Basic instructions - Prepare machine for service/Return machine to use

Read and understand all service procedures before beginning any repairs on the machine.

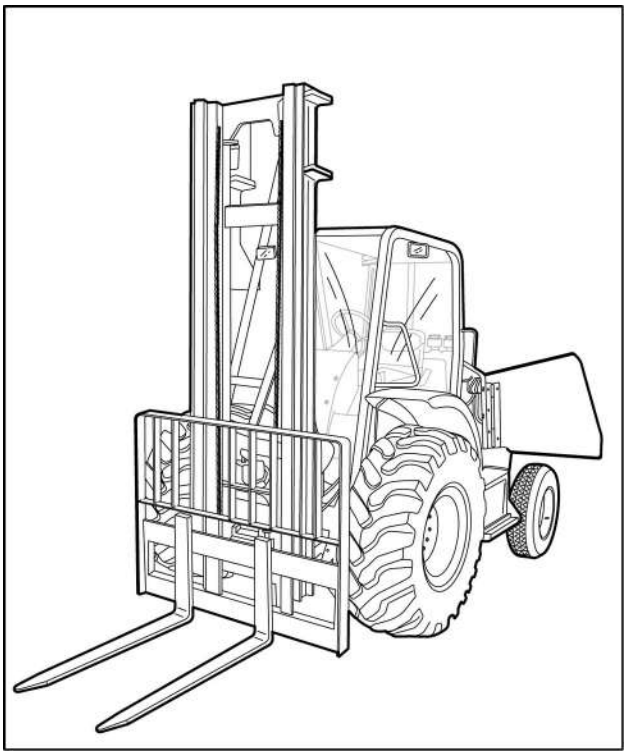
Prepare machine for service

1. Park the machine on a firm level surface.
2. Level the forks and lower the mast to the ground.
3. Make sure the park brake switch is in the park position.
4. Turn the engine OFF and chock all the wheels.

⚠ WARNING

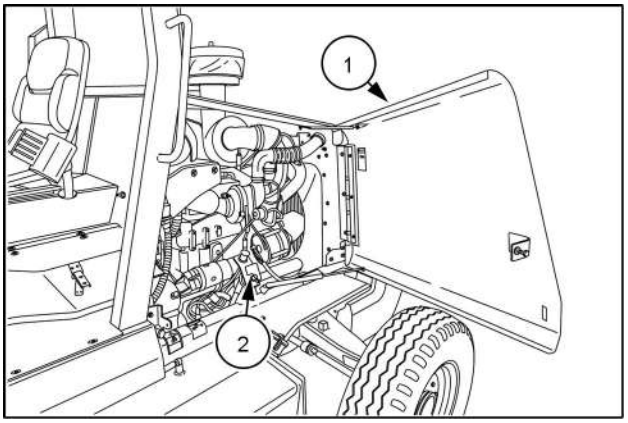
Escaping fluid!
Hydraulic fluid or diesel fuel leaking under pressure can penetrate the skin and cause infection or other injury. To prevent personal injury: Relieve all pressure before disconnecting fluid lines or performing work on the hydraulic system. Before applying pressure, make sure all connections are tight and all components are in good condition. Never use your hand to check for suspected leaks under pressure. Use a piece of cardboard or wood for this purpose. If injured by leaking fluid, see your doctor immediately.
Failure to comply could result in death or serious injury.

W0178A



RAPH12FRK0958BA 1

5. With the key in the ON position, engine NOT running, operate all hydraulic functions, including the service brakes, until all hydraulic and hydraulic accumulator pressure is discharged. Turn the key to the OFF position.
6. Open the left engine access door **(1)** and turn the battery disconnect switch **(2)** to the OFF position, if equipped.



RAPH12FRK0021BA 2

1. Manufacturer's Identification
2. Property Class
3. Clock Marking of Property Class and Manufacturer's Identification (Optional), i.e. marks **60 °** apart indicate Class 10 properties, and marks **120 °** apart indicate Class 8.

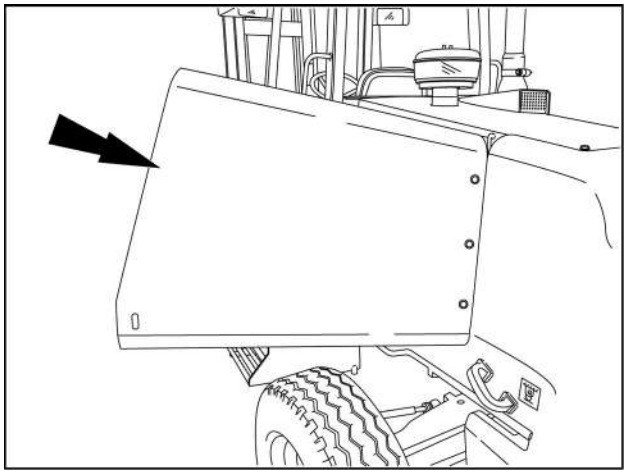
INCH NON-FLANGED HARDWARE

NOMINAL SIZE	SAE GRADE 5 BOLT and NUT		SAE GRADE 8 BOLT and NUT		LOCKNUT GrB W/ Gr5 BOLT	LOCKNUT GrC W/ Gr8 BOLT
	UN-PLATED or PLATED SILVER	PLATED W/ZnCr GOLD	UN-PLATED or PLATED SILVER	PLATED W/ZnCr GOLD		
1/4	**8 N·m (71 lb in)**	**11 N·m (97 lb in)**	**12 N·m (106 lb in)**	**16 N·m (142 lb in)**	**8.5 N·m (75 lb in)**	**12.2 N·m (109 lb in)**
5/16	**17 N·m (150 lb in)**	**23 N·m (204 lb in)**	**24 N·m (212 lb in)**	**32 N·m (283 lb in)**	**17.5 N·m (155 lb in)**	**25 N·m (220 lb in)**
3/8	**30 N·m (22 lb ft)**	**40 N·m (30 lb ft)**	**43 N·m (31 lb ft)**	**57 N·m (42 lb ft)**	**31 N·m (23 lb ft)**	**44 N·m (33 lb ft)**
7/16	**48 N·m (36 lb ft)**	**65 N·m (48 lb ft)**	**68 N·m (50 lb ft)**	**91 N·m (67 lb ft)**	**50 N·m (37 lb ft)**	**71 N·m (53 lb ft)**
1/2	**74 N·m (54 lb ft)**	**98 N·m (73 lb ft)**	**104 N·m (77 lb ft)**	**139 N·m (103 lb ft)**	**76 N·m (56 lb ft)**	**108 N·m (80 lb ft)**
9/16	**107 N·m (79 lb ft)**	**142 N·m (105 lb ft)**	**150 N·m (111 lb ft)**	**201 N·m (148 lb ft)**	**111 N·m (82 lb ft)**	**156 N·m (115 lb ft)**
5/8	**147 N·m (108 lb ft)**	**196 N·m (145 lb ft)**	**208 N·m (153 lb ft)**	**277 N·m (204 lb ft)**	**153 N·m (113 lb ft)**	**215 N·m (159 lb ft)**
3/4	**261 N·m (193 lb ft)**	**348 N·m (257 lb ft)**	**369 N·m (272 lb ft)**	**491 N·m (362 lb ft)**	**271 N·m (200 lb ft)**	**383 N·m (282 lb ft)**
7/8	**420 N·m (310 lb ft)**	**561 N·m (413 lb ft)**	**594 N·m (438 lb ft)**	**791 N·m (584 lb ft)**	**437 N·m (323 lb ft)**	**617 N·m (455 lb ft)**
1	**630 N·m (465 lb ft)**	**841 N·m (620 lb ft)**	**890 N·m (656 lb ft)**	**1187 N·m (875 lb ft)**	**654 N·m (483 lb ft)**	**924 N·m (681 lb ft)**

NOTE: *For Imperial Units,* ***1/4 in*** *and* ***5/16 in*** *hardware torque specifications are shown in pound-inches.* ***3/8 in*** *through* ***1 in*** *hardware torque specifications are shown in pound-feet.*

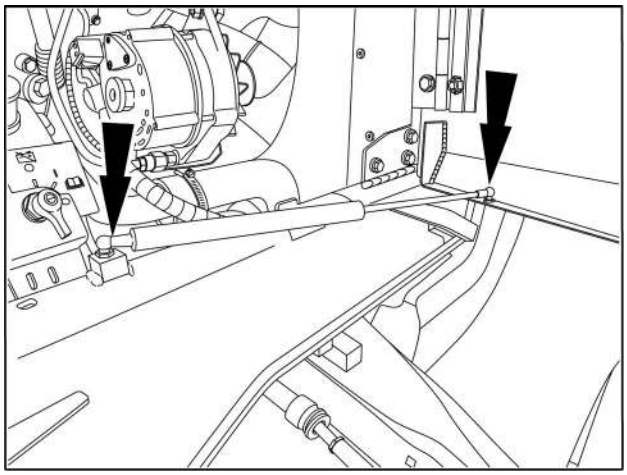
Engine - Remove

1. Prepare the machine for service.
2. Open both side panels.



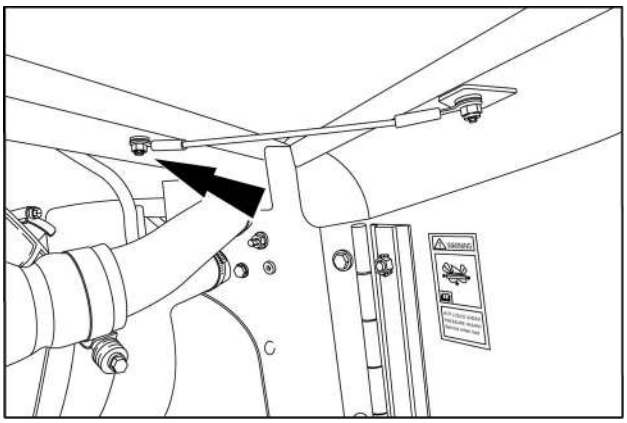
RAPH12FRK0026BA 1

3. Remove the retaining pin from both ends of the strut.
4. Pull the end of the strut off of the ball stud.
5. Pull the other end of the strut off of the ball stud.
6. Keep the retaining pins with the strut.



RAPH12FRK0027BA 2

7. Remove the nut and washer that secures the strap to the hood.



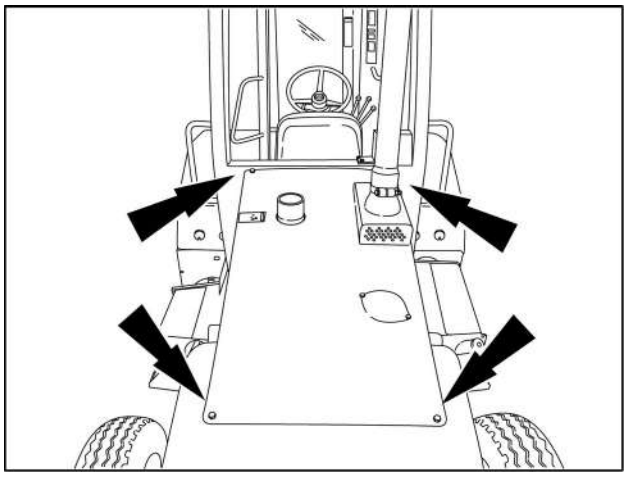
RAPH12FRK0028BA 3

12. Remove the four hood mounting bolts.

⚠ WARNING

Avoid injury!
The component is heavy. Removal/installation requires two persons or a lifting device.
Failure to comply could result in death or serious injury.

W1141A

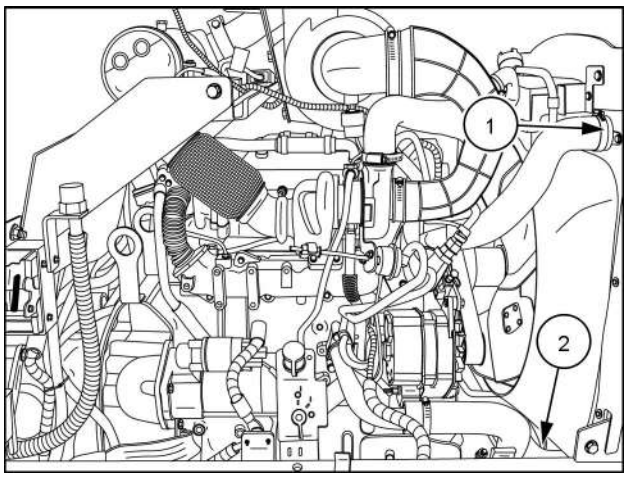


RAPH12FRK0058BA 7

Specification

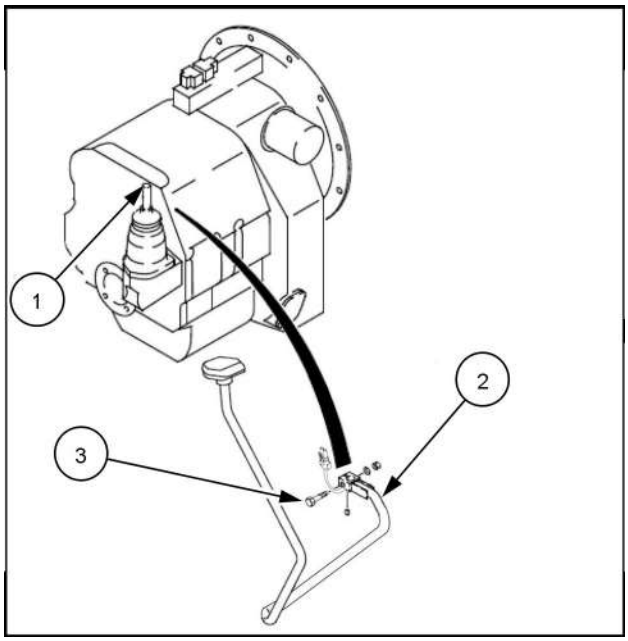
Hood weight (approximate)	**27.2 kg** (**60 lb**)

13. Using an appropriate lifting device or the aid of an assistant, remove the hood.
14. Remove the counterweight. Refer to **Counterweight - Remove (39.140)**
15. Drain the engine cooling system. Refer to **Engine cooling system - Drain fluid (10.400)**
16. Drain the hydraulic oil. Refer to **Oil reservoir - Drain fluid (35.300)**
17. Disconnect the upper radiator hose **(1)** at the radiator. Close all openings.
18. Disconnect the lower radiator hose **(2)** at the radiator. Close all openings



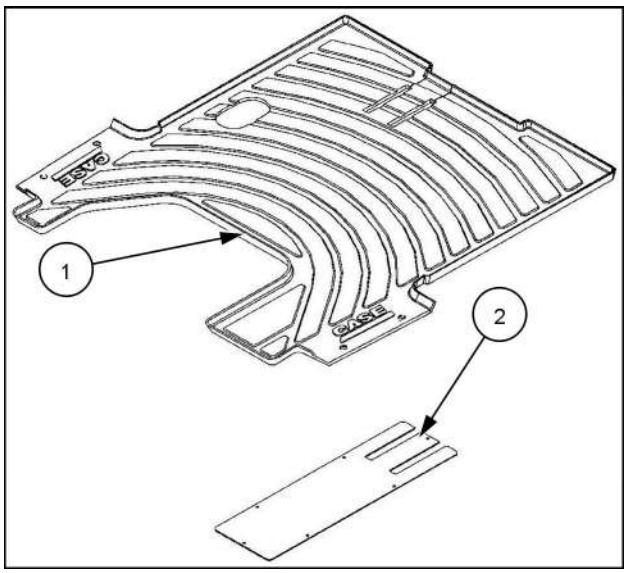
RAIL14FRK0109BA 8

25. Install the transmission gear shift lever **(2)** onto the transmission shift mechanism **(1)**. Tighten the pinch bolt **(3)** securely.



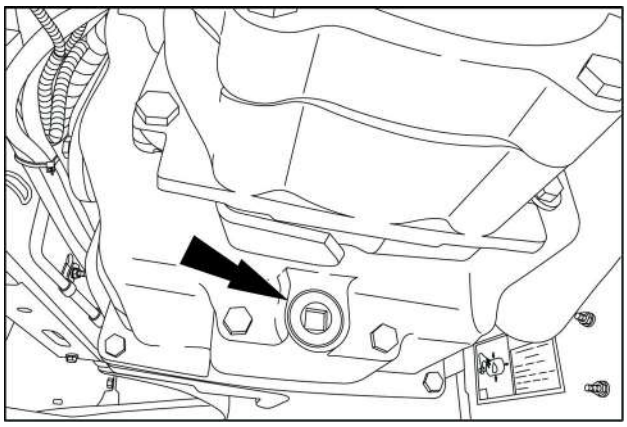
RAPH12FRK0087BA 17

26. Install the cab floor plate **(2)** and the floor mat **(1)**.



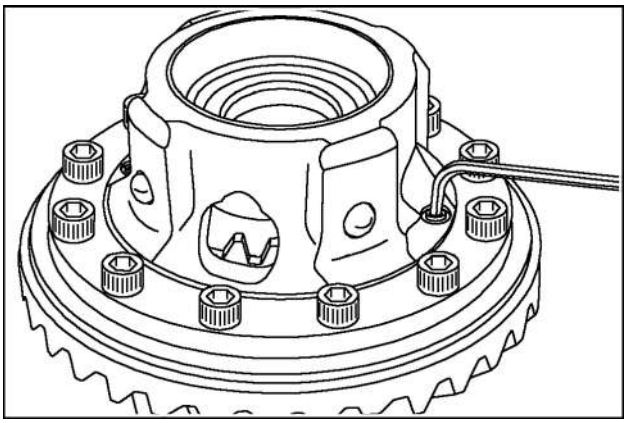
RAPH12FRK0101BA 18

27. Confirm the transmission drain plug is installed and tightened.



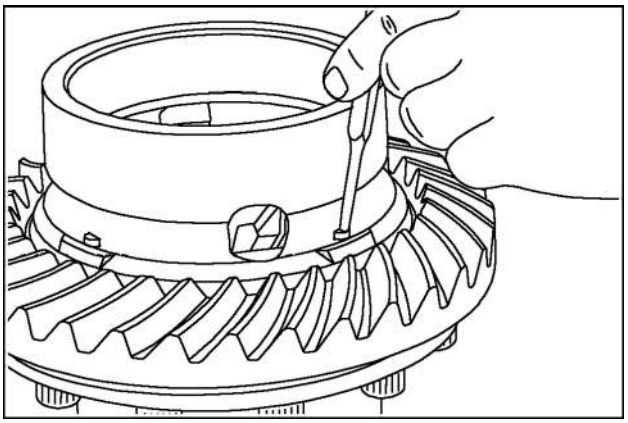
RAPH12FRK0084BA 19

9. Remove three plugs from the differential.



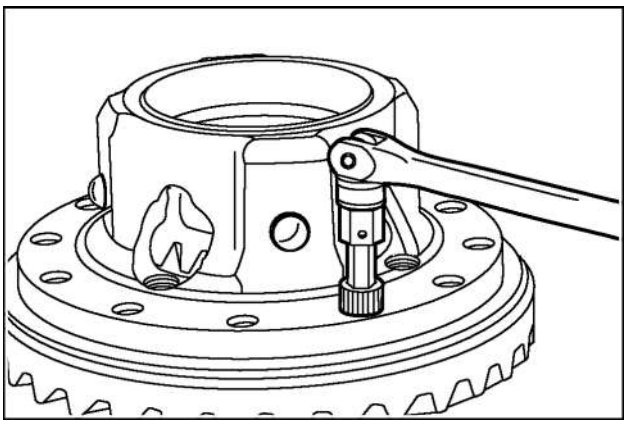
RCPH10TLB437AAL 8

10. Remove the three pins securing the spider pins in the differential.



RCPH10TLB438AAL 9

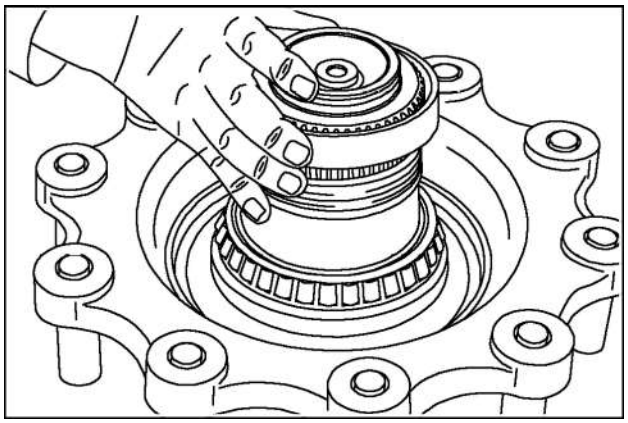
11. Remove the ring gear cap screws, remove the ring gear.



RCPH10TLB440AAL 10

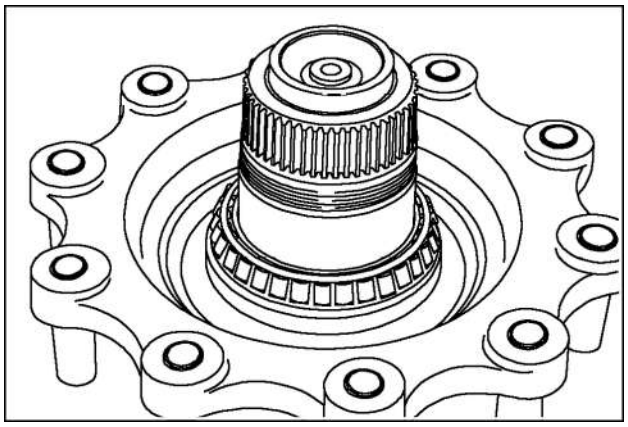
NOTE: *Large amounts of Loctite was used during assembly, remove cap screws slowly. If screw binds, turn back in and then back out.*

44. Remove spacer from wheel flange.



RCPH10TLB431AAL 44

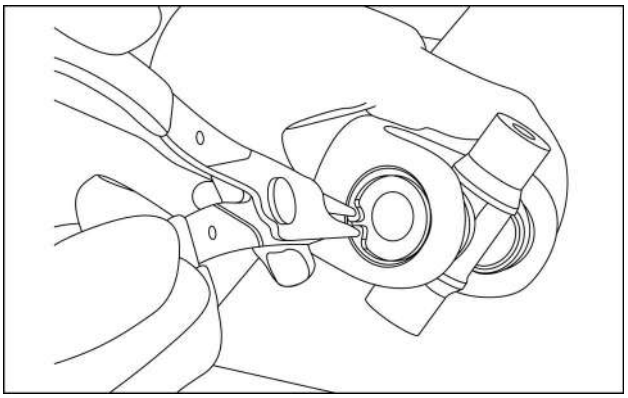
45. To remove the inner bearing, use a die grinder to cut the roller retainer and race. Use a chisel in the slot cut in the race to crack the race, remove the race.



RCPH10TLB430AAL 45

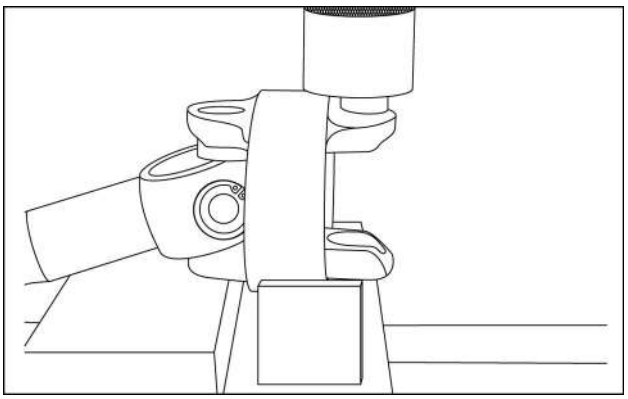
Next operation:
Planetary drive and hub - Inspect (25.108)

34. Install a snap ring.



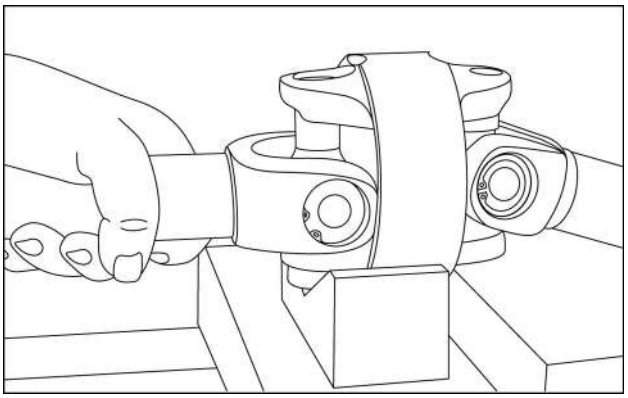
RCPH10TLB591ABL 32

35. Repeat steps 31and 32 for the remaining bearing cap.
36. Use the V-block to support the coupling and press a bearing cap into the coupling even with the outside diameter of the coupling.



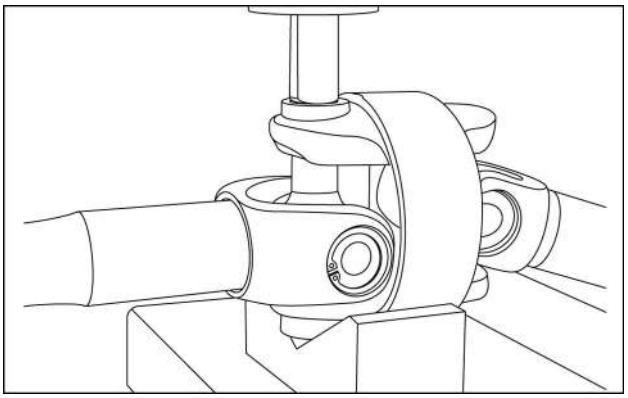
RCPH10TLB592ABL 33

37. Carefully install the cross in the bearing cap.



RCPH10TLB595ABL 34

38. Use an acceptable driver and press the other bearing cap into the coupling until the top of the bearing cap is **6 mm** (**0.24 in**) above the top of the coupling.



RCPH10TLB597ABL 35

Brake pedals - Travel adjust

586H	
588H	

NOTE: *Free travel is the distance that the brake pedal can move before the push rod makes contact with the outer piston in the master cylinders.*

1. Measure the free travel at the rear edge of each brake pedal (1 and 2) as shown. The free travel must be **2 - 4 mm** (**0.1 - 0.2 in**).
2. To increase or decrease the free travel, loosen the lock nut **(4)** at each clevis (11) and turn the push rod as necessary to get the correct free travel. Tighten the lock nut.
   Refer to **Brake pedals - Overview (33.202)** for more information.

Telescopic arm cylinder - Disassemble Standard Cylinder

586H	
588H	

1. Remove the Standard Cylinder.

⚠ WARNING

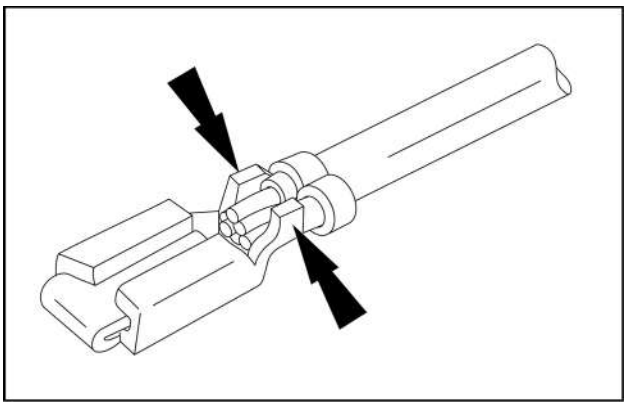
Chemical hazard!
Always wear protective clothing and goggles when cleaning with solvents, acids, or alkaline chemical agents. Always follow the chemical manufacturer's instructions.
Failure to comply could result in death or serious injury.

W0180A

2. To avoid any contamination from entering the cylinder cavity, clean the outside of the cylinder. If the hoses were removed with the cylinder, remove the hoses from the cylinder.
3. Fasten the tube **(1)** in a soft-jawed vise or other holding equipment. Be careful to prevent damage to the tube.
4. Use the spanner wrench to turn the gland **(2)** out of the tube.
5. Pull the piston rod **(5)** straight out of the tube to prevent damage to the tube.
6. Remove the gland from the piston rod.
7. Remove the wear ring **(4)** from the piston **(3)**.
8. Remove the O-ring **(6)**, backup ring **(7)**, wiper **(8)**, U-cup **(10)**, and the buffer seal **(9)** from the gland.
9. Replace parts as necessary.

Intermittent circuit

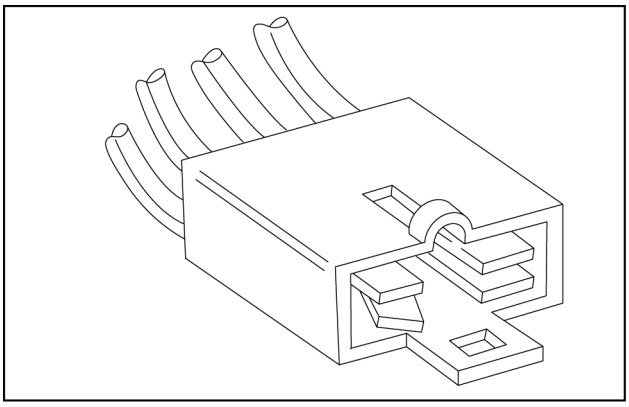
- The terminal is not crimped on the wire(s).



RAIL14SSL0596AA 10

Intermittent circuit

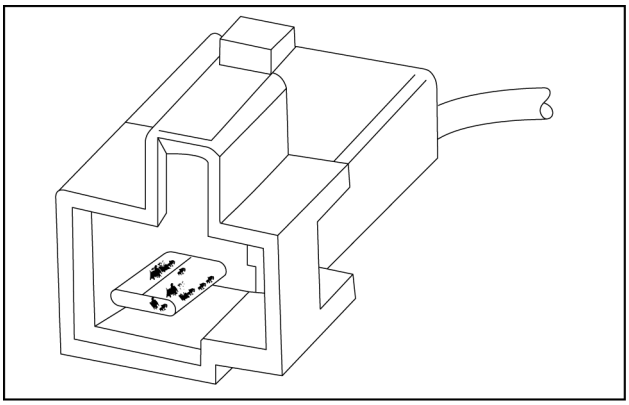
- Bent pins may cause a short circuit if the two terminals do not contact.
- The male and female connectors may not make contact because of the bent pin.



RAIL14SSL0597AA 11

Intermittent circuit

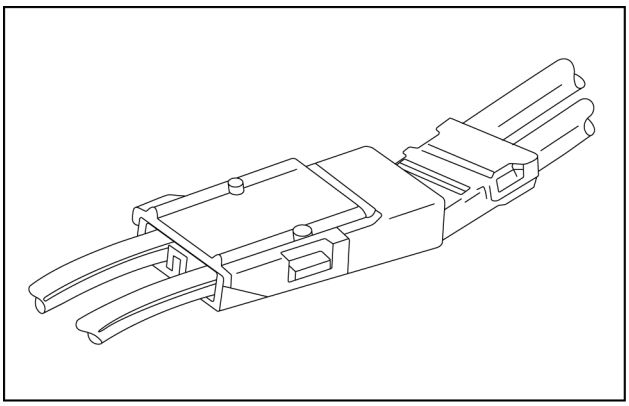
- Corrosion on the pin(s) is Indicated by a layer of greenish-white powder appearing on the pins.
- Corroded pins may overheat because of increased resistance due to corrosion.



RAIL14SSL0598AA 12

Intermittent circuit

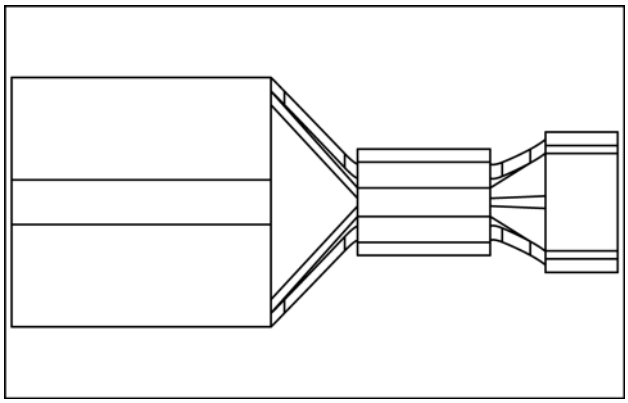
- Partially disconnected connectors make contact with only some terminals.



RAIL14SSL0599AA 13

CONNECTOR X-067 - X-067

CONNECTOR X-067 - X-067			
PIN NUMBER	**WIRE NUMBER**	**CIRCUIT REFERENCE**	**ELECTRICAL SCHEMATIC FRAME**
1	3801 (BL)	X-067 X-001TO MAIN (X-051)	



84177908 4

Schematic Legend			
(1)	Instrument cluster connector X-033	**(2)**	Transmission temperature sender connector X-071

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

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

3. Measure the resistance across the sensor.

   Turn the ignition switch OFF.

   Disconnect the transmission temperature sensor connector X-071.

   Measure the resistance across the transmission temperature sensor. The resistance should be between **30 Ω** and **68.7k Ω**. Refer to the chart for more details.

Temperature	Resistance		Temperature	Resistance
-35 °C	**68634 Ω**		**65 °C**	**456 Ω**
-25 °C	**35440 Ω**		**75 °C**	**321 Ω**
-15 °C	**19116 Ω**		**85 °C**	**230 Ω**
-5 °C	**10721 Ω**		**90 °C**	**168 Ω**
5 °C	**10721 Ω**		**105 °C**	**124 Ω**
15 °C	**3756 Ω**		**115 °C**	**93 Ω**
25 °C	**2336 Ω**		**125 °C**	**71 Ω**
35 °C	**1496 Ω**		**135 °C**	**55 Ω**
45 °C	**983 Ω**		**145 °C**	**43 Ω**
55 °C	**662 Ω**		**155 °C**	**34 Ω**

A. The resistance values are within range. Go to step **1**.

B. The resistance measurements are not within range. Temporarily replace the sender and retest. Return to step **1** to confirm elimination of the fault.

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

   Disconnect the transmission temperature sender from the harness.

   Disconnect the instrument cluster connector X-033.

   Measure the resistance between X-033, pin 16 and chassis ground. Wiggle the harness during measurement to reveal an intermittent condition. The resistance should be greater than **20,000 Ω**.

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

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

Wiring harnesses - Electrical schematic sheet 10 Instrument cluster (55.100.DP-C.20.E.10)

3252-Controller Watchdog - SPI Communication Failure

Context:
The Engine Control Unit (ECU) A-9000 monitors the communication between the ECU A-9000 processor and the power stage controller over the SPI bus. If there is an error in the communication, this fault will occur.

Solution:

1. Check the ECU A-9000 for the appropriate software and re-flash, if necessary.
   A. If the fault has been resolved, return the machine to service.
   B. If the fault has not been resolved, escalate an ASIST concern.

Disconnect the vehicle harness (VE) from the engine interface connector **X-9138**.

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

From	To	Value
X-9011 pin 6	**X-9011 pin 2**	There should be no continuity.
X-9011 pin 6	**X-9011 pin 1**	There should be no continuity.
X-9011 pin 2	**X-9011 pin 1**	There should be no continuity.
X-9138 pin 37	All pins in connector **X-9138**	There should be no continuity.
X-9138 pin 38	All pins in connector **X-9138**	There should be no continuity.

A. If there is continuity, there is a short circuit in the throttle valve actuator Z-9001 engine harness (EN) h-bridge circuit. Locate and repair the shorted conductor.

B. If there is no continuity, leave connectors **X-9138**, **X-9121**, and **X-9011** disconnected and continue to Step **5**.

5. Check the throttle valve actuator Z-9001 vehicle harness (VE) h-bridge circuit for a short to high source condition.

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

From	To	Value
X-9138 pin 37	All pins in connector **X-9138**	There should be no continuity.
X-9138 pin 38	All pins in connector **X-9138**	There should be no continuity.
X-9121 pin A49	All pins in connector **X-9121**	There should be no continuity.
X-9121 pin A34	All pins in connector **X-9121**	There should be no continuity.

A. If there is continuity, there is a short to high source in the throttle valve actuator Z-9001 vehicle harness (VE) h-bridge circuit. Use the appropriate service manual, if necessary, to locate and repair the shorted conductor.

B. If there is no continuity, leave connector **X-9011** disconnected and continue to Step **6**.

6. Replace the throttle valve actuator Z-9001.

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 A-9000 for the appropriate software and re-flash, if necessary.

7. Visually inspect the relevant harnesses and connectors for damage, bent or dislocated pins, corroded terminals, or broken wires. Verify that the connectors are fully installed. Flex the harnesses involved to reveal intermittent breaks or shorts in the wiring concerned. Operate the machine while 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 – Engine Control Unit (ECU) engine connector (55.100.DP-C.20.E.05)
Wiring harnesses - Electrical schematic sheet 06 – Engine control and fuel injection (55.100.DP-C.20.E.06)