650M
Tier 4B (final)
Crawler Dozer

PIN NHC100263 and above

SERVICE MANUAL

Part number 48153338
1st edition English
April 2018

CASE

Torque - Standard torque data for hydraulics

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

NOTICE: *Hydraulic connections require a minimum assembly torque in order to provide zero leakage at rated pressure with adequate fatigue resistance. Too much torque on a hydraulic connection can lead to leakage or failure.*

NOTICE: *There are several different kinds of parallel thread ports, including those using metric threads, inch threads, and British Standard Pipe Parallel (BSPP) threads. None of these port systems are interchangeable, and using the wrong connector in a port will not provide an adequate seal, even if it is possible to install the part.*

NOTE: *Hand install and hand tighten all connections before using tools to set the torque. This will reduce the possibility of thread damage.*

Torques for Metric O-Ring Boss (ORB) stud ends and port connections

Metric Thread	S-Series (Heavy Duty)		L-Series (Light Duty)	
	Ferrous	Non-Ferrous	Ferrous	Non-Ferrous
M8x1	**10.5 N·m (7.7 lb ft)**	**6.3 N·m (4.6 lb ft)**	**8.5 N·m (6.3 lb ft)**	**5 N·m (3.7 lb ft)**
M10x1	**21 N·m (15.5 lb ft)**	**12.5 N·m (9.2 lb ft)**	**15.5 N·m (11.4 lb ft)**	**9.3 N·m (6.9 lb ft)**
M12x1.5	**37 N·m (27.3 lb ft)**	**22 N·m (16.2 lb ft)**	**27 N·m (19.9 lb ft)**	**16 N·m (11.8 lb ft)**
M14x1.5	**47 N·m (34.7 lb ft)**	**28 N·m (20.7 lb ft)**	**37 N·m (27.3 lb ft)**	**22 N·m (16.2 lb ft)**
M16x1.5	**58 N·m (42.8 lb ft)**	**35 N·m (25.8 lb ft)**	**42 N·m (31.0 lb ft)**	**25 N·m (18.4 lb ft)**
M18x1.5	**74 N·m (54.6 lb ft)**	**44 N·m (32.5 lb ft)**	**47 N·m (34.7 lb ft)**	**28 N·m (20.7 lb ft)**
M22x1.5	**105 N·m (77.4 lb ft)**	**63 N·m (46.5 lb ft)**	**63 N·m (46.5 lb ft)**	**38 N·m (28.0 lb ft)**
M27x2	**178 N·m (131.3 lb ft)**	**107 N·m (78.9 lb ft)**	**105 N·m (77.4 lb ft)**	**63 N·m (46.5 lb ft)**
M30x2	**225 N·m (166.0 lb ft)**	**135 N·m (99.6 lb ft)**	**136 N·m (100.3 lb ft)**	**82 N·m (60.5 lb ft)**
M33x2	**325 N·m (239.7 lb ft)**	**195 N·m (143.8 lb ft)**	**168 N·m (123.9 lb ft)**	**101 N·m (74.5 lb ft)**
M42x2	**345 N·m (254.5 lb ft)**	**207 N·m (152.7 lb ft)**	**220 N·m (162.3 lb ft)**	**132 N·m (97.4 lb ft)**
M48x2	**440 N·m (324.5 lb ft)**	**264 N·m (194.7 lb ft)**	**273 N·m (201.4 lb ft)**	**164 N·m (121.0 lb ft)**
M60x2	**525 N·m (387.2 lb ft)**	**315 N·m (232.3 lb ft)**	**330 N·m (243.4 lb ft)**	**198 N·m (146.0 lb ft)**
NOTE: *Final torque tolerance +/– **10%** of the given torque specification.*				

Torques for Metric O-Ring Boss (ORB) port plugs

Metric Thread	Ferrous		Non-Ferrous
	Internal Hex	External Hex	
M8x1	**8.5 N·m (6.3 lb ft)**	**10.5 N·m (7.7 lb ft)**	**6.3 N·m (4.6 lb ft)**
M10x1	**16 N·m (11.8 lb ft)**	**21 N·m (15.5 lb ft)**	**12.5 N·m (9.2 lb ft)**
M12x1.5	**23 N·m (17.0 lb ft)**	**37 N·m (27.3 lb ft)**	**22 N·m (16.2 lb ft)**
M14x1.5	**47 N·m (34.7 lb ft)**		**28 N·m (20.7 lb ft)**
M16x1.5	**58 N·m (42.8 lb ft)**		**35 N·m (25.8 lb ft)**
M18x1.5	**74 N·m (54.6 lb ft)**		**44 N·m (32.5 lb ft)**
M22x1.5	**105 N·m (77.4 lb ft)**		**63 N·m (46.5 lb ft)**
M27x2	**178 N·m (131.3 lb ft)**		**107 N·m (78.9 lb ft)**
M30x2	**225 N·m (166.0 lb ft)**		**135 N·m (99.6 lb ft)**
M33x2	**325 N·m (239.7 lb ft)**		**195 N·m (143.8 lb ft)**
M42x2	**345 N·m (254.5 lb ft)**		**207 N·m (152.7 lb ft)**
M48x2	**440 N·m (324.5 lb ft)**		**264 N·m (194.7 lb ft)**
M60x2	**525 N·m (387.2 lb ft)**		**315 N·m (232.3 lb ft)**
NOTE: *Final torque tolerance +/– **10%** of the given torque specification.*			

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

		Ferrous		Non-Ferrous
SAE dash size	UN/UNF thread size	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)	–	–

Hydraulic contamination

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

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

Contamination can enter the hydraulic system in several ways:

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

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

The following list includes some of these problems:

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

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

There are two types of contamination: microscopic and visible.

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

Examples of problems caused by microscopic contamination:

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

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

Examples of problems caused by visible contamination:

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

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

Contents

Maintenance - 00

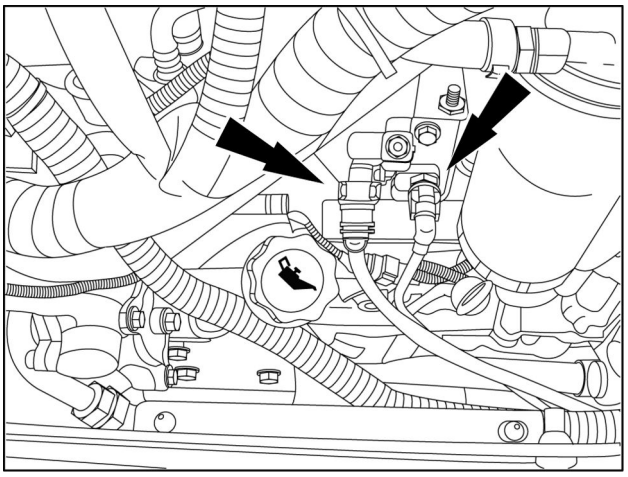
Start-up - 150

SERVICE

Machine

(*) See content for specific models

18. Disconnect fuel supply and return lines to engine.



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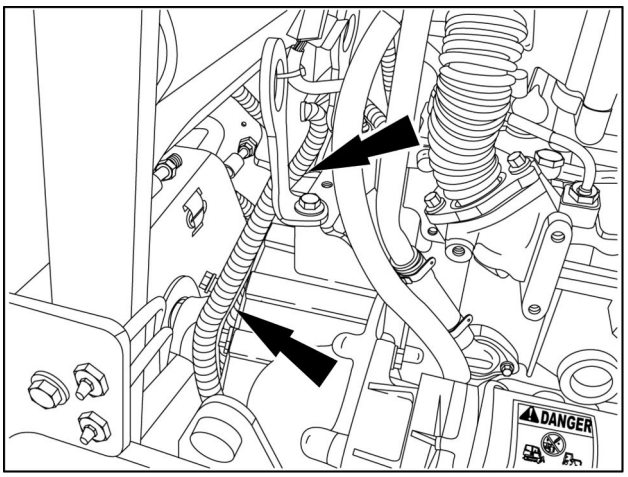
19. Remove wiring harness clamps and remove wiring harness from rear of engine.



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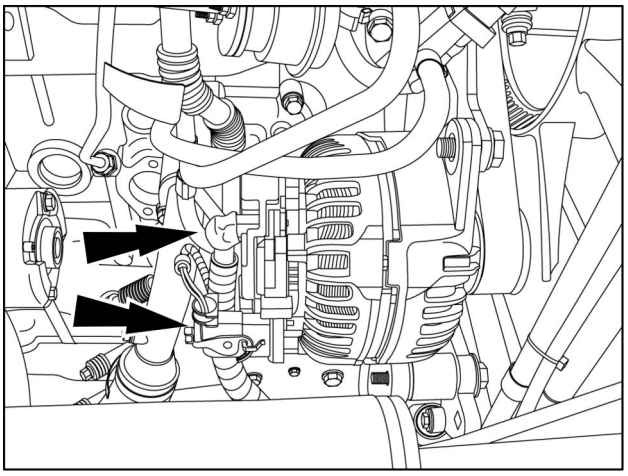
20. Disconnect all electrical connections from alternator.



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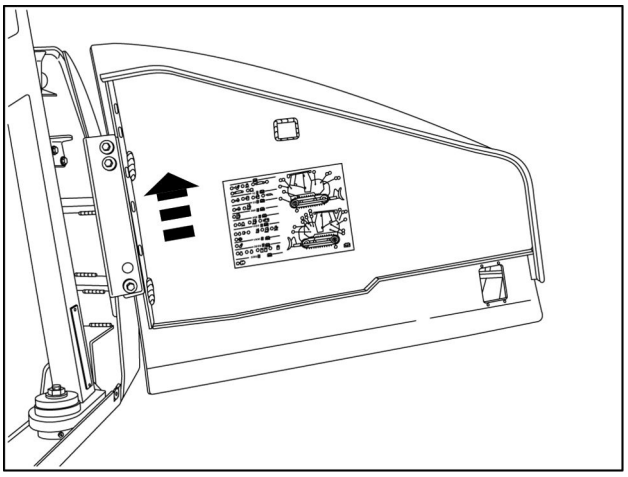
8. Remove battery access door.



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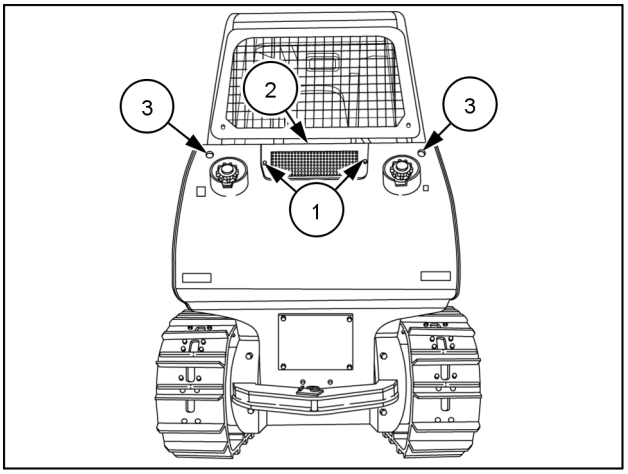
9. Repeat steps **6** through **8** to remove hydraulic system access door.
10. Remove two thumb screws **(1)** and remove backup alarm cover plate **(2)**.



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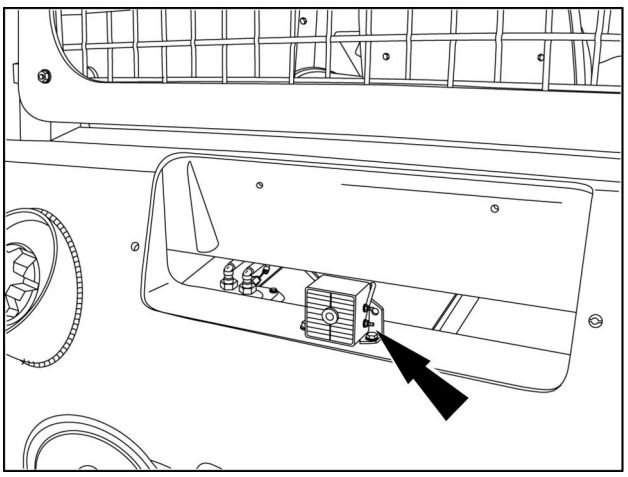
11. Remove two upper tank cover bolts, washers, and spacers **(3)**. Note location and quantity of spacers for installation.
12. Disconnect backup alarm wiring connections.



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Turbocharger and lines - 250

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(*) See content for specific models

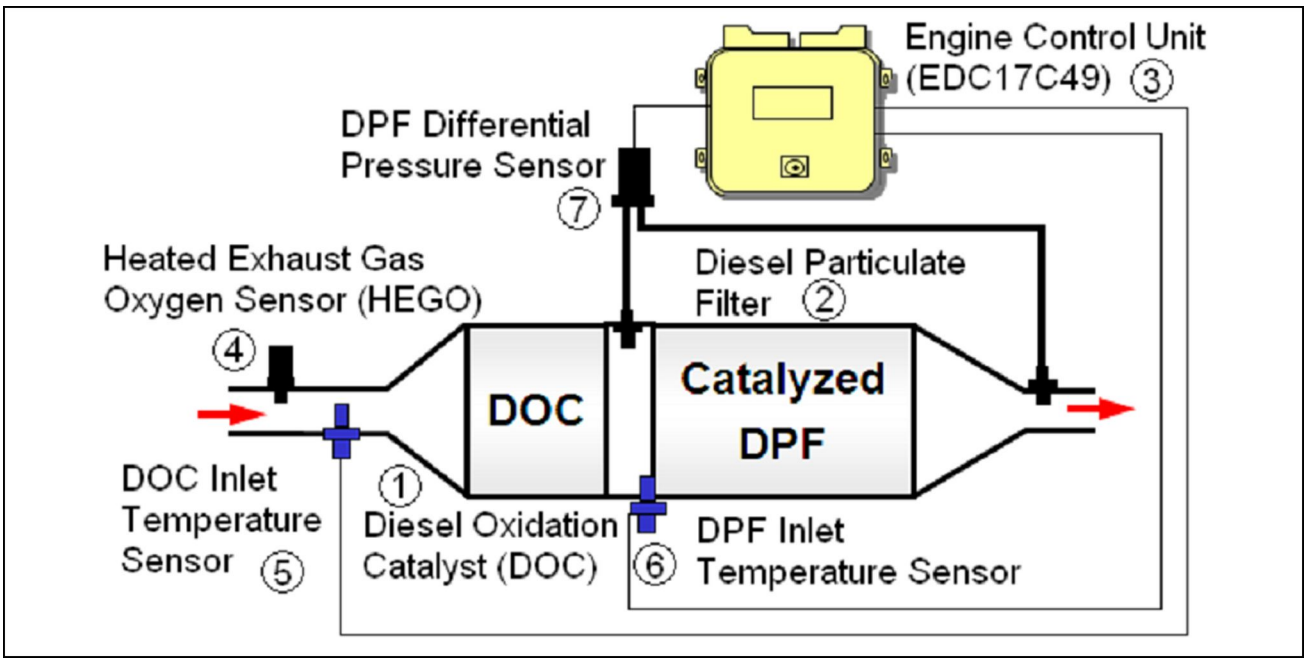

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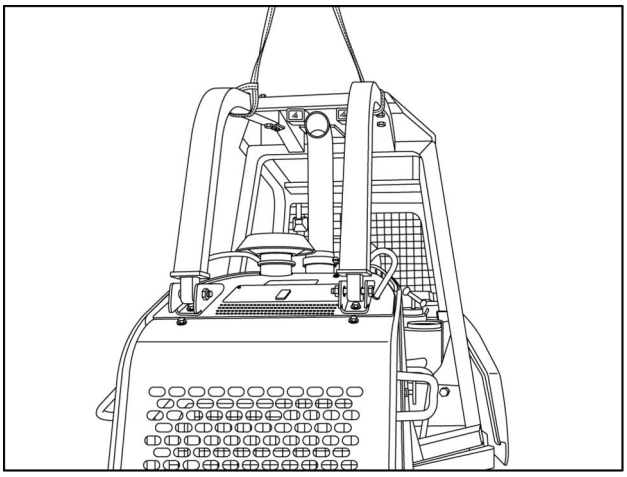
Diagram #1

1. Diesel Oxidation Catalyst (DOC)	6. DPF Inlet Temperature Sensor
2. Diesel Particulate Filter (DPF)	7. DPF Differential Pressure Sensor
3. Engine Control Unit (EDC17C49)	8. DPF Inlet Pressure Sensor
4. Heated Exhaust Gas Oxygen Sensor (HEGO)	9. DPF Outlet Pressure Sensor
5. DOC Inlet Temperature Sensor	

8. Attach an appropriate lifting device to brush guard.



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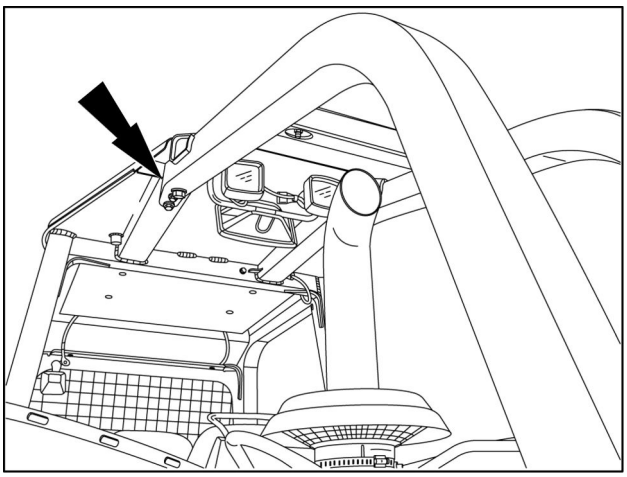
9. Remove two upper brush guard mounting bolts.



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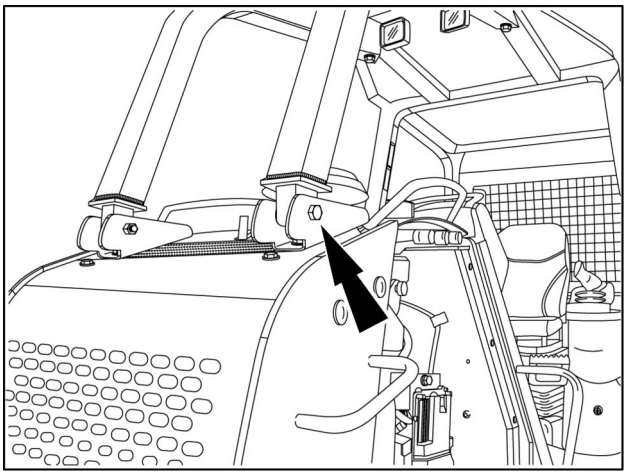
10. Remove two lower brush guard mounting bolts. Remove brush guard.



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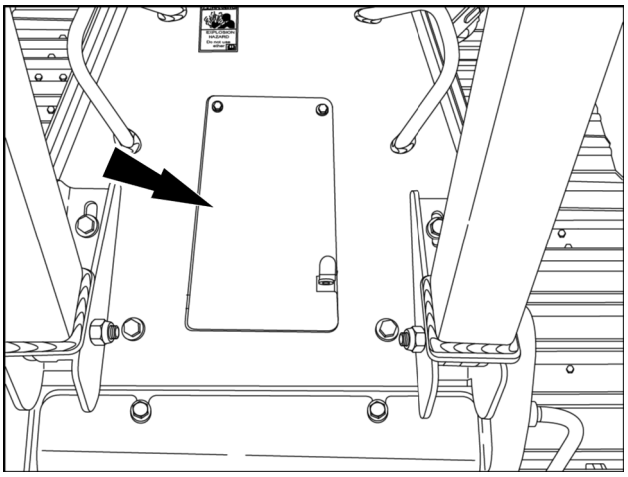
1. Wait for the engine to cool and the temperature of the coolant to reach a safe level.
2. Open the radiator cap access panel on top of the hood panel.



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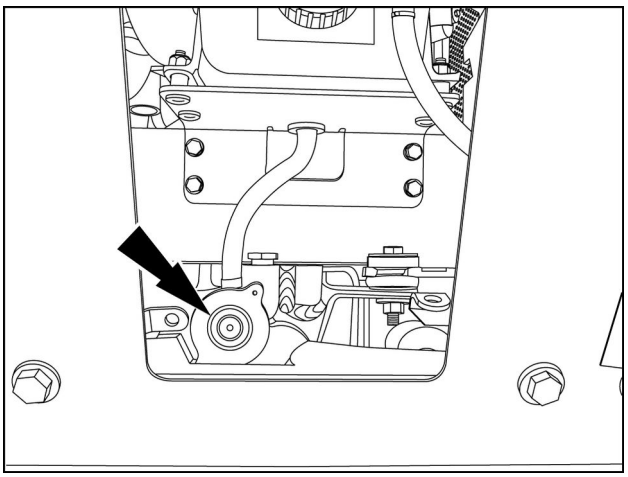
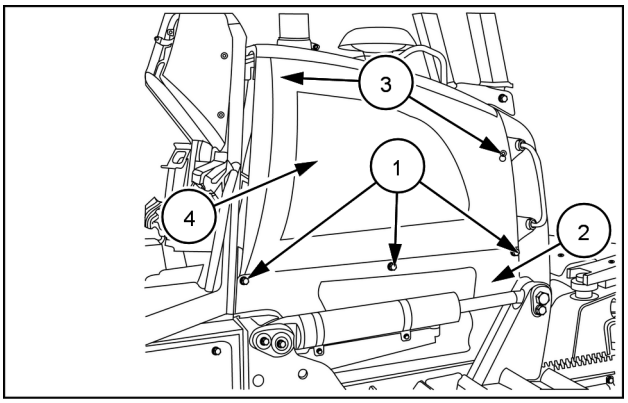
3. Loosen and remove the radiator cap.



RAIL17DOZ0389AA 2

4. Remove the bolts **(1)** and the lower engine access panel **(2)**.
5. Remove the bolts **(3)** and the upper engine access panel **(4)**.



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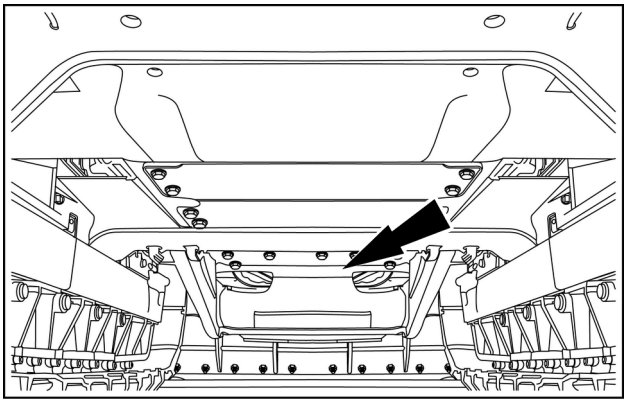
6. **⚠ CAUTION**

   Heavy object!
   The component is heavy. Use care not to drop the component when installing, removing, or handling.
   Failure to comply could result in minor or moderate injury.

   C0095A

   Remove the bolts that secure the front belly pan, and remove the belly pan.



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SERVICE

(*) See content for specific models

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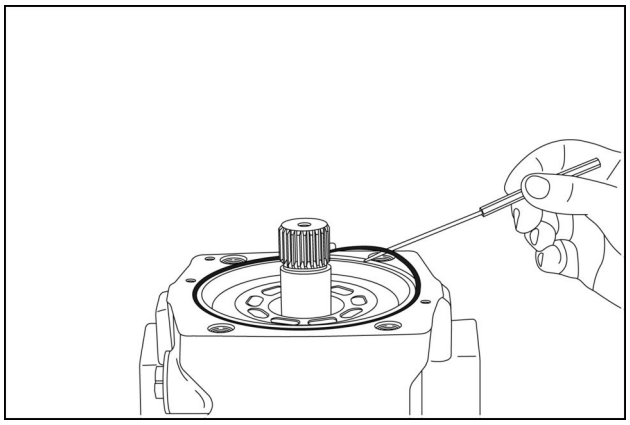
(36) continuously increase flow delivery as more machine speed is commanded by the operator. Once the pumps reach maximum delivery, the track drive motors **(1)** begin to reduce displacement to further increase travel speed. As the travel drive motors reduce displacement, the travel drive torque available is reduced. The minimum displacement of the travel drive motors **(1)** is restricted by repeatedly pressing the rabbit and turtle buttons on the left travel control lever. These commands are processed through the UCM with control signals then being sent to the proportional motor speed control solenoid valves **(4)**. At each inlet port to the track drive motors **(1)**, there is a high pressure check valve **(3)**. The hydrostatic drive pressure required to drive the machine flows through the check valve **(3)** on that side of the motor to the proportional motor speed control solenoid valve **(4)**, to the rod end of the motor travel speed control piston **(5)** and also seats the check valve on the opposite side of the drive motor. As the motor speed control solenoid valve is gradually activated, higher pressure is then ported to the base end of the motor travel speed control piston **(5)**. As equal pressure is ported to both ends of the travel speed control piston **(5)**, the larger differential area will shift the piston to reduce the motor displacement, which then increases travel speed. There are tamper resistant adjustment screws for maximum and minimum drive motor displacement. There is also an adjustment on the motor speed control solenoid valve **(4)** which controls the pressure that the drive motor begins to reduce displacement. Do not tamper with any of these adjustments. Contact Technical Services for assistance in case one of these adjustments are tampered with. A misadjustment may require replacement of the travel drive motor.

30. Lift off port plate and remove O-ring from housing.



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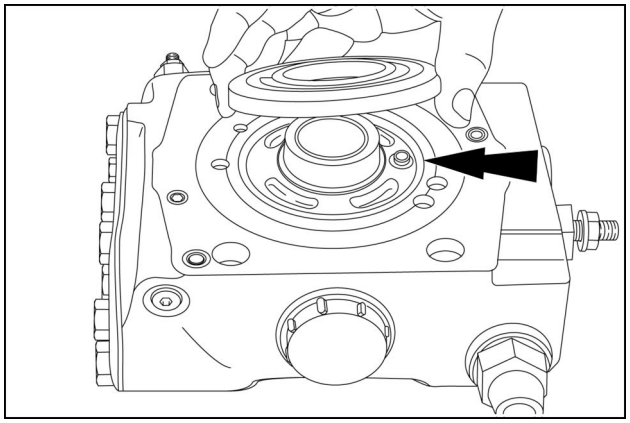
31. Remove control plate

NOTE: *Control plate is keyed to port plate note orientation.*



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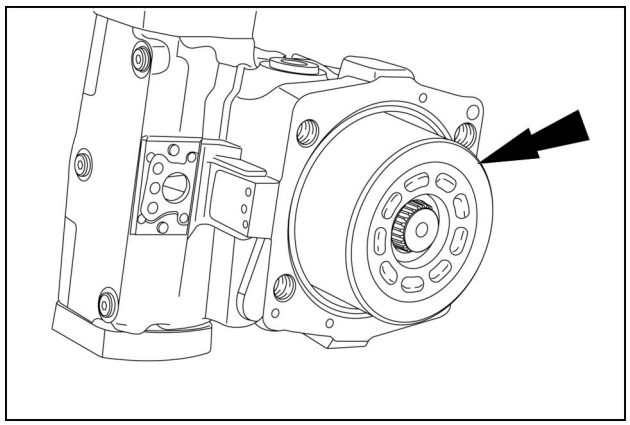
32. Remove rotary group.



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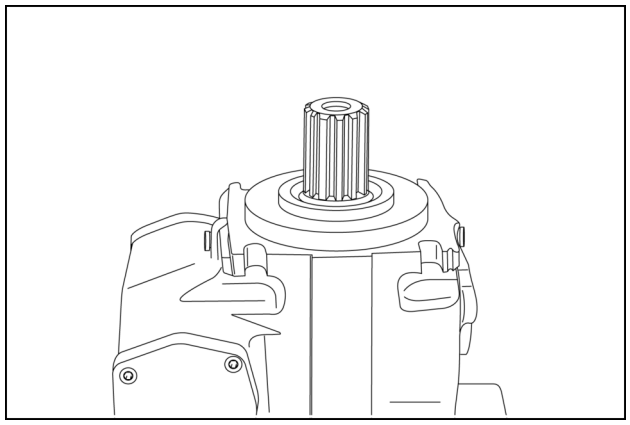
33. Position pump to get access to seals and O-rings.



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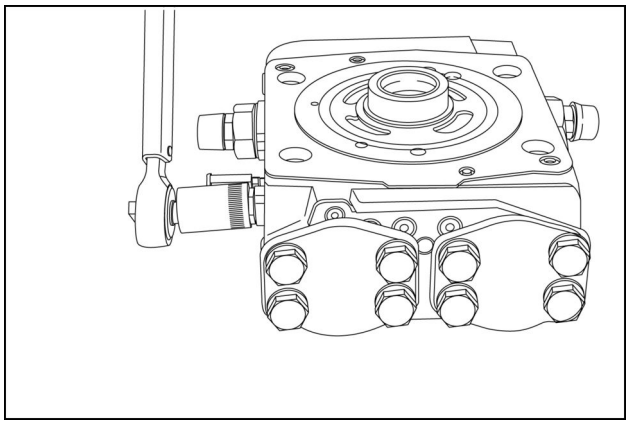
4. Torque pressure cut off valve to manufactures specification.



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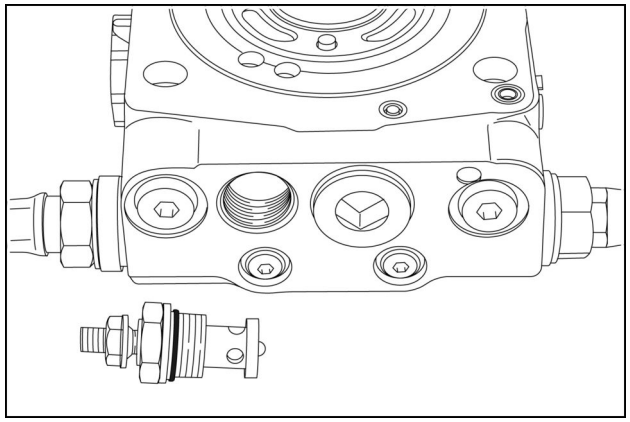
5. Replace charge pump pressure relief valve if defective. If valve is leaking replace O-ring. Torque valve to manufactures specification.



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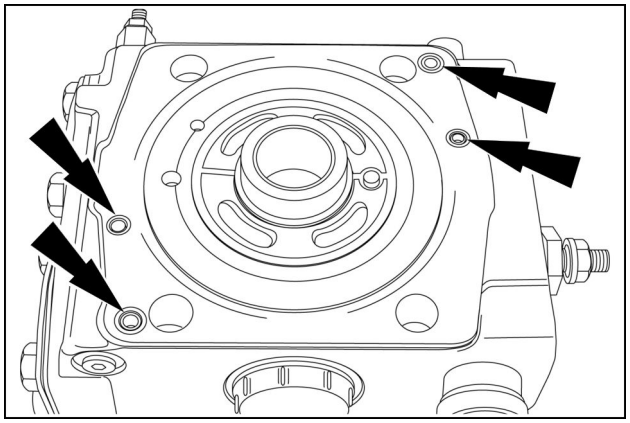
6. Replace the four O-rings on bottom side of port plate.



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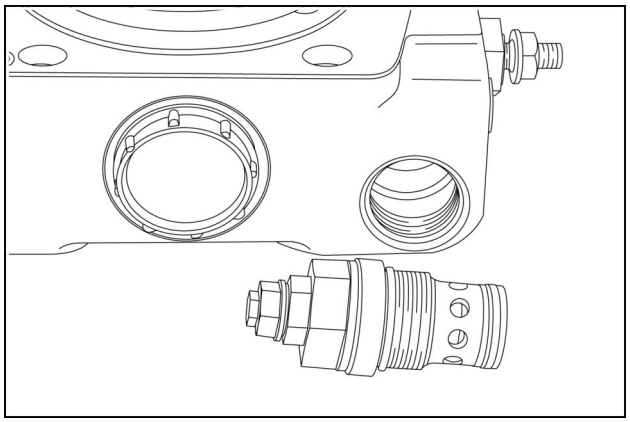
7. Replace high pressure relief valve quantity 2 (one on each side of port plate) if defective. If valves are leaking replace O-ring.



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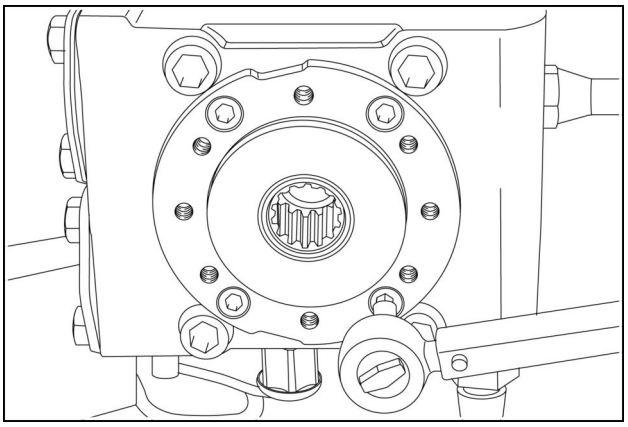
88. Install four allen head bolts to secure charge pump to port plate. Torque bolts to **24 Nm** (**18 lb ft**).



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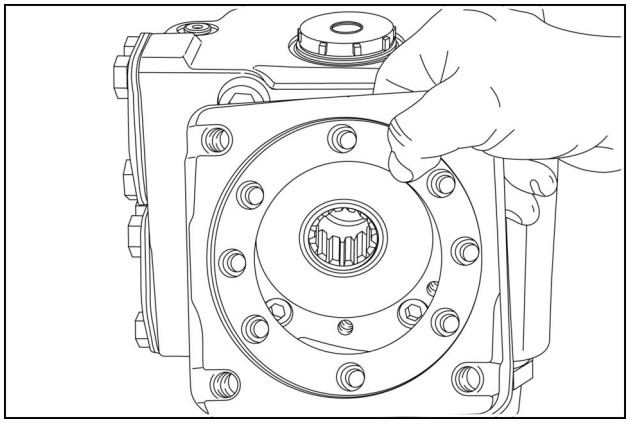
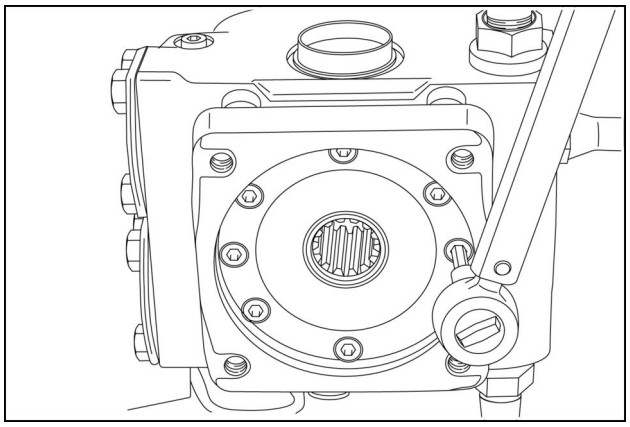
89. Install adapter plate onto front of charge pump.



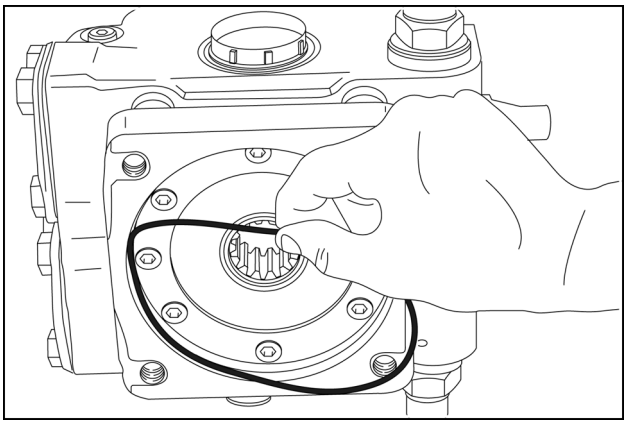
BD08H530-01 69

90. Install eight allen head bolts on adapter plate. Torque to **25 Nm** (**18 lb ft**).



BD08H529-01 70

91. Install a greased O-ring on adapter plate.



BD08H527-01 71

Hydrostatic circuit supply pump - Pressure test - Charge pressure drop test

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

⚠ WARNING

Hazard to bystanders!
The machine could move during calibration. Park on a flat surface, be prepared to apply the brake pedal and shift to neutral, and be sure that the area around the machine is clear before you start the calibration process.
Failure to comply could result in death or serious injury.

W1350A

ATTENTION: *Verify the machine is properly calibrated prior to performing the test procedure.*

1. Install a **41 – 69 bar** (**600 – 1000 psi**) gauge in the charge pressure test port behind the right hand access door.
2. Operate the unit to raise the hydraulic oil temperature to at least **49 °C** (**120 °F**) and key off the machine.
   a. Remove the retaining nut on the brake solenoid valve coil and leave connector V24 connected to the coil. Remove the coil from the shaft and lay it away from the brake valve. Failure to perform this will log a fault and disable the drivetrain.
   b. Disconnect the V25(brake pressure switch) connector at the brake pressure switch located on the brake valve and jumper the two terminals on the harness side.

NOTE: *The dozer might drive through the brakes during the test. If the machine drives through the brakes, pin the tracks in order to stop track movement.*

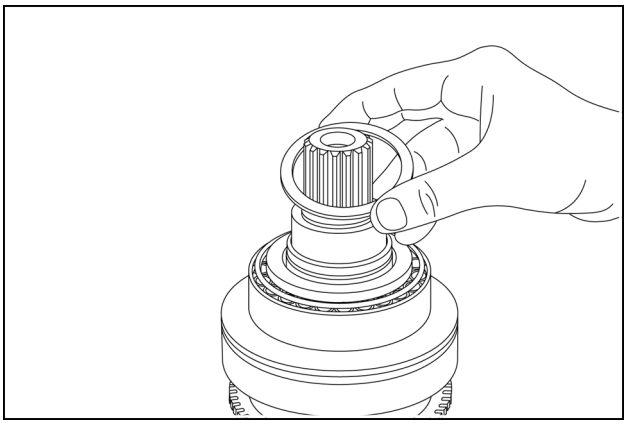
3. Using the chart below, record the pressure readings. In neutral, run the engine at low idle **800 – 1050 RPM**. Record the pressure at item 1 on the chart.
4. Increase the throttle to high idle and record the charge pressure at 2.

NOTE: *For the remaining steps, it is necessary to operate only 1 track (left or right) and only 1 direction (forward or reverse) . To obtain a 1 track and 1 direction operation, locate the left and right points on the FNR joystick, where the resistance to move the control lever increases significantly. This point is the end of operating only 1 track and the beginning of counter- rotation. This point is the correct position for each of the below steps.*

NOTICE: *Caution: Do not lug the engine during this test. Lugging the engine down may result in brake failure and inaccurate charge pressure readings.*

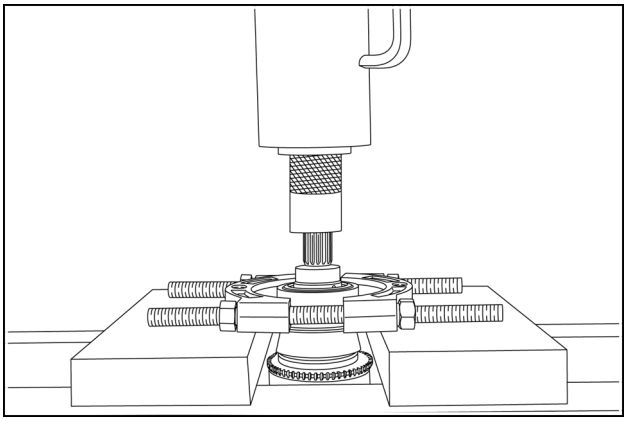
5. Set the engine rpm to high idle and record the pressure at 3 on the chart.
6. Press and hold the brake pedal to the floor. With the FNR joystick in neutral, pull the joystick to the right to locate the point just before right counter-rotation, and push the joystick forward. Slowly release the brake pedal to engage the forward left track drive (the park brake light turns off at this time) and monitor the charge pressure gauge for a drop in pressure. As soon as the pressure drops, record the lowest pressure reading at item 4 followed by pressing and holding the brake pedal to the floor.
7. Repeat step 6 for the right reverse position and record the pressure at 5 on the chart.

48. Remove shim from rotary group drive shaft.



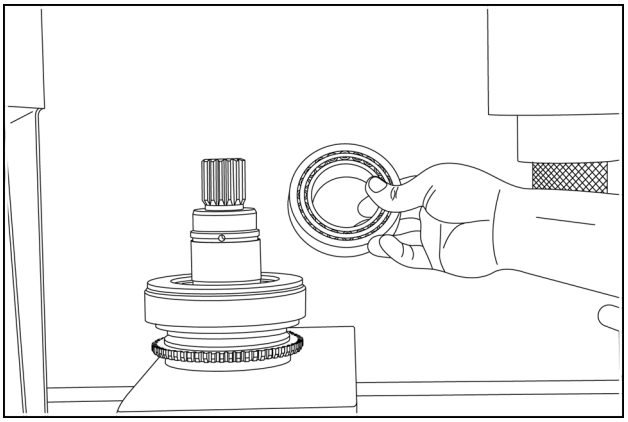
BD08H075-01 45

49. Press the top bearing (smaller) from the drive shaft.



BD08H077-01 46

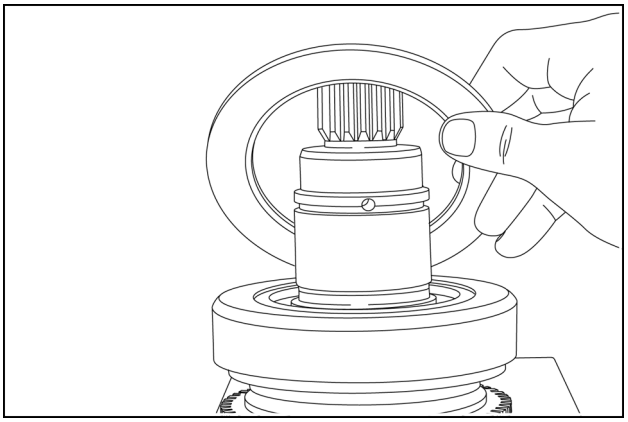
50. Remove bearing.



BD08H078-01 47

51. Remove shim.

NOTE: *take note of the orientation of shim for assembly beveled edge should face toward bottom bearing*



BD08H079-01 48

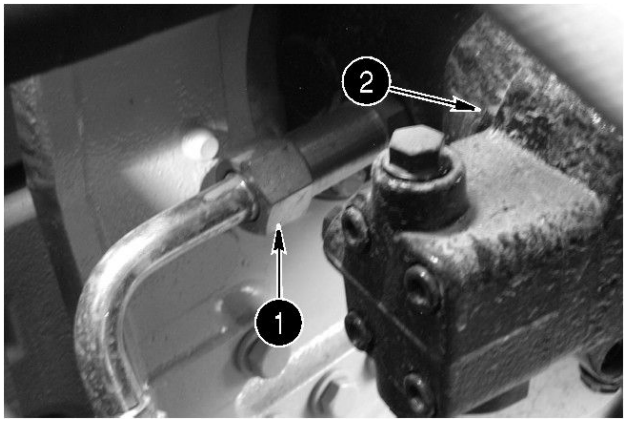
Motor - Install

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

1. Carefully work the motor into the machine and into the final drive.
2. Start all four mounting bolts to the final drive and snug them up evenly. Torque the mounting bolts to **122 – 135.6 Nm (90 – 100 lb ft)**.

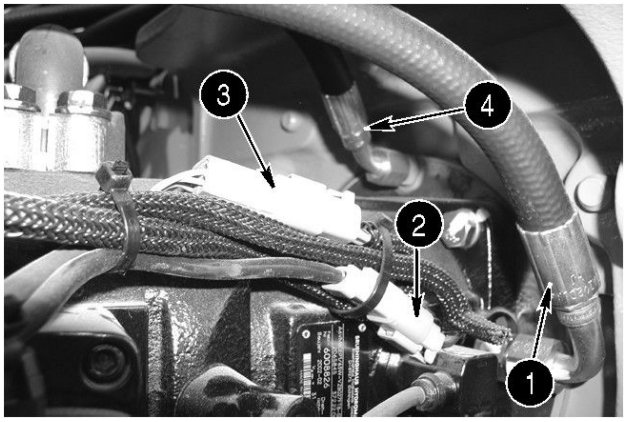
NOTICE: *Filling the case with as much oil as possible is critical for a safe startup.*

3. Fill the motor case with oil until oil is to the level of the fittings.
4. Connect the front case drain hose.



BD02H066 1

5. Connect high pressure hoses to the motor.
6. Connect the rear case drain hose, solenoid and speed sensor wiring harness.
   1. Case drain
   2. Solenoid connector
   3. Speed sensor
   4. Brake release



BD02H061 2

7. Turn off and disconnect the vacuum pump from the reservoir.
8. Lower the ROPS cab/canopy, refer to **Cab - Lower (90.150)**.
9. Check oil level in reservoir, fill to correct level. Refer to **Capacities ()** for correct oil type.
10. Perform hydraulic priming procedure. See **Hydraulic systems - Recover Hydraulic priming procedure (35.000)**
11. Start and run the engine at low idle for 3 minutes, run the machine at full throttle for 5 minutes while moving the machine in forward, reverse, left and right steering positions.

Contents

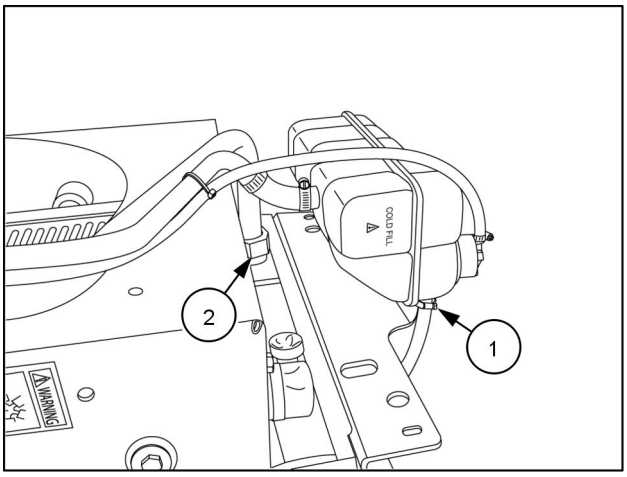
Hydraulic systems - 35

Hydraulic systems - 000

(*) See content for specific models

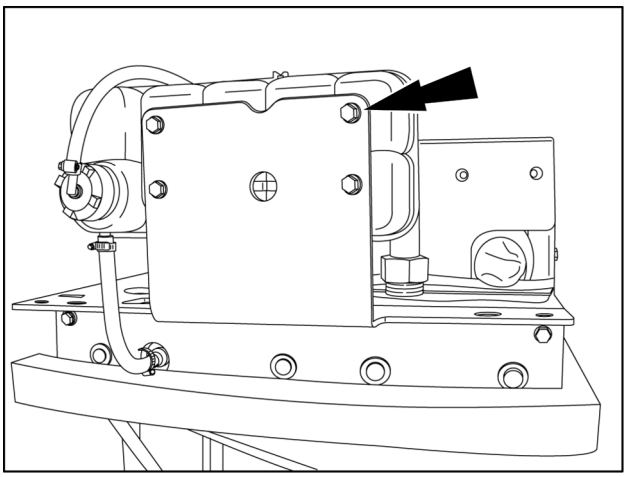
54. Support any attachments that will be in the RAISED position.
55. Stop the engine.
56. Disconnect the drain lines and connect the system lines to the cylinders.
57. Check the oil level in the hydraulic reservoir. Add oil as required.
58. Install the filler cap on the reservoir.
59. Remove the hydraulic and hydrostatic filter elements from the machine.
60. Install new hydraulic and hydrostatic filter elements on the machine.
61. Start and run the engine at 1500 rpm (r/min), operate each hydraulic circuit to completely extend and retract the cylinders.
62. Stop the engine and check for leaks. Check the oil level in the hydraulic reservoir. Add oil as required.

4. Install coolant hose **(1)** to coolant recovery tank and install upper hydraulic tube **(2)** to cooling package assembly.



RAIL13DOZ0353AA 4

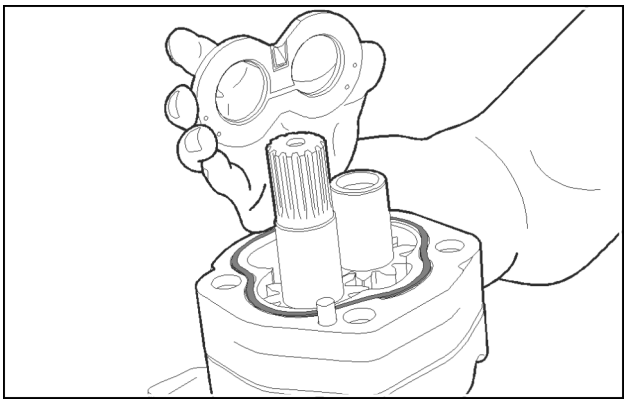
5. Install four mounting bolts to coolant recovery tank.



RAIL13DOZ0352AA 5

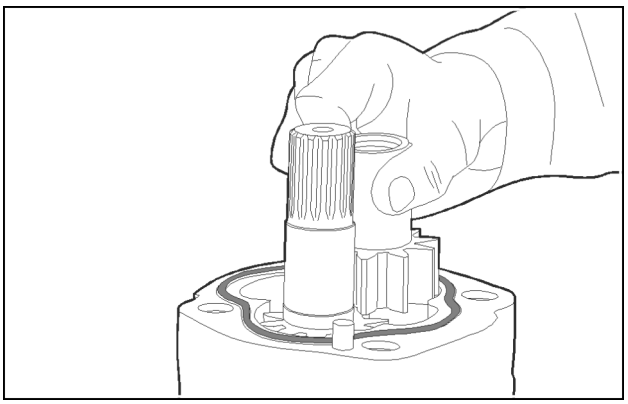
6. Install cooling package. See **Radiator - Install (10.400)**.

13. Remove the wear plate from the gear housing.



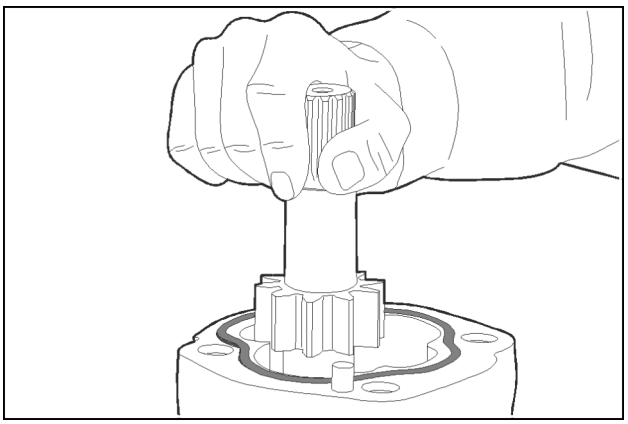
RCPH09CWL027AAD 12

14. Remove the driven gear.



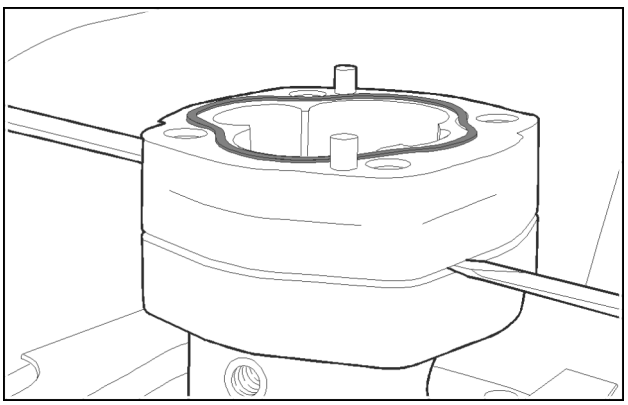
RCPH09CWL050AAD 13

15. Remove the drive gear.



RCPH09CWL003BAD 14

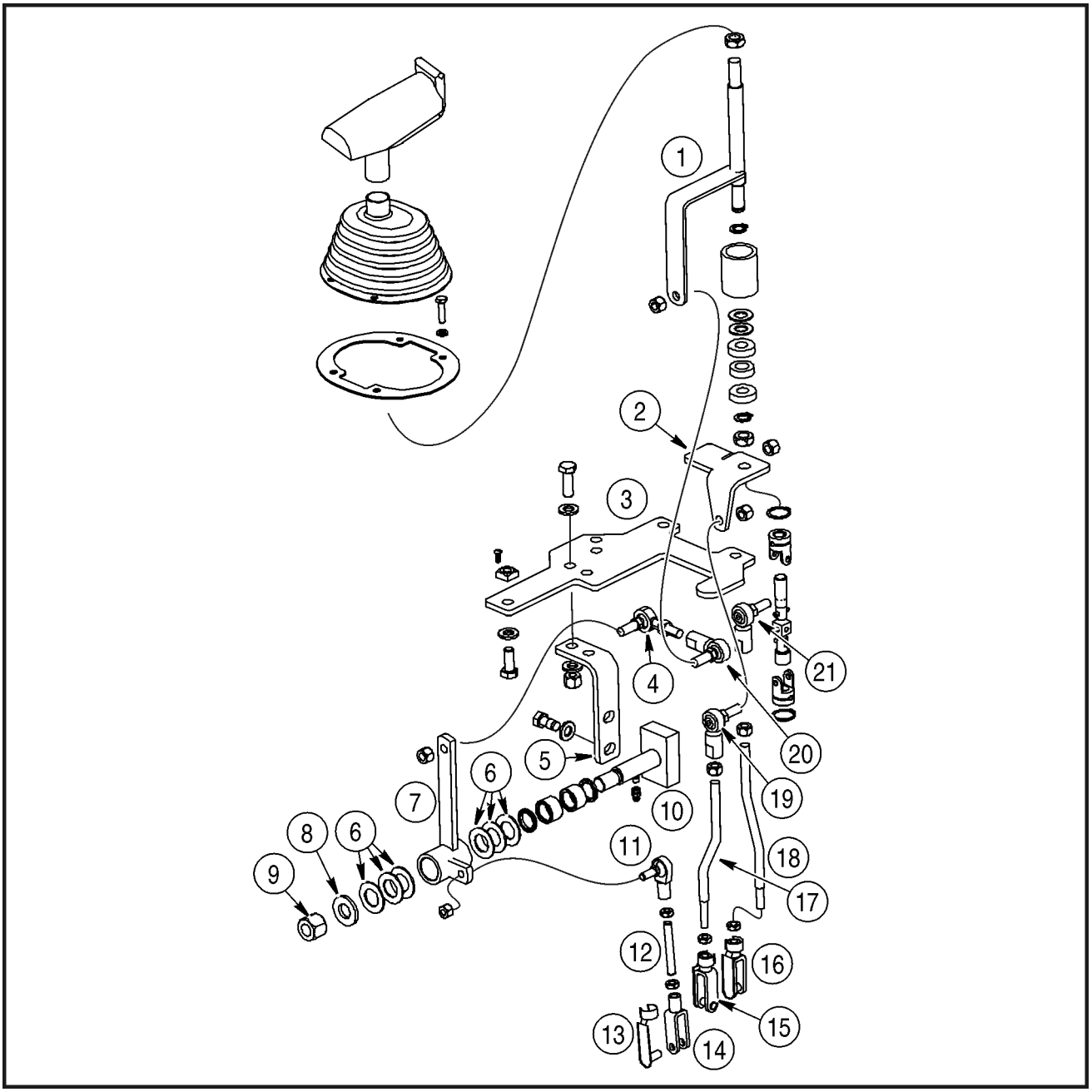
16. Remove the gear housing.



RCPH09CWL011AAD 15

Control valve lever - Exploded view

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA



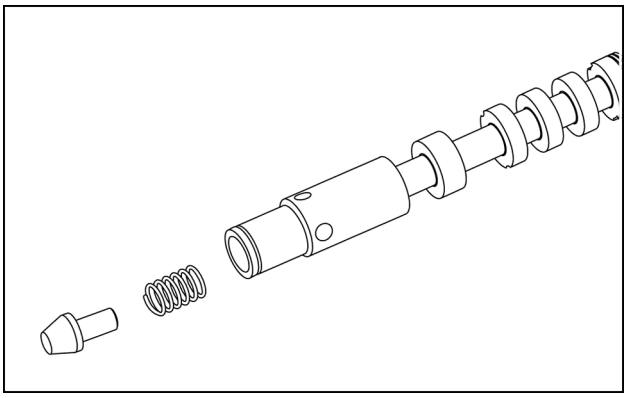
BT09A43101 1

(1) Angle control	**(8)** Washer	**(15)** Clevis tilt
(2) Lift and tilt control	**(9)** Self locking nut	**(16)** Clevis lift
(3) Bracket	**(10)** Rocker bracket	**(17)** Rod tilt
(4) Rod end	**(11)** Rod end	**(18)** Rod lift
(5) Bracket	**(12)** Angle rod	**(19)** Rod end tilt
(6) Shims	**(13)** Pin spring clevis	**(20)** Rod end
(7) Rocker angle control	**(14)** Clevis	**(21)**Rod end lift

Stacked control valves - Assemble

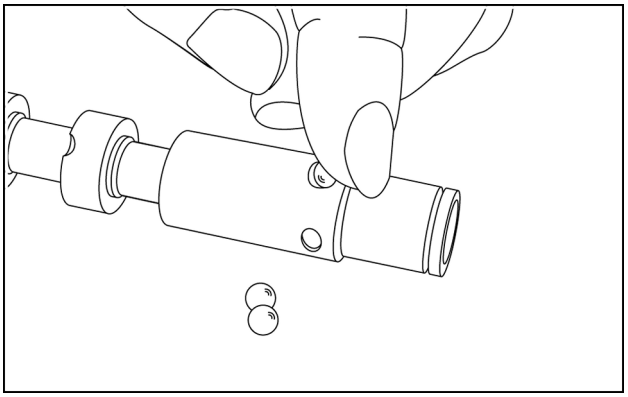
650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

1. Install the spring and the detent poppet in the end of the spool.



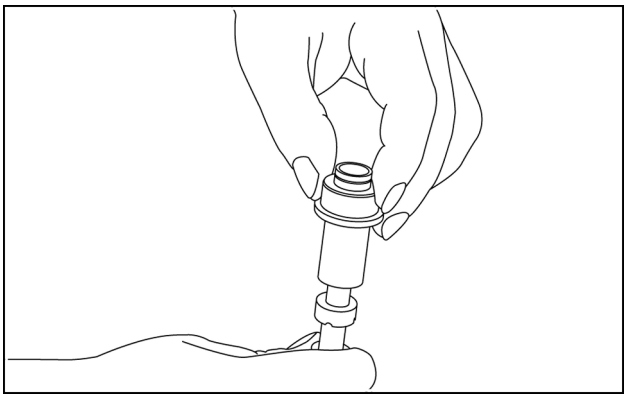
RCPH09CWL323AAD 1

2. Install the detent balls in the holes in the spool. Use petroleum jelly to hold the balls in position.



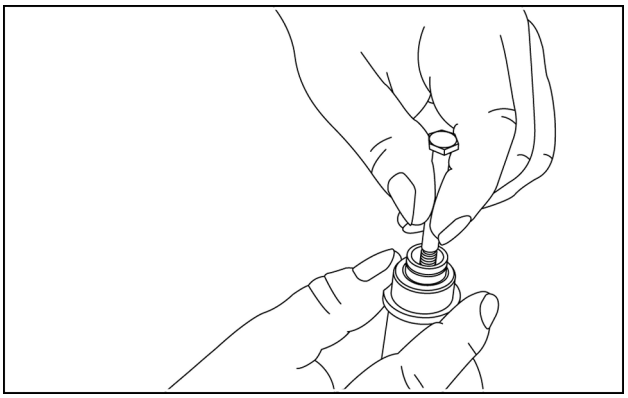
RCPH09CWL453AAD 2

3. Put the top spring seat in position so that it is sitting on the detent balls. The top spring seat will not fit over the detent balls at this time.



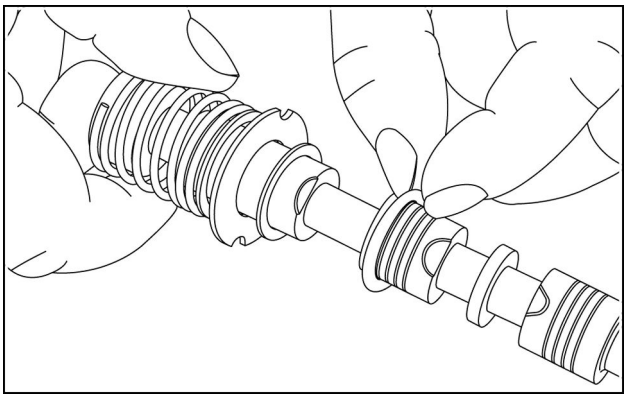
RCPH09CWL131AAD 3

4. Use a small bolt or rod to push down the detent poppet so that the detent balls can move toward the inside of the spool. Pull the top spring seat down over the detent balls.



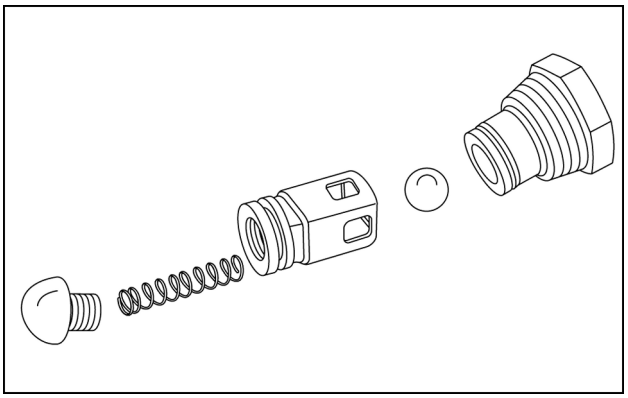
RCPH09CWL322AAD 4

4. Install the seal retainer, the backup ring, and the O-ring on the spool. Be careful so that you do not cut the O-ring on the edges of the spool.



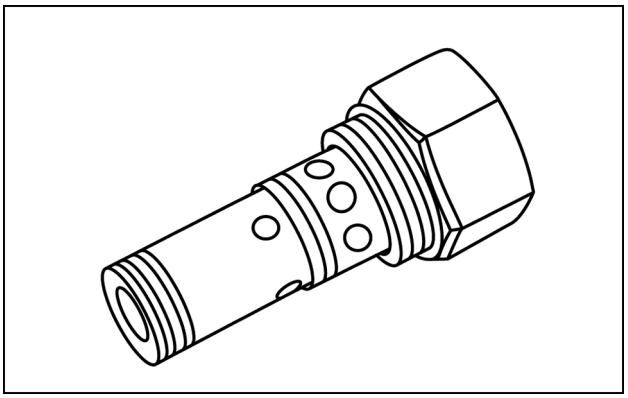
RCPH09CWL152AAD 4

5. Install new O-rings and backup rings on anti-cavitation bodies.



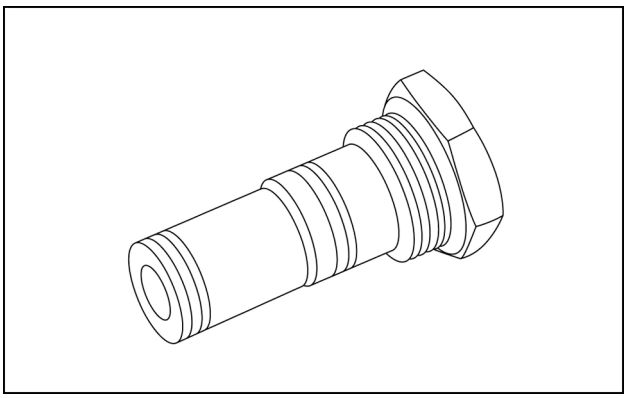
RCPH09CWL213AAD 5

6. Install new O-rings and backup rings on load check bodies.



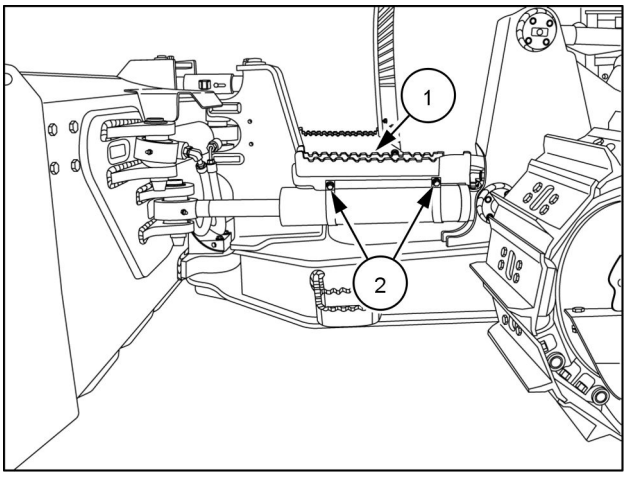
RCPH09CWL171AAD 6

7. Install new O-rings and backup rings on circuit relief bodies.



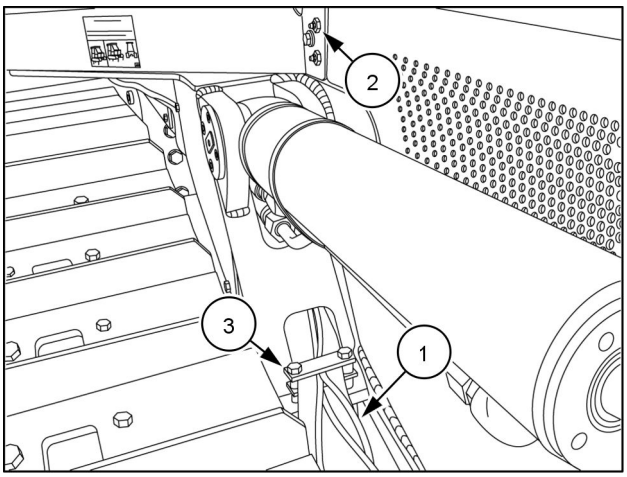
RCPH09CWL125AAD 7

9. Install step **(1)** to blade swiveling cylinder with bolts, washers, and nuts **(2)**.



RAIL13DOZ0690AA 3

10. Route grease line **(1)** into machine. Install grease line fitting **(2)** to front cab panel.



RAIL13DOZ0691AA 4

11. Install hydraulic hose clamp **(3)**.
12. Check oil level in oil reservoir and add as required.

NOTICE: *Keep hands and body away from any pressurized leak. DO NOT use your hand to check for leaks. Use a piece of cardboard or paper. If fluid penetrates the skin, seek medical attention immediately.*

13. Start and run the engine for 30 seconds and check for leaks. Stop engine.
14. Check oil level in oil reservoir and add as required.

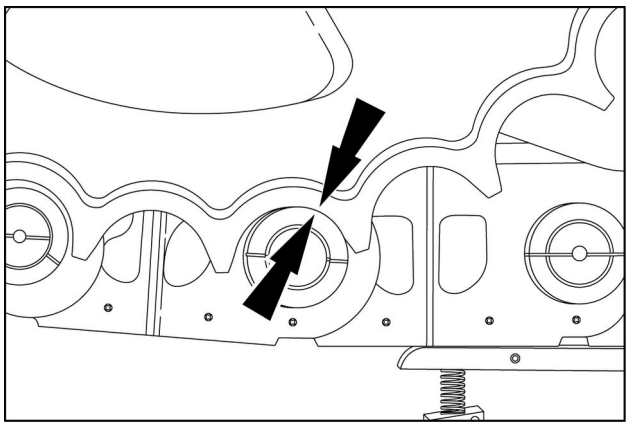
Contents

Tracks and track suspension - 48

Sprocket wear patterns

Forward drive side wear of sprocket, bushings and pins

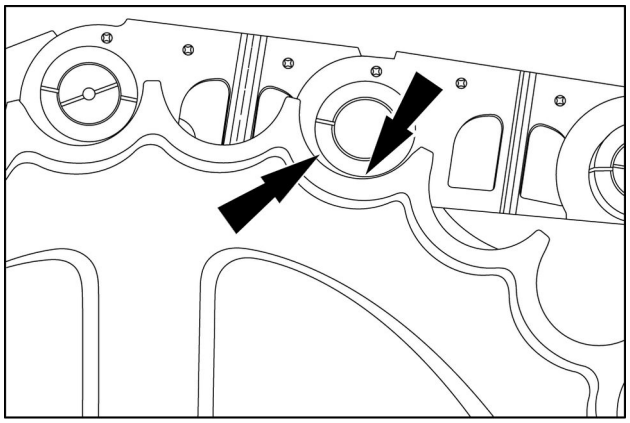
- With new sprocket, pins, and bushings, there is a correct match between the sprocket and the bushings in the 6 o'clock position.
- The track bushing to contact area is **60%**.
- There is no movement between the sprocket and bushing until the bushing leaves the sprocket. At this point, wear is very small.
- In the forward drive direction, the track pin is in the hinge point. Internal wear occurs between the outside diameter of the pin and the inside diameter of the bushing. The wear is greatly reduced with the Case Lubricated Track (CLT) and Case Extended Life Track (CELT) chain.
- With Case Extended Life Track (CELT), forward, reverse, and vertical wear are evenly distributed on the bushing because of its ability to rotate. This gives greater life to the external bushing surfaces.



RAIL13DOZ1049AA 4

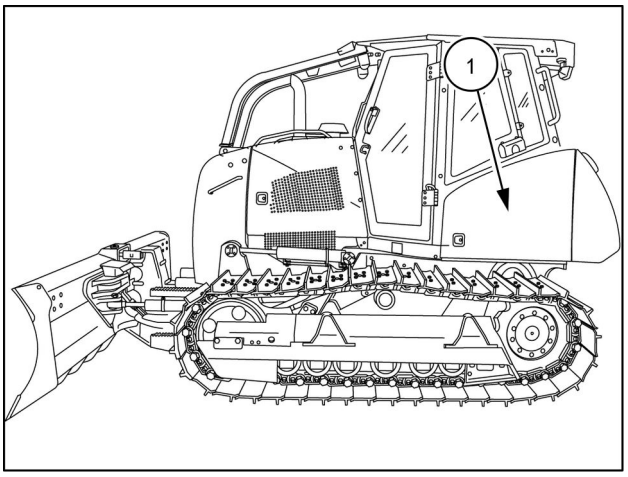
In the forward drive direction, the track bushings carry:

- **85%** of the load at the 6 o'clock position.
- **10%** of the load at the 7 o'clock position.
- **5%** of the load at the 8 o'clock position.



RAIL13DOZ1050AA 5

7. Close the battery access door **(1)**.



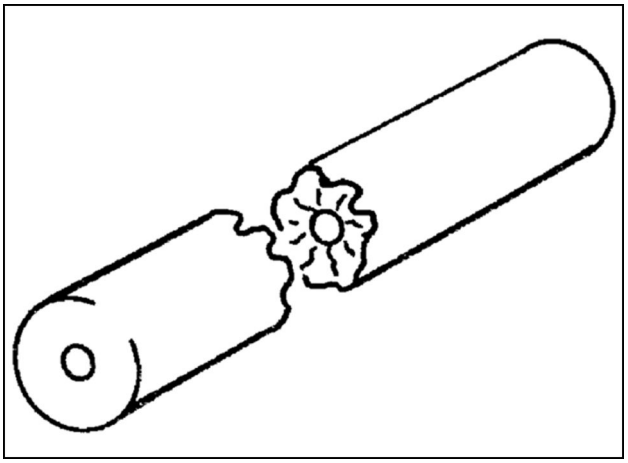
RAIL13DOZ1295AA 37

Final inspection

1. Run the machine for a few minutes.
2. Stop the machine.
3. Inspect the rollers for wear marks in the new paint. Be sure the that marks are equally spaced.
4. Install additional guides and rock guards that may have been removed during this procedure.

Pins breaking – CLT and CELT

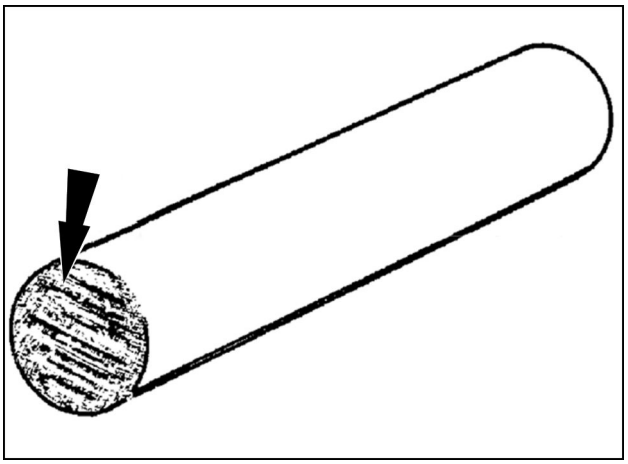
Tight tracks, high impact loads, severe packing, and track shoes that are too wide can cause the pins to break. Also, pins can break due to incorrect installation of the pins at assembly.
Cracks start at the outer surface at the reservoir hole and then spread through the pin at a rapid rate. This is not common in sealed pins.



RAPH13DOZ1110AA 4

Pin end wear

Misalignment, track shoes that are too wide, worn idlers or worn roller flanges cause pin wear. Hillside operations can also cause pin end wear. In this situation, the pin ends rub against the track guides.



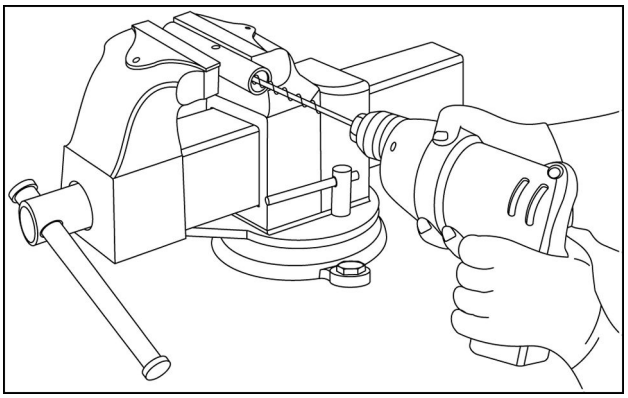
RAPH13DOZ1107AA 5

Track chain Chain - Visual inspection

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Preparing to turn the bushings.
General information.

1. A wet turn can be made when pins, bushings and seal are in condition to be used again to make a sealed and lubricated joint.
2. A dry turn can be made when pins, bushings and seals are in condition to be used again but not good enough to make a sealed joint. Lubricant is not added after assembly.
3. Check to see how many joints do not show leakage. A joint that shows leakage can be assembled only as a dry turn if new parts are not used.
4. Loosen and remove the bolts, nuts and track shoes.
5. If a wet turn is to be made, use a 12.5 mm (1/2 inch) wood drill and a low RPM electric drill and remove the plugs from the pins. The plugs can also be removed as shown after the track has been disassembled.



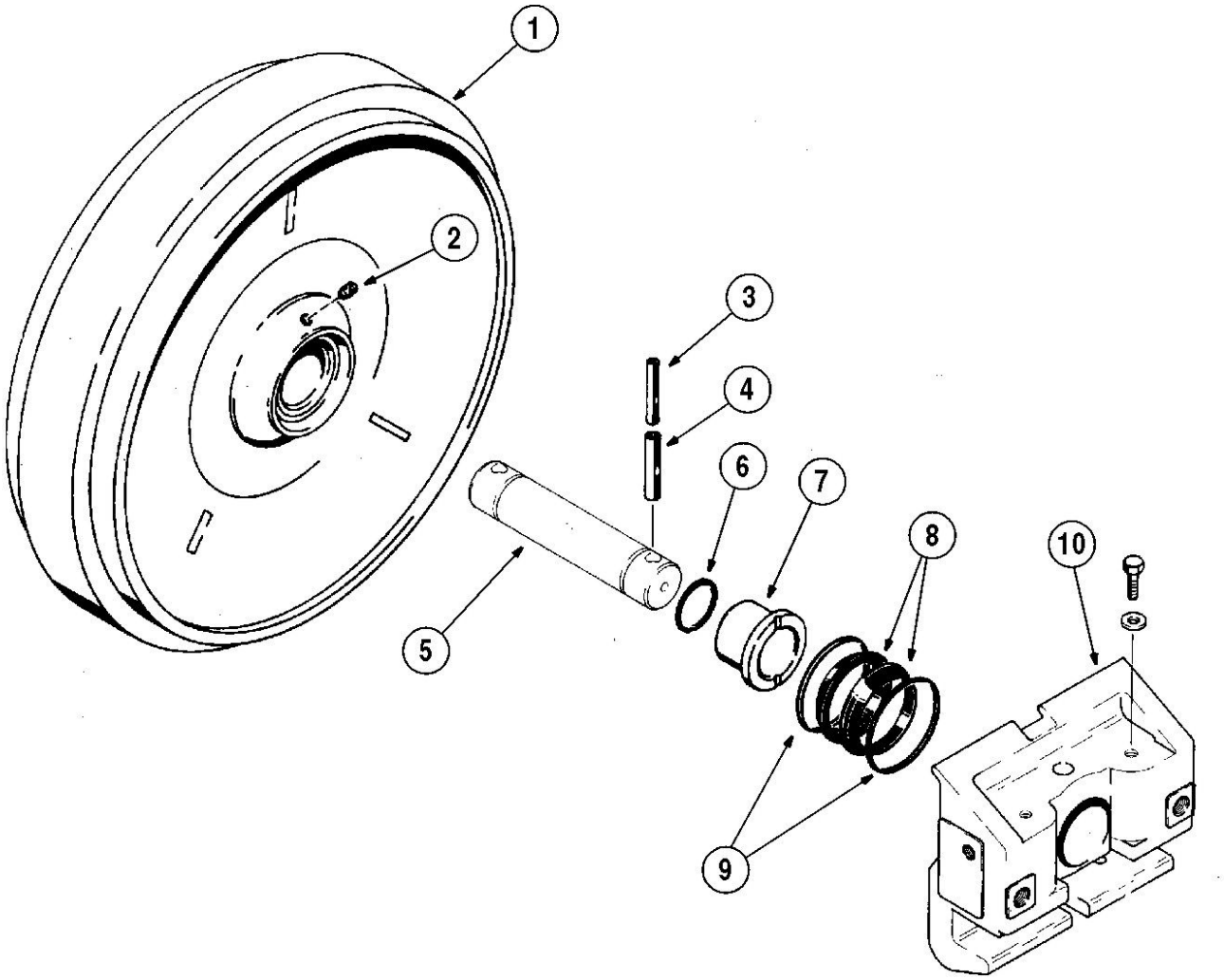
RCPH09CWL270AAD 1

6. Clean the track chain using high pressure water or steam. If a wet turn is to be made, the track chain must be clean.
7. With the track shoe surface down, make a mark on a top of each bushing. This will help you to turn the bushings the correct amount when the track chain is assembled.
8. With the track shoe surface up, make mark at one end of each pin at the top. This will help you install the pins correctly when the track is assembled.

NOTE: *The following information will help you to make a judgment as to whether track assembly will make a wet turn or a dry turn. A wet turn is made when pins, bushings and seals are in condition to be used again to make a sealed and lubricated joint. A dry turn is made when pins, bushings and seals are in condition to be used again, but not good enough to make a sealed joint. Lubricant is not added after assembly.*

Idler wheel - Exploded view

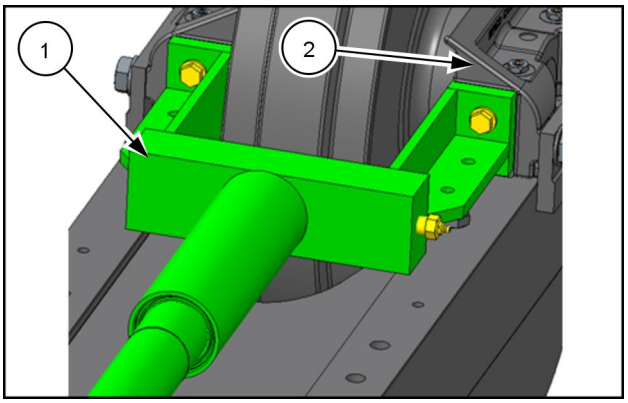
650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA



B9402090A 1

(1) IDLER WHEEL	**(5)** SHAFT	**(9)** RUBBER RING
(2) PLUG	**(6)** O-RING	**(10)** IDLER BRACKET
(3) SMALL ROLL PIN	**(7)** BUSHING	
(4) LARGE ROLL PIN	**(8)** METAL RING	

25. Install the tack adjuster yoke **(1)** and position it to the idler wheel assembly **(2)**.

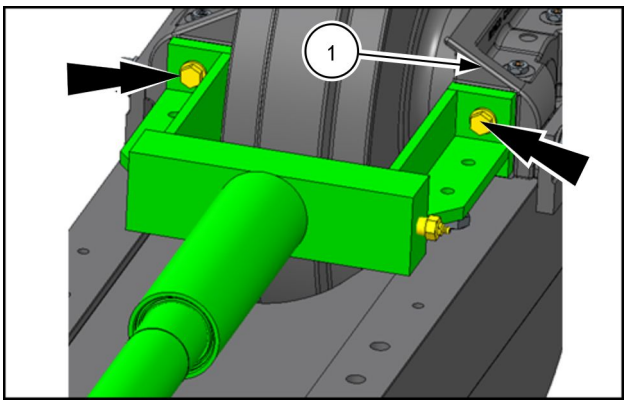


RAIL16DOZ0178AA 19

26. Put **LOCTITE® 242®** on the threads in the holes of the idler wheel assembly brackets **(1)**.

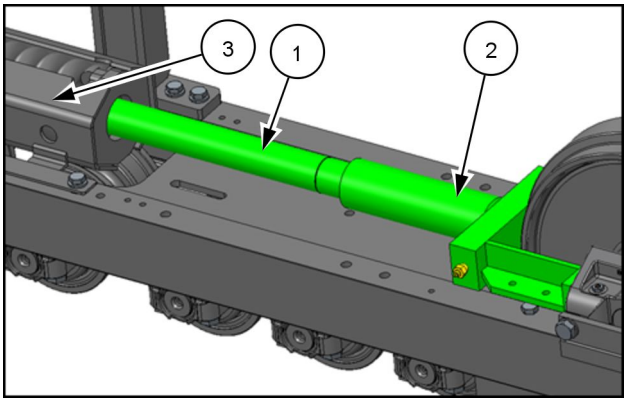
NOTE: *If new bolts are used for assemble, do not apply* ***LOCTITE® 242®****.*

NOTE: *The threaded hole and all fasteners should be clean and dry before application of* ***LOCTITE® 242®*** *and assembly.*



RAIL16DOZ0178AA 20

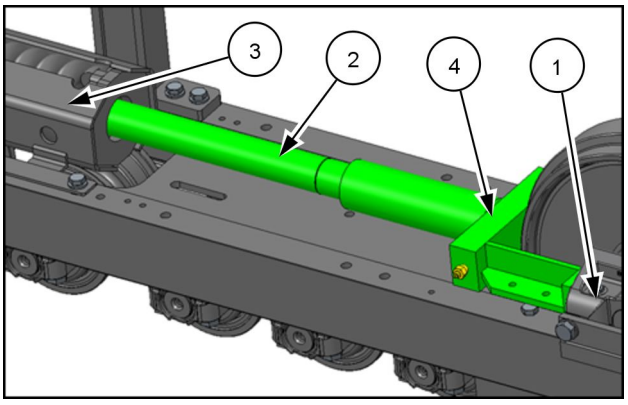
27. Install the recoil tube **(1)** between the tensioner **(2)** and the recoil spring housing **(3)**.



RAIL16DOZ0177AA 21

28. Slide the idler assembly **(1)** all the way back so the recoil tube **(2)** is firmly supported by the recoil housing **(3)** and tensioner **(4)**.

NOTE: *If the recoil housing is equipped with a counter bore for the recoil tube, ensure that the recoil tube is correctly positioned in the counter bore.*



RAIL16DOZ0177AA 22

29. When the idler is in the correct position, assemble the track according to the instructions in **Track chain - Install (48.100)**.

Track roller support - Torque

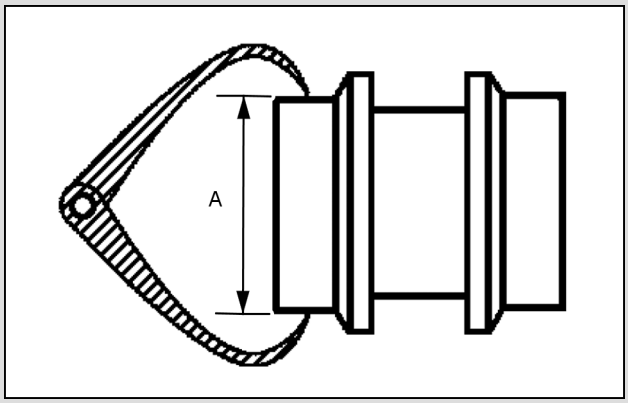
650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Track carrier roller mounting bolts to support bracket	**166 – 224 N·m** (**122 – 165 lb ft**)

Track roller support - Dimension

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

SALT HD and Max-Life Track carrier roller wear table



RAIL16DOZ0183AA 1

Caliper measurement (A)	Percent worn
149.00 mm (**5.87 in**)	New
148.00 mm (**5.83 in**)	**10%**
147.00 mm (**5.79 in**)	**20%**
146.00 mm (**5.75 in**)	**30%**
145.00 mm (**5.71 in**)	**40%**
143.90 mm (**5.67 in**)	**50%**
142.80 mm (**5.62 in**)	**60%**
141.70 mm (**5.58 in**)	**70%**
140.50 mm (**5.53 in**)	**80%**
139.40 mm (**5.49 in**)	**90%**
138.20 mm (**5.44 in**)	**100%***
136.40 mm (**5.37 in**)	**110%**
134.50 mm (**5.30 in**)	**120%**
* It is recommended the track carrier roller be replaced if the wear measurement exceeds this point.	

Track roller Lower roller - Install

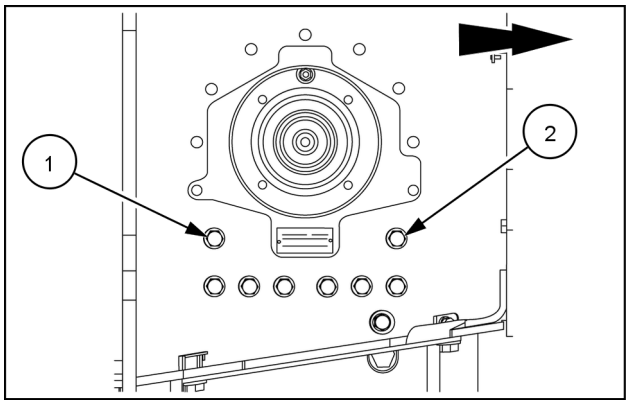
650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

1. Use **LOCTITE® 242®** on threads of cap screws, install the track roller and the cap screws.
2. Tighten the cap screws to **386 – 434 N·m** (**285 – 320 lb ft**).
3. Use **LOCTITE® 242®** on threads of cap screws, install the track guides and the cap screws and hardened washers.
4. Install the spacers, bolts and hardened washers, and hardened washers and self-locking nuts that hold the track guides.
5. Tighten the cap screws and the self-locking nuts that hold the track guides.
6. Remove the supports that hold the machine and lower the track rollers onto the track.

Next operation:
Adjust the track deflection, refer to **Track chain - Tighten - Tension adjust (48.100)**.

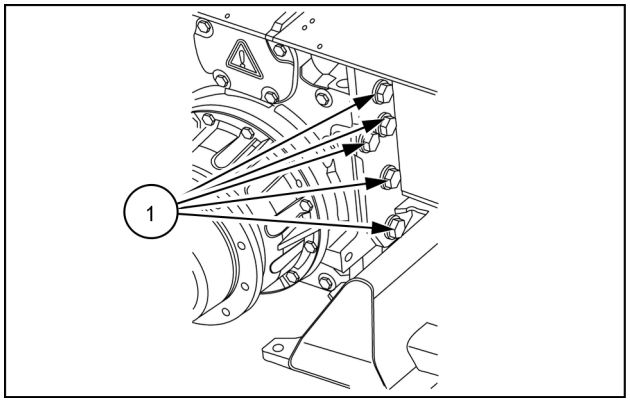
11. Tighten only bolts **(1)** and **(2)** located inside the chassis rear cover to a torque of **40 N·m** (**30 lb ft**).

NOTE: *Do not tighten any other bolts during this step. The arrow points towards the rear of the machine.*



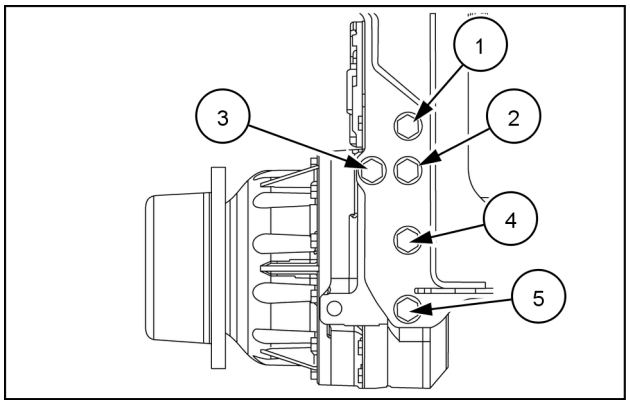
RAIL17DOZ0242AA 8

12. Install the five front final drive unit mounting bolts **(1)**.



RAIL17DOZ0243AA 9

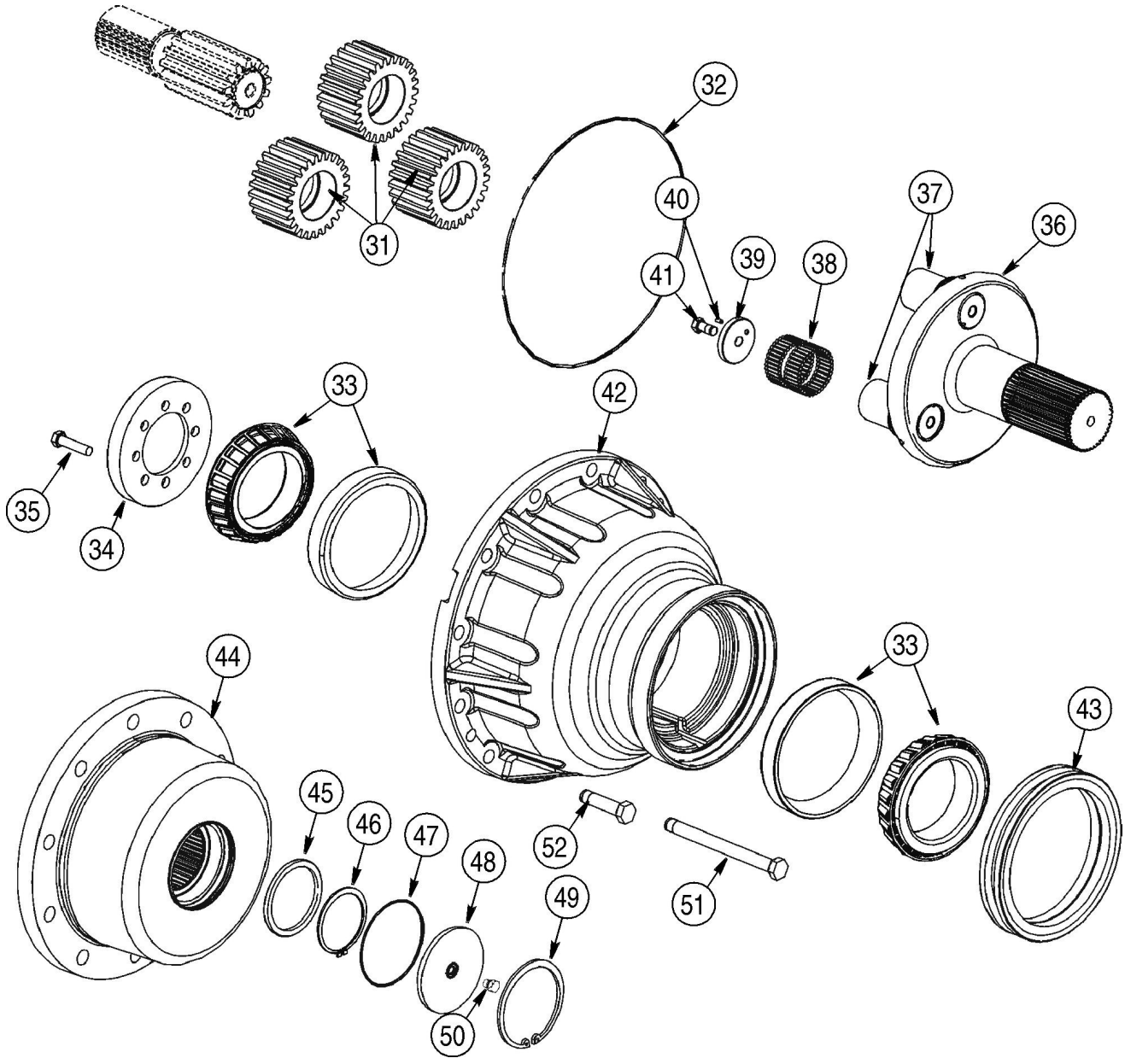
13. Tighten the five front mounting bolts to a torque of **135 N·m** (**100 lb ft**) in the numbered sequence shown.



RAIL17DOZ0244AA 10

Planetary final drive unit - Assemble - Planetary drive

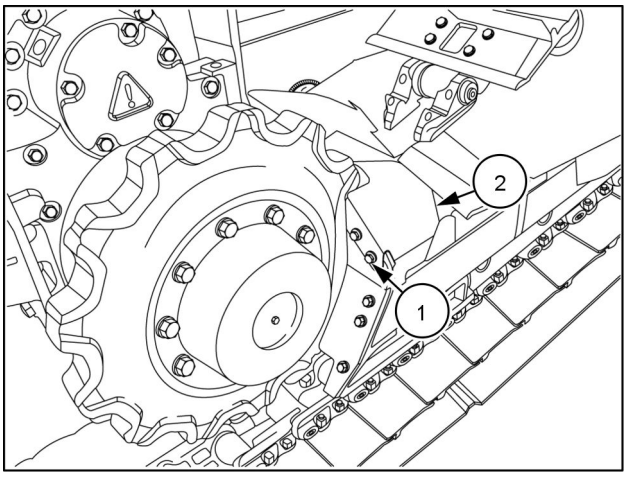
650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA



BC02J005 1

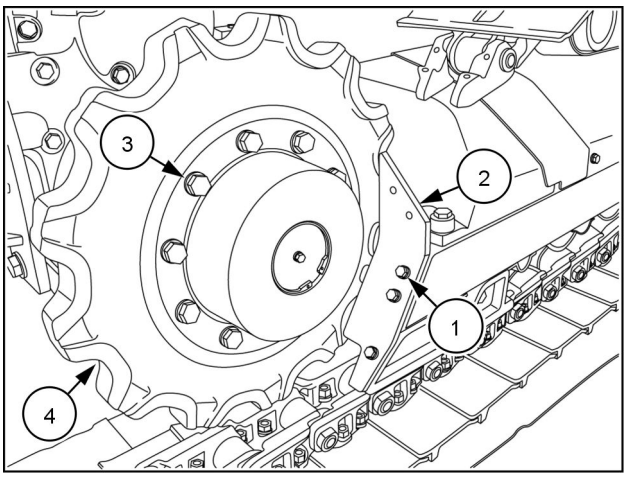
31. Planetary gears (3)	42. Wheel hub housing
32. O-ring wheel hub	43. Two piece face seal
33. Wheel hub bearings	44. Wheel hub
34. Bearing retainer plate	45. Spacer washer
35. Bearing retainer plate bolts (8)	46. External retaining ring
36. Planetary hub	47. O-ring
37. Planet gear pins	48. Wheel hub end plate
38. Bearing 66 per gear	49. Internal retaining ring
39. Pin washer (3)	50. Wheel end plate puller plug
40. Dowel pins (3)	51. Locking bolts (6)
41. Locking bolts (3)	52. Locking bolts (6)

14. Remove four bolts **(1)** and remove track frame cover **(2)**.



RAIL13DOZ0299BA 6

15. Remove three bolts **(1)** and remove rock guard **(2)**.



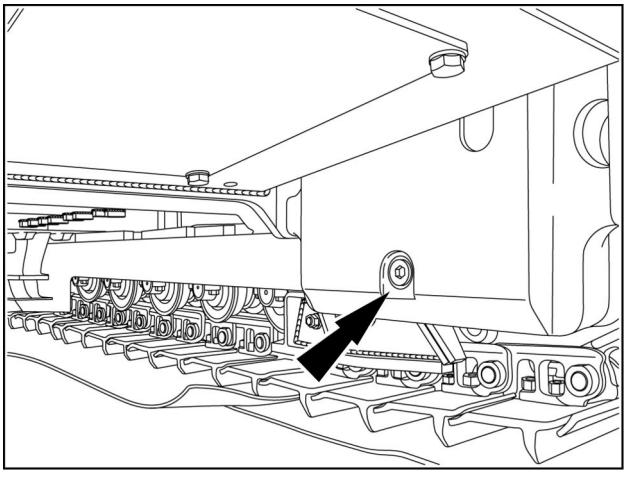
RAIL13DOZ0506AA 7

NOTICE: *Drive sprocket weighs approximately* ***91 kg*** *(****200 lb****). Use proper lifting equipment to prevent personal injury or property damage.*

16. Attach an appropriate lifting device to drive sprocket.
17. Remove 10 mounting bolts **(3)** from drive sprocket **(4)** and remove drive sprocket and shims, noting quantity and location of shims for installation.

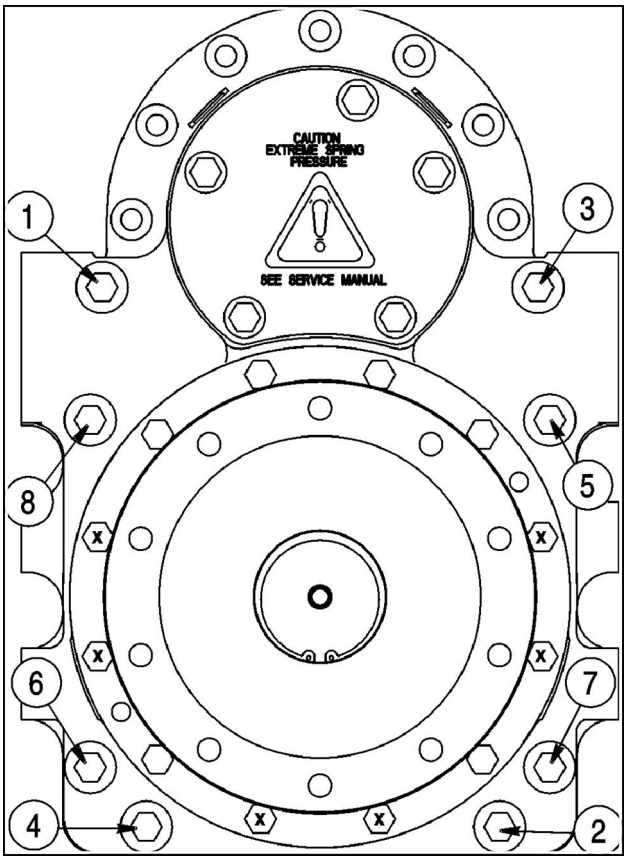
NOTICE: *Dropbox and final drive assembly oil capacity is approximately* ***11 l*** *(****3 US gal****).*

18. Remove drain plug from dropbox and drain dropbox. Install drain plug when dropbox has completed draining.



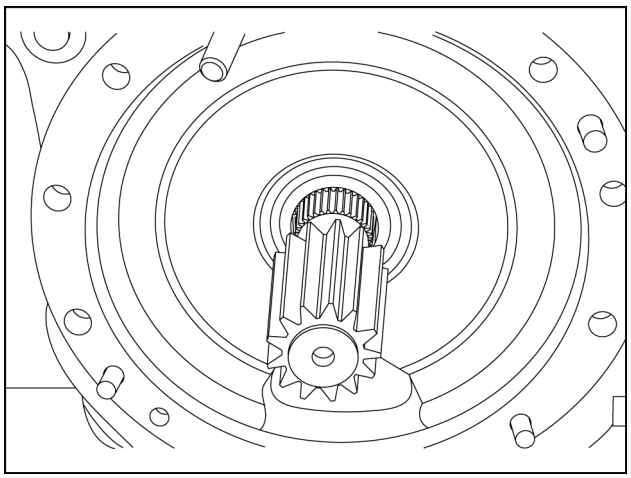
RAIL13DOZ0514AA 8

6. Using the torque pattern, torque the eight bolts **(29)** to **196 – 250 Nm** (**145 – 184 lb ft**).



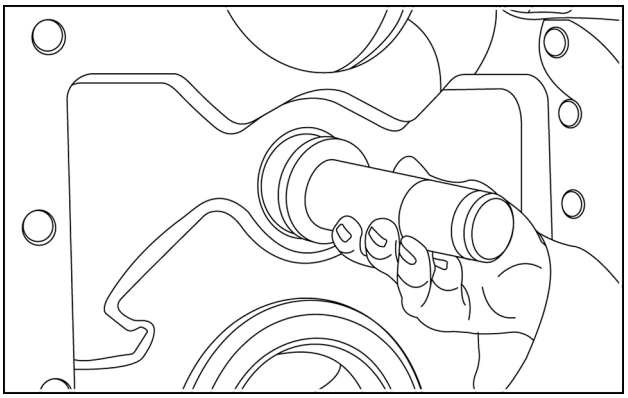
BC02M145 4

7. Turn off and disconnect the vacuum pump, replace the vent in the hydraulic reservoir.
8. Install the sun shaft **(15)** into the lower gear **(14)**.



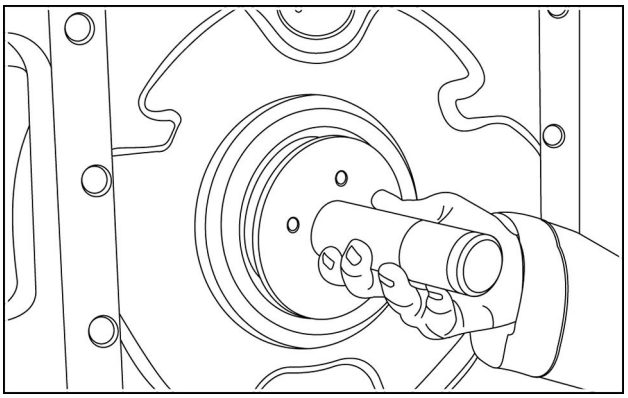
RAIL15DOZ0181AA 5

4. Use counter shaft bearing tool 380000846 with driver handle 380000847 to install the bearing cup for the counter shaft gear in the sandwich housing.



RCPH09CWL221AAD 4

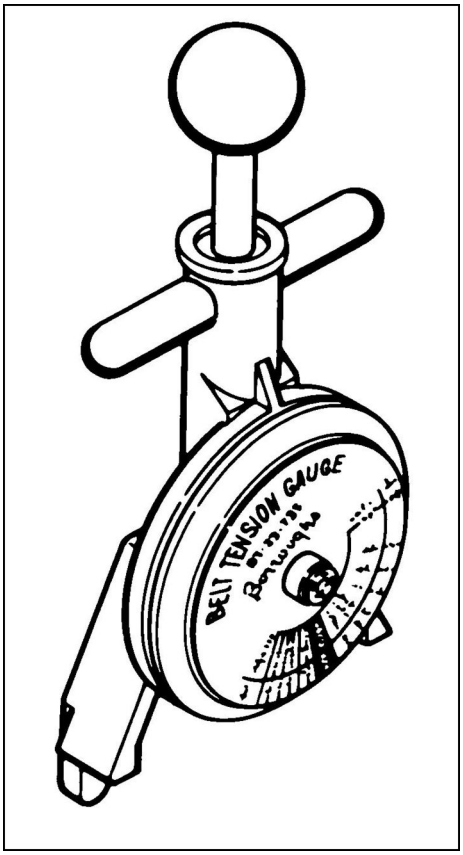
5. Use lower gear bearing tool 380001452 with driver handle 380000847 to install the bearing cup for the lower gear in the sandwich housing.



RCPH09CWL222AAD 5

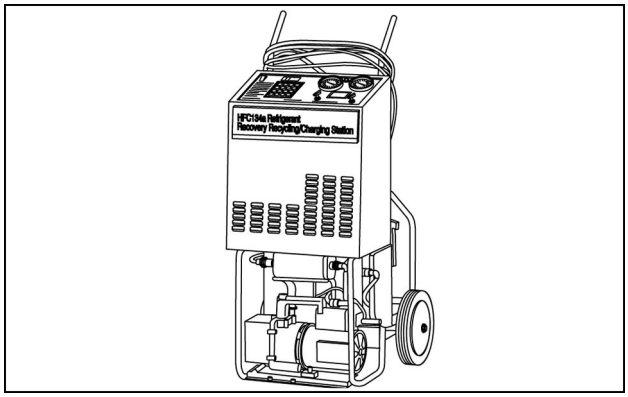
Air conditioning - Special tools

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA



299L7C 1

380001325 Belt tension tool



RCPH09CWL295AAD 2

Recovery and recharge portable system for discharging and recovery of the refrigerant.

Air conditioning - Charging

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

⚠ 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

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

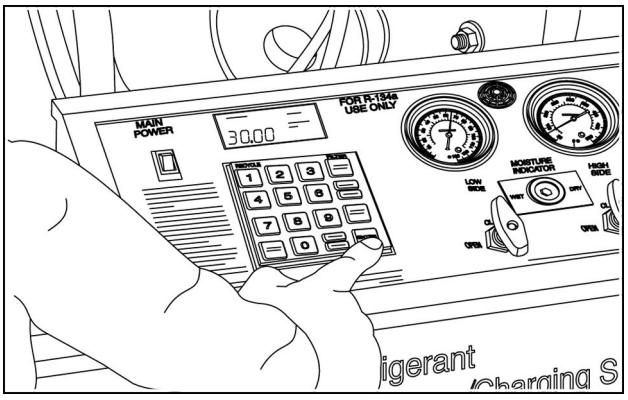
⚠ WARNING

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

Prior operation:
Air conditioning - Discharging (50.200)

1. Press the charge key to begin refrigerant charging. Automatic and Charge will appear on the display. The display shows the programmed amount and counts down to zero as charging proceeds. When charging is completed, the display shows CPL.



RCPH09CWL292AAD 1

Compressor drive belt - Check

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

⚠ WARNING

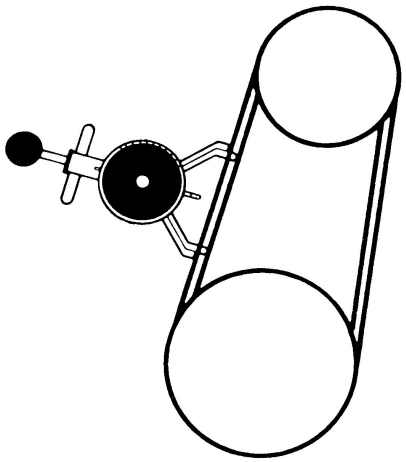
Rotating parts!
Stop the engine before you inspect and/or adjust the compressor belt. You could be injured by the rotating cooling fan or by the rotating fan belts.
Failure to comply could result in death or serious injury.

W1363A

1. Check interval every 250 hours of operation.

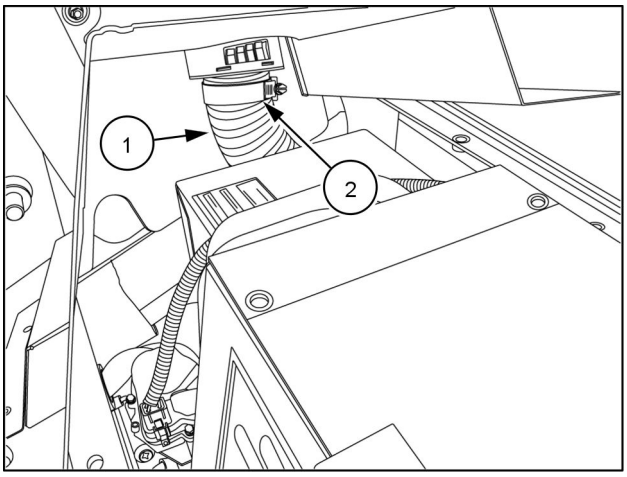
NOTE: *Check the belt tension after the first 50 hours of operation and then use the regular check interval.*

2. Measure the compressor belt for correct tension using a belt tension gauge **380001325**. Check the belt to the following specifications. A new belt **578 – 667 N** (**130 – 150 lb**). Used belt **356 – 534 N** (**80 – 120 lb**).



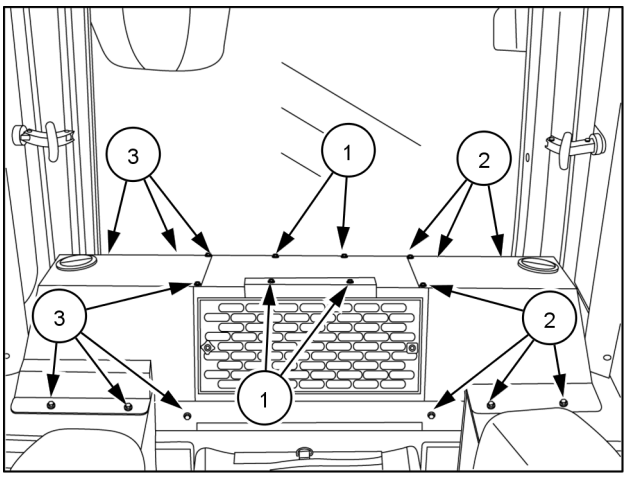
542L95 1

12. Connect right air duct **(1)** to console with hose clamp **(2)**.



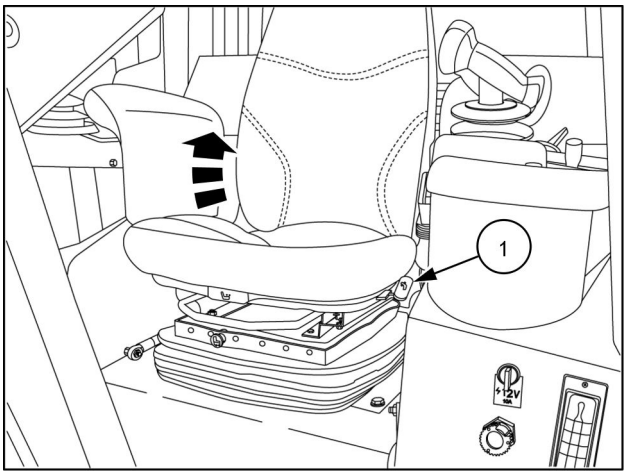
RAIL12DOZ0935BA 4

13. Install four screws **(1)** to top of center console.
14. Install seven left console screws **(2)**.
15. Install seven right console screws **(3)**.



RAIL12DOZ0934BA 5

16. Unlock seat back using lever **(1)** and raise seat back to the upright position.

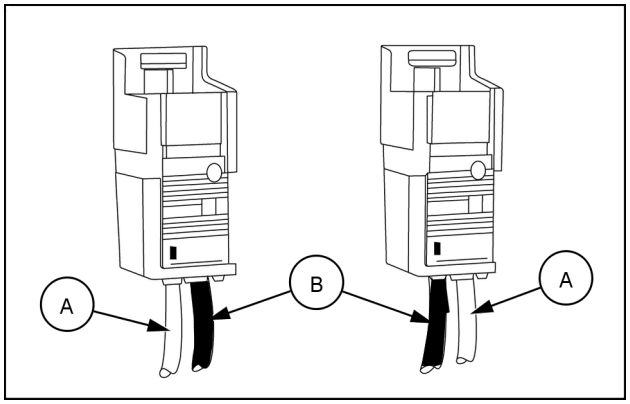


RAIL12DOZ0933BA 6

17. Check engine coolant fluid level and fill as necessary.
18. Charge air conditioning system.

Cross connection

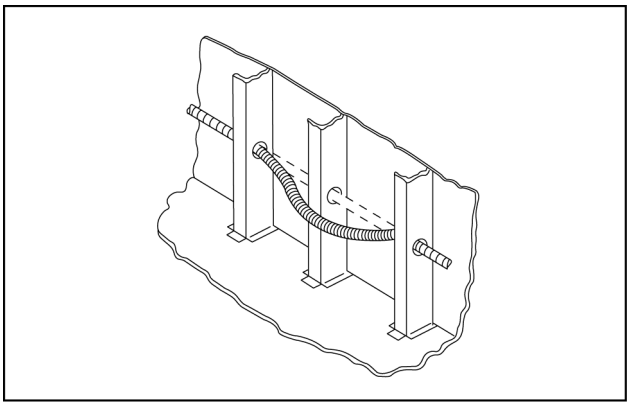
- Terminals that are connected in the wrong cavity will result in system malfunction.



RAIL14SSL0604AA 18

Incorrect routing

- A wiring harness not routed properly can lead to problems.



RAIL14SSL0607AA 19

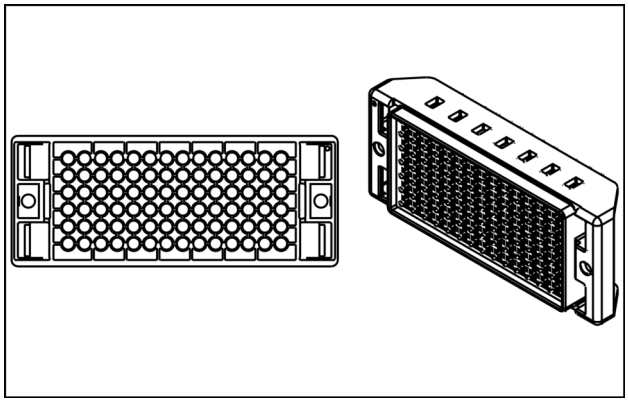
Electrical system - Overview - Component location

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Item #	Description
1	Master disconnect
2	Batteries
3	Electronic Control Unit (ECU) – Telematics
4	Blade level control switch – Leica, Topcon, Trimble
5	Glow plug control – Cold start
6	Antenna – Telematics
7	Blade level quick connect – Leica, Topcon, Trimble
8	Alternator
9	Starter
10	Controller – Trimble power
11	Module – Leica junction box
12	Controller – Trimble valve
13	CAN Terminator – Trimble

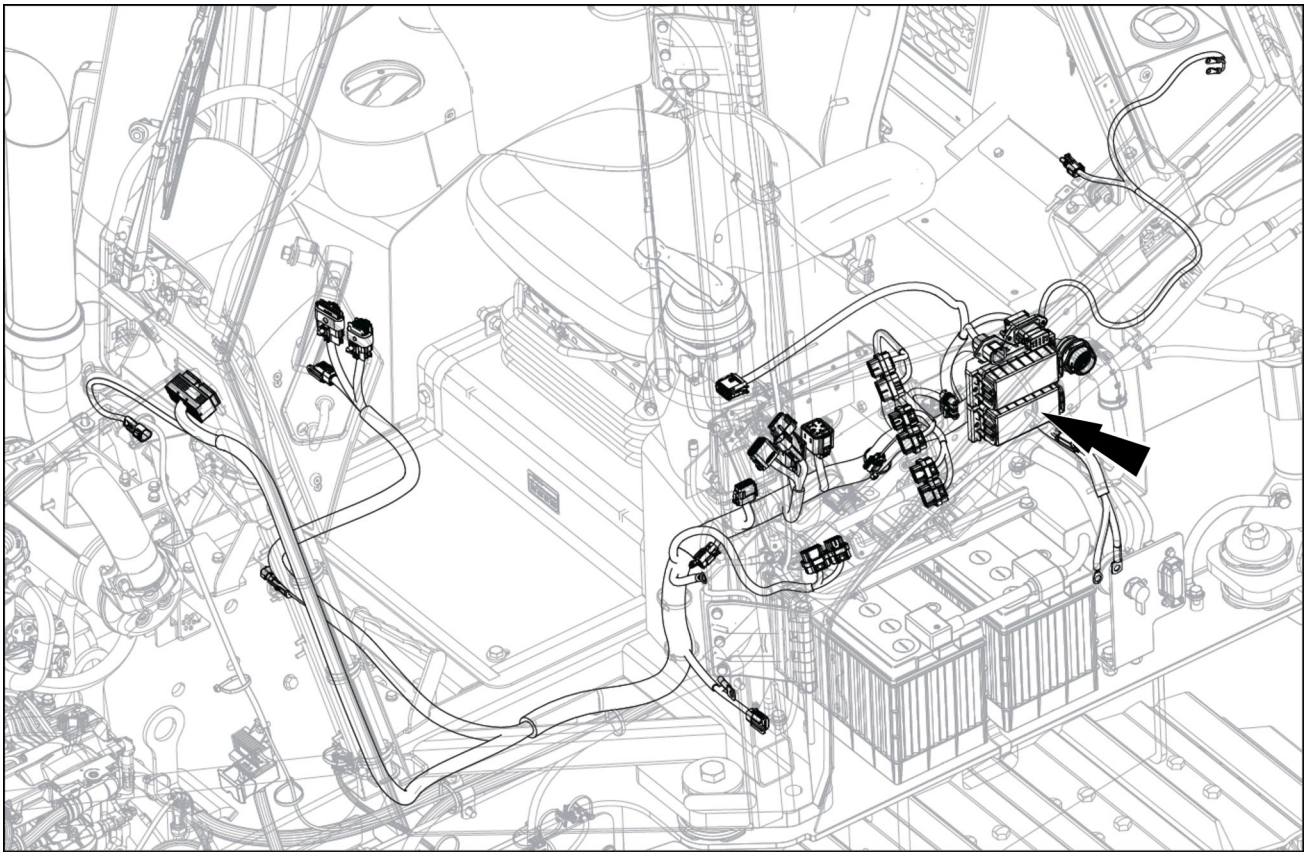
Pin	From	Wire	Description	Color-Size	Frame
83	SPLICE SP-S01	S002	K-002 ACCESSORIES RELAY	OR - 2.0	**SHEET 12 SH12 - EXTERIOR LIGHTS**
84	SPLICE SP-S03	S003	BATTERY SUPPLY FROM FUSE F-003	OR - 2.0	**SHEET 12 SH12 - EXTERIOR LIGHTS**

X-004 - FUSES AND RELAYS BLOCK [SH15: D-6] (47944422) (Receptacle)



47944422 11

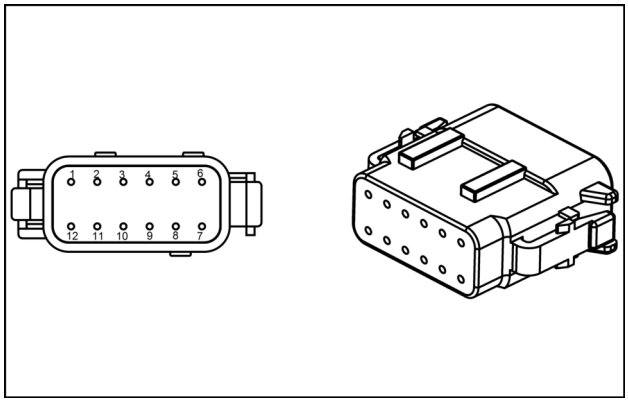
47944422



RAIL18DOZ0032FA 12

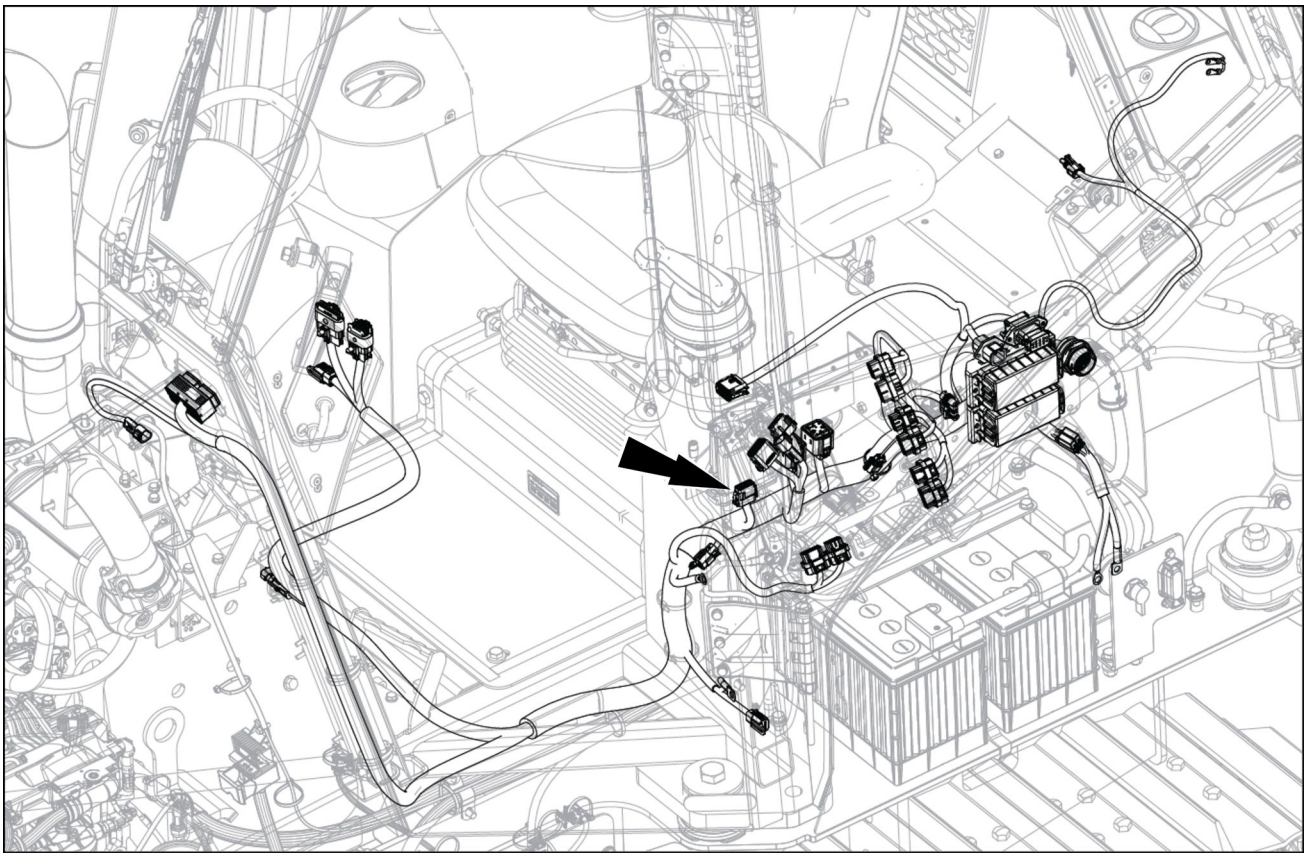
Pin	From	Wire	Description	Color-Size	Frame
1	**X-004 (Receptacle) pin 84**	S012	BATTERY SUPPLY FROM FUSE F-027	OR - 2.0	**SHEET 12 SH12 - EXTERIOR LIGHTS**
2	–	–	–	–	
3	SPLICE SP-313	3015	FRONT LIGHTS SWITCH	YE - 1.0	**SHEET 12 SH12 - EXTERIOR LIGHTS**
4	**X-004 (Receptacle) pin 54**	P058	BATTERY SUPPLY FROM FUSE F-042	RD - 3.0	**SHEET 03 SH03 - STARTING SYSTEM**
5	–	–	–	–	
6	SPLICE SP-C04	C041	STARTER INTERLOCK	OR - 0.75	**SHEET 03 SH03 - STARTING SYSTEM**
7	SPLICE SP-G33	G315	GROUND	BK - 1.0	**SHEET 12 SH12 - EXTERIOR LIGHTS**
8	–	–	–	–	

X-011 - TELEMATICS [SH21: B-1] (87700156) (Receptacle)



87700156 3

87700156



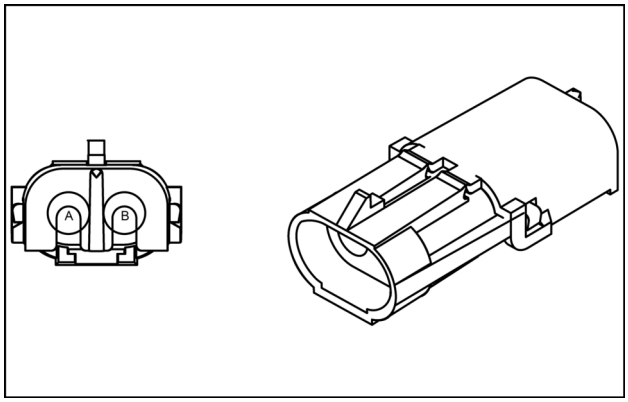
RAIL18DOZ0032FA 4

Pin	From	Wire	Description	Color-Size	Frame
1	SP-G31-P-X	G305	TELEMATICS GROUND	BK - 0.75	**SHEET 02 SH02 - POWER DISTRIBUTION/ CHARGING SYSTEM**
2	**X-004 pin 70** - FUSES AND RELAYS BLOCK [SH15: D-6] (47944422)	S092	IGNITION ON	OR - 0.75	**SHEET 21 SH21 - TELEMATICS**
3	SP-E43-P-X	E244	CAN 1 HI	YE - 0.75	**SHEET 23 SH23 - CAN BUS SYSTEM**
4	SP-E53-P-X	E254	CAN 1 LO	GN - 0.75	
6	**X-006 pin 3** - TELEMATICS DIAGNOSTICS CONNECTOR (47953198)	6501	RS-232-TX	GY - 0.75	**SHEET 21 SH21 - TELEMATICS**
7	**X-006 pin 2** - TELEMATICS DIAGNOSTICS CONNECTOR (47953198)	6502	RS-232 RX	BR - 0.75	
8	SP-213-P-X	2135	ALTERNATOR D+	BL - 0.75	
12	**X-034 (Receptacle) pin 2** - TELEMATICS UNSWITCHED B+ FUSE [SH21: B-6] (47620052)	P004	UNSWITCHED B+	RD - 0.75	

X-023B - SEAT (47953236)

Pin	From	Wire	Description	Color-Size	Frame
1			BATTERY SUPPLY FROM FUSE F-040	OR - 1.5	**SHEET 22 SH22 - VEHICLE SAFETY/AIR SEAT/ROPS HEAT**
2			BATTERY SUPPLY FROM FUSE F-040		**SHEET 22 SH22 - VEHICLE SAFETY/AIR SEAT/ROPS HEAT**
3			GROUND		**SHEET 22 SH22 - VEHICLE SAFETY/AIR SEAT/ROPS HEAT**
4			GROUND		**SHEET 22 SH22 - VEHICLE SAFETY/AIR SEAT/ROPS HEAT**
5			BATTERY SUPPLY TO THE SEAT SWITCH		**SHEET 22 SH22 - VEHICLE SAFETY/AIR SEAT/ROPS HEAT**
6			OUTPUT FROM THE SEAT SWITCH		**SHEET 22 SH22 - VEHICLE SAFETY/AIR SEAT/ROPS HEAT**
7	–	–	–	–	
8	–	–	–	–	
9	–	–	–	–	
10	–	–	–	–	
11	–	–	–	–	
12	–	–	–	–	

X-025 - CANOPY HEAT [M-008] (87692877) (Plug)



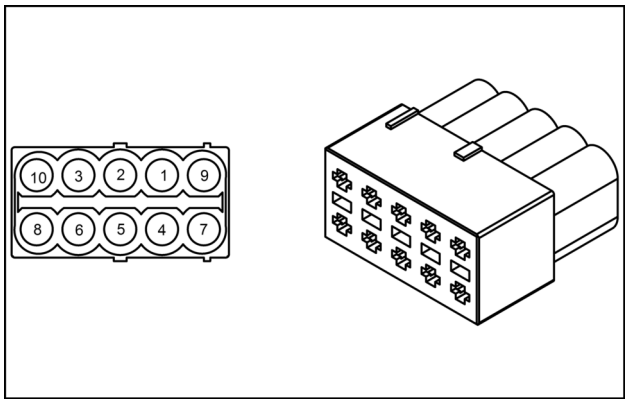
87692877 7

87692877

Wire connectors - Component diagram 05 Connectors X-050 to X-059

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

X-050 - FRONT HEADLIGHTS [S-004] (84159859) (Receptacle)

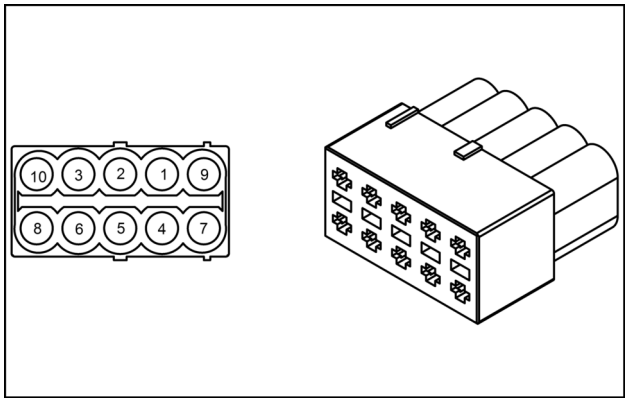


84159859 1

84159859

Pin	From	Wire	Description	Color-Size	Frame
2	**X-002B (Plug) pin 4** - TO MAIN HARNESS (84370155)	S006	FRONT HEADLAMPS SWITCHED B+	OR - 1.0	**SHEET 12 SH12 - EXTERIOR LIGHTS**
3	SP-301-P-X	3010	FRONT LIGHTS RELAY COIL SIGNAL	VT - 1.0	

X-051 - REAR LIGHTS [S-005] (84159859) (Receptacle)

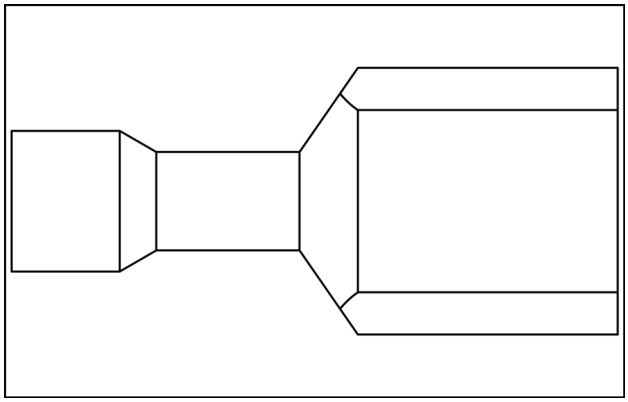


84159859 2

84159859

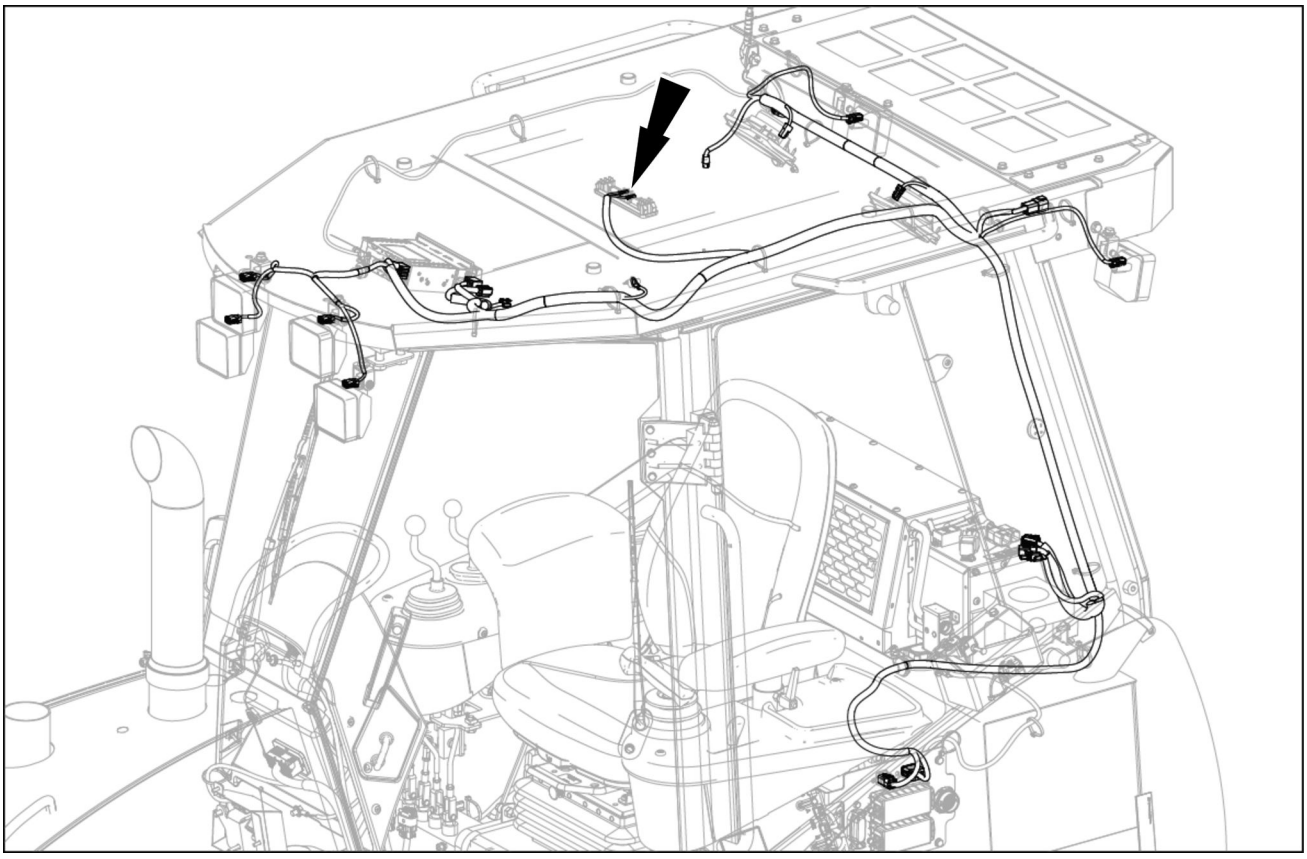
Pin	From	Wire	Description	Color-Size	Frame
2	**X-002B (Plug) pin 6** - TO MAIN HARNESS (84370155)	S015	REAR LIGHTS SW SWITCHED B+	OR - 2.0	**SHEET 12 SH12 - EXTERIOR LIGHTS**
3	SP-320-P-X	3020	REAR LIGHTS SWITCHED B+	VT - 2.0	

X-071 - DOME LIGHT GROUND [E-007] (87697629) (Plug)



87697629 3

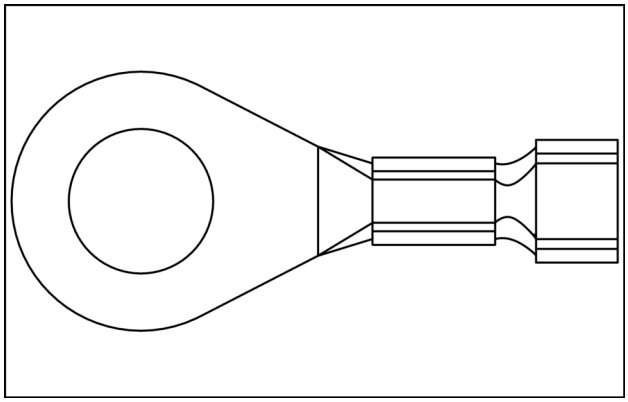
87697629



RAIL18DOZ0034FA 4

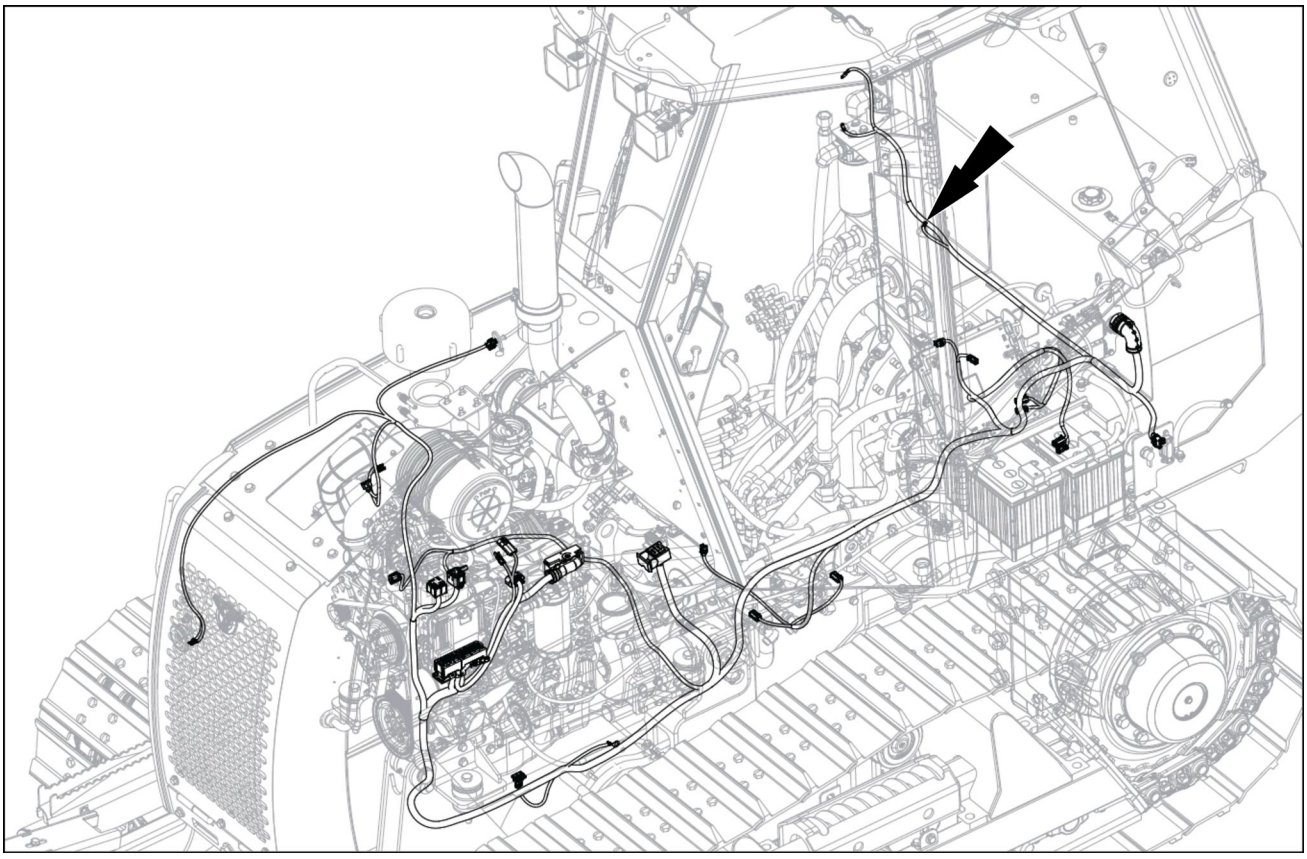
Pin	From	Wire	Description	Color-Size	Frame
1	SP-G50-P-X	G510	DOME LIGHT GROUND	BK - 0.75	**SHEET 04 SH04 - GROUNDING**

X-108 - TRANSMISSION TEMPERATURE SENSOR [B-008] (84352277) (Plug)



84352277 11

84352277

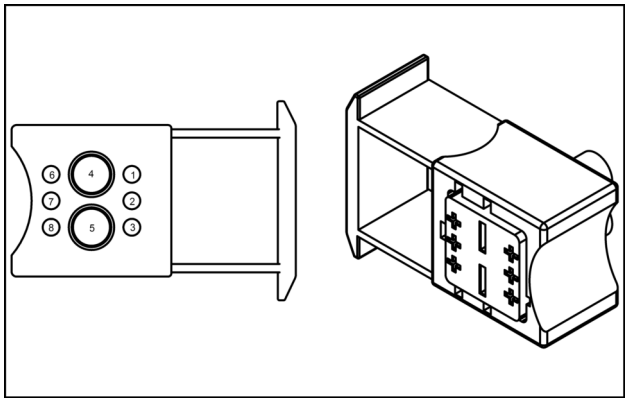


RAIL18DOZ0033FA 12

Pin	From	Wire	Description	Color-Size	Frame
1	**X-001A pin 32** - TO MAIN CAB HARNESS (47696620)	1052	HYD OIL TEMP SIGNAL	YE - 0.75	**SHEET 15 SH15 - INSTRUMENT CLUSTER**

Pin	From	Wire	Description	Color-Size	Frame
24	**X-001A pin 25** - TO MAIN CAB HARNESS (47696620)	E240	CAN 1 HI	YE - 0.75	**SHEET 06 SH06 - ENGINE CONTROL**
25	**X-001A pin 40** - TO MAIN CAB HARNESS (47696620)	E250	CAN 1 LO	GN - 0.75	
27	**X-001A pin 28** - TO MAIN CAB HARNESS (47696620)	E270	STARTER RELAY COIL SIGNAL	YE - 0.75	**SHEET 03 SH03 - STARTING SYSTEM**
28	**X-218 (Receptacle) pin 1** - MAIN RELAY [K-101] (84297431)	E280	ECU RELAY COIL SIGNAL	BL - 0.75	**SHEET 05 SH05 - ENGINE CONTROL**
30	**X-211 (Receptacle) pin 1** - WATER IN FUEL SENSOR [B-004] (87709663)	E300	WATER IN FUEL LEVEL SENSOR SIGNAL	YE - 0.75	
41	SP-410-P-X	E410	GLOW PLUG UNIT GROUND	BK - 0.75	
52	**X-213 (Receptacle) pin 8** - GCU [A-006] (84356962)	E520	GCU CTRL LINE	YE - 0.75	
53	**X-001A pin 27** - TO MAIN CAB HARNESS (47696620)	E530	STARTER RELAY COIL SIGNAL	YE - 0.75	**SHEET 03 SH03 - STARTING SYSTEM**
54	SP-S23-P-X	S233	SWITCHED B+	OR - 0.75	**SHEET 05 SH05 - ENGINE CONTROL**
68	**X-001A pin 29** - TO MAIN CAB HARNESS (47696620)	E680	K LINE	YE - 0.75	**SHEET 06 SH06 - ENGINE CONTROL**
79	**X-206 (Receptacle) pin 2** - GAS TEMPERATURE SENSOR [B-005] (84532147)	E790	EXHAUST GAS TEMP SENSOR 1 GROUND	BK/WH - 0.75	**SHEET 05 SH05 - ENGINE CONTROL**
80	**X-206 (Receptacle) pin 1** - GAS TEMPERATURE SENSOR [B-005] (84532147)	E800	EXHAUST GAS TEMP SENSOR 1 SIGNAL	YE - 0.75	
81	**X-217 (Receptacle) pin 25** - ENGINE INTERFACE [SH5: C-6] (84154706)	E810	INLET TURBINE TEMP GND	BK/WH - 0.75	
82	**X-217 (Receptacle) pin 26** - ENGINE INTERFACE [SH5: C-6] (84154706)	E820	INLET TURBINE TEMP SIGNAL	YE - 0.75	

X-213 - GCU [A-006] (84356962) (Receptacle)



84356962 5

84356962

Wire connectors - Component identification - Chassis and Engine Harness

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Connector Number	Connector Name	Schematic Frame
X-001A	TO MAIN CAB HARNESS	**Wiring harnesses - Electrical schematic sheet 02 SH02 - POWER DISTRIBUTION/CHARGING SYSTEM (55.100)** **Wiring harnesses - Electrical schematic sheet 03 SH03 - STARTING SYSTEM (55.100)** **Wiring harnesses - Electrical schematic sheet 05 SH05 - ENGINE CONTROL (55.100)** **Wiring harnesses - Electrical schematic sheet 07 SH07 - PARK BRAKE (55.100)** **Wiring harnesses - Electrical schematic sheet 15 SH15 - INSTRUMENT CLUSTER (55.100)** **Wiring harnesses - Electrical schematic sheet 17 SH17 - HVAC (55.100)** **Wiring harnesses - Electrical schematic sheet 20 SH20 - DRIVE TRAIN/PUMPS (55.100)** **Wiring harnesses - Electrical schematic sheet 23 SH23 - CAN BUS SYSTEM (55.100)** **Wiring harnesses - Electrical schematic sheet 24 SH24 - HORN/BACKUP ALARM (55.100)**
X-056	AIR FILTER RESTRICTION	**Wiring harnesses - Electrical schematic sheet 15 SH15 - INSTRUMENT CLUSTER (55.100)**
X-057	AIR FILTER RESTRICTION	**Wiring harnesses - Electrical schematic sheet 15 SH15 - INSTRUMENT CLUSTER (55.100)**
X-085	FUSES	**Wiring harnesses - Electrical schematic sheet 15 SH15 - INSTRUMENT CLUSTER (55.100)**
X-102	TRANSMISSION OIL FILTER RESTRICTION SWITCH	**Wiring harnesses - Electrical schematic sheet 15 SH15 - INSTRUMENT CLUSTER (55.100)**
X-103	HYDRAULIC OIL FILTER RESTRICTION SWITCH	**Wiring harnesses - Electrical schematic sheet 15 SH15 - INSTRUMENT CLUSTER (55.100)**
X-105	BRAKE PRESSURE SWITCH	**Wiring harnesses - Electrical schematic sheet 07 SH07 - PARK BRAKE (55.100)**
X-106	CHARGE PRESSURE SWITCH	**Wiring harnesses - Electrical schematic sheet 15 SH15 - INSTRUMENT CLUSTER (55.100)**
X-107	BRAKE SOLENOID	**Wiring harnesses - Electrical schematic sheet 07 SH07 - PARK BRAKE (55.100)**
X-108	TRANSMISSION OIL TEMPERATURE	**Wiring harnesses - Electrical schematic sheet 15 SH15 - INSTRUMENT CLUSTER (55.100)**
X-110	ALTERNATOR	**Wiring harnesses - Electrical schematic sheet 02 SH02 - POWER DISTRIBUTION/CHARGING SYSTEM (55.100)**
X-111	AIR CONDITIONER CLUTCH	**Wiring harnesses - Electrical schematic sheet 17 SH17 - HVAC (55.100)**
X-112	AIR CONDITIONER HIGH PRESSURE SWITCH	**Wiring harnesses - Electrical schematic sheet 17 SH17 - HVAC (55.100)**
X-114	FRONT PUMP	**Wiring harnesses - Electrical schematic sheet 20 SH20 - DRIVE TRAIN/PUMPS (55.100)**
X-115	REAR PUMP	**Wiring harnesses - Electrical schematic sheet 20 SH20 - DRIVE TRAIN/PUMPS (55.100)**
X-128	LEFT SPEED SENSOR	**Wiring harnesses - Electrical schematic sheet 20 SH20 - DRIVE TRAIN/PUMPS (55.100)**
X-129	RIGHT SPEED SENSOR	**Wiring harnesses - Electrical schematic sheet 20 SH20 - DRIVE TRAIN/PUMPS (55.100)**
X-130	HORN	**Wiring harnesses - Electrical schematic sheet 24 SH24 - HORN/BACKUP ALARM (55.100)**
X-131	HORN	**Wiring harnesses - Electrical schematic sheet 24 SH24 - HORN/BACKUP ALARM (55.100)**
X-132	LEFT MOTOR	**Wiring harnesses - Electrical schematic sheet 20 SH20 - DRIVE TRAIN/PUMPS (55.100)**
X-133	RIGHT MOTOR	**Wiring harnesses - Electrical schematic sheet 20 SH20 - DRIVE TRAIN/PUMPS (55.100)**
X-136	STARTER SOLENOID	**Wiring harnesses - Electrical schematic sheet 03 SH03 - STARTING SYSTEM (55.100)**
X-203	AIR TEMPERATURE SENSOR	**Wiring harnesses - Electrical schematic sheet 05 SH05 - ENGINE CONTROL (55.100)**
X-206	GAS TEMPERATURE SENSOR	**Wiring harnesses - Electrical schematic sheet 05 SH05 - ENGINE CONTROL (55.100)**
X-211	WATER IN FUEL SENSOR	**Wiring harnesses - Electrical schematic sheet 05 SH05 - ENGINE CONTROL (55.100)**
X-212	ECU	**Wiring harnesses - Electrical schematic sheet 05 SH05 - ENGINE CONTROL (55.100)**
X-213	GCU	**Wiring harnesses - Electrical schematic sheet 05 SH05 - ENGINE CONTROL (55.100)**
X-215	ELECTRIC VALVE	**Wiring harnesses - Electrical schematic sheet 06 SH06 - ENGINE CONTROL (55.100)**

Wire connectors - Component identification - Splice Locations - Main Harness

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Splice Number	Wires	Schematic Frame
SP-213	2133 BL 2134 BL 2135 BL	**Wiring harnesses - Electrical schematic sheet 15 SH15 - INSTRUMENT CLUSTER (55.100)**
SP-A09	A090 PK A091 PK A092 PK A093 PK A094 PK A095 PK A096 PK A097 PK	**Wiring harnesses - Electrical schematic sheet 19 SH19 - DRIVE TRAIN (55.100)**
SP-B25	B250 GN B251 GN B252 GN	**Wiring harnesses - Electrical schematic sheet 23 SH23 - CAN BUS SYSTEM (55.100)**
SP-B34	B340 YE B341 YE B2342 YE	**Wiring harnesses - Electrical schematic sheet 23 SH23 - CAN BUS SYSTEM (55.100)**
SP-C26	C260 BL C261 BL C262 BL C264 BL C265 BL	**Wiring harnesses - Electrical schematic sheet 19 SH19 - DRIVE TRAIN (55.100)**
SP-E43	E243 YL E244 YE E245 YE	**Wiring harnesses - Electrical schematic sheet 23 SH23 - CAN BUS SYSTEM (55.100)**
SP-E53	E253 GN E254 GN E255 GN	**Wiring harnesses - Electrical schematic sheet 23 SH23 - CAN BUS SYSTEM (55.100)**
SP-G38	G346 BK G347 BK G348 BL G349 BK G354 BK	**Wiring harnesses - Electrical schematic sheet 04 SH04 - GROUNDING (55.100)**
SP-G64	G640 BK G641 BK G642 BK G643 BK	**Wiring harnesses - Electrical schematic sheet 09 SH09 - UCM (55.100)**
SP-N20	N200 BL N201 BL N203 BL N204 BL N205 BL	**Wiring harnesses - Electrical schematic sheet 19 SH19 - DRIVE TRAIN (55.100)**
SP-P15	P015 RD P016 RD P017 RD P018 RD	**Wiring harnesses - Electrical schematic sheet 02 SH02 - POWER DISTRIBUTION/CHARGING SYSTEM (55.100)**
SP-S21	S211 YE S212 YE S214 YE	**Wiring harnesses - Electrical schematic sheet 03 SH03 - STARTING SYSTEM (55.100)**
SP-S26	S226 OR S227 OR S229 OR S230 OR	**Wiring harnesses - Electrical schematic sheet 02 SH02 - POWER DISTRIBUTION/CHARGING SYSTEM (55.100)**

Wiring harnesses - Electrical schematic sheet 06 SH06 - ENGINE CONTROL

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Type	Component	Connector / Link	Description
ECU	**A-004** - ENGINE INTERFACE (ECU)	**X-217** - ENGINE INTERFACE [SH5: C-6] (84154706)	ENGINE INTERFACE
ECU	**A-010** - ELECTRIC VALVE (ECU)	**X-215** - ELECTRIC VALVE [A-010] (87698252)	ELECTRIC VALVE
ECU	**A-011** - ECU (ECU)	**X-216** - ECU [A-011] (84474053)	ECU
Connector	X-212	**X-212** - ECU [SH5: B-6] (84474047)	ECU
Connector	X-215	**X-215** - ELECTRIC VALVE [A-010] (87698252)	ELECTRIC VALVE
Connector	X-216	**X-216** - ECU [A-011] (84474053)	ECU
Connector	X-217	**X-217** - ENGINE INTERFACE [SH5: C-6] (84154706)	ENGINE INTERFACE

Wiring harnesses - Electrical schematic sheet 16 SH16- LEVELING CONTROL

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Type	Component	Connector / Link	Description
Fuse	**F-005** - LEVELING (Fuse)		LEVELING
Fuse	**F-016** - LEVELING (Fuse)		LEVELING
Connector	X-003	**X-003** - FUSES AND RELAYS BLOCK [SH9: C-6] (47944422)	FUSES AND RELAYS BLOCK
Connector	X-038	**X-038** - TO LEVELING HARNESS [SH16: C-6] (84137520)	TO LEVELING HARNESS

S-010 - TRANSM OIL FILTER RESTRICTION (Switch)

Component Type	Switch
Wiring frames	**SHEET 15 SH15 - INSTRUMENT CLUSTER**
Connectors	**X-102 (Plug)** - TRANSMISSION OIL FILTER RESTRICTION SWITCH [S-010] (84352277)

S-011 - HYDRAULIC FILTER RESTRICTION (Switch)

Component Type	Switch
Wiring frames	**SHEET 15 SH15 - INSTRUMENT CLUSTER**
Connectors	**X-103 (Plug)** - HYDRAULIC FILTER RESTRICTION SWITCH [S-011] (84352277)

S-012 - CHARGE PRESSURE (Switch)

Component Type	Switch
Wiring frames	**SHEET 15 SH15 - INSTRUMENT CLUSTER**
Connectors	**X-106 (Receptacle)** - CHARGE PRESSURE SWITCH [S-012] (87691549)

S-013 - TEMPERATURE SWITCH (Switch)

Component Type	Switch
Wiring frames	**SHEET 17 SH17 - HVAC**
Connectors	**X-074 (Receptacle)** - TEMPERATURE SWITCH [S-013] (87693797)

S-014 - A/C HIGH PRESSURE SW (Switch)

Component Type	Switch
Wiring frames	**SHEET 17 SH17 - HVAC**
Connectors	**X-112 (Plug)** - A/C HIGH PRESSURE SWITCH [S-014] (87688788)

S-015 - A/C LOW PRESSURE SW (Switch)

Component Type	Switch
Wiring frames	**SHEET 17 SH17 - HVAC**
Connectors	**X-065 (Plug)** - A/C LOW PRESSURE SWITCH [S-015] (87692855)

S-016 - MODE SWITCH (Switch)

Component Type	Switch
Wiring frames	**SHEET 17 SH17 - HVAC**
Connectors	**X-073 (Plug)** - MODE SWITCH [S-016] (47726797)

S-017 - BLOWER SWITCH (Switch)

Component Type	Switch
Wiring frames	**SHEET 17 SH17 - HVAC**
Connectors	**X-072 (Receptacle)** - BLOWER SWITCH [S-017] (87697741)

S-018 - AIR FILTER RESTRICTION (Switch)

Component Type	Switch
Wiring frames	**SHEET 15 SH15 - INSTRUMENT CLUSTER**
Connectors	**X-057 (Plug)** - AIR FILTER RESTRICTION SWITCH[S-018] (84177908) **X-056 (Plug)** - AIR FILTER RESTRICTION SWITCH [S-018] (84177908)

S-019 - SEAT SW (Switch)

Component Type	Switch
Wiring frames	**SHEET 22 SH22 - VEHICLE SAFETY/AIR SEAT/ROPS HEAT**

Alternator - Testing

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Test N°1	
Test Point	**Condition** Turn the ignition switch OFF. **Check** Verify the battery connections are tight and secure. Verify connection to the alternator are tight and secure. Check the wiring and connections for corrosion, abrasion and damage. Verify that the chassis ground frame connections for the battery and alternator are secure and tight and free of oil, paint, dirt, damage and debris.
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 and damage. Repair as required.

Test N°2	
Test Point	**Condition** Turn the ignition switch OFF. **Check** Measure the resistance between the alternator case connection and chassis ground.
Expected Result	**Result** The resistance should be less than **10 Ω**.
Other Result (Possible Cause)	**Action** The resistance is greater than **10 Ω**, there is a problem with the chassis ground connection to the alternator. Repair as required.

Test N°3	
Test Point	**Condition** Turn the ignition switch OFF. **Check** Measure the resistance between the alternator B+ terminal and the starter B+ terminal.
Expected Result	**Result** The resistance should be less than **10 Ω**.
Other Result (Possible Cause)	**Action** The resistance is greater than **10 Ω**, there is a problem with the connection between the alternator and the starter. Verify that the cable connections are secure and tight. Verify that the connections are free of corrosion, abrasion, damage and incorrect attachment. Repair as required.

Test N°4	
Test Point	**Condition** Turn the ignition switch OFF. **Check** Measure the resistance between the alternator connector X-110 pin 3 and the ignition switch connector X-045/X-002 pin 10.
Expected Result	**Result** The resistance should be between **65 Ω** and **85 Ω**.
Other Result (Possible Cause)	**Action** The resistance is greater than **85 Ω** or less than **65 Ω**, there is a problem with the connection between the alternator and the ignition switch. Verify that resistor R-001 is not damaged. Verify that the cable connections are secure and tight. Verify that the connections are free of corrosion, abrasion, damage and incorrect attachment. Repair as required.

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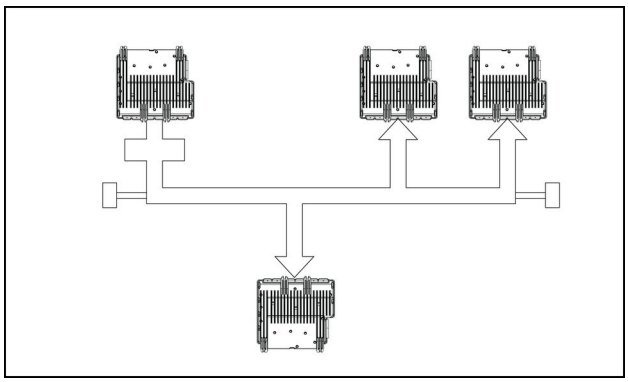
(*) See content for specific models



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If a controller has not sent any messages within five seconds, it will broadcast a message that announcing its existence. This is done in order to monitor each controller's status on the bus. If a certain controller has not transmitted any messages for more than five seconds, then the other controllers on the bus will generate an alarm message indicating that a controller is offline.

NOTE: *This offline status condition may vary from one machine type to another. Some machines may need to be configured to know that a specific controller is on the bus. However, this process of existence messages generally holds true.*

In a CAN system, controllers are positioned near the majority of their sensors and switches. For example, the Engine Control Unit (ECU) is located in the engine compartment near the engine sensors. This results in less wiring, fewer connections, and a reduction in the number of error sources.

The voltage signal from sensors and switches are processed by a controller, which converts the signal to a data message. The data message is sent to the bus by the controller. Every controller that is connected to the bus can read and process the data message as required. Each controller knows which information it needs based on the software that is programmed into it.

The terminators absorb the voltage signals at either end of the bus. They are constantly trying to maintain of voltage of **2.5 V** on the bus. Terminators prevent a signal from rebounding along the bus, clear the bus for the next signal, and allow clear messages to travel the bus.

Terminators

Terminators help eliminate the reflections that can occur when a message reaches the end of the bus. These reflections can cause interference (noise) on a CAN bus, creating communication problems between the controllers. A good way to explain how terminators work is to think about dropping a stone into a pond. After the stone hits the water, the waves travel to the edges of the pond and then rebound to the center. Terminators absorb the waves at the edges and deny the rebound of the waves to the source.

Passive terminator or active terminator

1. Passive terminators are usually **120 Ω** resistors placed at either end of the bus. Passive terminators are typically used with a two wire CAN system. These resistors are connected between the CAN HI and CAN LO wires. Passive termination is popular because it is a fraction of the cost of active terminators. Passive terminators act as snubbers to kill reflections and work efficiently on systems with lower bus loading (low CAN bus traffic).
2. Active terminators are voltage regulators, and require a external voltage supply to operate. Active terminators are typically used with a four wire CAN system. Active terminators produce **2.5 V** on the CAN HI and CAN LO wires to maintain the standard CAN wire voltage. This means they bring the wires to neutral. Active terminators are very efficient, and are typically used on systems with high bus loading (high traffic).

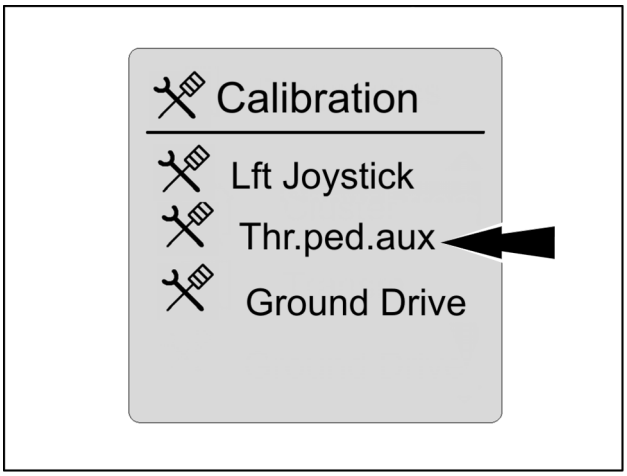
Troubleshooting

The CAN system is capable of diagnosing itself and generating an alarm messages to the operator when problems are present. The vehicle may continue to function when an alarm messages appears, but the systems related to that controller may no longer function. When troubleshooting a vehicle with suspected CAN system failure, it is important to determine if the problem is related to one or more controllers or if the bus is at fault.

CAN system problems will generally fall into two categories:

Calibrating transmission/deceleration pedal

5. Use Up and Down switch to highlight the thr.ped.aux (throttle pedal and auxiliary lever) icon from Calibration menu. Use the Enter / Confirm switch to choose the selection.



RAIL13DOZ0132AA 4

6. Use Up and Down switch to highlight the Thr.ped.aux icon from Calibration menu. Use the Enter / Confirm switch to choose the selection. Highlight selection and follow screen prompts.

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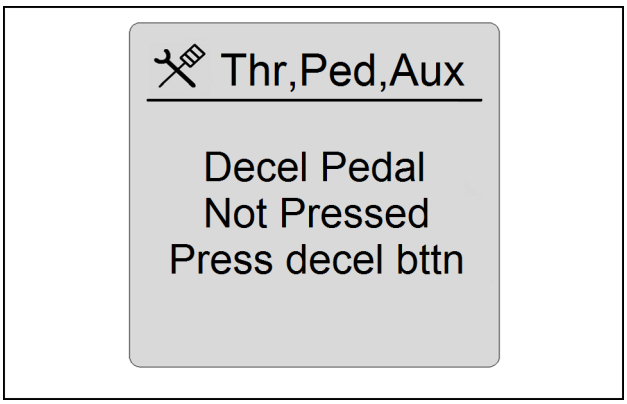
7. Keep the dual function (transmission/deceleration) pedal in the full up position. Press the decel button on the left joystick to confirm the step.



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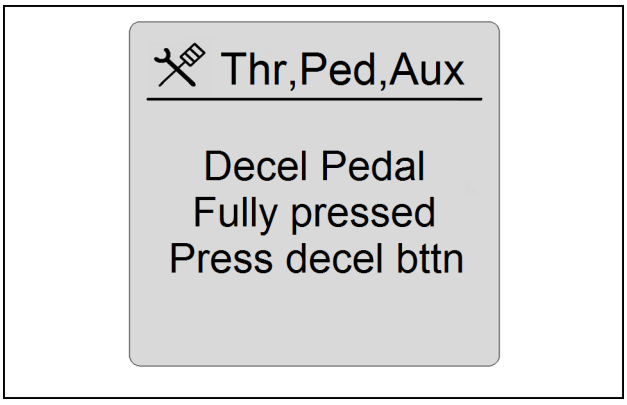
8. Press the dual function (brake/decelerator) pedal to the full down position. Press the decel button on the left joystick to confirm the step.



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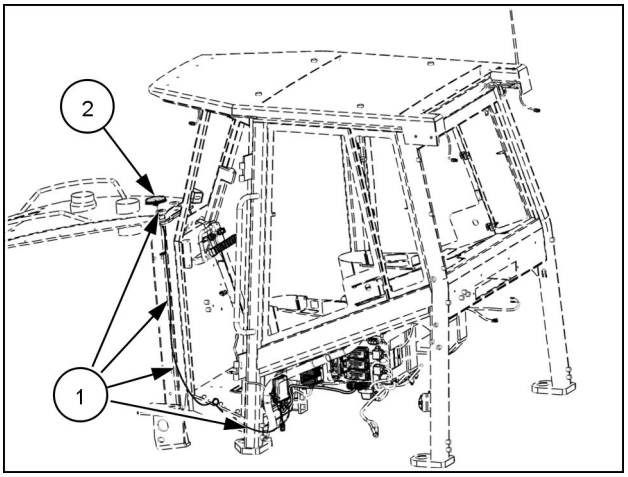
Antenna/Receiver - Install

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Prior operation:
Antenna/Receiver - Remove (55.991)

1. Wrap heat shield tubing **(1) 1000 mm** (**39 in**) in length around the portion of the antenna cables that will be routed through the engine compartment. Leave approximately **30 mm** (**1 in**) of exposed cable just below the antenna **(2)**.

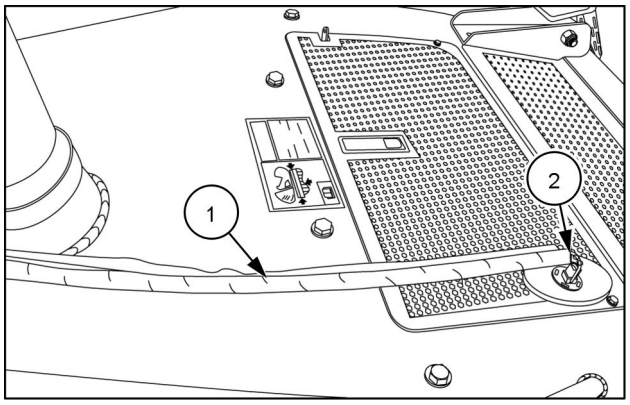


TELE3B 1

NOTE: *Heat shield tubing is slotted with a paper protected strip of adhesive along one side. Do not remove the protective paper until the tubing is set in place and secured with heat reflection tape.*

NOTE: *If multiple pieces of heat shield tubing are used, tape around each seam with heat reflection tape.*

2. Tape the top side of the heat shield tubing **(1)** to the antenna cables with heat reflection tape **(2)**.
3. Remove the protective paper from the adhesive strip. Tightly roll the heat shield tubing **(1)** to close the tubing with the adhesive.
4. Tape the bottom end of the heat shield tubing **(1)** with the heat reflection tape **(2)**.



RAIL13DOZ0115AA 2

1005 - Seat Switch: Plausibility Error

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The UCM detects a plausibility error in the seat switch circuit, **X-018 (Receptacle) pin 12**. Ground drive will operate in limp home mode while fault code **1005 – Seat Switch: Plausibility Error** is active.

Cause:
The UCM detects a plausibility error in the seat switch circuit, **X-018 (Receptacle) pin 12**.

Possible failure modes:

1. A short circuit in the seat switch wiring or circuits.
2. A faulty seat switch.
3. A 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. Go to step **8**.

   B. Fault code **1005 – Seat Switch: Plausibility Error** 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.

   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 the elimination of the fault.
3. Measure the resistance through the circuit.

   Turn the ignition switch OFF.

   Fabricate a jumper wire that will connected between **X-023A (Plug) pin 5** and **X-023A (Plug) pin 6**.

   Connect the jumper wire between **X-023A (Plug) pin 5** and **X-023A (Plug) pin 6**.

   Disconnect UCM connector **X-014** and **X-018**.

   Measure the resistance between **X-014 (Receptacle) pin 3** and **X-018 (Receptacle) pin 12**. The resistance should be less than **10 Ω**. Wiggle the harness during measurement to reveal an intermittent condition.

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

   B. The resistance is greater than **10 Ω**. There is an open circuit in the wiring between the UCM and connector **X-023A**. Repair or replace the harness as required. Return to step **1** to confirm the elimination of the fault.
4. Measure the resistance to other circuits.

   Turn the ignition switch OFF.

4. Check for an open circuit.

   Turn the ignition switch OFF.

   Disconnect UCM connectors **X-014** and **X-021**.

   Disconnect the left speed sensor connector **X-128**.

   Fabricate a jumper wire that will connect between **X-128 (Plug) pin 1** and **X-128 (Plug) pin 3**.

   Connect the jumper wire between **X-128 (Plug) pin 1** and **X-128 (Plug) pin 3**.

   Measure the resistance between **X-014 (Receptacle) pin 18** and **X-021 (Receptacle) 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 **5**.

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

5. Check for a short circuit to ground.

   Turn the ignition switch OFF.

   Leave UCM connectors **X-014** and **X-021** disconnected.

   Remove the jumper wire between **X-128 (Plug) pin 1** and **X-128 (Plug) pin 3**.

   Measure the resistance between **X-014 (Receptacle) pin 18** and **X-021 (Receptacle) pin 20**. 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 (Receptacle) pin 18** 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. Both resistance measurements are greater than **20,000 Ω**. Go to step **6**.

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

6. Test the UCM.

   Turn the ignition switch OFF.

   Reconnect the left speed sensor.

   Reconnect UCM connector **X-021**.

   Remove the wire from UCM connector **X-014 (Receptacle) pin 18**.

   Remove the wire from UCM connector **X-014 (Receptacle) pin 12**.

   Insert the wire from **X-014 (Receptacle) pin 12** into **X-014 (Receptacle) pin 18**.

   Reconnect UCM connector **X-014**.

   Turn the ignition switch ON. Start the machine.

   Access the EST fault code screen. Fault code **1301 – Left Speed Sensor Frequency Input Shorted to Ground or Open Circuit** should no longer be active. Fault code **1311 – Right Speed Sensor Frequency Input Shorted to Ground or Open Circuit** will be active, ignore this fault code.

   A. Fault code **1301 – Left Speed Sensor Frequency Input Shorted to Ground or Open Circuit** is no longer active. Temporarily replace the sensor and retest. Return to step **1** to confirm the elimination of the fault.

   B. Fault code **1301 – Left Speed Sensor Frequency Input Shorted to Ground or Open Circuit** is still present and active. Temporarily replace the UCM and retest. Return to step **1** to confirm the elimination of the fault.

1324 - Battery Voltage High

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The instrument cluster measured a battery voltage greater than **30.5 V** for a period greater than **5 s** on connector **X-059 (Receptacle) pin 14** and **X-059 (Receptacle) pin 20**.

Cause:
The instrument cluster measured a voltage greater than **30.5 V**.

Possible failure modes:

1. A faulty battery.
2. A faulty alternator.
3. A faulty instrument cluster.

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. Go to step **3**.

   B. Fault code **1324 – Battery Voltage High** is active along with fault code **3051 – Battery Voltage to ECM too High**. There is a problem with the battery or charging system. Repair as required. Return to step **1** to confirm the elimination of the fault.

   C. Fault code **1324 – Battery Voltage High** is recorded again. Go to step **2**.
2. Measure the voltage at the instrument cluster.

   Turn the ignition switch OFF.

   Disconnect instrument cluster connector **X-059**.

   Turn the ignition switch ON.

   Measure the voltage between **X-059 (Receptacle) pin 14** and **X-059 (Receptacle) pin 15**. The voltage should be approximately **12 V**. Wiggle the harness during measurement to reveal an intermittent condition.

   Measure the voltage between **X-059 (Receptacle) pin 20** and **X-059 (Receptacle) pin 22**. The voltage should be approximately **12 V**. Wiggle the harness during measurement to reveal an intermittent condition.

   A. The voltage is between **10 V** and **14 V**. Temporarily replace the instrument cluster and retest. Return to step **1** to confirm the elimination of the fault.

   B. The voltage is greater than **14 V**. There is a problem with the battery or the alternator charging circuit. Repair as required. Return to step **1** to confirm the elimination of the fault.
3. Check the harness for intermittent connections.

   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.

   Wiggle the harnesses to reveal an intermittent connection or a short circuit in the wiring.

1416 - 5VREF1 Sensor Supply Voltage Out of Range

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The UCM has sensed the voltage on **X-014 (Receptacle) pin 2** is out of range. The voltage is less than **4 V** or greater than **6 V**.

Cause:
The UCM has sensed the voltage on, **X-014 (Receptacle) pin 2** is out of range.

Possible failure modes:

1. A short circuit in the throttle sensor wiring or circuits.
2. A faulty throttle sensor.
3. A 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. Go to step **5**.

   B. Fault code **1416 – 5VREF1 Sensor Supply Voltage Out of Range** is recorded again. Go to step **2**.
2. Verify that the wiring and connectors are free of damage.

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

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

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

   B. The connectors or the harness has damage. Repair or replace the harness or connectors as required. Return to step **1** to confirm the elimination of the fault.
3. Measure the voltage at connector **X-029**.

   Turn the ignition switch OFF.

   Disconnect the throttle connector **X-029**.

   Turn the ignition switch ON.

   Measure the voltage between **X-029 (Receptacle) pin A** and chassis ground. The chassis ground must clean and free of paint, oil and dirt. The voltage should be approximately **5 V**. Wiggle the harness during measurement to reveal an intermittent condition.

   A. The voltage is approximately **5 V**. There is a problem in the throttle sensor wiring. Repair as required. Return to step **1** to confirm elimination of the fault.

   B. The voltage is less than **4 V** or greater than **6 V**. Go to step **4**.
4. Measure the voltage at the UCM.

   Turn the ignition switch OFF.

1819 - Engine overspeed

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Control Module: ECU

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 – UCM Temperature / Current Draw Over Limit** and other fault codes such as fault code **3007 (DTC 1113) – Engine coolant temperature sensor voltage is higher than expected** or fault code **1326 – Battery Voltage Low**.

Possible failure modes:

1. A problem in the engine cooling system.
2. A 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 machine.

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

   B. Fault code **1819 – UCM Temperature Above Normal** is recorded again along with other codes such as fault code **3007 (DTC 1113) – Engine coolant temperature sensor voltage is higher than expected** or fault code **1326 – Battery Voltage Low**, troubleshoot these codes first.

   C. Fault code **1819 – UCM Temperature Above Normal** is recorded again. No other codes are present. Temporarily replace the UCM and retest. Return to Step **1** to confirm elimination of the fault.

Wiring harnesses - Electrical schematic sheet 02 SH02 - POWER DISTRIBUTION/CHARGING SYSTEM (55.100.DP-C.20.E.02)
Wiring harnesses - Electrical schematic sheet 03 SH03 - STARTING SYSTEM (55.100.DP-C.20.E.03)
Wiring harnesses - Electrical schematic sheet 05 SH05 - ENGINE CONTROL (55.100.DP-C.20.E.05)
Wiring harnesses - Electrical schematic sheet 09 SH09 - UCM (55.100.DP-C.20.E.09)

With the key in the OFF position, use a multimeter to perform the following continuity check for an open circuit on the engine harness (EN) side :

From	To	Value
X-203 (Receptacle) pin 1	**X-212 (Receptacle) pin 20**	There should be continuity.
X-203 (Receptacle) pin 2	**X-212 (Receptacle) pin 19**	There should be continuity.
NOTE: *Wiggle the harness during measurement to reveal an intermittent condition.*		

A. If there is no continuity, there is an open circuit in the intake manifold temperature sensor wiring. Locate and repair the broken conductor. Repair or replace the harness as required.

B. If there is continuity, then continue to step **4**.

4. Replace the intake manifold temperature sensor.

   Use the Electronic Service Tool (EST) to check the status of this fault.

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

   B. If the fault is still active, check the ECU for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then 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 you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 05 SH05 - ENGINE CONTROL (55.100.DP-C.20.E.05)

3059 - Main relay stuck error

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The Engine Control Unit controls the ECU relay. The ECU relay is powered on by the ECU to achieve after-run. The ECU relay is powered off once after-run is completed. If the ECU determines that the ECU relay is stuck or will not shut off as commanded, then this fault will occur.

Cause:
The ECU has determined that the ECU relay will not shut off as commanded.

Possible failure modes:

1. Faulty ECU relay, wiring.
2. Faulty ECU relay, internal failure.
3. Faulty ECU, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with step **7**.

2. Check the ECU relay coil for an internal failure.

   Remove the ECU relay.

   Use a multimeter to measure the resistance on the ECU relay pins :

From	To	Value
ECU relay coil pin 85	ECU relay coil pin 86	There should be approximately **70 – 130 Ω**.

   A. If there is approximately **70 – 130 Ω**, then leave the ECU relay disconnected and continue to step **3**.

   B. If there is not approximately **70 – 130 Ω**, then the ECU relay has failed. Replace the ECU relay and retest.

3. Check the ECU relay low side driver wiring for a short circuit to ground.

   With the key in the OFF position, use a multimeter to perform the following continuity check for a short to ground on the vehicle harness (VE) side :

From	To	Value
ECU relay connector pin 85	Chassis ground	There should be no continuity.

   A. If there is continuity, then there is a short circuit in the ECU relay wiring in the vehicle harness (VE). Locate and repair the shorted conductor. Repair or replace the harness as required.

   B. If there is no continuity, then leave the ECU relay disconnected and continue to step **4**.

4. Check the ECU relay low side driver wiring for a short circuit.

   Disconnect the vehicle harness (VE) from the ECU at connector **X-212**.

   With the key in the OFF position, use a multimeter to perform the following continuity checks for a short circuit on the vehicle harness (VE) side :

3090 - Camshaft speed sensor values are not plausible

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The Engine Control Unit (ECU) monitors the camshaft position sensor characteristics for angle, speed determination, signal plausibility, and quality. If the ECU determines that no camshaft edge is detected for at least four crankshaft revolutions, this fault will occur.

Cause:
The ECU has detected no camshaft edge for at least four crankshaft revolutions.

Possible failure modes:

1. Faulty camshaft position sensor, wiring.
2. Faulty camshaft position sensor, improperly seated or mounted.
3. Faulty camshaft position sensor, internal failure.
4. Faulty ECU, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with step **2**.

   B. If the fault is no longer present or in an inactive state, the fault may be intermittent and not currently active. Continue with step **6**.
2. Check the physical integrity of the camshaft speed sensor. The sensor should be fully seated and mounted tightly.

   A. If the sensor is not mounted/secured properly, repair as necessary.

   B. If the sensor is not damaged and is mounted/secured properly, continue to step **3**.
3. Check the camshaft position sensor wiring in the engine harness (EN).

   Disconnect the engine harness (EN) from the camshaft position sensor.

   Disconnect the vehicle harness (VE) from the engine interface at connector **X-217**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
Camshaft position sensor connector pin 2	**X-217 (Receptacle) pin 4**	There should be continuity.
Camshaft position sensor connector pin 1	**X-217 (Receptacle) pin 8**	There should be continuity.
Camshaft position sensor connector pin 3	**X-217 (Receptacle) pin 12**	There should be continuity.
Camshaft position sensor connector pin 2	Chassis ground	There should be no continuity.
Camshaft position sensor connector pin 2	All pins in connector **X-217**	There should be no continuity.

   With the key in the ON position, use a multimeter to perform the following voltage check on the engine harness (EN) side :

3137 - Fuel metering unit has an open load error

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The Engine Control Unit (ECU) monitors the fuel metering unit signal circuit. If the ECU detects an open load error in the fuel metering unit signal circuit, then this fault will occur.

Cause:
There is an open load detected in the fuel metering unit signal circuit.

Possible failure modes:

1. Faulty fuel metering unit wiring, open circuit.
2. Faulty fuel metering unit, internal failure.
3. Faulty ECU, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, then continue with step **2**.

   B. If the fault is no longer present or in an inactive state, then the fault may be intermittent and not currently active. Continue with step **5**.

2. Test the fuel metering unit internal resistance.

   Disconnect the engine harness (EN) from the fuel metering.

   Use a multimeter to measure the resistance on the fuel metering unit pins :

From	To	Value
Fuel metering unit pin 1	Fuel metering unit pin 1	There should be between **2.6 – 3.2 Ω** at approximately **20.0 °C** (**68.0 °F**).

   A. If there is between **2.6 – 3.2 Ω**, then leave the fuel metering unit disconnected and continue to step **3**.

   B. If there is not between **2.6 – 3.2 Ω**, then the fuel metering unit has failed. Replace the fuel metering unit and retest.

3. Check the fuel metering unit engine harness (EN) wiring for an open circuit.

   Disconnect the vehicle harness (VE) from the engine interface at connector **X-217**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
Fuel metering unit connector pin 1	**X-217 (Receptacle) pin 1**	There should be continuity.
Fuel metering unit connector pin 2	**X-217 (Receptacle) pin 2**	There should be continuity.
NOTE: *Wiggle the harness during the measurement to reveal an intermittent condition.*		

   A. If there is continuity, then leave connector **X-217** disconnected and continue to step **4**.

   B. If there is no continuity, then there is an open circuit condition in the fuel metering unit engine harness (EN) wiring. Locate and repair the broken conductor. Repair or replace the harness as required.

4. Check the fuel metering unit vehicle harness (VE) wiring for an open circuit.

4. Check the fuel injector number 4 vehicle harness (VE) wiring for an open circuit.

   Disconnect the vehicle harness (VE) from the ECU at connector **X-216**.

   With they key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
X-215 (Receptacle) pin E	**X-216 (Receptacle) pin 17**	There should be continuity.
X-215 (Receptacle) pin F	**X-216 (Receptacle) pin 48**	There should be continuity.

   A. If there is no continuity, then there is an open circuit in the fuel injector number 4 vehicle harness (VE) wiring. Locate and repair the broken conductor. Repair or replace the harness as required.

   B. If there is continuity, then check the ECU for the appropriate service manual and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then 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 you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 06 SH06 - ENGINE CONTROL (55.100.DP-C.20.E.06)
Wiring harnesses - Electrical schematic sheet 05 SH05 - ENGINE CONTROL (55.100.DP-C.20.E.05)

3259 - Starter relay high side driver circuit shorted to ground

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The Engine Control Unit (ECU) controls the start relay using a low side and high side driver. If the ECU detects a short circuit to ground in the high side driver circuit, then this fault will occur.

Cause:
The ECU has detected a short circuit to ground in the start relay high side driver circuit.

Possible failure modes:

1. Faulty start relay wiring, short circuit to ground.
2. Faulty start relay, internal failure.
3. Faulty ECU, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with step **2**.

   B. If the fault is no longer present or in an inactive state, then the fault may be intermittent and not currently active. Continue with step **5**.

2. Check the start relay coil for an internal failure.

   Remove the start relay K-006.

   Use a multimeter to measure the relay coil resistance on the start relay pins :

From	To	Value
Start relay pin 85	Start relay pin 86	There should be approximately **70 – 130 Ω**.

   A. If there is approximately **70 – 130 Ω**, then leave the start relay disconnected and continue to step **3**.

   B. If there is not approximately **70 – 130 Ω**, then the relay has failed. Replace the start relay and retest.

3. Check the start relay high side driver vehicle harness (VE) wiring for a short circuit to ground.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

From	To	Value
Start relay connector pin 85	Chassis ground	There should be no continuity.
Start relay connector pin 85	Start relay connector pin 86	There should be no continuity.

   A. If there is continuity, then there is a short circuit to ground in the start relay wiring in the vehicle harness (VE). Locate and repair the shorted conductor. Repair or replace the harness as required.

   B. If there is no continuity, then continue to step **4**.

4. Check the start relay high side driver vehicle harness (VE) wiring for a short circuit.

   Disconnect the vehicle harness (VE) from the ECU at connector **X-212**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the vehicle harness (VE) side :

3338 - CAN communication failure between vehicle controller and ECU controller - TSC1_VE message

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The Engine Control Unit (ECU) is capable of connecting to and communicating on two separate Controller Area Networks (CAN). Proper configuration and monitoring of the two twisted pair configured networks is also a function of the ECU. CAN Node A Bus is the main vehicle interface bus. The ECU provides a CAN termination resistor for the CAN Node A Bus, internal to the ECU. If the ECU senses that CAN Node A Bus is not functioning properly, then this fault will occur.

Cause:
The ECU has sensed a timeout of required vehicle controller data provided on CAN Node A.

Possible failure modes:

1. Faulty supply voltage or ground, missing.
2. Faulty CAN circuit wiring, open circuit, short to ground, or short circuit.
3. Faulty ECU, termination resistor or software.

Solution:

1. Verify fault is present and in active state.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with step **2**.

   B. If the fault is no longer present or is in an inactive state, the fault may be intermittent and not currently active. Continue with step **6**.
2. Check for other vehicle CAN faults.

   Use the EST to determine if vehicle CAN faults exist.

   A. If other vehicle CAN faults exist, then resolve the vehicle CAN faults, then check to see that **3338 – CAN communication failure between vehicle controller and ECU controller - TSC1_VE message** is also resolved.

   B. If other vehicle CAN faults do not exist, then continue with step **3**.
3. Check the ECU supply voltage.

   Disconnect the vehicle (VE) harness from the ECU at connector **X-212**.

   Fabricate a jumper wire that will connect between **X-212 (Receptacle) pin 28** and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt.

   Connect the jumper wire that will connect between **X-212 (Receptacle) pin 28** and chassis ground.

   With the key switch in the ON position, use a multimeter to check for voltage on the vehicle (VE) harness side :

From	To	Value
X-212 (Receptacle) pin 1	Chassis ground	There should be **12.0 V**.
X-212 (Receptacle) pin 3	Chassis ground	There should be **12.0 V**.
X-212 (Receptacle) pin 5	Chassis ground	There should be **12.0 V**.

   A. If the voltage is present on all of the checks, then leave connector **X-212** disconnected and continue with step **4**.

3406 - Wastegate pressure modulator control circuit over temperature

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The Engine Control Unit (ECU) monitors the wastegate pressure modulator valve circuit. If the ECU determines that there is an over temperature/current condition in the wastegate pressure modulator valve circuit, then this fault will occur.

Cause:
The ECU has detected an over temperature/current condition in the wastegate pressure modulator valve circuit.

Possible failure modes:

1. Faulty wastegate pressure modulator valve wiring, short circuit to another voltage source.
2. Faulty wastegate pressure modulator valve, internal failure.
3. Faulty ECU, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, continue with step **2**.

   B. If the fault is no longer present or in an inactive state, then the fault may be intermittent and not currently active. Continue with step **7**.

2. Check the wastegate pressure modulator valve internal resistance.

   Disconnect the wastegate pressure modulator valve.

   Use a multimeter to perform the following resistance check on the wastegate pressure modulator valve pins :

From	To	Value
Wastegate pressure modulator valve pin 1	Wastegate pressure modulator valve pin 2	There should be between **21.8 – 24.2 Ω**.
NOTE: *The provided value should be measured at a temperature of approximately* ***20 °C (68 °F)****.*		

   A. If there is between **21.8 – 24.2 Ω**, then leave the wastegate pressure modulator valve disconnected and continue to step **3**.

   B. If there is not between **21.8 – 24.2 Ω**, then the wastegate pressure modulator valve has failed internally. Replace the wastegate pressure modulator valve and retest.

3. Check the wastegate pressure modulator valve wiring for a short circuit.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
Wastegate pressure modulator valve connector pin 1	Wastegate pressure modulator valve connector pin 2	There should be no continuity.

   A. If there is continuity, then there is a short circuit in the wastegate pressure modulator valve wiring. Locate and repair the shorted conductor. Repair or replace the harness as required.

   B. If there is no continuity, then continue to step **4**.

3430 - EGR Failure - Moderate Inducement

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The Engine Control Unit (ECU) monitors the efficiency of the Exhaust Gas Recirculation (EGR) valve. If the ECU detects an efficiency failure, inducement will be triggered and this fault will occur. This fault indicates a least severe inducement level. Other active faults may have caused this fault to occur.

From	To	Result
EGR valve actuator motor connector pin 1	**X-217 (Receptacle) pin 29**	There should be continuity.
EGR valve actuator motor connector pin 1	**X-217 (Receptacle) pin 30**	There should be continuity.

A. If there is continuity on both tests, then leave connector **X-217** disconnected and continue with step **4**.

B. If there is no continuity on either or both of the checks, then there is an open circuit in the engine harness. Locate and repair the broken conductor. Repair or replace the harness as required.

4. Check the vehicle harness (VE) for an open circuit.

   Disconnect the vehicle harness (VE) from the ECU at connector **X-216**.

   Use a multimeter to check for continuity in the vehicle harness (VE) :

From	To	Result
X-216 (Receptacle) pin 50	**X-217 (Receptacle) pin 29**	There should be continuity.
X-216 (Receptacle) pin 35	**X-217 (Receptacle) pin 30**	There should be continuity.

   A. If there is no continuity on either or both of the checks, there is an open circuit in the vehicle harness. Locate and repair the broken conductor. Repair or replace the harness as required.

   B. If there is continuity, then check the ECU for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then 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 you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

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3688 - Water in fuel sensor or sensor circuit failure

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

NOTE: *This fault code is for the Water in Fuel switch with black connector housing.*

Context:
The water in fuel switch provides a diagnostic self-test signal (less than **3.9 V** for **2.5 s +/- 20%**) at key-ON. If the Engine Control Unit (ECU) does not sense the diagnostic self-test signal, then this fault will occur and there will be no monitoring of water content in the fuel supply.

Cause:
The ECU has not received an acceptable water in fuel switch self-test signal.

Possible failure modes:

1. The water in fuel switch wiring is damaged.
2. An internal failure in the water in fuel switch.
3. A faulty ECU.

Solution:

1. Verify this fault code is still present and in an active state.

   Use the Easy Engine software provided on the Electronic Service Tool (EST) to check the fault status.

   A. If the fault is still present and active, then continue with step **2**.

   B. If the fault is no longer present or is in an inactive state, then continue with step **7**.
2. Use the EST to check the status of the related fault

   3146 – Water detected in fuel - Shorted to high source.

   A. If fault **3146 – Water detected in fuel - Shorted to high source** is active, then resolve fault **3146 – Water detected in fuel - Shorted to high source**, then return to this fault, **3688 – Water in fuel sensor or sensor circuit failure**.

   B. If fault **3146 – Water detected in fuel - Shorted to high source** is not active, then continue with step **3**.
3. Check the water in fuel switch for the initial self-test voltage pulse.

   Carefully back probe the water in fuel switch at connector **X-211**.

   With the help of an assistant, use a multimeter to perform the following test at key-ON:

From	To	Value
X-211 (Receptacle) pin 1	Chassis ground	There should be less than **3.9 V** for **2.5 s +/- 20%**.
NOTE: *The signal line should switch to battery voltage after the self-test period.*		

   A. If the self-test is successful, then continue with step **4**.

   B. If the self-test is not successful, then the water in fuel switch has failed internally. Replace the switch and retest.
4. Check for an open circuit, a short circuit, or a short circuit to ground in the water in fuel switch circuit.

   Disconnect the water in fuel switch at connector **X-211**.

   Disconnect the ECU at connector **X-212**.

   With the key switch in the OFF position, use a multimeter to perform the following test :

3739 - ECU internal failure - Loss of synchronization to MM from CPU

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The Engine Control Unit (ECU) performs a shut-off path test of the fuel injection power stages. Every time the key is turned ON, this test is performed to verify the correct functioning of the shut-off procedure. If an error is detected during the shut-off test, then the fault will occur.

Solution:

1. Check the ECU for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, then return the machine to service.
   B. If the fault has not been resolved, then escalate an ASIST concern.

3763 - ECU 5 volt supply voltage is lower than expected

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The Engine Control Unit (ECU) monitors the ECU internal **5 V** supply. If the **5 V** supply is below the minimum limit, then this fault will occur.

Cause:
The ECU has determined that the **5 V** internal voltage supply is too low.

Possible failure modes:

1. Faulty voltage supply.
2. Faulty ECU, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, then continue with step **2**.

   B. If the fault is no longer present or in an inactive state, then the fault may be intermittent and not currently active. Continue with step **3**.

2. Check the ECU supply voltage.

   Disconnect the ECU connector **X-212**.

   Place a jumper wire between **X-212 (Receptacle) pin 28** and chassis ground. This will energize the ECU relay.

   With the key in the ON position, use a multimeter to perform the following voltage check on the vehicle harness (VE) side :

From	To	Value
X-212 (Receptacle) pin 1	**X-212 (Receptacle) pin 2**	There should be approximately **12 V**.
X-212 (Receptacle) pin 3	**X-212 (Receptacle) pin 4**	There should be approximately **12 V**.
X-212 (Receptacle) pin 6	**X-212 (Receptacle) pin 6**	There should be approximately **12 V**.

   A. If there is not approximately **12 V**, then there is a problem with the battery supply to the ECU. Check fuse F-101. Repair or replace the harness as required. Check fuse F-101. Repair or replace the harness as required.

   B. If there is approximately **12 V**, then check the ECU for the appropriate software and re-flash, if necessary.

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 you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then 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 you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

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B. If there is no continuity, then leave the connector disconnect and continue to step **4**.

4. Check the exhaust gas absolute pressure sensor vehicle harness (VE) wiring.

   Disconnect the ECU connector **X-216**.

   With the key in the OFF position, use a multimeter to perform the following continuity check at the vehicle harness (VE) side of the connector from :

From	To	Value
X-217 (Receptacle) pin 23	Chassis ground	There should be no continuity.
X-217 (Receptacle) pin 23	All pins in connector **X-9138**	There should be no continuity.
X-216 (Receptacle) pin 43	All pins in connector **X-216**	There should be no continuity.

   A. If there is continuity, then there is a short circuit in the exhaust gas absolute pressure sensor signal circuit vehicle harness (VE) wiring. Locate and repair the shorted conductor. Repair or replace the harness as required.

   B. If there is no continuity, then leave the connector disconnect and continue to step **5**.

5. Replace the exhaust gas absolute pressure sensor.

   Use the Electronic Service Tool (EST) to verify the status of this fault.

   A. If the fault is no longer active, then return the machine to service.

   B. If the fault is still active, then check the ECU for the appropriate software and re-flash, if necessary.

6. 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 you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then 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 you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

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From	To	Value
X-217 (Receptacle) pin 37	All pins in connector **X-217**	There should be no continuity.
X-216 (Receptacle) pin 49	All pins in connector **X-216**	There should be no continuity.

A. If there is continuity, then there is a short circuit in the throttle valve actuator output 1 h-bridge circuit. Locate and repair the shorted conductor. Repair or replace the harness as required.

B. If there is no continuity, then leave the throttle valve actuator disconnected and continue to **4**.

4. Replace the throttle valve actuator.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is no longer active, then return the machine to service.

   B. If the fault is still active, then check the ECU for the appropriate software and re-flash, if necessary.

5. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while you monitor the display.

   A. If you find damage or the display indicates other than normal display readings, then 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 you do not find damage and the display indicates only normal readings, then erase the fault code and continue operation.

Wiring harnesses - Electrical schematic sheet 06 SH06 - ENGINE CONTROL (55.100.DP-C.20.E.06)

3910 - Fuel metering unit intermittent electrical connection failure

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The Engine Control Unit (ECU) monitors the fuel metering unit signal circuit. If the ECU detects an intermittent connection in the fuel metering unit signal circuit, then this fault will occur.

Cause:
The ECU has detected a intermittent connection in the fuel metering unit signal circuit.

Possible failure modes:

1. Faulty fuel metering unit wiring, open circuit.
2. Faulty fuel metering unit, internal failure.
3. Faulty ECU, software.

Solution:

1. Verify fault is present and active.

   Use the Electronic Service Tool (EST) to check the status of this fault.

   A. If the fault is present and active, then continue with step **2**.

   B. If the fault is no longer present or in an inactive state, then the fault may be intermittent and not currently active. Continue with step **5**.

2. Measure the fuel metering unit internal resistance.

   Disconnect the engine harness (EN) from the fuel metering unit.

   Use a multimeter to measure the resistance on the fuel metering unit pins :

From	To	Value
Fuel metering unit pin 1	Fuel metering unit pin 2	There should be between **2.6 – 3.2 Ω** at approximately **20.0 °C** (**68.0 °F**).

   A. If there is between **2.6 – 3.2 Ω**, then leave the fuel metering unit disconnected and continue to step **3**.

   B. If there is not between **2.6 – 3.2 Ω**, then the fuel metering unit has failed. Replace the fuel metering unit and retest.

3. Check the fuel metering unit engine harness (EN) wiring for an open circuit.

   Disconnect the vehicle harness (VE) from the engine interface at connector **X-217**.

   With the key in the OFF position, use a multimeter to perform the following continuity check on the engine harness (EN) side :

From	To	Value
Fuel metering unit connector pin 1	**X-217 (Receptacle) pin 1**	There should be continuity.
Fuel metering unit connector pin 2	**X-217 (Receptacle) pin 2**	There should be continuity.
NOTE: *Wiggle the harness during the measurement to reveal an intermittent connection.*		

   A. If there is continuity, then leave connector **X-217** disconnected and continue to step **4**.

   B. If there is no continuity, then there is an open circuit in the fuel metering unit engine harness (EN) wiring. Locate and repair the broken conductor. Repair or replace the harness as required.

4. Check the fuel metering unit vehicle harness (VE) wiring for an open circuit.

4113 - Left Pump Forward Solenoid High Side Shorted to Power

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The UCM detects a short circuit to another voltage source in the left forward solenoid circuit, **X-019 (Receptacle) pin 6**.

Cause:
There is a short circuit to another voltage source in the left forward solenoid circuit, **X-019 (Receptacle) pin 6**.

Possible failure modes:

1. A short circuit in the left forward solenoid circuit.
2. A faulty left forward solenoid.
3. A 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. Go to step **5**.

   B. Fault code **4113 – Left Pump Forward Solenoid High Side Shorted to Power** is recorded again. Go to step **2**.
2. Verify that the wiring and connectors are free of damage.

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

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

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

   B. The connectors or the harness has damage. Repair or replace the connectors or the harness as required. Return to step **1** to confirm the elimination of the fault.
3. Measure the voltage on the signal wire.

   Turn the ignition switch OFF.

   Disconnect UCM connector **X-019**.

   Disconnect the left forward solenoid.

   Turn the ignition switch ON.

   Measure the voltage between **X-019 (Receptacle) pin 6** 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**.

   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 harness as required. Return to step **1** to confirm the elimination of the fault.
4. Test the circuit.

4141 - Right Motor Solenoid High Side Open Circuit

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The UCM detects an open circuit in the right motor solenoid circuit, **X-021 (Receptacle) pin 19**.

Cause:
There is an open circuit in the right motor solenoid circuit, **X-021 (Receptacle) pin 19**.

Possible failure modes:

1. An open circuit in the right motor solenoid circuit.
2. A faulty right motor solenoid.
3. A 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. Go to step **5**.

   B. Fault code **4141 – Right Motor Solenoid High Side Open Circuit** is recorded again. Go to step **2**.
2. Verify that the wiring and connectors are free of damage.

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

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

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

   B. The connectors or the harness has damage. Repair or replace the connectors or the harness as required. Return to step **1** to confirm the elimination of the 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 (Plug) pin 1** and **X-133 (Plug) pin 2**.

   Connect the jumper wire between **X-133 (Plug) pin 1** and **X-133 (Plug) pin 2**.

   Turn the ignition switch ON.

   Access the fault code screen on the EST.

   Fault code **4141 – Right Motor Solenoid High Side Open Circuit** should no longer be active. Fault code **4142 – Right Motor Solenoid High Side Short to Ground** is now active.

   A. Fault code **4141 – Right Motor Solenoid High Side Open Circuit** is no longer active. Fault code **4142 – Right Motor Solenoid High Side Short to Ground** is now active. Temporarily replace the solenoid and retest. Return to step **1** to confirm the elimination of the fault.

4163 - Park Brake Valve Short to Power

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The UCM detects a short circuit to another voltage source in the park brake solenoid circuit, **X-018 (Receptacle) pin 25**. Ground drive is disabled while fault code 4163 is active.

Cause:
There is a short circuit to another voltage source in the park brake solenoid circuit, **X-018 (Receptacle) pin 25**.

Possible failure modes:

1. A short circuit in the park brake solenoid circuit.
2. A faulty park brake solenoid.
3. A 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. Go to step **5**.

   B. Fault code **4163 – Park Brake Valve Short to Power** is recorded again. Go to step **2**.
2. Verify that the wiring and connectors are free of damage.

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

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

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

   B. The connectors or the harness has damage. Repair or replace the harness or connectors as required. Return to step **1** to confirm the elimination of the fault.
3. Measure the voltage on the signal wire.

   Turn the ignition switch OFF.

   Disconnect UCM connector **X-018**.

   Disconnect the park brake solenoid.

   Turn the ignition switch ON.

   Measure the voltage between **X-018 (Receptacle) pin 25** 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**.

   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 harness as required. Return to step **1** to confirm the elimination of the fault.
4. Test the circuit.

   Turn the ignition switch OFF.

4315 - Park Brake Pressure Switch Plausibility Error

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The UCM detects a state that is not possible. The UCM inputs **X-020 (Receptacle) pin 15** and **X-018 (Receptacle) pin 25** do not agree. The UCM detects the brake solenoid is ON, but the brake pressure switch is not sending the correct signal or the brake solenoid is OFF, but the brake switch is sending a brake pressure signal to the UCM.

Cause:
The UCM inputs **X-020 (Receptacle) pin 15** and **X-018 (Receptacle) pin 25** do not agree.

Possible failure modes:

1. An open circuit in the brake pressure switch circuit.
2. A short circuit in the brake pressure switch circuit.
3. A faulty brake pressure switch.
4. A 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. Go to step **6**.

   B. Fault code **4315 – Park Brake Pressure Switch Plausibility Error** is recorded again. Go to step **2**.
2. Verify that the wiring and connectors are free of damage.

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

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

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

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

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

   Turn the ignition switch ON.

   Measure the voltage between the brake pressure switch **X-105 (Receptacle) pin A** and chassis ground. The chassis ground connection must be clean and free of paint, oil, and dirt. The voltage should be approximately **12 V**. Wiggle the harness during measurement to reveal an intermittent condition.

   A. The voltage is between **10 V** and **14 V**. Go to step **4**.

   B. The voltage is less than **10 V**. There is a problem in the battery supply to the switch. Check splice SP-S94. Check fuse F-030. Return to step **1** to confirm the elimination of the fault.
4. Measure the resistance through the signal wires.

4513 - Drive Joystick (Left Joystick) Forward-Reverse Axis 2 - Short to Power

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
The UCM detects a short circuit to another voltage source in the drive joystick F-B 2 signal, **X-017 (Receptacle) pin 31**.

Cause:
The UCM detects a short circuit to another voltage source in the drive joystick F-B 2 signal, **X-017 (Receptacle) pin 31**.

Possible failure modes:

1. A short circuit in the drive joystick F-B 2 signal.
2. Faulty joystick.
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. Go to step **5**.

   B. Fault code **4501 – Drive Joystick (Left Joystick) Forward-Reverse Axis 1 - Short to Ground or Open Circuit** is recorded again. Go to step **2**.

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

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

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

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

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

3. Measure the voltage on the signal wire.

   Turn the ignition switch OFF.

   Disconnect UCM connector **X-017**.

   Disconnect drive joystick connector **X-028**.

   Turn the ignition switch ON.

   Measure the voltage between UCM connector **X-017 (Receptacle) pin 31** 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**.

9129 - CAN timed out during operation

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Context:
CAN bus communications between the UCM and other modules on the CAN data bus have been lost. This fault code may be displayed with other CAN bus faults.
Implement functions and ground drive will operate in limp home mode while fault code **9129 – CAN timed out during operation** is active.

Cause:
The UCM has stopped receiving CAN messages from the Instrument Cluster. CAN bus communications between the instrument cluster and the UCM have been lost.

Possible failure modes:

1. An open circuit in the CAN bus wiring or circuits.
2. A short circuit in the CAN bus wiring or circuits.
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.

   Continue with this procedure if three or more CAN data link fault codes are active. This is an indication of a problem in the CAN Data Link circuit.
   If one or two CAN bus fault codes are active, check all CAN bus wires and connectors to verify they are secure and free of damage, corrosion, abrasion and incorrect attachment. This may be an indication of an intermittent connection in the CAN bus.

   A. CAN Data Link fault codes are not recorded again and are no longer active. OK to return the machine service.

   B. Fault code **9129 – CAN timed out during operation** is active. No other CAN based fault codes are active. Use the EST to confirm proper machine configuration. Reconfigure the parameters as required.

   C. CAN Data Link fault codes are present and ACTIVE. Continue with **2107 - CAN Communication Timeout Between AIC and UCM (55.953)** , step 2.

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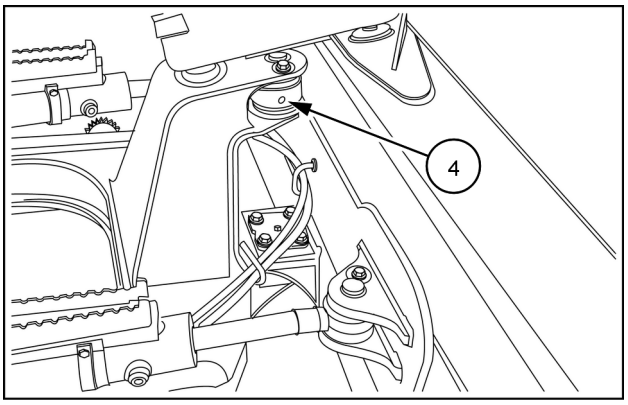
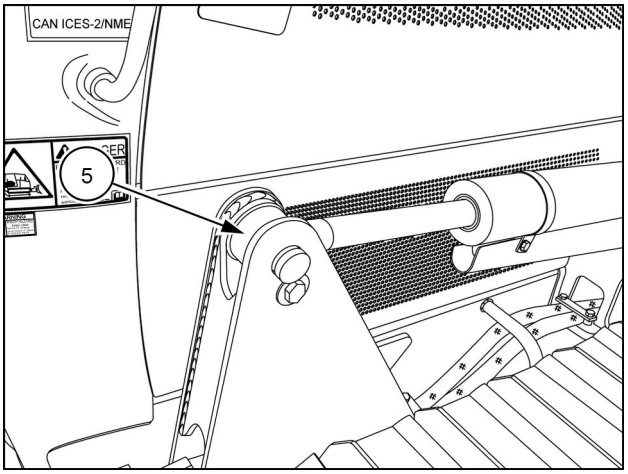
(4) Tilt cylinder, rod end



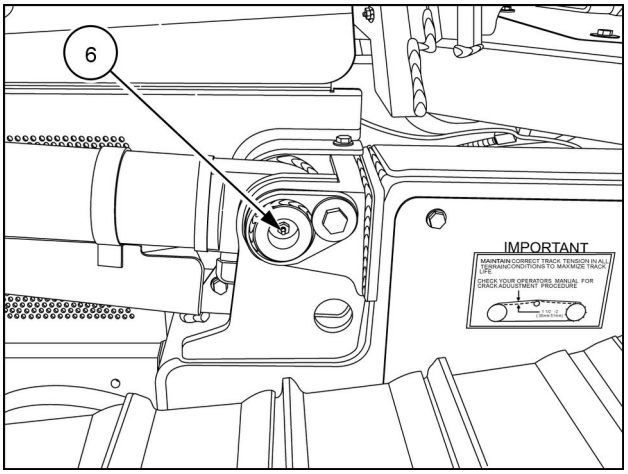
RAPH13DOZ0548AA 2

(5) Lift cylinder, rod end — one each side



RAIL17DOZ0358AA 3

(6) Lift cylinder, closed end — one each side



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C-frame or thrust arms - Install

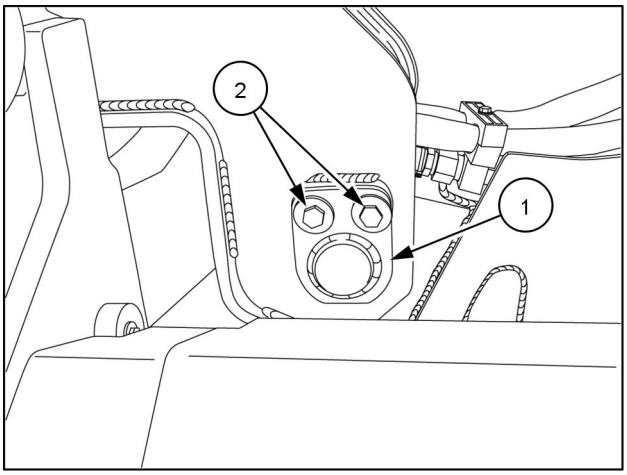
650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

Prior operation:
C-frame or thrust arms - Remove (86.124)

1. Support C-frame to correct height with appropriate supporting devices.
2. Drive machine forward until C-frame is in position.
3. Engage parking brake and shut engine off.
4. Relieve system of hydraulic pressure by actuating all hydraulic functions. Remove key when complete.

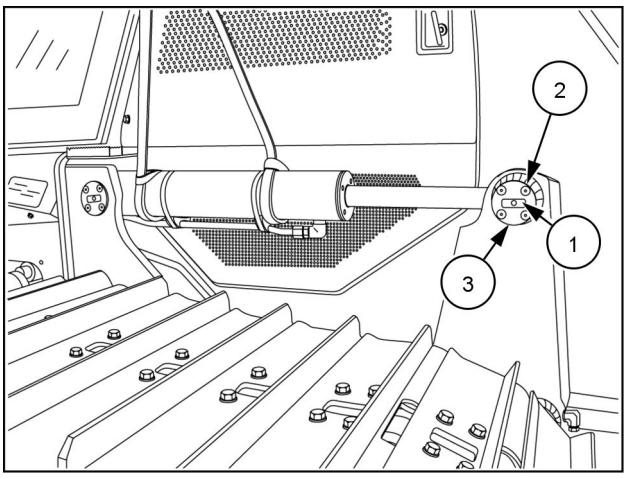
NOTE: *Wait 90 seconds after engine shutdown before turning master battery disconnect switch OFF. After engine shutdown, the Selective Catalytic Reduction (SCR) system module continues to run and conducts a purge cycle.*

5. Turn master battery disconnect switch to the OFF position.
6. Clean C-frame pins and components of dirt and debris before installing to machine.
7. Install C-frame pin spacers as noted during removal. Lightly grease pin **(1)** and install. Install C-frame pin retaining bolts **(2)**.



RAIL13DOZ0053BA 1

8. Remove C-frame supporting device.
9. Clean all rod end pin components of dirt and debris before installing to machine.
10. Install lift cylinder rod end spacers as noted during removal. Lightly grease rod end pin **(1)** and install. Install rod end pin retaining bolts **(2)**, rod end pin caps **(3)**, and spacers.



RAIL12DOZ0958BA 2

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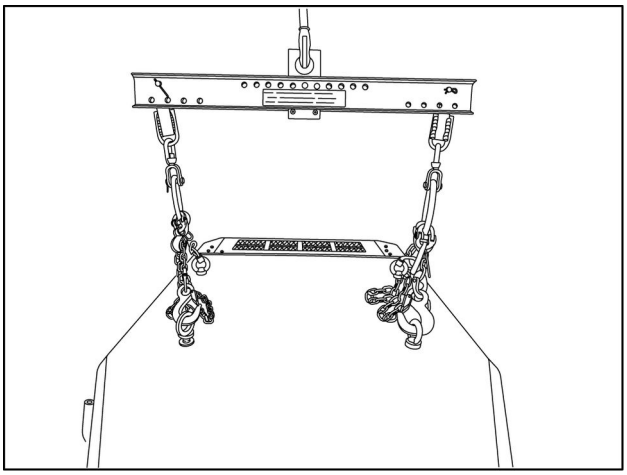
(*) See content for specific models

Cab and platform - Install

650M Long Track (LT) - Tier 4B (final) [NHC100263 -]	NA
650M Wide Track (WT) / Low Ground Pressure (LGP) - Tier 4B (final) [NHC100263 -]	NA

NOTICE: *Cab weighs approximately* ***907 kg*** *(****2000 lb****). Use appropriate lifting equipment to prevent personal injury or property damage.*

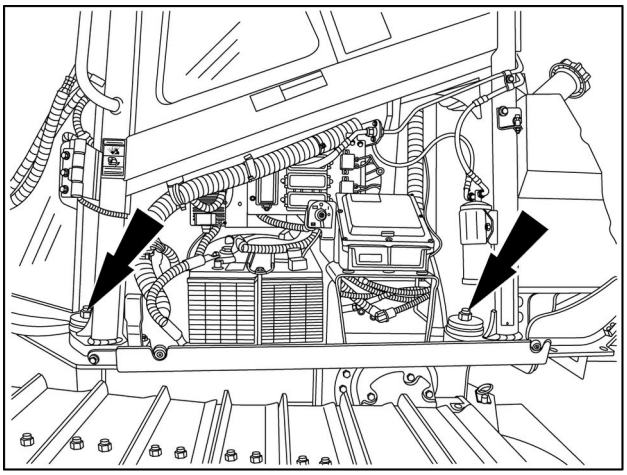
1. Attach an appropriate lifting device to cab.



RAIL13DOZ1454AA 1

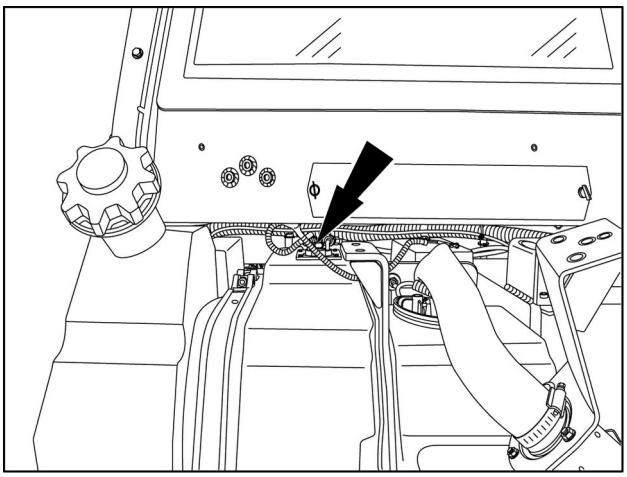
2. Install cab to machine.
3. Apply **LOCTITE® 242®** and install four cab mounting bolts, washers, and nuts. Tighten to specification. **550 – 624 N m** (**406 – 460 lb ft**)

NOTE: *Left side cab mounts, bolts, nuts, and washers are shown. Hardware on right side is similar.*



RAIL13DOZ1455AA 2

4. Remove lifting device from cab.
5. Connect fuel level sender electrical connector to top of fuel tank.



RAIL13DOZ1310AA 3