

Work Instructions – FL513R

Subject: Rack and Pinion Steering – Steering Stops

Models Affected: Specific Freightliner Cascadia, Century Class S/T, and Columbia vehicles manufactured November 1, 2004, through September 26, 2007, with rack and pinion steering. (Note: One Freightliner Classic XL vehicle and one Freightliner Coronado vehicle are also involved in this recall.)

This Work Instruction includes the following procedures:

- Replace Tie Rod Arms
- Replace I-Shaft
- Retrofit Steering Plumbing
- Retrofit Fuel/Water Separator Plumbing

Recall Procedures

1. Check the base label (Form WAR259) for a completion sticker for campaign FL513 (Form WAR260) indicating this work has been done. The base label is usually located on the passenger-side door about 12 inches (30 cm) below the door latch. If a completion sticker is present, no further action is necessary. If a completion sticker is not present, go to the next step.
2. Shut down the engine, apply the parking brake, and chock the rear tires.
3. Raise the hood.
4. Remove the driver-side front quarter fender and mud flap.
5. Remove the bumper.

NOTICE

Do not use a method that requires you to heat or otherwise deform the tie rod arms while releasing the ball studs from the tapered fit. This could weaken the tie rod arms.

6. Remove and discard the cotter pins and castle nuts from the outer tie rod ends, then separate the ball studs from the tie rod arms.
7. Replace the tie rod arms.
 - 7.1 Remove and discard the fasteners that hold the tie rod arms to the steering knuckles. See **Fig. 1** and **Fig. 2**.

IMPORTANT: Make sure that the new tie rod arms are installed on the correct side. The raised number on each arm will end in an "L" or an "R," which refers to left (driver) side or right (passenger) side of the vehicle.

- 7.2 Using a solvent, remove all dirt, oil, and other foreign material from the female threads on the steering knuckles. Let the solvent dry completely.
- 7.3 Apply Loctite 277 to the threads of the new M20 flanged hexbolts and install the new tie rod arms. Tighten the flanged hexbolts 387 to 461 lbf·ft (525 to 625 N·m).

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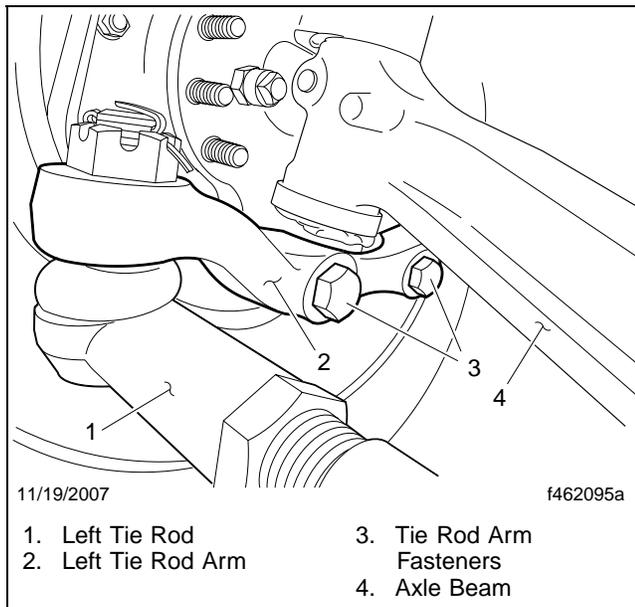


Fig. 1, Left Side of Vehicle

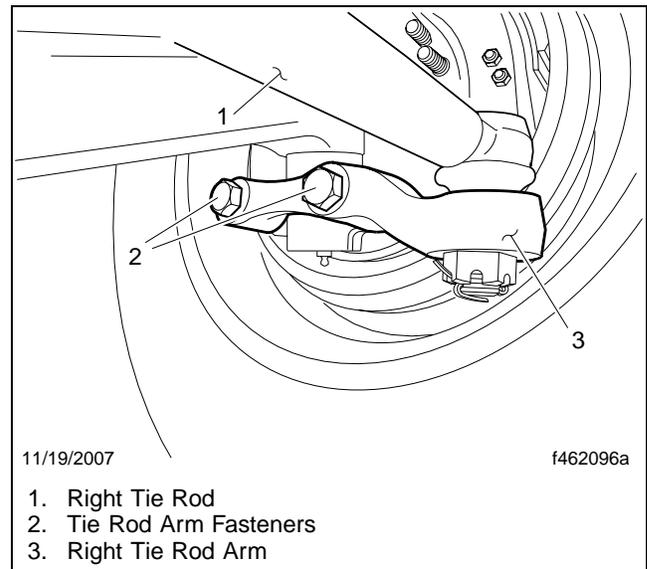


Fig. 2, Right Side of Vehicle

8. Using a backup wrench to keep the fittings from turning, disconnect the lines from the gear and drain the fluid. Cap the ports on the steering gear to keep dirt out of the system.
9. Remove the power steering fluid reservoir.
10. Remove the power steering fluid lines from the chassis.
11. Remove the left-front shock mount.
12. Remove the power steering reservoir bracket from the frame.
13. Remove and discard the upper and lower pinch bolts and nuts from the steering I-shaft, then remove the shaft.

⚠ WARNING

On vehicles equipped with an SRS air bag, do not rotate the upper steering column while the I-shaft is removed or disconnected. This can cause the clockspring in the steering wheel hub to become off center, which could result in the air bag failing to operate during a crash.

14. Drain the fuel/water separator, and mark and remove all lines and electrical connections that may be present.
15. Remove the fuel/water separator.
16. Mark the layout of the holes on the frame, using the drilling diagram. See **Fig. 3**.
17. Check the area to be drilled for lines and wires that may be attached to the inside of the frame rail, and reroute as necessary.
18. Drill and deburr the new holes in the frame.
19. Clean and prime the holes in the frame and the new U-bolts, but do not paint the U-bolt threads.
20. Paint the frame and the new U-bolts from the kit, but do not paint the U-bolt threads.
21. Install the axle-mounted hose bracket.

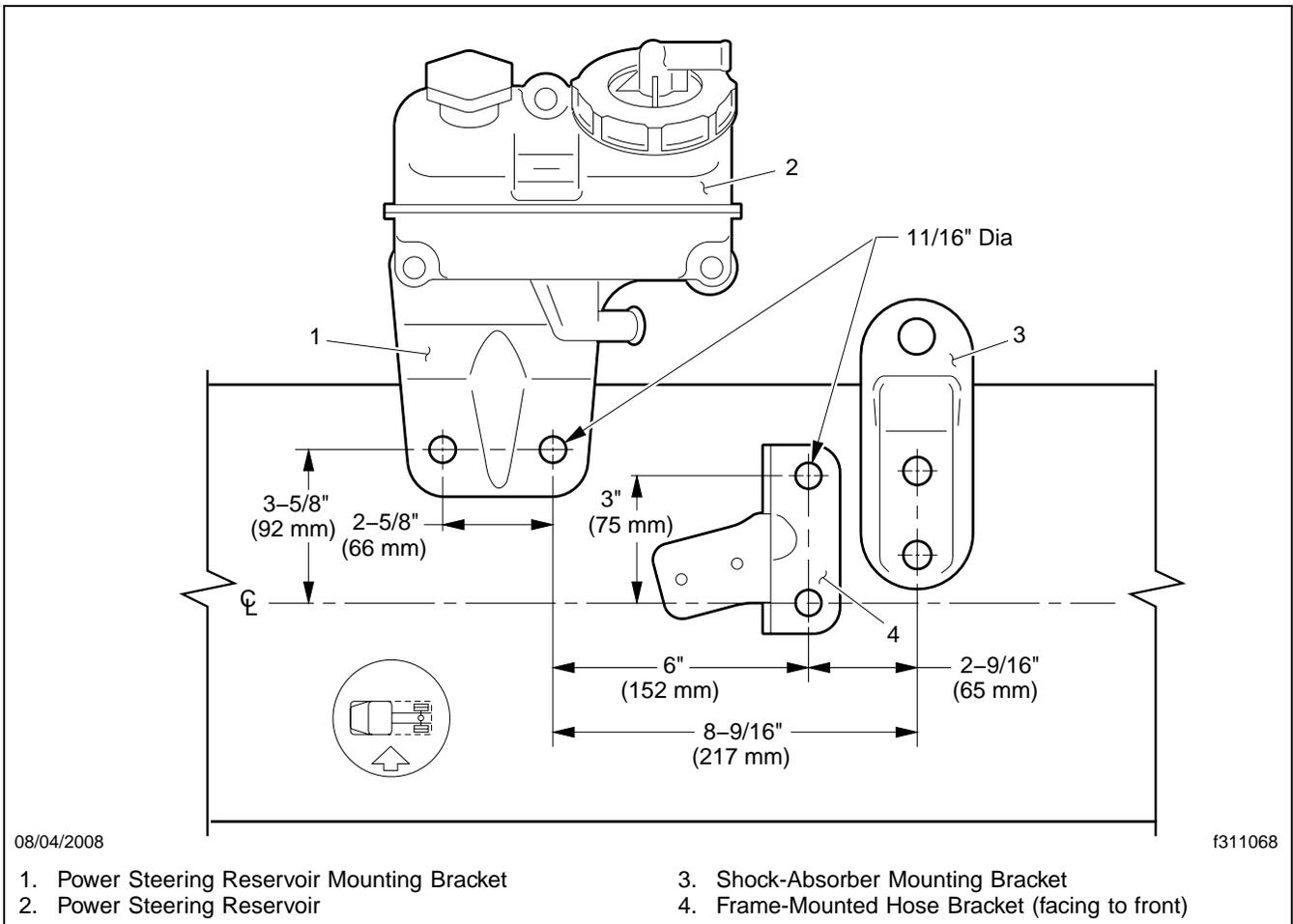


Fig. 3, Drilling and Mounting Locations

- 21.1 Remove the front U-bolt on the left side and replace it with a new one. Install the new plumbing bracket between the washers and axle pad.
- 21.2 Lubricate the U-bolt threads to prevent galling and to ensure that the proper torque is achieved.
- 21.3 Replace the second U-bolt on the left side, and evenly tighten the U-bolts 60 lbf ft (81 N m) in the sequence shown in **Fig. 4**.
22. Attach the tie rods to the tie rod arms. Tighten the new castle nuts 240 lbf-ft (325 N·m), then install and lock a new cotter pin in each of the ball studs and nuts. If needed, continue tightening each nut until a slot on the nut aligns with the cotter-pin hole in the ball stud. Do not back off the nut to align it with the cotter pin hole.
23. Install the fuel/water separator in the new location, as shown in **Fig. 5**.
24. Modify the fuel line routing for the new location of the fuel/water separator. The new line routing must allow for engine roll where traversing between the engine and frame, be kept away from heat sources, be kept as flat as possible (to ease the purging process), and maintain a minimum bend radius large enough to prevent kinking.
25. Raise the vehicle and place the front wheels on turnplates.
26. Install the shock bracket and the shock.

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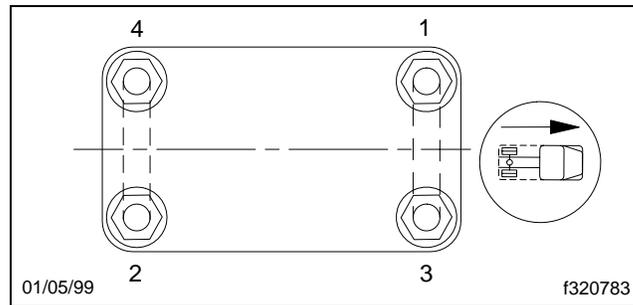


Fig. 4, U-Bolt Nut Tightening Sequence

27. Install the frame-mounted hose bracket, as shown in **Fig. 3**.
28. Install fasteners and washers in any holes in the frame that will not be occupied by parts, to maintain frame integrity.
29. Install the new fittings on the power steering pump. Tighten the pump suction adaptor 33 to 43 lbf·ft (45 to 58 N·m), and the pump output adaptor 42 to 52 lbf·ft (57 to 70 N·m).
30. Install and route the new pressure line from the frame-mounted hose bracket to the pump, and include extra hose between the L-bracket on the top-mount of the reservoir and the pump to allow for engine roll. See **Fig. 6**. Tighten the fitting 42 to 52 lbf·ft (57 to 70 N·m).
31. Install the power steering reservoir mounting bracket on the frame.
32. Install the power steering reservoir on the reservoir mounting bracket.
33. Attach the lines to the plumbing adaptors on the steering gear, while ensuring that the lines will not touch the axle or each other once installed. Snug the connection with a wrench to ensure the fittings are seated, which is equivalent to approximately 2 lbf·ft (3 N·m). Then, using a backup wrench to keep the adaptors from turning, tighten the return and supply hoses by 1 flat of the tube nut (60 degrees). See **Fig. 7**.
34. Include a little slack in the return line between the steering rack and the axle-mounted hose bracket (**Fig. 8**), to keep the hoses between the axle-mounted hose bracket and the frame bracket (**Fig. 9**) from rubbing together.
35. After securing the formed section of the line to the frame-mounted bracket and connecting the lines to the rack and pinion gear, fasten the rubber bushing and clamp to the axle-mounted hose bracket.
36. Center the rack and pinion gear.
 - 36.1 Measure the length of the bellows from clamp to clamp on each side of the gear. See **Fig. 10**. If measurements are not within 1 inch (25 mm) of each other, move the tires until the bellows lengths are within range.
 - 36.2 Align the pointers on the input shaft seal cover and the input shaft housing. See **Fig. 11**.
37. Install the I-shaft, then install a new upper and lower pinch bolt and nut in the U-joints of the steering I-shaft. Tighten the nuts 30 to 35 lbf·ft (41 to 47 N·m).
38. Prime the fuel system.
39. Install the quarter fender and mud flap.

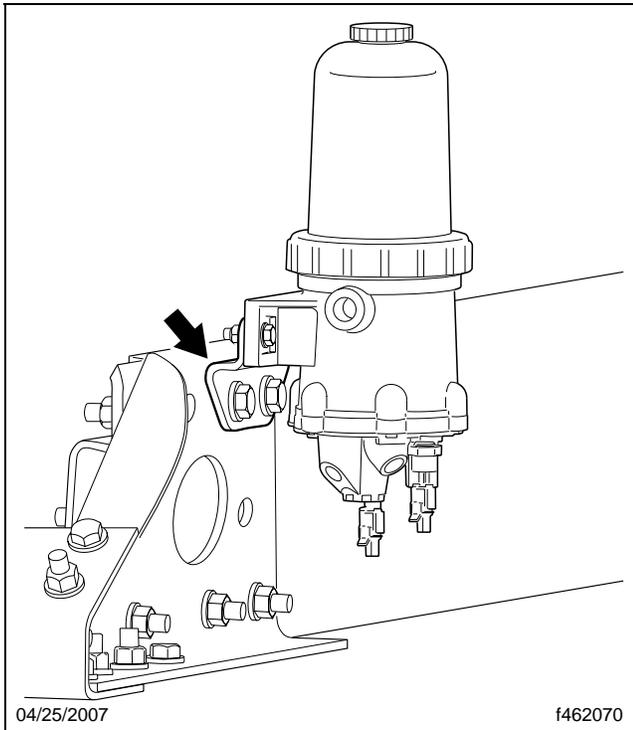
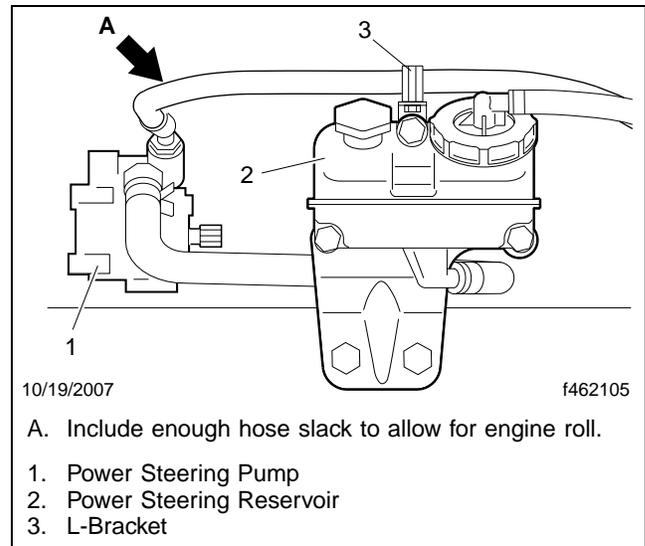


Fig. 5, Fuel/Water Separator Mounting Bracket



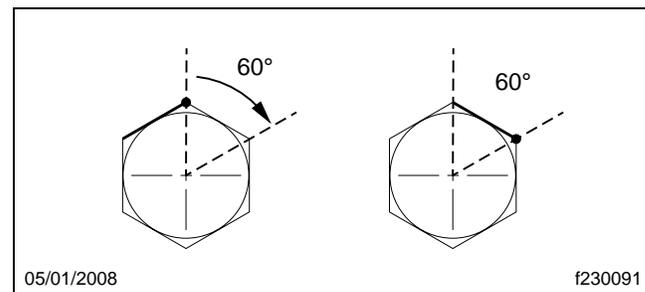
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A. Include enough hose slack to allow for engine roll.

1. Power Steering Pump
2. Power Steering Reservoir
3. L-Bracket

Fig. 6, Hose Routing To Pump (S60 shown)



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Fig. 7, Turning the Fitting One Flat (60 degrees)

40. Fill and bleed the power steering system.

40.1 Raise the front wheels off the ground or put the front wheels on turnplates.

40.2 Fill the power steering reservoir with automatic transmission fluid that meets Dexron III or TES-389 specifications.

40.3 With the engine off, turn the wheel fully left and right five times to bleed the air from the rack.

40.4 Start the engine, turn the wheel fully left and right several times to bleed the remaining air from the rack.

40.5 If the steering system needs additional bleeding, repeat the previous substep after the fluid in the reservoir has had time to release any air.

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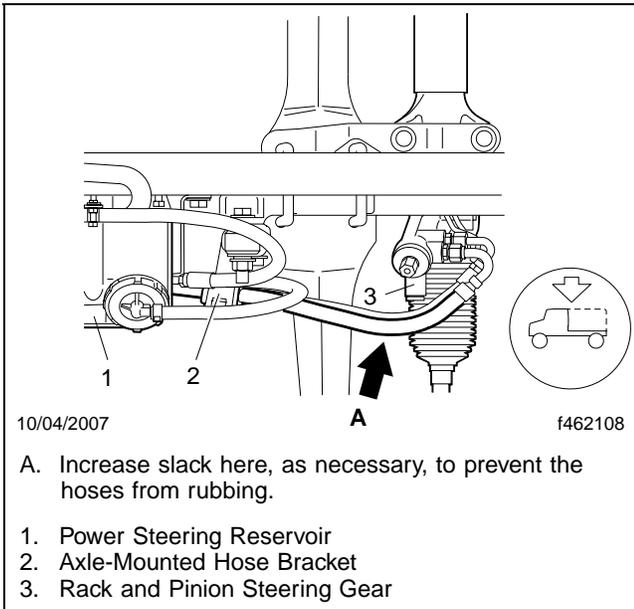


Fig. 8, View from Above

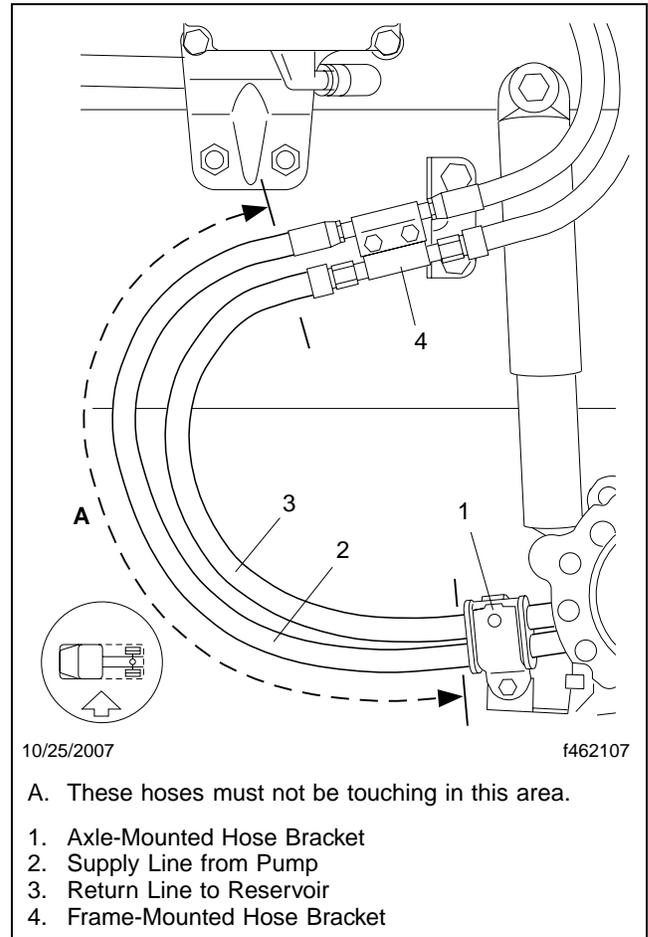


Fig. 9, Side View (fuel/water separator installed forward)

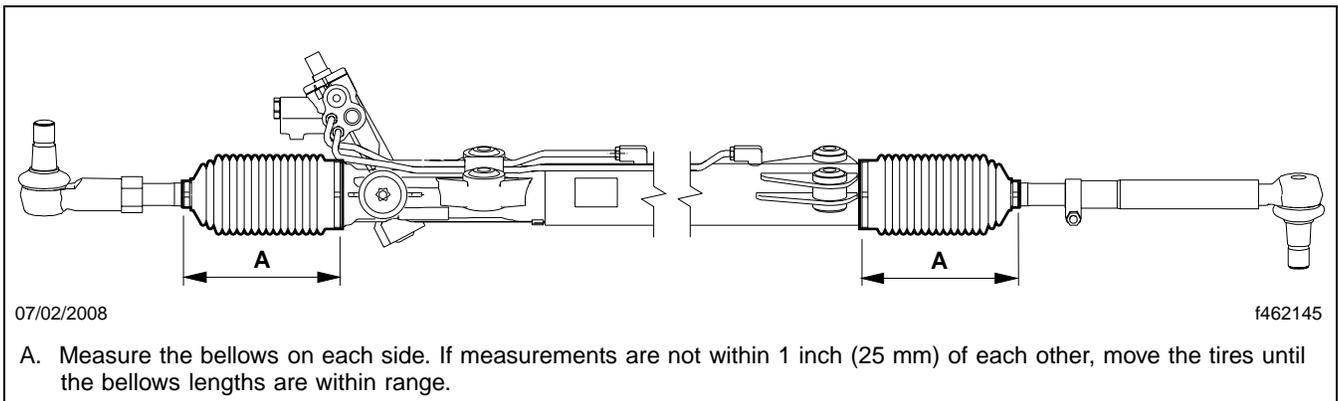


Fig. 10, Measuring the Tie Rod Bellows

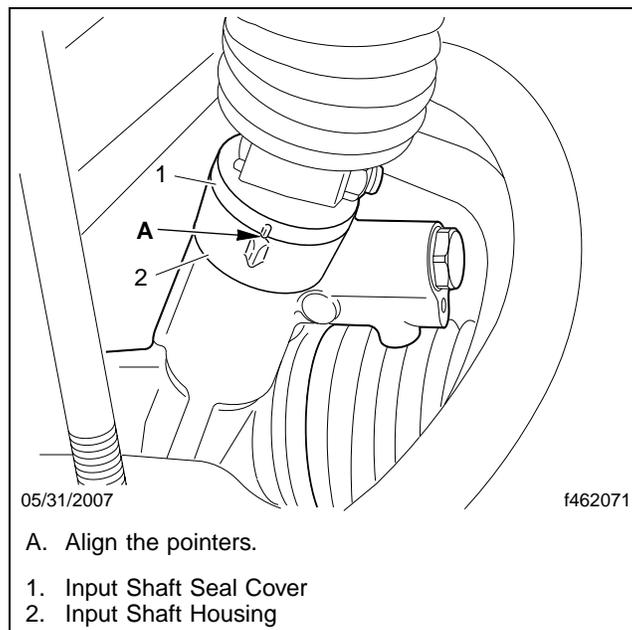


Fig. 11, Pointer Alignment

41. Align the front wheels using a computerized alignment tool.

NOTE: If you do not have access to this type of tool, the alignment procedure must be done by a facility that does.

41.1 Complete the setup needed for the computerized alignment tool (identical to the setup for integral steering gears).

41.2 With the wheels on turnplates, center the rack travel by aligning the timing pointers on the input shaft seal cover and the input shaft housing. See **Fig. 11**.

Whenever the computerized alignment program requires that the steering wheel be pointed straight ahead, the steering rack on-center pointers should be aligned.

NOTE: Do not center the steering wheel; it must be centered at the end of the procedure.

41.3 Loosen the driver-side tie rod jam nut. If necessary, hold the inner tie rod in place with a backup wrench on the inner tie rod flat.

41.4 With the gear on-center, place a wrench on the driver-side inner tie rod flat and align the left tire by rotating the inner tie rod.

Total left side toe-in should be between 0 and 1/16 inch (1.58 mm).

41.5 Tighten the tie rod jam nut 285 to 305 lbf-ft (386 to 413 N·m)

41.6 Loosen the passenger-side tie rod clamp nut.

41.7 With the gear on-center, place a wrench on the passenger-side inner tie rod flat and align the right tire by rotating the inner tie rod.

Total right side toe-in should be between 0 and 1/16 inch (1.58 mm).

41.8 Tighten the tie rod clamp nut 30 to 36 lbf-ft (41 to 48 N·m).

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IMPORTANT: Total toe-in for both sides should be between 0 and 1/8 inch (3.18 mm), and the target should be 1/16 inch (1.58 mm).

41.9 Check the clearance of the front wheels. With the wheels turned all the way to the right and left, there must be at least 1/2-inch (13-mm) clearance between the wheels and any stationary components, and at least 3/4-inch (19-mm) clearance between the wheels/tires and any moving components.

If the clearance is inadequate, back out the stop bolts and adjust the jam nuts to limit the turning angles and to prevent possible contact with components.

41.10 Tighten the stop-bolt jam nuts 80 to 120 lbf·ft (108 to 163 N·m).

41.11 Return the wheels to the straight-ahead position.

42. Make sure that the steering wheel is within 10 degrees of center as shown in **Fig. 12**. If it is not, remove and center the steering wheel.

IMPORTANT: The spline/pinch bolt connections between the steering gear and the steering wheel fit in only one position. Clocking the splined connections after alignment is not possible.

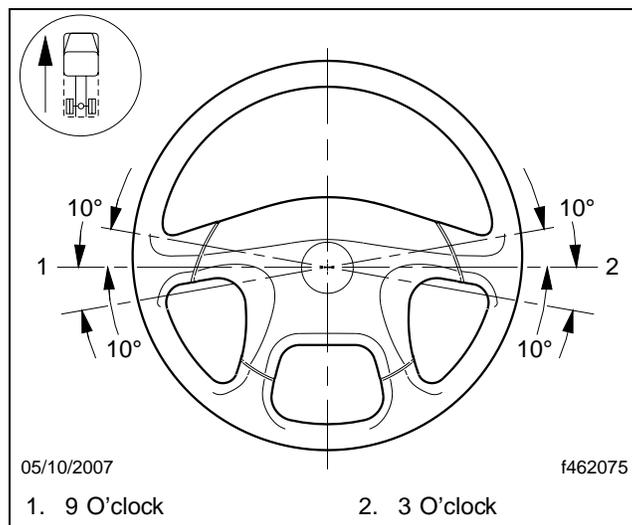


Fig. 12, Steering Wheel Centered

42.1 If the vehicle has an air bag, deactivate and remove the air bag according to the instructions in the applicable vehicle workshop manual. If the vehicle does not have an air bag, remove the horn button by prying it out around the edges.

IMPORTANT: The steering wheel does not have threaded wheel-puller holes. The tapered fit between the steering wheel and the column is designed to be removed by hand.

42.2 Loosen the nut that holds the steering wheel on the steering column, but leave it on the shaft until the wheel has been released from the tapered fit.

42.3 Remove the wheel from the tapered fit by striking it from below, at the rim/spoke intersections, with both hands.

42.4 Remove and discard the steering wheel nut, and install and center the steering wheel.

42.5 Install a new steering wheel nut and tighten it 33 to 41 lbf·ft (45 to 55 N·m).

42.6 If the vehicle has an air bag, install and reactivate the air bag according to the instructions in the applicable workshop manual. If the vehicle does not have an air bag, install the horn button.

43. Remove the turnplates and alignment equipment.
44. Recheck the power steering fluid level.
45. Install and adjust the bumper.
46. Clean a spot on the base label (Form WAR259), write the recall number, FL513, on a blank completion sticker (Form WAR260), and attach it to the base label.