# 47X, 48X and 49X Maintenance Manual

**Models:** 47X
48X
49X
47X RHD
48X RHD
49X RHD

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# 1. Introduction

## 1.01 Foreword

Foreword

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

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

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Environmental Concerns and Recommendations

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

**NOTICE:**

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

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**Daimler Truck North America LLC Service Systems and Documentation**

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**97208-3849**

## 1.02 Descriptions of Service Publications

### 1.02.01 Workshop/Service Manual

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

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

NOTE: **New Cascadia Workshop Manual** is available in an online format only.

### 1.02.02 Maintenance Manual

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

### 1.02.03 Driver's/Operator's Manual

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

### 1.02.04 Service Bulletins

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

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

### 1.02.05 Parts Technical Bulletins

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

### 1.02.06 DTNAConnect

Web-based repair, service, and parts documentation can be accessed using the following applications on the

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

### 1.02.07 PartsProX

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

### 1.02.08 EZWiring

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

### 1.02.09 Recall Campaigns

Warranty-related service information available on the

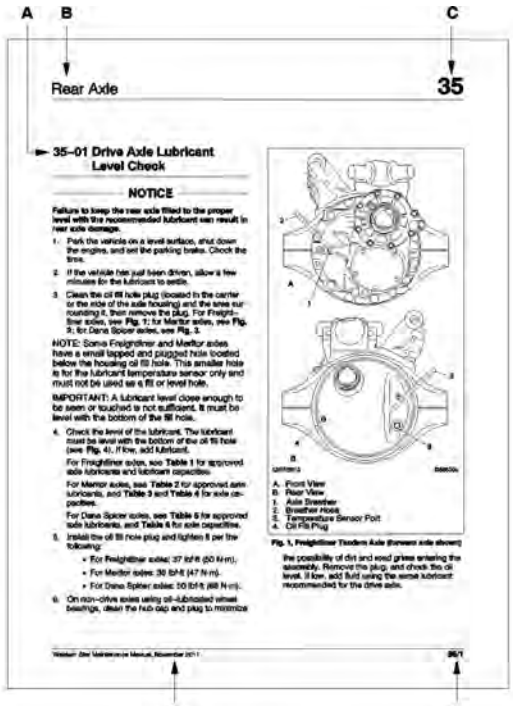
Recall campaigns cover situations that involve service work or replacement of parts in connection with a recall notice. These campaigns pertain to matters of vehicle safety. All recall campaigns are distributed to dealers; customers receive notices that apply to their vehicles.

### 1.02.10 Field Service Campaigns

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

## 1.03 Page Description

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




A. Maintenance Operation Number consists of the Group Number followed by the Sequence Number
B. Group Title
C. Group Number
D. Release Date
E. Group Number/Page Number

**Fig 1, Example Page**

2.01 Determining Scheduled Maintenance Intervals: 00–01 ..... 10
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## 2. General Information

### 2.01 Determining Scheduled Maintenance Intervals: 00–01

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.

### 2.02 Service Schedule Table: 00–02

**Table 1, Service Schedule**

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

## 2.03 Vehicle Maintenance Schedule Table: 00–03

**Table 2, Maintenance for Service Schedule I**

| 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 |
| 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 |
| 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**

**Table 3, Maintenance for Service Schedule II**

| 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 |

| | | | | |
|---|---|---|---|---|
| 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**

## 2.04 Initial Maintenance (IM) Operations: 00–04

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

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

| Maintenance Operation Number | Initial Maintenance (IM) Operations for Service Schedules I and II | Check |
|---|---|---|
| 2.05 | 2.05 M1 Maintenance Interval Operations: 00–05 | |
| 9.04 | 9.04 Frame Fastener Torque Check | |
| 10.02.01 | 10.02.01 General Information | |
| 10.06 | 10.06 Suspension TufTrac Gen2 I-Bolt Torque Check | |
| 10.08 | 10.08 NEWAY ADZ V-Rod Torque Check | |
| 11.05.01 | 11.05.01 General information | |
| 15.12.01 | 15.12.01 Operating Test[1] | |
| 17.04 | 17.04 Tightening the Fuel Tank Band-Nut | |

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

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

## 2.05 M1 Maintenance Interval Operations: 00–05

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

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

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

| Maintenance Operation Number | M1 Maintenance Interval Operations for Service Schedules I and II | Check |
|---|---|---|
| 4.02 | 4.02 Inspection of the Air Compressor | |
| 7.02 | 7.02 Lubrication of the Clutch Release Bearing[1] | |
| 9.02.01 | 9.02.01 General information | |
| 9.03.01 | 9.03.01 General information | |
| 10.02.01 | 10.02.01 General Information | |
| 10.08 | 10.08 NEWAY ADZ V-Rod Torque Check | |
| 13.01 | 13.01 Wheel Nut Check | |
| 13.02 | 13.02 Tire Check | |
| 14.02 | 14.02 Inspection of the Driveline | |
| 14.03.01 | 14.03.01 Lubrication of the Universal Joint | |
| 15.03.01 | 15.03.01 AD–9[2] | |
| 15.06.01 | 15.06.01 Parking Brake Operational Check | |
| 15.07 | 15.07 Lubrication of the Haldex Slack Adjuster | |
| 15.08.01 | 15.08.01 General Information | |
| 15.11 | 15.11 Replacement of the WABCO System Saver Air Dryer Desiccant Cartridge | |
| 15.12.01 | 15.12.01 Operating Test[3] | |
| 17.02 | 17.02 Replace The Fuel Filter | |
| 17.03.01 | 17.03.01 Detroit | |
| 18.02.01 | 18.02.01 General Information | |
| 20.01.01 | 20.01.01 Cab Shock Absorber Bracket Torque Check | |
| 20.01.02 | 20.01.02 Inspection of the Aerodynamic Component | |
| 21.04.01 | 21.04.01 Fuel-Operated Heater Check | |

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

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

## 2.06 M2 Maintenance Interval Operations: 00–06

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

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

| Maintenance Operation Number | M2 Maintenance Interval Operations for Service Schedules I and II | Check |
|---|---|---|
| 2.05 | 2.05 M1 Maintenance Interval Operations: 00–05 | |
| 5.02 | 5.02 Alternator, Battery, and Starter Connections Check | |
| 6.02 | 6.02 Pressure Relief Cap Check | |
| 6.04.01 | 6.04.01 Borg Warner (Kysor) K30 Fan Clutch | |
| 7.03 | 7.03 Fluid Level Check, Hydraulic Clutch Control | |
| 8.02 | 8.02 Cleaning the Detroit® Automated Transmission Fluid Change and Magnetic Plug | |
| 8.03 | 8.03 Inspection the Detroit® Automated Transmission Fluid Level | |
| 8.05.01 | 8.05.01 General information | |
| 8.06 | 8.06 Cleaning, or Replacement of the Eaton Fuller Manual Transmission Air Filter/ Regulator Check, | |
| 10.02.01 | 10.02.01 General Information | |
| 10.06 | 10.06 Suspension TufTrac Gen2 I-Bolt Torque CheckSuspension TufTrac Gen2 I-Bolt Torque Check | |
| 10.08 | 10.08 NEWAY ADZ V-Rod Torque Check | |
| 11.02.01 | 11.02.01 General information[1] | |
| 11.03 | 11.03 Inspection The Tie Rod | |
| 11.04 | 11.04 Tie Rod Lubrication | |
| 12.03.01 | 12.03.01 Detroit® Model 4 and Model 6 | |
| 15.02 | 15.02 Inspection of the Air Brake System Valve | |
| 15.04 | 15.04 Inspection of the Air Dryer | |
| 15.05.01 | 15.05.01 General Information | |
| 15.09.01 | 15.09.01 General Information | |
| 16.02 | 16.02 Inspection of the Drag Link | |
| 16.04 | 16.04 Lubrication of the Drag Link | |
| 19.01 | 19.01 Inspection and Cleaning the Trailer Cable | |
| 19.02 | 19.02 Inspection of the Electrical Component | |
| 20.01 | 20.01 Mirror Folding Check | |

| | | |
|---|---|---|
| 20.01.03 | 20.01.03 Baggage Door and Sleeper Access Door Release Cable and Latch Lubrication | |
| 21.02 | 21.02 Preliminary Checks | |
| 21.03.01 | 21.03.01 General Information | |

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

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

## 2.07 M3 Maintenance Interval Operations: 00–07

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

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

| Maintenance Operation Number | M3 Maintenance Interval Operations for Service Schedules I and II | Check |
|---|---|---|
| 2.05 | 2.05 M1 Maintenance Interval Operations: 00–05 | |
| 2.06 | 2.06 M2 Maintenance Interval Operations: 00–06 | |
| 3.01.01 | 3.01.01 Inspection of the Air Cleaner | |
| 6.03 | 6.03 Radiator Pressure-Flushing and Coolant Change | |
| 6.03 | 6.03 Radiator Pressure-Flushing and Coolant Change | |
| 8.04 | 8.04 Cleaning the Eaton Fuller Transmission Fluid Change and Magnetic Plug [1] | |
| 9.04 | 9.04 Frame Fastener Torque Check | |
| 10.06 | 10.06 Suspension TufTrac Gen2 I-Bolt Torque Check | |
| 12.02.01 | 12.02.01 Detroit® Model 4 and Model 6 | |
| 15.03.01 | 15.03.01 AD–9 | |
| 15.10 | 15.10 Inspection and Lubrication of the Bendix E-6 Foot Control Valve | |
| 15.11 | 15.11 Replacement of the WABCO System Saver Air Dryer Desiccant Cartridge | |
| 16.03 | 16.03 Power Steering Fluid and Filter Change | |

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

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

## 2.08 Maintenance Operation Sets Table: 00–08

**Table 8, Maintenance Operation Sets**

| Maintenance Operation Sets | | | | | |
|---|---|---|---|---|---|
| Maint. No. | Operation Description | Service Schedules I and II | | | |
| | | IM | M1 | M-2 | M3 |
| 3.01.01 | 3.01.01 Inspection of the Air Cleaner | | | | • |
| 4.02 | 4.02 Inspection of the Air Compressor | • | • | • | • |
| 5.02 | 5.02 Alternator, Battery, and Starter Connections Check | | | • | • |
| 6.02 | 6.02 Pressure Relief Cap Check | | | • | • |
| 6.03 | 6.03 Radiator Pressure-Flushing and Coolant Change | | | | • |
| 6.04.01 | 6.04.01 Borg Warner (Kysor) K30 Fan Clutch | | | • | • |
| 7.02 | 7.02 Lubrication of the Clutch Release Bearing[1] | • | • | • | • |
| 7.03 | 7.03 Fluid Level Check, Hydraulic Clutch Control | | | • | • |
| 7.04.01 | 7.04.01 General information | | | | • |
| 8.02 | 8.02 Cleaning the Detroit® Automated Transmission Fluid Change and Magnetic Plug | | | • | |
| 8.03 | 8.03 Inspection the Detroit® Automated Transmission Fluid Level | | | • | • |
| 8.04 | 8.04 Cleaning the Eaton Fuller Transmission Fluid Change and Magnetic Plug [2] | | | | • |
| 8.05.01 | 8.05.01 General information | | | • | • |
| 8.06 | 8.06 Cleaning, or Replacement of the Eaton Fuller Manual Transmission Air Filter/Regulator Check, | | | • | • |
| 9.02.01 | 9.02.01 General information | • | • | • | • |
| 9.03.01 | 9.03.01 General information | • | • | • | • |
| 9.04 | 9.04 Frame Fastener Torque Check | • | | | |
| 10.02.01 | 10.02.01 General Information | | | • | • |
| 10.04 | 10.04 Suspension U-Bolt Torque Check | • | • | • | • |
| 10.06 | 10.06 Suspension TufTrac Gen2 I-Bolt Torque Check | • | | • | • |
| 10.07 | 10.07 Third Party Suspension [3] | | | | |
| 10.08 | 10.08 NEWAY ADZ V-Rod Torque Check | • | • | • | • |
| 11.02.01 | 11.02.01 General information[4] | | | • | • |
| 11.03 | 11.03 Inspection The Tie Rod | | | • | • |

| | | | | | |
|---|---|---|---|---|---|
| 11.04 | 11.04 Tie Rod Lubrication | | | • | • |
| 11.05.01 | 11.05.01 General information | • | | | |
| 11.06.01 | 11.06.01 General Information | | • | • | • |
| 12.02.01 | 12.02.01 Detroit® Model 4 and Model 6 | | | | • |
| 12.03.01 | 12.03.01 Detroit® Model 4 and Model 6 | | | • | • |
| 13.01 | 13.01 Wheel Nut Check | • | • | • | • |
| 13.02 | 13.02 Tire Check | • | • | • | • |
| 14.02 | 14.02 Inspection of the Driveline | • | • | • | • |
| | | • | • | • | • |
| 15.02 | 15.02 Inspection of the Air Brake System Valve | | | • | • |
| 15.03.01 | 15.03.01 AD–9[5] | • | • | • | • |
| 15.04 | 15.04 Inspection of the Air Dryer | | | • | • |
| 15.05.01 | 15.05.01 General Information | | | • | • |
| 15.06.01 | 15.06.01 Parking Brake Operational Check | • | • | • | • |
| 15.07 | 15.07 Lubrication of the Haldex Slack Adjuster | • | • | • | • |
| 15.08.01 | 15.08.01 General Information | • | • | • | • |
| 15.09.01 | 15.09.01 General Information | | | • | • |
| 15.10 | 15.10 Inspection and Lubrication of the Bendix E-6 Foot Control Valve | | | | • |
| 15.11 | 15.11 Replacement of the WABCO System Saver Air Dryer Desiccant Cartridge | • | • | • | • |
| 15.12.01 | 15.12.01 Operating Test[6] | • | • | | |
| 16.02 | 16.02 Inspection of the Drag Link | | | • | • |
| 16.03 | 16.03 Power Steering Fluid and Filter Change | | | | • |
| 16.04 | 16.04 Lubrication of the Drag Link | | | • | • |
| 16.04 | 16.04 Lubrication of the Drag Link | | | • | • |
| 17.02 | 17.02 Replace The Fuel Filter | | • | • | • |
| 17.03.01 | 17.03.01 Detroit | | • | • | • |
| 17.04 | 17.04 Tightening the Fuel Tank Band-Nut | • | | | |
| 18.02.01 | 18.02.01 General Information | • | • | • | • |
| 19.01 | 19.01 Inspection and Cleaning the Trailer Cable | | | • | • |
| 19.02 | 19.02 Inspection of the Electrical Component | | | • | • |

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|---|---|---|---|---|---|
| 20.01 | 20.01 Mirror Folding Check | | | • | • |
| 20.01.01 | 20.01.01 Cab Shock Absorber Bracket Torque Check | • | • | • | • |
| 20.01.02 | 20.01.02 Inspection of the Aerodynamic Component | • | • | • | • |
| 20.01.03 | 20.01.03 Baggage Door and Sleeper Access Door Release Cable and Latch Lubrication | | | • | • |
| 21.02 | 21.02 Preliminary Checks | | | • | • |
| 21.03.01 | 21.03.01 General Information | | | • | • |
| 21.04.01 | 21.04.01 Fuel-Operated Heater Check | • | • | • | • |

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

**Table 8, Maintenance Operation Sets**

## 2.09 Noise Emission Controls Maintenance

### 2.09.01 Noise Emission Controls Maintenance: 00–09

Federal Law, Part 205: Transportation Equipment Noise Emission Controls

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

Recommendations for Replacement Parts

Replacement parts used for maintenance or repair of noise emission controls should be genuine 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:

Removal of engine noise-deadening panels.

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

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

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

Removal of the fan shroud.

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

Removal of air intake components.

### 2.09.02 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.

## 2.10 Verification of Inspections Log: 00–10

Verification of Inspections Log, Group 20

**Table 9, Verification of Inspections Log — Group 20 — Fan Clutch and Shroud**

| Verification of Inspections Log — Group 20 — Fan Clutch and Shroud | | | | |
|---|---|---|---|---|
| Date | Mileage | Item | Cost | Maintenance Facility |
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**Table 9, Verification of Inspections Log — Group 20 — Fan Clutch and Shroud**

Verification of Inspections Log, Group 49

**Table 10, Verification of Inspections Log — Group 49 — Exhaust System Components**

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

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**Table 10, Verification of Inspections Log — Group 49 — Exhaust System Components**

3.01 Air Cleaner Inspection ..... 26
3.01.01 Inspection of the Air Cleaner ..... 26
3.01.02 Pre-Cleaner Maintenance ..... 28

## 3. Air Intake

### 3.01 Air Cleaner Inspection

3.01.01 Inspection of the Air Cleaner

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

Vehicles may be equipped with either a manual-reset restriction indicator with graduations Fig. 2,Manual-Reset Air Restriction Indicator, Graduated or a go/no-go restriction indicator without graduations Fig. 3,Manual-Reset Air Restriction Indicator, Go/No-Go.

**Fig 2, Manual-Reset Air Restriction Indicator, Graduated**

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

**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.

1. Inspect the air restriction indicator to see if air restriction equals or exceeds the maximum allowable restriction. For instructions, see  of the **Western Star 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.4,Air Cleaner Assembly. Ensure the bonds between the rubber and the steel plates are completely intact. See Fig.5,Mounting Isolator. If a mounting isolator is damaged, replace it. For isolator replacement instructions, see Replacement of the Air Cleaner Element of the **Western Star 47X and 49X Workshop Manual**.

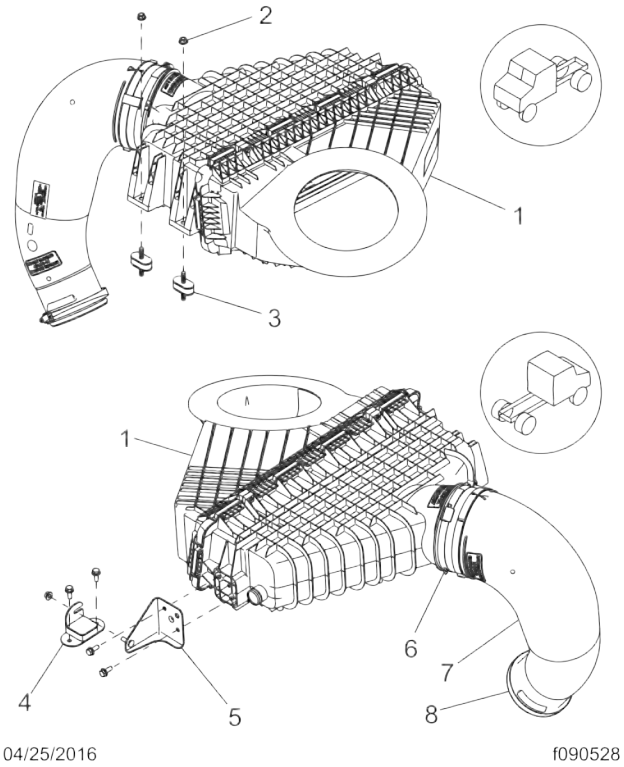



**Fig 4, Air Cleaner Assembly**

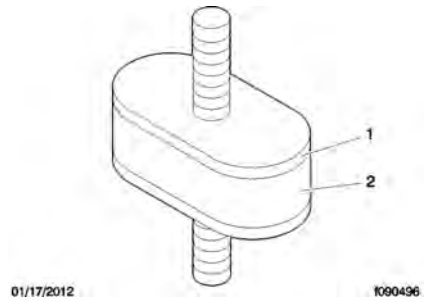
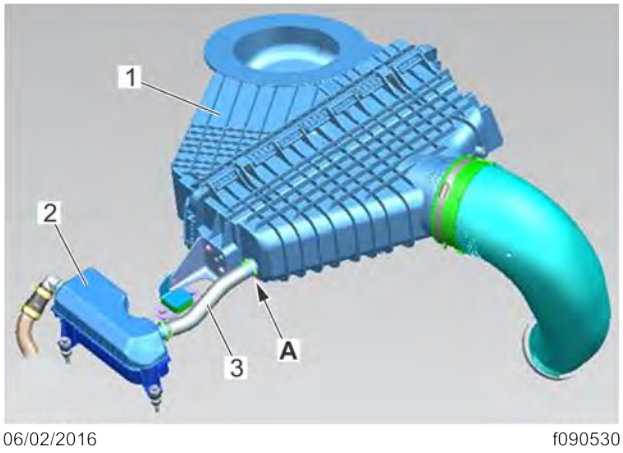



**Fig 5, Mounting Isolator**

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




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

**Fig 6, Compressor Supply Line Quick Connect**

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.a Exposure to highly dusty conditions a on regular basis.
   - 6.b 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**

## 3.01.02 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 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. 7, **Pre-Cleaner Location** for Pre-Cleaner location in the truck.

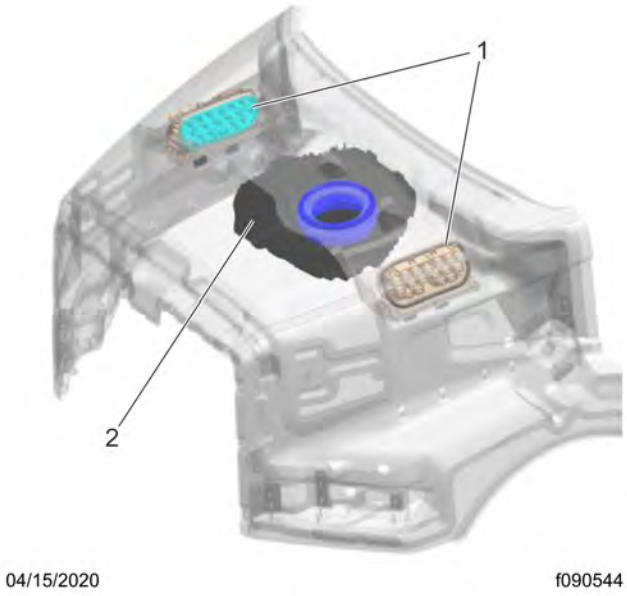



**Fig 7, Pre-Cleaner Location**

4.01 Safety Precautions ..... 32

4.02 Inspection of the Air Compressor ..... 32

## 4. Air Compressor

### 4.01 Safety Precautions

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

**DANGER:**

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

### 4.02 Inspection of the Air Compressor

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

5.01 Safety Precautions ..... 34

5.02 Alternator, Battery, and Starter Connections Check ..... 34

# 5. Alternators and Starters

## 5.01 Safety Precautions

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

**DANGER:**

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

## 5.02 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 General Information, Alternator 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 charging 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 General Description, Wiring of the **Western Star 47X and 49X Workshop Manual** for adjustment, repair, or replacement instructions.
   5.a Clean and tighten the battery ground cable, terminal, and clamps.

5.b Inspect the retainer assembly or battery hold-downs, and the battery box. Replace worn or damaged parts. Remove any corrosion with a wire brush, and wash with a weak solution of baking soda and water. Flush with clean water, and dry. Paint the retainer assembly if needed, to prevent rusting.

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

5.d After cleaning, connect the cables to the batteries and tighten them to the torque specifications listed on the battery, generally 10 to 15 lbf·ft (14 to 20 N·m).

5.e 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.

6.01 Safety Precautions ..... 38
6.02 Pressure Relief Cap Check ..... 38
6.03 Radiator Pressure-Flushing and Coolant Change ..... 39
6.04 Fan Clutch Check (Noise Emission Control) ..... 41
6.04.01 Borg Warner (Kysor) K30 Fan Clutch ..... 41

# 6. Engine Cooling/Radiator

## 6.01 Safety Precautions

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

**DANGER:**

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

## 6.02 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. 8,Surge Tank.

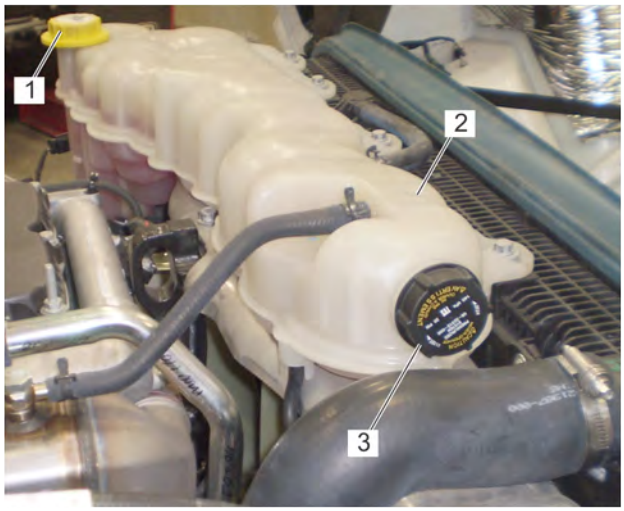



**Fig 8, Surge Tank**

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.

## 6.03 Radiator Pressure-Flushing and Coolant Change

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

1. 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 overtighten.
10. Connect the hoses. The hose clamps can be either T-bolt clamps, shown in Fig.9,T-Bolt Type Hose Clamp or Breeze Constant-Torque clamps, shown in Fig.10,Breeze Constant-Torque Hose Clamp Installation. When working with T-bolt hose clamps, tighten the clamps 55 lbf·in (620 N·cm). These clamps are now standard on hoses with an in diameter greater than 2 inches (51 mm). When installing Breeze Constant-Torque hose clamps, the clamps must be tightened to the correct torque. The screw tip of the clamp must extend about 1/4 inch (6 mm) from the clamp housing, and the

Belleville washer stacks must be collapsed almost flat. Use a torque wrench to install these clamps correctly. The correct installation torque is as follows: For Breeze Constant-Torque clamps with a 5/16-inch tightening screw hex: 55 lbf·in (620 N·cm). For Breeze Constant-Torque clamps with a 3/8-inch tightening screw hex: 90 lbf·in (1020 N·cm).

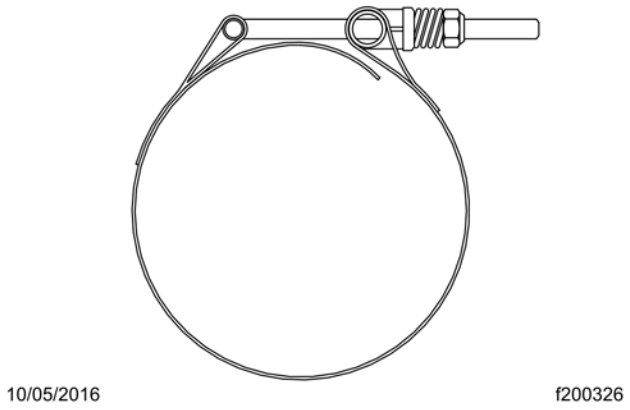
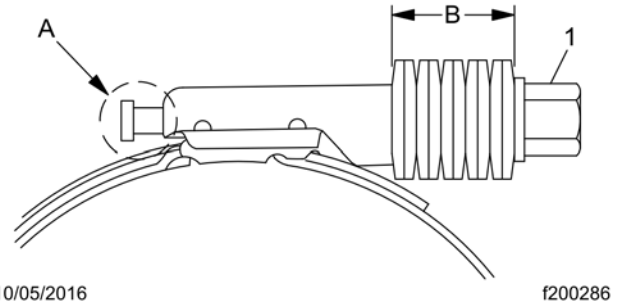



**Fig 9, T-Bolt Type Hose Clamp**




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

**Fig 10, 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 shutdown, 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.

## 6.04 Fan Clutch Check (Noise Emission Control)

### 6.04.01 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. 11,Tool Below Retainer Plate, Liner Life Remaining, and Fig. 12,Tool Above Retainer Plate, Liner Replacement Needed.

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

**Fig 11, Tool Below Retainer Plate, Liner Life Remaining**

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

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

**Fig 12, Tool Above Retainer Plate, Liner Replacement Needed**

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

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

## Horton DriveMaster® Fan Clutch

NOTE: see General Information, Radiator Assembly of the **Western Star 47X and 49X Workshop Manual** for instructions.

1. Disconnect the batteries at the negative terminals.
.
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.13,Wear Measurement and Fig. 14,Checking for Air Leaks (Horton DriveMaster).

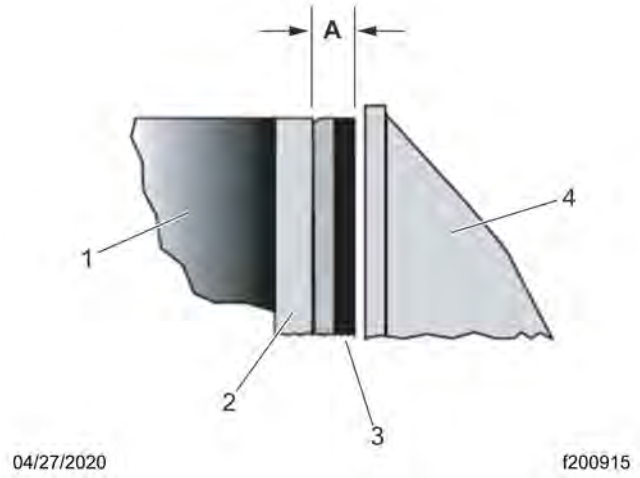


**Fig 13, Wear Measurement**

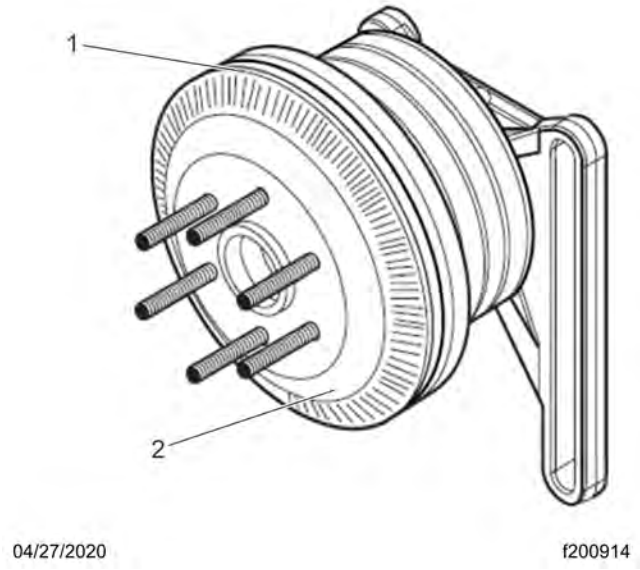


**Fig 14, Checking for Air Leaks (Horton DriveMaster)**

8. If a leak is detected, remove the fan blade. Install a new seal kit.
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.a Turn the fan in both directions and feel for worn hub bearings.

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

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

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# 7. Clutch

## 7.01 Safety Precautions

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

**DANGER:**

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

## 7.02 Lubrication of the Clutch Release Bearing

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. 15,Typical Clutch Inspection Plate.

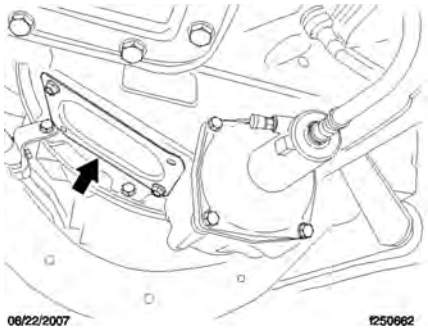


**Fig 15, Typical Clutch Inspection Plate**

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

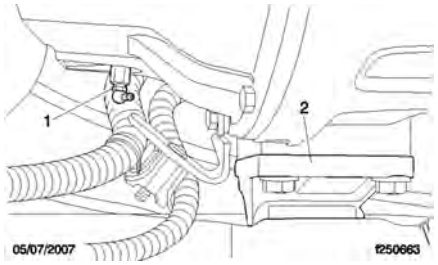


**Fig 16, Typical Release Bearing Grease Fitting**

**NOTICE:**

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

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

## 7.03 Fluid Level Check, Hydraulic Clutch Control

**WARNING:**

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

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

**NOTICE:**

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

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

If the fluid level is below the MIN line, fill the reservoir with new DOT 4 brake fluid from a tightly sealed container until the level reaches the MAX line. See Fig.17,Reservoir, Hydraulic Clutch Control.

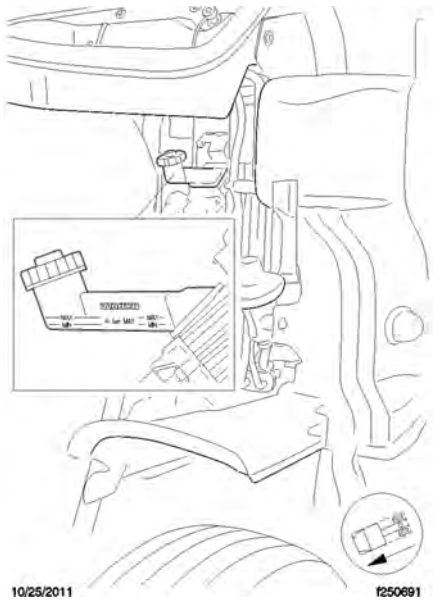


**Fig 17, Reservoir, Hydraulic Clutch Control**

## 7.04 Fluid Change, Hydraulic Clutch Control

### 7.04.01 General information

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

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

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

### 7.04.02 Pressure Bleeding

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

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 as shown in Fig.18,Reservoir, Hydraulic Clutch Control and install the pressure bleed adaptor on the reservoir.

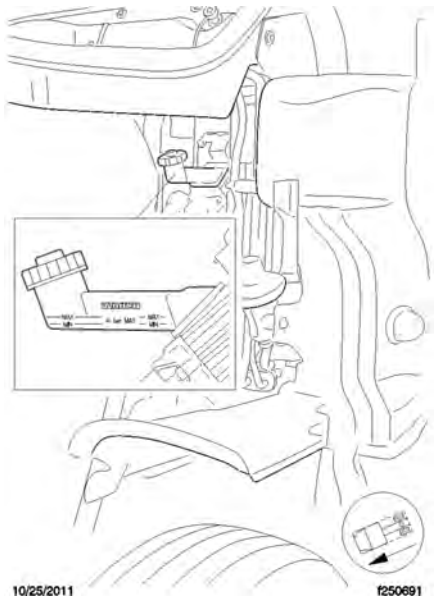


**Fig 18, Reservoir, Hydraulic Clutch Control**

4. Bleed the hydraulic system as follows.
   - 4.a Open the bleed valve on the bleed tank to pressurize the reservoir.
   - 4.b Remove the cap from the bleed valve of the secondary cylinder. See Fig. 19,Secondary Cylinder, Hydraulic Clutch Control. On the valve, install a transparent drain hose connected to a catch bottle. The hose needs to fit the bleed valve tight enough so it does not fall off when fluid is pumped out.

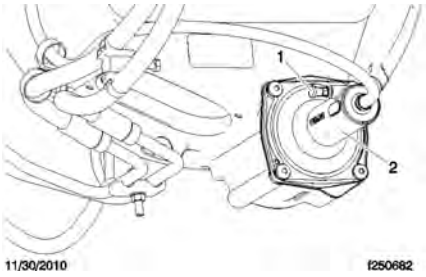


**Fig 19, Secondary Cylinder, Hydraulic Clutch Control**

4.c Open the bleed valve on the secondary cylinder.

4.d When the draining fluid is clear and free of air bubbles, close the bleed valve.

5. Check the fluid level in the reservoir. If necessary, add or drain fluid to bring the fluid level to between the MIN and MAX lines marked on the side of the reservoir.
6. Install the reservoir lid.
7. Disconnect the transparent hose. Tighten the bleed screw 88 lbf·in (994 N·cm) and install the cap on the secondary cylinder bleed valve.
8. Depress the clutch pedal a few times. There should be resistance over the full pedal stroke.

## 7.04.03 Manual Bleeding

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

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

2. Remove the reservoir lid and fill the reservoir with new DOT 4 brake fluid from a tightly sealed container. See Fig. 20,Reservoir, Hydraulic Clutch Control.

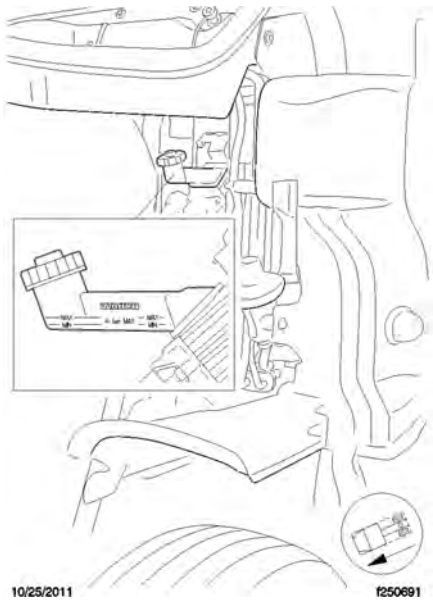


**Fig 20, Reservoir, Hydraulic Clutch Control**

3. Remove the cap from the bleed valve of the secondary cylinder. See Fig. 21,Secondary Cylinder, Hydraulic Clutch Control. On the valve, install a transparent drain hose connected to a catch bottle. The hose needs to fit the bleed valve tight enough so it does not fall off when fluid is pumped out.

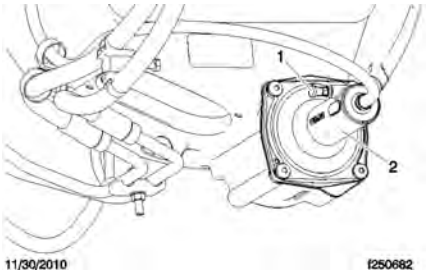


**Fig 21, Secondary Cylinder, Hydraulic Clutch Control**

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

4. Bleed the system, as follows.
   - 4.a Open the bleed valve.
   - 4.b Depress the clutch pedal until it stops.
   - 4.c Close the bleed valve.
   - 4.d Return the pedal to the upper position.
   - 4.e Repeat the previous steps until the fluid is clear and free of air bubbles.
   - 4.f Depress the clutch pedal. There should be resistance over the full pedal stroke.

5. Check the fluid level in the reservoir. If necessary, add or drain fluid to bring the fluid level to between the MIN and MAX lines marked on the side of the reservoir. Install the reservoir lid.
6. Disconnect the transparent hose. Tighten the bleed valve 88 lbf·in (994 N·cm) and install the cap on the secondary cylinder bleed valve.

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# 8. Transmission

## 8.01 Safety Precautions

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

**DANGER:**

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

## 8.02 Cleaning the Detroit® Automated Transmission Fluid Change and Magnetic Plug

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

**NOTICE:**

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/DT12Fluids-Manual** 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.

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

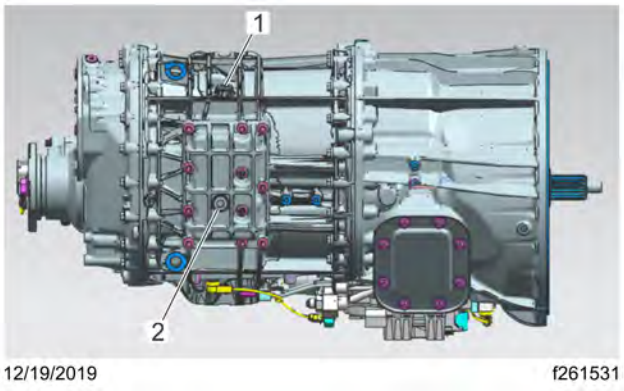


**Fig 22, Drain and Fill Plugs, Detroit Automated Transmissions**

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 athttp://dtna.info/DT12FluidsManual.

5. Add fluid until it is level with the lower edge of the fill opening; see Fig.23,Checking Transmission Fluid Level. 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.

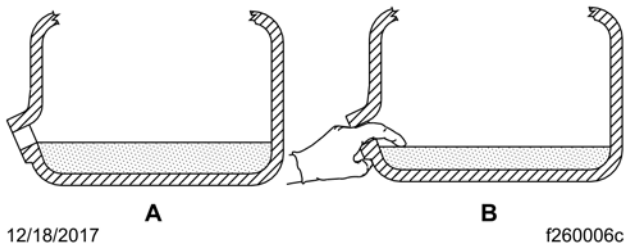


**Fig 23, Checking Transmission Fluid Level**

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

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

## 8.03 Inspection the Detroit® Automated Transmission Fluid Level

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

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

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

1. Clean the area around the fill plug, then remove it from the side of the gear case. See Fig. 24,Drain and Fill Plugs, Detroit Automated Transmissions.

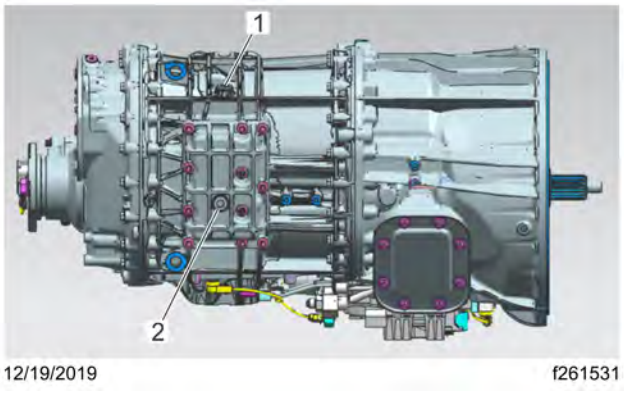


**Fig 24, Drain and Fill Plugs, Detroit Automated Transmissions**

2. Using your finger or a bent pipe cleaner, see if the fluid is level with the fill opening. See Fig. 25,Checking Transmission Fluid Level.

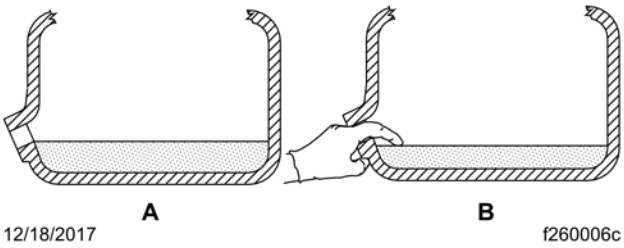


**Fig 25, Checking Transmission Fluid Level**

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

**NOTICE:**

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

## 8.04 Cleaning the Eaton Fuller Transmission Fluid Change and Magnetic Plug

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).

IMPORTANT: 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.a Place a drain pan under the transmission fluid filter.

**CAUTION:**

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

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

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

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

6. Add fluid until it is level with the lower edge of the fill opening. See Fig.26,Checking Transmission Fluid Level. If the transmission has two fill openings, add fluid to the level of both openings. See Table.11,Approved Manual Transmission Lubricants for approved transmission lubricants, and Table.12,Eaton Fuller Transmission Lubricant Capacities for transmission lubricant capacities. For more information and a complete listing of Eaton approved lubricants, refer to the Eaton website, www.roadranger.com.

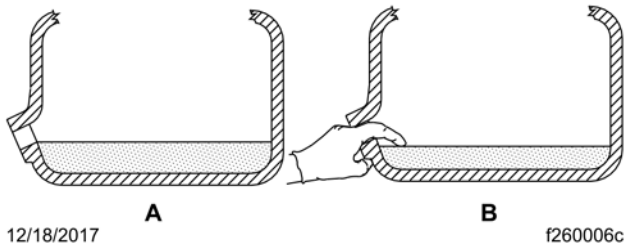


**Fig 26, Checking Transmission Fluid Level**

**Table 11, Approved Manual Transmission Lubricants**

| 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 |

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

**Table 11, Approved Manual Transmission Lubricants**

**Table 12, Eaton Fuller Transmission Lubricant Capacities**

| Eaton Fuller Transmission Lubricant Capacities | |
|---|---|
| **Transmission Model** | **Refill Capacity: qt (L)** |
| *7-Speed T Series* | |
| All Models | 18.0 (17.0) |
| *All 9-Speed Series* | |
| All Models | 13.5 (12.8) |

| | |
|---|---|
| *All 10-Speed Manual (except deep reduction)* | |
| FR and FRO Series | 11.75 (11.0) |
| RT and RTX Series | 13.0 (12.3) |
| RTLO Series | 14.0 (13.2) |
| *10-Speed Deep Reduction* | |
| RTO–14908LL | 14.0 (13.2) |
| RTO–16908LL | |
| *10-Speed Advantage* | |
| FA Series | 8.0 (7.5) |
| *10-Speed Automated* | |
| Lightning Top 2 (all) | 13.5 (12.8) |
| 10-Speed Autoshift AS2 (all) | 13.0 (12.3) |
| *13-Speed RTLO Series* | |
| All Models | 14.0 (13.2) |
| *15-Speed RTO Series* | |
| All Models | 14.0 (13.2) |
| *All 18-Speed Series* | |
| RTLO Series | 14.0 (13.2) |
| 18-Speed Autoshift AS2 (all) | |
| *UltraShift PLUS* | |
| LAS | 13.0 (12.0) |
| MHP and MXP | 14.0 (13.0) |

**Table 12, Eaton Fuller Transmission Lubricant Capacities**

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

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

9. Operate the vehicle to check for correct operation.

## 8.05 Eaton Fuller Transmission Fluid Level Inspection

### 8.05.01 General information

**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.

### 8.05.02 Checking the Fill Plug

1. Clean the area around the fill plug, and remove it from the side of the gear case.
2. Using your finger or a bent pipe cleaner, see if the fluid is level with the fill opening. See Fig. 27,Checking Transmission Fluid Level.

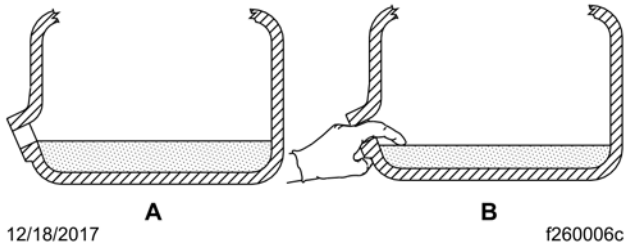


**Fig 27, Checking Transmission Fluid Level**

3. If the fluid level is low, check the transmission for leaks, and correct as needed.
4. If needed, add the recommended fluid, until it is level with the lower edge of the fill opening. See Table.13,Approved Manual Transmission Lubricants for approved transmission lubricants.

**Table 13, Approved Manual Transmission Lubricants**

| 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 |

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

**Table 13, Approved Manual Transmission Lubricants**

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

## 8.05.03 Checking with the Sight Glass

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

1. Clean the oil level sight glass. See Fig.28,Eaton Fuller Transmission With a Sight Glass.

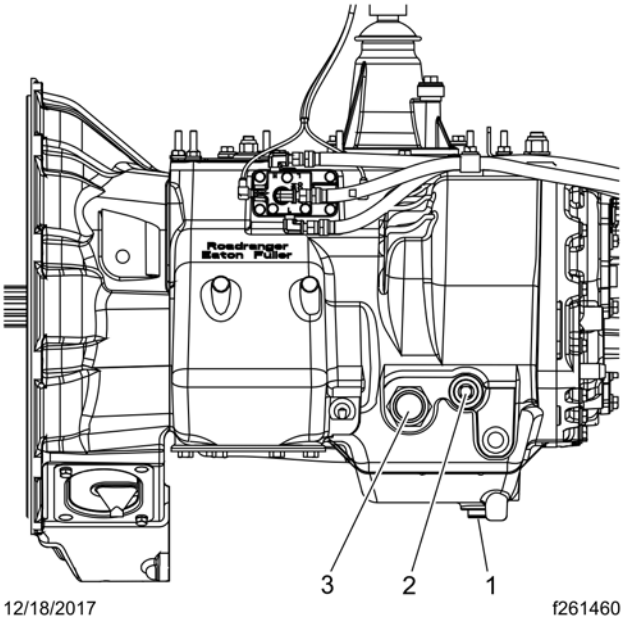


**Fig 28, Eaton Fuller Transmission With a Sight Glass**

2. Check the fluid level in the sight glass. When the fluid level is at or above 3/4 of the sight glass, then it is at or above the minimum fill level. See Fig.29,Transmission Fluid Level Sight Glass.

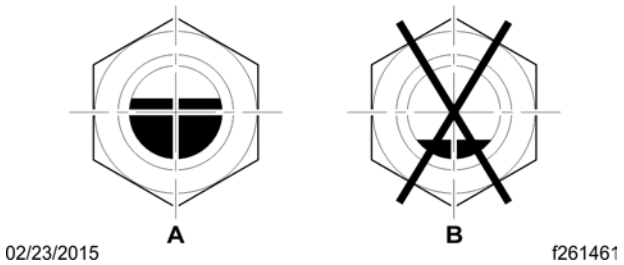


**Fig 29, Transmission Fluid Level Sight Glass**

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

**Table 14, Approved Manual Transmission Lubricants**

| 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 |

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

**Table 14, Approved Manual Transmission Lubricants**

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

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.30,Air Filter/Regulator Location.

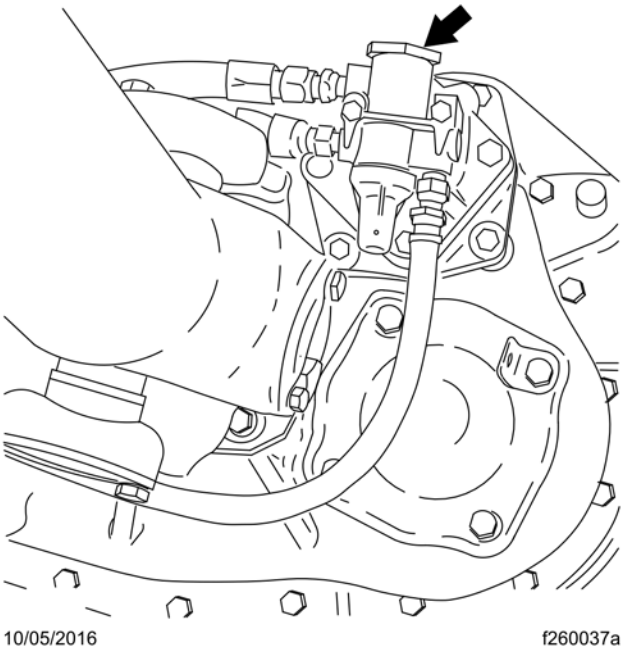


**Fig 30, Air Filter/Regulator Location**

3. Remove the end cap, large O-ring, and filter element from the filter housing. See Fig. 31,Eaton Fuller Transmission Air Filter/Regulator. Remove the small O-ring from the end cap.

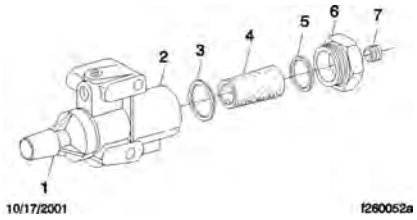


**Fig 31, Eaton Fuller Transmission Air Filter/Regulator**

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

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

4. Clean the filter element by dipping it in alcohol or other cleaning solvent. Blow compressed air through the element (inside to outside) to loosen surface dirt and to dry the element. If it is not damaged, the sintered metallic filter element will last the life of the vehicle. Wipe out the filter housing with a clean, dry, lint-free rag. Clean and inspect the O-rings and end cap. Replace any parts that are damaged.
5. Install the large O-ring, then the filter element (small end first) into the filter housing.
6. Install the small O-ring in the end cap, then install the end cap and tighten it until firm.

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

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

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# 9. Frame and Frame Components

## 9.01 Safety Precautions

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

**DANGER:**

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

## 9.02 Fifth Wheel Inspection

### 9.02.01 General information

**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.

### 9.02.02 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. 32,Holland Fifth Wheel Properly Closed.

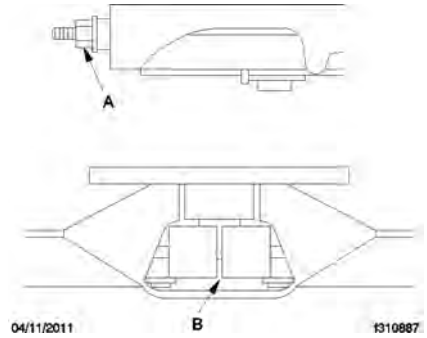
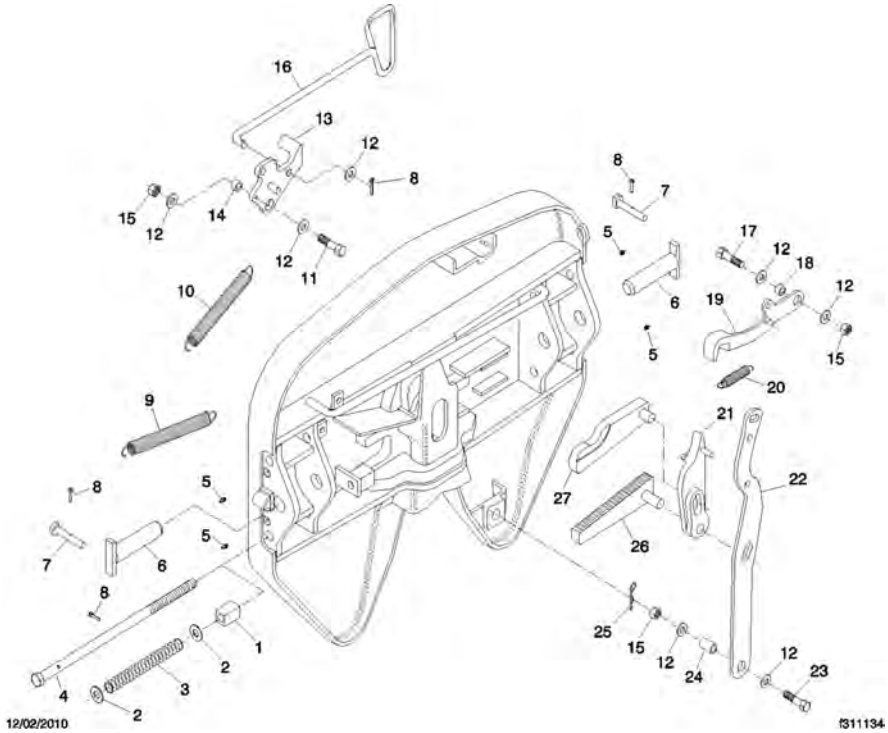



**Fig 32, Holland Fifth Wheel Properly Closed**

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.

### 9.02.03 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. 33,Fontaine Fifth Wheel.




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

**Fig 33, Fontaine Fifth Wheel**

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

5. For fifth wheels equipped with bracket liners, rock the fifth wheel. If it does not rock freely, remove the top plate and inspect the bracket liners. Replace liners that are broken or less than 0.125 inch (3 mm). For the liner replacement procedure, see the Fontaine website,www.fifthwheel.com.
6. Check the jaw and stationary jaw for mushrooming, and check that the serrations at the jaw and wedge are in good condition 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 Threaded Fastener Types of the **47X and 49X Driver's Manual.**
9. Check all springs to see if they are securely fastened, and are not deformed.

**WARNING:**

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. Check the wedge adjustment.
    10.a 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.

### 9.02.04 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. 34,Bracket Pin Bolt Locking Tabs.

**Fig 34, 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.35,Jost Fifth Wheel Adjustment ref. A.*The lock is too tight if:* the lock tester does not rotate freely in the lock. See Fig.35,Jost Fifth Wheel Adjustment ref. B.

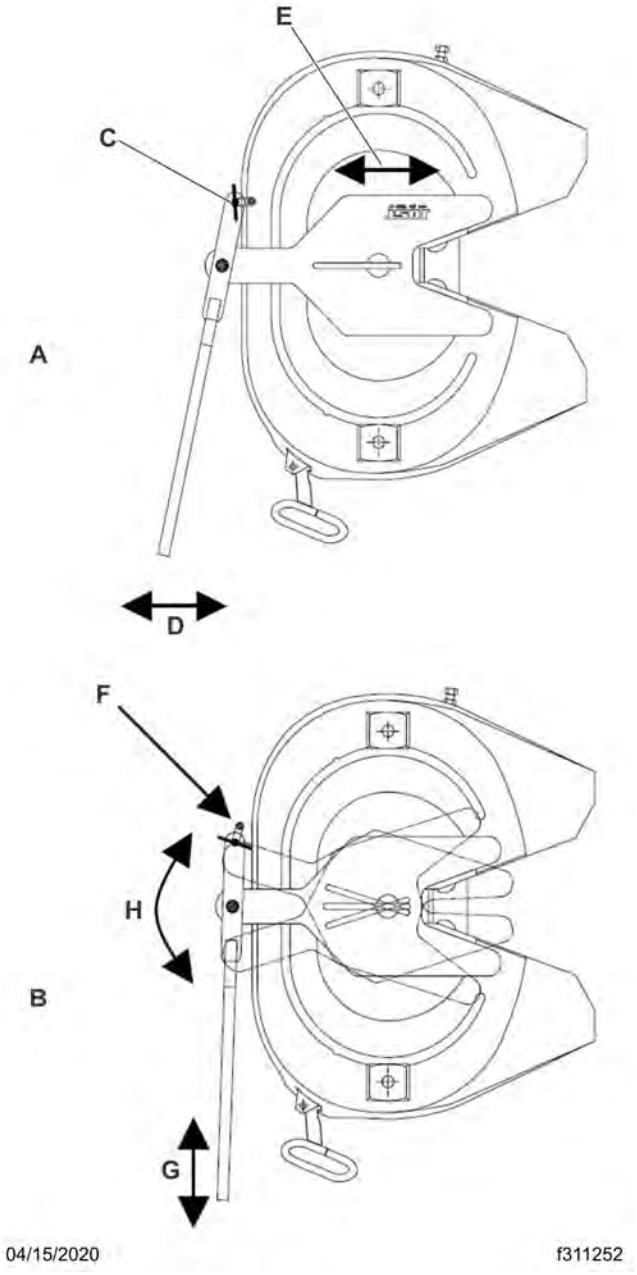



**Fig 35, Jost Fifth Wheel Adjustment**

8. If the lock is improperly adjusted, correct as follows. *If the lock is too tight,* loosen the jam nut, turn the adjustment bolt *clockwise* one full turn, then reset the jam nut. Lock and unlock the mechanism several times to test. Repeat if necessary. See Fig.36,Jost Fifth Wheel . *If the lock is too loose,* loosen the jam nut, turn the adjustment bolt *counter-clockwise* one full turn, then reset the jam nut. Lock and unlock the mechanism several times to test. Repeat if necessary. See Fig.36,Jost Fifth Wheel .

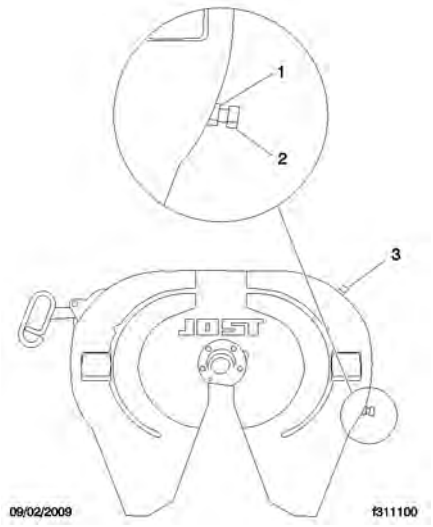



**Fig 36, Jost Fifth Wheel**

9. If the fifth wheel is equipped with a sliding mechanism, inspect and adjust it as follows.
   - 9.a Check the bracket for any cracks or missing and damaged parts.
   - 9.b Inspect the locking plungers for full engagement.
   - 9.c Check the locking mechanism for proper operation. *If the plungers will not release,* check the air cylinder or plunger adjustment. *If the plungers are loose,* check the plunger adjustment and the plunger springs for proper compression. Replace if needed.
   - 9.d The outboard slider assembly requires no adjustment. If the plungers are loose, inspect and replace locking mechanism parts as needed.
   - 9.e The inboard slider is adjustable for frame width and plunger engagement. For adjustment, refer to the fifth wheel installation instructions.
10. Replace cracked, worn, or damaged parts with new parts. Replace all loose mounting bolts with 5/8–11 SAE grade 8 bolts, grade C locknuts, and hardened washers. *Do not* re-use bolts, nuts, and washers on fifth wheel mountings.
11. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. Apply a generous coating of grease to the top plate to fill the grooves, or depressions, on the top plate. See **MOP 31–02** in this manual for lubrication instructions.

## 9.03 Fifth Wheel Lubrication

### 9.03.01 General information

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

IMPORTANT: Lubricate the fifth wheel:

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

9.03.02 Fontaine

**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.

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

   NOTE: Do not use a lube plate (high density polyethylene) on top of the fifth wheel or on the kingpin instead of grease. 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. 37,Fontaine Fifth Wheel. Open and close the fifth wheel several times to further distribute the grease. Lightly oil other moving parts in the fifth wheel.

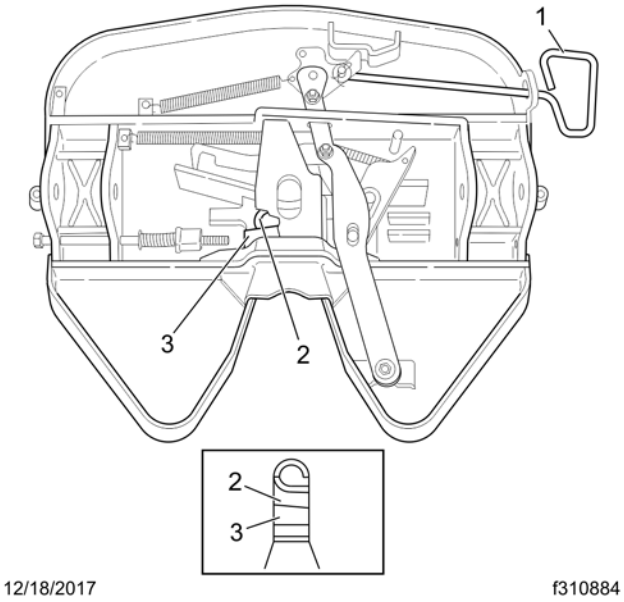
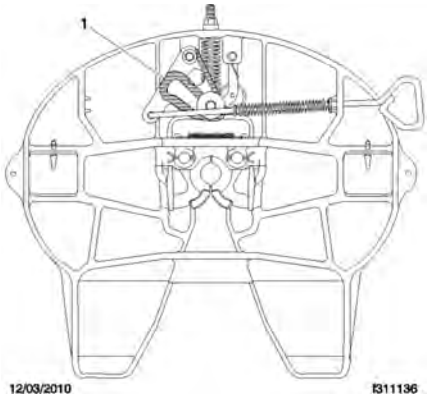



**Fig 37, Fontaine Fifth Wheel**

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.

### 9.03.03 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. 38,Holland FW35 Fifth Wheel, Oil Lubrication.




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

**Fig 38, Holland FW35 Fifth Wheel, Oil Lubrication**

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

3. Grease the yoke tips, locks, and the release handle and spring; see Fig. 39,Holland FW35 Fifth Wheel, Grease Lubrication. Grease the mounting bracket supports through the grease fittings. A “low temp” grade grease rated for -30°F (-34°C) or lower such as Cato Oil and Grease #5213, Craftsman Chemical Co. #LTF 2, Mystic LP-200, or equivalent is recommended.

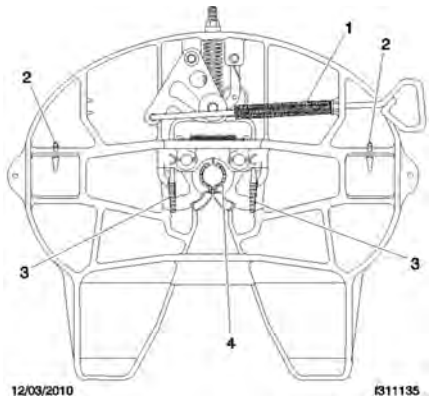



**Fig 39, Holland FW35 Fifth Wheel, Grease Lubrication**

## 9.03.04 Jost

Lubricate the kingpin lock using a hand pump grease gun through the grease zerk on the skirt of the fifth wheel; see Fig. 40,Jost Fifth Wheel. Apply a light oil to all moving parts. For sliding fifth wheels spray diesel fuel on the slide path of the base plate. 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.

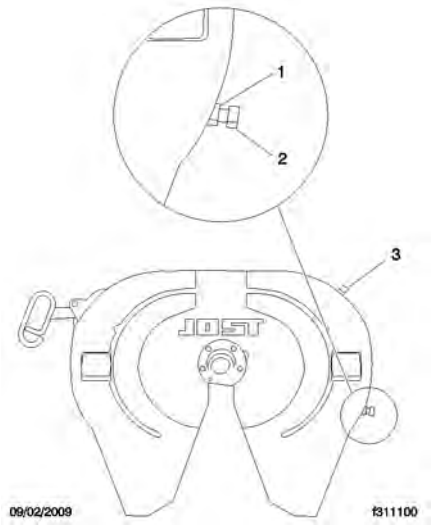



**Fig 40, Jost Fifth Wheel**

## 9.04 Frame Fastener Torque Check

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

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# 10. Suspension

## 10.01 Safety Precautions

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

**DANGER:**

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

## 10.02 Suspension Inspection

### 10.02.01 General Information

**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.

### 10.02.02 Check The Front Suspension

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 General Information, Front Suspension 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.

### 10.02.03 Check The Front and Rear Suspension Shock Absorber

Make sure the shock absorber 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.41,Direct-Acting Shock Absorber (front suspension shown). Check the rubber mounting bushings for cracks, cuts, swelling, dry rot, or missing pieces. If the shock absorber bushings are no longer serviceable, replace the shock absorber with a new one.

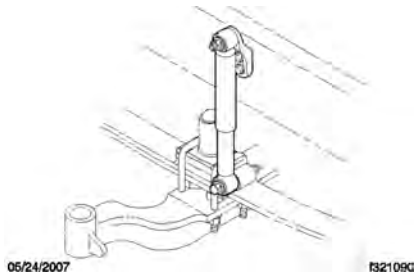



**Fig 41, Direct-Acting Shock Absorber (front suspension shown)**

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.

## 10.03 Western Star AirLiner Rear Suspension Check

### 10.03.01 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.

### 10.03.02 Checking the Suspension Height

IMPORTANT: 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.

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

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.42,, page 81. 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.15,Suspension Ride-Height Measurement, Dual-Leaf Spring, 21k/40k High Ride, Table.16,Suspension Ride-Height Measurement, Single-Leaf Spring, 21k/40k, High Ride, Table.17, **Suspension Ride-Height Measurement, Single-Leaf Spring, 40k Low and Mid Ride**, Table.18, **Suspension Ride-Height Measurement, Dual-Leaf Spring, 23k High Ride** and Table.19, **Suspension Ride-Height Measurement, Dual-Leaf Spring, 46k High Ride** for an acceptable range of heights for each suspension.

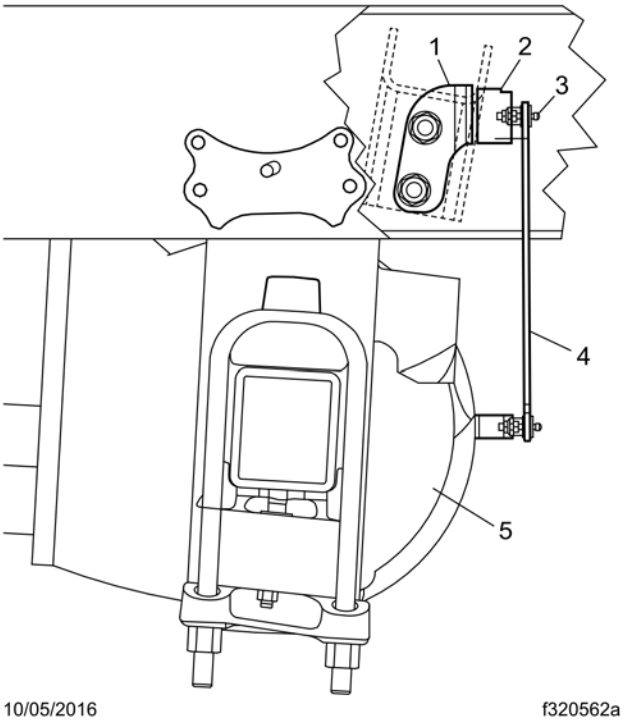
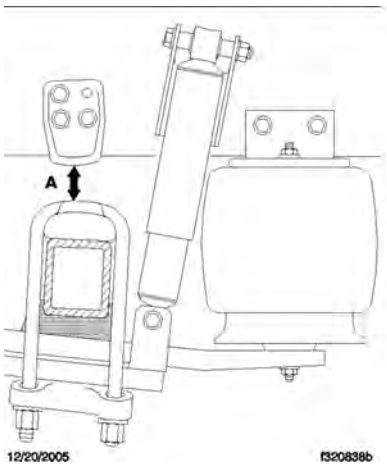



**Fig 42, Barksdale Height-Control Valve Installation (side view) (typical)**

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

4. If the measurement is not within the acceptable range, refer to General Information, Front Suspension in the **Western Star 47X and 49X Workshop Manual** for adjustment instructions. If the distance is within the acceptable range, apply the parking brakes.

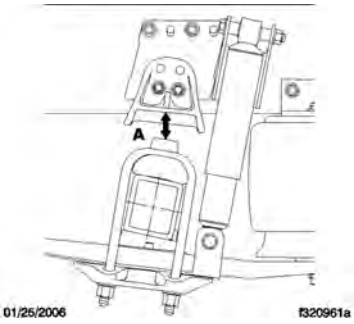
**Table 15, Suspension Ride-Height Measurement, Dual-Leaf Spring, 21k/40k High Ride**




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

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

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




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

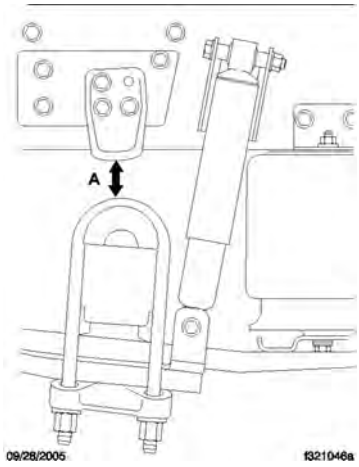
**Table 16, Suspension Ride-Height Measurement, Single-Leaf Spring, 21k/40k, High Ride**

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

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

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

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




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

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

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

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

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

## 10.04 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 and apply the parking brakes. Chock the tires.
2. Check the U-bolt torque. See Table.20,Spring U-Bolt High Nut Torque Values or U-bolt torque specifications. Tighten in a diagonal pattern as shown in Fig.43,Tightening Pattern for U-Bolt High Nuts. Set a click-type torque wrench to the mid-point torque value for the fastener being checked. Turn the wrench in a clockwise motion (looking up) until the torque wrench clicks, then release pressure on the torque wrench, and turn the wrench again until it clicks. If the nut turns on the second application, the bolt is stretching and must be replaced. See General Information, Front Suspension of the **Western Star 47X and 49X Workshop Manual**for bolt replacement procedures.

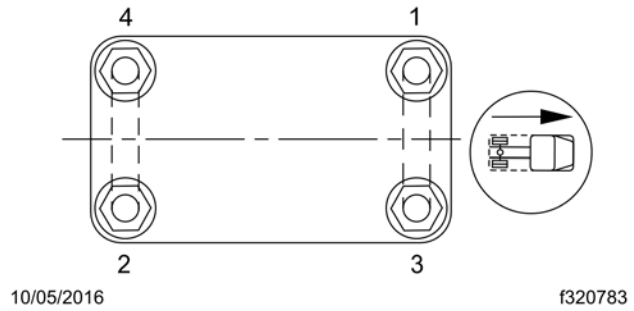



**Fig 43, Tightening Pattern for U-Bolt High Nuts**

**Table 20, Spring U-Bolt High Nut Torque Values**

| Spring U-Bolt High Nut Torque Values[1] | |
|---|---|
| **Size** | **Torque: lbf·ft (N·m)** |
| 5/8–18 | Stage 1: Hand-tighen 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-tighen 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) |

1. *Tighten in a diagonal pattern as shown in Fig.43,, page 84.

**Table 20, Spring U-Bolt High Nut Torque Values**

## 10.05 Suspension Lubrication

### 10.05.01 Front Suspension

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

### 10.05.02 Rear Suspension

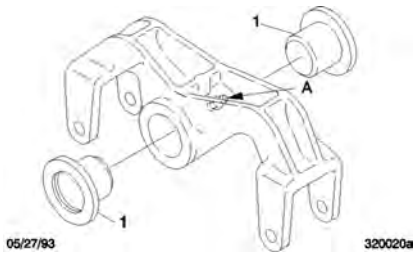
Single Axle

Lubrication is not required on single-axle spring rear suspensions.

Tandem Axle

**NOTICE:**
If the equalizer cap and tube assembly is equipped with a nonrelief grease fitting, excessive lubrication can damage the bushings.

Lubricate the equalizer cap-and-tube assembly bushings by applying multipurpose chassis grease at the pressure relief grease fitting. See Fig.44,Equalizer Assembly Lubrication. Lubricate with a hand gun or pressure gun until grease is forced out from the base of the pressure-relief fitting.




A. Lubricate here.
1. Cap-and-Tube Assembly Bushing

**Fig 44, Equalizer Assembly Lubrication**

### 10.05.03 Hendrickson

The Hendrickson RS Series Haulmaax®, HN®, and Primaax® suspensions do not require lubrication.

For Hendrickson RT™ and RTE™ series suspensions, lubricate the bronze, ball-indented bushings in the spring eye, as follows:

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the tires.
2. Using a multipurpose chassis grease, lubricate the bronze, ball-indented bushings in the spring eyes at the grease fitting; see Fig.45,Hendrickson RT and RTE Series Bushing Lubrication. Continue to lubricate until grease exits both ends of the bushing. If the pin will not accept lubricant, remove the pin and clean the lubrication channels where lubricant may have hardened.

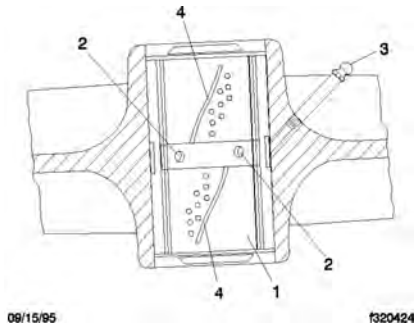



**Fig 45, Hendrickson RT and RTE Series Bushing Lubrication**

## 10.06 Suspension TufTrac Gen2 I-Bolt Torque Check

**NOTICE:**
Failure to retighten the I-Bolts could result in spring breakage and abnormal tire wear.

Check the I-Bolt torque of both the front and 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 I-Bolt torque. See Table.21,Axle Clamp I-Bolt Torque Values for I-Bolt torque specifications. Tighten in a diagonal pattern as shown in Fig.46,Drum Brakes Torque Pattern (looking up) and Fig. 47,Disc Brakes Torque Pattern (looking up). 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.

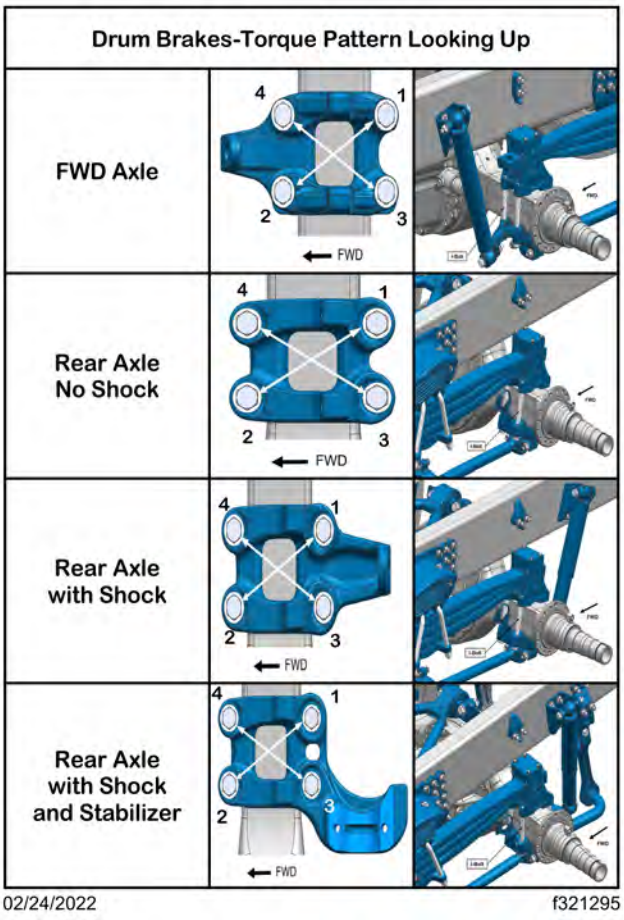



**Fig 46, Drum Brakes Torque Pattern (looking up)**

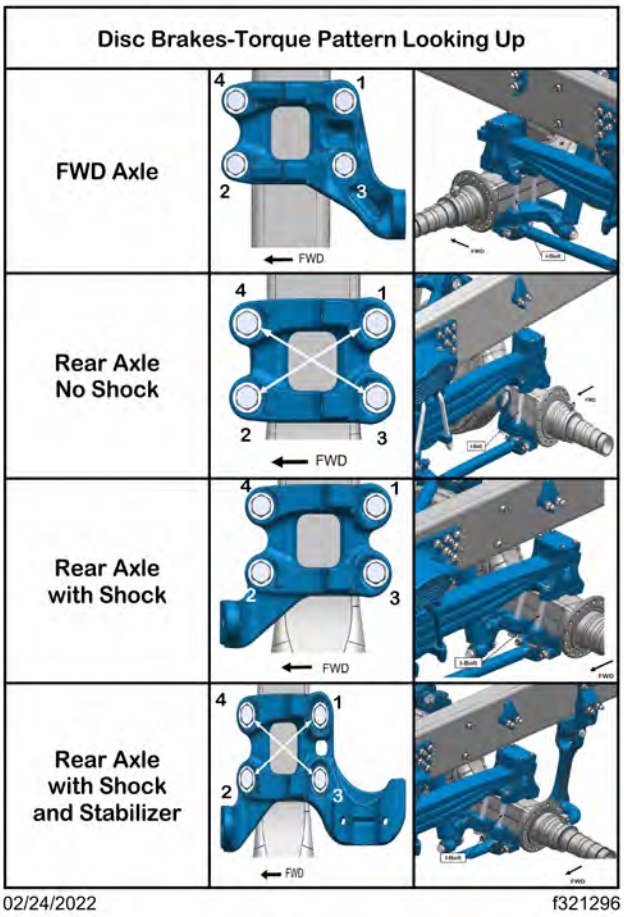



**Fig 47, Disc Brakes Torque Pattern (looking up)**

**Table 21, Axle Clamp I-Bolt Torque Values**

| Axle Clamp I-Bolt Torque Values[1] | |
|---|---|
| **Size** | **Torque: lbf·ft (N·m)** |
| M18–1.5 | Stage 1 : Hand tighten Stage 2: 60 (81) Stage 3 : 150 (203) Stage 4 : 212–260 (287 to 353) |

1. Tighten in a diagonal pattern as shown in Fig.46,, page 87 and Fig.47,, page 88.

**Table 21, Axle Clamp I-Bolt Torque Values**

## 10.07 Third Party Suspension

NOTE: For Chalmers, Henrickson, and NEWAY products, please consult vendor documentation for additional maintenance information.

## 10.08 NEWAY ADZ V-Rod Torque Check

**NOTICE:**
Failure to retighten the V-rod joint could result in vehicle damage.

Check the bolts and nuts at the pivot connections, frame crossmember connections, V-rod connections, and axle connections after 5,000 miles (8000 km) or 100 hours of service. See Fig.48,V-Rod Assembly (top view) for a top view of the V-rod assembly.

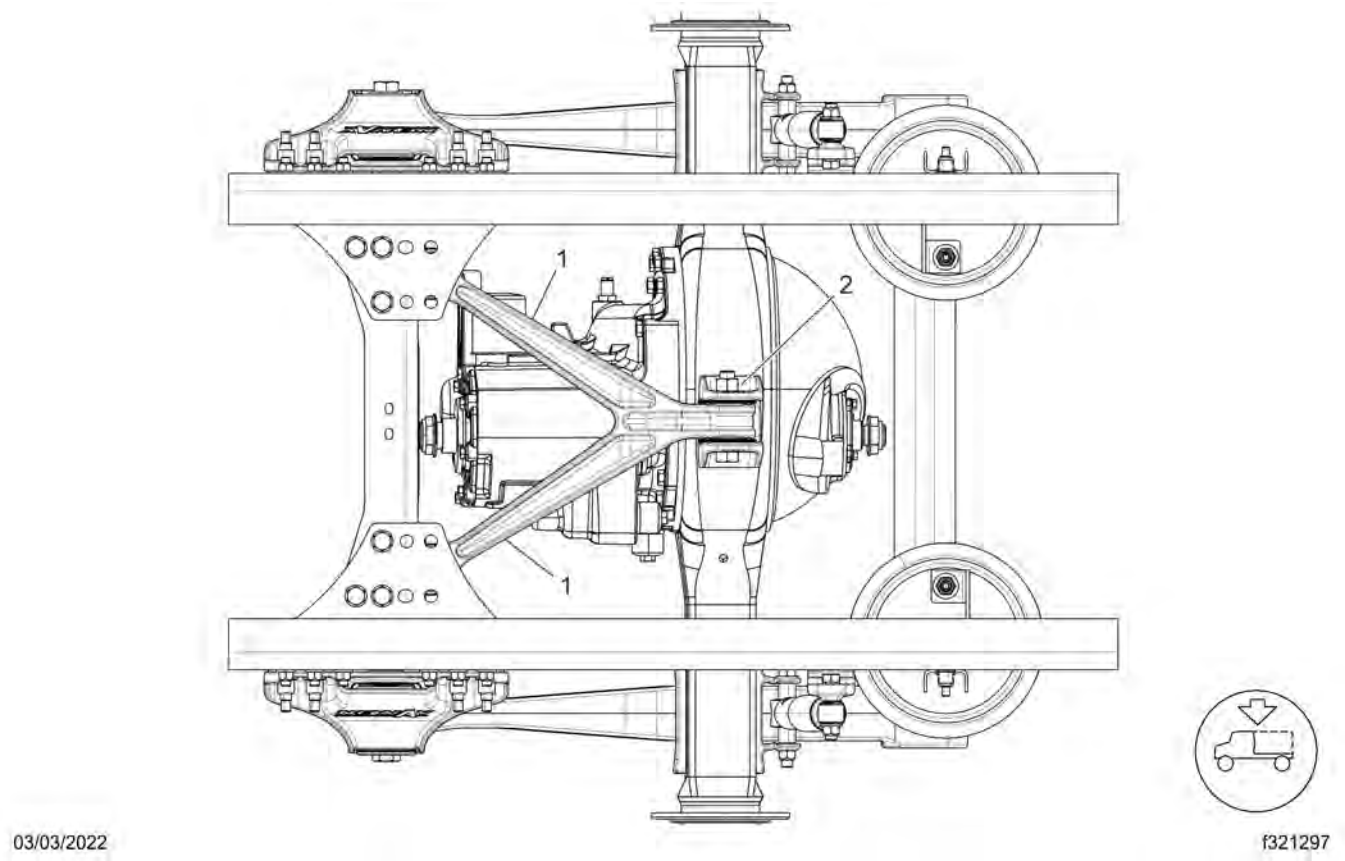



**Fig 48, V-Rod Assembly (top view)**

IMPORTANT: After tightening V-rod nuts, monitor these joints daily until no change occurs at any joint that required retightening. Establish a recheck interval equivalent to findings of this monitoring.

1. Park the vehicle on a level surface, shut down the engine and set the parking brake. Chock the tires
2. Check the V-rod torque. See Table.22,V-Rod Nut Torque Values for torque specifications. 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, shown in Fig.49,V-Rod Assembly (side view) and Fig.50,V-Rod Joint, turns on the second application, the bolt is stretching and must be replaced. See General Information, Front Suspension of the **Western Star 47X and 49X Workshop Manual** for bolt replacement procedures.

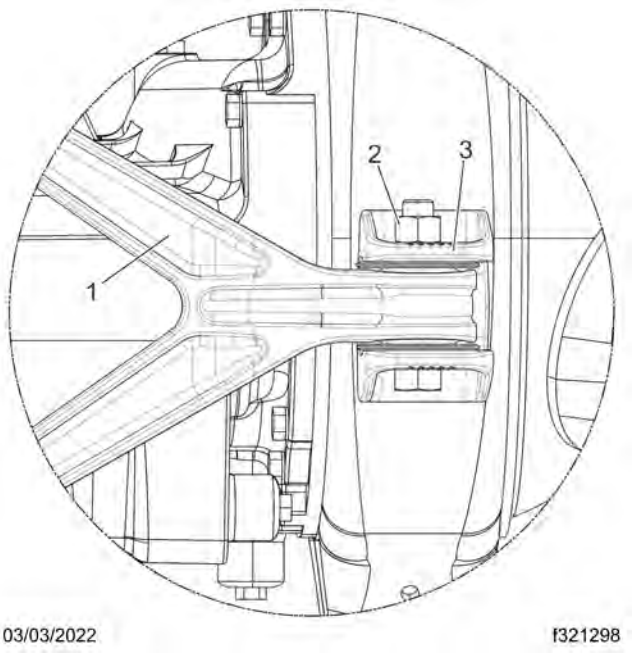



**Fig 49, V-Rod Assembly (side view)**

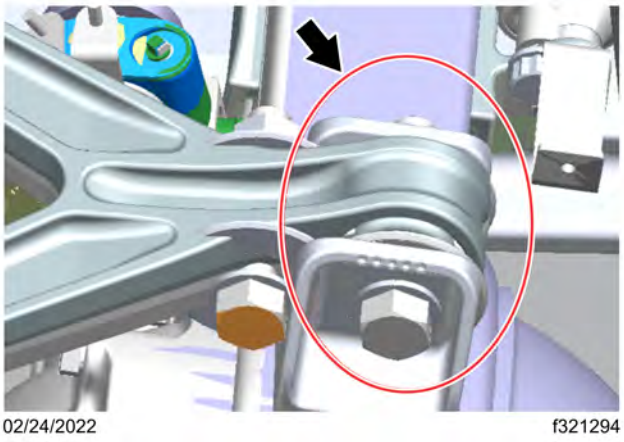



**Fig 50, V-Rod Joint**

**Table 22, V-Rod Nut Torque Values**

| V-Rod Connection at Axle Nut Torque Values | |
|---|---|
| **Size** | **Torque: lbf·ft (N·m)** |
| 1–8 | Stage 1 : Hand tighten Stage 2 : 571 to 697 (774 to 945) |

**Table 22, V-Rod Nut Torque Values**

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# 11. Front Axle

## 11.01 Safety Precautions

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

**DANGER:**

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

## 11.02 Knuckle Pin Lubrication

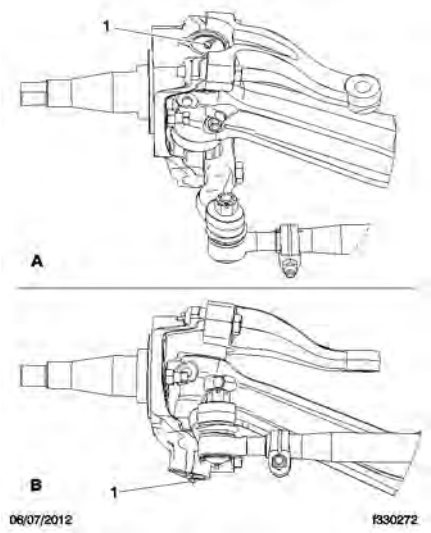
### 11.02.01 General information

**NOTICE:**

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

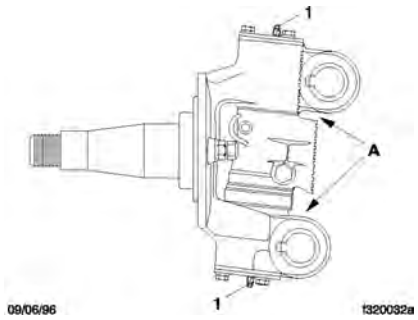
### 11.02.02 Detroit® Axles

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.51,Grease Fittings, Detroit Axles for grease exit points, see Fig. 52,Knuckle Pin Lubrication.




A. Upper View, LH Side
B. Lower View, LH Side
1. Grease Fitting

**Fig 51, Grease Fittings, Detroit Axles**

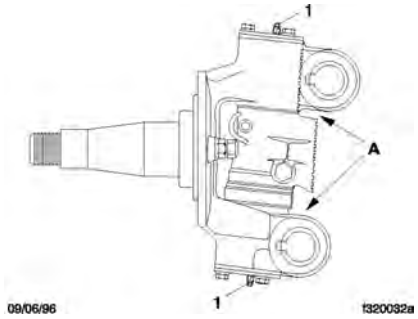



A. Grease Exit
1. Grease Fitting

**Fig 52, Knuckle Pin Lubrication**

## 11.02.03 Meritor Axles

1. When lubricating knuckle pin bushings, do not raise the front axle. Wipe the lube fittings clean, and apply multipurpose chassis grease, NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI Grade 2 (8% 12-hydroxy lithium stearate grease) until new grease is seen at the bushing grease seal opposite the fittings. The grease seal will accept grease pressure without damage, and is designed to have grease pumped out through it during lubrication. Even if grease leaks out around the top, or bottom-plate gasket, continue pumping until new grease is seen at the bushing seal opposite the grease fitting. See Fig.53,Knuckle Pin Lubrication.



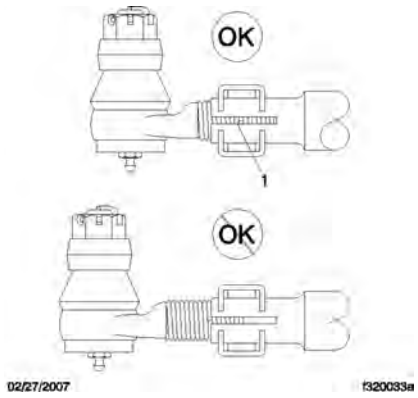

A. Grease Exit
1. Grease Fitting

**Fig 53, Knuckle Pin Lubrication**

## 11.03 Inspection The Tie Rod

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.54,Tie-Rod End Adjustment. Replace the components if this cannot be done. For instructions, refer toReplace the components if this cannot be done. For instructions, refer to  of the **Western Star 47X and 49X Workshop Manual**.



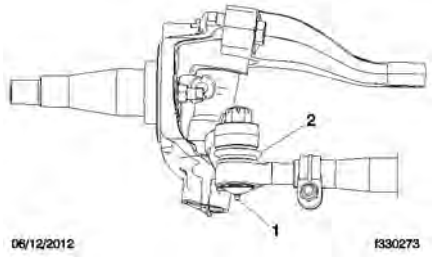

NOTE: Shown without pinch bolt to provide clarity.

**Fig 54, Tie-Rod End Adjustment**

## 11.04 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 multi-purpose chassis grease, NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI Grade 2 (8% 12-hydroxy lithium stearate grease), into the tie-rod ends until all used grease is forced out and fresh grease is seen at the ball stud neck. See Fig.55, **Grease Fitting and Boot (Detroit axle shown)**.




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

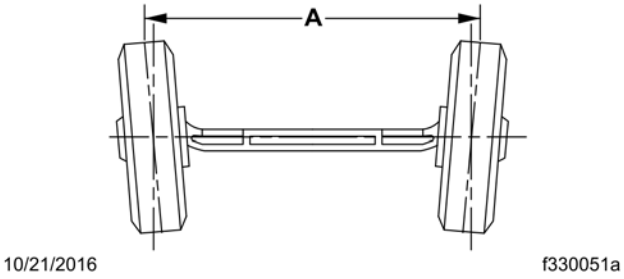
**Fig 55, Grease Fitting and Boot (Detroit axle shown)**

## 11.05 All-Axle Alignment Check

### 11.05.01 General information

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.56,Camber Angle (front view)) 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. 57,Tire Damage Due to Excessive Camber. If the front axle is damaged enough to affect the camber angle it must be replaced.




A. Camber (Positive)

**Fig 56, Camber Angle (front view)**

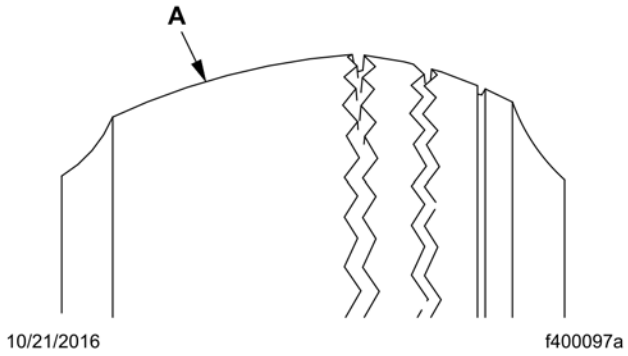
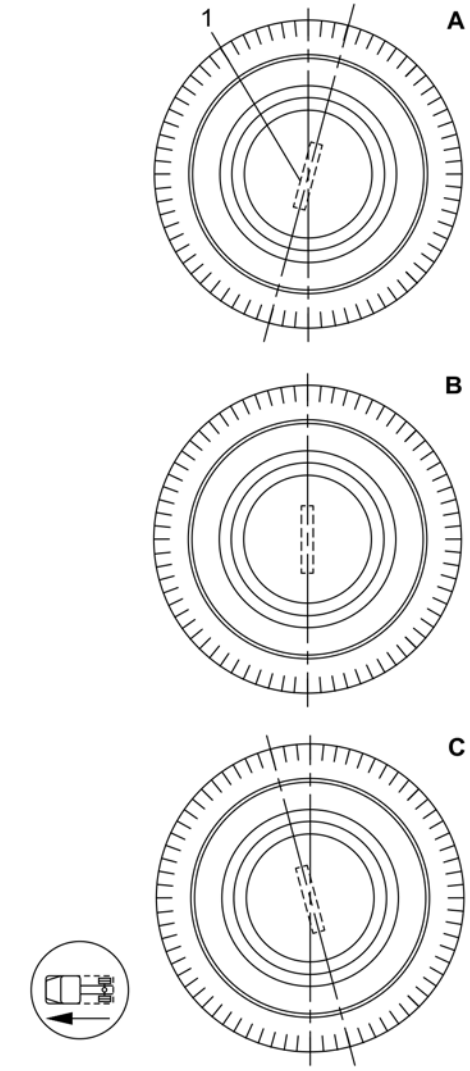



**Fig 57, Tire Damage Due to Excessive Camber**

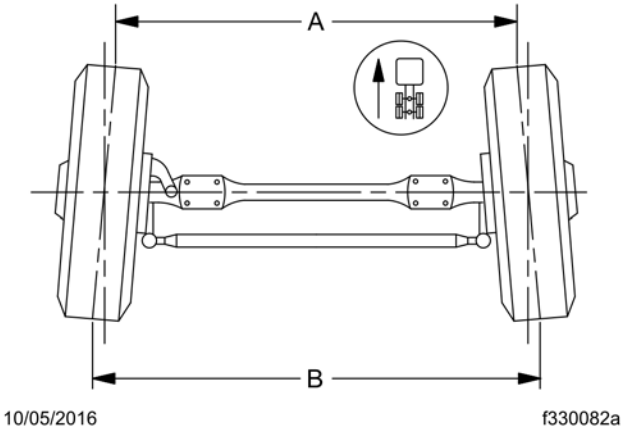
Caster angle (Fig.58,Camber Angle (front view)) is the tilt of the knuckle pin (or kingpin) as viewed from the side. Caster angle is measured in degrees and is adjustable. A positive caster angle is the tilt of the top of the knuckle pin toward the rear of the vehicle. A negative caster angle is the 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.




A. Camber (Positive)
B. Positive Caster
C. Zero Caster
D. Negative Caster
1. Knuckle Pin (King Pin)

**Fig 58, Camber Angle (front view)**

Wheel toe-in (Fig.59,Wheel Toe-In (overhead view)) 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. 60,Tire Damage Due to Excessive Toe-In or Incorrect Drive Axle Alignment.




NOTE: B minus A equals toe-in.

**Fig 59, Wheel Toe-In (overhead view)**

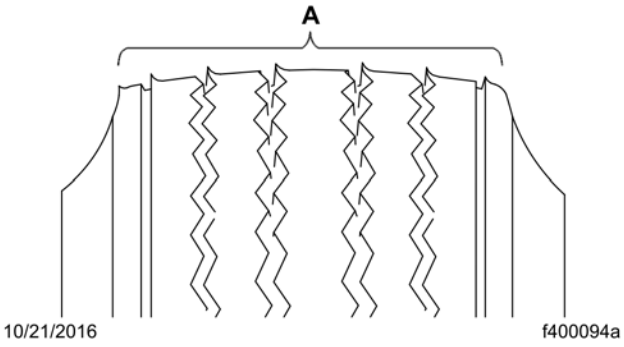
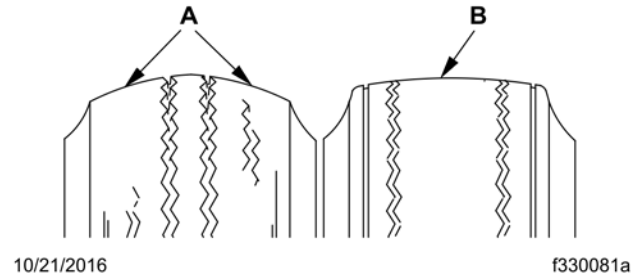



**Fig 60, Tire Damage Due to Excessive Toe-In or Incorrect Drive Axle Alignment**

## 11.05.02 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.
2. 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  in this manual and Wheels and Tires Preface for 47x and 49x (Workshop Manual) in the **Western Star 47X and 49X Workshop Manual** for more information. Replace any tire that is excessively worn.
3. 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. 61,Tire Damage Due to Underinflated or Overinflated Tires.




A. Underinflation Wear B. Overinflation Wear

**Fig 61, Tire Damage Due to Underinflated or Overinflated Tires**

4. Check for out-of-round wheels and wheel stud holes. Replace the wheel if any of these conditions exist.
5. 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. Replace damaged springs as instructed in the applicable suspension section.
6. On a vehicle equipped with a Freightliner AirLiner® rear suspension, check the ride height and make any necessary adjustments until it is within specification. See General Information, Front Suspension 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 General Information, Front Axle Wheel Hubs, Brake Drums, and Wheel Bearings in the **Western Star 47X and 49X Workshop Manual**.
10. Check the tie-rod ends for correct adjustment, tightness, and damage. Refer to 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.

## 11.05.03 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 Alignment of the Steering System in the **Western Star 47X and 49X Workshop Manual** for the alignment procedure.

## 11.05.04 Checking and Adjusting the Steering Angle

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.62, **Axle Stop**), which are located on the rear side of each front axle spindle.

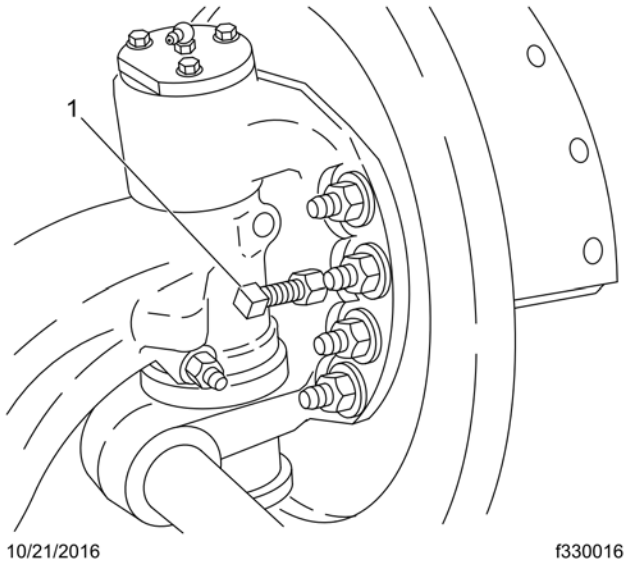



**Fig 62, Axle Stop**

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 interference 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 General Information, Steering I-Shaft in the **Western Star 47X and 49X Workshop Manual**.
5. Drive the vehicle off the turn-plates or turntables.

## 11.05.05 Camber Angle

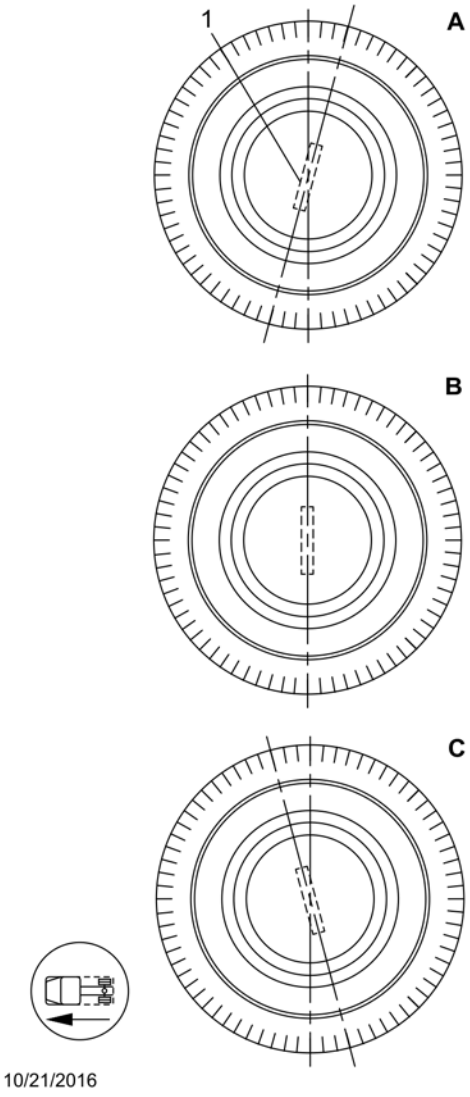
IMPORTANT: For vehicle alignment to be accurate, the shop floor must be level in every direction. The turn plates for the front wheels must rotate freely without friction, and the alignment equipment must be calibrated as directed in the alignment equipment manufacturers maintenance procedures and intervals. 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.

## 11.05.06 Adjusting the Caster Angle

Caster angle is the tilt of the knuckle pin (or kingpin) as viewed from the side of the vehicle. See Fig.63, **Caster Angle**.




A. Positive Caster
B. Zero Caster
C. Negative Caster
1. Knuckle Pin (King Pin)

**Fig 63, Caster Angle**

IMPORTANT: Do all the preliminary checks in General Information, Alignment of the Front Axle 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. 64, **Axle Spring Installation**):

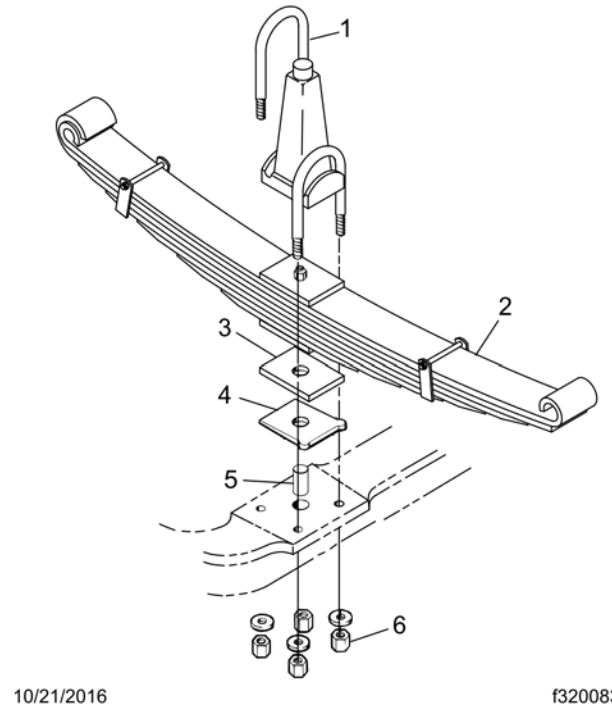



**Fig 64, Axle Spring Installation**

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.64, **Axle Spring Installation**.
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.64,, page 104.

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 Loctite® 242. Tighten the U-bolt nuts to the value in the appropriate table in General Information, Front Suspension of the **Western Star 47X and 49X Workshop Manual** for complete procedure. U-bolt nuts need periodic retightening. Refer to  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.

## 11.05.07 Wheel Toe-In Adjusting, Integral Gear Steering

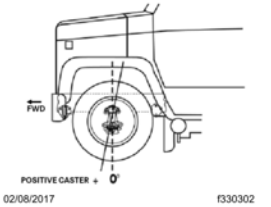
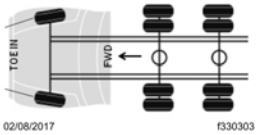
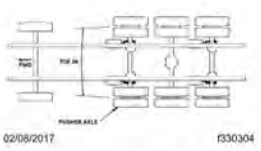
1. Loosen the tie rod (cross tube) clamp nuts, and turn the tie rod as needed. If the vehicle is not on turn-plates or turntables, move the vehicle backward and then forward about six feet (two meters) — this is important when setting the toe-in on vehicles equipped with radial tires. Apply the parking brakes and chock the rear tires. Do a final wheel toe-in check to make sure that it is correct.
2. Road test the vehicle.

## 11.05.08 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.

**Table 23, Caster**

| Western Star 47X and 49X Front Suspension, Set Back Axle - 49-00267-101/Set Forward Axle - 49-00267-102 | | | | |
|---|---|---|---|---|
| **Description** | | **Units** | **Target** | **Target** |
|  | 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 |
|  | Total Toe | Degrees | 0.09 | ±0.09 |
| **Pusher and Tag Axles** | | | | |
|  | Total Toe | Degrees | 0.09 | ±0.09 |

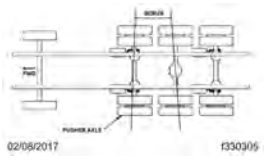
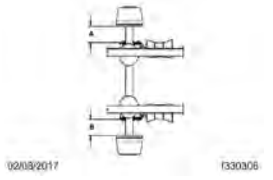
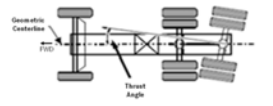
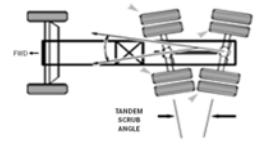
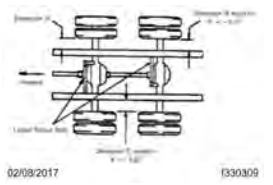
| | | | | |
|---|---|---|---|---|
|  | Scrub Angle | Degrees | 0 | ±0.08 |
|  | Tracking/Lateral Offset | Inches | 0 | ±0.25 |
| **Rear Suspension** | | | | |
|  | RDA Thrust Angle | Degrees | 0 | ±0.18 |
|  | FDA/RDA Scrub Angle | Degrees | 0 | ±0.08 |
|  | FDA/RDA Tracking/Lateral Offset | Inches | 0 | ±0.25 |

**Table 23, Caster**

Camber

**Table 24, Camber, Detroit and Meritor Axles**

| Camber, Detroit and Meritor Axles | | |
|---|---|---|
| **Axle Model** | **Left Camber: degrees** | **Right Camber: degrees** |
| All | –1/4 ± 7/16 | –1/4 ± 7/16 |

**Table 24, Camber, Detroit and Meritor Axles**

**Table 25, Camber, Dana/Eaton Axles**

| Camber, Dana/Eaton Axles | | |
|---|---|---|
| **Axle Model** | **Left Camber: degrees** | **Right Camber: degrees** |
| All E Series | +1/4 ± 7/16 | 0 ± 7/16 |

**Table 25, Camber, Dana/Eaton Axles**

**Table 26, Camber, Hendrickson Axles**

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

**Table 26, Camber, Hendrickson Axles**

Torque Values

**Table 27, Miscellaneous 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 27, Miscellaneous Torque Values**

**Table 28, Tie Rod Clamp Nut Torque Values**

| Tie Rod Clamp Nut Torque Values | | | | |
|---|---|---|---|---|
| **Axle Manufacturer** | **Axle Model** | **Tie Rod Clamp Nut Size** | **Plain Nut Torque: lbf·ft (N·m)[1]** | **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) |

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

**Table 28, Tie Rod Clamp Nut Torque Values**

## 11.06 Steer Axle Hub Cap Vent Plug Inspection

### 11.06.01 General Information

As a function of their design, hubcap vent plugs will on occasion exhibit signs of hub oil on their exterior surface. Depending on environmental conditions and/or age of the plug, the amount of oil present can vary. This is a normal result of the venting process due to pressure increase within the hub cavity. For an example of normal vent plug appearance, see Fig. 65, **Normal Oil Venting**.

**Fig 65, 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.66, **Excessive Leakage** and Fig.67, **Water in Oil**. Evidence of a leaking vent plug may appear as;

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

**Fig 66, Excessive Leakage**

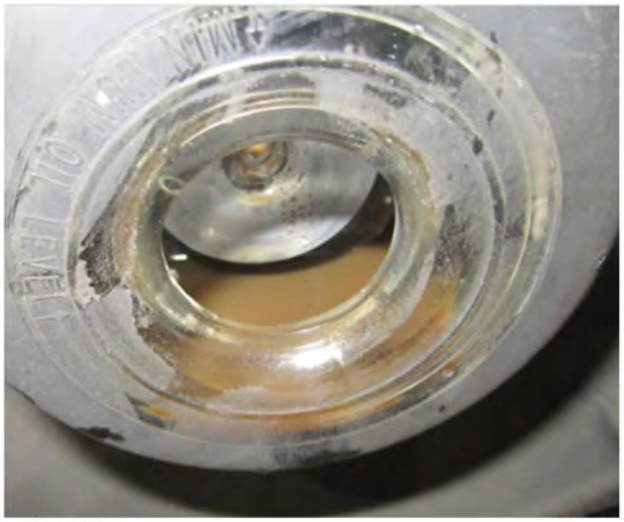



**Fig 67, Water in Oil**

11.06.02 Inspection

**NOTICE:**

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

1. Park the vehicle on a level surface, shut down the engine and set the parking brakes. Chock the tires.
2. Inspect the axle hub cap and vent plug for evidence of excessive leakage.
3. Wipe the hub cap and vent plug clean with a rag.
4. Remove the vent plug and check the oil for evidence of water contamination.If there is evidence of water contaminated oil in the hub, disassemble the effected axle end, clean, inspect, and reassemble the axle end. For instructions, refer to General Information, Alignment of the Front Axle 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.

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# 12. Rear Axle

## 12.01 Safety Precautions

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

**DANGER:**

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

## 12.02 Axle Lubricant and Filter Change, and Magnetic Strainer Cleaning

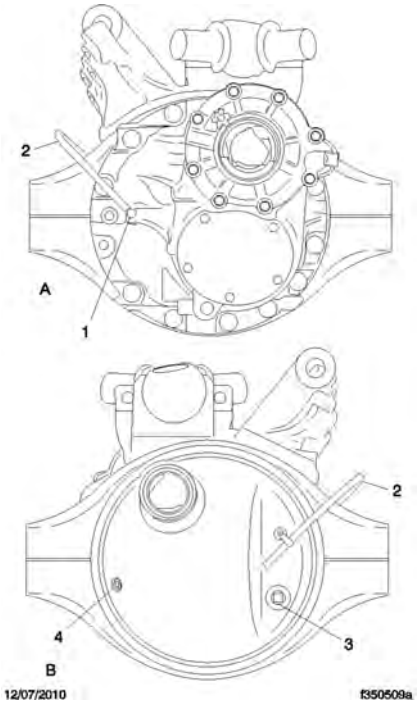
12.02.01 Detroit® Model 4 and Model 6

**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.’

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




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

**Fig 68, Detroit Model 4 and Model 6 Tandem Axle (forward axle shown)**

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

3. Place a drain pan under the rear axle drain plug. Drain the oil when it is warm. At this temperature, the oil will run more freely and ensure that the axle is flushed.
4. Clean the fill and drain plugs. Change them if necessary.
   - 4.a For magnetic plugs, use a piece of key stock or any other convenient steel slug to short the two magnetic poles and divert the magnetic field.
   - 4.b Clean away the collected material deposited on each pole. Magnets will rapidly lose their effectiveness as collected material bridges the gap between the two poles.
   - 4.c After the first oil is changed, inspect the drain plug each time for large quantities of metal particles.
   - 4.d After cleaning, install the drain plug(s) and tighten to 30 lbf·ft (41 N·m).
5. Fill the axle with the recommended lubricant. See Table.29,Detroit Drive Axle Lubricants, Model 4 and Model 6for recommended drive axle lubricants and Table.30,Detroit Rear Axle Lubricant Capacity, Model 4 and Model 6 for lubricant capacities.
   - 5.a Fill the axle through the oil fill hole. Lubricant should be level with the bottom of the oil fill hole. To check fluid level, see Fig.69, **Axle Lubricant Level Inspection**.

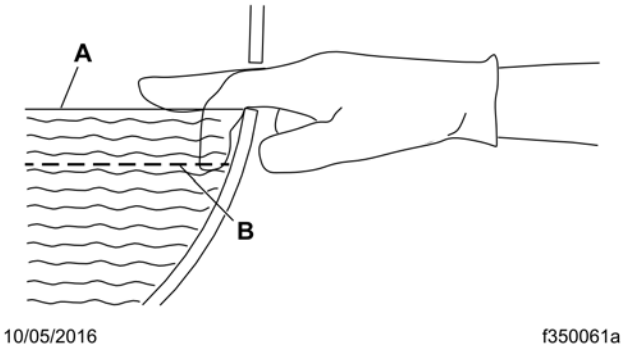



**Fig 69, Axle Lubricant Level Inspection**

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

**Table 29, Detroit Drive Axle Lubricants, Model 4 and Model 6**

| Detroit Drive Axle Lubricant, Model 4 and Model 6[1] | | |
|---|---|---|
| **Lubricant** | **Type** | **Ambient Temperature** |
| Mobil Delvac 1 Gear Oil 75W-90 | Synthetic | –40°F (–40°C) and up[2] |
| 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 | | |

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

**Table 29, Detroit Drive Axle Lubricants, Model 4 and Model 6**

**Table 30, Detroit Rear Axle Lubricant Capacity, 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)[1] |
| Single and Rearmost Tandem, Model 4 | 10.6 (10.0)[2] |

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

**Table 30, Detroit Rear Axle Lubricant Capacity, Model 4 and Model 6**

## 12.02.02 Detroit New Final Drive

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Clean the fill plug and the area around it. In the carrier housing, remove the plug from the oil fill hole. See Fig. 70,Detroit™ New Final Drive Forward Axle, Oil Fill Location for the forward axle, and Fig. 71,Detroit™ New Final Drive Rear Axle, Oil Fill Location for the rear axle.

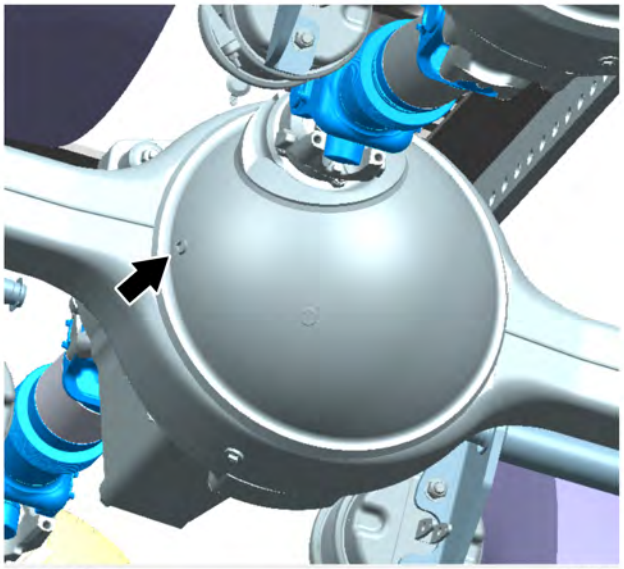



**Fig 70, Detroit™ New Final Drive Forward Axle, Oil Fill Location**

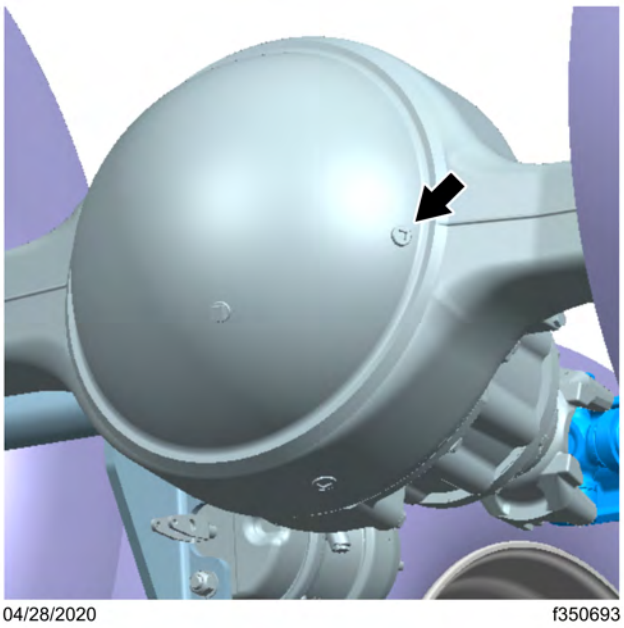



**Fig 71, Detroit™ New Final Drive Rear Axle, Oil Fill Location**

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

3. Place a drain pan under the rear axle drain plug. Drain the oil when it is warm. At this temperature, the oil will run more freely and ensure that the axle is flushed.
4. Clean the fill and drain plugs. Change them if necessary.
   - 4.a For magnetic plugs, use a piece of key stock or any other convenient steel slug to short the two magnetic poles and divert the magnetic field.
   - 4.b Clean away the collected material deposited on each pole. Magnets will rapidly lose their effectiveness as collected material bridges the gap between the two poles.
   - 4.c After the first oil is changed, inspect the drain plug each time for large quantities of metal particles.
5. Fill the axle with the recommended lubricant. See Table.31, **Detroit Drive Axle Lubricants, New Final Drive** for recommended drive axle lubricants and Table.32,New Final Drive Oil Capacity, New Final Drive for lubricant capacities.

**Table 31, Detroit Drive Axle Lubricants, New Final Drive**

| Detroit Drive Axle Lubricant, New Final Drive[1] | | |
|---|---|---|
| **Lubricant** | **Type** | **Ambient Temperature** |
| Must meet Detroit Fluids Specification (DFS) 93K219.03 | Synthetic | –40°F (–40°C) and up[2] |

1. Detroit rear axles do not require the use of friction modifiers.
2. There is no upper limit on the ambient temperature, but axle sump temperature must never exceed 250°F (121°C).

**Table 31, Detroit Drive Axle Lubricants, New Final Drive**

**Table 32, New Final Drive Oil Capacity, New Final Drive**

| New Final Drive Oil Capacity, New Final Drive | | |
|---|---|---|
| **Axle Type** | **Oil in Hubs (2)** | **Oil in Axle** |
| NFD Model 4 Forward Axle SP | 1.8 L | 14 L |
| NFD Model 4 Rear Rear Axle SP | 1.8 L | 11 L |
| NFD Model 6 TP | 1.8 L | 9.5 L |
| NFD Model 6 SP | 1.8 L | 11 L |

**Table 32, New Final Drive Oil Capacity, New Final Drive**

## 12.02.03 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.33,, page 118.

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. 72,Meritor Axle Oil Filter Removal. Discard the old filter.

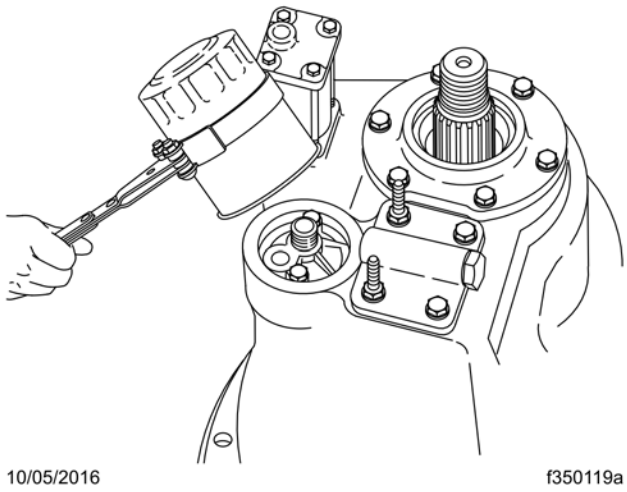



**Fig 72, Meritor Axle Oil Filter Removal**

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.33,Meritor Drive Axle Recommended Lubricant for recommended lubricants.

**Table 33, Meritor Drive Axle Recommended Lubricant**

| Meritor Drive Axle Recommended Lubricant | | | |
|---|---|---|---|
| **Recommended Lubricant Type** | **Ambient Temperature** | **Lubricant SAE Viscosity Grade** | **Meritor Specification** |
| Synthetic Gear Oil | –40°F (–40°C) and Up[1] | 75W–90 | 0–76–N |

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

**Table 33, Meritor Drive Axle Recommended Lubricant**

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

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

   5.b Check the drain plug for metal particles every 100,000 miles (160 000 km). Clean away the collected material deposited on each pole. Magnets will rapidly lose their effectiveness as collected material bridges the gap between the two poles.

   5.c 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.d 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.34,Meritor Drive Axle Lubricant Capacities 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.a With the vehicle on a level surface, fill the axle through the oil fill hole. Lubricant should be level with the bottom of the oil fill hole. To check fluid level, see Fig.73,Axle Lubricant Level Inspection.

**Table 34, Meritor Drive Axle Lubricant Capacities**

| Meritor Drive Axle Lubricant Capacities | | |
|---|---|---|
| Axle Model | | Capacity:pt (L)[1] |
| *Single Drive, Single Reduction* [2] | | |
| RS–21–160 | | 39.5 (18.7) |
| RS–23–160 | | 39.5 (18.7) |
| RS–23–161 | | 37.2 (17.6) |
| RS–23–185 | | 47.3 (22.4) |
| RS–25–160 | | 37.2 (17.6) |
| *Tandem Drive, Single Reduction* | | |
| RT–40–145, RT–40–145A, RT–40–145P | Forward | 30.2 (14.3) |
| | Rear | 25.8 (12.2) |
| RT–44–145, RT–44–145P | Forward | 29.3 (13.9) |
| | Rear | 25.1 (11.9) |
| RT–46–160, RT–46–160P | Forward | 39.1 (18.5) |
| | Rear | 34.4 (16.3) |

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

**Table 34, Meritor Drive Axle Lubricant Capacities**

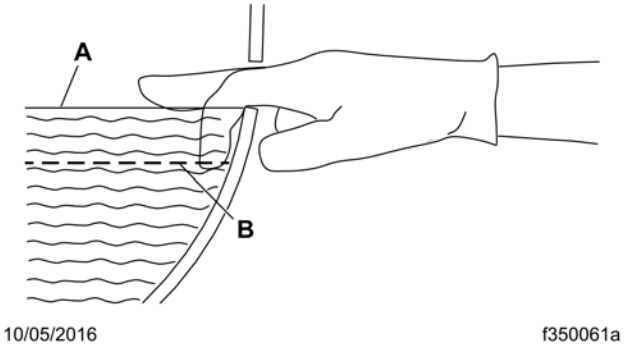



**Fig 73, Axle Lubricant Level Inspection**

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

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

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

## 12.02.04 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 stand-pipe, if installed in the oil fill hole). See Fig.74,Axle Housing Drain and Fill Plugs.

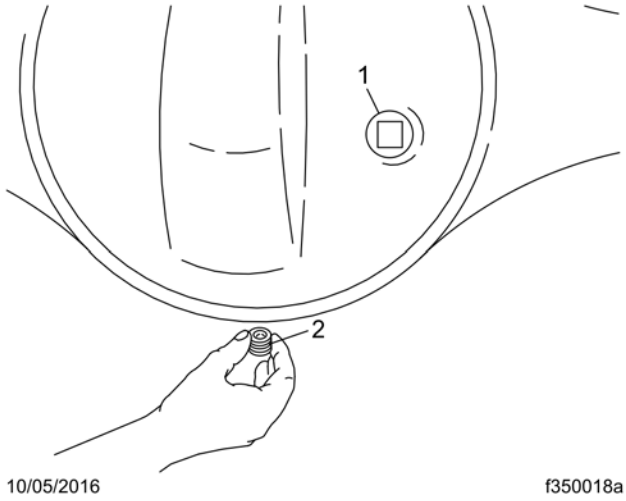



**Fig 74, Axle Housing Drain and Fill Plugs**

3. Place a drain pan under the rear axle drain plug. See Fig.74,Axle Housing Drain and Fill Plugs. 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. 75,Dana Spicer Tandem Drive Axle Magnetic Strainer.

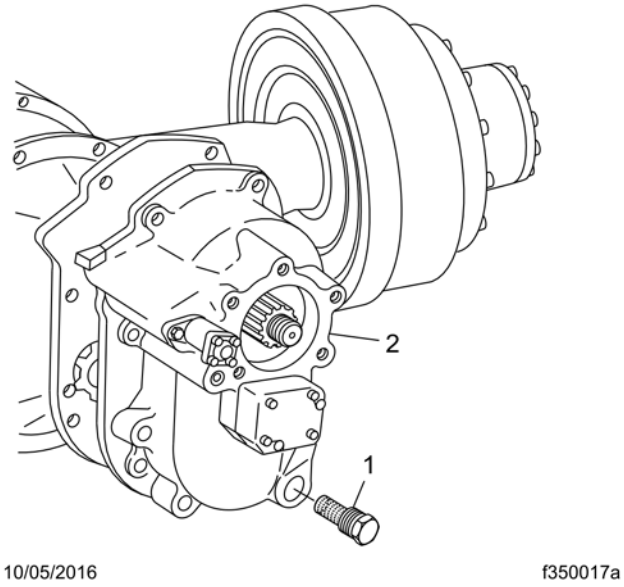



**Fig 75, Dana Spicer Tandem Drive Axle Magnetic Strainer**

4.a Remove the magnetic strainer from the power divider cover.

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

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

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

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

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

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

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

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

6. Fill the axle with the recommended lubricant. See Table.35,Dana Spicer Drive Axle Recommended Lubricant for recommended drive axle lubricants, and Table.36,Dana Spicer Drive Axle Lubricant Capacities for drive axle lubricant capacities.

**Table 35, Dana Spicer Drive Axle Recommended Lubricant**

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

**Table 35, Dana Spicer Drive Axle Recommended Lubricant**

**Table 36, Dana Spicer Drive Axle Lubricant Capacities**

| Dana Spicer Drive Axle Lubricant Capacities | | |
|---|---|---|
| **Axle Type** | **Axle Model** | **Capacity:** [1]Pints (liters) |
| *Single Drive Axle Installation* | | |
| Single Reduction | 23080S, 23080D | 40 (18.9) |
| | 23105S, 23105D | 48 (22.7) |
| *Tandem Drive Axle Installation* | | |
| Single Reduction | DD404, DD404–P | 31 (14.7)[2] |
| | DS404, DS404–P | 39 (18.5)[3] |
| | DS461–P | 43 (20.3)[4] |
| 2-Speed (dual-range) | DT402, 402–P | 34 (16.1)[5] |
| | DT451–P | 39 (18.5)[6] |
| | DT461–P | |
| Double Reduction | DP451–P | 34 (16.1)[7] |
| | DP461–P | 43 (20.3)[8] |

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

**Table 36, Dana Spicer Drive Axle Lubricant Capacities**

**NOTICE:**
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.a 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.76, **Axle Lubricant Level Inspection**.

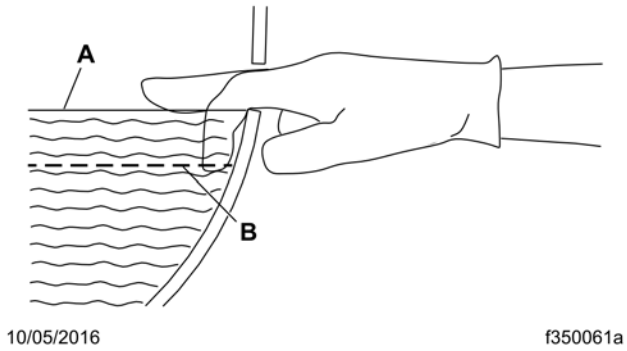



**Fig 76, Axle Lubricant Level Inspection**

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

## 12.03 Axle Breather and Axle Lubricant Level Inspection

### 12.03.01 Detroit® Model 4 and Model 6

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.'

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.77, **Axle Lubricant Level Inspection**. If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in Table.37,New Final Drive Oil Capacity, New Final Drive .

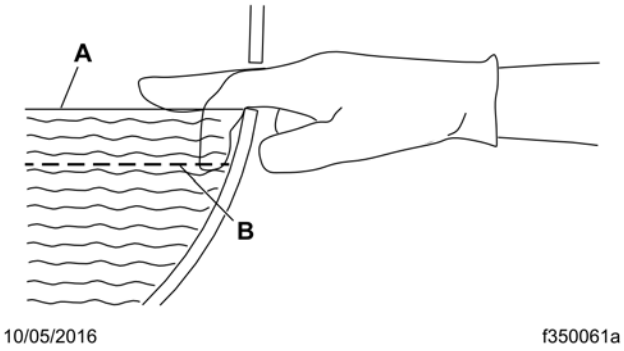



**Fig 77, Axle Lubricant Level Inspection**

**Table 37, New Final Drive Oil Capacity, New Final Drive**

| New Final Drive Oil Capacity, New Final Drive | | |
|---|---|---|
| **Axle Type** | **Oil in Hubs (2)** | **Oil in Axle** |
| NFD Model 4 Forward Axle TP | 1.8 L | 9 L |
| NFD Model 4 Rear Rear Axle TP | 1.8 L | 7.5 L |
| NFD Model 4 Forward Axle SP | 1.8 L | 14 L |
| NFD Model 4 Rear Rear Axle SP | 1.8 L | 11 L |
| NFD Model 6 TP | 1.8 L | 9.5 L |
| NFD Model 6 SP | 1.8 L | 11 L |

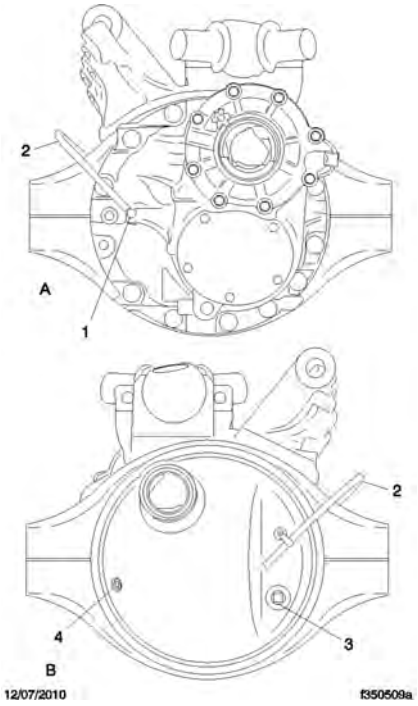
**Table 37, New Final Drive Oil Capacity, New Final Drive**

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

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

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

6. Check the axle housing breather (see Fig.78,Detroit Model 4 and Model 6 Tandem Axle (forward axle shown) ). Make sure that it is open and unclogged. If the breather is plugged or damaged, clean or replace it as needed.




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

**Fig 78, Detroit Model 4 and Model 6 Tandem Axle (forward axle shown)**

## 12.03.02 Detroit® New Final Drive

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. 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.79, **Axle Lubricant Level Inspection** if low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in Table.38,New Final Drive Oil Capacity, New Final Drive .

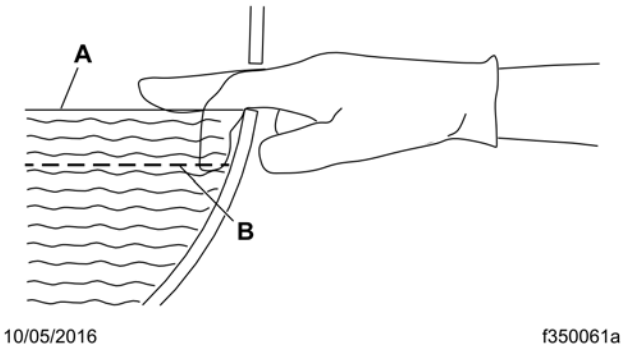



**Fig 79, Axle Lubricant Level Inspection**

**Table 38, New Final Drive Oil Capacity, New Final Drive**

| New Final Drive Oil Capacity, New Final Drive | | |
|---|---|---|
| **Axle Type** | **Oil in Hubs (2)** | **Oil in Axle** |
| NFD Model 4 Forward Axle TP | 1.8 L | 9 L |
| NFD Model 4 Rear Rear Axle TP | 1.8 L | 7.5 L |
| NFD Model 4 Forward Axle SP | 1.8 L | 14 L |
| NFD Model 4 Rear Rear Axle SP | 1.8 L | 11 L |
| NFD Model 6 TP | 1.8 L | 9.5 L |
| NFD Model 6 SP | 1.8 L | 11 L |

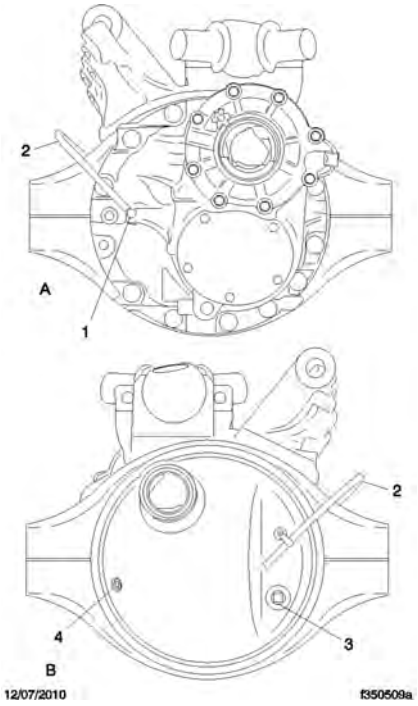
**Table 38, New Final Drive Oil Capacity, New Final Drive**

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

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

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

6. Check the axle housing breather. See Fig.80,Detroit Model 4 and Model 6 Tandem Axle (forward axle shown). Make sure that it is open and unclogged. If the breather is plugged or damaged, clean or replace it as needed.




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

**Fig 80, Detroit Model 4 and Model 6 Tandem Axle (forward axle shown)**

12.03.03 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.

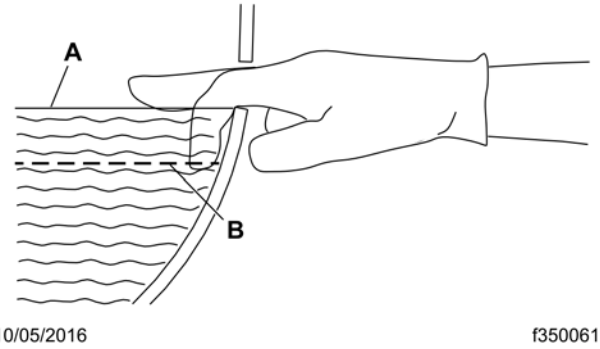
1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.

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.81, **Axle Lubricant Level Inspection**. If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in Table.39,Meritor Drive Axle Recommended Lubricant.




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

**Fig 81, Axle Lubricant Level Inspection**

**Table 39, Meritor Drive Axle Recommended Lubricant**

| Meritor Drive Axle Recommended Lubricant | | | |
|---|---|---|---|
| **Recommended Lubricant Type** | **Ambient Temperature** | **Lubricant SAE Viscosity Grade** | **Meritor Specification** |
| Synthetic Gear Oil | –40°F (–40°C) and Up[1] | 75W–90 | 0–76–N |

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

**Table 39, Meritor Drive Axle Recommended Lubricant**

4. Install and tighten the fill plug 35 lbf·ft (47 N·m).
5. Check the axle housing breather. Make sure that it is open and unclogged. See Fig. 82, **Meritor Axle Housing Breathers**. If the breather is plugged or damaged, clean or replace it as needed.

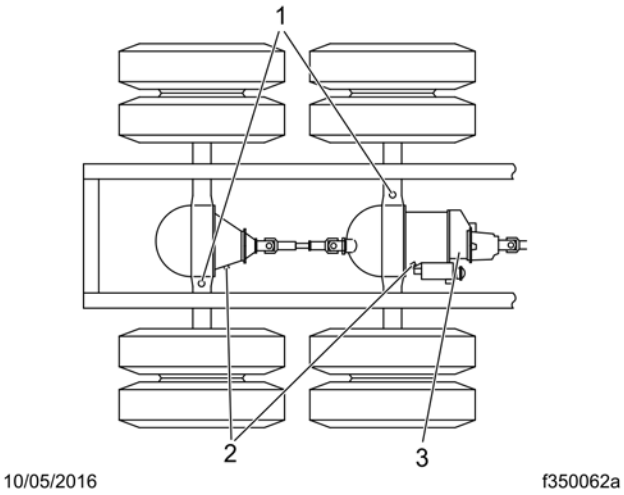



**Fig 82, Meritor Axle Housing Breathers**

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

## 12.03.04 Dana® Spicer®

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.

**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.83, **Meritor Axle Housing Breathers**. Remove the plug from the fill hole (or standpipe, if installed in the oil fill hole).

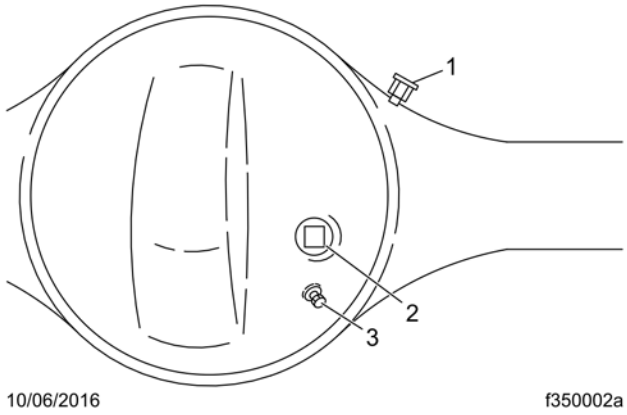



**Fig 83, Meritor Axle Housing Breathers**

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

4. Check that the lubricant is level with the bottom of the fill hole, or with the top of the standpipe opening. See Fig. 84, **Axle Lubricant Level Inspection**. If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant recommended in Table.40,Dana Spicer Drive Axle Recommended Lubricant.

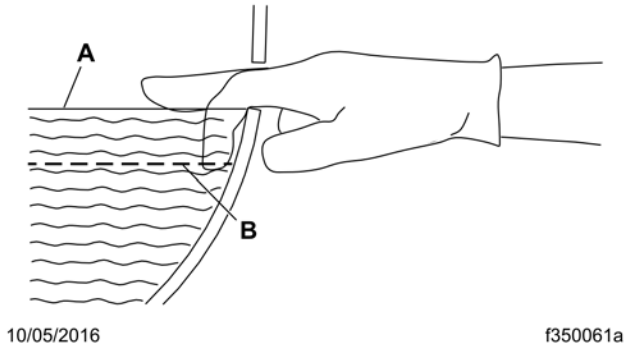



**Fig 84, Axle Lubricant Level Inspection**

**Table 40, Dana Spicer Drive Axle Recommended Lubricant**

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

**Table 40, Dana Spicer Drive Axle Recommended Lubricant**

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. 83, **Meritor Axle Housing Breathers**. If the breather is plugged or damaged, clean or replace it as needed.

13.01 Wheel Nut Check ..... 134
13.02 Tire Check ..... 134

## 13. Wheels and Tires

### 13.01 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.41,Disc Wheel Fastener Torque for torque specifications, and see Fig. 85,Wheel Nut Tightening Sequence for the wheel nut tightening sequence.

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

**NOTICE:**

Insufficient wheel nut torque can cause wheel shimmy, resulting in wheel damage, stud breakage, and extreme tire tread wear. Excessive wheel nut torque can break studs, damage threads, and crack discs in the stud hole area. Use the recommended torque values, and follow the tightening sequence shown in Fig.85,, page 134

**Table 41, Disc Wheel Fastener Torque**

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

**Table 41, Disc Wheel Fastener Torque**

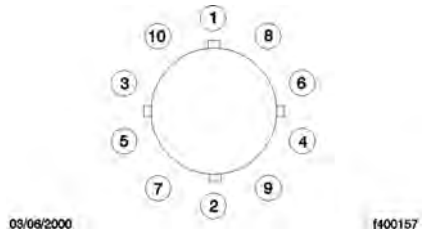



**Fig 85, Wheel Nut Tightening Sequence**

### 13.02 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 General Information, Alignment of the Front Axle

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.

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# 14. Driveline

## 14.01 Safety Precautions

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

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

## 14.02 Inspection of the Driveline

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

**NOTICE:**

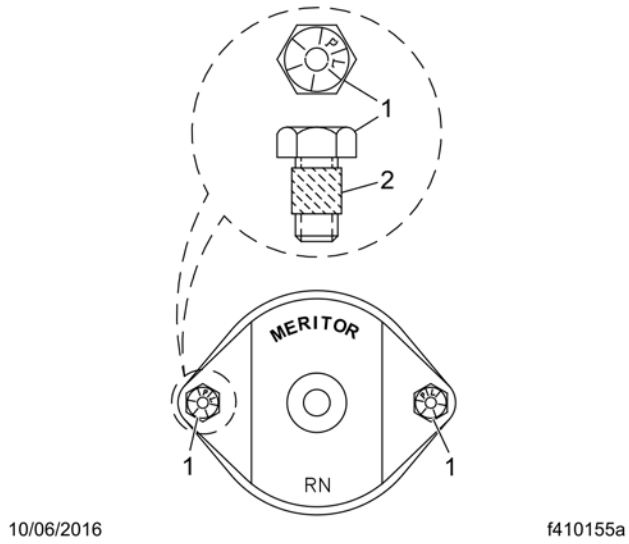
Due to the extreme load occurring at high-speed rotation, a loose or broken capscrew at any point in the driveline will weaken the driveline connection, which could eventually result in serious vehicle damage. Tighten bearing-cap capscrews or yoke-strap capscrews to specified torque, being careful to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

2. Tighten the U-joint capscrews. See Table.42,U-Joint Torque Specifications for torque specifications.

**Table 42, U-Joint Torque Specifications**

| U-Joint Torque Specifications | | |
|---|---|---|
| **Type** | **Torque** | **FigureFigure** |
| U-joints with bearing caps | 43 lbf·ft (58 N·m) | Fig. 86,Meritor U-Joint Fasteners for Bearing Caps. |
| Meritor RPL U-joints (except RPL35) | 125 lbf·ft (169 N·m) | Fig. 87,Meritor RPL Series U-Joint, Except RPL35. |
| Meritor RPL35 U-joints | 150 lbf·ft (203 N·m) | Fig.89,Meritor RPL35 Series U-Joint. |
| U-joints with yoke straps | 125 lbf·ft (169 N·m) | Fig.88,Components of a Basic Driveline. |

**Table 42, U-Joint Torque Specifications**




1. Self-Locking Capscrew
2. Adhesive Band

**Fig 86, Meritor U-Joint Fasteners for Bearing Caps**

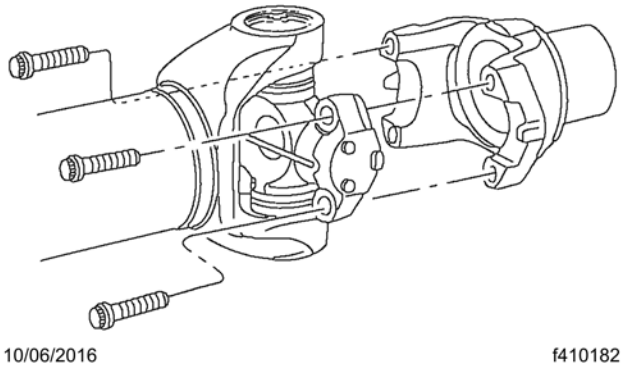
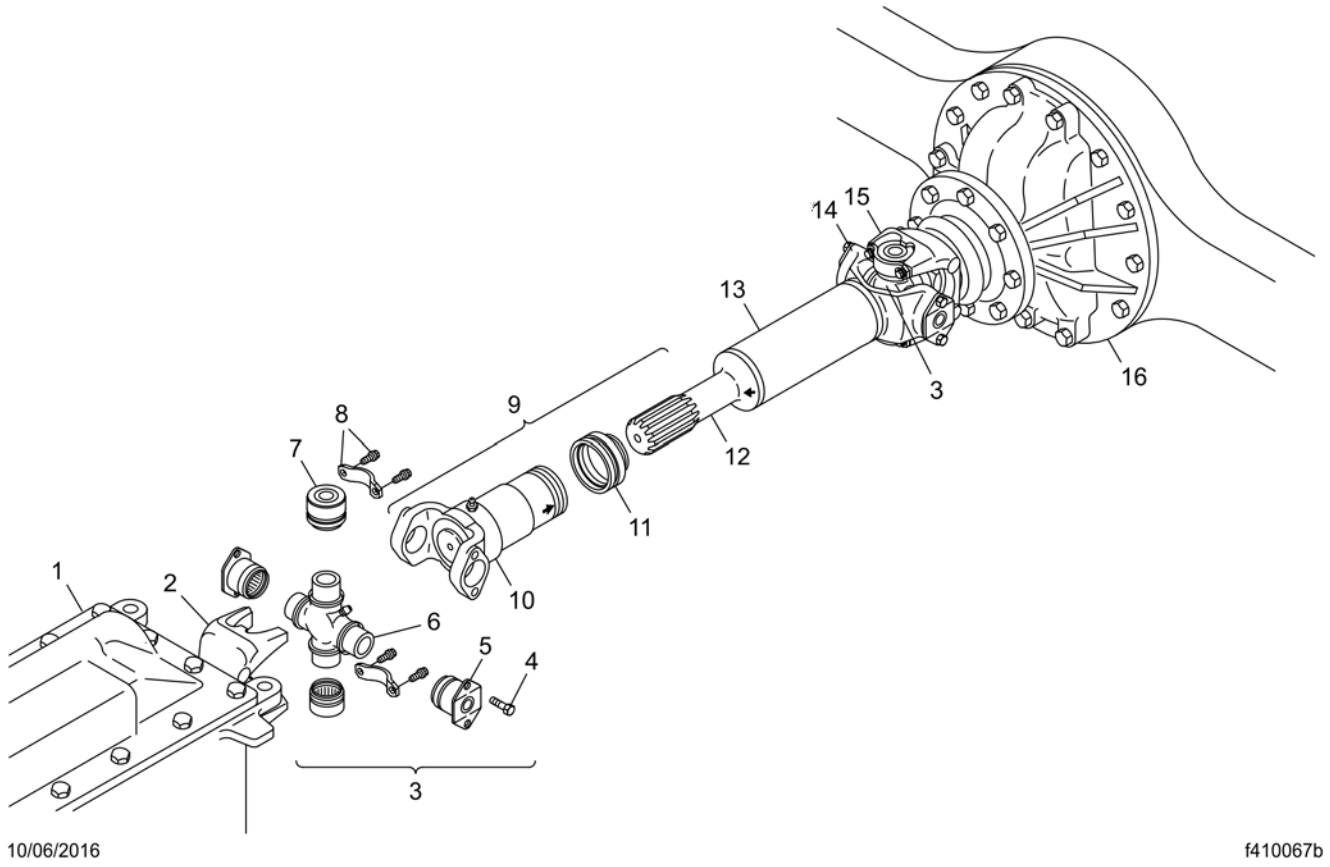


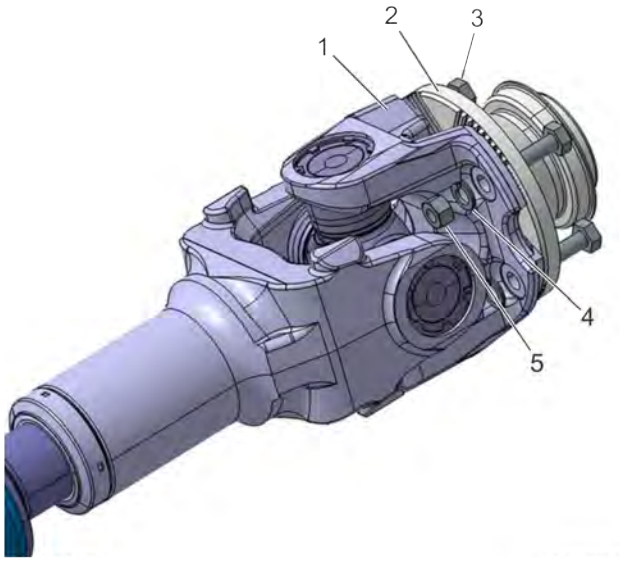

**Fig 87, Meritor RPL Series U-Joint, Except RPL35**




NOTE: All fasteners are not shown.

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

**Fig 88, Components of a Basic Driveline**




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

**Fig 89, Meritor RPL35 Series U-Joint**

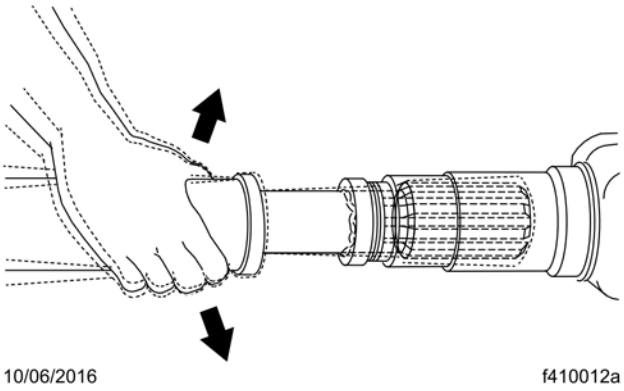
3. Check the driveline yokes or flanges for cracks, and check end-yokes for looseness. See Fig. 88,Components of a Basic Driveline.

   Replace cracked yokes and flanges.

   If any end-yoke can be moved in or out on its shaft, or can be rocked on its shaft, disconnect the driveshaft and U-joint from the yoke, then check the drive component's shaft seal for leakage or other visible damage that may have been caused by the loose yoke. Replace the seal if needed, then tighten the yoke nut. Refer to Uncoupling the U-Joint With a Half-Round End-Yoke, Driveline Components 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 any movement of the U-joint cross in the bearings can be felt or seen, replace the U-joint assembly.
5. Check if the midship bearing and mounting are loose or have deteriorated, by attempting to move the driveshaft up and down, and from side to side. If the bearing is loose on its shaft, or rattles, replace it. If the bearing mount is loose on the frame, tighten the mounting fasteners to the proper torque value. Replace the midship bearing assembly if the rubber cushion is deteriorated or oil-soaked.
6. Check slip joints for spline wear by moving the sleeve-yoke and splined shaft back and forth. See Fig. 90,Slip Joint Spline Wear Checking. If the slip joint can be twisted in a clockwise, or counterclockwise movement greater than 0.007 inch (0.18 mm), replace both the sleeve-yoke and the splined shaft.




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

**Fig 90, Slip Joint Spline Wear Checking**

7. Visually examine the driveshaft tubes for dents, bends, twists, or other damage. If any tube appears to be damaged, replace it.
8. Examine the driveshaft for evidence of missing balance weights, and for buildup of foreign material. Remove any foreign material. If there is any evidence that balance weights are missing, remove the driveshaft and have it balanced.
9. For driveshafts with slip joints, check to be sure the yoke plug is not loose or missing. See Fig. 91,Slip Joint and U-Joint Lubrication. Repair or replace the yoke plug as needed. If the yoke plug is missing, the splined shaft may be hitting the plug and knocking it out; contact your Regional Service Office for assistance in determining the correct driveshaft length.

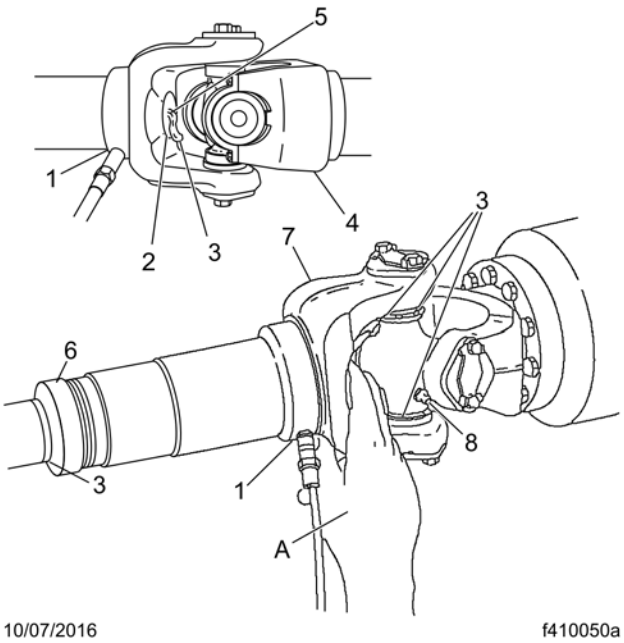


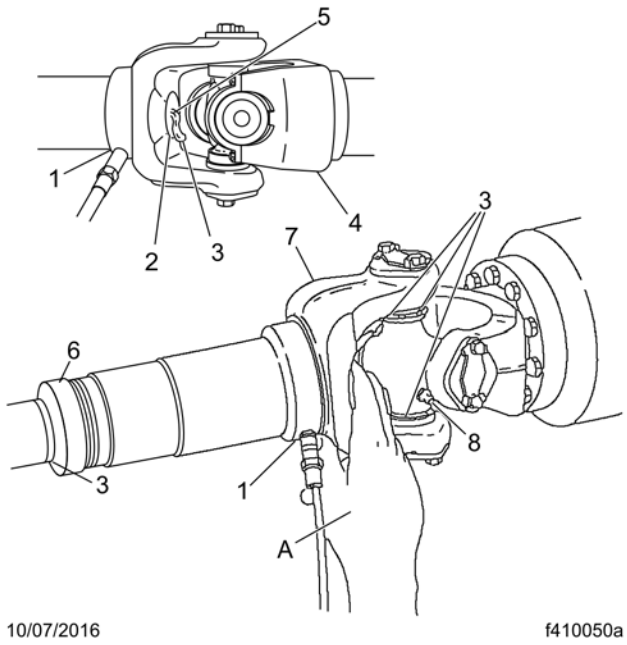

**Fig 91, Slip Joint and U-Joint Lubrication**

## 14.03 Driveline Lubrication

### 14.03.01 Lubrication of the Universal Joint

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

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the tires.
2. Wipe all old grease and dirt from each U-joint grease fitting. See Fig.92,Slip Joint and U-Joint Lubrication.




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

**Fig 92, Slip Joint and U-Joint Lubrication**

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

   Using lithium 12-Hydroxy stearate grease (NLGI Grade 2, with EP additives), lubricate until **new** grease can be seen at **all four** U-joint seals. Fresh grease must be seen escaping from **all four** bearing-cap seals of each U-joint. On full-round yokes equipped with a bearing cup, if most of the grease being added to a U-joint can be seen escaping from just one of the U-joint seals, check the torque on the capscrews at that seal.
4. Tighten the bearing-cup capscrews 43 lbf·ft (58 N·m). If the capscrews were already tight, or all of the U-joint seals still do not purge, remove the bearing cup at that seal, and examine the seal for damage. If the seal is damaged, replace the complete U-joint.
5. If grease does not appear at one seal, use a prying tool to pry the U-joint trunnion away from the non-purging seal, or tap the driveshaft or yoke with a plastic or rawhide mallet on the side opposite the dry seal, while continuing to lubricate. If grease still does not appear, loosen the capscrews at the bearing with the dry seal, to relieve seal tension.

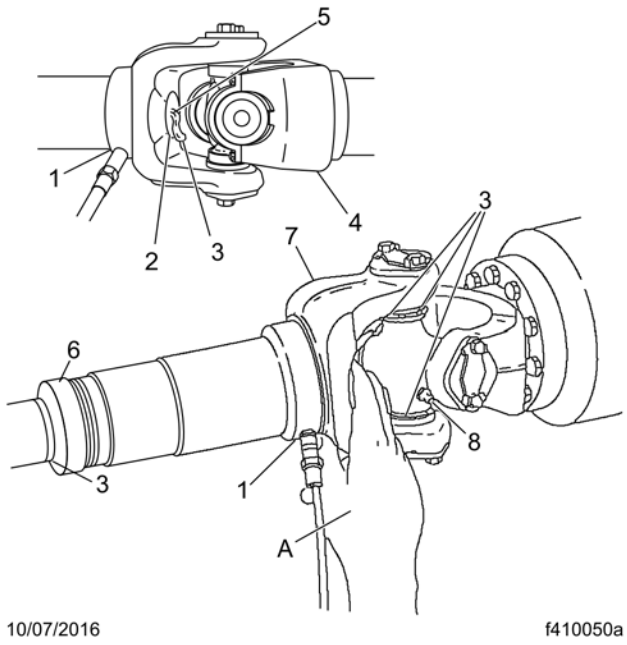
Lubricate the U-joint until new grease is seen at the seal, then tighten the capscrews to the correct torque specifications. If the bearing will not take grease, replace the U-joint. See of the **57X Workshop Manual** for replacement instructions.

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.

## 14.03.02 Lubrication of the Slip Joint Spline

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

1. If equipped with a grease fitting, wipe all old grease and dirt from the slip joint grease fitting. See Fig. 93,Slip Joint and U-Joint Lubrication.




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

**Fig 93, Slip Joint and U-Joint Lubrication**

2. Use a hand-type grease gun or a high-pressure gun with a low-pressure adaptor, to lubricate the slip joint. Add multi-purpose chassis grease (lithium 12-hydroxy stearate, NLGI Grade 2, with EP additives) until it appears at the pressure-relief hole in the yoke plug. Then cover the relief hole with your finger, while continuing to apply gun pressure until new grease appears at the slip joint seal. See Fig.93,Slip Joint and U-Joint Lubrication. This ensures complete lubrication of the splines.
3. Wipe the purged grease from the pressure-relief hole and slip joint seal, and any excess grease from the grease fitting.

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## 15. Brakes

### 15.01 Safety Precautions

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

**DANGER:**

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

### 15.02 Inspection of the Air Brake System Valve

NOTE: There is no scheduled air valve maintenance on vehicles equipped with Bendix air valves and a Bendix air dryer if the air dryer desiccant is replaced at 350,000 miles (563 000 km). If the desiccant is not changed at 350,000 miles (563 000 km), or if the vehicle is equipped with another air dryer, maintenance will have to be performed to the air brake valves. See General Description, Meritor WABCO Antilock Braking System, ABS 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.

### 15.03 Bendix Air Dryer Desiccant Replacement

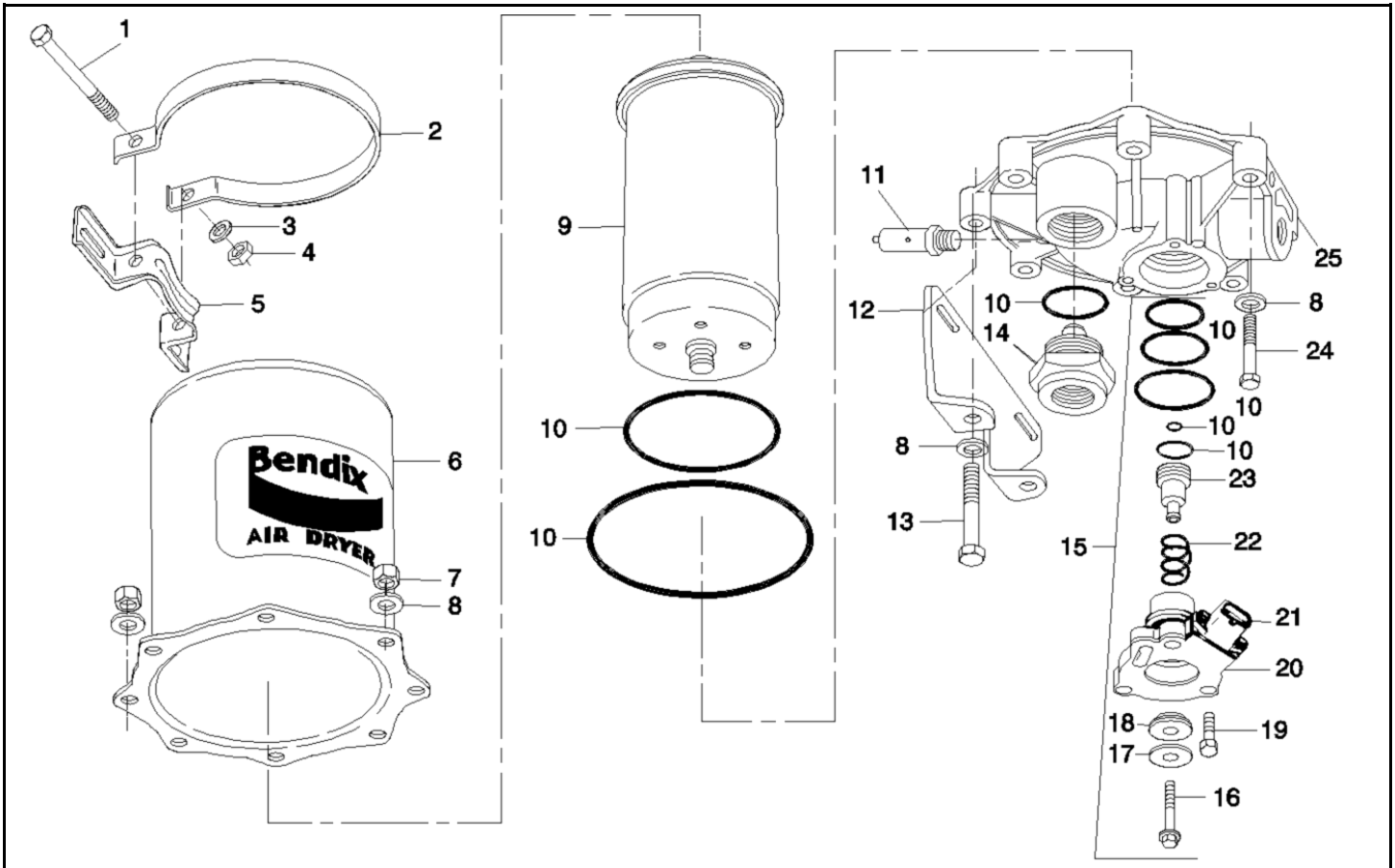
15.03.01 AD–9

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

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

   NOTE: The compressor discharge line may still contain residual air pressure, 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.94,AD–9 Air Dryer (exploded view) Discard the Nylok nuts. Remove the end-cover-to-housing O-ring.




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

**Fig 94, AD–9 Air Dryer (exploded view)**

9. Clamp the desiccant cartridge in a vise.

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

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

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

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

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

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

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

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

16. Install the 6 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.95,AD–9 End Cover to Housing Torque Pattern.

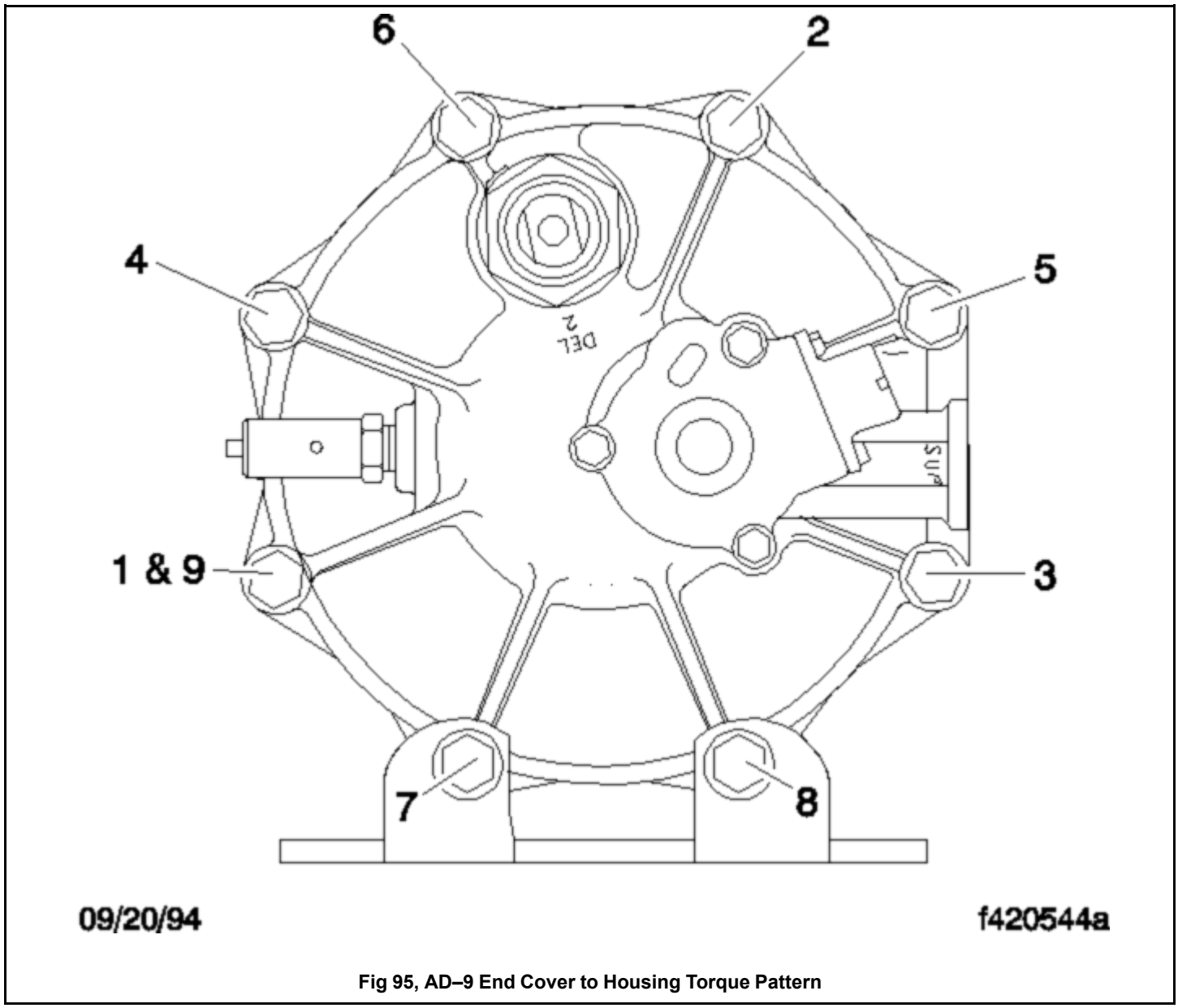



**Fig 95, AD–9 End Cover to Housing Torque Pattern**

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 General Description, Meritor WABCO Antilock Braking System, ABS of the **47X and 49X Workshop Manual** for diagnosis and repair information.

15.03.02 AD–IP

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the tires.
2. Using a wrench or a socket, loosen the desiccant cartridge bolt. Then separate the desiccant cartridge from the end cover.

3. Pull the cartridge bolt out of the cover and remove the cartridge.

**WARNING:**
Do not attempt to disassemble the desiccant cartridge assembly. Parts for the assembly are not available and the cartridge contains a 150 lb spring that cannot be mechanically caged. Disassembly could release the spring, resulting in personal injury.

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

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

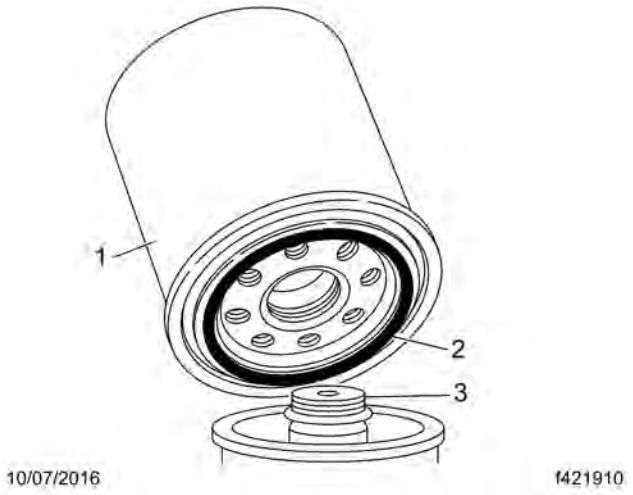
8. Lubricate the O-rings, bolt O-ring grooves, sealing rings, and cartridge grooves. Lubricate the end cover bore for the bolt.
9. Install both O-rings on the cartridge bolt, then, using a twisting motion, insert the assembled desiccant cartridge bolt in the end cover.
10. Install the desiccant cartridge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

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

11. Using a wrench or socket, tighten the desiccant cartridge bolt 70 lbf·ft (95 N·m). **Do not** over-torque.
12. Before placing the vehicle in service, perform the test below.
    - 12.a Close all reservoir drain cocks.
    - 12.b Build system pressure to governor cut-out, and note that the AD-IP air dryer purges with an audible escape of air.
    - 12.c Fan the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a purge at the AD-IP air dryer exhaust.
    - 12.d Check for excessive leakage around the head of the desiccant cartridge where it contacts the end cover. With the compressor in loaded mode (compressing air), apply a soapy solution to these areas, and observe that any leakage does not exceed a 1-inch bubble in 1 second. If leakage exceeds this measure, remove and re-install the desiccant cartridge.

### 15.03.03 AD-9si and AD–IS

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the tires.
2. Drain the air reservoirs.
3. Using a strap wrench or equivalent, loosen the desiccant cartridge. Spin the cartridge off by hand and discard it. See Fig.96,Desiccant Cartridge Replacement.




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

**Fig 96, 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.

## 15.04 Inspection of the Air Dryer

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the tires.
2. Check for moisture in the air brake system by opening the reservoir drain cocks. Examine the discharge. Some trace of water in the discharge is normal. A discharge of a milky gray liquid indicates excessive moisture is present in the air system and the desiccant cartridge needs to be replaced. See General Description, Meritor WABCO Antilock Braking System, ABS 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. 97,End Cover Terminals Location. The end cover contains the heater/thermostat. If the heater/thermostat is between 40 and 90°F (4 and 32°C), the heater/thermostat measured resistance will be infinite ohms. If the measured resistance is less than infinity, replace the heater/thermostat.

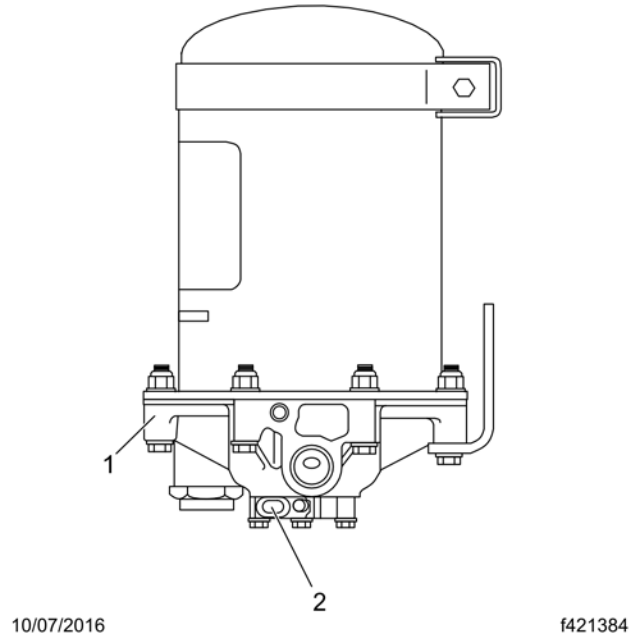



**Fig 97, End Cover Terminals Location**

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

## 15.05 Alcohol Evaporator Cleaning and Inspection

### 15.05.01 General Information

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

### 15.05.02 Off Season

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

### 15.05.03 Freeze Season Reactivation

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

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

## 15.06 Brake Inspection

### 15.06.01 Parking Brake Operational Check

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

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

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

### 15.06.02 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 hexhead bolt. See Table.43,Caliper Mounting Bolt Torque Values and Table.44,Torque Compensation with Meritor Extension Tool 3256B1354. 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.

**Table 43, Caliper Mounting Bolt Torque Values**

| 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 43, Caliper Mounting Bolt Torque Values**

**Table 44, Torque Compensation with Meritor Extension Tool 3256B1354**

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) |

| | | | | |
|---|---|---|---|---|
| | 135 | | | 444 (602) |

**Table 44, Torque Compensation with Meritor Extension Tool 3256B1354**

## 15.06.03 Drum Brakes

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

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

2. With the engine off, and 100 psi (690 kPa) of air tank pressure, have an assistant apply and hold an 80 to 90 psi (552 to 621 kPa) brake application.
3. Check to see if the colored over-stroke band on each brake chamber pushrod is exposed. If a band shows, the stroke is too long. Check the foundation brake components for wear or damage, and repair as needed. See General Description, Meritor WABCO Antilock Braking System, ABS of the **Western Star 47X and 49X Workshop Manual** for inspection, troubleshooting, and repair procedures.
4. Measure the applied chamber stroke. See Table. 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.

**Table 45, Brake Chamber Stroke Specifications**

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

| | | | |
|---|---|---|---|
| | | 20 | |
| | | 24 | |
| | | 24 | 2-1/2 (64) |
| | | 30 | |
| Haldex | Standard Stroke | 12 | 1-3/4 (44) |
| | | 16 | |
| | | 20 | |
| | | 24 | |
| | 2-1/2-Inch Extended Stroke | 24 | 2 (51) |
| | 3-Inch Extended Stroke | 24 | 2-1/2 (64) |
| | Standard Stroke | 30 | 2 (51) |
| | Long Stroke | 30 | 2-1/2 (64) |
| Meritor | Standard Stroke | 9 | Less than 1-1/2 (38) |
| | | 12 | |
| | | 16 | Less than 1-3/4 (44) |
| | | 20 | |
| | | 24 | Less than 1-7/8 (48)c |
| | Long Stroke | 24 | Less than 2 (51) |
| | Standard Stroke | 30 | |

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

**Table 45, Brake Chamber Stroke Specifications**

## 15.07 Lubrication of the Haldex Slack Adjuster

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

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

**CAUTION:**

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

Lubricate the automatic slack adjuster at the grease fitting. See Fig.98,Haldex Automatic Slack Adjuster Grease Fitting. Use standard chassis lubricant for Haldex slack adjusters.

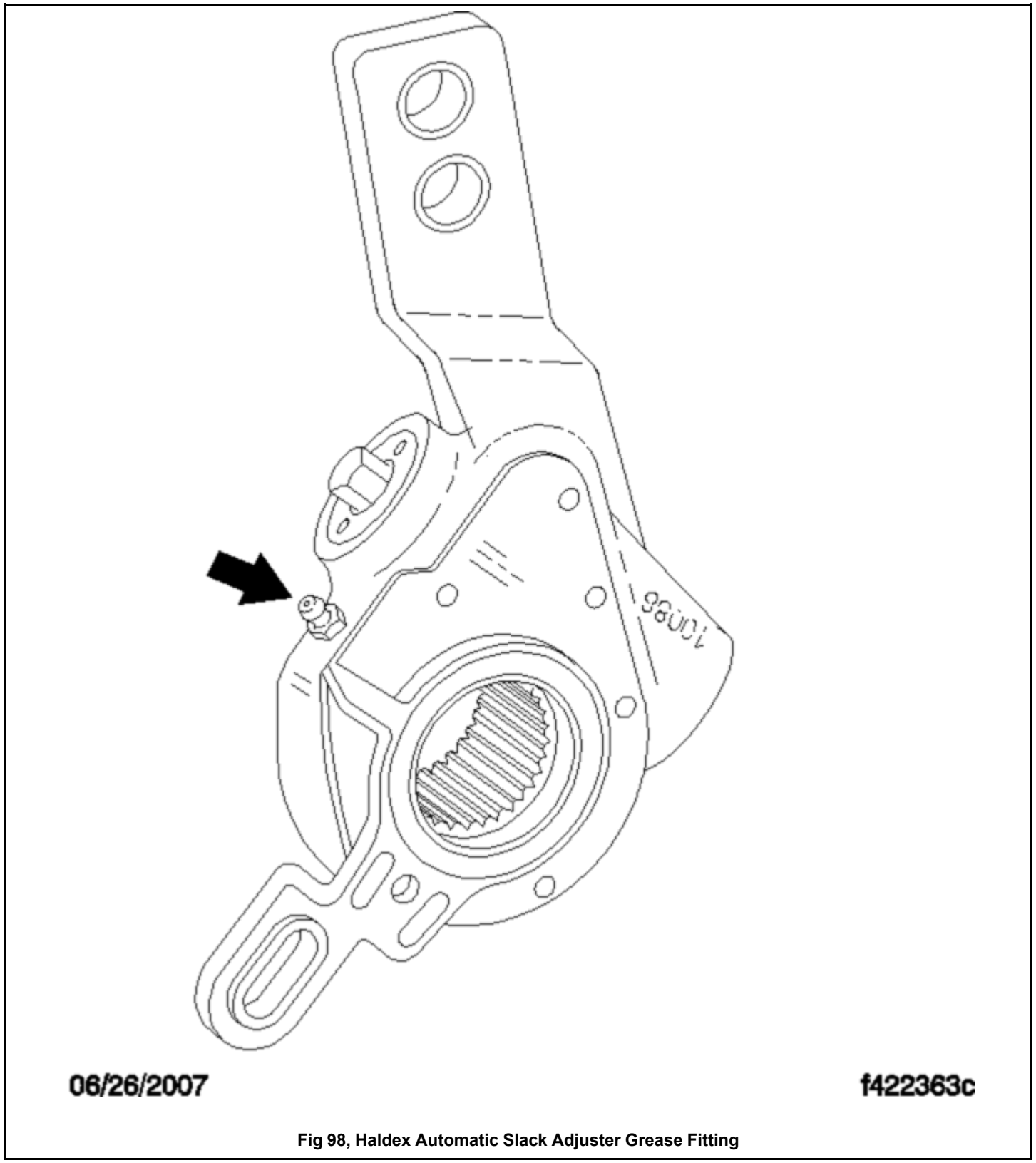



**Fig 98, Haldex Automatic Slack Adjuster Grease Fitting**

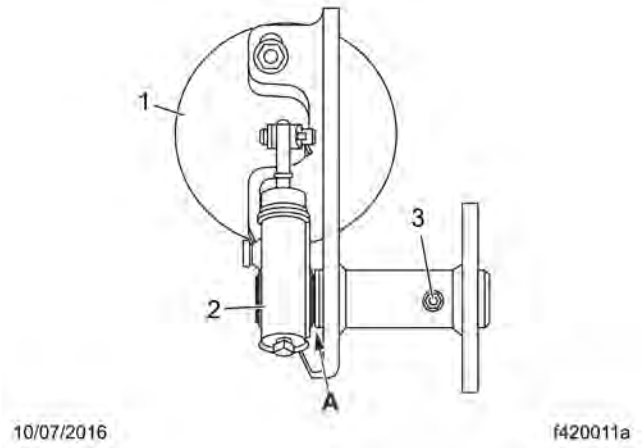
## 15.08 Meritor Camshaft Bracket Lubrication

### 15.08.01 General Information

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

NOTE: If equipped with an extended-maintenance Q Plus™ brake system, the camshaft bracket will not have a grease fitting. These camshafts use a special NLGI Grade synthetic polyurea grease and do not require lubrication for 3 years or 500,000 miles (800 000 km), whichever comes first. The extended-maintenance camshaft bushings are lubricated during the brake reline service interval. For service and lubrication instructions, see General Description, Meritor WABCO Antilock Braking System, ABS 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.99,Camshaft Bracket Lubrication. Follow the steps below for proper greasing.




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

**Fig 99, Camshaft Bracket Lubrication**

**WARNING:**

If grease leaks out under the camhead, the camshaft bracket grease seal is worn or damaged. See General Description, Meritor WABCO Antilock Braking System, ABS**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.

### 15.08.02 Greasing the Steer Axle S-cam Tube

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

15.08.03 Greasing the Drive Axle S-cam Tube

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

## 15.09 Meritor Slack Adjuster Lubrication

15.09.01 General Information

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

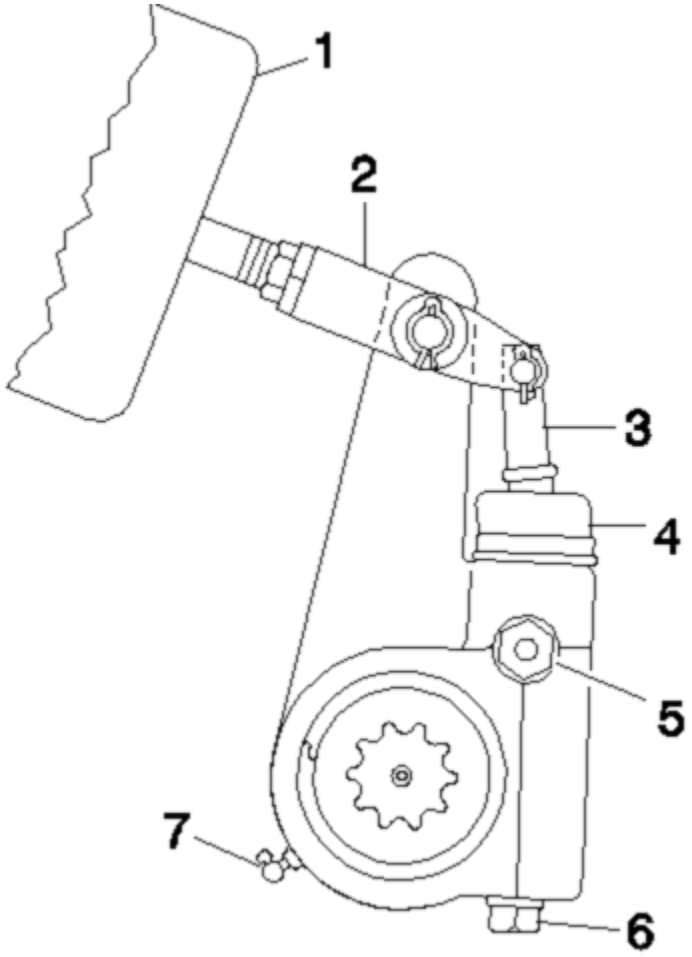
**WARNING:**
Failure to lubricate slack adjusters could lead to dragging brakes or a brake failure, resulting in property damage, personal injury, or death.

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 General Description, Meritor WABCO Antilock Braking System, ABS 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.100,Meritor Automatic Slack Adjuster. Follow the steps below for proper greasing.




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

**Fig 100, Meritor Automatic Slack Adjuster**

## 15.09.02 Greasing the Steer Axle Slack Adjuster

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

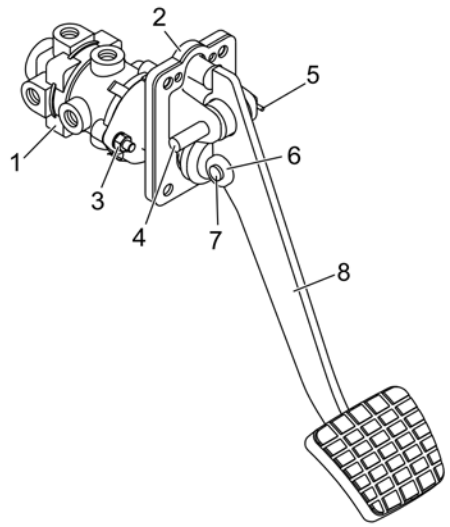
## 15.09.03 Greasing the Drive Axle Slack Adjuster

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

7. Move the drive-tire chock to the other side of the axle and chock the other set of tires.
8. Cage the drive-tire park-brake chamber opposite of the tire that is chocked.
9. Grease the slack adjuster on the caged brake side only.
10. Uncage the park brake.
11. If equipped with more than one drive-axle, repeat this process for the remaining drive-axles.

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

1. Remove the brake valve from the vehicle; see , of the **Western Star 47X and 49X Workshop Manual.** .
2. Remove the roll pin from the brake pedal pivot pin. See Fig.101,Brake Pedal and Valve Assembly.




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

**Fig 101, Brake Pedal and Valve Assembly**

3. Remove the brake pedal pivot pin.
4. Remove the brake pedal.
5. Check the brake pedal mounting plate adapter for signs of wear or cracks at the bosses (the area from which the pivot pin was removed). Replace it if necessary.
6. Check the brake pedal rollers for signs of wear or cracks. Replace the rollers as needed.
7. If the rollers are replaced, replace the roller pin, install a new cotter pin, bend it to 90 degrees and apply Torque Seal (OPG F900 White) 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.

## 15.11 Replacement of the WABCO System Saver Air Dryer Desiccant Cartridge

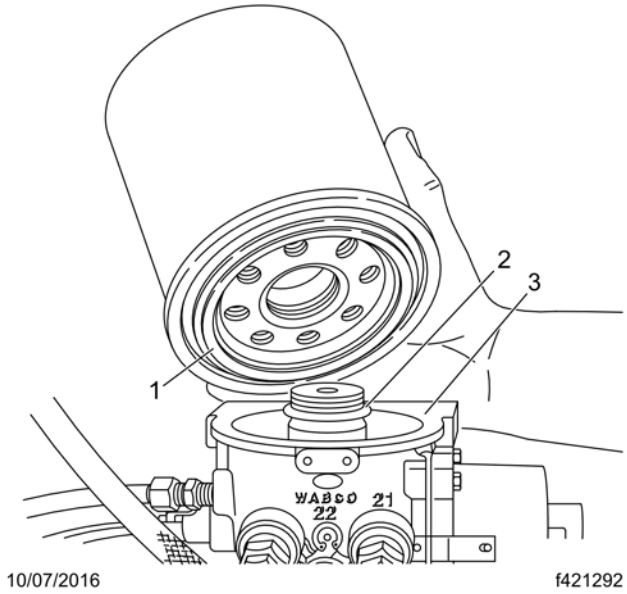
NOTE: The following instructions apply to the System Saver 1200, 1200 Plus, and Twin air dryers.

**NOTICE:**

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

Refer to Fig.102,Desiccant Cartridge Replacement for cartridge replacement.

1. Drain the air system.




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

**Fig 102, 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.

## 15.12 Bendix Automatic Drain Valve Operating and Leakage Tests

### 15.12.01 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 Wiring Diagrams, Meritor WABCO Antilock Braking System, ABS of the **Western Star 47X and 49X Workshop Manual** .

### 15.12.02 Leakage Test

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

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

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

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# 16. Steering

## 16.01 Safety Precautions

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

**DANGER:**

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

## 16.02 Inspection of the Drag Link

**WARNING:**

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

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

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

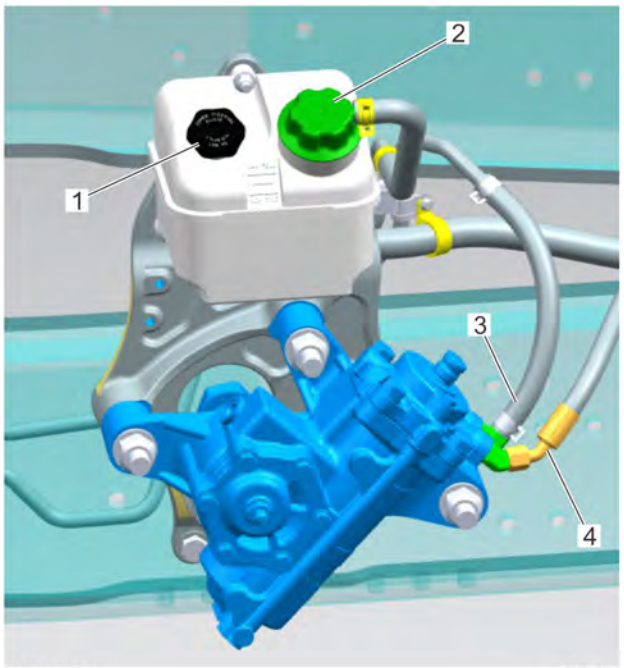
   If the castle nut is loose, replace it and the cotter pin. Tighten the new castle nut as follows:

   - 3/4–16: 90 to 180 lbf·ft (122 to 244 N·m)
   - 7/8–14: 160 to 300 lbf·ft (217 to 407 N·m)
4. Inspect the boot of the drag link at both the pitman arm and the steering arm end for cracks, splits, or other damage. Replace the boot if needed.
5. Grasp the drag link near the pitman arm end, then push and pull laterally to check for axial movement in the ball stud end. If it is loose, replace the drag link. See General Information, Steering I-Shaft of the **Western Star 47X and 49X Workshop Manual** for replacement instructions. If there is 1/8-inch (3-mm) movement or more, do not drive the vehicle until the drag link is replaced.

## 16.03 Power Steering Fluid and Filter Change

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

1. Set the parking brake and chock the rear tires.
2. Raise the front of the vehicle and support it with jack stands.
3. Put the vehicle in neutral.
4. Open the hood.
5. Wipe down the area around the steering gear and related hydraulic lines.
6. Place a drain pan under the steering gear and power steering reservoir.
7. Remove the pressure line and return hose (see Fig.103,Power Steering Reservoir) from the steering gear and allow the oil to drain.




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

**Fig 103, Power Steering Reservoir**

8. Remove the filter cap from the reservoir, then remove and discard the filter.

- Filter caps with a separate retaining ring have a threaded connection with the filter. Unscrew the filter and discard it.
- One-piece filter caps do not have a threaded fit with the filter. Pull off the filter and discard it.

9. Turn the steering wheel from full left to full right three times to purge oil from the gear.
10. Connect the pressure line and return hose to the steering gear.
11. Fill the reservoir with an approved power steering fluid to the line between the MIN COLD and MAX HOT lines. See Fig.103,Power Steering Reservoir. See Table.46,Approved Power Steering Fluids for approved power steering fluids.

**Table 46, Approved Power Steering Fluids**

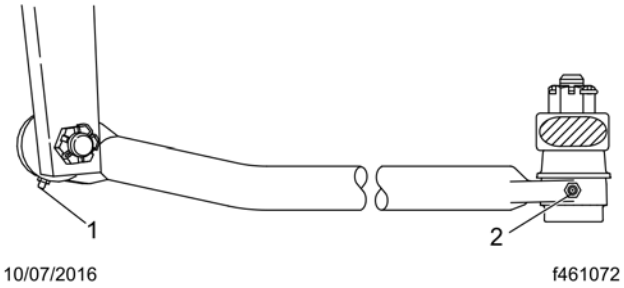
| Approved Power Steering Fluids | |
|---|---|
| **Fluid Type** | **Approved Fluid** |
| Automatic Transmission Fluid | Dexron® III |
| | Super ATF |
| | TES-389 |

**Table 46, Approved Power Steering Fluids**

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

## 16.04 Lubrication of the Drag Link

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Using a clean rag, wipe all dirt from the drag link grease fittings. See Fig.104,Drag Link.
3. Using a pressure gun and NLGI Grade 2 (8% 12-hydroxy lithium stearate grease) or NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) chassis grease, apply clean grease at the grease fittings until old grease is forced out of the socket.




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

**Fig 104, Drag Link**

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# 17. Fuel

## 17.01 Safety Precautions

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

**DANGER:**

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

## 17.02 Replace The Fuel Filter

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

## 17.03 Fuel/Water Separator Element Checking and Replacement

17.03.01 Detroit

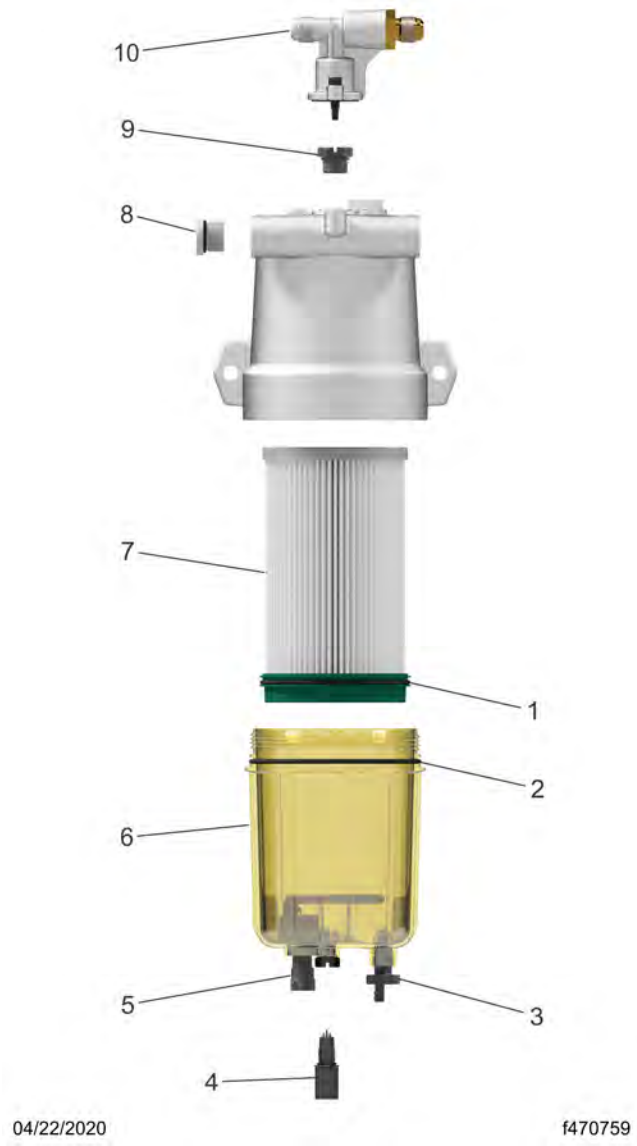
**WARNING:**

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.

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

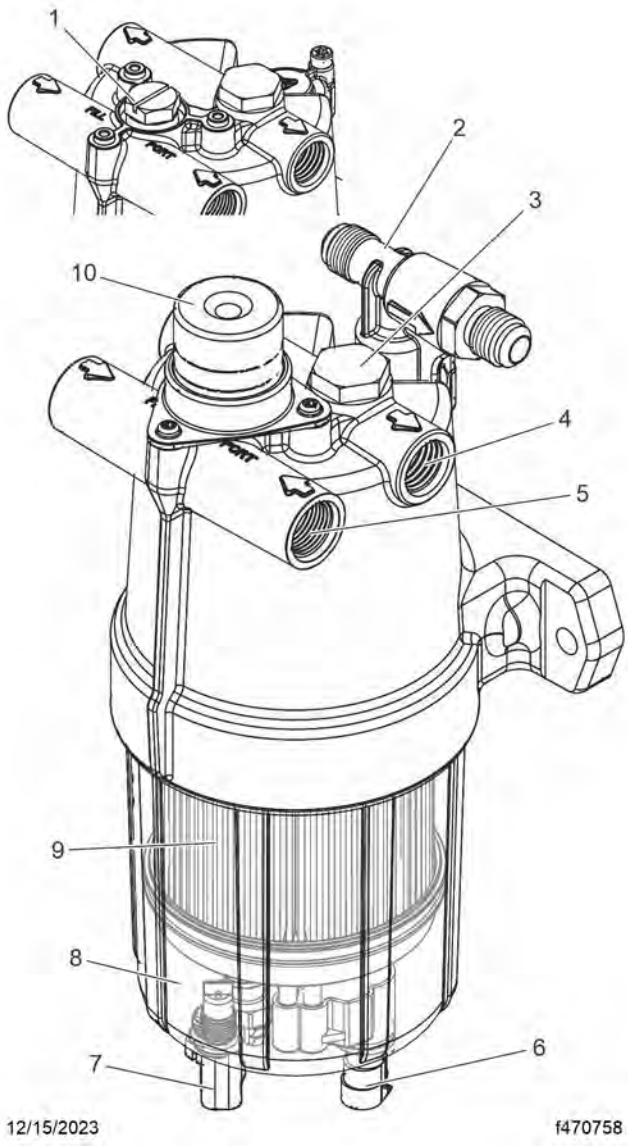
1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Place a suitable container under the fuel/water separator, to collect the draining fuel. The drain valve has a 3/8 inch (9.5 mm) slip-on hose connection.
3. Open the drain valve. See Fig.105,Fuel Water Separator, Detroit.




1. O-Ring, Filter Element
2. O-Ring, Clear Bowl
3. Drain Valve
4. WIF Sensor
5. Heater
6. Clear Bowl
7. Filter Element
8. Port Plug, M22
9. Vent Plug
10. Return Fuel Heating Loop

**Fig 105, Fuel Water Separator, Detroit**

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. 105,Fuel Water Separator, Detroit.
6. Remove bowl and filter. Dispose of the filter and the O-ring in an environmentally acceptable manner. Fig. 106,Fuel/Water Separator Assembly, Detroit.




1. Fill Port Plug (Optional)
2. Return Fuel Heating Loop
3. Fuel Outlet Port
4. Fuel Inlet Port
5. Fuel Heater, 12V
6. WIF Sensor
7. Clear Bowl
8. Filter Element
9. Primer (Optional)

**Fig 106, Fuel/Water Separator Assembly, Detroit**

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.

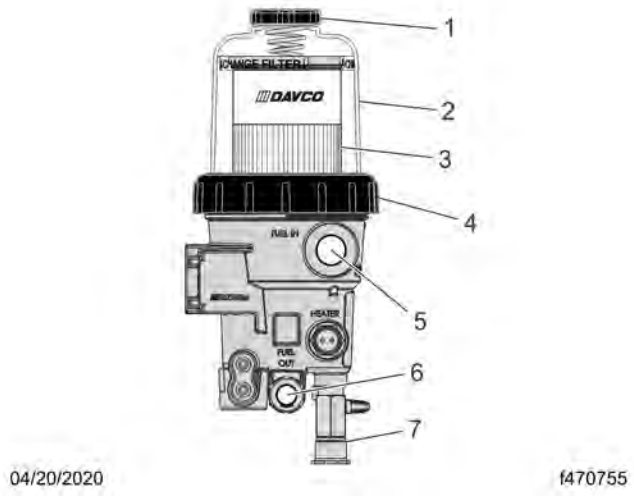
## 17.03.02 DAVCO Fuel Pro® 385 and 485

**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.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Check the fuel level in the fuel filter. Replace the fuel/water separator element **only** when the filter element is completely covered. If the fuel level has reached the top of the filter element, follow the procedure below to replace the element.
3. Put a clean receptacle under the fuel/water separator and attach a piece of hose to the drain valve, to direct fuel into the receptacle.The drain valve (Fig.107,DAVCO Fuel Pro 385, Item 7) has a 3/4-inch (19-mm) slip-on hose connection.




1. Vent Cap
2. Clear Cover
3. Filter Element
4. Collar
5. Inlet Port
6. Outlet Port
7. Drain Valve

**Fig 107, DAVCO Fuel Pro 385**

4. Remove the vent cap, shown in Fig.107,DAVCO Fuel Pro 385, to drain the fuel completely, then close the drain valve.
5. Using a DAVCO Collar Wrench, shown in Fig.108,DAVCO Collar Wrench, remove the collar and clear cover.

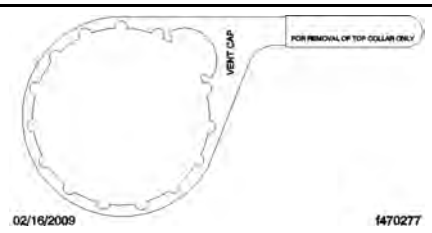
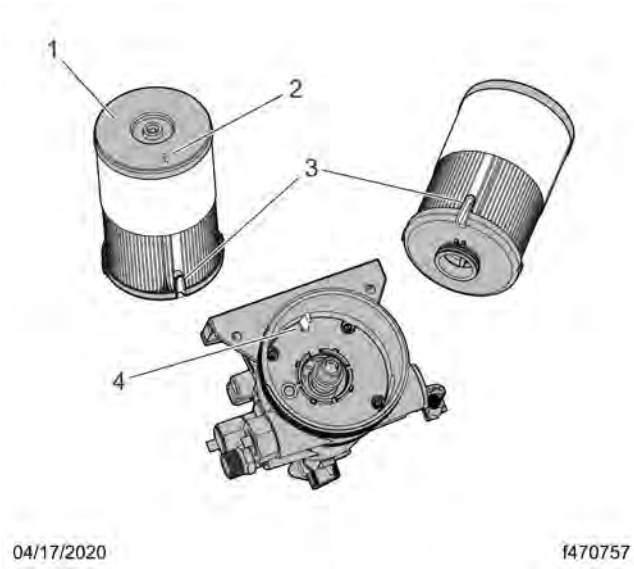



**Fig 108, DAVCO Collar Wrench**

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

6. Remove the filter, cover O-ring, and vent cap O-ring. Dispose of them in an environmentally acceptable manner. See Fig.107,DAVCO Fuel Pro 385.
7. Clean all threads and sealing surfaces very thoroughly. Even a small amount of dirt will prevent the fuel/water separator from sealing, and an air leak may result.
8. Install the new filter and grommet assembly and cover O-ring on the housing. Position the filter element so the key is lined up with the keyway on the separator plate of the housing. Use the arrow on the top of the endplate to align the filter. See Fig.109,Positioning the Filter Element. Ensure the filter element is fully seated by firmly pushing on the endplate. The filter should not rotate freely.




1. Endplate
2. Arrow
3. Keyway
4. Key

**Fig 109, Positioning the Filter Element**

9. Install the clear cover and the collar. Simultaneously apply downward pressure to the top of the clear cover until it is seated on the body of the lower housing and hand tighten the collar until it no longer spins freely. Using the collar wrench, tighten the cover 18 lbf·ft (24 N·m). This is equivalent to rotating the collar clockwise two or three additional ribs, depending on the specific filter model.

10. Prime the system
    - 10.a Ensure that the drain valve is closed.
    - 10.b Fill the housing to the top of the filter element with clean diesel fuel.
    - 10.c Install and hand-tighten the vent cap O-ring and vent cap.
    - 10.d Start the engine. When the lubricating oil reaches its normal operating pressure, increase the engine speed to high idle for one to two minutes to purge the air from the system.
    - 10.e While the engine is running, and after the air is purged from the system, loosen the vent cap until the fuel level falls to just above the collar, then hand-tighten the vent cap.
    - 10.f Check for leaks and shut down the engine.

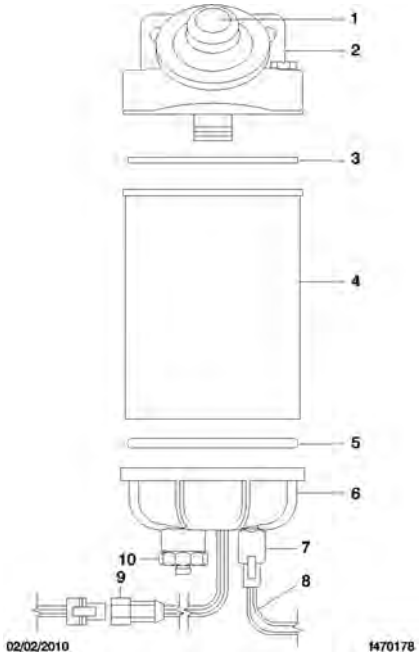
17.03.03 Alliance/Racor

**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.
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. 110,Fuel/Water Separator Assembly.




1. Priming Pump
2. Mounting Head
3. Gasket
4. Filter Element
5. O-Ring
6. Sight Bowl
7. Water Sensor Probe
8. Water Sensor Probe Wiring Harness
9. Heater Wiring Harness
10. Drain Plug

**Fig 110, 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.

## 17.04 Tightening the Fuel Tank Band-Nut

IMPORTANT: Do not overtighten the nuts.

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).

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# 18. Exhaust

## 18.01 Safety Precautions

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

**DANGER:**

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

## 18.02 Exhaust System Maintenance

### 18.02.01 General Information

The exhaust system must be free of leaks, binding, grounding, and excessive vibrations. These conditions are usually caused by loose, broken, or misaligned clamps, brackets, or pipes. If any of these conditions exist, check the exhaust system components and alignment. Align or replace as necessary; see General Information, Aftertreatment System of the **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.

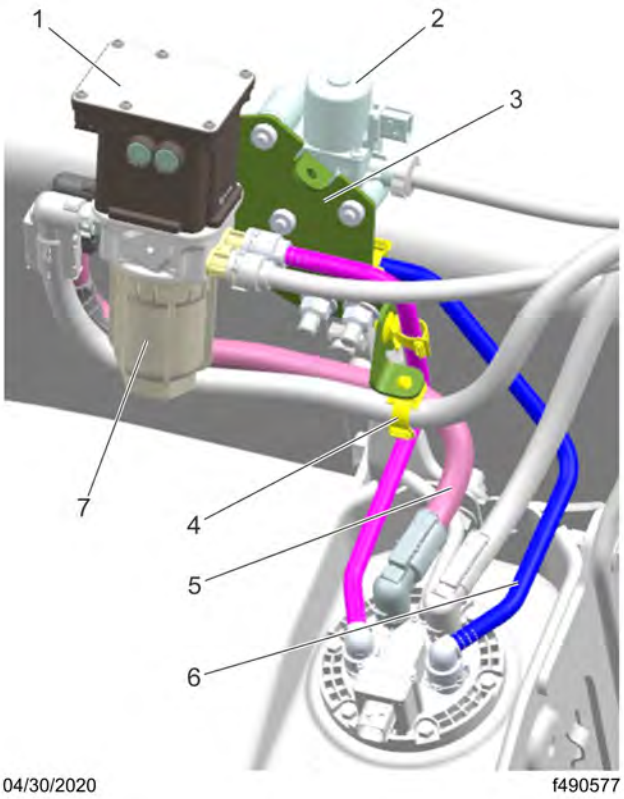
No visible exhaust gas leaks are allowed anywhere in the ATS. If any problems are discovered, refer to the engine manufacturer's service literature for repair instructions.

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.

### 18.02.02 Replacement of the Diesel Exhaust Fluid (DEF) Filter

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.111,DEF Pump, Cummins Engine.




1. DEF Pump
2. Water Supply Valve
3. DEF Pump Bracket
4. Tir-Fir Tree Mount
5. DEF Suction Line
6. Coolant Return Tube
7. DEF Filter Cover

**Fig 111, DEF Pump, Cummins Engine**

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

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## 19. Electrical, Instruments, and Controls

### 19.01 Inspection and Cleaning the Trailer Cable

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.

### 19.02 Inspection of the Electrical Component

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

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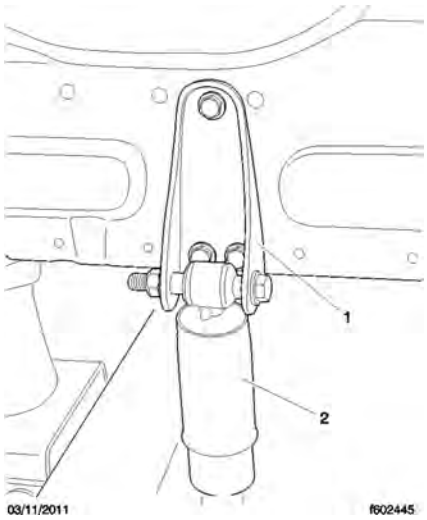
## 20. Cab

### 20.01 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.

#### 20.01.01 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.112,Cab Shock Absorber and Upper Bracket.




1. Upper Bracket
2. Shock Absorber

**Fig 112, Cab Shock Absorber and Upper Bracket**

3. From behind the cab skin, check the torque of each of the two lower nuts that attach shock absorber upper bracket to the cab, while holding the bolt in place with a box wrench. If loose, tighten the nuts 34 lbf·ft (46 N·m).

#### 20.01.02 Inspection of the Aerodynamic Component

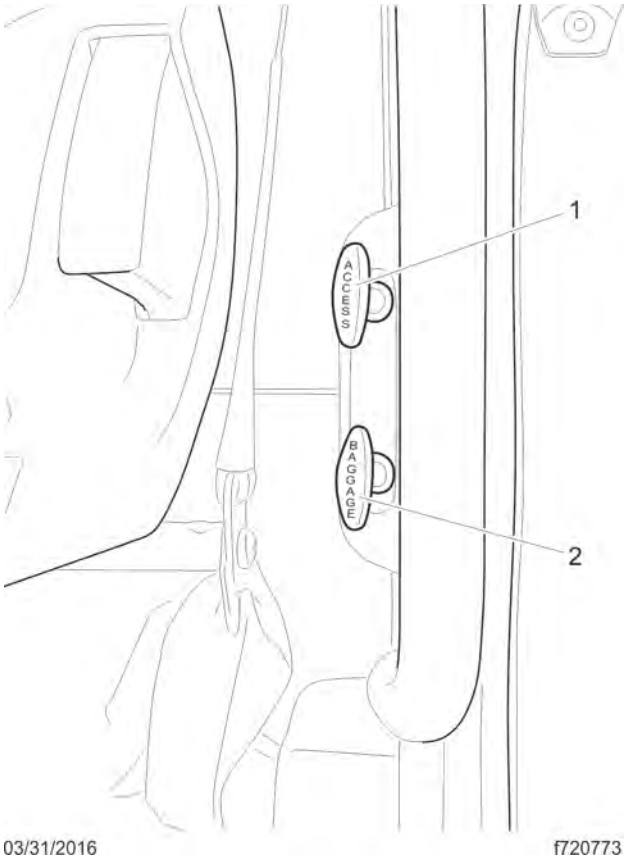
Inspect aerodynamic components, if equipped, for structural damage, cracks, or wear. These may include:

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

Replace or repair damaged or missing components as needed.

20.01.03 Baggage Door and Sleeper Access Door Release Cable and Latch Lubrication

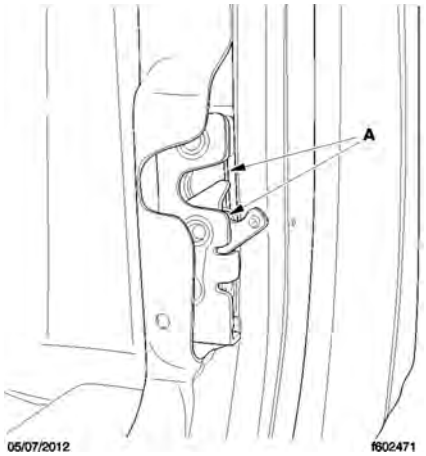
1. Open the baggage door and the sleeper access door, if equipped, by pulling the release handle(s) located inside the cab door opening. See Fig.113,Sleeper Door Release Handles.




1. Sleeper Access Door Handle
2. Baggage Door Handle

**Fig 113, Sleeper Door Release Handles**

2. Pull out on the baggage door handle, and apply a light coating of lubricant to the exposed length of cable. Repeat for the sleeper access door cable, if equipped.
3. At the opened baggage door, apply a light coating of lubricant to the latch jaw and the exposed length of cable. See Fig.114,Baggage Door Latch. Repeat for the sleeper access door, if equipped. Removal of trim panels is not required.




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

**Fig 114, Baggage Door Latch**

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# 21. Heater and Air Conditioner

## 21.01 Safety Precautions

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

**DANGER:**

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

## 21.02 Preliminary Checks

**WARNING:**

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

1. Park the vehicle on a level surface, shut down the engine, apply the parking brakes, and chock the tires.
2. Check the appearance of the air conditioner compressor pulley assembly. If the friction surface of the pulley shows signs of excessive grooving due to belt slippage, replace both the pulley and the drive plate. Inspect the refrigerant compressor drive belt for damage and check that the belt is set at the proper tension. Also check the tightness of the compressor mounting fasteners. For instructions and torque values, see Threaded Fastener Types 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 General Information, Cab Heater and Air Conditioner 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.47,Compressor Drive-Plate Clutch Clearance for clearance specifications. See Fig.115,Valeo Drive Plate Clutch Air Gap for the checking method. Adjust the drive plate clutch if needed.

**Fig 115, Valeo Drive Plate Clutch Air Gap**

**Table 47, Compressor Drive-Plate Clutch Clearance**

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

**Table 47, 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.

## 21.03 Air Filter Replacement

### 21.03.01 General Information

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.

### 21.03.02 Replacement of the Cab Fresh-Air Filter

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.116,Intake Filter Access Panel.

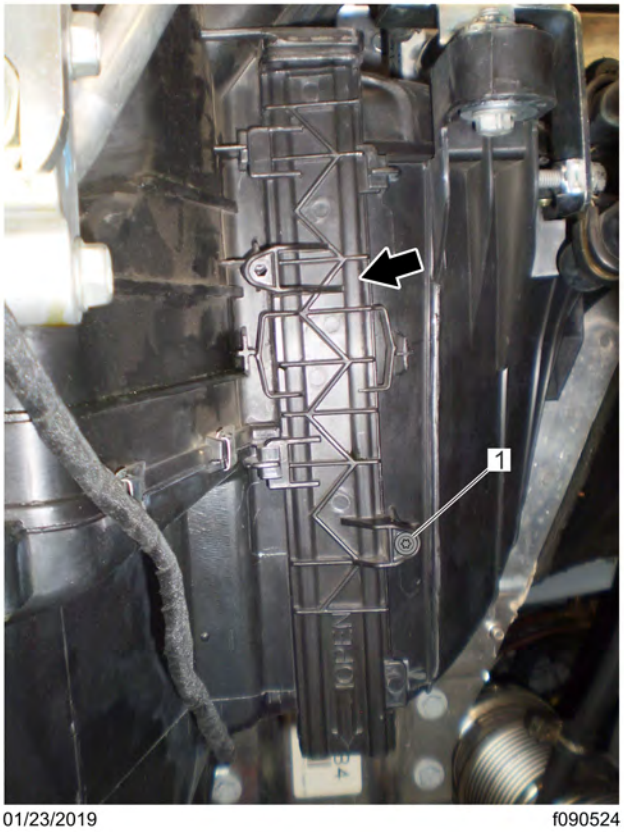



**Fig 116, Intake Filter Access Panel**

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.117,Airflow Directional Arrow.

1. Airflow Directional Arrow

**Fig 117, 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.

## 21.03.03 Replacement of the Cab Recirculation - Air Filter

The recirculation air filter is located on the evaporator housing facing the interior of the cab just to the right of center. It is accessed from the underside of the unit. It is a coarse sponge, or fiber, filter. See Fig.118,Cab Recirculation Air Filter.

1. Filter

**Fig 118, Cab Recirculation Air Filter**

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

## 21.03.04 Replacement of the Sleeper Air Filter

In vehicles with 60-inch and 72-inch sleepers, the sleeper air filter is located on the forward side of the blower fan housing, under the cabinet, directly behind the driver's seat. In vehicles with 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.119,Sleeper HVAC Access Panel, 60- and 72-inch Sleepers. In vehicles with 36-inch and 48-inch sleepers, raise the lower bunk, and lift to remove the HVAC cover panel. See Fig. 120,Sleeper HVAC Access Panel, 48-inch Sleeper and Fig.121,Sleeper HVAC Access Panel, 36-inch Sleeper.

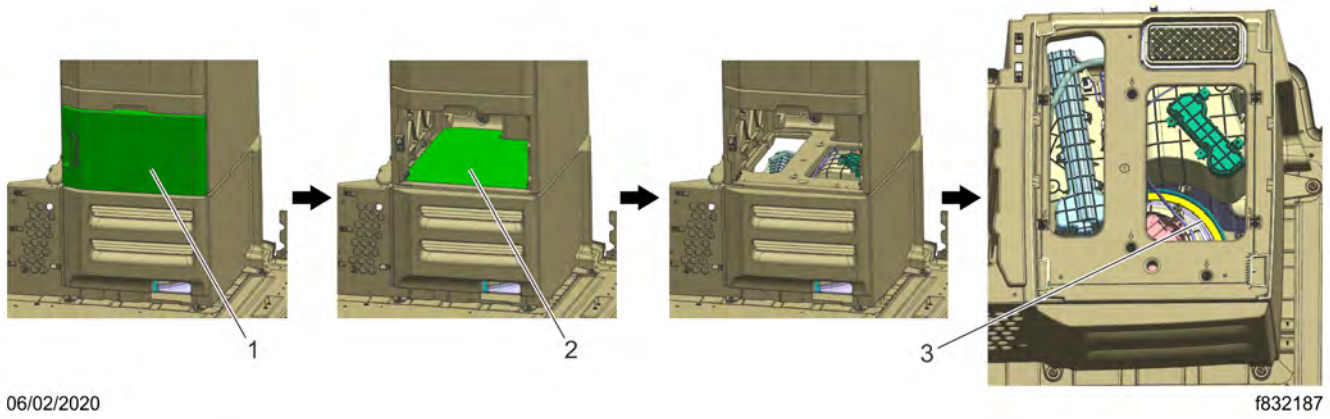
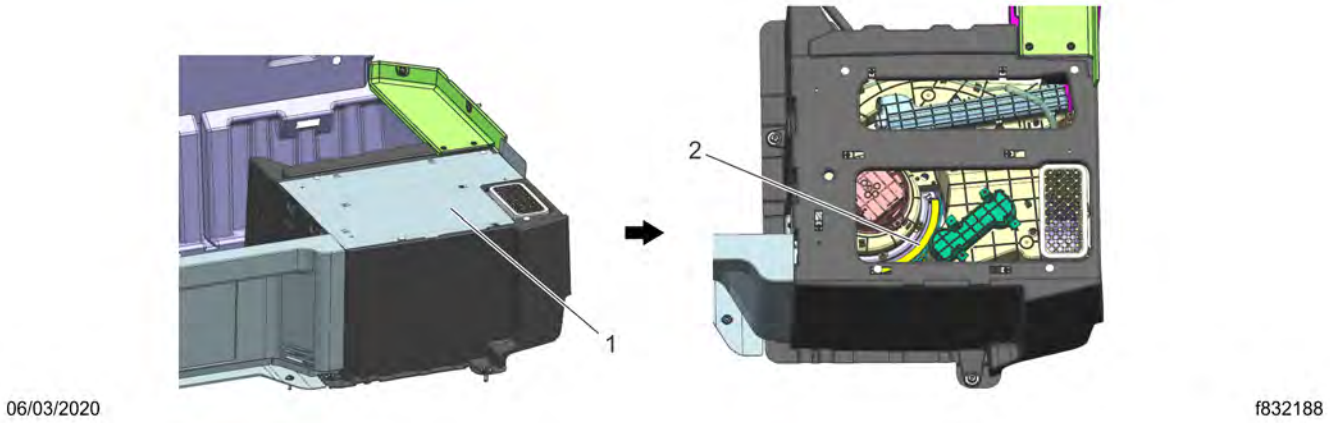


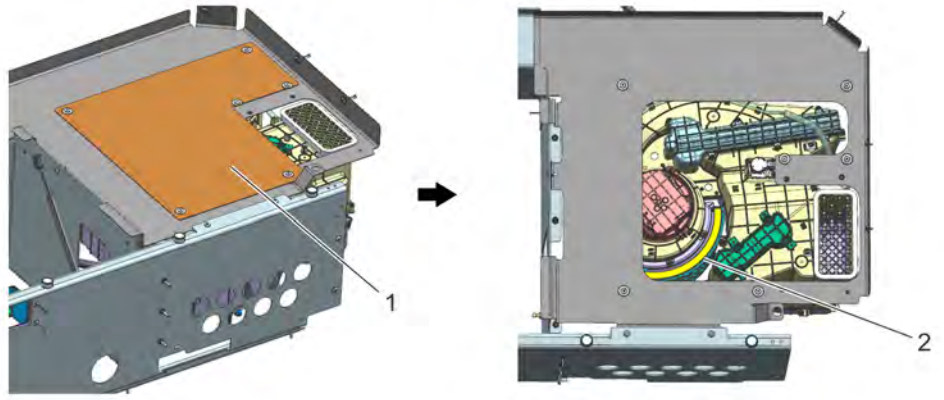

**Fig 119, Sleeper HVAC Access Panel, 60- and 72-inch Sleepers**

1. Lower Cabinet Door
2. Carpet
3. Air Filter




1. HVAC Cover Panel
2. Air Filter

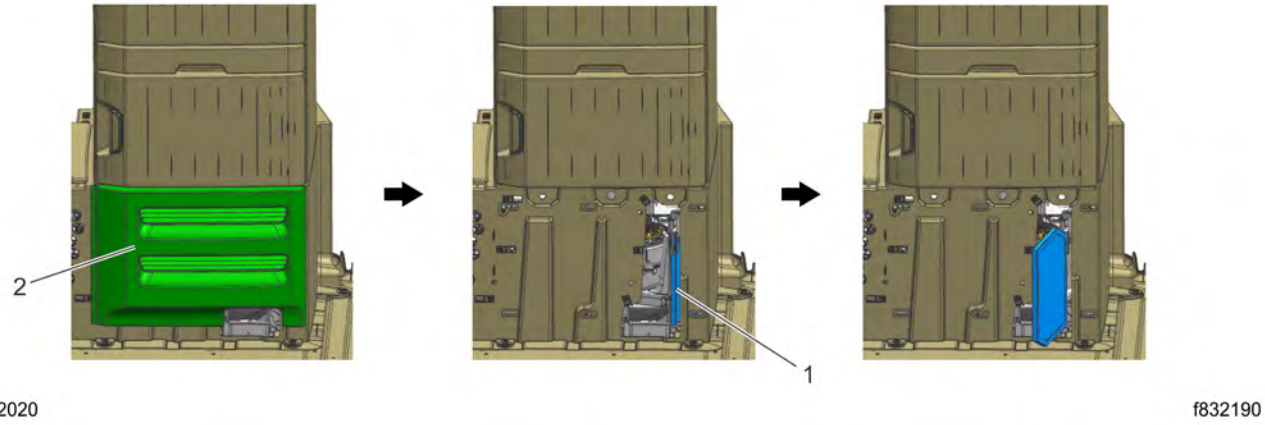
**Fig 120, Sleeper HVAC Access Panel, 48-inch Sleeper**




1. HVAC Cover Panel
2. Air Filter

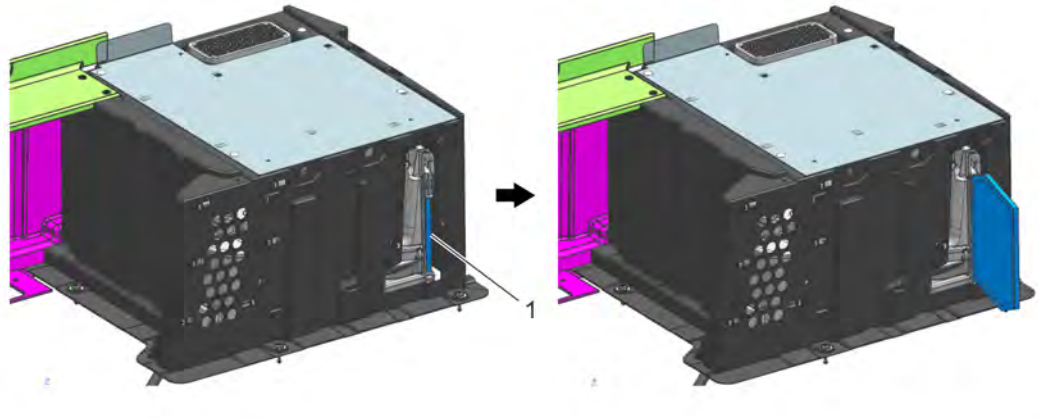
**Fig 121, Sleeper HVAC Access Panel, 36-inch Sleeper**

3. Lift the filter out of the slot. See Fig.121,Sleeper HVAC Access Panel, 36-inch Sleeper.
4. Lift the filter out of the slot. See Fig.119,Sleeper HVAC Access Panel, 60- and 72-inch Sleepers for 60- and 72-inch sleepers, or Fig.120,Sleeper HVAC Access Panel, 48-inch Sleeper for 48-inch sleepers.




1. Air Filter
2. HVAC Cover

**Fig 122, Removing the Dual HVAC System Filter, 72-inch Sleepers (Similar for 60-inch Sleeper)**




1. Air Filter

**Fig 123, Removing the Dual HVAC System Filter, 48-inch Sleeper**

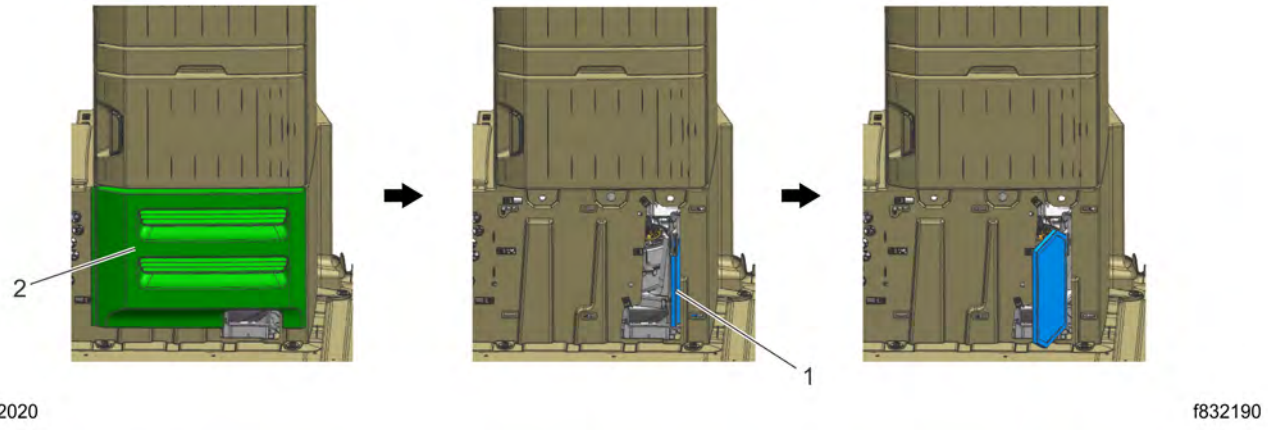
5. Install a new filter in the slot, making sure that it is completely seated in the slot.
6. Install the carpet. Close the cabinet door in vehicles with 60-inch and 72-inch sleepers.
7. Install the HVAC cover panels and close the bunks for 36-inch and 48-inch sleepers.

## 21.03.05 Replacement of the Dual HVAC System Air Filter

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.

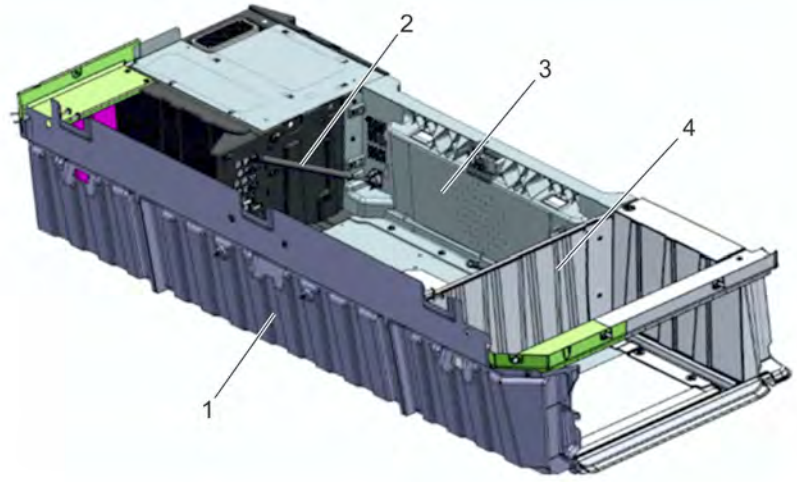
NOTE: When replacing the air filter, use only a Western Star-approved air filter.

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.124,Removing the Dual HVAC System Filter, 72-inch Sleepers (Similar for 60-inch Sleeper) . 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. 125,Lower Bunk Assembly, 48-Inch Sleeper.




1. Air Filter
2. HVAC Cover

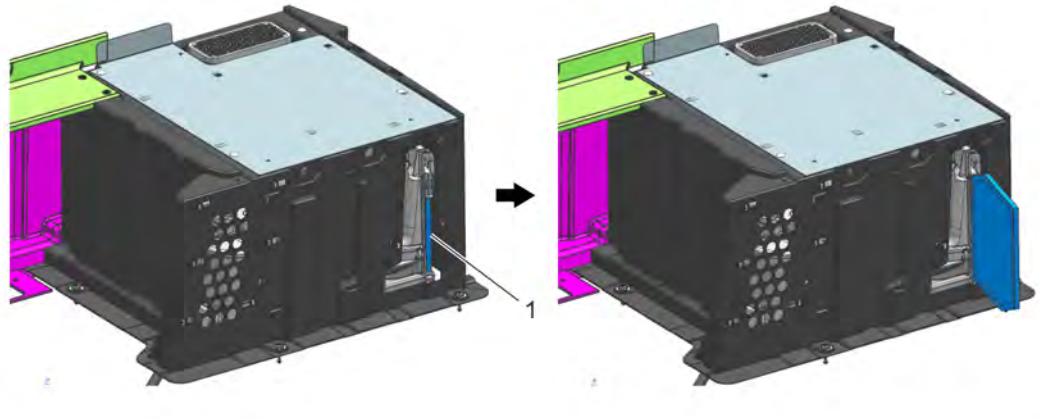
**Fig 124, Removing the Dual HVAC System Filter, 72-inch Sleepers (Similar for 60-inch Sleeper)**




1. Lower Bunk
2. Lower Bunk Strut
3. Front Center Bunk Partition
4. Storage Compartment Divider

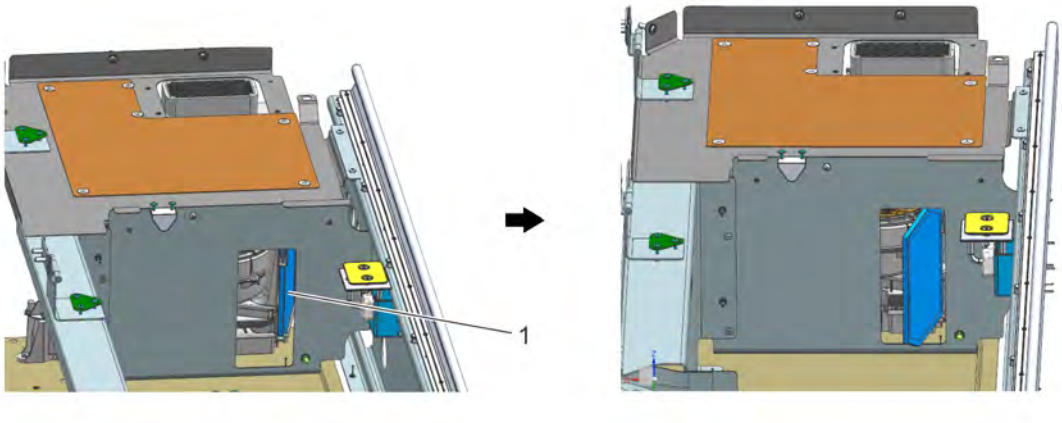
**Fig 125, Lower Bunk Assembly, 48-Inch Sleeper**

3. Pull the filter out of the slot. See Fig. 124,Removing the Dual HVAC System Filter, 72-inch Sleepers (Similar for 60-inch Sleeper) for 60- and 72-inch sleepers, or Fig.126,Removing the Dual HVAC System Filter, 48-inch Sleeper for 48-inch sleepers, or see Fig. 127, **Removing the Dual HVAC System Filter, 36-inch Sleeper** in vehicles with 36-inch sleepers.




1. Air Filter

**Fig 126, Removing the Dual HVAC System Filter, 48-inch Sleeper**




1. Air Filter

**Fig 127, Removing the Dual HVAC System Filter, 36-inch Sleeper**

4. Install a new filter, making sure that it is completely seated.
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.

## 21.04 Dual HVAC System Inspection

### 21.04.01 Fuel-Operated Heater Check

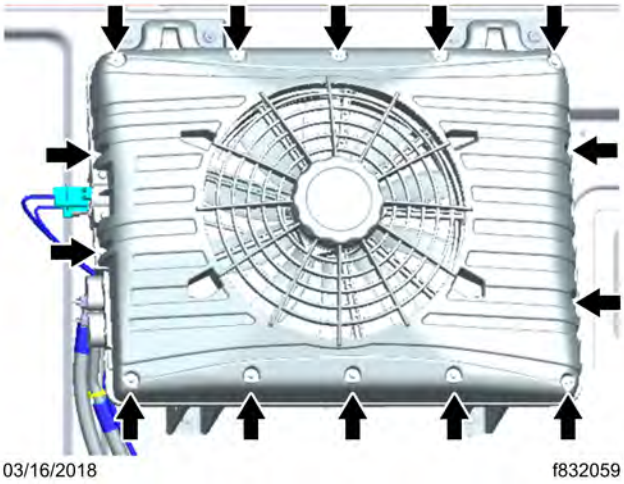
1. Start the Dual HVAC System and set the control knob to maximum heat. Run the heater for 15 minutes to achieve operating temperature, and clear old fuel from the lines.
2. Verify that the unit completes the start-up cycle, and continues to produce warm exhaust.

### 21.04.02 Inspection and Cleaning the External A/C Condenser

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.

2. If needed, remove the condenser cover fasteners, then remove the cover. See Fig. 128,Condenser Cover Fasteners (compact style condenser).




Remove the condenser cover.

**Fig 128, Condenser Cover Fasteners (compact style condenser)**

Remove the condenser cover.

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.

## CONTACT INFORMATION

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



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