Maintenance Manual Contents

Determining Scheduled Maintenance Intervals

Performing regular maintenance on your Freightliner vehicle will help ensure that your vehicle delivers safe reliable service and optimum performance for years to come. Failure to follow a regular maintenance program can result in inefficient operation and unscheduled down time.

To determine the correct maintenance intervals for your vehicle you must first determine the type of service or conditions the vehicle will be operating in. Generally, over-the-road vehicles operate under conditions that fall within one of the two types of service described. Before placing your new vehicle in service, determine the type of service (Service Schedule I or II) that applies to the intended use of the vehicle. After determining the vehicle's type of service, refer to the service schedule table or the vehicle maintenance schedule table, to determine how often maintenance should be performed.

When the vehicle reaches the distance given for a maintenance interval, see the Maintenance Interval Operation Table for a list of the maintenance operations to be performed at that maintenance interval. Use the maintenance operation reference numbers to find detailed instructions in the manual on each operation.

Types of Service

Service Schedule I (short-haul transport) applies to vehicles that annually travel less than 60,000 miles (100 000 kilometers) and operate under normal conditions. Examples of Schedule I usage are: operation primarily in cities and densely populated areas; local transport with infrequent freeway travel; or high percentage of stop-and-go travel.

Service Schedule II (long-haul transport) is for vehicles that annually travel *more than* 60,000 miles (100 000 kilometers) with minimal city or stop-and-go operation. Examples of Schedule II usage are: regional delivery that is mostly freeway miles; interstate transport; or any road operation with high annual mileage.

NOTE: Maintenance instructions in this manual are based on average vehicle use and normal operating conditions. Unusual vehicle operating conditions may require service at more frequent intervals.

Vehicle Maintenance Schedule Table: 00–03

Maintenance for Service Schedule II				
Maint. No.	Maintenance Interval	Service Date	Service Schedules II	
			Miles	km
1	IM and M1		25,000	40 000
2	M1		50,000	80 000
3	M1		75,000	121 000
4	M1 and M2		100,000	161 000
5	M1		125,000	201 000
6	M1		150,000	241 000
7	M1		175,000	281 000
8	M1 and M2		200,000	322 000
9	M1		225,000	362 000
10	M1		250,000	402 000
11	M1		275,000	443 000
12	M1, M2, and M3		300,000	483 000
13	M1		325,000	523 000
14	M1		350,000	563 000
15	M1		375,000	604 000
16	M1 and M2		400,000	644 000
17	M1		425,000	684 000
18	M1		450,000	724 000
19	M1		475,000	764 000
20	M1 and M2		500,000	805 000
21	M1		525,000	845 000
22	M1		550,000	885 000
23	M1		575,000	925 000
24	M1, M2, and M3		600,000	966 000
25	M1		625,000	1 005 800
26	M1		650,000	1 046 000
27	M1		675,000	1 086 000
28	M1 and M2		700,000	1 127 000
29	M1		725,000	1 167 000
30	M1		750,000	1 207 000
31	M1		775,000	1 248 000
32	M1 and M2		800,000	1 287 000
33	M1		825,000	1 328 000
34	M1		850,000	1 368 000
35	M1		875,000	1 408 000

Maintenance Operation Sets Table: 00–08

Maintenance Operation Sets					
Maint. No.	Operation Description	Service Schedules I and II			
		IM	M1	M2	M3
83–03	ParkSmart™ Inspection	•	•	•	•
88–01	Hood Rear Support Lubrication	•	•	•	•

* On vehicles equipped with Detroit transmissions, the release bearing does not need to be lubricated. On vehicles equipped with Eaton Fuller UltraShift PLUS transmissions, lubricate the release bearing every 50,000 miles (80 000 km) or 3 months.

† Replace the clutch assembly for Detroit automated transmissions at 750,000-mile (1 200 000-km) intervals.

‡ For Schedule II vehicles with Detroit automated transmissions spec'd to haul more than 80,000 lb (36 000 kg), change the transmission fluid at 200,000-mile (322 000-km) intervals.

§ For Eaton Fuller transmissions, fluid change intervals are extended to 500,000 miles (800 000 km) on vehicles filled with synthetic transmission fluid.

¶ For Schedule I vehicles with Detroit axles, complete this procedure once a year or every 25,000 miles (40 000 km), whichever comes first.

** If equipped with an oil-coalescing desiccant cartridge, replace the cartridge once a year, regardless of mileage. Otherwise use the M3 maintenance interval.

†† Complete this procedure every 25,000 miles (40 225 km), 3 months, or 500 operating hours, whichever comes first.

Table 8, Maintenance Operation Sets

15–00 Safety Precautions

Safety Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

15–01 Alternator, Battery, and Starter Connections Check

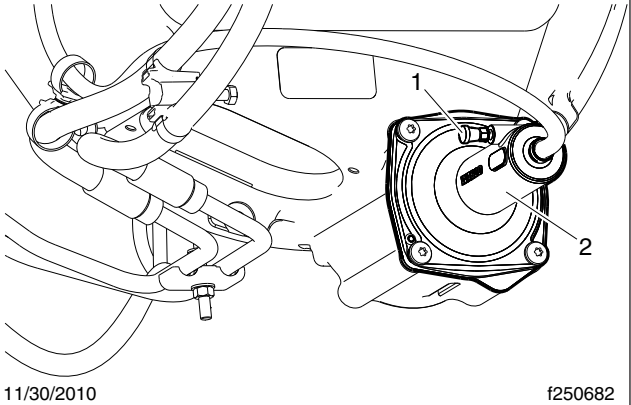
⚠ WARNING

Batteries generate explosive gas as a by-product of their chemical process. Do not smoke when working around batteries. Put out all flames and remove any source of sparks or intense heat in the vicinity of the battery compartment. Make sure the battery compartment has been completely vented before disconnecting or connecting the battery cables.

Battery acid is extremely harmful if splashed in the eyes or on the skin. Always wear a face shield and protective clothing when working around batteries.

1. Disconnect the batteries.
2. Check the tightness of the alternator bracket fasteners; tighten the fasteners as needed. For torque values, see **Group 15** of the *Cascadia™ Workshop Manual*.
3. Check that all electrical connections at the alternator and starter are clean. Clean and tighten all charging system electrical connections, including the connections at the starter B terminal and ground terminal, and where the alternator charging cable terminates.
4. Inspect the battery cables for wear, and replace them if they are damaged. Clean the cable connector terminals with a wire brush. See **Group 54** of the *Cascadia™ Workshop Manual* for adjustment, repair, or replacement instructions.
   - 4.1 Clean and tighten the battery ground cable, terminal, and clamps.
   - 4.2 Inspect the retainer assembly or battery hold-downs, and the battery box. Replace worn or damaged parts. Remove any corrosion with a wire brush, and wash with a weak solution of baking soda and water. Flush with clean water, and dry. Paint the retainer assembly if needed, to prevent rusting.
   - 4.3 Check that foreign objects, such as stones, bolts, and nuts, are removed from the battery box.
   - 4.4 After cleaning, connect the cables to the batteries and tighten them to the torque specifications listed on the battery, generally 10 to 15 lbf·ft (14 to 20 N·m).
   - 4.5 Coat the battery terminals with dielectric grease.
5. Check the alternator wiring for missing insulation, kinks, and heat damage. Replace or repair as needed.
6. Check the terminals on the battery shut-off switch and the magnetic switch. Make sure the terminal connections are clean and tight. Coat the terminal connections with dielectric red enamel after cleaning.

3. Remove the reservoir lid (see **Fig. 3**) and install the pressure bleed adaptor on the reservoir.
4. Bleed the hydraulic system as follows.
   - 4.1 Open the bleed valve on the bleed tank to pressurize the reservoir.
   - 4.2 Remove the cap from the bleed valve of the slave cylinder. See **Fig. 4**. On the valve, install a transparent drain hose connected to a catch bottle. The hose needs to fit the bleed valve tight enough so it does not fall off when fluid is pumped out.
   - 4.3 Open the bleed valve on the slave cylinder.
   - 4.4 When the draining fluid is clear and free of air bubbles, close the bleed valve.



1. Bleed Valve 2. Slave Cylinder

Fig. 4, Slave Cylinder, Hydraulic Clutch Control

5. Check the fluid level in the reservoir. If necessary, add or drain fluid to bring the fluid level to between the MIN and MAX lines marked on the side of the reservoir.
6. Install the reservoir lid.
7. Disconnect the transparent hose. Tighten the bleed screw 88 lbf·in (1000 N·cm) and install the cap on the slave cylinder bleed valve.
8. Depress the clutch pedal a few times. There should be resistance over the full pedal stroke.

Manual Bleeding

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires and open the hood.

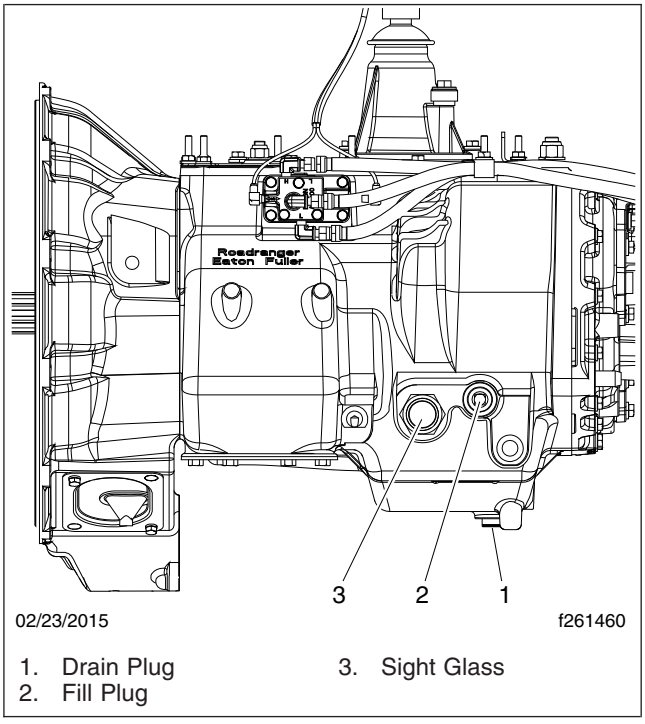
NOTE: The hydraulic system holds approximately 0.5 quart (0.5 liter) of fluid. It may need to be refilled during the bleeding process to prevent air from re-entering the system.

2. Remove the reservoir lid and fill the reservoir (see **Fig. 3**) with new DOT 4 brake fluid from a tightly sealed container.
3. Remove the cap from the bleed valve of the slave cylinder. See **Fig. 4**. On the valve, install a transparent drain hose connected to a catch bottle. The hose needs to fit the bleed valve tight enough so it does not fall off when fluid is pumped out.

NOTE: The following steps require two people—one in the cab to work the clutch pedal, and one to open and close the bleed valve and watch the fluid.

4. Bleed the system, as follows.
   - 4.1 Open the bleed valve.
   - 4.2 Depress the clutch pedal until it stops.
   - 4.3 Close the bleed valve.
   - 4.4 Return the pedal to the upper position.
   - 4.5 Repeat the previous steps until the fluid is clear and free of air bubbles.
   - 4.6 Depress the clutch pedal. There should be resistance over the full pedal stroke.
5. Check the fluid level in the reservoir. If necessary, add or drain fluid to bring the fluid level to between the MIN and MAX lines marked on the side of the reservoir. Install the reservoir lid.
6. Disconnect the transparent hose. Tighten the bleed valve 88 lbf·in (1000 N·cm) and install the cap on the slave cylinder bleed valve.

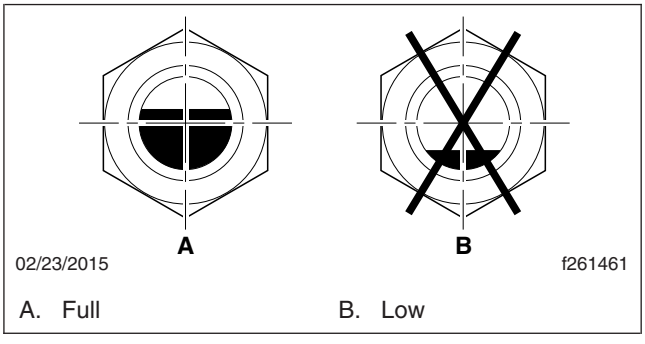
1. Clean the oil level sight glass. See **Fig. 6**.



1. Drain Plug
2. Fill Plug
3. Sight Glass

Fig. 6, Eaton Fuller Transmission With a Sight Glass

2. Check the fluid level in the sight glass. When the fluid level is at or above 3/4 of the sight glass, then it is at or above the minimum fill level. See **Fig. 7**.



A. Full
B. Low

Fig. 7, Transmission Fluid Level Sight Glass

3. If the fluid level is low, check the transmission for leaks, and correct as needed.
4. If needed, add the recommended fluid, until it is at or above 3/4 of the sight glass. See **Table 3** for approved transmission lubricants.

For more information and a complete listing of approved lubricants, refer to the Eaton website, **www.roadranger.com**.

26–06 Eaton Fuller Manual Transmission Air Filter/ Regulator Check, Cleaning, or Replacement

1. Apply the parking brakes, and chock the rear tires. Drain the air reservoirs.

⚠ WARNING

Drain the air supply; if the air supply is not drained before the air filter/regulator is serviced, serious injury and component damage could result.

2. Clean the outside of the air filter/regulator with cleaning solvent. See **Fig. 8**.

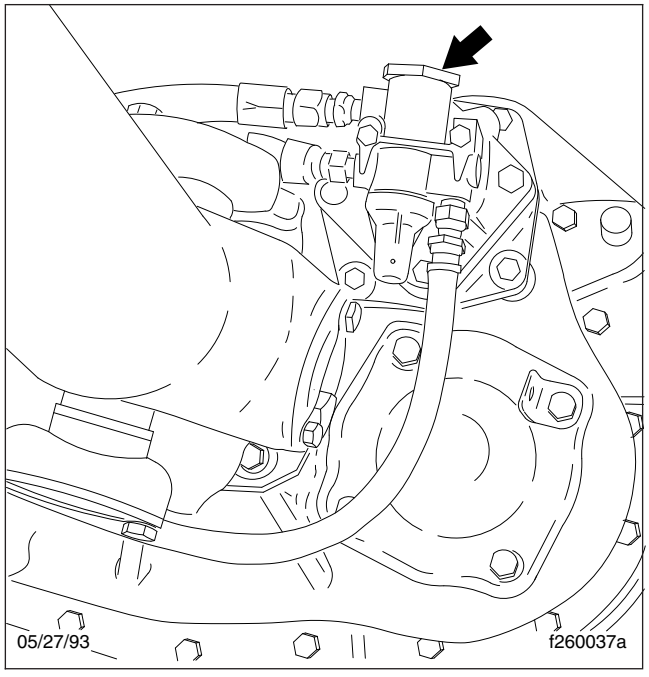


Fig. 8, Air Filter/Regulator Location

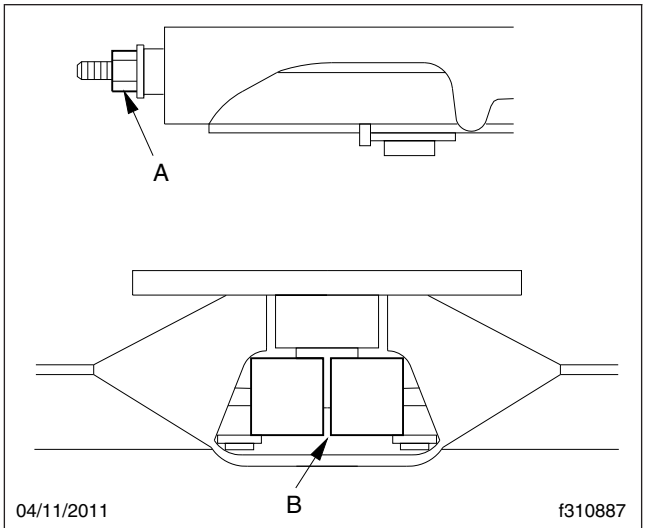
6. Check all cotter pins for cracking or damage. Replace any cotter pin that shows any signs of damage.
7. Check all mounting bolts for signs of fatigue, and tighten them to the proper torque. For torque specifications, see **Group 00** of the vehicle Workshop Manual. Inspect all angles, plates, and brackets for cracks or other damage.
8. Replace cracked, worn, or damaged parts with new parts. Replace all loose mounting bolts with 5/8–11 SAE grade 8 bolts, grade C locknuts, and hardened washers. *Do not* re-use bolts, nuts, and washers on fifth wheel mountings.
9. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. See **MOP 31–02** for lubrication instructions.

Holland FW35

1. Disconnect the tractor from the trailer. For instructions, see the vehicle Driver's/Operator's Manual.
2. Thoroughly steam clean all fifth wheel components before inspection.
3. Check for cracks in the fifth wheel assembly, mounting brackets, and mounting parts.
4. Check the fastener torques on the fifth wheel assembly and fifth wheel mounting. Tighten bolts and nuts as needed. Replace missing or damaged bolts.
5. Inspect the fifth wheel for bent, worn, damaged, and missing parts; replace them as needed with genuine Holland parts.
6. Using a Holland Kingpin Lock Tester (Holland tool number TF-TLN-5001, available through the PDCs as HLD TFTLN5001), check the operation of the locking mechanism by opening and closing the locks. See **Fig. 3**.
7. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. See **MOP 31–02** in this manual for lubrication instructions.

Fontaine

1. Disconnect the tractor from the trailer. For instructions, see the vehicle Driver's/Operator's Manual.



A. The nut and washer should be snug against the fifth wheel.
B. The locks should be completely closed around the kingpin.

Fig. 3, Holland Fifth Wheel Properly Closed

2. Thoroughly steam clean the fifth wheel.
3. Check for cracks in the fifth wheel assembly, mounting brackets, and mounting parts.
4. Ensure that both bracket pins are in place and secured by retainer pins and cotter pins. See **Fig. 4**.
5. For fifth wheels equipped with bracket liners, rock the fifth wheel. If it does not rock freely, remove the top plate and inspect the bracket liners. Replace liners that are broken or less than 0.125 inch (3 mm) thick at the top of the liners. For the liner replacement procedure, see the Fontaine website, **www.fifthwheel.com**.
6. Check the jaw and stationary jaw for mushrooming, and check that the serrations at the jaw and wedge are in good condition.
7. Test the secondary safety lock latch for ease of operation.
8. Check for loose nuts or bolts on the fifth wheel and the mounting. Set a torque wrench to the maximum torque value for the bolt being checked, and confirm that the torque is to specification. Do not loosen the bolt to check the torque. For torque specifications, see **Group 00** of the vehicle Workshop Manual.

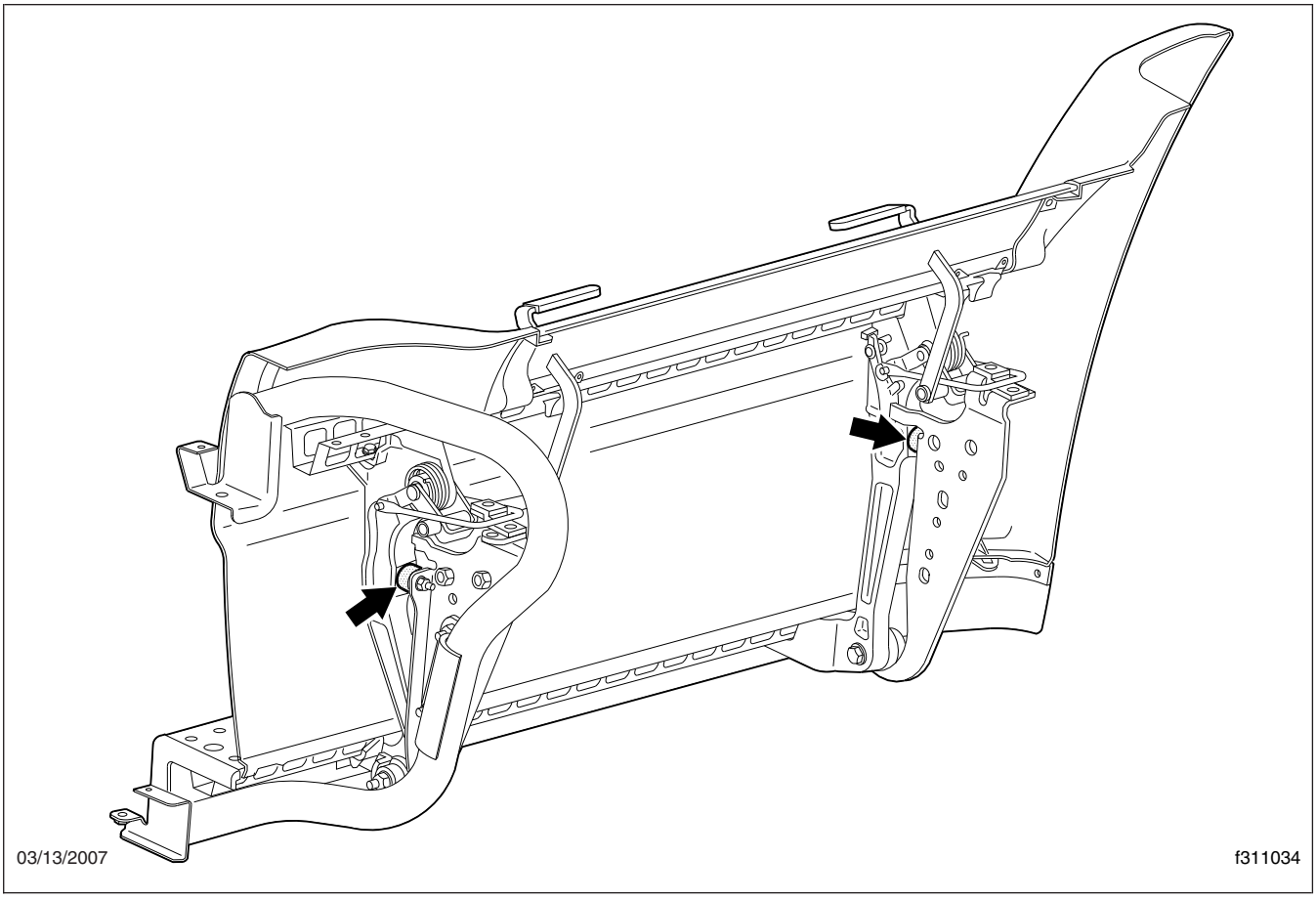
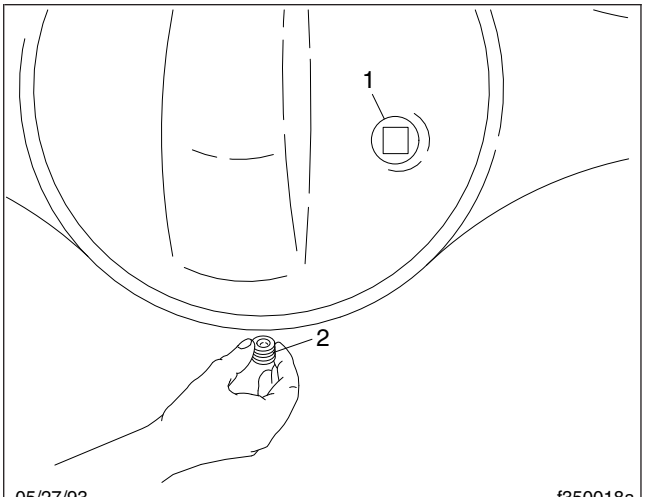
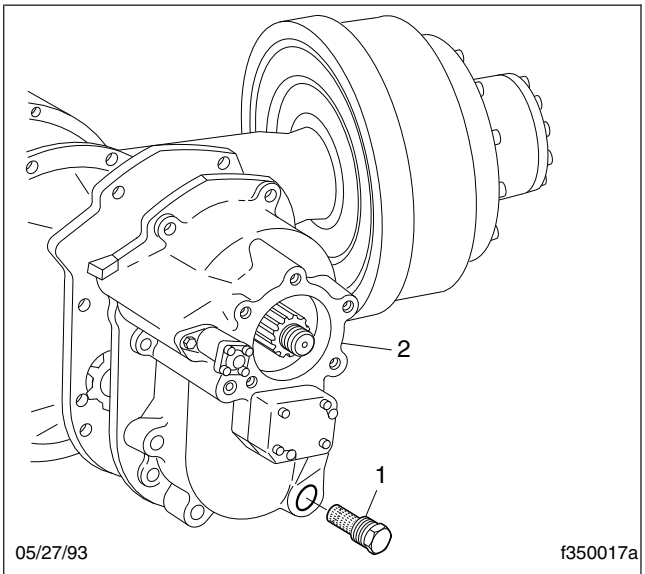


Fig. 12, Bumper Location



1. Oil Fill Plug 2. Oil Drain Plug

Fig. 4, Axle Housing Drain and Fill Plugs



1. Magnetic Strainer 2. Power Divider

Fig. 5, Dana Spicer Tandem Drive Axle Magnetic Strainer

⚠ WARNING

Always wear eye protection when using compressed air to clean parts, as flying debris could cause permanent damage to unprotected eyes. Do not point the air stream in the direction of other persons.

4.2 Wash the strainer in solvent, and blow it dry with compressed air to remove oil and metal particles.

4.3 Install and tighten the magnetic strainer 40 to 60 lbf·ft (54 to 81 N·m).

5. Clean the fill and drain plugs. Change them if necessary.

5.1 For magnetic plugs, use a piece of key stock or any other convenient steel slug to short the two magnetic poles and divert the magnetic field.

5.2 Clean away the collected material deposited on each pole. Magnets will rapidly lose their effectiveness as collected material bridges the gap between the two poles.

5.3 After the first oil is changed, inspect the drain plug each time for large quantities of metal particles.

5.4 After cleaning, install the drain plug(s) and tighten to 40 to 60 lbf·ft (54 to 81 N·m).

6. Fill the axle with the recommended lubricant. See **Table 5** for recommended drive axle lubricants, and **Table 6** for drive axle lubricant capacities.

Dana Spicer Drive Axle Recommended Lubricant		
Lubricant Type	**Condition**	**Lubricant SAE Viscosity Grade**
Dana Spicer Roadranger® Synthetic Drive Axle Lubricants, or Equivalent with Military Specification MIL–L–2105D	Over-the-Road Service	75W–90
	Off-Highway Equipment, or Under Extra Heavy Loads	80W–140

Table 5, Dana Spicer Drive Axle Recommended Lubricant

Dana Spicer Drive Axle Lubricant Capacities		
Axle Type	**Axle Model**	**Capacity:* Pints (liters)**
Single Drive Axle Installation		

40–01 Wheel Nut Check

IMPORTANT: After a wheel has been installed, the wheel nut torque must be rechecked after 50 to 100 miles (80 to 160 km) of operation.

Check the torque on all wheel nuts. See **Table 1** for torque specifications, and see **Fig. 1** for the wheel nut tightening sequence.

NOTE: Torque values are given for lubricated threads. Apply 2 drops of SAE 30W oil to a point between the nuts and flanges.

⚠ CAUTION

Insufficient wheel nut torque can cause wheel shimmy, resulting in wheel damage, stud breakage, and extreme tire tread wear. Excessive wheel nut torque can break studs, damage threads, and crack discs in the stud hole area. Use the recommended torque values, and follow the tightening sequence shown in Fig. 1.

Disc Wheel Fastener Torque	
Nut Size	**Torque: lbf·ft (N·m) Oiled**
M22 x 1.5	450–500 (610–678)
NOTE: If using specialty fasteners, consult the manufacturer for recommended torque levels.	

Table 1, Disc Wheel Fastener Torque

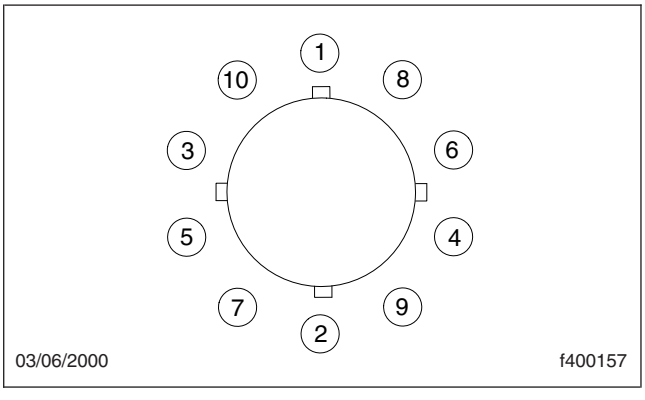


Fig. 1, Wheel Nut Tightening Sequence

40–02 Tire Check

Tires should be inspected closely during the first 3000 to 10,000 miles (5000 to 16 000 km) for abnormal wear.

Maintain the proper pressures for carried loads, per the tire manufacturers' recommendations, or the tire pressure label on the driver's door.

Have the wheel alignment checked after the first 10,000 miles (16 000 km), then every 40,000 miles (60 000 km) thereafter.

Do not continue to drive the vehicle if tires develop any of the following:

- blisters;
- cuts or punctures that reach to the cord;
- a nail, screw, rock, or other puncturing object;
- flat spots or irregular wear;
- tread worn to a minimum depth;
- inability to maintain proper tire pressure.

42–00 Safety Precautions

Safety Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

42–01 Air Brake System Valve Inspection

NOTE: There is no scheduled air valve maintenance on vehicles equipped with Bendix air valves and a Bendix air dryer if the air dryer desiccant is replaced at 350,000 miles (563 000 km). If the desiccant is not changed at 350,000 miles (563 000 km), or if the vehicle is equipped with another air dryer, maintenance will have to be performed to the air brake valves. See **Group 42** of the vehicle Workshop Manual for procedures.

IMPORTANT: For vehicles equipped with an oil-coalescing air dryer desiccant cartridge, replace the cartridge once a year, regardless of mileage.

42–02 Bendix Air Dryer Desiccant Replacement

IMPORTANT: For vehicles equipped with an oil-coalescing air dryer desiccant cartridge, replace the cartridge once a year, regardless of mileage.

AD–9

1. Park the vehicle on a level surface, apply the parking brakes, and chock the tires.
2. Completely drain all air reservoirs. Air pressure gauges should read 0 psi (0 kPa).

NOTE: The compressor discharge line may still contain residual air pressure, open the line slowly.

3. Identify, tag, and disconnect the three air lines from the end cover.
4. Disconnect the harness connector from the heater and thermostat assembly.
5. Loosen the bolt that secures the upper mounting bracket strap.
6. Remove the two bolts and Nylok® nuts that secure the air dryer to the lower mounting bracket. Mark the position of the mounting bracket to the end cover and mark the bolts to ease installation.
7. Remove the upper mounting bracket strap fasteners, then remove the strap and the air dryer.
8. Place the air dryer on a bench and remove the remaining 6 bolts, 12 washers, 6 Nylok nuts, and the air dryer housing. See **Fig. 1**. Discard the Nylok nuts. Remove the end-cover-to-housing O-ring.
9. Clamp the desiccant cartridge in a vise.

⚠ WARNING

Clamping the end cover or housing in a vise could seriously compromise the air dryer's ability to hold air pressure, which could cause a failure in the brake system, resulting in property damage, personal injury, or death.

10. Twist the end cover counterclockwise to release the cartridge from the end cover. Rotate the end cover until it completely separates from the desiccant cartridge.

NOTE: A substantial torque, up to 50 lbf·ft (68 N·m), may be necessary to remove the desiccant cartridge.

NOTICE

Dirt or obstructions in the O-ring grooves can cause an O-ring failure that will result in an air leak.

11. Inspect the condition of the O-ring seals. If they are cracked, crimped, or otherwise damaged, replace them to ensure an airtight seal. Clean the O-ring grooves of any dirt or obstruction.

8. Install the reservoir on the cover and tighten the capscrews.
9. Fill the reservoir with 40 ounces (1183 mL) of methyl alcohol, then install the filler cap.

42–05 Brake Inspection

Parking Brake Operational Check

IMPORTANT: This procedure should be performed prior to lubrication of the brake components.

⚠ CAUTION

Perform the following check in a clear safe area. If the parking brakes fail to hold the vehicle, personal injury or property damage may result.

1. With the engine running, and air pressure at cut-out pressure, set the parking brake.
2. Put the vehicle in the lowest gear and gently attempt to move it forward. The vehicle should not move. If the vehicle moves, the parking brakes are not operating correctly and must be repaired before the vehicle is returned to service. See **Group 42** of the vehicle Workshop Manual for repair procedures.

Brake Component Inspection

1. Park the vehicle on a level surface, set the parking brake, and chock the tires. Once the tires are chocked, release the parking brake.

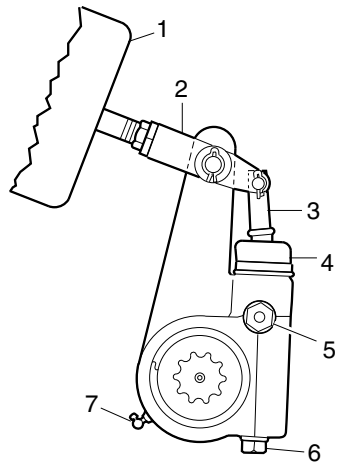
⚠ WARNING

Manually adjusting an automatic slack adjuster to bring the pushrod stroke within legal limits is likely masking a mechanical problem. Adjustment is not repairing. Before adjusting an automatic slack adjuster, troubleshoot the foundation brake system and inspect it for worn or damaged components. Improperly maintaining the vehicle braking system may lead to brake failure, resulting in property damage, personal injury, or death.

2. With the engine off, and 100 psi (689 kPa) of air tank pressure, have an assistant apply and hold an 80 to 90 psi (550 to 620 kPa) brake application.
3. Check to see if the colored over-stroke band on each brake chamber pushrod is exposed.

   If a band shows, the stroke is too long. Check the foundation brake components for wear or damage, and repair as needed. See **Group 42** of the vehicle Workshop Manual for inspection and repair procedures.
4. Measure the applied chamber stroke.

   See **Table 1** for the proper stroke for the type of chamber being used. If the stroke is too short, the brakes may drag or will not fully apply. Check for improper operation or adjustment of the automatic slack adjuster. See **Group 42** of the vehicle Workshop Manual.



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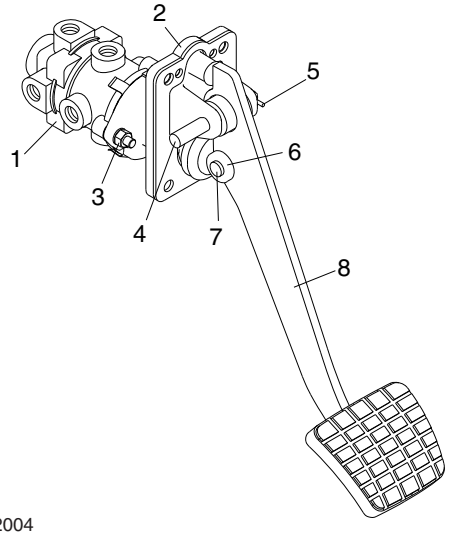
1. Brake Chamber
2. Clevis
3. Actuator Rod
4. Boot
5. Pressure-Relief Capscrew, Gasket, Pawl Spring, and Pawl
6. Manual Adjusting Nut
7. Grease Fitting (or plug)

Fig. 7, Meritor Automatic Slack Adjuster



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1. E-6 Foot Control Valve
2. Mounting Plate
3. Nut and Washer
4. Pivot Pin
5. Roll Pin
6. Roller
7. Roller Pin
8. Pedal

Fig. 8, Brake Pedal and Valve Assembly

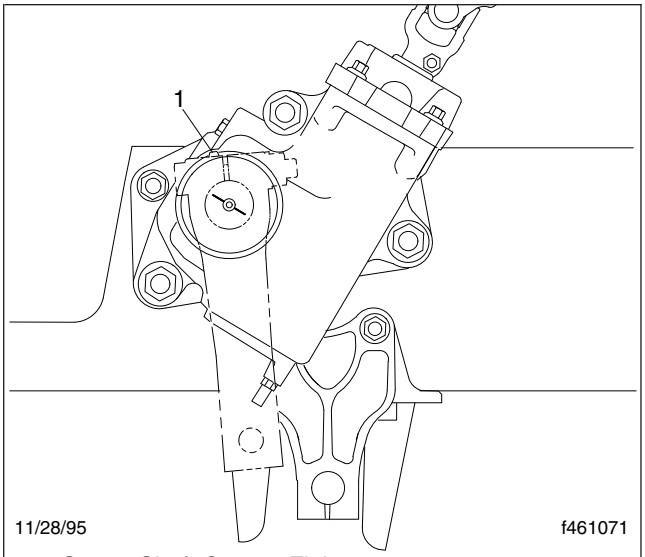
4. Remove the brake pedal.
5. Check the brake pedal mounting plate adapter for signs of wear or cracks at the bosses (the area from which the pivot pin was removed). Replace it if necessary.
6. Check the brake pedal rollers for signs of wear or cracks. Replace the rollers as needed.
7. If the rollers are replaced, replace the roller pin, install a new cotter pin, bend it to 90 degrees and apply Torque Seal (OPG F900 White) to the cotter pin.
8. Remove the plunger from the valve. Using alcohol, clean the existing grease from the plunger. Check the plunger for signs of wear or cracks. Replace it if necessary.
9. Lubricate the plunger with barium grease (BW 246671).
10. Insert the plunger in the valve.
11. Install the brake pedal with the pivot pin.
12. Install a new roll pin and apply Torque Seal (OPG F900 White) to the roll pin.
13. Install the brake valve assembly; see **Group 42**, of the vehicle Workshop Manual.
14. Test the brakes before returning the vehicle to service.

42–10 WABCO System Saver Air Dryer Desiccant Cartridge Replacement

NOTE: The following instructions apply to the System Saver 1200, 1200 Plus, and Twin air dryers.

NOTICE

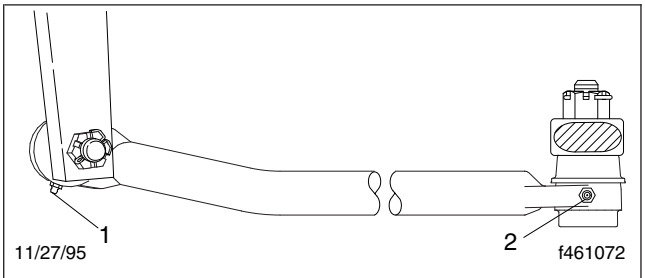
The WABCO System Saver air dryers can use either a standard or oil coalescing desiccant cartridge. When replacing the desiccant cartridge, it is very important to use the same type of cartridge that was originally installed on the dryer. Oil coalescing cartridges can be used in any application, but require more frequent service intervals (every 1 to 2 years instead of every 2 to 3 years for a standard cartridge). Do not replace an oil coalescing cartridge with a standard cartridge, as



1. Sector Shaft Grease Fitting

Fig. 2, Steering Gear Lubrication

Grade 1 (6% 12-hydroxy lithium stearate grease) chassis grease, apply clean grease at the grease fittings until old grease is forced out of the socket.



1. Grease Fitting at Pitman Arm
2. Grease Fitting at Axle Steering Arm

Fig. 3, Drag Link

46–06 Rack and Pinion Steering Gear Inspection

⚠ WARNING

All steering system components are critical for safe operation of the vehicle. Failure to maintain the steering system as specified may result in loss of steering control, which could lead to personal injury and property damage.

Inspect the rack and pinion steering system as described below, and repair or replace any components that are worn or damaged. **Figure 4** shows the components of the rack and pinion steering system.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Check the steering I-shaft U-joints for evidence of looseness or binding. If any is found, replace the I-shaft.
3. Check the steering I-shaft slip joint for evidence of lateral movement, looseness, or binding. If any is found, replace the I-shaft.
4. Jack up one axle end at a time, and move the tire in and out by hand to check the tie rod ends for free play. No free play is allowed. If the outer tie rod ends are damaged or worn, replace them. See **Group 46** of the *Cascadia Workshop Manual* for replacement instructions.
5. Check the steering gear mounting bolts for security.
6. Check that the outer tie rod castle nuts are tight, and the cotter pins are properly installed.

IMPORTANT: Do not remove the bellows unless they are damaged and require replacement, or there is evidence of a loose inner tie rod or there is hydraulic fluid leak.

7. Use a clean rag to remove all dirt and debris from the bellows. Check the bellows for holes or tears. If any are found, replace the bellows.
8. Check for evidence of hydraulic fluid leakage from the bellows. If hydraulic fluid is found to be leaking from within the bellows, replace the steering gear.
9. Check the input shaft for any leakage around the input shaft seal cover. If there is evidence of leakage from inside the cover, remove it and replace the input shaft seal. See **Group 46** of the *Cascadia Workshop Manual* for instructions.

   Check the steering system pressure and return lines and fittings for leaks and damaged lines or hoses. Repair or replace lines, hoses, and fittings as necessary.