



47X AND 49X MAINTENANCE MANUAL

**Models: 47X
49X**

Foreword

When performed on a regular basis, lubricating the parts of your vehicle is the least costly way of obtaining safe and reliable vehicle operation. Added benefits and savings occur when you check that the engine, undercarriage, and noise emission control parts are in good working order during lubrication.

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

Perform the operations in this maintenance manual at scheduled intervals based upon distance traveled or hours of operation. Perform daily, pretrip inspection and maintenance as outlined in the *Western Star 47X and 49X Driver's Manual*.

IMPORTANT: Descriptions and specifications in this manual were in effect at the time of printing. Western Star Trucks reserves the right to discontinue models and to change specifications or design at any time without notice and without incurring obligation. Descriptions and specifications contained in this publication provide no warranty, expressed or implied, and are subject to revision and editions without notice.

Refer to www.Daimler-TrucksNorthAmerica.com and www.WesternStarTrucks.com for more information, or contact Daimler Trucks North America LLC at the address below.

Environmental and Safety 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.

Servicing vehicles may result in contact with items known to the state of California to cause harm.



WARNING

Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Always start and operate the engine in a well-ventilated area. If in an enclosed are, vent the exhaust to the outside. Do not modify or tamper with the exhaust system. Do not idle the engine except as necessary.

For more information go to www.P65warnings.ca.gov/diesel.



WARNING

Cancer and Reproductive Harm www.P65warnings.ca.gov/diesel.

NOTICE: Parts Replacement Considerations

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

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

Descriptions of Service Publications

Daimler Trucks North America LLC distributes the following major service publications in paper and electronic formats. Refer to www.DTNACconnect.com.

Workshop/Service Manual	Workshop/service manuals contain service and repair information for all vehicle systems and components, except for major components such as engines, transmissions, and rear axles. Each workshop/service manual section is divided into subjects that can include general information, principles of operation, removal, disassembly, assembly, installation, and specifications.
Maintenance Manual	Maintenance manuals contain routine maintenance procedures and intervals for vehicle components and systems. They have information such as lubrication procedures and tables, fluid replacement procedures, fluid capacities, specifications, and procedures for adjustments and for checking the tightness of fasteners. Maintenance manuals do not contain detailed repair or service information.
Driver's/Operator's Manual	Driver's/operator's manuals contain information needed to enhance the driver's understanding of how to operate and care for the vehicle and its components. Each manual contains a chapter that covers pre-trip and post-trip inspections, and daily, weekly, and monthly maintenance of vehicle components. Driver's/operator's manuals do not contain detailed repair or service information.
Service Bulletins	Service bulletins provide the latest service tips, field repairs, product improvements, and related information. Some service bulletins are updates to information in the workshop/service manual. These bulletins take precedence over workshop/service manual information, until the latter is updated; at that time, the bulletin is usually canceled. The service bulletins manual is available only to dealers. When doing service work on a vehicle system or part, check for a valid service bulletin for the latest information on the subject. IMPORTANT: Before using a particular service bulletin, check the current service bulletin validity list to be sure the bulletin is valid.
Parts Technical Bulletins	Parts technical bulletins provide information on parts. These bulletins contain lists of parts and BOMs needed to do replacement and upgrade procedures.

Web-based repair, service, and parts documentation can be accessed using the following applications on the www.DTNACconnect.com website.

DTNACconnect	DTNACconnect provides Web-based access to the most up-to-date versions of the publications listed above. In addition, the Service Solutions feature provides diagnostic assistance with Symptoms Search, by connecting to a large knowledge base gathered from technicians and service personnel. Search results for both documents and service solutions can be narrowed by initially entering vehicle identification data.
PartsPro	PartsPro® is an electronic parts catalog system, showing the specified vehicle's build record.
EZWiring	EZWiring™ makes 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.

Introduction

Descriptions of Service Publications

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

Recall Campaigns

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

Field Service Campaigns

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

Page Description

For an example of a *Western Star Maintenance Manual* page, see [Fig. 1](#).

A **B**

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Rear Axle

C

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35

→ **35-01 Drive Axle Lubricant Level Check**

NOTICE

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

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. If the vehicle has just been driven, allow a few minutes for the lubricant to settle.
3. Clean the 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 Freightliner axles, see [Fig. 1](#); for Meritor axles, see [Fig. 2](#); for Dana Spicer axles, see [Fig. 3](#).

NOTE: Some Freightliner 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.

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.

4. Check the level of the lubricant. The lubricant must be level with the bottom of the oil fill hole (see [Fig. 4](#)). If low, add lubricant.

For Freightliner axles, see [Table 1](#) for approved axle lubricants and lubricant capacities.

For Meritor axles, see [Table 2](#) for approved axle lubricants, and [Table 3](#) and [Table 4](#) for axle capacities.

For Dana Spicer axles, see [Table 5](#) for approved axle lubricants, and [Table 6](#) for axle capacities.

5. Install the oil fill hole plug and tighten it per the following:
 - For Freightliner axles: 37 lbf-ft (50 N-m).
 - For Meritor axles: 35 lbf-ft (47 N-m).
 - For Dana Spicer axles: 50 lbf-ft (68 N-m).
6. On non-drive axles using oil-lubricated wheel bearings, clean the hub cap and plug to minimize

Fig. 1, Freightliner Tandem Axle (forward axle shown)

the possibility of dirt and road grime entering the assembly. Remove the plug, and check the oil level. If low, add fluid using the same lubricant recommended for the drive axle.

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D

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E

09/13/2011

A. Maintenance Operation Number consists of the Group Number followed by the Sequence Number

B. Group Title

C. Group Number

D. Release Date

E. Group Number/Page Number

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Fig. 1, Example Page

Introduction

Maintenance Manual Contents

Group No.	Group Title
00	General Information
09	Air Intake
13	Air Compressor
15	Alternators and Starters
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25	Clutch
26	Transmission
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Title of Maintenance Operation (MOP)	MOP Number
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Determining Scheduled Maintenance Intervals: 00–01

Determining Scheduled Maintenance Intervals

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

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

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

Types of Service

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

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

NOTE: Maintenance instructions in this manual are based on average vehicle use and normal

operating conditions. Unusual vehicle operating conditions may require service at more frequent intervals.

Service Schedule Table: 00–02

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

Table 1, Service Schedule

Vehicle Maintenance Schedule Table: 00–03

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

Vehicle Maintenance Schedule Table: 00–03

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

Vehicle Maintenance Schedule Table: 00–03

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

Table 2, Maintenance for Service Schedule I

00

General Information

Vehicle Maintenance Schedule Table: 00–03

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

Vehicle Maintenance Schedule Table: 00–03

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

Table 3, Maintenance for Service Schedule II

Initial Maintenance (IM) Operations: 00–04

The Initial Maintenance table lists all maintenance operations that are to be performed at the initial maintenance (IM) interval. Maintenance operation numbers are reference numbers used to help you find detailed instructions in this manual on the main-

tenance operations to be performed. All operations listed in the table, along with the operations listed in the applicable M1 maintenance interval table, must be performed to complete the initial maintenance (IM).

Maintenance Operation Number	Initial Maintenance (IM) Operations for Service Schedules I and II	Check
00–05	Perform all M1 Operations	
31–03	Frame Fastener Torque Check	
32–02	Suspension U-Bolt Torque Check	
33–04	All-Axle Alignment Check	
42–12	Bendix Automatic Drain Valve Operating and Leakage Tests*	
47–03	Fuel Tank Band-Nut Tightening	

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

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

M1 Maintenance Interval Operations: 00–05

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

IMPORTANT: After performing all operations listed in this table, perform all daily, weekly, and monthly maintenance operations listed in the **Pre- and Post-Trip Inspections and Maintenance** chapter of the *Western Star 47X and 49X Driver's Manual*.

Maintenance Operation Number	M1 Maintenance Interval Operations for Service Schedules I and II	Check
13–01	Air Compressor Inspection	
25–01	Clutch Release Bearing Lubrication*	
31–01	Fifth Wheel Inspection	
31–02	Fifth Wheel Lubrication	
33–05	Steer Axle Hub Cap Vent Plug Inspection	
40–01	Wheel Nut Check	
40–02	Tire Check	
41–01	Driveline Inspection	
41–02	Driveline Lubrication	
42–02	Bendix Air Dryer Desiccant Replacement (with an oil-coalescing desiccant cartridge)†	
42–05	Brake Inspection	
42–06	Dana Spicer, Haldex, and Gunitex Slack Adjuster Lubrication	
42–07	Meritor Camshaft Bracket Lubrication	
42–10	WABCO System Saver Air Dryer Desiccant Cartridge Replacement	
42–11	Versajust Slack Adjuster Inspection and Lubrication‡	
42–12	Bendix Automatic Drain Valve Operating and Leakage Tests§	
47–01	Fuel Filter Replacement	
47–02	Fuel/Water Separator Element Checking and Replacement	
49–01	Exhaust System Inspection (noise emission control)	
60–02	Cab Shock Absorber Bracket Torque Check	
60–03	Aerodynamic Component Inspection	
83–03	Battery-Powered HVAC System (BPHS) Inspection	

* On vehicles equipped with Detroit transmissions, the release bearing does not need to be lubricated. On vehicles equipped with Eaton Fuller UltraShift PLUS transmissions, lubricate the release bearing every 50,000 miles (80 000 km) or 3 months.

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

‡ Complete this procedure every 25,000 miles (40 225 km), 3 months, or 500 operating hours, whichever comes first.

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

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

M2 Maintenance Interval Operations: 00–06

The M2 Maintenance Interval Operations tables list all maintenance operations that are to be performed at the M2 maintenance interval. Maintenance operation numbers are reference numbers used to help

you find detailed instructions in this manual on the maintenance operations to be performed. Perform all M1 maintenance interval operations at the M2 maintenance interval.

Maintenance Operation Number	M2 Maintenance Interval Operations for Service Schedules I and II	Check
00–05	Perform All M1 Operations	
15–01	Alternator, Battery, and Starter Check	
20–01	Pressure Relief Cap Check	
20–03	Fan Clutch Check (noise emission control)	
25–02	Fluid Level Check, Hydraulic Clutch Control	
26–01	Detroit™ Automated Transmission Fluid Change and Magnetic Plug Cleaning	
26–02	Detroit™ Automated Transmission Fluid Level Inspection	
26–04	Eaton Fuller Transmission Fluid Level Inspection	
26–05	Eaton Fuller Manual Transmission Air Filter/Regulator Check, Cleaning, or Replacement	
32–01	Suspension Inspection	
32–02	Suspension U-Bolt Torque Check	
33–01	Knuckle Pin Lubrication*	
33–02	Tie Rod Inspection	
33–03	Tie Rod Lubrication*	
35–02	Axle Breather and Axle Lubricant Level Inspection	
42–01	Air Brake System Valve Inspection	
42–03	Air Dryer Inspection	
42–04	Alcohol Evaporator Cleaning and Inspection	
42–08	Meritor Slack Adjuster Lubrication	
46–01	Drag Link Inspection	
46–03	Power Steering Fluid Level Inspection	
46–04	Power Steering Gear Lubrication	
54–01	Trailer Cable Inspection and Cleaning	
60–01	Mirror Folding Check	
60–04	Baggage Door and Sleeper Access Door Release Cable and Latch Lubrication	
83–01	Air Conditioner Inspection	
83–02	Air Filter Replacement	

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

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

M3 Maintenance Interval Operations: 00–07

The M3 Maintenance Interval Operations table lists all maintenance operations that are to be performed at the M3 maintenance interval. Maintenance operation numbers are reference numbers used to help

you find detailed instructions in this manual on the maintenance operations to be performed. Perform all M1 and M2 maintenance interval operations at the M3 maintenance interval.

Maintenance Operation Number	M3 Maintenance Interval Operations for Service Schedules I and II	Check
00–05	Perform All M1 Operations	
00–06	Perform All M2 Operations	
09–01	Air Cleaner Inspection	
20–02	Radiator Pressure-Flushing and Coolant Change	
25–03	Fluid Change, Hydraulic Clutch Control	
26–03	Eaton Fuller Transmission Fluid Change and Magnetic Plug Cleaning*	
35–01	Axle Lubricant and Filter Change, and Magnetic Strainer Cleaning	
42–02	Bendix Air Dryer Desiccant Replacement	
42–09	Bendix E–6 Foot Control Valve Inspection and Lubrication	
42–10	WABCO System Saver Air Dryer Desiccant Cartridge Replacement	
46–02	Power Steering Fluid and Filter Change	

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

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

Maintenance Operation Sets Table: 00–08

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

General Information

00

Maintenance Operation Sets Table: 00–08

Maintenance Operation Sets					
Maint. No.	Operation Description	Service Schedules I and II			
		IM	M1	M2	M3
42–05	Brake Inspection	•	•	•	•
42–06	Haldex Slack Adjuster Lubrication	•	•	•	•
42–07	Meritor Camshaft Bracket Lubrication	•	•	•	•
42–08	Meritor Slack Adjuster Lubrication			•	•
42–09	Bendix E–6 Foot Control Valve Inspection and Lubrication				•
42–10	WABCO System Saver Air Dryer Desiccant Cartridge Replacement [§]	•	•	•	•
42–11	Versajust Slack Adjuster Inspection and Lubrication [¶]		•	•	•
42–12	Bendix Automatic Drain Valve Operating and Leakage Tests ^{**}	•	•		
46–01	Drag Link Inspection			•	•
46–02	Power Steering Fluid and Filter Change				•
46–03	Power Steering Fluid Level Inspection			•	•
46–04	Drag Link Lubrication			•	•
47–01	Fuel Filter Replacement		•	•	•
47–02	Fuel/Water Separator Element Checking and Replacement		•	•	•
47–03	Fuel Tank Band-Nut Tightening	•			
49–01	Exhaust System Inspection (noise emission control)	•	•	•	•
54–01	Trailer Cable Inspection and Cleaning			•	•
60–01	Mirror Folding Check			•	•
60–02	Cab Shock Absorber Bracket Torque Check	•	•	•	•
60–03	Aerodynamic Component Inspection	•	•	•	•
60–04	Baggage Door and Sleeper Access Door Release Cable and Latch Lubrication			•	•
83–01	Air Conditioner Inspection			•	•
83–02	Air Filter Replacement			•	•
83–03	Battery-Powered HVAC System (BPHS) Inspection	•	•	•	•

* On vehicles equipped with Detroit transmissions, the release bearing does not need to be lubricated. On vehicles equipped with Eaton Fuller UltraShift PLUS transmissions, lubricate the release bearing every 50,000 miles (80 000 km) or 3 months.

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

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

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

¶ Complete this procedure every 25,000 miles (40 225 km), 3 months, or 500 operating hours, whichever comes first.

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

Table 8, Maintenance Operation Sets

Noise Emission Controls Maintenance: 00–09

Noise Emission Control Maintenance

Federal Law, Part 205: Transportation Equipment Noise Emission Controls

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

Recommendations for Replacement Parts

Replacement parts used for maintenance or repair of noise emission controls should be genuine 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 to be equivalent to 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 purposes of maintenance, repair, or replacement) of any device or element of design incorporated into any new vehicle for

the purpose of noise control, prior to its sale or delivery to the ultimate purchaser, or while it is in use.

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

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

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

Maintenance Instructions

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

Verification of Inspections Log

Verification of Inspections Log, Group 20

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

Verification of Inspections Log, Group 49

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

Title of Maintenance Operation (MOP)	MOP Number
Air Cleaner Inspection	09-01

09–01 Air Cleaner Inspection

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

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

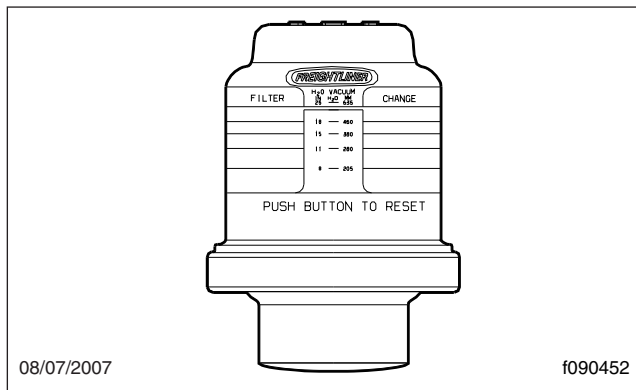


Fig. 1, Manual-Reset Air Restriction Indicator, Graduated

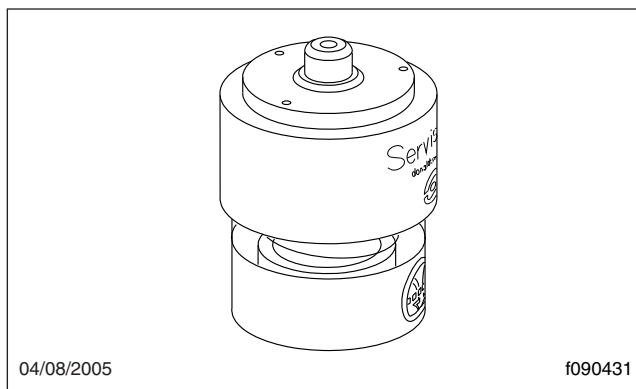


Fig. 2, Manual-Reset Air Restriction Indicator, Go/No-Go

1. Inspect the air restriction indicator to see if air restriction equals or exceeds the maximum allowable restriction. For instructions, see **Group 09** of the *Western Star 47X and 49X Workshop Manual*.

NOTICE

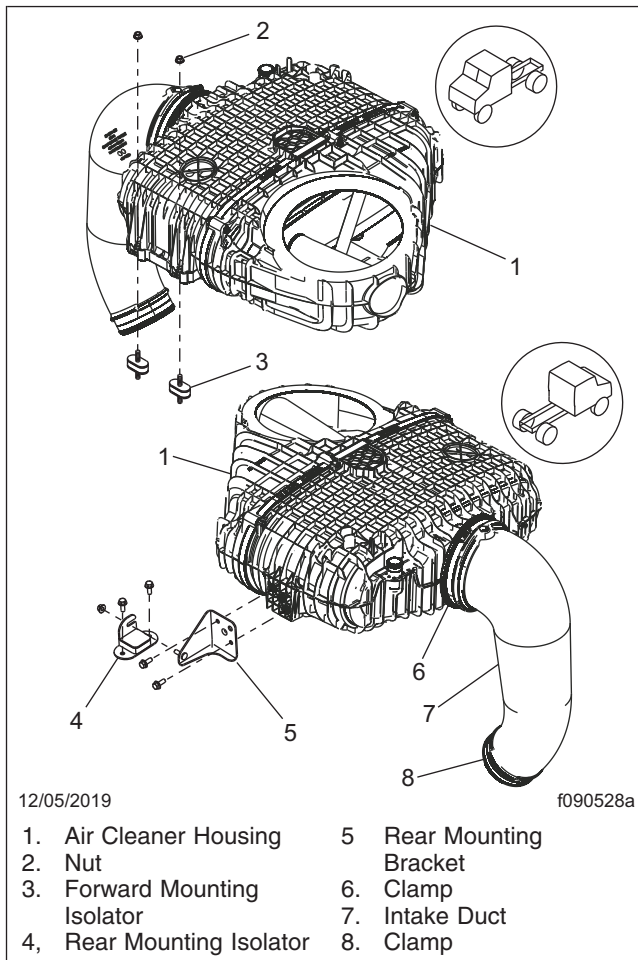
Do not use aftermarket air-cleaner elements. Aftermarket air-cleaner elements may not seal the housing correctly, which can lead to engine damage and potentially the loss of warranty. When replacing an air-cleaner element, use only the part listed in PartsPro for the serial number of the vehicle.

2. If necessary, replace the air cleaner element. For air cleaner element replacement instructions.
3. Inspect the air cleaner housing for cracks, leaks, or any other damage. If the air cleaner housing or element is damaged, replace it.
4. Inspect the forward and rear mounting isolators for damage. See [Fig. 3](#). Ensure the bonds between the rubber and the steel plates are completely intact. See [Fig. 4](#).
If a mounting isolator is damaged, replace it. For isolator replacement instructions, see **Section 09.01** of the *Western Star 47X and 49X Workshop Manual*.
5. Check that the quick connect fitting for the air compressor supply line is fully engaged with the air cleaner. See [Fig. 5](#).
6. The optional hood mounted pre-separators are designed to be maintenance free. If the vehicle experiences the following conditions, the pre-separators should be removed, disassembled, and if required, cleaned;
 - 6.1 Exposure to highly dusty conditions a on regular basis.
 - 6.2 Shorter than expected filter intervals.
7. Reset the air restriction indicator.
8. Each time the air cleaner housing is replaced, perform the procedures in [MOP 13–01](#).

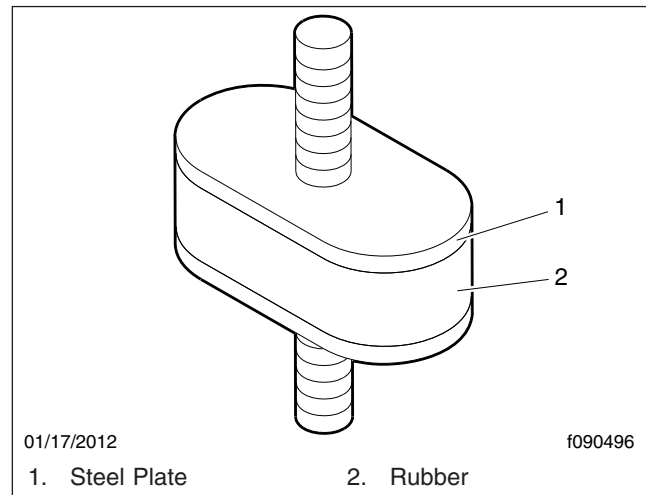
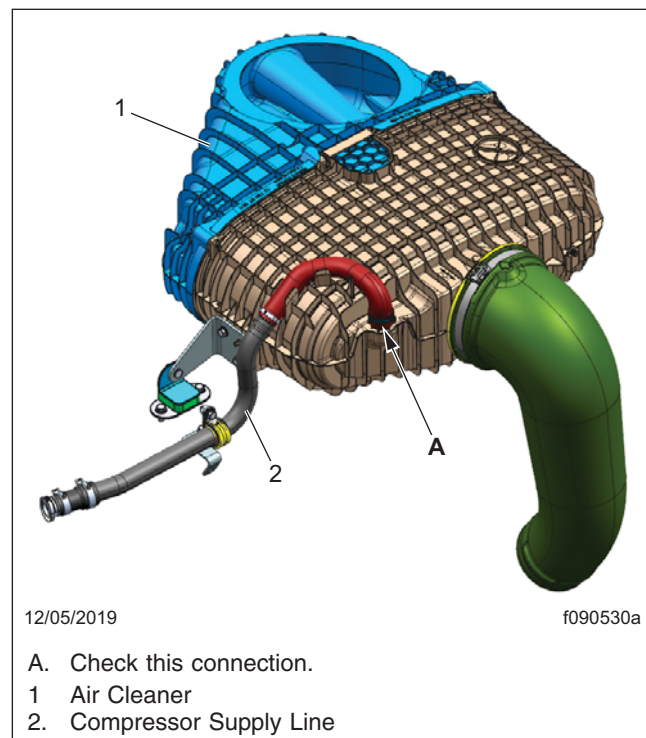
Pre-Cleaner Maintenance

If the vehicle often works in dusty conditions, or experiences shorter than expected filter life, inspect the cleaners for proper installation and internal dirt build-up that could have an effect on their dirt removal efficiency.

If the vehicle application exposes it to large, light weight, debris that could pass over the hood air intake passages, and the driver reports significant

**Fig. 3, Air Cleaner Assembly**

changes in the intake air restriction gauge readings, or loss of power. Inspect for possible clogging at the cleaner inlet passages, especially if the engine is running at an elevated idle. If the condition still exists, it may be resolvable by using a compressed air nozzle to back-blow from inside the separator, using the drain valves as an access to inject the air. Removal of the outside air intake grate may be required if the debris is not expelled from the cavity. See [Fig. 6](#) for Pre-Cleaner location in the truck.

**Fig. 4, Mounting Isolator****Fig. 5, Compressor Supply Line Quick Connect**

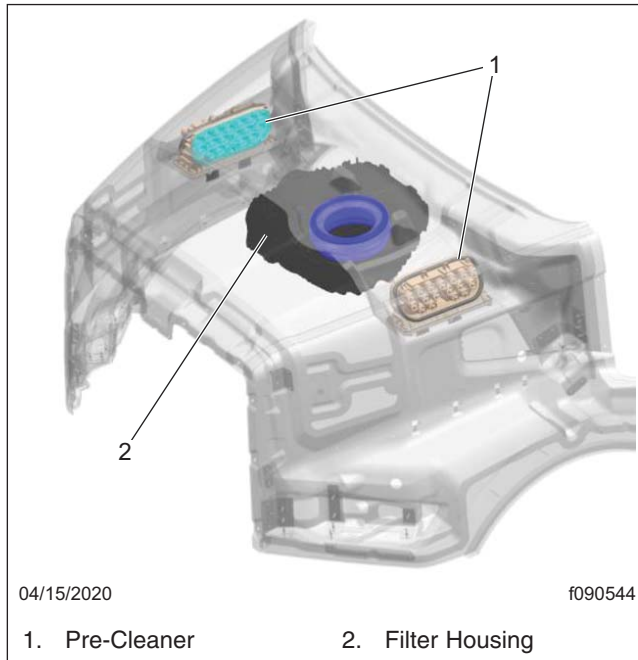


Fig. 6, Pre-Cleaner Location

Air Compressor

13

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Air Compressor Inspection	13-01
Safety Precautions	13-00

13–00 Safety Precautions

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



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.

13–01 Air Compressor Inspection

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

Alternators and Starters

15

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Alternator, Battery, and Starter Connections Check	15-01
Safety Precautions	15-00

15–00 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.

15–01 Alternator, Battery, and Starter Connections Check

WARNING

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

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

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Disconnect the batteries. Remove the negative cables first, and then the positive cables.
3. Check the tightness of the alternator bracket fasteners; tighten the fasteners as needed. For torque values, see **Group 15** of the *Western Star 47X and 49X Workshop Manual*.
4. Check that all electrical connections at the alternator and starter are clean. Clean and tighten all charging system electrical connections, including the connections at the starter B terminal and ground terminal, and where the alternator charg-

ing cable terminates. Connections should be free of corrosion, dirt and moisture. Connections should not have signs of thermal distortion, warping, discoloration, high amperage heating or discoloring. If needed, disconnect cables, scrub and clean using a nylon brush. Clean debris with vacuum or electrical contact cleaner such as CRC QD® Electronic Cleaner. Inspect terminals and mating contact terminal plating. If the terminal plating exhibits signs of unrecoverable corrosion, the component and terminal will need to be replaced. Indications of unrecoverable corrosion on terminal plating are:

- heavy staining that cannot be cleaned off with nylon brush or contact cleaner;
- erosion and pitting on terminal plating causing uneven surfaces; or
- discoloration caused by outer layer of plating being removed by corrosion or wear, exposing the under layer material of terminal.

5. Inspect the battery cables for wear, and replace them if they are damaged. Clean the cable connector terminals with a wire brush. See **Group 54** of the *Western Star 47X and 49X Workshop Manual* for adjustment, repair, or replacement instructions.
 - 5.1 Clean and tighten the battery ground cable, terminal, and clamps.
 - 5.2 Inspect the retainer assembly or battery hold-downs, and the battery box. Replace worn or damaged parts. Remove any corrosion with a wire brush, and wash with a weak solution of baking soda and water. Flush with clean water, and dry. Paint the retainer assembly if needed, to prevent rusting.
 - 5.3 Check that foreign objects, such as stones, bolts, and nuts, are removed from the battery box.
 - 5.4 After cleaning, connect the cables to the batteries and tighten them to the torque specifications listed on the battery, generally 10 to 15 lbf·ft (14 to 20 N·m).
 - 5.5 Coat the battery terminals with dielectric grease.

6. Check the alternator wiring for missing insulation, kinks, and heat damage. Replace or repair as needed.
7. 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.

Engine Cooling/Radiator

20

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Fan Clutch Check (Noise Emission Control)	20-03
Pressure Relief Cap Check.	20-01
Radiator Pressure-Flushing and Coolant Change.	20-02
Safety Precautions.	20-00

20-00 Safety Precautions

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

DANGER

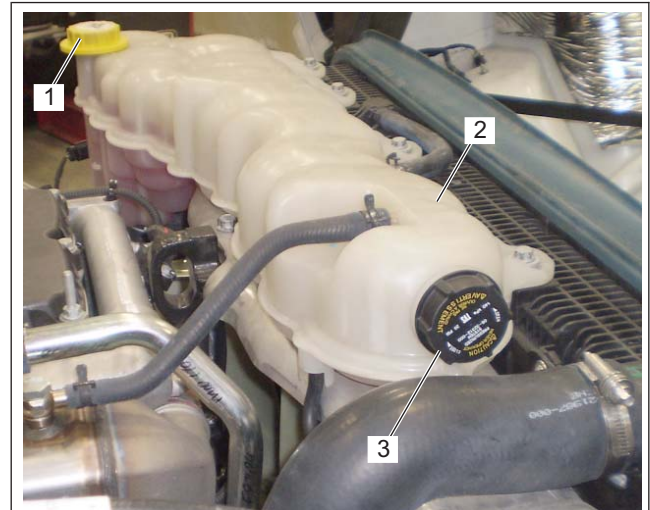
When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle cannot drop. Failure to follow these steps could result in serious personal injury or death.

20-01 Pressure Relief Cap Check

WARNING

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

1. Remove the surge tank filler cap first, to relieve the cooling system pressure, then remove the SAE cap; see [Fig. 1](#).
2. Using a radiator-cap tester, check the pressure relief cap to see if it maintains pressure to within 10% of the pressure rating marked on the cap. If it does not, replace the cap. Make sure that the replacement cap is correctly rated for the cooling system of the vehicle.
3. There is a second valve in the pressure relief cap that opens under vacuum. This prevents the collapse of hoses and other parts that are not internally supported when the system cools. Inspect the vacuum-relief valve to be sure it is not stuck.
4. Make sure that the filler cap seals properly on the coolant filler neck seat, and that the O-ring is not cracked or deteriorated. Replace the cap if the O-ring shows deterioration or damage.



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

Fig. 1, Surge Tank

20-02 Radiator Pressure-Flushing and Coolant Change

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

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires. Tilt the hood.
2. Place a suitable container under the elbow of the radiator outlet pipe and the radiator. The container should hold at least 60 quarts (59 liters) of fluid.

WARNING

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

surge of scalding coolant that could cause serious personal injury.

3. Remove the surge tank cap.
4. Remove the drain plugs from the radiator tank. Allow the coolant to drain.
5. Disconnect the radiator upper and lower hoses, and install the surge tank cap and the radiator tank drain plug. Attach the flushing gun nozzle to the radiator at the lower radiator hose opening. Run the water until the radiator is full.

CAUTION

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

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

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

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

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

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

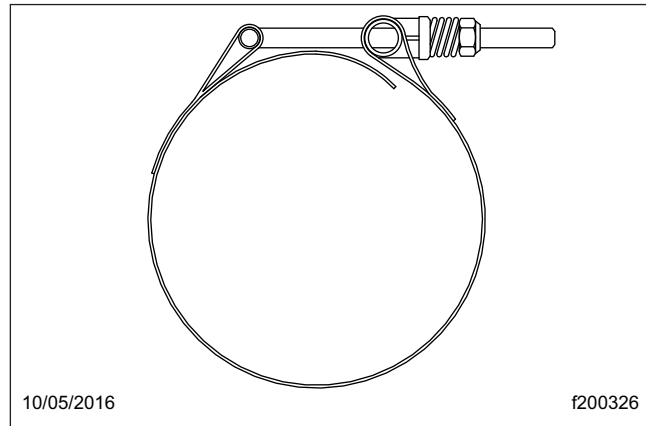


Fig. 2, T-Bolt Type Hose Clamp

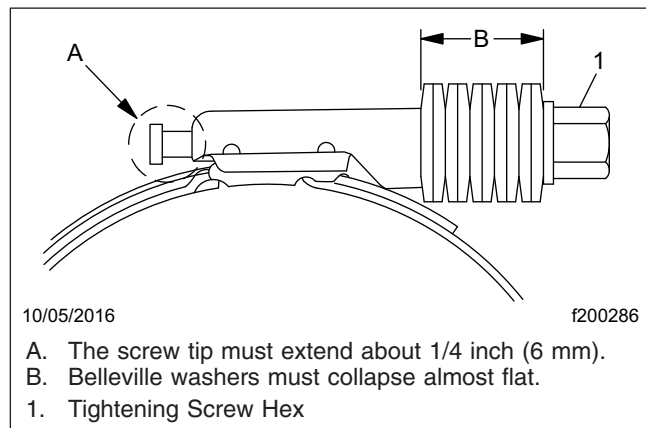


Fig. 3, Breeze Constant-Torque Hose Clamp Installation

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

11. Place a pan under the coolant filter to catch engine coolant.
12. Remove the coolant filter with a strap or chain wrench. Install a new coolant filter and tighten.
13. Fill the cooling system with new coolant. The cooling system is filled when the coolant level reaches the MAX line on the surge tank. Refer to

the engine manufacturer's service literature for specific coolant information.

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

20-03 Fan Clutch Check (Noise Emission Control)

Borg Warner (Kysor) K30 Fan Clutch

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

NOTE: the Borg Warner Service Alert Tool is available at no cost. To get one, contact your Borg Warner representative.

If the tool is not available, use a 0.062-inch (1.57mm) feeler gauge to check the clutch wear.

2. Using the Borg Warner Service Alert Tool, check the clutch wear as shown in **Fig. 4**, and **Fig. 5**.

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

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

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

Horton DriveMaster® Fan Clutch

NOTE: If any part of the fan clutch needs to be repaired or replaced after performing the checks below, see **Group 20** of the *Western Star 47X and 49X Workshop Manual* for instructions.

1. Disconnect the batteries at the negative terminals.



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

Fig. 4, Tool Below Retainer Plate, Liner Life Remaining



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

Fig. 5, Tool Above Retainer Plate, Liner Replacement Needed

2. Inspect the electrical connections and wires to the fan clutch solenoid. Secure the connection if loose; replace wires and connectors if damaged.
3. Check the fan for bent, cracked, or damaged blades. Replace if damaged. Check for adequate clearance between the fan and other components.

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

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

If the fan clutch does not operate correctly, repair it.
7. With the air system charged to 120 psi (827 kPa), check the fan clutch for audible air leaks, using a suitable listening device.

Check at the solenoid valve, the air filter assembly, and the air hoses and fittings. Using a wet finger or a soapy water solution, check for a leak in the same areas. See [Fig. 6](#) and [Fig. 7](#).

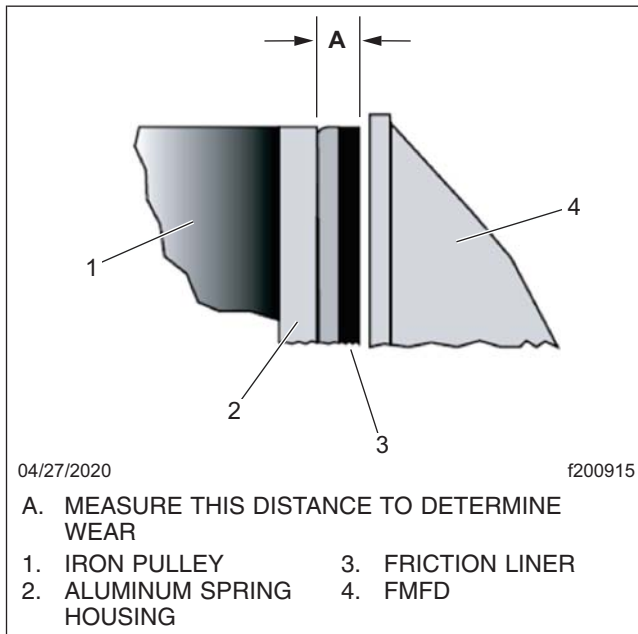


Fig. 6, Wear Measurement

8. If a leak is detected, remove the fan blade. Install a new seal kit.

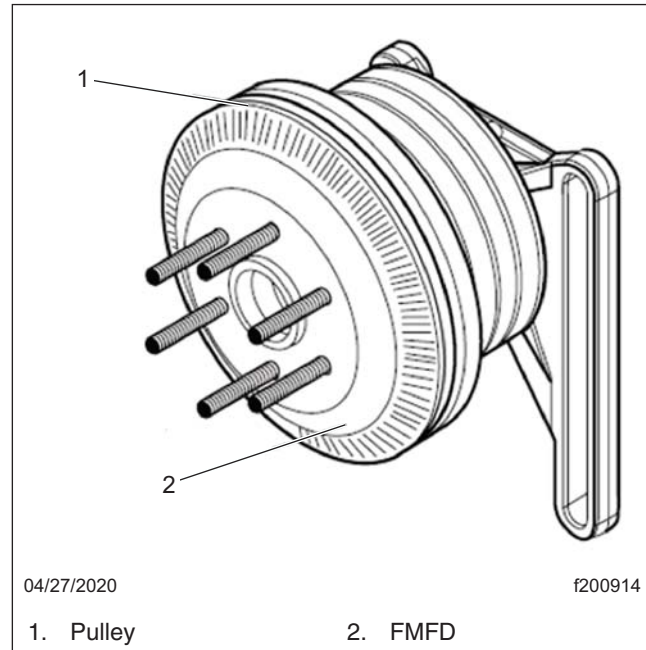


Fig. 7, Checking for Air Leaks (Horton DriveMaster)

9. Check the fan drive for discoloration or any other signs of slipping or overheating.

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

10. Check the fan clutch bearings as follows.
 - 10.1 Turn the fan in both directions and feel for worn hub bearings.
 - 10.2 If possible, remove the drive belt and check for worn sheave bearings by turning the sheave in both directions.
 - 10.3 If either the hub or sheave bearings are worn, replace them, using a Horton DriveMaster Super Kit.

Title of Maintenance Operation (MOP)	MOP Number
Clutch Release Bearing Lubrication.	25-01
Fluid Change, Hydraulic Clutch Control.	25-03
Fluid Level Check, Hydraulic Clutch Control	25-02
Safety Precautions.	25-00

25–00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

25–01 Clutch Release Bearing Lubrication

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

NOTE: On vehicles equipped with Detroit transmissions, the release bearing does not need to be lubricated. On vehicles equipped with Eaton Fuller UltraShift PLUS transmissions, lubricate the release bearing every 50,000 miles (80,000 km) or 3 months.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Remove the clutch inspection plate to see the release bearing while lubricating it. See [Fig. 1](#).
3. Clean the grease fitting. On some vehicles a lube tube will be used, and the fitting may be at the 9-o'clock position on the left side of the bell-housing (see [Fig. 2](#)).

NOTICE

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

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

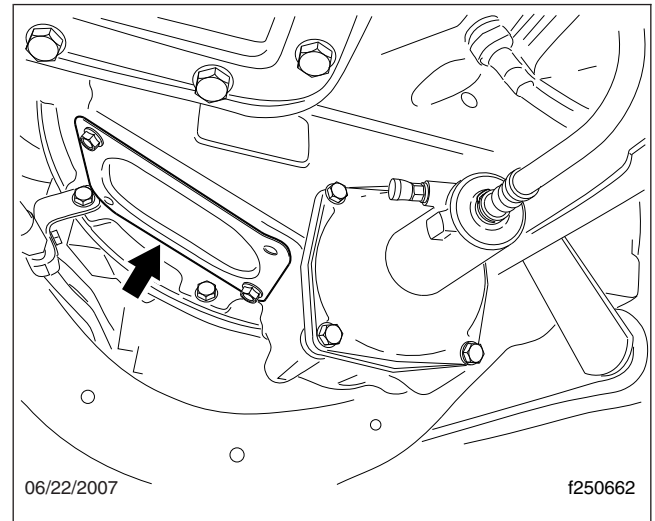


Fig. 1, Typical Clutch Inspection Plate

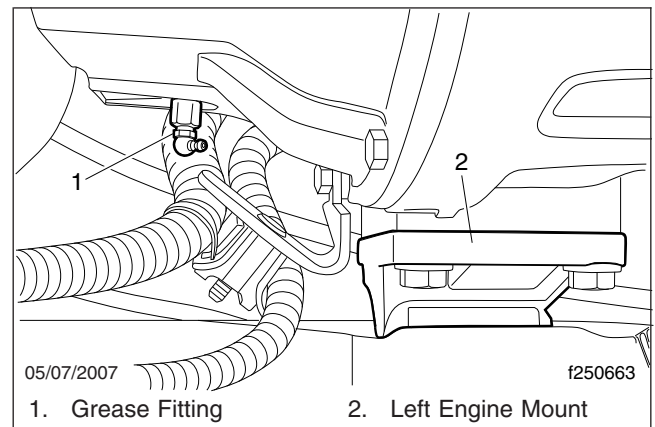


Fig. 2, Typical Release Bearing Grease Fitting

5. Install the clutch inspection plate.

25–02 Fluid Level Check, Hydraulic Clutch Control

WARNING

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

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

NOTICE

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

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

If the fluid level is below the MIN line, fill the reservoir with new DOT 4 brake fluid from a tightly sealed container until the level reaches the MAX line. See Fig. 3.

25-03 Fluid Change, Hydraulic Clutch Control

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

WARNING

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

NOTICE

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

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

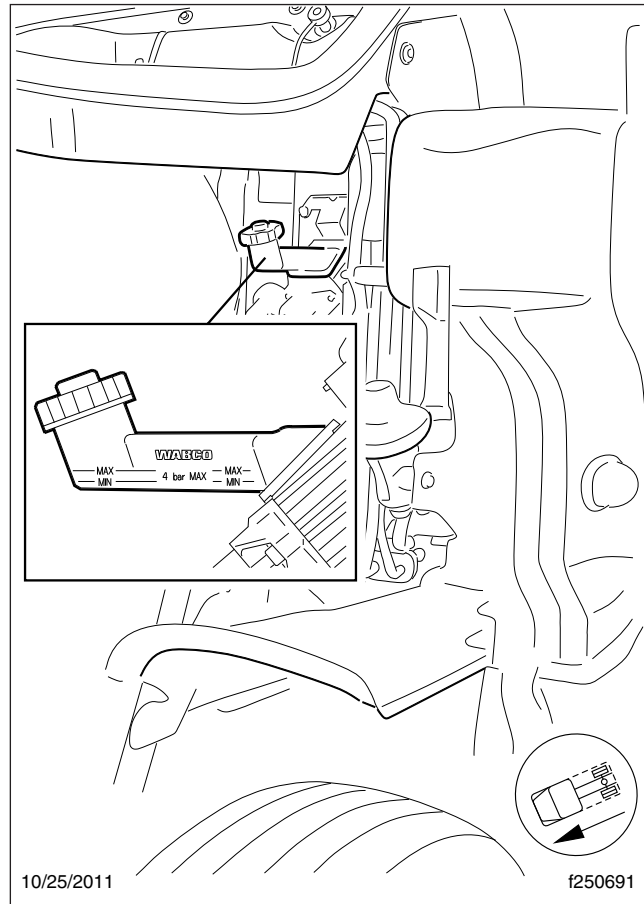


Fig. 3, Reservoir, Hydraulic Clutch Control

Pressure Bleeding

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 (see [Fig. 3](#)) and install the pressure bleed adaptor on the reservoir.
4. Bleed the hydraulic system as follows.
 - 4.1 Open the bleed valve on the bleed tank to pressurize the reservoir.
 - 4.2 Remove the cap from the bleed valve of the slave cylinder. See [Fig. 4](#). On the valve, install a transparent drain hose connected to a catch bottle. The hose needs to fit the bleed valve tight enough so it does not fall off when fluid is pumped out.
 - 4.3 Open the bleed valve on the slave cylinder.
 - 4.4 When the draining fluid is clear and free of air bubbles, close the bleed valve.

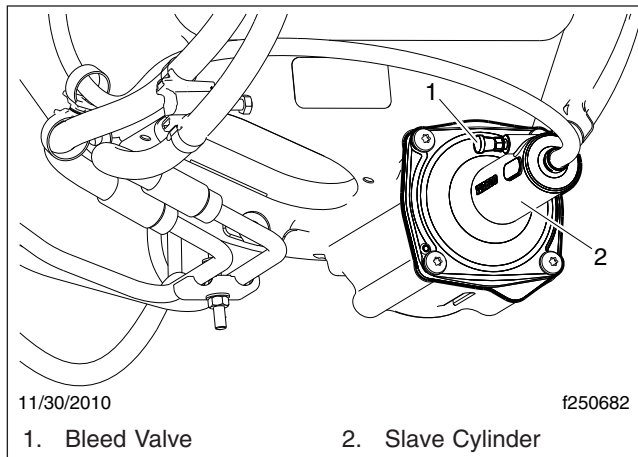


Fig. 4, Slave Cylinder, Hydraulic Clutch Control

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 slave cylinder bleed valve.
8. Depress the clutch pedal a few times. There should be resistance over the full pedal stroke.

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 (see [Fig. 3](#)) with new DOT 4 brake fluid from a tightly sealed container.
3. Remove the cap from the bleed valve of the slave cylinder. See [Fig. 4](#). On the valve, install a transparent drain hose connected to a catch bottle. The hose needs to fit the bleed valve tight enough so it does not fall off when fluid is pumped out.

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.
 - 4.1 Open the bleed valve.
 - 4.2 Depress the clutch pedal until it stops.
 - 4.3 Close the bleed valve.
 - 4.4 Return the pedal to the upper position.
 - 4.5 Repeat the previous steps until the fluid is clear and free of air bubbles.
 - 4.6 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 (994 N·cm) and install the cap on the slave cylinder bleed valve.

Title of Maintenance Operation (MOP)	MOP Number
Detroit™ Automated Transmission Fluid Change and Magnetic Plug Cleaning	26-01
Detroit™ Automated Transmission Fluid Level Inspection	26-02
Eaton Fuller Manual Transmission Air Filter/Regulator Check, Cleaning, or Replacement	26-05
Eaton Fuller Transmission Fluid Change and Magnetic Plug Cleaning	26-03
Eaton Fuller Transmission Fluid Level Inspection	26-04
Safety Precautions	26-00

26-00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

26-01 Detroit™ Automated Transmission Fluid Change and Magnetic Plug Cleaning

NOTICE

Transmission fluid drain intervals are based on many factors, and are specified by the transmission manufacturer. See the details published in the Transmission Fluid Service Information brochure at <http://dtna.info/DT12FluidsManual> to determine oil drain intervals, and use this information to complete the service at the specified mileage.

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.

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

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

2. Clean the area around the fill plug, then remove it from the side of the gear case. Remove the drain plug from the bottom of the case. See [Fig. 1](#).

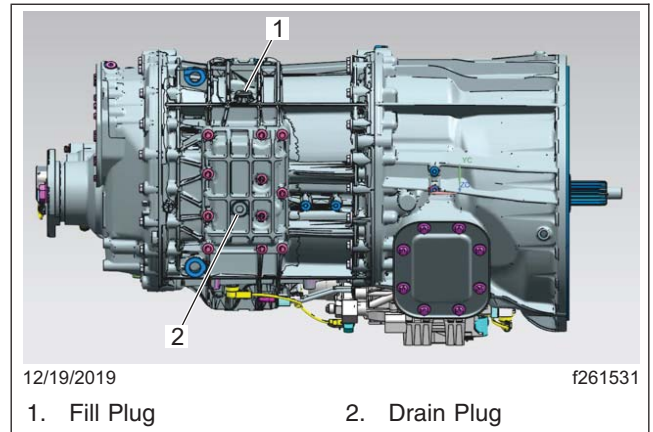


Fig. 1, Drain and Fill Plugs, Detroit Automated Transmissions

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

NOTICE

Detroit transmissions use synthetic lubricant that meets specific requirements. To see a list of approved lubricants, transmission models, and oil change intervals, see the Transmission Fluid Service Information brochure at <http://dtna.info/DT12FluidsManual>.

5. Add fluid until it is level with the lower edge of the fill opening; see [Fig. 2](#). See the Detroit Transmission Fluid Service Information brochure at <http://dtna.info/DT12FluidsManual>, for identifying the transmission type, estimated oil capacities, and applicable oil specifications.

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.

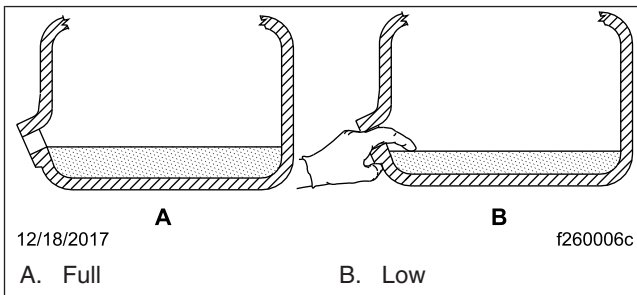


Fig. 2, Checking Transmission Fluid Level

26-02 Detroit™ Automated Transmission Fluid Level Inspection

NOTICE

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

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

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

1. Clean the area around the fill plug, then remove it from the side of the gear case. See Fig. 1.
2. Using your finger or a bent pipe cleaner, see if the fluid is level with the fill opening. See Fig. 2.
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, transmission models, and oil change intervals, see the Transmission Fluid Service Information brochure at <http://dtna.info/DT12FluidsManual>.

4. If needed, add the recommended fluid until it is level with the lower edge of the fill opening. See

the Transmission Fluid Service Information brochure at <http://dtna.info/DT12FluidsManual> for approved transmission lubricants.

5. Clean the fill plug and install a new seal on it. Install the plug in the side of the gear case, then tighten it 45 lbf-ft (60 N·m).

26-03 Eaton Fuller Transmission Fluid Change and Magnetic Plug Cleaning

NOTE: Information in this MOP applies to Eaton Fuller manual and automated transmissions. Fluid change intervals are extended to 500,000 miles (800 000 km) on any vehicles filled with synthetic transmission fluid.

NOTICE

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

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

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

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

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

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

5. For an Eaton Fuller transmission equipped with a transmission fluid filter(s), replace the fluid filter(s) as follows:
 - 5.1 Place a drain pan under the transmission fluid filter.



CAUTION

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

- 5.2 Place a strap or chain wrench around the filter canister, and rotate it in a counter-clockwise motion to separate the filter from the mounting. Carefully spin the filter off the mount and remove it from the vehicle.
- 5.3 Apply a light coat of transmission fluid to the O-ring gasket on the new filter. Fill the filter with specified transmission fluid, and spin the filter onto the mount.

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

- 5.4 Once the filter makes contact with the mount, use a strap wrench to rotate the canister an additional 180 to 270 degrees to firmly tighten the filter. Wipe the filter clean of any fluid after it is tightened.
6. Add fluid until it is level with the lower edge of the fill opening. See [Fig. 2](#). If the transmission has two fill openings, add fluid to the level of both openings. See [Table 1](#) for approved transmission lubricants, and [Table 2](#) for transmission lubricant capacities.

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

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

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

Table 1, Approved Manual Transmission Lubricants

Eaton Fuller Transmission Lubricant Capacities	
Transmission Model	Refill Capacity: qt (L)
7-Speed T Series	
All Models	18.0 (17.0)
All 9-Speed Series	
All Models	13.5 (12.8)
All 10-Speed Manual (except deep reduction)	
FR and FRO Series	11.75 (11.0)
RT and RTX Series	13.0 (12.3)
RTLO Series	14.0 (13.2)
10-Speed Deep Reduction	
RTO-14908LL	14.0 (13.2)
RTO-16908LL	
10-Speed Advantage	
FA Series	8.0 (7.5)
10-Speed Automated	
Lightning Top 2 (all)	13.5 (12.8)
10-Speed Autoshift AS2 (all)	13.0 (12.3)
13-Speed RTLO Series	
All Models	14.0 (13.2)
15-Speed RTO Series	
All Models	14.0 (13.2)
All 18-Speed Series	
RTLO Series	14.0 (13.2)
18-Speed Autoshift AS2 (all)	

Eaton Fuller Transmission Lubricant Capacities	
Transmission Model	Refill Capacity: qt (L)
<i>UltraShift PLUS</i>	
LAS	13.0 (12.0)
MHP and MXP	14.0 (13.0)

Table 2, Eaton Fuller Transmission Lubricant Capacities

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

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

26–04 Eaton Fuller Transmission Fluid Level Inspection

NOTICE

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

Do not mix types or brands of fluid, because of possible incompatibility. Do not use fluid additives, friction modifiers, 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.

Checking at the Fill Plug

- Clean the area around the fill plug, and remove it from the side of the gear case.
- Using your finger or a bent pipe cleaner, see if the fluid is level with the fill opening. See [Fig. 2](#).
- If the fluid level is low, check the transmission for leaks, and correct as needed.
- If needed, add the recommended fluid, until it is level with the lower edge of the fill opening. See [Table 1](#) for approved transmission lubricants.
- Clean the fill plug, then install it. Tighten the plug as follows:
 - For an Eaton Fuller transmission with a plug with 3/4-inch pipe threads, tighten the plug 25 to 35 lbf-ft (34 to 48 N·m).
 - For an Eaton Fuller transmission with a plug with 1-1/4-inch pipe threads, tighten the plug 60 to 75 lbf-ft (81 to 102 N·m).

Checking With the Sight Glass

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

- Clean the oil level sight glass. See [Fig. 3](#).
- 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. 4](#).
- If the fluid level is low, check the transmission for leaks, and correct as needed.
- If needed, add the recommended fluid, until it is at or above 3/4 of the sight glass. See [Table 1](#) for approved transmission lubricants.

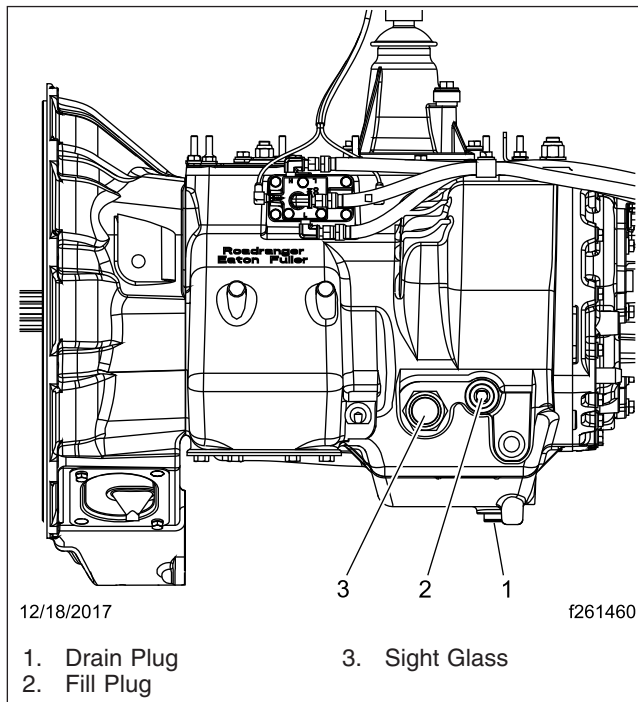


Fig. 3, Eaton Fuller Transmission With a Sight Glass

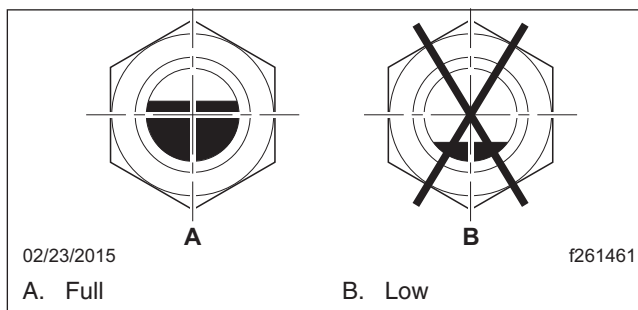


Fig. 4, Transmission Fluid Level Sight Glass

26-05 Eaton Fuller Manual Transmission Air Filter/Regulator Check, Cleaning, or Replacement

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

WARNING

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

2. Clean the outside of the air filter/regulator with cleaning solvent. See Fig. 5.

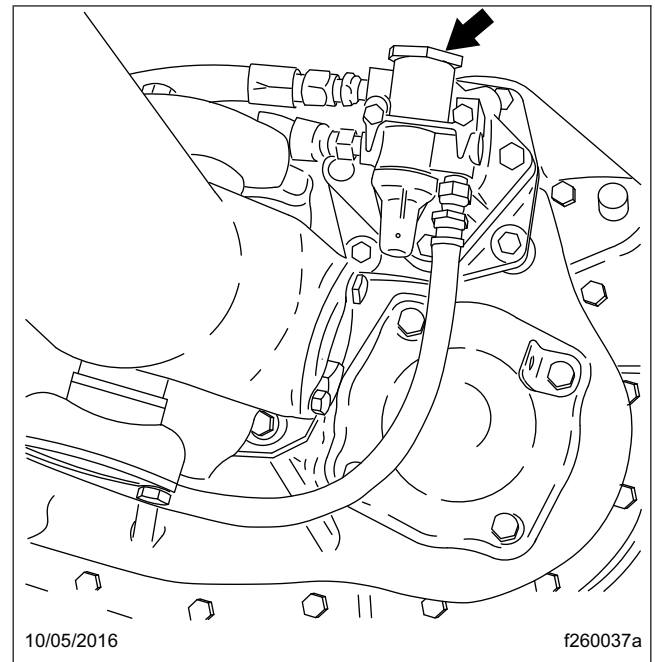


Fig. 5, Air Filter/Regulator Location

3. Remove the end cap, large O-ring, and filter element from the filter housing. See Fig. 6. Remove the small O-ring from the end cap.

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

WARNING

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

4. Clean the filter element by dipping it in alcohol or other cleaning solvent. Blow compressed air

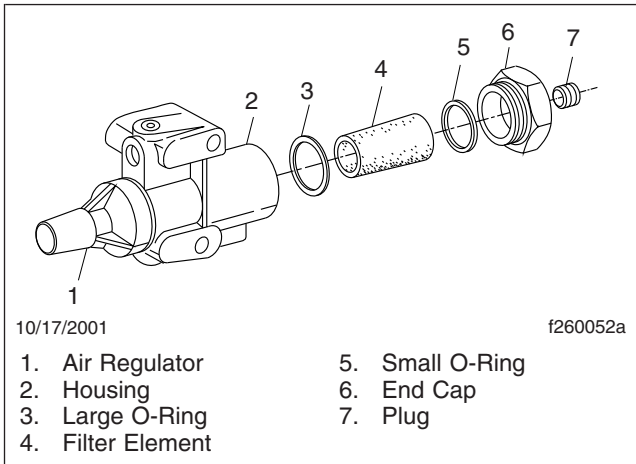


Fig. 6, Eaton Fuller Transmission Air Filter/Regulator Components

through the element (inside to outside) to loosen surface dirt and to dry the element. If it is not damaged, the sintered metallic filter element will last the life of the vehicle.

Wipe out the filter housing with a clean, dry, lint-free rag. Clean and inspect the O-rings and end cap. Replace any parts that are damaged.

5. Install the large O-ring, then the filter element (small end first) into the filter housing.
6. Install the small O-ring in the end cap, then install the end cap and tighten it until firm.

CAUTION

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

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

Frame and Frame Components

31

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Fifth Wheel Inspection	31-01
Fifth Wheel Lubrication	31-02
Frame Fastener Torque Check	31-03
Safety Precautions	31-00

31-00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

31-01 Fifth Wheel Inspection

WARNING

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

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

Holland FW35

1. Disconnect the tractor from the trailer. For instructions, see the **Fifth Wheels** chapter in the *47X and 49X 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. 1](#).

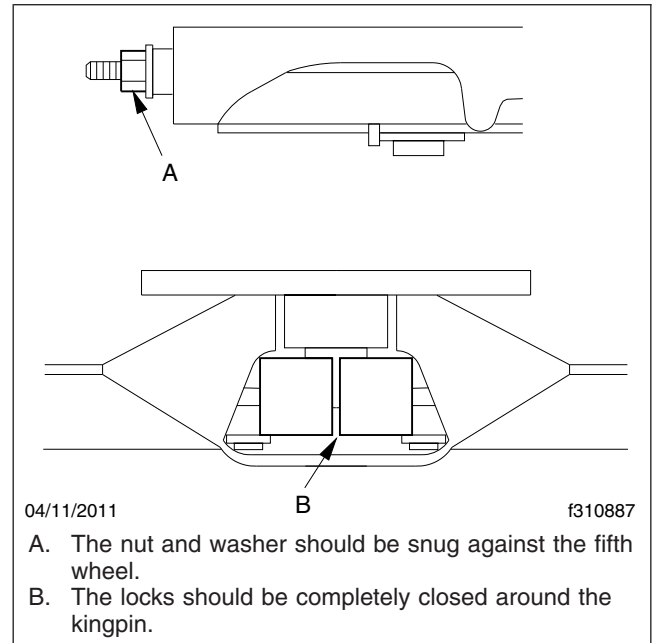


Fig. 1, Holland Fifth Wheel Properly Closed

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.

Fontaine

1. Disconnect the tractor from the trailer. For instructions, see the *47X and 49X 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. 2](#).
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). For the liner replacement procedure, see the Fontaine website, www.fifth-wheel.com.

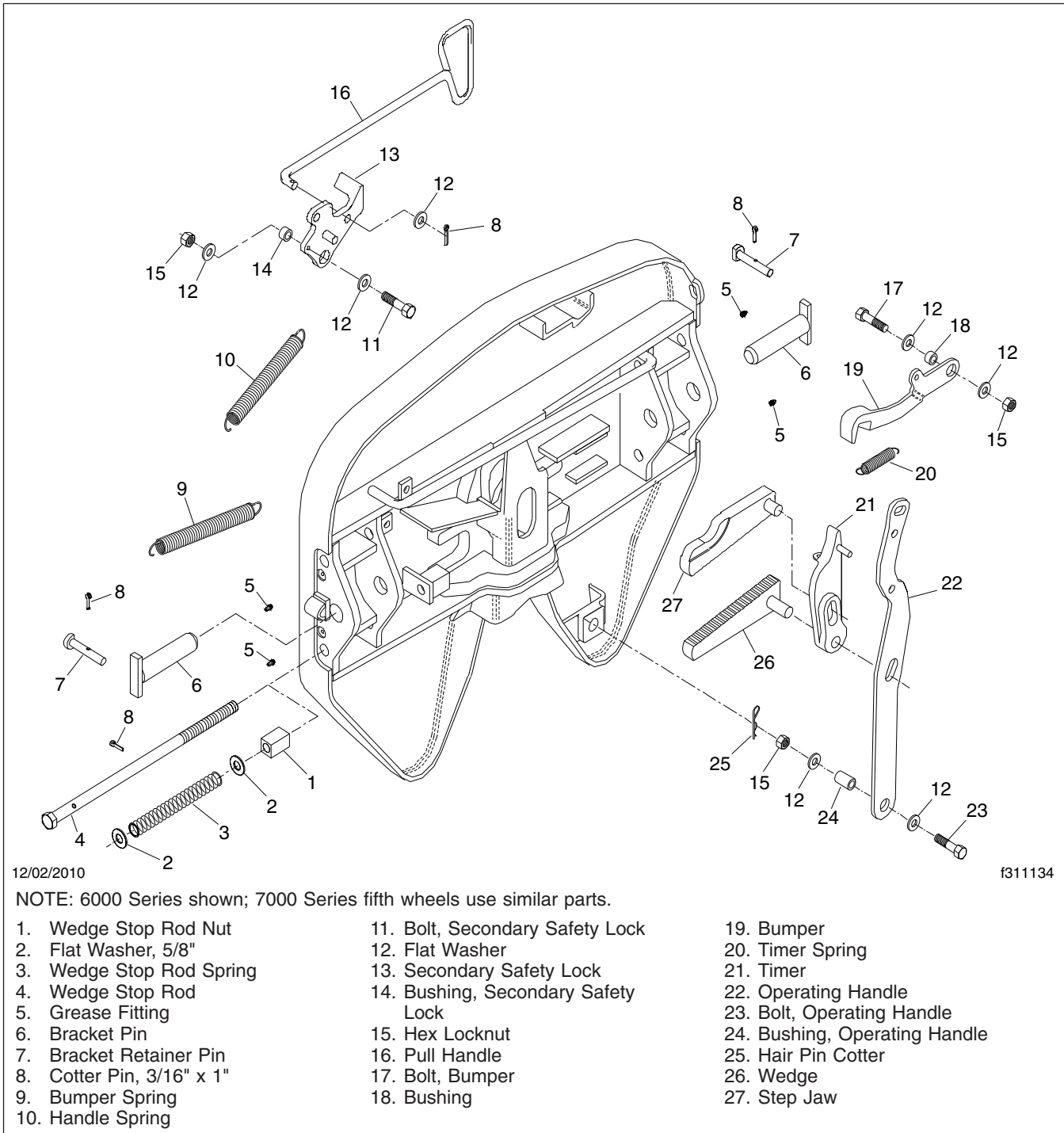


Fig. 2, Fontaine Fifth Wheel

6. Check the jaw and stationary jaw for mushrooming, and check that the serrations at the jaw and wedge are in good condition and not fully worn flat.
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. The secondary safety lock, bumper and operating handle bolts should be torqued to not more than 80 - 90 N.m (59 - 66 ft-lbs). The wedge stop rod bolt should be torqued to 4.1 - 20.4 N.m (3 - 15 ft-lbs). 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. For torque specifications, see **Group 00** of the *47X and 49X Driver's Manual*.
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.
 - 10.1 Close the fifth wheel on a standard 2-inch (50-mm) kingpin or similar 2-inch (50-mm) diameter shaft so that it locks.
 - 10.2 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* re-use bolts, nuts, and washers on fifth wheel mountings.
12. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. Apply a generous coating of grease to the top plate to fill the grooves, or depressions, on the

top plate. Lubricate grease channels in the top plate using a lithium complex grease, suitable for use in high pressure applications. For cold weather applications, use a less viscous lubricant such as 90-weight oil, diesel fuel, kerosene, motor oil, etc. See **MOP 31–02** in this manual for lubrication instructions.

Jost

1. Disconnect the tractor from the trailer. For instructions, see the *47X and 49X 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. 3**.

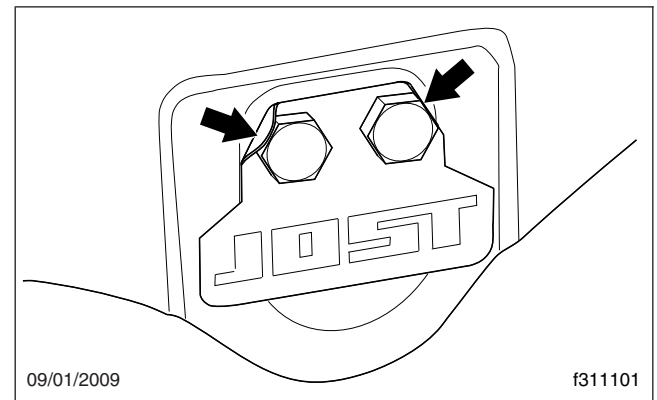


Fig. 3, Bracket Pin Bolt Locking Tabs

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

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

The lock is too loose if: you feel fore-aft play when pulling and pushing on the lock tester handle. See **Fig. 4**, Ref. A.

The lock is too tight if: the lock tester does not rotate freely in the lock. See **Fig. 4**, Ref. B.

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. 5**.

If the lock is too loose, loosen the jam nut, turn the adjustment bolt *counterclockwise* one full turn, then reset the jam nut. Lock and unlock the mechanism several times to test. Repeat if necessary. See **Fig. 5**.

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

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

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

Apply a generous coating of grease to the top plate to fill the grooves, or depressions, on the top plate. See **MOP 31–02** in this manual for lubrication instructions.

31–02 Fifth Wheel Lubrication

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

IMPORTANT: Lubricate the fifth wheel:

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

WARNING

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

Fontaine

1. Tilt the top plate forward (the front of the fifth wheel is down) and apply grease to each bearing area through the zerk fittings located on each side of the top plate just to the front of the bracket pins. Continue to apply grease until it is coming out of the back of the bearing. It may be necessary to raise the rear of the fifth wheel with a pry bar to open up the pocket slightly and allow the grease to flow through. A substantial amount of grease may be required initially to fill the reservoir.

Tilt the fifth wheel ramps down (the rear of the fifth wheel is down) and repeat the greasing procedure. Rock the top plate back and forth several times to spread the grease over the bearing surface.
2. Inspect the trailer kingpin plate and top surface of the fifth wheel to make sure each is properly greased. A liberal coating of grease should be applied to the complete surfaces of both the trailer kingpin plate and the top surface of the fifth wheel.

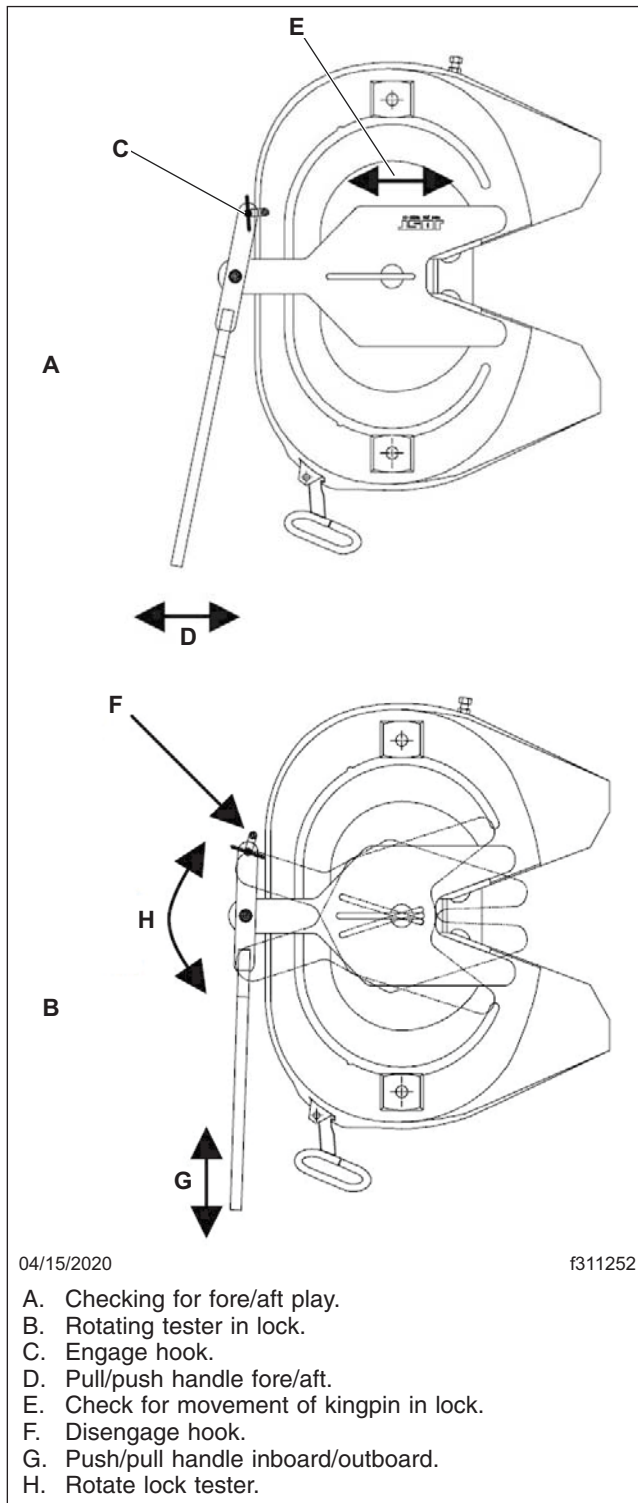


Fig. 4, Jost Fifth Wheel Adjustment

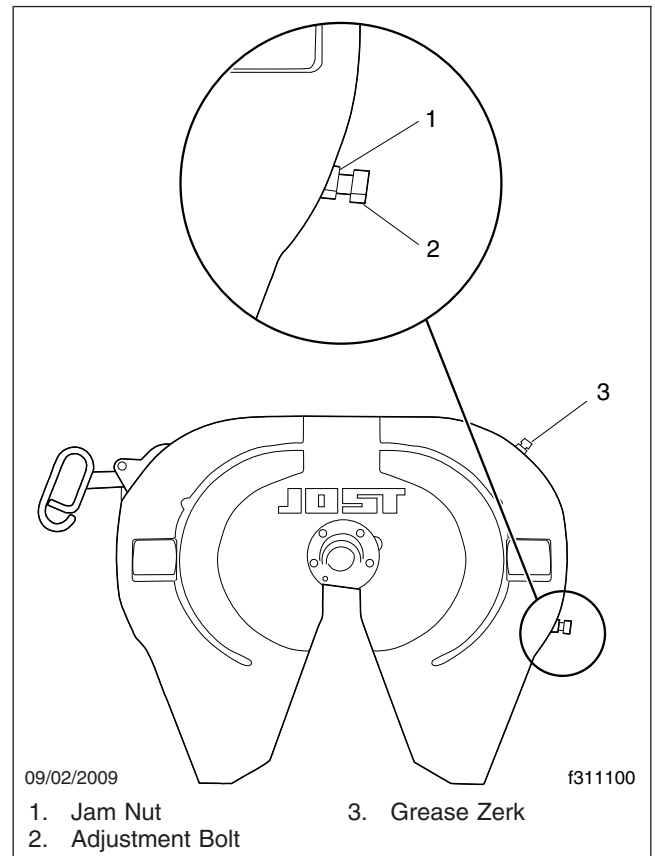


Fig. 5, Jost Fifth Wheel

NOTE: Do not use a lube plate (high density polyethylene) on top of the fifth wheel or on the kingpin instead of grease. The additional thickness of this material can prevent the fifth wheel and trailer from experiencing a proper coupling event. This may also cause damage to the trailer, kingpin, and/or fifth wheel.

NOTE: Fontaine suggests the use of a Lithium complex grease 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. 6. Open and close the fifth wheel several times to further distribute the grease.

Lightly oil other moving parts in the fifth wheel.

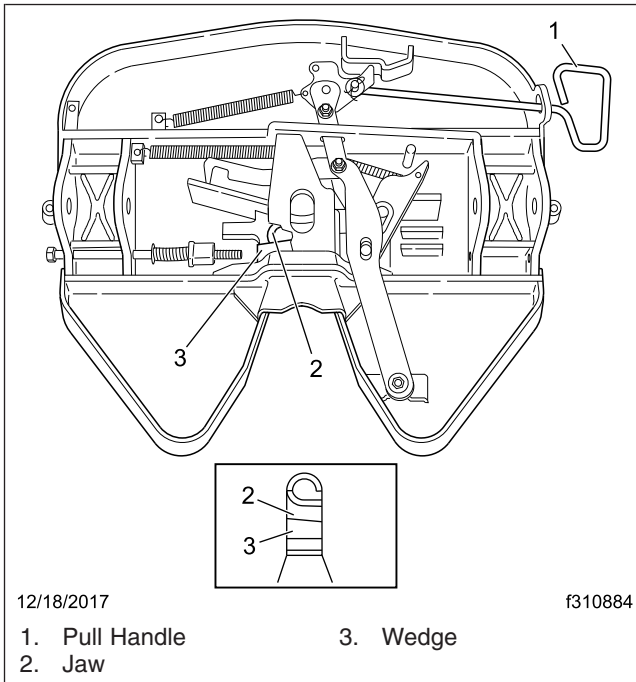


Fig. 6, Fontaine Fifth Wheel

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.

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. 7](#).
3. Grease the yoke tips, locks, and the release handle and spring; see [Fig. 8](#). Grease the mounting bracket supports through the grease fittings. A "low temp" grade grease rated for -30°F (-34°C) or lower such as Cato Oil and Grease #5213, Craftsman Chemical Co. #LTF 2, Mystic LP-200, or equivalent is recommended.

Jost

Lubricate the kingpin lock using a hand pump grease gun through the grease zerk on the skirt of the fifth wheel; see [Fig. 5](#). Apply a light oil to all moving

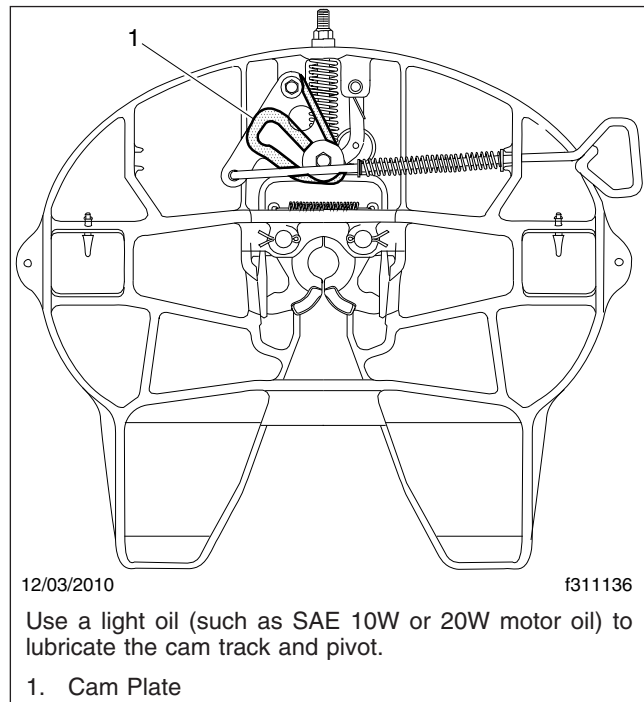


Fig. 7, Holland FW35 Fifth Wheel, Oil Lubrication

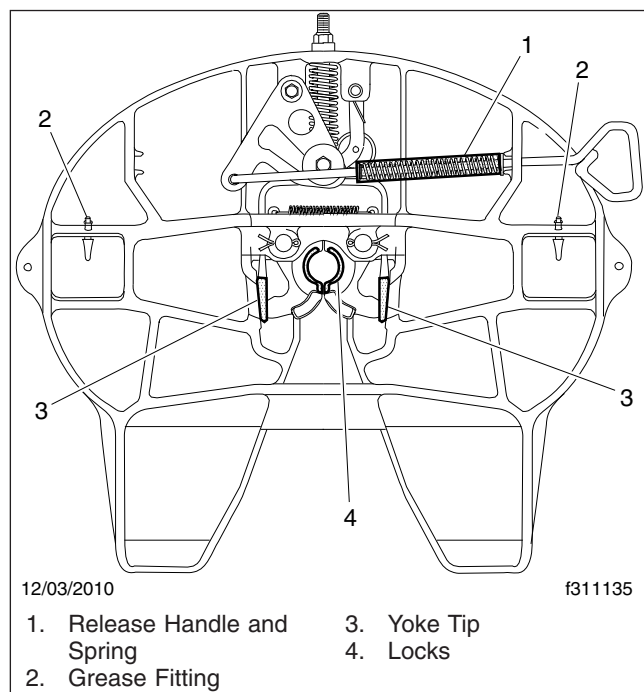


Fig. 8, Holland FW35 Fifth Wheel, Grease Lubrication

parts. For sliding fifth wheels spray diesel fuel on the slide path of the base plate.

Lubricate the Slide Release Arm center pivot bushing using Lithium based EP rated grease. The zerk is located under the slide bracket.

NOTICE

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

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

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

31–03 Frame Fastener Torque Check

Frame brackets and components secured with Huck-bolt® fasteners do not require a torque check, however, they should be inspected for damage. Frame brackets and components secured with conventional bolts and nuts are to be checked at Initial Maintenance (IM). Check the torque of frame fasteners to offset the effects of "bedding in" (or seating). When checking torque, torque the nut, not the bolt head whenever possible. This will give a true torque reading by eliminating bolt-body friction. When checking the torque of frame fasteners, inspect the frame for cracks and other damage. Set a click-type torque wrench to the maximum torque of the fastener you are checking. Apply pressure until the torque wrench clicks. Do not loosen the bolt to check the torque. See **Group 00** in the *47X and 49X Workshop Manual* for torque specifications.

NOTICE

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

Check the fasteners at the following locations:

- axle stops
- deck plates

- equalizer brackets
- exhaust brackets
- fifth wheel legs
- fifth wheel mountings
- frame crossmembers and gussets
- front frame brackets
- front suspension spring brackets
- fuel tank brackets
- radius rods
- rear suspension spring brackets
- shock absorbers
- all other suspension fasteners
- all other axle fasteners
- all other frame fasteners

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

Suspension

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Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Safety Precautions	32-00
Suspension Inspection	32-01
Suspension U-Bolt Torque Check	32-02

32-00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

32-01 Suspension Inspection

WARNING

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

Front Suspension Check

Inspect the front spring assemblies for cracked, broken, or abnormally bent leaves. If any of these conditions exist, replace the spring assembly; for instructions on this and all following replacements see **Group 32** of the *Western Star 47X and 49X Workshop Manual*.

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.

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.

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.

Front and Rear Suspension Shock Absorber Check

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

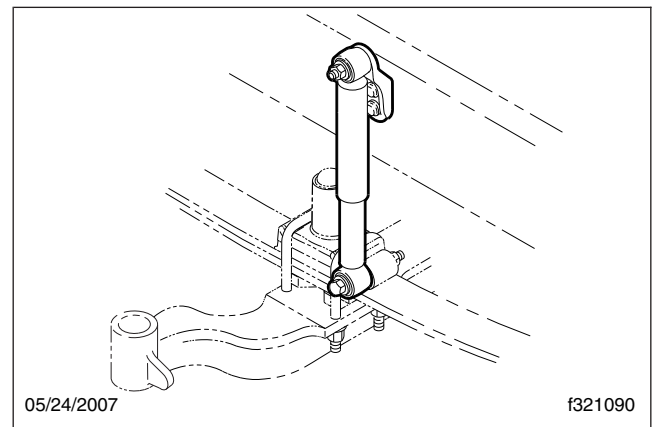


Fig. 1, Direct-Acting Shock Absorber (front suspension shown)

Inspect the shock absorber for oil leakage. Some misting of the oil is normal, and does not mean the shock is leaking. If the shock absorber is damaged or leaking, replace it with a new one.

Freightliner AirLiner Rear Suspension Check

Components Checking

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

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

WARNING

Replace worn, cracked, or damaged spring brackets. Failure to do so could result in bracket

breakage, possibly leading to loss of vehicle control and resulting in personal injury or property damage.

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

Visually check the air spring piston for cracks, chips, and broken areas. Check the air bag for rips, tears, and holes. Verify that the air spring assembly does not leak. If any of these conditions exist, replace the damaged parts.

Suspension Height Checking

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

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

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

NOTICE

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

1. Park the vehicle on a level surface, using a light application of the brakes. Do not apply the parking brakes. Shift the transmission into neutral,

and build the secondary air pressure to at least 100 psi (690 kPa). Shut down the engine. Have an assistant chock the tires on one axle only.

2. Mark the location of the front and rear tires on the floor.

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

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

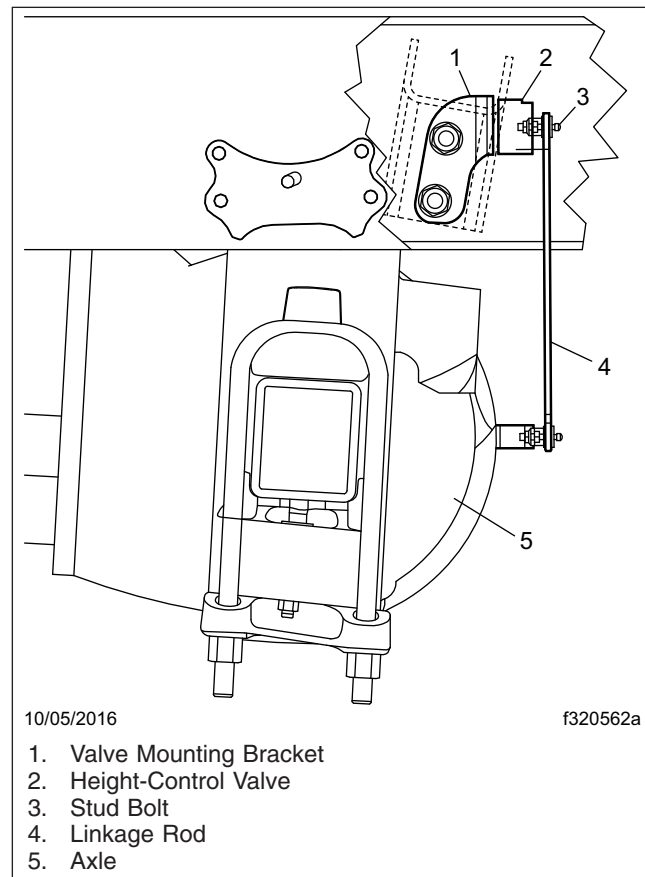


Fig. 2, Barksdale Height-Control Valve Installation (side view) (typical)

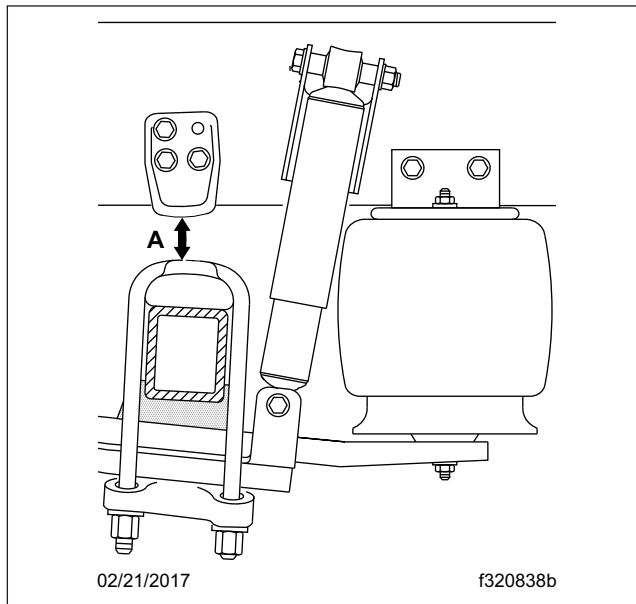
Suspension

32

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

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

4. If the measurement is not within the acceptable range, refer to **Section 32.01, Subject 100** in the *Western Star 47X and 49X Workshop Manual* for adjustment instructions. If the distance is within the acceptable range, apply the parking brakes.



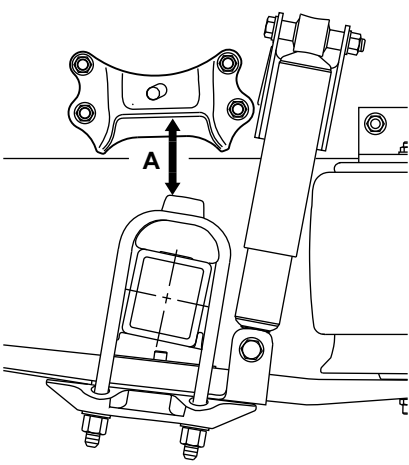
Measure Point	Suspension Height Measurement		
	Min	Target	Max
A = Measure Here	2-3/8 inch (60 mm)	2-5/8 inch (67 mm)	2-7/8 inch (73 mm)

Table 1, Suspension Ride-Height Measurement, Dual-Leaf Spring, 21k/40k High Ride

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

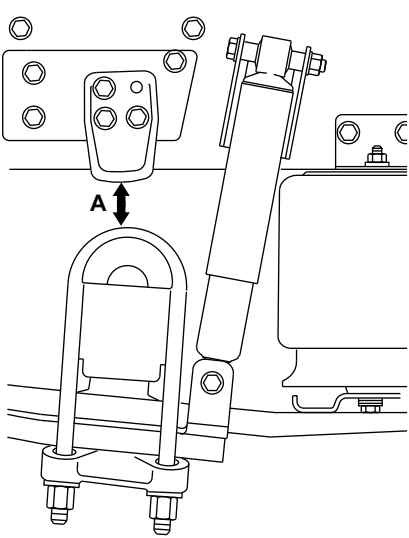
Table 2, Suspension Ride-Height Measurement, Single-Leaf Spring, 21k/40k, High Ride



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

**Table 3, Suspension Ride-Height Measurement,
Single-Leaf Spring, 40k Low and Mid Ride**



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

**Table 4, Suspension Ride-Height Measurement, Dual-
Leaf Spring, 23k High Ride**

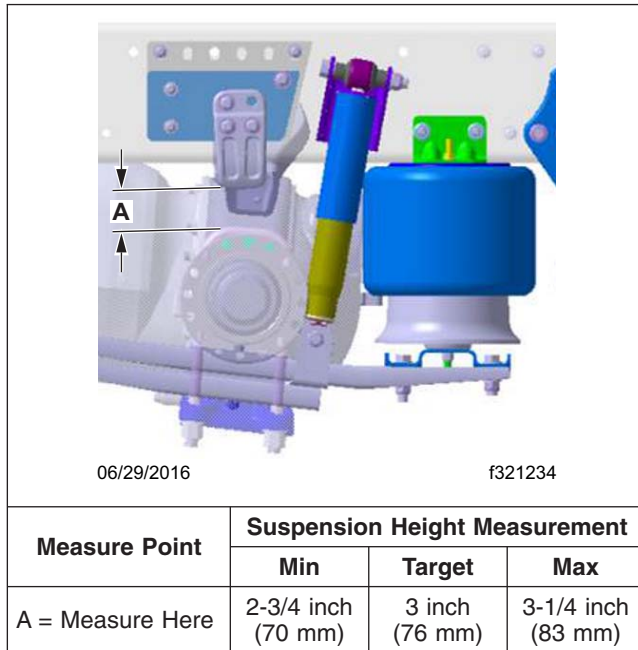


Table 5, Suspension Ride-Height Measurement, Dual-Leaf Spring, 46k High Ride

32-02 Suspension U-Bolt Torque Check

NOTICE

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

Check the U-bolt torque of both the front/rear axles and suspension spring packs where applicable.

1. Park the vehicle on a level surface, shut down the engine and set the parking brake. Chock the tires.
2. Check the U-bolt torque. See [Table 6](#) for U-bolt torque specifications. Tighten in a diagonal pattern as shown in [Fig. 3](#). Set a click-type torque wrench to the mid-point torque value for the fastener being checked. Turn the wrench in a clockwise motion (looking up) until the torque wrench clicks, then release pressure on the torque wrench, and turn the wrench again until it clicks. If the nut turns on the second application, the bolt is stretching and must be replaced. See **Group 32** of the *Western Star 47X and 49X*

Workshop Manual for bolt replacement procedures.

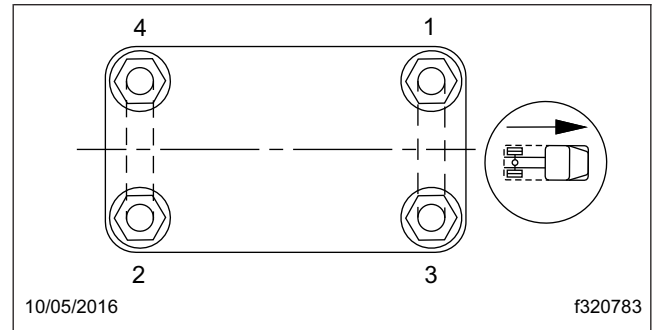


Fig. 3, Tightening Pattern for U-Bolt High Nuts

Spring U-Bolt High Nut Torque Values*	
Size	Torque: lbf-ft (N·m)
5/8-18	Stage 1: Hand-tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 180 to 230 (245 to 313)
3/4-16	Stage 1: Hand-tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 270 to 330 (367 to 449)
7/8-14	Stage 1: Hand-tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 420-500 (571 to 680)
1-14	Stage 1: Hand-tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 520-600 (707 to 816)
M20-1.5	Stage 1 : Hand tighten Stage 2: 60 (81) Stage 3 : 200 (271) Stage 4 : 268-329 (364 to 446)

* Tighten in a diagonal pattern as shown in [Fig. 3](#).

Table 6, Spring U-Bolt High Nut Torque Values

Title of Maintenance Operation (MOP)	MOP Number
All-Axle Alignment Check	33-04
Knuckle Pin Lubrication	33-01
Safety Precautions	33-00
Steer Axle Hub Cap Vent Plug Inspection	33-05
Tie Rod Inspection	33-02
Tie Rod Lubrication	33-03

33-00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

33-01 Knuckle Pin Lubrication

NOTICE

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

Detroit™ Axles

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. 1](#); for grease exit points, see [Fig. 2](#).

Meritor Axles

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

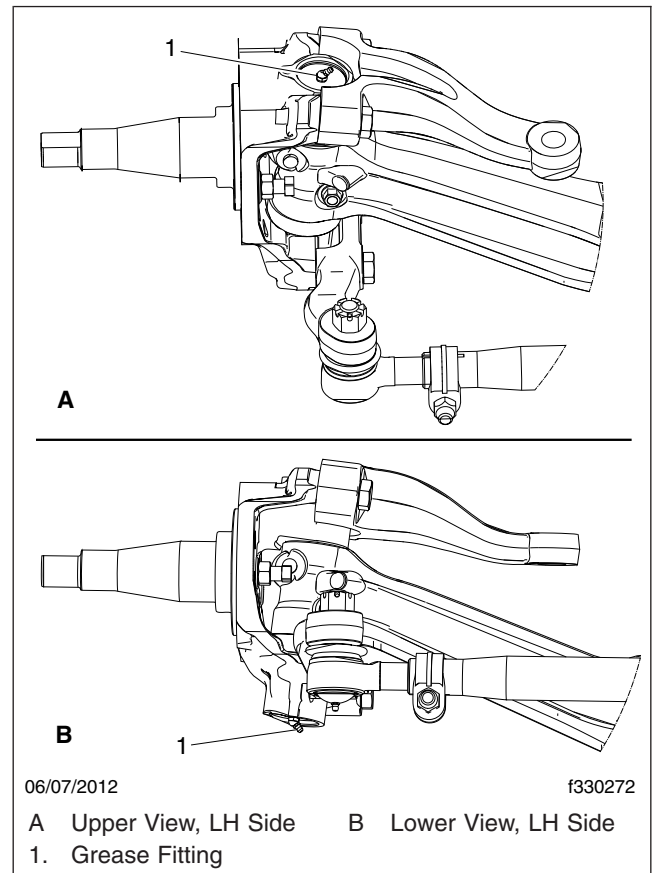


Fig. 1, Grease Fittings, Detroit Axles

seen at the bushing seal opposite the grease fitting. See [Fig. 2](#).

33-02 Tie Rod Inspection

Inspect the tie-rod ends as follows:

1. Shake the cross-tube. A loose fit, or movement between the tapered shaft of the ball and the cross-tube socket members indicates that the tie-rod end assembly must be replaced.
2. The threaded portion of the tie-rod end assembly must be inserted all the way into the cross-tube split for adequate clamping. See [Fig. 3](#). Replace the components if this cannot be done. For instructions, refer to **Group 33** of the *Western Star 47X and 49X Workshop Manual*.

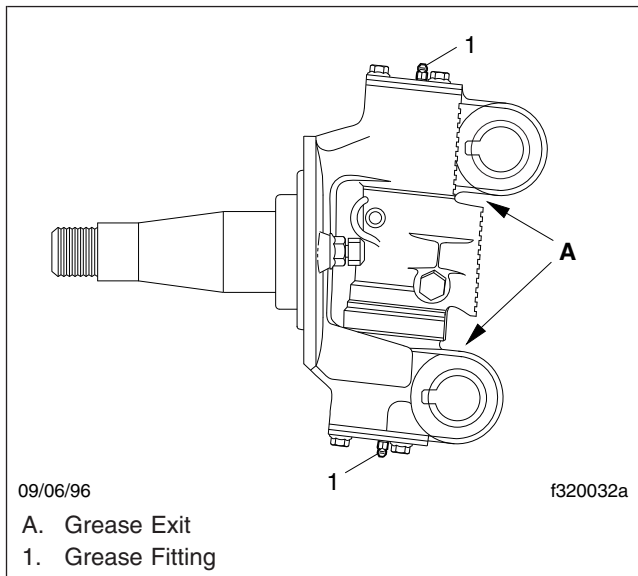


Fig. 2, Knuckle Pin Lubrication

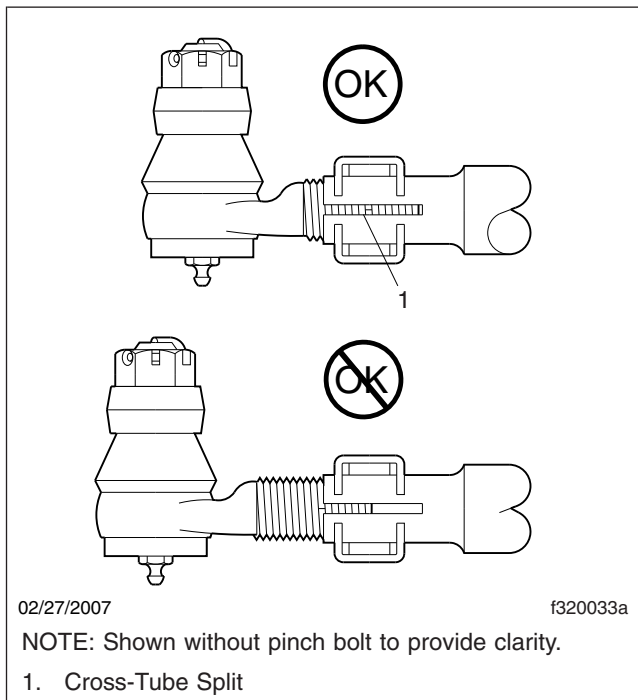


Fig. 3, Tie-Rod End Adjustment

33-03 Tie Rod Lubrication

Detroit and Meritor Axles

For any Detroit or Meritor axle that requires lubrication of the tie-rod ends, wipe the grease fittings clean, then pump 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. 4.

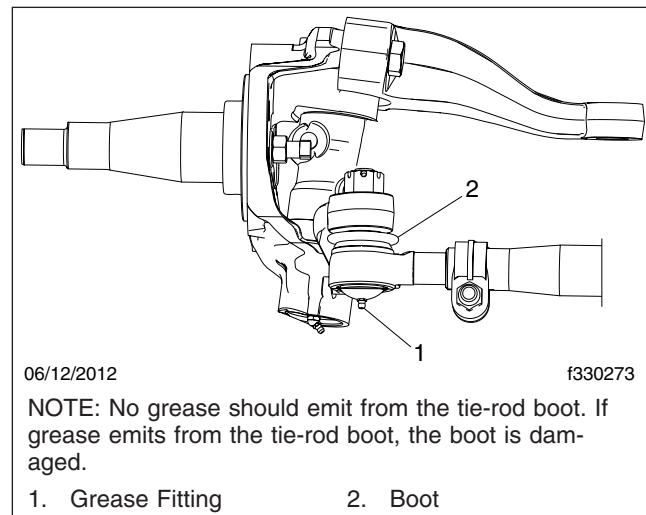


Fig. 4, Grease Fitting and Boot (Detroit axle shown)

33-04 All-Axle Alignment Check

The front axle requires periodic servicing to maintain accurate wheel alignment. Correct front axle wheel alignment is needed to ensure long tire life, ease of handling, and steering stability. When aligning the front axle, it is essential that the rear axle(s) be checked for correct alignment at the same time. Alignment of the rear axle(s) has a direct impact on how the vehicle tracks. All axles, front and rear, should be aligned whenever alignment is done.

Three factors are involved in wheel alignment: camber angle, caster angle, and wheel toe-in.

Camber angle (Fig. 5) 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.

Positive camber is the outward tilt of the wheel at the top. Excessive positive camber in one wheel causes the vehicle to pull in the opposite direction, rapidly wearing the outboard side of the tire tread. Negative camber is the inward tilt of the wheel at the top. Excessive negative camber in one wheel causes the vehicle to pull in the same direction that the negative-camber wheel is on, wearing the inboard side of the tire tread. If camber angles are not correct, the tires will wear smooth around the edge on one side. See [Fig. 6](#). If the front axle is damaged enough to affect the camber angle it must be replaced.

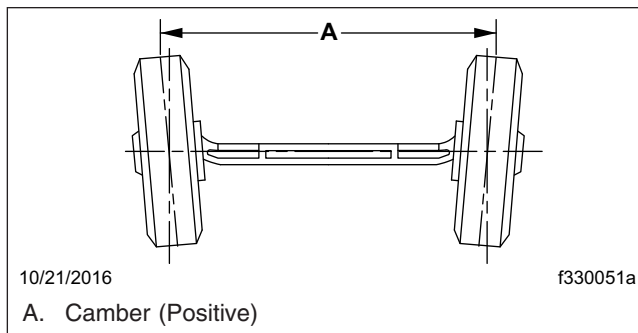


Fig. 5, Camber Angle (front view)

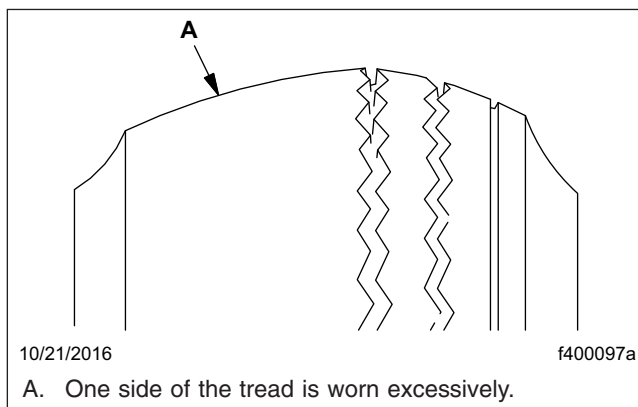


Fig. 6, Tire Damage Due to Excessive Camber

Caster angle ([Fig. 7](#)) is the tilt of the knuckle pin (or kingpin) as viewed from the side. Caster angle is measured in degrees and is adjustable. A positive caster angle is the tilt of the top of the knuckle pin toward the rear of the vehicle. A negative caster angle is the tilt of the top of the knuckle pin toward the front of the vehicle. Caster angles are based on the design load of the vehicle. An incorrect caster angle does not cause tire wear. However, a positive

caster angle that exceeds specifications could cause vehicle shimmy, road shock, and an increased steering effort. A negative caster angle that does not meet specifications could cause unstable steering. The vehicle may wander and weave, and extra steering effort may be necessary. After leaving a turn, the tendency to return to and maintain a straight-ahead position is reduced. Too much or too little caster in one wheel can cause erratic steering when the service brakes are applied to stop the vehicle.

Wheel toe-in ([Fig. 8](#)) is the distance in inches that the front of the wheels are closer together than the rear of the wheels, as viewed from the top. Wheel toe-in is adjustable. If it is not adjusted correctly, the vehicle could pull to one side while driving. Wheel shimmy and cupped tire treads (indentations on the road contact surface of the treads) could occur. Also, rapid or severe tire wear on the steering axle could occur, usually in a feather-edged pattern. See [Fig. 9](#).

Advanced wear patterns can be seen, but less severe wear patterns are detected only by rubbing the palm of your hand flat across the tire tread.

Feather-edging more often affects the front tire on the passenger's side of the vehicle, and is usually more apparent on the outside grooves of the tire.

If any of the conditions listed above occur, the vehicle could need a front end wheel alignment, and possibly, drive axle alignment. However, in some cases these conditions are not wheel alignment related.

If excessive tire tread wear has resulted from incorrect wheel alignment, replace the damaged tires. For minimum tread wear specifications, refer to [Group 40](#) in this manual.

Preliminary Checks

IMPORTANT: When aligning the front axle, it is essential that the rear axle(s) be checked for correct alignment at the same time. Alignment of the rear axle(s) has a direct impact on how the vehicle tracks.

1. Steering axle wheel assemblies should be balanced, especially for vehicles that travel at sustained speeds of more than 50 mph (80 km/h). Off-balance wheel assemblies cause vibrations that result in severely shortened life for tires, and steering suspension parts.

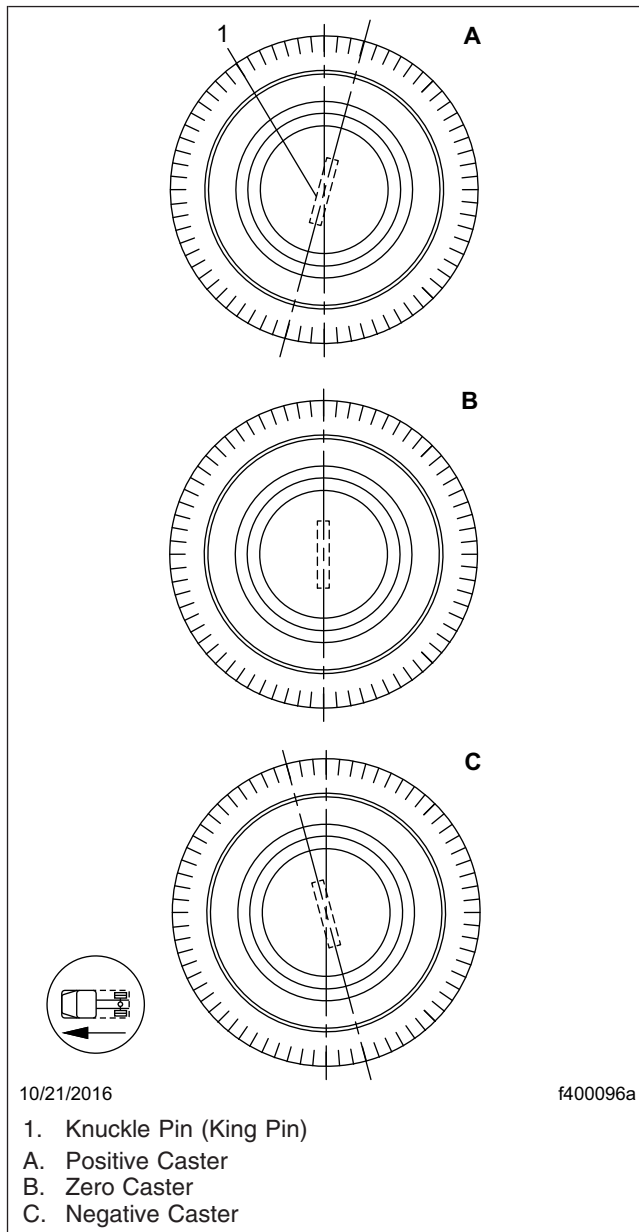


Fig. 7, Caster Angle

- Do not mix tires of different size, type, or weight. Tire wear should be even and not worn to limits exceeding government specifications. Refer to **Group 40** in this manual and **Group 40** in the *Western Star 47X and 49X Workshop Manual* for more information. Replace any tire that is excessively worn.

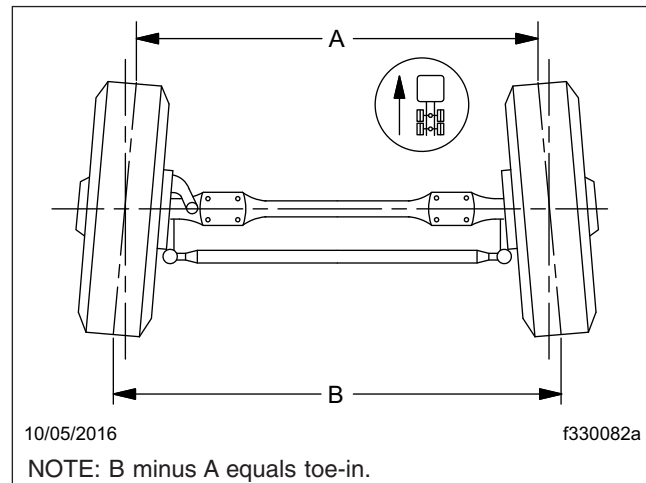


Fig. 8, Wheel Toe-In (overhead view)

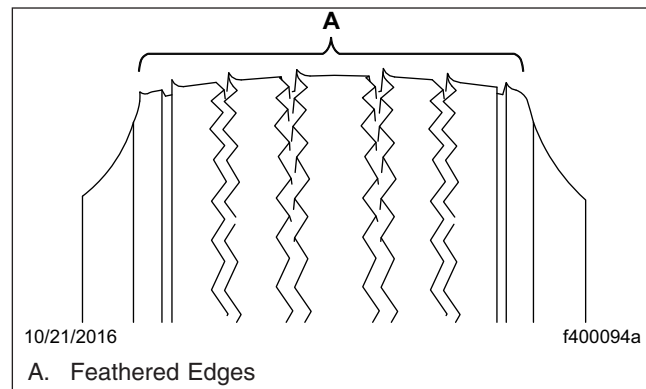


Fig. 9, Tire Damage Due to Excessive Toe-In or Incorrect Drive Axle Alignment

- Check the inflation pressure of the tires. An underinflated tire causes tread wear completely around both tire shoulders. An overinflated tire causes tread wear in the center of the tire. See **Fig. 10**.
- Check for out-of-round wheels and wheel stud holes. Replace the wheel if any of these conditions exist.
- On each side of the vehicle, check the height of the chassis above the ground. Sagging, fatigued, or broken suspension springs create a lopsided vehicle appearance. This causes an unbalanced weight distribution. Anything that changes the ratio of weight on the springs affects the alignment angles and also the tire tread contact area.

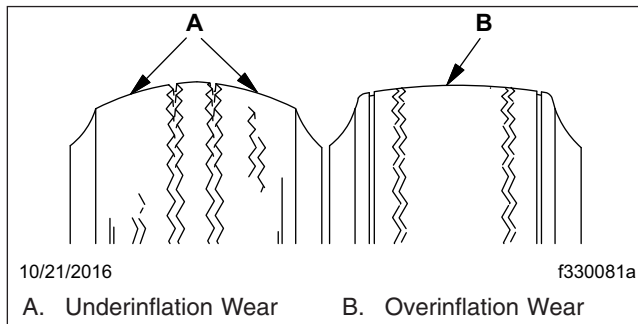


Fig. 10, Tire Damage Due to Underinflated or Overinflated Tires

Replace damaged springs as instructed in the applicable suspension section.

6. On a vehicle equipped with a Freightliner Air-Liner® rear suspension, check the ride height and make any necessary adjustments until it is within specification. See **Group 32** in the *Western Star 47X and 49X Workshop Manual* for instructions.
7. Inspect the front axle beam (also called the axle center) for bends or twists. If the axle beam is bent or twisted over 1/2 degree, replace it before aligning the front axle wheels.
8. Check for damaged, worn, or bent steering gear or linkage parts. Make sure the steering gear is centered. Replace damaged components, and adjust the steering gear, using the instructions in the applicable steering section.
9. Check the steering angle, and adjust the axle steering stops as needed. Refer to **Section 33.01, Subject 110** in the *Western Star 47X and 49X Workshop Manual*.
10. Check the tie-rod ends for correct adjustment, tightness, and damage. Refer to **Group 33** of this manual for instructions.
11. Check the front wheel bearings for wear and incorrect adjustment.
12. Perform a complete vehicle alignment check and compare the readings to those listed in Alignment Specifications in this manual.

Measuring

IMPORTANT: 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 as directed in the alignment equipment manufacturers maintenance procedures and intervals. Western Star dealers must have proof of this calibration history.

Precision instruments and equipment are needed for accurately measuring and adjusting wheel alignment. Refer to the operating instructions provided by the wheel alignment equipment manufacturer. Before checking or correcting wheel alignment, make sure the vehicle is at curb weight. Curb weight is the weight of the unloaded vehicle complete with accessories and full fuel tanks. If a road test is necessary, the route should be one that allows full left and right turns and full stops. It should also include a length of straight, level road to check the steering wheel position during straight ahead driving. During the road test, note any steering effort and possible roughness. Check for looseness, too much wheel play, any tendency for the vehicle to lead in one direction, and for pull during stopping. Note the position of the steering wheel while driving on a straight, level road. If the steering wheel is not in the straight-ahead position, refer to **Section 46.08, Subject 100** in the *Western Star 47X and 49X Workshop Manual* for the alignment procedure.

Steering Angle Checking and Adjusting

Steering (or turning) angle is the degree of front wheel movement from a straight-ahead position to either an extreme right or left position. Although front wheel movement can be limited by the amount of internal travel in the steering gear, it generally depends on how much clearance there is between chassis components and the tire and wheel assemblies. All axles have adjustable stopscrew-and locknut-type axle stops (**Fig. 11**), which are located on the rear side of each front axle spindle.

1. Make sure the steering gear is in the center of travel when the wheels are in a straight-ahead position. Center the gear, using the instructions in the applicable steering section in this manual. Bottoming of the steering gear must not occur when making an extreme right or left turn.
2. With the brakes fully applied, turn the steering wheel clockwise to the end of travel. Have someone check both sides of the vehicle for interfer-

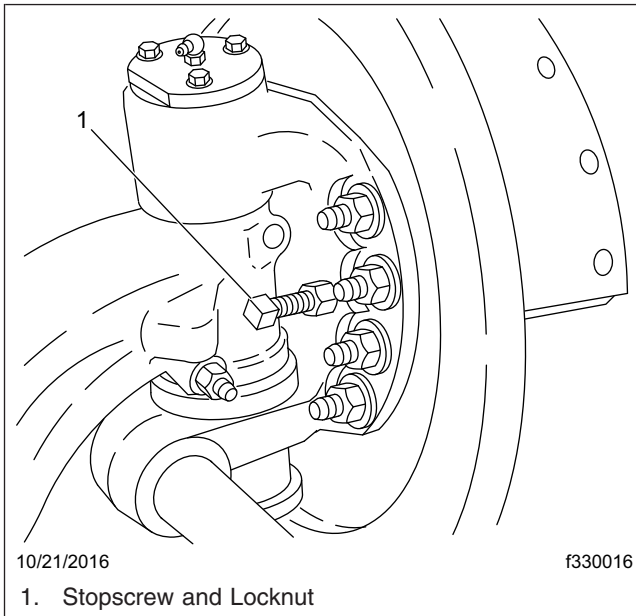


Fig. 11, Axle Stop

ence at the tires and wheels. There must be at least 0.50 inch (13 mm) clearance from any fixed object, and 0.75 inch (19 mm) from any moving object.

If necessary, loosen the stopscrew locknut; adjust the stopscrew to contact the axle when the maximum turning angle of the wheels is determined.

Tighten the locknut to the value in the torque table under Alignment Specifications.

3. Repeat the step above with the steering wheel turned counterclockwise. Adjust the axle stop, as needed.
4. Adjust the steering gear so that pressure is released ahead of the axle stop. This will prevent possible damage to the steering or axle components. For poppet valve adjustment instructions, refer to **Group 46** in the *Western Star 47X and 49X Workshop Manual*.
5. Drive the vehicle off the turn-plates or turntables.

Camber Angle

IMPORTANT: 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 as directed in the alignment equipment manufacturers maintenance procedures and intervals. Western Star dealers must have proof of this calibration history.

Compare the camber angles with those shown in the appropriate table in Alignment Specifications in this section. Differences between the measurements taken in the step above and the angles in the table are caused by damaged (bent) axle components.

Incorrect camber angles could be caused by damage in one or more of the following front axle components: the knuckle pin, the knuckle pin bushings, the axle spindle, or the axle beam. Replace twisted or otherwise damaged components. Don't try to straighten twisted or bent components; replace them with new components. If a bent or twisted front axle knuckle pin, axle spindle, or axle beam has been straightened, the axle warranty will be voided.

Caster Angle Adjusting

Caster angle is the tilt of the knuckle pin (or kingpin) as viewed from the side of the vehicle. See [Fig. 12](#).

IMPORTANT: Do all the preliminary checks in **Section 33.00, Subject 100** in the *Western Star 47X and 49X Workshop Manual* before checking the caster angle.

IMPORTANT: 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 as directed in the alignment equipment manufacturers maintenance procedures and intervals. Western Star dealers must have proof of this calibration history.

Using the alignment equipment manufacturer's operating instructions, measure the front wheel caster.

Compare the caster angles with those shown in the appropriate table in Alignment Specifications in this section. If needed, adjust the caster angle by placing wedge-shaped shims between the axle spacer and the axle beam, as follows (see [Fig. 13](#)):

IMPORTANT: Extreme angle shims cannot be used to correct caster angles that vary by more than 2 degrees from the values in the table.

Weak or broken leaf springs, or worn shackle bushings, can cause extreme deviations to caster angles. Replace damaged parts before doing caster adjustments.

1. Apply the parking brakes, and chock the front and rear tires.
2. Back off the U-bolt nuts from the U-bolts on one side of the front axle. See **Fig. 13**.
3. Raise the spring away from the axle enough to allow removal of the front caster shim.
4. Remove the shim, and install one that will provide the correct caster angle, as specified in the table in Alignment Specifications in this section. Install the dowel pin and check penetration.

IMPORTANT: Place front caster shims between the axle beam and the axle spacer, or between the axle beam and the shock absorber bracket. See **Fig. 13**.

5. Lower the vehicle onto the axle.
6. Coat the threaded ends of the U-bolts with chassis lube or an antiseize compound, such as Loc-tite® 242. Tighten the U-bolt nuts to the value in the appropriate table in **Group 32** of the *Western Star 47X and 49X Workshop Manual* for complete procedure.

U-bolt nuts need periodic retightening. Refer to **Group 32** of this manual for recommended intervals.



CAUTION

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

7. Using the steps above, replace the shim on the other side of the axle.
8. Do a final caster angle check.

Wheel Toe-In Adjusting, Integral Gear Steering

1. Loosen the tie rod (cross tube) clamp nuts, and turn the tie rod as needed.

If the vehicle is not on turn-plates or turntables, move the vehicle backward and then forward about six feet (two meters) — this is important

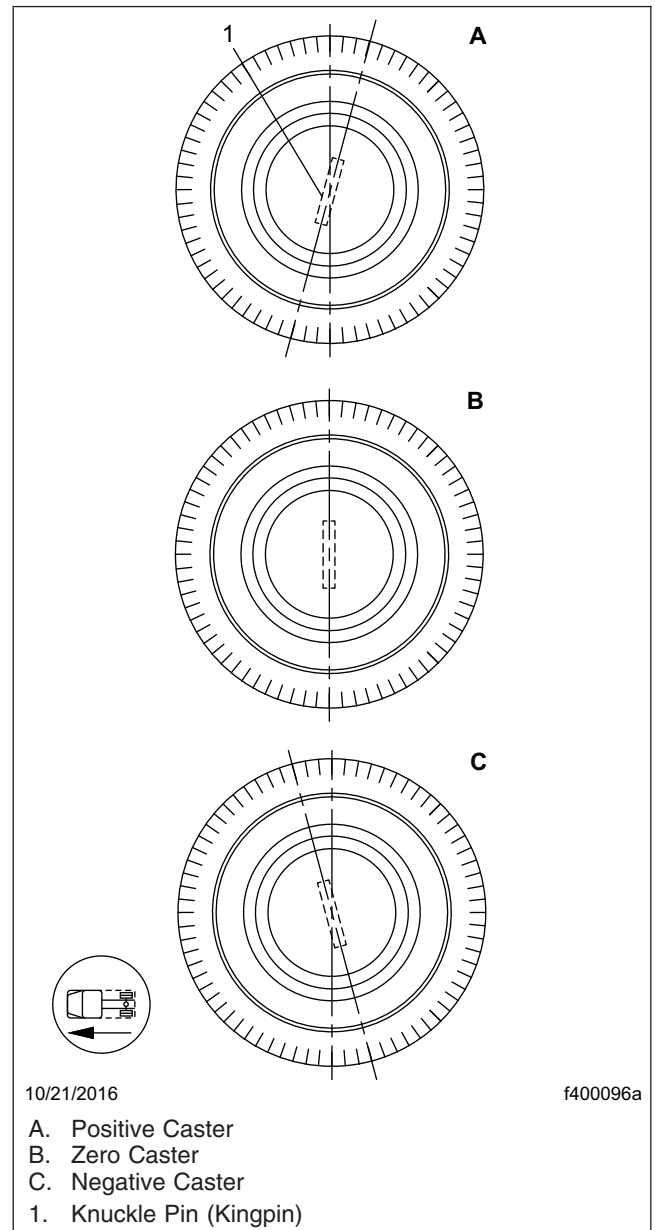


Fig. 12, Caster Angle

when setting the toe-in on vehicles equipped with radial tires. Apply the parking brakes and chock the rear tires.

Do a final wheel toe-in check to make sure that it is correct.

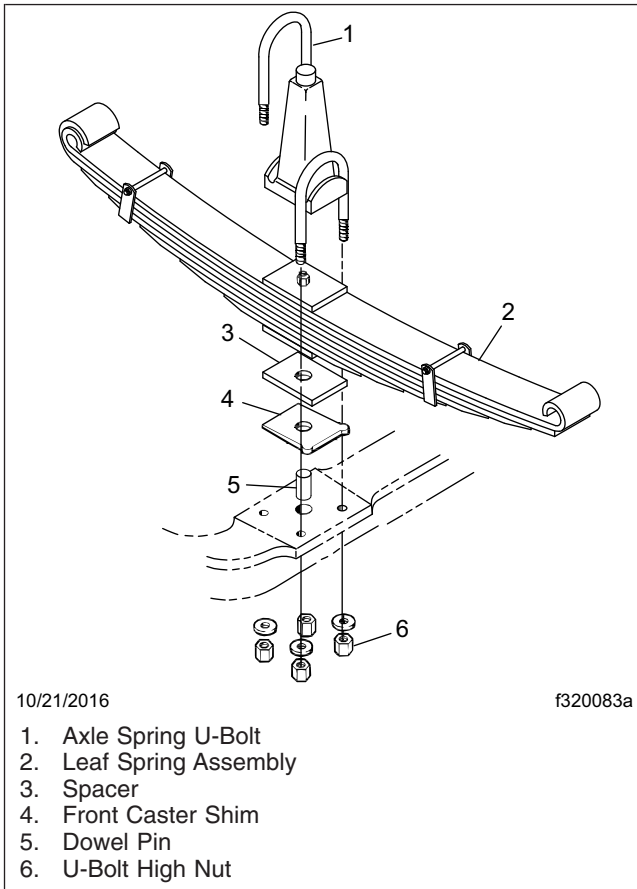


Fig. 13, Axle Spring Installation

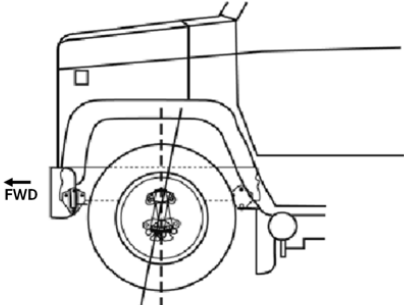
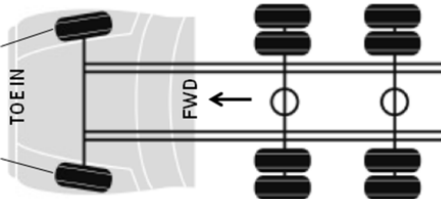
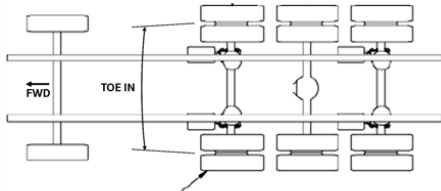
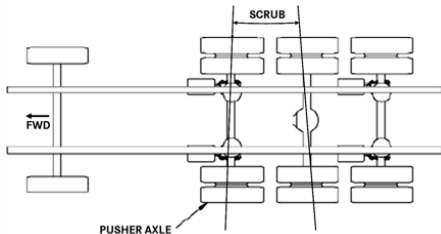
Tighten the clamp nuts to the values in the appropriate table in Alignment Specifications in this section.

2. Road test the vehicle.

Alignment Specifications

Caster

IMPORTANT: Caster angle settings for the left and right sides should be a minimum of 1.0 degree and no more than 5.0 degrees apart from each other, while not exceeding the upper and lower limits.

Western Star 47X and 49X Front Suspension, Set Back Axle - 49-00267-101/Set Forward Axle - 49-00267-102				
Description		Units	Target	Tolerance
 02/08/2017 f330302	Caster IMPORTANT: LH and RH caster angle settings should be a minimum of 1.0 degree and no more than 5.0 degrees apart from each other.	LH (degrees)	4.5	±1.5
		RH (degrees)	4.5	±1.5
 02/08/2017 f330303	Total Toe	Degrees	0.09	±0.09
Pusher and Tag Axles				
 02/08/2017 f330304	Total Toe	Degrees	0.09	±0.09
 02/08/2017 f330305	Scrub Angle	Degrees	0	±0.08

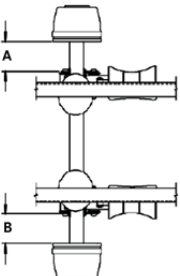
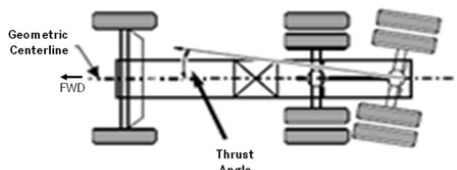
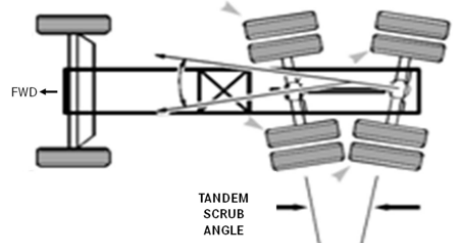
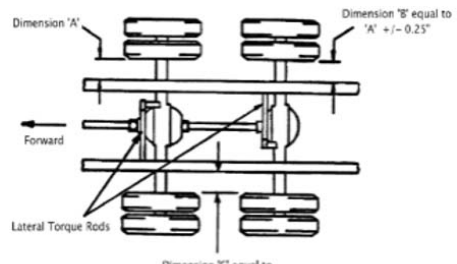
Western Star 47X and 49X Front Suspension, Set Back Axle - 49-00267-101/Set Forward Axle - 49-00267-102				
Description		Units	Target	Tolerance
 02/08/2017 f330306	Tracking/Lateral Offset	Inches	0	±0.25
Rear Suspension				
 02/08/2017 f330307	RDA Thrust Angle	Degrees	0	±0.18
 02/08/2017 f330308	FDA/RDA Scrub Angle	Degrees	0	±0.08
 02/08/2017 f330309	FDA/RDA Tracking/Lateral Offset	Inches	0	±0.25

Table 1, Caster

Camber

Camber, Detroit and Meritor Axles		
Axle Model	Left Camber: degrees	Right Camber: degrees
All	$-1/4 \pm 7/16$	$-1/4 \pm 7/16$

Table 2, Camber, Detroit and Meritor Axles

Camber, Dana/Eaton Axles		
Axle Model	Left Camber: degrees	Right Camber: degrees
All E Series	$+1/4 \pm 7/16$	$0 \pm 7/16$

Table 3, Camber, Dana/Eaton Axles

Camber, Hendrickson Axles		
Axle Model	Left Camber: degrees	Right Camber: degrees
STEERTEK	0 ± 1	0 ± 1

Table 4, Camber, Hendrickson Axles

Torque Values

Miscellaneous Torque Values	
Description	Torque: lbf·ft (N·m)
M22	339 (459)
U-Bolt Nuts 7/8–14	400 (542)
U-Bolt Nuts 7/8–16	460 (624)
U-Bolt Nuts 3/4–16	300 (406)
Meritor Stopscrew Locknut	50–65 (68–88)

Table 5, Miscellaneous Torque Values

Tie Rod Clamp Nut Torque Values				
Axle Manufacturer	Axle Model	Tie Rod Clamp Nut Size	Plain Nut Torque*: lbf·ft (N·m)	Locknut Torque*: lbf·ft (N·m)
Detroit	All	5/8–11	60–80 (81–108)	60–80 (81–108)
Meritor	All	5/8–11	50–60 (68–81)	50–60 (68–81)
Hendrickson	STEERTEK			
Dana/Eaton	All E Series	5/8–18	—	40–60 (55–81)

* All torque values in this table apply to parts lightly coated with rust-preventive type oil.

Table 6, Tie Rod Clamp Nut Torque Values

33-05 Steer Axle Hub Cap Vent Plug Inspection

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. 14](#).



09/01/2016

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Fig. 14, 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. 15](#) and [Fig. 16](#). Evidence of a leaking vent plug may appear as;

- Oil splatter around the wheel
- Goey/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)



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Fig. 15, Excessive Leakage



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Fig. 16, Water in Oil

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 *47X and 49X 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.

Title of Maintenance Operation (MOP)	MOP Number
Axle Breather and Axle Lubricant Level Inspection.	35-02
Axle Lubricant and Filter Change, and Magnetic Strainer Cleaning.	35-01
Safety Precautions.	35-00

35–00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

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

NOTICE

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

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

All Axle Models

Detroit™ Model 4 and Model 6

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Clean the fill plug and the area around it. In the axle housing rear cover, remove the plug from the oil fill hole. See [Fig. 1](#).

CAUTION

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

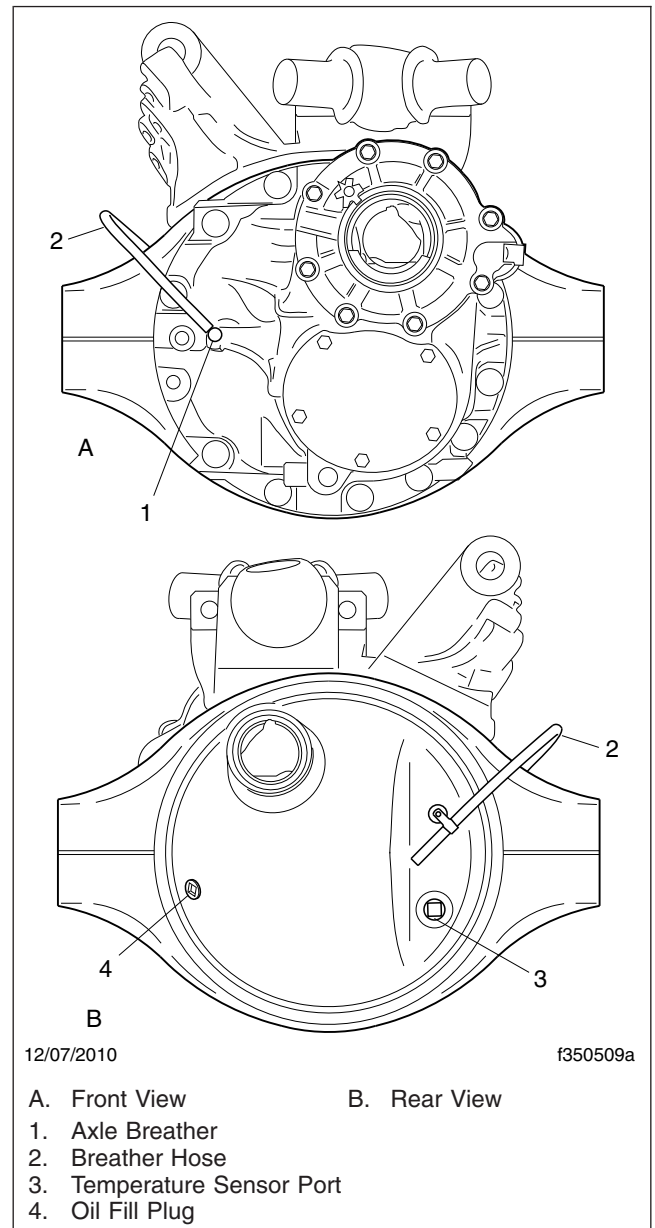


Fig. 1, Detroit Model 4 and Model 6 Tandem Axle (forward axle shown)

3. Place a drain pan under the rear axle drain plug. Drain the oil when it is warm. At this temperature, the oil will run more freely and ensure that the axle is flushed.
4. Clean the fill and drain plugs. Change them if necessary.

- 4.1 For magnetic plugs, use a piece of key stock or any other convenient steel slug to short the two magnetic poles and divert the magnetic field.
- 4.2 Clean away the collected material deposited on each pole. Magnets will rapidly lose their effectiveness as collected material bridges the gap between the two poles.
- 4.3 After the first oil is changed, inspect the drain plug each time for large quantities of metal particles.
- 4.4 After cleaning, install the drain plug(s) and tighten to 30 lbf·ft (41 N·m).
5. Fill the axle with the recommended lubricant. See **Table 3** for recommended drive axle lubricants and **Table 4** for lubricant capacities.

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.

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

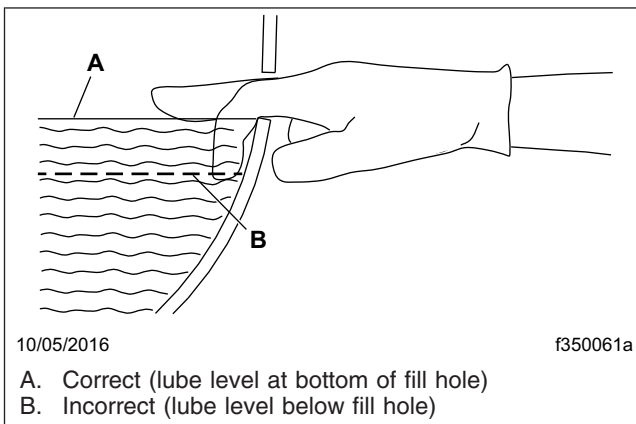


Fig. 2, Axle Lubricant Level Inspection

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

Detroit Drive Axle Lubricant, Model 4 and Model 6*		
Lubricant	Type	Ambient Temperature
Mobil Delvac 1 Gear Oil 75W-90	Synthetic	−40°F (−40°C) and up†
IMPORTANT: Lubricant used in Detroit rear axles must meet Mercedes-Benz specification 235.8/Detroit Fluids Specification (DFS) 93K219.01. Mobil Delvac 1 Gear Oil 75W-90 meets this specification. For more product information, see http://bevo.mercedes-benz.com or https://ddcsn-ddc.freightliner.com/cps/rde/xchg/ddcsn/hs/5931.htm .		

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

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

Table 1, Detroit Drive Axle Lubricants, Model 4 and Model 6

Detroit Rear Axle Lubricant Capacity, Model 4 and Model 6 (Hubs Full)	
Axle	Oil Capacity: Quarts (liters)
Forward-Rear, Model 4	14.3 (13.5)*
Single and Rearmost Tandem, Model 4	10.6 (10.0)*

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

Table 2, Detroit Rear Axle Lubricant Capacity, Model 4 and Model 6

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. 3** for the forward axle, and **Fig. 4** for the rear axle.



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 tempera-

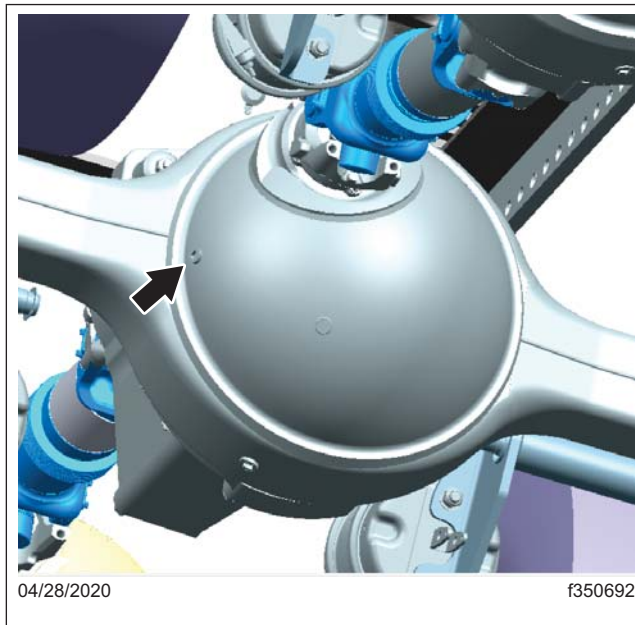


Fig. 3, Detroit™ New Final Drive Forward Axle, Oil Fill Location

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

4. Clean the fill and drain plugs. Change them if necessary.
 - 4.1 For magnetic plugs, use a piece of key stock or any other convenient steel slug to short the two magnetic poles and divert the magnetic field.
 - 4.2 Clean away the collected material deposited on each pole. Magnets will rapidly lose their effectiveness as collected material bridges the gap between the two poles.
 - 4.3 After the first oil is changed, inspect the drain plug each time for large quantities of metal particles.
5. Fill the axle with the recommended lubricant. See [Table 3](#) for recommended drive axle lubricants and [Table 4](#) for lubricant capacities.

New Final Drive Oil Capacity, New Final Drive		
Axle Type	Oil in Hubs (2)	Oil in Axle
NFD Model 4 Forward Axle SP	1.8 L	14 L
NFD Model 4 Rear Rear Axle SP	1.8 L	11 L

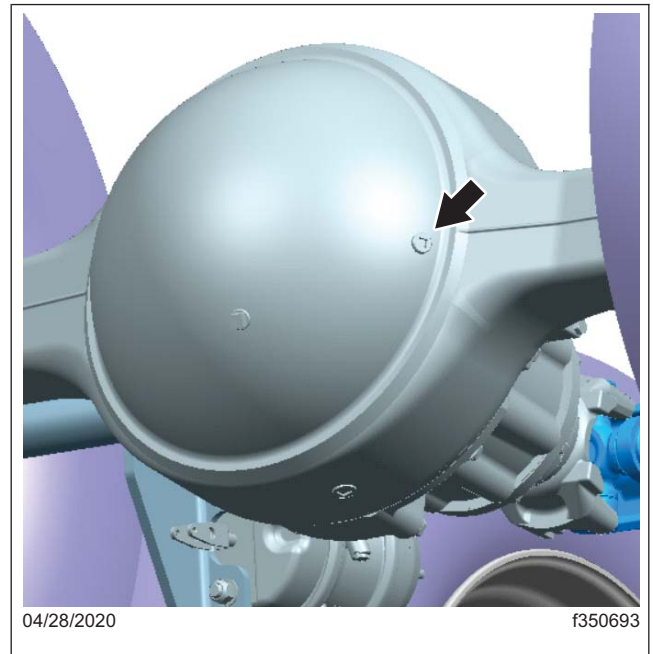


Fig. 4, Detroit™ New Final Drive Rear Axle, Oil Fill Location

- 5.1 Fill the axle through the oil fill hole. Lubricant should be level with the bottom of the oil fill hole.
- 5.2 Install and tighten the fill plug 30 lbf-ft (41 N·m).

Detroit Drive Axle Lubricant, New Final Drive*		
Lubricant	Type	Ambient Temperature
Must meet Detroit Fluids Specification (DFS) 93K219.03	Synthetic	−40°F (−40°C) and up†

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

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

Table 3, Detroit Drive Axle Lubricants, New Final Drive

New Final Drive Oil Capacity, New Final Drive		
Axle Type	Oil in Hubs (2)	Oil in Axle
NFD Model 6 TP	1.8 L	9.5 L
NFD Model 6 SP	1.8 L	11 L

Table 4, New Final Drive Oil Capacity, New Final Drive

Meritor®

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

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

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

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

IMPORTANT: These friction modifiers generally deteriorate faster than conventional extreme-pressure additives, so the lubricant change schedule must be shortened when using these additives. The traction equalizer additive (and recommended drive axle lubricant) must be changed at the Maintenance 2 (M2) interval, instead of the Maintenance 3 (M3) interval recommended in the Maintenance Operation Chart for axles that require only those lubricants recommended in [Table 5](#).

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Remove the axle carrier fill plug. Then remove the drain plug from the bottom of the housing.

Completely drain the lubricant while the unit is warm, to allow the lubricant to drain faster.

On tandem drive axles, it is also necessary to remove the plug at the bottom of the interaxle differential housing to drain that lubricant.

3. If equipped with an oil pump, use a suitable filter strap wrench to remove the axle oil filter. See [Fig. 5](#). Discard the old filter.

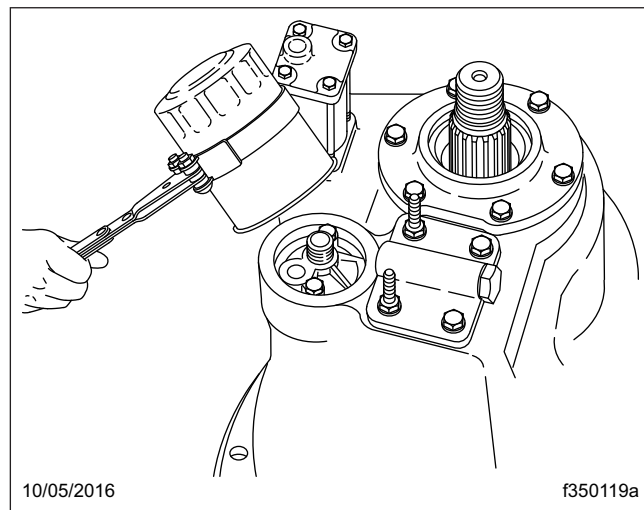


Fig. 5, Meritor Axle Oil Filter Removal

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

4. Using the recommended drive axle lubricant, coat the face of the gasket on the new oil filter, if it was replaced. Install the filter over the adapter, and tighten the filter one full turn after the gasket contacts the base; do not overtighten. See [Table 5](#) for recommended lubricants.

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

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

Table 5, Meritor Drive Axle Recommended Lubricant

5. Clean the fill and drain plugs. Change them if necessary.
 - 5.1 For magnetic plugs, use a piece of key stock or any other convenient steel slug to short the two magnetic poles and divert the magnetic field.
 - 5.2 Check the drain plug for metal particles every 100,000 miles (160 000 km). Clean away the collected material deposited on each pole. Magnets will rapidly lose their effectiveness as collected material bridges the gap between the two poles.
 - 5.3 Each time the oil is changed, replace any magnetic drain plug that does not meet the minimum pickup capacity.
- NOTE:** Meritor recommends plugs with elements having a minimum pickup capacity of 1.5 pounds (0.7 kg) of low-carbon steel.
- 5.4 After cleaning, install the drain plug(s) and tighten to 35 lbf-ft (47 N·m).
6. Fill the axle with recommended lubricant. See **Table 6** for drive axle lubricant capacities.

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

- 6.1 With the vehicle on a level surface, fill the axle through the oil fill hole. Lubricant should be level with the bottom of the oil fill hole. To check fluid level, see **Fig. 2**.

Meritor Drive Axle Lubricant Capacities	
Axle Model	Capacity:* pt (L)
<i>Single Drive, Single Reduction†</i>	
RS-21-160	39.5 (18.7)

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

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

† See "Traction Equalizer Additives" in the text.

Table 6, Meritor Drive Axle Lubricant Capacities

- 6.2 Install and tighten the fill plug 35 lbf-ft (47 N·m).
7. Whenever the interaxle differential housing has been drained, add an additional 2 pints (0.9 L) of the recommended lubricant directly into the inter-axle 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.

Dana® Spicer®

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

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 (or standpipe, if installed in the oil fill hole). See **Fig. 6**.

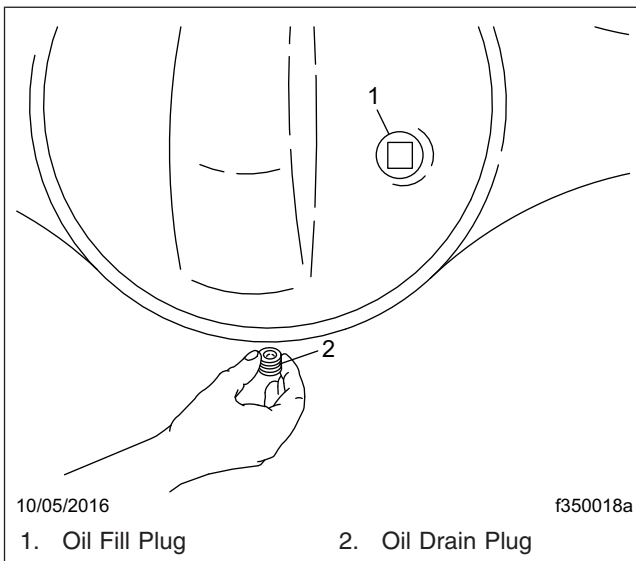


Fig. 6, Axle Housing Drain and Fill Plugs

3. Place a drain pan under the rear axle drain plug. See **Fig. 6**. Drain the oil at normal operating temperature, 150 to 200°F (65 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. See **Fig. 7**.
 - 4.1 Remove the magnetic strainer from the power divider cover.



WARNING

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

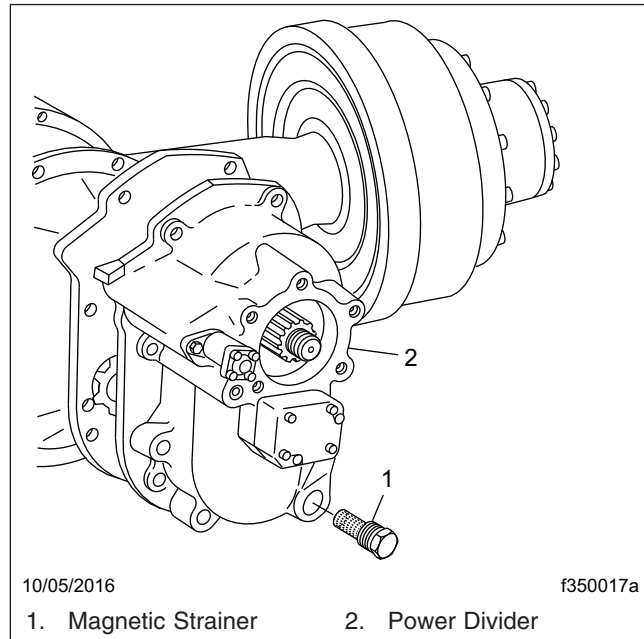


Fig. 7, Dana Spicer Tandem Drive Axle Magnetic Strainer

- 4.2 Wash the strainer in solvent, and blow it dry with compressed air to remove oil and metal particles.
- 4.3 Install and tighten the magnetic strainer 40 to 60 lbf·ft (54 to 81 N·m).
5. Clean the fill and drain plugs. Change them if necessary.
 - 5.1 For magnetic plugs, use a piece of key stock or any other convenient steel slug to short the two magnetic poles and divert the magnetic field.
 - 5.2 Clean away the collected material deposited on each pole. Magnets will rapidly lose their effectiveness as collected material bridges the gap between the two poles.
 - 5.3 After the first oil is changed, inspect the drain plug each time for large quantities of metal particles.
 - 5.4 After cleaning, install the drain plug(s) and tighten to 40 to 60 lbf·ft (54 to 81 N·m).

6. Fill the axle with the recommended lubricant. See [Table 7](#) for recommended drive axle lubricants, and [Table 8](#) for drive axle lubricant capacities.

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

Table 7, Dana Spicer Drive Axle Recommended Lubricant

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

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

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

Table 8, Dana Spicer Drive Axle Lubricant Capacities

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

- 6.1 Fill the axle through the oil fill hole or standpipe opening. Lubricant should be level with the bottom of the oil fill hole, or the top of the standpipe opening. To check fluid level, see [Fig. 2](#).
- 6.2 Install and tighten the fill plug 40 to 60 lbf-ft (54 to 81 N·m).

35-02 Axle Breather and Axle Lubricant Level Inspection

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

All Axle Models

Detroit™ Model 4 and Model 6

NOTICE

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

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. If the vehicle has just been driven, allow a few minutes for the lubricant to settle.
3. Clean the fill plug and the area surrounding the fill plug on the side of the axle carrier. Remove the plug. Check lubricant level when the axle is cold, or near room temperature.

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

4. Check that the lubricant is level with the bottom of the fill hole. See [Fig. 2](#). If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in [Table 4](#).

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

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

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

6. Check the axle housing breather (see [Fig. 1](#)). Make sure that it is open and unclogged. If the breather is plugged or damaged, clean or replace it as needed.

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. If the vehicle has just been driven, allow a few minutes for the lubricant to settle.
3. Clean the fill plug and the area surrounding the fill plug on the side of the axle carrier. Remove the plug. Check lubricant level when the axle is cold, or near room temperature.
4. Check that the lubricant is level with the bottom of the fill hole. See [Fig. 2](#). If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in [Table 4](#).

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

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

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

6. Check the axle housing breather (see [Fig. 1](#)). Make sure that it is open and unclogged. If the breather is plugged or damaged, clean or replace it as needed.

Meritor®

NOTICE

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

NOTICE

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

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

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

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

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

3. Check that the lubricant is level with the bottom of the fill hole. See [Fig. 2](#). If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in [Table 5](#).

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

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

5. Check the axle housing breather. Make sure that it is open and unclogged. See [Fig. 8](#). If the breather is plugged or damaged, clean or replace it as needed.
6. On non-drive axles using oil-lubricated wheel bearings, check the oil level at the wheels, and

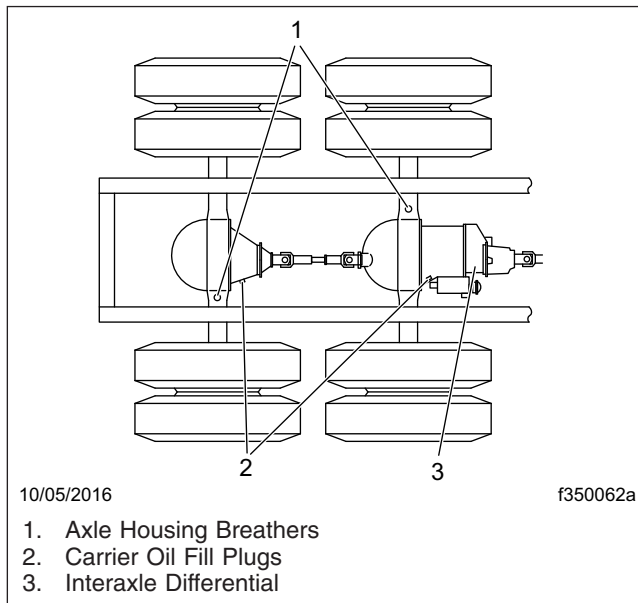


Fig. 8, Meritor Axle Housing Breathers

add oil if low. Use the same lubricant recommended for the drive axle.

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

Dana® Spicer®

NOTICE

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

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. If the vehicle has just been driven, allow a few minutes for the lubricant to settle.
3. Clean the oil fill plug and the area surrounding it; see [Fig. 9](#). Remove the plug from the fill hole (or standpipe, if installed in the oil fill hole).

IMPORTANT: A lubricant level close enough to be seen or touched is not sufficient. It must be

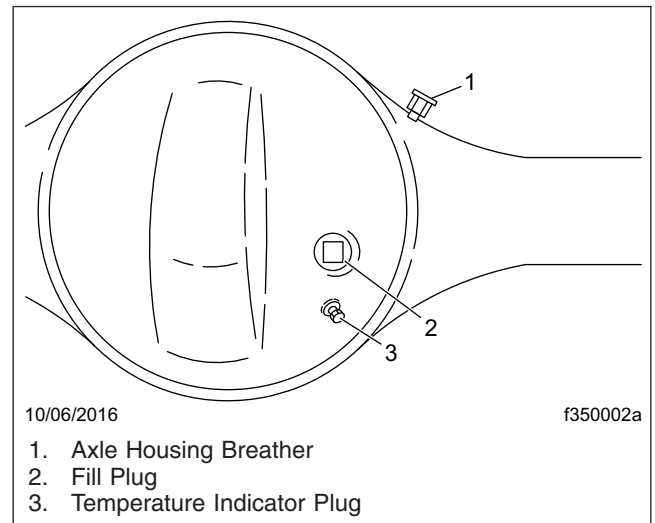


Fig. 9, Dana Spicer Axle Housing Breather

level with the bottom of the fill hole, or the top of the standpipe opening.

4. Check that the lubricant is level with the bottom of the fill hole, or with the top of the standpipe opening. See [Fig. 2](#). If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in [Table 7](#).
5. Install and tighten the fill plug 40 to 60 lbf·ft (54 to 81 N·m).

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

6. Check the axle housing breather. Make sure that it is unclogged and free from corrosion. See [Fig. 9](#). If the breather is plugged or damaged, clean or replace it as needed.

Title of Maintenance Operation (MOP)	MOP Number
Tire Check.	40-02
Wheel Nut Check.	40-01

40-01 Wheel Nut Check

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

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

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

NOTICE

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

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

Table 1, Disc Wheel Fastener Torque

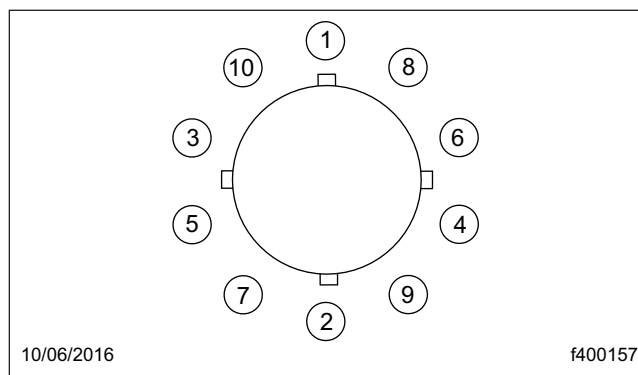


Fig. 1, Wheel Nut Tightening Sequence

40-02 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.

Truck alignment must be done at the initial maintenance. Refer to **Group 33** of the *Western Star 47X and 49X Workshop Manual* for instructions on the wheel alignment.

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.

Title of Maintenance Operation (MOP)	MOP Number
Driveline Inspection	41-01
Driveline Lubrication	41-02
Safety Precautions	41-00

41-00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

41-01 Driveline Inspection

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

CAUTION

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

2. Tighten the U-joint capscrews. See [Table 1](#) for torque specifications.

U-Joint Torque Specifications		
Type	Torque	Figure
U-joints with bearing caps	43 lbf·ft (49 N·m)	Fig. 1
Meritor RPL U-joints (except RPL35)	125 lbf·ft (169 N·m)	Fig. 2
Meritor RPL35 U-joints	150 lbf·ft (200 N·m)	Fig. 4
U-joints with yoke straps	125 lbf·ft (169 N·m)	Fig. 3

Table 1, U-Joint Torque Specifications

3. Check the driveline yokes or flanges for cracks, and check end-yokes for looseness. See [Fig. 3](#).
Replace cracked yokes and flanges.
If any end-yoke can be moved in or out on its shaft, or can be rocked on its shaft, disconnect the driveshaft and U-joint from the yoke, then check the drive component's shaft seal for leak-

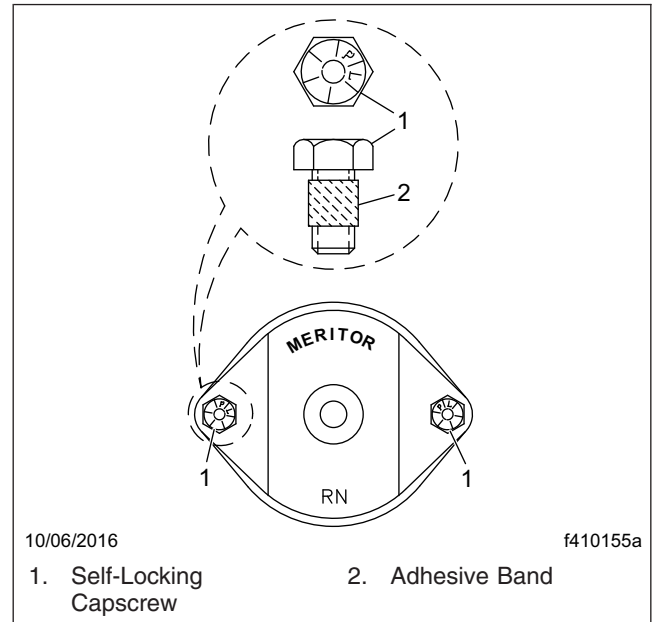


Fig. 1, Meritor U-Joint Fasteners for Bearing Caps

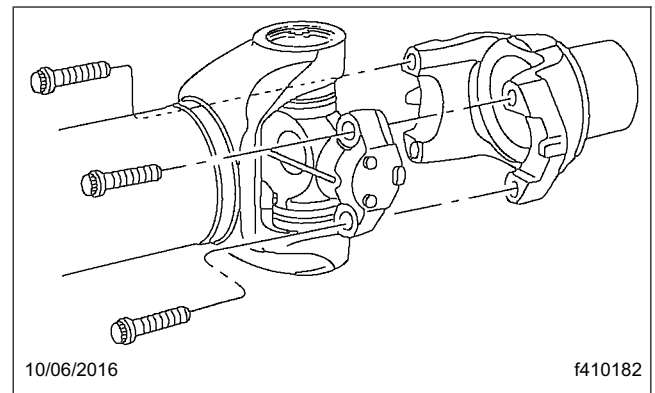


Fig. 2, Meritor RPL Series U-Joint, Except RPL35

age or other visible damage that may have been caused by the loose yoke. Replace the seal if needed, then tighten the yoke nut. Refer to **Group 41** of the *Western Star 47X and 49X Workshop Manual* for torque specifications. If the yoke is still loose after tightening the yoke nut, replace the end-yoke and yoke nut.

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

4. Check U-joint assemblies for wear by moving the driveshaft up and down, and from side to side. If

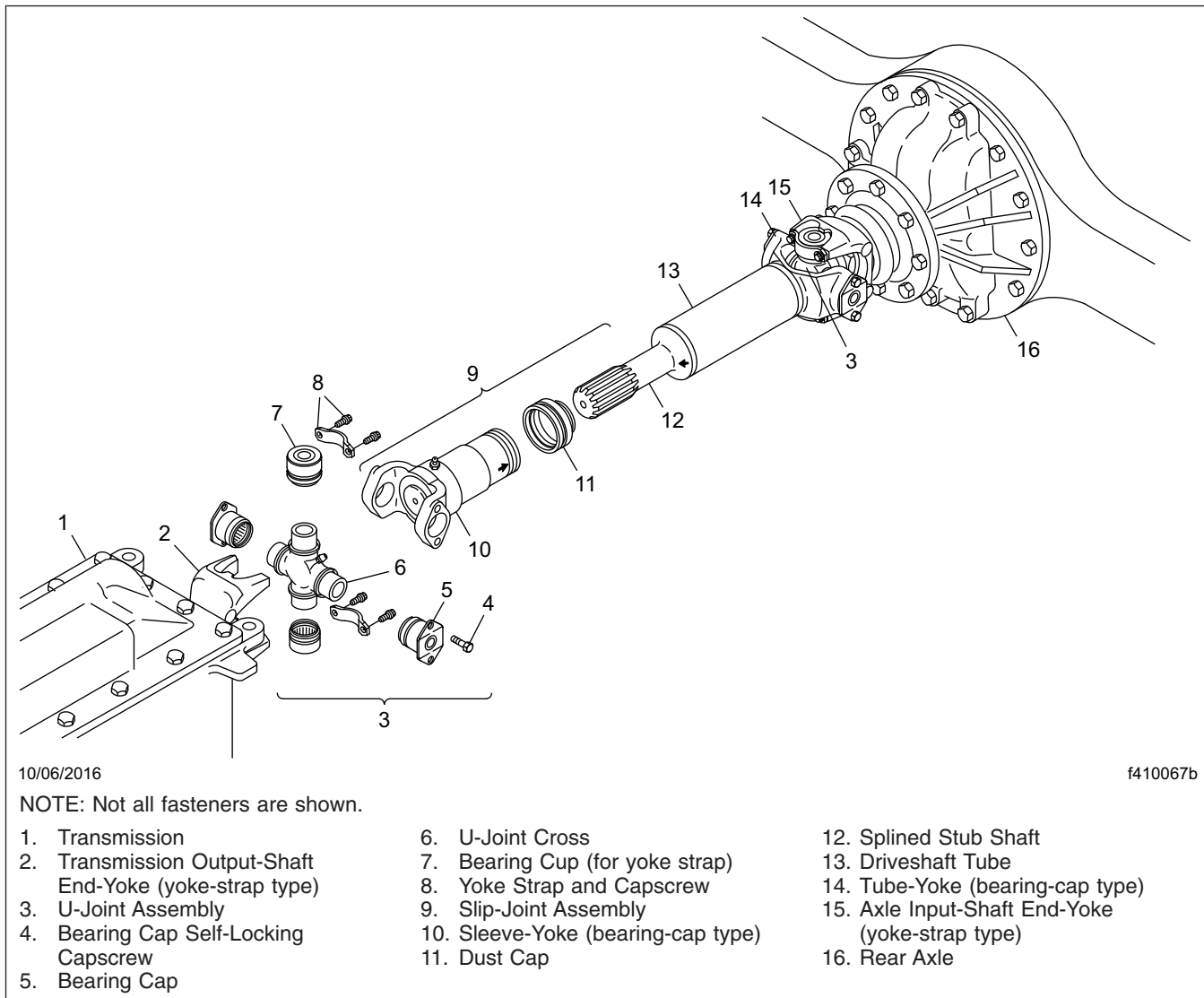


Fig. 3, Components of a Basic Driveline

- any movement of the U-joint cross in the bearings can be felt or seen, replace the U-joint assembly.
- Check if the midship bearing and mounting are loose or have deteriorated, by attempting to move the driveshaft up and down, and from side to side. If the bearing is loose on its shaft, or rattles, replace it. If the bearing mount is loose on the frame, tighten the mounting fasteners to the proper torque value. Replace the midship bearing assembly if the rubber cushion is deteriorated or oil-soaked.
 - Check slip joints for spline wear by moving the sleeve-yoke and splined shaft back and forth. See [Fig. 5](#). If the slip joint can be twisted in a clockwise, or counterclockwise movement greater than 0.007 inch (0.18 mm), replace both the sleeve-yoke and the splined shaft.
 - Visually examine the driveshaft tubes for dents, bends, twists, or other damage. If any tube appears to be damaged, replace it.
 - Examine the driveshaft for evidence of missing balance weights, and for buildup of foreign mate-

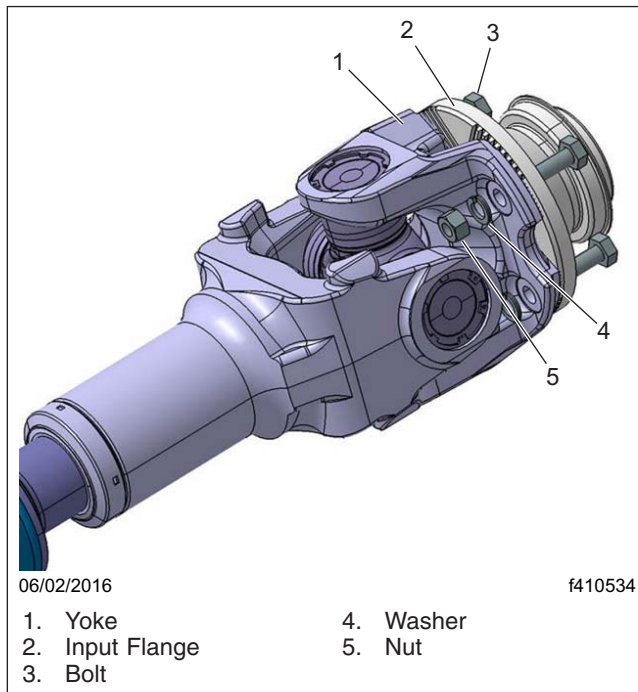


Fig. 4, Meritor RPL35 Series U-Joint

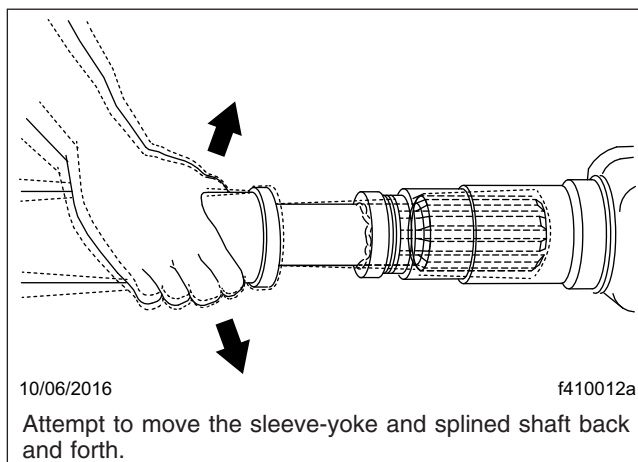


Fig. 5, Slip Joint Spline Wear Checking

rial. Remove any foreign material. If there is any evidence that balance weights are missing, remove the driveshaft and have it balanced.

9. For driveshafts with slip joints, check to be sure the yoke plug is not loose or missing. See Fig. 6. Repair or replace the yoke plug as needed. If the yoke plug is missing, the splined shaft may be hitting the plug and knocking it out; contact your

Regional Service Office for assistance in determining the correct driveshaft length.

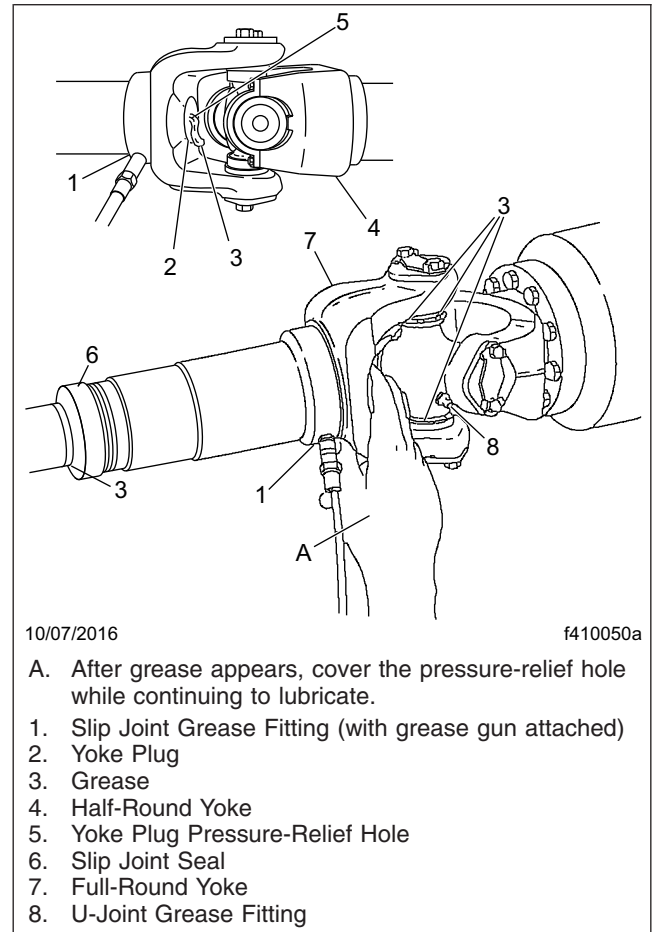


Fig. 6, Slip Joint and U-Joint Lubrication

41-02 Driveline Lubrication

Universal Joint Lubrication

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

1. Park the vehicle on a level surface, apply the parking brakes, and chock the tires.
2. Wipe all old grease and dirt from each U-joint grease fitting. See Fig. 6.
3. Use a hand-type grease gun, or a high-pressure gun with a low-pressure adapter, to lubricate

U-joints. If a low-pressure adapter is not used, U-joints may not receive enough grease.

Using lithium 12-Hydroxy stearate grease (NLGI Grade 2, with EP additives), lubricate until *new* grease can be seen at *all four* U-joint seals. Fresh grease must be seen escaping from *all four* bearing-cap seals of each U-joint. On full-round yokes equipped with a bearing cup, if most of the grease being added to a U-joint can be seen escaping from just one of the U-joint seals, check the torque on the capscrews at that seal.

4. Tighten the bearing-cup capscrews 43 lbf·ft (58 N·m). If the capscrews were already tight, or all of the U-joint seals still do not purge, remove the bearing cup at that seal, and examine the seal for damage. If the seal is damaged, replace the complete U-joint.
5. If grease does not appear at one seal, use a prying tool to pry the U-joint trunnion away from the non-purging seal, or tap the driveshaft or yoke with a plastic or rawhide mallet on the side opposite the dry seal, while continuing to lubricate. If grease still does not appear, loosen the capscrews at the bearing with the dry seal, to relieve seal tension. Lubricate the U-joint until new grease is seen at the seal, then tighten the capscrews to the correct torque specifications. If the bearing will not take grease, replace the U-joint. Refer to **Group 41** of the 47X and 49X Workshop Manual for replacement instructions.
6. Check the purged grease. If it appears rusty, gritty, or burned, replace the U-joint.
7. Wipe the purged grease from the seals, and any excess grease from the grease fitting.

gun pressure until new grease appears at the slip joint seal. See **Fig. 6**. 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.

Slip Joint Spline Lubrication

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

1. If equipped with a grease fitting, wipe all old grease and dirt from the slip joint grease fitting. See **Fig. 6**.
2. Use a hand-type grease gun or a high-pressure gun with a low-pressure adapter, to lubricate the slip joint. Add multipurpose chassis grease (lithium 12-hydroxy stearate, NLGI Grade 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

Title of Maintenance Operation (MOP)	MOP Number
Air Brake System Valve Inspection	42-01
Air Dryer Inspection	42-03
Alcohol Evaporator Cleaning and Inspection	42-04
Bendix Air Dryer Desiccant Replacement	42-02
Bendix Automatic Drain Valve Operating and Leakage Tests	42-12
Bendix E-6 Foot Control Valve Inspection and Lubrication	42-09
Brake Inspection	42-05
Haldex Slack Adjuster Lubrication	42-06
Meritor Camshaft Bracket Lubrication	42-07
Meritor Slack Adjuster Lubrication	42-08
Safety Precautions	42-00
WABCO System Saver Air Dryer Desiccant Cartridge Replacement	42-10

42–00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

42–01 Air Brake System Valve Inspection

NOTE: There is no scheduled air valve maintenance on vehicles equipped with Bendix air valves and a Bendix air dryer if the air dryer desiccant is replaced at 350,000 miles (563 000 km). If the desiccant is not changed at 350,000 miles (563 000 km), or if the vehicle is equipped with another air dryer, maintenance will have to be performed to the air brake valves. See **Group 42** of the *47X and 49X Workshop Manual* for procedures.

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

42–02 Bendix Air Dryer Desiccant Replacement

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

AD–9

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

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

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

WARNING

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

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

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

NOTICE

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

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

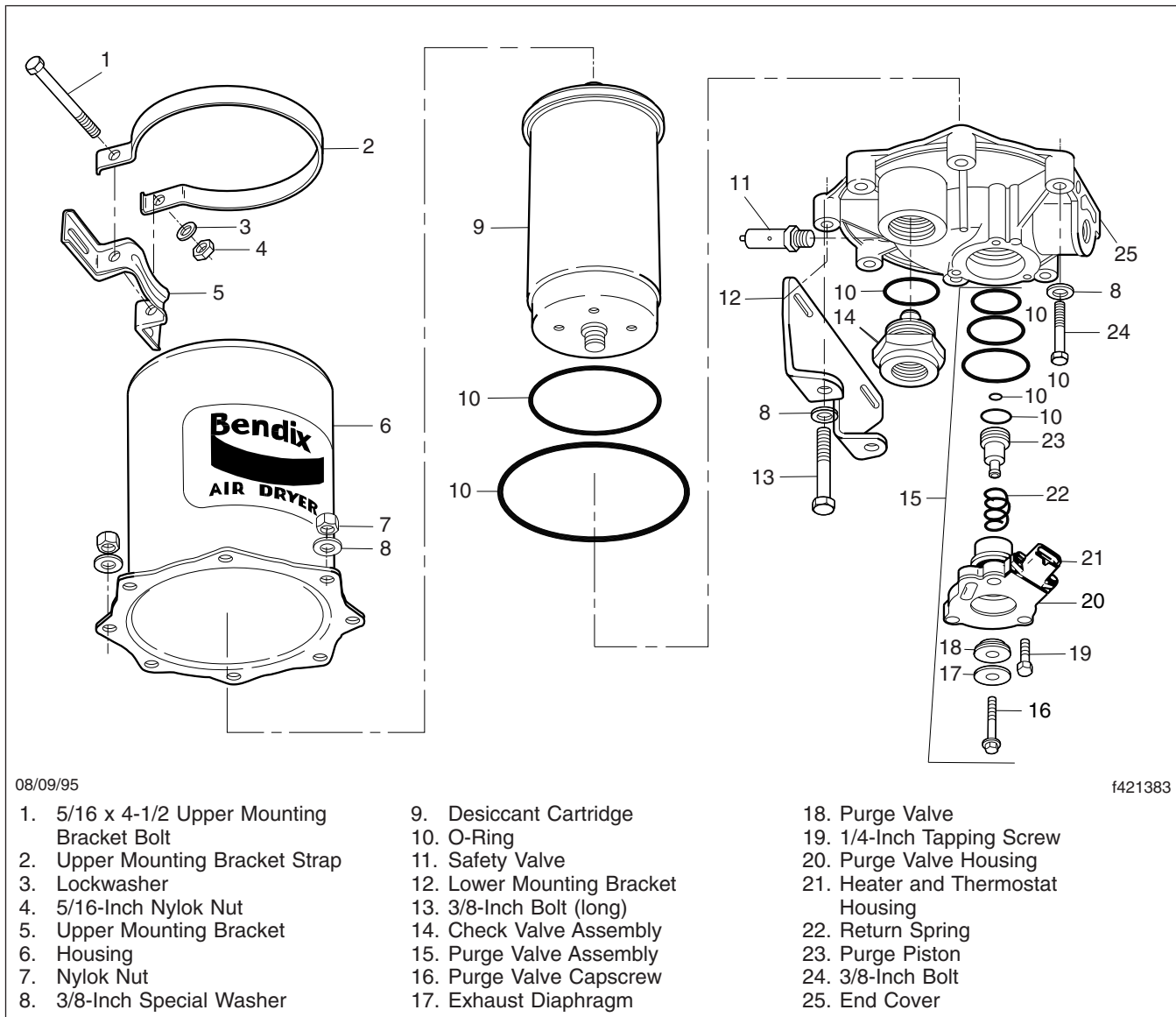


Fig. 1, AD-9 Air Dryer (exploded view)

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 bolts, 12 washers, and 6 new Nylok nuts. Torque the Nylok nuts in a star pattern 17 to 24 lbf·ft (23 to 33 N·m). See Fig. 2.

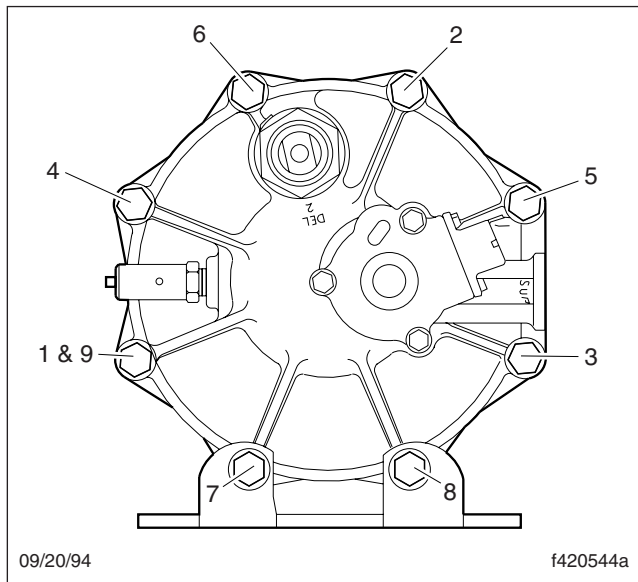


Fig. 2, AD-9 End Cover to Housing Torque Pattern

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 (900 to 1360 N·cm).
18. Connect and tighten the three air lines. Connect the harness connector to the heater and thermostat assembly until the lock tab snaps in place.
19. Start the engine, build the air pressure, and check the air brake system for leaks. If any air leaks are present, see **Group 42** of the *47X and 49X Workshop Manual* for diagnosis and repair information.

AD-IP

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

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.
 - 12.1 Close all reservoir drain cocks.
 - 12.2 Build system pressure to governor cut-out, and note that the AD-IP air dryer purges with an audible escape of air.

- 12.3 Fan the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a purge at the AD-IP air dryer exhaust.
- 12.4 Check for excessive leakage around the head of the desiccant cartridge where it contacts the end cover. With the compressor in loaded mode (compressing air), apply a soapy solution to these areas, and observe that any leakage does not exceed a 1-inch bubble in 1 second. If leakage exceeds this measure, remove and re-install the desiccant cartridge.

AD-9si and AD-IS

1. Park the vehicle on a level surface, apply the parking brakes, and chock the tires.
2. Drain the air reservoirs.
3. Using a strap wrench or equivalent, loosen the desiccant cartridge. Spin the cartridge off by hand and discard it. See [Fig. 3](#).

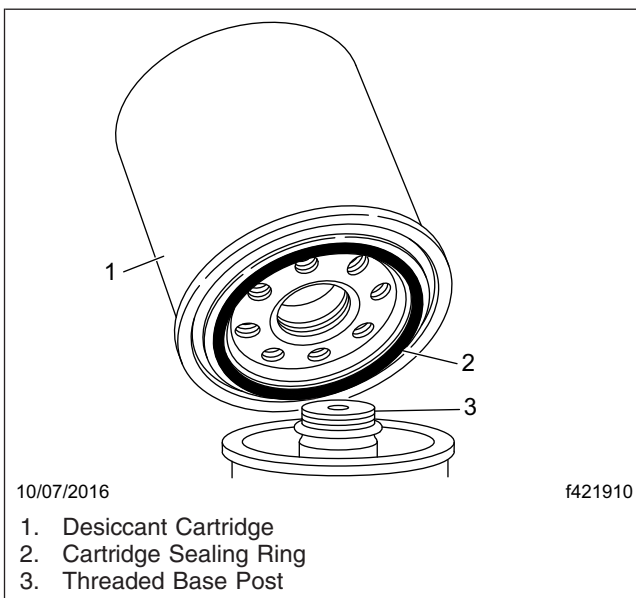


Fig. 3, Desiccant Cartridge Replacement

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.

42-03 Air Dryer Inspection

1. Park the vehicle on a level surface and apply the parking brakes. Shut down the engine. Chock the tires.
2. Check for moisture in the air brake system by opening the reservoir drain cocks. Examine the discharge. Some trace of water in the discharge is normal. A discharge of a milky gray liquid indicates excessive moisture is present in the air system and the desiccant cartridge needs to be replaced. See **Group 42** of the *47X and 49X Workshop Manual* for troubleshooting procedures. The following conditions could cause small amounts of moisture to be found in the air system:

- An outside air source has been used to charge the air brake system. This air did not pass through the drying bed.
- Air usage is unusually high and not normal. This may be due to accessory air demands or some unusual air requirement that does not allow the compressor to load and unload in a normal fashion. Check for air system leaks.
- The air dryer has been installed on a system that had previously been operated without an air dryer. This type of system will be saturated with moisture, and several weeks of operation may be needed to fully dry the system.
- The temperature range in your area fluctuates more than 30 degrees in one day. Small amounts of water can accumulate in the air brake system due to condensation. Under these conditions, the presence of moisture is normal and should not be considered an indication of poor air dryer performance.

3. Inspect the air dryer for external damage, and check that the unit is tightly mounted on the frame. If the air dryer mounting is loose, repair it.
4. Turn on the ignition switch, but do not start the engine.
5. Disconnect the harness connector from the air dryer.
6. Connect a voltmeter to circuit 94 on the air dryer's harness connector and to a body ground point. Check for battery voltage. If voltage is not found, check and repair the open or short to ground in wire 94.
7. Connect a voltmeter between the two terminals on the air dryer's harness connector. If voltage is not found, repair the open in the ground circuit wiring.
8. Use an ohmmeter to check resistance between the terminals on the end cover. See **Fig. 4**. The end cover contains the heater/thermostat. If the heater/thermostat is between 40 and 90°F (5 and 32°C), the heater/thermostat measured resistance will be infinite ohms. If the measured resistance is less than infinity, replace the heater/thermostat.
9. Remove the heater/thermostat assembly and place it in a freezer for about five minutes to cool it below 40°F (5°C). Remove the cold heater/thermostat assembly and check resistance between the heater/thermostat terminals. Resistance should be 1.5 to 3.0 ohms. As the temperature of the heater/thermostat assembly increases, the ohm reading will increase. When the temperature goes above 45°F (7°C) measured resistance should be infinite ohms. If the heater/thermostat does not operate as outlined, replace it. If it does operate as outlined, install it.

42-04 Alcohol Evaporator Cleaning and Inspection

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

Off Season

During the off season, drain the unit of alcohol. At regular engine service intervals, open the drain cock

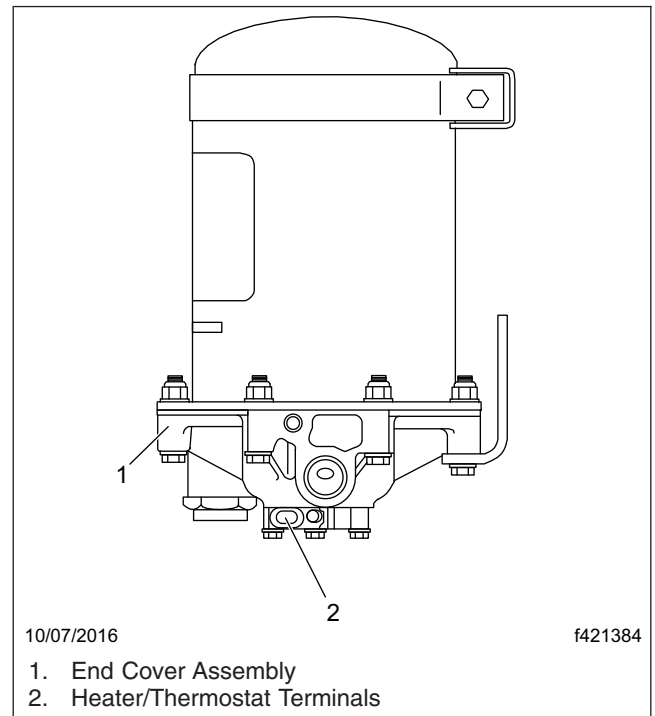


Fig. 4, End Cover Terminals Location

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

Freeze Season Reactivation

1. Park the vehicle on a level surface and apply the parking brakes. Shut down the engine. Chock the tires.
2. Remove the filler cap, and check the cap tetraseal.
3. Remove the capscrews and reservoir from the cover.
4. Remove the cover tetraseal.
5. Drain the air tank, and disconnect the line from the evaporator outlet. Remove the check-valve retainer, spring, and disc.
6. Install the disc, spring, and check-valve retainer, and connect the line to the evaporator outlet.

7. Install the cover tetraseal.
8. Install the reservoir on the cover and tighten the capscrews.
9. Fill the reservoir with 40 ounces (1183 mL) of methyl alcohol, then install the filler cap.

42–05 Brake Inspection

Parking Brake Operational Check

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



CAUTION

Perform the following check in a clear safe area. If the parking brakes fail to hold the vehicle, personal injury or property damage may result.

1. With the engine running, and air pressure at cut-out pressure, set the parking brake.
2. Put the vehicle in the lowest gear and gently attempt to move it forward. The vehicle should not move. If the vehicle moves, the parking brakes are not operating correctly and must be repaired before the vehicle is returned to service. See **Group 42** of the *47X and 49X Workshop Manual* for repair procedures.

Brake Component Inspection

Air Disc 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.
2. Grip the caliper/carrier assembly by the chamber and verify that it slides in and out freely. Free play movement is 0.024 to 0.043 in (0.6 to 1.1 mm).

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

3. Check the caliper mounting bolts by hand to see if they are loose.

Use a torque wrench set to the applicable torque value and the Meritor extension tool 3256B1354 to check the caliper mounting bolts. The Meritor extension tool will only work on M20 axial mounted bolts; radial calipers use a unique hex-head bolt. See [Table 1](#) and [Table 2](#).

If the caliper mounting bolts turn at all, take the vehicle to an authorized Western Star dealer for repair.

If the bolts do not turn, no further work is needed.

Caliper Mounting Bolt Torque Values	
Caliper Description	Torque: lbf·ft (N·m)
Bendix, Axial Mounted	375±25 (508±34)
Bendix, Radial Mounted	225±22.5 (305±31)
Meritor, Axial Mounted	400±50 (542±68)
Meritor, Radial Mounted	
Wabco Maxxus, Radial Mounted	295±22 (400±30)

Table 1, Caliper Mounting Bolt Torque Values

Torque Compensation with Meritor Extension Tool 3256B1354



11/11/2016

f422612

All torque settings are ± 40 lbf·ft (± 54 N·m).

Compensation is calculated for a 43.5 inch (110.5 cm) nominal torque wrench using Meritor extension tool 3256B1354 at various angles.

Angle View	Extension Angle (degrees)	Wrench Length [inches (cm)]	Target Torque [lbf·ft (N·m)]	Tool Setting [lbf·ft (N·m)]
 11/28/2016 f422613	0	43.5 (110.5)	400 (542)	334 (453)
 11/28/2016 f422614	45			364 (494)
 11/28/2016 f422615	90			400 (542)
 11/28/2016 f422616	135			444 (602)

Table 2, Torque Compensation with Meritor Extension Tool 3256B1354

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 brak-

ing 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 **Group 42** of the *Western Star 47X and 49X Workshop*

Manual for inspection, troubleshooting, and repair procedures.

4. Measure the applied chamber stroke. See **Table 3** 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.
5. Check all of the foundation brake components for damage, wear, and loose or missing parts. Repair as needed.

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

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

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

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

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

Table 3, Brake Chamber Stroke Specifications

42-06 Haldex Slack Adjuster Lubrication

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

WARNING

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

CAUTION

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

Lubricate the automatic slack adjuster at the grease fitting. See [Fig. 5](#). Use standard chassis lubricant for Haldex slack adjusters.

42-07 Meritor Camshaft Bracket Lubrication

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

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

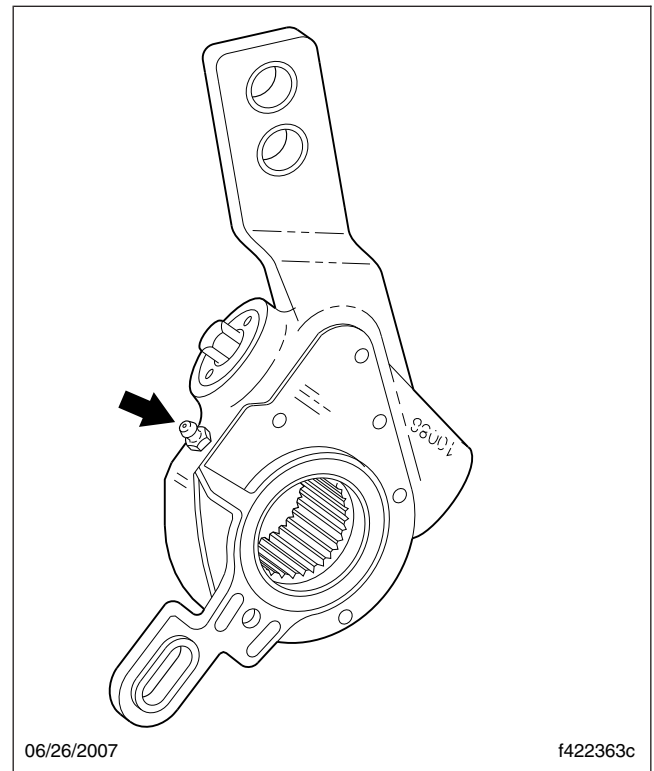


Fig. 5, Haldex Automatic Slack Adjuster Grease Fitting

shaft bracket will not have a grease fitting. These camshafts use a special NLGI Grade synthetic polyurea grease and do not require lubrication for 3 years or 500,000 miles (800

000 km), whichever comes first. The extended-maintenance camshaft bushings are lubricated during the brake reline service interval. For service and lubrication instructions, see **Group 42** of the *47X and 49X Workshop Manual*.

For camshaft brackets with grease fittings, use an NLGI Grade 1 or Grade 2 multipurpose chassis grease. Lubricate the camshaft bushings through the grease fitting on the camshaft bracket or the spider until new grease flows from the inboard seal. See **Fig. 6**. Follow the steps below for proper greasing.

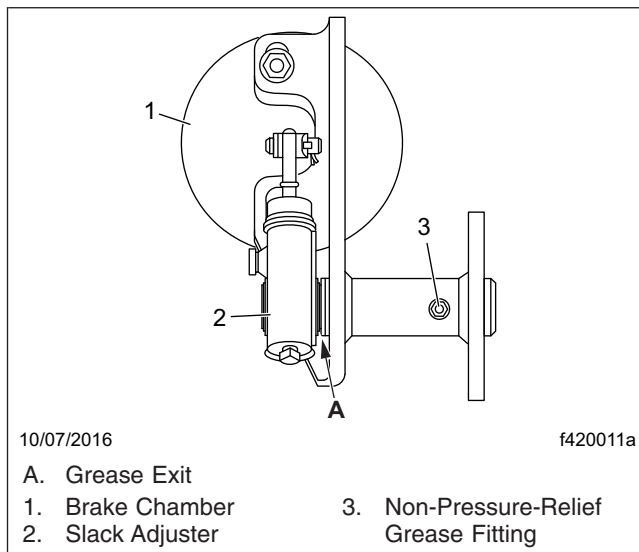


Fig. 6, Camshaft Bracket Lubrication

WARNING

If grease leaks out under the camhead, the camshaft bracket grease seal is worn or damaged. See **Group 42** in the *47X and 49X Workshop Manual* for grease seal replacement instructions. If this seal is not replaced, the brake linings could become contaminated with grease. The stopping distance of the vehicle will be increased, which could result in personal injury or property damage.

Steer Axle S-cam Tube Greasing

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

4. Grease the S-cam tubes.

Drive Axle S-cam Tube Greasing

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

42–08 Meritor Slack Adjuster Lubrication

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

WARNING

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

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

and lubrication instructions, see **Group 42** of the *47X and 49X Workshop Manual*.

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

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

Lubricate the slack adjuster at the grease fitting until grease is forced past the pressure-relief capscrew or past the gear splines around the inboard snap ring. See **Fig. 7**. Follow the steps below for proper greasing.

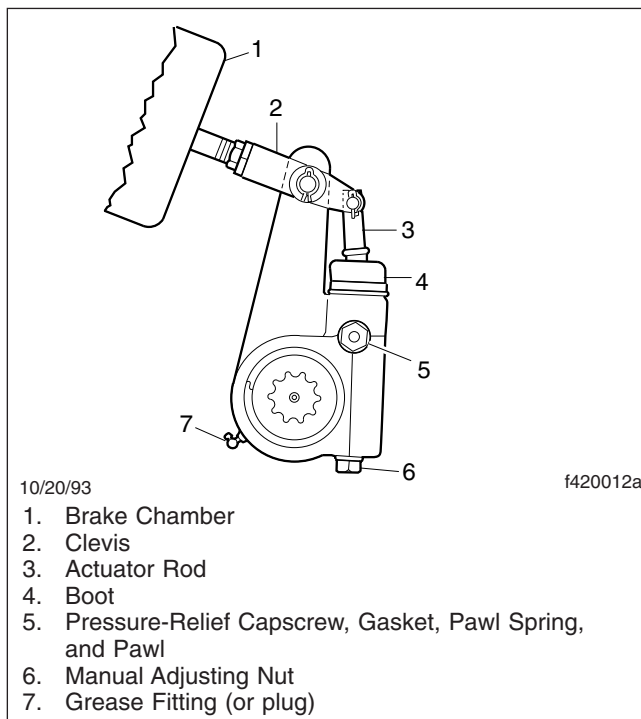


Fig. 7, Meritor Automatic Slack Adjuster

Steer Axle Slack Adjuster Greasing

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

4. Grease the slack adjuster.

Drive Axle Slack Adjuster Greasing

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

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

1. Remove the brake valve from the vehicle; see **Group 42**, of the *Western Star 47X and 49X Workshop Manual*.
2. Remove the roll pin from the brake pedal pivot pin. See **Fig. 8**.
3. Remove the brake pedal pivot pin.
4. Remove the brake pedal.
5. Check the brake pedal mounting plate adapter for signs of wear or cracks at the bosses (the area from which the pivot pin was removed). Replace it if necessary.
6. Check the brake pedal rollers for signs of wear or cracks. Replace the rollers as needed.
7. If the rollers are replaced, replace the roller pin, install a new cotter pin, bend it to 90 degrees

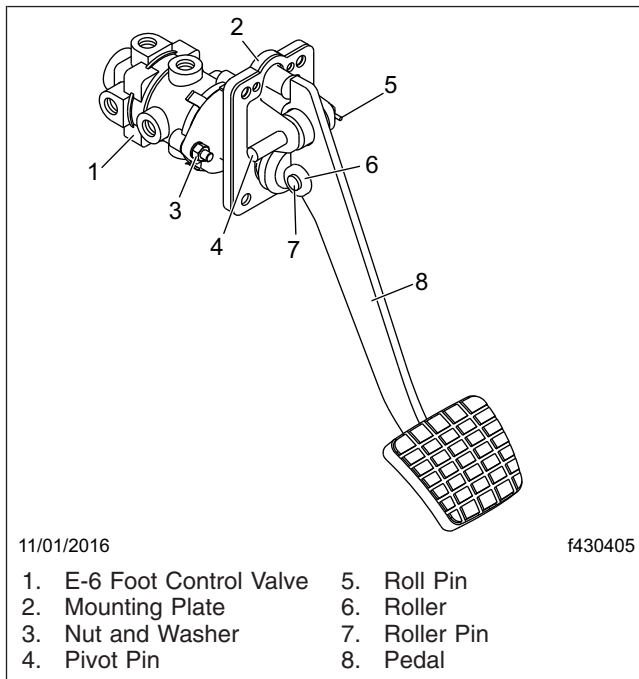


Fig. 8, Brake Pedal and Valve Assembly

and apply Torque Seal (OPG F900 White) to the cotter pin.

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

42-10 WABCO System Saver Air Dryer Desiccant Cartridge Replacement

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

NOTICE

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

Refer to [Fig. 9](#) for cartridge replacement.

1. Drain the air system.

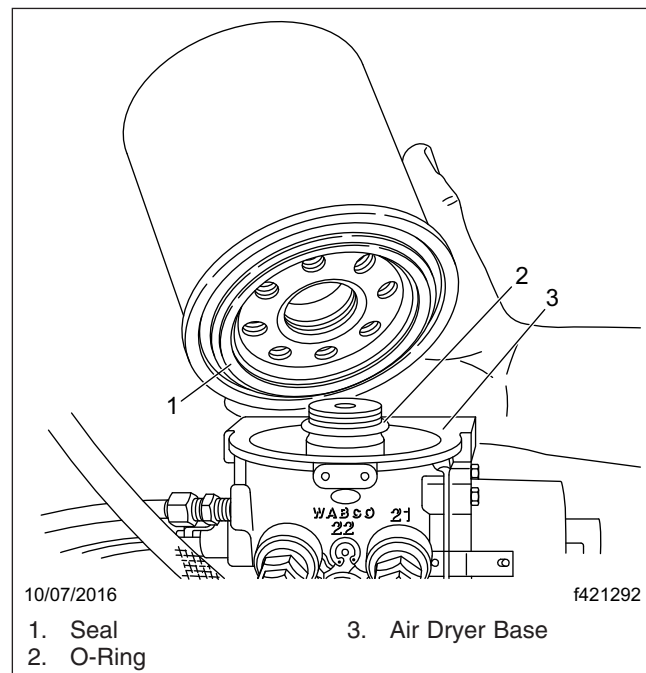


Fig. 9, Desiccant Cartridge Replacement

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

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

5. Using a multipurpose, high-temperature grease that resists water, steam, and alkali, lightly coat the surfaces of the new O-ring and the dryer base. Install the O-ring.
6. Thread the desiccant cartridge onto the dryer base (turn clockwise). When the seal contacts the base, tighten the cartridge one complete turn more. Do not overtighten.

If the drain valve is leaking excessively, repair or replace it.

42–12 Bendix Automatic Drain Valve Operating and Leakage Tests

Operating Test

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

With the system charged, apply the brakes several times. Each time the brakes are applied, an exhaust of air should occur from the exhaust port of the drain valve. If no air comes out, push the wire stem located inside the exhaust port. If no air comes out after pushing the wire stem, there may be a plugged filter in the adapter which should be replaced.

If the drain valve does not function properly, repair or replace it. See **Section 42.14** of the *Western Star 47X and 49X Workshop Manual*.

Leakage Test

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

With the system charged and pressure stabilized in the system, there should be no leaks at the drain valve exhaust port. A constant slight exhaust of air at the drain valve exhaust port could be caused by excessive leakage in the air brake system.

Title of Maintenance Operation (MOP)	MOP Number
Drag Link Inspection.	46-01
Drag Link Lubrication.	46-03
Power Steering Fluid and Filter Change	46-02
Safety Precautions.	46-00

46–00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

46–01 Drag Link Inspection

WARNING

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

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Have someone turn the steering wheel from left to right. Check for movement between the ball stud end and the pitman arm, and between the ball stud end and the steering arm.

If the ball stud end is loose, replace the drag link.

3. Check the ball stud castle nut for looseness.

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

- 3/4–16: 90 to 180 lbf·ft (122 to 230 N·m)
- 7/8–14: 160 to 300 lbf·ft (217 to 407 N·m)

4. Inspect the boot of the drag link at both the pitman arm and the steering arm end for cracks, splits, or other damage. Replace the boot if needed.
5. Grasp the drag link near the pitman arm end, then push and pull laterally to check for axial movement in the ball stud end. If it is loose, replace the drag link. See **Group 46** of the *Western Star 47X and 49X Workshop Manual* for re-

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

46–02 Power Steering Fluid and Filter Change

WARNING

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

1. Set the parking brake and chock the rear tires.
2. Raise the front of the vehicle and support it with jack stands.
3. Put the vehicle in neutral.
4. Open the hood.
5. Wipe down the area around the steering gear and related hydraulic lines.
6. Place a drain pan under the steering gear and power steering reservoir.
7. Remove the pressure line and return hose (see **Fig. 1**) from the steering gear and allow the oil to drain.
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. 1**. See **Table 1** for approved power steering fluids.

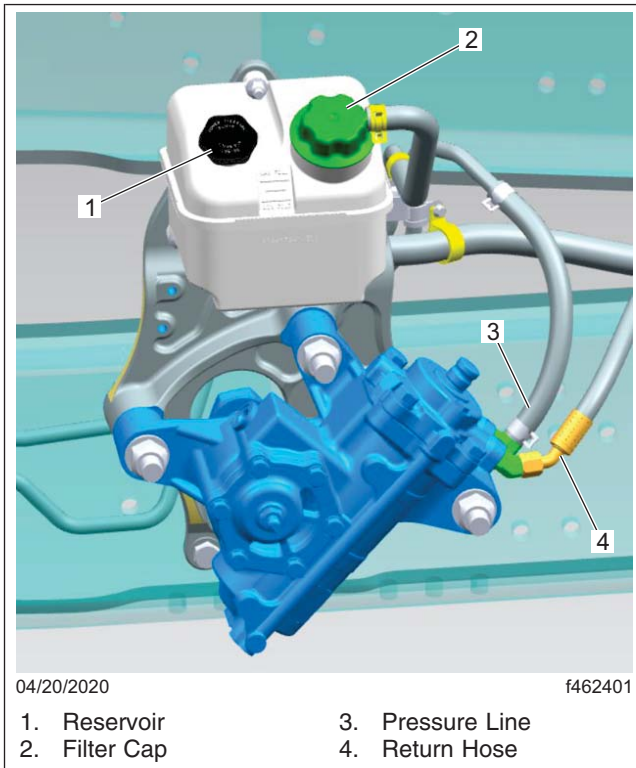


Fig. 1, Power Steering Reservoir

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

Table 1, 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 be-

tween 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.

46-03 Drag Link Lubrication

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Using a clean rag, wipe all dirt from the drag link grease fittings. See Fig. 2.
3. Using a pressure gun and NLGI Grade 2 (8% 12-hydroxy lithium stearate grease) or NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) chassis grease, apply clean grease at the grease fittings until old grease is forced out of the socket.

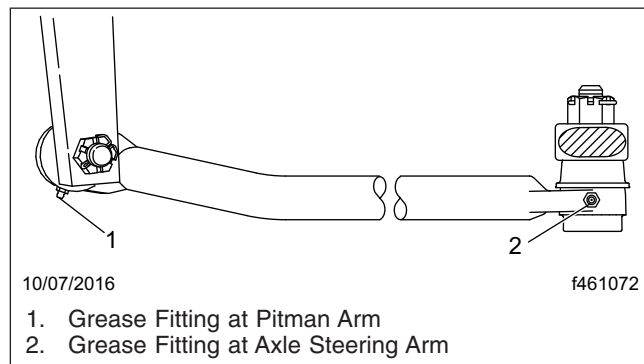


Fig. 2, Drag Link

Title of Maintenance Operation (MOP)	MOP Number
Fuel Filter Replacement	47-01
Fuel Tank Band-Nut Tightening	47-03
Fuel/Water Separator Element Checking and Replacement	47-02
Safety Precautions	47-00

47–00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

47–01 Fuel Filter Replacement

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

47–02 Fuel/Water Separator Element Checking and Replacement

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

Detroit

WARNING

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

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

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

2. Place a suitable container under the fuel/water separator, to collect the draining fuel. The drain valve has a 3/8 inch (9.5 mm) slip-on hose connection.
3. Open the drain valve. See [Fig. 1](#).
4. When the fuel/water separator is completely drained, close the valve.
5. If equipped, remove the water in fuel (WIF) and heater harness connectors. See [Fig. 1](#).
6. Remove bowl and filter. Dispose of the filter and the O-ring in an environmentally acceptable manner. [Fig. 2](#).
7. Lubricate new O-rings with motor oil or clean fuel and install them with the new filter.
8. Install the bowl and tighten snugly by hand or using a bowl wrench.
9. If equipped, install the WIF sensor and heater harness connectors.
10. If equipped with a priming pump, loosen the drain plug and operate the priming pump until the fuel comes out at the drain.
11. If not equipped with a priming pump, remove the fill port on top of the assembly, fill the filter element and bowl with clean fuel. Install the fill port and tighten snugly.
12. Start the engine and check for fuel leaks.
13. Shut down the engine and correct any fuel leaks.

DAVCO Fuel Pro® 385 and 485

WARNING

Fluid circulated through the fuel/water separator 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, the 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.

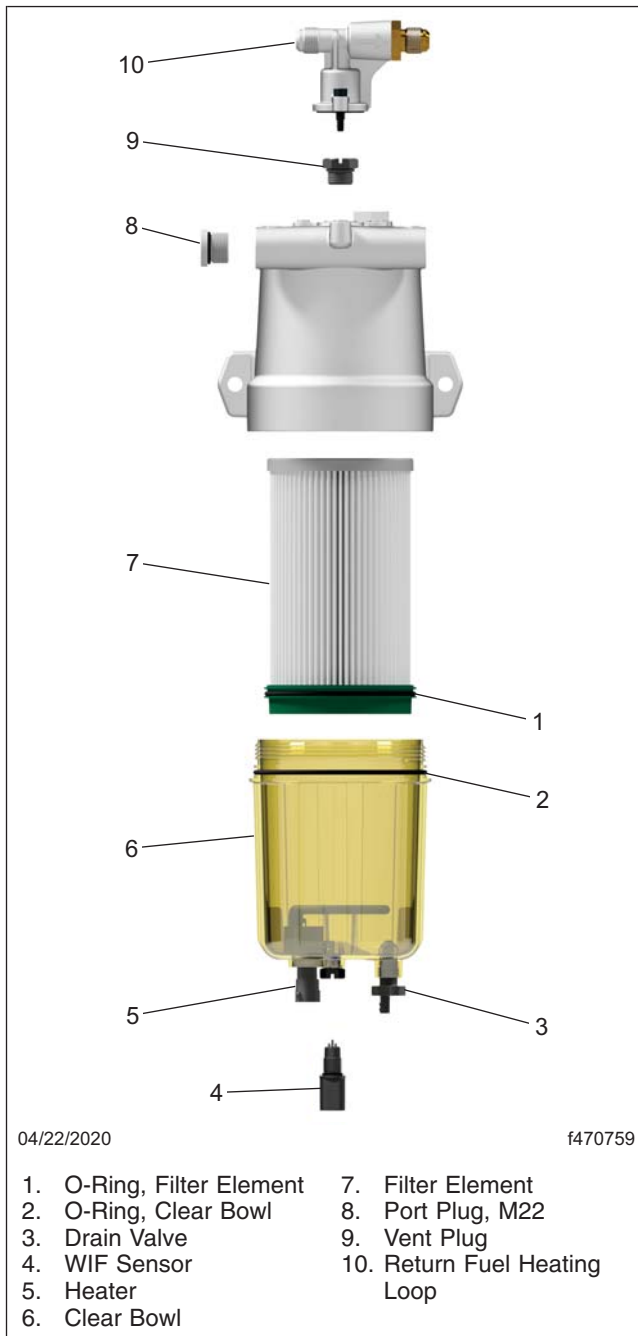


Fig. 1, Fuel Water Separator, Detroit

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

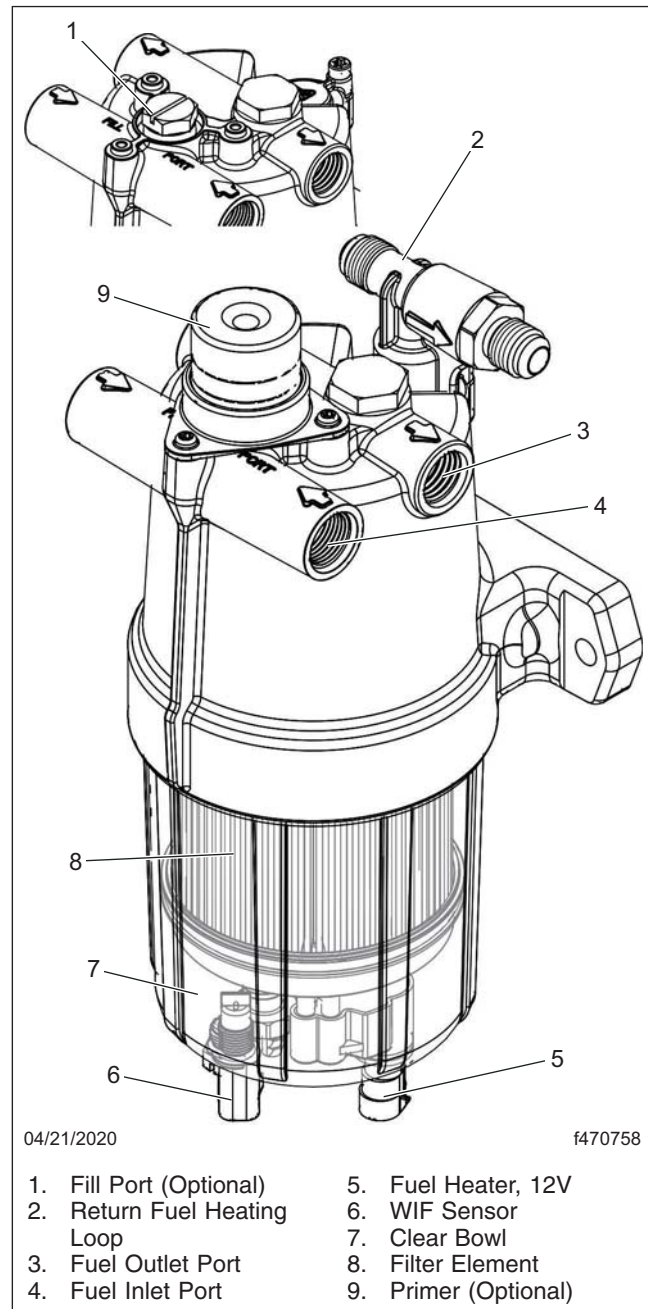


Fig. 2, Fuel/Water Separator Assembly, Detroit

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.

- 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 (Fig. 3, Item 7) has a 3/4-inch (19-mm) slip-on hose connection.

- Remove the vent cap, shown in Fig. 3, to drain the fuel completely, then close the drain valve.

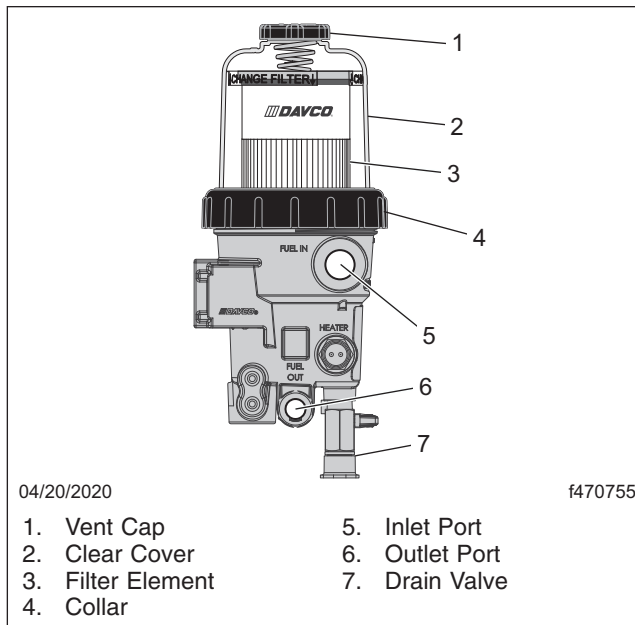


Fig. 3, DAVCO Fuel Pro 385

- Using a DAVCO Collar Wrench, shown in Fig. 4, remove the collar and clear cover.

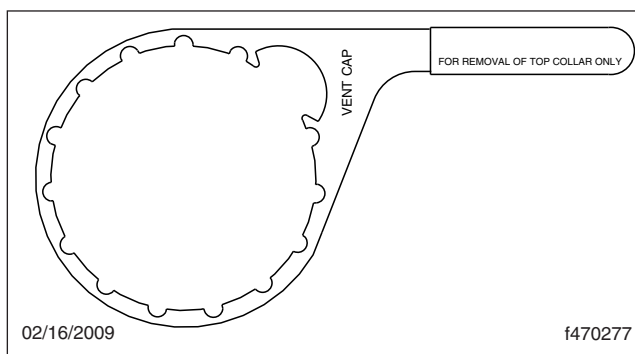


Fig. 4, DAVCO Collar Wrench

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.

- Remove the filter, cover O-ring, and vent cap O-ring. Dispose of them in an environmentally acceptable manner. See Fig. 3.
- 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.
- 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. 5. Ensure the filter element is fully seated by firmly pushing on the endplate. The filter should not rotate freely.

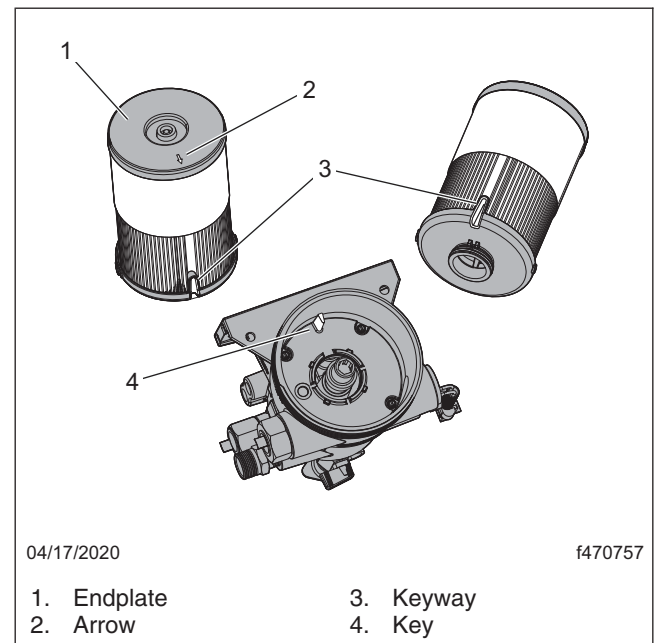


Fig. 5, Positioning the Filter Element

- 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

- 10.1 Ensure that the drain valve is closed.
- 10.2 Fill the housing to the top of the filter element with clean diesel fuel.
- 10.3 Install and hand-tighten the vent cap O-ring and vent cap.
- 10.4 Start the engine. When the lubricating oil reaches its normal operating pressure, increase the engine speed to high idle for one to two minutes to purge the air from the system.
- 10.5 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.
- 10.6 Check for leaks and shut down the engine.

Alliance/Racor

WARNING

Fluid circulated through the fuel/water separator 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, the vapors can ignite in the presence of any ignition source. Do not expose the fuel to, or work with the fuel system near open flame or intense heat. To do so could cause fire, possibly resulting in serious personal injury or property damage.

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

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

3. Empty the filter into a suitable container, and close the drain plug.
4. If equipped, remove the wiring harness connectors from the water sensor probe and the heater. See **Fig. 6**.

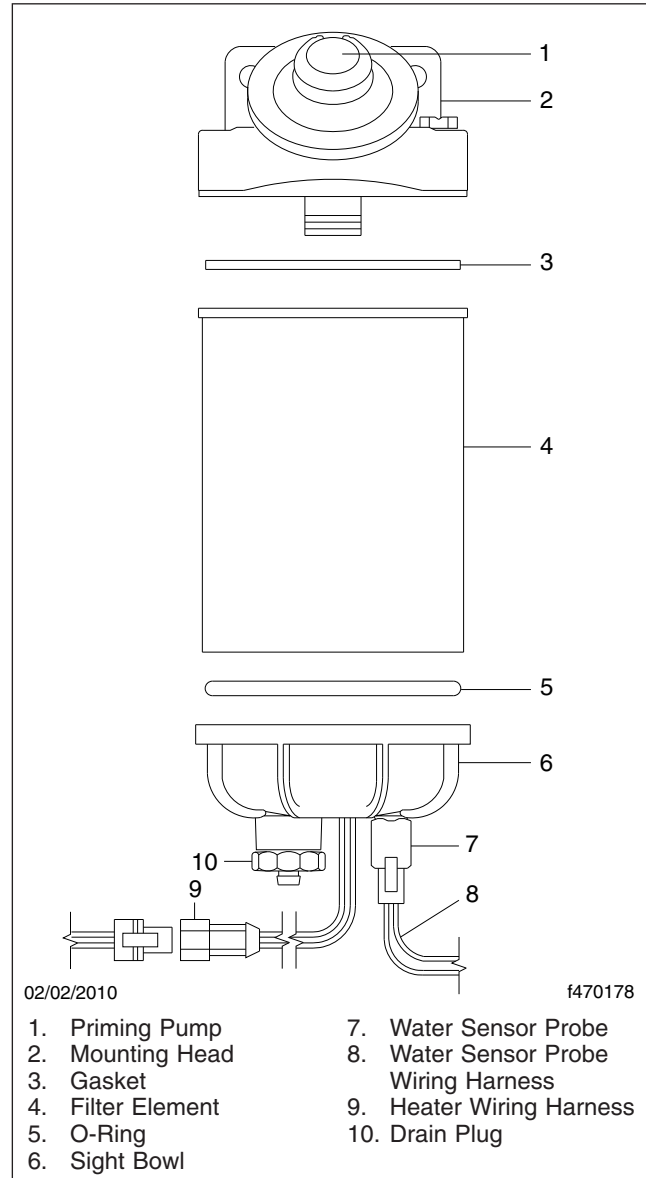


Fig. 6, Fuel/Water Separator Assembly

5. Spin off the sight bowl and the filter element as a unit. Remove the gasket from the top of the filter element.

6. Remove the sight bowl from the filter element. Clean the O-ring seating surface.
7. Apply a thin coating of clean diesel fuel or engine oil to the O-ring and the new gasket, and assemble filter and bowl.
8. If the filter head is not equipped with a priming pump, fill the filter element and sight bowl assembly with clean diesel fuel.
9. Spin the entire assembly onto the mounting head and tighten by hand until snug.
10. Connect the heater and water sensor wiring harnesses, if equipped.
11. If equipped with a priming pump, use it to fill the filter/bowl assembly. Prime the fuel/water separator.
12. Start the engine and check for leaks.
13. Shut down the engine and repair any leaks.

47-03 Fuel Tank Band-Nut Tightening

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

IMPORTANT: Do not overtighten.

Title of Maintenance Operation (MOP)	MOP Number
Exhaust System Maintenance	49-01
Safety Precautions	49-00

49–00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

49–01 Exhaust System Maintenance

The exhaust system must be free of leaks, binding, grounding, and excessive vibrations. These conditions are usually caused by loose, broken, or misaligned clamps, brackets, or pipes. If any of these conditions exist, check the exhaust system components and alignment. Align or replace as necessary; see **Group 49** of the *Western Star 47X and 49X Workshop Manual*.

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.

No visible exhaust gas leaks are allowed anywhere in the ATS. If any problems are discovered, refer to the engine manufacturer's service literature for repair instructions.

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.

1. Check the DEF tank, pump, metering unit, and lines for leaks. See **Section 49.02** of the *Western Star 47X and 49X Workshop Manual* for repair procedures.

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

Diesel Exhaust Fluid (DEF) Filter Replacement

The 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. Twist the filter cover to replace the filter. See **Fig. 1**.

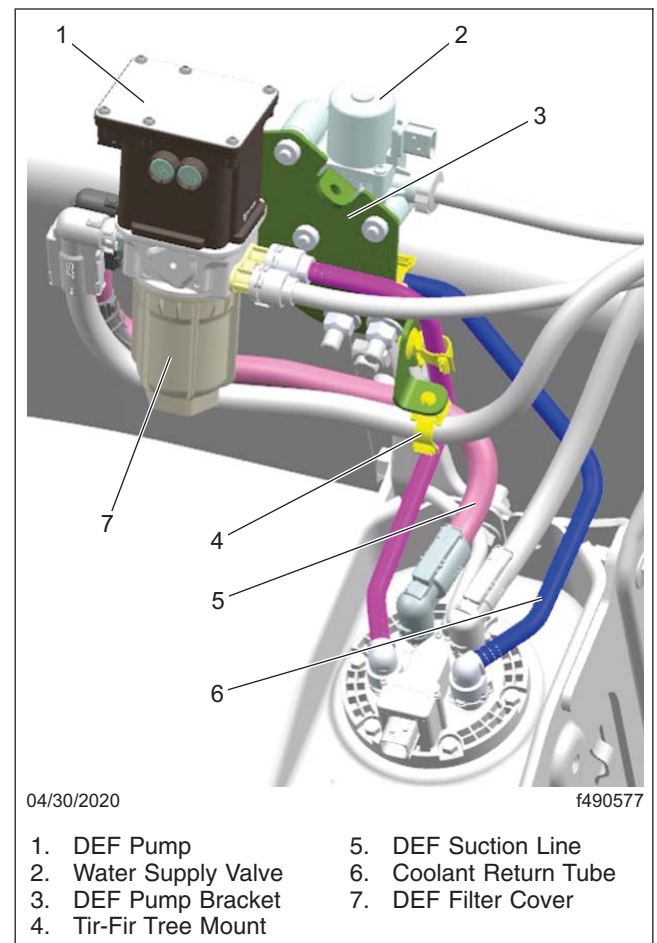


Fig. 1, DEF Pump, Cummins Engine

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

Title of Maintenance Operation (MOP)	MOP Number
Electrical Component Inspection.	54-02
Trailer Cable Inspection and Cleaning.	54-01

54-01 Trailer Cable Inspection and Cleaning

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Inspect the cables for cuts, abrasion, or other damage. If internal wiring is exposed, replace the cables.
3. Disconnect the trailer electrical cables from the sockets at the cab.
4. Inspect the cables and sockets for evidence of corrosion, and clean as necessary. If a socket is too badly corroded to clean, replace it. If corrosion has gotten into the wires and connectors inside the socket, replace the cable.

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

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

54-02 Electrical Component Inspection

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Disconnect the batteries.
3. Inspect the condition of the electrical component. Check for signs of excess dirt/debris build up on or around component. If exterior cleaning is needed for a thorough inspection, clean exterior debris from the component using a dry method such as a vacuum cleaner or using an electrical contact cleaner such as CRC QD® Electronic Cleaner.
4. Check all mounting points for loose, broken, or missing parts. Component must be securely mounted. All loose, broken, or missing parts must be repaired to maintain proper component function.

5. Inspect the component protective cover for proper fit and function. Inspect cover for cracks, broken mounting, missing sealing surfaces, warped or bulged surfaces. The cover must prevent moisture and debris from entering the components protected area. Missing, leaking, or damaged covers will result in moisture and debris entering the component and will result in component failure. When it is determined that a cover has not properly prevented moisture and debris from entering the component, the entire component must be replaced.
6. Inspect the component exterior for signs of thermal distortion, warping, bulging, discoloration, amperage related heating, color variance or shading across component which could be a sign of internal failure requiring replacement of the component. The root source causing conditions of high heat, excess amperage, and/or circuit overload component failures must be diagnosed and repaired prior to replacing the component.
7. Inspect component housing sub-assembly clips and fasteners for correct fit and location and that component sub-assembly housing seams are tight and secure. Missing, leaking, or damaged component housings must be replaced.
8. Check main power cable connections for a clean and secure fit. Connections should be free of corrosion, dirt and moisture. Connections should not have signs of thermal distortion, warping, discoloration, high amperage heating or discoloring. If needed, disconnect cables, scrub and clean as needed using a nylon brush. Clean debris with vacuum or electrical contact cleaner such as CRC QD® Electronic Cleaner, inspect terminals and mating contact terminal plating. If the terminal plating exhibits signs of unrecoverable corrosion, the component and terminal will need replaced. Indications of unrecoverable corrosion on terminal plating are:
 - Heavy staining that cannot be cleaned off with nylon brush or contact cleaner;
 - erosion and pitting on terminal plating causing uneven surfaces; or
 - discoloration caused by outer layer of plating being removed by corrosion or wear exposing the under layer material of terminal.

9. Check all electrical connectors for correct fit and that the connector locking tabs are in place and will hold the connector firmly into the component. Inspect connector terminals for signs of corrosion, thermal distortion, warping, discoloration, high amperage heating or discoloring. If needed, remove connectors and terminals, scrub and clean as needed using a nylon brush. Clean debris with vacuum or electrical contact cleaner such as CRC QD® Electronic Cleaner, inspect terminals and mating contact terminal plating. If the terminal plating exhibits signs of unrecoverable corrosion, the component and terminal will need to be replaced.
10. Inspect sealed harness connectors for presence of connector housing seals and connector pin seals designed to keep moisture and debris from entering the connector and component. Missing, leaking, or damaged seals will result in moisture and debris entering the connection and the component and will result in component failure. When it is determined that connector seals have not properly prevented moisture and debris from entering the component, the entire component must be replaced.
11. Inspect component harnesses for secured routing that prevents excess harness movement and prevents the harness from pulling too tight on the connector. Inspect harnesses for signs of rubbing or chafing that could result in wire circuit damage. Damaged wiring and/or damage to harness protective wrap must be repaired and harness must be wrapped and secured to prevent further damage. When possible, harness should be routed with drip loop.
12. Inspect fuses and relays for correct fit, and that the terminals hold the fuses and relays firmly in place. Inspect fuses and relays for signs of corrosion, thermal distortion, warping, discoloration, and high amperage heating or discoloring. If loose or corroded, remove, inspect, clean, and replace as needed.
13. Connect the batteries.

Title of Maintenance Operation (MOP)	MOP Number
Aerodynamic Component Inspection	60-03
Baggage Door and Sleeper Access Door Release Cable and Latch Lubrication	60-04
Cab Shock Absorber Bracket Torque Check	60-02
Mirror Folding Check	60-01

60-01 Mirror Folding Check

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

60-02 Cab Shock Absorber Bracket Torque Check

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Check the torque on the upper bolt that attaches the shock absorber upper bracket to the cab. If loose, tighten the bolt 34 lbf·ft (46 N·m). See [Fig. 1](#).
3. From behind the cab skin, check the torque of each of the two lower nuts that attach shock absorber upper bracket to the cab, while holding the bolt in place with a box wrench. If loose, tighten the nuts 34 lbf·ft (46 N·m).

60-03 Aerodynamic Component Inspection

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

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

Replace or repair damaged or missing components as needed.

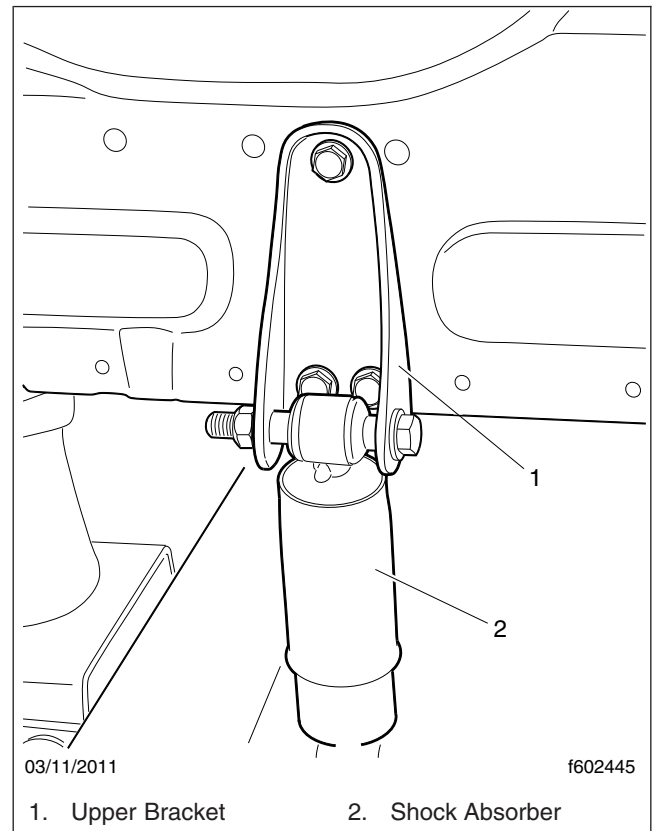


Fig. 1, Cab Shock Absorber and Upper Bracket

60-04 Baggage Door and Sleeper Access Door Release Cable and Latch Lubrication

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

1. Open the baggage door and the sleeper access door, if equipped, by pulling the release handle(s) located inside the cab door opening. See [Fig. 2](#).
2. Pull out on the baggage door handle, and apply a light coating of lubricant to the exposed length of cable. Repeat for the sleeper access door cable, if equipped.
3. At the opened baggage door, apply a light coating of lubricant to the latch jaw and the exposed

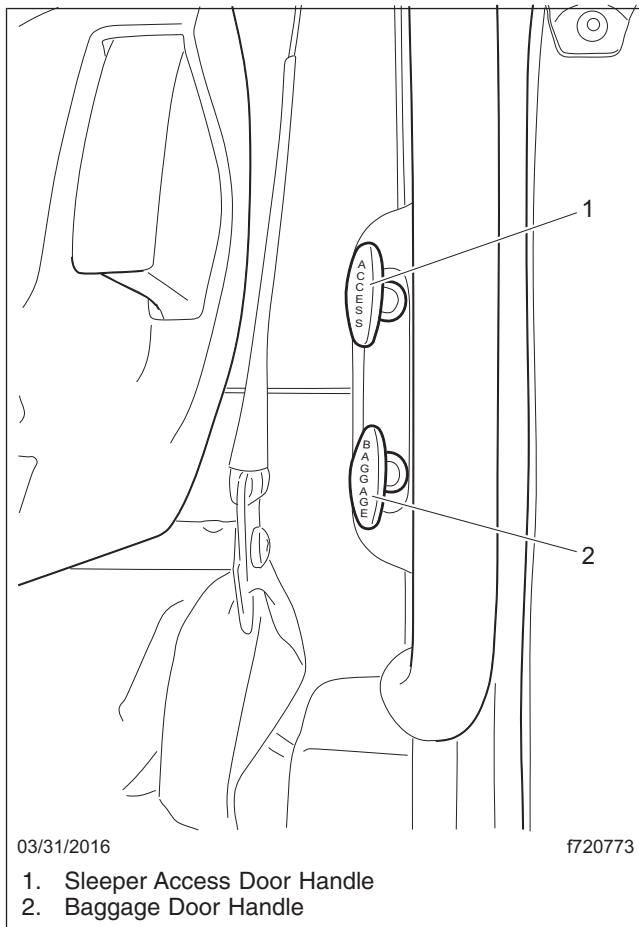


Fig. 2, Sleeper Door Release Handles

length of cable. See [Fig. 3](#). Repeat for the sleeper access door, if equipped. Removal of trim panels is not required.

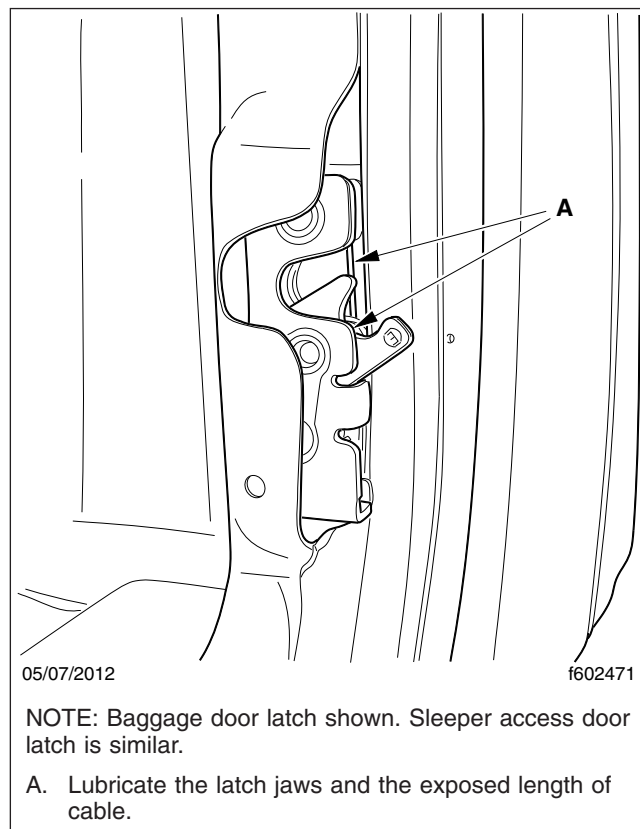


Fig. 3, Baggage Door Latch

Heater and Air Conditioner

83

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Air Conditioner Inspection	83-01
Air Filter Replacement	83-02
Dual HVAC System Inspection	83-03
Safety Precautions	83-00

83–00 Safety Precautions

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

DANGER

When working on the vehicle, shut down the engine, 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.

83–01 Air Conditioner Inspection

WARNING

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

Preliminary Checks

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brakes. Chock the tires.
2. Check the appearance of the air conditioner compressor pulley assembly. If the friction surface of the pulley shows signs of excessive grooving due to belt slippage, replace both the pulley and the drive plate. Inspect the refrigerant compressor drive belt for damage and check that the belt is set at the proper tension. Also check the tightness of the compressor mounting fasteners. For instructions and torque values, see **Group 01** of the *Western Star 47X and 49X Workshop Manual*.
3. Inspect the drive plate. If the drive plate shows visible signs of damage due to excessive heat, replace the drive plate and pulley assembly. For removal and installation procedures, see **Group 83** of the *Western Star 47X and 49X Workshop Manual*.
4. Using a feeler gauge, check that the drive plate clutch clearance is within limits. See [Table 1](#) for

clearance specifications. See [Fig. 1](#) for the checking method. Adjust the drive plate clutch if needed.



Fig. 1, Valeo Drive Plate Clutch Air Gap

Compressor Drive-Plate Clutch Clearance	
Manufacturer	Clearance: in (mm)
Valeo	0.012 to 0.024 (0.30 to 0.60)

Table 1, Compressor Drive-Plate Clutch Clearance

5. Inspect the compressor clutch coil wire. Check that the connector is not damaged or loose. Replace the wire if it is damaged.
6. Check the overall condition of the air conditioning hoses. Look for cracks, cuts, and abrasions on the hoses. Replace damaged hoses. Also check for loose fittings on all of the air conditioning components.
7. Check for a buildup of road debris on the condenser fins.

83–02 Air Filter Replacement

The HVAC system has three filters that must be replaced periodically to maintain proper system operation. The cabin fresh-air-intake filter is accessed from under the hood, and the recirculation filter is accessed from inside the cab. The sleeper air filter is

accessed through an access panel or under the bunk behind the driver's seat.

Cab Fresh-Air Filter Replacement

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

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Open the hood.
3. Remove the intake filter access panel. Slide it down until it comes loose. See **Fig. 2**.

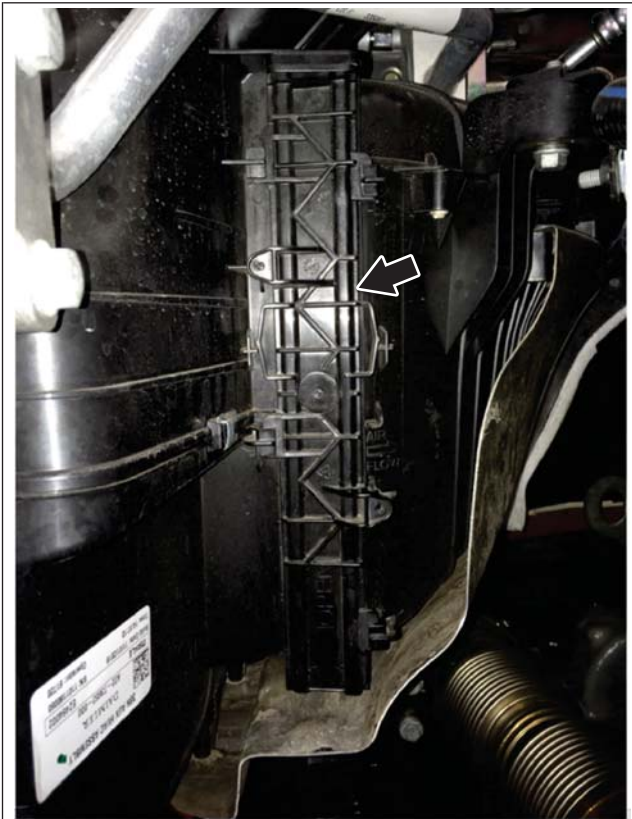


Fig. 2, Intake Filter Access Panel

4. Remove the filter from the slot. Note the airflow directional arrow on the filter's edge. When properly installed, the airflow arrow will point inboard, toward the engine. See **Fig. 3**.



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1. Airflow Directional Arrow Orientation

Fig. 3, Airflow Directional Arrow

5. Put a new filter in the slot, making sure the airflow arrow is correctly oriented, and install the access panel. Make sure the access panel locks into position.

Cab Recirculation-Air Filter Replacement

The recirculation air filter is located on the evaporator housing facing the interior of the cab just to the right of center. It is accessed from the underside of the unit. It is a coarse sponge, or fiber, filter. See **Fig. 4**.

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

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



Fig. 4, Cab Recirculation Air Filter

3. Remove the filter.
4. Install the new filter.
5. Install the access panel.

Sleeper Air Filter Replacement

In vehicles with 60-inch and 72-inch sleepers, the sleeper air filter is located on the forward side of the blower fan housing, under the cabinet, directly behind the driver's seat. In vehicles with 36-inch and 48-inch sleepers, the sleeper air filter is located on the forward side of the blower fan housing, under the L/H side of the sleeper bunk.

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

1. Park the vehicle on a level surface, set the parking brake, and shut down the engine. Chock the tires.
2. In vehicles with 60-inch and 72-inch sleepers, open the L/H lower cabinet door and remove carpet inside the cabinet. See [Fig. 5](#).
In vehicles with 36-inch and 48-inch sleepers, raise the lower bunk, and lift to remove the HVAC cover panel. See [Fig. 6](#) and [Fig. 7](#).
3. Lift the filter out of the slot for 36-inch sleeper. See [Fig. 7](#).

4. Lift the filter out of the slot. See [Fig. 5](#) for 60- and 72-inch sleepers, or [Fig. 6](#) for 48-inch sleepers.
5. Install a new filter in the slot, making sure that it is completely seated in the slot.
6. Install the carpet. Close the cabinet door in vehicles with 60-inch and 72-inch sleepers.
7. Install the HVAC cover panels and close the bunks for 36-inch and 48-inch sleepers.

Dual HVAC System Air Filter Replacement

The Dual HVAC System air filter is located on the forward side of the blower fan housing. In vehicles with 60-inch and 72-inch sleepers the Dual HVAC System air filter is located on the forward side of the blower fan housing, under the cabinet, directly behind the driver's seat. In vehicles with 36-inch and 48-inch sleepers, the Dual HVAC System air filter is located on the forward side of the blower fan housing, under the L/H side of the sleeper bunk.

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

1. Park the vehicle on a level surface, set the parking brake, and shut down the engine. Chock the tires.
2. In vehicles with 60-inch and 72-inch sleepers, remove the sleeper HVAC cover on the inboard side of the cabinet. See [Fig. 8](#). The panel is held in place with four spring clips. Pull straight out to remove the HVAC cover.

In vehicles with 36-inch and 48-inch sleepers, raise the lower bunk to access the Dual HVAC System air filter under the L/H side of the sleeper bunk. In vehicles with 48-inch sleepers, the front center bunk partition will need to be removed by detaching the lower bunk strut pivot to gain access to the Dual HVAC System air filter by removing the 12 fasteners. See [Fig. 10](#).

3. Pull the filter out of the slot. See [Fig. 8](#) for 60- and 72-inch sleepers, or [Fig. 9](#) for 48-inch sleepers, or see [Fig. 11](#) in vehicles with 36-inch sleepers.
4. Install a new filter, making sure that it is completely seated.

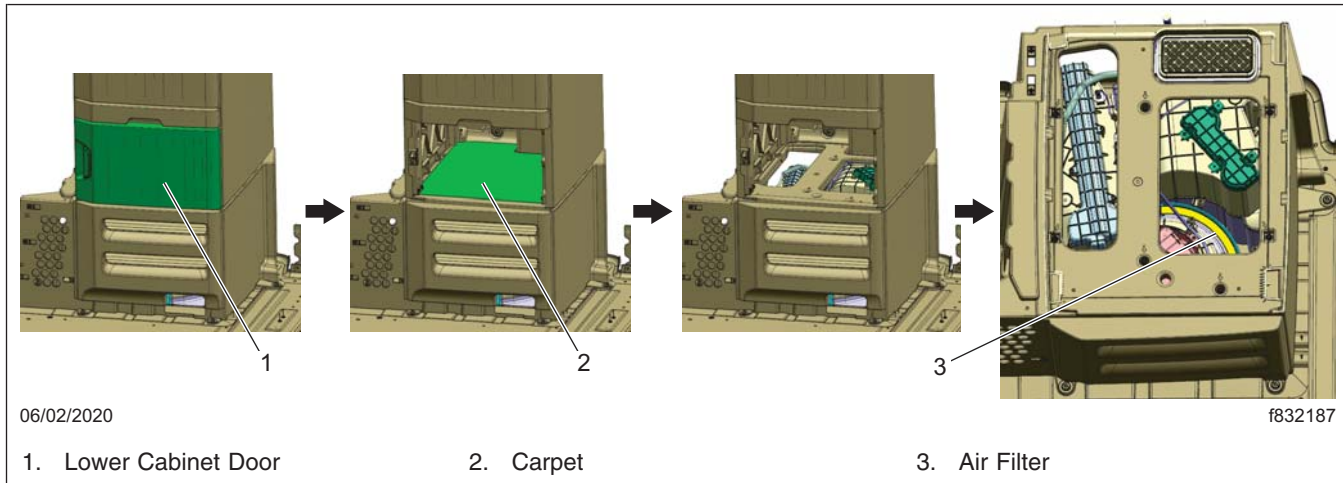


Fig. 5, Sleeper HVAC Access Panel, 72-inch Sleepers (Similar for 60-inch Sleeper)

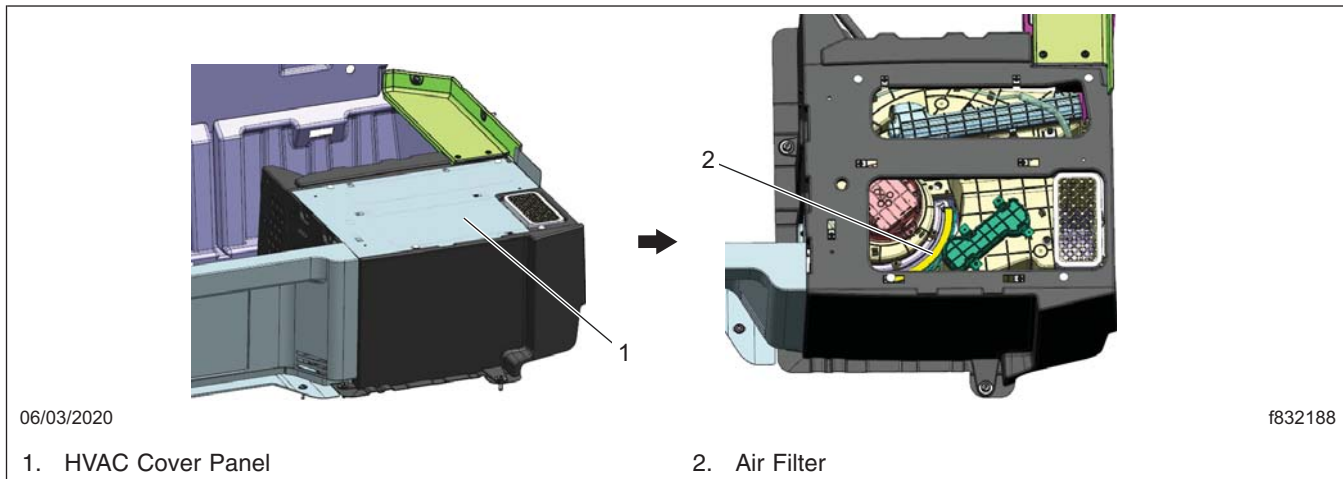


Fig. 6, Sleeper HVAC Access Panel, 48-inch Sleeper

5. Install the HVAC cover in vehicles with 60-inch and 72-inch sleepers or lower the bunk in vehicles with 36-inch sleepers or install the front center bunk partition by attaching the lower bunk strut pivot and lower the bunk in vehicles with 48-inch sleepers.

minutes to achieve operating temperature, and clear old fuel from the lines.

2. Verify that the unit completes the start-up cycle, and continues to produce warm exhaust.

83-03 Dual HVAC System Inspection

Fuel-Operated Heater Check

1. Start the Dual HVAC System and set the control knob to maximum heat. Run the heater for 15

External A/C Condenser Inspection and Cleaning

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

1. Check for debris in the condenser housing.

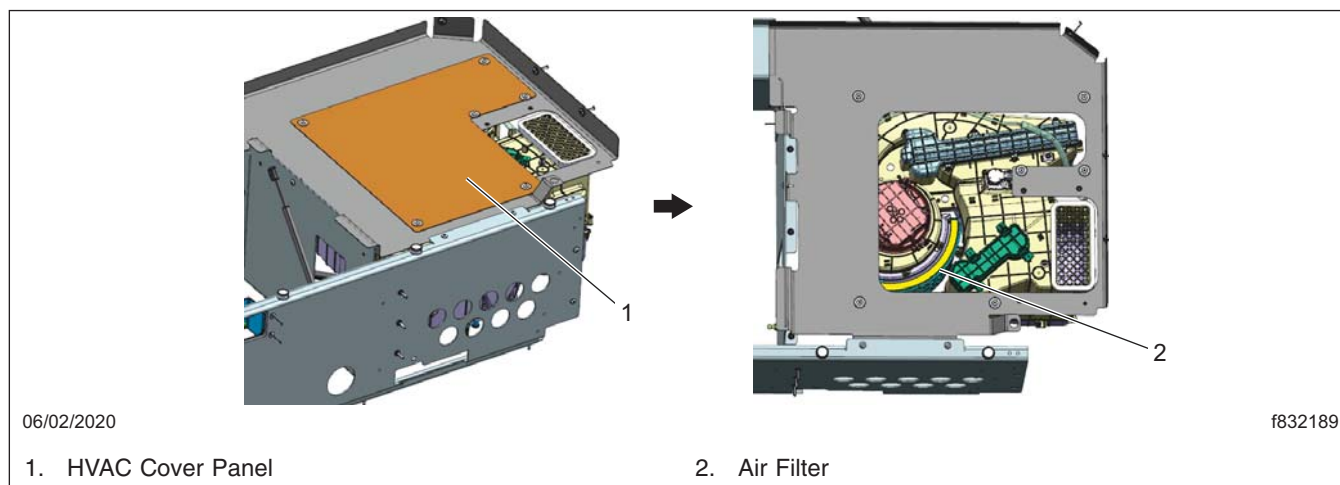


Fig. 7, Sleeper HVAC Access Panel, 36-inch Sleeper

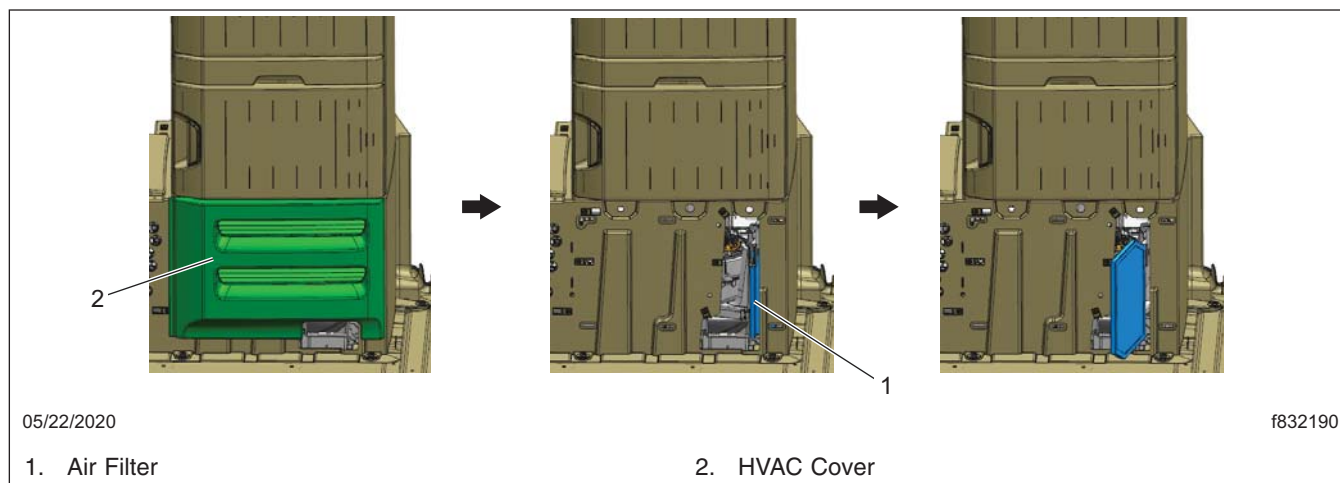


Fig. 8, Removing the Dual HVAC System Filter, 72-inch Sleepers (Similar for 60-inch Sleeper)

2. If needed, remove the condenser cover fasteners, then remove the cover. See [Fig. 12](#).

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

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

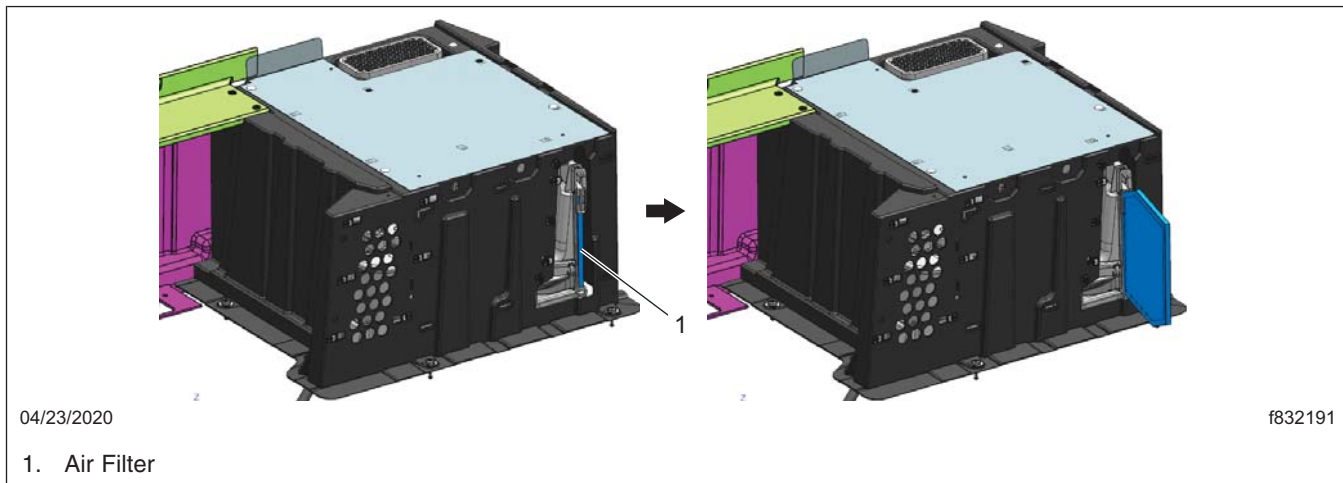


Fig. 9, Removing the Dual HVAC System Filter, 48-inch Sleeper

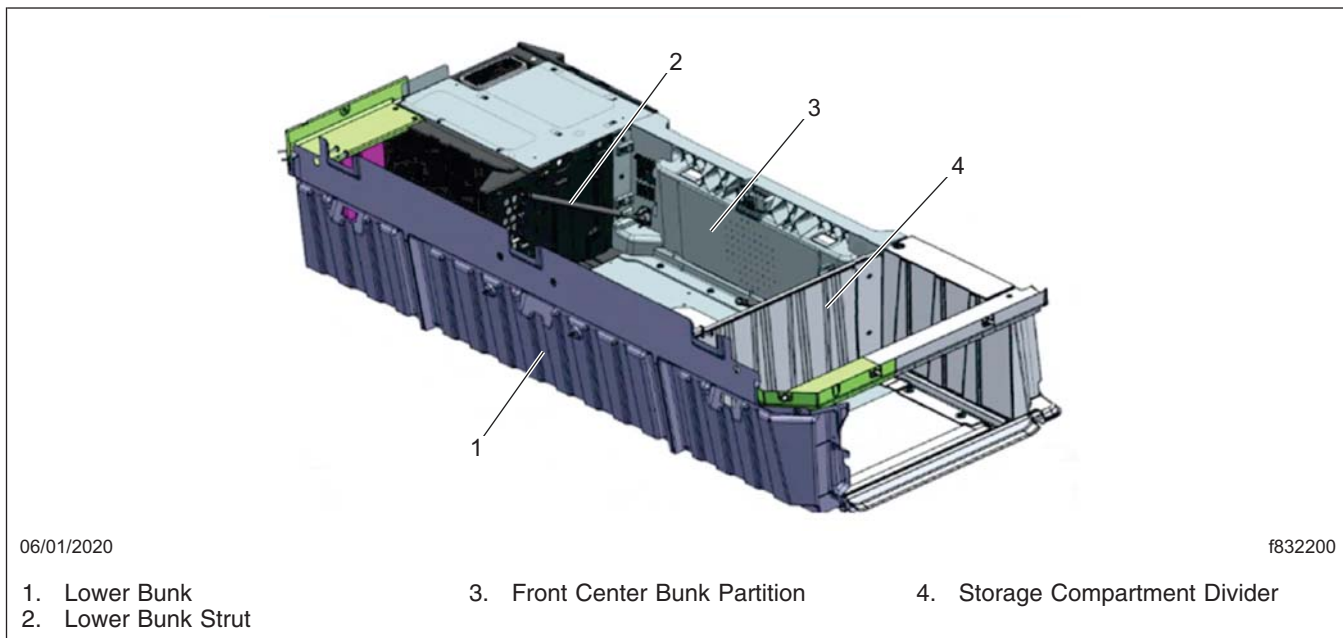


Fig. 10, Lower Bunk Assembly, 48-Inch Sleeper

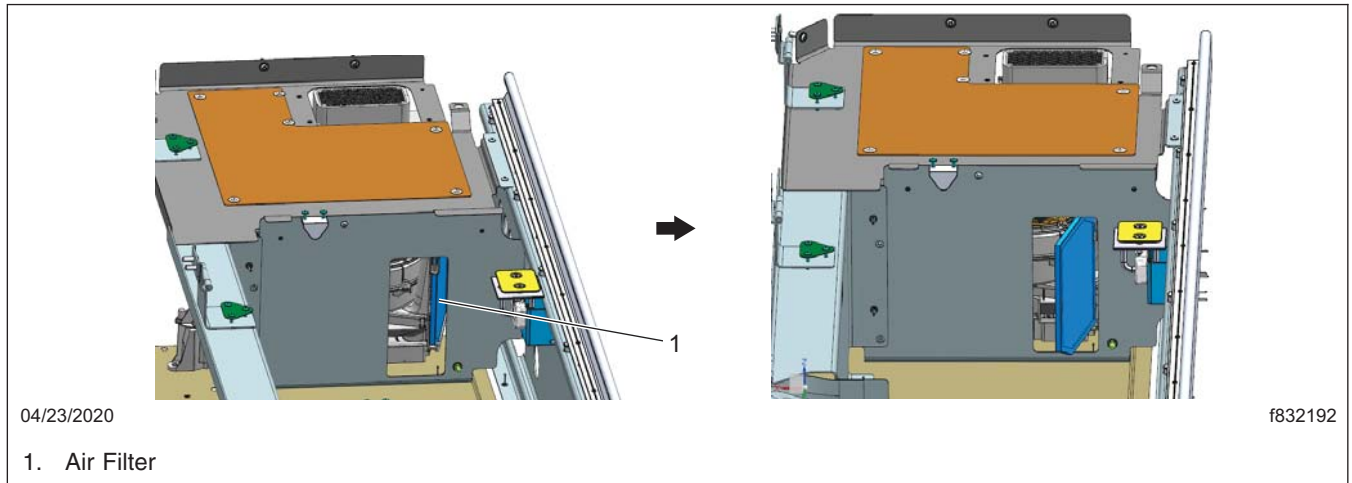


Fig. 11, Removing the Dual HVAC System Filter, 36-inch Sleeper

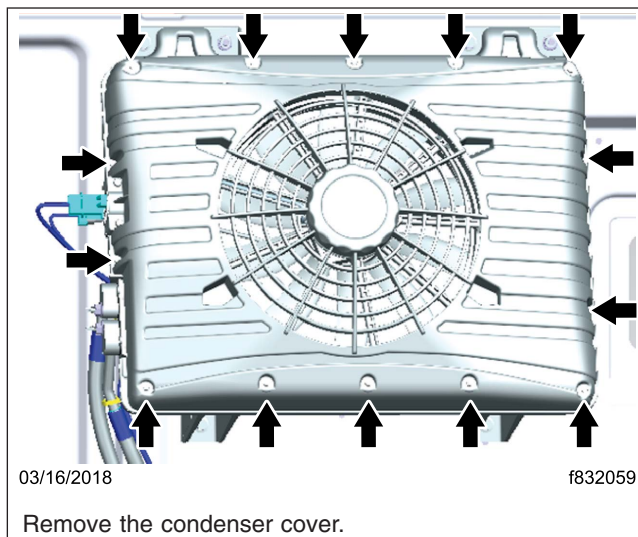


Fig. 12, Condenser Cover Fasteners (compact style condenser)

