



# RECREATIONAL VEHICLE CHASSIS MAINTENANCE MANUAL

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**Models: MC  
MCL  
XCL  
XCM  
XCP  
XCR  
XCS**

## Foreword

Scheduled maintenance provides a key element for safe operation of your vehicle. A proper maintenance program also helps to minimize downtime and to safeguard warranties. This maintenance manual provides information necessary for years of safe, reliable, and cost-efficient vehicle operation.

**IMPORTANT:** The maintenance operations in this manual are **not all-inclusive**. Also refer to other component and body manufacturers' instructions for specific inspection and maintenance instructions.

Perform the pretrip inspection and daily/weekly/monthly maintenance as outlined in the vehicle operator's manual. Perform the operations in this maintenance manual at scheduled intervals based upon distance traveled or months of operation. Your authorized servicing dealer has the qualified technicians and equipment to perform this maintenance for you. Your dealership can also set up a scheduled maintenance program tailored specifically to your needs. Optionally, your dealership can assist you in learning how to perform the maintenance procedures in this manual.

**IMPORTANT:** Descriptions and specifications in this manual were in effect at the time of printing. Freightliner Custom Chassis Corporation (FCCC) reserves the right to discontinue models and to change specifications or design at any time without notice and without incurring obligation. Descriptions and specifications contained in this publication provide no warranty, expressed or implied, and are subject to revision and editions without notice.

Refer to [www.Daimler-TrucksNorthAmerica.com](http://www.Daimler-TrucksNorthAmerica.com) and [www.FreightlinerChassis.com](http://www.FreightlinerChassis.com) for more information, or contact Daimler Trucks North America LLC at the address below.

## Environmental Concerns and Recommendations

Whenever you see instructions in this manual to discard materials, you should attempt to reclaim and recycle them. To preserve our environment, follow appropriate environmental rules and regulations when disposing of materials.

## NOTICE: Parts Replacement Considerations

Do not replace suspension, axle, or steering parts (such as springs, wheels, hubs, and steering gears) with used parts. Used parts may have been subjected to collisions or improper use and have undetected structural damage.

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## Descriptions of Service Publications

Daimler Trucks North America LLC distributes the following major service publications in paper and electronic (via ServicePro®) formats.

<b>Workshop/Service Manual</b>	Workshop/service manuals contain service and repair information for all vehicle systems and components, except for major components such as engines, transmissions, and rear axles. Each workshop/service manual section is divided into subjects that can include general information, principles of operation, removal, disassembly, assembly, installation, and specifications.
<b>Maintenance Manual</b>	Maintenance manuals contain routine maintenance procedures and intervals for vehicle components and systems. They have information such as lubrication procedures and tables, fluid replacement procedures, fluid capacities, specifications, and procedures for adjustments and for checking the tightness of fasteners. Maintenance manuals do not contain detailed repair or service information.
<b>Driver's/Operator's Manual</b>	Driver's/operator's manuals contain information needed to enhance the driver's understanding of how to operate and care for the vehicle and its components. Each manual contains a chapter that covers pre-trip and post-trip inspections, and daily, weekly, and monthly maintenance of vehicle components. Driver's/operator's manuals do not contain detailed repair or service information.
<b>Service Bulletins</b>	Service bulletins provide the latest service tips, field repairs, product improvements, and related information. Some service bulletins are updates to information in the workshop/service manual. These bulletins take precedence over workshop/service manual information, until the latter is updated; at that time, the bulletin is usually canceled. The service bulletins manual is available only to dealers. When doing service work on a vehicle system or part, check for a valid service bulletin for the latest information on the subject.  IMPORTANT: Before using a particular service bulletin, check the current service bulletin validity list to be sure the bulletin is valid.
<b>Parts Technical Bulletins</b>	Parts technical bulletins provide information on parts. These bulletins contain lists of parts and BOMs needed to do replacement and upgrade procedures.
Web-based repair, service, and parts documentation can be accessed using the following applications on the AccessFreightliner.com website.	
<b>ServicePro</b>	ServicePro® provides Web-based access to the most up-to-date versions of the publications listed above. In addition, the Service Solutions feature provides diagnostic assistance with Symptoms Search, by connecting to a large knowledge base gathered from technicians and service personnel. Search results for both documents and service solutions can be narrowed by initially entering vehicle identification data.
<b>PartsPro</b>	PartsPro® is an electronic parts catalog system, showing the specified vehicle's build record.
<b>EZWiring</b>	EZWiring™ makes Freightliner Custom Chassis Corporation, Freightliner, Sterling, Thomas Built Buses, and Western Star products' wiring drawings and floating pin lists available online for viewing and printing. EZWiring can also be accessed from within PartsPro.

## Descriptions of Service Publications

Warranty-related service information available on the AccessFreightliner.com website includes the following documentation.

### **Recall Campaigns**

Recall campaigns cover situations that involve service work or replacement of parts in connection with a recall notice. These campaigns pertain to matters of vehicle safety. All recall campaigns are distributed to dealers; customers receive notices that apply to their vehicles.

### **Field Service Campaigns**

Field service campaigns are concerned with non-safety-related service work or replacement of parts. All field service campaigns are distributed to dealers; customers receive notices that apply to their vehicles.

## Page Description

For an example of a maintenance manual page, see [Fig. 1](#).

**A**

**B**

**Front Axle**

**C**

**33**

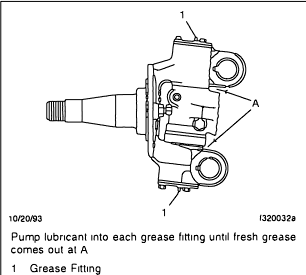
**33-01 Knuckle Pin Lubricating** (See Fig. 1)

Hold a high pressure gun on each fitting until fresh grease appears. This will ensure that all the old contaminated grease has been forced out.

When lubricating knuckle pin bushings *initially* (5000 miles (8000 km)), raise the front axle until the front tires are off the ground. Wipe the lube fittings clean, and slowly feed multipurpose chassis grease (NLGI grade 1 or 2) into each bushing area while turning the wheels from extreme right to left and back again (lock to lock). This will eliminate small air pockets and improve grease distribution.

Lower the tires to the ground, and regrease both top and bottom bushings until new grease is seen at the seal on the bushing opposite the fittings. The grease seal will accept the grease pressure without damaging the seal, and is designed to have grease pumped out through it during lubrication. Even if grease leaks out around the top or bottom plate gasket, continue pumping until new grease is seen at the seal on the bushing opposite the grease fitting.

When lubricating knuckle pin bushings at indicated maintenance intervals, do not raise the front axle. Wipe the lube fittings clean, and apply multipurpose chassis grease until new grease is seen at the grease seal on the bushing opposite the fittings.



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Pump lubricant into each grease fitting until fresh grease comes out at A

1 Grease Fitting

Fig. 1, Mentor Front Axle

**33-02 Tie-Rod End Lubricating and Inspecting**

- 1 Wipe the tie-rod end grease fittings clean, then pump multipurpose chassis grease (NLGI grade 1 or 2) to the tie-rod ends until all used grease is forced out and new grease appears at the ball stud neck.
- 2 Inspect the tie-rod ends.
  - 2.1 Shake the cross-tube. Movement or looseness between the tapered shaft of the ball and the cross-tube socket members means that the tie-rod end assembly must be replaced.
  - 2.2 The threaded portion of the tie-rod end assembly must be inserted all the way into the cross-tube split, for adequate clamping. See Fig. 2. Replace the parts if this cannot be done. For instructions, see the axle manufacturer's service manual.
  - 2.3 Check the tie-rod end nut and clamp nut torques. Tighten the tie-rod end nut 100 lbf ft (136 N m), and tighten the clamp nut 40 to 55 lbf ft (54 to 75 N m).

**33-03 Toe-In Inspection**

For vehicle alignment to be accurate, the shop floor must be level in every direction. The turn plates for the front wheels must rotate freely without friction, and the alignment equipment must be calibrated every three months by a qualified technician from the equipment manufacturer. Freightliner dealers must have proof of this calibration history.

- 1 Apply the parking brakes, and chock the rear tires.
- 2 Raise the front of the vehicle until the tires clear the ground. Check that the safety stands will support the combined weight of the cab, axle, and frame. Place safety stands under the axle.
- 3 Using spray paint or a piece of chalk, mark the entire center rib of each front tire.

**D**

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**E**

33/1

11/11/2002

12/00075

A. Maintenance Operation Number consists of the Group Number followed by the Sequence Number  
 B. Group Title  
 C. Group Number  
 D. Release Date  
 E. Group Number/Page Number

**Fig. 1, Example of a Maintenance Manual Page**

<b>Group No.</b>	<b>Group Title</b>
00 .....	General Information
01 .....	Engine
09 .....	Air Intake
15 .....	Alternators and Starters
20 .....	Engine Cooling/Radiator
26 .....	Transmission
30 .....	Throttle Control
32 .....	Suspension
33 .....	Front Axle
35 .....	Rear Axle
40 .....	Wheels and Tires
41 .....	Driveline
42 .....	Brakes
46 .....	Steering
47 .....	Fuel
49 .....	Exhaust
54 .....	Electrical
83 .....	Heater and Air Conditioner

<b>Title of Maintenance Operation (MOP)</b>	<b>MOP Number</b>
15,000 Mile or 12 Month Maintenance. . . . .	00-04
30,000 Mile or 24 Month Maintenance. . . . .	00-05
45,000 Mile or 36 Month Maintenance. . . . .	00-06
60,000 Mile or 48 Month Maintenance. . . . .	00-07
6000 Mile or 6 Month Initial Maintenance . . . . .	00-03
General Maintenance Schedule Information. . . . .	00-01
Metric/U.S. Customary Conversion Tables. . . . .	00-10
Noise Emission Controls Maintenance. . . . .	00-08
Torque Specifications Tables. . . . .	00-11
Vehicle Maintenance Schedule Table . . . . .	00-02
Verification of Inspections Log. . . . .	00-09

## General Maintenance Schedule Information

Performing regular maintenance on your 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.

When the vehicle reaches the distance or time (whichever comes first) given for a maintenance interval, see the Vehicle Maintenance Schedule 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 for each operation.

**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.

For specific engine maintenance information, see the *Cummins Operation and Maintenance Manual*.

**IMPORTANT:** Maintenance operations appearing in italics in the following tables are for emission control components. Numbers in the table are reference numbers matching those in the text of this manual.

## Camp Freightliner Owner Training

Owners who want to learn more about their vehicle can attend a two-day training class, offered at the Freightliner Custom Chassis Service Center in Gaffney, South Carolina. Some of the items covered during the training include the air brake system, electrical system, vehicle storage, weight distribution, and maintenance intervals.

To learn more about the class or to register, go to [www.freightlinerchassis.com](http://www.freightlinerchassis.com). After entering the website, click "Motorhomes" and select "Owner Info". A class description and the registration form are located under the "Camp Freightliner" tab.

If needed, service work can be scheduled for your vehicle at the service center during your stay.

## Tear-Out Checklists

**IMPORTANT:** Additional copies of the checklists should be made before giving this to a dealer, as they may not be returned to you. The correct number of checklists are included to cover the warranty period, however, if you want copies of the checklists for future maintenance after the warranty expires, you will need to make them. Freightliner Custom Chassis Corporation (FCCC) will not be able to send you additional copies.

At the back of the maintenance manual, there are checklists for each maintenance interval up to 60,000 miles (96 540 km). When a maintenance interval needs to be performed, take the vehicle to an authorized Freightliner dealer, remove the appropriate checklist, and give it to the dealer. These are the items that will be inspected for maintenance.



## Vehicle Maintenance Schedule Table: 00–02

Maintenance Operation Procedures and Schedule																						
Maintenance Operation Number and Description	Maintenance Interval in Miles x 1000																					
	6	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285		
	Maintenance Interval in Kilometers x 1000																					
	9	24	48	72	96	120	145	169	193	217	241	265	290	314	338	362	386	410	434	458		
	Maintenance Interval in Months																					
	6	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228		
01–01 Engine Drive Belt Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
01–02 Engine-Support Fasteners Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
01–03 Pacbrake Inspecting and Maintenance		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
09–01 Air Cleaner Inspecting and Replacing*	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
09–02 Charge Air Cooler Inspecting and Cleaning	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
15–01 Alternator, Battery, and Starter Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
20–01 Radiator Cap Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
20–02 Radiator Inspecting and Cleaning	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
20–03 Coolant Replacing†																						
20–04 Mechanical Fan Drive Gearbox Oil Changing	•		•		•		•		•		•		•		•		•		•			
26–01 Transmission Breather Checking		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
26–02 Allison MD/MH Series Transmission Fluid Level Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
26–03 Allison Transmission Fluid and Filter Changing (internal/external filter)‡																						
30–01 Throttle Pedal Pivot Pin Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
32–01 Suspension Fastener Torque Checking	•		•		•		•		•		•		•		•		•		•			
32–02 Suspension Height Control Valve Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
32–03 Suspension Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
32–04 ZF IFS Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
32–05 Suspension Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
32–06 Suspension U-Bolt Torque Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
33–01 Knuckle Pin Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		

## Vehicle Maintenance Schedule Table: 00–02

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	Maintenance Interval in Kilometers x 1000																					
	9	24	48	72	96	120	145	169	193	217	241	265	290	314	338	362	386	410	434	458		
	Maintenance Interval in Months																					
	6	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228		
33–02 Tie-Rod End Lubricating and Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
33–03 All-Axle Alignment Checking	•																					
33–04 Wheel Bearing Removal, Cleaning, Checking, Repacking, and Adjusting§																						
33–05 Oil-Filled Hubs Oil Level Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
33–06 Oil-Filled Hubs Oil Changing		•		•		•		•		•		•		•		•		•		•		
35–01 Axle Lubricant Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
35–02 Axle Lubricant Changing¶																						
35–03 Axle Breather Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
35–04 Oil-Filled Hubs Oil Level Checking, Tag Axle	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
35–05 Oil-Filled Hubs Oil Changing, Tag Axle		•		•		•		•		•		•		•		•		•		•		
40–01 Wheel Nut Checking	•		•		•		•		•		•		•		•		•		•			
40–02 Wheel Cleaning and Polishing**																						
41–01 Driveline Inspecting and Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
42–01 Brake System Valves Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
42–02 Air Dryer Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
42–03 Air Dryer Desiccant and Coalescent Filter Replacing††				•			•			•			•			•			•			
42–04 Camshaft Bracket Bushing Lubricating		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
42–05 Slack Adjuster Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
42–06 Foot Brake Valve Actuator Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
42–07 Bendix Hydro-Max® Brake System Inspecting (front-engine diesel chassis)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		

## Vehicle Maintenance Schedule Table: 00–02

Maintenance Operation Procedures and Schedule																						
Maintenance Operation Number and Description	Maintenance Interval in Miles x 1000																					
	6	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285		
	Maintenance Interval in Kilometers x 1000																					
	9	24	48	72	96	120	145	169	193	217	241	265	290	314	338	362	386	410	434	458		
	Maintenance Interval in Months																					
	6	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228		
<b>42–08</b> Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis) <sup>††</sup>																						
<b>42–09</b> Brake Lines Checking, Hydraulic Disc or Air Brakes	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>42–10</b> Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine diesel chassis)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>42–11</b> Brake Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>42–12</b> Meritor Roller Pin Lubricating		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>46–01</b> Drag Link Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>46–02</b> Power Steering Reservoir Fluid Level Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>46–03</b> Power Steering Reservoir Fluid and Filter Changing <sup>§§</sup>		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>46–04</b> Steering Driveline Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>46–05</b> Steering Gear Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>46–06</b> Hydraulic Reservoir Filter Changing (metal reservoir only)	•		•		•		•		•		•		•		•		•		•		•	
<b>47–01</b> Fuel Tank Mounts and Fuel Line Checking	•		•		•		•		•		•		•		•		•		•		•	
<b>47–02</b> Fuel/Water Separator Element Replacing <sup>†††</sup>																						
<b>49–01</b> Exhaust System Inspecting (Noise Emission Control)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>54–01</b> Ground Cables Checking and Cleaning	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<b>54–02</b> Battery Voltage Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

## Vehicle Maintenance Schedule Table: 00–02

Maintenance Operation Procedures and Schedule																						
Maintenance Operation Number and Description	Maintenance Interval in Miles x 1000																					
	6	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285		
	Maintenance Interval in Kilometers x 1000																					
	9	24	48	72	96	120	145	169	193	217	241	265	290	314	338	362	386	410	434	458		
	Maintenance Interval in Months																					
	6	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228		
<b>83–01</b> Air Conditioner Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

\* Inspect the air cleaner every 12 months. Replace the air cleaner element every 24 months, or when filter restriction reaches 25 inH<sub>2</sub>O (if equipped with an air restriction gauge).

† Beginning with model-year 2002 RV chassis, the coolant replacement interval is increased to 100,000 miles (161 000 km) or 60 months. You must check and, if necessary, recharge the SCA (supplemental coolant additive) levels and freeze point every 25,000 miles (40 000 km) or 6 months. See the Cummins Operation and Maintenance Manual for further information.

‡ For oil and filter change intervals, see the applicable Allison Operator's Manual.

§ For Freightliner/Meritor axles, check for correct end play every 15,000 miles (24 135 km). For ZF axles, lubricate grease fittings annually, and disassemble, inspect, and repack the bearings every 1, 000,000 miles (1 609 000 km).

¶ For Freightliner rear axles with petroleum-based oil, change the lubricant every 100,000 miles (161 000 km) or every 12 months, whichever comes first; if synthetic oil is used, change the lubricant every 250,000 miles (402 000 km) or every 12 months, whichever comes first. For Meritor rear axles with petroleum-based oil, change the lubricant every 100,000 miles (161 000 km) or every 12 months, whichever comes first; if synthetic oil is used, change the lubricant every 250,000 miles (402 000 km) or every 36 months, whichever comes first.

\*\* Perform these steps each time the wheels and/or the vehicle is washed.

†† Replace the Bendix AD9 filter and the Haldex (Midland) PURest® air dryer filter kit every 36 months.

‡‡ Lubricate every 6 months OR every 18,000 miles (28 000 km), whichever comes first.

§§ Change the TRW inline power steering filter every 12 months.

¶¶ See the Cummins Operation and Maintenance Manual for fuel/water separator element replacing intervals.

**Table 1, Maintenance Operation Procedures and Schedule**

**6000 Mile or 6 Month Initial Maintenance: 00–03**

Procedure Performed (check off or initial)	6000 Mile (9654 km) or 6 Month Initial Maintenance*	MOP
Inspect _____	Engine Drive Belt Inspecting	01–01
Check _____	Engine-Support Fasteners Checking	01–02
Change _____	Engine Oil and Filter (see the engine manufacturer's manual)	—
Inspect _____	Pacbrake Inspecting and Maintenance	01–03
Inspect _____	Air Cleaner Inspecting and Replacing	09–01
Inspect _____	Charge Air Cooler Inspecting and Cleaning (if cleaning is needed)	09–02
Check _____	Alternator, Battery, and Starter Checking	15–01
Inspect/ Check _____	Radiator (radiator cap, coolant freeze points, SCA levels, hose routing for chaffing and leaks)	20–01, 20–02, 20–03
Change _____	Mechanical Fan Drive Gearbox Oil Changing	20–04
Change _____	Transmission Fluid and Filter (if required by Allison)	26–03
Inspect _____	Transmission Hose Routing for Chaffing and Leaks	—
Lubricate _____	Throttle Pedal Pivot Pin Lubricating	30–01
Inspect _____	Suspension	32–01, 32–06
Check _____	Suspension Height Control Valve Checking	32–02
Lubricate _____	ZF IFS Lubricating	32–04
Check _____	Suspension U-Bolt Torque Checking	32–06
Lubricate _____	Knuckle Pin Lubricating	33–01
Lubricate _____	Tie-Rod End Lubricating and Inspecting	33–02
Check _____	All-Axle Alignment Checking	33–03
Check/ Lubricate _____	Wheel Bearing Removal, Cleaning, Checking, Repacking, and Adjusting	33–04
Check/ Change _____	Oil-Filled Hubs Oil Level Checking (front and tag axle)	33–05, 33–06, 35–04, 35–05
Check _____	Axle Seals for Leaks	—
Change _____	Axle Lubricant Changing (Freightliner axle only)	35–02
Check _____	Axle Breather Checking	35–03
Check _____	Wheel Nut Checking	40–01
Check _____	Tire Pressure	—
Lubricate _____	Driveline Inspecting and Lubricating	41–01
Inspect _____	Brake System Valves Inspecting	42–01

## 6000 Mile or 6 Month Initial Maintenance: 00-03

Procedure Performed (check off or initial)	6000 Mile (9654 km) or 6 Month Initial Maintenance*	MOP
Inspect _____	Air Dryer and Air Lines for Proper Routing, Chaffing, and Leaks	42-02
Lubricate _____	Camshaft Bracket Bushing Lubricating	42-04
Lubricate _____	Slack Adjuster Lubricating	42-05
Lubricate _____	Foot Brake Valve Actuator Lubricating	42-06
Inspect _____	Bendix Hydro-Max® Brake System Inspecting (front-engine only)	42-07
Lubricate _____	Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)	42-08
Check _____	Brake Lines Checking, Hydraulic Disc or Air Brakes	42-09
Check _____	Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine only)	42-10
Inspect _____	Brake Inspecting (Air Brakes)	42-11
Drain _____	Air Tanks	—
Lubricate _____	Drag Link Lubricating	46-01
Lubricate _____	Steering Driveline Lubricating	46-04
Lubricate _____	Steering Gear Lubricating	46-05
Change _____	Hydraulic Reservoir Filter Changing (metal reservoir only)	46-06
Inspect _____	Fuel Tank Mounts and Fuel Line Checking	47-01
Change _____	Fuel Filters	—
Inspect _____	Exhaust System Inspecting	49-01
Check _____	Ground Cables Checking and Cleaning	54-01
Inspect _____	Air Conditioner Component Inspection	83-01
Customer† _____ Date _____		

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## 15,000 Mile or 12 Month Maintenance: 00–04

Procedure Performed (check off or initial)	15,000 Mile (24 135 km) or 12 Month Maintenance*	MOP
Inspect _____	Engine Drive Belt Inspecting	01–01
Check _____	Engine-Support Fasteners Checking	01–02
Change _____	Engine Oil and Filter (see the engine manufacturer's manual)	—
Inspect _____	Pacbrake Inspecting and Maintenance	01–03
Change _____	Air Cleaner Inspecting and Replacing	09–01
Inspect _____	Charge Air Cooler Inspecting and Cleaning (if cleaning is needed)	09–02
Check _____	Alternator, Battery, and Starter Checking	15–01
Inspect/Check _____	Radiator (radiator cap, coolant freeze points, SCA levels, hose routing for chaffing and leaks)	20–01, 20–02, 20–03
Change _____	Transmission Fluid and Filter (if required by Allison)	26–03
Inspect _____	Transmission Hose Routing for Chaffing and Leaks	—
Lubricate _____	Throttle Pedal Pivot Pin Lubricating	30–01
Inspect _____	Suspension	32–01, 32–06
Check _____	Suspension Height Control Valve Checking	32–02
Lubricate _____	ZF IFS Lubricating	32–04
Check _____	Suspension U-Bolt Torque Checking	32–06
Lubricate _____	Knuckle Pin Lubricating	33–01
Lubricate _____	Tie-Rod End Lubricating and Inspecting	33–02
Check/Lubricate _____	Wheel Bearing Removal, Cleaning, Checking, Repacking, and Adjusting	33–04
Check/Change _____	Oil-Filled Hubs Oil Changing (front and tag axle)	33–05, 33–06, 35–04, 35–05
Check _____	Axle Seals for Leaks	—
Change _____	Axle Lubricant Changing (Freightliner and Meritor axles)	35–02
Check _____	Axle Breather Checking	35–03
Check _____	Tire Pressure	—
Lubricate _____	Driveline Inspecting and Lubricating	41–01
Inspect _____	Brake System Valves Inspecting	42–01
Inspect _____	Air Dryer and Air Lines for Proper Routing, Chaffing, and Leaks	42–02
Lubricate _____	Camshaft Bracket Bushing Lubricating	42–04
Lubricate _____	Slack Adjuster Lubricating	42–05

**15,000 Mile or 12 Month Maintenance: 00-04**

Procedure Performed (check off or initial)	15,000 Mile (24 135 km) or 12 Month Maintenance*	MOP
Lubricate _____	Foot Brake Valve Actuator Lubricating	42-06
Inspect _____	Bendix Hydro-Max® Brake System Inspecting (front-engine only)	42-07
Lubricate _____	Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)	42-08
Check _____	Brake Lines Checking, Hydraulic Disc or Air Brakes	42-09
Check _____	Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine only)	42-10
Inspect _____	Brake Inspecting (Air Brakes)	42-11
Lubricate _____	Meritor Roller Pin Lubricating	42-12
Drain _____	Air Tanks	—
Lubricate _____	Drag Link Lubricating	46-01
Change _____	Power Steering Reservoir Fluid and Filter Changing	46-03
Lubricate _____	Steering Driveline Lubricating	46-04
Lubricate _____	Steering Gear Lubricating	46-05
Change _____	Hydraulic Reservoir Filter Changing (including TRW)	46-06
Inspect _____	Fuel Tank Mounts and Fuel Line Checking	47-01
Change _____	Fuel Filters	—
Inspect _____	Exhaust System Inspecting	49-01
Check _____	Ground Cables Checking and Cleaning	54-01
Inspect _____	Air Conditioner Component Inspection	83-01
Customer† _____ Date _____		

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## 30,000 Mile or 24 Month Maintenance: 00–05

Procedure Performed (check off or initial)	30,000 Mile (48 270 km) or 24 Month Maintenance*	MOP
Inspect _____	Engine Drive Belt Inspecting	01–01
Check _____	Engine-Support Fasteners Checking	01–02
Change _____	Engine Oil and Filter (see the engine manufacturer's manual)	—
Inspect _____	Pacbrake Inspecting and Maintenance	01–03
Inspect _____	Air Cleaner Inspecting and Replacing	09–01
Inspect _____	Charge Air Cooler Inspecting and Cleaning (if cleaning is needed)	09–02
Check _____	Alternator, Battery, and Starter Checking	15–01
Inspect/ Check _____	Radiator (radiator cap, coolant freeze points, SCA levels, hose routing for chaffing and leaks)	20–01, 20–02, 20–03
Change _____	Mechanical Fan Drive Gearbox Oil Changing	20–04
Change _____	Transmission Fluid and Filter (if required by Allison)	26–03
Inspect _____	Transmission Hose Routing for Chaffing and Leaks	—
Lubricate _____	Throttle Pedal Pivot Pin Lubricating	30–01
Inspect _____	Suspension	32–01, 32–06
Check _____	Suspension Height Control Valve Checking	32–02
Lubricate _____	ZF IFS Lubricating	32–04
Check _____	Suspension U-Bolt Torque Checking	32–06
Lubricate _____	Knuckle Pin Lubricating	33–01
Lubricate _____	Tie-Rod End Lubricating and Inspecting	33–02
Check/ Lubricate _____	Wheel Bearing Removal, Cleaning, Checking, Repacking, and Adjusting	33–04
Check/ Change _____	Oil-Filled Hubs Oil Level Checking (front and tag axle)	33–05, 33–06, 35–04, 35–05
Check _____	Axle Seals for Leaks	—
Change _____	Axle Lubricant Changing (Freightliner axle only)	35–02
Check _____	Axle Breather Checking	35–03
Check _____	Wheel Nut Checking	40–01
Check _____	Tire Pressure	—
Lubricate _____	Driveline Inspecting and Lubricating	41–01
Inspect _____	Brake System Valves Inspecting	42–01
Inspect _____	Air Dryer and Air Lines for Proper Routing, Chaffing, and Leaks	42–02

## 30,000 Mile or 24 Month Maintenance: 00–05

Procedure Performed (check off or initial)	30,000 Mile (48 270 km) or 24 Month Maintenance*	MOP
Lubricate _____	Camshaft Bracket Bushing Lubricating	42–04
Lubricate _____	Slack Adjuster Lubricating	42–05
Lubricate _____	Foot Brake Valve Actuator Lubricating	42–06
Inspect _____	Bendix Hydro-Max® Brake System Inspecting (front-engine only)	42–07
Lubricate _____	Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)	42–08
Check _____	Brake Lines Checking, Hydraulic Disc or Air Brakes	42–09
Check _____	Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine only)	42–10
Inspect _____	Brake Inspecting (Air Brakes)	42–11
Lubricate _____	Meritor Roller Pin Lubricating	42–12
Drain _____	Air Tanks	—
Lubricate _____	Drag Link Lubricating	46–01
Change _____	Power steering fluid reservoir (fluid and filter changing, inline filter changing [including TRW])	46–03, 46–06
Lubricate _____	Steering Driveline Lubricating	46–04
Lubricate _____	Steering Gear Lubricating	46–05
Inspect _____	Fuel Tank Mounts and Fuel Line Checking	47–01
Change _____	Fuel Filters	—
Inspect _____	Exhaust System Inspecting	49–01
Check _____	Ground Cables Checking and Cleaning	54–01
Inspect _____	Air Conditioner Component Inspection	83–01
Customer† _____ Date _____		

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## 45,000 Mile or 36 Month Maintenance: 00–06

Procedure Performed (check off or initial)	45,000 Mile (72 405 km) or 36 Month Maintenance*	MOP
Inspect _____	Engine Drive Belt Inspecting	01–01
Check _____	Engine-Support Fasteners Checking	01–02
Inspect _____	Pacbrake Inspecting and Maintenance	01–03
Change _____	Engine Oil and Filter (see the engine manufacturer's manual)	—
Change _____	Air Cleaner Inspecting and Replacing	09–01
Inspect _____	Charge Air Cooler Inspecting and Cleaning (if cleaning is needed)	09–02
Check _____	Alternator, Battery, and Starter Checking	15–01
Inspect/ Check _____	Radiator (radiator cap, coolant freeze points, SCA levels, hose routing for chaffing and leaks)	20–01, 20–02, 20–03
Change _____	Transmission Fluid and Filter (if required by Allison)	26–03
Inspect _____	Transmission Hose Routing for Chaffing and Leaks	—
Lubricate _____	Throttle Pedal Pivot Pin Lubricating	30–01
Inspect _____	Suspension	32–01, 32–06
Check _____	Suspension Height Control Valve Checking	32–02
Lubricate _____	ZF IFS Lubricating	32–04
Check _____	Suspension U-Bolt Torque Checking	32–06
Lubricate _____	Knuckle Pin Lubricating	33–01
Lubricate _____	Tie-Rod End Lubricating and Inspecting	33–02
Check/ Lubricate _____	Wheel Bearing Removal, Cleaning, Checking, Repacking, and Adjusting	33–04
Check/ Change _____	Oil-Filled Hubs Oil Changing (front and tag axle)	33–05, 33–06, 35–04, 35–05
Check _____	Axle Seals for Leaks	—
Change _____	Axle Lubricant Changing (Freightliner and Meritor axles)	35–02
Check _____	Axle Breather Checking	35–03
Check _____	Tire Pressure	—
Lubricate _____	Driveline Inspecting and Lubricating	41–01
Inspect _____	Brake System Valves Inspecting	42–01
Inspect _____	Air Dryer and Air Lines for Proper Routing, Chaffing, and Leaks	42–02
Lubricate _____	Camshaft Bracket Bushing Lubricating	42–04
Lubricate _____	Slack Adjuster Lubricating	42–05

## 45,000 Mile or 36 Month Maintenance: 00-06

Procedure Performed (check off or initial)	45,000 Mile (72 405 km) or 36 Month Maintenance*	MOP
Lubricate _____	Foot Brake Valve Actuator Lubricating	42-06
Inspect _____	Bendix Hydro-Max® Brake System Inspecting (front-engine only)	42-07
Lubricate _____	Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)	42-08
Check _____	Brake Lines Checking, Hydraulic Disc or Air Brakes	42-09
Check _____	Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine only)	42-10
Inspect _____	Brake Inspecting (Air Brakes)	42-11
Lubricate _____	Meritor Roller Pin Lubricating	42-12
Drain _____	Air Tanks	—
Lubricate _____	Drag Link Lubricating	46-01
Inspect _____	Power Steering Reservoir Fluid and Filter Changing	46-03
Lubricate _____	Steering Driveline Lubricating	46-04
Lubricate _____	Steering Gear Lubricating	46-05
Inspect _____	Hydraulic Reservoir Filter Changing (including TRW)	46-06
Inspect _____	Fuel Tank Mounts and Fuel Line Checking	47-01
Change _____	Fuel Filters	—
Inspect _____	Exhaust System Inspecting	49-01
Check _____	Ground Cables Checking and Cleaning	54-01
Inspect _____	Air Conditioner Component Inspection	83-01
Customer† _____ Date _____		

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## 60,000 Mile or 48 Month Maintenance: 00–07

Procedure Performed (check off or initial)	60,000 Mile (96 540 km) or 48 Month Maintenance*	MOP
Inspect _____	Engine Drive Belt Inspecting	01–01
Check _____	Engine-Support Fasteners Checking	01–02
Change _____	Engine Oil and Filter (see the engine manufacturer's manual)	—
Inspect _____	Pacbrake Inspecting and Maintenance	01–03
Inspect _____	Air Cleaner Inspecting and Replacing	09–01
Inspect _____	Charge Air Cooler Inspecting and Cleaning (if cleaning is needed)	09–02
Check _____	Alternator, Battery, and Starter Checking	15–01
Inspect/ Check _____	Radiator (radiator cap, coolant freeze points, SCA levels, hose routing for chaffing and leaks)	20–01, 20–02, 20–03
Change _____	Mechanical Fan Drive Gearbox Oil Changing	20–04
Change _____	Transmission Fluid and Filter (if required by Allison)	26–03
Inspect _____	Transmission Hose Routing for Chaffing and Leaks	—
Lubricate _____	Throttle Pedal Pivot Pin Lubricating	30–01
Inspect _____	Suspension	32–01, 32–06
Check _____	Suspension Height Control Valve Checking	32–02
Lubricate _____	ZF IFS Lubricating	32–04
Check _____	Suspension U-Bolt Torque Checking	32–06
Lubricate _____	Knuckle Pin Lubricating	33–01
Lubricate _____	Tie-Rod End Lubricating and Inspecting	33–02
Check/ Lubricate _____	Wheel Bearing Removal, Cleaning, Checking, Repacking, and Adjusting	33–04
Check/ Change _____	Oil-Filled Hubs Oil Level Checking (front and tag axle)	33–05, 33–06, 35–04, 35–05
Check _____	Axle Seals for Leaks	—
Change _____	Axle Lubricant Changing (Freightliner axle only)	35–02
Check _____	Axle Breather Checking	35–03
Check _____	Wheel Nut Checking	40–01
Check _____	Tire Pressure	—
Lubricate _____	Driveline Inspecting and Lubricating	41–01
Inspect _____	Brake System Valves Inspecting	42–01
Inspect _____	Air Dryer and Air Lines for Proper Routing, Chaffing, and Leaks	42–02

## 60,000 Mile or 48 Month Maintenance: 00–07

Procedure Performed (check off or initial)	60,000 Mile (96 540 km) or 48 Month Maintenance*	MOP
Lubricate _____	Camshaft Bracket Bushing Lubricating	42–04
Lubricate _____	Slack Adjuster Lubricating	42–05
Lubricate _____	Foot Brake Valve Actuator Lubricating	42–06
Inspect _____	Bendix Hydro-Max® Brake System Inspecting (front-engine only)	42–07
Lubricate _____	Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)	42–08
Check _____	Brake Lines Checking, Hydraulic Disc or Air Brakes	42–09
Check _____	Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine only)	42–10
Inspect _____	Brake Inspecting (Air Brakes)	42–11
Lubricate _____	Meritor Roller Pin Lubricating	42–12
Drain _____	Air Tanks	—
Lubricate _____	Drag Link Lubricating	46–01
Change _____	Power Steering Reservoir Fluid and Filter Changing	46–03
Lubricate _____	Steering Driveline Lubricating	46–04
Lubricate _____	Steering Gear Lubricating	46–05
Change _____	Hydraulic Reservoir Filter Changing (including TRW)	46–06
Inspect _____	Fuel Tank Mounts and Fuel Line Checking	47–01
Change _____	Fuel Filters	—
Inspect _____	Exhaust System Inspecting	49–01
Check _____	Ground Cables Checking and Cleaning	54–01
Inspect _____	Air Conditioner Component Inspection	83–01
Customer† _____ Date _____		

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**Noise Emission Controls Maintenance: 00–08**

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**Noise Emission Control Maintenance**

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**Federal Law, Part 205:  
Transportation Equipment Noise  
Emission Controls**

Part 205, Transportation Equipment Noise Emission Controls, requires the vehicle manufacturer to furnish, with each new vehicle, such written instructions for the proper maintenance, use, and repair of the vehicle by the ultimate purchaser to provide reasonable assurance of the elimination or minimization of noise-emission-control degradation throughout the life of the vehicle. In compliance with the law, the noise emission controls maintenance information in each applicable group of this manual, in conjunction with the chassis workshop manual, provides these instructions to owners.

**Recommendations for  
Replacement Parts**

Replacement parts used for maintenance or repair of noise emission controls should be genuine Freightliner Custom Chassis Corporation (FCCC) parts. If other than genuine FCCC parts are used for replacement or repair of components affecting noise emission control, the owner should be sure that such parts are warranted by their manufacturer to be equivalent to genuine FCCC parts in performance and durability.

**Freightliner Noise Emission  
Controls Warranty**

See the vehicle owner's warranty information book for warranty information concerning noise emission controls.

**Tampering With Noise Controls is  
Prohibited**

Federal law prohibits the following acts or the causing thereof:

1. The removal or rendering inoperative by any person (other than for purposes of maintenance, repair, or replacement) of any device or element

of design incorporated into any new vehicle for the purpose of noise control, prior to its sale or delivery to the ultimate purchaser, or while it is in use.

2. The use of the vehicle after such device or element of design has been removed or rendered inoperative by any person.

Among those acts presumed to constitute tampering are the acts listed below:

- A. Removal of, or rendering inoperative, the engine speed governor so as to allow engine speed to exceed manufacturer's specifications.
- B. Removal of, or rendering inoperative, the fan clutch, including bypassing the control on any thermostatic fan drive to cause it to operate continuously.
- C. Removal of the fan shroud.
- D. Removal of, or rendering inoperative, exhaust components, including exhaust pipe clamping.
- E. Removal of air intake components.

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**Maintenance Instructions**

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Scheduled intervals are in the maintenance table in this group. A "Verification of Inspections Log (Group 49)" follows, and should be filled in each time noise emission controls on the vehicle are maintained or repaired.

[illegible]



## Metric/U.S. Customary Conversion Tables: 00–10

When You Know U.S. Customary	Multiply By	To Get Metric	When You Know Metric	Multiply By	To Get U.S. Customary
<b>Length</b>					
inches (in)	25.4	millimeters (mm)	0.03937		inches (in)
inches (in)	2.54	centimeters (cm)	0.3937		inches (in)
feet (ft)	0.3048	meters (m)	3.281		feet (ft)
yards (yd)	0.9144	meters (m)	1.094		yards (yd)
miles (mi)	1.609	kilometers (km)	0.6215		miles (mi)
<b>Area</b>					
square inches (in <sup>2</sup> )	645.16	square millimeters (mm <sup>2</sup> )	0.00155		square inches (in <sup>2</sup> )
square inches (in <sup>2</sup> )	6.452	square centimeters (cm <sup>2</sup> )	0.155		square inches (in <sup>2</sup> )
square feet (ft <sup>2</sup> )	0.0929	square meters (m <sup>2</sup> )	10.764		square feet (ft <sup>2</sup> )
<b>Volume</b>					
cubic inches (in <sup>3</sup> )	16387.0	cubic millimeter (mm <sup>3</sup> )	0.000061		cubic inches (in <sup>3</sup> )
cubic inches (in <sup>3</sup> )	16.387	cubic centimeters (cm <sup>3</sup> )	0.06102		cubic inches (in <sup>3</sup> )
cubic inches (in <sup>3</sup> )	0.01639	liters (L)	61.024		cubic inches (in <sup>3</sup> )
fluid ounces (fl oz)	29.54	milliliters (mL)	0.03381		fluid ounces (fl oz)
pints (pt)	0.47318	liters (L)	2.1134		pints (pt)
quarts (qt)	0.94635	liters (L)	1.0567		quarts (qt)
gallons (gal)	3.7854	liters (L)	0.2642		gallons (gal)
cubic feet (ft <sup>3</sup> )	28.317	liters (L)	0.03531		cubic feet (ft <sup>3</sup> )
cubic feet (ft <sup>3</sup> )	0.02832	cubic meters (m <sup>3</sup> )	35.315		cubic feet (ft <sup>3</sup> )
<b>Weight/Force</b>					
ounces (av) (oz)	28.35	grams (g)	0.03527		ounces (av) (oz)
pounds (av) (lb)	0.454	kilograms (kg)	2.205		pounds (av) (lb)
U.S. tons (t)	907.18	kilograms (kg)	0.001102		U.S. tons (t)
U.S. tons (t)	0.90718	metric tons (t)	1.1023		U.S. tons (t)
<b>Torque/Work Force</b>					
inch–pounds (lbf·in)	11.298	Newton–centimeters (N·cm)	0.08851		inch–pounds (lbf·in)
foot–pounds (lbf·ft)	1.3558	Newton–meters (N·m)	0.7376		foot–pounds (lbf·ft)
<b>Pressure/Vacuum</b>					
inches of mercury (inHg)	3.37685	kilo Pascals (kPa)	0.29613		inches of mercury (inHg)
pounds per square inch (psi)	6.895	kilo Pascals (kPa)	0.14503		pounds per square inch (psi)

Table 2, Metric/U.S. Customary Conversion

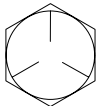
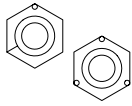
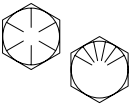
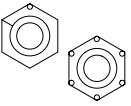
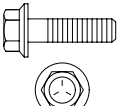
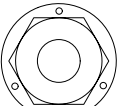
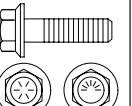
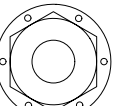
When You Know	Subtract	Then Divide By	To Get	When You Know	Multiply By	Then Add	To Get
degrees Fahrenheit (°F)	32	1.8	degrees Celsius (°C)	1.8	32		degrees Fahrenheit (°F)

Table 3, Temperature Conversion

## Torque Specifications Tables: 00–11

IMPORTANT: Grade 8 regular hex zinc-yellow plated capscrews and cadmium- and wax-coated prevailing torque locknuts may be tightened to a lower torque value than the grade 8 regular hex fasteners de-

scribed in [Table 4](#). See [Table 5](#) for torque values for grade 8 regular hex zinc-yellow plated capscrews and cadmium- and wax-coated prevailing torque locknuts.

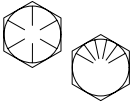
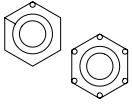
Torque Values for U.S. Customary Thread Fasteners With Lubricated* or Plated Threads†								
Thread Diameter–Pitch	Regular Hex				Flanged			
	Grade 5 Bolt	Grade 5 or B Nut	Grade 8 or 8.2 Bolt	Grade 8 or C Nut	Grade 5 Bolt	Grade B Nut	Grade 8 or 8.2 Bolt	Grade G Nut
	Torque: lbf-ft (N-m)		Torque: lbf-ft (N-m)		Torque: lbf-ft (N-m)		Torque: lbf-ft (N-m)	
	 f230002	 f230003	 f230004	 f230005	 f230006	 f230007	 f230008	 f230009
1/4–20	7 (9)		8 (11)		6 (8)		10 (14)	
1/4–28	8 (11)		9 (12)		7 (9)		12 (16)	
5/16–18	15 (20)		16 (22)		13 (18)		21 (28)	
5/16–24	16 (22)		17 (23)		14 (19)		23 (31)	
3/8–16	26 (35)		28 (38)		23 (31)		37 (50)	
3/8–24	30 (41)		32 (43)		25 (34)		42 (57)	
7/16–14	42 (57)		45 (61)		35 (47)		60 (81)	
7/16–20	47 (64)		50 (68)		40 (54)		66 (89)	
1/2–13	64 (87)		68 (92)		55 (75)		91 (123)	
1/2–20	72 (98)		77 (104)		65 (88)		102 (138)	
9/16–12	92 (125)		98 (133)		80 (108)		130 (176)	
9/16–18	103 (140)		110 (149)		90 (122)		146 (198)	
5/8–11	128 (173)		136 (184)		110 (149)		180 (244)	
5/8–18	145 (197)		154 (209)		130 (176)		204 (277)	
3/4–10	226 (306)		241 (327)		200 (271)		320 (434)	
3/4–16	253 (343)		269 (365)		220 (298)		357 (484)	
7/8–9	365 (495)		388 (526)		320 (434)		515 (698)	
7/8–14	402 (545)		427 (579)		350 (475)		568 (770)	
1–8	—		582 (789)		—		—	
1–12	—		637 (863)		—		—	
1–14	—		652 (884)		—		—	

\* Freightliner recommends that all plated and unplated fasteners be coated with oil before installation.

† Use these torque values if either the bolt or nut is lubricated or plated (zinc-phosphate conversion-coated, cadmium-plated, or waxed, Geomet 321XL coated, or waxed).

**Table 4, Torque Values for U.S. Customary Thread Fasteners With Lubricated or Plated Threads**

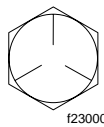
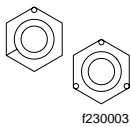
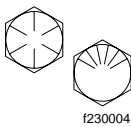
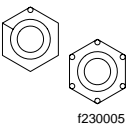
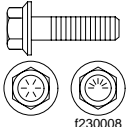
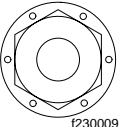
## Torque Specifications Tables: 00–11

Torque Values for Grade 8 Regular Hex Zinc-Yellow Plated Capscrews and Cadmium- and Wax-Coated Prevailing Torque Locknuts*		
Thread Diameter-Pitch	Regular Hex	
	Grade 8 or 8.2 Bolt	Grade 8 or C Nut
	Torque: lbf-ft (N-m)	
	 f230004	 f230005
1/4–20	6 (8)	
1/4–28	7 (9)	
5/16–18	13 (18)	
5/16–24	14 (19)	
3/8–16	23 (31)	
3/8–24	26 (35)	
7/16–14	37 (50)	
7/16–20	41 (56)	
1/2–13	56 (76)	
1/2–20	63 (85)	
9/16–12	81 (110)	
9/16–18	90 (122)	
5/8–11	112 (152)	
5/8–18	126 (171)	
3/4–10	198 (268)	
3/4–16	221 (300)	
7/8–9	319 (433)	
7/8–14	352 (477)	
1–8	479 (649)	
1–12	524 (710)	
1–14	537 (728)	

\* Freightliner recommends that all plated and unplated fasteners be coated with oil before installation.

**Table 5, Torque Values for Grade 8 Regular Hex Zinc-Yellow Plated Capscrews and Cadmium- and Wax-Coated Prevailing Torque Locknuts**

## Torque Specifications Tables: 00–11

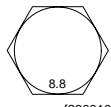
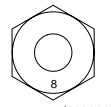
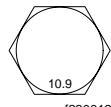
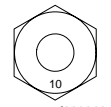
Torque Values for U.S. Customary Thread Fasteners With Dry (Unlubricated)* Plain (Unplated) Threads†						
Thread Diameter–Pitch	Regular Hex				Flanged	
	Grade 5 Bolt	Grade 5 or B Nut	Grade 8 or 8.2 Bolt	Grade 8 or C Nut	Grade 8 or 8.2 Bolt	Grade G Nut
	Torque: lbf-ft (N·m)		Torque: lbf-ft (N·m)		Torque: lbf-ft (N·m)	
	 f230002	 f230003	 f230004	 f230005	 f230008	 f230009
1/4–20	8 (11)		10 (14)		—	
1/4–28	9 (12)		12 (16)		—	
5/16–18	15 (20)		22 (30)		22 (30)	
5/16–24	17 (23)		25 (34)		—	
3/8–16	28 (38)		40 (54)		40 (54)	
3/8–24	31 (42)		45 (61)		—	
7/16–14	45 (61)		65 (88)		65 (88)	
7/16–20	50 (68)		70 (95)		—	
1/2–13	70 (95)		95 (129)		95 (129)	
1/2–20	75 (102)		110 (149)		—	
9/16–12	100 (136)		140 (190)		140 (190)	
9/16–18	110 (149)		155 (210)		—	
5/8–11	135 (183)		190 (258)		190 (258)	
5/8–18	155 (210)		215 (292)		—	
3/4–10	240 (325)		340 (461)		340 (461)	
3/4–16	270 (366)		380 (515)		—	
7/8–9	385 (522)		540 (732)		—	
7/8–14	425 (576)		600 (813)		—	
1–8	580 (786)		820 (1112)		—	
1–12	635 (861)		900 (1220)		—	
1–14	650 (881)		915 (1241)		—	

\* Threads may have residual oil, but will be dry to the touch.

† Male and female threads (bolt and nut) must both be unlubricated and unplated; if either is plated or lubricated, use [Table 4](#). Freightliner recommends that all plated and unplated fasteners be coated with oil before installation.

**Table 6, Torque Values for U.S. Customary Thread Fasteners With Dry (Unlubricated) Plain (Unplated) Threads**

## Torque Specifications Tables: 00–11

Torque Values for Metric Thread Fasteners With Lubricated* or Plated Threads†				
Thread Diameter–Pitch	Class 8.8 Bolt	Class 8 Nut	Class 10.9 Bolt	Class 10 Nut
	Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)	
	 f230010	 f230011	 f230012	 f230013
M6	5 (7)		7 (9)	
M8	12 (16)		17 (23)	
M8 x 1	13 (18)		18 (24)	
M10	24 (33)		34 (46)	
M10 x 1.25	27 (37)		38 (52)	
M12	42 (57)		60 (81)	
M12 x 1.5	43 (58)		62 (84)	
M14	66 (89)		95 (129)	
M14 x 1.5	72 (98)		103 (140)	
M16	103 (140)		148 (201)	
M16 x 1.5	110 (149)		157 (213)	
M18	147 (199)		203 (275)	
M18 x 1.5	165 (224)		229 (310)	
M20	208 (282)		288 (390)	
M20 x 1.5	213 (313)		320 (434)	
M22	283 (384)		392 (531)	
M22 x 1.5	315 (427)		431 (584)	
M24	360 (488)		498 (675)	
M24 x 2	392 (531)		542 (735)	
M27	527 (715)		729 (988)	
M27 x 2	569 (771)		788 (1068)	
M30	715 (969)		990 (1342)	
M30 x 2	792 (1074)		1096 (1486)	

\* Freightliner recommends that all plated and unplated fasteners be coated with oil before installation.

† Use these torque values if either the bolt or nut is lubricated or plated (zinc-phosphate conversion-coated, cadmium-plated, or waxed, Geomet 321XL coated, or waxed).

**Table 7, Torque Values for Metric Thread Fasteners With Lubricated or Plated Threads**

Title of Maintenance Operation (MOP)	MOP Number
Engine Drive Belt Inspecting . . . . .	01-01
Engine-Support Fasteners Checking . . . . .	01-02
Pacbrake Inspecting and Maintenance . . . . .	01-03

## 01-01 Engine Drive Belt Inspecting

### WARNING

The engine and the belt must be cool before you check the belt. Handling a hot belt can cause personal injury.

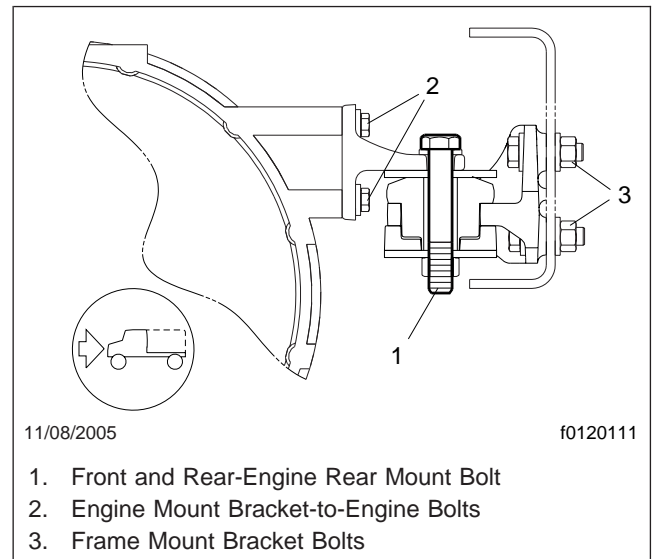
1. Inspect the belt for damage.  
Transverse (across the belt width) cracks are acceptable.  
Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable.
2. Replace the belt if it has unacceptable cracks, is frayed, or has pieces of material missing.  
For additional information, see the *Cummins Operation and Maintenance Manual*.

## 01-02 Engine-Support Fasteners Checking

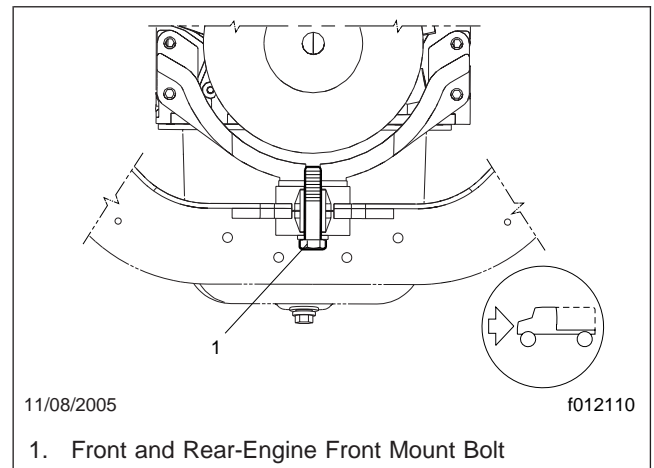
1. Check the rear engine-support fasteners. See [Fig. 1](#). Tighten the rear engine-mount bolt 157 lbf·ft (213 N·m).  
Tighten the insulator-to-frame mount bracket bolts 91 lbf·ft (123 N·m).  
Tighten the engine mount bracket-to-engine bolts 62 lbf·ft (84 N·m).
2. Check the 3/4-10 front-engine front mount bolt. See [Fig. 2](#). Tighten it 95 lbf·ft (128 N·m).  
Check the 3/4-10 rear-engine front mount bolt. Tighten it 95 lbf·ft (128 N·m).

## 01-03 Pacbrake Inspecting and Maintenance

Pacbrake recommends lubricating the moving parts of the exhaust brake with a synthetic based lubricant at every oil change. Once the lubricant is applied, the exhaust brake should be cycled a few times to ensure that the lubricant penetrates into the mating parts.

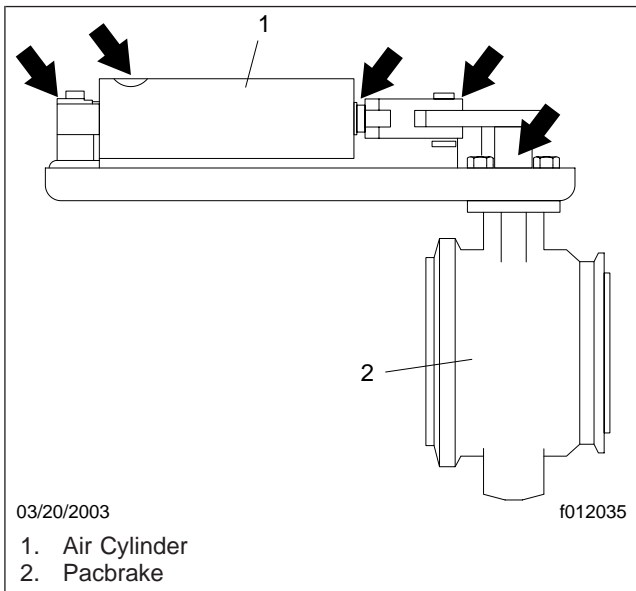


**Fig. 1, Front and Rear-Engine Rear Mount (ISB chassis built after 2002)**



**Fig. 2, Front and Rear-Engine Front Mount (ISB chassis built after 2002)**

1. With the engine turned off, use Pacbrake Synthetic Lube or Synco Super Lube, and spray or coat a sufficient amount on the restrictor air cylinder valve shaft and the attaching locations at each end of the actuation cylinder. See [Fig. 3](#) for the exhaust brake lubrication points.
2. Using your hands or a pair of pliers, slide the valve several times to distribute the lubricant down the shaft and the attaching locations.



**Fig. 3, Pacbrake Exhaust Brake Lube Point Locations**

**NOTE:** Operation of the Pacbrake could be affected by starting the engine and idling for short periods of time. During a cold engine start-up, moisture occurs in the engine and the exhaust system that creates a corrosion hazard. The brake housing may trap water in the valve shaft bore causing corrosion, resulting in an improper or non-functioning brake. If it is necessary to periodically start the engine, reach normal operating temperatures before shutting down the engine.

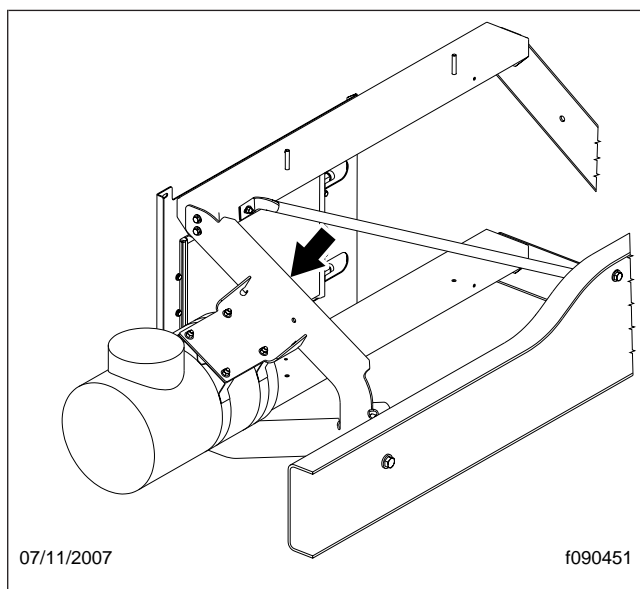


Title of Maintenance Operation (MOP)	MOP Number
Air Cleaner Inspecting and Replacing . . . . .	09-01
Charge Air Cooler Inspecting and Cleaning . . . . .	09-02

## 09–01 Air Cleaner Inspecting and Replacing

**NOTE:** Remove and visually inspect the air cleaner element for obvious damage such as holes, cuts, or dents. Remove loose debris, such as leaves or pine needles, from the filter housing.

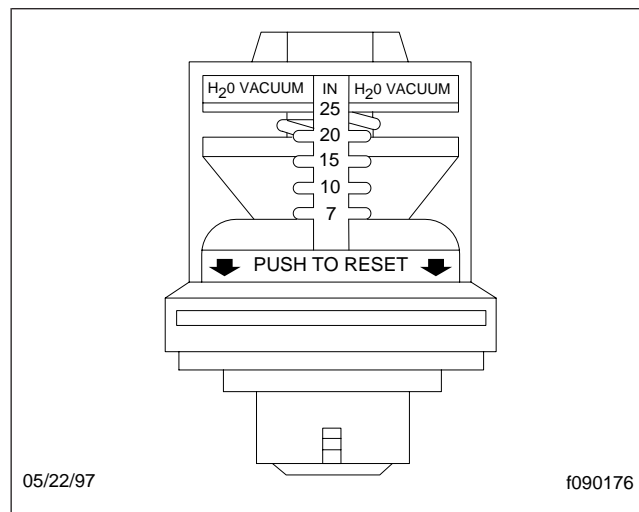
Inspect the air cleaner and plumbing for holes or tears at the recommended interval. If the air cleaner is damaged, replace it. See **Group 09** of the *Recreational Vehicle Chassis Workshop Manual* for removal and installation procedures, or take the vehicle to an authorized Freightliner dealer. A typical air cleaner mounting is shown in **Fig. 1**.



**Fig. 1, Air Cleaner Mounting**

Engine damage can occur if the air intake system is not properly maintained. Use the air intake restriction indicator to check for air intake system damage or leaks. See **Fig. 2**. Make sure the engine is off and note the existing reading on the indicator. Reset the indicator by pushing it down. See **Fig. 2**. Start the engine and take a short test drive. Check the indicator again and note the level of restriction on the indicator, verifying it is at the same level as seen earlier. A decrease from the previous level of restriction or a very low air restriction indicator reading (0 to 4 inH<sub>2</sub>O) could indicate an air intake system problem such as a damaged air filter, loose or disconnected

air intake piping, or a disconnected or damaged air restriction indicator.



**Fig. 2, Air Restriction Indicator**

Replace the air cleaner at the recommended interval, or when filter restriction reaches 25 inH<sub>2</sub>O. See the *Recreational Vehicle Chassis Operator's Manual* for specific restriction values for your engine. See **Group 09** of the *Recreational Vehicle Chassis Workshop Manual* for removal and installation procedures, or take the vehicle to an authorized Freightliner dealer.

## 09–02 Charge Air Cooler Inspecting and Cleaning

Good airflow through the radiator and charge air cooler core is essential for proper engine cooling. The cores allow air passage, but form a barrier that tends to collect insects and airborne debris.

If the charge air cooler core fins are bent, use a small pair of needle-nose pliers or a small screwdriver to straighten them. If the fins are clogged, use compressed air or water directed from the fan side of the radiator core to backflush any material restricting airflow.

Ensure that the hoses are not chafing and that the system is closed with no air leaks.

Title of Maintenance Operation (MOP)	MOP Number
Alternator, Battery, and Starter Checking. . . . .	15-01

## 15-01 Alternator, Battery, and Starter Checking

### WARNING

Batteries release explosive gas as a by-product of their chemical activity. Do not smoke when working around batteries. Put out all flames and remove any source of sparks or intense heat. Make sure the battery compartment is 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.

Damaged, chafed, or kinked wiring can cause electrical short-circuits and lead to fires, causing property damage, injury, or death. Clean, inspect, and maintain wiring and connections carefully.

1. Check the tightness of the alternator bracket fasteners and alternator mounting fasteners; tighten the fasteners as needed. For torque values, see **Group 15** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
2. Check that all electrical connections at the alternator and starter are clean. Clean and tighten all charging system electrical connections as needed. Spray each electrical connection at the alternator and starter with dielectric red enamel.  
Trace and inspect all wiring and cables connected to:

- alternator
- starter and depopulation studs
- batteries
- magnetic switch
- cab
- jump-start studs
- battery isolation relays
- battery shutoff switches

3. Check wires and cables for wear, chafing, kinks, discolored insulation, or loose clamps or ties.

Find the cause of any problems and repair, replace, and reroute wires and clamps as necessary.

**IMPORTANT:** Ensure that wires and cables are not near any heat sources; if they are, reroute them.

4. Clean all circuit breakers and relays.
5. Check the alternator wiring for missing insulation, kinks, and heat damage. Replace or repair as needed.
6. On the bundled cable that runs from the batteries to the starter, ensure that tie straps are installed at least every 12 inches (30 cm). Replace any missing tie straps, and add tie straps where spacing between them exceeds 12 inches (30 cm).
7. Ensure that all cables have sufficient slack to allow for engine movement, and that there is no force on any wiring connectors.
8. If any convoluted tubing is damaged, check the wiring inside it. Replace any damaged or missing convoluted tubing.
9. Inspect the battery cables for wear, and replace as needed. Clean the cable connector terminals with a wire brush. See **Group 54** of the *Recreational Vehicle Chassis Workshop Manual* for troubleshooting instructions, and for adjustment, repair, or replacement instructions, or take the vehicle to an authorized Freightliner dealer.
  - 9.1 Clean and tighten the battery ground cable, terminal, and clamps.
  - 9.2 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. Rinse with clean water, then dry. Paint the retainer assembly, if needed, to prevent rusting.
  - 9.3 Check that foreign objects, such as stones, bolts, and nuts, are removed from the battery box.
  - 9.4 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).

- 9.5 Coat the battery terminals with dielectric grease.
- 10. Check the terminals on the battery shut-off switch and the starter relay. Make sure that the terminal connections are clean and tight. Coat the terminal connections with dielectric red enamel after cleaning.

Title of Maintenance Operation (MOP)	MOP Number
Coolant Replacing . . . . .	20-03
Mechanical Fan Drive Gearbox Oil Changing . . . . .	20-04
Radiator Cap Checking. . . . .	20-01
Radiator Inspecting and Cleaning. . . . .	20-02

## 20-01 Radiator Cap Checking

### WARNING

Do not remove or loosen the radiator cap until the engine and cooling system have completely cooled. Use extreme care when removing the cap. A sudden release of pressure from removing the cap prior to the system cooling can result in a surge of scalding coolant that could cause serious personal injury.

The radiator cap is the most ignored part in the cooling system. If it is suspect, replace it. An inspection means checking the cap with a pressure tester. A radiator cap in good condition will not open below 9 psi (62 kPa). A visual check is also in order: look for signs of deterioration of the inner gasket. Also look for cracks or breaks in the spring retainer in the cap and for corrosion or deposits on the spring itself. If the spring is not in perfect condition, it has probably lost tension; replace it. See [Fig. 1](#).

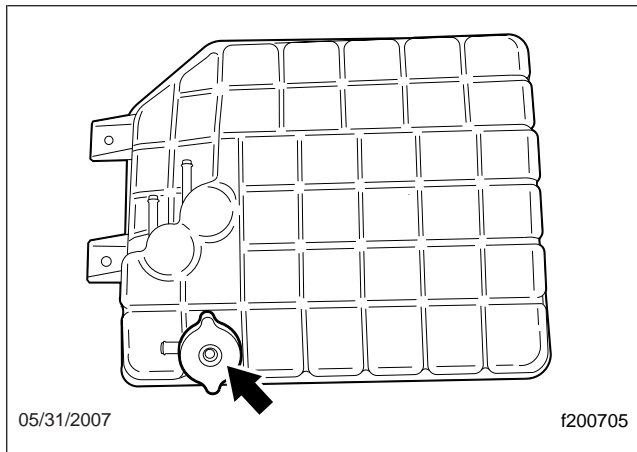


Fig. 1, Surge Tank Coolant Fill Cap

## 20-02 Radiator Inspecting and Cleaning

Inspect the radiator for clogging or damage and clean and/or repair it if necessary. Soak the radiator with a non-corrosive degreaser such as Simple Green. Let the unit sit for several minutes to work through the radiator. Using low water pressure, rinse the radiator. Be careful not to damage or bend the

fins of the radiator. Depending on the condition of the radiator, this process may have to be performed several times.

## 20-03 Coolant Replacing

At the intervals specified in the maintenance schedule, or whenever the coolant becomes dirty, flush and refill the cooling system.

NOTE: The coolant replacement interval is increased to 100,000 miles (161 000 km) or 60 months, whichever comes first. For this interval to apply, you must check and, if necessary, recharge the SCA (supplemental coolant additive) levels and the freeze point every 25,000 miles (40 000 km) or 6 months, whichever comes first. See the *Cummins Operation and Maintenance Manual* for further information.

### WARNING

Do not remove or loosen the radiator cap until the engine and cooling system have completely cooled. Use extreme care when removing the cap. A sudden release of pressure from removing the cap prior to the system cooling can result in a surge of scalding coolant that could cause serious personal injury.

1. Drain the cooling system, as follows.
  - 1.1 When the engine is cool, remove the radiator cap.
 

Turn the cap slowly counterclockwise until it reaches a "stop." Do not press down while turning the cap. Wait until any remaining pressure (indicated by a hissing sound) is relieved, then press down on the cap and continue turning it counterclockwise.
  - 1.2 When the cap is removed, run the engine until the upper radiator hose is hot—this shows that the thermostat is open and the coolant is flowing through the system.

### WARNING

Use extreme care when draining coolant that is very warm. It may still be hot enough to cause serious personal injury by scalding.

- 1.3 Stop the engine. Remove the lower radiator hose to drain the coolant. Drainage may be speeded by removing the plug in the bottom of the water inlet.
2. Flush the cooling system, as follows.

### CAUTION

**During filling, air must be vented from the engine coolant passages. Any air trapped in the system can cause severe engine damage.**

- 2.1 Connect the lower radiator hose and install the plug in the bottom of the water inlet.
- 2.2 Open the engine venting petcock.
- 2.3 Add water to the surge tank until the system is filled.
- 2.4 Start the engine. Run it at low idle for 10 seconds, then at high idle for 1 minute. Return to low idle.
- 2.5 Close the lower petcock when a steady stream of water is flowing from it. Don't let more than 1.5 quarts (1.4 L) of water escape.
- 2.6 Close the upper petcock when a steady stream of water is flowing from it. Don't let more than 1.5 quarts (1.4 L) of water escape.
- 2.7 Repeat several times until the drained liquid is nearly colorless.
- 2.8 Completely drain the system, then close the radiator and block the drain valves.
- 2.9 Disconnect all hoses from the surge tank. Remove the tank and pour out any fluid. Scrub and clean the inside of the surge tank with soap and water. Flush it with clean water, then drain it. Install the surge tank and hoses.

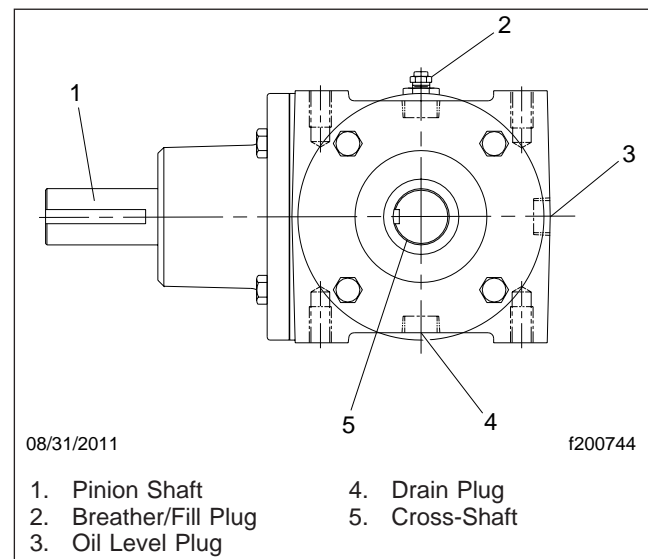
**IMPORTANT:** On vehicles with EPA07-compliant engines, the coolant capacity varies depending on the engine and accessory installation. After servicing the cooling system, always verify that the coolant level is between the MIN and MAX lines on the surge tank.

3. Fill the cooling system, as follows.

- 3.1 Slowly add a 50/50 mixture of antifreeze and water to the surge tank until the system is filled. Install the coolant fill cap.
- 3.2 Start the engine and run it at low idle for 10 seconds; then at high idle for 1 minute. Return to low idle.
- 3.3 Run the engine, with the radiator cap removed, until the upper radiator hose is hot. With the engine idling, add coolant to the radiator until it is between the MIN and MAX lines on the surge tank. Install the radiator cap.

## 20-04 Mechanical Fan Drive Gearbox Oil Changing

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
  2. Place a drain pan under the fan drive gearbox.
- IMPORTANT:** Label the plugs as they are removed. The breather/fill plug must always be installed in the top of the gearbox, opposite the drain plug.
3. Remove the drain plug and breather/fill plug, shown in [Fig. 2](#), to begin draining the oil.



**Fig. 2, Mechanical Fan Drive Gearbox**



4. Remove the oil level plug. See [Fig. 2](#).
5. Flush the fan drive gearbox with an approved nonflammable, nontoxic solvent such as:
  - Lubriplate Syn Flush
  - Lubriplate Pure Flush
  - Whitmore's Flushing Oil
  - Medallion™ Flushing Oil Kosher
6. Using degreaser, clean the thread on the drain hole and drain plug.
7. Install the drain plug.
8. Fill the fan drive gearbox with Mobil® Delvac 75W–90 lubricant until the lubricant starts to come out of the oil level plug hole.
9. Using degreaser, clean the thread on the oil level and fill holes and both plugs.
10. Install the plugs, making certain that the breather/fill plug is used in the fill plug hole.

<b>Title of Maintenance Operation (MOP)</b>	<b>MOP Number</b>
Allison MD/MH Series Transmission Fluid Level Checking . . . . .	26-02
Allison Transmission Fluid and Filter Changing (internal/external filter) . . . . .	26-03
Transmission Breather Checking . . . . .	26-01

## 26-01 Transmission Breather Checking

Transmission housing breathers must remain clear. A plugged breather could result in pressure build-up, which could cause lubricant leakage.

If the breather is plugged, clean or replace it. See [Fig. 1](#). Check more often if the vehicle is operating under very dusty conditions.

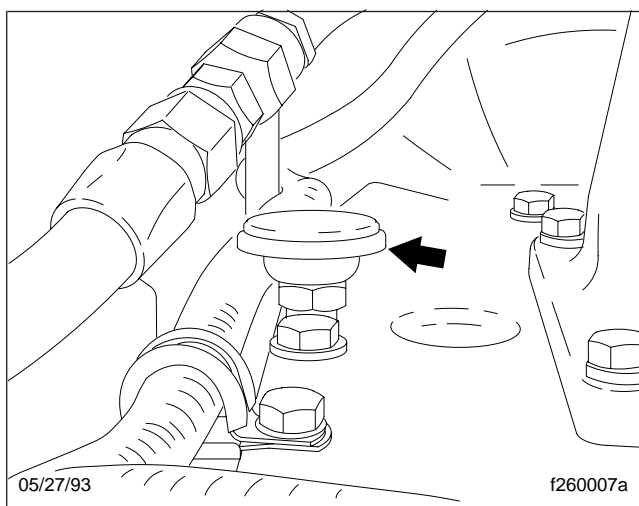


Fig. 1, Transmission Breather

## 26-02 Allison MD/MH Series Transmission Fluid Level Checking

### Cold Check

**IMPORTANT:** After replacing the transmission fluid or changing the filter(s), it is important to check the fluid level cold to determine if the transmission has a sufficient amount of fluid to be safely operated until a hot check can be performed.

1. A cold check may be made when the sump temperature is 60 to 104°F (15 to 40°C).
2. Run the engine for at least one minute to clear the fluid system of air.
3. With the engine running, wipe the dipstick clean and check the fluid level. Any level within the

COLD RUN (lower) band is satisfactory for operating the vehicle. See [Fig. 2](#). If the level is not within the COLD RUN band, add or drain fluid until it reaches the middle of the COLD RUN band.

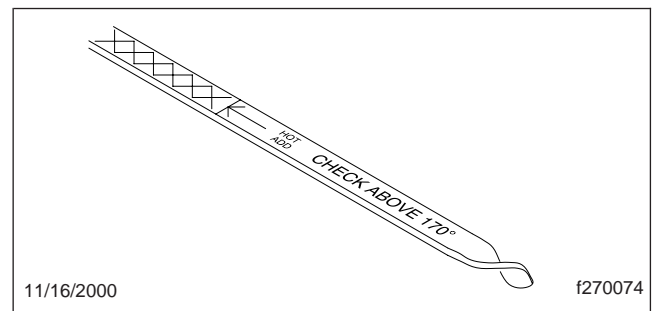


Fig. 2, Transmission Dipstick

4. Perform a hot check at the first opportunity after normal operating temperature, 160 to 200°F (71 to 93°C), is reached.

### Hot Check

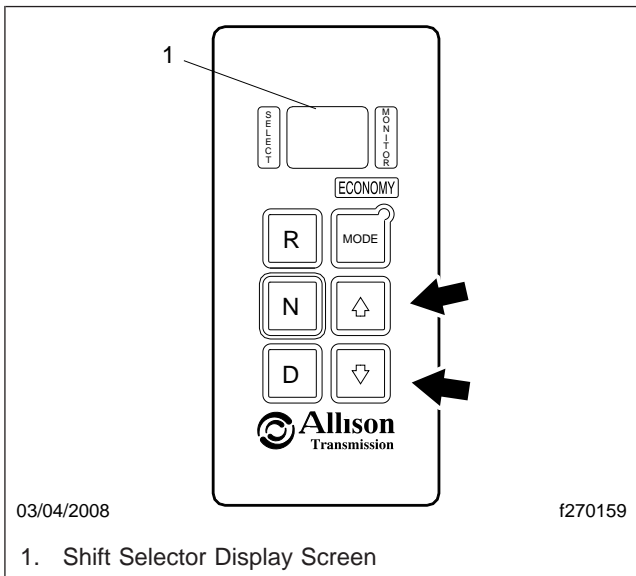
#### Recommended Method

With the vehicle on a level surface and the transmission in neutral at operating temperature, perform the steps below.

1. On the transmission shift selector, press the up and down arrow keys simultaneously. See [Fig. 3](#).
2. Release the arrow keys and wait for a two-minute countdown.
3. The transmission shift selector display screen will display one of the following messages.
  - OL - OK indicates an acceptable oil level.
  - OL - HI followed by a number indicates the amount that is over-filled.
  - OL - LO followed by a number indicates the amount that is under-filled.
  - OL - 70 indicates that the transmission is not up to operating temperature.

#### Alternate Method

1. Operate the transmission in a Drive (D) range until normal operating temperature, 160 to 200°F (71 to 93°C), is reached.



**Fig. 3, Transmission Shift Selector**

**NOTE:** The fluid must be warm to ensure an accurate check. The fluid level rises as temperature increases.

2. Park the vehicle. Shift to Neutral (N) and apply the parking brake. Let the engine run at idle.

3. Wipe the dipstick clean and check the fluid level. A safe operating level is any level within the HOT RUN (upper) band on the dipstick. See [Fig. 2](#).
4. If the fluid is not within this range, add or drain fluid as needed to bring the level to the top of the HOT RUN band. See [Table 1](#) for approved transmission lubricants. See [Table 2](#) for lubricant capacities.

## 26-03 Allison Transmission Fluid and Filter Changing (internal/external filter)

**IMPORTANT:** For oil and filter change intervals, see the applicable Allison Operator's Manual. To request a replacement Allison Operator's Manual, call 1-888-666-5799.

Oil and filter change intervals can also be found at [www.allisontransmission.com](http://www.allisontransmission.com). Choose "Service", and click "Service Tips". Then, select the appropriate transmission to view fluid and filter change recommendations.

Approved Allison Transmission Lubricants*		
TES-295 Approval Number	Company	Product Brand Name
AN-051005	ExxonMobil Lubricants and Petroleum Specialties Company	Mobil Delvac Synthetic ATF
AN-011001	Castrol Heavy Duty Lubricants	TranSynd
AN-031002	BP	Autran Syn 295
AN-031003	Cognis Corporation	Emgard 2805
AN-031004	International Truck & Engine Company	Fleetrite Synthetic ATF
AN-071006	John Deere & Company	HD SynTran

\* To check the latest Allison approved fluids, go to [www.allisontransmission.com](http://www.allisontransmission.com). Lubricants listed in order of preference. Do not mix types of oil.

**Table 1, Approved Allison Transmission Lubricants**

Automatic Transmission Lubricant Capacities	
Model	Refill Capacity*: qt (L)
1000, 2000, and 2000 MH	16.0 (15.1)

Automatic Transmission Lubricant Capacities	
Model	Refill Capacity*: qt (L)
3000 MH <sup>†</sup> and 4000 MH	17.5 (16.5)

\* Quantities listed are approximate. Add the recommended amount of fluid as listed under refill capacity. Do not overfill.

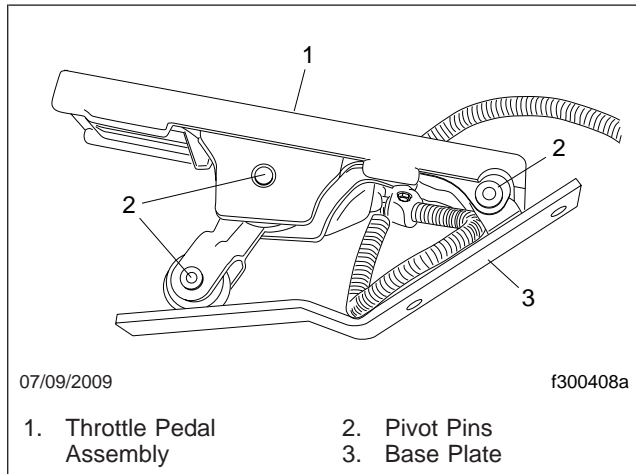
<sup>†</sup> Some Allison 3000 MH transmissions have a deeper oil sump than other models. These models require 3 additional quarts (2.8 L) of ATF.

**Table 2, Automatic Transmission Lubricant Capacities**

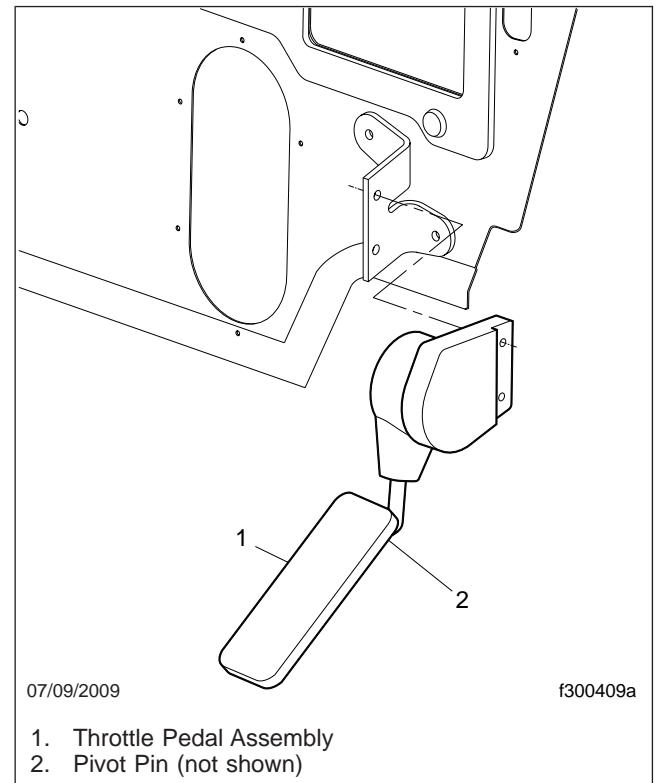
Title of Maintenance Operation (MOP)	MOP Number
Throttle Pedal Pivot Pin Lubricating. ....	30-01

## 30-01 Throttle Pedal Pivot Pin Lubricating

Using a silicone spray, lubricate the throttle pedal pivot pins as shown in **Fig. 1** and **Fig. 2**.



**Fig. 1, Floor-Mounted Throttle Pedal**



**Fig. 2, Suspended Throttle Pedal**

<b>Title of Maintenance Operation (MOP)</b>	<b>MOP Number</b>
Neway Suspension Inspecting . . . . .	32-03
Suspension Fastener Torque Checking . . . . .	32-01
Suspension Height Control Valve Checking . . . . .	32-02
Suspension Inspecting . . . . .	32-05
Suspension U-Bolt Torque Checking . . . . .	32-06
ZF IFS Lubricating . . . . .	32-04



## 32-01 Suspension Fastener Torque Checking

### WARNING

Inspect the suspension fasteners. Failure to perform inspections could result in separation of worn suspension components and loss of vehicle control, possibly causing personal injury or death, or property damage.

1. Chock the front or the rear tires. Working at the front of the vehicle or at the rear of the vehicle, raise the vehicle so that the tires just clear the ground and the suspension is fully extended. Place safety stands under the vehicle frame.
2. Check the suspension fasteners. See [Table 1](#) for correct fastener torques.
3. Check the torque of the rear axle U-bolts.  
In a diagonal pattern, tighten all 5/8–18 U-bolt nuts 205 lbf-ft (278 N-m); tighten all 3/4–16 U-bolt nuts 300 lbf-ft (407 N-m); and tighten all 7/8–14 U-bolt nuts 460 lbf-ft (624 N-m).

### NOTICE

**Failure to retorque the U-bolt nuts could result in spring breakage and abnormal tire wear.**

4. Remove the safety stands and lower the vehicle to the ground.

## 32-02 Suspension Height Control Valve Checking

### WARNING

Inspect the height control components and check their operation. Failure to perform these inspections and checks could result in separation of worn suspension components and loss of vehicle control, possibly causing personal injury or death, or property damage.

1. Park the vehicle on a level surface. Apply the parking brake and chock the tires to prevent the vehicle from moving.
2. Inspect the front and rear suspensions for any signs of damage, loose components, wear, or cracks. Replace any damaged components to prevent failure or equipment breakdown.
3. Inspect all bolts and nuts at the pivot axle connections to assure that they are properly torqued. Check all other nuts and bolts for proper torque. See [Group 00](#) of this manual for proper torque specifications.
4. Check the air pressure gauge to confirm that there is in excess of 65 psi (448 kPa) in the air system, and inspect the air springs for sufficient and equal firmness.

Suspension Torque Specifications (lubricated threads)		
Description	Size	Torque: lbf-ft (N-m)
Shock Absorber Mount Locknut	3/4–16	110 to 150 (149 to 203)
Air Spring Upper Mounting Plate Locknut	3/4–16	31 to 42 (42 to 57)
Air Spring Upper Mounting Plate Capscrew	1/2–13	31 to 42 (42 to 57)
Air Spring Lower Mounting Plate Capscrew	1/2–13	31 to 42 (42 to 57)
Transverse Beam Bushing Locknuts	1-1/4–12	600 to 700 (814 to 949)
Equalizing Beam Center Bushing Locknut	3/4–16	150 to 200 (203 to 271)
Equalizing Beam Front Bushing Locknut	1-1/8–12	600 to 700 (814 to 949)
	1-1/4–12	
Control Rod Ball Stud Locknut	1-1/8–12	550 to 650 (746 to 881)
Control and Torque Rod Mounting Locknuts	5/8–18	110 to 150 (149 to 203)

**Table 1, Suspension Torque Specifications (lubricated threads)**

NOTE: Height control valves control all front and rear suspension air springs. Check for air leaks by applying a soapy solution. Then, check for bubbles at all air connections and fittings.

5. Check the ride height of the air suspension by measuring the distance from the center of the lower shock bolt to the bottom of the frame rail. See **Fig. 1**. See **Table 2** for height control valve adjustment measurements. If ride height is incorrect, adjust the air suspension.

Height Control Valve Adjustment Measurements	
Suspension	Measurement Inches $\pm 1/4$ (mm $\pm 6$ )
AS120 (front)	10 (254) or 10-1/2 (267)*
AS140 (front)	11 (279)
IFS114 (front)	17-1/2 (445)
IFS ZF (front)	15-3/4 (400)
ADL-RS17/19/21	10-1/4 (260)
AD200-RS17/19	9-3/4 (248)
AD200-RS15	9-3/8 (238)
ADTB280 (rear)	17-1/4 (438)
Airliner 15k (rear)	8-3/4 (222)
AD123 (rear)	18 (457)

\* Some vehicles have a different shock location. When this is the case, the vehicle will have a 55 degree wheel cut. Ride height for these vehicles should be set at 10-1/2 inches (267 mm).

**Table 2, Height Control Valve Adjustment Measurements**

## 32-03 Neway Suspension Inspecting

### WARNING

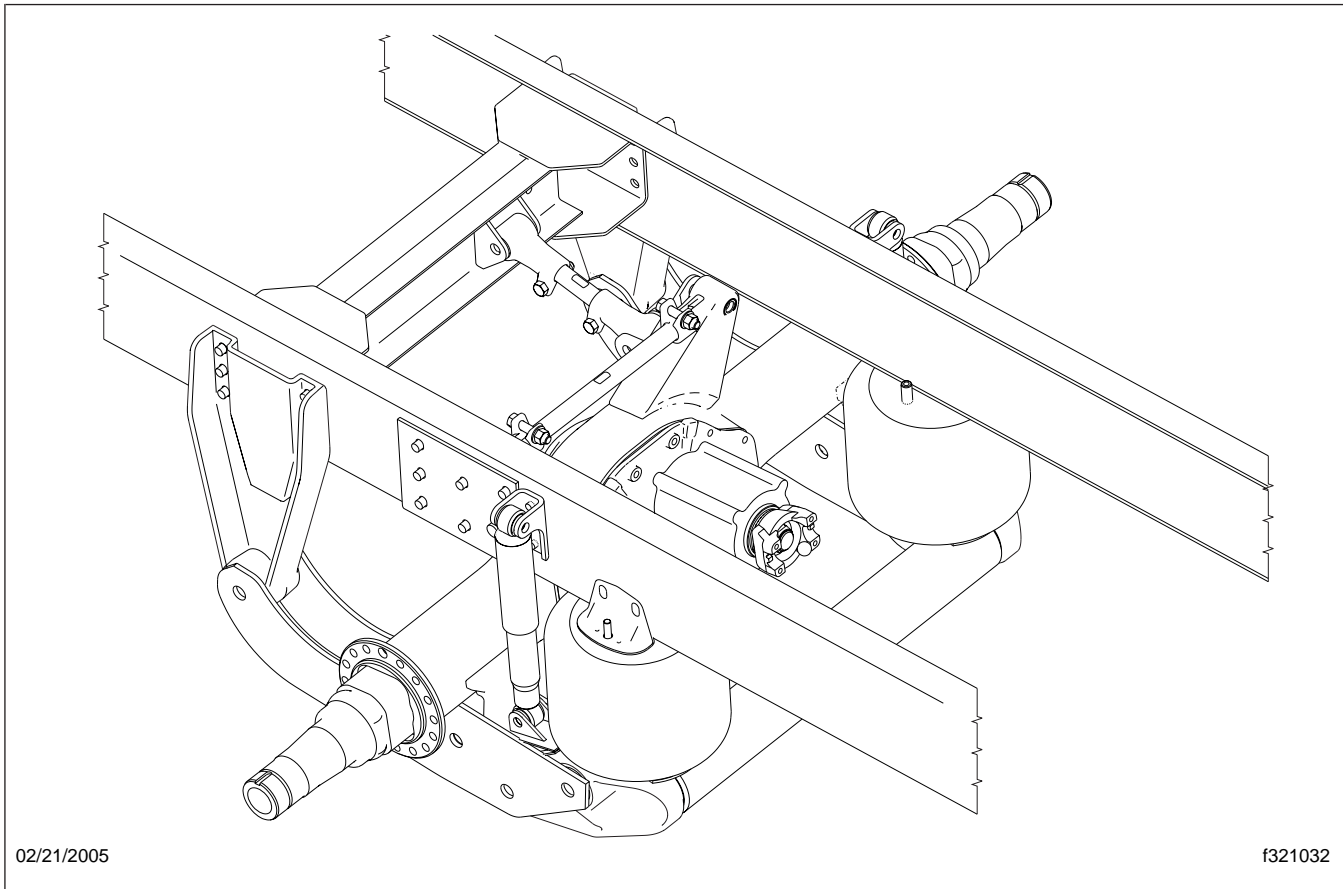
Inspect the components and check their operation as described below. Failure to perform these inspections and checks could result in separation of worn suspension components and loss of vehicle control, possibly causing personal injury or death, or property damage.

1. Check the front or the rear tires. Working at the front of the vehicle or at the rear of the vehicle,

raise the vehicle so that the tires just clear the ground and the suspension is fully extended. Place safety stands under the vehicle frame.

2. Squeeze all air springs to check for complete deflation. It may take ten minutes for the pressure to bleed down from the air spring. See **Fig. 2**. If any air springs remain partially or fully inflated, see **Group 32** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. Inspect the air springs for cracks, tears, or other damage.
3. Inspect each air spring for wear at the pedestal connection. Inspect for leaks at the upper and lower pedestal connections using a soapy solution. Replace any worn air springs; for instructions, see **Group 32** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
4. Inspect the bolts and nuts at the pivot connections, the transverse beam connections, and the axle connections to ensure they are tightened to the correct torque specification.
5. Check all of the other suspension components for any sign of damage, looseness, wear, or cracks. Replace worn or damaged parts. See **Group 32** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
6. Inspect for cracked welds. If cracks are found, contact Neway immediately for further instructions.
7. Inspect the torque rod and track bar pivot bushings for excessive wear. Replace worn or damaged bushings. See **Group 32** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
8. Move the axle up and down while checking for signs of looseness due to worn parts at the front pivot connections. Replace any worn parts by following the procedures in **Group 32** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
9. Check for leaks on the height control valves by applying a soapy solution, then, watching for bubbles at all air connections and fittings.





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Fig. 2, Holland Neway ADL 120/123 Suspension

**IMPORTANT:** Every 50,000 miles (80 450 km), ZF recommends that the wheel hub be removed to check the wheel bearing lash, and adjust as needed.

2. Remove the wheel hub. See **Group 33** of the *Recreational Vehicle Chassis Workshop Manual* for wheel bearing service procedures, or take the vehicle to an authorized Freightliner dealer.
3. Lubricate the steering knuckle/control arm at indicated maintenance intervals. Use only an NLGI Grade 2 lithium-based grease, multipurpose grease, or mineral oil on the lubricating points. See **Fig. 3** and **Fig. 4**.

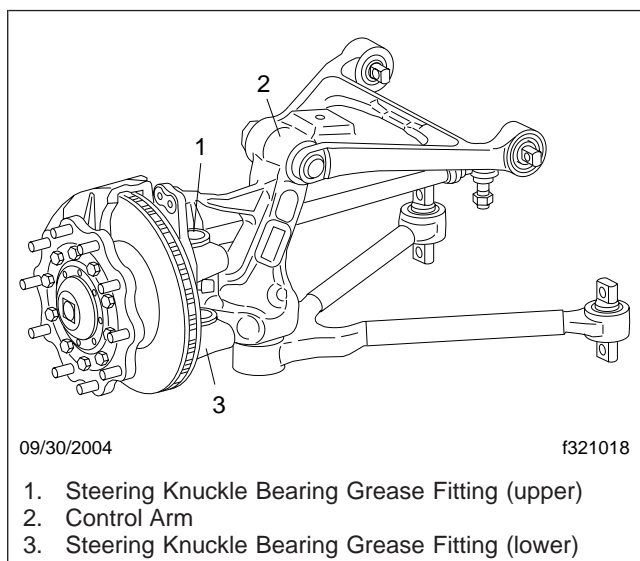
## 32–05 Suspension Inspecting

### Freightliner Spring Front and Rear Suspension Spring Assemblies Inspection

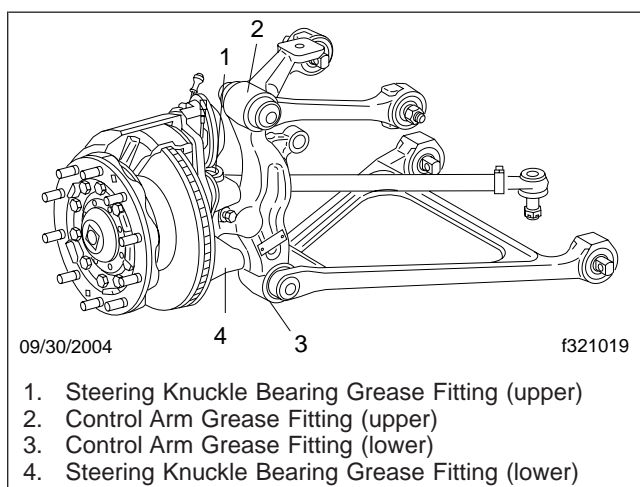
Inspect the front and rear suspension spring assemblies for pitted, cracked, broken, or abnormally bent leaves and extreme rust. If any of these conditions exist, replace the spring assembly. See **Group 32** of the *Recreational Vehicle Chassis Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.

#### **WARNING**

**Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring as-**



**Fig. 3, Pressure Grease Fitting Positions, RL-75E**



**Fig. 4, Pressure Grease Fitting Positions, RL-75EM**

**sembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. On front spring assemblies, if cracks or breaks exist in the**

**two top leaves, a loss of vehicle control could occur. Failure to replace a damaged spring assembly could cause an accident resulting in property damage, serious personal injury, or death.**

**IMPORTANT:** On multi-leaf suspensions, closely inspect each component of the leaf spring assemblies, including the brackets, U-bolts, and related parts.

## 60-Inch Taper-Leaf Spring Component Check

No lubrication is required on the 60-inch taper-leaf spring front and rear suspension.

Inspect the rear shackle brackets for bushing wear or cracks.

Inspect the stabilizer bar, if present, for irregular bushing wear or cracks in the brackets. Check the rubber helper spring, if present, for cracks.

## 32-06 Suspension U-Bolt Torque Checking

Check the U-bolt torque of both the front and rear axles where applicable.

### CAUTION

**Failure to retorque the U-bolt nuts could result in spring breakage and abnormal tire wear.**

1. Park the vehicle on a flat surface, apply the parking brake, and chock the tires.
2. Check the U-bolt torque in a diagonal pattern. Set a click-type torque wrench to the highest torque value for the fastener being checked. See [Table 3](#) for U-bolt torque specifications. Turn the wrench in a clockwise motion (looking up) until the torque wrench clicks.
3. Remove the chocks.

U-Bolt Torque Values		
Description	Size	Torque: lbf·ft (N·m)
Spring Assembly U-Bolt High Nuts*	5/8–18	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 180 to 230 (245 to 313)
	3/4–16	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 270 to 330 (367 to 449)

\* Tighten in the sequence shown in Fig. 5.

Table 3, U-Bolt Torque Values

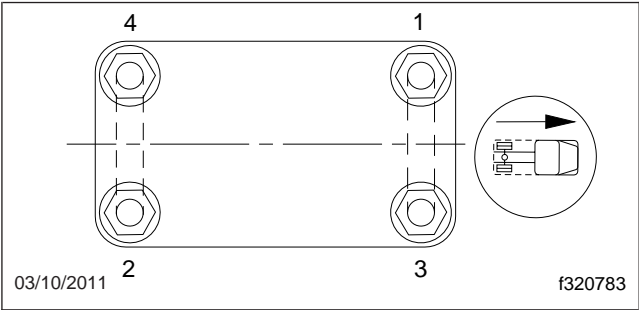


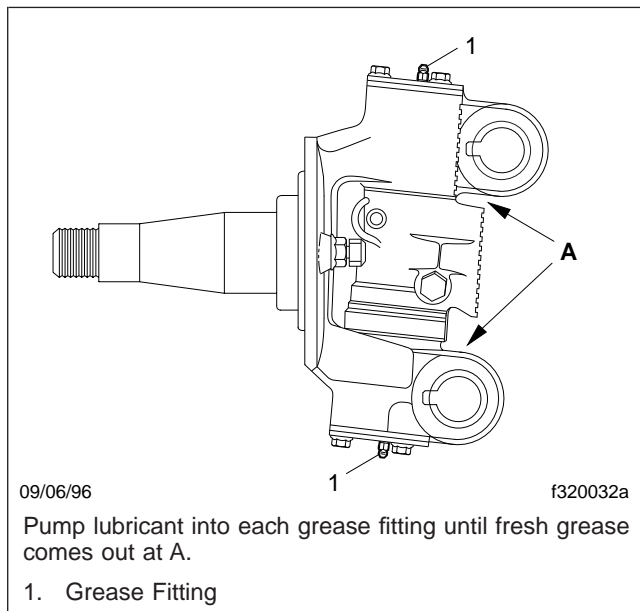
Fig. 5, Tightening Sequence for U-Bolt High Nuts

<b>Title of Maintenance Operation (MOP)</b>	<b>MOP Number</b>
All-Axle Alignment Checking . . . . .	33-03
Knuckle Pin Lubricating . . . . .	33-01
Oil-Filled Hubs Oil Changing . . . . .	33-06
Oil-Filled Hubs Oil Level Checking . . . . .	33-05
Tie-Rod End Lubricating and Inspecting . . . . .	33-02
Wheel Bearing Removal, Cleaning, Checking, Repacking, and Adjusting . . . . .	33-04

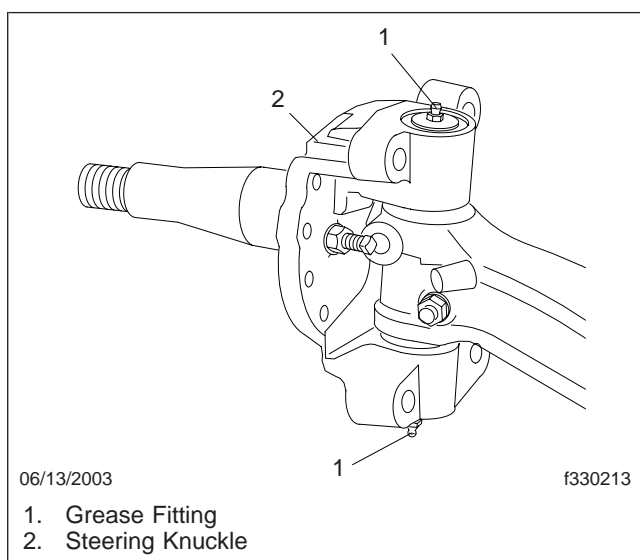


## 33-01 Knuckle Pin Lubricating

Hold a high-pressure grease gun on each fitting until fresh grease appears. See **Fig. 1** or **Fig. 2**. This will ensure that all of the old contaminated grease has been forced out.



**Fig. 1, Meritor Axle Grease Fittings**



**Fig. 2, ABP Axle Grease Fittings**

When lubricating Meritor axle knuckle pin bushings or Alliance Brand Product (ABP) axle needle bearings at the initial maintenance (IM) interval, first wipe the lube fittings clean. Then, slowly feed (for Meritor axles) multipurpose chassis grease (NLGI grade 1 or 2) into each bushing area, or (for ABP axles), lithium 12-hydroxy stearate (with molybdenum disulfide) WL grade 2 grease into each needle bearing area, while turning the wheels from extreme right to left, and back again (lock-to-lock). This will eliminate small air pockets and improve grease distribution.

**NOTE:** The grease seal will accept the grease pressure without damaging the seal, and is designed to have grease pumped out through it during lubrication. Even if grease leaks out around the top or bottom plate, continue pumping until new grease is seen at the seal on the bushing or needle bearing opposite the grease fitting.

When lubricating knuckle pin bushings or needle bearings after the IM maintenance interval, first wipe the lube fittings clean. Then, (for Meritor axles) apply multipurpose chassis grease, or (for ABP axles), lithium 12-hydroxy stearate (with molybdenum disulfide) WL grade 2 grease, until new grease is seen at the grease seal on the bushing or needle bearing opposite the fittings.

## 33-02 Tie-Rod End Lubricating and Inspecting

**IMPORTANT:** DOT roadside tie-rod assembly replacement criteria specifies that if tie-rod end-play is 1/8 inch (3 mm) or greater, measured on the road, the vehicle must be taken out of service immediately. If less than 1/8 inch (3 mm), the vehicle does not have to be taken out of service but a major out-of-service inspection and maintenance must be scheduled as soon as possible.

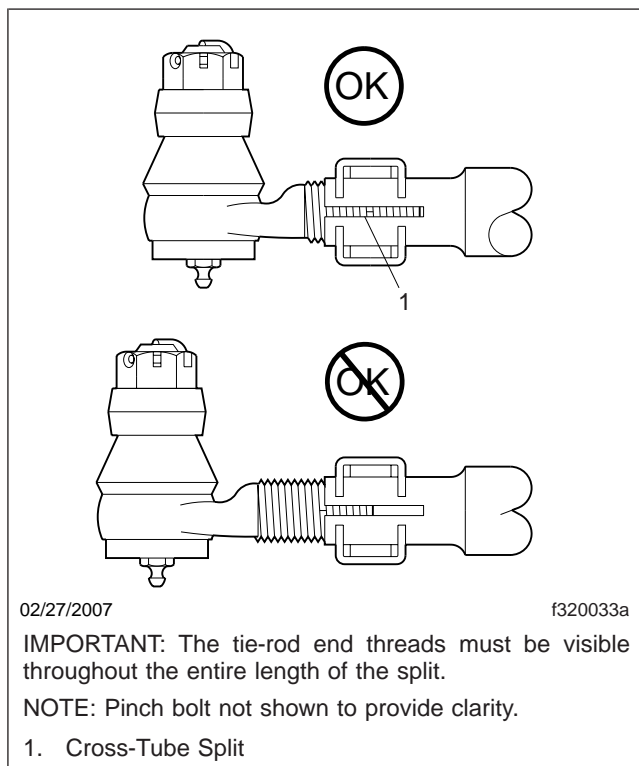
1. Wipe the tie-rod end grease fittings clean, then (for Meritor axles) pump multipurpose chassis grease (NLGI grade 1 or 2), or (for Freightliner axles), lithium 12-hydroxy stearate (with molybdenum disulfide) WL grade 2 grease, to the tie-rod ends until all used grease is forced out and new grease appears at the ball stud neck.



**NOTE:** Inspect the tie-rod end boots for cracks, wear, or damage. If a boot is cracked, worn, or damaged, replace the tie-rod assembly.

2. Inspect the tie-rod ends, as follows.

- 2.1 Shake the cross-tube. Movement or looseness between the tapered shaft of the ball and the cross-tube socket members means that the tie-rod end assembly must be replaced.
- 2.2 The threaded portion of the tie-rod end assembly must be inserted all the way into the cross-tube split for adequate clamping. See [Fig. 3](#). Replace the parts if this cannot be done. For instructions, see the axle manufacturer's service manual.



**Fig. 3, Tie-Rod End Adjustment**

- 2.3 Check the tie-rod end nut and clamp nut torques. For Meritor axles, tighten the tie-rod end nut 100 lbf-ft (136 N·m), and tighten the clamp nut 40 to 55 lbf-ft (54 to 75 N·m). For Freightliner axles, see [Table 1](#) for tie-rod end nut torque specifications and [Table 2](#) for tie-rod end clamp

nut torque specifications.

Freightliner Axle Tie-Rod End Nut	
Thread	Torque: lbf-ft (N·m)
5/8-16	60 to 115 (81 to 156)
5/8-18	60 to 115 (81 to 156)
3/4-16	90 to 170 (122 to 230)
7/8-14	160 to 300 (217 to 407)

**Table 1, Freightliner Axle Tie-Rod End Nut**

Freightliner Axle Tie-Rod End Clamp Nut	
Thread	Torque: lbf-ft (N·m)
1/2-13	35 to 45 (47 to 61)
5/8-11	40 to 60 (54 to 81)
5/8-18	50 to 64 (73 to 87)
3/4-10	155 to 175 (210 to 237)

**Table 2, Freightliner Axle Tie-Rod End Clamp Nut**

## 33-03 All-Axle Alignment Checking

**NOTE:** The final stage manufacturer is responsible for setting the vehicle ride height with air suspension and some vehicle alignments. On full-railed chassis, this includes the final toe-in setting on the front axle. For modular style chassis, both the front axle toe-in and rear axle thrust angle settings are included.

### Drive Axle Alignment Checking

**NOTE:** The maximum tolerance from perpendicular for rear axle alignment should be  $\pm 0.25$  degree.

Check the axle alignment, parallelism, and thrust angle measurements for the rear axle. Use the applicable procedure and specifications in **Group 35** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

### Toe-In Inspection

For vehicle alignment to be accurate, the shop floor must be level in every direction. The turn plates for

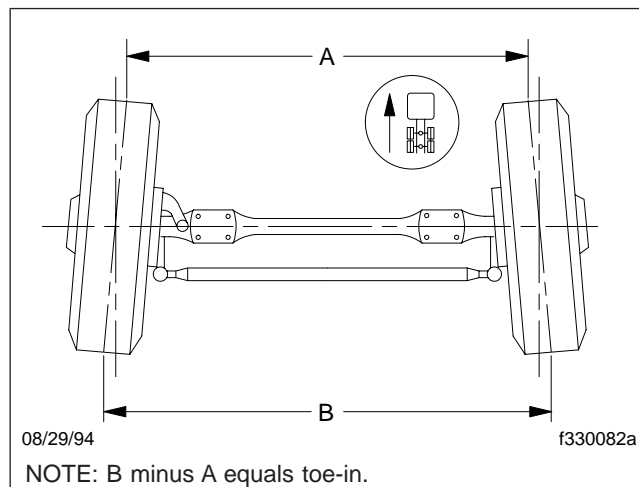
the front wheels must rotate freely without friction, and the alignment equipment must be calibrated every three months by a qualified technician from the equipment manufacturer. Freightliner dealers must have proof of this calibration history.

**NOTE:** Toe-in should be within 0 to 1/32 inch (0.8 mm).

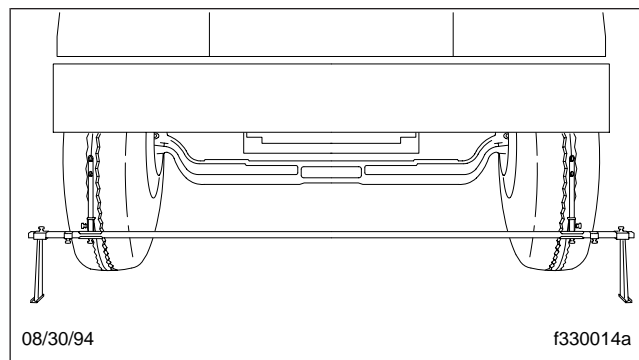
1. Apply the parking brake, and chock the rear tires.
2. Raise the front of the vehicle until the tires clear the ground. Check that the safety stands will support the combined weight of the body, axle, and frame. Place safety stands under the axle.
3. Using spray paint or a piece of chalk, mark the entire center rib of each front tire.
4. Place a scribe or pointed instrument against the marked center rib of each tire, and turn the tires. Hold the scribe firmly in place so that a single straight line is scribed all the way around each front tire.
5. Place a turn-plate or turntable under both front tires. Remove the safety stands from underneath the axle, then lower the vehicle. Remove the lockpins from the gauges; make sure that the tires are pointing straight ahead.

**NOTE:** If turn-plates or turntables are not available, lower the vehicle. Remove the chocks from the rear tires and release the parking brake. Move the vehicle backward and then forward about six feet (two meters).

6. Place a trammel bar at the rear of the front tires; locate the trammel pointers at spindle height, and adjust the pointers to line up with the scribe lines on the center ribs of the front tires. See [Fig. 4](#). Lock the pointers in place. Check that the scale is set to zero.
7. Place the trammel bar at the front of the tires and adjust the scale end so that the pointers line up with the scribe lines. See [Fig. 5](#) and [Fig. 6](#).
8. Read the toe-in from the scale, and compare it to the toe-in specification in **Group 33** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. If corrections are needed, see **Group 33** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.



**Fig. 4, Wheel Toe-In (overhead view)**



**Fig. 5, Trammel Bar Positioning**

## 33–04 Wheel Bearing Removal, Cleaning, Checking, Repacking, and Adjusting

### Freightliner/Meritor

Check for correct end play. Correct end play is between 1 to 0.005 inch (25.4 to 0.12 mm).

### ZF IFS

ZF recommends that all grease fittings be lubricated once a year, preferably before periods of inactivity. The wheel hub should be disassembled, inspected, and the wheel bearings repacked every 1,000,000 miles (1 609 000 km).

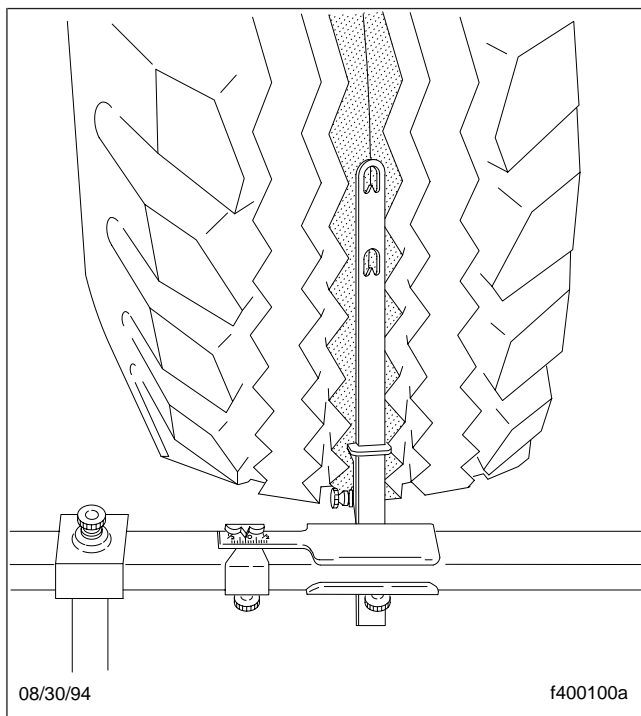


Fig. 6, Setting Trammel Bar Pointers

### 33-05 Oil-Filled Hubs Oil Level Checking

#### ⚠ WARNING

Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.

1. With the vehicle on a level surface, rotate the front wheels and allow the oil in the hubs to settle.
2. Chock the tires.

**IMPORTANT:** The oil level should be at, or no more than 1/4 inch (6 mm) above the level indicators on the hub caps.

3. If necessary, remove the filler caps (in the ends of the hub caps) and add enough oil (80W-90 hypoid gear oil) to bring the oil to the proper level.

4. Rotate the wheels, allow the oil to settle, and check the levels again.
5. Install the filler caps securely.
6. Remove the chocks from the tires.

### 33-06 Oil-Filled Hubs Oil Changing

#### ⚠ WARNING

Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.

1. With the vehicle on a level surface, rotate the front wheels so that the front hub drain plugs are positioned downward.
2. Chock the tires.
3. Place suitable containers under the hubs, remove the filler plugs (in the ends of the hub caps) and the drain plugs, and allow the hubs to drain completely. See Fig. 7.

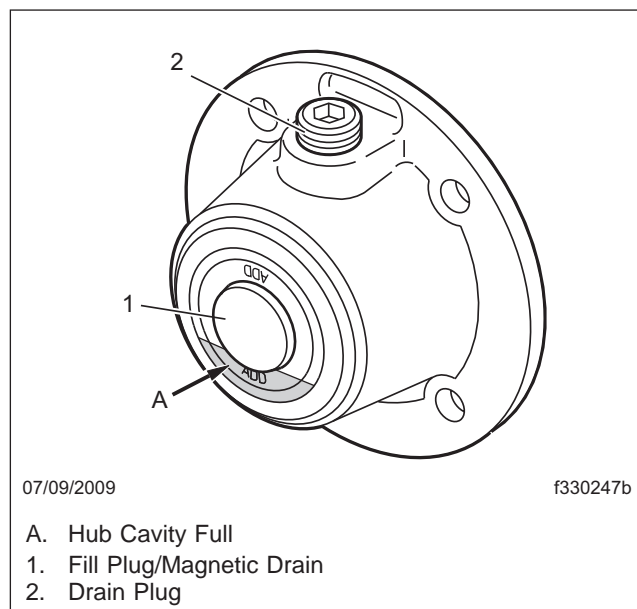


Fig. 7, Oil-Filled Hub Cap

4. Install the drain plugs and tighten 25 lbf-in (282 N-cm).
5. Add approximately 1 to 1-1/2 pints (0.5 to 0.7 L) of oil (80W-90 hypoid gear oil) to each hub.
6. Rotate the wheels, allow the oil to settle, and check the levels.

**IMPORTANT:** Fill the hubs to the level indicators on the hub caps, or to no more than 1/4 inch (6 mm) above the indicators. See [Fig. 7](#).

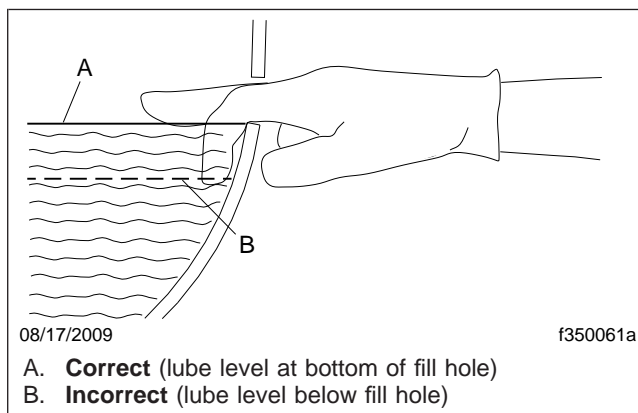
7. Install the filler plugs securely.

<b>Title of Maintenance Operation (MOP)</b>	<b>MOP Number</b>
Axle Breather Checking . . . . .	35-03
Axle Lubricant Changing. . . . .	35-02
Axle Lubricant Checking. . . . .	35-01
Oil-Filled Hubs Oil Changing, Tag Axle . . . . .	35-05
Oil-Filled Hubs Oil Level Checking, Tag Axle. . . . .	35-04

## 35–01 Axle Lubricant Checking

NOTE: If the vehicle is exposed to water deep enough to cover the hubs, disassemble and inspect them for water damage and/or contamination. See **Group 35** of the *Recreational Vehicle Chassis Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.

1. Clean the area around the filler plug, and remove the plug.
2. Make sure that the lubricant is level with the bottom of the filler plug hole. See **Fig. 1**.



**Fig. 1, Axle Lubricant Checking**

3. Add S.A.E. 80W–90 multipurpose gear lubricant, or an S.A.E. 75W–90 multipurpose synthetic gear lubricant. Either type of lubricant must meet Military Specification L–2105–D and be suitable for American Petroleum Institute service classification GL–5. Install and tighten the filler plug.
4. Inspect the axle for signs of leakage. If leakage is indicated and the lubricant level is down, have your dealer perform any necessary maintenance.

## 35–02 Axle Lubricant Changing

### Freightliner Axle

1. Remove the filler plug, then the drain plug (in the center bottom of the axle housing), and allow the differential to drain completely.
2. Install the drain plug and tighten it securely.

3. Fill the differential with 80/90 hypoid gear oil through the rear axle fill hole. See **Table 1** for axle lubricant capacities.

Freightliner Drive Axle Lubricant Capacity	
Differential/Hubs	Capacity: qt (L)
Differential Only	5.8 (5.5)
Differential and Hubs	7.4 (7.0)

**Table 1, Freightliner Drive Axle Lubricant Capacity**

NOTE: A normal oil change does not include the hubs. Drain the differential and add 5.8 qt (5.5 L) of 80/90 hypoid gear oil through the rear axle fill hole. The lubricant level should be at the bottom of the fill hole.

**IMPORTANT:** The entire axle capacity (axle completely dry) is 7.4 qt (7 L). Each hub contains 0.80 qt (0.75 L) of lubricant. To protect the outer bearings from oil starvation, jack up (articulate) each side of the axle a minimum of 4 inches (10 cm) to ensure that oil flows to the outer bearings. Articulate the short-side arm for 45 seconds and the long-side arm for 90 seconds. After articulating the axle, add 0.80 qt (0.75 L) of lubricant through the fill hole (in addition to the 5.8 qt [5.5 L] of a normal oil change) for each hub that has been removed. Check the oil level again and ensure that the axle is neither under- nor over-filled.

4. Install the fill plug and tighten it securely.

### Meritor Axle

1. Remove the filler plug, then the drain plug, and allow the differential to drain completely.
2. Install the drain plug. Tighten it 24 lbf·ft (34 N·m).
3. Fill the differential with an SAE 80W–90 multipurpose gear lubricant, or an SAE 75W–90 multipurpose synthetic gear lubricant. See **Table 2** for axle lubricant capacities. Either type of lubricant must meet Military Specification L–2105–D and be suitable for American Petroleum Institute service classification GL–5. The lubricant level within the differential must be even with the bottom of the fill hole.

4. Install the fill plug. Tighten it 24 lbf-ft (34 N·m).

Meritor Drive Axle Lubricant Capacity	
Axle Model	Capacity: pt (L)*
RS-15-120	16 (7.6)
RS-17-145	33.6 (15.9)
RS-19-145	34.4 (16.3)
RS-21-145	32 (15.1)
RS-23-160	42 (19.9)
RS-23-165	42 (19.9)

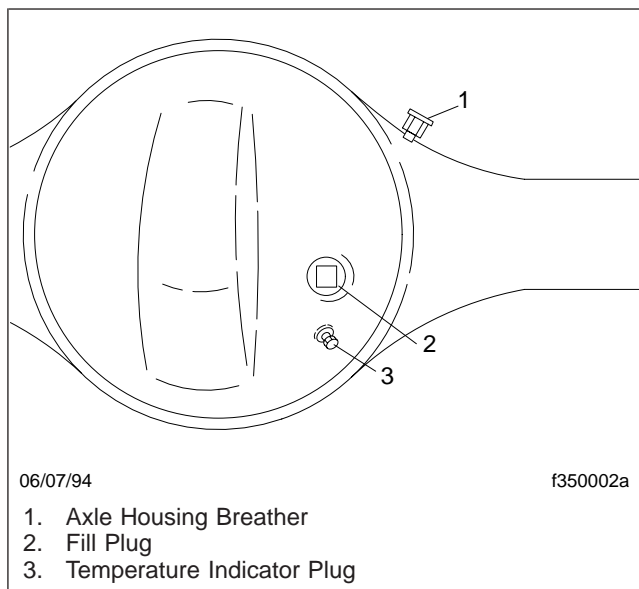
\* Quantities listed are approximate and include 1 pint (0.5 L) for each wheel end and with the drive pinion at 3 degrees.

**Table 2, Meritor Drive Axle Lubricant Capacity**

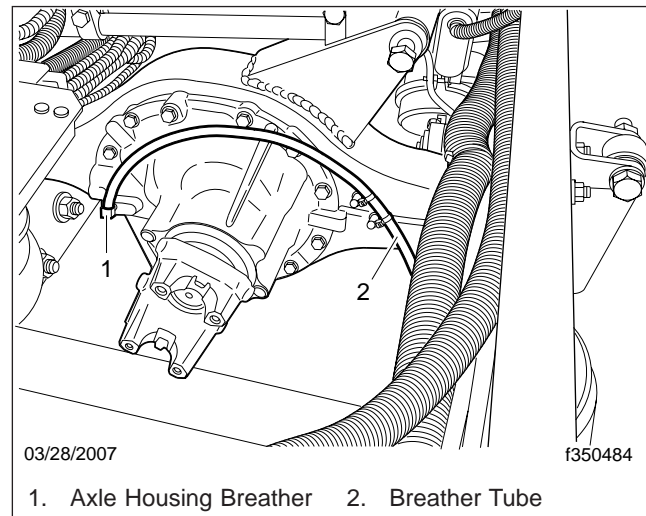
## 35-03 Axle Breather Checking

**NOTE:** On Freightliner axles, the axle housing breather is located on the carrier assembly.

The axle housing breather must remain unobstructed. Whenever the axle lubricant is checked or changed, also make sure that the breather is open. Check more often under poor operating conditions. If the breather is plugged, clean or replace it as needed. See [Fig. 2](#) and [Fig. 3](#).



**Fig. 2, Meritor Axle Housing (typical)**



**Fig. 3, Freightliner Axle Housing**

## 35-04 Oil-Filled Hubs Oil Level Checking, Tag Axle

### **WARNING**

**Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.**

1. With the vehicle on a level surface, remove the hub cap (also referred to as a beauty ring). See [Fig. 4](#).

2. Rotate the rear wheels and allow the oil in the hubs to settle.

3. Chock the tires.

**IMPORTANT:** The oil level should be at, or no more than 1/4 inch (6 mm) above the level indicators on the hub caps.

4. If necessary, remove the filler caps (in the ends of the hub caps) and add enough oil (80W-90 hypoid gear oil) to bring the oil to the proper level.

5. Rotate the wheels, allow the oil to settle, and check the levels again.

6. Install the filler caps securely.



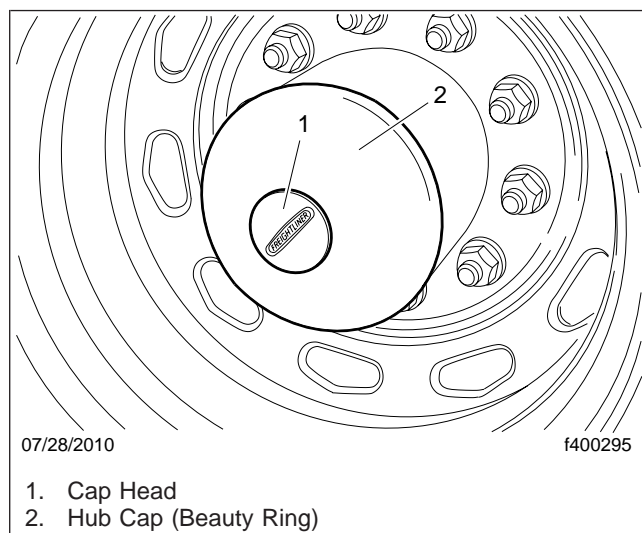


Fig. 4, Rear Axle Hub Cap Assembly

**NOTICE**

**Do not overtighten the cap head. Too much force will strip the screw.**

7. Install the hub cap and tighten the cap head just until snug.

## 35–05 Oil-Filled Hubs Oil Changing, Tag Axle

### **WARNING**

**Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.**

1. With the vehicle on a level surface, remove the hub cap (also referred to as a beauty ring).
2. Rotate the rear wheels so that the rear hub drain plugs are positioned downward.
3. Chock the tires.
4. Place suitable containers under the hubs, remove the filler plugs (in the ends of the hub caps) and the drain plugs, and allow the hubs to drain completely. See Fig. 5.

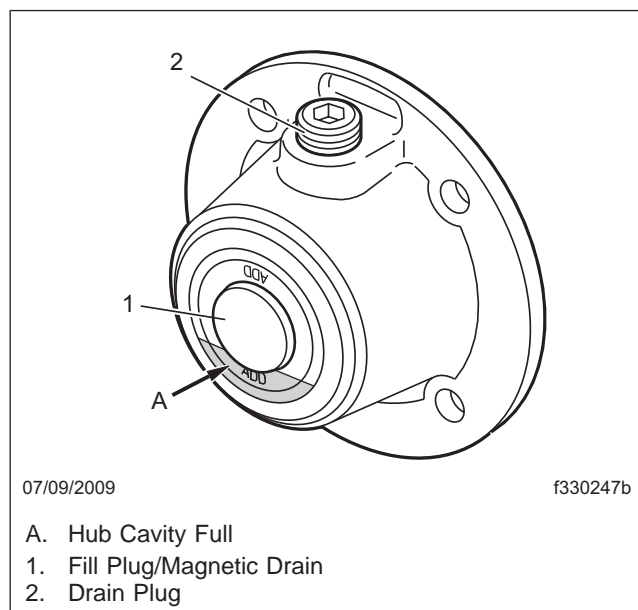


Fig. 5, Oil-Filled Hub Cap

5. Install the drain plugs and tighten securely.
6. Add approximately 1 to 1-1/2 pints (0.5 to 0.7 L) of oil (80W–90 hypoid gear oil) to each hub.

**IMPORTANT:** Fill the hubs to the level indicators on the hub caps, or to no more than 1/4 inch (6 mm) above the indicators. See Fig. 5.

7. Rotate the wheels, allow the oil to settle, and check the levels.
8. Install the filler plugs securely.

**NOTICE**

**Do not overtighten the cap head. Too much force will strip the screw.**

9. Install the hub cap and tighten the cap head just until snug.



Title of Maintenance Operation (MOP)	MOP Number
Wheel Cleaning and Polishing . . . . .	40-02
Wheel Nut Checking. . . . .	40-01

## 40-01 Wheel Nut Checking

**IMPORTANT:** In addition to the maintenance interval in this manual, check the wheel nut torque the first 50 to 100 miles (80 to 160 km) of operation after a wheel has been removed and installed.

**NOTE:** On each wheel stud, the end that faces away from the vehicle is stamped with an "L" or an "R," depending on which side of the vehicle the stud is installed. Studs stamped with an "L" are left-hand threaded and are installed on the driver's side of the vehicle. Studs stamped with an "R" are right-hand threaded and are installed on the passenger's side of the vehicle.

When checking wheel nuts on a dual disc assembly, remove one outer nut at a time, tighten the inner nut, then reinstall the outer nut. Repeat this procedure for all of the inner wheel nuts in the sequence shown in [Fig. 1](#), [Fig. 2](#), or [Fig. 3](#). Then, tighten all of the outer wheel nuts in the same sequence.

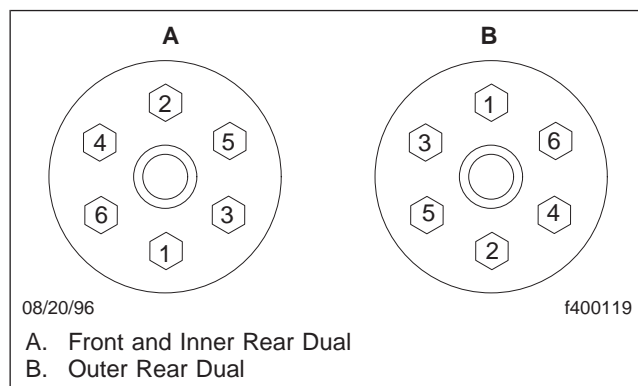
### CAUTION

**Too little wheel nut torque can cause wheel shimmy, resulting in wheel damage, stud breakage, and extreme tire tread wear. Too much wheel nut torque can break studs, damage threads, and crack discs in the stud hole area.**

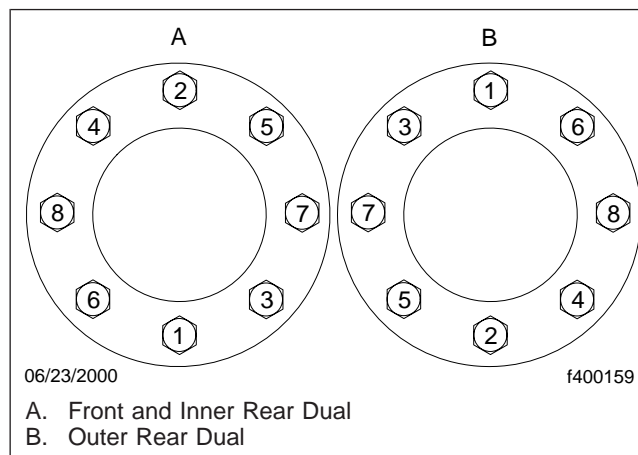
Tighten the wheel nuts.

- On 6-stud, stud-pilot hubs, tighten the wheel nuts 450 to 500 lbf-ft (610 to 678 N·m). See [Fig. 1](#) for the tightening sequence.
- On 8-stud or 10-stud, hub-pilot hubs with 20-mm studs, tighten the wheel nuts 280 to 310 lbf-ft (380 to 420 N·m). See [Fig. 2](#) or [Fig. 3](#) for the tightening sequence.
- On 8-stud or 10-stud, hub-pilot hubs with 22-mm studs, tighten the wheel nuts 450 to 500 lbf-ft (610 to 678 N·m). See [Fig. 2](#) or [Fig. 3](#) for the tightening sequence.

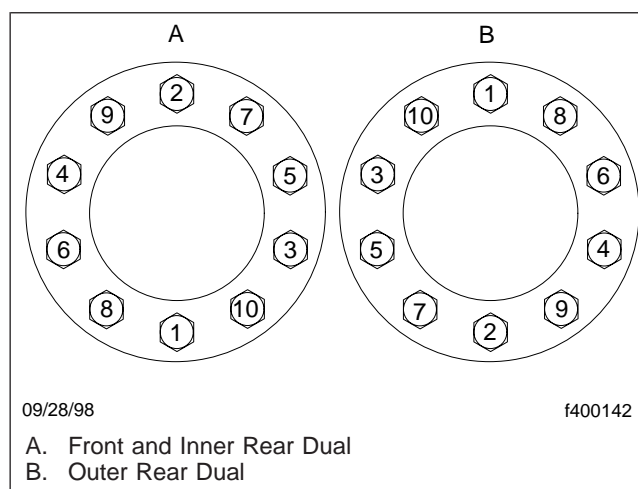
**NOTE:** Wheel nuts for 20-mm stud hubs require a 1- 3/16-inch (30-mm) socket. Wheel nuts for 22-mm stud hubs require a 1-5/16-inch (33-mm) socket.



**Fig. 1, Wheel Nut Tightening Sequence (6-stud hubs)**



**Fig. 2, Wheel Nut Tightening Sequence (8-stud hubs)**



**Fig. 3, Wheel Nut Tightening Sequence (10-stud hubs)**

## 40–02 Wheel Cleaning and Polishing

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### Accuride® Machined and Polished Aluminum Wheels

**IMPORTANT:** Do not scrub the wheels before rinsing off particles with high-pressure water. Rubbing debris against the surface of the wheel can result in scratches. Synthetic cleaning pads and wire brushes should not be used to clean the wheels.

Do not use strong detergents, alkaline, or acidic cleaners to clean Accuride aluminum wheels. These solutions can etch the surface of the aluminum and leave dull areas. Do not use polishes or wax on Accuride ACCU-SHIELD aluminum wheels.

1. Rinse the wheel with high-pressure water to remove debris.
2. Use a 100% cotton cloth dipped in a mild soap solution to help remove built up dirt and grease. Dish soap or automotive car wash soap are recommended.
3. Rinse the remaining soap residue from the wheel. Do not allow soap residue to dry on the surface of the wheel.
4. Dry the wheel thoroughly with a 100% cotton cloth.
5. Commercial bug/tar/grime cleaners may be used to remove stuck-on particles from the wheel. It is recommended that the cleaner be tested in an inconspicuous area for discoloration before treating the wheel.
6. Do not use strong solvents to remove grease or grime from the surface of the wheel. Damage to the wheel surface finish might occur.
7. Do not use polishes or wax on ACCU-SHIELD aluminum wheels. The finish will maintain the bright and shiny surface for years to come without the need for special polishes.

Title of Maintenance Operation (MOP)	MOP Number
Driveline Inspecting and Lubricating . . . . .	41-01

## 41-01 Driveline Inspecting and Lubricating

### Inspecting

Before lubricating the driveline U-joints and slip-joints, make the following checks.

1. Check that the yoke-strap capscrews are tightened 50 to 60 lbf·ft (68 to 81 N·m).

### NOTICE

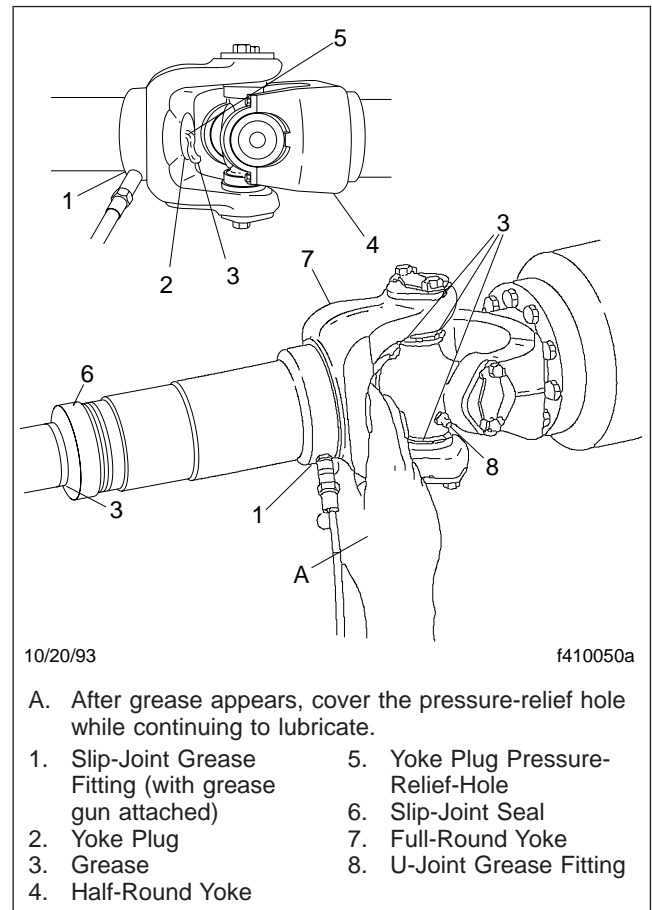
**Do not overtighten the yoke-strap capscrews, due to the extreme load occurring at high-speed rotation. A loose or broken capscrew at any point in the driveline weakens the driveline connection, which could eventually result in serious vehicle damage.**

2. Check the slip-joints for spline wear by trying to bend the sleeve-yoke and splined shaft back and forth. If looseness is greater than 0.007 inch (0.18 mm), replace both the sleeve-yoke and the splined shaft.
3. Check the driveshaft for missing balance weights, and for debris buildup. Remove any buildup. If any balance weights are missing, remove the driveshaft and have it balanced. For instructions, see **Group 41** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
4. Check that the yoke plug is not loose or missing. Replace the yoke plug if needed. If the yoke plug is missing, the splined shaft may be hitting the yoke plug and knocking it out; check the driveshaft for proper length.

### U-Joint Lubricating

1. Wipe all old grease and dirt from each U-joint grease fitting.
2. Use a hand-type grease gun, or a high-pressure gun with a low-pressure adaptor, to lubricate the U-joints. See **Fig. 1**.

**NOTE:** If a low-pressure adaptor is not used with the high-pressure gun, the U-joints may not receive enough lubricant.



**Fig. 1, Slip-Joint and U-Joint Lubricating**

3. Using lithium 12-hydroxy stearate grease (NLGI grade 1 or 2, with EP additives), lubricate until new grease can be seen at all four U-joint seals.

### NOTICE

**Fresh lubricant must be seen escaping from *all four* of the bearing cup seals of each U-joint. If not, the U-joint may fail prematurely.**

4. If the bearing will not take grease, replace the U-joint assembly. For instructions, see **Group 41** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
5. Check the old grease. If it appears rusty, gritty, or burned, replace the U-joint assembly. For instructions, see **Group 41** of the *Recreational Vehicle*

*Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

6. Wipe any excess grease from the seals and grease fittings.

## Slip-Joint Spline Lubricating

1. Wipe all old grease and dirt from the slip-joint grease fitting.
2. Use a hand-type grease gun or a high-pressure gun with a low-pressure adaptor, to lubricate the slip-joint. Using lithium 12-hydroxy stearate grease (NLGI grade 1 or 2, with EP additives), lubricate until fresh grease appears at the pressure-relief hole in the yoke plug. Then cover the relief hole with your finger, as shown in [Fig. 1](#), while continuing to lubricate until fresh grease appears at the slip-joint seal. This ensures complete lubrication of the splines.
3. Wipe any excess grease from the pressure-relief hole, slip-joint seal, and grease fitting.

<b>Title of Maintenance Operation (MOP)</b>	<b>MOP Number</b>
Air Dryer Desiccant and Coalescent Filter Replacing . . . . .	42-03
Air Dryer Inspecting . . . . .	42-02
Bendix Hydro-Max® Brake System Inspecting (front-engine diesel chassis). . . . .	42-07
Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis). . . . .	42-08
Brake Inspecting . . . . .	42-11
Brake Lines Checking, Hydraulic Disc or Air Brakes. . . . .	42-09
Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine diesel chassis). . . . .	42-10
Brake System Valves Inspecting . . . . .	42-01
Camshaft Bracket Bushing Lubricating . . . . .	42-04
Foot Brake Valve Actuator Lubricating . . . . .	42-06
Meritor Roller Pin Lubricating . . . . .	42-12
Slack Adjuster Lubricating . . . . .	42-05

## 42-01 Brake System Valves Inspecting

1. Clean the valves exterior and inspect them for corrosion and damage.
2. Inspect the air lines connected to the valves for signs of wear or damage. Replace the lines as needed.
3. Check the valves for leakage.
  - 3.1 Apply the service brakes and hold them on a full line pressure of at least 80 psi (552 kPa).
  - 3.2 Check the air line fittings for leaks; tighten or replace the fittings as needed.
  - 3.3 Coat the exhaust port and body of the valves with soapy water, and check for leakage. Leakage is excessive if it produces a 1-inch (25-mm) bubble within 5 seconds.

If a brake valve does not function as described above, or if leakage is excessive, replace it with a new or remanufactured unit. Repeat the leakage checks before placing the vehicle in service.

## 42-02 Air Dryer Inspecting

1. Check the reservoirs for moisture by pulling the lanyards. A small amount (a teaspoon or less) is normal. Larger amounts may mean that the desiccant needs to be replaced. Check the mounting and connecting lines.
2. Tighten the fasteners that attach the air dryer to the vehicle. Use the following torque values.

28 lbf·ft (38 N·m) for SAE grade 5, 3/8–16 fasteners.

135 lbf·ft (183 N·m) for SAE grade 5, 5/8–11 fasteners.

Check all air lines, fittings, and electrical connections for damage, leakage, or looseness.
3. Replace damaged or leaking parts, and tighten loose fittings or electrical connections.

## 42-03 Air Dryer Desiccant and Coalescent Filter Replacing

NOTE: Desiccant change intervals may vary from vehicle to vehicle. Typical desiccant cartridge life is three years. However, if experience has shown that extended or shortened life has resulted on a particular installation, then the interval can be increased or decreased accordingly.

### Bendix AD-9 Replacement

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).
  3. Loosen the desiccant cartridge with a strap wrench at the base of the cartridge. Spin off the cartridge and discard it.
  4. Remove the O-ring from the threaded neck and discard it.
  5. Remove the coalescent filter and discard it.
- IMPORTANT: Lubricate the new O-rings prior to installation.
6. Install the new small O-ring in the groove on the bottom of the new coalescent filter.
  7. Insert the coalescent filter with the O-ring end going into the air dryer opening first. The end of the filter with the "X" will then be facing out.
  8. Install the other new O-ring over the threaded neck of the desiccant cartridge.
  9. Screw on the desiccant cartridge until resistance is detected. Then, tighten the cartridge 1/4 to 3/4 of a turn by hand.

### Operational Check

1. Start the engine and build air pressure to 120 psi (827 kPa).
2. Listen for the purge valve to open and release air. A large volume of air will be expelled, fol-



lowed by a slow flow of air lasting approximately 30 seconds.

3. Shut down the engine and remove the chocks from the tires.
4. Perform the inspections in **Maintenance Operation 42–02**.

## Haldex PURest<sup>1</sup>

NOTE: The PURest cartridge contains both the desiccant and filter in one piece.

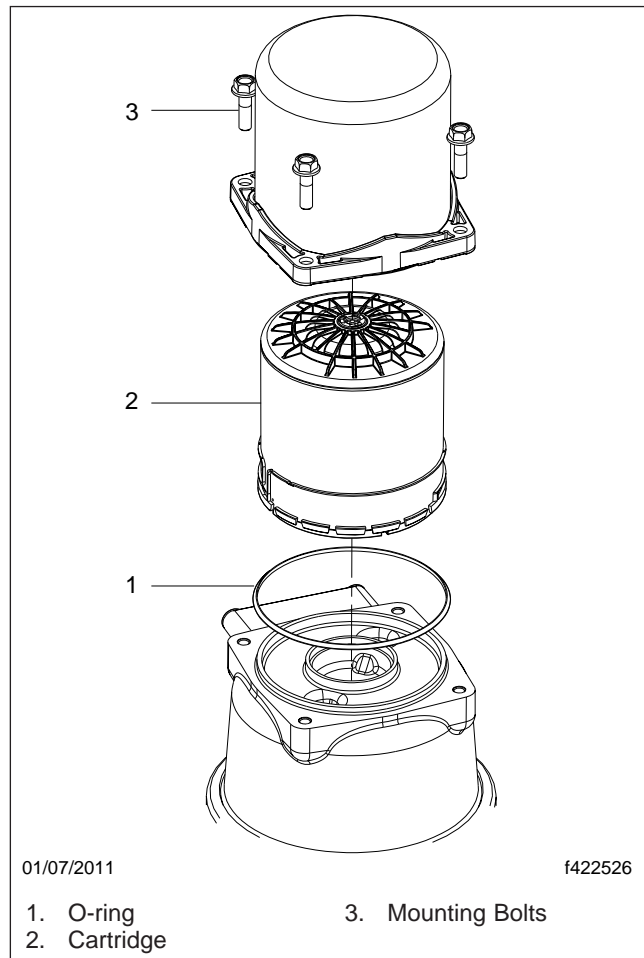
### Replacement

1. Remove the four mounting bolts and discard. See **Fig. 1**. Lift the canister about 1/2 inch and remove.
2. Place the assembly upside-down as shown in **Fig. 2**. Press the cartridge down to compress the rubber spring then rotate counterclockwise 45 degrees to release the cartridge. The cartridge itself contains no hazardous material, but there may be a small amount of oil from the compressor.
3. Clean the inside of the canister and aluminum housing.
4. Remove the cartridge O-ring and discard.
5. Remove the new cartridge from the kit and make certain the rubber spring is attached. See **Fig. 3**.
6. Install the new cartridge into the canister. Align the slots on the cartridge with the dimples inside the canister. Press the cartridge into the canister and rotate clockwise 45 degrees to engage the cartridge, as shown in **Fig. 4**.
7. Place a new O-ring on the aluminum housing.
8. Place the cartridge assembly on the air dryer housing and install four new mounting bolts. Use an alternating diagonal pattern and tighten the bolts 35 to 40 lbf·ft (47 to 54 N·m).

### Operational Check

1. Start the engine and build air pressure to 100 psi (690 kPa) and shut-off the engine.
2. Check for air leaks at the inlet, outlet, and canister assembly. Correct any leakage problem.

<sup>1</sup>Information in this section is provided by Haldex and is used with permission.



**Fig. 1, PURest Air Dryer Assembly**

3. Restart the engine and build-up pressure to cut-out pressure. At cut-out pressure, the air dryer purge valve opens and immediately expels a large volume of air, followed by a slow flow of air lasting approximately 30 seconds.

## 42–04 Camshaft Bracket Bushing Lubricating

Pump grease into the camshaft bracket bushing until it appears at the slack adjuster end of the bracket. See **Fig. 5**.

Use an NLGI Grade 1 or Grade 2 multipurpose chassis grease. If grease leaks out from under the cam head, the camshaft bracket grease seal is worn or damaged. For grease seal replacement instructions,

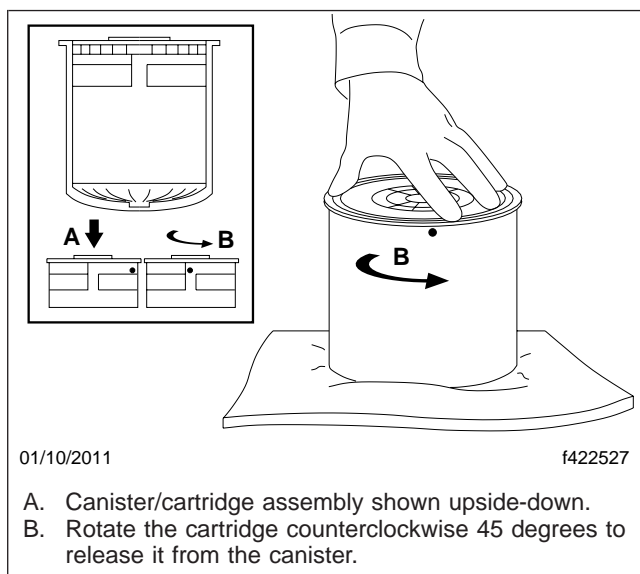


Fig. 2, Releasing the Cartridge

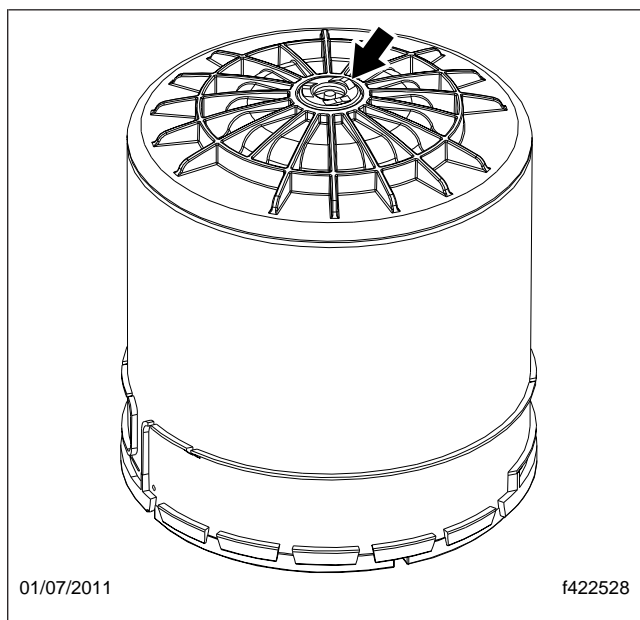


Fig. 3, New Cartridge with Rubber Spring

see **Group 42** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

Camshaft brackets without grease fittings are fitted with special seals and packed with extended-lubrication-interval chassis grease. Grease them only when the camshaft is disassembled for servicing.

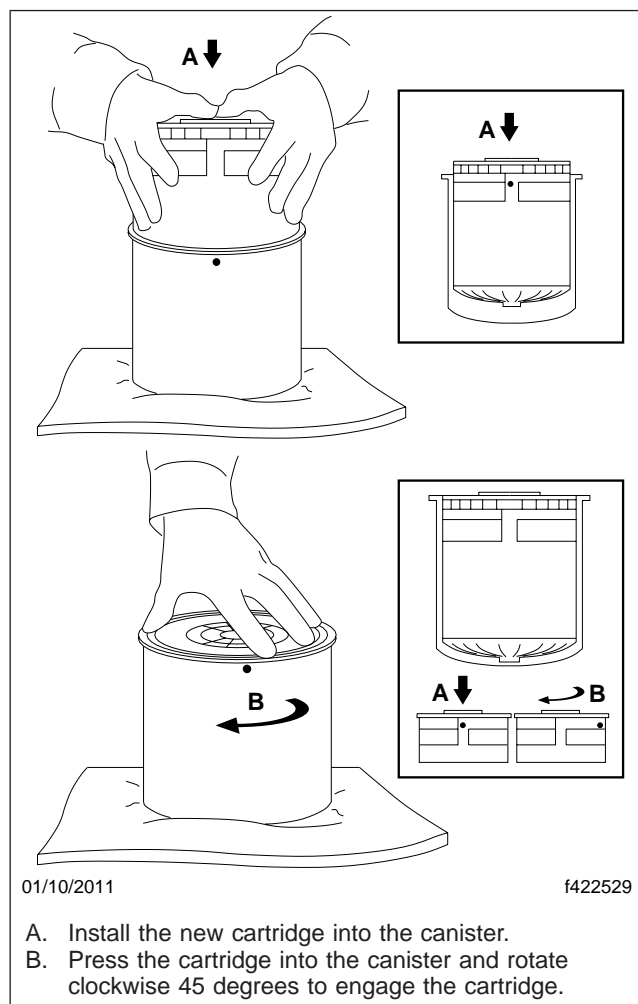


Fig. 4, Cartridge Rotation and Engagement

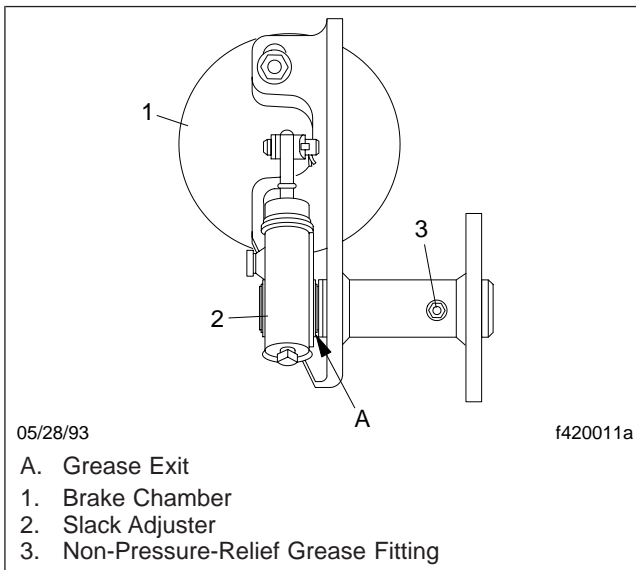
## 42-05 Slack Adjuster Lubricating

**IMPORTANT:** Perform **Maintenance Operation 42-11** before lubricating the slack adjusters.

Automatic slack adjusters must be lubricated periodically to ensure proper brake operation.

### **WARNING**

**Failure to lubricate slack adjusters could lead to dragging brakes or a brake failure, resulting in property damage, personal injury, or death.**



**Fig. 5, Camshaft Bracket Bushing Lubrication**

## Haldex

### NOTICE

**Do not use moly-disulfide-loaded grease or oil. Both the life and reliability of the slack adjuster will be reduced if this type of grease is used.**

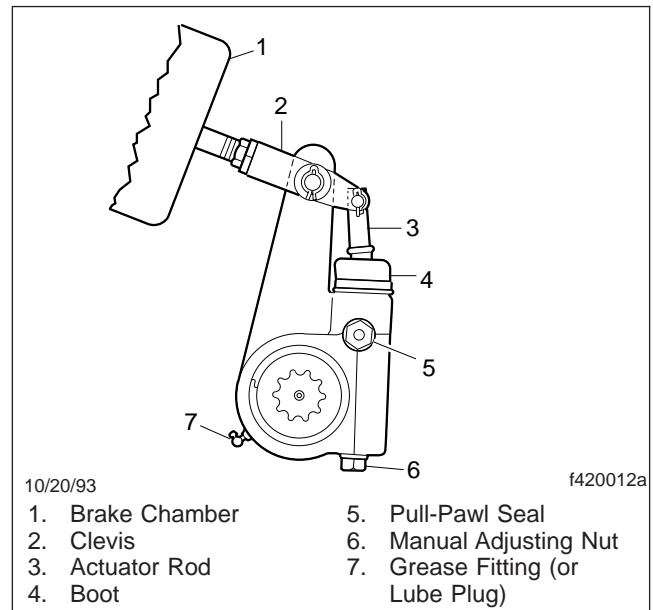
Lubricate a Haldex automatic slack adjuster at the grease fitting with any extreme-pressure NLGI Grade 1 or Grade 2 grease if the operating temperature is  $-20^{\circ}\text{F}$  ( $-29^{\circ}\text{C}$ ) and above. If the operating temperature is below  $-20^{\circ}\text{F}$  ( $-29^{\circ}\text{C}$ ), use a low-temperature extreme-pressure grease.

## Meritor

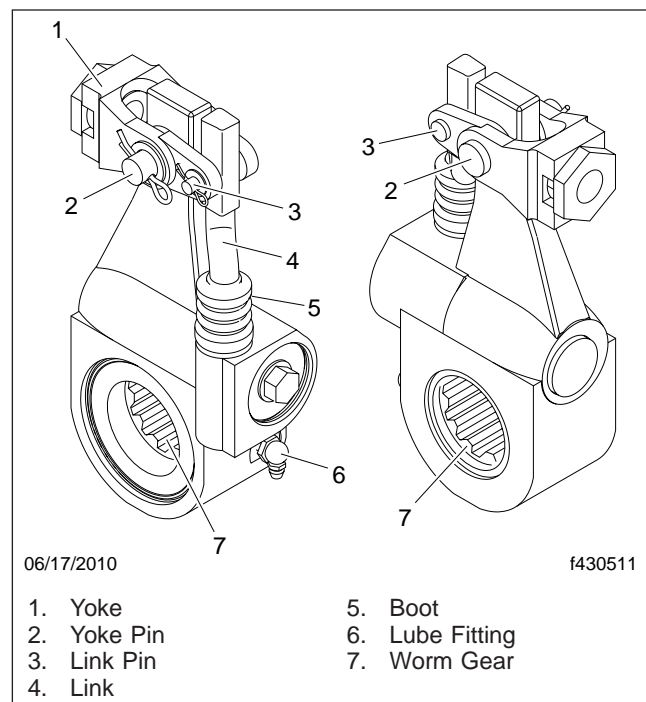
Lubricate the slack adjuster at the grease fitting until grease is forced past the pressure-relief capscrew or past the gear splines around the inboard snap ring. Use high-temperature, NLGI Grade 1 waterproof grease. See [Fig. 6](#).

## Bendix

Using a quality multipurpose chassis lubricant, NLGI Grade 2, lubricate the automatic slack adjuster through the lube fitting. See [Fig. 7](#). Lubricate the slack adjuster until clean lubricant flows from the grease relief opening in the boot.



**Fig. 6, Meritor Automatic Slack Adjuster (other slack adjusters are similar)**



**Fig. 7, Bendix Automatic Slack Adjuster**

## 42–06 Foot Brake Valve Actuator Lubricating

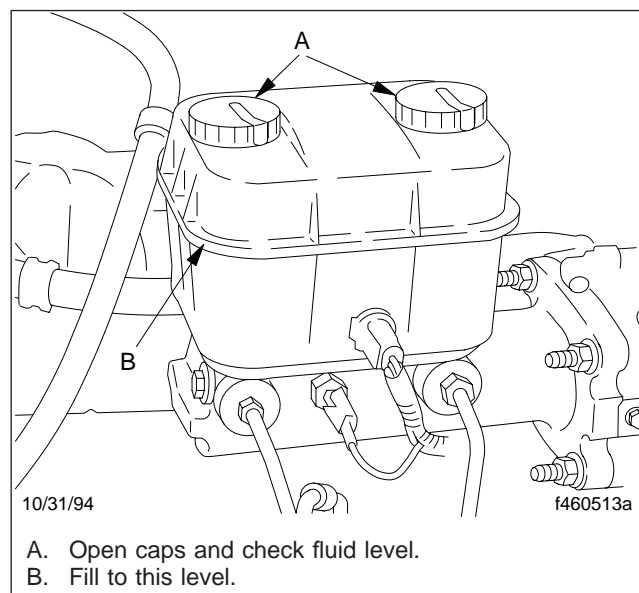
1. Clean any dirt, gravel, and other foreign material from the base of the brake pedal, the plunger boot, and the brake base bracket.
2. Use light oil to lubricate the brake pedal roller and pivot pin.
3. Check the brake plunger boot for cracks, holes, or deterioration. Replace it if necessary.
4. Lift the edge of the brake plunger boot and check the plunger for existing lubrication.
  - 4.1 If the plunger is dry, remove it by removing the brake pedal and brake plunger boot. Lubricate the plunger and the inside surface of the boot with barium grease (p/n BW 246671) or Pennzoil Adhezoplex EP2. Install the plunger, boot, and the brake pedal.

**IMPORTANT:** Use only these approved lubricants.

- 4.2 If the plunger has grease on it, lift the edge of the brake plunger boot enough to apply 2 to 4 drops of light oil around the brake plunger, where it slides into the brake base bracket. Install the plunger boot around the brake base bracket.

## 42–07 Bendix Hydro-Max® Brake System Inspecting (front-engine diesel chassis)

1. Check the fluid level in the hydraulic brake fluid reservoir. If needed, fill the reservoir up to the ridge that surrounds the reservoir. See [Fig. 8](#). Use only heavy-duty brake fluid, DOT 3.
2. Check all hydraulic lines and fittings for damage, leakage, or looseness.  
Replace damaged or leaking components, and tighten loose fittings.
3. Check the brake module for leaks. If leaks are found, repair or replace the brake module. See **Group 42** of the *Recreational Vehicle Chassis Workshop Manual* for replacement instructions,



**Fig. 8, Hydraulic Brake Fluid Reservoir**

or take the vehicle to an authorized Freightliner Chassis dealer.

4. Check the electrical connections and harnesses. Make sure the connectors are fully seated and the harnesses are not chafed or cut. Repair or replace any damaged harness. Disconnect any loose connectors and inspect the terminals for corrosion. If corrosion is present, replace the terminals. If corrosion is not present, reconnect the connector.
5. Check the fuse for the hydraulic brake booster pump, as follows.
  - 5.1 Open the cover to the main power distribution module (PDM).
  - 5.2 Pull the fuse in position F6 for the Hydro-Max relay.
  - 5.3 Inspect the relay to make sure the fuse is not damaged. If the fuse is damaged, install a new fuse. If the fuse is not damaged, install the fuse in position F6.
  - 5.4 Close the PDM cover.
6. Check the operation of the Hydro-Max brake booster, as follows.
  - 6.1 With the ignition off, depress the brake pedal and listen for the back-up motor to

engage. Also note that the pedal force relieves; the pedal should depress easily.

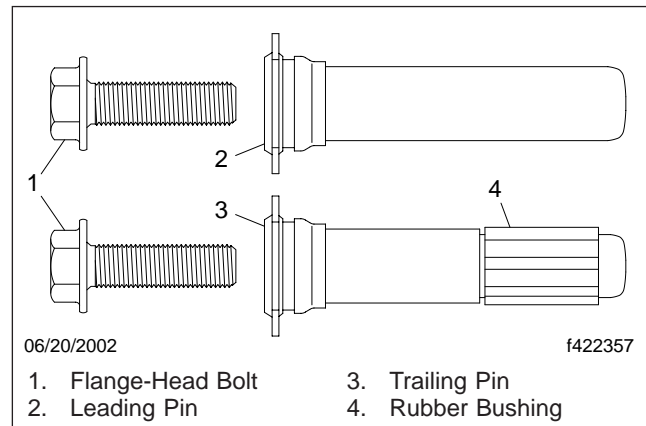
- 6.2 With the ignition on, engine running, parking brake released, ensure that the BRAKE warning indicator light is **not** on. This is a dual indicator and indicates that the parking brake is set, and warns if there is a hydro-max failure other than loss of back-up motor power.

## 42-08 Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)

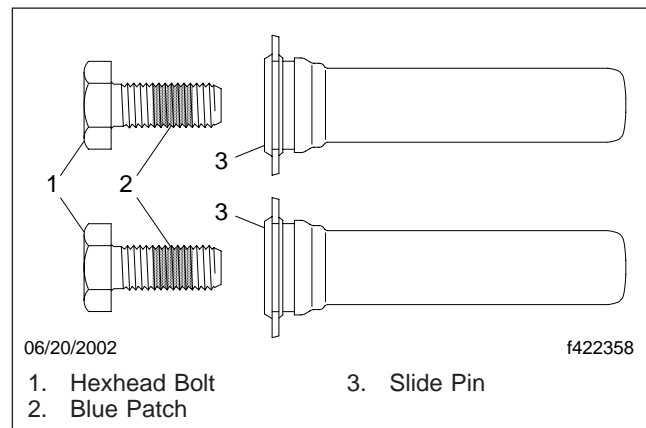
**NOTE:** There is no set maintenance interval for lubricating pin-slide hydraulic disc brake calipers.

Apply 1/8 oz (3.5 g) Aeroshell grade 5 grease to each of the two guide pin and guide pin bore sets. See the *Bosch Pin Slide Disc Brakes Service Manual* for additional information.

**IMPORTANT:** The later ZOH-T caliper has important differences from the early ZOPS caliper. ZOPS calipers (since 1998) and ZOH-T calipers (since 2002) use different slide pins and bolts. See **Fig. 9** and **Fig. 10**. The later trailing pin is identified by notches and has a rubber bushing. Flange-head instead of hexhead bolts are used with the later caliper. The later bolts have a fine thread rather than a coarse thread pitch, are longer, differently colored, and are tightened to a higher torque specification. Use only the ZOH-T bolts to assemble a ZOH-T caliper. The ZOPS caliper bolts have a different thread pitch and will not assemble correctly in a ZOH-T caliper mounting. Also, the ZOH-T bolts will not assemble correctly in a ZOPS caliper. **Do not interchange parts.** It is permissible to use both ZOH-T pins and ZOH-T bolts in a ZOPS anchor plate, but they must be replaced as sets. Both the pins and the bolts must be changed.



**Fig. 9, ZOH-T Slide Pins and Bolts**



**Fig. 10, ZOPS Slide Pins and Bolts**

### **! DANGER**

**The correct pins, bolts, and bolt torque must be used. If not, brake function could be impaired and lead to loss of control of the vehicle, which could result in personal injury, death, or property damage.**

**IMPORTANT:** The ZOH-T caliper assembly is similar in appearance to the existing ZOPS caliper. The only obvious difference is that one of the anchor plate slide pins (trailing side) has notches for identification. With ZOH-T calipers, install the solid pin (no bushing) only in the anchor plate leading hole position. Install the pin with the rubber bushing and notches only in the

anchor plate trailing hole position. Tighten the leading-side pin first, then tighten the trailing-side pin.

Tighten ZOH-T bolts 93 to 107 lbf-ft (126 to 145 N·m).

Tighten ZOPS bolts 70 to 80 lbf-ft (95 to 108 N·m).

## 42-09 Brake Lines Checking, Hydraulic Disc or Air Brakes

Check all hydraulic/air lines and fittings for damage, leakage, or looseness.

Replace damaged or leaking components, and tighten loose fittings.

## 42-10 Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine diesel chassis)

Before checking lining wear with the wheel removed, review the following brake lining exposure warnings.

### WARNING

**Breathing brake lining dust (asbestos or non-asbestos) could cause lung cancer or lung disease. Unless exposure can be reduced below legal limits, wear an air purifying respirator approved by MSHA or NIOSH at all times when servicing the brakes, starting with removal of the wheels and continuing through assembly.**

To minimize the possibility of creating airborne brake lining dust, clean the dust from the brake rotor, brake caliper, and brake assembly, using an industrial-type vacuum cleaner equipped with a high-efficiency filter system. Then, using a rag soaked in water and wrung until nearly dry, remove any remaining dust. Do not use compressed air or dry brushing to clean the brake assembly.

1. Apply the brake and chock the tires to prevent vehicle movement.

2. Check the brake lining wear. On front and rear axles, replace linings worn to less than 3/16 inch (4.8 mm).
3. Make sure that the brake rotor and linings are free of oil and grease.

NOTE: To replace the brake linings, see the applicable foundation brake section in **Group 42** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

## 42-11 Brake Inspecting

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

### Parking Brake Operational Check

#### 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 *Recreational Vehicle Chassis Workshop Manual* for repair procedures, or take the vehicle to an authorized Freightliner dealer.

## 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 *Recreational Vehicle Chassis Workshop Manual* for inspection, troubleshooting, and repair procedures, or take the vehicle to an authorized Freightliner dealer.

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 *Recreational Vehicle Chassis Workshop Manual* for inspection and troubleshooting procedures, or take the vehicle to an authorized Freightliner dealer.

5. Start the engine and build air pressure to at least 100 psi (689 kPa). Shut down the engine.
6. Check all of the foundation brake components for damage, wear, and loose or missing parts. Repair as needed. See **Group 42** of the *Recreational Vehicle Chassis Workshop Manual* for repair procedures, or take the vehicle to an authorized Freightliner dealer.

## 42–12 Meritor Roller Pin Lubricating

### **WARNING**

**Remove all grease or oil from the camshaft head, rollers and brake linings. Always replace linings contaminated with grease or oil, which can increase stopping distances, causing component damage and serious personal injury.**

For Q and P series Meritor brakes, lube the cam anchor and cam roller pins when the brake is disassembled, or every six months, with Meritor specification grease 0-617-A or 0-617-B. See **Fig. 11** for roller and anchor pin lubrication points.

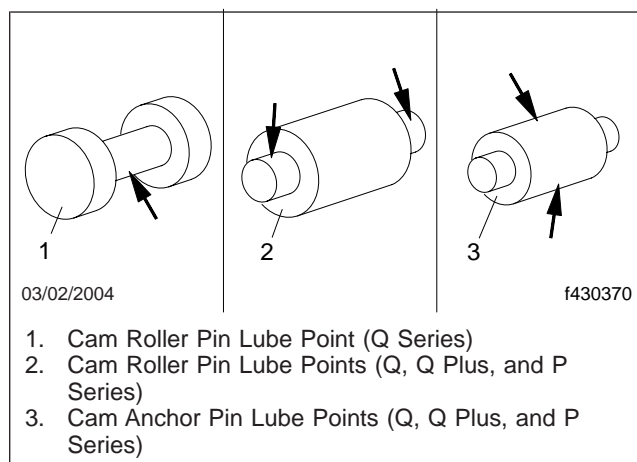
Brake Chamber Stroke Specifications			
Chamber			Max Applied Stroke: inch (mm)
Manufacturer	Type*	Size†	
Haldex	Standard Stroke	12	1-3/8 (35)
		16	1-3/4 (44)
		20	
		24	
	2-1/2-Inch Extended Stroke	24	2 (51)
	3-Inch Extended Stroke	24	2-1/2 (64)
	Standard Stroke	30	2 (51)
	Long Stroke	30	2-1/2 (64)

Brake Chamber Stroke Specifications			
Chamber			Max Applied Stroke: inch (mm)
Manufacturer	Type*	Size†	
Meritor	Standard Stroke	9	Less than 1-1/2 (38)
		12	
		16	Less than 1-3/4 (44)
		20	
		24	Less than 1-7/8 (48)
	Long Stroke	24	Less than 2 (51)
	Standard Stroke	30	

\* Long stroke design is indicated by a tag, or embossing, on the brake chamber.

† Specifications are relative to a brake application with 80 to 90 psi (550 to 620 kPa) air pressure in the brake chambers.

**Table 1, Brake Chamber Stroke Specifications**



**Fig. 11, Cam and Anchor Roller Pin Lubrication Points**



<b>Title of Maintenance Operation (MOP)</b>	<b>MOP Number</b>
Drag Link Lubricating . . . . .	46-01
Hydraulic Reservoir Filter Changing (metal reservoir only) . . . . .	46-06
Power Steering Reservoir Fluid Level Checking . . . . .	46-02
Power Steering Reservoir Fluid and Filter Changing . . . . .	46-03
Steering Driveline Lubricating . . . . .	46-04
Steering Gear Lubricating . . . . .	46-05

## 46-01 Drag Link Lubricating

1. Using a clean rag, wipe the dirt from both grease fittings on the drag link.
2. Using a pressure gun, apply multipurpose chassis grease at the grease fittings until old grease is forced out of the socket.

**NOTE:** Use multipurpose chassis grease NLGI grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI grade 2 (8% 12-hydroxy lithium stearate grease). The grade 2 chassis grease is preferred.

## 46-02 Power Steering Reservoir Fluid Level Checking

### Side-Mounted

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the rear tires.
2. Clean around the power steering reservoir dipstick (fill cap) with a clean rag, then remove the dipstick.



### WARNING

Fill only with approved clean fluid. Do not mix fluid types. Any mixture or any unapproved fluid could lead to seal deterioration and leaks. Fluid leakage could cause loss of power steering assist, possibly resulting in personal injury and property damage.

3. With the power steering fluid at operating temperature, check the fluid level on the dipstick. If below the "Add" mark, add enough fluid to bring the level up to the "Full" mark on the dipstick. See [Table 1](#) for approved power steering fluid.

Approved Power Steering Fluid	
Fluid Type	Approved Fluid*
Automatic Transmission Fluid	Dexron® III

Approved Power Steering Fluid	
Fluid Type	Approved Fluid*
Hydraulic System Fluid (power steering with side-mounted radiator)	15W40

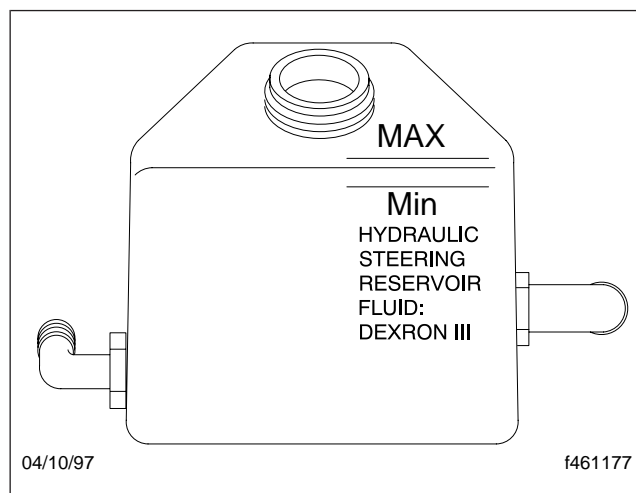
\* Use the same lubricant when assembling parts as is used in the power steering system.

**Table 1, Approved Power Steering Fluid**

4. Install the dipstick (fill cap) in the power steering reservoir.

### Rear-Mounted

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the rear tires.
2. Clean around the power steering reservoir cap with a clean rag, then remove the reservoir cap. See [Fig. 1](#).



**Fig. 1, Steering System Hydraulic Fluid Reservoir (rear-mounted)**



### WARNING

Fill only with approved clean fluid. Do not mix fluid types. Any mixture or any unapproved fluid could lead to seal deterioration and leaks. Fluid leakage could cause loss of power steering assist, possibly resulting in personal injury and property damage.

**IMPORTANT:** Do not confuse coolant with hydraulic fluid. Both are pink in color.

3. Fill the reservoir to a level between the MIN and MAX marks. Use only Dexron III automatic transmission fluid (ATF), or an equivalent. See [Table 1](#) for approved power steering fluid.
4. Replace the reservoir cap.

## 46-03 Power Steering Reservoir Fluid and Filter Changing

1. Remove the dipstick, if so equipped.
2. Drain the power steering reservoir by disconnecting the power steering gear-to-reservoir hose from the reservoir. Catch the fluid from the reservoir in a drain bucket, then cap the reservoir port.
3. Loosen the clamps on each end of the inline power steering filter and save them for reuse. Remove the old filter, if so equipped.

**IMPORTANT:** Do not use teflon tape on the threads of the hose-barb fittings.

4. Unscrew the hose-barb fitting and the 90-degree hose-barb elbow fitting from the old filter and inspect them for any damage. If no damage is found, screw the two fittings into the new 25-micron filter. If damage is found in the fittings, replace them with a new 1/2-14 NPT hose-barb fitting and elbow.

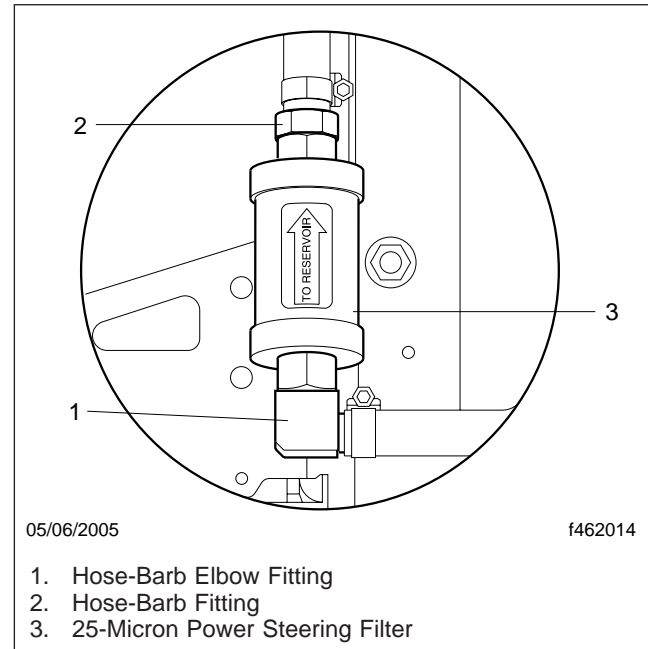
**IMPORTANT:** Ensure that the "TO RESERVOIR" arrow on the power steering filter, if so equipped, is pointing towards the power steering fluid reservoir and that the hose-barb 90-degree elbow fitting is located on the bottom of the power steering filter. See [Fig. 2](#).

5. Place the ends of the power steering gear-to-reservoir hose onto the hose-barb fittings and tighten the two hose clamps securely.

### **WARNING**

**Fill only with approved clean fluid. Do not mix fluid types. Any mixture or any unapproved fluid could lead to seal deterioration and leaks. Fluid leakage could cause loss of power steering assist, possibly resulting in personal injury and property damage.**

6. Fill the reservoir with approved power steering fluid. See [Table 1](#).



**Fig. 2, Power Steering Filter, Typical Installation (if so equipped)**

7. Place the disconnected end of the steering gear-to-reservoir hose in a drain bucket. *Do not start the engine while draining the system.* Raise the front of the vehicle with a floor jack and support it with jack stands. Have an assistant turn the steering wheel to full lock left and right, and capture the fluid flowing from the hose in the drain bucket. Add fluid to the reservoir as needed. Continue turning the steering wheel until clean power steering fluid flows from the hose into the drain bucket. Remove the plug from the reservoir and reconnect the steering gear-to-reservoir hose to the reservoir.
8. Tighten the hose fitting nut finger-tight, then with a wrench, tighten until there is firm resistance. Tighten one-sixth turn more. Do not overtighten. Remove the jack stands and lower the vehicle.
9. Fill the reservoir with approved fluid as needed. Start the engine and let it idle for 10 seconds. Have an assistant turn the steering wheel from lock-to-lock until no bubbles are seen in the reservoir. Shut down the engine.

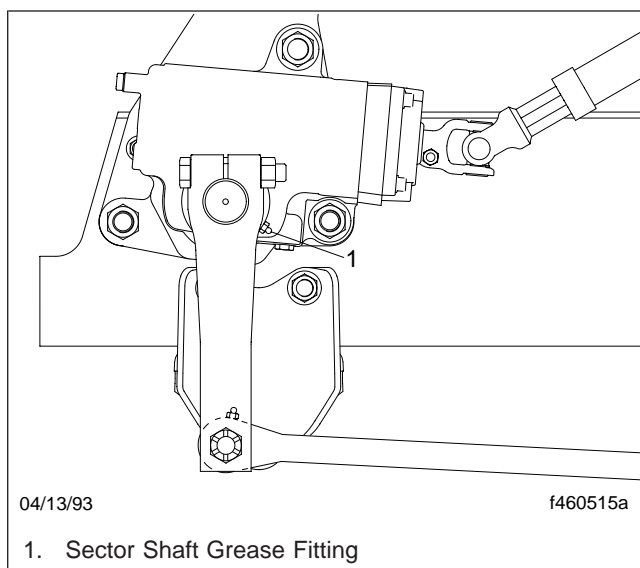
10. Install a new cover gasket, the cover, and the dipstick.
11. Start the engine and check the power steering reservoir fluid level. If the fluid level is low, add more of the approved fluid to bring the level up to the full mark on the dipstick. Turn the steering wheel from lock-to-lock to flush out any air. Shut down the engine.

### 46-04 Steering Driveline Lubricating

Wipe the grease fittings clean. Using a pressure gun, apply a lithium-based grease (NLGI grade 2) sparingly to the universal joints and slip-joint splines.

### 46-05 Steering Gear Lubricating

1. Wipe off debris from the grease fitting.
2. Using a hand-type grease gun, apply multipurpose chassis grease until the grease starts coming out of the sector shaft dirt and water seal. **Figure 3** shows the location of the sector shaft grease fitting.



**Fig. 3, Sector Shaft Lubricating**

### 46-06 Hydraulic Reservoir Filter Changing (metal reservoir only)

**NOTE:** On XC chassis vehicles with a side-mounted radiator, the hydraulic reservoir supplies both the steering and the fan circuits.

1. Drain the entire steering and fan hydraulic systems.
2. Remove the reservoir lid and remove the nut that secures the filter.
3. Remove the old filter and install the new filter.
4. Install the filter nut and tighten it securely.
5. Fill the reservoir with the approved hydraulic fluid. See [Table 1](#).
6. Start the engine, run it for five seconds, then shut down the engine.
7. Fill the reservoir with 15W40 hydraulic system fluid.
8. Start the engine. Turn the steering wheel lock-to-lock several times until the steering wheel turns easily. Shut down the engine.
9. Fill the reservoir with 15W40 hydraulic system fluid.

**NOTE:** The steering circuit is now purged. Follow the remaining steps to purge the fan circuit.

10. Start the engine. Run the engine at half-throttle until the fans engage (loud chirping sound). Shut down the engine.
11. The fan circuit is now purged. Top off the reservoir fluid and install the reservoir lid.

Title of Maintenance Operation (MOP)	MOP Number
Fuel Tank Mounts and Fuel Line Checking . . . . .	47-01
Fuel/Water Separator Element Replacing . . . . .	47-02

## 47-01 Fuel Tank Mounts and Fuel Line Checking



### WARNING

Inspect the components as described below. Failure to perform these inspections could result in the failure of the fuel tank mounting assembly and loss of vehicle control, possibly causing personal injury or death, or property damage.

1. Chock the tires. Working at the front of the vehicle or at the rear of the vehicle, raise the vehicle so that the tires just clear the ground and so that the suspension is fully extended. Place safety stands under the vehicle frame.
2. Check the T-bolts that attach the fuel tank mounting straps to the mounting brackets. Check to see that the nuts are tight.
3. Inspect the fuel tank straps for damage or wear. Replace them if necessary.
4. Inspect the fuel tank for leaks or damage. Replace the tank if necessary.

**IMPORTANT:** Do not attempt to repair a damaged fuel tank; always replace a damaged fuel tank.

5. Inspect the fuel lines for damage or wear.
6. Remove the safety stands and lower the vehicle. Remove the chocks from the tires.

## 47-02 Fuel/Water Separator Element Replacing

1. Chock the front tires.
2. Locate the fuel/water separator.
3. See the *Cummins Operation and Maintenance Manual* for fuel/water separator element replacing intervals.
4. Remove the chocks from the tires.

**Title of Maintenance Operation (MOP)****MOP Number**

Exhaust System Inspecting (Noise Emission Control). . . . . 49-01

## 49–01 Exhaust System Inspecting (Noise Emission Control)

The exhaust system must be free of leaks, binding, grounding, and excessive vibrations. In addition to inspecting the exhaust system at the scheduled maintenance interval, inspect the exhaust system if the noise level of the vehicle has increased. Replace parts that show leakage, wear, or damage, with genuine Freightliner parts.

These conditions are usually caused by loose, broken, or misaligned clamps, brackets, or pipes. If any of these conditions exist, check the exhaust system components and alignment. Align or replace as necessary. For alignment or adjustment instructions, see **Group 49** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

### EPA10 Exhaust System

#### Definitions of Aftertreatment System (ATS) Terms

Refer to the following list of definitions of ATS terms and components.

- Aftertreatment System (ATS)—the entire exhaust system from the turbocharger to the tail pipe, including the Selective Catalytic Reduction (SCR) components.
- Aftertreatment Device (ATD)—a device that removes pollutants from exhaust gas after the gas leaves the combustion chamber.
- BlueTec®—Daimler's proprietary SCR technology.
- Diesel Oxidation Catalyst (DOC)—a flow-through device that enhances the oxidation of hydrocarbons in the ATD.
- Diesel Particulate Filter (DPF)—a component in the ATD that traps particulate matter from the exhaust gas.
- Diesel Exhaust Fluid (DEF)—the chemical agent that reacts with the exhaust gases in the SCR to reduce NOx.
- DEF Pump—filters and supplies DEF to the DEF metering unit.

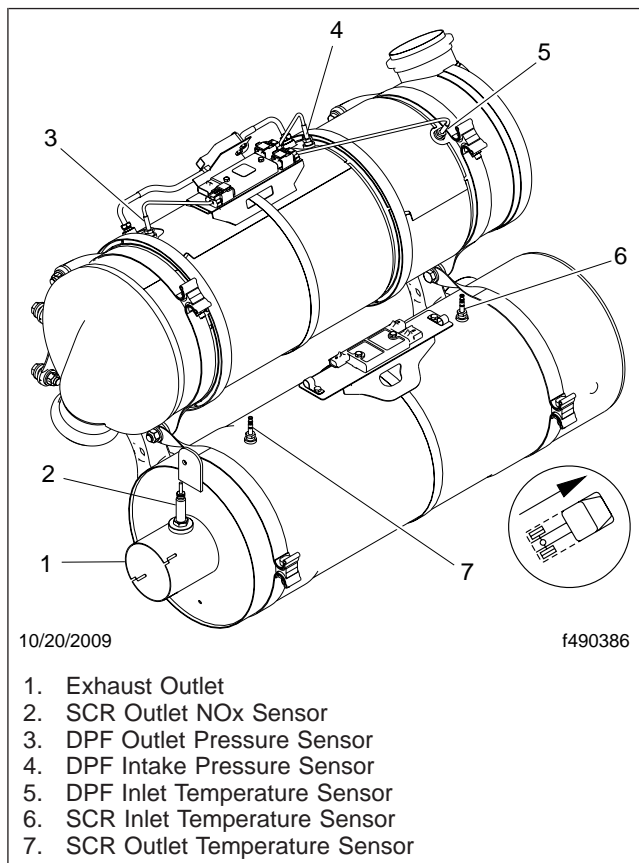
- DEF Tank—holds DEF and regulates its temperature.
- DEF Metering Unit—mixes DEF with compressed air, and meters this mixture into the exhaust flow via an injection nozzle.
- SCR Catalyst—the housing containing a treated ceramic flow-through block where the DEF and exhaust gases undergo selective catalytic reduction.
- Selective Catalytic Reduction (SCR)—a process used to reduce NOx emissions.

### Inspection

**IMPORTANT:** The Environmental Protection Agency's 2010 regulations mandate lowered exhaust emissions, thus requiring exhaust system components that reduce emissions. In particular the aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections. See **Fig. 1** for Cummins ATD sensor locations. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.
3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf-ft (41 N-m) if needed. Do not overtighten.
5. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD. No leaks are allowed anywhere in the system.





**Fig. 1, Cummins ATD Sensor Locations**

6. Check all sensors attached to the ATD for leaks or damaged wires. No leaks are allowed.
7. Check the DPF exterior surface for dents or other damage. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
8. Check the SCR catalyst for dents and other damage.
9. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.

**NOTE:** Diesel exhaust fluid creeps, causing white crystals to form around the line fittings. The presence of crystals does not mean the system has a leak. Replacing fittings or troubleshooting components is not necessary unless there is a system failure or a fault code.

10. Check the DEF tank, pump, metering unit, and lines for leaks. See **Group 49** of the *Recreational Vehicle Chassis Workshop Manual* for repair procedures.
11. Check any wires, lines, or hoses within 4 inches (10 cm) of the exhaust system for heat damage. Repair or reroute as needed.

## Diesel Exhaust Fluid (DEF) Filter Replacement

The Environmental Protection Agency's 2010 regulations require lower nitrogen oxide (NOx) exhaust emissions. Selective catalytic reduction (SCR) uses diesel exhaust fluid (DEF) to lower NOx emissions in the vehicle exhaust. A filter in the DEF pump prevents clogging of the DEF metering unit injection nozzle.

See the engine manufacturer's maintenance manual for DEF filter replacement instructions and maintenance intervals.

## EPA07 Exhaust System

### Definitions of ATS Terms

Refer to the following list of definitions of ATS terms and components.

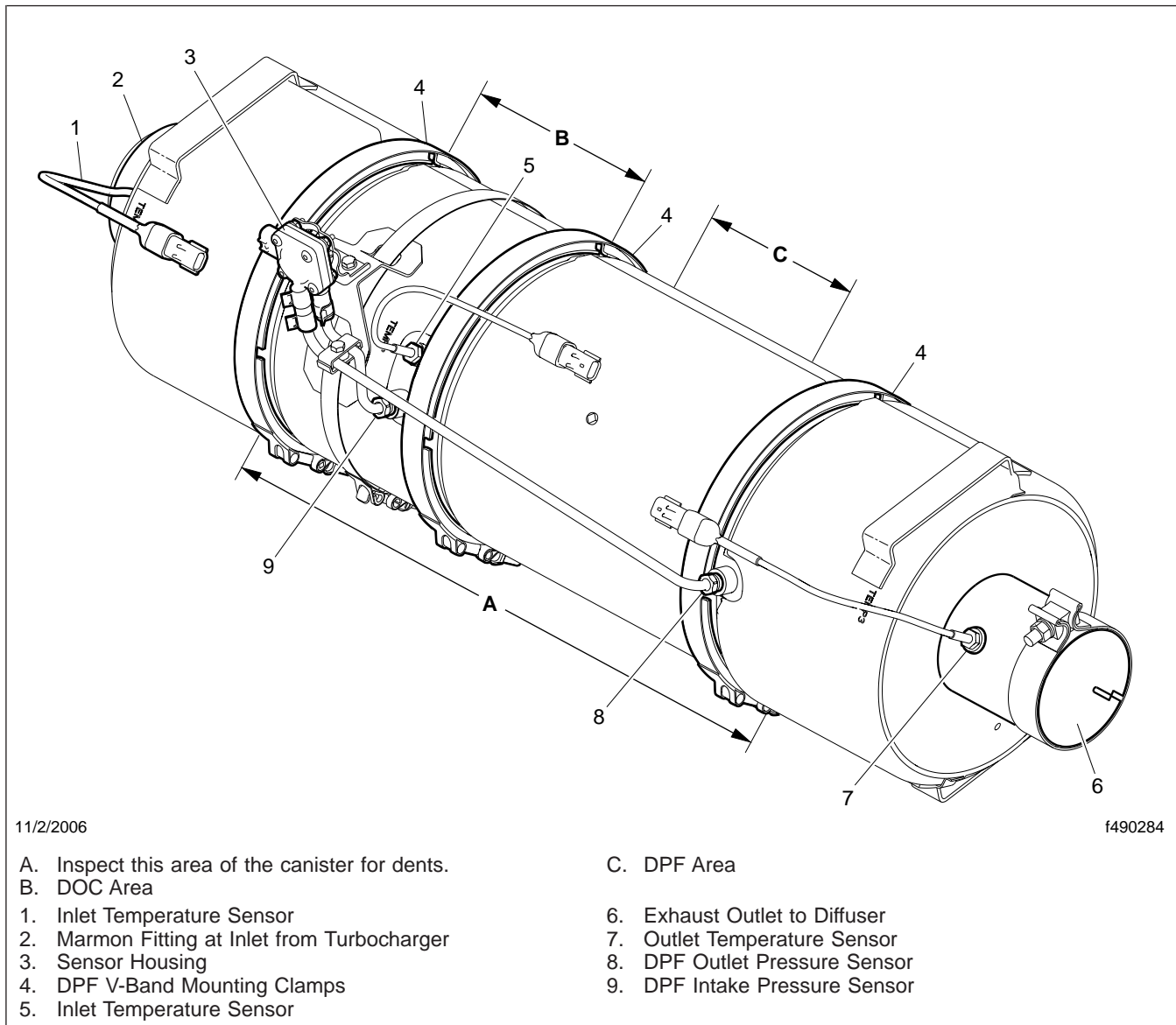
- Aftertreatment System (ATS) — the entire exhaust system from the turbocharger to the tail pipe.
- Aftertreatment Device (ATD)—a muffler-like canister that houses a DPF and sensors.
- Diesel Particulate Filter (DPF)—a filter that collects and holds particulate matter (soot and ash).
- Diesel Oxidation Catalyst (DOC)—oxidizes hydrocarbons and reduces NOx.
- Sensors—detect temperatures and pressure within the ATS.
- Diffuser—a device, used as a deflector, for distributing, mixing, and reducing the velocity of air flow.

## Inspection

**IMPORTANT:** The Environmental Protection Agency's 2007 regulations require lower exhaust emissions, thus requiring new exhaust

system components. See **Fig. 2**. In particular the aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.
3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD, as well as the exhaust wrap from the ATD to the diffuser.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.
5. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD. No leaks are allowed anywhere in the system.
6. Check all sensors attached to the ATD for leaks or damaged wires. No leaks are allowed.
7. Check the DPF exterior surface for dents or other damage. See **Fig. 2**, Item A. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
8. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.
9. Check any wires, lines, or hoses within 4 inches (10 cm) of the exhaust system for heat damage. Repair or reroute as needed.



**Fig. 2, Cummins Aftertreatment Device**

<b>Title of Maintenance Operation (MOP)</b>	<b>MOP Number</b>
Battery Voltage Checking . . . . .	54-02
Ground Cables Checking and Cleaning . . . . .	54-01

### **54–01 Ground Cables**

#### **Checking and Cleaning**

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Check that the ground cables are clean, undamaged, and tight. If needed, disconnect them, clean the mating surfaces with a soda solution, then connect them securely. Spray the ground cable connections with dielectric red enamel.

### **54–02 Battery Voltage**

#### **Checking**

---

Check the battery open circuit voltage using an accurate voltmeter. If the voltmeter registers 12.5V or below, fully charge the battery to 12.65V. A fully charged battery will have a voltage of 12.65V with the charger disconnected.

Title of Maintenance Operation (MOP)	MOP Number
Air Conditioner Inspecting. . . . .	83-01

## 83–01 Air Conditioner Inspecting



### WARNING

**Wear eye protection, gloves, and protective clothing when working on the air conditioning system. Leaking refrigerant from a damaged hose or line could cause blindness or serious skin burns.**

1. Park the vehicle on a level surface, shutdown the engine, apply the parking brake, and chock the tires.



### CAUTION

**To avoid the possibility of burns, make certain that the engine and air conditioner components are not hot.**

2. Check the appearance of the air conditioner compressor pulley assembly. If the friction surface of the pulley shows signs of excessive grooving due to belt slippage, replace both the pulley and the drive plate. Visually inspect the refrigerant compressor drive belt for damage, and check that the belt is set at the proper tension. Also check the tightness of the compressor mounting fasteners. For instructions and torque values and for removal and installation procedures, see **Group 83** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
3. Inspect the compressor clutch coil wire. Ensure that the connector is not damaged or loose. Replace the wire if it is damaged.
4. Check the overall condition of the air conditioning hoses. Look for cracks, cuts, and abrasions on the hoses. Replace damaged hoses; see **Group 83** of the *Recreational Vehicle Chassis Workshop Manual* for replacement instructions, or take the vehicle to an authorized Freightliner dealer. Also, visually check for loose fittings on all air conditioning components. Do not over-tighten the fittings.
5. Check for a buildup of road debris on the condenser fins. Using air pressure and a whisk broom or a soapy spray of water, carefully clean off the condenser. Be careful not to bend the fins.