S2 CHASSIS MAINTENANCE MANUAL

STI-479 (8/08P)

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Foreword

Performing scheduled maintenance operations is important in obtaining safe, reliable operation of your vehicle. A proper maintenance program will also help to minimize downtime and safeguard warranties.

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 *S2 Chassis Operator's Manual*. Perform the maintenance operations in this manual at scheduled intervals based on the distance the vehicle has traveled or hours of operation. Your Freightliner dealership has qualified technicians and equipment to perform this maintenance.

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 and 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.

Daimler Trucks North America LLC
Service Systems and Documentation (POC-SSD)
P.O. Box 3849
Portland, Oregon 97208-3849

Descriptions of Service Publications

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

Workshop/Service Manual

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.

Maintenance Manual

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.

Driver's/Operator's Manual

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.

Service Bulletins

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.

Parts Technical Bulletins

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.

ServicePro

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.

PartsPro

PartsPro® is an electronic parts catalog system, showing the specified vehicle's build record.

EZWiring

EZWiring™ makes Freightliner Custom Chassis Corporation, Freightliner, Sterling, Western Star, and Thomas Built Buses 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

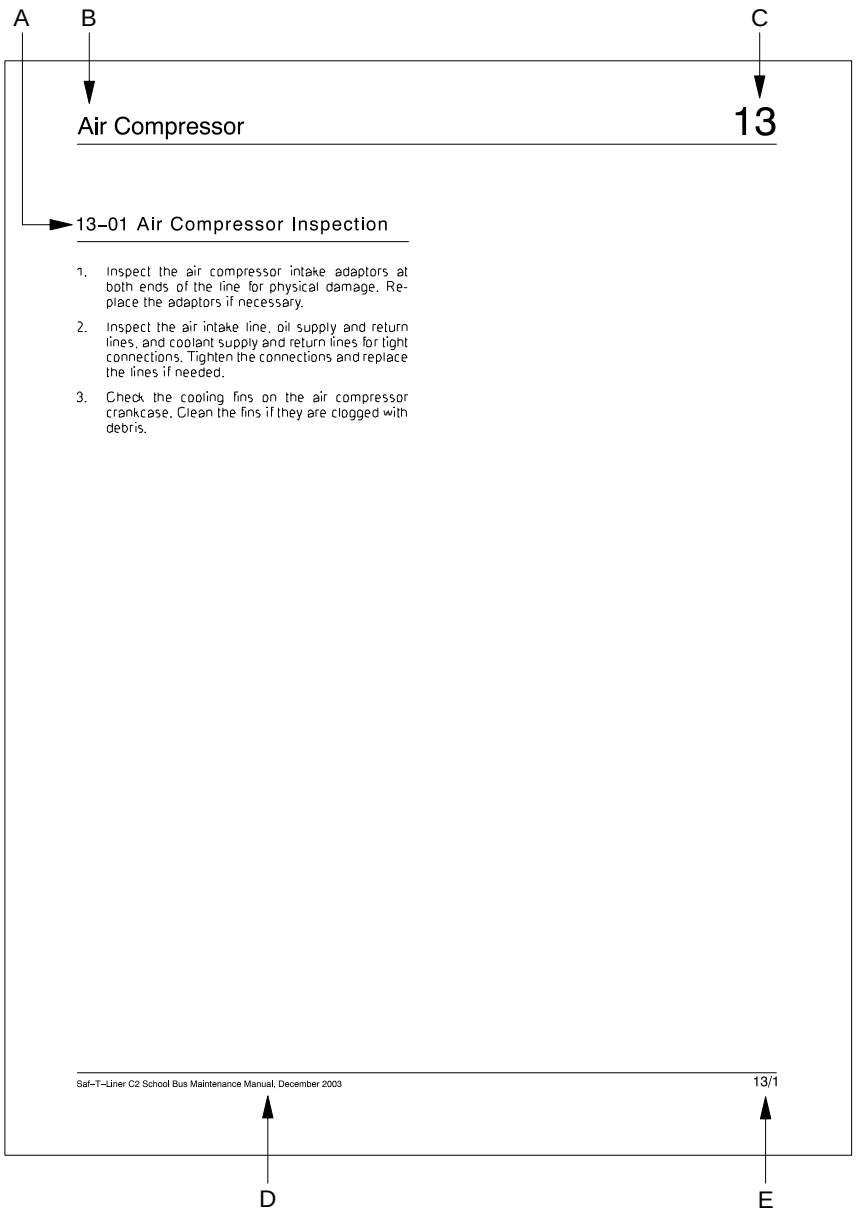
Warranty-related service information available on the AccessFreightliner.com website includes the following documentation.

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 a page example of the printed manual, see **Fig. 1**.



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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, Page Example of the Printed Manual

Maintenance Manual Contents

Index, Alphabetical

Determining Scheduled Maintenance Intervals

Performing regular maintenance will help ensure that your vehicle delivers safe, reliable service, and optimum performance. A proper maintenance program will also help to minimize downtime and safeguard warranties.

To determine the correct maintenance intervals for your vehicle, you must first determine the type of service or conditions the vehicle will be operating in. Most vehicles operate in conditions that fall within one of two schedules. Before placing your vehicle in service, determine whether schedule I or II applies to your vehicle.

Schedules I and II

Schedule I (urban transport) applies to vehicles that travel up to 20,000 miles (32 000 kilometers) annually. Examples of Schedule I usage are:

- frequent short-distance travel
- operation primarily in cities and densely populated areas
- local transport with infrequent freeway travel
- high percentage of stop-and-go travel

Schedule II (rural transport) applies to vehicles that travel over 20,000 miles (32 000 kilometers) annually. An example of Schedule II usage is:

- less frequent stop-and-go travel

Maintenance Schedules

After determining the schedule appropriate to your vehicle, refer to the **Maintenance Schedules** to determine when to perform the Initial Maintenance (IM) and the frequency of performing subsequent maintenance intervals for each schedule.

Maintenance Intervals

Refer to the **Maintenance Interval Table** to determine which maintenance interval(s) should be performed when your vehicle reaches the mileage or months of operation listed in these subjects.

Before placing your new vehicle in service, determine the maintenance schedule (Schedule I or II) that applies to your intended use of the vehicle. Once a schedule is choosen, continue using it for the life of the vehicle.

Maintenance Operations

Groups 01 through 83 in this manual have an index at the beginning of each Group. The index lists the Title of Maintenance Operations and the Maintenance Operation (MOP) Numbers for that Group. Follow the instructions under the MOP number to perform the required maintenance.

In addition to the maintenance operations required for the maintenance interval, perform all of the pre- and post-trip inspections and maintenance procedures in **Chapter 12** and **Chapter 13**, "Pre- and Post-Trip Checklists" and "Pre- and Post-Trip Inspections and Maintenance," in the *S2 Chassis Operator's Manual*.

Maintenance Schedules: 00-02

Vehicle Maintenance Schedule Table

Vehicle Maintenance Schedule Table					
Description	**Maintenance Operation Set**	**Maintenance Intervals**			
		Frequency	**Miles**	**km**	**Months**
Schedule I (Urban Transport) vehicles that annually travel up to 20,000 miles (32 000 km)	Initial Maintenance (IM)	first	2500	4000	3
	Maintenance 1 (M1)	every	2500	4000	3
	Maintenance 2 (M2)	every	10,000	16 000	12
	Maintenance 3 (M3)	every	30,000	48 000	36
Schedule II (Rural Transport) vehicles that annually travel over 20,000 miles (32 000 km)	Initial Maintenance (IM)	first	5000	8000	3
	Maintenance 1 (M1)	every	5000	8000	3
	Maintenance 2 (M2)	every	20,000	32 000	12
	Maintenance 3 (M3)	every	60,000	96 500	36

Maintenance Interval Table: 00-03

Maintenance Interval Table

Maintenance Interval Table							
Maint. No.	Maint. Oper. Set	Category I			Category II		
		Miles	km	Months	Miles	km	Months
1st	IM + M1	2500	4000	3	5000	8000	3
2nd	M1	5000	8000	6	10,000	16 000	6
3rd	M1	7500	12 000	9	15,000	24 000	9
4th	M2	10,000	16 000	12	20,000	32 000	12
5th	M1	12,500	20 000	15	25,000	40 000	15
6th	M1	15,000	24 000	18	30,000	48 000	18
7th	M1	17,500	28 000	21	35,000	56 000	21
8th	M2	20,000	32 000	24	40,000	64 000	24
9th	M1	22,500	36 000	27	45,000	72 000	27
10th	M1	25,000	40 000	30	50,000	80 000	30
11th	M1	27,500	44 000	33	55,000	88 500	33
12th	M3	30,000	48 000	36	60,000	96 500	36

Overview of Maintenance Operations: 00-04

Maintenance Operation Sets

Maint. No.	Operation Description	Service Schedule			
		Initial	M1	M2	M3
01-01	Engine Drive Belt Inspecting				•
01-02	Engine Support Fastener Checking				•
09-01	Air Cleaner Element Inspecting and Replacing*				•
13-01	Air Compressor Inspecting			•	•
15-01	Alternator, Battery, and Starter Checking				•
20-01	Radiator Cap Inspecting			•	•
20-02	Radiator Pressure Flushing and Coolant Changing				•
20-03	Fan Drive Inspecting (Noise Emission Control)			•	•
20-04	Coolant Heater Checking, Webasto			•	•
25-01	Eaton Fuller Clutch Release Bearing Lubricating	•	•	•	•
25-02	Eaton Fuller Clutch Release Cross-Shaft Lubricating	•	•	•	•
25-03	Clutch Hydraulic Fluid Level Checking	•	•	•	
25-04	Clutch Hydraulic Fluid Changing				•
26-01	Manual Transmission Oil Level Checking	•	•	•	
26-02	Eaton Fuller Transmission Fluid Changing and Magnetic Plug Cleaning†				•
26-03	Allison and Eaton Fuller Transmission Breather Checking	•	•	•	•
26-04	Allison Transmission Fluid and Filter Changing‡				
31-01	Frame Fastener Torque Checking	•			•
32-01	Suspension Inspecting	•	•	•	•
32-02	Suspension U-Bolt Torque Checking	•			•
33-01	Kingpin Lubricating, Freightliner Axle	•	•	•	•
33-02	Draw Key Nut Inspecting	•			•
33-03	Tie Rod End Inspecting	•	•	•	•
35-01	Axle Lubricant Level Checking	•	•	•	
35-02	Axle Breather Checking	•	•	•	•
35-03	Axle Lubricant Changing and Magnetic Plug Cleaning				•
40-01	Wheel Nut Checking				•
41-01	Driveline Inspecting	•	•	•	•
41-02	Driveline Lubricating	•	•	•	•
42-01	Air Dryer AD-9 or AD-IP Desiccant Replacing				•
42-02	Governor D-2A Checking				•
42-03	Hydraulic Brake Lining Wear Checking	•	•	•	•
42-04	Slack Adjuster Lubricating§	•	•	•	•
42-05	Meritor Camshaft Bracket Lubricating§			•	•
42-06	Air Dryer AD-9, AD-IP Checking			•	•

Overview of Maintenance Operations: 00-04

Maint. No.	Operation Description	Service Schedule			
		Initial	M1	M2	M3
42-07	Brake Lines and Fittings Inspecting, Hydraulic Brakes	•	•	•	•
42-08	Brake Pedal Linkage and Mounting Plate Inspecting			•	•
42-09	Air Brake Inspecting and Leakage Testing				•
42-10	ABS Tone Rings Cleaning	•	•	•	•
42-11	Bendix Hydro-Max® Brake System Inspecting	•	•	•	•
42-12	Brake Caliper Slide Pin Lubricating, Hydraulic Brakes¶				
42-13	Drum Brake Shoe Roller Lubricating			•	•
42-14	Foot Brake Valve Actuator Lubricating, Bendix E-6	•		•	•
42-15	Brake Inspecting	•			
46-01	Drag Link Inspecting				•
46-02	Power Steering Fluid and Filter Changing				•
46-03	Power Steering Fluid Level Inspecting	•	•	•	
46-04	Power Steering Gear Lubricating	•	•	•	•
46-05	Drag Link Lubricating	•	•	•	•
47-01	Fuel Tank Band Nut Tightening	•			
47-02	Fuel/Water Separator Element Replacing				•
47-03	Inline Fuel Strainer Replacing, MBE900 Engine			•	•
47-04	Fuel Sender Checking			•	•
49-01	Exhaust System Inspecting (Noise Emission Control)	•	•	•	•
54-01	Battery Voltage Checking	•	•	•	•
83-01	Air Conditioner Inspecting	•	•	•	•
83-02	HVAC Air Filter Cleaning**			•	•

* Replace the primary air cleaner element when the intake-air restriction indicator reaches the maximum restriction. See **Group 09**.

† For oil change intervals, see the applicable Eaton Fuller Driver Manual or Service Manual.

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

§ Meritor Q Plus brake system slack adjusters and camshaft brackets use a special NLGI Grade synthetic polyurea grease and do not require lubrication for 3 years or 500,000 miles (800 000 km), whichever comes first.

¶ See the "Bosch Pin Slide Disc Brakes Service Manual" for more information.

** Clean the HVAC air filter at the recommended interval or every six months.

Noise Emission Controls

Federal Law, Part 205: Transportation Equipment Noise Emission Controls

Part 205, Transportation Equipment Noise Emission Controls, requires the vehicle manufacturer to furnish each new vehicle with 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 degradation throughout the life of the vehicle. In compliance with the law, the Noise Emission Control Systems maintenance located in each applicable group within this manual, in conjunction with the vehicle workshop manual, provides these instructions to owners.

Recommendations for Replacement Parts

Replacement parts used for maintenance or repair of noise emission control systems should be genuine Freightliner parts. If other than genuine Freightliner 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 Freightliner parts in performance and durability.

Freightliner Noise Emissions Warranty

Refer to the vehicle owner's warranty information book for warranty information concerning noise emission control systems.

Tampering With the Noise Control System 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:

1. Removal of engine noise-deadening panels, including cab or hood liners.
2. Removal of or rendering inoperative the engine speed governor so as to allow engine speed to exceed the manufacturer's specifications.
3. Removal of or rendering inoperative the fan clutch, including bypassing the control on any thermostatic fan drive to cause it to operate continuously.
4. Removal of the fan shroud.
5. Removal of or rendering inoperative exhaust system components, including exhaust pipe clamping.
6. Removal of air intake system components.

Verification of Inspections Log

The "Verification of Inspections Log" should be filled out each time the noise emission controls on the vehicle are maintained or repaired.

Verification of Inspections Log, Group 20

Verification of Inspections Log, Group 20, Engine Cooling/Radiator				
Date	**Mileage**	**Repair Description**	**Cost**	**Repair Facility**

Verification of Inspections Log, Group 49

Verification of Inspections Log, Group 49, Exhaust				
Date	**Mileage**	**Repair Description**	**Cost**	**Repair Facility**

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01-01 Engine Drive Belt Inspecting

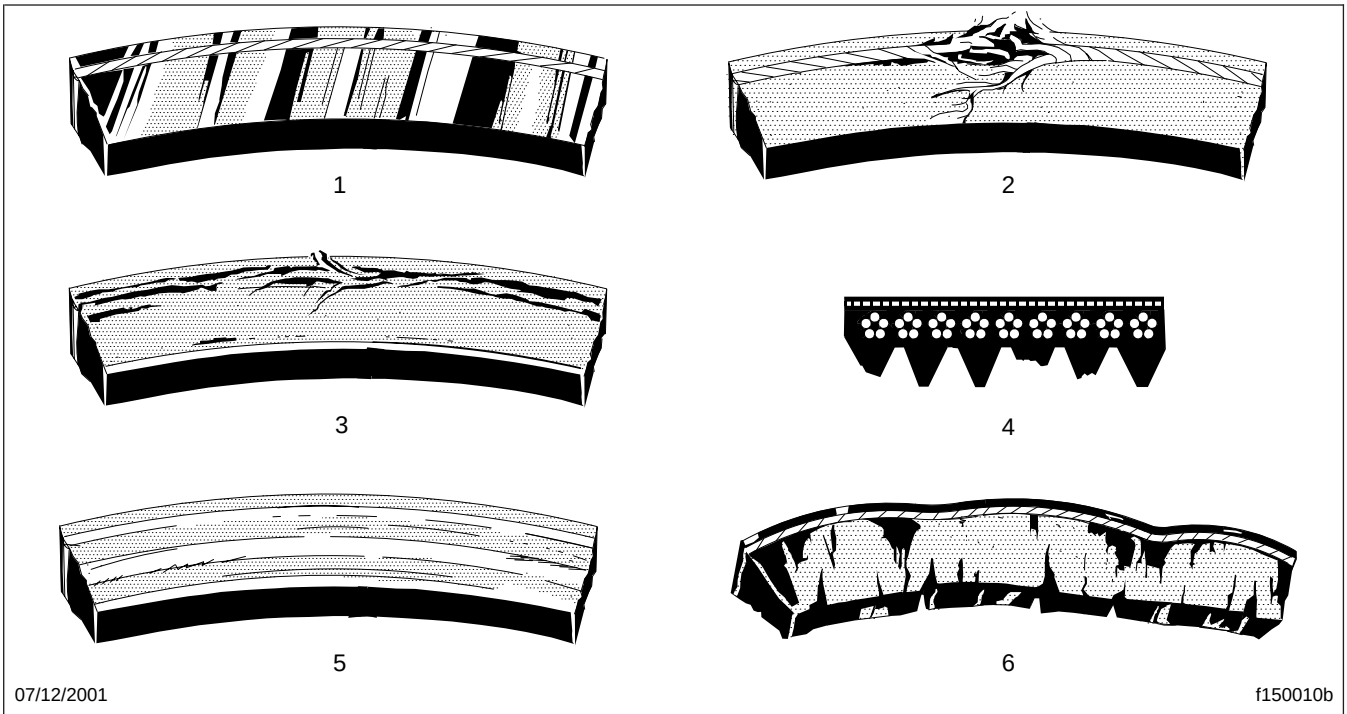
Worn or loose drive belts may cause premature pulley bearing failure or engine overheating. Too much or too little tension on the belt may result in excessive or premature belt wear. Replace the engine drive belt if any conditions described under "Visual Inspection" are found.

Visually inspect all drive belts, then perform the belt tension inspection. To inspect a belt, gently twist the belt to view the belt sidewalls and the underside of the belt. When replacing a matched set of belts, always replace both belts at the same time. Matched belts must be from the same manufacturer.

Visual Inspection

For examples of drive belt conditions, see **Fig. 1**.

1. Inspect the belt for glazing. Shiny sidewalls are evidence of glazing, which is caused by friction created when a loose belt slips in the pulleys. It can also be caused by oil or grease contamination on the pulleys.
2. Check for tensile breaks or breaks in the cord body. Cuts in a belt are usually caused by foreign material in the pulley or by prying or forcing the belt during removal or installation.
3. Check the belt for ply separation. Oil, grease, or belt dressing can cause the belt to fall apart in layers. Repair any oil or coolant leaks that are affecting the belts before replacing the drive belts. Do not use belt dressing on any belt.
4. Check for uneven ribs on serpentine (poly-V) belts. Foreign material in the pulley will erode the undercord ribs causing the belt to lose its gripping power.
5. Check the belt for a jagged or streaked sidewall. Jagged or streaked sidewalls are the result of



1. Glazing
2. Tensile Break
3. Separating Layers
4. Uneven Ribs
5. Streaked Sidewalls
6. Cracks

Fig. 1, Drive Belt Replacement Conditions

foreign material, such as sand or gravel, in the pulley, or a rough pulley surface.

6. Check the drive belts for cracks. Small, irregular cracks are usually an indication of an old belt.
7. Visually inspect the pulleys for excessive play or wobble. Excessive play or wobble indicates a failure of the pulley bearing. Check for belt squealing or squeaking. Replace the bearings as necessary.

NOTE: If it is difficult to distinguish the location of a supposed bearing noise, obtain a stethoscope and place it on the component being checked, not the pulley, to isolate the area from outside interference.

8. Inspect all pulleys for foreign material, oil, or grease in the grooves.

   If the engine drive belt needs to be replaced, see **Group 01** of the *S2 Chassis Workshop Manual*.

Belt Tension Inspection

Engine drive belts on Mercedes-Benz engines have belt tensioners that automatically adjust the tension on the belt. These belts do not require adjustment.

01-02 Engine Support Fastener Checking

NOTE: Front and rear engine supports for vehicles built from January 2007 require the same maintenance as shown below.

Mounts should be inspected when the engine is removed for service. Perform the following check.

1. Check the engine support fasteners at the rear of the engine for tightness. Tighten the fasteners 241 lbf·ft (327 N·m).
2. Check the engine support fasteners at the front of the engine for tightness. Tighten the fasteners 136 lbf·ft (184 N·m).

NOTE: Whenever the engine is removed, inspect the lower and upper isolators for wear. Replace the isolators if necessary.

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09-01 Air Cleaner Element Inspecting and Replacing

NOTE: Visually inspect the air cleaner element for obvious damage such as holes, cuts, or dents.

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. 1**. Make sure the engine is off and note the existing reading on the indicator. Start the engine and take a short test drive. Check the indicator again and note the level of restriction on the indicator. A decrease from the previous level of restriction or a very low air restriction indicator reading (0 to 4 inH_2O) 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.

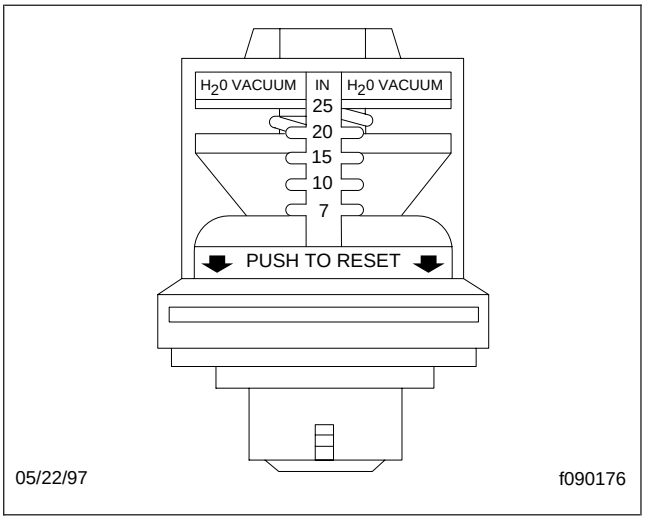

Fig. 1, Air Restriction Indicator

Method 1

Replace the primary air cleaner element at the recommended interval or when the air restriction indicator reaches 22 inH_2O on a vehicle with a Mercedes-Benz engine. Replace the secondary or safety air cleaner element with every third primary air cleaner element replacement. For replacement instructions, see **Section 09.01, Subject 100**, of the *S2 Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. Reset the air restriction indicator.

Each time the primary air cleaner element is replaced, perform the procedures in **Group 13** of this manual.

If the maximum restriction is not reached, record the air restriction value. If the value is higher than the previous recording, reset the air restriction indicator. If the value is lower than the previous recording, inspect the air cleaner and air cleaner element for cracks, leaks, or any other damage.

If the air cleaner or air cleaner element is damaged, replace it and reset the air restriction indicator.

Method 2

Replace the primary air cleaner element at the recommended interval or when the air restriction indicator reaches 22 inH_2O on a vehicle with a Mercedes-Benz engine. Replace the secondary or safety air cleaner element with every third primary air cleaner element replacement. For replacement instructions, see **Section 09.01, Subject 100** of the *S2 Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. Reset the air restriction indicator.

If the maximum restriction is not reached, inspect the air cleaner and air cleaner element for cracks, leaks, or any other damage. If the air cleaner or air cleaner element is damaged, replace it. Reset the air restriction indicator.

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13-01 Air Compressor Inspecting

1. Inspect the air compressor intake adaptors at both ends of the line for physical damage. Replace the adaptors if necessary.
2. Inspect the air intake line, oil supply and return lines, and coolant supply and return lines for tight connections. Tighten the connections and replace the lines if needed.
3. Check the cooling fins on the air compressor crankcase. Clean the fins if they are clogged with debris.

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15-01 Alternator, Battery, and Starter Checking

1. Inspect the alternator.
   - 1.1 Check that the alternator is securely mounted to the engine or the bracket and that the bracket is securely mounted to the engine. Tighten the fasteners as needed.
   - 1.2 Check that all electrical connections on the alternator and starter are clean and free of corrosion. Clean and tighten all charging system electrical connections as needed.
   - 1.3 Check the alternator wiring for missing insulation, kinks, and heat damage. Replace or repair as needed.

⚠ WARNING

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

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

2. Inspect the battery.
   - 2.1 Inspect the battery cables for wear. Replace the battery cables if necessary.
   - 2.2 Clean the cable connector terminals with a wire brush.
   - 2.3 After cleaning, connect the cables to the batteries and tighten them to the torque specifications provided on the battery.
   - 2.4 Clean the battery ground cable, terminal, and clamps.
   - 2.5 Inspect the battery retainer assembly or battery hold-downs and the battery box. Remove any corrosion with a wire brush and wash with a weak solution of baking soda and water. Rinse with clean water and dry. Paint the retainer assembly if needed to prevent rusting.
   - 2.6 Check to be sure that there are no loose items such as stones, bolts, and nuts in the battery box.
   - 2.7 Spray each connection with dielectric red enamel and coat the battery terminals with dielectric grease. See **Table 1** for approved dielectric protectants.

Approved Dielectric Protectants	
Protectant Type	**Brand Name**
Dielectric Grease	Lubriplate FLP DS-ES
Dielectric Red Enamel Spray	3M 1602 IVI-Spray Sealer
	Spray-On B-6-665

Table 1, Approved Dielectric Protectants

3. Check the terminals on the battery shut-off switch and the magnetic switch. Make sure the terminal connections are clean and tight. Coat the terminal connections with dielectric red enamel after cleaning. See **Table 1** for approved dielectric protectants.

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20-01 Radiator Cap Inspecting

⚠ 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.

⚠ CAUTION

The radiator cap currently installed may not be the same one installed when the vehicle was built. If the radiator cap must be replaced, make sure that it is the correct cap for the cooling system of the vehicle. Because the radiator cap pressure rating affects the operating temperature of the engine, installing an improperly rated radiator cap may have adverse effects on the cooling system, and engine operating temperatures. This could cause premature engine wear or damage.

1. Using a radiator-cap tester, check the pressure cap to see if it maintains pressure to within 10 percent of the pressure rating marked on the cap. If it doesn't, replace the cap. Make sure that the replacement radiator cap is correctly rated for the cooling system of the vehicle.
2. There is a second valve in the radiator cap that opens under vacuum. This prevents the collapse of hoses and other parts that are not internally supported when the system cools. Inspect the vacuum-relief valve to be sure it is not stuck.
3. Make sure that the cap seals properly on the coolant filler neck seat, and that the radiator cap gasket is not damaged. On vehicles with screw-on caps with O-rings, make sure that the O-ring is not cracked or deteriorated. Replace the cap if the gasket shows deterioration or damage.

20-02 Radiator Pressure Flushing and Coolant Changing

NOTE: For additional instructions on cleaning and flushing the cooling system, see the engine manufacturer's maintenance and operation manual.

1. Place a large container under the radiator.
2. Remove the surge tank cap.
3. Open the petcock at the bottom of the radiator to drain the engine coolant.
4. Disconnect the radiator inlet and outlet hose connections.
5. Attach a flushing gun nozzle to the radiator outlet.
6. Add water to the radiator until it is full.

⚠ CAUTION

When flushing the radiator, do not apply more than 20 psi (138 kPa) air pressure. Excessive pressure can damage the radiator or heater core.

7. Apply no more than 20 psi (138 kPa) air pressure intermittently to help dislodge sediment buildup in the core.
8. Drain the radiator, then flush the radiator until clean water flows from the radiator. Remove the flushing gun.
9. Close the petcock.
10. Using clamps, connect the hoses to the radiator. Torque the clamps 33 to 38 lbf·in (370 to 430 N·cm).

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.

11. Fill the radiator with coolant. Use a mixture of 50 percent water and 50 percent corrosion-inhibiting antifreeze to protect the engine to –34°F (–37°C) year round.

See **Table 1** for engine cooling system capacities.

See **Table 2** for approved antifreezes.

Coolant Capacities*	
Engine Make and Model	**Coolant Volume: quarts (liters)**
MBE900 (6.4L)	37 (35)

* The total coolant volume is dependent on the number and location of optional passenger heaters.

Table 1, Coolant Capacities

Approved Coolants		
Engine Type	**Coolant Manufacturer**	**Coolant Designation***
Diesel	Texaco	JC04 Antifreeze
	Van Waters and Rogers Ltd. (Canada)	Diesel Antifreeze No. 6038

* Freightliner-approved antifreeze must meet one of the following conditions: A. Ethylene glycol solution that meets GM 6038–M Engineering Standards. B. Ethylene glycol solution that has less than 0.1% anhydrous sodium metasilicate and meets either GM 1825–M or GM 1899–M Engineering Standards.

Table 2, Approved Coolants

20-03 Fan Drive Inspecting (Noise Emission Control)

Horton Advantage® Fan Clutch

1. Disconnect the batteries at the negative terminals. Drain all air from the air system. If equipped with an air starter, drain the air starter reservoir.

⚠ WARNING

Make sure the batteries are disconnected before checking the fan clutch. If the engine starts during this procedure, the fan could engage, which could result in serious personal injury.

2. Check the fan for loose rivets and missing weights. Check for bent, cracked, or missing blades. Tighten loose components. Replace the fan drive if necessary.
3. Check for adequate clearance between the fan and the fan shroud or other engine compartment components in both the engaged mode and the disengaged mode. If the clearance is not adequate, make the necessary adjustments.
4. Check the fan belt condition and the belt alignment. Replace or correct as necessary.
5. Connect the battery cables. Start the engine, and charge the air system to 120 psi (827 kPa). Manually engage and disengage the fan clutch.

   Check the fan and the fan clutch from a distance. Look for vibration, fan blade contact, fan clutch slippage, and overall fan clutch operation.

   If the fan clutch does not operate correctly, see **Group 20** of the *S2 Chassis Workshop Manual* for troubleshooting and repair procedures.

Horton HT650 Fan Drive

Check for friction facing wear condition. Replace when worn to 1/16-inch (1.5-mm) thick, when oil-spotted, or when burn marks are visible.

Horton DriveMaster® Fan Clutch

NOTE: If any part of the fan clutch needs to be repaired or replaced after performing the checks below, see **Group 20** of the *S2 Chassis Workshop Manual*.

1. Disconnect the batteries at the negative terminals. Drain all air from the air system. If equipped with an air starter, drain the air starter reservoir.

⚠ WARNING

Make sure the batteries are disconnected before checking the fan clutch. If the engine starts during this procedure, the fan could engage, which could result in serious personal injury.

2. Inspect the electrical connections and wires to the fan clutch solenoid. Secure the connection if loose; replace wires and connectors if damaged.
3. If so equipped, clean the fan clutch air solenoid valve filter as follows.

   3.1 Unscrew the fan clutch solenoid valve air filter assembly and remove the filter element.

3.2 Clean the filter element with cleaning solvent.

3.3 Using a clean, lint-free cloth, wipe off any excess solvent.

3.4 Reassemble the clutch valve solenoid air filter assembly and install it on the vehicle.

4. Check the fan for bent, cracked, or damaged blades, and replace the fan if it's damaged. Check for adequate clearance between the fan and other components.
5. Check the fan belt for wear, tension, and alignment. Correct as necessary.
6. Check for wear on the friction facing. Replace the friction facing if it is worn to a 3/16-inch (4.8-mm) thickness or less. Also check the facing for signs of oil contamination or burn marks. If evidence of oil or burn marks are found, replace the friction facing.
7. Connect the battery cables. Start the engine, and charge the air system to 120 psi (827 kPa). Manually engage and disengage the fan clutch.

   Check the fan and the fan clutch from a distance. Look for vibration, fan blade contact, fan clutch slippage, and overall fan clutch operation.

   If the fan clutch does not operate correctly, see **Group 20** of the *S2 Chassis Workshop Manual* for troubleshooting and repair procedures.
8. With the air system charged to 120 psi (827 kPa), check the fan clutch for audible air leaks, using a suitable listening device.

   Check at the solenoid valve, the air filter assembly, and the air hoses and fittings. See **Fig. 1**. Using a wet finger or a soapy water solution, check for a leak in the same areas.
9. If a leak is detected, remove the fan blade. Install a new seal kit. See **Group 20** of the *S2 Chassis Workshop Manual* for repair procedures.
10. Check the fan drive for discoloration or any other signs of slipping or overheating.

NOTE: The fan clutch may slip if the air supply pressure is below 70 psi (483 kPa) or if there is a leak inside the fan clutch. Any leak must be remedied.

11. Check the fan clutch bearings as follows.

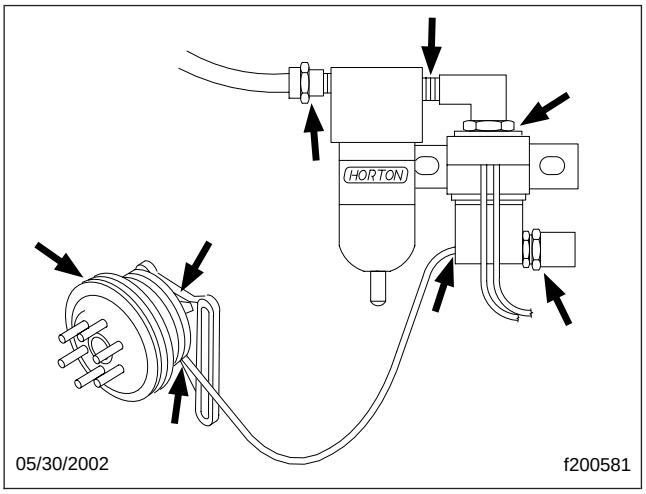

Fig. 1, Checking for Air Leaks (Horton DriveMaster)

11.1 Turn the fan in both directions and feel for worn hub bearings.

11.2 If possible, remove the drive belt and check for worn sheave bearings by turning the sheave in both directions.

11.3 If either the hub or sheave bearings are worn, replace them, using a Horton DriveMaster Super Kit.

For instructions and kit part number, see **Group 20** of the *S2 Chassis Workshop Manual*.

Borg Warner Viscous Fan Drive

NOTE: The Borg Warner viscous fan drive does not require any maintenance. If the fan drive is damaged, replace the unit. Do not attempt to repair it.

⚠ CAUTION

If the fan drive assembly is damaged, replace the unit as soon as possible. Operating a seized or otherwise damaged clutch reduces fuel economy, and could cause serious engine damage.

See **Section 20.03** of the *S2 Chassis Workshop Manual* for replacement instructions.

1. With the engine shut down, rotate the fan at least one full turn by hand. It should have a smooth, steady drag. If it does not, replace the fan clutch.

2. Check for physical damage to the fan or fan shroud.
3. Check for correct drive belt alignment and tension. For specifications, see **Group 01** of the *S2 Chassis Workshop Manual*.
4. Check for wear of the fan clutch bearings. There should be no side-to-side or in-and-out movement of the fan clutch.
5. Do all of the checks in **Section 20.00** of the *S2 Chassis Workshop Manual*.

20-04 Coolant Heater Checking, Webasto

1. Using compressed air, clean any accumulated debris or dust from the heater and enclosure box. Inspect all components for wear or damage.
2. Check that the batteries are in good condition. If the voltage is too low or too high, the heater will automatically shut down. Check the wiring harnesses for damage. Replace the harnesses if necessary.
3. Check the air intake port for obstructions. Carefully check the air intake tube for any restrictions or damage, and repair or replace the tube if necessary.
4. Check the exhaust system for restrictions or corrosion. Replace any damaged parts.
5. Change the fuel filter, if so equipped. Inspect the fuel line for damage, restrictions, or loose connections. Repair or replace the line if it is damaged.
6. Inspect all coolant lines and clamps for leakage, restrictions, or damage. Replace the lines as needed. Inspect the coolant circulation pump for leakage. Repair or replace the pump if it is damaged.
7. Run the heater at least once a month for 10 minutes.
8. Check the water and fuel connections for leakage. Tighten the hose clamps if needed.

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25-01 Eaton Fuller Clutch Release Bearing Lubricating

The standard clutch release bearing is sealed, and does not require lubrication. If the vehicle is not equipped with a maintenance-free sealed clutch release bearing, lubricate the bearing as follows:

1. Park the vehicle on a level surface. Apply the parking brake, and chock the rear tires.
2. Remove the clutch inspection plate.

NOTE: Some clutch release bearings are equipped with a lubrication extension that extends outside of the clutch housing. It is not necessary to remove the clutch inspection plate when the lubrication extension is used.

NOTE: For lubricating the release bearing, Eaton Fuller recommends a lithium-base high-temperature grease that meets the NLGI Grade 1 or 2 specification.

3. Wipe the dirt away from the grease fitting. See **Fig. 1**. Use a low-pressure-type grease gun equipped with the recommended grease, and lubricate the bearing until excess grease purges from the rear of the release bearing (toward the transmission).

⚠ CAUTION

Do not over-lubricate the clutch release bearing. Over-lubrication could contaminate the clutch internally, causing clutch slippage and premature failure. Do not use chassis grease or multipurpose lubricants.

4. Wipe off excess grease and apply to both the yoke finger and sleeve bushing contact points. See **Fig. 2**.
5. Install the clutch inspection plate.
6. Remove the chocks.

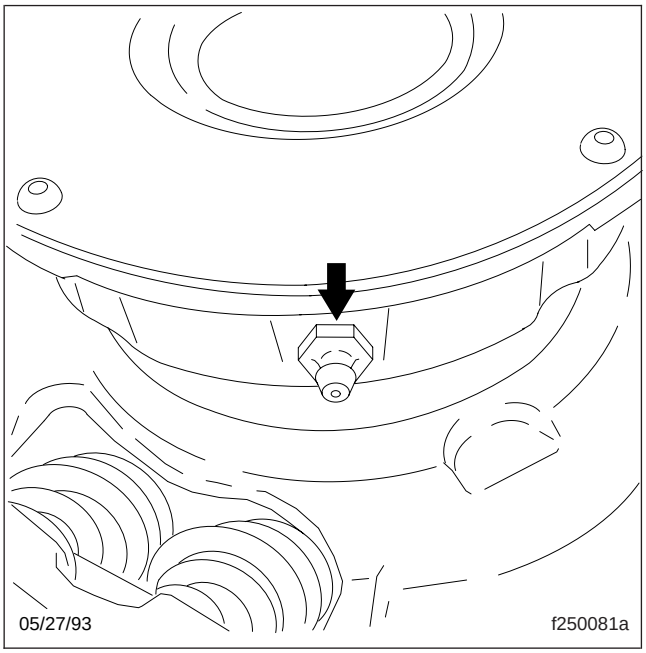
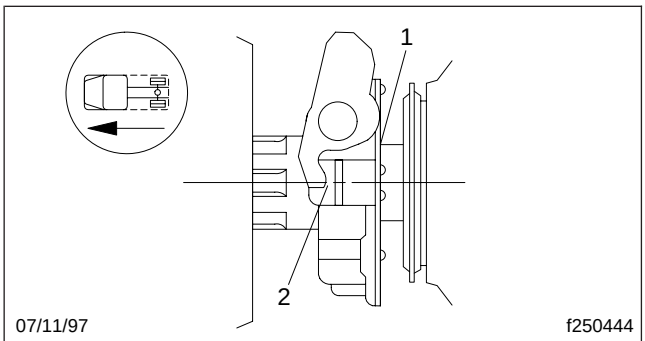


Fig. 1, Release Bearing Grease Fitting



1. Sleeve Bushing Contact Point
2. Yoke Finger Contact Points

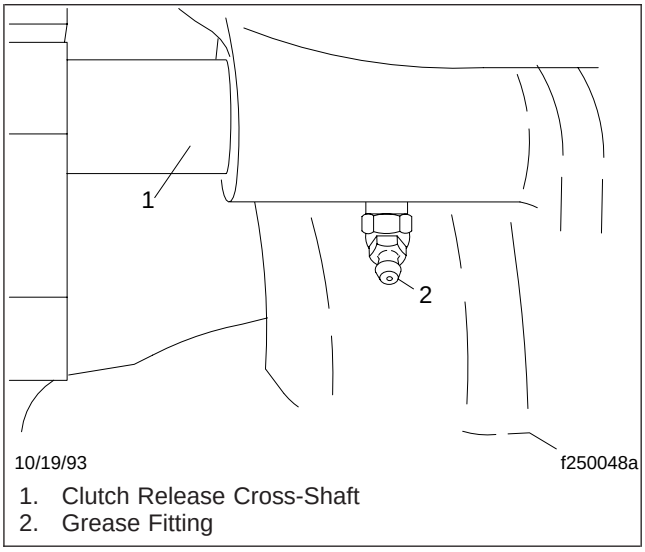
Fig. 2, Contact Points Requiring Grease

25-02 Eaton Fuller Clutch Release Cross-Shaft Lubricating

IMPORTANT: This maintenance operation pertains only to vehicles equipped with mechanical (not hydraulic) linkages.

The clutch release cross-shaft is equipped with two grease fittings in the transmission clutch housing. See **Fig. 3** and **Fig. 4**. Wipe the dirt from the grease

fittings and lubricate with multipurpose chassis grease.



1. Clutch Release Cross-Shaft
2. Grease Fitting

Fig. 3, Cross-Shaft Grease Fitting, Left Side

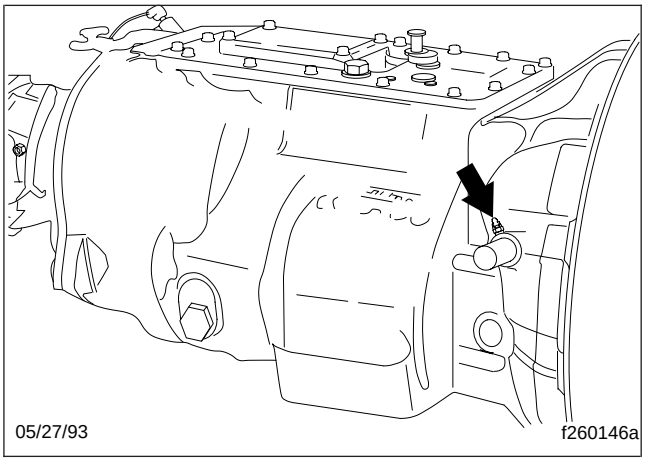


Fig. 4, Cross-Shaft Grease Fitting, Right Side

25-03 Clutch Hydraulic Fluid Level Checking

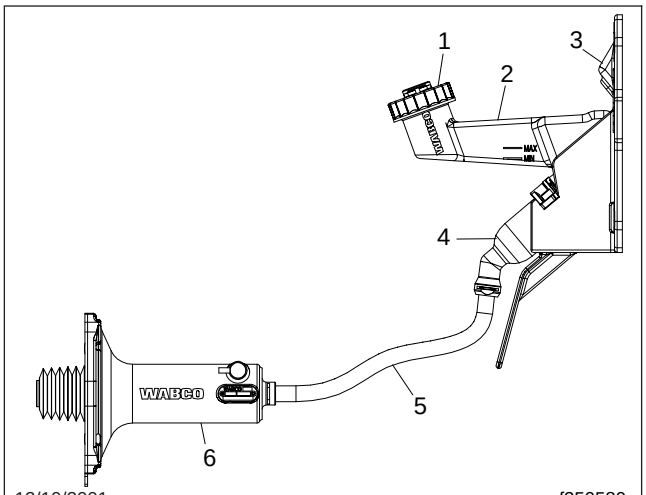
⚠ WARNING

Use only approved clutch hydraulic fluid (DOT 4 brake fluid) in the clutch hydraulic system. Do not mix different types of brake fluid. The wrong fluid will damage the rubber parts of the system, causing loss of clutch function and the risk of serious personal injury.

⚠ CAUTION

Do not allow the fluid level in the reservoir to go below the MIN line. If too much air enters, the hydraulic system will not operate correctly, and the clutch could be damaged.

If the fluid level is below the MIN line, fill the reservoir with DOT 4 brake fluid until the level reaches the MAX line. See **Fig. 5**.



1. Reservoir Cap
2. Reservoir
3. Pedal Unit
4. Master Cylinder
5. Hydraulic Hose
6. Slave Cylinder

Fig. 5, Clutch Components

25-04 Clutch Hydraulic Fluid Changing

Replace the clutch hydraulic fluid every two years to ensure clutch function is reliable and correct. Use the procedures below. Fluid replacement must be done at an authorized Freightliner service facility.

Flushing

1. Shut down the engine.
2. Apply the parking brakes, chock the front and rear tires, and raise the hood.

⚠ WARNING

Clutch hydraulic fluid (DOT 4 brake fluid) is hazardous. It may be a skin irritant and can cause blindness if it gets in your eyes. Always wear safety glasses when handling clutch hydraulic fluid or bleeding hydraulic lines. If you get clutch hydraulic fluid on your skin, wash it off as soon as possible.

3. Prepare the pressure bleeding equipment according to the manufacturer's instructions. Use DOT 4 brake fluid. Pressurize the bleed adaptor to 15 psi (103 kPa).

⚠ CAUTION

Do not spill clutch hydraulic fluid (DOT 4 brake fluid) on the body paint. Clean it off immediately if any is spilled. DOT 4 brake fluid can damage paint.

4. Remove the reservoir lid and install the pressure bleed adaptor on the reservoir.
5. Pressurize the reservoir, filling the system. Open the bleed valve on the bleed tank of the adaptor.

NOTE: A pressure bleeder hose (J-29532) and a bleed adaptor (J-35798) for the fluid reservoir are available through SPX Kent-Moore Tools and may be used to complete the following procedure. To order these parts, call Kent-Moore at 1-800-328-6657.

6. Flush the hydraulic system, as follows. See **Fig. 6**.
   - 6.1 Open the bleed screw on the slave cylinder.
   - 6.2 Using a drain pan or other suitable container, collect the fluid that drains from the slave cylinder bleed valve, at least 0.5 quarts (0.5 liters).
   - 6.3 When all the old fluid has passed through the system and only new, clean fluid is coming out, close the bleed screw.
7. Check the fluid level in the reservoir and bleed the system according to the steps under the heading "Bleeding the Clutch." See **Fig. 7**.

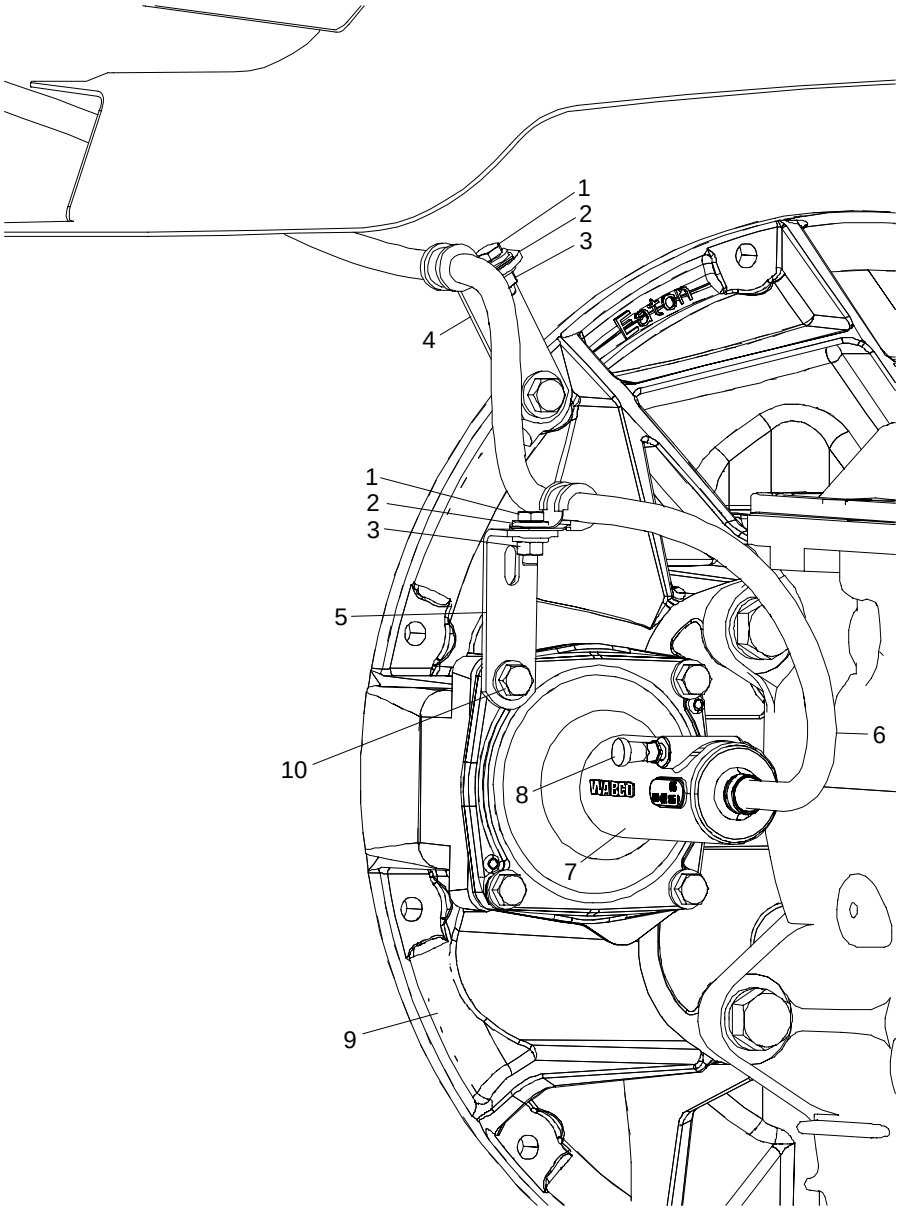
Bleeding the Clutch

1. Remove the cap from the bleed valve. Install a transparent drain hose on the bleed valve of the slave cylinder.
2. Open the slave cylinder bleed screw. Observe the flow of clutch hydraulic fluid through the drain hose. When no bubbles appear in the fluid, close the slave cylinder bleed screw.
3. Disconnect the transparent hose. Tighten the bleed screw 88 lbf·in (1000 N·cm) and install the cap on the slave cylinder bleed valve.
4. Close the valve on the bleed tank of the pressure bleed adaptor. Remove the pressure bleed adaptor.
5. Check the fluid level in the reservoir. If necessary, add or remove clutch hydraulic fluid to bring the fluid level to the MAX line. Install the reservoir lid.

⚠ CAUTION

When removing fluid from the reservoir, use a clean tool that is used only for brake fluid. Using a tool contaminated with oil or chemical residue will destroy hydraulic system parts and cause the system to malfunction.

6. Depress the clutch pedal a few times. There should be resistance over the full pedal stroke.
7. Check the entire system for leaks. Tighten the connections between the components if necessary. Check the fluid level in the reservoir again.
8. Make sure the reservoir lid is tight.
9. Lower the hood and remove the chocks from the front and rear tires.



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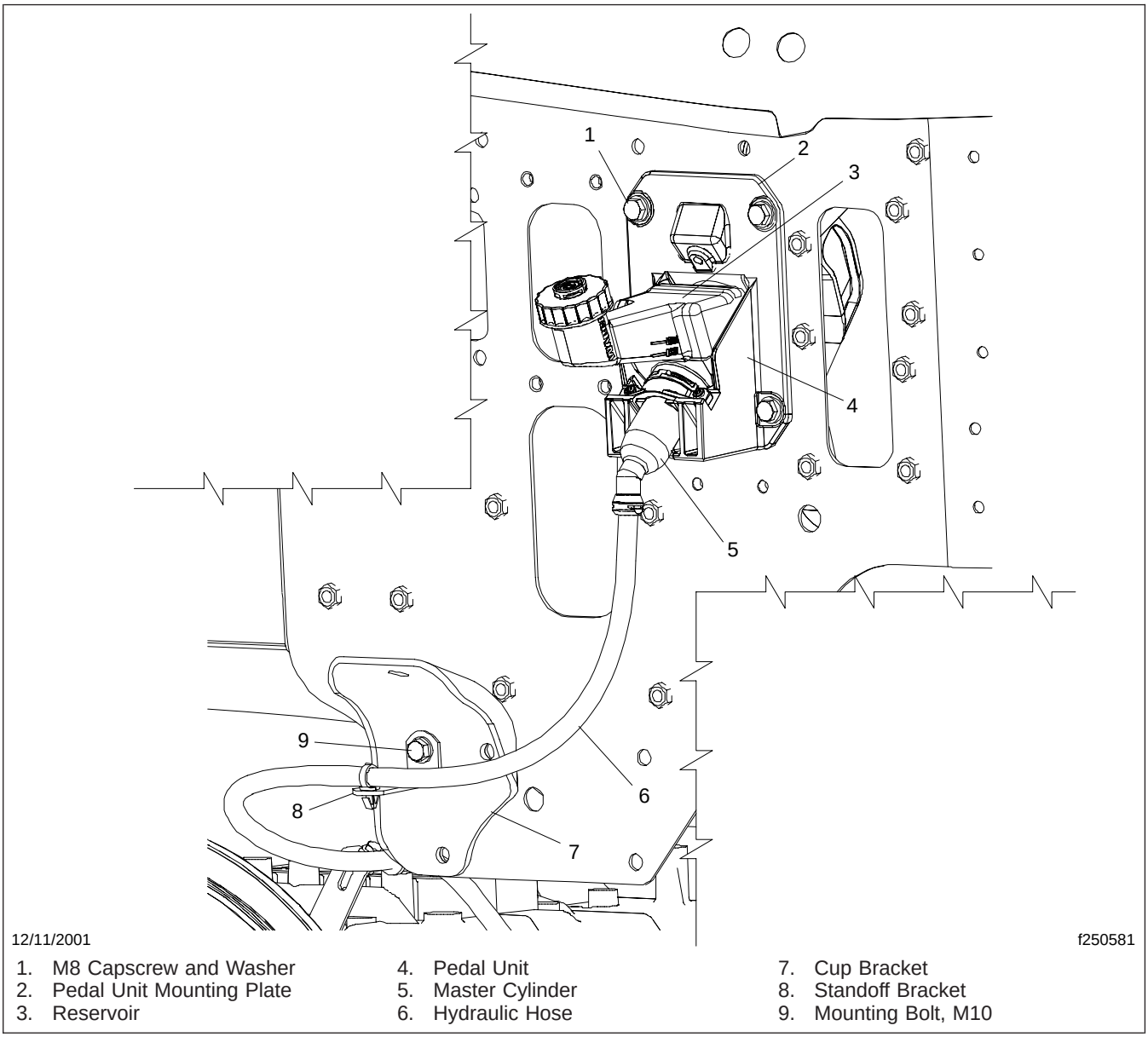
1. Clamp Mounting Bolt, 1/4–20
2. Plated Steel Washer
3. Locknut, 1/4–20
4. Bell Housing Standoff Bracket
5. Slave Cylinder Standoff Bracket
6. Hydraulic Hose
7. Slave Cylinder
8. Bleed Valve
9. Bell Housing
10. Slave Cylinder Mounting Capscrew, M8

Fig. 6, Clutch Slave Cylinder



1. M8 Capscrew and Washer
2. Pedal Unit Mounting Plate
3. Reservoir
4. Pedal Unit
5. Master Cylinder
6. Hydraulic Hose
7. Cup Bracket
8. Standoff Bracket
9. Mounting Bolt, M10

Fig. 7, Clutch Master Cylinder

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26-01 Manual Transmission Oil Level Checking

1. Park the vehicle on a level surface. Apply the parking brake and chock the rear tires.
2. Clean the area around the fill plug, then remove the plug from the side of the case.
3. Check that the oil is level with the lower edge of the transmission fill opening. See **Fig. 1**.

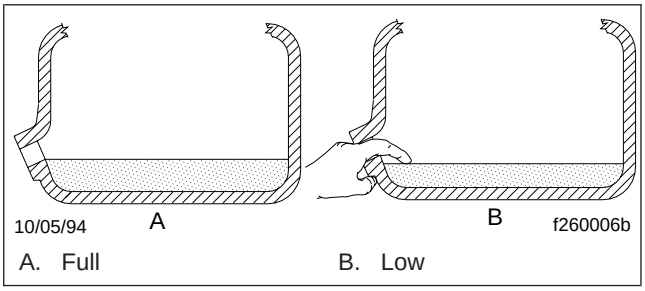


Fig. 1, Transmission Oil Level Checking

IMPORTANT: A lubricant level close enough to be seen or touched is not sufficient. It must be level with the lower edge of the fill opening.

4. If needed, fill the transmission with oil until level with the lower edge of the fill opening. See **Table 1** for approved lubricants.

Approved Manual Transmission Lubricants*		
Lubricant Type†	**Temperature: °F (°C)**	**SAE Viscosity**
MobilTrans SHC 50 (RN 2952 E-5)	All	50
Synthetic lubricant approved by Eaton	All	50
API MT-1 gear oils meeting MIL-PRF-2105E specification	Above 10 (–12)	80 or 90
	Below 10 (–12)	75

* Call 1-800-826-4357 for a complete list of Eaton approved lubricants.

† Lubricants listed in order of preference. Do not mix types of oil.

Table 1, Approved Manual Transmission Lubricants

⚠ CAUTION

Operating a manual transmission with the fluid level higher or lower than recommended can result in transmission damage. Do not overfill the transmission; overfilling will force fluid out of the case through the main shaft openings. Fluid overflow may also drain onto the clutch or clutch brake, causing additional problems.

IMPORTANT: Do not mix types of oil, because of possible incompatibility. Do not use oil additives or friction modifiers. Do not use multiviscosity oils or EP (Extreme Pressure) gear oils. If switching from a petroleum-based lubricant to a synthetic, all areas of each affected component must be thoroughly drained. Switching to a synthetic lubricant, when a petroleum-based lubricant has been used for 50,000 miles (80 000 km) or longer may affect transmission performance. Monitor all seal areas for the first 10,000 miles (16 000 km) after changing to a synthetic from a petroleum-based lubricant.

5. Clean the fill plug, then install it in the transmission. Tighten the plug as follows:
   - 25 to 35 lbf·ft (34 to 48 N·m) for transmissions with 3/4-inch pipe threads.
   - 60 to 75 lbf·ft (81 to 102 N·m) for transmissions with 1-1/4-inch pipe threads.

26-02 Eaton Fuller Transmission Fluid Changing and Magnetic Plug Cleaning

IMPORTANT: For oil change intervals, see the applicable Eaton Fuller Driver Manual or Service Manual.

Eaton Fuller has a complete listing of approved lubricants for its transmissions on its internet website. Refer to the Eaton website for additional information, www.roadranger.com.

Draining

IMPORTANT: Manual transmissions filled with approved synthetic lubricants require a lubricant drain and fill, and a magnetic plug cleaning every 500,000 miles (800 000 km), regardless of the service or vocation of the vehicle. Manual transmissions with petroleum-based lubricants require a lubricant drain and fill, and a magnetic

plug cleaning at each Maintenance 2 (M2) interval. All transmissions, regardless of lubrication used, also require a check of the transmission breather at each Maintenance 1 (M1) interval.

1. Park the vehicle on a level surface. Apply the parking brake and chock the rear tires.
2. Drain the fluid while the transmission is warm.
   - 2.1 Clean the area around the drain plug(s). Remove the drain plug(s) from the gear case.
   - 2.2 Clean the area around the fill plug. Remove the fill plug from the gear case.
3. Clean the magnetic plug(s) before installing it. Use a piece of key stock, or any other convenient steel slug, to short the two magnetic poles and divert the magnetic field.
4. Install and tighten the drain plug(s) 50 lbf·ft (68 N·m).

Filling

⚠ CAUTION

Operating a manual transmission with the fluid level higher or lower than recommended can result in transmission damage. Do not overfill the transmission; overfilling will force fluid out of the case through the main shaft openings. Fluid overflow may also drain onto the clutch or clutch brake, causing additional problems.

IMPORTANT: Do not mix types of fluid, because of possible incompatibility. Do not use multi-viscosity fluids or EP (Extreme Pressure) gear fluids. Do not use fluid additives or friction modifiers. If switching from a petroleum-based lubricant to a synthetic, all areas of each affected component must be thoroughly drained. Switching to a synthetic lubricant, when a petroleum-based lubricant has been used for 50,000 miles (80 000 km) or longer may affect transmission performance. Monitor all seal areas for the first 10,000 miles (16 000 km) after changing to a synthetic from a petroleum-based lubricant.

NOTE: The correct fluid level is established by checking at the fill plug opening.

1. Add fluid until it is level with the lower edge of the fill opening. See **Fig. 1**. If the transmission has two fill openings, add fluid to the level of both fill openings. See **Table 1** for approved transmission lubricants, and **Table 2** for lubricant capacities.

Eaton Fuller Transmission Lubricant Capacities*	
Transmission Model	**Capacity: qt (L)**
5-Speed	
FS–4205A/B, FS–5205A/B	6.25 (5.9)
FS–6305A/B	9.75 (9.2)
6-Speed	
FS–5406A	9.75 (9.2)
FS–6406A, FSO–6406A	9.75 (9.2)
FO–6406A, FO-8406	10.5 (10.0)
FSO–8406A	9.75 (9.2)

* Quantities listed are approximate. Fill the transmission until the lubricant is level with the bottom of the fill hole, with the vehicle in normal operating position.

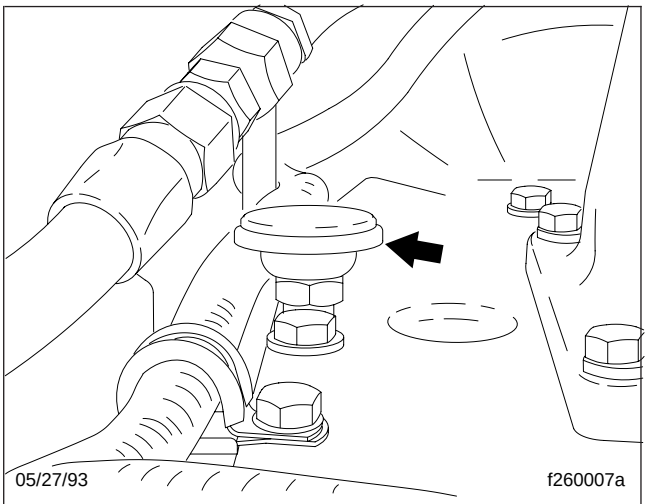
Table 2, Eaton Fuller Transmission Lubricant Capacities

2. Clean the fill plug, then install it in the transmission. Tighten the plug as follows:
   - 25 to 35 lbf·ft (34 to 48 N·m) for transmissions with 3/4-inch pipe threads.
   - 60 to 75 lbf·ft (81 to 102 N·m) for transmissions with 1-1/4 inch pipe threads.

26-03 Allison and Eaton Fuller Transmission Breather Checking

Transmission housing breathers, if so equipped, must remain clear. A plugged breather could result in pressure buildup, which could cause oil leakage.

If the breather is plugged, clean or replace it. See **Fig. 2**. Check more often if the vehicle is operating under very dusty conditions.



NOTE: Location of the transmission breather will vary depending on transmission model.

Fig. 2, Transmission Breather (Eaton Fuller shown)

26-04 Allison Transmission Fluid and Filter Changing

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

When draining transmission fluid, check for evidence of dirt or water contamination. A small amount of condensation will appear in the fluid during operation.

Water contamination is normally characterized as a milky discoloration of the transmission fluid. Obvious contamination of the transmission fluid indicates a leak between the water and fluid areas of the transmission cooler. Inspect and pressure-test the cooler to confirm the leak; replace leaking transmission coolers.

2100/2200/2500 Series

1. Park the vehicle on a level surface and apply the parking brake.
2. Run the engine until the transmission fluid reaches the operating temperature of 160 to 200°F (71 to 93°C). Shift the transmission to neutral (N) and shut down the engine.

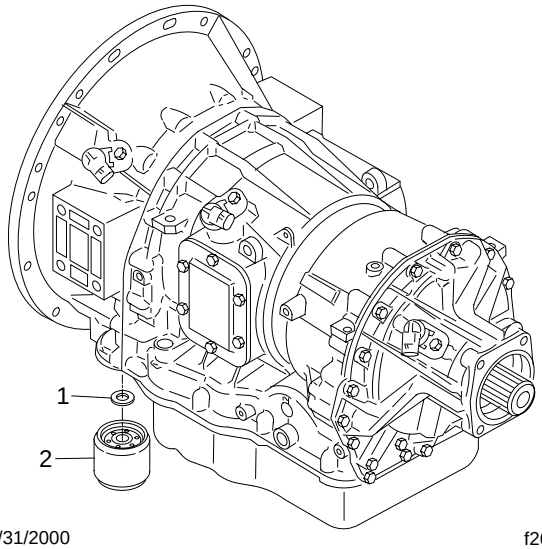
⚠ CAUTION

To prevent dirt from entering the transmission, use only clean containers and fillers for the transmission fluid. Do not use fillers or containers that have been used for water or antifreeze. Dirt, water, or antifreeze could damage the transmission.

3. Clean the area around the drain plug. Place a drain pan under the transmission and remove the drain plug. Examine the fluid while it drains. If only the filter is being changed, do not drain the fluid.

NOTE: A lot of fluid will drain when the filter is removed.

4. Using a standard strap-type filter wrench, remove the filter by turning it counterclockwise. See **Fig. 3**.



1. Magnet
2. External Filter

Fig. 3, 2100/2200/2500 Series Transmission External Filter

5. Remove the magnet from the filter attachment tube or from the top of the filter element.
6. Clean any metal debris from the magnet. Then, install the magnet on the filter attachment tube.
7. Using transmission fluid, lubricate the gasket on the filter.

8. Using your hand, install the filter by turning it clockwise until the filter gasket contacts the converter housing or cooler manifold. Then, turn the filter one more complete turn.
9. Install the drain plug and sealing washer. Tighten the plug 22 to 30 lbf·ft (30 to 40 N·m).
10. Clean the area around the fill tube and remove the dipstick. Using a clean funnel in the fill tube, add transmission fluid. See **Table 3** for approved transmission lubricants, and **Table 4** for lubricant capacities.
11. Check and adjust the fluid level using the procedure under "Checking the Fluid Level".

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. Lubricants listed in order of preference. Do not mix types of oil.

Table 3, Approved Allison Transmission Lubricants

Allison Transmission Lubricant Capacities	
Transmission Model	**Fill Capacity:* qt (L)**
2100/2200/2500 Series (standard sump)	15 (14)
2100/2200/2500 Series (shallow sump)	13 (12)
3000 Series (4 inch sump)	29 (27)
3000 Series (2 inch sump)	26 (25)

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

Table 4, Allison Transmission Lubricant Capacities

3000 Series

CAUTION

To prevent dirt from entering the transmission, use only clean containers and fillers for the transmission fluid. Do not use fillers or containers that have been used for water or antifreeze. Dirt, water, or antifreeze could damage the transmission.

1. Park the vehicle on a level surface and apply the parking brakes.
2. Operate the vehicle until the transmission reaches normal operating temperature: 160 to 200°F (71 to 93°C).
3. Clean the area around the drain plug and the transmission fluid pan. Place a drain pan under the transmission and remove the drain plug. Examine the fluid as it drains. If only the filter is being changed, do not drain the fluid.
4. Remove the 12 mounting bolts (6 each) from the 2 filter covers.

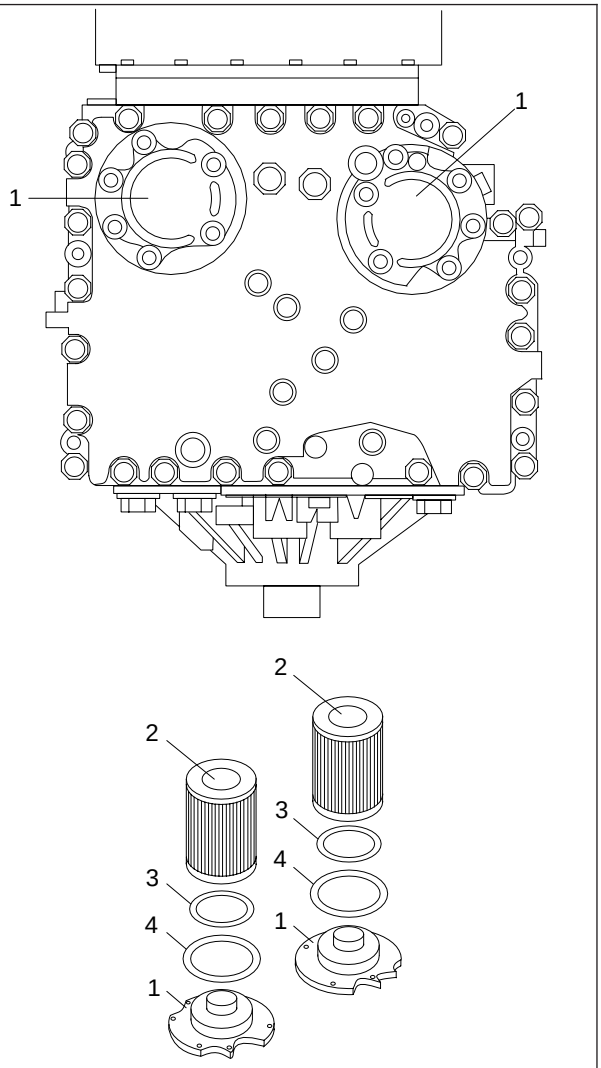
NOTE: A lot of fluid will drain when the filter covers are removed.

5. Remove the filter covers, O-rings, and two square-cut seals from the transmission. See **Fig. 4**.
6. Remove the filters from the bottom of the control module.
7. Lubricate the new O-rings with transmission fluid, and install them on the cover assemblies.
8. Install a new square-cut seal on each cover assembly, and install the fluid filter elements on the cover assemblies.
9. Install the filter and cover assemblies into the filter compartment.
10. Align each cover assembly with the holes in the channel plate sump, and push the cover assemblies in by hand to seat the seals.

CAUTION

Do not use the bolts to draw the filter covers to the sump. This can damage the covers, seals, or sump.

11. Install six bolts in each cover, and tighten the bolts 38 to 44 lbf·ft (51 to 61 N·m).



1. Filter Cover
2. Filter Element
3. Filter Element O-Ring
4. Square-Cut Seal

Fig. 4, Allison 3000 Series Transmission Filter Location and Components

12. Install a new drain plug O-ring, and install the drain plug. Tighten the drain plug 18 to 24 lbf·ft (25 to 32 N·m).
13. Fill the transmission with fresh transmission fluid and check the fluid level. See **Table 3**. See **Table 4** for lubricant capacities.
14. Check and adjust the fluid level using the procedures under "Checking the Fluid Level".

Checking the Fluid Level

CAUTION

Operating a transmission with the fluid level higher or lower than recommended can result in transmission damage. Do not overfill the transmission. Overfilling will force fluid out of the case through the main shaft openings.

Do not mix types and brands of fluid, because of possible incompatibility. Do not use fluid additives, friction modifiers, extreme-pressure gear fluids, or multiviscosity lubricants.

Cold Check

Clean all dirt away from around the end of the fluid fill tube before removing the dipstick.

CAUTION

Do not allow foreign matter to enter the transmission. Dirt or foreign matter in the hydraulic system may cause undue wear of transmission parts, make valves stick, and clog passages.

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. Park the vehicle on a flat, level surface.
2. Apply the parking brake and chock the rear tires.
3. Run the engine for at least one minute.
4. Shift from DRIVE to NEUTRAL, and then shift to REVERSE to fill the hydraulic system.
5. Shift to NEUTRAL and allow the engine to idle at 500 to 800 rpm.
6. With the engine running at idle, remove the dipstick from the tube, then wipe the dipstick clean.
7. Insert the dipstick into the tube and remove the dipstick.
8. Check the fluid level reading and repeat the check procedure to verify the reading.

   If the fluid level is within the COLD RUN band, the transmission may be operated until the fluid is hot enough to perform a HOT RUN check.

If the fluid level is not within the COLD RUN band, add or drain fluid as needed to adjust the fluid level to the middle of the COLD RUN band. See **Fig. 5**.

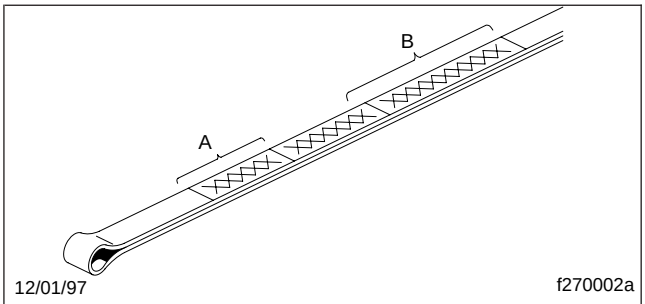


Fig. 5, Dipstick Markings

CAUTION

Do not fill above the COLD RUN band if the transmission fluid is below normal operating temperature. As fluid temperature increases, so does the fluid level. Filling above the COLD RUN band when the transmission is below normal operating temperature may result in an overfilled transmission, which causes fluid foaming and aeration. Fluid foaming and aeration cause transmission overheating and erratic shifting.

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

Hot Check

1. Park the vehicle on a flat, level surface. Apply the parking brake and chock the rear tires.
2. Shift the transmission to NEUTRAL.
3. Operate the engine at idle (500 to 800 rpm) until normal operating temperature is reached. Check that the sump temperature is 160 to 200°F (71 to 93°C). Check that the converter-out temperature is 180 to 220°F (82 to 104°C).
4. With the engine idling, remove the dipstick from the tube and wipe it clean.
5. Insert the dipstick into the tube and remove it.
6. Check the fluid level reading and repeat the check procedure to verify the reading. Safe operating level is within the HOT RUN band on the dipstick. The HOT RUN band is between the HOT FULL and HOT ADD marks.

If the fluid level is not within the HOT RUN band, add or drain fluid as needed to bring the fluid level within the HOT RUN band. See **Fig. 5**.

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31-01 Frame Fastener Torque Checking

Frame brackets and components secured with Huckbolt® fasteners do not require a torque check, however, they should be inspected for damage. Frame brackets and components secured with conventional bolts and nuts are to be checked at initial maintenance (IM).

Check the torque of frame fasteners to offset the effects of bedding in or seating. When possible, always check the torque of the nut, not the bolt head. This will give a true torque reading by eliminating bolt body friction.

When checking the torque of frame fasteners, inspect the frame for cracks and other damage. Set a click-type torque wrench to the maximum torque of the fastener you are checking. Apply pressure until the torque wrench clicks. Do not loosen the bolt to check the torque. See the applicable torque table in **Group 00** for torque specifications.

⚠ CAUTION

Make sure frame fasteners are properly tightened. Continued vehicle operation with loose fasteners could result in bracket or frame damage.

NOTE: Engine supports on vehicles built from January 2007 require require the same maintenance as shown below.

Inspect the fasteners at the following locations:

- axle stops
- engine trunnion supports
- exhaust brackets
- frame crossmembers and gussets
- front frame brackets
- front suspension spring brackets
- fuel tank brackets
- radius rods
- rear engine supports
- rear suspension spring brackets
- shock absorbers
- all other frame fasteners

Any component that shows signs of cracking or damage must be repaired or replaced. See the applicable group in the *S2 Chassis Workshop Manual* for repair or replacement information.

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32-01 Suspension Inspecting

Freightliner Spring Front and Rear Suspension Spring Assemblies Inspection

NOTE: Lubrication is not required on Freightliner Spring front and rear suspensions.

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 *S2 Chassis Workshop Manual* for instructions.

⚠ WARNING

Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. 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.

Freightliner Spring Shock Absorber Check

Make sure that the shock absorber brackets are tight and that the shock absorber is not striking or rubbing on the frame or some other part of the chassis. Check the rubber mounting bushings and replace them if worn. Inspect the shock absorber for oil leakage, which is defined as being drips of oil on the sides of the shock absorber.

If the shock absorber is worn or damaged, replace it with a new one.

Freightliner AirLiner Torque Arm Bushing Check

1. Without detaching the torque arms, use your hand to attempt to move each of the torque arm ends up, down, in, and out. If there is any movement, replace the torque arm.
2. Inspect the weld seams between the torque arm tube and the shorter bushing tubes. If there are cracks, replace the torque arm. Do not weld the torque arm for any reason.
3. Inspect the rubber bushing ends. See **Fig. 1**. Replace the torque arm for any of the following reasons.
    - There are gaps between the rubber bushing and the pin or the outer steel sleeve.
    - Either bushing end contacts a torque arm pin mounting bolt.
    - There are cracks in the bushing.
    - Part of the rubber bushing extends beyond the outside diameter of the outer bushing sleeve.

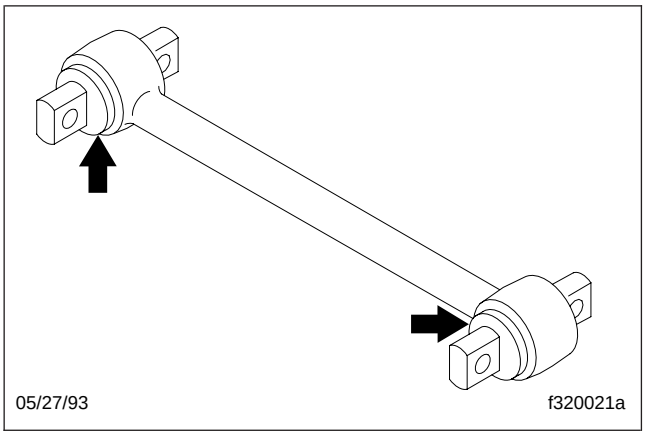

Fig. 1, Torque Arm Bushings

52-Inch Multi-Leaf Spring Component Check

No lubrication is required on the 52-inch multi-leaf spring rear suspension.

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

60-Inch Taper-Leaf Spring Component Check

No lubrication is required on the 60-inch taper-leaf spring 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.

Freightliner AirLiner Component Clearance Check

Check that the air line support brackets are positioned so the air lines do not rub against anything. Reposition any configurations that could contact the air line and result in friction and wear. There must be at least 1 inch (25 mm) clearance around the rubber air spring when inflated. If the clearance is less than 1 inch (25 mm), relocate the obstructing parts.

⚠ CAUTION

Failure to relocate obstructing parts could result in damage to the air spring.

Freightliner AirLiner Component Inspection and Operation Check

⚠ 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. Chock the front tires and apply the parking brake. Raise the rear of the vehicle so 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.
3. Inspect each air spring for wear at its connection to its pedestal. Replace any worn air springs.
4. Check the axle connection welds (beam seat to equalizing beam) and axle adapter to axle for cracks. If the welds are cracked, grind them out and reweld the parts.
5. 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.
6. Inspect the shock absorbers for oil leaks and worn rubber bushings. Replace the shock absorbers and/or rubber bushings if wear or damage is noted.
7. Inspect the stabilizer bar, if so equipped, for irregular bushing wear or cracks in the brackets. The stabilizer bar is optional on 10,000- and 15,000-pound AirLiner suspension systems.
8. Remove the safety stands and lower the rear of the vehicle to the ground. Run the engine until air pressure of at least 100 psi (689 kPa) is maintained throughout the system.
9. Check that all air springs are inflated.

32-02 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 and apply the parking brake. 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 1** for U-bolt torque specifications. Turn the wrench in a clockwise motion (looking up) until the torque wrench clicks.

   Remove the chocks.

U-Bolt High Nut Torque*	
Size	**Torque: lbf·ft (N·m)**
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)
7/8–14	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 420 to 500 (571 to 680)
1–14	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 520 to 600 (707 to 816)

* Tighten in the sequence shown in **Fig. 2**.

Table 1, U-Bolt High Nut Torque

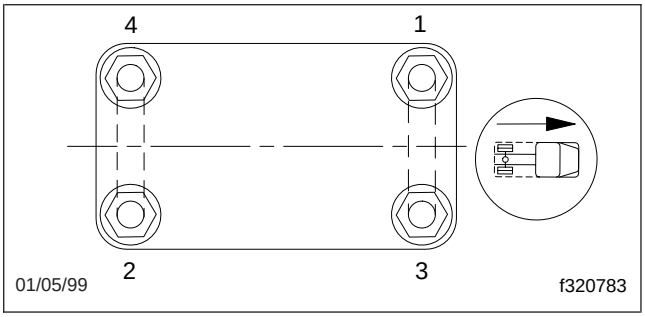

Fig. 2, Tightening Sequence for U-Bolt High Nuts

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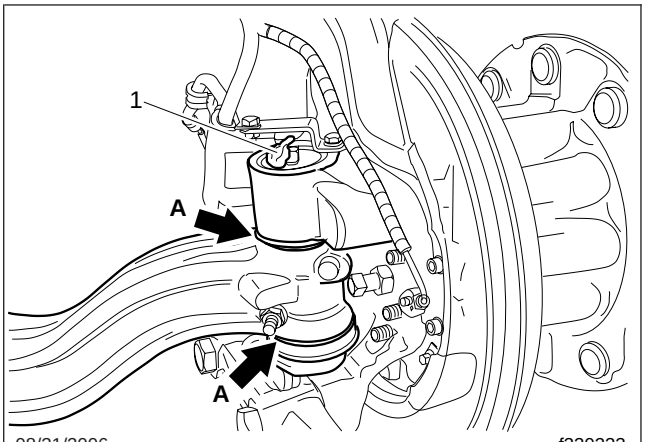
33-01 Kingpin Lubricating, Freightliner Axle

On the front axle, grease fittings are on the top and bottom kingpin caps of each knuckle.

1. Shut down the engine, apply the parking brake, and chock the rear tires.
2. Make sure the tires touch the ground. **Do not** raise the vehicle.
3. Clean all grease fittings prior to lubrication.

IMPORTANT: Daimler Trucks North America LLC recognizes that industry trends are moving toward increased selection and usage of synthetic grease in vehicle maintenance. However, some seals are known to expand when in contact with synthetic grease. Vehicle owners should consult their Freightliner dealership (and dealers should consult their DSM) for synthetic grease application references **before** using any synthetic grease when performing axle service and maintenance.

4. Using a multipurpose grease, NLGI grade 2, lubricate the kingpins through the grease fittings on the top and bottom of the knuckle. See **Fig. 1**.



A. Apply lubricant until new lubricant comes from these areas.
1. Grease Fitting

Fig. 1, Kingpin Lubrication

5. Force lubricant into the upper and lower kingpin grease fitting caps until new lubricant flows from between the upper axle beam end and the knuckle and between the lower axle beam end and the knuckle.
6. Remove the chocks from the tires.

NOTE: Tie rod end lubrication is not required. The tie rod ends are sealed, and do not release the grease.

33-02 Draw Key Nut Inspecting

Axles With Unitized Wheel Ends

Check the torque of the nut that holds the draw key on the side of the knuckle. The torque should be 30 to 45 lbf·ft (41 to 61 N·m). See **Fig. 2**.

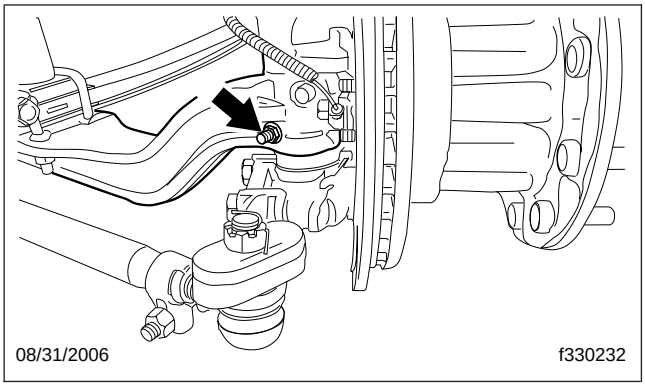


Fig. 2, Draw Key Nut

33-03 Tie Rod End Inspecting

IMPORTANT: If the tie rod end boot is torn or missing, replace the entire tie rod assembly or the tie rod end. Do not replace the boot only.

1. Shut down the engine, apply the parking brake, and chock the rear tires.
2. Check the tie rod boot for cracks, tears, or other damage. If the tie rod boot is damaged, replace the entire tie rod end.
3. Grasp by hand (or use a pipe wrench with jaw protectors to avoid gouging the cross tube) and slightly rotate the cross tube toward the front of the vehicle and then slightly toward the rear. Then center the cross tube between the stop po-

sitions. If the cross tube does not rotate in either direction, replace both tie rod ends.

4. Position yourself directly below the ball stud socket. Using both hands, grab the end as close to the socket as possible, no more than 6 inches (15.2 cm) from the end. Firmly apply about 100 pounds of hand pressure in an up and down motion several times. When moving the assembly, check for any movement at both tie rod ends. See **Fig. 3**.

   If any movement is detected at one tie rod end, replace **both** tie rod ends. Always replace tie rod ends in pairs, even if only one tie rod end is damaged.

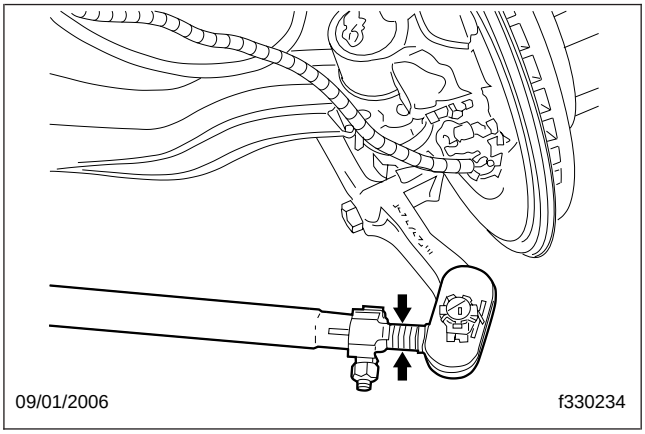


Fig. 3, Checking Tie Rod End Movement

⚠ CAUTION

Do not attempt to straighten a bent cross tube. Doing so could result in damage to the axle. Be sure to replace the cross tube with an original equipment cross tube with the same length, diameter, and thread size as the existing cross tube.

5. Check the cross tube for cracks or other damage. If the cross tube is bent or damaged, replace the cross tube.
6. Check the clamps for damage. If a clamp is damaged, replace the clamp. Replace the entire cross tube assembly if either clamp is welded to the cross tube.
7. Check for proper installation of the tie rod end clamp to the cross tube. Make sure that the tie rod ends are threaded in the cross tube past the clamps and the slots at the cross tube ends.
8. Check the grease fittings for damage. If a grease fitting is damaged, replace it.

   Some tie rod ends have no grease fittings because they are not greaseable. Do not install a grease fitting on a nongreaseable tie rod end.
9. Check that the cotter pin is in place. If it is not, tighten the tie rod end nut to the applicable value depending on the size of the stud.
   - 7/8–14, 160 to 300 lbf·ft (217 to 406 N·m)
   - 1–14, 250 to 450 lbf·ft (339 to 610 N·m)
   - 1-1/8–12, 350 to 650 lbf·ft (475 to 881 N·m)
   - 1-1/4–12, 500 to 675 lbf·ft (678 to 915 N·m)
10. Check the steering arm bolts for a minimum torque of 300 lbf·ft (406 N·m). If the steering arm bolt torque has fallen below this specification, remove the bolt, clean all the threads, and apply new Loctite® 680. Tighten the bolt 300 to 450 lbf·ft (406 to 610 N·m).
11. Remove the chocks from the tires.

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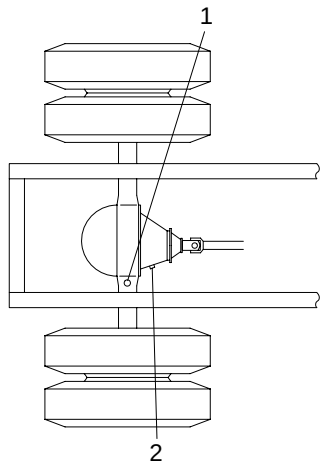
35-01 Axle Lubricant Level Checking

CAUTION

Failure to keep the rear axle filled to the proper level with the recommended lubricant can result in rear axle damage.

1. Clean the oil fill hole plug located in the carrier or the side of the axle housing and the area surrounding it. See **Fig. 1** and **Fig. 2**. Remove the plug.



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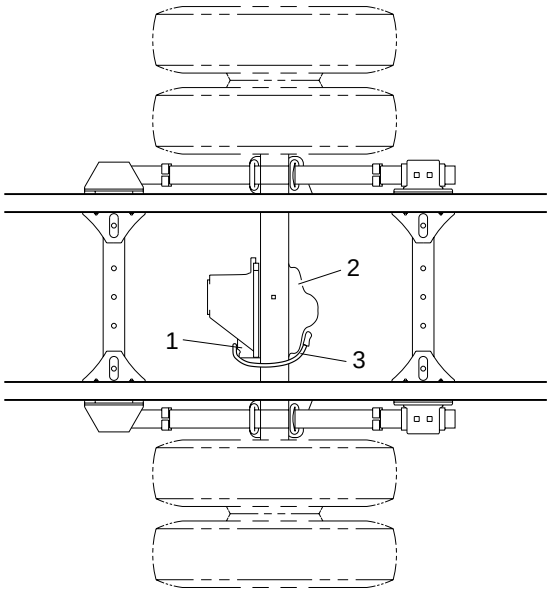
1. Axle Housing Breather
2. Carrier Oil Fill Plug

Fig. 1, Meritor Fill Hole Plug and Axle Housing Breather Locations

NOTE: Some Meritor and Freightliner axles have a small tapped and plugged hole located below the housing oil fill hole. This smaller hole is for the lubricant temperature sensor only and must not be used as a fill or level hole.

2. When the vehicle is on level ground, the lubricant must be level with the bottom of the oil fill hole. If low, add lubricant. See **Table 1** for approved axle lubricants.



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1. Axle Housing Breather
2. Carrier Oil Fill Plug
3. Axle Housing Breather Hose

Fig. 2, Freightliner Fill Hole Plug and Axle Housing Breather Locations

Drive Axle Recommended Lubricant		
Recommended Lubricant Type	**Ambient Temperature**	**Lubricant SAE Viscosity Grade**
Hypoid Gear Oil API Service Classification GL–5	10°F (–12.2°C) and up*	85W–140
	–15°F (–26.1°C) and up*	80W–90
	–40°F (–40°C) and up*	75W–90
	–40°F (–40°C) to 35°F (2°C)	75W
	–40°F (–40°C) and up*	75W–140
Synthetic Gear Oil	–40°F (–40°C) and up*	75W–90
	–40°F (–40°C) and up*	75W–140

* There is no upper limit on the ambient temperature, but axle sump temperature must never exceed 250°F (121°C).

Table 1, Drive Axle Recommended Lubricant

35-02 Axle Breather Checking

NOTE: Freightliner axles have a breather hose wrapped around the housing breather. The breather hose length should not be lower than approximately 1 inch below the axle housing weld seam.

The axle housing breather must remain clean. See **Fig. 1** and **Fig. 2**. When the axle lubricant level is checked, check that the axle breather is open. Check more often under poor operating conditions. If the breather is plugged, clean it or replace it as needed.

35-03 Axle Lubricant Changing and Magnetic Plug Cleaning

A regular schedule for changing the axle lubricant in a particular vehicle and operation can be accurately determined by analyzing oil samples taken from the axle at specified intervals or mileages. Lubricant suppliers frequently make their laboratory facilities available for determining the useful life of their product under actual service conditions. The final schedule that is recommended may, for economic reasons, be related to lubricant changes that are governed by climatic conditions and magnetic plug maintenance. Change lubricant type and viscosity as climatic temperatures demand, regardless of vehicle mileage or established change schedule.

The normal operating temperature of compounded lubricants during the summer season is about 160 to 220°F (71 to 104°C). The chemicals and additives that give these lubricants increased load carrying capacity oxidize faster at temperatures above 220°F (104°C), contributing to more rapid lubricant deterioration. For this reason, lubricants of this type that operate continuously at high temperatures must be changed more frequently.

⚠ CAUTION

Failure to change the axle lubricant at more frequent intervals, when adverse operating conditions require, could result in axle damage.

Axle Draining

1. Remove the plug at the bottom of the housing and drain the lubricant while the unit is warm. Allow enough time for all the old lubricant to drain completely.
2. Clean the drain plugs. For magnetic drain plugs, a piece of key stock or any other convenient steel slug may be used to short the two magnetic poles and divert the magnetic field.

NOTE: Meritor recommends using magnetic plugs with elements having a minimum pickup capacity of two pounds (one kilogram) of low-carbon steel in plate or bar form. Magnets will rapidly lose effectiveness as collected material bridges the gap between the two poles. Clean or change the plugs before this occurs. It may be necessary to clean or change the plugs one or more times between lubrication change intervals.

3. After cleaning the drain plugs, install and tighten the plugs 35 lbf·ft (47 N·m) for Meritor, or 40 lbf·ft (54 N·m) for Freightliner axles.

Axle Filling

1. With the vehicle on a level surface, fill the axle housings to the bottom of the oil fill hole (in the carrier or housing) with recommended lubricant; see **Table 1**. Refer to **Table 2** for Meritor drive axle lubricant capacities or **Table 3** for Freightliner drive axle lubricant capacities.

NOTE: Some Meritor and Freightliner axles have a small tapped and plugged hole located below the housing oil fill hole. This smaller hole is for the lubricant temperature sensor only and must not be used as a fill or level hole.

2. Install the fill hole plug and tighten it 35 lbf·ft (47 N·m) for Meritor axles, or 40 lbf·ft (54 N·m) for Freightliner axles.
3. After filling the carrier and housing assembly with lubricant, drive the vehicle unloaded for one or two miles (two or three kilometers) at speeds not to exceed 25 mph (40 km/h) to thoroughly circulate the lubricant throughout the assembly.

Meritor Drive Axle Lubricant Capacities	
Axle Model	**Capacity*: pints (L)**
MS–10–113D	14 (6.6)
MS–12–113D	15 (7.1)
RS–13–120	18.4 (8.7)
RS–15–120	14.3 (6.8)
RS–17–145	33.6 (15.9)
RS–17–144	32.3 (15.3)
RS–19–144	32.3 (15.3)
RS–19–145	33.2 (15.7)
RS–21–145	32.3 (15.3)
RS–21–160	39.5 (18.7)
RS–21–230	38.9 (18.4)
RS–23–160	39.5 (18.7)
RS–23–161	39.5 (18.7)
RS–23–186	47.3 (22.4)
RS–23–240	37.4 (17.7)
RS–26–185	38.0 (18.0)
RS–30–185	38.0 (18.0)

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

Table 2, Meritor Drive Axle Lubricant Capacities

Freightliner Drive Axle Lubricant Capacities	
Axle Model	**Capacity*: pints (L)**
ARS–13.0–2	15 (7)
ARS–15.0–2	15 (7)
ARS–17.5–2	15 (7)
ARS–19.0–2	15 (7)
ARS–20.0–2	15 (7)
ARS–21.0–2	15 (7)
ARS–21.0–4	23 (11)
ARS–23.0–4	23 (11)

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

Table 3, Freightliner Drive Axle Lubricant Capacities

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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.

When checking wheel nuts on a stud-piloted 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**, then tighten all of the outer wheel nuts in the same sequence.

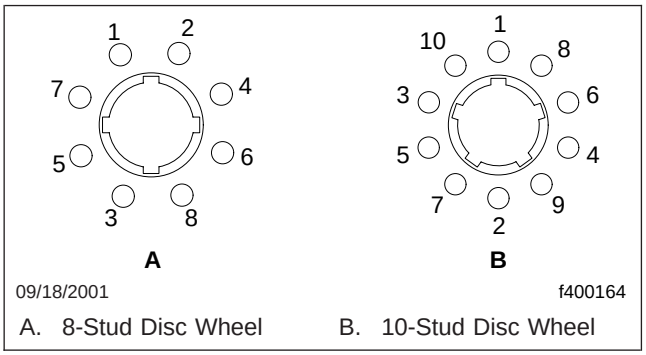

Fig. 1, Wheel Nut Tightening Sequence

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.

See **Table 1** for wheel nut torque specifications and see **Fig. 1** for the tightening sequence.

Wheel Nut Torque Specifications		
Thread Size	**Wheel Manufacturer**	**Torque (oiled) lbf·ft (N·m)**
M20 x 1.5	Accuride Corporation	280 to 330 (380 to 447)
M22 x 1.5	Accuride Corporation	450 to 500 (610 to 678)
1-1/8–16	Accuride Corporation	450 to 500 (610 to 678)
3/4–16	Accuride Corporation	450 to 500 (610 to 678)

Table 1, Wheel Nut Torque Specifications

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41-01 Driveline Inspecting

⚠ WARNING

Do not service or inspect a driveshaft with the engine running. A rotating driveshaft can cause serious personal injury.

Loose end yokes, excessive radial looseness, slip spline radial looseness, bent shaft tubing, or missing plugs in the slip yoke can cause universal joint and bearing defects.

See **Fig. 1** for an illustration of half-round end yokes.

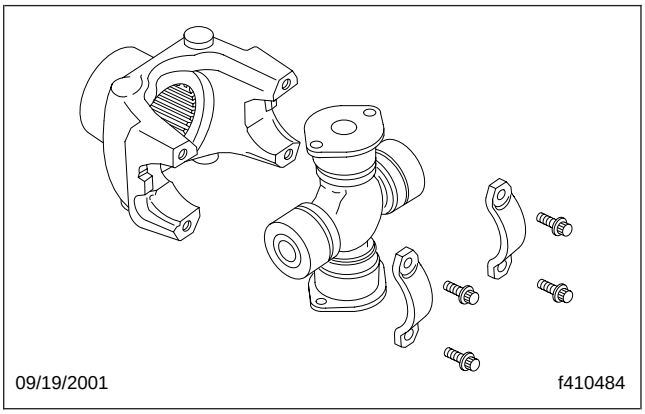


Fig. 1, Half-Round End Yoke

1. Check the output and input end yokes on both the transmission and axle for axial looseness. Refer to the axle or transmission manufacturer's service information for the correct specifications.

   If loose, disconnect the driveshaft. For instructions, see **Group 41** of the *S2 Chassis Workshop Manual*. Tighten the end yoke retaining nut to the proper specification. Refer to the axle or transmission manufacturer's service information for the correct specifications.

2. Inspect for worn universal joints. Apply a vertical force of about 50 pounds to the driveline near the universal joints. If there is any movement, replace the universal joint. For instructions, see **Group 41** of the *S2 Chassis Workshop Manual*.
3. Examine the slip yoke spline for excessive radial movement. See **Fig. 2**. If excessive radial looseness exists between the slip yoke and the tube shaft, replace the slip yoke and the tube shaft. For instructions, see **Group 41** of the *S2 Chassis Workshop Manual*.

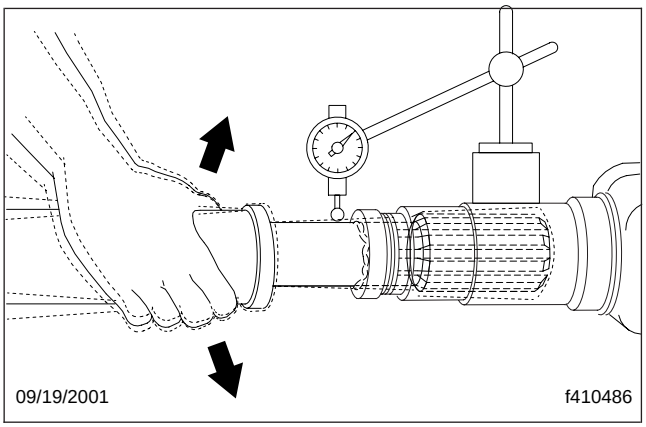


Fig. 2, Checking for Radial Looseness of the Slip Yoke Spline

4. Examine the shaft for damaged or bent tubing. Carefully remove any foreign material such as mud or dirt that has built up on the shaft.

41-02 Driveline Lubricating

The Easy Service driveline requires periodic lubrication of the universal joints and slip yoke splines. See **Table 1** for approved lubricants.

Approved Lubricants	
Lubricant and Specification	**Lubricant Brands**
Universal joint, slip joint, and spline grease must meet ArvinMeritor Specification O–634–B (NLGI Grade No. 2, Lithium 12-Hydroxy Stearate with Molybdenum Disulfide)	Phillips Petroleum Philube MW–EP2 Grease
	Exxon 5160
	Amalie All Purpose Grease with Moly–L1–2M
	Shell Super Duty Special FF
	Marathon Maralube Molycode 529
	Shell Moly Poly Grease
	Kendall L424 Grease
	Amoco Super Chassis Grease
	Ford Specification M1C–75B or part number PN™C1AZ 19590

Table 1, Approved Lubricants

Index, Alphabetical

42-01 Air Dryer AD–9 or AD–IP Desiccant Replacing

Bendix AD–9 Air Dryer

1. Park the vehicle on a level surface and apply the parking brake. Shut down the engine. Chock the tires.
2. Completely drain all air reservoirs. Air pressure gauges should read 0 psi (0 kPa).

IMPORTANT: The compressor discharge line may contain residual air pressure.

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

⚠ WARNING

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

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

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

11. Remove and discard desiccant cartridge O-rings.

⚠ CAUTION

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

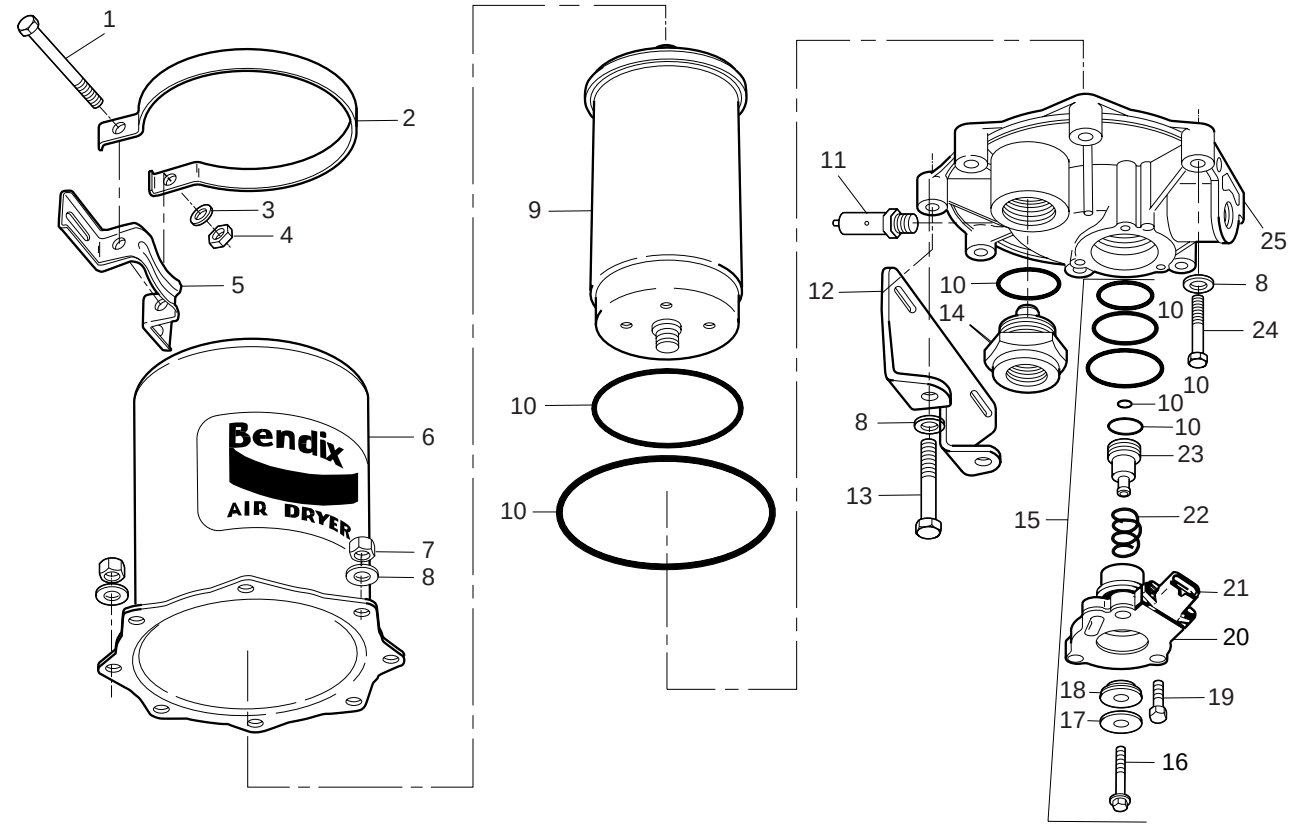
12. Lubricate new O-rings with grease supplied in the kit and install them in the end cover.
13. Install the desiccant cartridge on the end cover. Turn the cartridge clockwise until the desiccant cartridge makes contact with the end cover.
14. Place the desiccant cartridge in a vise, and turn the end cover clockwise an additional 180 to 225 degrees to fully tighten the desiccant cartridge to the end cover.

NOTE: Desiccant cartridge torque should not exceed 50 lbf·ft (68 N·m).

15. Place the housing over the desiccant cartridge and align the mounting holes with the end cover.
16. Install the 6 bolts, 12 washers, and 6 new nuts. Torque the bolts in a star pattern 270 to 385 lbf·in (3060 to 4340 N·cm). See **Fig. 2**.
17. Install the air dryer on the lower mounting bracket. Install the two previously marked bolts, four washers, and two new nuts. Torque the two remaining bolts 270 to 385 lbf·in (3060 to 4340 N·cm). Install the bolt, two washers, and a new nut in the upper mounting bracket strap. Torque the upper mounting bracket strap nut 80 to 120 lbf·in (904 to 1356 N·cm).
18. Connect and tighten the three air lines. Connect the harness connector to the heater and thermostat assembly until the lock tab snaps in place.
19. Start the engine, build the air pressure, and check the air brake system for leaks. If any air leaks are present, see **Group 42** of the *S2 Chassis Workshop Manual* for diagnosis and repair information.
20. Remove the chocks from the tires.

Bendix AD–IP Air Dryer

1. Park the vehicle on a level surface and apply the parking brake. Shut down the engine. Chock the tires.
2. Completely drain all air reservoirs. Air pressure gauges should read 0 psi (0 kPa).



1. 5/16 x 4-1/2-Inch Upper Mounting Bracket Bolt
2. Upper Mounting Bracket Strap
3. 5/16-Inch Lockwasher
4. 5/16-Inch Nylok® Nut
5. Upper Mounting Bracket
6. Housing
7. Nylok Nut
8. 3/8-Inch Special Washer
9. Desiccant Cartridge
10. O-Ring
11. Drain Valve
12. Lower Mounting Bracket
13. 3/8-Inch Bolt (long)
14. Check Valve Assembly
15. Purge Valve Assembly
16. Purge Valve Capscrew
17. Exhaust Diaphragm
18. Purge Valve
19. 1/4-Inch Screw
20. Purge Valve Housing
21. Heater and Thermostat Housing
22. Return Spring
23. Purge Piston
24. 3/8-Inch Bolt
25. End Cover

Fig. 1, AD-9 Air Dryer

IMPORTANT: The compressor discharge line may contain residual air pressure.

3. Using a wrench or a socket, loosen the desiccant cartridge bolt. Then separate the desiccant cartridge from the end cover.
4. Pull the cartridge bolt out of the end of the cover and remove the cartridge.

Do not attempt to disassemble the desiccant cartridge assembly. Parts for the assembly are not available and the cartridge contains a 150 lb spring that cannot be mechanically caged.

5. Remove and discard both O-rings from the desiccant cartridge bolt.
6. Using a clean rag, wipe the inside of the end cover clean. Clean the cartridge bolt bore in the end cover and the sealing surfaces for the large and small diameter desiccant cartridge sealing rings.

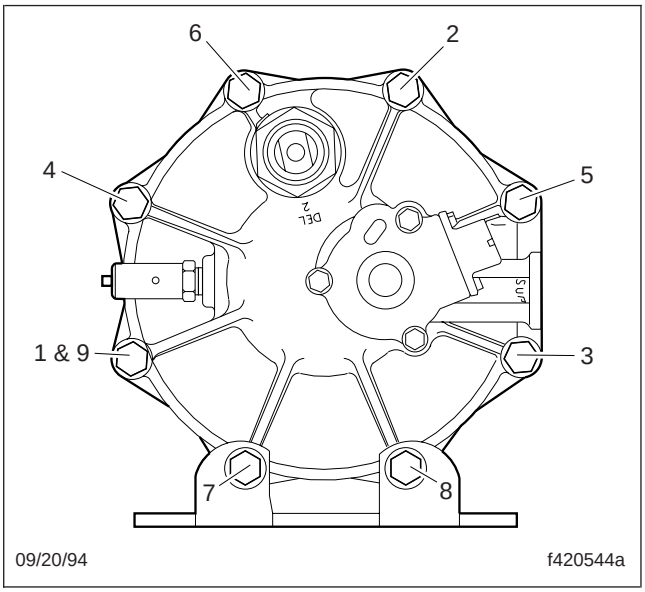


Fig. 2, End Cover to Housing Torque Pattern

7. Inspect the end cover for physical damage, then inspect all air line fittings for corrosion, and replace as necessary.
8. Inspect the bolt, paying attention to the threads and O-ring grooves. Clean the bolt.

IMPORTANT: Use only the grease supplied with Bendix replacement kits.

9. Lubricate the O-rings, bolt O-ring grooves, the sealing rings, and the cartridge grooves. Lubricate the end cover bore for the bolt.
10. Install both O-rings on the cartridge bolt and, using a twisting motion, insert the assembled desiccant cartridge bolt in the end cover.
11. Install the desiccant cartridge on the end cover, making sure that the cartridge is properly seated and flush on the end cover.

NOTE: It may be necessary to rotate the cartridge slightly until the anti-rotation lugs are properly aligned and allow the cartridge to rest flush against the end cover.

12. Using a wrench or socket, tighten the desiccant cartridge bolt to 70 lbf·ft (95 N·m). **Do not** overtorque.
13. Before placing the vehicle into service, perform the testing listed below.
    - 13.1 Close all reservoir drain cocks.
    - 13.2 Build the system pressure to governor cutout and note that the AD-IP air dryer purges with an audible escape of air.
    - 13.3 Fan the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a purge at the AD-IP air dryer exhaust.
    - 13.4 Check for excessive leakage around the head of the desiccant cartridge where it contacts the end cover. With the compressor in loaded mode (compressing air), apply a soapy solution to these areas and observe that any leakage does not exceed a one-inch bubble in one second. If leakage exceeds this measure, remove and re-install the desiccant cartridge.
14. Remove the chocks from the tires.

42-02 Governor D–2A Checking

IMPORTANT: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Every 12 months perform the operational tests as listed below.

Operational Tests

1. Start the engine, build air pressure in the air brake system, and check the pressure registered by a dash or test gauge at the time the governor cuts out, stopping the compression of air by the compressor. The cutout pressure should be in accordance with the pressure setting of the piece number being used. Common cutout pressures are between 125 to 135 psi (862 to 931 kPa).

   With the engine still running, make a series of brake applications to reduce the air pressure and observe at what pressure the governor cuts in the compressor. As in the case of the cutout pressure, the cut-in pressure should be in accordance with the pressure setting of the piece

number being used. Cut-in pressure is 105 psi (724 kPa).

As in the case of the cutout pressure, the cut-in pressure should be in accordance with the pressure setting of the piece number being used. Cut-in pressure is 105 psi (724 kPa).

NOTE: If the governor cover is marked nonadjustable and the adjusting stem has been sheared off, this is a non-serviceable governor and must be replaced with a new or remanufactured unit.

2. Never condemn or adjust the governor pressure settings unless they are checked with an accurate test gauge or a dash gauge that is registering accurately. If the pressure settings of the D-2 governor are inaccurate or it is necessary that they be changed, the adjustment procedure follows.

   2.1 Remove the top cover from the governor.

   2.2 Loosen the adjusting screw locknut.

   2.3 To raise the pressure settings, turn the adjusting screw counterclockwise. To lower the pressure settings, turn the adjusting screw clockwise. Be careful not to overadjust. Each 1/4 turn of the adjusting screw raises or lowers the pressure setting approximately 4 psi (28 kPa).

   2.4 When proper adjustment is obtained, tighten the adjusting screw locknut and replace the cover. The pressure range between cut-in and cut-out is not adjustable.

Cut-In Position

Apply soap solution around the cover and to the exhaust port. Slight bubble leakage is permitted. Excessive leakage indicates either a faulty inlet valve or lower piston O-ring.

Cutout Position

Apply soap solution around the cover and to the exhaust port. Slight bubble leakage is permitted. Excessive leakage indicates a faulty exhaust valve seat, exhaust stem O-ring, or O-ring at the top of the piston.

If the governor does not function as described or leakage is excessive, it is recommended that it be replaced with a new or remanufactured unit, or repaired with genuine Bendix parts.

42-03 Hydraulic Brake Lining Wear Checking

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

⚠ 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.

1. Chock the tires on the axle that isn't being worked on.
2. Remove the wheel and tire assemblies from the axle that is not chocked.
3. 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.
4. Measure the thickness of the brake pads at each end of the raised axle. Replace all of the pads at both axle ends if any of the linings is worn to less than 3/16 inch (4.8 mm) at the thinnest point.
5. Make sure that the brake rotor and linings are free of oil and grease.
6. Install the wheel and tire assemblies, then repeat all of the above steps on the other axle.

42-04 Slack Adjuster Lubricating

IMPORTANT: Perform **MOP 42-15** before lubricating the slack adjusters.

Automatic slack adjusters that have a grease fitting, must be lubricated periodically to ensure proper brake operation.

⚠ WARNING

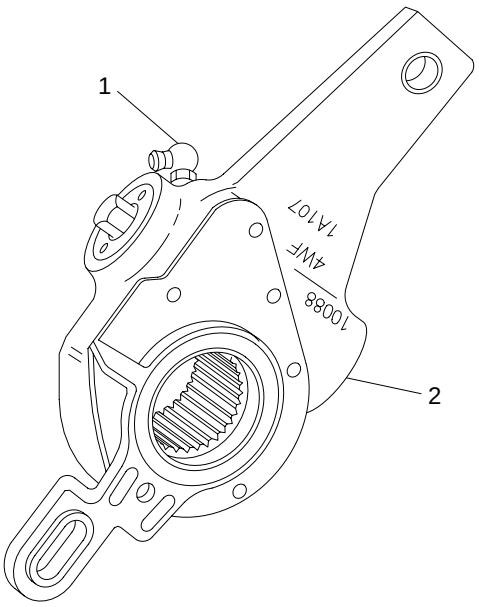
Failure to lubricate slack adjusters could lead to dragging brakes, or a brake failure, resulting in pesonal injury or property damage.

Haldex

⚠ CAUTION

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 the automatic slack adjuster at the grease fitting. See **Fig. 3**. Use standard chassis lubricant for Haldex slack adjusters.



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1. Grease Fitting
2. Slack Adjuster

Fig. 3, Haldex Slack Adjuster Grease Fitting

Gunite

For operating temperatures of –20°F (–29°C) and higher, use Texaco Multifak EP-2 or Mobil Grease No. 77.

For operating temperatures between –20°F (–29°C) and –40°F (–40°C), use Lubriplate Aero grease.

Gunite automatic slack adjusters are produced without a grease relief. During lubrication with a grease gun, lubricant is forced through the drilled worm wheel onto the camshaft. Lubricate the automatic slack adjuster at the grease fitting until grease appears on the camshaft.

Meritor

NOTE: If equipped with an extended maintenance Q Plus™ brake system, the slack adjuster will not have a grease fitting. These slack adjusters use a special NLGI Grade synthetic polyurea grease and do not require lubrication for 3 years or 500,000 miles (800 000 km), whichever comes first. Extended maintenance slack adjusters should be lubricated during brake reline service. For service and lubrication instructions, see **Group 42** of the *S2 Chassis Workshop Manual*.

For slack adjusters with grease fittings and for operating temperatures above –40°F (–40°C), use an NLGI Grade 1 clay-base grease or an NLGI Grade 1 and 2 lithium-base grease.

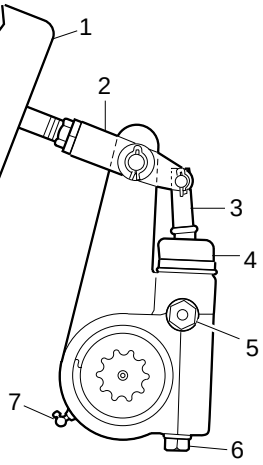
For slack adjusters with grease fittings, and for operating temperatures below –40°F (–40°C) and above –65°F (–54°C), use a NLGI Grade 2 synthetic oil or a clay-base grease.

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. See **Fig. 6**.

42-05 Meritor Camshaft Bracket Lubricating

IMPORTANT: Perform **MOP 42-15** before lubricating the camshaft brackets.

NOTE: If equipped with an extended maintenance Q Plus™ brake system, the camshaft



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1. Brake Chamber
2. Clevis
3. Actuator Rod
4. Boot
5. Pull-Pawl Seal
6. Manual Adjusting Nut
7. Grease Fitting (or plug)

Fig. 4, Meritor Automatic Slack Adjuster

bracket will not have a grease fitting. These camshafts use a special NLGI Grade synthetic polyurea grease and do not require lubrication for 3 years or 500,000 miles (800 000 km), whichever comes first. Extended maintenance camshaft bushings should be lubricated during brake reline service. For service and lubrication instructions, see **Group 42** of the *S2 Chassis Workshop Manual*.

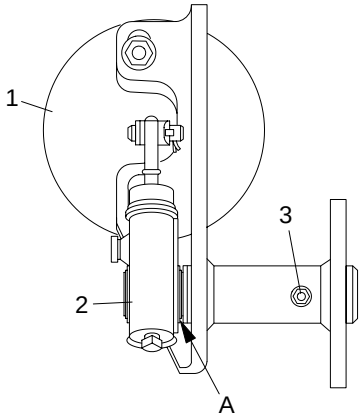
For camshaft brackets with grease fittings, use an NLGI Grade 1 or Grade 2 multipurpose chassis grease.

Lubricate the camshaft bushings through the grease fitting on the camshaft bracket or the spider until new grease flows from the inboard seal. See **Fig. 5**.

If grease leaks out under the camhead, the camshaft bracket grease seal is worn or damaged. See **Group 42** of the *S2 Chassis Workshop Manual* for grease seal replacement instructions.

⚠ WARNING

If a worn or damaged camshaft bracket grease seal is not replaced, the brake linings could become contaminated with grease. The stopping distance of the vehicle will be increased, which could result in personal injury or property damage.



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A. Grease Exit
1. Brake Chamber
2. Slack Adjuster
3. Non-Pressure-Relief Grease Fitting

Fig. 5, Camshaft Bracket Lubricating

42-06 Air Dryer AD–9, AD–IP Checking

IMPORTANT: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

Every 3 months:

1. Check for moisture in the air brake system by opening reservoir drain valves and checking for presence of water. If moisture is present, the desiccant cartridge may require replacement; however, the following conditions can also cause water accumulation and should be considered before replacing the desiccant:

- An outside air source has been used to charge the system. This air did not pass through the drying bed.
- Air usage is exceptionally high and not normal. This may be due to high air system leakage.
- In areas where more than a 30-degree range of temperature occurs in one day, small amounts of water can temporarily accumulate in the air brake system due to condensation. Under these conditions, the presence of small amounts of moisture is normal.

NOTE: A small amount of oil in the system is normal and should not be considered as a reason to replace the desiccant cartridge. Some oil at the dryer exhaust is normal.

2. Visually check for physical damage, such as chaffed or broken air and electrical lines and broken or missing parts.
3. Check mounting bolts for tightness. Torque 30 to 35 lbf·ft (41 to 47 N·m).
4. Perform the operational and leakage tests listed below.

Operational and Leakage Tests

1. Check all lines and fittings leading to and from the air dryer for leakage and integrity. Repair any leaks found.
2. Build system pressure to governor cutout and note that the dryer purges with an audible escape of air. Watch the system pressure and note the pressure fall-off for a 10-minute period. If the pressure drop exceeds 1 psi/minute from either service reservoir, inspect the vehicle air systems for sources of leakage and repair them. Refer to troubleshooting information in Bendix service literature.
3. Check for excessive leakage around the purge valve with the compressor in the loaded mode (compressing air). Apply a soap solution to the purge valve exhaust port and observe that leakage does not exceed a 1-inch (25-mm) bubble in 1 second. If the leakage exceeds the maximum specified, refer to troubleshooting information in the Bendix service literature.
4. Build system pressure to governor cutout and note that the dryer purges with an audible escape of air. Fan the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a dryer purge. If the system does not follow this pattern, refer to troubleshooting information in the Bendix service literature.
5. Check the operation of the end cover heater and thermostat assembly during cold weather operation as follows:

   5.1 Electric Power to the Dryer: With the ignition in the ON position, check for voltage to the heater and thermostat assembly using a voltmeter or testlight. Unplug the electrical connector at the air dryer and place the test leads on each of the connections of the female connector on the vehicle power lead. If there is no voltage, look for a blown fuse, broken wires, or corrosion in the vehicle wiring harness. Check to see if a good ground path exists.

   5.2 Thermostat and Heater Assembly Operation: These tests are not possible except in cold weather operation. Turn off the ignition switch and cool the thermostat and heater assembly to below 40°F (4°C). Using an ohmmeter, check the resistance between the electrical pins in the air dryer connector half. The resistance should be 1.5 to 3.0 ohms for the 12-volt heater assembly and 6.0 to 9.0 ohms for the 24-volt heater assembly.

   NOTE: Some models of the AD–9 may have a resistance reading of 1.0 to 2.5 ohms.

   Warm the thermostat and heater assembly to approximately 90°F (32°C) and again check the resistance. The resistance should exceed 1000 ohms. If the resistance values obtained are within the stated limits, the thermostat and heater assembly is operating properly. If the resistance values obtained are outside the stated limits, replace the heater and thermostat assembly.

42-07 Brake Lines and Fittings Inspecting, Hydraulic Brakes

Chock the tires, release the parking brake, and make a full service brake application.

Replace damaged or leaking components, and tighten loose fittings.

42-08 Brake Pedal Linkage and Mounting Plate Inspecting

Inspect the pedal, pedal linkage, and mounting plate assembly for proper operation to ensure that any problems believed to be valve-related are not actually mechanism issues.

42-09 Air Brake Inspecting and Leakage Testing

IMPORTANT: There is no scheduled (Bendix) air valve maintenance that requires disassembly of the valve within the warranty period. If the valve does not function while within the warranty period, do not disassemble the part as this will void the warranty.

If any of the tests in the following procedure fail, refer to **Group 42** of the *S2 Chassis Workshop Manual* to test individual air brake components and valves.

⚠ WARNING

Some steps in this operation require the parking brakes to be released. Make sure the vehicle is on a level surface and all tires are chocked. Failure to do so could result in the vehicle rolling, causing personal injury and/or vehicle damage.

1. Park the vehicle on a level surface, shut down the engine, apply the parking brake, and chock all tires.
2. Completely drain all air reservoirs.
3. Install accurate test gauges in the primary and secondary reservoirs.
4. Start the engine and run it at a fast idle.
5. Record reservoir pressures when the low-pressure warning turns off.
6. Record governor cutout pressure and air dryer purge pressure.
7. Reduce service air pressure by applying and releasing the service brakes several times, and record the governor cut-in pressure.
8. Charge the air system to governor cutout, shut down the engine, and apply the parking brake.
9. Allow pressure to stabilize for one minute.
10. Observe the installed service reservoir gauges. Pressure should not drop more than 10 psi (69 kPa) within five minutes.
11. If necessary, start the engine and charge the air system. Shut down the engine and release the parking brake.
12. Make and hold a full service brake application, allowing the pressure to stabilize for one minute. Observe the installed service reservoir gauges. The pressure should not drop more than 15 psi (103 kPa) in five minutes.
13. With the air system at full pressure and the engine idling, operate the parking brake control valve and note that all spring brake chambers apply and release the parking brake promptly as the control valve knob is pulled out and pushed in.
14. Build air system pressure to cutout, then shut down the engine.
15. Completely drain the secondary (front axle) reservoir. On vehicles equipped with single check valves, where the air dryer is not attached to the reservoir, the primary reservoir should not lose pressure.
16. Make a service brake application. The rear axle brakes should apply and release, and brake lights should illuminate.
17. Close the drain cocks, recharge the system, and completely drain the primary reservoir. On vehicles equipped with single check valves, where the air dryer is not attached to the reservoir, the secondary reservoir should not lose air pressure.

18. Start the engine and charge the air system until the governor cuts out.
19. Shut down the engine and leave the parking brake released.
20. Completely drain the primary reservoir.
21. Make a modulated service brake application. Both front and rear brakes should modulate. At a steady full brake application, pressure should not drop more than 10 psi (69 kPa) within five minutes.
22. Drain all reservoirs, then remove the gauges from the service reservoirs. Close the reservoir drain cocks.
23. Remove the chocks from the tires.

42-10 ABS Tone Rings Cleaning

⚠ CAUTION

An accumulation of road salt, dirt, and debris on the antilock braking system (ABS) tone rings and sensors can cause the ABS warning light to illuminate.

IMPORTANT: During winter months in areas where corrosive materials are used on the highways, periodically clean the underside of the vehicle to ensure proper ABS functioning. Thoroughly clean the wheel/ABS sensor/tone ring areas, removing all corrosive materials.

42-11 Bendix Hydro-Max® Brake System Inspecting

1. Check the fluid level in the hydraulic brake fluid reservoir. If needed, fill the reservoir to the ridge that surrounds the reservoir. See **Fig. 6**. 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 *S2 Chassis Workshop Manual* for replacement instructions, 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. The operator should also feel the pedal force relieve and the pedal should depress easily.
   - 6.2 With the engine running and the 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 condition other than loss of back-up motor power.

42-12 Brake Caliper Slide Pin Lubricating, Bosch Hydraulic Brakes

⚠ WARNING

Breathing brake lining dust (asbestos or non-asbestos) could cause lung cancer or lung disease. Unless exposure can be reduced below legal

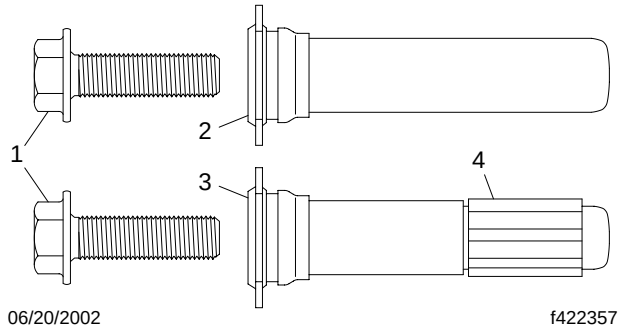
limits, wear an air purifying respirator approved by MSHA or NIOSH at all times when servicing the brakes, starting with removal of the wheels and continuing through assembly.

NOTE: See the *Bosch Pin Slide Disc Brakes Service Manual* for more information.

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

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). See **Fig. 7**.



1. Flanged Bolt
2. Leading Pin
3. Trailing Pin
4. Rubber Bushing

Fig. 7, ZOH-T Slide Pins and Bolts

42-13 Drum Brake Shoe Roller Lubricating

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.

1. Park the vehicle on a level surface. Shut down the engine, set the parking brake, and chock the tires.
2. Raise the front or the rear axle and then place safety stands under the frame or axle. Be sure that the stands will support the weight of the vehicle.
3. Remove the wheels and the brake drums.

CAUTION

Before you back off automatic slack adjusters, see the slack adjuster manufacturer's service information for instructions. Failure to do so could result in damage to the slack adjusters.

4. Back off the slack adjusters.
5. Push down on the bottom brake shoe and then (by pulling on the roller-retaining clip) remove the bottom cam roller.
6. Lift the top brake shoe and then (by pulling on the roller-retaining clip) remove the top cam roller.
7. Thoroughly clean the rollers, retaining clips, and the roller pin recesses in the brake shoes.

CAUTION

Do not apply grease to the outer diameters of the rollers (where they contact the cam head).

8. Apply a good-quality, multipurpose chassis grease to the retaining clips, brake spider, and the shoe rollers where they contact the brake shoes.
9. One at a time, pull each brake shoe away from the cam and install the top and the bottom shoe rollers.
10. Install the brake drums and the wheels.

DANGER

Do not operate the vehicle until the brakes have been adjusted and checked for proper operation. To do so could result in inadequate or no braking ability, which could cause personal injury, or death, or property damage.

IMPORTANT: See the slack adjuster manufacturer's service information and adjust the brakes at the slack adjusters.

11. Remove the safety stands, lower the vehicle, and remove the chocks from the tires.
12. In a safe area, drive the vehicle and check for proper brake operation.

42-14 Foot Brake Valve Actuator Lubricating, Bendix E–6

1. Remove the brake valve. For instructions, see **Group 42** of the *S2 Chassis Workshop Manual*.
2. From the outside of the cab, pull the valve away from the frontwall and remove the brake plunger.
3. Wipe off the old grease from the plunger and the adaptor.
4. Inspect the bore of the adaptor and the sliding surface of the plunger. While some discoloration is permissible, there should be no pitting or roughness of the adaptor bore or the sliding surface of the plunger. If pitting or roughness exists, replace damaged parts with new ones.
5. Lubricate the adaptor bore and the sliding surface of the plunger with an approved silicone-based grease, Dow Corning 55 O-Ring Lubricant (formerly Molykote DC–55M), or Loctite® V–755 O-Ring Lubricant.
6. Using a new gasket, install the plunger and brake valve following the instructions in **Group 42** of the *S2 Chassis Workshop Manual*.

42-15 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 *S2 Chassis Workshop Manual* for repair procedures.

Brake Component Inspection

1. Park the vehicle on a level surface, set the parking brake, 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 *S2 Chassis Workshop Manual* for inspection, troubleshooting, and repair procedures.
4. Measure the applied chamber stroke. See **Table 1** for the proper stroke for the type of chamber being used. If the stroke is too short, the brakes may drag or will not fully apply. Check the im-

proper operation or adjustment of the automatic slack adjuster. See **Group 42** of the *S2 Chassis Workshop Manual* for inspection and troubleshooting procedures.

5. Start the engine and build air pressure to at least 100 psi (689 kPa). Shut down the engine.
6. Check all foundation brake components for damage, wear, and loose or missing parts. Repair as needed. See **Group 42** of the *S2 Chassis Workshop Manual* for repair procedures.

Brake Chamber Stroke Specifications

Chamber			Max Applied Stroke: inch (mm)
Manufacturer	**Type***	**Size†**	
Gunite	Standard Stroke	9	1-3/8 (35)
		12	
		16	1-3/4 (44)
		20	
		24	
		30	2 (51)
		36‡	2 1/4 (57)
	Long Stroke	16	2 (51)
		20	
		24 (2-1/2 inch rated stroke)	
		24 (3 inch rated stroke)	2 1/2 (64)
		30	
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.

‡ If type 36 chamber is used, slack length should be less than 6 inches.

Table 1, Brake Chamber Stroke Specifications

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46-01 Drag Link Inspecting

⚠ WARNING

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

Have someone turn the steering wheel from left to right. Check for movement between the ball stud end at both the pitman arm and the steering arm. Also check if the ball stud nut is loose.

If the ball stud end is loose, replace the drag link. If the ball stud nut is loose, replace the nut and cotter pin. See **Group 00** for torque specifications.

Inspect the boot of the drag link at both the pitman arm and the steering arm end for cracks, splits, or other damage. Replace the boot as needed. See **Group 46** of the *S2 Chassis Workshop Manual* for drag link removal and installation instructions.

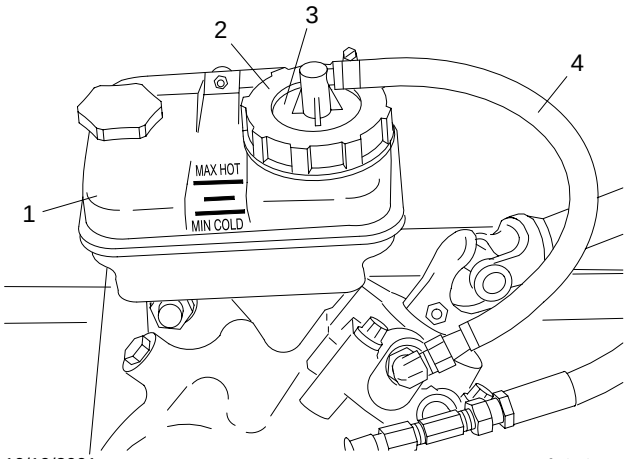
Grasp the drag link near the pitman arm end and move the drag link side to side to check for axial movement in the ball stud end. If it is loose, replace the drag link. See **Group 46** of the *S2 Chassis Workshop Manual* for replacement instructions. If there is 1/8-inch (3-mm) movement or more, do not drive the vehicle until the drag link is replaced.

46-02 Power Steering Fluid and Filter Changing

⚠ WARNING

Fill only with approved clean fluid. Failure to use the proper fluid could cause seal deterioration and leaks. Fluid leaks could eventually cause loss of power steering assist. This could lead to an accident resulting in personal injury or property damage. Wear eye protection when changing the fluid and filter.

1. Apply the parking brakes and chock the rear tires.
2. Place a drain pan under the power steering reservoir.
3. Remove the retaining ring from the reservoir. See **Fig. 1**.



1. Power Steering Reservoir
2. Retaining Ring
3. Filter Cover
4. Return Hose

Fig. 1, Power Steering Reservoir

4. Remove the filter and filter cover from the reservoir. Disconnect the filter from the filter cover and discard the filter.
5. Remove the bolts, nuts, and washers that attach the power steering reservoir to the mounting bracket. Drain the fluid from the reservoir, but do not remove the supply line to the reservoir.
6. Using bolts, nuts, and washers, attach the reservoir to the mounting bracket.
7. Fill the reservoir with an approved power steering fluid to the line between the MIN COLD and MAX HOT lines. See **Fig. 1**. See **Table 1** for approved power steering fluids.

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

* Do not mix fluid types. Refer to the text in this group for a detailed warning statement.

Table 1, Approved Power Steering Fluids

8. Raise the front of the vehicle and support it with jack stands.

9. Start the engine and operate it at idle. Turn the steering wheel from full left and full right several times until clean fluid starts flowing from the power steering filter. Add fluid to the reservoir to maintain the fluid level between the MIN COLD and MAX HOT lines.
10. Shut down the engine. Apply a thin film of power steering fluid on the gasket of a new filter. Then attach the filter to the filter cover. Make sure that the gasket under the filter cover is not damaged. If the gasket is damaged, replace it. Install the gasket on the reservoir. Install the filter and filter cover in the reservoir.
11. Attach the retaining ring to the reservoir to secure the filter and filter cover.
12. Start the engine and check that the power steering fluid level is between the MIN COLD and MAX HOT lines. Add more fluid if needed.
13. Raise the vehicle, remove the jack stands, and lower the vehicle.
14. Remove the chocks from the tires.

46-03 Power Steering Fluid Level Inspecting

1. Apply the parking brake and chock the rear tires.
2. With the engine cool, the fluid level should be between the MIN COLD and MAX HOT lines with the engine off.
3. Add or remove fluid as necessary to bring the fluid level between the MIN COLD and MAX HOT lines. See **Table 1** for approved power steering fluids.
4. With the engine hot, the fluid level should be at the MAX HOT line with the engine off.
5. Add or remove fluid as necessary to bring the fluid level to the MAX HOT line. See **Table 1** for approved power steering fluids.
6. Remove the chocks from the tires.

46-04 Power Steering Gear Lubricating

TRW THP Series

⚠ CAUTION

Apply grease to the sector shaft with only a hand-type grease gun. Use of a high-pressure power grease gun will supply grease too quickly and could affect the high pressure seal, contaminating the hydraulic fluid.

Using a hand-type grease gun, apply NLGI Grade 2 or 3 multipurpose chassis grease until it starts to come out past the sector shaft seal.

46-05 Drag Link Lubricating

1. Using a clean rag, wipe all dirt from both drag link grease fittings.
2. Using a pressure gun, apply grease at the grease fittings until old grease is forced out of the socket. Use multipurpose chassis grease NLGI Grade 2 (8% 12-hydroxy lithium stearate grease) or NLGI Grade 1 (6% 12-hydroxy lithium stearate grease).

NOTE: NLGI Grade 2 is the preferred grade.

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47-01 Fuel Tank Band Nut Tightening

IMPORTANT: Do not overtighten the nuts.

Hold the retention nut on the fuel tank band with a wrench while backing off the jam nut. Then tighten the retention nut 13 to 17 lbf·ft (18 to 23 N·m). After the retention nut has been tightened, hold the retention nut with a wrench while tightening the jam nut 13 to 17 lbf·ft (18 to 23 N·m).

47-02 Fuel/Water Separator Element Replacing

Alliance Fuel/Water Separator Replacement

The only maintenance necessary on an Alliance fuel/water separator is to replace the filter element.

⚠ WARNING

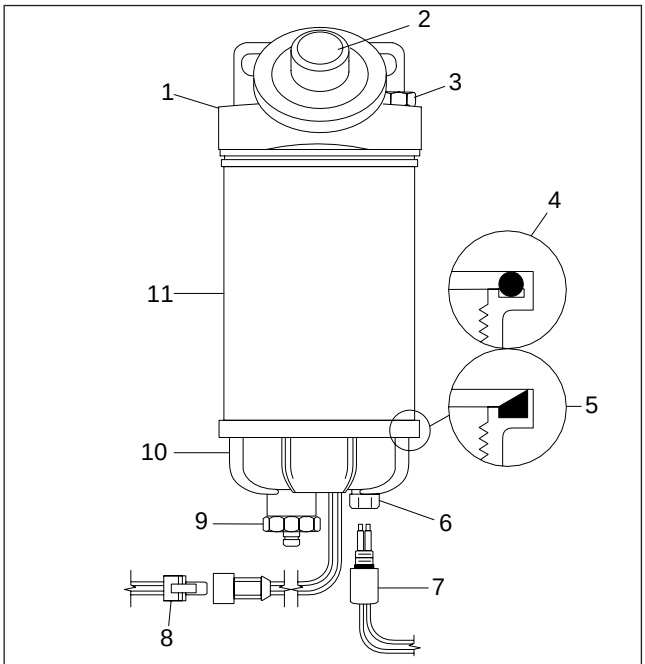
Diesel fuel is flammable and can ignite if exposed to an open flame, intense heat, or other ignition source. Do not drain fuel near, or expose fuel vapor to open flame or intense heat. Exposure to open flame or intense heat could start a fire, possibly resulting in personal injury or property damage. When working on a fuel system, have a fire extinguisher within easy reach.

1. Drain off some fuel by loosening the vent plug and opening the drain valve.
2. Disconnect the water sensor and heater connections if so equipped.
3. Remove the element and bowl together by turning counterclockwise.
4. Remove the bowl from the element and clean the O-ring gland.
5. Apply a coating of clean fuel or motor oil to the new O-ring and element seal.
6. Spin the bowl onto the new element, then spin them both onto the filter head snugly by hand only.

IMPORTANT: Do not use tools to tighten the bowl and element.

7. Connect the water sensor and heater connectors if so equipped.
8. If equipped with a primer pump, loosen the vent plug. Then operate the primer pump until the fuel purges at the vent plug. See **Fig. 1**.

   Close the vent plug.
9. Start the engine and check for fuel leaks.
10. Shut down the engine and correct any fuel leaks.



1. Mounting Head
2. Fuel Primer Pump
3. Vent Plug
4. Bowl O-Ring
5. Bowl Gasket
6. Bowl Probe Plug
7. Water Sensor Probe
8. Heater Connector
9. Drain Plug
10. Sight Bowl
11. Filter Element

Fig. 1, Alliance Fuel/Water Separator

Davco Fuel Pro® 382 Fuel/Water Separator Filter Replacement

Replace the fuel/water separator element only when the filter element is completely covered.

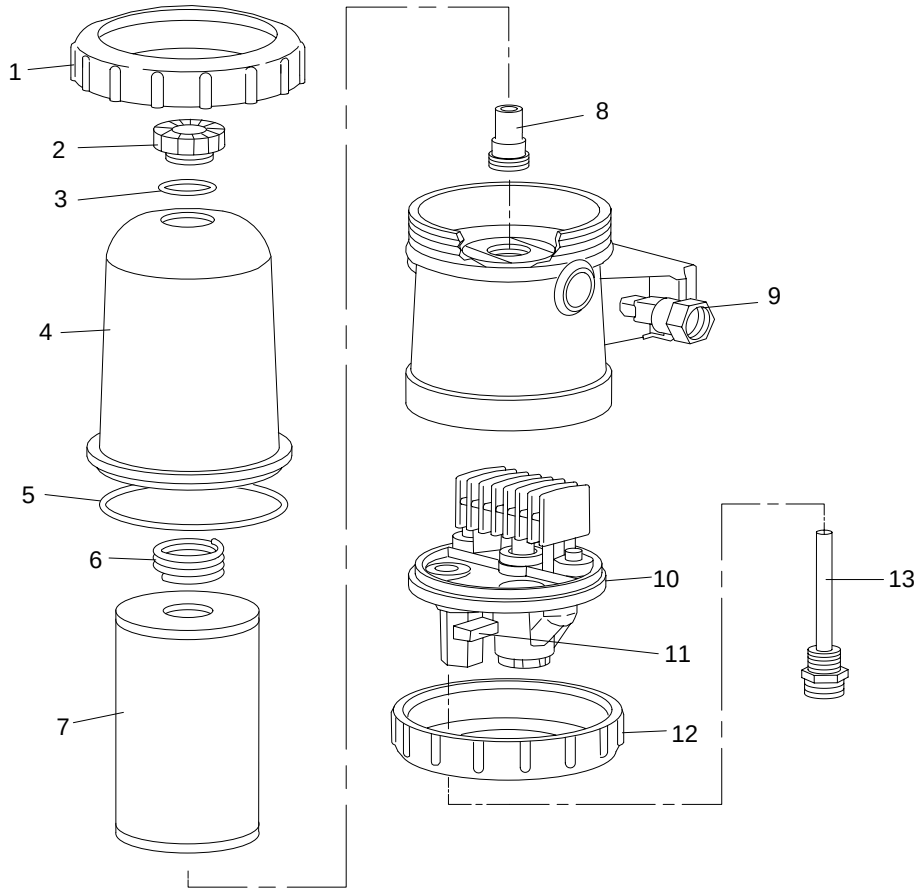
⚠ WARNING

Diesel fuel is flammable and can ignite if exposed to an open flame, intense heat, or other ignition

source. Do not drain fuel near, or expose fuel vapor to open flame or intense heat. Exposure to open flame or intense heat could start a fire, possibly resulting in personal injury or property damage. When working on a fuel system, have a fire extinguisher within easy reach.

1. Place a suitable drain pan under the fuel/water separator and open the drain valve. Drain enough fuel to empty the filter, then close the drain valve. See **Fig. 2**.
2. Using Davco wrench 380134 or 382002, remove the filter collar. Then remove the filter cover.
3. Remove the element and dispose of it properly.
4. Install a new element. Make sure the grommet is in place on the filter stud.
5. Install a new cover seal on the filter cover.
6. Using the collar, attach the filter cover with the spring to the base.

IMPORTANT: Tighten the collar by hand only.



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1. Filter Collar
2. Filter Vent
3. Vent Seal
4. Filter Cover
5. Cover Seal
6. Filter Spring
7. Filter Element
8. Temporary Filter Stud
9. Check Valve Fuel Inlet
10. Fluid Heater/Bottom Plate and Seal
11. Drain
12. Bottom Plate Collar
13. Electric Heater (optional)

Fig. 2, Davco Fuel Pro 382 (exploded view)

7. Remove the filter vent. Then fill the fuel/water separator with fuel until the fuel level is 1 inch (2.5 cm) above the collar.
8. Install the filter vent on the fuel/water separator.
9. Start the engine and raise the rpm for 1 minute to purge air.

47-03 Inline Fuel Strainer Replacing, MBE900 Engine

NOTE: Vehicles with an MBE900 engine have an inline fuel strainer, located on the left-hand frame rail under the cowl area.

1. Remove the brackets on each end of the fuel strainer.
2. Remove the P-clip.

IMPORTANT: The fuel flow arrow on the fuel strainer must be pointed toward the front of the vehicle.

3. Remove the strainer, and install a new one.
4. Install the P-clip.
5. Install the brackets on each end of the fuel strainer.

47-04 Fuel Sender Checking

1. Check the fuel sender connections for tightness, and tighten if needed. Apply dielectric grease to the connections if needed.
2. Check the fuel fill hose for tightness, and tighten if needed.

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49-01 Exhaust System Inspecting (Noise Emission Control)

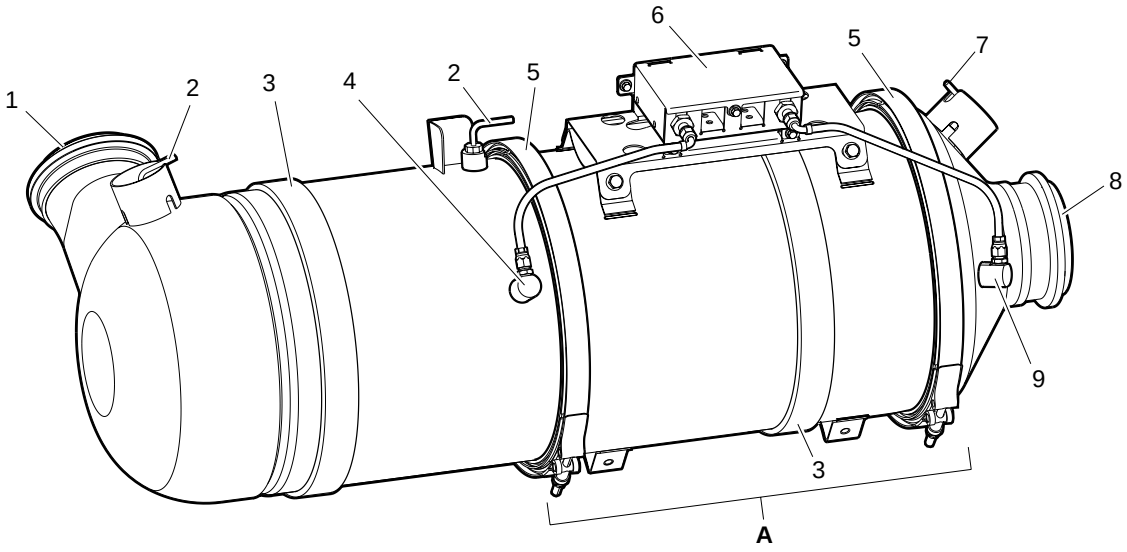
Pre-EPA07 Exhaust System

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, using genuine Freightliner parts.

1. Inspect the muffler body, muffler outlet stack, muffler shield, and inlet tubes for leakage, dents, corrosion, or holes in the muffler.
2. Inspect the exhaust pipe for leakage, wear, or damage. Replace the exhaust pipe if needed. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.
3. 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.
4. Check for leakage at each exhaust seal clamp. If leakage exists, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp.

EPA07 Exhaust System Inspecting

IMPORTANT: The Environmental Protection Agency's 2007 regulations require lower exhaust emissions, thus requiring new exhaust system components. See **Fig. 1**. In particular the after-treatment device (ATD), which is part of the after-treatment system (ATS), requires special attention during regularly scheduled maintenance inspections. If any discrepancies



A. Inspect this area of the canister for dents.
1. Marmon Fitting at Inlet from Turbocharger
2. Temperature Sensor
3. ATD Mounting Band
4. DPF Intake Pressure Sensor
5. DPF V-Band Mounting Clamps
6. Sensor Junction Box
7. Temperature Sensor
8. Exhaust Outlet Marmon Fitting
9. DPF Outlet Pressure Sensor

Fig. 1, Typical After-Treatment Device

are discovered, refer to the engine manufacturer's service literature for repair instructions.

Definitions of ATS Components

Refer to the following list of definitions of ATS components.

- After-Treatment System (ATS)—the entire exhaust system from the turbocharger to the exhaust stack or tail pipe.
- After-Treatment 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 pressures in the ATS.

Inspection

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.
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. 1**, item A. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6mm) 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.

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54-01 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.

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72-01 Door Seals Lubrication

NOTE: The main entry door, rear emergency exit, and emergency hatch seals require lubrication. Do *not* lubricate the door latches or hinges. They come from the manufacturer with lifetime lubrication and require no maintenance.

Lightly coat the door seals with a lubricant that is safe for rubber.

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83-01 Air Conditioner Inspecting

1. Park the vehicle on a level surface, apply the parking brake, and chock the tires.
2. Operate the heater and, if equipped with an air conditioner, the air conditioner to check for proper operation in all modes.

NOTE: If the vehicle is not equipped with an air conditioner, the following steps do not apply.

3. Tilt the hood.
4. Check the condition of the refrigerant compressor clutch 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.
5. Inspect the refrigerant compressor drive belt for damage, and replace it if necessary.
6. Check the tightness of the compressor mounting fasteners. Correct fastener torque is 15 to 19 lbf·ft (20 to 26 N·m).
7. Inspect the drive plate. If the friction surface of the drive plate shows visible signs of damage due to excessive heat, make sure the refrigerant compressor turns freely. If the compressor does not turn freely, replace the drive plate and clutch assembly. For instructions, see **Section 83.01, Subject 140** of the *S2 Chassis Workshop Manual*. If the compressor does not turn freely, replace the compressor. For instructions, see **Section 83.01, Subject 120** of the *S2 Chassis Workshop Manual*.
8. Using a feeler gauge, check that the drive plate clutch clearance is 0.016 to 0.031 inch (0.4 to 0.8 mm). If the gap is not even around the clutch, gently tap down at the high areas. If the overall gap is out of spec, remove the drive plate assembly and change the shims as necessary. For instructions, see **Section 83.01, Subject 140** of the *S2 Chassis Workshop Manual*.
9. Check that the wiring harness connector is not damaged or loose. Replace the wiring harness if it is damaged.
10. Check the overall condition of the air conditioning hoses. Look for cracks, cuts, and abrasions on the hoses. Replace damaged hoses.
11. 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.
12. Close the hood and remove the chocks from the tires.

83-02 HVAC Air Filter Cleaning

The HVAC air filter must be cleaned every 12 months or 8000 miles (28 962 km), whichever comes first, to permit proper operation of the HVAC system.

1. Park the vehicle on a level surface, apply the parking brake, and chock the tires.
2. Disconnect the batteries.
3. Remove the lower HVAC cover. Remove the three Torx screws; two at the bottom of the filter and one on the right.
4. Disconnect the wiring harness from the evaporator probe, if equipped with air conditioning.
5. Remove the capscrews that attach the evaporator service cover to the HVAC assembly. Remove the evaporator service cover.
6. Pull the filter out of the HVAC assembly.
7. Clean the filter with a warm detergent solution. Dry the filter before installing it.
8. Install the filter in the HVAC assembly. See **Fig. 1**.
9. Remove the condensate seal from the evaporator service cover and install a new condensate seal on the cover.
10. Using capscrews, attach the evaporator service cover to the HVAC assembly.
11. Connect the wiring harness to the evaporator probe.
12. Attach the lower HVAC cover to the dash panel. Install the three Torx screws; two at the bottom of the filter and one on the right.
13. Connect the batteries.
14. Remove the chocks from the tires.

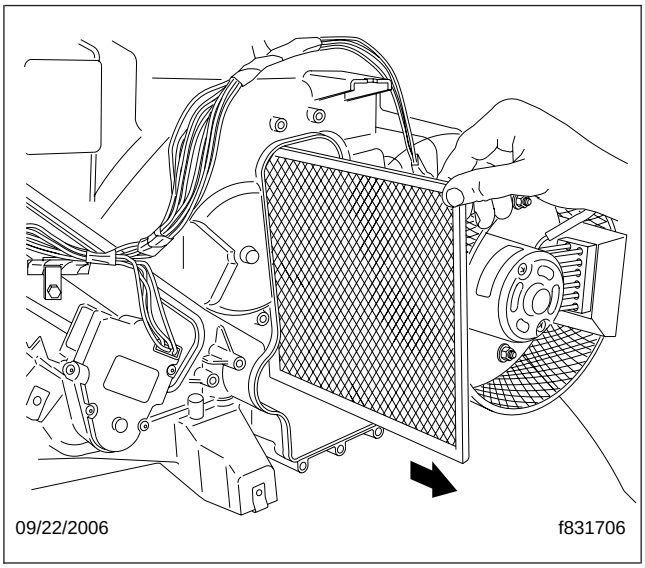

Fig. 1, HVAC Assembly Filter