Walk-In Van Chassis Maintenance Manual

Models: MT45
MT45 G
MT50e
MT55
MT55 G

STI-471, ()

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1. Introduction

1.01 Foreword

Foreword

Instructions and procedures are those recommended by Freightliner Custom Chassis Corporation (FCCC), or the component manufacturer. Maintenance schedules and additional service information are included in the product Maintenance Manual.

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

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

Environmental Concerns and Recommendations

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



NOTICE:

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

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Daimler Truck North America LLC Service Systems and Documentation

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1.02 Service Publications

Descriptions of Service Publications

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

Workshop/Service Manual

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

Maintenance Manual

Maintenance manuals contain routine maintenance procedures and intervals for vehicle components and systems. They have information such as lubrication procedures and tables, fluid replacement procedures, fluid capacities, and

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

Troubleshooting Manual

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

Technical Service Bulletins (TSBs)

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

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

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

Customer Service Announcements (CSAs)

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

Tool Letters (TLs)

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

18SP Letters

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

Original Equipment Manufacturer (OEM) Letters

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

DTNA Portal

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

TechLit

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

PartsProX

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

EZWiring

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

Service Solutions

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

Vehicle Info

Vehicle Information is a single point of entry to search for DTNA and Detroit Diesel service information. This allows you to search for information specific to a vehicle or Detroit Diesel engine. Vehicle specifications, vehicle recalls and campaigns, warranty information, and vehicle literature can all be found within Vehicle Info. It also contains the registration information for the selected vehicle.

Warranty Lit

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

Recall Campaigns

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

Field Service Campaigns

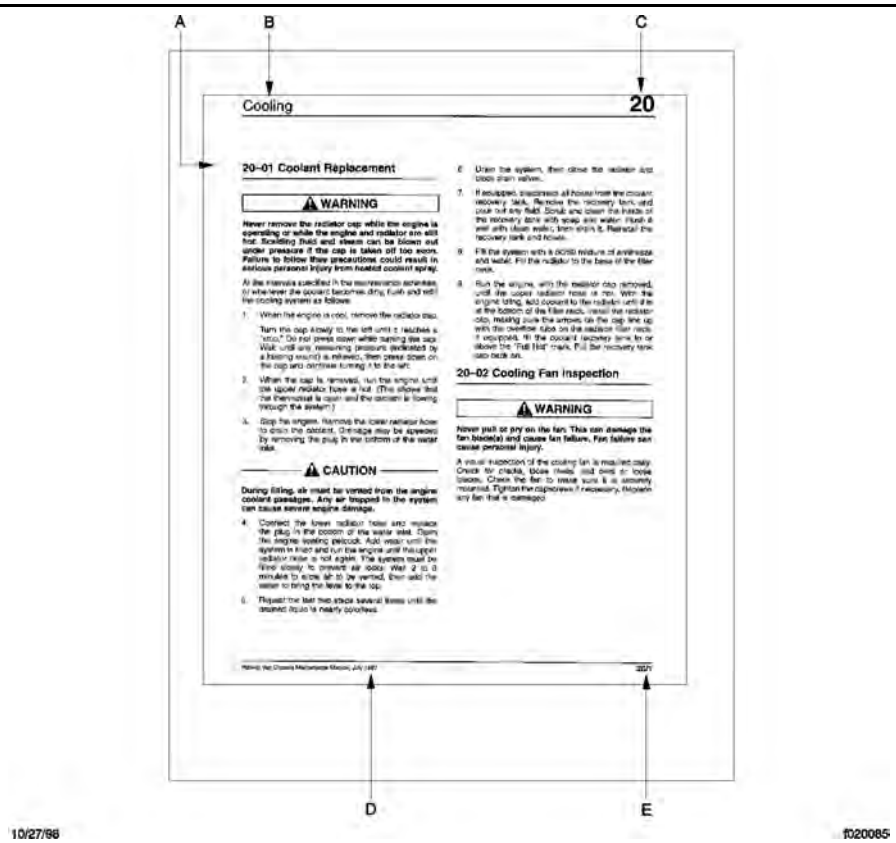
Field service campaigns are concerned with non-safety-related service work or replacement of parts. All field service campaigns are distributed to dealers; customers receive notices that apply to their vehicles.

Warranty Manual

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

1.03 Page Description

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



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

Fig 1, Example of a Maintenance Manual Page

2.01 General Maintenance Schedule Information 12
2.02 Vehicle Maintenance Schedule Table: 00–02 12
2.03 Noise Emission Controls Maintenance: 00–03 16
2.03.01 Noise Emission Controls Maintenance 16
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2. General Information

2.01 General Maintenance Schedule Information

Performing regular maintenance on your 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.

When the vehicle reaches the distance given for a maintenance interval, see the Vehicle Maintenance Schedule 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 for each operation.

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.

For specific engine maintenance information, see the Cummins or Mercedes-Benz Operation and Maintenance Manual.

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

2.02 Vehicle Maintenance Schedule Table: 00–02

Table 1, Vehicle Maintenance Schedule

Vehicle Maintenance Schedule																					
Maintenance Operation Number and Description	Maintenance Interval in Miles x 1000																				
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
	Maintenance Interval in Kilometers x 1000																				
	8	16	24	32	40	48	56	64	72	80	88	96	1-04	1-12	1-20	1-28	1-36	1-44	1-52	160	
3.02	•				•					•					•					•	
3.03.02	•				•					•					•					•	
3.04.01	For 6.0 L gasoline engines, change the engine oil and filter every 5000 miles (8045 km). For 6.6 L gasoline engines, change the engine oil and filter every 7500 miles (12 068 km); more frequent oil changes may be required for severe driving conditions.																				
3.05.01	For gasoline engines, replace spark plugs and wires every 97,500 miles (157 000 km). For propane and CNG engines, replace the spark plugs every 50,000 miles (80 450 km).																				
3.06		•		•		•		•		•		•		•		•		•		•	
4.02	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
5.02	Inspect the air filter every six months. Replace the air filter every 12 months, or when filter restriction reaches 25 inH_20 for Cummins diesel engines OR when the air restriction indicator is completely red for gasoline and Detroit™ diesel engines (if equipped with an air restriction indicator).																				
5.04	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
5.05	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	

Vehicle Maintenance Schedule																					
Maintenance Operation Number and Description	**Maintenance Interval in Miles x 1000**																				
	5	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
	Maintenance Interval in Kilometers x 1000																			
	8	**16**	**24**	**32**	**40**	**48**	**56**	**64**	**72**	**80**	**88**	**96**	**1-04**	**1-12**	**1-20**	**1-28**	**1-36**	**1-44**	**1-52**	**160**
5.06	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
7.02	•				•					•					•					•
8.02.01	Replace the organic acid technology (OAT) coolant every 600,000 miles (965 400 km); supplemental coolant additives (SCAs) are not used with OAT coolant. Replace SCA pre-charge ethylene glycol coolants every 35,000 miles (56 315 km). You must check and, if necessary, recharge the SCA levels and freeze point every 25,000 miles (40 225 km) or 6 months, whichever comes first. Replace DEX-COOL coolant (gasoline engines only) every 150,000 miles (241 350 km). See the applicable engine operation and maintenance manual for further information.																			
8.03	•				•					•					•					•
8.04	Inspect the coolant heater every 12 months.																			
8.05	Replace the organic acid technology (OAT) coolant every 600,000 miles (965 400 km); supplemental coolant additives (SCAs) are not used with OAT coolant. Replace SCA pre-charge ethylene glycol coolants every 35,000 miles (56 315 km). You must check and, if necessary, recharge the SCA levels and freeze point every 25,000 miles (40 225 km) or 6 months, whichever comes first. Replace DEX-COOL coolant (gasoline engines only) every 150,000 miles (241 350 km). See the applicable engine operation and maintenance manual for further information.																			
10.02	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
11.02.01	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
11.03.01	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
11.04	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
11.05	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
12.02					•					•					•					•
12.03.01[1]	•				•					•					•					•
12.04[2]	Lubricate twice each month. Lubricate the tie-rod ends each time the chassis is power-washed.																			
12.05.01	•									•										
12.06	•	•	•	•		•	•	•	•		•	•	•	•		•	•	•	•	
12.07					•					•					•					•
	For Detroit™ rear axles with petroleum-based oil, change the lubricant every 100,000 miles (160 900 km) or every 12 months, whichever comes first; if synthetic oil is used, change the lubricant every 250,000 miles (402 250 km) or every 36 months, whichever																			

Vehicle Maintenance Schedule																						
Maintenance Operation Number and Description	Maintenance Interval in Miles x 1000																					
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100		
	Maintenance Interval in Kilometers x 1000																					
	8	16	24	32	40	48	56	64	72	80	88	96	1-04	1-12	1-20	1-28	1-36	1-44	1-52	160		
	comes first. For Meritor rear axles with petroleum-based oil, change the lubricant at 100,000 miles (160 900 km) or at 12 months of service, whichever comes first, and every 24 months thereafter; if synthetic oil is used, change the lubricant every 250,000 miles (402 250 km) or every 36 months, whichever comes first.																					
13.03	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
13.04	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
13.05.01	For Dana eAxles with petroleum-based oil, change the lubricant every 60,000 miles (96 540 km) or every 12 months, whichever comes first; if synthetic oil is used, change the lubricant every 180,000 miles (289 620 km) or every 36 months, whichever comes first.																					
14.01 [3]	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
15.02.01	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
16.02	•				•					•					•					•		
16.03	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
16.04 [4]	•				•					•					•					•		
16.05	No specific lubrication interval. See the **Bosch Pin Slide Disc Brakes Service Manual** for more information.																					
16.06.01	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
16.07.01	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
16.08.01	Replace the Bendix AD9 filter and the Haldex PURest air dryer filter kit every 36 months.																					
16.09.01	Perform the air dryer check every six months.																					
16.10.01	Complete this procedure every 25,000 miles (40 225 km), 3 months, or 500 operating hours, whichever comes first.																					
16.11	The automatic drain valve should be inspected every 6 months or 1500 operating hours, whichever comes first.																					
17.02	Lubricate twice each month. Lubricate the drag link ends each time the chassis is power-washed.																					
17.03	•				•					•					•					•		
17.04	•				•					•					•					•		
17.05	•									•										•		

Vehicle Maintenance Schedule																						
Maintenance Operation Number and Description	**Maintenance Interval in Miles x 1000**																					
	5	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
	Maintenance Interval in Kilometers x 1000																			
	8	**16**	**24**	**32**	**40**	**48**	**56**	**64**	**72**	**80**	**88**	**96**	**1-04**	**1-12**	**1-20**	**1-28**	**1-36**	**1-44**	**1-52**	**160**
17.06.01																				•
17.07	Lubricate the power steering motor in the electric vehicle every 6000 miles (9654 km) or 12,000 operating hours, whichever comes first.																			
17.08																				•
18.02	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
18.03	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
18.04	Drain the high-pressure fuel filter every 2500 miles (4023 km).																			
18.05					•					•					•					•
18.06					•					•					•					•
18.07	•	•	•	•		•	•	•	•		•	•	•	•		•	•	•	•	
18.08	Inspect the fuel tank every 12 months. The fuel tank must be replaced every 15 years.																			
18.09.01		•		•		•		•		•		•		•		•		•		•
19.02.01			•			•			•			•			•			•		
20.02	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
20.03	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
20.04	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
20.05.01	•				•					•					•					•
20.06	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
20.07	Inspect the charge port every 16,000 miles (25 750 km) or 12 months, whichever comes first.																			
20.08	Replace the battery pack desiccant every 16,000 miles (25 750 km) or 12 months, whichever comes first.																			

1. Lubricate knuckle pins at first 5000 miles (8000 km); thereafter, at indicated intervals OR every 12 months, whichever comes first. For vehicles with Detroit axles, complete this procedure once a year or every 5000 miles (8000 km), whichever comes first.
2. For vehicles with Detroit axles, complete this procedure once per year or at 5000 miles (8000 km), whichever comes first.
3. Wheel nuts must be retightened to torque specifications at 50 and 500 miles (80 and 900 km), OR at new vehicle operation, and at any wheel change or any time the nuts have been loosened; thereafter, at indicated intervals.
4. Check brake lining at first 5,000 miles (8045 km); thereafter, at indicated intervals OR every 12 months, whichever comes first.

Table 1, Vehicle Maintenance Schedule

2.03 Noise Emission Controls Maintenance: 00–03

2.03.01 Noise Emission Controls Maintenance

Federal Law, Part 205: Transportation Equipment Noise Emission Controls

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

Recommendations for Replacement Parts

Replacement parts used for maintenance or repair of noise emission controls should be genuine Freightliner Custom Chassis Corporation (FCCC) parts. If other than genuine FCCC 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 FCCC parts in performance and durability.

Freightliner Noise Emission Controls Warranty

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

Tampering With Noise Controls is Prohibited

Federal law prohibits the following acts or the causing thereof:

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

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

   a. Removal of, or rendering inoperative, the engine speed governor so as to allow engine speed to exceed manufacturer's specifications.
   b. Removal of, or rendering inoperative, the fan clutch, including bypassing the control on any thermostatic fan drive to cause it to operate continuously.
   c. Removal of the fan shroud.
   d. Removal of, or rendering inoperative, exhaust components, including exhaust pipe clamping.
   e. Removal of air intake components.

2.03.02 Maintenance Instructions

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

2.04 Verification of Inspections Log

Verification of Inspections Log

Table 2, Verification of Inspections Log, Groups 20 and 49

Date	Mileage	Item	Cost	Maintenance Facility
Group 20 — Fan Clutch				

Group 49 — Exhaust System Components				

Table 2, Verification of Inspections Log, Groups 20 and 49

3.01 Safety Precautions 20
3.02 Checking the Engine-Support Fasteners 20
3.03 Inspecting the Engine Drive Belt 20
3.03.01 General Description 20
3.03.02 Inspection of the Drive Belt 21
3.03.03 Inspection of the Belt Tension 21
3.04 Checking and Changing of the Engine Oil and Filter, Gasoline Engines 22
3.04.01 Checking the Engine Oil and Filter 22
3.04.02 Changing the Engine Oil and Filter 22
3.05 Spark Plugs and Wires Inspecting and Replacing—Gasoline, Propane and CNG Engines 23
3.05.01 Inspection of the Spark Plug Wires 23
3.05.02 Replacement of the Spark Plugs and Wires 23
3.06 Inspecting the Evaporative Control System, Gasoline Engines 24

3. Engine

3.01 Safety Precautions

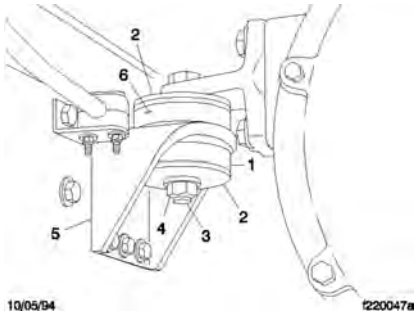
IMPORTANT: Safety Precautions in this section apply to all procedures within this group.

DANGER:

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

3.02 Checking the Engine-Support Fasteners

Check the front and the rear engine-support fasteners for tightness. See Fig.2,Engine Mount (rear). See **Chapter 18** of the **Walk-In Van Chassis Operator's Manual** for torque specifications, or take the vehicle to an authorized Freightliner dealer.



1. Lower Isolator
2. Engine Support Washer
3. Capscrew
4. Hexnut
5. Engine Mount
6. Upper Isolator

Fig 2, Engine Mount (rear)

3.03 Inspecting the Engine Drive Belt

3.03.01 General Description

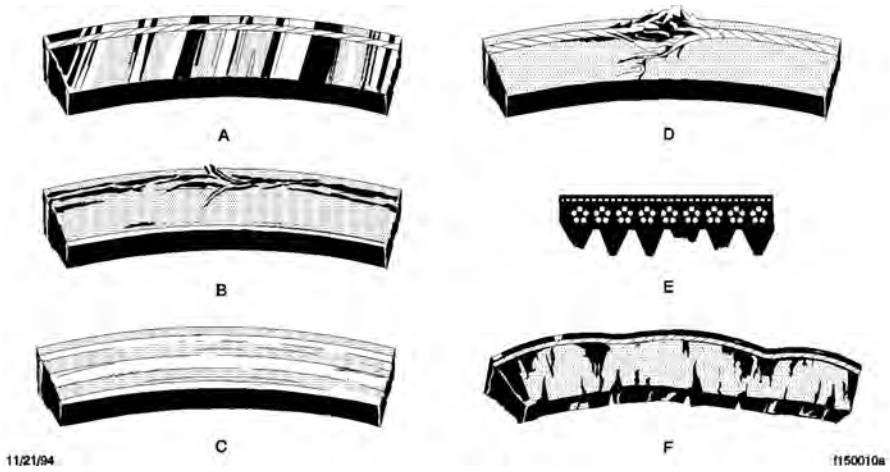
WARNING:

The engine and the belt must be cool before you check the belt. Handling a hot belt can cause personal injury.

Worn or loose drive belts may cause premature bearing failure or engine overheating. Excessive tension, or too little tension on the belt may result in excessive and premature belt wear. Poly-V belts, or serpentine belts, are retained by a belt tensioner that requires no tension adjustment. Replace the engine drive belt if any conditions described in the visual description are found. V-belts are installed as individual belts, and as matched sets. When replacing a matched set of belts, always replace both belts at the same time. Matched belts must be from the same manufacturer. To inspect a belt, gently twist the belt to view the belt sidewalls and bottom. Visually inspect all drive belts for the following conditions, then perform the belt tension inspection.

3.03.02 Inspection of the Drive Belt

1. Inspect the belt for glazing. See Fig.3,Drive Belt Replacement Conditions, Ref. A. Glazing is represented by shiny sidewalls, and is caused by friction created when a loose belt slips in the pulleys. It can also be caused by oil or grease contamination on the pulleys.



A. Glazing
B. Separating Layers
C. Streaked Sidewalls
D. Tensile Break
E. Uneven Ribs
F. Cracks

Fig 3, Drive Belt Replacement Conditions

2. Check the belt for ply separation. See Fig.3,Drive Belt Replacement Conditions, Ref. B. Oil, grease, or belt dressing can cause the belt to fall apart in layers. Repair any oil or coolant leaks that are affecting the belts before replacing the drive belts. Do not use belt dressing on any belt.
3. Check the belt for a jagged or streaked sidewall. See Fig.3,Drive Belt Replacement Conditions, Ref. C. Jagged or streaked sidewalls are the result of foreign objects, such as sand or gravel in the pulley, or a rough pulley surface.
4. Check for tensile breaks (breaks in the cord body). See Fig.3,Drive Belt Replacement Conditions, Ref. D. Cuts in a belt are usually caused by foreign objects in the pulley, or by prying or forcing the belt during removal or installation.
5. Check for uneven ribs on serpentine (poly-V) belts. See Fig.3,Drive Belt Replacement Conditions, Ref. E. Foreign objects in the pulley will erode the undercord ribs, causing the belt to lose its gripping power.
6. Check the drive belts for cracks. See Fig.3,Drive Belt Replacement Conditions, Ref. F. Small irregular cracks are usually the signs of an old belt.
7. Visually inspect the pulleys for excessive play or wobble. Excessive play or wobble indicates a failure of the pulley bearing. Check for belt squealing or squeaking. Replace the bearings as necessary.

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

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

3.03.03 Inspection of the Belt Tension

Spring-Tension Type

On belts equipped with a spring tensioner, the belt tension is automatically adjusted. Check that the tensioner is holding tension on the belt by inserting the end of a breaker bar in the 1/2-inch square hole on the forward face of the tensioner, and

rotating the tensioner down, away from the belt. When the breaker bar is slowly released, the tensioner should return to its original position.

3.04 Checking and Changing of the Engine Oil and Filter, Gasoline Engines

3.04.01 Checking the Engine Oil and Filter

It is important to check the oil regularly and keep it at the proper level. In order to get an accurate reading, the oil must be warm and the vehicle must be on level ground.

1. Turn off the engine and give the oil several minutes to drain back into the oil pan. If this is not done, the oil dipstick may not show the actual level.
2. Pull out the dipstick and clean it with a paper towel or cloth, then push the dipstick back in all the way. Remove it again, keeping the tip down, and check the level.
3. If the oil is below the cross-hatched area at the tip of the dipstick, add at least one quart (liter) of the recommended oil. See Fig.4,Oil Dipstick.



NOTE: Oil should be within the cross-hatched area of the dipstick.

Fig 4, Oil Dipstick

3.04.02 Changing the Engine Oil and Filter

1. Park the vehicle on a level surface, apply the park brake, and shutdown the engine.
2. Place a drain pan under the oil pan.
3. Remove the oil drain plug and let the oil drain into the drain pan.
4. Clean the drain plug and set aside.
5. Remove the oil filter and clean the rim of the oil filter housing.
6. Lubricate the O-ring of the new oil filter, then install the oil filter. Tighten the filter by hand until snug, being careful not to overtighten.
7. Install the oil drain plug. Tighten the plug 18 lbf·ft (24 N·m).
8. When determining the type of engine oil to use, look for the API starburst symbol, shown in Fig.5,API Symbol. Also look for the Dexos 1 Approved-Gen 2 symbol (for 6.6 L engines), shown in Fig. 6,Dexos 1 Approved-Gen 2 Symbol (for 6.6 L engines).

   Fill the engine with SAE 5W–30 oil as follows:

   - 6.0 L engines—6 quarts (5.6 L) of oil
   - 6.6 L engines—8.4 quarts (8 L) of oil



Fig 5, API Symbol



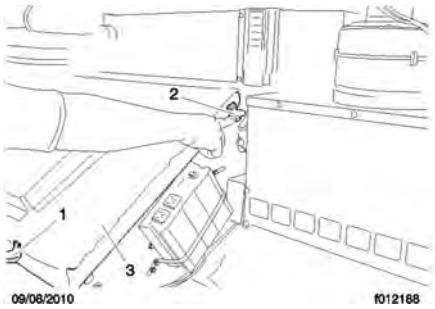
Fig 6, Dexos 1 Approved-Gen 2 Symbol (for 6.6 L engines)

9. Pull out the dipstick, clean it and put the dipstick all the way back in. Remove the dipstick again to check that the correct amount of oil has been added.

3.05 Spark Plugs and Wires Inspecting and Replacing—Gasoline, Propane and CNG Engines

3.05.01 Inspection of the Spark Plug Wires

1. Lift the four latches and remove the engine access cover. See Fig.7,Engine Access Cover.



1. Bottom Latch (two latches at the front)
2. Top Latch (one on each side)
3. Access Cover

Fig 7, Engine Access Cover

2. Inspect the spark plug wires for cracks and chaffing.
3. If the spark plug wires need to be replaced, see the instructions under **Replacement**. If replacement is not needed, install the engine access cover and lock the four latches.

3.05.02 Replacement of the Spark Plugs and Wires

IMPORTANT: When replacing spark plugs and wires, remove and replace one plug and wire at a time. This will eliminate the possibility of incorrectly installing the wires and having a misfire issue.

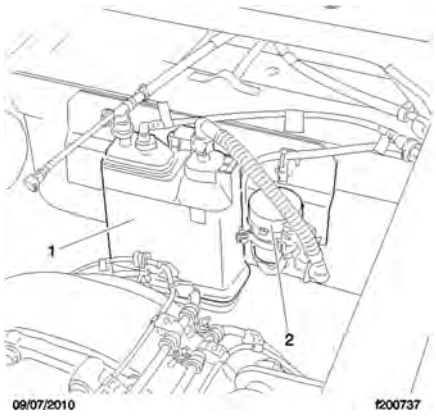
1. Hold both ends of the spark plug wire, and gently pull one end of the wire off at a time.

NOTE: Do not discard the insulation shields. The shields will be needed for the new wires.

2. Use a spark plug socket, a 3-inch extension, and ratchet to remove the spark plug.
3. Install the new spark plug(s) and tighten just until snug.
4. Take a new spark plug wire and put the insulation shield at the plug-end of the wire.
5. Put a small amount of dielectric grease on each end of the spark plug wire electrode, then install the wire.
6. Repeat the above steps for the remaining spark plugs and wires.
7. Install the engine access cover and lock the four latches.

3.06 Inspecting the Evaporative Control System, Gasoline Engines

Inspect the solenoid, evaporative control system canister, and lines. See Fig.8,Evaporative Control System. Look for damaged lines, leaking fuel, or any damage to the canister itself. Make certain the electrical connections are properly connected.



1. Evaporative Control System Canister
2. Solenoid

Fig 8, Evaporative Control System

4.01 Safety Precautions 26

4.02 Inspection of the Electric Motor, Electric Vehicle 26

4. Electric Drive

4.01 Safety Precautions

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

DANGER:

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

4.02 Inspection of the Electric Motor, Electric Vehicle

DANGER:

Electric vehicles are equipped with a high-voltage system. Do not attempt any type of electrical work on the vehicle unless you have completed HV3 Daimler Safety Training. Failure to do so could cause severe personal injury or death.

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

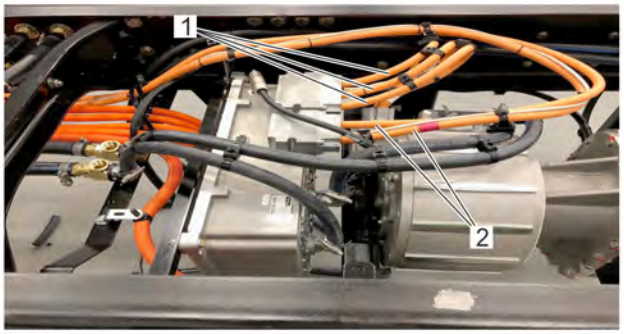
DANGER:

Do not touch the high-voltage cables. Doing so may result in severe personal injury or death.

2. Inspect the drive motor supply cables and high voltage power supply cables for chaffing, rubbing, and cracks. **do not touch the cables.** See Fig.9,High Voltage Cables.

NOTE: The drive motor supply cables are bolted inside the motor; they do not plug in.

3. Inspect the drive motor supply cables where they connect to the motor and ensure that they are properly connected; **do not touch the cables.** See Fig.9,High Voltage Cables.



1. Drive Motor Supply High Voltage Cables
2. High Voltage Power Supply Cables

Fig 9, High Voltage Cables

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5.02 Inspecting the Air Cleaner Element 30
5.03 Replacing the Air Cleaner Element 32
5.04 Checking the Air Cleaner Filter Minder Gauge 32
5.05 Inspecting the Air Intake System 33
5.06 Checking of the Charge Air Cooler 33

5. Air Intake

5.01 Safety Precautions

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



DANGER:

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

5.02 Inspecting the Air Cleaner Element



NOTICE:

All air intake components and connections must be air- and water-tight. Dirt or dust entering the engine can cause internal engine damage. Most of the dirt and dust particles are silicates, which fuse into abrasive glass-like particles when exposed to engine combustion. These particles can grind piston rings, pistons, and cylinder liners. Do not operate the engine with the air filter element or any air intake component removed.

IMPORTANT: Due to the variety of possible driving conditions (dirt roads, paved roads, etc.), it is critical to check the air restriction indicator, if so equipped. If the vehicle is not equipped with an air restriction indicator, inspect all components of the air intake system and air filter every six months. Replace the air filter every 12 months, or when filter restriction reaches 25 inH ^{2}O for Cummins diesel engines, or when the air restriction indicator is completely red for gasoline and Detroit™ diesel engines (if equipped with an air restriction indicator). **More frequent inspections and/or filter replacement may be needed if the vehicle is being operated in a dusty environment, to avoid damaging the vehicle.**



NOTICE:

All air intake components and connections must be air- and water-tight. Dirt or dust entering the engine can cause internal engine damage. Most of the dirt and dust particles are silicates, which fuse into abrasive glass-like particles when exposed to engine combustion. These particles can grind piston rings, pistons, and cylinder liners. Do not operate the engine with the air filter element or any air intake component removed.

IMPORTANT: Due to the variety of possible driving conditions (dirt roads, paved roads, etc.), it is critical to check the air restriction indicator, if so equipped. If the vehicle is not equipped with an air restriction indicator, inspect all components of the air intake system and air filter every six months. Replace the air filter every 12 months, or when filter restriction reaches 25 inH ^{2}O for Cummins diesel engines, or when the air restriction indicator is completely red for gasoline and Detroit™ diesel engines (if equipped with an air restriction indicator). **More frequent inspections and/or filter replacement may be needed if the vehicle is being operated in a dusty environment, to avoid damaging the vehicle.**

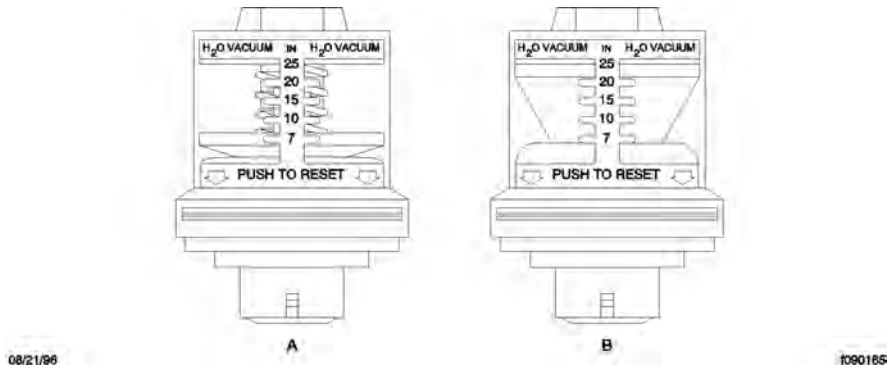
NOTICE:

Use the air intake restriction gauge rather than visual inspection to determine if servicing the air filter element is necessary. Removal of the air filter element can cause damage to the primary seal, which may allow contaminants into the engine, potentially causing engine damage.

IMPORTANT: Removal and visual inspection of the air filter should only occur if the vehicle is not equipped with an air restriction indicator.

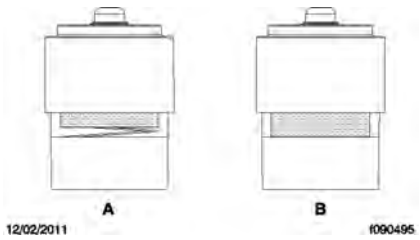
Remove and visually inspect the air filter for holes, tears, cracks, or other damage at the recommended interval. Remove loose debris, such as leaves or pine needles, from the filter housing. If the air filter is damaged, replace it. See 5.01 Safety Precautions of the **Walk-In Van Workshop Manual** for removal and installation instructions, or take the vehicle to an authorized Freightliner dealer.

Engine damage can occur if the air intake system is not properly maintained. Use the air intake restriction indicator to check for air intake system damage or leaks. See Fig.10,Air Restriction Indicator, Cummins Diesel Engines and Fig. 11,Air Restriction Indicator, Gasoline and Detroit Diesel Engines. Make sure the engine is off and note the existing reading on the indicator. Reset the indicator by pushing it down. See Fig.10,Air Restriction Indicator, Cummins Diesel Engines and Fig.11,Air Restriction Indicator, Gasoline and Detroit Diesel Engines. Start the engine and take a short test drive. Check the indicator again and note the level of restriction on the indicator. A decrease from the previous level of restriction or a very low air restriction indicator reading (0 to 4 inH ^{2}O) could indicate an air intake system problem such as a damaged air filter, loose or disconnected air intake piping, or a disconnected or damaged air restriction indicator.



A. Partial Restriction B. Full Restriction

Fig 10, Air Restriction Indicator, Cummins Diesel Engines



A. Partial Restriction B. Full Restriction

Fig 11, Air Restriction Indicator, Gasoline and Detroit Diesel Engines

5.03 Replacing the Air Cleaner Element

NOTICE:
All air intake components and connections must be air- and water-tight. Dirt or dust entering the engine can cause internal engine damage. Most of the dirt and dust particles are silicates, which fuse into abrasive glass-like particles when exposed to engine combustion. These particles can grind piston rings, pistons, and cylinder liners. Do not operate the engine with the air filter element or any air intake component removed.

IMPORTANT: Due to the variety of possible driving conditions (dirt roads, paved roads, etc.), it is critical to check the air restriction indicator, if so equipped. If the vehicle is not equipped with an air restriction indicator, inspect all components of the air intake system and air filter every six months. Replace the air filter every 12 months, or when filter restriction reaches 25 inH ^{2}O for Cummins diesel engines, or when the air restriction indicator is completely red for gasoline and Detroit™ diesel engines (if equipped with an air restriction indicator). **More frequent inspections and/or filter replacement may be needed if the vehicle is being operated in a dusty environment, to avoid damaging the vehicle.**

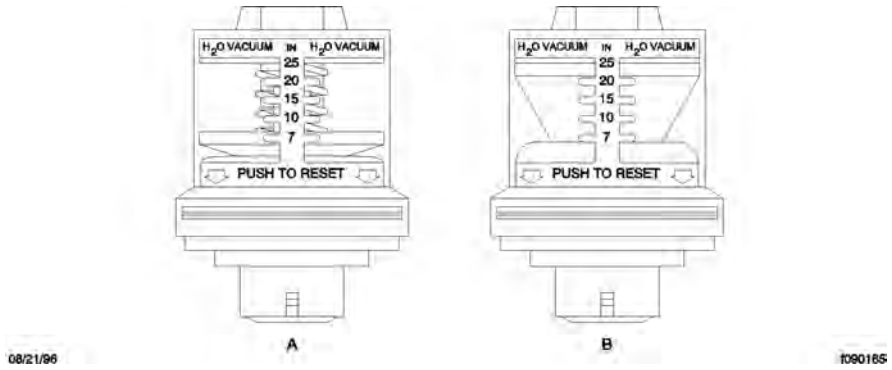
NOTICE:
Do not use aftermarket air-cleaner elements. Aftermarket air-cleaner elements may not seal the housing correctly, which can lead to engine damage and potentially the loss of warranty. When replacing an air-cleaner element, use only the part listed in PartsPro for the serial number of the vehicle.

NOTICE:
Do not clean or reuse the air filter. Cleaning and reusing the the air filter increases the chances of dirt entering the engine. Always replace with a new air filter.

Replace the air filter every 12 months, or when filter restriction reaches 25 inH ^{2}O for Cummins diesel engines, or when the air restriction indicator is completely red for gasoline and Detroit diesel engines (if equipped with an air restriction indicator). See 5.01 Safety Precautions of the **Walk-In Van Workshop Manual** for removal and installation instructions, or take the vehicle to an authorized Freightliner dealer.

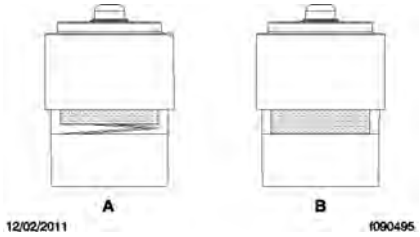
5.04 Checking the Air Cleaner Filter Minder Gauge

The filter minder gauge measures the amount of air restriction (in inches or millimeters of water vacuum) in the air intake system. It is connected to the air intake tube by a vacuum hose and a small vacuum filter. The gauge takes its measurements when the engine is running at full load, and then locks in place until reset. See Fig. 12,Air Restriction Indicator, Cummins Diesel Engines or Fig. 13,Air Restriction Indicator, Gasoline and Detroit Diesel Engines as applicable to the vehicle, for depictions of how the indicator appears when the air intake is partially restricted and when it is fully restricted and should be replaced.



A. Partial Restriction B. Full Restriction

Fig 12, Air Restriction Indicator, Cummins Diesel Engines



A. Partial Restriction B. Full Restriction

Fig 13, Air Restriction Indicator, Gasoline and Detroit Diesel Engines

5.05 Inspecting the Air Intake System

Check the air intake system for damaged or cracked hoses, and for loose clamps. Also check the air filter.

5.06 Checking of the Charge Air Cooler

Good airflow through the radiator and charge air cooler core is essential for proper engine cooling. The cores allow air passage, but form a barrier that tends to collect insects and airborne debris.

If the charge air cooler core fins are bent, use a small pair of needle-nose pliers or a small screwdriver to straighten them. If the fins are clogged, use compressed air or water directed from the fan side of the radiator core to backflush any material restricting airflow.

Ensure that the hoses are not chafing and that the system is closed with no air leaks.

6.01 Safety Precautions 36
6.02 Inspection of the Air Compressor 36

6. Air Compressor

6.01 Safety Precautions

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



DANGER:

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

6.02 Inspection of the Air Compressor

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

7.01 Safety Precautions 38

7.02 Alternator, Battery, and Starter Connections Check 38

7. Alternators and Starters

7.01 Safety Precautions

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

DANGER:

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

7.02 Alternator, Battery, and Starter Connections Check

WARNING:

Batteries release explosive gas as a by-product of their chemical activity. Do not smoke when working around batteries. Put out all flames and remove any source of sparks or intense heat. Make sure the battery compartment is 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.

Damaged, chafed, or kinked wiring can cause electrical short-circuits and lead to fires, causing property damage, injury, or death. Clean, inspect, and maintain wiring and connections carefully.

1. Disconnect the batteries.
2. Check the tightness of the alternator bracket fasteners and alternator mounting fasteners; tighten the fasteners as needed. For torque values, see 7.01 Safety Precautions of the vehicle **Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.
3. Check that all electrical connections at the alternator and starter are clean. Clean and tighten all charging system electrical connections as needed. Spray each electrical connection at the alternator and starter with dielectric red enamel.

   Trace and inspect all wiring and cables connected to:

   - alternator
   - starter and depopulation studs
   - batteries
   - magnetic switch
   - cab
   - jump-start studs
   - battery isolation relays
   - battery shutoff switches
4. Check wires and cables for wear, chafing, kinks, discolored insulation, or loose clamps or ties. Find the cause of any problems and repair, replace, and reroute wires and clamps as necessary.

IMPORTANT: Ensure that wires and cables are not near any heat sources; if they are, reroute them.

5. Clean all circuit breakers and relays.
6. Check the alternator wiring for missing insulation, kinks, and heat damage. Replace or repair as needed.
7. On the bundled cable that runs from the batteries to the starter, ensure that tie straps are installed at least every 12 inches (30 cm). Replace any missing tie straps, and add tie straps where spacing between them exceeds 12 inches (30 cm).
8. Ensure that all cables have sufficient slack to allow for engine movement, and that there is no force on any wiring connectors.
9. If any convoluted tubing is damaged, check the wiring inside it. Replace any damaged or missing convoluted tubing.
10. Inspect the battery cables for wear, and replace as needed. Clean the cable connector terminals with a wire brush. See 20.01 Safety Precautions of the vehicle **Workshop Manual** for troubleshooting instructions, and for adjustment, repair, or replacement instructions, or take the vehicle to an authorized Freightliner dealer.
    - 10.a Clean and tighten the battery ground cable, terminal, and clamps.
    - 10.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. Rinse with clean water, then dry. Paint the retainer assembly, if needed, to prevent rusting.
    - 10.c Check that foreign objects, such as stones, bolts, and nuts, are removed from the battery box.
    - 10.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).
    - 10.e Coat the battery terminals with dielectric grease.
11. Check the terminals on the battery shut-off switch and the starter relay. Make sure that the terminal connections are clean and tight. Coat the terminal connections with dielectric red enamel after cleaning.

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8.02 Replacement of the Coolant 42
8.02.01 Diesel Engine 42
8.02.02 Alternative Fuel Engine, 6.0 L and 6.6 L 44
8.03 Inspection of the Cooling Fan 46
8.04 Coolant Heater Check, Webasto 46
8.05 Replacement of the Coolant, Electric Vehicle 47

8. Engine Cooling/Radiator

8.01 Safety Precautions

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



DANGER:

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

8.02 Replacement of the Coolant

8.02.01 Diesel Engine

At the intervals specified in the maintenance schedule, or whenever the coolant becomes dirty, flush and refill the cooling system as follows, based on the type of engine installed in the vehicle.



WARNING:

Never remove the surge tank cap while the engine is operating or while the engine and radiator are still hot. Scalding fluid and steam can blow out under pressure if the cap is taken off too soon. Failure to follow these precautions could result in serious personal injury from heated coolant spray.

1. When the engine is cool, remove the surge tank cap.

   Turn the cap slowly counterclockwise until it reaches a "stop." Do not press down while turning the cap. Wait until any remaining pressure (indicated by a hissing sound) is relieved, then press down on the cap and continue turning it counterclockwise.
2. When the cap is removed, run the engine until the upper radiator hose is hot. This shows that the thermostat is open and that the coolant is flowing through the system.



WARNING:

Drain the coolant only when the coolant and engine are cool. Draining it when these are hot could cause severe personal injury due to scalding.

3. Shut down the engine. Remove the lower radiator hose and drain the coolant. Draining may be speeded up by removing the plug from the bottom of the water inlet.

NOTICE:
During filling, air must be vented from the engine coolant passages. Any air trapped in the system can cause severe engine damage.

4. Connect the lower radiator hose and install the plug in the bottom of the water inlet. Add water until the system is filled and run the engine until the upper radiator hose is hot again. The system must be filled slowly to prevent air locks. Wait 2 to 3 minutes to allow air to be vented, then add water to bring the level to the top.
5. Repeat the last two steps several times until the drained liquid is nearly colorless.
6. Drain the system, then close the radiator and block the drain valves.
7. Disconnect all hoses from the coolant surge tank. Remove the surge tank and pour out any fluid. Scrub and clean the inside of the surge tank with soap and water. Flush it thoroughly with clean water, then drain it. Reinstall the surge tank and hoses.

IMPORTANT: The coolant capacity varies depending on the engine and accessory installation. After servicing the cooling system, always verify that the coolant level is between the MIN and MAX lines on the surge tank.

8. Fill the cooling system.
   8.a Slowly add a 50/50 mixture of antifreeze and water to the surge tank, no more than 3.0 gallons per minute (gpm). Fill to the top of the surge tank. For approved coolants, refer to the coolant label on the vehicle or the engine manufacturer's service literature. Coolant used must be compatible with the engine manufacturer's coolant specifications. For Cummins engine service literature, refer to the **Cummins Online** website, see https://www.cummins.com/support/manuals or scan the QR code. See Fig.14,Cummins QR Code. For Detroit™ engine service literature, refer to the **Detroit Diesel** link on the DTNA TechLit website, see https://www.dtnatechlit.com/portal-public or scan the QR code. See Fig.15,TechLit QR Code.



Fig 14, Cummins QR Code

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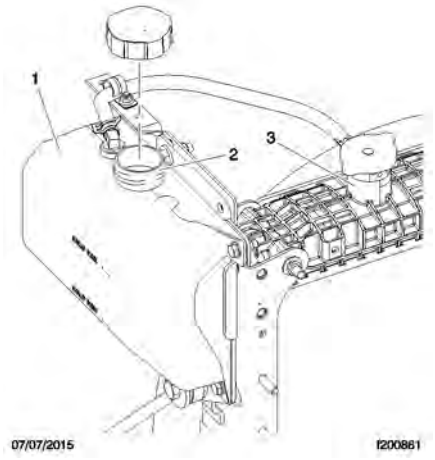
Fig 15, TechLit QR Code

8.b With the radiator cap removed, start the engine and run it at low idle for 1 minute; then at high idle for 1 minute. Return to low idle for 1 minute.

8.c Turn the engine off. Fill the surge tank to the COLD MAX line. Install the radiator cap.

8.02.02 Alternative Fuel Engine, 6.0 L and 6.6 L

See Fig.16,Overflow Bottle when performing the following procedure.



1. Overflow Bottle
2. Overflow Bottle Fill Neck
3. Radiator Fill Neck

Fig 16, Overflow Bottle

WARNING:
Never remove the radiator cap while the engine is operating or while the engine and radiator are still hot. Scalding fluid and steam can blow out under pressure if the cap is taken off too soon. Failure to follow these precautions could result in serious personal injury from heated coolant spray.

1. When the engine is cool, remove the radiator cap.

   Turn the cap slowly counterclockwise until it reaches a "stop." Do not press down while turning the cap. Wait until any remaining pressure (indicated by a hissing sound) is relieved, then press down on the cap and continue turning it counterclockwise.

2. When the cap is removed, run the engine until the upper radiator hose is hot. This shows that the thermostat is open and that the coolant is flowing through the system.
3. Shut down the engine. Remove the lower radiator hose and drain the coolant. Draining may be speeded up by removing the plug from the bottom of the water inlet.

NOTICE:
During filling, air must be vented from the engine coolant passages. Any air trapped in the system can cause severe engine damage.

NOTE: The maximum fill rate of the radiator is 2 gallons per minute.

4. Connect the lower radiator hose and install the plug in the bottom of the water inlet. Add water until the system is filled and run the engine until the upper radiator hose is hot again. The system must be filled slowly to prevent air locks. Wait 2 to 3 minutes to allow air to be vented, then add water to bring the level to the top.
5. Repeat the last two steps several times until the drained liquid is nearly colorless.
6. Drain the system, then close the radiator and block the drain valves.
7. Disconnect the hose from the coolant overflow bottle. Remove the bottle and pour out any fluid. Scrub and clean the inside of the overflow bottle with soap and water. Flush it thoroughly with clean water, then drain it. Reinstall the overflow bottle and hoses.

NOTE: The maximum fill rate of the radiator is 2 gallons per minute.

8. Fill the system with a 50/50 mixture of antifreeze and water to the base of the filler neck. Refer to the coolant label on the vehicle or the engine manufacturer's service literature for approved coolants. Coolant used must be compatible with the engine manufacturer's coolant specifications.For Cummins engine service literature, refer to the **Cummins Online** website, see https://www.cummins.com/support/manuals or scan the QR code. See Fig. 17,Cummins QR Code. For Detroit™ engine service literature, refer to the **Detroit Diesel** link on the DTNA TechLit website, see https://www.dtnatechlit.com/portal-public or scan the QR code. See Fig.18,TechLit QR Code.



Fig 17, Cummins QR Code



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Fig 18, TechLit QR Code

9. With the radiator cap removed, start the engine and run it at low idle for 60 seconds. Increase engine speed to 1200 rpm for 60 seconds, then decrease engine speed to low idle for 60 seconds. Top off the coolant level to the base of the radiator fill neck. Install the radiator cap. Fill the coolant overflow bottle to the COLD MAX line. Install the cap on the overflow bottle. Shut down the engine.

8.03 Inspection of the Cooling Fan

WARNING:
Never pull or pry on the fan. This can damage the fan blade(s) and cause fan failure. Fan failure can cause personal injury.

A visual inspection of the cooling fan is required daily. Check for cracks, loose rivets, and bent or loose blades. Check the fan to make sure that it is securely mounted. Tighten the capscrews if necessary. Replace any fan that is damaged. Also check the fan recirculation shield, if so equipped.

8.04 Coolant Heater Check, Webasto

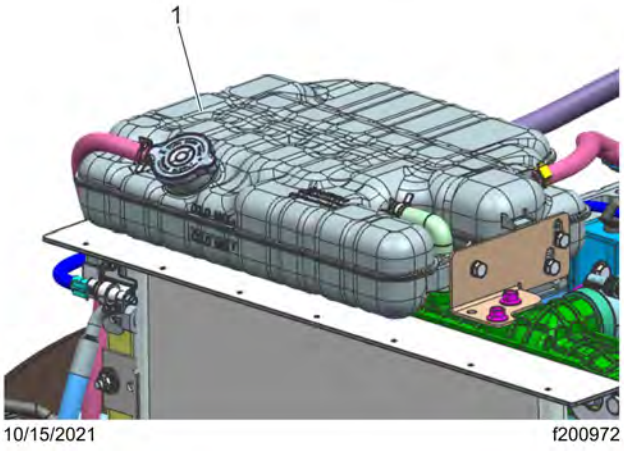
1. Using compressed air, clean any accumulated debris or dust from the heater and enclosure box. Inspect all components for wear or damage.
2. Check that the batteries are in good condition. If the voltage is too low or too high, the heater will automatically shut down. Check the wiring harnesses for damage. Replace the harnesses if necessary.
3. Check the air intake port for obstructions. Carefully check the air intake tube for any restrictions or damage, and repair or replace the tube if necessary.
4. Check the exhaust system for restrictions or corrosion. Replace any damaged parts.
5. Change the fuel filter, if so equipped. Inspect the fuel line for damage, restrictions, or loose connections. Repair or replace the line if it is damaged.
6. Inspect all coolant lines and clamps for leakage, restrictions, or damage. Replace the lines as needed. Inspect the coolant circulation pump for leakage. Repair or replace the pump if it is damaged.
7. Run the heater at least once a month for 10 minutes.
8. Check the water and fuel connections for leakage. Tighten the hose clamps if needed.

8.05 Replacement of the Coolant, Electric Vehicle

WARNING:

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

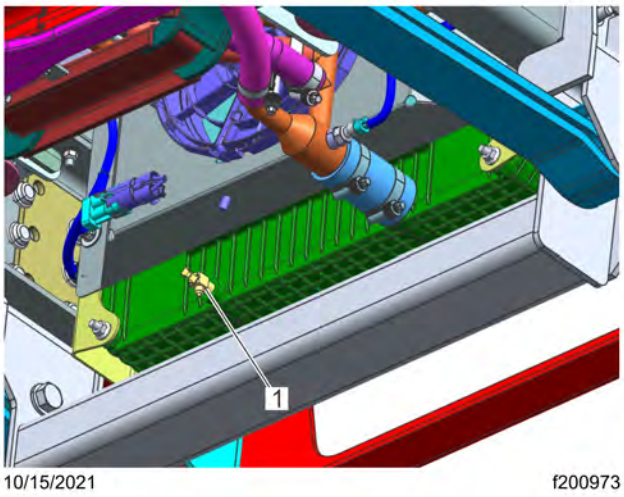
1. Remove the fill cap from the surge tank. See Fig.19,Surge Tank.



1. Powertrain/Battery Loop Surge Tank

Fig 19, Surge Tank

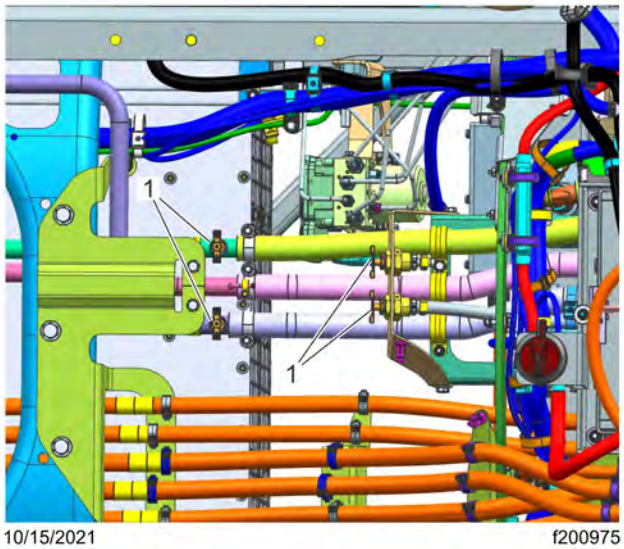
2. Place a large container under the radiator.
3. Open the drain valve at the bottom of the radiator. See Fig.20,Radiator Drain Valve.



1. Drain Valve

Fig 20, Radiator Drain Valve

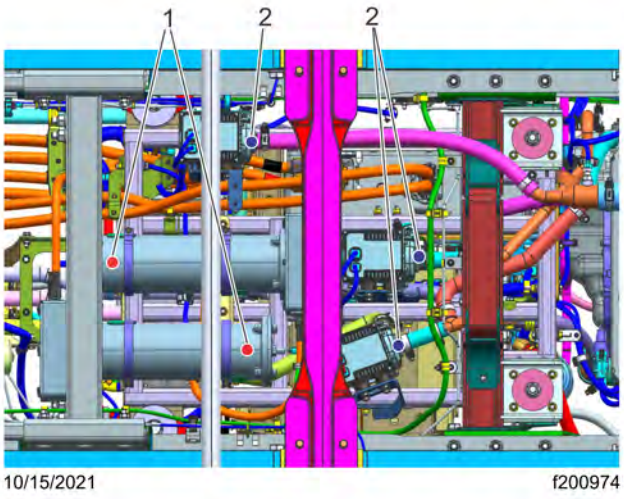
4. Locate the petcock valves under the center of the cab and open the valves to drain the coolant faster. See Fig. 21,Accessing the Petcock Valves.



1. Petcock Valves

Fig 21, Accessing the Petcock Valves

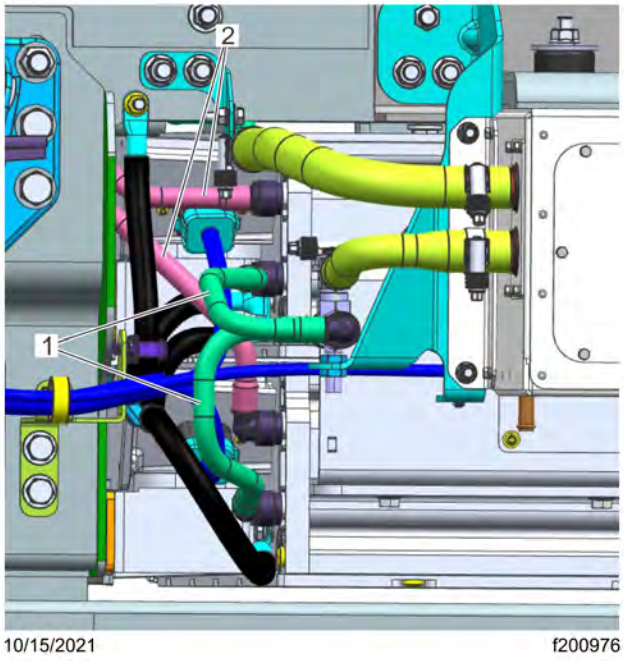
5. Remove the 1 inch hose from the three coolant pump inlets and replace them with longer 1 inch lines to drain into a bucket. See Fig.22,Coolant Heater Plugs and Pump Inlets.



1. Coolant Heaters Plugs
2. Coolant Pump Inlets

Fig 22, Coolant Heater Plugs and Pump Inlets

6. When the coolant has completely drained, remove the longer 1 inch lines.
7. Install the original 1 inch lines removed from the coolant pump inlets in the previous step and secure the lines.
8. Disconnect the 5/8 inch supply and return lines from the high-voltage battery pack. Drain any coolant in the lines or batteries into a bucket. See Fig.23,High-Voltage Battery Supply and Return Lines.

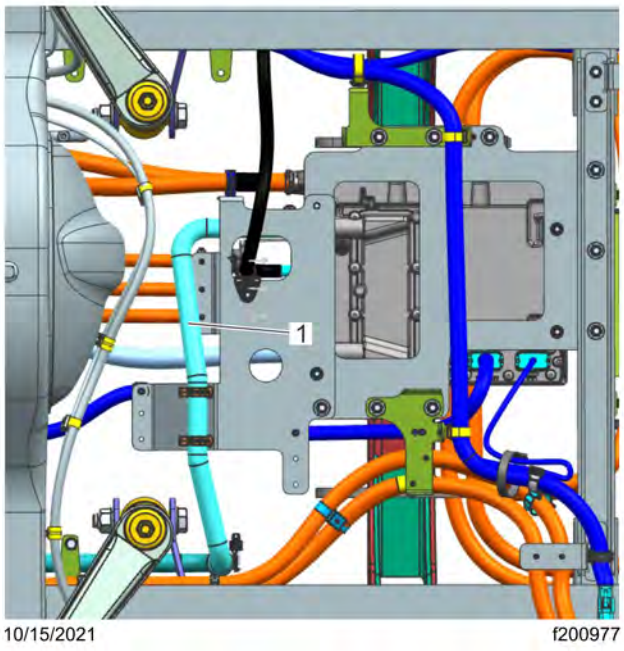


1. Supply Lines
2. Return Lines

Fig 23, High-Voltage Battery Supply and Return Lines

9. Once the coolant has been drained, install and secure the 5/8 inch supply and return lines on the high-voltage battery pack.

10. Remove the hose from the inverter inlet and drain the coolant into a bucket.
11. Once the coolant is completely drained, install and secure the invertor hose. See Fig.24,Invertor Inlet Hose.



1. Invertor Line

Fig 24, Invertor Inlet Hose

12. Close all of the petcock valves. See Fig.21,Accessing the Petcock Valves.
13. Close the drain valve on the radiator. See Fig.20,Radiator Drain Valve.
14. Install any coolant lines that were removed to drain the coolant.

IMPORTANT: The powertrain/battery loop surge tank must be filled **first**. Ensure that the dash controls are set to cold and the blower is off. Supplemental coolant additives (SCAs) are not used with OAT coolant.

NOTICE:

Distilled water must always be used when mixing a 50/50 mixture of coolant concentrate and water. Normal tap water will lead to corrosion of the powertrain and battery coolant loops. This type of damage is not covered by warranty.

If a pre-mixed coolant/water solution is used, distilled water does not need to be added.

15. Fill the surge tank to the COLD FULL mark on the tank with organic acid technology (OAT) coolant at a rate of 3 gallons per minute (GPM).
16. Once the vehicle is filled to the COLD FULL mark, start the vehicle and allow it to run for 10 minutes.

17. After the vehicle has run 10 minutes, turn it off and open all of the petcock valves, shown in Fig. 21,Accessing the Petcock Valves to release air in the system.
18. With the petcock valves open, check the coolant level again and add coolant to the COLD FULL mark. If coolant is seen coming from any of the petcock valves, close them immediately.

    IMPORTANT: Fill the dash/body heater surge tank **after** the powertrain/battery loop surge tank. Starting the vehicle automatically turns on the pumps for the powertrain/battery loop; these pumps must not be ran without the proper amount of coolant in the system. The dash/body heater pump activates when the dash control is set to hot and the blower is running.

19. Ensure that the powertrain/battery loop surge tank is at the full mark. Do not let the pumps run dry.
20. Fill the dash/body heater surge tank until the sight glass is filled with coolant.
21. Start the vehicle, then set the heater control to hot and run the blower. Allow the vehicle to run for 30 minutes to deaerate.
22. Add coolant until the sight glass is filled and ensure that the coolant level is within limits on the surge tank.

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9.03 Checking the Allison Transmission Fluid Level 54
9.03.01 Cold Check 54
9.03.02 Hot Check 55
9.04 Changing the Allison Transmission Fluid and Filter 56

9. Transmission

9.01 Safety Precautions

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

DANGER:

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

9.02 Checking the Transmission Breather

Transmission housing breathers must remain clear. A plugged breather could result in pressure build-up, which could cause lubricant leakage.

If the breather is plugged, clean or replace it. See Fig.25,Transmission Breather. Check more often if the vehicle is operating under very dusty conditions.

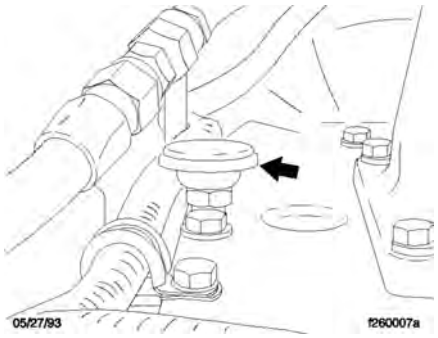


Fig 25, Transmission Breather

9.03 Checking the Allison Transmission Fluid Level

9.03.01 Cold Check

NOTICE:

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

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

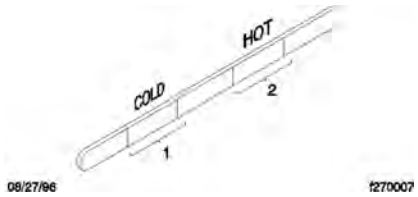
IMPORTANT: For oil and filter change intervals, see the applicable Allison Operator's Manual.

IMPORTANT: After replacing the transmission fluid or changing the filter(s), it is important to check the fluid level cold to determine if the transmission has a sufficient amount of fluid to be safely operated until a hot check can be performed.

1. A cold check may be made when the sump temperature is 60 to 104°F (15 to 40°C).
2. Run the engine for at least one minute to clear the fluid system of air.

NOTICE:
Do not allow foreign matter to enter the transmission. Dirt or foreign matter in the hydraulic system may cause undue wear of transmission parts, make valves stick, and clog passages.

3. Clean all dirt away from around the end of the fluid fill tube before removing the dipstick. With the engine running, wipe the dipstick clean and check the fluid level. Any level within the COLD RUN (lower) band is satisfactory for operating the vehicle. If the level is not within the COLD RUN band, add or drain fluid until it reaches the middle of the COLD RUN band. See Fig.26,Dipstick Markings.



1. COLD RUN Band 2. HOT RUN Band

Fig 26, Dipstick Markings

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

9.03.02 Hot Check

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

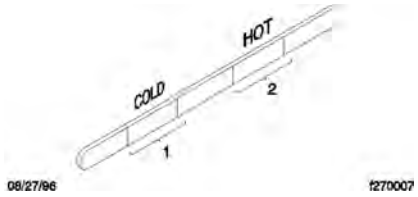
Do not mix types and brands of fluid, because of possible incompatibility. Do not use fluid additives, friction modifiers, extreme-pressure gear fluids, or multiviscosity lubricants.

IMPORTANT: For oil and filter change intervals, see the applicable Allison Operator's Manual.

1. Operate the transmission in a drive range until normal operating temperature, 160 to 200°F (71 to 93°C), is reached.

   NOTE: The fluid must be warm to ensure an accurate check. The fluid level rises as temperature increases.

2. Park the vehicle. Shift to neutral (N) and apply the parking brake. Let the engine run at idle.
3. Wipe the dipstick clean and check the fluid level. A safe operating level is any level within the HOT RUN (upper) band on the dipstick. See Fig.27,Dipstick Markings.



1. COLD RUN Band
2. HOT RUN Band

Fig 27, Dipstick Markings

4. If the fluid is not within this range, add or drain fluid as needed to bring the level to the top of the HOT RUN band. See Table.3,Approved Allison Transmission Lubricants for approved transmission lubricants, and Table.4,Transmission Lubricant Capacities for lubricant capacities.

Table 3, Approved Allison Transmission Lubricants

Approved Allison Transmission Lubricants [1]		
TES-295 Approval Number	**Company**	**Product Brand Name**
AN-051005	ExxonMobil Lubricants and Petroleum Specialties Company	Mobil Delvac Synthetic ATF
AN-011001	Castrol Heavy Duty Lubricants	TranSynd
AN-031002	BP	Autran Syn 295
AN-031003	Cognis Corporation	Emgard 2805
AN-031004	Fleetrite Synthetic ATF	
AN-071006	John Deere & Company	HD SynTran

1. To check the latest Allison approved fluids, go to the Allison Transmission website, seewww.allisontransmission.com/my-allison/customer. Lubricants listed in order of preference. Do not mix types of oil.

Table 3, Approved Allison Transmission Lubricants

Table 4, Transmission Lubricant Capacities

Transmission Lubricant Capacities	
Model	**Refill Capacity [1] quarts (liters)**
1000/2000/2400 Standard Sump	10.6 (10)
1000/2000/2400 Shallow Sump	7.4 (7)

1. Quantities listed are approximate. Add the recommended amount of fluid as listed under refill capacity. Do not overfill.

Table 4, Transmission Lubricant Capacities

9.04 Changing the Allison Transmission Fluid and Filter

IMPORTANT: For oil and filter change intervals, see the applicable Allison Operator's Manual.

For Allison Transmission Operators Manual and Warranty Information for on-highway vehicle applications, see www.allison-transmission.com/my-allison/customer or scan the QR code. See Fig.28,Allison Transmission QR Code.



Fig 28, Allison Transmission QR Code

NOTE: To check the latest Allison approved fluids, go to the Allison Transmission website, seewww.allisontransmission.com/my-allison/customer. Lubricants listed in order of preference. Do not mix types of oil.

Table 5, Approved Allison Transmission Lubricants

TES-295 Approval Number	Company	Product Brand Name
AN-051005	ExxonMobil Lubricants and Petroleum Specialties Company	Mobil Delvac Synthetic ATF
AN-011001	Castrol Heavy Duty Lubricants	TranSynd
AN-031002	BP	Autran Syn 295
AN-031003	Cognis Corporation	Emgard 2805
AN-031004	Fleetrite Synthetic ATF	
AN-071006	John Deere & Company	HD SynTran

Table 5, Approved Allison Transmission Lubricants

Table 6, Transmission Lubricant Capacities

Model	**Refill Capacity [1] quarts (liters)**
1000/2000/2400 Standard Sump	10.6 (10)
1000/2000/2400 Shallow Sump	7.4 (7)

1. Quantities listed are approximate. Add the recommended amount of fluid as listed under refill capacity. Do not overfill.

Table 6, Transmission Lubricant Capacities

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10. Frame

10.01 Safety Precautions

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

DANGER:

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

10.02 Inspecting the Interlube Chassis Lubrication System

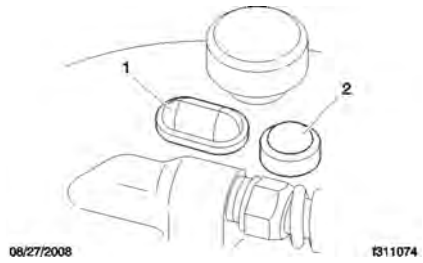
1. Inspect all lubrication points for signs of fresh grease.
2. Check the condition of all fittings and connections. Tighten or replace loose or damaged fittings.
3. Check all lubrication lines; be sure there are no breaks. Check for wear or chafing that may lead to leakage.
4. Inspect the bottom of the Interlube pump for leaks. If there are any signs of lubricant on the pump, use a 12 mm wrench and turn all of the injectors and blanking plugs 1/8 to 1/4 inch clockwise. Do not overtighten the blanking plugs. See Fig.29,Tightening the Injectors and Blanking Plugs.



NOTE: Do not overtighten the blanking plugs.

Fig 29, Tightening the Injectors and Blanking Plugs

5. Confirm pump operation by pressing the manual override button (located on top of the reservoir) and check to see if the indicator light flashes. See Fig.30,Interlube System Reservoir.



1. Indicator Light
2. Manual Override Button

Fig 30, Interlube System Reservoir

6. Using clean grease, fill the reservoir every 2 to 3 months as follows. See Table.7,Approved Grease for a list of approved grease.

IMPORTANT: To avoid air pockets and contaminants from entering the reservoir, use the grease fill fitting when filling the reservoir.

6.a Remove the dirt cap from the grease fill fitting, then wipe the grease fill fitting to remove any dirt.

NOTE: Do not use heavy/tacky grease, or clay-based high temperature grease.

Table 7, Approved Grease

NLGI Grade	Temperature Rating: Down to °F (°C)
2	10 (–12)
1	0 (–18)
0	–10 (–23)
00	–20 (–29)
000	–30 (–34)

Table 7, Approved Grease

6.b Using approved grease, fill the reservoir through the grease fill fitting to the maximum level label on the reservoir.

6.c Install the dirt cap on the grease fill fitting.

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11. Suspension

11.01 Safety Precautions

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



DANGER:

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

11.02 Inspecting the Suspension

11.02.01 Front and Rear Suspension Spring Assemblies

Some reverse bow in the suspension leaf springs is normal. Deflection in the springs is affected by the carrying capacity of the spring package furnished with the chassis and the load applied. If the springs appear to bow considerably more than normal, have a service dealer check for broken springs, or (consider) adding a heavier spring package.

11.02.02 Rear Air Suspension

Air-Consuming Devices Turned Off

Follow the procedure below to determine if a pressure drop in the rear air suspension system is within the allowable range.

NOTE: With all air-consuming devices turned off (service brakes released and parking brake applied [exhausted]), pressure drop must not exceed 2 psi (14 kPa) in one minute.

1. Park the vehicle on a level surface, place the transmission in Neutral (N), and apply the parking brake.
2. Turn off all air-consuming devices.
3. Run the engine until the air system reaches full pressure.

   NOTE: The minimum compressor cut-out pressure is 110 psi (758 kPa).

4. Shut down the engine and wait one minute for the air pressure to stabilize. Note the reading on the air pressure gauge.
5. Wait one additional minute and check the gauge reading again to see if there has been any pressure drop.
6. Pressure drop from air leakage must be less than 2 psi (14 kPa).

Air-Consuming Devices in Use

Follow the procedure below to determine if a pressure drop in the rear air suspension system is within the allowable range.

NOTE: With the service brakes applied and the parking brake released (pressurized), pressure drop must not exceed 3 psi (21 kPa) in one minute.

1. Park the vehicle on a level surface, place the transmission in Neutral (N), and chock the tires to prevent the vehicle from rolling.
2. Turn off all air-consuming devices.
3. Run the engine until the air system reaches full pressure.

4. Release the parking brake.
5. Shut down the engine, apply the brake pedal fully, and wait one minute for the air pressure to stabilize. Note the reading on the air pressure gauge.
6. Wait one additional minute (with the brake pedal fully applied) and check the gauge reading again to see if there has been any pressure drop.
7. Pressure drop from air leakage must be less than 3 psi (21 kPa).

11.03 Inspecting the Freightliner Suspension

11.03.01 Inspection of the Spring Front and Rear Suspension Spring Assemblies

Inspect the front and rear suspension spring assemblies for pitted, cracked, broken, or abnormally bent leaves and extreme rust. If any of these conditions exist, replace the spring assembly. See of the **Walk-In Van Chassis Workshop Manual** for instructions, or take the vehicle to an authorized Freightliner dealer.



WARNING:

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

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

11.03.02 Spring Shock Absorber Check

Make sure that the shock absorber brackets are tight and that the shock absorber is not striking or rubbing on the frame or some other part of the chassis. Check the rubber mounting bushings and replace them if worn. Inspect the shock absorber for oil leakage, which is defined as being drips of oil on the sides of the shock absorber.

If the shock absorber is worn or damaged, replace it with a new one.

11.03.03 Single Spring and Radius Rod Bushing Check

1. Without detaching the torque arms, use your hand to attempt to move each of the radius rod ends up, down, in, and out. If there is any movement, replace the torque arm.
2. Inspect the weld seams between the torque arm tube and the shorter bushing tubes. If there are cracks, replace the torque arm. Do not weld the torque arm for any reason.
3. Inspect the rubber bushing ends. See Fig.31,Torque Arm Bushings. Replace the torque arm for any of the following reasons:
   - There are gaps between the rubber bushing and the pin or the outer steel sleeve.
   - Either bushing end contacts a torque arm pin mounting bolt.
   - There are cracks in the bushing.
   - Part of the rubber bushing extends beyond the outside diameter of the outer bushing sleeve.

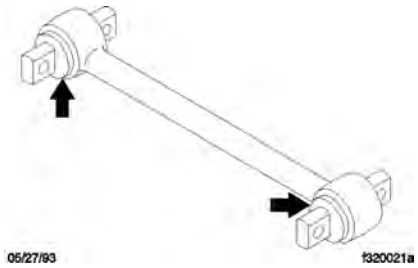


Fig 31, Torque Arm Bushings

11.03.04 56-Inch Multi-Leaf Spring Component Check

No lubrication is required on the 56-inch multi-leaf spring rear suspension.

Inspect the stabilizer bar, if present, for irregular bushing wear or cracks in the brackets. Check the rubber helper spring, if present, for cracks.

11.03.05 AirLiner Component Clearance Check

Check that the air line support brackets are positioned so the air lines do not rub against anything. Reposition any configurations that could contact the air line and result in friction and wear. There must be at least 1 inch (25 mm) clearance around the rubber air spring when inflated. If the clearance is less than 1 inch (25 mm), relocate the obstructing parts.

NOTICE:
Failure to relocate obstructing parts could result in damage to the air spring.

11.03.06 AirLiner Control Rod Check

1. Without disconnecting the control rods, use your hand to attempt to move each of the control rod ends up, down, in, and out. If there is any movement, examine the control rods for wear or damage. Replace the control rod(s) if necessary.
2. Inspect the rubber bushings for cracks or cuts.
3. Check for any shifting of the barpin.
4. Check for cracks in the metal components and welds.

11.04 Inspecting and Operation Checking of the Component, Freightliner AirLiner

WARNING:
Inspect the components and check their operation as described below. Failure to perform these inspections and checks could result in separation of worn suspension components and loss of vehicle control, possibly causing personal injury and property damage.

1. Chock the front tires. Raise the rear of the vehicle so that the tires just clear the ground and so that the suspension is fully extended. Place safety stands under the vehicle frame.
2. Squeeze all air springs to check for complete deflation. If any air springs remain partially or fully inflated, see of the **Walk-In Van Chassis Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.

3. Inspect each air spring for wear at its connection to the pedestal. Replace any worn air springs; for instructions, see of the **Walk-In Van Chassis Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.
4. Check the axle connection welds (beam-seat to equalizing-beam) and axle-adapter to axle for cracks. If welds are cracked, take the vehicle to an authorized Freightliner dealer for repair.
5. Move the axle up and down while checking for signs of looseness due to worn parts at the front pivot connections. Replace any worn parts by following the procedures, see of the **Walk-In Van Chassis Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.
6. Inspect the shock absorbers for oil leaks and worn rubber bushings. Replace the shock absorbers and/or rubber bushings if wear or damage is noted. For instructions, see of the **Walk-In Van Chassis Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.
7. Remove the safety stands and lower the rear of the vehicle to the ground. Run the engine until air pressure of at least 100 psi (689 kPa) is maintained throughout the system.
8. Check that all air springs are inflated. If the air springs do not inflate, see of the **Walk-In Van Chassis Workshop Manual** for possible causes and corrections, or take the vehicle to an authorized Freightliner dealer.

11.05 Checking the Suspension U-Bolt Torque

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

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

1. Park the vehicle on a flat surface and apply the parking brake. Chock the tires.
2. Check the U-bolt torque in a diagonal pattern. Set a click-type torque wrench to the highest torque value for the fastener being checked. See Table.8,U-Bolt Torque Values for U-bolt torque specifications. Turn the wrench in a clockwise motion (looking up) until the torque wrench clicks.
3. Remove the chocks.

Table 8, U-Bolt Torque Values

Description	Size	Torque: lbf·ft (N·m) [1]
Spring Assembly U-Bolt High Nuts	5/8–18	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 180 (244) Stage 4: 200 to 230 (271 to 312)
	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 to 500 (571 to 680)

Description	Size	Torque: lbf·ft (N·m) [1]
	1–14	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 520 to 600 (707 to 816)

1. Tighten in the sequence shown in Fig.32,, page 68.

Table 8, U-Bolt Torque Values

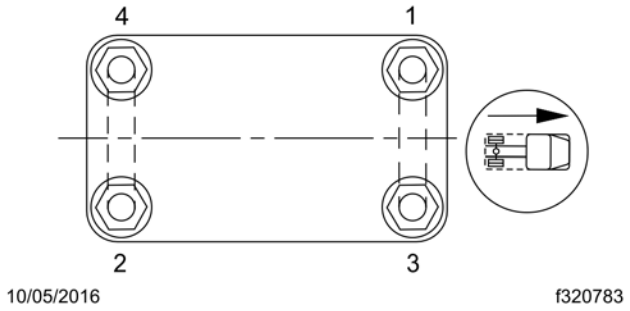


Fig 32, Tightening Sequence for U-Bolt High Nuts

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12. Front Axle

12.01 Safety Precautions

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

DANGER:

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

12.02 Cleaning, Inspecting, Repacking and Adjusting of the Grease-Lubricated Wheel Bearing, Front Axle

See of the **Walk-In Van Chassis Workshop Manual** for grease-lubricated wheel bearing service procedures, or take the vehicle to an authorized Freightliner dealer.

12.03 Lubricating the Knuckle Pin

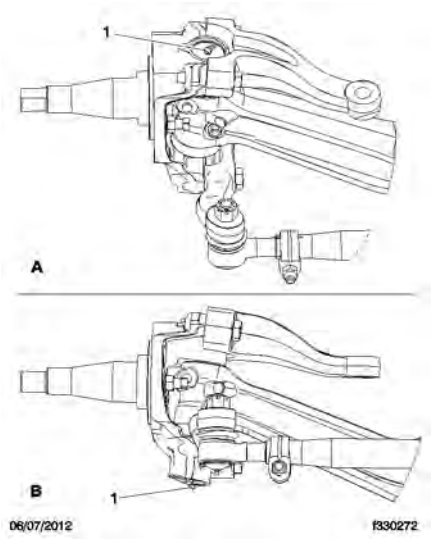
12.03.01 Detroit™ Axles

NOTICE:

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

On the front axle, grease fittings are on the top and bottom caps of each knuckle.

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 grease 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.33,Grease Fittings, Detroit Axles; for grease exit points, see Fig. 34,Knuckle Pin Grease Exit Points, Detroit Axles.



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

Fig 33, Grease Fittings, Detroit Axles

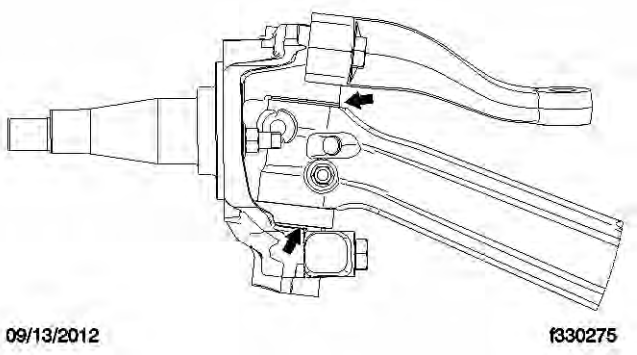
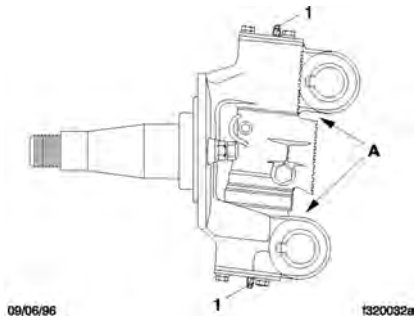


Fig 34, Knuckle Pin Grease Exit Points, Detroit Axles

12.03.02 Meritor Axles

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

Hold a pressure gun on each fitting until fresh grease appears. See Fig.35,Grease Fittings, Meritor Axle. This will ensure that all of the old contaminated grease has been forced out. It is not necessary to exceed 4000 psi (27 560 kPa). The best distribution of new lubricant and the best purging of old lubricant occurs when about 4000 psi (27 560 kPa) pressure is applied at the grease gun nozzle. Using a 40 to 1 booster, the air should be limited to 100 psi (689 kPa); using a 50 to 1 booster, the air should be limited to 80 psi (551 kPa). Higher or lower pressures are not recommended.



NOTE: Pump lubricant into each grease fitting until fresh grease comes out at A

Fig 35, Grease Fittings, Meritor Axle

When lubricating Meritor knuckle pin bushings **initially (5000 miles [8000 km])**, raise the front axle until the front tires are off of the ground. Wipe the lube fittings clean, and slowly feed multipurpose chassis grease (NLGI grade 1 or 2) into each bushing area while turning the wheels from extreme right to left and back again (lock-to-lock). This will eliminate small air pockets and improve grease distribution.

Lower the tires to the ground, and regrease both top and bottom bushings until new grease is seen at the seal on the bushing opposite the fittings.

NOTE: The grease seal will accept the grease pressure without damaging the seal, and is designed to have grease pumped out through it during lubrication. Even if grease leaks out around the top or bottom plate, continue pumping until new grease is seen at the seal on the bushing opposite the grease fitting.

When lubricating knuckle pin bushings at **indicated maintenance intervals**, do not raise the front axle. Wipe the lube fittings clean, and apply multipurpose chassis grease until new grease is seen at the grease seal on the bushing opposite the fittings.

12.04 Lubricating and Inspecting the Tie-Rod End

IMPORTANT: DOT roadside tie-rod assembly replacement criteria specifies that if tie-rod endplay is 1/8 inch (3 mm) or greater, measured on the road, the vehicle must be taken out of service immediately. If less than 1/8 inch (3 mm), the vehicle does not have to be taken out of service but a major out-of-service inspection and maintenance must be scheduled as soon as possible.

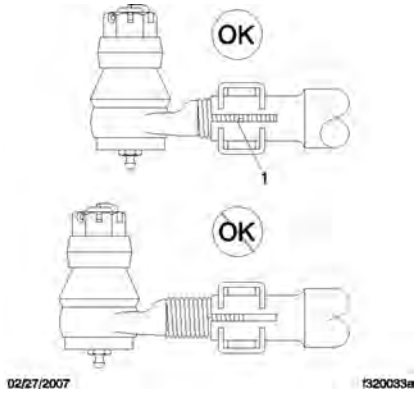
NOTICE:
If a power washer is used to clean the chassis in the area of the tie-rod ends, you must adjust the tie-rod end inspection and lubrication intervals. If the vehicle is power washed often, you must inspect and lubricate the tie-rod ends more frequently.

NOTE: Inspect the tie-rod end boots for cracks, wear, or damage. If a boot is cracked, worn, or damaged, replace the tie-rod assembly.

1. Wipe the tie-rod end grease fittings clean, then (for Detroit or Meritor axles) pump multipurpose chassis grease (NLGI grade 1 or 2) to the tie-rod ends until all used grease is forced out and new grease appears at the ball stud neck.
2. Inspect the tie-rod ends, as follows.

2.a Shake the cross-tube. Movement or looseness between the tapered shaft of the ball and the cross-tube socket members means that the tie-rod end assembly must be replaced.

2.b 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.36,Tie-Rod End Adjustment. Replace the parts if this cannot be done. For instructions, see the axle manufacturer's service manual.



IMPORTANT: The tie-rod end threads must be visible throughout the entire length of the split.

NOTE: Pinch bolt not shown to provide clarity.

1. Cross-Tube Split

Fig 36, Tie-Rod End Adjustment

2.c Check the tie-rod end nut and clamp nut torques. For Detroit axles, see Table 9,Detroit Axle Tie-Rod End Nut for tie-rod end nut torque specifications and Table 10,Detroit Axle Tie-Rod End Clamp Nut for tie-rod end clamp nut torque specifications. For Meritor axles, tighten the tie-rod end nut 100 lbf·ft (136 N·m), and tighten the clamp nut 40 to 55 lbf·ft (54 to 75 N·m).

Table 9, Detroit Axle Tie-Rod End Nut

Thread	Torque: lbf·ft (N·m)
5/8–16	60 to 115 (81 to 156)
5/8–18	60 to 115 (81 to 156)
3/4–16	90 to 170 (122 to 230)
7/8–14	160 to 300 (217 to 407)

Table 9, Detroit Axle Tie-Rod End Nut

Table 10, Detroit Axle Tie-Rod End Clamp Nut

Thread	Torque: lbf·ft (N·m)
1/2–13	35 to 45 (47 to 61)
5/8–11	40 to 60 (54 to 81)

5/8–18	50 to 64 (73 to 87)
3/4–10	155 to 175 (210 to 237)

Table 10, Detroit Axle Tie-Rod End Clamp Nut

12.05 Checking the All-Axle Alignment

12.05.01 Checking the Drive Axle Alignment

Check the axle alignment, parallelism, and thrust angle measurements for the rear drive axle. Use the applicable procedure and specifications, see of the **Walk-In Van Chassis Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.

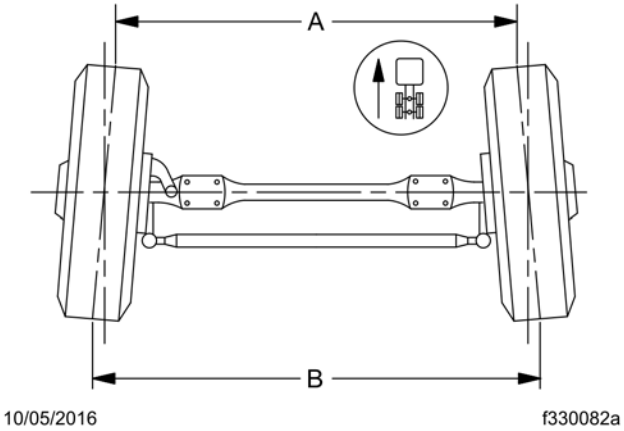
12.05.02 Inspection of the Toe-in

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

1. Apply the parking brakes, and chock the rear tires.
2. Raise the front of the vehicle until the tires clear the ground. Check that the safety stands will support the combined weight of the body, axle, and frame. Place safety stands under the axle.
3. Using spray paint or a piece of chalk, mark the entire center rib of each front tire.
4. Place a scribe or pointed instrument against the marked center rib of each tire, and turn the tires. Hold the scribe firmly in place so that a single straight line is scribed all the way around each front tire.
5. Place a turn-plate or turntable under both front tires. Remove the safety stands from underneath the axle, then lower the vehicle. Remove the lock-pins from the gauges; make sure that the tires are pointing straight ahead.

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

6. Place a trammel bar at the rear of the front tires; locate the trammel pointers at spindle height, and adjust the pointers to line up with the scribe lines on the center ribs of the front tires. See Fig.37,Wheel Toe-In (overhead view). Lock the pointers in place. Check that the scale is set to zero.



NOTE: B minus A equals toe-in.

Fig 37, Wheel Toe-In (overhead view)

7. Place the trammel bar at the front of the tires and adjust the scale end so that the pointers line up with the scribe lines. See Fig.38,Trammel Bar Positioning and Fig.39,Setting Trammel Bar Pointers.

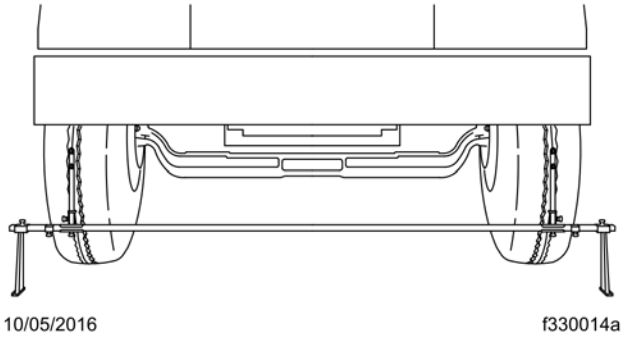


Fig 38, Trammel Bar Positioning

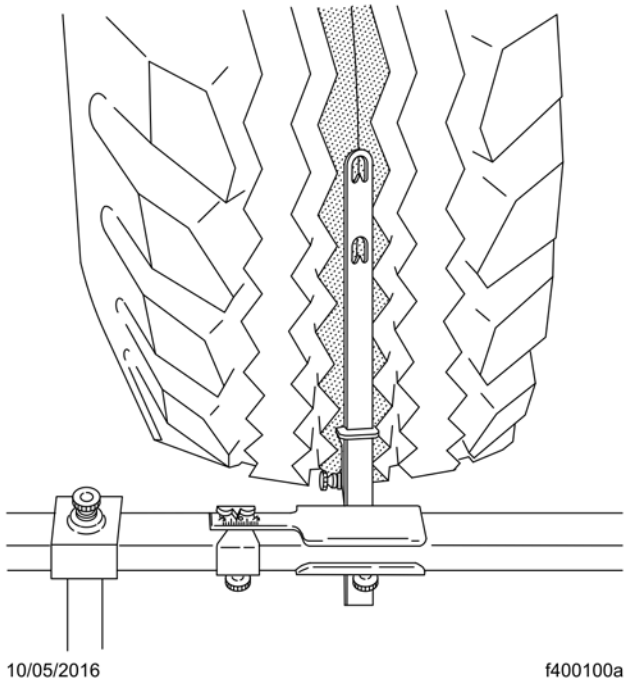


Fig 39, Setting Trammel Bar Pointers

8. Read the toe-in from the scale, and compare it to the toe-in specification, see of the **Walk-In Van Chassis Workshop Manual**, or take the vehicle to an authorized Freightliner dealer. If corrections are needed, see of the **Walk-In Van Chassis Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.

12.06 Checking the Oil-Filled Hubs Oil Level

WARNING:
Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.

1. With the vehicle on a level surface, rotate the front wheels and allow the oil in the hubs to settle.
2. Chock the tires.

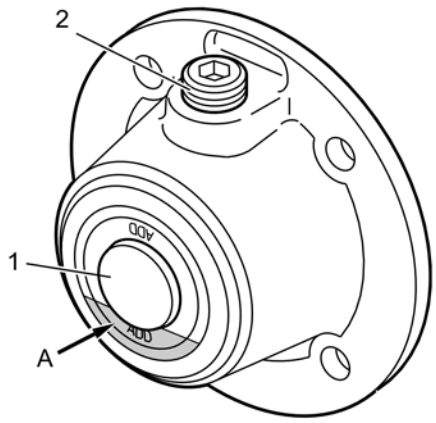
IMPORTANT: The oil level should be at, or no more than 1/4 inch (6 mm) above the level indicators on the hub caps.

3. If necessary, remove the filler caps (in the ends of the hub caps) and add enough oil (80W–90 hypoid gear oil) to bring the oil to the proper level.
4. Rotate the wheels, allow the oil to settle, and check the levels again.
5. Install the filler caps securely.
6. Remove the chocks from the tires.

12.07 Changing the Oil-Filled Hubs Oil

WARNING:
Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.

1. With the vehicle on a level surface, rotate the front wheels so that the front hub drain plugs are positioned downward.
2. Chock the tires.
3. Place suitable containers under the hubs, remove the filler caps (in the ends of the hub caps) and the drain plugs, and allow the hubs to drain completely. See Fig.40,Oil-Filled Hub Cap.



A. Hub Cavity Full
1. Fill Plug/Magnetic Drain
2. Drain Plug

Fig 40, Oil-Filled Hub Cap

4. Install the drain plugs and tighten 25 lbf·in (282 N·cm).
5. Add approximately 1 to 1-1/2 pints (0.5 to 0.7 L) of oil (80W–90 hypoid gear oil) to each hub.
6. Rotate the wheels, allow the oil to settle, and check the levels.

IMPORTANT: Fill the hubs to the level indicators on the hub caps, or to no more than 1/4 inch (6 mm) above the indicators. See Fig.40,, page 77.

7. Install the filler caps securely.

13.01 Safety Precautions 80
13.02 Changing the Axle Lubricant 80
13.02.01 Detroit Axle 80
13.02.02 Meritor Axle 83
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13.04 Checking the Axle Breather 86
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13.05.01 Draining of the Axle 87
13.05.02 Filling of the Axle 88

13. Rear Axle

13.01 Safety Precautions

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

DANGER:

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

13.02 Changing the Axle Lubricant

13.02.01 Detroit Axle

Draining of the Axle

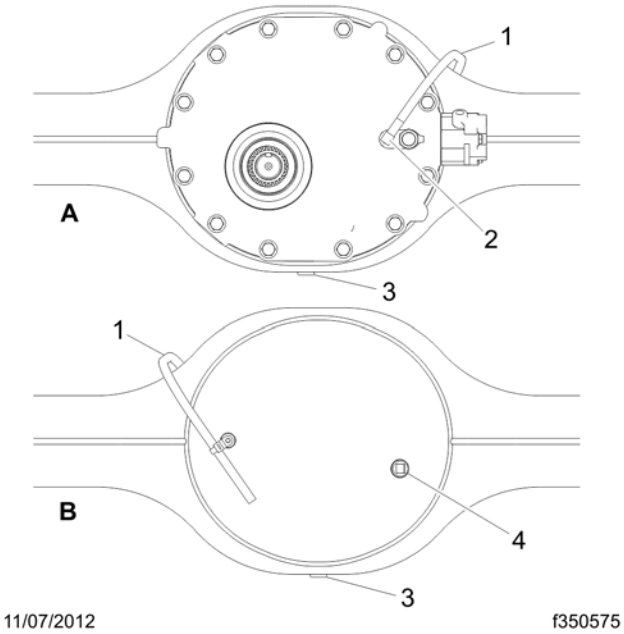
Procedures for Detroit™ and Meritor axles are provided below.

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. Remove the plug from the oil fill hole. See Fig. 41,Component Locations, Detroit Axle.

CAUTION:

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

3. Remove the plug at the bottom of the housing and drain the lubricant while the unit is warm. Allow enough time for all the old lubricant to drain completely.
4. Clean the drain plug. For magnetic drain plugs, a piece of key stock or any other convenient steel slug may be used to short the two magnetic poles and divert the magnetic field.



A. Front View
B. Rear View
1. Breather Hose
2. Axle Housing Breather
3. Oil Drain Plug
4. Oil Fill Plug

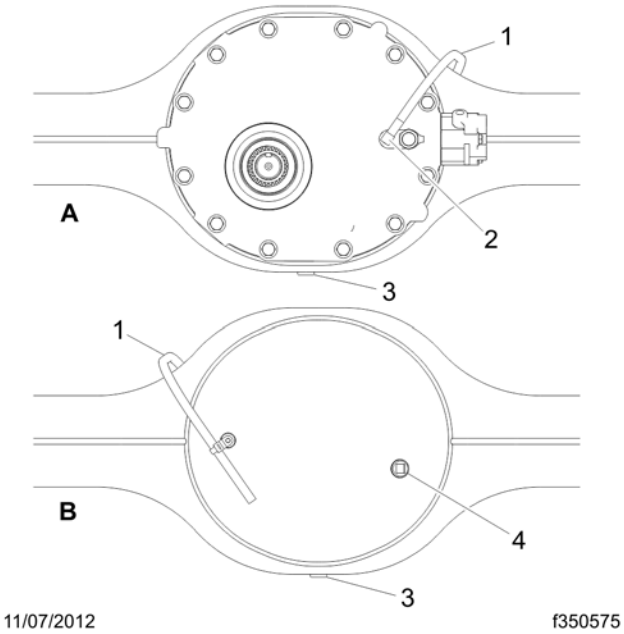
Fig 41, Component Locations, Detroit Axle

5. After cleaning the drain plug, install and tighten the plug 30 lbf·ft (41 N·m).

Filling the Axle

Procedures for Detroit™ and Meritor axles are provided below.

1. With the vehicle on a level surface, fill the axle housings to the bottom of the oil fill hole (in the carrier or housing) with recommended lubricant; see Table11,Detroit Drive Axle Lubricants. Refer to Table.12,Detroit Drive Axle Lubricant Capacities for Detroit drive axle lubricant capacities.
2. Install the fill hole plug and tighten it 30 lbf·ft (41 N·m).
3. After filling the carrier and housing assembly with lubricant, drive the vehicle unloaded for one or two miles (two or three kilometers) at speeds not to exceed 25 mph (40 km/h) to thoroughly circulate the lubricant throughout the assembly.



A. Front View
B. Rear View
1. Breather Hose
2. Axle Housing Breather
3. Oil Drain Plug
4. Oil Fill Plug

Fig 42, Component Locations, Detroit Axle

IMPORTANT: Lubricant used in Detroit rear axles must meet Mercedes-Benz specification 235.20 (mineral) or 235.8 (synthetic). Mobil Delvac™ Gear Oil A 80W-90 and Mobilube™ HD-A Plus 80W-90 meet specification 235.20. Mobil Delvac 1 Gear Oil 75W-90 and Mobilube 1 SHC 75W-90 meet specification 235.8.

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

Table 11, Detroit Drive Axle Lubricants

Type	Ambient Temperature	SAE Viscosity Grade
Mineral Oil	–15°F (–26.1°C) and up [1]	80W–90
Synthetic Oil	–40°F (–40°C) and up [2]	75W–90

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

Table 11, Detroit Drive Axle Lubricants

Table 12, Detroit Drive Axle Lubricant Capacities

Axle Model [1]	Capacity [2]: pints (L)
ARS–13.0–2	15 (7)
ARS–15.0–2	15 (7)

Axle Model [1]	Capacity [2]: pints (L)
ARS–17.5–2	15 (7)
ARS–19.0–2	15 (7)
ARS–20.0–2	15 (7)
ARS–21.0–2	15 (7)
ARS–21.0–4	23 (11)
ARS–23.0–4	23 (11)

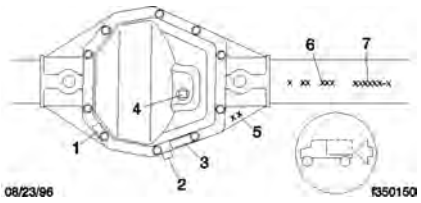
1. Model code may have a "D" in the prefix (for example, DA–RS–13.0–2).
2. Quantities listed are approximate and include 1 pint (0.5 liter) for each wheel end and with the drive pinion at 3 degrees.

Table 12, Detroit Drive Axle Lubricant Capacities

13.02.02 Meritor Axle

Procedures for Detroit™ and Meritor axles are provided below.

1. Remove the filler plug, then the drain plug and allow the differential to drain completely. See Fig. 43,Rear Axle Differential, Meritor Axle.



1. Ratio Tag
2. Drain Plug
3. Limited Slip Lubrication Tag
4. Filler Plug
5. Model Number
6. Axle Housing Breather
7. Manufacturing Date
8. Part Number

Fig 43, Rear Axle Differential, Meritor Axle

2. Install and tighten the drain plug securely.
3. Fill the differential with an SAE 80W–90 multipurpose gear lubricant, or an SAE 75W–90 multipurpose synthetic gear lubricant. See Table.13,Meritor Drive Axle Lubricant Capacities (single axle) for axle lubricant capacities. Either type of lubricant must meet MIL L–2105–D and be suitable for American Petroleum Institute service classification GL–5. The lubricant levelwithin the differential must be even with the bottom of the fill hole.
4. Install and tighten the fill plug securely.

NOTE: Single drive axles equipped with traction equalizers may require a "friction modifier" to correct a slip-stick condition, as described in the vehicle driver's manual. Meritor's experience shows that the following additives perform adequately: Add Elco No. 2 Friction Modifier (1 ounce [30 ml] of additive for each 1 pint [0.5 liter] of lube capacity) or Lubrizol No. 797 or 762 (one ounce [30 mL] of additive for each 1 pint [0.5 liter] of lube capacity).

Table 13, Meritor Drive Axle Lubricant Capacities (single axle)

Axle Model	Capacity [1]: pints (L)
RS-15-120	16 (7.6)
RS-17-145	33.6 (15.9)
RS-19-145	34.4 (16.3)
RS-21-145	32 (15.1)
RS-23-160	42 (19.9)
RC-23-165	42 (19.9)

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

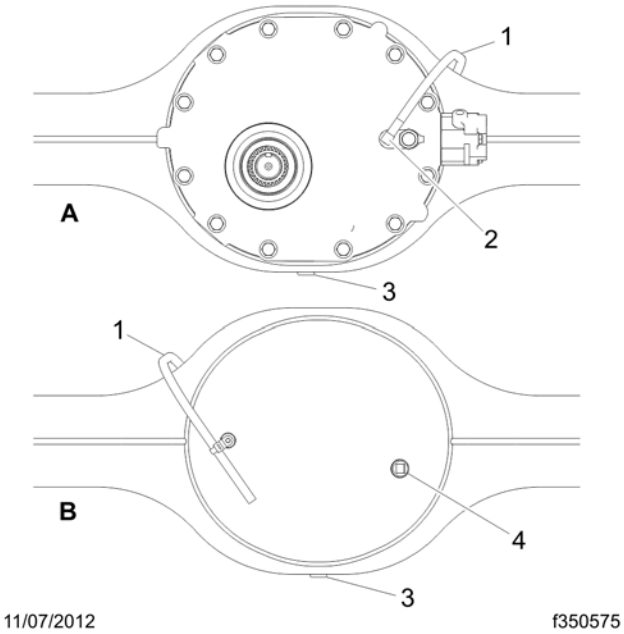
Table 13, Meritor Drive Axle Lubricant Capacities (single axle)

13.03 Checking the Axle Lubricant

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

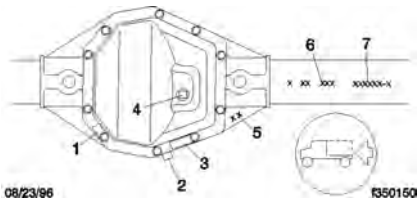
NOTE: If the vehicle is exposed to water deep enough to cover the hubs, disassemble and inspect them for water damage and/or contamination. See of the **Walk-In Van Chassis Workshop Manual** for instructions, or take the vehicle to an authorized Freightliner dealer.

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. See Fig.44,Component Locations, Detroit Axle for a Detroit axle, or Fig.45,Rear Axle Differential, Meritor Axle for a Meritor axle.



A. Front View
B. Rear View
1. Breather Hose
2. Axle Housing Breather
3. Oil Drain Plug
4. Oil Fill Plug

Fig 44, Component Locations, Detroit Axle



1. Ratio Tag
2. Drain Plug
3. Limited Slip Lubrication Tag
4. Filler Plug
5. Model Number
6. Axle Housing Breather
7. Manufacturing Date
8. Part Number

Fig 45, Rear Axle Differential, Meritor Axle

4. Check that the lubricant is level with the bottom of the fill hole. See Fig.46, Axle Lubricant Level Inspection. If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug. For a Detroit axle, use the lubricant recommended in Table.14,Detroit Drive Axle Lubricants.

   For a Meritor axle, add SAE 80W-90 multipurpose gear lubricant, or an SAE 75W-90 multipurpose synthetic gear lubricant. Either type of lubricant must meet MIL L-2105-D and be suitable for American Petroleum Institute service classification GL-5.

   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 the oil fill plug and tighten it 30 lbf·ft (41 N·m) for Detroit axles or 35 lbf·ft (47 N·m) for Meritor axles.

IMPORTANT: Lubricant used in Detroit rear axles must meet Mercedes-Benz specification 235.20 (mineral) or 235.8 (synthetic). Mobil Delvac™ Gear Oil A 80W-90 and Mobilube™ HD-A Plus 80W-90 meet specification 235.20. Mobil Delvac 1 Gear Oil 75W-90 and Mobilube 1 SHC 75W-90 meet specification 235.8.

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

Table 14, Detroit Drive Axle Lubricants

Type	Ambient Temperature	SAE Viscosity Grade
Mineral Oil	–15°F (–26.1°C) and up [1]	80W–90
Synthetic Oil	–40°F (–40°C) and up [2]	75W–90

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

Table 14, Detroit Drive Axle Lubricants

6. Inspect the axle for signs of leakage. If leakage is indicated and the lubricant level is down, have your dealer perform any necessary maintenance.

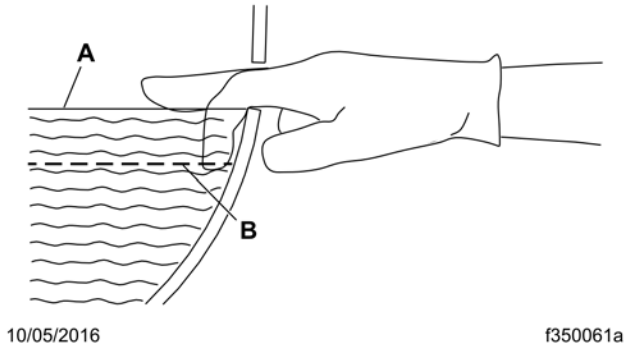
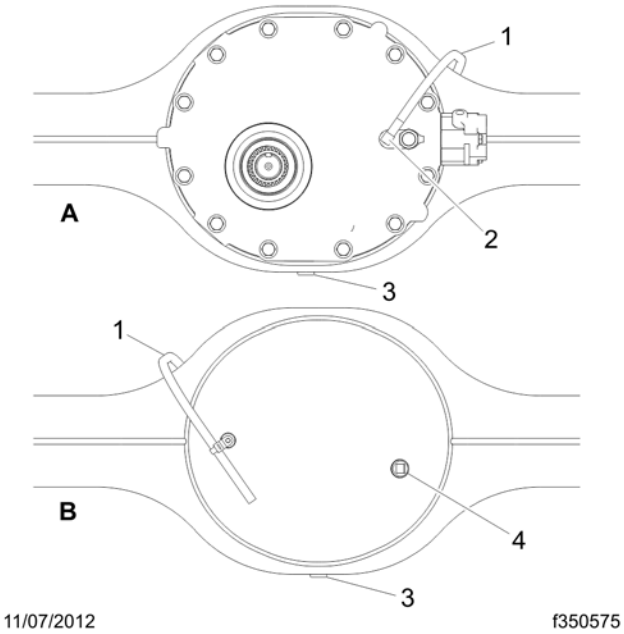


Fig 46, Axle Lubricant Level Inspection

13.04 Checking the Axle Breather

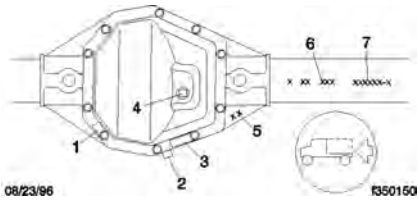
NOTE: For component locations, see Fig.47,Component Locations, Detroit Axle for a Detroit axle or Fig. 48,Rear Axle Differential, Meritor Axle for a Meritor axle.

The axle housing breather must remain unobstructed. Whenever the axle lubricant level is checked, also check that the axle breather is open. Check more often under poor operating conditions. If the breather is plugged, clean or replace it as needed.



A. Front View
B. Rear View
1. Breather Hose
2. Axle Housing Breather
3. Oil Drain Plug
4. Oil Fill Plug

Fig 47, Component Locations, Detroit Axle



1. Ratio Tag
2. Drain Plug
3. Limited Slip Lubrication Tag
4. Filler Plug
5. Model Number
6. Axle Housing Breather
7. Manufacturing Date
8. Part Number

Fig 48, Rear Axle Differential, Meritor Axle

13.05 Changing the Dana eAxle Lubricant

13.05.01 Draining of the Axle

1. Park the vehicle on a level surface, put the transmission in neutral, shut down the motor, and set the parking brake. Chock the tires.

   NOTE: Drain the drive axle lubricant at normal operating temperature. The lubricant will run freely and minimize the time necessary to fully drain the axle; this ensures the axle is flushed.

2. Place a drain pan under the axle, then remove the drain plug from the bottom of the drive axle housing to allow the lubricant to drain. See Fig.49,Drive Axle Drain Plug.



1. Drain Plug

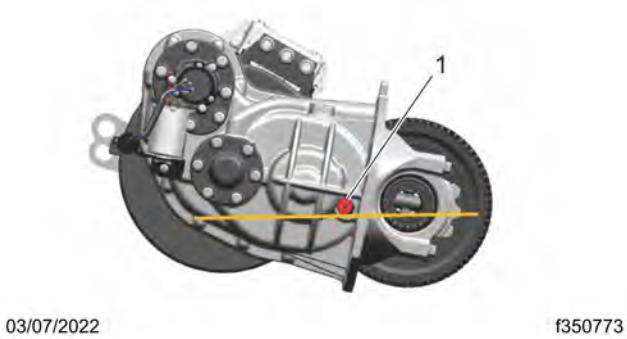
Fig 49, Drive Axle Drain Plug

3. After the initial lubricant change, inspect the drain plug for large amounts of metal particles. Metal particles may be a sign of damage or extreme wear in the axle. Clean and install the drain plug after the axle has completely drained.

   Dispose the lubricant properly, following appropriate environmental rules and regulations.

13.05.02 Filling of the Axle

1. Remove the fill plug from the drive axle rear cover or the side of the carrier assembly, depending on the axle model.
2. Fill the drive axle with lubricant until the level is even with the bottom of the fill hole, as shown in Fig. 50,Drive Axle Fill Plug.
3. Install the fill plug.



1. Drive Axle Fill Plug

Fig 50, Drive Axle Fill Plug

14.01 Checking the Wheel Nut 90

14. Wheels and Tires

14.01 Checking the Wheel Nut

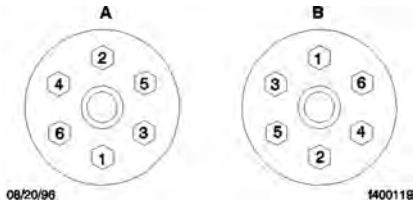
IMPORTANT: In addition to the maintenance interval in this manual, check the wheel nut torque the first 50 to 100 miles (80 to 160 km) of operation after a wheel has been removed and installed.

NOTE: For all stud-piloted wheels, on each wheel stud, the end that faces away from the vehicle is stamped with an "L" or "R," depending on which side of the vehicle the stud is installed. Studs stamped with an "L" are left-hand threaded and are installed on the driver's side of the vehicle. Studs stamped with an "R" are right-hand threaded and are installed on the passenger's side of the vehicle.

For all stud-piloted wheels, when checking wheel nuts on a dual disc assembly, remove one outer nut at a time, tighten the inner nut, then reinstall the outer nut. Repeat this procedure for all of the inner wheel nuts in the sequence shown in Fig. 51,Wheel Nut Tightening Sequence (stud-piloted 6-stud wheels), then tighten all of the outer wheel nuts in the same sequence.

CAUTION:
Too little wheel nut torque can cause wheel shimmy, resulting in wheel damage, stud breakage, and extreme tire tread wear. Too much wheel nut torque can break studs, damage threads, and crack discs in the stud hole area.

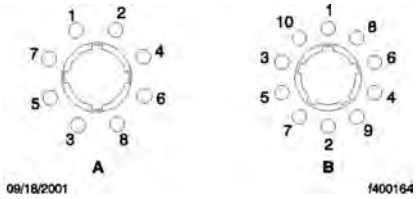
Tighten the wheel nuts 450 to 500 lbf·ft (610 to 680 N·m), and see Fig. 51,Wheel Nut Tightening Sequence (stud-piloted 6-stud wheels) for the tightening sequence of stud-piloted, 6-stud wheels.



A. Front and Inner Rear Dual B. Outer Rear Dual

Fig 51, Wheel Nut Tightening Sequence (stud-piloted 6-stud wheels)

For hub piloted, 8- and 10- stud wheels, torque values vary with the stud size; consult the wheel manufacturer for recommended torque values. See Fig.52,Wheel Nut Tightening Sequence (8- and 10-stud hub-mounted wheels) for the tightening sequence of hub-piloted, 8- and 10-stud wheels. Before tightening, apply 2 drops of SAE 30W oil to a point between the nuts and flanges.



A. 8-Stud Disc Wheel B. 10-Stud Disc Wheel

Fig 52, Wheel Nut Tightening Sequence (8- and 10-stud hub-mounted wheels)

15.01 Safety Precautions 92
15.02 Inspection and Lubrication of the Driveline 92
15.02.01 Inspection of the Driveline 92
15.02.02 Lubrication of the U-Joint 92
15.02.03 Lubrication of the Slip-Joint Spline 93

15. Driveline

15.01 Safety Precautions

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

DANGER:

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

15.02 Inspection and Lubrication of the Driveline

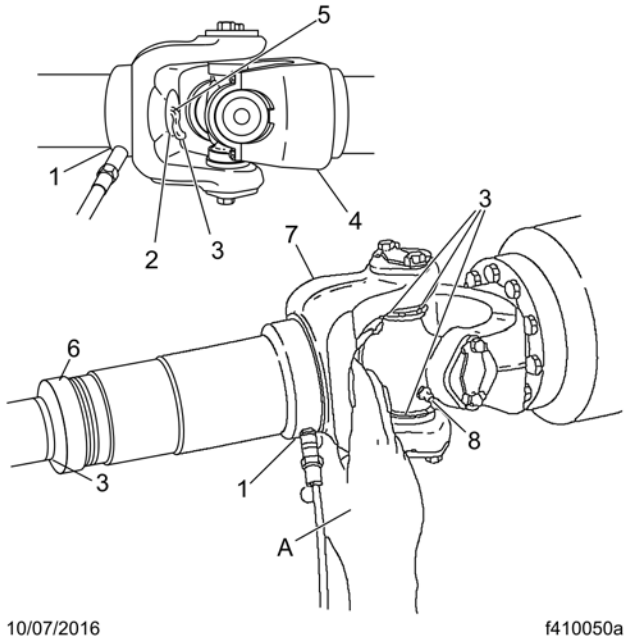
15.02.01 Inspection of the Driveline

Before lubricating the driveline U-joints and slip-joints, make the following checks.

1. Check that the yoke-strap capscrews are tightened 50 to 60 lbf·ft (68 to 81 N·m).
2. Check the slip-joints for spline wear by trying to bend the sleeve-yoke and splined shaft back and forth. If looseness is greater than 0.007 inch (0.18 mm), replace both the sleeve-yoke and the splined shaft.
3. Check the driveshaft for missing balance weights, and for debris buildup. Remove any buildup. If any balance weights are missing, remove the driveshaft and have it balanced. For instructions, see of the vehicle **Workshop Manual** , or take the vehicle to an authorized Freightliner dealer.
4. Check that the yoke plug is not loose or missing. Replace the yoke plug if needed. If the yoke plug is missing, the splined shaft may be hitting the yoke plug and knocking it out; check the driveshaft for proper length.

15.02.02 Lubrication of the U-Joint

1. Wipe all old grease and dirt from each U-joint grease fitting.
2. Use a hand-type grease gun, or a high-pressure gun with a low-pressure adaptor, to lubricate the U-joints. See Fig. 53,Slip-Joint and U-Joint Lubricating.



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 53, Slip-Joint and U-Joint Lubricating

NOTE: If a low-pressure adaptor is not used with the high-pressure gun, the U-joints may not receive enough lubricant.

3. Using lithium 12-hydroxy stearate grease (NLGI grade 1 or 2, with EP additives), lubricate until new grease can be seen at all four U-joint seals.

NOTICE:

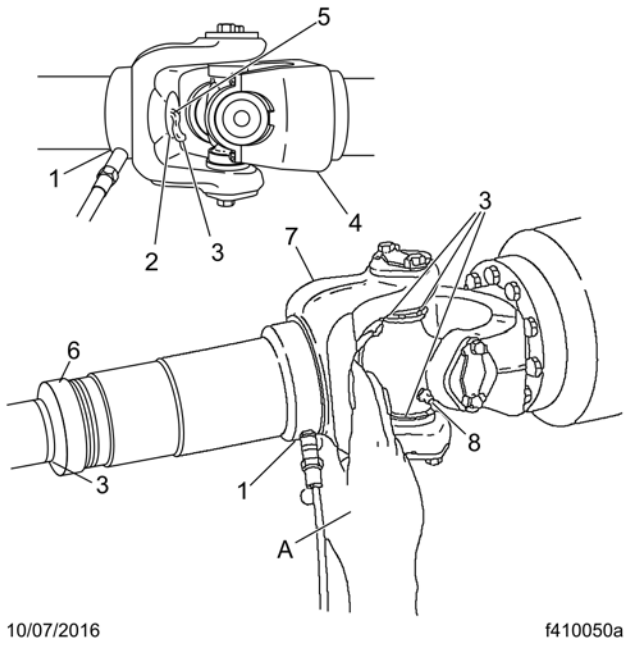
Fresh lubricant must be seen escaping from ***all four*** **of the bearing cup seals of each U-joint. If not, the U-joint may fail prematurely.**

4. If the bearing will not take grease, replace the U-joint assembly. For instructions, see of the vehicle **Workshop Manual** , or take the vehicle to an authorized Freightliner dealer.
5. Check the old grease. If it appears rusty, gritty, or burned, replace the U-joint assembly. For instructions, see of the vehicle **Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.
6. Wipe any excess grease from the seals and grease fittings.

15.02.03 Lubrication of the Slip-Joint Spline

1. Wipe all old grease and dirt from the slip-joint grease fitting.

2. Use a hand-type grease gun or a high-pressure gun with a low-pressure adaptor, to lubricate the slip-joint. Using lithium 12-hydroxy stearate grease (NLGI grade 1 or 2, with EP additives), lubricate until fresh grease appears at the pressure-relief hole in the yoke plug. Then cover the relief hole with your finger, as shown in Fig. 54,Slip-Joint and U-Joint Lubricating, while continuing to lubricate until fresh grease appears at the slip-joint seal. This ensures complete lubrication of the splines.



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 54, Slip-Joint and U-Joint Lubricating

3. Wipe any excess grease from the pressure-relief hole, slip-joint seal, and grease fitting.

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16. Brakes

16.01 Safety Precautions

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

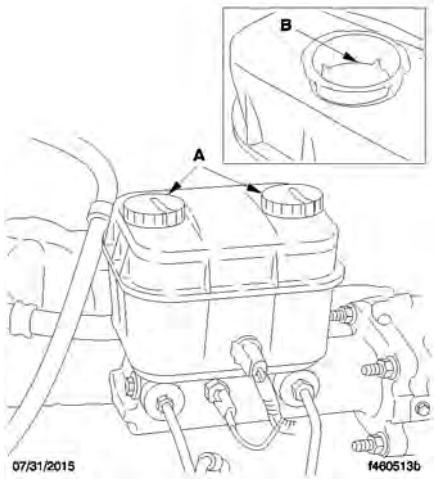
DANGER:

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

16.02 Inspection of the Bendix Hydro-Max® Brake System

NOTE: If possible, remove both caps when filling the reservoir. If only one cap can be removed, allow ample time for the reservoir to fill.

1. Check the fluid level in the hydraulic brake fluid reservoir. If needed, fill the reservoir up to the ridge that surrounds the reservoir. See Fig.55,Hydraulic Brake Fluid Reservoir. Use only heavy-duty brake fluid, DOT 3.



A. Open caps and check fluid level.
B. Fill to this level.

Fig 55, Hydraulic Brake Fluid Reservoir

2. Check all hydraulic lines and fittings for damage, leakage, or looseness.

   Replace damaged or leaking components, and tighten loose fittings.

3. Check the brake module for leaks. If leaks are found, repair or replace the brake module. See of the **Walk-In Van Chassis Workshop Manual** for replacement instructions, or take the vehicle to an authorized Freightliner dealer.
4. Check the electrical connections and harnesses. Make sure the connectors are fully seated and the harnesses are not chafed or cut. Repair or replace any damaged harness. Disconnect any loose connectors and inspect the terminals for corrosion. If corrosion is present, replace the terminals. If corrosion is not present, reconnect the connector.
5. Check the operation of the Hydro-Max brake booster, as follows.

   5.a With the ignition off, depress the brake pedal; listen for the back-up motor to engage. The operator should feel the pedal force relieve and the pedal should depress easily.

5.b With the ignition on, engine running, and park brake released; operator checks that the BRAKE warning indicator is not on. This is a dual indicator, and it indicates that the park brake is set, and it warns if there is a hydro-max failure condition other than loss of back-up motor power.

6. Check the fuse for the hydraulic brake booster pump, as follows.
   - 6.a Open the cover to the main power distribution module (Pmm).
   - 6.b Pull the fuse in position F6 for the Hydro-Max relay.
   - 6.c Inspect the relay to make sure the fuse is not damaged. If the fuse is damaged, install a new fuse. If the fuse is not damaged, install the fuse in position F6.
   - 6.d Close the Pmm cover.

16.03 Brake Lines Check, Hydraulic Disc Brakes

Check all hydraulic lines and fittings for damage, leakage, or looseness.

Replace damaged or leaking components, and tighten loose fittings.

16.04 Brake Lining Wear Check, Hydraulic Disc Brakes

Before checking lining wear with the wheel removed, review the following brake lining exposure warnings.



WARNING:

Breathing brake lining dust (asbestos or non-asbestos) could cause lung cancer or lung disease. Unless exposure can be reduced below legal limits, wear an air purifying respirator approved by MSHA or NIOSH at all times when servicing the brakes, starting with removal of the wheels and continuing through assembly.

To minimize the possibility of creating airborne brake lining dust, clean the dust from the brake rotor, brake caliper, and brake assembly, using an industrial-type vacuum cleaner equipped with a high-efficiency filter system. Then, using a rag soaked in water and wrung until nearly dry, remove any remaining dust. Do not use compressed air or dry brushing to clean the brake assembly.

1. Check lining wear.
   - 1.a Apply the parking brake and chock the tires to prevent vehicle movement.
   - 1.b On front and rear axles, replace linings worn to less than 3/16 inch (4.8 mm).
   - 1.c Make sure that the brake rotor and linings are free of oil and grease.
2. If the wheel and hub assembly is removed from the axle, check lining wear. Replace the linings on all brake assemblies if worn to less than 3/16 inch (4.8 mm) at the thinnest point.

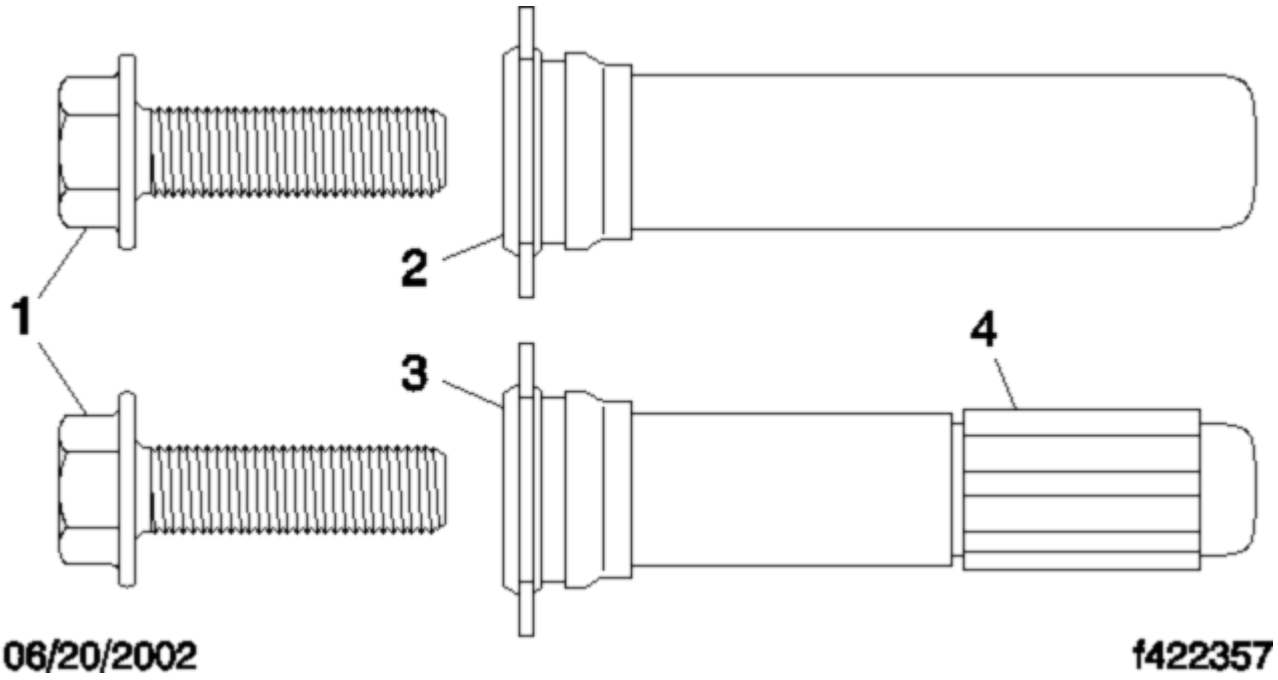
NOTE: To replace the brake linings, see the applicable foundation brake section, see of the **Walk-In Van Chassis Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.

16.05 Brake Caliper Slide Pin Lubrication, Bosch Brakes

NOTE: There is no set maintenance interval for lubricating pin-slide hydraulic disc brake calipers.

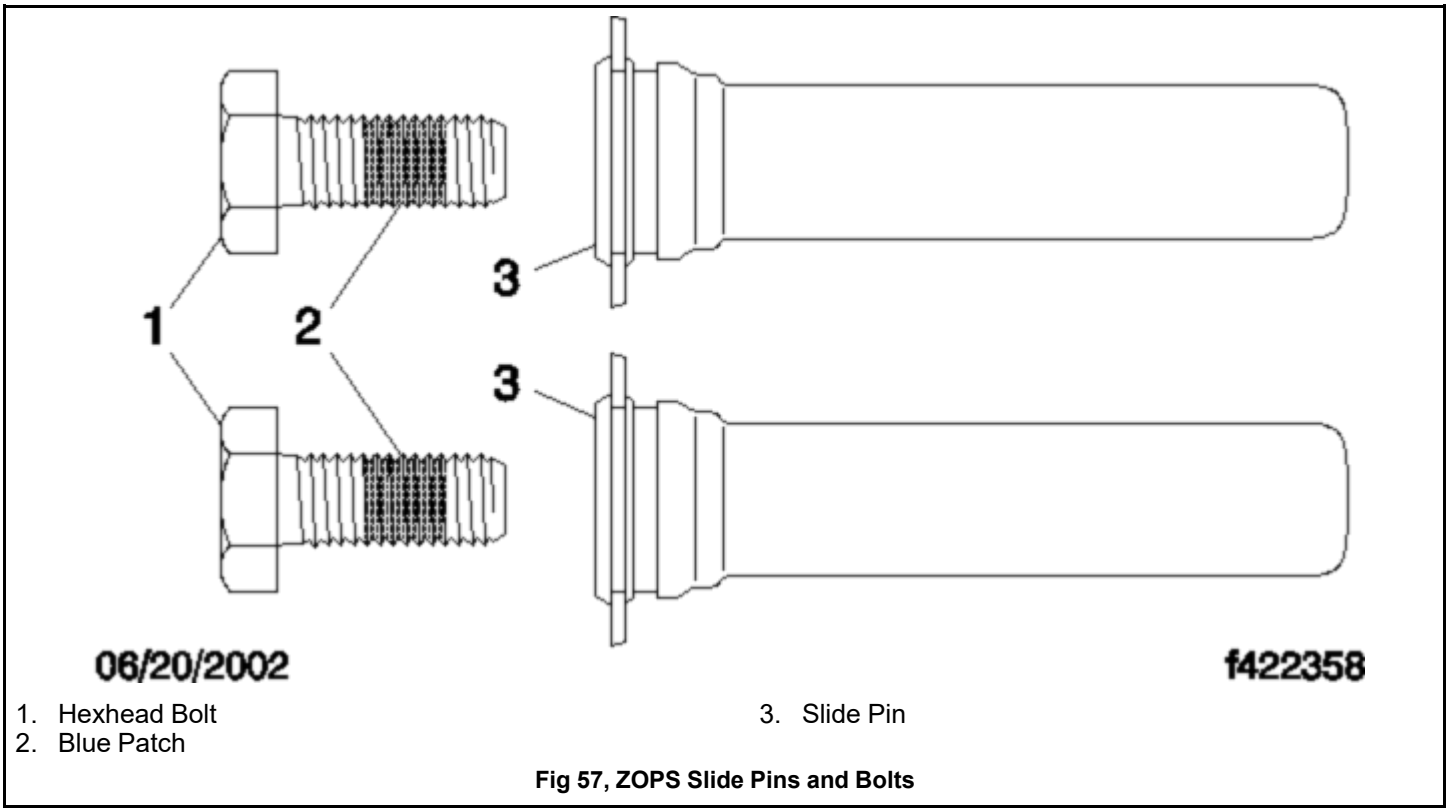
Apply 1/8 oz (3.5 g) Aeroshell grade 5 grease to each of the two guide pin and guide pin bore sets. See the **Bosch Pin Slide Disc Brakes Service Manual** for additional information.

IMPORTANT: The later ZOH-T caliper has important differences from the early ZOPS caliper. ZOPS calipers (since 1998) and ZOH-T calipers (since 2002) use different slide pins and bolts. See Fig.56,ZOH-T Slide Pins and Bolts and Fig. 57,ZOPS Slide Pins and Bolts. The later trailing pin is identified by notches and has a rubber bushing. Flange-head instead of hex-head bolts are used with the later caliper. The later bolts have a fine thread rather than a coarse thread pitch, are longer, differently colored, and are tightened to a higher torque specification. Use only the ZOH-T bolts to assemble a ZOH-T caliper. The ZOPS caliper bolts have a different thread pitch and will not assemble correctly in a ZOH-T caliper mounting. Also, the ZOH-T bolts will not assemble correctly in a ZOPS caliper. **Do not interchange parts**. It is permissible to use both ZOH-T pins and ZOH-T bolts in a ZOPS anchor plate, but they must be replaced as sets. Both the pins and the bolts must be changed.



1. Flange-Head Bolt
2. Leading Pin
3. Trailing Pin
4. Rubber Bushing

Fig 56, ZOH-T Slide Pins and Bolts



1. Hexhead Bolt
2. Blue Patch
3. Slide Pin

Fig 57, ZOPS Slide Pins and Bolts

DANGER:

The correct pins, bolts, and bolt torque must be used. If not, brake function could be impaired and lead to loss of control of the vehicle, which could result in personal injury, death, or property damage.

IMPORTANT: The ZOH-T caliper assembly is similar in appearance to the existing ZOPS caliper. The only obvious difference is that one of the anchor plate slide pins (trailing side) has notches for identification. With ZOH-T calipers, install the solid pin (no bushing) only in the anchor plate leading hole position. Install the pin with the rubber bushing and notches only in the anchor plate trailing hole position. Tighten the leading-side pin first, then tighten the trailing-side pin.

Tighten ZOH-T bolts 93 to 107 lbf·ft (126 to 145 N·m). Tighten ZOPS bolts 70 to 80 lbf·ft (95 to 108 N·m).

16.06 Inspection of the Brake

16.06.01 Pneumatic (Air) Parking Brake Operational Check

IMPORTANT: This procedure should be performed prior to lubrication of the brake components. If the brakes must be repaired, or they require adjustment, see of the **Walk-In Van Chassis Workshop Manual** for repair, adjustment, and troubleshooting procedures. Or take the vehicle to an authorized Freightliner dealer.

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

1. With the engine running, and air pressure at cut-out pressure, set the parking brake.
2. Put the vehicle in the lowest gear and gently attempt to move it forward. The vehicle should not move. If the vehicle moves, the parking brakes are not operating correctly and must be repaired before the vehicle is returned to service.

16.06.02 Inspection of the Mechanical Parking Brake Component

IMPORTANT: This procedure should be performed prior to lubrication of the brake components. If the brakes must be repaired, or they require adjustment, see of the **Walk-In Van Chassis Workshop Manual** for repair, adjustment, and troubleshooting procedures. Or take the vehicle to an authorized Freightliner dealer.

1. Park the vehicle on a level surface, set the parking brake, and chock the tires. Once the tires are chocked, release the parking brake.
2. If more than 3/4 of the available travel of the parking brake is required to hold the vehicle, the parking brake lining should be checked and, if needed, repaired by an authorized Freightliner dealer.
3. Inspect the parking brake shoes for lining wear. If thickness of any lining material is worn to within 0.030 inch (0.79 mm) of the shoe table at the thinnest place, replace both of the shoe and lining assemblies.
4. Inspect the park brake cable from the hand lever to the brake drum (ICE) or wheel ends (EV), and ensure there is adequate clearance to all surrounding components.

16.06.03 Inspection of the Brake Component

Air Disc Brakes

IMPORTANT: This procedure should be performed prior to lubrication of the brake components. If the brakes must be repaired, or they require adjustment, see of the **Walk-In Van Chassis Workshop Manual** for repair, adjustment, and troubleshooting procedures. Or take the vehicle to an authorized Freightliner dealer.

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

Axial Mounted Brakes

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

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Raise the vehicle and support it on jack stands.
3. Remove all of the wheel assemblies. For instructions, see of the **Walk-In Van Chassis Workshop Manual**.

NOTE: In all steps that require a torque wrench, use a Snap On torque wrench ATECH4RS600, or an equivalent, with a center to handle length of 47 inches (119 cm).

4. Set a torque wrench to 350 lbf·ft (475 N·m) and tighten the caliper mounting bolts following the tightening pattern shown in Fig.58,Axial Bolt Tightening Pattern. If they do not turn, no further work is needed. If they turn, take the vehicle to an authorized Freightliner dealer to have all of the caliper bolts on that wheel end replaced. Due to limited caliper bolt access, it may be necessary to use tool DDC DSNCHA018005 referenced in tool letter 18TL18. If the tool is needed, use tool DDC DSNCHA018005 only and no other tools. See Fig. 59,DDC DSNCHA018005 30mm Air Disc Brake Caliper Brake Bolt Torque Adaptor. If the tool is needed, see Table.15,Torque Check with 47 Inch (119 cm) Torque Wrench and Tool DDC DSNCHA018005 for torque specifications for a 47 in (119 cm) long wrench.

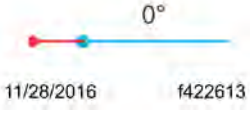


Fig 58, Axial Bolt Tightening Pattern



Fig 59, DDC DSNCHA018005 30mm Air Disc Brake Caliper Brake Bolt Torque Adaptor

Table 15, Torque Check with 47 Inch (119 cm) Torque Wrench and Tool DDC DSNCHA018005

Torque Check with 47 Inch (119 cm) Torque Wrench and Tool DDC DSNCHA018005			
Angle View	**Extension Angle (degrees)**	**Target Torque ~~*~lbf·ft (N·m)]**	**Tool Setting ~~*~lbf·ft (N·m)]**
	0	350 (475)	296 (401)

	45		310 (420)
	60		320 (434)
	90		350 (475)
	120		386 (523)
	135		402 (545)

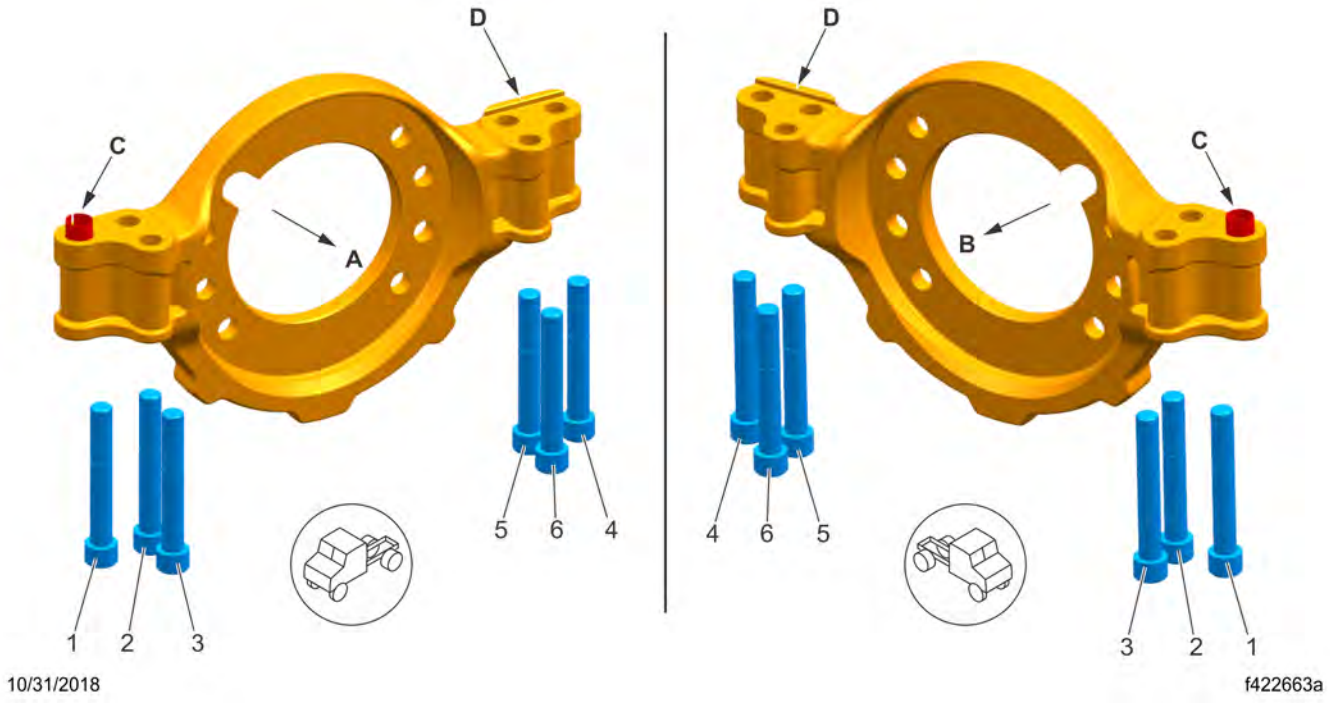
Table 15, Torque Check with 47 Inch (119 cm) Torque Wrench and Tool DDC DSNCHA018005

5. Install the wheel assemblies. For instructions, see of the **Walk-In Van Chassis Workshop Manual**.
6. Remove the jack stands and lower the vehicle.

Radial Mounted Brakes

Bendix Calipers

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Raise the vehicle and support it on jack stands.
3. Remove all of the wheel assemblies. For instructions, see of the **Walk-In Van Chassis Workshop Manual**.
4. Set a torque wrench to 200 lbf·ft (271 N·m) and tighten the caliper mounting bolts following the tightening pattern shown in Fig.60,Bendix Radial Mounted Caliper Tightening Pattern (viewed from below). If they do not turn, no further work is needed. If they turn, take the vehicle to an authorized Freightliner dealer to have all of the caliper bolts on that wheel end replaced.



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

Fig 60, Bendix Radial Mounted Caliper Tightening Pattern (viewed from below)

5. Install the wheel assemblies. For instructions, see of the **Walk-In Van Chassis Workshop Manual**.
6. Remove the jack stands and lower the vehicle.

Drum Brakes

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

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

2. With the engine off, and 100 psi (690 kPa) of air tank pressure, have an assistant apply and hold an 80 to 90 psi (552 to 621 kPa) brake application.
3. Check to see if the colored over-stroke band on each brake chamber pushrod is exposed.

   If a band shows, the stroke is too long. Check the foundation brake components for wear or damage, and repair as needed.

4. Measure the applied chamber stroke. See Table.16,Brake Chamber Stroke Specifications for the proper stroke for the type of chamber being used. If the stroke is too short, the brakes may drag or will not fully apply. Check for improper operation or adjustment of the automatic slack adjuster.
5. Start the engine and build air pressure to at least 100 psi (689 kPa). Shut down the engine.
6. Check all of the foundation brake components for damage, wear, and loose or missing parts. Repair as needed.

Table 16, Brake Chamber Stroke Specifications

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

1. Long stroke design is indicated by a tag, or embossing, on the brake chamber.
2. Specifications are relative to a brake application with 80 to 90 psi (550 to 620 kPa) air pressure in the brake chambers.

Table 16, Brake Chamber Stroke Specifications

16.07 Lubrication of the Slack Adjuster

16.07.01 Meritor

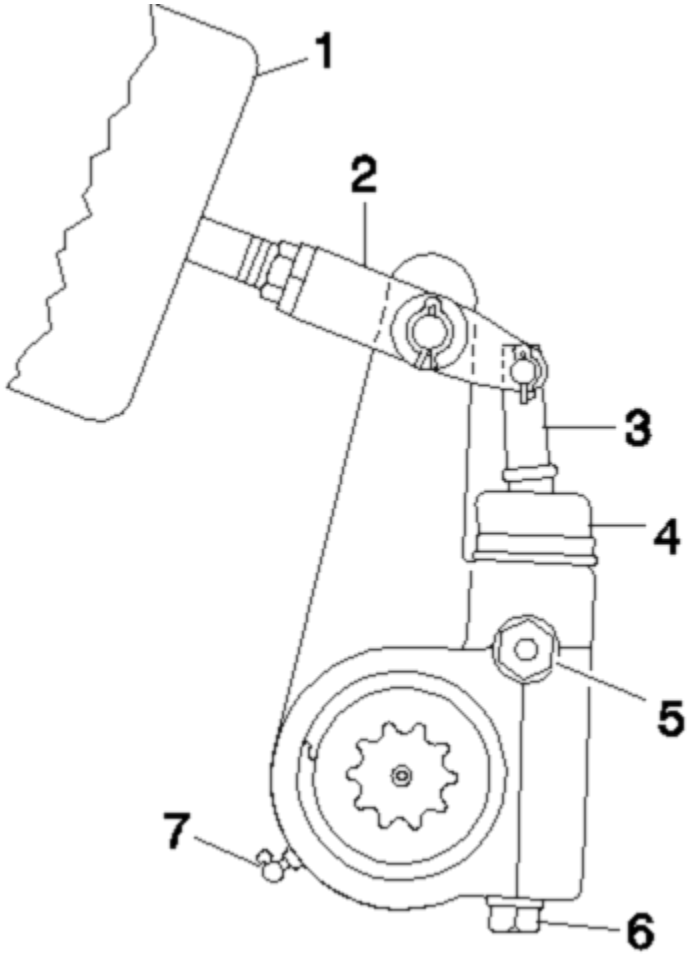
IMPORTANT: Perform 16.08.01 Bendix AD-9 before lubricating the slack adjusters.

Automatic slack adjusters 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.

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. Use high-temperature, NLGI Grade 1 waterproof grease. See Fig. 61,Meritor Automatic Slack Adjuster (other slack adjustors are similar).



1. Brake Chamber
2. Clevis
3. Actuator Rod
4. Boot
5. Pull-Pawl Seal
6. Manual Adjusting Nut
7. Grease Fitting (or Lube Plug)

Fig 61, Meritor Automatic Slack Adjuster (other slack adjustors are similar)

16.07.02 Bendix

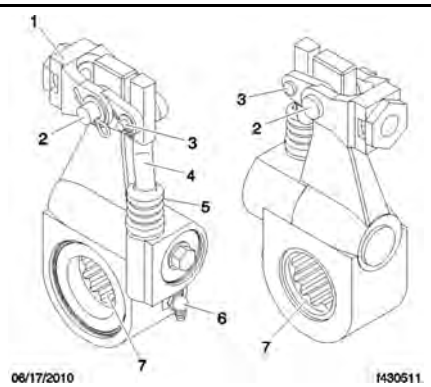
IMPORTANT: Perform 16.08.01 Bendix AD-9 before lubricating the slack adjusters.

Automatic slack adjusters 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.

Using a quality multipurpose chassis lubricant, NLGI Grade 2, lubricate the automatic slack adjuster through the lube fitting. See Fig.62,Bendix Automatic Slack Adjuster. Lubricate the slack adjuster until clean lubricant flows from the grease relief opening in the boot.



1. Yoke
2. Yoke Pin
3. Link Pin
4. Link
5. Boot
6. Lube Fitting
7. Worm Gear

Fig 62, Bendix Automatic Slack Adjuster

16.08 Replacement of the Air Dryer Desiccant and Coalescent Filter

16.08.01 Bendix AD-9

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Completely drain all air reservoirs. Air pressure gauges should read 0 psi (0 kPa).
3. Loosen the desiccant cartridge with a strap wrench at the base of the cartridge. Spin off the cartridge and discard it.
4. Remove the O-ring from the threaded neck and discard it.
5. Remove the coalescent filter and discard it.

   IMPORTANT: Lubricate the new O-rings prior to installation.

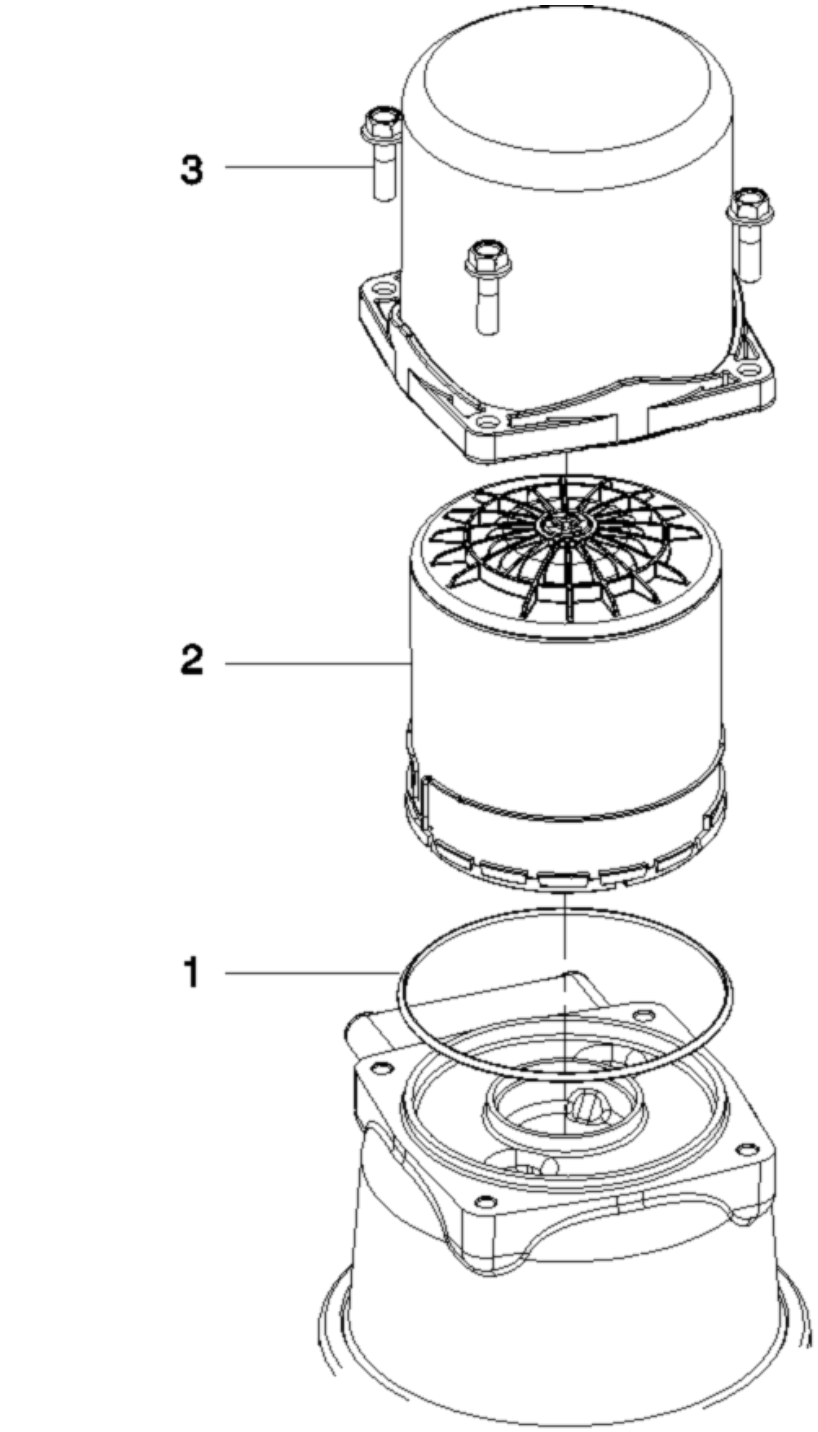
6. Install the new small O-ring in the groove on the bottom of the new coalescent filter.
7. Insert the coalescent filter with the O-ring end going into the air dryer opening first. The end of the filter with the "X" will then be facing out.
8. Install the other new O-ring over the threaded neck of the desiccant cartridge.
9. Screw on the desiccant cartridge until resistance is detected. Then, tighten the cartridge 1/4 to 3/4 of a turn by hand.
10. Before placing the vehicle in service, perform the test below.
    - 10.a Start the engine and build air pressure to 120 psi (827 kPa).
    - 10.b Listen for the purge valve to open and release air. A large volume of air will be expelled, followed by a slow flow of air lasting approximately 30 seconds.
    - 10.c Shut down the engine.
    - 10.d Perform the checks, see16.11 OperatingTests of the Bendix Automatic Drain Valve.

16.08.02 Replacement of the Haldex PURest Cartridge[1]

1. Information in this section is provided by Haldex and is used with permission.

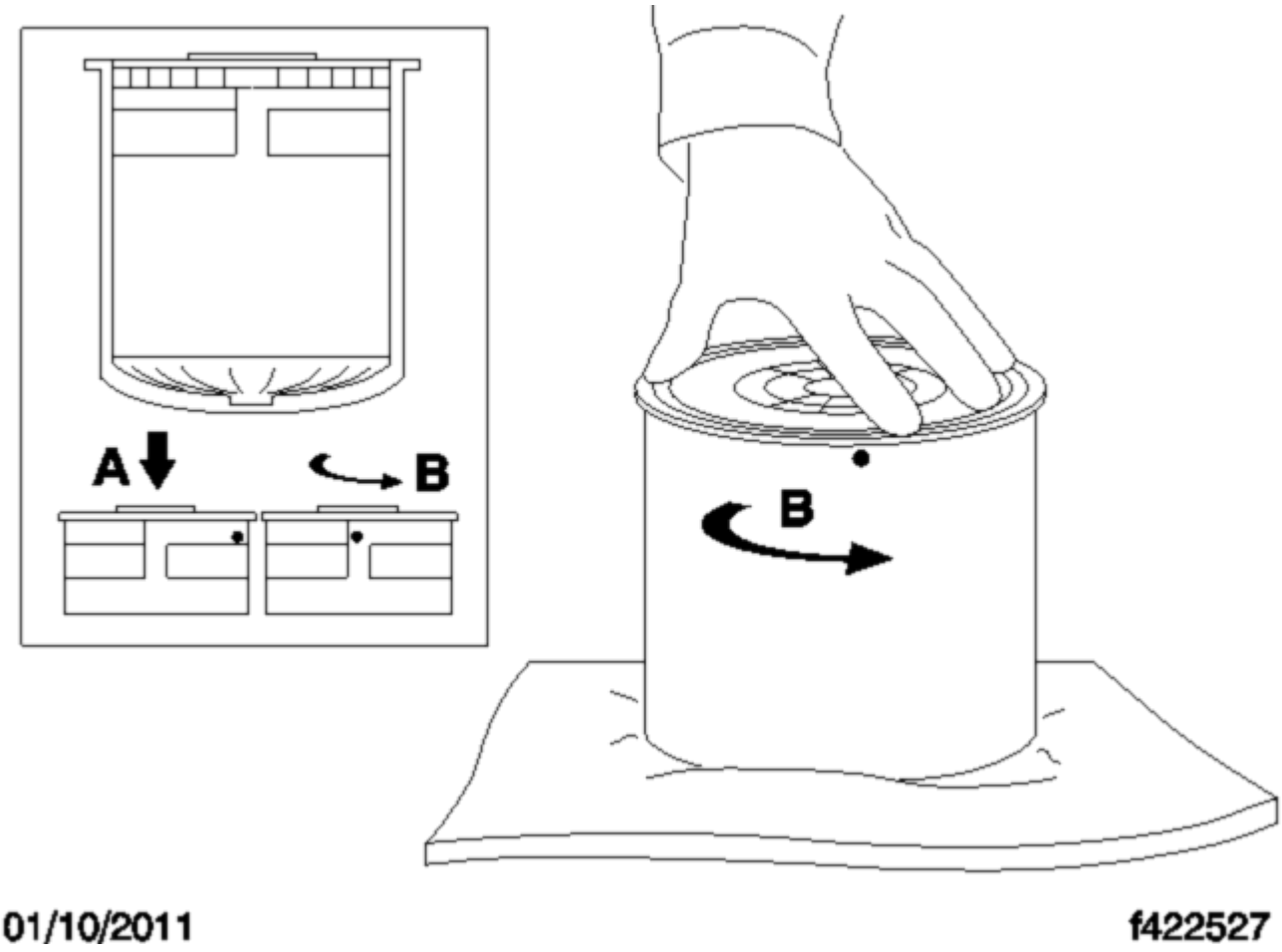
NOTE: The PURest cartridge contains both the desiccant and filter in one piece.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Remove the four mounting bolts and discard. See Fig.63,PURest Air Dryer Assembly. Lift the canister about 1/2 inch and remove.



1. O-Ring
2. Cartridge
3. Mounting Bolts

3. Place the assembly upside-down as shown in Fig.64,Releasing the Cartridge. Press the cartridge down to compress the rubber spring then rotate counterclockwise 45 degrees to release the cartridge. The cartridge itself contains no hazardous material, but there may be a small amount of oil from the compressor.



A. Canister/cartridge assembly shown upside-down.

B. Rotate the cartridge counterclockwise 45 degrees to release it from the canister.

Fig 64, Releasing the Cartridge

4. Clean the inside of the canister and aluminum housing.
5. Remove the cartridge O-ring and discard.
6. Remove the new cartridge from the kit and make certain the rubber spring is attached. See Fig. 65,New Cartridge with Rubber Spring.

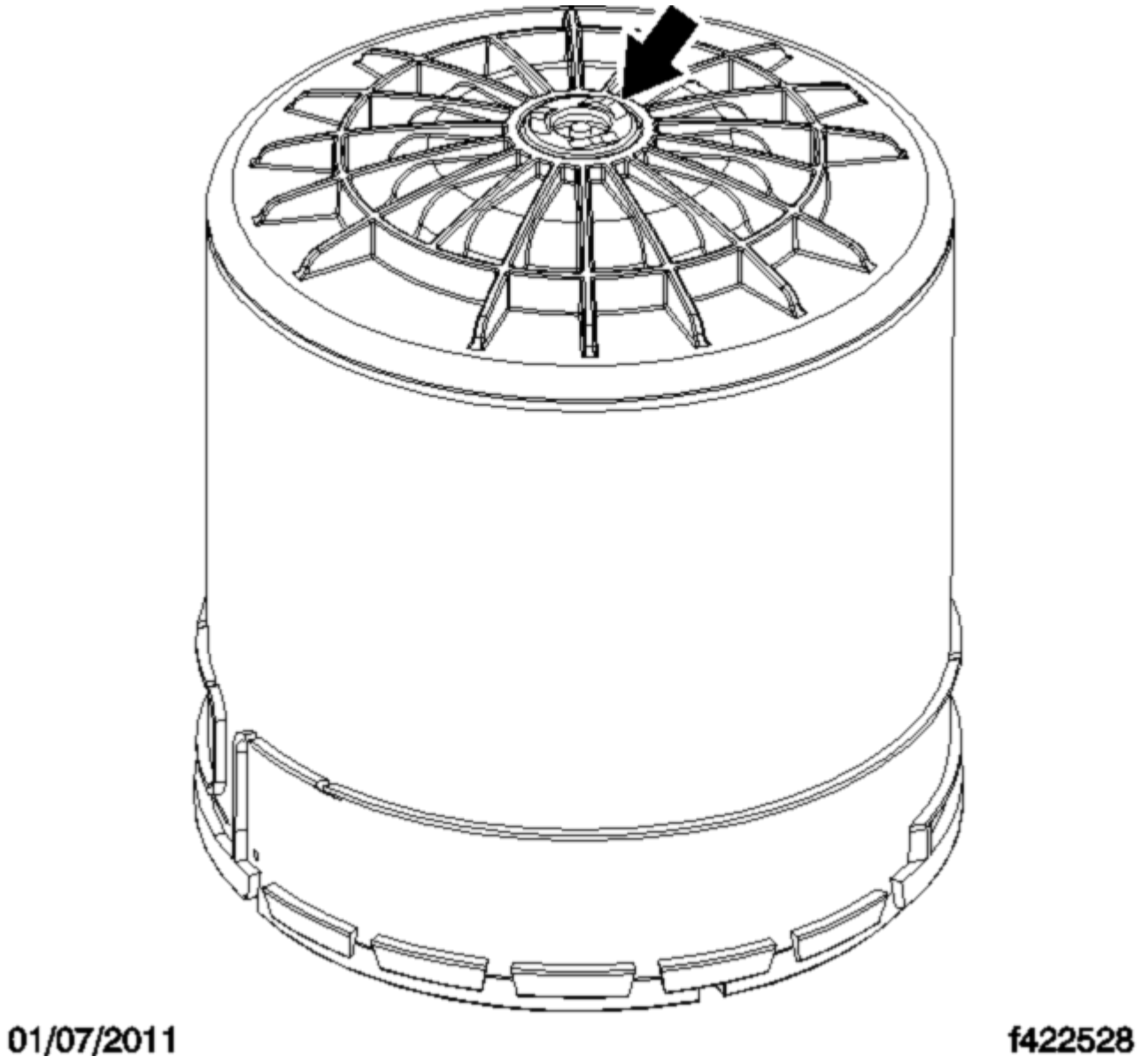
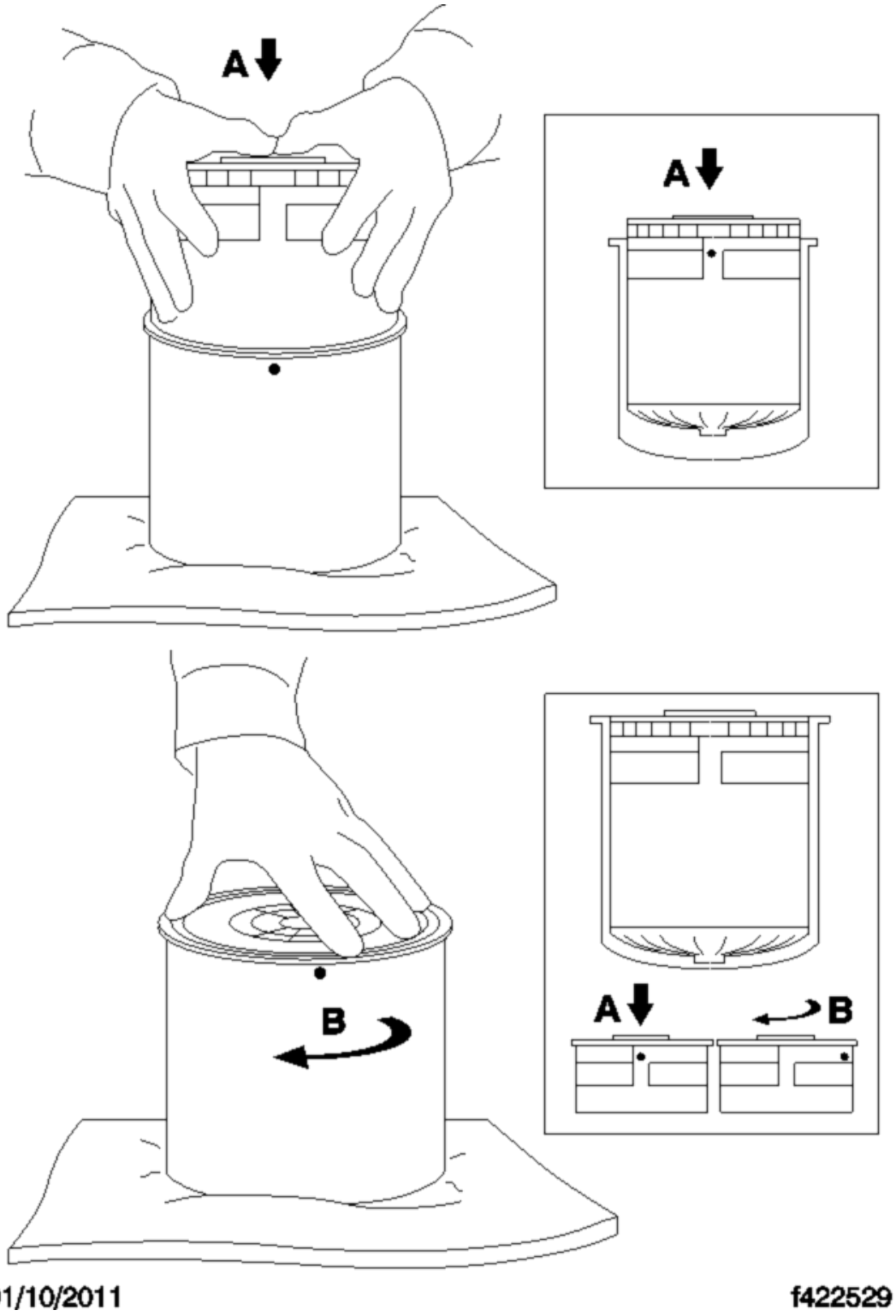


Fig 65, New Cartridge with Rubber Spring

7. Install the new cartridge into the canister. Align the slots on the cartridge with the dimplets inside the canister. Press the cartridge into the canister and rotate clockwise 45 degrees to engage the cartridge, as shown in Fig. 66,Cartridge Rotation and Engagement.



A. Install the new cartridge into the canister.
B. Press the cartridge into the canister and rotate

8. Place a new O-ring on the aluminum housing.
9. Place the cartridge assembly on the air dryer housing and install four new mounting bolts. Use an alternating diagonal pattern and tighten the bolts 35 to 40 lbf·ft (47 to 54 N·m).
10. Before placing the vehicle in service, perform the test below.
    - 10.a Start the engine and build air pressure to 100 psi (690 kPa) and shut-off the engine.
    - 10.b Check for air leaks at the inlet, outlet, and canister assembly. Correct any leakage problem.
    - 10.c Restart the engine and build-up pressure to cut-out pressure. At cut-out pressure, the air dryer purge valve opens and immediately expels a large volume of air, followed by a slow flow of air lasting approximately 30 seconds.
    - 10.d Perform the checks, see16.11 OperatingTests of the Bendix Automatic Drain Valve.

16.09 Air Dryer Check

16.09.01 General Guidelines

IMPORTANT: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

Every six months:

1. Check for moisture in the air brake system by opening reservoir drain valves and checking for presence of water. If moisture is present, the desiccant cartridge may require replacement; however, the following conditions can also cause water accumulation and should be considered before replacing the desiccant:
   - An outside air source has been used to charge the system. This air did not pass through the drying bed.
   - Air usage is exceptionally high and not normal. This may be due to high air system leakage.
   - In areas where more than a 30-degree range of temperature occurs in one day, small amounts of water can temporarily accumulate in the air brake system due to condensation. Under these conditions, the presence of small amounts of moisture is normal.

   NOTE: A small amount of oil in the system is normal and should not be considered as a reason to replace the desiccant cartridge. Some oil at the dryer exhaust is normal.

2. Visually check for physical damage, such as chaffed or broken air and electrical lines and broken or missing parts.
3. Check the mounting bolts for tightness. See Table.17,Torque Values for torque values.

Table 17, Torque Values

Vendor	Size	Torque: lbf·ft (N·m)
Bendix	Grade 5, 3/8–16	28 (38)
	Grade 5, 5/8–11	135 (183)
Haldex	1/2–13	45 to 55 (61 to 75)

Table 17, Torque Values

4. Perform the operational and leakage tests listed below.

16.09.02 Operational and Leakage Tests

1. Check all lines and fittings leading to and from the air dryer for leakage and integrity. Repair any leaks found.
2. Build system pressure to governor cutout and note that the dryer purges with an audible escape of air. Watch the system pressure and note the pressure fall-off for a 10-minute period. If the pressure drop exceeds 1 psi/minute from either service reservoir, inspect the vehicle air systems for sources of leakage and repair them. Refer to troubleshooting information in Bendix or Haldex service literature.
3. Check for excessive leakage around the purge valve with the compressor in the loaded mode (compressing air). Apply a soap solution to the purge valve exhaust port and observe that leakage does not exceed a 1-inch (25-mm) bubble in 1 second. If the leakage exceeds the maximum specified, refer to troubleshooting information in the Bendix or Haldex service literature.
4. Build system pressure to governor cutout and note that the dryer purges with an audible escape of air. 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 dryer purge. If the system does not follow this pattern, refer to troubleshooting information in the Bendix or Haldex service literature.
5. Check the operation of the end cover heater and thermostat assembly during cold weather operation as follows:

   5.a Electric Power to the Dryer: With the ignition in the ON position, check for voltage to the heater and thermostat assembly using a voltmeter or testlight. Unplug the electrical connector at the air dryer and place the test leads on each of the connections of the female connector on the vehicle power lead. If there is no voltage, look for a blown fuse, broken wires, or corrosion in the vehicle wiring harness. Check to see if a good ground path exists.

   5.b Thermostat and Heater Assembly Operation: These tests are not possible except in cold weather operation. Turn off the ignition switch and cool the thermostat and heater assembly to below 40°F (4°C). Using an ohmmeter, check the resistance between the electrical pins in the air dryer connector half. The resistance should be 1.5 to 3.0 ohms for the 12-volt heater assembly and 6.0 to 9.0 ohms for the 24-volt heater assembly.

   NOTE: Some models of the AD–9 may have a resistance reading of 1.0 to 2.5 ohms.

   Warm the thermostat and heater assembly to approximately 90°F (32°C) and again check the resistance. The resistance should exceed 1000 ohms. If the resistance values obtained are within the stated limits, the thermostat and heater assembly is operating properly. If the resistance values obtained are outside the stated limits, replace the heater and thermostat assembly.

16.10 Inspection and Lubrication of the Versajust Slack Adjuster

16.10.01 General Guidelines

IMPORTANT: Perform the maintenance operation before lubricating the slack adjusters.

1. Visually check for physical damage, such as broken air lines and broken or missing parts.
2. Using a quality multipurpose chassis lubricant, NLGI Grade 2, lubricate the slack adjuster through the grease fitting until clean lubricant flows from the grease relief opening in the boot.
3. Perform the 16.10.02 In Service Inspection.

16.10.02 In Service Inspection

1. Apply and release the brakes several times while observing the slack adjuster. The slack adjuster and brake actuator should move freely, without binding or interference, and should return to the full released position. Observe the looseness that exists between the clevis and adapter bushing and the yoke and link pins and their mating parts (clevis, body, link). Replace these parts if looseness appears excessive. Make certain the brake actuator pushrod jam nut is tightened securely.
2. Inspect the slack adjuster for physical damage, paying attention to the link, boot, and clevis. If any components are damaged, repair or replace them as necessary.
3. Measure the brake actuator pushrod stroke while making an 80 to 90 psi (552 to 621 kPa) brake application. Actuator pushrod strokes should not exceed the values shown in Table 18,Actuator Stroke–Standard Stroke and Table 19,Actuator Stroke–Long Stroke. To achieve the correct pressure for this test, build the system pressure up to a 100 psi (690 kPa). Shut down the engine. Fan the brakes to attain a 90 to 95 psi (621 to 655 kPa) reading. Make and hold a full brake application while the strokes are checked.

Table 18, Actuator Stroke–Standard Stroke

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

Table 18, Actuator Stroke–Standard Stroke

Table 19, Actuator Stroke–Long Stroke

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

Table 19, Actuator Stroke–Long Stroke

16.11 OperatingTests of the Bendix Automatic Drain Valve

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 of the **Walk-In Van Chassis Workshop Manual** .

16.12 Leakage Tests of the Bendix Automatic Drain Valve

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

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

If the drain valve is leaking excessively, repair or replace it. See of the **Walk-In Van Chassis Workshop Manual**

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17.02 Lubricating the Drag Link 118
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17.06 Changing the Power Steering Reservoir Fluid and Filter 121
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17.08 Changing the Power Steering Fluid and Filter, Electric Vehicle 126

17. Steering

17.01 Safety Precautions

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

DANGER:

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

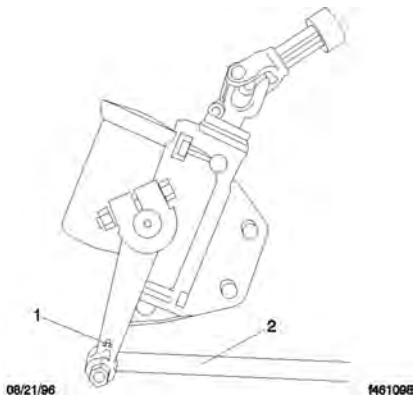
17.02 Lubricating the Drag Link

NOTICE:

If a power washer is used to clean the chassis in the area of the drag link ends, you must adjust the drag link lubrication intervals. If the vehicle is power-washed often, you must lubricate the drag link more frequently.

1. Using a clean rag, wipe the dirt from both grease fittings on the drag link. See Fig.67,Steering Drag Link Lubricating.
2. Using a pressure gun, apply multipurpose chassis grease at the grease fittings until old grease is forced out of the socket.

NOTE: Use multipurpose chassis grease NLGI grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI grade 2 (8% 12-hydroxy lithium stearate grease). The grade 2 chassis grease is preferred.



1. Grease Fitting
2. Drag Link (pitman arm end shown)

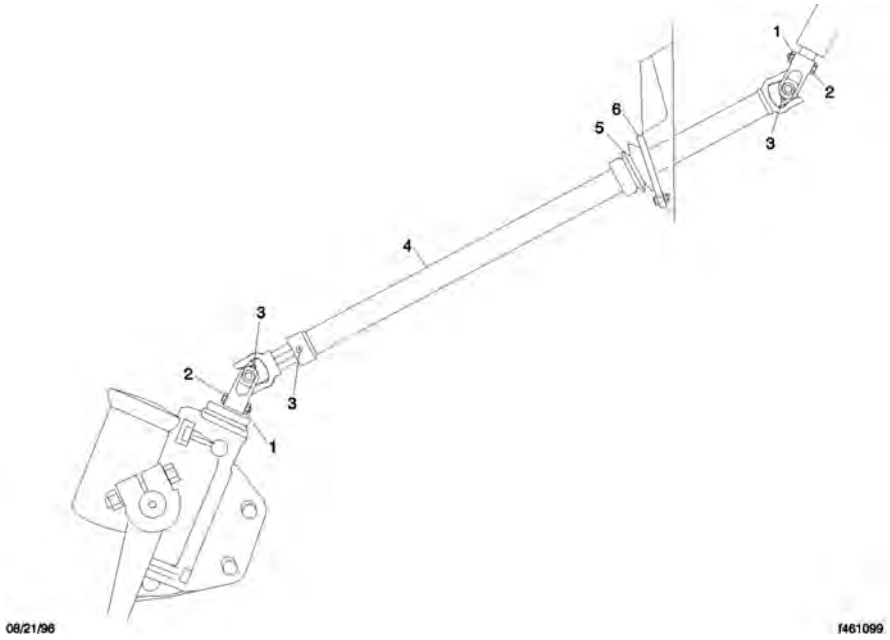
Fig 67, Steering Drag Link Lubricating

17.03 Checking the Power Steering Hose

Check the power steering hoses for chafing. Also, check for leakage around the fittings. Replace any damaged hoses, and tighten all fittings to stop leakage.

17.04 Lubricating the Steering Driveline

Wipe the grease fittings clean. See Fig.68,Steering Driveline. Using a pressure gun, apply a lithium-based grease (NLGI grade 2) sparingly to the universal joints and slip-joint splines.



1. Prevailing Torque Locknut
2. Pinch Bolt
3. Grease Fitting
4. Universal Joint Shaft
5. Boot
6. Boot Retainer

Fig 68, Steering Driveline

17.05 Checking the Steering Gear Bolts Torque

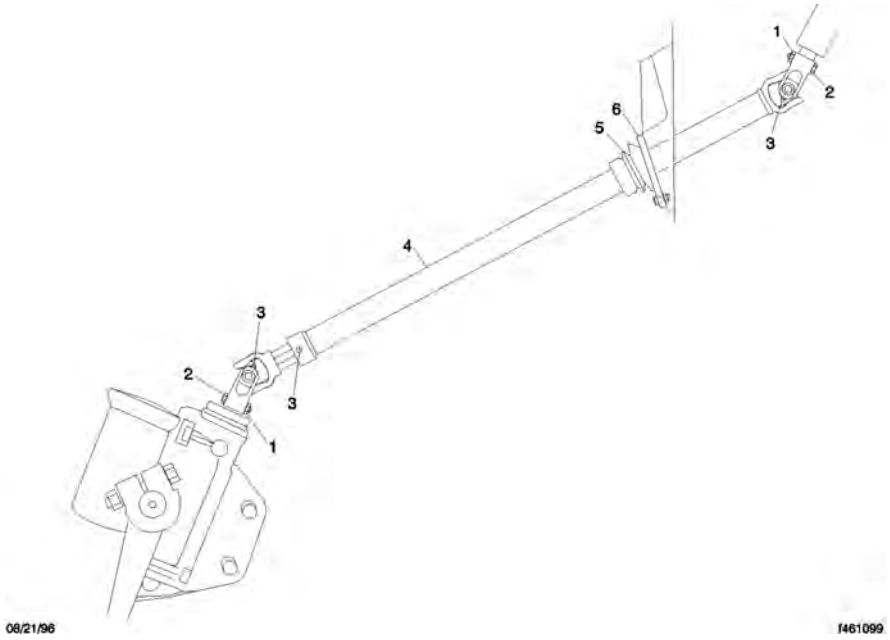
Tighten the steering gear mounting bolt nuts, pitman arm pinch-bolt nut, and steering driveline end yoke pinch-bolt nuts to the specifications in Table.20,Steering System Torque Values. See Fig.69,Steering Driveline and Fig. 70,Saginaw Model 710 Steering Gear Installation. After the end yoke pinch-bolt nuts have been torqued, apply white Torque Seal F900 to the exposed pinch-bolt thread and locknut.

Table 20, Steering System Torque Values

Description	Size	Torque: lbf·ft (N·m)
Pitman Arm Pinch-Bolt Hexnut	5/811	190 (258)
Steering Gear to Mounting Bracket		
Flanged Capscrew	M16 x 2 x 55	170180 (230244)

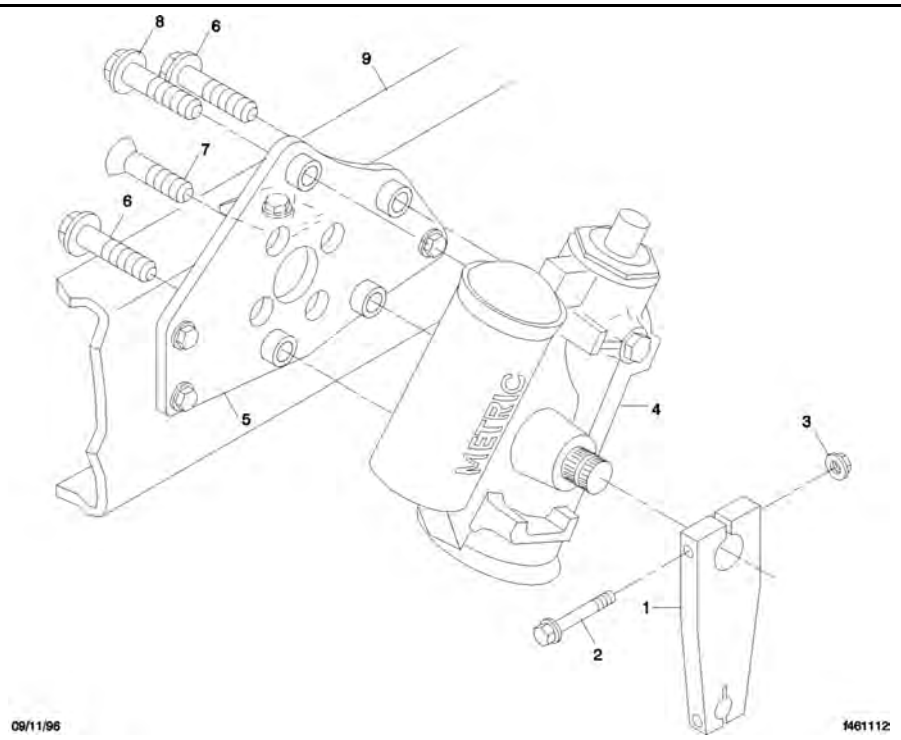
Description	Size	Torque: lbf·ft (N·m)
Flanged Capscrew	M16 x 2 x 60	170180 (230244)
Countersunk Capscrew	M16 x 2 x 50	150 (203)
Steering Driveline		
Upper End Yoke Pinch-Bolt Nut	7/1620	47 (64)
Lower End Yoke Pinch-Bolt Nut	7/1620	47 (64)

Table 20, Steering System Torque Values



1. Prevailing Torque Locknut
2. Pinch Bolt
3. Grease Fitting
4. Universal Joint Shaft
5. Boot
6. Boot Retainer

Fig 69, Steering Driveline



1. Pitman Arm
2. Pitman Arm Pinch Bolt
3. Pitman Arm Pinch-Bolt Nut
4. Steering Gear
5. Mounting Bracket
6. Flanged Capscrew, M16 x 2 x 60
7. Countersunk Capscrew, M16 x 2 x 50
8. Flanged Capscrew, M16 x 2 x 55
9. Frame Rail

Fig 70, Saginaw Model 710 Steering Gear Installation

If the steering driveline end yoke pinch-bolt nut(s) is loose, disassemble and check the input shaft serrations, upper column and jacket assembly wheel tube shaft serrations, and steering driveline end yoke serrations for wear or damage. If worn or damaged, replace the parts as necessary, following the instructions, see of the **Walk-In Van Chassis Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.

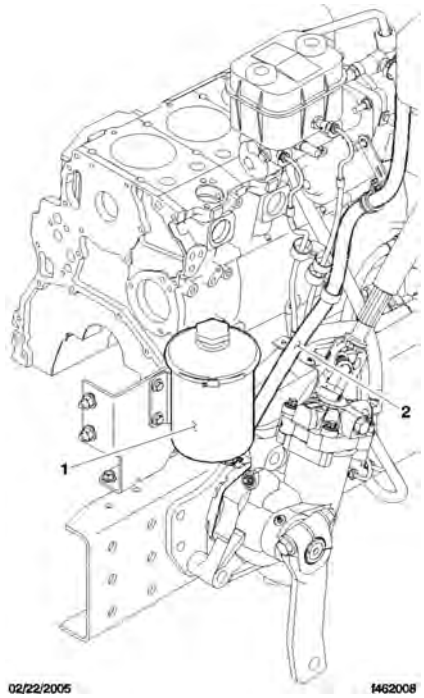
WARNING:

Failure to tighten the steering gear pinch-bolt nuts to the recommended torque value could cause disengagement of the components and loss of steering control, possibly resulting in personal injury or property damage.

17.06 Changing the Power Steering Reservoir Fluid and Filter

17.06.01 Diesel Engine

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the rear tires.
2. Remove the retaining clamp, cover, and cover gasket.
3. Drain the power steering reservoir by disconnecting the power steering hydromax return hose from the reservoir. Keep the hose in an upright position to prevent drainage of fluid. See Fig.71,Power Steering Reservoir.



1. Power Steering Fluid Reservoir
2. Hydromax Return Hose

Fig 71, Power Steering Reservoir

4. Catch the fluid from the reservoir in a drain pan, then cap the reservoir port.
5. Unscrew and remove the 10-micron filter that is located on the bottom of the power steering fluid reservoir.
6. Thoroughly clean the reservoir with a lint-free cloth.
7. Install a new filter element. Tighten the filter element finger-tight, then tighten one-eighth of a turn past finger-tight.
8. Connect the hydromax return hose to the power steering fluid reservoir.

WARNING:
Fill only with approved clean fluid. Do not mix fluid types. Any mixture or any unapproved fluid could lead to seal deterioration and leaks. Fluid leakage could cause loss of power steering assist, possibly resulting in personal injury and property damage.

9. Fill the reservoir with Dexron® III automatic transmission fluid (ATF), or an equivalent.

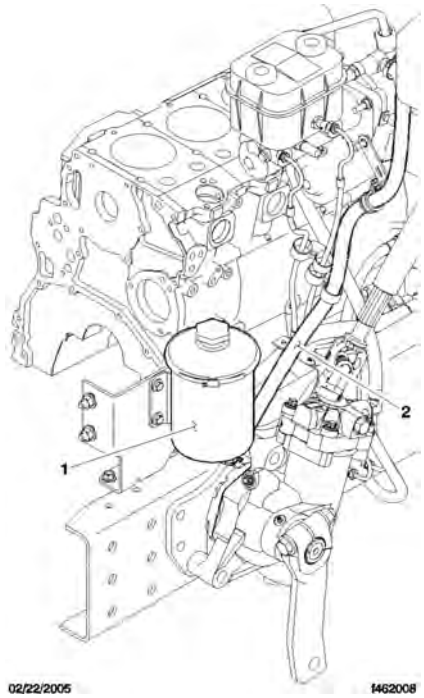
NOTE: When assembling power steering parts, use the same lubricant that is currently in the power steering system. See the warning above.

10. Start the engine and let it idle. Have someone turn the steering wheel to full-lock left and full-lock right until no bubbles are seen in the reservoir. Turn off the engine.
11. Install a new cover gasket, cover, and retaining clamp until firmly seated.

12. Check the power steering reservoir fluid level. If the fluid level is low, add approved fluid to bring the level up to the full mark on the dipstick.

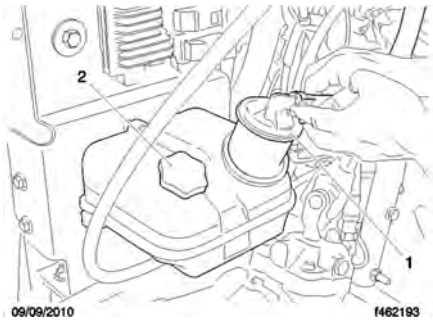
17.06.02 Gasoline Engine

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the rear tires.
2. Remove the reservoir cap and unscrew the power steering fitting shown in Fig. 73,Steering Reservoir, Gasoline Engine. Gently pull the fitting away from the reservoir.



1. Power Steering Fluid Reservoir
2. Hydromax Return Hose

Fig 72, Power Steering Reservoir



1. Power Steering Fitting
2. Reservoir Cap

Fig 73, Steering Reservoir, Gasoline Engine

3. Place a drain pan under the reservoir.
4. Drain the power steering reservoir by disconnecting the power steering return hose from the reservoir. Keep the hose in an upright position to prevent drainage of fluid.

5. Thoroughly clean the reservoir with a lint-free cloth.
6. Remove the filter located at the power steering fitting. See Fig.73,Steering Reservoir, Gasoline Engine.
7. Install a new filter. Tighten the power steering fitting finger-tight, then tighten one-eighth of a turn past finger-tight.
8. Connect the return hose to the power steering fluid reservoir.

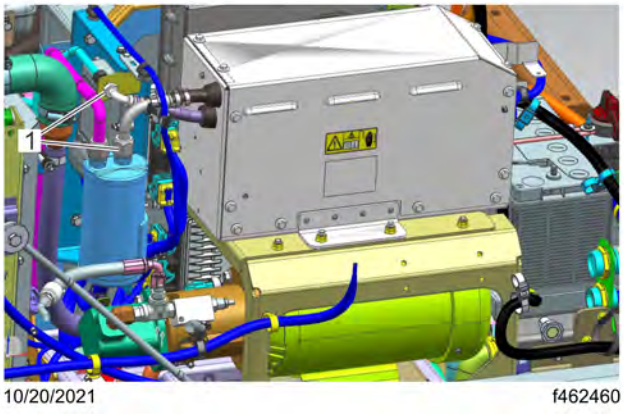
WARNING:

Fill only with approved clean fluid. Do not mix fluid types. Any mixture or any unapproved fluid could lead to seal deterioration and leaks. Fluid leakage could cause loss of power steering assist, possibly resulting in personal injury and property damage.

9. Fill the reservoir with Dexron III automatic transmission fluid (ATF), or an equivalent and install the reservoir cap.
10. Start the engine and let it idle. Have someone turn the steering wheel to full-lock left and full-lock right until no bubbles are seen in the reservoir. Turn off the engine.
11. Check the power steering reservoir fluid level. If the fluid level is low, add approved fluid to bring the level up to the full mark on the dipstick.

17.07 Lubrication of the Power Steering Motor, Electric Vehicle

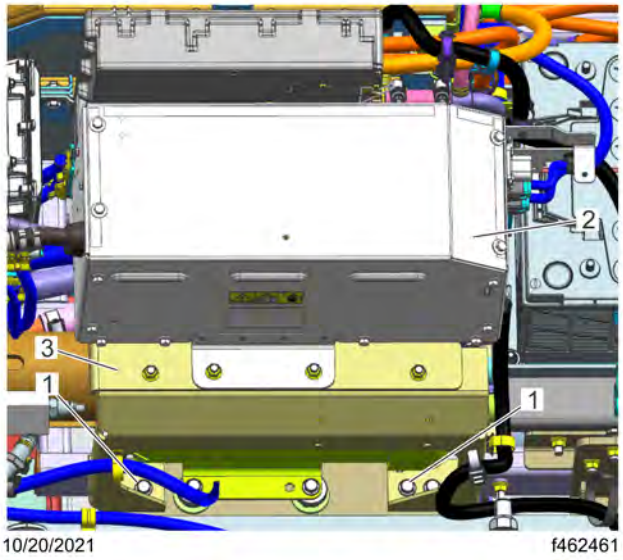
1. Park the vehicle on a level surface, shut down the vehicle, and set the parking brake. Chock the tires.
2. Open the hood.
3. Evacuate the refrigerant system. For instructions, see of the **Walk-In Van Chassis Workshop Manual**.
4. Remove the compressor fittings at the end of the connected hoses. See Fig.74,Remove Compressor Fittings.



1. Compressor Fittings

Fig 74, Remove Compressor Fittings

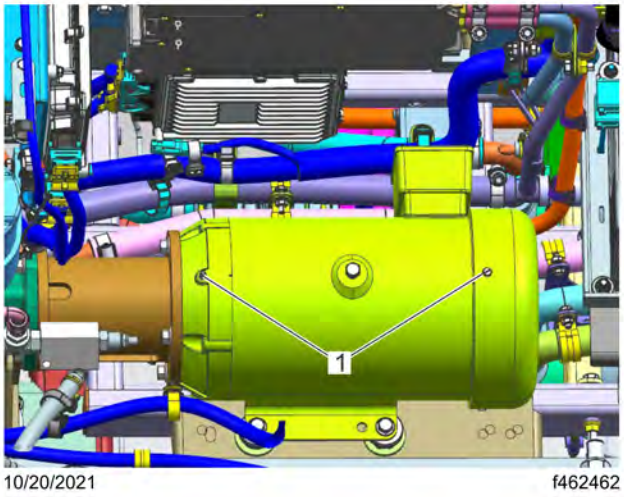
5. Remove the bolts, nuts and washers that attach the compressor box bracket to the front box and remove the assembly. See Fig.75,Compressor Box Bracket.



1. Remove Bolts, Nuts and Washer Assembly
1. Compressor Box
1. Compressor Box Bracket

Fig 75, Compressor Box Bracket

6. Using a clean rag, wipe all dirt from both power steering motor grease fittings. See Fig. 76,Power Steering Motor Grease Fittings for the location of the grease fittings.



1. Grease Fittings

Fig 76, Power Steering Motor Grease Fittings

IMPORTANT: Due to the high operating temperatures of the motor, use Darmex RPL-707 grease for motor lubrication.

NOTICE:

Do not over-lubricate the power steering motor. Over-lubrication of a motor can seriously damage it by forcing grease into motor windings, as well as the centrifugal switch, causing it to malfunction.

7. Using a hand-type grease gun with Darmex RPL-707 grease, insert the adaptor over the grease fittings and pump the handle two or three times to fill the grease cavity.

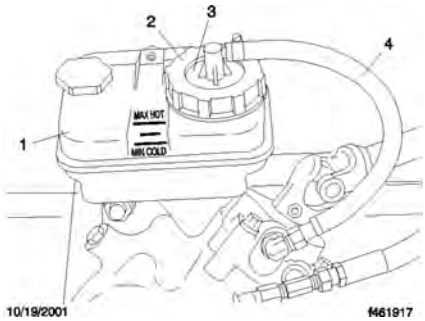
   Listen closely as the grease is pumped in. When you hear a sound like air being released, the grease cavity is full.
8. Wipe off any excess grease from the fittings.
9. Install the compressor assembly to the front box and refrigerant system.
10. Charge the refrigerant system per, see of the **Walk-In Van Chassis Workshop Manual**.
11. Close the hood.

17.08 Changing the Power Steering Fluid and Filter, Electric Vehicle

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. Apply the parking brake.
2. Place a drain pan under the power steering reservoir.
3. Remove the retaining ring from the reservoir. See Fig.77,Power Steering Reservoir.



1. Power Steering Reservoir
2. Retaining Ring
3. Filter Cover
4. Return Hose

Fig 77, Power Steering Reservoir

4. Remove the filter and filter cover from the reservoir. Disconnect the filter from the filter cover and discard the filter.
5. Remove the bolts, nuts, and washers that attach the power steering reservoir to the mounting bracket. Drain the fluid from the reservoir, but do not remove the supply line to the reservoir.
6. Using bolts, nuts, and washers, attach the reservoir to the mounting bracket.
7. Fill the reservoir with an approved power steering fluid to the line between the MIN COLD and MAX HOT lines. See Fig.77,Power Steering Reservoir. See Table.21,Approved Power Steering Fluid, Electric Vehicle for approved power steering fluid.

Table 21, Approved Power Steering Fluid, Electric Vehicle

Fluid Type [1]	Approved Fluid
Automatic Transmission Fluid	Dexron® III

1. Do not mix fluid types. Refer to the text in this group for a detailed warning statement.

Table 21, Approved Power Steering Fluid, Electric Vehicle

8. Raise the front of the vehicle and support it with jack stands.
9. Start the motor and operate it at idle. Turn the steering wheel from full left and full right several times until clean fluid starts flowing from the power steering filter cover. Add fluid to the reservoir to maintain the fluid level between the MIN COLD and MAX HOT lines.
10. Shut down the motor. Apply a thin film of power steering fluid on the gasket of a new filter. Then attach the filter to the filter cover. Make sure that the gasket under the filter cover is not damaged. If the gasket is damaged, replace it. Install the gasket on the reservoir. Install the filter and filter cover in the reservoir.
11. Attach the retaining ring to the reservoir to secure the filter and filter cover.
12. Start the motor and check that the power steering fluid level is between the MIN COLD and MAX HOT lines. Add more fluid if needed.
13. Raise the vehicle, remove the jack stands, and lower the vehicle.

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18. Fuel

18.01 Safety Precautions

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

DANGER:

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

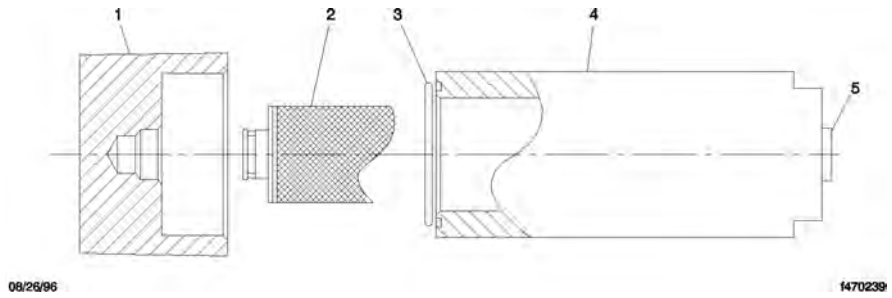
18.02 Replacement of the CNG High-Pressure Fuel Filter

WARNING:

Compressed natural gas is highly flammable. See the safety precautions listed, see **Walk-In Van Chassis Operator's ManualWalk-In Van Chassis Workshop Manual**

The high-pressure fuel filter is located inside of the left-hand frame rail, near the rear of the fuel tank.

1. Shut off the fuel supply at the tanks.
2. Vent the fuel supply system.
3. After the system has been vented, remove the filter housing. See Fig.78,CNG High-Pressure Fuel Filter Assembly.
4. Remove and discard the O-ring used to seal the filter housing.
5. Remove and discard the filter element.
6. Install the new element and press it into place.
7. Install the new O-ring.



1. Fuel Filter Head
2. Filter Element
3. O-Ring
4. Filter Housing
5. Filter Drain

Fig 78, CNG High-Pressure Fuel Filter Assembly

8. Apply a thread lubricant to the housing threads, and screw the filter housing onto the filter head.
9. Check for leaks using a natural gas detector.

10. Tighten the filter housing.
11. Turn the fuel supply back on at the tanks.

18.03 Test the CNG Fuel Leak



WARNING:

Compressed natural gas is highly flammable. See the safety precautions listed, see **Walk-In Van Chassis Operator's ManualWalk-In Van Chassis Workshop Manual**

Inspect and test the fuel tanks and the fuel lines. Use a natural gas detector to check for any leaks.

Replace leaking fuel tanks; repair or replace any lines or connections that are leaking. For procedures, see of the **Walk-In Van Chassis Workshop Manual** , or take the vehicle to an authorized Freightliner dealer.

Safety precautions are listed, see of the **Walk-In Van Chassis Workshop Manual** .

18.04 Draining the CNG High-Pressure Fuel Filter



WARNING:

Compressed natural gas is highly flammable. See the safety precautions listed, see **Walk-In Van Chassis Operator's ManualWalk-In Van Chassis Workshop Manual**

Shut off the fuel supply at the fuel tanks. Vent the system.

Drain the fuel filters, which are mounted on the left-hand frame rail of the vehicle near the fuel regulator, by removing the drain nut located at the bottom of the housing of each filter.

Perform this maintenance procedure as indicated in the maintenance interval chart in this manual.

18.05 Draining the CNG Fuel Block Housing



WARNING:

Compressed natural gas is highly flammable. See the safety precautions listed, see **Walk-In Van Chassis Operator's ManualWalk-In Van Chassis Workshop Manual**

Shut off the fuel supply at the fuel tanks. Vent the system.

Remove the drain nut at the bottom of the engine internal fuel filter, which is mounted on the left-hand side of the engine.

Perform this maintenance procedure as indicated in the maintenance interval chart in this manual.

See the engine manufacturer's operation and maintenance manual for further information.

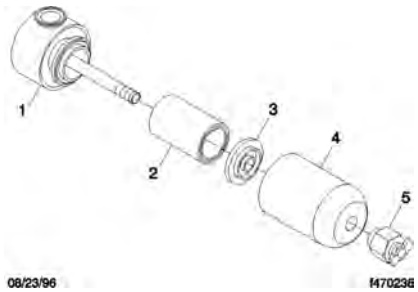
18.06 Replacement of the CNG Low-Pressure Fuel Filter

WARNING:
Compressed natural gas is highly flammable. See the safety precautions listed, see **Walk-In Van Chassis Operator's ManualWalk-In Van Chassis Workshop Manual**

The low-pressure fuel filter is located inside of the left-hand frame rail, near the center of the fuel tank.

Turn the valve counterclockwise to close the filter drain.

1. Shut off the fuel supply at the tanks.
2. Vent the fuel supply system.
3. After the system has been vented, remove the filter bowl. See Fig.79,CNG Low-Pressure Fuel Filter Assembly. Using a 26-mm wrench, remove the bowl nut. Then remove the bowl, the element retainer, and the filter element.



1. Fuel Filter Head
2. Filter Element
3. Element Retainer
4. Filter Bowl
5. Bowl Nut

Fig 79, CNG Low-Pressure Fuel Filter Assembly

NOTE: Be sure that the O-ring is positioned properly inside of the filter head.

4. Install the new element, the element retainer, the bowl, and the bowl nut.
5. Turn the fuel supply on at the tanks.

18.07 Draining the CNG Low-Pressure Fuel Filter

WARNING:
Compressed natural gas is highly flammable. See the safety precautions listed, see **Walk-In Van Chassis Operator's ManualWalk-In Van Chassis Workshop Manual**

Shut off the fuel supply at the fuel tanks.

Drain the fuel filters, which are mounted on the left-hand frame near the fuel regulator, by removing the drain nut located at the bottom of the housing of each filter.

Perform this maintenance procedure as indicated in the maintenance interval chart in this manual.

18.08 Inspection of the CNG Fuel Tank Visual

WARNING:

Compressed natural gas is highly flammable. See the safety precautions listed, see **Walk-In Van Chassis Operator's ManualWalk-In Van Chassis Workshop Manual**

Each fuel tank must be visually inspected at specified intervals for external damage and deterioration. The inspection must be performed by a qualified person, in accordance with the manufacturer's established reinspection criteria and Compressed Gas Association documents.

Perform this maintenance procedure as indicated in the maintenance interval chart in this manual. See Table.22,CNG Tank Visual Inspection for the remedies to any damage found on the tank. See of the **Walk-In Van Chassis Workshop Manual** for tank repair procedures, or take the vehicle to an authorized Freightliner dealer.

Table 22, CNG Tank Visual Inspection

CNG Tank Visual Inspection		
Damage	**Condition**	**Remedy**
Abrasion on the Fiberglass Wrap	Less Than 0.010 Inch (0.3 mm) Deep	No repair needed.
	More Than 0.010 Inch (0.3 mm) But Less Than 0.030 Inch (0.8 mm) Deep	Repair.
	More Than 0.030 Inch (0.8 mm) Deep	Replace tank.
Cuts in the Fiberglass Wrap	Less Than 0.020 Inch (0.5 mm) Deep	No repair needed.
	More Than 0.020 Inch (0.5 mm) But Less Than 0.030 Inch (0.8 mm) Deep	Repair if less than 8 inches (200 mm) long.
	More Than 0.030 Inch (0.8 mm) Deep	Replace tank.
Dents on Metal Ends	Less Than 0.060 Inch (1.6 mm) Deep	No repair needed
	More Than 0.060 Inch (1.6 mm) Deep	Replace tank.
Gouges on Metal Ends	Bare Metal is Exposed	Replace tank.
Chipped Paint on Tank Ends	No Gray Primer Seen	No repair is needed.
	Gray Primer Seen, But Not Damaged	Repair with two-part epoxy resin.
	Gray Primer Damaged	Repair. Sand and remove rust, clean with pre-paint solvent, apply cold-galvanizing zinc primer and apply two-part epoxy resin.
Stress Cracks from Acid	Cracks in Fiberglass	Remove tank for inspection if exposed to acid. Replace if cracks are seen. Replace strap gaskets if exposed to acid.

CNG Tank Visual Inspection		
Damage	**Condition**	**Remedy**
Strap Gaskets	Gaskets Damaged or Missing	Approved gaskets must be installed between strap and tank. Replace strap gaskets if exposed to acid.
Tank Shield	Shield is Damaged	Repair or replace shield.
Tank Is Old	Tank is 15 Years Old	Replace tank after 15 years from date on label.
Vehicle Was in Accident or Fire	Tank Was Hot or Damaged From Impact.	Replace tank or remove tank and test.

Table 22, CNG Tank Visual Inspection

18.09 Replacement of the Diesel Fuel Filter

18.09.01 DAVCO Diesel Pro® 245



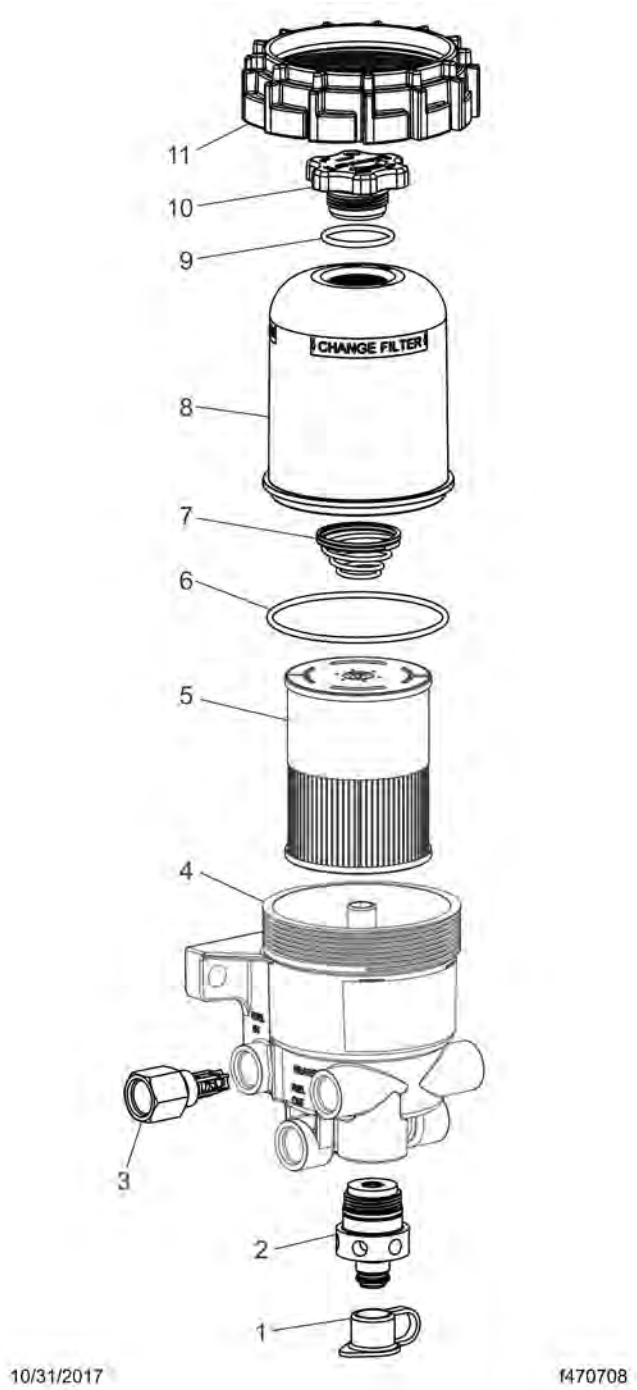
WARNING:

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

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

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

   The drain valve has a 3/4-inch (19-mm) slip-on hose connection. Open the drain valve by turning it one to one-and-a-half revolutions.
4. Remove the vent cap, shown in Fig.80,DAVCO Diesel Pro 245, to drain the fuel completely, then close the drain valve.



1. Drain Valve Cap
2. Drain Valve
3. Inlet Port/Check Valve
4. Lower Housing
5. Filter Element
6. Cover O-Ring
7. Spring
8. Clear Cover
9. Vent Cap O-Ring
10. Vent Cap
11. Collar

Fig 80, DAVCO Diesel Pro 245

5. Using a DAVCO Collar Wrench, shown in Fig.81,DAVCO Collar Wrench, remove the clear cover and collar.

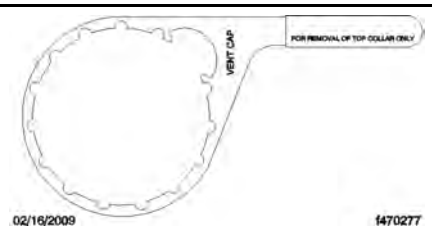
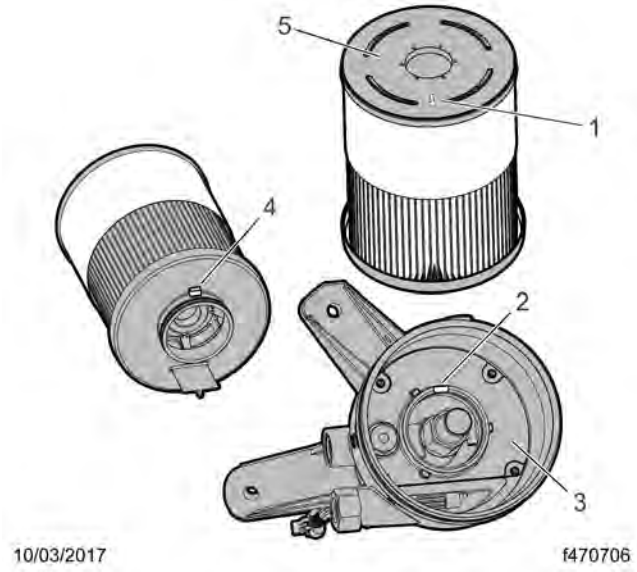


Fig 81, DAVCO Collar Wrench

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.80,DAVCO Diesel Pro 245.
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.82,Positioning the Filter Element. Ensure the filter element is fully seated by firmly pushing on the endplate. The filter should not rotate freely.



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

Fig 82, Positioning the Filter Element

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

18.09.02 DAVCO Fuel Pro® 382

WARNING:

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

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

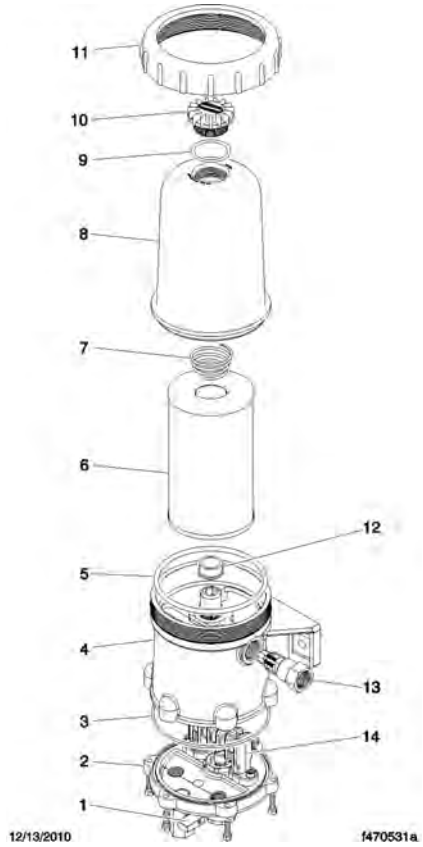
The filter element should be changed only when the fuel level has reached the top of the filter element. There is no significant restriction to fuel flow until the element is completely clogged.

1. Shut down the engine, apply the parking brake, and chock the tires.
2. Check the fuel level in the fuel filter. Replace the fuel/water separator element **only** when the filter element is completely covered. If the fuel level has reached the top of the filter element, follow the procedure below to replace the element.

   NOTE: In the event of an emergency, when the filter needs replacement but a Davco filter is not available for the Fuel Pro 382, a temporary filter can be used; see the procedure under the heading "Emergency Temporary Filter Replacement, Fuel Pro 382."

3. Put a clean receptacle under the fuel/water separator and attach a piece of hose to the drain valve, to direct fuel into the receptacle.

   The drain valve has a 1/2-inch (12.7-mm) pipe; use a hose with a 1/2-inch pipe thread to fit correctly.
4. Remove the vent cap (see Fig.83,DAVCO Fuel Pro 382, Item 10) and open the drain valve (see Fig. 83,DAVCO Fuel Pro 382, Item 1) to drain the fuel completely, then close the drain valve.



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

Fig 83, DAVCO Fuel Pro 382

5. Using a DAVCO Collar Wrench, shown in Fig.84,DAVCO Collar Wrench, remove the clear cover and collar.

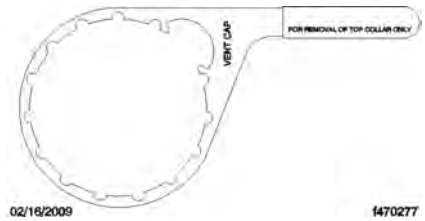


Fig 84, DAVCO Collar Wrench

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

6. Remove the filter, cover O-ring, and vent cap O-ring. Dispose of them in an environmentally acceptable manner. See Fig.83,DAVCO Fuel Pro 382.

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

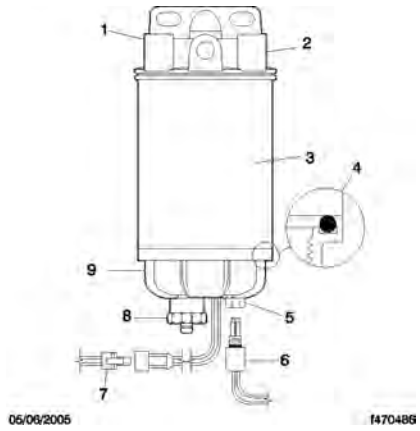
18.09.03 Alliance

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

WARNING:

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

1. Place a suitable drain pan under the fuel/water separator and open the drain valve. Drain enough fuel to empty the filter, then close the drain valve. See Fig.85,Alliance Fuel/Water Separator.



1. Fuel Outlet
2. Fuel Inlet
3. Filter Element
4. Bowl O-ring
5. Bowl Probe Plug
6. Water Sensor Probe
7. Heater Connector
8. Drain Plug
9. Sight Bowl

Fig 85, Alliance Fuel/Water Separator

2. Disconnect the water sensor and heater connections if equipped.
3. Remove the element and bowl together by turning counterclockwise.
4. Remove the bowl from the element and clean the O-ring gland.
5. Apply a coating of clean fuel or motor oil to the new O-ring and element seal.
6. Spin the bowl onto the new element, then spin them both onto the filter head snugly by hand only.

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

7. Connect the water sensor and heater connectors if equipped.
8. Start the engine and check for fuel leaks.
9. Shut down the engine and correct any fuel leaks.

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19. Exhaust

19.01 Safety Precautions

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

DANGER:

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

19.02 Inspecting the Exhaust System (Noise Emission Control)

19.02.01 General Description

The exhaust system must be free of leaks, binding, grounding, and excessive vibrations. In addition to inspecting the exhaust system at the scheduled maintenance interval, inspect the exhaust system if the noise level of the vehicle has increased. Replace parts that show leakage, wear, or damage, with genuine Freightliner parts.

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. For alignment or adjustment instructions, see of the **Walk-In Van Chassis Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.

19.02.02 EPA10 and Newer Exhaust System

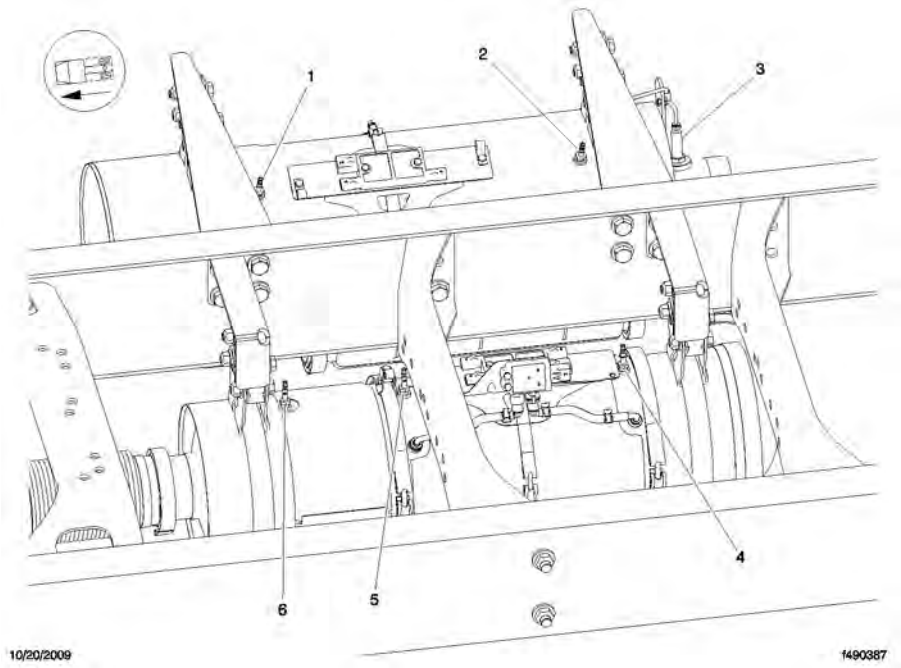
Definitions of Aftertreatment System (ATS) Terms

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

- Aftertreatment System (ATS)the entire exhaust system from the turbocharger to the tail pipe, including the Selective Catalytic Reduction (SCR) components.
- Aftertreatment Device (ATD)a device that removes pollutants from exhaust gas after the gas leaves the combustion chamber.
- BlueTec®Daimler's proprietary SCR technology.
- Diesel Oxidation Catalyst (DOC)a flow-through device that enhances the oxidation of hydrocarbons in the ATD.
- Diesel Particulate Filter (DPF)a component in the ATD that traps particulate matter from the exhaust gas.
- Diesel Exhaust Fluid (DEF)the chemical agent that reacts with the exhaust gases in the SCR to reduce NOx.
- DEF Pumpfilters and supplies DEF to the DEF metering unit.
- DEF Tankholds DEF and regulates its temperature.
- DEF Metering Unitmixes DEF with compressed air, and meters this mixture into the exhaust flow via an injection nozzle.
- SCR Catalystthe housing containing a treated ceramic flow-through block where the DEF and exhaust gases undergo selective catalytic reduction.
- Selective Catalytic Reduction (SCR)a process used to reduce NOx emissions.

Inspection of the EPA10 and Newer Exhaust System

IMPORTANT: The Environmental Protection Agency's 2010 regulations mandate lowered exhaust emissions, thus requiring exhaust system components that reduce emissions. In particular the aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections. See Fig. 86,Cummins ATD Sensor Locations, Side-by-Side Mounting for Cummins ATD sensor locations. The side-by-side mounting is shown, however, left inline and top side-by-side mountings are possible depending on the chassis design. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.



1. SCR Inlet Temperature Sensor
2. SCR Outlet Temperature Sensor
3. SCR Outlet NOx Sensor
4. DPF Outlet Temperature Sensor
5. DPF Catalyst Outlet Temperature Sensor
6. DPF Outlet Temperature Sensor

Fig 86, Cummins ATD Sensor Locations, Side-by-Side Mounting

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.
3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.
5. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD. No leaks are allowed anywhere in the system.
6. Check all sensors attached to the ATD for leaks or damaged wires. No leaks are allowed.
7. Check the DPF exterior surface for dents or other damage. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
8. Check the SCR catalyst for dents and other damage.

9. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.

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

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

Replacement of the Diesel Exhaust Fluid (DEF) Filter

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

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

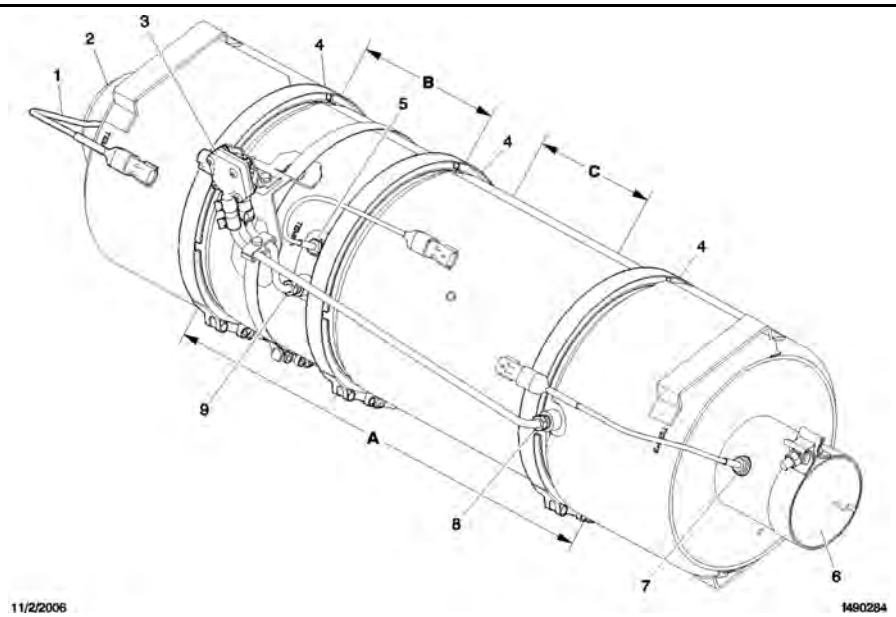
19.02.03 Inspecting the EPA07 Exhaust System

Definitions of ATS Components

Refer to the following list of definitions of ATS components.

- Aftertreatment System (ATS)the entire exhaust system from the turbocharger to the exhaust stack or tail pipe.
- Aftertreatment Device (ATD)a muffler-like canister that houses a DPF and sensors.
- Diesel Particulate Filter (DPF)a filter that collects and holds particulate matter (soot and ash).
- Diesel Oxidation Catalyst (DOC)oxidizes hydrocarbons and reduces NOx.
- Sensorsdetect temperatures and pressure within the ATS.
- Diffusera device, used as a deflector, for distributing, mixing, and reducing the velocity of air flow.

IMPORTANT: The Environmental Protection Agency's 2007 regulations require lower exhaust emissions, thus requiring new exhaust system components. See Fig.87,Cummins Aftertreatment Device. In particular the aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

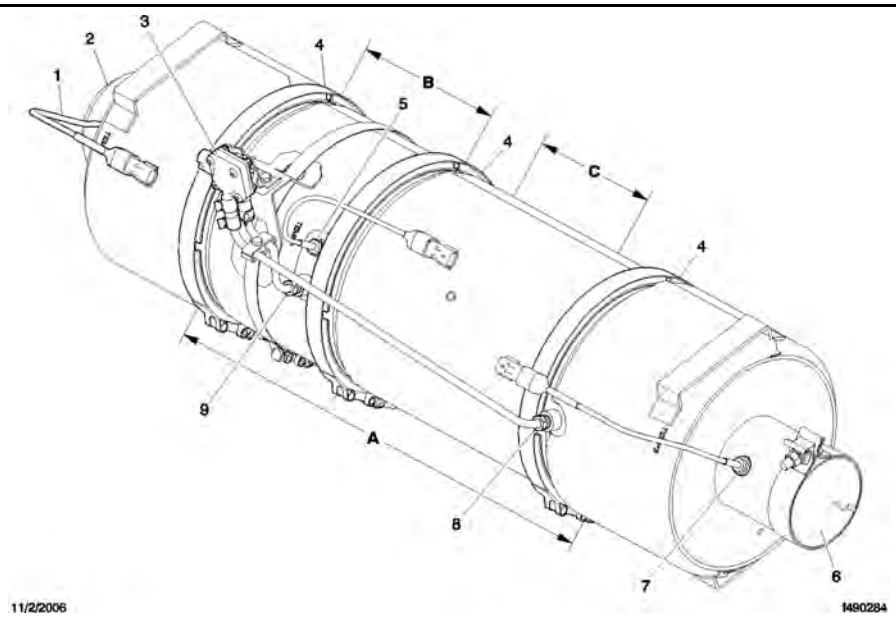


A. Inspect this area of the canister for dents.
B. DOC Area
C. DPF Area
1. Inlet Temperature Sensor
2. Marmon Fitting at Inlet from Turbocharger
3. Sensor Housing
4. DPF V-Band Mounting Clamps
5. Inlet Temperature Sensor
6. Exhaust Outlet to Diffuser
7. Outlet Temperature Sensor
8. DPF Outlet Pressure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

Fig 87, Cummins Aftertreatment Device

Inspection of the EPA07 Exhaust System

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.
3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.
5. Check for leaks around all clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD. No leaks are allowed anywhere in the system.
6. Check all sensors attached to the ATD for leaks or damaged wires.
7. Check the DPF exterior surface for dents or other damage. See Fig.88,Cummins Aftertreatment Device, Reference A. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.



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

Fig 88, Cummins Aftertreatment Device

8. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.
9. Check any wires, lines, or hoses within 4 inches (10 cm) of the exhaust system for heat damage. Repair or reroute as needed.

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20. Electrical, Instruments, and Controls

20.01 Safety Precautions

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

DANGER:

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

20.02 Checking the Lighting System

Check all lighting units and wiring for loose connections, corrosion, poor grounds, loose mountings, and pinched or damaged wires; repair or replace as needed.

20.03 Checking and Cleaning the Battery, Battery Box, and Cable

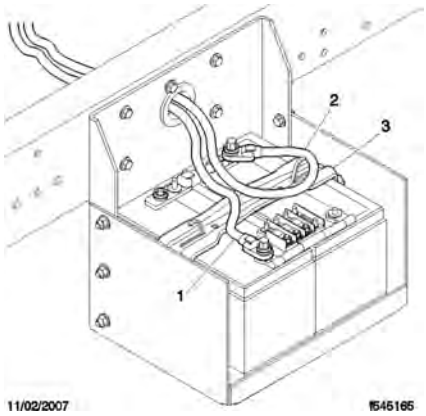
WARNING:

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. Remove any corrosion from the battery box and the top of the battery. See Fig.89,Battery Box.

   Use distilled ammonia or a soda solution to neutralize any acid present. Flush off the ammonia or soda solution with clear water.



1. Negative Terminal
2. Positive Terminal
3. Clamp Assembly

Fig 89, Battery Box

2. Check the battery cases for cracks. Replace a battery if its case is cracked.
3. Disconnect the battery cables from the battery posts, and check for corrosion.

   If corrosion is found, clean the terminals and posts, using a wire brush and a solution of baking soda and water. Use the solution sparingly.
4. Connect the cables to the batteries, and tighten them 10 to 15 lbf·ft (14 to 20 N·m). Spray each connection terminal with dielectric red enamel.
5. Check the battery-to-starter cables. Look for kinking, corrosion, breaks in the insulation, and heat damage. Check that the cable clamps are not bent, damaged, or stripped of insulation.

   IMPORTANT: If a battery cable is damaged, replace the entire cable. Never splice a battery cable.

6. Check the mounting fasteners for tightness, and tighten them 60 lbf·ft (81 N·m) if necessary. The battery box must be kept in good condition to support the batteries securely and to keep them level.

NOTICE:

Failure to keep the batteries held securely in place could result in battery damage, such as loose plates or posts.

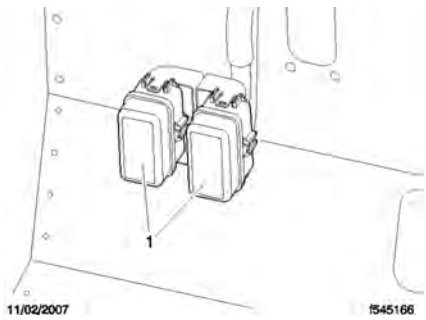
20.04 Checking and Cleaning the Ground Cables

Check that the ground cables are clean, undamaged, and tight. If needed, disconnect them, clean the mating surfaces with a soda solution, then connect them securely. Protect the ground cable connections with dielectric red enamel.

20.05 Checking the Electrical System

20.05.01 Dash

1. Uncover the electrical power center and remove the fasteners. See Fig.90,Electrical Power Center.



1. Fuse, Relay, and Circuit Breaker

Fig 90, Electrical Power Center

2. Check the wiring harness for movement that could strain the electrical connections. Install more clamps on the harness, if needed.
3. Check all the wiring for chafing, kinks, and discolored insulation. Find the cause of any problems, then repair, replace, or reroute the wires, as needed.
4. Check that all the relays are firmly seated in their mounting plates.
5. Remove the instrument and control panels and check all the wiring behind them for kinks, chafing, heat damage, and discolored insulation. Reroute, repair, or replace the wires as needed.
6. Check the tightness of all the electrical connections behind the panels. Make sure that all male and female connectors are firmly connected, and check the tightness of the nuts on the ring connectors. Tighten them 30 lbf·in (339 N·cm).
7. Test the electric horn. If it is not fully operational, use the schematics and troubleshooting information in and of the **Walk-In Van Chassis Workshop Manual** to identify and repair any problems.

20.05.02 Chassis

1. Check the main wiring harness. Check the wiring insulation for damage from chafing or heat. Also check for kinks. Reroute, repair, or replace the wires as needed.
2. Check all the tie straps for breakage or damage. Replace any broken or cracked tie straps.

NOTICE:

Do not use flat-strip aluminum tie straps for holding electrical wiring. The sharp edges on these tie straps may cause breaks in the wire insulation, allowing the aluminum tie strap to make contact with the wire. This could cause a short circuit and damage to the wiring.

3. Check all clamps, plastic connectors, and grommets. Replace any that are damaged. Make sure all grommets are fully seated.
4. Check the battery cable connections on the starter for tightness. Make sure they are free of corrosion. Add dielectric grease as needed.

5. Check the magnetic switch terminals and connections for tightness. Protect the magnetic switch terminals with dielectric red enamel as needed.
6. Check the wires of all sensors mounted on or near the engine. Make sure no wires are closer than 6 inches (15 cm) to hot surfaces. If any are, and they cannot be rerouted, make sure they are protected by heat shields. Check the sensor connectors. Make sure they are tight, clean, and undamaged.

20.06 Checking the Battery Voltage

Check the battery open circuit voltage using an accurate voltmeter. If the voltmeter registers 12.5V or below, fully charge the battery to 12.65V. A fully charged battery will have a voltage of 12.65V with the charger disconnected.

20.07 Inspection of the Charge Port, Electric Vehicle

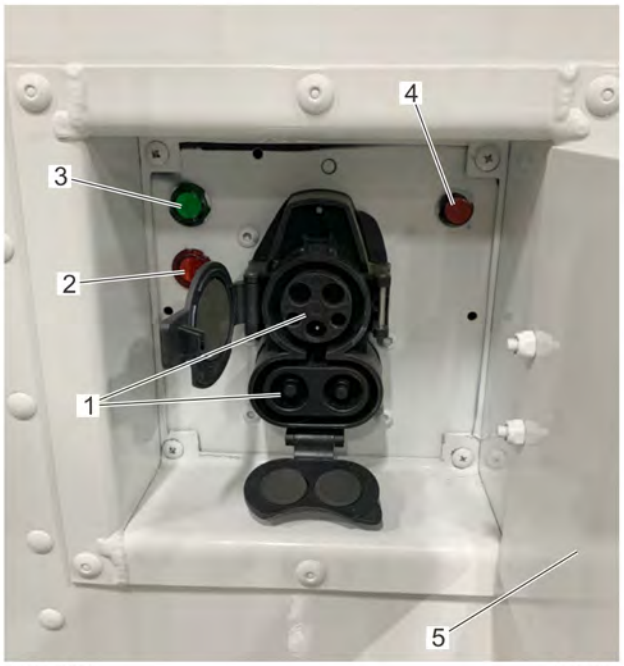
Verify that there is no debris around the charge port. Connect a battery charging dispenser to the vehicle charge port and verify that the charge port functions correctly.

IMPORTANT: The following battery charging instructions are used with the Proterra battery charging dispenser. If another battery charging dispenser is used, refer to the manufacturer's instructions to charge the vehicle batteries.

1. Park the vehicle near the charging dispenser, turn the ignition key to the OFF position, and set the parking brake.

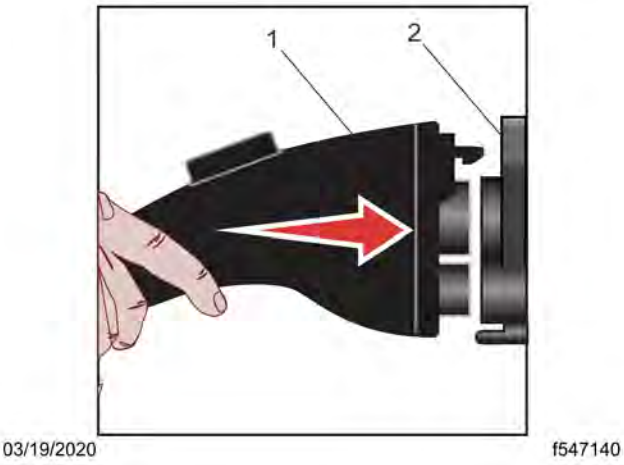
   NOTE: The battery disconnect switch is located inside the battery box on the side-wall.

2. Ensure that the battery disconnect switch is in the ON position. The disconnect switch must be in the ON position in order to charge the batteries.
3. Open the charge port door, located behind the entrance door. See Fig.91,Vehicle Charge Port.
4. Plug the power feed connector into the charge port. Push hard until a 'click' sound is made. See Fig. 92,Plugging the Power Feed Connector into the Charge Port.



1. Charge Port
2. Red LED - indicates a problem with the charger connection.
3. Green LED - flashes when charging; remains solid when charging is complete.
4. End Charge Button - press when charging is complete.
5. Charge Port Door

Fig 91, Vehicle Charge Port



1. Power Feed Connector
2. Charge Port

Fig 92, Plugging the Power Feed Connector into the Charge Port

5. The green lamp above the charge port will begin to flash, indicating the batteries are being charged. Wait 2 to 5 minutes, then verify that the lamp continues to flash.

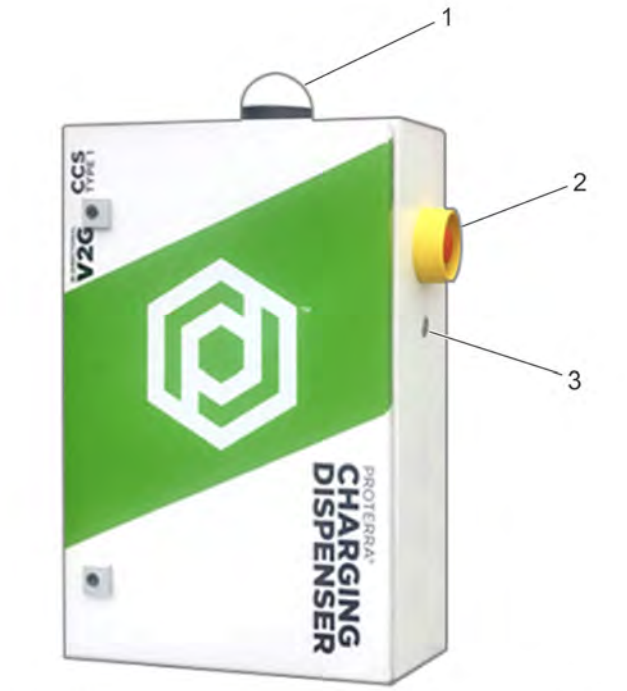
   After this time, the inspection is complete; you can go to the remaining steps to end the charging session and disconnect the power feed connector. The vehicle batteries do not need to be fully charged to complete this inspection.

6. The charging dispenser has a lamp to indicate the charging status. See Table.23,Charging Dispenser Lamp Legend.
7. Once battery charging is complete, or to end a charging session, press the end charge button either on the vehicle charging port, shown in Fig.91,Vehicle Charge Port, item 2, or on the charging dispenser, shown in Fig. 93,Charging Dispenser, item 3, then wait 15 seconds.
8. After waiting 15 seconds, ensure that the green lamp above the charge port is flashing rapidly. Then press the release button to disconnect the power feed connector. See Fig.94,Removing the Power Feed Connector.

Table 23, Charging Dispenser Lamp Legend

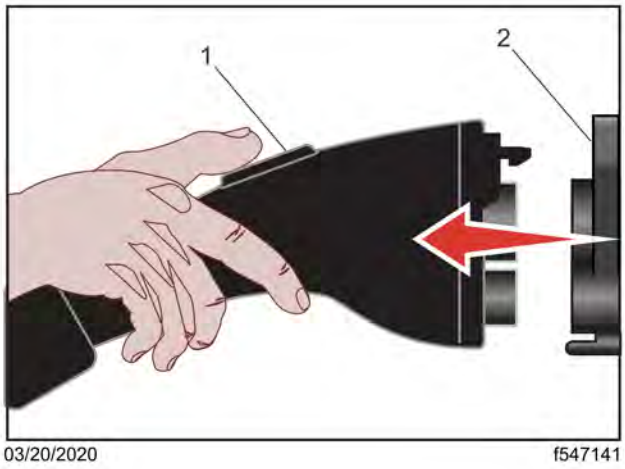
Lamp Color	Description
White	Available to charge the vehicle.
Green (communication)	Solid - charging dispenser is plugged up but not communicating with the vehicle.
	Flashing - charging dispenser is communicating with the vehicle.
Blue (charging)	Flashing - batteries are being charged.
	Solid - batteries charged to 100% capacity.
Red	Out of service.

Table 23, Charging Dispenser Lamp Legend



1. Charge Dispenser Status Lamp
2. E-Stop Button (for emergency only)
3. End Charge Button

Fig 93, Charging Dispenser



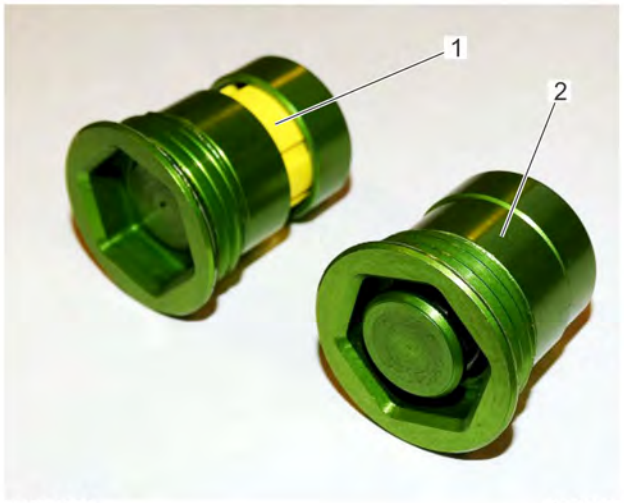
1. Release Button
2. Charge Port

Fig 94, Removing the Power Feed Connector

20.08 Replacement of the Battery Pack Desiccant, Electric Vehicle

Battery pack desiccant replacement should be performed every 12 months. This procedure describes the steps to replace the battery pack desiccant in the battery packs of the electric vehicle. The battery pack desiccant may be replaced based on time in service or an indication that moisture has entered the pack. The salt plugs for the desiccant area have a built-in

indicator for moisture contamination. See Fig.95,Normal and Contaminated Salt Plugs shows normal and contaminated plugs. If a plug has been exposed to moisture, it will be necessary to override spring tension when inserting an Allen wrench for removal. If a battery pack desiccant has internal leakage, indicated by the salt plug, this should be diagnosed and repaired before replacing the desiccant.

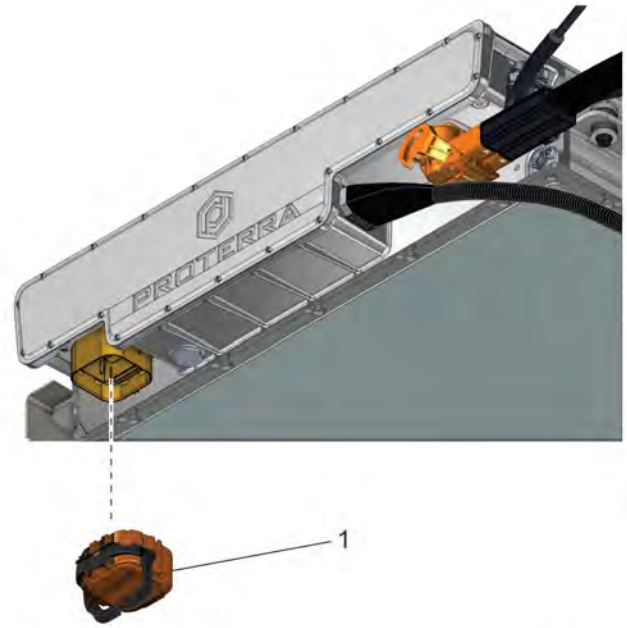


NOTE: A normal plug is yellow at the end; a contaminated plug does not appear yellow at the end.

1. Normal Salt Plug
2. Contaminated Salt Plug

Fig 95, Normal and Contaminated Salt Plugs

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake.
2. Ensure that the battery pack manual service disconnect is removed. See Fig. 96,Battery Pack Manual Service Disconnect.



1. Battery Pack Manual Service Disconnect

Fig 96, Battery Pack Manual Service Disconnect

3. Using a torque wrench with a 17 mm Allen socket, remove the salt plugs at each end of the battery pack desiccant chamber. See Fig.97,Removing the Salt Plugs.



NOTE: Remove the salt plugs at each end of the battery pack desiccant chamber.

1. Salt Plug

Fig 97, Removing the Salt Plugs

4. Attach the hook end of a Jameson Glow Rod (or equivalent) to a straight section of rod. See Fig. 98,Attaching the Hook to an Extension Rod and Fig.99,Assembled Hook and Extension Rod.

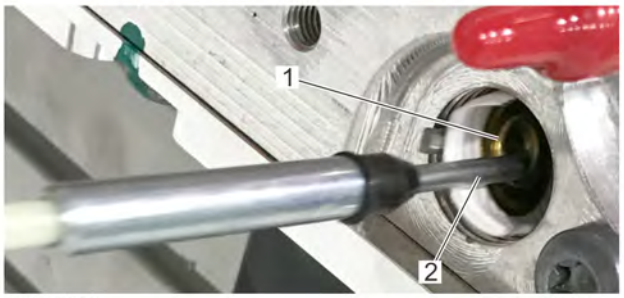


Fig 98, Attaching the Hook to an Extension Rod



Fig 99, Assembled Hook and Extension Rod

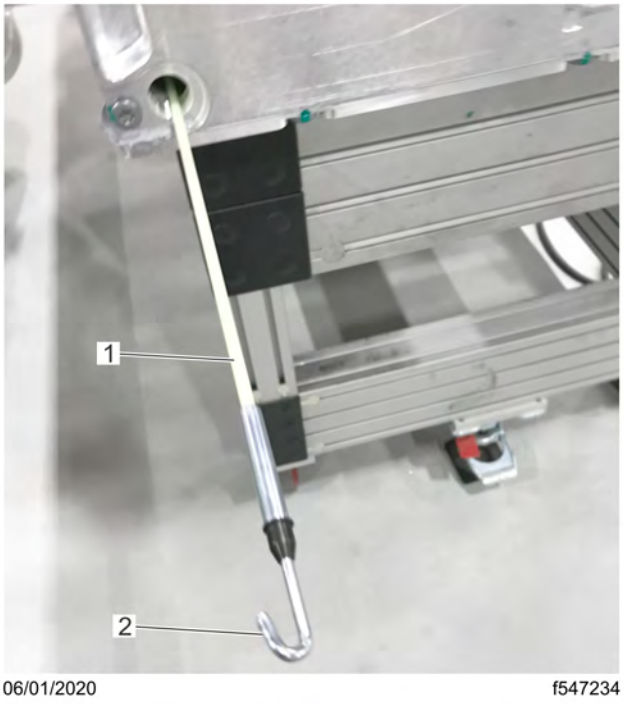
5. Locate the grommet on the end of the battery pack desiccant near the cooling loop. Grab the grommet with the hook-end of the Jameson Glow Rod (or equivalent) and pull the old battery pack desiccant out of the battery pack and discard it. See Fig.100,Removing the Battery Pack Desiccant.



1. Grommet
2. Extension Rod and Hook

Fig 100, Removing the Battery Pack Desiccant

6. Starting at the end of the battery pack with the coolant loop, push the hooked end of the Jameson Glow Rod all the way through the pack until the hook exits the other side, as shown in Fig. 101,Pushing the Hooked End of the Rod Through the Desiccant Chamber.

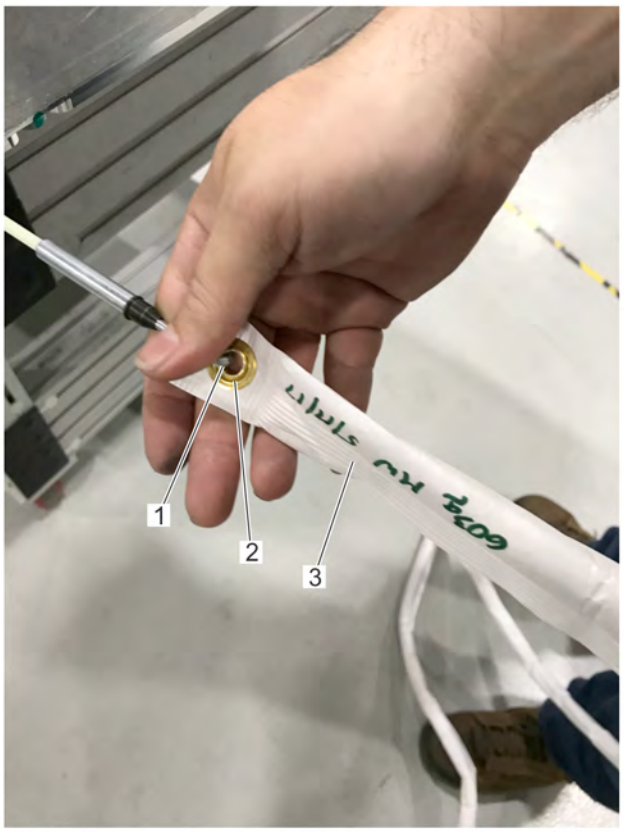


NOTE: The hooked end exits the other side of the battery pack.

1. Glow Rod
2. Hook

Fig 101, Pushing the Hooked End of the Rod Through the Desiccant Chamber

7. Attach the hook-end of the glow rod to the grommet of a new battery pack desiccant. See Fig. 102,Attaching a New Battery Pack Desiccant to the Glow Rod.



1. Glow Rod (hook-end)
2. Grommet
3. Battery Pack Desiccant

Fig 102, Attaching a New Battery Pack Desiccant to the Glow Rod

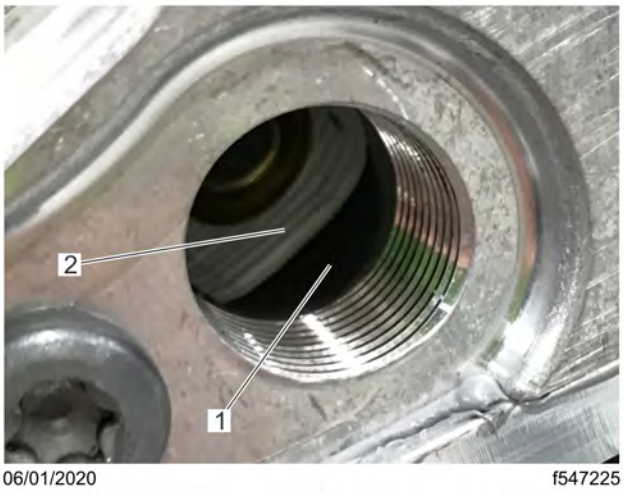
NOTE: Two technicians are needed for the following step.

8. Carefully push the new battery pack desiccant from one end of the battery pack and pull it from the other end, as shown in Fig.103,Pulling Desiccant Through the Battery Pack.



Fig 103, Pulling Desiccant Through the Battery Pack

9. Tuck both ends of the battery pack desiccant securely into the desiccant chamber of the battery pack. See Fig. 104,Ends of the Battery Pack Desiccant Tucked into the Desiccant Chamber.



1. Desiccant Chamber
2. Battery Pack Desiccant

Fig 104, Ends of the Battery Pack Desiccant Tucked into the Desiccant Chamber

10. Apply Vibra-Tite 42050 thread sealant as needed to the salt plugs that were removed earlier (or new salt plugs if they were replaced). See Fig.105,Applying Thread Sealant to the Salt Plugs.

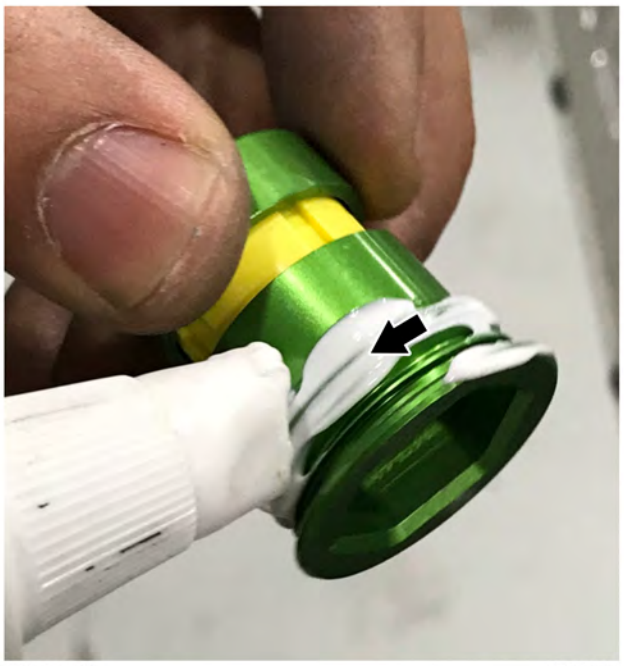


Fig 105, Applying Thread Sealant to the Salt Plugs

11. Install the salt plugs at each end of the battery pack desiccant chamber using a calibrated torque wrench with a 17 mm Allen socket. Tighten the plugs 22 lbf·ft (30 N·m). For reference, refer to Fig. 95,Normal and Contaminated Salt Plugs and Fig.97,Removing the Salt Plugs.
12. Install the battery pack manual service disconnect removed earlier. See Fig. 96,Battery Pack Manual Service Disconnect.

CONTACT INFORMATION

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

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