5th Generation Cascadia Maintenance Manual

Models: Gen 5 Cascadia 116
Gen 5 Cascadia 126
Gen 5 Cascadia 116 RHD
Gen 5 Cascadia 126 RHD

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Foreword

Foreword

Instructions and procedures are those recommended by Freightliner Trucks, or the component manufacturer. Maintenance schedules and additional service information are included in the product Maintenance Manual.

IMPORTANT: Descriptions and specifications in this manual were in effect at the time of printing. Daimler Truck North America LLC 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.

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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:

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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Service Publications

Descriptions of Service Publications

Daimler Truck North America (DTNA) LLC distributes the following major service publications in paper and electronic formats. Refer to DTNA TechLit for more information.

Workshop/Service Manual

Workshop and 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 and service manual section is divided into subjects that can include general information, principles of operation, removal, disassembly, assembly, installation, and specifications. Workshop and service manuals contain service and repair information for all vehicle systems and components installed in our plants.

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, and specifications. Maintenance manuals do not contain detailed repair or service information. Maintenance manuals should not be used for covering plant quality or quality assurance issues. The purpose of maintenance manuals is to increase the life of the component being maintained. Except for federally required maintenance items, like mufflers, these are recommendations, not requirements.

Troubleshooting Manual

Troubleshooting manuals contain diagnostic procedures for determining the root cause of fault codes and symptoms in vehicle components and systems, including multiplexed systems. In addition to fault codes and symptoms, testing procedures and ‘how to’ sections are included in troubleshooting manuals. The troubleshooting manual does not include information on the removal, inspection, or installation of components.

Technical Service Bulletins (TSBs)

TSBs provide issue notifications to the service network. They are intended for issues that can be addressed when the expected symptom or failure is present when the vehicle arrives in the shop for normal service. TSBs should not be used to bring a vehicle in for inspection, or update a vehicle before a failure has occurred. In the literature request system, they have a higher priority than Workshop, Drivers, and Maintenance Manuals. All TSBs must have a clearly defined symptom or customer complaint that is causing the customer to bring the vehicle into the dealership. If they do not, dealerships will take it as an expectation that they should be proactively checking every single vehicle when they come in. TSBs are not visible to vehicle owners and operators.

Parts Bulletin (PB) or Parts Technical Bulletin (PTB)

PBs are used to communicate information on parts. These bulletins contain lists of parts and Bills of Material (BOMs) needed to do replacement and upgrade procedures. PBs do not contain service procedures or Standard Repair Times (SRTs).

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Customer Service Announcements (CSAs)

CSAs are used to communicate information to the dealer or distributor network. They remain on DTNA Portal and continue to be communicated via myComm.

Tool Letters (TLs)

TLs are used to communicate the release of both physical and electronic tools. They remain on DTNA Portal and continue to be communicated via myComm.

18SP Letters

18SPs are special procedures or instructions that are included in unique service parts kits. They are available on TechLit in the event that someone lost their kit's original copy.

Original Equipment Manufacturer (OEM) Letters

OEM letters are other suppliers' letters that we make available on TechLit as a courtesy.

DTNA Portal

Service and parts applications and information can be accessed on the DTNA Portal. While there is some content available to users without logging in, access to most content and applications on DTNA Portal requires authentication by registered users. Registration requirements for each user type can be found on the main landing page before logging in. In addition to accessing Aftermarket applications, DTNA Portal can be used for searching all content published within DTNA Portal pages as well as within many applications. The following applications can be accessed via DTNA Portal.

TechLit

Web-based service manuals can be accessed on the TechLit application.

PartsProX

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

EZWiring

EZWiring™ makes products' wiring drawings and floating pin lists available online for viewing and printing. EZWiring can also be accessed from within PartsProX.

Service Solutions

The Service Solutions application provides diagnostic assistance with Symptoms Search, by connecting to a large knowledge base gathered from technicians and service personnel. Solutions published within Service Solutions are routed through DTNA Compliance, but are not vetted through the normal reviews that service bulletins, service manuals, and campaigns go through. Content published should only be published on Service Solutions if it doesn't meet the criteria to be published in one of the more official publication types.

Vehicle Info

Vehicle Information is a single point of entry to search for DTNA and Detroit Diesel service information. This allows you to search for information specific to a vehicle or Detroit Diesel engine. Vehicle specifications, vehicle recalls

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and campaigns, warranty information, and vehicle literature can all be found within Vehicle Info. It also contains the registration information for the selected vehicle.

Warranty Lit

Review important warranty information including warranty manuals, letters, recall and field service information and more.

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.

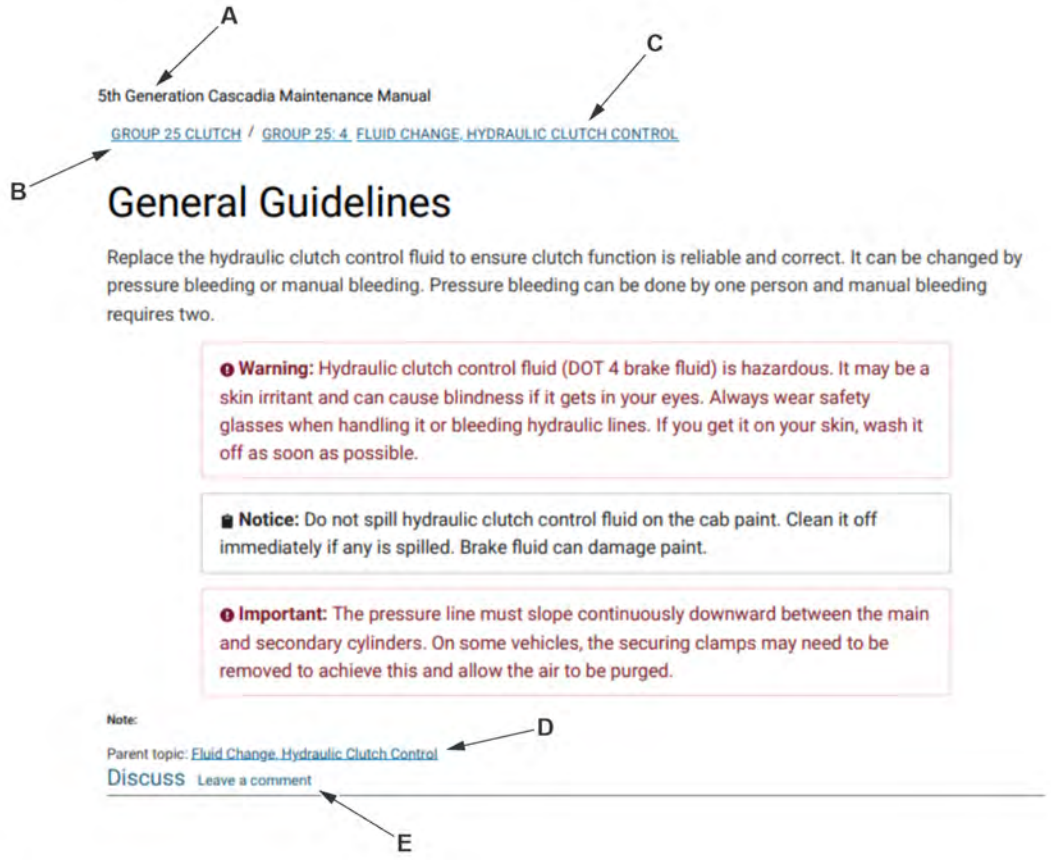
Warranty Manual

This manual covers the provisions and procedures under which authorized service facilities will be reimbursed for warranty-related work on products, parts, and accessories manufactured or supplied by DTNA.

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Page Description



A. Vehicle Name
B. Group Number and Group Title
C. Maintenance Operation Number consists of the Group Number followed by the Sequence Number and Title.
D. Parent Topic
E. Commenting Option

Fig 1, Example of a Maintenance Manual Page

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1.01 Determining Scheduled Maintenance Intervals: 00–01 10
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1. Group 00 General Information

1.01 Determining Scheduled Maintenance Intervals: 00–01

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: 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.

1.02 Service Schedule Table: 00–02

Table 1, Service Schedule

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

1.03 Vehicle Maintenance Schedule Table: 00–03

Table 2, Maintenance for Service Schedule I

Maintenance Number	Maintenance Interval	Service Date	Service Schedule I	
			Miles	km
1st	IM, 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, 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, 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, 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, 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, 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, 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, M2		350,000	560 000
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, 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, 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, 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, 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, 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, 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, M2		700,000	1 127 000
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, 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, 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, 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, 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, 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, M2		1,000,000	1 609 000

Table 2, Maintenance for Service Schedule I

Maintenance Number	Maintenance Interval	Service Date	Service Schedule II	
			Miles	km
1st	IM, M1		25,000	40 000
2nd	M1		50,000	80 000
3rd	M1		75,000	121 000
4th	M1, M2		100,000	161 000
5th	M1		125,000	201 000
6th	M1		150,000	241 000
7th	M1		175,000	281 000
8th	M1, M2		200,000	322 000

9th	M1		225,000	362 000
10th	M1		250,000	402 000
11th	M1		275,000	443 000
12th	M1, M2, M3		300,000	483 000
13th	M1		325,000	523 000
14th	M1		350,000	563 000
15th	M1		375,000	604 000
16th	M1, M2		400,000	644 000
17th	M1		425,000	684 000
18th	M1		450,000	724 000
19th	M1		475,000	764 000
20th	M1, M2		500,000	805 000
21st	M1		525,000	845 000
22nd	M1		550,000	885 000
23rd	M1		575,000	925 000
24th	M1, M2, M3		600,000	966 000
25th	M1		625,000	1 005 800
26th	M1		650,000	1 046 000
27th	M1		675,000	1 086 000
28th	M1, M2		700,000	1 127 000
29th	M1		725,000	1 167 000
30th	M1		750,000	1 207 000
31st	M1		775,000	1 248 000
32nd	M1, M2		800,000	1 287 000
33rd	M1		825,000	1 328 000
34th	M1		850,000	1 368 000
35th	M1		875,000	1 408 000
36th	M1, M2, M3		900,000	1 448 000
37th	M1		925,000	1 490 000

38th	M1		950,000	1 529 000
39th	M1		975,000	1 569 000
40th	M1, M2		1,000,000	1 609 000

1.04 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).

Table 3, Initial Maintenance (IM) Operations for Service Schedules I and II

Maintenance Operation Number	Initial Maintenance (IM) Operations for Service Schedules I and II	Check
1.0500–05	1.05 M1 Maintenance Interval Operations: 00–05	
8.0431–4	8.04 Frame Fastener Torque Check	
9.0332–3	9.03 Suspension U-Bolt Torque Check	
33. 5	All-Axle Alignment Check	
14.1242–13	14.12 Operating and Leakage Tests of the Bendix Automatic Drain Valve[1]	
16.0447–4	16.04 Tightening the Fuel Tank Band-Nut	

1. The automatic drain valve should be inspected every 6 months or 1500 operating hours, whichever comes first.

Table 3, Initial Maintenance (IM) Operations for Service Schedules I and II

1.05 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 *5th Generation Cascadia™ Driver's Manual*.

Table 4, M1 Maintenance Interval Operations for Service Schedules I and II

Maintenance Operation Number	M1 Maintenance Interval Operations for Service Schedules I and II	Check
3.02	3.02 Inspection of the Air Compressor	
6.02	6.02 Lubrication of the Clutch Release Bearing[1]	
8.02	8.02 Inspection of the Fifth Wheel	
8.03	8.03 Lubrication of the Fifth Wheel	

10.06.02	10.06.02 Inspection of the Steer Axle Hub Cap Vent Plug	
12.01	12.01 Wheel Nut Check	
12.02	12.02 Tire Check	
13.02	13.02 Inspection of the Driveline	
13.03	13.03 Lubrication of the Driveline	
14.03	[2]	
14.05	14.05 Inspection of the Brake	
14.06	14.06 Lubrication of the Haldex Slack Adjuster	
14.07	14.07 Lubrication of the Meritor Camshaft Bracket	
14.10	14.10 Replacement of the WABCO System Saver Air Dryer Desiccant Cartridge	
14.11	14.11 Inspection and Lubrication of the Versajust Slack Adjuster[3]	
14.12	14.12 Operating and Leakage Tests of the Bendix Automatic Drain Valve[4]	
16.02	16.02 Replacement of the Fuel Filter	
17.02	17.02 Inspection of the Exhaust System (noise emission control)	
19.02	19.02 Cab Shock Absorber Bracket Torque Check	
19.03	19.03 Inspection of the Aerodynamic Component	
20.04	20.04 Inspection of the Battery Powered HVAC System (BPHS)	

1. On vehicles equipped with Detroit transmissions, the release bearing does not need to be lubricated. On vehicles equipped with Eaton Fuller UltraShift PLUS transmissions, lubricate the release bearing every 50,000 miles (80 000 km) or 3 months. † If equipped with an oil-coalescing desiccant cartridge, replace the cartridge once a year, regardless
2. If equipped with an oil-coalescing desiccant cartridge, replace the cartridge once a year, regardless of mileage. Otherwise use the M3 maintenance interval.
3. Complete this procedure every 25,000 miles (40 225 km), 3 months, or 500 operating hours, whichever comes first.
4. The automatic drain valve should be inspected every 6 months or 1500 operating hours, whichever comes first.

Table 4, M1 Maintenance Interval Operations for Service Schedules I and II

1.06 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.

Table 5, M2 Maintenance Interval Operations for Service Schedules I and II

Maintenance Operation Number	M2 Maintenance Interval Operations for Service Schedules I and II	Check
1.05	1.05 M1 Maintenance Interval Operations: 00–05	

4.02	4.02 Alternator, Battery, and Starter Connections Check	
5.02	5.02 Pressure Relief Cap Check	
5.04	5.04 Fan Clutch Check (Noise Emission Control)	
6.03	6.03 Fluid Level Check, Hydraulic Clutch Control	
7.02	7.02 Detroit™ Automated Transmission Fluid Change and Magnetic Plug Cleaning	
7.03	7.03 Detroit™ Automated Transmission Fluid Level Inspection	
7.04.01	7.04.01 Inspection of the Eaton Fuller Transmission Fluid Level	
7.05	7.05 Check, Cleaning, or Replacement of the Eaton Fuller Manual Transmission Air Filter/Regulator	
9.02	9.02 Inspection of the Suspension	
9.03	9.03 Suspension U-Bolt Torque Check	
10.02	10.02 Lubrication of the Knuckle Pin	
10.03	10.03 Inspection of the Tie Rod End	
10.04	10.04 Lubrication of the Tie Rod End	
	[1]	
14.02	14.02 Inspection of the Air Brake System Valve	
14.04	14.04 Inspection of the Air Dryer	
14.08	14.08 Lubrication of the Meritor Slack Adjuster	
15.02	15.02 Inspection of the Drag Link	
15.03	15.03 Power Steering Fluid and Filter Change	
15.04	15.04 Lubrication of the Power Steering Gear	
18.01	18.01 Inspection and Cleaning of the Trailer Cab	
19.01	19.01 Mirror Folding Check	
19.04	19.04 Lubrication of the Baggage Door and Sleeper Access Door Release Cable and Latch	
20.02	20.02 Inspection of the Air Conditioner	
20.03	20.03 Replacement of the Air Filter	

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

Table 5, M2 Maintenance Interval Operations for Service Schedules I and II

1.07 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.

Table 6, M3 Maintenance Interval Operations for Service Schedules I and II

Maintenance Operation Number	M3 Maintenance Interval Operations for Service Schedules I and II	Check
1.06	1.06 M2 Maintenance Interval Operations: 00–06	
1.05	1.05 M1 Maintenance Interval Operations: 00–05	
2.01	2.01 Inspection of the Air Cleaner	
5.03	5.03 Radiator Pressure-Flushing and Coolant Change	
6.04	6.04 Fluid Change, Hydraulic Clutch Control	
7.04	7.04 Eaton Fuller Transmission Fluid Change and Magnetic Plug Cleaning[1]	
11.02	11.02 Axle Lubricant and Filter Change, and Cleaning the Magnetic Strainer	
14.03	14.03 Replacement of the Bendix Air Dryer Desiccant	
14.09	14.09 Inspection and Lubrication of the Bendix E-6 Foot Control Valve	
14.10	14.10 Replacement of the WABCO System Saver Air Dryer Desiccant Cartridge	
15.03	15.03 Power Steering Fluid and Filter Change	

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

Table 6, M3 Maintenance Interval Operations for Service Schedules I and II

1.08 Maintenance Operation Sets Table: 00–08

Table 7, Maintenance Operation Sets

Maintenance Number	Operation Description	Service Schedules I and II			
		IM	M1	M2	M3
2.01	2.01 Inspection of the Air Cleaner				•
3.02	3.02 Inspection of the Air Compressor	•	•	•	•
4.02	4.02 Alternator, Battery, and Starter Connections Check			•	•
5.02	5.02 Pressure Relief Cap Check			•	•
5.03	5.03 Radiator Pressure-Flushing and Coolant Change				•
5.04	5.04 Fan Clutch Check (Noise Emission Control)			•	•
6.02	6.02 Lubrication of the Clutch Release Bearing[1]	•	•	•	•
6.03	6.03 Fluid Level Check, Hydraulic Clutch Control			•	•
6.04	6.04 Fluid Change, Hydraulic Clutch Control				•

7.02	7.02 Detroit™ Automated Transmission Fluid Change and Magnetic Plug Cleaning			•	
7.03	7.03 Detroit™ Automated Transmission Fluid Level Inspection			•	•
7.04	7.04 Eaton Fuller Transmission Fluid Change and Magnetic Plug Cleaning[2]				•
7.04.01	7.04.01 Inspection of the Eaton Fuller Transmission Fluid Level			•	•
7.05	7.05 Check, Cleaning, or Replacement of the Eaton Fuller Manual Transmission Air Filter/Regulator			•	•
8.02	8.02 Inspection of the Fifth Wheel	•	•	•	•
8.03	8.03 Lubrication of the Fifth Wheel	•	•	•	•
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10.02	10.02 Lubrication of the Knuckle Pin[3]			•	•
10.03	10.03 Inspection of the Tie Rod End			•	•
10.04	10.04 Lubrication of the Tie Rod End			•	•
10.05	10.05 All-Axle Alignment Check	•			
10.06.02	10.06.02 Inspection of the Steer Axle Hub Cap Vent Plug		•	•	•
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14.09	14.09 Inspection and Lubrication of the Bendix E-6 Foot Control Valve			•	•
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13.02	13.02 Inspection of the Driveline	•	•	•	•
13.03	13.03 Lubrication of the Driveline	•	•	•	•
14.02	14.02 Inspection of the Air Brake System Valve			•	•
14.03	14.03 Replacement of the Bendix Air Dryer Desiccant[4]	•	•	•	•
14.04	14.04 Inspection of the Air Dryer			•	•
14.05	14.05 Inspection of the Brake	•	•	•	•
14.06	14.06 Lubrication of the Haldex Slack Adjuster	•	•	•	•
14.07	14.07 Lubrication of the Meritor Camshaft Bracket	•	•	•	•
14.08	14.08 Lubrication of the Meritor Slack Adjuster			•	•

14.09	14.09 Inspection and Lubrication of the Bendix E-6 Foot Control Valve				•
14.10	14.10 Replacement of the WABCO System Saver Air Dryer Desiccant Cartridge	•	•	•	•
14.11	14.11 Inspection and Lubrication of the Versajust Slack Adjuster[5]		•	•	•
14.12	14.12 Operating and Leakage Tests of the Bendix Automatic Drain Valve[6]	•	•		
15.02	15.02 Inspection of the Drag Link			•	•
15.03	15.03 Power Steering Fluid and Filter Change				•
15.04	15.04 Lubrication of the Power Steering Gear			•	•
15.05	15.05 Lubrication of the Drag Link			•	•
16.02	16.02 Replacement of the Fuel Filter			•	•
16.03	16.03 Fuel/Water Separator Element Checking and Replacement			•	•
16.04	16.04 Tightening the Fuel Tank Band-Nut	•			
18.01	18.01 Inspection and Cleaning of the Trailer Cab			•	•
19.01	19.01 Mirror Folding Check			•	•
19.02	19.02 Cab Shock Absorber Bracket Torque Check	•	•	•	•
19.03	19.03 Inspection of the Aerodynamic Component	•	•	•	•
19.04	19.04 Lubrication of the Baggage Door and Sleeper Access Door Release Cable and Latch			•	•
20.02	20.02 Inspection of the Air Conditioner			•	•
20.03	20.03 Replacement of the Air Filter			•	•
20.04	20.04 Inspection of the Battery Powered HVAC System (BPHS)	•	•	•	•

1. On vehicles equipped with Detroit transmissions, the release bearing does not need to be lubricated. On vehicles equipped with Eaton Fuller UltraShift PLUS transmissions, lubricate the release bearing every 50,000 miles (80 000 km) or 3 months.
2. For Eaton Fuller transmissions, fluid change intervals are extended to 500,000 miles (800 000 km) on vehicles filled with synthetic transmission fluid.
3. For Schedule I vehicles with Detroit axles, complete this procedure once a year or every 25,000 miles (40 000 km), whichever comes first.
4. If equipped with an oil-coalescing desiccant cartridge, replace the cartridge once a year, regardless of mileage. Otherwise use the M3 maintenance interval.
5. Complete this procedure every 25,000 miles (40 225 km), 3 months, or 500 operating hours, whichever comes first.
6. The automatic drain valve should be inspected every 6 months or 1500 operating hours, whichever comes first.

Table 7, Maintenance Operation Sets

1.09 Noise Emission Controls Maintenance: 00–09

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:

Removal of engine noise-deadening panels.

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

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

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

Removal of the fan shroud.

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

Removal of air intake components.

Maintenance Instructions

Scheduled intervals are in the maintenance tables in this group. A 'Verification of Inspections Log,' see should be filled in each time noise emission controls on the vehicle are maintained or repaired.

1.10 Verification of Inspections Log: 00–10

Verification of Inspections Log — Fan Clutch

Table 8, Verification of Inspections Log — Fan Clutch

Date	Mileage	Item	Cost	Maintenance Facility

Date	Mileage	Item	Cost	Maintenance Facility

Table 8, Verification of Inspections Log — Fan Clutch

Verification of Inspections Log — Exhaust System Components

Table 9, Verification of Inspections Log — Exhaust System Components

Date	Mileage	Item	Cost	Maintenance Facility

Date	Mileage	Item	Cost	Maintenance Facility

Table 9, Verification of Inspections Log — Exhaust System Components

2.01 Inspection of the Air Cleaner 26

2. Group 09 Air Intake

2.01 Inspection of the Air Cleaner

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 (see Fig. 2,Manual-Reset Air Restriction Indicator, Graduated), or a go/no-go restriction indicator without graduations (see Fig. 3,Manual-Reset Air Restriction Indicator, Go/No-Go).



Fig 2, Manual-Reset Air Restriction Indicator, Graduated



Fig 3, Manual-Reset Air Restriction Indicator, Go/No-Go

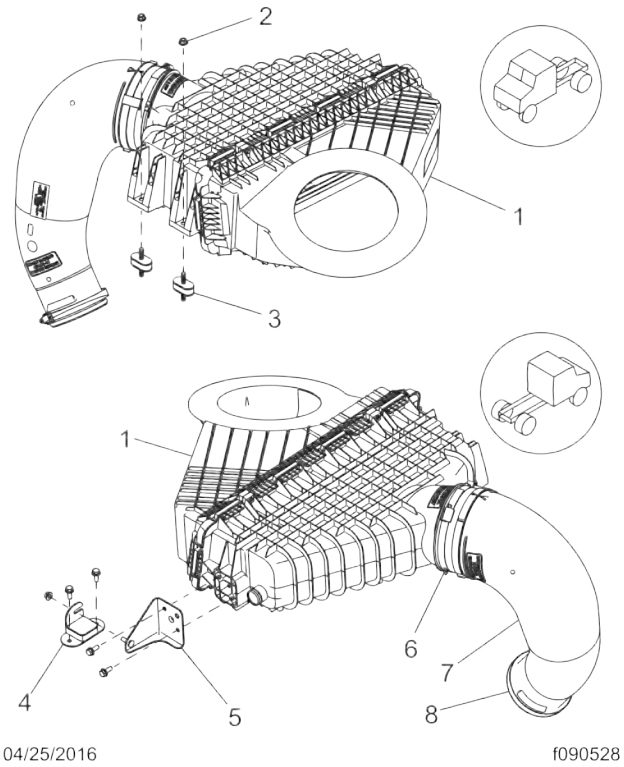
1. Inspect the air restriction indicator to see if air restriction equals or exceeds the maximum allowable restriction. For instructions, see **General Information** of the *5th Generation Cascadia Workshop Manual*.

NOTICE:

Do not use aftermarket air-cleaner elements. Aftermarket air-cleaner elements may not seal the housing correctly, which can lead to engine damage and potentially the loss of warranty. When replacing an air-cleaner element, use only the part listed in PartsPro for the serial number of the vehicle.

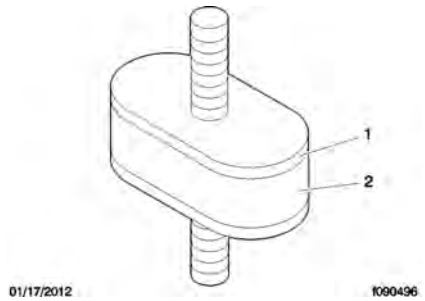
2. If necessary, replace the air cleaner element. For air cleaner element replacement instructions, see **General Information, Air Intake Ducting** of the *5th Generation Cascadia Workshop Manual*.
3. Inspect the air cleaner housing for cracks, leaks, or any other damage. If the air cleaner housing or element is damaged, replace it.
4. Inspect the forward and rear mounting isolators for damage. See Fig. 4,Air Cleaner Assembly. Ensure the bonds between the rubber and the steel plates are completely intact. See Fig. 5,Mounting Isolator.

If a mounting isolator is damaged, replace it. For isolator replacement instructions, see **Removal of the Air Cleaner Element** of the *5th Generation Cascadia Workshop Manual*.



1. Air Cleaner Housing
2. Nut
3. Forward Mounting Isolator
4. Rear Mounting Isolator
5. Rear Mounting Bracket
6. Clamp
7. Intake Duct
8. Clamp

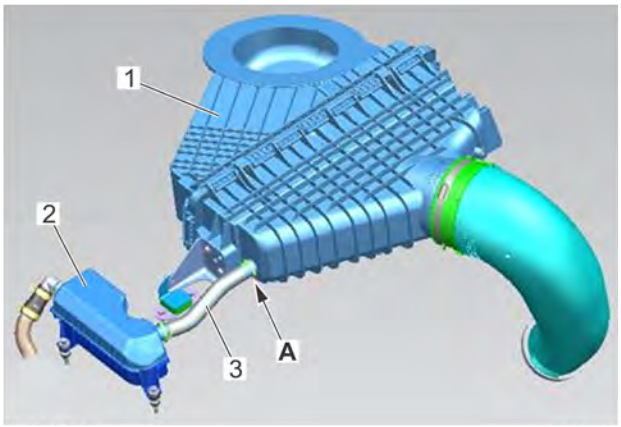
Fig 4, Air Cleaner Assembly



1. Steel Plate
2. Rubber

Fig 5, Mounting Isolator

5. Check that the quick connect fitting for the air compressor supply line is fully engaged with the air cleaner. See Fig. 6,Compressor Supply Line Quick Connect.



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A. Check this connection.
1. Air Cleaner
2. Resonator
3. Compressor Supply Line

Fig 6, Compressor Supply Line Quick Connect

6. Remove the pre-cleaners (if so equipped) from the hood plenum, then clean them with compressed air.
7. Reset the air restriction indicator.
8. Each time the air cleaner housing is replaced, perform the procedures in 3.02 Inspection of the Air Compressor.

3.01 Safety Precautions 30
3.02 Inspection of the Air Compressor 30

3. Group 13 Air Compressor

3.01 Safety Precautions

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

DANGER:

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

3.02 Inspection of the Air Compressor

1. Inspect the air compressor intake hoses and connections at the air intake at the air cleaner, the resonator, and the air compressor for physical damage or loose connections. If needed, change the hoses, and/or tighten or replace the connections.
2. Inspect the coolant supply and return lines for tight connections. Tighten the connections and replace the lines and fasteners if needed.
3. For the air governor, inspect the piping and connections for leaks. Replace gaskets and faulty components as needed.

4.01 Safety Precautions 32

4.02 Alternator, Battery, and Starter Connections Check 32

4. Group 15 Alternators and Starters

4.01 Safety Precautions

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

DANGER:

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

4.02 Alternator, Battery, and Starter Connections Check

WARNING:

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

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

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

5.01 Safety Precautions 34
5.02 Pressure Relief Cap Check 34
5.03 Radiator Pressure-Flushing and Coolant Change 35
5.04 Fan Clutch Check (Noise Emission Control) 37
5.04.01 Borg Warner (Kysor) K30 Fan Clutch 37
5.04.02 Horton DriveMaster® Fan Clutch) 38

5. Group 20 Engine Cooling/Radiator

5.01 Safety Precautions

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

DANGER:

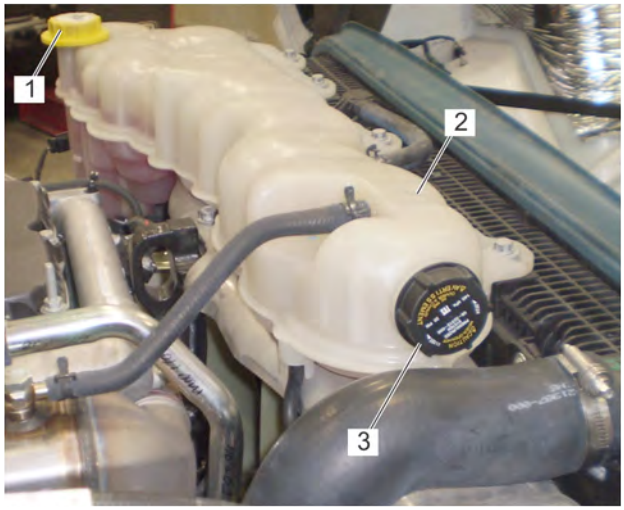
When working on the vehicle, shut down the engine or motor, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle cannot drop. Failure to follow these steps could result in serious personal injury or death.

5.02 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 surge tank filler cap first, to relieve the cooling system pressure, then remove the SAE cap; see Fig. 7,Surge Tank.



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1. Surge Tank Filler Cap
2. Surge Tank
3. Pressure Relieve Cap (for coolant overflow pressure relief only)

Fig 7, Surge Tank

2. Using the Snap-On tool radiator-cap tester shown in Table 10,Snap-On Tool For Pressure Relief Cap Test, check the pressure relief cap to see if it maintains pressure to within 10% of the pressure rating marked on the cap. If it does not, replace the cap. Make sure that the replacement cap is correctly rated for the cooling system of the vehicle. Use the recommended tool in Table 10,Snap-On Tool For Pressure Relief Cap Test.

Table 10, Snap-On Tool For Pressure Relief Cap Test

Tool	Part Number
Radiator-Cap Tester	TA53

Table 10, Snap-On Tool For Pressure Relief Cap Test

3. There is a second valve in the pressure relief 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 filler cap seals properly on the coolant filler neck seat, and that the O-ring is not cracked or deteriorated. Replace the cap if the O-ring shows deterioration or damage.

5.03 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 drain plugs from the radiator tank. Allow the coolant to drain.
4. Remove the surge tank cap.
5. Disconnect the radiator upper and lower hoses, and install the surge tank cap and the radiator 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 drain plug and allow the radiator to drain. Install and tighten the drain plug after the radiator has been drained. Do not overtighten.
10. Connect the hoses. Your hose clamps can be either T-bolt clamps (see Fig. 8,T-Bolt Type Hose Clamp) or Breeze Constant-Torque clamps (see Fig. 9,Breeze Constant-Torque Hose Clamp Installation).

    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 in 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).

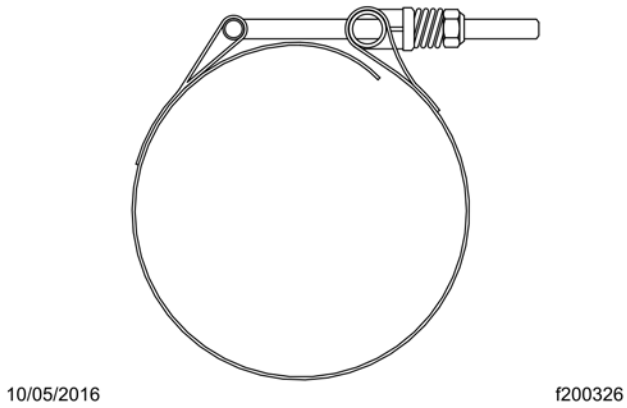
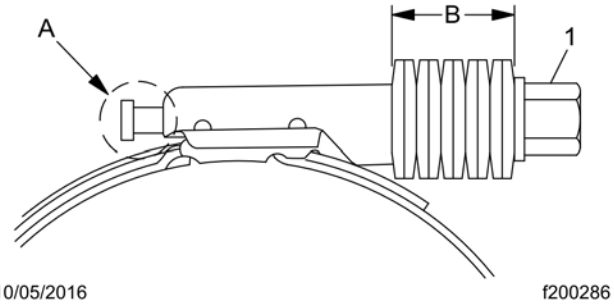


Fig 8, T-Bolt Type Hose Clamp



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

1. Tightening Screw Hex

Fig 9, 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. The cooling system is filled when the coolant level reaches the MAX line on the surge tank. Refer to the engine manufacturer's service literature for specific coolant information.
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 at the MAX line on the surge tank.

5.04 Fan Clutch Check (Noise Emission Control)

See ‘In this section’ below for a link to fan clutch check (noise emission control) topics.

5.04.01 Borg Warner (Kysor) K30 Fan Clutch

1. Disconnect the batteries at the negative terminals. Drain all air from the air system.

2. Using the Borg Warner Service Alert Tool, check the clutch wear as shown in Fig. 10,Tool Below Retainer Plate, Liner Life Remaining, and Fig. 11,Tool Above Retainer Plate, Liner Replacement Needed.

   If the tool is sitting below the retainer plate, the fan clutch liner has remaining life.

   If the tool is sitting above the retainer plate, replace the fan clutch liner.



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NOTE: With the fan clutch engaged, check the remaining life in the clutch liner.

Fig 10, Tool Below Retainer Plate, Liner Life Remaining



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NOTE: With the fan clutch engaged, check the remaining life in the clutch liner.

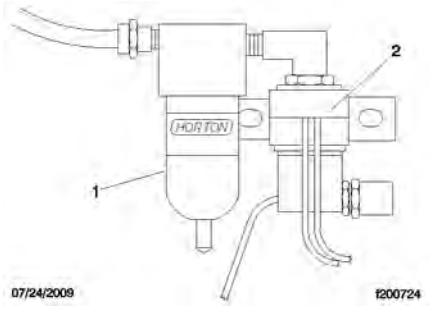
Fig 11, Tool Above Retainer Plate, Liner Replacement Needed

3. Connect the battery cables.
4. Start the engine, and check for air leaks. Repair as needed.

5.04.02 Horton DriveMaster® Fan Clutch)

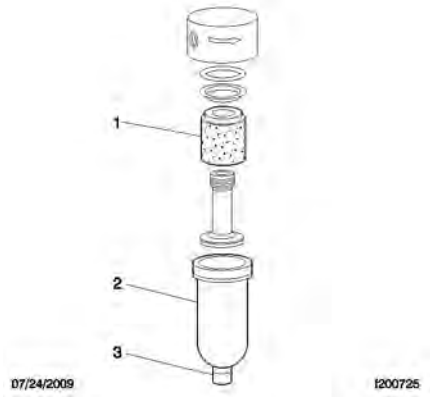
1. Disconnect the batteries at the negative terminals.
2. Inspect the electrical connections and wires to the fan clutch solenoid; see Fig. 12,Horton DriveMaster Air Solenoid Valve. Secure the connection if loose; replace wires and connectors if damaged.

3. Clean the fan clutch air solenoid valve filter, if equipped, as follows.
   - 3.a Unscrew the fan clutch solenoid valve air filter assembly and remove the filter element; see Fig. 13,Horton DriveMaster Solenoid Valve Air Filter.
   - 3.b Clean the filter element with cleaning solvent.
   - 3.c Using a clean, lint-free cloth, wipe off any excess solvent.
   - 3.d Reassemble the clutch valve solenoid air filter, then install it on the vehicle.



1. Air Filter Housing
2. Solenoid Valve

Fig 12, Horton DriveMaster Air Solenoid Valve



1. Filter Element
2. Filter Bowl
3. Bleed Valve

Fig 13, Horton DriveMaster Solenoid Valve Air Filter

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**, **Fan Clutch, Horton Drivemaster** of the vehicle 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. 14,Checking for Air Leaks (Horton DriveMaster). Using a wet finger or a soapy water solution, check for a leak in the same areas.

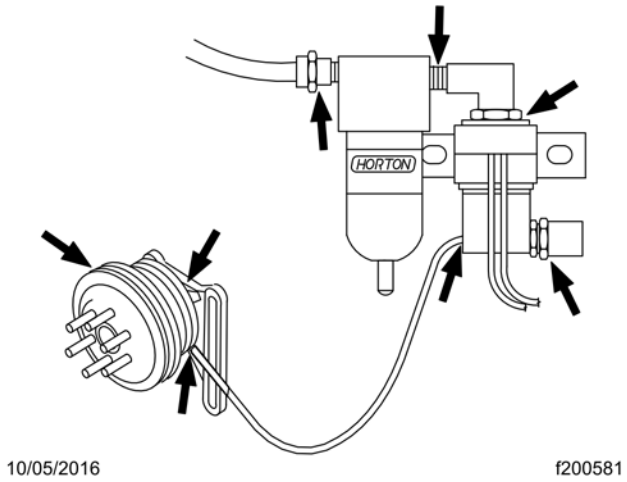


Fig 14, Checking for Air Leaks (Horton DriveMaster)

9. If a leak is detected, remove the fan blade. Install a new seal kit. See **General Information, Radiator Assembly** of the vehicle Workshop Manual for repair procedures.
10. Check the fan drive for discoloration or any other signs of slipping or overheating.
11. Check the fan clutch bearings as follows.
    - 11.a Turn the fan in both directions and feel for worn hub bearings.
    - 11.b If possible, remove the drive belt and check for worn sheave bearings by turning the sheave in both directions.
    - 11.c If either the hub or sheave bearings are worn, replace them, using a Horton DriveMaster Super Kit; see of the vehicle Workshop Manual.

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6. Group 25 Clutch

6.01 Safety Precautions

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

DANGER:

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

6.02 Lubrication of the Clutch Release Bearing

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

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Remove the clutch inspection plate to see the release bearing while lubricating it. See Fig. 15,Typical Clutch Inspection Plate.

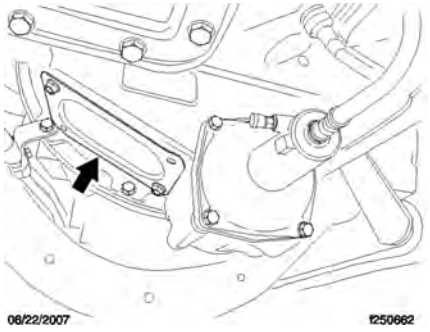
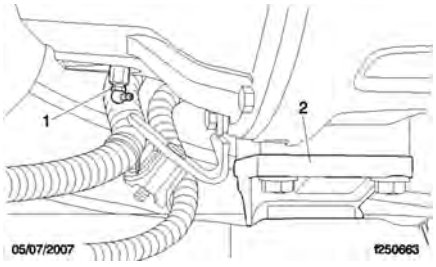


Fig 15, Typical Clutch Inspection Plate

3. Clean the grease fitting. On some vehicles a lube tube will be used, and the fitting may be at the 9-o'clock position on the left side of the bellhousing (see Fig. 16,Typical Release Bearing Grease Fitting).



1. Grease Fitting
2. Left Engine Mount

Fig 16, Typical Release Bearing Grease Fitting

NOTICE:

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

4. Using a pressure-type grease gun, lubricate the release bearing with NLGI Grade 3 grease until excess grease purges from the rear of the release bearing (toward the transmission).
5. Install the clutch inspection plate.

6.03 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.

Hydraulic clutch control 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.

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.

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. 17,Reservoir, Hydraulic Clutch Control.

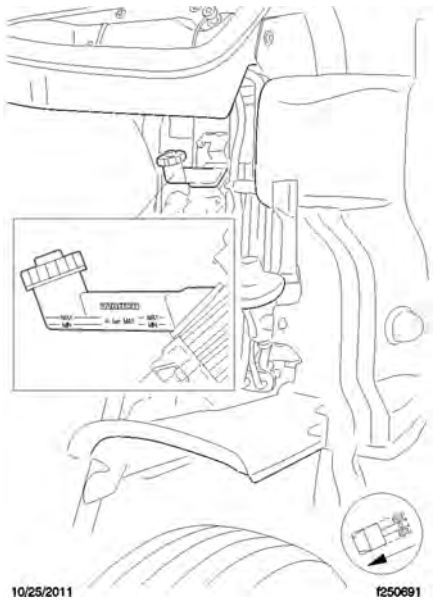


Fig 17, Reservoir, Hydraulic Clutch Control

6.04 Fluid Change, Hydraulic Clutch Control

See ‘In this section’ below for a link to Fluid Change, Hydraulic Clutch Control topics.

6.04.01 General Guidelines

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.

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.

NOTICE:

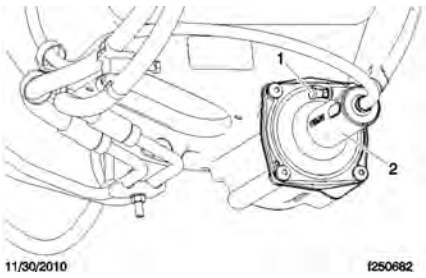
Do not spill hydraulic clutch control fluid on the cab paint. Clean it off immediately if any is spilled. Brake fluid can damage paint.

IMPORTANT: The pressure line must slope continuously downward between the main and secondary cylinders. On some vehicles, the securing clamps may need to be removed to achieve this and allow the air to be purged.

6.04.02 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.

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 bleeder system to 15 psi (103 kPa).
3. Remove the reservoir lid (see Fig. 18,Secondary Cylinder, Hydraulic Clutch Control) and install the pressure bleed adaptor on the reservoir.
4. Bleed the hydraulic system as follows.
   - 4.a Open the bleed valve on the bleed tank to pressurize the reservoir.
   - 4.b Remove the cap from the bleed valve of the secondary cylinder. See Fig. 18,Secondary Cylinder, Hydraulic Clutch Control. On the valve, install a transparent drain hose connected to a catch bottle. The hose needs to fit the bleed valve tight enough so it does not fall off when fluid is pumped out.
   - 4.c Open the bleed valve on the secondary cylinder.
   - 4.d When the draining fluid is clear and free of air bubbles, close the bleed valve.



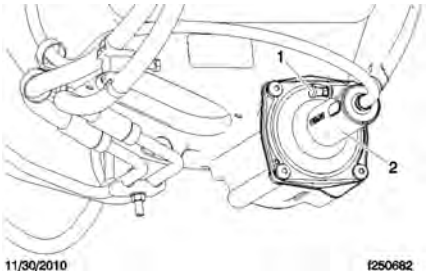
1. Bleed Valve
2. Secondary Cylinder

Fig 18, Secondary Cylinder, Hydraulic Clutch Control

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

6.04.03 Manual Bleeding

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires and open the hood.
2. Remove the reservoir lid and fill the reservoir with new DOT 4 brake fluid from a tightly sealed container.
3. Remove the cap from the bleed valve of the secondary cylinder. See Fig. 19,Secondary Cylinder, Hydraulic Clutch Control. On the valve, install a transparent drain hose connected to a catch bottle. The hose needs to fit the bleed valve tight enough so it does not fall off when fluid is pumped out.



1. Bleed Valve
2. Secondary Cylinder

Fig 19, Secondary Cylinder, Hydraulic Clutch Control

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

6.05 Replacement of the Clutch, Detroit™ Automated Transmissions

Replace the clutch assembly for a Detroit Automated transmission at 750,000-mile (1 200 000-km) intervals. Follow the procedure published on the DTNA Portal.

7.01 Safety Precautions 48
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7.05 Check, Cleaning, or Replacement of the Eaton Fuller Manual Transmission Air Filter/Regulator 56

7. Group 26 Transmission

7.01 Safety Precautions

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

DANGER:

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

7.02 Detroit™ Automated Transmission Fluid Change and Magnetic Plug Cleaning

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.

NOTICE:

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

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, then remove it from the side of the gear case. Remove the drain plug from the bottom of the case. See Fig.20,Drain and Fill Plugs, Detroit Automated Transmissions.



1. Drain Plug
2. Fill Plug

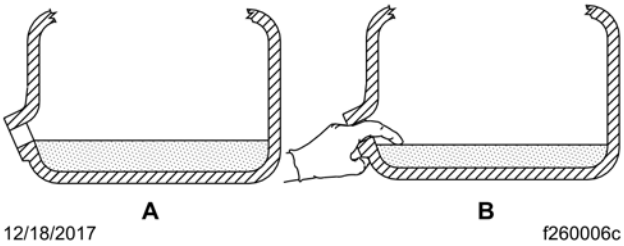
Fig 20, Drain and Fill Plugs, Detroit Automated Transmissions

3. Clean the fill plug and the drain plug.
4. Install a new seal on the drain plug, then install the plug and tighten it 45 lbf·ft (60 N·m).

NOTICE:

Detroit transmissions use synthetic lubricant that meets specific requirements. To see a list of approved lubricants and information to identify which transmissions they can be used with, see the Transmission Fluid Service Information brochure at http://dtna.info/DT12FluidsManual.

5. Add fluid until it is level with the lower edge of the fill opening; see Fig.21,Checking Transmission Fluid Level. See the Detroit Transmission Fluid Service Information brochure at http://dtna.info/DT12FluidsManual, for identifying the transmission type, estimated transmission fluid capacities, and applicable fluid specifications.



A. Full
B. Low

Fig 21, Checking Transmission Fluid Level

6. Install the fill plug and operate the engine for five minutes after filling the transmission, then check the fluid level again.
7. Install a new seal on the fill plug, then install the plug and tighten it 45 lbf·ft (60 N·m).

7.03 Detroit™ Automated Transmission Fluid Level Inspection

NOTICE:

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

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, then 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.
3. If the fluid level is low, check the transmission for leaks, and correct as needed.

NOTICE:

Detroit transmissions use synthetic lubricant that meets specific requirements. To see a list of approved lubricants and information to identify which transmissions they can be used with, see the Transmission Fluid Service Information brochure at http://dtna.info/DT12FluidsManual.

4. If needed, add the recommended fluid until it is level with the lower edge of the fill opening. See the Transmission Fluid Service Information brochure at http://dtna.info/DT12FluidsManual for approved transmission lubricants.
5. Clean the fill plug and install a new seal on it. Install the plug in the side of the gear case, then tighten it 45 lbf·ft (60 N·m).

7.04 Eaton Fuller Transmission Fluid Change and Magnetic Plug Cleaning

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.

NOTICE:

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

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

5. For an Eaton Fuller transmission equipped with a transmission fluid filter(s), replace the fluid filter(s) as follows:

   5.a Place a drain pan under the transmission fluid filter.

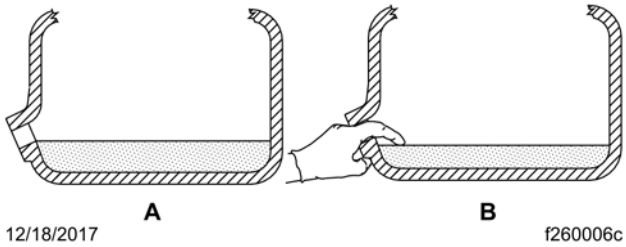
CAUTION:
To prevent skin burns from hot transmission fluid, wear protective gloves when removing the filter.

   5.b 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.

   5.c Apply a light coat of transmission fluid to the O-ring gasket on the new filter. Fill the filter with specified transmission fluid, and spin the filter onto the mount.

   5.d 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.

6. Add fluid until it is level with the lower edge of the fill opening. See Fig.22,Checking Transmission Fluid Level. If the transmission has two fill openings, add fluid to the level of both openings. See Table 11,Approved Manual Transmission Lubricants for approved transmission lubricants, and Table 12,Eaton Fuller Transmission Lubricant Capacities for transmission lubricant capacities.



A. Full B. Low

Fig 22, Checking Transmission Fluid Level

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

Table 11, Approved Manual Transmission Lubricants

Transmission Model	Lubricant Type [1]	Temp. Range	SAE Viscosity
All Eaton Fuller	MobilTrans SHC 50 (RN 2952 E-5)	All	50W
	Synthetic transmission lubricant approved by Eaton	All	50W

1. Do not mix types or brands of fluid. Multi-weight and extreme-pressure gear fluids are not recommended.

Table 11, Approved Manual Transmission Lubricants

Table 12, 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 Advantage	
FA Series	8.0 (7.5)
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)	
UltraShift PLUS	

LAS	13.0 (12.0)
MHP and MXP	14.0 (13.0)

Table 12, Eaton Fuller Transmission Lubricant Capacities

7. Install the fill plug and operate the engine for five minutes after filling the transmission, then check the fluid level again.
8. Clean the fill plug, then install it in the transmission. Tighten the plug as follows:
   - For an Eaton Fuller transmission with a plug with 3/4-inch pipe threads, tighten the plug 25 to 35 lbf·ft (34 to 48 N·m).
   - For an Eaton Fuller transmission with a plug with 1-1/4-inch pipe threads, tighten the plug 60 to 75 lbf·ft (81 to 102 N·m).

7.04.01 Inspection of the Eaton Fuller Transmission Fluid Level

See 'In this section' below for a link to Inspection of the Eaton Fuller Transmission Fluid Level topics.

Checking the Fill Plug

NOTICE:

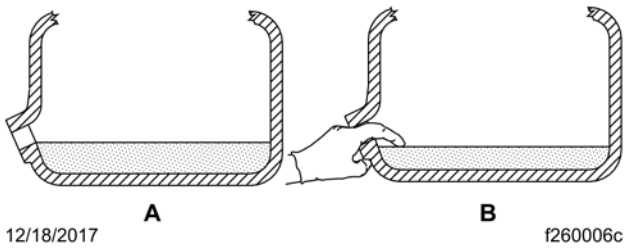
Operating a transmission with the fluid level higher or lower than recommended can result in transmission damage. Do not overfill the transmission. Overfilling will force fluid out of the case through the main shaft openings.

Do not mix types or 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.

Some transmissions are equipped with a sight glass for checking the fluid level. For transmissions not so equipped, check the fluid level at the fill plug.

1. Clean the area around the fill plug, and remove it from the side of the gear case.
2. Confirm the fluid is level with the fill opening. See Fig.23,Checking Transmission Fluid Level.



A. Full B. Low

Fig 23, Checking Transmission Fluid Level

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 13,Approved Manual Transmission Lubricants for approved transmission lubricants.

   Approved Manual Transmission Lubricants

Table 13, Approved Manual Transmission Lubricants

Transmission Model	Lubricant Type[1]	Temp. Range	SAE Viscosity
All Eaton Fuller	MobilTrans SHC 50 (RN 2952 E-5)	All	50W
	Synthetic transmission lubricant approved by Eaton	All	50W

1. Do not mix types or brands of fluid. Multi-weight and extreme-pressure gear fluids are not recommended.

Table 13, Approved Manual Transmission Lubricants

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

Checking With the Sight Glass

NOTICE:

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.

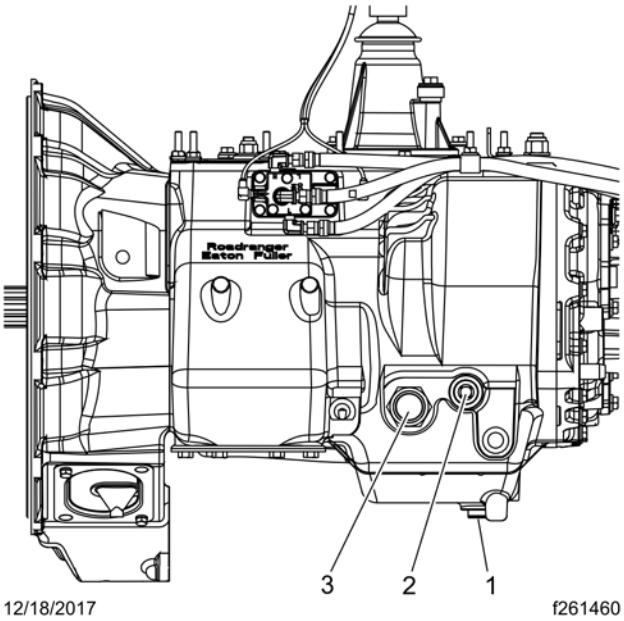
Do not mix types or brands of fluid, because of possible incompatibility. Do not use fluid additives, friction modifiers, extreme-pressure gear fluids, or multiviscosity lubricants.

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

Some transmissions are equipped with a sight glass for checking the fluid level. For transmissions not so equipped, check the fluid level at the fill plug.

If the transmission is equipped with a sight glass, check the fluid level as follows:

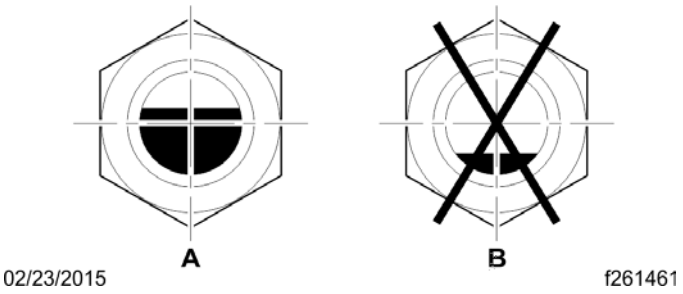
1. Clean the oil level sight glass. See Fig. 24,Eaton Fuller Transmission With a Sight Glass.



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

Fig 24, Eaton Fuller Transmission With a Sight Glass

2. Check the fluid level in the sight glass. When the fluid level is at or above 3/4 of the sight glass, then it is at or above the minimum fill level. See Fig.25,Transmission Fluid Level Sight Glass.



A. Full
B. Low

Fig 25, Transmission Fluid Level Sight Glass

3. If the fluid level is low, check the transmission for leaks, and correct as needed.
4. If needed, add the recommended fluid, until it is at or above 3/4 of the sight glass. See Table 14,Approved Manual Transmission Lubricants for approved transmission lubricants.

Table 14, Approved Manual Transmission Lubricants

Transmission Model	Lubricant Type[1]	Temp. Range	SAE Viscosity
All Eaton Fuller	MobilTrans SHC 50 (RN 2952 E-5)	All	50W
	Synthetic transmission lubricant approved by Eaton	All	50W

1. Do not mix types or brands of fluid. Multi-weight and extreme-pressure gear fluids are not recommended.

Table 14, Approved Manual Transmission Lubricants

7.05 Check, Cleaning, or Replacement of the Eaton Fuller Manual Transmission Air Filter/ Regulator

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.26,Air Filter/Regulator Location.

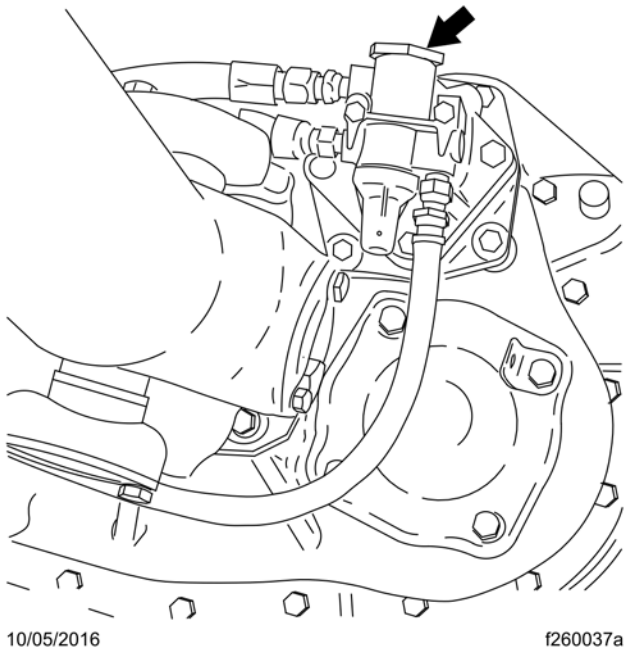
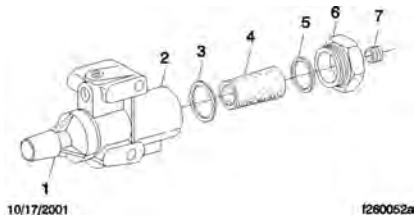


Fig 26, Air Filter/Regulator Location

3. Remove the end cap, large O-ring, and filter element from the filter housing. See Fig. 27,Eaton Fuller Transmission Air Filter/Regulator Components. Remove the small O-ring from the end cap.



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

Fig 27, Eaton Fuller Transmission Air Filter/Regulator Components

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.

   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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8. Group 31 Frame and Frame Components

8.01 Safety Precautions

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

DANGER:

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

8.02 Inspection of the Fifth Wheel

See ‘In this section’ below for a link to inspection of the fifth wheel topics.

8.02.01 Holland FW35

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.

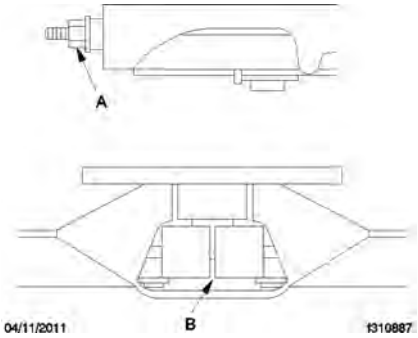
Parts are under spring compression. Wear safety goggles while servicing the fifth wheel. Failure to do so can result in personal injury, due to parts ejecting with force.

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.

1. Disconnect the tractor from the trailer. For instructions, see the vehicle 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. 28,Holland Fifth Wheel Properly Closed.



A. The nut and washer should be snug against the fifth wheel.

B. The locks should be completely closed around the kingpin.

Fig 28, Holland Fifth Wheel Properly Closed

7. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. See 8.03.01 Holland FW35 in this manual for lubrication instructions.

8.02.02 Fontaine

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.

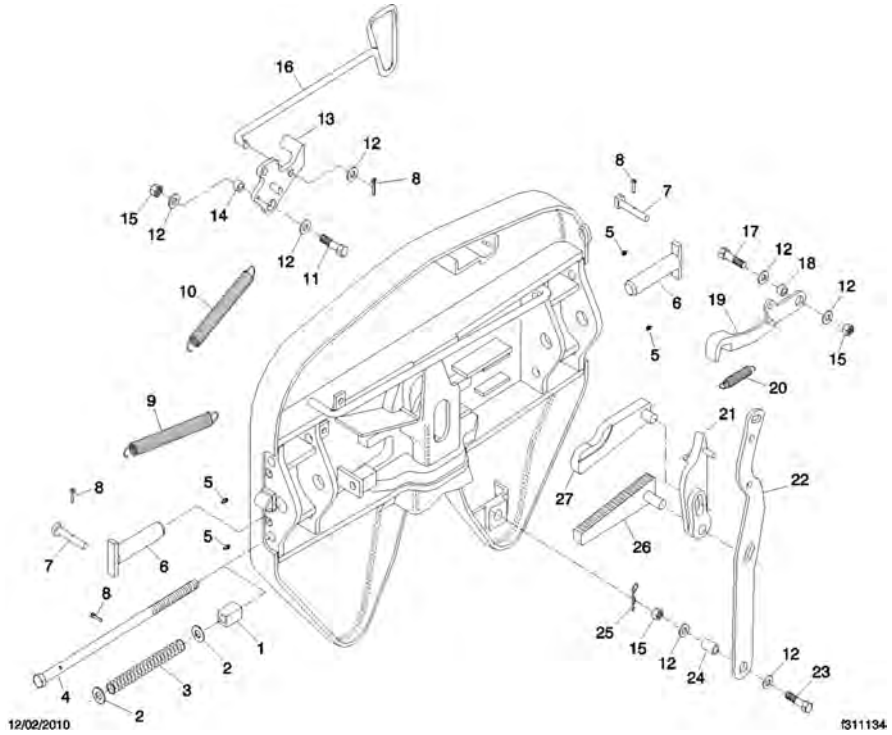
Parts are under spring compression. Wear safety goggles while servicing the fifth wheel. Failure to do so can result in personal injury, due to parts ejecting with force.

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.

1. Disconnect the tractor from the trailer. For instructions, see the vehicle Driver's/Operator'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. 29,Fontaine Fifth Wheel.



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 29, Fontaine Fifth Wheel

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.



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

9. Check all springs to see if they are securely fastened, and are not deformed.
10. Check the wedge adjustment.
    - 10.a Close the fifth wheel on a standard 2-inch (50-mm) kingpin or similar 2-inch (50-mm) diameter shaft so that it locks.
    - 10.b Push on the wedge stop rod with hand pressure. It should move in 1/4 inch (6 mm) and spring back out on release.

      If the free travel is not 1/4 inch (6 mm), adjust the distance to 1/4 inch (6 mm) by turning the wedge stop rod, on the right side of the top plate, clockwise to reduce the gap and counterclockwise to increase it.
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 8.03.02 Fontaine in this manual for lubrication instructions.

8.02.03 Jost



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.



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.

1. Disconnect the tractor from the trailer. For instructions, see the vehicle 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. 30,Bracket Pin Bolt Locking Tabs.

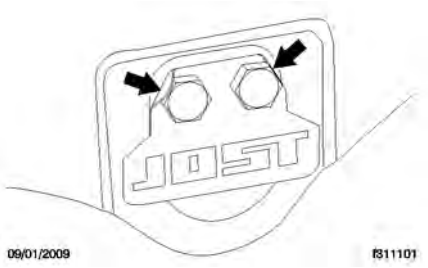


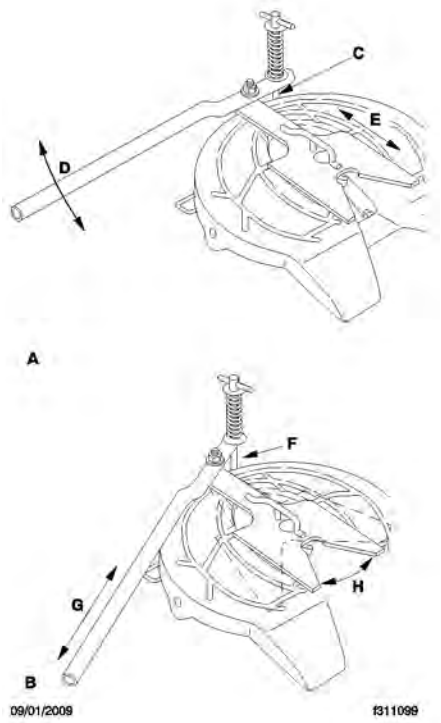
Fig 30, Bracket Pin Bolt Locking Tabs

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 front-rear play when pulling and pushing on the lock tester handle. See Fig. 31,Jost Fifth Wheel Adjustment, Ref. A.

   The lock is too tight if: the lock tester does not rotate freely in the lock. See Fig.31,Jost Fifth Wheel Adjustment, Ref. B.



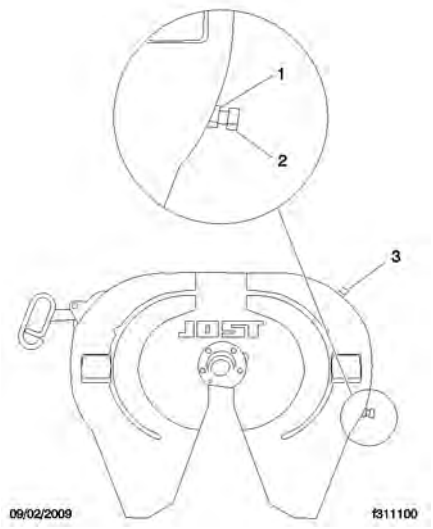
A. Checking for front/rear play.
B. Rotating tester in lock.
C. Engage hook.
D. Pull/push handle front/rear.
E. Check for movement of kingpin in lock.
F. Disengage hook.
G. Push/pull handle inboard/outboard.
H. Rotate lock tester.

Fig 31, Jost Fifth Wheel Adjustment

8. If the lock is improperly adjusted, correct as follows.

   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.32,Jost Fifth Wheel.

   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.32,Jost Fifth Wheel.



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

Fig 32, Jost Fifth Wheel

9. If the fifth wheel is equipped with a sliding mechanism, inspect and adjust it as follows.
   - 9.a Check the bracket for any cracks or missing and damaged parts.
   - 9.b Inspect the locking plungers for full engagement.
   - 9.c 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.d The outboard slider assembly requires no adjustment. If the plungers are loose, inspect and replace locking mechanism parts as needed.
   - 9.e 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 8.03.03 Jost in this manual for lubrication instructions.

8.03 Lubrication of the Fifth Wheel

See ‘In this section’ below for a link to lubrication of the fifth wheel topics.

8.03.01 Holland FW35

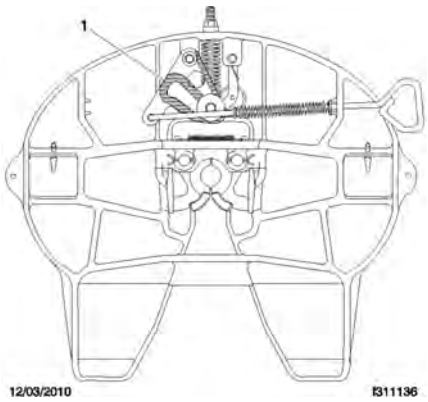
To maintain proper fifth wheel operation, always lubricate the fifth wheel after an inspection has been performed.

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.

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.

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. 33,Holland FW35 Fifth Wheel, Oil Lubrication.

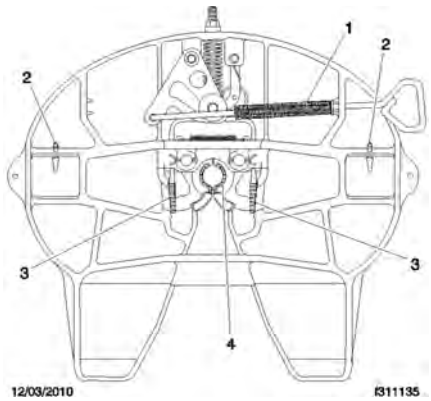


NOTE: Use a light oil (such as SAE 10W or 20W motor oil) to lubricate the cam track and pivot.

1. Cam Plate

Fig 33, Holland FW35 Fifth Wheel, Oil Lubrication

3. Grease the yoke tips, locks, and the release handle and spring; see Fig. 34,Holland FW35 Fifth Wheel, Grease Lubrication. 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.



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

Fig 34, Holland FW35 Fifth Wheel, Grease Lubrication

8.03.02 Fontaine

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

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.

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.

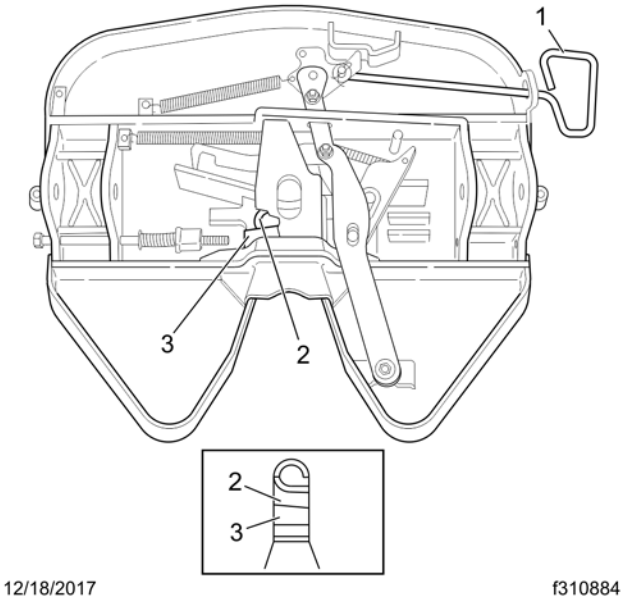
1. Tilt the top plate forward (the front of the fifth wheel is down) and apply grease to each bearing area through the zerk fittings located on each side of the top plate just to the front of the bracket pins. Continue to apply grease until it is coming out of the back of the bearing. It may be necessary 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.

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. 35,Fontaine Fifth Wheel. Open and close the fifth wheel several times to further distribute the grease.

   Lightly oil other moving parts in the fifth wheel.



1. Pull Handle
2. Jaw
3. Wedge

Fig 35, Fontaine 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.

8.03.03 Jost

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

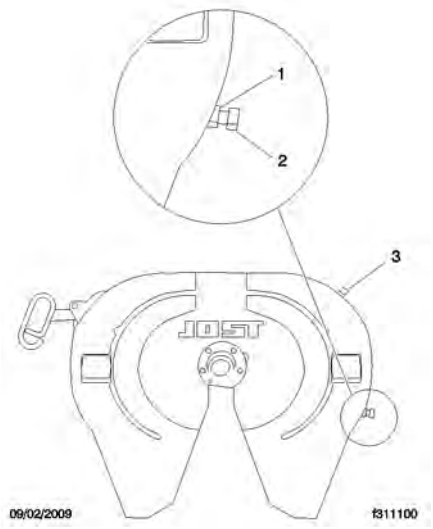
IMPORTANT: Lubricate the fifth wheel:

- 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.

Lubricate the kingpin lock using a hand pump grease gun through the grease zerk on the skirt of the fifth wheel; see Fig. 36,Jost Fifth Wheel. Apply a light oil to all moving parts. For sliding fifth wheels spray diesel fuel on the slide path of the base plate.



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

Fig 36, Jost Fifth Wheel

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.

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.

8.04 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 in the vehicle 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 brackets
- front suspension spring brackets
- fuel tank brackets
- radius rods
- rear suspension spring brackets
- shock absorbers
- all other suspension fasteners
- all other axle fasteners
- all other frame fasteners

Any component that shows signs of cracking or other damage must be repaired or replaced. Refer to the vehicle workshop manual for repair or replacement information.

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9.02.01 Front Suspension Check 74
9.02.02 Front and Rear Suspension Shock Absorber Check 74
9.02.03 Checking the Components 75
9.02.04 Checking the Suspension Height 75
9.03 Suspension U-Bolt Torque Check 79

9. Group 32 Suspension

9.01 Safety Precautions

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

DANGER:

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

9.02 Inspection of the Suspension

See ‘In this section’ below for a link to Inspection of the Suspension topics.

9.02.01 Front Suspension Check

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.

Inspect the front spring assemblies for cracked, broken, or abnormally bent leaves. If any of these conditions exist, replace the spring assembly; see **General Information, Front Suspension** of the *5th Generation Cascadia Workshop Manual.*

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

9.02.02 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. 37,Direct-Acting Shock Absorber (front suspension shown). 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.

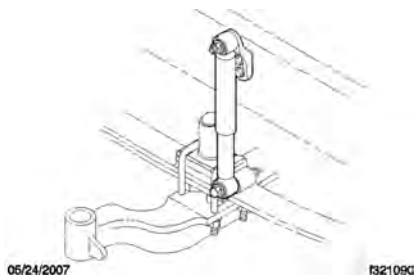


Fig 37, Direct-Acting Shock Absorber (front suspension shown)

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 **General Information, Front Suspension** of the *5th Generation Cascadia Workshop Manual*.

9.02.03 Checking the Components

Inspect the forward spring brackets for wear, cracks, and other damage. If any of these conditions exist, replace the damaged bracket(s); see **General Information, Front Suspension** of the *5th Generation Cascadia Workshop Manual*.

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 **General Information, Front Suspension** of the *5th Generation 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 **General Information, Front Suspension** of the *5th Generation Cascadia Workshop Manual*.

9.02.04 Checking the Suspension Height

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 (508 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.

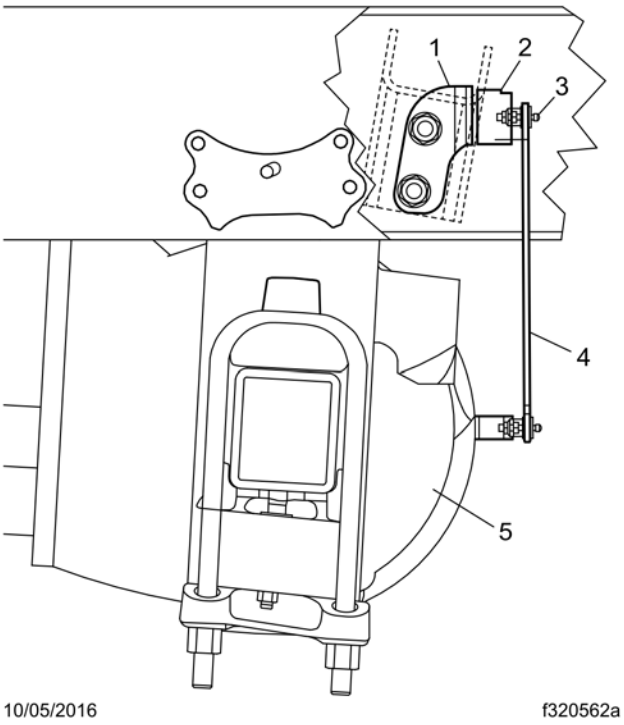


NOTICE:

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.

3. Measure the distance between the left forwardmost axle stop and the suspension as indicated; see Table 15,Suspension Ride-Height Measurement, Dual-Leaf Spring, 21k/40k High Ride, Table 16,Suspension Ride-Height Measurement, Single-Leaf Spring, 21k/40k, High Ride, Table 17,Suspension Ride-Height Measurement, Single-Leaf Spring, 40k Low and Mid Ride, Table 18,Suspension Ride-Height Measurement, Dual-Leaf Spring, 23k High Ride and Table 19,Suspension Ride-Height Measurement, Dual-Leaf Spring, 46k High Ride for an acceptable range of heights for each suspension.



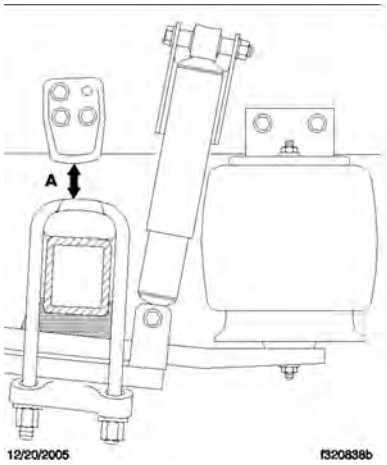
1. Valve Mounting Bracket
2. Height-Control Valve
3. Stud Bolt
4. Linkage Rod
5. Axle

Fig 38, Barksdale Height-Control Valve Installation (side view, typical)

IMPORTANT: **Suspensions with Dual-Leaf Springs:** Measure between the top of the U-bolt and the bottom of the axle stop. **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 *5th Generation Cascadia Workshop Manual* for adjustment instructions. If the distance is within the acceptable range, apply the parking brakes.

Table 15, Suspension Ride-Height Measurement, Dual-Leaf Spring, 21k/40k High Ride



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 15, Suspension Ride-Height Measurement, Dual-Leaf Spring, 21k/40k High Ride

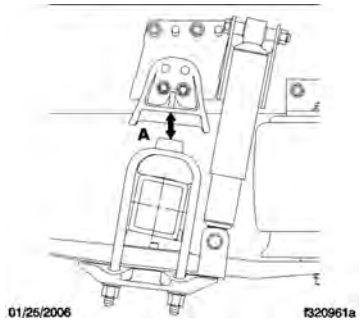
Table 16, Suspension Ride-Height Measurement, Single-Leaf Spring, 21k/40k, High Ride



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 16, Suspension Ride-Height Measurement, Single-Leaf Spring, 21k/40k, High Ride

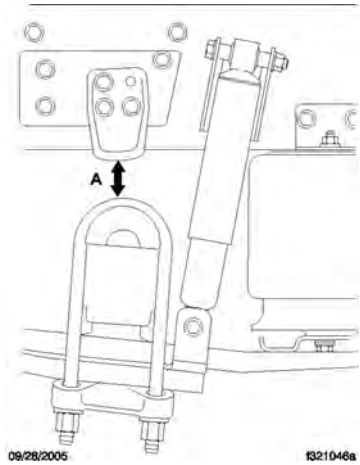
Table 17, Suspension Ride-Height Measurement, Single-Leaf Spring, 40k Low and Mid Ride



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 17, Suspension Ride-Height Measurement, Single-Leaf Spring, 40k Low and Mid Ride

Table 18, Suspension Ride-Height Measurement, Dual-Leaf Spring, 23k High 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 18, Suspension Ride-Height Measurement, Dual-Leaf Spring, 23k High Ride

Table 19, Suspension Ride-Height Measurement, Dual-Leaf Spring, 46k High 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 19, Suspension Ride-Height Measurement, Dual-Leaf Spring, 46k High Ride

9.03 Suspension U-Bolt Torque Check

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

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

1. Park the vehicle on a level surface and apply the parking brakes. Chock the tires.
2. Check the U-bolt torque. See Table 20,Spring U-Bolt High Nut Torque Values for U-bolt torque specifications. Tighten in a diagonal pattern as shown in Fig. 39,Tightening Pattern for U-Bolt High Nuts. 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 **General Information, Front Suspension** of the *5th Generation Cascadia Workshop Manual* for bolt replacement procedures.

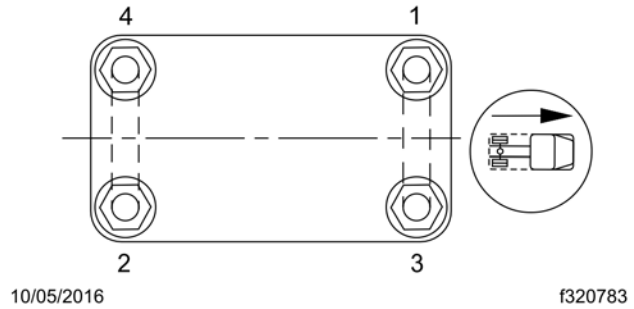


Fig 39, Tightening Pattern for U-Bolt High Nuts

Table 20, 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)
M20	216–274 (292–372)
M20 (Airtek)	330–370 (447–502)

Table 20, Spring U-Bolt High Nut Torque Values

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10. Group 33 Front Axle

10.01 Safety Precautions

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

DANGER:

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

10.02 Lubrication of the Knuckle Pin

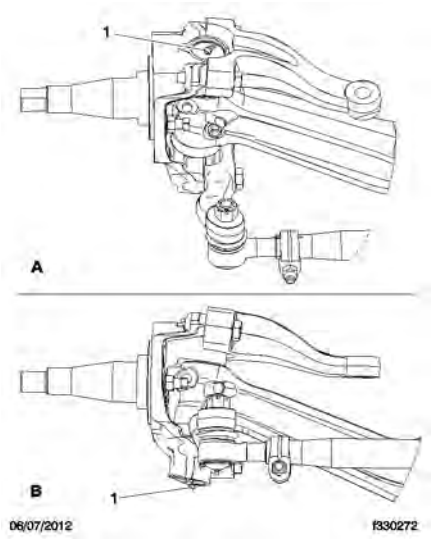
See ‘In this section’ below for a link to Lubrication of the Knuckle Pin topics.

10.02.01 Detroit™ Axles

NOTICE:

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

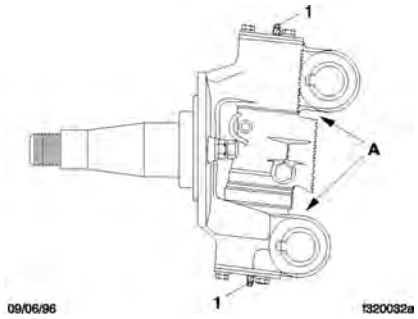
1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires. When lubricating upper and lower knuckle assemblies, do not raise the front axle.
2. Wipe the fittings clean.
3. Apply multipurpose chassis grease, NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI Grade 2 (8% 12-hydroxy lithium stearate grease), until new grease is seen at the junctions of the axle beam and knuckles. For locations of grease fittings, see Fig. 40,Grease Fittings, Detroit Axles; for grease exit points, see Fig. 41,Knuckle Pin Lubrication.



A. Upper View, LH Side.
B. Lower View, LH Side.

1. Grease Fitting

Fig 40, Grease Fittings, Detroit Axles



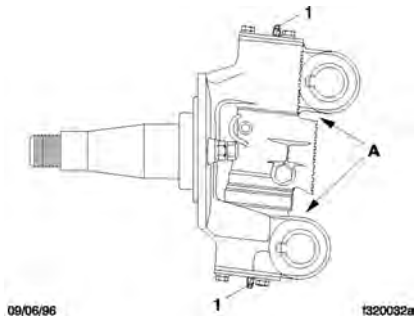
A. Grease Exit.

1. Grease Fitting

Fig 41, Knuckle Pin Lubrication

10.02.02 Meritor Axles

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.42,Knuckle Pin Lubrication.



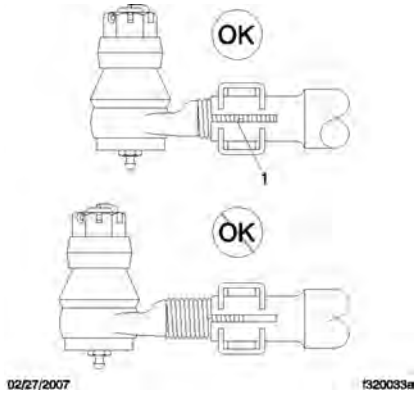
A. Grease Exit.
1. Grease Fitting

Fig 42, Knuckle Pin Lubrication

10.03 Inspection of the Tie Rod End

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. 43,Tie-Rod End Adjustment. Replace the components if this cannot be done. For instructions, see **General Information, Alignment of the Front Axle** of the *5th Generation Cascadia Workshop Manual*.



NOTE: Shown without pinch bolt to provide clarity.

1. Cross-Tube Split

Fig 43, Tie-Rod End Adjustment

10.04 Lubrication of the Tie Rod End

Detroit and Meritor Axles

For any Detroit or Meritor axle that requires lubrication of the tie-rod ends, wipe the grease fittings clean, then pump multi-purpose 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. See Fig. 44,Grease Fitting and Boot (Detroit axle shown).

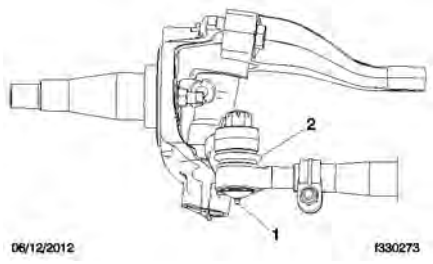


Fig 44, Grease Fitting and Boot (Detroit axle shown)

10.05 All-Axle Alignment Check

See 'In this section' below for a link to All-Axle Alignment Check topics.

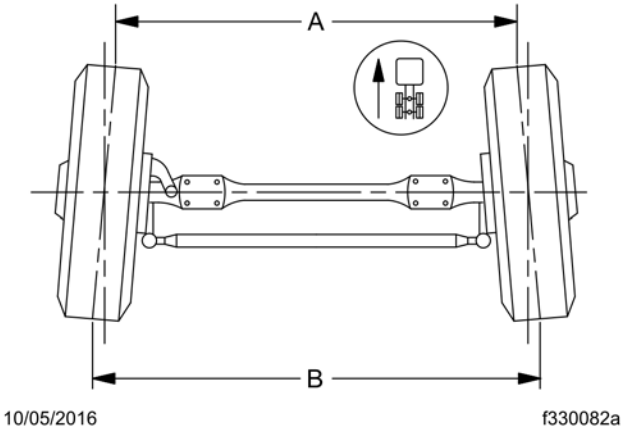
10.05.01 Checking the Drive Axle Alignment

Check the axle alignment, parallelism, and thrust angle measurements for the rear drive axles. Use the applicable procedure and specifications in **General Information, Alignment of the Rear Axle** of the *5th Generation 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.
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. 45,Wheel Toe-In (overhead view). Lock in place. Check that the scale is set on zero.



NOTE: B minus A equals toe-in.

Fig 45, Wheel Toe-In (overhead view)

7. Place the trammel bar at the front of the tires (see Fig. 46,Trammel Bar Positioning) and adjust the scale end so that the pointers line up with the scribe lines. See Fig. 47,Setting Trammel Bar Pointers.

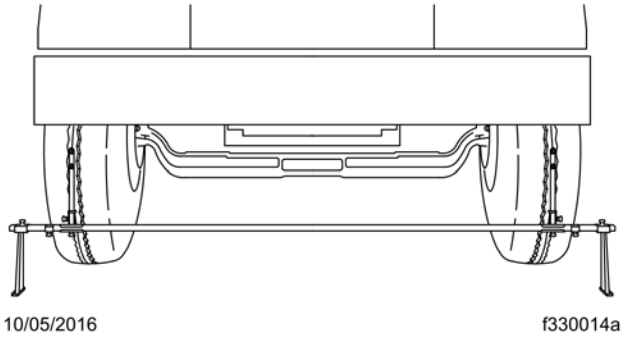


Fig 46, Trammel Bar Positioning

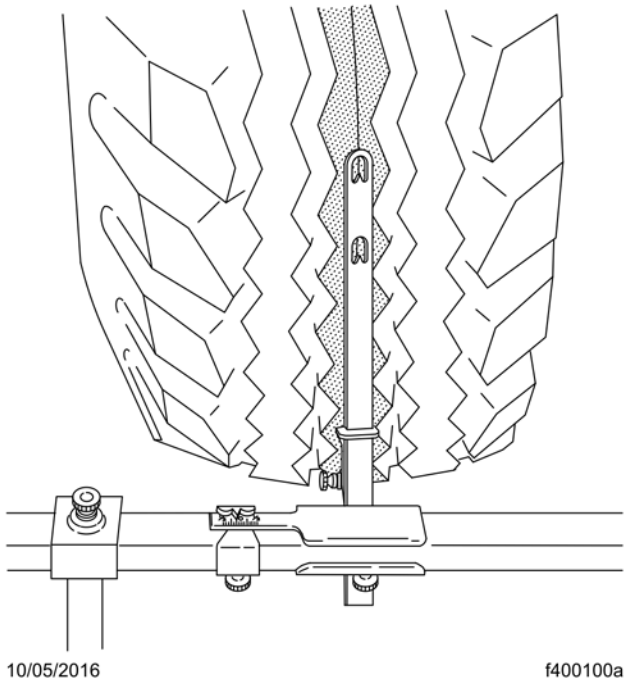


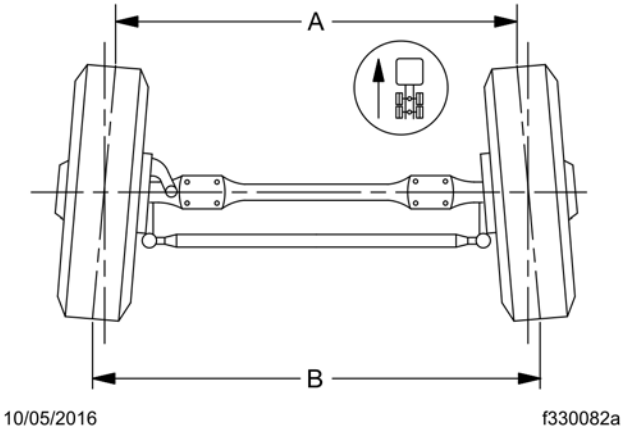
Fig 47, Setting Trammel Bar Pointers

8. Read the toe-in from the scale, and compare it to the toe-in specification in **General Information, Alignment of the Rear Axle** of the *5th Generation Cascadia Workshop Manual*. If corrections are needed, see **General Information, Alignment of the Rear Axle** of the *5th Generation Cascadia Workshop Manual* for instructions on adjusting the toe-in.

10.05.02 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.
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.48,Wheel Toe-In (overhead view) Lock in place. Check that the scale is set on zero.



NOTE: B minus A equals toe-in.

Fig 48, Wheel Toe-In (overhead view)

7. Place the trammel bar at the front of the tires, as shown in Fig.49,Trammel Bar Positioning and adjust the scale end so that the pointers line up with the scribe lines. See Fig.50,Setting Trammel Bar Pointers

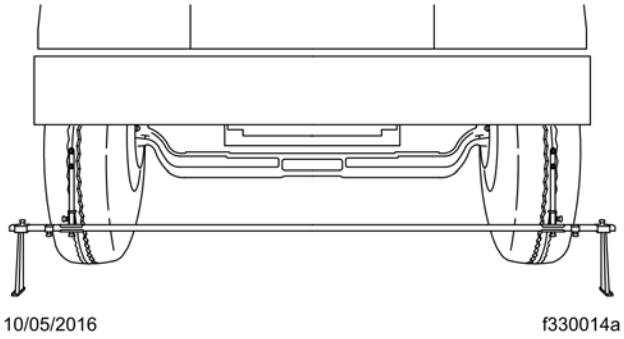


Fig 49, Trammel Bar Positioning

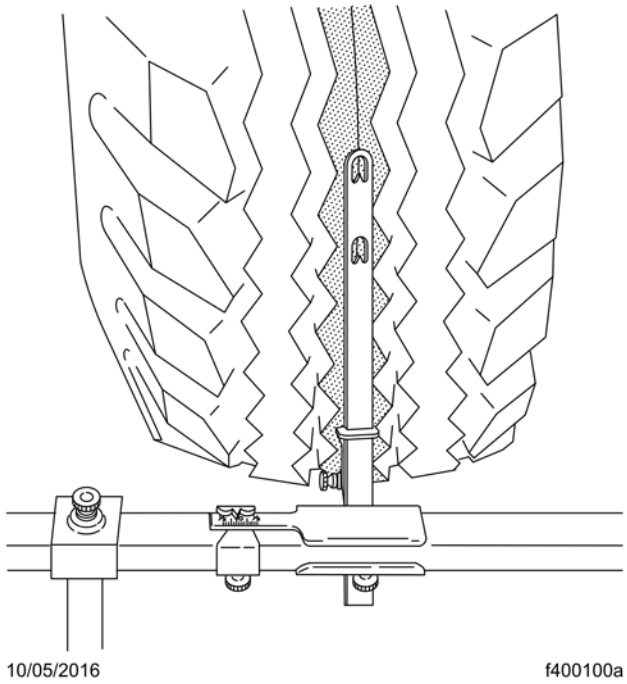


Fig 50, Setting Trammel Bar Pointers

8. Read the toe-in from the scale, and compare it to the toe-in specification in**General Information, Alignment of the Front Axle** of the *5th Generation Cascadia Workshop Manual.* If corrections are needed, see **General Information, Alignment of the Front Axle** of the *5th Generation Cascadia Workshop Manual.* for instructions on adjusting the toe-in.

10.06 Inspection of the Steer Axle Hub Cap Vent Plug

See ‘In this section’ below for a link to Inspection of the Steer Axle Hub Cap Vent Plug topics.

10.06.01 General Information

As a function of their design, hubcap vent plugs will on occasion exhibit signs of hub oil on their exterior surface. Depending on environmental conditions and/or age of the plug, the amount of oil present can vary. This is a normal result of the venting process due to pressure increase within the hub cavity. For an example of normal vent plug appearance, see Fig. 51,Normal Oil Venting.



Fig 51, Normal Oil Venting

A vent plug can wear or be damaged and cause excessive leakage, or allow water to enter the hub and contaminate the oil. For examples of a leaking vent plug, see Fig. 52,Excessive Leakage and Fig. 53,Water in Oil. Evidence of a leaking vent plug may appear as;

- Oil splatter around the wheel.
- Gooey/gummy oil around the vent plug purge point.
- Hub/plug area is dirty, and water contaminated oil in the hub.
- Hub/plug area is clean, but there is water contaminated oil in the hub. (pressure washing is the most likely cause)

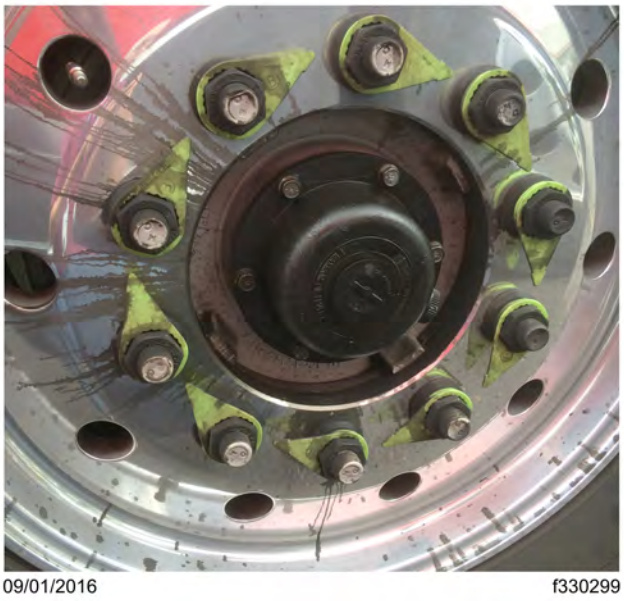


Fig 52, Excessive Leakage

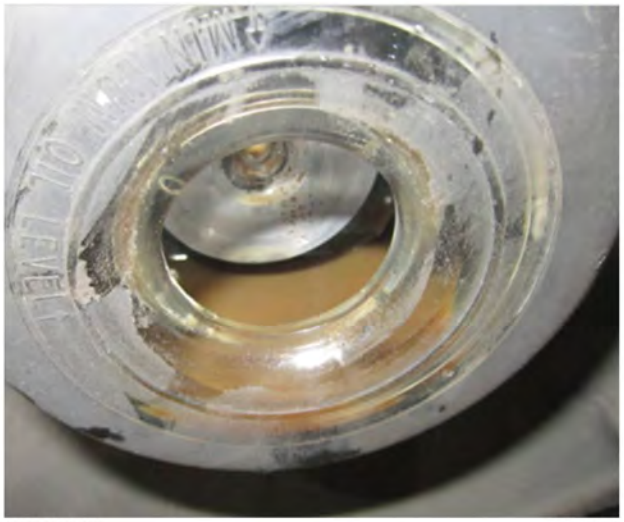


Fig 53, Water in Oil

10.06.02 Inspection of the Steer Axle Hub Cap Vent Plug

NOTICE:

Only remove vent plugs by hand. They can be damaged if a tool is used. Wipe the hub/plug area clean before checking the oil. Do not use a pressure washer to clean the hub/plug area. The plug has a vent and this can contaminate the oil with water.

1. Park the vehicle on a level surface, shut down the engine and set the parking brakes. Chock the tires.
2. Inspect the axle hub cap and vent plug for evidence of excessive leakage.
3. Wipe the hub cap and vent plug clean with a rag.
4. Remove the vent plug and check the oil for evidence of water contamination.

   If there is evidence of water contaminated oil in the hub, disassemble the effected axle end, clean, inspect, and reassemble the axle end. For instructions, see **Group 33**, **General Information, Alignment of the Front Axle** of the vehicle's Workshop Manual.

   If there is evidence of excessive leakage, remove the damaged part and replace it with a new part.
5. Check the oil level in the hub, and fill the hub with new approved oil as needed.

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11. Group 35 Rear axle

11.01 Safety Precautions

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

DANGER:

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

11.02 Axle Lubricant and Filter Change, and Cleaning the Magnetic Strainer

See ‘In this section’ below for a link to Axle Lubricant and Filter Change, and Cleaning the Magnetic Strainer topics.

11.02.01 General Guidelines

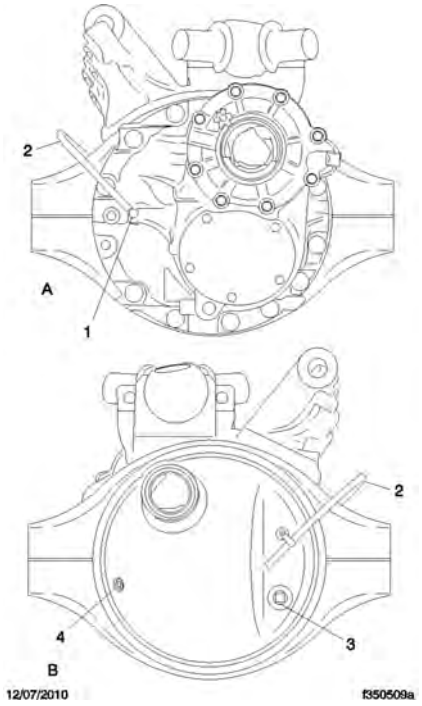
NOTICE:

When operating under adverse conditions, it may be necessary to change the axle lubricant at more frequent intervals than listed in the scheduled maintenance tables. Failure to do so could result in axle damage.

For all axles including tandem drive axles, perform the applicable procedures under the heading, ‘All Axle Models.’

11.02.02 Detroit™ Model 4 and Model 6

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. 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. See Fig. 54,Detroit Model 4 and Model 6 Tandem Axle (forward axle shown).



A. Front View
B. Rear View
1. Axle Breather
2. Breather Hose
3. Temperature Sensor Port
4. Oil Fill Plug

Fig 54, Detroit Model 4 and Model 6 Tandem Axle (forward axle shown)

CAUTION:
Be careful when draining the axle oil. It may be very hot, and could cause personal injury if it contacts the skin.

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.a 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.b 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.c After the first oil is changed, inspect the drain plug each time for large quantities of metal particles.
   - 4.d After cleaning, install the drain plug(s) and tighten 30 lbf·ft (41 N·m).

IMPORTANT: Lubricant used in Detroit rear axles must meet specification 235.8/Detroit Fluids Specification (DFS) 93K219.01.

NOTE: Detroit rear axles do not require the use of friction modifiers.

5. Fill the axle with the recommended lubricant. See Table 21,Detroit Drive Axle Lubricant, Model 4 and Model 6 for recommended drive axle lubricants and Table 22,Detroit Rear Axle Lubricant Capacity, Model 4 and Model 6 (Hubs Full) for lubricant capacities.

Table 21, Detroit Drive Axle Lubricant, Model 4 and Model 6

Lubricant	Type	Ambient Temperature
See DDC-SVC-BRO-0119	Synthetic	–40°F (–40°C) and up [1]

1. There is no upper limit on the ambient temperature.

Table 21, Detroit Drive Axle Lubricant, Model 4 and Model 6

Table 22, Detroit Rear Axle Lubricant Capacity, Model 4 and Model 6 (Hubs Full)

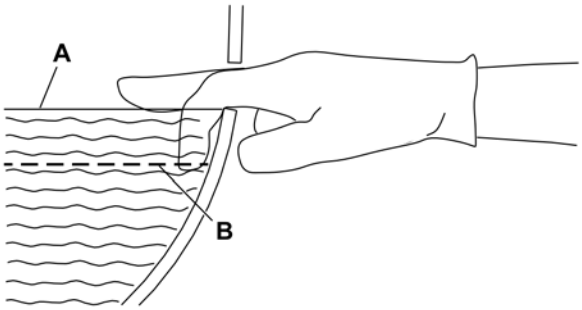
Axle	Oil Capacity: Quarts (liters)
Forward-Rear, Model 4	14.3 (13.5) [1]
Single and Rearmost Tandem, Model 4	10.6 (10.0)

1. These values assume the wheel ends are properly lubricated. Actual oil capacity might vary slightly depending on gear ratio.

Table 22, Detroit Rear Axle Lubricant Capacity, Model 4 and Model 6 (Hubs Full)

NOTE: Some Detroit 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.a 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. 55,Axle Lubricant Level Inspection.



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

Fig 55, Axle Lubricant Level Inspection

5.b Install and tighten the fill plug 30 lbf·ft (41 N·m).

11.02.03 Detroit™ New Final Drive

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Clean the fill plug and the area around it. In the carrier housing, remove the plug from the oil fill hole. See Fig. 56,Detroit™ New Final Drive Forward Axle, Oil Fill Location for the forward axle, and Fig. 57,Detroit™ New Final Drive Rear Axle, Oil Fill Location for the rear axle .

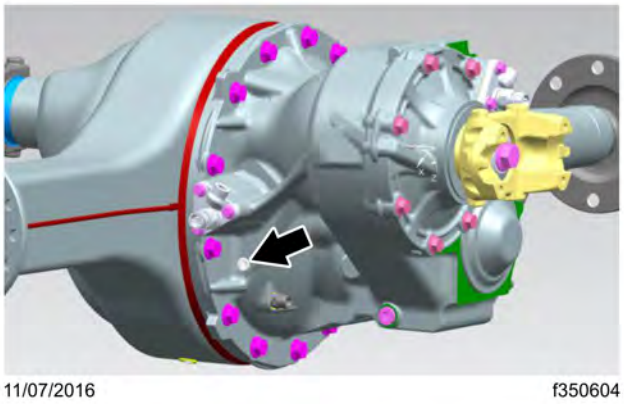


Fig 56, Detroit™ New Final Drive Forward Axle, Oil Fill Location

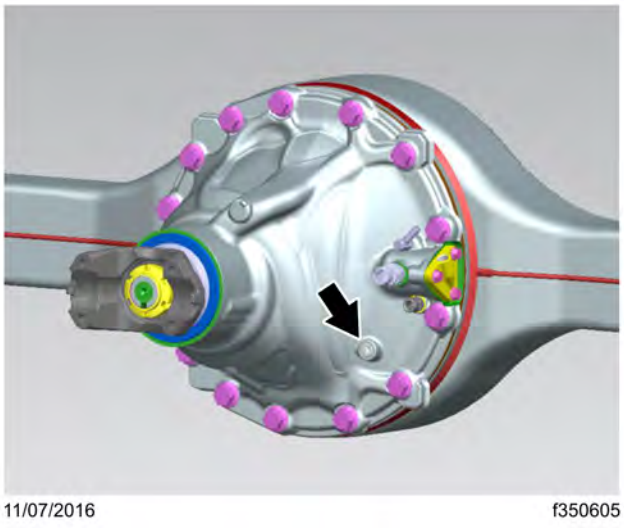
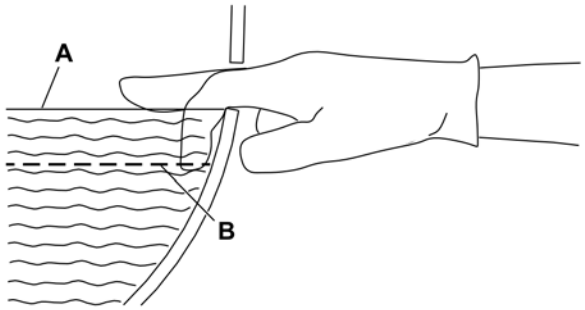


Fig 57, Detroit™ New Final Drive Rear Axle, Oil Fill Location

CAUTION:
Be careful when draining the axle oil. It may be very hot, and could cause personal injury if it contacts the skin.

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.a 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.b 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.c After the first oil is changed, inspect the drain plug each time for large quantities of metal particles.
5. Fill the axle with the recommended lubricant. See Table 23,Detroit Drive Axle Lubricant, New Final Drive for recommended drive axle lubricants and Table .24,New Final Drive Oil Capacity, New Final Drive for lubricant capacities.
   - 5.a 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. 58,Axle Lubricant Level Inspection.



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

Fig 58, Axle Lubricant Level Inspection

NOTE: Detroit rear axles do not require the use of friction modifiers.

5.b Install and tighten the fill plug 30 lbf·ft (41 N·m).

Table 23, Detroit Drive Axle Lubricant, New Final Drive

Lubricant	Type	Ambient Temperature
Must meet Detroit Fluids Specification DDC-SVC-BRO-0119	Synthetic	–40°F (–40°C) and up [1]

1. There is no upper limit on the ambient temperature.

Table 23, Detroit Drive Axle Lubricant, New Final Drive

Table 24, New Final Drive Oil Capacity, New Final Drive

Axle Type	Oil in Hubs (2)	Oil in Axle
NFD Model 4 Forward Axle TP	1.8 L	9 L
NFD Model 4 Rear Rear Axle TP	1.8 L	7.5 L
NFD Model 4 Forward Axle SP	1.8 L	14 L
NFD Model 4 Rear Rear Axle SP	1.8 L	11 L
NFD Model 6 TP	1.8 L	9.5 L
NFD Model 6 SP	1.8 L	11 L

Table 24, New Final Drive Oil Capacity, New Final Drive

11.02.04 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, the driver will hear intervals of shrill noises when the vehicle is driven at low speed or 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 25,Meritor Drive Axle Recommended Lubricant.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the 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, use a suitable filter strap wrench to remove the axle oil filter. See Fig. 59,Meritor Axle Oil Filter Removal. Discard the old filter.

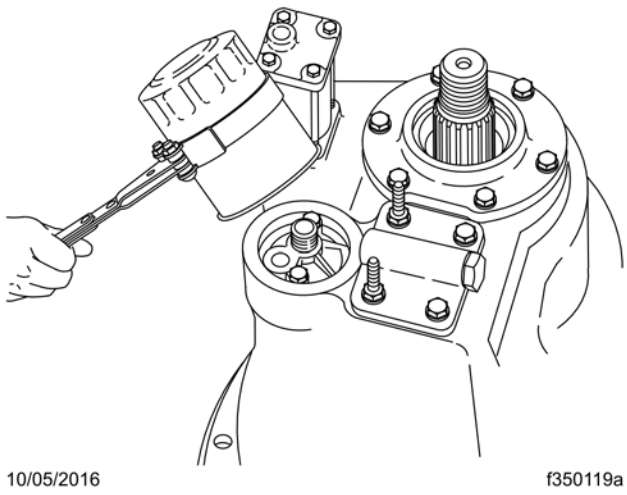


Fig 59, Meritor Axle Oil Filter Removal

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 it was replaced. Install the filter over the adapter, and tighten the filter one full turn after the gasket contacts the base; do not overtighten. See Table 25,Meritor Drive Axle Recommended Lubricant for recommended lubricants.

Table 25, 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 [1]	75W–90	0–76–N
	–40°F (–40°C) and Up	75W–140	0–76–M

1. There is no upper limit on these outside temperatures.

Table 25, Meritor Drive Axle Recommended Lubricant

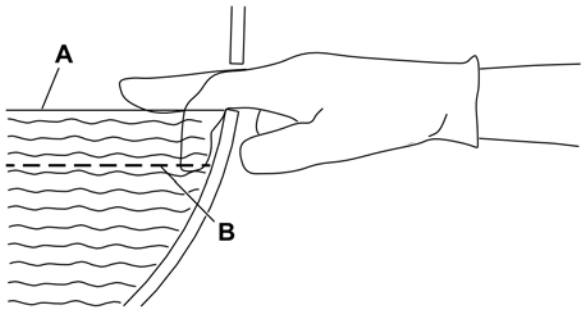
5. Clean the fill and drain plugs. Change them if necessary.
   - 5.a For magnetic plugs, use a piece of key stock or any other convenient steel slug to short the two magnetic poles and divert the magnetic field.
   - 5.b Check the drain plug for metal particles every 100,000 miles (160 000 km). Clean away the collected material deposited on each pole. Magnets will rapidly lose their effectiveness as collected material bridges the gap between the two poles.

     NOTE: Meritor recommends plugs with elements having a minimum pickup capacity of 1.5 pounds (0.7 kg) of low-carbon steel.

   - 5.c Each time the oil is changed, replace any magnetic drain plug that does not meet the minimum pickup capacity.
   - 5.d After cleaning, install the drain plug(s) and tighten to 35 lbf·ft (47 N·m).

   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. Fill the axle with recommended lubricant. See Table 26,Meritor Drive Axle Lubricant Capacities for drive axle lubricant capacities.
   - 6.a 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. 60,Axle Lubricant Level Inspection.



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

Fig 60, Axle Lubricant Level Inspection

Table 26, Meritor Drive Axle Lubricant Capacities

Axle Model	Capacity: [1] pt (L)	
Single Drive, Single Reduction[2]		
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)

1. Quantities listed are approximate. Fill axle until lubricant is level with bottom of fill hole with vehicle on level ground.
2. See "Traction Equalizer Additives" in the text.

Table 26, Meritor Drive Axle Lubricant Capacities

6.b 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.

11.03 Inspection of the Axle Breather and Axle Lubricant Level

See ‘In this section’ below for a link to Inspection of the Axle Breather and Axle Lubricant Level topics.

11.03.01 General Guidelines

For all axles including tandem drive axles, perform the applicable procedures under the heading, "All Axle Models."

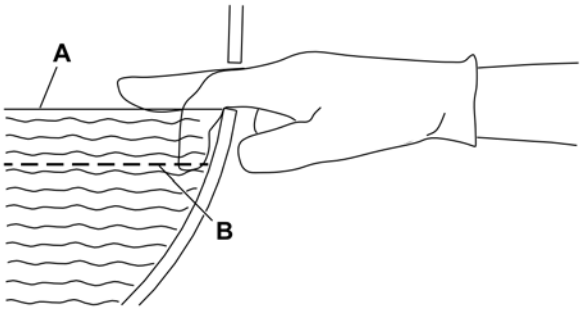
11.03.02 Detroit™ Model 4 and Model 6

NOTICE:
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 a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. If the vehicle has just been driven, allow a few minutes for the lubricant to settle.
3. 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 Detroit 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.

4. Check that the lubricant is level with the bottom of the fill hole. See Fig. 61,Axle Lubricant Level Inspection. 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 27,New Final Drive Oil Capacity, New Final Drive.



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

Fig 61, Axle Lubricant Level Inspection

Table 27, New Final Drive Oil Capacity, New Final Drive

Axle Type	Oil in Hubs (2)	Oil in Axle
NFD Model 4 Forward Axle TP	1.8 L	9 L
NFD Model 4 Rear Rear Axle TP	1.8 L	7.5 L
NFD Model 4 Forward Axle SP	1.8 L	14 L
NFD Model 4 Rear Rear Axle SP	1.8 L	11 L
NFD Model 6 TP	1.8 L	9.5 L
NFD Model 6 SP	1.8 L	11 L

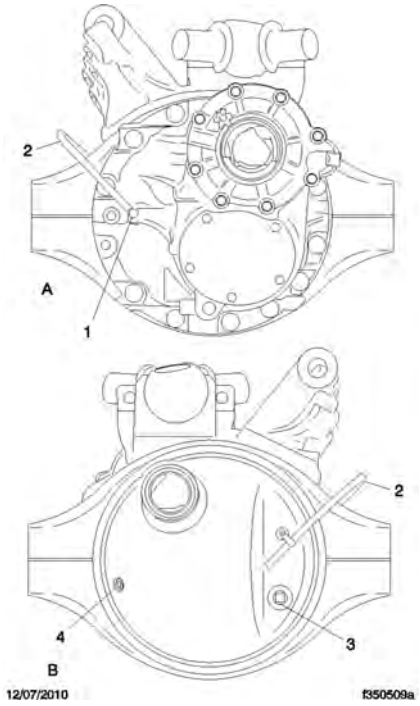
Table 27, New Final Drive Oil Capacity, New Final Drive

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.

5. Install and tighten the fill plug 30 lbf·ft (41 N·m).

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

6. Check the axle housing breather (see Fig. 62,Detroit Model 4 and Model 6 Tandem Axle (forward axle shown)). Make sure that it is open and unclogged. If the breather is plugged or damaged, clean or replace it as needed.

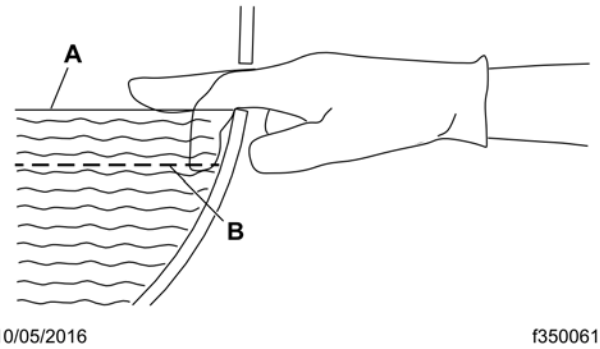


A. Front View.
B. Rear View.
1. Axle Breather
2. Breather Hose
3. Temperature Sensor Port
4. Oil Fill Plug

Fig 62, Detroit Model 4 and Model 6 Tandem Axle (forward axle shown)

11.03.03 Detroit™ New Final Drive 6

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. If the vehicle has just been driven, allow a few minutes for the lubricant to settle.
3. 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.
4. Check that the lubricant is level with the bottom of the fill hole. See Fig. 63,Axle Lubricant Level Inspection. 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 64,Detroit Model 4 and Model 6 Tandem Axle (forward axle shown).



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

Fig 63, Axle Lubricant Level Inspection

Table 28, New Final Drive Oil Capacity, New Final Drive

Axle Type	Oil in Hubs (2)	Oil in Axle
NFD Model 4 Forward Axle TP	1.8 L	9 L
NFD Model 4 Rear Rear Axle TP	1.8 L	7.5 L
NFD Model 4 Forward Axle SP	1.8 L	14 L
NFD Model 4 Rear Rear Axle SP	1.8 L	11 L
NFD Model 6 TP	1.8 L	9.5 L
NFD Model 6 SP	1.8 L	11 L

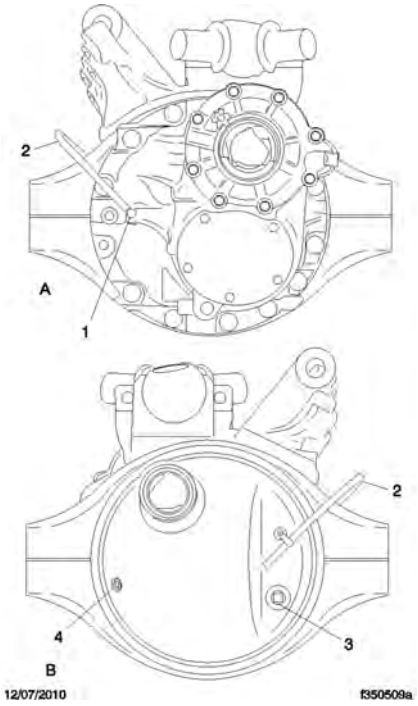
Table 28, New Final Drive Oil Capacity, New Final Drive

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.

5. Install and tighten the fill plug 30 lbf·ft (41 N·m).

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

6. Check the axle housing breather (see Fig. 64,Detroit Model 4 and Model 6 Tandem Axle (forward axle shown)). Make sure that it is open and unclogged. If the breather is plugged or damaged, clean or replace it as needed.



A. Front View.
B. Rear View.
1. Axle Breather
2. Breather Hose
3. Temperature Sensor Port
4. Oil Fill Plug

Fig 64, Detroit Model 4 and Model 6 Tandem Axle (forward axle shown)

11.03.04 Meritor®

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

NOTICE:
When operating under adverse conditions, it may be necessary to change the axle lubricant at more frequent intervals than listed in the scheduled maintenance tables. Failure to do so could result in axle damage.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. 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 the lubricant level when the axle is cold, or near room temperature.

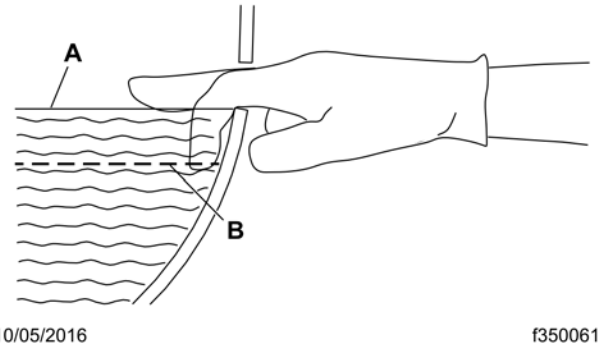
3. Check that the lubricant is level with the bottom of the fill hole. See Fig. 65,Axle Lubricant Level Inspection. If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in Table 29,Meritor Drive Axle Recommended Lubricant.

Table 29, 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 [1]	75W–90	0–76–N
	–40°F (–40°C) and Up	75W–140	0–76–M

1. There is no upper limit on these outside temperatures.

Table 29, Meritor Drive Axle Recommended Lubricant



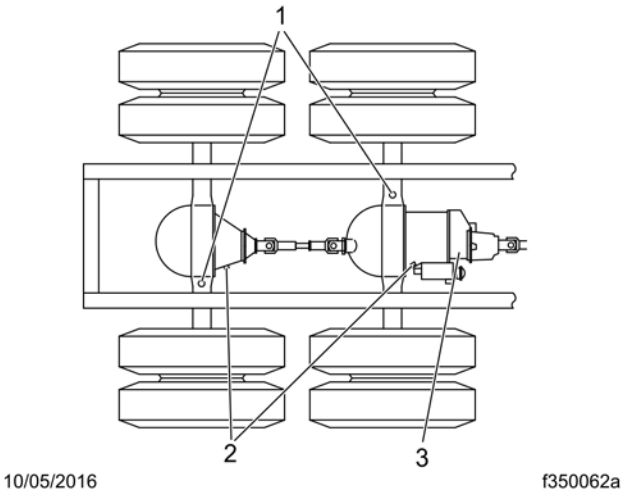
A. Correct (lube level at bottom of fill hole)
B. Incorrect (lube level below fill hole)

Fig 65, Axle Lubricant Level Inspection

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

IMPORTANT: Always check the axle breather whenever checking the 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. 66,Meritor Axle Housing Breathers. 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 66, Meritor Axle Housing Breathers

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.

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.

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12.02 Tire Check 112

12. Group 40 Wheels and Tires

12.01 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 30,Disc Wheel Fastener Torque for torque specifications, and see Fig. 67,Wheel Nut Tightening Sequence 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.

NOTICE:

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. 67,, page 112.

Table 30, Disc Wheel Fastener Torque

Nut Size	Torque: lbf·ft (N·m) Oiled
M22 x 1.5	450–500 (610–678)

Table 30, Disc Wheel Fastener Torque

NOTE: If using specialty fasteners, consult the manufacturer for recommended torque levels.

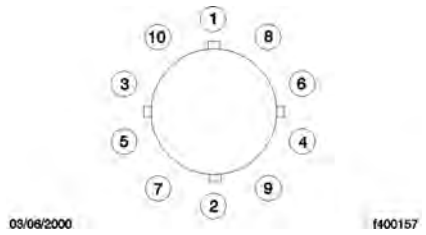


Fig 67, Wheel Nut Tightening Sequence

12.02 Tire Check

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

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

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

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

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

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13.02 Inspection of the Driveline 116
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13.03.01 Lubrication of the Universal Joint 121
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13. Group 41 Driveline

13.01 Safety Precautions

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

DANGER:

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

13.02 Inspection of the Driveline

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

CAUTION:

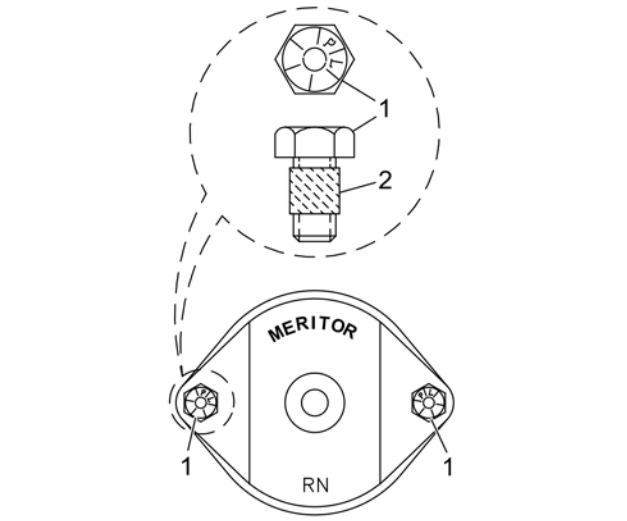
Due to the extreme load occurring at high-speed rotation, a loose or broken capscrew at any point in the driveline will weaken the driveline connection, which could eventually result in serious vehicle damage. Tighten bearing-cap capscrews or yoke-strap capscrews to specified torque, being careful to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

2. Tighten the U-joint capscrews. For torque specifications, see Table 31,U-Joint Torque Specifications.

Table 31, U-Joint Torque Specifications

Type	Torque	Figure
U-joints with bearing caps	43 lbf·ft (49 N·m)	Fig. 68,Meritor U-Joint Fasteners for Bearing Caps
Meritor RPL U-joints (except RPL35)	125 lbf·ft (169 N·m)	Fig. 69,Meritor RPL Series U-Joint, Except RPL35
Meritor RPL35 U-joints	150 lbf·ft (200 N·m)	Fig. 71,Meritor RPL35 Series U-Joint
U-joints with yoke straps	125 lbf·ft (169 N·m)	Fig. 70,Components of a Basic Driveline

Table 31, U-Joint Torque Specifications



1. Self-Locking Capscrew
2. Adhesive Band

Fig 68, Meritor U-Joint Fasteners for Bearing Caps

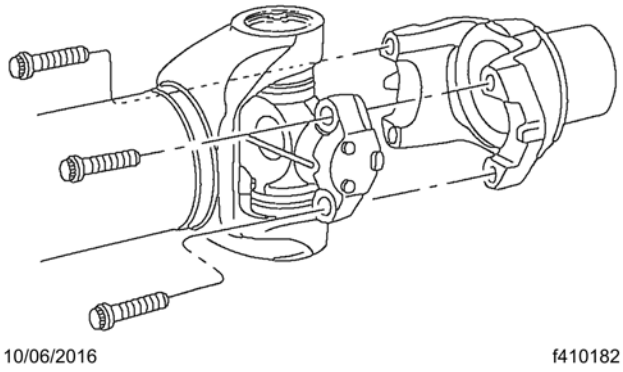
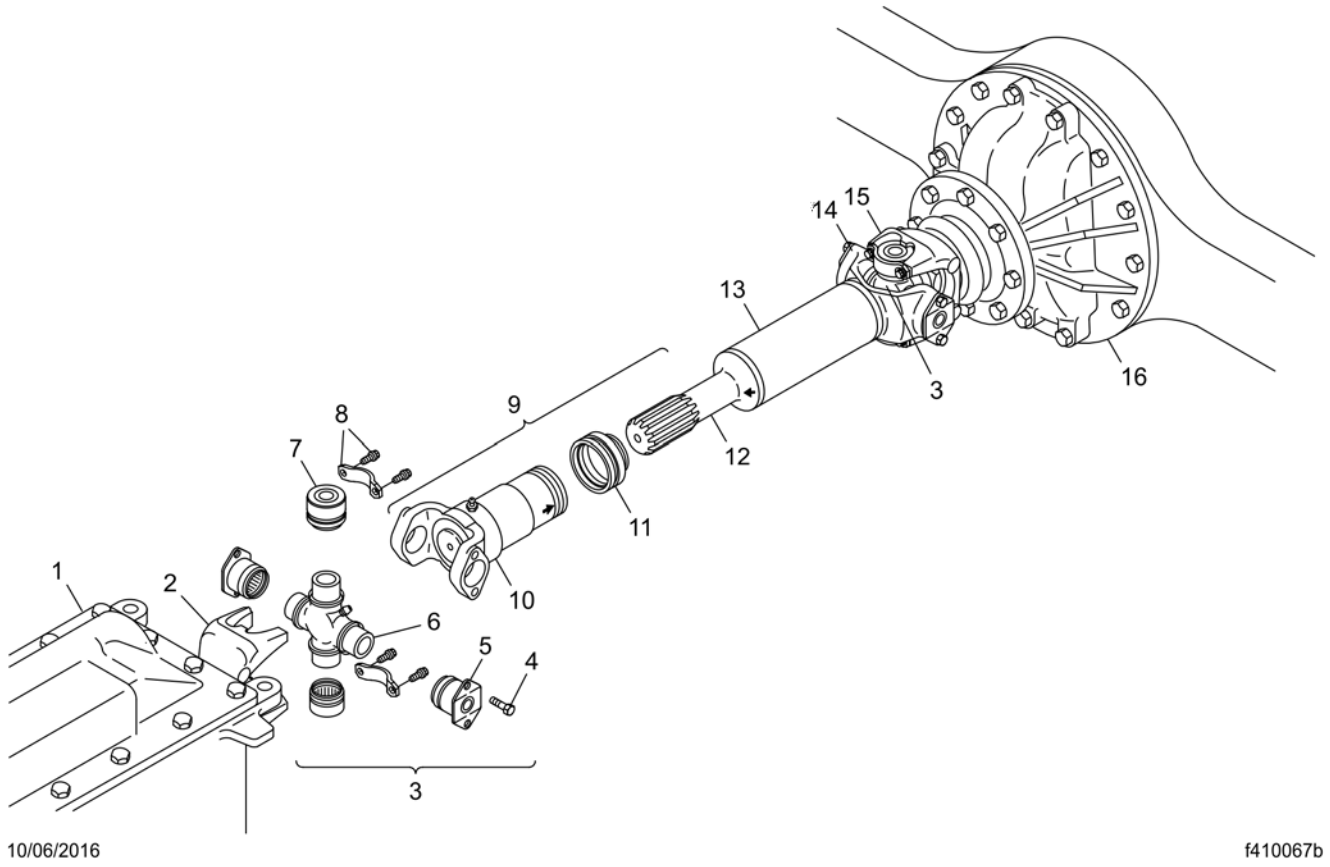


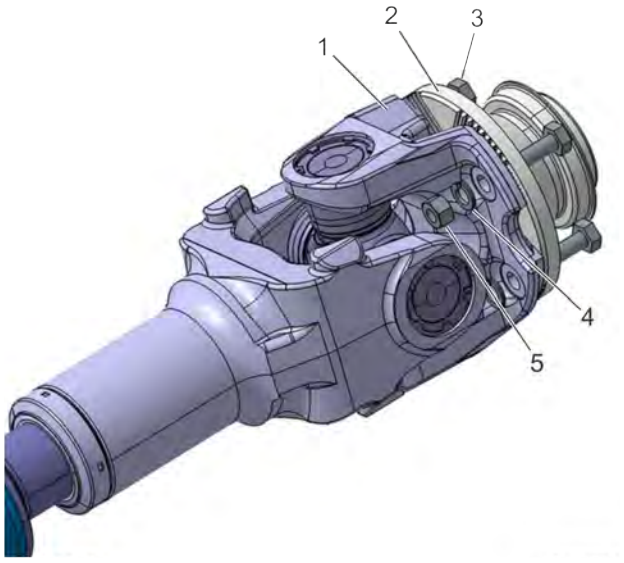
Fig 69, Meritor RPL Series U-Joint, Except RPL35



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 70, Components of a Basic Driveline



1. Yoke
2. Input Flange
3. Bolt
4. Washer
5. Nut

Fig 71, Meritor RPL35 Series U-Joint

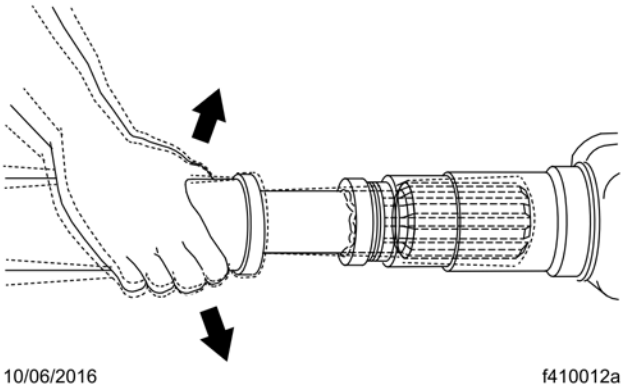
3. Check the driveline yokes or flanges for cracks, and check end-yokes for looseness. See Fig. 70,Components of a Basic Driveline.

   Replace cracked yokes and flanges.

   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 **Driveline Angularity** of the *5th Generation 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.

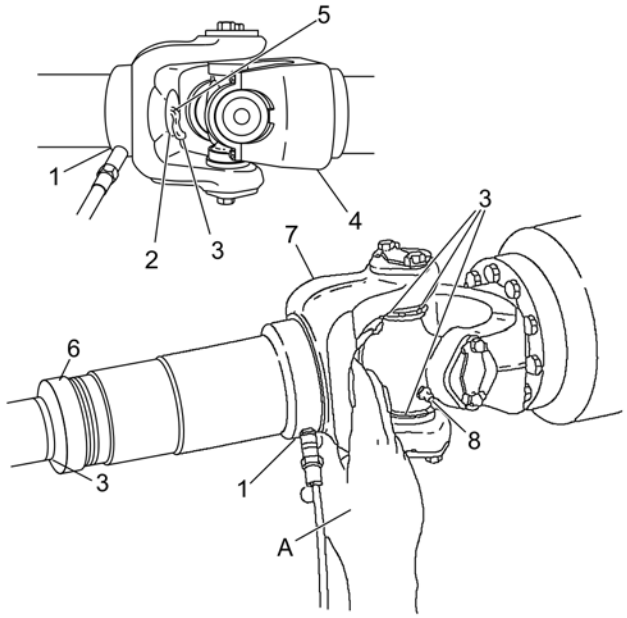
4. Check U-joint assemblies for wear by moving the driveshaft up and down, and from side to side. If any movement of the U-joint cross in the bearings can be felt or seen, replace the U-joint assembly.
5. Check if the midship bearing and mounting are loose or have deteriorated, by attempting to move 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 **Driveline Angularity** of the *5th Generation 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. 72,Slip Joint Spline Wear Checking. If the slip joint can be twisted in a clockwise, or counterclockwise movement greater than 0.007 inch (0.18 mm), replace both the sleeve-yoke and the splined shaft.



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

Fig 72, Slip Joint Spline Wear Checking

7. Visually examine the driveshaft tubes for dents, bends, twists, or other damage. If any tube appears to be damaged, refer to **Driveline Angularity** of the *5th Generation 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. 73,Slip Joint and U-Joint Lubrication. 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.



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

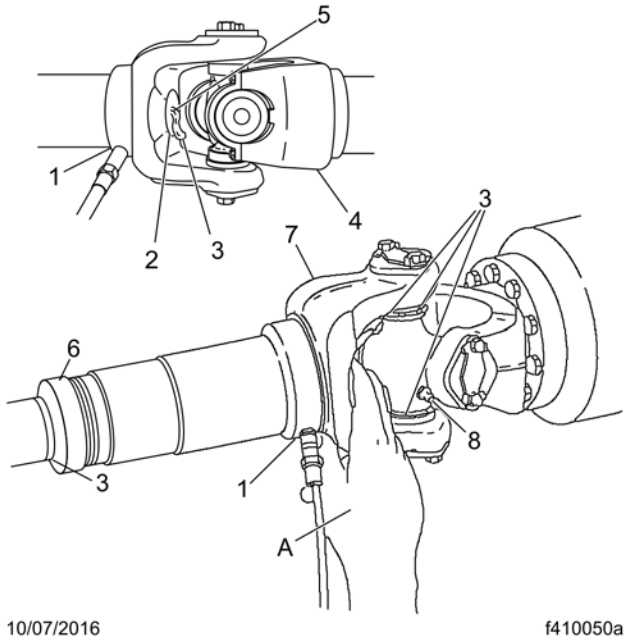
Fig 73, Slip Joint and U-Joint Lubrication

13.03 Lubrication of the Driveline

See ‘In this section’ below for a link to lubrication of the driveline topics.

13.03.01 Lubrication of the Universal Joint

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. 74,Slip Joint and U-Joint Lubrication.



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 74, Slip Joint and U-Joint Lubrication

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 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 full-round yokes equipped with a bearing cup, 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-cup capscrews 43 lbf·ft (58 N·m). If the capscrews were already tight, or all of the U-joint seals still do not purge, remove the bearing cup at that seal, and examine the seal for damage. If the seal is damaged, replace the complete U-joint.

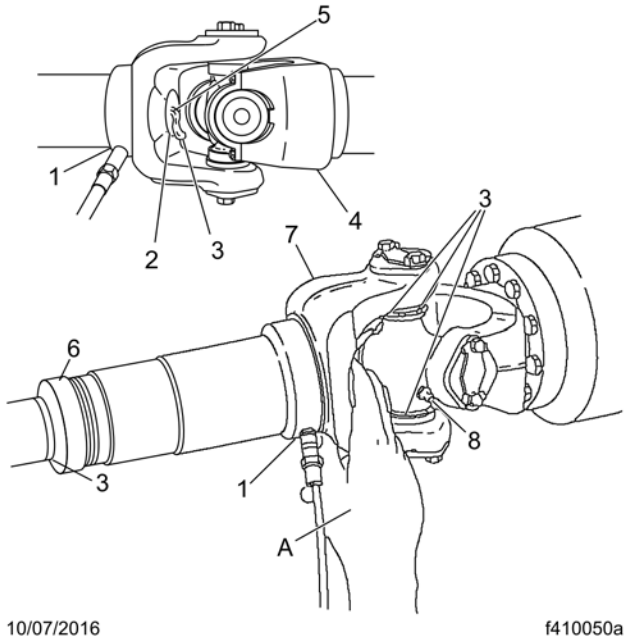
5. If grease does not appear at one seal, use a prying tool to pry the U-joint trunnion away from the non-purging seal, or tap the driveshaft or yoke with a plastic or rawhide mallet on the side opposite the dry seal, while continuing to lubricate. If grease still does not appear, loosen the capscrews 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**, **Driveline Components** of the vehicle 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.

13.03.02 Lubrication of the Slip Joint Spline

1. If equipped with a grease fitting, wipe all old grease and dirt from the slip joint grease fitting. See Fig. 75,Slip Joint and U-Joint Lubrication.



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 75, Slip Joint and U-Joint Lubrication

2. Use a hand-type grease gun or a high-pressure gun with a low-pressure adapter, to lubricate the slip joint. Add multi-purpose chassis grease (lithium 12-hydroxy stearate, NLGI 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. 75,Slip Joint and U-Joint Lubrication. 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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14. Group 42 Brakes

14.01 Safety Precautions

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

DANGER:

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

14.02 Inspection of the Air Brake System Valve

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

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

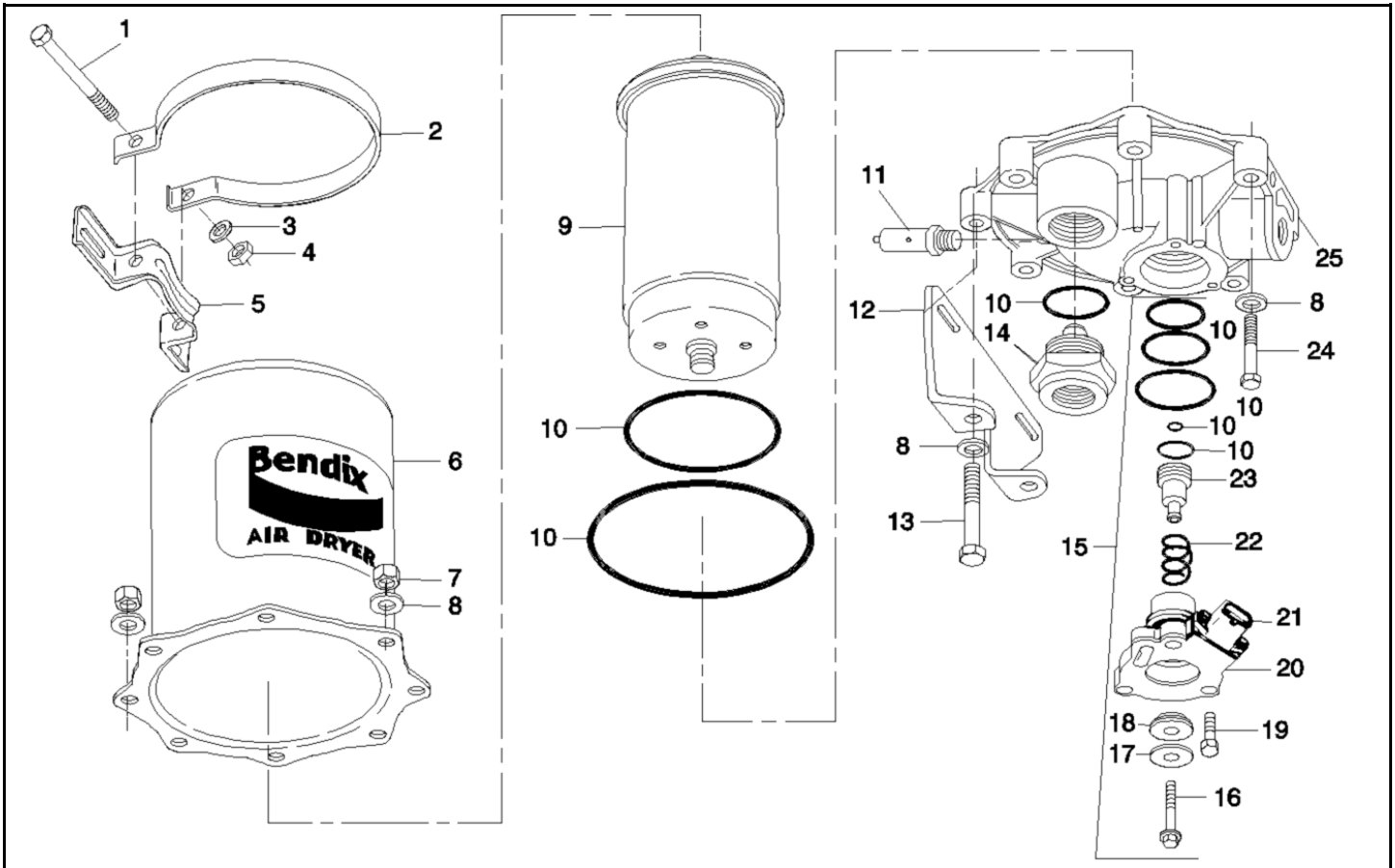
14.03 Replacement of the Bendix Air Dryer Desiccant

See ‘In this section’ below for a link to Replacement of the Bendix Air Dryer Desiccant topics.

14.03.01 AD–9

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

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Completely drain all air reservoirs. Air pressure gauges should read 0 psi (0 kPa).
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. 76,AD–9 Air Dryer (exploded view). Discard the Nylok nuts. Remove the end-cover-to-housing O-ring.



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 76, AD–9 Air Dryer (exploded view)

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.

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.
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.

16. Install the 6 bolts, 12 washers, and 6 new Nylok nuts. Tighten the Nylok nuts in a star pattern 17 to 24 lbf·ft (23 to 33 N·m). See Fig. 77,AD–9 End Cover to Housing Torque Pattern.

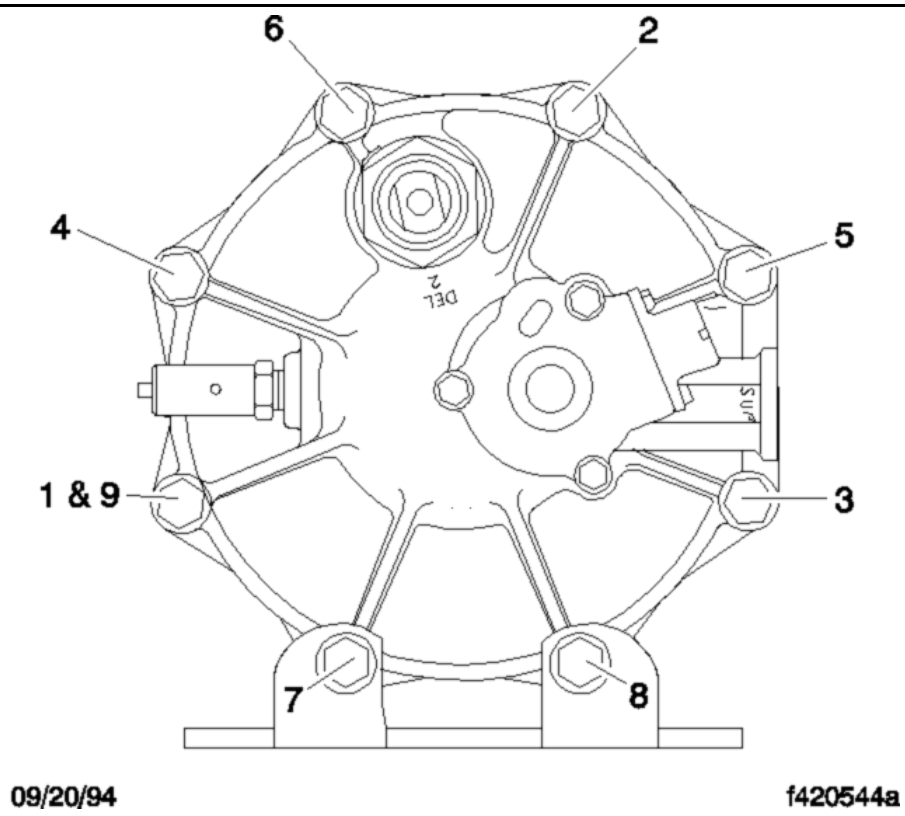


Fig 77, AD–9 End Cover to Housing Torque Pattern

17. Install the air dryer on the lower mounting bracket. Install the two previously marked bolts, four washers, and two new Nylok nuts. Tighten the two remaining Nylok nuts 17 to 24 lbf·ft (23 to 33 N·m). Install the bolt, two washers, and a new Nylok nut in the upper mounting bracket strap. Tighten 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 of the vehicle Workshop Manual for diagnosis and repair information.

14.03.02 AD–IP

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

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.

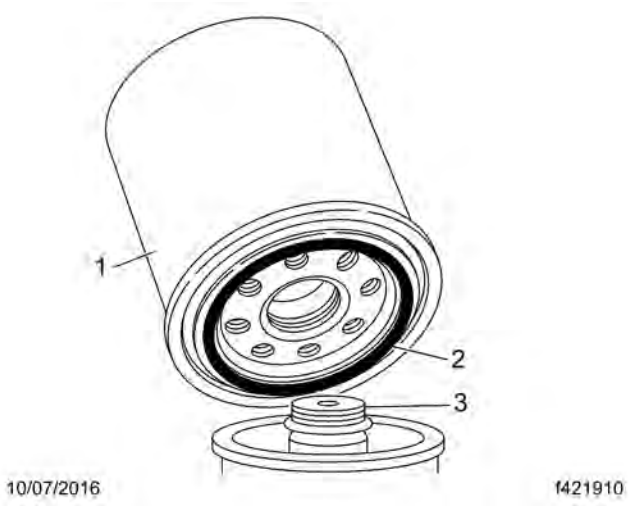
4. Remove and discard both O-rings from the cartridge bolt.
5. Using a clean rag, wipe clean the inside of the end cover. Clean the cartridge bolt bore in the end cover, and the sealing surfaces for the large- and small-diameter desiccant cartridge sealing rings.
6. Inspect the end cover for physical 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.
11. Using a wrench or socket, tighten the desiccant cartridge bolt 70 lbf·ft (95 N·m). **Do not** over-torque.
12. Before placing the vehicle in service, perform the test below.
    - 12.a Close all reservoir drain cocks.
    - 12.b Build system pressure to governor cut-out, and note that the AD-IP air dryer purges with an audible escape of air.
    - 12.c 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.d 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 reinstall the desiccant cartridge.

14.03.03 AD-9si and AD–IS

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. 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. 78,Desiccant Cartridge Replacement.



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

Fig 78, Desiccant Cartridge Replacement

4. On the new desiccant cartridge, lubricate the sealing rings with silicone grease.

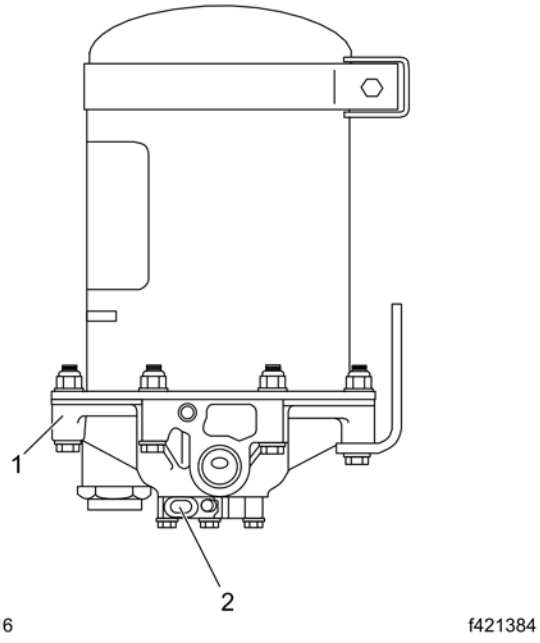
   IMPORTANT: Only use the silicone grease supplied with Bendix replacement kits.

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.

14.04 Inspection of the Air Dryer

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. 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 vehicle workshop manual for trouble-shooting 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 vehicle 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. 79,End Cover Terminals Location. The end cover contains the heater/thermostat. If the heater/thermostat is between 40 and 90°F (5 and 32°C), the heater/thermostat measured resistance will be infinite ohms. If the measured resistance is less than infinity, replace the heater/thermostat.



1. End Cover Assembly
2. Heater/Thermostat Terminals

Fig 79, End Cover Terminals Location

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.

14.05 Inspection of the Brake

See ‘In this section’ below for a link to inspection of the brake topics.

14.05.01 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.

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

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 **General Description, Meritor WABCO Antilock Braking System, ABS** of the *5th Generation Cascadia Workshop Manual*.

14.05.02 Inspection of the Brake Component

Air Disc Brakes

IMPORTANT: The following step to inspect the caliper mounting bolts should only be performed at the initial maintenance (IM) interval.Vehicles may have both **axial and radial** mounted calipers. Follow the instructions based on the type of calipers installed on the vehicle.

Axial Mounted Brakes

IMPORTANT: The following information applies to all types of axial mounted brake applications.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Raise the vehicle and support it on jack stands.
3. Remove all of the wheel assemblies. For instructions, see **General Information, Wheels and Tires** in the *5th Generation Cascadia Workshop Manual*.
4. Set a torque wrench to 350 lbf·ft (475 N·m) and tighten the caliper mounting bolts following the tightening pattern shown in Fig. 80,Axial Bolt Tightening Pattern. If they do not turn, no further work is needed. If they turn, take the vehicle to an authorized Freightliner dealer to have all of the caliper bolts on that wheel end replaced. Due to limited caliper bolt access, it may be necessary to use tool DDC DSNCHA018005 referenced in tool letter 18TL18. If the tool is needed, use tool DDC DSNCHA018005 only and no other tools. See Fig. 81,DDC DSNCHA018005 30mm Air Disc Brake Caliper Brake Bolt Torque Adaptor. If the tool is needed, see Table 32,Torque Check with 47 Inch (119 cm) Torque Wrench and Tool DDC DSNCHA018005 for torque specifications for a 47 in (119 cm) long wrench.

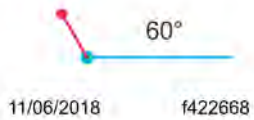


Fig 80, Axial Bolt Tightening Pattern



Fig 81, DDC DSNCHA018005 30mm Air Disc Brake Caliper Brake Bolt Torque Adaptor

Table 32, Torque Check with 47 Inch (119 cm) Torque Wrench and Tool DDC DSNCHA018005

Angle View	Extension Angle (degrees)	Target Torque lbf·ft (N·m)]	Tool Setting lbf·ft (N·m)]
	0	350 (475)	296 (401)
	45		310 (420)
	60		320 (434)
	90		350 (475)

	120		386 (523)
	135		402 (545)

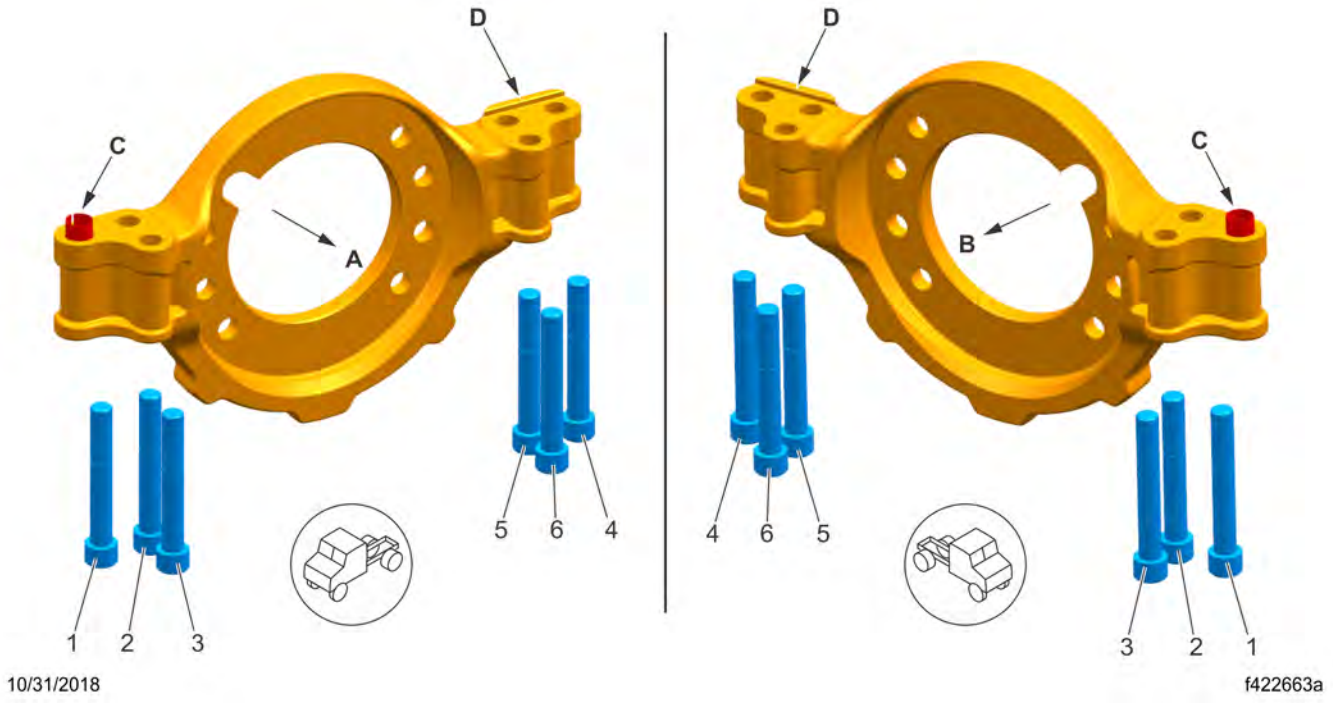
Table 32, Torque Check with 47 Inch (119 cm) Torque Wrench and Tool DDC DSNCHA018005

5. Install the wheel assemblies. For instructions, see **General Information, Wheels and Tires** in the *5th Generation Cascadia Workshop Manual*.
6. Remove the jack stands and lower the vehicle.

Radial Mounted Brakes

Bendix Calipers

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Raise the vehicle and support it on jack stands.
3. Remove all of the wheel assemblies. For instructions, see **General Description, Wheels and Tires** of the *5th Generation Cascadia Workshop Manual*.
4. Set a torque wrench to 200 lbf·ft (271 N·m) and tighten the caliper mounting bolts following the tightening pattern shown in Fig. 82,Bendix Radial Mounted Caliper Tightening Pattern (viewed from below). If they do not turn, no further work is needed. If they turn, take the vehicle to an authorized Freightliner dealer to have all of the caliper bolts on that wheel end replaced.



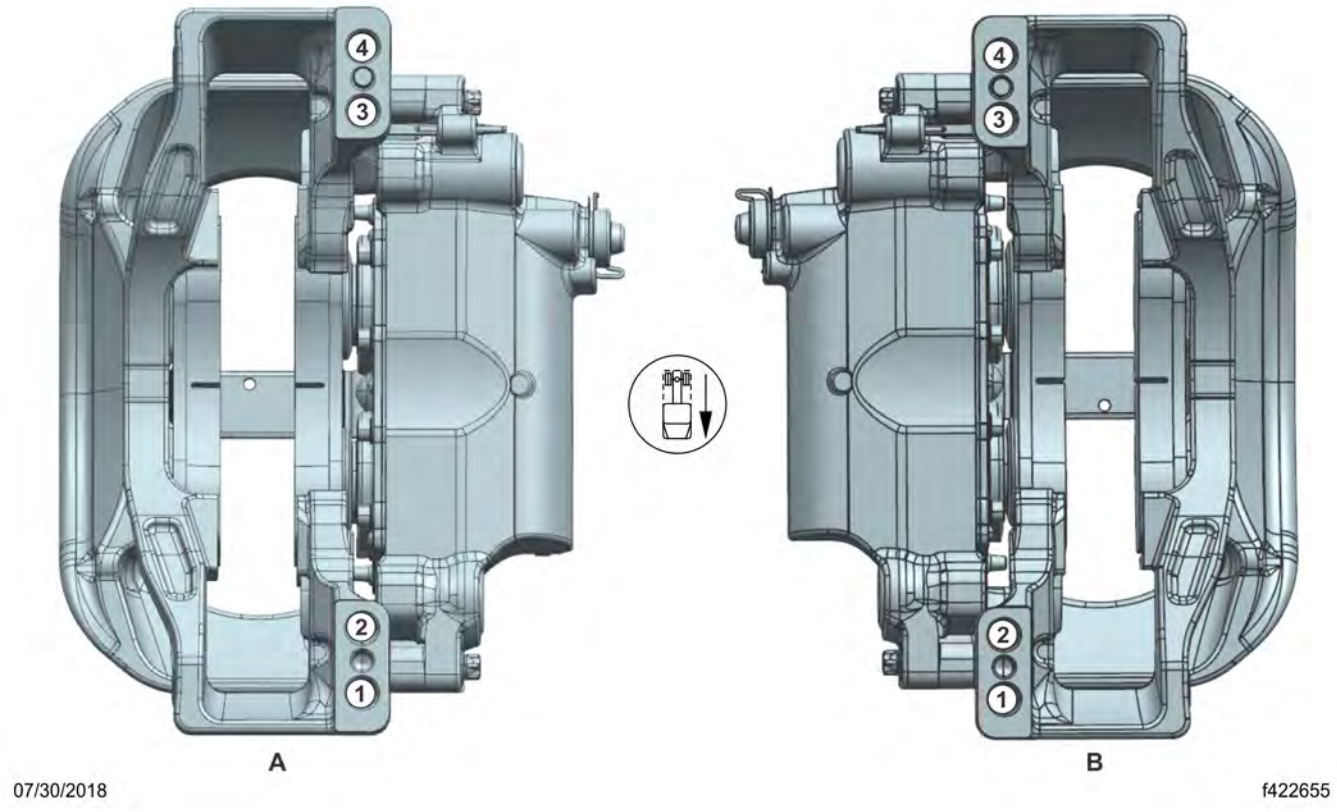
A. Right-hand brake **(viewed from below)**.
B. Left-hand brake **(viewed from below)**.
C. Sheer sleeve above in this location.
D. Shelf above in this location.

Fig 82, Bendix Radial Mounted Caliper Tightening Pattern (viewed from below)

5. Install the wheel assemblies. For instructions, see **General Description, Wheels and Tires** of the *5th Generation Cascadia Workshop Manual*.
6. Remove the jack stands and lower the vehicle.

Meritor Calipers

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Raise the vehicle and support it on jack stands.
3. Remove all of the wheel assemblies. For instructions, see **General Description, Wheels and Tires** of the *5th Generation Cascadia Workshop Manual*.
4. Set a torque wrench to 350 lbf·ft (475 N·m) and tighten the caliper mounting bolts following the tightening pattern shown in Fig. 83,Meritor Radial Mounted Caliper Tightening Pattern . If they do not turn, no further work is needed. If they turn, take the vehicle to an authorized Freightliner dealer to have all of the caliper bolts on that wheel end replaced.



NOTE: Tighten the fasteners in the order indicated.

A. Left Hand, Bottom View

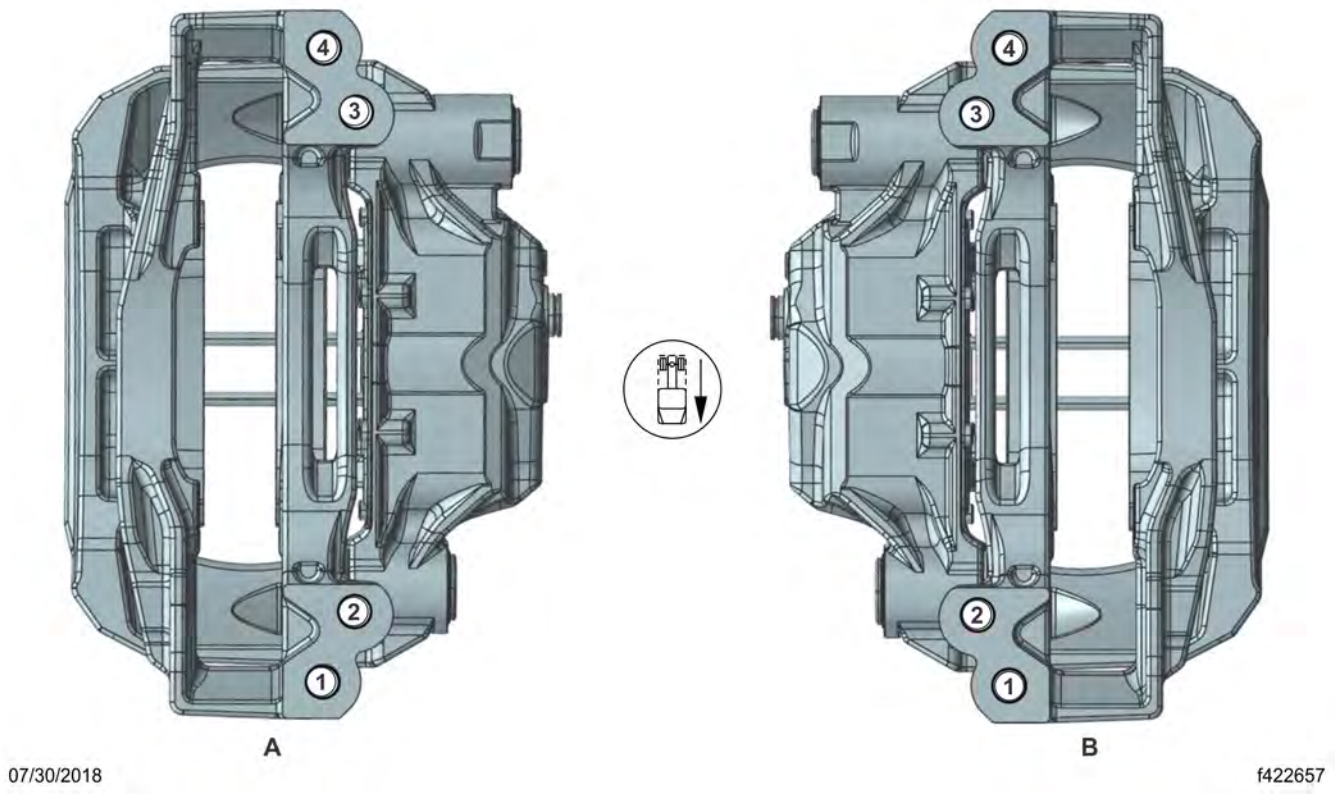
B. Right Hand, Bottom View

Fig 83, Meritor Radial Mounted Caliper Tightening Pattern

5. Install the wheel assemblies. For instructions, see **General Description, Wheels and Tires** of the *5th Generation Cascadia Workshop Manual*.
6. Remove the jack stands and lower the vehicle.

WABCO Maxxus Calipers

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Raise the vehicle and support it on jack stands.
3. Remove all of the wheel assemblies. For instructions, see **General Description, Wheels and Tires** of the *5th Generation Cascadia Workshop Manual*.
4. Set a torque wrench to 273 lbf·ft (370 N·m) and tighten the caliper mounting bolts following the tightening pattern shown in Fig. 84,Wabco Maxxus Radial Mounted Caliper Tightening Pattern. If they do not turn, no further work is needed. If they turn, take the vehicle to an authorized Freightliner dealer to have all of the caliper bolts on that wheel end replaced.



NOTE: Tighten the fasteners in the order indicated.

A. Left Hand, Bottom View B. Right Hand, Bottom View

Fig 84, Wabco Maxxus Radial Mounted Caliper Tightening Pattern

5. Install the wheel assemblies. For instructions, see **General Description, Wheels and Tires** of the *5th Generation Cascadia Workshop Manual*.
6. Remove the jack stands and lower the vehicle.

Drum Brakes

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

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

2. With the engine off, and 100 psi (690 kPa) of air tank pressure, have an assistant apply and hold an 80 to 90 psi (552 to 621 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 **General Description, Meritor WABCO Antilock Braking System, ABS** of the *5th Generation Cascadia Workshop Manual* for inspection, troubleshooting, and repair procedures.

4. Measure the applied chamber stroke. See Table 33,Brake Chamber Stroke Specifications 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 **General Description, Meritor WABCO Antilock Braking System, ABS** of the *5th Generation Cascadia Workshop Manual* for inspection, troubleshooting, and repair procedures.
5. Check all of the foundation brake components for damage, wear, and loose or missing parts. Repair as needed. See **General Description, Meritor WABCO Antilock Braking System, ABS** of the *5th Generation Cascadia Workshop Manual* for inspection, troubleshooting, and repair procedures.

Table 33, Brake Chamber Stroke Specifications

Chamber			Max Applied Stroke: inch (mm)
Manufacturer	**Type**[1]	**Size**[2]	
Gunite	Standard Stroke	9	1-3/8 (35)
		12	
		16	1-3/4 (45)
		20	
		24	
		30	2 (51)
		36 [3]	2-1/4 (57)
	Long Stroke	16	2 (51)
		20	
		24	
		24	2-1/2 (64)
		30	
Haldex	Standard Stroke	12	1-3/8 (35)
		16	1-3/4 (44)
		20	
		24	
	2-1/2-Inch Extended Stroke	24	2 (51)
	3-Inch Extended Stroke	24	2-1/2 (64)
	Standard Stroke	30	2 (51)
	Long Stroke	30	2-1/2 (64)

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	

1. Long stroke design is indicated by a tag, or embossing, on the brake chamber.
2. Specifications are relative to a brake application with 80 to 90 psi (550 to 620 kPa) air pressure in the brake chambers.
3. If type 36 chamber is used, slack length should be less than 6 inches.

Table 33, Brake Chamber Stroke Specifications

14.06 Lubrication of the Haldex Slack Adjuster

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. 85,Haldex Automatic Slack Adjuster Grease Fitting. Use standard chassis lubricant for Haldex slack adjusters.

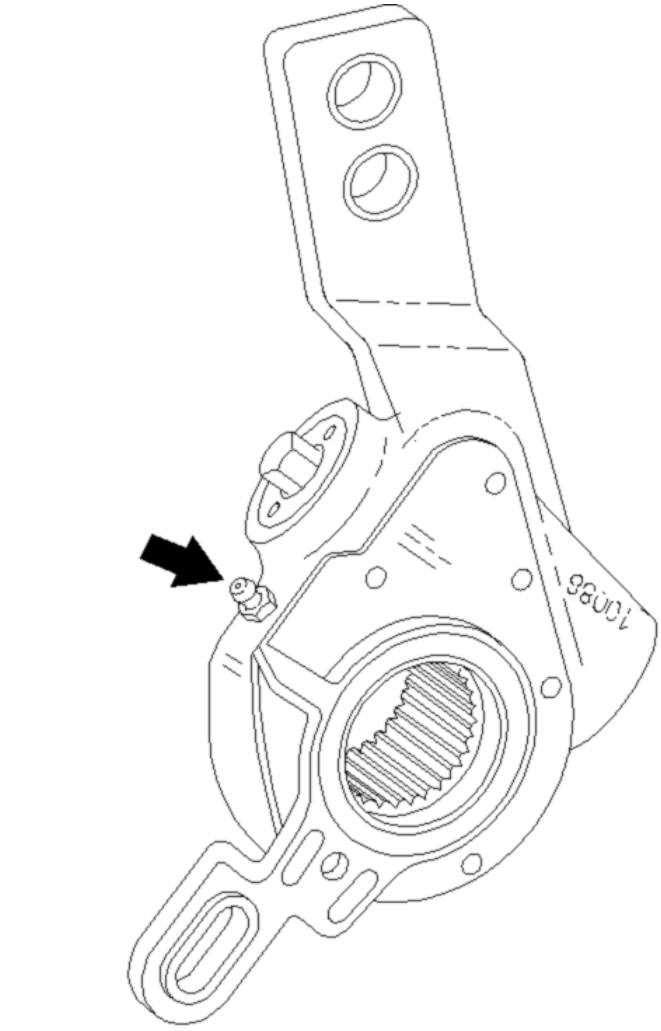


Fig 85, Haldex Automatic Slack Adjuster Grease Fitting

14.07 Lubrication of the Meritor Camshaft Bracket

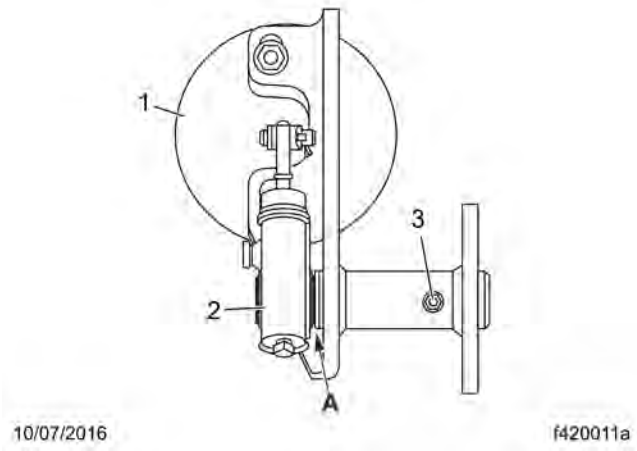
See ‘In this section’ below for a link to lubrication of the meritor camshaft bracket topics.

14.07.01 General Information

IMPORTANT: Perform a brake inspection before lubricating the camshaft bracket.

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 the vehicle 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. 86,Camshaft Bracket Lubrication. Follow the steps below for proper greasing.



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

Fig 86, Camshaft Bracket Lubrication

WARNING:

If grease leaks out under the camhead, the camshaft bracket grease seal is worn or damaged. See in the vehicle 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.

14.07.02 Greasing the Steer Axle S-cam Tube

1. Park the vehicle on a level surface, shut down the engine, and set the park brake.
2. Chock the drive-axle tires.
3. Chock steer-axle tires.
4. Grease the S-cam tubes.

14.07.03 Greasing the Drive Axle S-cam Tube

1. Park the vehicle on a level surface, shut down the engine, and set the park brake.
2. Chock the front tires.
3. Chock one drive tire.
4. Cage the drive tire park-brake chamber opposite of the tire that is chocked.
5. Grease the S-cam tube on the caged park-brake chamber side only.
6. Uncage the park-brake chamber.
7. Move the drive tire chock to the other side of the axle and chock the other set of tires.
8. Cage the drive-tire park-brake chamber opposite of the tire that is chocked.
9. Grease the S-cam tube on the caged brake side only.
10. Uncage the park-brake chamber.
11. If equipped with more than one drive-axle, repeat this process for the remaining drive-axle.

14.08 Lubrication of the Meritor Slack Adjuster

See ‘In this section’ below for a link to Lubrication of the Meritor Slack Adjuster topics.

14.08.01 General Guidelines

IMPORTANT: Perform a brake inspection following the instructions in this group before lubricating the slack adjusters.

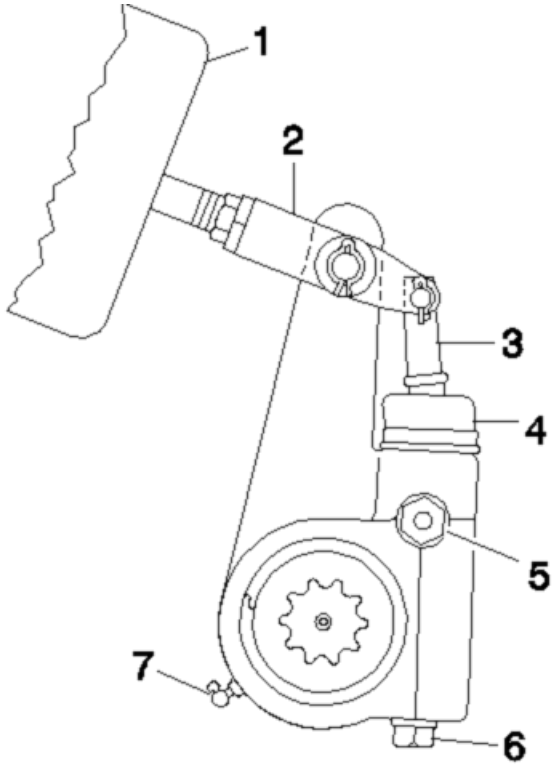
WARNING:
Failure to lubricate slack adjusters could lead to dragging brakes or a brake failure, resulting in property damage, personal injury, or death.

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 the vehicle 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. 87,Meritor Automatic Slack Adjuster. Follow the steps below for proper greasing.



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 87, Meritor Automatic Slack Adjuster

14.08.02 Greasing the Steer Axle Slack Adjuster

1. Park the vehicle on a level surface, shut down the engine, and set the park brake.
2. Chock the drive-axle tires.
3. Chock steer-axle tires.
4. Grease the slack adjuster.

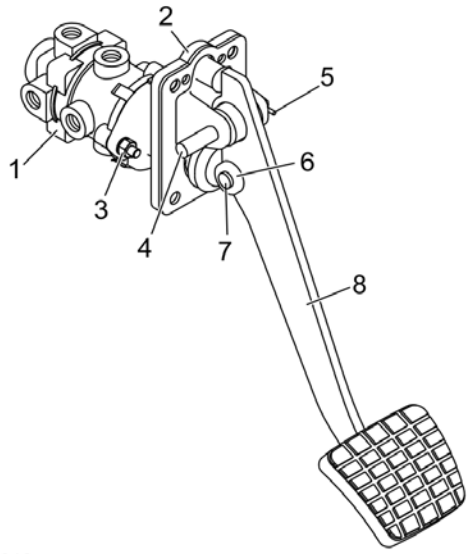
14.08.03 Greasing the Drive Axle Slack Adjuster

1. Park the vehicle on a level surface, shut down the engine, and set the park brake.
2. Chock the front tires.
3. Chock one drive-axle tire.
4. Cage the drive-tire park-brake chamber opposite of the tire that is chocked.
5. Grease the slack adjuster on the caged brake side only.
6. Uncage the park brake.
7. Move the drive-tire chock to the other side of the axle and chock the other set of tires.
8. Cage the drive-tire park-brake chamber opposite of the tire that is chocked.
9. Grease the slack adjuster on the caged brake side only.
10. Uncage the park brake.

11. If equipped with more than one drive-axle, repeat this process for the remaining drive-axles.

14.09 Inspection and Lubrication of the Bendix E-6 Foot Control Valve

1. Remove the brake valve from the vehicle; see Group 42, of the vehicle workshop manual.
2. Remove the roll pin from the brake pedal pivot pin. See Fig. 88,Brake Pedal and Valve Assembly.



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 88, Brake Pedal and Valve Assembly

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) on the cotter pin.
8. Remove the plunger from the valve. Using alcohol, clean the existing grease from the plunger. Check the plunger for signs of wear or cracks. Replace it if necessary.
9. Lubricate the plunger with barium grease (BW 246671).
10. Insert the plunger in the valve.
11. Install the brake pedal with the pivot pin.
12. Install a new roll pin and apply Torque Seal (OPG F900 White) on the roll pin.
13. Install the brake valve assembly; see Group 42, of the vehicle workshop manual.
14. Test the brakes before returning the vehicle to service.

14.10 Replacement of the WABCO System Saver Air Dryer Desiccant Cartridge

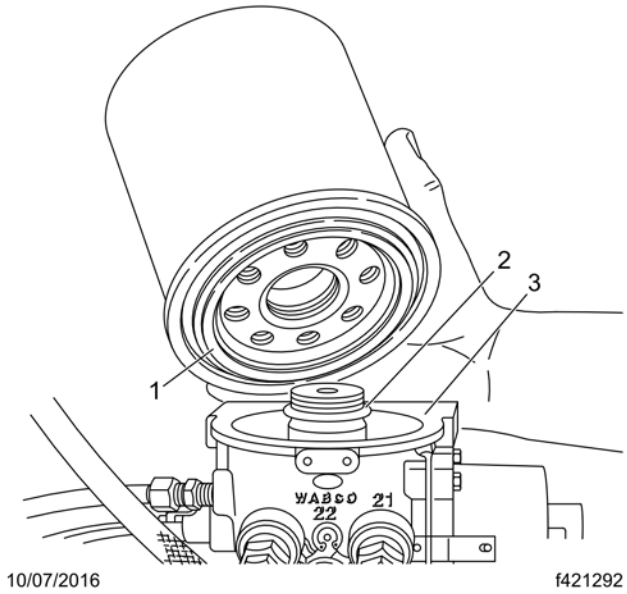
NOTE: The following instructions apply to the System Saver 1200, 1200 Plus, and Twin air dryers.

NOTICE:

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

See Fig. 89,Desiccant Cartridge Replacement for cartridge replacement.

1. Drain the air system.



1. Seal
2. O-Ring
3. Air Dryer Base

Fig 89, Desiccant Cartridge Replacement

2. Using a strap wrench, turn the desiccant cartridge counterclockwise and remove it.
3. Remove and discard the O-ring.
4. Clean the top surface of the dryer base with a commercial cleaning solvent.

   IMPORTANT: If the air dryer base is damaged, preventing a tight seal, replace the air dryer.

5. Using a multipurpose, high-temperature grease that resists water, steam, and alkali, lightly coat the surfaces of the new O-ring and the dryer base. Install the O-ring.

6. Thread the desiccant cartridge onto the dryer base (turn clockwise). When the seal contacts the base, tighten the cartridge one complete turn more. Do not overtighten.

14.11 Inspection and Lubrication of the Versajust Slack Adjuster

See ‘In this section’ below for a link to inspection and lubrication of the versajust slack adjuster topics.

14.11.01 General Guidelines

IMPORTANT: Perform the **Brake Inspection** maintenance operation before lubricating the slack adjusters.

1. Visually check for physical damage, such as broken air lines and broken or missing parts.
2. Using a quality multipurpose chassis lubricant, NLGI Grade 2, lubricate the slack adjuster through the grease fitting until clean lubricant flows from the grease relief opening in the boot.
3. Perform the 'In Service Inspection.'

14.11.02 In Service Inspection

1. Apply and release the brakes several times while observing the slack adjuster. The slack adjuster and brake actuator should move freely, without binding or interference, and should return to the full released position. Observe the looseness that exists between the clevis and adapter bushing and the yoke and link pins and their mating parts (clevis, body, link). Replace these parts if looseness appears excessive. Make certain the brake actuator pushrod jam nut is tightened securely.
2. Inspect the slack adjuster for physical damage, paying attention to the link, boot, and clevis. If any components are damaged, repair or replace them as necessary.
3. Measure the brake actuator pushrod stroke while making an 80 to 90 psi (552 to 621 kPa) brake application. Actuator pushrod strokes should not exceed the values shown in Table 34,Actuator Stroke–Standard Stroke and Table 35,Actuator Stroke–Long Stroke. To achieve the correct pressure for this test, build the system pressure up to a 100 psi (690 kPa). Shut down the engine. Fan the brakes to attain a 90 to 95 psi (621 to 655 kPa) reading. Make and hold a full brake application while the strokes are checked.

Table 34, Actuator Stroke–Standard Stroke

Brake Actuator Size	Recommended Maximum Operating Stroke (Inches)
30	2
24	1-3/4
20	1-3/4
16	1-3/4
12	1-3/8

Table 34, Actuator Stroke–Standard Stroke

Table 35, Actuator Stroke–Long Stroke

Brake Actuator Size	Recommended Maximum Operating Stroke (Inches)
30 Long Stroke	2-1/2
24 Long	2

Brake Actuator Size	Recommended Maximum Operating Stroke (Inches)
24 Long Stroke	2-1/2
20 Long	2
16 Long	2

Table 35, Actuator Stroke–Long Stroke

14.12 Operating and Leakage Tests of the Bendix Automatic Drain Valve

Operating Test

Perform the following test after repairing or replacing the DV-2 valve, to ensure that the valve is functioning properly.

With the system charged, apply the brakes several times. Each time the brakes are applied, an exhaust of air should occur from the exhaust port of the drain valve. If no air comes out, push the wire stem located inside the exhaust port. If no air comes out after pushing the wire stem, there may be a plugged filter in the adapter which should be replaced.
If the drain valve does not function properly, repair or replace it. See **Cleaning and Inspection of the Drain Valve, Air Reservoir Automatic Drain Valve, Bendix DV-2** of the *5th Generation Cascadia Workshop Manual*.

Leakage Test

Perform the following test after repairing or replacing the DV-2 valve, to ensure that the valve is functioning properly.

With the system charged and pressure stabilized in the system, there should be no leaks at the drain valve exhaust port. A constant slight exhaust of air at the drain valve exhaust port could be caused by excessive leakage in the air brake system. If the drain valve is leaking excessively, repair or replace it. See **Cleaning and Inspection of the Drain Valve, Air Reservoir Automatic Drain Valve, Bendix DV-2** of the *5th Generation Cascadia Workshop Manual*.

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15.04 Lubrication of the Power Steering Gear 152
15.05 Lubrication of the Drag Link 153

15. Group 46 Steering

15.01 Safety Precautions

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

DANGER:

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

15.02 Inspection of the Drag Link

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.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. 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.

   If the ball stud end is loose, replace the drag link.
3. Check the ball stud castle nut for looseness.

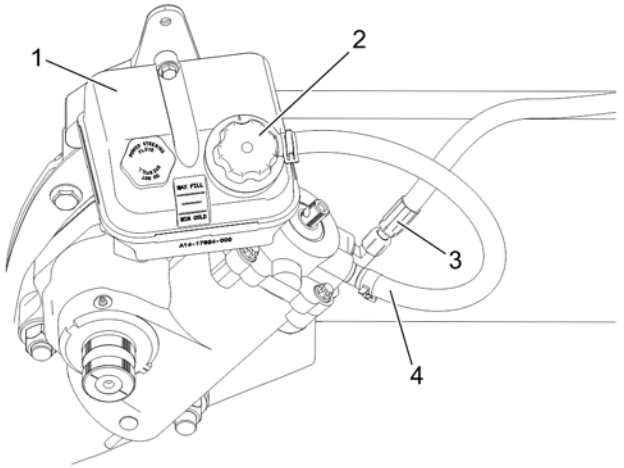
   If the castle nut is loose, replace it and the cotter pin. Tighten the new castle nut as follows:

   - 3/4–16: 90 to 180 lbf·ft (122 to 230 N·m)
   - 7/8–14: 160 to 300 lbf·ft (217 to 407 N·m)
4. 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 if needed.
5. 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 **General Information, Steering I-Shaft** of the *5th Generation 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.

15.03 Power Steering Fluid and Filter Change

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. Set the parking brake and chock the rear tires.
2. Raise the front of the vehicle and support it with jack stands.
3. Put the vehicle in neutral.
4. Open the hood.
5. Wipe down the area around the steering gear and related hydraulic lines.
6. Place a drain pan under the steering gear and power steering reservoir.
7. Remove the pressure line and return hose (see Fig. 90,Power Steering Reservoir) from the steering gear and allow the oil to drain.



1. Reservoir
2. Filter Cap
3. Pressure Line
4. Return Hose

Fig 90, Power Steering Reservoir

8. Remove the filter cap from the reservoir, then remove and discard the filter.
   - Filter caps with a separate retaining ring have a threaded connection with the filter. Unscrew the filter and discard it.
   - One-piece filter caps do not have a threaded fit with the filter. Pull off the filter and discard it.
9. Turn the steering wheel from full left to full right three times to purge oil from the gear.
10. Connect the pressure line and return the hose to the steering gear.

11. Fill the reservoir with an approved power steering fluid to the line between the MIN COLD and MAX HOT lines. See Fig. 90,Power Steering Reservoir. See Table 36,Approved Power Steering Fluids for approved power steering fluids.

Table 36, Approved Power Steering Fluids

Fluid Type	Approved Fluid
Automatic Transmission Fluid	Dexron® III
	Super ATF
	TES-389

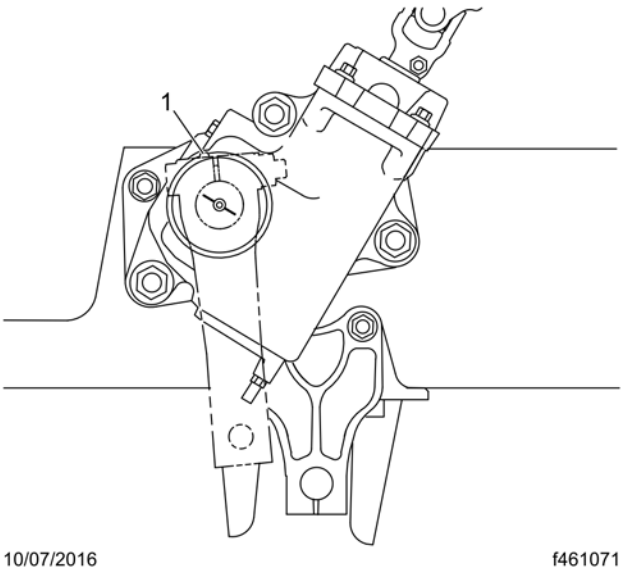
Table 36, Approved Power Steering Fluids

12. Apply a thin film of power steering fluid on the gasket of the new filter, then attach the filter to the filter cap and install the cap on the reservoir.
    - For filter caps with a separate retaining ring, hand-tighten the filter, then turn it an additional 1/4 turn.
    - For one-piece filter caps, the filter is not threaded.
13. With the engine off, turn the steering wheel from full left to full right three times. Add more power steering fluid as needed.
14. Start the engine and operate the engine at idle. Check that the power steering fluid level is between the MIN COLD and MAX HOT lines. Add more power steering fluid if needed.
15. Turn the steering wheel from full left to full right several times. Add fluid to the reservoir as needed to maintain the fluid level between the MIN COLD and MAX HOT lines.
16. Shut down the engine.
17. Raise the vehicle, remove the jack stands, and lower the vehicle.

15.04 Lubrication of the Power Steering Gear

NOTICE:
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. See Fig. 91,Steering Gear Lubrication.

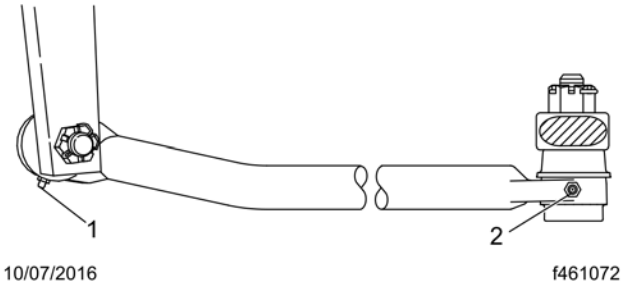


1. Sector Shaft Grease Fitting

Fig 91, Steering Gear Lubrication

15.05 Lubrication of the Drag Link

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Using a clean rag, wipe all dirt from the drag link grease fittings. See Fig. 92,Drag Link.



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

Fig 92, Drag Link

3. Using a pressure gun and NLGI Grade 2 (8% 12-hydroxy lithium stearate grease) or NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) chassis grease, apply clean grease at the grease fittings until old grease is forced out of the socket.

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16. Group 47 Fuel

16.01 Safety Precautions

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

DANGER:

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

16.02 Replacement of the Fuel Filter

For engine-mounted fuel filter replacement, refer to the engine manufacturer's service manual for removal and installation procedures.

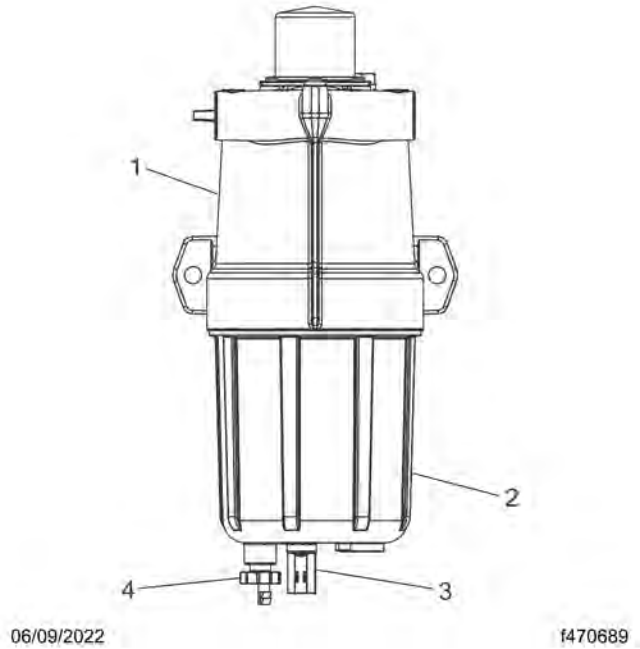
16.03 Fuel/Water Separator Element Checking and Replacement

See ‘In this section’ below for a link to fuel/water separator element checking and replacement topics.

16.03.01 Detroit

IMPORTANT: For chassis-mounted fuel filter replacement, refer to the engine manufacturer's service literature for replacement intervals.

The only maintenance necessary on an Detroit fuel/water separator is to replace the filter element. See Fig. 93,Detroit Fuel/Water Separator.



1. Mounting Head
2. Sight Bowl
3. Electrical Connector for Bowl Heater
4. Bowl Drain

Fig 93, Detroit Fuel/Water Separator

WARNING:

Fluid circulated through the fuel/water separator to heat the fuel may be diesel fuel returned from the engine, or engine coolant. Drain the fuel/water separator only when the engine and fluids have cooled. Draining it when the engine is hot could cause severe personal injury due to scalding.

If returning fuel is released into the atmosphere, its vapors can ignite in the presence of any ignition source. Do not expose the fuel to, or work with the fuel system near, open flame or intense heat. To do so could cause fire, possibly resulting in serious personal injury or property damage.

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 bowl by turning counterclockwise.
4. Remove the element, bowl O-ring, and element o-ring. Dispose of them in an environmentally acceptable manner.
5. Thoroughly clean all of the threads and sealing surfaces. Even a small amount of dirt will prevent the fuel/water separator from sealing, and an air leak may result.
6. Apply a coating of clean fuel or motor oil to the new O-ring and to the new element o-ring.
7. Insert the new element into the upper housing.

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

8. Spin the bowl onto the onto the upper housing by hand only.
9. Connect the water sensor and heater connectors if equipped.
10. If equipped with a primer pump, prime the fuel/water separator as follows.
    10.a Loosen the vent plug. Then operate the primer pump until the fuel purges at the vent plug.
    10.b Close the vent plug.
11. Start the engine and check for fuel leaks.
12. Shut down the engine and correct any fuel leaks.

16.03.02 DAVCO Fuel Pro® 485

WARNING:

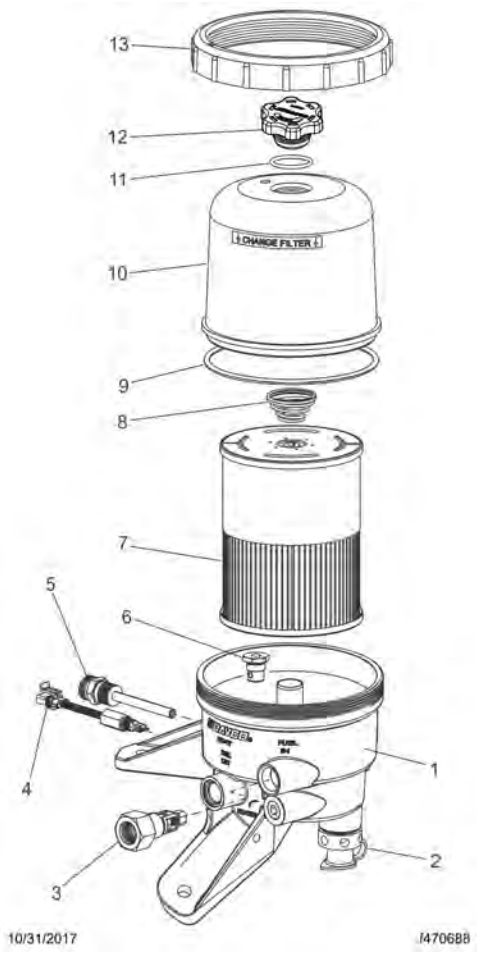
Fluid circulated through the fuel/water separator to heat the fuel may be diesel fuel returned from the engine, or engine coolant. Drain the fuel/water separator only when the engine and fluids have cooled. Draining it when the engine is hot could cause severe personal injury due to scalding.

If returning fuel is released into the atmosphere, its vapors can ignite in the presence of any ignition source. Do not expose the fuel to, or work with the fuel system near, open flame or intense heat. To do so could cause fire, possibly resulting in serious personal injury or property damage.

1. Shut down the engine, apply the parking brake, and chock the tires.
2. Check the fuel level in the fuel filter. Replace the fuel/water separator element **only** when the filter element is completely covered. If the fuel level has reached the top of the filter element, follow the procedure below to replace the element.
3. Put a clean receptacle under the fuel/water separator and attach a piece of hose to the drain valve, to direct fuel into the receptacle.

   On older models, the drain valve has a 1/2-inch (12.7-mm) pipe with threads. Use a hose with a 1/2-inch pipe thread to fit correctly and open the drain valve by turning it one-quarter revolution.

   On new models, the drain valve has a 3/4-inch (19-mm) slip-on hose connection; pipe threads are no longer used. Open the drain valve by turning it one to one-and-a-half revolutions.
4. Remove the vent cap, shown in Fig. 94,DAVCO Fuel Pro 485, to drain the fuel completely, then close the drain valve.



1. Lower Housing
2. Drain Valve
3. Inlet Port/Check Valve
4. 12VDC Pre-Heater
5. 120VAC Pre-Heater
6. Bypass Valve
7. Filter Element
8. Spring
9. Cover O-Ring
10. Clear Cover
11. Vent Cap O-Ring
12. Vent Cap
13. Collar

Fig 94, DAVCO Fuel Pro 485

5. Using a DAVCO Collar Wrench, shown in Fig. 95,DAVCO Collar Wrench, remove the clear cover and collar.

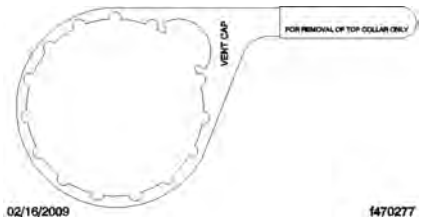
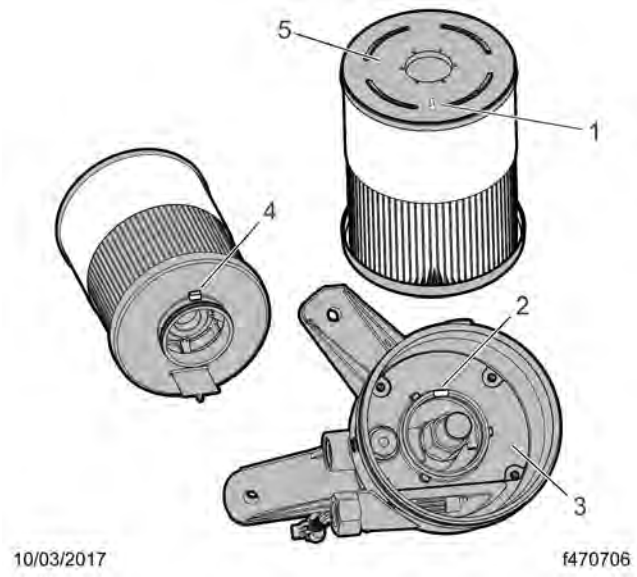


Fig 95, DAVCO Collar Wrench

6. Remove the filter, cover O-ring, and vent cap O-ring. Dispose of them in an environmentally acceptable manner. See Fig. 96,Positioning the Filter Element.
7. Clean all threads and sealing surfaces very thoroughly. Even a small amount of dirt will prevent the fuel/water separator from sealing, and an air leak may result.
8. Install the new filter and grommet assembly and cover O-ring on the housing.

   Position the filter element so the key is lined up with the keyway on the separator plate of the housing. Use the arrow on the top of the endplate to align the filter. See Fig. . Ensure the filter element is fully seated by firmly pushing on the endplate. The filter should not rotate freely.



1. Arrow (on the endplate)
2. Keyway
3. Separator Plate
4. Key
5. Endplate

Fig 96, Positioning the Filter Element

9. Install the clear cover and the collar. Simultaneously apply downward pressure to the top of the clear cover until it is seated on the body of the lower housing and hand tighten the collar until it no longer spins freely. Using the collar wrench, tighten the cover 18 lbf·ft (24 N·m). This is equivalent to rotating the collar clockwise two or three additional ribs, depending on the specific filter model.
10. Prime the system.
    - 10.a Ensure that the drain valve is closed.
    - 10.b Fill the housing to the top of the filter element with clean diesel fuel.
    - 10.c Install and hand-tighten the vent cap O-ring and vent cap.
    - 10.d Start the engine. When the lubricating oil reaches its normal operating pressure, increase engine speed to high idle for one to two minutes to purge air from the system.
    - 10.e While the engine is running, and after the air is purged from the system, loosen the vent cap until the fuel level falls to just above the collar, then hand-tighten the vent cap.
    - 10.f Check for leaks and shut down the engine.

16.04 Tightening the Fuel Tank Band-Nut

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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17. Group 49 Exhaust

17.01 Safety Precautions

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



DANGER:

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

17.02 Inspection of the Exhaust System (noise emission control)

See ‘In this section’ below for a link to inspection of the exhaust system (noise emission control) topics.

17.02.01 General Guidelines

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 **General Information, Aftertreatment System** of the *5th Generation 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.
For information on the EPA10 and Newer Exhaust System, see *EPA10 DD Platform Application and Installation Manual*.

17.02.02 Replacement of the Diesel Exhaust Fluid (DEF) Filter

The Environmental Protection Agency's 2010 and later 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.

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18. Group 54 Electrical, Instruments, and Controls

18.01 Inspection and Cleaning of the Trailer Cab

1. Inspect the cables for cuts, abrasion, or other damage. If internal wiring is exposed, replace the cables.
2. Disconnect the trailer electrical cables from the sockets at the cab.
3. Inspect the cables and sockets for evidence of corrosion, and clean as necessary. If a socket is too badly corroded to clean, replace it. If corrosion has gotten into the wires and connectors inside the socket, replace the cable.

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

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

18.02 Inspection of the Electrical Component

1. Park the vehicle, apply the parking brakes, and shut down the engine. Chock the tires.
2. Disconnect the batteries.
3. Inspect the condition of the electrical component. Check for signs of excess dirt/debris build up on or around component. If exterior cleaning is needed for a thorough inspection, clean exterior debris from the component using a dry method such as a vacuum cleaner or using an electrical contact cleaner such as CRC QD® Electronic Cleaner.
4. Check all mounting points for loose, broken, or missing parts. Component must be securely mounted. All loose, broken, or missing parts must be repaired to maintain proper component function.
5. Inspect the component protective cover for proper fit and function. Inspect cover for cracks, broken mounting, missing sealing surfaces, warped or bulged surfaces. The cover must prevent moisture and debris from entering the components protected area. Missing, leaking, or damaged covers will result in moisture and debris entering the component and will result in component failure. When it is determined that a cover has not properly prevented moisture and debris from entering the component, the entire component must be replaced.
6. Inspect the component exterior for signs of thermal distortion, warping, bulging, discoloration, amperage related heating, color variance or shading across component which could be a sign of internal failure requiring replacement of the component. The root source causing conditions of high heat, excess amperage, and/or circuit overload component failures must be diagnosed and repaired prior to replacing the component.
7. Inspect component housing sub-assembly clips and fasteners for correct fit and location and that component sub-assembly housing seams are tight and secure. Missing, leaking, or damaged component housings must be replaced.
8. Check main power cable connections for a clean and secure fit. Connections should be free of corrosion, dirt and moisture. Connections should not have signs of thermal distortion, warping, discoloration, high amperage heating or discoloring. If needed, disconnect cables, scrub and clean as needed using a nylon brush. Clean debris with vacuum or electrical contact cleaner such as CRC QD® Electronic Cleaner, inspect terminals and mating contact terminal plating. If the terminal plating exhibits signs of unrecoverable corrosion, the component and terminal will need replaced. Indications of unrecoverable corrosion on terminal plating are:
   - Heavy staining that cannot be cleaned off with nylon brush or contact cleaner;
   - erosion and pitting on terminal plating causing uneven surfaces; or
   - discoloration caused by outer layer of plating being removed by corrosion or wear exposing the under layer material of terminal.
9. Check all electrical connectors for correct fit and that the connector locking tabs are in place and will hold the connector firmly into the component. Inspect connector terminals for signs of corrosion, thermal distortion, warping, discoloration, high amperage heating or discoloring. If needed, remove connectors and terminals, scrub and clean as needed

using a nylon brush. Clean debris with vacuum or electrical contact cleaner such as CRC QD® Electronic Cleaner, inspect terminals and mating contact terminal plating. If the terminal plating exhibits signs of unrecoverable corrosion, the component and terminal will need to be replaced.

10. Inspect component harnesses for secured routing that prevents excess harness movement and prevents the harness from pulling too tight on the connector. Inspect harnesses for signs of rubbing or chafing that could result in wire circuit damage. Damaged wiring and/or damage to harness protective wrap must be repaired and harness must be wrapped and secured to prevent further damage. When possible, harness should be routed with drip loop.
11. Inspect fuses and relays for correct fit, and that the terminals hold the fuses and relays firmly in place. Inspect fuses and relays for signs of corrosion, thermal distortion, warping, discoloration, and high amperage heating or discoloring. If loose or corroded, remove, inspect, clean, and replace as needed.
12. Connect the batteries.

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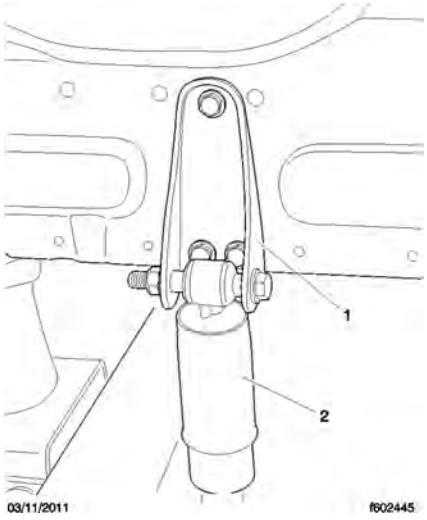
19. Group 60 Cab

19.01 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.

19.02 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. 97,Cab Shock Absorber and Upper Bracket.
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 97, Cab Shock Absorber and Upper Bracket

19.03 Inspection of the Aerodynamic Component

Inspect aerodynamic components, if equipped, for structural damage, cracks, or wear. These may include:

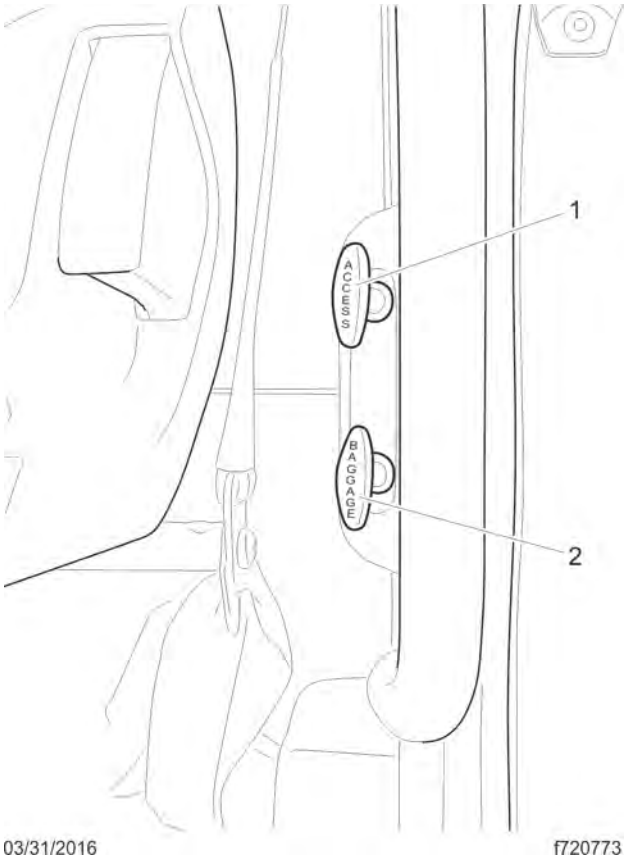
- Chassis fairings
- Battery access kickplate
- Side skirts
- Cab side extenders
- Roof fairing/deflector
- Bumper
- Hood

Replace or repair damaged or missing components as needed.

19.04 Lubrication of the Baggage Door and Sleeper Access Door Release Cable and Latch

NOTE: Use a silicone lubricant such as WD-40 or equivalent. Removal of trim panels is not required.

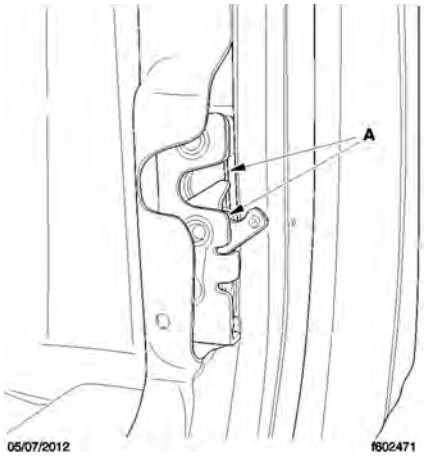
1. Open the baggage door and the sleeper access door (if equipped) by pulling the release handle(s) located inside the cab door opening. See Fig. 98,Sleeper Door Release Handles.



1. Sleeper Access Door Handle
2. Baggage Door Handle

Fig 98, Sleeper Door Release Handles

2. Pull out on the baggage door handle, and apply a light coating of lubricant to the exposed length of cable. Repeat for the sleeper access door cable, if equipped.
3. At the opened baggage door, apply a light coating of lubricant to the latch jaw and the exposed length of cable. See Fig. 99,Baggage Door Latch. Repeat for the sleeper access door, if equipped. Removal of trim panels is not required.



NOTE: Baggage door latch shown. Sleeper access door latch is similar.

A. Lubricate the latch jaws and the exposed length of cable.

Fig 99, Baggage Door Latch

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20. Group 83 Heater and Air Conditioner

20.01 Safety Precautions

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

DANGER:

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

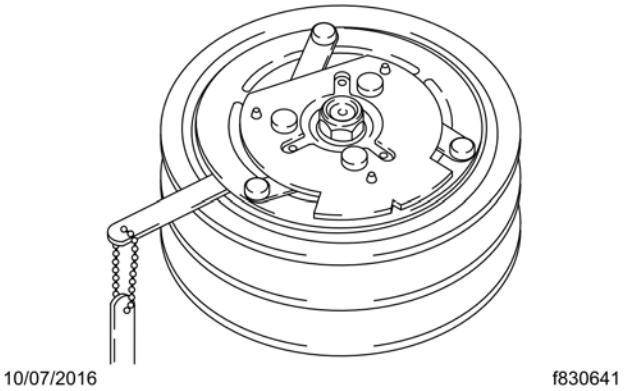
20.02 Inspection of the Air Conditioner

Preliminary Checks

WARNING:

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

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brakes. 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 **Description of Operation, Engine Mounts** of the *5th Generation 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 **General Information, Cab Heater and Air Conditioner** of the *5th Generation Cascadia Workshop Manual*.
4. Using a feeler gauge, check that the drive plate clutch clearance is within limits. See Table 37,Compressor Drive-Plate Clutch Clearance for clearance specifications. See Fig. 100,Drive-Plate Clearance Inspection for the checking method. If the drive plate clutch requires adjustment, see **General Information, Cab Heater and Air Conditioner** of the *5th Generation Cascadia Workshop Manual*.



NOTE: Check clearance in three equally spaced places.

Fig 100, Drive-Plate Clearance Inspection

Table 37, Compressor Drive-Plate Clutch Clearance

Manufacturer	Clearance: in (mm)
Denso	0.014 to 0.024 (0.35 to 0.60)

Table 37, 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 **General Information, Cab Heater and Air Conditioner** of the *5th Generation 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 **General Information, Cab Heater and Air Conditioner** of the *5th Generation Cascadia Workshop Manual*.

20.03 Replacement of the Air Filter

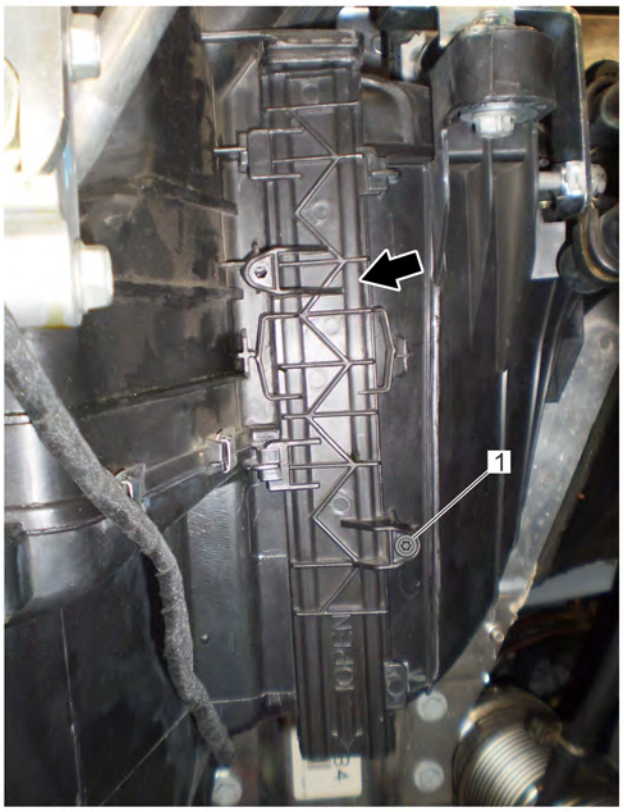
See ‘In this section’ below for a link to Replacement of the Air Filter topics.

20.03.01 Replacement of the Cab Fresh-Air Filter

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.

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

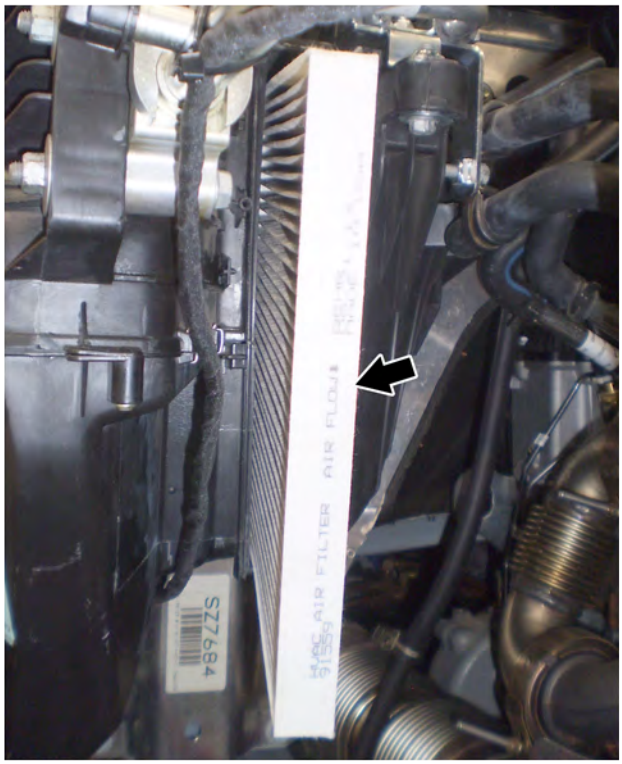
1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Open the hood.
3. Remove the self tapping screw.
4. Remove the intake filter access panel. Slide it down until it comes loose. See Fig. 101,Intake Filter Access Panel.



1. Self Tapping Screw

Fig 101, Intake Filter Access Panel

5. Remove the filter from the slot. Note the airflow directional arrow on the filter's edge. When properly installed, the airflow arrow will point inboard, toward the engine. See Fig. 102,Airflow Directional Arrow.



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1. Airflow Directional Arrow Orientation

Fig 102, Airflow Directional Arrow

6. Put a new filter in the slot, making sure the airflow arrow is correctly oriented, and install the access panel. Make sure the access panel locks into position.
7. Install a new self tapping screw (part number: 23-12187-050). Tighten the screw 12 to 17 lbf·in (135 to 192 N·cm). See Fig. .

20.03.02 Replacement Cab Recirculation-Air Filter

The recirculation air filter is located on the evaporator housing facing the interior of the cab just to the right of center. It is accessed from the underside of the unit. It is a coarse sponge, or fiber, filter. See Fig. 103,Cab Recirculation Air Filter.



1. Filter

Fig 103, Cab Recirculation Air Filter

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

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Remove the dash front right-hand access panel.
3. Remove the filter.
4. Install the new filter.
5. Install the access panel.

20.03.03 Replacement of the Sleeper Air Filter

In vehicles with 60-inch and 72-inch sleepers, the sleeper air filter is located on the forward side of the blower fan housing, under the cabinet, directly behind the driver's seat. In vehicles with 48-inch sleepers, the sleeper air filter is located on the forward side of the blower fan housing, under the bunk, 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. In vehicles with 60-inch and 72-inch sleepers, remove the sleeper HVAC access panel on the inboard side of the cabinet. See Fig. 104,Sleeper HVAC Access Panel, 60- and 72-inch Sleepers. The panel is held in place with four spring clips. Pull straight out to remove it.

   In vehicles with 48-inch sleepers, raise the lower bunk, and lift the access panel. See Fig. 105,Sleeper HVAC Access Panel, 48-inch Sleeper.

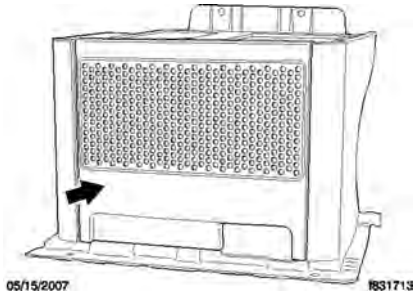


Fig 104, Sleeper HVAC Access Panel, 60- and 72-inch Sleepers

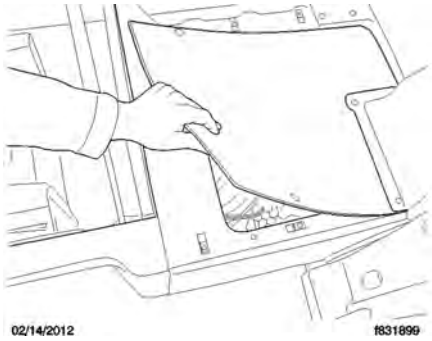
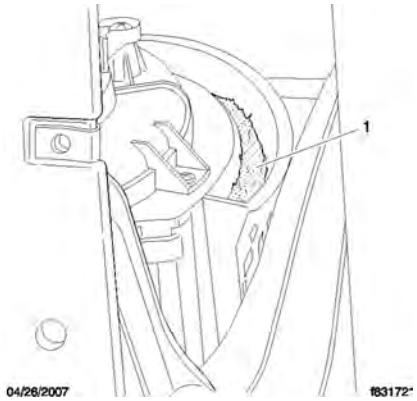


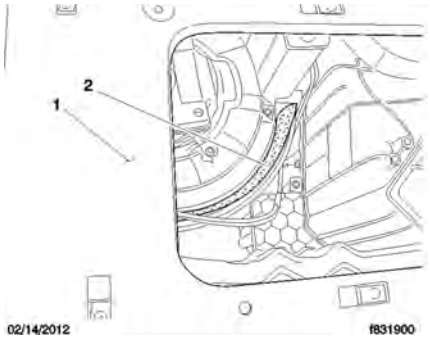
Fig 105, Sleeper HVAC Access Panel, 48-inch Sleeper

3. Lift the filter out of the slot. See Fig. 106,Removing the Filter, 60- and 72-inch Sleepers for 60- and 72-inch sleepers, or Fig. 107,Removing the Filter, 48-inch Sleeper for 48-inch sleepers.



1. Filter

Fig 106, Removing the Filter, 60- and 72-inch Sleepers



1. Bunk Frame Upper Surface
2. Filter

Fig 107, Removing the Filter, 48-inch Sleeper

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

20.03.04 Replacement of the Battery-Powered HVAC System (BPHS) Air Filter

The BPHS 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. 108,Sleeper HVAC Access Panel, 60- and 72-inch Sleepers. The panel is held in place with four spring clips. Pull straight out to remove it.

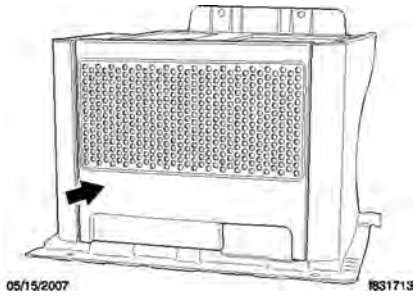
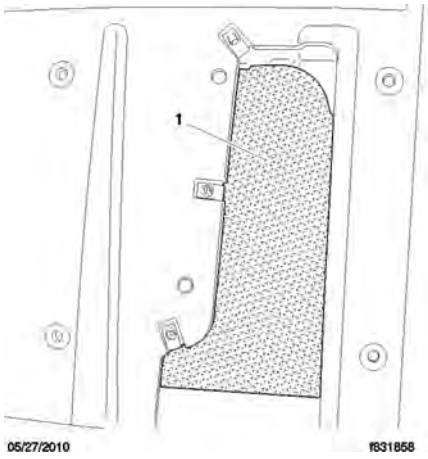


Fig 108, Sleeper HVAC Access Panel, 60- and 72-inch Sleepers

3. Pull the filter out of the slot. See Fig. 109,Removing the BPHS Filter.



1. Filter

Fig 109, Removing the BPHS Filter

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

20.04 Inspection of the Battery Powered HVAC System (BPHS)

See ‘In this section’ below for a link to inspection of the battery powered HVAC system (BPHS) topics.

20.04.01 Fuel-Operated Heater Check

1. Start the BPHS 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.

20.04.02 Inspection of the Drain Tube

NOTICE:
The BPHS 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 BPHS unit.

   NOTE: Remove and clean the drain tubes.

2. Remove the drain tube(s) from the bottom of the unit. See Fig. 110,Drain Tube Inspection.

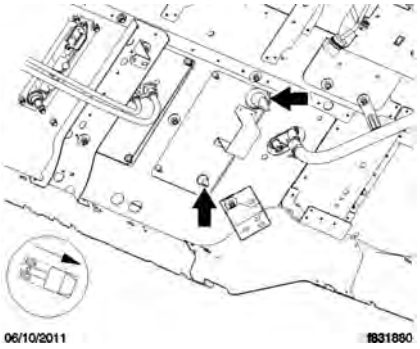


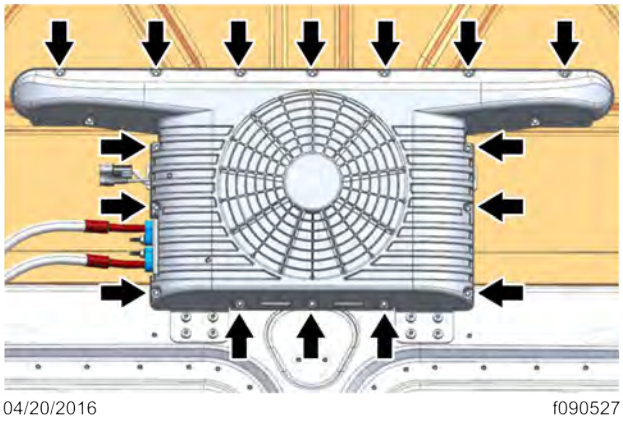
Fig 110, Drain Tube Inspection

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.

20.04.03 Inspection and Cleaning of the External A/C Condenser

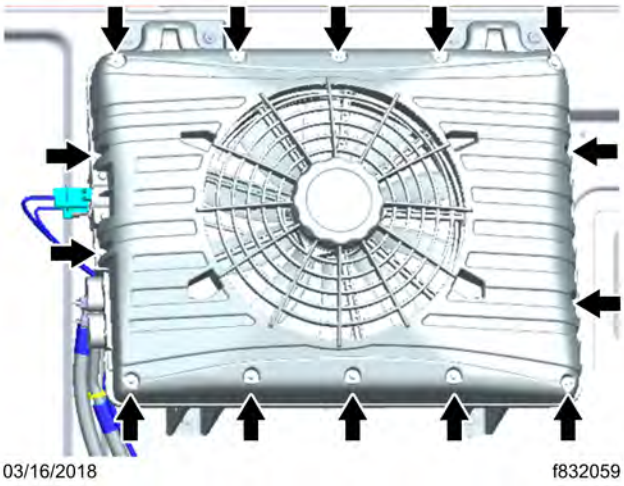
The BPHS A/C condenser is located on the backwall of the sleeper. Inspect the condenser as follows.

1. Check for debris in the condenser housing.
2. If needed, remove the condenser cover fasteners, then remove the cover. See Fig. 111,Condenser Cover Fasteners (wide style condenser) or Fig. 112,Condenser Cover Fasteners (compact style condenser).



NOTE: Remove the condenser cover.

Fig 111, Condenser Cover Fasteners (wide style condenser)



NOTE: Remove the condenser cover.

Fig 112, Condenser Cover Fasteners (compact style condenser)

3. Clean out any debris in the module.
4. Install the cover.

CONTACT INFORMATION

For questions, please create a Service Technical Request using the DTTS Application on the DTNA Portal.

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