4700, 5700, 4900, 6900 Maintenance Manual

Models: 4700 Models
4900 Models
5700 Models
6900 Models

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1. Introduction

1.01 Foreword

Foreword

Instructions and procedures are those recommended by Freightliner Trucks, Western Star, Freightliner Custom Chassis Corporation (FCCC), Thomas Built Buses (TBB), 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.

Refer to https://northamerica.daimlertruck.com/ for more information, or contact Daimler Truck North America LLC at the address below.

Environmental Concerns and Recommendations

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

NOTICE:
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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Daimler Truck North America LLC Service Systems and Documentation

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1.02 Descriptions of Service Publications

1.02.01 Workshop/Service Manual

Daimler Truck North America LLC distributes the following major service publications in paper and electronic formats.

Refer to Workshop/service manuals contain service and repair information for all vehicle systems and components, except for major components such as engines, transmissions, and rear axles. Each workshop/service manual section is divided into subjects that can include general information, principles of operation, removal, disassembly, assembly, installation, and specifications.

1.02.02 Maintenance Manual

Maintenance manuals contain routine maintenance procedures and intervals for vehicle components and systems. They have information such as lubrication procedures and tables, fluid replacement procedures, fluid capacities, specifications, and procedures for adjustments and for checking the tightness of fasteners. Maintenance manuals do not contain detailed repair or service information. 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. These are recommendations, not requirements.

1.02.03 Driver’s/Operator’s Manual

Driver's/operator's manuals contain information needed to enhance the driver's understanding of how to operate and care for the vehicle and its components. Each manual contains a chapter that covers pre-trip and post-trip inspections, and daily, weekly, and monthly maintenance of vehicle components. Driver's/operator's manuals do not contain detailed repair or service information.

1.02.04 Service Bulletins

Service bulletins provide the latest service tips, field repairs, product improvements, and related information. Some service bulletins are updates to information in the workshop/service manual. These bulletins take precedence over workshop/service manual information, until the latter is updated; at that time, the bulletin is usually canceled. The service bulletins manual is available only to dealers. When doing service work on a vehicle system or part, check for a valid service bulletin for the latest information on the subject.

IMPORTANT: Before using a particular service bulletin, check the current service bulletin validity list to be sure the bulletin is valid.

1.02.05 Parts Technical Bulletins

Parts technical bulletins provide information on parts. These bulletins contain lists of parts and BOMs needed to do replacement and upgrade procedures.

1.02.06 DTNAConnect

Web-based repair, service, and parts documentation can be accessed using the following applications on the DTNAConnect provides Web-based access to the most up-to-date versions of the publications listed above. In addition, the Service Solutions feature provides diagnostic assistance with Symptoms Search, by connecting to a large knowledge base gathered from technicians and service personnel. Search results for both documents and service solutions can be narrowed by initially entering vehicle identification data.

1.02.07 PartsProX

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

1.02.08 EZWiring

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

1.02.09 Recall Campaigns

Warranty-related service information available on the 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.

1.02.10 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.

1.03 Page Description

For an example of a **Western Star Maintenance Manual** page, see Fig.1,Example of a Maintenance Manual Page.

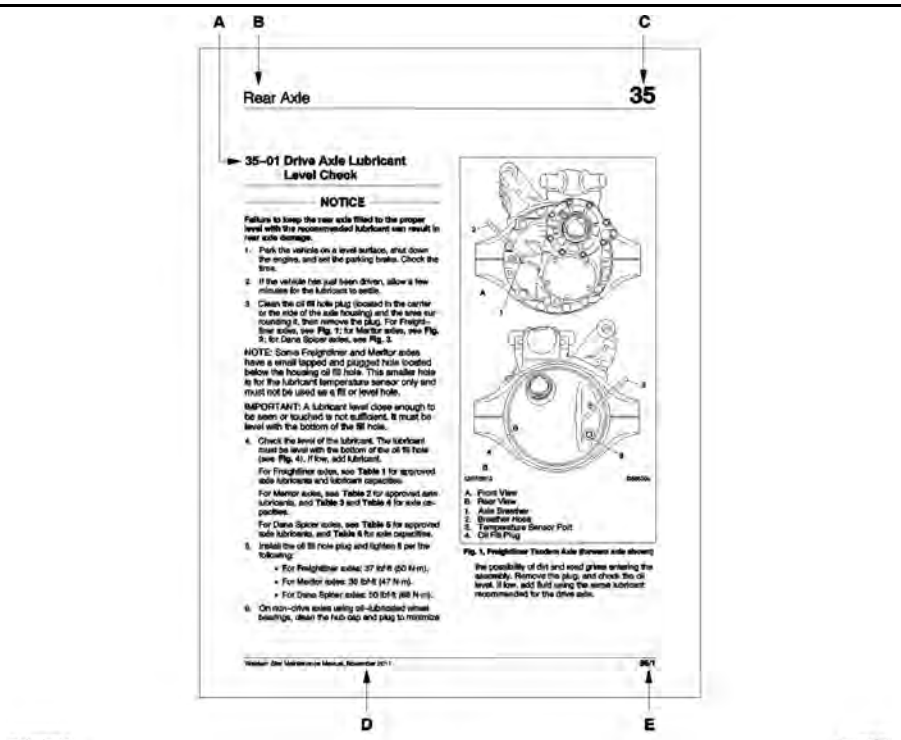


Fig 1, Example of a Maintenance Manual Page

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2. General Information

2.01 Determining Scheduled Maintenance Intervals: 00–01

Performing regular maintenance will help ensure that your Western Star 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 downtime.

To determine the correct maintenance intervals for your vehicle, you must first determine the type of service or conditions in which the vehicle will be operating. Generally, most 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 Maintenance Service Table (**00–02**) or the Vehicle Maintenance Schedule Tables (**00–03**) to determine how often maintenance should be performed.

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

Types of Service

Service Schedule I (severe service) applies to vehicles that travel less than 60,000 miles (100 000 km) annually or that operate under severe conditions. Examples of Service Schedule I usage are:

- operation on extremely poor roads or where there is heavy dust accumulation
- constant exposure to extreme hot, cold, salt air, or other extreme climates
- frequent short-distance travel
- construction-site operation
- city operation such as fire truck or garbage truck
- logging
- farm operation

Service Schedule II(long-haul transport) applies to vehicles that travel more than 60,000 miles (100 000 km) annually with minimal city or stop-and-go operation. Examples of Service Schedule II usage are:

- regional delivery that is mostly freeway miles
- interstate transport
- any highway operation with high annual mileage

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

2.02 Maintenance Service Table: 00–02

Table 1, Maintenance Service Schedule Table

Service Schedule	Maintenane Interval Operation	Maintenance Interval			
		Frequency	Miles	km	Hours
Schedule I [1] (Severe service) vehicles that travel up to 60,000 miles (100 000 km) annually	Initial Maintenance (IM)	first	1000	1600	100
	Maintenance 1 (M1)	every	1000	1600	100
	Maintenance 2 (M2)	every	5000	8000	500

	Maintenance 3 (M3)	every	10,000	16 000	1000
	Maintenance 4 (M4)	every	20,000	32 000	2000
Schedule II [2] (Long-Haul Transport) vehicles that travel over 60,000 miles (100 000 km) annually	Initial Maintenance (IM)	first	12,500	20 000	
	Maintenance 1 (M1)	every	12,500	20 000	
	Maintenance 2 (M2)	every	50,000	80 000	
	Maintenance 3 (M3)	every	100,000	160 000	
	Maintenance 4 (M4)	every	300,000	480 000	

1. *For Service Schedule I (severe service) vehicles equipped with an hourmeter, use maintenance intervals based on hours of operation rather than distance traveled.
2. †Use Service Schedule I (severe service) maintenance intervals for vehicles that operate under severe conditions, such as extremely poor roads, heavy dust accumulation, extreme climate, frequent short distance travel, construction-site operation, logging, city operation, or farm operation.

Table 1, Maintenance Service Schedule Table

2.03 Vehicle Maintenance Schedule Table: 00–03

Table 2, 1st through 34th Maintenance for Service Schedule I Vehicles

1st through 34th Maintenance for Service Schedule I Vehicles					
Maint. No.	**Required Maintenance Operation Interval**	**Service Date**	**Service I**		
			Miles	**km**	**Hours**
1st	Initial Maintenance (IM)/M1		1000	1600	100
2nd	M1		2000	3200	200
3rd	M1		3000	4800	300
4th	M1		4000	6400	400
5th	M1 and M2		5000	8000	500
6th	M1		6000	9600	600
7th	M1		7000	11 200	700
8th	M1		8000	12 800	800
9th	M1		9000	14 400	900
10th	M1, M2, and M3		10,000	16 000	1000
11th	M1		11,000	17 600	1100
12th	M1		12,000	19 200	1200

13th	M1		13,000	20 800	1300
14th	M1		14,000	22 400	1400
15th	M1 and M2		15,000	24 000	1500
16th	M1		16,000	25 600	1600
17th	M1		17,000	27 200	1700
18th	M1		18,000	28 800	1800
19th	M1		19,000	30 400	1900
20th	M1, M2, M3, and M4		20,000	32 000	2000
21st	M1		21,000	33 600	2100
22nd	M1		22,000	35 200	2200
23rd	M1		23,000	36 800	2300
24th	M1		24,000	38 400	2400
25th	M1 and M2		25,000	40 000	2500
26th	M1		26,000	41 600	2600
27th	M1		27,000	43 200	2700
28th	M1		28,000	44 800	2800
29th	M1		29,000	46 400	2900
30th	M1, M2, and M3		30,000	48 000	3000
31st	M1		31,000	49 600	3100
32nd	M1		32,000	51 200	3200
33rd	M1		33,000	52 800	3300
34th	M1		34,000	54 400	3400

Table 2, 1st through 34th Maintenance for Service Schedule I Vehicles

Table 3, 35th through 68th Maintenance for Service Schedule I Vehicles

35th through 68th Maintenance for Service Schedule I Vehicles					
Maint. No.	**Required Maintenance Operation Interval**	**Service Date**	**Service I**		
			Miles	**km**	**Hours**
35th	M1 and M2		35,000	56 000	3500
36th	M1		36,000	57 600	3600

37th	M1		37,000	59 200	3700
38th	M1		38,000	60 800	3800
39th	M1		39,000	62 400	3900
40th	M1, M2, M3, and M4		40,000	64 000	4000
41st	M1		41,000	65 600	4100
42nd	M1		42,000	67 200	4200
43rd	M1		43,000	68 800	4300
44th	M1		44,000	70 400	4400
45th	M1 and M2		45,000	72 000	4500
46th	M1		46,000	73 600	4600
47th	M1		47,000	75 200	4700
48th	M1		48,000	76 800	4800
49th	M1		49,000	78 400	4900
50th	M1, M2, and M3		50,000	80 000	5000
51st	M1		51,000	82 000	5100
52nd	M1		52,000	83 700	5200
53rd	M1		53,000	85 300	5300
54th	M1		54,000	86 900	5400
55th	M1 and M2		55,000	88 500	5500
56th	M1		56,000	90 100	5600
57th	M1		57,000	91 700	5700
58th	M1		58,000	93 300	5800
59th	M1		59,000	94 900	5900
60th	M1, M2, M3, and M4		60,000	96 500	6000
61st	M1		61,000	98 200	6100
62nd	M1		62,000	99 800	6200
63rd	M1		63,000	101 400	6300
64th	M1		64,000	103 000	6400

65th	M1 and M2		65,000	104 600	6500
66th	M1		66,000	106 200	6600
67th	M1		67,000	107 800	6700
68th	M1		68,000	109 400	6800

Table 3, 35th through 68th Maintenance for Service Schedule I Vehicles

Table 4, 69th through 100th Maintenance for Service Schedule I Vehicles

69th through 100th Maintenance for Service Schedule I Vehicles					
Maint. No.	Required Maintenance Operation Interval	Service Date	Service I		
			Miles	km	Hours
69th	M1		69,000	111 000	6900
70th	M1, M2, and M3		70,000	112 700	7000
71st	M1		71,000	114 300	7100
72nd	M1		72,000	115 900	7200
73rd	M1		73,000	117 500	7300
74th	M1		74,000	119 100	7400
75th	M1 and M2		75,000	120 700	7500
76th	M1		76,000	122 300	7600
77th	M1		77,000	123 900	7700
78th	M1		78,000	125 500	7800
79th	M1		79,000	127 100	7900
80th	M1, M2, M3, and M4		80,000	128 700	8000
81st	M1		81,000	130 400	8100
82nd	M1		82,000	132 000	8200
83rd	M1		83,000	134 000	8300
84th	M1		84,000	135 200	8400
85th	M1 and M2		85,000	137 000	8500
86th	M1		86,000	138 400	8600
87th	M1		87,000	140 000	8700
88th	M1		88,000	141 600	8800

89th	M1		89,000	143 200	8900
90th	M1, M2, and M3		90,000	144 800	9000
91st	M1		91,000	146 500	9100
92nd	M1		92,000	148 100	9200
93rd	M1		93,000	150 000	9300
94th	M1		94,000	151 300	9400
95th	M1 and M2		95,000	153 000	9500
96th	M1		96,000	155 000	9600
97th	M1		97,000	156 100	9700
98th	M1		98,000	157 700	9800
99th	M1		99,000	159 300	9900
100th	M1, M2, M3, and M4		100,000	160 900	10,000

Table 4, 69th through 100th Maintenance for Service Schedule I Vehicles

Table 5, 1st through 24th Maintenance for Service Schedule II Vehicles

1st through 24th Maintenance for Service Schedule II Vehicles				
1st	Initial Maintenance (IM)/ M1		12,500	20 000
2nd	M1		25,000	40 000
3rd	M1		37,000	60 000
4th	M1 and M2		50,000	80 000
5th	M1		62,000	100 000
6th	M1		75,000	120 000
7th	M1		87,000	140 000
8th	M1, M2, and M3		100,000	160 000
9th	M1		112,000	180 000
10th	M1		125,000	200 000
11th	M1		137,000	220 000
12th	M1 and M2		150,000	240 000
13th	M1		162,000	260 000

14th	M1		175,000	280 000
15th	M1		187,000	300 000
16th	M1, M2, and M3		200,000	320 000
17th	M1		212,000	340 000
18th	M1		225,000	360 000
19th	M1		237,000	380 000
20th	M1 and M2		250,000	400 000
21st	M1		262,000	420 000
22nd	M1		275,000	440 000
23rd	M1		287,000	460 000
24th	M1, M2, M3, and M4		300,000	480 000

Table 5, 1st through 24th Maintenance for Service Schedule II Vehicles

2.04 Maintenance Operation Sets Table: 00–04

IMPORTANT: At each Maintenance Operation Set, in addition to the maintenance operations listed here, perform all daily, weekly, and monthly maintenance operations listed in the "Pretrip and Post-Trip Inspection and Maintenance" chapter of the *Western Star Driver's Manual*.

NOTE: Maintenance operations appearing in italics in this table are for noise emission control components. Numbers in this table are reference numbers matching those in the text of this manual.

Table 6, Maintenance Operation Sets for Groups 00 through 88

Maintenance Operation Sets for Groups 00 through 88							
Maint. Oper. No.	Operation Description	Maintenance Interval				
		I-M	M1	M2	M3	M4
3.02	3.02 Engine Noise Panel Inspection (Noise Emission Control)				•	•
3.03.01	3.03.01 Inspection of the Belt and Pulley				•	•
3.04	3.04 Inspection and Maintenance Of The Pacbrake®			•	•	•
3.05	3.05 Engine-Support Fasteners Check (Noise Emission Control)				•	•
4.01.01	4.01.01 Engine-Mounted Air Cleaner, 5700 Models				•	•
4.02.01	4.02.01 Engine-Mounted Air Cleaner, 5700 Models[1]				•	•

4.03	4.03 Inspection Of The Charge Air Cooler				•	•
5.02	5.02 Inspection Of The Air Compressor	•	•	•	•	•
6.02	6.02 Alternator and Starter Check	•			•	•
6.03	6.03 Battery Check	•			•	•
7.02.01	7.02.01 General Information	•	•	•	•	•
7.03	7.03 Inspection Of The Cooling System (Noise Emission Control)			•	•	•
7.04	7.04 Pressure/Filler Cap Test			•	•	•
7.05	7.05 Cooling System Pressure-Flush					•
8.02	8.02 Clutch Release Bearing Lubrication[2]	•	•	•	•	•
8.03	8.03 Clutch Release Cross-Shaft Lubrication	•	•	•	•	•
8.04	8.04 Sleeve Assembly Bronze Bushing Lubrication	•	•	•	•	•
8.05	8.05 Fluid Level Check, Hydraulic Clutch Control		•	•	•	•
8.06.01	8.06.01 General information					•
9.02.01	9.02.01 Allison Transmission	•	•	•	•	•
9.03	9.03 Manual Transmission Fluid Change	•		•	•	•
9.04.01	9.04.01 Eaton/Fuller	•		•	•	•
9.05	9.05 Inspection Of The ESS Transmission Filter and Boot					•
9.06	9.06 Inspection Of The Transmission					•
9.07	9.07 Allison and Eaton Fuller Transmission Breather Check		•	•	•	•
9.08	9.08 Allison Transmission Fluid and Filter Change[3]			•	•	•
9.09	9.09 Detroit™ Automated Transmission Fluid Change and Magnetic Plug Cleaning				•	
9.10	9.10 Inspection Of The Detroit™ Automated Transmission Fluid Level				•	•
10.02.01	10.02.01 General information	•	•	•	•	•
10.03.01	10.03.01 General information	•	•	•	•	•
10.04	10.04 Inspection Of The Holland Fifth Wheel Sliding Mechanism			•	•	•
10.05	10.05 Frame Fastener Torque Check	•			•	•
10.06	10.06 Trailer Electrical Connector Lubrication	•	•	•	•	•
10.07	10.07 Inspection Of The Premier 690 Coupling	•	•			

11.02.01	11.02.01 Front Suspension Check	•	•	•	•	•
11.03.01	11.03.01 Front Suspension	•	•	•	•	•
11.04	11.04 Suspension U-Bolt Torque Check	•			•	•
12.02.01	12.02.01 Detroit® Axles[4]	•	•	•	•	•
12.03	12.03 Lubrication of the Tie Rod[5]	•	•	•	•	•
12.04	12.04 Inspection of the Tie Rod	•	•	•	•	•
12.05	12.05 Lubrication of the Front Axle Wheel Bearing	•	•	•	•	•
12.06	12.06 Front Drive Axle Lubricant Level Check	•	•	•	•	•
12.07	12.07 Front Drive Axle Lubricant Change	•			•	•
12.08.01	12.08.01 General Information	•				
12.09.01	12.09.01 General Information		•	•	•	•
13.02	13.02 Drive Axle Lubricant Level Check	•	•	•	•	•
13.03	13.03 Two-Speed-Axle Shift Unit Lubricant Level Check				•	•
13.04	13.04 Drive Axle Breather Check	•	•	•	•	•
13.05.01	13.05.01 Detroit	•			•	•
14.01	14.01 Wheel Nut and Rim Nut Torque Check	•	•	•	•	•
14.02	14.02 Tire Check	•	•	•	•	•
15.02	15.02 Inspection of the Driveline	•	•	•	•	•
15.03.01	15.03.01 Lubrication Of The Universal Joint	•	•	•	•	•
16.03	16.03 Air Dryer Inspection	•	•	•	•	•
16.04.01	16.04.01 Bendix AD-9 Air Dryers[6]		•	•	•	•
16.05.01	16.05.01 Midland				•	•
16.06	16.06 Camshaft Bracket Lubrication	•	•	•	•	•
16.07.01	16.07.01 General Information	•	•	•	•	•
16.08.01	16.08.01 Parking Brake Operational Check	•	•	•	•	•
16.09.01	16.09.01 General Information[7]		•	•	•	•
16.10.01	16.10.01 Operating Test[8]	•	•			
17.02	17.02 Inspection Of The Drag Link	•	•	•	•	•
17.03	17.03 Lubrication of the Drag Link	•	•	•	•	•
17.04.01	17.04.01 Cylindrical Reservoir, Bottom Return Port (Fig.)					•

17.05	17.05 Lubrication Of The Steering Shaft	•	•	•	•	•
17.06	17.06 Lubrication Of The Power Steering Gear	•	•	•	•	•
18.02	18.02 Replacement Of The Fuel Filter	•	•	•	•	•
18.03.01	18.03.01 Alliance/Racor			•	•	•
18.04.01	18.04.01 Rectangular Fuel Tank	•	•	•	•	•
19.02.01	19.02.01 General Information	•	•	•	•	•
19.03	19.03 Replacement Of The CAT CGI Bellows					•
20.02	20.02 Inspection Of The Cab Suspension			•	•	•
20.03	20.03 Mirror Folding Check				•	•
20.04	20.04 Inspection Of The Aerodynamic Component		•	•	•	•
21.01	21.01 Door Seal, Door Latch, Door Hinge, and Door Check Lubrication	•	•	•	•	•
22.02	22.02 Inspection Of The Air Conditioner			•	•	•
22.03.01	22.03.01 General Information	•	•	•	•	•
23.01	23.01 Hood Rear Support Lubrication		•	•	•	•

1. For 5700 models, complete this procedure every 300,000 miles (485 000 km).
2. For Eaton Easy Pedal Advantage clutches, the interval is 50,000 miles (161 000 km) for linehaul applications.
3. Intervals vary by transmission model, application, lubricant, and use. Contact Allison to determine the precise interval(s) for the transmission model and lubricant used on the vehicle.
4. For Detroit axles, complete this procedure once a year or at the following applicable interval, whichever comes first: every 5000 miles (8000 km) for Schedule I vehicles; or every 100,000 miles (161 000 km) for Schedule II vehicles.
5. For Detroit axles, complete this procedure once a year or at the following applicable interval, whichever comes first: every 5000 miles (8000 km) for Schedule I vehicles; or every 100,000 miles (161 000 km) for Schedule II vehicles.
6. If equipped with an oil-coalescing desiccant cartridge, replace the cartridge once a year, regardless of mileage. Otherwise use the M4 maintenance interval.
7. Complete this procedure every 25,000 miles (40 225 km), 3 months, or 500 operating hours, whichever comes first.
8. The automatic drain valve should be inspected every 6 months or 1500 operating hours, whichever comes first.

Table 6, Maintenance Operation Sets for Groups 00 through 88

2.05 Initial Maintenance (IM) Operations: 00–05

IMPORTANT: After performing all operations listed in this table, perform all daily and weekly maintenance operations listed in the "Pretrip Inspection and Daily Maintenance" chapter of the *Western Star Driver's Manual* .

NOTE: Numbers in this table are reference numbers matching those in the text of this manual.

Table 7, Initial Maintenance (IM) Operations

Initial Maintenance (IM) Operations		
Maintenance Operation Number	**Operation Description**	**Check**
2.07	2.07 M1 Maintenance Interval Operations Table: 00–07	
6.02	6.02 Alternator and Starter Check	

6.03	6.03 Battery Check	
9.03	9.03 Manual Transmission Fluid Change	
9.04.01	9.04.01 Eaton/Fuller	
10.05	10.05 Frame Fastener Torque Check	
10.07	10.07 Inspection Of The Premier 690 Coupling	
11.04	11.04 Suspension U-Bolt Torque Check	
12.07	12.07 Front Drive Axle Lubricant Change	
12.08.01	12.08.01 General Information	
13.05.01	13.05.01 Detroit	
16.10.01	16.10.01 Operating Test[1]	

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

Table 7, Initial Maintenance (IM) Operations

2.06 Lubrication and Fluid Level Check: 00–06

Table.8,Lubrication and Fluid Level Check for Service Schedules I and II summarizes all operations that must be performed to complete Lubrication and Fluid Level Check Operation 00–06 called for as an M1 maintenance interval for Service Schedule I and II vehicles.

Maintenance operation numbers given in the table are reference numbers used to help you find detailed instructions in the manual on the lubrication or fluid checking.

Table 8, Lubrication and Fluid Level Check for Service Schedules I and II

Lubrication and Fluid Level Check for Service Schedules I and II		
Maintenance Operation Number	**Operation Description**	**Check**
8.02	8.02 Clutch Release Bearing Lubrication[1]	
8.03	8.03 Clutch Release Cross-Shaft Lubrication	
8.04	8.04 Sleeve Assembly Bronze Bushing Lubrication	
8.05	8.05 Fluid Level Check, Hydraulic Clutch Control	
9.02.01	9.02.01 Allison Transmission	
10.03.01	10.03.01 General information	
10.06	10.06 Trailer Electrical Connector Lubrication	
11.03.01	11.03.01 Front Suspension	
12.02.01	12.02.01 Detroit® Axles[2]	
12.03	12.03 Lubrication of the Tie Rod[3]	
12.05	12.05 Lubrication of the Front Axle Wheel Bearing	
12.06	12.06 Front Drive Axle Lubricant Level Check	
13.02	13.02 Drive Axle Lubricant Level Check	
15.03.01	15.03.01 Lubrication Of The Universal Joint	

16.06	16.06 Camshaft Bracket Lubrication	
16.07.01	16.07.01 General Information	
17.03	17.03 Lubrication of the Drag Link	
17.05	17.05 Lubrication Of The Steering Shaft	
17.06	17.06 Lubrication Of The Power Steering Gear	
21.01	21.01 Door Seal, Door Latch, Door Hinge, and Door Check Lubrication	
23.01	23.01 Hood Rear Support Lubrication[4]	

1. For Eaton Easy Pedal Advantage clutches, the interval is 50,000 miles (161 000 km) for linehaul applications.
2. For Detroit axles, complete this procedure once a year or at the following applicable interval, whichever comes first: every 5000 miles (8000 km) for Schedule I vehicles; or every 100,000 miles (161 000 km) for Schedule II vehicles.
3. For Detroit axles, complete this procedure once a year or at the following applicable interval, whichever comes first: every 5000 miles (8000 km) for Schedule I vehicles; or every 100,000 miles (161 000 km) for Schedule II vehicles.
4. The automatic drain valve should be inspected every 6 months or 1500 operating hours, whichever comes first.

Table 8, Lubrication and Fluid Level Check for Service Schedules I and II

2.07 M1 Maintenance Interval Operations Table: 00–07

The M1 Maintenance Interval Operations table lists 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 **Western Star® Driver's Manual**.

Table 9, M1 Maintenance Interval Operations for Service Schedules I and II

M1 Maintenance Interval Operations for Service Schedules I and II		
Maintenance Operation Number	**Operation Description**	**Check**
2.06	2.06 Lubrication and Fluid Level Check: 00–06	
5.02	5.02 Inspection Of The Air Compressor	
7.02.01	7.02.01 General Information	
9.07	9.07 Allison and Eaton Fuller Transmission Breather Check	
10.02.01	10.02.01 General information	
10.07	10.07 Inspection Of The Premier 690 Coupling	
11.02.01	11.02.01 Front Suspension Check	
12.04	12.04 Inspection of the Tie Rod	
12.09.01	12.09.01 General Information	
13.04	13.04 Drive Axle Breather Check	
14.01	14.01 Wheel Nut and Rim Nut Torque Check	
14.02	14.02 Tire Check	
15.02	15.02 Inspection of the Driveline	

16.03	16.03 Air Dryer Inspection	
16.04.01	16.04.01 Bendix AD-9 Air Dryers	
16.08.01	16.08.01 Parking Brake Operational Check	
16.09.01	16.09.01 General Information[1]	
16.10.01	16.10.01 Operating Test[2]	
17.02	17.02 Inspection Of The Drag Link	
18.02	18.02 Replacement Of The Fuel Filter	
18.03.01	18.03.01 Alliance/Racor	
19.02.01	19.02.01 General Information	
20.04	20.04 Inspection Of The Aerodynamic Component	
22.03.01	22.03.01 General Information	

1. Complete this procedure every 25,000 miles (40 225 km), 3 months, or 500 operating hours, whichever comes first.
2. The automatic drain valve should be inspected every 6 months or 1500 operating hours, whichever comes first.

Table 9, M1 Maintenance Interval Operations for Service Schedules I and II

2.08 M2 Maintenance Interval Operations Table: 00–08

The M2 Maintenance Interval Operations table lists 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.

NOTE: Maintenance operations appearing in italics in this table are for noise emission control components.

Table 10, M2 Maintenance Interval Operations for Service Schedules I and II

M2 Maintenance Interval Operations for Service Schedules I and II		
Maintenance Operation Number	**Operation Description**	**Check**
2.07	2.07 M1 Maintenance Interval Operations Table: 00–07	
3.04	3.04 Inspection and Maintenance Of The Pacbrake®	
7.03	7.03 Inspection Of The Cooling System (Noise Emission Control)	
7.04	7.04 Pressure/Filler Cap Test	
9.03	9.03 Manual Transmission Fluid Change	
9.04.01	9.04.01 Eaton/Fuller	
9.08	9.08 Allison Transmission Fluid and Filter Change[1]	
10.04	10.04 Inspection Of The Holland Fifth Wheel Sliding Mechanism	
18.03.01	18.03.01 Alliance/Racor	
20.02	20.02 Inspection Of The Cab Suspension	
22.02	22.02 Inspection Of The Air Conditioner	

1. Intervals vary by transmission model, application, lubricant, and use. Contact Allison to determine the precise interval(s) for the transmission model and lubricant used on the vehicle.

Table 10, M2 Maintenance Interval Operations for Service Schedules I and II

2.09 M3 Maintenance Interval Operations Table: 00–09

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 maintenance interval operations in M1 and M2 when performing M3 maintenance interval operations.

NOTE: Maintenance operations appearing in italics in this table are for noise emission control components.

Table 11, M3 Maintenance Interval Operations for Service Schedules I and II

M3 Maintenance Interval Operations for Service Schedules I and III		
Maintenance Operation Number	**Operation Description**	**Check**
2.07	2.07 M1 Maintenance Interval Operations Table: 00–07	
2.08	2.08 M2 Maintenance Interval Operations Table: 00–08	
3.02	3.02 Engine Noise Panel Inspection (Noise Emission Control)	
3.03.01	3.03.01 Inspection of the Belt and Pulley	
3.05	3.05 Engine-Support Fasteners Check (Noise Emission Control)	
4.01.01	4.01.01 Engine-Mounted Air Cleaner, 5700 Models	
4.02.01	4.02.01 Engine-Mounted Air Cleaner, 5700 Models[1]	
4.03	4.03 Inspection Of The Charge Air Cooler	
6.02	6.02 Alternator and Starter Check	
6.03	6.03 Battery Check	
9.09	9.09 Detroit™ Automated Transmission Fluid Change and Magnetic Plug Cleaning	
9.10	9.10 Inspection Of The Detroit™ Automated Transmission Fluid Level	
10.05	10.05 Frame Fastener Torque Check	
11.04	11.04 Suspension U-Bolt Torque Check	
12.07	12.07 Front Drive Axle Lubricant Change	
13.03	13.03 Two-Speed-Axle Shift Unit Lubricant Level Check	
13.05.01	13.05.01 Detroit	
16.05.01	16.05.01 Midland	
20.03	20.03 Mirror Folding Check	

1. For 5700 models, complete this procedure every 300,000 miles (485 000 km).

Table 11, M3 Maintenance Interval Operations for Service Schedules I and II

2.10 M4 Maintenance Interval Operations Table: 00–10

The M4 Maintenance Interval Operations table lists all maintenance operations that are to be performed at the M4 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 maintenance interval operations in M1, M2, and M3 when performing M4 maintenance interval operations.

Table 12, M4 Maintenance Interval Operations for Service Schedules I and II

M4 Maintenance Interval Operations for Service Schedules I and II		
Maintenance Operation Number	**Operation Description**	**Check**
2.07	2.07 M1 Maintenance Interval Operations Table: 00–07	
2.08	2.08 M2 Maintenance Interval Operations Table: 00–08	
2.09	2.09 M3 Maintenance Interval Operations Table: 00–09	
7.05	7.05 Cooling System Pressure-Flush	
8.06.01	8.06.01 General information	
9.05	9.05 Inspection Of The ESS Transmission Filter and Boot	
9.06	9.06 Inspection Of The Transmission	
16.04.01	16.04.01 Bendix AD-9 Air Dryers	
17.04.01	17.04.01 Cylindrical Reservoir, Bottom Return Port (Fig.)	
19.03	19.03 Replacement Of The CAT CGI Bellows	

Table 12, M4 Maintenance Interval Operations for Service Schedules I and II

2.11 Noise Emission Controls Maintenance

2.11.01 Noise Emission Controls Maintenance: 00–11

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 service manual, provides these instructions to owners.

Recommendations for Replacement Parts

Replacement parts, used for the maintenance or repair of noise emission controls, should be genuine Western Star parts. If other than genuine Western Star 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 or to be equivalent to the genuine Western Star parts in performance and durability.

Western Star 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 the 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 the vehicle 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.

The removal of engine sound-suppression panels.

The removal of cab tunnel or hood sound-suppression panels.

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

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

The removal of the fan shroud.

The removal of, or rendering inoperative, engine exhaust components, including the exhaust pipe clamping.

The removal of air intake components.

2.11.02 Maintenance Instructions

Scheduled intervals are in the maintenance tables in this group. A “Verification of Inspections Log (Groups 01, 20, and 49)” follows. These logs should be filled in each time the noise emission controls on the vehicle are maintained, repaired, or replaced.

2.12 Verification of Inspections Log: 00–12

Verification of Inspections Log

Table 13, Verification of Inspections Log (Group 01) Engine Rear Supports and Engine Noise Panels

Verification of Inspections Log (Group 01) Engine Rear Supports and Engine Noise Panels				
Date	**Mileage**	**Item**	**Cost**	**Maintenance Facility**

Table 13, Verification of Inspections Log (Group 01) Engine Rear Supports and Engine Noise Panels

Table 14, Verification of Inspections Log (Group 20) Fan Drive

Verification of Inspections Log (Group 20) Fan Drive				
Date	**Mileage**	**Item**	**Cost**	**Maintenance Facility**

Table 14, Verification of Inspections Log (Group 20) Fan Drive

Table 15, Verification of Inspections Log (Group 49) Exhaust System Components

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

Table 15, Verification of Inspections Log (Group 49) Exhaust System Components

3.01 Safety Precautions 30
3.02 Engine Noise Panel Inspection (Noise Emission Control) 30
3.03 Engine Belt Inspection 30
3.03.01 Inspection of the Belt and Pulley 30
3.03.02 Inspection of the Belt Tension 32
3.03.03 Belt Routing 33
3.04 Inspection and Maintenance Of The Pacbrake® 37
3.05 Engine-Support Fasteners Check (Noise Emission Control) 38

3. Engine

3.01 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.

3.02 Engine Noise Panel Inspection (Noise Emission Control)

If equipped, inspect for torn engine panels. See Fig.2,Caterpillar Engine Noise Panels for Caterpillar noise panel locations. If the panels are torn, contact your Western Star dealer to have them replaced. Cummins M11, N14, ISC, and ISL engines, and Detroit Diesel Series 60 and DD13 engines do not have engine noise panels.

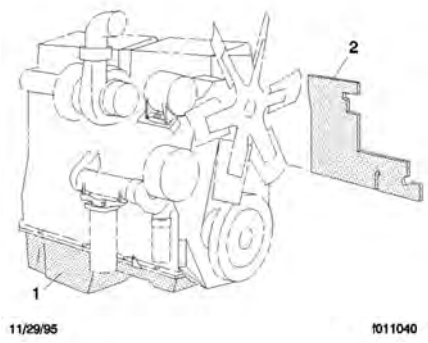


Fig 2, Caterpillar Engine Noise Panels

3.03 Engine Belt Inspection

3.03.01 Inspection of the Belt and Pulley

Worn or loose drive belts may cause engine overheating or loss of alternator power. Replace the drive belt if any conditions described in Fig.3,Damaged Belts are found. To inspect a belt, gently twist it to view the belt sidewalls and bottom.

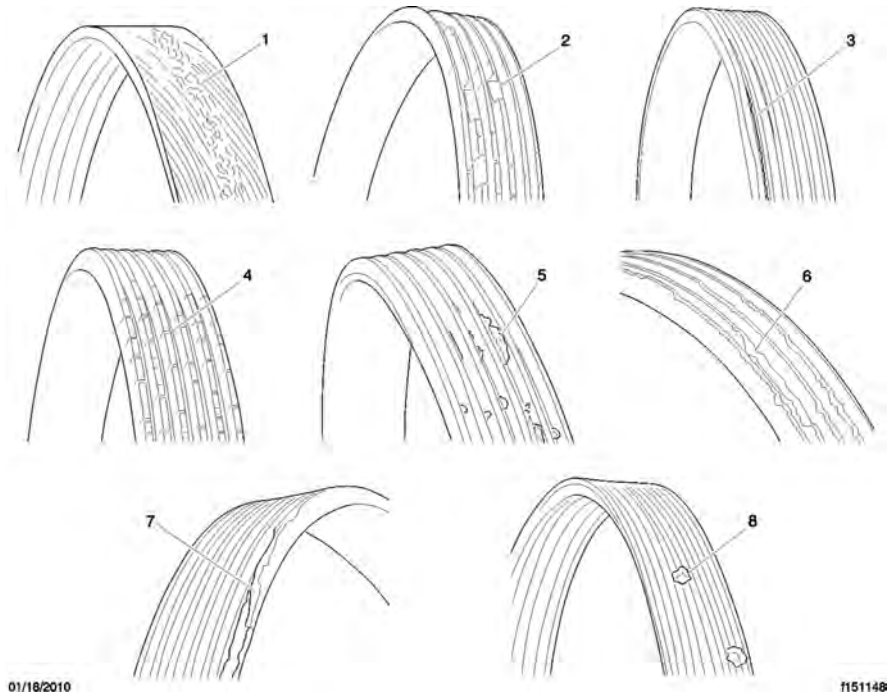


Fig 3, Damaged Belts

1. Inspect the belt contact surfaces for chips, flaking, cracks, discoloration, and other damage. See Fig. 3,Damaged Belts.

   IMPORTANT: For EPDM rubber drive belts, do not rely on cracking as an indicator of belt wear. EPDM rubber drive belts resist cracking better than neoprene belts. A better indicator of wear on EPDM belts is material loss.

2. For EPDM belts, check the belt for material loss, which causes the belt to seat further down in the pulley and to ride directly on the pulley tips. See Fig.4,EPDM Belt Wear.

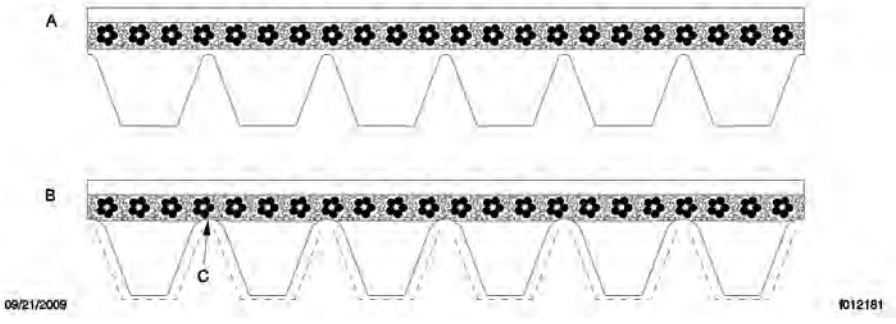


Fig 4, EPDM Belt Wear

3. Inspect the pulleys for excessive play or wobble. Excessive play or wobble indicates a failure of the pulley bearing. Check for belt squealing or squeaking. Replace the bearings as necessary.

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

4. Inspect all pulleys for foreign objects, oil, or grease in the grooves.

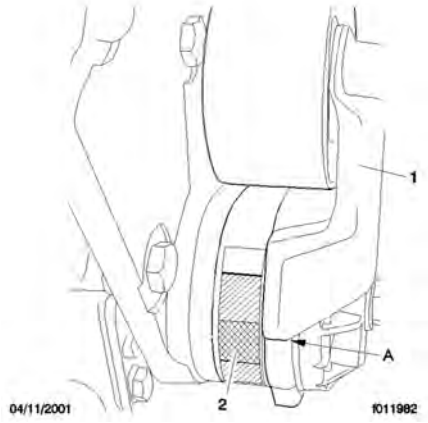
3.03.02 Inspection of the Belt Tension

Some V-belts use a threaded adjustment, and the ONLY accurate way to check belt tension is to use a belt tension gauge. See your Western Star dealer for this type of adjustment.

Serpentine belts are tensioned by spring-loaded idler pulleys that are usually maintenance free. Uneven belt wear can indicate a loose, worn out, or bad bearing on the auto tensioner. A build up of dirt or grime around the front bearing surface of the wheel can indicate a future bearing failure due to inadequate lubrication.

Caterpillar

On Caterpillar engines, there is a red and green decal on the side of the idler arm mount. See Fig. 5,Caterpillar Self-Tensioner. A properly tensioned belt is indicated by the shoulder of the idler arm aligned with the green zone of the decal. As the belt stretches, the shoulder will drift into the red zone. If the idler arm shoulder moves into the red zone, the belt needs to be replaced.



A. Shoulder
1. Spring-Loaded Tensioner
2. Label Green Zone

Fig 5, Caterpillar Self-Tensioner

Cummins

On Cummins engines, a properly tensioned belt is indicated by the stop bar being in the center between the idler arm stops. See Fig.6,Cummins Self-Tensioner. As the belt stretches, the idler arm stop will rotate to the stop bar. If the idler arm stop has rotated to contact the stop bar, the belt needs to be replaced.

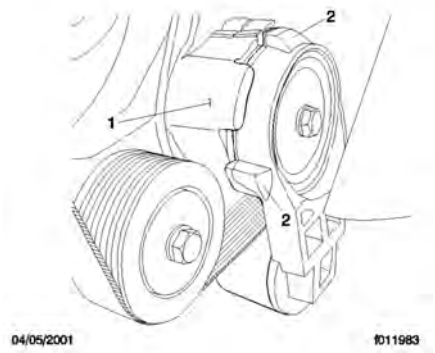


Fig 6, Cummins Self-Tensioner

Detroit Diesel Series 60

The idler arm pivot on Detroit Diesel Series 60 engines has a pointer cast into the arm. See Fig. 7,Detroit Diesel Self-Tensioner. This pointer should align with the V-groove mark at the rear of the mount, when belt tension is correct. As the belt stretches, the pointer will drift to the left of the V-groove. If the pointer is moved past the end of the V-groove, the belt needs to be replaced.

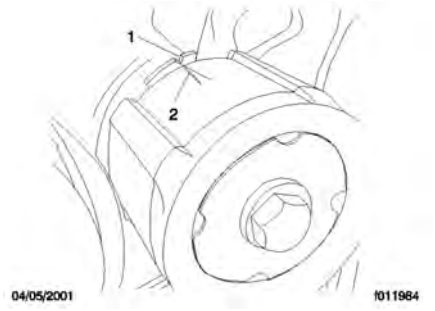


Fig 7, Detroit Diesel Self-Tensioner

3.03.03 Belt Routing

Refer to the following diagrams for belt routings on the various engines.

- **Caterpillar:**

  See Fig.8,Caterpillar 3126B for CAT 3126B model.

  See Fig.9,Caterpillar C10 and C12 for CAT C10 and C12 models.

  See Fig.10,Caterpillar C15 and C16 for CAT C15 and C16 models.

- **Cummins:**

  See Fig.11,Cummins ISX Signature 600 (pre-2007) for Cummins ISX Signature 600 model, pre-2007.

  See Fig.12,Cummins ISM for Cummins ISM model.

  See Fig.13,Cummins N14 for Cummins N14 model.

  See Fig.14,Cummins ISX (2007 or later) for Cummins ISX models, 2007 or later.

  See Fig.15,Cummins ISC/ISL for Cummins ISC and ISL models.

- **Detroit Diesel:**

  See Fig.16,Detroit Diesel Series 60 for DD Series 60 model.

  See Fig.17,DD 13/15/16 for DD 13/15/16 models.

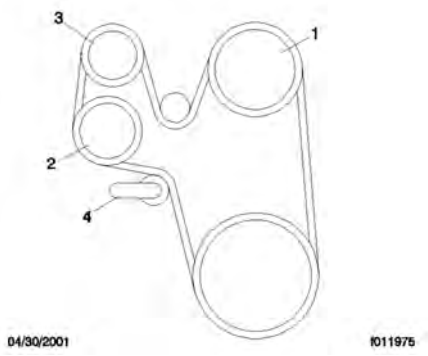


Fig 8, Caterpillar 3126B

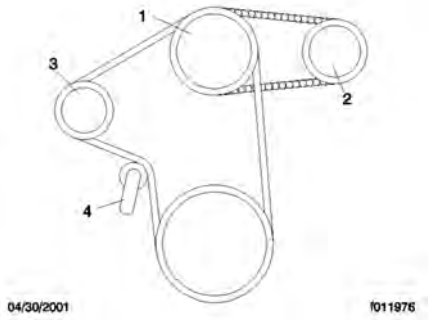


Fig 9, Caterpillar C10 and C12

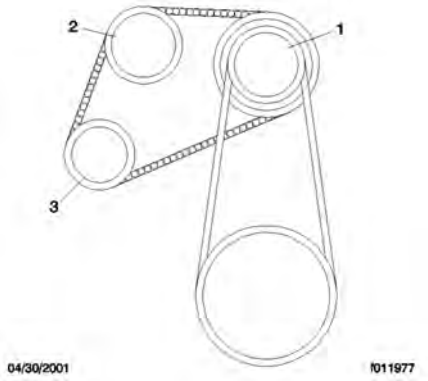


Fig 10, Caterpillar C15 and C16

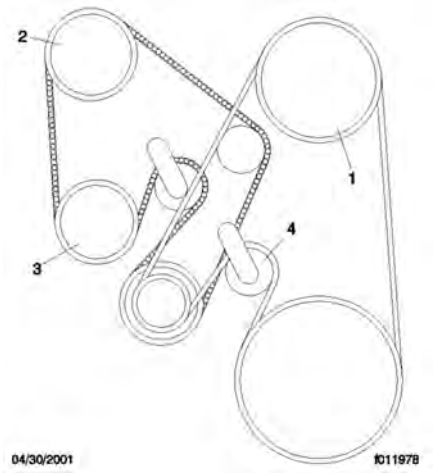


Fig 11, Cummins ISX Signature 600 (pre-2007)

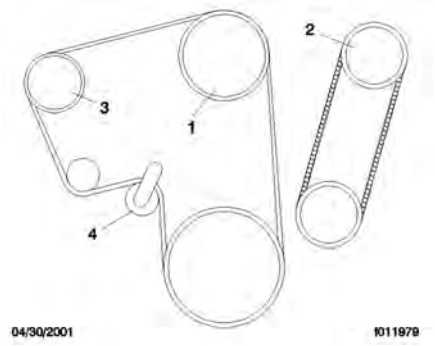


Fig 12, Cummins ISM

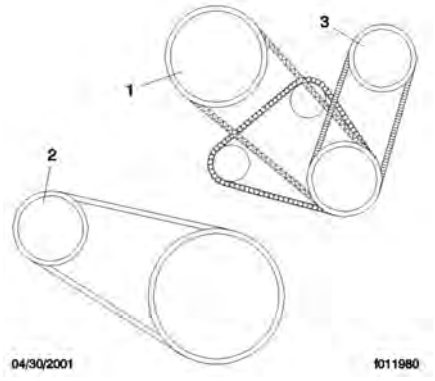


Fig 13, Cummins N14

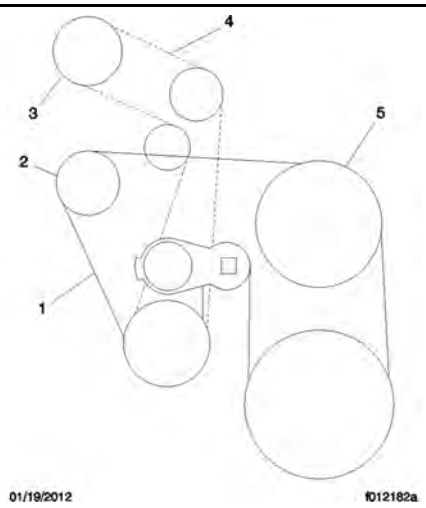


Fig 14, Cummins ISX (2007 or later)

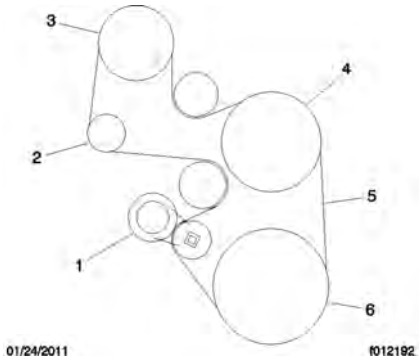


Fig 15, Cummins ISC/ISL

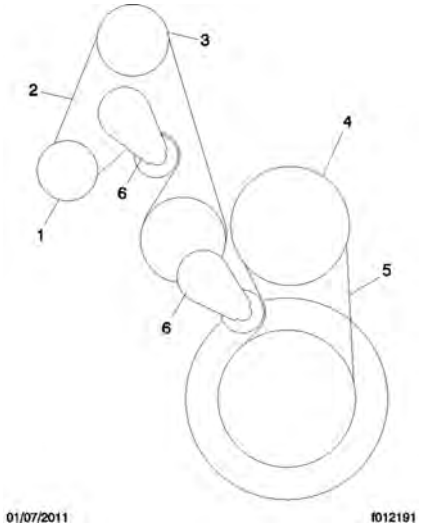


Fig 16, Detroit Diesel Series 60

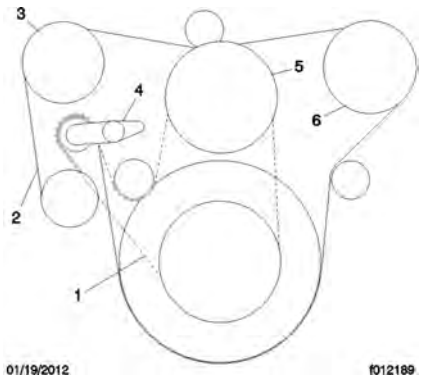


Fig 17, DD 13/15/16

3.04 Inspection and Maintenance Of The Pacbrake®

With frequent use, the Pacbrake exhaust brake will operate maintenance-free. If the vehicle is used inconsistently or seasonally, it will be necessary to perform preventative maintenance. If the vehicle is exposed to excess moisture, or is used only for periodical or seasonal use, perform the following steps.

1. With the engine off, using any oil-free or non-petroleum-based high-heat lubricant, spray or coat a sufficient amount on the restricter valve shaft and the attaching locations at each end of the actuation cylinder.

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

2. With your hands or a pair of pliers, motion the valve several times to distribute the lubricant down the shaft and the attaching locations.

3.05 Engine-Support Fasteners Check (Noise Emission Control)

Front and rear engine supports for vehicles built from January 2007 require no periodic maintenance. Mounts should be inspected when the engine is removed for service. For vehicles manufactured prior to January 2007, perform the following check.

Check the rear engine-support fasteners (see Fig.18,Rear Engine-Support, Ref. 3) for tightness. Tighten the 5/8-inch fasteners 150 to 180 lbf·ft (203 to 244 N·m).

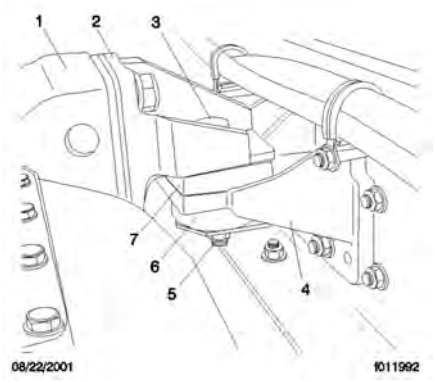


Fig 18, Rear Engine-Support

Check the front engine-support fasteners for tightness. Tighten the 3/4-inch fasteners 260 to 310 lbf·ft (350 to 420 N·m).

NOTE: At engine overhaul, and whenever the engine has been removed, inspect the lower and upper isolators (Refs. 6 and 7), and replace them if they are worn.

4.01 Intake Piping Inspection 40
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4. Air Intake

4.01 Intake Piping Inspection

4.01.01 Engine-Mounted Air Cleaner, 5700 Models

1. Ensure that the mounting fasteners for the air cleaner housing are tight. See Fig. 19,Engine-Mounted Air Cleaner and Ducting, 5700 Models.

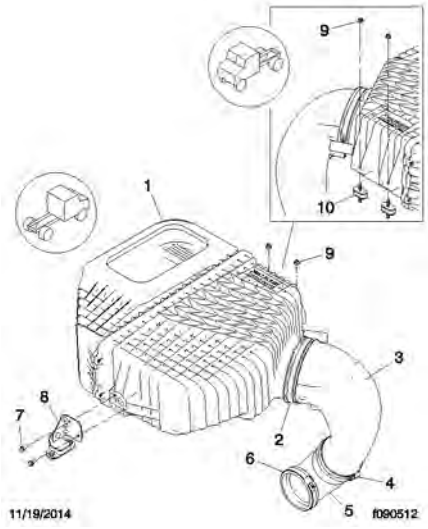


Fig 19, Engine-Mounted Air Cleaner and Ducting, 5700 Models

2. Check the tightness and condition of the clamping hardware. The hose clamps should be tightened 40 lbf·in (4.5 N·m).
3. Ensure that the clamps are properly indexed.
4. Check the intake ducting for abrasions, cracks, and holes. Replace as needed.

4.01.02 Frontwall-Mounted Air Cleaner, 4700 Models

1. Ensure that the fasteners for the air cleaner element and air cleaner housing are tight. See Fig. 20,Frontwall-Mounted Air Cleaner, 4700 Models.

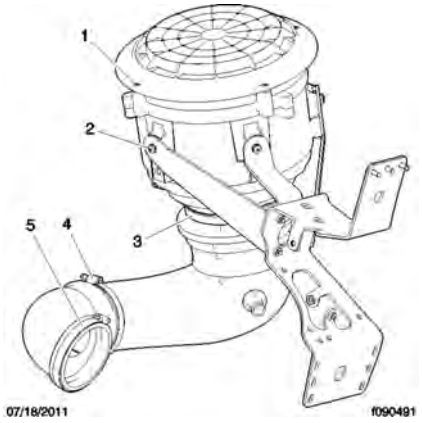


Fig 20, Frontwall-Mounted Air Cleaner, 4700 Models

2. Check the tightness and condition of the clamping hardware. The molded-duct-to-air-cleaner and molded-duct-to-elbow clamps should be tightened 40 lbf·in (4.5 N·m). The elbow-duct-to-turbo clamp should be tightened 90 lbf·in (10.2 N·m).
3. Ensure that the molded-duct-to-air-cleaner clamp is properly indexed.
4. Check the intake ducting for abrasions, cracks, and holes. Replace as needed.

4.01.03 Cowl-Mounted Air Cleaner

1. Check the connections between the plastic or aluminum piping and the rubber elbows. See Fig. 21,Air Intake, Cowl-Mounted Air Cleanerls.

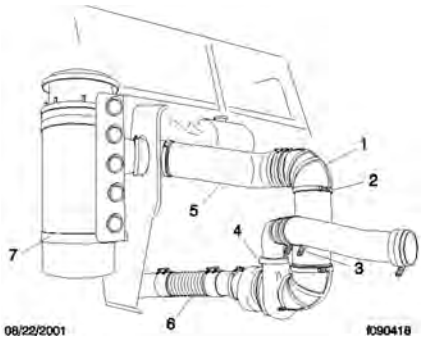


Fig 21, Air Intake, Cowl-Mounted Air Cleanerls

2. Check the tightness and condition of the clamping hardware. Clamps at rubber-to-plastic duct connections should be tightened 39 to 41 lbf·in (440 to 460 N·cm), and clamps at rubber-to-metal duct connections should be tightened 90 to 100 lbf·in (1015 to 1130 N·cm).
3. Inspect the mating surfaces of the plastic or aluminum pipes. If it appears that the rubber elbow has moved on the plastic pipe, or if the hose clamps were loose, disassemble for further inspection.
4. After disassembly of the plastic pipe from the rubber connection elbow, inspect the ends of the pipe for evidence of the rubber elbow rubbing on it. If chaffing marks are visible replace the worn pipe. Wipe any dust from the inside of the pipe.
5. Check the inside of the rubber elbow for wear and contamination. If the rubber elbow is reusable, clean it internally with a shop towel, or soap and water. Blow-dry the elbow as needed, and install it.

6. Check the condition of the gear clamp. If wear is evident, replace the gear clamp with a constant-torque clamp. Constant-torque clamps should be used if a vehicle is routinely exposed to rough road conditions or off-road applications.
7. Check the two band clamps that hold the air cleaner in place on the cowl. Ensure the canister has not slipped downwards. If this condition is present, loosen the two band clamp bolts and slide the canister upward until the outlet pipe is properly aligned with the opening in the cowl.
8. Inspect the alignment and fit of the rubber elbow that passes through the cowl and attaches the intake duct to the canister outlet pipe. Adjust as necessary to ensure a proper connection and tighten the clamps as follows: clamps at rubber-to-plastic duct connections should be tightened 39 to 41 lbf·in (440 to 460 N·cm), and clamps at rubber-to-metal duct connections should be tightened 90 to 100 lbf·in (1015 to 1130 N·cm). Do not over-tighten the clamps.

4.01.04 Frontwall-Mounted Air Cleaner, Non–4700 Models

This style of air intake system has the air cleaner element mounted horizontally across the left side of the firewall. The air intake is through ducting built into the hood and routed into the top of the air cleaner canister. See Fig. 22,Frontwall-Mounted Air Cleaner, Non–4700 Models.

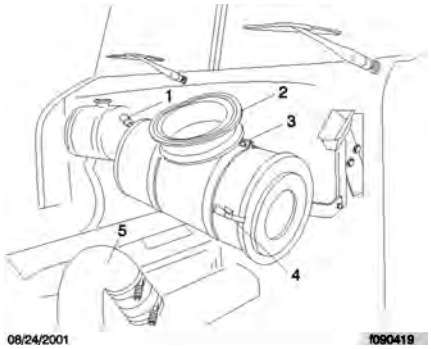


Fig 22, Frontwall-Mounted Air Cleaner, Non–4700 Models

1. Check that the bolts on the canister mounting brackets are tight.
2. Check the mounting angle of the air cleaner canister inlet boot. It must be rotated forward slightly to ensure a correct seal to the hood intake duct. Inspect the hood and boot contact points for proper contact as evident by the polished area on the hood where the boot contacts it.
3. Check the connection points of the entire intake system to ensure the alignment of the rubber hoses to the charge air cooler pipe connections are correct. Check the piping for evidence of movement at the joint connections.
4. Check the tightness and condition of the clamping hardware. Clamps at rubber-to-plastic duct connections should be tightened 39 to 41 lbf·in (440 to 460 N·cm), and clamps at rubber-to-metal duct connections should be tightened 90 to 100 lbf·in (1015 to 1130 N·cm). Replace any clamps that are corroded or fail to operate smoothly when tightened.

4.02 Air Cleaner Element Inspection and Replacement

4.02.01 Engine-Mounted Air Cleaner, 5700 Models

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.

For an installation diagram of the engine-mounted air cleaner used on 5700 models, see Fig. 23,Air Cleaner Assembly and Mounting Components, 5700 Models.

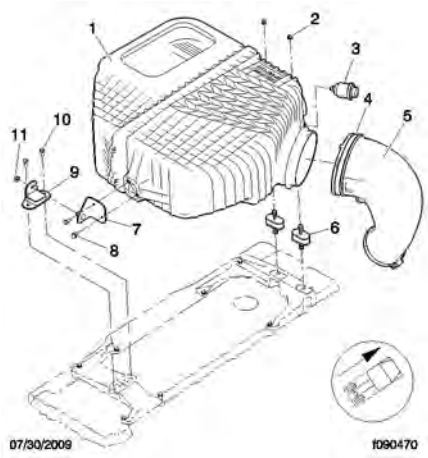


Fig 23, Air Cleaner Assembly and Mounting Components, 5700 Models

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

Vehicles may be equipped with either a manual-reset restriction indicator with graduations (Fig. 24,Manual-Reset Air Restriction Indicator, Graduated), or a go/no-go restriction indicator without graduations (Fig. 25,Manual-Reset Air Restriction Indicator, Go/No-Go).



Fig 24, Manual-Reset Air Restriction Indicator, Graduated



Fig 25, 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 of the *Western Star Workshop Manual*.

2. Inspect the air cleaner housing for cracks, leaks, and any other damage. If the air cleaner housing or element is damaged, replace it.
3. Check the inserts at all four assembly fastener locations (see Fig.26,Air-Cleaner Assembly, 5700 Models). Each insert should protrude from the housing as shown in Fig.27,Air-Cleaner-Housing Fasteners, 5700 Models.

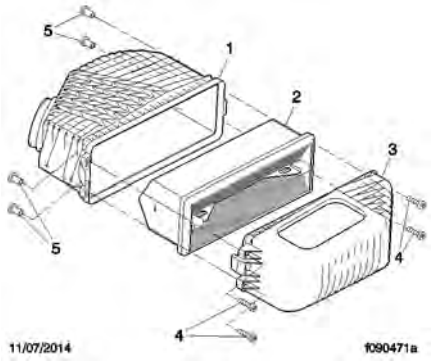
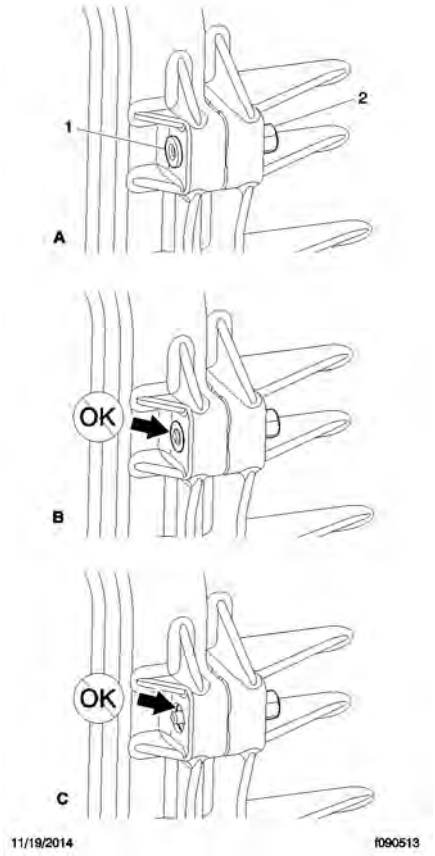


Fig 26, Air-Cleaner Assembly, 5700 Models



NOTE: Each insert should protrude from the housing as shown in item A.

A. Proper Fastener Installation
B. Damaged Insert, Flush
C. Damaged Insert, Countersunk

1. Insert
2. Screw

Fig 27, Air-Cleaner-Housing Fasteners, 5700 Models

4. Inspect the forward and rear mounting isolators (see Fig. 23,Air Cleaner Assembly and Mounting Components, 5700 Models) for damage. Ensure the bonds between the rubber and the steel plates are completely intact. See Fig.28,Mounting Isolator. If a mounting isolator is damaged, replace it. For isolator replacement instructions, see **Section 09.05** of the **Western Star Workshop Manual**.

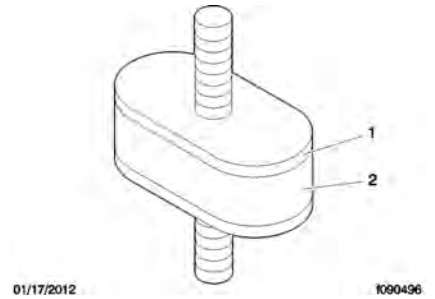


Fig 28, Mounting Isolator

5. If necessary, replace the air cleaner element. For air cleaner element replacement instructions, see **Section 09.05** of the **Western Star Workshop Manual**.
6. Reset the air restriction indicator.

4.02.02 Frontwall-Mounted Air Cleaner, 4700 Models

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

Vehicles may be equipped with either a manual-reset restriction indicator with graduations (Fig. 29,Manual-Reset Air Restriction Indicator, Graduated), or a go/no-go restriction indicator without graduations (Fig. 30,Manual-Reset Air Restriction Indicator, Go/No-Go).



Fig 29, Manual-Reset Air Restriction Indicator, Graduated



Fig 30, 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 the **Western Star Driver's Manual**.
2. If necessary, replace the air cleaner element. For air cleaner element replacement instructions, see of the **Western Star Workshop Manual**.
3. Inspect the air cleaner housing for cracks, leaks, or any other damage. If the air cleaner housing or element is damaged, replace it.
4. Reset the air restriction indicator.
5. Each time the air cleaner housing is replaced, perform the procedures in **MOP 13–01**.

4.02.03 Cowl-Mounted Air Cleaner

The standard cowl-mounted air cleaner system used on Western Star trucks is a reverse air flow design. The air flow in this system flows from the inside of the element, outward through the filter element into the canister, then into the air intake piping on route to the turbocharger. It is highly recommended that only original equipment filter elements are used to service the air cleaner assemblies. Aftermarket replacement elements may vary in size to the original equipment, or may use a different type of seal at the top and bottom of the element. A variance in the size of the element, or the thickness and type of seal material, can affect the crush of the gasket seal and could result in a poor seal on one of the mating surfaces. Elements

that do not fit properly may allow the element to bounce in the canister and allow dirt to pass over the upper seal and into the canister and intake piping.

If the vehicle is equipped with dual air cleaners, replace both elements at the same interval.

1. Remove the cap nuts that secure the service cover to the canister. See Fig.31,Cowl-Mounted Air Cleaner. Take note of the orientation of the air intake screen so the service cover can be reinstalled in the correct position.

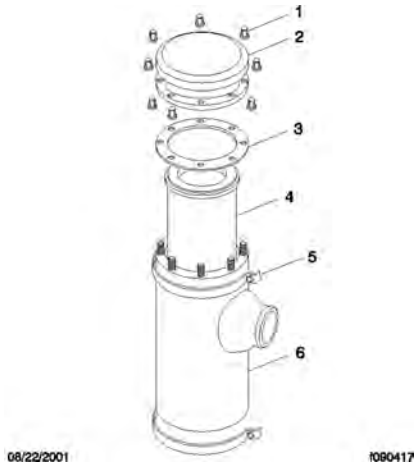


Fig 31, Cowl-Mounted Air Cleaner

2. After removing the canister cap, carefully pull the element straight up out of the canister, ensuring no dust or debris is dropped into the canister.
3. Inspect the clean side of the element and canister for evidence of contamination. The clean side of the element is the area outside the gaskets on either end of the element, including the top cover. If debris is present, find the leak, determine the cause, and correct the problem area immediately.
4. Clean the inside of the canister thoroughly. Use a clean damp cloth to wipe every surface clean. If unable to remove all debris, use a vacuum cleaner to remove all remaining dirt, dust, and contamination.
5. Clean the gasket sealing surfaces of the canister. Properly fitted gaskets are crucial to prevent dirt from entering the canister. Use a damp cloth to wipe clean and remove any hard ridges of dirt built up around the old gasket sealing area on the top cover and the bottom of the canister.
6. Apply pressure to the new gasket with your fingers to test for resilience. When you release pressure, the gasket should instantly spring back to its original shape.

   NOTE: The element will be sitting higher than normal until the cover bolts compress the gaskets.

7. Slide in the new element, ensuring that the bottom gasket seats firmly. Install a new cover gasket, making sure the sealing area around the studs is clean and free of any old gasket material.
8. Inspect the threaded area of the studs. They should be clean and free of corrosion and foreign material. Apply a light coating of oil. Inspect the cap nuts. If wear is apparent replace them with new ones. Torque the cap nuts in sequence 96 lbf·in (1080 N·cm). Do not over-tighten the cap nuts. Be certain that the cover has pulled down evenly around the canister, because both element gaskets and the cover gasket are being compressed as the cap nuts are tightened.
9. Recheck the torque of the canister band mounting clamps and be certain the blank portion of the top cap screen area is facing forward.

10. Press the reset button on the bottom of the air restriction indicator to reset to zero. If the indicator fails to reset to zero, replace it with a new one. If the truck is not equipped with a restriction indicator or a dash-mounted restriction gauge, check that the pipe plugs located in the canister, or in the aluminum piping just before the turbocharger, are tight and correctly torqued.

4.02.04 Frontwall-Mounted Air Cleaner, Non–4700 Models

1. Release the spring clamp fasteners located at the left end of the air cleaner canister. See Fig. 32,Frontwall-Mounted Air Cleaner, Non–4700 Models, Ref. 4. Use caution when removing the element from the canister as some maneuvering may be necessary to avoid the radiator stay rod or brackets mounted in that area.

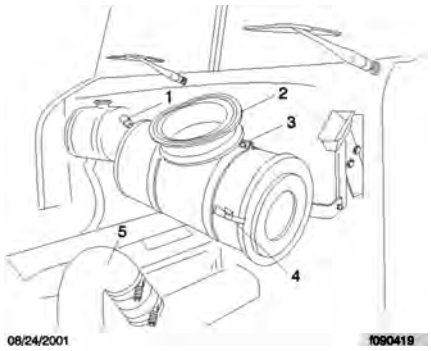


Fig 32, Frontwall-Mounted Air Cleaner, Non–4700 Models

2. Inspect the interior of the canister. The under-hood air intake system has the air flow directed from the outside of the element to the inside. Therefore, all dirt will be accumulated inside the canister housing, and it must be cleaned thoroughly before reinstalling a replacement element.
3. Use caution when installing the new element to prevent damage to the paper pleats. Be certain the element is properly seated in the canister, then fasten the four spring clamp fasteners.
4. Inspect the air restriction indicator mounted at the outlet end pipe of the canister, and reset it.
5. If equipped with a dash-mounted restriction gauge, inspect the tube and mounting fittings on the air cleaner canister outlet pipe for tightness and correct routing of the line to the dash-mounted gauge.
6. If no restriction indicator of any kind is present, check that the plugs in the canister are torqued to specifications.

4.03 Inspection Of The Charge Air Cooler

1. Check the condition of the charge air cooler piping and clamping hardware. If damaged, replace components and carefully reassemble it to ensure proper penetration and alignment. Tighten the constant-torque clamps 98 lbf·in (11 N·m), and the turbo-out-elbow clamp 62 lbf·in (7 N·m). See Fig.33,Charge Air Cooler and Piping.

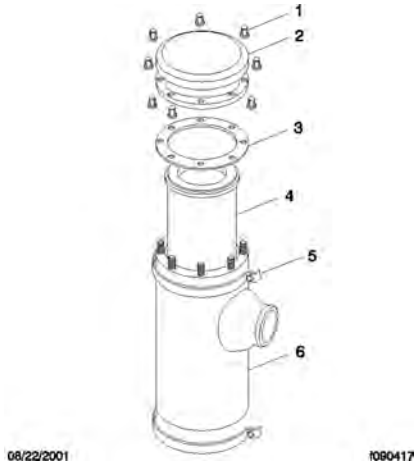


Fig 33, Charge Air Cooler and Piping

2. Check the connections at the charge air cooler and all pipe-to-hose penetrations. If acceptable, tighten the constant-torque clamps 98 lbf·in (11 N·m) and the turbo-out-elbow clamp 62 lbf·in (7 N·m). Angle the clamps downward to prevent interference with the hood.
3. Check the mounting and condition of the cooler core.

Chapter 5 Air Compressor 5.0

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5. Air Compressor

5.01 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.

5.02 Inspection Of The Air Compressor

1. Inspect the air compressor intake hoses and connections at the air intake and air compressor for physical damage. 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.

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6. Alternators and Starters

6.01 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.

6.02 Alternator and Starter Check

1. Disconnect the batteries.
2. Check the tightness of the alternator bracket fasteners; tighten the fasteners as needed. See List of Abbreviations for torque specifications.
3. Check the tension of the alternator belt. See Principles of Operation, EPA10 Engine for belt tension instructions. Some engines are equipped with dual alternator belts. Always check both belts for correct tension. Engines equipped with a serpentine or poly-V belt have automatic belt tensioners and do not require belt tension inspection.
4. Check that all electrical connections at the alternator and starter are clean. Clean and tighten all charging system electrical connections as needed.
5. Check the alternator wiring for missing insulation, kinks, and heat damage. Replace or repair as needed.

6.03 Battery 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.

CAUTION:

The vehicle is equipped with an alternator charging system. Make sure the polarity (+ and –) is correct when connecting battery cables. Reversing the polarity will damage the alternator.

1. Make sure the batteries are disconnected.
2. Inspect the battery cables for wear and replace as needed. Clean cable connector terminals with a wire brush. Consult your Western Star Dealer for troubleshooting, adjustment, and battery replacement.

2.a Clean and tighten the battery cables, terminals, and clamps.

2.b Inspect the battery hold-down assembly and the battery box. Replace worn or damaged parts. Remove any corrosion with a wire brush, and wash with a weak solution of baking soda and water. Rinse with clean water, and dry. If needed, paint the retainer assembly to prevent corrosion.

2.c Check that foreign objects, such as stones, bolts, and nuts are removed from the battery box.

2.d After cleaning, connect the cables to the batteries, and tighten them to the specification listed on the battery. If no specifications are found, then use 10 to 15 lbf·ft (14 to 20 N·m).

2.e Coat the battery terminals with dielectric grease.

3. Check the terminals on the battery shut-off switch and the magnetic switch. Make sure the terminal connections are clean and tight. Coat the terminal connections with dielectric red enamel after cleaning.

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7. Engine Cooling/Radiator

7.01 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.

7.02 Coolant Inspection

7.02.01 General Information

The engine produces large quantities of heat during its operation. Too high or low an engine operating temperature will damage the engine. The purpose of the cooling system is to keep the engine at its optimum operating temperature. The optimum operating temperature results in the most efficient use of fuel and allows the engine oil to do its job properly.

The cooling system on Western Star vehicles is a closed or pressure type system, with a mixture of antifreeze and water. By pressurizing the system and using an antifreeze/water mixture, the boiling temperature of the coolant is raised, permitting more efficient, higher operating temperatures.

The coolant supplied with a Western Star vehicle is a 50/50 mix of antifreeze and water giving protection down to –35°F (–37°C). It is recommended that this be the minimum antifreeze mixture strength used. The maximum coolant mixture of 60 percent antifreeze to 40 percent water gives freeze protection to –62°F (–52°C).

Over-concentration of antifreeze or coolant conditioner can cause silicate to settle out of the coolant, forming a silica-gel on cooling system inner surfaces, resulting in overheating.

In addition, the tendency for silica-gel to form increases with water hardness. Hard water (with high levels of calcium and magnesium ions) increases likelihood of the formation of silica-gel. Do not use softened water. The salt used to artificially soften it is corrosive. Most engine manufacturers prefer use of distilled or de-ionized water to reduce the potential and severity of silica dropouts.

Keep the cooling system filled. On vehicles equipped with a frontwall-mounted translucent surge tank (see Fig. 34,Frontwall-Mounted Translucent Surge Tank), keep the coolant level between the FULL and LOW marks. On vehicles equipped with a frontwall-mounted steel surge tank (see Fig.35,Steel Surge Tank, High Flow Radiators), keep the cooling system filled so that coolant can be seen in the sight glass in the surge tank. On vehicles equipped with a radiator-mounted translucent surge tank (see Fig.36,Radiator-Mounted Translucent Surge Tank), keep the coolant level between the FULL and LOW marks. If the coolant is low, add the antifreeze solution mixture specified for the vehicle in PartsPro (Group 01).

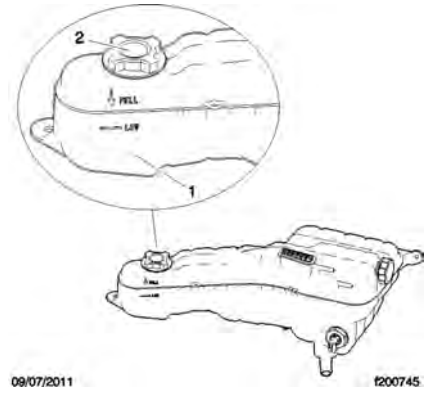


Fig 34, Frontwall-Mounted Translucent Surge Tank

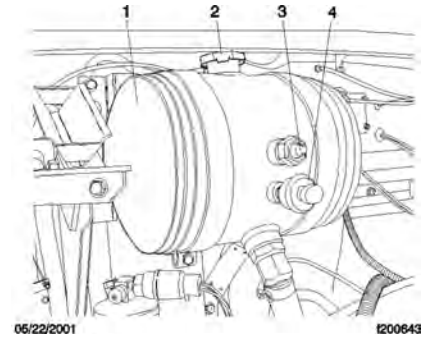


Fig 35, Steel Surge Tank, High Flow Radiators

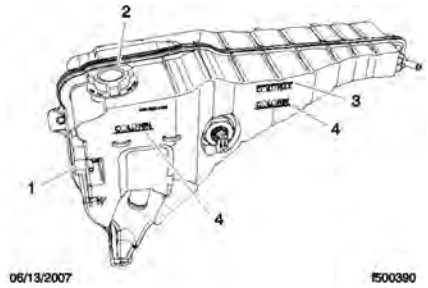


Fig 36, Radiator-Mounted Translucent Surge Tank

7.02.02 Inspection

WARNING:

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

NOTICE:
Never add cold water into the system when the engine is hot as damage to the engine may result.

Every six months have the coolant mixture checked to ensure it is at the proper concentration to protect the cooling system from damage. Refer to the engine manufacturer's service literature for specific coolant information.

1. Park the vehicle on a level surface, set the parking brake, and chock the wheels. Open the hood.
2. The level of coolant should be between the FULL and LOW marks in a translucent surge tank (see Fig. 37,Frontwall-Mounted Translucent Surge Tank and Fig.38,Steel Surge Tank, High Flow Radiators) or visible through the sight glass on a steel surge tank (see Fig.39,Radiator-Mounted Translucent Surge Tank). If the coolant is low or not visible in the sight glass, check the system for leaks.

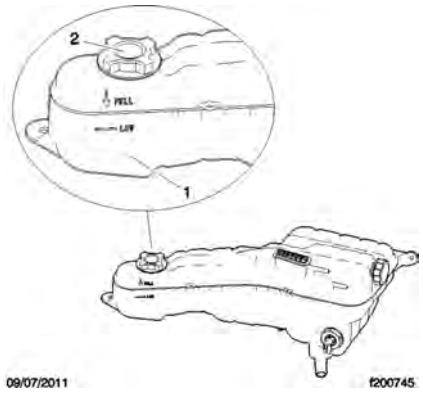


Fig 37, Frontwall-Mounted Translucent Surge Tank

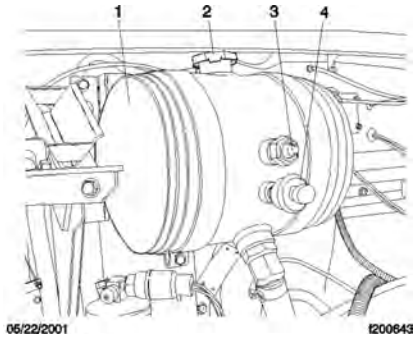


Fig 38, Steel Surge Tank, High Flow Radiators

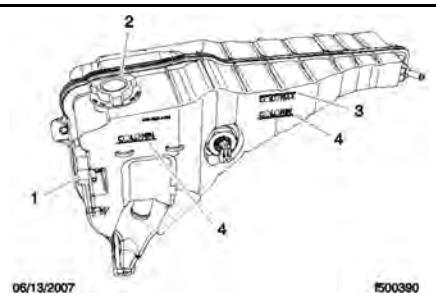


Fig 39, Radiator-Mounted Translucent Surge Tank

WARNING:

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

3. Slowly turn the SAE pressure/filler cap until it stops, to allow the coolant pressure to bleed off. Press down on the cap and turn it at the same time, then lift off the cap.
4. While the SAE pressure/filler cap is OFF, smell the coolant for strong odors (i.e., diesel fuel). A strong diesel smell indicates that fuel is contaminating the coolant, and the vehicle must be taken to a Western Star dealer to have the source found and the cooling system chemically flushed.

   NOTE: Due to environmental concerns, it is recommended that coolant flushing and the replacement of coolant conditioners and coolant filters be performed by your Western Star dealer.

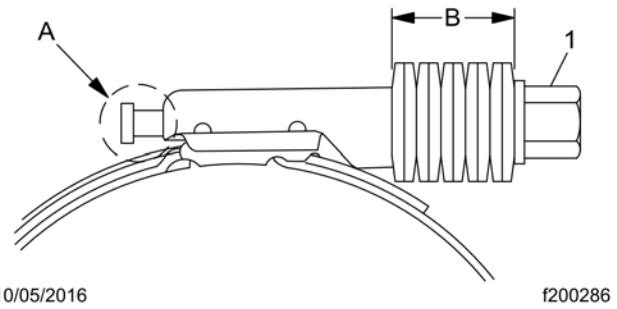
5. Check the condition of the coolant. If the coolant shows scale, rust, silica-gel, oil, or has a frothy scum, the vehicle must be taken to a Western Star dealer to have the contaminate source found and fixed, and the cooling system chemically flushed.

7.03 Inspection Of The Cooling System (Noise Emission Control)

1. Park the vehicle on a level surface, set the parking brake, and chock the wheels. Open the hood.

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

2. Inspect the SAE pressure/filler cap gaskets. Replace the cap if the gasket shows any signs of deterioration or damage. Install the cap and check to ensure that it seals properly on the surge tank filler neck. Replace the cap if it appears not to seat properly.
3. There is a valve on the bottom of the SAE pressure/filler cap that opens under vacuum. This prevents components in the cooling/heating systems from collapsing. Inspect the vacuum-relief valve to be sure it is not stuck. Replace the cap if the vacuum-relief valve is stuck.
4. Check the hoses for possible leaks. Replace any worn, soft, or perforated hoses.
5. Western Star uses Breeze Constant-Torque hose clamps on the radiator hoses. Check the hose clamps to ensure that they are properly torqued. See Fig.40,Breeze Constant-Torque Hose Clamp. The tip of the screw must extend about 1/4 inch (6 mm) from the clamp housing, and the washer stacks must be compressed almost flat. Hose clamps lose torque after installation due to "compression set." Breeze Constant-Torque hose clamps will hold enough torque to automatically keep consistent sealing pressure. Due to temperature changes, the screw tip extension may change. The clamp screw may need to be adjusted for individual applications.



A. Screw tip must extend about 1/4 inch (6 mm).
B. Washer stack must be compressed almost flat.
1. Adjusting Screw Hex

Fig 40, Breeze Constant-Torque Hose Clamp

NOTE: Due to environmental concerns, it is recommended that coolant flushing and the replacement of coolant conditioners and coolant filters be performed by your Western Star dealer.

6. If the coolant is low, check the engine oil for possible coolant contamination. If the oil is discolored, there may be an internal engine leak, and the unit should be taken to your Western Star dealer to be repaired before the engine is damaged.
7. Check to see if the front of the radiator, charge air cooler, and oil cooler fins are clogged. Material in the fins will cause the cooling system to overheat. Pressure-wash the radiator to wash out radiator clogging material.

8. Check the fan belts for wear and tightness. For more information on fan belts, see Principles of Operation, EPA10 Engine. If belts are damaged, replace them. If belts are loose, have the proper belt tension set by your Western Star dealer.
9. Check the fan and fan shroud for damage. A damaged fan or shroud will affect the air flow and can cause heating problems. Have the damaged fan or shroud replaced by your Western Star dealer. If all the previous steps are correct and the engine is overheating, there may be a problem with the fan not operating properly, or the thermostat may be stuck closed. Take your vehicle to a Western Star dealer to have the problem repaired. If there is a tendency for the engine to run cool, the fan may be running continously, or the thermostat may be stuck open. Take the vehicle to a Western Star dealer to have the problem repaired.

7.04 Pressure/Filler Cap Test



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



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

1. Park the vehicle on a level surface, set the parking brake, and chock the wheels. Open the hood.
2. After the coolant has cooled, loosen the pressure/filler cap to relieve system pressure.
3. Remove the pressure/filler cap. Using the Snap-On tool radiator-cap tester shown in Table.16,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 radiator cap is correctly rated for the cooling system of the vehicle. Use the recommended tool in Table.16,Snap-On Tool For Pressure Relief Cap Test.

Table 16, Snap-On Tool For Pressure Relief Cap Test

Tool	Part Number
Radiator-Cap Tester	TA53

Table 16, Snap-On Tool For Pressure Relief Cap Test

4. Inspect the pressure/filler cap gaskets. Replace the cap if the gasket shows any signs of deterioration or damage. Install the cap and check that the cap seals properly on the surge tank filler neck. Replace the cap if it appears not to seat properly.
5. There is a valve on the bottom of the pressure/filler cap that opens under vacuum. This prevents components in the cooling/heating systems from collapsing. Inspect the vacuum-relief valve to be sure it is not stuck. Replace the cap if the vacuum-relief valve is stuck.

7.05 Cooling System Pressure-Flush

NOTE: See the engine manufacturer's operation and maintenance manual for cooling system maintenance. The engine manufacturer's manual is provided with each new vehicle at the time of delivery.

1. Park the vehicle on a level surface, set the parking brake, and chock the wheels. Open the hood.
2. Place a suitable container under the lower elbow of the radiator outlet pipe and under the radiator. The container should be capable of holding 60 quarts (57 L) of fluid.



WARNING:

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

3. Remove the surge tank pressure/filler cap.
4. Remove the drain plug located at the elbow of the lower radiator outlet pipe. Allow the coolant to drain.



WARNING:

Coolant, conditioners, and coolant filters must be sent to proper recyclers.

5. Disconnect the radiator upper and lower hoses. Attach the flushing gun nozzle to the radiator at the lower radiator hose opening. Run the water until the radiator is full.



WARNING:

When flushing the radiator, do not apply more than 10 psi (103 kPa) air pressure. Excessive pressure can damage the radiator.

6. Gradually, apply air pressure to help dislodge sediment build up in the radiator core.

IMPORTANT: All liquid that is flushed out of the radiator must be collected and disposed of properly. Pouring contaminated water down the drain is illegal.

7. Shut off the air at the pressure gun nozzle and allow the radiator to refill with water, then repeat the previous two steps until clean water flows from the radiator.

8. Detach the gun nozzle from the lower radiator hose opening. Connect the hoses.
9. Place a pan under the coolant filter to catch engine coolant.
10. Remove the coolant filter. Install and tighten a new filter.
11. Fill the cooling system with new coolant.
12. Install the pressure/filler cap.
13. Start the engine and turn on the cab heater. Allow the engine to warm to normal operating temperature. Check the radiator and hoses for leaks. Repair as required.
14. Shut off the engine and check the coolant level. See "Coolant Inspection" 20–01.

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8. Clutch

8.01 Safety Precautions

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

DANGER:

death.
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

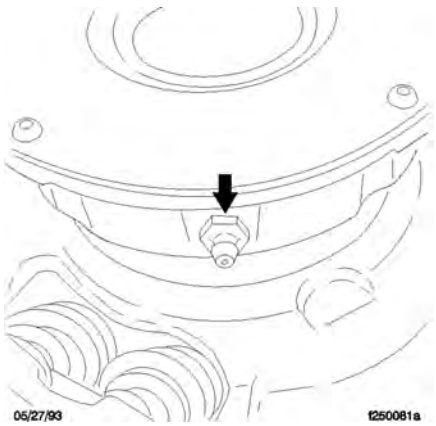
8.02 Clutch Release Bearing Lubrication

Lubricate the release bearing as follows:

1. With the vehicle parked on a level surface, apply the parking brakes and chock the rear tires.
2. Remove the clutch inspection plate.

   NOTE: For lubricating the release bearing, Eaton Fuller recommends a lithium-base grease that can operate up to at least 325°F (163·C) and meets the NLGI Grade 2 or 3 specification. Meritor recommends a lithium-base high-temperature grease that meets the NLGI Grade 3 specification.

3. Wipe away any dirt from the grease fitting. See Fig.41,Release Bearing Grease Fitting. Using a pressure-type grease gun equipped with the recommended grease, lubricate the bearing until excess grease purges from the rear of the release bearing (toward the transmission).



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

Fig 41, 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. Wipe off excess grease and apply it to both the yoke finger and sleeve bushing contact points. See Fig. 42,Grease Contact Points.

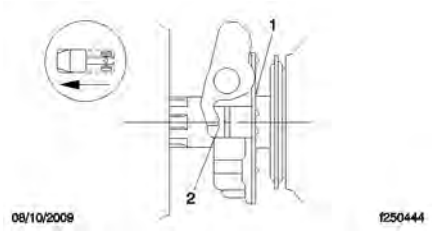


Fig 42, Grease Contact Points

5. Install the clutch inspection plate.

8.03 Clutch Release Cross-Shaft Lubrication

The clutch release cross-shaft is equipped with two grease fittings in the transmission clutch housing. See Fig. 43,Cross-Shaft Grease Fitting, Left-Side and Fig.44,Cross-Shaft Grease Fitting, Right-Side. Wipe the dirt from the grease fittings and lubricate with multipurpose chassis grease.

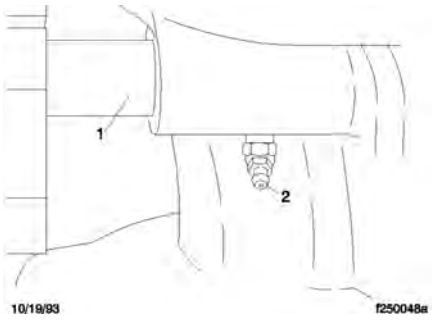


Fig 43, Cross-Shaft Grease Fitting, Left-Side

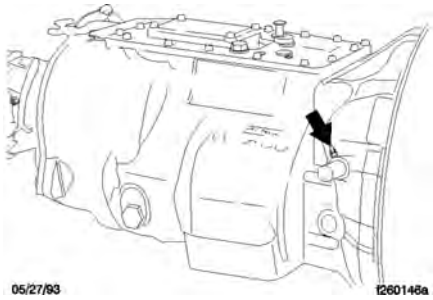


Fig 44, Cross-Shaft Grease Fitting, Right-Side

8.04 Sleeve Assembly Bronze Bushing Lubrication

Vehicles equipped with the sealed clutch-release bearing have a lubrication extension outside of the clutch housing. This extension is needed to provide lubrication to the bronze bushing located between the clutch bearing housing and the transmission input shaft.

Using a pressure-type grease gun equipped with high-temperature grease only, lubricate until grease flows from the release bearing housing.

Depress the clutch pedal a couple of times before starting the engine.

8.05 Fluid Level Check, Hydraulic Clutch Control

WARNING:

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

NOTICE:

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

If the fluid level is below the MIN line, fill the reservoir with new DOT 4 brake fluid from a tightly sealed container until the level reaches the MAX line. See Fig.45,Reservoir, Hydraulic Clutch Control.

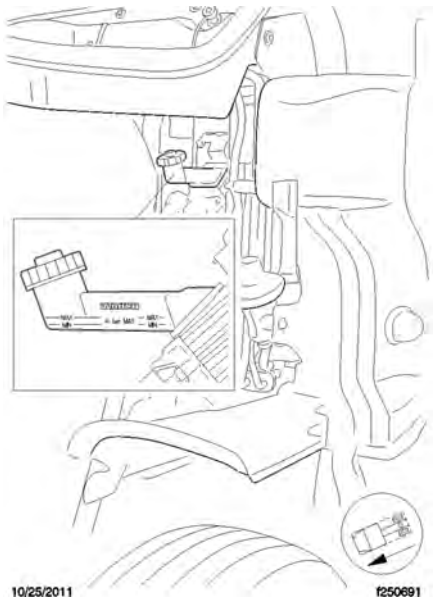


Fig 45, Reservoir, Hydraulic Clutch Control

8.06 Fluid Change, Hydraulic Clutch Control

8.06.01 General information

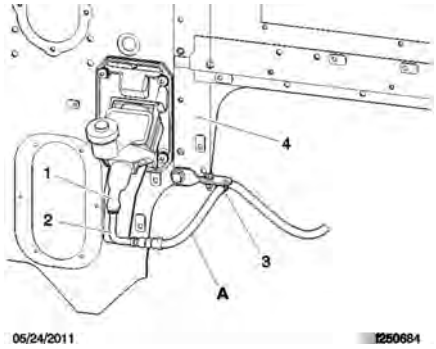
Replace the hydraulic clutch control fluid to ensure clutch function is reliable and correct. It can be changed by pressure bleeding or manual bleeding. Pressure bleeding can be done by one person and manual bleeding requires two.

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.

8.06.02 Pressure Bleeding

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. See Fig. 46,Hydraulic Hose, Upward Slope Installation.



A. On vehicles where the pressure line slopes upward, unclamp the hose before bleeding the system; when finished, fasten the hose as removed.
1. Main Cylinder
2. Hydraulic Hose
3. Bracket and P-Clamp Assembly
4. Frontwall

Fig 46, Hydraulic Hose, Upward Slope Installation

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

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 and install the pressure bleed adaptor on the reservoir. See Fig. 47,Reservoir, Hydraulic Clutch Control

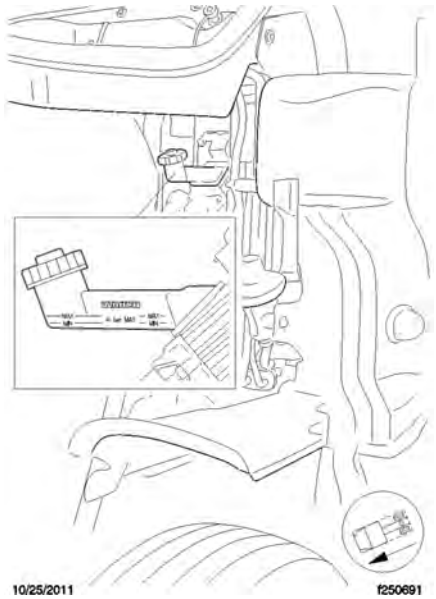


Fig 47, Reservoir, Hydraulic Clutch Control

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. 48,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.

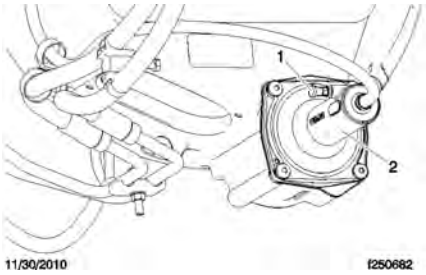


Fig 48, Secondary Cylinder, Hydraulic Clutch Control

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 (994 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.

8.06.03 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.

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

2. Remove the reservoir lid and fill the reservoir with new DOT 4 brake fluid from a tightly sealed container. See Fig. 49,Reservoir, Hydraulic Clutch Control.

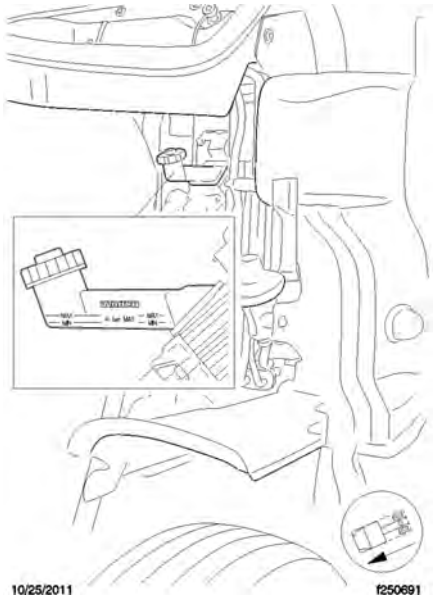


Fig 49, Reservoir, Hydraulic Clutch Control

3. Remove the cap from the bleed valve of the secondary cylinder. See Fig. 50,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.

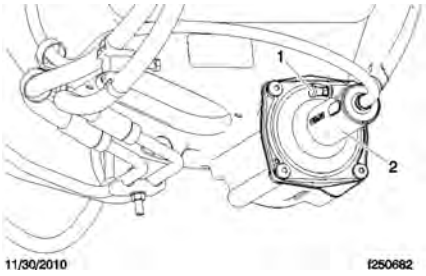


Fig 50, Secondary Cylinder, Hydraulic Clutch Control

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

4. Bleed the system, as follows.
   - 4.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.

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9. Transmission

9.01 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.

9.02 Transmission Fluid Level Inspection

9.02.01 Allison Transmission

NOTICE:

Operating a transmission with the fluid level higher or lower than recommended can result in transmission damage. Do not overfill the transmission.

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

9.02.02 Cold Check

Clean all dirt from around the end of the fluid fill tube before removing the dipstick. Do not allow foreign matter to enter the transmission. Dirt or foreign matter in the hydraulic system may cause undue wear of transmission parts, make valves stick, and clog passages.

It is important to check the fluid level cold to determine if the transmission has a sufficient amount of fluid to be safely operated until a hot check can be performed.

1. Park the vehicle on a flat, level surface.
2. Apply the parking brake and chock the tires.
3. Run the engine for at least one minute.
4. Shift from DRIVE to NEUTRAL, and then shift to REVERSE to fill the hydraulic system.
5. Shift to NEUTRAL and allow the engine to idle at 500 to 800 rpm.
6. Open the hood, and with the engine running at idle, remove the dipstick from the tube and wipe it clean.
7. Insert the dipstick into the tube completely, then remove the dipstick.
8. Check the fluid level mark and repeat the check procedure to verify the reading. If the fluid level is within the COLD RUN band, the transmission may be operated until the fluid is hot enough to perform a hot check. If the fluid level is not within the COLD RUN band, add or drain fluid as needed to adjust the fluid level to the middle of the COLD RUN band. See Fig.51,Dipstick Markings.

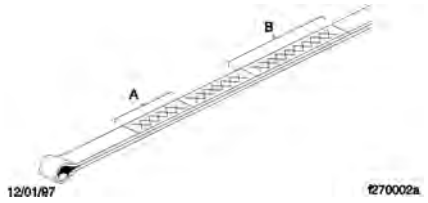


Fig 51, Dipstick Markings

9.02.03 Hot Check

NOTICE:
As the fluid temperature increases, so does the fluid level. Do not fill above the COLD RUN band if the transmission fluid is below normal operating temperature.

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

1. Park the vehicle on a flat, level surface. Apply the parking brake and chock the tires.
2. Shift the transmission to NEUTRAL.
3. Operate the engine at idle (500 to 800 rpm) until normal operating temperature is reached. Check that the sump temperature is 160 to 200°F (71 to 93°C). Check that the converter-out temperature is 180 to 220°F (82 to 104°C).
4. Open the hood, and with the engine idling, remove the dipstick from the tube and wipe it clean.
5. Insert the dipstick completely into the tube, and remove the dipstick.
6. Check the fluid level mark and repeat the check procedure to verify the reading. Safe operating level is within the HOT RUN band on the dipstick. The HOT RUN band is between the HOT FULL and HOT ADD marks. If the fluid level is not within the HOT RUN band, add or drain fluid as needed to bring the fluid level within the HOT RUN band. See Fig. 52,Dipstick Markings.

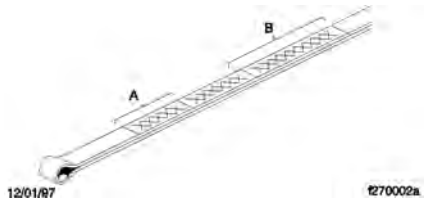


Fig 52, Dipstick Markings

9.02.04 Eaton/Fuller Transmission

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

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

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.

9.02.05 Checking at the Sight Glass

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

1. Clean the oil level sight glass. See Fig.53,Eaton Fuller Transmission With a Sight Glass.

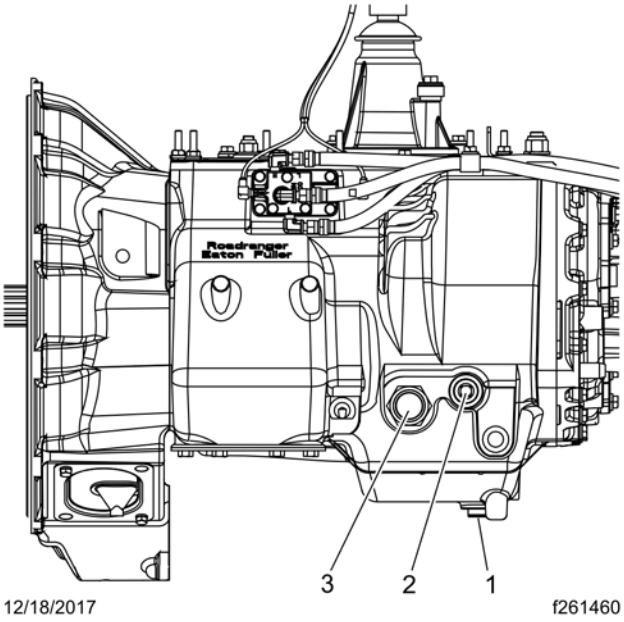


Fig 53, Eaton Fuller Transmission With a Sight Glass

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.54,Transmission Fluid Level Sight Glass.

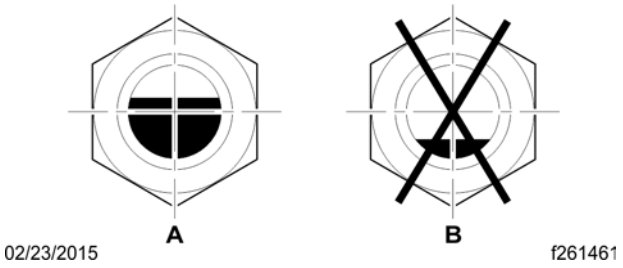


Fig 54, Transmission Fluid Level Sight Glass

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.17, **Eaton and Meritor Approved Transmission Lubricants** for approved transmission lubricants.

Table 17, Eaton and Meritor Approved Transmission Lubricants

Eaton and Meritor Approved Transmission Lubricants			
Transmission Model	**Lubricant Type**[1]	**Temp. Range**	**SAE Viscosity**
Eaton Fuller	Synthetic transmission lubricant meeting Eaton PS-386 lubricant specification	All	—
Meritor	Synthetic engine oil meeting Meritor specification 0–81, or MIL–L–2104D or E	All	50W

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

Table 17, Eaton and Meritor Approved Transmission Lubricants

9.02.06 Meritor Transmission

NOTICE:

Operating a transmission with the fluid level higher or lower than recommended can result in transmission damage. Do not overfill the transmission.

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

1. Remove the fill plug from the transmission.
2. Insert a finger or pipe cleaner into the transmission.
3. Check that the fluid level is even with the base of the fill plug. The correct fluid capacity is established by the fill opening. If the transmission has two fill plugs, check that the fluid level is consistent at both fill plugs.
4. If the transmission fluid level is low, check the transmission for leaks, and correct as needed.

5. If needed, add the recommended fluid, until it is level with the lower edge of the fill opening. See Table.18, **Eaton and Meritor Approved Transmission Lubricants** for approved transmission lubricants. For more information and a complete listing of Eaton approved lubricants, refer to the Eaton website, www.roadranger.com . For more information and a complete listing of Meritor approved lubricants, refer to the ZF Meritor website, www.zf.com.

Table 18, Eaton and Meritor Approved Transmission Lubricants

Eaton and Meritor Approved Transmission Lubricants			
Transmission Model	**Lubricant Type**[1]	**Temp. Range**	**SAE Viscosity**
Eaton Fuller	Synthetic transmission lubricant meeting Eaton PS-386 lubricant specification	All	—
Meritor	Synthetic engine oil meeting Meritor specification 0–81, or MIL–L–2104D or E	All	50W

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

Table 18, Eaton and Meritor Approved Transmission Lubricants

6. Clean the fill plug, install it in the transmission, then tighten it 50 lbf·ft (68 N·m).

9.03 Manual Transmission Fluid Change

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

NOTE: Fluid change intervals are extended to 500,000 miles (800 000 km) on vehicles equipped with a Meritor RM10–115A or RM10–145A transmission or any vehicle equipped with an Eaton/Fuller transmission filled with synthetic transmission fluid.

1. Park the vehicle on level ground, apply the parking brakes, and chock the tires. Place a large drain pan under the transmission.

CAUTION:

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

2. Clean the area around the fill plug, and remove it from the side of the case. Remove each drain plug from the bottom of the transmission case. Drain the fluid while the transmission is warm.

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. Clean the material that may have been attracted to the magnet. The amount of material on the magnetic plug shows the condition and wear in the transmission; excessive material may indicate that the transmission should be looked at. Remove the key stock or steel slug from the magnetic drain plug. Install and tighten each drain plug 50 lbf·ft (68 N·m).

   NOTE: Eaton/Fuller transmissions are available with an optional transmission fluid filter. The filter is a remote-mount, spin-on type, and is located between the transmission and the fluid cooler. The filter bracket is attached to the frame rail. The filter is mounted in a vertical position, and should be filled with fluid before installation to ensure the proper fluid level in the transmission case. For optimum transmission performance, change the filter each time the fluid is changed.

4. For an Eaton/Fuller transmission with a transmission fluid filter(s), replace the filter(s), as follows.

   4.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 drain plugs.

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

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

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

   4.d Once the filter has made contact with the mount, use a strap or chain wrench to rotate the filter canister an additional 180 to 270 degrees to firmly tighten the filter. Wipe the filter clean of any fluid after it is tightened.

5. Add fluid until it is level with the lower edge of the fill opening. See Fig.55,Dipstick Markings. If the transmission has two fill openings, add fluid to the level of both openings. See Table.19, **Eaton and Meritor Approved Transmission Lubricants** for approved transmission lubricants, and Table.20,Transmission Lubricant Capacities for lubricant capacities. The correct capacity is established by the location of the fill opening.

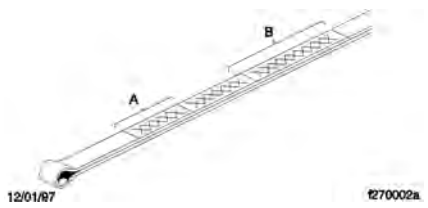


Fig 55, Dipstick Markings

Table 19, Eaton and Meritor Approved Transmission Lubricants

Eaton and Meritor Approved Transmission Lubricants			
Transmission Model	**Lubricant Type**[1]	**Temp. Range**	**SAE Viscosity**
Eaton Fuller	Synthetic transmission lubricant meeting Eaton PS-386 lubricant specification	All	—
Meritor	Synthetic engine oil meeting Meritor specification 0–81, or MIL–L–2104D or E	All	50W

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

Table 19, Eaton and Meritor Approved Transmission Lubricants

Table 20, Transmission Lubricant Capacities

Transmission Lubricant Capacities	
Transmission Make and Model [1]	**Capacity: pt (L)**
Eaton/Fuller 7-Speed	
T–14607A/B	37 (17.5)
TX–14607B	37 (17.5)
Eaton/Fuller 9-Speed	
RT–11609A	27 (12.8)
RTX–11609B/R	27 (12.8)
RT/RTX–11709H	27 (12.8)
RT–12609A	27 (12.8)
RTX–12609B/R	27 (12.8)
RT/RTX–12709H	27 (12.8)
RT–13609A	27 (12.8)
RTX–13609B/R	27 (12.8)
RT/RTX–13709H	27 (12.8)
RT–14609A	27 (12.8)
RTX–14609B/R	27 (12.8)
RT/RTX–14709H	27 (12.8)
RTX–16709B/H	27 (12.8)

Eaton/Fuller 10-Speed	
FR–11210B	23.5 (11)
FR–14210B	23.5 (11)
FR–15210B	23.5 (11)
RTO/RTX–11708LL	28 (13.2)
RT–11710B	26 (12.3)
RTX–11710B/C	26 (12.3)
RTO–11908LL	29 (13.7)
RTLO–12610B	26 (12.3)
RT–12710B	26 (12.3)
RTX–12710B/C	26 (12.3)
RTL0–13610B	28 (13.2)
RT–13710B	26 (12.3)
RTX–13710B/C	26 (12.3)
RTLO–14610B	28 (13.2)
RTO/RTX–14708LL	29 (13.7)
RT–14710B	26 (12.3)
RTX–14710B/C	26 (12.3)
RTLO–15610B	28 (13.2)
RTX–15710B/C	26 (12.3)
RTO–16210C	22 (10.4)
RTLO–16610B	28 (13.2)
RTX–16710B	26 (12.3)
Eaton/Fuller 13-Speed	
RTLO–12713A	28 (13.2)
RTLO–14713A	28 (13.2)
RTLO–16713A	28 (13.2)
Eaton/Fuller 15-Speed	

RT/RTO/RTX–14715	28 (13.2)
RT/RTO/RTX–15715	28 (13.2)
Eaton/Fuller 18-Speed	
RTLO–14718B	28 (31.2)
RTLO–16718B	28 (13.2)
RTLO–18718B	28 (13.2)
Meritor 9-Speed	
RM9–115A	20 (9.5)
RMO9–115B	20 (9.5)
RMX9–115B/R	20 (9.5)
RM9–125A	20 (9.5)
RMO9–125A/B	20 (9.5)
RMX9–125A/B/R	20 (9.5)
RM9–135A	20.5 (9.7)
RMO9–135A/B	20.5 (9.7)
RMX9–135A/B/R	20.5 (9.7)
RM9–145A	20.5 (9.7)
RMO9–145A/B	20.5 (9.7)
RMX9–145A/B/R	20.5 (9.7)
RM9–155A	20.5 (9.7)
RMX9–155B	20.5 (9.7)
Meritor 10-Speed	
RM10–115A	20 (9.5)
RMX10–115A	20 (9.5)
RM10–125A	20 (9.5)
RMX10–125A	20 (9.5)
RM10–135A	20.5 (9.7)
RMX10–135A	20.5 (9.7)

RM10–145A	20.5 (9.7)
RMX10–145A	20.5 (9.7)
RMX10–155A	20.5 (9.7)
RMX10–165A	20.5 (9.7)
Meritor 13-Speed	
RMO13–145A	22 (10.4)

1. For models not listed in this table see the Eaton website, www.roadranger.com

Table 20, Transmission Lubricant Capacities

6. For a transmission equipped with a fluid pump or a fluid cooler, operate the engine for five minutes after filling the transmission, then check the fluid level again.
7. Install the fill plug, then tighten it 50 lbf·ft (68 N·m).
8. Operate the vehicle to check for correct operation.

9.04 Manual Transmission Air Filter/Regulator Check, and Clean or Replace

9.04.01 Eaton/Fuller

1. Apply the parking brakes and chock the 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. 56,Air Filter/Regulator Location (Eaton/Fuller transmission shown).

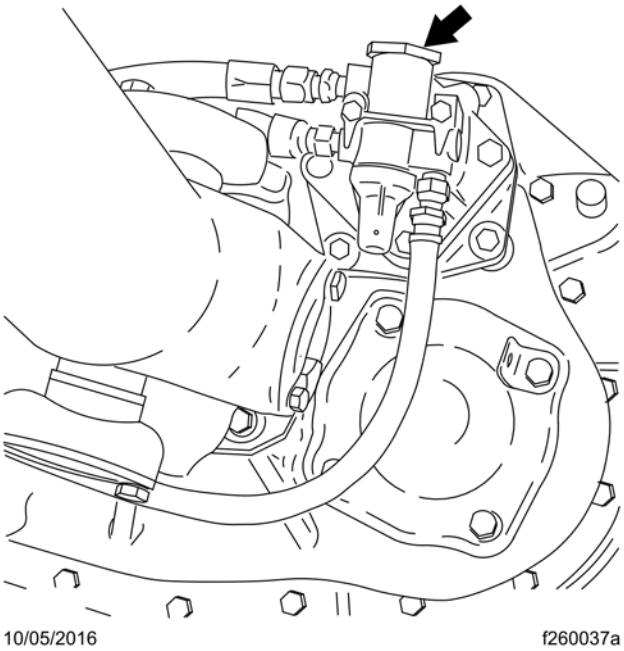


Fig 56, Air Filter/Regulator Location (Eaton/Fuller transmission shown)

3. Remove the end cap, large O-ring, and filter element from the filter housing. See Fig.. Remove the small O-ring from the end cap.

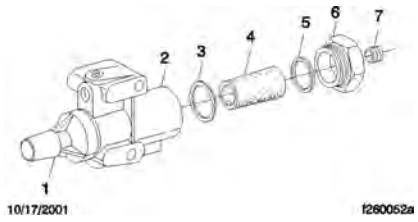


Fig 57, Eaton/Fuller Transmission Air Filter/Regulator Components



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

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

4. Clean the filter element by dipping it in alcohol or other cleaning solvent. Blow compressed air through the filter 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 the 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 8 to 12 lbf·ft (11 to 16 N·m).



NOTICE:
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.

9.04.02 Meritor

1. Park the vehicle on a level surface. Apply the parking brakes and chock the tires.
2. Remove the element from the air filter/regulator assembly. Inspect the O-rings in the end cap; replace worn or damaged O-rings. Inspect the element for fluid contamination. If fluid is present, replace the element. Inspect the air supply system for the source of the fluid, and service it as needed.
3. Install the element in the filter/regulator assembly.
4. Apply a light coat of silicone grease, or an equivalent grease to the O-rings in the end cap. Install and tighten the end cap 10 to 15 lbf·ft (14 to 20 N·m).
5. Build air pressure in the system, check for leaks, and make any needed repairs.

9.05 Inspection Of The ESS Transmission Filter and Boot

On ESS transmissions only, inspect the filter and protective boots.

1. Remove the filter from its location on the top right-hand side of the transmission.
2. Clean the filter with solvent.
3. Install the filter, as removed.
4. Inspect the protective boots, both right and left, for tears or signs of cracking. Replace if needed.

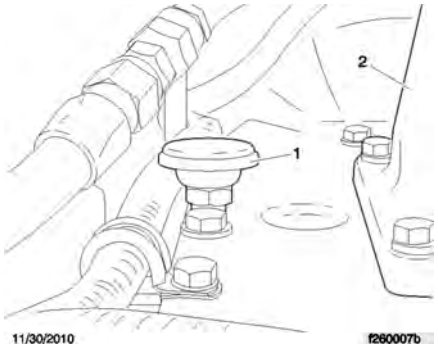
9.06 Inspection Of The Transmission

Check the transmission for oil leaks, as follows.

1. Check at the transmission output shaft for oil leaks. A small amount of oil and dirt accumulation is normal, as a small amount of oil is allowed past the seal to lubricate it. If the rear of the transmission is wet with oil, the rear seal may need replacing.
2. Check for oil leaks around the speedometer pickup.
3. Check the transmission case joints for oil leaks.
4. Check transmission oil line fittings for oil leaks.
5. Check the bottom of the flywheel housing for oil accumulation. Oil along the bottom seam or around the inspection cover of the flywheel housing may be an indication of a transmission input seal leak. Not replacing a leaking input oil seal will cause clutch slippage.
6. If leaks are found, take the vehicle to your Western Star dealer to have the problem corrected.

9.07 Allison and Eaton Fuller Transmission Breather Check

If the transmission is equipped with a housing breather (see Fig.58,Transmission Breather (Eaton Fuller shown)), it must remain clear. A plugged breather could result in pressure build-up, which could cause oil leakage.



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

Fig 58, Transmission Breather (Eaton Fuller shown)

IMPORTANT: Do not spray water, steam, or cleaning solution directly at the breather. These actions can force water or cleaning solution into the transmission and contaminate the transmission fluid.

If the breather is plugged, clean or replace it. If replacing it, use a correct-size wrench (pliers or a pipe wrench can crush or damage the breather stem and produce metal particles that could enter the transmission).

Check more often if the vehicle is operating under very dusty conditions.

9.08 Allison Transmission Fluid and Filter Change

Allison 3000 Family and 4000 Family Transmissions

NOTE: When the optional prognostics feature is enabled on an Allison transmission, the system monitors oil life and filter life. To reset the indicator, press the Mode button (on the electronic shift control) for 10 seconds with the ignition on but the engine not running. For more information, see the Allison Transmission website, www.allisontransmission.com .

1. Park the vehicle on a level surface and apply the parking brakes.
2. Operate the vehicle until the transmission reaches normal operating temperature: 160 to 200°F (71 to 93°C).

IMPORTANT: When draining transmission fluid, check for evidence of dirt or water contamination. A small amount of condensation could appear in the fluid during operation.Water contamination is normally characterized as a milky discoloration of the transmission fluid. Obvious contamination of the transmission fluid could indicate a leak between the water and fluid areas of the transmission cooler. Inspect and pressure-test the cooler to confirm the leak. If the transmission cooler is leaking and the oil has been contaminated, replace the transmission cooler and overhaul the transmission.



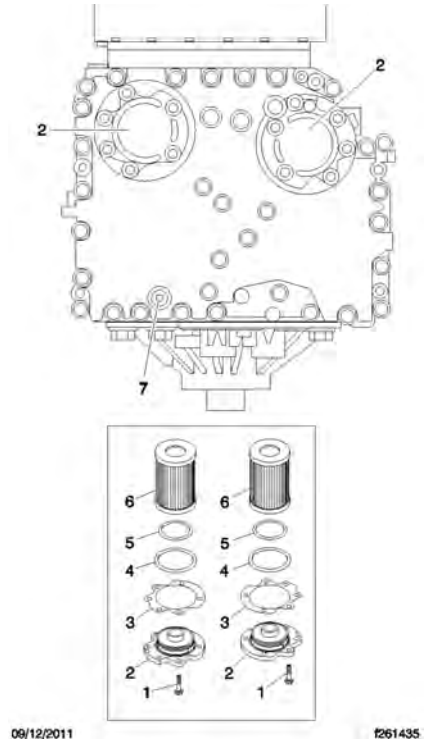
NOTICE:

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

Engine coolant in the transmission hydraulic system requires immediate action to prevent malfunction and possible serious transmission damage. For more information, see the Allison Transmission website, **www.allisontransmission.com** .

NOTE: If only the filters are being changed, do not drain the fluid.

3. Clean the area around the drain plug and the transmission fluid pan. Place a drain pan under the transmission and remove the drain plug. Examine the fluid as it drains.
4. Remove the 12 mounting capscrews (six each) from the two filter covers. See Fig. 59,Allison Transmission Filter Locations and Components.



NOTE: Allison 4000 Family transmission shown. Components and location are similar for Allison 3000 Family transmissions.

Fig 59, Allison Transmission Filter Locations and Components

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

5. Remove the filter covers, gaskets, O-rings, and filters from the transmission.
6. Lubricate the new O-rings with transmission fluid, and install them on the covers.
7. Install the filter over the gaskets.
8. Install the fluid filters on the cover assemblies.
9. Install the filter and cover assemblies into the filter compartment. Align each cover assembly with the holes in the channel plate sump, and push the cover assemblies in by hand to seat the seals.

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

10. Install six capscrews in each cover, and torque the bolts 38 to 44 lbf·ft (51 to 61 N·m).
11. Install a new drain plug O-ring, and install the drain plug. Tighten the drain plug 18 to 24 lbf·ft (25 to 32 N·m).

NOTE: Fluids meeting specification TES 295 are preferred over TES 389 fluids for use in Allison 3000 and 4000 family transmissions. See the Allison Transmission website (www.allisontransmission.com) for a list of approved transmission fluids and usage recommendations.

12. Refill the transmission with fresh transmission fluid. Use only a fluid that meets Allison Transmission specification TES 295 or TES 389. Castrol TranSynd® is a TES 295 fluid available through Allison distributors and dealerships. See Table.21, Lubricant Refill Capacities, Allison 3000 and 4000 Family Transmissions for lubricant refill capacities.

Table 21, Lubricant Refill Capacities, Allison 3000 and 4000 Family Transmissions

Lubricant Refill Capacities, Allison 3000 and 4000 Family Transmissions[1]		
Family	**Sump Size**	**Capacity : qt (L)**
3000	4 Inch	19 (18)
	2 Inch	17 (16)
4000	4 Inch	39 (37)[2]
	2 Inch	31 (30)[3]

1. Quantities listed are approximate. Add listed amount of fluid, then perform a "hot check" and add fluid as needed. Do not overfill.
2. Add 3 qt (2.8 L) for transmissions with PTO.
3. Add 3 qt (2.8 L) for transmissions with PTO.

Table 21, Lubricant Refill Capacities, Allison 3000 and 4000 Family Transmissions

13. Check and adjust the fluid level using the appropriate Allison Transmission procedures in **MOP 26–01**.

9.09 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.

1. Apply the parking brakes, and chock the rear tires. Place a large drain pan under the transmission.

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

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.60,Drain and Fill Plugs, Detroit Automated Transmissions.



Fig 60, 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).

NOTE: 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 athttp://dtna.info/DT12FluidsManual.

5. Add fluid until it is level with the lower edge of the fill opening; see Fig.61,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.

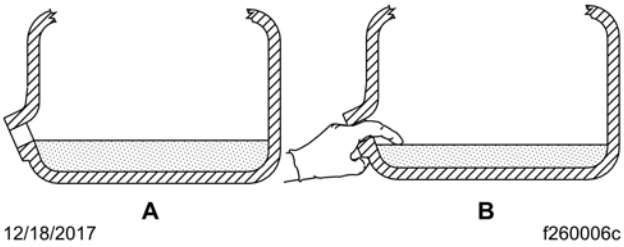


Fig 61, Checking Transmission Fluid Level

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

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

9.10 Inspection Of The Detroit™ Automated Transmission Fluid Level

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. See Fig. 62,Checking Transmission Fluid Level.

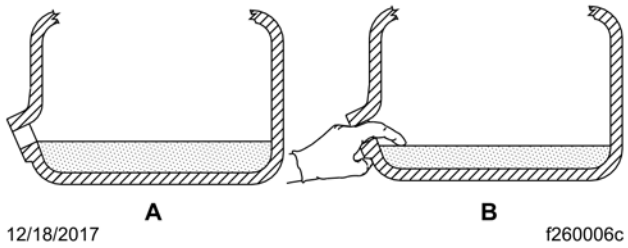


Fig 62, Checking Transmission Fluid Level

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 athttp://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).

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10. Frame and Frame Components

10.01 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.

10.02 Fifth Wheel Inspection

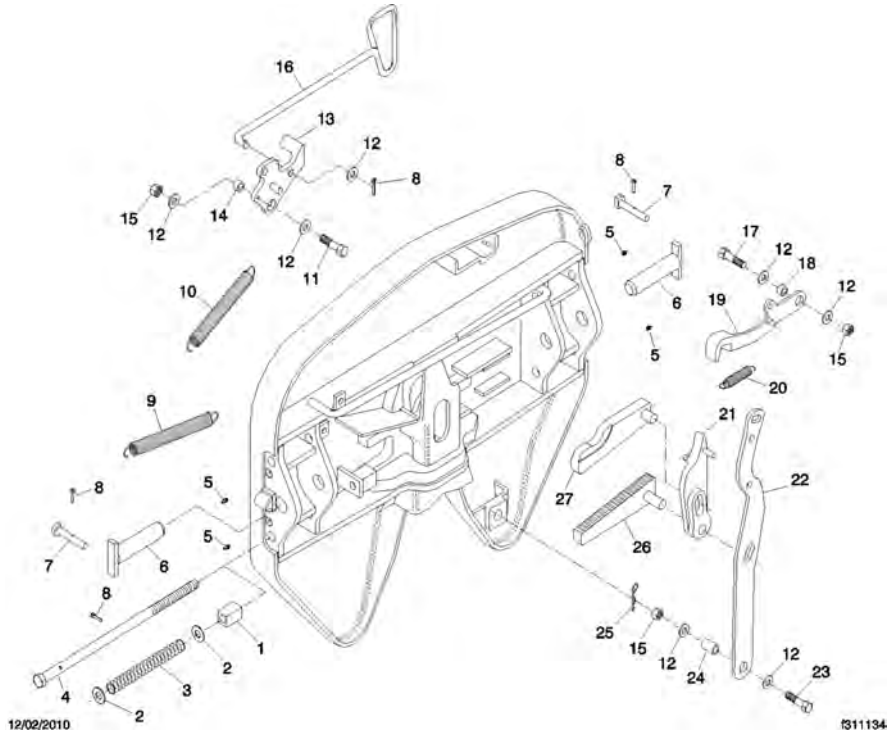
10.02.01 General information

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.

10.02.02 Fontaine

1. Disconnect the tractor from the trailer. For instructions, see the **Western Star Driver's Manual**.
2. Thoroughly steam clean the fifth wheel.
3. Check for cracks in the fifth wheel assembly, mounting brackets, and mounting parts.
4. Ensure that both bracket pins are in place and secured by retainer pins and cotter pins. See Fig. 63,Fontaine Fifth Wheel.



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

Fig 63, Fontaine Fifth Wheel

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

5. For fifth wheels equipped with bracket liners, rock the fifth wheel. If it does not rock freely, remove the top plate and inspect the bracket liners. Replace liners that are broken or less than 0.125 inch (3 mm) thick at the top of the liners. For the liner replacement procedure, see the Fontaine website, www.fifthwheel.com .
6. Check the jaw and stationary jaw for mushrooming, and check that the serrations at the jaw and wedge are in good condition.
7. Test the secondary safety lock latch for ease of operation.
8. Check for loose nuts or bolts on the fifth wheel and the mounting. Set a torque wrench to the maximum torque value for the bolt being checked, and confirm that the torque is to specification. Do not loosen the bolt to check the torque. See List of Abbreviations for bolt torque specifications.
9. Check all springs to see if they are securely fastened, and are not deformed.

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

10. Check the wedge adjustment.
    10.a Close the fifth wheel on a standard 2-inch (51-mm) kingpin or similar 2-inch (51-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 counter-clockwise 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* reuse bolts, nuts, and washers on fifth wheel mountings.
12. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. Apply a generous coating of grease to the top plate to fill the grooves, or depressions, on the top plate. See **MOP 31–02** in this manual for lubrication instructions.

10.02.03 Holland FWS1

1. Disconnect the tractor from the trailer. For instructions, see the **Western Star Driver's Manual**.
2. Thoroughly steam clean the fifth wheel.
3. Check the fifth wheel plate for cracks. Check for sharp edges on top; the chamfer should be 1/8 to 1/4 inch (3 to 6 mm).
4. When the wheel is locked, the safety latch must swing free and fall freely into position. See Fig. 64, **Holland FWS1 Fifth Wheel**.

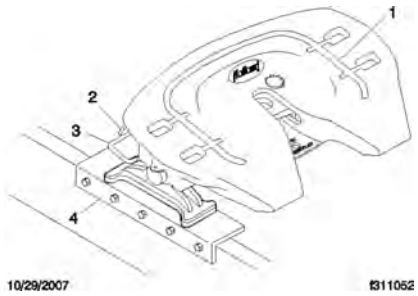


Fig 64, Holland FWS1 Fifth Wheel

5. The lever bar and release handle must be in proper alignment. See Fig. 65, **Lever Bar and Release Handle Alignment**. Compare the lever bar and release handle alignment to a new, or a properly operating lever bar and release handle. Replace any bent or misaligned lever bar or release handle.

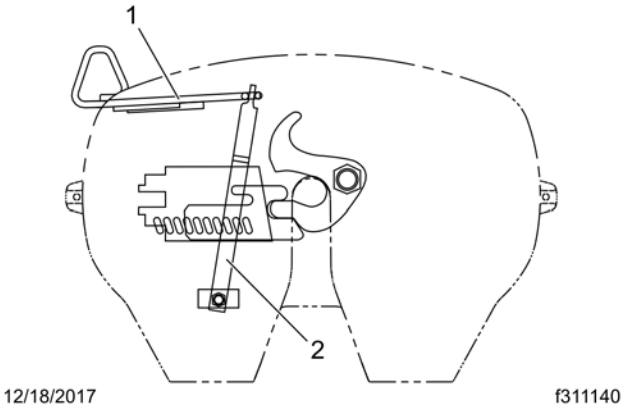
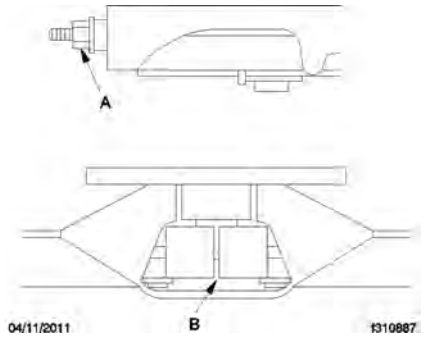


Fig 65, Lever Bar and Release Handle Alignment

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

10.02.04 Holland FW35

1. Disconnect the tractor from the trailer. For instructions, see the **Western Star 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. 66,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 66, Holland Fifth Wheel Properly Closed

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

10.02.05 Castloc II and Simplex Series

1. Disconnect the tractor from the trailer. For instructions, see **Chapter 10** of the **Western Star Driver's Manual**.
2. Thoroughly steam clean the fifth wheel.
3. Check the fifth wheel plate for cracks. Check for sharp edges on top; the chamfer should be 1/8 to 1/4 inch (3 to 6 mm).
4. When the wheel is locked, the safety latch must swing free and fall freely into position. See Fig. 67,Simplex Series Fifth Wheel.

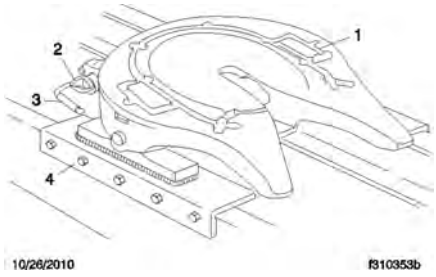


Fig 67, Simplex Series Fifth Wheel

5. The lever bar and operating handle must be in proper alignment. See Fig. 68,Lever Bar and Operating Handle Alignment Compare the lever bar and operating handle alignment to a new, or a properly operating lever bar and operating handle. Replace any bent or misaligned lever bar or operating rod.

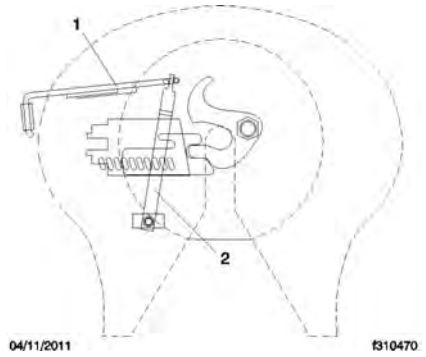
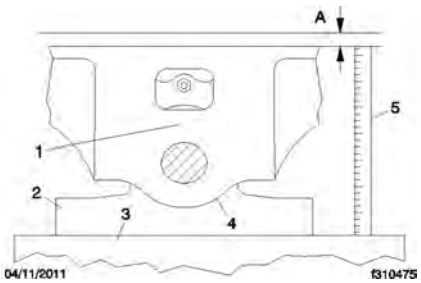


Fig 68, Lever Bar and Operating Handle Alignment

6. Check all cotter pins for cracking or damage. Replace any cotter pin that shows any signs of damage.
7. Level the fifth wheel plate to a horizontal position. Measure the height from a stationary mounting point (see Fig. 69,Measuring Fifth Wheel Top Plate Lift , item 3), such as the frame rail to the top of the fifth wheel plate (item 1). Pry up on the fifth wheel plate (item 4) below the pin boss, and measure the vertical movement (item 5). The bracket connection provides a 9/32 inch (7 mm) vertical clearance to provide cushioning and to avoid downward pin-loading while retaining minimum plate lift. If the plate lift (Ref. A) exceeds 5/16 inch (8 mm) as a result of wear or rubber deterioration, install new bracket-shoe rubber pads.



A. Extended Top Plate Lift Height
1. Fifth Wheel Top Plate
2. Fifth Wheel Frame Mount
3. Frame Rail
4. Lifting Point
5. Static Top Plate Height

Fig 69, Measuring Fifth Wheel Top Plate Lift

8. Check all mounting bolts for signs of fatigue, and tighten them to the proper torque. For torque specifications, see List of Abbreviations. Inspect all angles, plates, and brackets for cracks or other damage.
9. Replace cracked, worn, or damaged parts with new parts. Replace all loose mounting bolts with 5/8–11 Grade 8 bolts, Grade C locknuts, and hardened washers. *Do not* re-use bolts, nuts, and washers on fifth wheel mountings.
10. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. See **Maintenance Operation 31–02** for lubrication instructions.

10.02.06 Jost

1. Disconnect the tractor from the trailer. For instructions, see the **Western Star 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. 70,Bracket Pin Bolt Locking Tabs.

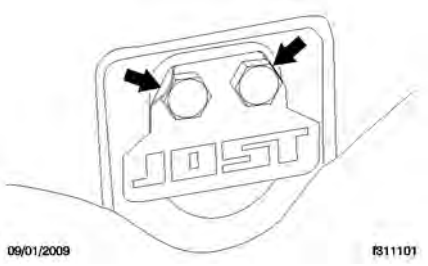
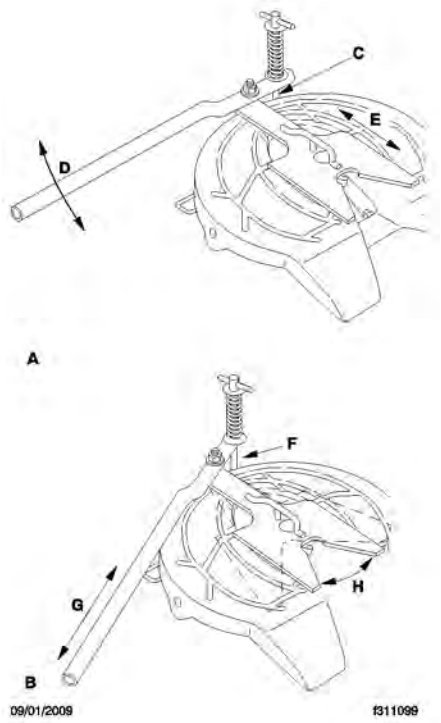


Fig 70, Bracket Pin Bolt Locking Tabs

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.71,Jost Fifth Wheel Adjustment ref. A.*The lock is too tight if:* the lock tester does not rotate freely in the lock. See Fig.71,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 71, 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.72,Jost Fifth Wheel *If the lock is too loose,* loosen the jam nut, turn the adjustment bolt *counter-clockwise* one full turn, then reset the jam nut. Lock and unlock the mechanism several times to test. Repeat if necessary. See Fig.72,Jost Fifth Wheel

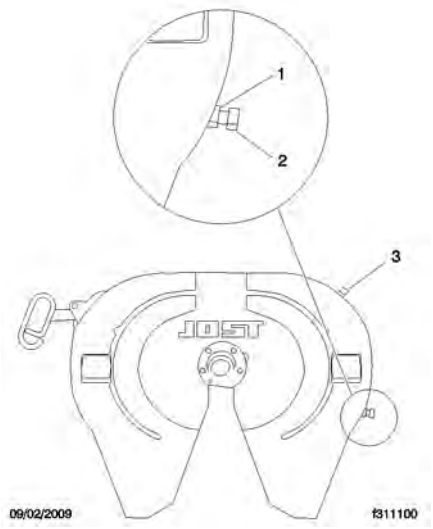


Fig 72, Jost Fifth Wheel

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 **MOP 31–02** in this manual for lubrication instructions.

10.03 Fifth Wheel Lubrication

10.03.01 General information

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.

10.03.02 Fontaine

1. Tilt the top plate forward (the front of the fifth wheel is down) and apply grease to each bearing area through the zerk fittings located on each side of the top plate just to the front of the bracket pins. Continue to apply grease until it is coming out of the back of the bearing. It may be necessary to raise the rear of the fifth wheel with a pry bar to open up the pocket slightly and allow the grease to flow through. A substantial amount of grease may be required initially to fill the reservoir. Tilt the fifth wheel ramps down (the rear of the fifth wheel is down) and repeat the greasing procedure. Rock the top plate back and forth several times to spread the grease over the bearing surface.
2. Inspect the trailer kingpin plate and top surface of the fifth wheel to make sure each is properly greased. A liberal coating of grease should be applied to the complete surfaces of both the trailer kingpin plate and the top surface of the fifth wheel.

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

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

3. Lubricate the fifth wheel prior to opening and closing it. Separate the jaw and wedge with a screwdriver, and grease the full length of their mating surfaces. Lubricate the top and bottom contact surfaces of the jaw and wedge. See Fig. 73,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.

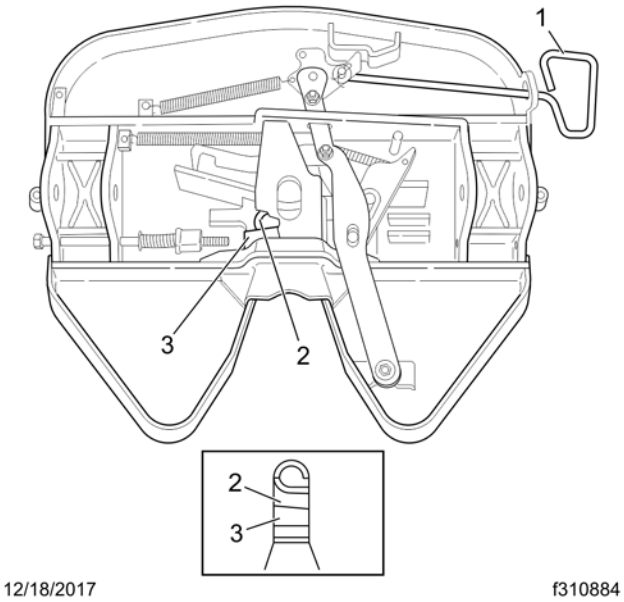


Fig 73, Fontaine Fifth Wheel

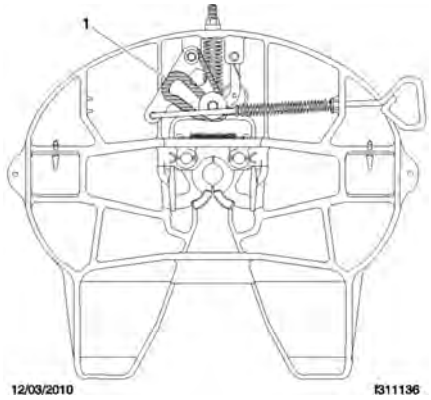
4. Apply grease to the top plate. Spread grease all over the mating surface of the top plate. Be sure the grease pockets built into the top plates are full of grease.

10.03.03 Holland FWS1

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

10.03.04 Holland FW35

1. Using a water-resistant lithium-base grease, grease the top plate.
2. Using a light oil (such as SAE 10W or 20W motor oil), lubricate the cam track and pivot. See Fig. 74,Holland FW35 Fifth Wheel, Oil Lubrication.



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

Fig 74, Holland FW35 Fifth Wheel, Oil Lubrication

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

3. Grease the yoke tips, locks, and the release handle and spring; see Fig. 75,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.

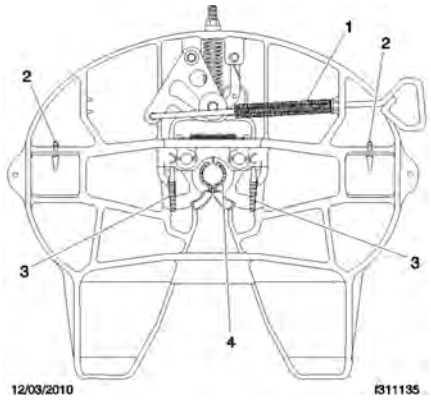


Fig 75, Holland FW35 Fifth Wheel, Grease Lubrication

10.03.05 Castloc II and Simplex Series

Use a chassis or multipurpose grease to lubricate the two grease fittings located on either side of the fifth wheel top plate. Lubricate the two grease fittings located in the grease grooves on the fifth wheel top plate. Lubricate the two grease fittings located below the top plate mounting pins. Lubricate the lock mechanism.

Once the fifth wheel's moving parts are lubricated, apply a heavy coat of grease to the top plate, either through the grease fittings located on the underside of the top plate, or by direct application. On slide-mount applications, lubricate the slider lock pockets and the slider bracket.

10.03.06 Jost

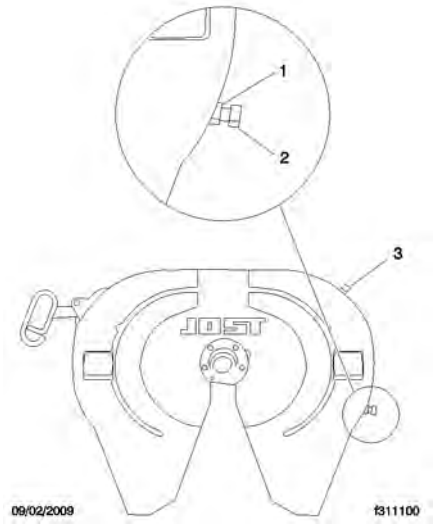
Lubricate the kingpin lock using a hand pump grease gun through the grease zerk on the skirt of the fifth wheel; see Fig. 76,Jost Fifth Wheel Apply a light oil to all moving parts. For sliding fifth wheels spray diesel fuel on the slide path of the base plate.

NOTICE:

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

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

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



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

Fig 76, Jost Fifth Wheel

10.04 Inspection Of The Holland Fifth Wheel Sliding Mechanism

1. Loosen the locking plunger jam nut and turn the adjusting bolt out (counterclockwise). See Fig. 77,Holland Fifth Wheel Sliding Mechanism.

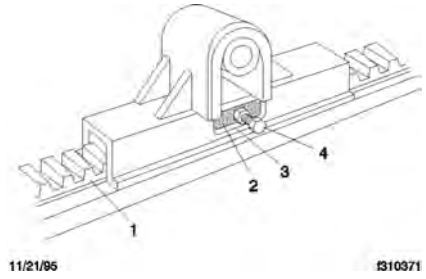


Fig 77, Holland Fifth Wheel Sliding Mechanism

2. Disengage and engage the locking plungers. Check that the plungers are securely seated without binding. If the locking plungers do no operate properly see General Information, Frame Fasteners of the **Western Star Workshop Manual** for adjustment procedures.
3. Turn the adjusting bolt clockwise until it contacts the rack. Turn the adjusting bolt an additional 1/2 turn, then securely tighten the locking nut.

10.05 Frame Fastener Torque Check

Frame brackets and components are to be checked at initial maintenance (IM). Check the torque of frame fasteners to offset the effects of "bedding in" (or seating). When possible, always check the torque of the nut, not the bolt head. This will give a true torque reading by eliminating bolt body friction. When checking the torque of frame fasteners, inspect the frame for cracks and other damage. Set a click-type torque wrench to the maximum torque of the fastener you are checking. Apply pressure until the torque wrench clicks. **Do not** loosen the fastener to check the torque. See List of Abbreviations 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.

NOTE: Engine supports on vehicles built from January 2007 do not require checking.

Inspect and check the fasteners at the following locations:

- air tank mounting brackets
- axle stops
- cab mount brackets
- deck plates
- battery and tool box brackets
- engine supports
- equalizer brackets
- exhaust brackets
- fifth wheel legs
- fifth wheel mounting
- frame crossmembers and gussets
- front frame brackets

- front suspension spring brackets
- fuel tank brackets
- radius rods
- rear engine supports
- rear suspension spring brackets
- shock absorbers
- all other suspension fastenersc
- 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.

10.06 Trailer Electrical Connector Lubrication

In some cases, failure of trailer cables occurs due to intrusion of chloride-based road deicing chemicals into the trailer connector. Once inside the connector, the chloride-based chemicals corrode the brass terminals and create bridging between positive and ground terminals.

NOTE: The use of soap is not recommended for cleaning the electrical connector, as some soaps may increase the corrosion process.

1. Wash out any existing grease, dirt, and corrosion on the trailer connectors with electrical contact cleaner spray.
2. Grease the trailer connector with a lithium-based dielectric grease.

10.07 Inspection Of The Premier 690 Coupling

IMPORTANT: Before servicing the Premier coupling, refer to the Premier web site at www.premier-mfg.com for complete safety, operation, and maintenance instructions.

WARNING:

If at any time the 690 coupling is bound up (jackknifed), the 294 bolt MUST be replaced immediately! Do not use the coupling until the bolt has been replaced. In addition, carefully inspect the 690 coupling, drawbar, drawbar eye, front end assembly, and tail board for damage. Failure to do so may result in trailer separation from the truck while in use, resulting in serious personal injury or property damage.

The time-in-service of the 294 bolt located in the 690 coupling must be monitored, and maintenance performed as follows. See Fig.78,Premier 690 Trailer Coupling.

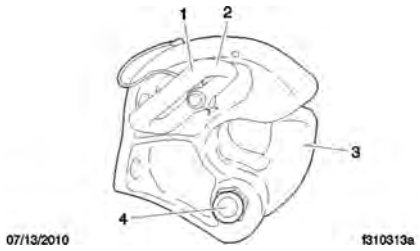


Fig 78, Premier 690 Trailer Coupling

For a new or replaced 294 bolt:

- Record the date of installation.

6 months after installation date:

- Remove the 294 bolt. Using dye penetrate or magnetic particle testing along the length of the bolt, inspect for fractures.
- If the 294 bolt has no damage, install it and continue to use for another 6 months.
- If the 294 bolt is fractured, DO NOT USE. Contact Premier Mfg. Co.

1 year after installation date:

- Regardless of service duty, replace the 294 bolt with a new one.

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11. Suspension

11.01 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.

11.02 Suspension Inspection

11.02.01 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 your Western Star dealer for replacement.

Inspect the spring pin bushings. If there is any indication of the outer bushing casing moving within the spring eye, the complete spring assembly must be replaced. Refer to General Information, Front Leaf-Spring Suspension of the **Western Star Workshop Manual** for instructions.

For threaded and bronze bushings, ensure the center pin is free to rotate within the outer bushing. If the pin is seized, replace the complete spring assembly. Refer to General Information, Front Leaf-Spring Suspension of the **Western Star Workshop Manual** for instructions.

For maintenance free rubber bushings, inspect the bushings at the forward spring eye and shackle. If there is any indication of the rubber bushing being cracked or damaged, replace the bushing. Refer to General Information, Front Leaf-Spring Suspension of the **Western Star Workshop Manual** for instructions.

Front and Rear Suspension Shock Absorber Check

Regularly checking shock absorbers and having weak shock absorbers replaced will help avoid unscheduled down time and reduce overall maintenance costs.

The role of a shock has changed dramatically. Not so many years ago, most suspensions had heavy multi-leaf springs with limited travel and a great deal of inherent friction. These suspensions quickly self dampened and therefore limited the amount of work the shock needed to perform.

Low-friction suspensions, such as air and taper leaf, have dramatically changed the shock's role. Shocks now play a critical role in dampening suspension oscillation.

Properly functioning shocks can help to reduce the wear of more expensive suspension components, such as air bags, while assisting in the reduction of tire wear. Worn shocks simply cannot assist in providing control over today's sophisticated suspension systems.

Quick Test

Shock absorbers function at temperatures ranging from air temperature to 350°F (177°C). A shock's function is to slow the bounce of the vehicle's springs. It does this by transforming the energy produced by the spring to heat and dissipating it. As a result the shock should be slightly warm to hot to the touch after normal use.

If ride deterioration is experienced and there is a suspicion that a shock has failed internally, which is visually undetectable, perform the following checks within a few minutes of operating the vehicle.

1. Drive the vehicle at moderate speeds for at least 15 minutes.
2. Within a few minutes of driving, touch each shock absorber carefully on its body below the dust cover or tube. First touch a part close to the shock absorber (spring, frame) to establish a reference temperature of metal.
3. All shock absorbers should be warmer than any part near the shock absorber (spring, frame). Suspect a failure in any shock absorber that is noticeably cooler than the shock absorber on the other end of the axle. Different temperatures from axle to axle do not indicate failures, but cooler temperatures on any one axle does warrant removal and examination of the cooler shock absorber. See Fig.79,Temperature Touch Test.



Fig 79, Temperature Touch Test

4. To inspect for an internal failure, remove and shake the suspected shock. Listen for the sound of metal rattling inside. Rattling of metal parts can indicate that the shock has an internal failure.

Inspection Of The Shock Absorber

There are many conditions that indicate it may be time to replace shocks. Check for the following conditions.

1. Uneven tire wear (check wheel balance first).
2. Ride deterioration.
3. Excess vibration.
4. Sagging taper leaf springs (this is not caused by weak shocks).
5. Premature wear on cab, electrical, and cooling system components.
6. Broken or torn air springs. Shocks will only affect this if they are broken or missing.
7. Upper or lower mount eye broken and dust tube broken. See Fig.80,Shock With Broken Eye and Tube.



Fig 80, Shock With Broken Eye and Tube

8. Upper or lower bushing cracked or deformed (when not under load). See Fig.81,Shock With Cracked Bushing.



Fig 81, Shock With Cracked Bushing

9. Bent or dented body. See Fig.82,Bent and Dented Shock . Misting shocks are often misdiagnosed as failures. Misting is the process whereby very small amounts of shock fluid evaporate at high operating temperatures. The mist passes through the upper seal of the shock. When the mist reaches the cooler outside air it condenses and forms a film on the outside of the shock body. When mixed with road debris and dust, a grime will often coat the body of the shock. Misting is perfectly normal and a necessary function of the shock. The fluid which evaporates through the upper seal area helps to lubricate and prolong the life of the seal. Many technicians find it difficult to differentiate between a misting shock and a true leaker, which needs replacing. A leaker will show clear signs of fluid leaking in streams from the upper seal. These streams can most easily be seen when the shock is fully extended and one inspects as far up the main body of the shock (underneath the dust cover or tube) as possible. See Fig.83,Misting Shock and Fig. 84,Leaking Shock.

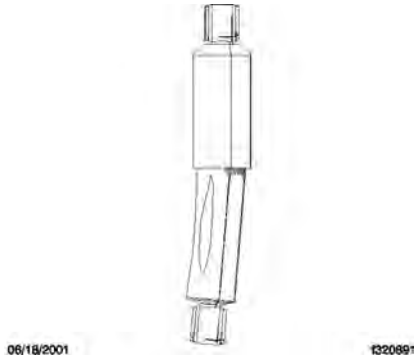


Fig 82, Bent and Dented Shock

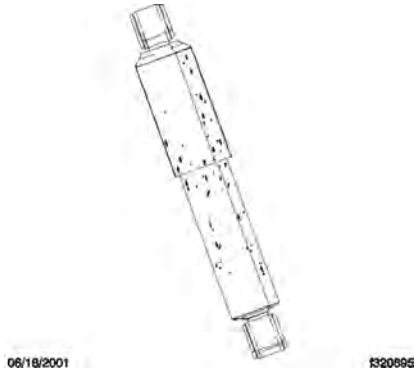


Fig 83, Misting Shock

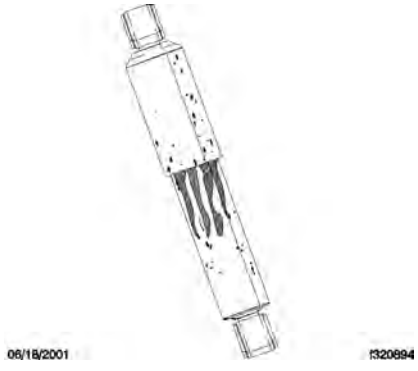


Fig 84, Leaking Shock

11.02.02 Rear Suspension Check

TufTrac Suspension

1. Inspect the suspension spring assemblies for pitted, cracked, broken, or abnormally bent leaves, and extreme rust. If any of these conditions exist, replace the spring assembly.

WARNING:
Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. On front spring assemblies, if cracks or breaks exist in the two top leaves, a loss of vehicle control could occur. Failure to replace a damaged spring assembly could cause an accident resulting in property damage, serious personal injury, or death.

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

2. Inspect the brackets for cracks in the castings. Inspect the V-rod tower welds for cracking or other signs of damage. Also check for contact between the frame rail and the upper axle clamp brackets. If contact exists, check the V-rod bushing for wear. Check the V-rod fastener torques.
3. Inspect the rubber center bearing and spring tip pads for excessive wear, including de-lamination of the rubber-to-metal shim interface, and distortion and degradation of rubber.
4. Inspect the V-rods and lower control rods for wear and looseness.
   - 4.a Without disconnecting the control rods, use your hand to attempt to move each of the control rod ends up, down, in, and out. If there is any movement, examine the control rods for wear or damage. Replace if necessary.
   - 4.b Inspect the rubber bushings for cracks or cuts.
   - 4.c Check for any shifting of the barpin.
   - 4.d Check for cracks in the metal components and welds.
5. Check all fasteners for looseness.
6. Inspect the shock absorbers for oil leaks and worn rubber bushings. Replace the shock absorbers and/or rubber bushings if wear or damage is noted.

AirLiner Suspension

WARNING:
Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. On front spring assemblies, if cracks or breaks exist in the two top leaves, a loss of vehicle control could occur. Failure to replace a damaged spring assembly could cause an accident resulting in property damage, serious personal injury, or death.

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

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

NOTICE:

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

1. Inspect the fasteners that attach the suspension brackets to the frame for proper torque. See List of Abbreviations for bolt torque specifications.

WARNING:

Be sure that the fasteners are torqued correctly. Fasteners that are not tight can cause separation of components or premature failure of components, loss of vehicle control and possible personal injury or property damage.

2. Inspect the forward and rear spring brackets for wear, cracks, and other damage. If any of these conditions exist, replace the damaged bracket(s).

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.

3. Inspect the crossmember(s) and gussets for wear, cracks, and other damage. If any of these conditions exist, replace the damaged parts.
4. 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.

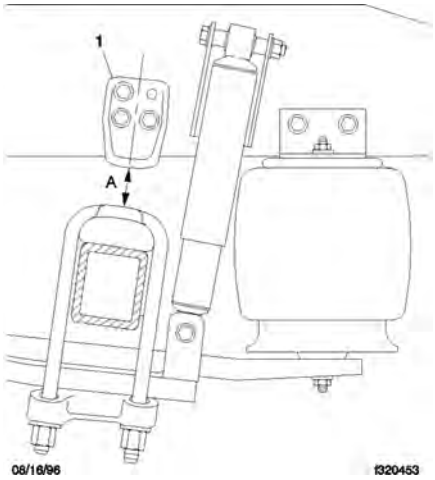
WARNING:

If damaged air bags are found, do not continue to use the vehicle, take the vehicle to your Western Star dealer to have the air bags replaced because the sudden loss of air bag pressure can cause loss of vehicle control resulting in serious personal injury and property damage.

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

5. 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.

6. Mark the location of the front and rear tires on the floor, and chock the tires on one axle only.
7. On single-drive rear axle configurations, measure the distance from the bottom of the left axle stop to the top of the U-bolt pad. On dual-drive rear axle configurations, measure the distance from the bottom of the forwardmost left axle stop to the top of the axle U-bolt pad. See Fig.85,AirLiner Axle Stop Measurement , Ref. A. The correct distance for single and dual-drive rear axles is from 2-3/8 to 2-7/8 inches (60 to 73 mm).



A. Measure height here.
1. Left Forwardmost Axle Stop

Fig 85, AirLiner Axle Stop Measurement

8. If the axle stop measurement is not correct, contact your Western Star dealer to adjust the leveling valves.
9. Check the shock absorbers. For instructions, see 11.02.01 Front Suspension Check, "Suspension Inspection."

Chalmers Suspension

WARNING:
Before making any inspections, always make sure that the vehicle's park brake is set and that the wheels are chocked to prevent accidental vehicle movement to prevent serious injury.

1. Inspect the fasteners that attach the suspension brackets to the frame for proper torque. See List of Abbreviations for bolt torque specifications.



WARNING:
Be sure that the fasteners are torqued correctly. Fasteners that are not tight can cause separation of components or premature failure of components, loss of vehicle control and possible personal injury or property damage.

2. Chock the front tires to prevent the vehicle from moving. Place the transmission in neutral, and release the parking brakes before inspecting the Chalmers rear suspension.
3. Power-wash the Chalmers rear suspension, or clean it with a hard-bristle brush before performing a visual inspection.
4. Visually inspect the rubber bushings for cracks or other damage. Try to move the torque rod ends using your hands only, and check for any free-play. If free-play is felt, replace the torque rod end bushing. Do not use a pry bar to check for free-play. Use of a pry bar may lead to premature bushing replacement.
5. Visually inspect the walking beam for cracks or other damage. If damage is found, replace the walking beam.
6. Visually inspect the restrictor cans for cracks, severe corrosion, and distortion. If any of these conditions are present, or the restrictor can is missing, replace it.



WARNING:
Replace all cracked or missing restrictor cans. Failure to do so could lead to loss of vehicle control, which could result in property damage, serious personal injury, or death.

7. Check the shock absorbers. For instructions, see 11.02.01 Front Suspension Check, "Suspension Inspection."

Hendrickson RS Series



WARNING:
Before making any inspections, always make sure that the vehicle's park brake is set and that the wheels are chocked to prevent accidental vehicle movement to prevent serious injury.

1. Inspect the fasteners that attach the suspension brackets to the frame for proper torque. See List of Abbreviations for bolt torque specifications.

WARNING:
Be sure that the fasteners are torqued correctly. Fasteners that are not tight can cause separation of components or premature failure of components, loss of vehicle control and possible personal injury or property damage.

2. Visually inspect each frame hanger for any evidence of cracks and rust streaks coming out from between the frame rail and the bracket.
3. Visually inspect the load cushions for cuts and swelling. Cushions cut by the retaining lips of the saddles of frame hangers indicate the cushions may not be the correct hardness or configuration for the use of the vehicle.
4. Check the shock absorbers. For instructions, see 11.02.01 Front Suspension Check, "Suspension Inspection."

Hendrickson RT Series

WARNING:
Before making any inspections, always make sure that the vehicle's park brake is set and that the wheels are chocked to prevent accidental vehicle movement to prevent serious injury.

1. Inspect the fasteners that attach the suspension brackets to the frame. See Fig. 86,Hendrickson RT Series Suspension. See List of Abbreviations for bolt torque specifications.

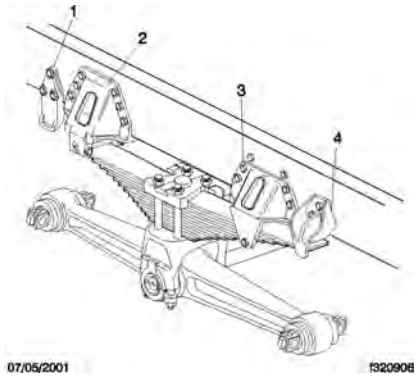


Fig 86, Hendrickson RT Series Suspension

WARNING:
Be sure that the fasteners are torqued correctly. Fasteners that are not tight can cause separation of components or premature failure of components, loss of vehicle control and possible personal injury or property damage.

2. Check that the torque on the number one spring bracket lock bolts is 45 to 63 lbf·ft (62 to 85 N·m). See Fig. 86,Hendrickson RT Series Suspension.
3. Inspect the leaf springs for worn or broken spring leaves.
4. Inspect the cam surfaces of the number two spring bracket and number three spring bracket for wear due to high mileage. See Fig.86,Hendrickson RT Series Suspension. Also check the inner side edges of the hanger legs for wear. Excessive wear on the sides of the legs is an indicator there my be problems with the spring eye bushing. Excessive wear at either point requires that the spring hanger be replaced.
5. Check the shock absorbers. For instructions, see 11.02.01 Front Suspension Check, "Suspension Inspection."

Hendrickson HAS

WARNING:
Before making any inspections, always make sure that the vehicle's park brake is set and that the wheels are chocked to prevent accidental vehicle movement to prevent serious injury.

1. Inspect the fasteners that attach the suspension brackets to the frame for proper torque. See List of Abbreviations for bolt torque specifications.

WARNING:
Be sure that the fasteners are torqued correctly. Fasteners that are not tight can cause separation of components or premature failure of components, loss of vehicle control and possible personal injury or property damage.

2. Check the torque of the suspension U-bolts every 24,000 miles (40,000 kilometers). For instructions, see 11.04 Suspension U-Bolt Torque Check, "Suspension U-Bolt Torque Check."
3. Visually inspect each suspension bracket for any evidence of cracks and rust streaks coming out from between the frame rail and the bracket.
4. Check shock absorbers every 18,000 miles (30,000 kilometers). For instructions, see 11.02.01 Front Suspension Check, "Suspension Inspection."
5. Inspect the air bags for sufficient and equal pressure. Examine the air bags for wear and cuts.



WARNING:

If damaged air bags are found, do not continue to use the vehicle, take the vehicle to your Western Star dealer to have the air bags replaced because the sudden loss of air bag pressure can cause loss of vehicle control resulting in serious personal injury and property damage.

6. 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.
7. Mark the location of the front and rear tires on the floor, and chock the tires on one axle only.
8. Check the ride height by measuring, directly above the axle, the distance from the bottom of the frame rail to the bottom of the main support member. The correct ride height is 4-1/4 inches (108 mm). If any problem is found, take the vehicle to your Western Star dealer to have the problem corrected.

Neway Suspension



WARNING:

Before making any inspections, always make sure that the vehicle's park brake is set and that the wheels are chocked to prevent accidental vehicle movement to prevent serious injury.

1. Inspect the fasteners that attach the suspension brackets to the frame for proper torque. See List of Abbreviations for bolt torque specifications.



WARNING:

Be sure that the fasteners are torqued correctly. Fasteners that are not tight can cause separation of components or premature failure of components, loss of vehicle control and possible personal injury or property damage.

2. Visually inspect each suspension bracket for any evidence of cracks and rust streaks coming out from between the frame rail and the bracket.
3. Check the shock absorbers. For instructions, see 11.02.01 Front Suspension Check, "Suspension Inspection."
4. Inspect the air bags for sufficient and equal pressure. Examine the air bags for wear and cuts.



WARNING:

If damaged air bags are found, do not continue to use the vehicle, take the vehicle to your Western Star dealer to have the air bags replaced because the sudden loss of air bag pressure can cause loss of vehicle control resulting in serious personal injury and property damage.

5. 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.
6. Mark the location of the front and rear tires on the floor, and chock the tires on one axle only.
7. Check the ride height by measuring the distance from the bottom of the frame rail to the center of the axle. The correct ride height is from 9-3/4 to 10-1/4 inches (248 to 260 mm).

Reyco Suspension



WARNING:

Before making any inspections, always make sure that the vehicle's park brake is set and that the wheels are chocked to prevent accidental vehicle movement to prevent serious injury.

1. Inspect the fasteners that attach the suspension brackets to the frame for proper torque. See List of Abbreviations for bolt torque specifications.



WARNING:

Be sure that the fasteners are torqued correctly. Fasteners that are not tight can cause separation of components or premature failure of components, loss of vehicle control and possible personal injury or property damage.

2. Check the torque of the suspension U-bolts. For instructions, see 11.04 Suspension U-Bolt Torque Check, "Suspension U-Bolt Torque Check."
3. Check the shock absorbers. For instructions, see 11.02.01 Front Suspension Check, "Suspension Inspection."
4. Inspect the leaf springs for worn or broken spring leaves.

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.

5. Inspect each frame hanger for any evidence of cracks and rust streaks coming out from between the frame rail and the bracket.

11.03 Suspension Lubrication

11.03.01 Front Suspension

Weekly, grease the front spring pins and rear shackle pins. Wipe all dirt away from grease fittings (if equipped) on the spring-eye bushings. Apply multipurpose extreme pressure (EP) chassis grease with a pressurized grease gun until old grease is forced out. For some applications, like twin steer, the grease fitting is toward the inside, for clearance. When greasing the spring pins, *always* raise the vehicle to remove vehicle weight from the springs.

11.03.02 Rear Suspension

Freightliner

Single Axle

No lubrication is required on a Freightliner single-axle rear suspension.

Tandem Axle

Lubricate the equalizer cap-and-tube assembly bushings by applying multipurpose chassis grease at the grease fitting until the old grease is forced out from the cap-and-tube assembly. See Fig. 9.

Chalmers

No lubrication is required on a Chalmers rear suspension.

11.03.03 Hendrickson

The Hendrickson RS Series suspension does not require lubrication.

For Hendrickson RT2 and RTE2 Series, lubricate the bronze, ball-indented bushings in the spring eye, as follows.

1. Park the vehicle on a level surface, apply the parking brakes, and chock the front tires.
2. Raise the rear of the vehicle until the rear wheels are suspended in the air, then support the vehicle with safety stands. This relieves the load on the bushings and pins to allow the proper flow of lubricant around them.
3. Use a multipurpose chassis grease, and lubricate the bronze, ball-indented bushings in the spring eyes at the grease fitting. See Fig.87,Hendrickson RT2 and RTE2 Series Bushing Lubrication. Continue to lubricate until grease exits both ends of the bushing. If the pin will not accept lubricant, remove the pin and clean the lubrication channels where lubricant may have hardened.

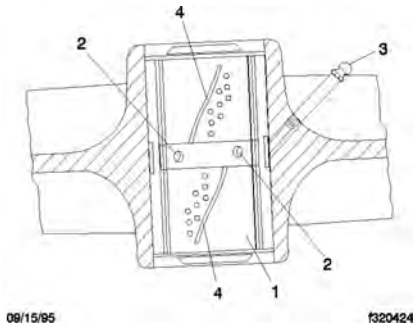


Fig 87, Hendrickson RT2 and RTE2 Series Bushing Lubrication

11.03.04 Neway

No lubrication is required on a Neway rear suspension.

11.03.05 Reyco

No lubrication is required on a Reyco rear suspension.

11.04 Suspension U-Bolt Torque Check

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

1. Park the vehicle on a flat surface and apply the parking brakes. Chock the tires.
2. Check U-bolt torque in a diagonal pattern. Set a click-type torque wrench to the highest torque value for the fastener being checked. See List of Abbreviations for torque specifications. Turn the wrench in a clockwise motion (looking up) until the torque wrench clicks. See Fig.88,Tightening Pattern for U-Bolt Nuts.

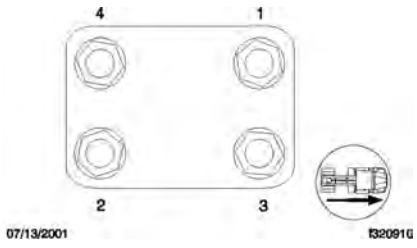


Fig 88, Tightening Pattern for U-Bolt Nuts

3. Remove the chocks.

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12. Front Axle

12.01 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..

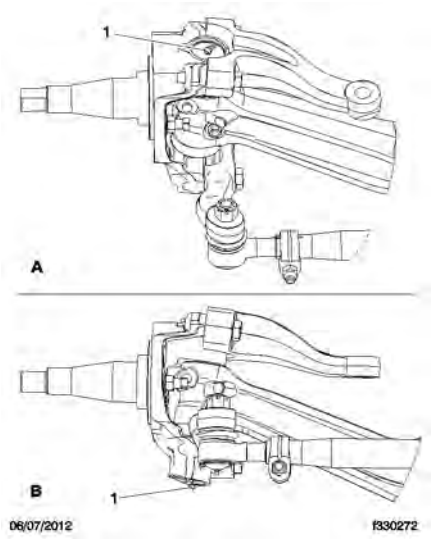
12.02 Knuckle Pin Lubrication

12.02.01 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.89,Grease Fittings, Detroit Axles for grease exit points, see Fig. 90,Knuckle Pin Grease Exit Points, Detroit Axles.



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

1. Grease Fitting

Fig 89, Grease Fittings, Detroit Axles

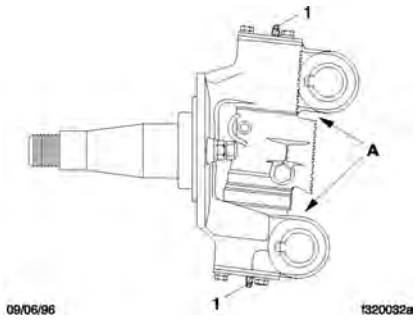
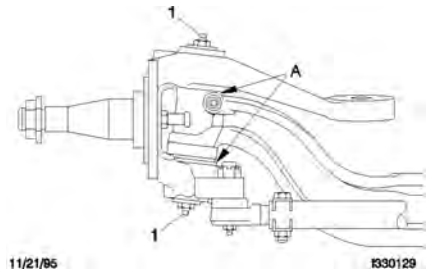


Fig 90, Knuckle Pin Grease Exit Points, Detroit Axles

12.02.02 Dana Spicer Axles

Park the vehicle on a level surface, apply the parking brakes, and chock the tires. When lubricating knuckle pin bushings, do not raise the front axle. Wipe the lube fittings clean, and apply multipurpose chassis grease, 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.91, **Dana Spicer Knuckle Pin Lubrication**.

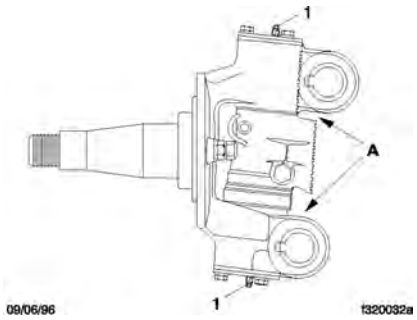


A. Grease Exit 1. Grease Fitting

Fig 91, Dana Spicer Knuckle Pin Lubrication

12.02.03 Meritor Axles

1. Park the vehicle on a level surface, apply the parking brakes, and chock the tires. When lubricating knuckle pin bushings, do not raise the front axle. Wipe the lube fittings clean, and apply multipurpose chassis grease, 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.92,Knuckle Pin Lubrication, Meritor Axles.



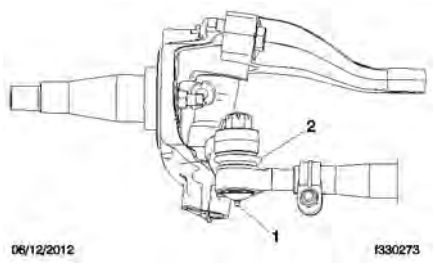
A. Grease Exit 1. Grease Fitting

Fig 92, Knuckle Pin Lubrication, Meritor Axles

12.03 Lubrication of the Tie Rod

NOTE: Some axles require lubrication of the tie rod ends.

1. Wipe the tie rod end grease fittings clean.
2. Pump multipurpose chassis grease, NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI Grade 2 (8% 12-hydroxy lithium stearate grease), into the tie rod ends until all used grease is forced out and fresh grease is seen at the ball stud neck. See Fig.93,Grease Fitting and Boot (Detroit axle shown).



NOTE: No grease should emit from the tie-rod boot. If grease emits from the tie-rod boot, the boot is damaged.

Fig 93, Grease Fitting and Boot (Detroit axle shown)

12.04 Inspection of the Tie Rod

1. Shut off the engine, apply the brakes, and chock the rear tires.
2. Check the tie rod boot for cracks, tears, or other damage. If the tie rod boot is damaged, replace the entire tie rod end.
3. Grasp by hand (or use a pipe wrench with jaw protectors to avoid gouging the cross tube) and slightly rotate the cross tube toward the front of the vehicle and then slightly toward the rear. Then center the cross tube between the stop positions. If the cross tube does not rotate in either direction, replace both tie rod ends.
4. Position yourself directly below the ball stud socket. Using both hands, grab the end as close to the socket as possible, no more than 6 inches (15.2 cm) from the end. Firmly apply about 100 pounds of hand pressure in an up and down motion several times. When moving the assembly, check for any movement at both tie rod ends. See Fig. 94,Check Movement of Tie Rod End. If any movement is detected at one tie rod end, replace **both** tie rod ends. Always replace tie rod ends in pairs, even if only one tie rod end is damaged.

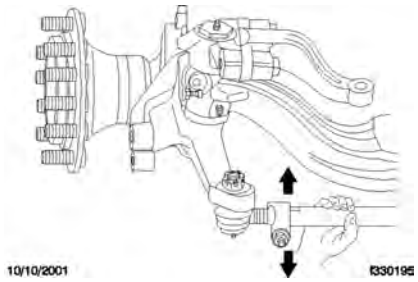


Fig 94, Check Movement of Tie Rod End

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

5. Check the cross tube for cracks or other damage. If the cross tube is bent or damaged, replace the cross tube.

6. Check the clamps for damage. If a clamp is damaged, replace the clamp. Replace the entire cross tube assembly if either clamp is welded to the cross tube.
7. Check for proper installation of the tie rod end clamp to the cross tube. Make sure that the tie rod ends are threaded in the cross tube past the clamps and the slots at the cross tube ends.
8. Check the zerk fittings for damage. If a zerk fitting is damaged, replace it. Some tie rod ends have no zerk fittings because they are not greaseable. Do not install a zerk fitting on a nongreaseable tie rod end.
9. Check that the cotter pin is in place. If it is not, tighten the tie rod end nut to one of the following specs depending on the axle manufacturer. For Detroit axles, tighten the castle nut to 120 to 170 lbf·ft (163 to 230 N·m). To align the cotter pin hole with the castle nut slot, turn the nut up to 1/6 turn (maximum). For Meritor axles, tighten the tie rod end nut per the size of the stud:
   - 7/8–14, 160 to 300 lbf·ft (217 to 406 N·m)
   - 1–14, 250 to 450 lbf·ft (339 to 610 N·m)
   - 1-1/8–12, 350 to 650 lbf·ft (475 to 881 N·m)
   - 1-1/4–12, 500 to 675 lbf·ft (678 to 915 N·m)
10. Check the steering arm bolts for a minimum torque of 300 lbf·ft (406 N·m). If the steering arm bolt torque has fallen below this specification, remove the bolt, clean all the threads, and apply new Loctite® 680. Tighten the bolt 300 to 450 lbf·ft (406 to 610 N·m).

12.05 Lubrication of the Front Axle Wheel Bearing

Stemco front axle hub caps have a transparent inspection window with lubrication level marks for checking the amount of lubricant available for the front wheel bearings. See Fig.95,Front Hubcap Inspection Window. If the lubricant level is low, remove the center fill plug and add lubricant until the level reaches the 'full' mark. Fill the hub with Hypoid Gear Oil API-GL-5 with Military Specification MIL-L-2105C, SAE viscosity 75W-90.

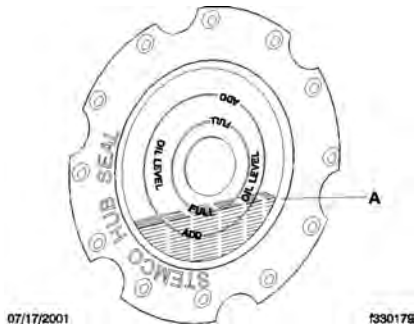


Fig 95, Front Hubcap Inspection Window

12.06 Front Drive Axle Lubricant Level Check

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

NOTE: Follow the recommended maintenance schedule for draining and flushing the drive axles. See **Group 00** for time or mileage intervals.

1. With the vehicle parked on level ground, apply the parking brakes and chock the tires.
2. If the vehicle has just been driven, allow a few minutes for the lubricant to settle.
3. Clean the oil fill plug and the area surrounding it. Remove the fill plug. See Fig.96,Drive Axle Housing.

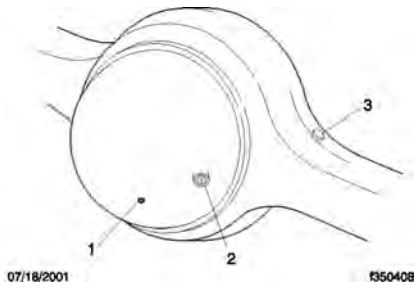


Fig 96, Drive Axle Housing

4. Lubricant should be level with the bottom of the fill hole. See Fig.97,Drive Axle Lubrication Level. If low, check the axle for leaks, and have any leaks corrected. Add lubricant as required. See Table.22,Eaton Drive Axle Recommended Lubricants and Table.23,Meritor Drive Axle Recommended Lubricants for recommended drive axle lubricants.

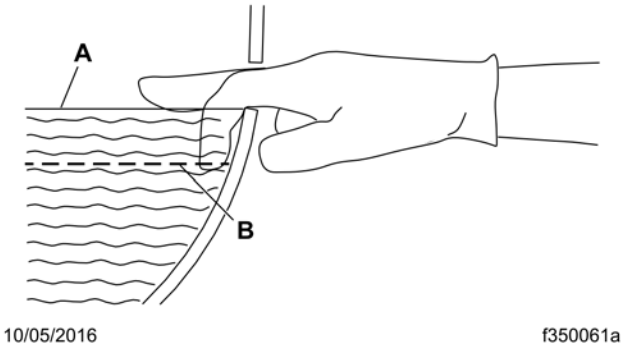


Fig 97, Drive Axle Lubrication Level

Table 22, Eaton Drive Axle Recommended Lubricants

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

Table 22, Eaton Drive Axle Recommended Lubricants

Table 23, Meritor Drive Axle Recommended Lubricants

Eaton Drive Axle Recommended Lubricants		
Lubricant Type	**Outside Air Temperature**	**SAE Viscosity**
Hypoid Gear Oil API-GL-5 with Military Specification MIL-L-2105C	+10°F (-12°C) & Up[1]	85W-140
	-40°F (-40°C) & Up[2]	75W-90
	-40°F (-40°C) & Up[3]	75W-140
Synthetic Gear Oil	-40°F (-40°C) & Up[4]	75W-90
	-40°F (-40°C) & Up[5]	75W-140

1. There is no upper limit on these outside air temperatures, but axle sump temperature must never exceed 250°F (121°C).
2. There is no upper limit on these outside air temperatures, but axle sump temperature must never exceed 250°F (121°C).
3. There is no upper limit on these outside air temperatures, but axle sump temperature must never exceed 250°F (121°C).
4. There is no upper limit on these outside air temperatures, but axle sump temperature must never exceed 250°F (121°C).
5. There is no upper limit on these outside air temperatures, but axle sump temperature must never exceed 250°F (121°C).

Table 23, Meritor Drive Axle Recommended Lubricants

5. Apply a small amount of thread sealant (Loctite® or equivalent), to the threads of the filler plug. Install and tighten the fill plug 40 to 60 lbf·ft (54 to 81 N·m).

12.07 Front Drive Axle Lubricant Change



NOTICE:

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

Refer to Table.24,Eaton Drive Axle Recommended Lubricants and Table.25,Meritor Drive Axle Recommended Lubricants for recommended drive axle lubricants.

Table 24, Eaton Drive Axle Recommended Lubricants

Eaton Drive Axle Recommended Lubricants		
Lubricant Type	**Conditions**	**SAE Viscosity**

Eaton® Roadranger® Synthetic Drive Axle Lubricants, or Equivalent with Military Specification MIL-L-2105D	Over-the-Road Service	75W-90
	Off-Highway, or Under Extra-Heavy Loads	80W-140

Table 24, Eaton Drive Axle Recommended Lubricants

Table 25, Meritor Drive Axle Recommended Lubricants

Eaton Drive Axle Recommended Lubricants		
Lubricant Type	**Outside Air Temperature**	**SAE Viscosity**
Hypoid Gear Oil API-GL-5 with Military Specification MIL-L-2105C	+10°F (-12°C) & Up[1]	85W-140
	-40°F (-40°C) & Up[2]	75W-90
	-40°F (-40°C) & Up[3]	75W-140
Synthetic Gear Oil	-40°F (-40°C) & Up[4]	75W-90
	-40°F (-40°C) & Up[5]	75W-140

1. There is no upper limit on these outside air temperatures, but axle sump temperature must never exceed 250°F (121°C).
2. There is no upper limit on these outside air temperatures, but axle sump temperature must never exceed 250°F (121°C).
3. There is no upper limit on these outside air temperatures, but axle sump temperature must never exceed 250°F (121°C).
4. There is no upper limit on these outside air temperatures, but axle sump temperature must never exceed 250°F (121°C).
5. There is no upper limit on these outside air temperatures, but axle sump temperature must never exceed 250°F (121°C).

Table 25, Meritor Drive Axle Recommended Lubricants

1. With the vehicle parked on level ground, apply the parking brakes and chock the tires.
2. Clean the area around the fill plug. Remove the fill plug.
3. Place a drain pan under the axle. Remove the drain plug from the bottom of the housing and completely drain the lubricant, while the unit is warm.
4. The drained oil should be stored appropriately for recycling.
5. It is necessary to flush the axle the first time (ONLY) that the axle lubricant is changed. Flush the axle with clean flushing oil, then drain it thoroughly. The drained oil should be stored appropriately for recycling.

   IMPORTANT: The axle should not be flushed with any solvent, such as kerosene.

6. Clean the fill and drain plugs. A piece of keystock or other convenient steel bar may be used across the magnetic poles to divert the magnetic field. Clean the metallic particles from the plug.

   NOTE: The magnetic plug should have a minimum pickup capacity of 1-1/2 lb (0.7 kg) of low-carbon steel, in bar or plate form. Magnets will rapidly loose effectiveness as collected material bridges the gap between the two poles. Clean or change the plugs before this occurs. It may be necessary to clean or change the plugs one or more times between lubricant change intervals.

7. Install and tighten the drain plug to 35 lbf·ft (47 N·m).
8. Fill the axle housing to the bottom of the fill hole, (Fig.98,Drive Axle Lubrication Level) using the specified lubricant. See Table.24,Eaton Drive Axle Recommended Lubricants and Table.25,Meritor Drive Axle Recommended Lubricants for recommended drive axle lubricants.

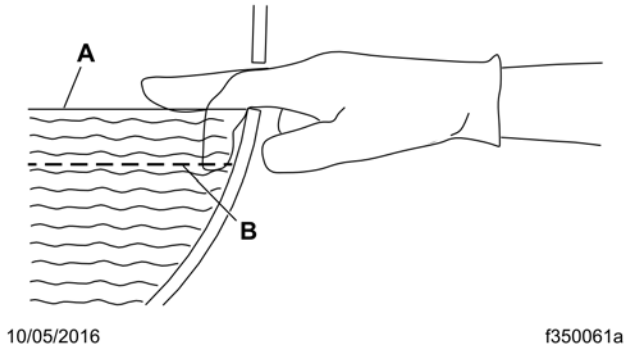


Fig 98, Drive Axle Lubrication Level

9. Install and tighten the fill plug to 35 lbf·ft (47 N·m).
10. Remove the chocks. Then drive the vehicle, unloaded, for 1 to 2 miles (2 to 3 km) at speeds not to exceed 25 mph (40 km/h), to thoroughly circulate lubricant throughout the carrier and housing assembly.

12.08 Wheel Alignment Check

12.08.01 General Information

The axles and wheels are aligned at Western Star using Hunter laser alignment equipment. Correct front axle alignment is needed to ensure long tire life, ease of handling, and steering stability.

1. Camber is the vertical tilt of the wheel as viewed from the front of the vehicle. Camber angle is measured in degrees, and is not adjustable. Negative camber is the top of the wheels tilted inwards. Front tires wearing on the inboard side may be due to excessive negative camber. See Fig.99,Tire Wear Due to Excessive Camber.

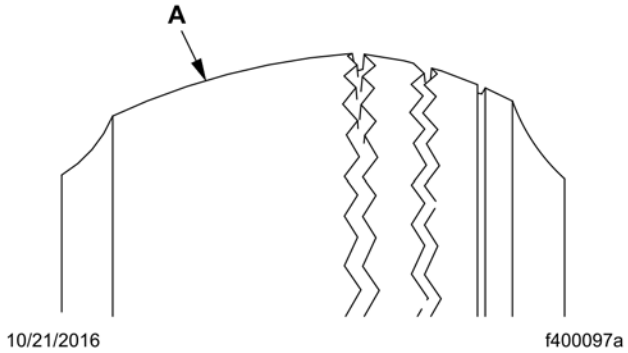


Fig 99, Tire Wear Due to Excessive Camber

2. Caster is the tilt of the knuckle pin (or king-pin), as viewed from the side. Caster angle is measured in degrees and is adjustable. An incorrect caster angle does not cause tire wear. However, a positive caster angle that exceeds specifications could cause vehicle shimmy and an increased steering effort. Excessive negative caster angle could cause unstable steering, and the vehicle may wander and weave.
3. Wheel toe-in is the distance that the front of the wheels are closer together than the rear of the wheels. Wheel toe-in is adjustable. If toe-in is not correct, the vehicle could pull to one side while driving. Wheel shimmy and excessive tire wear could occur. The tires would display indentations on the road contact surfaces of the tread. Also, a rapid wear on

the steering axle could occur usually in a feathered-edge pattern. See Fig.100,Tire Wear Due to Excessive Toe-In. Feathered-edging more often affects the front tire on the passenger's side of the vehicle, and is usually more apparent on the outside groves of the tire. If any of these listed conditions occur, the vehicle could need a front end alignment.

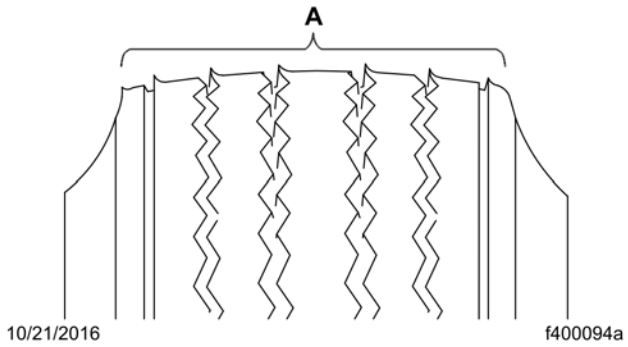


Fig 100, Tire Wear Due to Excessive Toe-In

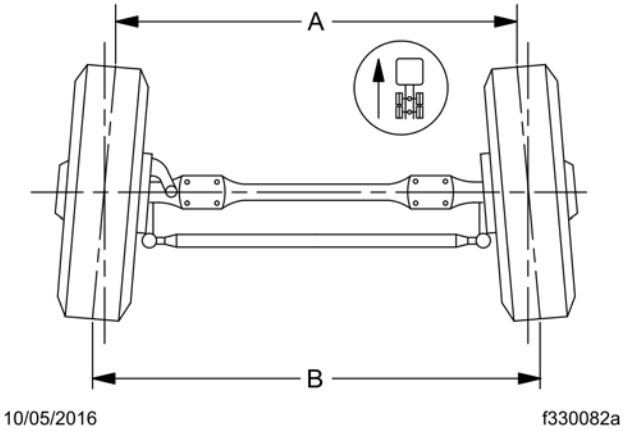
12.08.02 Inspection Of The Toe-In

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. Western Star 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 each front tire. Remove the safety stands from under the axle, then lower the vehicle. Remove the lock-pins from the gauges; make sure the tires are exactly straight ahead.

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

6. Place a trammel bar at the rear of the front tires; locate the trammel pointers at spindle height, and adjust the pointers to line up with the scribe lines on the center ribs of the front tires. See Fig.101,Wheel Toe-In (overhead view) Lock in place. Check that the scale is set on zero.



NOTE: B minus A equals toe-in.

Fig 101, Wheel Toe-In (overhead view)

7. Place the trammel bar at the front of the tires, as shown in Fig.102,Trammel Bar Positioning and adjust the scale end so that the pointers line up with the scribe lines. See Fig.103, Setting Trammel Bar Pointers

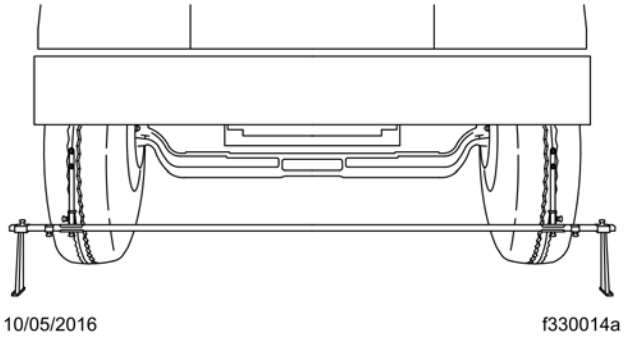


Fig 102, Trammel Bar Positioning

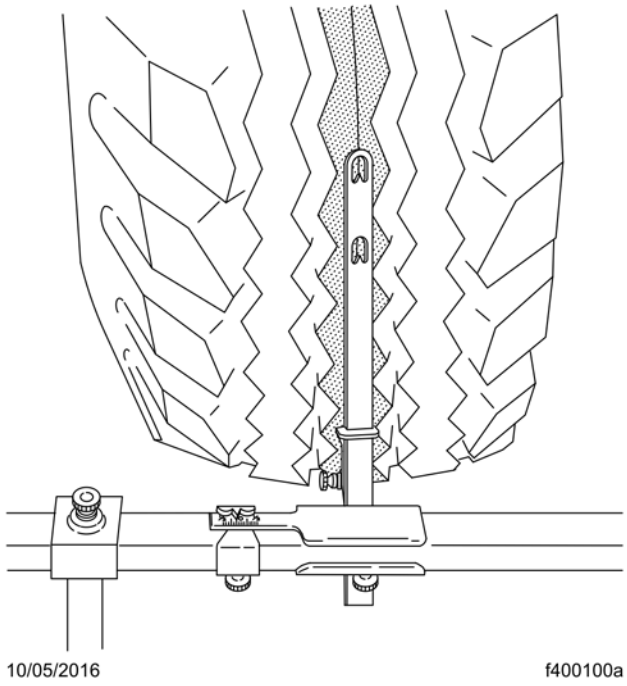


Fig 103, Setting Trammel Bar Pointers

8. Read the toe-in from the scale. Toe-in should be in the range of -1/32 to +3/32 inch. If corrections are needed, take the vehicle to your Western Star Dealer to adjust the toe-in. The Toe-in should be set as close as possible to +1/32 inch.

12.09 Steer Axle Hub Cap Vent Plug Inspection

12.09.01 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. 104, **Normal Oil Venting**.



Fig 104, 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.105, **Excessive Leakage** and Fig.106, **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)

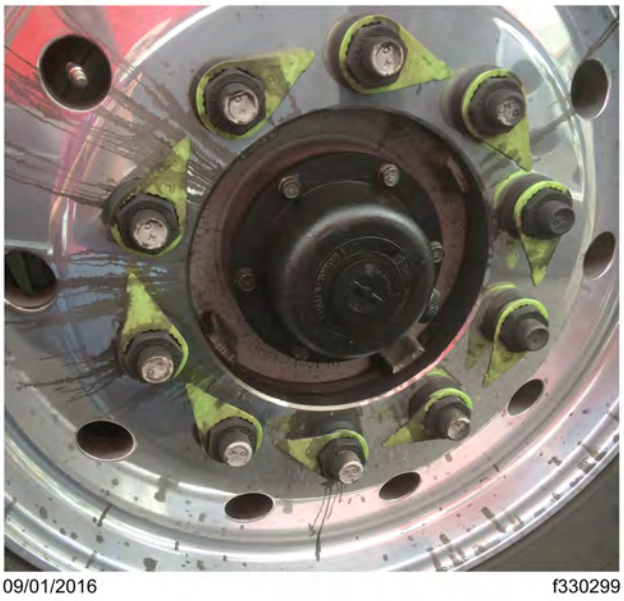


Fig 105, Excessive Leakage

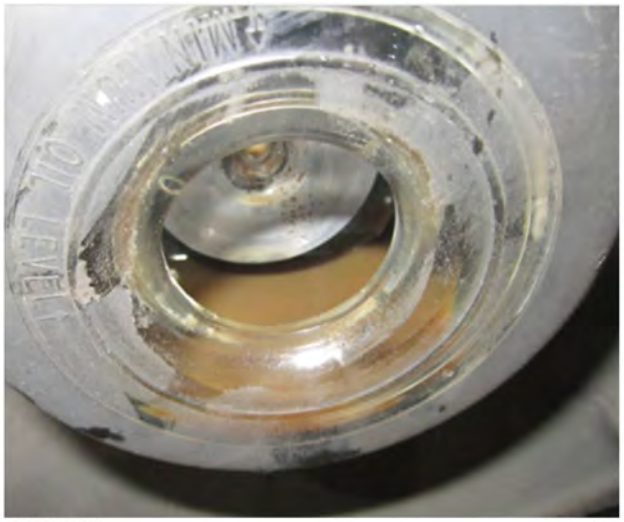


Fig 106, Water in Oil

12.09.02 Inspection

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, refer to **Group 33** of the vehicle's Workshop Manual. of the vehicle 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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13. Rear Axle

13.01 Safety Precautions

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

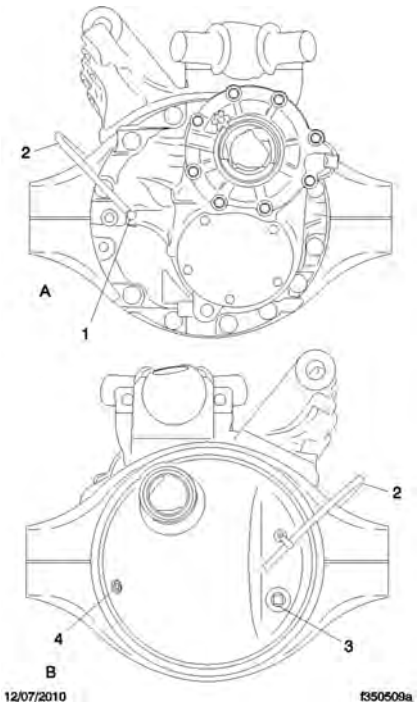
DANGER:

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.

13.02 Drive Axle Lubricant Level Check

NOTE: 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 oil fill hole plug (located in the carrier or the side of the axle housing) and the area surrounding it, then remove the plug. For Detroit axles, see Fig.107,Detroit Tandem Axle (forward axle shown); for Meritor axles, see Fig. 108,Plug and Breather Locations, Meritor Axles ; for Dana Spicer axles, see Fig. 109,Plug and Breather Locations, Dana Spicer Axles.



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

Fig 107, Detroit Tandem Axle (forward axle shown)

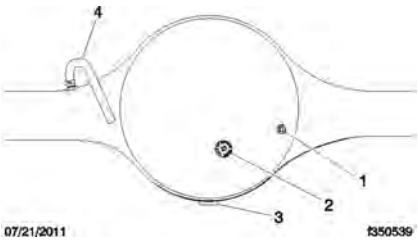


Fig 108, Plug and Breather Locations, Meritor Axles

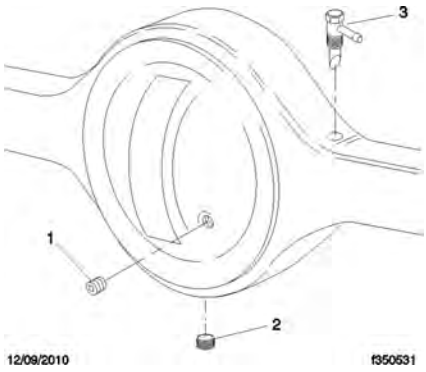


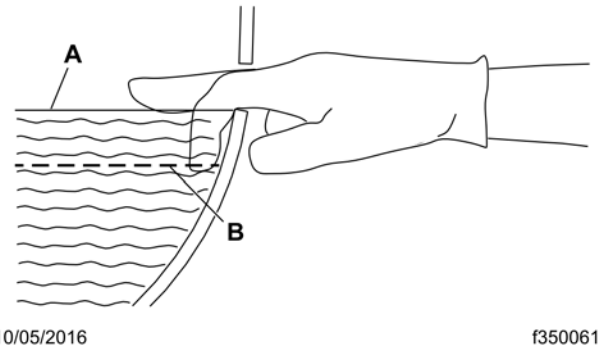
Fig 109, Plug and Breather Locations, Dana Spicer Axles

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.

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

NOTE: The same lubricant that is used for the drive axle lubricates the rear axle wheel bearings. See Fig.111,, page 152.

4. Check the level of the lubricant. The lubricant must be level with the bottom of the oil fill hole (see Fig. 110, **Axle Lubricant Level Check**). If low, check for oil leaks (and make corrections as needed), and add oil to the level of the fill plug. For Detroit axles, see Table.26,Detroit Drive Axle Lubricants for approved axle lubricants and Table.27,Detroit Rear Axle Lubricant Capacity for lubricant capacities. For Meritor axles, see Table.28,Meritor Drive Axle Recommended Lubricant for approved axle lubricants, and Table.29,Meritor Drive Axle Lubricant Capacities for Single Axles and Table.30,Meritor Drive Axle Lubricant Capacities for Tandem Axles for axle capacities. For Dana Spicer axles, see Table.31,Dana Spicer Drive Axle Recommended Lubricant for approved axle lubricants, and Table.32,Dana Spicer Drive Axle Lubricant Capacities for axle capacities.



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

B. Incorrect (lube level below fill hole)

Fig 110, Axle Lubricant Level Check

Table 26, Detroit Drive Axle Lubricants

Detroit Drive Axle Lubricants[1]		
IMPORTANT: Lubricant used in Detroit rear axles must meet Mercedes-Benz specification 235.20 (mineral) or 235.8 (synthetic). Mobil Delvac™ Gear Oil A 80W-90 and Mobilube™ HD-A Plus 80W-90 meet specification 235.20. Mobil Delvac 1 Gear Oil 75W-90 and Mobilube 1 SHC 75W-90 meet specification 235.8.		
Type	**Ambient Temperature**	**SAE Viscosity Grade**
Mineral Oil	–15°F (–26.1°C) and up[2]	80W–90
Synthetic Oil	–40°F (–40°C) and up[3]	75W–90

1. Detroit rear axles do not require the use of friction modifiers.
2. There is no upper limit on the ambient temperature.
3. There is no upper limit on the ambient temperature.

Table 26, Detroit Drive Axle Lubricants

Table 27, Detroit Rear Axle Lubricant Capacity

Detroit Rear Axle Lubricant Capacity (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)[2]
Single, Model 2	5.8 (5.5)[3]

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

Table 27, Detroit Rear Axle Lubricant Capacity

Table 28, Meritor Drive Axle Recommended Lubricant

Meritor Drive Axle Recommended Lubricant			
Lubricant Type	Ambient Temperature	Viscosity Grade	Meritor Specification
Non-Extended Drain Lubricants	10°F (–12.2°C) and up[1]	85W–140	0–76–A
	–15°F (–26.1°C) and up[2]	80W–140	0–76–B
	–15°F (–26.1°C) and up[3]	80W–90	0–76–D
	–40°F (–40°C) and up[4]	75W–90	0–76–E
	–40°F (–40°C) to 35°F (2°C)	75W	0–76–J
	–40°F (–40°C) and up[5]	75W–140	0–76–L
Extended Drain Lubricants	–40°F (–40°C) and up[6]	75W–90	0–76–N

	–40°F (–40°C) and up[7]	75W–140	0–76–M

1. There is no upper limit on the ambient temperature.
2. There is no upper limit on the ambient temperature.
3. There is no upper limit on the ambient temperature.
4. There is no upper limit on the ambient temperature.
5. There is no upper limit on the ambient temperature.
6. There is no upper limit on the ambient temperature.
7. There is no upper limit on the ambient temperature.

Table 28, Meritor Drive Axle Recommended Lubricant

Table 29, Meritor Drive Axle Lubricant Capacities for Single Axles

Meritor Drive Axle Lubricant Capacities for Single Axles	
Axle Model	**Capacity: Pints (liters)** [1]
RS–23–160	39.5 (18.7)
RS–23–161	37.2 (17.6)
RS–23–186	47.3 (22.4)
RS–25–160	37 (17)
RS–26–185	46.0 (22.0)
RS–30–185	46.0 (22.0)
RS–30–380	58.2 (27.5)
RS–38–380	53.1 (25.1)

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

Table 29, Meritor Drive Axle Lubricant Capacities for Single Axles

Table 30, Meritor Drive Axle Lubricant Capacities for Tandem Axles

Meritor Drive Axle Lubricant Capacities for Tandem Axles		
Axle Model	**Axle Position**	**Capacity* Pints (liters)**
MT–40–14X	Forward	30 (14.2)
	Rear	32 (15.14)
RT–40–145	Forward	30.2 (14.3)
	Rear	25.8 (12.2)
RT–40–145P	Forward	30.2 (14.3))
	Rear	25.8 (12.2)
RT–40–160	Forward	39.1 (18.5)

	Rear	34.4 (16.3)
RT–44–1450 RT–44–145P	Forward	29.3 (13.9)
	Rear	25.1 (11.9)
RT–46–160	Forward	39.1 (18.5)
	Rear	34.4 (16.3)
RT–46–164EH/P	Forward	38.0 (18.0)
	Rear	33.0 (15.0)
RT–50–160	Forward	38.0 (18.0)
	Rear	33.0 (15.0)
RT–52–185	Forward	56.1 (26.5)
	Rear	36.1 (17.1)
RT–58–185	Forward	56.1 (26.5)
	Rear	36.1 (17.1)

Table 30, Meritor Drive Axle Lubricant Capacities for Tandem Axles

Table 31, Dana Spicer Drive Axle Recommended Lubricant

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

Table 31, Dana Spicer Drive Axle Recommended Lubricant

Table 32, Dana Spicer Drive Axle Lubricant Capacities

Dana Spicer Drive Axle Lubricant Capacities	
Axle Model	**Capacity: Pints (liters)** [1]
DD405	31 (14.7)][2]
DP463P	40 (18.9)[3]

1. Quantities listed are approximate. Fill axle until lubricant is level with bottom of fill hole with vehicle on level ground.
2. Add 2 pints (1 L) of additional lubricant to the power divider.
3. Add 2 pints (1 L) of additional lubricant to the power divider.

Table 32, Dana Spicer Drive Axle Lubricant Capacities

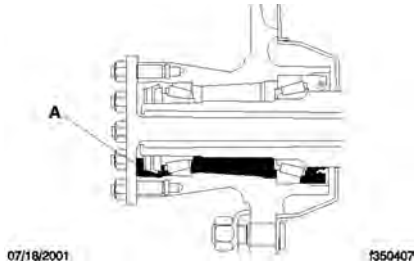


Fig 111, Drive Axle Wheel Bearing Lubrication

13.03 Two-Speed-Axle Shift Unit Lubricant Level Check

CAUTION:
Failure to keep the two-speed-axle shift unit filled to the proper level with the recommended lubricant can result in shift unit damage.

1. Clean the oil fill plug and the area surrounding it. Remove the fill plug. See Fig.112,Two-Speed-Axle Shift Unit.

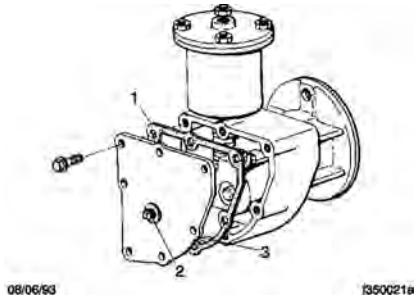
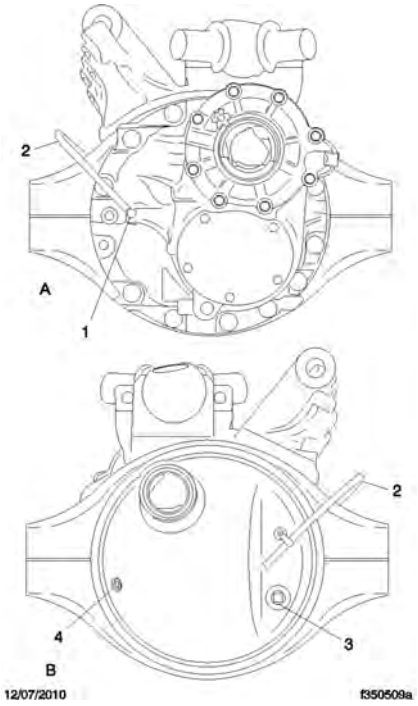


Fig 112, Two-Speed-Axle Shift Unit

2. Lubricant should be level with the bottom of the fill hole. If lubricant level is low, check for leaks and have them corrected. Add lubricant as required. Use the same lubricant as the drive axle.

13.04 Drive Axle Breather Check

Axle breathers must NOT be clogged. Whenever the axle lubricant level is checked, be sure the axle breather is also checked. If operating under adverse conditions, check the breathers more often. If the breather is damaged or plugged, have it cleaned or replaced. For the location of the breather on Detroit axles, see Fig. 113,Detroit Tandem Axle (forward axle shown) ; for Meritor axles, see Fig.114,Plug and Breather Locations, Meritor Axles ; and for Dana Spicer axles, see Fig.115,Plug and Breather Locations, Dana Spicer Axles.



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

Fig 113, Detroit Tandem Axle (forward axle shown)

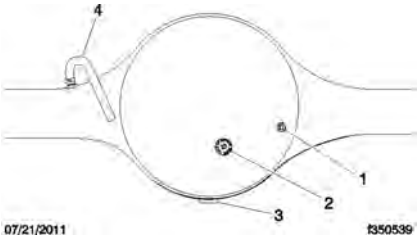


Fig 114, Plug and Breather Locations, Meritor Axles

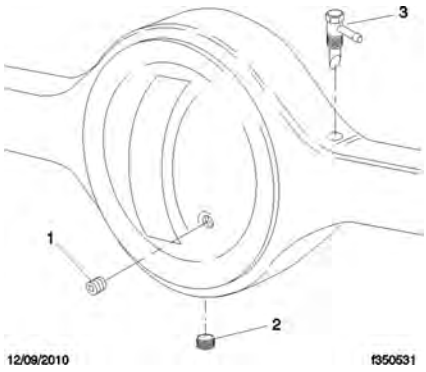


Fig 115, Plug and Breather Locations, Dana Spicer Axles

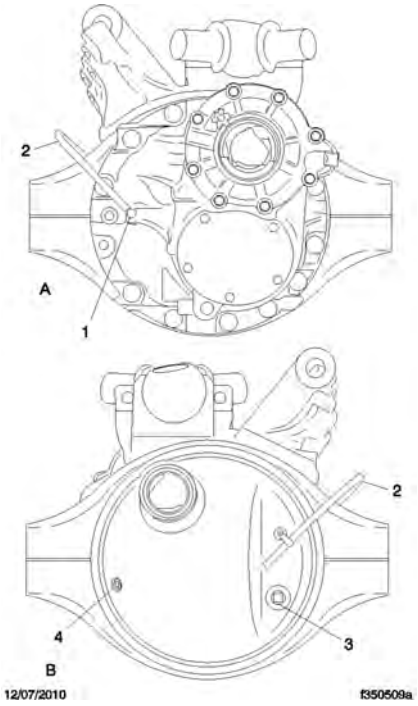
13.05 Axle Lubricant and Filter Change, and Magnetic Strainer Cleaning and Check

13.05.01 Detroit

IMPORTANT:

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.
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. 116,Detroit 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 116, Detroit 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 to 30 lbf·ft (41 N·m).
5. Fill the axle with the recommended lubricant. See Table.33,Detroit Drive Axle Lubricants for recommended drive axle lubricants and Table.34,Detroit Rear Axle Lubricant Capacity for lubricant capacities.

Table 33, Detroit Drive Axle Lubricants

Detroit Drive Axle Lubricants[1]		
IMPORTANT: Lubricant used in Detroit rear axles must meet Mercedes-Benz specification 235.20 (mineral) or 235.8 (synthetic). Mobil Delvac™ Gear Oil A 80W-90 and Mobilube™ HD-A Plus 80W-90 meet specification 235.20. Mobil Delvac 1 Gear Oil 75W-90 and Mobilube 1 SHC 75W-90 meet specification 235.8.		
Type	**Ambient Temperature**	**SAE Viscosity Grade**
Mineral Oil	–15°F (–26.1°C) and up[2]	80W–90
Synthetic Oil	–40°F (–40°C) and up[3]	75W–90

1. Detroit rear axles do not require the use of friction modifiers.
2. There is no upper limit on the ambient temperature.
3. There is no upper limit on the ambient temperature.

Table 33, Detroit Drive Axle Lubricants

Table 34, Detroit Rear Axle Lubricant Capacity

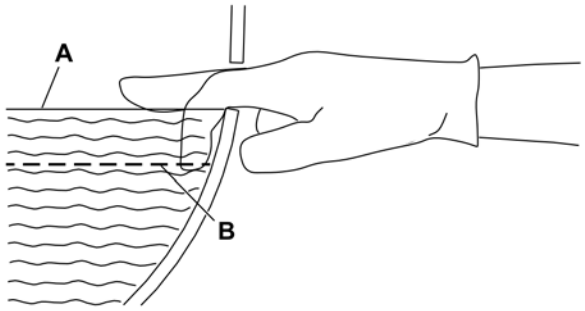
Detroit Rear Axle Lubricant Capacity (Hubs Full)	
Axle	**Oil Capacity: Quarts (liters)**
Forward-Rear, Model 4	14.3 (13.5)[1]
Single and Rearmost Tandem, Model 4	10.6 (10.0)[2]
Single, Model 2	5.8 (5.5)[3]

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

Table 34, Detroit Rear Axle Lubricant Capacity

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.117, **Axle Lubricant Level Check**.



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

Fig 117, Axle Lubricant Level Check

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

13.05.02 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. 118,Detroit New Final Drive Forward Axle, Oil Fill Location for the forward axle, and Fig. 119,Detroit New Final Drive Rear Axle, Oil Fill Location for the rear axle .

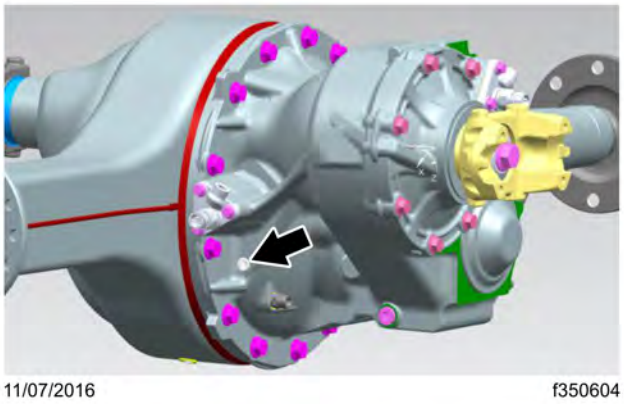


Fig 118, Detroit New Final Drive Forward Axle, Oil Fill Location

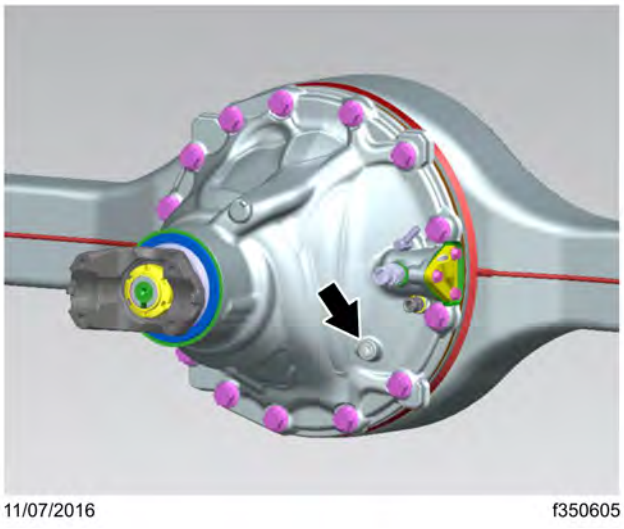


Fig 119, Detroit New Final Drive Rear Axle, Oil Fill Location

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.35, **Detroit Drive Axle Lubricants, New Final Drive** for recommended drive axle lubricants and Table.36,New Final Drive Oil Capacity, New Final Drive for lubricant capacities.

Table 35, Detroit Drive Axle Lubricants, New Final Drive

Detroit Drive Axle Lubricant, New Final Drive [1]		
Lubricant	**Type**	**Ambient Temperature**
Must meet Detroit Fluids Specification DDC-SVC-BRO-0119	Synthetic	–40°F (–40°C) and up[2]

1. Detroit rear axles do not require the use of friction modifiers.
2. There is no upper limit on the ambient temperature.

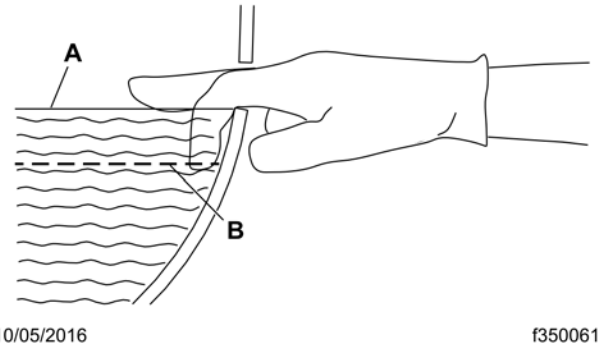
Table 35, Detroit Drive Axle Lubricants, New Final Drive

Table 36, New Final Drive Oil Capacity, New Final Drive

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 36, New Final Drive Oil Capacity, New Final Drive

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.120, **Axle Lubricant Level Inspection**.



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

Fig 120, Axle Lubricant Level Inspection

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

13.05.03 Meritor Axles

IMPORTANT: If using synthetic lubricant, the lubricant change interval is extended to 100,000 miles (160 000 km). On axles with a pump and filter system, the filter change interval is 100,000 miles (160 000 km).

1. Park the vehicle on level ground, apply the parking brakes, and chock the front tires.
2. Clean the area around the fill plug, then remove the fill plug.
3. Place a drain pan under the drain 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.
4. If equipped with an oil pump, replace the filter.

NOTE: There may be about one pint (0.5 L) of lubricant remaining in the filter.

4.a Remove the axle oil filter using a suitable filter strap wrench (see Fig.121,Meritor Axle Oil Filter Removal) and discard it.

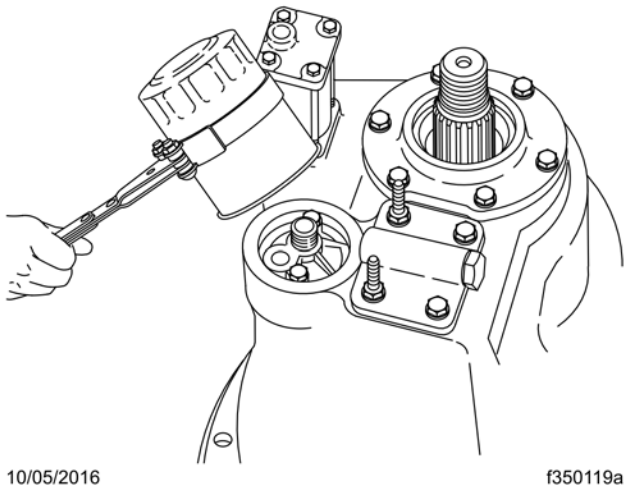


Fig 121, Meritor Axle Oil Filter Removal

4.b Using recommended drive axle lubricant (see Table.37,Meritor Drive Axle Recommended Lubricant), coat the face of the gasket on the new oil filter.

Table 37, Meritor Drive Axle Recommended Lubricant

Meritor Drive Axle Recommended Lubricant			
Lubricant Type	Ambient Temperature	Viscosity Grade	Meritor Specification
Non-Extended Drain Lubricants	10°F (–12.2°C) and up[1]	85W–140	0–76–A
	–15°F (–26.1°C) and up[2]	80W–140	0–76–B
	–15°F (–26.1°C) and up[3]	80W–90	0–76–D
	–40°F (–40°C) and up[4]	75W–90	0–76–E
	–40°F (–40°C) to 35°F (2° C)	75W	0–76–J
	–40°F (–40°C) and up[5]	75W–140	0–76–L
Extended Drain Lubricants	–40°F (–40°C) and up[6]	75W–90	0–76–N
	–40°F (–40°C) and up[7]	75W–140	0–76–M

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

3. There is no upper limit on the ambient temperature.
4. There is no upper limit on the ambient temperature.
5. There is no upper limit on the ambient temperature.
6. There is no upper limit on the ambient temperature.
7. There is no upper limit on the ambient temperature.

Table 37, Meritor Drive Axle Recommended Lubricant

4.c Install the filter over the adapter, and tighten the filter one full turn after the gasket contacts the base; do not overtighten.

5. Clean the fill and drain plugs as follows. 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.

5.c Meritor recommends plugs with elements having a minimum pickup capacity of 1.5 pounds (0.7 kg) of low-carbon steel. Each time the oil is changed, replace any magnetic drain plug that does not meet the minimum pick-up capacity.

5.d Install the drain plug(s) and tighten to 35 lbf·ft (47 N·m).

6. Fill the axle with recommended lubricant as follows. For lubricant capacities, see Table.38,Meritor Drive Axle Lubricant Capacities for Single Axles (single axles) or Table.39,Meritor Drive Axle Lubricant Capacities for Tandem Axles (tandem axles). See Table.37,Meritor Drive Axle Recommended Lubricant for recommended lubricant.

Table 38, Meritor Drive Axle Lubricant Capacities for Single Axles

Meritor Drive Axle Lubricant Capacities for Single Axles	
Axle Model	**Capacity: Pints (liters)** [1]
RS–23–160	39.5 (18.7)
RS–23–161	37.2 (17.6)
RS–23–186	47.3 (22.4)
RS–25–160	37 (17)
RS–26–185	46.0 (22.0)
RS–30–185	46.0 (22.0)
RS–30–380	58.2 (27.5)
RS–38–380	53.1 (25.1)

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

Table 38, Meritor Drive Axle Lubricant Capacities for Single Axles

Table 39, Meritor Drive Axle Lubricant Capacities for Tandem Axles

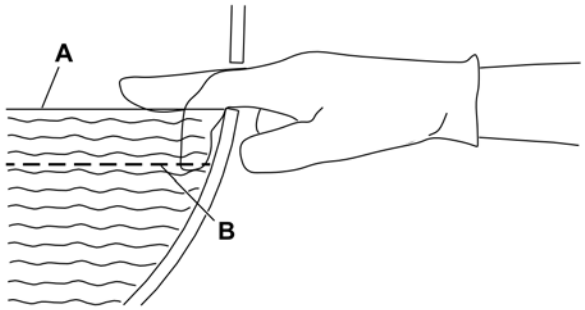
Meritor Drive Axle Lubricant Capacities for Tandem Axles		
Axle Model	**Axle Position**	**Capacity* Pints (liters)**
MT–40–14X	Forward	30 (14.2)

	Rear	32 (15.14)
RT–40–145	Forward	30.2 (14.3)
	Rear	25.8 (12.2)
RT–40–145P	Forward	30.2 (14.3))
	Rear	25.8 (12.2)
RT–40–160	Forward	39.1 (18.5)
	Rear	34.4 (16.3)
RT–44–1450 RT–44–145P	Forward	29.3 (13.9)
	Rear	25.1 (11.9)
RT–46–160	Forward	39.1 (18.5)
	Rear	34.4 (16.3)
RT–46–164EH/P	Forward	38.0 (18.0)
	Rear	33.0 (15.0)
RT–50–160	Forward	38.0 (18.0)
	Rear	33.0 (15.0)
RT–52–185	Forward	56.1 (26.5)
	Rear	36.1 (17.1)
RT–58–185	Forward	56.1 (26.5)
	Rear	36.1 (17.1)

Table 39, Meritor Drive Axle Lubricant Capacities for Tandem Axles

6.a With the vehicle on a level surface, fill the axle through the oil fill hole. Allow a few minutes for the oil to flow into the axle. Lubricant should be level with the bottom of the oil fill hole.

6.b Check the fluid level; see Fig.122,Axle Lubricant Level Inspection.



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

Fig 122, Axle Lubricant Level Inspection

6.c 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.

13.05.04 Dana Spicer Axles

NOTE: If using a Roadranger synthetic drive axle lubricant, the lubricant change interval is extended to 180,000 miles (288 000 km).

1. Park the vehicle on level ground, set the parking brakes, and chock the tires.
2. Clean the oil fill plug and the area around it (see Fig.123,Plug and Breather Locations, Dana Spicer Axles), then remove it from the oil fill hole.

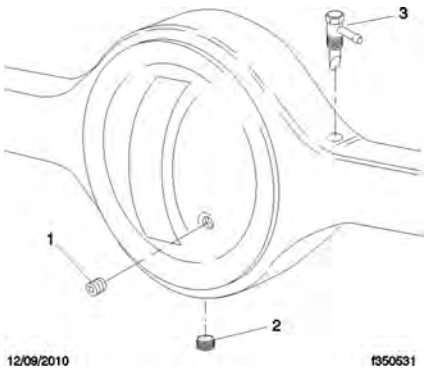


Fig 123, Plug and Breather Locations, Dana Spicer Axles

3. Place a drain pan under the rear axle drain plug; see Fig.123,Plug and Breather Locations, Dana Spicer Axles. Drain the oil at normal operating temperature, 150°F to 200°F (65°C to 93°C). At this temperature, the oil will run more freely and ensure that the axle is flushed.

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

4. At each axle oil change, remove and clean the magnetic strainer, if equipped, as follows.
   4.a Remove the magnetic strainer from the power divider cover. See Fig. 124,Dana Spicer Tandem Drive Axle Magnetic Strainer.

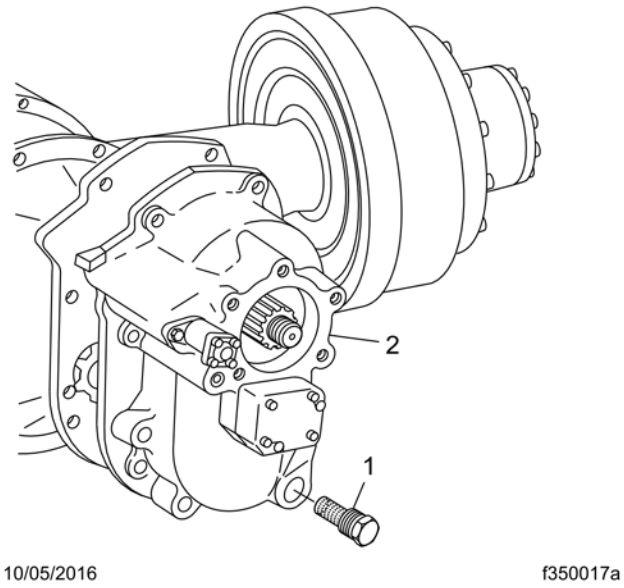


Fig 124, Dana Spicer Tandem Drive Axle Magnetic Strainer

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

   4.b Wash the strainer in solvent, and blow it dry with compressed air to remove oil and metal particles.
   4.c Install and tighten the magnetic strainer 40 to 60 lbf·ft (54 to 81 N·m).
5. Clean the fill and drain plugs as follows. 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 Clean away the collected material deposited on each pole. Magnets will rapidly lose their effectiveness as collected material bridges the gap between the two poles.
   5.c Inspect the drain plug for large quantities of metal particles.
   5.d After cleaning, install the drain plug(s) and tighten to 40 to 60 lbf·ft (54 to 81 N·m).

6. Fill the axle with the recommended lubricant as follows. See Table.40,Dana Spicer Drive Axle Recommended Lubricant for recommended lubricants, and Table.41,Dana Spicer Drive Axle Lubricant Capacities for drive axle lubricant capacities.

Table 40, Dana Spicer Drive Axle Recommended Lubricant

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

Table 40, Dana Spicer Drive Axle Recommended Lubricant

Table 41, Dana Spicer Drive Axle Lubricant Capacities

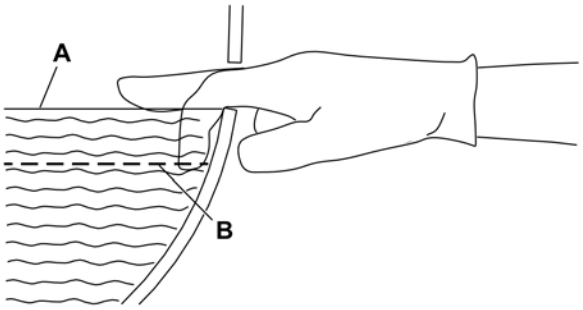
Dana Spicer Drive Axle Lubricant Capacities	
Axle Model	**Capacity: Pints (liters)** [1]
DD405	31 (14.7)][2]
DP463P	40 (18.9)[3]

1. Quantities listed are approximate. Fill axle until lubricant is level with bottom of fill hole with vehicle on level ground.
2. Add 2 pints (1 L) of additional lubricant to the power divider.
3. Add 2 pints (1 L) of additional lubricant to the power divider.

Table 41, Dana Spicer 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.

6.b Check the fluid level; see Fig.125, **Axle Lubricant Level Check**.



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

B. Incorrect (lube level below fill hole)

Fig 125, Axle Lubricant Level Check

6.c Install and tighten the fill plug 50 lbf·ft (68 N·m).

14.01 Wheel Nut and Rim Nut Torque Check 168
14.02 Tire Check 170

14. Wheels and Tires

14.01 Wheel Nut and Rim Nut Torque Check

CAUTION:

Insufficient wheel nut (rim nut) torque can cause wheel shimmy, resulting in wheel damage, stud breakage, and extreme tire tread wear. Excessive wheel nut torque can break studs and clamps (if so equipped), damage threads, and crack discs in the stud hole area. Use the recommended torque values, and follow the tightening sequence shown in Fig.126,, page 168.

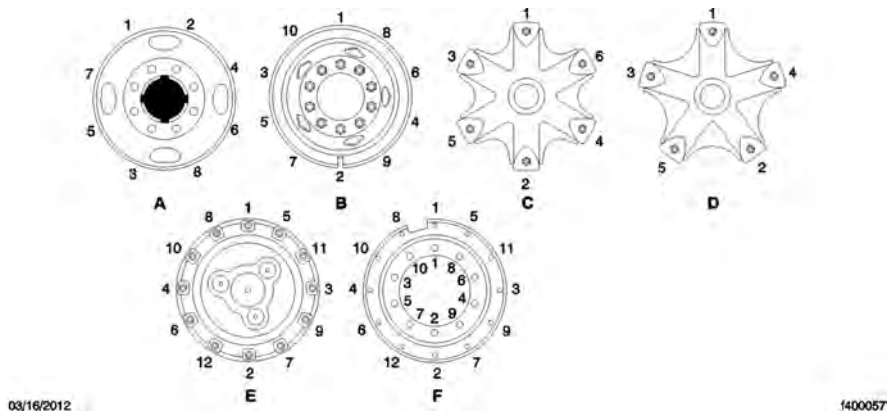


Fig 126, Wheel Nut and Rim Nut Tightening Sequence

After an 8- or 10-stud wheel has been installed, the wheel or rim nut torque must be rechecked after 50 to 100 miles (80 to 161 km) of operation.

See **Table 1** for wheel nut torque specifications, and see Fig.126,Wheel Nut and Rim Nut Tightening Sequence for the wheel nut tightening sequence.

Table 42, Wheel Fastener Torque

Wheel Fastener Torque			
Application	**Nut Size**	**Wheel Manufacturer**	
8-Stud Disc Wheel With Two-Piece Flanged Locknuts			
Front and Rear Wheel Nut	—	All	450–500 (610–680)[1]
10-Stud Disc Wheel With Two-Piece Flanged Nuts			
Front and Rear Wheel Nut	M22 x 1.5	All	450–500 (610–680)[2]
10-Stud Disc Wheel With Inner and Outer Locknuts			
Front Wheel Nut	1-1/8–16	Alcoa	400–500 (540–680)

		All Others	450–500 (610–680)
Rear Wheel Inner Nut	3/4–16	Alcoa	400–500 (540–680)
		All Others	450–500 (610–680)
Rear Wheel Outer Nut	1-1/8–16	Alcoa	400–500 (540–680)
		All Others	450–500 (610–680)
Wheel Stud Retainer Nut	3/4–16	All	175–200 (235–270)
12-Stud Wheel Rim Clamp and Nuts			
Adaptor Wheel Nut on Inside Bolt Circle	M22 x 1.5	OTR	450–500 (610–680)
Adaptor Wheel Nut on Outside Bolt Circle	3/4–10	OTR	50 (68)[3]100 (136) 150 (203)
Rear Wheel Nut	3/4–10	OTR	50 (68)[4] 100 (136) 150 (203)
Spoke Wheel Rim Nuts			
Front Wheel Nut, 5- and 6-Spoke	3/4–10	Gunite	200–225 (271–305)[5]
Rear Wheel Nut, 5- and 6-Spoke With Non-Corrugated Channel Spacer	3/4–10	Gunite	200–225 (271–305)
Rear Wheel Nut, 5- and 6-Spoke With Corrugated Channel Spacer	3/4–10	Gunite	240–260 (325–350)

1. Torque values given for these fasteners are for lubricated threads.
2. Torque values given for these fasteners are for lubricated threads.
3. Use the tightening sequence shown in Fig.126,, page 168 for each of the three stages of tightening.
4. Use the tightening sequence shown in Fig.126,, page 168 for each of the three stages of tightening.
5. On front axles with over 12,000 lb (5448 kg) capacity, tighten the wheel nuts 240 to 265 lbf·ft (325 to 359 N·m). Gunite part number W–854 nut with a phosphate-and-oil coating must be used.

Table 42, Wheel Fastener Torque

When checking wheel nuts on a dual disc assembly, remove one outer nut at a time, tighten the inner nut, then reinstall the outer nut. Repeat this procedure for all wheel nuts, using the tightening sequence shown in Fig. 126,Wheel Nut and Rim Nut Tightening Sequence.

After a 12-stud wheel rim has been installed, the wheel or rim nut torque must be rechecked as follows:

- after the first load;
- every four hours of operation for a minimum of five days;
- every 8 to 10 hours of operation.

When checking wheel or rim nut torque on 12-stud wheel rims, use the tightening sequence shown in Fig. 126,Wheel Nut and Rim Nut Tightening Sequence for each of the three stages of tightening as follows:

1. Tighten each nut 50 lbf·ft (68 N·m).
2. Tighten each nut 100 lbf·ft (136 N·m).
3. Tighten each nut 150 lbf·ft (203 N·m).

For additional information on 12-stud wheel rims, see **Section 40.00, Subject 220** of the **Western Star Workshop Manual.**

14.02 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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15. Driveline

15.01 Safety Precautions

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

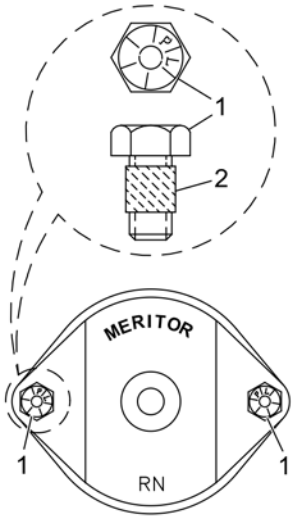
NOTE: .When working on the vehicle, shut down the engine or motor, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle cannot drop. Failure to follow these steps could result in serious personal injury or death.

15.02 Inspection of the Driveline

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. Do not over-tighten bearing-cap capscrews or yoke-strap capscrews.

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the tires.
2. *For driveline universal joints with bearing caps,* tighten bearing-cap capscrews 43 lbf·ft (49 N·m). See Fig. 127,Meritor U-Joint Fasteners for Bearing Caps, item 1. *For RPL series universal joints,* tighten bearing-cap capscrews 125 lbf·ft (169 N·m). See Fig.128,Meritor RPL Series U-Joint. *For driveline universal joints with yoke straps,* tighten yoke-strap capscrews 125 lbf·ft (169 N·m). See Fig.129,Components of a Basic Driveline.



1. Self-Locking Capscrew
2. Adhesive Band

Fig 127, Meritor U-Joint Fasteners for Bearing Caps

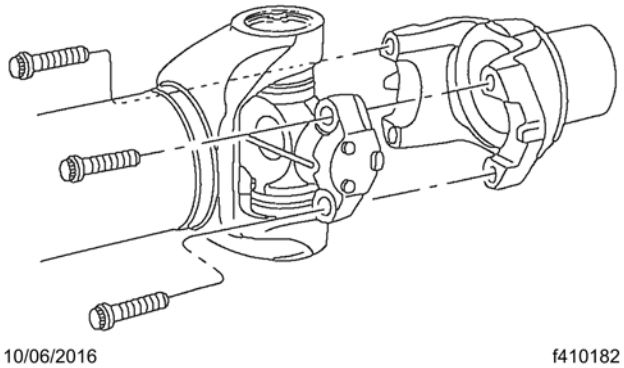
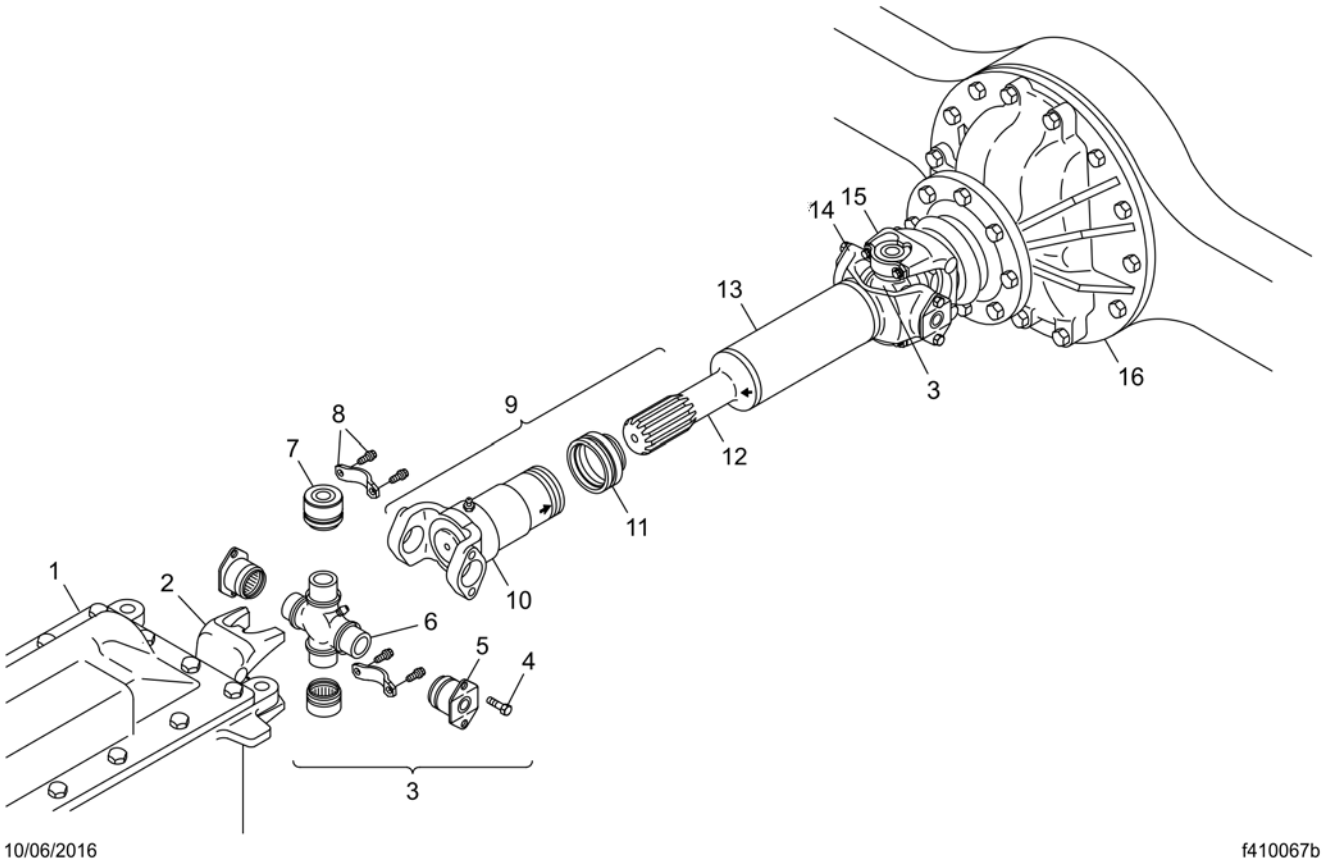


Fig 128, Meritor RPL Series U-Joint

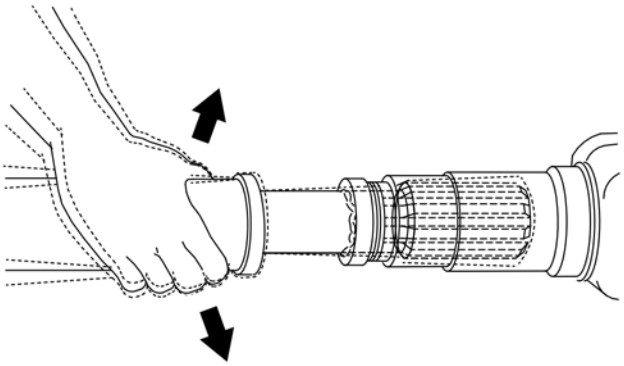


NOTE: All fasteners are not shown.

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 129, Components of a Basic Driveline

3. Check the driveline yokes for cracks, and check end-yokes for looseness. See Fig. 129,Components of a Basic Driveline. Have any cracked yokes replaced by an authorized Western Star dealer. If any end-yoke can be moved in or out on its shaft, or can be rocked on its shaft, take it to an authorized Western Star dealer for service.
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, have the U-joint assembly replaced.
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, have it replaced. If the bearing mount is loose on the frame, have your Western Star dealer tighten the mounting fasteners to the proper torque value. Have the midship bearing assembly replaced 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. 130,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), have both the sleeve-yoke and the splined shaft replaced.

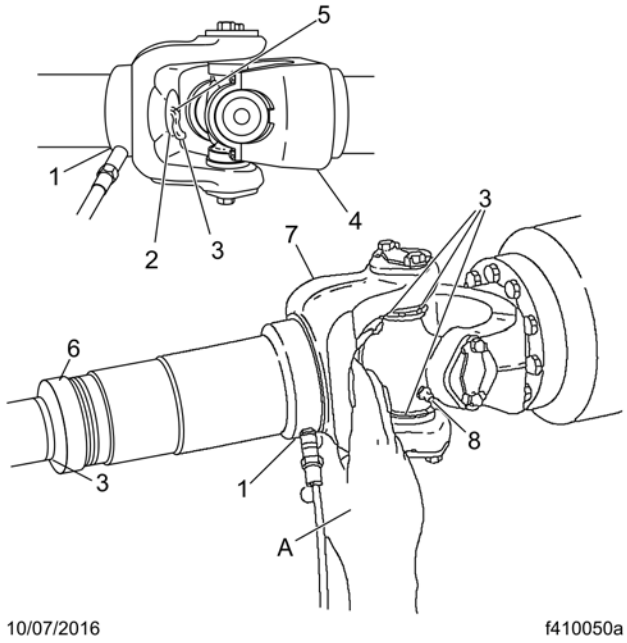


Attempt to move the sleeve-yoke and splined shaft back and forth.

Fig 130, Slip Joint Spline Wear Checking

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

7. Visually examine the driveshaft tubes for dents, bends, twists, or other damage. If any tube appears to be damaged, have it repaired or replaced by an authorized Western Star dealer.
8. Examine the driveshaft for evidence of missing balance weights, and for build-up of foreign material. Remove any foreign material. If there is any evidence that balance weights are missing, have the driveshaft removed and balanced.
9. For driveshafts with slip joints, check to be sure the yoke plug is not loose or missing. See Fig. 131,Slip Joint and U-Joint Lubrication item 2. Have your Western Star dealer 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; have your Western Star dealer determine 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

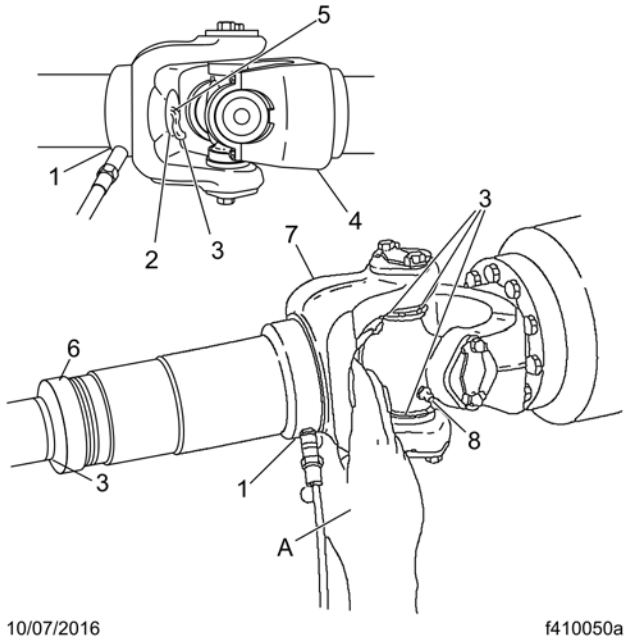
Fig 131, Slip Joint and U-Joint Lubrication

15.03 Lubrication of the Driveline

15.03.01 Lubrication Of The Universal Joint

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

1. Park the vehicle on a flat surface, apply the parking brakes, and chock the tires.
2. Wipe all old grease and dirt from each U-joint grease fitting. See Fig.132,Slip Joint and U-Joint Lubrication. Ref. 8.



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 132, Slip Joint and U-Joint Lubrication

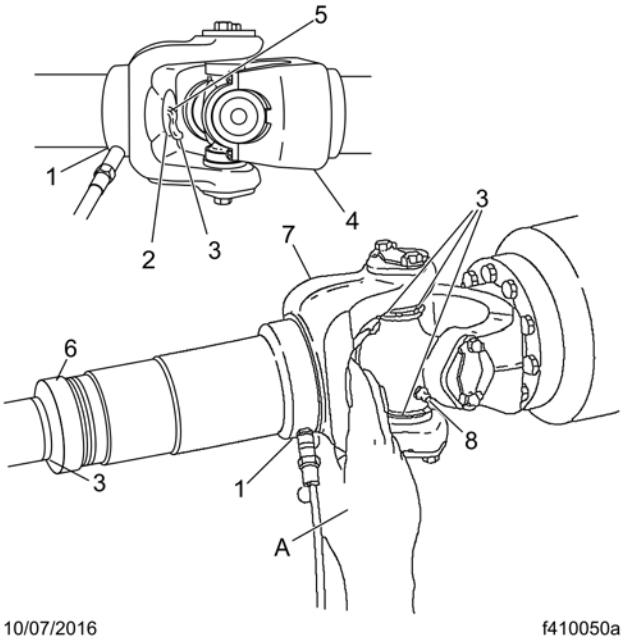
3. Use a hand-type grease gun, or a high-pressure gun with a low-pressure adaptor, to lubricate U-joints. If a low-pressure adaptor is not used, U-joints may not receive enough grease.

   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, have the U-joint replaced.
6. Check the purged grease. If it appears rusty, gritty, or burned, have the U-joint replaced.
7. Wipe the purged grease from the seals, and any excess grease from the grease fitting.

15.03.02 Lubrication Of The Slip Joint Spline

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

1. If equipped with a grease fitting, wipe all old grease and dirt from the slip joint grease fitting. See Fig. 133,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 133, Slip Joint and U-Joint Lubrication

2. Use a hand-type grease gun or a high-pressure gun with a low-pressure adaptor, 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.133,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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16. Brakes

16.01 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.

16.02 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 on the air brake valves.

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

16.03 Air Dryer Inspection

1. Park the vehicle on a level surface and apply the parking brakes. Shut down the engine. Chock the tires.
2. Completely drain all air reservoirs. Air pressure gauges should read 0 psi (0 kPa).
3. Close the drain cocks on all reservoirs.
4. Start the vehicle and allow the air system pressure to build while the engine idles.

   NOTE: Some compressors may need to run above idle to build system air pressure in a reasonable time. If air pressure build-up is extremely slow after two to three minutes, raise the engine speed to 1000 to 2000 rpm.

5. Place your hand under the air dryer purge valve, located at the base of the dryer; see Fig.134,Air Dryer Inspection. You should feel a light air flow that will continue until the air compressor unloads.

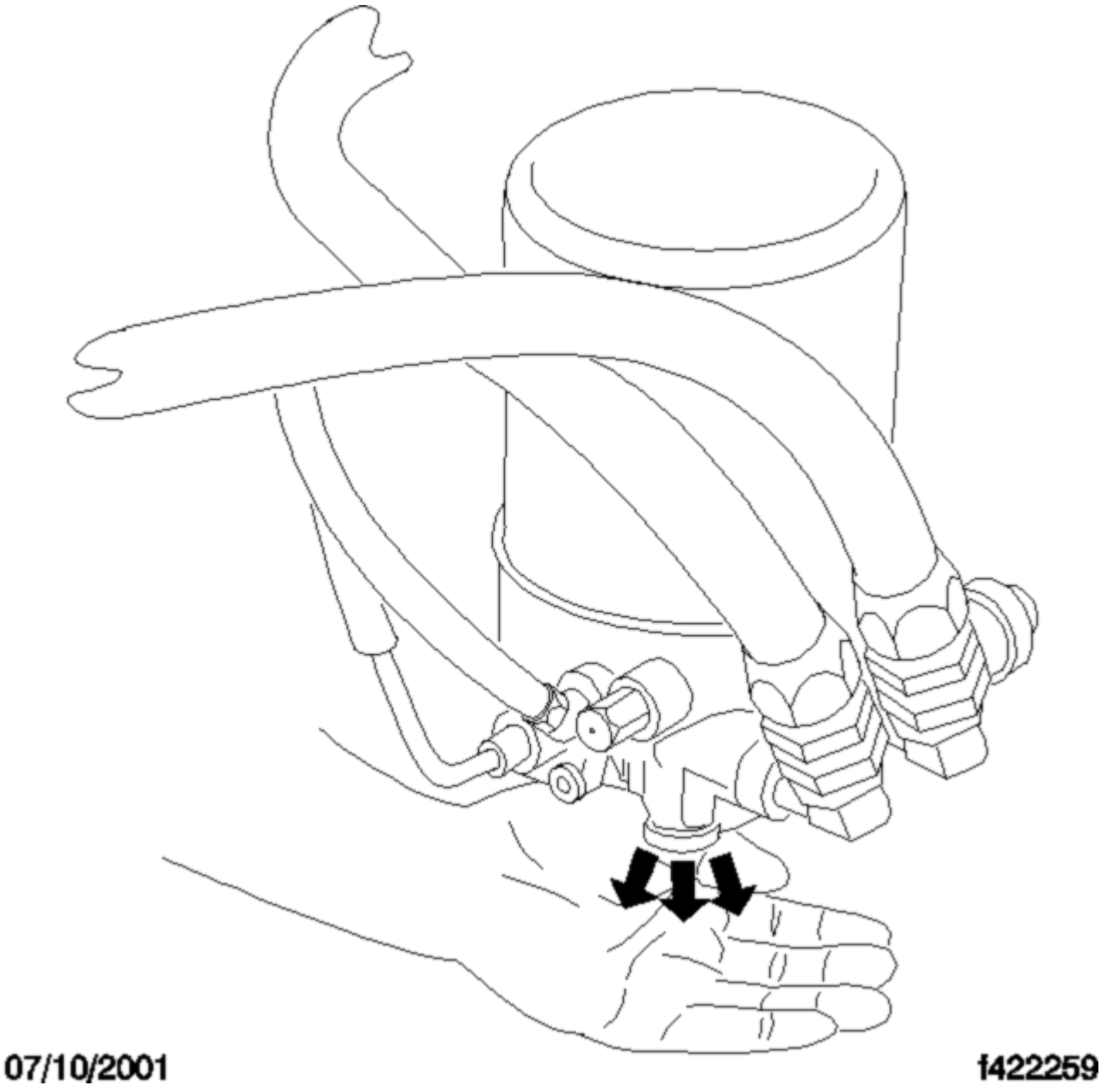


Fig 134, Air Dryer Inspection

6. On the System Saver Twin only, if the compressor continues to run, after 50 to 60 seconds you will feel a "mini-purge", or exhaust of air, as the dryer switches cartridges. This is normal and will recur every 50 to 60 seconds as long as the compressor is running.
7. When the air system reaches "cut-out" pressure, the dryer will purge completely. After this, the dryer will not exhaust any air until the compressor starts up again.
8. Shut off the engine and apply a soap solution to each connection that contains pressurized air. If soap bubbles do not appear, connections are sealed properly. If soap bubbles appear, drain all reservoirs and remove the leaking connection. Inspect it for damaged threads or cracks, and replace as necessary. Apply pipe sealant or teflon tape to the connection before re-installing it. Repeat the process until all connections are properly sealed.

16.04 Bendix Air Dryer Desiccant Replacement

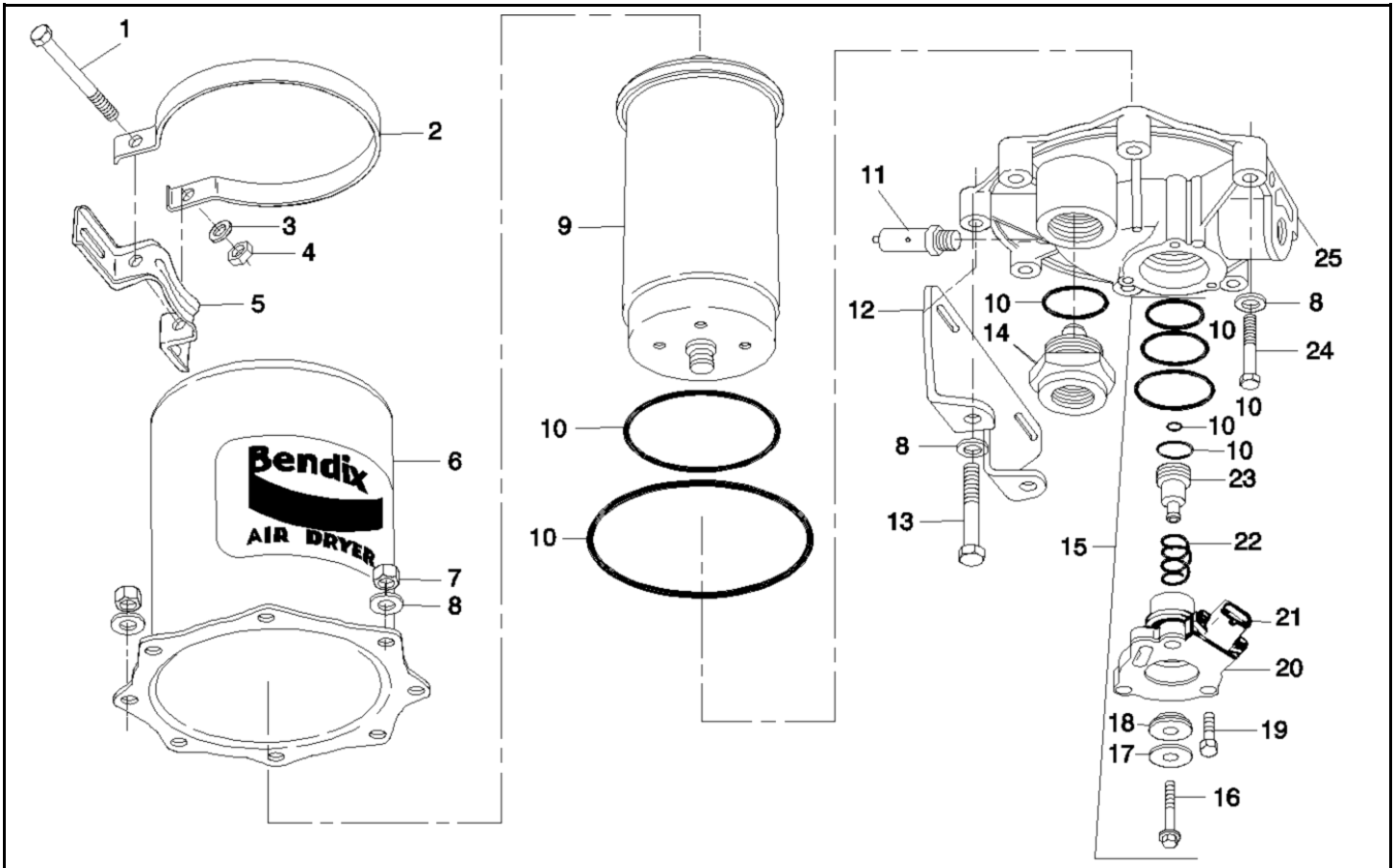
16.04.01 Bendix AD-9 Air Dryers

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 apply the parking brake. Chock the tires.
2. Completely drain all air reservoirs. Air pressure gauges should read 0 psi (0 kPa).

NOTE: The compressor discharge line may still contain residual air pressure.

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 capscrew, and remove the air dryer from the vehicle.
8. Place the air dryer on a bench and remove the remaining 6 bolts, 12 washers, 6 Nylok nuts, and the air dryer housing. See Fig.135,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 135, 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.

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

11. Inspect the condition of the O-ring seals. If they are cracked, crimped, or otherwise damaged, replace them to ensure an airtight seal. Clean the O-ring grooves of any dirt or obstruction.
12. Lubricate the O-rings with silicone or lithium grease and install them in the end cover.
13. Install the desiccant cartridge on the end cover. Turn the cartridge clockwise until the desiccant cartridge makes contact with the end cover.
14. Place the desiccant cartridge in a vise, and turn the end cover clockwise an additional 180 to 225 degrees to fully tighten the desiccant cartridge to the end cover.

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

15. Place the housing over the desiccant cartridge and align the mounting holes with the end cover.

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

16. Install the 6 capscrews, 12 washers, and 6 new Nylok nuts. Torque the capscrews in a star pattern 270 to 385 lbf·in (3050 to 4350 N·cm); See Fig.136,AD–9 End Cover to Housing Torque Pattern.

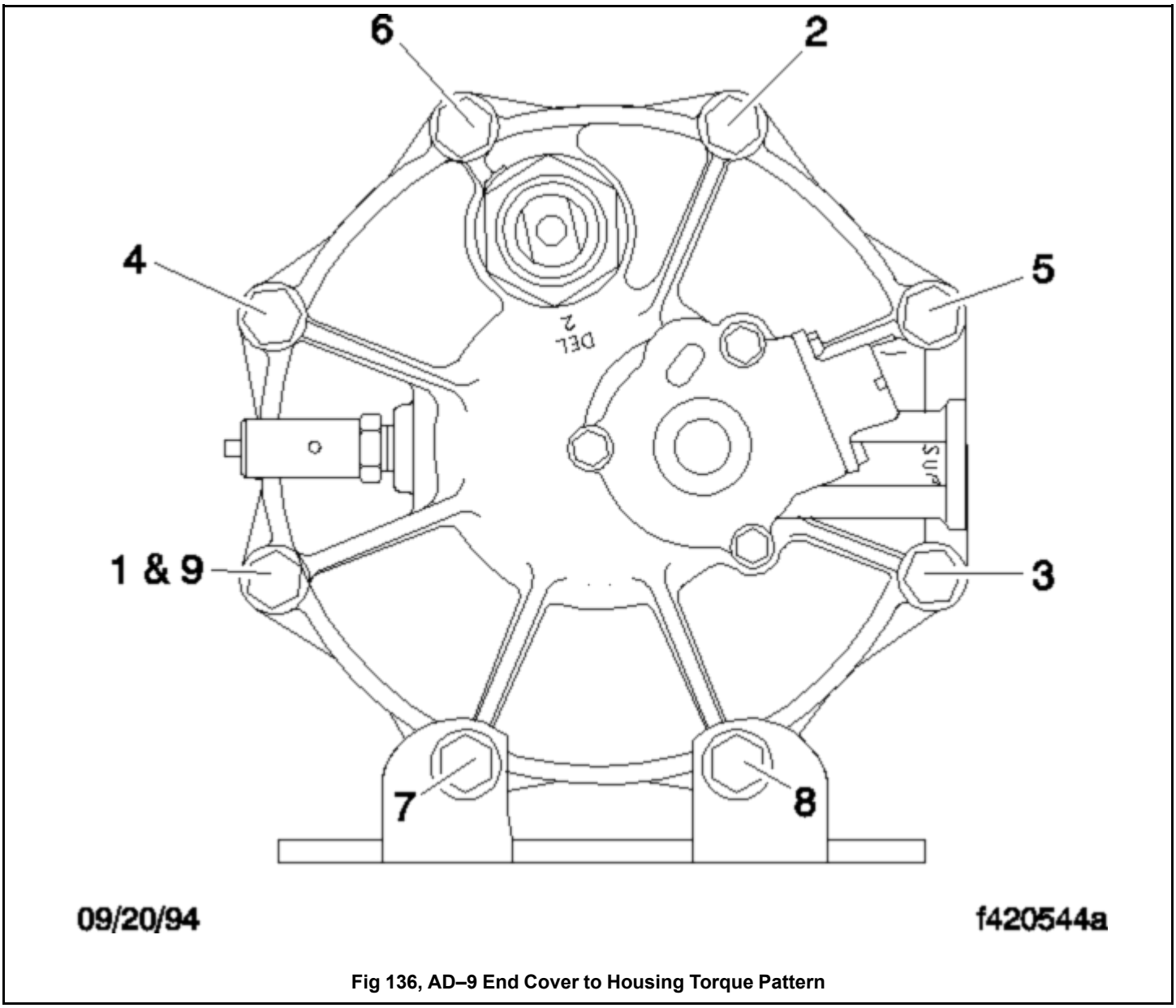


Fig 136, AD–9 End Cover to Housing Torque Pattern

17. Install the air dryer on the lower mounting bracket. Install the two previously marked bolts, four washers, and two new Nylok nuts. Torque 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. Torque the upper mounting bracket strap Nylok nut 80 to 120 lbf·in (904 to 1356 N·cm).
18. Connect and tighten the three air lines. Connect the harness connector to the heater and thermostat assembly until the lock tab snaps in place.
19. Start the engine, build air pressure, and check the air brake system for leaks.

16.04.02 Bendix AD–IP Air Dryers

1. Park the vehicle on a level surface, shut down the engine, and apply 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.

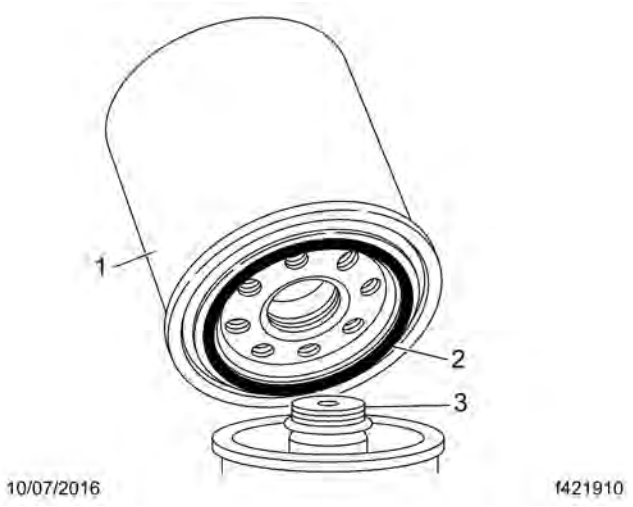
8. Lubricate the O-rings, bolt O-ring grooves, sealing rings, and cartridge grooves. Lubricate the end cover bore for the bolt.
9. Install both O-rings on the cartridge bolt, then, using a twisting motion, insert the assembled desiccant cartridge bolt in the end cover.
10. Install the desiccant cartridge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

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

11. Using a wrench or socket, tighten the desiccant cartridge bolt 70 lbf·ft (95 N·m). **Do not** 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 re-install the desiccant cartridge.

16.04.03 Bendix AD-9si, AD-IS and CR Turbo 2000 Air Dryers

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the tires.
2. Drain the air reservoirs.
3. Using a strap wrench or equivalent, loosen the desiccant cartridge. See Fig.137,Desiccant Cartridge Replacement. Spin the cartridge off by hand and discard it.



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

Fig 137, 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.

16.04.04 WABCO System Saver 1200, 1200 Plus, and Twin Air Dryers

IMPORTANT: 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.

Refer to Fig.138,Desiccant Cartridge Replacement, WABCO Air Dryers for cartridge replacement.

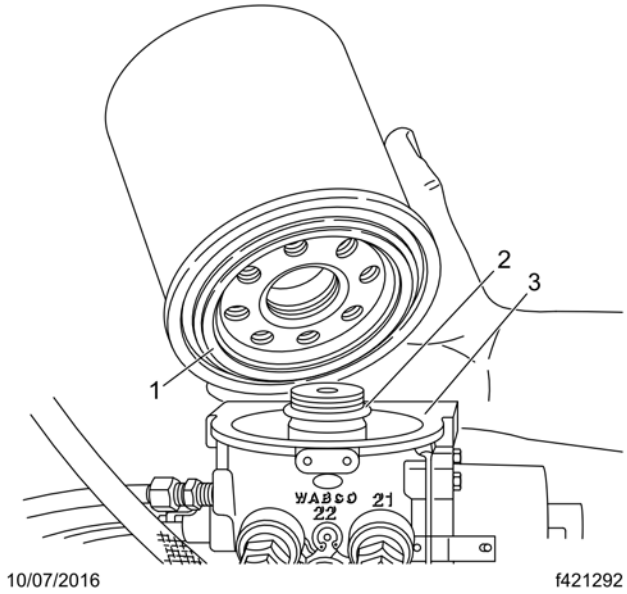


Fig 138, Desiccant Cartridge Replacement, WABCO Air Dryers

1. Drain the air system.
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.

16.05 Alcohol Evaporator Cleaning and Inspection

16.05.01 Midland

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

16.05.02 Off Season

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

16.05.03 Freeze Season Reactivation

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the tires.
2. Remove the filler cap, and check the cap tetraseal.

3. Remove the capscrews and reservoir from the cover.
4. Remove the cover tetraseal.
5. Drain the air tank, and disconnect the line from the evaporator outlet. Remove the check-valve retainer, spring, and disc.
6. Install the disc, spring, and check-valve retainer, and connect the line to the evaporator outlet.
7. Install the cover tetraseal.
8. Install the reservoir on the cover and tighten the capscrews.
9. Fill the reservoir with 40 ounces (1182 mL) of methyl alcohol, then install the filler cap.
10. Remove the chocks from the tires.

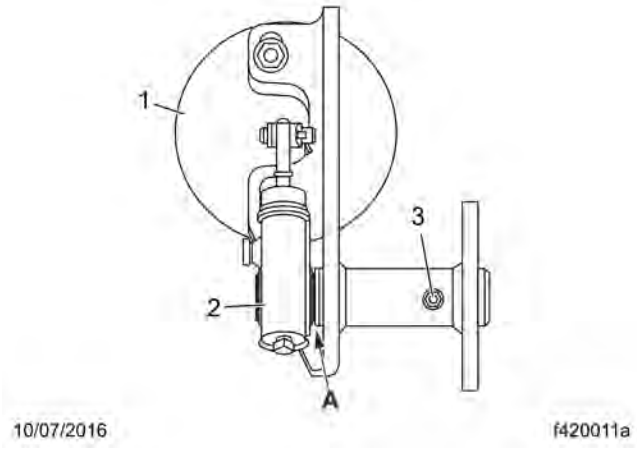
16.06 Camshaft Bracket Lubrication

IMPORTANT: Perform **MOP 42–07** before lubricating the camshaft brackets.

NOTE: If equipped with a Meritor 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 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.139,Camshaft Bracket Lubrication.



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

Fig 139, Camshaft Bracket Lubrication

WARNING:
If grease leaks out under the camhead, the camshaft bracket grease seal is worn or damaged and should be replaced. 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.

16.07 Slack Adjuster Lubrication

16.07.01 General Information

IMPORTANT: IMPORTANT: Perform **MOP 42–07** before lubricating the slack adjusters.

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.

16.07.02 Dana Spicer and Haldex

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

Lubricate the slack adjuster at the grease fitting. See Fig.140,Dana Spicer Slack Adjuster. Use standard chassis lubricant for Haldex slack adjusters. Dana Spicer Low Lube slack adjusters should be lubricated with SHC 460 synthetic lubricant.

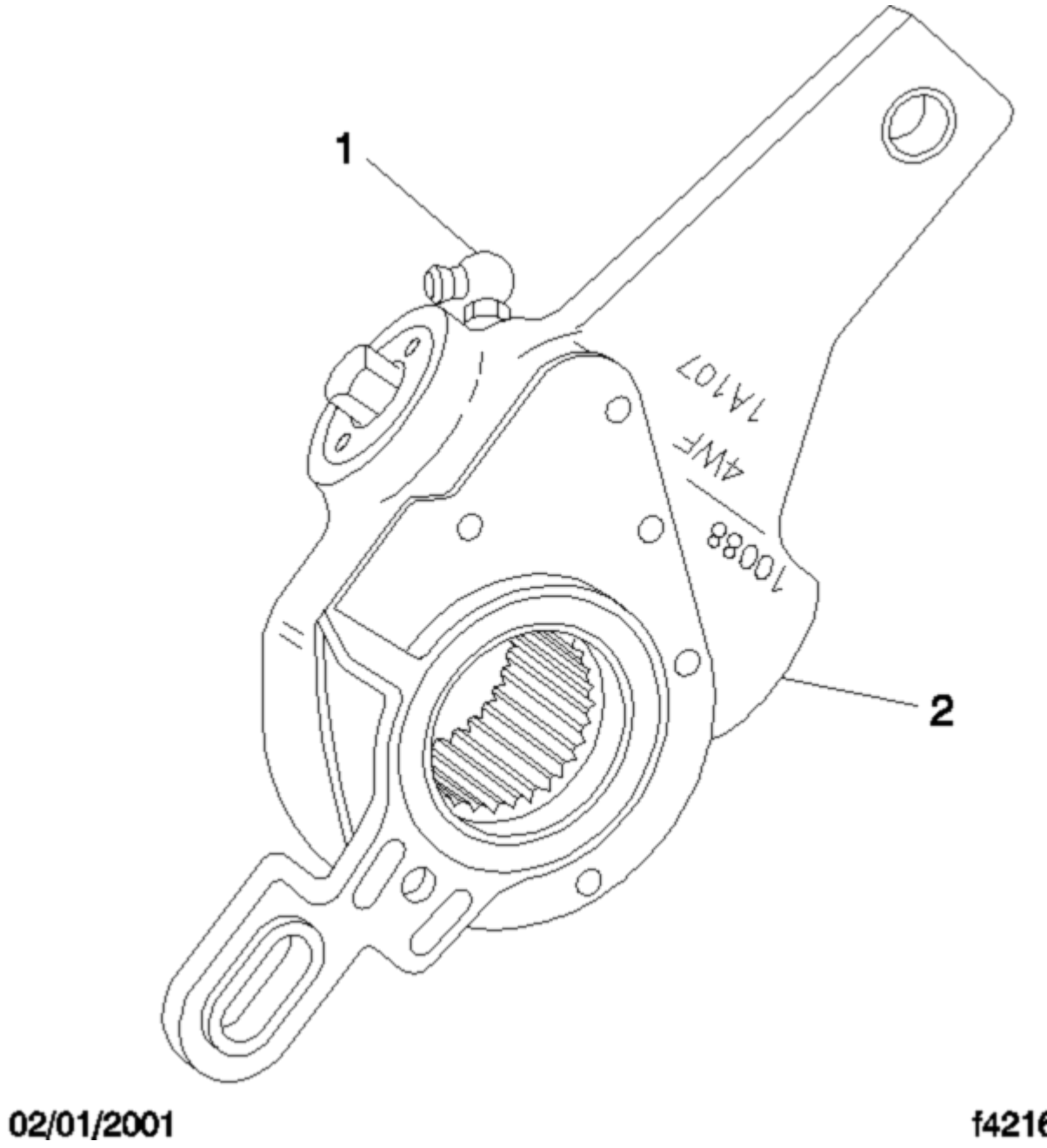


Fig 140, Dana Spicer Slack Adjuster

16.07.03 Gunite Slack Adjuster

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

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

Lubricate a Gunite slack adjuster at the grease fitting until grease appears on the camshaft, or flows from the grease relief. See Fig.141,Gunite Slack Adjuster.

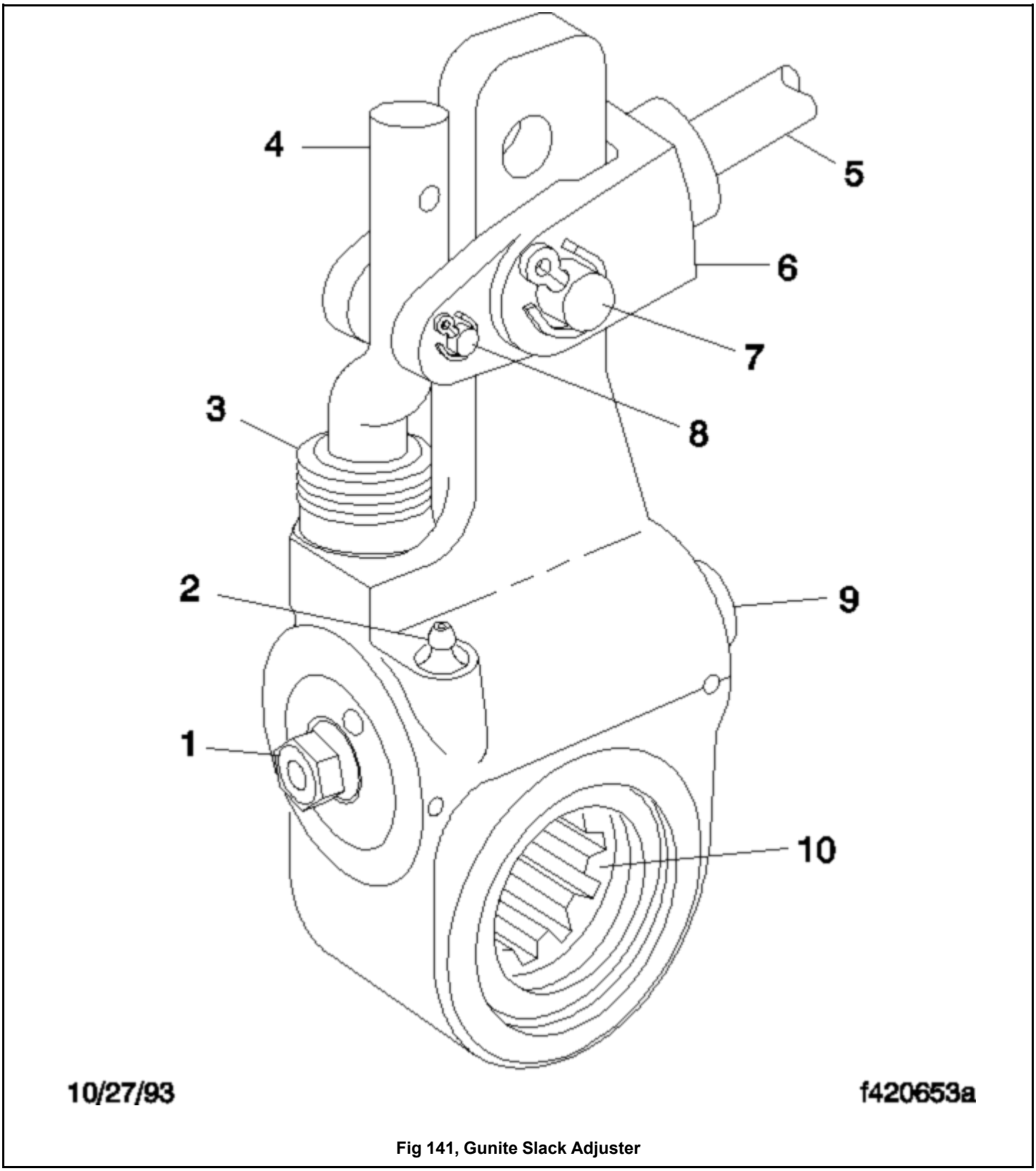


Fig 141, Gunite Slack Adjuster

The newest Gunite slack adjusters are produced without a grease relief. During lubrication with a grease gun, the lubricant is forced through the drilled worm wheel onto the camshaft. Lubricate the slack adjuster at the grease fitting until grease appears on the camshaft. See Fig.141,Gunite Slack Adjuster.

16.07.04 Meritor

NOTE: If equipped with an extended-maintenance Q Plus™ brake system, the slack adjuster will not have a grease fitting. These slack adjusters use a special NLGI Grade synthetic polyurea grease, and do not require lubrication for 3 years or 500,000 miles (800 000 km), whichever comes first. The extended-maintenance slack adjusters are lubricated during the brake reline service interval.

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

For slack adjusters with grease fittings and for operating temperatures below –40°F (–40°C) and above –65°F (–54°C), use a NLGI Grade 2 synthetic oil, 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.142,Meritor Slack Adjuster.

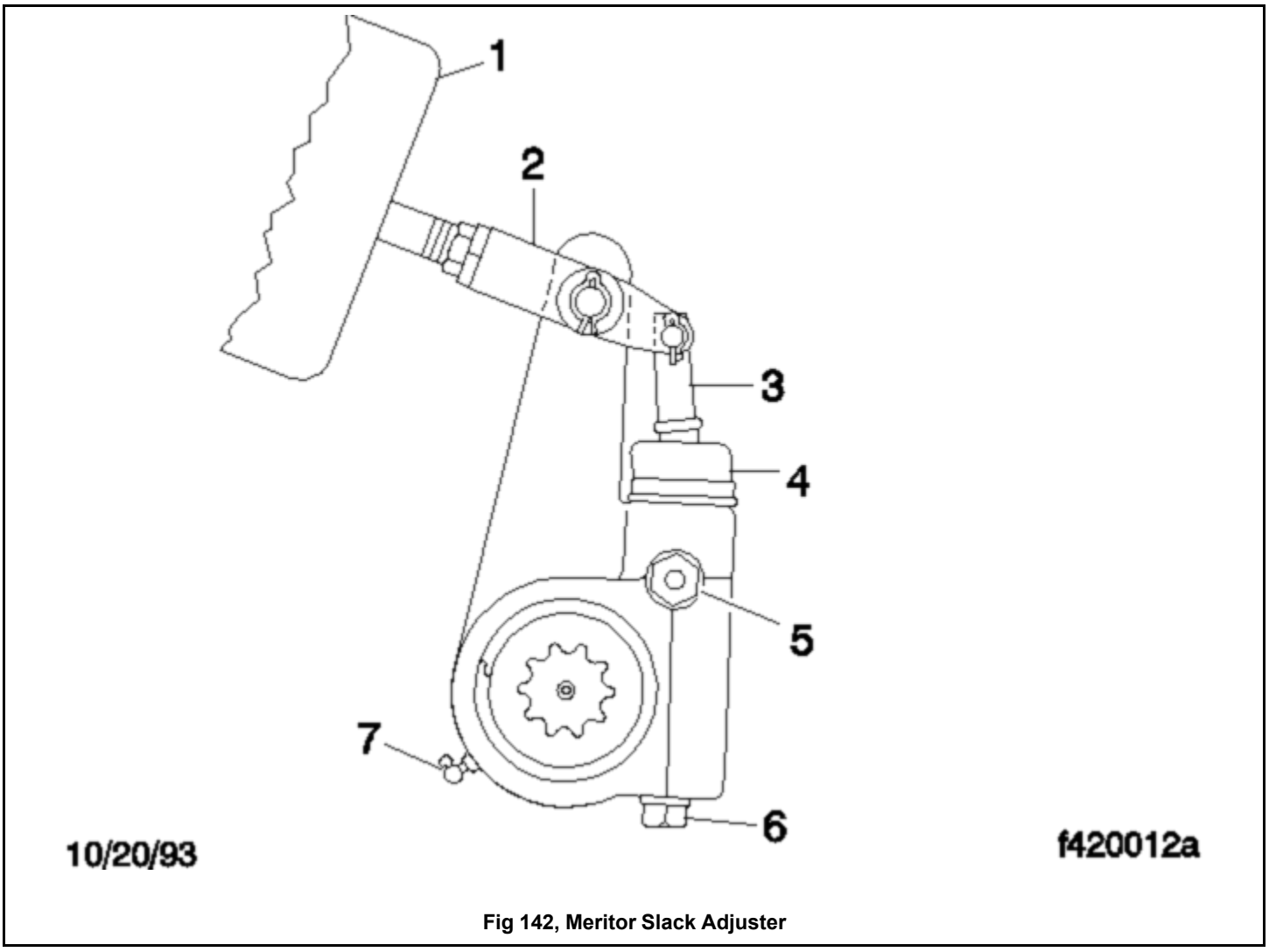


Fig 142, Meritor Slack Adjuster

16.08 Brake Inspection

16.08.01 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 **Group 42** of the *Western Star Workshop Manual* for repair procedures.

16.08.02 Brake Component Inspection

Air Disc Brakes

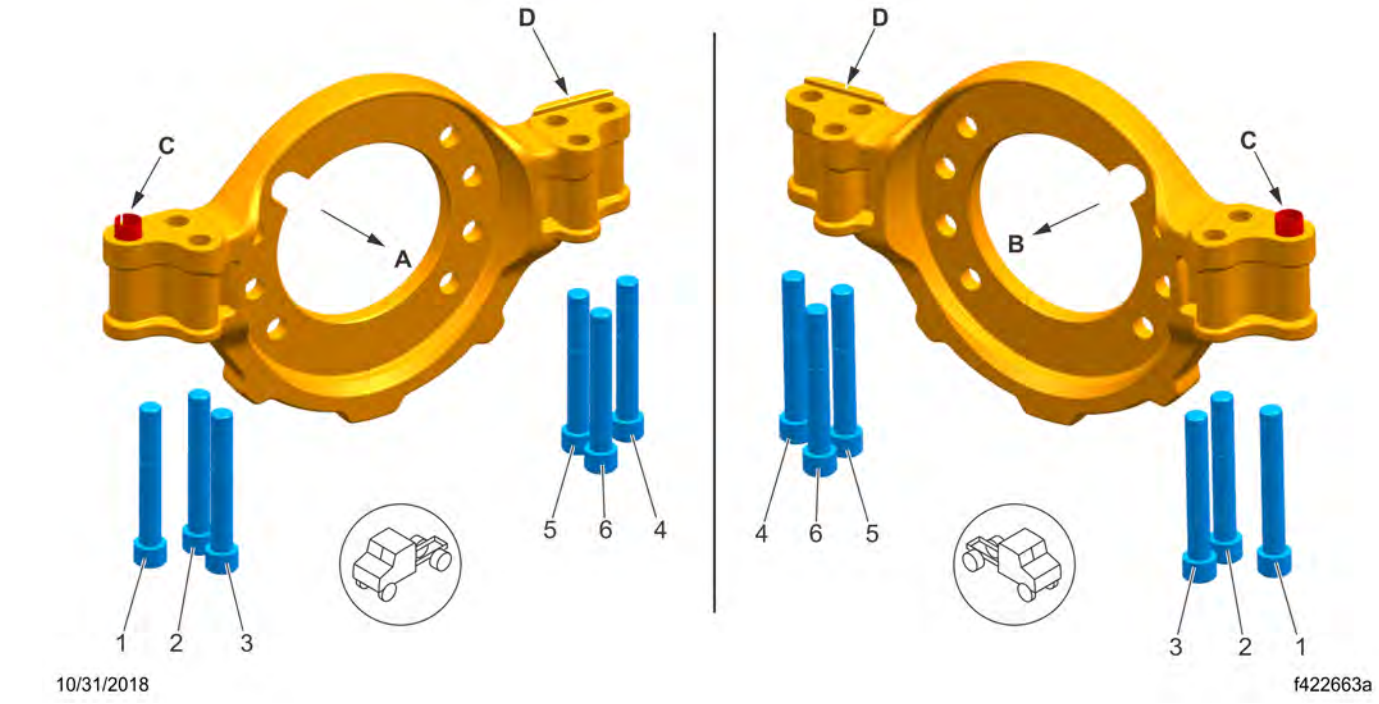
IMPORTANT: The following step to inspect the caliper mounting bolts should only be performed at the initial maintenance (IM) interval.

Vehicles may have both **axial and radial** mounted calipers. Follow the instructions based on the type of calipers installed on the vehicle.

16.08.03 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 Information, Wheels and Tires of the **Western Star 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.143,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 Western Star dealer to have all of the caliper bolts on that wheel end replaced.



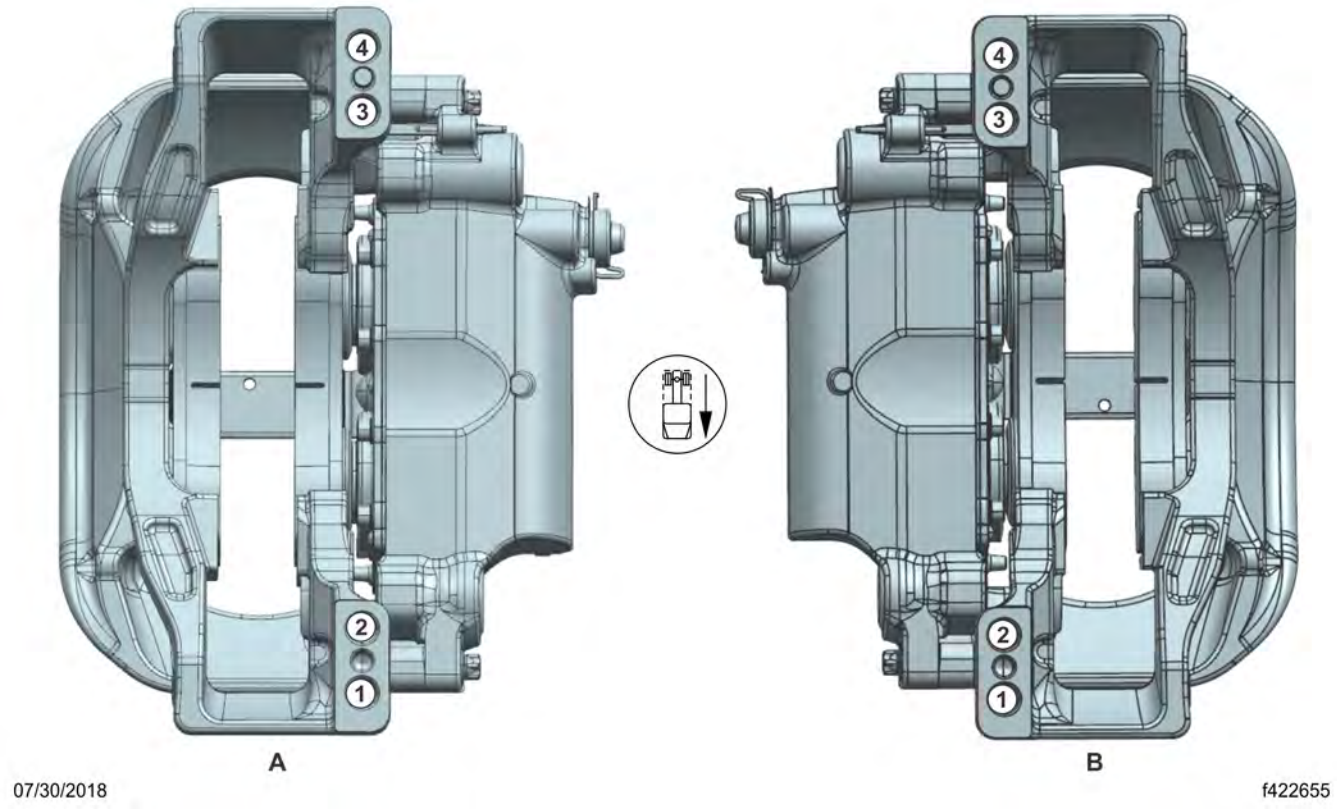
A. Right-hand brake (viewed from below).
B. Left-hand brake (viewed from below).
C. Sheer sleeve above in this location.
D. Shelf above in this location.

Fig 143, Bendix Radial Mounted Caliper Tightening Pattern (viewed from below)

5. Install the wheel assemblies. For instructions, see General Information, Wheels and Tires of the **Western Star 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 Information, Wheels and Tires of the **Western Star 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.144,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 Western Star 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

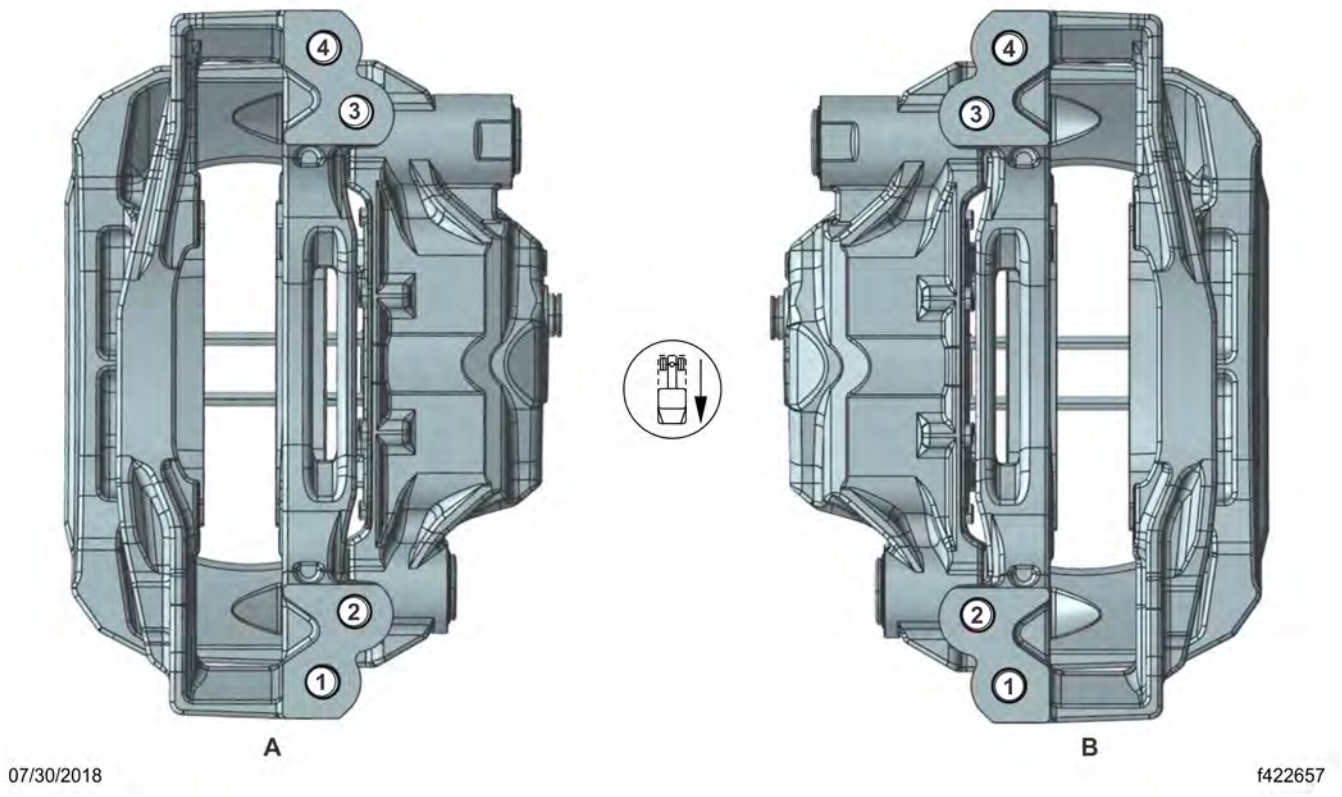
B. Right Hand, Bottom View

Fig 144, Meritor Radial Mounted Caliper Tightening Pattern

5. Install the wheel assemblies. For instructions, see General Information, Wheels and Tires of the **Western Star 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 Information, Wheels and Tires of the **Western Star 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.145,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 Western Star 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 145, Wabco Maxxus Radial Mounted Caliper Tightening Pattern

5. Install the wheel assemblies. For instructions, see General Information, Wheels and Tires of the **Western Star Workshop Manual**.
6. Remove the jack stands and lower the vehicle.

16.08.04 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, Parking Brake Dash Valve, Bendix PP-DC of the **Western Star Workshop Manual** for inspection, troubleshooting, and repair procedures.

4. Measure the applied chamber stroke. See Table.43,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, Parking Brake Dash Valve, Bendix PP-DC of the **Western Star 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 of the **57X Workshop Manual** for inspection, troubleshooting, and repair procedures.

Table 43, Brake Chamber Stroke Specifications

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 43, Brake Chamber Stroke Specifications

16.09 Versajust Slack Adjuster Inspection and Lubrication

16.09.01 General Information

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."

16.09.02 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.44,Actuator Stroke–Standard Stroke and Table.45,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 44, Actuator Stroke–Standard Stroke

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 44, Actuator Stroke–Standard Stroke

Table 45, Actuator Stroke–Long Stroke

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

Table 45, Actuator Stroke–Long Stroke

16.10 Bendix Automatic Drain Valve Operating and Leakage Tests

16.10.01 Operating Test

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 **Section 42.12** of the **Western Star Workshop Manual**.

16.10.02 Leakage Test

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 **Section 42.12** of the **Western Star Workshop Manual**.

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17. Steering

17.01 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.

17.02 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.

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

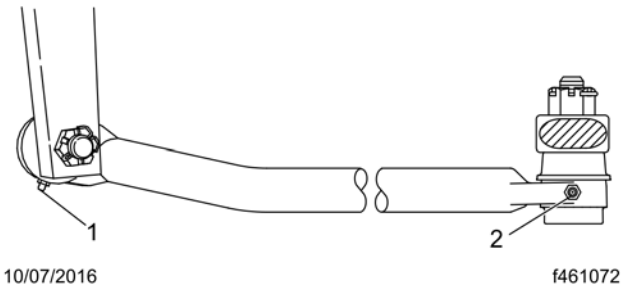
If the ball stud end is loose, replace the drag link. If the ball stud nut is loose, replace the nut and cotter key. See List of Abbreviations for proper torque specifications.

Inspect the boot of the drag link at both the pitman arm and the steering arm end for cracks, splits, or other damage. Replace the boot as needed.

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. If there is 1/8-inch (3-mm) movement or more, do not drive the vehicle until the drag link has been replaced.

17.03 Lubrication of the Drag Link

1. Using a clean rag, wipe all dirt from both drag link grease fittings. See Fig.146,Drag Link.



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

Fig 146, Drag Link

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

17.04 Power Steering Fluid and Filter Changing

17.04.01 Cylindrical Reservoir, Bottom Return Port (Fig.)

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.

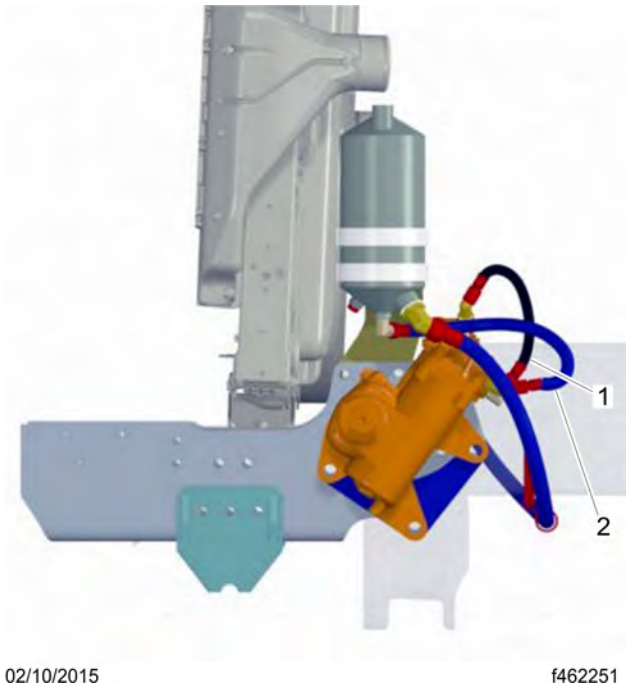


Fig 147, Power Steering Reservoir, Side View

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.148,Power Steering Reservoir, Top View) from the steering gear and allow the oil to drain.

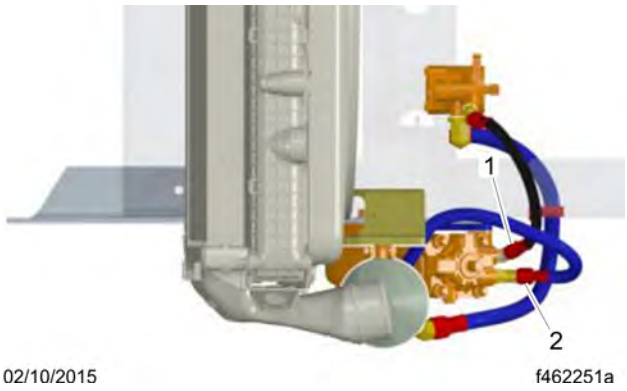


Fig 148, Power Steering Reservoir, Top View

8. Loosen the clamp, and remove the cover along with the filter spring and the filter top plate. Do not use pliers to aid in removal of the filter; pliers could cause metal chips to enter the steering system.
9. Remove the filter. It may be necessary to wiggle the filter to remove it from its base.
10. Turn the steering wheel from full left to full right three times to purge oil from the gear.
11. Connect the pressure line and return hose to the steering gear.
12. Install a new filter into the reservoir. Position the new filter with the larger opening up.
13. Clean the reservoir cover and gasket. Inspect the O-ring and the cover for cracks, deformities, or damage. Replace the gasket seal or cover as needed.
14. Install the reservoir cover along with the spring and the top plate. Make sure the center of the top plate fits into the opening at the top of the filter.
15. Place the clamp over the flanges of the cover and shell assembly, then tighten 25 to 30 lbf·ft (35 to 40 N·m).
16. Fill the reservoir with an approved power steering fluid. See Table.46,Approved Power Steering Fluids for approved power steering fluids.

Table 46, Approved Power Steering Fluids

Approved Power Steering Fluids	
Fluid Type	**Approved Fluid**
Automatic Transmission Fluid	Dexron® III
	Super ATF
	TES-389

Table 46, Approved Power Steering Fluids

17. With the engine off, turn the steering wheel from full left to full right three times. Add more power steering fluid as needed.
18. Start the engine and operate the engine at idle. Check the power steering fluid and add more fluid if needed.

19. Turn the steering wheel from full left to full right several times. Add fluid to the reservoir as needed to maintain the fluid level.
20. Shut down the engine.
21. Raise the vehicle, remove the jack stands, and lower the vehicle.

17.04.02 Flat Reservoir, Top Return Port

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.149,Power Steering Reservoir) from the steering gear and allow the oil to drain.

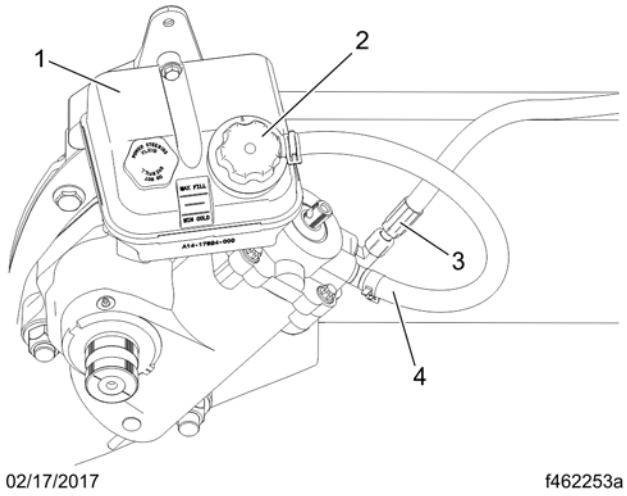


Fig 149, Power Steering Reservoir

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 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.149,Power Steering Reservoir. See Table.47,Approved Power Steering Fluids for approved power steering fluids.

Table 47, Approved Power Steering Fluids

Approved Power Steering Fluids	
Fluid Type	**Approved Fluid**
Automatic Transmission Fluid	Dexron® III
	Super ATF
	TES-389

Table 47, 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.

17.05 Lubrication Of The Steering Shaft

IMPORTANT: Only steering shafts with zerk fittings should be lubricated. Shafts without zerk fittings come with grease sealed inside and should not be greased.

IMPORTANT: Some vehicles may have additional U-joints on the steering column or stubshaft. These should also be lubricated at this interval.

1. Open the hood and locate the lower steering shaft U-joint grease fitting.
2. Using a clean rag, wipe all dirt from the grease fitting.
3. Using a pressure gun, apply clean grease at the grease fitting until old grease is forced out of the seals. Use multipurpose chassis grease NLGI Grade 2 (8% 12-hydroxy lithium stearate grease) or NLGI Grade 1 (6% 12-hydroxy lithium stearate grease); Grade 2 is preferred. See Fig.150,Steering Shaft, Under-Hood.

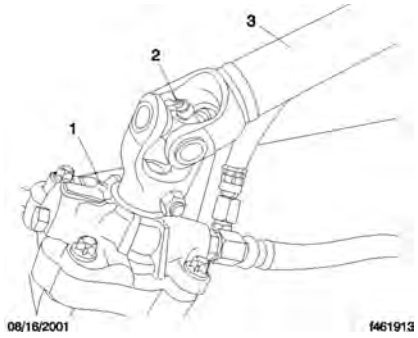


Fig 150, Steering Shaft, Under-Hood

4. Locate the upper steering shaft slip joint and U-joint grease fittings.
5. Using a clean rag, wipe all dirt from the grease fittings.
6. Using a pressure gun, apply clean grease at both grease fittings until old grease is forced out of the seals. Use multi-purpose chassis grease NLGI Grade 2 (8% 12-hydroxy lithium stearate grease) or NLGI Grade 1 (6% 12-hydroxy lithium stearate grease); Grade 2 is preferred. See Fig.151,Steering Shaft, Inside the Cab.

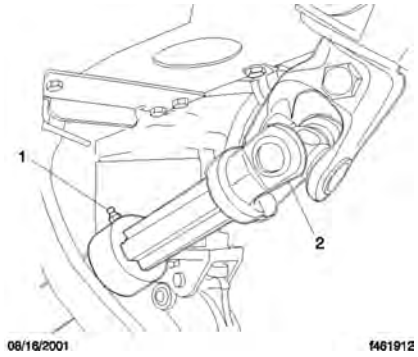


Fig 151, Steering Shaft, Inside the Cab

17.06 Lubrication Of The Power Steering Gear

TRW TAS Series

CAUTION:

Apply grease to the sector shaft only with a hand-type grease gun. See Fig.152,, page 208. Use of a high-pressure power grease gun will supply grease too quickly and could affect the high pressure seal, contaminating the hydraulic fluid.

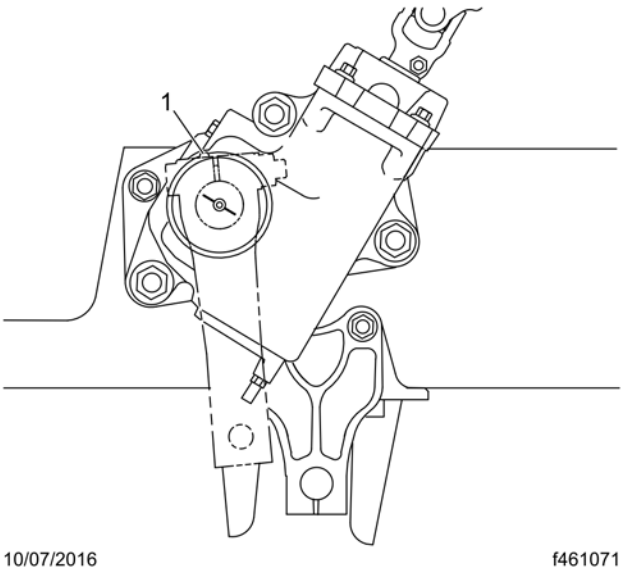


Fig 152, TRW TAS Series Sector Shaft Lubrication

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18. Fuel

18.01 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.

18.02 Replacement Of The Fuel Filter

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

18.03 Fuel/Water Separator Element Checking and Replacement

18.03.01 Alliance/Racor

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

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. Place a suitable container under the fuel/water separator.

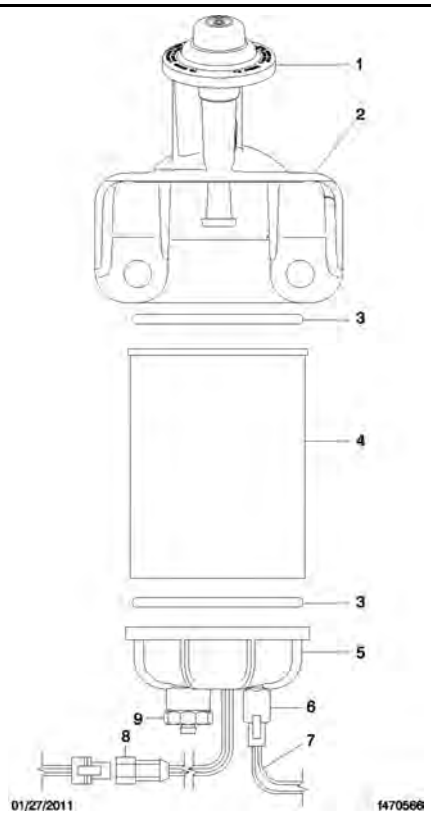
   IMPORTANT: When draining fluid from a fuel/water separator, drain the fluid into an appropriate container, and dispose of it properly. Many jurisdictions now issue fines for draining fuel/water separators onto the ground.

3. Turn the drain plug counterclockwise to open it.
4. When the fuel/water separator is completely drained, turn the drain plug clockwise to close it.

WARNING:

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

5. Disconnect the wiring harnesses from the water-in-fuel sensor and, if equipped, the heater. See Fig. 153,Fuel/Water Separator Assembly, Alliance/Racor.



1. Primer Pump
2. Mounting Head
3. O-Ring
4. Filter Element
5. Sight Bowl
6. Water-in-Fuel Sensor
7. Wiring Harness, Water-in-Fuel Sensor
8. Wiring Harness, Heater
9. Drain Plug

Fig 153, Fuel/Water Separator Assembly, Alliance/Racor

6. Spin off the sight bowl and the filter element as a unit. Remove the O-ring from the top of the filter element.
7. Remove the sight bowl from the filter element. Clean the O-ring seating surface.
8. Apply a thin coating of clean diesel fuel or engine oil to the O-rings.
9. Spin the sight bowl onto the new filter element and then fill the filter element and sight bowl assembly with clean diesel fuel.
10. Spin the entire assembly onto the mounting head and tighten by hand until snug.
11. Connect the wiring harnesses for the water-in-fuel sensor and, if equipped, the heater.
12. Prime the fuel/water separator, as follows. If equipped with a primer pump, operate the primer pump until fuel comes out at the drain. If not equipped with a primer pump, fill the filter element and sight bowl with clean fuel and crank the engine until it starts.
13. Start the engine and check for leaks.
14. Shut down the engine and repair any leaks.

18.03.02 DAVCO Fuel Pro® 382 and 482, and Diesel Pro® 243

NOTE: DAVCO Fuel Pro® 382 and 482, and Diesel Pro® 243

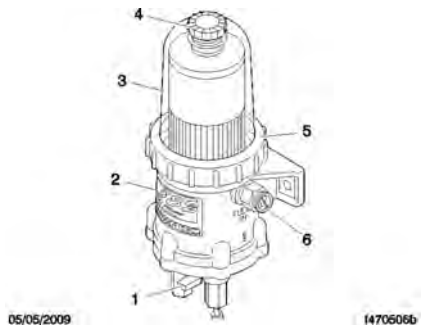
WARNING:

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.

The filter element should be changed only when the fuel level has reached the top of the filter element. There is no significant restriction to fuel flow until the element is completely clogged.

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. 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. The drain valve has a 1/2-inch (12.7-mm) pipe; use a hose with a 1/2-inch pipe thread to fit correctly.
4. Remove the vent cap (Fig.154,DAVCO Fuel/Water Separator (Fuel Pro 382 Shown)g, Item 4) and open the drain valve (Fig.154,DAVCO Fuel/Water Separator (Fuel Pro 382 Shown)g, Item 1) to drain the fuel completely, then close the drain valve.



1. Drain Valve
2. Lower Housing
3. Clear Cover
4. Vent Cap
5. Collart
6. Inlet Port/Check Valve

Fig 154, DAVCO Fuel/Water Separator (Fuel Pro 382 Shown)g

5. Using a DAVCO Collar Wrench (Fig.155,DAVCO Collar Wrench), remove the clear cover and collar.

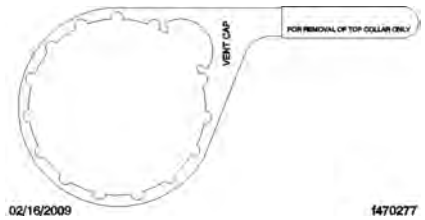
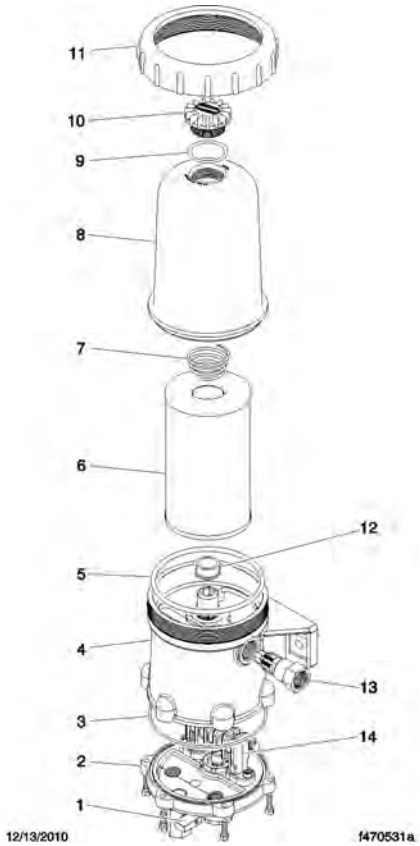


Fig 155, DAVCO Collar Wrench

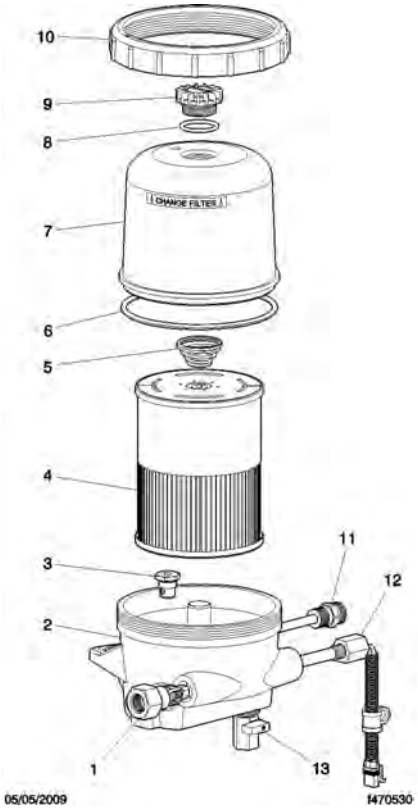
NOTE: Broken vent cap and collar warranty claims will not be accepted if any tool other than a DAVCO Collar Wrench is used for removal. During installation, the vent cap is to be **hand-tightened only** , not tightened with a wrench. Use part number 482017 on Fuel Pro 482 units; part number 380134 on Fuel Pro 382 units.

6. Remove the filter, cover O-ring, and vent cap O-ring. Dispose of them in an environmentally acceptable manner. See Fig.156,DAVCO Fuel Pro 382, Fig.157,DAVCO Fuel Pro 482, or Fig.158,DAVCO Diesel Pro 243.



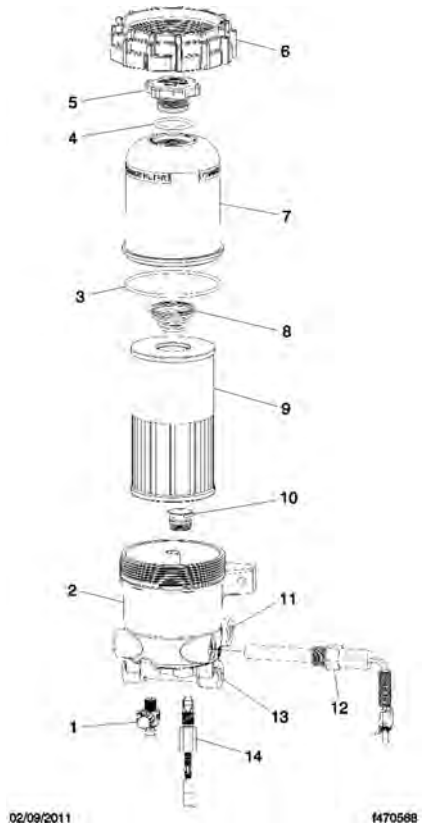
1. Drain Valve
2. Bottom Plate Assembly
3. Bottom Plate O-Ring
4. Lower Housing
5. Cover O-Ring
6. Filter Element
7. Spring
8. Clear Cover
9. Vent Cap O-Ring
10. Vent Cap
11. Collar
12. Grommet
13. Inlet Port/Check Valve
14. Heat Exchanger

Fig 156, DAVCO Fuel Pro 382



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

Fig 157, DAVCO Fuel Pro 482



1. Drain Valve
2. Lower Housing
3. Cover O-Ring
4. Vent Cap O-Ring
5. Vent Cap
6. Collar
7. Clear Cover
8. Spring
9. Filter Element
10. Check Valve Assembly
11. Fuel Inlet Port
12. Pre-Heater
13. Fuel Outlet Port
14. Water-In-Fuel Sensor

Fig 158, DAVCO Diesel Pro 243

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. On Fuel Pro 382 units, install the grommet on the bottom of the new filter.
9. Install the new filter and grommet assembly and cover O-ring on the housing.
10. 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.
11. Prime the system.
    - 11.a Ensure that the drain valve is closed.
    - 11.b Fill the housing to the top of the filter element with clean diesel fuel.
    - 11.c Install and hand-tighten the vent cap O-ring and vent cap.
    - 11.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.
    - 11.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 about one inch (2.5 cm) above the collar, then hand-tighten the vent cap.

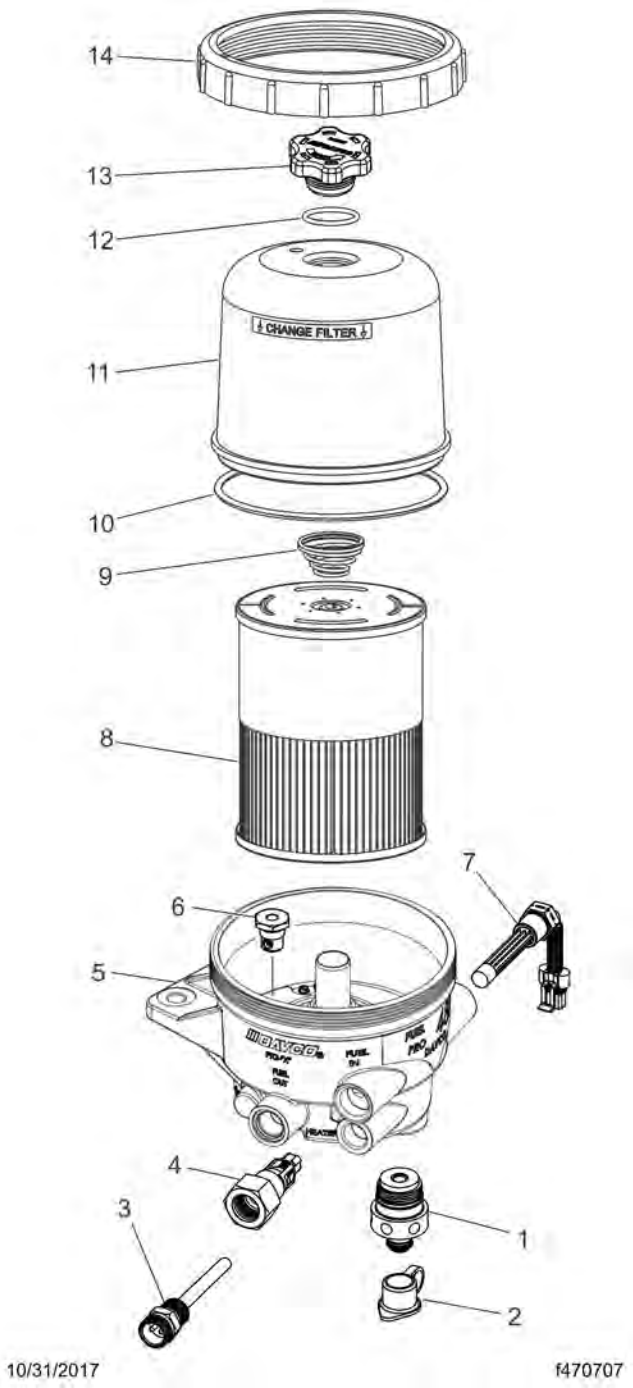
11.f Check for leaks and shut down the engine.

18.03.03 DAVCO Fuel Pro® 487

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.

1. Shut down the engine, apply the parking brake, and chock the tires.

   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.
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.159,DAVCO Fuel Pro 487, to drain the fuel completely, then close the drain valve.



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

Fig 159, DAVCO Fuel Pro 487

5. Using a DAVCO Collar Wrench, shown in Fig.160,DAVCO Collar Wrench, remove the clear cover and collar.

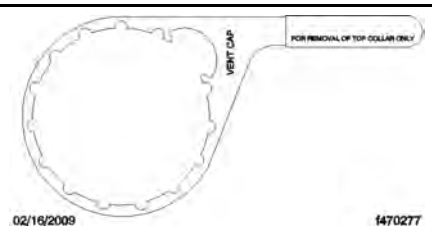
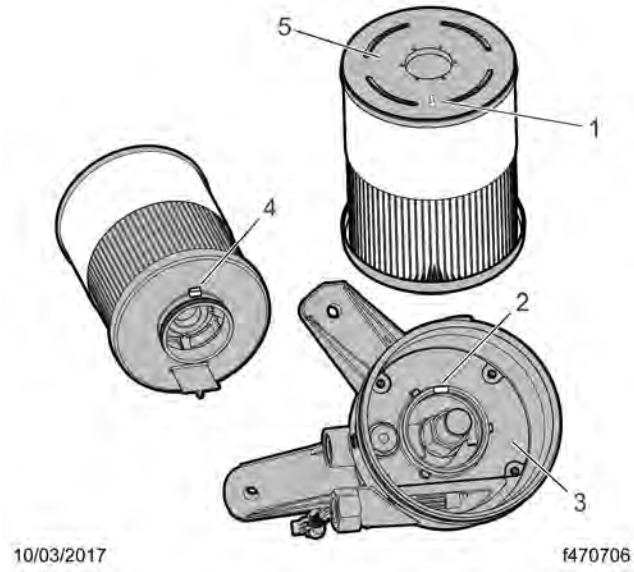


Fig 160, DAVCO Collar Wrench

NOTE: Broken vent cap and collar warranty claims will not be accepted if any tool other than a DAVCO Collar Wrench (part number 482017) is used for removal. During installation, the vent cap is to be **hand-tightened only** , not tightened with a wrench.

6. Remove the filter, cover O-ring, and vent cap O-ring. Dispose of them in an environmentally acceptable manner. See Fig.159,DAVCO Fuel Pro 487.
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.161,Positioning the Filter Element. 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

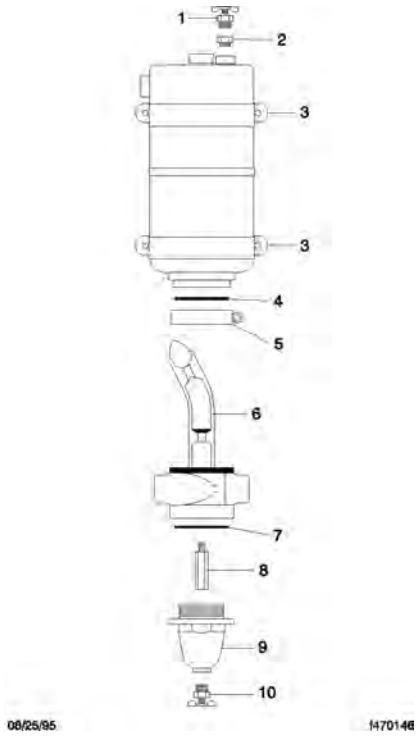
Fig 161, Positioning the Filter Element

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.

18.03.04 ConMet Fuel Separator Sight Bowl Cleaning

The only maintenance necessary on ConMet fuel separators is to clean the sight bowl, if equipped. See Fig. 162,ConMet Fuel Separator.



1. Vacuum Breaker/Drain Valve
2. Reducer Bushing
3. Mounting Brackets
4. O-ring (when equipped with heater)
5. Stainless Steel V-Clamp (when equipped with heater)
6. Heater Assembly
7. Gasket
8. Sight Bowl Heater Rod
9. Sight Bowl Assembly
10. Vacuum Breaker/Drain Valve

Fig 162, ConMet Fuel Separator

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

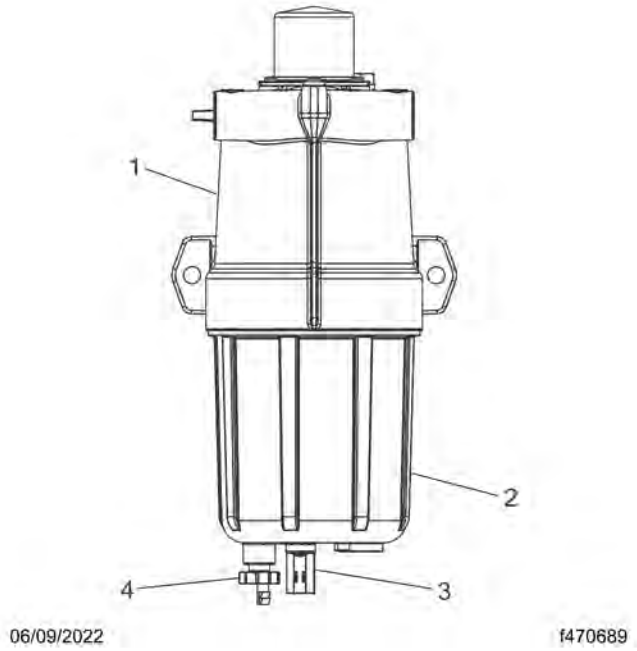
1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires and open the hood.

   NOTE: When draining fluid from a fuel/water separator, drain the fluid into an appropriate container, and dispose of it properly. Many jurisdictions now issue fines for draining fuel/water separators onto the ground.

2. Drain the fuel separator.
3. Unscrew the sight bowl from the fuel separator.
4. Wipe the sight bowl clean using a soft cloth.
5. Lubricate the gasket with a film of oil, and reinstall it on the sight bowl. If the gasket appears dry-rotted or damaged, replace the gasket.
6. Lightly lubricate the threads on the sight bowl with oil, then thread the sight bowl into the bottom of the fuel separator.
7. Hand-tighten until the gasket is in full contact with the fuel separator, then tighten an additional 1/4 to 1/3 turn.
8. Check that the drain valve is tightened and closed.
9. To prime the fuel separator, remove the vacuum breaker fitting and fill the unit with diesel fuel, then install and close the fitting when the unit is full.

18.03.05 Detroit

The only maintenance necessary on an Detroit fuel/water separator is to replace the filter element. See Fig. 163, Detroit Fuel/Water Separator.



1. Mounting Head
2. Sight Bowl

Fig 163, Detroit Fuel/Water Separator

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.

   NOTE: 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.

18.04 Fuel Tank Band Nut Tightening

18.04.01 Rectangular Fuel Tank

IMPORTANT: Do not overtighten the nuts.

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

18.04.02 Cylindrical Fuel Tank

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

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19. Exhaust

19.01 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.

19.02 Exhaust System Inspection (Noise Emission Control)

19.02.01 General Information

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. Western Star Trucks recommends replacing parts that show leakage, wear, or damage, with genuine Western Star 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 Regeneration of the **Western Star 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.

19.02.02 EPA10 and Newer Exhaust System

Definitions of Aftertreatment (ATS) Terms

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

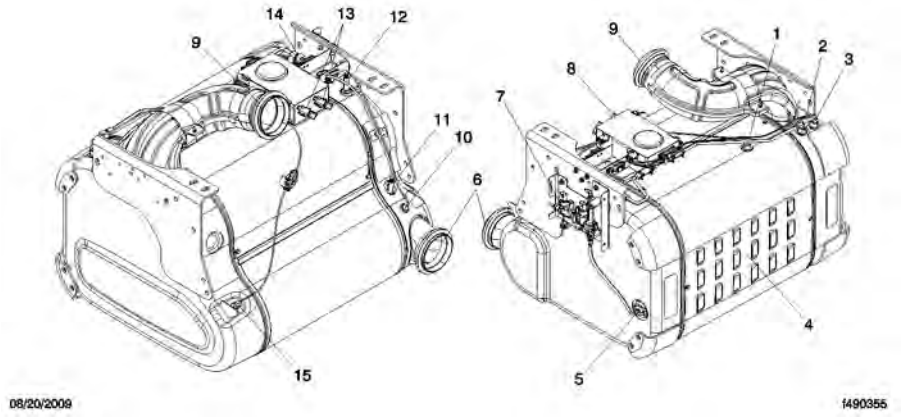
- Aftertreatment System (ATS)—the entire exhaust system from the turbocharger to the exhaust stack or tail pipe.
- Aftertreatment Device (ATD)—a housing that contains the DOC and DPF (also the SCR and the mixing tube in one-box systems).
- BlueTec®—Daimler's proprietary SCR technology.
- Diesel Oxidation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

Inspection

IMPORTANT: Depending upon local jurisdictional emissions guidelines, vehicles that are domiciled outside of the U.S. and Canada may not have engines and/or emissions aftertreatment systems that are compliant with EPA10 or GHG21 regulations.

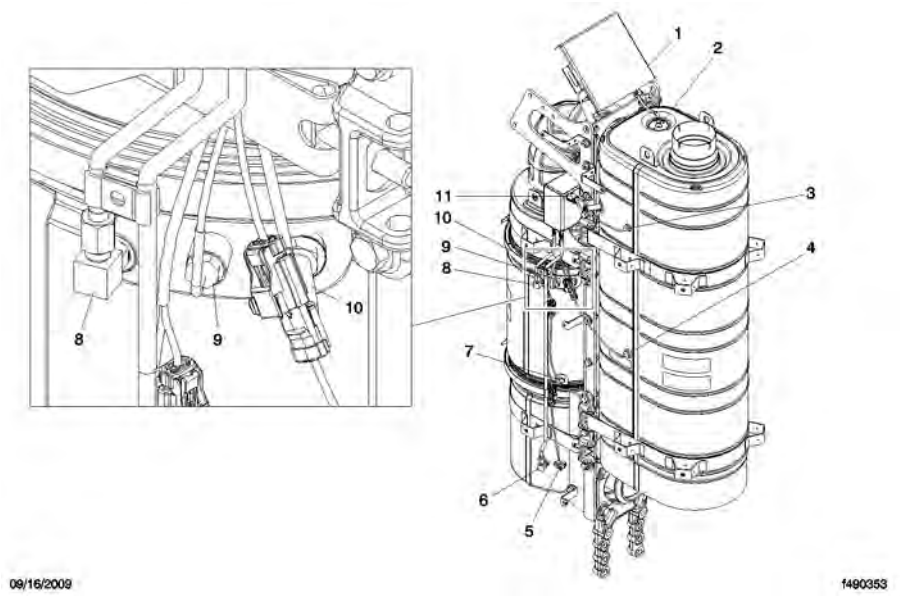
IMPORTANT: The aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections. No leaks are allowed anywhere in the system. If any discrepancies are discovered, refer to the engine manufacturer's service literature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

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.
3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.
5. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD.
6. Check all sensors attached to the ATS for leaks or damaged wires. No leaks are allowed. See Fig. 164,One-Box ATS Sensor Locations , Fig.165,2V2 Two-Box ATS Sensor Locations, or Fig. 166,2HV Two-Box ATS Sensor Locations for Detroit Diesel ATS sensor locations.



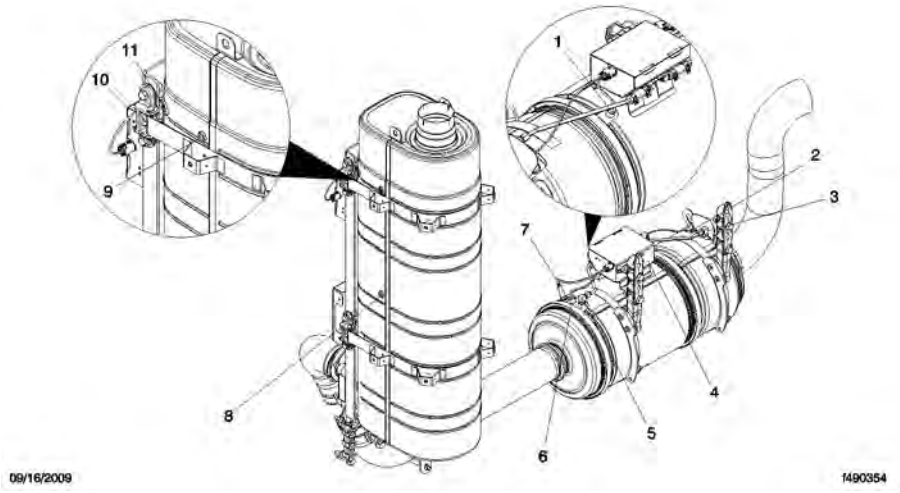
NOTE: The sensor box (item 8) contains the SCR inlet and outlet NOx sensors, DPF outlet pressure sensor, and the DOC inlet pressure sensor.

Fig 164, One-Box ATS Sensor Locations



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

Fig 165, 2V2 Two-Box ATS Sensor Locations



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

Fig 166, 2HV Two-Box ATS Sensor Locations

7. Check the DPF exterior surface for dents or other damage. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
8. Check the SCR catalyst for dents and other damage.
9. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.

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

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

Replacement of the Diesel Exhaust Fluid (DEF) Filter

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

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

19.02.03 EPA07 Exhaust System

Definitions of ATS Components

Refer to the following list of definitions of ATS components.

- Aftertreatment System (ATS)—the entire exhaust system from the turbocharger to the exhaust stack or tail pipe.
- Aftertreatment Device (ATD)—a muffler-like canister that houses a DPF, DOC, and sensors.
- Diesel Particulate Filter (DPF)—a filter that collects and holds particulate matter (soot and ash).
- Diesel Oxidation Catalyst (DOC)—oxidizes hydrocarbons and reduces NOx.
- Sensors—detect temperatures and pressures in the ATS.

Inspection

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

IMPORTANT: The aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections; see Fig.167,, page 228. No leaks are allowed anywhere in the system. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.

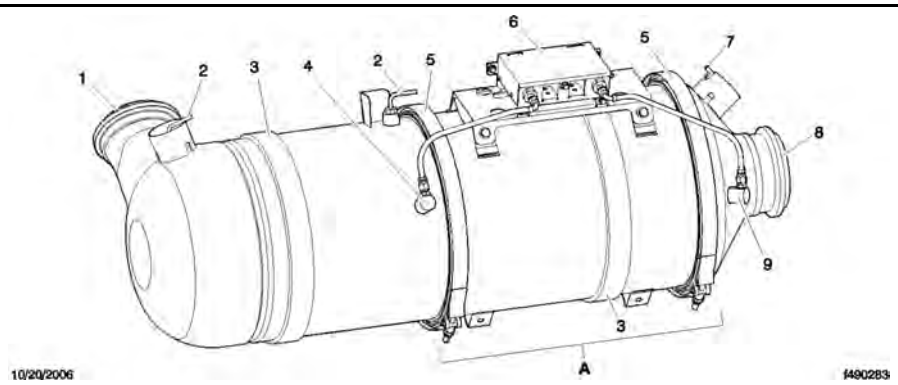
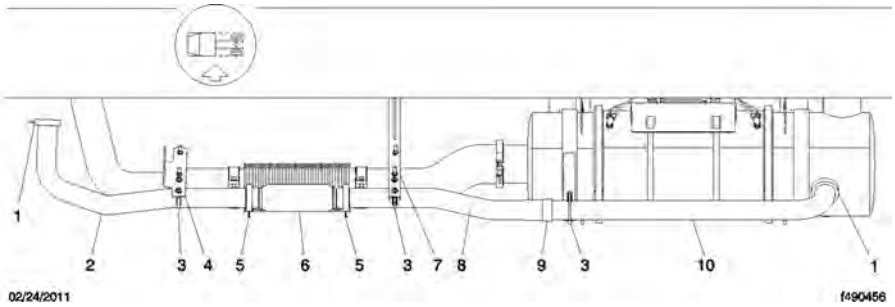


Fig 167, Typical EPA07 Aftertreatment Device

2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.
3. On vehicles with CAT engines, inspect the CGI bellows and piping for evidence of damage or leakage. See Fig. 168,CAT EPA07 Exhaust Installation with CGI Bellows. If the bellows is damaged or leaking, replace it. See **49–02** for the replacement procedure.



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

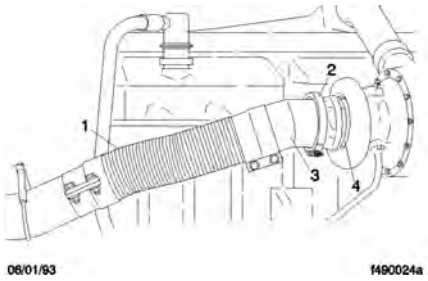
Fig 168, CAT EPA07 Exhaust Installation with CGI Bellows

4. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
5. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.
6. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD.
7. Check all sensors attached to the ATD for leaks or damaged wires. No leaks are allowed.
8. Check the DPF exterior surface for dents or other damage. See Item A of Fig. 167,Typical EPA07 Aftertreatment Device. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
9. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.

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

Inspection Of The Pre-EPA07 Exhaust System

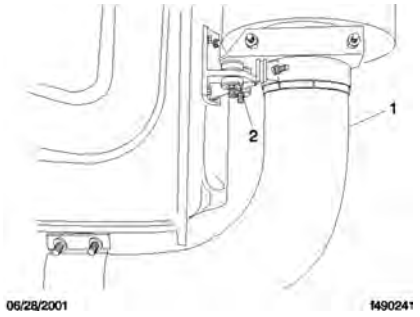
1. On all vehicles, check the condition of the muffler body and the top stack. Check the inlet/outlet tubes for leakage, dents, and corrosion, and check for holes in the muffler. Replace parts as required. Use new parts, equivalent to parts originally installed on the vehicle.
2. Inspect the exhaust flex hose (see Fig.169,V-Band Coupling and Flex Hose) for leakage, wear, or damage. Replace with new parts if replacement is needed.



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

Fig 169, V-Band Coupling and Flex Hose

3. Check for leakage at the V-band coupling, which attaches the exhaust pipe to the turbocharger exhaust outlet. See Fig.169,V-Band Coupling and Flex Hose.
4. If leakage exists, tighten the nut on the V-band coupling 85 lbf·in (940 N·cm). If leakage persists, install a new V-band coupling.
5. Inspect the turbocharger outlet pipe, and replace it as needed.
6. Check the U-bolt clamps for tightness, and tighten as needed.
7. Check the isolator at the base and the top of the exhaust stack (see Fig.170,Exhaust Isolator) for cracking, damage, and dry rot. Replace as needed.



1. Exhaust Elbow
2. Exhaust Isolator

Fig 170, Exhaust Isolator

8. Check for leakage at all wide-band exhaust clamps. See Fig. 171, **Donaldson SealClamp Wide-Band Exhaust Clamp**. If leakage exists, tighten the nuts 40 to 60 lbf·ft (54 to 81 N·m). If leakage persists, inspect the wide-band exhaust clamps. Install a new Donaldson SealClamp™ if necessary.

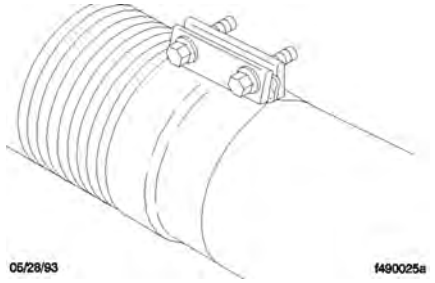


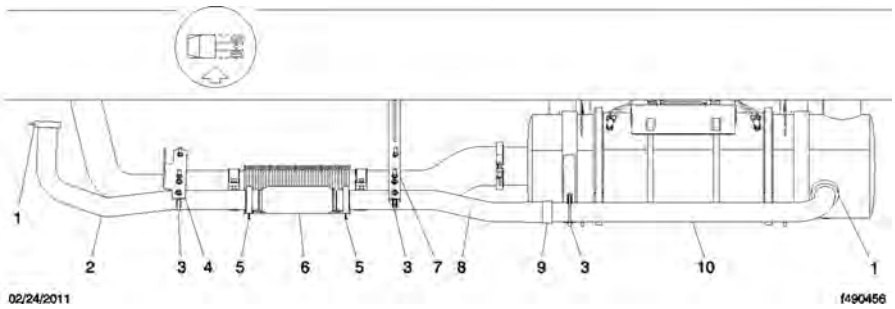
Fig 171, Donaldson SealClamp Wide-Band Exhaust Clamp

19.03 Replacement Of The CAT CGI Bellows

On vehicles with CAT EPA07 compliant engines, replace the CGI bellows at the M4 maintenance interval to prevent a later failure.

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

1. Park the vehicle, set the parking brake, chock the wheels.
2. Open the hood.
3. Remove the right side inner fender/splash shield as needed.
4. Remove the CGI piping between the engine and aftertreatment device (ATD). See Fig. 172,CAT EPA07 Exhaust Installation with CGI Bellows.



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

Fig 172, CAT EPA07 Exhaust Installation with CGI Bellows

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

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

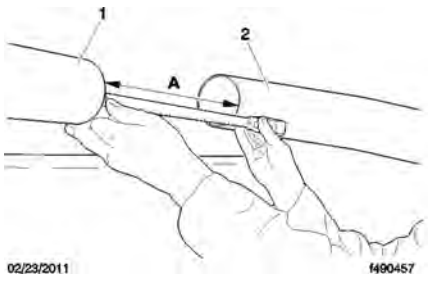
6. Install the CGI piping (without CGI bellows) and align piping.
   6.a Attach the aft CGI pipe to the ATD.
   6.b Attach the forward CGI pipe to the engine.

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

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

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

7. Once the pipes are aligned, measure the pipe gap between the CGI pipes and record the distance. See Fig. 173,Measuring the Pipe Gap (typical) , Ref. A. The existing pipe gap is designed at 10 inches (254 mm). A 10.75 inches (273 mm) pipe gap is required for the replacement CGI bellows and clamps. This requires one or both of the CGI pipes to be shortened.

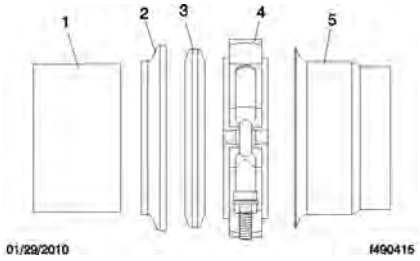


A. Measure the pipe gap.
1. CGI Aft Pipe
2. CGI Forward Pipe

Fig 173, Measuring the Pipe Gap (typical)

8. Using a yellow paint pen, mark the pipes 1.5 inches (38 mm) in from the end of each pipe. These two marks will be used to center the bellows between the two pipes.

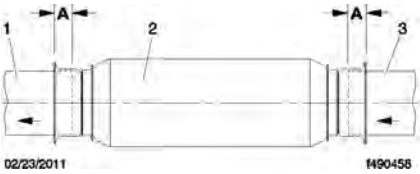
9. Once the pipes are correctly aligned and separated at the correct distance, secure the aft CGI pipe to the ATD and to any CGI pipe support brackets.
10. Remove the forward CGI pipe from the truck.
11. Slide the slip clamp, with the retaining ring and graphite gasket ring, on the aft CGI pipe. See Fig. 174,Aft Facing Slip Clamp Installation for proper installation.



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

Fig 174, Aft Facing Slip Clamp Installation

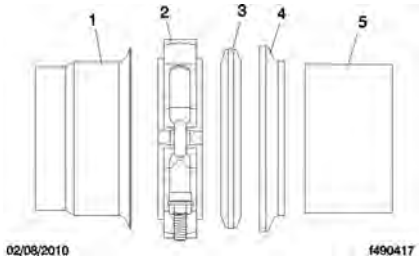
12. Slide the new bellows onto the aft CGI pipe as far as it will go. See Fig.175,CGI Bellows Installation, Ref. A. Measurement A should be at least 7/16 inch (10 mm) past the face of the flange.



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

Fig 175, CGI Bellows Installation

13. Install the slip clamp with the retaining ring and graphite gasket ring onto the forward CGI pipe. See Fig. 176,Forward Facing Slip Clamp Installation for proper installation.



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

Fig 176, Forward Facing Slip Clamp Installation

14. Slide the end of the forward CGI pipe into the bellows, and properly align the pipe.
15. Secure the forward CGI pipe to the engine and any CGI pipe support brackets.
16. Using the yellow marks, center the bellows between the exhaust pipes. Verify that the pipe is inserted at least 7/16 inch (10 mm) past the face of the flange. See Fig.175,CGI Bellows Installation, Ref. A.
17. Install the slip clamps on the bellows. Tighten the slip clamps 11 lbf·ft (15 N·m).
18. Start the engine and check for exhaust leaks. Tighten any clamps as needed.

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20.02 Inspection Of The Cab Suspension 236
20.03 Mirror Folding Check 237
20.04 Inspection Of The Aerodynamic Component 237

20. Cab

20.01 Safety Precautions

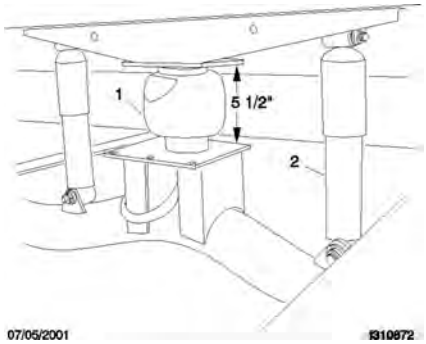
Safety Precautions in this section apply to all procedures within this group.

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.

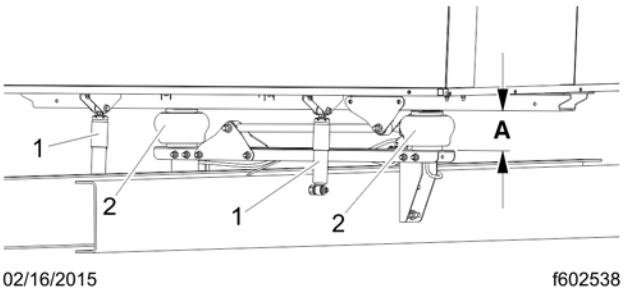
20.02 Inspection Of The Cab Suspension

1. On single and dual air spring systems, inspect the air spring(s) at the rear of the cab. Check for wear, air leaks, and damage. See Fig.177,Single Air Spring Cab Suspension (typical) for typical single air spring suspension, Fig. 178,Dual Air Spring Cab Suspension (typical) for a typical dual air spring suspension. Replace damaged components if necessary. On combined air spring/shock absorber suspension, check for wear, air leaks, fluid leaks, and damage. See Fig.179,Air Spring/Shock Absorber Suspension for air spring/shock absorber suspension. Replace damaged components if necessary.



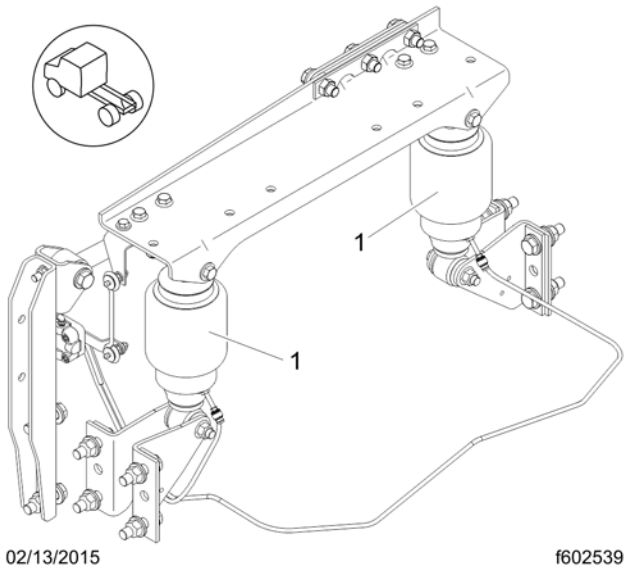
1. Air Spring
2. Shock Absorber

Fig 177, Single Air Spring Cab Suspension (typical)



A. 5-1/2 inches (140 mm)
1. Shock Absorber
2. Air Spring

Fig 178, Dual Air Spring Cab Suspension (typical)



Ride height is not adjustable.

1. Combined Air Spring/Shock Absorber

Fig 179, Air Spring/Shock Absorber Suspension

Ride height is not adjustable.

2. On single or dual air spring suspensions, check the distance between the top and bottom air spring mounting brackets. the air spring(s) should be inflated so that the distance between the top and bottom brackets measures 5-1/2 inches (140 mm). See Fig.177,Single Air Spring Cab Suspension (typical) for typical single air spring suspension, Fig. 178,Dual Air Spring Cab Suspension (typical) for a typical dual air spring suspension.
3. Inspect the cab suspension shock absorbers for wear, damage, or leaking fluid. See Fig. 177,Single Air Spring Cab Suspension (typical) for single air spring suspension, Fig. 178,Dual Air Spring Cab Suspension (typical) for dual air spring suspension or, Fig. 179,Air Spring/Shock Absorber Suspension for air spring/shock absorber suspension. Replace if necessary.

20.03 Mirror Folding Check

For vehicles with folding cab-mounted 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.

20.04 Inspection Of The Aerodynamic Component

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

- Cab side extenders
- Roof fairing/deflector
- Bumper
- Hood
- Side fairings

Replace or repair damaged or missing components as needed.

21.01 Door Seal, Door Latch, Door Hinge, and Door Check Lubrication 240

21. Door

21.01 Door Seal, Door Latch, Door Hinge, and Door Check Lubrication

NOTE: Light penetrating oils, such as WD–40, should not be used because they wash out beneficial factory-installed grease, and they evaporate.

Door Seals

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

Door Latches

Wipe old grease and dirt from all door latch assemblies, then apply liberal amounts of an approved grease to each moving joint; see Table.48,Approved Grease. Use an appropriate applicator that will not leave material behind.

Table 48, Approved Grease

Approved Grease		
Application	**Lubricant**	**NLGI Grade**
Door Latches	ConocoPhillips Triton® 460	1.5
Door Checks	ConocoPhillips Megaplex® XD3	2

Table 48, Approved Grease

Door Hinges

Lubricate external hinges every six months. Wipe old grease and dirt from the hinge, then force an approved grease into the hinge components; see Table.48,Approved Grease. Use an appropriate applicator that will not leave material behind. Wipe off any excess grease.

Door Checks

Wipe old grease and dirt from door checks. Lubricate each moving joint of the door checks at installation and every six months thereafter, with an approved grease; see Table.48,Approved Grease. Use an appropriate applicator that will not leave material behind.

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22.02 Inspection Of The Air Conditioner 242
22.03 HVAC Air Filter Cleaning and Replacement 243
22.03.01 General Information 243
22.03.02 Replacement Of The Cab Fresh-Air Filter 243
22.03.03 Cab Fresh-Air Filter Cleaning, Foam Filters 244
22.03.04 Cleaning Of The HVAC Pre-Filter 246
22.03.05 Replacement Of The Sleeper Fresh-Air Filter 246
22.03.06 Sleeper Fresh-Air Filter Cleaning, Foam Filters 247

22. Heater and Air Conditioner

22.01 Safety Precautions

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

DANGER:

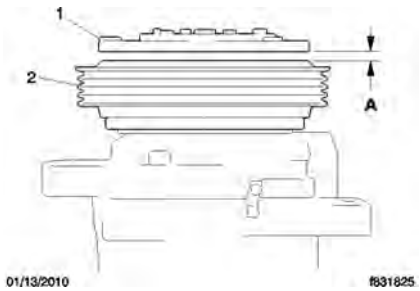
When working on the vehicle, shut down the engine or motor, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle cannot drop. Failure to follow these steps could result in serious personal injury or death.

22.02 Inspection Of The Air Conditioner

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, apply the parking brake, and chock the tires.
2. Inspect the A/C compressor hub. A torn or melted rubber dampener (center section) indicates internal damage has occurred within the compressor. Inspect friction surfaces for wear, oil-soaked conditions, or discoloration due to excessive heat.
3. With the belt removed, check to make sure that the rotor (pulley) spins freely. It should not wobble or contact the hub when it is spinning. Using a feeler gauge, check the clearance between the rotor and hub at several locations, and average the results. See Fig.180,Hub/Rotor Clearance. See Table.49,Acceptable Compressor Clutch Clearances for acceptable clearances. For a Denso compressor, if the clearance is greater than 0.024 inch (0.6 mm), replace the clutch. For instructions, see **Section 83.04, Subject 140** of the **Western Star Workshop Manual**. For a Sanden compressor, if the drive plate clutch needs adjustment, see **Section 83.01, Subject 130** of the **Western Star Workshop Manual**. For a Climate Control compressor, if the clearance is 0.035 inch (0.89 mm) or greater, replace the clutch. For instructions, see **Section 83.00, Subject 140** of the **Western Star Workshop Manual**.



See Table.49,, page 243 for acceptable clearances.

A. Clearance
1. Fill Port Plug (Optional)
2. Return Fuel Heating Loop

Fig 180, Hub/Rotor Clearance

See Table.49,Acceptable Compressor Clutch Clearances for acceptable clearances.

Table 49, Acceptable Compressor Clutch Clearances

Acceptable Compressor Clutch Clearances	
Compressor	**Acceptable Clearance: inch (mm)**
Denso	0.014 to 0.024 (0.35 to 0.6)
Sanden	0.016 to 0.031 (0.40 to 0.78)
Climate Control	0.020 to 0.030 (0.50 to 0.76)

Table 49, Acceptable Compressor Clutch Clearances

4. Check the overall condition of the air conditioning hoses. Look for cracks, cuts, and abrasions on the hoses. Replace damaged hoses. Also check for signs of loose fittings on all of the air conditioning components.

22.03 HVAC Air Filter Cleaning and Replacement

22.03.01 General Information

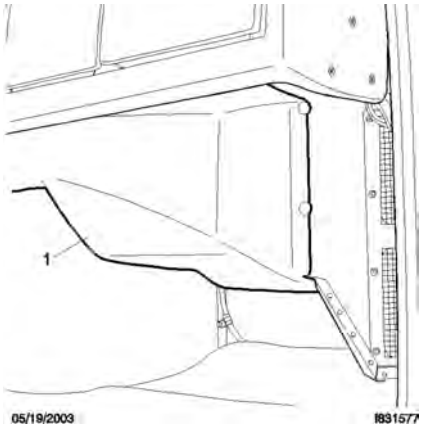
The cab HVAC assembly has either two pleated, dust/odor air filters that are not cleanable and must be replaced every three months, or two foam air filters with aluminum screens that can be cleaned every three months and replaced once a year.

Additionally, some vehicles are equipped with an HVAC pre-filter that should be cleaned every three months and replaced once a year.

On sleeper cabs, the sleeper HVAC assembly has either two pleated, dust/odor air filters that are not cleanable and must be replaced every three months, or two foam air filters with aluminum screens that can be cleaned every three months and replaced once a year.

22.03.02 Replacement Of The Cab Fresh-Air Filter

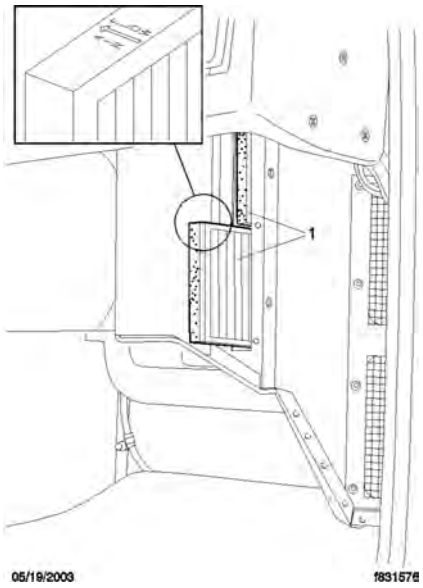
1. Shut down the engine, set the parking brake, and chock the tires.
2. From inside the cab, remove the fasteners that attach the HVAC cover, if equipped, to the HVAC assembly. Remove the HVAC cover. See Fig.181,HVAC Cover.



1. HVAC Cover

Fig 181, HVAC Cover

3. To access the air filters, remove the screws that attach the air filter cover to the HVAC assembly. Remove the air filter cover.
4. Remove the two air filters from the air intake plenum. See Fig.182,Cab Fresh-Air Filters.



1. Air Filters

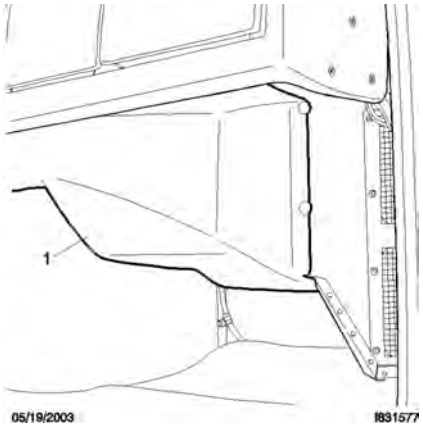
Fig 182, Cab Fresh-Air Filters

5. Install two new air filters in the air intake plenum. Make sure the arrow on the air filter is pointing in the direction shown in Fig.182,Cab Fresh-Air Filters.
6. Using screws, attach the air filter cover to the HVAC assembly.
7. Attach the HVAC cover, if equipped, to the HVAC assembly.

22.03.03 Cab Fresh-Air Filter Cleaning, Foam Filters

1. Shut down the engine, set the parking brake, and chock the tires.

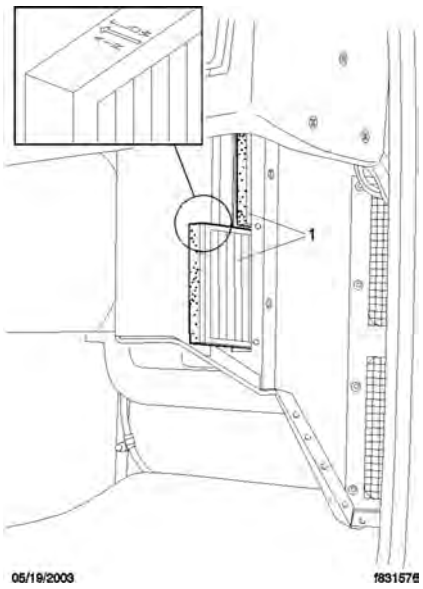
2. From inside the cab, remove the fasteners that attach the HVAC cover, if equipped, to the HVAC assembly. Remove the HVAC cover. See Fig.183,HVAC Cover.



1. HVAC Cover

Fig 183, HVAC Cover

3. To access the air filters, remove the screws that attach the air filter cover to the air intake plenum. Remove the air filter cover.
4. Remove the two air filters from the air intake plenum. See Fig.184,Cab Fresh-Air Filters.



1. Air Filters

Fig 184, Cab Fresh-Air Filters

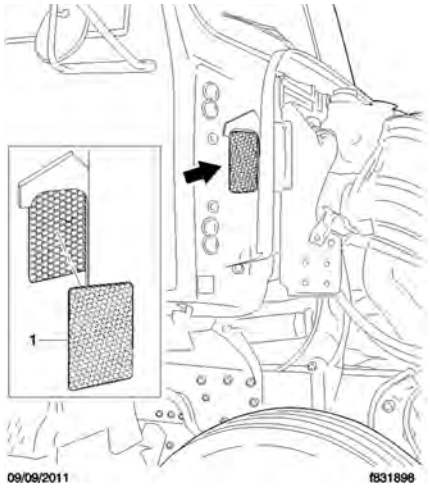
5. Clean the air filters, as follows.
   - 5.a Wash the air filters by flushing soapy water from the air-outlet side of the filter to the air-intake side of the filter.
   - 5.b Rinse the air filters by flushing clear water from the air-outlet side of the filter to the air-intake side of the filter.
   - 5.c Allow the air filters to air dry.

6. Install the air filters in the air intake plenum. Make sure the arrow on the air filter is pointing in the direction shown in Fig.184,Cab Fresh-Air Filters.
7. Using screws, attach the air filter cover to the HVAC assembly.
8. Attach the HVAC cover, if equipped, to the HVAC assembly.

22.03.04 Cleaning Of The HVAC Pre-Filter

NOTE: On vehicles equipped with an HVAC pre-filter, the pre-filter should be cleaned every three months and replaced yearly.

1. Shut down the engine and set the parking brake. Chock the tires.
2. Open the hood.
3. Remove the pre-filter mounted at the HVAC intake. See Fig.185,HVAC Pre-Filter.



NOTE: On vehicles equipped with an HVAC pre-filter, the pre-filter is held in place by friction and a small clamping force; it has no fasteners.

1. Pre-Filter

Fig 185, HVAC Pre-Filter

4. Clean the pre-filter, as follows.
   - 4.a Wash the pre-filter by flushing soapy water from the air-outlet side of the filter to the air-intake side of the filter.
   - 4.b Rinse the pre-filter by flushing clear water from the air-outlet side of the filter to the air-intake side of the filter.
   - 4.c Allow the pre-filter to air dry.
5. Install the pre-filter, as removed.

22.03.05 Replacement Of The Sleeper Fresh-Air Filter

1. Shut down the engine, set the parking brake, and chock the tires.
2. To access the sleeper HVAC assembly, enter the sleeper and remove the bottom drawer from the left-side cabinet.
3. Remove the air filters from the sleeper HVAC assembly. See Fig.186,Orientation of Sleeper Fresh-Air Filters.

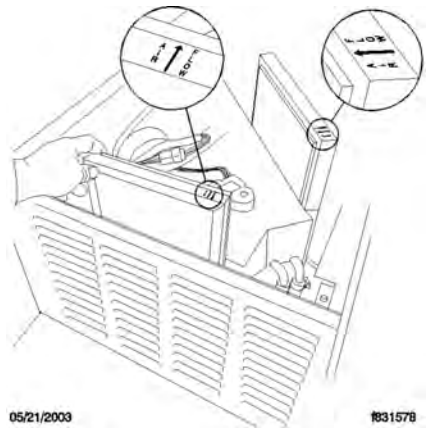


Fig 186, Orientation of Sleeper Fresh-Air Filters

4. Install new air filters in the sleeper HVAC assembly. Make sure the arrow on the air filter is pointing toward the sleeper HVAC assembly; see Fig.186,Orientation of Sleeper Fresh-Air Filters.
5. Install the drawer in the cabinet.

22.03.06 Sleeper Fresh-Air Filter Cleaning, Foam Filters

1. Shut down the engine, set the parking brake, and chock the tires.
2. To access the sleeper HVAC assembly, enter the sleeper and remove the bottom drawer from the left-side cabinet.
3. Remove the air filters from the sleeper HVAC assembly. See Fig.187,Orientation of Sleeper Fresh-Air Filters.

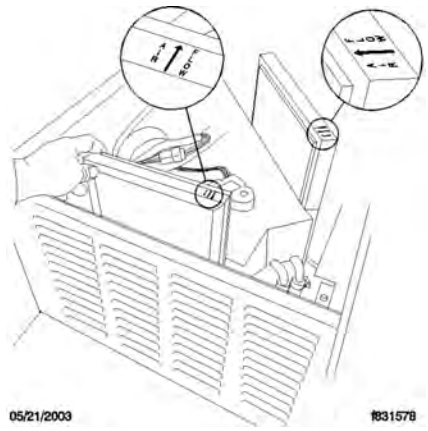


Fig 187, Orientation of Sleeper Fresh-Air Filters

4. Clean the air filters, as follows.
   - 4.a Wash the air filters by flushing soapy water from the air-outlet side of the filter to the air-intake side of the filter.
   - 4.b Rinse the air filters by flushing clear water from the air-outlet side of the filter to the air-intake side of the filter.
   - 4.c Allow the air filters to air dry.
5. Install the air filters in the sleeper HVAC assembly. Make sure the arrow on the air filter is pointing toward the sleeper HVAC assembly; see Fig.187,Orientation of Sleeper Fresh-Air Filters.
6. Install the drawer in the cabinet.

23.01 Hood Rear Support Lubrication 250

23. Hood, Grille, and Cab Fenders

23.01 Hood Rear Support Lubrication

1. Apply the parking brakes and chock the tires.
2. Open the hood.
3. Clean both the hood- and cab-mounted hood rear support components with a soapy water solution.
4. Cover all contact surfaces of the hood rear support brackets and isolators with an approved multi-purpose, lithium-complex, soap-based grease; see Table.50,Approved Suppliers of Multi-Purpose Lithium Grease.

Table 50, Approved Suppliers of Multi-Purpose Lithium Grease

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

Table 50, Approved Suppliers of Multi-Purpose Lithium Grease

5. Close the hood.

CONTACT INFORMATION

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

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