FREIGHTLINER

Run Smart™

CASCADIA MAINTENANCE MANUAL

Models: CA113DC
CA113SLP
CA125DC
CA125SLP

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Foreword

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

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

Perform the operations in this maintenance manual at scheduled intervals. Perform the pretrip inspection and daily/weekly/monthly maintenance, as outlined in the vehicle driver's manual. Major components, such as engines, transmissions, and rear axles, are covered in their own maintenance and operation manuals, that are provided with the vehicle. Perform any maintenance operations listed at the intervals scheduled in those manuals. Your Freightliner Dealership has the qualified technicians and equipment to perform this maintenance for you. They can also set up a scheduled maintenance program tailored specifically to your needs. Optionally, they can assist you in learning how to perform these maintenance procedures.

IMPORTANT: Descriptions and specifications in this manual were in effect at the time of printing. Freightliner Trucks 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.FreightlinerTrucks.com** for more information, or contact Daimler Trucks North America LLC at the address below.

Environmental Concerns and Recommendations

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

NOTICE: Parts Replacement Considerations

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

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Descriptions of Service Publications

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

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.

Troubleshooting Manual

Troubleshooting manuals contain diagnostic procedures for determining causes of problems in vehicle components and systems. Information on multiplexing diagnosis is included. These manuals are organized by functional systems, such as cab, chassis, and powertrain. Troubleshooting manuals do not contain 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.

Descriptions of Service Publications

EZWiring — EZWiring™ makes Freightliner, Sterling, Western Star, Thomas Built Buses, and Freightliner Custom Chassis Corporation products' wiring drawings and floating pin lists available online for viewing and printing. EZWiring can also be accessed from within PartsPro.

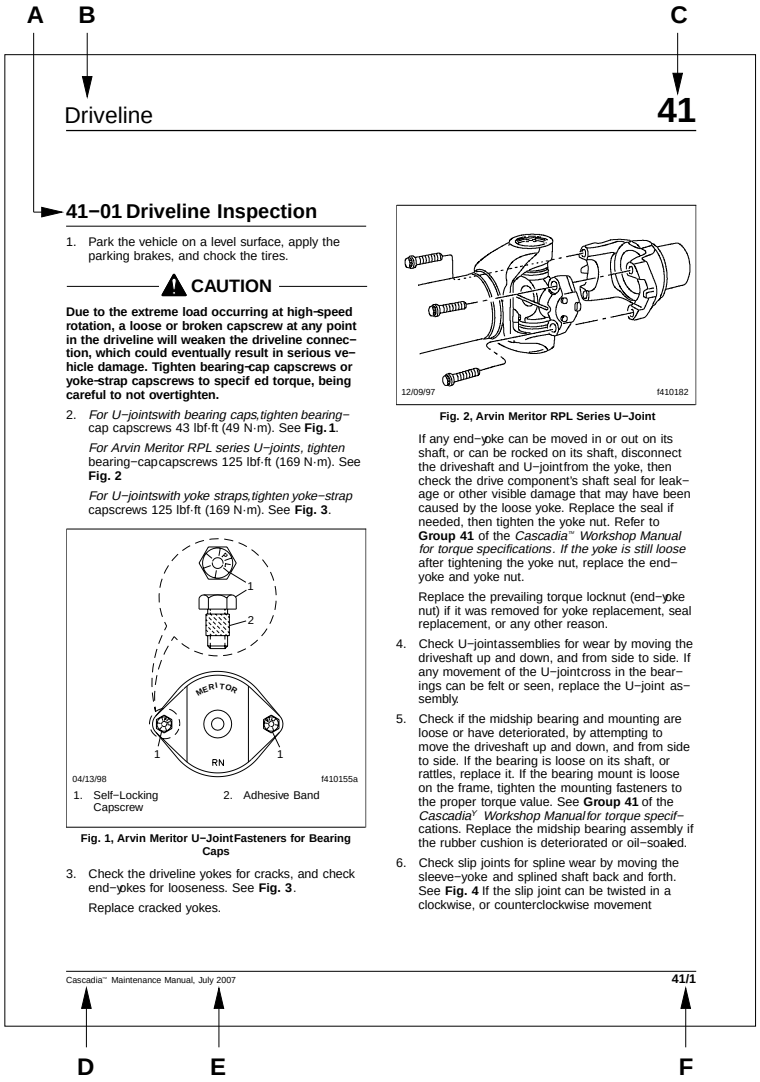
Warranty-related service information available on the AccessFreightliner.com website includes the following documentation.

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

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

Page Description

For an example of a Maintenance Manual page, see **Fig. 1**.



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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. Vehicle Name
E. Release Date
F. Group Number/Page Number

Fig. 1, Example of a Maintenance Manual Page

Maintenance Manual Contents

Index, Alphabetical

Determining Scheduled Maintenance Intervals

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

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

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

Types of Service

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

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

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

Service Schedule Table: 00–02

Service Schedule	Maintenance Interval Operation	Maintenance Interval		
		Frequency	Miles	km
Schedule I (Short-Haul Transport) vehicles that annually travel less than 60,000 miles (100 000 km)	Initial Maintenance (IM)	first	10,000	16 000
	Maintenance 1 (M1)	every	10,000	16 000
	Maintenance 2 (M2)	every	50,000	80 000
	Maintenance 3 (M3)	every	150,000	240 000
Schedule II (Long-Haul Transport) vehicles that annually travel over 60,000 miles (100 000 km)	Initial Maintenance (IM)	first	25,000	40 000
	Maintenance 1 (M1)	every	25,000	40 000
	Maintenance 2 (M2)	every	100,000	161 000
	Maintenance 3 (M3)	every	300,000	483 000

Table 1, Service Schedule

Vehicle Maintenance Schedule Table: 00–03

Maintenance for Service Schedule I				
Maint. No.	Maintenance Interval	Service Date	Service Schedule I	
			Miles	km
1st	IM and M1		10,000	16 000
2nd	M1		20,000	32 000
3rd	M1		30,000	48 000
4th	M1		40,000	64 000
5th	M1 and M2		50,000	80 000
6th	M1		60,000	96 000
7th	M1		70,000	112 000
8th	M1		80,000	128 000
9th	M1		90,000	144 000
10th	M1 and M2		100,000	160 000
11th	M1		110,000	176 000
12th	M1		120,000	192 000
13th	M1		130,000	208 000
14th	M1		140,000	224 000
15th	M1, M2, and M3		150,000	240 000
16th	M1		160,000	256 000
17th	M1		170,000	272 000
18th	M1		180,000	288 000
19th	M1		190,000	304 000
20th	M1 and M2		200,000	320 000
21st	M1		210,000	336 000
22nd	M1		220,000	352 000
23rd	M1		230,000	368 000
24th	M1		240,000	384 000
25th	M1 and M2		250,000	400 000
26th	M1		260,000	416 000
27th	M1		270,000	432 000
28th	M1		280,000	448 000
29th	M1		290,000	464 000
30th	M1, M2, and M3		300,000	480 000
31st	M1		310,000	496 000
32nd	M1		320,000	512 000
33rd	M1		330,000	528 000
34th	M1		340,000	544 000
35th	M1 and M2		350,000	560 000

Vehicle Maintenance Schedule Table: 00–03

Maintenance for Service Schedule I				
Maint. No.	Maintenance Interval	Service Date	Service Schedule I	
			Miles	km
36th	M1		360,000	576 000
37th	M1		370,000	592 000
38th	M1		380,000	608 000
39th	M1		390,000	624 000
40th	M1 and M2		400,000	640 000
41st	M1		410,000	656 000
42nd	M1		420,000	672 000
43rd	M1		430,000	688 000
44th	M1		440,000	704 000
45th	M1, M2, and M3		450,000	720 000
46th	M1		460,000	736 000
47th	M1		470,000	752 000
48th	M1		480,000	768 000
49th	M1		490,000	784 000
50th	M1 and M2		500,000	800 000
51st	M1		510,000	820 000
52nd	M1		520,000	837 000
53rd	M1		530,000	853 000
54th	M1		540,000	869 000
55th	M1 and M2		550,000	885 000
56th	M1		560,000	901 000
57th	M1		570,000	917 000
58th	M1		580,000	933 000
59th	M1		590,000	949 000
60th	M1, M2, and M3		600,000	965 000
61st	M1		610,000	982 000
62nd	M1		620,000	998 000
63rd	M1		630,000	1 014 000
64th	M1		640,000	1 030 000
65th	M1 and M2		650,000	1 046 000
66th	M1		660,000	1 062 000
67th	M1		670,000	1 078 000
68th	M1		680,000	1 094 000
69th	M1		690,000	1 110 000
70th	M1 and M2		700,000	1 127 000

Vehicle Maintenance Schedule Table: 00–03

Maintenance for Service Schedule I				
Maint. No.	Maintenance Interval	Service Date	Service Schedule I	
			Miles	km
71st	M1		710,000	1 143 000
72nd	M1		720,000	1 159 000
73rd	M1		730,000	1 175 000
74th	M1		740,000	1 191 000
75th	M1, M2, and M3		750,000	1 207 000
76th	M1		760,000	1 223 000
77th	M1		770,000	1 239 000
78th	M1		780,000	1 255 000
79th	M1		790,000	1 271 000
80th	M1 and M2		800,000	1 287 000
81st	M1		810,000	1 304 000
82nd	M1		820,000	1 320 000
83rd	M1		830,000	1 340 000
84th	M1		840,000	1 352 000
85th	M1 and M2		850,000	1 370 000
86th	M1		860,000	1 384 000
87th	M1		870,000	1 400 000
88th	M1		880,000	1 416 000
89th	M1		890,000	1 432 000
90th	M1, M2, and M3		900,000	1 448 000
91st	M1		910,000	1 465 000
92nd	M1		920,000	1 481 000
93rd	M1		930,000	1 500 000
94th	M1		940,000	1 513 000
95th	M1 and M2		950,000	1 530 000
96th	M1		960,000	1 550 000
97th	M1		970,000	1 561 000
98th	M1		980,000	1 577 000
99th	M1		990,000	1 593 000
100th	M1 and M2		1,000,000	1 609 000

Table 2, Maintenance for Service Schedule I

Vehicle Maintenance Schedule Table: 00–03

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

Vehicle Maintenance Schedule Table: 00–03

Maintenance for Service Schedule II				
Maint. No.	Maintenance Interval	Service Date	Service Schedules II	
			Miles	km
36	M1, M2, and M3		900,000	1 448 000
37	M1		925,000	1 490 000
38	M1		950,000	1 529 000
39	M1		975,000	1 569 000
40	M1 and M2		1,000,000	1 609 000

Table 3, Maintenance for Service Schedule II

Initial Maintenance (IM) Operations: 00–04

The Initial Maintenance table lists all maintenance operations that are to be performed at the initial maintenance (IM) interval. Maintenance operation numbers are reference numbers used to help you find detailed instructions in this manual on the maintenance operations to be performed. All operations listed in the table, along with the operations listed in the applicable M1 maintenance interval table, must be performed to complete the initial maintenance (IM).

Maintenance Operation Number	Initial Maintenance (IM) Operations for Service Schedules I and II	Check
00–05	Perform all M1 Operations	
31–03	Frame Fastener Torque Check	
32–02	Suspension U-Bolt Torque Check	
33–04	All-Axle Alignment Check	
47–03	Fuel Tank Band-Nut Tightening	

Table 4, Initial Maintenance (IM) Operations for Service Schedules I and II

M1 Maintenance Interval Operations: 00–05

The M1 Maintenance Interval Operations tables list all maintenance operations that are to be performed at the M1 maintenance interval. Maintenance operation numbers are reference numbers used to help you find detailed instructions in this manual on the maintenance operations to be performed.

IMPORTANT: After performing all operations listed in this table, perform all daily, weekly, and monthly maintenance operations listed in the "Pretrip and Post-Trip Inspections and Maintenance" chapter of the *Cascadia™ Driver's Manual*.

Maintenance Operation Number	M1 Maintenance Interval Operations for Service Schedules I and II	Check
13–01	Bendix Air Compressor Inspection	
25–01	Eaton Fuller Clutch Release Bearing Lubrication	
31–01	Fifth Wheel Inspection	
31–02	Fifth Wheel Lubrication	
33–05	Knuckle Pin Lubrication, Dana Spicer Axles	
33–06	Tie Rod Lubrication, Dana Spicer Axles	
40–01	Wheel Nut Check	
41–01	Driveline Inspection	
41–02	Driveline Lubrication	
42–02	Bendix Air Dryer Desiccant Replacement (with an oil-coalescing desiccant cartridge)*	
42–05	Brake Inspection	
42–06	Dana Spicer, Haldex, and Gunite Slack Adjuster Lubrication	
49–01	Exhaust System Inspection (noise emission control)	
60–02	Cab Shock Absorber Bracket Torque Check	
83–03	ParkSmart™ Inspection	
88–01	Hood Rear Support Lubrication	

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

Table 5, M1 Maintenance Interval Operations for Service Schedules I and II

M2 Maintenance Interval Operations: 00–06

The M2 Maintenance Interval Operations tables list all maintenance operations that are to be performed at the M2 maintenance interval. Maintenance operation numbers are reference numbers used to help you find detailed instructions in this manual on the maintenance operations to be performed. Perform all M1 maintenance interval operations at the M2 maintenance interval.

Maintenance Operation Number	M2 Maintenance Interval Operations for Service Schedules I and II	Check
00–05	Perform All M1 Operations	
15–01	Alternator, Battery, and Starter Check	
20–01	Pressure Relief Cap Check	
20–03	Fan Clutch Check (noise emission control)	
25–02	Fluid Level Check, Hydraulic Clutch Control	
26–02	Transmission Fluid Level Inspection	
26–03	Manual Transmission Air Filter/Regulator Check, Cleaning, or Replacement	
31–04	Fairing Bumper Wear Check	
32–01	Suspension Inspection	
32–02	Suspension U-Bolt Torque Check	
33–01	Knuckle Pin Lubrication, Meritor Axles	
33–02	Tie Rod Inspection	
33–03	Tie Rod Lubrication, Meritor Axles	
35–02	Axle Breather and Axle Lubricant Level Inspection	
42–01	Air Brake System Valve Inspection	
42–03	Air Dryer Inspection	
42–04	Alcohol Evaporator Cleaning and Inspection	
42–07	Meritor Camshaft Bracket Lubrication	
42–08	Meritor Slack Adjuster Lubrication	
46–01	Drag Link Inspection	
46–03	Power Steering Fluid Level Inspection	
46–04	Power Steering Gear Lubrication	
46–05	Drag Link Lubrication	
46–06	Rack and Pinion Steering Inspection	
47–01	Fuel Filter Replacement	
47–02	Fuel/Water Separator Element Checking and Replacement	
54–01	Trailer Cable Inspection and Cleaning	
60–01	Mirror Folding Check	
83–01	Air Conditioner Inspection	
83–02	Air Filter Replacement	

Table 6, M2 Maintenance Interval Operations for Service Schedules I and II

M3 Maintenance Interval Operations: 00–07

The M3 Maintenance Interval Operations table lists all maintenance operations that are to be performed at the M3 maintenance interval. Maintenance operation numbers are reference numbers used to help you find detailed instructions in this manual on the maintenance operations to be performed. Perform all M1 and M2 maintenance interval operations at the M3 maintenance interval.

Maintenance Operation Number	M3 Maintenance Interval Operations for Service Schedules I and II	Check
00–05	Perform All M1 Operations	
00–06	Perform All M2 Operations	
09–01	Air Cleaner Element Inspection and Replacement	
20–02	Radiator Pressure-Flushing and Coolant Change	
25–03	Fluid Change, Hydraulic Clutch Control	
26–01	Manual Transmission Fluid Change, and Magnetic Plug Cleaning (synthetic lubricant)	
35–01	Axle Lubricant and Filter Change, and Magnetic Strainer Cleaning (synthetic lubricant)	
42–02	Bendix Air Dryer Desiccant Replacement	
42–09	Bendix E–6 Foot Control Valve Inspection and Lubrication	
46–02	Power Steering Fluid and Filter Change	
49–02	CAT CGI Bellows Replacement	

Table 7, M3 Maintenance Interval Operations for Service Schedules I and II

Maintenance Operation Sets Table: 00–08

Maintenance Operation Sets					
Maint. No.	Operation Description	Service Schedules I and II			
		IM	M1	M2	M3
09–01	Air Cleaner Element Inspection and Replacement				•
13–01	Bendix Air Compressor Inspection	•	•	•	•
15–01	Alternator, Battery, and Starter Check			•	•
20–01	Pressure Relief Cap Check			•	•
20–02	Radiator Pressure-Flushing and Coolant Change				•
20–03	Fan Clutch Check (noise emission control)			•	•
25–01	Eaton Fuller Clutch Release Bearing Lubrication	•	•	•	•
25–02	Fluid Level Check, Hydraulic Clutch Control			•	•
25–03	Fluid Change, Hydraulic Clutch Control				•
26–01	Manual Transmission Fluid Change, and Magnetic Plug Cleaning (Synthetic Lubricant)				•
26–02	Transmission Fluid Level Inspection			•	•
26–03	Manual Transmission Air Filter/Regulator Check, Cleaning, or Replacement			•	•
31–01	Fifth Wheel Inspection	•	•	•	•
31–02	Fifth Wheel Lubrication	•	•	•	•
31–03	Frame Fastener Torque Check	•			
31–04	Fairing Bumper Wear Check			•	•
32–01	Suspension Inspection			•	•
32–02	Suspension U-Bolt Torque Check	•		•	•
33–01	Knuckle Pin Lubrication, Meritor Axles			•	•
33–02	Tie Rod Inspection			•	•
33–03	Tie Rod Lubrication, Meritor Axles			•	•
33–04	All-Axle Alignment Check	•			
33–05	Knuckle Pin Lubrication, Dana Spicer Axles	•	•	•	•
33–06	Tie Rod Lubrication, Dana Spicer Axles	•	•	•	•
35–01	Axle Lubricant and Filter Change, and Magnetic Strainer Cleaning (synthetic lubricant)				•
35–02	Axle Breather and Axle Lubricant Level Inspection			•	•
40–01	Wheel Nut Check	•	•	•	•
41–01	Driveline Inspection	•	•	•	•
41–02	Driveline Lubrication	•	•	•	•
42–01	Air Brake System Valve Inspection			•	•
42–02	Bendix Air Dryer Desiccant Replacement*		•	•	•
42–03	Air Dryer Inspection			•	•
42–04	Alcohol Evaporator Cleaning and Inspection			•	•
42–05	Brake Inspection	•	•	•	•

Maintenance Operation Sets Table: 00–08

Maintenance Operation Sets					
Maint. No.	Operation Description	Service Schedules I and II			
		IM	M1	M2	M3
42–06	Dana Spicer, Haldex, and Gunite Slack Adjuster Lubrication	•	•	•	•
42–07	Meritor Camshaft Bracket Lubrication			•	•
42–08	Meritor Slack Adjuster Lubrication			•	•
42–09	Bendix E–6 Foot Control Valve Inspection and Lubrication				•
46–01	Drag Link Inspection			•	•
46–02	Power Steering Fluid and Filter Change				•
46–03	Power Steering Fluid Level Inspection			•	•
46–04	Power Steering Gear Lubrication			•	•
46–05	Drag Link Lubrication			•	•
46–06	Rack and Pinion Steering Inspection			•	•
47–01	Fuel Filter Replacement			•	•
47–02	Fuel/Water Separator Element Checking and Replacement			•	•
47–03	Fuel Tank Band-Nut Tightening	•			
49–01	Exhaust System Inspection (noise emission control)	•	•	•	•
49–02	CAT CGI Bellows Replacement				•
54–01	Trailer Cable Inspection and Cleaning			•	•
60–01	Mirror Folding Check			•	•
60–02	Cab Shock Absorber Bracket Torque Check		•	•	•
83–01	Air Conditioner Inspection			•	•
83–02	Air Filter Replacement			•	•
83–03	ParkSmart™ Inspection		•	•	•
88–01	Hood Rear Support Lubrication		•	•	•

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

Table 8, Maintenance Operation Sets

Noise Emission Controls Maintenance: 00–09

Noise Emission Control Maintenance

Federal Law, Part 205: Transportation Equipment Noise Emission Controls

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

Recommendations for Replacement Parts

Replacement parts used for maintenance or repair of noise emission controls should be genuine Freightliner 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 Emission Controls Warranty

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

Tampering with Noise Controls is Prohibited

Federal law prohibits the following acts or the causing thereof:

1. The removal or rendering inoperative by any person (other than for purposes of maintenance, repair, or replacement) of any device or element of design incorporated into any new vehicle for the purpose of noise control, prior to its sale or delivery to the ultimate purchaser, or while it is in use.
2. The use of the vehicle after such device or element of design has been removed or rendered inoperative by any person.

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

   A. Removal of engine noise-deadening panels.

   B. Removal of cab-tunnel or hood noise-deadening panels.

   C. Removal of, or rendering inoperative, the engine speed governor so as to allow engine speed to exceed manufacturer's specifications.

   D. Removal of, or rendering inoperative, the fan clutch, including bypassing the control on any thermostatic fan drive to cause it to operate continuously.

   E. Removal of the fan shroud.

   F. Removal of, or rendering inoperative, exhaust components, including exhaust pipe clamping.

   G. Removal of air intake components.

Maintenance Instructions

Scheduled intervals are in the maintenance tables in this group. A "Verification of Inspections Log" for Groups 20 and 49 follows, and should be filled in each time noise emission controls on the vehicle are maintained or repaired.

Verification of Inspections Log

Verification of Inspections Log, Group 20

Verification of Inspections Log — Group 20 — Fan Clutch				
Date	**Mileage**	**Item**	**Cost**	**Maintenance Facility**

Verification of Inspections Log, Group 49

Verification of Inspections Log — Group 49 — Exhaust System Components				
Date	**Mileage**	**Item**	**Cost**	**Maintenance Facility**

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09–01 Air Cleaner Element Inspection and Replacement

Restriction of air flow through the air cleaner element is measured at the tap in the air cleaner outlet. Check the restriction indicator at the air cleaner or in the cab if the vehicle is equipped with a dash-mounted restriction gauge.

Vehicles may be equipped with either a manual-reset restriction indicator with graduations (**Fig. 1**), or a go/no-go restriction indicator without graduations (**Fig. 2**).

1. Inspect the air restriction indicator to see if air restriction equals or exceeds the maximum allowable restriction. For instructions, see the *Cascadia™ Driver's Manual*.
2. If necessary, replace the air cleaner element. For air cleaner element replacement instructions, see **Group 09** of the *Cascadia™ Workshop Manual*.
3. Inspect the air cleaner housing for cracks, leaks, or any other damage. If the air cleaner housing or element is damaged, replace it.
4. Reset the air restriction indicator.
5. Each time the air cleaner housing is replaced, perform the procedures in **MOP 13–01**.

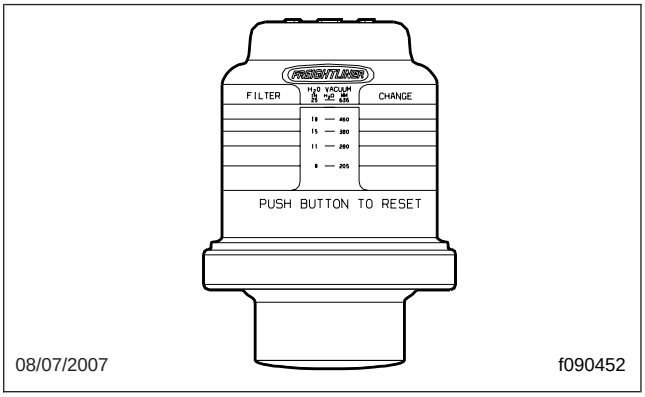

Fig. 1, Manual-Reset Air Restriction Indicator, Graduated

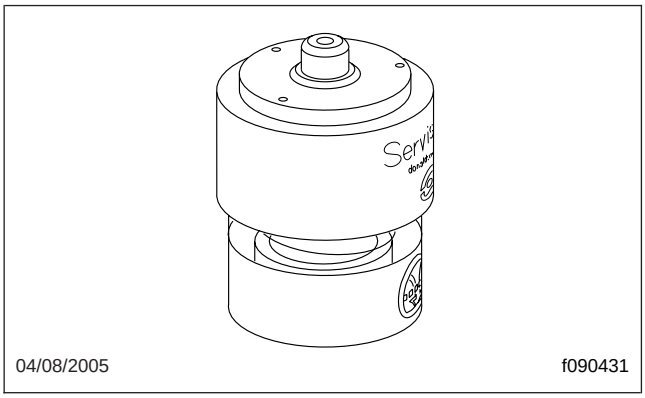

Fig. 2, Manual-Reset Air Restriction Indicator, Go/No-Go

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13–01 Air Compressor Inspection

Inspect the air intake line, oil supply and return lines, and coolant supply and return hoses for tight connections and general condition. Tighten the connections and replace the lines and hoses as needed. If the compressor intake-air adapter is loose, remove the adapter, replace the adapter gaskets, and securely install the adapter.

Check the cooling fins on the compressor crankcase, if equipped. Clean the fins if they are clogged with dirt or grease.

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15–01 Alternator, Battery, and Starter Connections Check

⚠ WARNING

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

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

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

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20–01 Pressure Relief Cap Check

WARNING

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

1. Remove the fill cap first, to relieve the cooling system pressure, then remove the SAE cap.
2. Using a radiator-cap tester, check the pressure cap to see if it maintains pressure to within 10% 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.
3. 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.
4. 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 Change

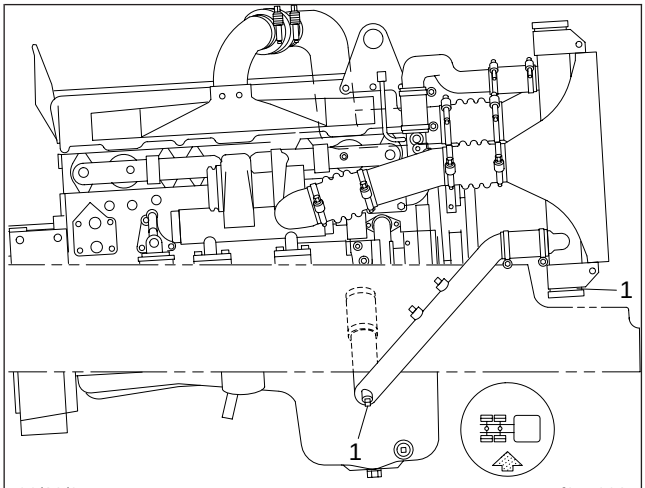
NOTE: For additional instructions on cleaning and flushing the engine cooling system, see the applicable engine manufacturer's maintenance and operation manual.

1. Apply the vehicle parking brakes, then chock the tires. Tilt the hood.
2. Place a suitable container under the elbow of the radiator outlet pipe and the radiator. The container should hold at least 60 quarts (59 liters) of fluid.

WARNING

Do not remove or loosen the surge tank 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.

3. Remove the surge tank cap.
4. Remove the drain plugs at the radiator side tank and at the lower radiator outlet pipe elbow, if equipped. See **Fig. 1**. Allow the coolant to drain.



NOTE: Cummins engine shown.

1. Coolant Drain Plug

Fig. 1, Coolant Drain Plug Location

5. Disconnect the radiator upper and lower hoses, and install the surge tank cap and the radiator side-tank drain plug. Attach the flushing gun nozzle to the radiator at the lower radiator hose opening. Run the water until the radiator is full.

CAUTION

When flushing the radiator, do not apply more than 15 psi (100 kPa) air pressure. Excessive pressure can damage the radiator.

6. Gradually, apply up to 15 psi (100 kPa) air pressure to help dislodge sediment that has built up in the radiator core.
7. Shut off the air at the pressure gun nozzle and allow the radiator to refill with water.
8. Repeat the previous two steps until clean water flows from the radiator.
9. Remove the radiator side-tank drain plug and allow the radiator to drain. Install and tighten the side-tank drain plug and the radiator outlet pipe drain plug after the radiator has been drained. Do not overtighten the plugs.
10. Connect the hoses. Your hose clamps can be either T-bolt clamps (see **Fig. 2**) or Breeze Constant-Torque clamps (see **Fig. 3**).

    When working with T-bolt hose clamps, tighten the clamps 55 lbf·in (620 N·cm). These clamps are now standard on hoses with an inside diameter greater than 2 inches (51 mm).

    When installing Breeze Constant-Torque hose clamps, the clamps must be tightened to the correct torque. The screw tip of the clamp must extend about 1/4 inch (6 mm) from the clamp housing, and the Belleville washer stacks must be collapsed almost flat. Use a torque wrench to install these clamps correctly. The correct installation torque is as follows:

    For Breeze Constant-Torque clamps with a 5/16-inch tightening screw hex: 55 lbf·in (620 N·cm).

    For Breeze Constant-Torque clamps with a 3/8-inch tightening screw hex: 90 lbf·in (1020 N·cm).

NOTE: All hose clamps will lose torque after installation due to "compression set." However, when correctly installed, Breeze Constant-Torque clamps will hold enough torque to automatically adjust and keep consistent sealing pressure. During vehicle operation and shutdown, the screw tip may adjust according to temperature and pressure changes. The torque may need to be adjusted for individual applications.

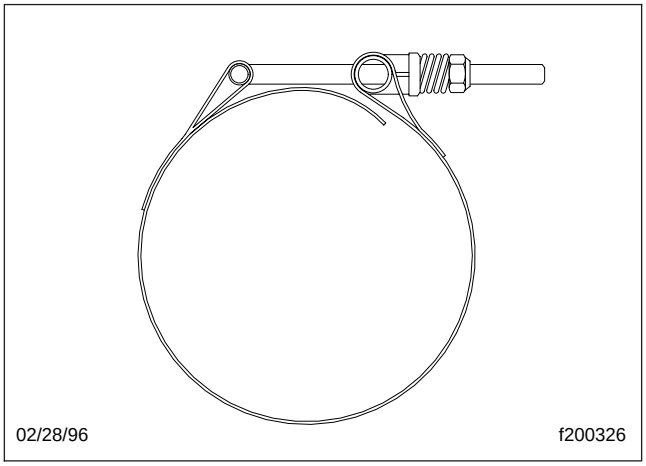
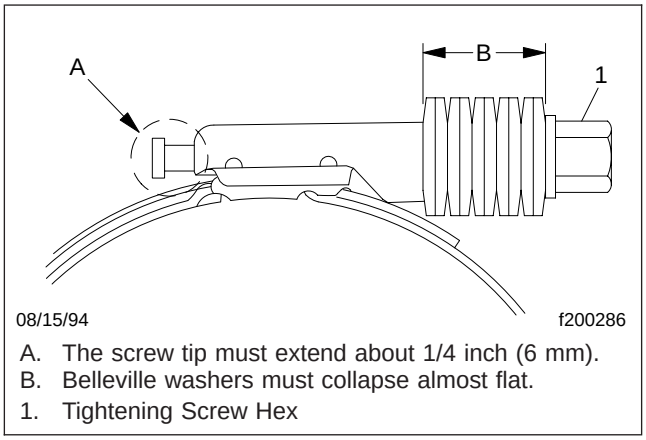


Fig. 2, T-Bolt Type Hose Clamp



A. The screw tip must extend about 1/4 inch (6 mm).
B. Belleville washers must collapse almost flat.
1. Tightening Screw Hex

Fig. 3, Breeze Constant-Torque Hose Clamp Installation

11. Place a pan under the coolant filter to catch engine coolant.
12. Remove the coolant filter with a strap or chain wrench. Install a new coolant filter and tighten.
13. Fill the cooling system with new coolant. Certain equipment such as fuel heaters, water filters, and auxiliary heaters may increase the coolant capacity and require additional coolant. The cooling system is filled when the coolant level reaches the MAX line on the surge tank. Freightliner recommends the use of a precharged and premixed antifreeze when refilling the cooling system. See **Table 1** for a list of some of the precharged antifreeze available. Use of an equivalent antifreeze to those listed in the table is also acceptable. Always check that the antifreeze meets Freightliner's specifications and is at the proper concen-

tration for protection in the vehicle operating area. Freightliner specifies that antifreeze must be an ethylene glycol solution that meets GM 6038 M Engineering Standards or a ethylene glycol solution that has less than 0.1% anhydrous sodium metasilicate, and meets either GM 1825 M or GM 1899 M Engineering Standards. If supplemental coolant additives are being used, add the supplements to the coolant as necessary. See the coolant additive manufacturer's instructions for the correct amount of additive required. Don't forget to consider the volume of the supplemental coolant additive being added to the system when determining the amount of coolant required to refill the system.

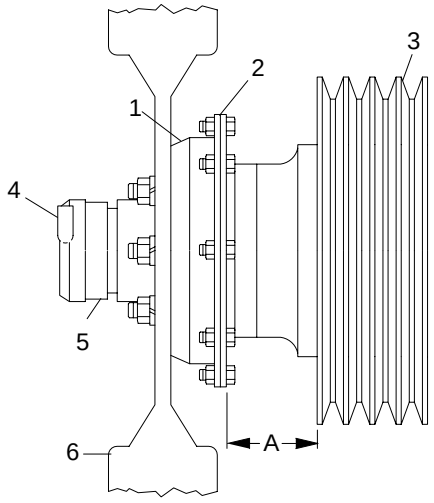
NOTE: You can mix purple-pink coolant (precharged with a borate/nitrate-based additive) with the common green coolant, although some color change will be apparent.

14. Replace the surge tank cap(s).
15. Return the hood to the operating position.
16. Start the engine and turn on the cab heater. Allow the engine to warm up to normal operating temperature. Check the radiator and hoses for leaks. Repair as needed.
17. Shut off the engine, then check the coolant level in the surge tank. Add coolant if the level isn't between MIN and MAX lines on the surge tank.

20–03 Fan Clutch Check (Noise Emission Control)

Borg Warner (Kysor) K26RA Fan Clutch

1. Disconnect the batteries at the negative terminals. Drain all air from the air system.
2. Measure the distance from the back surface of the fan clutch retaining plate to the forward-most edge of the fan belt pulley. See **Fig. 4**, Ref. A.
3. Disconnect the line from the air inlet of the air cylinder. Connect a shop air hose to the inlet.
4. Apply a minimum of 100 psi (690 kPa) air pressure to the air cylinder—the bearing housing will move backwards, disengaging the clutch. Again, measure the distance from the back surface of the retaining plate to the forward-most edge of the fan belt pulley.
5. Compare the two measurements; if the difference between the two measurements exceeds 0.150 inches (3.8 mm), the clutch lining is worn and must be replaced. See **Group 20** of the *Cascadia™ Workshop Manual* for clutch lining replacement instructions.
6. Release the air pressure, then disconnect the shop hose from the air inlet of the air cylinder. Connect the vehicle air hose to the inlet.
7. Connect the battery cables. Start the engine.



With the fan clutch engaged, measure the distance at *A*; measure it again with the fan clutch disengaged.

1. Bearing Housing
2. Retaining Plate
3. Fan Pulley
4. Air Inlet (from solenoid valve)
5. Air Cylinder
6. Fan

Fig. 4, Kysor K26RA Fan Clutch Lining Wear Check

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 *Cascadia™ Workshop Manual*.

1. Disconnect the batteries at the negative terminals.

Approved Antifreeze		
Manufacturer	**Antifreeze**	**Type**
Caterpillar	Caterpillar Diesel Engine Antifreeze/Coolant	Contains supplement additives. Available as a premixed solution.
Cummins	Fleetguard® Compleat Premix	Premixed solution with supplement additives.
Detroit Diesel	Detroit Diesel Power Cool	Premixed solution with supplement additives.
Old World Industries	Fleet Charge™	With supplement additives.

Table 1, Approved Antifreeze

2. Inspect the electrical connections and wires to the fan clutch solenoid. Secure the connection if loose; replace wires and connectors if damaged.
3. Clean the fan clutch air solenoid valve filter, if equipped, 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, then install it on the vehicle.
4. Check the fan for bent, cracked, or damaged blades. Replace if damaged. Check for adequate clearance between the fan and other components.
5. Check the fan belt for wear, tension, and alignment. Correct if 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 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 *Cascadia™ 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. 5**. Using a wet finger or a soapy water solution, check for a leak in the same areas.

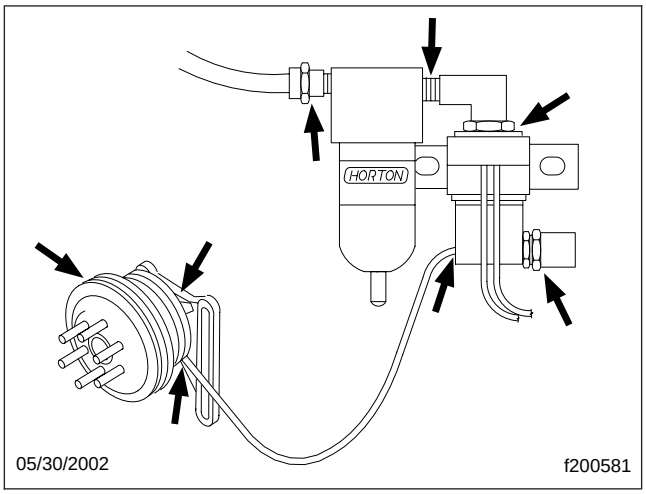


Fig. 5, Checking for Air Leaks (Horton DriveMaster)

9. If a leak is detected, remove the fan blade. Install a new seal kit. See **Group 20** of the *Cascadia™ 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.

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 Drive-Master Super Kit.

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

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25–01 Eaton Fuller Clutch Release Bearing Lubrication

The standard clutch release bearing is not sealed, and requires lubrication. Lubricate the bearing, as follows.

1. Apply the parking brakes, and chock the rear tires.
2. Remove the clutch inspection plate so that you can see the release bearing while lubricating it. See **Fig. 1**.

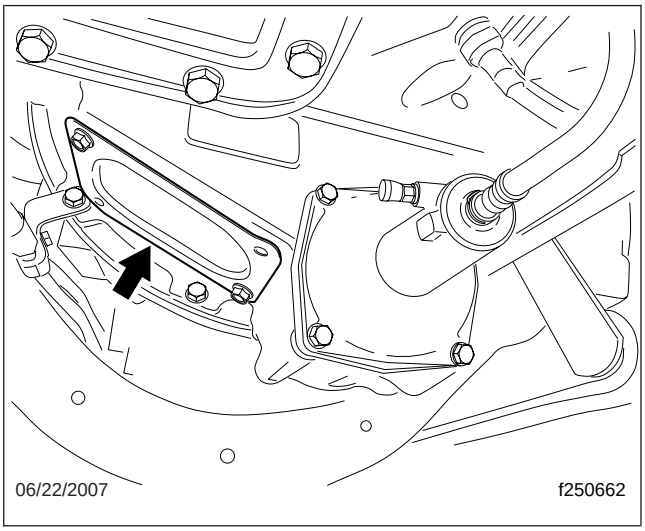


Fig. 1, Clutch Inspection Plate

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

3. Locate the grease fitting at the 9-o'clock position on the left side of the bellhousing, and wipe any dirt away from the grease fitting. See **Fig. 2**.

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.

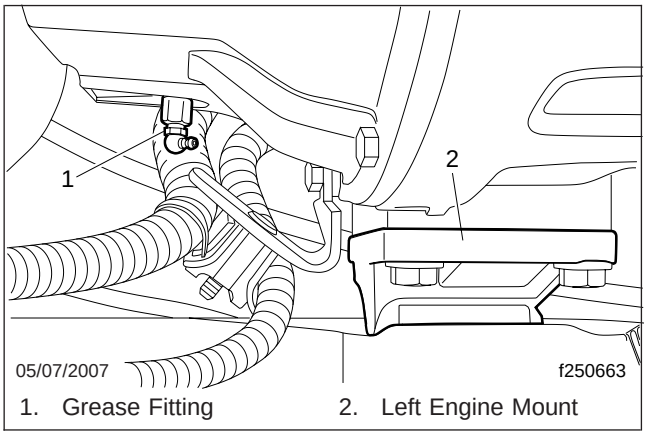


Fig. 2, Release Bearing Grease Fitting

4. Using a pressure-type grease gun equipped with the recommended grease, lubricate the bearing until excess grease purges from the rear of the release bearing (toward the transmission).
5. Install the clutch inspection plate.

25–02 Fluid Level Check, Hydraulic Clutch Control

WARNING

Use only approved fluid (DOT 4 brake fluid) in the hydraulic clutch control 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.

NOTICE

Do not allow the fluid level in the reservoir to go below the MIN line. If air enters the system, 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 new DOT 4 brake fluid from a tightly sealed container until the level reaches the MAX line. See **Fig. 3**.

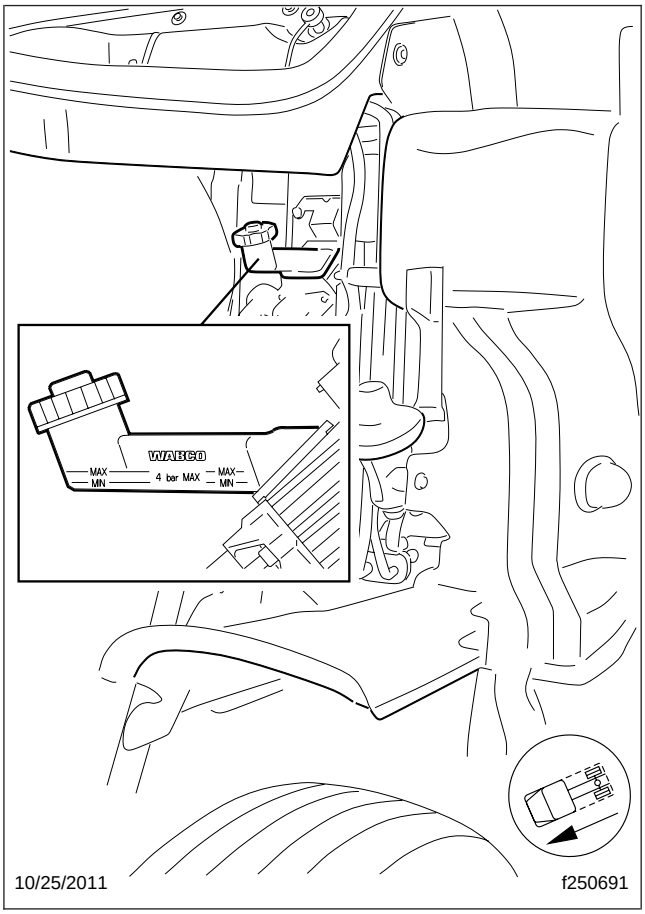


Fig. 3, Reservoir, Hydraulic Clutch Control

25–03 Fluid Change, Hydraulic Clutch Control

Replace the hydraulic clutch control fluid to ensure clutch function is reliable and correct. It can be changed by pressure bleeding or manual bleeding. Pressure bleeding can be done by one person and manual bleeding requires two.

IMPORTANT: The pressure line must slope continuously downward between the master and slave cylinders. On some vehicles, the securing clamps may need to be removed to achieve this and allow the air to be purged. If an air bubble enters the system, bleed it out using the procedures in **Section 25.01** of the *Cascadia Workshop Manual*.

Pressure Bleeding

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

⚠ WARNING

Hydraulic clutch control 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 it or bleeding hydraulic lines. If you get it on your skin, wash it off as soon as possible.

2. Prepare the pressure bleeding equipment according to the manufacturer's instructions. Use new DOT 4 brake fluid from a tightly sealed container. Pressurize the bleed adaptor to 15 psi (103 kPa).

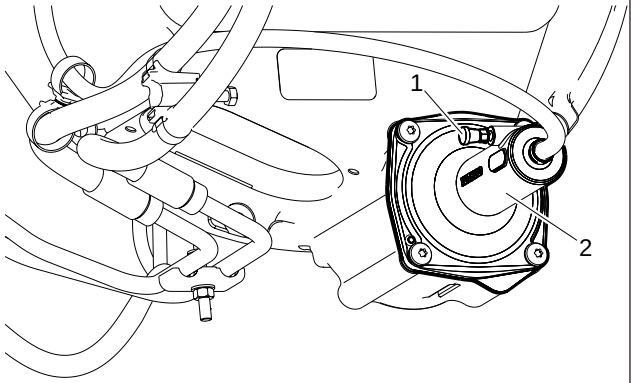
NOTICE

Do not spill hydraulic clutch control fluid on the cab paint. Clean it off immediately if any is spilled. Brake fluid can damage paint.

3. At the reservoir (see **Fig. 3**), remove the reservoir cap and install the pressure bleed adaptor.
4. 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.

5. Flush the hydraulic system as follows.
   - 5.1 Open the bleed valve on the slave cylinder. See **Fig. 4**.
   - 5.2 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).
   - 5.3 When all the old fluid has passed through the system and only new, clean fluid is coming out, close the bleed screw.
6. Check the fluid level in the reservoir, and add fluid to the MAX fluid mark on the reservoir.



1. Bleed Valve
2. Slave Cylinder

Fig. 4, Slave Cylinder, Hydraulic Clutch Control

Manual Flushing

1. Remove the cap from the bleed valve of the slave cylinder (see **Fig. 4**). On the valve, install a transparent drain hose connected to a catch bottle. The hose needs to fit the bleed valve tight enough so it doesn't fall off as fluid is pumped out.
2. Open the slave cylinder bleed screw. Observe the flow of clutch hydraulic fluid through the drain hose.
3. At the reservoir (see **Fig. 3**), remove the reservoir cap and pour new fluid in as the level drops. Have an assistant slowly pump the clutch pedal to help purge the old fluid.
4. When all the old fluid has passed through the system and only new, clean fluid is coming out, stop cycling the pedal and quickly close the bleed screw.
5. Disconnect the transparent hose. Tighten the bleed screw 88 lbf·in (1000 N·cm) and install the cap on the slave cylinder bleed valve.
6. Check the fluid level in the reservoir. If necessary, add or drain clutch hydraulic fluid to bring the fluid level to the MAX line. Install the reservoir cap.
7. Depress the clutch pedal a few times. There should be resistance over the full pedal stroke.

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26–01 Manual Transmission Fluid Change, and Magnetic Plug Cleaning (Synthetic Lubricant)

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.

NOTE: Fluid change intervals are extended to 500,000 miles (800 000 km) on any vehicles filled with synthetic transmission fluid.

IMPORTANT: Drain the transmission when the fluid is warm. If not already warm, run the engine until the transmission fluid reaches operating temperature. Shift the transmission to neutral (N) and shut down the engine.

1. Apply the parking brakes, and chock the rear tires. Place a large drain pan under the transmission.
2. Clean the area around the fill plug, and remove it from the side of the gear case. Remove each drain plug from the bottom of the case.
3. Clean the fill and drain plugs. For magnetic plugs, use a piece of key stock or any other convenient steel slug to short the two magnetic poles and divert the magnetic field.

   Install and tighten each drain plug 50 lbf·ft (68 N·m).

NOTE: The optional transmission fluid filter is a remote-mount, spin-on type, and is located between the transmission and the fluid cooler. The filter bracket is attached to the frame rail or some other nearby location. The filter is mounted in a vertical position, and should be filled with fluid before installation to assure the proper fluid level. For optimum transmission performance, change the filter each time that the fluid is changed.

4. For a transmission equipped with a transmission fluid filter(s), replace the fluid filter(s) as follows:

   4.1 Place a drain pan under the transmission fluid filter.

CAUTION

To prevent skin burns from hot transmission fluid, wear protective gloves when removing the filter.

   4.2 Place a strap or chain wrench around the filter canister, and rotate it in a counterclockwise motion to separate the filter from the mounting. Carefully spin the filter off the mount and remove it from the vehicle.

   4.3 Apply a light coat of transmission fluid to the O-ring gasket on the new filter. See **Fig. 1**. Fill the filter with specified transmission fluid, and spin the filter onto the mount.

   NOTE: The filter fills slowly, so be patient to ensure the proper fluid level has been set.

   4.4 Once the filter makes contact with the mount, use a strap wrench to rotate the canister an additional 180 to 270 degrees to firmly tighten the filter. Wipe the filter clean of any fluid after it is tightened.

5. 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 openings. See **Table 1** for approved transmission lubricants. See **Table 2** for transmission lubricant capacities.

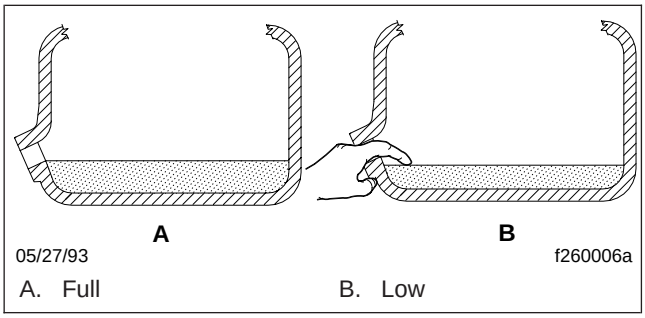


Fig. 1, Checking Transmission Fluid Level

Approved Manual Transmission Lubricants			
Transmission Model	**Lubricant Type***	**Temp. Range**	**SAE Viscosity**
All Eaton Fuller	MobilTrans SHC 50 (RN 2952 E-5)	All	50W
	Synthetic transmission lubricant approved by Eaton	All	50W

* Do not mix types or brands of fluid. Multi-weight and extreme-pressure gear fluids are not recommended. Call 1-800-826-4357 for a complete list of Eaton approved lubricants.

Table 1, Approved Manual Transmission Lubricants

Eaton Fuller Transmission Lubricant Capacities	
Transmission Model	**Refill Capacity:* qt (L)**
7-Speed T Series	
All Models	18.0 (17.0)
All 9-Speed Series	
All Models	13.5 (12.8)
All 10-Speed Manual (except deep reduction)	
FR and FRO Series	11.75 (11.0)
RT and RTX Series	13.0 (12.3)
RTLO Series	14.0 (13.2)
10-Speed Deep Reduction	
RTO–14908LL	14.0 (13.2)
RTO–16908LL	
10-Speed Automated	
Lightning Top 2 (all)	13.5 (12.8)
10-Speed Autoshift AS2 (all)	13.0 (12.3)
13-Speed RTLO Series	
All Models	14.0 (13.2)
15-Speed RTO Series	
All Models	14.0 (13.2)
All 18-Speed Series	
RTLO Series	14.0 (13.2)
18-Speed Autoshift AS2 (all)	

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

Table 2, Eaton Fuller Transmission Lubricant Capacities

NOTE: In all cases, the correct fluid level is established by checking at the fill opening.

6. Operate the engine for five minutes after filling the transmission, then check the fluid level again.
7. 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 plugs with 3/4-inch pipe threads.
   - 60 to 75 lbf·ft (81 to 102 N·m) for plugs with 1-1/4-inch pipe threads.
8. Operate the vehicle to check for correct operation.

26–02 Transmission Fluid Level Inspection

⚠ 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.

With the transmission at operating temperature, and the vehicle on a level surface, check the fluid level in the transmission.

1. Clean the area around the fill plug, and remove it from the side of the gear case.
2. Using your finger or a bent pipe cleaner, see if the fluid is level with the fill opening. See **Fig. 1**.
3. If the fluid level is low, check the transmission for leaks, and correct as needed.
4. If needed, add the recommended fluid, until it is level with the lower edge of the fill opening. See **Table 1** for approved transmission lubricants.

5. Clean the fill plug, then install it. 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 Manual Transmission Air Filter/Regulator Check, Cleaning, or Replacement

Eaton Fuller

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

⚠ WARNING

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

2. Clean the outside of the air filter/regulator with cleaning solvent. See **Fig. 2**.
3. Remove the end cap, large O-ring, and filter element from the filter housing. See **Fig. 3**. Remove the small O-ring from the end cap.

NOTE: Do not remove, disassemble, or adjust the air regulator. If the air regulator is not keeping air pressure between 58 and 63 psi (400 and 435 kPa), replace the air filter/regulator. It cannot be repaired.

⚠ WARNING

Wear safety goggles when using compressed air to clean parts, as permanent harm to eyes could result from flying debris.

4. Clean the filter element by dipping it in alcohol or other cleaning solvent. Blow compressed air through the element (inside to outside) to loosen surface dirt and to dry the element. If it is not damaged, the sintered metallic filter element will last the life of the vehicle.

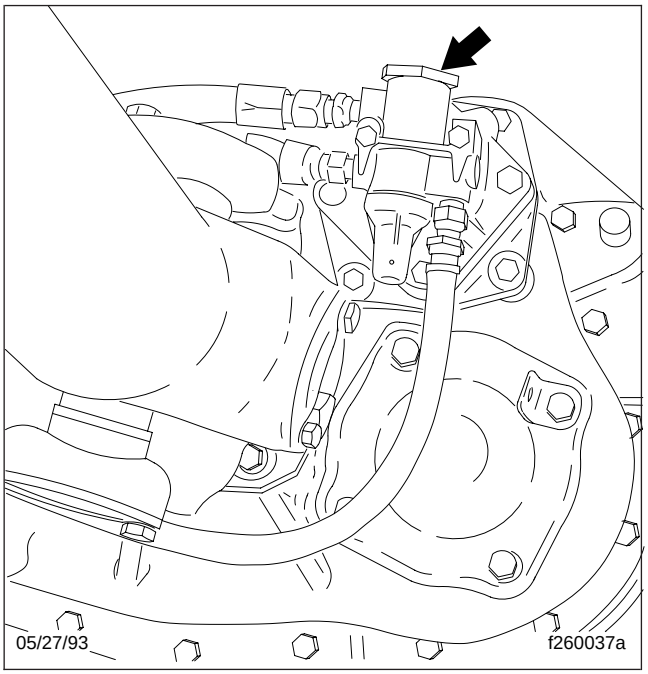
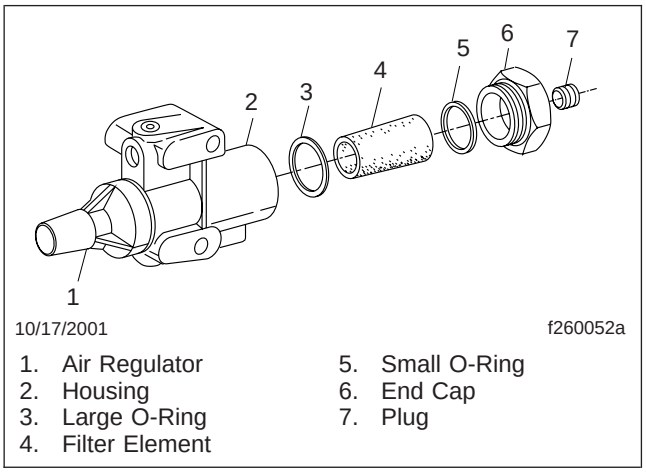


Fig. 2, Air Filter/Regulator Location



1. Air Regulator
2. Housing
3. Large O-Ring
4. Filter Element
5. Small O-Ring
6. End Cap
7. Plug

Fig. 3, Eaton Fuller Transmission Air Filter/Regulator Components

   Wipe out the filter housing with a clean, dry, lint-free rag. Clean and inspect the O-rings and end cap. Replace any parts that are damaged.
5. Install the large O-ring, then the filter element (small end first) into the filter housing.
6. Install the small O-ring in the end cap, then install the end cap and tighten it until firm.

CAUTION

A leaking air filter or air lines can cause slow or hard shifting of the transmission, and eventual transmission damage.

7. Start the engine, and build pressure in the air system. Check for air leaks at the filter housing and air line connections; repair any leaks.

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31–01 Fifth Wheel Inspection

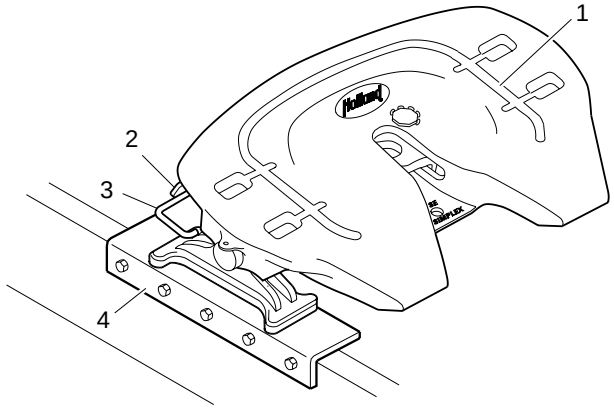
⚠ WARNING

All fifth wheel maintenance, adjustment, and rebuilding must be done only by a qualified mechanic. Improper or incomplete procedures could result in a possible disengagement of the trailer from the tractor, which could result in personal injury or property damage.

Parts are under spring compression. Wear safety goggles while servicing the fifth wheel. Failure to do so can result in personal injury, due to parts ejecting with force.

Holland FWS1

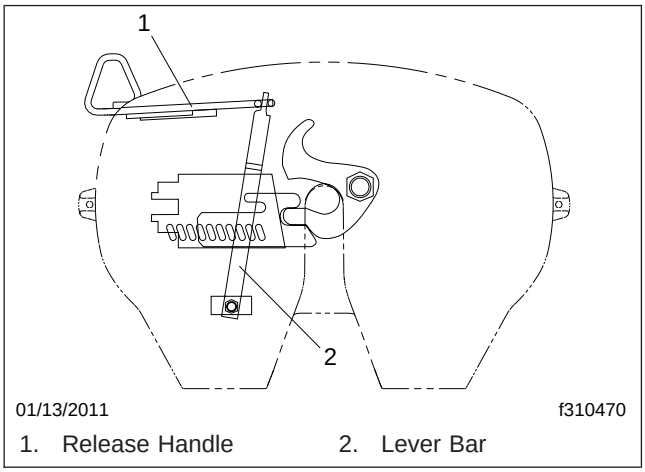
1. Disconnect the tractor from the trailer. For instructions, see the *Cascadia Driver's Manual*.
2. Thoroughly steam clean the fifth wheel.
3. Check the fifth wheel plate for cracks. Check for sharp edges on top; the chamfer should be 1/8 to 1/4 inch (3 to 6 mm).
4. When the wheel is locked, the safety latch must swing free and fall freely into position. See **Fig. 1**.



1. Lubricant Grooves
2. Safety Latch
3. Release Handle
4. Mount

Fig. 1, Holland FWS1 Fifth Wheel

5. The lever bar and release handle must be in proper alignment. See **Fig. 2**. Compare the lever bar and release handle alignment to a new, or a properly operating lever bar and release handle. Replace any bent or misaligned lever bar or release handle.



1. Release Handle
2. Lever Bar

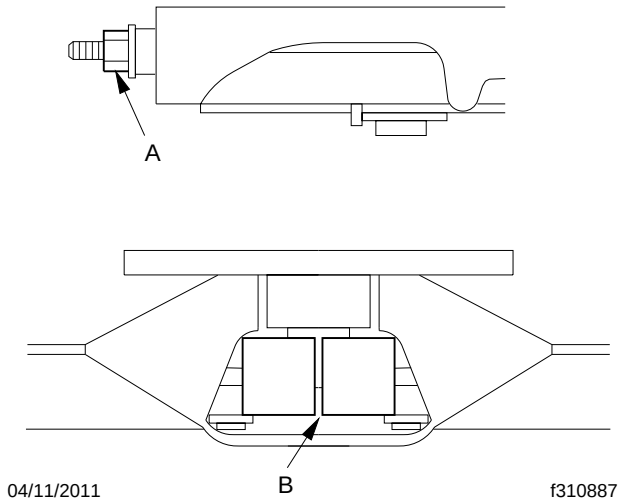
Fig. 2, Lever Bar and Release Handle Alignment

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

Holland FW35

1. Disconnect the tractor from the trailer. For instructions, see the *Cascadia Driver's Manual*.
2. Thoroughly steam clean all fifth wheel components before inspection.
3. Check for cracks in the fifth wheel assembly, mounting brackets, and mounting parts.
4. Check the fastener torques on the fifth wheel assembly and fifth wheel mounting. Tighten bolts and nuts as needed. Replace missing or damaged bolts.

5. Inspect the fifth wheel for bent, worn, damaged, and missing parts; replace them as needed with genuine Holland parts.
6. Using a Holland Kingpin Lock Tester (Holland tool number TF-TLN-5001, available through the PDCs as HLD TFTLN5001), check the operation of the locking mechanism by opening and closing the locks. See **Fig. 3**.



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

Fig. 3, Holland Fifth Wheel Properly Closed

7. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. See **MOP 31–02** for lubrication instructions.

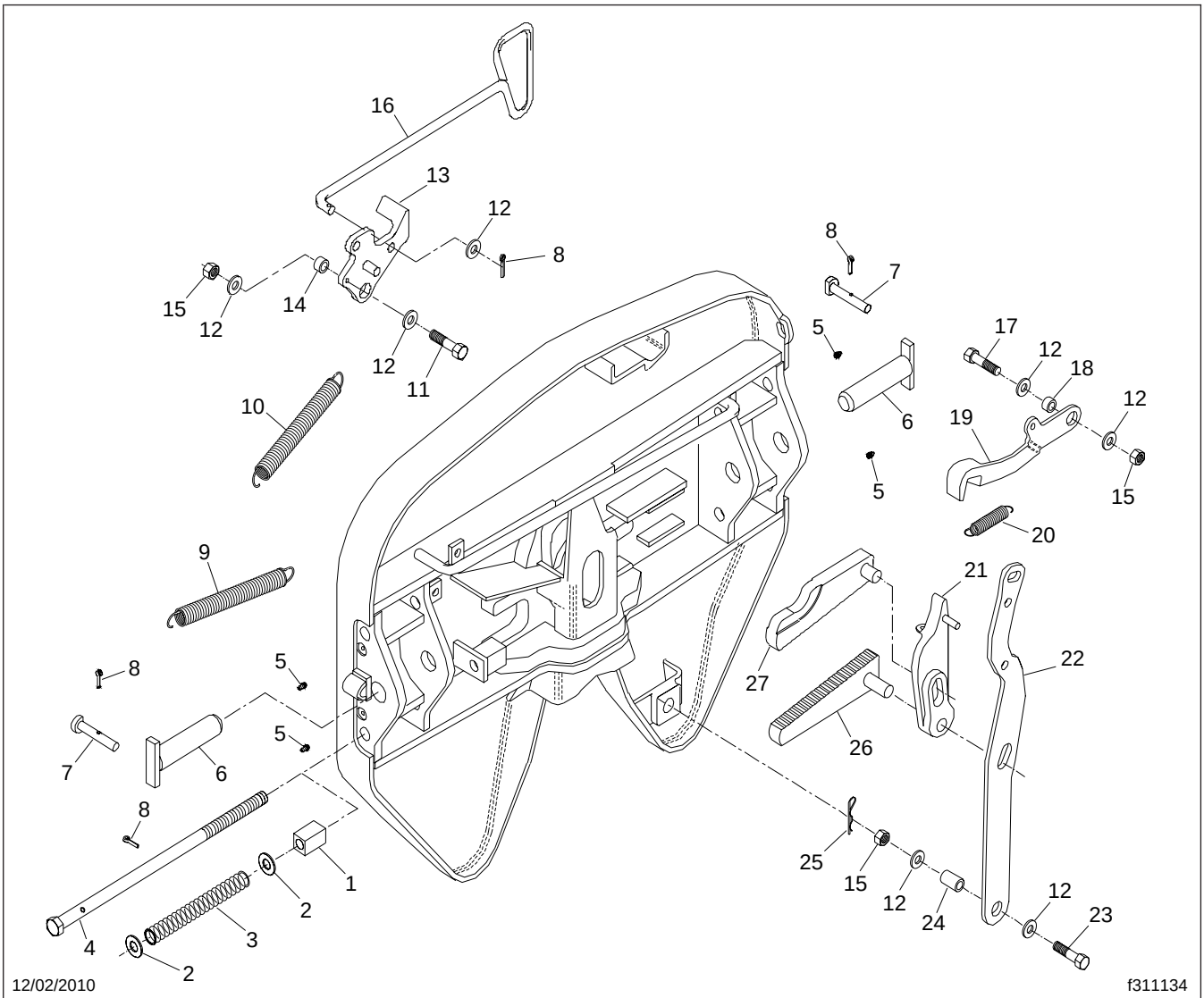
Fontaine

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

WARNING

Do not disassemble the fifth wheel to inspect the springs. The springs are under extreme pressure, and could cause serious injury.

10. Check wedge adjustment.
    - 10.1 Open the kingpin lock, and vertically insert a 2-inch (50-mm) diameter shaft.
    - 10.2 Release the lock by tripping the release latch at the bottom of the throat.
    - 10.3 Adjust the wedge stop at the end of the wedge to approximately 1/4-inch (6-mm) clearance by turning the wedge stop rod located on the right side of the top plate.
11. Replace cracked, worn, or damaged parts with new parts. Replace all loose mounting bolts with 5/8–11 SAE grade 8 bolts, grade C locknuts, and hardened washers. *Do not* re-use bolts, nuts, and washers on fifth wheel mountings.
12. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. Apply a generous coating of grease to the top plate to fill the grooves, or depressions, on the top plate. See **MOP 31–02** for lubrication instructions.



NOTE: 6000 Series shown; 7000 Series fifth wheels use similar parts.

1. Wedge Stop Rod Nut
2. Flat Washer, 5/8"
3. Wedge Stop Rod Spring
4. Wedge Stop Rod
5. Grease Fitting
6. Bracket Pin
7. Bracket Retainer Pin
8. Cotter Pin, 3/16" x 1"
9. Bumper Spring
10. Handle Spring
11. Bolt, Secondary Safety Lock
12. Flat Washer
13. Secondary Safety Lock
14. Bushing, Secondary Safety Lock
15. Hex Locknut
16. Pull Handle
17. Bolt, Bumper
18. Bushing
19. Bumper
20. Timer Spring
21. Timer
22. Operating Handle
23. Bolt, Operating Handle
24. Bushing, Operating Handle
25. Hair Pin Cotter
26. Wedge
27. Step Jaw

Fig. 4, Fontaine Fifth Wheel

Jost

1. Disconnect the tractor from the trailer. For instructions, see the *Cascadia Driver's Manual*.
2. Thoroughly steam clean the fifth wheel.
3. Check the mounting for missing or damaged fasteners, and broken components. Replace or repair as needed.
4. Inspect the bracket pin bolts. Make sure the locking tabs are properly securing the bolts in place. See **Fig. 5**.

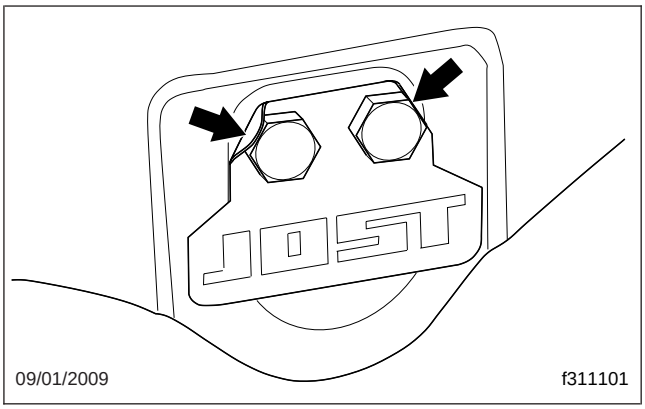


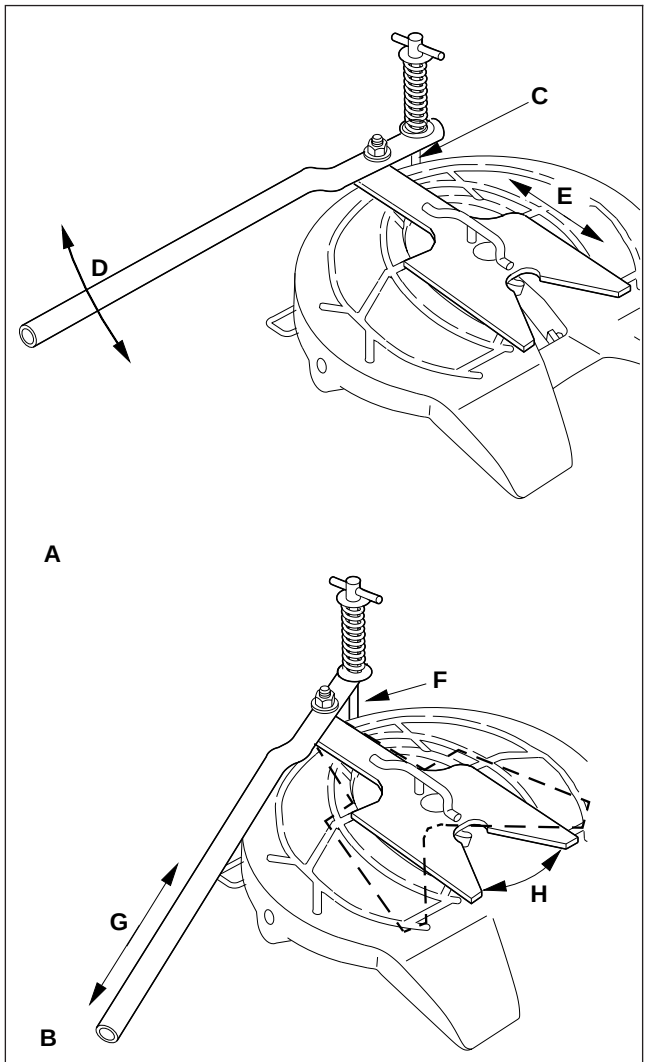
Fig. 5, Bracket Pin Bolt Locking Tabs

5. Check the fifth wheel for bent, worn, or broken parts. Replace as needed.
6. If the fifth wheel is equipped with low-lube plates, check the plates and replace if damaged or worn down to the securing bolts. It is normal for outside edges of the plate to pucker slightly; this does not affect performance.
7. Check the fifth wheel adjustment. Using a lock tester, lock and unlock the fifth wheel several times. Make sure that the locking mechanism works properly.

   The lock is properly adjusted if: the wheel locks and unlocks easily each time and the lock tester rotates freely.

   The lock is too loose if: you feel fore-aft play when pulling and pushing on the lock tester handle. See **Fig. 6**, Ref. A.

   The lock is too tight if: the lock tester does not rotate freely in the lock. See **Fig. 6**, Ref. B.
8. If the lock is improperly adjusted, correct as follows.

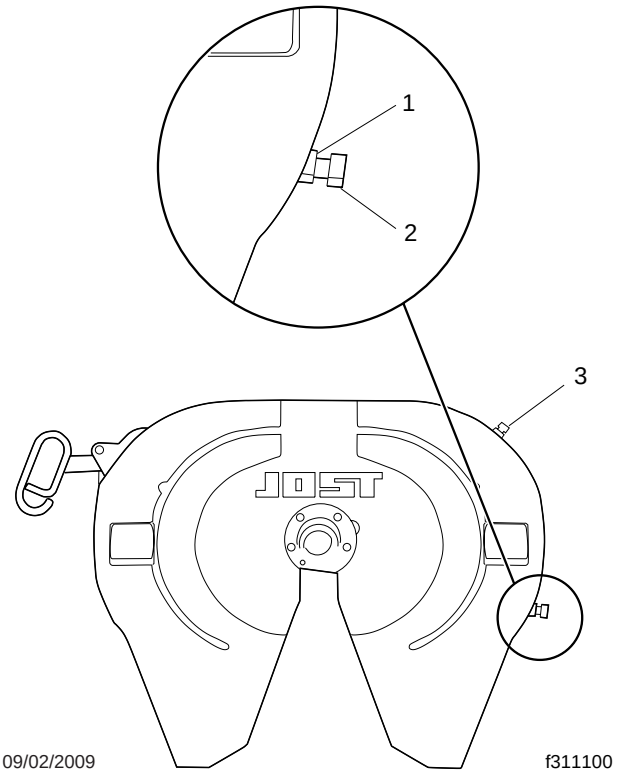


A. Checking for fore/aft play.
B. Rotating tester in lock.
C. Engage hook.
D. Pull/push handle fore/aft.
E. Check for movement of kingpin in lock.
F. Disengage hook.
G. Push/pull handle inboard/outboard.
H. Rotate lock tester.

Fig. 6, Jost Fifth Wheel Adjustment

If the lock is too tight, loosen the jam nut, turn the adjustment bolt *clockwise* one full turn, then reset the jam nut. Lock and unlock the mechanism several times to test. Repeat if necessary. See **Fig. 7**.

If the lock is too loose, loosen the jam nut, turn the adjustment bolt *counterclockwise* one full turn, then reset the jam nut. Lock and unlock the mechanism several times to test. Repeat if necessary. See **Fig. 7**.



1. Jam Nut
2. Adjustment Bolt
3. Grease Zerk

Fig. 7, Jost Fifth Wheel

9. If the fifth wheel is equipped with a sliding mechanism, inspect and adjust it as follows.
   - 9.1 Check the bracket for any cracks or missing and damaged parts.
   - 9.2 Inspect the locking plungers for full engagement.
   - 9.3 Check the locking mechanism for proper operation.

     If the plungers will not release, check the air cylinder or plunger adjustment.

     If the plungers are loose, check the plunger adjustment and the plunger springs for proper compression. Replace if needed.
   - 9.4 The outboard slider assembly requires no adjustment. If the plungers are loose, inspect and replace locking mechanism parts as needed.
   - 9.5 The inboard slider is adjustable for frame width and plunger engagement. For adjustment, refer to the fifth wheel installation instructions.
10. Replace cracked, worn, or damaged parts with new parts. Replace all loose mounting bolts with 5/8–11 SAE grade 8 bolts, grade C locknuts, and hardened washers. *Do not* re-use bolts, nuts, and washers on fifth wheel mountings.
11. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. Apply a generous coating of grease to the top plate to fill the grooves, or depressions, on the top plate. See **MOP 31–02** for lubrication instructions.

31–02 Fifth Wheel Lubrication

To maintain proper fifth wheel operation, always lubricate the fifth wheel after an inspection has been performed.

IMPORTANT: Lubricate the fifth wheel:

- After power washing, or steam cleaning.
- If the vehicle operates in harsh conditions such as salt spray from road surfaces, or in extremely dusty environments.
- After any service that requires removal of lubricant from the fifth wheel head or components.

⚠ WARNING

Failure to properly lubricate the fifth wheel could result in a possible disengagement of the trailer from the tractor, which could result in personal injury or property damage.

Fontaine

1. Tilt the top plate forward (the front of the fifth wheel is down) and apply grease to each bearing area through the zerk fittings located on each side of the top plate just to the front of the

bracket pins. Continue to apply grease until it is coming out of the back of the bearing. It may be necessary to raise the rear of the fifth wheel with a pry bar to open up the pocket slightly and allow the grease to flow through. A substantial amount of grease may be required initially to fill the reservoir.

Tilt the fifth wheel ramps down (the rear of the fifth wheel is down) and repeat the greasing procedure. Rock the top plate back and forth several times to spread the grease over the bearing surface.

2. Inspect the trailer kingpin plate and top surface of the fifth wheel to make sure each is properly greased. A liberal coating of grease should be applied to the complete surfaces of both the trailer kingpin plate and the top surface of the fifth wheel.

NOTE: Do not use a lube plate (high density polyethylene) on top of the fifth wheel or on the kingpin instead of grease without prior approval by Fontaine Fifth Wheel. The additional thickness of this material can prevent the proper operation of the fifth wheel and may cause a dangerous condition.

NOTE: Fontaine suggests the use of a Moly based lubricant such as Mobilgrease XHP 320 or equivalent when applying lubricant to the locking jaw and wedge.

3. Lubricate the fifth wheel prior to opening and closing it. Separate the jaw and wedge with a screwdriver, and grease the full length of their mating surfaces. Lubricate the top and bottom contact surfaces of the jaw and wedge. See **Fig. 4**. Open and close the fifth wheel several times to further distribute the grease.

   Lightly oil other moving parts in the fifth wheel.

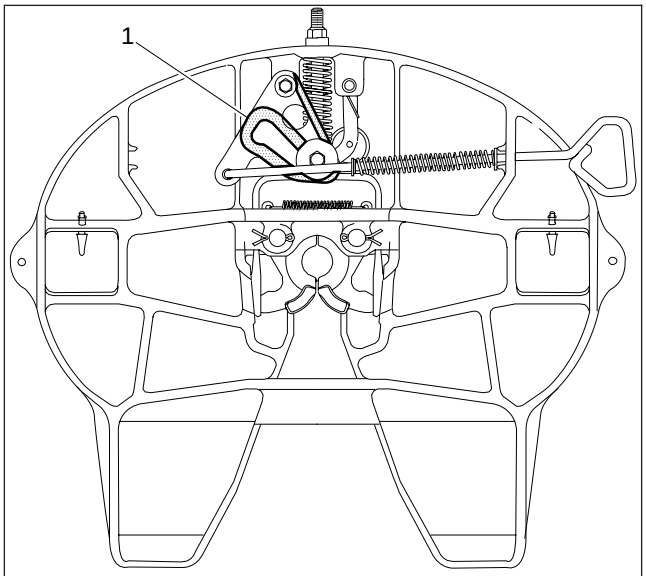
4. Apply grease to the top plate. Spread grease all over the mating surface of the top plate. Be sure the grease pockets built into the top plates are full of grease.

Holland FWS1

Apply a heavy coat of grease to the top plate, either through the grease fittings located on the underside of the top plate, or by direct application.

Holland FW35

1. Using a water-resistant lithium-base grease, grease the top plate.
2. Using a light oil (such as SAE 10W or 20W motor oil), lubricate the cam track and pivot. See **Fig. 8**.



Use a light oil (such as SAE 10W or 20W motor oil) to lubricate the cam track and pivot.

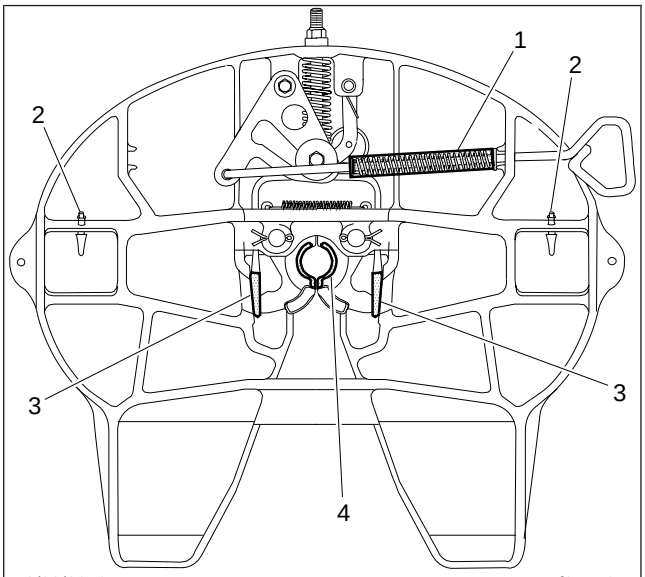
1. Cam Plate

Fig. 8, Holland FW35 Fifth Wheel, Oil Lubrication

3. Grease the yoke tips, locks, and the release handle and spring; see **Fig. 9**. Grease the mounting bracket supports through the grease fittings. A “low temp” grade grease rated for -30°F (-34°C) or lower such as Cato Oil and Grease #5213, Craftsman Chemical Co. #LTF 2, Mystic LP-200, or equivalent is recommended.

Jost

Lubricate the kingpin lock using a hand pump grease gun through the grease zerk on the skirt of the fifth wheel; see **Fig. 7**. Apply a light oil to all moving parts. For sliding fifth wheels spray diesel fuel on the slide path of the base plate.



1. Release Handle and Spring
2. Grease Fitting
3. Yoke Tip
4. Locks

Fig. 9, Holland FW35 Fifth Wheel, Grease Lubrication

NOTICE

Do not use a power grease gun. The pressure will damage the lube line.

If the fifth wheel is not equipped with low-lube plates, apply a lithium-based grease with extreme pressure (EP) additive to the trailer contact surface of the fifth wheel.

NOTE: If the fifth wheel is equipped with low-lube plates, the top plate only requires lubrication at the new product break-in stage. The low-lube plates require no further lubrication.

31–03 Frame Fastener Torque Check

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 checking torque, torque the nut, not the bolt head whenever possible. 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 the *Cascadia™ Workshop Manual* for torque specifications.

NOTICE

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

Check the fasteners at the following locations:

- Axle Stops
- Deck Plates
- Equalizer Brackets
- Exhaust Brackets
- Fifth Wheel Legs
- Fifth Wheel Mountings
- Frame Crossmembers and Gussets
- Front Frame Extension and Brackets
- Front Suspension Spring Brackets
- Fuel Tank Brackets
- Radius Rods
- Rear Suspension Spring Brackets
- Shock Absorbers
- All Other Frame Fasteners

Any component that shows signs of cracking or other damage must be repaired or replaced. Refer to the *Cascadia™ Workshop Manual* for repair or replacement information in the respective section for the component in question.

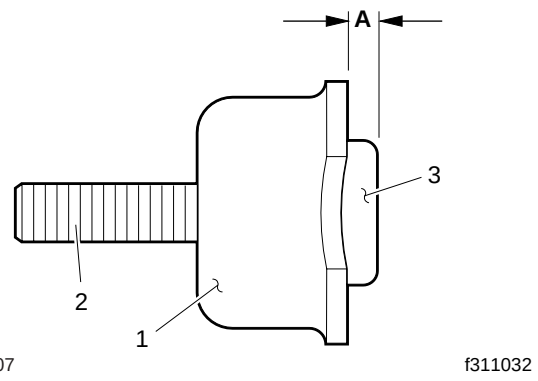
31–04 Fairing Bumper Wear Check

Vehicles equipped with chassis side fairings, and forward mounted battery boxes, have latched front panels. The bumpers on these fairings provide the ten-

sion for the latch mechanism. These bumpers will wear over time, and will not properly hold the fairings in place.

1. Open the latched section of the fairing panel.
2. Inspect the rubber bumpers for wear. See **Fig. 10** for the bumper wear area, and **Fig. 11** for the bumper location.

   If the bumper rubber is worn down even with the top of the metal cup, or if there are signs of the metal cup coming in contact with the surface of the brace that the bumper makes contact with, replace the bumper.
3. Tighten the fastener 10 to 13 lbf·ft (14 to 18 N·m).
4. Close and latch the fairing.



A. Wear Area
1. Metal Cup
2. Mounting Stud
3. Rubber Bumper

Fig. 10, Fairing Bumper

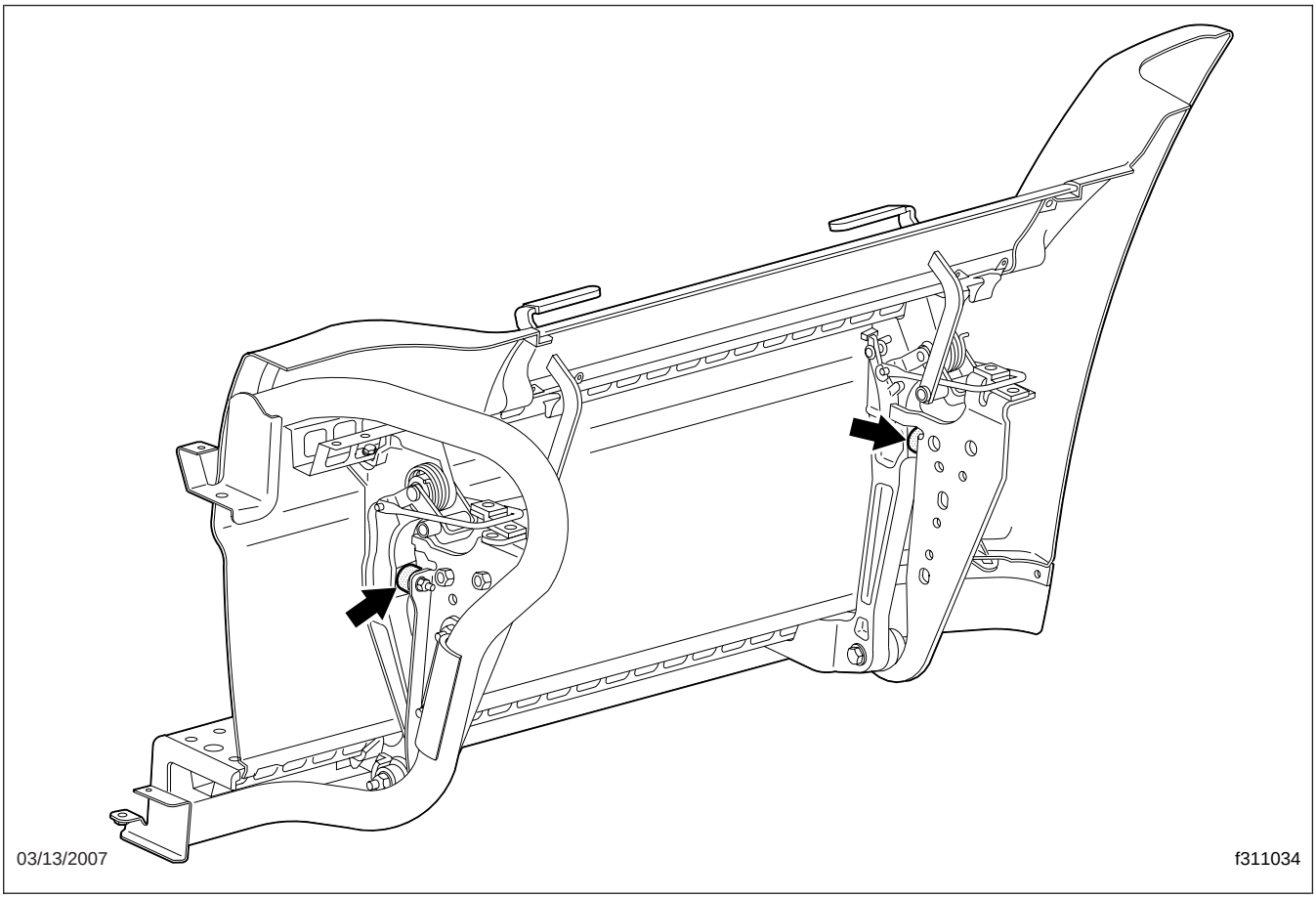


Fig. 11, Bumper Location

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32–01 Suspension Inspection

⚠ 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.

Front Suspension Check

Inspect the front spring assemblies for cracked, broken, or abnormally bent leaves. If any of these conditions exist, replace the spring assembly; see **Group 32** of the *Cascadia™ Workshop Manual*.

Front and Rear Suspension Shock Absorber Check

Make sure the shock absorber brackets are tight, and the shock absorber is not striking or rubbing the frame or some other part of the chassis. Striking or rubbing the frame is characterized by chafe marks on the shock absorber body and the frame rail; see **Fig. 1**. Check the rubber mounting bushings for cracks, cuts, swelling, dry rot, or missing pieces. If the shock absorber bushings are no longer serviceable, replace the shock absorber with a new one.

Inspect the shock absorber for oil leakage. Some misting of the oil is normal, and does not mean the shock is leaking. If the shock absorber is damaged or leaking, replace it with a new one; see **Group 32**of the *Cascadia™ Workshop Manual*.

Freightliner AirLiner Rear Suspension Check

Components Checking

Inspect the forward spring brackets for wear, cracks, and other damage. If any of these conditions exist, replace the damaged bracket(s); see **Group 32** of the *Cascadia™ Workshop Manual*.

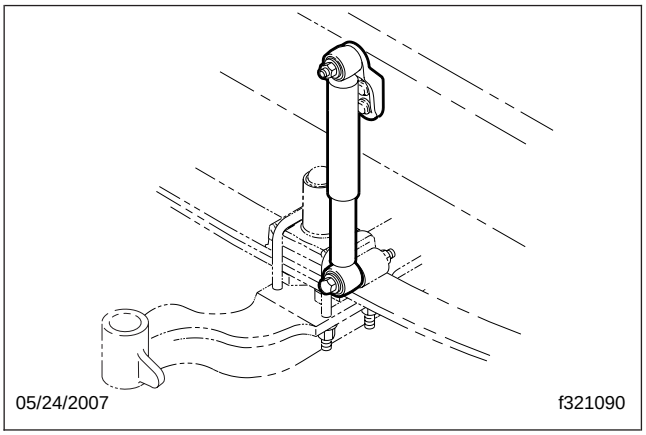


Fig. 1, Direct-Acting Shock Absorber (front suspension shown)

Inspect the spring bushings for wear or other damage. If any of these conditions exist, replace the damaged bushings.

⚠ WARNING

Replace worn, cracked, or damaged spring brackets. Failure to do so could result in bracket breakage, possibly leading to loss of vehicle control and resulting in personal injury or property damage.

Inspect the crossmember(s) and gussets for wear, cracks, and other damage. If any of these conditions exist, replace the damaged parts; see **Group 32** of the *Cascadia™ Workshop Manual*.

Visually check the air spring piston for cracks, chips, and broken areas. Check the air bag for rips, tears, and holes. Verify that the air spring assembly does not leak. If any of these conditions exist, replace the damaged parts; see **Group 32** of the *Cascadia™ Workshop Manual*.

Suspension Height Checking

IMPORTANT: Before checking the AirLiner suspension height, make sure there is no load on the chassis, and the trailer is unhitched.

IMPORTANT: To prevent voiding the warranty on Barksdale height-control valves, note the following:

- Do not overtighten the bolts in the Barksdale height-control valve housing. The bolts should not be loose, and should not require tightening. Only if necessary, tighten the valve housing bolts 45 lbf·in (500 N·cm). Any damage to the valve housing will void the warranty.
- Do not attempt to disassemble the Barksdale valve body or the control lever. There are no serviceable parts in the valve, and any disassembly will void the warranty.

NOTICE

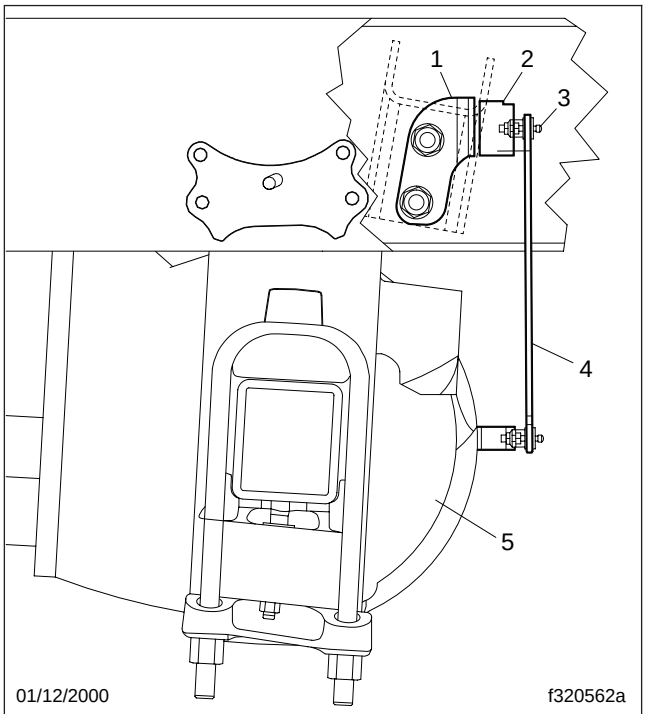
When removing or loosening a Barksdale height-control valve from a mounting bracket, always hold the valve-side mounting studs in place with an Allen wrench while loosening or tightening the nuts that attach the valve to the bracket. Because the mounting studs are threaded into the valve body, loosening the nuts without holding the studs can tighten the studs, which can crush the valve body and damage the valve. Conversely, tightening the nuts without holding the studs can back the studs out, causing a separation of the two halves of the valve body, and possibly a leak.

1. Park the vehicle on a level surface, using a light application of the brakes. Do not apply the parking brakes. Shift the transmission into neutral, and build the secondary air pressure to at least 100 psi (690 kPa). Shut down the engine. Have an assistant chock the tires on one axle only.
2. Mark the location of the front and rear tires on the floor.

NOTE: The stud bolt that fastens the valve's height-control lever to the vertical linkage is oriented correctly when the linkage rod is vertical, as viewed from the side of the vehicle; see **Fig. 2**. The rod may be on the forward or aft side of the lever to get it to be vertical.

3. Measure the distance between the left forward-most axle stop and the suspension as indicated; see **Table 1**, **Table 2**, **Table 3**, **Table 4**, and **Table 5** for an acceptable range of heights for each suspension.

IMPORTANT: **Suspensions with Dual-Leaf Springs:** Measure between the top of the U-bolt and the bottom of the axle stop.



1. Valve Mounting Bracket
2. Height-Control Valve
3. Stud Bolt
4. Linkage Rod
5. Axle

Fig. 2, Barksdale Height-Control Valve Installation (side view) (typical)

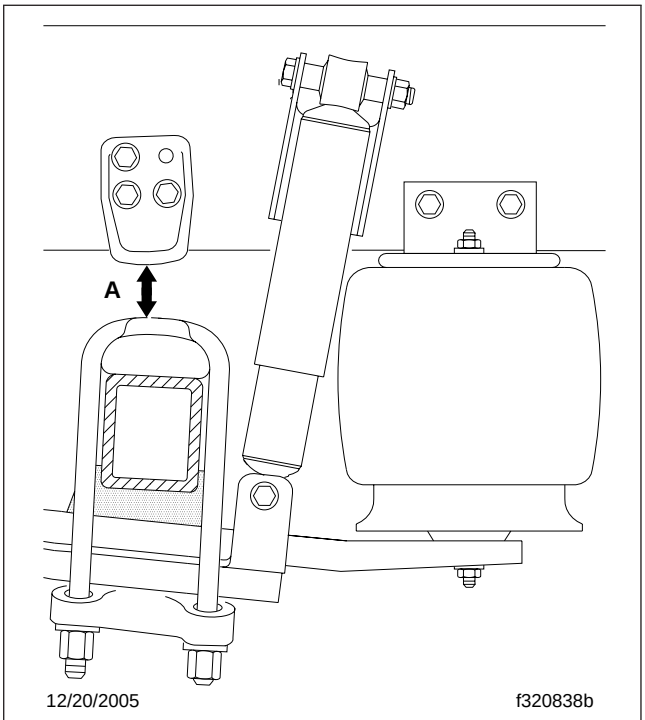
Suspensions with Single-Leaf Springs: Measure between the top of the U-bolt **pad** and the bottom of the axle stop.

4. If the measurement is not within the acceptable range, refer to the *Cascadia™ Workshop Manual* for adjustment instructions. If the distance is within the acceptable range, apply the parking brakes.

32–02 Suspension U-Bolt Torque Check

⚠ CAUTION

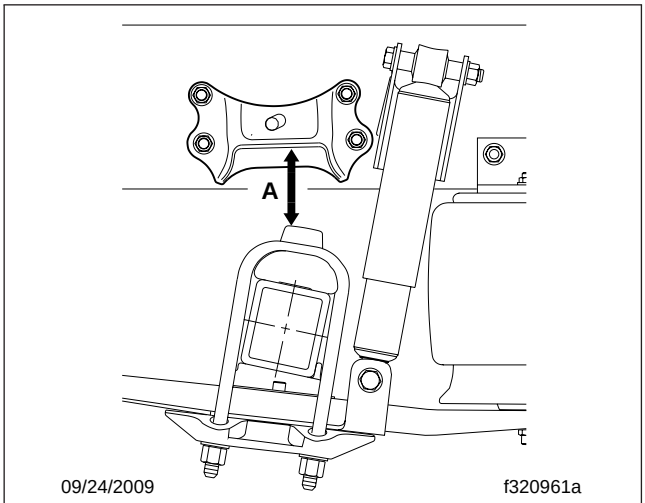
Failure to retorque the U-bolt nuts could result in spring breakage and abnormal tire wear.



Measure Point	Suspension Height Measurement		
	Min	Target	Max
A = Measure Here	2-3/8 inch (60 mm)	2-5/8 inch (67 mm)	2-7/8 inch (73 mm)

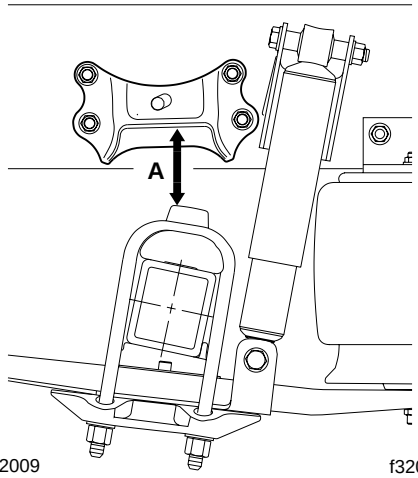
Table 1, Suspension Ride-Height Measurement, Dual-Leaf Spring, 20k/40k High Ride

1. Park the vehicle on a level surface and apply the parking brakes. Chock the tires.
2. Check the U-bolt torque. See **Table 6** for U-bolt torque specifications. Tighten in a diagonal pattern as shown in **Fig. 3**. Set a click-type torque wrench to the mid-point torque value for the fastener being checked. Turn the wrench in a clockwise motion (looking up) until the torque wrench clicks, then release pressure on the torque wrench, and turn the wrench again until it clicks. If the nut turns on the second application, the bolt is stretching and must be replaced. See **Group 32** of the *Cascadia™ Workshop Manual* for bolt replacement procedures.



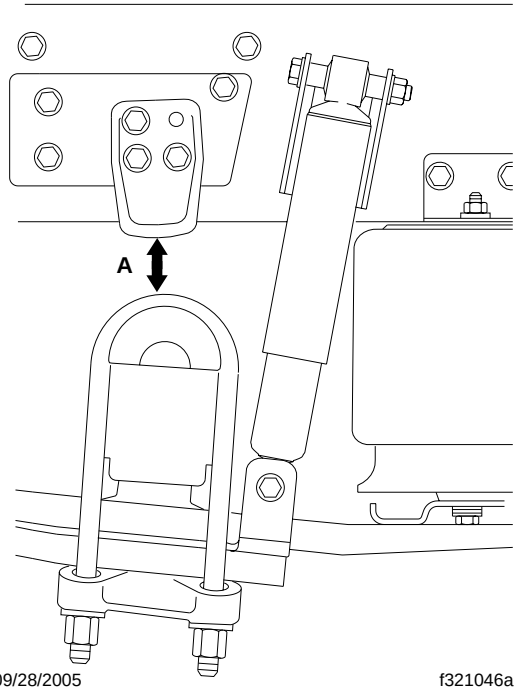
Measure Point	Suspension Height Measurement		
	Min	Target	Max
A = Measure Here	2-3/8 inch (60 mm)	2-5/8 inch (67 mm)	2-7/8 inch (73 mm)

Table 2, Suspension Ride-Height Measurement, Single-Leaf Spring, 20k/40k, High Ride



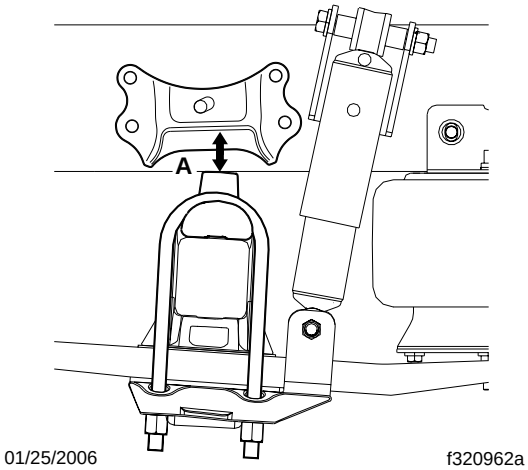
Measure Point	Suspension Height Measurement		
	Min	Target	Max
A = Measure Here	2-3/8 inch (60 mm)	2-1/2 inch (64 mm)	2-7/8 inch (73 mm)

Table 3, Suspension Ride-Height Measurement, Single-Leaf Spring, 10k/12k/15k/18k Mid Ride and 40k Low and Mid Ride



Measure Point	Suspension Height Measurement		
	Min	Target	Max
A = Measure Here	2-3/4 inch (70 mm)	3 inch (76 mm)	3-1/4 inch (83 mm)

Table 4, Suspension Ride-Height Measurement, Dual-Leaf Spring, 23k/46k/69k High Ride



Measure Point	Suspension Height Measurement		
	Min	Target	Max
A = Measure Here	2-1/8 inch (54 mm)	2-9/32 inch (58 mm)	2-5/8 inch (67 mm)

Table 5, Suspension Ride-Height Measurement, Single-Leaf Spring, 10k/12k/15k Low and Extra-Low Ride

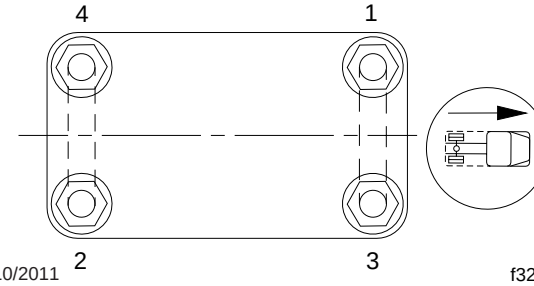


Fig. 3, Tightening Pattern for U-Bolt High Nuts

Spring U-Bolt High Nut Torque Values	
Size	**Torque: lbf·ft (N·m)**
5/8–18	180–230 (245–313)
3/4–16	270–330 (367–449)
7/8–14	420–500 (571–680)
1–14	520–600 (707–816)

Table 6, Spring U-Bolt High Nut Torque Values

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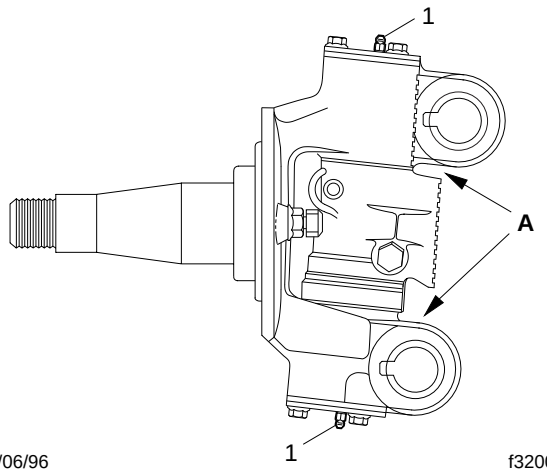
33–01 Knuckle Pin Lubrication, Meritor Axles

CAUTION

Use regulated pressure when lubricating the knuckle assemblies, otherwise damage could result to the knuckle caps.

When lubricating knuckle pin bushings, do not raise the front axle. Wipe the lube fittings clean, and apply multipurpose chassis grease, NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI Grade 2 (8% 12-hydroxy lithium stearate grease) until new grease is seen at the bushing grease seal opposite the fittings. The grease seal will accept grease pressure without damage, and is designed to have grease pumped out through it during lubrication. Even if grease leaks out around the top, or bottom-plate gasket, continue pumping until new grease is seen at the bushing seal opposite the grease fitting. See **Fig. 1**.



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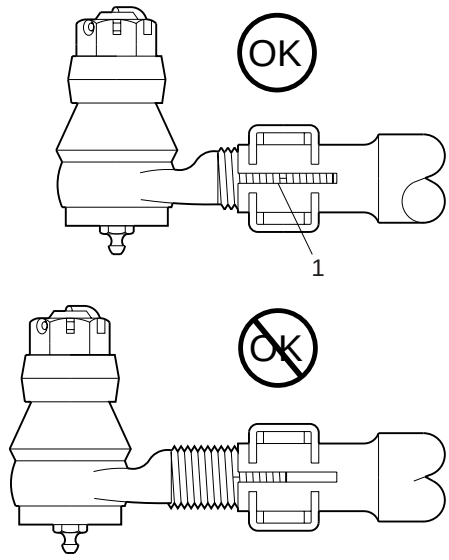
A. Grease Exit
1. Grease Fitting

Fig. 1, Meritor Knuckle Pin Lubrication

33–02 Tie Rod Inspection

Inspect the tie-rod ends as follows:

1. Shake the cross-tube. A loose fit, or movement between the tapered shaft of the ball and the cross-tube socket members indicates that the tie-rod end assembly must be replaced.
2. The threaded portion of the tie-rod end assembly must be inserted all the way into the cross-tube split for adequate clamping. See **Fig. 2**. Replace the components if this cannot be done. For instructions, refer to **Group 33** of the *Cascadia™ Workshop Manual*.



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NOTE: Shown without pinch bolt to provide clarity.

1. Cross-Tube Split

Fig. 2, Tie-Rod End Adjustment

33–03 Tie Rod Lubrication, Meritor Axles

For any Meritor axle that requires lubrication of the tie-rod ends, wipe the grease fittings clean, then pump multipurpose chassis grease, NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI Grade 2 (8% 12-hydroxy lithium stearate grease), into the tie-rod ends until all used grease is forced out and fresh grease is seen at the ball stud neck.

33–04 All-Axle Alignment Check

Drive Axle Alignment Checking

Check the axle alignment, parallelism, and thrust angle measurements for the rear drive axles. Use the applicable procedure and specifications in **Group 35** of the *Cascadia™ Workshop Manual*.

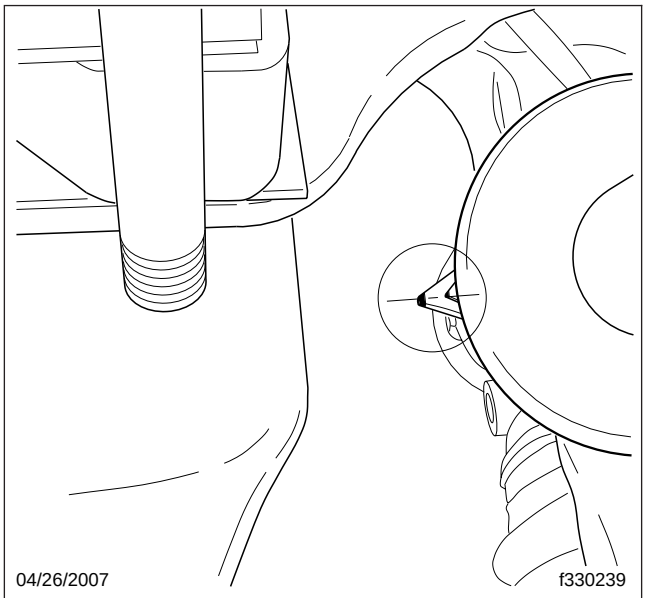
Toe-In Inspection

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

1. Apply the parking brakes and chock the rear tires.
2. Raise the front of the vehicle until the tires clear the ground. Place safety stands under the axle.
3. Using spray paint or a piece of chalk, mark the entire center rib of each front tire.
4. Place a scribe or pointed instrument against the marked center rib of each tire, and turn the tires. The scribe must be held firmly in place so that a single straight line is scribed all the way around each front tire.
5. Place a turn-plate or turntable under both front tires. Remove the safety stands and lower the vehicle. Remove the lock-pins from the gauges; make sure the tires are exactly straight ahead. On vehicles with rack and pinion steering, center the rack using the pointers on the front of the input shaft housing. See **Fig. 3**.

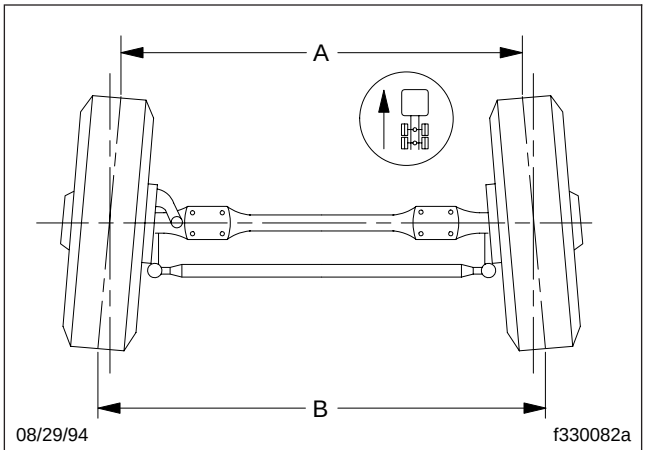
NOTE: If turn-plates or turntables are not available, lower the vehicle. Remove the chocks from the rear tires and release the parking brakes. Move the vehicle backward, then forward about six feet (two meters).

6. Place a trammel bar at the rear of the front tires; locate the trammel pointers at spindle height, and adjust the pointers to line up with the scribe lines on the center ribs of the front tires. See **Fig. 4**. Lock in place. Check that the scale is set on zero.



Align the pointers to center the steering.

Fig. 3, Centering the Rack and Pinion Steering Gear



NOTE: B minus A equals toe-in.

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

7. Place the trammel bar at the front of the tires (see **Fig. 5**) and adjust the scale end so that the pointers line up with the scribe lines. See **Fig. 6**.
8. Read the toe-in from the scale, and compare it to the toe-in specification in **Group 33** of the *Cascadia™ Workshop Manual*. If corrections are needed, refer to **Group 33** of the *Cascadia™ Workshop Manual* for instructions on adjusting the toe-in.

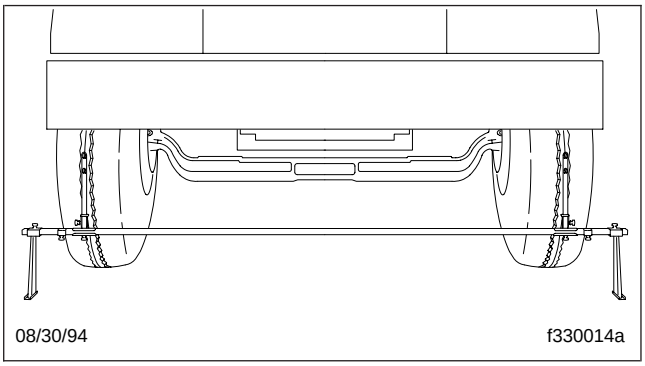


Fig. 5, Trammel Bar Positioning

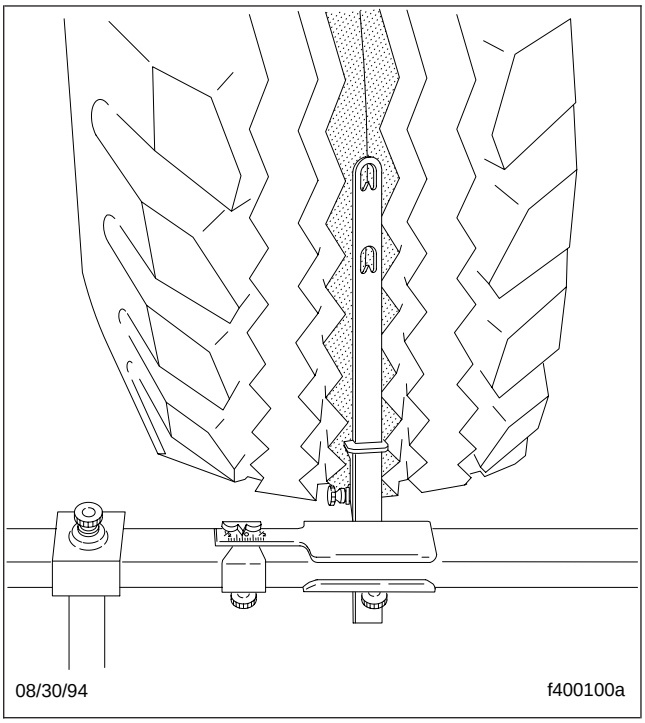


Fig. 6, Setting Trammel Bar Pointers

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35–01 Axle Lubricant and Filter Change, and Magnetic Strainer Cleaning (Synthetic Lubricant)

⚠ CAUTION

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

For all axles, including tandem drive axles and two-speed axles, do the procedures under the heading, "All Axle Models." For a two-speed axle with a shift unit, also change the shift unit lubricant. See under the heading, "Two-Speed Axles With Shift Unit."

All Axle Models

Meritor®

IMPORTANT: On Meritor axles, the oil change interval for Schedule III vehicles is extended to 500,000 miles (800 000 km) for axles using synthetic lubricant with a pump and filter system.

On single drive axles so equipped, the traction equalizer may slip or stick. When this happens, you will hear intervals of shrill noises when the vehicle operates at low speed, or when the vehicle makes sharp turns. Use a "limited-slip friction modifier" to correct this slip/stick condition. Add 1.6 ounces (35 mL) of additive for each pint (0.5 L) of lube capacity.

For all GL-5 oils, add one of the following limited-slip friction modifiers:

- Lubrizol No. 6178 (Lubrizol Corporation)
- DSL-178 (Guardsman Products)
- Equa-Torque No. 2411 (Sta-Lube Corporation)
- Equa-Torque No. 2414 (Sta-Lube Corporation)

IMPORTANT: These friction modifiers generally deteriorate faster than conventional extreme-pressure additives, so the lubricant change schedule must be shortened when using these additives. The traction equalizer additive (and recommended drive axle lubricant) must be changed at the Maintenance 2 (M2) interval, instead of the Maintenance 3 (M3) interval recommended in the Maintenance Operation Chart for axles that require only those lubricants recommended in **Table 1**.

1. Park the vehicle on a level surface, set the parking brakes, and chock the front tires.
2. Remove the axle carrier fill plug. Then remove the drain plug from the bottom of the housing. Completely drain the lubricant while the unit is warm, to allow the lubricant to drain faster.

   On tandem drive axles, it is also necessary to remove the plug at the bottom of the interaxle differential housing to drain that lubricant.
3. If equipped with an oil pump, remove the axle oil filter. Use a suitable filter strap wrench. See **Fig. 1**. Discard the old filter.

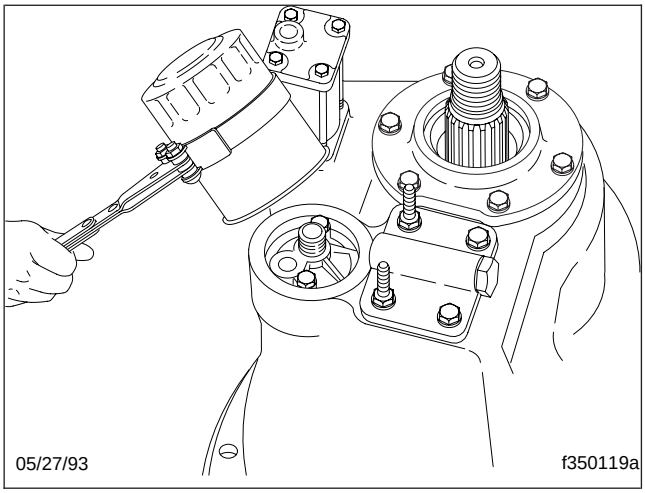


Fig. 1, Meritor Axle Oil Filter Removal

NOTE: There may be about one pint (0.5 L) of lubricant remaining in the filter. Be careful not to spill it when removing the filter.

4. Using the recommended drive axle lubricant, coat the face of the gasket on the new oil filter, if one was removed. Install the filter over the adapter, and tighten the filter one full turn after the gasket contacts the base; do not overtighten. See **Table 1** for recommended lubricants.

Meritor Drive Axle Recommended Lubricant			
Recommended Lubricant Type	**Ambient Temperature**	**Lubricant SAE Viscosity Grade**	**Meritor Specification**
Synthetic Gear Oil	–40°F (–40°C) and Up*	75W–90	0–76–N
	–40°F (–40°C) and Up*	75W–140	0–76–M

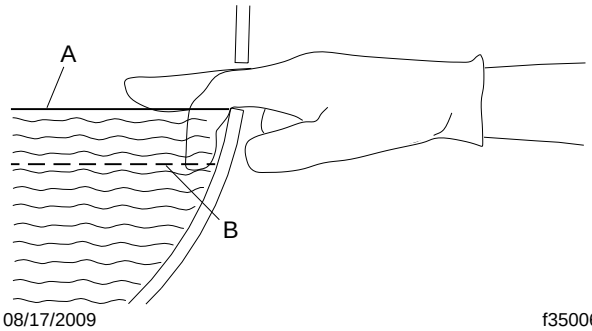
* There is no upper limit on these outside temperatures, but axle sump temperature must never exceed 250°F (121°C).

Table 1, Meritor Drive Axle Recommended Lubricant

5. Clean the fill and drain plugs. Change them if necessary.
   - 5.1 For magnetic plugs, use a piece of key stock or any other convenient steel slug to short the two magnetic poles and divert the magnetic field.
   - 5.2 Check the drain plug for metal particles every 100,000 miles (160 000 km). Clean away the collected material deposited on each pole. Magnets will rapidly lose their effectiveness as collected material bridges the gap between the two poles.
   - 5.3 Each time the oil is changed, replace any magnetic drain plug that does not meet the minimum pickup capacity.

   NOTE: Meritor recommends plugs with elements having a minimum pickup capacity of 1.5 pounds (0.7 kg) of low-carbon steel.
   - 5.4 After cleaning, install the drain plug(s) and tighten to 35 lbf·ft (47 N·m).
6. Fill the axle with recommended lubricant. See **Table 2** for drive axle lubricant capacities.

   NOTE: Some Meritor axles have a small tapped and plugged hole near and below the housing lubricant fill hole. This smaller hole is for a lubricant temperature indicator only, and should not be used as a fill or level hole.
   - 6.1 With the vehicle on a level surface, fill the axle through the oil fill hole. Lubricant should be level with the bottom of the oil fill hole. To check fluid level, see **Fig. 2**.



A. Correct (lube level at bottom of fill hole)
B. Incorrect (lube level below fill hole)

Fig. 2, Axle Lubricant Level Inspection

Meritor Drive Axle Lubricant Capacities		
Axle Model		**Capacity:* pt (L)**
Single Drive, Single Reduction†		
RS–21–160		39.5 (18.7)
RS–23–160		39.5 (18.7)
RS–23–161		37.2 (17.6)
RS–23–185		47.3 (22.4)
RS–25–160		37.2 (17.6)
Tandem Drive, Single Reduction		
RT–40–145, RT–40–145A, RT–40–145P	Forward	30.2 (14.3)
	Rear	25.8 (12.2)
RT–44–145, RT–44–145P	Forward	29.3 (13.9)
	Rear	25.1 (11.9)
RT–46–160, RT–46–160P	Forward	39.1 (18.5)
	Rear	34.4 (16.3)

* Quantities listed are approximate. Fill axle until lubricant is level with bottom of fill hole with vehicle on level ground.

† See "Traction Equalizer Additives" in the text.

Table 2, Meritor Drive Axle Lubricant Capacities

6.2 Install and tighten the fill plug 35 lbf·ft (47 N·m).

7. Whenever the interaxle differential housing has been drained, add an additional 2 pints (0.9 L) of the recommended lubricant directly into the interaxle differential housing.

8. Remove the chocks, then drive the vehicle, unloaded, for 1 or 2 miles (2 or 3 km) at speeds not to exceed 25 mph (40 km/h), to thoroughly circulate lubricant throughout the carrier and housing assemblies.

Freightliner

IMPORTANT: On Freightliner axles, the oil change interval for Schedule III vehicles is extended to 500,000 miles (800 000 km) for axles with weight ratings of 34,000 to 40,000 lb (15 000 to 18 000 kg) using synthetic lubricant. Oil must be changed at least every four years, and more often if the axle is exposed to high temperatures and steep grades.

1. Park the vehicle on a level surface, set the parking brakes, and chock the tires.

IMPORTANT: Freightliner rear axles do not require the use of friction modifiers.

2. Clean the fill plug and the area around it. In the axle housing rear cover, remove the plug from the oil fill hole.

3. Place a drain pan under the rear axle drain plug. Drain the oil when it is warm. At this temperature, the oil will run more freely and ensure that the axle is flushed.

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

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

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

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

4.4 After cleaning, install the drain plug(s) and tighten to 41 lbf·ft (55 N·m).

5. Fill the axle with the recommended lubricant. See **Table 3** for recommended drive axle lubricants and drive axle lubricant capacities.

Freightliner Rear Axle Approved Lubricant Type and Capacity

Lubricant Type	Axle	Oil Capacity: Quarts (liters)	
		Hubs Full	Hubs Dry
80W/90 Gear Oil	Forward Tandem	14.3 (13.5)	15.9 (15.0)
75W/90 Synthetic Gear Oil			
80W/90 Gear Oil	Single & Rear Tandem	10.6 (10.0)	12.2 (11.5)
75W/90 Synthetic Gear Oil			

Table 3, Freightliner Rear Axle Approved Lubricant Type and Capacity

NOTE: Some Freightliner axles have a small tapped and plugged hole near and below the housing oil fill hole. This smaller hole is for a lubricant temperature indicator only, and should not be used as a fill or level hole.

5.1 Fill the axle through the oil fill hole. Lubricant should be level with the bottom of the oil fill hole. To check fluid level, see **Fig. 2**.

5.2 Install and tighten the fill plug 41 lbf·ft (55 N·m).

Dana® Spicer®

IMPORTANT: The use of friction modifiers is not approved in Dana drive axles.

1. Park the vehicle on a level surface, set the parking brakes, and chock the tires.

2. Clean the fill plug and the area around it. In the axle housing rear cover, remove the plug from the oil fill hole (or standpipe, if installed in the oil fill hole). See **Fig. 3**.

3. Place a drain pan under the rear axle drain plug. See **Fig. 3**. Drain the oil at normal operating temperature, 150 to 200°F (65 to 93°C). At this

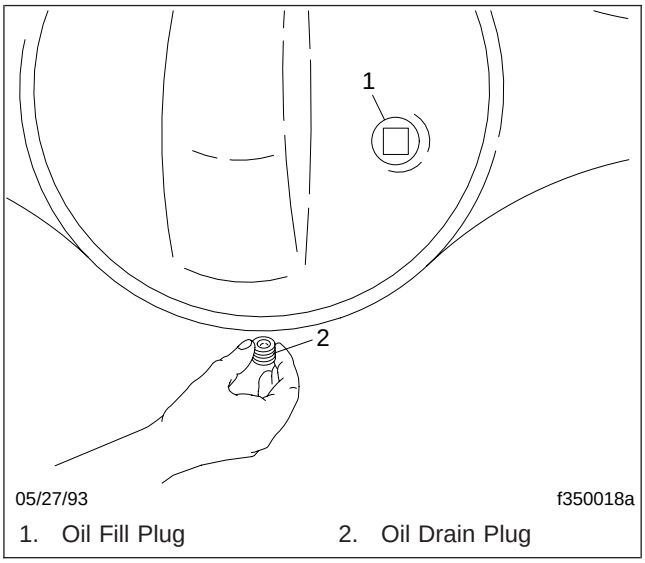


Fig. 3, Axle Housing Drain and Fill Plugs

temperature, the oil will run more freely and ensure that the axle is flushed.

NOTE: Some tandem drive axles are equipped with a cylindrical magnetic strainer, located below the lube pump on the front of the power divider cover. All rear axles are fitted with magnetic drain and fill plugs.

4. At each axle oil change, remove and clean the magnetic strainer, if equipped. See **Fig. 4**.

   4.1 Remove the magnetic strainer from the power divider cover.

⚠ WARNING

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

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

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

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

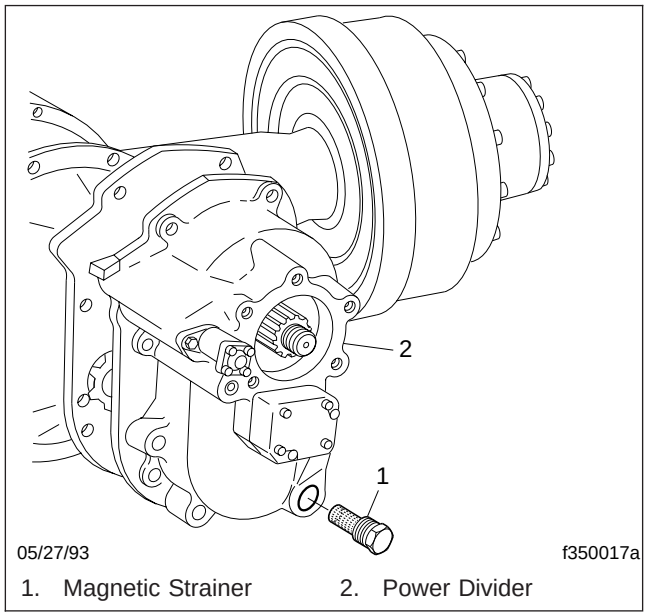


Fig. 4, Dana Spicer Tandem Drive Axle Magnetic Strainer

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

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

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

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

6. Fill the axle with the recommended lubricant. See **Table 4** for recommended drive axle lubricants, and **Table 5** for drive axle lubricant capacities.

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

Table 4, Dana Spicer Drive Axle Recommended Lubricant

Dana Spicer Drive Axle Lubricant Capacities		
Axle Type	**Axle Model**	**Capacity:* Pints (liters)**
Single Drive Axle Installation		
Single Reduction	23080S, 23080D	40 (18.9)
	23105S, 23105D	48 (22.7)
Tandem Drive Axle Installation		
Single Reduction	DD404, DD404–P	31 (14.7)†
	DS404, DS404–P	39 (18.5)†
	DS461–P	43 (20.3)†
2-Speed (dual-range)	DT402, 402–P	34 (16.1)†
	DT451–P	39 (18.5)†
	DT461–P	43 (20.3)†
Double Reduction	DP451–P	34 (16.1)†
	DP461–P	43 (20.3)†

* Quantities listed are approximate. Fill axle until lubricant is level with bottom of fill hole with vehicle on level ground.

† Add 2 pints (1 L) of additional lubricant to the power divider.

Table 5, Dana Spicer Drive Axle Lubricant Capacities

NOTE: Some Dana Spicer axles have a small tapped and plugged hole near and below the housing oil fill hole. This smaller hole is for a lubricant temperature indicator only, and should not be used as a fill or level hole.

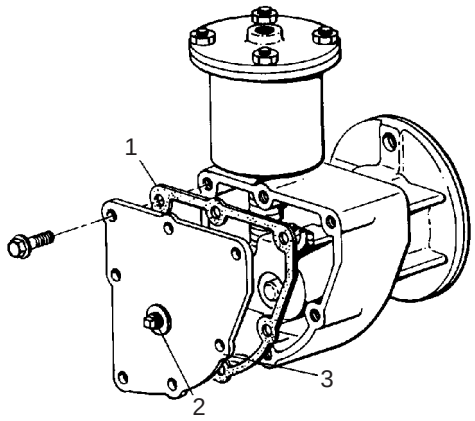
6.1 Fill the axle through the oil fill hole or standpipe opening. Lubricant should be level with the bottom of the oil fill hole, or the top of the standpipe opening. To check fluid level, see **Fig. 2**.

6.2 Install and tighten the fill plug 40 to 60 lbf·ft (54 to 81 N·m).

Two-Speed Axles With Shift Unit

Dana Spicer and Meritor

1. Remove the shift unit housing cover. See **Fig. 5**. Drain and discard the old lubricant. Discard the housing cover gasket.



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1. Housing Cover Gasket
2. Oil Fill Plug
3. Shift Unit Housing Cover

Fig. 5, Two-Speed-Axle Shift Unit

2. Thoroughly wash the axle shift parts and housing cover, and allow them to air dry.
3. Install the housing cover and a new cover gasket. Tighten the housing cover capscrews 90 to 110 lbf·in (1020 to 1240 N·cm), then remove the oil fill plug from the cover.

IMPORTANT: When the ambient temperature is above 0°F (–18°C), use SAE 10 heavy-duty engine oil, API service classification SD (sulfated ash content must not exceed 1.85%). When the ambient temperature is below 0°F (–18°C), use one part kerosene to three parts SAE 10 heavy-duty engine oil, API service classification SD (sulfated ash content must not exceed 1.85%). This cold-weather mixture can be safely used up to 32°F (0°C).

Commercially available automatic transmission fluid may be used in place of SAE 10 engine oil. Automatic transmission fluid can be used for all temperatures; do not mix it with kerosene. To prevent component damage, do not mix engine oil and automatic transmission fluid.

4. Using the recommended lubricant, fill the shift unit housing through the oil fill hole until the lubricant is level with the bottom of the opening.
5. Coat the threads of the fill plug with a small amount of Loctite® 242, or equivalent sealant. Install the fill plug finger-tight in the rear axle shift unit housing. Using a wrench, tighten it an additional 1-1/2 turns.

35–02 Axle Breather and Axle Lubricant Level Inspection

For all axles, including tandem drive axles and two-speed axles, do the procedures under the heading, "All Axle Models." For a two-speed axle with a shift unit, also check the shift unit lubricant. See under the heading, "Two-Speed Axles With Shift Unit."

All Axle Models

Meritor®

⚠ CAUTION

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

1. Park the vehicle on level ground, set the parking brakes, and chock the tires.

IMPORTANT: Oil level must be checked at each M1 interval on Meritor axles.

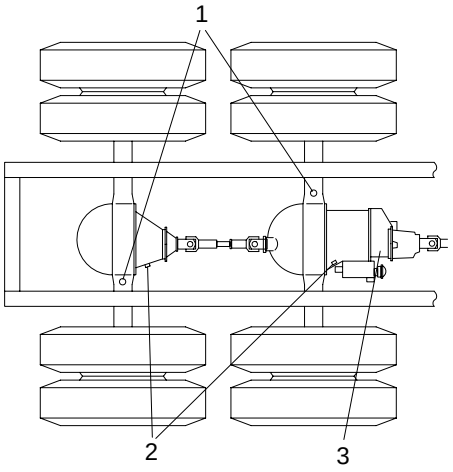
2. Clean the fill plug and the area surrounding the fill plug on the side of the axle carrier. Remove the plug. Check lubricant level when the axle is cold, or near room temperature.

NOTE: Some Meritor axles have a small tapped and plugged hole near and below the housing oil fill hole. This smaller hole is for a lubricant temperature indicator only, and should not be used as a fill or level hole.

3. Check that the lubricant is level with the bottom of the fill hole. See **Fig. 2**. If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in **Table 1**.
4. Install and tighten the fill plug 35 lbf·ft (47 N·m).

IMPORTANT: Always check the axle breather whenever checking lubricant level. Check the breather more frequently under adverse operating conditions.

5. Check the axle housing breather. Make sure that it is open and unclogged. See **Fig. 6**. If the breather is plugged or damaged, clean or replace it as needed.



1. Axle Housing Breathers
2. Carrier Oil Fill Plugs
3. Interaxle Differential

Fig. 6, Meritor Axle Housing Breathers

6. On non-drive axles using oil-lubricated wheel bearings, check the oil level at the wheels, and add oil if low. Use the same lubricant recommended for the drive axle.

NOTE: When adding to or checking the oil level, make certain the hub cap and plug are clean before removing the plug; this will minimize the possibility of dirt and road grime entering the assembly.

Freightliner

CAUTION

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

1. Park the vehicle on level ground, set the parking brakes, and chock the tires.

IMPORTANT: After 300,000 miles (500 000 km), oil level must be checked at each M1 interval on Freightliner axles.

2. Clean the fill plug and the area surrounding the fill plug on the side of the axle carrier. Remove the plug. Check lubricant level when the axle is cold, or near room temperature.

NOTE: Some Freightliner axles have a small tapped and plugged hole near and below the housing oil fill hole. This smaller hole is for a lubricant temperature indicator only, and should not be used as a fill or level hole.

3. Check that the lubricant is level with the bottom of the fill hole. See **Fig. 2**. If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in **Table 3**.
4. Install and tighten the fill plug 41 lbf·ft (55 N·m).

IMPORTANT: Always check the axle breather whenever checking lubricant level. Check the breather more frequently under adverse operating conditions.

5. Check the axle housing breather. Make sure that it is open and unclogged. If the breather is plugged or damaged, clean or replace it as needed.
6. On non-drive axles using oil-lubricated wheel bearings, check the oil level at the wheels, and add oil if low. Use the same lubricant recommended for the drive axle.

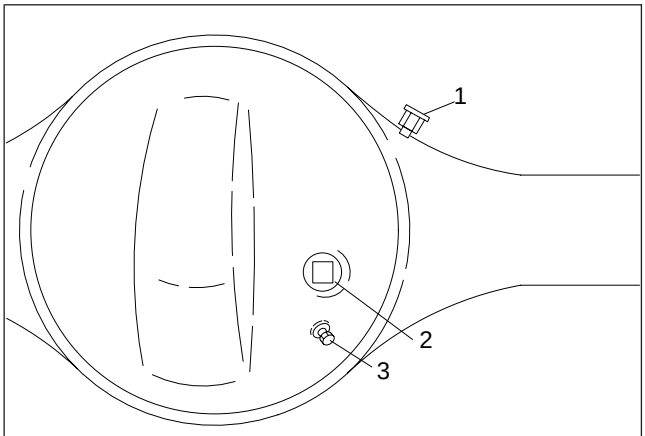
NOTE: When adding to or checking the oil level, make certain the hub cap and plug are clean before removing the plug; this will minimize the possibility of dirt and road grime entering the assembly.

Dana® Spicer®

CAUTION

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

1. Park the vehicle on level ground, set the parking brakes, and chock the tires.
2. If the vehicle has just been driven, allow a few minutes for the lubricant to settle.
3. Clean the oil fill plug and the area surrounding it. See **Fig. 7**. Remove the plug from the fill hole (or standpipe, if installed in the oil fill hole).



1. Axle Housing Breather
2. Fill Plug
3. Temperature Indicator Plug

Fig. 7, Dana Spicer Axle Housing Breather

IMPORTANT: A lubricant level close enough to be seen or touched is not sufficient. It must be level with the bottom of the fill hole, or the top of the standpipe opening.

4. Check that the lubricant is level with the bottom of the fill hole, or with the top of the standpipe opening. See **Fig. 2**. If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in **Table 4**.
5. Install and tighten the fill plug 40 to 60 lbf·ft (54 to 81 N·m).

IMPORTANT: Always check the axle breather whenever checking lubricant level. Check the breather more frequently under adverse operating conditions.

6. Check the axle housing breather. Make sure that it is unclogged and free from corrosion. See **Fig. 7**. If the breather is plugged or damaged, clean or replace it as needed.

Two-Speed Axles With Shift Unit

Dana Spicer and Meritor

CAUTION

Failure to keep lubricant at the specified level could cause damage to the axle shift unit.

1. Clean the shift unit oil fill plug, and the area surrounding the plug. See **Fig. 5**. Turn the fill plug counterclockwise to remove it.
2. Insert a finger or pipe cleaner into the fill plug hole and check the fluid level. The lubricant should be level with the bottom of the fill hole. If low, add the recommended lubricant.

CAUTION

Before adding additional lubricant, make sure of the type currently in the shift unit. To prevent component damage, do not mix engine oil with automatic transmission fluid.

IMPORTANT: When the ambient temperature is above 0°F (–18°C), use SAE 10 heavy-duty engine oil, API service classification SD (sulfated ash content must not exceed 1.85%). When the ambient temperature is below 0°F (–18°C), use one part kerosene to three parts SAE 10 heavy-duty engine oil, API service classification SD (sulfated ash content must not exceed 1.85%). This cold-weather mixture can be safely used up to 32°F (0°C).

Commercially available automatic transmission fluid may be used in place of SAE 10 engine oil. Automatic transmission fluid can be used for all temperatures; do not mix it with kerosene.

3. Coat the threads of the fill plug with a small amount of Loctite® 242, or equivalent sealant. Install the fill plug finger-tight in the rear axle shift unit housing. Using a wrench, tighten it an additional 1-1/2 turns.

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40–01 Wheel Nut Check

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

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

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

⚠ CAUTION

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

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

Table 1, Disc Wheel Fastener Torque

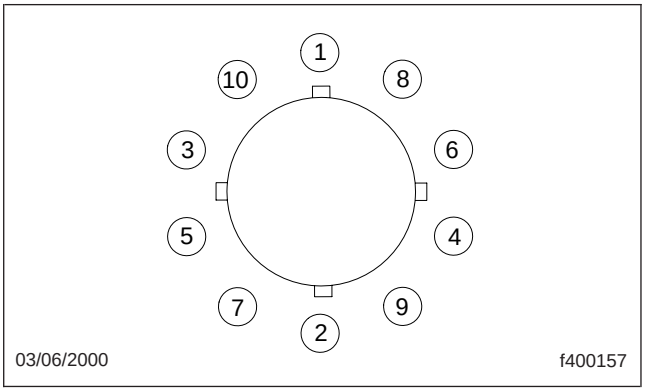

Fig. 1, Wheel Nut Tightening Sequence

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41–01 Driveline Inspection

1. Park the vehicle on a level surface, apply the parking brakes, and chock the tires.

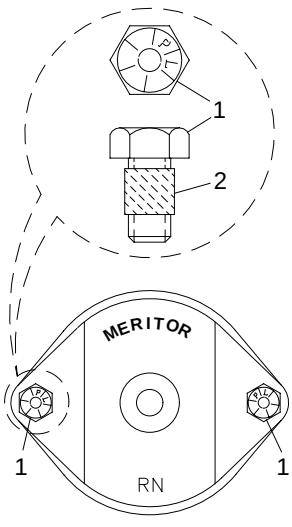
⚠ CAUTION

Due to the extreme load occurring at high-speed rotation, a loose or broken capscrew at any point in the driveline will weaken the driveline connection, which could eventually result in serious vehicle damage. Tighten bearing-cap capscrews or yoke-strap capscrews to specified torque, being careful to not overtighten.

2. *For U-joints with bearing caps,* tighten bearing-cap capscrews 43 lbf·ft (49 N·m). See **Fig. 1**.

   For Arvin Meritor RPL series U-joints, tighten bearing-cap capscrews 125 lbf·ft (169 N·m). See **Fig. 2**.

   For U-joints with yoke straps, tighten yoke-strap capscrews 125 lbf·ft (169 N·m). See **Fig. 3**.



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1. Self-Locking Capscrew
2. Adhesive Band

Fig. 1, Arvin Meritor U-Joint Fasteners for Bearing Caps

3. Check the driveline yokes for cracks, and check end-yokes for looseness. See **Fig. 3**.

   Replace cracked yokes.

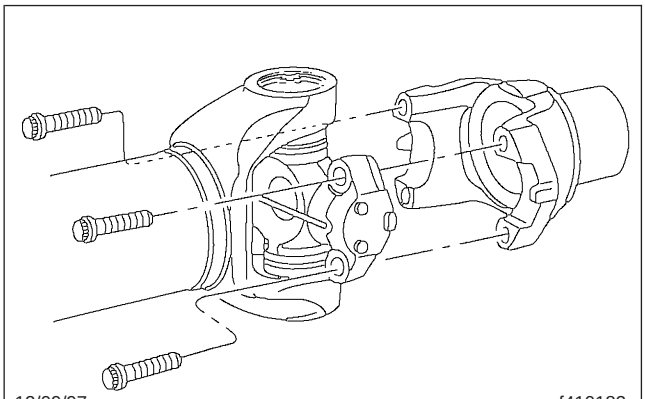

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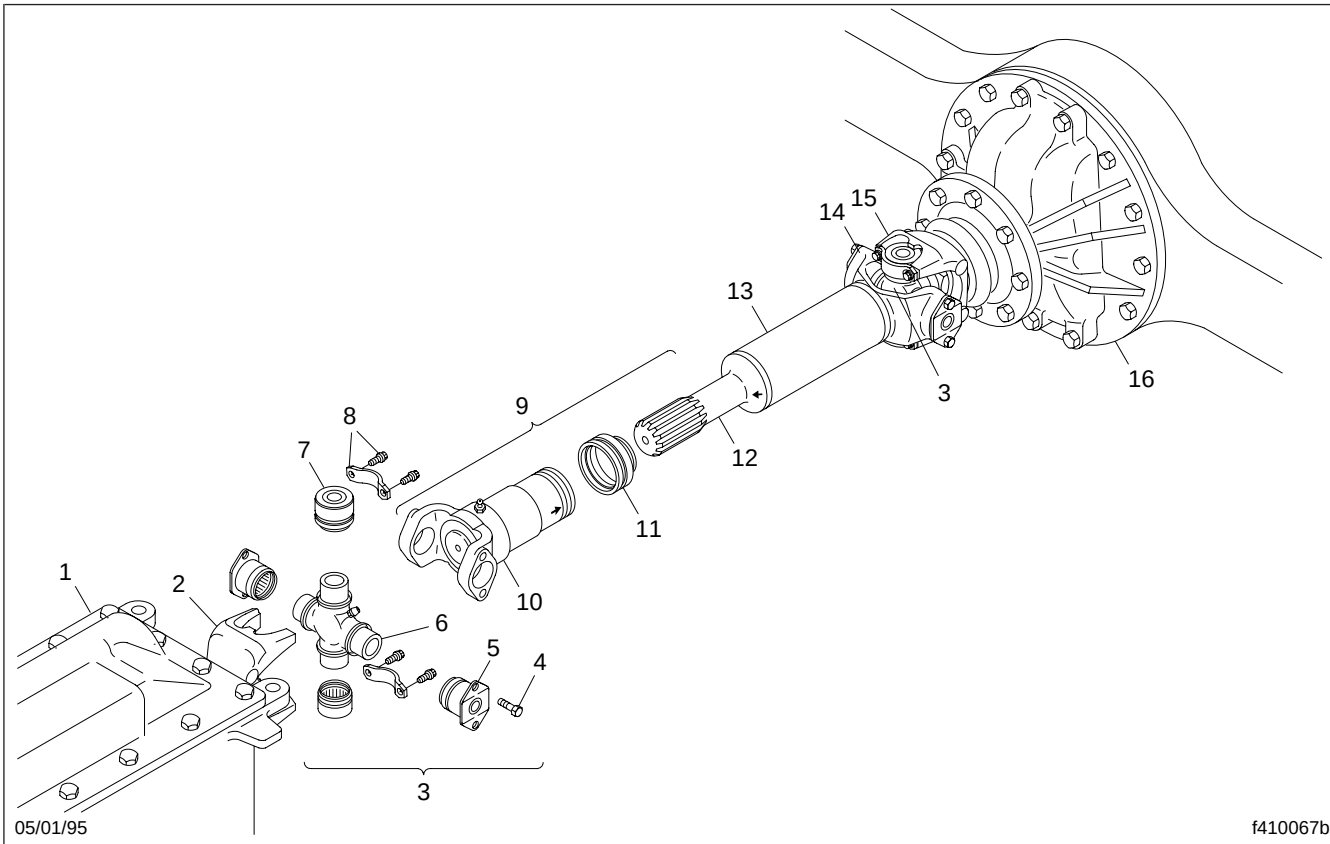
Fig. 2, Arvin Meritor RPL Series U-Joint

If any end-yoke can be moved in or out on its shaft, or can be rocked on its shaft, disconnect the driveshaft and U-joint from the yoke, then check the drive component's shaft seal for leakage or other visible damage that may have been caused by the loose yoke. Replace the seal if needed, then tighten the yoke nut. Refer to **Group 41** of the *Cascadia™ Workshop Manual* for torque specifications. If the yoke is still loose after tightening the yoke nut, replace the end-yoke and yoke nut.

Replace the prevailing torque locknut (end-yoke nut) if it was removed for yoke replacement, seal replacement, or any other reason.

4. Check U-joint assemblies for wear by moving the driveshaft up and down, and from side to side. If any movement of the U-joint cross in the bearings can be felt or seen, replace the U-joint assembly.
5. Check if the midship bearing and mounting are loose or have deteriorated, by attempting to move the driveshaft up and down, and from side to side. If the bearing is loose on its shaft, or rattles, replace it. If the bearing mount is loose on the frame, tighten the mounting fasteners to the proper torque value. See **Group 41** of the *Cascadia™ Workshop Manual* for torque specifications. Replace the midship bearing assembly if the rubber cushion is deteriorated or oil-soaked.
6. Check slip joints for spline wear by moving the sleeve-yoke and splined shaft back and forth. See **Fig. 4**. If the slip joint can be twisted in a clockwise, or counterclockwise movement



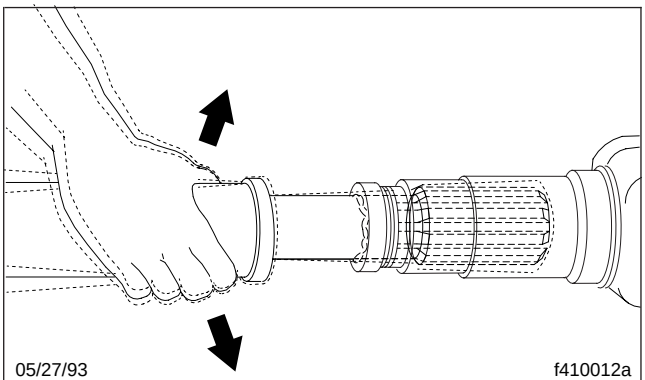
NOTE: Not all fasteners are shown.

1. Transmission
2. Transmission Output-Shaft End-Yoke (yoke-strap type)
3. U-Joint Assembly
4. Bearing Cap Self-Locking Capscrew
5. Bearing Cap
6. U-Joint Cross
7. Bearing Cup (for yoke strap)
8. Yoke Strap and Capscrew
9. Slip-Joint Assembly
10. Sleeve-Yoke (bearing-cap type)
11. Dust Cap
12. Splined Stub Shaft
13. Driveshaft Tube
14. Tube-Yoke (bearing-cap type)
15. Axle Input-Shaft End-Yoke (yoke-strap type)
16. Rear Axle

Fig. 3, Components of a Basic Driveline

greater than 0.007 inch (0.18 mm), replace both the sleeve-yoke and the splined shaft.

7. Visually examine the driveshaft tubes for dents, bends, twists, or other damage. If any tube appears to be damaged, refer to **Group 41** of the *Cascadia™ Workshop Manual* for repair and replacement instructions.
8. Examine the driveshaft for evidence of missing balance weights, and for buildup of foreign material. Remove any foreign material. If there is any evidence that balance weights are missing, remove the driveshaft and have it balanced.
9. For driveshafts with slip joints, check to be sure the yoke plug is not loose or missing. See **Fig. 5**. Repair or replace the yoke plug as needed. If the yoke plug is missing, the splined shaft may be hitting the plug and knocking it out; contact your Regional Service Office for assistance in determining the correct driveshaft length.



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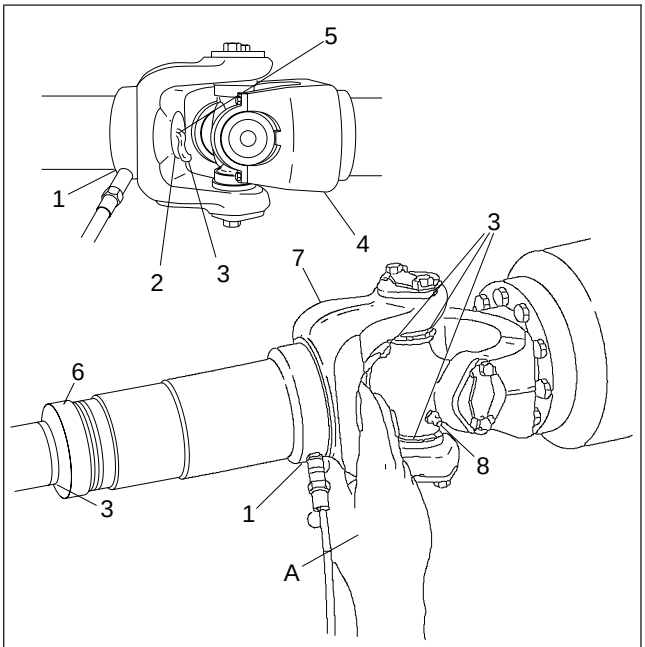
Attempt to move the sleeve-yoke and splined shaft back and forth.

Fig. 4, Slip Joint Spline Wear Checking



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A. After grease appears, cover the pressure-relief hole while continuing to lubricate.
1. Slip Joint Grease Fitting (with grease gun attached)
2. Yoke Plug
3. Grease
4. Half-Round Yoke
5. Yoke Plug Pressure-Relief Hole
6. Slip Joint Seal
7. Full-Round Yoke
8. U-Joint Grease Fitting

Fig. 5, Slip Joint and U-Joint Lubrication

41–02 Driveline Lubrication

Universal Joint Lubrication

NOTE: Vehicles equipped with Meritor RPL Series drivelines do not require periodic lubrication.

1. Park the vehicle on a level surface, apply the parking brakes, and chock the tires.
2. Wipe all old grease and dirt from each U-joint grease fitting. See **Fig. 5**.
3. Use a hand-type grease gun, or a high-pressure gun with a low-pressure adapter, to lubricate U-joints. If a low-pressure adapter is not used, U-joints may not receive enough grease.

   Using lithium 12-Hydroxy stearate grease (NLGI Grade 1 or Grade 2, with EP additives), lubricate until *new* grease can be seen at *all four* U-joint seals. Fresh grease must be seen escaping from *all four* bearing-cap seals of each U-joint. On yokes equipped with a yoke-bearing cap, if most of the grease being added to a U-joint can be seen escaping from just one of the U-joint seals, check the torque on the capscrews at that seal.
4. Tighten the bearing-cap capscrews 43 lbf·ft (49 N·m). If the capscrews were already tight, or all of the U-joint seals still do not purge, remove the bearing cap at that seal, and examine the seal for damage. If the seal is damaged, replace the complete U-joint.
5. If grease does not appear at one seal, use a prying tool to pry the U-joint trunnion away from the non-purging seal, or tap the driveshaft or yoke with a plastic or rawhide mallet on the side opposite the dry seal, while continuing to lubricate. If grease still does not appear, loosen the capscrews at the bearing with the dry seal, to relieve seal tension. Lubricate the U-joint until new grease is seen at the seal, then tighten the capscrews to the correct torque specifications. If the bearing will not take grease, replace the U-joint. Refer to **Group 41** of the *Cascadia™ Workshop Manual* for replacement instructions.
6. Check the purged grease. If it appears rusty, gritty, or burned, replace the U-joint.
7. Wipe the purged grease from the seals, and any excess grease from the grease fitting.

Slip Joint Spline Lubrication

NOTE: Vehicles equipped with Meritor RPL Series drivelines do not require periodic lubrication.

1. If equipped with a grease fitting, wipe all old grease and dirt from the slip joint grease fitting. See **Fig. 5**.
2. Use a hand-type grease gun or a high-pressure gun with a low-pressure adapter, to lubricate the slip joint. Add multipurpose chassis grease (lithium 12-hydroxy stearate, NLGI Grade 1 or Grade 2, with EP additives) until it appears at the pressure-relief hole in the yoke plug. Then cover the relief hole with your finger, while continuing to apply gun pressure until new grease appears at the slip joint seal. See **Fig. 5**. This ensures complete lubrication of the splines.
3. Wipe the purged grease from the pressure-relief hole and slip joint seal, and any excess grease from the grease fitting.

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42–01 Air Brake System Valve Inspection

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

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

42–02 Bendix Air Dryer Desiccant Replacement

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

AD–9

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

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

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

⚠ WARNING

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

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

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

NOTICE

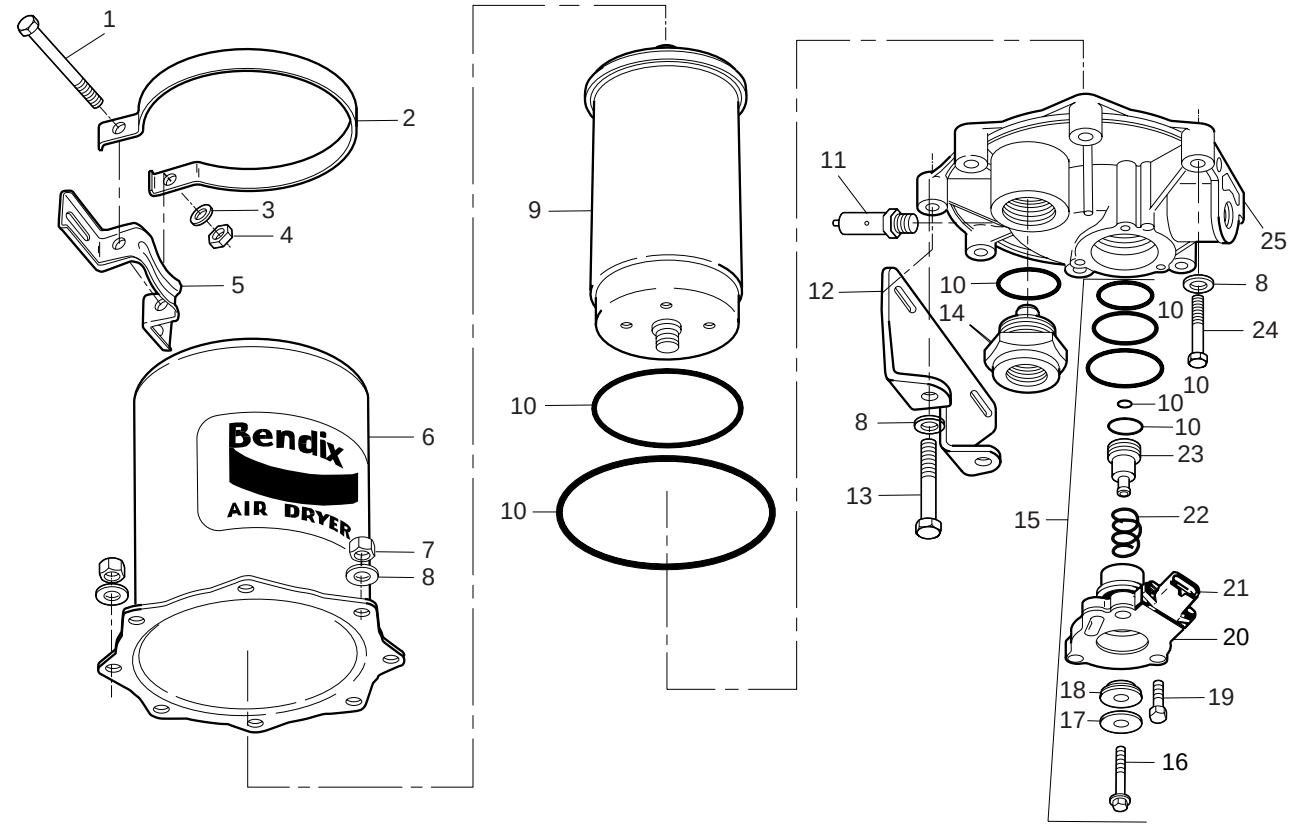
Dirt or obstructions in the O-ring grooves can cause an O-ring failure that will result in an air leak.

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

IMPORTANT: Replace, do not reuse the Nylok nuts on the air dryer cover.



1. 5/16 x 4-1/2 Upper Mounting Bracket Bolt
2. Upper Mounting Bracket Strap
3. 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. Safety 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 Tapping 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 (exploded view)

16. Install the 6 bolts, 12 washers, and 6 new Nylok nuts. Torque the Nylok nuts in a star pattern 17 to 24 lbf·ft (370 to 520 N·m). See **Fig. 2**.
17. Install the air dryer on the lower mounting bracket. Install the two previously marked bolts, four washers, and two new Nylok nuts. Torque the two remaining Nylok nuts 17 to 24 lbf·ft (370 to 520 N·m). Install the bolt, two washers, and a new Nylok nut in the upper mounting bracket strap. Torque the upper mounting bracket strap Nylok nut 80 to 120 lbf·in (900 to 1360 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 *Cascadia™ Workshop Manual* for diagnosis and repair information.

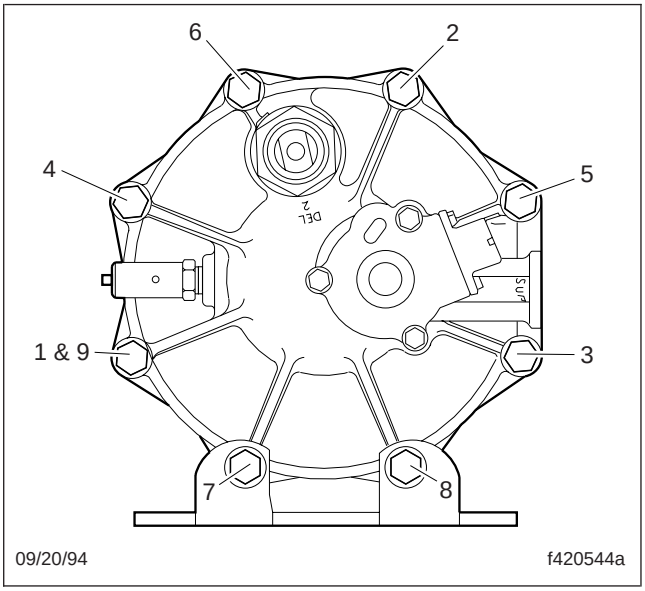


Fig. 2, AD–9 End Cover to Housing Torque Pattern

AD–IS

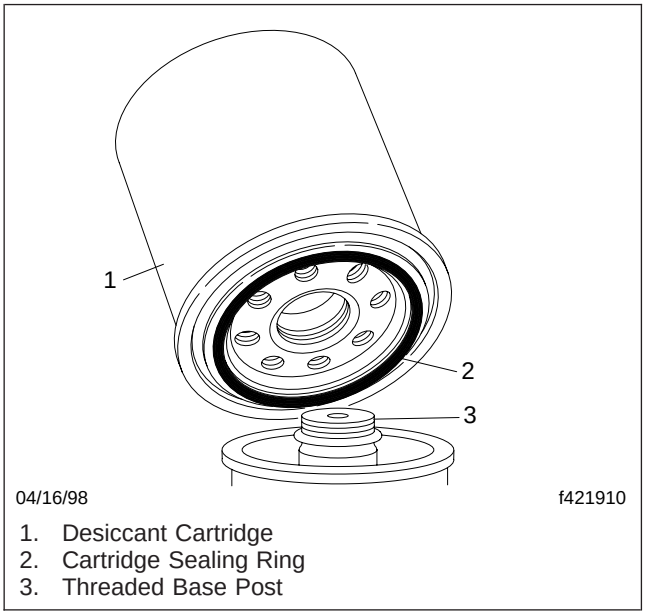
1. Park the vehicle on a level surface, apply the parking brakes and chock the tires.
2. Drain the air reservoirs.
3. Using a strap wrench or equivalent, loosen the desiccant cartridge. Spin the cartridge off by hand and discard it. See **Fig. 3**.
4. On the new desiccant cartridge, lubricate the sealing rings with silicone grease.

IMPORTANT: Only use the silicone grease supplied with Bendix replacement kits.

5. Screw the desiccant cartridge onto the body by hand until the seal makes contact with the body. Rotate the cartridge clockwise about one full turn. Tighten the cartridge firmly.

AD–IP

1. With the vehicle parked on a level surface, apply the parking brakes and chock the tires.
2. Using a wrench or a socket, loosen the desiccant cartridge bolt. Then separate the desiccant cartridge from the end cover.
3. Pull the cartridge bolt out of the cover and remove the cartridge.



1. Desiccant Cartridge
2. Cartridge Sealing Ring
3. Threaded Base Post

Fig. 3, AD–IS Desiccant Cartridge Replacement

⚠ WARNING

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. Disassembly could release the spring, resulting in personal injury.

4. Remove and discard both O-rings from the cartridge bolt.
5. Using a clean rag, wipe clean the inside of the end cover. Clean the cartridge bolt bore in the end cover, and the sealing surfaces for the large- and small-diameter desiccant cartridge sealing rings.
6. Inspect the end cover for physical damage, then inspect all air line fittings for corrosion; replace as necessary.
7. Clean and inspect the bolt, paying attention to the threads and O-ring grooves.

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

8. Lubricate the O-rings, bolt O-ring grooves, sealing rings, and cartridge grooves. Lubricate the end cover bore for the bolt.

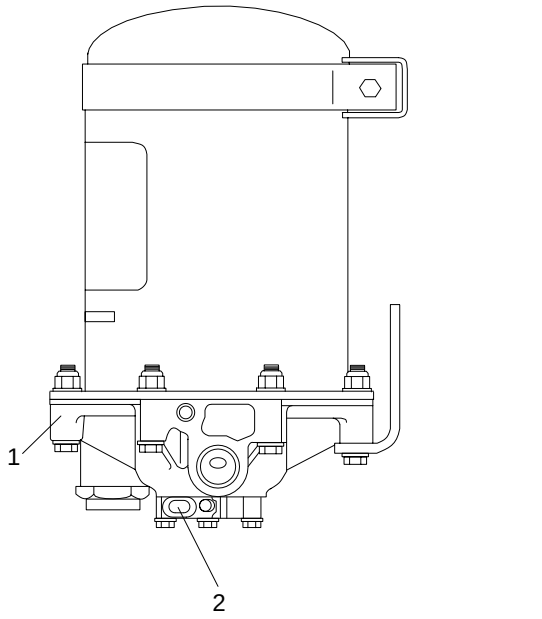
9. Install both O-rings on the cartridge bolt, then, using a twisting motion, insert the assembled desiccant cartridge bolt in the end cover.
10. Install the desiccant cartridge on the end cover, making sure the cartridge is properly seated and flush on the end cover.

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.

11. Using a wrench or socket, tighten the desiccant cartridge bolt 70 lbf·ft (95 N·m). **Do not** overtorque.
12. Before placing the vehicle in service, perform the test below.
    - 12.1 Close all reservoir drain cocks.
    - 12.2 Build system pressure to governor cut-out, and note that the AD-IP air dryer purges with an audible escape of air.
    - 12.3 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.
    - 12.4 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 1-inch bubble in 1 second. If leakage exceeds this measure, remove and re-install the desiccant cartridge.

42–03 Air Dryer Inspection

1. Park the vehicle on a level surface and apply the parking brakes. Shut down the engine. Chock the tires.
2. Check for moisture in the air brake system by opening the reservoir drain cocks. Examine the discharge. Some trace of water in the discharge is normal. A discharge of a milky gray liquid indicates excessive moisture is present in the air system and the desiccant cartridge needs to be replaced. See **Group 42** of the *Cascadia™ Workshop Manual* for troubleshooting procedures. The following conditions could cause small amounts of moisture to be found in the air system:
    - An outside air source has been used to charge the air brake system. This air did not pass through the drying bed.
    - Air usage is unusually high and not normal. This may be due to accessory air demands or some unusual air requirement that does not allow the compressor to load and unload in a normal fashion. Check for air system leaks.
    - The air dryer has been installed on a system that had previously been operated without an air dryer. This type of system will be saturated with moisture, and several weeks of operation may be needed to fully dry the system.
    - The temperature range in your area fluctuates more than 30 degrees in one day. Small amounts of water can accumulate in the air brake system due to condensation. Under these conditions, the presence of moisture is normal and should not be considered an indication of poor air dryer performance.
3. Inspect the air dryer for external damage, and check that the unit is tightly mounted on the frame. If the air dryer mounting is loose, See **Group 42** of the *Cascadia™ Workshop Manual* for mounting instructions.
4. Turn on the ignition switch, but do not start the engine.
5. Disconnect the harness connector from the air dryer.
6. Connect a voltmeter to circuit 94 on the air dryer's harness connector and to a body ground point. Check for battery voltage. If voltage is not found, check and repair the open or short to ground in wire 94.
7. Connect a voltmeter between the two terminals on the air dryer's harness connector. If voltage is not found, repair the open in the ground circuit wiring.
8. Use an ohmmeter to check resistance between the terminals on the end cover. See **Fig. 4**. The end cover contains the heater/thermostat. If the heater/thermostat is between 40 and 90°F (5 and



1. End Cover Assembly
2. Heater/Thermostat Terminals

Fig. 4, End Cover Terminals Location

32°C), the heater/thermostat measured resistance will be infinite ohms. If the measured resistance is less than infinity, replace the heater/thermostat.

9. Remove the heater/thermostat assembly and place it in a freezer for about five minutes to cool it below 40°F (5°C). Remove the cold heater/thermostat assembly and check resistance between the heater/thermostat terminals. Resistance should be 1.5 to 3.0 ohms. As the temperature of the heater/thermostat assembly increases, the ohm reading will increase. When the temperature goes above 45°F (7°C) measured resistance should be infinite ohms. If the heater/thermostat does not operate as outlined, replace it. If it does operate as outlined, install it.

42–04 Alcohol Evaporator Cleaning and Inspection

Maintenance is required during both the freeze season and the off season to keep the alcohol evaporator in good working order.

Off Season

During the off season, drain the unit of alcohol. At regular engine service intervals, open the drain cock to remove moisture from the alcohol evaporator. Before reactivating the evaporator for the next freeze season, drain, disassemble, inspect, and steam-clean the unit of any sludge that may have accumulated. It is advisable to replace any rubber parts when assembling the alcohol evaporator. Perform this service just before the freeze season.

Freeze Season Reactivation

1. Park the vehicle on a level surface and apply the parking brakes. Shut down the engine. Chock the tires.
2. Remove the filler cap, and check the cap tetraseal.
3. Remove the capscrews and reservoir from the cover.
4. Remove the cover tetraseal.
5. Drain the air tank, and disconnect the line from the evaporator outlet. Remove the check-valve retainer, spring, and disc.
6. Install the disc, spring, and check-valve retainer, and connect the line to the evaporator outlet.
7. Install the cover tetraseal.
8. Install the reservoir on the cover and tighten the capscrews.
9. Fill the reservoir with 40 ounces (1183 mL) of methyl alcohol, then install the filler cap.

42–05 Brake Inspection

Parking Brake Operational Check

⚠ 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 *Cascadia™ Workshop Manual* for repair procedures.

Brake Component Inspection

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

⚠ WARNING

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

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

   If a band shows, the stroke is too long. Check the foundation brake components for wear or damage, and repair as needed. See **Group 42** of the *Cascadia™ Workshop Manual* for inspection and repair procedures.
4. Measure the applied chamber stroke. See **Table 1** for the proper stroke for the type of chamber being used. If the stroke is too short, the brakes may drag or will not fully apply. Check for improper operation or adjustment of the automatic slack adjuster. See **Group 42** of the *Cascadia™ Workshop Manual*, or see the *Cascadia™ Troubleshooting Manual* for procedures.

Brake Chamber Stroke Specifications			
Chamber			Max Applied Stroke: inch (mm)
Manufacturer	Type*	Size†	
Haldex	Standard Stroke	12	1-3/8 (35)
		16	1-3/4 (44)
		20	
		24	
	2-1/2-Inch Extended Stroke	24	2 (51)
	3-Inch Extended Stroke	24	2-1/2 (64)
	Standard Stroke	30	2 (51)
	Long Stroke	30	2-1/2 (64)
Meritor	Standard Stroke	9	Less than 1-1/2 (38)
		12	
		16	Less than 1-3/4 (44)
		20	
		24	Less than 1-7/8 (48)
	Long Stroke	24	Less than 2 (51)
	Standard Stroke	30	

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

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

Table 1, Brake Chamber Stroke Specifications

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

42–06 Haldex Slack Adjuster Lubrication

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 property damage, personal injury, or death.

⚠ 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. 5**. Use standard chassis lubricant for Haldex slack adjusters.

42–07 Meritor Camshaft Bracket Lubrication

NOTE: If equipped with an extended-maintenance Q Plus™ brake system, the camshaft 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. The extended-maintenance camshaft bushings are lubricated during the brake reline service interval. For service and lubrication instructions, see **Group 42** of the *Cascadia™ 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. 6**.

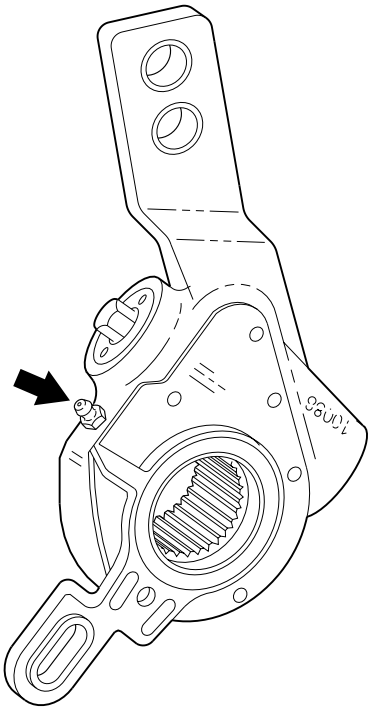


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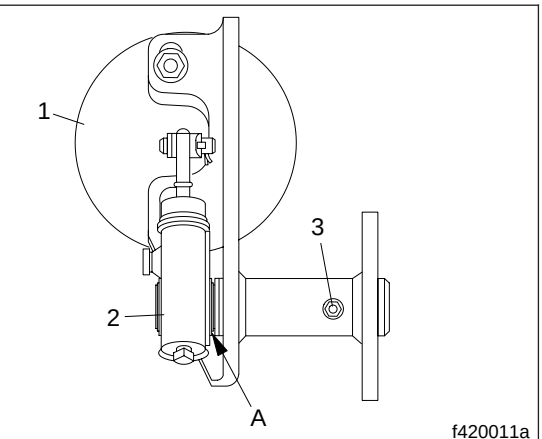
Fig. 5, Haldex Automatic Slack Adjuster Grease Fitting



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

Fig. 6, Camshaft Bracket Lubrication

WARNING

If grease leaks out under the camhead, the camshaft bracket grease seal is worn or damaged. See Group 42 in the *Cascadia™ Workshop Manual* for grease seal replacement instructions. If this 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.

42–08 Meritor Slack Adjuster Lubrication

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. The extended-maintenance slack adjusters are lubricated during the brake reline service interval. For service and lubrication instructions, see **Group 42** of the *Cascadia™ Workshop Manual*.

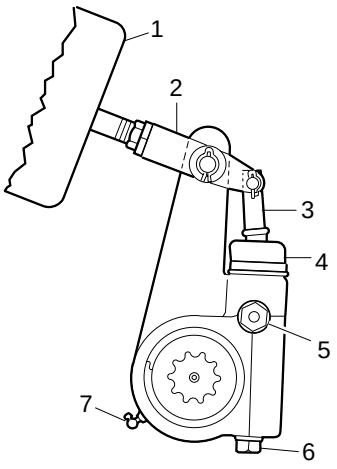
For slack adjusters with grease fittings and for operating temperatures above –40°F (–40°C), use an NLGI Grade 1 clay-base grease, or an NLGI Grade 1 or 2 lithium-base grease.

For slack adjusters with grease fittings and for operating temperatures below –40°F (–40°C) and above –65°F (–54°C), use an NLGI Grade 2 synthetic oil, 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. 7**.

42–09 Bendix E-6 Foot Control Valve Inspection and Lubrication

1. Remove the brake valve from the vehicle. See **Section 42.08, Subject 110**, of the *Cascadia™ Workshop Manual* for instructions.



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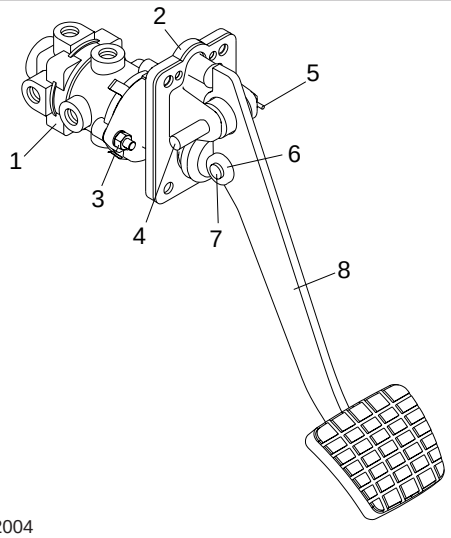
1. Brake Chamber
2. Clevis
3. Actuator Rod
4. Boot
5. Pressure-Relief Capscrew, Gasket, Pawl Spring, and Pawl
6. Manual Adjusting Nut
7. Grease Fitting (or plug)

Fig. 7, Meritor Automatic Slack Adjuster

2. Remove the roll pin from the brake pedal pivot pin. See **Fig. 8**.
3. Remove the brake pedal pivot pin.
4. Remove the brake pedal.
5. Check the brake pedal mounting plate adapter for signs of wear or cracks at the bosses (the area from which the pivot pin was removed). Replace it if necessary.
6. Check the brake pedal rollers for signs of wear or cracks. Replace the rollers as needed.
7. If the rollers are replaced, replace the roller pin, install a new cotter pin, bend it to 90 degrees and apply Torque Seal (OPG F900 White) to the cotter pin.
8. Remove the plunger from the valve. Using alcohol, clean the existing grease from the plunger. Check the plunger for signs of wear or cracks. Replace it if necessary.
9. Lubricate the plunger with barium grease (BW 246671).
10. Insert the plunger in the valve.



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

Fig. 8, Brake Pedal and Valve Assembly

11. Install the brake pedal with the pivot pin.
12. Install a new roll pin and apply Torque Seal (OPG F900 White) to the roll pin.
13. Install the brake valve assembly. See **Section 42.08, Subject 110**, of the *Cascadia™ Workshop Manual* for instructions.
14. Test the brakes before returning the vehicle to service.

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46–01 Drag Link Inspection

WARNING

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

Have someone turn the steering wheel from left to right. Check for movement between the ball stud end and the pitman arm, and between the ball stud end 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 key. See **Group 46** of the *Cascadia™ Workshop Manual* for proper 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 *Cascadia™ Workshop Manual* for drag link removal and installation instructions.

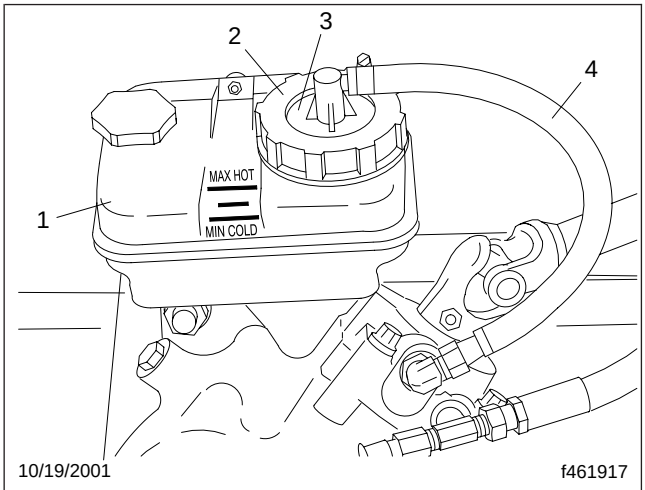
Grasp the drag link near the pitman arm end, then push and pull laterally to check for axial movement in the ball stud end. If it is loose, replace the drag link. See **Group 46** of the *Cascadia™ Workshop Manual* for replacement instructions. If there is 1/8-inch (3-mm) movement or more, do not drive 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. Park the vehicle on a level surface, shut down the engine, 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, filter cover, and gasket from the reservoir. Drain the fluid from the filter into the drain pan. Leave the filter hanging over the drain pan.
5. Remove the nuts, bolts, and washers that attach the power steering reservoir to the mounting bracket, but do not remove the supply line to the reservoir. Drain the power steering fluid from 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	TES-389

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 to 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.

NOTE: Always install a new power steering reservoir filter when changing the fluid.

11. Disconnect the filter from the filter cover, and discard the filter.
12. Apply a thin film of power steering fluid on the gasket of the new filter. Then attach the filter to the filter cover. Hand-tighten the filter, then turn it an additional 1/4 turn.
13. Install the filter and filter cover in the reservoir. 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.
14. Attach the retaining ring to the reservoir to secure the filter and filter cover.
15. Start the engine and check that the power steering fluid level is between the MIN COLD and MAX HOT lines. Add more power steering fluid if needed.
16. Raise the vehicle, remove the jack stands, and lower the vehicle.

46–03 Power Steering Fluid Level Inspection

1. Apply the parking brakes and chock the tires.
2. With the engine cool, use a shop towel or a clean rag to clean the area around the power steering reservoir fill cap. Twist the cap counterclockwise to remove it. Check the cold power steering fluid level. The level should be between ADD COLD and FULL COLD with the engine off.
3. Start the engine and run it at idle until it reaches operating temperature.

   Remove the dipstick, and check that power steering fluid is between ADD HOT and FULL HOT. If the fluid level is low, add enough fluid to bring the level up to the FULL HOT mark on the dipstick. See **Table 1** for recommended power steering fluids.

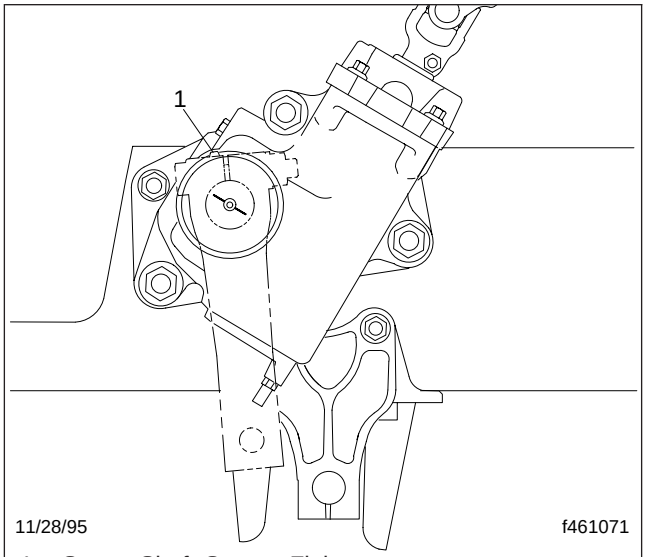
46–04 Power Steering Gear Lubrication

TRW TAS and THP Series Sector Shaft

⚠ CAUTION

Apply grease to the sector shaft with a hand-type grease gun only. 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. **Fig. 2**.



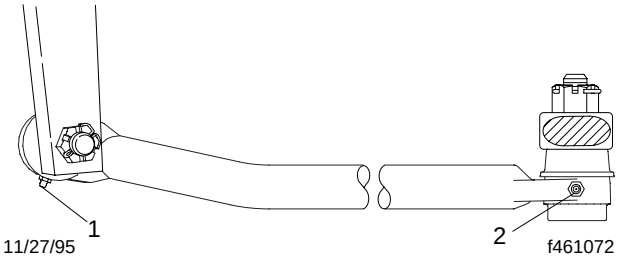
1. Sector Shaft Grease Fitting

Fig. 2, TRW TAS Series Sector Shaft Lubrication

46–05 Drag Link Lubrication

1. Using a clean rag, wipe all dirt from both drag link grease fittings. See **Fig. 3**.

2. Using a pressure gun, apply clean 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). Grade 2 is preferred.



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

Fig. 3, Drag Link

46–06 Rack and Pinion Steering Inspection

⚠ WARNING

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

The rack and pinion steering system is designed to be maintenance-free. Inspect the system as described below, and repair or replace any components that are worn or damaged. **Figure 4** shows the components of the rack and pinion steering system.

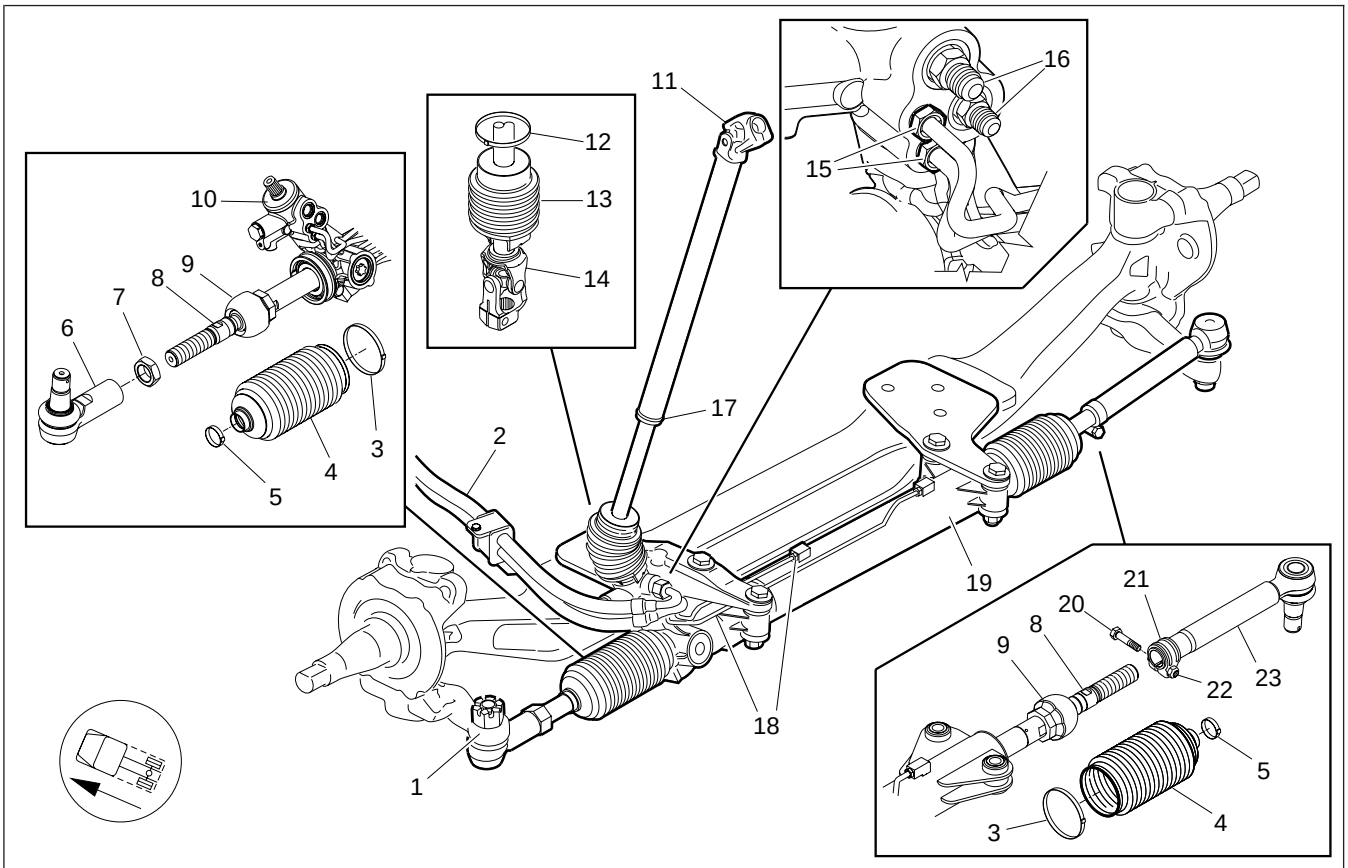
1. Park the vehicle on a level surface, and chock the rear tires.
2. Check the steering I-Shaft U-joints for evidence of looseness or binding. If any is found, replace the I-Shaft.
3. Check the steering I-Shaft slip joint for evidence of lateral movement, looseness, or binding. If any is found, replace the I-Shaft.
4. Jack up one axle end at a time, and move the tire in and out by hand to check the tie rod ends for free play. No free play is allowed. If the outer tie rod ends are damaged or worn, replace them. For repair procedures, see **Group 46** of the *Cascadia™ Workshop Manual*.
5. Check the rack and pinion gear mounting bolts for security.
6. Check that the outer tie rod castellated nuts are tight, and the cotter pins are properly installed.

IMPORTANT: Do not remove the rack and pinion bellows unless they are damaged, and must be replaced, or there is evidence of a loose inner tie rod, or there is hydraulic fluid leaking from the bellows.

7. Check the rack tie rod bellows for holes or tears. If any are found, remove the bellows and check the rack for evidence of corrosion. No corrosion is allowed. If corrosion is found, replace the rack and pinion unit. If there is no corrosion, replace the damaged bellows with a new one.
8. Check the rack and pinion tie rod bellows for evidence of leakage from the bellows. If hydraulic fluid is found to be leaking from within the bellows, replace the rack and pinion unit.
9. Check the input shaft for any leakage around the on-center cap. If there is evidence of leakage from inside the on-center cap, remove the on-center cap and replace the input shaft seal. See **Group 46** of the *Cascadia™ Workshop Manual* for instructions.

   Check the steering system pressure and return lines and fittings for leaks and damaged lines or hoses. Repair or replace lines, hoses, and fittings as necessary.
10. Check the tube fittings on the hard transfer lines of the gear, see **Fig. 4**, Item 15. If there is leakage from either of the fittings, replace the rack and pinion unit.

IMPORTANT: Tightening the tube fittings can cause tearing of the O-ring seal and increased fluid leakage.



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1. Steering Tie Rod Arm
2. Power Steering Fluid Lines
3. Large Bellows Clamp
4. Bellows
5. Small Bellows Clamp
6. Driver-Side Outer Tie Rod
7. Tie Rod Jam Nut
8. Inner Tie Rod Flat
9. Inner Tie Rod Ball Joint
10. Input Shaft Seal Cover
11. I-Shaft Upper Yoke
12. I-Shaft Lower Yoke Boot Clamp
13. I-Shaft Lower Yoke Boot
14. I-Shaft Lower End Yoke
15. Transfer Line Tube Fittings
16. Power Steering Fluid Line Fittings
17. I-Shaft Slip Joint
18. Transfer Lines
19. Rack and Pinion Gear
20. Pinch Bolt
21. Tie Rod Clamp
22. Tie Rod Clamp Nut
23. Passenger-Side Outer Tie Rod

Fig. 4, Rack and Pinion Steering System

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47–01 Fuel Filter Replacement

Refer to the engine manufacturer's service manual for removal and installation procedures.

47–02 Fuel/Water Separator Element Checking and Replacement

Alliance

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.

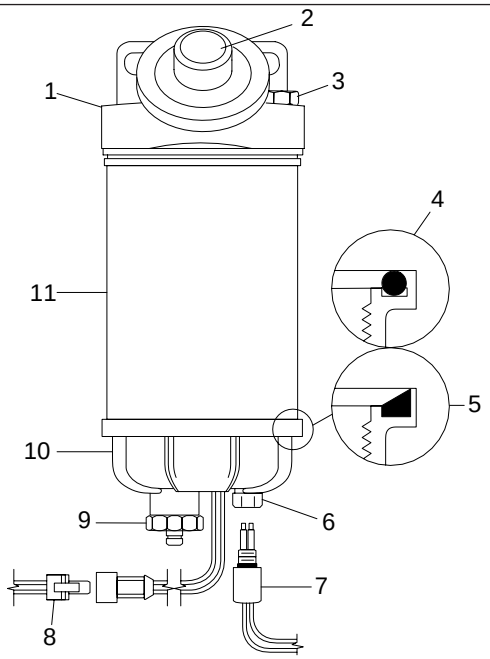
1. Drain off some fuel by loosening the vent plug and opening the drain valve.
2. Disconnect the water sensor and heater connections if equipped.
3. Remove the element and bowl together, by turning counterclockwise.
4. Remove the bowl from the element and clean the O-ring land.
5. Apply a coating of 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 equipped.
8. If equipped with a primer pump, prime the fuel/water separator.

8.1 Loosen the vent plug. Then operate the primer pump until the fuel purges at the vent plug. See **Fig. 1**.

8.2 Close the vent plug.



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

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

Davco Fuel Pro® 382

Check the level of fuel in the fuel filter.

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

NOTE: In the event of an emergency, when the filter needs replacement but a Davco filter is not available, a temporary filter can be used. For instructions, see **Chapter 24** of the *Cascadia™ Driver's Manual*.

⚠ 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 the fuel below the collar level. 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 bottom of the filter element, and seats completely 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.

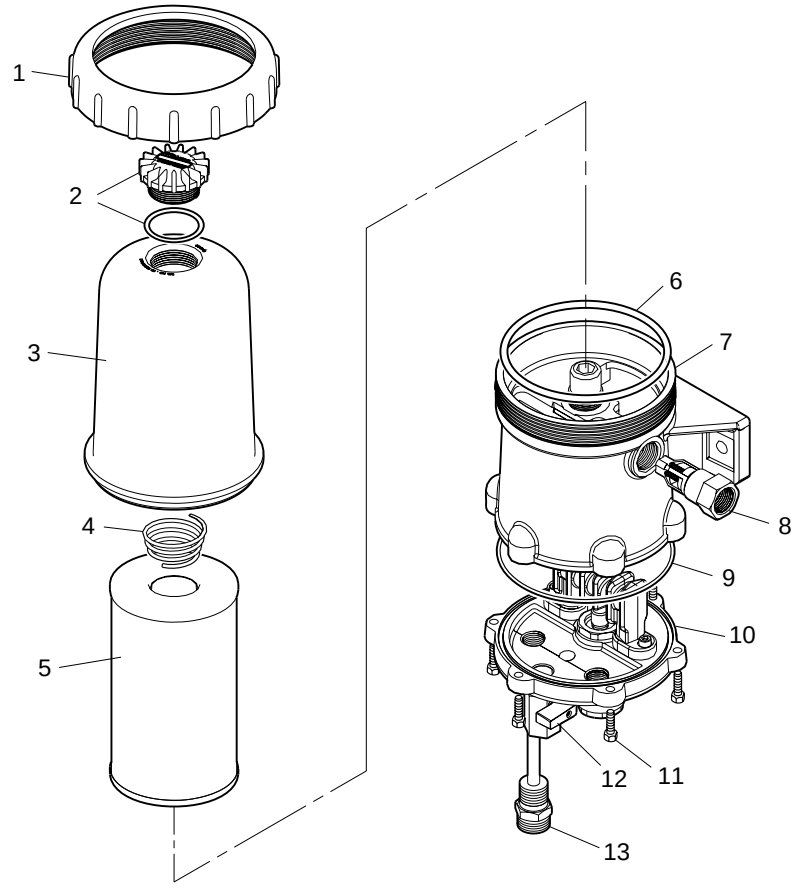
IMPORTANT: Tighten the collar by hand only.

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 one minute to purge air.

47–03 Fuel Tank Band-Nut Tightening

Hold each fuel tank band retention nut with a wrench while backing off its jam nut. Then tighten the retention nuts 30 to 35 lbf·ft (41 to 46 N·m). After the retention nuts have been tightened, hold each retention nut with a wrench while tightening its jam nut 30 lbf·ft (41 N·m).

IMPORTANT: Do not overtighten.



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

Fig. 2, Davco Fuel Pro 382

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49–01 Exhaust System Inspection (Noise Emission Control)

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. Freightliner Trucks recommends replacing parts that show leakage, wear, or damage, with genuine Freightliner parts.

The exhaust system must be free of leaks, binding, grounding, and excessive vibrations. These conditions are usually caused by loose, broken, or misaligned clamps, brackets, or pipes. If any of these conditions exist, check the exhaust system components and alignment. Align or replace as necessary; see **Group 49** of the *Cascadia™ Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

It is a violation of US federal law to alter exhaust plumbing or aftertreatment in any way that would bring the engine out of compliance with certification requirements. (Ref: 42 U.S.C. S7522(a) (3).) It is the owner's responsibility to maintain the vehicle so that it conforms to EPA regulations.

EPA10 Exhaust System

Definitions of Aftertreatment (ATS) Terms

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

- Aftertreatment System (ATS)—the entire exhaust system from the turbocharger to the exhaust stack or tail pipe.
- Aftertreatment Device (ATD)—a housing that contains the DOC and DPF (also the SCR and the mixing tube in one-box systems).
- BlueTec®—Daimler's proprietary SCR technology.
- Diesel Oxidation Catalyst (DOC)—a flow-through device that oxidizes soot in the ATD.
- Diesel Particulate Filter (DPF)—a component in the ATD that traps soot from the exhaust gas.
- Diesel Exhaust Fluid (DEF)—the chemical agent that reacts with the exhaust gases in the SCR to reduce NOx.
- DEF Pump—filters and supplies DEF to the DEF metering unit.
- DEF Tank—holds DEF and regulates its temperature.
- DEF Metering Unit—mixes DEF with compressed air, and meters this mixture into the exhaust flow via an injection nozzle.
- SCR Catalyst—the housing containing a treated ceramic flow-through block where the DEF and exhaust gases undergo selective catalytic reduction (SCR).
- Selective Catalytic Reduction (SCR)—a process used to reduce NOx emissions.

Inspection

To meet EPA10 emissions regulations for vehicles domiciled in the USA or Canada, engines manufactured after December 31, 2009 are equipped with an emission aftertreatment system. Vehicles domiciled outside of the USA and Canada may not have aftertreatment equipment, depending upon local statutory emissions guidelines.

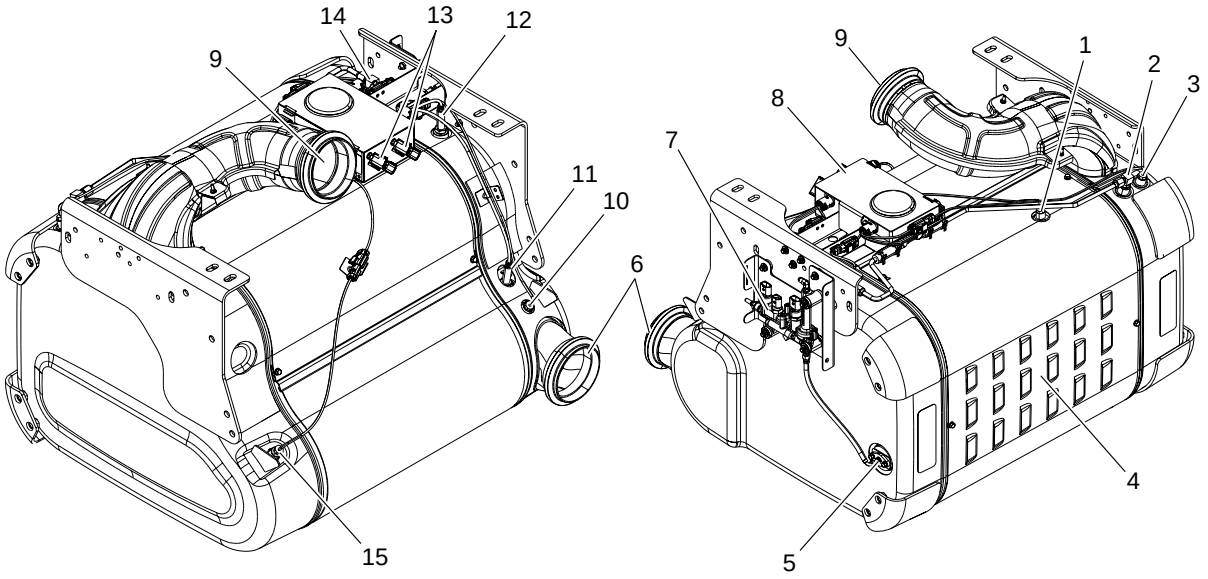
IMPORTANT: The aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections. No leaks are allowed anywhere in the system. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.

3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.
5. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD.
6. Check all sensors attached to the ATS for leaks or damaged wires. No leaks are allowed. See **Fig. 1**, **Fig. 2**, or **Fig. 3** for Detroit Diesel ATS sensor locations.
7. Check the DPF exterior surface for dents or other damage. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
8. Check the SCR catalyst for dents and other damage.
9. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.

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

10. Check the DEF tank, pump, metering unit, and lines for leaks. See **Section 49.02** of the *Cascadia™ Workshop Manual* for repair procedures.
11. Check any wires, lines, or hoses within 4 inches (10 cm) of the exhaust system for heat damage. Repair or reroute as needed.



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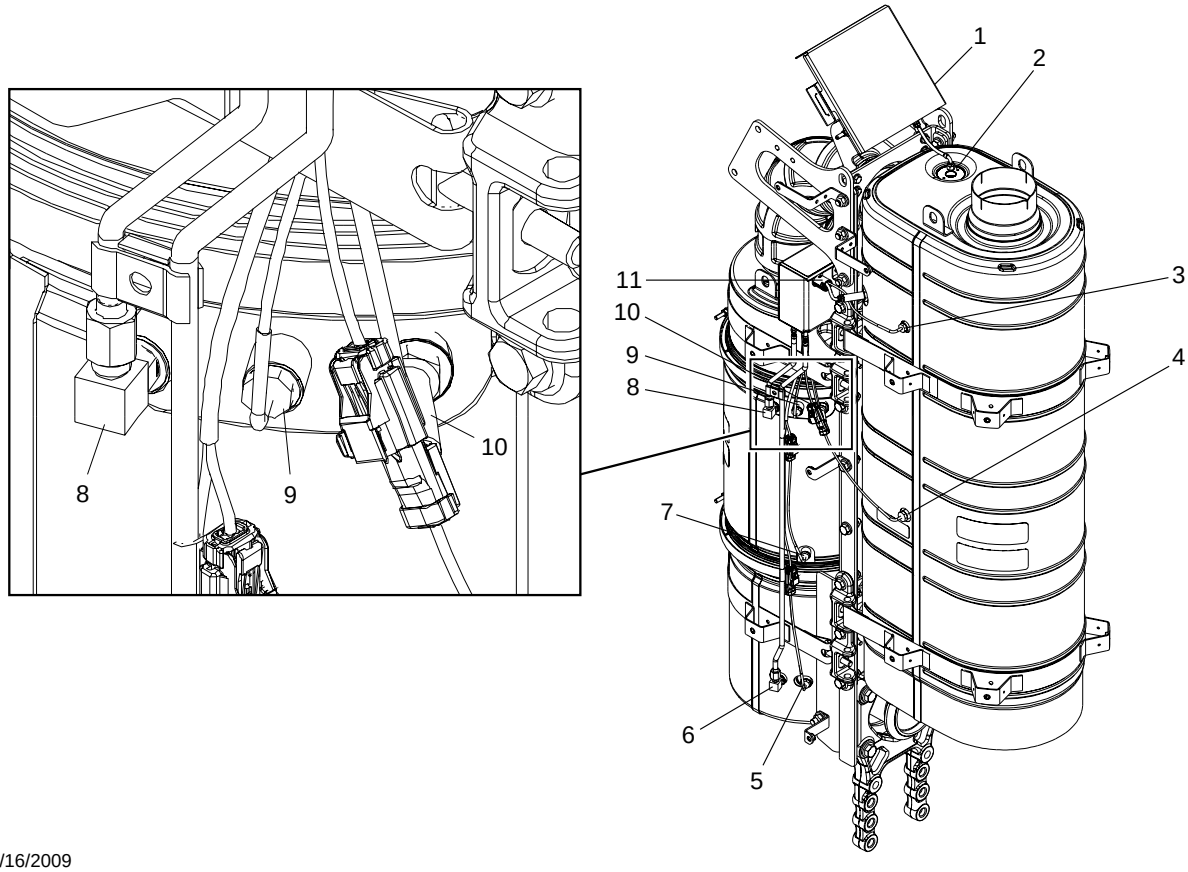
NOTE: The sensor box (item 8) contains the SCR inlet and outlet NOx sensors, DPF outlet pressure sensor, and the DOC inlet pressure sensor.

1. DOC Outlet Temperature Sensor
2. DOC Inlet Pressure Sensor Port
3. DOC Inlet Temperature Sensor
4. Front Heat Shield
5. DEF Nozzle
6. Exhaust Outlet
7. DEF Metering Unit
8. Sensor Box (see note above)
9. Exhaust Inlet
10. SCR Outlet Temperature Sensor
11. SCR Outlet NOx Sensor Port
12. SCR Inlet NOx Sensor Port
13. 14-Pin Connectors
14. DPF Outlet Pressure Sensor Port
15. SCR Inlet Temperature Sensor

Fig. 1, One-Box ATS Sensor Locations



1. DEF Metering Unit
2. DEF Nozzle
3. SCR Outlet Temperature Sensor
4. SCR Inlet Temperature Sensor
5. DOC Inlet Temperature Sensor
6. DOC Inlet Pressure Sensor
7. DPF Inlet Temperature Sensor
8. DPF Outlet Pressure Sensor
9. DPF Outlet Temperature Sensor
10. DPF Outlet NOx Sensor
11. SCR Outlet NOx Sensor

Fig. 2, 2V2 Two-Box ATS Sensor Locations

Diesel Exhaust Fluid (DEF) Filter Replacement

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

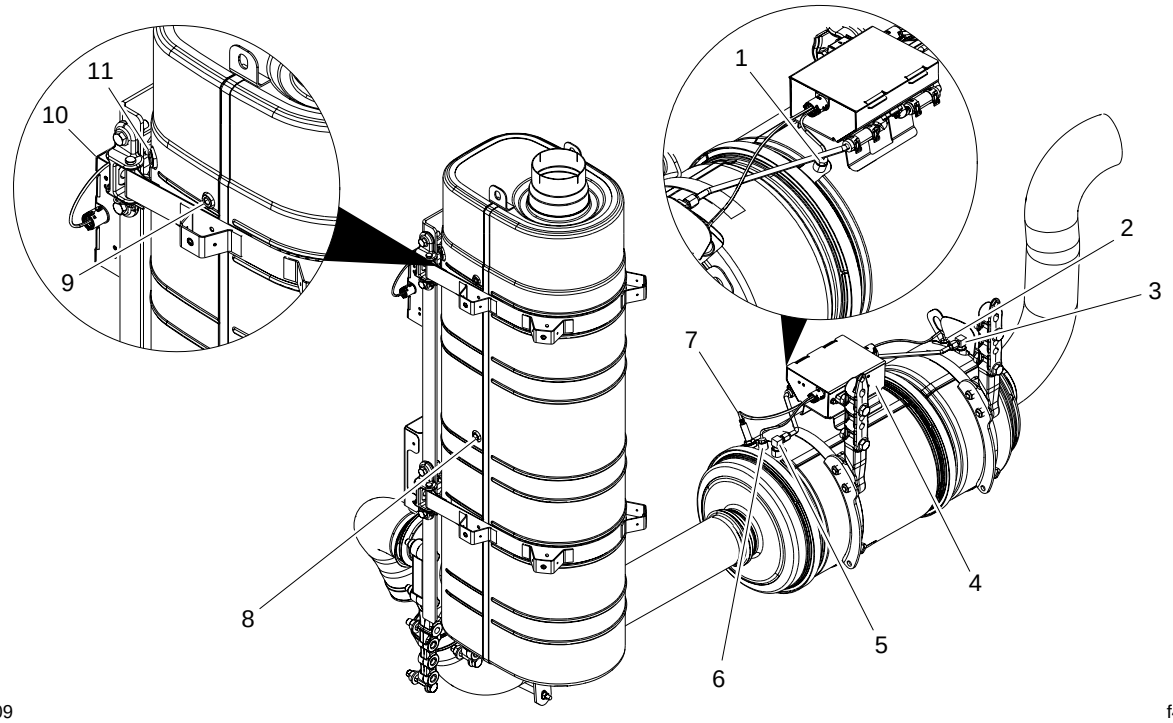
See the engine manufacturer's maintenance manual for filter replacement instructions and maintenance intervals.

EPA07 Exhaust System

Definitions of ATS Terms

Refer to the following list of definitions of ATS components.

- Aftertreatment System (ATS)—the entire exhaust system from the turbocharger to the exhaust stack or tail pipe.
- Aftertreatment Device (ATD)—a muffler-like canister that houses a DPF, DOC, and sensors.



1. DPF Inlet Temperature Sensor
2. DOC Inlet Temperature Sensor
3. DOC Inlet Pressure Sensor
4. DPF Sensor Box
5. DPF Outlet Pressure Sensor
6. DPF Outlet Temperature Sensor
7. DPF Outlet NOx Sensor
8. SCR Inlet Temperature Sensor
9. SCR Outlet Temperature Sensor
10. SCR Sensor Box
11. SCR Outlet NOx Sensor

Fig. 3, 2HV Two-Box ATS Sensor Locations

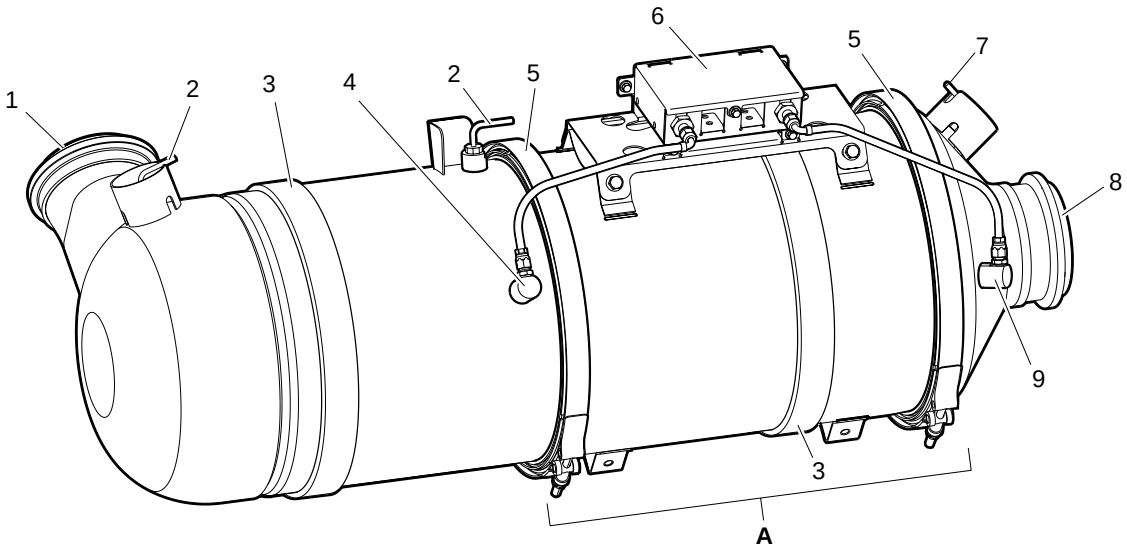
- Clean Gas Injection (CGI)—a Caterpillar (CAT) proprietary system that recirculates clean exhaust gasses back into the engine intake system.
- Diesel Particulate Filter (DPF)—a filter that collects and holds particulate matter (soot and ash).
- Diesel Oxidation Catalyst (DOC)—oxidizes hydrocarbons and reduces NOx.
- Sensors—detect temperatures and pressures in the ATS.

Inspection

To meet EPA07 emissions regulations for vehicles domiciled in the USA or Canada, engines manufactured after December 31, 2006 are equipped with an emission aftertreatment system. Vehicles domiciled outside of the USA and Canada may not have aftertreatment equipment, depending upon local statutory emissions guidelines.

IMPORTANT: The aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections; see **Fig. 4**. No leaks are allowed anywhere in the system. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or



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

Fig. 4, Typical EPA07 Aftertreatment Device

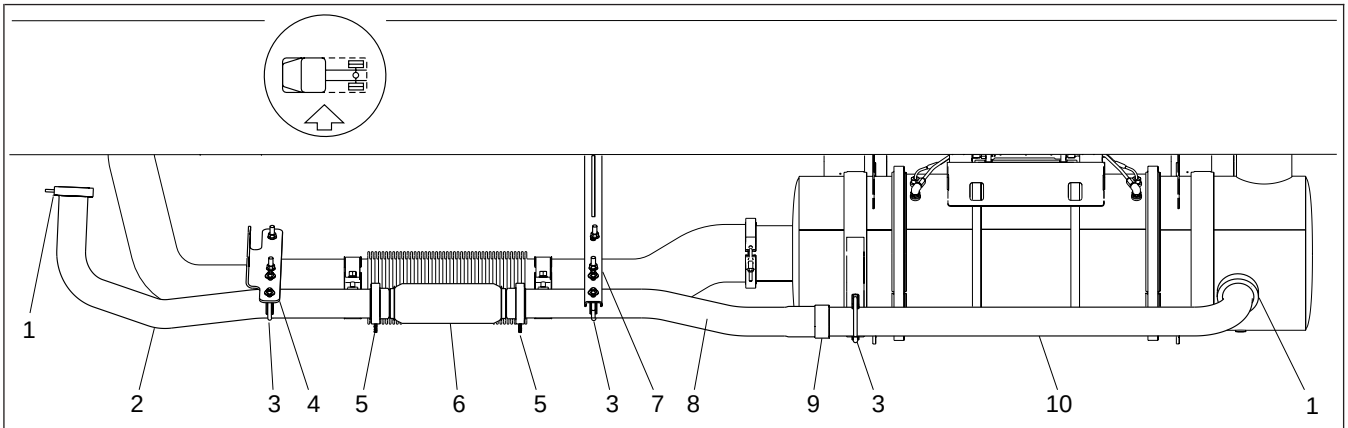
damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.

NOTICE

A leak in the CGI piping, including the bellows, will allow unfiltered air and contaminants into the engine intake, and can cause serious engine damage.

NOTE: Because the CGI bellows is covered with a metal mesh, it is difficult to see cracks or damage that may cause a leak.

3. On vehicles with CAT engines, inspect the CGI bellows and piping for evidence of damage or leakage. See **Fig. 5**. If the bellows is damaged or leaking, replace it. See **49–02** for the replacement procedure.
4. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
5. Check the ATD mounting bands for tightness. If needed, tighten the mounting bands on horizontally and vertically mounted ATDs to 30 lbf·ft (41 N·m); on step-mounted ATDs, tighten the mounting bands to 15 lbf·ft (20 N·m). Do not overtighten.
6. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD.
7. Check all sensors attached to the ATD for leaks or damaged wires. No leaks are allowed.
8. Check the DPF exterior surface for dents or other damage. See Ref. A of **Fig. 4**. A dent over 3 inches (76 mm) in diameter or 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
9. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.



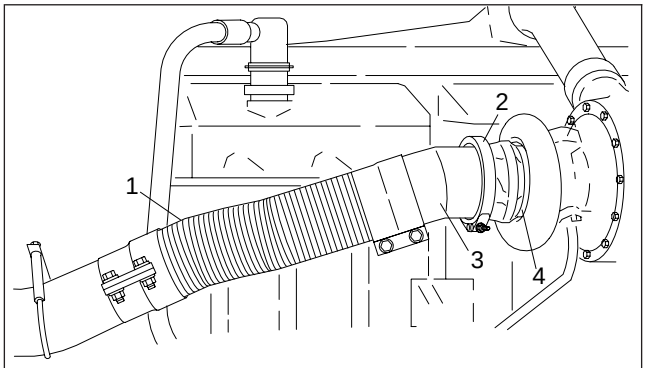
1. Clamp
2. Inlet Pipe
3. U-Clamp
4. Forward Pipe-Support Brace
5. Slip Clamp
6. CGI Bellows
7. Center Pipe-Support Brace
8. Center Pipe
9. Clamp
10. Outlet Pipe

Fig. 5, CAT EPA07 Exhaust Installation with CGI Bellows

10. Check any wires, lines, or hoses within 4 inches (10 cm) of the exhaust system for heat damage. Repair or reroute as needed.

Pre-EPA07 Exhaust System

1. On all vehicles, check the condition of the muffler body and the top stack. Check the inlet/outlet tubes for leakage, dents, and corrosion, and check for holes in the muffler. Replace parts as required. Use new parts, equivalent to parts originally installed on the vehicle.
2. Inspect the exhaust flex hose (see **Fig. 6**) for leakage, wear, or damage. Replace with new parts if replacement is needed.
3. Check for leakage at the V-band coupling, which attaches the exhaust pipe to the turbocharger exhaust outlet. See **Fig. 6**.
4. If leakage exists, tighten the nut on the V-band coupling 85 lbf·in (940 N·cm). If leakage persists, install a new V-band coupling.
5. Inspect the turbo outlet pipe, and replace it as needed.
6. Check the U-bolt clamps for tightness, and tighten as needed.
7. Check the isolator at the base of the exhaust stack elbow(s) (see **Fig. 7**), for cracking, damage, and dry rot. Replace as needed.

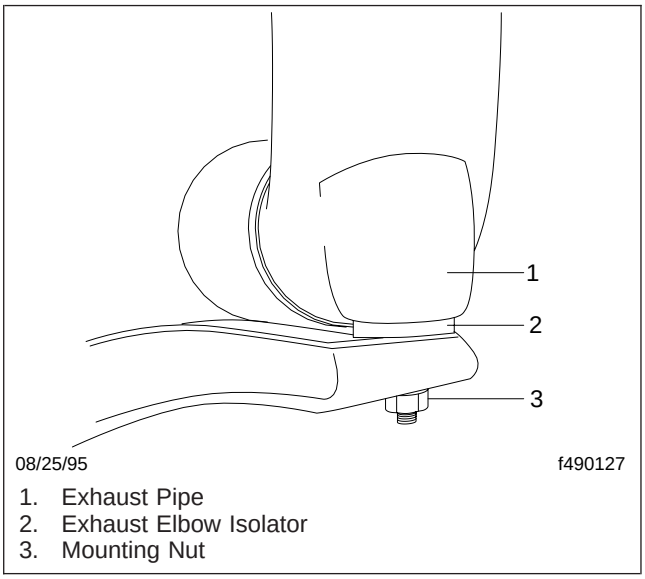


1. Flex Hose
2. V-Band Coupling
3. Exhaust Pipe
4. Turbocharger Exhaust Outlet

Fig. 6, V-Band Coupling and Flex Hose

8. Check for leakage at all wide-band exhaust clamps. See **Fig. 8**.

   If leakage exists, tighten the nuts 40 to 60 lbf·ft (54 to 81 N·m). If leakage persists, inspect the sealclamps. If necessary, install a new wide-band exhaust clamp.



1. Exhaust Pipe
2. Exhaust Elbow Isolator
3. Mounting Nut

Fig. 7, Exhaust Elbow Isolator

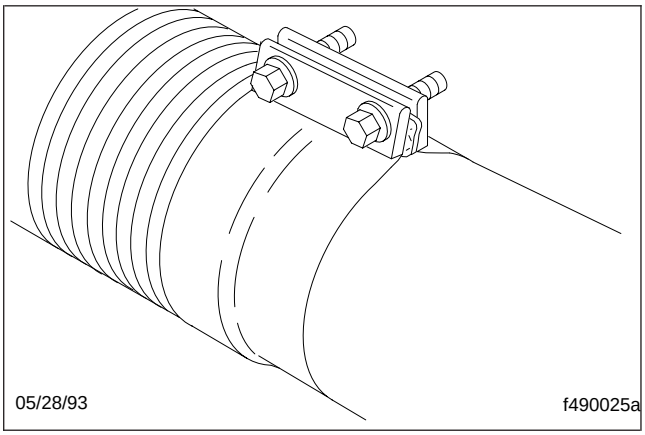


Fig. 8, Donaldson Sealclamp Wide-Band Exhaust Clamp

49–02 CAT CGI Bellows Replacement

On vehicles with CAT EPA07 compliant engines, replace the CGI bellows at the M3 maintenance interval to prevent a later failure.

NOTICE

A leak in the CGI piping, including the bellows, will allow unfiltered air and contaminants into the engine intake, and can cause serious engine damage.

1. Park the vehicle, set the parking brake, chock the wheels.
2. Open the hood.
3. Remove the right side inner fender/splash shield as needed.
4. Remove the CGI piping between the engine and aftertreatment device (ATD).

   See **Fig. 5**.
5. On the workbench, remove the CGI bellows from the exhaust piping. Do not damage the piping.

NOTE: The following step, and its substeps, is to be done without the bellows installed. This will align the pipes so that the bellows can be installed correctly.

6. Install the CGI piping (without CGI bellows) and align piping.

   6.1 Attach the aft CGI pipe to the ATD.

   6.2 Attach the forward CGI pipe to the engine.

NOTICE

When the CGI pipes and bellows are installed, there should be approximately 3/4 inch (19 mm) clearance from the main bellows. Contact between the bellows could result in an exhaust leak, which in this case may allow ingestion of contaminants into the engine causing engine damage.

   6.3 Use a straightedge to align the pipes so that the pipe ends that attach to the bellows are parallel and concentric.

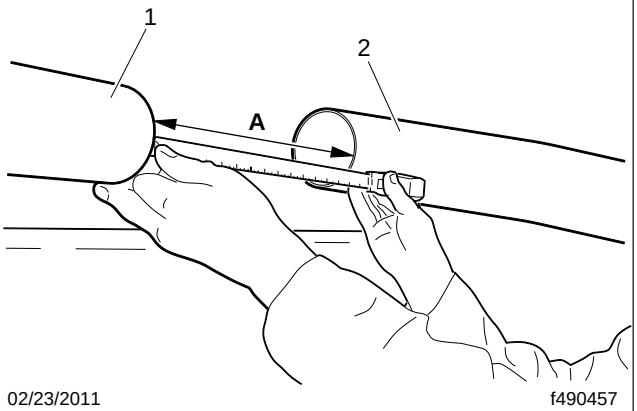
NOTICE

When shortening the CGI pipe(s), it is critical to leave a minimum of 1 inch (25.4 mm) of straight pipe on the end of each CGI pipe to allow for pipe insertion and clamp clearance. Failure to do this could result in an exhaust leak, which in this case

may allow ingestion of contaminants into the engine causing engine damage.

7. Once the pipes are aligned, measure the pipe gap between the CGI pipes and record the distance. See **Fig. 9**, Ref. A.

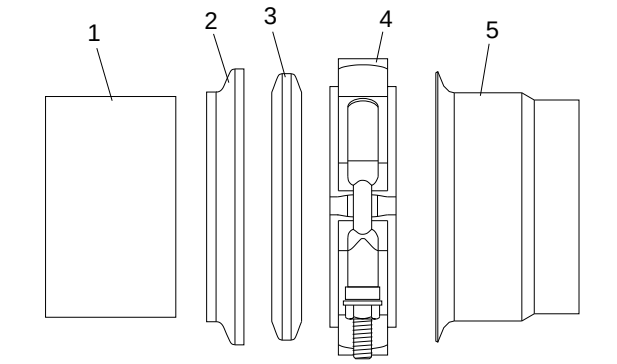
   The existing pipe gap is designed at 10 inches (254 mm). A 10.75 inches (273 mm) pipe gap is required for the replacement CGI bellows and clamps. This requires one or both of the CGI pipes to be shortened.



A. Measure the pipe gap.
1. CGI Aft Pipe
2. CGI Forward Pipe

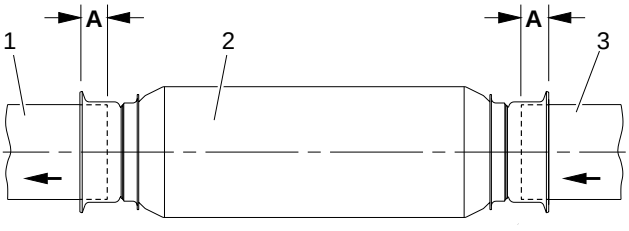
Fig. 9, Measuring the Pipe Gap (typical)

8. Using a yellow paint pen, mark the pipes 1.5 inches (38 mm) in from the end of each pipe. These two marks will be used to center the bellows between the two pipes.
9. Once the pipes are correctly aligned and separated at the correct distance, secure the aft CGI pipe to the ATD and to any CGI pipe support brackets.
10. Remove the forward CGI pipe from the truck.
11. Slide the slip clamp, with the retaining ring and graphite gasket ring, on the aft CGI pipe. See **Fig. 10** for proper installation.
12. Slide the new bellows onto the aft CGI pipe as far as it will go. See **Fig. 11**, Ref. A. Measurement A should be at least 7/16 inch (10 mm) past the face of the flange.
13. Install the slip clamp with the retaining ring and graphite gasket ring onto the forward CGI pipe. See **Fig. 12** for proper installation.



1. Aft CGI Pipe
2. Retaining Ring
3. Graphite Gasket
4. Slip Clamp
5. CGI Bellows

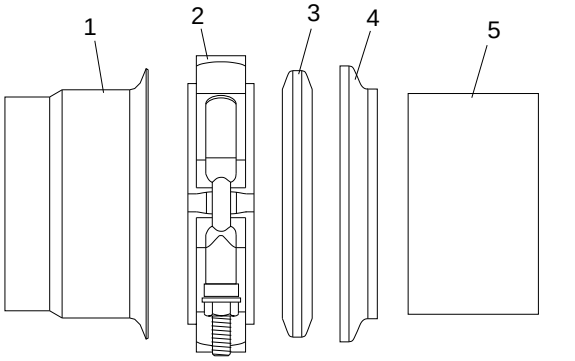
Fig. 10, Aft Facing Slip Clamp Installation



A. At least 7/16 inch (10 mm)
1. Forward CGI Pipe
2. CGI Bellows
3. Aft CGI Pipe

Fig. 11, CGI Bellows Installation

14. Slide the end of the forward CGI pipe into the bellows, and properly align the pipe.
15. Secure the forward CGI pipe to the engine and any CGI pipe support brackets.
16. Using the yellow marks, center the bellows between the exhaust pipes. Verify that the pipe is inserted at least 7/16 inch (10 mm) past the face of the flange. See **Fig. 11**, Ref. A.
17. Install the slip clamps on the bellows. Tighten the slip clamps 11 lbf·ft (15 N·m).
18. Start the engine and check for exhaust leaks. Tighten any clamps as needed.



1. CGI Bellows
2. Slip Clamp
3. Retaining Ring
4. Graphite Gasket
5. Forward CGI Pipe

Fig. 12, Forward Facing Slip Clamp Installation

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54–01 Trailer Cable Inspection and Cleaning

1. Disconnect the trailer electrical cables from the sockets at the cab.
2. Inspect the cables and sockets for evidence of corrosion, and clean as necessary. If a socket is too badly corroded to clean, replace it. Freightliner recommends also replacing the socket's harness as well, if the corrosion has gotten into the wires and connectors inside the socket.

IMPORTANT: If using a spray cleaner to remove corrosion, be careful to protect any surrounding painted surfaces.

3. Coat the inside of the sockets with a lithium-based dielectric grease such as Lubriplate FLP DS–ES.
4. Connect the cables.

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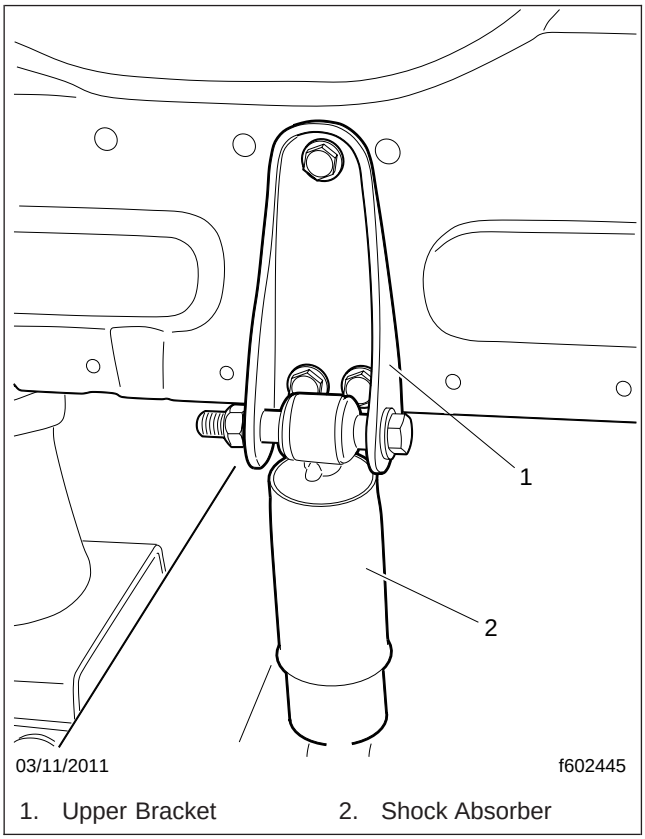
60–01 Mirror Folding Check

For vehicles with folding main mirrors, make sure that the mirrors fold freely on the pivot points. Pivot each mirror fully forward and backward two times to break loose any debris that may affect the fold-away feature of the mirror.

60–02 Cab Shock Absorber Bracket Torque Check

1. Apply the parking brake and chock the tires.
2. Check the torque on the upper bolt that attaches the shock absorber upper bracket to the cab. If loose, tighten the bolt 34 lbf·ft (46 N·m). See **Fig. 1**.
3. From behind the cab skin, check the torque of each of the two lower nuts that attach shock absorber upper bracket to the cab, while holding the bolt in place with a box wrench. If loose, tighten the nuts 34 lbf·ft (46 N·m).



1. Upper Bracket 2. Shock Absorber

Fig. 1, Cab Shock Absorber and Upper Bracket

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83–01 Air Conditioner Inspection

⚠ WARNING

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

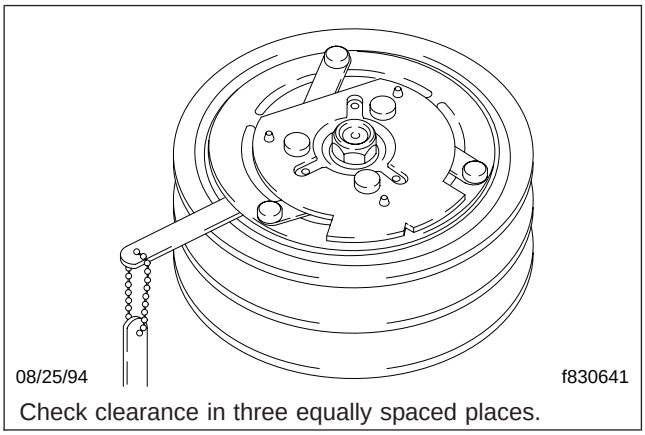
Preliminary Checks

1. Park the vehicle on a level surface, apply the parking brakes, and chock the tires.
2. Check the appearance of the air conditioner compressor pulley assembly. If the friction surface of the pulley shows signs of excessive grooving due to belt slippage, replace both the pulley and the drive plate. Inspect the refrigerant compressor drive belt for damage and check that the belt is set at the proper tension. Also check the tightness of the compressor mounting fasteners. For instructions and torque values, see **Group 01** of the *Cascadia™ Workshop Manual*.
3. Inspect the drive plate. If the drive plate shows visible signs of damage due to excessive heat, replace the drive plate and pulley assembly. For removal and installation procedures, see **Group 83** of the *Cascadia™ Workshop Manual*.
4. Using a feeler gauge, check that the drive plate clutch clearance is within limits. See **Table 1** for clearance specifications. See **Fig. 1** for the checking method. If the drive plate clutch requires adjustment, see **Group 83** of the *Cascadia™ Workshop Manual*.

Compressor Drive-Plate Clutch Clearance	
Manufacturer	**Clearance: in (mm)**
Sanden	0.016 to 0.040 (0.4 to 1.0)
Denso	0.014 to 0.024 (0.35 to 0.60)

Table 1, Compressor Drive-Plate Clutch Clearance

5. Inspect the compressor clutch coil wire. Check that the connector is not damaged or loose. Replace the wire if it is damaged.
6. Check the overall condition of the air conditioning hoses. Look for cracks, cuts, and abrasions on the hoses. Replace damaged hoses. For replacement instructions, see **Group 83** of the *Cascadia™ Workshop Manual*. Also check for loose fittings on all of the air conditioning components.
7. Check for a buildup of road debris on the condenser fins. For cleaning instructions, see **Group 83** of the *Cascadia™ Workshop Manual*.



Check clearance in three equally spaced places.

Fig. 1, Drive-Plate Clearance Inspection

83–02 Air Filter Replacement

The HVAC system has three filters that must be replaced periodically to maintain proper system operation. The cabin fresh-air-intake filter is accessed from under the hood, and the recirculation filter is accessed from inside the cab. The sleeper air filter is accessed through an access panel on the cabinet behind the driver's seat.

Cab Fresh-Air Filter Replacement

IMPORTANT: When replacing the air filter, use only a Freightliner-approved air filter.

1. Park the vehicle on a level surface, set the parking brake, and shut down the engine. Chock the tires.
2. Open the hood.
3. Remove the intake screen. See **Fig. 2**.
4. Lightly press on the filter tray handle to disengage the lock (see **Fig. 3**), and slide the tray out of the slot in the plenum.

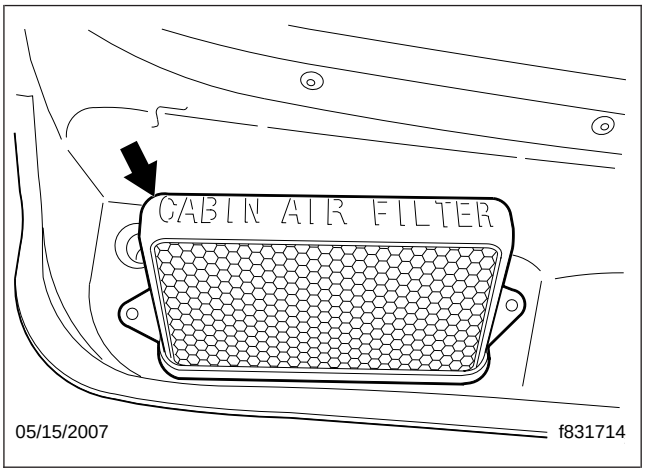


Fig. 2, Intake Screen

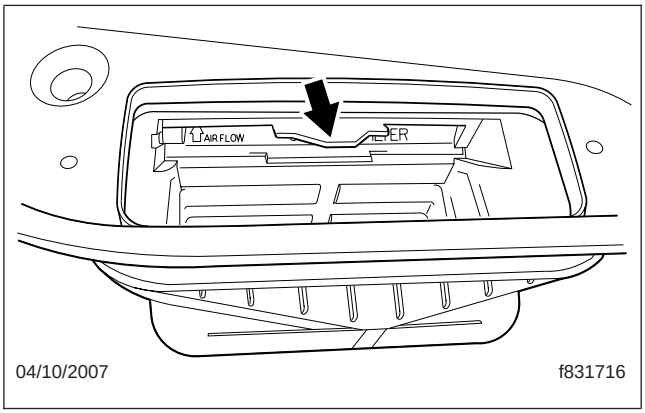
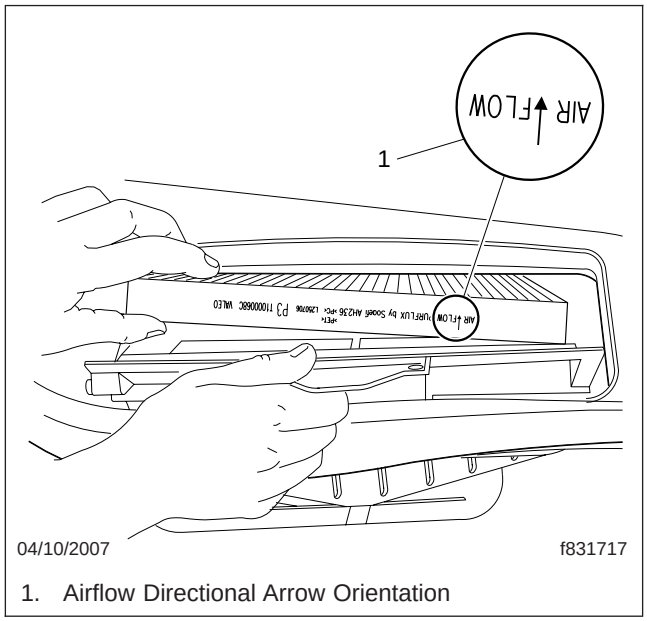


Fig. 3, Disengaging the Lock

5. Remove the filter from the tray. Note the airflow directional arrow on the filter's edge. When properly installed, the airflow arrow will point in the same direction as the marking on the front edge of the tray. Both will point toward the cab. See **Fig. 4**.
6. Put a new filter in the tray, making sure the airflow arrow is correctly oriented, and install the tray in the slot in the plenum. Make sure the tray locks into position.
7. Install the intake screen.
8. Return the hood to the operating position.



1. Airflow Directional Arrow Orientation

Fig. 4, Airflow Directional Arrow

Cab Recirculation Air Filter Replacement

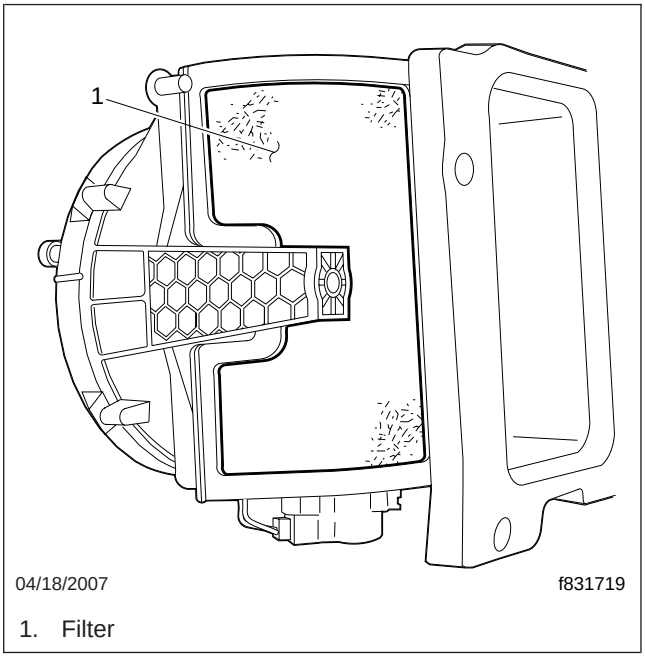
The recirculation air filter is located on the "back" side of the evaporator housing, in the corner of the frontwall and the right side of the cab. See **Fig. 5**. It is accessed from the underside of the unit. It is a coarse sponge, or fiber, filter.

IMPORTANT: When replacing the air filter, use only a Freightliner-approved air filter.

NOTE: Filter replacement is done "blind".

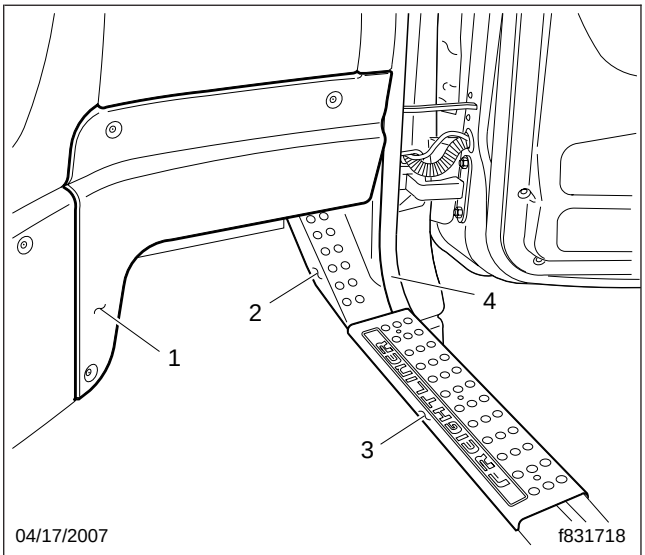
1. Park the vehicle on a level surface, set the parking brake, and shut down the engine. Chock the tires.
2. Loosen the passenger side kick panel, tilt it out, and carefully twist and remove the light bulb socket from the lens on the back of the panel. Move the panel out of the way. See **Fig. 6**.
3. Remove the door step plate, and then pull the door seal loose from the bottom of the door opening to just above the filter area.

   Remove the A-pillar trim panel; remove the screw (located under the step plate) and disengage the spring clips by pushing the panel towards the center of the cab.



1. Filter

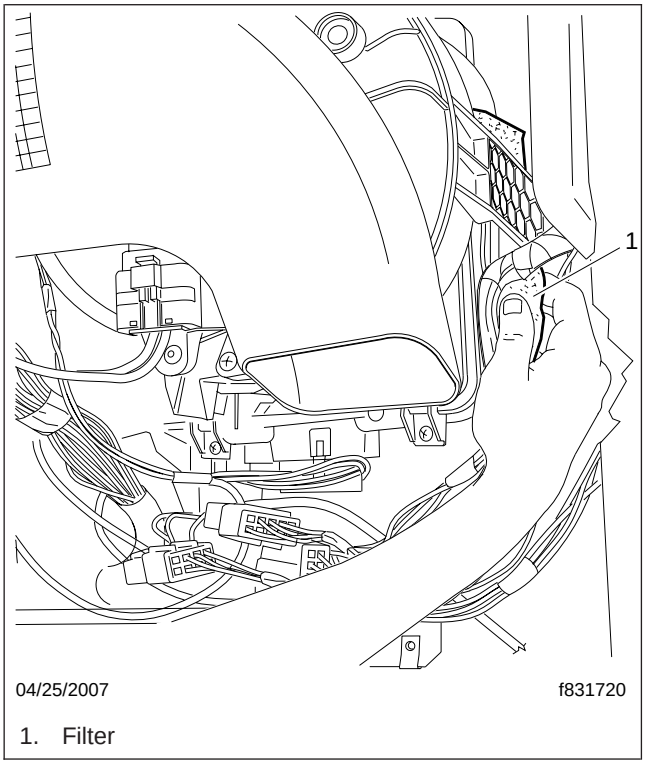
Fig. 5, Cab Recirculation Air Filter (shown out of the vehicle for clarity)



1. Kick Panel
2. Side Trim Panel
3. Step Plate
4. Door Seal

Fig. 6, Panels

4. Remove the filter from the intake recess in the back of the plenum. Pull it loose along the bottom edge of the recess, and slide it straight down. See **Fig. 7**.



1. Filter

Fig. 7, Removing the Filter

5. Slide a new filter up into the recess slots of the plenum. Be sure that it fully seats into the slot all the way around the opening.
6. Install the A-pillar trim panel, and then the door seal, and finally, the door step plate.
7. Position the passenger side kick panel, and install the light bulb socket in the lens, then fasten the panel.

Sleeper Air Filter Replacement

The sleeper air filter is located on the forward side of the blower fan housing, under the cabinet, directly behind the driver's seat.

IMPORTANT: When replacing the air filter, use only a Freightliner-approved air filter.

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

2. Remove the sleeper HVAC access panel on the inboard side of the cabinet. See **Fig. 8**. The panel is held in place with four spring clips. Pull straight out to remove it.

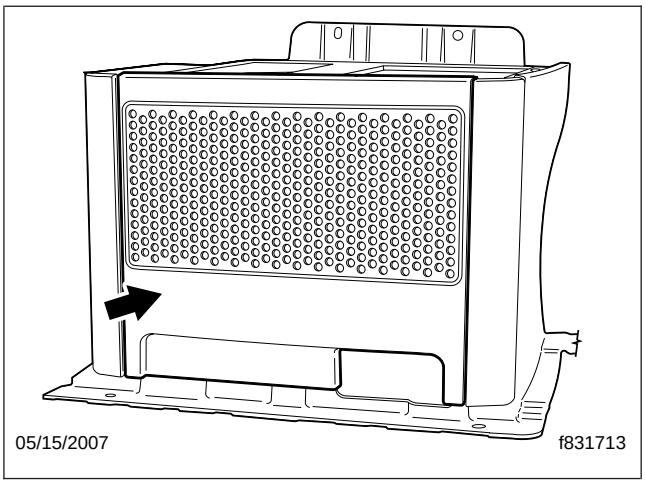


Fig. 8, Sleeper HVAC Access Panel

3. Lift the filter out of the slot. See **Fig. 9**.

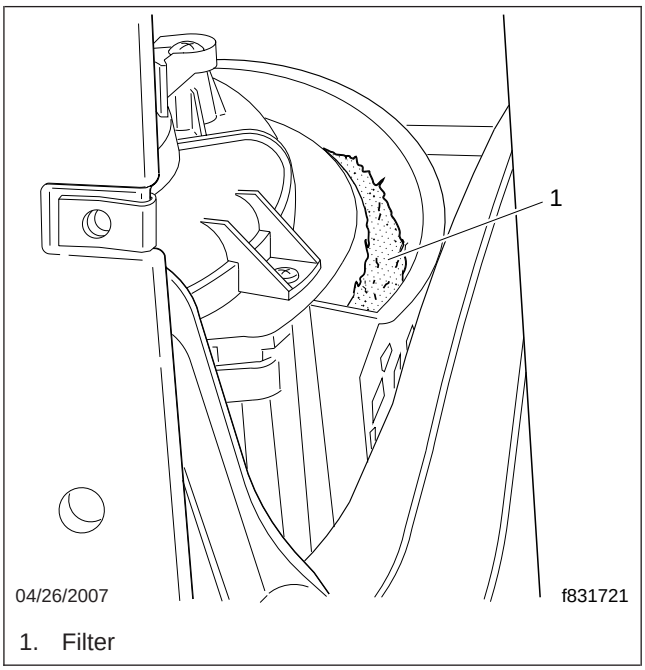


Fig. 9, Removing the Filter

4. Install a new filter in the slot, making sure that it is completely seated in the slot.
5. Install the access panel.

ParkSmart Air Filter Replacement

The ParkSmart air filter is located on the inboard side of the blower fan housing, under the cabinet, directly behind the driver's seat.

IMPORTANT: When replacing the air filter, use only a Freightliner-approved air filter.

1. Park the vehicle on a level surface, set the parking brake, and shut down the engine. Chock the tires.
2. Remove the sleeper HVAC access panel on the inboard side of the cabinet. See **Fig. 8**. The panel is held in place with four spring clips. Pull straight out to remove it.
3. Pull the filter out of the slot. See **Fig. 10**.

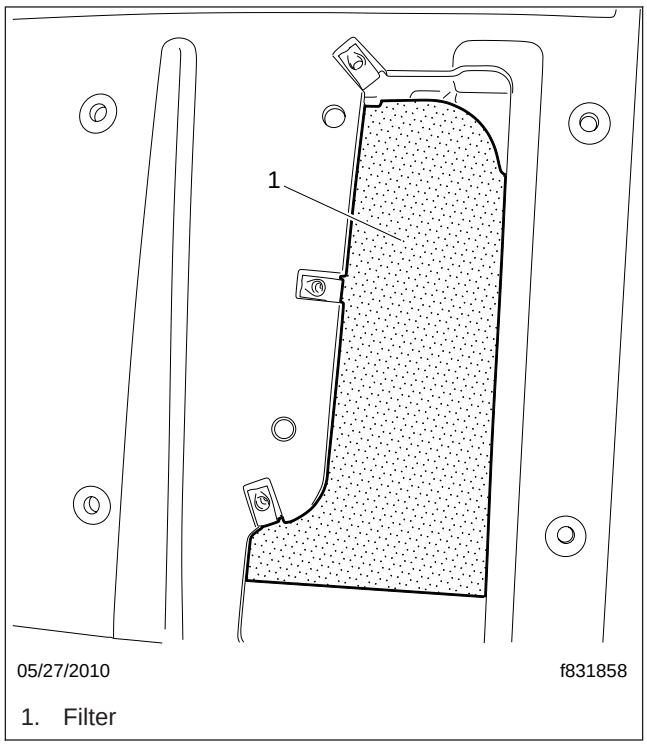


Fig. 10, Removing the Filter

4. Install a new filter, making sure that it is completely seated.
5. Install the access panel.

83–03 ParkSmart™ Inspection

Espar Heater Operational Check

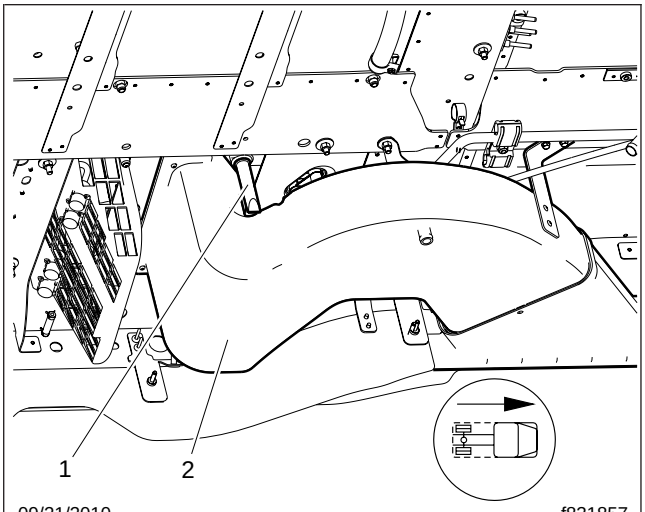
1. Start the ParkSmart and set the control knob to maximum heat. Run the heater for 15 minutes to achieve operating temperature, and clear old fuel from the lines.
2. Verify that the unit completes the start-up cycle, and continues to produce warm exhaust.

Drain Tube Inspection

NOTICE

The ParkSmart drain tube(s) must be kept clear of debris. Failure to do so will cause excessive water build-up in the base of the unit and may cause damage to the internal components.

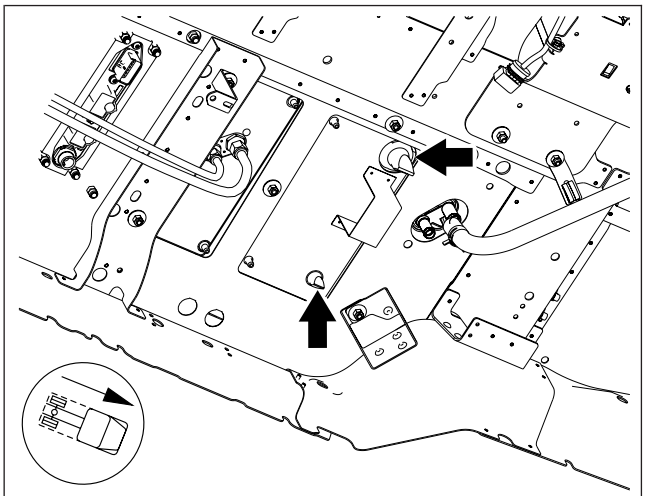
1. Remove the battery cover/step or forward side fairing, as needed, to improve access to the underside of the ParkSmart unit.
2. Remove the drain tube(s) from the bottom of the unit. See **Fig. 11** for systems manufactured before July 2011, or **Fig. 12** for systems manufactured from July 2011.



Remove and clean the drain tube.

1. Drain Tube
2. Intake Duct

Fig. 11, Drain Tube Inspection (pre-July 2011)



Remove and clean the drain tubes.

Fig. 12, Drain Tube Inspection (from July 2011)

3. Check the drain tube(s) for debris, and clean as needed.
4. Install the drain tube(s).
5. Install any components that were removed for access.

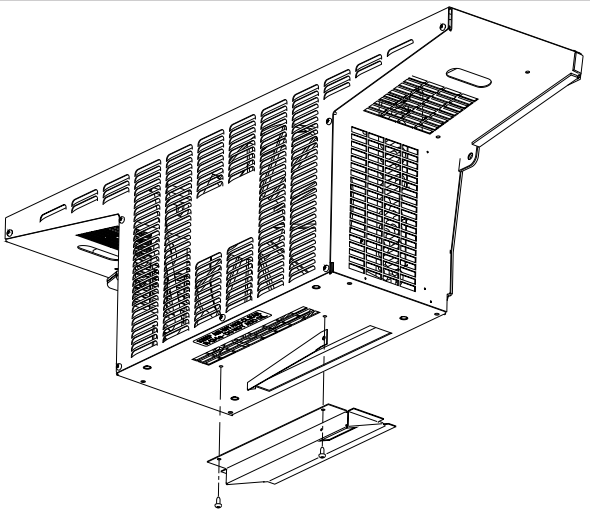
External A/C Condenser Inspection and Cleaning

On vehicles manufactured from July 2011, the ParkSmart A/C condenser is located on the backwall of the sleeper. Inspect the condenser as follows.

1. Remove the inspection plate on the bottom of the condenser module. See **Fig. 13**.

NOTE: If the condenser core has a build up of fine debris, an A/C core cleaner, approved for copper and aluminum cores, and a low pressure water can be use to clean it.

2. Clean out any debris in the module.
3. Install the inspection plate.



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Remove the inspection plate.

Fig. 13, Condenser Cleaning

Index, Alphabetical

88–01 Hood Rear Support Lubrication

1. Apply the parking brakes and chock the tires.
2. Open the hood.
3. Clean both the hood- and cab-mounted hood rear support components with a soapy water solution.
4. Cover all contact surfaces of the hood rear support brackets and isolators with an approved multi-purpose, lithium-complex, soap-based grease; see **Table 1**.
5. Close the hood.

Approved Suppliers of Multi-Purpose Lithium Grease	
Supplier	**Grease**
Chevron	Delo Heavy Duty EP
Exxon	Unirex EP2
Mobil	Mobil Grease XHP 222
Shell	Retinax LC Grease
Texaco	Starplex 2

Table 1, Approved Suppliers of Multi-Purpose Lithium Grease