

I650M
Tier 2
Crawler Dozer
PIN NGC107000 and above

SERVICE MANUAL

Part number 48048568
1st edition English
April 2017



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INTRODUCTION

Torques for British Standard Pipe Parallel (BSPP) straight-pipe-thread port connections

BSPP Thread	Metric Tube OD		Ferrous		Non-Ferrous	
	S-Series (Heavy Duty)	L-Series (Light Duty)	S-Series (Heavy Duty)	L-Series (Light Duty)	S-Series (Heavy Duty)	L-Series (Light Duty)
G 1/8 A	—	6 mm	—	21 N·m (15.5 lb ft)	—	12.5 N·m (9.2 lb ft)
G 1/4 A	6 mm	8 mm	63 N·m (46.5 lb ft)	53 N·m (39.1 lb ft)	38 N·m (28.0 lb ft)	32 N·m (23.6 lb ft)
	8 mm	10 mm				
G 3/8 A	10 mm	12 mm	95 N·m (70.1 lb ft)	84 N·m (62.0 lb ft)	57 N·m (42.0 lb ft)	50 N·m (36.9 lb ft)
	12 mm					
G 1/2 A	16 mm	15 mm	136 N·m (100.3 lb ft)	105 N·m (77.4 lb ft)	82 N·m (60.5 lb ft)	63 N·m (46.5 lb ft)
		18 mm				
G 3/4 A	20 mm	22 mm	210 N·m (154.9 lb ft)	210 N·m (154.9 lb ft)	126 N·m (92.9 lb ft)	126 N·m (92.9 lb ft)
G 1 A	25 mm	28 mm	400 N·m (295.0 lb ft)	400 N·m (295.0 lb ft)	240 N·m (177.0 lb ft)	240 N·m (177.0 lb ft)
G 1-1/4 A	30 mm	35 mm	525 N·m (387.2 lb ft)	525 N·m (387.2 lb ft)	315 N·m (232.3 lb ft)	315 N·m (232.3 lb ft)
G 1-1/2 A	38 mm	42 mm	660 N·m (486.8 lb ft)	660 N·m (486.8 lb ft)	396 N·m (292.1 lb ft)	396 N·m (292.1 lb ft)

NOTE: Final torque tolerance is +/- 10% of the given torque specification.

INTRODUCTION

Torque values for inch O-Ring Boss (ORB) port plugs

SAE dash size	UN/UNF thread size	Ferrous		Non-Ferrous
		Internal hex N·m (lb ft) ± 10%	External hex N·m (lb ft) ± 10%	N·m (lb ft) ± 10%
2	5/16-24	7.5 (5.5)	12.5 (9.2)	7.5 (5.5)
3	3/8-24	14.5 (10.7)	21 (15.5)	12.5 (9.2)
4	7/16-20	21 (15.5)	37 (27.3)	22 (16.2)
5	1/2-20	28 (20.7)	42 (31)	25 (18.4)
6	9/16-18	47 (34.7)	47 (34.7)	28 (20.7)
8	3/4-16	89 (65.6)	89 (65.6)	53 (39.1)
10	7/8-14	116 (85.6)	116 (85.6)	70 (51.6)
12	1-1/16-12	176 (129.8)	176 (129.8)	106 (78.2)
14	1-3/16-12	247 (182.2)	247 (182.2)	148 (109.2)
16	1-5/16-12	284 (209.5)	284 (209.5)	170 (125.4)
20	1-5/8-12	357 (263.3)	357 (263.3)	214 (157.8)
24	1-7/8-12	441 (325.3)	441 (325.3)	265 (195.5)
32	2-1/2-12	536 (395.3)	536 (395.3)	322 (237.5)

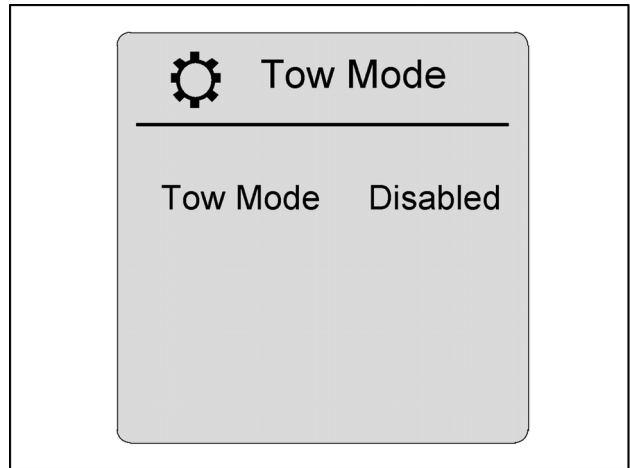
Torque values for four-bolt flange connections (Metric Screws, Class 10.9)

Metric size mm	Imperial size in	Screw code 61	Code 61 N·m (lb ft) ± 10%	Screw code 62	Code 62 N·m (lb ft) ± 10%
13	1/2	M8 x 1.25	34 (25.1)	M8 x 1.25	34 (25.1)
19	3/4	M10 x 1.5	74 (54.6)	M10 x 1.5	74 (54.6)
25	1	M10 x 1.5	74 (54.6)	M12 x 1.75	137 (101)
32	1-1/4	M10 x 1.5	74 (54.6)	M12 x 1.75	137 (101)
				M14 x 1.5	189 (139.4)
38	1-1/2	M12 x 1.75	137 (101)	M16 x 2	310 (228.6)
51	2	M12 x 1.75	137 (101)	M20 x 2.5	575 (424.1)
64	2-1/2	M12 x 1.75	137 (101)	M24 x 3	575 (424.1)
76	3	M16 x 2	310 (228.6)	M30 x 3.5	680 (501.5)
89	3-1/2	M16 x 2	310 (228.6)	–	–
102	4	M16 x 2	310 (228.6)	–	–
127	5	M16 x 2	310 (228.6)	–	–

Torque values for four-bolt flange connections (Metric Screws, Class 8.8)

Metric size mm	Imperial size in	Screw code 61	Code 61 N·m (lb ft) ± 10%	Screw code 62	Code 62 N·m (lb ft) ± 10%
13	1/2	M8 x 1.25	29 (21.4)	M8 x 1.25	29 (21.4)
19	3/4	M10 x 1.5	57(42)	M10 x 1.5	57(42)
25	1	M10 x 1.5	57(42)	M12 x 1.75	100 (73.8)
32	1-1/4	M10 x 1.5	57(42)	M12 x 1.75	100 (73.8)
				M14 x 1.5	160 (118)
38	1-1/2	M12 x 1.75	100 (73.8)	M16 x 2	250 (184.4)
51	2	M12 x 1.75	100 (73.8)	M20 x 2.5	500 (368.8)
64	2-1/2	M12 x 1.75	100 (73.8)	M24 x 3	575 (424.1)
76	3	M16 x 2	250 (184.4)	M30 x 3.5	680 (501.5)
89	3-1/2	M16 x 2	250 (184.4)	–	–
102	4	M16 x 2	250 (184.4)	–	–
127	5	M16 x 2	250 (184.4)	–	–

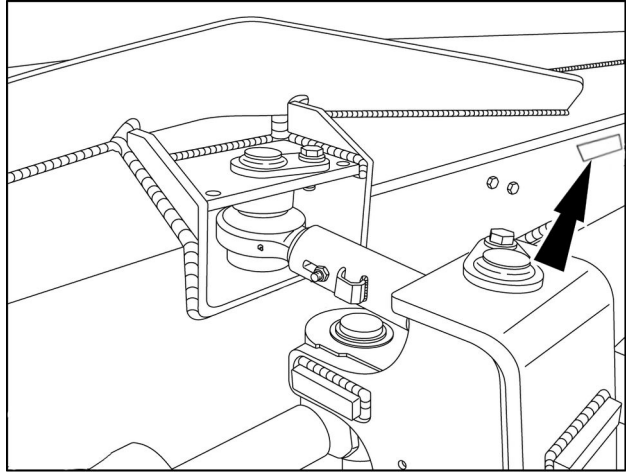
9. Change the Tow Mode from “Enabled” to “Disabled” by highlighting and pressing the enter switch.



RAIL12DOZ0592AA 22

Dozer blade

The serial number plate is on the right side of the dozer blade.



RAIL13DOZ1609AA 5

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Engine - 10

Air cleaners and lines - 202

Air cleaner - Install (*)	6
Air cleaner - Remove (*)	3

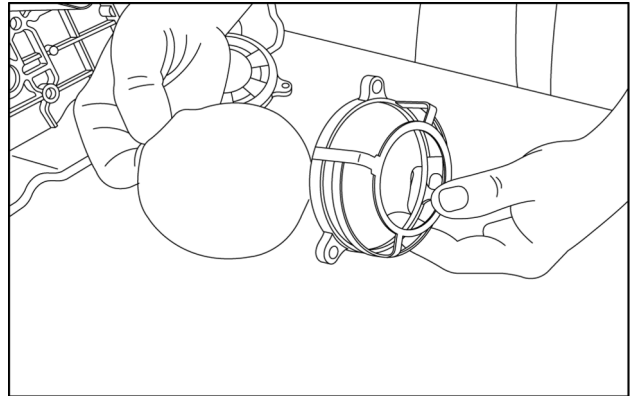
(*) See content for specific models

Crankcase ventilation system - Install

1650M

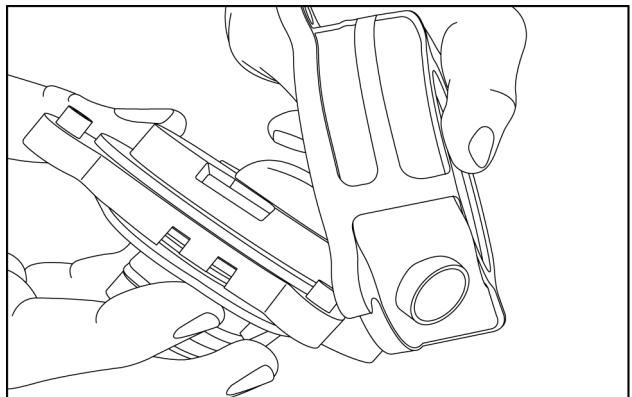
ANZ --- APAC --- LA --- MEA

1. Place the clean foam filter back in the filter holder.



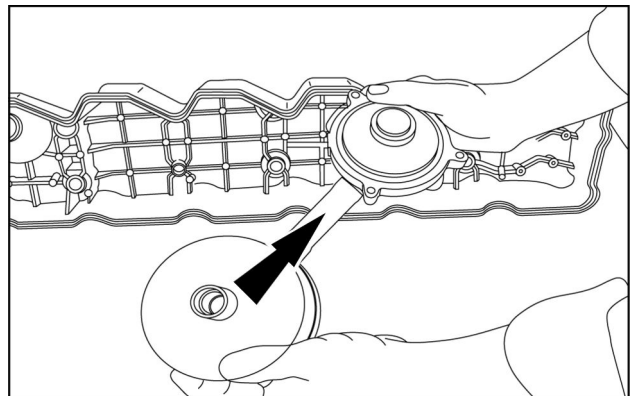
RAPH12DOZ0296AA 1

2. Align the foam filter housing to the guide pegs on the filter assembly and snap in place.



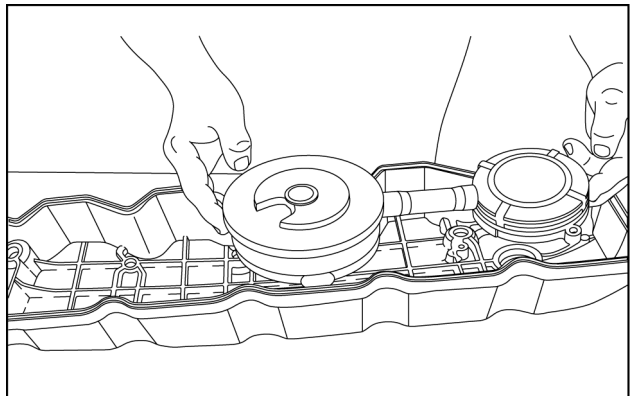
RAPH12DOZ0278AA 2

3. Reattach the canister to the foam filter assembly.



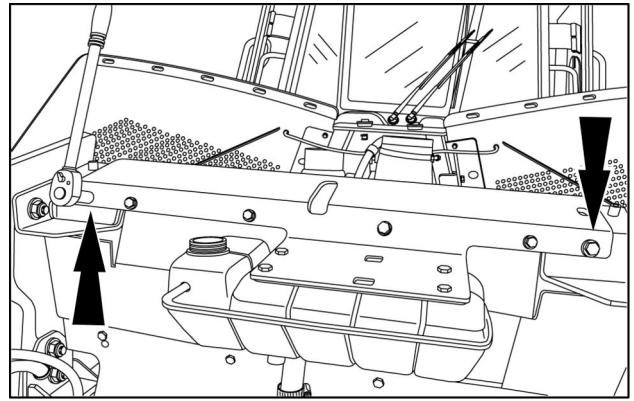
RAPH12DOZ0300AA 3

4. With the foam filter facing up, line up the valve system to the openings in the valve cover.



RAPH12DOZ0302AA 4

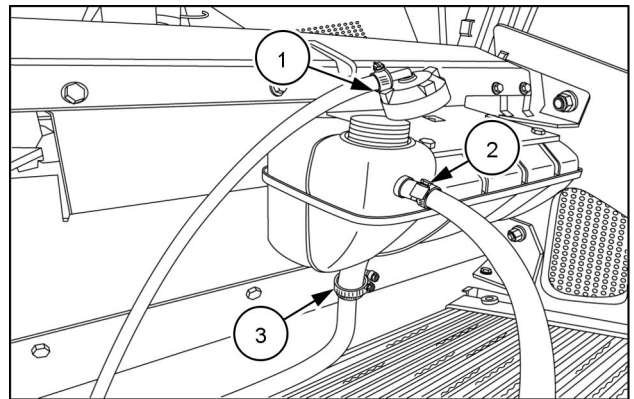
- Insert the washers and the end bolts through the end bolt holes on the DA bottle bracket. Secure with the nuts.



RAPH12DOZ1139AA 7

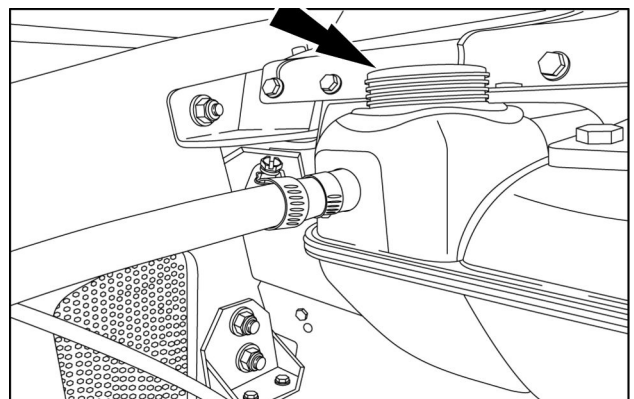
- Reattach the hoses (2) and (3) with the clamps. Reattach the top coolant hose (1) to the coolant bottle.

NOTE: Torque hose clamp (3) to 9.5 – 10.8 N·m (84 – 96 lb in)



RAPH12DOZ1138AA 8

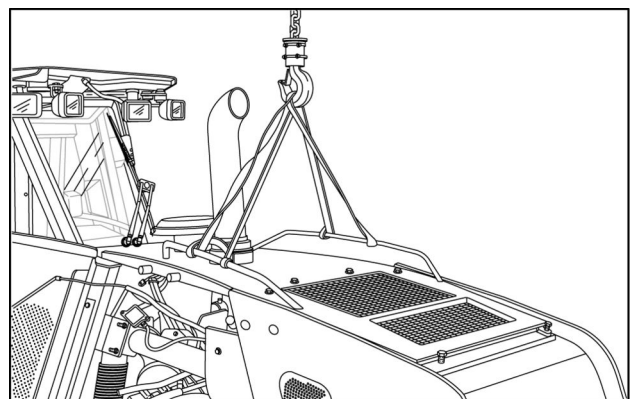
- Add the coolant to the system.
- Check for leaks.



RAPH12DOZ1134AA 9

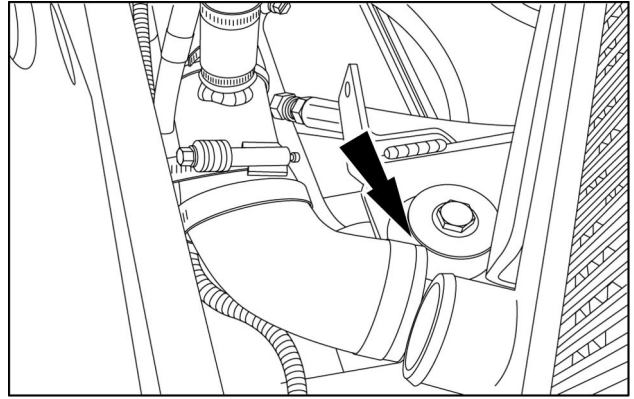
Hood installation

- With the safety lift straps properly placed on the grab rails, lift the hood and line up the bolt holes on the chassis.



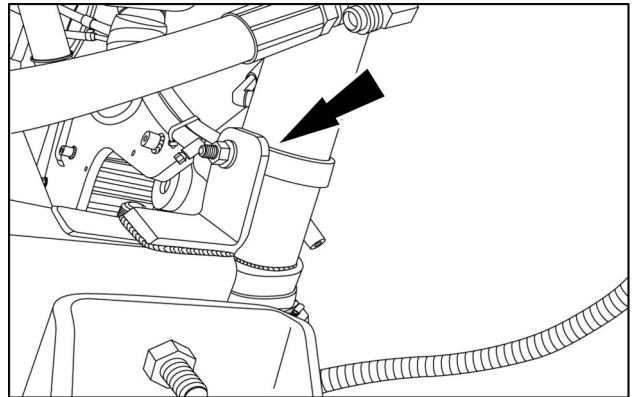
RAPH12DOZ0897AA 10

8. Reconnect the lower red hose to the radiator. Torque the hose clamp **11 – 12 N·m (97 – 106 lb in)**.



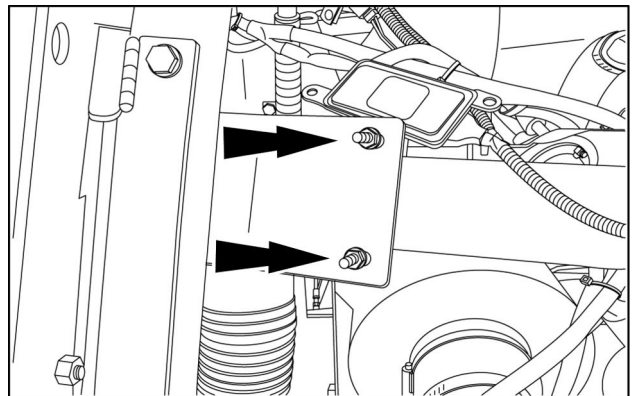
RAPH12DOZ1218AA 8

9. Reconnect the p-clamp to the lower red hose.



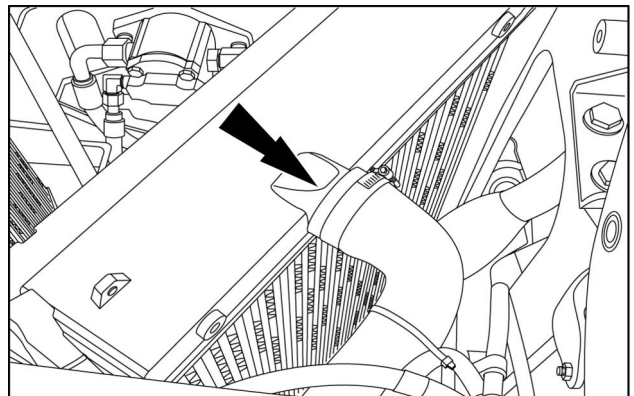
RAPH12DOZ1215AA 9

10. Tighten the bolts to the u-clamp that supports the lower red hose to the bracket.



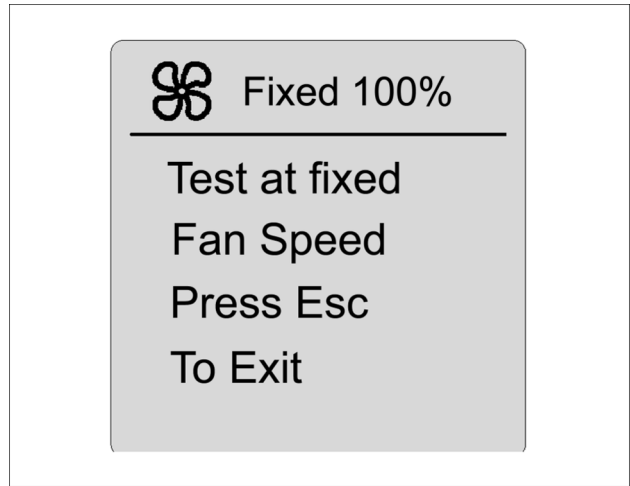
RAPH12DOZ1201AA 10

11. Reconnect the upper red hose to the radiator. Torque the hose clamp **11 – 12 N·m (97 – 106 lb in)**.



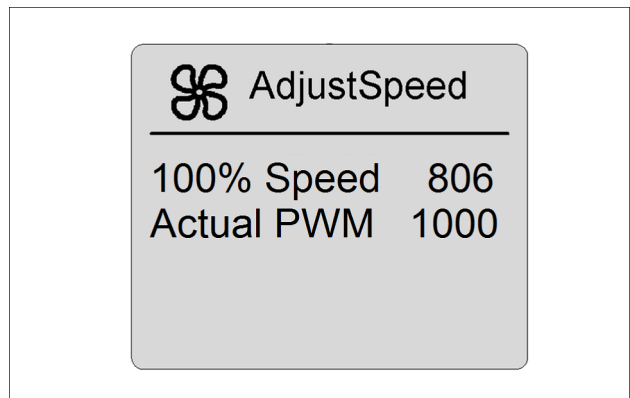
RAPH12DOZ1214AA 11

6. Use the Enter / Confirm switch to start the 100% or full fan speed adjustment for that model.



RCPH11WHL031BAN 6

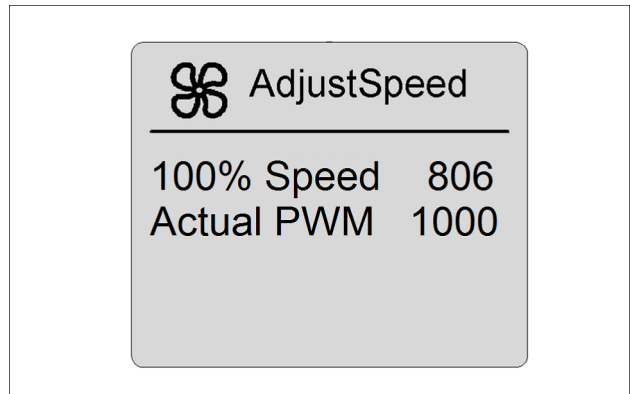
7. Use up or down arrows to highlight Adjust 100% speed or Reset (factory default). Use the Enter / Confirm switch to choose either option.



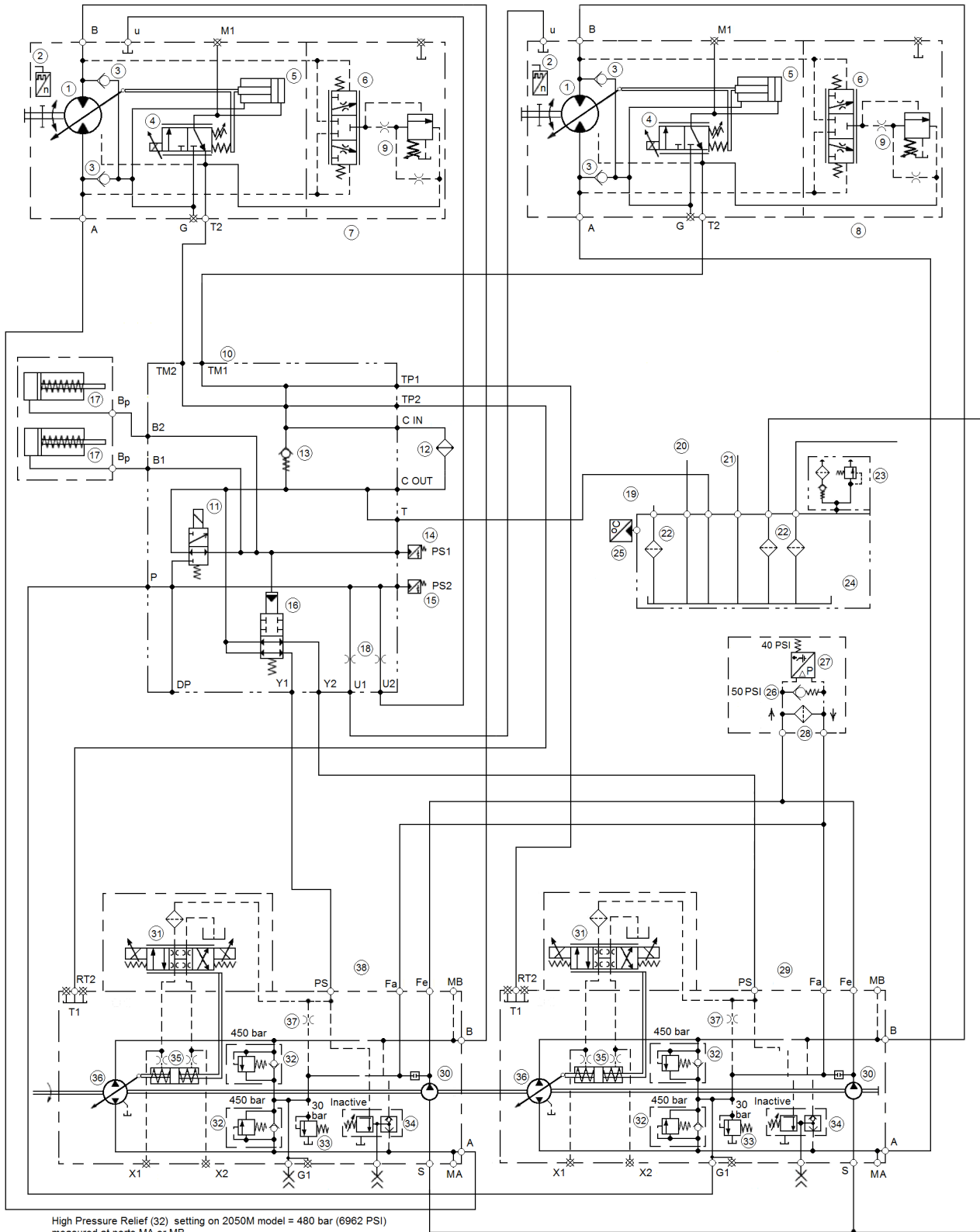
RAIL13DOZ1103AA 7

8. To adjust the 100% fan speed, scroll up or down to the required speed. Use the Enter / Confirm to choose the adjustment. Use the escape key to return to the main menu.

Model	100% Default Speed
1650M	1900 to 2000 RPM
2050M	2500 to 2600 RPM



RAIL13DOZ1103AA 8



RAIL12DOZ0912HA 4

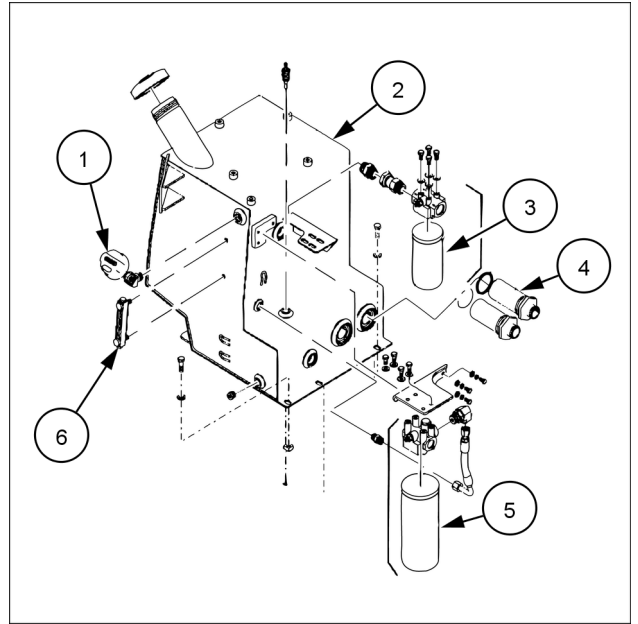
Hydrostatic Drive Schematic

Hydrostatic system feed pump - Pressure setting

1650M

ANZ --- APAC --- LA --- MEA

1. Remove the breather (vent) from the hydraulic reservoir and connect a vacuum pump to the reservoir. Turn on the pump.



RAIL13DOZ1481GA 1

Item	Description
1	Breather (vent)
2	Hydraulic oil reservoir
3	Filter 6 micron– return to tank
4	Filter strainers
5	Filter 4 micron – hydrostatic
6	Level gauge

2. Disconnect the filter bypass return line, plug the line and cap the fitting.
3. Turn off the vacuum pump, repeat procedures 2 through 8 in **Hydrostatic system feed pump - Pressure test (29.218)** and check the pressure.

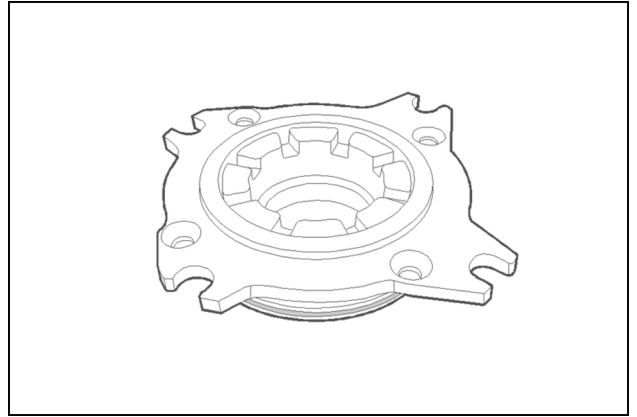
NOTE: If the pressure increased, replace the filter head. If the pressure did not increase, reconnect the filter bypass line and go to the next procedure.

4. Verify the following parts are not damaged:
5. Remove access panels to the hydrostatic pump area.
6. Remove the breather (vent) from the hydraulic reservoir and connect a vacuum pump to the reservoir. Turn on the pump.

18. Alternative test method:
 - With Straight Tracking turned on and the machine still in the air, measure the hub RPM for the left and right motors at speed 15. Hub RPMs should be equal.

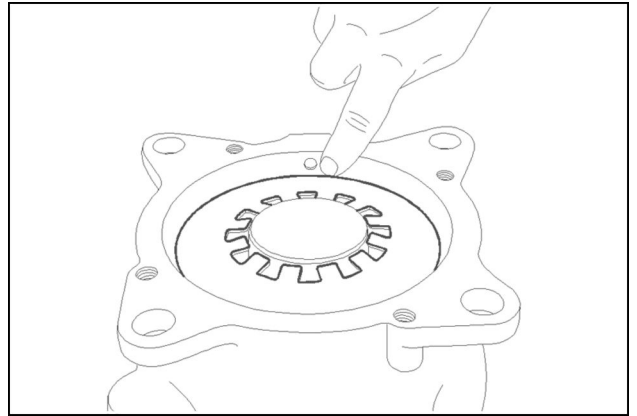
8. Insert the piston into the cover.

NOTICE: Make sure to start the cover straight onto the piston, the piston and or O-rings can be damaged if not straight.



RAIL16DOZ0062AA 8

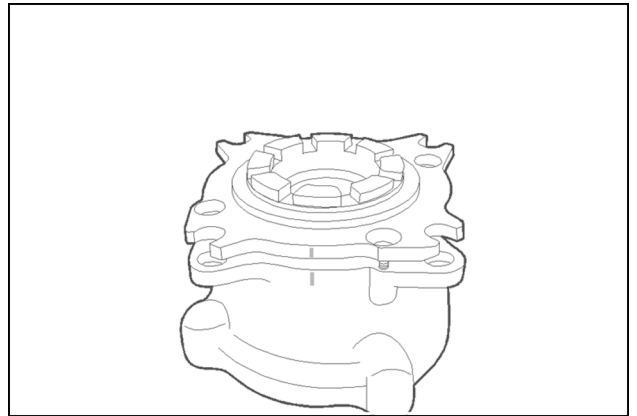
9. Lubricate the bore of the housing with hydraulic oil.



RAIL16DOZ0063AA 9

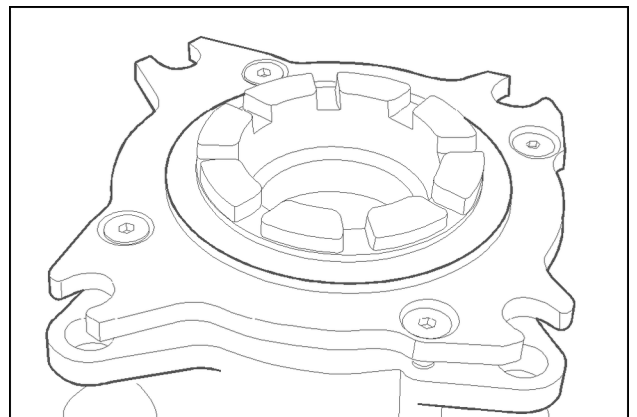
10. Install the piston and cover into the housing. Align the marks made during disassembly.

NOTICE: Make sure to start the cover straight into the housing, the piston and or O-rings can be damaged if not straight.



RAIL16DOZ0064AA 10

11. Install the four mounting screws.

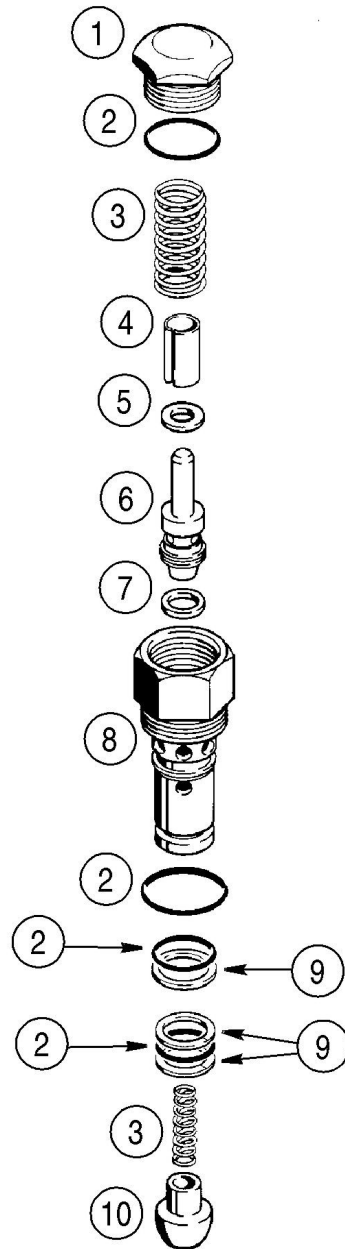


RAIL16DOZ0065AA 11

Hydraulic systems - Exploded view - Secondary relief valve

1650M

ANZ --- APAC --- LA --- MEA



BS99M021 1

(1) Cap	(6) Plunger
(2) O-ring	(7) Seal
(3) Spring	(8) Body
(4) Sleeve	(9) Backup ring
(5) Shim(s)	(10) Load check poppet

15. If the temperature of the hydraulic oil is not as specified, run the engine at full throttle and close the pressure Load Valve on the flowmeter until the pressure gauge indicates **103 bar (1494 psi)** . Continue to run the engine until the temperature of the oil is as specified.
16. Open the pressure Load Valve completely.
17. Adjust the engine speed to **2000 RPM** . Make sure the pressure Load Valve on the flowmeter is fully open and read the flow gauge. Write the flow reading on line 1 on the check sheet for minimum pressure.
18. Slowly close the pressure Load Valve on the flowmeter until the pressure gauge indicates **138 bar (2001 psi)** . Make sure to keep the engine running at **2000 RPM** . Read the flow gauge and write the reading on line 2 on the check sheet.
19. Open the pressure Load Valve on the flowmeter. Decrease the engine speed and stop the engine.

Understanding Test Results

20. If the output at minimum pressure was less than **129.8 L/min (34.3 US gpm)** the problem can be a leak or a restriction between the equipment pump and reservoir, or a badly worn or damaged equipment pump.
21. If the output at minimum pressure was **129.8 L/min (34.3 US gpm)** or more there are no problems between the equipment pump and reservoir. The equipment pump can be worn or damaged and still have good flow at minimum pressure.
22. Some loss of output at **138 bar (2001 psi)** is normal. The loss can also show the equipment pump is worn or damaged. Use the efficiency of the equipment pump to make a judgement as to whether or not the equipment pump must be repaired or replaced.
23. The efficiency of the equipment pump is found by dividing the flow at **138 bar (2001 psi)** by the flow at minimum pressure. (Step 18 divided by Step 17 = % efficient)
24. If the efficiency is below 75% it is recommended that the equipment pump be repaired or replaced.

Test No. 2– Dozer / Equipment valve circuit tests

WARNING

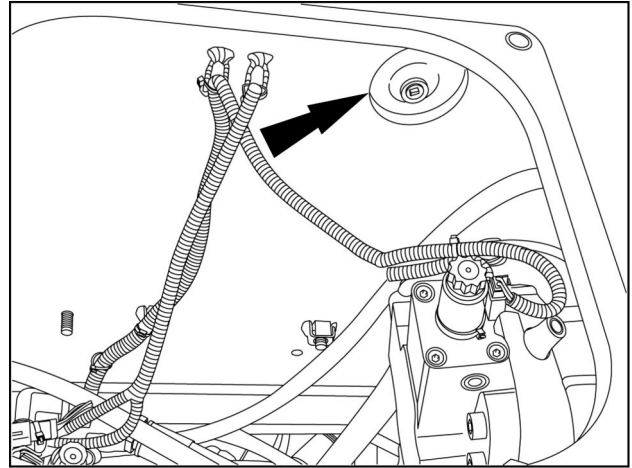
Hazard to bystanders!

**Make sure the area surrounding the machine is clear of all persons before starting the engine.
Failure to comply could result in death or serious injury.**

W0090A

25. Park the machine on a level surface.
26. Lower the dozer and the ripper to the ground.
27. Put the directional control in neutral and apply the parking brakes. Stop the engine.

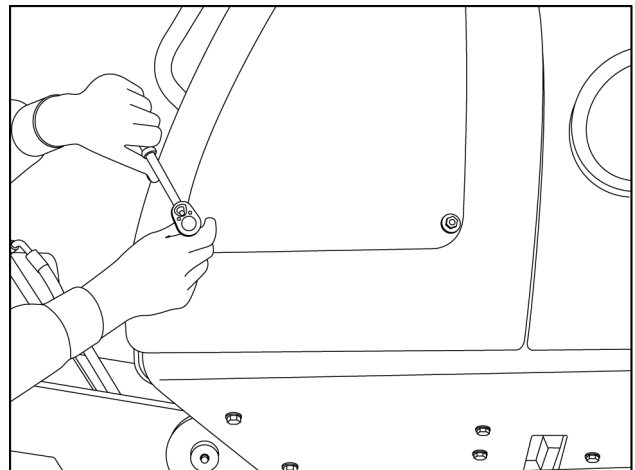
5. Locate the hydraulic reservoir drain in the upper right hand side of the access compartment.



RAIL12DOZ0378AA 3

NOTE: A drain hose is included on machines equipped with the environmental drain option.

6. Open the hydraulic reservoir drain, and drain the oil into a suitable container.
7. After oil has completely drained, close the drain, and replace the access cover.
8. Remove and replace the hydraulic oil filter (1). Turn the filter counterclockwise to remove.
9. Clean the contact surface on the filter head. Make sure that all dirt and gasket material has been removed.
10. Apply a thin coat of clean oil to the hydraulic oil gasket and threads.
11. Install and tighten the filter firmly to the filter head by hand. Do not use a filter wrench to tighten the filter.
12. Remove the bolts and the cover from the right rear access panel.



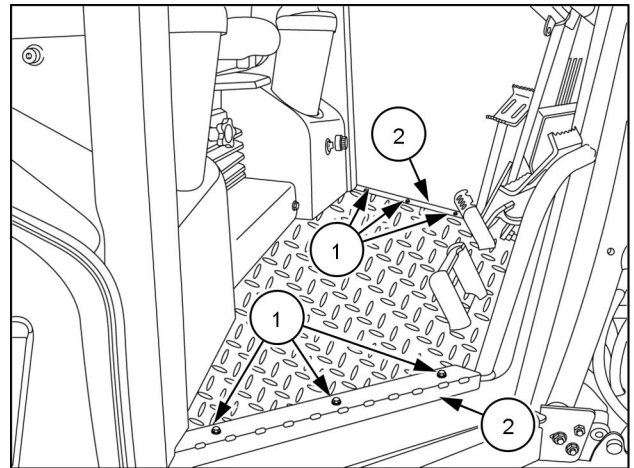
RAIL12DOZ0177AA 4

Pump - Remove - Equipment pump

1650M

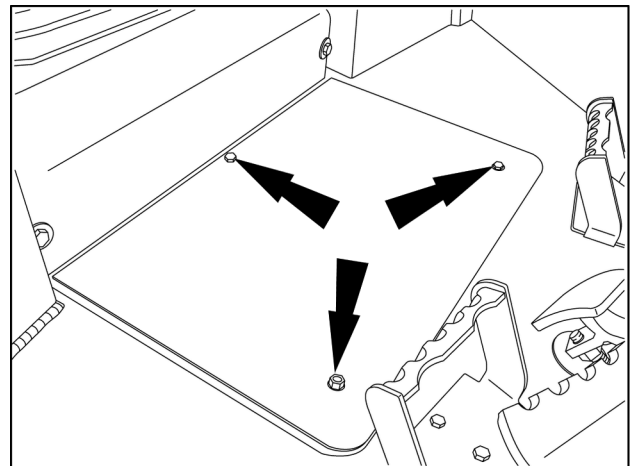
ANZ --- APAC --- LA --- MEA

1. Release the system hydraulic pressure. See **Hydraulic systems - Depressurising (35.000)**.
2. Remove six mounting screws (1) and two cab floor brackets (2).



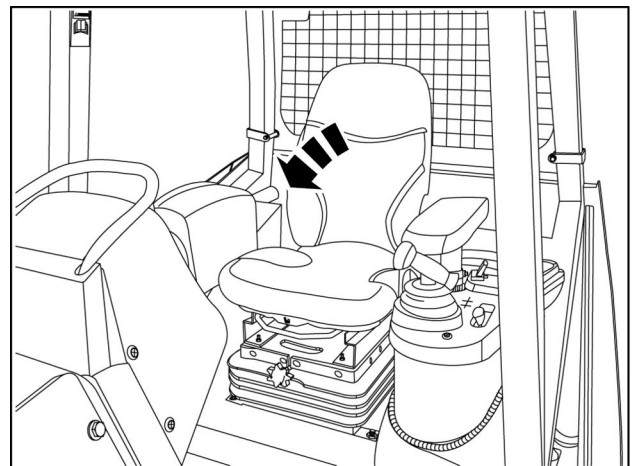
RAIL13DOZ0333AA 1

3. Remove cab floor mat.
4. Remove three bolts and washers and remove access panel.



RAIL13DOZ0331AA 2

5. Fold seat backrest forward.

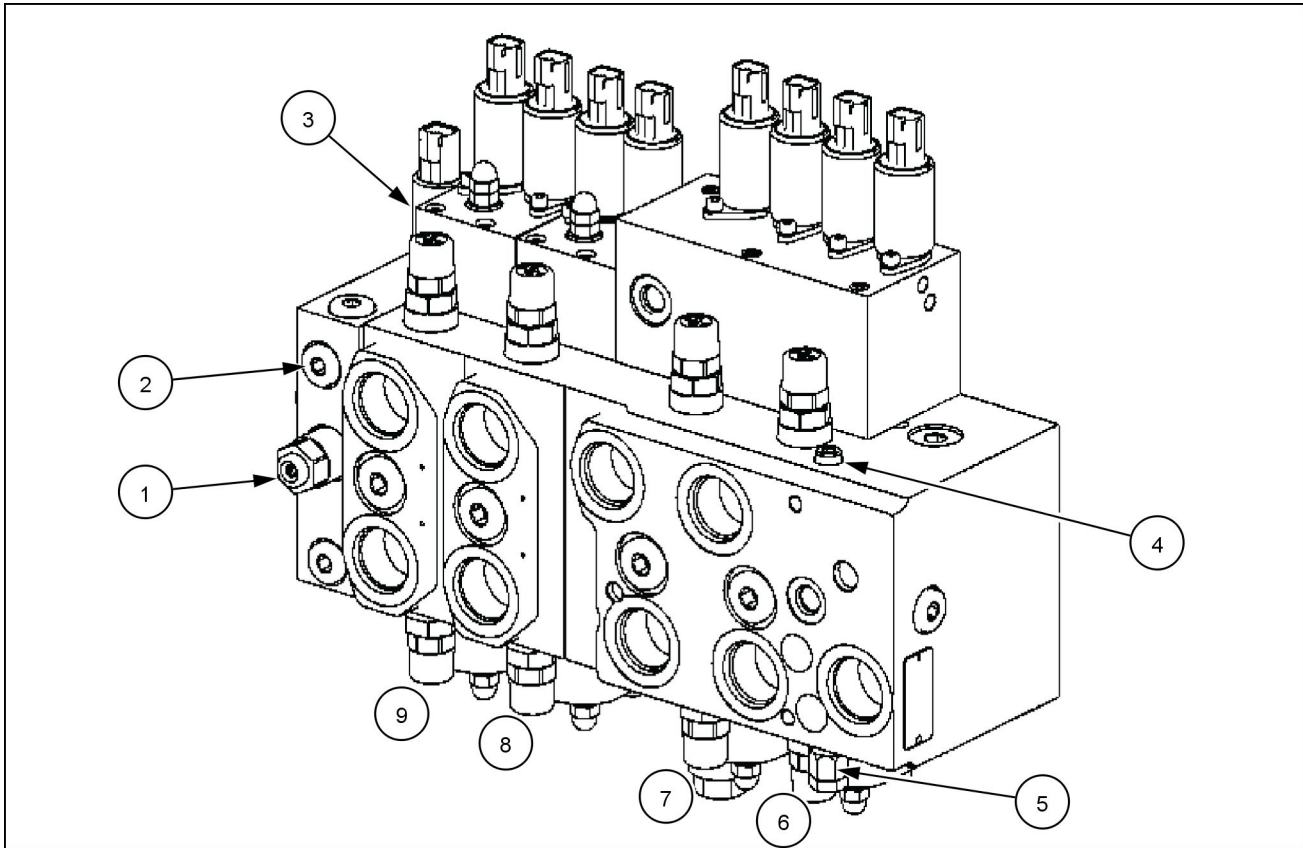


RAIL13DOZ0339AA 3

Stacked control valves - Overview

1650M

ANZ --- APAC --- LA --- MEA



RAIL14DOZ0410FA 1

Item	Description
(1)	Spike clipper valve
(2)	Check valve
(3)	Safety valve
(4)	Flow limiting valve (Signal bleed down orifice)
(5)	Load sense (LS) relief
(6)	Tilt valve
(7)	Lift valve
(8)	Angle valve
(9)	Ripper valve (optional)

Blade tilt cylinder - Remove

1650M Power Angle Tilt (PAT) Blade, Extra Lont Track (XLT) - Tier 2 [NGC107000 -]	ANZ --- APAC --- LA --- MEA
1650M Power Angle Tilt (PAT) Blade, Low Ground Pressure (LGP) - Tier 2 [NGC107000 -]	ANZ --- APAC --- LA --- MEA

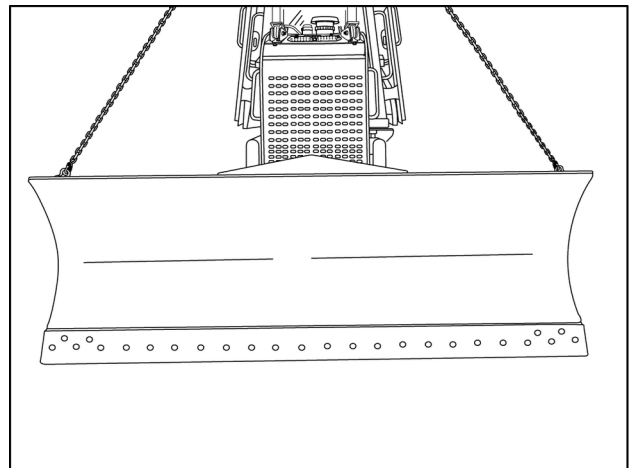
1. Park machine on a firm, level surface.
2. Lower all equipment to the ground.
3. Engage parking brake and shut engine off.
4. Relieve system of hydraulic pressure by actuating all hydraulic functions. Remove key when complete.

NOTE: Wait 90 seconds after engine shutdown before turning master battery disconnect switch OFF. After engine shutdown, the Selective Catalytic Reduction (SCR) system module continues to run and conducts a purge cycle.

5. Turn master battery disconnect switch to the OFF position.

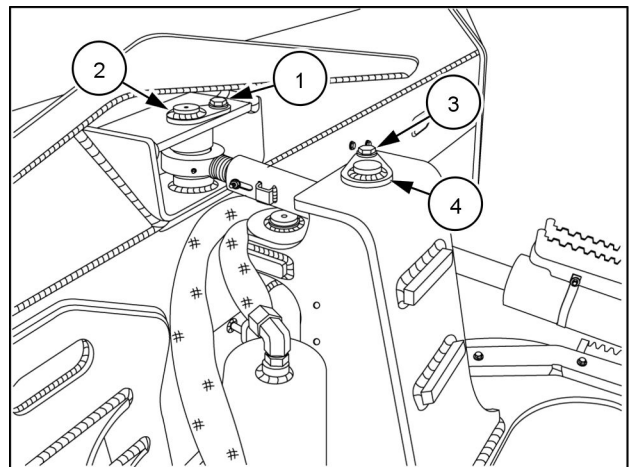
NOTICE: Blade weighs approximately 953 kg (2100 lb). Use proper equipment to prevent personal injury or property damage.

6. Support blade with an appropriate lifting device.



RAIL12DOZ0938BA 1

7. Remove diagonal tie rod front pin retaining bolt (1) and spacer. Remove diagonal tie rod front pin (2), noting location and quantity of spacers to aid installation.
8. Remove diagonal tie rod inner pin retaining bolt (3) and spacer. Remove diagonal tie rod inner pin (4), noting location and quantity of spacers to aid installation. Remove diagonal tie rod.
9. Apply vacuum to hydraulic system.

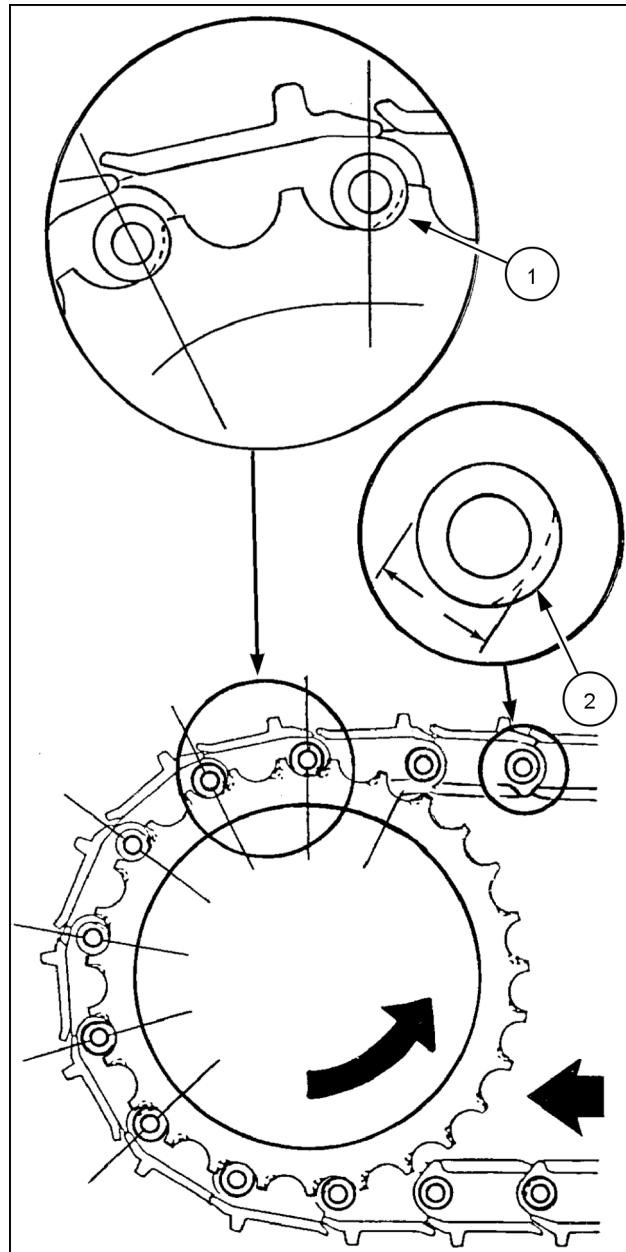


RAIL12DOZ0960BA 2

Sprocket reverse drive side wear (machine traveling in reverse)

Reverse drive side wear can be the most severe wear you can have with the socket teeth and bushings. When you move in reverse, the sprocket teeth contact the chain bushings close to the 12 o'clock position. Most of the torque, required to move the machine, transfers to the track between the 12 and 11 o'clock position. At this time, the bushing rotates against the sprocket. A pocket forms on the reverse side of the sprocket tooth where the rotating bushing makes contact. This contact causes accelerated wear, especially when you travel at high speeds.

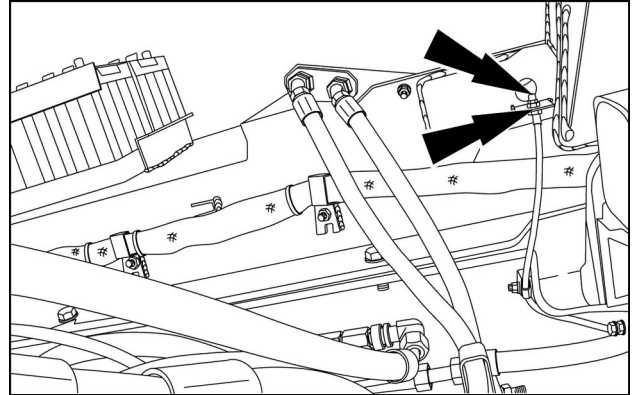
- Reverse wear of the sprocket **(1)**.
- Reverse wear of the bushing **(2)**.



RAPH13DOZ1047CA 15

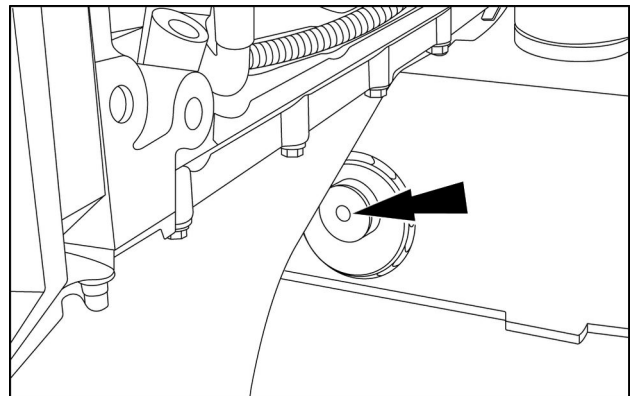
Track equalizer beam - Remove

1. Remove the track from one side of the machine.
2. Raise the front of the machine just enough to remove the weight of the machine from the center pivot for the equalizer beam.
3. Block the machine.
4. Remove the grease fitting and the nut from the hose.



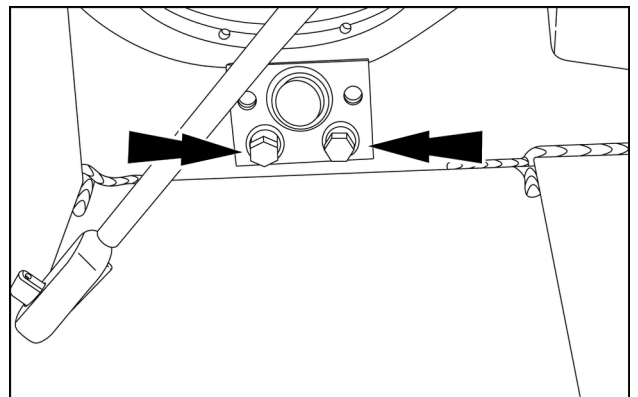
RAIL15DOZ0233AA 1

5. Remove the hose and elbow from the center pivot pin.



RAIL15DOZ0234AA 2

6. Remove the bolts, washers and the bushings from the center pivot pin.
7. Install the bolts into the threaded holes in the center pivot pin retainer plate.
8. Tighten the bolts to start the pivot pin out of the frame.
9. Remove the pivot pin.



RAIL15DOZ0235AA 3

Vertical wear of the bushing

Vertical wear occurs as the track bushings slide through the sprocket root. Accelerated wear occurs with frequent forward and reverse shifting. The bushing moves back and forth between the sprocket teeth. This wear is greater if the track tension is too tight. Accelerated wear is also called vertical wear.

Reverse side drive wear of the bushing

Sprocket reverse tip wear or sprocket reverse drive side wear can cause reverse side drive wear of the bushing. This wear is a major wear pattern for bushings in all track chains. Wear accelerates with a tight track and in high speed reverse operation.

Forward wear of the bushing

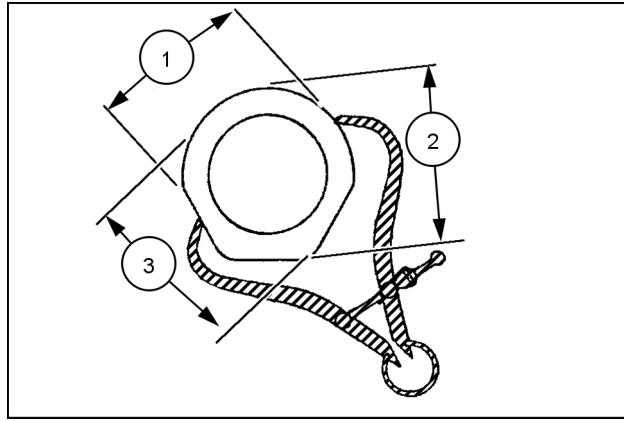
Forward wear is the normal wear that occurs as the machine drives forward. This wear shows less wear than reverse or vertical wear because the bushing does not rotate when you drive the machine forward.

Right-hand track

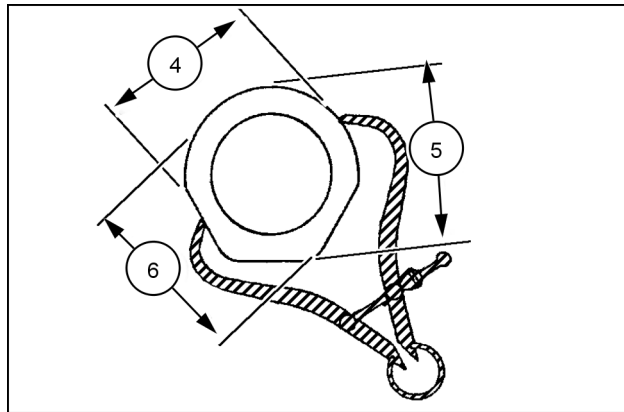
- Forward wear (1)
- Vertical wear (2)
- Reverse wear (3)

Left-hand track

- Reverse wear (4)
- Vertical wear (5)
- Forward wear (6)



RAPH13DOZ1079AA 3



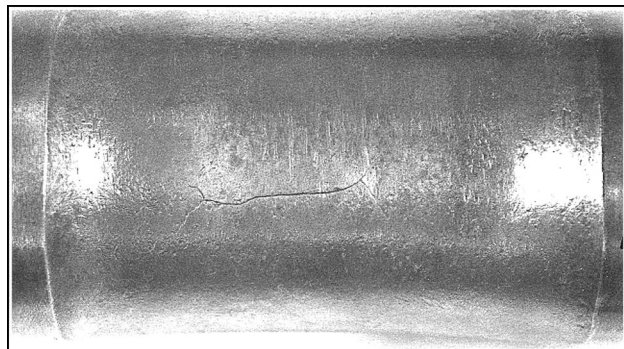
RAPH13DOZ1080AA 4

Bushing cracks (Non-lubricated track)

Excessive external bushing wear with excessive internal wear will cause thin bushing sides. This reduces the bushing strength. Impact loads can then cause cracks in the bushings.

Bushing cracks Case Lubricated Track (CLT)

Excessive external bushing wear and high impact loads will cause the bushings to crack. Turn the pins and bushings at the recommended time to prevent this problem.



RAPH13DOZ1102AA 5

Bushing cracks can result when you run the undercarriage to destruction. This will prevent you from being able to turn the pins and bushings (for sealed and CLT). Perform wear measurements and turn the pins and bushings at the recommended time.

Track chain - Tighten - Track shoe pads

Prior operation:

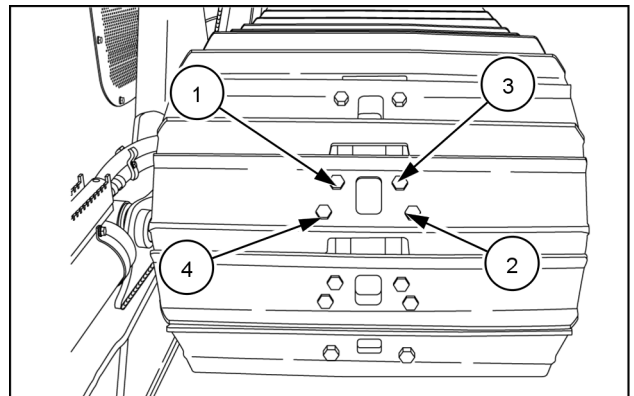
Keep all unauthorized personnel clear of the area. Park the machine on level ground, in neutral with the parking brake applied, and the attachment lowered to the ground, turn off the engine, remove the key, and verify that engine components have cooled or avoid contact. Make sure that all residual pressure is relieved from circuits before beginning maintenance. Make certain all mating surfaces are clean and free of dirt, rust, and paint.

Check track shoe bolt torque

Minimum torque values for track shoe bolts:

Track	Minimum torque
Standard link bolts	491 N·m (362 lb ft)
Master link bolts	491 N·m (362 lb ft)

1. If the bolts are loose or if a bolt rotates before you reach the minimum torque value, tighten the bolts in the sequence shown. Refer to the above table for minimum torque values.



RAPH12DOZ0115AA 1

NOTICE: If the torque value of the wrench decreases as you tighten the bolts, stop and replace the bolt with a new bolt.

New track shoe bolt torque

1. If you replace a bolt with a new bolt, tighten the new bolt to the correct torque values. Refer to the below table for new track shoe bolts torque values.

Torque values for new track shoe bolts:

Track	Torque
Standard link bolts	270 N·m (199 lb ft) +/- 30 N·m (266 lb in) then turn the bolt an additional 120°
Master link bolts	270 N·m (199 lb ft) +/- 30 N·m (266 lb in) then turn the bolt an additional 180°

NOTE: After you torque a new bolt, check the torque after 20 hours of operation as describe above.

Idler wheel - Install

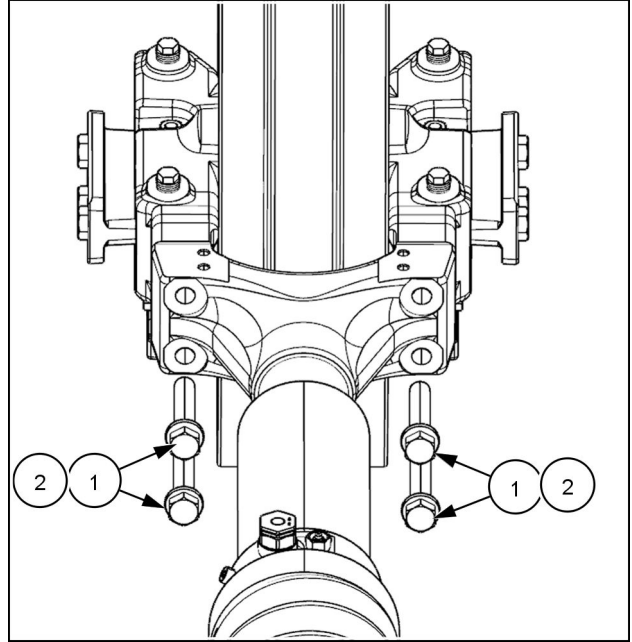
Prior operation:

Idler wheel - Remove (48.134) Track chain Chain - Visual inspection (48.100)

Prior operation:

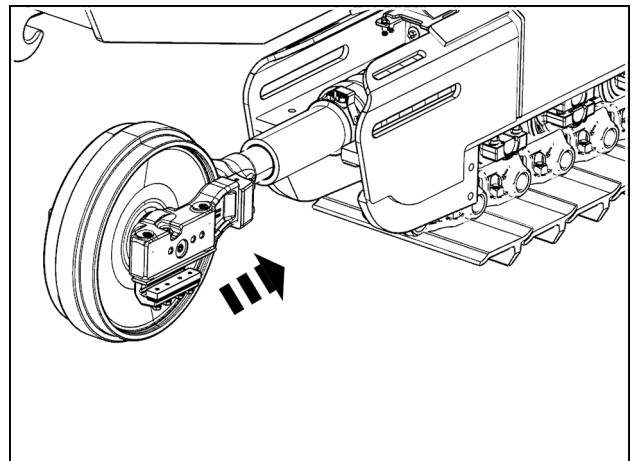
NOTE: Idler wheel weighs approximately **390 kg (860 lb)**. Use proper lifting equipment to prevent personal injury or property damage.

1. Attach an appropriate lifting device to idler wheel.
2. Install the track adjuster to the idler wheel with the four bolts (1) and washers (2). Torque the bolts to **500.0 – 600.0 N·m (369.0 – 443.0 lb ft)**.



RAIL16DOZ0773AA 1

3. Using an appropriate lifting device, raise and slide the idler assembly into the track frame.



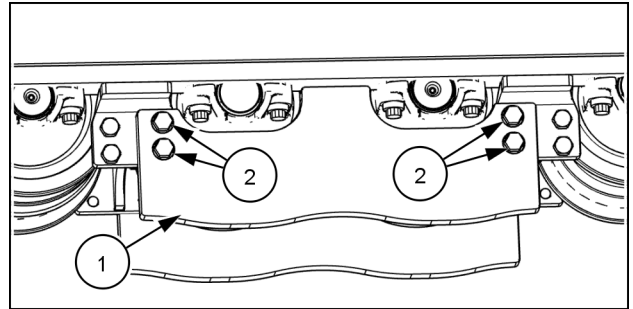
RAIL16DOZ0773AA 2

10. Raise the machine until there is clearance for removal of the lower track roller(s). Use acceptable supports to hold the machine in place.

NOTE: Raising the machine may also create enough slack in the track to remove the rollers.

11. Remove the track guides (1) by removing the hardware (2) securing them to the frame.

NOTE: To remove some rollers, the track guides must be removed.

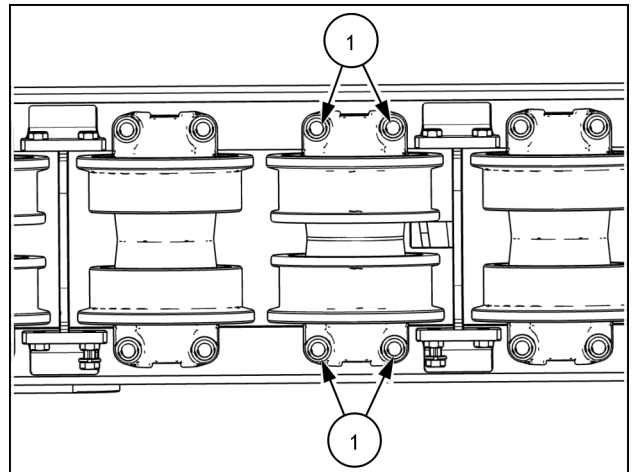


RAPH16DOZ0754AA 4

12. Loosen and remove the cap screws (1) that hold the track roller(s).

13. Remove the track roller(s).

NOTE: The track roller(s) weigh approximately 45.0 – 51.0 kg (100.0 – 112.0 lb) each.

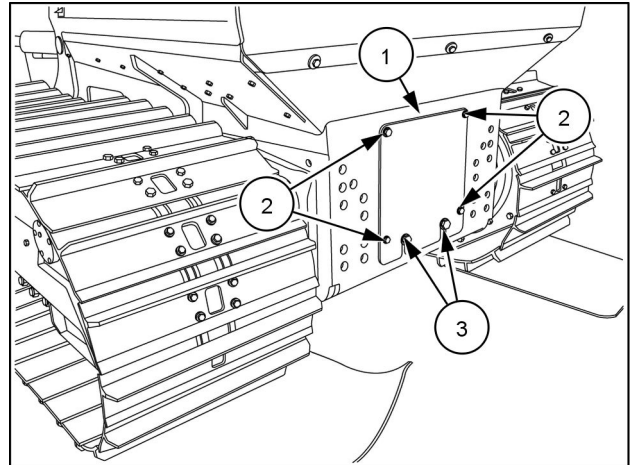


RAPH16DOZ0755BA 5

Next operation:

Track roller - Visual inspection (48.138) Track roller - Install (48.138)

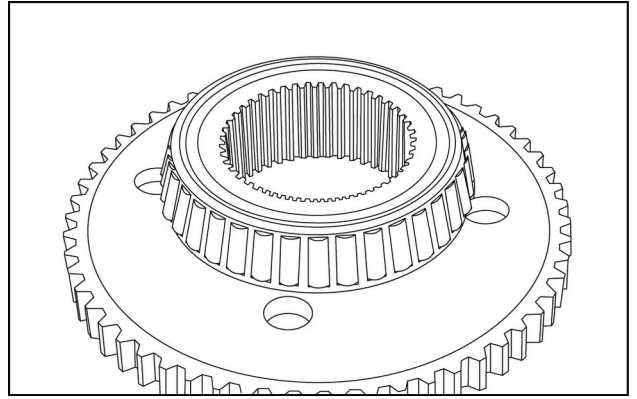
18. Check oil level in oil reservoir and add as required.
See **Hydraulic systems - General specification (35.000)** .
19. Install rear hydrostatic motor access panel (1) with four bolts and washers (2) and tighten two bolts (3).



RAIL12DOZ0942BA 9

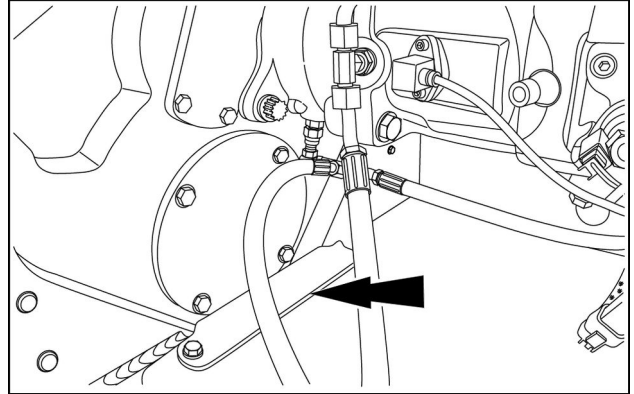
20. Adjust track tension.

5. Use an acceptable tool to remove the bearing.



RAIL15DOZ0367AA 5

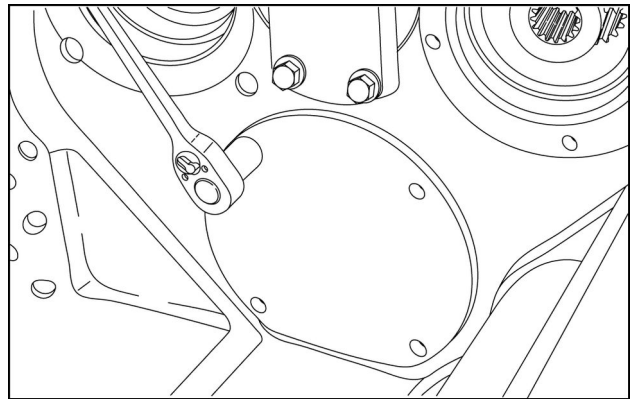
12. Remove the carrier.
13. Remove the rear cover from the machine to gain access to the hydrostatic motors.
14. Remove the plate in the bottom to the center section.



RAIL15DOZ0259AA 8

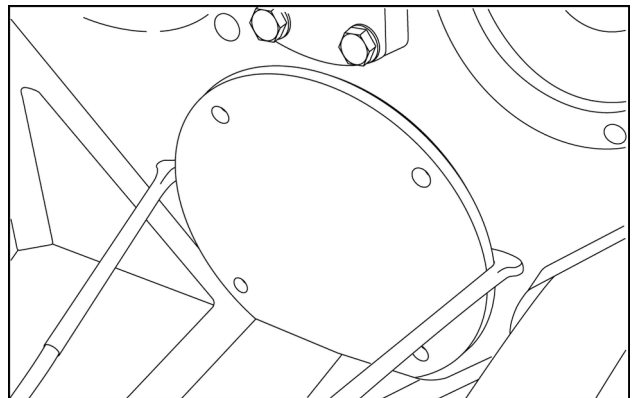
NOTE: The some of the images are from an older machine, the procedures are the same. The motor and brake have been removed to better show the work area. It is not necessary to remove the brake and motor at this time.

15. Loosen and remove the cap screws that hold the retainer for the output gear.



RAIL15DOZ0260AA 9

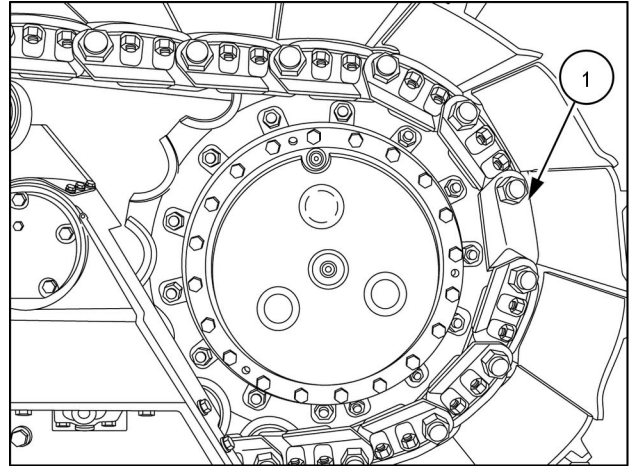
16. Use pry bars to remove the retainer and shims.



RAIL15DOZ0261AA 10

Dropbox or gearbox - Remove

1. Park machine on a firm, level surface with master link (1) centered on rear drive sprocket.



RAIL12DOZ0741BA 1

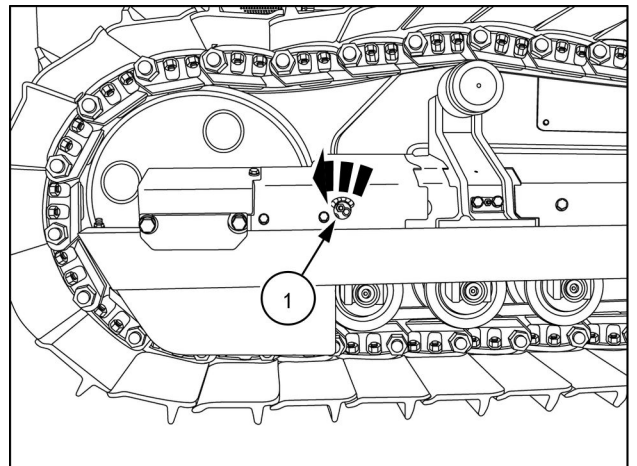
2. Lower all equipment to the ground.
3. Engage parking brake and shut engine off.
4. Relieve system of hydraulic pressure by actuating all hydraulic functions. Remove key when complete.

NOTE: Wait 90 seconds after engine shutdown before turning master battery disconnect switch OFF. After engine shutdown, the Selective Catalytic Reduction (SCR) system module continues to run and conducts a purge cycle.

5. Turn master battery disconnect switch to the OFF position.

NOTICE: The grease in the track mechanism is under high pressure. Keep face and body away from grease fitting.

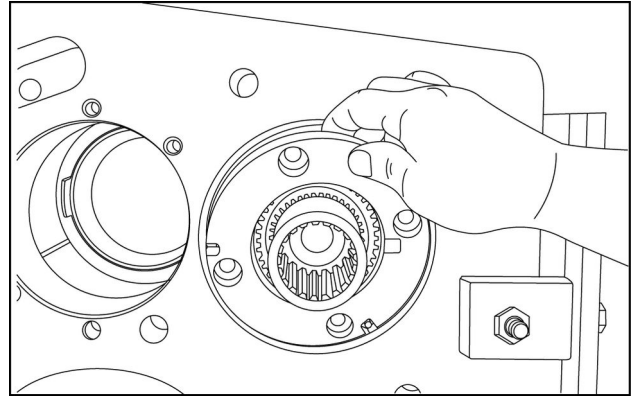
6. Open track adjuster valve (1) only two turns to relieve tension.



RAIL12DOZ0742BA 2

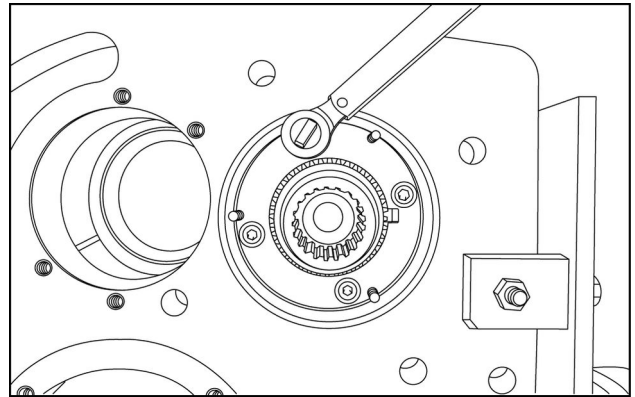
7. Use an appropriate lifting device to lift top of track and compress track adjuster piston as far as possible.
8. Remove lifting device from track.

17. Install the input shaft bearing retainer.



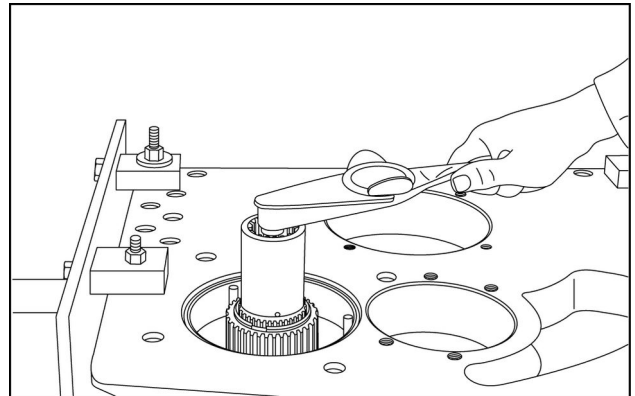
RAIL15DOZ0430AA 17

18. Torque bearing retainer Allen screws to **77 – 87 N·m**
(**57 – 64 lb ft**).



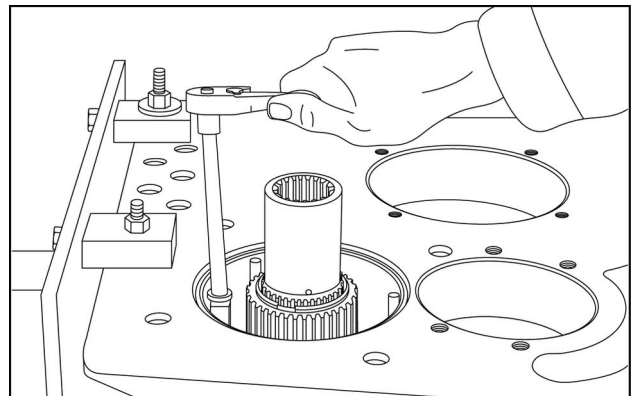
RAIL15DOZ0431AA 18

19. Check the input shaft rolling torque.



RAIL15DOZ0432AA 19

20. Remove the four Allen screws from the bearing retainer plate.



RAIL15DOZ0433AA 20

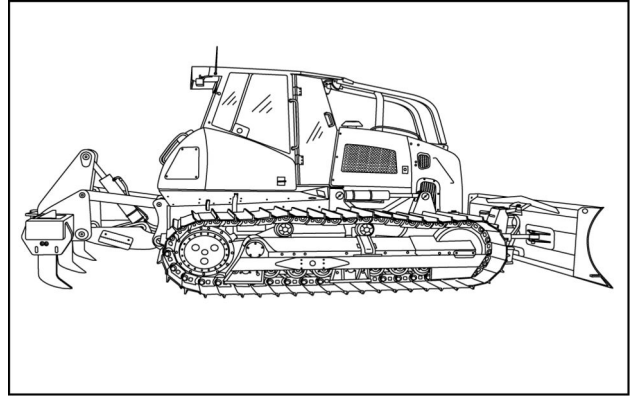
32. Check oil level in the oil reservoir and add as required.
See . **Hydraulic systems - General specification (35.000)**
33. Fill planetary carrier with appropriate type and quantity of gear lubricant.

Cab air filters - Remove

1650M

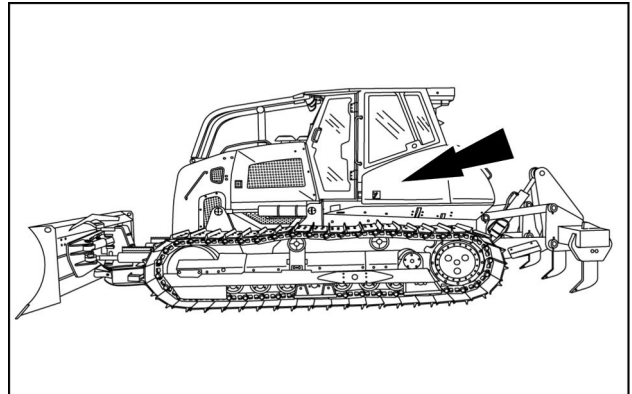
ANZ --- APAC --- LA --- MEA

1. Park the machine on a firm level surface.



RAPH12DOZ0102AA 1

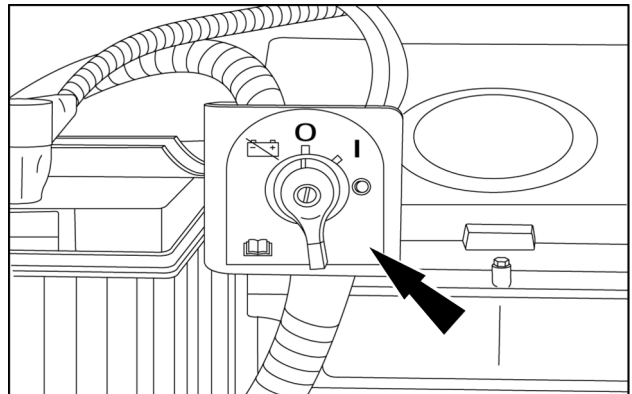
2. Lower the blade and ripper tool (if so equipped).
3. Engage the park brake and turn the ignition key to the OFF position.
4. Locate the battery master disconnect switch behind the panel on the left side of the cab.



RAPH12DOZ0101AA 2

5. Switch the master battery disconnect switch to the OFF position.

NOTE: Wait 90 seconds after engine shutdown before turning off the master battery disconnect. After engine shut down, the Selective Catalytic Reduction (SCR) system does a purge cycle and the supply module continues to run.

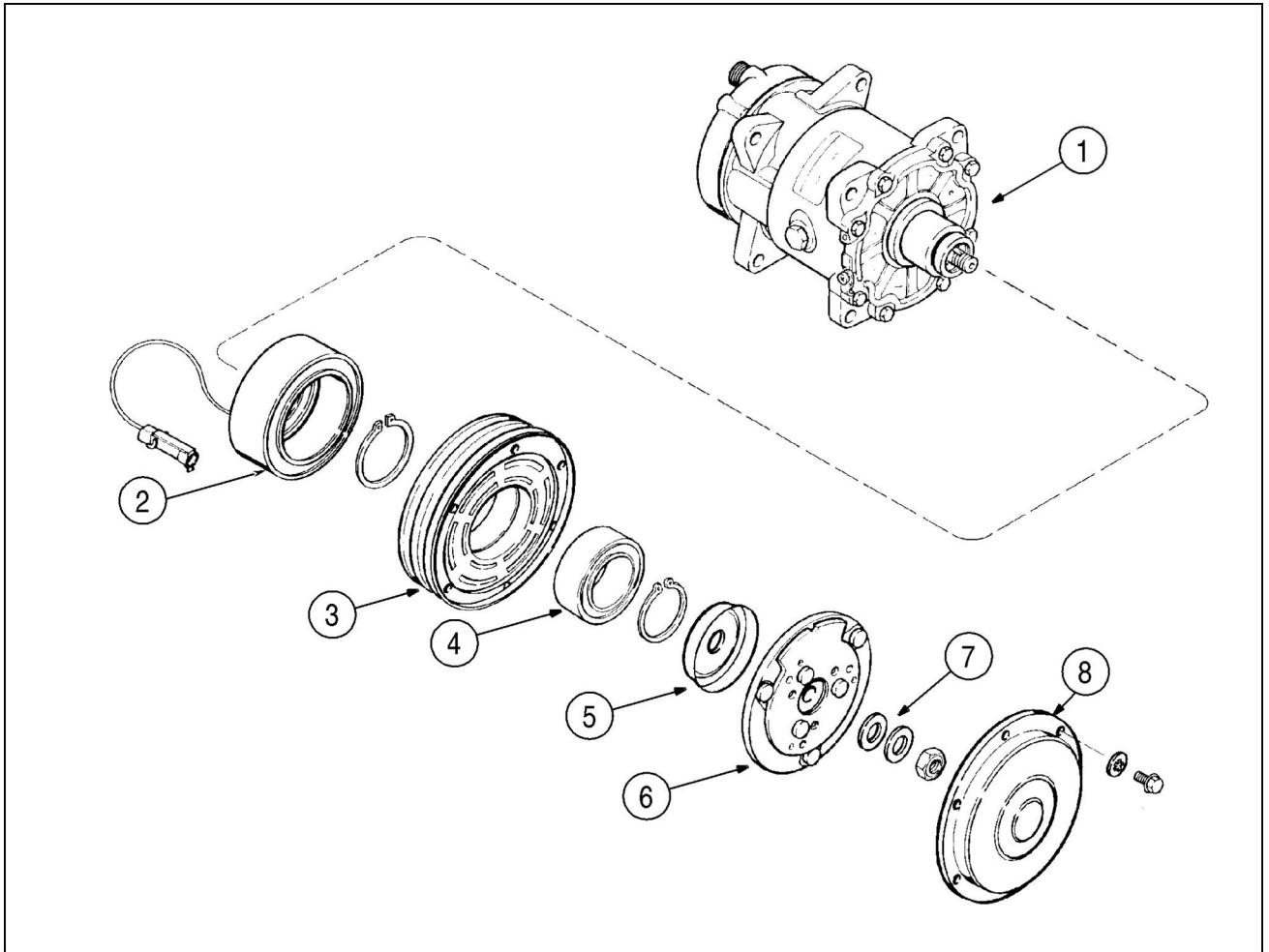


RAPH12DOZ0487AA 3

Air-conditioning compressor Magnetic clutch - Exploded view

1650M

ANZ --- APAC --- LA --- MEA



1016L93 1

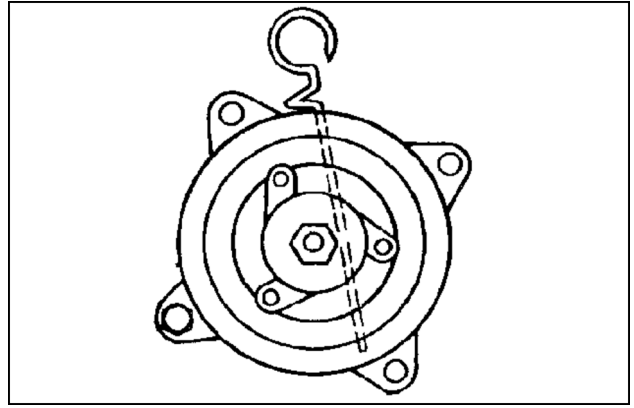
Clutch Assembly

1. Compressor	5. Bearing dust cover
2. Coil assembly	6. Front plate
3. Pulley	7. Shim(s)
4. Bearing	8. Dust cover

15. Make sure the dipstick is inserted all the way to the stop.

NOTE: The illustration shows the front view for the compressor with the dust cover removed.

NOTICE: When compressor is replaced, the old oil should be drained and this amount of new oil should be put into the (drained) replacement compressor.



850L0-1 3

16. Remove the dipstick. Count the oil level marks on the dipstick. Use the following table to find the correct oil level for the mounting angle of the compressor.

Compressor Oil Level

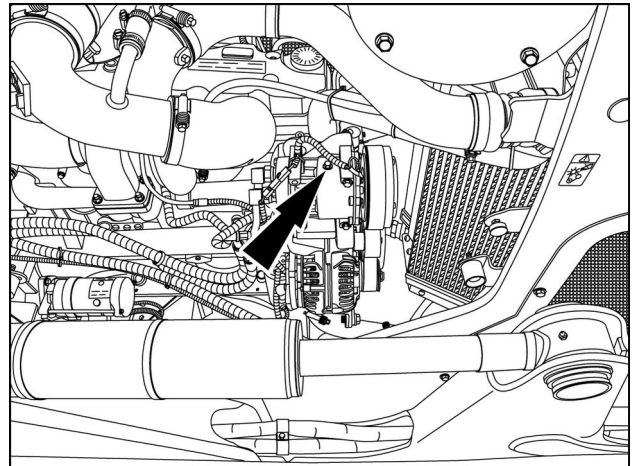
MOUNTING ANGLE (DEGREES)	DIPSTICK READING
0	4 to 6
10	6 to 8
20	7 to 9
30	8 to 10
40	9 to 11
50	9 to 11

BS04D060 4

17. If the oil level is not correct, add or subtract oil to the correct level shown in the above chart.

NOTICE: Use only **SANDEN SP-15 LUBRICANT**.

18. Install a new O-ring on the oil filler plug. Install the plug and tighten to a torque of **15 – 24 Nm (11 – 18 lb ft)**.



RAIL15DOZ0103AA 5

Receiver-dryer - Remove

1650M

ANZ --- APAC --- LA --- MEA

⚠ DANGER

Avoid injury!

Observe ALL precautions listed below when servicing the air-conditioning system and handling refrigerant.

Failure to comply will result in death or serious injury.

D0043A

⚠ WARNING

Pressurized system!

Refrigerant under pressure. Service, repair, or recharging must be performed only by trained service technician.

Failure to comply could result in death or serious injury.

W1180A

⚠ WARNING

Explosion hazard!

Air-conditioning refrigerant boils at -12 °C (10 °F)!

-NEVER expose any part of the air-conditioning system to a direct flame or excessive heat.

-NEVER disconnect or disassemble any part of the air-conditioning system.

Discharging refrigerant gas into the atmosphere is illegal in many countries.

Failure to comply could result in death or serious injury.

W0340A

⚠ WARNING

Avoid injury!

Avoid breathing air-conditioning refrigerant, lubricant vapor or mist. If accidental system discharge occurs, ventilate the work area before resuming service.

Failure to comply could result in death or serious injury.

W1000B

⚠ WARNING

Escaping refrigerant may cause frostbite!

Always wear protective goggles when handling refrigerant. If you get refrigerant in your eye, immediately flush your eyes with water for 15 minutes. Seek medical assistance immediately.

Failure to comply could result in death or serious injury.

W0339A

⚠ WARNING

Escaping refrigerant may cause frostbite!

If you get refrigerant on your skin:

-Warm the area with your hand or lukewarm water, 32 - 38 °C (90 - 100 °F).

-Cover the area loosely with a bandage to protect the area and the prevent infection.

-Seek medical assistance immediately.

Failure to comply could result in death or serious injury.

W0341A

1. Park machine on a firm, level surface.
2. Lower all equipment to the ground.
3. Engage parking brake and shut engine off.
4. Relieve system of hydraulic pressure by actuating all hydraulic functions. Remove key when complete.

NOTE: Wait 70 seconds after engine shutdown before turning master battery disconnect switch OFF. After engine shutdown, the Selective Catalytic Reduction (SCR) system module continues to run and conducts a purge cycle.

Air-conditioning condenser Fan - Testing

1650M

ANZ --- APAC --- LA --- MEA

NOTE: For wiring diagram refer to *Harnesses and connectors - Electrical schematic sheet 20 (55.100)* , *Harnesses and connectors - Electrical schematic sheet 02 (55.100)* , and *Harnesses and connectors - Electrical schematic sheet 18 (55.100)* .

Test N°1	
Test Point	Condition Turn the ignition switch OFF. Check Check the inline fuses to the condenser fans.
Expected Result	Result Fuse is good.
Other Result (Possible Cause)	Action Bad fuse on the condenser fans. Replace fuse and check wiring or fans for shorts.

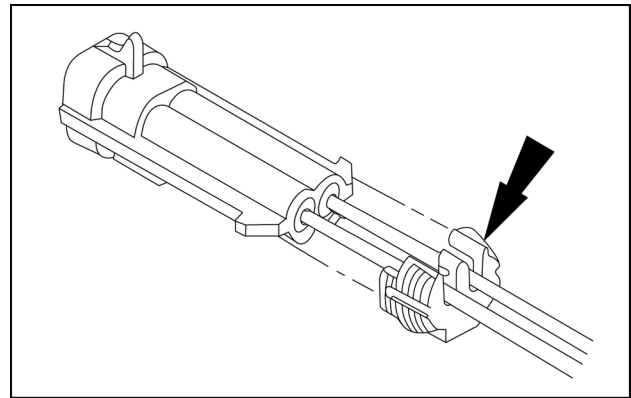
Test N°2	
Test Point	Condition Put the master disconnect switch in the ON position. Check Connector X-067 pin 1 to ground.
Expected Result	Result Continuity
Other Result (Possible Cause)	Action Bad ground circuit.

Test N°3	
Test Point	Condition Put the ignition switch in the RUN position. Check Connector X-067 pin 3 to ground.
Expected Result	Result 24volts
Other Result (Possible Cause)	Action Bad Fuse from J/CASE-C., Bad Condenser relay, Splice SP-8021, or wiring from condenser relay.

Test N°4	
Test Point	Condition Put the ignition switch in the RUN position. Check Check power through condenser control system relay to the inline fan fuse.
Expected Result	Result 24 volts
Other Result (Possible Cause)	Action Bad condenser control system relay. If all tests are good, check all the wiring and fuses on the condenser fans. If the wiring is good, repair or replace the condenser fans.

Sealed connector - wire lock

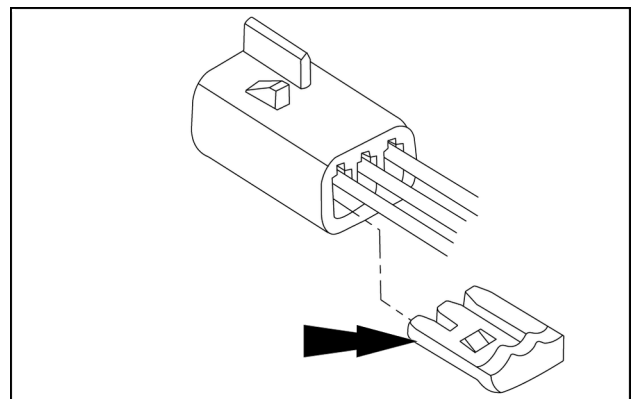
1. Install the wire lock after all terminals have been seated in the connector.
2. Push the lock over the back of the connector until it locks onto the connector.



RAIL14SSL0619AA 31

Unsealed connector - TPA lock

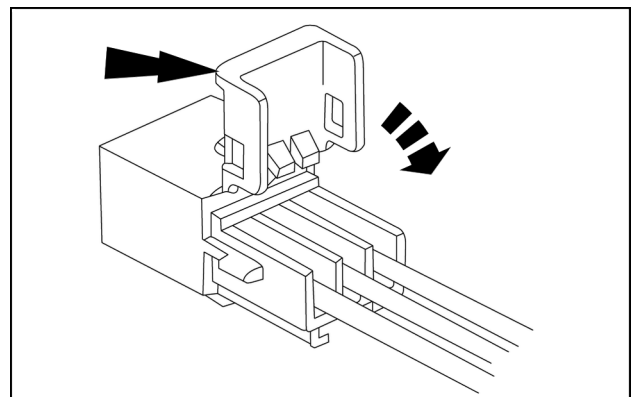
1. Install the TPA lock after all terminals have been seated in the connector.
2. Push the lock into the back of the connector until it locks into place.



RAIL14SSL0618AA 32

Hinged wire lock

1. On connectors with a hinged wire lock, snap the wire lock over back of the connector .



RAIL14SSL0620AA 33



Electrical systems - 55

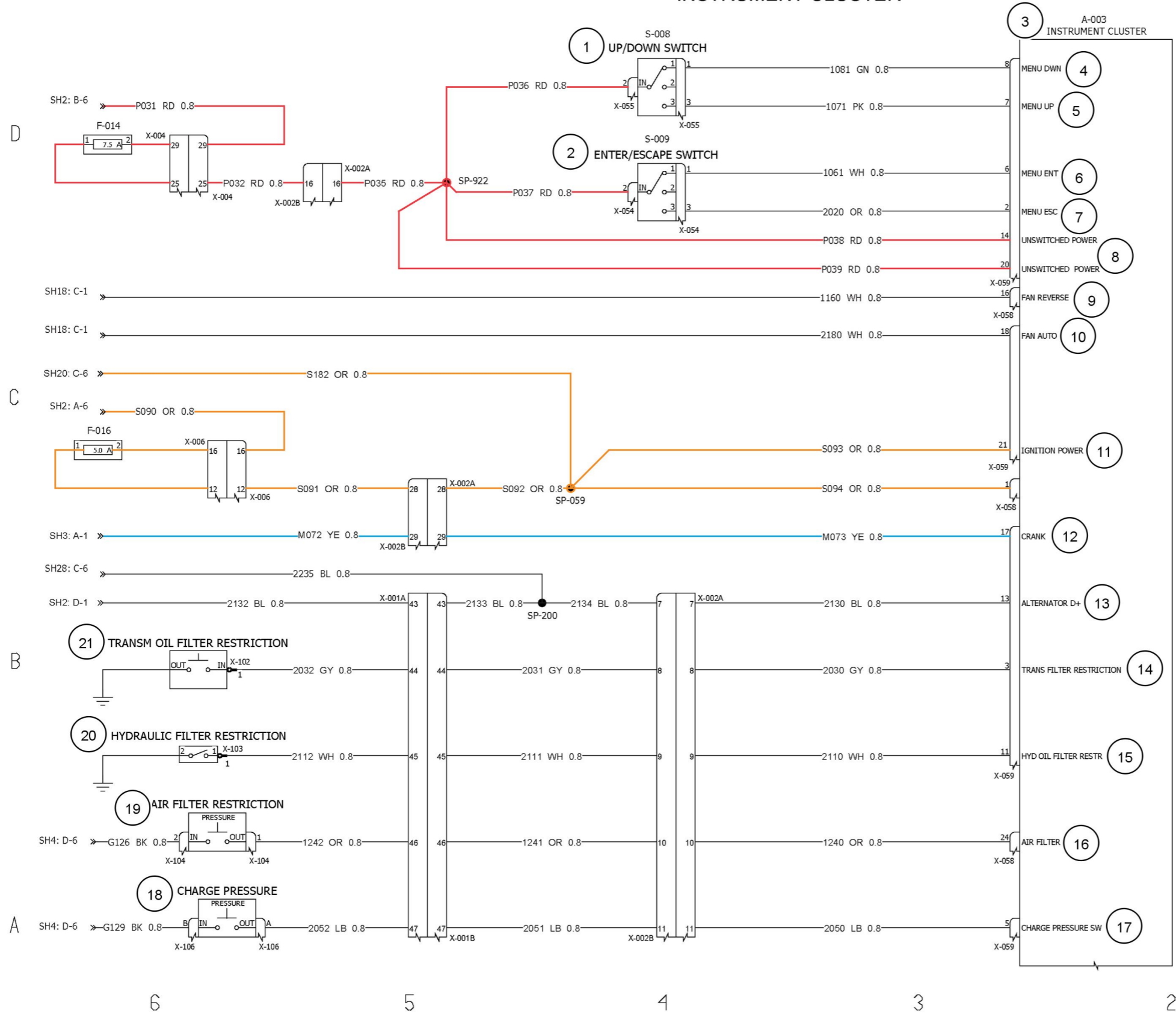
**Heating, Ventilation, and Air-Conditioning (HVAC) control system -
050**

**1650M Bulldozer (BD) Blade, Extra Long Track (XLT) - Tier 2 [NGC107000 -]
1650M Power Angle Tilt (PAT) Blade, Extra Long Track (XLT) - Tier 2
[NGC107000 -]
1650M Power Angle Tilt (PAT) Blade, Low Ground Pressure (LGP) - Tier 2
[NGC107000 -]**

Harnesses and connectors - Electrical schematic sheet 06 - Exhaust control

Item	Description
1	Auxiliary relay

INSTRUMENT CLUSTER



SHEET 15

RAIL16DOZ0583JA 1

Harnesses and connectors - Electrical schematic sheet 25 - Blade control

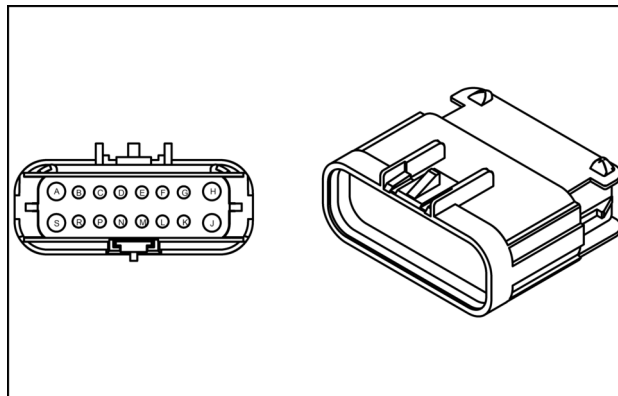
Item	Description
1	5V 1
2	5V 2
3	Ground 1
4	Ground
5	Blade
6	Thumb 1
7	Thumb 2
8	Right joystick F-B 1
9	Right joystick F-B 2
10	Right joystick L-R 1
11	Right joystick L-R 2
12	Level up
13	Level down
14	Auto / Manual

CONNECTOR X-002 - TO DASH

CONNECTOR X-002 - TO DASH			
PIN NUMBER	WIRE NUMBER	CIRCUIT REFERENCE	ELECTRICAL SCHEMATIC FRAME
1	E359 (YE)	CAN 1 HI	28
2	6010 (TN)	FRONT WIPER SPEED SWITCHED +24V	12
3	6011 (TN)	FRONT WIPER RELAY COIL SIGNAL	12
4	S083 (OR)	LEVELING SW SWITCHED +24V	18
5	6018 (TN)	LEFT WIPER RELAY COIL SIGNAL	13
6	6003 (TN)	REAR WIPER RELAY COIL SIGNAL	12
7	S117 (OR)	FRONT/REAR WIPER/WASHER SWITCHED +24V	12
8	E349 (GN)	CAN 1 LO	28
9	6005 (TN)	FRONT/REAR WASHER PUMP SIGNAL	12
10	S108 (OR)	IGNITION ON	2
11	S033 (OR)	LEFT/RIGHT WIPER/WASHER SWITCHED +24V	13
12	6008 (TN)	FRONT WIPER PARK FEED SIGNAL	12
13	A047 (PK)	DECEL PEDAL SENSOR SUPPLY 2 (5V)	8
14	6020 (TN)	RIGHT WIPER RELAY COIL SIGNAL	13
15	P032 (RD)	BATT+	14
16	S011 (OR)	FRONT HEADLAMPS SWITCHED +24V	11
17	3019 (YE)	FRONT LIGHTS RELAY COIL SIGNAL	11
18	3001 (VT)	FRONT LIGHTS SWITCHED +24V	11
19	3005 (VT)	FRONT LIGHTS SWITCHED +24V	11
20	S014 (OR)	REAR LIGHTS SW SWITCHED +24V	11
21	3013 (VT)	REAR LIGHTS SWITCHED +24V	11
22	6022 (TN)	LEFT/RIGHT WASHER PUMP SIGNAL	11
23	S057 (OR)	PARK BRAKE SW SWITCHED +24V	6
24	C170 (WH)	PARK BRAKE SWITCH NO	6
25	C100 (WH)	PARK BRAKE SWITCH NC	6
26	C120 (WH)	DECEL PEDAL SIGNAL	8
27	M170 (WH)	IMPLEMENT ENABLE ON	19
28	1231 (YE)	FAN REVERSE RELAY COIL SIGNAL	17
29	S091 (OR)	SW BATT+	14
30	2134 (BL)	ALTERNATOR D+	14
31	2031 (GY)	TRANS FILTER RESTRICTION SIGNAL	14
32	2111 (WH)	HYD OIL FILTER RESTR SIGNAL	14
33	G106 (BL)	DECEL PEDAL SIGNAL RETURN	14
34	1241 (OR)	AIR FILTER RESTRICTION SIGNAL	14
35	2051 (LB)	CHARGE PRESSURE SW SIGNAL	14
36	1021 (YE)	FUEL LEVEL SIGNAL	15
37	1051 (YE)	HYD OIL TEMP SIGNAL	15
38	M072 (YE)	CRANK SIGNAL	14
39	P014 (RD)	BATT+	2
40	S049 (OR)	FAN CONTROL SW SWITCHED +24V	17

CONNECTOR X-011 - X-011

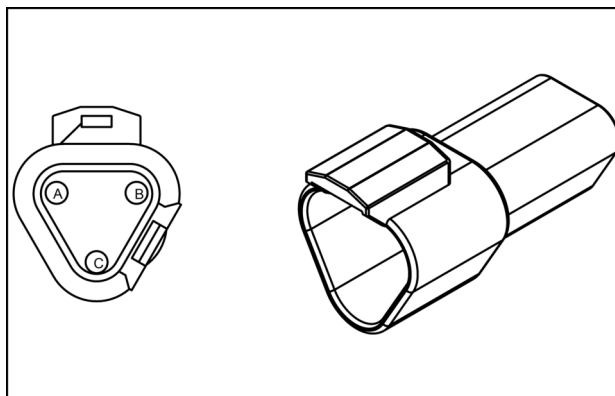
CONNECTOR X-011 - X-011			
PIN NUMBER	WIRE NUMBER	CIRCUIT REFERENCE	ELECTRICAL SCHEMATIC FRAME
A	P052 (RD)	TELEMATICS BATT+	27
B	-	-	
C	S106 (OR)	TELEMATICS SW BATT+	27
D	2235 (BL)	ALTERNATOR D+	27
E	K273 (GY)	TELEMATICS WORKING IN SIGNAL	27
F	-	-	
G	-	-	
H	G036 (BK)	TELEMATICS GROUND	27
J	-	-	
K	-	-	
L	E358 (YE)	CAN 1 HI	28
M	E348 (GN)	CAN 1 LO	28
N	-	-	
P	-	-	
R	-	-	
S	-	-	



87696550 2

CONNECTOR X-029 - X-029

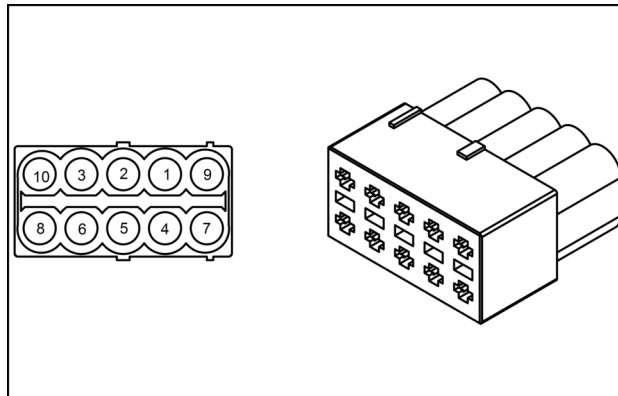
CONNECTOR X-029 - X-029			
PIN NUMBER	WIRE NUMBER	CIRCUIT REFERENCE	ELECTRICAL SCHEMATIC FRAME
A	A025 (PK)	HAND THROTTLE SENSOR SUPPLY 3 (5V)	30
B	C180 (WH)	HAND THROTTLE SENSOR SIGNAL	30
C	G071 (BL)	HAND THROTTLE SENSOR GROUND	30



84146312 10

CONNECTOR X-048 - PARK BRAKE

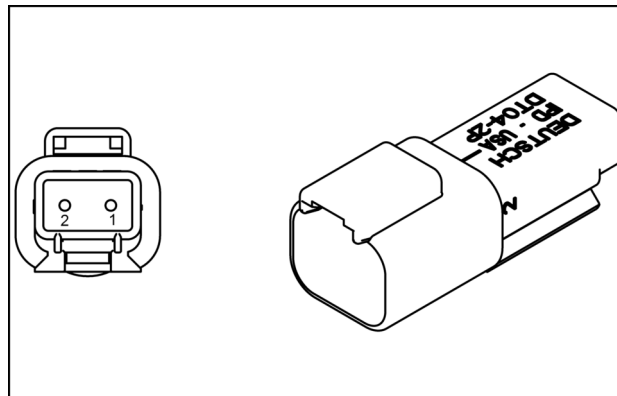
CONNECTOR X-048 - PARK BRAKE			
PIN NUMBER	WIRE NUMBER	CIRCUIT REFERENCE	ELECTRICAL SCHEMATIC FRAME
1	C171 (WH)	PARK BRAKE SWITCH NO	6
2	S058 (OR)	PARK BRAKE SW SWITCHED +24V	6
3	C101 (WH)	PARK BRAKE SWITCH NC	6
4	-	-	
5	-	-	
6	-	-	
7	-	-	
8	-	-	
9	-	-	
10	-	-	



84159859 8

CONNECTOR X-066A - DUST CAP

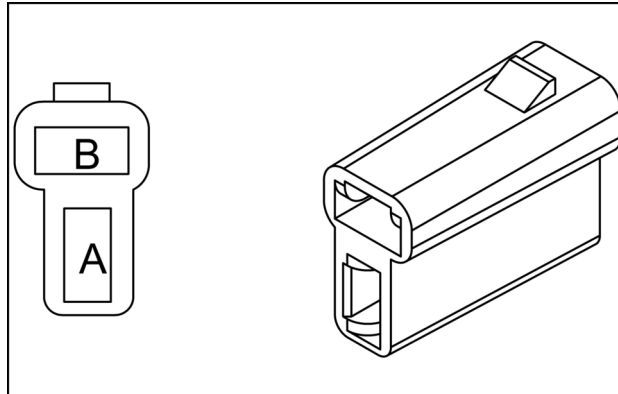
CONNECTOR X-066A - DUST CAP			
PIN NUMBER	WIRE NUMBER	CIRCUIT REFERENCE	ELECTRICAL SCHEMATIC FRAME
1	-	-	
2	-	-	



87695584 8

CONNECTOR X-083 - IGN RELAY

CONNECTOR X-083 - IGN RELAY			
PIN NUMBER	WIRE NUMBER	CIRCUIT REFERENCE	ELECTRICAL SCHEMATIC FRAME
A	S109 (OR)	IGNITION ON	1
B	G047 (BK)	IGNITION RELAY COIL CROUND	1



87693325 5

CONNECTOR X-155 - BACK UP ALARM

CONNECTOR X-155 - BACK UP ALARM			
PIN NUMBER	WIRE NUMBER	CIRCUIT REFERENCE	ELECTRICAL SCHEMATIC FRAME
1	K100 (YE)	BACKUP ALARM SIGNAL	29

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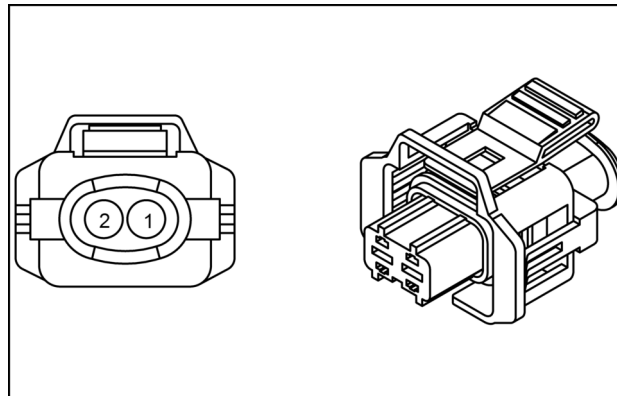
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CONNECTOR X-102 - TRANS OIL FILTER RESTRICTION

CONNECTOR X-102 - TRANS OIL FILTER RESTRICTION			
PIN NUMBER	WIRE NUMBER	CIRCUIT REFERENCE	ELECTRICAL SCHEMATIC FRAME
1	2032 (GY)	TRANS FILTER RESTRICTION SIGNAL	14

CONNECTOR X-124 - DOSING SENSOR

CONNECTOR X-124 - DOSING SENSOR			
PIN NUMBER	WIRE NUMBER	CIRCUIT REFERENCE	ELECTRICAL SCHEMATIC FRAME
1	7110 (YE)	DENOX DOSING	5
2	7120 (OR)	DENOX DOSING 24V	5



87709793 5

Wire connectors - Overview - Dashboard harness connectors

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Connector	Description
X-045	To main harness
X-046	Decel pedal
X-047	Key switch
X-057	Leveling
X-056	Implement enable/Disable
X-055	Up/Down
X-054	Escape/Enter
X-053	Front/Rear wiper and washer
X-052	Left/Right wiper and washer
X-051	Rear lights
X-050	Front headlights
X-049	Fan control
X-048	Park brake
X-GND1	Ground
X-GND2	Ground
X-040	Buzzer
X-039	Buzzer
X-058	Cluster
X-059	Cluster
X-060	Front wiper

Engine starting system - Testing - Engine will not crank

1650M | ANZ --- APAC --- LA --- MEA

Test N°1	
Test Point	<p>Condition Turn the ignition switch OFF.</p> <p>Check Verify the connections to the starter and battery are tight and secure. Verify the minus battery connections from the starter and the battery are tight and secure. Verify the wiring and connections are free of corrosion, abrasion and damage.</p>
Expected Result	Result The connections are secure. The connections are free of corrosion, abrasion and damage.
Other Result (Possible Cause)	Action The connections are not secure or the connections show signs of corrosion, abrasion or damage. Repair as required.

Test N°2	
Test Point	<p>Condition Turn the ignition switch OFF.</p> <p>Check Verify the connections to the ignition switch, ECU, and UCM are tight and secure. Verify the connections to the starter relay, the vehicle safety relay, and the starter are tight and secure. Verify the wiring and connections are free of corrosion, abrasion and damage.</p>
Expected Result	Result The connections are secure. The connections are free of corrosion, abrasion and damage.
Other Result (Possible Cause)	Action The connections are not secure or the connections show signs of corrosion, abrasion or damage. Repair as required.

Test N°3	
Test Point	<p>Condition Turn the ignition switch OFF.</p> <p>Check Disconnect the UCM connector X-017. Turn the ignition switch to START. Measure the voltage between UCM connector X-017 pin 14 and chassis ground while the ignition switch is in the start position.</p>
Expected Result	Result The voltage should be approximately 24 V .
Other Result (Possible Cause)	Action The voltage is less than 10 V . There is a problem with the battery supply from the ignition switch. Verify the ignition switch is function properly. Verify the wiring from the ignition switch to the UCM is not damaged. Repair as required.

Test N°4	
Test Point	<p>Condition Turn the ignition switch OFF. Disconnect the vehicle safety relay.</p> <p>Check Turn the ignition switch to the START position. Measure the voltage between the vehicle safety relay connector X-005 pin 48 and chassis ground.</p>
Expected Result	Result The voltage should be approximately 24 V . Go to Engine start relay - Testing - Starter Relay (55.201) and Engine start relay - Testing - Vehicle Safety Relay (55.201) .
Other Result (Possible Cause)	Action The voltage is less than 18 V . There is a problem with the start signal from the UCM. Repair as required.

Instrument cluster - Calibrate - Ground drive calibration

1650M

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Ensure the tracks and undercarriage are free of debris and mud.

Ensure overall track tension is per the decal on the side of the machine.

The tracks and/or chains must not be binding or under a load before you start ground drive calibration.

Prior operation:

Set the throttle to greater than **1800 RPM**.

Ensure the Park brake is OFF.

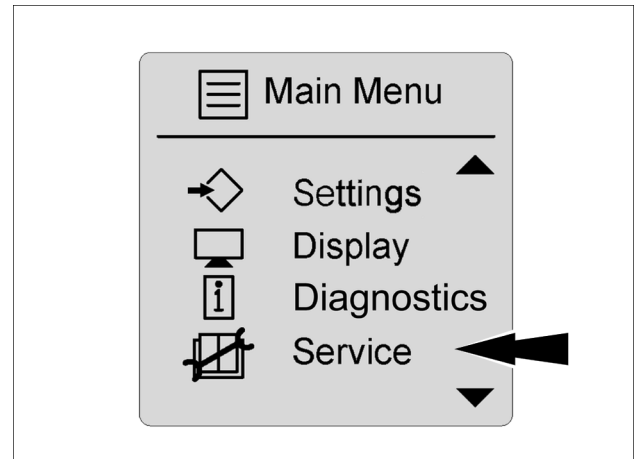
Make sure the implements (blade and ripper) are off the ground and disabled.

Make sure the hydraulic oil temperature is greater than **40 °C (104.0 °F)** and less than **45 °C (113 °F)**.

Ground drive calibration

NOTE: To initiate the ground drive calibration set the throttle greater than **1800 RPM**, park brake OFF, and the hydraulic oil temperature greater than **40 °C (104.0 °F)**

1. To access the main menu screen, hold the confirm switch for two seconds.

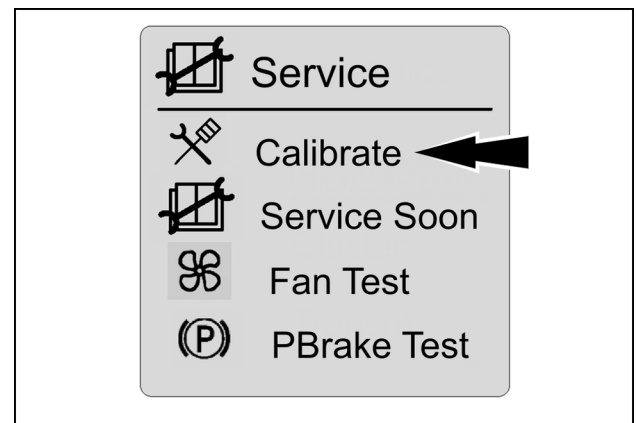


RCPH11WHL020BAN 1

2. Use Up and Down switch to highlight Service icon from main menu screen. Use the Enter / Confirm switch to choose the selection.

NOTE: Screen arrows will display to indicate if additional menu options are available.

3. Use Up and Down switch to highlight Calibrate icon from Service menu. Use the Enter / Confirm switch to choose the selection. Highlight selection and follow screen prompts. For enabling conditions, the ignition key must be ON, the engine must be OFF, the implement setting must be OFF, the operator is in the seat, the parking brake is ON, and there are no joystick related error codes.



RAIL12DOZ0222AA 2

Contents

Electrical systems - 55

Wiper and washer system - 518

DIAGNOSTIC

Windshield washer fluid pump	
Testing (*)	3
Wiper switches	
Testing - Front \ Rear, Left \ Right (*)	4

(*) See content for specific models

1003 - Seat Switch: Short to Power

1650M

ANZ --- APAC --- LA --- MEA

Context:

The UCM detects a short circuit to another voltage source in the seat switch circuit, X-018 pin 12. Ground drive will operate in limp home mode while Diagnostic Trouble Code 1003 is active.

To reset, the operator must be present in the seat. Turn the ignition switch OFF. Parking brake must change from engaged to disengaged.

Cause:

The UCM detects a short circuit to another voltage source in the seat switch circuit, X-018 pin 12.

Possible failure modes:

1. A short circuit in the seat switch wiring or circuits.
2. Faulty seat switch.
3. Faulty UCM.

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.

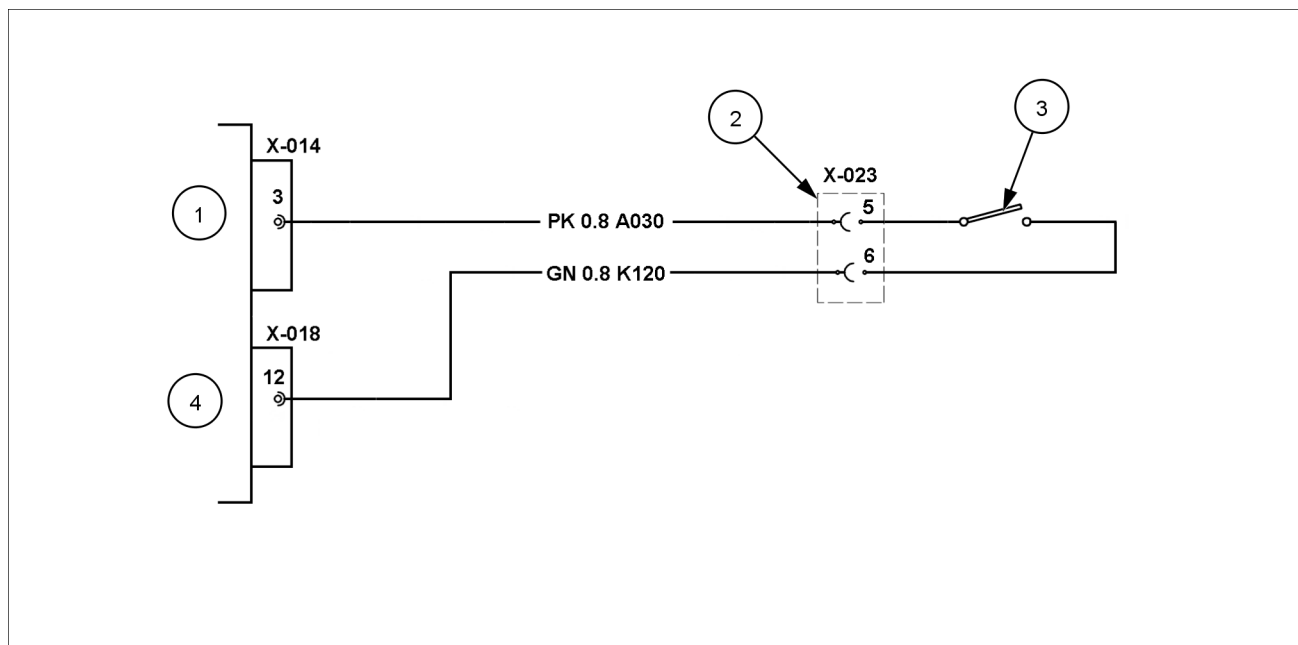
A. The fault is not recorded again. OK to return the machine to service.

B. Fault code 1003 is recorded again. Go to step 2.

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

Inspect the UCM and the seat switch connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the UCM to the seat switch. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.



RAIL12DOZ0154FA 1

1202 - Backup Alarm Shorted to Ground

1650M

ANZ --- APAC --- LA --- MEA

Context:

The UCM detects a short circuit to ground in the backup alarm circuit, X-019 pin 10. The backup alarm is disabled while fault code 1202 is active.

Cause:

There is a short circuit to ground in the backup alarm circuit, X-019 pin 10.

Possible failure modes:

1. Short circuit in the backup alarm wiring.
2. Faulty backup alarm.
3. Faulty UCM.

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.

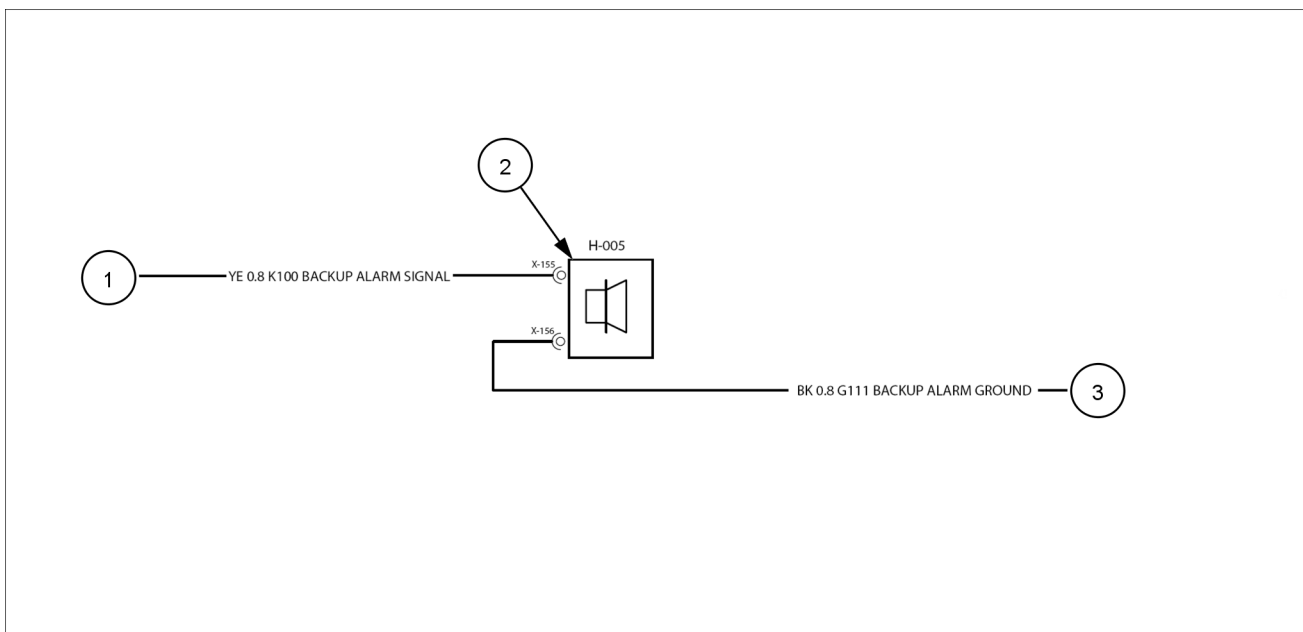
A. The fault code is not recorded again. OK to return the machine to service.

B. Fault code 1202 is recorded again. Go to step **2**.

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

Inspect the UCM and the backup alarm connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the UCM to the backup alarm. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.



RAIL12DOZ0429FA 1

Remove ODFT connector from the oil temp / press sensor and check for voltages between connector pins outlined in the table below.

Test Type	From	To	Expected Results
1. Voltage	ODFT (Pin 3)	ODFT (Pin 1)	Approx. 5 volts
2. Voltage	ODFT (Pin 2)	ODFT (Pin 1)	Approx. 5 volts
3. Voltage	ODFT (Pin 4)	ODFT (Pin 1)	Approx. 5.4 volts

- A. If the voltage test sequence is successful, proceed to step **5**.
 - B. If the voltage test sequence is not successful, proceed to step **4**.
4. Operation: Check for Faulty Wiring.
Vehicle status: Key Off Engine Off.

Remove and perform continuity tests between connectors ODFT and 2 on engine wiring 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	ODFT (Pin: 1)	2 (Pin: 24)	Approx. 0 – 0.10 ohms
2. Continuity	ODFT (Pin: 2)	2 (Pin: 28)	Approx. 0 – 0.10 ohms
3. Continuity	ODFT (Pin: 3)	2 (Pin: 32)	Approx. 0 – 0.10 ohms
4. Continuity	ODFT (Pin: 4)	2 (Pin: 27)	Approx. 0 – 0.10 ohms
5. Short Circuit	2 (Pin: 28)	2 (Pin: 24, 27, 32)	Open Circuit
6. Short Circuit	2 (Pin: 24)	2 (Pin: 27, 32)	Open Circuit
7. Short Circuit	2 (Pin: 27)	2 (Pin: 32)	Open Circuit

- A. If continuity/shorts test is successful, go to step **5**.
 - B. If continuity/shorts test is unsuccessful, find and repair the damaged section(s) of the wiring harness.
5. 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.

Use product schematic 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.

Important Note:

Check and verify that the vehicle status is correct for each operation. Potential ECU damage could result when removing and replacing main ECU connectors if this is not followed.

Test Type	From	To	Expected Results
1. Voltage	1 (Pin 2, 3, 8, 9, 40)	Ground (engine block)	Approx. 12 volts
2. Continuity	1 (Pin 5, 6, 10, 11)	Ground (engine block)	Approx. 0 – 0.10 ohms

- A. If the voltages and ground paths are correct and the oil temp / press sensor was not replaced on a prior diagnostic of this type, replace the sensor.
- B. If the voltages and ground paths are correct and the oil temp / press sensor was replaced on a prior diagnostic of this type, re-initialize the ECU as if it was blank (new) and load the appropriate data-set.
- C. If the voltages and ground paths are correct and the ECU was re-initialized on a prior diagnostic of this type, replace the ECU.
- D. If the voltages and ground paths are not correct, refer to schematic and determine root cause of power or continuity problem(s).

Schematic legend			
(1)	UCM connector X-020 Pin 20, Right speed sensor frequency	(6)	UCM connector X-018 Pin 11, Left speed sensor direction
(2)	UCM connector X-018 Pin 16, Right speed sensor direction	(7)	UCM connector X-020 Pin 34, Left speed sensor ground
(3)	UCM connector X-020 Pin 32, Right speed sensor ground	(8)	Connector X-001/ X-090
(4)	Speed sensor switched battery, 24 V Fuse F-033, 7.5 A	(9)	Right speed sensor Connector X-129
(5)	UCM connector X-020 Pin 28, Left speed sensor frequency	(10)	Left speed sensor Connector X-128

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 at the sensor.

Turn the ignition switch OFF.

Disconnect the right speed sensor connector X-129.

Turn the ignition switch ON.

Measure the voltage between X-129 pin 1 and X-129 pin 2. The voltage should be approximately **24 V**. Wiggle the harness during measurement to reveal an intermittent condition.

A. The voltage is between **20 V** and **28 V**. Go to step **4**.

B. The voltage is less than **20 V**. There is a problem in the battery supply to the sensor. Check fuse F-033. Repair as required. Return to step **1** to confirm elimination of fault.

4. Measure the resistance of the signal wire to other circuits.

Turn the ignition switch OFF.

Disconnect UCM connectors X-020 and X-018.

Disconnect the right speed sensor connector X-129.

Measure the resistance between X-018 pin 16 and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between X-018 pin 16 and X-018 pin 13. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between X-018 pin 16 and X-020 pin 32. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

A. The resistance is greater than **20,000 Ω**. Go to step **5**.

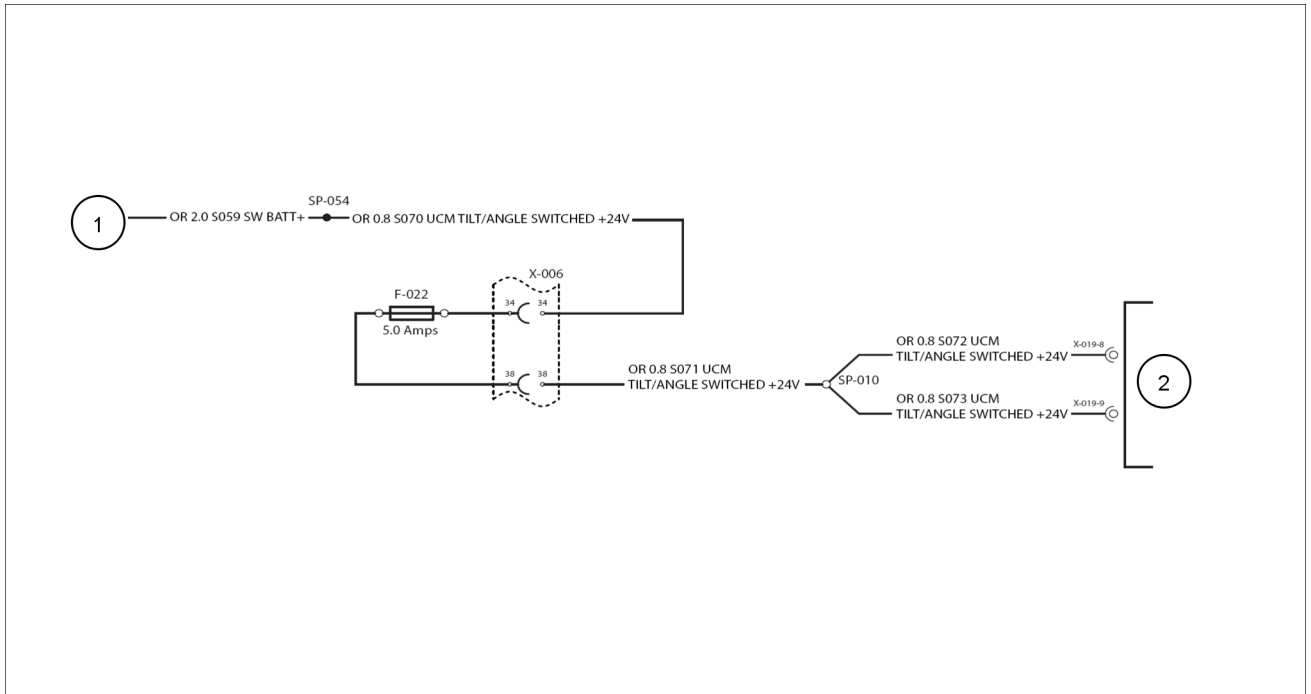
B. The resistance is less than **20,000 Ω**, there is a short circuit in the wiring. Repair or replace the harness as required. Return to step **1** to confirm elimination of fault.

5. Measure the resistance through the wiring.

Fabricate a jumper wire that will connect between X-129 pin 4 and chassis ground.

Connect the jumper wire between X-129 pin 4 and chassis ground. The chassis ground connection must be clean and free of paint, oil and dirt.

Measure the resistance between UCM connector X-018 pin 16 and chassis ground. The resistance should be less than **10 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.



RAIL12DOZ0577FA 1

Schematic legend			
(1)	24 V battery supply to fuse F-022	(2)	UCM connector X-019 Pin 8 and pin 9

- 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 at the UCM connector.
- Turn the ignition switch OFF.
- Disconnect UCM connector X-019.
- Turn the ignition switch ON.
- Measure the voltage between X-019 pin 8 and chassis ground. The chassis ground must clean and free of paint, oil and dirt. The voltage should be approximately **24 V**. Wiggle the harness during measurement to reveal an intermittent condition.
- Measure the voltage between X-019 pin 9 and chassis ground. The chassis ground must clean and free of paint, oil and dirt. The voltage should be approximately **24 V**. Wiggle the harness during measurement to reveal an intermittent condition.
- A. Both voltage measurements are greater than **20 V**. There is a problem in the UCM. Temporarily replace the UCM and retest. Return to step 1 to confirm elimination of the fault.
 - B. The voltage is less than **20 V**. There is a problem in the wiring to the UCM. Check fuse F-022. Repair as required. Return to step 1 to confirm elimination of the fault.

1819 - UCM Temperature Above Normal

1650M

ANZ --- APAC --- LA --- MEA

Context:

The internal UCM temperature is greater than a predefined limit.

Cause:

The UCM temperature is greater than normal. This fault code may be active with 1809 and other fault codes such as high engine temperatures or low battery voltages.

Possible failure modes:

1. A problem in the engine cooling system.
2. Faulty UCM.

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 1819 is recorded again along with other codes such as fault code 3007 high coolant temperature or fault code 1408 low battery voltage troubleshoot these codes first.
- C. Fault code 1819 is recorded again. No other codes are present. Temporarily replace the UCM and retest. Return to Step 1 to confirm elimination of the fault.

If necessary, use the test lead labeled "Coolant/Fuel Temp Sensor" from the Tier II (NEF) Diagnostic Repair Kit 380040185 to access the pins on the coolant temperature sensor, connector WTF. Also, use the **0.4 mm (0.017 in)** diameter test probes from the repair kit when connecting the multi-meter to the ECU engine connector 2. There should be **5 volts**.

- A. If **5 volts** is present, locate a repair the open circuit condition between the ECU engine connector 2, pin 15 and the Coolant temperature sensor connector WTF, pin 1.
 - B. If **5 volts** is not present, replace the ECU.
5. Verify the coolant temperature sensor ground path. Place the ignition switch in the OFF position, disconnect ECU engine connector, 2, and check for continuity to ground from pin 26 of the ECU. Use the **0.4 mm (0.017 in)** diameter test probes from the Tier II (NEF) Diagnostic Repair Kit 380040185 when connecting the multi-meter to the ECU engine connector, 2.
- A. If there is continuity, locate and repair short to ground in Engine sensor harness between the ECU engine connector, 2, and the Coolant temperature sensor connector, WTF.
 - B. If there is not continuity, replace the ECU.

- C. If the voltages and ground paths are correct and the ECU was re-initialized on a prior diagnostic of this type, replace the ECU.
- D. If the voltages and ground paths are not correct, refer to schematic and determine root cause of power or continuity problem(s).

Test Type	From:	To:	Expected Results
1. Continuity	Boost pressure sensor connector (Pin: 1)	connector on engine wiring harness (Pin: 25)	Approx. 0 – 0.10 ohms
2. Continuity	Boost pressure sensor connector (Pin: 2)	connector on engine wiring harness (Pin: 36)	Approx. 0 – 0.10 ohms
3. Continuity	Boost pressure sensor connector (Pin: 3)	connector on engine wiring harness (Pin: 33)	Approx. 0 – 0.10 ohms
4. Continuity	Boost pressure sensor connector (Pin: 4)	connector on engine wiring harness (Pin: 34)	Approx. 0 – 0.10 ohms
5. Shorts	connector on engine wiring harness (Pin: 36)	connector on engine wiring harness (Pin: 25, 34, 33)	Open Circuit
6. Shorts	connector on engine wiring harness (Pin: 25)	connector on engine wiring harness (Pin: 34, 33)	Open Circuit
7. Shorts	connector on engine wiring harness (Pin: 34)	connector on engine wiring harness (Pin: 33)	Open Circuit

A. If continuity/shorts test is successful, go to step 4.

B. If continuity/shorts test is unsuccessful, find and repair the damaged section(s) of the wiring harness.

4. Operation: Check for ECU Voltages and Ground Continuity.

Vehicle Status (when removing connector on ECU): Key Off Engine Off.

Vehicle Status (when performing test): Key On Engine Off.

Vehicle Status (when replacing connector on ECU): Key Off Engine Off.

Use product schematic for a reference, remove connector from the ECU and check for voltage and continuity at the appropriate pins defined in the test table below. Use the **0.4 mm (0.017 in)** diameter test probes from the Tier II (NEF) Diagnostic Repair Kit **380040185** when connecting the DMM to the connector on ECU. Make sure the DMM's test lead resistance is taken into account when making any continuity measurements.

Important Note:

Check and verify that the Vehicle Status is correct for each operation. Potential ECU damage could result when removing and replacing main ECU connectors if this is not followed.

Test Type	From	To	Expected Results
1. Voltage	ECU vehicle connector (pin 2, 3, 8, 9, 40) .	Ground (engine block)	Approx. 12 volts
2. Continuity	ECU vehicle connector (pin 5, 6, 10, 11)	Ground (engine block)	Approx. 0 – 0.10 ohms

A. If the voltages and ground paths are correct and the boost pressure sensor was not replaced on a prior diagnostic of this type, replace the sensor.

B. If the voltages and ground paths are correct and the boost pressure sensor was replaced on a prior diagnostic of this type, re-initialize the ECU as if it was blank (new) and load the appropriate data-set.

C. If the voltages and ground paths are correct and the ECU was re-initialized on a prior diagnostic of this type, replace the ECU.

D. If the voltages and ground paths are not correct, refer to schematic and determine root cause of power or continuity problem(s).

3068 - Cylinder 3 - Unclassifiable Error In Injector

1650M

ANZ --- APAC --- LA --- MEA

Context:

The engine control unit (ECU) has determined that an unclassifiable failure exists in the Cylinder #3 injector circuit. A power stage component energizes the 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 failure in the Cylinder #3 injector circuit that is unclassifiable over 8 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 injector output power driver stage.

Possible failure modes:

1. Faulty injection valve.
2. Faulty electrical wiring (damaged connector or conductor).
3. Faulty 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 **3**.
2. Visually check the electrical integrity of the injector circuit (Inspect connector housing body/latch, pins and wiring harness for damage or corrosion).
 - A. If damage is determined after careful inspection, repair wiring and/or replace connector parts to ensure a good and sound electrical connection.
 - B. If no damage is determined, the ECU or injector may have failed. Try reloading the ECU software. If the fault reoccurs, try replacing the injector. If the fault reoccurs, replace the ECU.
3. 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.

3081 - Cylinder 4 - Injector Cable Short Circuit (Low Side To Battery)

1650M

ANZ --- APAC --- LA --- MEA

NOTE: This diagnostic procedure requires a good quality Digital Multi-meter (DMM) to be able to take accurate resistance measurements. The meter should be able to measure to a resolution of **0.1 ohms**. Some of the measurements required to be taken, could be as low as **0.4 ohms** and any inaccuracies in the DMM could cause a technician to take the wrong diagnostic path.

Context:

The Engine Control Unit (ECU) generated an error associated with the injector power driver stage. The power stage component of the ECU energizes the injection system transistors and simultaneously observes the current flow (sense resistors) in the high-side and low-side switching branches. If there is a deviation from the expected current flow, the driver circuitry detects the specific error and reports it back to the ECU. The ECU will process the error message so that it records information on performed injections, cylinder bank specific errors and cylinder specific errors. The error message is then compared to applicable error patterns and if there is a match, a fault code is generated. If an error message doesn't match any pattern, the error is treated as unclassifiable. This monitoring function is performed once per camshaft revolution.

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 electrical wiring, short to high source or damaged wiring harness.
2. Faulty injection valve or shorted solenoid windings.
3. Faulty ECU, supply voltages or grounds.

Solution:

1. Operation: Electrical Inspection.
Vehicle Status: Key Off Engine Off.

Remove the following connector for electrical inspection:

1. ECU injector connector 3.
2. Valve cover connector VC2.

Inspect connector housing body/latch, pins and wiring harness for damage or corrosion.

- A. If damage is determined after careful inspection, repair wiring and/or replace connector parts to ensure a good and sound electrical connection.
- B. If no damage is determined, proceed to step 2.
2. Operation: Injector Resistance Test Cylinder #3/4 injector connector VC2 to Cylinder #3/4 injector.
Vehicle Status: Key Off Engine Off.

Remove connector VC2 and perform an injector resistance test on the Cylinder #3/4 injector connector VC2. Use the standard multi-meter test leads to access the connector pins. Make sure that the multi-meter's test lead resistance is taken into account when resistance measurements are taken. Record the multi-meter's test lead resistance by touching the leads together on the lowest Ohms scale and mentally recording the resistance value. Subtract this value from the actual resistance measurement taken. See test table below.

Test Type	From	To	Expected Results
1. Resistance	Cylinder #3/4 injector connector VC2 connector pin: 1	Cylinder #3/4 injector connector VC2 connector pin: 2	Approx. 0.4 – 0.5 ohms

- A. If resistance test was not successful, proceed to step 4
- B. If resistance test was successful, reconnect connector VC2. Proceed to step 3.

3095 - Operating With Camshaft Sensor Only - Backup Mode

1650M

ANZ --- APAC --- LA --- MEA

Context:

The Engine Control Unit (ECU) has reported an error with the monitoring of the Increment speed sensor (Crankshaft speed sensor). In the case of a defective Crankshaft speed sensor the engine can also be run alone with the Segment speed sensor (Camshaft speed sensor) in a BACKUP mode. This operation, however, imposes a lot of restrictions on the system since the precise position of the crankshaft can only be roughly estimated by the camshaft information. In case the engine enters this BACKUP operation due to a crankshaft sensor error the fault path at hand is set.

Cause:

The ECU has determined that there are errors in the signal from the Crankshaft speed sensor and is currently operating in BACKUP mode. The engine is operating with input from only the Camshaft speed sensor.

Possible failure modes:

1. Faulty electrical wiring and/or connections.
2. Faulty Crankshaft speed sensor.
3. Faulty ECU, or ECU supply voltages or grounds.

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 7.
2. Remove Crankshaft speed sensor connector DG6 Incr. and inspect housing body/latch, pins and wiring harness for damage or corrosion. Also, inspect connector portion of the Crankshaft speed sensor.
 - A. If damage is determined after careful inspection, repair wiring and/or replace connector parts to ensure a good and sound electrical connection. Replace Crankshaft speed sensor if damaged.
 - B. If no damage is determined, leave connector disconnected and proceed to step 3.
3. Operation: Resistance Check for Faulty Crankshaft speed sensor.
Vehicle Status: Key Off Engine Off

Connect the test lead labeled "Coolant/Fuel Temp Sensor" from the Tier II (NEF) Diagnostic Repair Kit 380040185 to access the sensor terminals. See test table below.

Test Type	From	To	Results (Min)	Results (Max)
1. Resistance	Crankshaft speed sensor connector DG6 Incr. (Pin 1)	Crankshaft speed sensor connector DG6 Incr. (Pin 2)	750 ohms	1000 ohms

- A. If the resistance test does not fall in the specified range, replace the Crankshaft speed sensor .
- B. If the resistance test does fall in the specified range, leave connector disconnected and proceed to step 4.
4. Operation: Check Output of Crankshaft speed sensor.
Vehicle Status: Key Off Engine Off (test setup)
Vehicle Status: Key On Engine On (during test)

Make the following electrical tests in the table below. There will be (2) types of tests (in-line and single ended) that will need to be performed which use the test lead labeled "Coolant/Fuel Temp Sensor" from the Tier II (NEF) Diagnostic Repair Kit 380040185. Reference the descriptions below to make the proper electrical connections for each test type.

Single Ended Test Lead Connection Test (Standalone Crankshaft speed sensor test):

Schematic legend			
(1)	ECU connector X-120	(3)	Grid heater relay connector X-127 pin A and X-127 pin B
(2)	ECU ground	(4)	Positive battery to the ECU

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 signal wires to chassis ground.

Turn the ignition switch OFF.

Disconnect ECU connector X-120.

Measure the resistance between ECU connector X-120 pin 12 and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between ECU connector X-120 pin 75 and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

A. The resistance is less than **20,000 Ω**. There is a short circuit to chassis ground in the harness. Repair or replace the harness as required. Return to step 1 to confirm elimination of the fault.

B. The resistance is greater than **20,000 Ω**. Go to step 4.

4. Test the grid heater relay circuit.

Turn the ignition switch OFF.

Reconnect ECU connector X-120.

Disconnect the grid heater relay.

Fabricate a jumper wire that will connect between connector X-127 pin A and positive battery.

Connect the jumper wire between X-127 pin A and positive battery.

Turn the ignition switch ON.

Fault code 3114 should no longer be active. Fault code 3113 is now active.

A. Fault code 3114 is still active. Fault code 3113 did not become active. There is a problem with the ECU. Temporarily replace the ECU and retest. Return to step 1 to confirm elimination of the fault.

B. Fault code 3113 is now active. Fault code 3114 is no longer active. There is a problem with the grid heater relay. Temporarily replace the relay and retest. Return to step 1 to confirm elimination of the fault.

3156 - Grid Heater Relay - No Load

1650M

ANZ --- APAC --- LA --- MEA

Context:

The ECU detects an open circuit in the grid heater relay circuit, X-120 pin 12 or X-120 pin 75.

Cause:

The ECU detects an open circuit in the grid heater relay circuit.

Possible failure modes:

1. An open circuit in the grid heater relay wiring.
2. Faulty grid heater relay.
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.

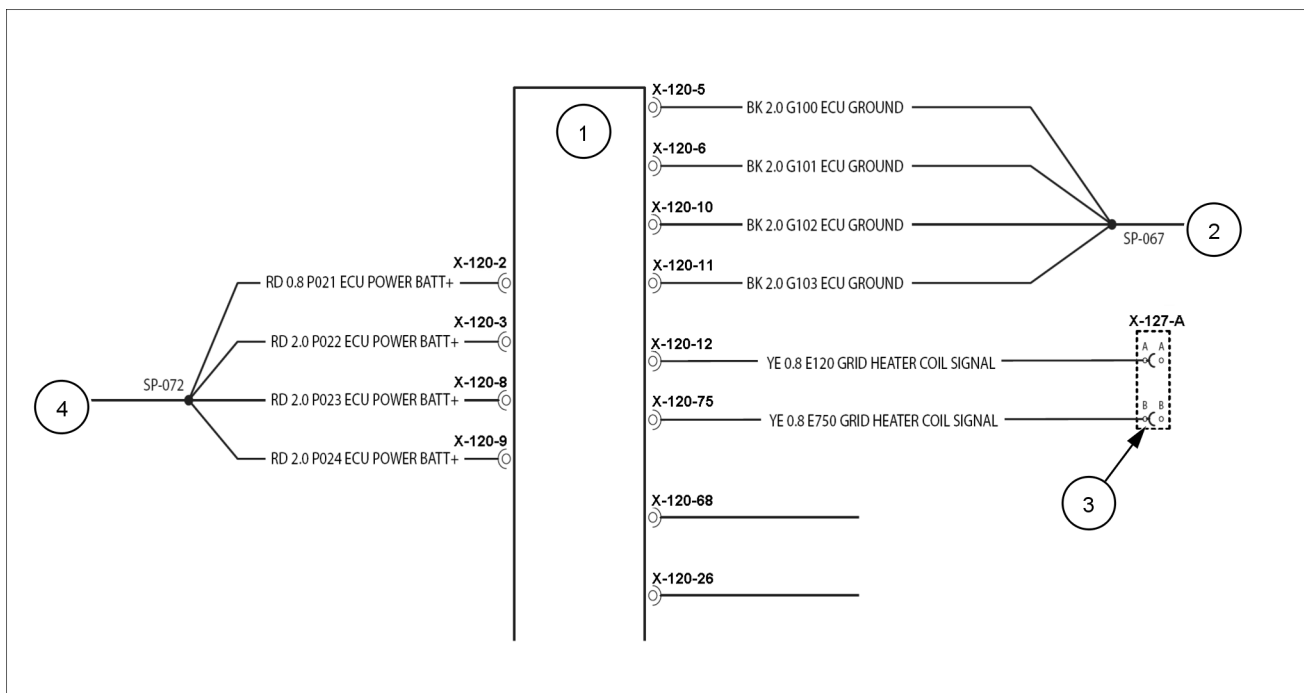
A. The fault code is not recorded again. OK to return the machine to service.

B. Fault code 3156 is recorded again. Go to step **2**.

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

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

Inspect the harness from the ECU to the grid heater relay. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.



RAIL12DOZ0676FA 1

3211 - Bank 1 - Injector Cable Short Circuit Low Side To Ground

1650M

ANZ --- APAC --- LA --- MEA

Context:

The Engine Control Unit (ECU) has determined a short circuit exists in an injector cable in Bank 1 (Group A, Cylinders 1, 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 the injector output power driver stage in Bank 1.

Possible failure modes:

1. Faulty injection valve (solenoid coil shorted to ground).
2. Faulty electrical wiring, short low side to ground (damaged wiring).
3. Faulty 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 **5**.
2. Carefully disconnect the engine injector harness from the ECU at connector 3. Use a multi-meter to check for continuity, on the engine injector harness side of ECU connector 3 from pins 13, 6 and 12 to chassis ground. There should not be continuity.
 - A. If there is continuity on any of the pins to chassis ground, record the pin number and continue with step **3**.
 - B. If there is no continuity, the ECU may have failed. Try reloading the ECU software and if the fault reoccurs, replace the ECU.
3. Disconnect the engine injector harness from the injector (valve) cover at connector VC1 and VC2. Use a multi-meter to check for continuity, on the injector (valve) cover side of connector VC1 from pin 3, if recorded pin in Step 2 was pin 13, or pin 2, if recorded pin in Step 2 was pin 6 or connector VC2 pin 3, if recorded pin in Step 2 was pin 12, to chassis ground. There should not be continuity.
 - A. If there was continuity to chassis ground, leave connector VC1 and VC2 disconnected, and continue with step **4**.
 - B. If there was no continuity to chassis ground, there is a short to ground condition in the engine injector harness between connector VC1 pin 3 or 2 and ECU connector 3 pin 13 or 6 or between connector VC2 pin 3 and ECU connector 3 pin 12. Locate and repair the grounded conductor.
4. Remove the injector (valve) cover and disconnect the injector harness from the Cylinder #1 injector at connector INJ1 terminal 2 (low side ring terminal), if recorded pin in Step 2 was pin 13, or disconnect the injector harness from the Cylinder #2 injector at connector INJ2, if recorded pin in Step 2 was pin 6 or disconnect the injector harness from the Cylinder #3 injector at connector INJ3, if recorded pin in Step 2 was pin 12. Use a multi-meter to check for continuity, on the injector, from terminal 2 to chassis ground. There should not be continuity.
 - A. If there is continuity, the injector solenoid coil has failed, replace the injector.

3240 - Engine controller EEPROM - Write operation failure

1650M

ANZ --- APAC --- LA --- MEA

Context:

The engine control unit (ECU) has detected an error during the last EEPROM write operation. The hardware encapsulation of the ECU checks each data block of the EEPROM and sets a status flag depending on if an error is found or not found. These flags are processed every 20 milliseconds by the Diagnostic System Management (DSM) and depending on their value a failure or no failure is detected. If a failure is detected this error 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. Try to flash the ECU correctly with the proper data set. If the error persists, replace the ECU.

3261 - Low side power - short circuit to battery or excess temperature

1650M

ANZ --- APAC --- LA --- MEA

Possible failure modes:

1. Faulty harness.
2. Problem in the starter circuit.

Solution:

1. Before proceeding clear the error code with the approved diagnostic equipment. Run the machine under normal conditions and retest. Is starting system functioning okay.
 - A. If the error code is not indicated, and the starting system is operating correctly return unit to field operation.
 - B. If the error code is indicated, continue to step 2
2. Check for other engine related error codes.
 - A. If other engine related error codes are displayed, continue to these tests.
 - B. If no other engine related error codes are displayed, download the correct level of software. If the fault reoccurs, remove and replace the engine controller.

3297 - Rail Pressure Positive Deviation High and High Fuel Flow Setpoint

1650M

ANZ --- APAC --- LA --- MEA

Context:

The rail pressure is monitored by various fault paths during active pressure control by the metering unit. The fault path at hand detects high positive rail pressure governor deviations in combination with a high set-point value of the fuel volume flow through the metering unit. 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 positive rail pressure governor deviation exceeds 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 above the engine speed dependent limit from a curve established by the ECU for over 2.5 seconds this error will occur. This error is the result of a stuck fuel pressure regulator (on high pressure pump), or a leak in the high or low pressure side of the fuel rail system. Measure the resistance on the fuel pressure regulator for **3.2 Ω**. 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.

3370 - Torque limitation due to engine protection

1650M

ANZ --- APAC --- LA --- MEA

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.

Schematic legend			
(1)	UCM connector X-016 Pin 5 L Pump FWD (Front A) Fault Codes 4111, 4112, 4113, 4114, and 4302	(6)	UCM connector X-016 Pin 22 REV Pump RTN (Both B) Fault Codes 4311, 4313 and 4312
(2)	UCM connector X-016 Pin 6 L Pump REV (Front B) Fault Codes 4131, 4132, 4133, 4134, and 4312	(7)	UCM connector X-016 Pin 19 R Pump FWD (Rear A) Fault Codes 4101, 4102, 4103, 4104, and 4302
(3)	UCM connector X-014 Pin 21 FWD Pump RTN (Both A) Fault Codes 4301, 4303, and 4302	(8)	UCM connector X-016 Pin 25 R Pump REV (Rear B) Fault Codes 4121, 4122, 4123, 4124, and 4312
(4)	Left Pump Connector X-115	(9)	Right Pump Connector X-114
(5)	Connector X-001/ X-090		

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. Test the circuit.

Turn the ignition switch OFF.

Disconnect the right forward solenoid.

Fabricate a jumper wire that will connect between X-114 pin 3 and X-114 pin 4.

Connect the jumper wire between X-114 pin 3 and X-114 pin 4.

Turn the ignition switch ON.

Access the fault code screen on the EST.

Fault code 4101 should no longer be active. Fault code 4102 is now active. Fault code 4121 will also be active, ignore this fault code.

A. Fault code 4101 is no longer active. Fault code 4102 is now active. Temporarily replace the solenoid and retest. Return to step 1 to confirm elimination of the fault.

B. Fault code 4101 is still present and active. Fault code 4102 did not become active. Go to step 4.

4. Measure the resistance through the signal wires.

Leave the jumper wire installed in connector X-114.

Turn the ignition switch OFF.

Disconnect UCM connectors X-016 and X-014.

Measure the resistance between X-016 pin 19 and X-014 pin 21. 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**. Temporarily replace the UCM and retest. Return to step 1 to confirm elimination of the fault.

B. The resistance is greater than **10 Ω**, there is an open circuit in the UCM wiring. Repair or replace the harness as required. Return to step 1 to confirm elimination of fault.

4123 - Right Pump Reverse Solenoid High Side Shorted to Power

1650M

ANZ --- APAC --- LA --- MEA

Context:

The UCM detects a short circuit to another voltage source in the right reverse solenoid circuit, X-016 pin 25.

Cause:

There is a short circuit to another voltage source in the right reverse solenoid circuit, X-016 pin 25.

Possible failure modes:

1. Short circuit in the right reverse solenoid circuit.
2. Faulty right reverse solenoid.
3. Faulty UCM.

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.

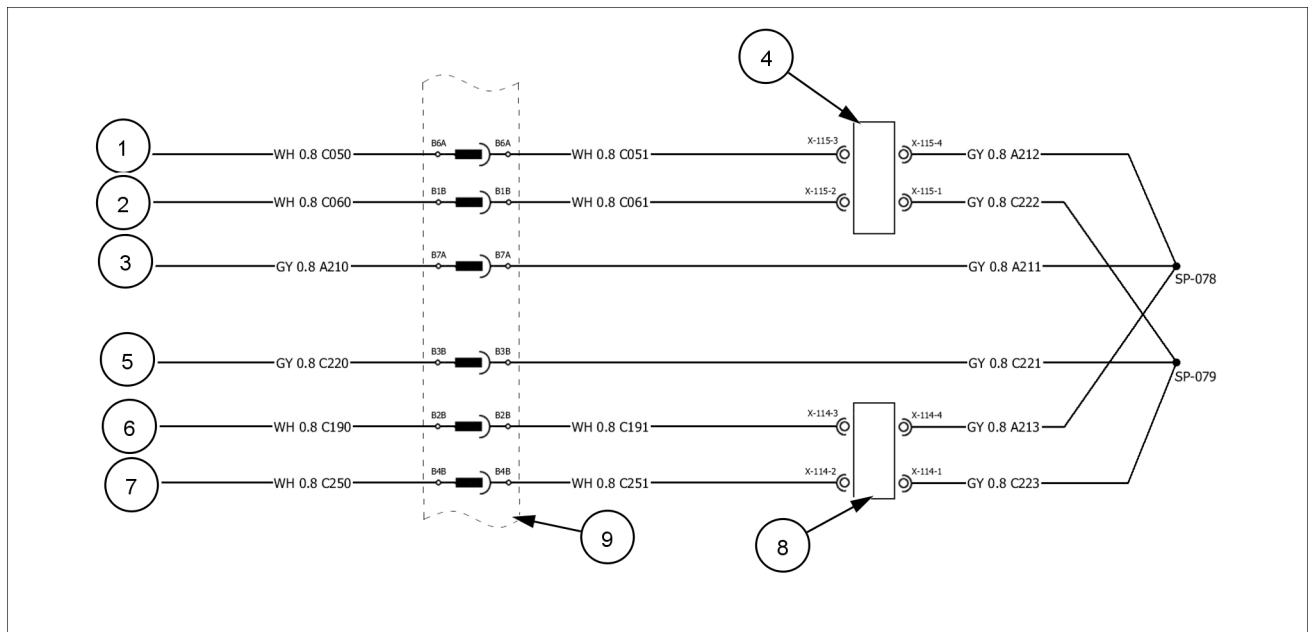
A. The fault is not recorded again. OK to return the machine to service.

B. Fault code 4123 is recorded again. Go to step 2.

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

Inspect the UCM and the right reverse solenoid connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the UCM to the right reverse solenoid. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.



Schematic legend			
(1)	UCM connector X-018 Pin 6 Right Motor Solenoid Signal Fault Codes 4141, 4142, 4143, 4144, and 4322	(4)	Connector X-001/ X-090
(2)	UCM connector X-016 Pin 21 Right/ Left Motor Solenoid Return Fault Codes 4321, 4323, and 4322	(5)	Right Motor Solenoid Connector X-131
(3)	UCM connector X-018 Pin 19 Left Motor Solenoid Signal Fault Codes 4151, 4152, 4153, 4154, and 4322	(6)	Left Motor Solenoid Connector X-132

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. Test the circuit.

Turn the ignition switch OFF.

Disconnect the right motor solenoid.

Fabricate a jumper wire that will connect between X-133 pin 1 and X-133 pin 2.

Connect the jumper wire between X-133 pin 1 and X-133 pin 2.

Turn the ignition switch ON.

Access the fault code screen on the EST.

Fault code 4144 should no longer be active. Fault code 4142 is now active.

A. Fault code 4144 is no longer active. Fault code 4142 is now active. Temporarily replace the solenoid and retest. Return to step 1 to confirm elimination of the fault.

B. Fault code 4144 is still present and active. Fault code 4142 did not become active. Go to step 4.

4. Measure the resistance through the signal wires.

Leave the jumper wire installed in connector X-133.

Turn the ignition switch OFF.

Disconnect UCM connectors X-018 and X-016.

Measure the resistance between X-018 pin 6 and X-016 pin 21. 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**. Temporarily replace the UCM and retest. Return to step 1 to confirm elimination of the fault.

B. The resistance is greater than **10 Ω**, there is an open circuit in the UCM wiring. Repair or replace the harness as required. Return to step 1 to confirm elimination of fault.

- B. One or both resistance measurements are greater than **10 Ω** , there is an open circuit in the UCM wiring. Check splice SP-078. Repair or replace the harness as required. Return to step **1** to confirm elimination of fault.

Measure the voltage between X-017 pin 12 and chassis ground. The voltage should be approximately **24 V**. Wiggle the harness during measurement to reveal an intermittent condition.

A. The voltage is between **20 V** and **28 V**. Go to step **5**.

B. The voltage is less than **20 V**, there is an open circuit in the wiring from the switch to the UCM. Repair or replace the harness as required. Return to step **1** to confirm elimination of fault.

5. Test the brake circuit.

Turn the ignition switch OFF.

Leave the jumper wire between X-105 pin A and pin B connected.

Reconnect UCM connector X-017.

Activate the parking brake.

Turn the ignition switch ON.

Access the fault code screen on the EST. Fault code 4135 should no longer active.

A. Fault code 4135 is not longer active. Replace the pressure switch and retest. Return to step **1** to confirm elimination of the fault.

B. Fault code 4135 is still active. Temporarily replace the UCM and retest. Return to step **1** to confirm elimination of fault.

Turn the ignition switch OFF.

Disconnect UCM connector X-015. Disconnect the drive joystick connector X-028.

Measure the resistance between X-028 pin 10 and chassis ground. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between X-028 pin 7 and chassis ground. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between X-028 pin 10 and X-028 pin 7. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

A. The resistance is greater than **20,000 Ω**. Go to step **5**.

B. The resistance is less than **20,000 Ω**. There is a short circuit in the wiring. Repair or replace the harness as required. Return to step **1** to confirm elimination of fault.

5. Measure the resistance through the signal wire.

Fabricate a jumper wire that will connect between joystick connector X-028 pin 10 and X-028 pin 7.

Connect the jumper wire between X-028 pin 10 and X-028 pin 7.

Measure the resistance between connector X-015 pin 19 and X-015 pin 20. 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 **6**.

B. The resistance is greater than **10 Ω**. There is an open circuit in the signal wire. Repair or replace the harness as required. Return to step **1** to confirm elimination of fault.

6. Measure the voltage to the sensor.

Turn the ignition switch OFF.

Disconnect the joystick connector X-028. Reconnect UCM connector X-015.

Turn the ignition switch ON.

Measure the voltage between X-028 pin 1 and X-028 pin 2. The voltage should be approximately **5 V**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the voltage between X-028 pin 4 and X-028 pin 5. The voltage should be approximately **5 V**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the voltage between X-028 pin 9 and X-028 pin 8. The voltage should be approximately **5 V**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the voltage between X-028 pin 12 and X-028 pin 11. The voltage should be approximately **5 V**. Wiggle the harness during measurement to reveal an intermittent condition.

A. The voltage is approximately **5 V**. Go to step **7**.

B. The voltage is not within range. There is a problem with the voltage supply to the sensor. Verify the voltage from the UCM. If the voltage from the UCM is correct, there is an open circuit in the voltage supply to the sensor. Repair as required. Return to step **1** to confirm elimination of fault.

7. Measure the voltage output of the sensor.

Turn the ignition switch OFF.

Reconnect all connectors.

Turn the ignition switch ON. Leave the joystick in the neutral position.

Measure the voltage between X-015 pin 21 and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The voltage should be approximately **2.5 V** while the joystick in the neutral position.

Continue measuring the voltage while slowly moving the throttle in the F-B position. The voltage should change between **0.5 V** and **4.5 V**. The voltage change should be smooth and steady as the joystick is moved between the stop points.

Measure the voltage between X-015 pin 22 and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The voltage should be approximately **2.5 V** while the joystick in the neutral position.

Continue measuring the voltage while slowly moving the throttle in the F-B position. The voltage should change between **0.5 V** and **4.5 V**. The voltage change should be smooth and steady as the joystick is moved between the stop points.

- A. For both measurements, the voltage is approximately **2.5 V** in the neutral position and the voltage changes at a smooth rate between **0.5 V** and **4.5 V**. Temporarily replace the UCM and retest. Return to step **1** to confirm elimination of the fault.
- B. On one or both measurements, the voltage was not **2.5 V** in the neutral position or the voltage change was erratic. Temporarily replace the Joystick and retest. Return to step **1** to confirm elimination of fault.

5101 - Blade Lift Solenoid High Side Open Circuit

1650M

ANZ --- APAC --- LA --- MEA

Context:

The UCM detects an open circuit in the blade lift solenoid circuit, X-021 pin 7.

Cause:

There is an open circuit in the blade lift solenoid circuit, X-021 pin 7.

Possible failure modes:

1. Open circuit in the blade lift solenoid circuit.
2. Faulty blade lift solenoid.
3. Faulty UCM.

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.

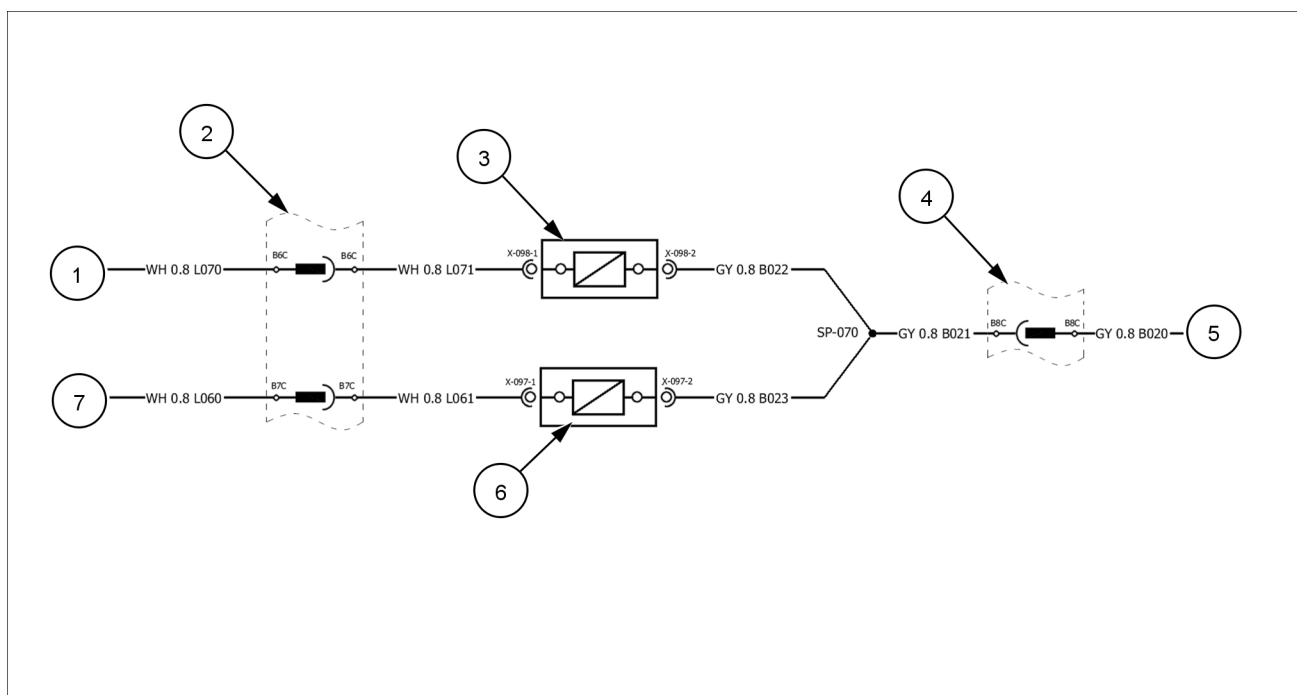
A. The fault code is not recorded again. OK to return the machine to service.

B. Fault code 5101 is recorded again. Go to step 2.

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

Inspect the UCM and the blade lift solenoid connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the UCM to the blade lift solenoid. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.



RAIL12DOZ0204FA 1

Schematic legend			
(1)	UCM connector X-019 Pin 25, Blade tilt right	(5)	UCM connector X-015 Pin 30, Blade tilt right/left ground
(2)	Connector X-001/X-090Pin B8B	(6)	Blade tilt left solenoid Connector X-100
(3)	Blade tilt right solenoid Connector X-099	(7)	UCM connector X-019 Pin 17, Blade tilt left
(4)	Connector X-090/X-001Pin B2C		

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. Test the circuit.

Turn the ignition switch OFF.

Disconnect the blade tilt left solenoid.

Fabricate a jumper wire that will connect between X-100 pin 1 and X-100 pin 2.

Connect the jumper wire between X-100 pin 1 and X-100 pin 2.

Turn the ignition switch ON.

Access the fault code screen on the EST.

Fault code 5121 should no longer be active. Fault code 5122 is now active.

A. Fault code 5121 is no longer active. Fault code 5122 is now active. Temporarily replace the solenoid and retest. Return to step **1** to confirm elimination of the fault.

B. Fault code 5121 is still present and active. Fault code 5122 did not become active. Go to step **4**.

4. Measure the resistance through the signal wires.

Leave the jumper wire installed in connector X-100.

Turn the ignition switch OFF.

Disconnect UCM connectors X-019 and X-015.

Measure the resistance between X-019 pin 17 and X-015 pin 30. 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**. Temporarily replace the UCM and retest. Return to step **1** to confirm elimination of the fault.

B. The resistance is greater than **10 Ω**, there is an open circuit in the UCM wiring. Repair or replace the harness as required. Return to step **1** to confirm elimination of fault.

5142 - Blade Angle Right Solenoid High Side Shorted to Ground

1650M

ANZ --- APAC --- LA --- MEA

Context:

The UCM detects a short circuit in the blade angle right solenoid circuit, X-019 pin 33. Blade angle will be disabled while fault code 5142 is active.

Cause:

There is a short circuit to chassis ground in the blade angle right solenoid circuit, X-019 pin 33.

Possible failure modes:

1. Short circuit in the blade angle right solenoid circuit.
2. Faulty blade angle right solenoid.
3. Faulty UCM.

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.

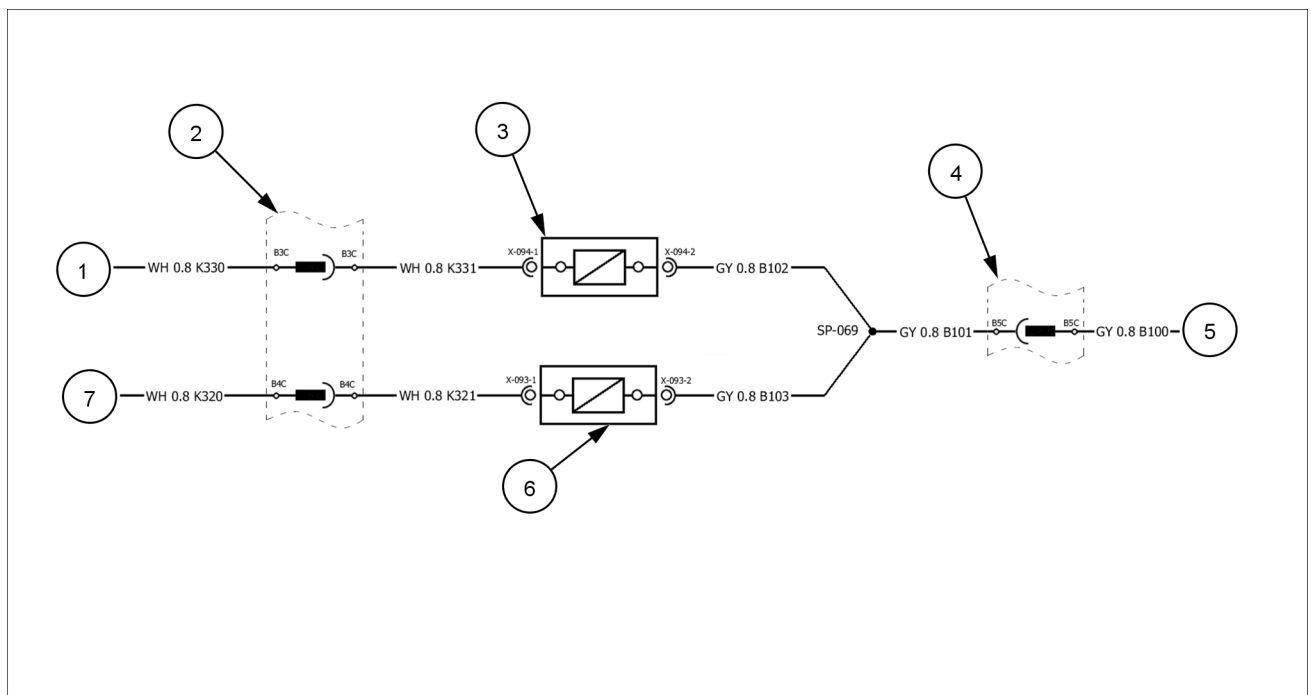
A. The fault code is not recorded again. OK to return the machine to service.

B. Fault code 5142 is recorded again. Go to step 2.

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

Inspect the UCM and the blade angle right solenoid connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the UCM to the blade angle right solenoid. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.



RAIL12DOZ0205FA 1

Schematic legend			
(1)	UCM connector X-021 Pin 13, Ripper down	(5)	UCM connector X-014 Pin 22, Ripper up/down ground
(2)	Connector X-001/X-090 Pin A5C and Pin A6C	(6)	Ripper up solenoid Connector X-095
(3)	Ripper down solenoid Connector X-096	(7)	UCM connector X-021 Pin 19, Ripper up
(4)	Connector X-090/X-001 Pin A7C		

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. Test the circuit.

Turn the ignition switch OFF.

Disconnect the ripper up solenoid.

Turn the ignition switch ON.

Access the fault code screen on the EST.

Fault code 5162 should no longer be active. Fault code 5161 is now active.

A. Fault code 5162 is no longer active. Fault code 5161 is now active. Temporarily replace the solenoid and retest. Return to step **1** to confirm elimination of the fault.

B. Fault code 5162 is still present and active. Fault code 5161 did not become active. Go to step **4**.

4. Measure the resistance through the signal wire.

Turn the ignition switch OFF.

Disconnect UCM connector X-021.

Measure the resistance between X-021 pin 19 and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

A. The resistance is greater than **20,000 Ω**. Temporarily replace the UCM and retest. Return to step **1** to confirm elimination of the fault.

B. The resistance is less than **20,000 Ω**, there is a short circuit to chassis ground in the wiring from the UCM to the solenoid. Repair or replace the harness as required. Return to step **1** to confirm elimination of fault.

Schematic legend			
(1)	Unswitched battery 24 V	(4)	Winch ground GND-MAIN
(2)	Winch relay signal from winch relay K-007 pin 87	(5)	UCM connector X-018 Pin 5, Winch high side drive signal
(3)	Connector X-010 X-034	(6)	UCM connector X-019 Pin 4, Winch low side drive signal

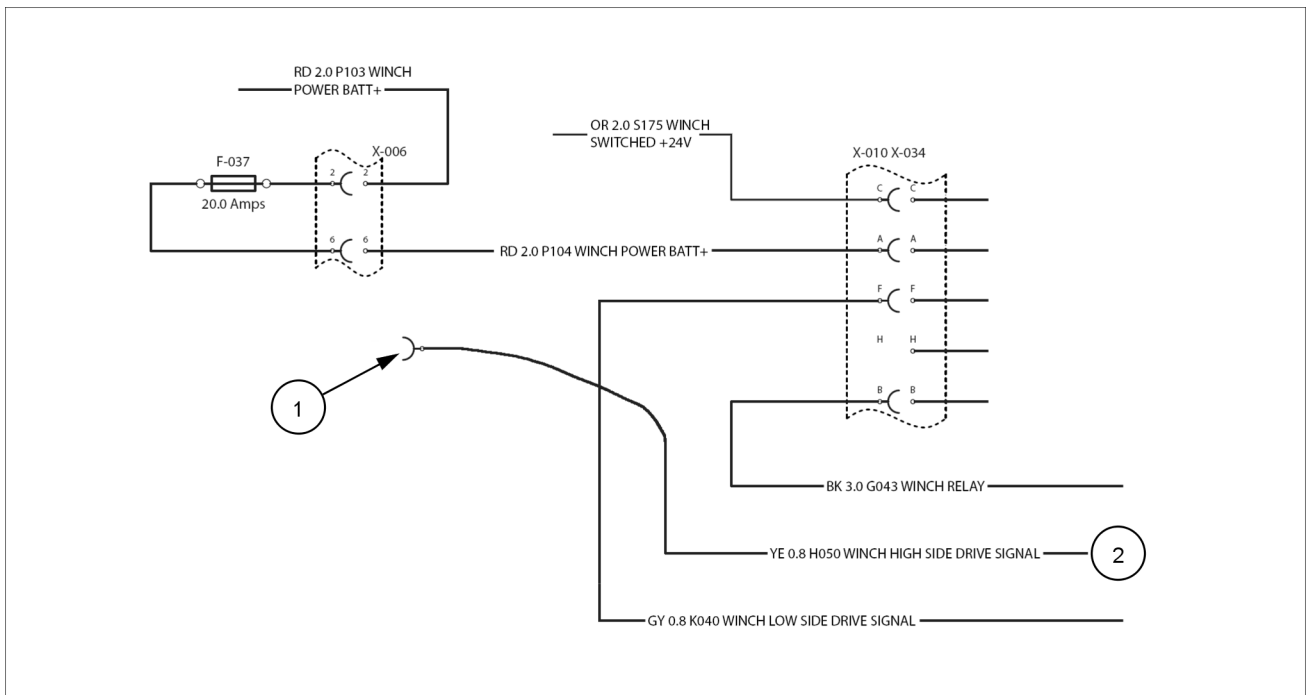
- A. The connectors are secure and the harness is free of damage. Go to step 3.
 - B. The connectors or the harness has damage. Repair or replace the harness or connectors as required. Return to step 1 to confirm elimination of fault.
3. Test the circuit.

Turn the ignition switch OFF.

Disconnect the connector X-010 X-034.

Remove wire YE H050 from connector X-010.

Reconnect connector X-010 X-034.



RAIL12DOZ0673FA 2

Schematic legend			
(1)	Wire YE H050 removed from connector X-010.	(2)	UCM connector X-018 Pin 5, Winch high side drive signal

Turn the ignition switch ON.

Access the fault code screen on the EST.

Fault code 5183 should no longer be active. Fault code 5184 should be active.

- A. Fault code 5183 is no longer active. Fault code 5184 is now active. There is a problem in the wiring between connector X-010 X-034 and the winch solenoid. Repair as required. Return to step 1 to confirm elimination of the fault.
 - B. Fault code 5183 is still present and active. Fault code 5184 did not become active. Go to step 4.
4. Measure the voltage on the signal wire.

5302 - Blade Lift-Lower Solenoids Return Open Circuit

1650M

ANZ --- APAC --- LA --- MEA

Context:

The UCM detects a short circuit to ground in the blade lift solenoid circuit, X-021 pin 7, the blade lower solenoid circuit, X-021 pin 6, and the blade lift/lower ground circuit, X-015 pin 2. Blade lift and lower will be disabled while fault code 5302 is active.

Cause:

There is a short circuit to chassis ground in the blade lift/lower solenoid circuit.

Possible failure modes:

1. Short circuit to ground in the blade lift solenoid circuit, blade lower solenoid circuit, and the solenoid return line.
2. Faulty blade lift solenoid and blade lower solenoid.
3. Faulty UCM.

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.

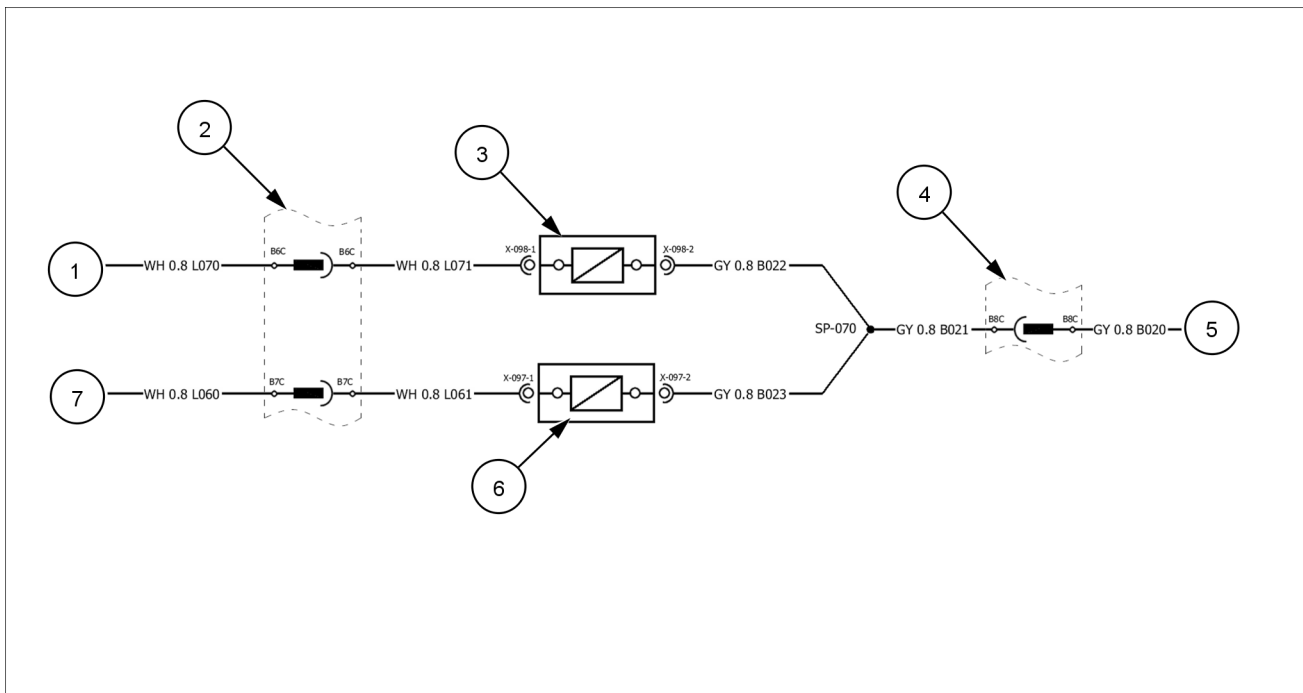
A. The fault code is not recorded again. OK to return the machine to service.

B. Fault code 5302 is recorded again. Go to step 2.

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

Inspect the UCM, the blade lift solenoid and the blade lower solenoid connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the UCM to the blade lift solenoid and blade lower solenoid. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.



RAIL12DOZ0204FA 1

Schematic legend			
(1)	UCM connector X-021 Pin 13, Ripper down	(5)	UCM connector X-014 Pin 22, Ripper up/down ground
(2)	Connector X-001/X-090 Pin A5C and pin A6C	(6)	Ripper up solenoid Connector X-095
(3)	Ripper down solenoid Connector X-096	(7)	UCM connector X-021 Pin 19, Ripper up
(4)	Connector X-090/X-001 Pin A7C		

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. Test the circuit.

Turn the ignition switch OFF.

Disconnect the ripper up solenoid and the ripper down solenoid.

Turn the ignition switch ON.

Access the fault code screen on the EST.

Fault code 5332 should no longer be active. Fault code 5331 is now active.

A. Fault code 5332 is no longer active. Fault code 5331 is now active. Temporarily replace both solenoids and retest. Return to step 1 to confirm elimination of the fault.

B. Fault code 5332 is still present and active. Fault code 5331 did not become active. Go to step 4.

4. Measure the resistance through the signal wires.

Turn the ignition switch OFF.

Disconnect UCM connector X-021 and X-014.

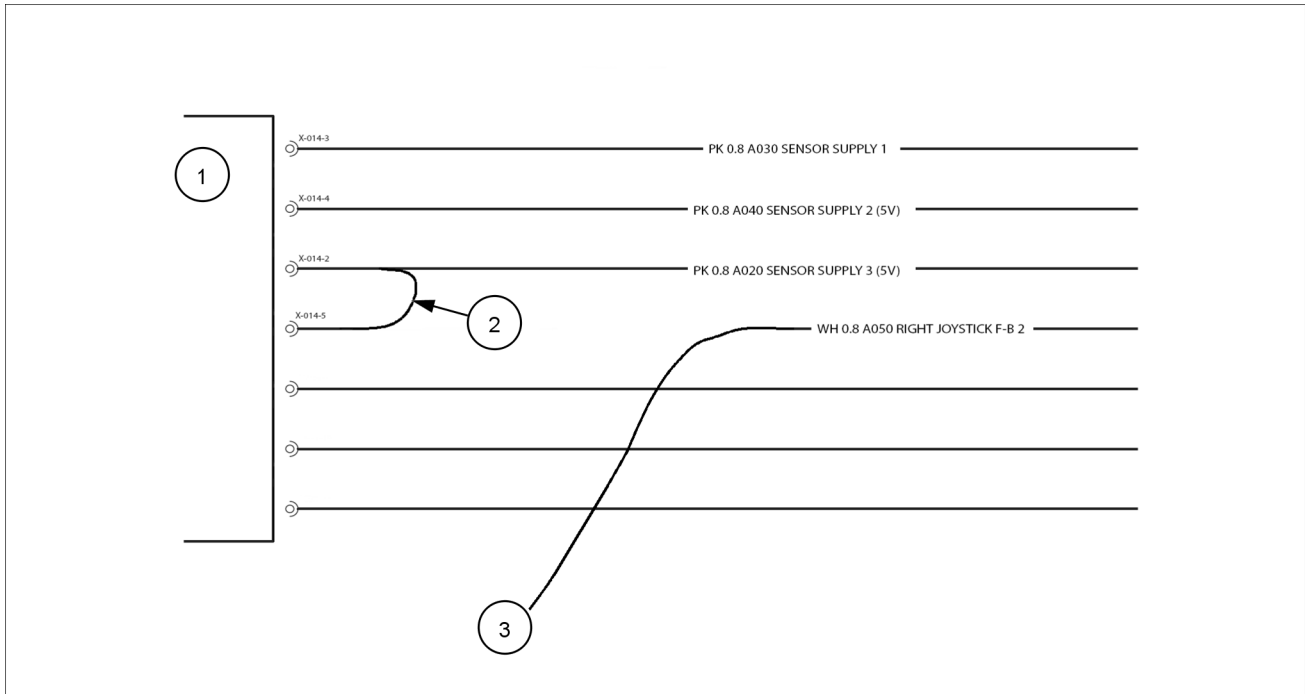
Measure the resistance between X-021 pin 19 and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between X-021 pin 13 and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between X-014 pin 22 and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

A. All resistance measurements are greater than **20,000 Ω**. Temporarily replace the UCM and retest. Return to step 1 to confirm elimination of the fault.

B. One or more resistance measurements are less than **20,000 Ω**, there is a short circuit to chassis ground in the UCM wiring. Repair or replace the harness as required. Return to step 1 to confirm elimination of fault.



RAIL12DOZ0440FA 2

Schematic legend			
(1)	UCM connector X-014	(3)	Wire WH A050 removed from connector X-014 Pin 5
(2)	Jumper wire installed between X-014 pin 5 and X-014 pin 2		

Reconnect UCM connector X-014.

Turn the ignition switch ON. Access the EST fault code screen.

Fault code 5511 should no longer be active. Fault code 5513 is now active.

- A. Fault code 5511 is no longer active. Fault code 5513 is now active. Temporarily replace the joystick and retest. Return to step 1 to confirm elimination of the fault.
- B. Fault code 5511 is still present and active. 5513 did not become active. Temporarily replace the UCM and retest. Return to step 1 to confirm elimination of the fault.

5541 - Angle Thumbwheel Axis-1 Shorted to Ground or Open Circuit

1650M

ANZ --- APAC --- LA --- MEA

Context:

The UCM detects a short to ground or an open circuit in the joystick angle thumbwheel 1 signal, X-014 pin 11.

Cause:

The UCM detects a short to ground or an open circuit in the joystick angle thumbwheel 1 signal, X-014 pin 11.

Possible failure modes:

1. A short circuit in the joystick angle thumbwheel 1 signal.
2. An open circuit in the joystick angle thumbwheel 1 signal.
3. Faulty joystick.
4. Faulty UCM.

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.

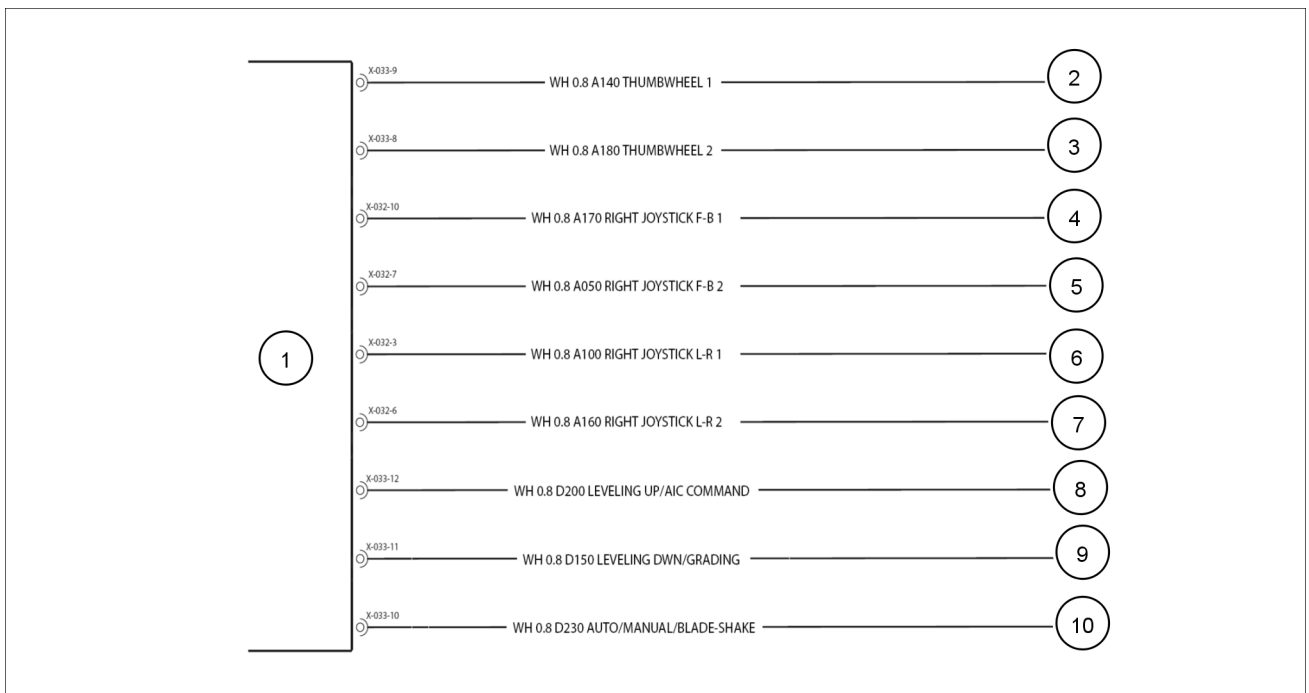
A. The fault code is not recorded again. OK to return the machine to service.

B. Fault code 5541 is recorded again. Go to step 2.

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

Inspect the UCM and the joystick connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the UCM to the joystick. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.



RAIL12DOZ0436FA 1

Schematic legend			
(1)	UCM connector X-014 Pin 2, Ripper blade sensor supply 3	(5)	Ripper control Connector X-142
(2)	UCM connector X-014 Pin 4, Ripper blade sensor supply 2	(6)	UCM connector X-014 Pin 15, Ripper 2 signal
(3)	UCM connector X-014 Pin 6, Sensor ground	(7)	UCM connector X-014 Pin 8, Ripper 1 signal
(4)	UCM connector X-015 Pin 9, Sensor ground		

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 on the signal wire.

Turn the ignition switch OFF.

Disconnect UCM connector X-014.

Disconnect ripper joystick connector X-142.

Turn the ignition switch ON.

Measure the voltage between UCM connector X-014 pin 8 and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. 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 to another voltage source. Repair or replace the wiring harness as required. Return to step **1** to confirm elimination of the fault.

4. Test the UCM.

Turn the ignition switch OFF.

Reconnect ripper joystick connector X-142.

Leave UCM connector X-014 disconnected.

Remove the wire A080 WH from X-014 pin 8.

8005 - Leveling Enable Switch Plausibility Error

1650M

ANZ --- APAC --- LA --- MEA

Context:

The UCM detects a state that is not possible. The voltage on UCM inputs X-016 pin 16 and X-017 pin 16 are the same. The leveling system will be disabled while Fault Code 8005 is active.

Cause:

The UCM inputs X-016 pin 16 and X-017 pin 16 are shorted to another voltage source or chassis ground or there is an open circuit in the wiring.

Possible failure modes:

1. Open circuit in the leveling enable switch circuit.
2. Short circuit in the leveling enable switch circuit.
3. Faulty leveling enable switch.
4. Faulty UCM.

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.

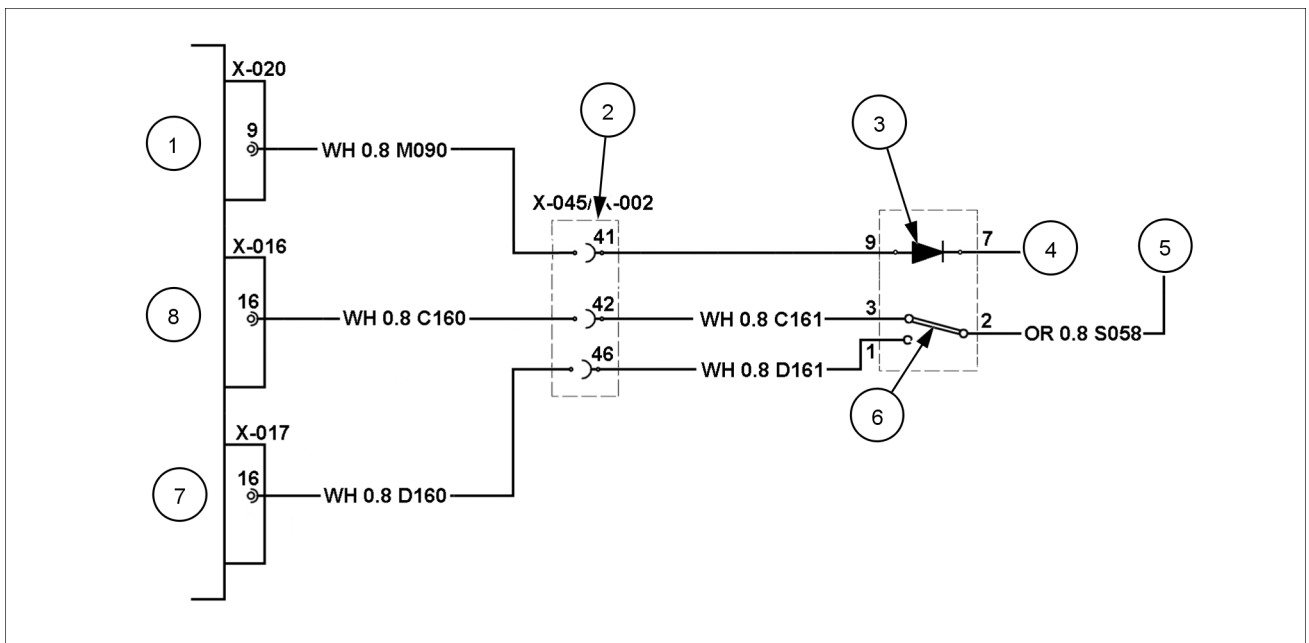
A. The fault code is not recorded again. OK to return the machine to service.

B. Fault code 8005 is recorded again. Go to step 2.

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

Inspect the UCM and the leveling enable switch connections. All connections should be secure, tight, free of corrosion, abrasion and damage.

Inspect the harness from the UCM to the leveling enable switch. Verify that the harness is free of damage, corrosion, abrasion and incorrect attachment.



RAIL12DOZ0240FA 1

C. The resistance is between **108 Ω** and **132 Ω**. Go to Step 7.

D. The resistance is greater than **133 Ω**. Go to Step 6.

4. Measure the resistance between the CAN High and CAN Low signal wires.

Turn the ignition switch OFF.

Disconnect all modules on the CAN bus.

Measure the resistance between CAN High diagnostic connector **X-026 pin C** and CAN Low diagnostic connector **X-026 pin D**.

A. The resistance is greater than **20,000 Ω**. Connect each component to the CAN Bus one at a time while measuring the resistance. The resistance should be greater than **54 Ω**. Replace the module that drops the CAN Bus resistance below **54 Ω**. Return to Step 1 to confirm elimination of the fault.

B. The resistance is less than **54 Ω** there is a short circuit between the CAN High and CAN Low wires. Repair or replace the harness as required. Return to test Step 1 to confirm elimination of the fault.

5. Measure harness resistance between chassis ground and positive battery.

Turn the ignition switch OFF.

Disconnect the instrument cluster connector, **X-058**.

Disconnect all devices connected to the CAN bus.

Measure the resistance between **X-058 pin 4** and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between **X-058 pin 4** and switched battery **X-059 pin 21**. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between **X-058 pin 4** and unswitched positive battery **X-059 pin 14**. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between **X-058 pin 3** and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between **X-058 pin 3** and switched battery **X-059 pin 21**. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

Measure the resistance between **X-058 pin 3** and unswitched positive battery **X-059 pin 14**. The resistance should be greater than **20,000 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

A. All resistance measurements are greater than **20,000 Ω**. Verify the ECU and other CAN Bus modules are powered and operational. Verify that all minus battery and chassis ground connections to the CAN Bus modules are clean and secure. Repair as required. Return to Step 1 to confirm elimination of the fault.

B. The resistance is less than **20,000 Ω**. There is a short circuit in the CAN bus to chassis ground or positive battery. Temporarily replace the CAN bus wires and retest. Repair or replace the harness as required. Return to Step 1 to confirm elimination of the fault code.

6. Measure the resistance through the CAN bus circuit.

Turn the ignition switch OFF. Disconnect all components connected to the CAN Bus.

Fabricate a jumper **20 cm (8 in)** that will connect between ECU connector X-120 pin 34 and pin 35.

Connect the jumper wire between **X-120 pin 34** and **X-120 pin 35**.

Measure the resistance between diagnostic connector **X-026 pin C** and **X-026 pin D**. The resistance should be less than **10 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.



Dozer blade and arm - 86

Dozer blade - 110

- 1650M Bulldozer (BD) Blade, Extra Long Track (XLT) - Tier 2 [NGC107000 -]**
- 1650M Power Angle Tilt (PAT) Blade, Extra Long Track (XLT) - Tier 2
[NGC107000 -]**
- 1650M Power Angle Tilt (PAT) Blade, Low Ground Pressure (LGP) - Tier 2
[NGC107000 -]**

Blade cylinder support - Remove - Clevis

1650M Bulldozer (BD) Blade, Extra Long Track (XLT) - Tier 2 [NGC107000 -] | ANZ --- APAC --- LA --- MEA

⚠ WARNING

Heavy objects!

Lift and handle all heavy components using lifting equipment with adequate capacity. Always support units or parts with suitable slings or hooks. Make sure the work area is clear of all bystanders. Failure to comply could result in death or serious injury.

W0398A

⚠ WARNING

Crushing hazard!

Always lower the machine hydraulic lift and all other hydraulic equipment to the ground before shutting off the engine and removing key. Failure to comply could result in death or serious injury.

W0063C

Prior operation:

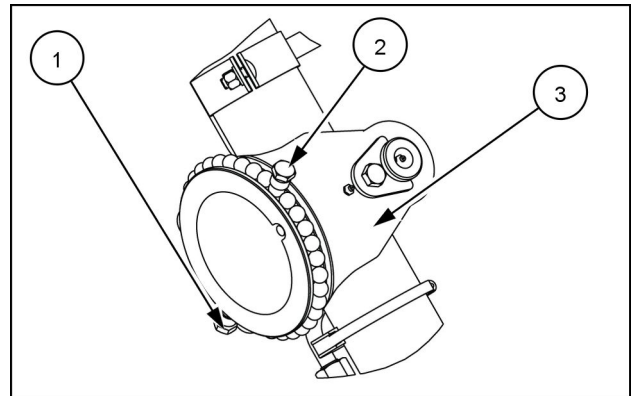
Blade lifting cylinder - Remove - Bulldozer blade (35.741)

1. Remove the lower plug (1) and upper plug (2) from the lift cylinder trunnion clevis (3) on the front of the machine.

NOTE: The Semi-U blade option is shown. Straight blade and Semi-U blade options are available. The procedures are the same for both blade types.

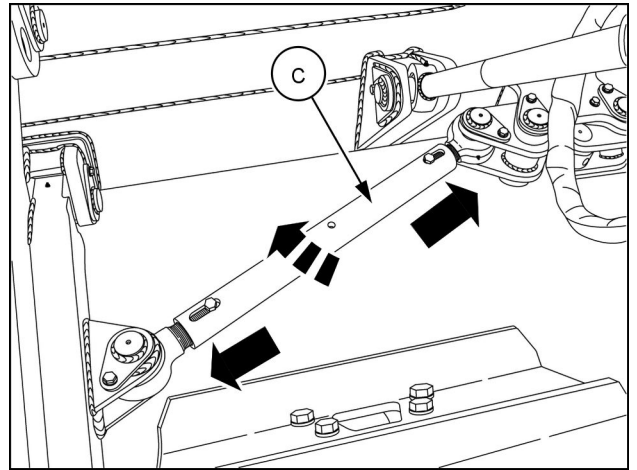
NOTE: The lift cylinder trunnion clevis weighs approximately **22.6 kg (49.8 lb)**

2. Rotate the clevis (3) and remove all 70 ball bearings (4) through the bottom plug (1).
3. When all of the ball bearings (4) have been removed, remove the clevis (3) from the trunnion.
4. Service or replace components and necessary.

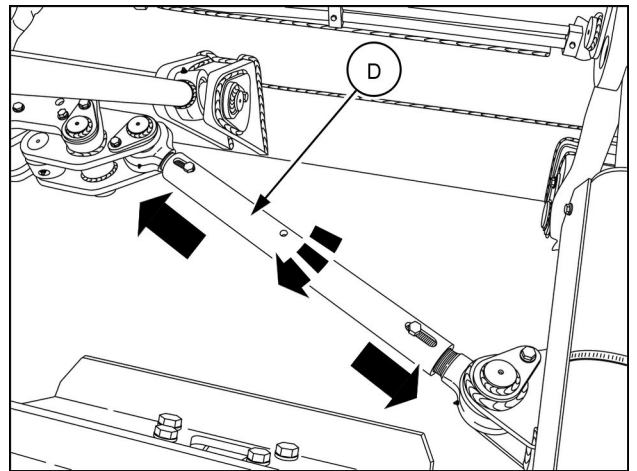


RAIL16DOZO153AA 1

4. Extend the left-hand tie rod **(C)** (rotate 1/2 turn) counter-clockwise when positioned behind the blade as shown. Extend the right-hand tie rod **(D)** (rotate 1/2 turn) counter-clockwise when positioned behind the blade. Continue to alternately turn each tie rod until both tie rods are tight.



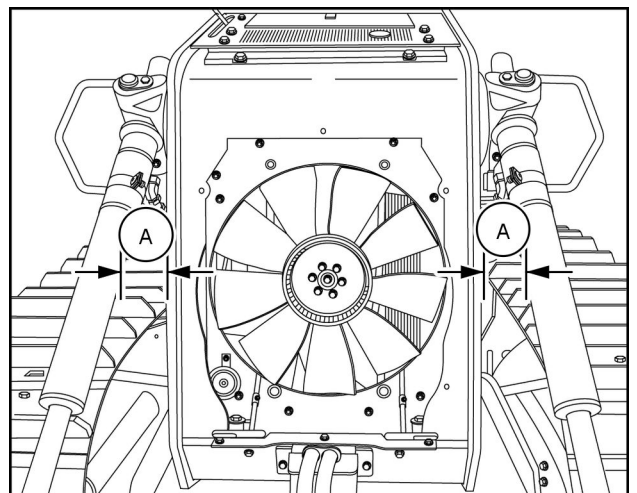
RAIL16DOZ0101AA 3



RAIL16DOZ0102AA 4

5. Measure from the body of the vertical lift cylinder to the side of the frame at the same point **(A)** on both sides.
6. Adjust the tie rod, on the side of the smallest measurement, in (retract) by 1/2 turn. Then adjust the opposite side out (extend) by 1/2 turn.
7. Measure again as noted in step 5 and continue until the smallest measurement is on the opposite side.
8. If the difference between the left-hand and right-hand measurements is now greater than it was before the last adjustment, reverse the last adjustment.

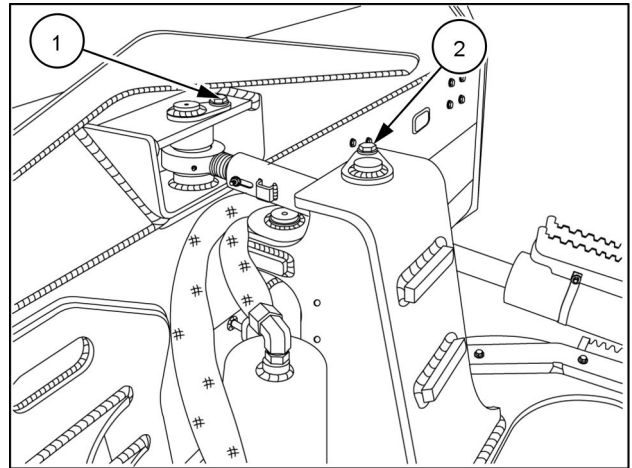
NOTE: By reversing the last adjustment, it will make the difference between the sides as small as possible.



RAIL15DOZ0035BA 5

9. Lower the blade to the ground and rotate the tie rods two full turns in, then reinstall the tie rod bolts to hold the tie rods in position.

7. Remove the pitch link assembly front pin retaining bolt and washer (1).
8. Remove the pitch link assembly rear pin retaining bolt and washer (2).



RAIL12DOZ0960BA 2

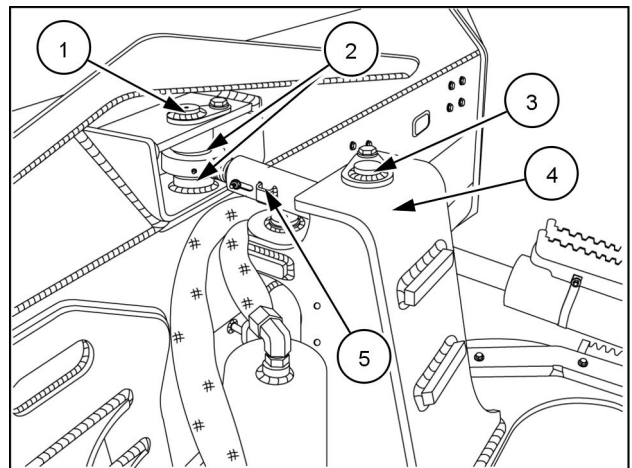
9. Remove the pitch link assembly front pin (1).
10. Remove the spacers (2) located above and below the pitch link assembly between the pitch link assembly and the crawler dozer blade.

NOTE: Make note of the quantity, thickness and positioning of the spacers for the reassembly process.

11. Remove the pitch link assembly rear pin (3).
12. Remove the spacers (4) located above and below the pitch link assembly between the pitch link assembly and the C-frame tower mounting point (view is obscured).

NOTE: Make note of the quantity, thickness and positioning of the spacers for the reassembly process.

13. Remove the pitch link (5).
14. Repair or replace components as necessary.



RAIL12DOZ0960BA 3



Tools - 89

Ripper assembly - 128

- 1650M Bulldozer (BD) Blade, Extra Long Track (XLT) - Tier 2 [NGC107000 -]**
- 1650M Power Angle Tilt (PAT) Blade, Extra Long Track (XLT) - Tier 2
[NGC107000 -]**
- 1650M Power Angle Tilt (PAT) Blade, Low Ground Pressure (LGP) - Tier 2
[NGC107000 -]**

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