Work Instructions – FL513T, FL513U, FL513V, FL513W

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 Steering Stop Bolts and Set Wheel Cut (if needed)
- Replace Rack and Pinion Gear

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.

⚠ CAUTION

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.

4. 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.
5. Disconnect the hydraulic lines from the rack and pinion gear.
6. Plug the hydraulic lines to keep out dirt.
7. Remove and discard the lower pinch bolt and nut from the steering I-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.

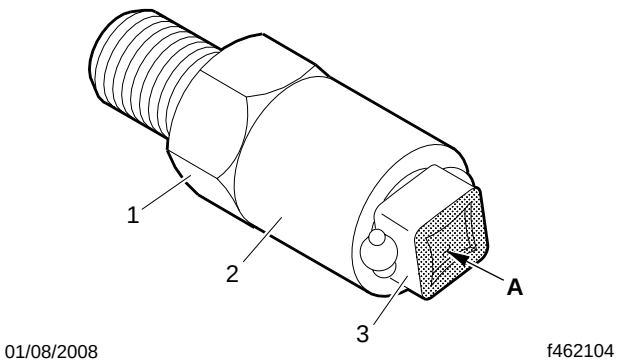
8. Remove and discard the fasteners that hold the rack and pinion gear to the axle-mounted brackets, then remove the gear from the vehicle.
9. Using new fasteners, install the new rack and pinion gear. Tighten the fasteners 202 to 256 lbf·ft (274 to 347 N·m).

10. 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.
11. Raise the vehicle and place the front wheels on turnplates.
12. If **FL512** has been completed on the vehicle (a claim, a completion sticker, or both), installing new stop bolts is not needed; skip those steps below, and go to step 15.
13. Remove the existing axle-stop bolts from the steering knuckles.
14. If not already done, hand-tighten the jam nut against the welded spacer before installing each stop bolt. See **Fig. 1**.
15. Install the new axle-stop bolts with the red-marked bolt heads.
16. Install the adaptor fittings in the steering gear, and tighten 30 to 35 lbf·ft (41 to 47 N·m).
17. 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. 2**.
18. Center the rack and pinion gear.
    - 18.1 Measure the length of the bellows from clamp to clamp on each side of the gear. See **Fig. 3**. If measurements are not within 1 inch (25 mm) of each other, move the tires until the bellows lengths are within range.
    - 18.2 Align the pointers on the input shaft seal cover and the input shaft housing. See **Fig. 4**.
19. Connect the I-shaft, then install a new lower pinch bolt and nut in the lower U-joint of the I-shaft. Tighten the nut 30 to 35 lbf·ft (41 to 47 N·m).
20. Fill and bleed the power steering system.
    - 20.1 Raise the front wheels off the ground or put the front wheels on turnplates.
    - 20.2 Fill the power steering reservoir with automatic transmission fluid that meets Dexron III or TES-389 specifications.
    - 20.3 With the engine off, turn the wheel fully left and right five times to bleed the air from the rack.
    - 20.4 Start the engine, turn the wheel fully left and right several times to bleed the remaining air from the rack.
    - 20.5 If the steering system needs additional bleeding, repeat the previous substep after the fluid in the reservoir has had time to release any air.
21. 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.

    - 21.1 Complete the setup needed for the computerized alignment tool (identical to the setup for integral steering gears).
    - 21.2 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. 4**.

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



A. Surface marked with color: red is long, yellow is medium, and blue is short.

1. Jam Nut
2. Welded Spacer
3. Stop Bolt (square-head)

Fig. 1, New Axle Stop Bolt

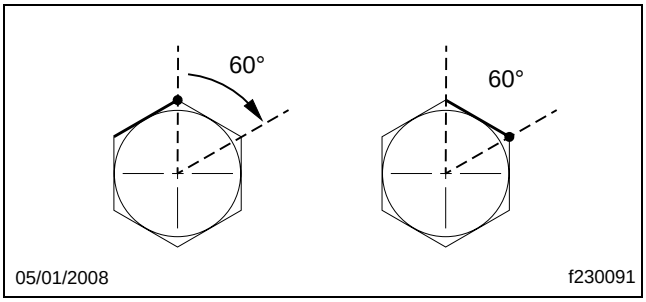
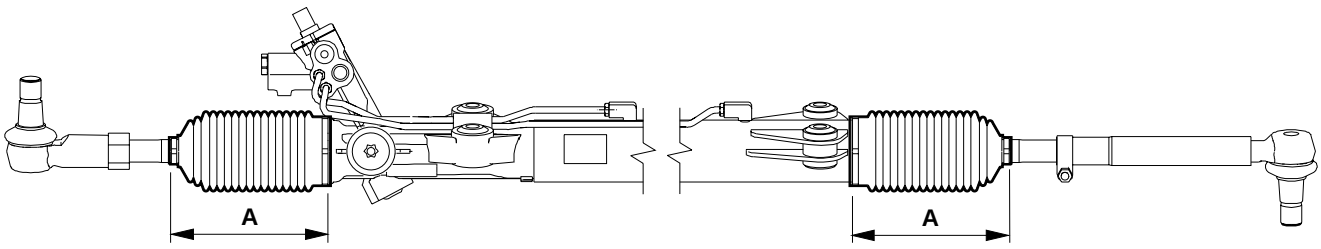


Fig. 2, Turning the Fitting One Flat (60 degrees)



A. Measure the bellows on each side. If measurements are not within 1 inch (25 mm) of each other, move the tires until the bellows lengths are within range.

Fig. 3, Measuring the Tie Rod Bellows

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

21.3 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.

21.4 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).

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

21.6 Loosen the passenger-side tie rod clamp nut.

21.7 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).

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

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).

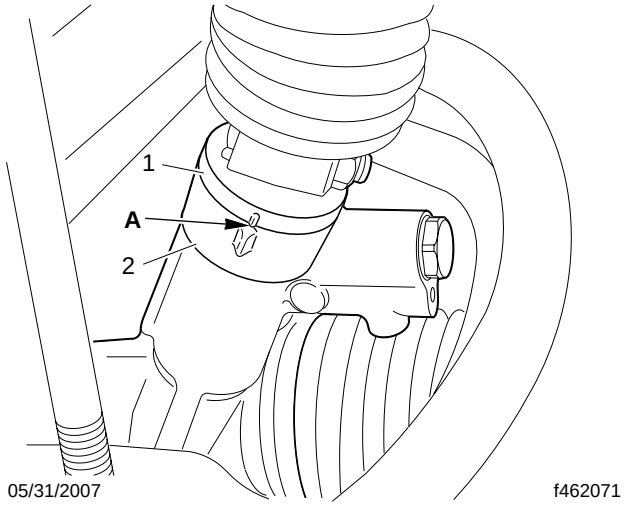
NOTICE

Wheel cut cannot exceed 46 degrees. Excessive wheel cut may damage the inner tie rod.

21.9 If the vehicle is not included in FL512 **or** FL512 has been completed, go to step 19.11. If the vehicle is included in FL512 and it has not been completed, to go step 19.10.

21.10 Check the wheel cut. With the wheels turned all the way to the right and left, the wheel cut should be 44 degrees to 46 degrees. It should never exceed 46 degrees. If it is less than 44 degrees, from kit 25-FL512-000, use the yellow-marked stop bolts to increase the wheel cut by 2 degrees, or the blue-marked stop bolts to increase the wheel cut by 4 degrees. Every 2 mm (0.79 inch) of stop-bolt spacing equals 2 degrees of wheel cut.

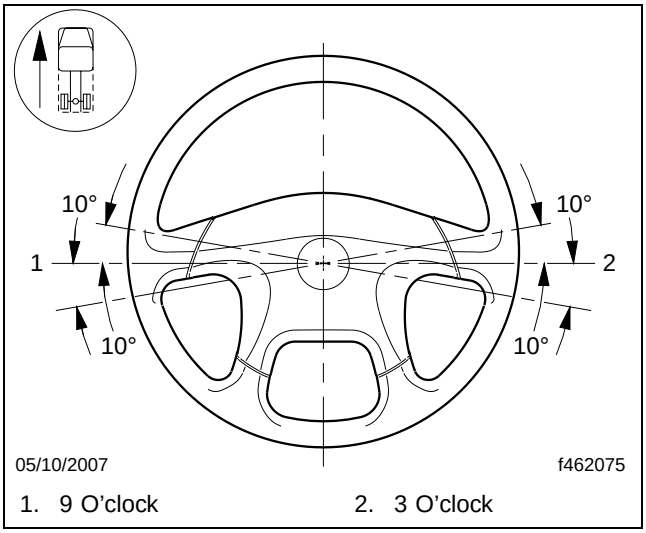
NOTE: Because the stop-bolt lengths are in 2 mm (0.79 inch) increments, you may ultimately have to use different lengths for the left and right sides to achieve wheel cuts in the acceptable range. The wheel cuts do not have to be exactly the same on both sides of the vehicle, just within the acceptable range.



A. Align the pointers.

1. Input Shaft Seal Cover
2. Input Shaft Housing

Fig. 4, Pointer Alignment



1. 9 O'clock
2. 3 O'clock

Fig. 5, Steering Wheel Centered

21.11 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.

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

21.13 Return the wheels to the straight-ahead position.

22. Make sure that the steering wheel is within 10 degrees of center as shown in **Fig. 5**. 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.

22.1 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.

22.2 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.

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

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

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

22.6 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.

23. Remove the turnplates and alignment equipment.

24. Recheck the power steering fluid level.

25. 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.