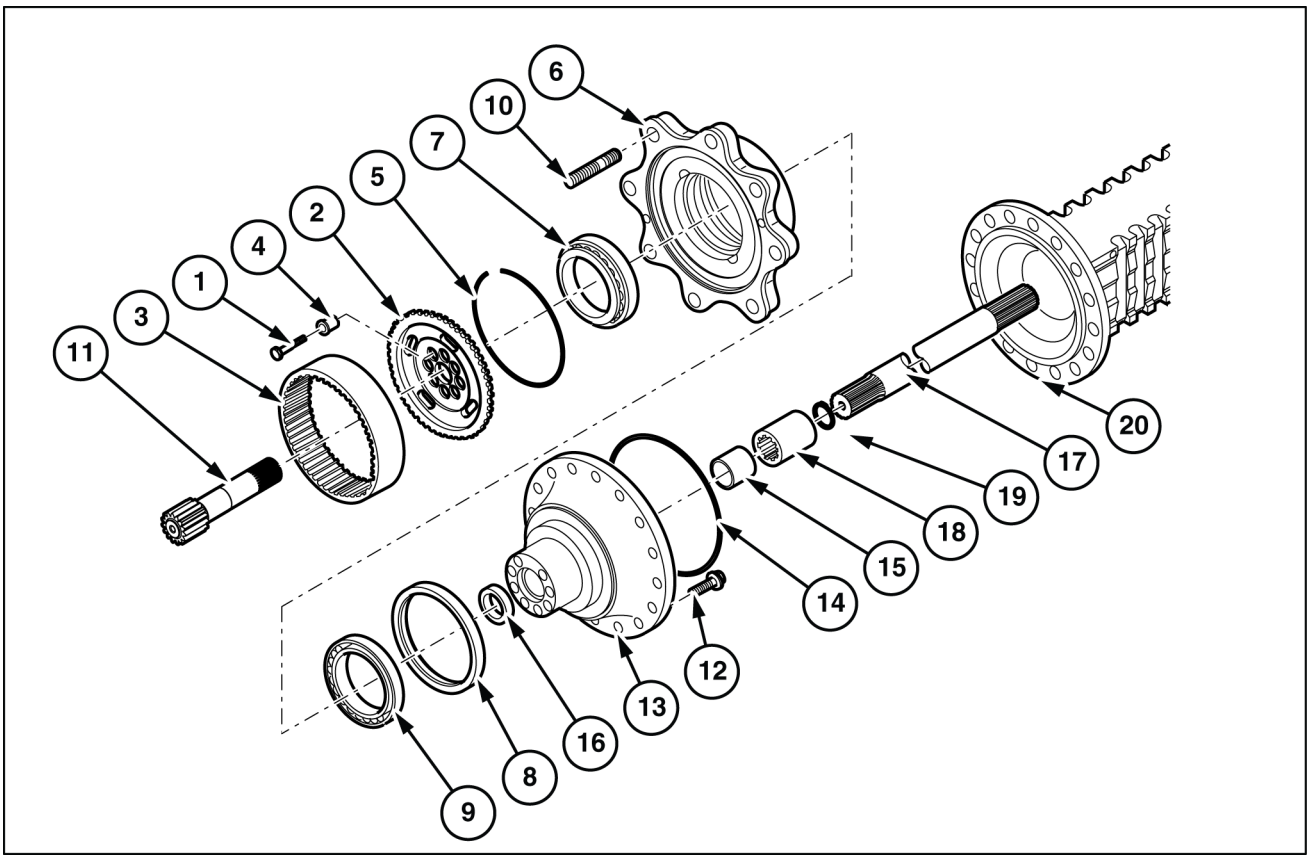
LEIL14CWL0309AB 3

4. Remove the control shaft **(3)** then collect the lock ring **(7)** and the fork **(8)**.



LEIL14CWL0310AB 4

Wheel hub - Component identification



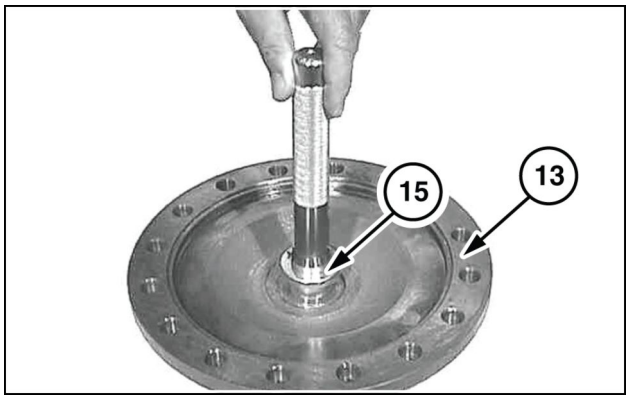
LELI12WHL0217FB 1

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

Wheel hub - Assemble

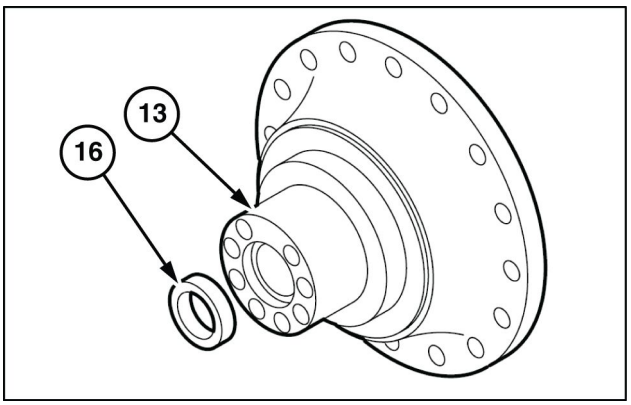
Assemble the bushing **(15)** into the wheel shaft **(13)** with the driver **380002226** and a hammer.

NOTE: *wear protective gloves.*



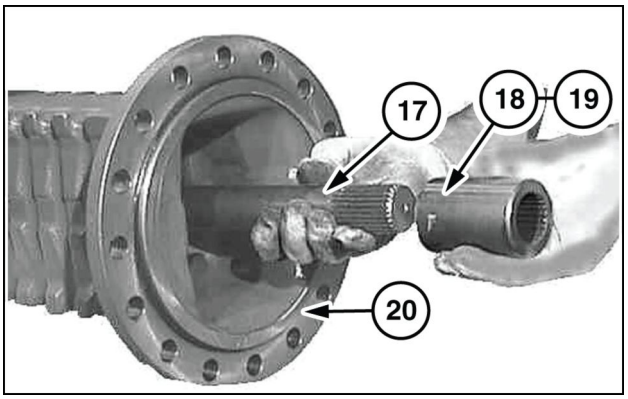
LEPH12WHL0759AB 1

Turn the wheel shaft **(13)** upside down and install the seal ring **(16)**.



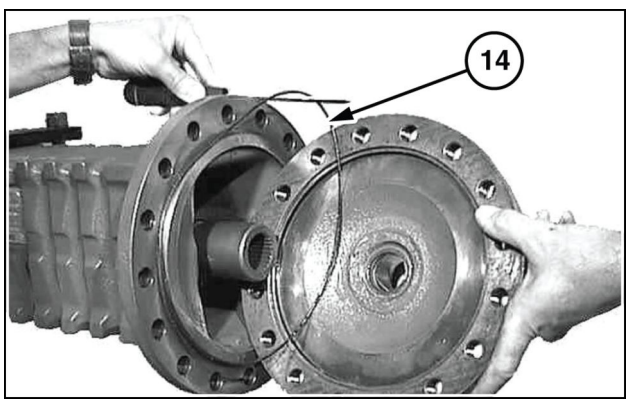
LELI12WHL0756AB 2

Check that the elastic ring **(19)** is assembled to the sleeve **(18)**.
Fasten the sleeve **(18)** to the long half shaft **(17)**.
Insert the long half shaft **(17)** in the axle beam **(20)**.



LEPH12WHL0760AB 3

Assemble a new O-ring **(14)**.



LEPH12WHL0761AB 4

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Hydrostatic drive - 29

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Brakes and controls - 33

Hydraulic service brakes - 202

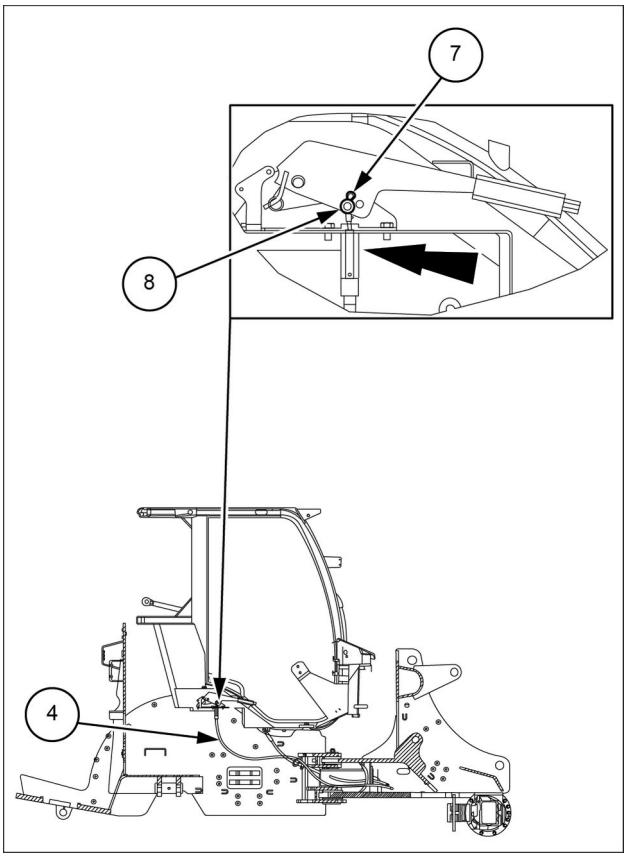
FUNCTIONAL DATA

SERVICE

(*) See content for specific models

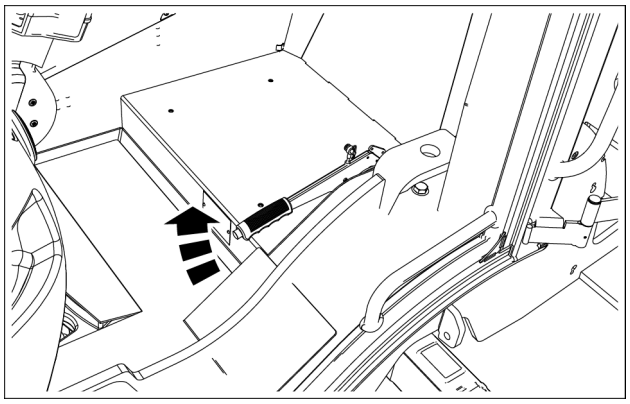
9. Check for leaks. Check the oil level in the brake oil tank. Add oil as required.

5. Insert the parking brake cable **(4)** in the installation hole of the parking brake lever (see arrow in figure **5**).
6. Install the clevis pin **(8)** and the cotter pin **(7)** to secure the parking brake cable **(4)** to the parking brake lever.



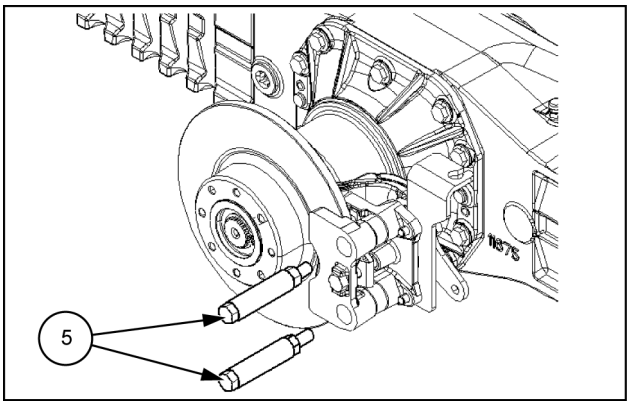
LEIL16CWL0230BB 5

7. After the parking brake cable installation, ensure a maximum of 6–7 clicks of the parking brake lever.



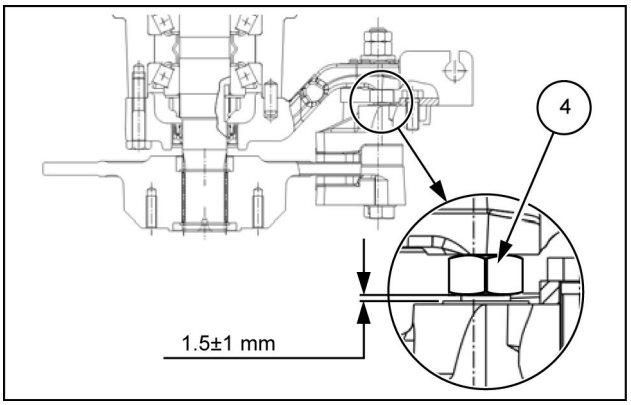
LEIL16CWL0233AB 6

10. Assemble the two screws **(5)** and tighten the nuts **(4)**.



LEIL14CWL0342AB 9

11. After tightening the nuts, make sure that is present a space of **0.5 – 2.5 mm** (**0.0 – 0.1 in**) between the nuts **(4)** and the caliper as shown in figure; if necessary adjust the position of the nuts.



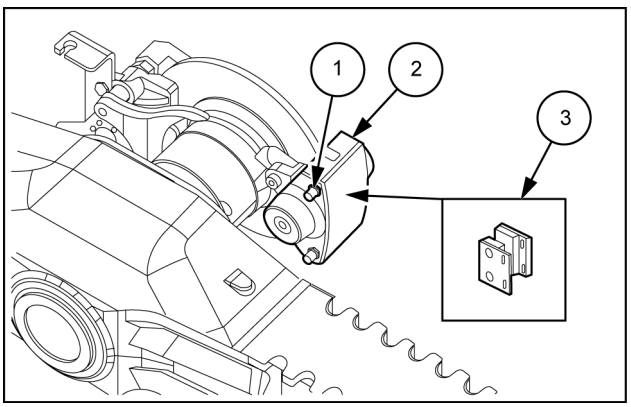
LEIL14CWL0352AB 10

Only for 21F and 121F Models

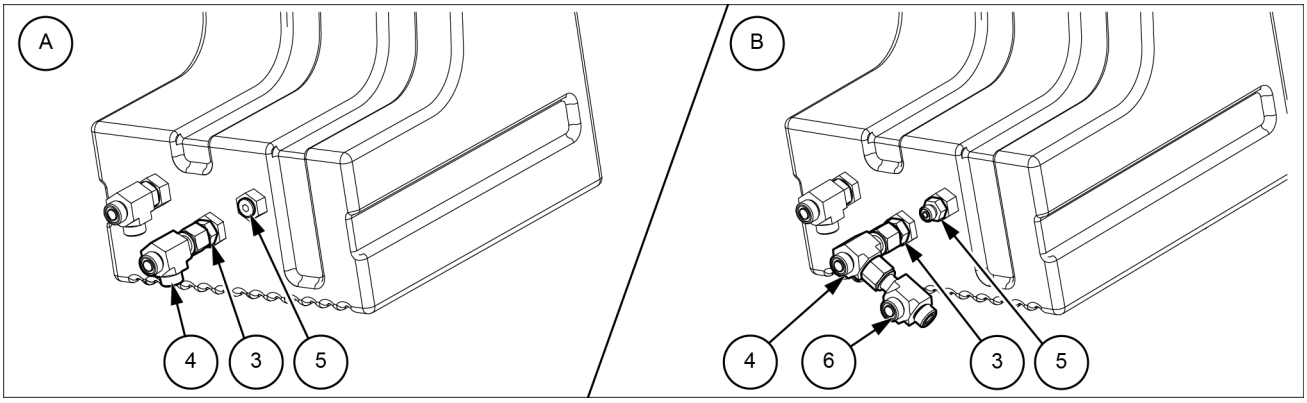
1. Position the brake caliper **(2)**, with relative pads **(3)**, on the brake disc.
   Tighten the two screws **(1)**.

NOTE: *proceed with care, in order to avoid damaging the brake pads.*

NOTICE: *do not invert the brake pads position if the brake pads are not replaced; the brake efficiency would be compromised.*



LEIL14CWL0773AB 11

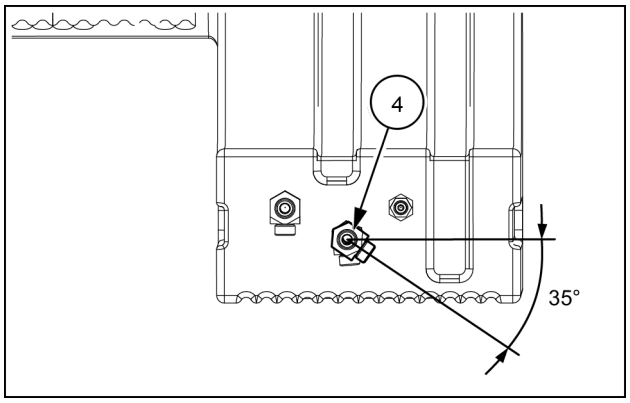


LEIL17CWL0345EB 9

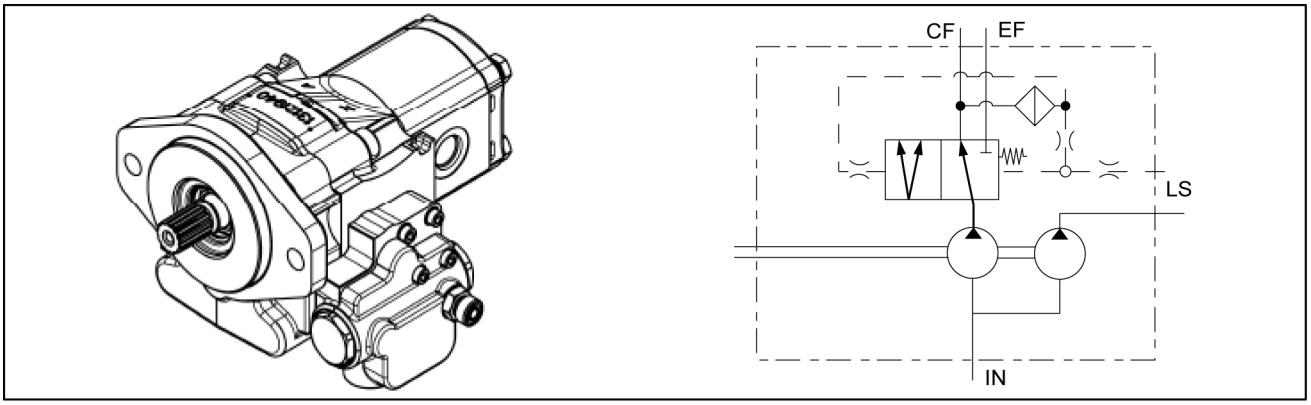
A. Machine models without differential lock
B. Machine models with differential lock

7. Install the fitting **(3)** on the hydraulic oil tank. Tighten to **35 N·m** (**25.8 lb ft**).
8. For machine models equipped with drain line or without drain line with Ride control, install the T-fitting **(4)** on the fitting **(3)**. Tighten to **65 N·m** (**47.9 lb ft**).
   For machine models equipped with High flow or without High flow with Ride control and drain line, install the T-fitting **(6)** on the T-fitting **(4)**. Tighten the T-fitting **(6)** to **65 N·m** (**47.9 lb ft**).
9. For machine models without differential lock, install the plug **(5)** on the hydraulic oil tank. Tighten to **35 N·m** (**25.8 lb ft**).
   For machine models equipped with differential lock, install the fitting **(5)** on the hydraulic oil tank. Tighten to **35 N·m** (**25.8 lb ft**).

NOTE: *for machine models equipped with High flow, apply to the T-fitting **(4)** the angle orientation as shown in figure **10**.*



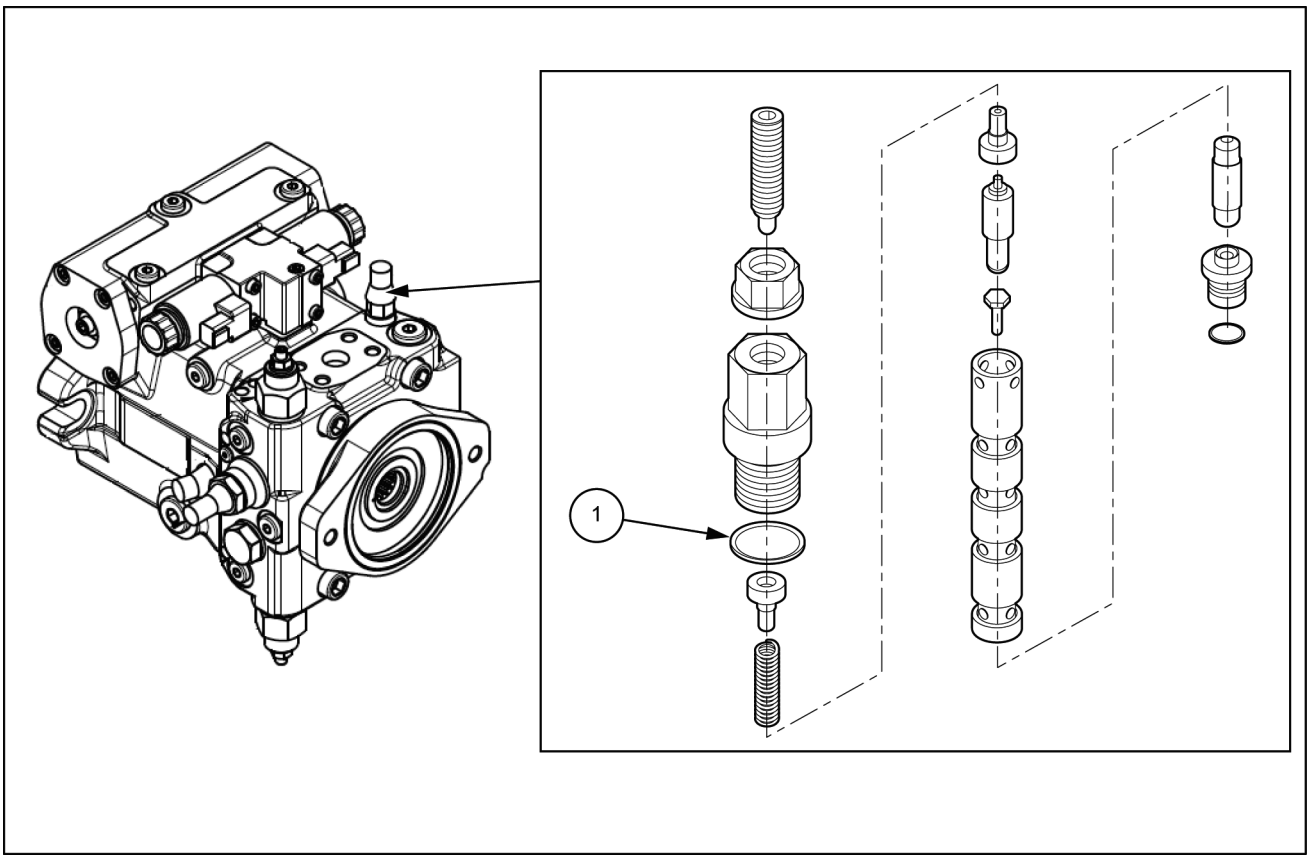
LEIL17CWL0261AB 10



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)**	

Pump - Component identification - Pressure cut-off valve



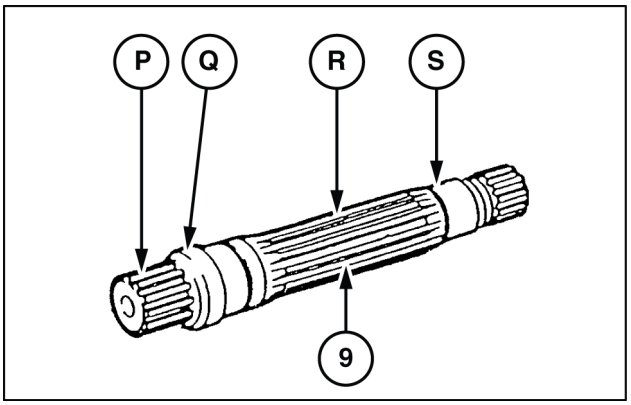
LEIL16CWL0110FB 1

1. O-ring

Pump - Inspect - Complete Rotary Assembly

Check on shaft **(9)**:

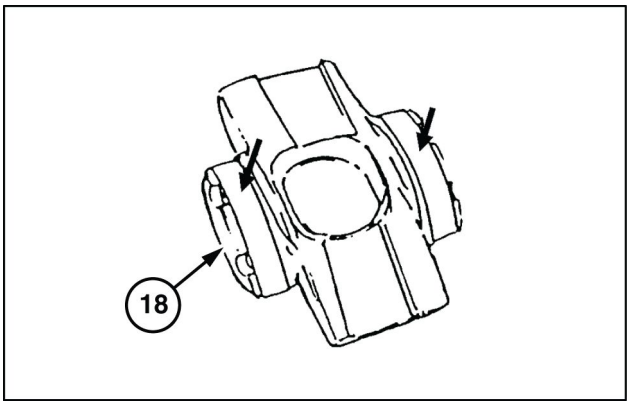
- Teeth **(P)**
- Sealing surface **(Q)**
- Splined surface **(R)**
- Bearing seat **(S)**



LELI12WHL0601AB 1

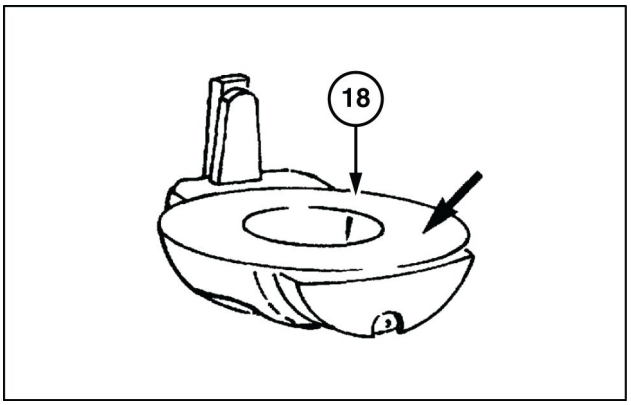
Check the swash plate **(18)**:

- The sliding surfaces of the bearings.



LELI12WHL0602AB 2

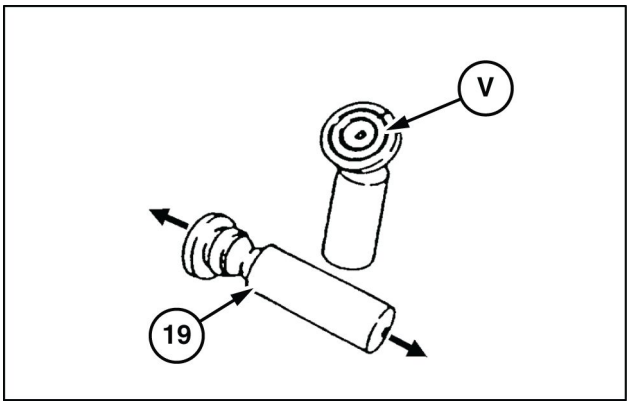
- The sliding surface.



LELI12WHL0603AB 3

Check the pistons **(19)**:

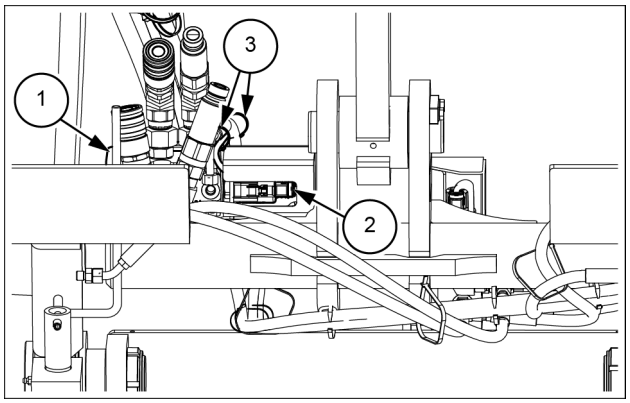
- Slides **(V)** and than check the axial backlash.



LELI12WHL0604AB 4

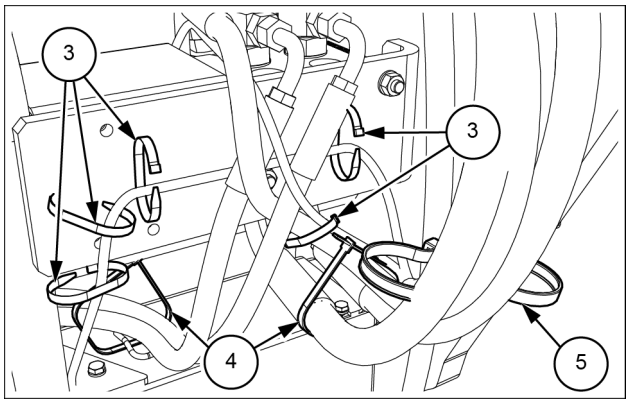
Z-bar configuration - “SSL” Quick coupler

6. Remove the cable tie **(3)**.
   Disconnect the electrical connector X-094 **(2)** from the flow diverter valve **(1)**.



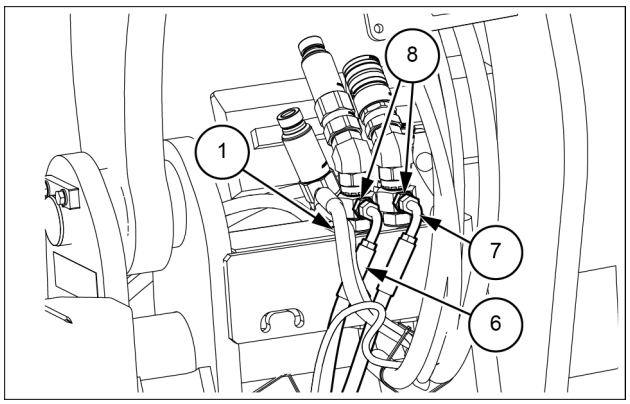
LEIL17CWL0286AB 11

7. Remove the cable ties **(3)**, **(4)** and **(5)**.



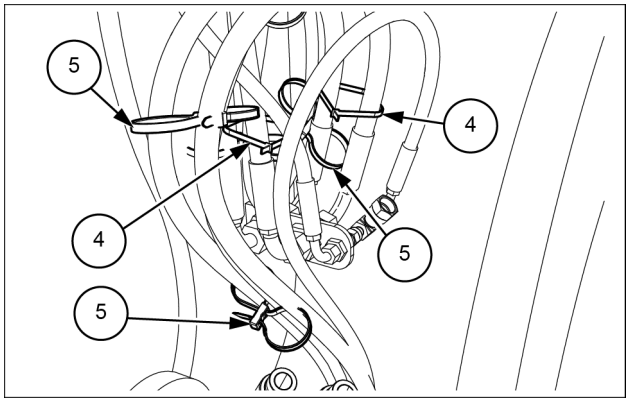
LEIL16CWL0606AB 12

8. Disconnect the hoses **(6)** and **(7)** from the fittings **(8)** on the flow diverter valve **(1)**.



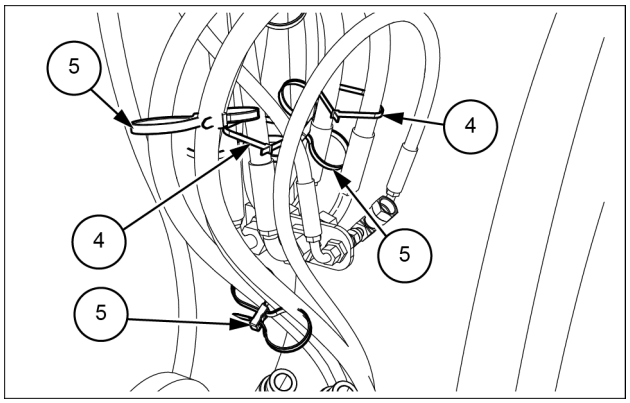
LEIL17CWL0287AB 13

9. Remove the cable ties **(4)** and **(5)** from the hoses on the loader arm.



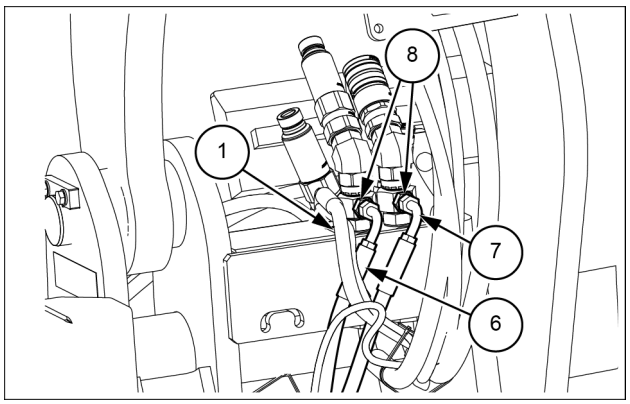
LEIL16CWL0608AB 14

7. Install the cable ties **(4)** and **(5)** on the hoses on the loader arm, as shown in figure **25**.



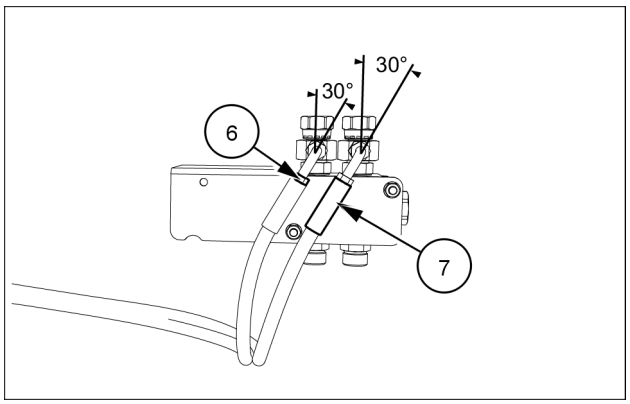
LEIL16CWL0608AB 25

8. Connect the hoses **(6)** and **(7)** to the fittings **(8)** on the flow diverter valve **(1)**.
   Tighten the hoses **(6)** and **(7)** to **27 N·m** (**19.9 lb ft**).



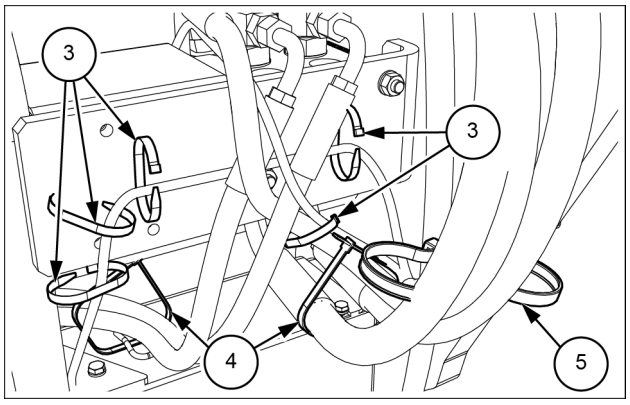
LEIL17CWL0287AB 26

NOTE: *apply the angle orientation shown in figure **27** when installing the hoses **(6)** and **(7)**.*



LEIL16CWL0087AB 27

9. Install the cable ties **(3)**, **(4)** and **(5)** as shown in figure **28**.

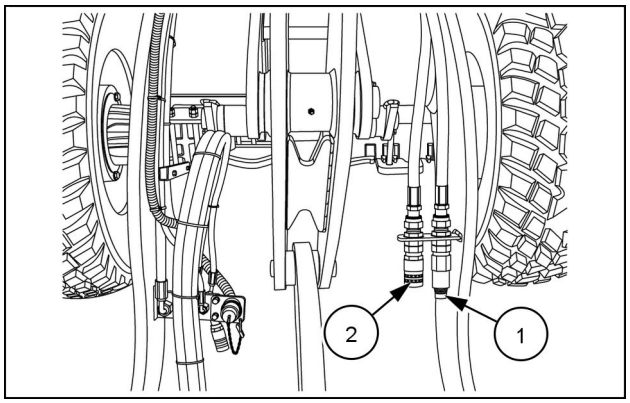


LEIL16CWL0606AB 28

Quick coupling - Remove - High flow

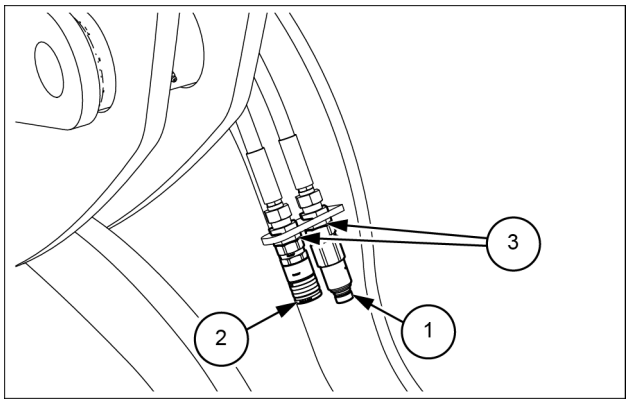
221F HS	WE
221F STD	WE
321F HS	WE
321F STD	WE

1. Park the machine on a level surface. Lower the bucket to the ground.
2. Stop the engine and apply the parking brake.
3. Place the direction-of-travel switch in neutral position.
4. Move the joystick in all directions to release the hydraulic pressure.
5. Place the wheel chocks against the tires to prevent machine movements.
6. The high flow male coupler **(1)** and female coupler **(2)** are located on the front arm.



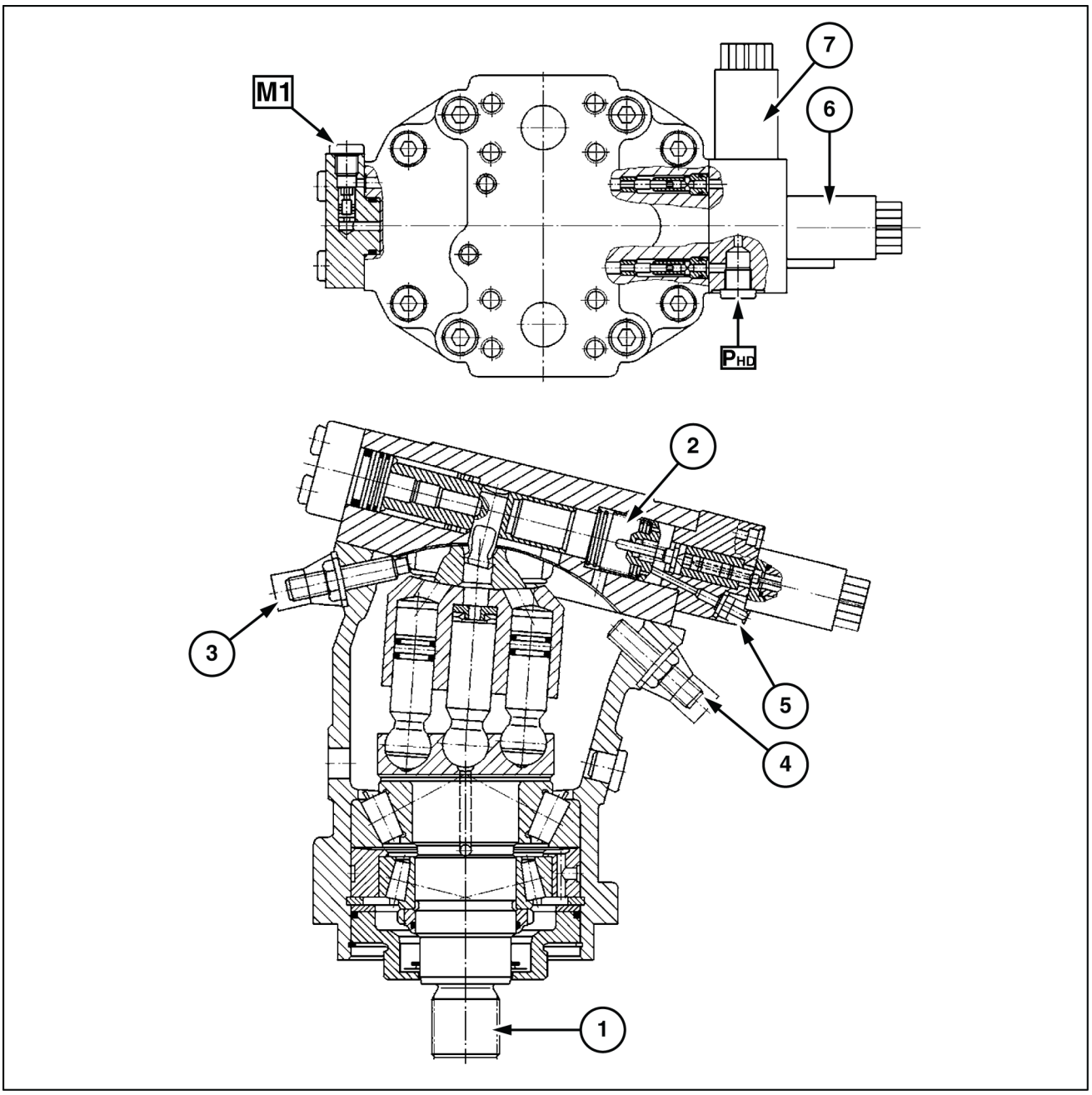
LEIL15CWL0099AA 1

7. Remove the male coupler **(1)** and the female coupler **(2)** from the bulkhead fittings **(3)**.



LEIL16CWL0571AB 2

Travel motor - Component identification

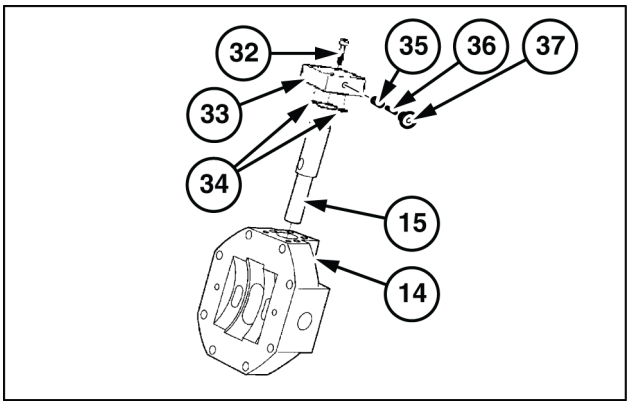


LELI12WHL0643GB 1

1. Rotary assembly
2. Regulator assembly
3. Qmin setscrew of swivel angle limitation; not adjustable
4. Qmax setscrew of swivel angle limitation
5. Setscrew
6. Solenoid valve
7. Travel direction valve

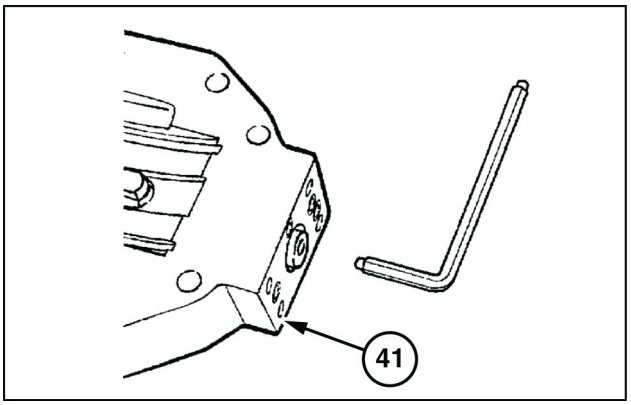
M1. Measuring point of regulation start
PHD. Measuring point of high travel pressure

11. Loosen and remove the screws **(32)**.
    Remove the cover **(33)** checking the condition of the O-ring **(34)**.
    Remove the actuator spool **(15)**.



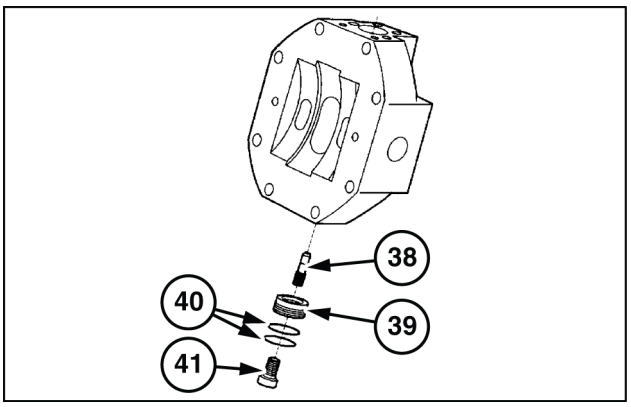
LELI12WHL0659AB 12

12. Loosen and remove the screw **(41)**.



LELI12WHL0660AB 13

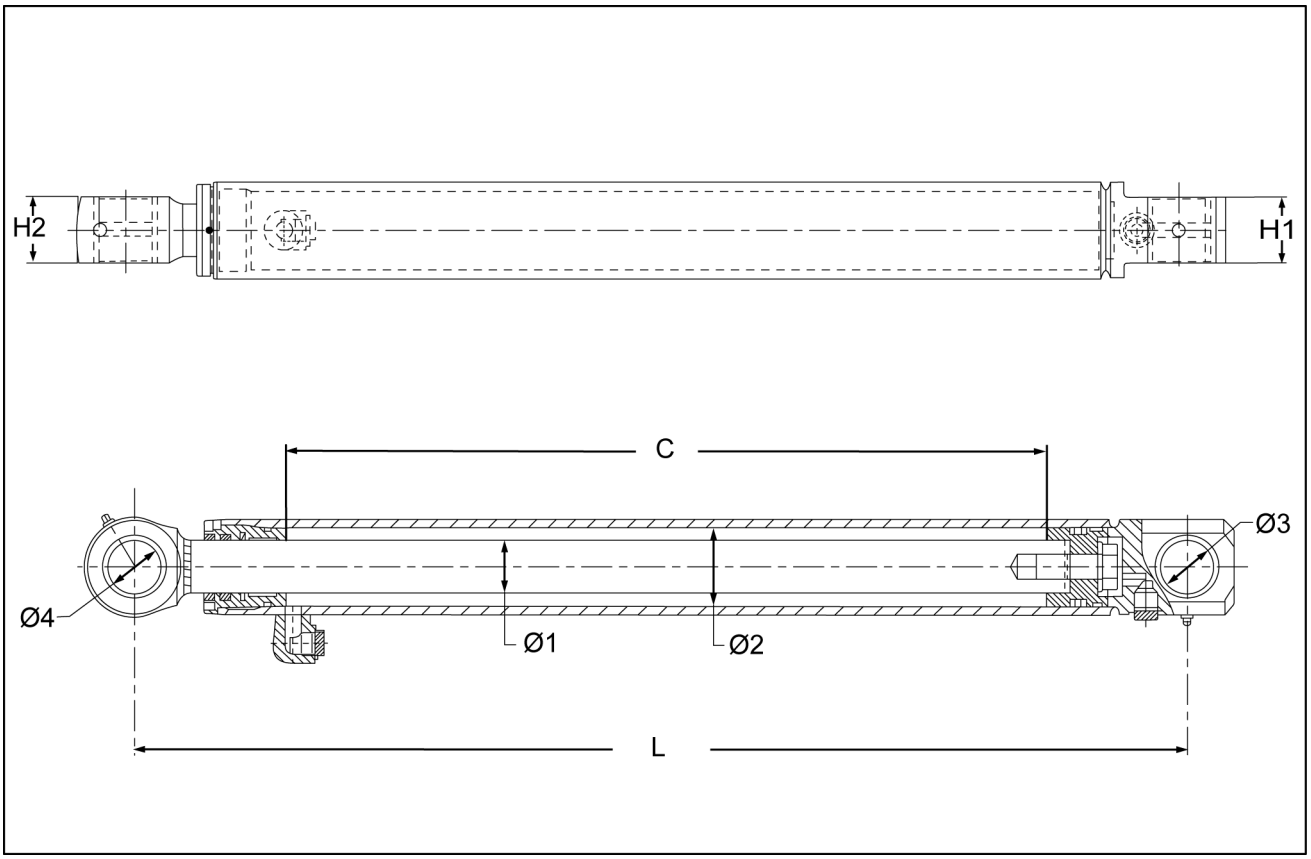
13. Remove the screw **(41)**, the valve body **(39)** and the pin **(38)**.
    Check the O-ring **(40)** conditions.



LELI12WHL0661AB 14

21F Z-BAR – 121F Z-BAR Models

Ø1	Rod	**50.8 mm** (**2.0 in**)
Ø2	Bore	**76.2 mm** (**3.0 in**)
Ø3	Bottom connection	**51 mm** (**2.0 in**)
Ø4	Rod connection	**51 mm** (**2.0 in**)
L	Completely retracted	**1007 mm** (**39.6 in**)
C	Stroke	**728 mm** (**28.7 in**)
H1		**63.5 mm** (**2.5 in**)
H2		**63.5 mm** (**2.5 in**)



LEIL14CWL0211FA 2

Lift arm cylinder - Disassemble

NOTE: *for the numbering, refer to* ***Lift arm cylinder - Exploded view (35.701)****.*

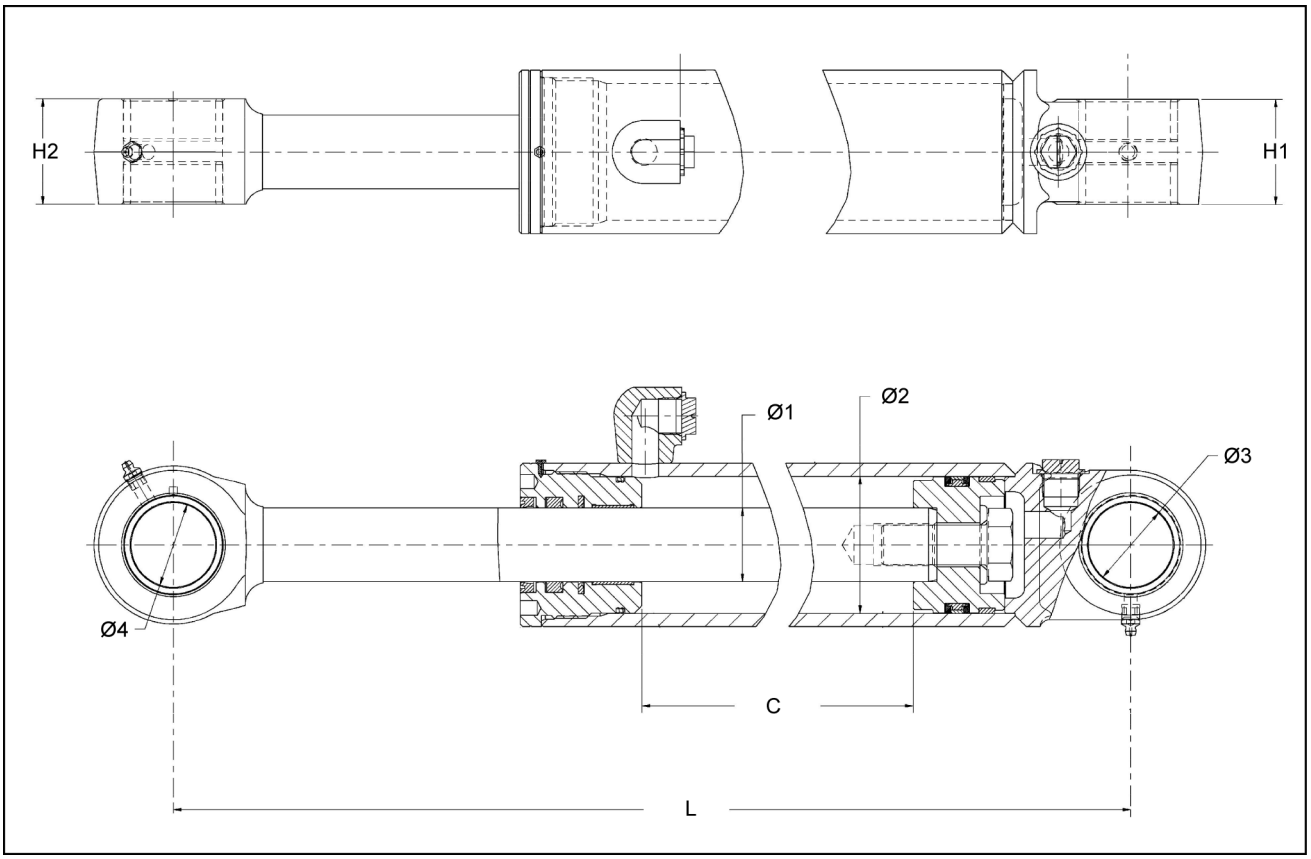
1. Clean the exterior of the cylinder. If the hoses were removed with the cylinder, remove the hoses from the cylinder.
2. Fasten the tube **(16)** in an acceptable repair stand or other holding equipment. Do not damage the tube **(16)**.
3. Loosen and remove the self-tapping screw **(4)**.
4. Use a spanner wrench to loosen and remove the gland **(8)** from the tube **(16)**.
5. Pull the rod **(1)** straight out of the tube **(16)** to prevent damage to the tube.
6. Fasten the rod eye or yoke in a vise and put a support under the rod **(1)** near the piston **(11)**. Put a shop cloth between the support and the rod to prevent damage to the rod.
7. Use a torque multiplier to loosen and remove the bolt **(15)** that fastens the piston **(11)** to the rod **(1)**.
8. Remove the piston **(11)** from the rod **(1)**.
9. Remove the gland **(8)** from the rod **(1)**.

NOTE: *the square ring* ***(13)*** *is only present on the TC/XT version.*

10. Remove and discard the square ring **(13)**, seal **(12)** and the wear ring **(14)** from the piston **(11)**.
11. Remove and discard the seal **(10)**, wiper **(6)**, rod/buffer seal **(7)** and bushing **(9)** from the gland **(8)**.

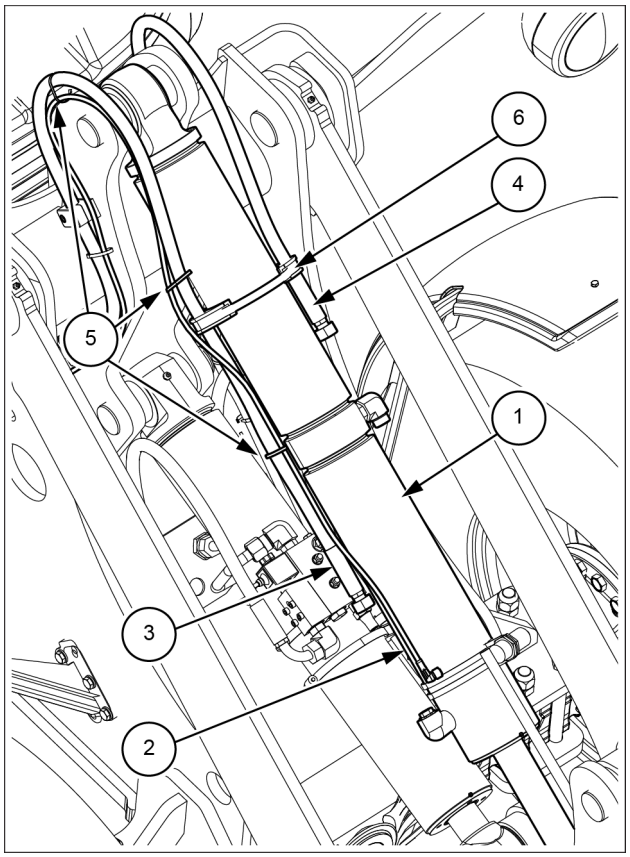
21F Z-BAR – 121F Z-BAR Models

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

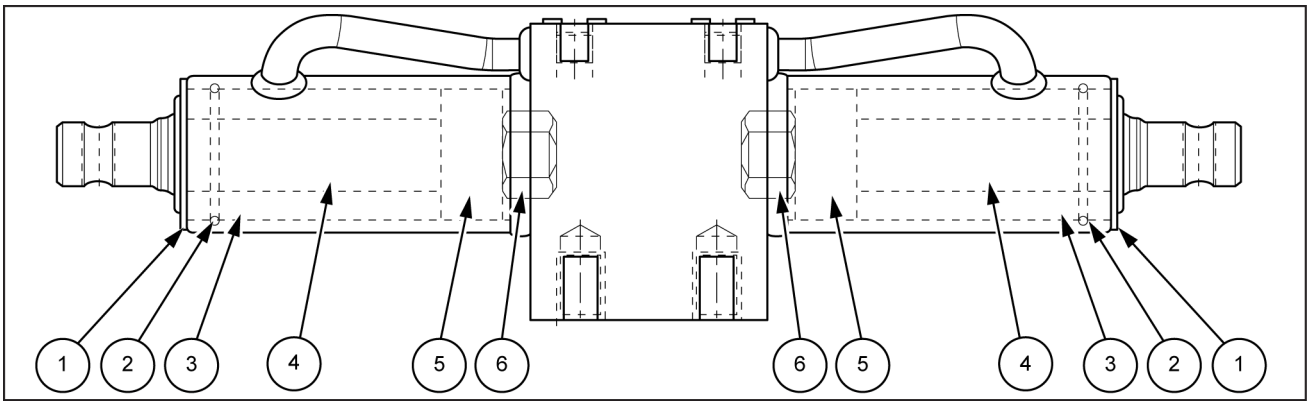
13. Place the hoses **(3)** and **(4)** next to the bucket cylinder **(1)**.
14. Install the tube clamp **(6)** to fasten the hoses **(3)** and **(4)** to the bucket cylinder **(1)**.
15. Place the wiring harness **(2)** next to the hose **(3)** and the bucket cylinder **(1)**.
16. Install the three cable ties **(3)** to tie the wiring harness **(2)** with the hose **(3)**.



LEIL17CWL0028BB 5

Next operation:
Relief valve - Install - Anti-drop valve (35.723)

Quick coupler cylinder - Component identification - Horizontal pin version

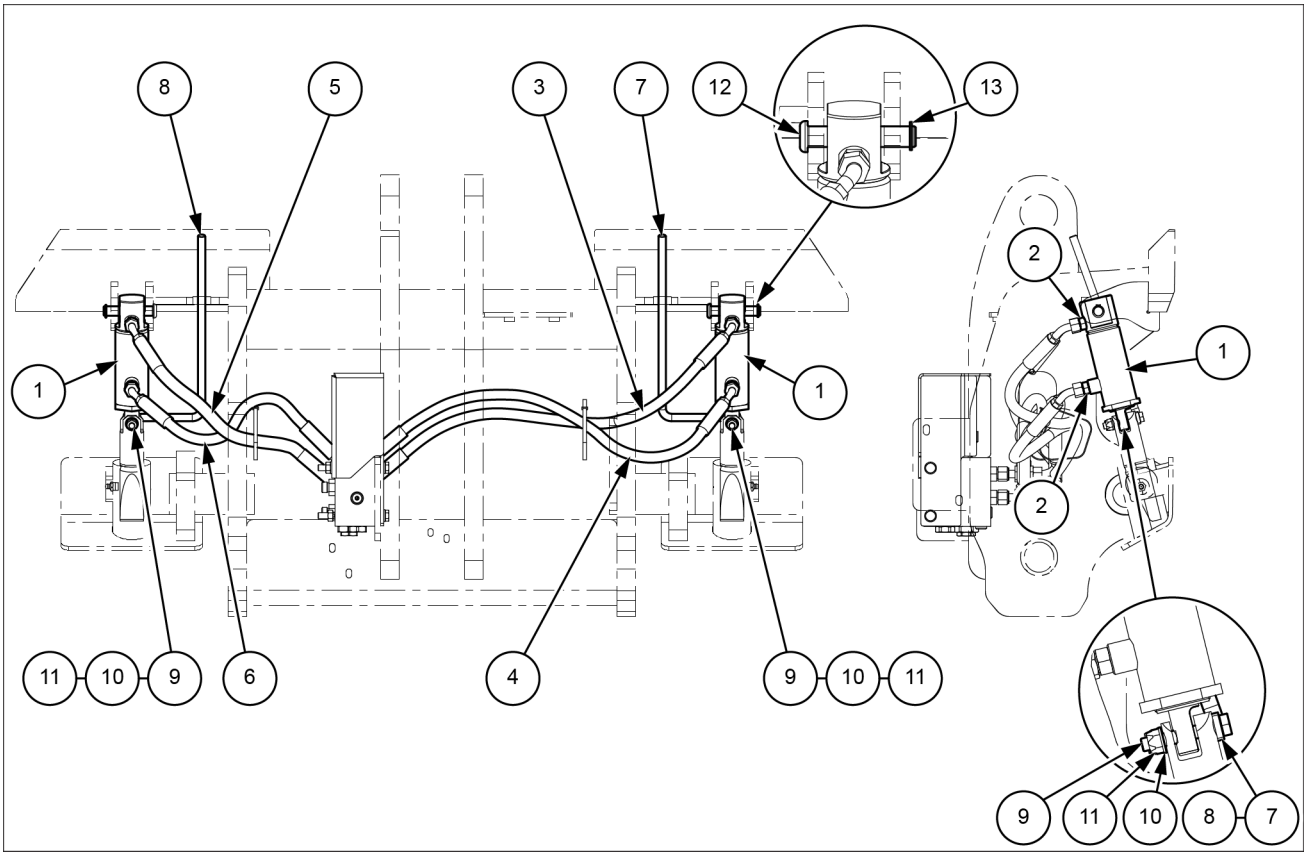


LEIL16CWL0175EB 1

1. Seeger ring
2. Retaining ring
3. Gland
4. Rod
5. Piston
6. Nut

Tool Carrier (TC)/XT configuration

NOTE: *if necessary, install new O-rings where required.*



LEIL17CWL0010FB 3

1. Position the Quick coupler cylinders **(1)** in the proper location on the Quick coupler frame. Install the handle pivot pin **(12)** and the retaining ring **(13)** on the Quick coupler cylinders **(1)**.
2. Position the left-hand position indicator rod **(7)** on the Quick coupler cylinder **(1)**.
3. Install the bolt **(9)**, the washer **(10)** and the nut **(11)** to fix the left-hand position indicator rod **(7)** to the Quick coupler cylinder **(1)**.
4. Repeat steps **2** and **3** for the right-hand position indicator rod **(8)**.
5. Install the fittings **(2)** on the Quick coupler cylinders **(1)**
6. Connect properly the hoses **(3)**, **(4)**, **(5)** and **(6)** to the fittings **(2)** installed on the Quick coupler cylinders **(1)**, as shown in figure **3**.

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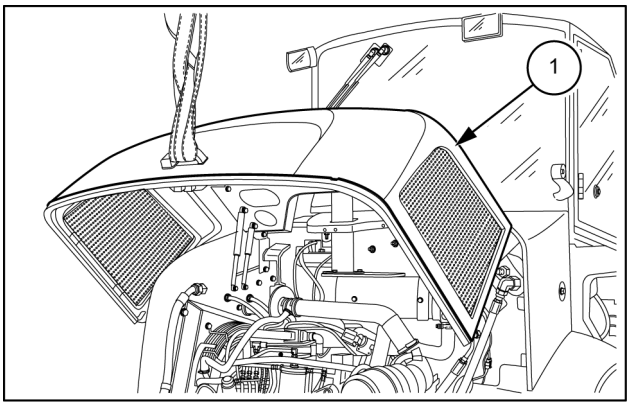
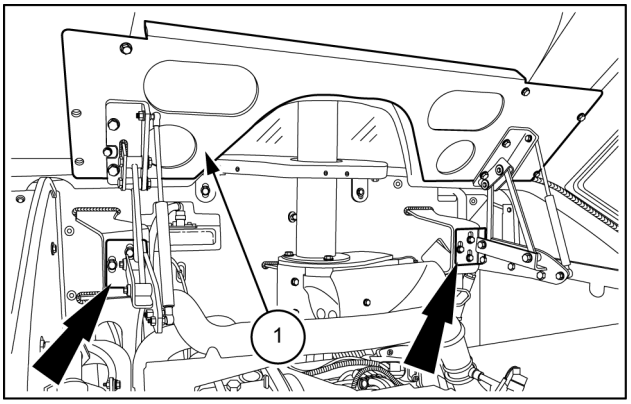
Frames and ballasting - 39

5. Connect a suitable lifting device to the hood **(1)**. Carefully raise the hood over the machine and lower into position.



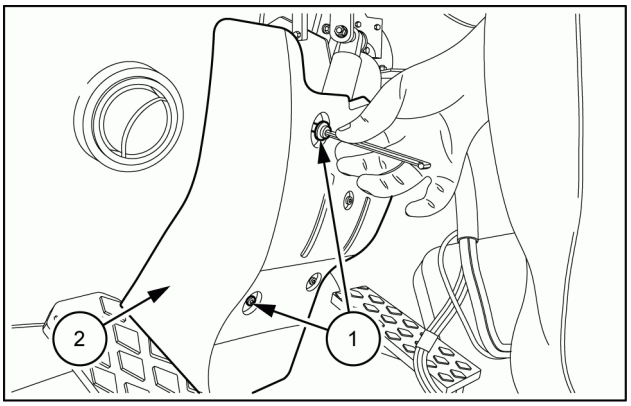
LEIL14CWL0216AB 5

6. Have another person to balance the hood **(1)** and install the hood hinge mounting bolts (arrows) on the machine structure.



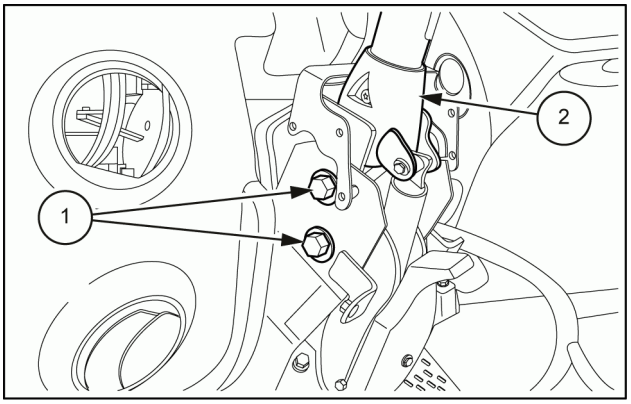
LEIL14CWL0162AB 6

9. From the inside of the cab, remove the screws **(1)** from the half column cover **(2)**.
   Remove the half column cover **(2)** from the steering column.
   Repeat the same operation for the other half column cover.



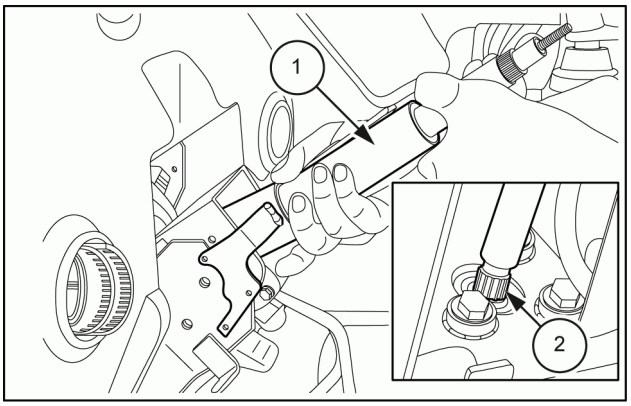
LEIL14CWL0736AB 9

10. Remove the fixing screws **(1)** of the steering column **(2)** on both sides.



LEIL14CWL0752AB 10

11. Remove the steering column **(1)**, being careful not to damage the connection **(2)** to the steering valve.



LEIL14CWL0753AB 11

14. Screw M5x10 (quantity 9)
15. Washer
16. Bracket
17. Gasket
18. Electric blower
19. Plate
20. Air duct
21. Gasket
22. Screw (quantity 2)

Air conditioning - Dynamic description - A/C thermal operation

The refrigerant circuit of the air conditioning system contains five major components:

- compressor,
- condenser,
- receiver-drier,
- expansion valve,
- evaporator.

These components are connected by tubes and hoses and operate as a closed system. The air conditioner system is charged with HFC-134a refrigerant.

The compressor receives the refrigerant as a low pressure gas. The compressor then compresses the refrigerant and sends it in the form of a high pressure gas to the condenser. Air flow through the condenser removes the heat from the refrigerant. As the heat is removed the refrigerant is “condensed” to a high pressure liquid.

The high pressure refrigerant liquid flows from the condenser to the receiver-drier. The receiver-drier is a container filled with moisture removing material, which removes any moisture that may have entered the air conditioner system in order to prevent corrosion of the internal components.

NOTE: *not all refrigerant leaves the condenser as a liquid. Some leaves as a gas without affecting system performance. Liquid refrigerant pools at the bottom of the receiver-drier, while the lighter gas collects at the top. Since the pick-up tube draws refrigerant from the bottom of the receiver-drier, only liquid refrigerant flows to the thermal expansion valve.*

The refrigerant, still in high pressure liquid form, flows from the receiver-drier to the expansion valve. The expansion valve provides a restriction to refrigerant flow to cause a pressure drop which allows the liquid refrigerant to expand, decreasing its temperature and pressure.

NOTE: *the thermal expansion valve is internally equalized: the need for refrigerant to handle the heat load is balanced with the ability to fully vaporize the refrigerant within the one valve.*

This low temperature, low pressure liquid or mist flows through the evaporator. The hot cab air passes through the evaporator fins cooling the air and evaporating the liquid refrigerant.

The low pressure gas returns to the compressor and the cycle starts all over again.

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ITEM	DESCRIPTION	CODE COMPONENT	SHEET
122	Heatshrink	SP-049	15
123	Heatshrink	SP-052	13
124	Floating switch	X-042	13
125	Ride control	X-032	13
126	Return to diag	X-035	13
127	Heatshrink	SP-GND2	9
128	1st/2nd gear switch	X-033	13
129	Main hydraulic switch	X-034	15
130	CAB roof interconnect	X-401S	17-18- 19-20
131	Telematics	X-076	22
132	Air suspension	X-258	22
133	Heatshrink	SP-LED3	20
134	Ground	X-240	9
135	Atum heatshrink	SP-GND4	
136	Heatshrink	SP-037	18
137	Rotary beacon	X-057	18
138	Heatshrink	SP-LED5	20
139	Rear work light	X-046	18
140	Front work light	X-045	18
141	Heatshrink	SP-005	15
142	Ground	X-200	9

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

Electrical system - Electrical schematic sheet 06 - Harness of right-hand travel light and horn

ITEM	DESCRIPTION	CODE COMPONENT	SHEET
1	Chassis interconnect	X-501P-1	17
2	Chassis interconnect	X-501P-2	17
3	Chassis interconnect	X-501P-3	17
4	Chassis interconnect	X-501P-4	17
5	Chassis interconnect	X-501P-5	17
6	Chassis interconnect	X-501P-6	17
7	Heatshrink	SP-035	9
8	Right hand front road light	X-051	17
9	Horn	X-065A	20
10	Horn	X-065B	20

Electrical system - Electrical schematic sheet 15 - Battery cable

ITEM	DESCRIPTION	CODE COMPONENT	SHEET
1	Battery positive	X-418	2
2	Battery positive	X-419	2

Electrical system - Electrical schematic sheet 24 - Arm harness of front auxiliary electrical system

ITEM	DESCRIPTION	CODE COMPONENT	SHEET
1	Arm AUX jumper	X-610P	26
2	Multifunction attachment	X-608P	26

Harnesses and connectors - Electrical schematic sheet 05

Power distribution, fuse module, X-002

Location	Component	Code component
8	Fuse transmission speed sensor (**5 A**)	F-031
8	Fuse RTD proximity sensor (**5 A**)	F-032
8	Fuse cluster wake-up & brake fluid level (**7.5 A**)	F-033
8	Fuse seat air suspension (**30 A**)	F-034
8	Fuse hazard sw. (**15 A**)	F-035
8	Fuse LH front/RH rear road lights (**5 A**)	F-036
8	Fuse RH front/LH rear road lights & number plate light (**5 A**)	F-037
8	Fuse cab switches backlight (**5 A**)	F-038
8	Fuse hand brake switch (**5 A**)	F-039
8	Fuse ignition signal ECU (**7.5 A**)	F-040
8	Fuse module	Z-006

Harnesses and connectors - Electrical schematic sheet 11

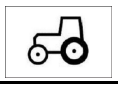
Engine control, engine control unit

Location	Component	Code component
15	Air temperature sensor	B-001
10	Engine control unit	A-011
15	Exhaust gas temperature sensor #1	B-011
15	Exhaust gas temperature sensor #2	B-012
6	Glow control unit (GCU)	A-012
2	G1-Glow Plugs (Cyl.1)	R-001
2	G2-Glow Plugs (Cyl.2)	R-002
2	G3-Glow Plugs (Cyl.3)	R-004
2	G4-Glow Plugs (Cyl.4)	R-005
15	Inlet turbine temperature sensor (T3)	B-007
6	Lambda sensor	B-005
2	Water in fuel switch	B-004

Harnesses and connectors - Electrical schematic sheet 19

Multifunction lever, front and rear wiper switch

Location	Component	Code component
6	Diode module	D-003
11	Front & rear wiper washer motor	M-004
13	Front wiper motor	M-002
4	Multifunction Lever Front & Rear Wiper	Z-002
13	Rear wiper motor	M-003
8	Relay timer circuit for front wiper	K-010
8	Relay timer circuit for rear wiper	K-011
8	Timer Circuit	Z-008

Fault Code Range	Sub-system	Icon
2001-3000	Driveline Control (UCM)	
3001-4000	Engine Control (UCM)	
4001-5000	Electro Hydraulic Control (UCM)	
12001-13000	Brake Control (UCM)	
13001-14000	Vehicle Control (UCM)	
14001-15000	Instrument Cluster (ADIC)	

Fault code check

Type of Fault Code	Intervention
Input	After the restoration and the validation of a fault code, if the fault code is removed, the fault code is not more valid
Output	After the restoration and the validation of a fault code, if the fault code is removed, the fault code remains valid and present until the performing of a key cycle
Power rails	After the fault code validation and after a fuse restoring, the fault code on power rail is not more valid. All the Fault codes of the type “power supply”, on all the power rail functionality, are set on power rail after the zero setting of the fault code. The Fault codes are not more valid to the next key cycle.

The recommendable procedure to restore a fault code is:

1. Key OFF / Battery OFF
2. Fault code removal
3. Key ON, clear the errors memory
4. Key OFF
5. Key ON, check the Fault code again

The key cycle of the steps 4. and 5. must occur with a time of at least 5 seconds.

2761 - Power supply fault on Reverse solenoid (HSD)

Control Module: UCM

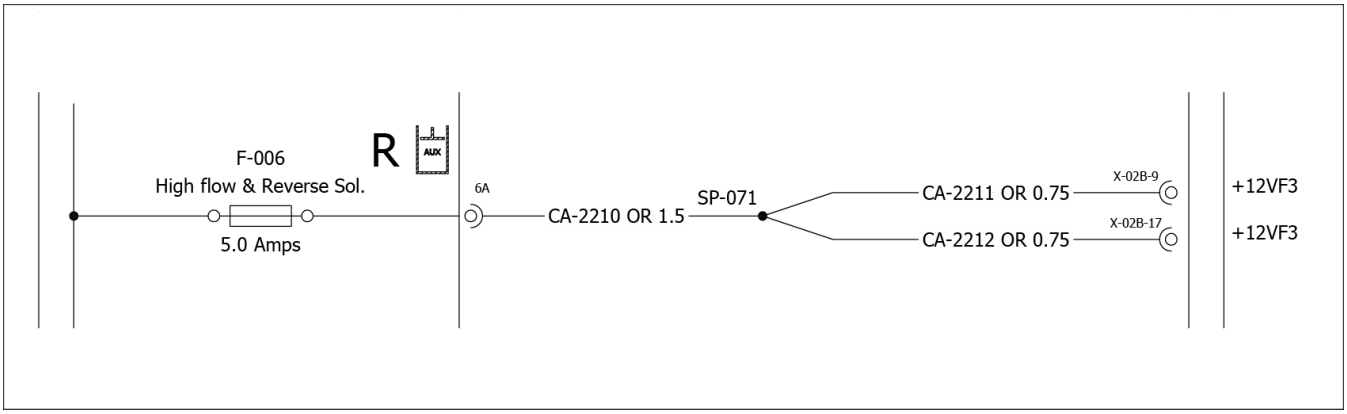
Context:
The error code on HSD Power supply is linked to the error code on relevant Power rail. The error can be displayed after the execution of the remedial action for the power rail fault, if reset with key cycle is not performed.

Possible failure modes:

1. Faulty fuse F-006 (**5 A**).

Solution:

1. Replace the fuse F-006 (**5 A**) on the Fuse module.



LEIL15CWL0008EA 1

2801 - Power supply fault on Turtle/Rabbit solenoid (HSD)

Control Module: UCM

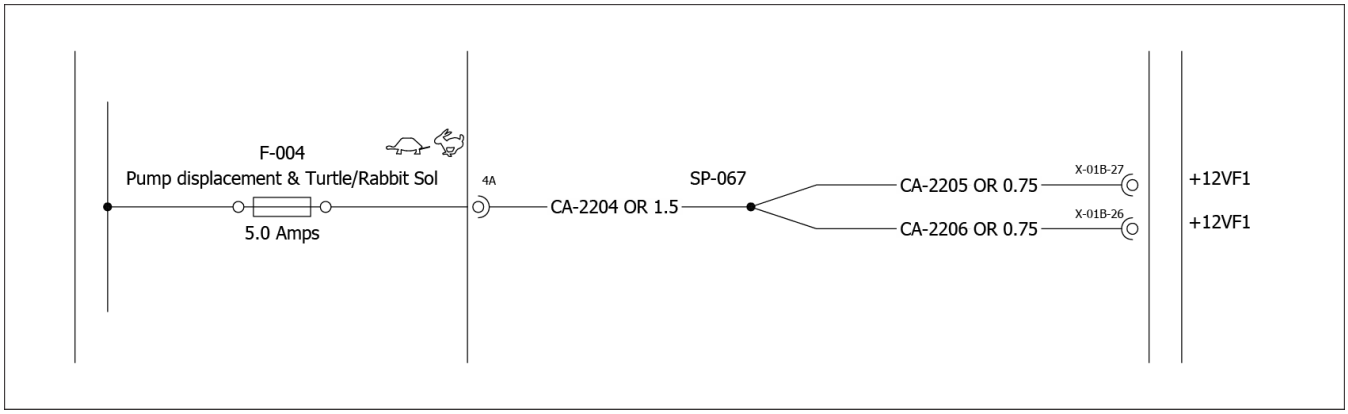
Context:
The error code on HSD Power supply is linked to the error code on relevant Power rail. The error can be displayed after the execution of the remedial action for the power rail fault, if reset with key cycle is not performed.

Possible failure modes:

1. Faulty fuse F-004 (**5 A**).

Solution:

1. Replace the fuse F-004 (**5 A**) on the Fuse module.



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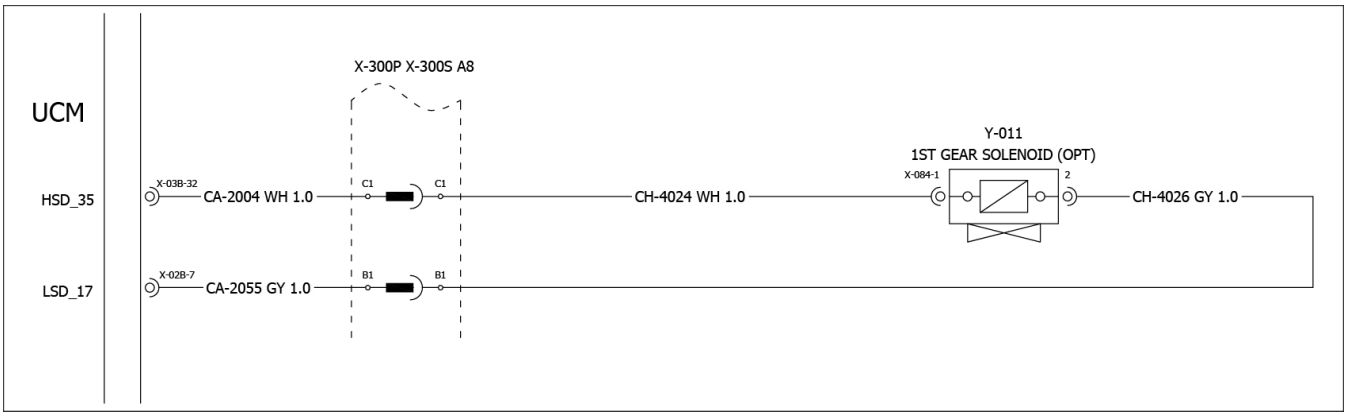
2832 - Short circuit to battery on 1st Gear solenoid (LSD)

Control Module: UCM

Context:
UCM has detected a short circuit to battery on the 1st Gear solenoid supply line with function not active.

Solution:

1. Check if the connection X-03B-32 of UCM is shorted to battery (**12 V**).
2. Check if the connection X-300-C1 is shorted to battery (**12 V**).
3. Check if the connection X-084-1 of solenoid Y-011 (valve) is shorted to battery (**12 V**).



LEIL15CWL0014EA 1

2870 - Plausibility check failed on Creep speed Plus/Mem-Minus switch command

Control Module: UCM

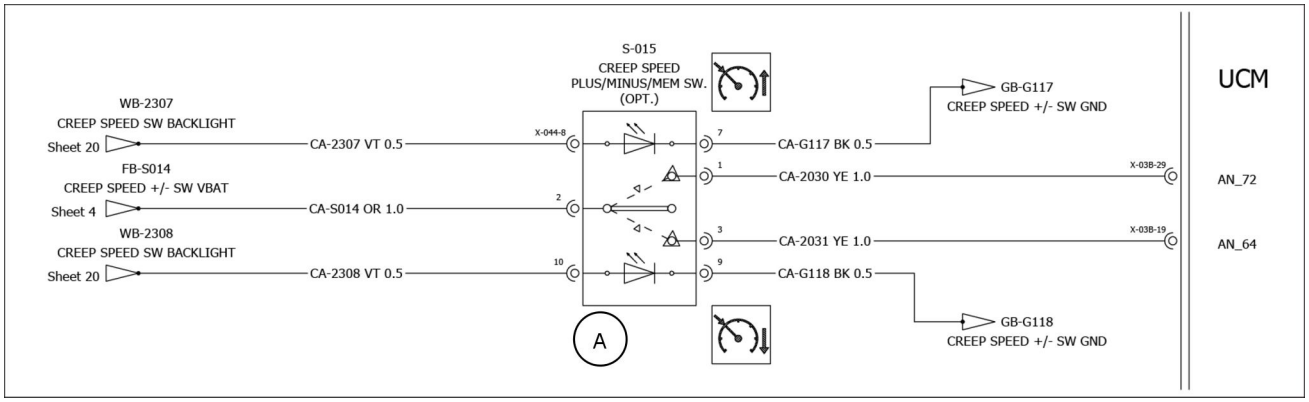
Context:
UCM has detected no plausibility between Creep speed Plus/Mem-Minus switch command.

Possible failure modes:

1. Pin X-03B-19 or X-02B-29 of UCM is shorted to ground.
2. Faulty UCM.

Solution:

1. Check the Creep speed Plus/Mem-Minus switch **(A)**. If the Creep speed Plus/Mem-Minus switch **(A)** is faulty, replace the Creep speed Plus/Mem-Minus switch **(A)**.
2. Check the connection between X-044-1 and X-03B-29.
3. Check the connection between X-044-3 and X-03B-19.
4. UCM does not work properly. Replace the UCM.



LEIL15CWL0019EA 1

3008 - Engine Coolant Temperature Sender - Open Circuit

Context:
Instrument Cluster has received a message from the ECM that the Engine Coolant Temperature Sender signal is below the minimum range.

Cause:
Instrument Cluster has received a message from the ECM that the Engine Coolant Temperature Sender signal is below the minimum range. The ECM monitors coolant temperature on X-078 pin 58 and sends a message via the CAN Bus to the Instrument Cluster. The signal voltage is less than **0.2 V**.

Possible failure modes:

1. Coolant temperature signal wire shorted to ground or has an open circuit.
2. Failure of Engine Coolant Temperature Sender.
3. Failure of ECU.

Solution:

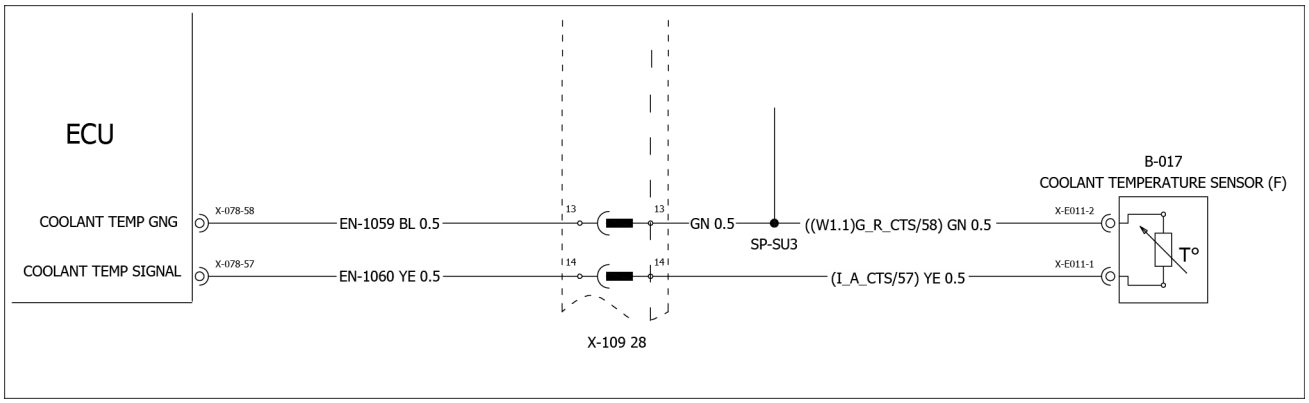
1. Verify that the fault code is still active.

   (1) Use the Electronic Service Tool to clear all fault codes. Prior to clearing fault codes write down all fault codes, number of occurrences, and engine hours at last occurrence.

   (2) To check for fault code: Start and operate machine.

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

   B. Fault code 3008 is recorded again. Go to Step **2**.
2. Verify that the wiring and connectors are free of damage.



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Schematic Legend			
(1)	Coolant Temperature Sender	**(3)**	ECU connector X-078 Sender ground, pin 58 Coolant Temperature signal pin 57
(2)	Connector X-109 Sender ground, pin 13 Coolant Temperature signal pin 14		

(1) Inspect the ECU and the Coolant Temperature sender. All connections should be secure, tight, free of corrosion, abrasion and damage.

(2) Inspect the harness from the ECU to the Coolant Temperature sender. 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**.

3061 - Cylinder 1 - Injector Cable Short Circuit (Low Side To Battery)

Control Module: ECU

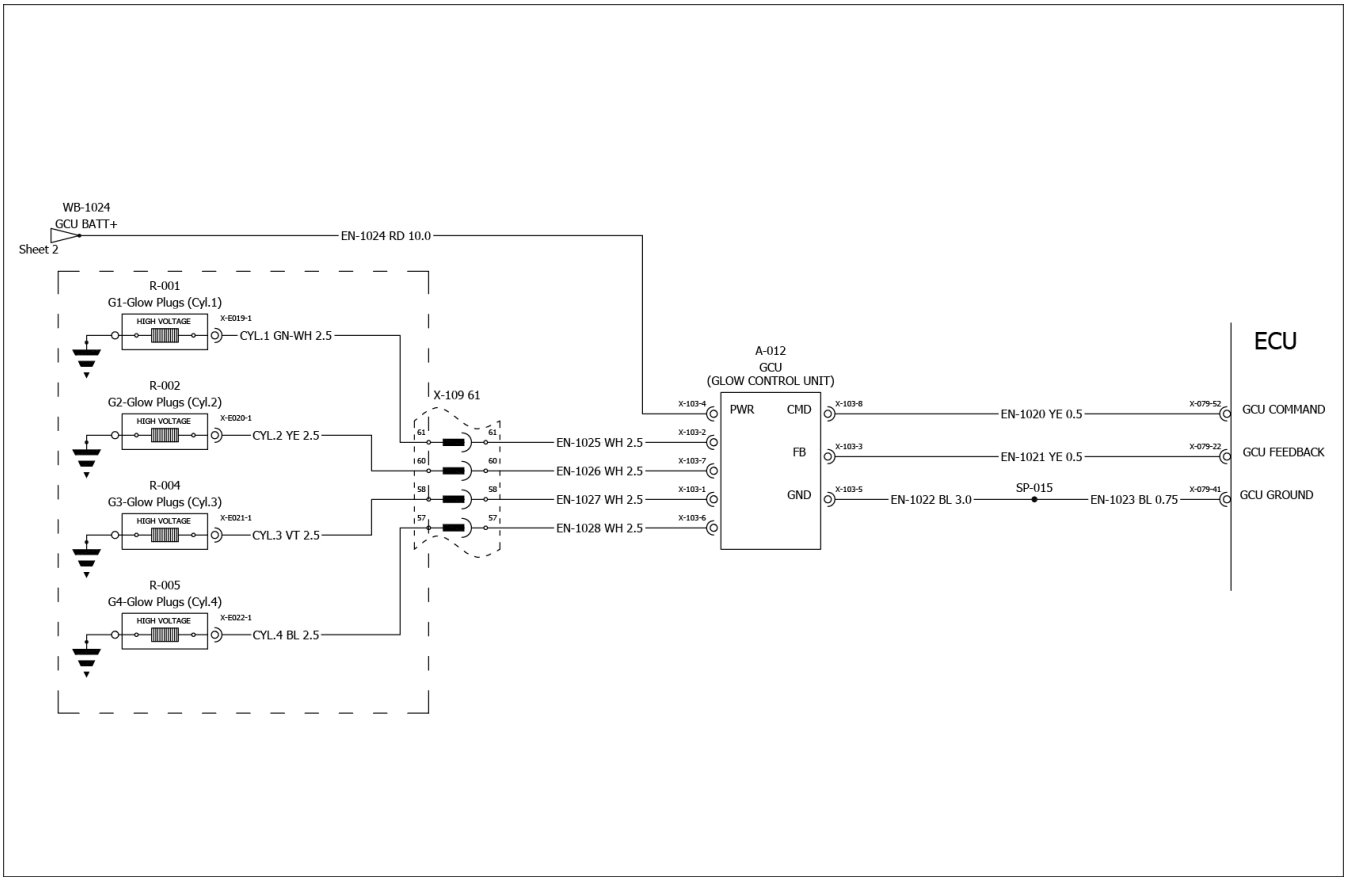
Context:
The Engine Control Unit (ECU) generated an error associated with the injector power driver stage. Diagnostic procedure uses pattern detection to identify specific errors and trigger appropriate substitute reaction. The behavior pattern describes in a bit mask different detected problem (over current, command collision, RAM error, short circuit) when the expected combination of errors is detected (measured and reference pattern are matching) a failure is detected and the fault code is generated.

Possible failure modes:

1. Short circuit at the wiring harness.
2. Short circuit at the injector of the cylinder 1.

Solution:

1. Check the wiring harness.
2. Check the fuel injector of the cylinder 1. If the injector is faulty replace it.



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6. Check voltage and ground supply to ECU. Disconnect ECU vehicle connector 1 and use a multi-meter to verify the ECU has sufficient supply voltage and ground paths. Use the table below as a reference.

Test Type	From	To	Expected Results
1. Voltage	ECU vehicle connector X-079, (Pin: 1, 3, 5, 54)	Ground (engine block)	Approx. **12 V** (DC)
2. Continuity	ECU vehicle connector 1, (Pin: 2, 4, 6)	Ground (engine block)	Approx. **0 – 0.10 Ω**

   A. If the voltage supply and ground paths are sufficient, continue with step **7**.

   B. If the voltage supply and ground paths are not present, use the vehicle schematics to find and repair the cause.

7. 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.

3105 - Rail Pressure Relief Valve - Pressure Shock Requested

Context:
The engine control unit (ECU) has determined that the fuel rail/system pressure is too high and the pressure relief valve (PRV) did not open. Normally the fuel pressure in the rail is regulated by the metering unit of the high pressure pump. However, if this component is malfunctioning the rail pressure can rise to critical levels. For this reason the common rail has a PRV which is a mechanical safety valve (no electrical connectors) that opens at a certain pressure level. An opening of the PRV is detected by evaluating the gradient of the rail pressure (calculated by the ECU). If the PRV does not open on its own after exceeding the pressure threshold it can also be forced open by a so-called 'kickoff' or pressure shock when the metering valve of the high pressure fuel pump is set to maximum possible quantity. Rail pressure in excess of **148500 kPa** (**21538.1 psi**) for **1 s** evokes a kickoff (pressure shock) request by the ECU. If the pressure shock (kickoff) does not immediately open the PRV, this error will occur. This fault will only be cleared after an ECU reset.

Possible failure modes:

1. Faulty ECU, improper data set.
2. Faulty PRV, mechanical valve does not function.

Solution:

1. Use the EST to flash the ECU with the appropriate data set.
   A. If the error reoccurs, replace the PRV.
   B. If the error does not reoccur, return the combine to service.

3176 - Setpoint of metering unit not plausible in overrun

Context:
The engine control unit (ECU) has determined that the Metering Unit (High Pressure Pump Regulator solenoid/valve) has excessively opened to reach the desired Rail pressure. The rail pressure is monitored by various fault paths during active pressure control by the metering unit. The fault path at hand detects an excessive leakage of fuel by monitoring the set-point value of the fuel volume flow through the metering unit during overrun. The monitoring is only active if the high pressure governor (High Pressure Pump Regulator solenoid/valve) is operating in closed loop control, the engine is in overrun condition, the fuel injection quantity is zero and the monitoring has not been inhibited by other faults. If the set-point value of the rail pressure governor for the fuel volume flow through the metering unit exceeds an upper limit over 2.5 seconds this error will occur. [This limit is interpolated from the rail pressure dependent curve, established by the ECU]. This error is the result of leakage in the high pressure section; injection nozzle stuck in open position, worn or defective high pressure pump, worn injector, leaking pressure relief valve. or leakage in the low pressure system; 'Zero delivery' is not active in metering unit (excessive leakage in metering unit).

3218 - Bank 2 - General Short Circuit On Injector Cable

NOTE: *this diagnostic procedure requires a good quality Digital Multi-meter (DMM) to accurately measure resistance . The DMM must measure to a resolution of* ***0.1 Ω****. The required measurements are as low as* ***0.4 Ω*** *(typical injector solenoid coil resistance is* ***0.4 – 0.5 Ω****) and any DMM inaccuracies will cause the technician to inaccurately troubleshoot.*

NOTE: *ensure the DMM's test lead resistance is considered when measuring resistance. Touch the leads together on the lowest Ohms scale and record the resistance measurement. Subtract this value from all future resistance measurements.*

Context:
The Engine Control Unit (ECU) has determined a short circuit exists in an injector cable in Bank 2 (Group B, Cylinders 2 & 3). A power stage component energizes the injection system transistors while observing the current flow in the high-side and low-side switching branch by sensing resistors. Deviations from the expected current flow are detected as specific errors by the component and reported to the ECU. Error messages are configured to contain information on performed injections, same bank cylinder errors, bank specific errors and cylinder specific errors. The configured error message is compared to applicable error patterns, and the failure matching the pattern is output. If an error message doesn't match a pattern the defect becomes an unclassifiable error. Monitoring is performed once per camshaft revolution. This error is a result of a general short circuit of the high side to battery or ground over 4 camshaft revolutions. This error shuts off an individual cylinder or bank, based on ECU parameters. Certain parameters, as currently applied, are permanent; there is no healing possibility after testing: switching on the component to ascertain the defect's presence. Others evoke an irreversible or reversible engine shut off.

Cause:
The Engine Control Unit (ECU) has determined that there is a fault associated with the current monitoring of an injector output power driver stage in Bank 2.

Possible failure modes:

1. Faulty electrical wiring.
2. Faulty injection valve or shorted solenoid windings.
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 code: Start and operate machine.

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

   B. Fault code 3218 is active and recorded again. Go to step **2**.
2. Verify that the wiring and connectors are free of damage.

   Inspect the ECU and all four injector connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

   Inspect the harness from the ECU to all four injectors. 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 through the harness.

   Turn the ignition switch OFF.

   Disconnect ECU connector X-078.

3255 - ADC Monitoring Test Impulse Error

Context:
The Analog Digital Converter (ADC) of the Engine Control Unit (ECU) is monitored for plausibility using redundantly read input and test voltage inputs.

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.

3301 - Fuel high pressure pump is at minimum delivery and the Rail pressure is not reducing

Context:
The engine control unit (ECU) has determined that the Fuel Rail/System Pressure is too high with a closed Metering Unit (High Pressure Pump Regulator - solenoid valve). The rail pressure is monitored by various fault paths during active pressure control by the metering unit. The fault path at hand detects an excessive negative rail pressure governor deviation (too high rail pressure) at zero delivery of fuel volume flow through the metering unit. The monitoring is only active if the high pressure governor is operating in closed loop control, the engine is not in overrun, the fuel system temperature is above **29.96 °C** (**85.93 °F**), the current injection quantity is above **0.0 g** (**0.00 oz**) per cycle and the monitoring has not been inhibited by other faults. If the negative rail pressure governor deviation is below the engine speed dependent limit from a curve established by the ECU and the rail pressure governor set-point value of the fuel volume flow is below threshold (parameter established by the ECU) over 8 seconds, this error will occur.

Cause:

Possible failure modes:

1. Faulty high pressure pump regulator solenoid/valve, stuck open.
2. Pressure too high, low pressure side.

Solution:

1. Check for high pressure pump regulator (solenoid/valve) errors.
   A. If high pressure pump regulator (solenoid/valve) errors exist, follow troubleshooting procedure for existing high pressure pump regulator (solenoid/valve) error.
   B. If no high pressure pump regulator (solenoid/valve) errors exist, locate and repair high pressure condition in low pressure side of fuel system.

3370 - Torque limitation due to engine protection

Context:
The Engine Control Unit (ECU) has detected an active power reduction due to engine mechanics protection. This error is for informational purposes and is initiated by a power reduction due to engine mechanics protection being active causing a torque limitation greater than **25%** of the desired torque for longer than 60 seconds and is reset once the torque limitation due to engine mechanics protection is less than **25%** of the desired torque over 10 seconds. Though no action is necessary due to this error, if the power reduction occurred due to an actual defect, the error triggering the torque limitation should also be in fault memory. Follow the troubleshooting procedure for that error.

3415 - Short circuit in cylinder 2 glow plug

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

   B. A fault code pertaining to the glow plugs is active. Fault code 3414, 3415, 3416 or 3417 is recorded again. Go to step **2**.

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

Wiring connections	Circuit Name	Wiring connections GCU
X-079 pin 22	GCU Diagnostics	X-103 pin 3
X-079 pin 41	Glow plug ground	X-103 pin 5
X-079 pin 52	GCU Control ST	X-103 pin 8
X-109 pin 58	Glow Plug Cylinder 3	X-103 pin 1
X-109 pin 61	Glow Plug Cylinder 1	X-103 pin 2
	Battery supply	X-103 pin 4
X-109 pin 57	Glow Plug Cylinder 4	X-103 pin 6
X-109 pin 60	Glow Plug Cylinder 2	X-103 pin 7

   Inspect the ECU, GCU and the glow plug connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

   Inspect the harness from the GCU to the glow plugs. 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 through the glow plug wire.

   Turn the ignition switch OFF.

   Disconnect GCU connector X-103. Measure the resistance between the glow plug wire on connector X-103 and chassis ground. The chassis ground connection must be clean and free of paint, oil and dirt. The resistance should be approximately **1 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

GCU connector	A-011 connector	Cylinder
X-103 pin 1	X-109 pin 58	Cyl. 3
X-103 pin 2	X-109 pin 61	Cyl. 1
X-103 pin 6	X-109 pin 57	Cyl. 4
X-103 pin 7	X-109 pin 60	Cyl. 2

   A. The resistance is approximately **1 Ω**. Temporarily replace the GCU and retest. Return to step **1** to confirm elimination of the fault.

   B. The resistance is less than **0.75 Ω**. Go to step **4**.

   C. The resistance is greater than **20000 Ω**. There is an open circuit in the glow plug wire or the glow plug. Repair as required. Return to step **1** to confirm elimination of the fault.

4. Measure the resistance at the glow plug.

   Turn the ignition switch OFF.

3433 - Moderate inducement

Control Module: ECU

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 Oxidation Catalyst ‘DOC inducement’. If at least one error belonging to '(DOC) inducement’ group is set and the engine is running, the timer for inducement level 1 (less severe torque reduction) is increased. When timer exceeds **0 s** and at least one error belonging to the triggered group is active, level 1 for ‘DOC inducement’ group is set.

Cause:
The Engine Control Unit (ECU) has detected a fault with the Diesel Oxidation Catalyst (DOC) and inducement level, due to ‘DOC inducement’ has been activated.

Possible failure modes:

1. DOC system failure.

Solution:

1. Check for other fault codes relating the to the DOC system.
   A. If other DOC 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.

3666 - Permanent governor deviation for valve

Context:
The negative limit of EGR valve governor deviation has been exceeded.

Cause:
Desired EGR valve position can not be reached due to sticking EGR valve. Possible EGR valve position sensor mismatched.

Possible failure modes:

1. Faulty wiring.
2. EGR valve binding inside assembly.

Solution:

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

   Inspect the ECU and the EGR valve connections. 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 or incorrect attachment.

   A. The connectors are secure and the harness is free of damage. Go to step **2**.

   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.
2. Verify the fault code is still present and in an active state.

   A. If the fault is no longer active or present, OK to return the machine to service.

   B. If the fault is still present and active, temporarily replace the EGR valve assemble and retest. Return to step **1** to confirm elimination of the fault.

4. Measure for stray voltage to chassis ground.

   Turn the key switch OFF.

   Disconnect the ECU connector, X-078. Disconnect the EGR valve connector.

   Turn the key switch ON.

   Measure the voltage from ECU connector X-078 pin 9 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 39 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 24 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**. Go to Step **4**.

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

5. Measure the resistance through the position sensor

   Turn the key switch OFF.

   Disconnect the EGR valve.

   Measure the resistance between the EGR position sensor supply pin and the EGR position sensor signal pin. The resistance should be less than **10000 Ω**. If possible, move the valve while monitoring the resistance. The resistance should change at an even rate.

   Measure the resistance between the EGR position sensor supply ground and the EGR position sensor signal pin. The resistance should be less than **10000 Ω**. If possible, move the valve while monitoring the resistance. The resistance should change at an even rate.

   A. The resistance is less than **10000 Ω** and the resistance changes at an even rate when the valve is moved. Temporarily replace the ECU and retest. Return to Step **1** to confirm elimination of the fault.

   B. The resistance is greater than **10000 Ω** or the resistance did not change at a smooth rate. There is an open circuit in the valve position sensor. Temporarily replace the EGR valve and retest. Return to Step **1** to confirm elimination of fault.

3704 - 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.

B. If the injection system is in good condition, continue with step **6**.

6. Check the EGR valve. Remove the EGR valve, and check if the valve is stuck open.

   A. If the EGR valve is stuck open, clean or replace the EGR valve.

   B. If the EGR valve is in good condition, place the EGR valve back onto the machine. Re-flash the ECU software. Check to verify the fault has cleared. If the fault has not cleared. Replace the ECU.

3741 - Power stages, Injector : Wrong set response time

Context:
If the engine control unit (ECU) times out during start up, this fault will occur. Try to flash the ECU correctly with the proper data set. If the fault persists, replace the ECU.

3758 - Level 2 Monitoring: Diagnosis fault check to report the error to demand for an ICO due to an error in the post injection 3 efficiency factor

Context:
The Engine Control Unit (ECU) monitors the injection cycle.

Cause:
Post injection 3 efficiency is plausible.

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.

3789 - Regeneration duration exceeds maximum allowed duration

Control Module: ECU

Context:
Duration of regeneration is monitored. If the maximum defined time is exceeded a failure is detected.

Possible failure modes:

1. The regeneration exceeds maximum duration due to lose of the efficiency of the catalyst, leakage on exhaust gas path.
2. DPF temperature sensor is not plausible.
3. Wrong wiring harness.

Solution:

1. Check harness for correct installation of the temperature sensor and DPF temperature sensor.
2. Check the temperature sensor on DPF for correct mechanical installation.
3. Check exhaust path for leakage.
4. Perform a Service Regeneration and check feedback by service tester.
5. Replace the catalyst and perform a service regeneration in order to have a positive feedback by service tester."

3814 - ECU temperature sensor: SPI error ECU temperature sensor (LM71)

Context:
Erratic temperatures can damage the Engine Control Unit (ECU) processor, one or more sensors can be provided to monitor ECU temperatures.

Cause:
The ECU has sensed the internal voltage is not plausible.

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.

3838 - Oxidation catalyst upstream temperature shorted to high source

Context:
The engine control unit (ECU) has detected the exhaust gas temperature sensor #1 sensed voltage is above **5.2 V**.

Cause:
The exhaust gas temperature sensor #1 signal is shorted to a high voltage 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 3838 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 ignition switch OFF

   Disconnect ECU connector X-079. Disconnect the Temperature Sensor #1 connector.

   Fabricate a jumper wire **20 cm** (**8 in**) long. Use the jumper wire to short the Exhaust Gas Temperature Sensor connector X-107 pin 1 to pin 2.

   Measure the resistance between X-079 pin 79 and X-079 pin 80. The resistance should be less than **10 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

   A. The resistance is less than **10 Ω**. Go to step **4**.

   B. The resistance is greater than **10 Ω** there is an open circuit in 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 battery.

   Disconnect ECU connector X-079. Disconnect the Temperature Sensor #1 connector.

   Turn the ignition switch ON.

3850 - Zero fuel calibration by lambda (ZFL) : DFC reporting error state on comparing energizing time to min value injector 3

Context:
This fault has been generated due to the injector 3 (cylinder 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.

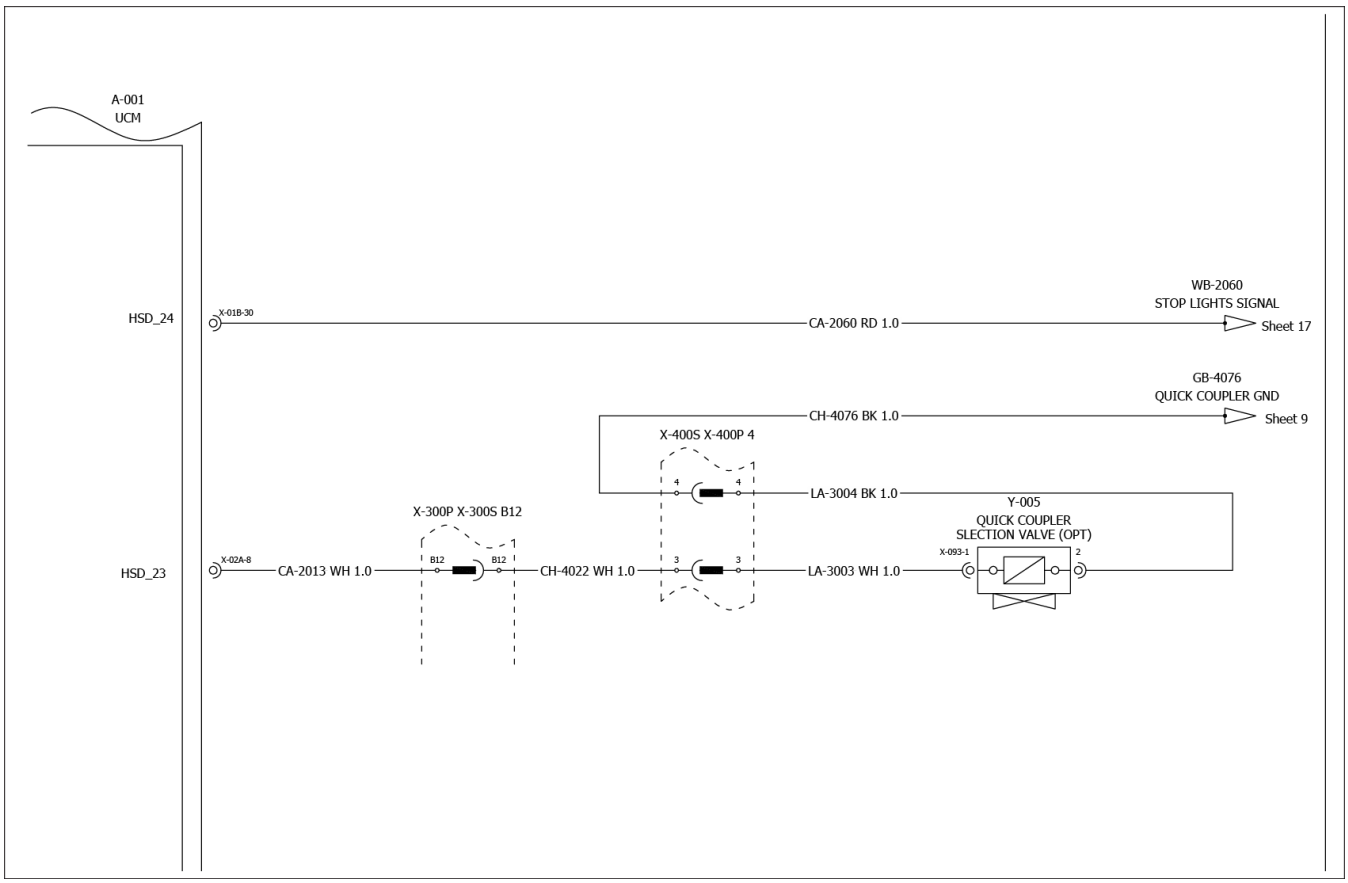
4352 - Short circuit to battery on Quick coupler solenoid (HSD)

Control Module: UCM

Context:
UCM has detected the error with ignition key on and the Quick coupler switch S-008 turned off with function not active.

Solution:

1. Check the supply line of the solenoid Y-005 to verify where is located the short circuit to battery.



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A. pin X-02A-8

B. X-300P-B12

C. X-400S -3

D. X-093-1

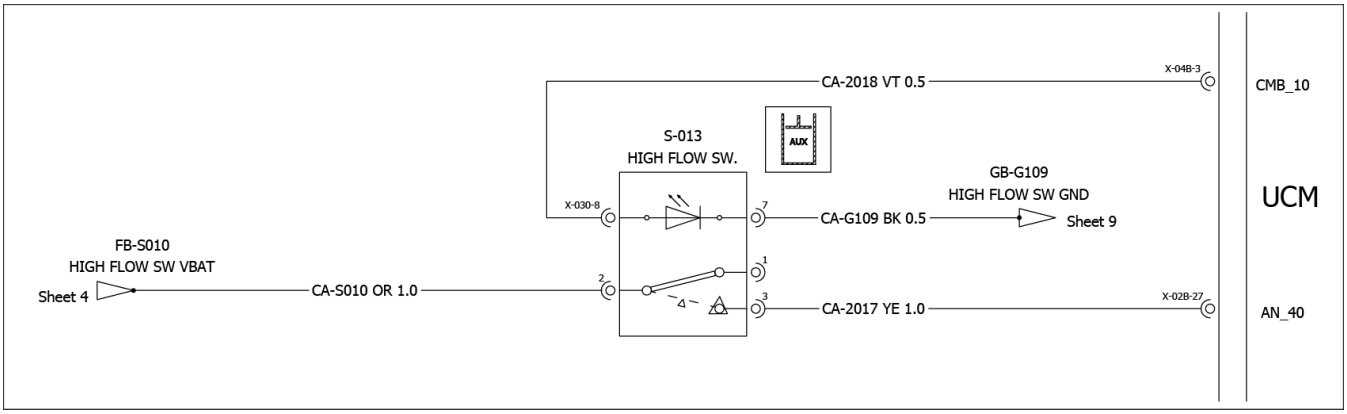
4432 - Short circuit to battery on High Flow LED (CMB)

Control Module: UCM

Context:
UCM has detected a short circuit High Flow LED supply line (X-04B-3 of UCM)

Solution:

1. Pin X-04B-3 is shorted to battery (**12 V**)
2. Check if the pin X-030-8 of the switch S-013 if is shorted with pin X-030-2.



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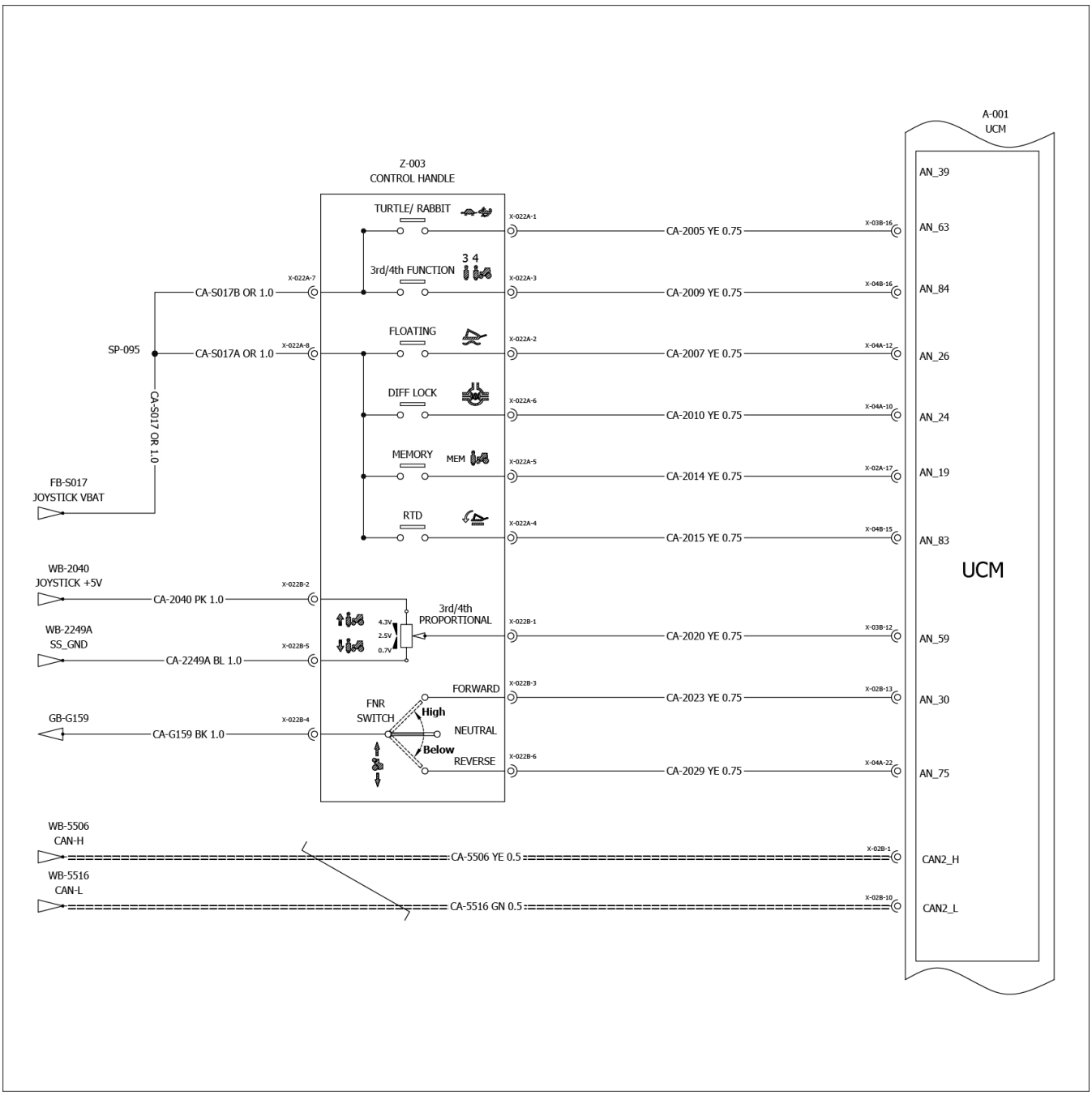
4479 - Proportional roller signal out of range

Control Module: UCM

Context:
UCM has detected the output voltage signal of roller out of the previous range.

Solution:

1. Check using the multimeter the supply voltage between X-022B-2 (+ **5 V**) and X-022B-5 (ground).
2. Check using the multimeter the supply voltage between X-03B-12 (UCM) and X-022B-1 (**4.3 V**, **2.5 V** – neutral, **0.7 V**).



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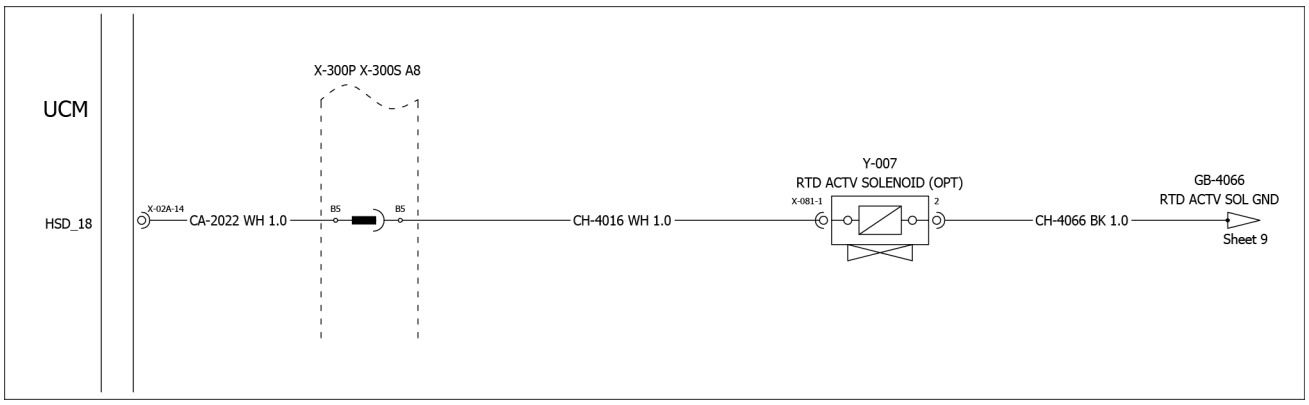
4753 - Open circuit on Return-to-dig solenoid (HSD)

Control Module: UCM

Context:
UCM has detected an open circuit on the Return-to-dig supply line.

Solution:

1. Check the connection X-02A-14 of UCM.
2. Check the connection X-300-B5.
3. Check the connection X-081-1.
4. Check the connection X-081-2.



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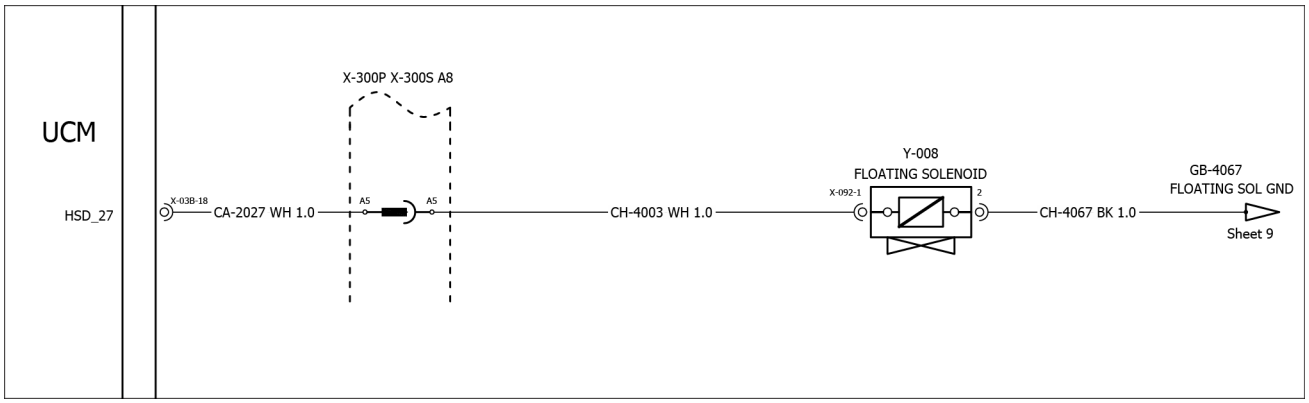
4852 - Short circuit to battery on Floating solenoid (HSD)

Control Module: UCM

Context:
UCM has detected a short circuit to battery on the Floating supply line with function not active.

Solution:

1. Check if the connection X-03B-18 of UCM is shorted to battery (**12 V**).
2. Check if the connection X-300-A5 is shorted to battery.
3. Check if the connection X-092-1 of the valve Y-0068 is shorted to battery.



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12492 - Short circuit to battery on brake light (HSD)

Control Module: UCM

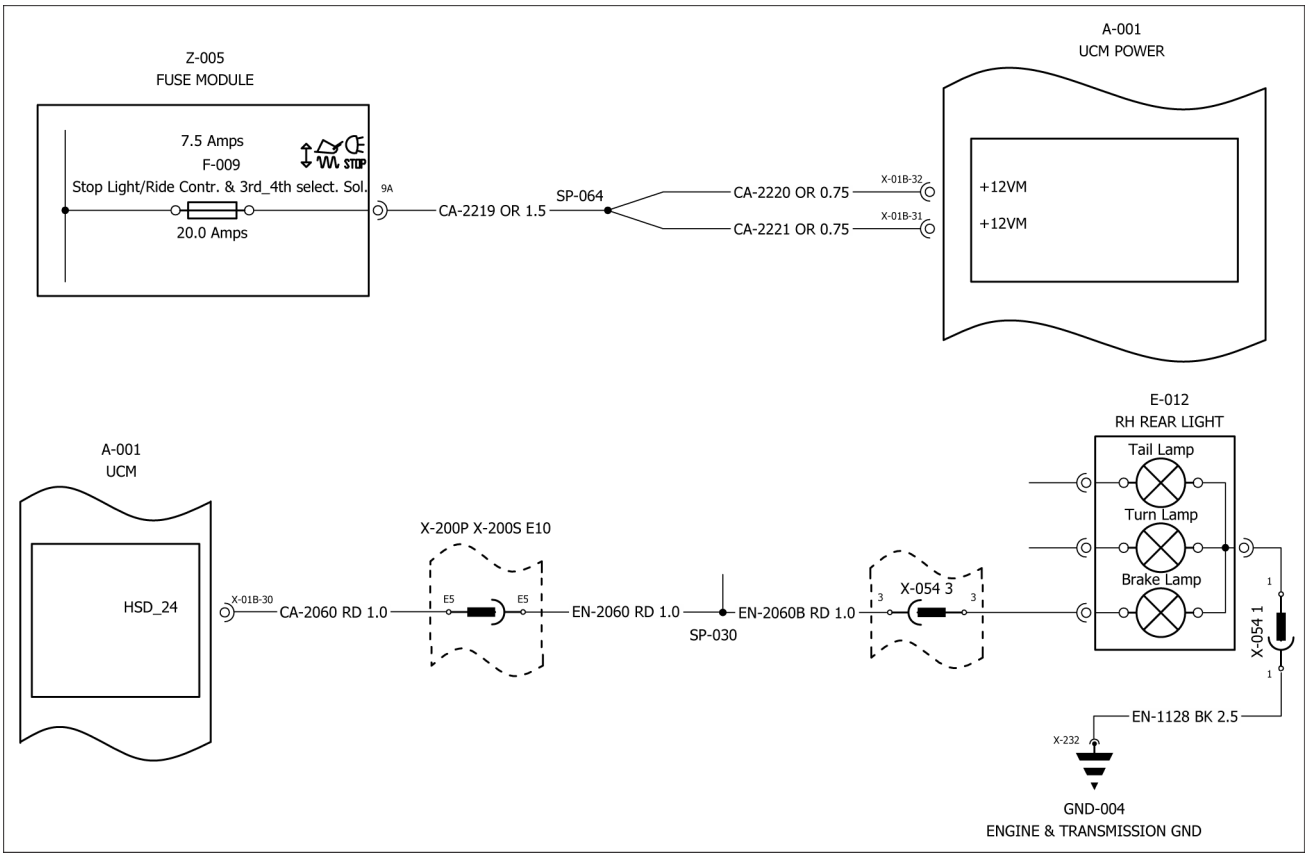
Context:
UCM has detected a short circuit on brake lights supply line.

Possible failure modes:

1. Short circuit to battery.

Solution:

1. Check if the brake lights supply line is shorted to battery on the following points:
   A. X-01B-30
   B. X-200-E5
   C. X-054-3
   D. Brake lights



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13018 - Power rail failure on VM

Control Module: UCM

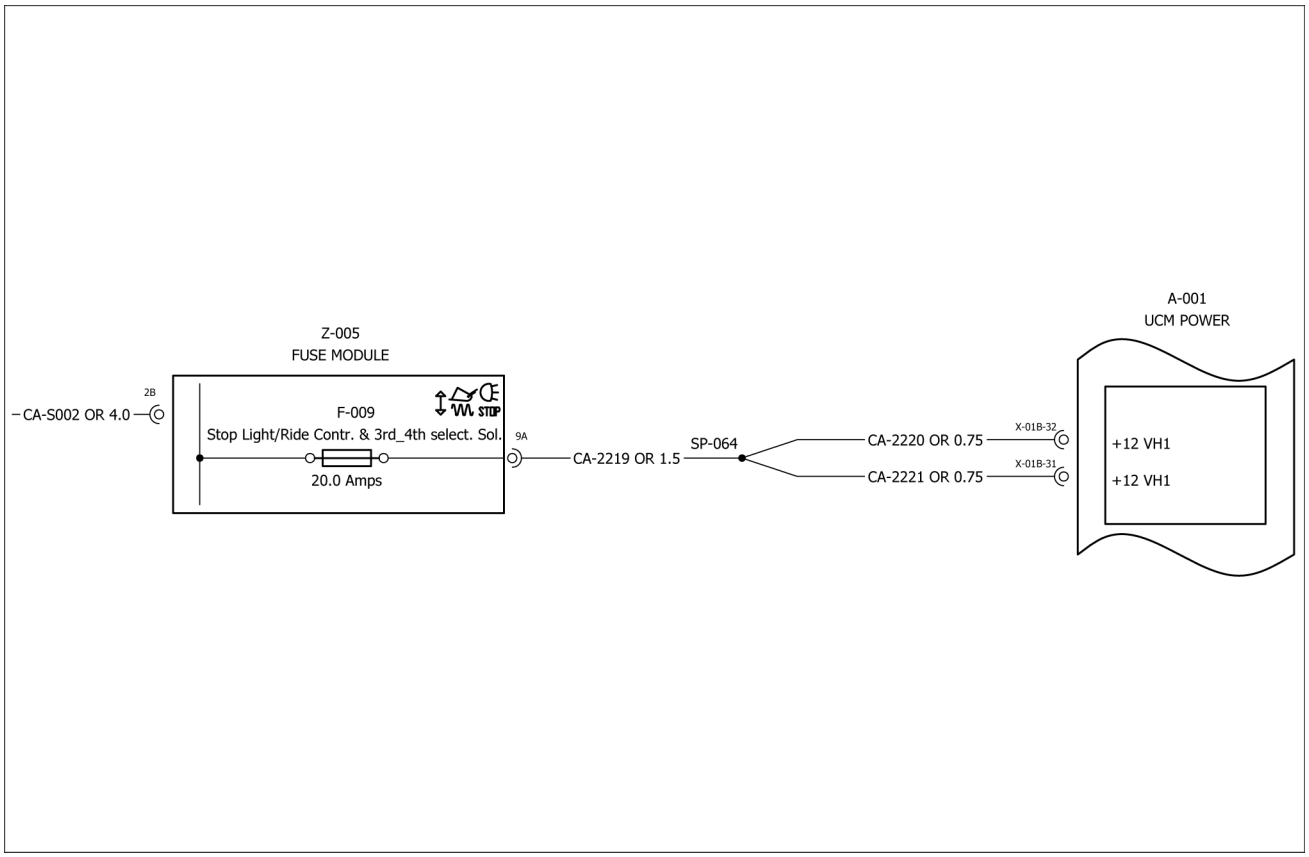
Context:
UCM has detected a failure on power supply on VM input.

Possible failure modes:

1. Fuse burnt
2. Open load

Solution:

1. Check the fuse F-009 (**20 A**)
2. Check the fuse line from X-01B-31, 32 to X-001-9A (+12VM)



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13611 - Input fault on transmission speed sensor signal

Control Module: UCM

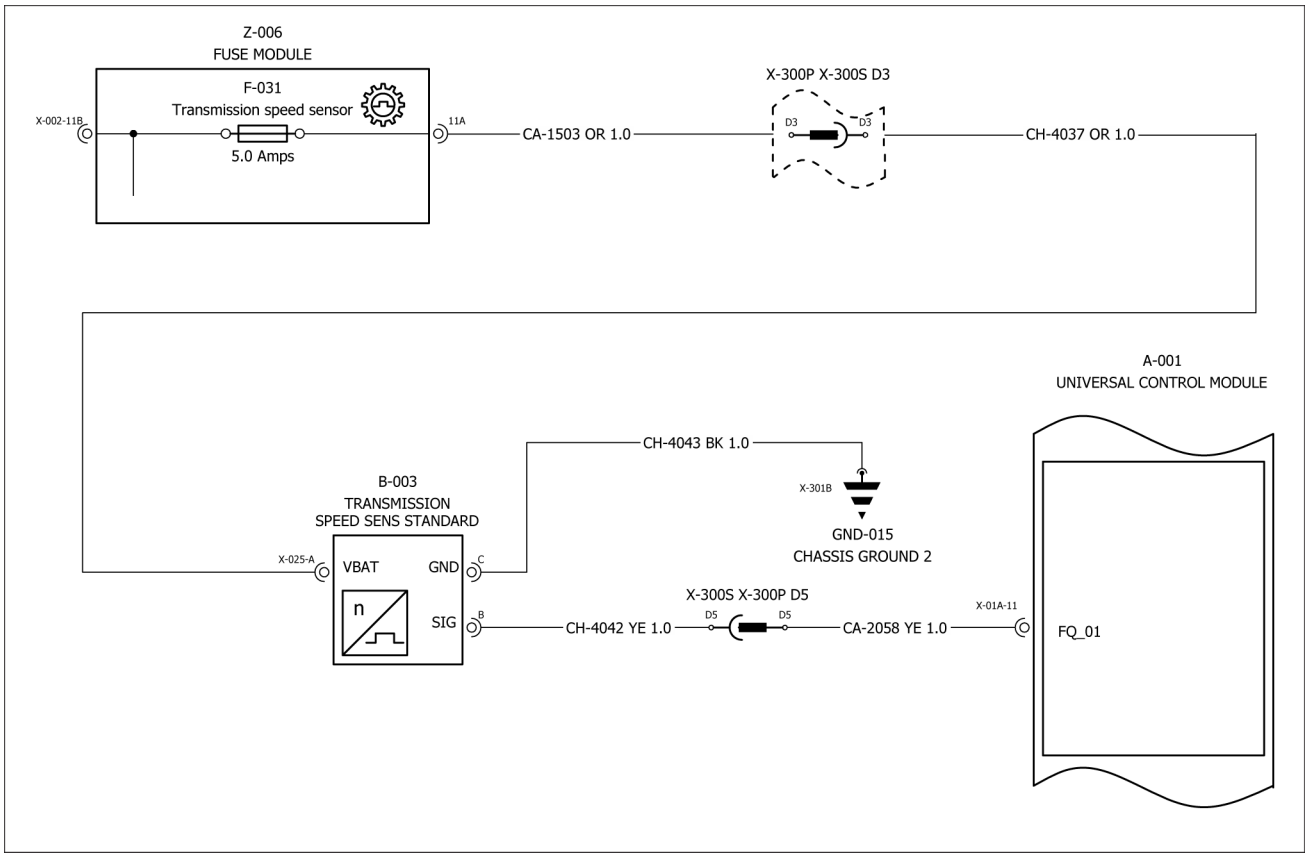
Context:
UCM has detected a plausibility failure on transmission speed sensor signal

Possible failure modes:

1. Sensor failure
2. UCM failure

Solution:

1. Replace the sensor
2. Replace UCM



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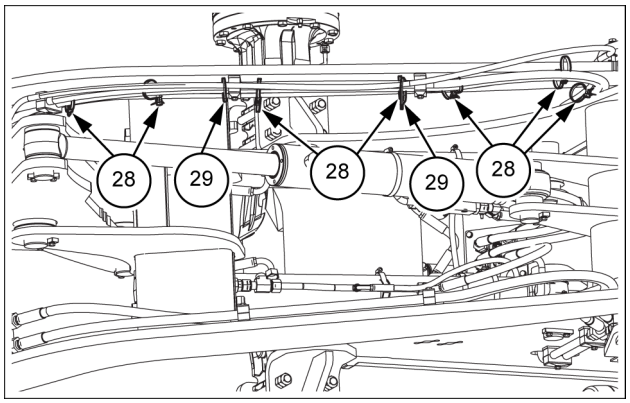
27. Install the cable ties **(29)** to attach the hose **(31)** with the two hoses **(30)** (see figure **9**).
28. Install the cable ties **(28)** to attach the harness with the hoses **(30)** and **(31)** (see figure **9**).



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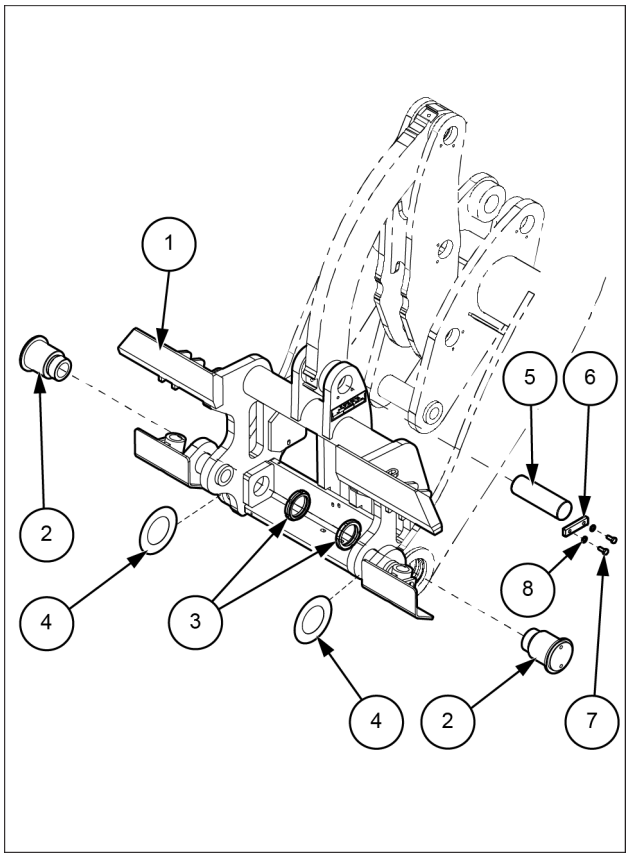
Next operation:
Lift arm cylinder - Install - Z-bar loader (35.701)
Loader bucket control cylinder - Install - Z-Bar loader (35.723)
Quick coupler - Install - Horizontal pin version (82.300) (if equipped with Horizontal pin Quick coupler)
Quick coupler - Install - SSL version (82.300) (if equipped with SSL Quick coupler)

NOTE: *figure **3** shows the layout of the Tool Carrier (TC)/XT machine configuration for the steps from **2** to **6**.*



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