ISSUE DATE:	1-25-2021
SERVICE BULLETIN SUBJECT:	Duopower Wheel End Replacement
VINs or MODELS AFFECTED:	Service Specified Buses
COMPLETE BY:	Next Service Opportunity
SERVICE BULLETIN #:	SC-21-29
Labor Operation Code:	PP44Z

NOTICE! It is expected that this process will require 16 person-hours per bus. It is recommended to use two associates for this work. Please schedule appropriately to minimize vehicle downtime.

DUOPOWER WHEEL END REPLACEMENT

Retrofit Description:

This procedure is used to replace Wheel Ends on Duopower axles.

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Tools/Parts Required

Tools and Supplies Required:

- Approved Wheel Lifts (4 Required)
- Jack Stands (4 Required)
- Approved Lifting Device for Duopower Axle
- Ratchet
- 1/2-Inch Drive Pull Handle
- 10mm Socket
- 12mm Socket
- 13mm Socket
- 16mm Socket (6-Point)
- TMFS 5 Socket (Proterra P/N 120-7746)
- TMFS #7 Lock Nut Socket (Proterra P/N 120-7747)
- Wheel-end Tool (Proterra P/N 120-5847)
- Approved Lifting Device for Wheel End
- Dog Bone Tool
- Snap Ring Pliers
- Pick or Flat Blade Screwdriver
- Heat Gun
- Brass Mallet
- Pry-Bar
- Small Hammer
- Flashlight
- Calibrated Torque Wrench
- Offset Adapter for Torque Wrench (Proterra P/N 128-2242)
- Flashlight
- Orange Paint Pen
- Orange Torque Stripe Paint
- US Lube or other approved SAE 80W90 Oil
- Loctite 243
- Never Seize

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Kit Parts Required:

- 057134 KIT, REPAIR, DUOPOWER WHEELEND (Consisting of)
  - 050316 O RING, WHEEL END, AXLE 1 EA
  - 125-6417 WASHER, LOCK 2 EA
  - 050317 SNAP RING COVER, WHEEL END, AXLE 1 EA
  - 050320 THRUST WASHER, WHEEL END, AXLE 1 EA
  - 050321 SHAFT NUT,WHEEL END, AXLE 1 EA
  - 050560 WHEEL END RING GEAR, WHEEL END, AXLE 1 EA
  - 050562 WHEEL HUB, WHEEL END, AXLE 1 EA
  - 050390 SHAFT, PLANETARY GEAR, AXLE 1 EA
  - 050393 BEARING, SHAFT, PLANETARY GEAR, AXLE 1 EA
  - 050394 PLANET GEAR CARRIER, AXLE 1 EA
  - 050395 WHEEL END PLANETARY SUN GEAR, AXLE 2 EA
  - 050262 SHAFT NUT, GEAR BOX, AXLE 1 EA
  - 050306 SPINDLE NUT RETAIN-WASHER, WHEEL END, AXLE 1 EA
  - 050307 SPINDLE NUT, WHEEL END, AXLE 1 EA
  - 050309 WHEEL END COVER, WHEEL END, AXLE 1 EA
  - 050311 SHAFT RETAIN-WASHER, WHEEL END, AXLE 1 EA
  - 050312 DRAIN/FILL PLUG,WHEEL END, AXLE 2 EA
  - 050313 COVER BOLTS, WHEEL END, AXLE 7 EA
  - 050314 SEAL WASHER,WHEEL END, AXLE 7 EA

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Procedure:

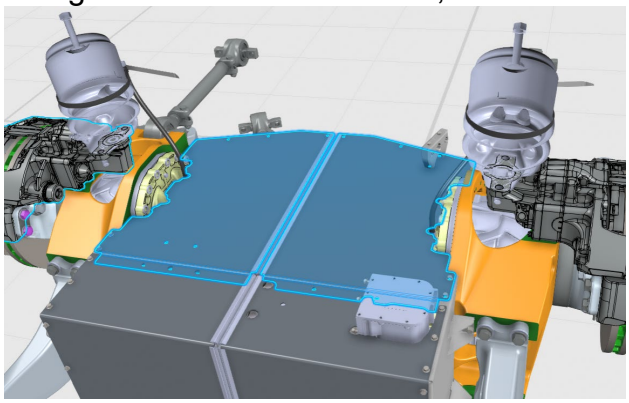
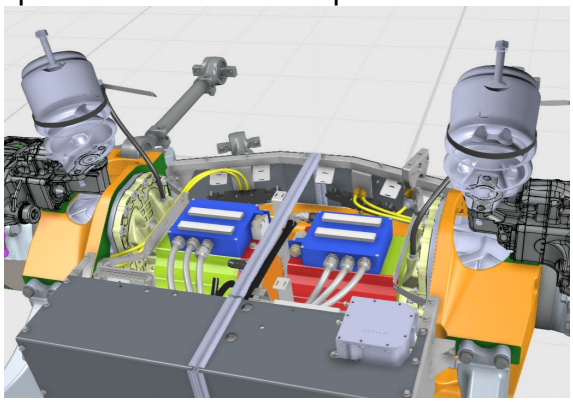
1. This procedure requires the removal and replacement of the Duopower Axle from the bus. The Axle removal and replacement procedures are included in the Maintenance Manual applicable to the bus that you are working on. Prior to beginning the procedure, you should familiarize yourself with the removal and replacement procedure for the Axle in the Maintenance Manual as well as the procedure in this document. The latest version of the Maintenance Manual should be downloaded from the following location before beginning the procedure.
   \\bus.local\files\Engineering\Service Bulletins\Service Bulletin Files for SC-21-29

2. Complete the Proterra approved Lockout/Tagout procedure to make the bus safe for work.

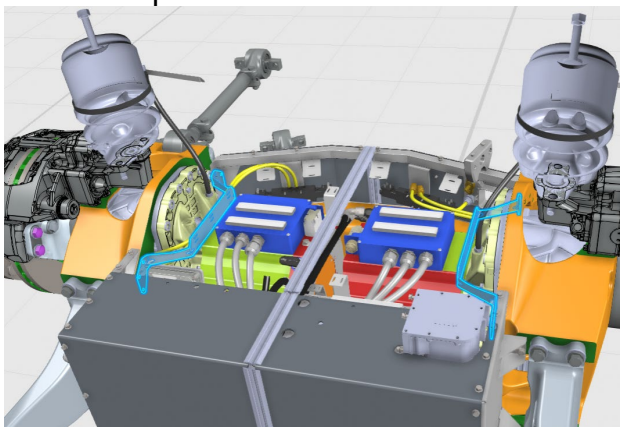
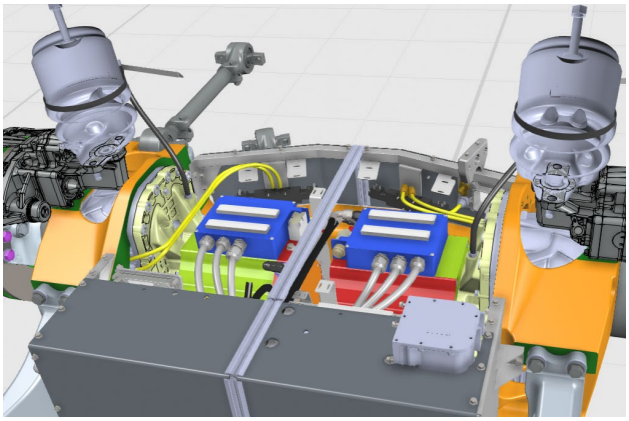
3. Lift the bus using Wheel Lifts and support it with Jack Stands to access the Duopower Drive.

4. Refer to the Maintenance Manual for lifting the bus and the removal and reinstallation of the Duopower Drive.

5. Using a 10mm Ratchet/Socket, remove the top covers from the Duopower Axle.

6. Using a 13mm Ratchet/Socket, remove the bolts that secure the Harness Brackets (046740) to the Duopower Drive.

7. Carefully remove the Harness Brackets (046740) from the Gearboxes

8. Access one of the Gearboxes through the area where the Harness Brackets (046740) were removed. Cut any Cable Ties (001912) necessary to access the gearbox.

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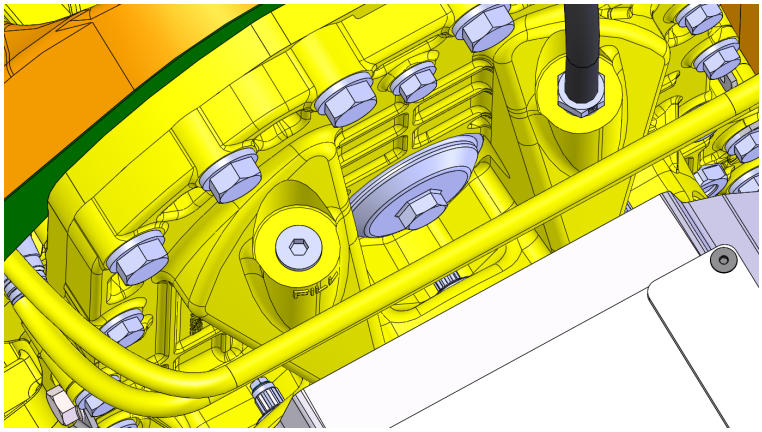
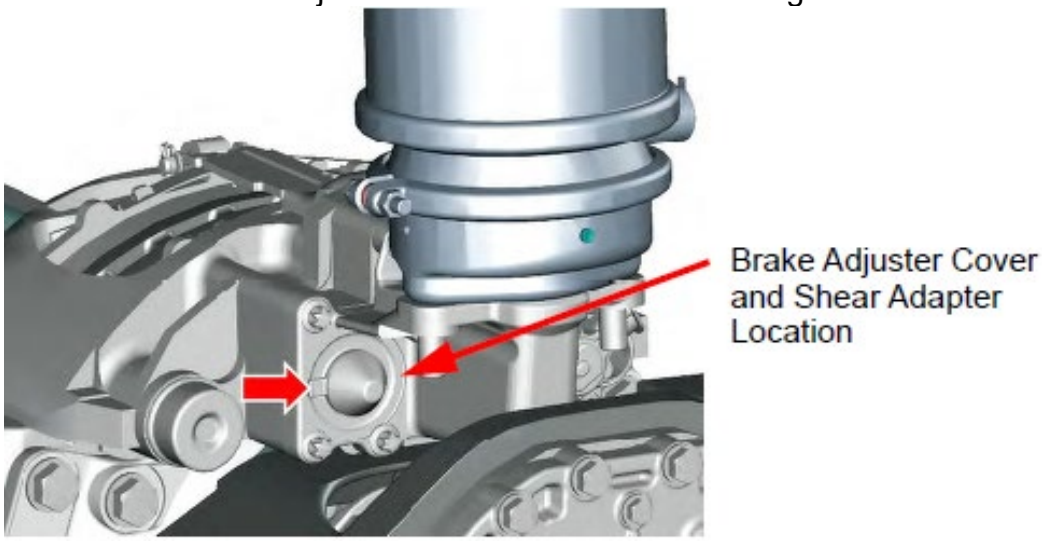


9. Remove the Brake Adjuster cover shown in the following illustration and set it aside.



10. Using the Shear Adapter, back off the brakes.
    Note: If two Shear Adapters fail while attempting to back off the brakes, install a new brake caliper as internal damage may be present.

11. Disconnect the Brake Lining Wear Sensor electrical connector.

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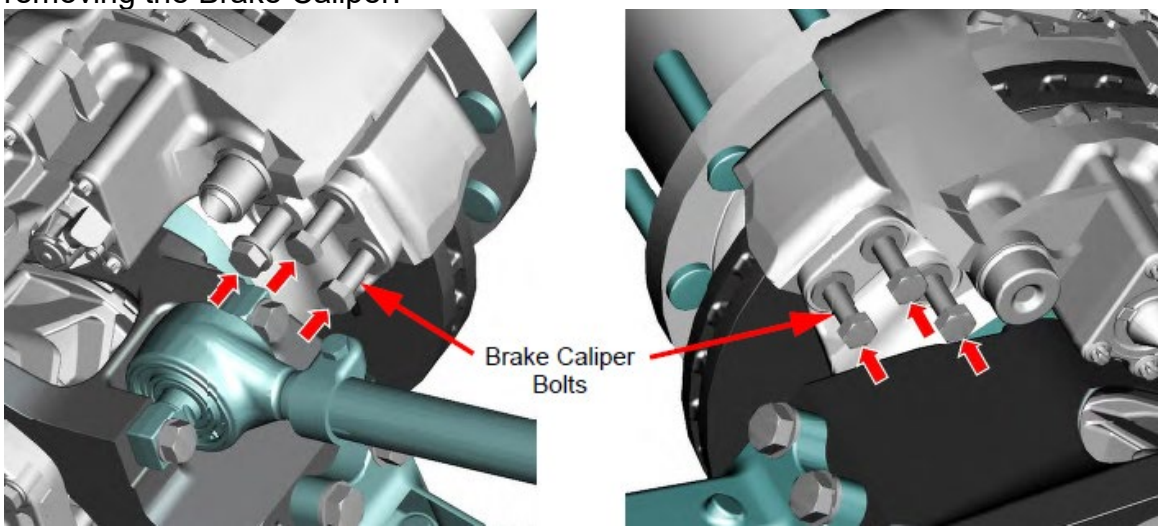
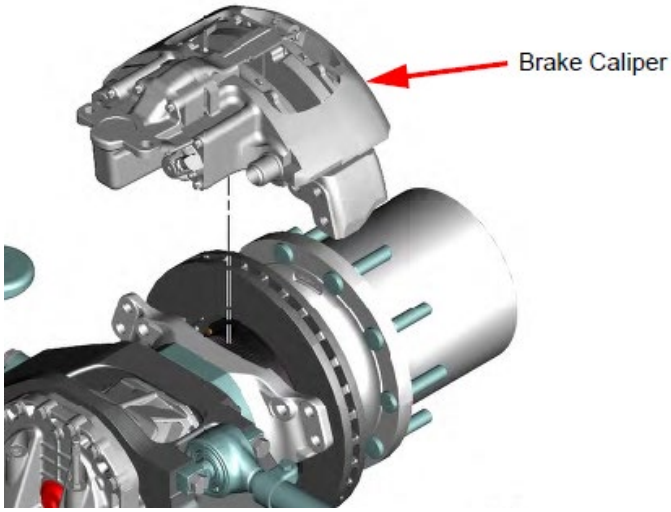
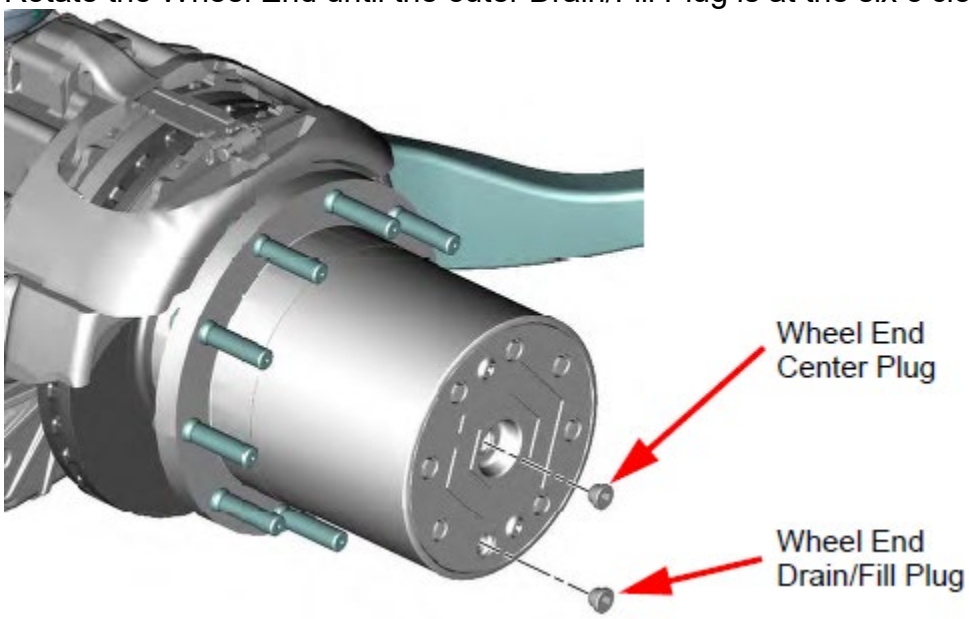
12. Using a Dog Bone Tool, loosen the Brake Caliper Bolts. Leave the Bolts in the Bracket after removing the Brake Caliper.



13. Remove the Brake Caliper.



14. Rotate the Wheel End until the outer Drain/Fill Plug is at the six o'clock position.



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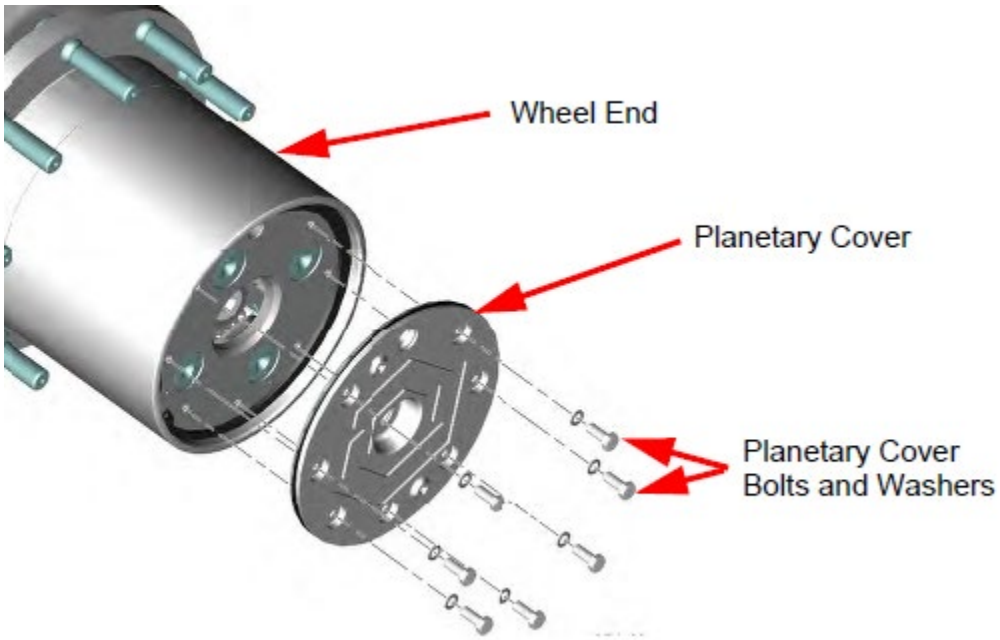
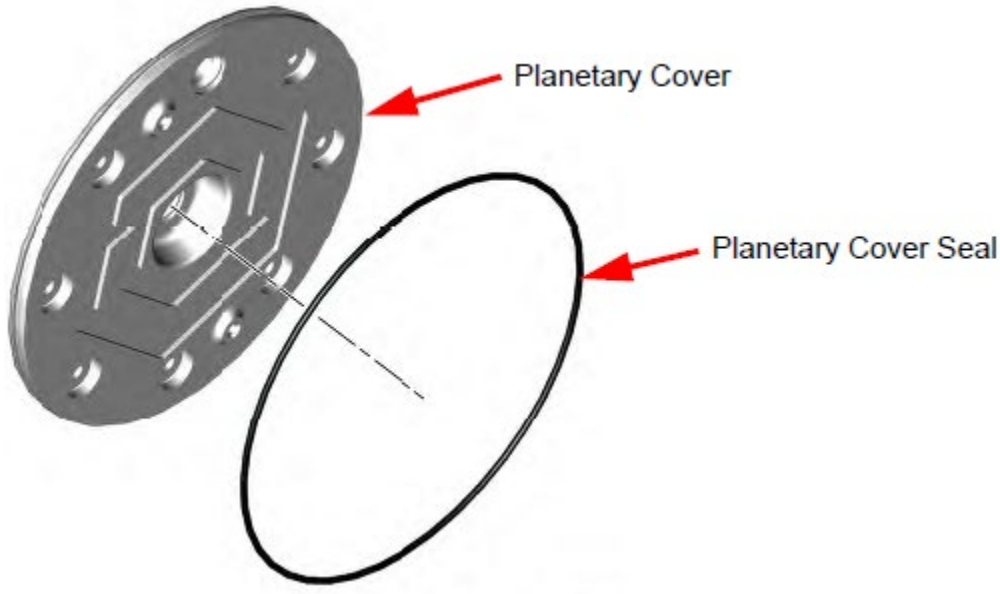
15. Place a Catch Pan capable of holding three quarts of fluid below the hub.

16. Using a 12mm Ratchet/Socket, remove the Drain/Fill Plug and Center Plug to allow the Wheel End to drain into the Catch Pan.

17. Using a 16mm Ratchet/Socket, remove the Bolts, Washer Seals, and Planetary Cover. Discard the Washer Seals.



18. Remove and discard the Planetary Cover and O-ring Seal.



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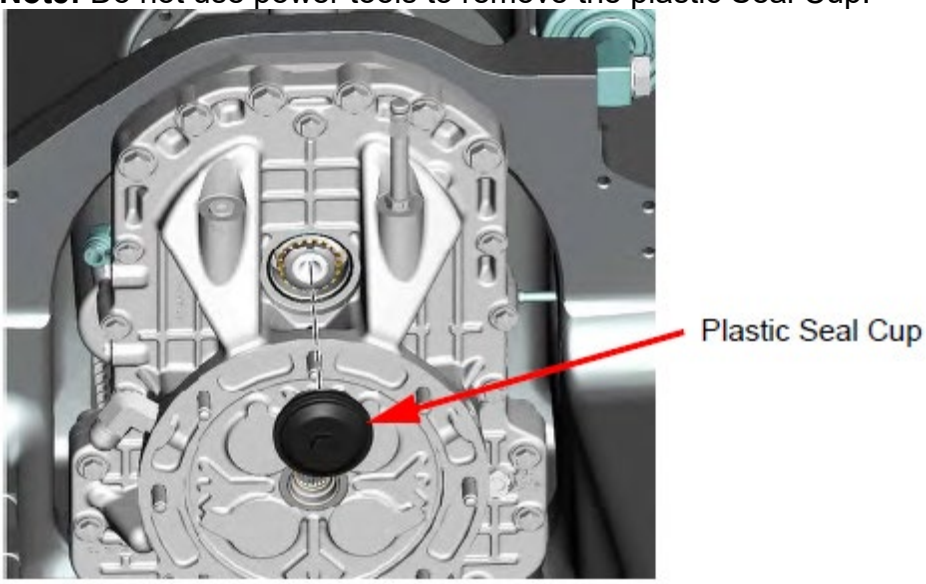
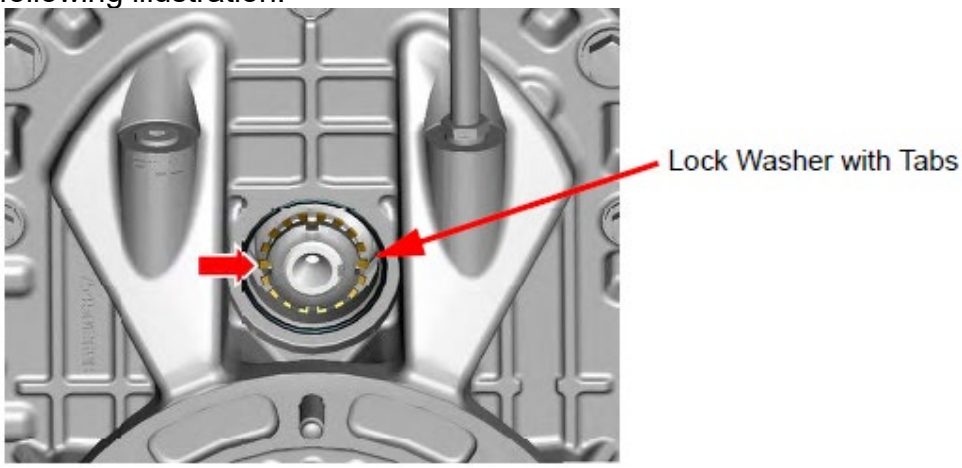
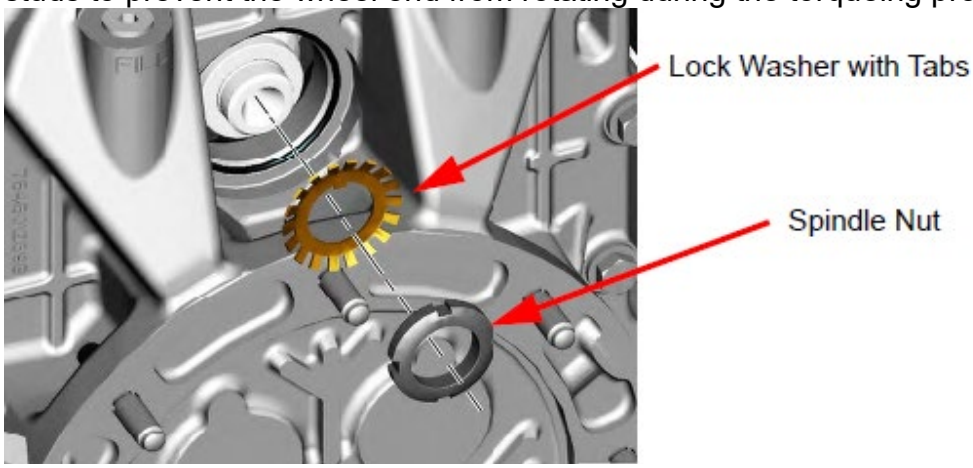
19. Using a 16mm Ratchet/Socket, remove and discard the Seal Cup.
    Note: Do not use power tools to remove the plastic Seal Cup.



20. Using a Pick or Flat Blade Screwdriver, straighten the tab shown on the Lock Washer in the following illustration.



21. Using a 1/2-Inch Pull Handle with a TMS #5 Spindle Nut Socket, remove the Nut and Lock Washer. Discard the Lock Washer.
    Note: An assistant may be required to position a Pry-Bar or similar tool between the wheel studs to prevent the wheel end from rotating during the torqueing process.



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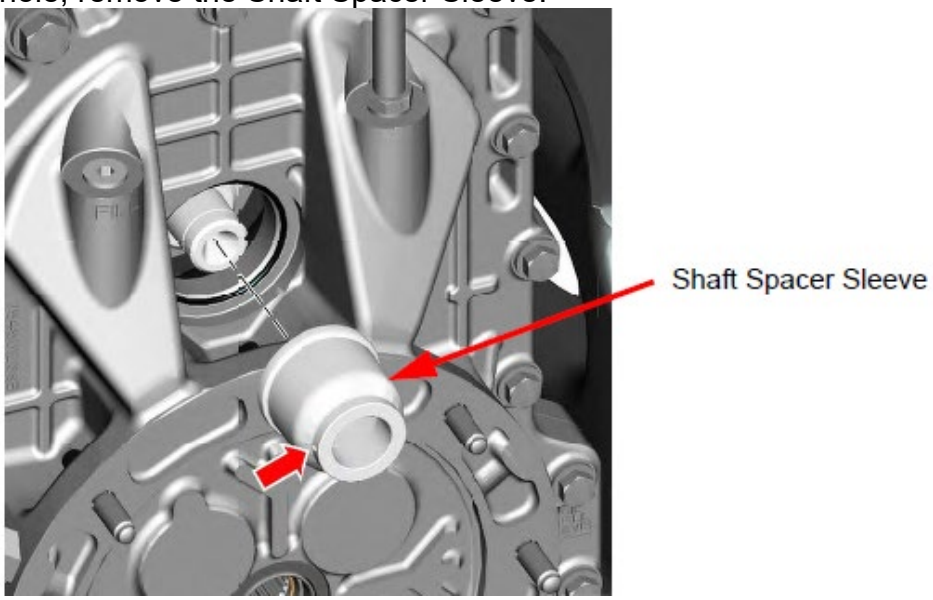
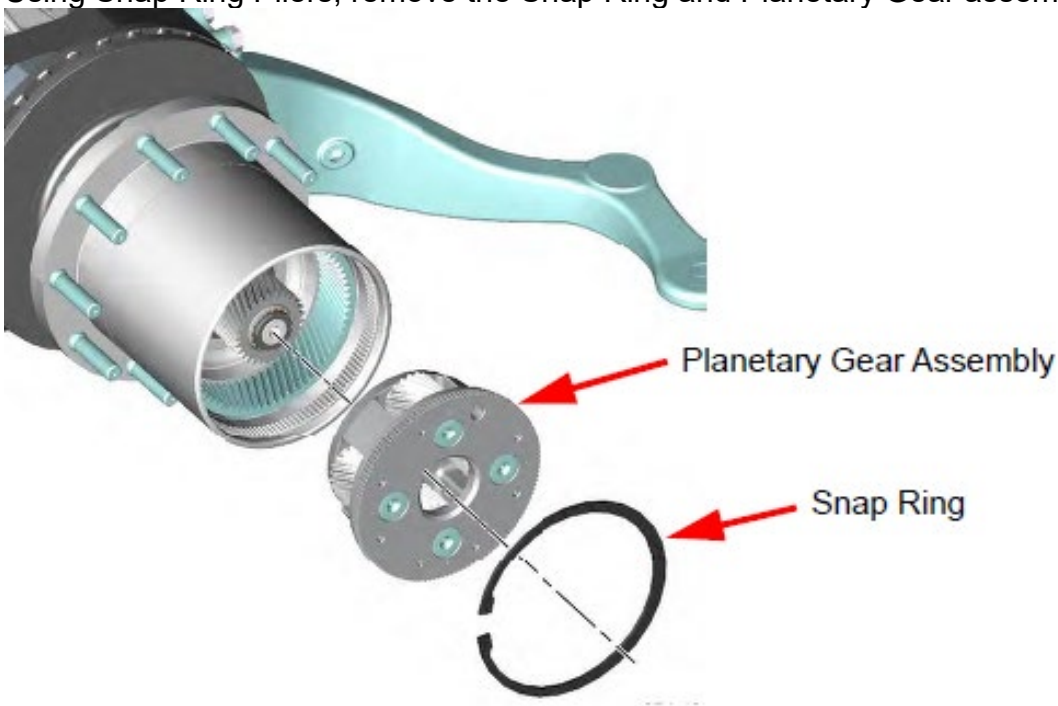
22. Locate the small hole in the Shaft Spacer Sleeve shown below. Using a Pick placed in the hole, remove the Shaft Spacer Sleeve.



23. Using Snap Ring Pliers, remove the Snap Ring and Planetary Gear assembly.



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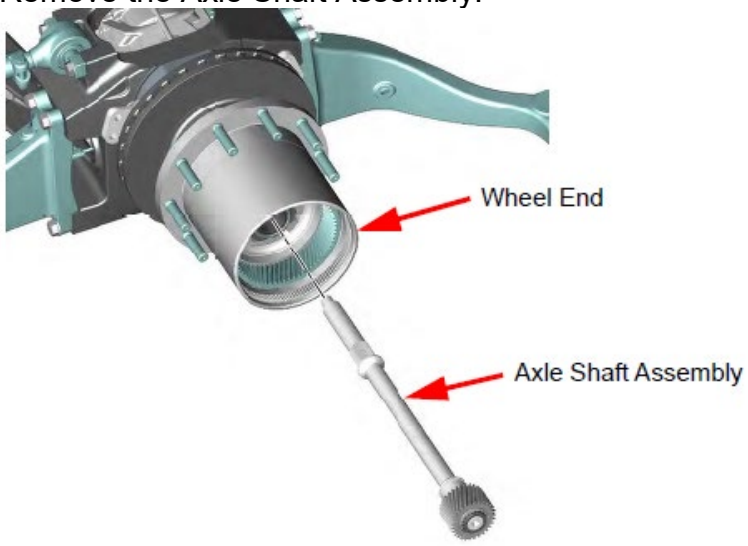
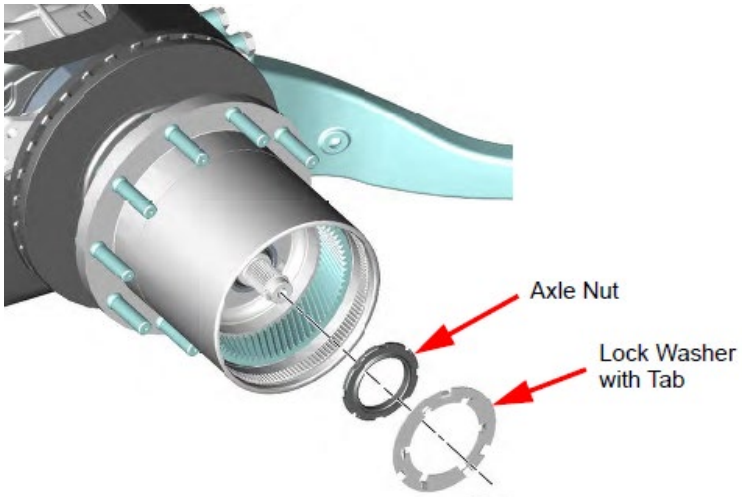
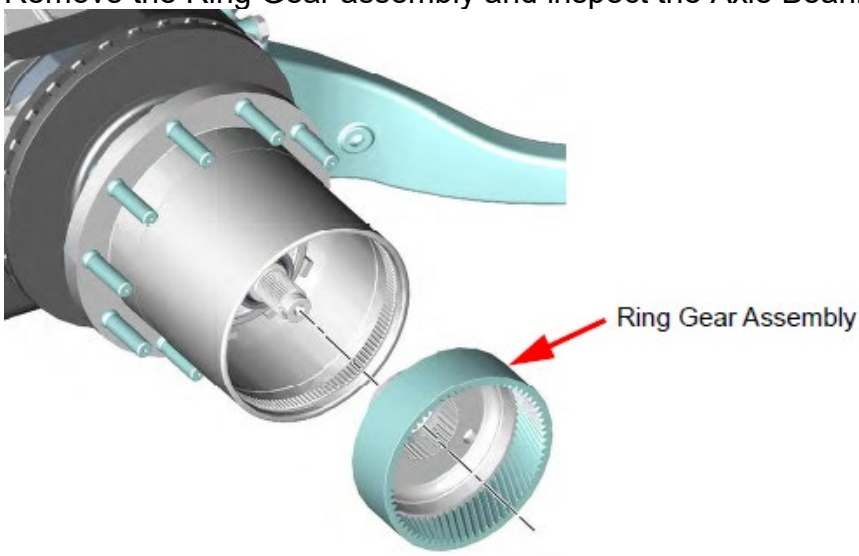
24. Remove the Axle Shaft Assembly.



25. Using a Flat Blade Screwdriver, drive the two engaged tabs of the Spindle Lockwasher down flat. Using the Wheel End Tool (120-5847), remove the Spindle Nut and Lock Washer shown below. Discard the Lock Washer.



26. Remove the Ring Gear assembly and inspect the Axle Bearing.



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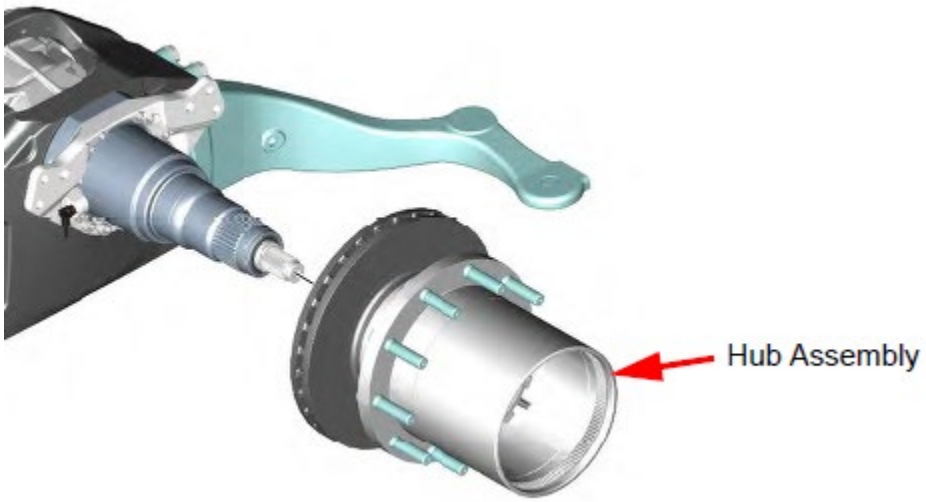
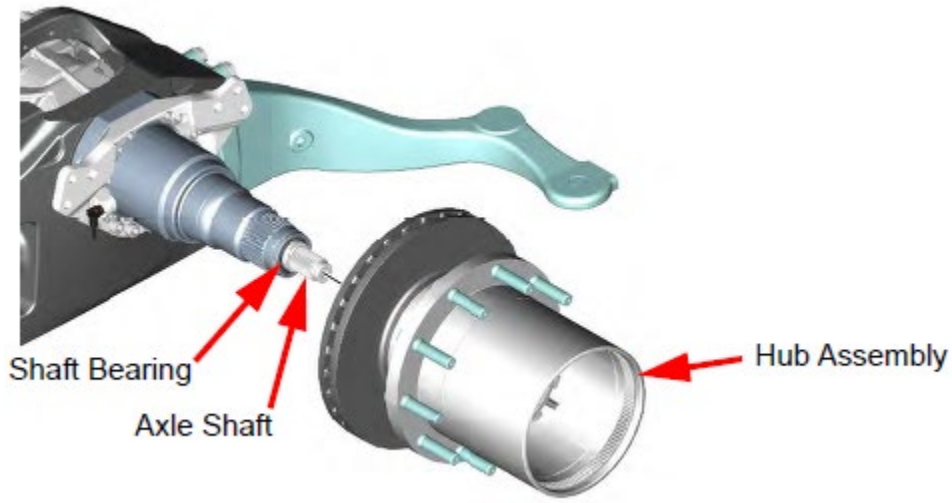
27. Using an Approved Lifting Device, remove the Hub Assembly and place it on a workbench.



28. Using a Heat Gun set to 1000° Fahrenheit, apply heat to the inner race of the Shaft Bearing (050393) until it can slide onto the Axle Shaft (050390).



29. Install the Axle Shaft into the Spindle with the splined end outward.

30. Apply US Lube or other approved SAE 80W90 Oil to the Wheel Hub and Spindle.

31. Using an Approved Lifting Device, carefully position the Hub Assembly onto the Spindle. **Caution!** Use extreme care to ensure that the wheel seal does not hit the spindle while positioning and installing the hub assembly. Damage to the wheel seal can occur if allowed to hit the spindle.

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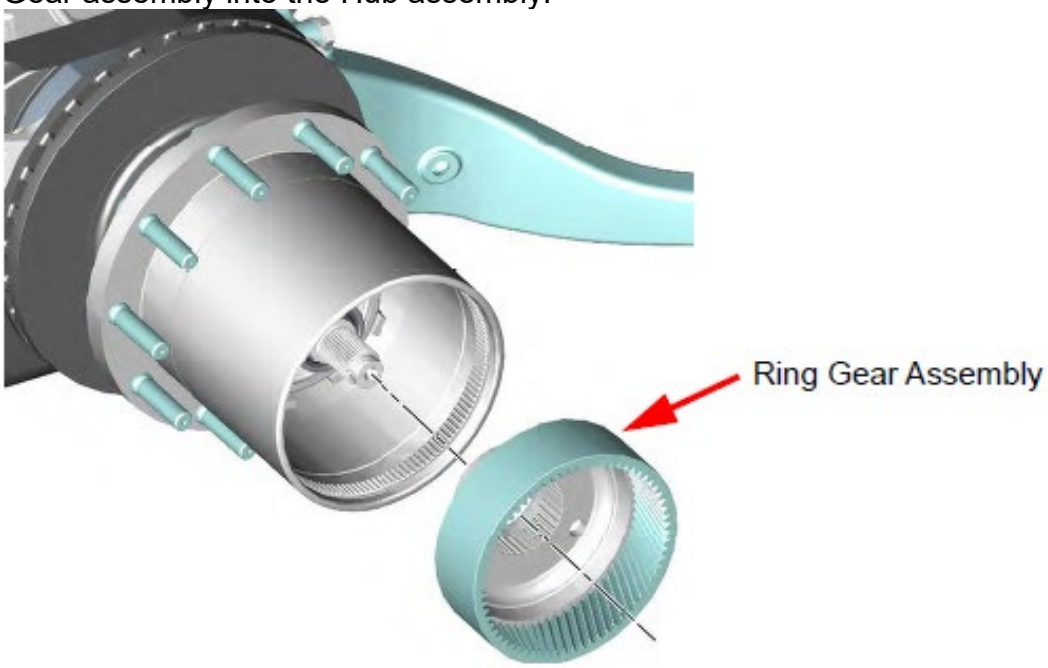
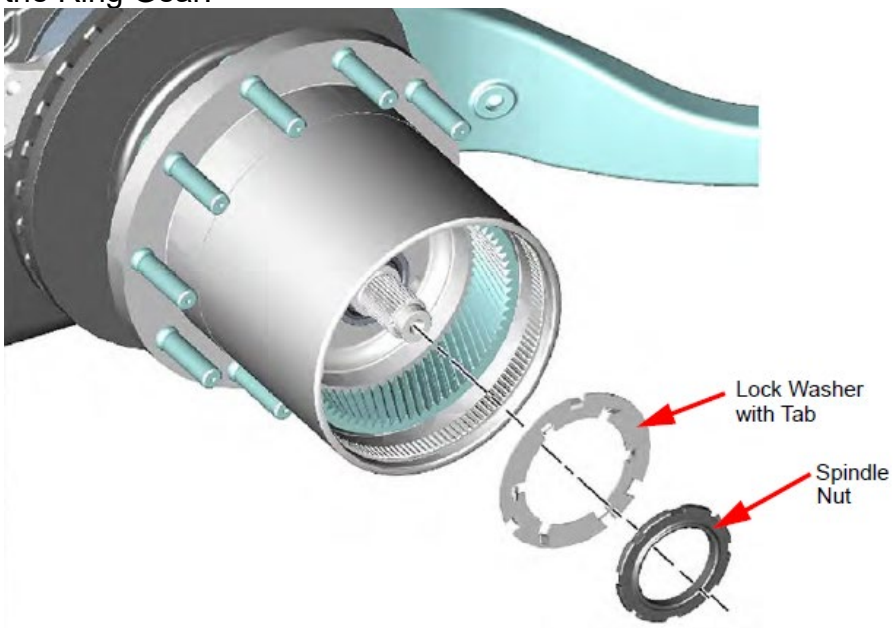
32. Apply US Lube or other approved SAE 80W90 oil to the Axle Bearing and install the Ring Gear assembly into the Hub assembly.



33. Install the new Lock Washer into the Ring Gear with three tabs bent down into the holes on the Ring Gear.



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34. Apply a small amount of “Never Seize” onto the threads of the Spindle Nut and start the Nut by hand onto the Spindle.

35. Using a Calibrated Torque Wrench with a Wheel-end Tool (120-5847), **torque the Spindle Nut to 150 foot pounds.**
Note: This is the first step in a three-step torqueing process. Ensure that both torque wrench detents are aligned with the detent holes on the Spindle Nut Tool. Failure to align the detents may result in permanent coupling of Torque Wrench and the Spindle Nut Tool.

36. Rotate the hub in both directions and strike it with a Brass Mallet.

37. Using a Calibrated Torque Wrench with a Wheel-end Tool (120-5847), **torque the Spindle Nut to 300 foot pounds.**

38. Rotate the hub in both directions and strike it with a Brass Mallet.

39. Using a Calibrated Torque Wrench with a Wheel-end Tool (120-5847), **torque the Spindle Nut to 450 foot pounds.**

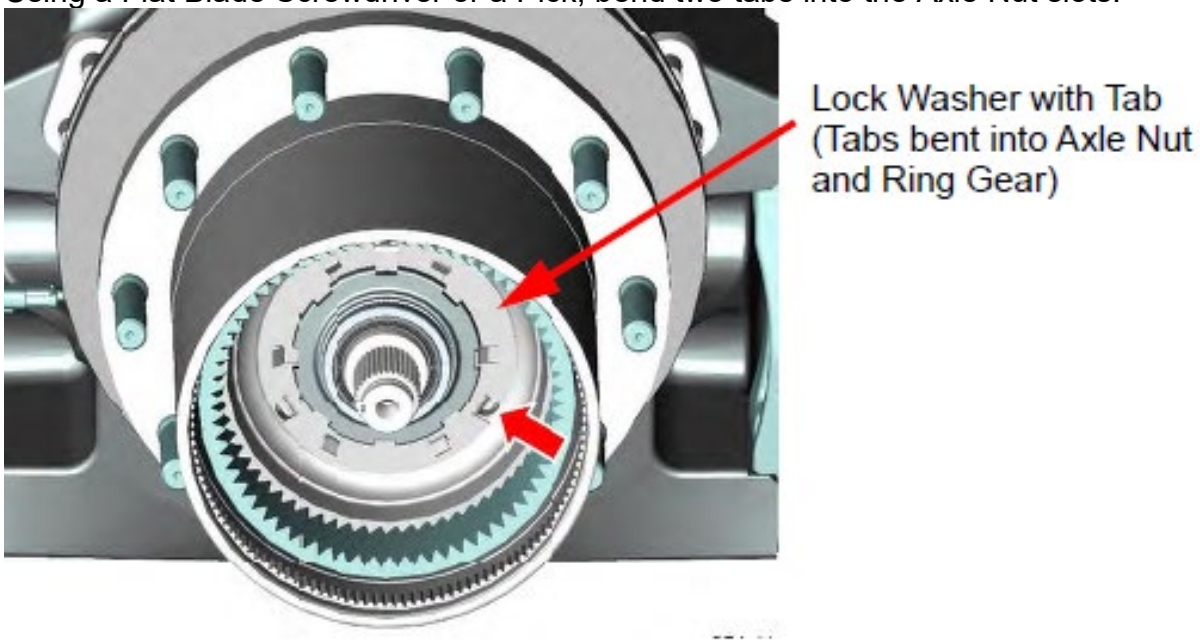
40. Rotate the hub in both directions and strike it with a Brass Mallet.

41. Using a Pull Handle with a Wheel-end Tool (120-5847), loosen the Spindle Nut.

42. Using a Calibrated Torque Wrench with a Wheel-end Tool (120-5847), **torque the Spindle Nut to 290 foot pounds.**

43. Continue torqueing the Spindle Nut until it aligns with the Lock Washer Tags.
Note: Do not exceed 345 foot pounds of torque.

44. Using a Flat Blade Screwdriver or a Pick, bend two tabs into the Axle Nut slots.



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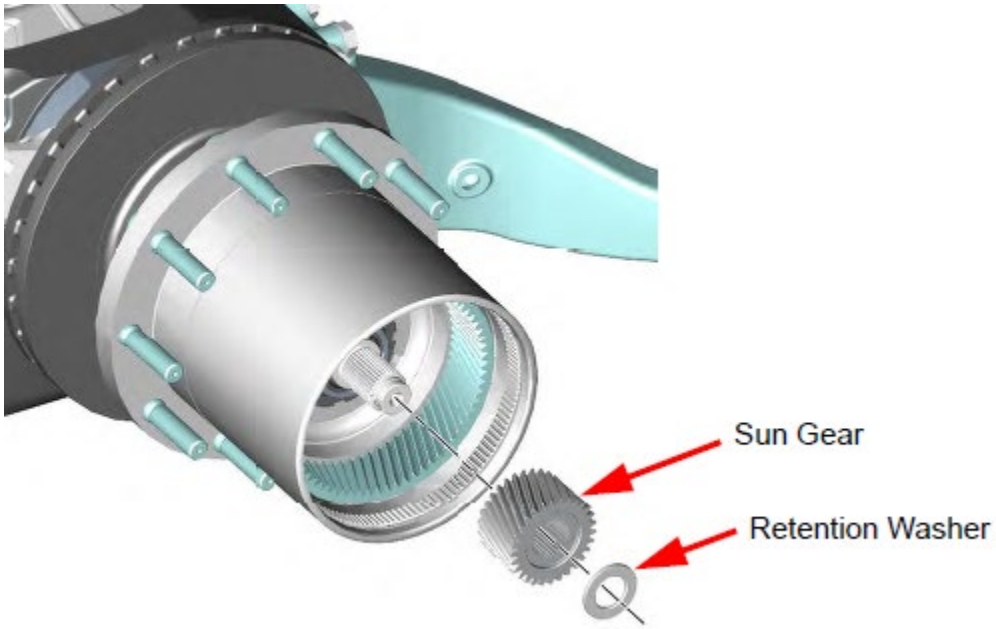
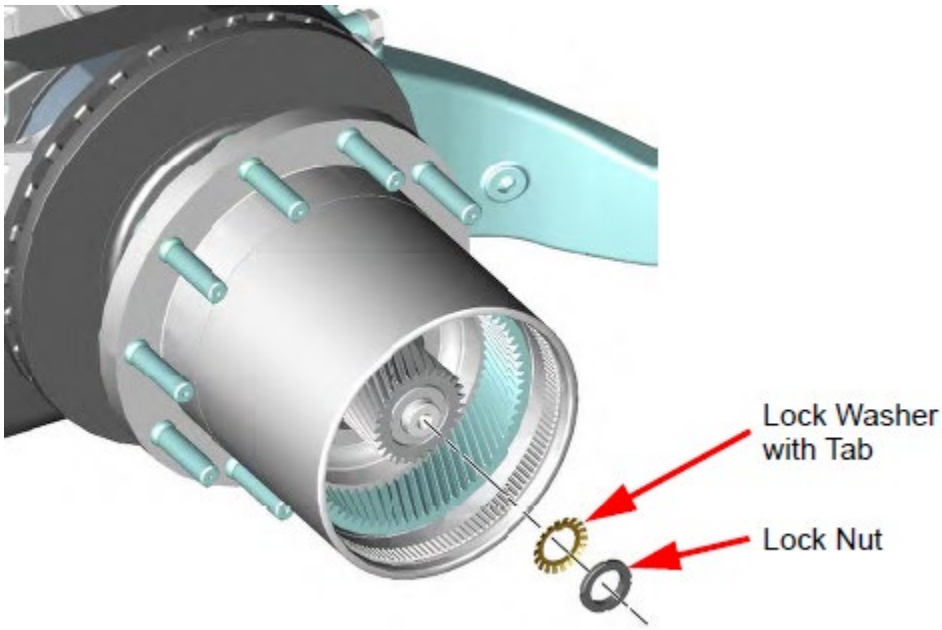
45. Install the Sun Gear and Retention Washer onto the axle shaft.



46. Install a new Lock Washer (125-6417) and the Lock Nut (050321) onto the Axle Shaft and hand tighten it. Torqueing is not required at this time.
Note: The Lock Nut should be installed with the chamfer side inward.



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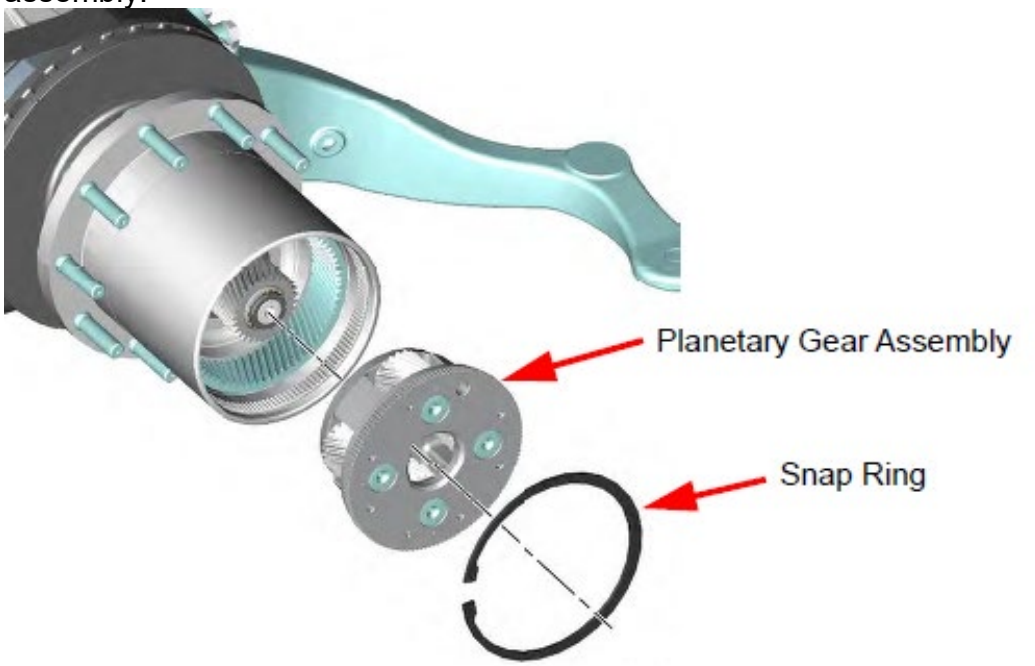
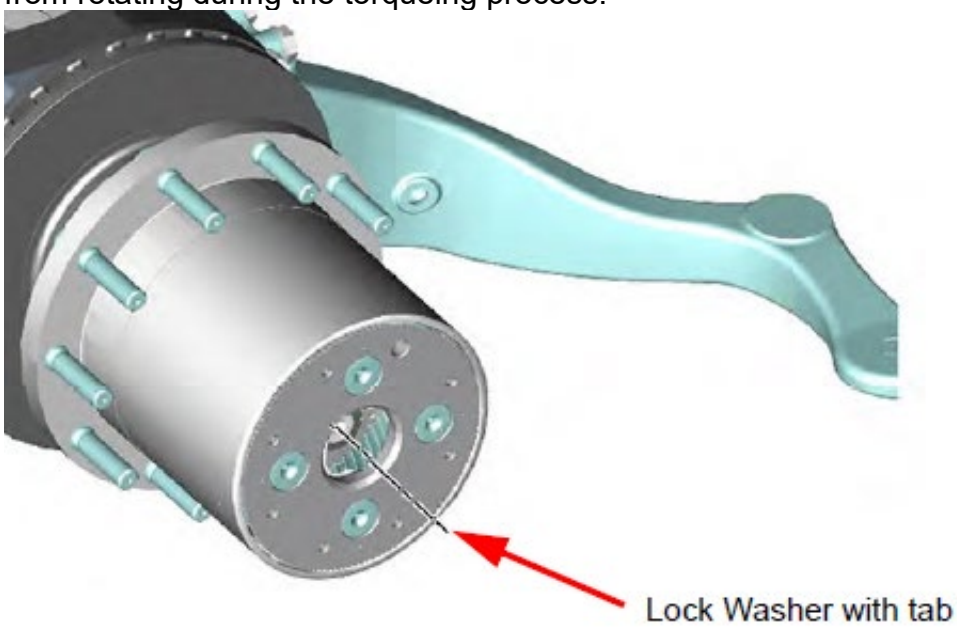
47. Using Snap Ring Pliers, install the Planetary Gear assembly and Snap Ring (050317).
Note: A Soft-Headed Hammer or Rubber Mallet may be needed to seat the Planetary Gear assembly.



48. Using a Calibrated Torque Wrench with a TMFS #7 Lock Nut Socket (120-7747), **torque the Lock Nut to 45 foot pounds.**
Note: Position a Pry-Bar or similar tool between the wheel studs to prevent the wheel end from rotating during the torqueing process.



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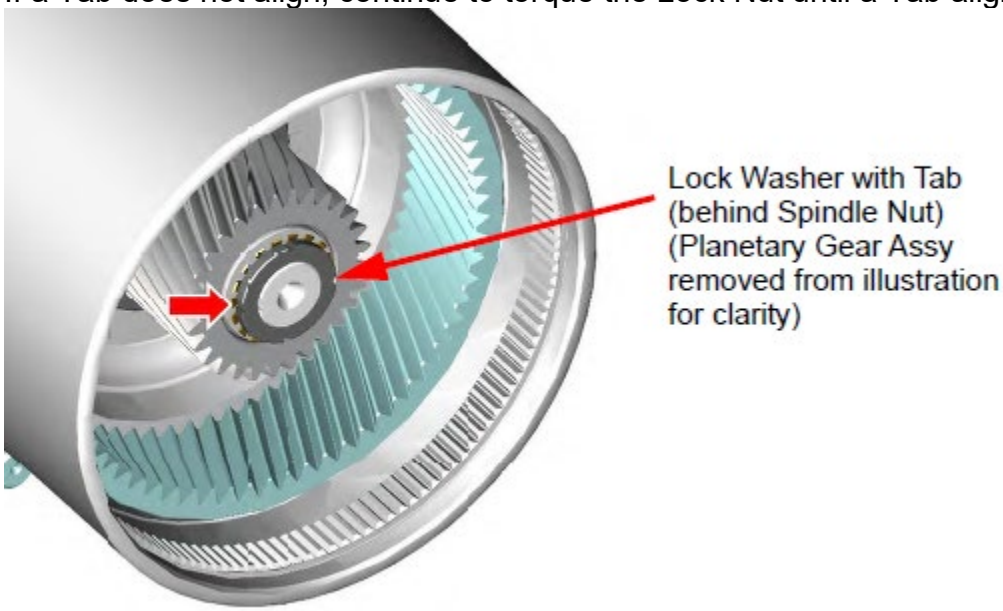
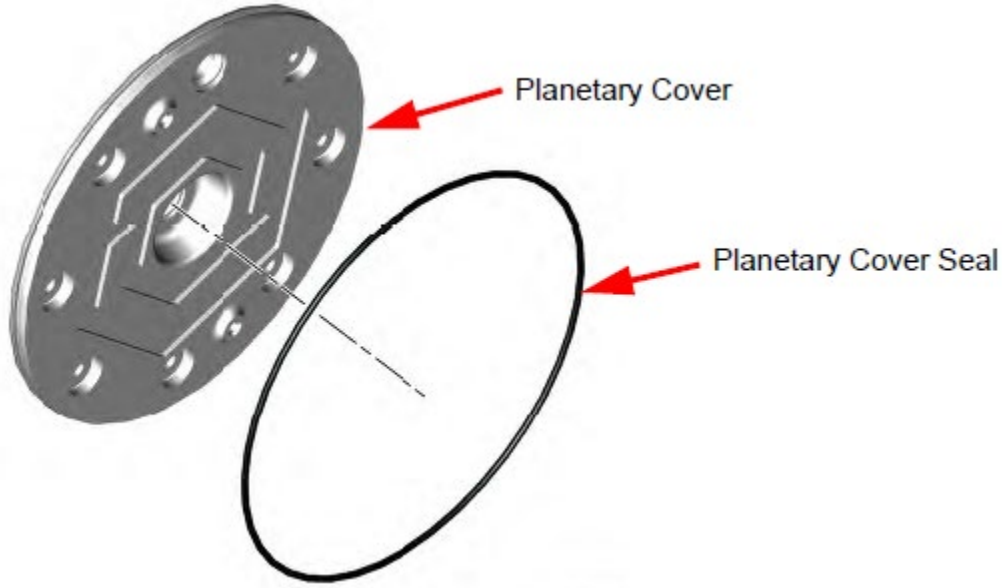
49. If a Tab does not align, continue to torque the Lock Nut until a Tab aligns with a Lock Nut slot.



50. Using a Flat Blade Screwdriver or a Pick, bend over a Lock Washer Tab into a slot.

51. Using Orange Torque Stripe Paint, mark the Lock Washer and Lock Nut.

52. Install a New O-ring Seal (050316) on the Planetary Cover (050309) and lubricate the Seal (050316) with US Lube or other approved SAE 80W90 oil.



53. Apply a small amount of Loctite 243 to the threads of the Planetary Cover Bolts (050313).

54. Verify the location of the fill hole on the Planetary Cover in relation to the Planetary Gear and align them.

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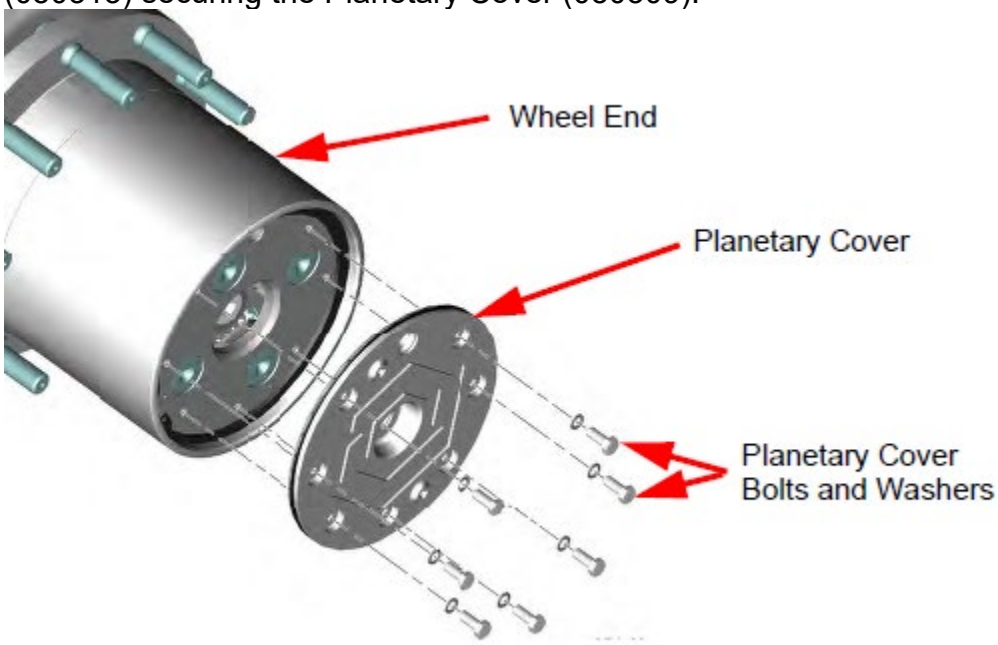
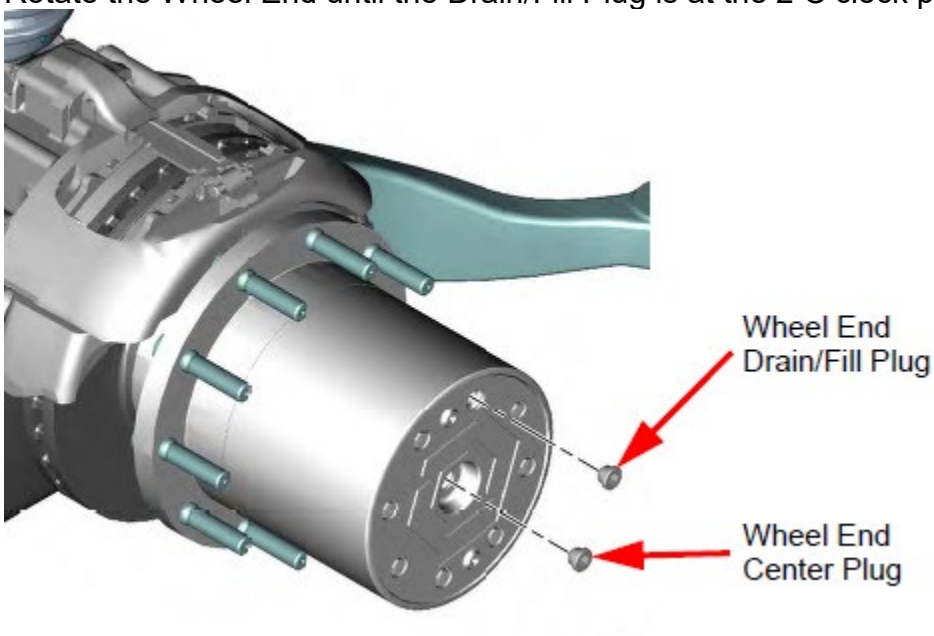
55. Using a 16mm Ratchet/Socket, install new Washer Seals (050314) and the Cover Bolts (050313) securing the Planetary Cover (050309).



56. Using a Calibrated Torque Wrench with a 16mm Socket, **torque the Bolts to 50 foot pounds.**

57. Inspect and clean the Drain/Fill Plug (050312) and Center Plug (050312). Lube the O-rings on the plugs with approved SAE 80W90 oil prior to reinstalling the plugs.

58. Rotate the Wheel End until the Drain/Fill Plug is at the 2 O'clock position.



59. Fill the Wheel End with approved SAE 80W90 oil until the oil flows out of the center hole.

60. Using a 12mm Allen Socket, install the Center Plug and the Drain/Fill plug.

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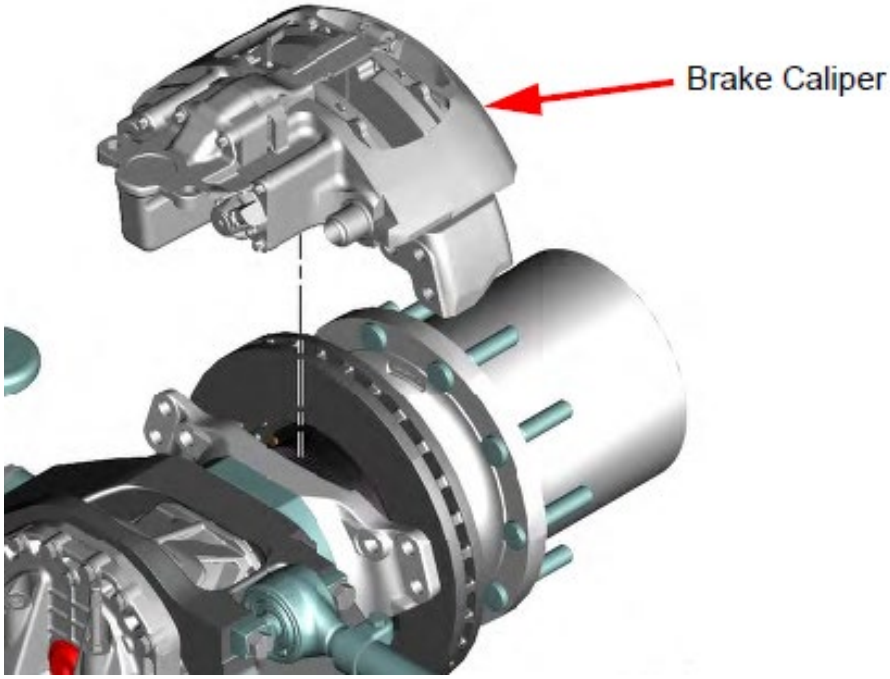
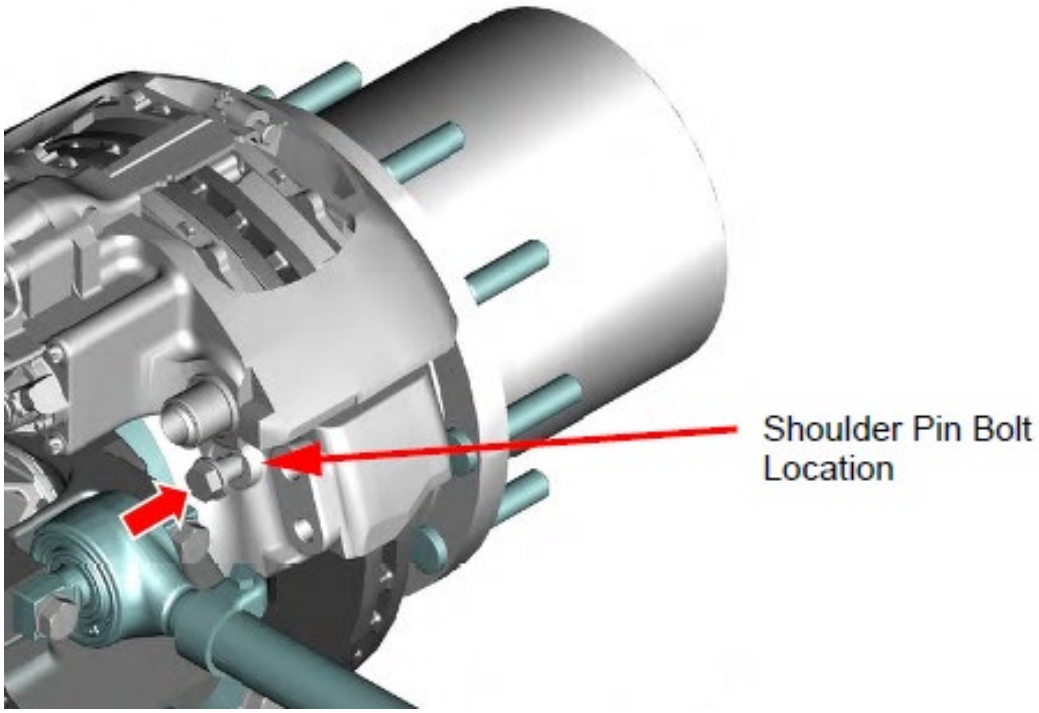
61. Using a Calibrated Torque Wrench with a 12mm Allen Socket, **torque the Plugs to 22 foot pounds.**

62. Position the Brake Caliper on the Rotor and the Bracket.



63. Start the Shoulder Pin Bolt by hand. This is the inside front bolt as shown in the following illustration.



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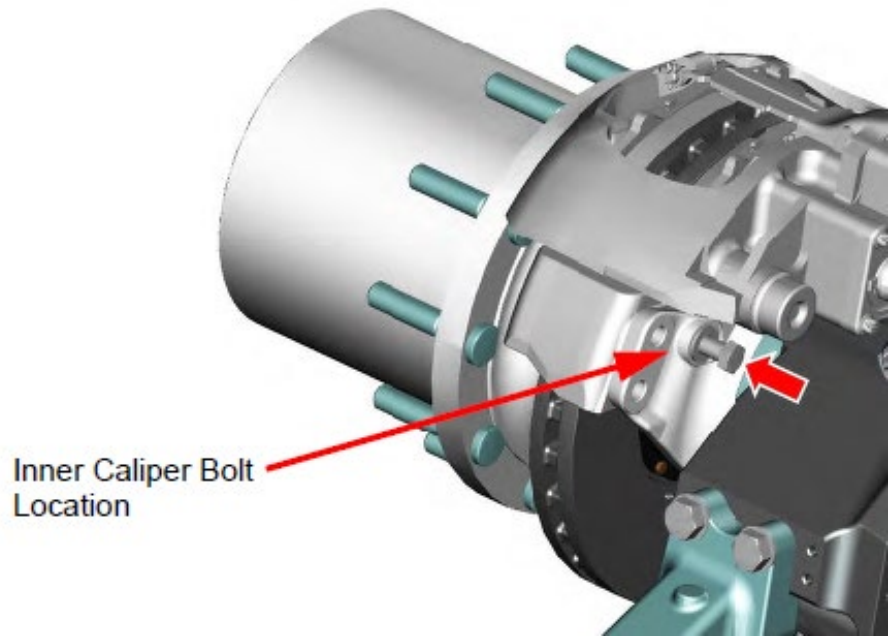
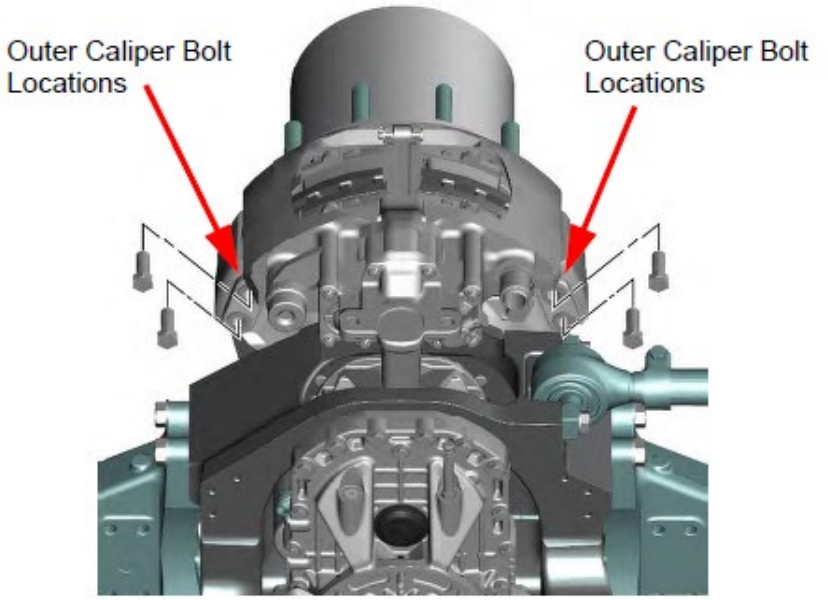
64. Start the Inner Caliper Bolt shown in the following illustration by hand.



65. Start the Outer Bolts shown in the following illustration by hand.



66. Using the Dog Bone Tool, snug the Outer Bolts and Inner Bolts.

67. Using a Calibrated Torque Wrench with the Dog Bone Tool**, torque the Shoulder Pin Bolt to 229 foot pounds.**

68. Using a Calibrated Torque Wrench with the Dog Bone Tool**, torque thee four Outer Bolts and the Inner Bolt to 229 foot pounds.**

69. Reconnect the Brake Lining Wear Sensor electrical connector.

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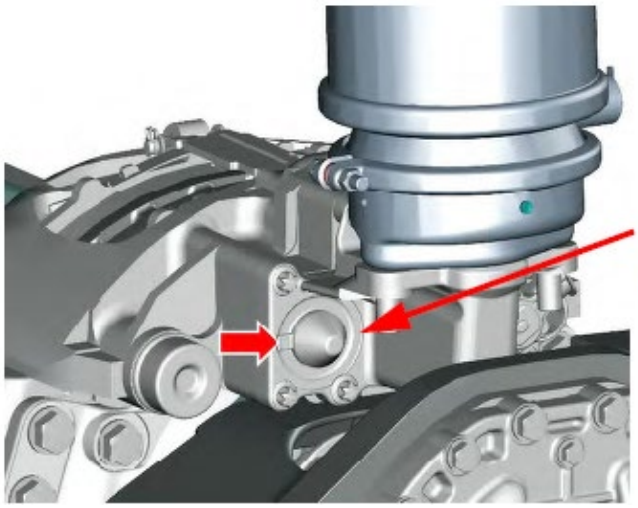
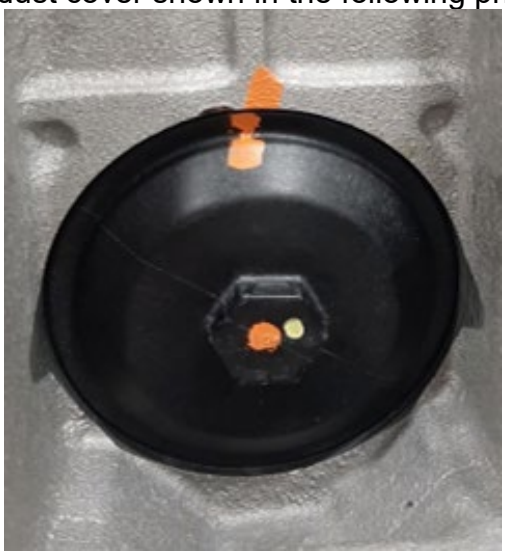
70. Adjust the Brakes until the Brake Pad comes in contact with the brake rotor, then back the adjuster back out three clicks.

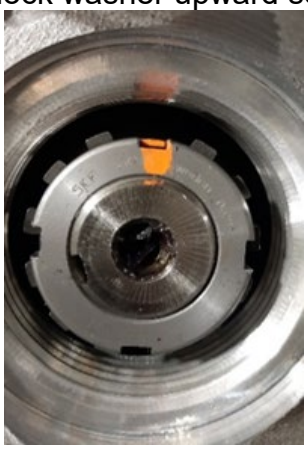
71. Install the Brake Adjuster Cover.



72. Move to the other gearbox. Using a Ratchet with a 6-Point 16mm Socket, remove the black dust cover shown in the following photograph.



73. Using a Flat Blade Screwdriver and a Small Hammer, bend the locking tab of the installed lock washer upward so that the Lock Nut may be removed.



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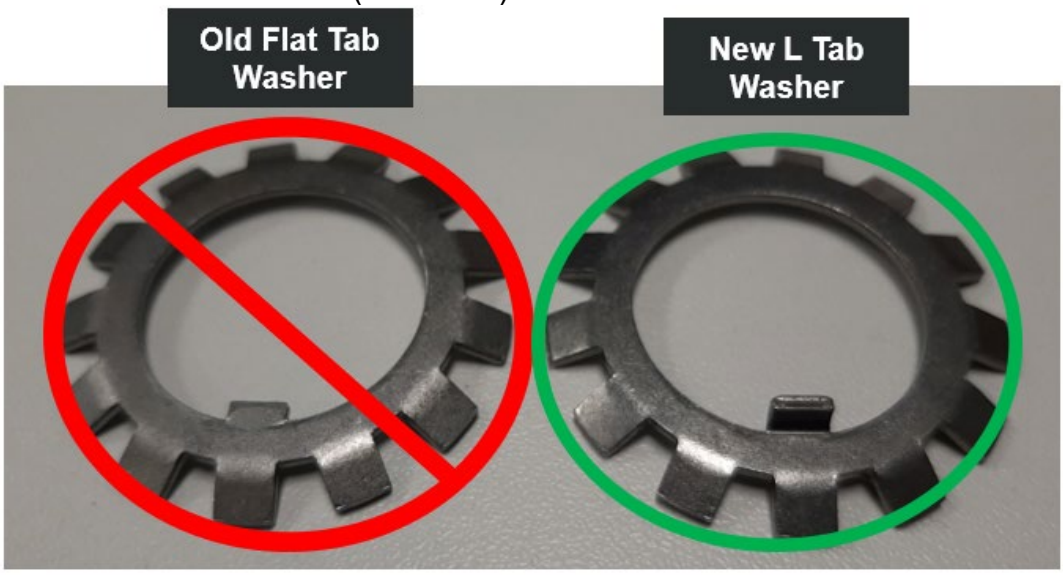
74. Using a 1/2-Inch Drive Pull Handle with a TMFS 5 Socket, remove the Lock Nut.

75. Inspect the removed Lock Washer. Is the ID Tab within the axel shaft keyway? Is the ID Tab Damaged? If the Lock Washer is damaged, take a photograph of it and email it to jotto@proterra.com.

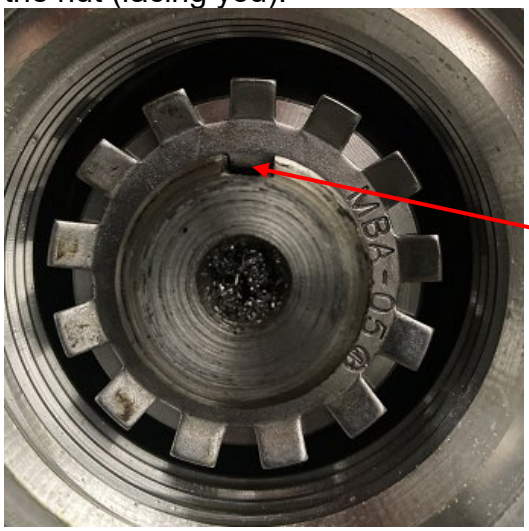
76. If the ID Tab of the Lock Washer is not in the keyway, rotate it until it is.

77. Using Needle Nose Pliers, remove the Lock Washer.

78. The following photographs show the difference between the old style of Lock Washer and the new L-Tab Lock Washer (125-6417).



79. Place the Lock Washer (125-6417) into position with the L-Tab facing outward toward the Wheel Ends (facing away from you). The Outer Diameter Tabs will be facing inward toward the nut (facing you).



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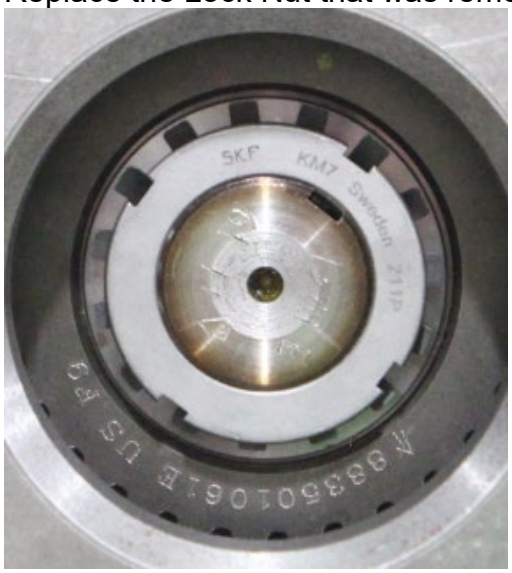
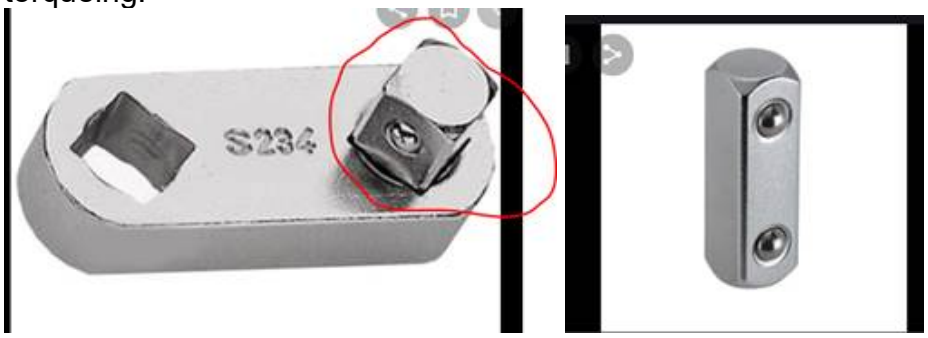
80. Replace the Lock Nut that was removed earlier and hand tighten it.



81. Using a Calibrated Torque Wrench with an Offset Adapter set at ninety degrees, **torque the Lock Nut to 33 foot pounds.** Use a pry bar between the wheel studs to prevent rotation when torqueing the Lock Nut.
Note: The 1/2-Inch Driver Square may be removed from the offset adapter and inserted into the TMFS 5 Socket and used with a 15mm Wrench on the square to snug the lock nut before torqueing.



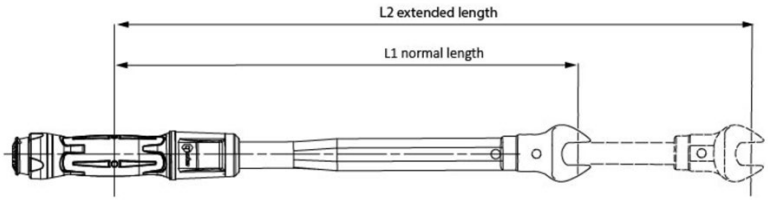
82. If you cannot torque the lock nut with the Torque Wrench set at 90 degrees to the offset adapter, place the torque wrench at 180 degrees to the offset adapter and use the equation below to determine the proper setting for the Torque Wrench. For example, you may need to set the Torque Wrench to 30 foot pounds to achieve 33 foot pounds at the lock nut.

The following formula has been used:

- $M1 = M2 \times L1 / L2$

Where:

- M1 is the torque setting of the wrench
- M2 is the actual torque applied to the nut
- L1 is the normal length of the wrench
- L2 is the extended length of the wrench



83. After torqueing the Lock Nut, observe the Lock Washer (125-6417) to determine if one of the Outside Diameter Tabs aligns with one of the four slots in the Lock Nut.

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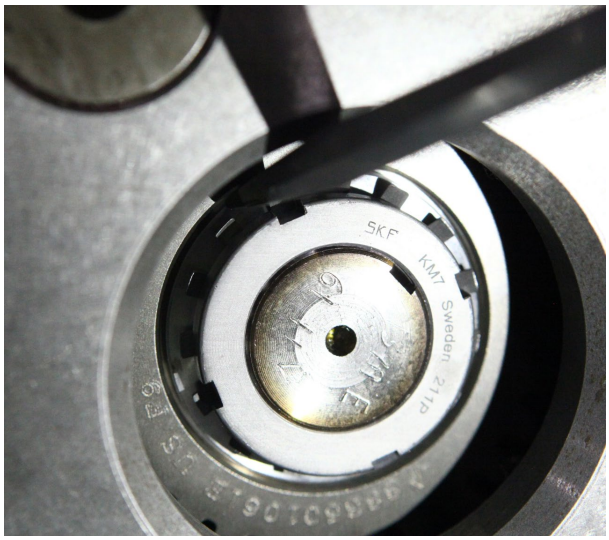
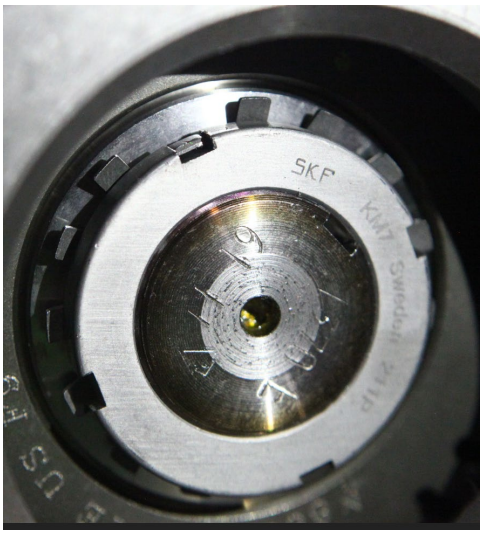
84. If none of the Outside Diameter Tabs align with a Lock Nut Slot, continue using the Torque Wrench to tighten the Lock Nut until a Tab is in alignment. **Do not exceed 50 foot pounds of Torque.**

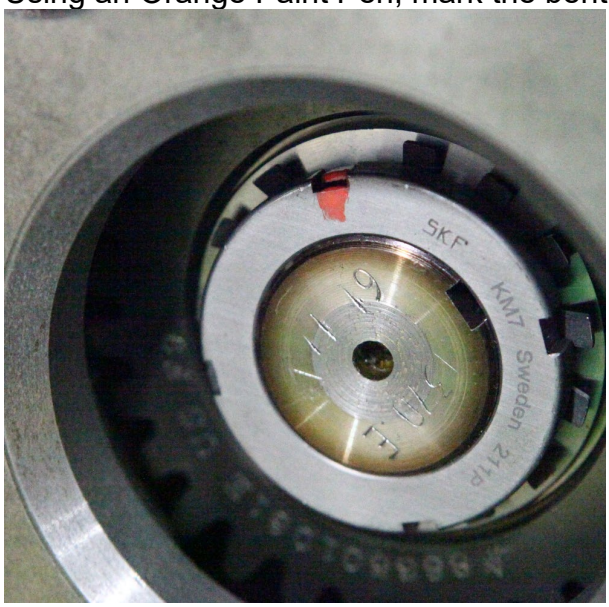
85. Using a Flashlight, inspect the Lock Washer (125-6417) for damage. If the Lock Washer is damaged, it must be replaced with one of the spares from the kit.

86. Using a Flat Blade Screwdriver or a Pick, bend the Outside Diameter Tab into the slot on the Lock Nut.





87. Using an Orange Paint Pen, mark the bent Tab.



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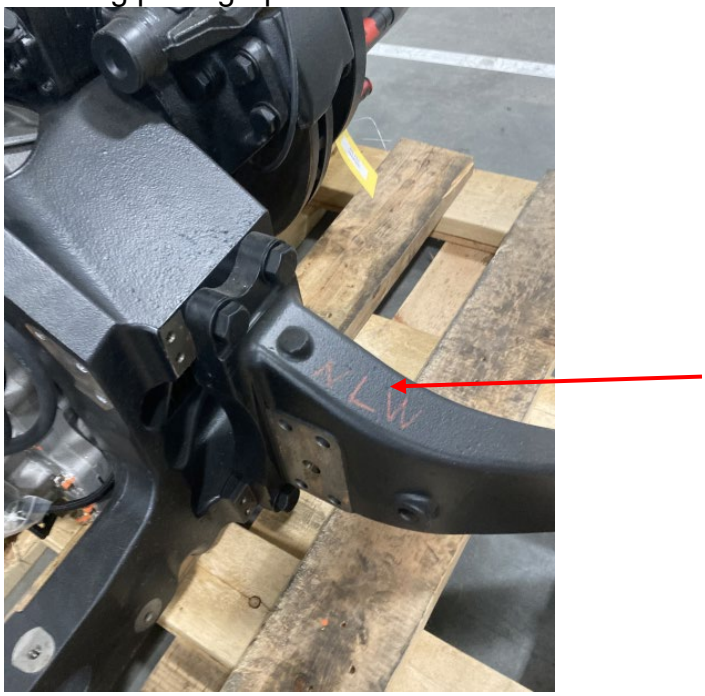
88. Using a Ratchet with a 6-Point 16mm Socket, replace the black dust cover shown in the following photograph.

89. Using a Calibrated Torque Wrench with a 6-Point 16mm Socket, **torque the Dust Cover to 12 foot pounds.**

90. Mark the Dust Cover with the Orange Paint Pen.

91. Using an Orange Paint Pen, paint the letters “NLW” in large print onto the suspension arm closest to the gearbox where the Lock Washer (125-6417) was replaced as shown in the following photograph.



92. Repeat the process to replace the Lock Washer (125-6417) on the other gearbox.

93. Carefully replace the Harness Brackets (046740) back onto the Gearboxes.

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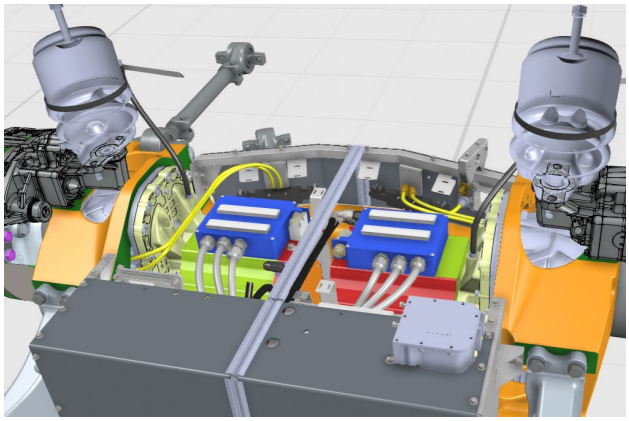
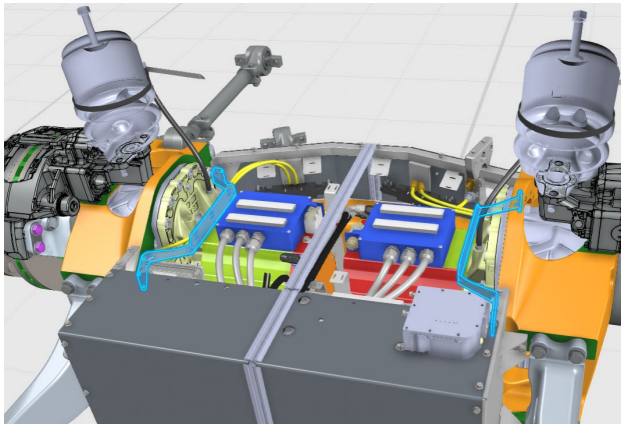
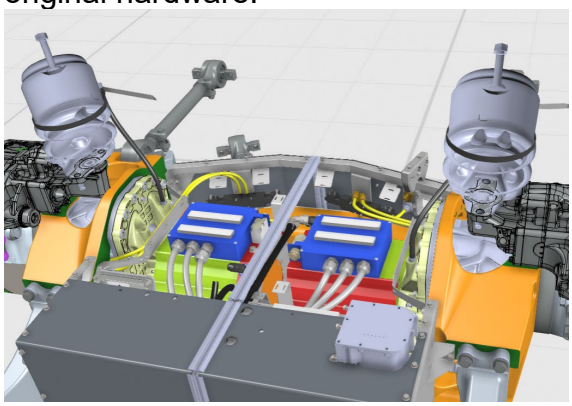
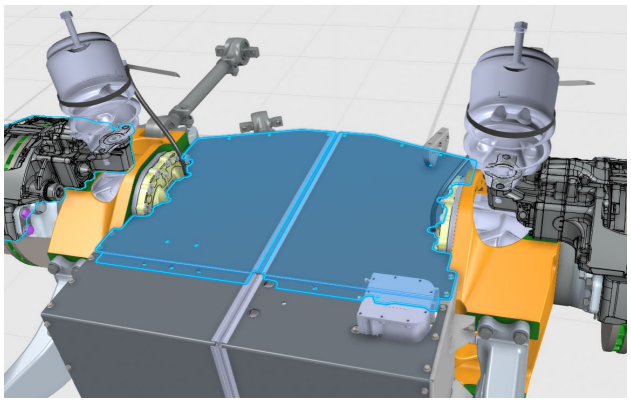
94. Using a 13mm Ratchet/Socket, replace the bolts that secure the Harness Brackets (046740) to the Duopower Drive.

95. Using a Calibrated Torque Wrench with a 13mm Socket, **torque the bolts to 27 foot pounds.**

96. Using an Orange Paint Pen, mark the properly torqued bolts.

97. Using a 10mm Ratchet/Socket, replace the top covers on the Duopower Axle using the original hardware.

98. Using a Calibrated Torque Wrench with a 10mm Socket, **torque the bolts to 11 foot pounds.**

99. Using an Orange Paint Pen, mark the properly torqued fasteners.

100. Record the Axle Serial Number on the Work Order.

101. Using 300 Grit Sandpaper and/or a Wire Brush, remove any surface rust from the Wheel Ends.

102. Using Alcohol and Shop Towels, remove any oil and debris from the Wheel Ends.

103. Using Flat Black Paint, paint the Wheel Ends.

104. Refer to the Maintenance Manual for replacing the Duopower Drive and lowering of the bus.

105. Remove the Lockout/Tagout Devices and return the bus to service.

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