



Run Smart™

BUSINESS CLASS® M2



Driver's Manual

STI-455-6
A24-01238-000

Introduction

This manual provides information needed to operate and understand the vehicle and its components. More detailed information is contained in the *Owner's Warranty Information for North America* booklet, and in the vehicle's workshop and maintenance manuals.

Custom-built Freightliner vehicles are equipped with various chassis and cab components. Not all of the information contained in this manual applies to every vehicle. For details about components in your vehicle, refer to the chassis specification pages included in all new vehicles and to the vehicle specification decal, located inside the vehicle.

For your reference, keep this manual in the vehicle at all times.

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

Environmental Concerns and Recommendations

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

Event Data Recorder

This vehicle is equipped with one or more devices that record specific vehicle data. The type and amount of data recorded varies depending on how the vehicle is equipped (such as the brand of engine, if an air bag is installed, or if the vehicle features a collision avoidance system, etc.).

Emissions and Fuel Efficiency Compliance

This vehicle must be regularly inspected and maintained as indicated in the *Business Class M2 Maintenance Manual*, and in the *Pretrip and Post-Trip Inspections and Maintenance* chapter in this manual, in order to continue satisfactory performance and ensure coverage of the vehicle under the manufacturer's warranty. Many maintenance procedures ensure that the vehicle and engine continue to comply with applicable emissions standards. Maintenance procedures, using components engineered to comply with greenhouse gas emissions and fuel efficiency regulations, may be performed by an authorized Daimler Trucks North America dealer, an independent outlet, or the vehicle owner or operator.

The vehicle owner is responsible for determining the suitability of replacement components to maintain compliance with federal and local jurisdictional regulations. Components including, but not limited to, tires, cab/sleeper side extenders, chassis fairings, bumper, hood, vehicle speed limiters, and idle reduction timers are specifically designed and manufactured to exacting standards for regulatory fuel efficiency and greenhouse gas emissions compliance. It is important that these components are always replaced with components that meet or exceed the performance of the originally installed components.

Customer Assistance Center

Having trouble finding service? Call the Customer Assistance Center at 1-800-385-4357 or 1-800-FTL-HELP. Call night or day, weekdays or weekends, for dealer referral, vehicle information, breakdown coordination, or Fleetpack assistance. Our people are knowledgeable, professional, and committed to following through to help you keep your truck moving.

Reporting Safety Defects

If you believe that your vehicle has a defect which could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying Daimler Trucks North America LLC.

If the NHTSA receives similar complaints, it may open an investigation, and if it finds that a safety

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defect exists in a group of vehicles, it may order a recall and remedy campaign. However, NHTSA cannot become involved in individual problems between you, your dealer, or Daimler Trucks North America LLC.

To contact NHTSA, you may call the Vehicle Safety Hotline toll-free at 1-888-327-4236 (TTY: 1-800-424-9153); go to www.safercar.gov; or write to: Administrator, NHTSA, 1200 New Jersey Avenue, SE, Washington, DC 20590. You can also obtain other information about motor vehicle safety from www.safercar.gov.

Canadian customers who wish to report a safety-related defect to Transport Canada, Defect Investigations and Recalls, may telephone the toll-free hotline 1-800-333-0510, or contact Transport Canada by mail at: Transport Canada, ASFAD, Place de Ville Tower C, 330 Sparks Street, Ottawa, Ontario, Canada K1A 0N5.

For additional road safety information, please visit the Road Safety website at: www.tc.gc.ca/roadsafety.

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Vehicle Identification

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Vehicle Identification

Component Information Label

NOTE: Labels shown in this chapter are examples only. Actual specifications may vary from vehicle to vehicle.

The component information label lists the vehicle model, identification number, and major component models. It also lists the major assemblies and installations shown on the chassis specification sheet. One copy of the component information label is installed on the right-side dash; another copy is inside the rear cover of the *Owner's Warranty Information for North America* booklet. An illustration of the label is shown in **Fig. 1.1**.

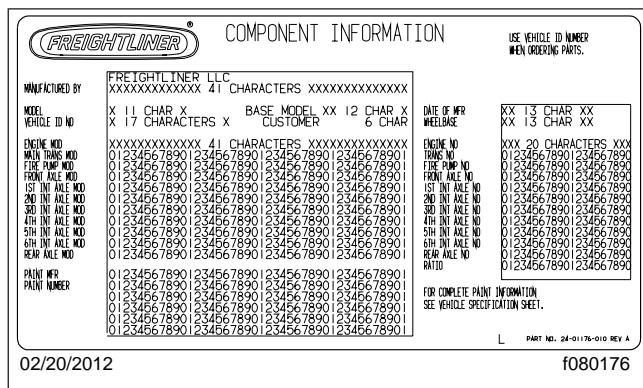


Fig. 1.1, Component Information Label

Federal Motor Vehicle Safety Standard Labels

NOTE: Due to the variety of Federal Motor Vehicle Safety Standard (FMVSS) certification requirements, not all of the labels shown will apply to your vehicle.

Tractors with or without fifth wheels purchased in the U.S. are marked as certified by means of an FMVSS certification label. See **Fig. 1.2**. This label is attached to the driver-side B-pillar, as shown in **Fig. 1.3**.

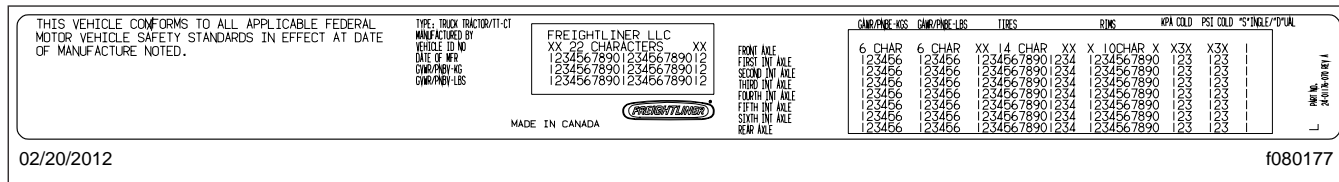


Fig. 1.2, Vehicle Certification Label

The tire and rim portion of the FMVSS certification label certifies suitable tire and rim combinations that can be installed on the vehicle, for the given gross axle weight rating. Tires and rims installed on the vehicle at the time of manufacture may have a higher load capacity than that certified by the tire and rim label. If the tires and rims currently on the vehicle have a lower load capacity than that shown on the tire and rim label, then the tires and rims determine the load limitations on each of the axles.

Trucks built without a cargo body that are intended for service in the U.S. have an incomplete vehicle certification label attached by the final-stage manufacturer. See **Fig. 1.4**. This label will be attached to the incomplete vehicle document included with the vehicle, and certifies that the vehicle conforms to all applicable FMVSS regulations in effect on the date of completion.

Canadian Motor Vehicle Safety Standard Labels

In Canada, tractors with fifth wheels are marked as certified by means of a statement of compliance label with the Canadian National Safety Mark attached to the driver-side door frame B-pillar. See **Fig. 1.5**.

If purchased for service in Canada, trucks built without a cargo body and tractors built without a fifth wheel are marked as certified by a "Statement of Compliance" label, similar to **Fig. 1.4**. This label must be attached by the final-stage manufacturer to certify that the vehicle conforms to all applicable Canada Motor Vehicle Safety Standard (CMVSS) regulations in effect on the date of completion.

Component GWR Label

The component GWR label is located on the passenger-side B-pillar. The label provides maximum GWR ratings for each component.

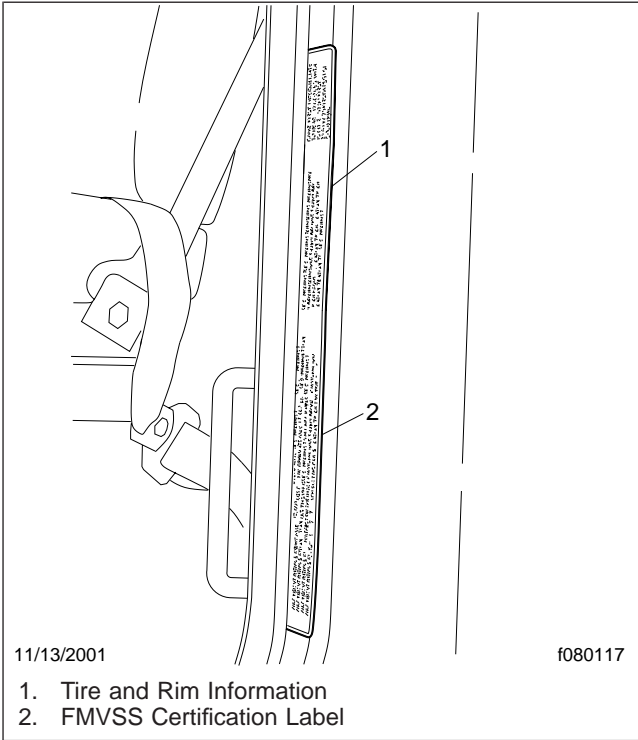


Fig. 1.3, Label Locations

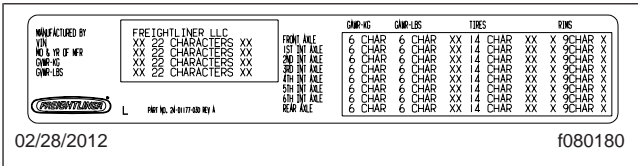


Fig. 1.4, Incomplete Vehicle Certification Label



Fig. 1.5, Canadian National Safety Mark

See [Fig. 1.6](#) for a typical component GWR label.

Emission Labels

Aftertreatment System Indicators Label

Engines and vehicles manufactured after December 31, 2006 and domiciled in the U.S. or Canada are required to meet all EPA regulations effective as of the vehicle build date, and are equipped with an emission aftertreatment system (ATS). Vehicles domiciled outside of the U.S. and Canada may not have aftertreatment equipment, depending upon local statutory emissions guidelines. See [Table 1.1](#).

A warning label on the driver-side visor contains important warning indicators in the instrument cluster that pertain to the ATS. See [Fig. 1.7](#) or [Fig. 1.8](#).

It is a violation of U.S. federal law to alter exhaust plumbing, ATS, or other components in any way that would bring the engine/vehicle out of compliance with certification requirements [Ref: 42 U.S.C. S7522(a) (3)]. It is the owner's responsibility to maintain the vehicle so that it conforms to EPA regulations.

EPA Noise Emission Control Label

A vehicle noise emission control label ([Fig. 1.9](#)) is located on the driver-side B-pillar as shown in [Fig. 1.3](#). It is the owner's responsibility to maintain the vehicle so that it conforms to EPA regulations.

IMPORTANT: Certain Freightliner incomplete vehicles may be produced with incomplete noise control hardware and will not have a noise emission control information label. For such vehicles, it is the final-stage manufacturer's responsibility to complete the vehicle in conformity to EPA regulations (40 CFR Part 205) and label it for compliance.









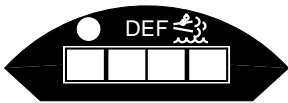
EXHAUST AFTERTREATMENT SYSTEM INFORMATION					
INDICATOR LAMP(S)	 (Solid) Level 1	 (Flashing) Level 2	 (Flashing) CHECK Level 3	 STOP Level 4	 WARNING 
Indicator Lamp Message(s)	Filter Regeneration Recommended.	Filter Regeneration Necessary	Parked Regeneration Required – Engine Derate	Service Regeneration Required. Engine Derate To Idle Only.	HEST (High Exhaust System Temperature)
Diesel Particulate Filter Condition	Filter is reaching capacity.	Filter is now reaching maximum capacity.	Filter has reached maximum capacity.	Filter has exceeded maximum capacity.	Flashing A regeneration is in progress.
Required Action	Bring vehicle to highway speeds to allow for an Automatic Regeneration or perform a Parked Regeneration.	To avoid engine derate, bring vehicle to highway speeds to allow for an Automatic Regeneration, or perform a Parked Regeneration as soon as possible.	Vehicle must be parked, and a Parked Regeneration must be performed. Engine will begin derate.	Vehicle must be parked, and a Service Regeneration must be performed. Check engine operator's manual for details. Engine will shut down.	Solid Exhaust components and exhaust gas are at high temperature. When stationary, keep away from people and flammable materials or vapors.
For a driver performed Parked Regeneration, vehicle must be equipped with a dash mounted Regeneration Switch.					

Fig. 1.7, ATS Indicators, EPA07

02/20/2009

f080156

Vehicle Identification

IMPORTANT	
<p>DPF Regen Needed</p> 	<ul style="list-style-type: none"> • Diesel Particulate Filter (DPF) regeneration is needed. • If flashing, regenerate as soon as possible. Engine derate possible.
<p>Hot Exhaust</p> 	<ul style="list-style-type: none"> • Hot exhaust can cause fire. • Keep flammables and people away from exhaust.
<p>DEF Refill Needed</p> 	<ul style="list-style-type: none"> • Diesel Exhaust Fluid (DEF) level is low. Engine derate likely. • Refill tank with certified DEF.
<p>See operator's manual for complete instructions.</p>	
<p style="text-align: right;">24-01656-000</p>	

11/30/2010 f080162

Fig. 1.8, ATS Indicators, EPA10 and Newer

VEHICLE NOISE EMISSION CONTROL INFORMATION

FREIGHTLINER CORPORATION (Freightliner) DATE OF MANUFACTURE 01/96
 THIS VEHICLE CONFORMS TO U.S. EPA REGULATIONS FOR NOISE EMISSION APPLICABLE TO MEDIUM AND HEAVY TRUCKS.
 THE FOLLOWING ACTS OR THE CAUSING THEREOF BY ANY PERSON ARE PROHIBITED BY THE NOISE CONTROL ACT OF 1972:
 A. THE REMOVAL OR RENDERING INOPERATIVE, OTHER THAN FOR PURPOSES OF MAINTENANCE, REPAIR, OR REPLACEMENT, OF ANY NOISE CONTROL DEVICE OR ELEMENT OF DESIGN (LISTED IN THE OWNER'S MANUAL) INCORPORATED INTO THIS VEHICLE IN COMPLIANCE WITH THE NOISE CONTROL ACT.
 B. THE USE THIS VEHICLE AFTER SUCH DEVICE OR ELEMENT OF DESIGN HAS BEEN REMOVED OR RENDERED INOPERATIVE.

24-00273-000

10/06/98 f080026

Fig. 1.9, Vehicle Noise Emission Control Label

VEHICLE EMISSION CONTROL INFORMATION

MANUFACTURED BY:	REGULATORY CLASS:	DATE OF MANUFACTURE:
VEH:		
VEH FAMILY CD:		
GVWR-RG:		
GVWR-LBS:	EMISSION CONTROL IDENTIFIERS:	

(Freightliner) THIS VEHICLE COMPLIES WITH U. S. EPA REGULATIONS FOR XXXX HEAVY DUTY VEHICLES. SEE OWNER'S MANUAL FOR PROPER MAINTENANCE OF THIS VEHICLE. U PART NO. 24-0117-060 REV A

02/29/2012 f080181

Fig. 1.10, Vehicle Emission Control Information Label



CERTIFIED
CLEAN IDLE

02/20/2012 f080179

Fig. 1.11, CARB Clean Idle Label

2

Vehicle Access

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Vehicle Access

Cab Door Locks and Handles

One key operates the ignition switch and all of the door locks.

IMPORTANT: Each key is numbered. Record the number so a duplicate key can be made, if needed.

To unlock the driver's door from outside the cab, insert the key in the lockset and turn it one-quarter turn clockwise (**Fig. 2.1**). To remove the key, turn it counterclockwise to its original position. Pull out on the door pull handle to open the door.

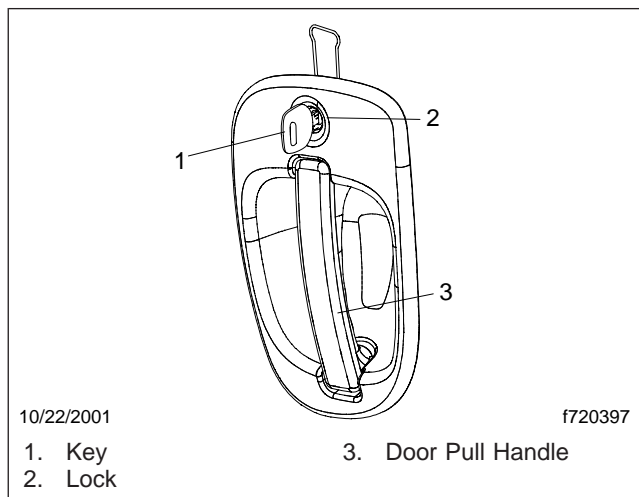


Fig. 2.1, Exterior Door Handle

To unlock the passenger's door from outside the cab, insert the key in the lockset and turn it one-quarter turn counterclockwise. Turn the key clockwise to the original position to remove it.

NOTE: The cab door locks can be operated when the doors are open.

To lock a door from outside the cab, do either one of the following:

- Insert the key in the lockset and turn it in the direction opposite to the unlocking direction (counterclockwise for the driver's door, clockwise for the passenger's door). Close the door if it is open.
- Push down the inside lock button (**Fig. 2.2**). Close the door.

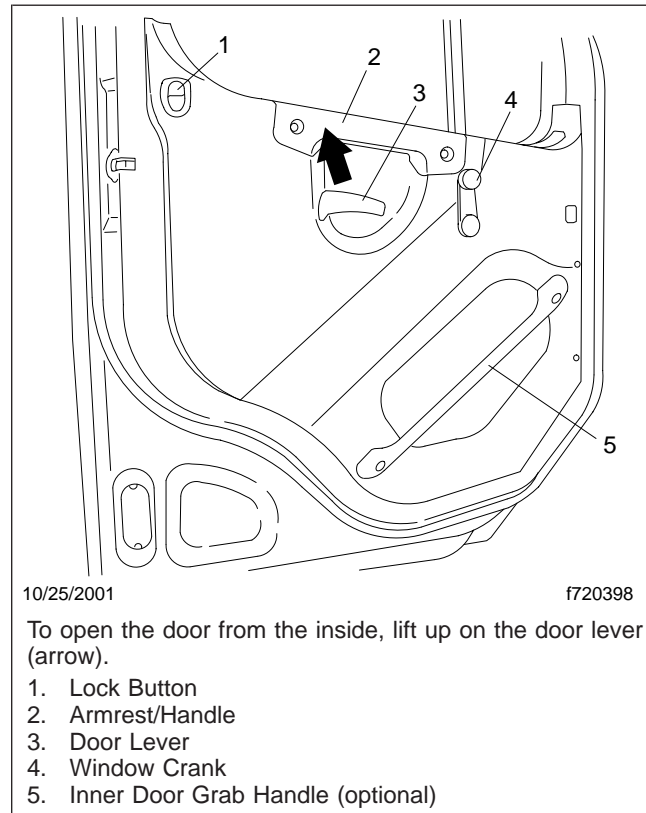


Fig. 2.2, Door Interior

To open the door from the inside, lift up on the door lever. This will unlatch the door whether or not it is locked. If it is open, close the door by pulling the inner door grab handle.

To lock either door from inside the cab, slide the lock button downwards (**Fig. 2.3**). To unlock the door without unlatching it, push the lock button upwards. A red dot will show below the lock button when it is unlocked.

Grab Handles and Access Steps

For ease of entry and exit, there are three grab handles, one on the A-pillar, one on the inner B-pillar, and an optional one on the inside of the door. In addition, the steering wheel may be used to provide secure handholds. There are one or two access steps to provide secure footholds.

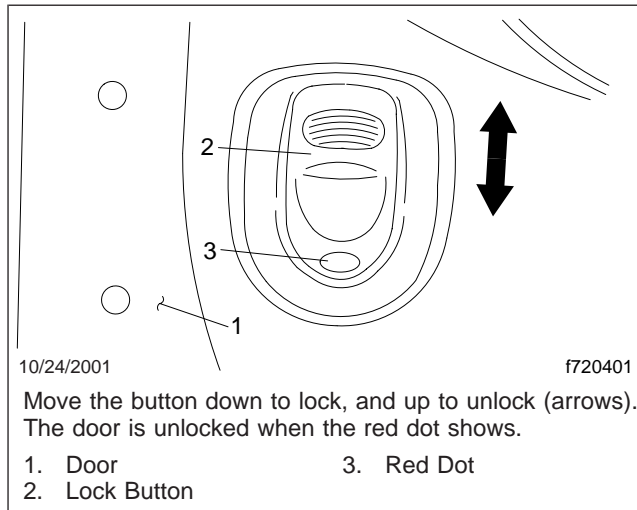


Fig. 2.3, Door Lock Button

NOTE: The A-pillar grab handle is not installed on the driver's side.

The grab handles, access steps, and steering wheel are all part of the cab access system. Use these "helping hands" when getting into, or out of, the cab. They will increase your security and comfort.

Cab Entry and Exit, Vehicles With Two Steps

WARNING

Wet or dirty shoe soles greatly increase the chance of slipping or falling. If your soles are wet or dirty, be especially careful when climbing onto, or down from, the back-of-cab area.

Always maintain three-point contact with the back-of-cab access supports while entering and exiting the back-of-cab area. Three-point contact means both feet and one hand, or both hands and one foot, on the grab handles, steps, and deck plates. Other areas are not meant to support back-of-cab access, and grabbing or stepping in the wrong place could lead to a fall, and personal injury.

Be careful not to get hands or feet tangled in hoses or other back-of-cab equipment. Carelessness could cause a person to trip and fall, with possible injury.

Use the cab access system (grab handles, access steps, and steering wheel) to enter or exit the cab.

Entering from the Driver's Side

To enter the cab from the driver's side, do the following steps (**Fig. 2.4**):

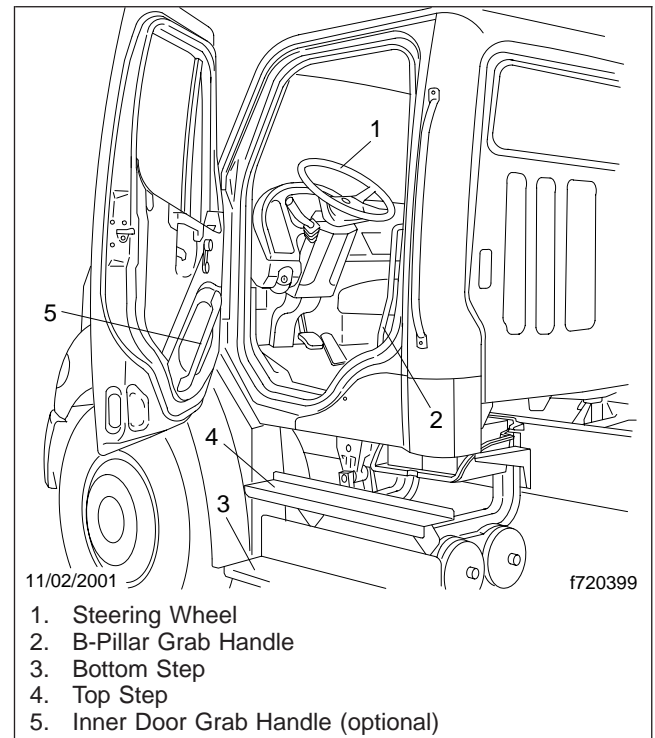


Fig. 2.4, Cab Access System, Driver's Side

1. Use the door pull handle to open the driver's door, and place anything that you are carrying in the cab.
2. Grasp the B-pillar grab handle with both hands. Reach up as far as is comfortable.
3. Place your right foot on the bottom step, and pull yourself up.
4. Place your left foot on the top step.
5. Grasp the steering wheel with your left hand, and step up.
6. Step into the cab with your right foot first, and grasp the steering wheel with your right hand.

Vehicle Access

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Exiting from the Driver's Side

To exit the cab from the driver's side, do the following steps (**Fig. 2.4**):

IMPORTANT: Do not attempt to exit the cab while carrying any items in your hands.

1. If you wish to take any items with you, after you exit the cab, place them in an accessible location on the seat or cab floor. Make sure they will not get in your way as you exit.

WARNING

Always face in when exiting the cab. Do not attempt to exit with your back to the cab, as you would going down a flight of stairs. It is easier to slip or lose your balance. If you slip when exiting in this way, there is a greater likelihood of personal injury.

2. Grasp the steering wheel with both hands. Place your left foot on the top step, and stand on the threshold, facing into the cab.
3. Move your right hand to the B-pillar grab handle.
4. Move your right foot to the bottom step.
5. Move your left hand to the B-pillar grab handle.
6. Step to the ground with your left foot first.
7. Retrieve from the cab any items that you wish to take with you.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Entering from the Passenger's Side

To enter the cab from the passenger's side, do the following steps (**Fig. 2.5**):

1. Open the passenger's door, and place anything that you are carrying in the cab.
2. Grasp the B-pillar grab handle on the door with both hands.

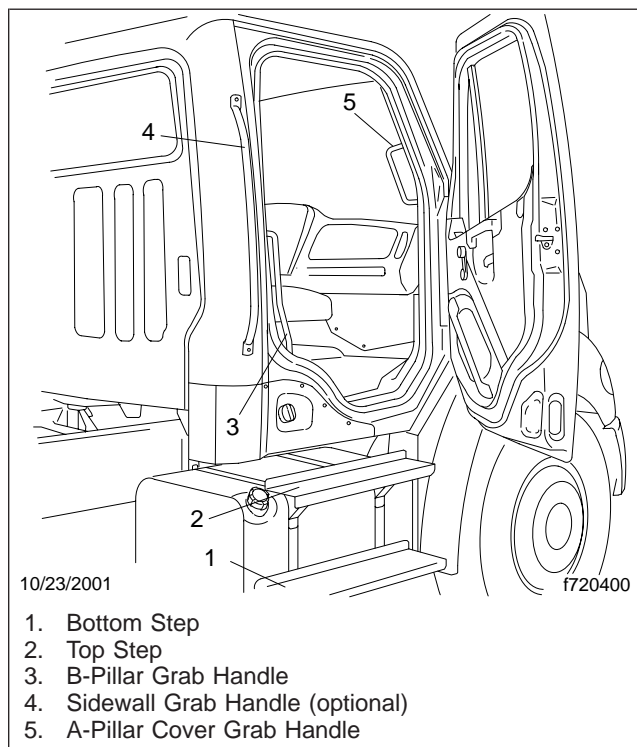


Fig. 2.5, Cab Access System, Passenger's Side and Back of Cab

3. Place your left foot on the bottom step and step up to the upper step with your right foot.
4. Move your right hand to the A-pillar cover grab handle.
5. Place your left foot on the top step and step up.
6. Move your left hand to the A-pillar cover grab handle.
7. Step into the cab with your left foot first.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Exiting from the Passenger's Side

To exit the cab from the passenger's side, do the following steps (**Fig. 2.5**):

IMPORTANT: Do not attempt to exit the cab while carrying any items in your hands.

1. If you wish to take any items with you, after you exit the cab, place them in an accessible location

on the seat or cab floor. Make sure they will not get in your way as you exit.

WARNING

Always face in when exiting the cab. Do not attempt to exit with your back to the cab, as you would going down a flight of stairs. It is easier to slip or lose your balance. If you slip when exiting in this way, there is a greater likelihood of personal injury.

2. Grasp the A-pillar cover grab handle with both hands, then place your right foot on the top step while standing up from the seat facing inward.
3. Place your left foot on the top step.
4. Move your left hand to the B-pillar grab handle.
5. Move your left foot to the bottom step.
6. Move your right hand to the B-pillar grab handle.
7. Step to the ground with your right foot first.
8. Retrieve from the cab any items that you wish to take with you.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Cab Entry and Exit, Vehicles With One Step

WARNING

Wet or dirty shoe soles greatly increase the chance of slipping or falling. If your soles are wet or dirty, be especially careful when climbing onto, or down from, the back-of-cab area.

Always maintain three-point contact with the back-of-cab access supports while entering and exiting the back-of-cab area. Three-point contact means both feet and one hand, or both hands and one foot, on the grab handles, steps, and deck plates. Other areas are not meant to support back-of-cab access, and grabbing or stepping in the wrong place could lead to a fall, and personal injury.

Be careful not to get hands or feet tangled in hoses or other back-of-cab equipment. Careless-

ness could cause a person to trip and fall, with possible injury.

Use the cab access system (grab handles, access steps, and steering wheel) to enter or exit the cab.

Entering from the Driver's Side

To enter the cab from the driver's side, do the following steps ([Fig. 2.4](#)):

1. Use the door pull handle to open the driver's door, and place anything that you are carrying in the cab. Use the door armrest/handle and, if available, the inner door grab handle, as a support if needed.
2. Grasp the B-pillar grab handle with both hands. Reach up as far as is comfortable.
3. Place your right foot on the step, and pull yourself up.
4. Step into the cab with your left foot.
5. Grasp the steering wheel with your left hand.
6. Step into the cab with your right foot, and grasp the steering wheel with your right hand.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Exiting from the Driver's Side

To exit the cab from the driver's side, do the following steps ([Fig. 2.4](#)):

IMPORTANT: Do not attempt to exit the cab while carrying any items in your hands.

1. If you wish to take any items with you, after you exit the cab, place them in an accessible location on the seat or cab floor. Make sure they will not get in your way as you exit.

WARNING

Always face in when exiting the cab. Do not attempt to exit with your back to the cab, as you would going down a flight of stairs. It is easier to slip or lose your balance. If you slip when exiting in this way, there is a greater likelihood of personal injury.

Vehicle Access

2. Grasp the steering wheel with both hands. Place your left foot on the step, and stand on the threshold, facing into the cab.
3. Move your right hand to the B-pillar grab handle.
4. Move your left hand to the B-pillar grab handle.
5. Move your right foot onto the step.
6. Step to the ground with your left foot first.
7. Retrieve from the cab any items that you wish to take with you.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Entering from the Passenger's Side

To enter the cab from the passenger's side, do the following steps (Fig. 2.5):

1. Open the passenger's door, and place anything that you are carrying in the cab.
2. Grasp the B-pillar grab handle with both hands.
3. Place your left foot on the step and step up to the cab with your right foot.
4. Move your right hand to the A-pillar cover grab handle.
5. Move your left hand to the A-pillar cover grab handle.
6. Step into the cab with your left foot.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Exiting from the Passenger's Side

To exit the cab from the passenger's side, do the following steps (Fig. 2.5):

IMPORTANT: Do not attempt to exit the cab while carrying any items in your hands.

1. If you wish to take any items with you, after you exit the cab, place them in an accessible location on the seat or cab floor. Make sure they will not get in your way as you exit.

WARNING

Always face in when exiting the cab. Do not attempt to exit with your back to the cab, as you would going down a flight of stairs. It is easier to slip or lose your balance. If you slip when exiting in this way, there is a greater likelihood of personal injury.

2. Grasp the A-pillar cover grab handle with both hands, then place your right foot on the step while standing up from the seat facing inward.
3. Place your left foot on the step.
4. Move your left hand to the B-pillar grab handle.
5. Move your right hand to the B-pillar grab handle.
6. Step to the ground with your right foot first.
7. Retrieve from the cab any items that you wish to take with you.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Back-of-Cab Access

When trailer air and electrical connections cannot be reached conveniently from the ground, Federal Motor Carrier Safety Regulations require commercial carriers to provide back-of-cab access.

Optional grab handles are mounted on each cab sidewall, or on the left sidewall only. See Fig. 2.6. Steps are mounted either on the fuel tank(s) or on metal brackets. When a deck plate is necessary, it is mounted across the top of the frame rails.

IMPORTANT: Climb onto, and down from, back-of-cab access facing in toward the vehicle, as you would on a ladder. Do not climb up or down facing out away from the vehicle.

WARNING

Wet or dirty shoe soles greatly increase the chance of slipping or falling. If your soles are wet or dirty, be especially careful when climbing onto, or leaving, the back-of-cab area.

Always maintain three-point contact with the back-of-cab access supports while entering and

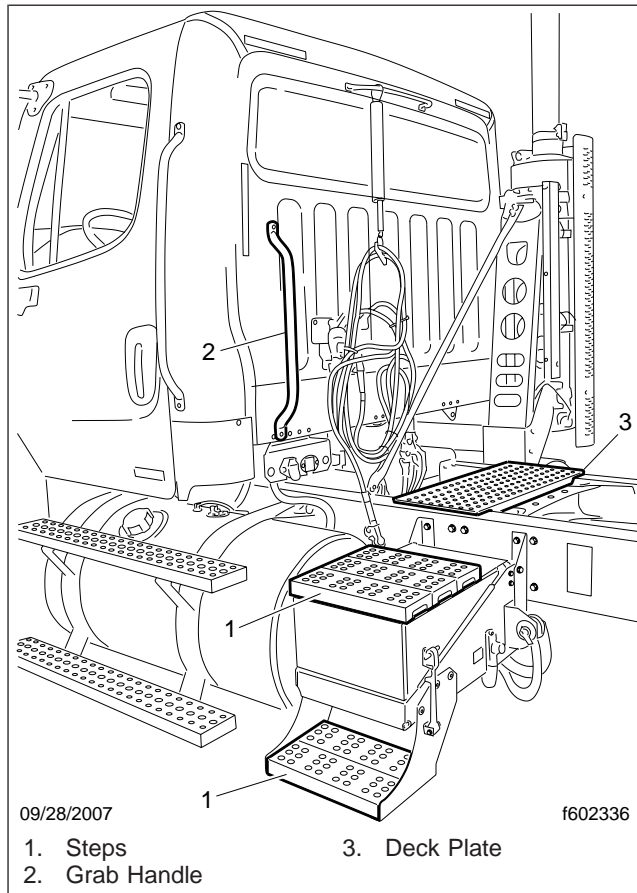


Fig. 2.6, Back-of-Cab Access Supports (typical)

exiting the back-of-cab area. Three-point contact means both feet and one hand, or both hands and one foot, on the grab handles, steps, and deck plates. Other areas are not meant to support back-of-cab access, and grabbing or stepping in the wrong place could lead to a fall, and personal injury.

Be careful not to get hands or feet tangled in hoses or other back-of-cab equipment. Carelessness could cause a person to trip and fall, with possible injury.

Entering Back-of-Cab

When climbing onto the deck plate, do the following:

1. Grasp the sidewall grab handle with both hands. Reach up as far as is comfortable.

2. Place one foot on the bottom step and pull yourself up.
3. Place your other foot on the top step.
4. Move your lower hand to a higher position on the grab handle.
5. Step onto the deck plate.

Climbing Down from Back-of-Cab

To climb down from the back-of-cab area:

1. Grasp the sidewall grab handle with both hands.
2. Step one foot at a time onto the top step.
3. Move your upper hand to a lower position on the grab handle.
4. Move one foot to the bottom step.
5. Move your upper hand to a lower position on the grab handle.
6. Step to the ground with your upper foot first.

Battery Access

Battery Compartment

The battery compartment is located in the lower part of the cab beneath and to the rear of the driver's door. It is fastened by a quarter-turn fastener. To open the battery access door, turn the quarter-turn fastener with a small screwdriver. See [Fig. 2.7](#).

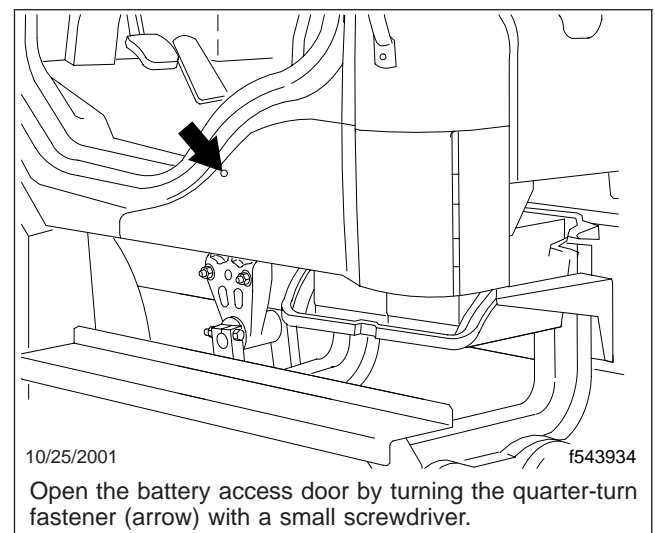


Fig. 2.7, Battery Compartment, Closed

Vehicle Access

With the battery access door open (**Fig. 2.8**), it is easy to get access to the battery terminals for cleaning, charging, or emergency jump starting.

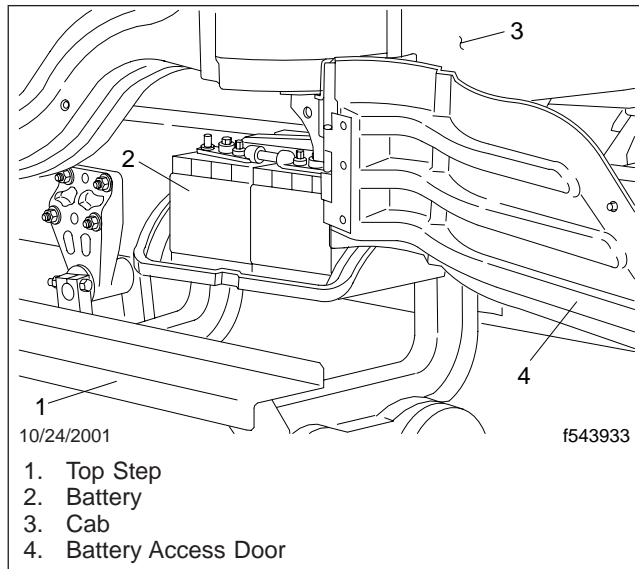


Fig. 2.8, Battery Compartment, Open

To close the battery access door, do the following steps:

1. Swing the battery access door to line up the quarter-turn fastener with the hole in the cab door frame.
2. Close the battery access door and check to be sure the quarter-turn fastener is engaged with the hole.
3. Turn the fastener one-quarter turn.

Cab (Battery) Isolation Switch

The cab isolation switch (see **Fig. 2.9**) is located on the cab floor at the left of the driver's seat, or inside the battery box. The battery isolation switch reduces the power to the cab and engine power wiring. Use it whenever the vehicle is to be put out of service for extended periods.

IMPORTANT: The battery disconnect switch does not completely isolate the batteries from the electrical system. For service operations that require that the batteries be disconnected, always shut down the engine and remove the negative battery cables.

NOTE: Whenever battery power is disconnected, clocks and electronically tuned radios must be reset.

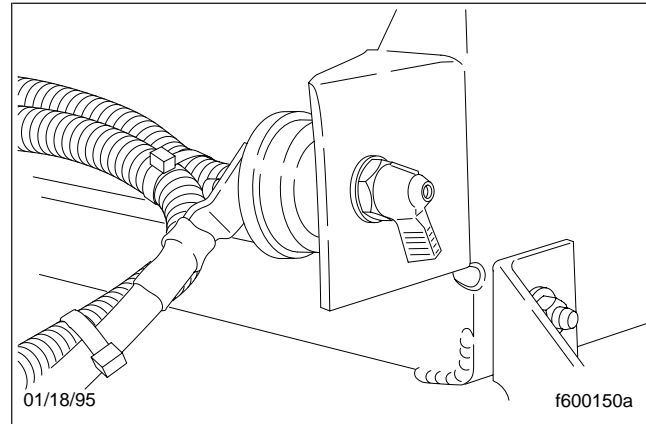


Fig. 2.9, Cab (Battery) Isolation Switch

Hood Opening and Closing

The hood can be raised to a full-open position. A torsion bar helps you to raise the hood, and to lower it to the operating position. Hood restraint cables prevent the hood from overtravel. A hood damper limits the closing speed. In the operating position, the hood is secured to the cab-mounted half-fenders by a hold-down latch on each side of the hood.

To Open the Hood

1. Apply the parking brakes.
2. Release both hood hold-down latches by pulling the ends outward. See **Fig. 2.10**.

CAUTION

Do not let the hood free-fall to the full-open position. To do so could cause damage to the hood or hood straps.

3. Standing in front of the hood, raise the rear of the hood upward until it reaches the over-center position (45 degrees from vertical). Then slowly bring it to a stop.

To Close the Hood

1. Push the hood over center.

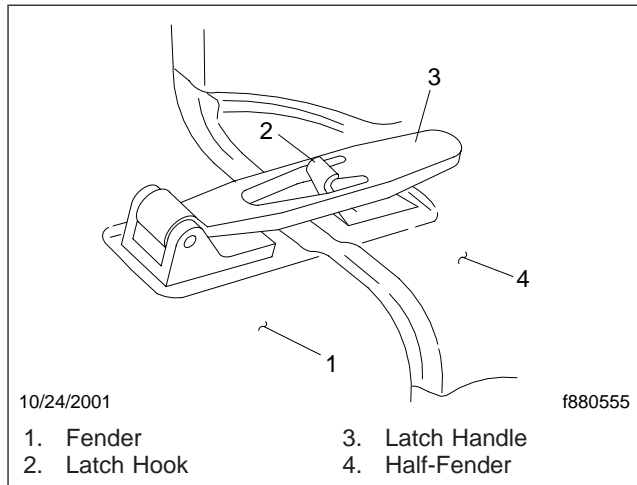


Fig. 2.10, Hood Hold-Down Latch

2. As the hood goes over center, the damper automatically slows its rate of descent. If needed, you can also slow its rate of descent with your hand.
3. Make sure the hood is flush with the cowl, then secure the hood by engaging both hood hold-down latches.

IMPORTANT: Make sure that both hold-down latches are fully engaged before operating the vehicle.

Fuse Identification

Main Fuse Box/PDM

The main fuse box, also known as the power distribution module, or PDM, is located under the hood on the left front fender just forward of the bulkhead module. See [Fig. 2.11](#). To open the fuse box, pull down on the wire clips holding the lid on the fuse box.

A sticker inside the lid of the fuse box shows the locations of the fuses and describes the circuit(s) that each fuse protects (see [Fig. 2.12](#)). See [Table 2.1](#) for descriptions of a typical set of fuses. The fuses in the main fuse box are mini blade-type fuses. Battery power fuses, located near the batteries, are bolt-in megafuses.

Because the electrical system is multiplexed, no relays are needed. The multiplexing module performs the functions normally provided by relays.

Fuse Identification, Main Fuse Box			
Pos. No.	Description	Fuse Color	Rating
F1	VCU (MBE900 only)	Red	10 Amp
F2	Blower Motor	Green	30 Amp
F3	Engine ECU	Yellow	20 Amp
F4	Transmission Control Unit	Green	30 Amp
F5	Ignition Switch	Tan	5 Amp
F6	Spare	—	—
F7	Bulkhead Module	Green	30 Amp
F8	ICU	Red	10 Amp
F9	Transmission Control Unit	Yellow	20 Amp
F10	Door Locks (optional)	Red	10 Amp
F11	Mirrors (optional)	Blue	15 Amp
F12	Radio/Diagnostics	Yellow	20 Amp
F13	Chassis Module	Green	30 Amp
F14	L/H Power Windows (optional)	Blue	15 Amp
F15	Bulkhead Module	Green	30 Amp
F16	ABS ECU	Blue	15 Amp
F17	Chassis Module	Green	30 Amp
F18	Bulkhead Module	Green	30 Amp
F19	Chassis Module	Green	30 Amp
F20	Bulkhead Module	Green	30 Amp
F21	R/H Power Windows (optional)	Blue	15 Amp
F22	Bulkhead Module	Green	30 Amp
F23	Spare	—	—
F24	Spare	—	—
F25	Spare	—	—
F26	Spare	—	—
M1	Battery Power	—	125 Amp
M2	Battery Power	—	125 Amp
M3	Battery Power	—	150 Amp

Table 2.1, Fuse Identification, Main Fuse Box

Trailer and Taillight Fuse Boxes

The trailer fuse box and the taillight fuse box, on vehicles so equipped, are mounted on a bracket with the chassis module on the left-hand frame rail aft of the cab, or on a crossmember at the end of the frame rail. These may be referred to as the chassis fuse box or chassis PDM. See [Fig. 2.13](#) for trailer fuse and relay information, and [Fig. 2.14](#) for taillight fuse and relay information.

Vehicle Access

These fuse boxes contain mini blade-type fuses, 12-volt mini relays, and 12-volt micro relays.

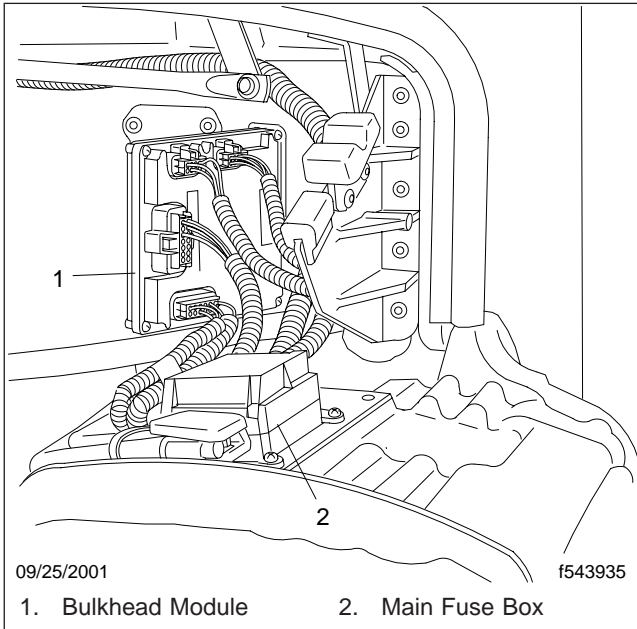


Fig. 2.11, Location of the Main Fuse Box

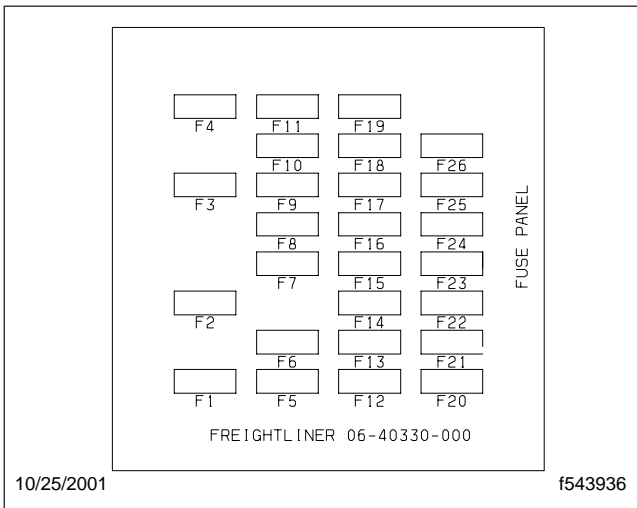


Fig. 2.12, Main Fuse Box Diagram

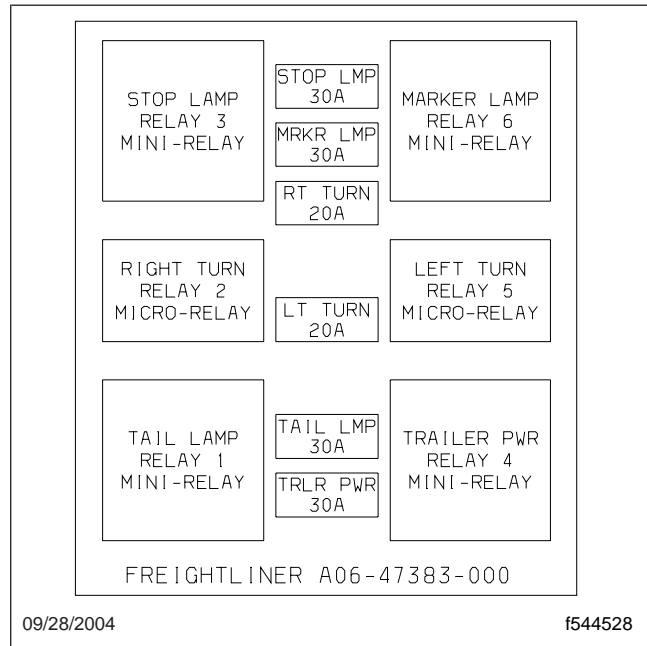


Fig. 2.13, Trailer Fuse Box Diagram

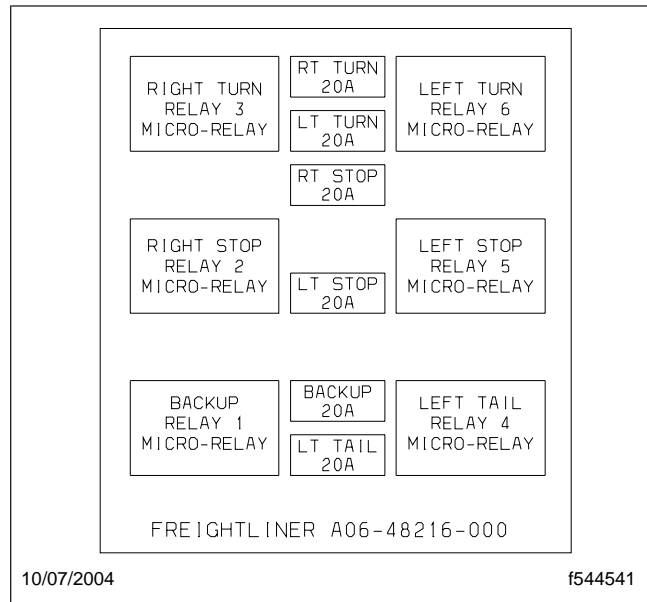


Fig. 2.14, Taillight Fuse Box Diagram

3

Instruments

Instrumentation Control Unit	3.1
Warning and Indicator Lights	3.2
Driver Message Center	3.7
Instruments	3.8
Overhead Instrument Panel	3.13

Instruments

Instrumentation Control Unit

The instrumentation control unit (ICU) provides the driver with engine and vehicle information. It is comprised of standard and optional gauges, an audible warning, a driver message center, and a lightbar containing warning and indicator lamps (also known as telltales). Warning and indicator lamps illuminate in red (danger), amber (caution), green (status advisory), or blue (high-beam headlights active).

The following headings in this chapter provide additional information and operating instructions for ICU components:

- "Warning and Indicator Lights"
- "Instruments"

- "Driver Message Center"

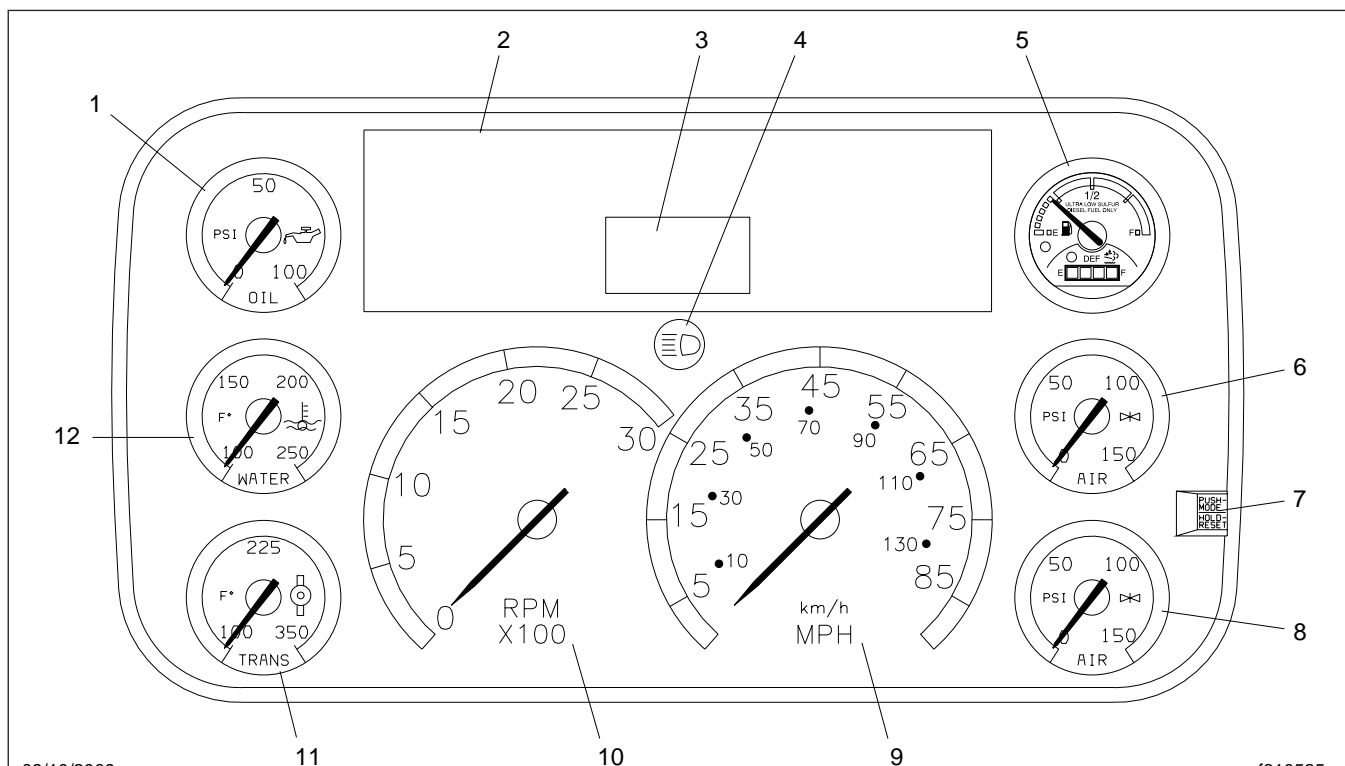
Figure 3.1 shows a typical ICU3 instrument cluster.

Ignition Sequence

When the ignition is turned on, the ICU runs a self-check. See Fig. 3.2. Observing the ignition sequence is a good way to ensure the ICU is functioning properly.

IMPORTANT: Do not crank the engine until the ICU self-check is complete.

When the ignition is turned on, the following actions should occur:



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NOTE: This instrument cluster is shown with the U.S. speedometer, which shows miles per hour (mph) more prominently than kilometers per hour (km/h).

- | | | |
|----------------------------------|---------------------------------|------------------------------------|
| 1. Engine Oil Pressure Gauge | 5. Fuel/DEF Level Gauge | 9. Speedometer (U.S. version) |
| 2. Lightbar | 6. Primary Air Pressure Gauge | 10. Tachometer |
| 3. Driver Message Center | 7. Mode/Reset Button | 11. Transmission Temperature Gauge |
| 4. Headlight High-Beam Indicator | 8. Secondary Air Pressure Gauge | 12. Coolant Temperature Gauge |

Fig. 3.1, Typical Gauge Layout, U.S. (EPA10 and newer shown)

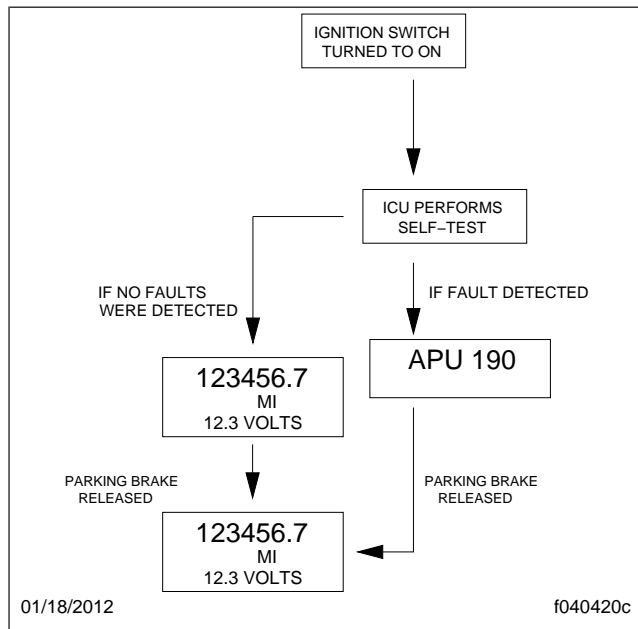


Fig. 3.2, Ignition Sequence

- electronic gauges complete a full sweep of their dials
- some warning and indicator lamps illuminate, then are extinguished
- audible alert sounds until sufficient air pressure builds up in the primary and secondary air systems
- DEF level indicator illuminates all segments green, then turns them off one at a time before turning the leftmost segment amber, then red
- software revision level of the ICU is displayed on the driver message center, followed by active faults

NOTE: Air gauges do not complete a sweep of their dials during the ignition sequence.

IMPORTANT: If any red or amber warning and indicator lamps, or telltales, do not illuminate during the ICU self-check, take the vehicle to an authorized Freightliner service facility as soon as possible. If any of the red or amber telltales or do not go out after the self-check completes, use [Table 3.1](#) to determine if the lamp illuminated indicates a problem requiring service.

If the ICU receives active fault codes, it displays them one after the other until the parking brake is released or the ignition is turned off. Once the parking brake is completely released, the ICU displays the odometer. If there are no active faults, the ICU displays the odometer after the self-check completes.

NOTE: If active faults are present, take the vehicle to an authorized Freightliner service facility as soon as possible.

Audible Alerts

An audible alert sounds during the ignition sequence and whenever one of the following conditions exists:

- Engine oil pressure falls below the minimum preset value.
- Coolant temperature rises above the maximum preset value.
- Air pressure falls below about 70 psi (483 kPa).
- Parking brake is set with the vehicle moving faster than two miles per hour.
- System voltage falls below 12 volts.
- Door is open with the headlights on and the parking brake off.
- Driver seat belt is not fastened with the parking brake off (optional).
- Outside temperature falls below 35°F (1.7°C) (optional).

Warning and Indicator Lights

There can be up to 28 telltales installed in the ICU. If an optional lamp is not requested, the position is blank.











See [Table 3.1](#) for a list of standard and commonly used warning and indicator lamps.












Warning and indicator lamps illuminate in red (danger), amber (caution), green (status advisory), or blue (high-beam headlights active).

IMPORTANT: Depending upon local jurisdictional emissions guidelines, vehicles and/or engines that are domiciled outside of the U.S. and Canada may not be compliant with EPA07, EPA10, or GHG14 regulations. Noncompliant










Instruments


vehicles may not be equipped with all of the lamps shown in [Table 3.1](#).

Common Warning and Indicator Lamps			
Lamp Description		Color	
	STOP Engine *	Red	
	Indicates a serious fault that requires engine shutdown immediately. The engine protection system will reduce the maximum engine torque and speed, and, if the condition does not improve, will shut down the engine within 30 to 60 seconds. Safely bring the vehicle to a stop on the side of the road and shut down the engine as soon as the red light is seen. If the engine shuts down while the vehicle is in a hazardous location, turn the key to the OFF position for a few seconds, then restart the engine and move the vehicle to a safer location.		
	High Coolant Temperature		Indicates the coolant temperature is above the maximum allowable temperature.
	Low Air Pressure (EPA07)		Indicates air pressure in the primary or secondary reservoir has dropped below approximately 70 psi (483 kPa).
	Low Air Pressure (EPA10 and Newer)		Indicates air pressure in the primary or secondary reservoir has dropped below approximately 70 psi (483 kPa).
	Low Engine Oil Pressure		Indicates the engine oil pressure is below the minimum allowable pressure.
	Parking Brake (EPA07)		Indicates the parking brake is engaged, or hydraulic brake fluid level is low. An audible alert activates when the vehicle is moving over 2 mph (3 km/h) with the parking brake set.
	Parking Brake (EPA10 and Newer)		Indicates the parking brake is engaged.
	Low Battery Voltage		Indicates that battery voltage is 11.9 volts or less.
	Unfastened Seat Belt		Activates with an audible alert when the system detects that the parking brake is off and the driver seat belt is not fastened on some vehicles. On other vehicles, this lamp illuminates for 15 seconds when the ignition is first turned on.
	CHECK Engine*	Indicates an engine condition (low oil pressure, low coolant level, high coolant temperature, high DPF soot level, or uncontrolled DPF regeneration) that requires correction. Correct the condition as soon as possible. If the condition worsens, the STOP engine lamp will illuminate.	Amber

Common Warning and Indicator Lamps			
Lamp Description			Color
	High Exhaust System Temperature (HEST) ^{8*}	<p>Slow (10-second) flashing indicates a regeneration (regen) is in progress.</p> <p>IMPORTANT: When the HEST lamp is illuminated, do not park the vehicle near flammable material.</p> <p>Solid illumination indicates high exhaust temperatures at the outlet of the tail pipe when speed is below 5 mph (8 km/h).</p>	Amber
	Diesel Particulate Filter (DPF) Status	<p>Solid illumination indicates a regen is required. Change to a more challenging duty cycle (such as highway driving) to raise exhaust temperatures for at least twenty minutes, or perform a parked regen.</p> <p>Blinking indicates that a parked regen is required immediately. An engine derate and shutdown will occur.</p>	
	Malfunction Indicator Lamp (MIL)	Indicates an emissions-related fault. See the engine operation manual for details.	
	Vehicle ABS	<p>Momentary illumination indicates the vehicle ABS is engaged.</p> <p>Solid illumination indicates a problem with the vehicle ABS. Repair the ABS immediately to ensure full braking capability.</p>	
	Trailer ABS	<p>Momentary illumination indicates the trailer ABS is engaged.</p> <p>Solid illumination indicates a problem with the trailer ABS. Repair the ABS immediately to ensure full braking capability.</p>	
	No Charge	Indicates the alternator is not properly powering the electrical system.	
	Water in Fuel	Indicates the fuel may contain water. Drain any water collected in the fuel/water separators.	
	Fuel Filter Restriction	Indicates the fuel filter is clogged and requires service.	
	Optimized Idle	Indicates optimized idle is enabled.	
	Check Transmission	Indicates an undesirable transmission condition.	
	Transmission Overheat	Indicates high transmission temperature.	

Instruments

Common Warning and Indicator Lamps		
Lamp Description		Color
	Wait To Start (EPA07/ EPA10)	Amber
<p>EPA10 Detroit engines: Indicates that the system is preventing the starter from cranking. This can occur when the ignition switch is turned to START before the gauge sweep has completed, or if the starter has overheated.</p> <p>Cummins/Mercedes-Benz engines: Indicates that the intake warmer is active.</p> <p>Turn the ignition switch back to ON, wait for the lamp to go out, then turn the ignition switch to START again.</p>		
	Start Blocked (GHG14 Detroit engines)	
<p>Indicates that the system is preventing the starter from cranking. This can occur when the ignition switch is turned to START before the gauge sweep has completed, or if the starter has overheated.</p> <p>NOTE: Illumination of the Start Blocked lamp does not indicate a problem with the starter.</p> <p>Turn the ignition switch back to ON, wait for the lamp to go out, then turn the ignition switch to START again.</p>		
	Wheel Spin	
<p>Flashing indicates the ATC system is active, or the ATC button has been pressed to allow wheel slip.</p> <p>Solid illumination indicates a problem with the ATC system. Repair the ATC system immediately to ensure full braking capability.</p>		
	Roll Stability	Green
<p>Momentary illumination indicates that a stability event has occurred.</p> <p>On vehicles that are also equipped with ATC, flashing indicates the ATC button has been pressed to allow wheel slip.</p>		
	Hill Start Aid (HSA) Override	
<p>Indicates the HSA switch has been pressed to override the hill start assist feature.</p>		
	Engine Brake	Green
<p>Indicates the engine brake is enabled.</p>		
	Left-Turn Signal	
<p>Flashing indicates the outside left-turn signal lights are activated.</p>		
	Right-Turn Signal	Green
<p>Flashing indicates the outside right-turn signal lights are activated.</p>		
	Cruise Control	Green
<p>Indicates the cruise control is enabled.</p> <p>NOTE: The ICU4Me does not have a green cruise control telltale.</p>		

Common Warning and Indicator Lamps		
Lamp Description		Color
	High-Beam Headlights Indicates the high-beam headlights are on.	Blue

* See Fig. 3.3 for an explanation of the aftertreatment system (ATS) warning indicators, and actions required to avoid further engine protection steps.

Table 3.1, Common Warning and Indicator Lamps

Engine Protection System









When the red STOP engine lamp illuminates, most engines are programmed to shut down automatically within 30 seconds. The driver must immediately move the vehicle to a safe location at the side of the road to prevent causing a hazardous situation that could cause bodily injury, property damage, or severe damage to the engine.

See Fig. 3.3 for an explanation of the aftertreatment system (ATS) warning indicators, and actions required to avoid further engine protection steps.

The STOP engine lamp illuminates when the engine protection system is activated in one of two ways. On some engines, the engine protection system will derate the engine, allowing it to run at lower rpm and slower vehicle speed. Drive the vehicle to a safe location or to a service facility.

IMPORTANT: Safely bring the vehicle to a stop on the side of the road and shut down the engine as soon as the red light is seen. If the engine shuts down while the vehicle is in a hazardous location, turn the key to the OFF position for a few seconds, then restart the engine and move the vehicle to a safer location.

EXHAUST AFTERTREATMENT SYSTEM INFORMATION					
INDICATOR LAMP(S)	 (Solid)	 (Flashing)	 (Flashing)		 WARNING
	Level 1	Level 2	Level 3	Level 4	
Indicator Lamp Message(s)	Filter Regeneration Recommended.	Filter Regeneration Necessary	Parked Regeneration Required – Engine Derate	Service Regeneration Required. Engine Derate To Idle Only.	HEST (High Exhaust System Temperature)
Diesel Particulate Filter Condition	Filter is reaching capacity.	Filter is now reaching maximum capacity.	Filter has reached maximum capacity.	Filter has exceeded maximum capacity.	Flashing A regeneration is in progress.
Required Action	Bring vehicle to highway speeds to allow for an Automatic Regeneration or perform a Parked Regeneration.	To avoid engine derate, bring vehicle to highway speeds to allow for an Automatic Regeneration, or perform a Parked Regeneration as soon as possible.	Vehicle must be parked, and a Parked Regeneration must be performed. Engine will begin derate.	Vehicle must be parked, and a Service Regeneration must be performed. Check engine operator's manual for details. Engine will shut down.	Solid Exhaust components and exhaust gas are at high temperature. When stationary, keep away from people and flammable materials or vapors.
For a driver performed Parked Regeneration, vehicle must be equipped with a dash mounted Regeneration Switch.					

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Fig. 3.3, ATS Warning Lamps

Instruments

On other engines, the engine protection system will shut down the engine. It will first derate the engine, then shut it down completely 30 to 60 seconds after the indicator illuminates (depending on the critical fault type) if the condition does not improve. Bring the vehicle to a stop on the side of the road before the engine shuts down.

Some vehicles may have a shutdown-override switch, which may be used to momentarily override the shutdown sequence. See [Chapter 7](#) for detailed information regarding the shutdown process.

IMPORTANT: Do not attempt to restart the engine while the vehicle is moving. Bring the vehicle to a safe stop, then restart the engine.

To restart the engine, turn the ignition to OFF, leave it there a few seconds, then turn the ignition to START. The engine will run for a short period and shut down again if the condition does not improve.

Driver Message Center

The driver message center is controlled using the mode/reset switch, located on the right side of the ICU. See [Fig. 3.1](#). Tap the mode/reset switch to advance one screen; press and hold the switch to select a menu choice or reset the display. When the display resets, an audible chirp sounds.

Driving Screens

The following screens are available when the parking brake is off (when the vehicle is mobile) and no active fault codes are found. Use the mode/reset switch to scroll through the screens. To reset any values, press and hold the mode/reset switch. The driving screens appear in the following order:

- i. Odometer
- ii. Trip distance
- iii. Trip hours
- iv. Outside temperature

Parked Screens/Menus

The parked screens and menus are available when the parking brake is on and no active fault codes are found. See [Fig. 3.4](#). Use the mode/reset switch to scroll through the parked screens. To reset any values, press and hold the mode/reset switch. The parked screens appear in the following order:

- i. Odometer
- ii. Trip distance
- iii. Trip hours
- iv. Outside temperature
- v. Select units
- vi. Temperature alert
- vii. Diagnostics
- viii. Engine miles
- ix. Engine hours
- x. Setup

Temperature Alert

When the outside temperature drops to 34°F (1.7°C) or less, the ICU displays a caution text at one-second intervals for five seconds, and an audible alert sounds. Tap the mode/reset switch to acknowledge the message. The audible alert will not sound again unless the temperature cycles above 37°F (4°C) and back to 34°F (1.7°C) or less. This warning only occurs while the ignition is on and the parking brake is released.

The temperature alert message allows the driver to enable or disable the ambient temperature warning.

Press and hold the mode/reset switch to toggle between on and off. Release the mode/reset switch, then tap it to select the displayed choice.

Diagnostics

When the DIAG screen is displayed, press and hold the mode/reset switch to access the various diagnostic screens.

The diagnostic screens are used by trained technicians to retrieve fault codes and other diagnostic information pertaining to the vehicle. If active fault codes display during start-up or at any other time, make a note of the fault code and take the vehicle to an authorized Freightliner service facility.

If fault codes are displayed, press and hold the mode/reset switch to view the next fault code until reaching the DIAG screen.

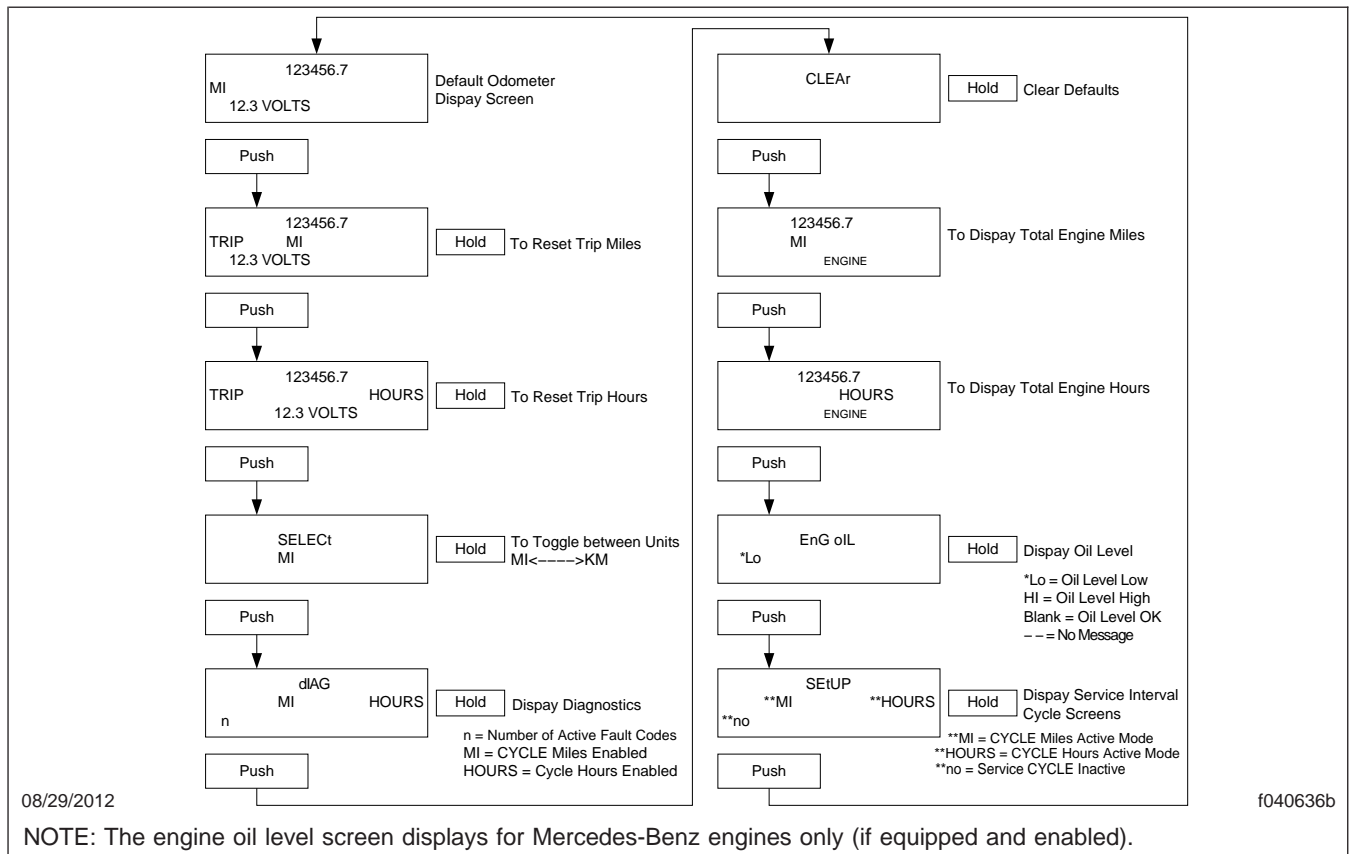


Fig. 3.4, ICU3 Stationary Screens

Engine Miles/Hours

When the engine miles/hours screen is displayed, press and hold the mode/reset switch to access the engines screen submenu.

Setup

The setup menu allows the driver to manage ICU parameters. The setup screen submenu allows the driver to enable and change service intervals.

If service intervals are enabled and service distance or time has been exceeded, the text SERVICE HOUR/MI (KM) will display at start-up to indicate vehicle service is required.

For each parameter, press and hold the mode/reset switch to navigate to the parameter change screen. In each change screen, tap the mode/reset switch to toggle between options.

The last screen in the setup menu, **RESET EE**, is for resetting certain parameters to the original settings. Press and hold the mode/reset switch to reset the antilock braking system (ABS), SAMs roll call, automated transmission display, transmission heartbeat, sensor fault codes, seat belt switch learning, and engine oil level.

Instruments

Standard instruments are present on every vehicle. They are listed here in alphabetical order to make the information easier to find.

Optional instruments, typically located on the auxiliary dash panel or right-hand control panel, are not found on every vehicle. They are listed here in alphabetical order, to make the information easier to find.

Instruments

Air Intake Restriction Gauge

The air intake restriction gauge indicates the vacuum on the engine side of the air cleaner. On standard installations, it is mounted on the air intake duct in the engine compartment. As an option for easier viewing, the air intake restriction indicator (see [Fig. 3.5](#)) can be mounted on the dash, usually on the right-hand control panel.

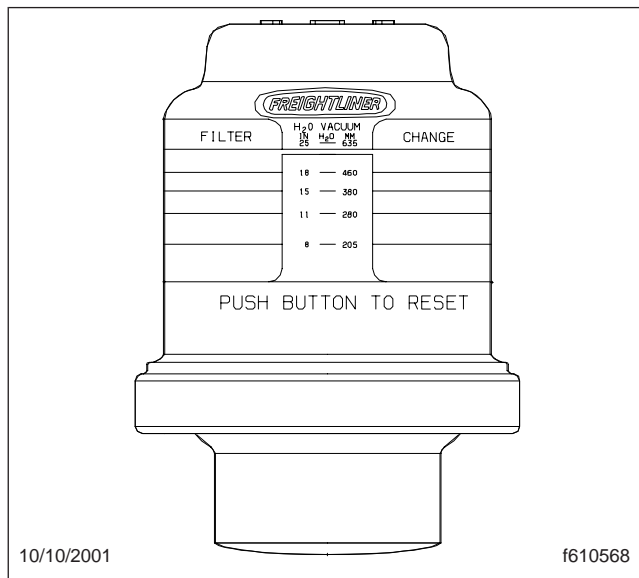


Fig. 3.5, Air Intake Restriction Indicator

NOTE: Rain or snow can wet the filter and cause a temporary high reading.

Air intake restriction vacuum is measured in inches of water (inH₂O). For vehicles equipped with a graduated indicator or a restriction gauge on the dash, check the gauge with the engine off. If the yellow signal stays locked in the red zone once the engine is shut down, or is at or above the values shown in [Table 3.2](#), the air cleaner element needs to be replaced.

Vehicles may be equipped with a go/no-go restriction indicator without graduations (see [Fig. 3.6](#)) instead of a graduated indicator.

Air Intake Maximum Restriction Values (inH ₂ O)		
Engine	Pre-EPA07 Engines	EPA07 and Newer Engines
Caterpillar	25	—
Cummins	25	25

Air Intake Maximum Restriction Values (inH ₂ O)		
Engine	Pre-EPA07 Engines	EPA07 and Newer Engines
Detroit™	20	22
Mercedes-Benz	22	22

Table 3.2, Air Cleaner Element Maximum Restriction

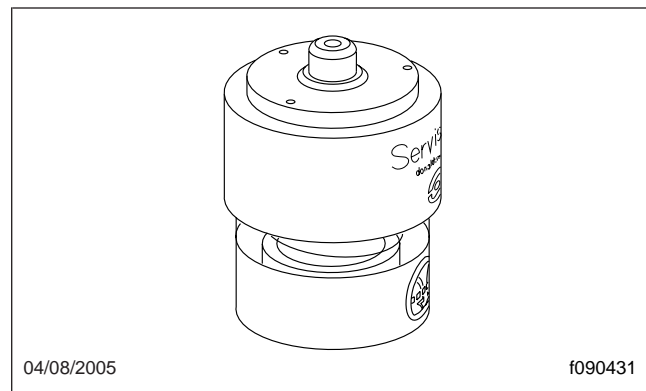


Fig. 3.6, Manual-Reset Air Restriction Indicator, Go/No-Go

Ambient Temperature Gauge

The ambient temperature gauge, shown in [Fig. 3.7](#), displays the in-cab or outside temperature, depending on the settings selected.

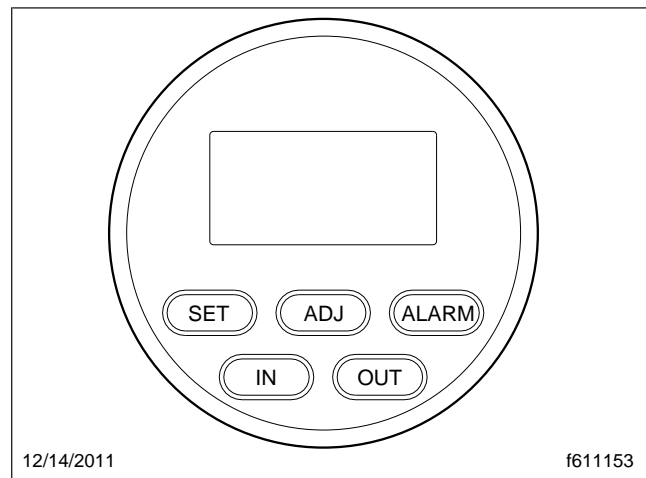


Fig. 3.7, Ambient Temperature Gauge

When the alarm is enabled, the ambient temperature gauge will sound an audible alert and the amber

lamp will illuminate when the outside or inside temperature (depending on the setting selected) reaches the set temperature. Turn the alarm on and off using the steps below.

1. Press the IN button for in-cab temperature, or the OUT button for outside temperature.
2. Press the SET button.
3. Press the ADJ button until the desired temperature is displayed.
4. Press the ALARM button and "AL" will appear on the display.
5. Press the SET button to return to the current temperature display.

NOTE: To turn the alarm off, press the ALARM button again and "AL" will disappear from the display.

Coolant Temperature Gauge

NOTICE

A sudden increase in coolant temperature may indicate engine or cooling system failure. Bring the vehicle to a safe stop and investigate the cause to prevent further damage. Do not operate the engine until the cause has been determined and corrected.

During normal engine operation, the coolant temperature gauge, as shown in **Fig. 3.8**, should read 175 to 195°F (79 to 91°C). If the temperature remains below 160°F (71°C), inspect the cooling system to determine the cause.

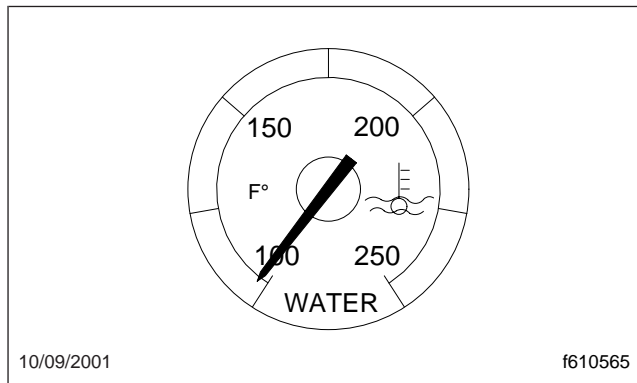


Fig. 3.8, Coolant Temperature Gauge

If coolant temperature rises above the maximum temperature listed in **Table 3.3**, the CHECK engine lamp will illuminate. If the condition does not improve, the STOP engine lamp will also illuminate and an audible warning will sound. The engine will then derate or shut down, depending on the type of engine protection system installed.

Maximum Coolant Temperature	
Engine Make	Temperature: °F (°C)
Caterpillar	230 (110)
Cummins	225 (107)
Detroit	215 (101)
Mercedes-Benz	222 (105)

Table 3.3, Maximum Coolant Temperature

Drive Axle Oil Temperature Gauges

NOTICE

A sudden increase in oil temperature that is not caused by a load increase may indicate mechanical failure. Bring the vehicle to a safe stop and investigate the cause to prevent further damage. Do not operate the vehicle until the cause has been determined and corrected.

During normal operation, forward-rear and rear-rear axle oil temperature gauges (see **Fig. 3.9**) should read between 160 and 220°F (71 and 104°C).

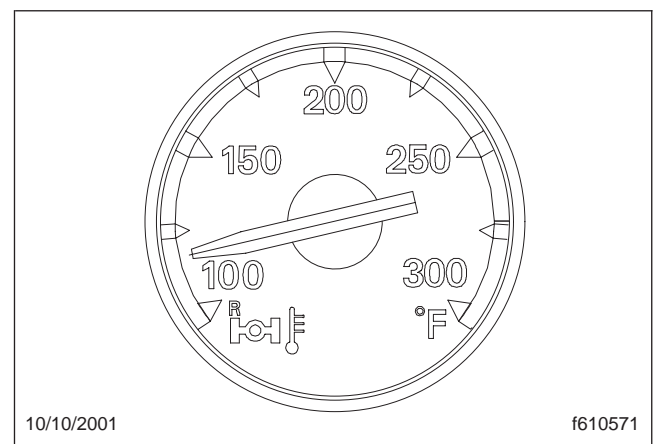


Fig. 3.9, Axle Oil Temperature Gauge

Instruments

Under heavy loads, such as when climbing steep grades, temperatures that exceed the normal oil temperature range for a short period are not unusual. If the temperature returns to normal when the load decreases, there is no problem.

Engine Oil Pressure Gauge

NOTICE

A sudden decrease or absence of oil pressure may indicate mechanical failure. Bring the vehicle to a safe stop and investigate the cause to prevent further damage. Do not operate the engine until the cause has been determined and corrected.

The engine oil pressure gauge, as shown in [Fig. 3.10](#), displays the current engine oil pressure. If engine oil pressure falls below the minimum levels shown in [Table 3.4](#), the CHECK engine lamp will illuminate. If the condition does not improve, the STOP engine lamp will also illuminate and an audible warning will sound. The engine will then derate or shut down, depending on the type of engine protection system installed.

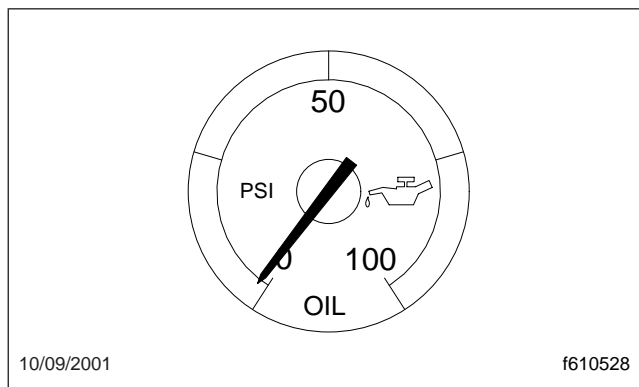


Fig. 3.10, Engine Oil Pressure Gauge

Minimum Oil Pressure*		
Engine Model	At Idle Speed: psi (kPa)	At Rated RPM: psi (kPa)
Caterpillar	10–20 (69–138)	30–45 (207–310)
Cummins	15 (103)	35 (241)
Detroit	14 (97)	55 (350)

Minimum Oil Pressure*		
Engine Model	At Idle Speed: psi (kPa)	At Rated RPM: psi (kPa)
Mercedes-Benz	7 (50)	36 (250)

* Oil pressures are given with the engine at operating temperature. With the engine cold, oil pressure may be higher. Individual engines may vary from the listed pressures; observe and record pressures when the engine is new to create a guide for checking engine condition.

Table 3.4, Minimum Oil Pressure

Engine Oil Temperature Gauge

NOTICE

A sudden increase in oil temperature that is not caused by a load increase may indicate mechanical failure. Bring the vehicle to a safe stop and investigate the cause to prevent further damage. Do not operate the engine until the cause has been determined and corrected.

During normal operation, the optional engine oil temperature gauge ([Fig. 3.11](#)) should read in the following temperature ranges:

- 160 to 195°F (71 to 91°C) for Caterpillar engines
- 200 to 260°F (93 to 126°C) for Detroit and Cummins engines
- 177 to 203°F (81 to 95°C) for Mercedes-Benz engines

Under heavy loads, such as when climbing steep grades, temperatures that exceed the normal oil temperature range for a short period are not unusual. If the temperature returns to normal when the load decreases, there is no problem.

Fuel Gauge, Pre-EPA10

The fuel gauge indicates the level of fuel in the fuel tank(s). A single fuel gauge is standard. If equipped with an optional second fuel tank, each fuel tank level is indicated on a separate gauge. See [Fig. 3.12](#).

Fuel/Diesel Exhaust Fluid (DEF) Gauge, EPA10 and Newer

For engines that are EPA10-compliant or newer, the fuel and DEF levels are measured in a dual purpose fuel/DEF level gauge. See [Fig. 3.13](#).

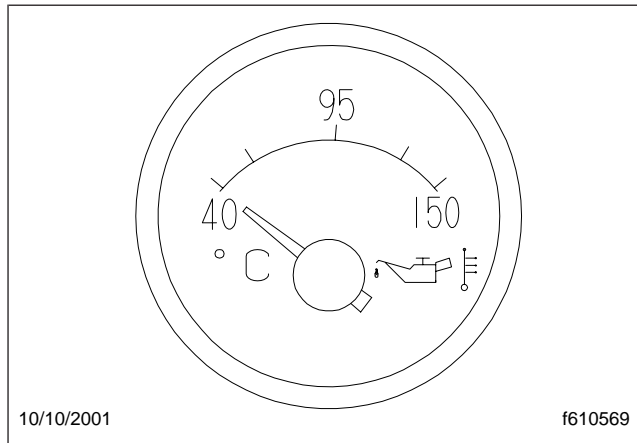


Fig. 3.11, Engine Oil Temperature Gauge

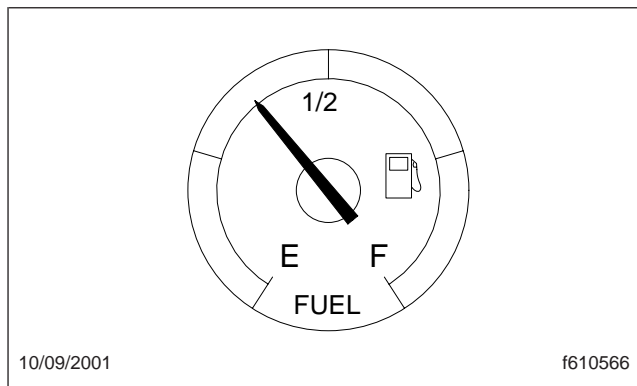


Fig. 3.12, Fuel Level Gauge, Pre-EPA10

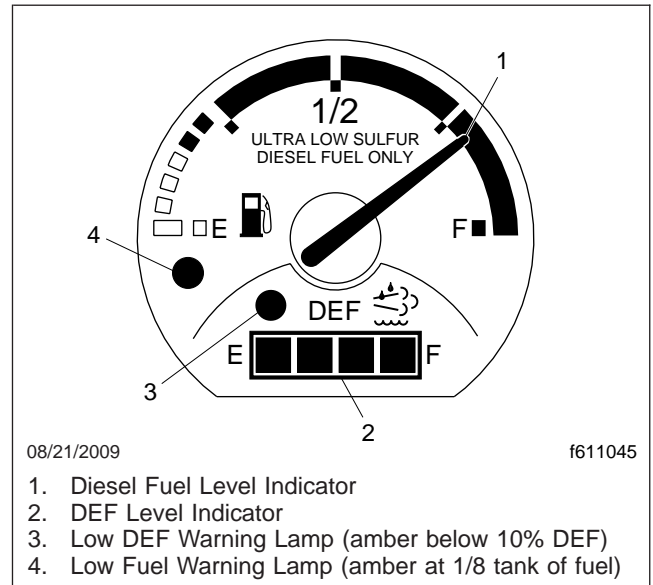
The diesel fuel level is indicated at the top of the gauge, with a low-fuel warning lamp that illuminates when the diesel fuel level registers 1/8th of capacity.

The DEF level is indicated in the lightbar on the lower portion of the gauge. There is a low DEF level warning lamp that illuminates amber when the DEF level reaches 10% of capacity. See [Chapter 7](#) for details of the DEF gauge functions.

Primary and Secondary Air Pressure Gauges

WARNING

If air pressure falls below minimum pressure, the braking ability of the vehicle will be limited. Slow the vehicle down and bring it to a gradual stop. Do not attempt to move the vehicle until air pres-



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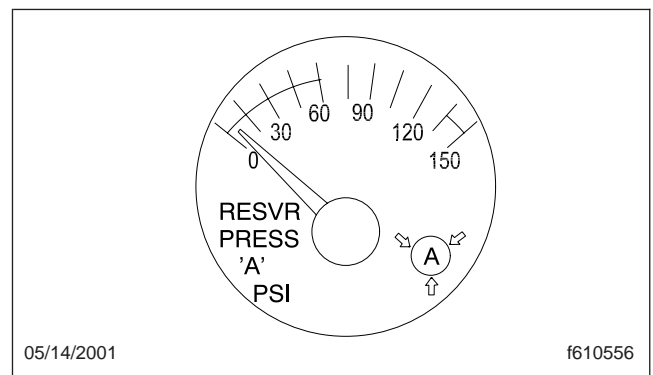
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1. Diesel Fuel Level Indicator
2. DEF Level Indicator
3. Low DEF Warning Lamp (amber below 10% DEF)
4. Low Fuel Warning Lamp (amber at 1/8 tank of fuel)

Fig. 3.13, Fuel/DEF Gauge, EPA10

sure has risen above the minimum level. Moving a vehicle without adequate braking power could cause an accident resulting in personal injury or death.

Air pressure gauges, as shown in [Fig. 3.14](#), register the pressure in the primary and secondary air systems. The gauges are labeled for the A or B reservoir. Normal pressure with the engine running is 100 to 120 psi (689 to 827 kPa) in both systems.



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Fig. 3.14, Air Pressure Gauge (reservoir A shown)

A low-air-pressure warning light and audible alert, connected to both the primary and secondary systems, activate when air pressure in either system drops below approximately 70 psi (483 kPa).

Instruments

When the engine is started, the warning light and audible warning remain on until air pressure in both systems exceeds minimum pressure.

Speedometer

Three speedometer options are available. The U.S. version of the speedometer registers speed in both miles per hour (mph) and kilometers per hour (km/h), with mph in larger numbers. The metric version of the speedometer face reverses this arrangement, with km/h in larger numbers. The metric-only version shows km/h exclusively.

Tachometer

The tachometer indicates engine speed in revolutions per minute (rpm) and serves as a guide for shifting the transmission and keeping the engine in the appropriate rpm range. For low idle and rated rpm, see the engine identification plate.

Transmission Fluid Temperature Gauge

The transmission fluid temperature gauge, shown in **Fig. 3.15**, measures the transmission lubricant operating temperature. Temperatures vary by application, but the transmission fluid temperature gauge reading should not exceed 250°F (121°C).

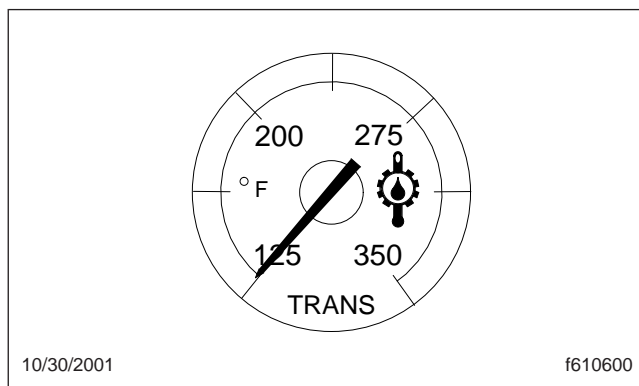


Fig. 3.15, Transmission Fluid Temperature Gauge

NOTICE

A sudden increase in transmission fluid temperature that is not caused by a load increase may indicate mechanical failure. Bring the vehicle to a safe stop and investigate the cause to prevent

further damage. Do not operate the vehicle until the cause has been determined and corrected.

Under heavy loads, such as when climbing steep grades, temperatures that exceed the normal oil temperature range for a short period are not unusual. If the temperature returns to normal when the load decreases, there is no problem.

Turbocharger Boost Pressure Gauge

A turbocharger boost pressure gauge indicates the pressure in the intake manifold, in excess of atmospheric pressure, being created by the turbocharger.

Voltmeter

The voltmeter indicates the vehicle charging system voltage when the engine is running and the battery voltage when the engine is off. By monitoring the voltmeter, the driver can stay aware of potential battery charging problems and have them fixed before the batteries discharge enough to create starting difficulties. Cascadia vehicles are equipped with either a voltmeter gauge, or a digital voltmeter readout located on the bottom line of the dash message center.

The voltmeter will normally show approximately 13.7 to 14.1 volts when the engine is running. The voltage of a fully charged battery is 12.7 to 12.8 volts when the engine is off. Battery voltage under 12.0 volts is considered a low battery, and a completely discharged battery will produce only about 11.0 volts.

If the voltmeter shows an undercharged or overcharged condition for an extended period, have the charging system and batteries checked at an authorized Freightliner service facility.

On a vehicle equipped with a battery isolator system, the voltmeter measures the average voltage of all the batteries when the engine is running. When the engine is off, the voltmeter shows only the isolated battery voltage and does not indicate the voltage of the engine-starting batteries.

Overhead Instrument Panel

The optional overhead instrument panel, shown in **Fig. 3.16**, may hold a citizen's band (C/B) radio, a microphone clip, and any switches that can not be accommodated on the driver's or auxiliary dash panels.

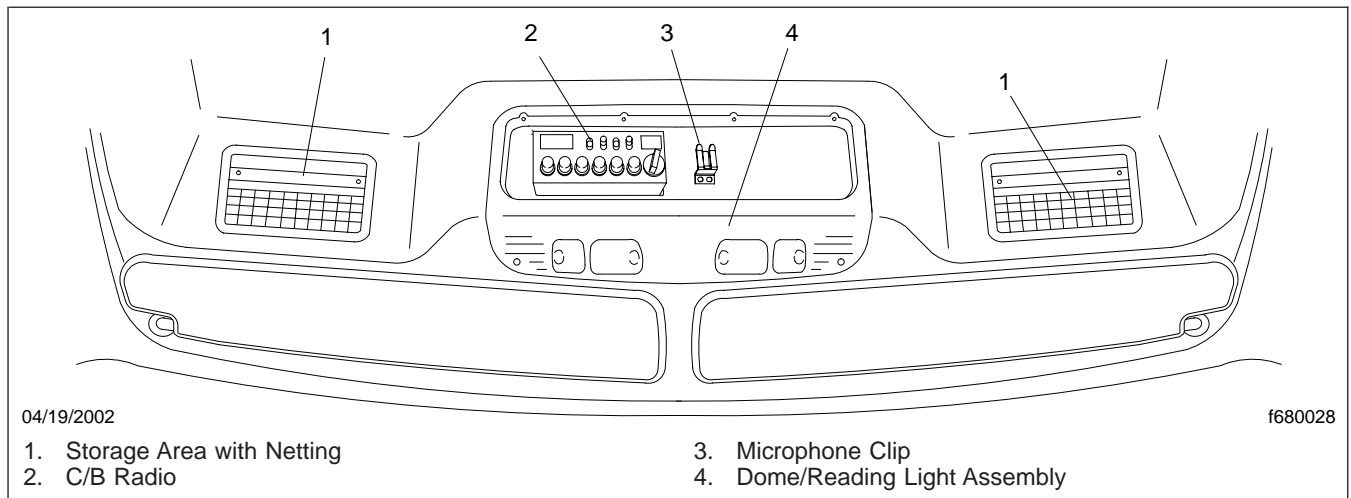


Fig. 3.16, Overhead Instrument Panel

The underside of the overhead console also holds the sun visors and the optional dome/reading light assembly. For more information on the dome/reading light assembly, see [Chapter 4](#).

4

Controls

Ignition Switch and Key	4.1
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Controls

Ignition Switch and Key

The ignition switch (**Fig. 4.1**) has four positions: ACCESSORY, OFF, ON, and START. In addition, the same key locks and unlocks the cab doors.

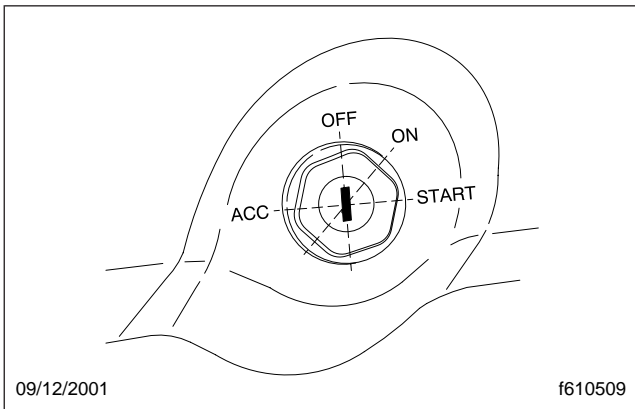


Fig. 4.1, Ignition Switch Positions

In the OFF position, the key slot is vertical; the key can be inserted and removed only in this position. The following can be operated in the off position (regardless of whether the key is inserted): The low-beam headlights, taillights, brake lights, road lights, dome lights, clearance lights, turn signals, hazard warning lights, horn, CB radio, power windows, cigarette lighter, clock, and electric oil pan heater.

In the ACCESSORY position, the key is turned counterclockwise. The radio, stereo system, mirror heat, air dryer, backup lights, and all of the electrical systems that are operable in the off position are operable in the accessory position.

In the ON position, the key is turned clockwise and all electrical systems are operable. The low air pressure and low oil pressure warning lights (or messages) and buzzer operate until the engine is started and pressure is built up.

Electrical System

The Business Class® M2 features a new type of electrical system, different from any previous vehicle. Multiple electrical signals are carried along a simplified set of wires, reducing the size of wiring bundles. There are significantly fewer wires overall, meaning less chance of damage, shorts and other problems.

WARNING

Do not attempt to modify, add, splice, or remove electrical wiring on this vehicle without authorization from Freightliner Engineering. Doing so could damage the electrical system and result in a fire that could cause serious personal injury or property damage.

There are two new electrical modules, a master module located near the frontwall (bulkhead module) and a slave module located between the frame rails (chassis module).

This new wiring system features intelligent controls that blink to show switch activity and error conditions. These controls cannot be distinguished by their appearance, only by their function.

For more information about these controls, see under the headings "Axle Switches" and "Suspension Dump Switch."

Lighting Controls

The lighting controls mentioned under this heading generally operate through switches located on the dash.

Two types of dash switches are used:

- Paddle switches with a single paddle located in the center of the switch. The paddle can be raised or lowered to perform a function.
- Rocker switches that can be pressed at either the upper or lower end to perform a function. Certain rocker switches are guarded to prevent them from being switched on or off accidentally.

When the panel lights are on, most switch legends are backlit with a colored light, usually green. This allows the driver to find the switch more easily in the dark. When the switch is on, the switch icon is normally backlit with a colored light, usually amber. Some switch icons are dead-fronted (not visible until the switch is turned on). When turned on, some switches are illuminated from within by a red or amber LED (light-emitting diode).

Control Panels

The left-hand control panel (**Fig. 4.2**) contains a louvered window outlet for the face vents of the heating,

ventilation, and air conditioning system (HVAC), and four switches arranged in a vertical line, usually the headlight, panel light increase/decrease, and the cruise control On/Off and Set/Resume switches.

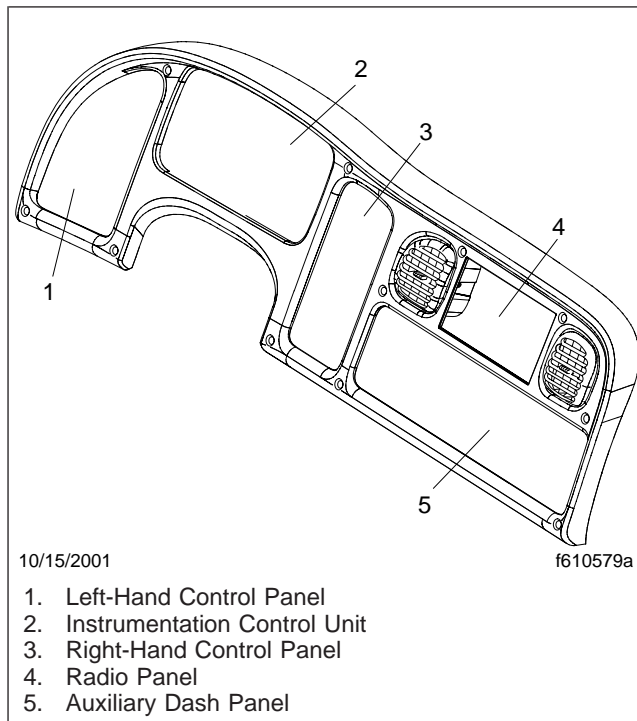


Fig. 4.2, Switch and Gauge Panels

The instrument cluster (ICU3-M2) is located right behind the steering wheel. No controls are installed on the standard instrument cluster.

The right-hand control panel (**Fig. 4.2**) usually contains the transmission push-button shift selector (on vehicles with automatic or automated transmission) and the trailer brake lever (hand control valve). On vehicles with manual transmission, a variety of switches are installed here. If there is a dash-mounted air-restriction indicator, it is often mounted here.

The radio panel contains two louvered dash outlets for the face vents of the HVAC, one on either side of the radio (if installed).

The auxiliary dash panel (**Fig. 4.2**) below the radio panel contains the marker interrupt switch, the air brake valve knobs, the cigarette lighter, and a variety of switch options.

The HVAC climate control panel is on a separate panel below the auxiliary dash panel, between the two cupholders.

Exterior Light Controls

Headlight/Parking Light Switch

The headlight/parking light switch (**Fig. 4.3**) is a paddle switch located on the left-hand control panel above the cruise control switches. When the paddle is lowered, the parking lights illuminate (the front turn signals, the cab marker and identification lights, and the taillights). When the paddle is raised, the low-beam headlights illuminate, along with all the parking lights. To turn off all lights, return the paddle to the center position.

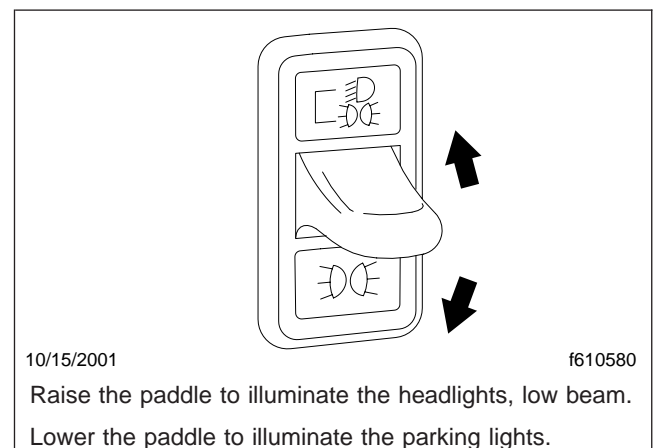


Fig. 4.3, Headlight/Parking Light Switch

NOTE: The front turn signal is the amber lens in each headlight unit. The low-beam headlight is the top clear lens in each headlight unit.

When the headlights or parking lights are on, the panel lights also illuminate. An amber light in the switch backlights either the top icon (for headlights and parking lights) or the bottom icon (for parking lights only).

Panel Light Increase/Decrease Switch

When the panel lights are on, they can be either brightened or dimmed by using the INCR/DECR rocker switch just below the headlight switch (**Fig. 4.4**). To brighten the panel lights, press on the upper part of the rocker (at the INCR legend). To dim

Controls

the panel lights, press on the lower part of the rocker (at the DECR legend).

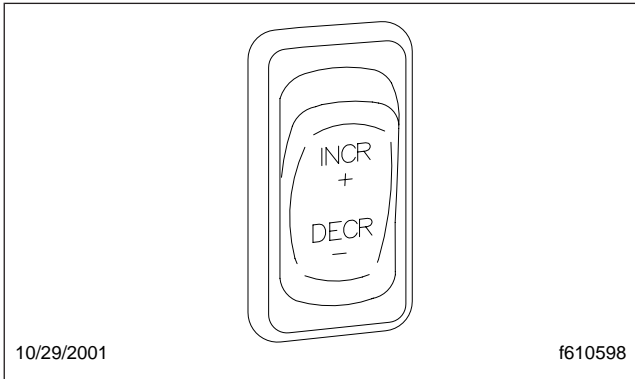


Fig. 4.4, Panel Light Increase/Decrease Switch

When the panel lights are on, both legends are backlit in green.

Daytime Running Lights

Switching on the ignition and releasing the parking brakes automatically activates the daytime running lights, if equipped. The daytime running lights will operate until the parking brakes are applied or the headlights are turned on.

NOTE: Daytime running lights are standard on all Canadian vehicles.

The daytime running lights illuminate at about two-thirds of normal power.

Marker Light Interrupt Switch

The marker light interrupt (MRKR INT) paddle switch temporarily flashes the marker lights and taillights (**Fig. 4.5**). With the vehicle lights on, raise the paddle to briefly turn off the marker lights and taillights. With the vehicle lights off, raise the paddle to briefly turn on the marker lights and taillights.

Turning off the vehicle lights automatically turns off the marker lights. When the panel lights are on, the marker light icon and MRKR INT legend are backlit in green.

Road Light Switch, Optional

The road light (ROAD LAMP) rocker switch operates the optional road lights, which are recessed into the front bumper or mounted on the lower edge of a cut-out in the center of the front bumper.

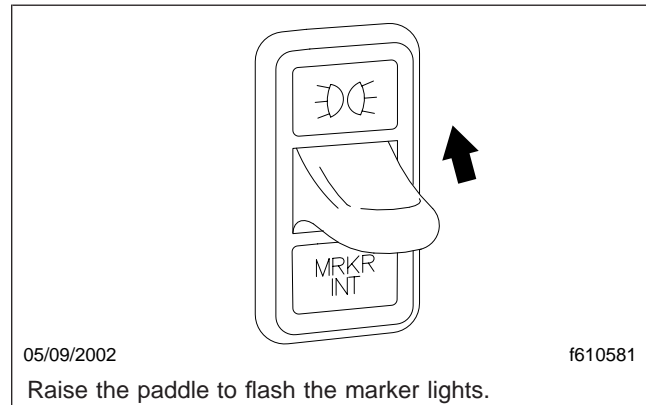


Fig. 4.5, Marker Light Interrupt Switch

The low beam headlights must be turned on before the road lights can be turned on. The road lights will not illuminate if the high beam headlights are already on, and switching from low beams to high beams will switch off the road lights.

To turn the road lights on, press on the upper part of the rocker (at the road light icon). See **Fig. 4.6**. To turn the road lights off, press on the lower part of the rocker (at the ROAD LAMP legend).

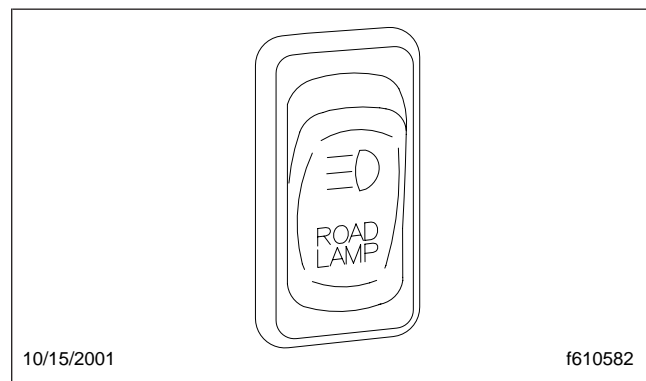


Fig. 4.6, Road Light Switch

When the road lights are on, the road light icon is backlit in amber. When the panel lights are on, the ROAD LAMP legend is backlit in green.

Utility Light Switch, Optional

The utility light switch operates one of the following lights or sets of lights:

- A single round utility light swivel-mounted in the center of the cab roof;

- Two round utility lights mounted in fixed positions on each side of the cab roof;
- Two flush-mounted utility lights mounted on the back of the cab, one on each side.

To turn the utility light(s) on, press in on the upper part of the utility light (UTLY LAMP) rocker switch (**Fig. 4.7**). To turn the utility light(s) off, press on the lower part of the rocker (at the UTLY LAMP legend).



Fig. 4.7, Utility Light Switch

When the utility lights are on, the diagonal light beam icon is backlit in red. When the panel lights are on, the UTLY LAMP legend is backlit in green.

Spotlight, Optional

The spotlight switch is located on the pivoting handle of the spotlight. There may be a single spotlight assembly mounted on the driver's door, or one on each door.

Interior Lights and Light Controls

The interior lights include dome lights, red map lights, and clear reading lights.

Dome Lights

Diffuse dome lights are installed on all cabs. The standard dome light has a clear lens and is installed on the back of the cab above the rear window. See **Fig. 4.8** for the rear dome light.

On cabs with an overhead console, there is an optional overhead dome light assembly containing a diffuse dome and a clear reading light. See **Fig. 4.9** for the optional dome/reading lights on the overhead console.

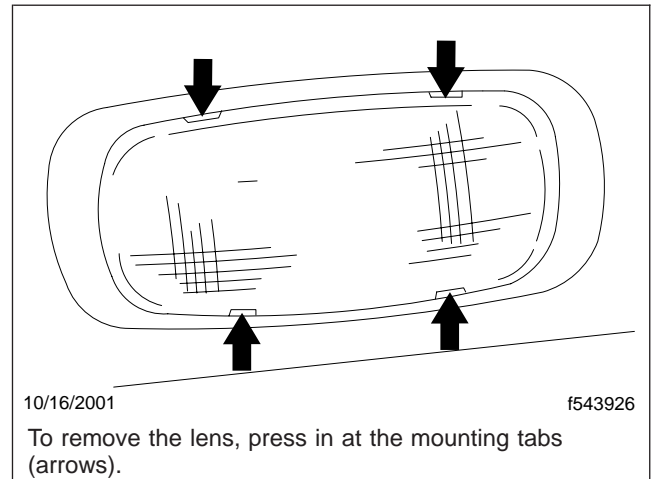


Fig. 4.8, Rear Dome Light

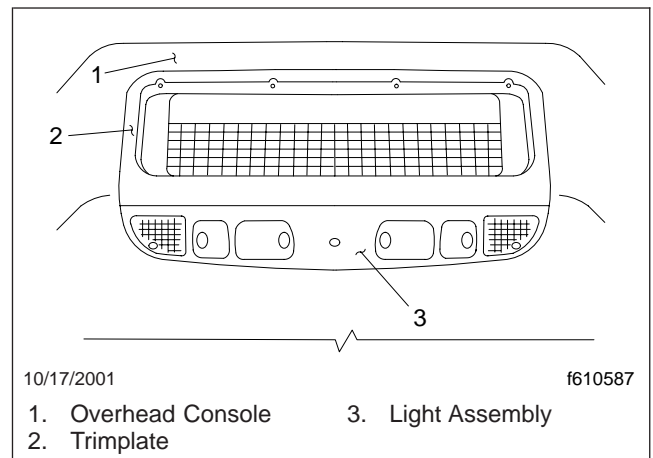


Fig. 4.9, Overhead Console Dome Lights

Light Replacement

Rear Dome Light

To replace the rear dome light (**Fig. 4.8**), do the following steps:

1. Press in on the lens at the four mounting tabs (arrows).
2. Replace the bullet-type bulb and install the lens on the lamp base with the button at the bottom.

Overhead Console Dome/Reading Lights

To replace the overhead console dome/reading lights (**Fig. 4.9**), do the following steps:

Controls

1. Remove the tapping screws that attach the lamp assembly and trimplate to the overhead console.
2. Separate the lamp assembly from the trimplate and disconnect the wiring harness.
3. Replace the lamp assembly.
4. Snap the lamp assembly and trimplate together.
5. Connect the lamp assembly to the wiring harness.
6. Insert the tabs on the trimplate into the slots on the overhead console attachment plate.
7. Center the lamp assembly in the headliner cutout and install the center tapping screw.
8. Install the remaining tapping screws.

Dome Light Switches

In the standard cab, there is one dome light switch in the driver's door that turns on the diffuse dome light when the driver's door is opened. In one option, two switches are installed, so that the diffuse dome light turns on when either the driver's or passenger's door is opened.

Clear Reading Lights, Optional

Clear reading lights are available as a option. They are included only in the light assembly installed in the overhead console, located next to the diffuse dome light in the same fixture (Fig. 4.9). Like the dome lights, the reading lights are door-activated.

Multifunction Turn Signal Switch

The multifunction turn signal switch is attached to the steering column, just below the steering wheel, on the left-hand side. This switch has the following functions:

- The turn signals
- The windshield wipers and washers
- The headlight high beams
- The hazard warning flasher

See Fig. 4.10 for the multifunction switch and its component parts.

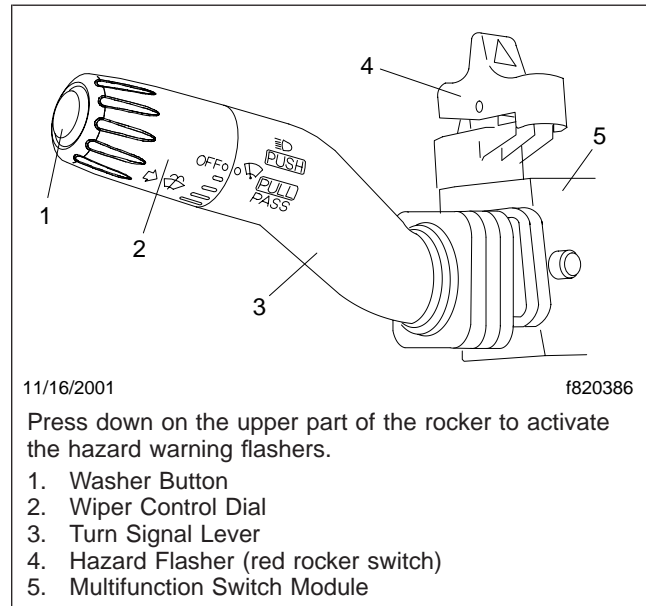


Fig. 4.10, Multifunction Turn Signal Switch

Turn-Signal Controls

The turn signal lever (Fig. 4.11) is mounted on the steering column. Moving the lever down turns on the left turn signal lights; moving it up turns on the right turn signal lights.

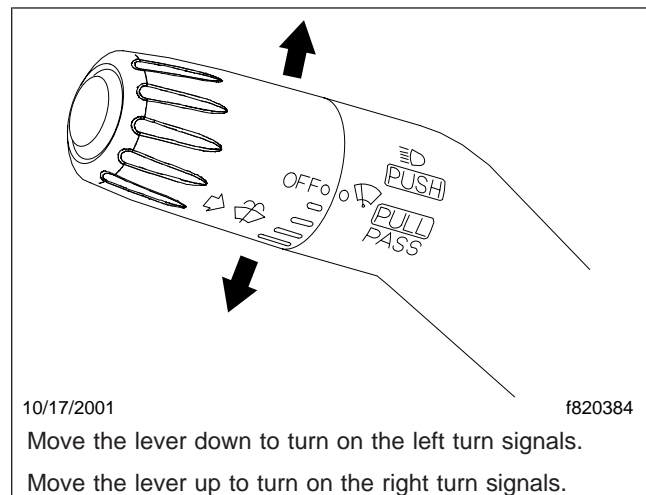


Fig. 4.11, Turn Signal Controls

When one of the turn-signal lights is on, a green indicator arrow flashes at the far left or far right of the warning and indicator light panel.

The lever automatically returns to the neutral position (self-cancels the switch) when the steering wheel returns to the straight ahead position after a turn. To cancel the signal manually, move the lever to the neutral position.

Windshield Wiper/Washer Controls



Do not move the wiper arms manually. Wiper motor damage will occur if the arms are moved.

The wipers are operated by a rotary switch in the wiper control dial, which is on the end of the turn signal lever. See Fig. 4.12. There are five delay settings, marked on the dial by lines of increasing length, and two steady speed settings, LO and HI.

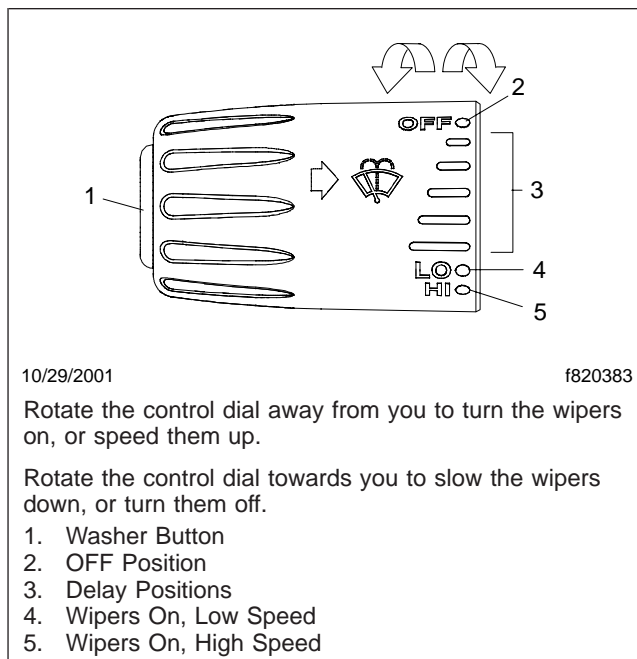


Fig. 4.12, Wiper/Washer Controls

Rotating the control dial forward (in a counterclockwise direction) turns the wipers on. If they are already on, rotating the handle further forward (to a faster speed setting) increases the speed of the wipers through the various delay settings, and to LO and then HI.

Rotating the control dial in the opposite direction (clockwise) causes the wipers to slow down. Rotating

the control dial clockwise as far as it will go (to the OFF setting) turns the wipers off.

The washers are operated by a yellow button at the very end of the turn signal lever. To operate the washers, press the button in and hold it in until you want the washers to stop.

Headlight High Beams

Push the turn signal lever forward, towards the windshield, to turn on the high-beam headlights. Pull the turn signal lever back to its original position to turn them off. See Fig. 4.13.

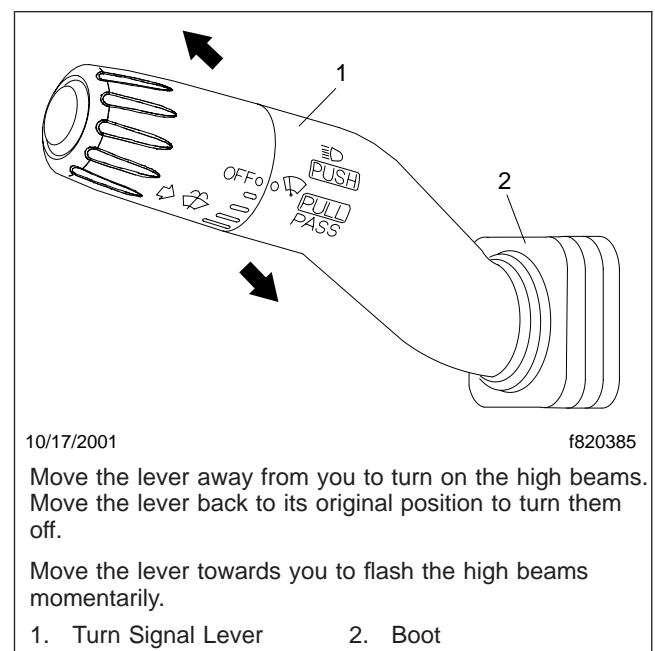


Fig. 4.13, Headlight High Beams

When the high beam headlights are on, a blue light illuminates on the instrument cluster between the tachometer and speedometer. For vehicles built to operate in the United States, switching on the high beams will switch off the road lights.

NOTE: The ignition switch must be on for the high beams to work.

With the headlight low beams on, pull the lever backward, towards the steering wheel, to flash the high beams (turn them on momentarily).

Controls

The headlight low beams remain on continuously during high beam operation. If the low beam headlights are turned off by use of the headlight switch, the high beams turn off also.

Hazard Warning Flasher

The hazard warning light flasher (**Fig. 4.10**) is a red rocker switch located on the top of the multifunction switch module. When the flashers are activated, all of the turn signal lights (front, side, and rear) and the two green indicator arrows on the control panel will blink on and off.

To flash the hazard warning lights, press down on the upper part of the rocker (towards the dash). To stop the hazard warning lights, press down on the lower part of the rocker (towards the steering wheel).

Horn Controls

NOTE: It is possible to have both the electric and the air horn installed on one vehicle.

Electric Horn

A single electric horn is standard. Dual electric horns are available as an option.

The button for the electric horn is located in the center of the steering wheel. To sound the horn, press down on the button. See **Fig. 4.14**.

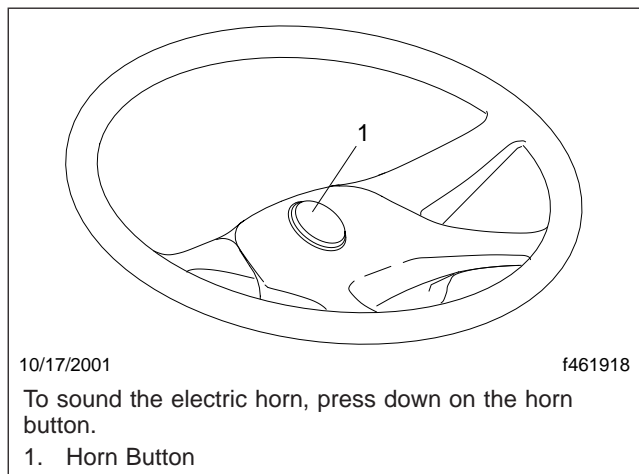


Fig. 4.14, Electric Horn Control

Air Horn, Optional

Single and dual air horns are available as options.

The air horn is controlled by a wire lanyard hanging down just inboard on the driver's door. See **Fig. 4.15**. Pull downward on the lanyard to sound the air horn.

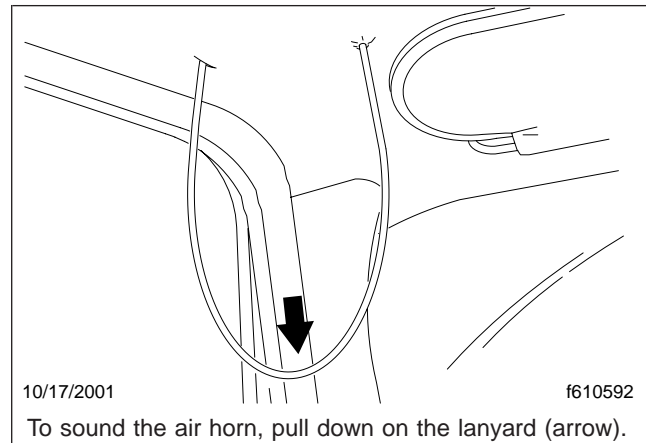


Fig. 4.15, Air Horn Control

Powertrain Controls

After-Treatment System (ATS) Request/Inhibit Regen Switch

A parked regen of the ATS can be initiated with the request/inhibit regen switch. It may also be used to inhibit the vehicle from performing an automatic regen. See **Fig. 4.16**.

The style and function of switch will vary with the engine make and model. See the engine operation manual for operation details.

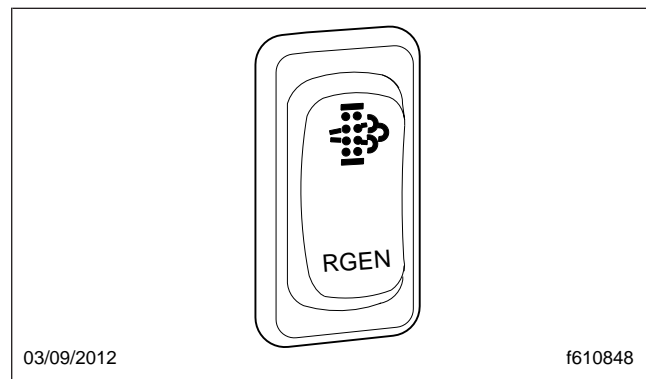


Fig. 4.16, Request/Inhibit Regen Switch

Cruise Control Switches

CAUTION

Do not attempt to shift gears without using the clutch pedal when the cruise control is engaged. Failure to follow this precaution will result in a temporarily uncontrolled increase in engine speed; transmission damage and gear stripping could result.

On standard models, cruise control is activated by two dash switches. See [Fig. 4.17](#). On some models, cruise control can be activated by a button on the transmission shift knob.

- The On/Off Switch—this two-position rocker switch bears the legend SPD CNTL on the lower half of the switch. When cruise control is on, an amber light illuminates in the top part of the switch.
- The Set/Resume Switch—this three-position paddle switch bears the legend RES/ACC above the paddle and SET/CST below the paddle.

NOTE: For more information about cruise control operation, see [Chapter 7](#).

Engine Brake Switch, Optional

The engine brake switch controls the degree of engine braking. Normally there are two paddle switches, a two-position On/Off Switch to activate the engine brake, and a two-position HI-LO Switch to control the amount of engine braking.

To turn the two-position On/Off Switch on, raise the paddle. When the two-position switch is on, an amber LED (light-emitting diode) illuminates inside the switch.

To turn the two-position HI-LO Switch on high, raise the paddle (at the HI-LO icon). To turn the two-position HI-LO Switch on low, lower the paddle (at the ENG BRK legend). See [Fig. 4.18](#).

A three-position switch is used on MBE900 engines equipped with both the regular engine brake and the constant-throttle (decompression) brake. It works the same as the two-position HI-LO switch, except that there is a third (off) position when the switch is left at its normal position.

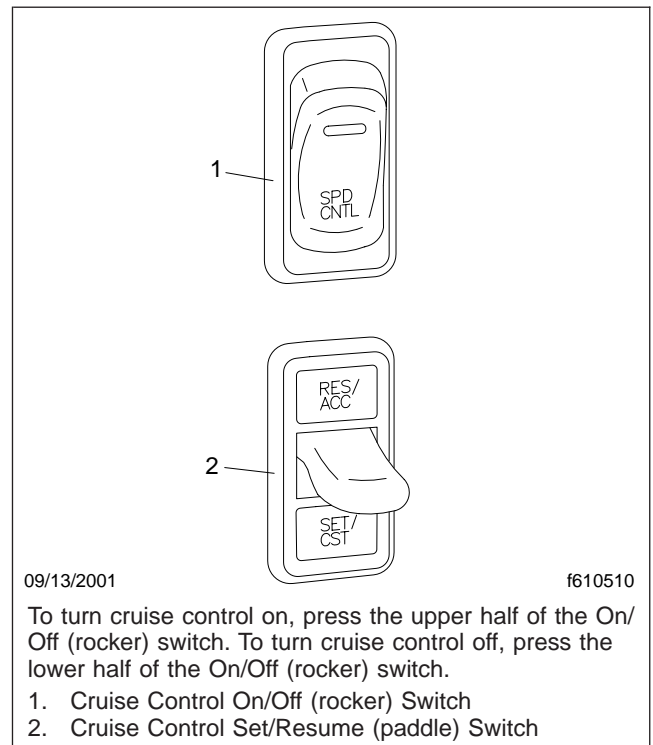


Fig. 4.17, Cruise Control Switches, Dash-Mounted

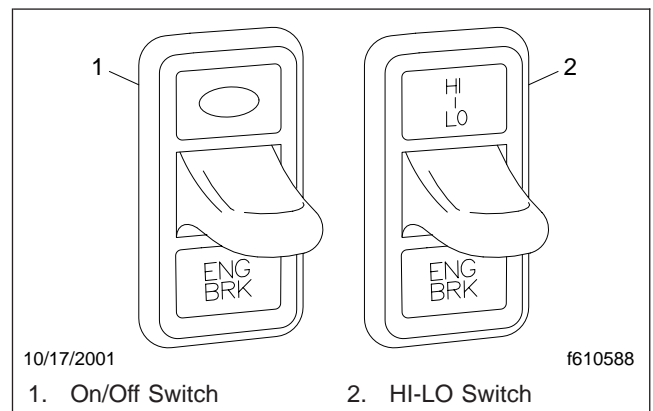


Fig. 4.18, Engine Brake Switches

The engine brake turns off automatically or when the clutch pedal is pressed. On vehicles without a clutch pedal, the brake pedal can be used to deactivate the engine brake. For more information about engine brake operation, see [Chapter 7](#).

When the panel lights are on, the HI-LO icon is backlit in amber on the HI-LO switch. On both switches,

Controls

the ENG BRK legend is backlit in green when the panel lights are on.

Exhaust Brake Switch, Optional

The optional exhaust brake is controlled by a dash-mounted rocker switch to help slow the vehicle when the accelerator is released. See [Chapter 7](#) under the heading "Exhaust Braking System, Optional" for additional information.

To turn the exhaust brake on, press on the upper part of the rocker (at the light inside the switch). The exhaust brake turns off automatically. See [Fig. 4.19](#) or [Fig. 4.20](#).

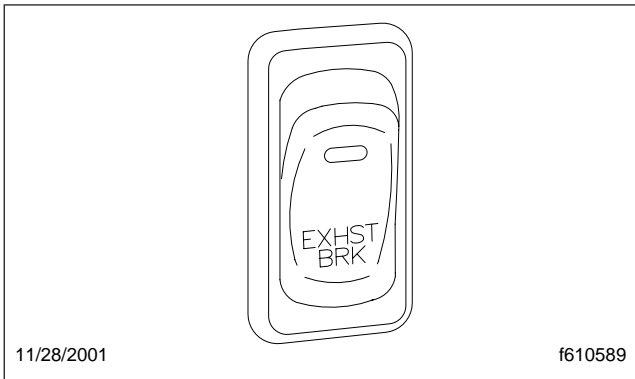


Fig. 4.19, Exhaust Brake Switch

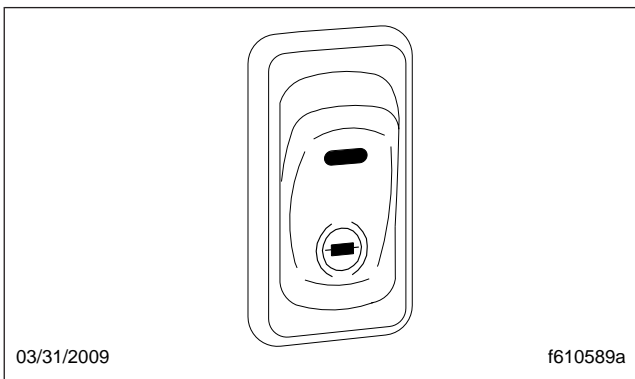


Fig. 4.20, Exhaust Brake Switch

When the exhaust brake switch is on, an amber LED illuminates inside the switch. When the panel lights are on, the EXHST BRK legend is backlit in green.

Engine Fan Switch, Optional

The engine cooling fan can be turned on by the engine fan switch (ENG FAN legend). The fan will continue to operate for a set amount of time and then turn off unless the coolant temperature is high enough to continue the fan operation.

To turn the engine fan on, press on the upper part of the rocker (at the fan icon). See [Fig. 4.21](#).

When the engine fan is running, the fan blade icon is backlit in amber. When the panel lights are on, the ENG FAN legend is backlit in green.

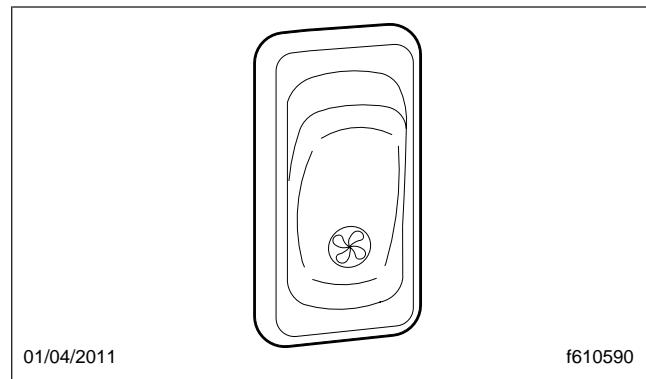


Fig. 4.21, Engine Fan Switch

Transmission Controls

If so equipped, the transmission range control valve and splitter valve are attached to the gearshift knob. Transmission shift pattern labels are located inside the cab. See [Chapter 8](#) for complete transmission operating instructions.

On vehicles with standard Allison On-Highway Series automatic transmission, the shift selector is lever-activated. The display mounted on the steering column provides four forward ranges and one reverse range. See [Fig. 4.22](#).

When the transmission is in D (drive), the vehicle will operate in the overdrive (5th) gear. To shift down into the direct drive (4th) gear, use the overdrive lockout switch (O/D legend). See [Fig. 4.23](#). The transmission will shift into 4th gear and remain in that gear unless a range inhibitor is active, such as engine overspeed. See [Chapter 8](#) for more information about range inhibitors.

To shift to fourth gear, press on the upper part of the rocker (at the LED). The LED will come on and stay

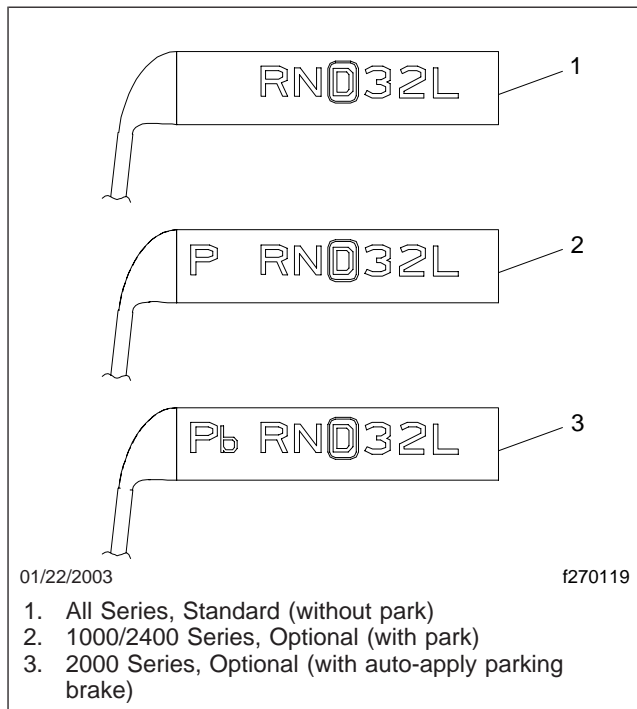


Fig. 4.22, Steering Column-Mounted Shift Controls

1. All Series, Standard (without park)
2. 1000/2400 Series, Optional (with park)
3. 2000 Series, Optional (with auto-apply parking brake)

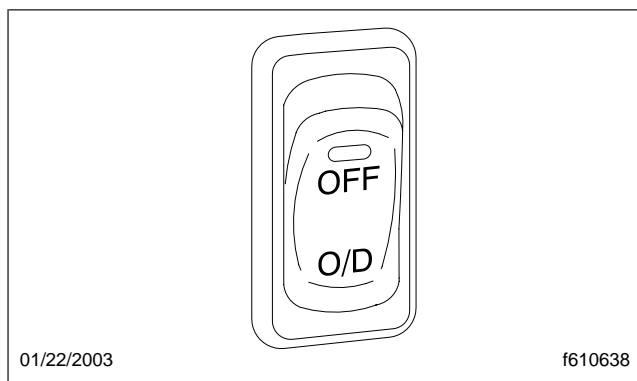


Fig. 4.23, Overdrive Lockout Switch

illuminated until the bottom part of the rocker switch is pressed.

On vehicles with Allison MD Series automatic transmission or Eaton Autoshift automated transmission, a push-button shift selector provides four, five, or six forward ranges and one reverse range. See [Chapter 8](#) for more information about the push-button shift selector.

Axle Switches

All axle switches contain a red LED (light-emitting diode) that illuminates the switch from within when the switch is turned on (the upper part of the rocker is pressed). The legend under the LED, if any, is not visible until the switch is turned on.

IMPORTANT: A guard is positioned around all axle switches to prevent unintentional activation.

NOTE: For more information on axle switch function, see [Chapter 8](#).

Differential Lock Switch



Differential lock should only be engaged when the vehicle is stopped or moving slowly at low throttle. This will prevent internal axle damage.

The differential lock switch is a two-position guarded rocker switch. See [Fig. 4.24](#). It causes the wheels on each axle governed by the switch to rotate together. It is also known as side-to-side wheel lock.

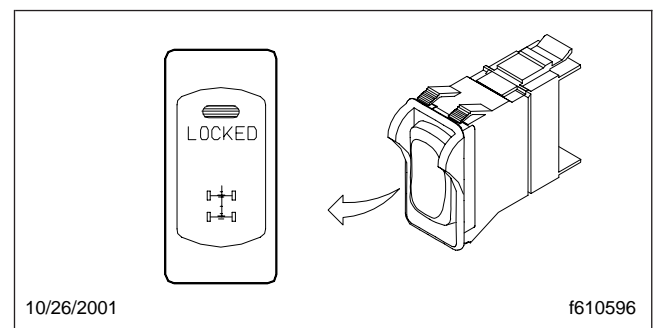


Fig. 4.24, Differential Lock Switch

To lock the wheels together, press the upper half of the rocker momentarily (at the LED). To turn off differential lock, press the upper half of the rocker again.

When the panel lights are on, the double-axle icon is backlit in green.

IMPORTANT: The differential lock switch is guarded to prevent unintentional switch activation. If the LED in the switch begins to blink during normal operation, when the switch has not been activated, this indicates an error condition.

Controls

Bring the vehicle to an authorized Freightliner service facility as soon as possible.

Interaxle Lock Switch



The interaxle lock should not be engaged on a vehicle with obviously spinning wheels. Engagement at high speed or power can damage the axle(s).

The interaxle lock switch is a two-position guarded rocker switch installed on vehicles with dual drive axles. See Fig. 4.25. It causes both axle shafts to rotate together.

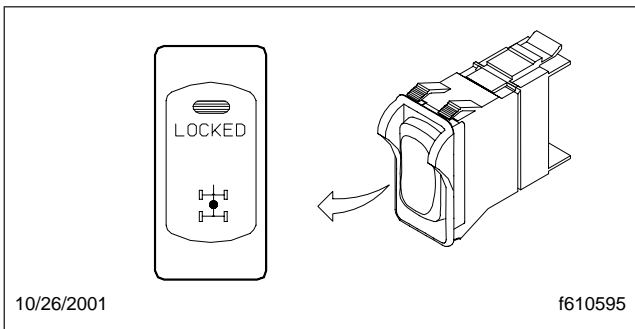


Fig. 4.25, Interaxle Lock Switch

To lock the axles together, press the upper half of the rocker momentarily (at the LED). To turn off interaxle lock, press the upper half of the rocker again.

When the panel lights are on, the double-axle icon is backlit in green.

IMPORTANT: The interaxle lock rocker switch is guarded to prevent unintentional switch activation. This switch does not have a diagnostic blink function when inactive.

Axle Shift Switch



To prevent transmission and axle damage, make sure the automatic transmission is in high range when performing an axle shift with the vehicle moving.

The axle shift switch is a two-position guarded rocker switch installed on vehicles with two-speed axles. See Fig. 4.26.

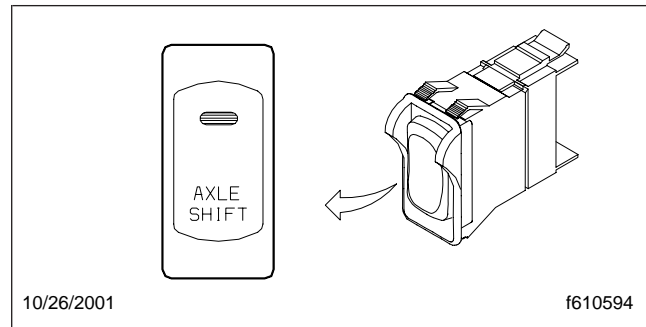


Fig. 4.26, Axle Shift Switch

To shift the axle from low speed to high speed, press the upper half of the rocker momentarily (at the LED). To turn the axle shift off (switch from high speed back to low speed), press the upper half of the rocker again.

NOTE: On vehicles with tandem drive axles, there is an interlock that prevents a 2-speed axle from shifting whenever the interaxle lock is on.

When the panel lights are on, the AXLE SHIFT legend is backlit in green.

IMPORTANT: The axle shift switch is guarded to prevent unintentional switch activation. If the LED in the switch begins to blink during normal operation, when the switch has not been activated, this indicates an error condition. Bring the vehicle to an authorized Freightliner service facility as soon as possible.

All-Wheel-Drive Controls, Optional

All-wheel-drive (AWD) allows the driver to direct driveline power to all four axles, front and rear. Two switches are used to control AWD: an AWD operation switch used to activate all-wheel-drive, and an AWD range switch used to select the high or low range. AWD controls are not multiplexed.

AWD Operation Switch

The AWD operation switch is a two-position rocker switch with a light-emitting diode (LED) that illuminates when AWD is engaged. The legend LOCKED is underneath the LED on the upper half of the switch. On the lower half is the legend AWD. See Fig. 4.27. When the panel lights are on, the AWD legend is backlit in green.

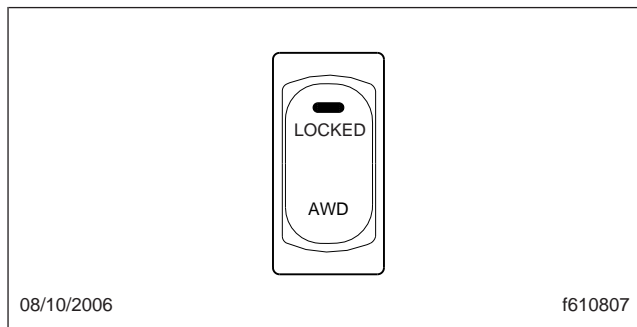


Fig. 4.27, AWD Operation Switch

To engage AWD, press the upper half of the rocker switch. The LED illuminates to indicate that AWD is engaged. To turn off AWD, press the lower half of the switch. The LED goes out to indicate the AWD is no longer engaged.

When AWD is engaged, the LOCKED legend is backlit in red. In addition, a red indicator with the legend T-CASE ENGAGED displays on the dash message center.

AWD Range Switch



To prevent damage to the transfer case and the driveline, stop the vehicle and apply the parking brake before using the range switch.

The AWD range switch is used under similar conditions to those of the axle shift switch on a two-speed rear axle. Use the high range when driving at normal speeds under off-road conditions, or on non-paved surfaces. Use the low range when extra traction is needed at lower speeds; for example, under conditions of mud, snow, or ice. This switch should be used only when AWD has been engaged.

In most cases, the AWD range switch is a two-position rocker switch with the legends LO RANGE

at the upper end and HIGH RANGE at the lower end. On vehicles with a power take-off unit (PTO), the three-position switch has a neutral (N-TRL) position in the middle. See Fig. 4.28. When the panel lights are on, the HIGH RANGE legend is backlit in green.

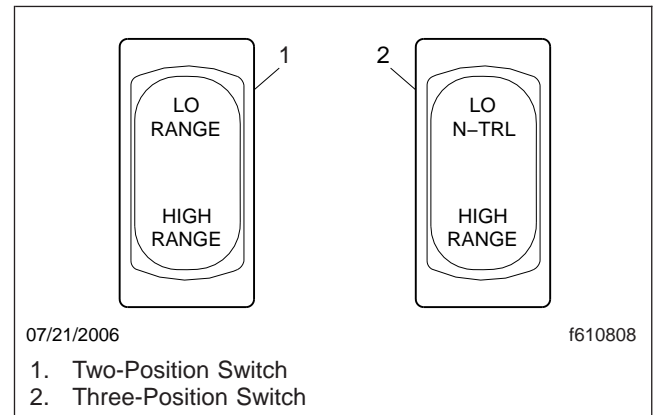


Fig. 4.28, AWD Range Switches

Two-Position Switch (no PTO)

On vehicles without a PTO, high range is considered standard operation. To activate the low range, press the upper half of the switch. When the low range is activated, the LO RANGE legend is backlit in red. In addition, a red indicator with the legend T-CASE LO RNG displays on the dash message center. To switch back to HIGH RANGE, press the lower half of the switch.

Three-Position Switch (with PTO)

IMPORTANT: Always use the N-TRL switch position when operating the PTO.

On vehicles with a PTO, neutral is considered standard operation (switch in the middle position). An amber indicator with the legend T-CASE NTRL displays on the dash message center.

To activate the high range, press the lower half of the switch. No indicator displays on the dash message center with the high range activated. Press the upper half to return to N-TRL.

To activate the low range, press the upper half of the switch. A red indicator with the legend T-CASE LO RNG displays on the dash message center. On the switch, the LO N-TRL legend is backlit in red. Press

Controls

the lower half to return to N-TRL, and then press the lower half again to select HIGH RANGE.

Braking

Parking Brake Control Valve

The yellow diamond-shaped knob (**Fig. 4.29**) on the auxiliary dash panel operates the parking brake control valve (park brake switch). Pulling the yellow knob applies the tractor parking brakes (spring brakes). Pushing in the knob releases the tractor parking brakes. Before the parking brakes can be released, the air pressure in either air brake system must be at least 65 psi (448 kPa).

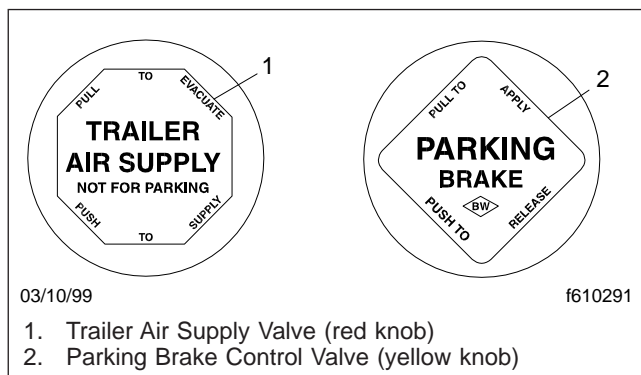


Fig. 4.29, Brake Valve Control Knobs

See **Chapter 9** under the heading "Dual Air Brake System" for further information about the parking brake control valve.

Trailer Air Supply Valve

The red octagonal-shaped knob (**Fig. 4.29**) on the auxiliary dash panel operates the trailer air supply valve. After the vehicle and its air hoses are connected to a trailer, and the pressure in the air system is at least 65 psi (448 kPa), the red knob must be pushed in (and should stay in) to charge the trailer air supply system and release the trailer spring parking brakes. Before disconnecting a trailer or when operating a vehicle without a trailer, the red knob must be pulled out.

See **Chapter 9** under the heading "Dual Air Brake System" for further information about the trailer air supply valve.

Trailer Brake Lever

The trailer brake lever (hand control valve) is used for applying the trailer brakes without applying the truck or tractor brakes. It is usually mounted on the right-hand control panel. See **Fig. 4.30**. See **Chapter 9** under the heading "Dual Air Brake System" for operating instructions.

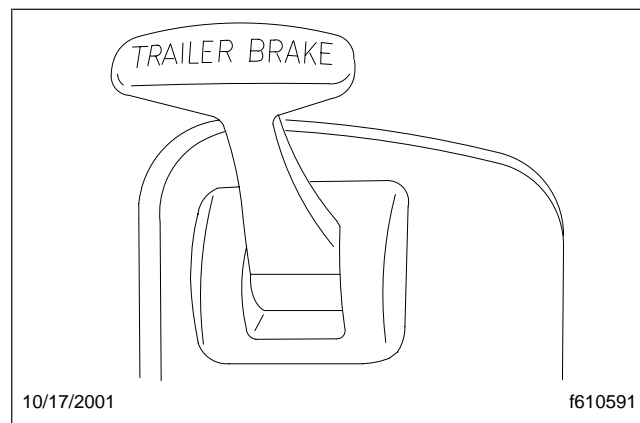


Fig. 4.30, Trailer Brake Lever

Meritor™ WABCO® Antilock Braking System (ABS)

The Meritor WABCO Antilock Braking System (ABS) has an amber tractor indicator light (TRACTOR ABS legend) and, if equipped with automatic traction control (ATC), an amber wheel spin indicator light (WHEEL SPIN legend). See **Fig. 4.31**.

On vehicles equipped with a compatible trailer, there is also an amber trailer indicator light (TRAILER ABS legend).

See the brake system operating instructions in **Chapter 9** for more information about ABS.

Adjustable Steering Column

To tilt the steering column, press down on the foot pedal located below the steering column. Tilt the steering column up or down to the desired position. Release the foot pedal to lock the steering column in place. See **Fig. 4.32**.

To telescope the steering column, press down on the foot pedal located below the steering column. Pull the steering wheel closer to you or push the steering

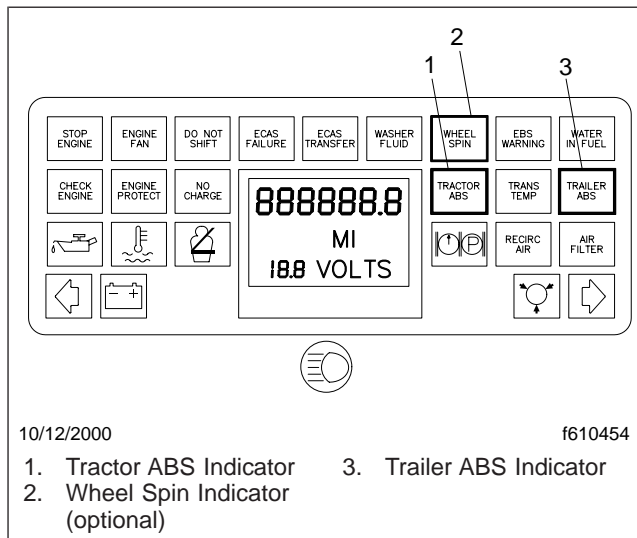


Fig. 4.31, ABS Indicator Lights

wheel farther away from you. Release the foot pedal to lock the steering column in place.

Other Dash-Mounted Controls

Windshield-Fan Switches, Optional

Ceiling-mounted defogger fans are operated by LOW/OFF/HIGH toggle switches located in the base of the fan.

Cigarette Lighter

Push in the lighter to heat the element. The lighter will stay in and will automatically pop out when the element is hot.

CB Radio Connections

An antenna connection and positive (+) and negative (-) power connections are provided for a CB radio.

Suspension Dump Switch

NOTICE

Do not operate the vehicle over uneven ground such as ramps, speed bumps, curbs, etc. with the air springs deflated. Doing this may lead to air bag separation from the piston, preventing the suspension air springs from reinflating.

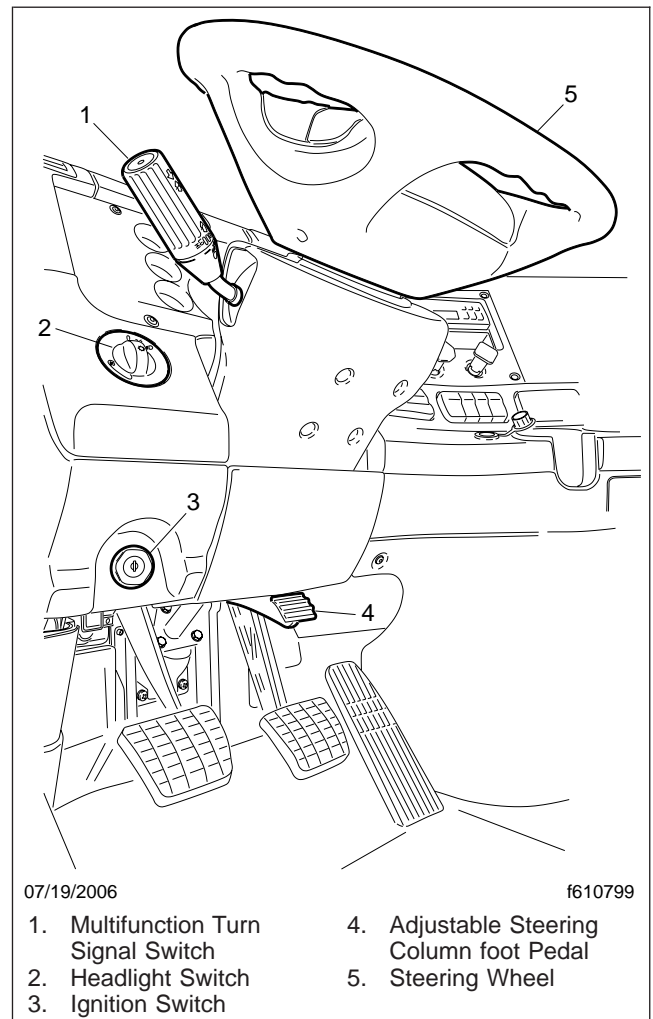


Fig. 4.32, Adjustable Steering Column

NOTICE

Never exhaust air from the suspension while driving. When the air is exhausted, the suspension will not absorb road shocks, and components may be damaged.

The suspension dump switch is a two-position guarded rocker switch (Fig. 4.33). It allows the air in the vehicle air suspension to be quickly exhausted, lowering the rear of the vehicle. This makes it easier to connect to, or disconnect from, a trailer.

To lower the rear of the vehicle quickly, press the upper half of the rocker momentarily (at the LED). To

Controls

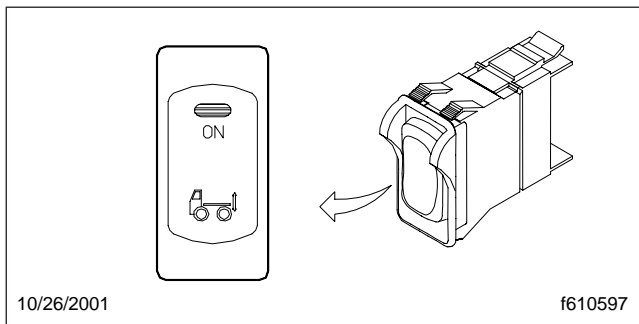


Fig. 4.33, Suspension Dump Switch

raise the suspension to its normal height, press the upper half of the rocker again.

When the panel lights are on, the tractor icon is backlit in green.

IMPORTANT: The suspension dump switch is guarded to prevent unintentional switch activation. This switch does not have a diagnostic blink function when inactive.

When the suspension dump switch is pressed, three responses are possible: a normal response, a slow response, and an abnormal response.

Normal Response: The LED in the switch blinks while the suspension is deflating or filling. When it is completely deflated, the LED comes on steady and stays illuminated. In normal operation, the suspension may dump or fill so quickly that the blinking of the switch is barely noticeable.

If operation of the switch is not possible for any reason (vehicle is moving faster than 5 mph, ignition is turned off, etc.), the LED will stop blinking and turn off.

Slow Response: If operation of the switch is slowed for any reason (by cold weather, low air pressure, etc.), the switch will continue to blink until the suspension completes a dump or fill. As in the normal response, the LED comes on steady and stays illuminated when the suspension is fully deflated.

Abnormal Response: If the LED blinks for more than 10 seconds, the suspension dump mechanism may not be operating properly. Bring the vehicle to an authorized Freightliner service facility for testing.

If the ignition is turned off while the vehicle is in dump mode, the power to the dump solenoid is cut off to prevent battery drain, and the suspension system will autofill the rear air springs. The suspension

will also autofill if the vehicle is operated with the suspension dumped, and the speed is over 5 mph (e.g. -- driver forgot to inflate the bags or there was a system failure).

Suspension Autofill Override Valve

The suspension autofill override option is a dash air valve, that keeps the suspension deflated when the ignition is turned off. To operate it, turn off the ignition then push the override valve knob. See [Fig. 4.34](#). When the ignition is turned on, the override valve will release automatically, and the suspension will autofill. The suspension dump switch will then operate normally as described previously.

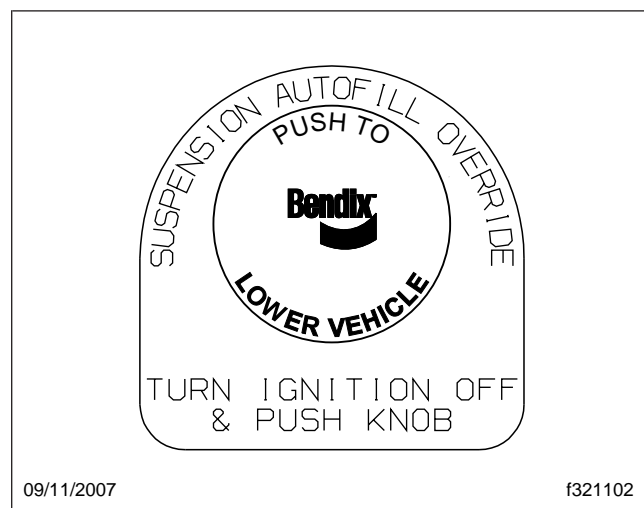


Fig. 4.34, Suspension Autofill Override Valve

Heater/Air Conditioner Control Panel

Standard controls ([Fig. 4.35](#)) for the heating, ventilation, and air-conditioning system (HVAC) consist of an eight-speed fan switch, an air selection switch, and a temperature control switch. On vehicles with air conditioning, the panel also contains a telltale LED and an air recirculation button. See [Chapter 6](#) for detailed operating instructions for the HVAC.

Seat Controls

Bench Seat Adjustment Controls

The standard bench seat has one control: the seat slide lever. See [Fig. 4.36](#). The two-person bench

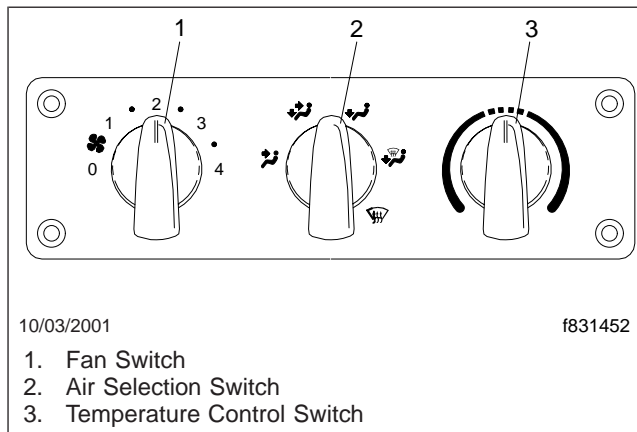


Fig. 4.35, HVAC Climate Control Panel, Standard

seat and the non-suspended passenger seat have no controls.

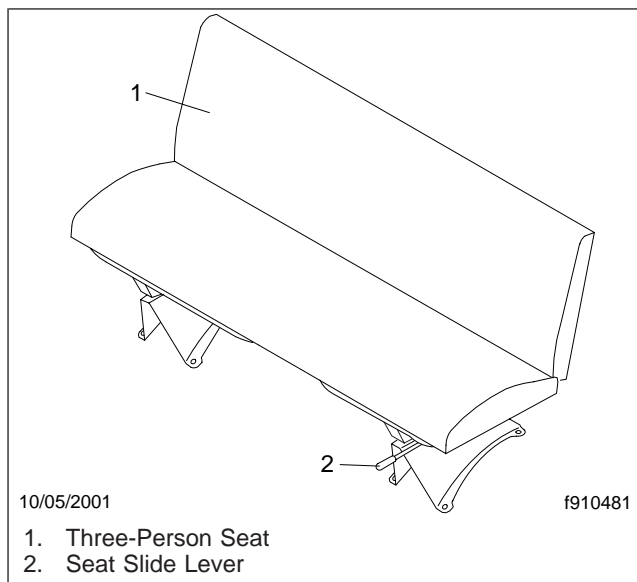


Fig. 4.36, Full Bench Seat

Suspension Seat Adjustment Controls

All controls for adjusting air suspension seats are located within easy reach of the occupant.

Due to the maximum adjustability of mid- and high-back air suspension seats, it is possible to combine the seat back recline adjustment and the seat slide adjustment so that the seat back contacts the back-wall. It is the responsibility of the driver to adjust the

seat to prevent damage to the seat and the cab interior.

All adjustment controls for a suspension seat are located on the seat base. See [Chapter 5](#) for complete instructions.

5

Cab Features

Windows	5.1
Mirrors	5.1
Seats	5.2
Seat Belts and Tether Belts	5.7
Cab Amenities	5.9
Windshield Washer Reservoir	5.10

Cab Features

Windows

Standard windows operate mechanically using a hand crank.

Power windows are optional, and can be installed on one side or both sides. One power window switch (window icon) will be installed on the dash for each window. See [Fig. 5.1](#). If your vehicle is equipped with power windows, press up to raise the window; press down to lower the window. Releasing the switch causes the window to stop.

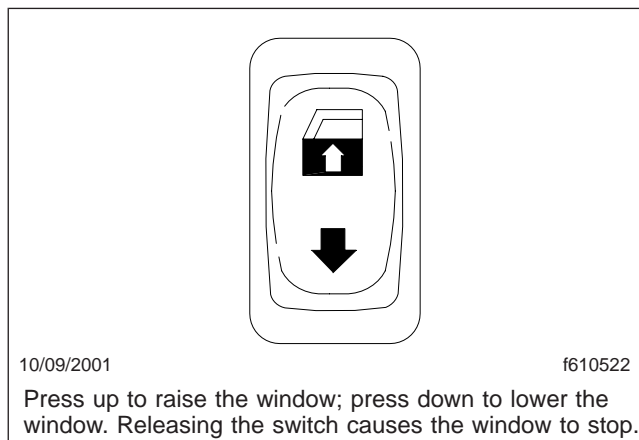


Fig. 5.1, Power Window Switch

Standard vent (wing) windows do not open. Operating vent windows are optional. To open the operating vent window, turn the latch on the window and push the window open. See [Fig. 5.2](#).

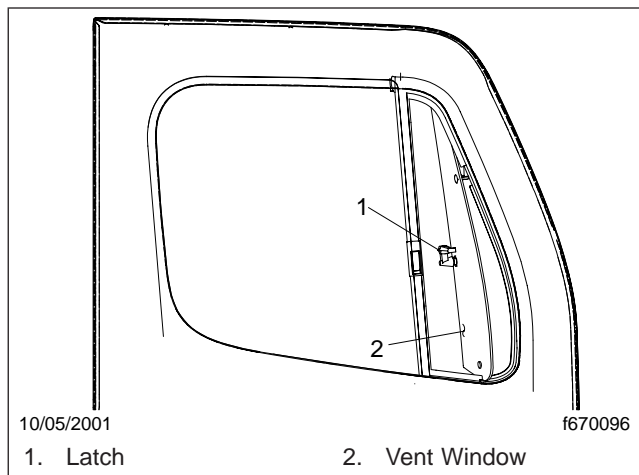


Fig. 5.2, Operating Vent Window (optional)

Mirrors

The standard outside mirrors are mounted on the door frame. There is a primary rear view mirror and a convex mirror.

Mirror Heat Switch, Optional

One or both outside door mirrors can be heated to keep them clear of fog, frost, and ice.

To heat the mirrors, press the upper part of the mirror heat switch (MIRR HEAT) on the dash. See [Fig. 5.3](#). When the mirror heat switch is on, an amber indicator light illuminates inside the switch.

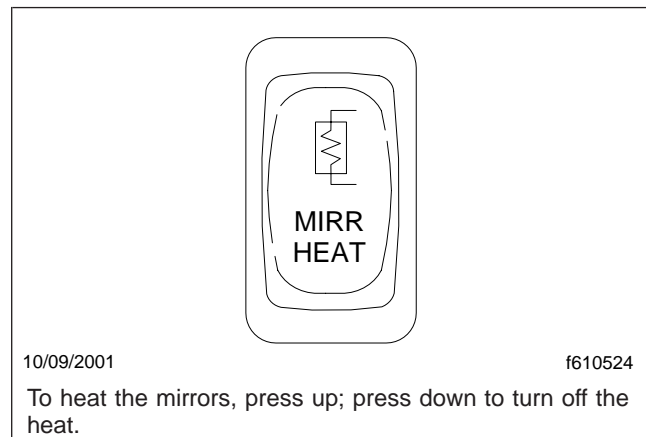


Fig. 5.3, Mirror Heat Switch

The mirror heat switch is a smart switch (fully multiplexed).

Power Mirrors, Optional

The main outside mirrors, if heated, can be equipped with an electrical remote control located on the driver's door. See [Fig. 5.4](#).

To select the mirrors on the left-hand side, press the left side of the mirror select switch. To select the mirrors on the right-hand side, press the right side of the mirror select switch.

The keypad has four arrow keys, pointing up, down, left, and right. To adjust the mirror position, press the keypad in the direction you want the mirror to move.

Down View Mirror, Optional

A down view mirror can be installed on the top of the passenger door frame to allow the driver a view of

the area adjacent to the right side of the cab. See [Fig. 5.5](#).

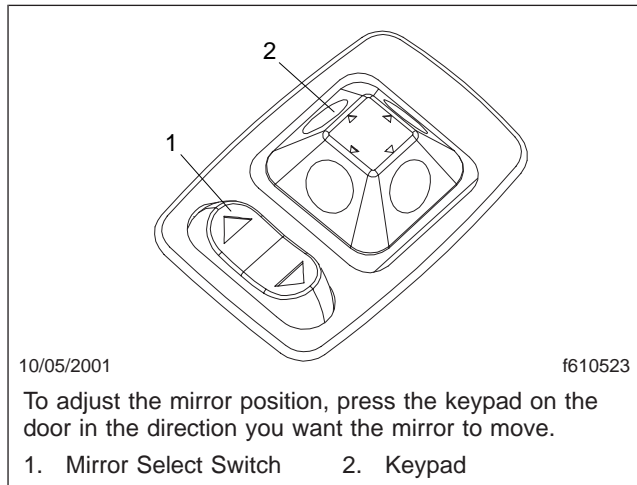


Fig. 5.4, Power Mirror Switch Pad

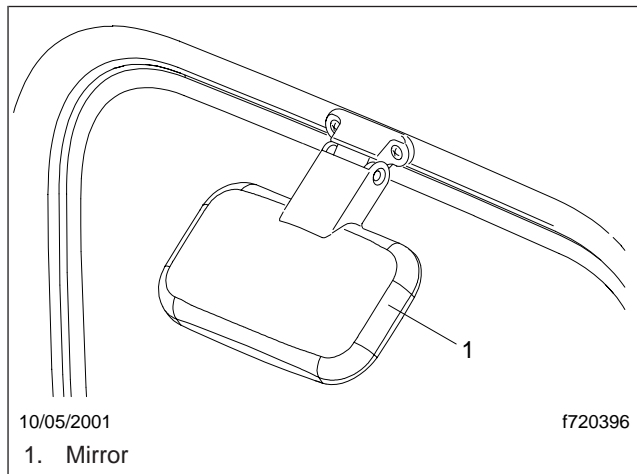


Fig. 5.5, Down View Mirror (optional)

Seats

General Information

WARNING

Keep hands, tools, and other objects away from the scissor points under the seats. Failure to do so could cause personal injury.

Unless otherwise noted, all seat adjustments should be made while seated and before the engine is started.

Due to the high degree of adjustability found in high-back air suspension seats, it is possible to set the seat back recline adjustment and the seat slide adjustment in such a combination that the seat back will come into contact with the rear wall of the cab. It is the responsibility of the driver to adjust the seat to prevent damage to the seat and the cab interior.

The following is a description of adjustments that are available on one or more seats. Not all seats have all of the adjustments listed below.

1. **Seat Slide (fore-and-aft):** When this adjustment is made, the entire seat moves forward or backward on its track ([Fig. 5.6](#)).

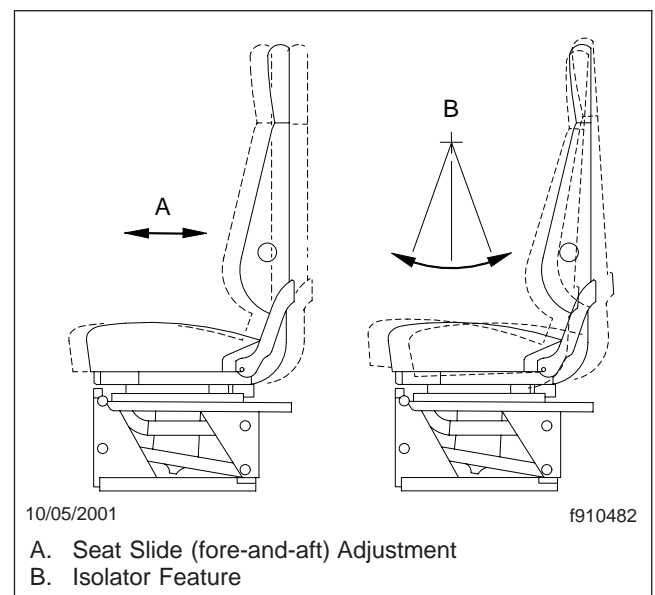


Fig. 5.6, Seat Slide Adjustment and Isolator Feature

2. **Isolator:** This feature (also referred to as backslap isolator or Chugger-Snubber[®]) reduces the amount of road shock by isolating the occupant from the motion of the vehicle, and allowing the upper seat to move in a simple pendulum motion. Whenever the isolator is not desired, it can be locked out ([Fig. 5.6](#)).
3. **Lumbar Support:** Lumbar support changes the shape of the seat back to give more or less support to the occupant's lumbar (lower back) area.

Cab Features

This adjustment is either mechanical or air controlled, depending on make and model of the seat (Fig. 5.7).

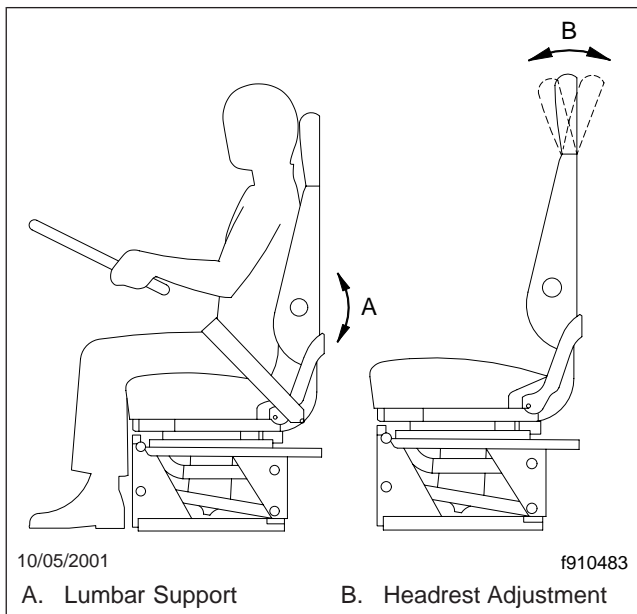


Fig. 5.7, Lumbar Support and Headrest Adjustment

4. Headrest: When this adjustment is made, the upper part of the backrest (back cushion) changes angle to provide head and upper back support (Fig. 5.7).
5. Backrest Tilt: This adjustment pivots the backrest forward or backward (Fig. 5.8).
6. Seat Cushion Tilt: This adjustment raises or lowers the front and/or back of the seat (bottom) cushion. This adjustment is easier to perform when all weight is removed from the seat (Fig. 5.8).
7. Seat Tilt: When this adjustment is made, the seat assembly, both backrest and seat cushion, tilts forward or backward (Fig. 5.8).
8. Ride Height Adjustment: The entire seat moves up or down when adjusting the ride height. The adjustment is either manual or air controlled, depending on the make and model of the seat (Fig. 5.9).
9. Damper: When you sit on the seat, a leveling valve places you in the center of the ride zone. When the damper is adjusted properly under nor-

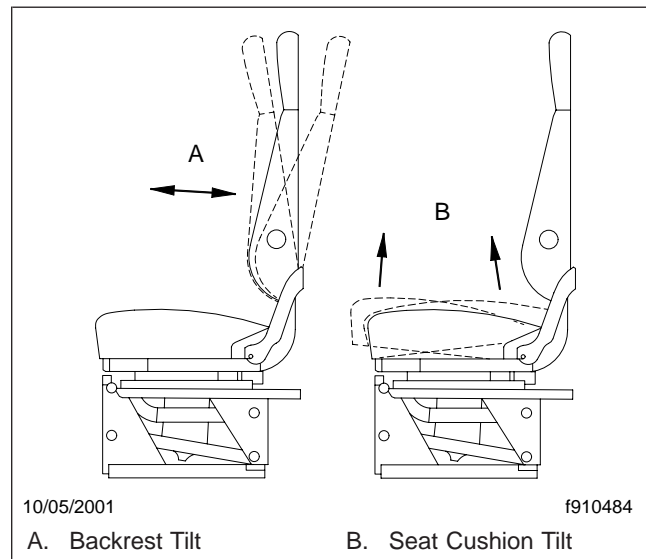


Fig. 5.8, Cushion Tilt Adjustments

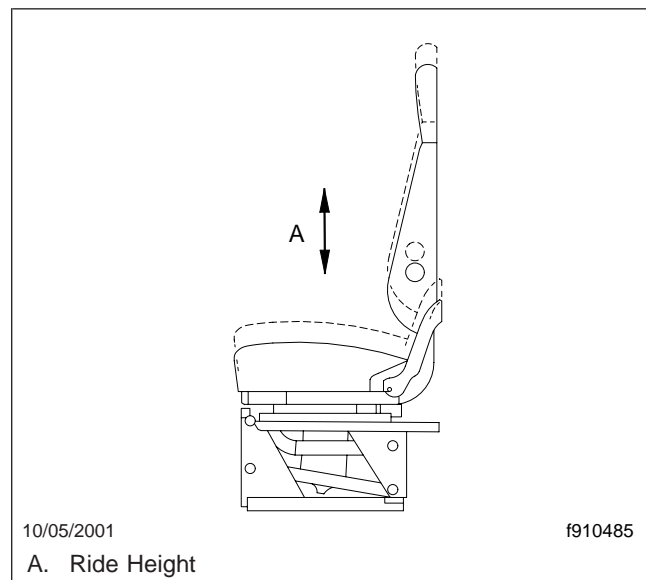


Fig. 5.9, Ride Height Adjustment

- mal driving conditions, the seat should not top or bottom against the limits of the vertical travel.
10. Ride Firmness: A firmer ride gives a better feel for the road but less protection against unevenness in the road surface. A softer ride smooths out the bumps.

Bench Seats

The three-person full bench seat is standard. See [Fig. 5.10](#).

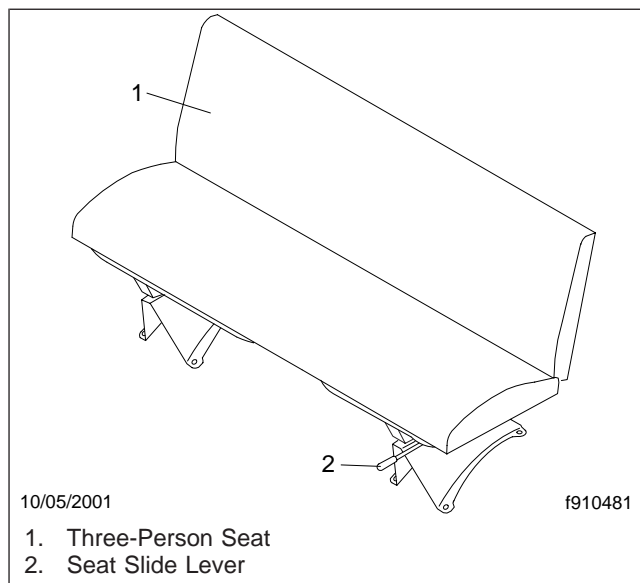


Fig. 5.10, Full Bench Seat

The full bench seat has a seat slide adjustment to allow more or less leg room for the driver and passengers. Release the seat slide lever and push backwards or forwards to move the seat along its track.

High-back air suspension seats are optional for both driver's and passenger's seats. Also available are a non-suspended passenger's seat, and a two-person bench seat with a safe or tool box located under the seat.

No adjustments are possible on the two-person bench seat or the non-suspended passenger seat.

Bostrom Seat

Seat Slide Adjustment

Move the seat slide and isolator lever ([Fig. 5.11](#)) to the left and hold it there to slide the seat forward or backward to the desired position.

Isolator

To engage the isolator, put the seat slide and isolator lever in the center position. Lock out the isolator by moving the lever to the right.

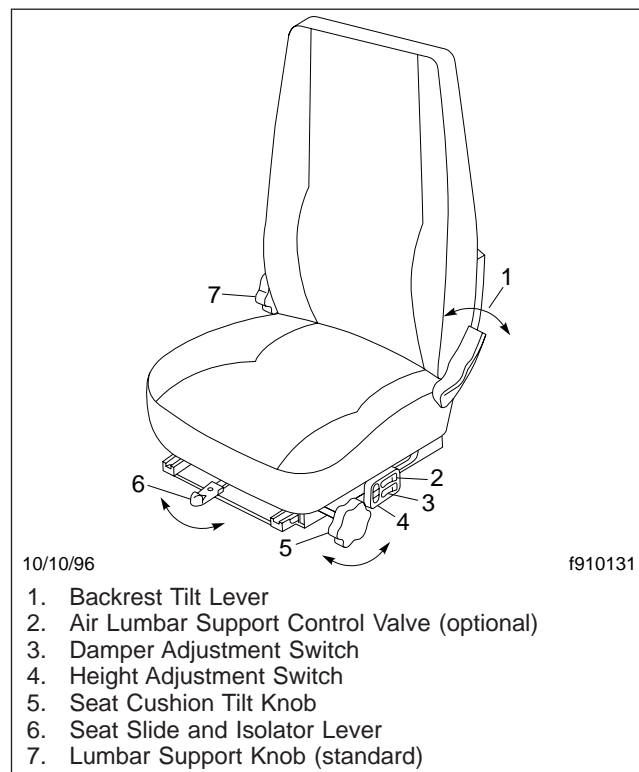


Fig. 5.11, Bostrom Seat

Lumbar Support

To increase lumbar support, rotate the lumbar support knob forward. To decrease lumbar support, rotate the knob rearward.

On seats equipped with air lumbar support, press the control valve upward to increase lumbar support. Press the control valve downward to decrease lumbar support.

Seat Cushion Tilt

Rotate the seat cushion tilt knob to increase or decrease seat cushion tilt.

Backrest Tilt

To tilt the backrest, lean forward slightly to remove pressure from the cushion and hold the backrest tilt lever rearward. Lean backward slowly to the desired position and release the lever to lock the backrest in place.

Cab Features

Ride Height and Damper Adjustment

To raise the seat, press the upper portion of the height adjustment switch. To lower the seat, press the lower portion of the switch.

Press the damper adjustment switch to adjust the damper.

National 2000 Series Seat

Seat Slide Adjustment

Move the seat slide lever (**Fig. 5.12**) to the left and hold it there to slide the seat forward or backward to the desired position. Move the lever back to its original position to lock the seat in place.

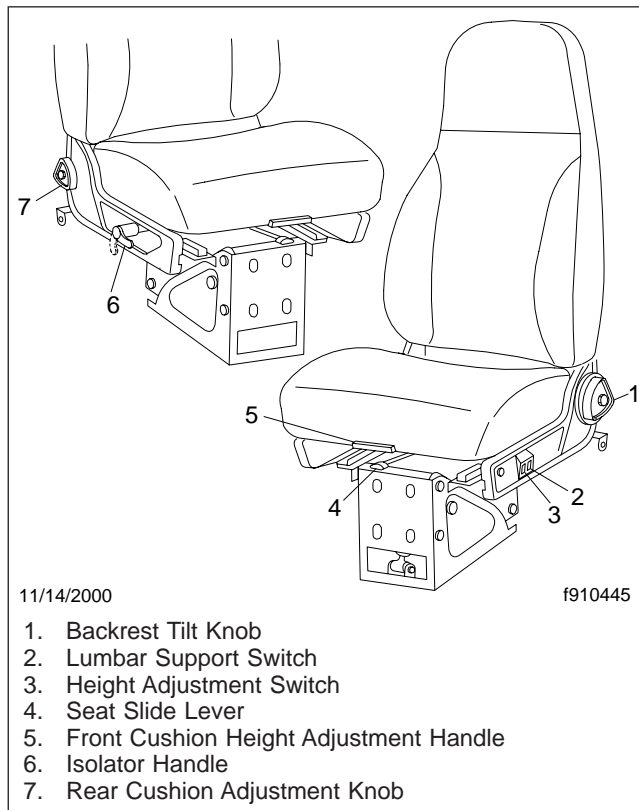


Fig. 5.12, National 2000 Series Seat

Isolator

To use the isolator feature, turn the isolator handle to the horizontal position. Turn the isolator handle down to lock out the isolator.

Lumbar Support

To adjust the lumbar support, use the lumbar support switch on the side of the seat to give more or less support to your lower back.

Backrest Tilt

To tilt the backrest, turn the backrest tilt knob until the desired position is reached.

Seat Cushion Adjustment

To adjust the height of the front of the seat cushion, lift the front cushion height adjustment handle, and pull forward or push back to the desired setting.

To adjust the height of the rear of the seat cushion, remove your weight from the seat and turn the rear cushion adjustment knob to one of three positions.

Ride Height Adjustment

To raise or lower the height of the seat, use the height adjustment switch on the side of the seat.

Sears Seat

Seat Slide Adjustment

Push the seat slide (fore-and-aft adjustment) lever (**Fig. 5.13**) all the way to the left and slide the seat forward or backward, as desired. Release the lever to lock the seat in the desired position.

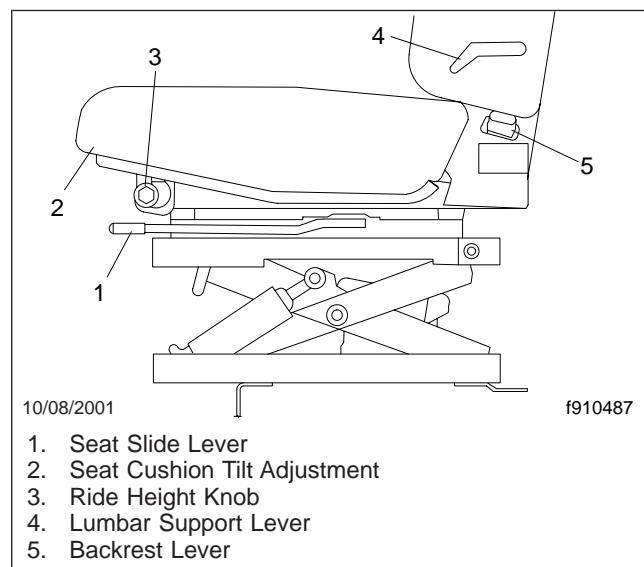


Fig. 5.13, Sears Low Profile Seat

Isolator

To engage the isolator (if installed), move the seat slide and isolator lever (Fig. 5.14) all the way to the right. To lock out the isolator, move the isolator lever to the center position.

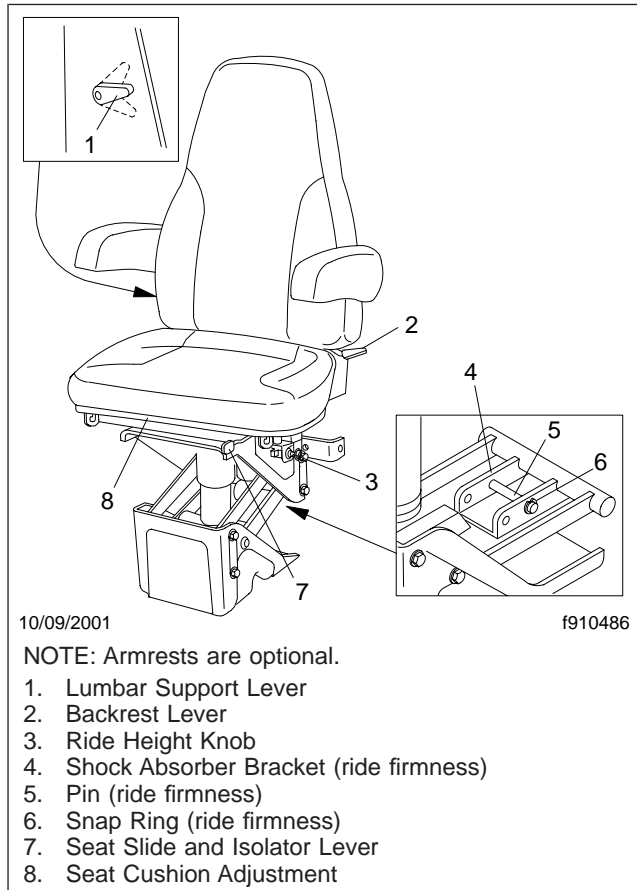


Fig. 5.14, Sears Fleetmaster Seat (with isolator)

Lumbar Support

Move the three-position lumbar support lever upward to increase lumbar support (firmer). Move the lever downward to decrease lumbar support (less firm).

NOTE: This three-position lever (see inset) does not rotate a full 360 degrees.

For seats with air support, use the aft rocker switch on the control panel on the left-hand side of the seat (Fig. 5.15). Press up to make the seat firmer; press down to make the seat less firm.

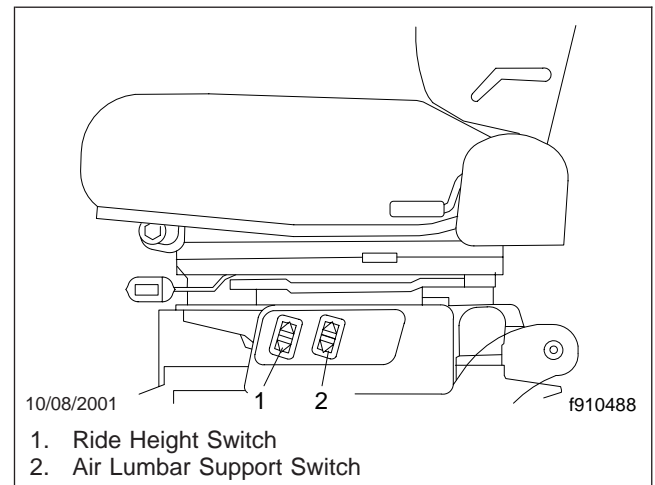


Fig. 5.15, Air Controls, Sears Seat

Seat Cushion Tilt

To raise the seat cushion, lift upward on the front of the seat cushion, and then push it rearwards. To lower the seat cushion, pull forward on the front of the seat cushion, and then push downwards.

Backrest Adjustment

To adjust the backrest, push downwards on the backrest lever just below the bottom of the backrest cushion. With the lever down, lean forward or backward to the desired position. Release the lever to lock the backrest in place.

Ride Height Adjustment

Push the ride height knob inwards to inflate the air cylinder, raising the height of the seat. Pull the ride height knob outwards to deflate the air cylinder, lowering the height of the seat.

For seats with air support, use the forward rocker switch on the control panel on the left-hand side of the seat (Fig. 5.15). Press up to raise the seat; press down to lower the seat.

Ride Firmness Adjustment

For a softer ride, remove the snap ring and pin from the shock absorber bracket (see inset). Relocate the pin in the other set of holes in the bracket and secure it with the snap ring.

Cab Features

Seat Belts and Tether Belts

General Information

Seat belt assemblies are designed to secure persons in the vehicle to help reduce the chance of injury or the amount of injury resulting from accidents or sudden stops. For this reason, Daimler Trucks North America LLC urges that the driver and *all* passengers, regardless of age or physical condition, use seat belts when riding in the vehicle.

WARNING

Always use the vehicle's seat belt system when operating the vehicle. Failure to do so can result in severe personal injury or death.

Seat belt assemblies in Daimler Trucks North America (DTNA) vehicles meet Federal Motor Vehicle Safety Standard 209, "Type 1" and "Type 2" requirements.

When transporting a child, always use a child restraint system or the vehicle seat belts as appropriate. To determine whether a child restraint system is required, review and comply with applicable state and local laws. Any child restraint used must comply with Federal Motor Vehicle Safety Standard 213, "Child Restraint Systems." When providing a child restraint system, always carefully read and follow all instructions pertaining to installation and usage for the child. Make certain the child remains in the restraint system at all times when the vehicle is in motion.

In addition to seat belt assemblies, tether belts are installed on suspension-type seats. Tether belts help secure the seat to the floor and are intended to restrain the seat and seat belt in case of an accident or sudden stop.

IMPORTANT: Seat belts have a finite life which may be much shorter than the life of the vehicle. Regular inspections and replacement as needed are the only assurance of adequate seat belt security over the life of the vehicle.

Seat Belt Inspection

WARNING

Inspect and maintain seat belts. When any part of a seat belt system needs replacement, the entire seat belt must be replaced, both retractor and buckle side. Any time a vehicle is involved in an accident, and the seat belt system was in use, the entire vehicle seat belt system must be replaced before operating the vehicle. Do not attempt to modify the seat belt system; doing so could change the effectiveness of the system. Failure to replace worn or damaged seat belts, or making any modifications to the system, may result in personal injury or death.

Inspect the seat belts and tether belts (if so equipped).

1. Check the web for fraying, cuts, extreme dirt and dust, or for severe fading from exposure to sunlight, especially near the buckle latch plate and in the D-loop guide area.
2. Check operation of the buckle, latch, Komfort Latch or Sliding Komfort Latch (if equipped), web retractor, and upper seat belt mount on the door pillar. Check all visible components for wear or damage.
3. Check the seat belt and tether belt connection points and tighten any that are loose.

Seat Belt Operation

Three-Point Seat Belt With Komfort Latch or Sliding Komfort Latch

WARNING

Wear three-point seat belts only as described below. Three-point seat belts are designed to be worn by one person at a time. In case of an accident or sudden stop, personal injury or death could result from misuse.

Fasten the seat belts before driving. Fastening a three-point seat belt while driving creates a hazard.

When engaged and used properly, the Komfort Latch ([Fig. 5.16](#)) and the Sliding Komfort Latch ([Fig. 5.17](#))

introduce a small amount of slack into the seat belt, resulting in a more comfortable ride.

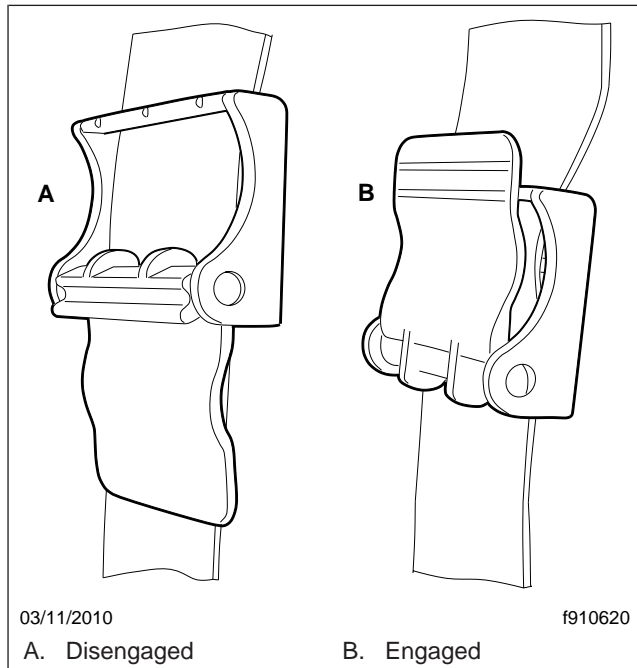


Fig. 5.16, Komfort Latch

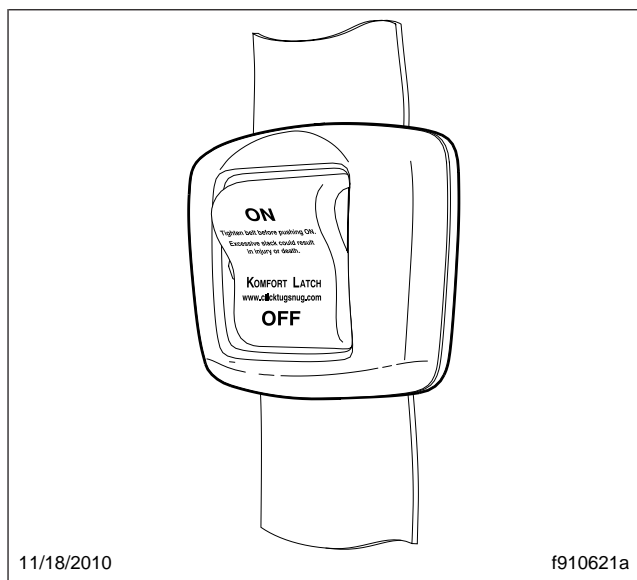


Fig. 5.17, Sliding Komfort Latch

1. Slowly pull the latch end of the three-point seat belt out of the retractor and pull it across your

lap (from outboard to inboard) far enough to engage the buckle. If the retractor locks too soon, allow the belt to retract slightly, then slowly pull it out again.

2. Fasten the three-point seat belt by pushing the latch into the buckle. Listen for an audible click. See **Fig. 5.18**.

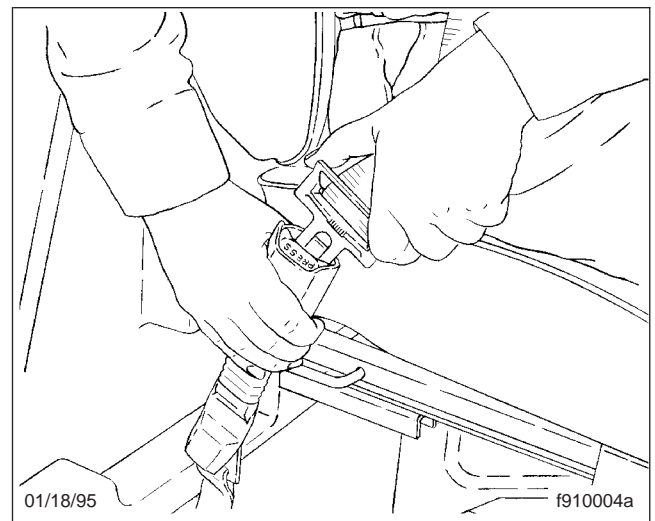


Fig. 5.18, Fastening the Three-Point Belt

3. Tug on the seat belt to make sure it is securely fastened. If the buckle unlatches, repeat this step. If the problem continues, replace the three-point seat belt.
4. Snug the seat belt to your waist.
5. Position the shoulder strap diagonally across your chest with the adjustable D-loop bracket (if equipped). If desired, engage the Komfort Latch or Sliding Komfort Latch as follows.

*If equipped with a Sliding Komfort Latch, make sure that the shoulder strap is snug against your chest. Without loosening the shoulder strap, push the Sliding Komfort Latch switch to the "ON" position. See **Fig. 5.17**. To activate the latch lean forward until you hear a click. This will allow for approximately 1 inch (2.5 cm) of slack between your chest and the shoulder harness. Once engaged, the latch will allow you to lean forward about 5 inches (13 cm) without having to reset the latch. Leaning forward more than 5 inches (13 cm) will disengage the Sliding Komfort Latch, requiring it to be reset.*

Cab Features

If equipped with a *Komfort Latch*, pull on the shoulder strap to lessen the pressure of the strap on your shoulder and chest. Allow no more than 1 inch (2.5 cm) of slack between your chest and the shoulder harness. More slack can significantly reduce the seat belt effectiveness in an accident or a sudden stop. While holding the belt slack, press the *Komfort Latch* lever up, clamping the seat belt webbing (Fig. 5.19 and Fig. 5.20).

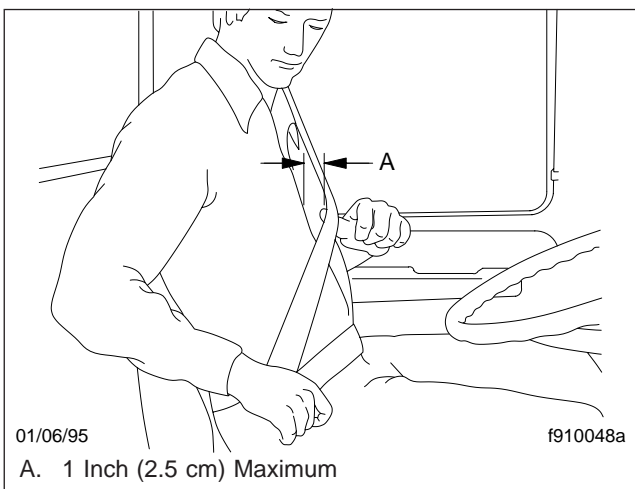


Fig. 5.19, Adjusting Shoulder Harness Clearance, Komfort Latch

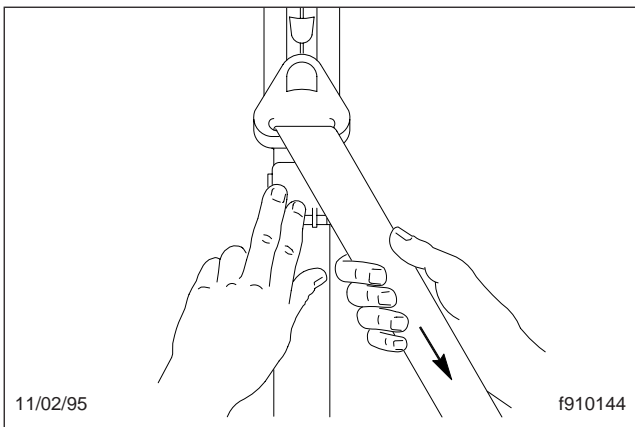


Fig. 5.20, Locking the Komfort Latch

6. Unbuckle the three-point seat belt and release the *Komfort Latch* or the *Sliding Komfort Latch* as follows.

If equipped with a *Sliding Komfort Latch*, unbuckle the seat belt, then tug on the shoulder

belt to release the *Sliding Komfort Latch*, or press the *Sliding Komfort latch* to the "OFF" position, then unbuckle the seat belt.

If equipped with a *Komfort Latch*, unbuckle the seat belt, then release the *Komfort Latch* by giving the shoulder belt a quick tug. If you lean forward against the shoulder belt, the *Komfort Latch* will automatically release, and will need to be reset.

NOTE: Neither the *Komfort Latch* nor the *Sliding Komfort Latch* need to be manually released in an emergency situation. Each will release by itself under rough road or other abnormal conditions. Make sure the three-point seat belt is completely retracted when it is not in use.

Cab Amenities

Cup Holders

There are two cup holders molded into the lower part of the auxiliary dash panel, one on either side of the HVAC control head.

Cab Storage

There are storage bins in the dash and the overhead console. On vehicles with optional individual driver's and passenger seats, there is a center storage console between the seats.

There is a dash storage bin located under the cup holders on the center panel. The bin has a hinged cover and can be used to store sunglasses. There is also a small storage pocket above the radio.

Overhead Storage

Vehicles without an overhead console have two storage bins located above the windshield.

On vehicles equipped with an overhead console, most vehicles have a storage bin located in the overhead console. See Fig. 5.21. The overhead storage bin is often removed and replaced with a CB radio.

Two map holders with netted openings are located overhead, one on either side of the overhead console.

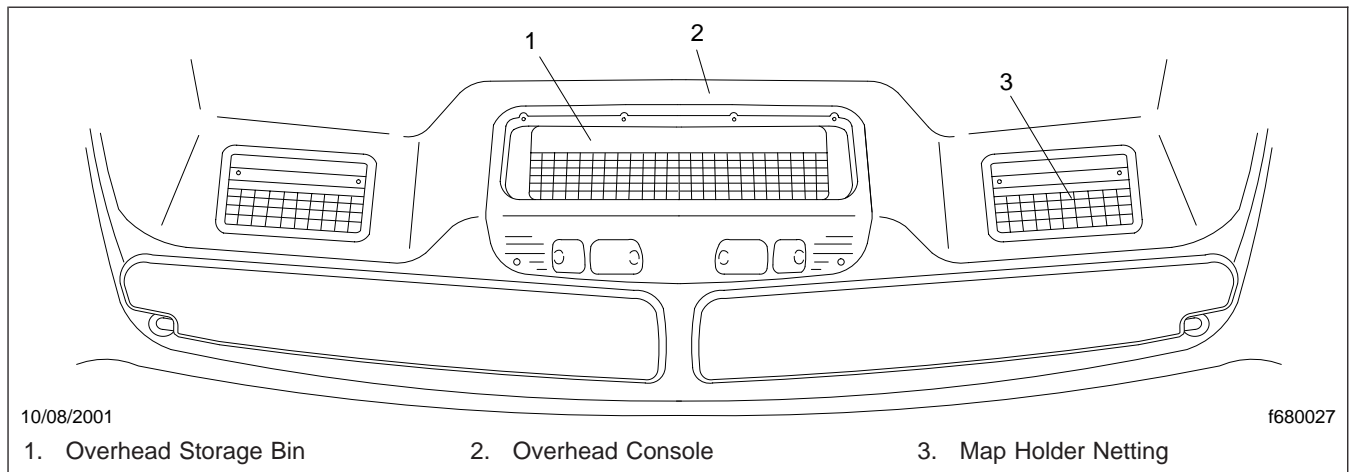


Fig. 5.21, Overhead Storage

Center Storage Console (optional)

On vehicles with individual driver's and passenger's seats, a center storage console can be installed between the seats.

The center storage console has a table top that can be lifted up to deploy a writing surface. See [Fig. 5.22](#).

In another version, the center storage console has a printer top with a paper slot in it. See [Fig. 5.23](#).

Windshield Washer Reservoir

The standard location for the windshield washer reservoir is on the right-hand side of the cab underneath the door, just above the trailing edge of the top cab step. See [Fig. 5.24](#).

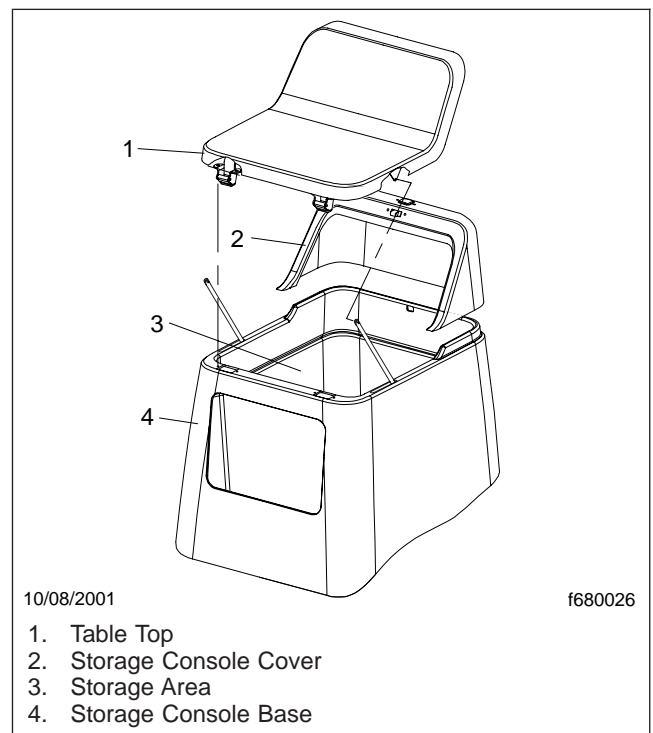


Fig. 5.22, Center Storage Console (with writing surface)

Cab Features

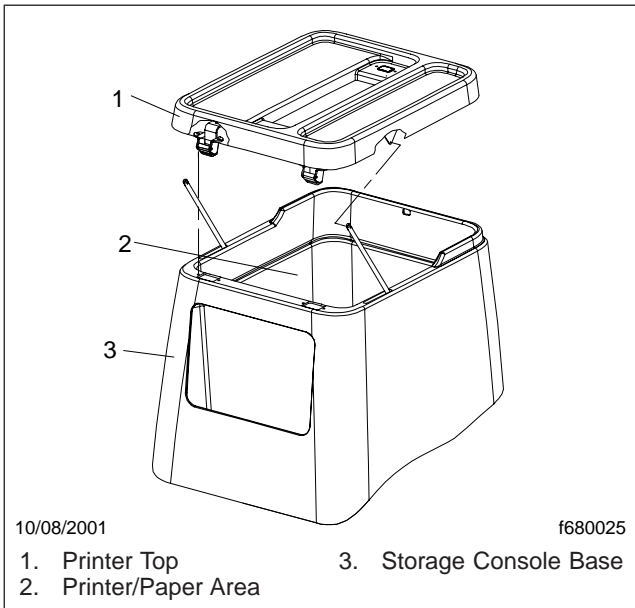


Fig. 5.23, Center Storage Console (printer option)

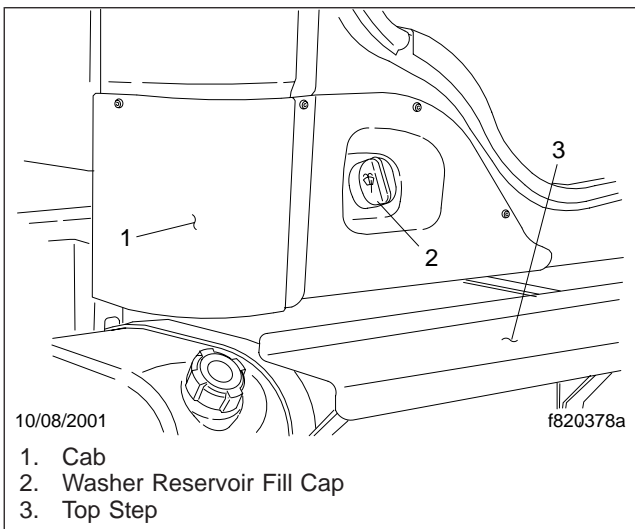


Fig. 5.24, Windshield Washer Reservoir

6

Heater, Ventilator and Air Conditioner

Climate Control Panel	6.1
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Heater, Ventilator and Air Conditioner

Climate Control Panel

The climate control panel allows you to control the heating, ventilating, defrosting, and air conditioning functions. The climate control panel without air conditioning is shown in **Fig. 6.1**. The climate control panel with air conditioning is shown in **Fig. 6.2**.

Fan Switch

The fan switch controls the fan speed and forces fresh or recirculated air through the air outlets. The fan switch has eight fan speeds and an off position.

To increase airflow, turn the fan switch to the right or to a higher number. To decrease the airflow, turn the switch to the left or to a lower number.

Air Selection Switch

The air selection switch allows you to control the flow of air through the face outlets, the floor outlets, the defrost (windshield) outlets, or a combination of these outlets to give you nine air selection modes on a system without air conditioning. See **Fig. 6.3**. A system with air conditioning has 11 air selection

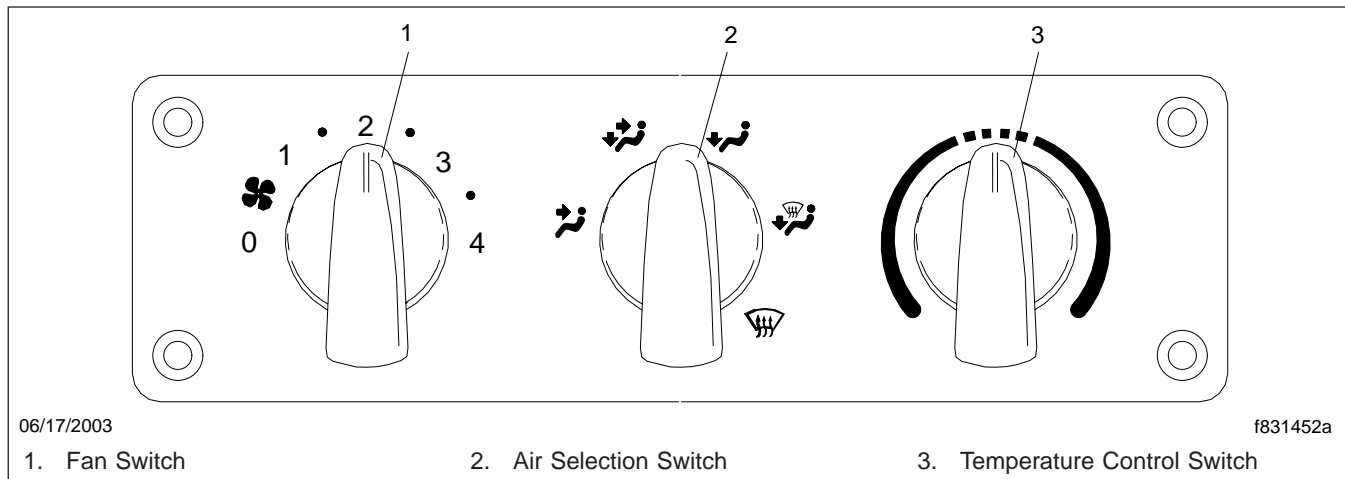


Fig. 6.1, Climate Control Panel Without Air Conditioning

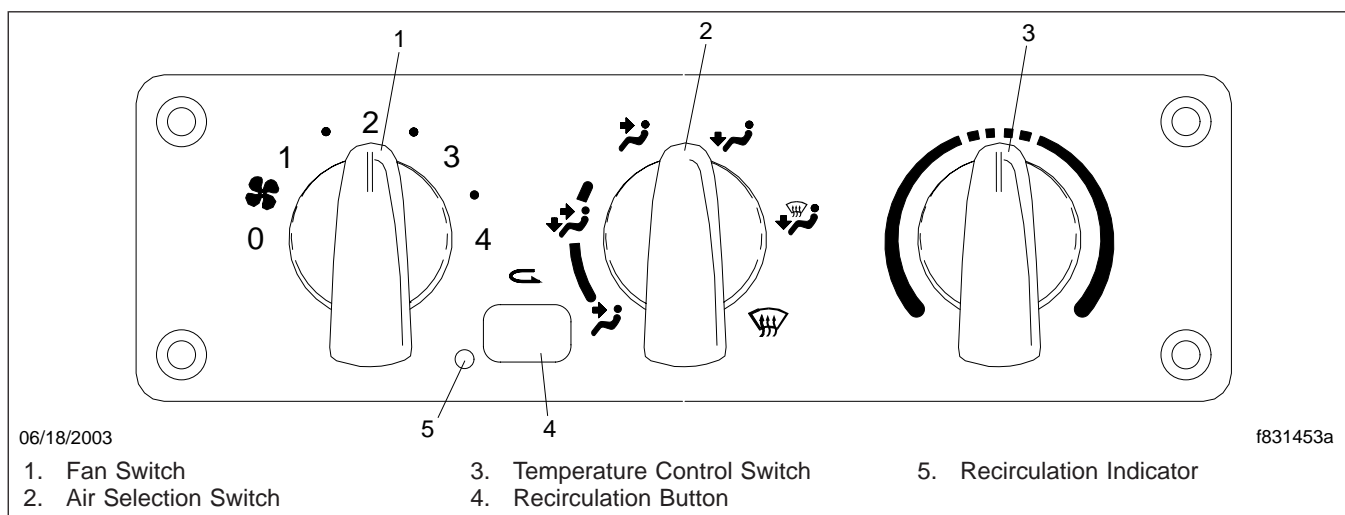


Fig. 6.2, Climate Control Panel With Air Conditioning

Heater, Ventilator and Air Conditioner

modes, four of which are air conditioning modes. See Fig. 6.4.

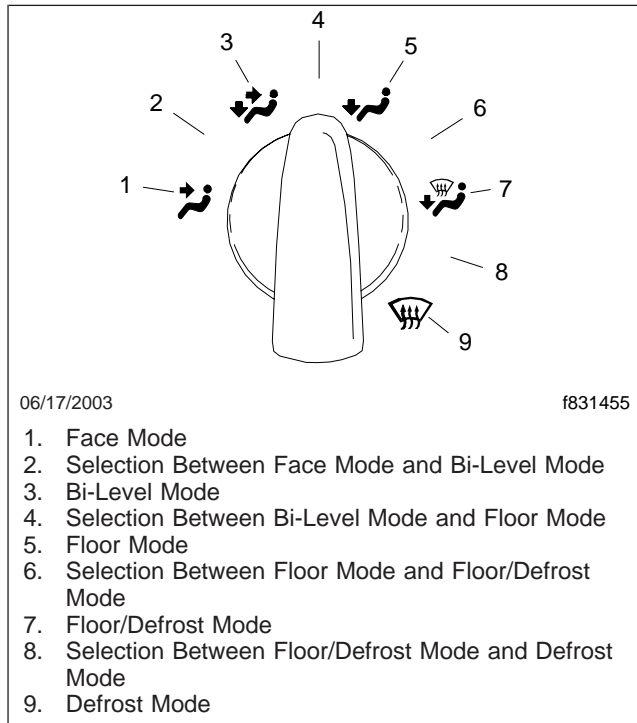


Fig. 6.3, Air Selection Switch Without Air Conditioning

Air Selection Switch Without Air Conditioning

1. **Face Mode:** Directs all airflow through the face or instrument panel outlets.
2. **Selection between Face Mode and Bi-Level Mode:** Directs 75 percent of the airflow through the face outlets and 25 percent through the floor outlets.
3. **Bi-Level Mode:** Directs the airflow equally to the face outlets and the floor outlets.
4. **Selection between Bi-Level Mode and Floor Mode:** Directs 25 percent of the airflow through the face outlets and 75 percent through the floor outlets.
5. **Floor Mode:** Directs all airflow through the floor outlets.
6. **Selection between Floor Mode and Floor/Defrost Mode:** Directs 75 percent of the airflow

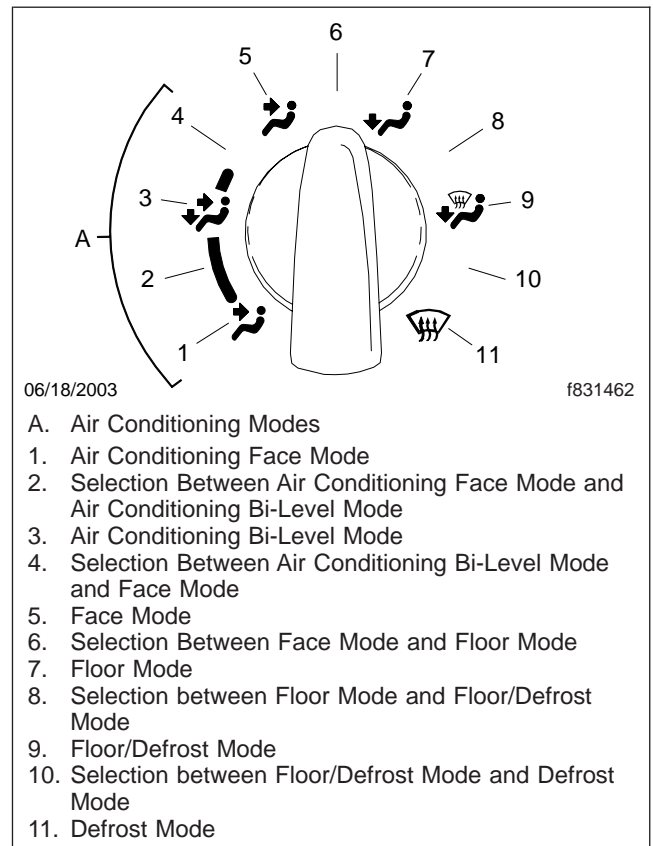


Fig. 6.4, Air Selection Switch With Air Conditioning

through the floor outlets and 25 percent through the defrost outlets.

7. **Floor/Defrost Mode:** Directs the airflow equally to the floor outlets and the defrost outlets.
8. **Selection between Floor/Defrost Mode and Defrost Mode:** Directs 75 percent of the airflow through the defrost outlets and 25 percent through the floor outlets.
9. **Defrost Mode:** Directs all airflow through the defrost outlets.

Air Selection Switch With Air Conditioning

1. **Air Conditioning Face Mode:** Directs all airflow through the face or instrument panel outlets.
2. **Selection between the Air Conditioning Face Mode and the Air Conditioning Bi-Level**

Heater, Ventilator and Air Conditioner

Mode: Directs 75 percent of the airflow to the face outlets and 25 percent to the floor outlets.

3. **Air Conditioning Bi-Level Mode:** Directs the airflow equally to the face outlets and the floor outlets.
4. **Selection between the Air Conditioning Bi-Level Mode and the Face Mode:** Directs 25 percent of the airflow to the face outlets and 75 percent to the floor outlets.
5. **Face Mode:** Directs all airflow through the face outlets.
6. **Selection between Face Mode and Floor Mode:** Directs the airflow equally through the face outlets and the floor outlets.
7. **Floor Mode:** Directs all airflow through the floor outlets.
8. **Selection between Floor Mode and Floor/Defrost Mode:** Directs 75 percent of the airflow through the floor outlets and 25 percent through the defrost outlets.
9. **Floor/Defrost Mode:** Directs the airflow equally to the floor outlets and the defrost outlets. The recirculation button will not work in this mode.
10. **Selection between Floor/Defrost Mode and Defrost Mode:** Directs 75 percent of the airflow through the defrost outlets and 25 percent through the floor outlets. The recirculation button will not work in this mode.
11. **Defrost Mode:** Directs all airflow through the defrost outlets. The recirculation button will not work in this mode.

Temperature Control Switch

The temperature control switch is used to select the desired temperature. Turn the switch to the left (counterclockwise) for cool air, or to the right (clockwise) for hot air. There are 21 positions on the temperature control switch ranging from full cool air to full hot air.

Fresh Air Mode

Fresh air, or outside air, is circulated through the heating and air conditioning system unless the recirculation mode, if equipped, is turned on.

Recirculation Mode

The recirculation mode is only available on vehicles with air conditioning.

The recirculation mode limits the amount of outside air entering the cab. Press the recirculation button to prevent dusty or smoky air from entering the cab. The recirculation mode can also be used to decrease the time required to cool or heat the cab interior during extreme outside temperature conditions. When the recirculation mode is on, the recirculation indicator will be on. See **Fig. 6.2**.

The recirculation mode is not available when the air selection switch is in one of the following modes:

- floor/defrost mode
- selection between floor/defrost mode and defrost mode
- defrost mode

When the recirculation mode is turned on, it will stay on for 20 minutes, or until the recirculation button is pressed again, or the air selection switch is turned to a defrost mode.

IMPORTANT: On vehicles built before May 2, 2003, the recirculation mode turns off after twenty minutes and can be turned back on when the recirculation button is pressed again. On vehicles built from May 2, 2003, the system enters a partial recirculation mode for five minutes after being in full recirculation mode for 20 minutes. This cycle repeats as long as the system is in recirculation mode.

NOTE: To prevent the buildup of fumes or odors inside the cab on a vehicle built before May 2, 2003, do not use the recirculation mode for more than 20 minutes. It is recommended that the recirculation mode remains off for five minutes before it is turned back on.

Defrosting

Before using any of the defrost modes, clear the screen at the base of the windshield if snow or ice is present.

Heater, Ventilator and Air Conditioner

Air Conditioning, Optional

There are four air conditioning modes on the air selection switch. The air conditioning settings on the air selection switch are blue, in addition to the selection between the air conditioning bi-level mode and the face mode.

IMPORTANT: Operate the air conditioner at least five minutes each month, even during cool weather. This helps prevent drying and cracking of the refrigerant compressor seals and reduces the chance of refrigerant leaks in the system.

NOTE: The heating and air conditioning system has a brushless blower motor with a protection or shutdown mode to prevent damage due to overheating and overcurrent conditions. If the brushless blower motor goes into a protection mode, the motor will operate at a slower speed. If the overheating or overcurrent condition continues, the motor will shut down and stop completely.

The motor will resume proper operation after the motor has cooled or the overcurrent condition has been resolved. It will be necessary to cycle the fan switch off, and then on, to reset the motor. If the problem appears repeatedly, take the vehicle to an Freightliner dealer or authorized service outlet for repairs.

Accessory Heaters

Optional accessory heaters are available from the factory in several configurations. Familiarize yourself with the equipment on your specific vehicle, and follow the manufacturer's operating and maintenance instructions.

 **WARNING**

Do not operate fuel-operated heaters in an area where flammable vapors, including gasoline or diesel fumes, are present, such as at filling stations and tank farms. Turn off a fuel-operated heater and allow it shut down completely before entering an area where flammable gases or liquids are present. Heaters continue to operate for up to three minutes after being turned off.

Failure to observe these precautions could cause an explosion or fire, resulting in serious property damage, and personal injury or death.

7

Engines

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Engines

Emissions and Fuel Efficiency

IMPORTANT: Depending on local jurisdictional guidelines, vehicles that are domiciled outside of the U.S. and Canada may not have emissions aftertreatment systems (ATS) that are compliant with EPA regulations.

NOTICE

Follow these guidelines for engines that comply with EPA07 or newer regulations, or damage may occur to the aftertreatment device (ATD) and the warranty may be compromised.

- **Use ultralow-sulfur diesel with 15 ppm sulfur content or less.**
- **Do not use fuel blended with used engine lube oil or kerosene.**
- **Engine lube oil must have a sulfated ash level less than 1.0 wt %; currently referred to as CJ-4 oil.**

IMPORTANT: Using non-specification fuels or oils can lead to shortened diesel particulate filter (DPF) cleaning or replacement intervals. For example, using CJ-4+ oil with 1.3% sulfated ash (30% more ash content) may result in the need for DPF cleaning or replacement 20 to 30% sooner than would normally be required.

IMPORTANT: See the engine manufacturer's operation manual for complete details and operation of the ATS.

Greenhouse Gas Emissions and Fuel Consumption Standards

Vehicles and/or engines manufactured after December 31, 2006 and domiciled in the U.S. or Canada are required to meet all EPA and NHTSA regulations effective as of the vehicle build date. Engines manufactured between January 1, 2007 and December 31, 2009 meet EPA07 requirements. Engines manufactured between January 1, 2010 and December 31, 2012 meet EPA10 requirements.

Model year 2013 and later vehicles meet additional requirements as specified by GHG14 requirements. These vehicles are equipped with components that increase fuel efficiency and reduce GHG emissions.

Components may include, but are not limited to, low-rolling resistance tires; aerodynamic devices such as hood, cab/sleeper extenders, and fuel tank fairings; vehicle speed limiter; and idle shutdown timer. If replacement of any drag-reducing component is required, the replacement component must meet or exceed the drag reduction performance of the originally installed component in order to maintain compliance with GHG14 requirements.

EPA07 Engines

Engines built between January 1, 2007 and December 31, 2009 are required to meet EPA07 guidelines for reduced exhaust emissions of particulate matter and nitrogen oxides (NOx). NOx is limited to just over 1 gram per brake horsepower hour (g/bhp-hr), and particulate matter cannot exceed 0.01 g/bhp-hr.

The EPA07 ATS varies according to engine manufacturer and vehicle configuration, but the exhaust muffler is replaced by an aftertreatment device (ATD). Inside the ATD, the exhaust first passes over the diesel oxidation catalyst (DOC), then passes through the diesel particulate filter (DPF), which traps soot particles. The soot is burned to ash during a process called regeneration (regen).

EPA10 and Newer Engines

The EPA mandates that all engines built after December 31, 2009 must reduce the level of emissions exhausted by the engine to the following levels:

- Nitrogen Oxides (NOx) – 0.2 g/bhp-hr
- Particulate Matter (PM) – .01 g/bhp-hr

To meet EPA guidelines, engines that are compliant with EPA10 and newer regulations use an ATS that has, in addition to a DOC/DPF device like that used in an EPA07 ATD, a Selective Catalytic Reduction (SCR) device to reduce NOx downstream of the engine. After exhaust gases leave the DPF, a controlled quantity of diesel exhaust fluid (DEF) is injected into the exhaust stream. In the presence of heat, DEF is converted to ammonia gas, which reacts with NOx in the selective catalyst chamber to yield nitrogen and water vapor, which exit through the tailpipe.

Regeneration

The harder an engine works, the better it disposes of soot. If the exhaust temperature is high enough, a process called **passive regeneration** (regen) occurs

as the vehicle is driven normally. However, if the engine isn't running hot enough, the electronic controls may initiate an **active regen**, whereby extra fuel is injected into the exhaust stream to superheat and reduce the soot trapped in the DPF to ash. Active regen happens only when the vehicle is moving above a certain speed, determined by the engine manufacturer. See your engine operation manual for complete details. Both active and passive regen happen automatically, without driver input.

⚠ WARNING

Active regeneration can occur automatically anytime the vehicle is moving. The exhaust gas temperature could reach 1500°F (800°C), which is hot enough to cause a fire, heat damage to objects or materials, or personal injury to persons near the exhaust outlet. The exhaust temperature can remain high even after the vehicle has stopped. When stopping the vehicle shortly after an automatic regen, ensure the exhaust outlets are directed away from structures, trees, vegetation, flammable materials, and anything else that may be damaged or injured by exposure to high heat.

See *Regen Switches*, below, for instructions on preventing automatic regen if necessary.

When operating conditions do not allow for ATD filter cleaning by active or passive regen, the vehicle may require a driver-activated **parked regen**. When this occurs, the DPF lamp illuminates, indicating that a regen is required. The driver must either bring the vehicle up to highway speed to increase the load (thus starting an active regen), or park the vehicle and initiate a parked regen. See *Regen Switches*, below, for instructions on initiating a parked regen.

Regen Switches

The regen request switch, located on the dash, is used to initiate a parked regen. See [Fig. 7.1](#). The function of the switch varies by the engine make and model in the vehicle. See the engine operation manual for switch operation details.

Some vehicles may be equipped with a regen request/inhibit switch. See [Fig. 7.2](#). To stop a regen in progress or prevent the start of a regen, press the lower half of the switch. Regen is then delayed until the switch is no longer active.

NOTE: The regen switch can initiate a parked regen only when the DPF lamp is illuminated.

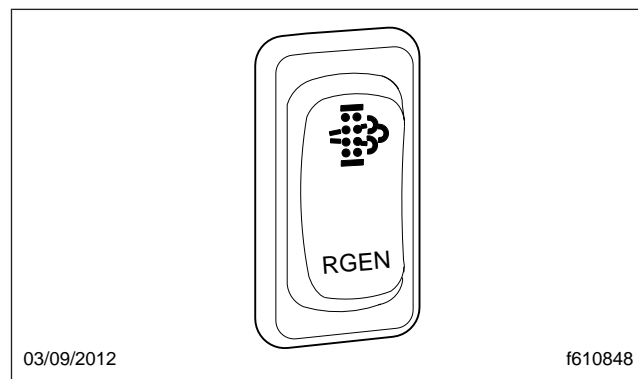


Fig. 7.1, Regen Request Switch

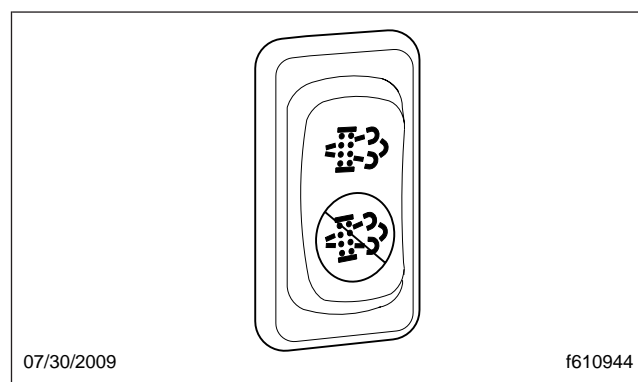


Fig. 7.2, Regen Request/Inhibit Switch

⚠ WARNING

During parked regen, exhaust temperatures are very high and could cause a fire, heat damage to objects or materials, or personal injury to persons near the exhaust outlet.

Before initiating a parked regeneration, make certain the exhaust outlets are directed away from structures, trees, vegetation, flammable materials, and anything else that may be damaged or injured by prolonged exposure to high heat.

To initiate a parked regen, perform the following steps.

1. Park the vehicle away from all flammable materials, set the parking brake, and put the transmission in neutral.

Engines

2. Start and warm the engine until the coolant temperature is at least 150°F (66°C).
3. Lift the regen request switch guard and press and hold the yellow button for five seconds. As the regen process is initiated, engine rpm increases and the HEST lamp illuminates to indicate extremely high exhaust temperatures.

IMPORTANT: The driver must remain with the vehicle during the entire regen cycle.

4. The regen cycle will finish after 20 to 60 minutes, at which time engine idle speed drops to normal and the vehicle can be driven normally. The HEST lamp is extinguished when vehicle speed exceeds 5 mph (8 km/h) or the system has cooled to normal operating temperature.
5. To stop a parked regen at any time during the process:
 - depress the clutch pedal, brake pedal, or accelerator pedal;
 - press and hold the regen inhibit switch until idle returns to normal;
 - shut down the engine.

ATS Warning Lamps

There are three warning lamps that alert the driver of high exhaust temperature, the need to perform a parked regen or service the DPF, or of an engine fault that affects emissions. A decal attached to the driver's sun visor explains the ATS warning lamps. [Fig. 7.3](#).

See [Fig. 7.4](#) for an explanation of the ATS warnings, and actions required to avoid engine protection sequences.

Malfunction Indicator Lamp (MIL)

A steadily illuminated yellow malfunction indicator lamp (MIL) indicates an engine fault that affects emissions. See [Fig. 7.5](#).

DPF Status Lamp

When soot accumulates in the DPF and the DPF status lamp illuminates, see [Fig. 7.6](#), perform a parked regen or bring the vehicle up to highway speed to increase the load (thus starting an active regen).

If the DPF status lamp blinks while the CHECK engine lamp is illuminated, initiate a parked regen immediately in order to prevent an engine derate.

If the red STOP engine lamp illuminates with the blinking DPF lamp and the CHECK engine lamp, begin a parked regen in order to prevent an engine shutdown. Park the vehicle and perform a parked regen.

High Exhaust System Temperature (HEST) Lamp

Slow (10-second) flashing of the high exhaust system temperature (HEST) lamp indicates that a parked regen is in progress, and the engine's high idle speed is being controlled by the engine software, not the vehicle driver.

Steady illumination of the HEST lamp alerts the driver of high exhaust temperature during the regen process if the vehicle speed is below 5 mph (8 km/h), or during a parked regen. See [Fig. 7.7](#).

Maintenance

Authorized service facilities must perform any DPF service. For warranty purposes, maintain a record that includes:

- date of cleaning or replacement;
- vehicle mileage;
- particulate filter part number and serial number.

Diesel Exhaust Fluid and Tank, EPA10 and Newer Engines

Diesel Exhaust Fluid

Diesel exhaust fluid (DEF) is used in the ATS to lower NOx in the exhaust stream. DEF is colorless and close to odorless (it may have a slightly pungent odor similar to ammonia). It is nontoxic, nonflammable, and biodegradable. It is mildly corrosive to aluminum, but does not affect the strength or structure of the aluminum.

White crystals may be noticeable around components that come into contact with DEF. The crystals are easily removed with water.

DEF consumption varies depending on ambient conditions and vehicle application.

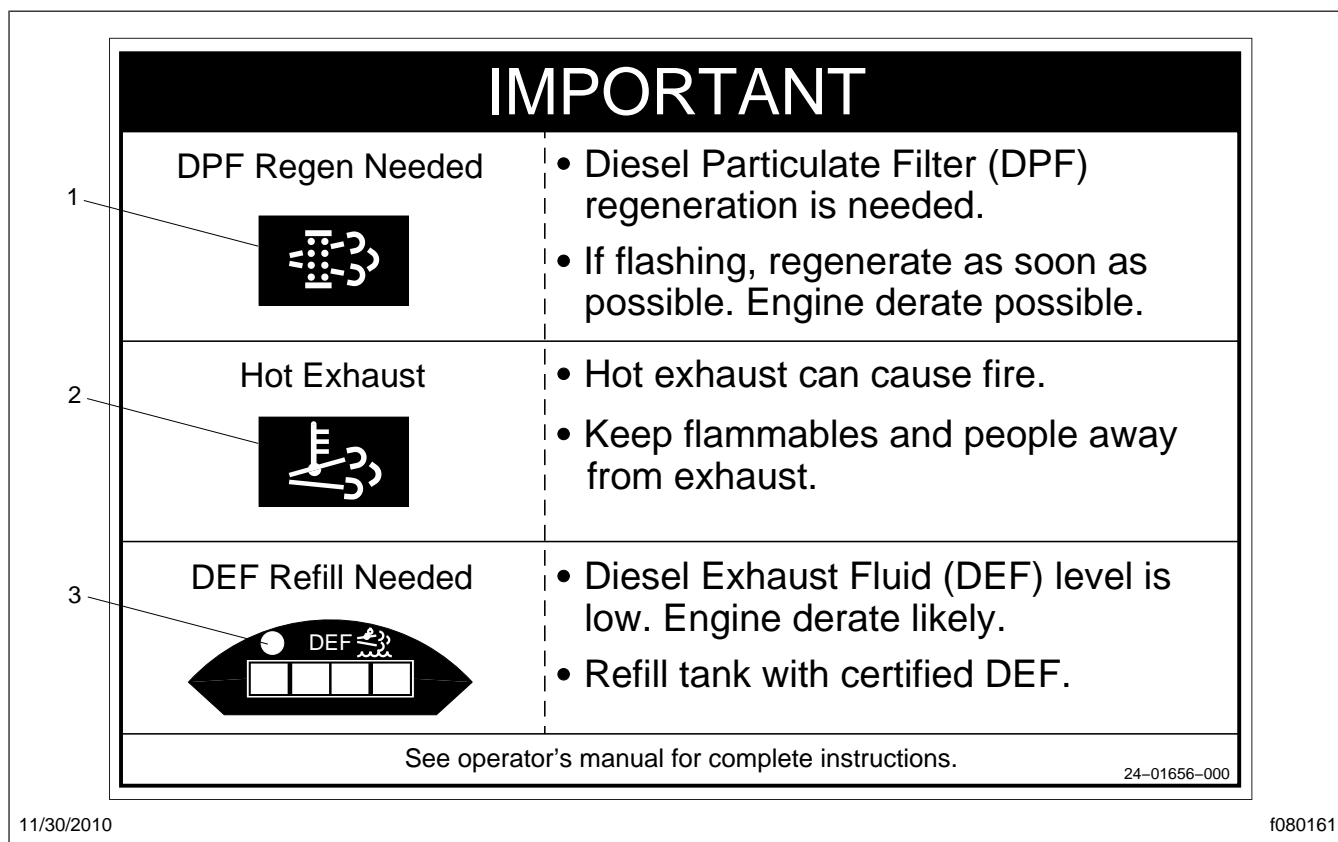


Fig. 7.3, Warning Lamp Decal, Sun Visor

Freezing Conditions

DEF freezes to slush at around 12°F (-11°C). It is not damaged or destroyed if frozen, and is fully usable when thawed. The DEF in the tank is allowed to freeze while a vehicle is non-operational. At start-up, normal operation of the vehicle is not inhibited if the DEF is frozen; an immersion heater with engine coolant flowing through it warms the DEF once the engine is running, allowing the SCR system to operate.

Pre-2013 DEF supply lines are electrically-heated and are purged when the engine is shut down; complete purging of the DEF lines requires approximately five minutes after the engine is shut down.

DEF supply lines with engine model year 2013 and newer are designed to survive freezing conditions while containing DEF, so purging is not required.

DEF Tank






Engines that are compliant with EPA10 and newer regulations are equipped with a DEF tank located on the driver's side of the vehicle behind the battery box or forward of the fuel tank. See Fig. 7.8 and Fig. 7.9. The DEF tank has a 19 mm filler neck inlet that prevents the hose from a diesel outlet from being inserted, and has a blue cap for easy identification.

Fuel/DEF Gauge

The diesel fuel and DEF levels are measured in a dual-purpose gauge. See Fig. 7.10.

Fuel level is indicated at the top of the gauge. Below the fuel level, a low fuel warning lamp illuminates amber when the fuel level drops below 1/8th of the capacity.

The lower portion of the gauge has a DEF warning lamp that illuminates amber when the DEF tank is near empty, and a lightbar that indicates the level of

EXHAUST AFTERTREATMENT SYSTEM INFORMATION					
INDICATOR LAMP(S)	 (Solid) Level 1	 (Flashing) Level 2	 (Flashing) CHECK Level 3	 (Flashing) CHECK STOP Level 4	 WARNING HEST (High Exhaust System Temperature)
Indicator Lamp Message(s)	Filter Regeneration Recommended	Filter Regeneration Necessary	Parked Regeneration Required – Engine Derate	Parked Regeneration Required – Engine Shut Down	Flashing A regeneration is in progress.
Diesel Particulate Filter Condition	Filter is reaching capacity.	Filter is now reaching maximum capacity.	Filter has reached maximum capacity.	Filter has exceeded maximum capacity.	Solid Exhaust Components and exhaust gas are at high temperature. When stationary, keep away from people and flammable materials or vapors.
Required Action	Bring vehicle to highway speeds to allow for an Automatic Regeneration or perform a Parked Regeneration.	To avoid engine derate bring vehicle to highway speeds to allow for an Automatic Regeneration or perform a Parked Regeneration as soon as possible.	Vehicle must be parked and a Parked Regeneration must be performed – engine will begin derate.	Vehicle must be parked and a Parked Regeneration or Service Regeneration must be performed. Check engine operator's manual for details –engine will shut down.	
For a driver performed Parked Regeneration, vehicle must be equipped with a dash mounted Regeneration Switch.					
See Engine Operator's Manual for complete Regeneration Instructions.					
<small>24-01583-0008</small>					

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Fig. 7.4, ATS Warning Lamps

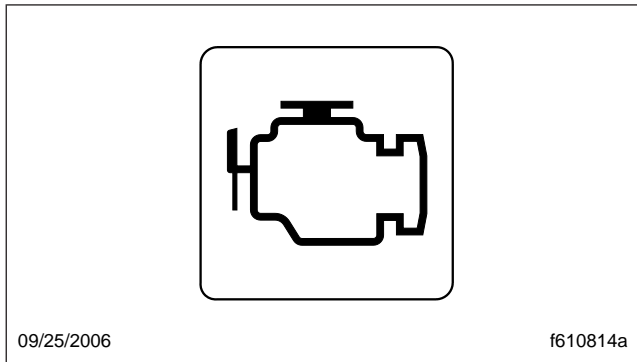


Fig. 7.5, Malfunction Indicator Lamp (MIL)

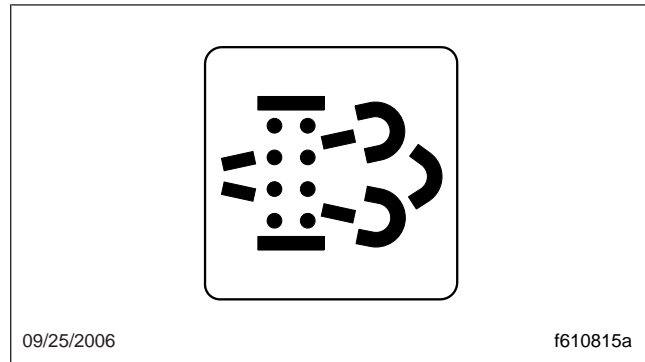


Fig. 7.6, DPF Status Lamp

DEF in the tank. The DEF light bar illuminates as follows:

- Four bars illuminated green—Between 75% and 100% full
- Three bars illuminated green—Between 50% and 75% full
- Two bars illuminated green—Between 25% and 50% full
- One bar illuminated green—Between approximately 10% and 25% full

- One bar illuminated amber—DEF very low, refill DEF
- One bar flashing red—DEF empty, refill DEF

DEF Warnings and Engine Limits

IMPORTANT: Ignoring the DEF warning lights results in limited engine power, with the application of a 5 mph (8 km/h) speed limit after the engine is shut down and started again.

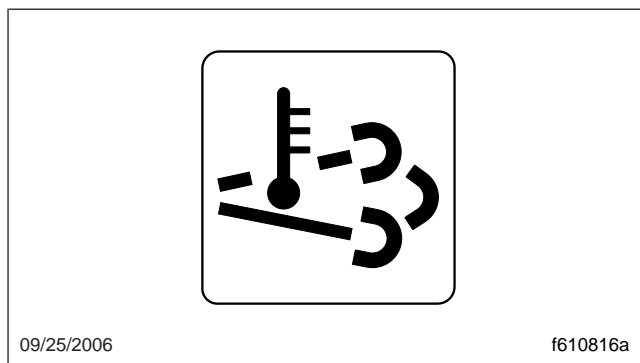


Fig. 7.7, HEST Lamp

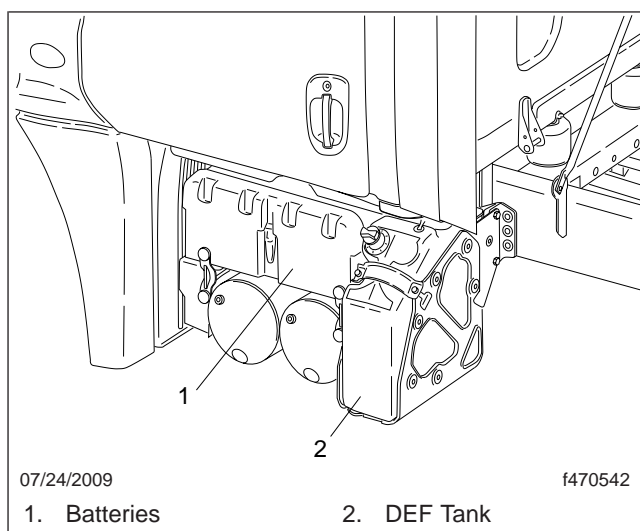


Fig. 7.8, DEF Tank Located Behind the Battery Box

DEF Level Low—Initial Warning

When the DEF level is low, the following lamps notify the driver. See [Fig. 7.11](#). Refill the DEF tank in order to cancel the warning sequence.

- One bar of the DEF level indicator illuminates amber—DEF very low, refill DEF
- The DEF warning lamp illuminates solid amber

DEF Empty

When the DEF level reads empty, the following lamps notify the driver. See [Fig. 7.12](#).

- One bar of the DEF level indicator flashes red—DEF empty, refill DEF
- The DEF warning lamp flashes amber

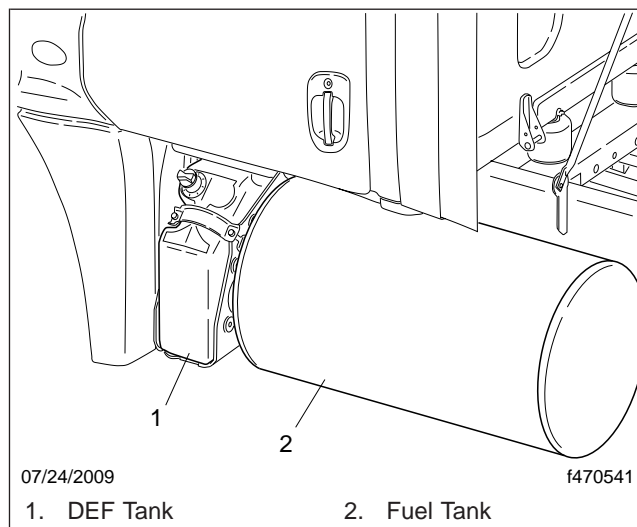


Fig. 7.9, DEF Tank Located Forward of the Fuel Tank

- The MIL lamp illuminates

Detroit engines: Power is limited, with a 55 mph (90 km/h) speed limit.

Cummins engines: Power is limited with progressively harsher engine power limits applied.

DEF Tank Empty and Ignored

If the empty warning is ignored and the DEF tank is not refilled, the red STOP engine lamp illuminates in addition to the MIL lamp and CHECK engine lamp (on vehicles with a Cummins ISB or ISC/L engine.) See [Fig. 7.13](#).

If the DEF is not refilled, a 5 mph (8 km/h) speed limit is applied after the next engine shutdown or if a fuel refill is detected.

DEF Contamination or SCR Tampering

NOTICE

Once contaminated DEF or tampering has been detected, the vehicle must be taken to an authorized service facility to check the SCR system for damage and to deactivate the warning lights and engine limits.

If contaminated DEF or tampering with the ATS is detected, the DEF warning light flashes and the MIL

Engines

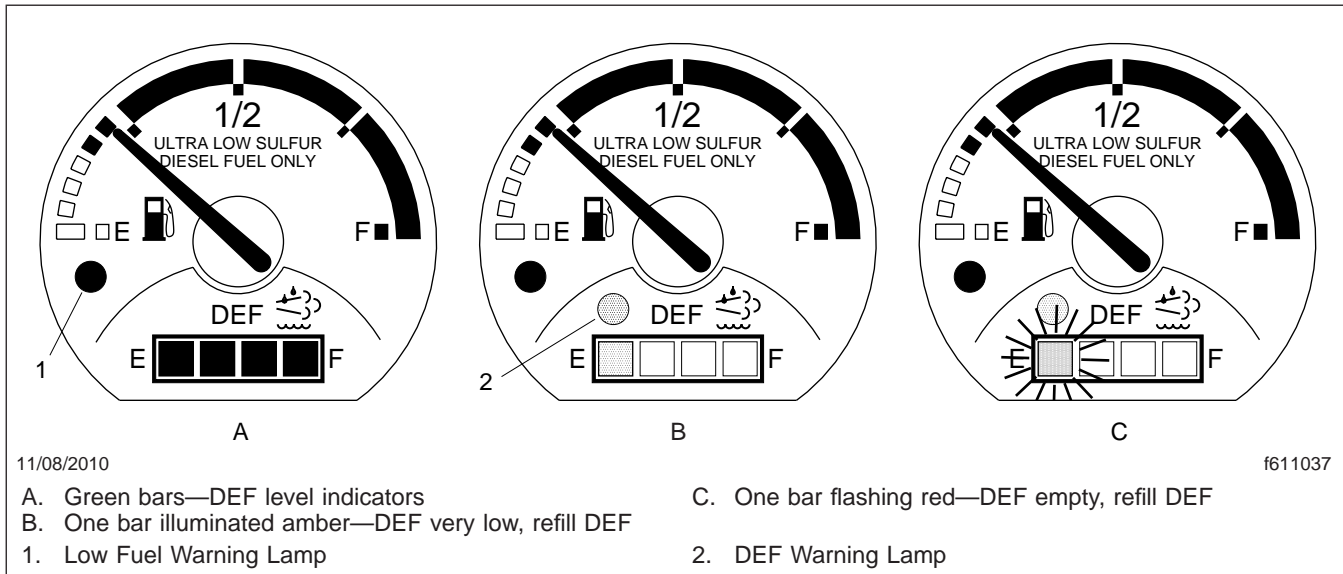


Fig. 7.10, Fuel/DEF Gauge

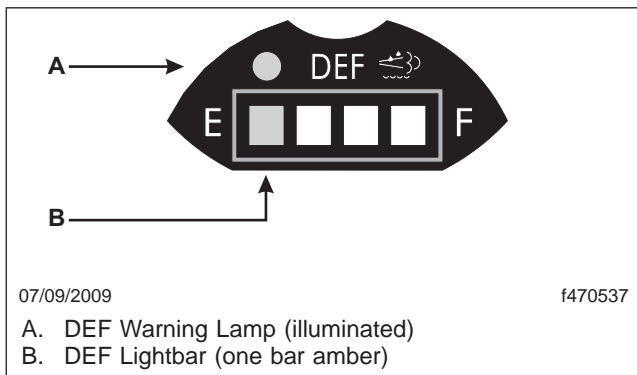


Fig. 7.11, DEF Level Low Initial Warning

lamp illuminates to warn the driver. The CHECK engine lamp also illuminates on vehicles with a Cummins ISB or ISC/L engine. See [Fig. 7.13](#).

- Detroit engines: Engine power is limited with progressively harsher limits applied. If the fault is not corrected, the STOP engine light illuminates and a 5 mph (8 km/h) speed limit is applied after the next engine shutdown or if a fuel refill is detected.
- Cummins engines: Engine power is limited with progressively harsher limits applied. If the fault is not corrected, the STOP engine light illuminates and a 5 mph (8 km/h) speed limit is ap-

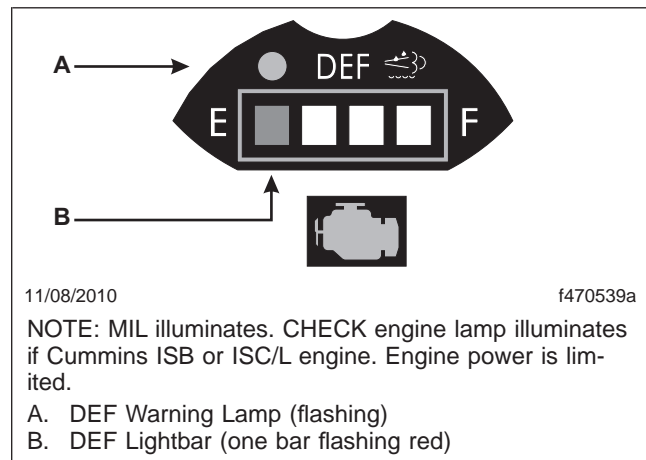


Fig. 7.12, DEF Empty Warning

plied after the next engine shutdown, or while parked and idling.

Engine Starting

For cold-weather starting, refer to "Cold Weather Starting" later in this chapter.

This engine chapter is to serve as a guide for best practices only. Each make and model engine may have operating characteristics that are unique to that particular engine, and will be documented in the engine manufacturer's literature. Always refer to specific

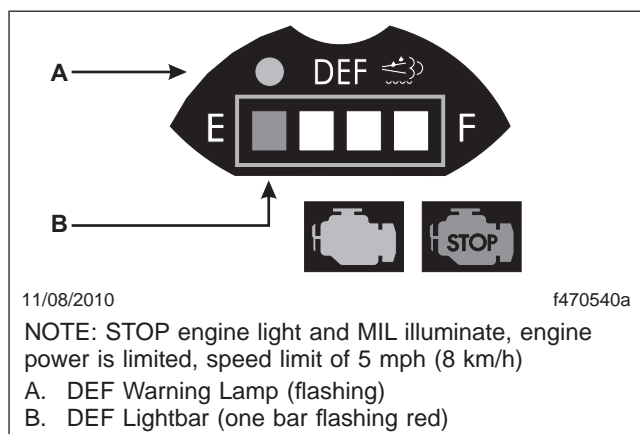


Fig. 7.13, DEF Empty and Ignored Warning

instructions and recommendations from the engine manufacturer.

NOTE: Before starting the engine, read **Chapter 3** for detailed information on how to read the instruments and see **Chapter 4** for detailed information on how to operate the controls. Read the operating instructions in the manufacturer's engine operation manual before starting the engine.

⚠ WARNING

Never pour fuel or other flammable liquid into the air inlet opening in the air intake in an attempt to start the vehicle. This could result in a flash fire causing serious personal injury or property damage.

1. Before engine start-up, complete the pretrip inspections and maintenance procedures in **Chapter 11**.
2. Set the parking brake.
3. For manual transmissions, place the transmission in neutral and fully depress the clutch pedal. Do not depress the accelerator pedal.

For automatic transmissions, put the transmission in neutral. Do not depress the accelerator pedal.

NOTE: Depending on local jurisdictional emissions regulations, vehicles and/or engines that are domiciled outside of the U.S. and Canada may not be equipped with the WAIT TO START or START BLOCKED lamp.

4. Turn the ignition switch to ON. See **Fig. 7.14**. The following actions should occur:
 - electronic gauges complete a full sweep of their dials
 - warning and indicator lamps illuminate, then are extinguished
 - DEF level indicator illuminates all segments green, then turns them off one at a time before turning the leftmost segment amber and then red
 - During cold conditions, the WAIT TO START lamp may illuminate.

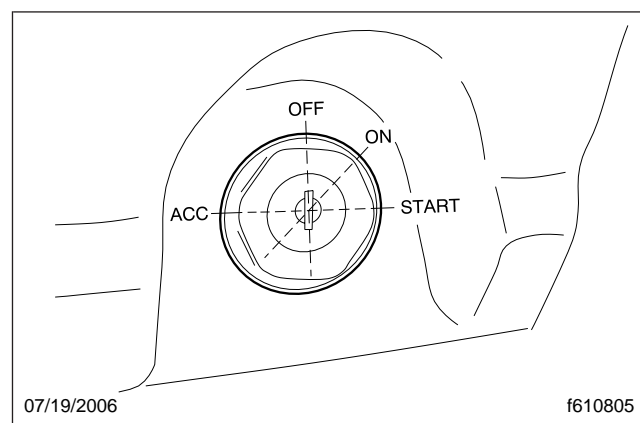


Fig. 7.14, Ignition Switch

NOTE: The length of time the WAIT TO START lamp remains illuminated depends on the ambient temperature. The lower the ambient temperature, the longer the lamp will be illuminated.

NOTE: If the ignition switch is turned to START before the gauge sweep has completed or if the starter has overheated, the START BLOCKED lamp may illuminate. Turn the ignition switch back to ON, wait for the lamp to go out, then turn the ignition switch to START again.

5. Once the gauge sweep has completed, turn the ignition key to the START position. Release the key the moment the engine starts.

NOTICE

Do not rev the engine if the oil pressure gauge indicates no oil pressure. Shut down the engine

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if oil pressure does not build within approximately ten seconds. Check to determine the cause of the problem. Operating the engine with no oil pressure will damage the engine.

6. It is not necessary to idle the engine before engaging or starting the operation, but load should be applied gradually during the warm-up period until the oil temperature reaches 140°F (60°C).
7. Apply load gradually during the warm-up period.

NOTICE

If the oil pressure gauge indicates no oil pressure, shut down the engine within approximately ten seconds to avoid engine damage.

8. Check the oil pressure gauge for any drop in lubricating oil pressure or mechanical malfunction in the lubricating oil system. Minimum oil pressure at idle is 7 psi (50 kPa).

Cold-Weather Starting

Electronic engines do not normally require special starting aids.

See the engine manufacturer's operation manual for starting aids that are approved for specific engines.

Starting After Extended Shutdown or Oil Change

Before engine start-up, complete the engine pretrip and post-trip inspections and maintenance procedures in [Chapter 11](#).

NOTICE

Failure to eliminate water-diluted lubricating oil may lead to serious engine damage at startup.

An engine in storage for an extended period of time (over winter, for example) may accumulate water in the oil pan through normal condensation of moisture on the internal surfaces of the engine. Oil diluted by water cannot provide adequate bearing protection at start-up. For this reason, change the engine oil and filters after extended storage.

Engine Break-In

Each engine must pass a full-load operating test on a dynamometer before shipment, thereby eliminating the need for a break-in. Before running the engine for the first time, follow the instructions in the engine manufacturer's operation manual specific to your engine.

Engine Operation

Safety and Environmental Considerations

All Freightliner diesel engines comply with the requirements of the Federal (U.S.) Clean Air Act. Once an engine is placed in service, the responsibility for meeting local jurisdictional regulations is with the owner/operator.

IMPORTANT: EPA emissions regulations apply to vehicles domiciled in Canada and the U.S. at the time of printing this manual. Vehicles that are domiciled outside of the U.S. and Canada may not have engines with an emission after-treatment system that is compliant with EPA regulations, depending upon local statutory emissions guidelines.

NOTICE

It is extremely important that the following guidelines be followed for vehicles with EPA07 or newer engines, or damage may occur to the aftertreatment device, and the warranty may be compromised.

- Use ultralow-sulfur diesel with 15 ppm sulfur content or less.
- Do not use fuel blended with used engine lube oil or kerosene.
- Use only engine lube oil with a sulfated ash level less than 1.0 wt %; currently referred to as CJ-4 oil.

Adequate maintenance of the engine and the diesel particulate filter (DPF) are the responsibility of the owner/operator, and are essential to keep the emission levels low. Good operating practices, regular maintenance, and correct adjustments are factors that will help keep emissions within the regulations.

Normal Operation

WARNING

Do not operate the engine in an area where flammable vapors such as gasoline or diesel fumes are present. Shut off the engine when in an area where flammable liquids or gases are being handled. Failure to observe these precautions could result in serious injury or death.

Every engine has an operating range in which it performs most efficiently. The operating range extends from maximum torque rpm at the low end, to engine rated speed at the high end. Most engines deliver best fuel economy when operated in the low- and mid-speed segments of the efficiency range and produce maximum horsepower at rated speed, which is also the recommended maximum speed of the engine. For further engine-specific information, refer to the engine manufacturer's operation manual.

Prolonged idling of engines is not recommended, and is illegal in some states. Idling produces sulfuric acid, that is absorbed by the lubricating oil, and eats into bearings, rings, valve stems, and engine surfaces. If you must idle the engine for cab heat or cooling, use the high idle function of the cruise control switches. An idle speed of 900 rpm should be enough to provide cab heat in above freezing ambient temperatures.

If the engine is programmed with the idle shutdown timer, ninety seconds before the preset shutdown time, the CHECK ENGINE light will begin to flash at a rapid rate. If the position of the clutch pedal or service brake changes during this final ninety seconds the idle shutdown timer will be disabled until reset.

Cold-Weather Operation

Satisfactory performance of a diesel engine operating in low ambient temperatures requires modification of the engine, surrounding equipment, operating practices, and maintenance procedures. The lower the temperature, the greater the amount of modification required. For service products approved for use in cold weather for your engine, see the engine manufacturer's engine operation manual, supplied in the vehicle documentation package.

If satisfactory engine temperature is not maintained, maintenance costs will increase due to greater engine wear. If the engine coolant temperature be-

comes too low, raw fuel will wash the lubricating oil off the cylinder walls and dilute the crankcase oil, causing all moving parts of the engine to suffer from poor lubrication.

If the engine is in good mechanical condition and the precautions necessary for cold-weather operation are taken, ordinary cold weather will not cause difficulty in starting or loss of efficiency.

The following points are important to observe when operating in cold weather:

- Check for cracks in the batteries, for corrosion of the terminals, and for tightness of the cable clamps at the terminals.
- Charge the batteries to full capacity. Replace any battery that is damaged.
- If equipped, turn off the load disconnect switch after the engine is shut down, to prevent battery discharge.
- Have the alternator output checked at an authorized service provider.
- Check the condition and tension of the drive belts.
- Refer to the engine manufacturer's engine operation manual for recommended heaters, low-viscosity lubricating oils, wintergrade fuels, and approved coolants.

A winterfront may be used to improve cab heating while idling. If a winterfront is used, at least 25% of the grille opening should remain open in sectioned, vertical strips. This assures even cooling across each tube, and reduces header to tube stress, and possible failure. Winterfronts should only be used when the ambient temperature remains below 10°F (-12°C).

High-Altitude Operation

Engines lose horsepower when operated at high altitude because the air is too thin to burn as much fuel as at sea level. This loss is about three percent for each 1000 feet (300 m) altitude above sea level for a naturally aspirated engine.

All Business Class M2 engines are altitude-compensated by the use of a turbocharger. This reduces smoky exhaust at high altitudes, requires less downshifting, and allows the engine to make better

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use of its fuel. Nevertheless, shift gears as needed to avoid excessive exhaust smoke.

Engine Shutdown

1. With the vehicle stopped, apply the parking brake, and place the transmission in neutral.

NOTICE

Idle the engine one to two minutes before shutting it down. After hard operation, shutting down the engine without idling may cause damage to the turbocharger.

2. Allow the engine to idle one to two minutes before shutting it down. This allows the lubricating oil and the coolant to carry heat away from the combustion chambers, bearings, shafts, and seals. The extreme heat may cause bearings to seize or oil seals to leak.

IMPORTANT: Bearings and seals in the turbocharger are subjected to the high heat of combustion exhaust gases. While the engine is running, this heat is carried away by oil circulation, but if the engine is stopped suddenly, the turbocharger temperature may rise as much as 115°F (46°C).

NOTICE

Except in an emergency, do not shut down the engine when the coolant temperature is above 194°F (90°C). To do so could damage the engine.

3. Turn off the ignition switch and shut down the engine.

Cruise Control

 **WARNING**

Do not use the cruise control system when driving conditions do not permit maintaining a constant speed, such as in heavy traffic or on roads that are winding, icy, snow-covered, slippery, or roads with a loose driving surface. Failure to follow this precaution could cause a collision or loss of vehicle control, possibly resulting in personal injury or property damage.

Dash-Mounted Switches

NOTICE

When the cruise control is engaged, do not attempt to shift gears without using the clutch pedal. Failure to follow this precaution will result in a temporarily uncontrolled increase in engine speed. Transmission damage and gear stripping could result.

Cruise control is activated by two dash-mounted switches (**Fig. 7.15**).

- On/Off Switch—this two-position rocker is labeled SPD CNTL on the lower half of the switch. When cruise control is on, an amber light illuminates the top part of the switch.
- Set/Resume Switch—this three-position paddle switch is labeled RES/ACC above the paddle and SET/CST below the paddle.

1. To cruise at a particular speed:
 - 1.1 Press the upper half of the On/Off switch.
 - 1.2 Depress the accelerator pedal until the speedometer reaches the desired speed.
 - 1.3 Momentarily lower the paddle of the Set/Resume switch to set the desired speed.

NOTE: The speed memory is lost whenever the ignition switch is turned to OFF, or cruise control is turned off.

2. To disengage the cruise control, do one of the following:
 - Press the lower half of the on/off switch button.
 - Depress the brake pedal.
 - Depress the clutch pedal (on a manual transmission only).
3. To resume a preselected cruise speed:
 - 3.1 Ensure the cruise control is on.
 - 3.2 Momentarily raise the paddle of the Set/Resume switch. Cruise will return to the last speed selected.

NOTE: If vehicle speed drops below the minimum cruise control speed, cruise control

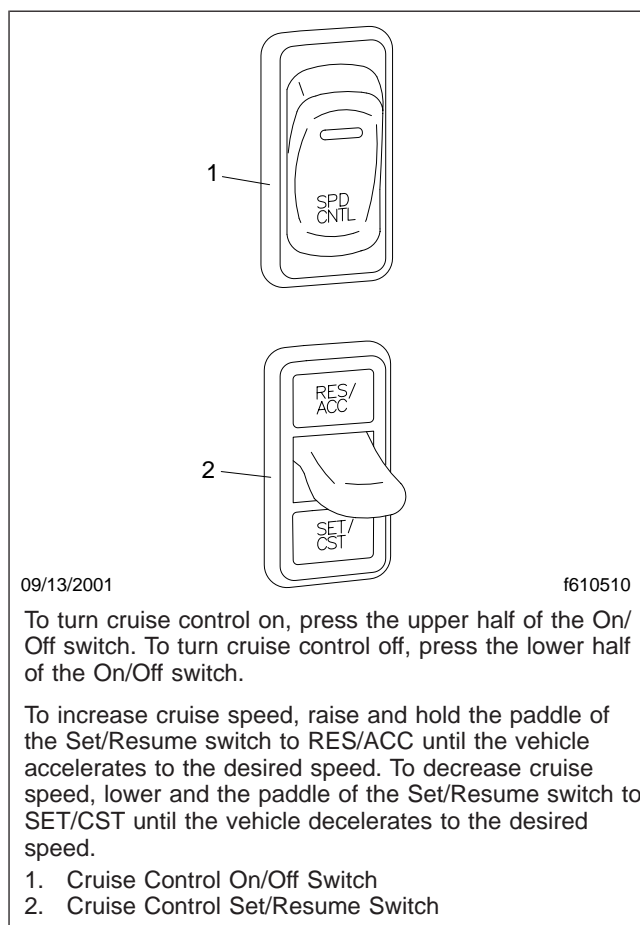


Fig. 7.15, Cruise Control Switches

will disengage. To resume to the preselected cruise speed, increase vehicle speed to above minimum cruise control speed and press the ACC/RES button.

NOTE: The speed memory is lost whenever the ignition is turned off or the cruise control switch is toggled to Off.

4. To increase cruise speed, raise and hold the paddle of the Set/Resume switch until the vehicle accelerates to the desired speed.
5. To decrease cruise speed, lower and the paddle of the Set/Resume switch until the vehicle decelerates to the desired speed.

Shift Knob Controls, Optional

Cruise control can also be activated by the optional PAUSE, RESUME, and SET buttons on the transmission shift knob (Fig. 7.16).

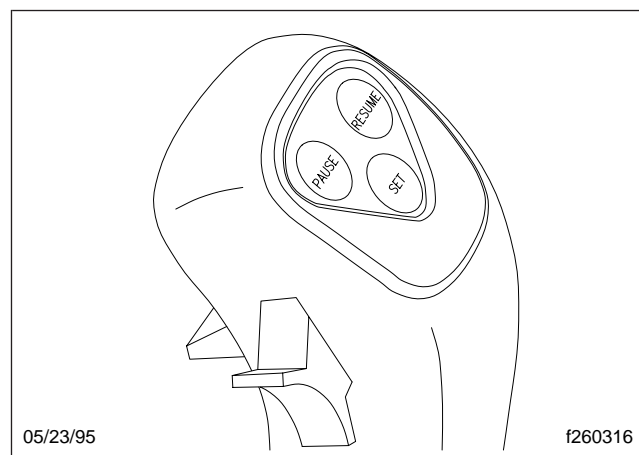


Fig. 7.16, Cruise Control Buttons on the Transmission Shift Knob

1. To cruise at a particular speed, do these steps:
 - 1.1 Hold the accelerator pedal down until the speedometer reaches the desired speed.
 - 1.2 Push the SET button on the transmission shift knob.
2. To disengage the cruise control, do these steps:
 - 2.1 Press down the brake pedal (on automatic and manual transmission) *or* Press down the clutch pedal (on manual transmission only)
 - 2.2 Push the PAUSE button on the transmission shift knob.
3. To resume a preselected cruise speed, push the RESUME button on the transmission shift knob. Cruise will return to the last speed selected.

NOTE: If the ignition is shut off, the speed memory will be lost.

4. To adjust cruise speed up, push the SET button and hold it in until the vehicle accelerates to the desired speed.

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5. To adjust cruise speed down, push the RESUME button and hold it in until the vehicle decelerates to the desired speed.

Power Takeoff (PTO) Governor

Engine power takeoffs (PTO) are devices used to tap into engine power to run auxiliary devices, such as hydraulic pumps that power additional equipment. The following instructions are general guidelines for operating a PTO.

1. Set the parking brake and put the transmission in neutral.
2. Press the dash-mounted PTO switch. Release the switch when the amber light behind the switch begins to blink.

When the light is steadily illuminated, the PTO is engaged and ready to operate. In stationary mode, the vehicle must remain in neutral with the parking brake set.

3. To activate the mobile mode, shift from neutral to reverse, 1st, or 2nd gear. The clutch will open and the PTO will disengage for a moment.
4. Touch the throttle pedal to close the clutch and engage the PTO in mobile mode. The PTO may be operated with the transmission in reverse, neutral, 1st, or 2nd gears only.

NOTE: Do not attempt to change gears while the vehicle is moving. The transmission will ignore the request.

5. To end the mobile mode, bring the vehicle to a stop. The clutch will open and shut down power to the PTO.
6. To resume stationary mode, shift to neutral. The PTO will engage.
7. To end stationary mode, press the dash switch. When the light in the switch goes out, power to the PTO is shut off.

Engine Braking

Each engine manufacturer uses a specific engine brake for their engine. Regardless of the manufacturer, the engine brake is operated with the principles outlined in this chapter. Refer to the engine manufacturer's operation manual for details of their particular engine brake product.

WARNING

To avoid injury from loss of vehicle control, do not activate the engine brake system under the following conditions:

- on wet or slippery pavement, unless the vehicle is equipped with antilock braking system (ABS) and you have had prior experience driving under these conditions;
- when driving without a trailer or pulling an empty trailer;
- if the tractor drive wheels begin to lock, or there is fishtail motion after the engine brake is activated.

Whenever vehicle braking is required on good road conditions, the engine brake may be used in conjunction with the service brakes. There is no time limit for operation of the engine brake. However, an engine brake does not provide the precise control of, and is not a substitute for, service brakes.

WARNING

Usage of the engine brake as the primary braking system can cause unpredictable stopping distances, that could result in personal injury or property damage. Service brakes are the primary vehicle braking system.

Two dash-mounted switches control the engine brake:

- The On/Off switch (ENG BRK), is used to turn the engine brake on and off. See [Fig. 7.17](#). When the engine brake is on, an amber light will illuminate behind the switch.
- The engine brake intensity switch (HI/MED/LO or, in some cases, HI/LO) controls the amount of engine braking. When the panel lights are on, the ENG BRK legend is backlit in green.

Since the engine brake is most effective at rated engine speed, gear selection is very important. Gearing down the vehicle within the limits of the rated engine speed makes the engine brake more effective. Recommended engine braking speed is above 1800 rpm and below the rated speed.

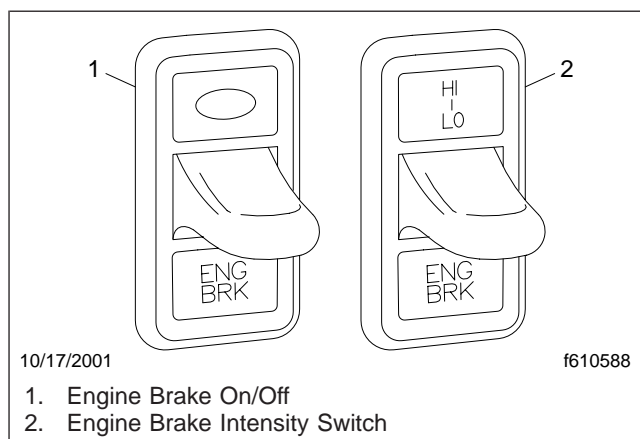


Fig. 7.17, Engine Brake Switches

⚠ WARNING

The engine brake must be disengaged when shifting gears using the clutch pedal. If the engine brake is engaged when the transmission is in neutral, the braking power of the engine brake can stall the engine, which could result in loss of vehicle control, possibly causing personal injury and property damage.

"Control speed" is the speed at which the engine brake performs 100 percent of the required downhill braking, resulting in a constant speed of descent. The control speed varies, depending on vehicle weight and the downhill grade.

For faster descent, select a higher gear than that used for control speed. Service brakes must then be used intermittently to prevent engine overspeed and to maintain desired vehicle speed.

For slower descent, select a lower gear, being careful not to overspeed the engine. Occasional deactivation of the engine brake may be necessary to maintain the designated road speed under these conditions.

If the engine is equipped with both cruise control and an engine brake, the engine brake can operate automatically while in cruise control mode. If the cruise control/engine brake function is turned on in the DDEC VI system programming, the engine brake will come on low when the set road speed increases a few mph (km/h) above the cruise set speed. The maximum amount of braking is selected with the

dash switches. When the vehicle returns to the set cruise speed, the engine brake will turn off.

The engine brake will only operate when the accelerator pedal is fully released. Depressing the clutch will also prevent the engine brake from operating.

Vehicles equipped with ABS have the ability to turn the engine brake off if wheel slip is detected. The engine brake will automatically turn back on once wheel slip is no longer detected.

The DDEC VI system will deactivate the engine brake when the engine speed falls below 1000 rpm or when the vehicle slows down to a preset speed, depending on DDEC programming. This prevents stalling the engine.

Engine Brake Operation

Depending on the brake type, the engine brake may be disabled when engine temperature falls below a set level.

NOTICE

Do not allow the engine to exceed 2500 rpm. Serious engine damage could result.

To activate the engine brake after the engine is warmed up and the vehicle is in motion:

1. Remove your feet from both the clutch and throttle pedals.
2. Press the On/Off switch to toggle the engine brake on. See [Fig. 7.17](#). The engine brake will engage at the rate last set on the brake intensity switch.
3. Move the intensity switch to the desired intensity.

On vehicles with a HI/MED/LO intensity switch, LO will provide 1/3 of the full braking capacity of the engine, MED will provide 2/3 of the full braking capacity, and HI will provide maximum engine braking. On vehicles with a HI/LO intensity switch, LO will provide 1/2 of the full braking capacity of the engine; HI will provide maximum engine braking.

4. Use the intensity switch set at the LO position when driving on flat, open stretches of road. If the service brakes are still required to slow down on a grade, switch to a higher setting on the dash switch until there is no need for the service brakes. Grade descent speed should be such

Engines

that the service brakes are used infrequently and remain cool, thus retaining their effectiveness.

5. For maximum retarding, maintain the top governed speed of the engine through the appropriate selection of gears. When shifting gears, the engine brake will disengage when the clutch pedal is depressed, then engage when the clutch pedal is released.
6. To cancel the engine brake application, toggle the On/Off to off.

Exhaust Braking Systems

Exhaust Brake Switch

The optional exhaust brake is controlled by a dash-mounted rocker switch to help slow the vehicle when the accelerator is released.

To turn the exhaust brake on, press on the upper part of the rocker (at the light inside the switch). The exhaust brake turns off automatically. See [Fig. 7.18](#) or [Fig. 7.19](#).



Fig. 7.18, Exhaust Brake Switch

When the exhaust brake switch is on, an amber LED illuminates inside the switch. When the panel lights are on, the EXHST BRK legend is backlit in green.

Mercedes-Benz Exhaust Brake

An exhaust brake is an optional auxiliary braking system that assists but does not replace the service brake system. The exhaust brake can be used alone or together with the constant-throttle valves for steep or long grades. The exhaust brake switch located on the control panel, in combination with the accelerator and clutch pedals, allows the driver to make maxi-

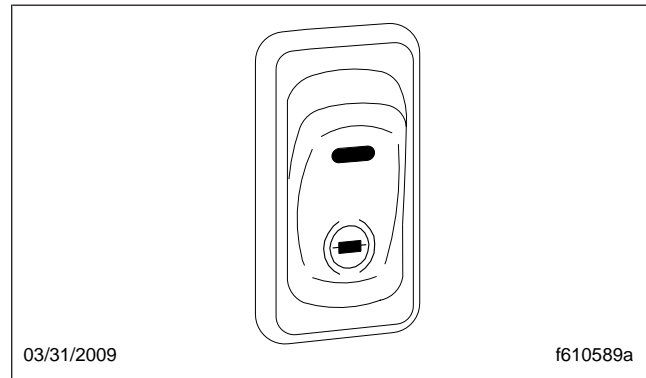


Fig. 7.19, Exhaust Brake Switch

mum use of the exhaust brake in off-highway and mountain driving as well as in traffic or high-speed highway driving.

When only the exhaust brake is installed, a two-position switch on the dash controls the engine braking system. The exhaust brake is only active when the engine speed is between 1100 and 2700 rpm. Depressing the accelerator or clutch pedal deactivates the exhaust brake. The ABS system, when active, also deactivates the exhaust brake.

The exhaust brake is a butterfly valve mounted in the exhaust pipe. When the driver's foot is not on the accelerator pedal and the upper half of the exhaust brake switch is pressed in, with the amber light on the switch illuminated, an air cylinder shuts the butterfly valve, which restricts the flow of exhaust gases and retards the engine. This retarding action is carried through the engine and drivetrain, slowing the vehicle and reducing the need for frequent service brake applications.

Exhaust brakes are not intended for use as the primary braking system during vehicle operation.

Operating Characteristics



Do not use the exhaust brake when driving on slippery or low-traction road surfaces. Failure to follow this precaution could result in a loss of vehicle control and possible personal injury or property damage.

Before starting the engine, make sure that the lower half of the exhaust brake switch is pressed in and

the amber light is not illuminated. Do not turn the exhaust brake on until the engine has reached normal operating temperatures.

When you remove your feet from both the accelerator and clutch pedals and the upper half of the exhaust brake switch is pressed in with the amber light illuminated, the exhaust brake is applied. The following conditions should exist if the brake is operating properly:

- A slight change in the sound of the engine may be noticed when the exhaust brake is applied.
- Exhaust smoke should appear normal.
- Engine temperature should remain in the normal operating range.
- Road speed usually decreases when the exhaust brake is applied during a descent. When the vehicle is carrying a heavy load or the grade is extremely steep, you may need to apply the service brakes occasionally.
- Do not expect a retarding effect similar to sudden hard application of the service brakes. The exhaust brake retards the vehicle with a smooth braking effect.
- During a descent, the tachometer usually shows a drop in rpm, depending on the grade and the vehicle load.
- Depending on the grade and vehicle load, you may or may not feel the retarding force acting against your body when the brake is applied. The retarding force of the brake may not always be noticed, but it is actually preventing the vehicle from going much faster.

Make sure the exhaust brake is turned off before shutting down the engine.

Driving Downhill

While approaching a steep grade, make sure that the upper half of the exhaust brake switch is pressed in, with the amber light illuminated. The exhaust brake comes on as soon as you remove your foot from the accelerator pedal. While going down the grade, use a low enough gear to safely descend with a minimum application of the service brakes. As a general guideline, use the same gear as you would to ascend the hill.

NOTICE

Do not allow the engine to exceed its governed speed, or serious engine damage could result.

Apply the service brakes to reduce the engine rpm or make a slower descent by using a lower gear.

Pacbrake® Exhaust Brake

The Pacbrake exhaust brake is intended as a supplement to the service brakes and will *not* bring the vehicle to a complete stop. The Pacbrake will assist in the control or reduction of road speed in conjunction with, or independent of, the service brakes. The amount of retarding or braking force is controlled by the driver.

Pacbrake Operation (Caterpillar)

The Pacbrake is controlled by the exhaust brake switch and the throttle pedal. All applications are additionally affected, controlled, or governed by engine speed through transmission gear selection. The Allison MD3060 transmission has automatic downshifting when the exhaust brake is requested. See the information on the "Allison World Transmission" later in this chapter.

On some applications, when the Pacbrake is in use, it may be necessary to check that the cruise control is not set and that the throttle is in the idle position.

On some applications, the engine, transmission, cruise control, and the Pacbrake exhaust brake may electronically interact with each other, which automatically operates their functions. Following are some examples of the programmed options that may be available with the cruise control in the on position:

- The coast mode engages the Pacbrake when the service brake is applied and disengages when the service brake is released.
- The latch mode engages the Pacbrake when the service brake is applied and the Pacbrake remains on after the service brake is released. The Pacbrake is disengaged when another input (depressing the throttle or clutch, engine speed drops below 800 rpm, or the exhaust brake switch is turned off) is supplied.
- The manual mode does not require the cruise control switch to be on, and operates the Pacbrake manually at the driver's discretion.

Engines

The amount of braking power the engine will develop is related to the speed (rpm) of the engine. The higher the engine rpm, the greater the retarding power.

Certain conditions may require that the transmission be downshifted in order to generate adequate rpm for the amount of retarding power required. Pacbrake exhaust brakes are designed and approved for safe use at 300 rpm above the engine's maximum governed rpm. Refer to individual engine manufacturer's specifications.

The Pacbrake will function best if it is used all of the time. However, if the vehicle is used inconsistently or seasonally, it may be necessary to perform a preventive maintenance procedure.

1. With the engine shut down, use any oil-free or nonpetroleum-based high-heat lubricant, and spray or coat a sufficient amount on the restricter valve shaft and the attaching locations at each end of the actuation cylinder. See [Fig. 7.20](#).

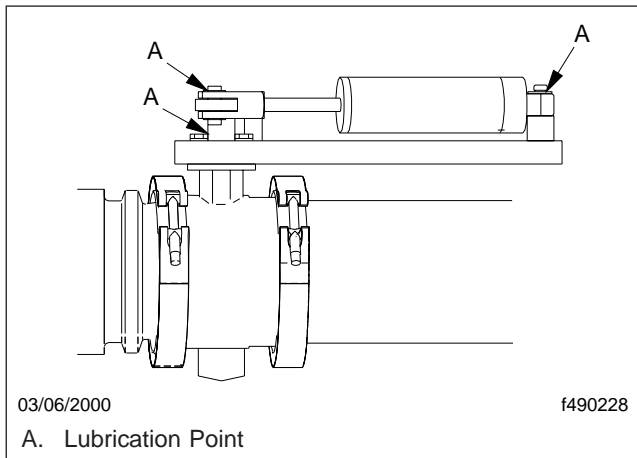


Fig. 7.20, Pacbrake Exhaust Brake and Air Cylinder

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

NOTE: Starting the engine and idling for short periods of time is not recommended. During a cold engine start-up, enough moisture is developed within the engine and the exhaust system to create a corrosion hazard that could affect the future operation of the Pacbrake. The brake housing may trap water in the valve shaft bore causing corrosion in an improperly functioning

or nonfunctioning brake. If it is necessary to periodically start the engine, it is recommended that normal operating temperatures be attained before shutting down the engine.

Allison World Transmission

Pacbrake exhaust brakes used with the Allison World Transmission MD series, are interfaced with the transmission electronic control module (ECM). An exhaust-brake-enabled transmission ECM will usually provide converter lockup in gears two through six. Effective exhaust braking begins when the transmission automatically downshifts into fifth gear (62 mph or less). Once on, the Pacbrake exhaust brake will control road speed and/or slow the vehicle sufficiently that the transmission will automatically downshift, if necessary, to Allison's preselect mode.

The preselect mode is normally assigned to second gear; however, the transmission can be reprogrammed by an Allison Transmission Distributor to third or fourth gear, should the operator desire. If additional retarding power is required before the automatic downshifting occurs, you can select a lower transmission gear on the Allison shift selector.

8

Drivetrain

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Drivetrain

Clutches

Clutch Operation

Applying the Clutch Brake

The purpose of the clutch brake is to stop the transmission gears from rotating in order to engage the transmission gears quickly in making an initial start. To apply the clutch brake, put the transmission in neutral and press the clutch pedal to the floor.

⚠ CAUTION

Never apply the clutch brake while the vehicle is moving. The clutch pedal should never be pressed down fully before putting the transmission in neutral. Considerable heat will be generated, which will be detrimental to the friction discs, release bearings, and transmission front bearings.

Applying the clutch brake with the transmission still in gear puts a reverse load on the gear. At the same time, it will have the effect of trying to stop or decelerate the vehicle with the clutch brake. Rapid wear of friction discs will take place necessitating frequent replacement.

Vehicle Overload, or Overloading the Clutch

⚠ CAUTION

Overloading will not only result in damage to the clutch, but also to the entire powertrain.

Clutches are designed for specific vehicle applications and loads. These limitations should not be exceeded.

Riding the Clutch Pedal

Riding the clutch pedal is destructive to the clutch. Partial clutch engagement permits slippage, and generates excessive heat. Riding the clutch pedal will also put a constant thrust load on the release bearing, which can thin out the lubricant. Release bearing failures can be attributed to this type of misuse.

Holding the Vehicle on an Incline With a Slipping Clutch

A slipping clutch accumulates heat faster than it can be dissipated, resulting in early clutch failures. Never use the clutch to hold a vehicle on a hill.

Coasting With the Clutch Released (pedal down) and the Transmission in Gear

⚠ WARNING

Do not coast with the clutch released (pedal depressed) and the transmission in gear. High driven-disc rpm could cause the clutch facing to be thrown off the disc. Flying debris could cause injury to persons in the cab.

If the transmission remains in a low gear and the vehicle gains speed, as may occur on a downgrade, the input shaft and clutch driven disc will turn at speeds that are higher than normal. This occurs because the rear wheels and the driveline become the input for the transmission, and a higher-than-normal speed for a given transmission gear translates to a higher rpm value for the clutch driven disc.

Clutch driven discs are designed to allow for some amount of excess rotational speed, but the facing has a limited burst strength. If the clutch driven disc rpm increases too much, the clutch facing can be thrown off the disc(s).

Engaging the Clutch While Coasting

Engaging the clutch while coasting can result in tremendous shock loads and possible damage to the clutch as well as to the entire drivetrain.

Report Erratic Clutch Operation Promptly

Reporting erratic clutch operation as soon as possible will give maintenance personnel a chance to inspect the clutch components.

⚠ CAUTION

Operating the vehicle with incorrect clutch pedal free-travel could result in clutch damage. See Group 25 of the *Business Class® M2 Workshop Manual* for free-pedal adjustment procedures and specifications.

On mechanical clutch linkages, free-pedal travel should be included and commented on daily in the driver's report, since clutch free-pedal travel is the best guide to the condition of the clutch and the release mechanism.

Clutch Wear

The major reason clutches wear out too soon is excessive heat. Clutches are designed to absorb and dissipate more heat than encountered in typical operation. The temperatures developed in typical operation will not break down the clutch friction surfaces. However, if a clutch is slipped excessively or required to do the job of a fluid coupling, high temperatures develop quickly and destroy the clutch. Temperatures generated between the flywheel, driven discs, and pressure plates can be high enough to cause the metal to flow and the friction facing material to char and burn.

CAUTION

Do not allow sustained slippage of the clutch; this could severely damage the clutch disc, pressure plate, or flywheel. Damage caused by clutch slippage due to improper break-in is not warrantable.

Slipping and excessive heat are practically nonexistent when a clutch is fully engaged. But during the moment of engagement, when the clutch is picking up the load, it generates considerable heat. An incorrectly adjusted or slipping clutch will rapidly generate sufficient heat to destroy itself.

The most important items that a driver should be aware of to ensure long service life of the clutch include: starting in the right gear, recognizing clutch malfunctions, and knowing when to adjust a clutch.

Clutch Adjustments

Some clutches have an internal adjustment. See the applicable section in **Group 25** of the *Business Class® M2 Workshop Manual* for clutch adjustment procedures and specifications.

CAUTION

Operating the vehicle with the clutch incorrectly adjusted could result in clutch or clutch brake failure.

Clutch Lubrication

The release bearing should be lubricated at frequent intervals. See **Group 25** of the *Business Class® M2 Maintenance Manual* for intervals and procedures.

CAUTION

Failure to lubricate the release bearing as recommended could result in release bearing damage and damage to the clutch.

NOTE: The Sachs hydraulic clutch does not require lubrication of the release bearing.

Sachs Hydraulic Clutch

The Sachs hydraulic clutch is a 14.5-inch (365 mm) push-type clutch that is used with the Mercedes-Benz medium-duty transmissions, models MBT520 and MBT660.

NOTE: All Mercedes-Benz transmission models require a hydraulic clutch system. For more information on the Mercedes-Benz transmissions, see under the heading "Mercedes-Benz Manual Transmissions."

The clutch hydraulic system consists of three main components:

- A pedal unit, including the pedal, master cylinder and fluid reservoir,
- A slave cylinder at the clutch,
- A hydraulic hose that connects the master and slave cylinders.

Keep the clutch fluid reservoir full to the MAX mark. If fluid level falls below the MIN mark, have the hydraulic system checked for leaks at an authorized Freightliner service facility. Use only DOT 4 brake fluid to fill the reservoir.

The hydraulic clutch provides smooth, quiet, and reliable clutch actuation with a minimum of maintenance.

Pressure builds up in the master cylinder when the clutch pedal is pressed. This pressure is transmitted through the brake fluid in the hose to the slave cylinder, where it acts directly on the clutch release fork.

Allison On-Highway Transmissions

The Allison on-highway transmissions are fully automatic and include the 1000 Series™, 2000 Series™, and 2400 Series™. Refer to the Allison website for additional information, www.allisontransmission.com.

Safety Precautions



Do not leave the vehicle unattended with the engine running. If you leave the vehicle and the engine is running, the vehicle can move suddenly, which could result in personal injury or property damage.

1000 Series

On vehicles with Allison 1000 series transmissions, do the following steps if you have to leave the cab with the engine running (for example, when checking the transmission fluid):

Without Park Position

1. Bring the vehicle to a complete stop using the service brake.
2. Ensure that the engine is at low idle rpm.
3. Put the transmission in neutral.
4. Apply the parking brake, and make sure it is properly engaged.
5. Chock the rear tires and take any other steps necessary to keep the vehicle from moving.

With Park Position

1. Bring the vehicle to a complete stop using the service brake.
2. Ensure that the engine is at low idle rpm.
3. Put the transmission in P (park).
4. Apply the parking brake (if equipped), and make sure it is properly engaged.
5. Engage the park range by slowly releasing the service brake.

6. Chock the rear tires and take any other steps necessary to keep the vehicle from moving.

2000 Series

On vehicles with Allison 2000 series transmissions, do the following steps if you have to leave the cab with the engine running (for example, when checking the transmission fluid):

Without Auto-Apply Parking Brake

Follow the instructions for vehicles with 1000 series transmissions, under the heading "Without Park Position."

With Auto-Apply Parking Brake

1. Bring the vehicle to a complete stop using the service brake.
2. Ensure that the engine is at low idle rpm.
3. Put the transmission in PB (auto-apply parking brake).
4. Apply the parking brake (if equipped), and make sure it is properly engaged.
5. Chock the rear tires and take any other steps necessary to keep the vehicle from moving.

2400 Series

On vehicles with 2400 series transmissions, follow the instructions for vehicles with 1000 series transmissions.

Range Inhibit Indicator, 2000 and 2400 Series

A RANGE INHIBIT indicator is a standard feature of the 2000 series and 2400 series transmissions. The RANGE INHIBIT indicator comes on to alert the driver that transmission operation is being inhibited and that the range shifts being requested by the driver may not occur. When certain operating conditions are detected by the TCM (transmission control module), the controls will lock the transmission in the current operating range.

Shift inhibits occur under the following conditions:

- Shifts from neutral to reverse or from neutral to a forward range when the engine is above idle, greater than 900 rpm.

- Forward/reverse directional shifts are typically not permitted if appreciable output shaft speed is detected.
- When some types of unusual transmission operating conditions are detected by the TCM, the TCM temporarily limits transmission operation until the vehicle can be driven to a service location. When this type of situation is detected, the TCM will lock the transmission in a safe gear range.
- The TCM will prevent shifts from park or neutral to range when auxiliary equipment, such as a power takeoff unit (PTO), is in operation.

Operating Instructions, On-Highway Transmissions

Allison automatic transmissions are electronically controlled. The shift selector provides five or six forward ranges and one reverse range.

P (Park, optional on 1000 and 2400 Series)

Use park when turning the engine on or off, to check vehicle accessories, to operate the engine in idle for longer than 5 minutes, and for stationary operation of the power takeoff, if equipped. This position places the transmission in neutral and engages the park pawl of the transmission.

NOTE: This does not apply the parking brake.

PB (Auto-Apply Parking Brake, optional on 2000 Series)

The auto-apply parking brake places the transmission in neutral and applies the parking brake.

R (Reverse)

Reverse is used to back the vehicle. When the selector is in reverse, the reverse warning signal will sound. Always bring the vehicle to a complete stop before shifting from a forward range to reverse, or from reverse to a forward range.

CAUTION

Extended idling in reverse may cause transmission overheating and damage.

Do not idle in reverse for more than 5 minutes. Select P (park), PB (auto-apply parking brake), or N (neutral) when time at idle exceeds 5 minutes.

NOTE: The shift into reverse may not succeed if a range inhibitor is active. Check for illumination of the RANGE INHIBIT indicator.

N (Neutral)

The neutral position places the transmission in neutral. This position is used when starting the engine and for stationary operation.

WARNING

Failure to apply the vehicle parking brakes when the transmission is in neutral may allow the vehicle to move unexpectedly, possibly causing property damage or personal injury.

When neutral is selected, the vehicle service brakes, parking brake, or emergency brake must be applied. Selecting neutral does not apply vehicle brakes unless an auxiliary system to apply the parking brake is installed.

WARNING

Do not coast in neutral. Coasting in neutral can cause an accident, possibly resulting in severe personal injury or death.

Do not let the vehicle coast in neutral. If the vehicle is allowed to coast in neutral, the engine brake will not work and you could lose control of the vehicle.

CAUTION

Coasting in neutral can cause severe transmission damage.

D (Drive)

WARNING

When going downhill, use a combination of downshifting, braking, and other retarding devices to control vehicle speed and the engine's rated governed speed. Failure to do so could reduce vehicle braking, possibly causing loss of vehicle control and resulting in personal injury or property damage.

Drivetrain

In the drive position, the transmission will initially go into first range when drive is selected. As vehicle speed increases, the transmission will upshift automatically through each available range up to fourth range or fifth range. As the vehicle slows, the transmission will downshift automatically.

When going downhill, downshift to a lower transmission range to increase engine braking and to help maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, the transmission may upshift to the next higher range, if the engine is exceeding its governed speed in the lower range.

CAUTION

Do not idle in drive for more than 5 minutes. Extended idling in drive may cause transmission overheating and damage. Always select PB (auto-apply parking brake) or P (park) if time at idle is longer than 5 minutes.

NOTE: The shift into drive may not succeed if a range inhibitor is active. Check for illumination of the RANGE INHIBIT indicator.

4 and 3 (Fourth and Third Ranges, optional)

Use the fourth or third range for city traffic and for braking on steep downgrades.

3 and 2 (Third and Second Ranges, standard)

Use the third or second range for heavy city traffic and for braking on steeper downgrades.

1 (First Range)

Use first range when pulling through mud or deep snow, when maneuvering in tight spaces, or when driving up or down very steep grades. First range provides the vehicle with its maximum driving torque and maximum engine braking effect.

NOTE: To have the transmission select these ranges automatically, leave the selector lever in D (drive).

Allison MD Series

Refer to the Allison website for additional information, www.allisontransmission.com.

Safety Precautions

WARNING

Do not leave the vehicle unattended with the engine running. If you leave the vehicle and the engine is running, the vehicle can move suddenly, which could result in personal injury or property damage.

On vehicles with MD series transmissions, do the following steps if you have to leave the cab with the engine running (for example, when checking the transmission fluid):

1. Bring the vehicle to a complete stop using the service brake.
2. Put the transmission in N (neutral).
3. Ensure that the engine is at low idle (500 to 800 rpm).
4. Apply the parking brake and emergency brakes, and make sure they are properly engaged.
5. Chock the rear tires and take any other steps necessary to keep the vehicle from moving.

Operating Instructions, MD Series

The Allison MD transmission is electronically controlled and comes with a push-button shift control that provides five or six forward ranges and one reverse range. The push-button shift selector has an R (reverse), an N (neutral), a D (drive), an up arrow, a down arrow, a mode button, and a digital display.

New shift controls — known as "fourth generation" — were introduced in mid-2006. They replaced the previous units that are commonly referred to as "WTEC III". See [Fig. 8.1](#) and [Fig. 8.2](#).

R (Reverse)

Press the R button to select reverse. The digital display will show R when reverse is selected. Always bring the vehicle to a complete stop and let the engine return to idle before shifting from a forward range to reverse, or from reverse to a forward range.

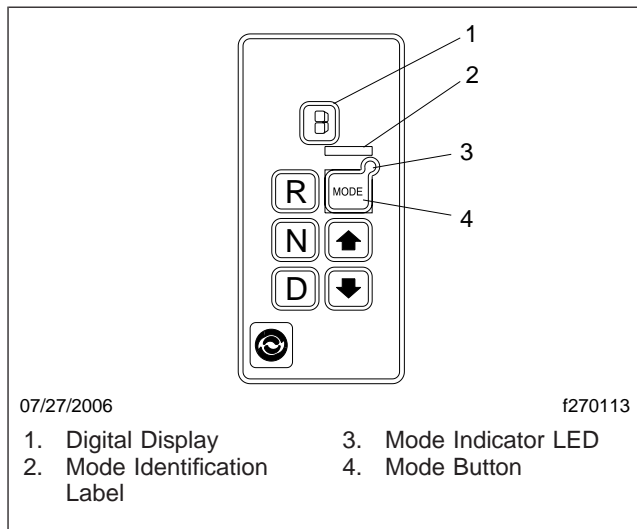


Fig. 8.1, WTEC III Push-Button Shift Selector

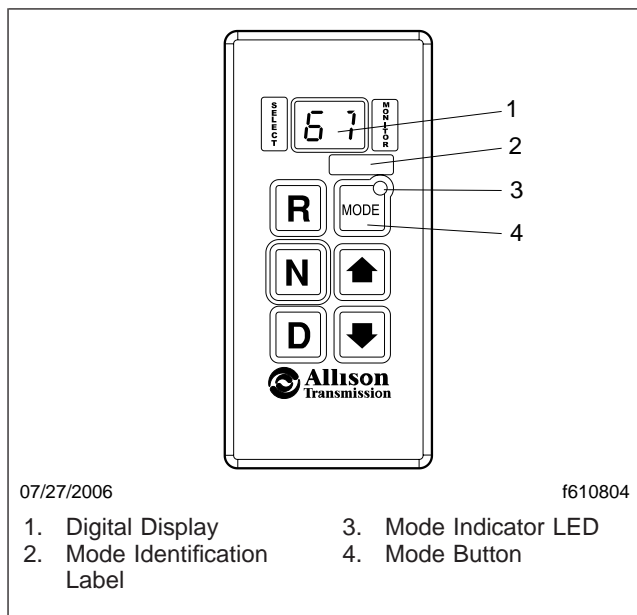


Fig. 8.2, Fourth Generation Push-Button Shift Selector

⚠ CAUTION

Extended idling in reverse may cause transmission overheating and damage.

Do not idle in reverse for more than 5 minutes. Select neutral when time at idle exceeds 5 minutes.

NOTE: The shift into reverse may not succeed if a range inhibitor is active. When reverse is selected, always be sure that R is not flashing.

N (Neutral)

⚠ WARNING

When starting the engine, make sure that the service brakes are applied. Failure to apply the service brakes may result in unexpected vehicle movement, which could cause severe personal injury or death. Failure to apply the vehicle parking brakes when the transmission is in neutral may allow the vehicle to move unexpectedly, possibly causing property damage or personal injury.

Press the N button to select neutral. The digital display will display N when neutral is selected. It is not necessary to press neutral before starting the vehicle. The ECU (electronic control unit) or TCM (transmission control module) automatically places the transmission in neutral at start-up.

⚠ WARNING

Failure to apply the vehicle parking brakes when the transmission is in neutral may allow the vehicle to move unexpectedly, possibly causing property damage or personal injury.

When neutral is selected, the vehicle service brakes, parking brake, or emergency brake must be applied. Selecting neutral does not apply vehicle brakes unless an auxiliary system to apply the parking brake is installed.

⚠ WARNING

Do not coast in neutral. Coasting in neutral can cause an accident, possibly resulting in severe personal injury or death.

Do not let the vehicle coast in neutral. If the vehicle is allowed to coast in neutral, the engine brake will not work and you could lose control of the vehicle.

Always select neutral before turning off the engine. Neutral is also used during stationary operation of the power takeoff if your vehicle is equipped with a PTO.

Drivetrain

D (Drive)

When the D button is pushed, the highest forward range will appear in the display. The transmission will normally go into first range when drive is selected (except for those units programmed to start in second range). As vehicle speed increases, the transmission will upshift automatically through each range. As the vehicle slows, the transmission will downshift automatically.

CAUTION

Do not idle in drive for more than 5 minutes. Extended idling in drive may cause transmission overheating and damage. Always select neutral if time at idle is longer than 5 minutes.

NOTE: The shift into drive may not succeed if a range inhibitor is active. When drive is selected, always be sure that D is not flashing.

5, 4, 3, and 2 (Fifth, Fourth, Third, and Second Ranges)

Occasionally, road conditions, load, or traffic conditions will make it desirable to restrict automatic shifting to a lower range. Lower ranges provide greater braking for going down grades. The lower the range, the greater the braking effect.

Push the up or down arrows on the push-button shift selector to select individual forward ranges. The digital display will display your choice of range. When a lower range is selected, the transmission may not downshift until the vehicle speed or engine RPM (engine governed speed) is reduced.

WARNING

When going downhill, use a combination of downshifting, braking, and other retarding devices to control vehicle speed and the engine's rated governed speed. Failure to do so could reduce vehicle braking, possibly causing loss of vehicle control and resulting in personal injury or property damage.

When going downhill, downshift to a lower transmission range to increase engine braking and to help maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, if the

engine governed speed is exceeded in the lower range, the transmission may upshift to the next higher range.

1 (First Range)

Use the first range when pulling through mud or deep snow, when maneuvering in tight spaces, or when driving up or down steep grades. First range provides the vehicle with its maximum driving torque and maximum engine braking effect. Push the down arrow until the first range appears on the display.

Up and Down Arrows

When a lower range is desired, after D has been pressed, press the down arrow until the desired range is shown on the display. Pressing the down arrow continuously causes the range position to continue to go down until the button is released or the lowest range is attained.

When the transmission is in drive and the down arrow has the transmission in a lower range position, press the up arrow to shift to a higher selector position. Pressing the up arrow continuously causes the range position to continue to rise until the button is released or the highest available position is attained.

Pressing the up or down arrows does not override the transmission automatic shifting operation. If a higher or lower position is selected, the transmission continues shifting through the ranges according to the vehicle operating characteristics until the highest or lowest selected position is reached.

Mode Button

The MODE button starts a specialized input or output function that has been previously programmed into the ECU or TCM. Pressing the MODE button changes transmission operation for a specific function.

Mode Indicator LED

When the MODE button is pressed, the mode indicator LED illuminates. A mode identification label, located above the MODE button, identifies the function associated with a mode change.

Digital Display

The dual digital display shows both the selected range (SELECT) and actual range attained (MONITOR). The single digital display shows the selected range.

Oil Level Sensor

Allison MD Series transmissions have an electronic oil level sensor to read fluid level information. The fluid level diagnostic will display whether the oil level is OK, too low, or too high. It will also display a default code and indicate if the preconditions (of receiving the fluid level information) are not met.

IMPORTANT: Maintain the the proper fluid level at all times. If the fluid level is too low, the converter and clutch do not receive an adequate supply of fluid. If the level is too high, the transmission may shift erratically or overheat.

To access the oil level display mode, park the vehicle on a level surface, shift to N (Neutral), apply the parking brake, and idle the engine. Then simultaneously press both the up and down arrows once. The oil level will display at the end of a two-minute countdown.

Diagnostic Codes

Diagnostic codes are numerical indications relating to a malfunction in transmission operation. These codes are logged in the TCM/ECU memory. The most severe or most recent code is listed first. A maximum of five codes (numbered d1-d5) may be listed in memory at one time. If the mode indicator LED is illuminated, the displayed code is active. If it is not illuminated, the displayed code is not active.

NOTE: During normal operation, an illuminated mode indicator LED signifies the specialized mode operation is in use.

To enter diagnostics mode, first park the vehicle and apply the parking brake. Then simultaneously press both the up and down arrows twice.

Eaton® Fuller® Straight-Shift Transmissions

Refer to the Eaton website for additional information, www.roadranger.com.

General Information, Straight-Shift

Eaton Fuller 5-speed FS models are fully synchronized. They have five forward speeds and one reverse. See [Fig. 8.3](#) for the shift pattern.

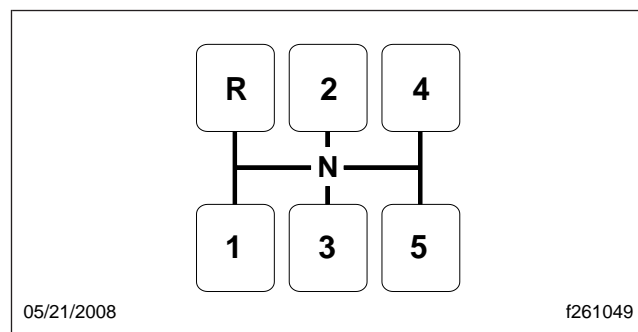


Fig. 8.3, Shift Pattern, 5-Speed FS Models

Eaton Fuller 6-speed FS and FSO models are fully synchronized. They have six forward speeds and one reverse. See [Fig. 8.4](#) for the shift pattern.

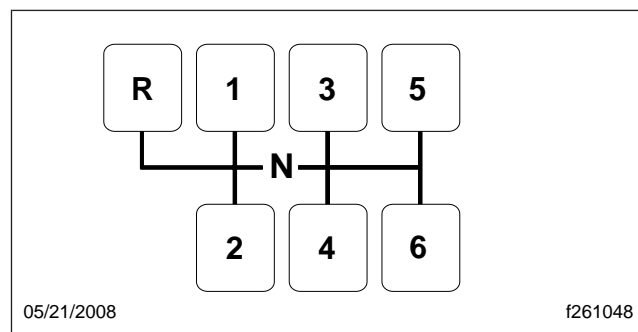


Fig. 8.4, Shift Pattern, 6-Speed FS and FSO Models

Eaton Fuller 7-speed T models are not synchronized. They have seven forward speeds and one reverse. See [Fig. 8.5](#) for the shift pattern.

These transmissions are designed for use with on-highway, fuel economy engines where a minimum of shifting is desired and less gear reduction is acceptable.

Operation, Straight-Shift

1. Always use first gear when starting to move the vehicle forward.

IMPORTANT: Do not rest your foot on the clutch pedal while driving. This causes partial clutch

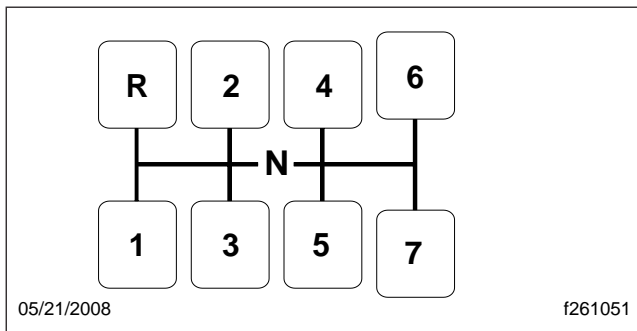


Fig. 8.5, Shift Pattern, 7-Speed T Models

disengagement which could cause premature clutch wear.

2. On synchronized models, press the clutch pedal to the floor when shifting gears. Double-clutching is unnecessary.

On unsynchronized models, press the clutch pedal to the floor to contact the clutch brake only when engaging the first or reverse gears.

NOTE: If the vehicle is moving when shifting, press the clutch pedal just far enough to disengage the clutch. Pressing it to the floor will engage the clutch brake, if so equipped, causing premature clutch brake wear.

3. To upshift, do the following steps:
 - 3.1 Accelerate to engine governed speed.
 - 3.2 On synchronized models, disengage the clutch and move the shift lever to second gear.
On unsynchronized models, disengage the clutch and move the shift lever to neutral. Engage the clutch again. With the shift lever in neutral, disengage the clutch and move the shift lever to second gear.
 - 3.3 Engage the clutch and note the drop in engine rpm before accelerating up to engine governed speed again.
 - 3.4 Continue upshifting using the same sequence described in the previous step. Follow the pattern on the shift lever.
4. To downshift, do the following steps:
 - 4.1 Wait until the engine speed drops to the rpm noted immediately after the upshift.

- 4.2 On synchronized models, disengage the clutch and move the shift lever to the next lower gear.

On unsynchronized models, disengage the clutch and move the shift lever to neutral. Engage the clutch again. With the shift lever in neutral, disengage the clutch and move the shift lever to the next lowest gear.

- 4.3 Engage the clutch smoothly.

- 4.4 Use the sequence described above to shift progressively down through each successive lower gear, as driving conditions require.

Eaton Fuller Range-Shift Transmissions

Refer to the Eaton website for additional information, www.roadranger.com.

General Information, Range-Shift Eaton Fuller 9-Speed Models

Eaton Fuller 9-speed range-shift models are not synchronized. They have nine forward speeds and two reverse speeds. The shift lever controls five forward gears and one reverse gear in the transmission front section, and the range lever controls a LO and HI range in the two-speed auxiliary section. The first position in the front section is used only as a starting gear. The other four ratios are used once in LO range and once again in HI range. See [Fig. 8.6](#) for the shift patterns.

After shifting out of the first gear position, use the Roadranger® "repeat H" shift pattern. Select both LO range and HI range with the range lever (range knob). It is used once during the upshift sequence and once during the downshift sequence.

Always preselect the range shift. After preselection, the transmission will automatically make the synchronizer range shift as the shift lever passes through neutral.

Eaton Fuller 10-Speed Models

Eaton Fuller 10-speed range-shift models are not synchronized. They have ten forward speeds and

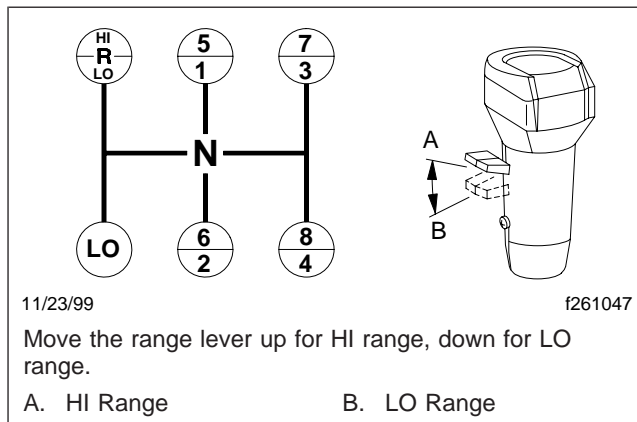


Fig. 8.6, Shift Pattern, 9-Speed Models

two reverse speeds. The shift lever controls five forward gears and one reverse gear in the transmission front section, and the range lever controls a LO and HI range in the two-speed auxiliary section. The five forward gears selected in LO range are used again in HI range to provide the 10 progressive forward gears. See [Fig. 8.7](#) for the shift patterns. See [Table 8.1](#) for the shift progressions.

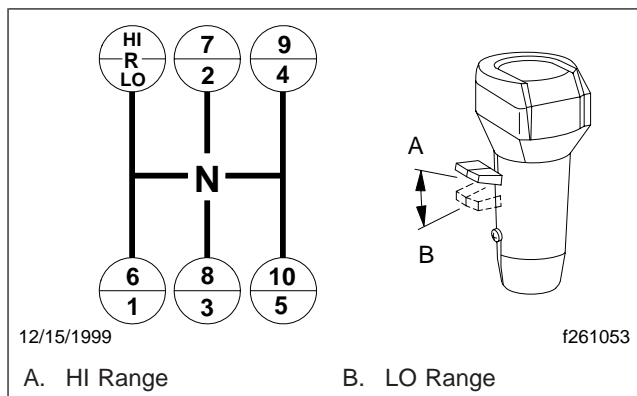


Fig. 8.7, Shift Pattern, 10-Speed Models

Once the highest shift lever position (fifth gear) is reached in LO range, the driver preselects the range shift lever for HI range. The range shift occurs automatically as the shift lever is moved from fifth gear position to the sixth gear position.

Eaton Fuller Shift Progressions			
Model	LO Range		HI Range
	Off-Highway	On-Highway	
9-Speed Direct or Overdrive			
10-Speed Direct or Overdrive			

Table 8.1, Eaton Fuller Shift Progressions

When downshifting, the driver preselects the range lever for LO range and the range shift occurs automatically during the shift lever movement to the next gear position.

Eaton Fuller Deep-Reduction Models

Eaton Fuller deep-reduction models are not synchronized. They have a five-speed front section and a two-speed auxiliary section which has an extra deep reduction gear. The LO gear in the front section is used only as a starting gear. The other four ratios are used once in LOW RANGE and once in HIGH RANGE giving eight highway ratios. LO-LO is selected by the DEEP REDUCTION lever on the dashboard. See [Fig. 8.8](#) for the shift pattern.

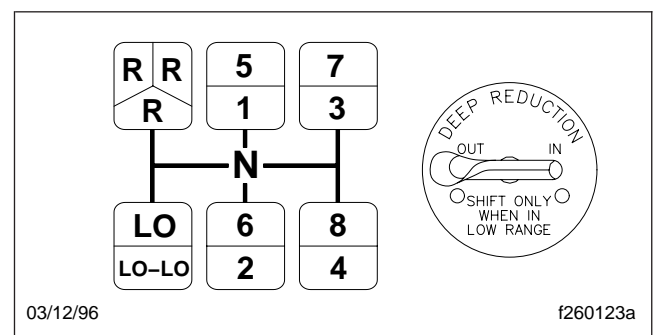


Fig. 8.8, Shift Pattern, Deep Reduction

Operation, Range-Shift

1. When operating off-highway or under adverse conditions, always use low gear when starting to move the vehicle.

Drivetrain

When operating on-highway, with no load or under ideal conditions, use first gear when starting to move the vehicle.

For all conditions, use the highest gear that is still low enough to start the vehicle moving with the engine idling and without excessively slipping the clutch.

2. Use the clutch brake to stop gear rotation when shifting into low (or first) or reverse when the vehicle is stationary. The clutch brake is applied by pressing the clutch pedal all the way to the floor.

For normal upshifts and downshifts, only a partial disengagement of the clutch is necessary to break engine torque.

3. Do not make range shifts with the vehicle moving in reverse gear.
4. Never attempt to move the range preselection lever with the gear shift lever in neutral while the vehicle is moving. Preselection with the range preselection lever must be made prior to moving the shift lever out of gear into neutral.
5. Do not shift from high range to low range at high vehicle speeds.
6. Use double-clutching between all upshifts and downshifts.
7. After your shifting ability improves, you may want to skip some of the ratios. This may be done only when operating conditions such as load, grade, and road speed permit.

Upshifting

1. Position the gear shift lever in neutral. Start the engine and bring the air system pressure up to 100 to 120 psi (689 to 827 kPa).
2. Position the range preselection lever down into low range.
3. Press the clutch pedal to the floor. Shift into low or first gear, then engage the clutch with the engine at or near idle speed to start the vehicle moving. Accelerate to 80 percent of engine governed speed.
4. Shift progressively up from low or 1st gear to the top gear in low range, double-clutching between shifts and accelerating to 80 percent of engine governed speed.

5. While in the top gear of the low-range shift pattern and ready for the next upshift, flip the range preselection lever up into high range. Double-clutch through neutral and shift into the bottom gear in high range. As the shift lever passes through neutral, the transmission will automatically shift from low range to high range.
6. With the transmission in high range, shift progressively up through each of the high range gears, double-clutching between shifts.

Downshifting

1. With the transmission in high range, shift progressively down to the bottom gear in high range, double-clutching between shifts.
2. When in the bottom gear of the high-range shift pattern and ready for the next downshift, push the range preselection lever down into low range. Double-clutch through neutral and shift into the top gear of the low-range shift pattern. As the shift lever passes through neutral, the transmission will automatically shift from high range to low range.
3. With the transmission in low range, downshift through the low range gears as conditions require.

Never use the clutch brake when downshifting or as a brake to slow the vehicle.

Operation, Deep-Reduction Models

Upshifting

1. Position the gear shift lever in neutral. See [Fig. 8.8](#) for the shift pattern. Start the engine, and bring the air system pressure up to 95 to 125 psi (655 to 862 kPa).
2. Position the range preselection lever down, into low range.

NOTE: If conditions are difficult, start out in LO-LO. Move the DEEP REDUCTION lever on the dashboard to the IN position. Otherwise start out in LO with the DEEP REDUCTION lever in the OUT position.

3. Depress the clutch pedal to the floor. Shift into LO gear; then, engage the clutch, with the engine at or near idle rpm to start the vehicle moving. The vehicle will start in LO or LO-LO depending on the DEEP REDUCTION lever position.
4. To upshift if in LO-LO, move the DEEP REDUCTION lever to the OUT position and *immediately* release the accelerator, depress the clutch pedal once to break torque, and reengage the clutch. The auxiliary section will shift from LO-LO to LO when the gears reach the same speed.
5. Shift progressively upward from LO through 1st, 2nd, 3rd, and 4th gears while the range preselection lever is in LO. Always double-clutch between gears.
6. When in 4th gear and ready for the next upshift, pull up the range preselection lever and move the shift lever, double-clutching, to the 5th gear position. As the shift lever passes through neutral, the auxiliary section will automatically shift from low to high range.

CAUTION

Never move the shift lever into the LO gear position after high range preselection or anytime the auxiliary section is in high range. Transmission damage could result.

7. Continue upshifting from 5th gear through 8th gear, always double-clutching between gears.

Downshifting

1. While in high range, move the gear shift lever from 8th gear through 5th gear as conditions require, always double-clutching between gears.
2. When in 5th gear and ready for the next downshift, push down the range preselection lever and move the shift lever to the 4th gear position, being sure to double-clutch. As the shift lever passes through neutral, the auxiliary section will automatically shift from high to low range.
3. While in the low range, continue downshifting from 4th through LO as conditions require, always double-clutching between gears.
4. *Do not* downshift into LO-LO from LO unless operating conditions make it necessary. If it is necessary, make sure that the shift lever is in the LO

gear position and the auxiliary section is in the low range. Then, move the DEEP REDUCTION lever on the dashboard to the IN position. *Immediately* release the accelerator, depress the clutch pedal once to break torque, engage the clutch, and accelerate. The auxiliary section will automatically shift from LO to LO-LO when the gears reach the same speed.

CAUTION

Never use the clutch brake when downshifting, or as a brake to slow the vehicle. This will cause premature clutch brake wear.

Eaton Fuller AutoShift™

Refer to the Eaton website for additional information, www.roadranger.com.

IMPORTANT: Before starting the vehicle, always do the following:

- Be seated in the driver's seat.
- Place the transmission in neutral.
- Set the parking brakes.
- Press the clutch pedal (if equipped) down to the floor.

The AutoShift ASW is an automated 6-speed Eaton Fuller transmission. No clutch is necessary to operate the vehicle.

The AutoShift AS2 is a partially automated 10-speed Eaton Fuller transmission. The driver must use the clutch and put the transmission in neutral to start and stop the vehicle. A push-button shift selector (**Fig. 8.9**) is used with AutoShift AS2 and ASW transmissions.

IMPORTANT: If you have to leave the cab with the engine running:

- Place the transmission in neutral.
- Set the parking brakes.
- Chock the tires.

Push-Button Shift Selector

Gear information is presented to the driver on the push-button shift selector, usually mounted on the

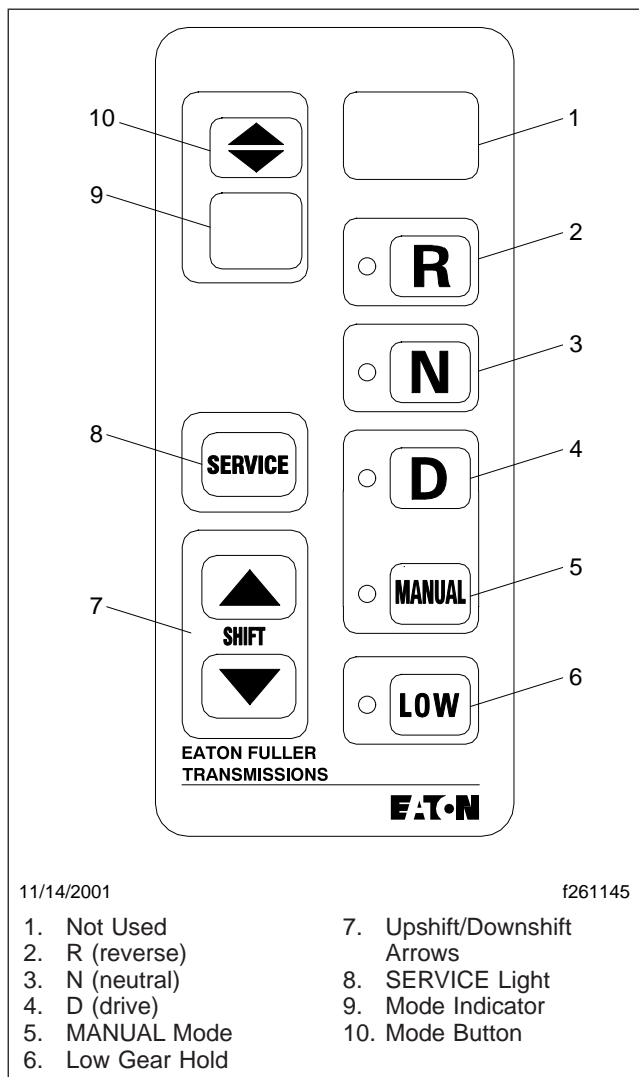


Fig. 8.9, Eaton Push-Button Shift Selector

right-hand control panel. On this display, the information is presented as follows:

- To select neutral, press the N button. When neutral is engaged, the telltale LED will light up next to the N button.
- To select reverse, press the R button. When reverse is engaged, the telltale LED will light up next to the R button.
- To select drive, press the D button. When drive is engaged, the telltale LED will light up next to the D button.

- To select low gear, press the LOW button. When low is engaged, the telltale LED will light up next to the LOW button.
- To change gears manually, press the MANUAL button. When the manual mode is engaged, the telltale LED will light up next to the MANUAL button.
- Use the shift buttons (upshift/downshift) to change the current starting gear selection in R, D, and LOW. In MANUAL, the shift buttons can be used to select gears.
- In automatic mode, the number of the forward gear currently engaged appears continually on the mode indicator when in drive. In MANUAL, the last gear selected appears on the mode indicator.
- If the SERVICE indicator illuminates, take the vehicle as soon as possible to an authorized Freightliner service facility.
- The mode button is reserved for future use.

IMPORTANT: To prevent engine overspeed, the transmission software will override both MANUAL and LOW if necessary. The system will not respond to gear selection requests that will either overspeed or excessively lug the engine.

Automatic Mode

The AutoShift AS2 transmission is normally operated in an automatic mode. To select MANUAL mode, press the MANUAL button on the push-button shift selector.

When the transmission is in automatic mode, the transmission automatically selects and engages the gears, although the transmission will respond to upshift and downshift requests as though in manual mode. See the instructions for shifting under heading "Manual Mode" below.

Manual Mode

When the transmission is in manual mode, the driver must select the appropriate gear, using the shift buttons on the push-button shift selector.

To upshift in MANUAL, press the upshift button (up arrow), and release. The number of the gear will appear on the mode indicator. If the requested gear is available, the transmission will shift up.

CAUTION

Do not attempt to upshift until the vehicle has reached a sufficient speed. The clutch absorbs the speed difference by generating heat, which causes the clutch to wear out too soon.

Many drivers upshift into the next gear or even skip-shift into a higher gear before the vehicle has reached the correct speed. This type of shifting is almost as bad as starting off in a gear that is too high. When the engine speed (rpm) and the vehicle speed (mph or km/h) are too far apart, the clutch must absorb the difference in speed by generating heat.

To downshift in MANUAL, press the downshift button (down arrow), and release. The number of the gear will appear on the mode indicator. If the requested gear is available, the transmission will shift down.

If any requested gear is not available, an audible warning will sound and the digital display will indicate that the gear is not available.

Selecting Gears

R (Reverse)

Reverse (R) is used to back the vehicle. Make sure the vehicle comes to a full stop and the clutch pedal has been pressed before shifting into reverse.

To select reverse, press the clutch pedal to the floor. Then press the R button.

N (Neutral)

Neutral (N) is used for starting, parking, or any stationary operation. No gear is selected. The transmission must be in neutral to start the engine.

IMPORTANT: If the vehicle starts up in any gear but neutral, bring the vehicle to an authorized Freightliner service facility as soon as possible.

To select neutral, press the clutch pedal to the floor. Then press the N button. Set the parking brakes and slowly release the clutch pedal.

NOTE: Neutral is always available during vehicle operation. When in neutral, requests to upshift or to downshift are ignored.

D (Drive)

Drive (D) is used for normal highway driving. In drive, the transmission shifts into the proper gear for starting, and then automatically selects additional gears as needed, in a range between the starting gear and the highest gear.

To select drive, press the clutch pedal to the floor. Then press the D button. Slowly release the clutch pedal and drive the vehicle.

To start up in a gear other than the normal starting gear, push the upshift arrow with D selected, and while the vehicle is stopped.

IMPORTANT: AutoShift will not start up in any gear higher than third gear.

The number of the gear selected will flash on the auxiliary display until the driver presses the clutch pedal. This gear will be stored in memory as the default starting gear until a different starting gear is selected by the driver, or until the engine is shut down.

NOTE: The transmission may be programmed so that it is not possible to select a starting gear other than the preprogrammed starting gear.

L (Low)

LOW is used to hold the transmission in low gear when descending steep hills. If LOW is selected when the vehicle is stopped, the transmission remains in low gear until drive is selected. If LOW is selected while the vehicle is moving, the transmission downshifts at a higher engine speed than normal, in order to maximize the engine braking effect.

To select LOW, press the clutch pedal to the floor. Then press the LOW button. Slowly release the clutch pedal and drive the vehicle.

IMPORTANT: Before parking the vehicle, always do the following:

- Place the transmission in neutral.
- Set the parking brakes.
- Chock the tires, if parking on an incline.

Freightliner SmartShift Shift Control

General Information, SmartShift

The SmartShift transmission control is an electronic transmission control device. It is installed with the following transmissions:

- Eaton Fuller UltraShift™
- Mercedes-Benz Automated Gear Shift (AGS)

It replaces the typical floor-mounted shift lever or dash-mounted push button control.

SmartShift accepts driver requests for transmission functions and transmits them through hard wiring to the transmission control unit (TCU). SmartShift is a true shift-by-wire system.

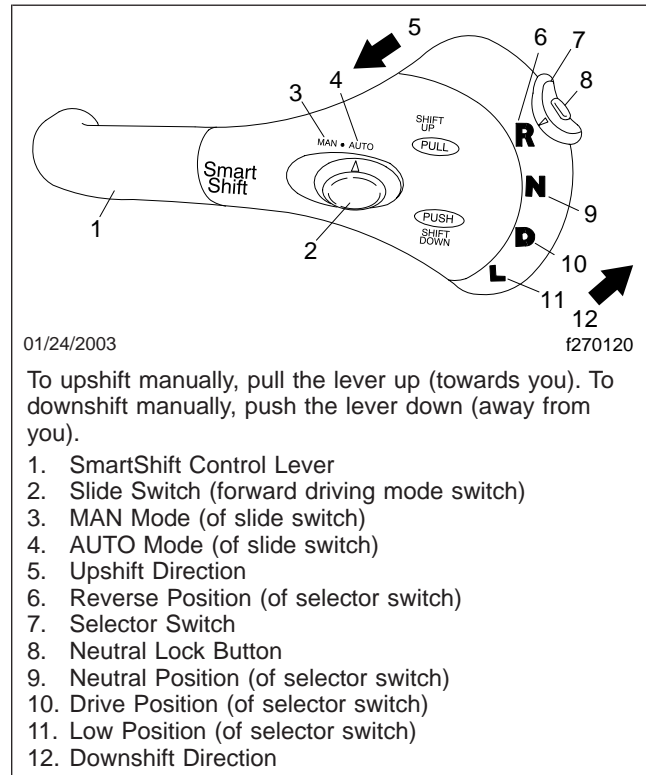
SmartShift offers two main advantages over conventional transmission control devices. Without a floor-mounted shift control, usable cab space is increased. The SmartShift control mounts to the right-hand side of the steering column and is operated by the fingers of the driver's right hand, allowing both hands to remain on the steering wheel.

A two-position slide switch (**Fig. 8.10**) is mounted on the body of the control lever just before the paddle widens out. The slide switch allows the driver to choose automatic (AUTO) or manual (MAN) mode.

In AUTO mode, gears shift automatically, without driver interaction. Manual gearshifts are accomplished by a momentary pull or push on the control in the plane perpendicular to the steering wheel. Pull upward (toward you) on the control to upshift and push downward (away from you) to downshift. The control is spring-loaded and returns to mid-position when released after an upshift or downshift.

For Eaton Fuller UltraShift (**Fig. 8.10**), a four-position (R, N, D, L) selector switch is located at the end of the lever. For the Mercedes-Benz AGS (**Fig. 8.11**), a three-position (R, N, D) selector switch is located at the end of the lever.

Embedded in the selector switch is a small neutral lock button to prevent accidental shifts into gear from neutral. Any time you shift through N, press down on the neutral lock button to move the switch from neutral (N) to another gear, such as drive (D), low (L), or reverse (R). When shifting to N, it is not necessary to press the neutral lock button.



To upshift manually, pull the lever up (towards you). To downshift manually, push the lever down (away from you).

1. SmartShift Control Lever
2. Slide Switch (forward driving mode switch)
3. MAN Mode (of slide switch)
4. AUTO Mode (of slide switch)
5. Upshift Direction
6. Reverse Position (of selector switch)
7. Selector Switch
8. Neutral Lock Button
9. Neutral Position (of selector switch)
10. Drive Position (of selector switch)
11. Low Position (of selector switch)
12. Downshift Direction

Fig. 8.10, SmartShift Control (with Eaton Fuller UltraShift)

Eaton Fuller UltraShift

The Eaton® Fuller® UltraShift™ transmission uses the four-position SmartShift control lever on the steering column to change gears, combined with a gear indicator on the right-hand control panel as shown in **Fig. 8.12**. All forward shifts can be made either manually or automatically, at the driver's choice. No clutch pedal is required to operate the vehicle.

General Information, UltraShift ASW

UltraShift ASW is a six-speed medium-duty fully automated transmission used on the M106 only. Six-speed UltraShift ASW uses a "wet" clutch system in which the drive and driven discs rotate in a bath of transmission fluid (Dexron III).

General Information, UltraShift DM

UltraShift DM is a ten-speed heavy-duty fully-automated transmission used on the M112 only. Ten-speed UltraShift DM uses a dry clutch system which

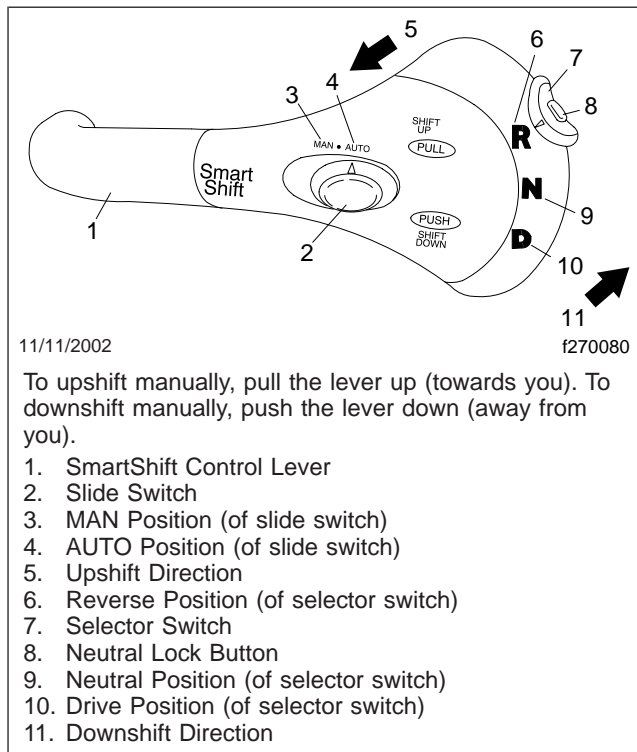


Fig. 8.11, SmartShift Control (with Mercedes-Benz AGS)

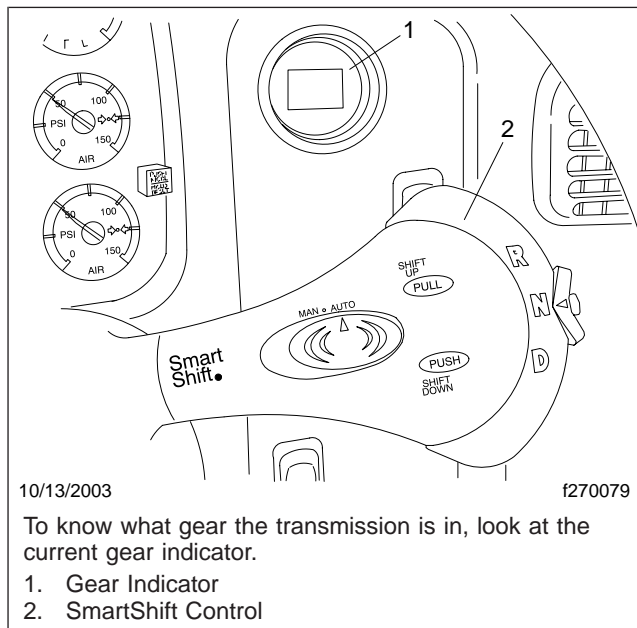


Fig. 8.12, Shift Controls and Indicators, UltraShift Transmissions

is offered only on this automated transmission system.

Operation, UltraShift

Power Up

NOTE: These operating instructions apply equally to six-speed UltraShift ASW and ten-speed UltraShift DM, with the exceptions explained below.

1. With the parking brake set, select neutral (N) by moving the selector switch to the N position.
2. With the transmission in neutral, turn on the ignition switch. The "CHECK TRANS" and "TRANS TEMP" telltale lights come on and go out again (bulb check). See [Fig. 8.13](#).

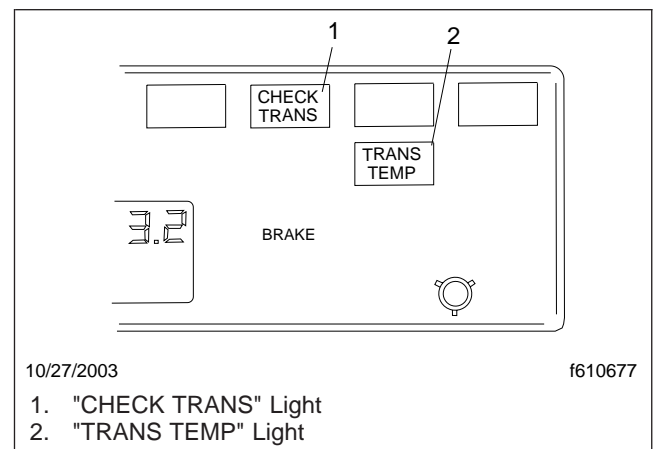


Fig. 8.13, Telltale Lights, UltraShift Transmission

3. After the ignition is turned on, the current gear indicator shows the dot display, arranged in a square pattern. All dots in the pattern should light up, without gaps or spaces. See [Fig. 8.14](#).
4. Wait for the current gear indicator to show a solid "N." When the "N" is solid, rather than flashing, the UltraShift transmission control unit (TCU) is powered up. Apply the service brake and start the engine.
5. Select drive (D) by pressing in the neutral lock button and moving the selector switch downward to the position below neutral. Release the parking brake. The gear is displayed on the current gear indicator.

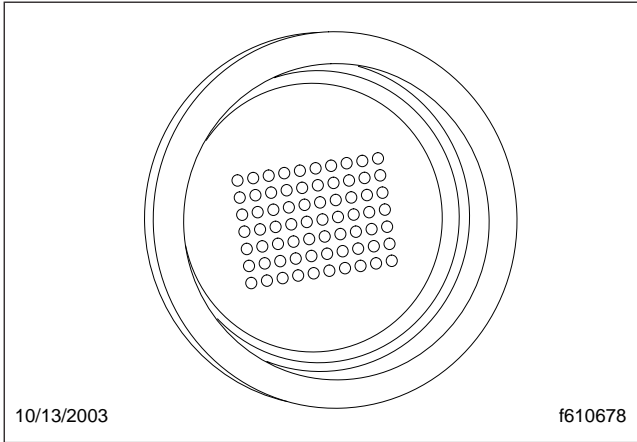


Fig. 8.14, Power-Up Dot Display

NOTE: When D is selected, the transmission controller starts up in second gear. On both six-speed Ultrashift ASW and ten-speed Ultrashift DM, the driver can select to start up in first. No other start gear is available.

6. On a level grade, release the service brake and press down on the throttle pedal to allow the vehicle to move forward.

⚠ WARNING

When starting or stopping on hills and grades, use extra care to prevent the vehicle from rolling back. A rollback accident could cause death, serious personal injury, or property damage.

7. Prevent the vehicle from rolling backward when stopped on a hill or grade, or when the vehicle is starting from a stop on a hill or grade.
 - 7.1 *To start from a full stop on a hill or grade,* quickly move your foot from the brake pedal and press firmly on the throttle pedal.
On steep hills, set the parking brake and release it only when there is enough engine power to prevent rollback.
 - 7.2 *To stop on a hill or grade,* press and hold the brake pedal to keep the vehicle from moving.

On steep hills, set the parking brake. When parking, chock the tires, front and/or rear. Never hold a hill with the throttle pedal. This will cause the clutch to over-heat.

Power Down

1. Apply the service brake.
2. Select neutral (N) by moving the selector switch to the N position. When the "N" on the gear indicator is solid, rather than flashing, the UltraShift TCU is ready to power down. See **Fig. 8.13**.
3. With the transmission in neutral, set the parking brake.
4. Turn off the ignition key and shut down the engine.

Automatic and Manual Modes

The SmartShift control has a slide switch located on the body of the control lever just before the paddle widens out. See **Fig. 8.15**. The slide switch controls the forward driving mode, automatic or manual.

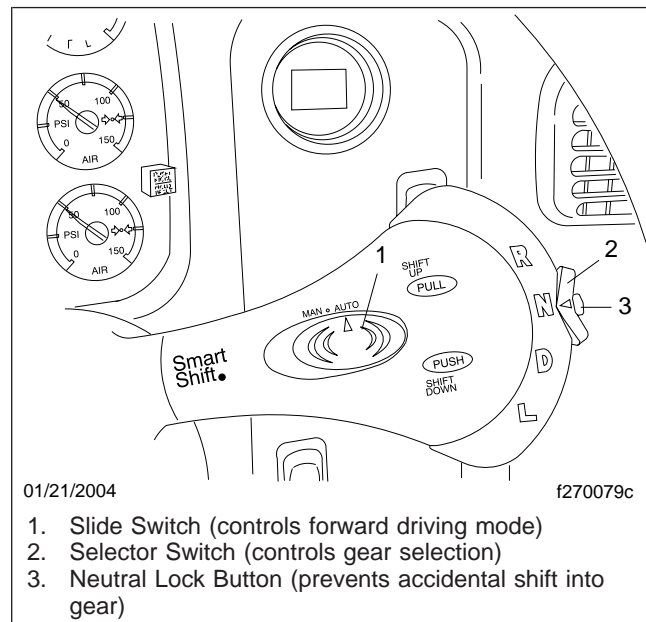


Fig. 8.15, Switches, Ultrashift Transmission

1. Slide Switch (controls forward driving mode)
2. Selector Switch (controls gear selection)
3. Neutral Lock Button (prevents accidental shift into gear)

To change mode at any time, move the slide switch in the desired direction. This allows the driver to respond to a wide range of driving conditions, such as blind corners, tight curves, and steep hills.

IMPORTANT: Whatever the mode, it is always possible to shift manually by moving the lever up or down as needed. When the engine speed is within 75 revolutions per minute (rpm) of the load-based shift point for an automatic shift, the UltraShift TCU will advance the shift.

In either mode, the gear indicator displays the current gear. See **Fig. 8.16**.

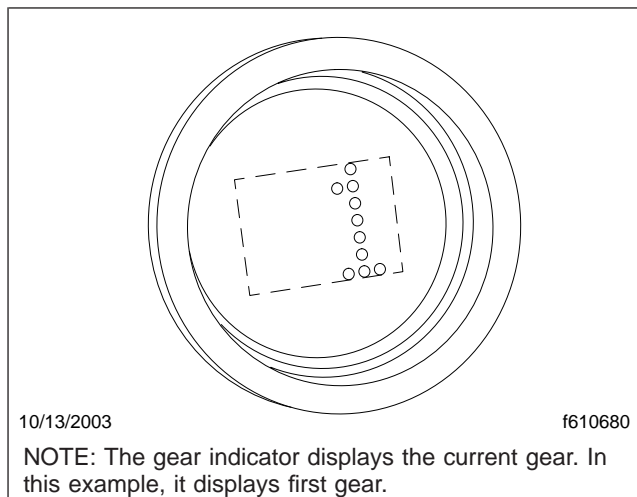


Fig. 8.16, Current Gear Display

At the start of a shift, the current gear continues to display until the transmission has been pulled into neutral. At this point, as the transmission is synchronizing for the new (target) gear, the gear indicator flashes the number of the new gear.

When the shift is complete, the new gear displays solid, without flashing.

Automatic Mode (AUTO)

In automatic drive mode (AUTO), upshifts and downshifts are made by the transmission without driver intervention. Press in the neutral lock button, move the selector switch to drive (D), and press down on the throttle pedal. The transmission will shift automatically.

If driving conditions require, it is still possible to request a manual shift. The transmission will make the

shift if the engine speed is within 75 rpm of the load-based shift point for that gear.

If the driver presses down on the throttle pedal after a manual downshift in automatic mode, the transmission will upshift again if the UltraShift TCU requires it.

Manual Mode (MAN)

In manual drive mode (MAN), upshifts and downshifts are made by the driver:

- To shift up, pull the lever up (towards you).
- To shift down, push the lever down (away from you).

The system will hold the current gear until the driver requests a shift. In downhill situations in particular, the driver must be alert to vehicle speed by downshifting and/or using the service brake.

A shift request will still be refused if the selected gear would cause engine overspeed or excessive lugging.

Selecting Gears

Reverse

Reverse (R) is at the upper end of the four-position selector switch located at the end of the SmartShift control lever. To select R, press in the neutral lock button and move the selector switch upward to the position above neutral.

Six-speed UltraShift ASW has one reverse gear. When reverse is selected, the letter "R" displays on the gear indicator. See **Fig. 8.17**.

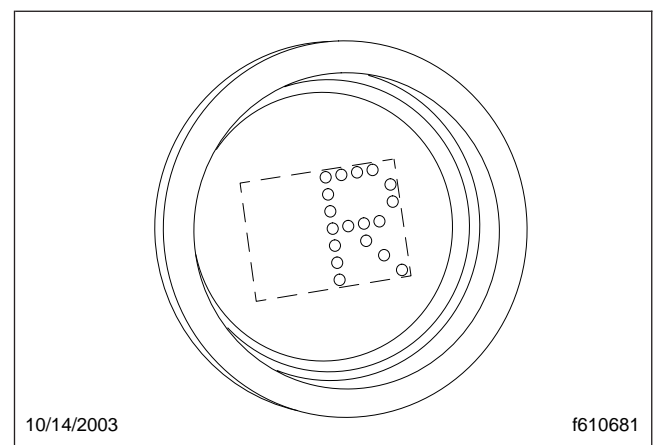


Fig. 8.17, Reverse Gear Display

Drivetrain

Ten-speed UltraShift DM has two reverse gears, reverse low and reverse high. To shift manually between them, use the shift lever as described for MAN mode. There is no AUTO mode for reverse.

When reverse low is selected, the letter "R" displays on the current gear indicator. When reverse high is selected, the letter "H" displays on the current gear indicator.

IMPORTANT: Under normal conditions, do not select reverse with the vehicle moving forward.

The vehicle must be moving at less than two miles per hour (3 km/h) before selecting reverse. If reverse is selected when the vehicle is moving faster, an audible alert will sound and continue sounding at three-second intervals until the control lever is returned to the D position. When the vehicle is moving at the proper speed, reverse can be engaged.

On ten-speed UltraShift DM only, if necessary to rock the vehicle, use the selector switch to shift back and forth at low speed between reverse and drive.

Neutral

IMPORTANT: Always start the engine with the transmission in neutral, the parking brake set, and the service brakes applied.

Neutral (N) is directly below R on the four-position selector switch located at the end of the SmartShift control lever. To select N, move the selector switch to the position below R. When neutral is selected, the letter "N" displays on the gear indicator. See [Fig. 8.18](#).

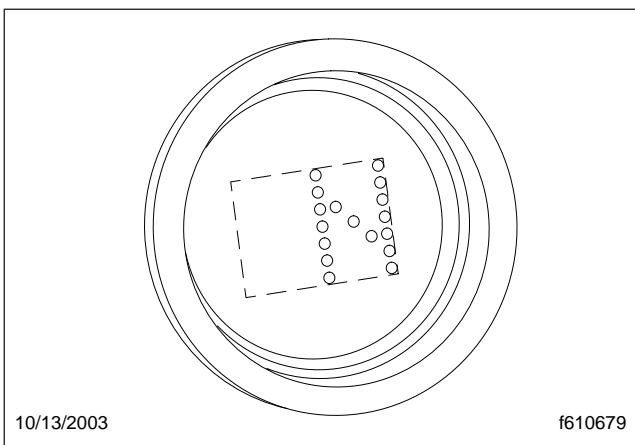


Fig. 8.18, Neutral Display

WARNING

Do not coast in neutral. Coasting in neutral can cause an accident, possibly resulting in severe personal injury or death.

Neutral is always available during operation, whatever the vehicle speed. When in neutral, requests to upshift or downshift are ignored. If the selector switch is moved from neutral to drive while the vehicle is moving, the transmission will shift into a gear within the engine's operating speed range.

When shifting from neutral, always press on the brake pedal. If the brake pedal is not pressed, the transmission will not shift, the current gear display will flash "N," and an audible alert will sound.

NOTE: To reset the transmission, return the selector switch on the SmartShift lever to N and attempt the shift again, this time with the brake pedal pressed.

Before shutting down the engine, return the selector switch to "N." When the ignition is turned off, the transmission will reset to neutral in a few minutes regardless of the position of the shift lever.

Drive

Drive (D) is directly below N on the four-position selector switch located at the end of the SmartShift control lever. To select D, press in the neutral lock button and move the selector switch to the position below N. When drive is selected, the number of the currently selected forward gear (1 through 6 on six-speed UltraShift ASW; 1 through 10 on ten-speed UltraShift DM) displays on the gear indicator. See [Fig. 8.16](#).

When in drive, requests to upshift or downshift are enabled. Either manual or automatic mode can be selected on the slide switch.

Two starting gears are available, first and second. The default starting gear is second, but first can be selected by the driver, if desired. To change the starting gear, press the brake pedal and select D with the vehicle stopped. The current gear indicator will display the starting gear. Move the shift lever up or down until the desired starting gear is displayed.

The UltraShift TCU adapts to the working conditions of each vehicle and its driver. After power-up or a load change, it needs to learn the new conditions.

While learning, it may hold a gear too long before upshifting. Start the upshift manually. It may take three or four shifts before UltraShift succeeds in learning the new load-based shift points, but after that it will handle the shifting automatically.

Low

Low (L) is located at the lower end of the four-position selector switch located at the end of the SmartShift control lever. To select L, press in the neutral lock button and move the selector switch to the position below D.

When in low, the current gear is maintained. Requests to upshift are not enabled.

IMPORTANT: If the engine is approaching overspeed, the UltraShift TCU will override the current gear setting and upshift to prevent engine damage.

To enhance engine braking, downshifts are performed at higher rpm than normal.

If L is selected from neutral while stopped, the vehicle starts up in first gear and stays there until the engine approaches overspeed.

Upshifting

To request an upshift with the transmission in drive, pull the control lever up (towards you). If the gear is available, the transmission upshifts and the new gear displays on the gear indicator. No skip shifts are available while upshifting.

No upshifts are available in low, except to prevent engine overspeed.

If the transmission does not upshift quickly enough after power-up or a load change, begin the shift manually. The UltraShift TCU will learn the new load-based shift conditions after three or four shifts.

If the gear requested is unavailable, a tone will sound. An unavailable request to upshift is not stored in memory. The upshift must be requested again.

Downshifting

NOTE: The driver can manually downshift at any time, even when the slide switch is set to AUTO mode.

To request a downshift with the transmission in drive or low, push the control lever down (away from you).

If the gear is available, the transmission downshifts and the new gear displays on the gear indicator. Skip shifts are available while downshifting.

For best engine braking, select low while moving. In low, downshifts are performed at higher rpm than in drive.

IMPORTANT: If the engine is approaching overspeed, the UltraShift TCU will override the current gear setting and upshift to prevent engine damage.

If the gear requested is unavailable, a tone will sound. An unavailable request to downshift is not stored in memory. The downshift must be requested again.

When coasting to a stop, the UltraShift TCU may not finish the downshift until the driver presses down on the throttle pedal again.

IMPORTANT: A downshift request can never result in a shift into neutral, even if the vehicle is in the drive position in the lowest possible gear.

Before starting down a hill, slow down. Downshift to a speed that you can control without hard pressure on the service brakes.

Before entering a curve, slow down to a safe speed. Downshift if necessary. This lets you use some power through the curve to help the vehicle be more stable on the turn. It also allows you to regain speed faster as you come out of the curve.

UltraShift Diagnostics

Clutch Calibration

NOTE: Clutch calibration only occurs on six-speed UltraShift ASW.

The UltraShift TCU automatically adjusts for clutch wear. The calibration takes place whenever the following conditions are met:

- The engine is at normal operating temperature
- The vehicle is stopped
- The engine is at idle speed
- The selector switch on the control lever is in neutral

Drivetrain

Calibration may take up to two minutes to complete. The engine may slow and return to normal idle several times during calibration.

To stop calibration at any time, select one of the drive positions on the selector switch (R, D, or L).

Clutch Protection Fault

Excessive clutch slippage creates heat and reduces the life of the clutch. These are some conditions which lead to clutch abuse:

- Using the throttle to hold the vehicle on a grade
- Starting the vehicle in too high a gear
- Overloading the vehicle
- Using high idle with the vehicle in gear

The UltraShift TCU is programmed to prevent clutch abuse. When the clutch overheats, the following alerts take place:

- The "TRANS TEMP" light comes on
- The gear indicator displays "CA"
- A warning tone sounds at one second intervals

The alerts continue until the clutch cools, the throttle is released, or the clutch is fully engaged.

System Problem

In the event of a problem, do the following steps:

1. Note the driving conditions at the time the problem occurred.
2. Record the status of the transmission at the time of the problem (AUTO or MAN mode, gear setting R, N, D, or L, current gear, engine speed, etc.)
3. Reset the system, using the procedure below.

Reset Procedure

Transmission operation can sometimes be restored by doing the following reset procedure:

1. Stop the vehicle when it is safe to do so.
2. Place the selector switch in neutral and turn off the ignition.
3. Check all harness connectors as described in [Chapter 11](#).

4. Wait at least two minutes with the engine shut down.
5. Restart the engine.

If the problem continues, contact an authorized Freightliner or Eaton service facility.

Locked In Gear

If the transmission becomes locked in gear, a dash (–) will appear on the gear indicator when the vehicle is restarted during the reset procedure.

NOTE: If the transmission becomes locked in gear while the vehicle is moving, increased braking effort may be required to stop the vehicle.

If the current gear indicator displays a dash during power-up with the selector switch in neutral, do the following steps:

1. Make sure the parking brake is set.
2. Turn off the ignition and wait at least two minutes.
3. Apply the service brakes.
4. With the service brakes applied, release the parking brake.
5. Make sure the selector switch is in neutral and turn on the ignition key. Do not attempt to start the engine at this time.
6. If necessary to get the transmission to shift into neutral, release the pressure on the brake pedal slightly.
7. Once the UltraShift TCU reaches neutral, a solid "N" will appear on the current gear indicator and the vehicle will start. Make sure the service brakes are applied and the parking brake is set.

If the gear indicator continues to display a dash, contact an authorized Freightliner or Eaton service facility.

Mercedes-Benz Manual Transmissions

⚠ CAUTION

Operating a manual transmission with the fluid level higher or lower than recommended can result in transmission damage.

Mercedes-Benz transmissions use a simple 6-speed gear pattern as shown in Fig. 8.19.

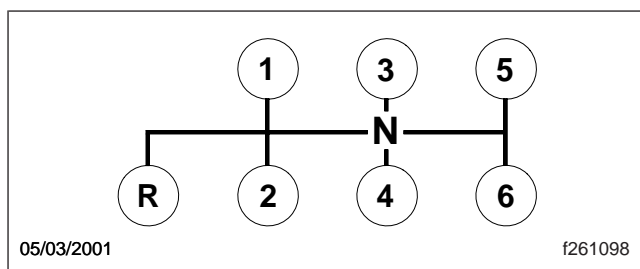


Fig. 8.19, Shift Pattern, M-B Transmissions

Always use first gear when starting to move the vehicle forward.

IMPORTANT: Do not rest your foot on the clutch pedal while driving. This causes partial clutch disengagement which could cause premature clutch wear.

While traveling, check the tachometer regularly to be sure the engine speed is within the most economical range (1400 to 2000 rpm).

On level roads, drive in the highest usable gear, keeping engine speed down.

⚠ CAUTION

Do not rest your hand on the gear shift lever while driving. This can cause synchronizer damage.

When approaching an uphill grade, shift down ahead of time to prevent loss of engine rpm. When approaching a downhill grade, shift down ahead of time to prevent runaway speed. For information about shift points and "progressive shifting," see [Chapter 7](#).

Change gears only when absolutely necessary. Skip gears if needed.

When shifting, always press the clutch pedal all the way down. Do not force the gear lever.

Before shifting into reverse, be sure the engine is idling and the vehicle is not moving.

⚠ CAUTION

If the transmission locks up while driving, making further shifting impossible, continue driving in the gear already selected to reach service assistance, as circumstances allow. Or, safely park the vehicle off the roadway and contact your nearest Freightliner dealer or other qualified service provider for roadside assistance. To prevent further transmission damage, do not move the vehicle from a standing start unless this can be accomplished safely, taking into account the gear that is engaged and the load on the vehicle.

Mercedes-Benz Automated Transmissions

General Information, AGS

The AGS Automated Gear Shift is a fully automated 6-speed medium-duty transmission. The clutch is activated by a hydraulic system that is integral to the transmission. No clutch pedal is needed to operate the vehicle.

AGS transmissions use the SmartShift control lever on the steering column to select gears. A manual shift is possible at any time by moving the SmartShift lever up or down as needed.

The transmission control unit (TCU) can direct all forward shifts in response to driving conditions and the driver's pressure on the brake and throttle pedals. To know which gear the transmission is in, look at the round current gear indicator on the right-hand control panel as shown in [Fig. 8.12](#).

The TCU always selects first gear to start the vehicle in motion. It is possible, in manual mode, to start an unloaded or lightly loaded vehicle in second gear. In most cases, second gear is acceptable for downhill starts. In other situations, for best results always start moving in first gear. Loaded vehicles, or vehicles on substantial grades, must start moving only in first gear.



CAUTION

At the first sign of a transmission malfunction, take the vehicle out of service immediately. Depending on the type of problem, further shifting may not be possible, and driveline torque may be interrupted.

Operation, AGS

Power Up

1. With the parking brake set and/or the brake pedal pressed down, select neutral (N) by moving the selector switch to the center position.
2. With the transmission in neutral, turn on the ignition switch. The "CHECK TRANS" and "TRANS TEMP" telltale lights come on and go out again (bulb check). See [Fig. 8.13](#).
3. On power up, the current gear indicator shows the dot display, arranged in a square pattern. All dots in the pattern should light up, without gaps or spaces. See [Fig. 8.14](#).
4. When the current gear indicator shows "N," start the engine.

NOTE: No matter what the circumstances, do not start the engine unless the current gear indicator shows "N." See [Chapter 13](#) for jump starting information.

5. Select drive (D) by pressing in the neutral lock button and moving the selector switch downward to the position below neutral. Release the parking brake and/or service brake pedal. The gear is displayed on the current gear indicator.

NOTE: When D is selected, the transmission starts up in first gear. To start up in second gear (downhill start, vehicle unloaded or lightly loaded), pull up on the SmartShift lever when the current gear indicator displays "1."

6. On a level grade, press down on the throttle pedal to allow the vehicle to move forward. The vehicle will not move until the pedal is depressed.



WARNING

When starting or stopping on hills and grades, use extra care to prevent the vehicle from rolling back. A rollback accident could cause death, serious personal injury, or property damage.

7. Prevent the vehicle from rolling backwards when stopped on a hill or grade, or when the vehicle is starting from a stop on a hill or grade.

7.1 *To start from a full stop on a hill or grade, quickly move your foot from the brake pedal and press firmly on the throttle pedal.*

On steep hills, set the parking brake and release it only when there is enough engine power to prevent rollback.

7.2 *To stop on a hill or grade, press and hold the brake pedal to keep the vehicle from moving.*

On steep hills, set the parking brake. Never hold a hill with the throttle pedal. This will cause the clutch to overheat.

Power Down

1. Bring the vehicle to a complete stop.
2. Set the parking brake.
3. Move the selector switch to N. Wait until "N" appears on the current gear indicator.



WARNING

Always apply the parking brake before shutting down the engine. AGS will shift into neutral after shutdown, regardless of the position of the shift lever. If you do not set the parking brake, the vehicle could roll and cause an accident resulting in death, serious personal injury, or property damage.

4. Turn the ignition switch off and shut down the engine.
5. If the current gear indicator flashes "PB" when the engine is shut down, set the parking brake and move the selector switch to "N."

Automatic and Manual Modes

The SmartShift control has a slide switch located on the body of the lever just before the paddle widens out. See **Fig. 8.20**. The slide switch controls the forward driving mode, automatic or manual.

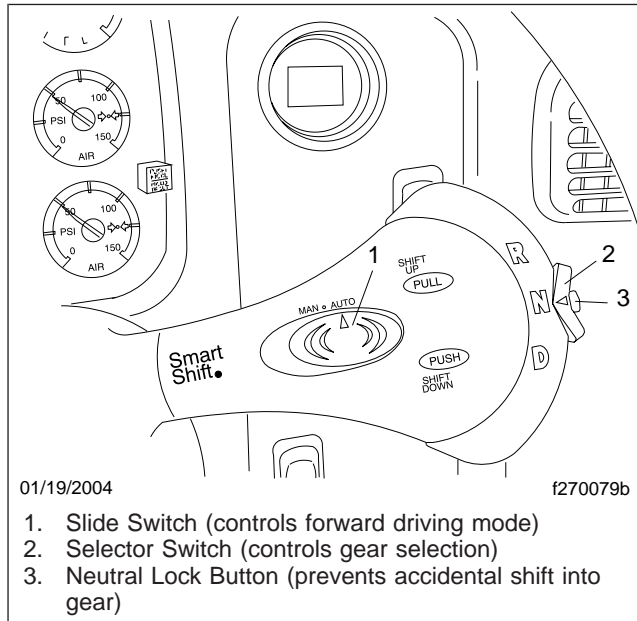


Fig. 8.20, Switches, AGS Transmissions

To change mode at any time, move the slide switch in the desired direction. This allows the driver to respond to a wide range of driving conditions, such as blind corners, tight curves, and steep hills.

IMPORTANT: Whatever the mode, it is always possible to shift manually by moving the lever up or down as needed.

In either mode, the gear indicator displays the current gear. See **Fig. 8.16**.

Automatic Mode (AUTO)

Automatic drive mode (AUTO) is recommended for most driving conditions. For the best fuel economy, always use AUTO mode.

In AUTO mode, upshifts and downshifts are made by the transmission without driver intervention. Press in the neutral lock button, move the selector switch to drive (D), and press down on the throttle pedal. The transmission will shift automatically through the forward gears.

If driving conditions require, it is still possible to request a manual shift. The transmission will make the shift unless the selected gear would cause engine overspeed.

If the driver presses down on the throttle pedal after a manual downshift in automatic mode, the transmission will upshift again if the TCU requires it.

On downgrades, the transmission holds the current gear until the driver requests a shift, or presses the throttle pedal.

WARNING

While driving off-road or with locked differential in AUTO mode, use extra caution. Shifts of the AGS could interrupt power to the drive wheels, causing a rollback accident while climbing steep grades at low speeds. A rollback accident could cause death, serious personal injury, or property damage.

Manual Mode (MAN)

Manual mode may be required under certain conditions, such as:

- In difficult or slippery conditions
- On hills, steep grades, or other situations where driveline torque interruption is not desirable
- During off-road driving or driving with a locked differential
- In downhill driving where control of engine braking is needed
- If necessary to hold a specific gear on a downgrade

In manual drive mode (MAN), upshifts and downshifts are made by the driver:

- To shift up, pull the lever up (towards you).
- To shift down, push the lever down (away from you).

The system will hold the current gear until the driver requests a shift. In downhill situations in particular, the driver must be alert to vehicle speed and maintain vehicle control by downshifting and/or using the service brakes as needed.

Drivetrain

When braking or slowing in MAN, downshift as necessary to prevent lugging the engine when speed is resumed. If the vehicle comes to a complete stop, the TCU resets the transmission to neutral.

NOTE: A downshift request will be refused if the selected gear would cause engine overspeed.

Cruise Control

Cruise control is fully functional with AGS transmission in either AUTO or MAN mode.

In AUTO, the TCU will adjust the gear selections to maintain the speed settings as desired. No driver action is necessary.

In MAN, the vehicle speed settings must be within the engine speed range for the gear selected. If the engine cannot maintain set speed due to changes in road grade, the driver must downshift or upshift as necessary.

For vehicles equipped with a power take-off (PTO) unit, two modes of operation are possible, stationary and mobile. For PTO operation, see [Chapter 7](#).

Selecting Gears

Reverse

Reverse (R) is at the upper end of the three-position selector switch located at the end of the SmartShift control lever. To select reverse (R), press in the neutral lock button and move the selector switch upward to the position above neutral. When reverse is selected, the letter "R" displays on the gear indicator. See [Fig. 8.17](#).

IMPORTANT: The vehicle must come to a complete stop before selecting reverse. If reverse is selected with the vehicle moving forward, an audible alert will sound and continue sounding at three-second intervals until the selector switch is returned to N or D.

Once the vehicle has come to a complete stop, reverse can be engaged.

Neutral

Neutral (N) is in the center of the three-position selector switch located at the end of the SmartShift control lever. Always start the engine in neutral. To select neutral, move the selector switch to the center position. When neutral is selected, the letter "N" displays on the gear indicator. See [Fig. 8.18](#).

WARNING

Do not coast in neutral. Coasting in neutral can cause an accident, possibly resulting in severe personal injury or death.

Neutral is always available during operation, whatever the vehicle speed. When in neutral, requests to upshift or downshift are ignored. If the selector switch is moved from neutral to drive while the vehicle is moving, the transmission will shift into a gear within the operating torque range of the engine.

WARNING

Always apply the parking brake before shutting down the engine. AGS will shift into neutral after shutdown, regardless of the position of the shift lever. If you do not set the parking brake, the vehicle could roll and cause an accident resulting in death, serious personal injury, or property damage.

Before shutting down the engine, return the selector switch to "N." When the ignition is turned off, the transmission will reset to neutral during power down.

Drive

IMPORTANT: The vehicle must come to a complete stop before selecting drive. If drive is selected with the vehicle moving in reverse, an audible alert will sound and continue sounding at three-second intervals until the selector switch is returned to N or R.

Drive (D) is at the lower end of the three-position selector switch located at the end of the SmartShift control lever. To select drive, press in the neutral lock button and move the selector switch to the position below neutral. When drive is selected, the number of the currently selected forward gear (1, 2, 3, 4, 5, or 6) displays on the gear indicator.

Upshifting

NOTE: The driver can manually upshift at any time, even when the slide switch is set to AUTO mode.

To request an upshift with the transmission in drive, pull the control lever up (towards you). If the gear is

available, the transmission upshifts and the new gear displays on the gear indicator.

As in a manual transmission, upshifting too early causes engine lugging and uneven operation.

To achieve smooth operation in MAN mode, upshift when the engine speed reaches approximately 2000 revolutions per minute (rpm). Heavy loads or steep grades require higher rpm; lighter loads require lower rpm.

An unavailable request to upshift is not stored in memory. The upshift must be requested again.

Downshifting

NOTE: The driver can manually downshift at any time, even when the slide switch is set to AUTO mode.

To request a downshift with the transmission in drive, push the control lever down (away from you). If the gear is available, the transmission downshifts and the new gear displays on the gear indicator.

Downshifts are not available if the engine speed after the shift would exceed 2700 rpm. If the gear requested is unavailable, an audible alert will sound. An unavailable request to downshift is not stored in memory. The downshift must be requested again.

To achieve smooth operation in MAN mode, downshift when the engine speed reaches approximately 1200 rpm.

Before starting down a hill, slow down. Downshift to a speed that you can control without hard pressure on the service brakes.

Before entering a curve, slow down to a safe speed. Downshift if necessary. This lets you use some power through the curve to help the vehicle be more stable when turning. It also allows you to regain speed faster as you come out of the curve.

AGS Diagnostics



CAUTION

At the first sign of a transmission malfunction, take the vehicle out of service immediately. Depending on the type of problem, further shifting may not be possible, and driveline torque may be interrupted.

System Malfunction

If the "CHECK TRANS" telltale light comes on while driving, the audible alert sounds, and the current gear indicator begins to flash between the current gear and "SM" (system malfunction), there is a problem which may or may not be apparent to the driver. Bring the vehicle at once to a safe stopping place and call an authorized Freightliner service facility for assistance.

Clutch Overload

If the "TRANS TEMP" telltale light comes on while driving and the current gear indicator begins to flash between the current gear and "CO" (clutch overload), the clutch has begun to overheat.

The clutch overload may have been caused by improper driving practices such as frequent and rapid start/stop driving, or hillholding with the throttle pedal. In this case, allow the clutch to cool, and continue on, but cease the improper driving practices.

If the clutch overload message returns or continues, the clutch is worn or damaged. Bring the vehicle at once to a safe stopping place and call an authorized Freightliner service facility for assistance.

Low Hydraulic Fluid Level

IMPORTANT: The only hydraulic fluid permitted in this system is Pentosin CHF 11S. No other fluid can be substituted.

If the "CHECK TRANS" telltale light comes on while driving and the current gear indicator begins to flash between the current gear and "FL" (fluid level), there has been an unusual loss of hydraulic fluid. Bring the vehicle at once to a safe stopping place and call an authorized Freightliner service facility for assistance. The hydraulic reservoir holds about 1.05 quarts (one liter) of Pentosin CHF 11S.

NOTE: After hydraulic fluid loss, a special procedure is required to fill the hydraulic reservoir. This procedure must be carried out by an authorized Freightliner service facility.

Meritor™ Drive Axles

Refer to the Meritor website for additional information, www.arvinmeritor.com.

Drive Axles With Differential Lock

The Meritor driver-controlled differential lock feature (side-to-side wheel lock, traction control, or traction equalizer) is available on single-drive or dual-drive rear axles. It is available on both axles of a dual-drive vehicle, or on one only. It is only available on drive axles. Differential lock must only be used under adverse road conditions where greater traction is needed. With differential lock on, the turning radius is increased and vehicle handling is affected. The differential lock switch (**Fig. 8.21**) allows the driver to lock the wheels on the same axle together. The red differential lock warning light illuminates on the dash message center when differential lock is engaged.

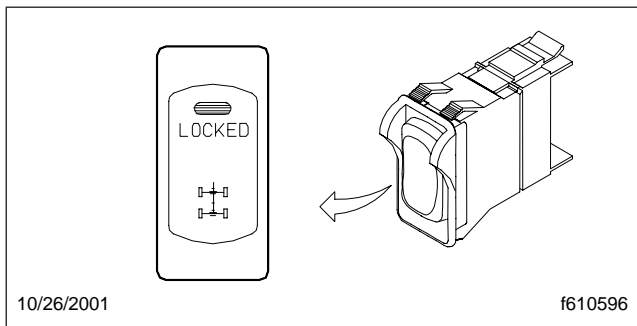


Fig. 8.21, Differential Lock Switch

Differential lock provides maximum traction under slippery conditions. When the differential lock is engaged, the clutch collar completely locks the differential case, gearing, and axle shafts together, maximizing the traction of both wheels and protecting against spinout.

Under normal traction conditions, do not use the differential lock feature.

Differential Lock Switch



Differential lock should only be engaged when the vehicle is stopped or moving slowly at low throttle. This will prevent internal axle damage.

Normally, when differential lock is available on dual-drive vehicles, one switch activates the lock on both rear drive axles. As an option, it is possible to have two differential lock switches, one for the forward rear and one for the rearmost drive axle. It is also pos-

sible for some vehicles to have differential lock on only one of the drive axles.

A two-position guarded rocker switch (**Fig. 8.21**) controls differential lock, causing the wheels on each axle governed by the switch to rotate together. To lock the wheels together, press the upper half of the rocker momentarily (at the red LED). To unlock the wheels, press the upper half of the rocker again.

IMPORTANT: The differential lock rocker switch is guarded to prevent unintentional switch activation. If the LED in the switch begins to blink during normal operation, when the switch has not been activated, this indicates an error condition. Bring the vehicle to an authorized Freightliner service facility as soon as possible.

When the differential lock switch is pressed, three responses are possible: a normal response, a slow response, and an abnormal response.

Normal Response: The LED in the switch blinks until the axle has responded to the request to lock the wheels. At this point, the LED comes on steady and stays illuminated. In normal operation, the wheels may lock so quickly that the blinking of the switch is barely noticeable.

If operation of the switch is not possible for any reason (ignition is turned off, vehicle is moving faster than 25 mph, etc.), the LED will stop blinking and turn off.

Slow Response: If operation of the switch is slowed for any reason (vehicle moving too fast, low air pressure, etc.), the switch will continue to blink until the wheels are able to lock. As in the normal response, the LED comes on steady and stays illuminated once the wheels have locked.

NOTE: If the vehicle is moving too fast, let up slightly on the accelerator. As the vehicle slows, the wheels will lock.

Abnormal Response: If the LED blinks for more than 30 seconds, the lock mechanism may not be fully engaged/disengaged. Bring the vehicle to an authorized Freightliner service facility for testing.

Differential Lock Operation

WARNING

Locking the wheels when the vehicle is traveling down steep grades or when the wheels are slipping could damage the differential and/or lead to loss of vehicle control, causing personal injury and property damage.

Lock the wheels only when the vehicle is standing still or moving at very low speed, less than 5 mph (8 km/h). Never lock the wheels when the vehicle is traveling down steep grades or when the wheels are slipping.

NOTE: On some vehicles, the differential lock system is connected through the low speed range of the transmission. If this system is used, the transmission must be in the low speed range for the wheels to fully lock.

WARNING

A vehicle with locked wheels can still slip sideways, causing possible loss of vehicle control, personal injury, and property damage.

Be especially careful when driving under slippery conditions with the wheels locked. Though forward traction is improved, the vehicle can still slip sideways.

If the vehicle is moving, maintain a constant vehicle speed when the differential lock is turned on. Briefly let up on the accelerator to relieve torque on the gearing, allowing the wheels to lock completely. When the wheels are fully locked, the turning radius will increase because the vehicle understeers. See **Fig. 8.22**. Drive cautiously and do not exceed 25 mph (40 km/h).

To disengage differential lock after leaving poor road conditions, operate the differential lock switch as discussed above while maintaining vehicle speed. Let up momentarily on the accelerator to allow the wheels to fully unlock, then resume driving at normal speed.

NOTE: If the differential lock system is connected with the transmission in its low speed range, shifting out of the low speed range will also disengage the differential lock function. The

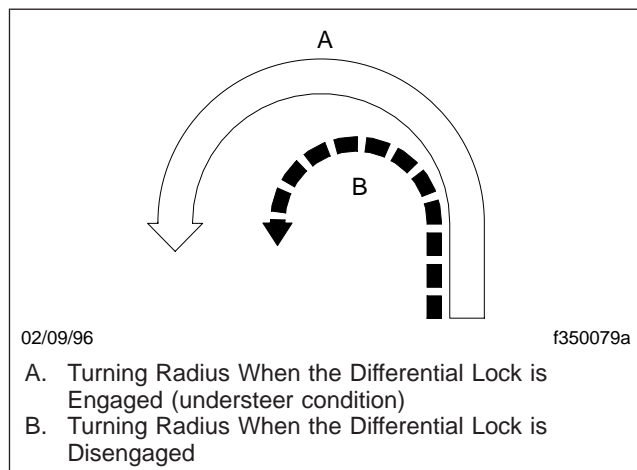


Fig. 8.22, Turning Radii

switch will blink until the wheels unlock, and then go out.

Tandem Drive Axles With Interaxle Lock

CAUTION

The interaxle lock should not be engaged on a vehicle with obviously spinning wheels. Engagement at high speed or power can damage the axle(s).

Meritor has an interaxle lock (axle lock, interaxle differential lockout) feature that is standard on all dual-drive (tandem-drive) vehicles. Interaxle lock is recommended for use under adverse road conditions where greater traction is needed. See the axle manufacturer's manual provided with the vehicle for more information.

The interaxle lock switch (**Fig. 8.23**) allows the driver to lock both rear axles together. The red interaxle warning light illuminates on the dash message center when interaxle lock is engaged.

When the interaxle lock is not engaged, there is differential action between the two axles. The differential compensates for different wheel speeds and variations in tire size. Keep the interaxle lock disengaged when driving on roads where traction is good.

When the interaxle lock is engaged, the differential action between the two axles is locked. Both drive axles now share the power. Both axles, and both

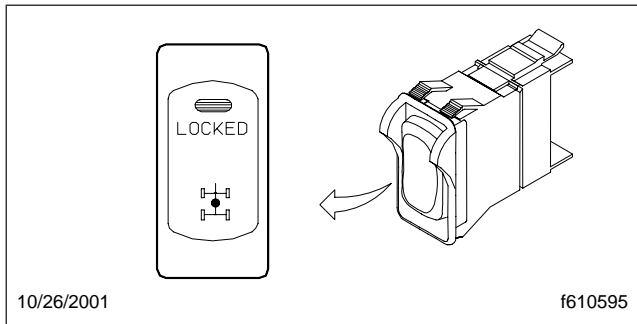


Fig. 8.23, Interaxle Lock Switch

sets of wheels, turn together at the same speed. The interaxle lock should be used when the vehicle encounters poor traction conditions; however, it also increases drivetrain and tire wear and should be used only when improved traction is required.

Interaxle Lock Switch

A two-position guarded rocker switch (**Fig. 8.23**) controls interaxle lock, causing both axle shafts to rotate together. To lock the axles together, press the upper half of the rocker momentarily (at the red LED). To turn off interaxle lock, press the lower half of the rocker (at the double-axle icon).

IMPORTANT: The interaxle lock rocker switch is guarded to prevent unintentional switch activation. This switch does not have a diagnostic blink function when inactive.

When the interaxle lock switch is pressed, three responses are possible: a normal response, a slow response, and an abnormal response.

Normal Response: The LED in the switch blinks until the interaxle lock is engaged. At this point, the LED comes on steady and stays illuminated. In normal operation, the interaxle may lock so quickly that the blinking of the switch is barely noticeable.

If operation of the switch is not possible for any reason (ignition is turned off, vehicle is moving too fast, etc.), the LED will stop blinking and turn off.

Slow Response: If operation of the switch is slowed for any reason (by cold weather, low air pressure, etc.), the switch will continue to blink until the axles lock together, or for a maximum of 10 seconds. As in the normal response, the LED comes on steady and stays illuminated.

Abnormal Response: If the LED blinks for more than 30 seconds, the lock mechanism may not be fully engaged/disengaged. Bring the vehicle to an authorized Freightliner service facility for testing.

Interaxle Lock Operation

To engage interaxle lock and achieve maximum pulling power in slippery or hazardous road conditions, operate the interaxle lock switch as discussed above, while maintaining vehicle speed. Let up momentarily on the accelerator until the axle lock engages. Proceed over poor road conditions with caution. Do not wait until traction is lost and the tires are spinning before engaging the interaxle lock.

CAUTION

Do not turn on the interaxle lock switch when the tires are slipping. Do not continuously operate the vehicle with the interaxle lock engaged during good road conditions. To do so could result in damage to the axle gearing and excessive tire wear.

To disengage the interaxle lock after leaving poor road conditions, operate the interaxle lock switch as discussed above while maintaining vehicle speed. Let up momentarily on the accelerator to allow the axles to fully unlock, then resume driving at normal speed.

Axle Shift

CAUTION

To prevent transmission and axle damage, make sure the automatic transmission is in high range when performing an axle shift with the vehicle moving.

Axle shift is a function installed on vehicles with two-speed axles to allow the use of the low speed range when greater traction and maximum pulling power is needed at low engine speed (rpm).

Under normal operating conditions, the vehicle is operated using the high-speed gear ratios of the axle. Under extreme weather or off-road conditions, at low speed and rpm and/or to pull heavy loads, the vehicle must be operated using the low-speed, or reduction, gear ratios of the axle.

Axle Shift Switch

The axle shift switch is a two-position guarded rocker switch (Fig. 8.24) installed on vehicles with two-speed axles.

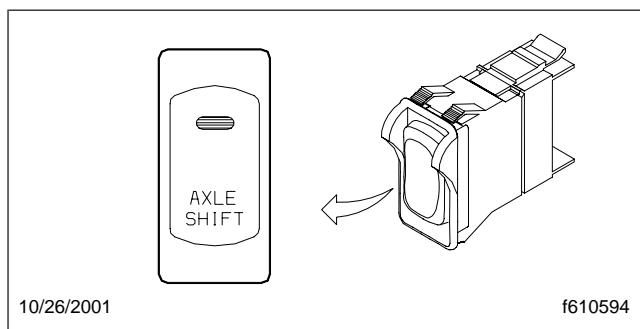


Fig. 8.24, Axle Shift Switch

To shift the axle from low speed to high speed, press the upper half of the rocker momentarily (at the LED). To turn the axle shift off (switch from high speed back to low speed), press the upper half of the rocker again. When the axle has shifted speed, the LED turns off.

When the panel lights are on, the AXLE SHIFT legend is backlit in green.

IMPORTANT: The axle shift rocker switch is guarded to prevent unintentional switch activation. If the LED in the switch begins to blink during normal operation, when the switch has not been activated, this indicates an error condition. Bring the vehicle to an authorized Freightliner service facility as soon as possible.

When the axle shift switch is pressed, three responses are possible: a normal response, a slow response, and an abnormal response.

Normal Response: The LED in the switch blinks until the axle shifts speed. At this point, the LED comes on steady and stays illuminated. In normal operation, the axle may shift so quickly that the blinking of the switch is barely noticeable.

If operation of the switch is not possible for any reason (interaxle lock is on, ignition is turned off, etc.), the LED will stop blinking and turn off.

Slow Response: If operation of the switch is slowed for any reason (by cold weather, low air pressure, etc.), the switch will continue to blink until the axle

shifts. As in the normal response, the LED comes on steady and stays illuminated.

Abnormal Response: If the LED blinks for more than 30 seconds, the axle shift function/mechanism may not be operating correctly. Bring the vehicle to an authorized Freightliner service facility for testing.

Axle Switch Interlock

NOTE: On vehicles with tandem drive axles, there is an interlock that prevents an axle from shifting speed whenever the interaxle lock is on.

If the axle shift switch is pressed when the interaxle lock is on, the axle shift will not be completed. The LED does the following:

- If the LED is off, the LED comes on briefly and turns off again.
- If the LED is on, it stays on.

To complete the axle shift, turn off the interaxle lock and press the axle shift switch again. If still needed, the interaxle lock can then be reactivated.

9

Steering and Brake Systems

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Steering and Brake Systems

Steering System

The power steering system includes the power steering gear, hydraulic hoses, power steering pump, reservoir, steering wheel and column, and other components. Some models are also equipped with a separate hydraulic power cylinder on the right side of the front axle, or a right-hand slave gear.

The power steering pump, driven by the engine, provides the power assist for the steering system. If the engine is not running, there is no power assist.

If the power-assist feature does not work due to hydraulic fluid loss, steering pump damage, or another cause, bring the vehicle to a safe stop. Do not drive the vehicle until the cause of the problem has been corrected.

WARNING

Driving the vehicle without the power-assist feature of the steering system requires much greater effort, especially in sharp turns or at low speeds, which could result in an accident and possible injury.

NOTICE

Never steam clean or high-pressure wash the steering gear. Internal damage to gear seals, and ultimately the steering gear, can result.

Drivers should carefully use the power available with a power steering system. If the front tires become lodged in a deep hole or rut, drive the vehicle out instead of using the steering system to lift the tires out of the hole.

NOTICE

Avoid turning the tires when they are against a curb, as this places a heavy load on steering components and could damage them.

Steering Wheel Adjustment

Two steering wheels are available: a standard 18-inch (450-mm) steering wheel and an optional 20-inch (500-mm) steering wheel.

When there is no load on the vehicle and the front tires are pointed straight ahead, the standard steer-

ing wheel spokes should be at the 3 o'clock and 9 o'clock positions or within 10 degrees of these positions. See **Fig. 9.1**.

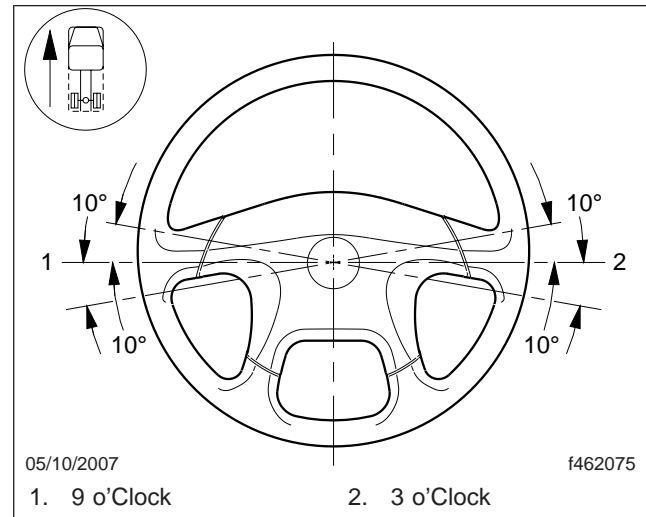


Fig. 9.1, Steering Wheel Centered

On the optional 20-inch (500-mm) wheel, the steering wheel spokes should be at the 4 o'clock and 8 o'clock positions or within 10 degrees of these positions. For steering wheel adjustment procedures, see **Group 46** of the *Business Class® M2 Workshop Manual*.

Air Brake System

A dual air brake system consists of two independent air systems that use a single set of brake controls. Each system has its own reservoirs, plumbing, and brake chambers. The primary system operates the service brakes on the rear axle; the secondary system operates the service brakes on the front axle. Service brake signals from both systems are sent to the trailer.

WARNING

Do not operate the vehicle with the front brakes backed off or disconnected. Backing off or disconnecting the front brakes will not improve vehicle handling and may lead to loss of vehicle control, resulting in property damage or personal injury.

Air Brake System, General Information

The warning light and buzzer come on if air pressure drops below 64 to 76 psi (441 to 524 kPa) in either system. If this happens, check the dual system air pressure gauge to determine which system has low air pressure. Although the vehicle's speed can be reduced using the brake pedal, either the front or rear service brakes will not be operating at full capacity, causing a longer stopping distance. Bring the vehicle to a safe stop and have the air system repaired before continuing.

IMPORTANT: In the event of a total loss of service brakes with full system air pressure, use the parking brake control valve (yellow knob) to bring the vehicle to a complete stop in the safest location possible.

Before a vehicle with insufficient system air pressure can be moved, the spring parking brakes must be released by applying an external air source at the gladhands, or by manually caging the parking brake springs.

WARNING

Do not release the spring parking brakes and then drive the vehicle. There would be no means of stopping the vehicle, which could result in serious personal injury or vehicle damage. Before releasing the spring parking brakes, make the connection to a towing vehicle or chock the tires.

After correcting the brake system problem, uncage the spring parking brakes before resuming normal vehicle operation.

Primary Air Brake System

Loss of air pressure in the primary air system causes the rear service brakes to become inoperative. The secondary air system will continue to operate the front brakes and the trailer brakes (if equipped).

Secondary Air System

Loss of air pressure in the secondary air system causes the front axle brakes to become inoperative. The primary air system will continue to operate the rear service brakes and the trailer brakes (if equipped).

Air Brake System Operation

Before driving your vehicle, allow time for the air compressor to build up a minimum of 100 psi (689 kPa) pressure in both the primary and secondary systems. Monitor the air pressure system by observing the dual system air pressure gauge and the low-air-pressure warning light and buzzer. The warning light and buzzer shut off when air pressure in both systems reaches 64 to 76 psi (441 to 524 kPa).

IMPORTANT: Before driving the vehicle, secure all loose items in the cab so that they will not fly forward during a full brake application. Make sure all passengers are wearing seat belts.

During normal brake stops, depress the brake pedal until braking action slows down the vehicle. Increase or decrease the pressure on the pedal so that the vehicle comes to a smooth, safe stop. Apply the parking brake if the vehicle is to be parked.

IMPORTANT: An air brake proportioning system may be used in tractor air brake systems when the vehicle is not equipped with antilock braking system (ABS). When operating in bobtail mode, the rear brake chambers (on which the axle load has been greatly reduced) receive reduced (proportional) air pressure, while the front axle brake chambers receive full (normal) air pressure. This results in a different brake pedal "feel," as the pedal seems to require more travel and/or effort to slow or stop the vehicle. However, the air brake proportioning system actually improves vehicle control when the tractor is in bobtail mode. When the tractor is towing a trailer, the rear brake chambers will receive full (normal) application air pressure.

When parking a vehicle attached to a trailer that does not have spring parking brakes, apply the tractor parking brake. Chock the trailer tires before disconnecting the vehicle from the trailer.

WARNING

If a trailer or combination vehicle is not equipped with spring parking brakes, do not park it by pulling out only the trailer air supply valve knob. This would apply only the trailer service brakes. If air were to bleed from the trailer brake system,

Steering and Brake Systems

the trailer brakes would release, possibly causing an unattended runaway vehicle.

NOTICE

Never apply the service and spring parking brakes simultaneously. To do so transmits excessive input force to the brake components, which could damage or cause eventual failure of brake actuating components.

Brake Controls

The trailer brake lever (hand control valve) is used for applying the trailer brakes without applying the truck or tractor service brakes. It is usually mounted on the right-hand control panel. See [Fig. 9.2](#). The valve can be partially or fully applied, but in any partially applied position, it will be overridden by a full application of the brake pedal. Moving the lever down applies the trailer brakes, while moving it up releases the trailer brakes. The lever will automatically return to the up position when it is released.

WARNING

Do not use the trailer service brakes for parking; they are not designed for this purpose. If air bleeds out of the trailer air tank during parking, the vehicle could roll, causing serious personal injury or property damage.

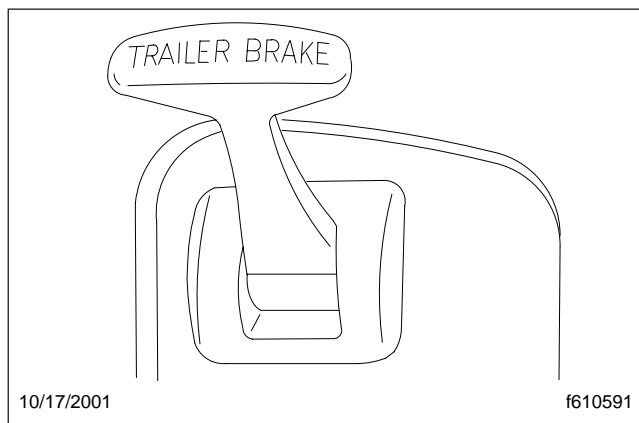


Fig. 9.2, Trailer Brake Lever

The red octagonal-shaped knob in the control panel actuates the trailer air supply valve. See [Fig. 9.3](#). After the vehicle's air hoses are connected to a trailer and the pressure in both air systems is at least

65 psi (448 kPa), the trailer air supply valve must be pushed in. It should stay in to charge the trailer air supply system and to release the trailer spring parking brakes.

Pull the trailer air supply valve out before disconnecting a trailer or when operating a vehicle without a trailer. If pressure in both air systems drops to 35 to 45 psi (242 to 310 kPa), the trailer air supply valve automatically pops out, exhausting the trailer air supply, and applying the trailer service or spring parking brakes.

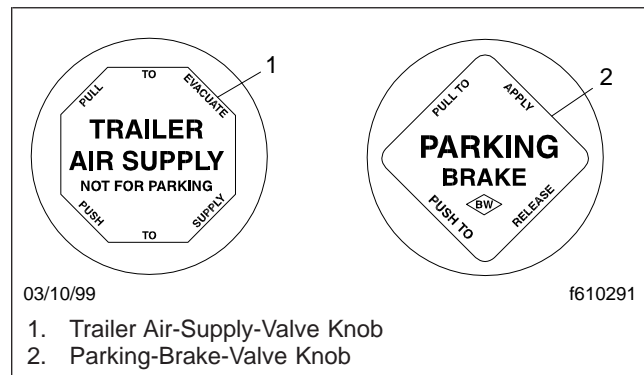


Fig. 9.3, Brake Valve Knobs

The yellow diamond-shaped knob in the control panel actuates the parking brake valve. See [Fig. 9.3](#). Pulling out the parking brake valve applies both the tractor and trailer parking brakes and automatically causes the trailer air supply valve to pop out.

NOTICE

Do not use the spring parking brakes if the service brakes are hot, such as after descending a steep grade. To do so could damage the brakes. Allow hot brakes to cool before using the spring parking brakes.

Do not use the spring parking brakes during freezing temperatures if the service brakes are wet. To do so could cause them to freeze. If the brakes are wet, drive the vehicle in low gear and lightly apply the brakes to heat and dry them.

If the trailer is not equipped with spring parking brakes, pulling out the parking brake valve applies the tractor parking brake and the trailer service brakes. When the tractor and trailer parking brakes (or trailer service brakes) are both applied, the trailer

brakes are released by pushing in the trailer air supply valve, leaving the tractor parking brake applied. Air pressure in the primary or secondary reservoir must be at least 65 psi (448 kPa) before the tractor spring parking brakes, or the trailer service or spring parking brakes, can be released.

Automatic Slack Adjusters

Automatic slack adjusters should never be manually adjusted except during routine maintenance of the foundation brakes (e.g., replacing shoes), during slack adjuster installation, or in an emergency situation.

When the brake pushrod stroke exceeds the legal brake adjustment limit on a vehicle, there is likely a mechanical problem with the foundation brake components or the adjuster is improperly installed.

Visit a repair facility as soon as possible when brakes equipped with automatic slack adjusters are determined to be out of adjustment.

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.

Hydraulic Brake System

Hydraulic Brake System, General Information

The hydraulic brake system includes a power booster, master cylinder, reservoir, hydraulic lines, a brake rotor on each wheel hub, and a brake caliper and pad assembly at each rotor.

The master cylinder controls braking power to the front and rear brakes. The Bendix Hydro-Max[®] power booster is attached to the rear of the master cylinder and is connected to the power steering system (which provides pressurized power steering fluid). An electrical backup pump operates if there is inadequate fluid flow from the power steering pump to the power booster.

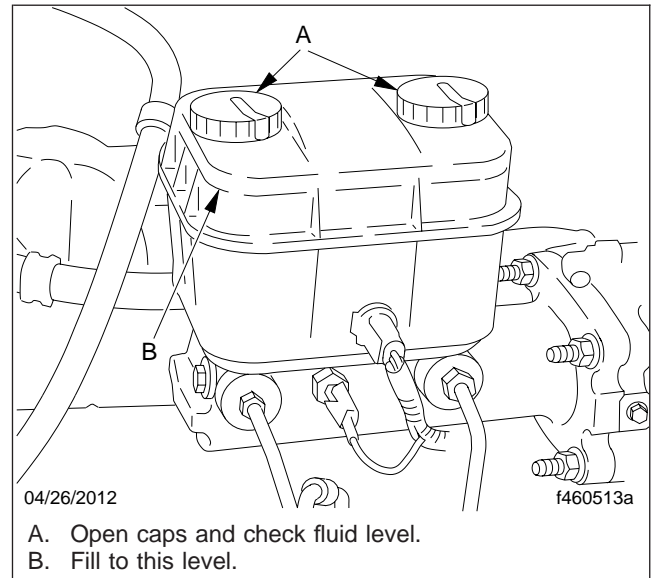


Fig. 9.4, Hydraulic Brake Reservoir

The brake system warning light illuminates if there is a problem within the system. Bring the vehicle to a safe stop and correct the problem before continuing operation of the vehicle. See **Group 42** of the *Business Class[®] M2 Workshop Manual* for hydraulic brake system troubleshooting and adjustment procedures.

Hydraulic Brake System Operation

IMPORTANT: Make sure that the fluid level in the master cylinder reservoir is up to the ridge that surrounds the reservoir. See **Fig. 9.4**. Use only heavy-duty brake fluid, DOT 3 or DOT 4, in the hydraulic brake system.

IMPORTANT: Before driving the vehicle, secure all loose items in the cab so that they will not fly forward during a full brake application. Make sure all passengers are wearing seat belts.

During normal brake stops, depress the brake pedal until braking action slows down the vehicle. Increase or decrease the pressure on the pedal so that the vehicle comes to a smooth, safe stop. Apply the parking brake if the vehicle is to be parked.

When parking a vehicle attached to a trailer, apply the tractor parking brake. Chock the trailer tires before disconnecting the vehicle from the trailer.

Steering and Brake Systems

Meritor WABCO® Antilock Braking System

The Meritor WABCO Antilock Braking System (ABS) is an electronic wheel speed monitoring and control system that works with the brake system. ABS passively monitors vehicle wheel speed at all times, and controls wheel speed during emergency stops or wheel lock situations.

NOTICE

An accumulation of road salt, dirt, or debris on the ABS tone wheels and sensors can cause the ABS warning light to come on. If the ABS light does come on, the tone rings and sensors should be inspected for corrosion and serviced if necessary. The service should include cleaning of the tone rings and sensors. If any tone ring on a vehicle shows severe corrosion, all tone rings on that vehicle should be replaced.

During winter months in areas where corrosive materials are used on the highways, periodically clean the underside of the vehicle, including the tone rings and sensors, to ensure proper ABS function and to protect the components from corrosion. Clean more frequently when unusually corrosive chemicals are being used.

IMPORTANT: For proper ABS system operation, do not change tire sizes. The sizes of the tires installed during production are programmed into the electronic control unit (ECU). Installing different-sized tires could result in a reduced braking force, leading to longer stopping distances.

The ABS includes signal-generating tone wheels and sensors located in the wheel hubs of each sensed wheel. The sensors transmit vehicle wheel speed information to an electronic control unit ECU located behind the center dash. The ECU's main circuit interprets the speed sensor signals and calculates wheel speed, wheel retardation, and a vehicle reference speed. If the calculations indicate wheel lockup, the main circuit signals the appropriate modulator valve to reduce braking pressure. During emergency braking, the modulator valve alternately reduces, increases, or maintains air pressure supply in the brake chamber to prevent front and rear wheel lockup.

The Meritor WABCO ABS combines one front-axle control channel with one rear-axle control channel to form one control circuit. For example, the sensor and modulator valve on the left-front axle form a control circuit with the sensor and modulator valve on the right-rear axle.

The ECU has a safety circuit that constantly monitors the wheel sensors, traction control valve (if equipped), modulator valves, and the electrical circuitry. If the safety circuit senses a failure in any part of the ABS, the tractor warning lamp (TRACTOR ABS) illuminates and the control circuit where the failure occurred is switched to normal braking action. The remaining control circuit will retain the ABS effect. Even if the ABS is completely inoperative, normal braking ability is maintained.

The ABS indicator lamp illuminates after the ignition is switched on and will go out within three seconds if the system is functioning correctly. If the ABS indicator lamp does not illuminate, or does not go out after three seconds, have the vehicle serviced before operation.

During emergency or reduced-traction stops, fully depress the brake pedal until the vehicle comes to a safe stop. *Do not pump the brake pedal.* With the brake pedal fully depressed, the ABS will control all wheels to provide steering control and a reduced braking distance.

Although the ABS improves vehicle control during emergency braking situations, the driver still has the responsibility to change driving styles depending on existing traffic and road conditions. For example, the ABS cannot prevent an accident if the driver is speeding or following too closely.

Trailer ABS Compatibility

The Meritor WABCO ABS is designed to communicate with a trailer ABS, if they are compatible. Compatibility will result in the illumination of the TRAILER ABS lamp during vehicle start-up and fault detection.

The TRAILER ABS lamp will not illuminate unless a compatible trailer is connected to the tractor. The dash-mounted lamp will operate as follows when a compatible trailer is properly connected to the tractor:

- When the ignition key is turned to the ON position, the TRAILER ABS lamp will illuminate momentarily, then turn off.

- If the lamp illuminates momentarily during vehicle operation, then shuts off, a fault was detected and corrected.
- If the lamp illuminates and stays on during vehicle operation, there is a fault with the trailer ABS. Repair the trailer ABS system immediately to ensure full antilock braking capability.

IMPORTANT: If a compatible trailer is connected, and the lamp is not illuminating momentarily when the ignition key is turned to the ON position, it is possible that the lamp is burnt out.

Automatic Traction Control

Vehicles with electronic engines and ABS may have Automatic Traction Control (ATC). On these vehicles, the ATC system automatically limits wheel spin during reduced-traction situations. In normal braking applications, the standard air brake system is in effect.

An additional solenoid valve is installed. During reduced-traction situations, the ATC solenoid valve controls air pressure to the modulator valves and they in turn increase, hold, or reduce pressure to the appropriate brake chambers to provide better traction whenever wheel spin occurs.

When the ATC system is in the NORMAL mode, it will apply gentle braking to the spinning wheel, to feed power to the wheel(s) with better traction. If both wheels are spinning, the system will signal the engine to reduce power.

ATC includes a deep snow and mud option to increase available traction on extra soft surfaces like snow, mud, or gravel. A momentary contact rocker switch labeled ATC will be located on the dash. Pressing the switch will temporarily allow more wheel spin. The activation of the deep snow and mud option is indicated by a flashing WHEEL SPIN lamp. Pressing the switch again will cycle the system back to normal operation.

NOTICE

The deep snow and mud option is intended to be used under specific slippery conditions that require momentary increased wheel spin. Using this option for an extended period of time may damage the vehicle brake system.

After the ignition switch is turned on, the TRACTOR ABS lamp and the WHEEL SPIN indicator lamp illu-

minate for about three seconds. After three seconds, the warning lights go out if all of the tractor's ABS components are working.

IMPORTANT: If any of the ABS warning lights do not work as described above, or illuminate while driving, repair the ABS immediately to ensure full antilock braking capability.

Enhanced Stability Control



Enhanced Stability Control (ESC) is intended only as an aid for a conscientious and alert driver. Carefully read the information in this manual to understand this system and its limitations. ESC is not a substitute for safe driving procedures. Failure to drive safely, and use the system properly, could result in personal injury and/or death and property damage.

ESC automatically reduces engine power, applies the engine brake, and/or applies the tractor and trailer brakes when the acceleration sensor detects that the vehicle is at risk of rolling over. In addition, ESC offers the added capability of complete directional stability (yaw control) in oversteer and understeer conditions to reduce the likelihood of drift-out or jackknife. The system determines where the driver is attempting to steer the vehicle and how much brake demand is required in order to more precisely control the vehicle in an emergency situation.

ESC works by constantly comparing the driver's intention with the vehicle's actual behavior. The system does this by monitoring systems such as wheel speed, steering angle, yaw rate, lateral acceleration, throttle position, and brake application. A central microcomputer analyzes the collected data and triggers a response to keep the vehicle on course when an unstable condition is detected.

The roll stability control system automatically reduces engine power, applies the engine brake, and/or applies the tractor and trailer brakes when the acceleration sensor detects that the vehicle is at risk of rolling over. The control can intervene even before an advisory message is displayed.

When the system detects that the vehicle is at risk of oversteering or understeering, it applies individual tractor wheel end brakes and trailer brakes, activates

Steering and Brake Systems

the engine brake (if equipped), and/or cuts engine power, depending on the severity. As a result, the driver has full control over the vehicle until the system detects a potential risk and intervenes accordingly. ESC operates automatically; the driver does not monitor or activate the system.

10

Fifth Wheels and Trailer Couplings

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Fifth Wheel Uncoupling	10.4
Fifth Wheel Slide	10.7

Fifth Wheels and Trailer Couplings

Fifth Wheels, General Information

WARNING

Do not use any fifth wheel that fails to operate properly. Doing so may cause loss of vehicle control, possibly resulting in severe personal injury or death.

Air-Suspension Dump Valve

The air-suspension dump valve may be used to adjust the tractor height to aid with coupling to or uncoupling from a trailer. See [Fig. 10.1](#). When the switch is set to LOWER, the air-suspension dump valve deflates the air springs to lower the rear of the vehicle. In the AUTO position, the automatic ride-control valves operate for normal driving.

WARNING

Never exhaust air from the suspension while driving. The suspension will not absorb road shocks, possibly damaging components, and vehicle handling may be compromised. This could result in loss of vehicle control, possibly resulting in severe personal injury or death.

NOTICE

Do not operate the vehicle over uneven ground such as ramps, speed bumps, curbs, etc. with the air springs deflated. Doing this may lead to air bag separation from the piston, preventing the suspension air springs from inflating.

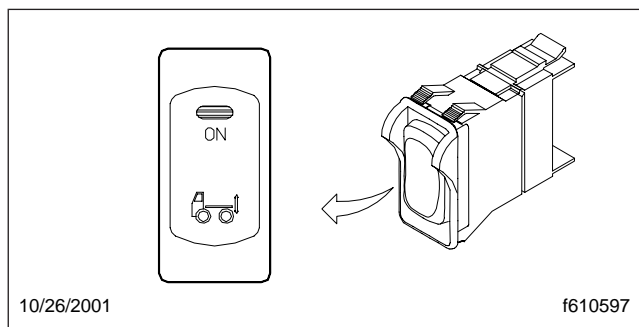


Fig. 10.1, Air-Suspension Dump Valve

Fifth Wheel Lubrication

WARNING

Keep the fifth wheel plate lubricated to prevent binding between the tractor and trailer. A binding fifth wheel could cause erratic steering and loss of vehicle control, possibly resulting in personal injury or death.

The standard fifth wheel plate must be kept well lubricated with chassis grease to prevent friction and binding between the tractor fifth wheel plate and the trailer.

For a low-lube fifth wheel plate, inspect the condition of the low-lube pads. There should be no damaged or missing pieces. Slight puckering at the outside edges is normal.

For lubrication instructions, see **Group 31** of the *Business Class M2 Maintenance Manual*.

Fifth Wheel Coupling

Fifth wheel coupling is activated with the lock control handle located on either the right side or left side of the fifth wheel. Coupling has successfully occurred when the kingpin has been forced into the jaws and the lock control handle has moved to the locked position.

NOTICE

Some fifth wheels may be mounted on sliding rails. Before attempting to couple a trailer to a sliding fifth wheel, the slide feature must be locked to prevent the top plate from sliding rapidly forward or rearward, causing damage to the fifth wheel or kingpin.

Fontaine and Holland Fifth Wheels Coupling

1. Chock the front and rear of the trailer tires to prevent the trailer from moving.
2. Ensure the fifth wheel jaw is fully open and the operating rod is in the unlocked position. See [Fig. 10.2](#) or [Fig. 10.3](#).
3. Make sure the fifth wheel top plate is tilted so the ramps are as low as possible.

Fifth Wheels and Trailer Couplings

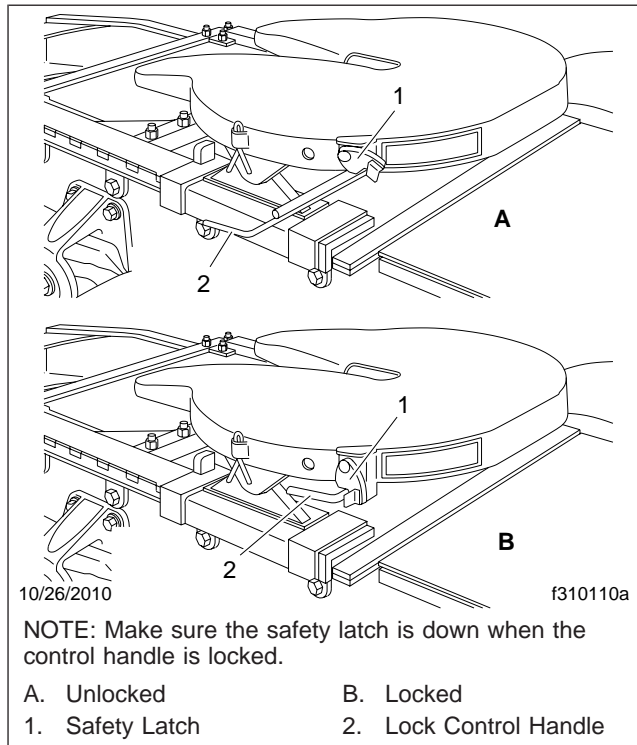


Fig. 10.2, Fontaine Locking Mechanism

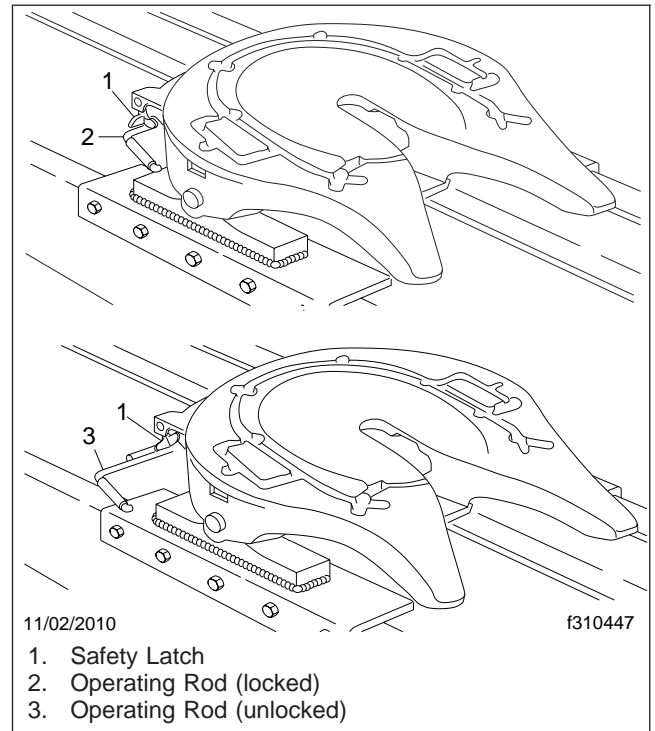


Fig. 10.3, Holland Simplex SE Locking Mechanism

- Position the tractor so that the center of the fifth wheel is in line with the trailer kingpin. The kingpin should be in a position to enter the throat of the locking mechanism.

NOTICE

Attempting to couple at the wrong height may cause improper coupling, which could result in damage to the fifth wheel or kingpin.

- Adjust the trailer height if required.
For a standard fifth wheel plate, the trailer should contact the fifth wheel approximately 4 to 8 inches (10 to 20 cm) behind the fifth wheel pivot. See **Fig. 10.4**.
For a low-lube fifth wheel plate, the fifth wheel must slide freely under the trailer, and the trailer should contact the fifth wheel at the pivot. See **Fig. 10.5**.
- With the fifth wheel lock opening aligned with the trailer kingpin, back the tractor slowly toward the trailer. After sliding under the trailer, STOP to

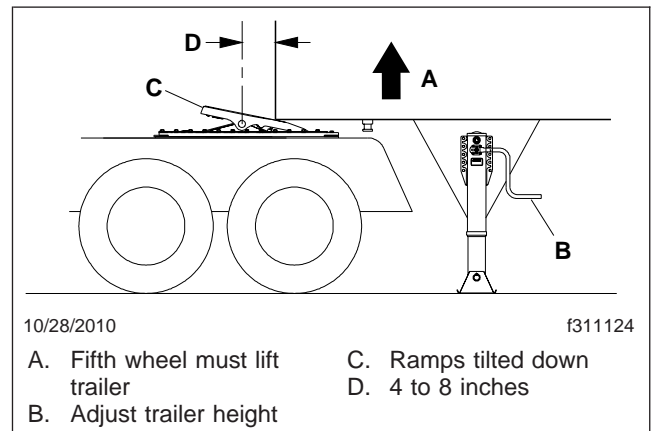


Fig. 10.4, Trailer Connection Point, Standard Fifth Wheel

prevent from hitting the kingpin too hard, then resume backing slowly until the fifth wheel locks.

On a standard fifth wheel, the fifth wheel must lift the trailer.

On a low-lube fifth wheel, do not lift the trailer as this may damage the fifth wheel plate.

Fifth Wheels and Trailer Couplings

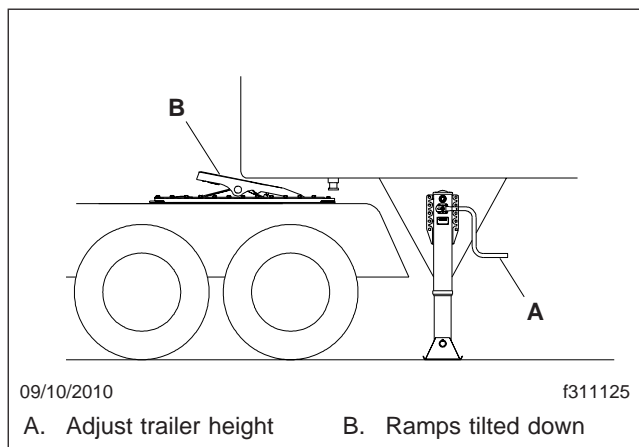


Fig. 10.5, Trailer Connection Point, Low-Lube Fifth Wheel

7. Apply the tractor parking brakes.

WARNING

A visual inspection is required by law. Some improper couplings can pass a pull test. Sound is not reliable. Get out of the cab and look. Incorrect coupling could cause the trailer to disconnect, possibly resulting in serious personal injury or death.

8. Perform a coupling inspection, checking that there is no gap between the bottom of the trailer and the fifth wheel, and that the kingpin is securely locked. See **Fig. 10.6**

When lockup has occurred, the fifth wheel control handle moves to the locked position. Make sure that the safety latch is down over the lock control handle to hold the control handle in the locked position. (The safety latch will only rotate down if the operating rod is fully retracted in the locked position.) See **Fig. 10.2** for Fontaine fifth wheels. See **Fig. 10.3** for Holland fifth wheels.

9. Release the tractor parking brakes. Test for kingpin lockup slowly inching the tractor forward, pulling on the trailer against the chocks.
10. After lockup is completed, connect the tractor-to-trailer air system lines and the electrical cable to the trailer. Take care to prevent dirt or foreign material from entering the air system lines.

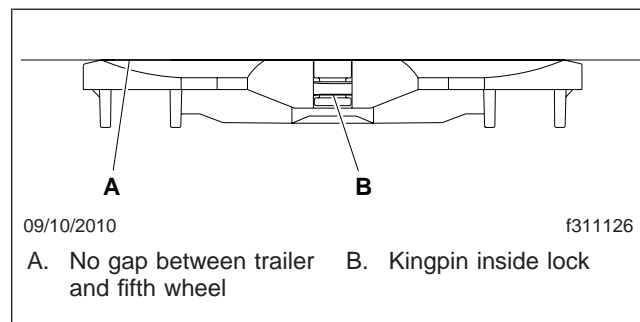


Fig. 10.6, Coupling Inspection

NOTICE

Always make sure the connection hanger keeps the trailer air hoses and electrical cables positioned so that they do not rub on anything. Rubbing may wear through hoses or cables, resulting in air leaks, or exposed or broken wires, potentially affecting trailer brake or electrical systems.

11. Charge the air brake system with air, checking that the air connections do not leak.

WARNING

Incorrect fifth wheel lock adjustment could cause the trailer to disconnect, possibly resulting in serious personal injury or death.

12. With the trailer wheels chocked and the brakes set, check for clearance between the kingpin and the fifth wheel jaws by moving the tractor forward and backward against the locked kingpin. If slack is present, uncouple the trailer and have the fifth wheel inspected and adjusted by a certified technician.

Jost Fifth Wheel Coupling

1. Tilt the ramp down.
2. Open the kingpin locks. See **Fig. 10.7**.
3. Back the vehicle close to the trailer, centering the kingpin on the fifth wheel.
4. Chock the trailer wheels.
5. Connect the air lines and electrical cable.
6. Ensure that the red trailer air supply valve (trailer brake) is pulled out, and that the trailer parking

Fifth Wheels and Trailer Couplings

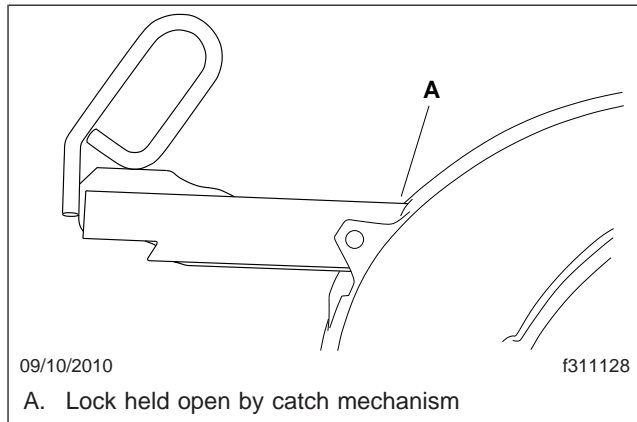


Fig. 10.7, Jost Release Handle Unlocked

brakes are set. See [Chapter 5](#) in this manual for operation of the dash-mounted brake controls.

NOTICE

Attempting to couple at the wrong height may cause improper coupling, which could result in damage to the fifth wheel or kingpin.

7. Adjust the trailer height (if required).

For a standard fifth wheel plate, the trailer should contact the fifth wheel approximately 4 to 8 inches (10 to 20 cm) behind the pivot. See [Fig. 10.4](#).

For a low-lube fifth wheel plate, the fifth wheel must slide freely under the trailer, and the trailer should contact the fifth wheel at the pivot. See [Fig. 10.5](#).

8. Back the tractor under the trailer.

On a standard fifth wheel, the fifth wheel must lift the trailer.

On a low-lube fifth wheel, do not lift the trailer as this may damage the fifth wheel plate.

9. After sliding under the trailer, STOP to prevent from hitting the kingpin too hard, then resume backing slowly until the fifth wheel locks.

WARNING

A visual inspection is required by law. Some improper couplings can pass a pull test. Sound is not reliable. Get out of the cab and look. Incorrect coupling could cause the trailer to discon-

nect, possibly resulting in serious personal injury or death.

10. Apply the tractor parking brake, then perform a physical check for positive kingpin lockup, and that there is no gap between the trailer and the fifth wheel. See [Fig. 10.6](#).
11. Ensure that the release handle is in the locked position adjacent to the casting. See [Fig. 10.8](#).
12. Release the tractor parking brakes and test for kingpin lockup by slowly moving the tractor forward, pulling on the trailer against the chocks.

Fifth Wheel Uncoupling

Manual Uncoupling

1. Apply the tractor and trailer parking brakes.
2. Chock the trailer rear wheels.
3. Lower the trailer landing gear until the weight is removed from the fifth wheel.
4. Disconnect the tractor-to-trailer air system lines and electrical cable. Plug the air lines to prevent dirt or foreign material from entering the lines.
5. Verify that both the yellow parking-brake and red trailer-air-supply knobs are out, the tractor and trailer parking brakes are set, and that the trailer is prepared for uncoupling.
6. Release the kingpin locking mechanism following the instructions for each manufacturer below.

6.1 **Fontaine:** Lift the safety latch and pull the lock control handle to the unlocked position.

6.2 **Holland:** In the locked position the safety indicator swings freely over the operating rod. See [Fig. 10.9](#), View A.

To unlock the mechanism, manually rotate the safety indicator toward the rear of the fifth wheel. See [Fig. 10.9](#), View B.

Pull the operating rod out. When the upper operating rod shoulder is outside the slot, raise the handle and place the shoulder of the upper rod against the plate casting, above the slot. See [Fig. 10.9](#), View C.

Fifth Wheels and Trailer Couplings

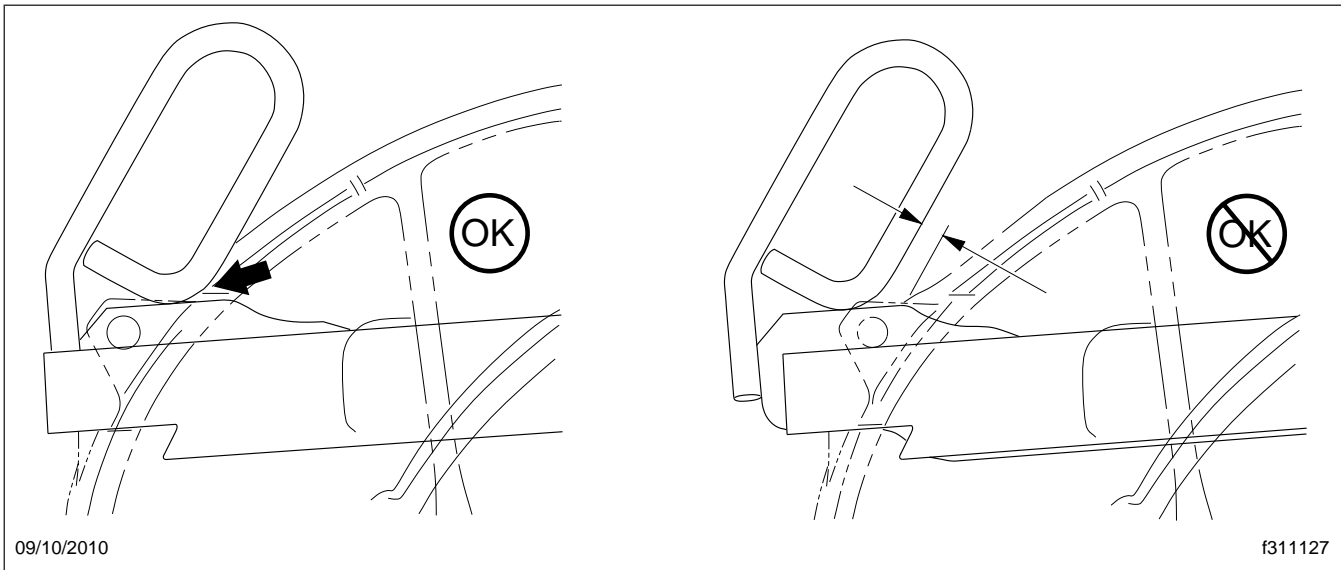


Fig. 10.8, Jost Release Handle Locked

The fifth wheel is now in the lockset position and is ready for uncoupling. As the tractor pulls away from the trailer the kingpin forces the jaw to rotate, contacting the lock. Continued rotation of the jaw forces the lock to move outward, and drops the upper rod back into the slot. See Fig. 10.9 View D. The wheel is now ready for coupling.

- 6.3 **Jost:** Pull the retractable handle out, then secure it in the open position with the catch.
7. Release the tractor parking brake then drive out slowly, allowing the trailer to slide down the fifth wheel and pick-up ramps.

Air-Actuated Uncoupling

An air-actuated kingpin release valve is optional with all fifth wheels. See Fig. 10.10.

NOTE: In the event of an air system failure, air-actuated kingpins can be manually released following the instructions for manual unlocking.

WARNING

Once the kingpin release valve has been pulled the kingpin lock is released. The vehicle **MUST NOT** be driven with the trailer until the trailer has

been uncoupled and coupled again. Failure to do so may result in separation of the trailer from the tractor, possibly causing serious personal injury or death.

Preparing the Trailer for Uncoupling

Before using the air valve to unlock a fifth wheel kingpin, prepare the trailer as follows.

1. Apply the tractor and trailer parking brakes.
2. Chock the trailer rear wheels.
3. Lower the trailer landing gear until the weight is removed from the fifth wheel.
4. Disconnect the tractor-to-trailer air lines and electrical cable. Plug the air lines to prevent dirt or foreign material from entering the lines.

Fontaine and Holland Fifth Wheels Air-Activated Kingpin Unlock

1. Verify that both the yellow parking-brake and red trailer-air supply knobs are out, the tractor and trailer parking brakes are set, and that the trailer is prepared for uncoupling.

NOTE: On Fontaine and Holland fifth wheels, if the tractor parking brake is not set, the air-actuated kingpin-release valve will not activate.

Fifth Wheels and Trailer Couplings

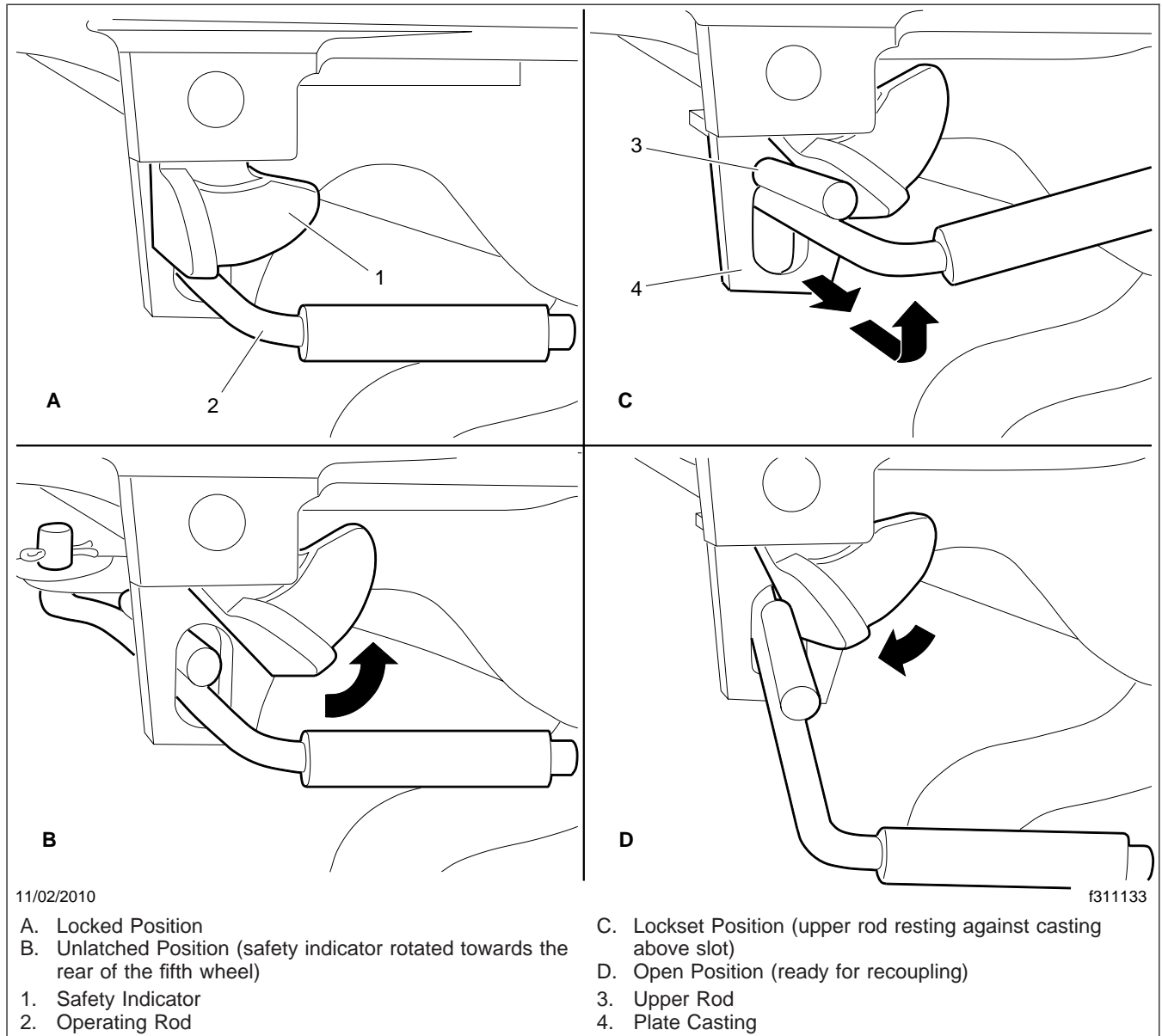


Fig. 10.9, Holland Kingpin Locking Mechanism

2. Pull and hold the kingpin release valve until the kingpin lock mechanism opens and locks in place. See Fig. 10.10.
3. Release the pull valve.
4. Release the tractor parking brake.
5. Drive out from under the trailer.

Jost Fifth Wheels Air-Activated Kingpin Unlock

1. Verify that both the yellow parking-brake and red trailer-air-supply knobs are out, the tractor and trailer parking brakes are set, and that the trailer is prepared for uncoupling.

Fifth Wheels and Trailer Couplings

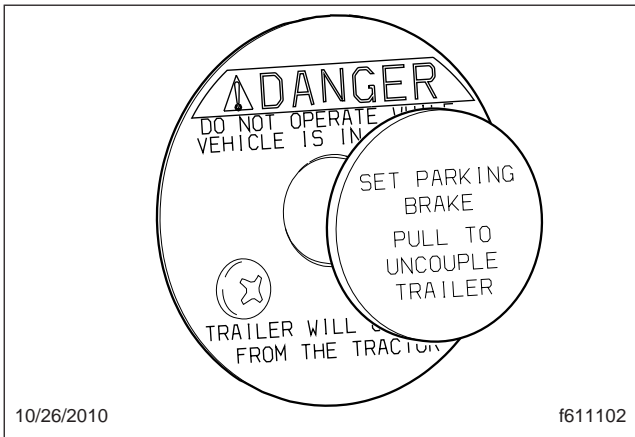


Fig. 10.10, Air-Actuated Kingpin Release Valve

NOTE: With Jost fifth wheels, if the trailer parking brake is not set the air-actuated valve will not activate.

2. Release the tractor parking brake.
3. Pull and hold the kingpin release valve, then drive forward slowly.
4. After the trailer has slid down the fifth wheel and pick-up ramps, release the pull valve.

Fifth Wheel Slide

WARNING

Adjust the fifth wheel slide correctly, and do not overload any tractor axle by incorrectly loading the trailer. Incorrect slide adjustment or improper axle loading could cause erratic steering and loss of vehicle control, possibly resulting in serious personal injury or death.

On sliding fifth wheel assemblies, the fifth-wheel plate is attached to rails that allow forward and rearward movement of the fifth wheel to optimally distribute the load across the axles. Slots are evenly spaced along the slide rails, and retractable wedges are positioned through the slots to hold the fifth wheel in the desired position.

The amount of load distribution on the front steering axle and rear drive axle(s) will have a direct effect on the steering control of the vehicle. Determine the front and rear axle weights by weighing the vehicle on scales designed for this purpose.

The maximum axle weight ratings are shown on the Federal Motor Vehicle Safety Standard (FMVSS) label or Canadian Motor Vehicle Safety Standard (CMVSS) label attached to the left rear door post of the tractor. The desired load on the axle is no less than 80 percent of the maximum axle weight rating, but in no instances should the axle load exceed the maximum axle weight rating given on the FMVSS or CMVSS label.

Manual Slide Operation

The manual slide feature is operated from the fifth wheel plate with a manual release handle using the following procedure. See Fig. 10.11.

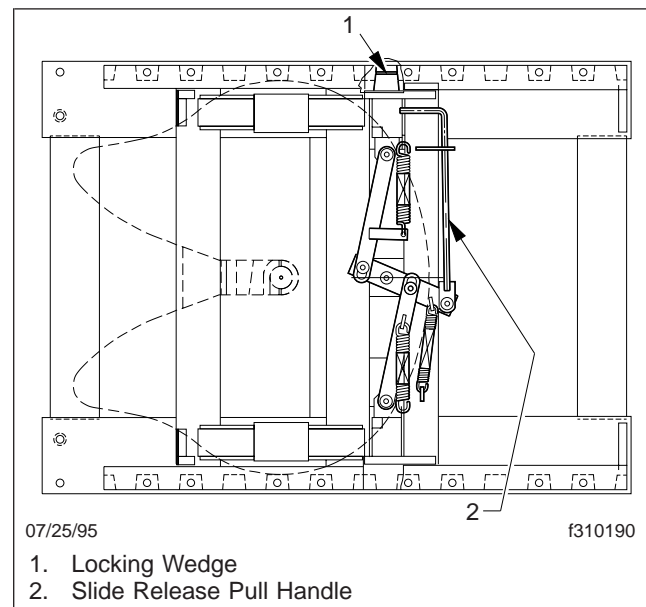


Fig. 10.11, Manual Release Sliding Fifth Wheel (Fontaine shown)

1. Stop the tractor and trailer in a straight line on level ground. Pull the red trailer air supply knob to apply the trailer parking brakes.
2. Apply the tractor parking brake, then release the sliding mechanism using the appropriate method for the fifth wheel manufacturer.
 - 2.1 **Fontaine:** Lift the slide release pull handle to disengage it from the guide plate. Then, pull out the handle until it is in the unlocked position and can be positioned against the guide plate to hold it out. The

Fifth Wheels and Trailer Couplings

handle will stay in the unlocked position until it is manually disengaged from the guide plate. See **Fig. 10.12**.

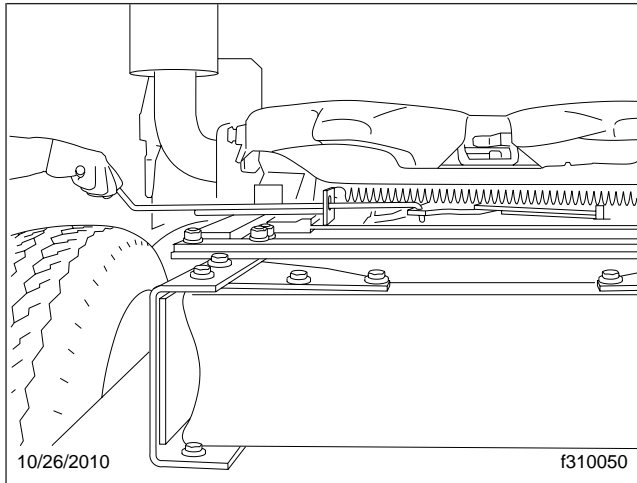


Fig. 10.12, Releasing the Sliding Fifth Wheel, (Fontaine)

- 2.2 **Holland:** Pull the operating rod out. Make sure both side plungers have released. See **Fig. 10.13**.

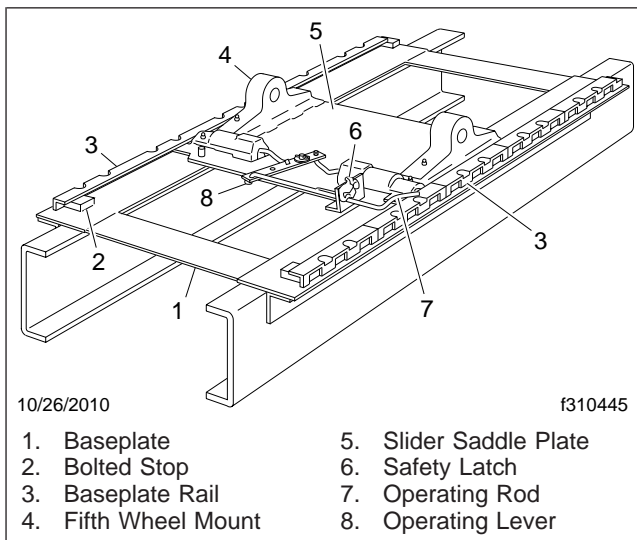


Fig. 10.13, Sliding Fifth Wheel Manual Release, (Holland Simplex)

3. Lower the trailer landing gear just enough to remove the weight from the tractor.
4. Chock the front and rear of the trailer tires to prevent the trailer from moving.

5. Release the tractor parking brakes, then slowly move the tractor forward or backward until the fifth wheel is in the desired location.

NOTICE

When moving the fifth wheel to the desired position, be sure the trailer landing gear will not at any time come in contact with the tractor frame or other components. Make sure that the front of the trailer will not come in contact with the rear of the cab or with other components if they extend beyond the rear of the cab.

WARNING

Check that the locking wedges have seated in the slots. Failure to achieve complete lockup may allow disengagement of the tractor from the trailer, possibly resulting in serious personal injury or death.

6. Apply the tractor parking brakes, then lock the sliding member in position using one of the following methods:
 - 6.1 **Fontaine:** Disengage the slide release pull handle from the guide plate. The slide release pull handle is spring-loaded in the locked position and will seek the locked position when disengaged from the guide plate. After the slide release pull handle returns to the fully locked position, visually and physically check the locking wedges to make sure they are fully inserted into the slots in the slide rails. Make sure the handle is locked in position against the guide plate.
 - 6.2 **Holland:** Raise the operating rod so that it is free to move inward. Make sure that the lock pins have seated in the base plate rail holes and the operating rod moves into the locked position.

NOTE: The fifth wheel may need to be moved slightly to enable the locking wedges to enter the fully locked position.

Fifth Wheels and Trailer Couplings

Air Slide Operation

The slide feature may be operated with an air switch mounted in the dash, that operates an air cylinder that locks and unlocks the slide. See [Fig. 10.14](#).

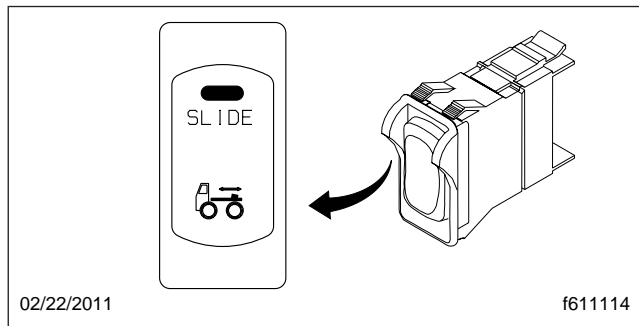


Fig. 10.14, Air-Slide Switch

1. Set the air-slide switch to UNLOCK. See [Fig. 10.14](#)
Ensure the locking plungers have released. See [Fig. 10.15](#).
For Jost fifth wheels, the mechanism activates as shown in [Fig. 10.16](#).
2. Lower the trailer landing gear just enough to remove the weight from the tractor.

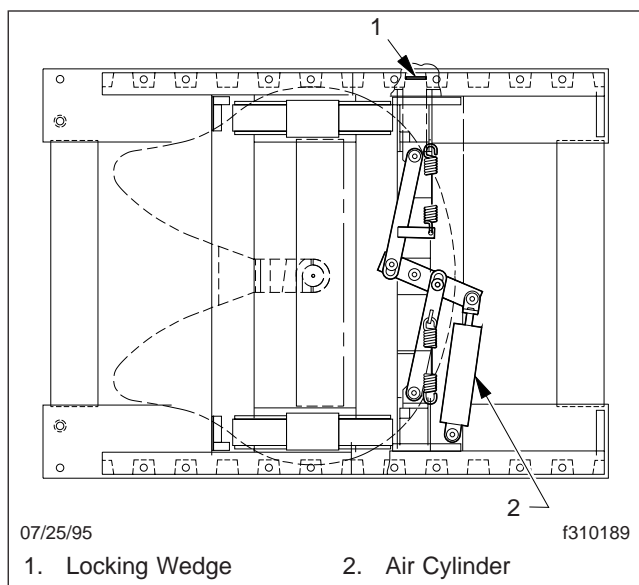


Fig. 10.15, Air-Operated Sliding Fifth Wheel (Fontaine shown)

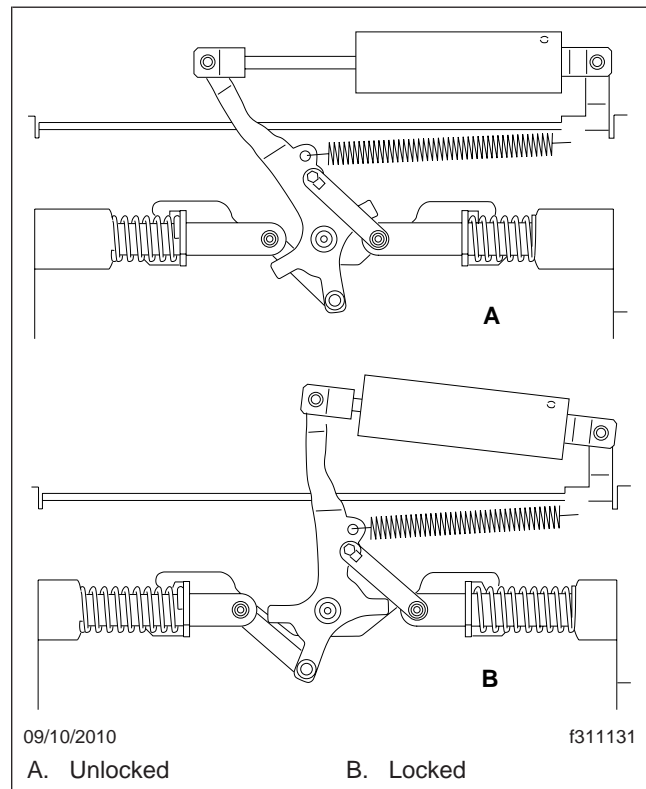


Fig. 10.16, Jost Sliding Fifth Wheel

3. Pull the red trailer-air-supply knob to set the trailer-parking brakes.
4. Slowly move the tractor forward or backward until the fifth wheel is in the desired location.

NOTICE

Ensure the trailer landing gear does not come in contact with the tractor frame or other components, and that the front of the trailer will not come in contact with the rear of the cab or other components if they extend beyond the rear of the cab.

5. Apply the tractor parking brakes.

WARNING

Check that the locking wedges have seated in the slots. Failure to achieve complete lockup may allow disengagement of the tractor from the

Fifth Wheels and Trailer Couplings

trailer, possibly resulting in serious personal injury or death.

6. Set the air-slide switch to LOCK. Visually inspect the locking wedges or plungers to make sure that they are fully inserted in the slide rail slots. Verify that the plungers have engaged by tugging the tractor forward while the trailer brakes are locked and the wheels are chocked.

NOTE: The fifth wheel may need to be moved slightly to enable the locking wedges to fully lock.

11

Pretrip and Post-Trip Inspections and Maintenance

Pre- and Post-Trip Inspection Checklists	11.1
Daily Pretrip Inspection and Maintenance	11.3
Weekly Post-Trip Inspection and Maintenance	11.11
Monthly Post-Trip Inspection and Maintenance	11.13

Pretrip and Post-Trip Inspections and Maintenance

Pre- and Post-Trip Inspection Checklists

Regulations in Canada and the U.S. clearly indicate that it is the driver's responsibility to perform an inspection, and ensure the complete road-worthiness of a vehicle, before placing it into service. Commercial vehicles may be subject to inspection by authorized inspectors, and an unsafe vehicle can be taken out of service until the driver or owner repairs it.

Use the following checklists to ensure that vehicle components are in good working condition before each trip. Careful inspections eliminate stops later to fix overlooked or forgotten items.

The checklists in this chapter can be copied and kept as a record that the procedures have been completed. For details on how to inspect each item on the checklists, see the corresponding procedure (step number) in this chapter.

NOTE: Checklists in this chapter correspond with the procedures and steps later in this chapter. Your vehicle may not be equipped with all components listed below.

Checklists

Daily Pretrip Inspection Checklists

See the following tables for a list of procedures that should be performed daily, before the first trip. Place a check mark in the complete (**Comp.**) column to indicate a procedure has been performed.

Inspector	Date

Suspension and Slack Adjusters		Comp.
1	Suspension components	
2	Slack adjusters	

Wheels and Tires		Comp.
1	Wheel covers	
2	Tire condition	
3	Tire inflation	
4	Rims and wheel components	
5	Wheel bearing oil seals and lubrication levels	
6	Mud Flaps	

Saddle Tank Areas		Comp.
1	Drain air reservoirs (without automatic drain valves)	
2	Fuel tank(s) secure	
3	Frame rails and crossmembers	
4	Visible exhaust components	

Engine Compartment		Comp.
1	Leakage under engine	
2	Air intake system	
3	Engine oil level	
4	Power steering reservoir level	
5	Engine coolant level	
6	Visible engine wiring	
7	Frame rails	

Cab		Comp.
1	Reset dash-mounted air intake restriction indicator	
2	Air-pressure warning system	
3	Air governor cut-in and cut-out pressures	
4	Air pressure build-up time	
5	Air system leakage	
6	Air pressure reserve	
8	Mirrors, windows, windshield	
9	Horn, windshield wipers, windshield washers	
10	Heater and defroster	
11	Interior lights	
12	Exterior lights	
13	Seat belts and tether belts	
14	Fuel level	
15	Mirror adjustment	
16	Service brakes	

Natural Gas Fuel System Inspection		Comp.
1	Fuel tanks	
2	Required decals	
3	Vent caps	
4	Plumbing components, fuel fill fitting, fuel lines	
5	Fuel gauge components, fuel level sender cable, LNG fuel tank pressure	
6	Coolant hoses	
7	LNG fuel tank pressure	
8	LNG vaporizer	

Pretrip and Post-Trip Inspections and Maintenance

Weekly Post-Trip Inspection Checklist

See the following table for procedures that should be performed weekly, post-trip. Place a check mark in the complete (**Comp.**) column to indicate a procedure has been performed.

Inspector	Date

Engine Compartment		Comp.
1	Windshield washer reservoir level	
2	Air intake restriction indicator	
3	Automatic transmission fluid level	
4	Water in fuel/water separator	
5	Steering components	
6	Serpentine drive belts	

Monthly Post-Trip Inspection Checklists

See the following tables for procedures that should be performed monthly, post-trip. Place a check mark in the complete (**Comp.**) column to indicate a procedure has been performed.

Inspector	Date

Brake Components		Comp.
1	Brake system components	
2	Brake chambers	
3	Air brake lines	
4	Flex air hoses	
5	Brake linings and brake drums	
6	Brake lining thickness	

Driver-Side Saddle Tank Area		Comp.
1	Drain air reservoirs (with automatic drain valves)	
2	Batteries	
3	Aerodynamic components	

Engine Compartment		Comp.
1	Hood and bumper	
2	Hydraulic clutch reservoir	
3	Radiator and heater hoses	
4	Steering wheel play	

Natural Gas Fuel System		Comp.
1	System leak test	
2	Drain CNG high-pressure fuel filter housing	

Fluids Added

Use the following table to note any fluids that were added during the inspection and maintenance procedures.

Fluids Added During Inspection	
Fluid	Amount Added
Wheel Bearing Oil Seal Lubricant	
Engine Oil	
Power Steering Fluid	
Engine Coolant	
Windshield Washer Fluid	
Automatic Transmission Fluid	
Hydraulic Clutch Fluid, DOT4	

Pretrip and Post-Trip Inspections and Maintenance

Daily Pretrip Inspection and Maintenance

Complete the following inspection and maintenance procedures to ensure that vehicle components are in good working condition before each trip. A driver who is familiar with the vehicle and drives it regularly can perform the daily inspections, then add the weekly and monthly post-trip inspections as scheduled.

If the driver does not operate the vehicle on a consistent basis, all daily, weekly, and monthly inspection and maintenance procedures should be performed before the trip.

IMPORTANT: The pre- and post-trip checklists, inspections, and maintenance procedures detailed in this chapter are **not all-inclusive**. Refer to other component and body manufacturers' instructions for specific inspection and maintenance instructions, as well as local, state, and federal guidelines.

NOTE: If any system or component does not pass this inspection, it must be corrected before operating the vehicle. Whenever equipment requires adjustment, replacement, and/or repair, see the *Business Class M2 Workshop Manual* for procedures and specifications.

Suspension and Slack Adjuster Inspection

Walk around the vehicle and visually inspect suspension and slack adjuster components.

1. Inspect the following suspension components for signs of structural damage, cracks, or wear.
 - springs
 - spring hangers
 - shocks
 - suspension arms
 - suspension brackets
 - axle seats
 - bushings
2. Inspect slack adjusters for signs of damage. See [Fig. 11.1](#), [Fig. 11.2](#), or [Fig. 11.3](#).

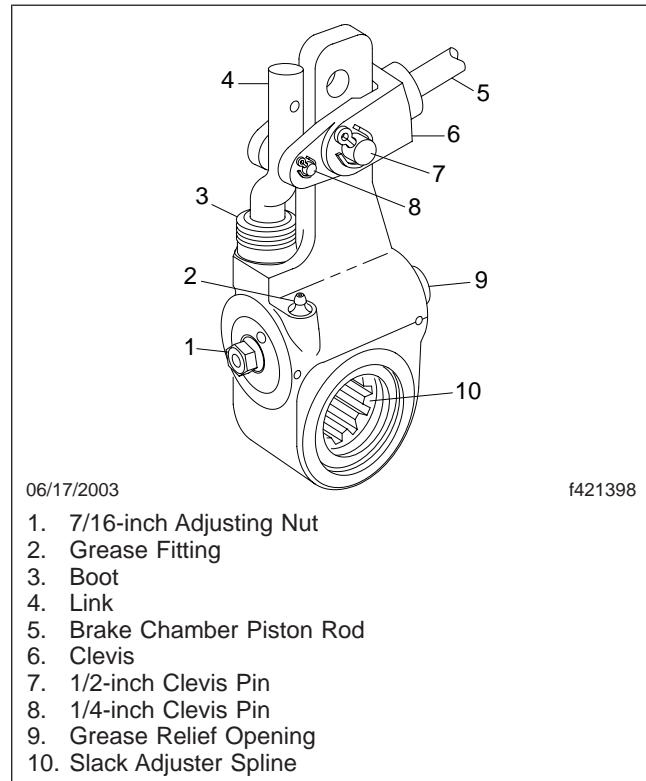


Fig. 11.1, Gunite Automatic Slack Adjuster

- Inspect slack adjuster boots, if equipped, for cuts or tears.
- Inspect anchor straps, if equipped, for damage.
- Look for worn clevis pins on brake chamber pushrods.
- Look for missing or damaged cotter pins on the clevis pins.
- Ensure chamber piston rods are in line with the slack adjusters.

Wheel and Tire Inspection

Walk around the vehicle and visually inspect each wheel and tire assembly.

IMPORTANT: Wheel covers decrease drag force as a vehicle moves, thereby improving fuel efficiency. If replacement of a wheel cover is necessary, the replacement cover must meet or exceed the drag reduction performance of the

Pretrip and Post-Trip Inspections and Maintenance

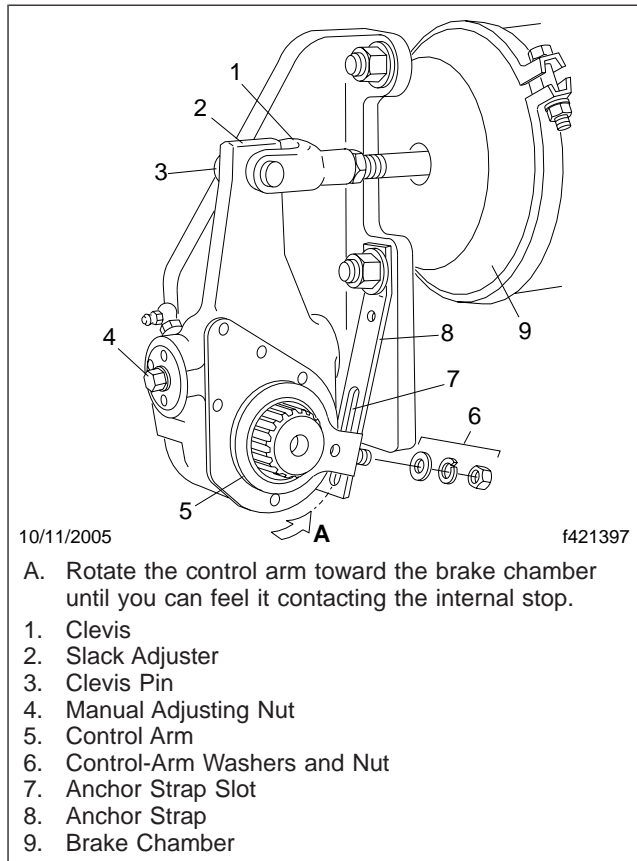


Fig. 11.2, Haldex Automatic Slack Adjuster

originally installed cover in order to maintain compliance with greenhouse gas and full efficiency regulations (GHG14).

1. If the vehicle was originally equipped with wheel covers, ensure all wheel covers are present. Inspect wheel covers for damage or wear. Remove wheel covers from rear drive wheels, if equipped, prior to inspecting the tires and wheel components.

NOTE: During wheel cover installation, ensure the V-notch in the liner inner retaining ring is centered on the valve stem. The inner and outer retaining rings should be uniformly aligned to each other and to the wheel rim. The outer retaining ring of the liner is equipped with two canvas flaps. When installing the face cover, make sure the cover retaining ring is inserted between the two canvas flaps on the liner outer

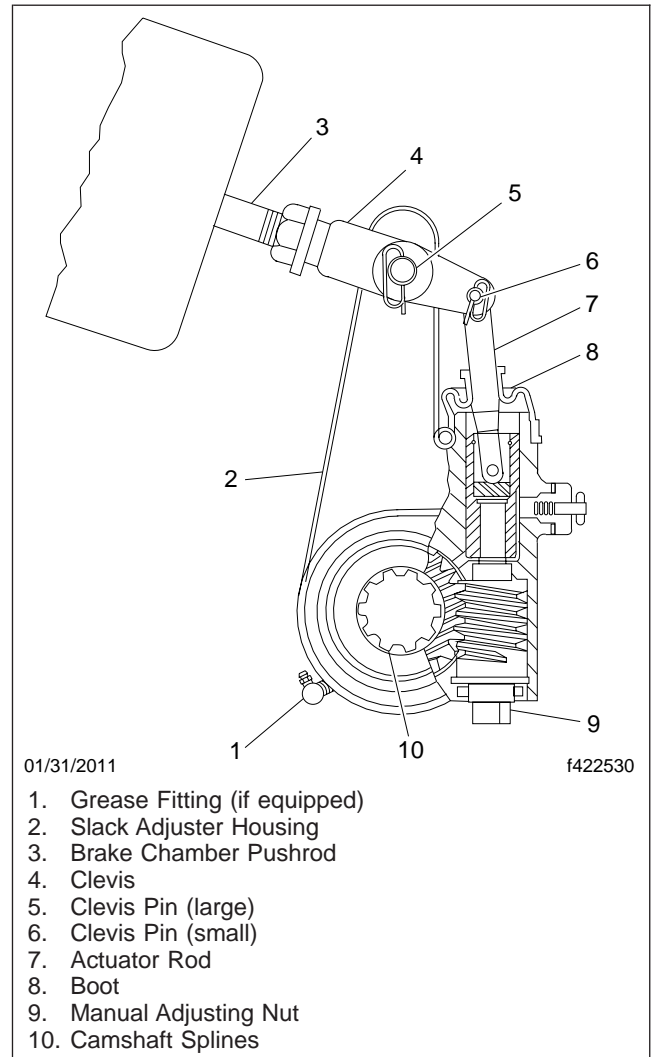


Fig. 11.3, Meritor Automatic Slack Adjuster

retaining ring so that the Velcro strips line up between the face cover and the liner. Make certain the detachable view cover is centered on the face cover, and the Velcro strips are pressed firmly in place.

2. Inspect each tire for the following:
 - valve stem caps on every tire, screwed on finger-tight
 - bulges, cracks, cuts, and penetrations
 - oil contamination (petroleum derivatives will soften the rubber and destroy the tire)

Pretrip and Post-Trip Inspections and Maintenance

- tread depth—if tread is less than 4/32 inch (3 mm) on any front tire, or less than 2/32 inch (1.5 mm) on any rear tire, replace the tire
- debris lodged between dual tire sets

IMPORTANT: Low-rolling resistance (LRR) tires minimize wasted energy as a tire rolls, thereby decreasing rolling effort and improving fuel efficiency. If tire replacement is necessary, replacement tires must meet or exceed the rolling resistance of the originally installed tires in order to maintain compliance with greenhouse gas and full efficiency regulations (GHG14).

Contact your tire manufacturer/supplier to determine the rolling resistance of the originally installed tires. Visit www.epa.gov/smartway for additional information and resources.

3. Check tire inflation.

For inflation pressures and maximum loads, see the tire manufacturer's guidelines. Inflate the tires to the applicable pressures if needed.

If a tire has been run flat or under-inflated, check the wheel and tire for damage before adding air.

Keep compressed air reservoirs and lines dry during tire inflation. Use well-maintained inline moisture traps and service them regularly.

WARNING

Do not operate the vehicle with underinflated or overinflated tires. Incorrect inflation can stress the tires and make the tires and rims more susceptible to damage, possibly leading to rim or tire failure and loss of vehicle control, resulting in serious personal injury or death.

NOTICE

A weekly pressure loss of 4 psi (28 kPa) or more in a tire may indicate damage. The tire should be inspected and, if necessary, repaired or replaced by a qualified tire service facility.

IMPORTANT: The load and cold inflation pressure must not exceed the rim or wheel manufacturer's recommendations, even though the tire may be approved for a higher load inflation.

Consult the rim or wheel manufacturer for the correct tire inflation pressure for the vehicle load.

4. Examine each rim and wheel component. Check the wheel nuts or rim nuts for indications of looseness.
 - 4.1 Remove all dirt and debris from the assembly. Rust streaks or metal build-up around stud holes, or out-of-round or worn stud holes, may be caused by loose wheel nuts.

WARNING

Have any worn or damaged wheel components replaced by a qualified person using the wheel manufacturer's instructions and the wheel industry's standard safety precautions and equipment. Otherwise a vehicle or workshop accident could occur, possibly resulting in serious personal injury or death.

- 4.2 Inspect for broken, cracked, badly worn, bent, rusty, or sprung rings and rims.

NOTICE

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

- 4.3 Make sure all wheel nuts are tightened. If tightening is necessary, use the tightening pattern in [Fig. 11.4](#) or [Fig. 11.5](#).
5. Inspect the outboard side of all wheel hubs and the hub oil seal area on the inboard side of each wheel for signs of oil leakage. If any oil is found on wheel and tire or brake components, remove the vehicle from service until the leak has been fixed.

If needed, fill the hubs to the level indicated on the hub cap. See **Group 35** of the *Business Class M2 Maintenance Manual* for recommended lubricants.
6. Check that mud flaps are undamaged and hang 10 inches (25.4 cm) or less from the ground.

Pretrip and Post-Trip Inspections and Maintenance

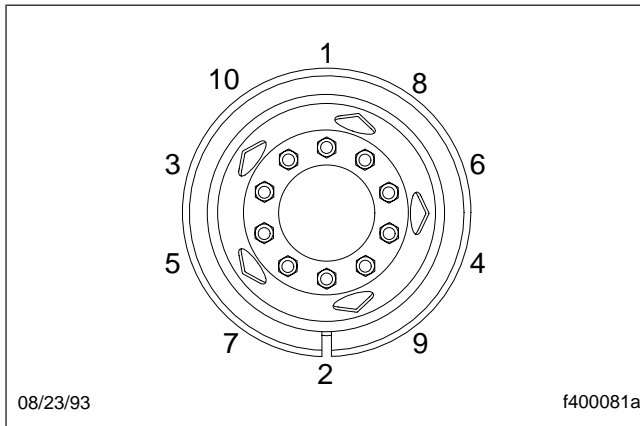


Fig. 11.4, Tightening Pattern, 10-Hole Wheels

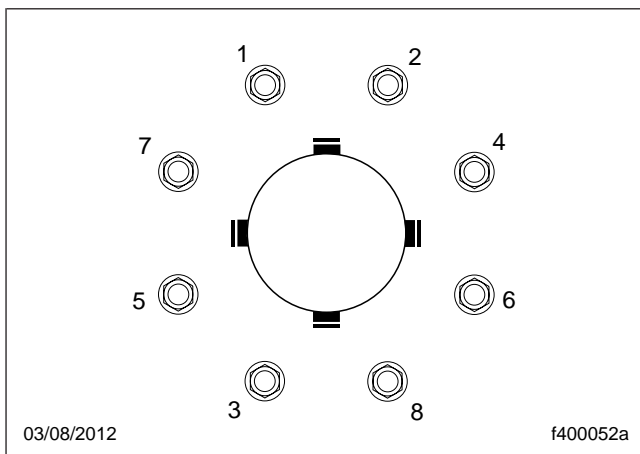


Fig. 11.5, Tightening Pattern, 8-Hole Wheels

Saddle Tank Area Inspections

WARNING

When draining the air reservoir, do not look into the air jets or direct them toward anyone. Dirt or sludge particles may be in the airstream and could cause injury.

NOTICE

If the water drained from the air reservoirs is cloudy or oily, it may indicate a problem with the compressor. If oil is allowed to contaminate the air dryer, it will not remove the water from the air brake system, which could adversely affect braking.

1. Drain the brake system air reservoirs (reservoirs without automatic drain valves only).

WARNING

Never operate the engine with the fuel tank shut-off valves partially closed. This could damage the fuel pump, causing sudden loss of engine power, possibly resulting in serious personal injury due to reduced vehicle control.

2. Ensure fuel tanks are secured to their mounting brackets and that the mounting brackets are secured to the frame.

If equipped with fuel tank shutoff valves, be sure the valves are fully open.
3. Inspect visible frame rails for missing bolts, shiny areas, or rust streaks. Check all visible cross-members for damage or signs of looseness.
4. Inspect visible components of the exhaust system to ensure connections are tight.

Inspect upstream of the aftertreatment device (ATD) for cracking or signs of leaks, such as soot trails. Inspect downstream of the ATD for signs of exhaust leaks, such as blistering or warping of nearby components.

Engine Compartment Inspection

1. Check the ground underneath the engine for fuel, oil, or coolant leaks.
2. Inspect the air intake system for leaks or damage.

NOTICE

Failure to maintain a sealed air intake system could allow the entry of dirt and contaminants into the engine. This could adversely affect engine performance and result in engine damage.

- 2.1 Push the reset button on the air intake restriction indicator located on the air cleaner, if equipped.
- 2.2 Check the air intake duct from the air cleaner to the engine intake. Make sure the duct components are secure and airtight.

Pretrip and Post-Trip Inspections and Maintenance

2.3 Check the vacuator (spitter) valve(s) for damage, and make sure the lips of the valve are pliable and free of debris.

3. Check the engine oil level.

NOTICE

Operating the engine with the oil level below the minimum fill (or "add") mark or above the maximum fill (or "full") mark could result in engine damage.

3.1 Check the oil level with the vehicle parked on a level surface. See the engine manufacturer's guidelines for engine shutdown time requirements prior to checking the oil level.

IMPORTANT: On engines that comply with EPA07 or newer regulations, use CJ-4 engine oil with less than 1% sulfated ash. Failure to use CJ-4 oil may void the warranty on emission aftertreatment components.

3.2 If the oil level is at or below the minimum fill (or "add") mark on the dipstick, add enough oil to maintain the level between the minimum and maximum fill marks. See the engine operation manual for recommended lubricants.

For natural gas vehicles, use only Exxon Busgard® Geo 15W-40 natural gas engine oil.

4. Check the power steering reservoir fluid level.

The power steering fluid level should be between the MIN COLD mark and the middle mark just above it. See [Fig. 11.6](#). If needed, fill the reservoir with automatic transmission fluid that meets Dexron III or TES-389 specifications.

NOTICE

Low coolant could result in engine overheating, which could cause engine damage.

IMPORTANT: The surge tank must be cool to check the coolant level.

5. Check the engine coolant level in the radiator surge tank.

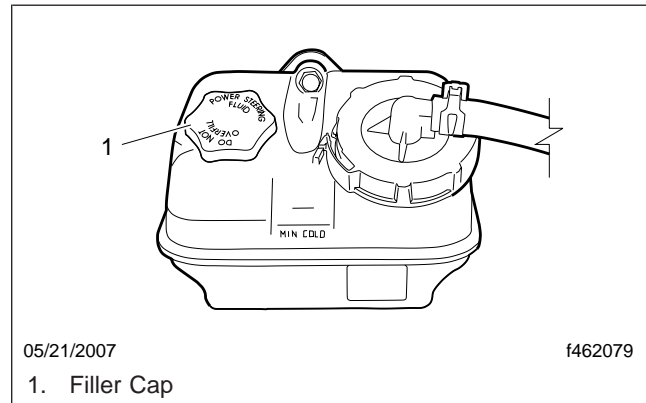


Fig. 11.6, Power Steering Fluid Reservoir

5.1 If the coolant is low, fill the surge tank to the MAX line with a 50/50 mixture of water and the type of antifreeze currently installed in your vehicle.

For natural gas vehicles, use only Fleet-guard ES Compleat™ EG Premix 50/50 engine coolant.

5.2 If the surge tank was empty, start the engine after refilling and check the level again when the engine is at operating temperature.

6. Inspect visible engine wiring for damage or looseness.

7. Inspect visible frame rails for missing bolts, shiny areas, or rust streaks.

Cab Inspection

1. Push the reset button on the dash-mounted air intake restriction indicator, if equipped.

2. With the ignition switch in the OFF position, check the air-pressure warning system.

2.1 If not previously drained, drain the air reservoirs using moderate brake applications until pressure in both reservoirs is less than 70 psi (483 kPa).

2.2 Turn the ignition to the ON position. The ICU will complete a full gauge sweep and bulb check, and the warning buzzer will sound. Ensure the BRAKE AIR lamp remains illuminated and the warning buzzer continues to sound after the gauge sweep is complete.

Pretrip and Post-Trip Inspections and Maintenance

3. Check air governor cut-in and cut-out pressures.

- 3.1 Start the engine and ensure the BRAKE AIR lamp goes out and the buzzer silences when pressure reaches approximately 70 psi (483 kPa) in both air reservoirs.

The air governor should cut out at approximately 120 psi (827 kPa). For vehicles with an optional dryer reservoir module (DRM), the cut-out pressure is approximately 130 psi (896 kPa).

- 3.2 With the engine idling, apply the brake pedal several times. The air governor should cut in when pressure in the primary air reservoir (top air gauge) reaches approximately 100 psi (689 kPa).

4. Check air pressure build-up time.

- 4.1 With the air system fully charged, make one full brake application and note the air pressure reading on the primary air gauge.
- 4.2 Further reduce air pressure using moderate brake applications, then run the engine at governed rpm.
- 4.3 Note the time that the pressure reaches the previously noted reading on the primary air gauge, then note the time that the air pressure reaches cut-out pressure.
- 4.4 If it takes longer than 30 seconds to reach cut-out pressure after the primary air gauge passes the previously noted pressure (noted after one full brake application), eliminate any leaks or replace the air compressor before operating the vehicle.

5. Check air leakage in the system.

- 5.1 With the parking brake applied, the transmission out of gear, and the air system fully charged, release the service brakes and shut down the engine.
- 5.2 Wait one minute and note the air pressure drop in psi (kPa) per minute from the primary air reservoir.

If the pressure drop exceeds the limits shown in **Table 11.1**, eliminate any leaks before operating the vehicle.

6. Check the air pressure reserve.

With the engine still off, make one full brake application and observe the pressure drop on the primary air gauge. If pressure drops more than 25 psi (172 kPa), eliminate any leaks before operating the vehicle.

Maximum Allowable Air Leakage		
Description	Pressure Drop: psi (kPa) Per Minute	
	Released	Applied
Truck or Tractor Only	2 (14)	3 (21)
Truck or Tractor w/Single Trailer	3 (21)	4 (28)

Table 11.1, Maximum Allowable Air Leakage

WARNING

When cleaning windshields and windows, always stand on the ground or on a secure ladder or platform. Use a long-handled window cleaner. Do not use the cab steps, tires, fenders, fuel tanks, engine, or under-hood components to access the windshield or windows. Doing so could cause a fall and result in an injury.

7. Inspect the mirrors, window glass, and windshield for cracks or other damage.
8. Ensure that the horn, windshield wipers, and windshield washers are operating properly. These devices must be in good working order for safe vehicle operation.
9. Ensure the heater and defroster are operating properly.
10. Check the operation of all interior lights.
- 10.1 Turn on the headlights and leave them on. Ensure all equipped gauge bulbs illuminate in the dash message center.
- 10.2 Ensure all equipped driver control switches illuminate.
- 10.3 Ensure both turn signal indicator bulbs illuminate in the dash message center when the turn signal switch is activated.
11. Check the operation of all exterior lights. See **Fig. 11.7**.
- 11.1 Activate the high-beam headlights and hazard warning lights.

Pretrip and Post-Trip Inspections and Maintenance

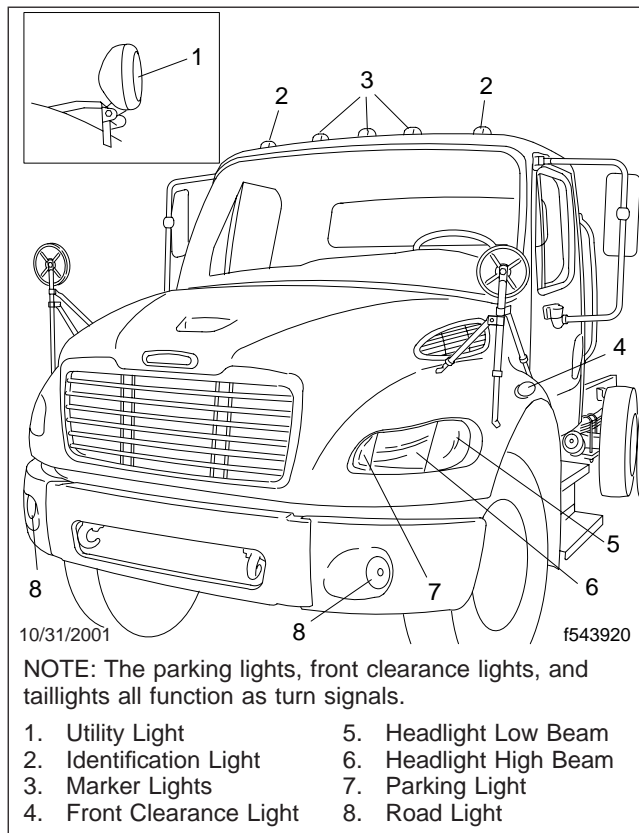


Fig. 11.7, Exterior Lights

11.2 Exit the cab and check that all exterior lights and reflectors are clean and intact.

11.3 Check that the brake lights, taillights, headlights, turn signals, marker lights, identification lights, and clearance lights are working properly.

12. *Inspect the seat belts and tether belts.*

WARNING

Inspect and maintain seat belts. When any part of a seat belt system needs replacement, the entire seat belt must be replaced, both retractor and buckle side. Any time a vehicle is involved in an accident, and the seat belt system was in use, the entire vehicle seat belt system must be replaced before operating the vehicle. Do not attempt to modify the seat belt system; doing so could change the effectiveness of the system. Failure to replace worn or damaged seat belts, or

making any modifications to the system, may result in personal injury or death.

- 12.1 Check the web for fraying, cuts, extreme dirt and dust, or for severe fading from exposure to sunlight, especially near the buckle latch plate and in the D-loop guide area.
- 12.2 Check operation of the buckle, latch, Komfort Latch or Sliding Komfort Latch (if equipped), web retractor, and upper seat belt mount on the door pillar. Check all visible components for wear or damage.
- 12.3 Check the seat belt and tether belt connection points and tighten any that are loose.

WARNING

Never fill fuel tanks to more than 95 percent of their liquid capacity. This could make them more likely to rupture from impact, possibly causing fire and resulting in serious personal injury or death by burning.

Do not mix gasoline or alcohol with diesel fuel. This mixture could cause an explosion, possibly resulting in serious personal injury or death. Do not fill the fuel tanks in the presence of sparks, open flames, or intense heat. These could ignite the fuel, possibly causing severe burns.

IMPORTANT: On engines that comply with EPA07 or newer regulations, use ultralow-sulfur diesel (ULSD) with 15 ppm sulfur content or less. Failure to use ULSD fuel may void the warranty on emission components.

13. Check the fuel level in the fuel tank(s). To keep condensation to a minimum, fuel tanks should be filled at the end of each day.
14. Adjust the rearview and down view mirrors as necessary.
15. Test the service brakes.
 - 15.1 With the engine running and air system fully charged, set the parking brake.
 - 15.2 Put the vehicle in the lowest gear and gently attempt to move it forward. The vehicle should not move.

Pretrip and Post-Trip Inspections and Maintenance

If the vehicle moves, the parking brakes are not operating correctly and must be repaired before the vehicle is operated.

Natural Gas Fuel System Inspection, If Equipped

1. Inspect fuel tanks for dents, scratches, gouges, or other signs of damage. Inspect the fuel lines and connections for leaks.

Check that the fuel tanks are securely mounted. Look for signs of abrasion between components.

Compressed Natural Gas (CNG) Fuel System: Ensure that the CNG fuel cylinder storage box is secured to the frame. Inspect for signs of looseness.

Liquefied Natural Gas (LNG) Fuel System: Ensure that the LNG fuel tank is secured to the mounting brackets and that the mounting brackets are secured to the frame. Ensure all rubber isolator straps are secure around the LNG fuel tank.

2. Check for the presence of all required decals present in the following locations:
 - Gas detection system overhead console;
 - Above the door handle on both doors;
 - Left front bumper;
 - End-of-frame crossmember;
 - LNG fuel tank fill port (maximum psi), if equipped.

3. Check for the presence of vent caps on pressure relief valves and devices. If any caps are missing, have the fuel system inspected by a qualified technician.

CNG Fuel System: Each fuel cylinder should have two caps (one on each end), which are visible on the back of the CNG fuel cylinder storage box. One additional cap is located on the pressure relief valve on the inboard side of the CNG fuel box, next to the fuel outlet line.

LNG Fuel System: A red cap should be present on the secondary relief valve (**Fig. 11.8**).

4. Inspect all plumbing components, including the fuel shutoff valve(s), primary and secondary relief valves, and the LNG vapor shutoff and excess

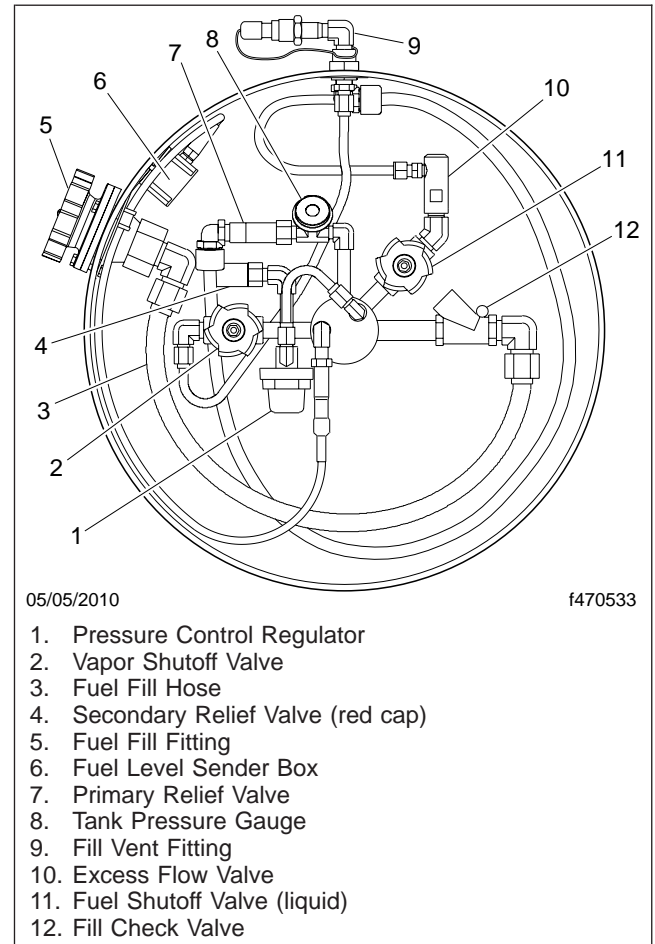


Fig. 11.8, LNG Tank Plumbing Components

flow valves, if equipped, for signs of damage or leaks. See **Fig. 11.8** or **Fig. 11.9**.

Inspect the fuel fill fitting for signs of damage or leaks.

Inspect all lines for signs of leaks or damage, and check all threaded connections.

5. Inspect all fuel gauge components for signs of leaks or damage. Inspect the fuel level sender cable and wiring.
6. Inspect all coolant hoses for signs of chafing, kinks, or leaks. The LNG fuel system utilizes coolant hoses between the engine and the vaporizer; the CNG fuel system utilizes coolant hoses between the engine and the pressure regulator inside the fuel panel.

Pretrip and Post-Trip Inspections and Maintenance

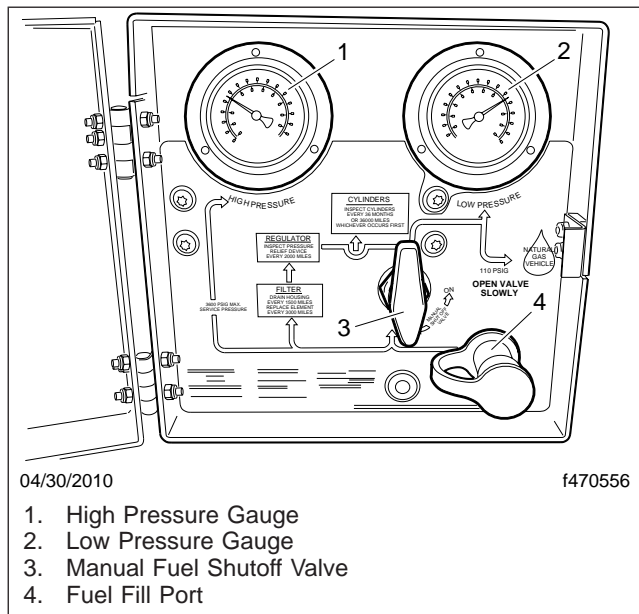


Fig. 11.9, CNG Fuel Panel

7. If equipped with an LNG fuel system, check the fuel tank pressure gauge to ensure that pressure is within the normal range of 120 to 150 psi (827 to 1034 kPa). If tank pressure exceeds 230 psi (1586 kPa) and the pressure relief valve does not open automatically, vent the tank immediately.
8. Inspect the LNG vaporizer for signs of damage or leaks. See Fig. 11.10. Inspect the vaporizer mounting brackets for signs of looseness.

Weekly Post-Trip Inspection and Maintenance

Engine Compartment Inspection

WARNING

Washer fluids may be flammable and poisonous. Do not expose washer fluid to an open flame or any burning material, such as a cigarette. Always comply with the washer fluid manufacturer's recommended safety precautions.

1. Check the windshield washer reservoir fluid level. The reservoir is usually located near the right-hand frame rail.

2. After resetting the air intake restriction indicator during the daily pretrip inspection, check the indicator again with the engine off.

- 2.1 Check an indicator with graduations to see if air restriction exceeds the value shown in Table 11.2.

Check a go/no-go indicator without graduations to see if the colored bar shows through the clear window.

Air Intake Maximum Restriction Values (inH ₂ O)		
Engine	Pre-EPA07 Engines	EPA07 and Newer Engines
Caterpillar	25	—
Cummins	25	25
Detroit Diesel	20	22
Mercedes-Benz	22	22

Table 11.2, Air Cleaner Element Maximum Restriction

- 2.2 If air restriction exceeds the maximum allowable value, operate the vehicle for one more day, making sure not to run the engine over rated rpm. Refer to the engine operation manual for more information on rated rpm for your engine.
- 2.3 If air restriction exceeds the maximum value again, replace the air cleaner. For instructions, refer to **Group 09** of the *Business Class M2 Workshop Manual*.
3. If the vehicle is equipped with an Allison automatic transmission, check the automatic transmission fluid level.
4. Check for water in the fuel/water separator, if equipped.

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

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

NOTE: A hose may be used to direct water into the container. Use a hose with a ½-inch pipe thread on DAVCO models.

Pretrip and Post-Trip Inspections and Maintenance

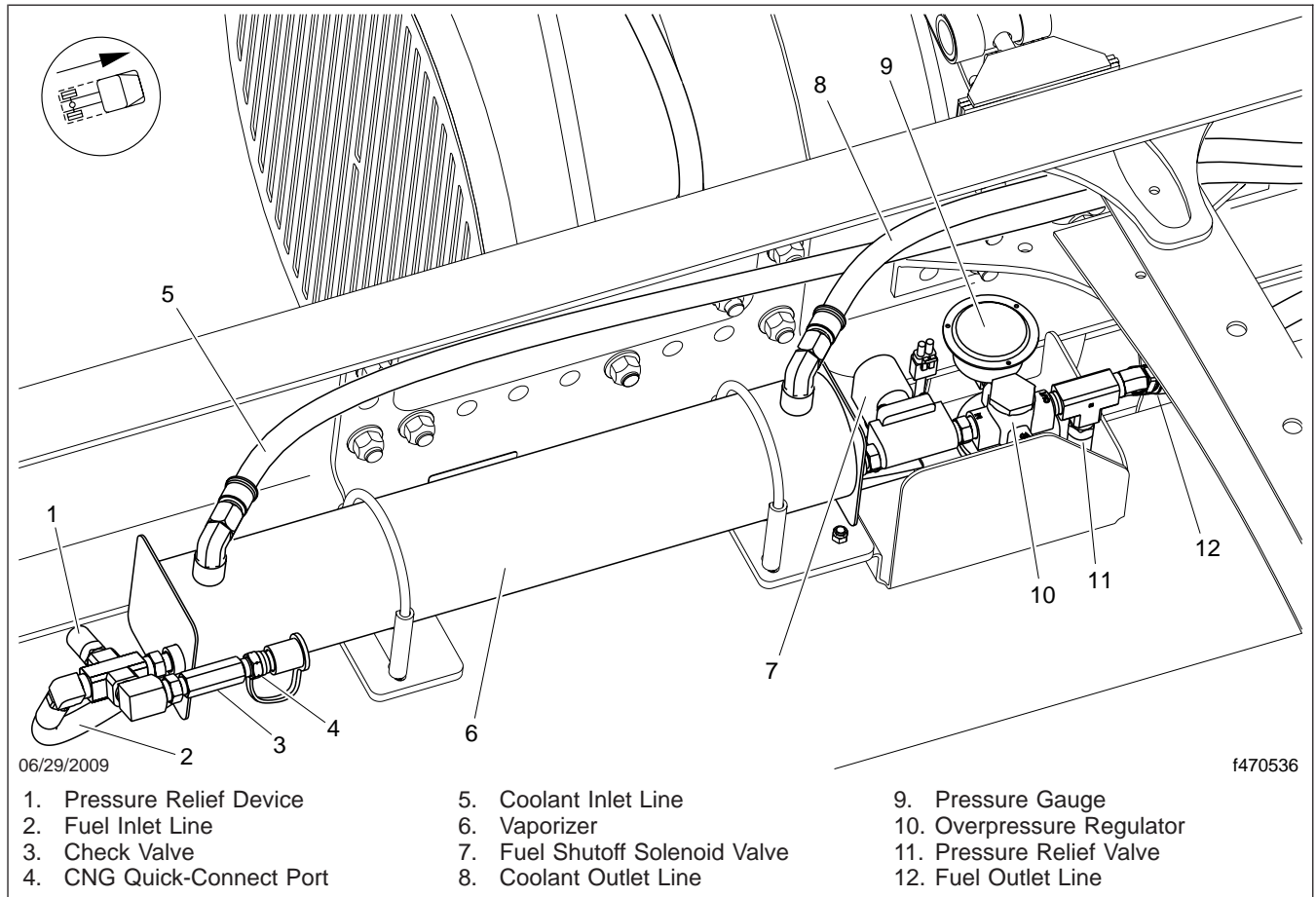


Fig. 11.10, LNG Vaporizer Assembly

- 4.2 If the engine is equipped with a built-in water separator, loosen the drain valve, and allow the water to run out. Close the drain valve, taking care not to overtighten it.
- 4.3 *Alliance/Racor Models:* Turn the drain plug counterclockwise to open it. See [Fig. 11.11](#).
DAVCO Models: Remove the vent cap and open the drain. See [Fig. 11.12](#).
- 4.4 Stop draining fluid when fuel begins to drain out.
Alliance/Racor Models: turn the drain plug clockwise to close it.
DAVCO Models: close the drain valve. Install and hand-tighten the vent cap.
5. Inspect the steering components. See [Fig. 11.13](#).
 - 5.1 Inspect tie rods, steering arms, and the drag link for signs of looseness (i.e., shiny spots or rust tracks).
 - 5.2 Check the steering gear mounting bolts and pitman arm nut for signs of looseness.
 - 5.3 Check the drag link nuts for missing cotter pins.
 - 5.4 Inspect the steering intermediate shaft and end yokes for excessive looseness or other damage.

Pretrip and Post-Trip Inspections and Maintenance

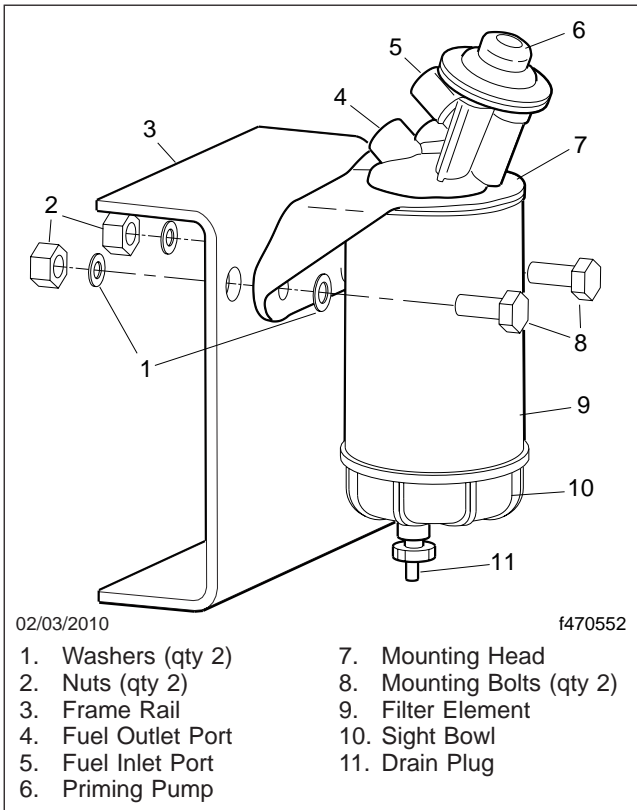


Fig. 11.11, Alliance Fuel/Water Separator Assembly and Installation

NOTICE

Do not drive with a drive belt that is visibly worn or damaged. If it fails, the lack of coolant flow could rapidly cause damage to engine components.

6. Inspect the serpentine drive belts for signs of glazing, frayed edges, breaks, cracks, or oil contamination.

Monthly Post-Trip Inspection and Maintenance

Brake Component Inspection

Walk around the vehicle and visually the brake system components for visible damage.

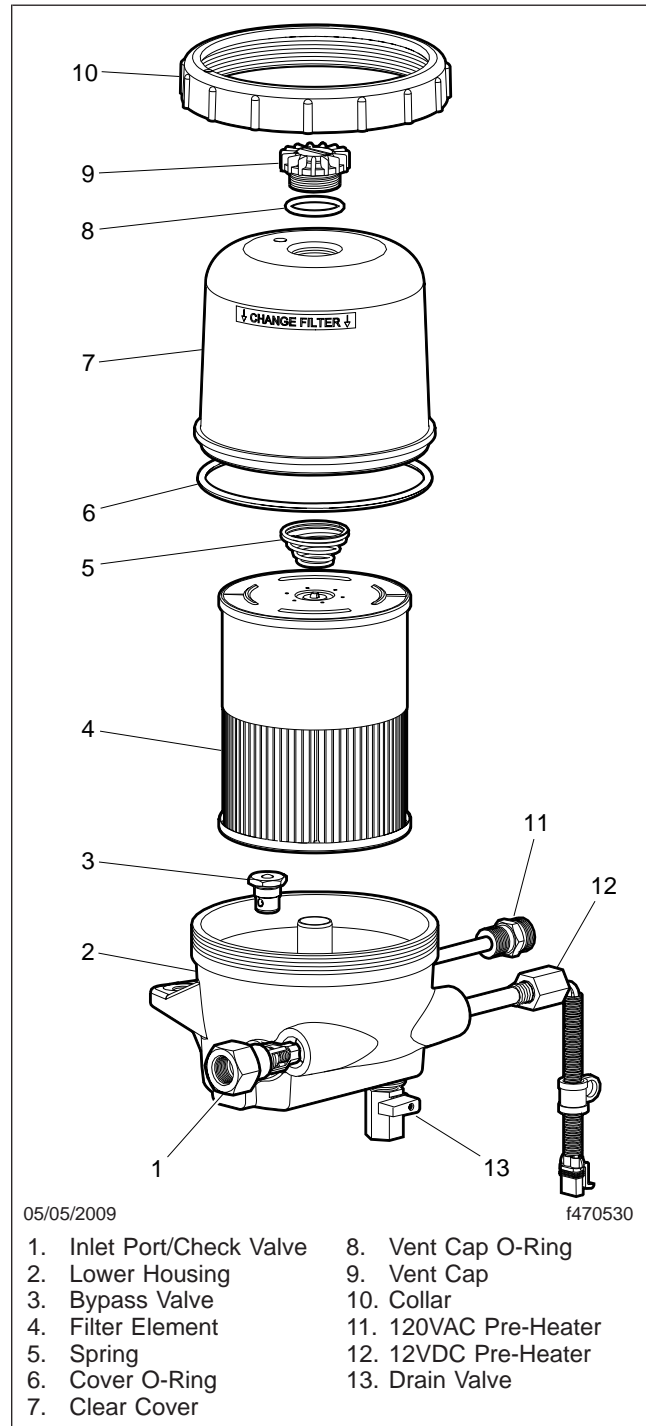


Fig. 11.12, DAVCO Fuel/Water Separator (Fuel Pro 482 shown)

Pretrip and Post-Trip Inspections and Maintenance

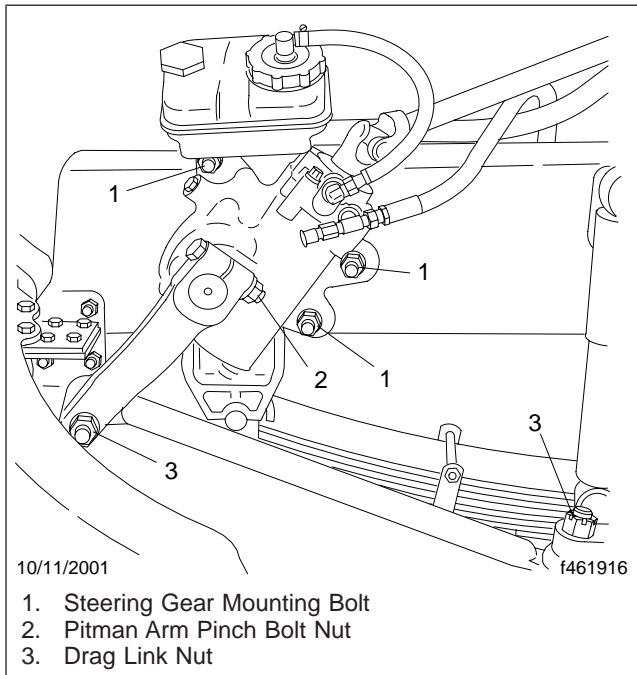


Fig. 11.13, Steering Gear Fasteners

1. Inspect all visible brake system components for missing fasteners or signs of looseness, such as rust tracks.

NOTICE

If the external breather tube or breather cap is missing or incorrectly installed, road dirt and debris can adversely affect the operation of the brake chamber. Once inside of the chamber, dirt and debris can cause the internal parts of the chamber to deteriorate faster.

2. Inspect the exterior surfaces of brake chambers for damage. Make sure that breather holes are open and free of debris.

NOTE: Do not route air brake lines on top of anything likely to be stepped on.

3. Inspect air brake lines for dents, swelling, kinks, twisting, abrasion, and damage, especially near moving parts.
4. Inspect flex air lines for deterioration or signs of abrasion.
5. Inspect for cracked, worn, or oil-contaminated brake linings and brake drums (or rotors).

6. Check the thickness of the brake linings. Replace brake linings on all brake assemblies on the axle if any brake linings are worn to less than approximately 1/4 inch (6.4 mm) at the thinnest point.

Saddle Tank Area Inspections

WARNING

When draining the air reservoir, do not look into the air jets or direct them toward anyone. Dirt or sludge particles may be in the airstream and could cause injury.

NOTICE

If the water drained from the air reservoirs is cloudy or oily, it may indicate a problem with the compressor. If oil is allowed to contaminate the air dryer, it will not remove the water from the air brake system, which could adversely affect braking.

1. Drain the brake system air reservoirs (reservoirs with automatic drain valves only).

NOTE: Battery locations vary between vehicles.

2. Inspect the batteries.

WARNING

Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. To prevent possible personal injury, always wash your hands after handling battery parts and related accessories.

- 2.1 Remove the battery box cover and inspect all visible battery cables for loose wiring or damage.
- 2.2 Check that the battery hold-down is secure.

IMPORTANT: Aerodynamic components decrease drag force as a vehicle moves, thereby improving fuel efficiency. If replacement of an aerodynamic component is necessary, replacement components must meet or exceed the

Pretrip and Post-Trip Inspections and Maintenance

drag reduction performance of the originally installed component in order to maintain compliance with greenhouse gas and full efficiency regulations (GHG14).

3. Inspect the following aerodynamic components, if equipped, for structural damage, cracks, or wear.
 - Chassis fairings
 - Roof fairing/deflector
 - Side skirts
 - Cab extenders
 - Battery access cover

Engine Compartment Inspection and Adjustments

IMPORTANT: If replacement of the hood or bumper is necessary, the replacement component must meet or exceed the drag reduction performance of the originally installed item in order to maintain compliance with greenhouse gas and full efficiency regulations (GHG14).

1. Inspect the bumper and hood for structural damage, cracks, or wear.
2. Check the hydraulic clutch reservoir, if equipped. If necessary, add DOT 4 brake fluid.
3. Inspect the radiator and heater hoses, including the clamps and support brackets.
 - 3.1 Inspect the radiator and charge air cooler for damage and accumulated debris. Straighten bent or damaged fins to permit airflow across all areas of the cores.

NOTE: When traveling through areas of high insect concentration, it may be necessary to clean the exterior of the radiator or the charge air cooler core as often as every 200 miles (320 km).

- 3.2 Make sure the radiator inlet and outlet hoses are pliable and are not cracking or ballooning.
- 3.3 Make sure the heater hoses are pliable and are not cracking or ballooning.
- 3.4 Tighten hose clamps as necessary.

IMPORTANT: Do not overtighten hose clamps, as hose life can be adversely affected.

- 3.5 Ensure hose support brackets are securely fastened. Make sure hoses are not located near sources of wear, abrasion, or high heat.

IMPORTANT: When replacing hoses, install service-type knitted or braided yarn-reinforced neoprene hose. Extended-service-life silicone hoses may also be used. See the Alliance Parts Catalog at www.alliancebrandparts.com or contact your Freightliner Dealer.

4. Check the steering wheel for excessive play.
 - 4.1 Start the engine. With the front tires straight ahead, turn the steering wheel until motion is observed at the front wheels.
 - 4.2 Align a reference mark on the steering wheel to a rule, then slowly turn the steering wheel in the opposite direction until motion is again detected at the wheels.
 - 4.3 Measure the lash (free play) at the rim of the steering wheel. Excessive lash exists if steering wheel movement exceeds 2-1/2 inches (64 mm) with a 20-inch (508-mm) steering wheel, or 2-1/4 inches (57 mm) with an 18-inch (450-mm) steering wheel.
 - 4.4 If there is excessive lash, check the steering system for wear or incorrect adjustment before operating the vehicle.

Natural Gas Fuel System Inspection, If Equipped

1. Leak test all fuel system components, joints, and fittings using a methane detector. A bubble solution can be used to pinpoint the exact location of leaks.

Replace any leaking or damaged fuel tanks and fuel lines; repair or replace leaking or damaged fittings.
2. Drain the CNG high-pressure fuel filter housing, if equipped.

Pretrip and Post-Trip Inspections and Maintenance

- 2.1 Purge the CNG fuel lines by closing the CNG fuel cylinder shutoff valves. Start the engine and let it idle until the fuel lines are empty and the engine stops.

Gauges on the fuel panel should now read at or near 0 psi (0 kPa).

- 2.2 Close the manual fuel shutoff valve on the fuel panel.

- 2.3 Remove the two capscrews that secure the access cover to the fuel panel, then remove the access cover. See Fig. 11.14. Save the capscrews for installation.

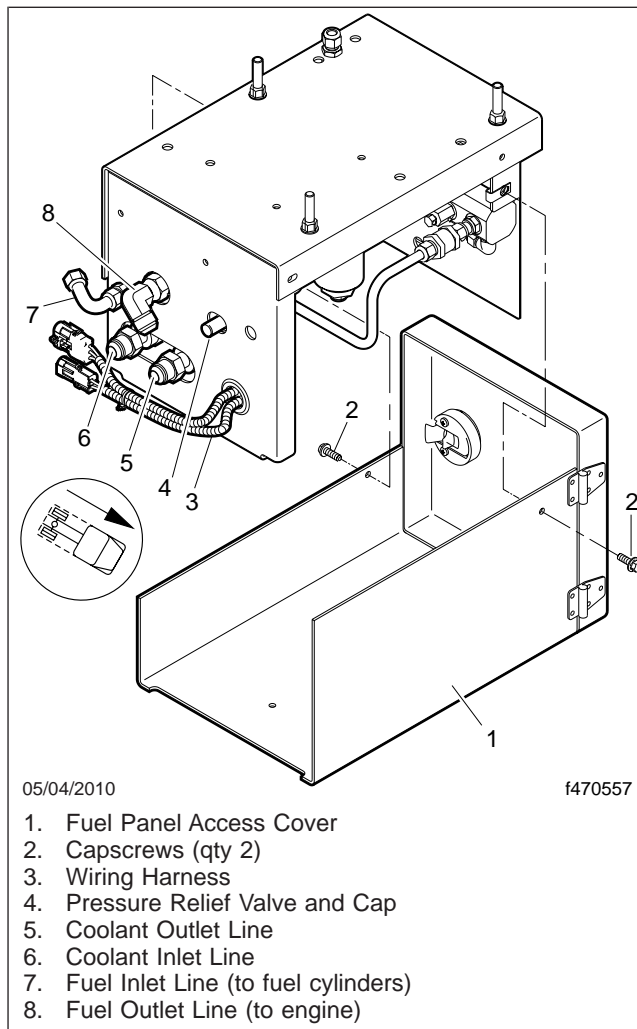


Fig. 11.14, CNG Fuel Panel Assembly

- 2.4 Slowly open the bleed valve on the manifold to relieve remaining fuel pressure within the system. See Fig. 11.15.

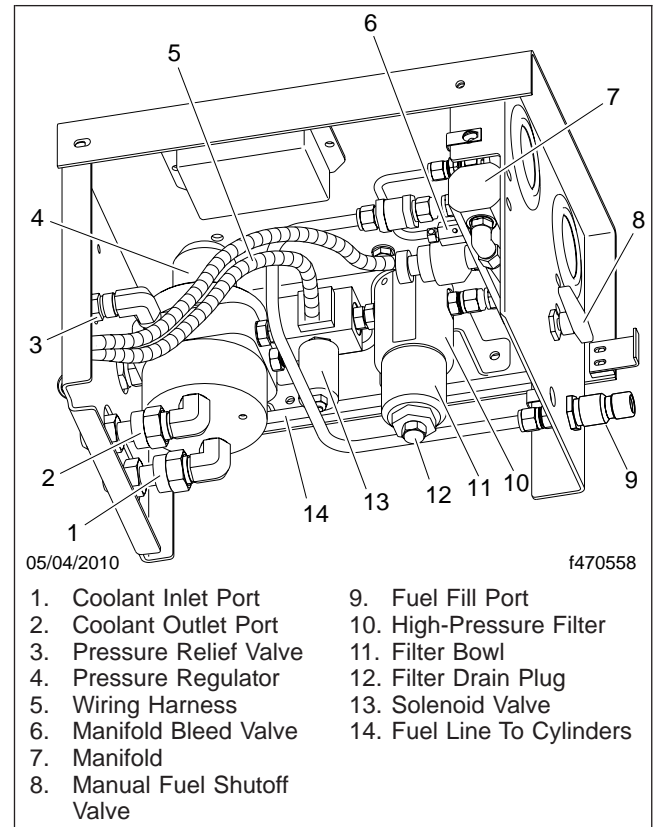


Fig. 11.15, CNG Fuel Panel Components

IMPORTANT: Some pressure may remain in the fuel system between the solenoid valve and the engine. Use caution when loosening fittings, as a small amount of gas may leak out.

- 2.5 Put a clean receptacle under the filter assembly.
- 2.6 Using an 11/16-inch wrench, remove the drain plug from the filter bowl.
When all liquid has drained, install and tighten the drain plug on the filter bowl.
- 2.7 Close the bleed valve on the manifold and open the manual fuel shutoff valve on the fuel panel.

Open the fuel cylinder shutoff valves.

Pretrip and Post-Trip Inspections and Maintenance

- 2.8 Use a methane detector to leak test all fuel system components between the fuel cylinders and the solenoid valve. A bubble solution can be used to pinpoint the exact location of leaks.
Repair or replace any leaking components.
- 2.9 Install the access cover on the fuel panel.

12

Cab Appearance

Cab Washing and Polishing	12.1
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Cab Appearance

Cab Washing and Polishing



When pressure washing the vehicle or leaving the hood open when parked outdoors and subject to rain, cover the air cleaner inlet with a plastic bag to prevent water from entering the air intake system and possibly damaging the engine.

To protect the finish of your new vehicle, follow these guidelines carefully:

- During the first 30 days, rinse your vehicle frequently with water. If the vehicle is dirty, use a mild liquid soap. Do not use detergent.
- During the first 30 days, do not use anything abrasive on your vehicle. Brushes, chemicals, and cleaners may scratch the finish.
- During the first 120 days, do not wax your vehicle.

To extend the life of your vehicle's finish, follow these guidelines:

- Avoid washing your vehicle in the hot sun. Always use water. After the cab is completely washed, dry it with a towel or chamois.
- Do not dust painted surfaces with a dry cloth, as this will scratch the paint.
- Do not remove ice or snow from a painted surface with a scraper of any sort.
- To prevent damage to the finish, wax it regularly. If the finish has become dull, before waxing, remove oxidized paint using a cleaner specifically designed for this purpose. Remove all road tar and tree sap before waxing. Freightliner recommends that a quality brand of cleaner or cleaner-polish and polishing wax be used.
- Do not let diesel fuel or antifreeze stand on a painted surface. If either should occur, rinse the surface off with water.
- To prevent corrosion, have any nicks or other damage on the finish touched up as soon as possible.
- Park your vehicle in a sheltered area whenever possible.

Care of Fiberglass Parts

Wash unpainted fiberglass air fairings and shields monthly with a mild detergent, such as dishwashing liquid. Avoid strong alkaline cleansers.

Apply a wax specifically designed for fiberglass.

Care of Chrome Parts

To prevent rust, keep chrome parts clean and protected at all times. This is especially important during winter driving and in coastal areas where there is exposure to salt air.

When cleaning chrome parts, use clean water and a soft cloth or sponge. A mild detergent may also be used.

Sponge gently, then rinse. If necessary, use a non-abrasive chrome cleaner to remove stubborn rust or other material. Do not use steel wool.

To help protect the chrome after cleaning, apply a coat of polishing wax to the surface. Never use wax on parts that are exposed to high heat, such as exhaust pipes.

Care of Exterior Lights

Clean the headlight lenses by hand only, using a flannel cloth with mild, non-caustic soap or detergent, and water.



Do not use a power buffer, paper towels, chemical solvents, or abrasive cleaners on the headlight lens, all of which can remove the UV coating from the surface, and result in yellowing of the lens.

Dashboard Care

Periodically wipe the dashboard with a water-dampened cloth. A mild detergent can be used, but avoid using strong detergents.



Do not use Armor-All Protectant®, STP Son-of-a-Gun®, or other equivalent treatments. These cleaners contain vinyl plasticizers that can cause

stress crazing in the interior plastic panels, which can result in cracking of the panels.

Vinyl Upholstery Cleaning

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Harsh cleaning agents can cause permanent damage to vinyl upholstery. To preserve the upholstery and prevent damage, carefully review the following sections for recommended cleaning procedures. Waxing or refinishing improves soil resistance and cleanability for all vinyls. Any hard wax, such as that used on automobiles, may be used.

Ordinary Dirt

Wash the upholstery with warm water and mild soap, such as saddle or oil soap. Apply soapy water to a large area and allow to soak for a few minutes, then rub briskly with a cloth to remove the dirt. This can be repeated several times as necessary.

If dirt is deeply imbedded, use a soft bristle brush after applying the soap.

If dirt is extremely difficult to remove, wall-washing preparations normally found around the home can be used. Powdered cleaners, such as those used for sinks and tiles, are abrasive and must be used with caution as they can scratch the vinyl or give it a permanent dull appearance.

Chewing Gum

Harden the gum with an ice cube wrapped in a plastic bag, then scrape it off with a dull knife. Any remaining traces of gum can be removed with an all-purpose light oil (peanut butter will also work) and wiped off.

Tars, Asphalts, and Creosote

Tars, asphalts, and creosote stain vinyl after prolonged contact. They should be wiped off immediately and the area carefully cleaned, using a cloth dampened with naphtha.

Paint, Shoe Heel Marks

Paint should be removed immediately. Do not use paint remover or liquid-type brush cleaner on vinyl. An unprinted cloth, dampened with naphtha or tur-

pentine may be used. Use care to prevent contact with parts of the upholstery that are not vinyl.

Sulfide Stains

Sulfide compounds, such as those found in eggs and some canned goods, can stain after prolonged contact with vinyl. These stains can be removed by placing a clean, unprinted piece of cloth over the spotted area and pouring a liberal amount of 6 percent hydrogen peroxide onto the cloth. Allow the saturated cloth to remain on the spot for 30 to 60 minutes. For stubborn spots, allow the hydrogen-peroxide saturated cloth to remain on the area overnight. Use caution to prevent the solution from seeping into the seams or it will weaken the cotton thread.

Nail Polish and Nail Polish Remover

Prolonged contact with these substances causes permanent damage to vinyl. Careful blotting immediately after contact minimizes damage. Do not spread the liquid during removal.

Shoe Polish

Most shoe polishes contain dyes which penetrate vinyl and stain it permanently. Shoe polish should be wiped off as quickly as possible using naphtha or lighter fluid. If staining occurs, try the procedure used for sulfide stains.

Ball Point Ink

Ball point ink can sometimes be removed if rubbed immediately with a damp cloth, using water or rubbing alcohol. If this does not work, try the procedure used for sulfide stains.

Miscellaneous

If stains do not respond to any of the treatments described above, it is sometimes helpful to expose the vinyl to direct sunlight for up to 30 hours. Mustard, ball point ink, certain shoe polishes, and dyes often bleach out in direct sunlight leaving the vinyl undamaged.

Velour Upholstery Cleaning

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Spot clean with a mild solvent or an upholstery shampoo,

Cab Appearance

or the foam from a mild detergent. When using a solvent or a dry-cleaning product, follow the instructions carefully and clean only in a well-ventilated area. Avoid any product that contains carbon tetrachloride or other toxic materials. With either method, pretest a small area before proceeding. Use a professional upholstery cleaning service when extensive cleaning is needed.

Grease and Oil-Based Stains

Dampen a small absorbent cloth with dry-cleaning solvent or spot remover. Apply the cloth carefully to the spot from the outer edge to the center. Pat and blot the spot with a clean, dry cloth. Repeat several times, as necessary, turning the cloths so that the stain does not redeposit on the fabric.

Sugar and Water-Based Stains

Apply water-based detergent or cleaner, working in circular motions. Pat and blot as dry as possible. Repeat if necessary before drying thoroughly.

Chewing Gum or Wax

Harden the gum or wax with an ice cube wrapped in a plastic bag, then scrape it off with a dull knife. Excess wax can be absorbed by placing a thick white blotter over the wax and heating with a warm (not hot) iron. Remove the remainder by using the procedure for grease and oil-based stains.

Mildew

Brush the dry fabric with a soft brush. Sponge with detergent, and blot. If the fabric is colorfast, dilute a teaspoon of bleach in one quart (one liter) of cool water. Apply with a swab, directly on the mildew stain. Dab repeatedly with clear, cool water, and blot dry.

13

In an Emergency

Hazard Warning Lights	13.1
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In an Emergency

Hazard Warning Lights

The hazard warning light flasher (**Fig. 13.1**) is part of the multifunction turn signal switch. It is a red rocker switch located on the top of the multifunction switch module.

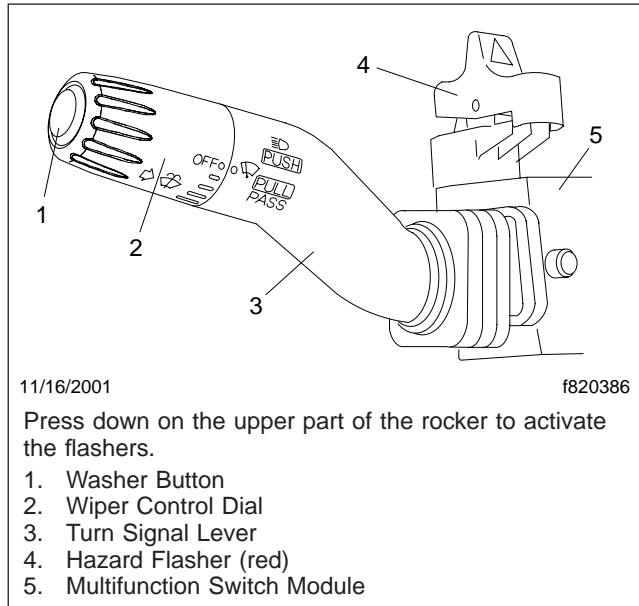


Fig. 13.1, Hazard Warning Flashers

To flash the hazard warning lights, press down on the upper part of the rocker (towards the dash). To stop the hazard warning lights, press down on the lower part of the rocker (towards the steering wheel).

Fire Extinguisher

A fire extinguisher is located in the cab by the driver's door.

Emergency Kit, Optional

An optional emergency kit is located in the cab. The kit includes one or more of the following: a first aid kit, a reflective vest, a triangular reflector, a flare kit, and (on vehicles with a Davco fuel/water separator) a spin-on fuel filter element.

If there is an emergency while driving, cautiously pull off the road. Turn on the hazard warning lights. Place the flares and reflector along the side of the road to alert other drivers that an emergency situation exists.

WARNING

Use extreme care when placing flares in emergency situations that involve exposure to flammable substances such as fuel. An explosion or fire could occur causing serious personal injury.

Emergency Filter Replacement, Davco

If the filter cover on the Davco fuel/water separator is broken, it will not be possible to operate the vehicle. A standard spin-on filter will correct this problem.

Refer to the Davco web site for additional information, www.davcotec.com.

To replace the filter on all Davco fuel/water separators, follow these procedures:

1. Drain the fuel until it is below the level of the filter collar. See **Fig. 13.2** for the model 232/233 fuel/water separator and **Fig. 13.3** for the model 382 fuel/water separator.

2. Remove the filter vent and vent seal.

NOTE: The filter vent and vent seal are not needed in the emergency replacement. They should be retained for later installation at the time when the filter cover is replaced.

3. Remove the filter collar using channel-lock pliers.
4. Remove the filter cover, filter cover seal and spring. Retain them for later assembly.
5. Remove the filter element and dispose of it properly.
6. Install the standard engine spin-on filter (included in the emergency kit) on the threaded stud.

NOTE: Remove the rubber grommet from the stud.

7. Install the filter cover, filter cover seal, and spring, as removed.
8. Install the filter collar over the filter cover. Tighten the filter collar finger-tight.
9. Start the engine and run it at increased rpm for one minute to purge air from the fuel lines.

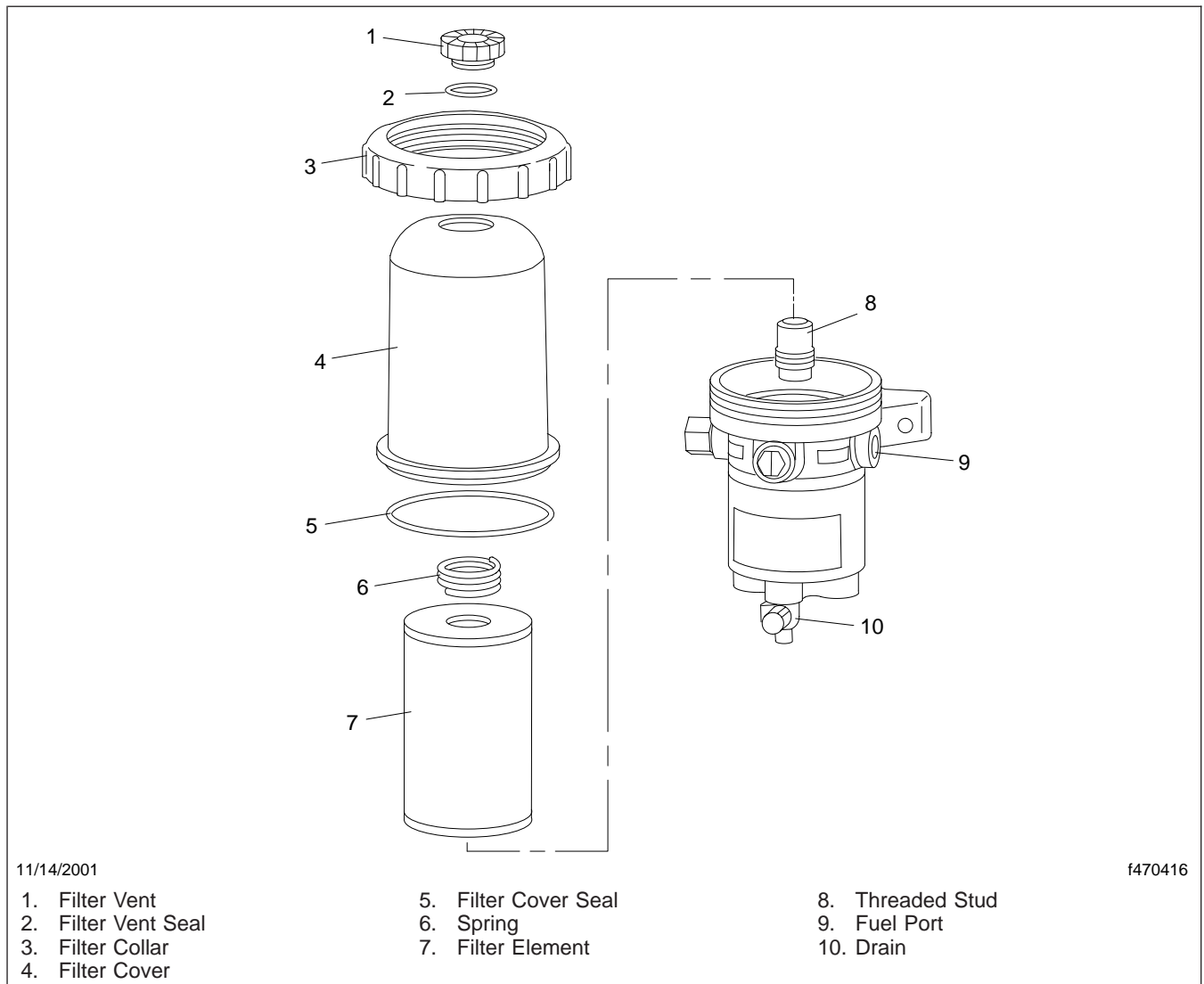


Fig. 13.2, Davco Model 232 and 233 Fuel/Water Separator

Emergency Starting With Jumper Cables

When using jumper cables, follow the instructions below.

WARNING

Batteries release explosive gas. Do not smoke when working around batteries. Put out all flames and remove all sources of sparks or intense heat

in the vicinity of the battery. Do not allow the vehicles to touch each other. Do not lean over the batteries when making connections, and keep all other persons away from the batteries. Failure to follow these precautions could lead to severe personal injury as a result of an explosion or acid burns.

In an Emergency

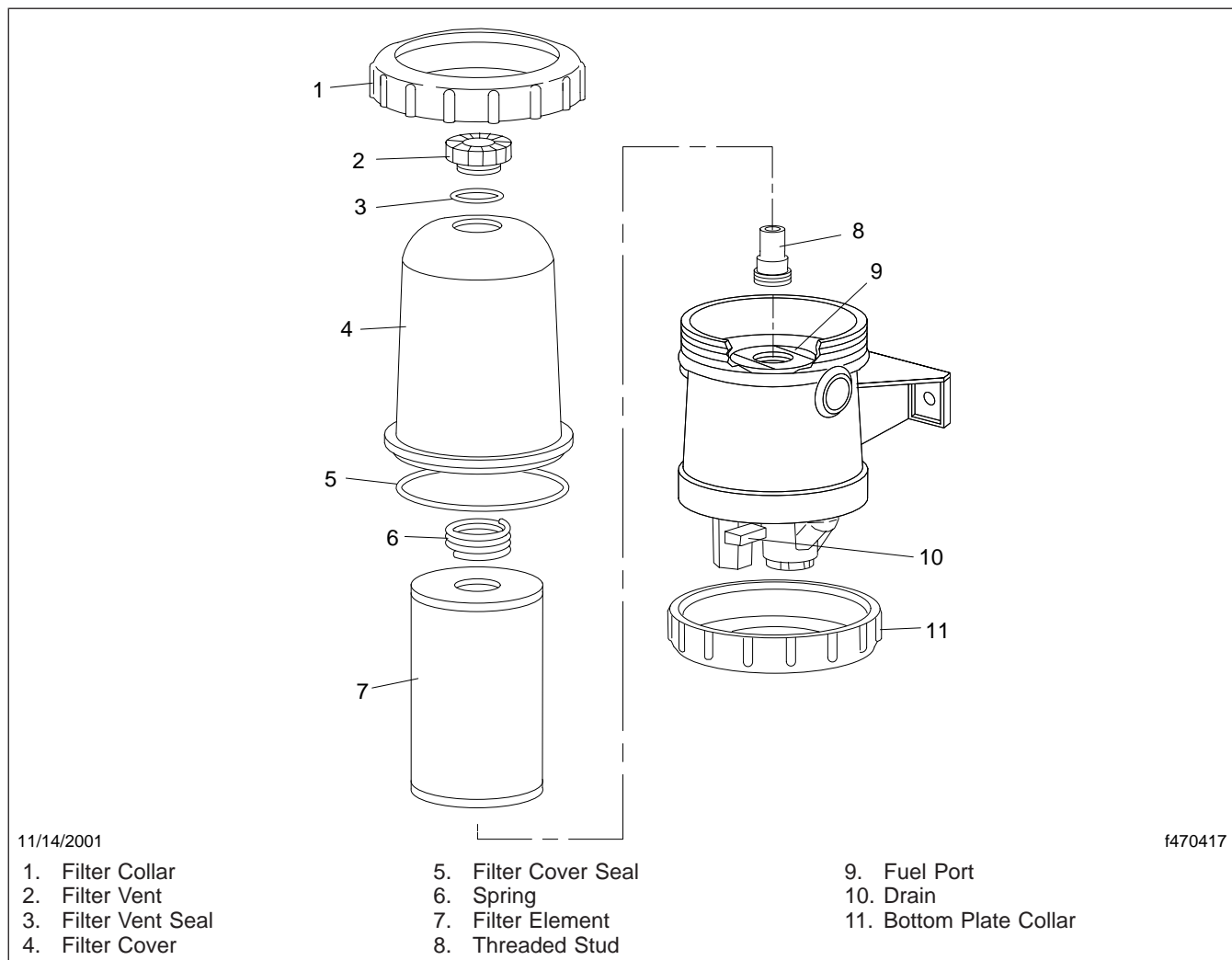


Fig. 13.3, Davco Model 382 Fuel/Water Separator

CAUTION

Make sure both starting systems have the same voltage outputs, and avoid making sparks. Otherwise the vehicle charging systems could be severely damaged. Also, do not attempt to charge isolated, deep-cycle batteries with jumper cables. Follow the battery manufacturer's instructions when charging deep-cycle batteries.

NOTE: On vehicles equipped with an optional jump-start post, attach the positive cable clamp to that post instead of to the battery.

1. Apply the parking brakes and turn off the lights and all other electrical devices.
2. To gain access to the batteries, open the battery compartment. See Fig. 13.4. For detailed instructions, see Chapter 2.

CAUTION

Always connect the battery, jumper cables, and charger correctly (positive-to-positive and negative-to-negative). Connecting a charging device backwards (positive-to-negative) will blow fuses that power the bulkhead module (BHM) and

chassis module (CHM), and the devices they control will not work.

3. Connect an end of one jumper cable to the positive terminal of the booster battery (or jump-start post if equipped), and connect the other end of the cable to the positive terminal of the discharged battery (or jump-start post if equipped). See Fig. 13.5.

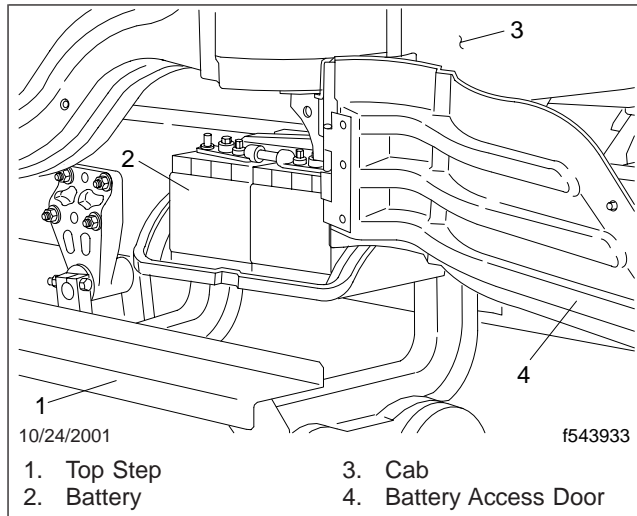


Fig. 13.4, Battery Compartment, Open

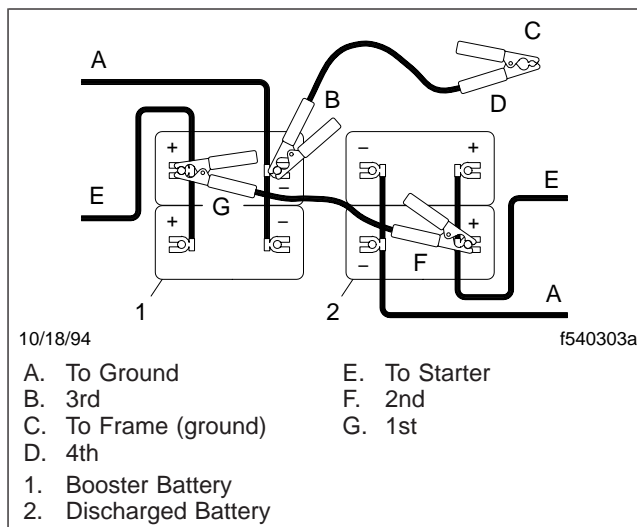


Fig. 13.5, Jumper Connections

⚠ WARNING

Do the next step exactly as instructed and do not allow the clamps of one cable to touch the clamps of the other cable. Otherwise, a spark could occur near a battery, possibly resulting in severe personal injury from explosion or acid burns.

4. Connect one end of the second jumper cable to the negative terminal of the booster battery, and connect the other end of the cable to a ground at least 12 inches (300 mm) away from the batteries of the vehicle needing the start. The vehicle frame is usually a good ground. Do *not* connect the cable to or near the discharged batteries.

⚠ WARNING

On vehicles with Mercedes-Benz AGS transmissions, make sure the current gear indicator displays "N" before starting the vehicle. If the transmission starts in gear, it could cause an accident resulting in death, serious personal injury, or property damage.

5. Start the engine of the vehicle with the booster batteries, and let the engine run a few minutes to charge the batteries of the other vehicle.
6. Attempt to start the engine of the vehicle with the batteries receiving the charge. Do not operate the starter longer than 30 seconds, and wait at least two minutes between starting attempts to allow the starter to cool.
7. When the engine starts, let it idle a few minutes.

⚠ WARNING

Do the next step exactly as instructed and do not allow the clamps of one cable to touch the clamps of the other cable. Otherwise, a spark could occur near a battery, possibly resulting in severe personal injury from explosion or acid burns.

8. Disconnect the grounded cable from the frame or other non-battery location, then disconnect the other end of the cable.
9. Disconnect the remaining cable from the newly charged battery (or jump-start post if equipped) first, then disconnect the other end.

In an Emergency

10. Close the battery compartment. For detailed instructions, see [Chapter 2](#).

Towing

When it is necessary to tow the vehicle, make sure the instructions below are closely followed to prevent damage to the vehicle.

WARNING

Do not tow an unbraked vehicle if the combined weight of both vehicles is more than the sum of the gross axle weight ratings (GAWR) of the towing vehicle. Otherwise brake capacity will be inadequate, which could result in personal injury or death.

Front Towing Hookup

1. Disconnect the battery ground cables.

CAUTION

Failure to remove the axle shafts when towing the vehicle with the rear wheels on the ground could result in damage to the transmission and other parts.

2. Remove both drive axle shafts. On dual drive axles, if the vehicle is to be lifted and towed, remove only the rearmost drive axle shafts.

On vehicles equipped with an air fairing, remove both the forward and rearmost drive axle shafts if there is insufficient towing clearance.
3. Cover the ends of the hubs with metal plates or plywood cut to fit the axle opening, and drilled to fit the axle shaft studs. This prevents lubricant from leaking out and will keep contaminants from getting into and damaging the wheel bearings and axle lubricant.

CAUTION

Failure to protect the frame rails from the chains could cause damage, leading to eventual frame failure.

4. On dual drive axles, if the vehicle is to be lifted and towed, chain the forward rear-axle assembly

to the vehicle frame. Use protection to keep the chains from damaging the frame.

5. Remove the bumper end caps and chrome bumper (if equipped).

CAUTION

Do not pass a sling (for example, a rope or chain) from one tow hook to another to fasten for towing (see [Fig. 13.6](#)). Known as reeving, this practice is *not* permissible in most industrial applications of towing and hoisting. Reeving can overload the hooks and result in damage to the vehicle.

6. Attach the towing device. Due to the many variables that exist in towing, positioning the lifting and towing device is the sole responsibility of the towing-vehicle operator.
7. Lift the vehicle and secure the safety chains. If extra towing clearance is needed, remove the front wheels.
8. Connect the clearance lights, taillights, and signal lights. Connect any special towing lights required by local regulations.

WARNING

Failure to chock the tires or connect the tow truck's air brake system before releasing the spring parking brakes could allow the disabled vehicle to suddenly roll. This could cause property damage or personal injury.

9. Chock the tires on the disabled vehicle and connect the towing vehicle's air brake system to the vehicle being towed. Then, release the spring parking brakes and remove the chocks.

Rear Towing Hookup

CAUTION

Using a rear towing hookup on a vehicle equipped with a roof fairing could cause damage to the cab structure.

1. Place the front tires straight forward and secure the steering wheel in this position.
2. Disconnect the battery ground cables.

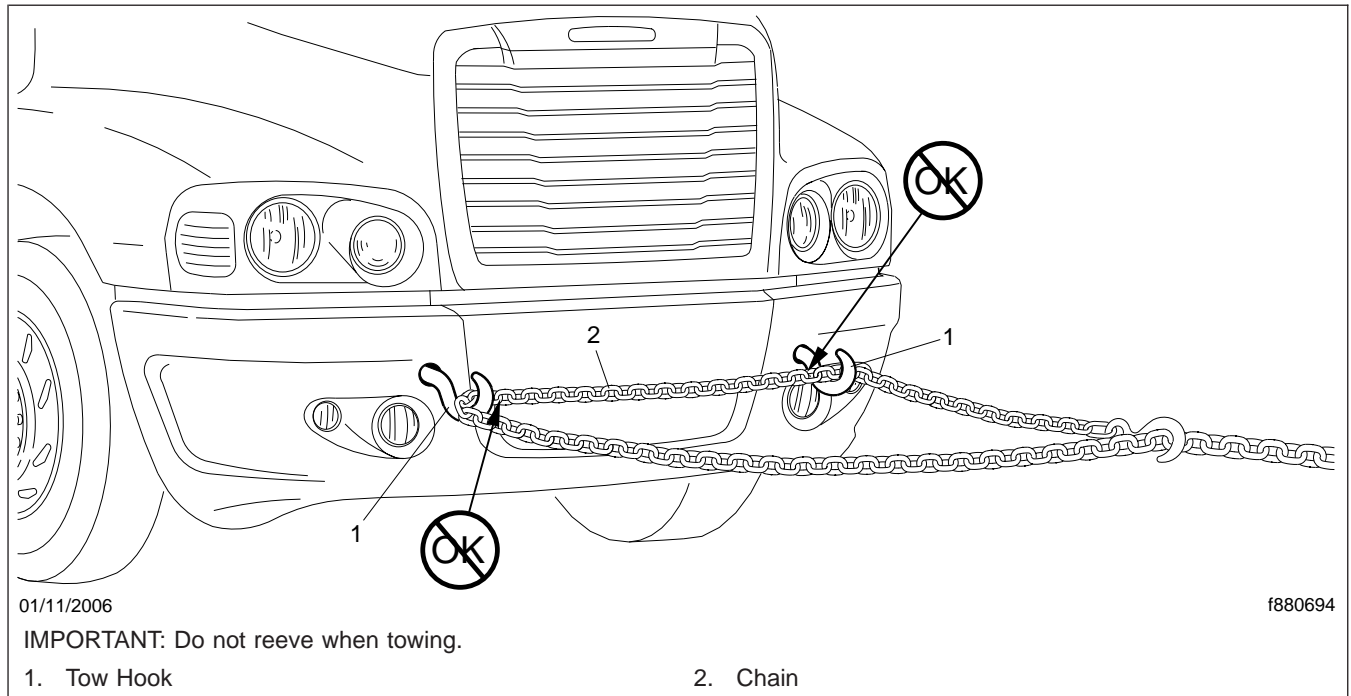


Fig. 13.6, Reeving

CAUTION

Failure to protect the frame rails from the chains could cause damage, leading to eventual frame failure.

3. On dual drive axles, using protection to keep the chains from damaging the vehicle frame, chain the forward-rear drive axle to the frame.
4. Attach the towing device. Due to the many variables that exist in towing, positioning the lifting and towing device is the sole responsibility of the towing-vehicle operator.
5. Lift the vehicle and secure the safety chains. If extra clearance is needed, remove the bumper extension if equipped.
6. Connect the clearance lights, taillights, and signal lights. Also connect any special towing lights required by local regulations.

Fire in the Cab

The incidence of fire in medium-duty trucks is rare, according to data from the National Highway Traffic

Safety Administration. Federal Motor Vehicle Safety Standard #302 limits the flammability of specified materials used inside the cab, but despite this, most materials will burn. The cab of this vehicle contains urethane foam, which is of concern in this respect.

WARNING

Urethane foam is flammable! Do not allow any flames, sparks, or other heat sources such as cigarettes or light bulbs to contact urethane foam. Urethane foam in contact with such heat sources could cause a serious, rapid fire, which could result in death, severe burns, or gas poisoning, as well as damage to the vehicle.

In Case of a Cab Fire

As quickly as possible, bring the vehicle to a safe stop, apply the parking brake, turn off the ignition, and get out of the vehicle.

14

Headlight Aiming

Preliminary Checks	14.1
Checking Headlight Aim	14.1
Adjusting Headlight Aim	14.1

Headlight Aiming

Preliminary Checks

Before checking or adjusting the headlight aim, do the following:

- Check that the hood is closed and latched.
- Check the suspension for proper functioning of the leveling mechanism. On cabs with air suspensions, make sure that the height is properly adjusted.
- Remove any large amounts of mud or ice from the underside of the fenders.
- Check the springs for sagging or broken leaves.
- Check for damage to the hood and hinge assembly. Repair as necessary.
- With the vehicle unloaded, check that the tires are inflated to the recommended air pressure.
- Clean the headlight lenses. Use a soft cloth with mild, non-caustic soap or detergent, and water.

Checking Headlight Aim

1. Park the vehicle on a level surface, 25 ft (7.6 m) away from, and perpendicular to, a vertical screen or wall. Shut down the engine and set the parking brake. Chock the tires.
2. Each headlight has a height adjusting dot. See [Fig. 14.1](#). Measure the distance from the ground to the height adjusting dot on each headlight. Note those distances. See [Fig. 14.2](#), Ref. A.

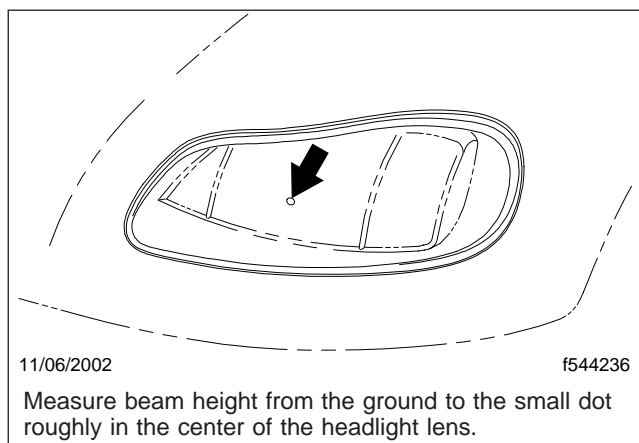


Fig. 14.1, Headlight Beam Height Adjusting Dot

3. Mark the vertical distances found in step 2 on the screen or wall, directly in front of the headlights. These marks represent the desired locations of each headlight bulb center in the following steps. See [Fig. 14.2](#), Items 2 and 3.
4. Turn on the low-beam headlights.
5. Identify the center of each beam projection by marking the area of brightest intensity on the wall. The area of brightest intensity should fall on or very near the marks made during step 3. See [Fig. 14.3](#).
6. Use [Table 14.1](#) to determine the maximum vertical distance allowable between the marks made in step 3 and the marks made in step 5. If the vertical distance between the marks made in steps 3 and 5 is greater than the maximum distance given in [Table 14.1](#), adjust the vertical positioning of that headlight.

Adjusting Headlight Aim

NOTE: Freightliner vehicles are offered with various headlight assembly options. Because of the various options, the location of adjustment screws on the vehicle's headlight assembly may vary from what is shown here.

1. Lift the flap over the rear end of the headlight bucket to expose the two plastic adjusting knobs on each headlight. See [Fig. 14.4](#).
2. If necessary, adjust the horizontal positioning of the headlights so that each projection points directly forward.
3. Turn the vertical adjustment knob to adjust the headlight beam to meet the desired height. See [Table 14.1](#). Turn the knob clockwise to raise the beam; turn the knob counterclockwise to lower it.
4. Adjust the other headlight.

Headlight Aiming

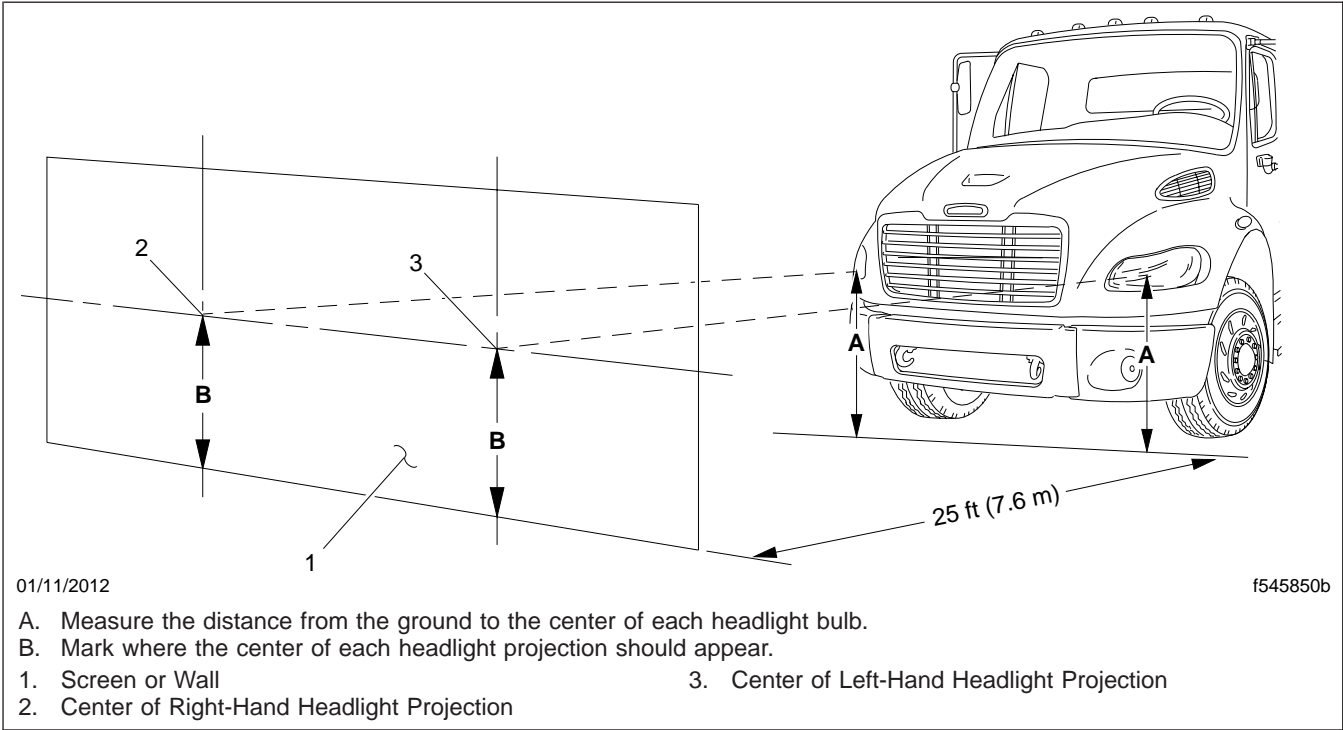


Fig. 14.2, Headlight Aiming Screen/Wall

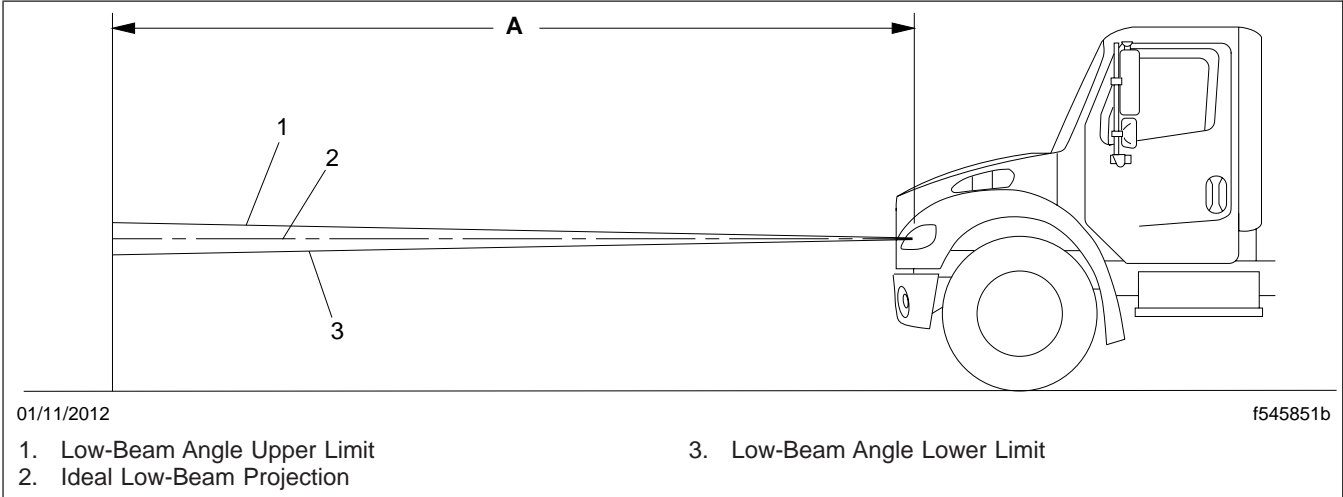


Fig. 14.3, Vertical Low-Beam Headlight Variation Limits

Headlight Aiming

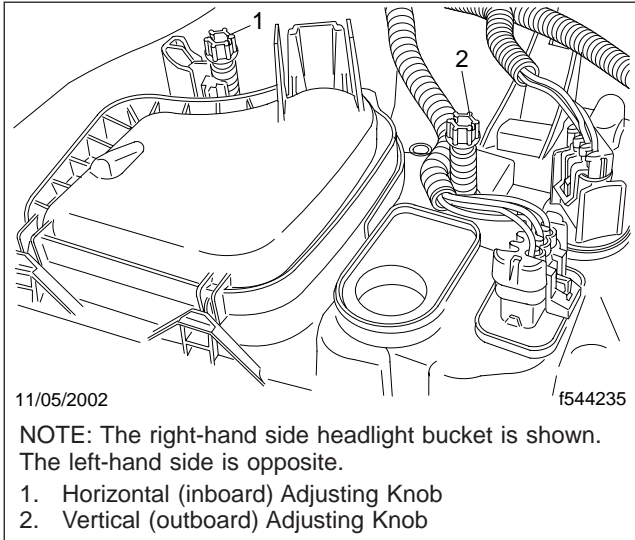


Fig. 14.4, Headlight Adjusting Knobs

Vertical Low-Beam Headlight Variation Limits			
Distance Between Ground and Headlight: in (mm)	Desired Variation (Fig. 14.3, Item 2): in (mm)	Upper Limit (Fig. 14.3, Item 1): in (mm) up	Lower Limit (Fig. 14.3, Item 3): in (mm) down
22–36 (560–900)	0	3.9 (100)	3.9 (100)
36–48 (900–1200)	2 (50) down	2 (50)	6 (150)
48–54 (1200–1400)	2.5 (64) down	1.6 (40)	6.5 (165)

Table 14.1, Vertical Low-Beam Headlight Variation Limits

15

Hybrid Electric Vehicle

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Starting, and Engine Shutdown (HEV)	15.2
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Hybrid Electric Vehicle

Hybrid Electric Vehicle (HEV) Overview

A hybrid electric vehicle (HEV) has both a diesel engine and an electric motor. Engine torque is augmented with electrical torque. The electric motor is powered by batteries, which are charged by regenerative braking and, on vehicles equipped with the ePTO option, the diesel engine.

The batteries cannot move the vehicle for long distances at highway speeds. In the event of a diesel engine failure, drive the vehicle to a safe location as quickly as possible.

Eaton Corporation developed and supplies the hybrid electric system for Freightliner Trucks. The primary system components are the hybrid drive unit (or "HDU", which includes the electric generator/motor and automated transmission), power electronics carrier (PEC), and the motor inverter/controller. Electric power take-off (ePTO) and auxiliary power generator (APG) components are optional on the HEV system.

Freightliner Trucks designed the stand-alone liquid cooling system required to support the operation of Eaton's HEV system. Its primary system components are the electric water pump, reservoir/expansion tank, radiator, electric radiator fan, and coolant plumbing.

Body builders will develop the components for the PTO, the PTO plumbing, and a safety switch to prevent the diesel engine from starting when the hood is open.

Regenerative Braking

Regenerative braking reduces vehicle speed by converting some of the vehicle's kinetic energy into electric energy to charge the hybrid system's batteries. When the accelerator pedal is at idle while coasting, or the service brake is depressed to slow the vehicle, the hybrid system charges the batteries.

The regeneration will feel as if the brake is being lightly applied when you remove your foot from the accelerator pedal. The full power of the service brake is always available to the driver, and regenerative braking is automatically shut off during an ABS (antilock brake) event.

The Eaton Hybrid Control Unit will automatically shut off regenerative braking when the batteries are fully charged.

High-Voltage Safety Features

The HEV has high-voltage cables and a service switch on the PEC.

High-voltage cables are covered in orange insulation and conduit. Each high-voltage component is tagged with a warning or danger label.

IMPORTANT: The service switch on the PEC should only be used for an emergency shutdown, or when the service manual or troubleshooting guide calls for work on the high-voltage system. The service manual and troubleshooting guide for the hybrid electric system are available from www.roadranger.com.

The red service switch is located next to the high-voltage cable connections at one end of the PEC. Pushing in the red service switch will shut down the engine. The hybrid system will be disabled, and the high-voltage batteries in the PEC, though still live, are isolated in the PEC.

NOTE: The PEC may be mounted in an area with limited access.

For information on emergency shutdowns, see "Emergencies" in this chapter.

Cooling System

The HEV requires a liquid cooling system for the HDU, inverter, DC/DC Converter (if ePTO equipped), and APG (if equipped). The HEV's cooling system is separate from the engine cooling system.

For coolant, use a mixture of 50 percent ethylene glycol and 50 percent water.

Electric Power Take-Off (ePTO)

The Electric Power Take-Off (ePTO) option provides standard hydraulic functions without continuous diesel engine operation. The PTO drive power is provided by the hybrid motor and hybrid batteries. When the hybrid batteries deplete, the diesel engine automatically starts to recharge them and provide PTO drive power. Once the batteries are fully charged, the engine shuts down automatically. Vehicles with the ePTO option are designed with a safety switch to ensure the diesel engine does not start when the hood is open.

A DC/DC converter is required for ePTO applications to convert high-voltage DC to 12-volt DC.

NOTE: To maintain a power supply from the vehicle's low-voltage batteries, the alternator charges them when the vehicle is being driven.

Safety Precautions (HEV)

The HEV has high-voltage components, including 340-volt DC batteries and a 500-volt AC motor. Never cut high-voltage cables or connectors. Do not paint high-voltage cables.

Avoid direct pressure wash on high-voltage connections (PEC, DC/DC Converter) and the air intake and exhaust on the PEC.

Starting, and Engine Shutdown (HEV)

The Cranking System

The primary engine starter is the electric motor in the HDU, which cranks the engine very quickly. The back-up cranking system is the standard 12-volt starter on the engine. If the hybrid system is offline or the hybrid batteries are insufficiently charged, the vehicle will automatically use the 12-volt cranking system to start the engine.

Starting

1. Set the parking brake.
2. Place the key in the ignition, and turn it clockwise to the ON position to initiate power to the hybrid system.

Wait for the gauges on the instrument panel to complete two sweeps (one from left to right, and one from right to left) and return to their normal ranges.

3. Ensure the transmission is in neutral. The gear display should display a solid "N".

WARNING

Never start the engine unless the transmission is in neutral and the brake is applied. Accidental movement of the vehicle could result in property damage, personal injury, or death.

4. Turn the key clockwise to the START position. The engine will crank after a brief delay. As soon as the engine starts, release the key, allowing it

to return to the ON position. The engine will continue to run with the key in the ON position.

5. Apply the service brake, then release the parking brake.
6. With the service brake applied, press the desired mode on the shift control to put the vehicle into gear.
7. Slowly release the service brake.

NOTE: The vehicle may be powered by the electric motor or the diesel engine, depending on battery charge and the demand for driveline torque. If the electric motor alone is powering the driveline, the diesel engine will stay at idle.

Engine Shutdown

1. Place the transmission in neutral by selecting N on the shift control.

IMPORTANT: The transmission must be in neutral for proper shutdown.

2. Set the parking brake.
3. Turn the key counterclockwise to the OFF position.

NOTE: Intermittent noises such as clicking and transmission shifting may be audible from the transmission while it completes a self-test and shutdown.

Hybrid System Fault Lamps (HEV)

There are two lamps on the dashboard that indicate a hybrid system fault is active — the red STOP HYBRID lamp and the amber CHECK HYBRID lamp. See [Fig. 15.1](#). When the red STOP HYBRID lamp is illuminated, do not drive the vehicle; have it towed to a Freightliner dealer or an authorized service center for repairs. When the amber CHECK HYBRID lamp is illuminated, the vehicle can still be driven, though it may operate without the assistance of the hybrid electrical system.

Hybrid Electric Vehicle

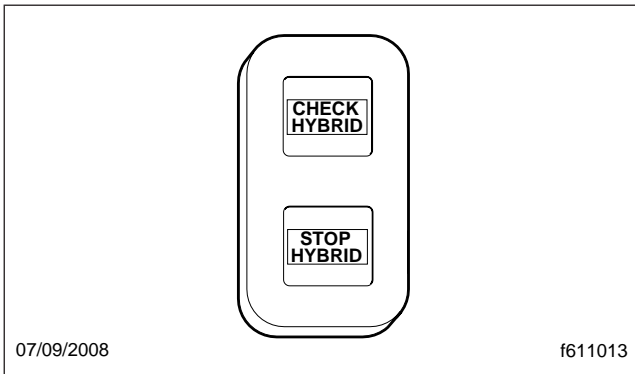


Fig. 15.1, Hybrid System Fault Lamps

Emergencies (HEV)

Emergency Shutdown



After disabling the vehicle, power is maintained in the high-voltage electrical system for up to five minutes. Unprotected contact with any "live" high voltage components can cause serious injury or even death.

There are two options for performing an emergency shutdown. The preferred method is to turn off the ignition key. The other option is to disconnect the low-voltage (12-volt) vehicle batteries. In either case, the engine will shut down, dash lights will shut down, the hybrid electrical system will shut down, and the high-voltage batteries in the Power Electronics Carrier (PEC) will remain "live" but isolated in the PEC.

NOTE: If the service switch on the PEC is accessible, it may be pushed in to shut down the hybrid electrical system and isolate the "live" HEV batteries in the PEC.

In Case of an Accident or Fire

If the HEV becomes involved in an accident or fire, be aware of the following:

- Use CO2 or dry chemical extinguishers. The batteries in the PEC are lithium ion.
- Do not cut into high-voltage cables. The high-voltage wiring is covered in orange insulation or convoluted tubing.
- Do not cut into or open the PEC.

- Do not cut into or open the DC/DC converter.
- Do not cut into or open the inverter.

If it is necessary to remove occupants using cutting equipment, avoid high-voltage cables and the PEC.

Jumpstarting (HEV)

Jumpstarting vehicles equipped with the Eaton® Hybrid System is identical to Non-Hybrid vehicles, which use the vehicle 12-volt battery system.

Towing (HEV)

When towing the vehicle, the output shaft of the transmission must not be allowed to spin or turn. If the vehicle is towed with the drive wheels still in contact with the road surface, the vehicle axle shafts or driveline must be removed or disconnected. See "Towing" in [Chapter 13](#).

16

Natural Gas Vehicle

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Natural Gas Vehicle

Natural Gas Vehicles, General Information

The vehicle can be equipped with a compressed natural gas (CNG) fuel system, or a liquefied natural gas (LNG) fuel system. CNG is made by compressing natural gas to less than 1% of its volume at standard atmospheric pressure. LNG is created by condensing natural gas into a liquid by cooling it to approximately -259°F (-162°C).

When vaporized at ambient temperatures, natural gas is less dense than air, and it rises and disperses. However, LNG is initially heavier than air due to its cryogenic temperature. When released in large amounts, it may drop or pool on the ground before its temperature rises enough to vaporize. Cold atmospheric conditions may prevent natural gas from dispersing quickly when released in large amounts.

Natural gas is nontoxic, but it can cause asphyxiation if present in very large concentrations.

CNG often contains an odor-producing chemical, while LNG does not have any odor. Users of natural-gas-fueled vehicles should never expect to detect natural gas leaks by scent.

For natural gas to burn, it must first vaporize, then mix with air in the proper proportions (flammable range is 5 to 15% by volume in air), and then be ignited.

A typical natural gas fuel system consists of:

- Fuel supply cylinders that store compressed gas at high pressure (CNG), or a tank that stores liquefied gas at an extremely low temperature (LNG).
- A vaporizer or heat exchanging device that changes LNG to gaseous form (LNG fuel systems only).
- Pressure relief and manual fuel shutoff valves.
- A filling connection with a check valve that prevents the gas from flowing back out of the fuel filling line.
- High-pressure and low-pressure fuel filters.
- A pressure control regulator that reduces the high fuel tank or cylinder pressure to the lower pressure needed for the engine.

- A fuel contents gauge that indicates the fuel supply in the tank or cylinders.

Natural Gas Vehicles, Safety Precautions



Natural gas is highly flammable. Failure to observe the following safety precautions could lead to the ignition of the natural gas, which could cause serious bodily injury or death.

Follow these safety precautions when operating or repairing a natural gas vehicle.

- Do not start the engine if a natural gas leak is detected.
- Do not transfer CNG from one vehicle to another, as a buildup of static electricity could cause a spark and ignite the fuel.
- Do not attempt to cut any fuel supply piping components.
- Avoid open flames or sparks near a natural gas vehicle.
- Cover eyes and exposed skin when working on a natural gas fuel system or fueling a natural gas vehicle.
- Permit no smoking or other ignition sources within thirty feet of a natural gas vehicle.
- Have CO₂ fire extinguishers (ABC minimum) located in a highly visible and easily accessible location.
- Use Purple-K powder (PKP) or a similar dry powder to extinguish an LNG fire. Do not attempt use water around an LNG fire.
- Always purge the fuel lines before performing maintenance or repairs on a natural gas fuel system. To purge the lines, close the manual fuel shutoff valve, and start the engine. Let the vehicle idle until the fuel lines are empty and the engine stops.
- Always use a natural gas detector to test the system for leaks, whether an odor is present or not. Routinely inspect the fuel filtering and regulating mechanisms, and the fuel lines. A

bubble solution can be used to pinpoint the exact location of leaks.

- Always tighten fasteners and fuel connections to the required torque specification. Overtightening or undertightening could cause leaks.
- Close the fuel shutoff valve(s) before performing maintenance and repairs.
- Do not store a natural gas vehicle indoors for any extended period of time. Do not bring a natural gas vehicle indoors unless the workshop is equipped with a methane detection and ventilation system.

In Case of Emergency

If a vehicle has sustained damage or a leak has been discovered:

1. Turn the ignition switch off, set the parking brake, and disconnect the battery.
2. Remove all ignition sources from the area surrounding the vehicle.
3. If it is safe to do so, close all fuel shutoff valves.
4. Open the vehicle doors to introduce fresh air.
5. Use a natural gas detector to identify leaks in the fuel system.

Natural Gas Fuel Tank Filling Procedures

CNG Vehicle Fueling

CNG is moved from the fuel station storage tanks to the vehicle cylinders through a metered dispenser. During fueling, as pressure inside of the vehicle cylinders increases, so does the temperature. The dispenser shuts off when it determines the CNG cylinders are full.

CNG fuel cylinders cannot be filled to their full capacity of 3600 psi (24 800 kPa) in cooler weather. Since temperature change causes gas to expand and contract, less pressure in the cylinders on a cold day is equal to the same amount of gas at a higher pressure on a warm day. The fuel station dispenser has a temperature-pressure compensating device, which accounts for ambient temperature during fueling. See [Table 16.1](#) for approximate full cylinder pressures at various temperatures.

CNG Temperature/Pressure Compensation Values		
Temperature: °F (°C)	Fill Station Pressure Set Point	
	3000 psi (20 684 kPa) Set Point	3600 psi (24 821 kPa) Set Point
100 (37.8)	3415 (23 546)	4086 (28 172)
90 (32.2)	3276 (22 587)	3909 (26 952)
80 (26.7)	3138 (21 636)	3754 (25 883)
70 (21.1)	3000 (20 684)	3600 (24 821)
60 (15.6)	2861 (19 726)	3445 (23 752)
50 (10)	2723 (18 774)	3288 (22 670)
40 (4.4)	2584 (17 816)	3131 (21 587)
30 (-1.1)	2446 (16 865)	2973 (20 498)
20 (-6.7)	2307 (15 906)	2814 (19 402)
10 (-12.2)	2169 (14 955)	2655 (18 306)
0 (-17.8)	2031 (14 003)	2495 (17 202)
-10 (-23.3)	1893 (13 052)	2336 (16 106)
-20 (-28.9)	1755 (12 100)	2180 (15 031)
-30 (34.4)	1616 (11 142)	2024 (13 955)
-40 (-40)	1477 (10 184)	1868 (12 879)

Table 16.1, CNG Temperature/Pressure Compensation Values

Use the following steps to fuel a CNG vehicle.

1. Shut down the engine and apply the parking brake.

IMPORTANT: Close all windows and doors during the fueling process. Keeping windows and doors closed allows for easier leak detection inside the cab after fueling.

WARNING

Natural gas fuel tanks, lines, and valves are always pressurized. Always observe safety precautions. Failure to do so could lead to loss of control over a filling hose or to ignition of the natural gas, which could cause serious bodily injury, death, or severe property damage.

2. Ensure all fuel cylinder shutoff valves are open. See [Fig. 16.1](#).
3. Ensure the vehicle fuel system main shutoff valve is open.
4. Open the CNG fuel panel access door and remove the dust cap from the vehicle fuel fill port.

Natural Gas Vehicle

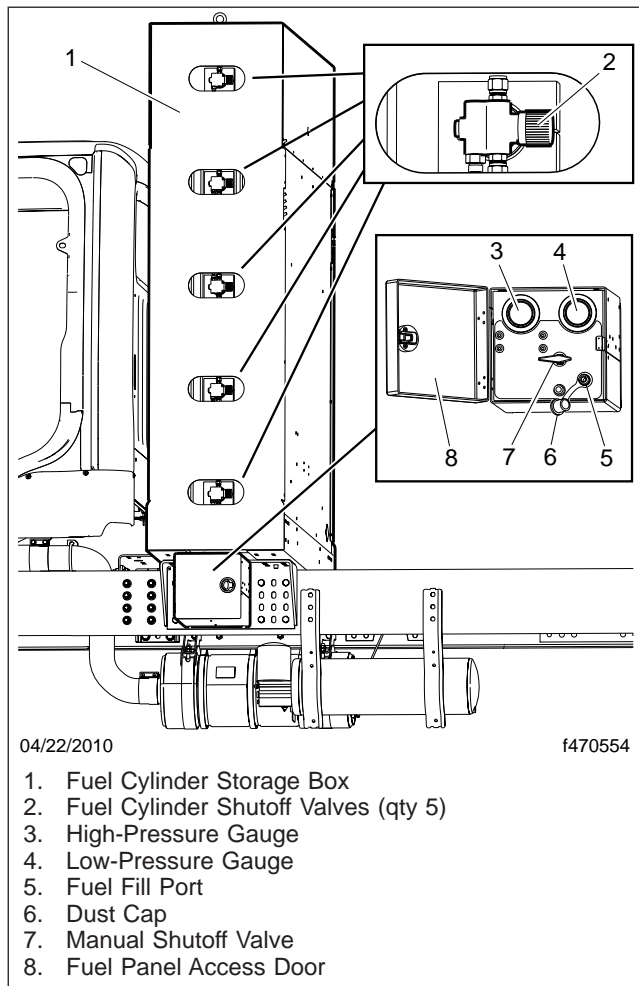


Fig. 16.1, CNG Fuel Cylinder Storage Box (5-cylinder system shown)

5. Ensure the O-ring is present inside the fuel fill port. If the O-ring has been dislodged or is missing, the station dispensing nozzle will not connect securely to the fill port.
6. Turn the selector knob on the service pump to the VENT position, if equipped.
7. Connect the quick coupling on the dispensing nozzle securely to the vehicle fuel fill port.
8. Turn the selector knob on the service pump to the FILL position, if equipped.

IMPORTANT: If at any time the service pump or vehicle begins to vent CNG uncontrollably, notify a station attendant or activate the service sta-

tion emergency shut-off switch to cease the flow of CNG.

9. Switch on the service pump. A slight hissing noise may be heard as the fuel cylinders fill.
10. Watch the pressure gauge on the service pump. When the gauge reads approximately 3600 psi (24 800 kPa), or when the fill pressure stops climbing, the CNG cylinders are full. The service pump will shut itself down automatically. See **Table 16.1** for pressure compensation values based on ambient temperatures.
11. Move the selector knob on the service pump to the VENT position, if equipped. A short hiss will be heard as a small amount of natural gas is vented into the hose.

⚠ WARNING

Do not attempt to remove the fill station nozzle from the tank fill fitting until venting of pressure is noted. If no venting occurs, ask for assistance from the station attendant. Removing an unvented coupling could result in an uncontrolled hose, which could lead to property damage or personal injury.

12. Remove the station dispensing nozzle from the vehicle fill port.
13. Install the dust cap on the vehicle fuel fill port and close the fuel panel access door.

LNG Vehicle Fueling

The LNG fuel tank is designed to be filled from any LNG fuel source that has a 100 micron or finer fuel filter and a fuel delivery pressure between 120 and 225 psi (827 and 1551 kPa).

The LNG fuel tank is designed to be top-filled through a single hose with no vent return. As cold LNG is sprayed into the vapor space of the tank, the cold liquid condenses the vapor and creates space for itself inside the tank, eliminating any need to vent during the filling process.

The LNG tank is equipped with a small internal ullage tank for vapor space, which allows for fuel expansion and increases vehicle standby time. When an LNG tank is full, fuel can continue to flow into the ullage tank. However, if the ullage tank is completely filled during fueling, standby time will be reduced to

zero and the primary relief valve will open almost immediately after fueling, allowing excess LNG vapor to escape. If fueling is stopped when the ullage tank is empty (i.e., the fuel tank has sufficient vapor space to accommodate fuel expansion due to temperature increase), the vehicle will have approximately one week of standby time before venting will occur.

Use the following steps to fuel an LNG vehicle.

1. Shut down the engine and apply the parking brake.

IMPORTANT: Close all windows and doors during the fueling process. Keeping windows and doors closed allows for easier leak detection inside the cab after fueling.

WARNING

Liquefied natural gas is a cryogenic liquid stored at approximately -259°F (-162°C). Cryogenic burns can be caused by coming into contact with the pressurized liquid stream, or by coming into contact with fuel system components that have been cooled to cryogenic temperatures. Always wear gloves and a face shield, and cover exposed skin when fueling.

2. Remove the fuel fill fitting dust cap. See [Fig. 16.2](#).
3. Using compressed air, remove any dirt, debris, or water that may have collected in the fuel fill fitting and the station dispensing nozzle. Contaminants in the fuel system can cause drivability problems.

WARNING

Natural gas fuel tanks, lines, and valves are always pressurized. Always observe safety precautions. Failure to do so could lead to loss of control over a filling hose or to ignition of the natural gas, which could cause serious bodily injury, death, or severe property damage.

4. Connect the station fueling nozzle to the tank fuel fill fitting.
5. Connect an electrical ground clamp and cable to the fuel tank.

IMPORTANT: An LNG tank which is first installed, or is on a vehicle that has not been op-

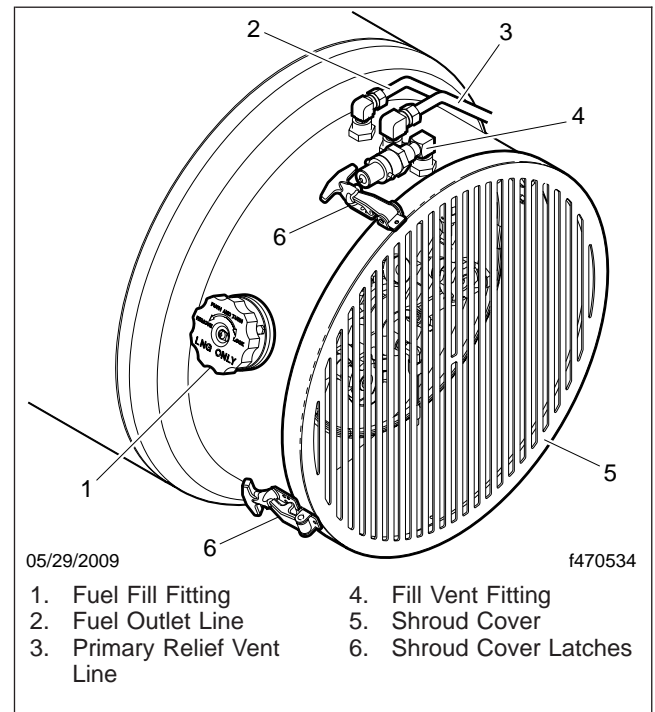


Fig. 16.2, LNG Fuel Tank

erated in approximately ten days, is considered to be a hot tank. When fueling a hot tank, LNG entering the tank will immediately vaporize, causing tank pressure to spike above 250 psi (1724 kPa) and automatically shutting down the station fuel pump. To prevent the pump from shutting down, connect a vent line to the fill vent fitting on the LNG tank to capture escaping vapor, then open the shroud cover and open the vapor shutoff valve ([Fig. 16.3](#), Item 2).

6. Open the station's fill valve, if equipped, and start fueling. Monitor the flow or line pressure as filling progresses. When filling begins, line pressure will spike quickly until the vehicle tank cools down. The flow and pressure will then remain stable during the remainder of the filling procedure.

IMPORTANT: When fueling a hot tank, initially put 5 to 10 gallons (19 to 37 liters) of LNG in the tank and manually stop the fueling process. Drive the vehicle for 15 to 20 minutes to cool the tank and reduce tank pressure, then continue fueling the tank to full.

Natural Gas Vehicle

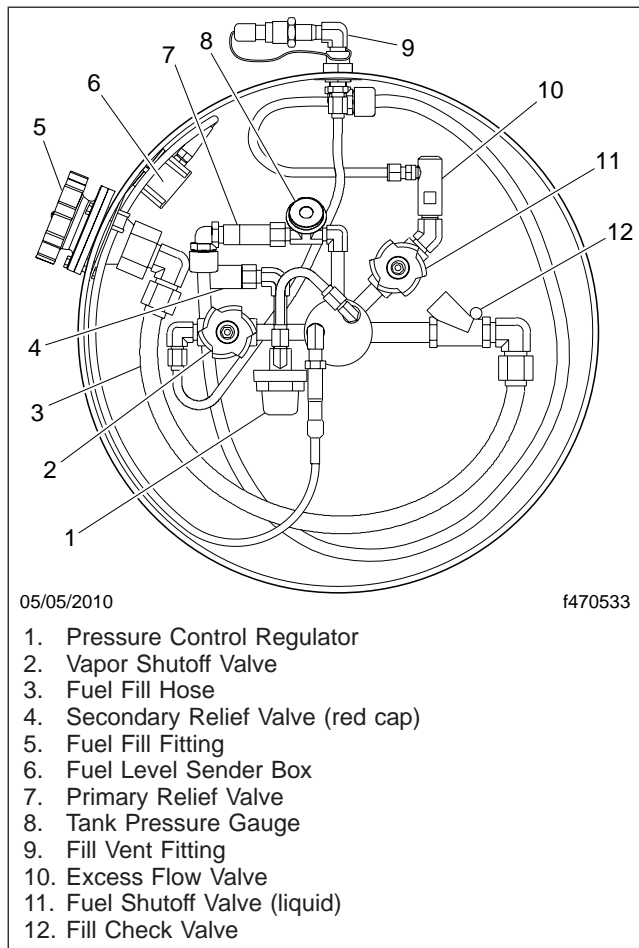


Fig. 16.3, LNG Fuel Tank Plumbing Components

7. When the tank is full, the line pressure will rapidly spike and the flow rate will fall. When a pressure rise or flow rate drop is observed, close the station's fill valve, if equipped.

NOTE: Do not over-fill an LNG tank. If the ullage tank is completely filled during fueling, tank standby time will be reduced to zero and the primary relief valve will open almost immediately after fueling.

8. Disconnect the station hose from the tank fuel fill fitting.
9. Disconnect the electrical ground clamp and cable from the fuel tank.
10. Install the dust cap on the tank fuel fill fitting.

Natural Gas Detection System

A gas detection system is used in all Daimler Trucks natural-gas-fueled vehicles. This system has a sensor in the engine compartment and one in the cab, both situated in high areas to detect natural gas buildup as a result of leaks.

The AMGaDS III Plus is a natural gas detection system. This device is meant to serve as a supplemental warning only. It is not intended to replace standard safety practices that should be conducted around flammable gases.

IMPORTANT: To function properly, the gas detection system must be powered at all times. The gas detection system is directly powered by the batteries, and can only be powered off by disconnecting the batteries. When servicing a natural-gas-fueled vehicle, disconnect the batteries only when necessary, and do not leave the batteries disconnected for extended periods of time.

The lower flammability limit (LFL) is the smallest amount of the gas that supports a flame when mixed with oxygen and ignited. Zero percent (0%) LFL indicates a gas-free atmosphere. One hundred percent (100%) LFL indicates that gas concentration has reached its lower flammability limit (5% gas in air by volume). The red warning light and audible alarm located in the overhead console activate when a sensor detects gas fumes in concentrations above 50% LFL, and should allow ample time to utilize safety procedures. However, individuals with special needs should review the system with a professional safety engineer.

Alarm Procedure

Before operating the vehicle, the driver must be familiar with the procedures as shown on the interior sticker on the overhead panel (**Fig. 16.4**) and the exterior sticker on the door (**Fig. 16.5**).

IMPORTANT: If an audible alarm activates, do not operate any electrical switch, including lights. Avoid causing sparks and stay away from arcing switches and equipment. Do not use a telephone, including cellular phones or any types of portable communication or electronic devices that have a battery.



Fig. 16.4, Interior Warning Sticker



Fig. 16.5, Exterior Warning Sticker

If the vehicle is in motion when the audible alarm activates, bring it to a safe stop, shut down the engine, and exit the vehicle. *Do not open the hood.*

If outside the vehicle when the audible alarm activates, *do not open the cab door or hood.*

In the event of an audible alarm, immediately follow these procedures, as allowed by conditions:

1. Immediately shut off all engines. Extinguish any cigarettes, pilot lights, flames, or other sources of ignition in the area and adjacent areas.
2. Manually close all fuel shutoff valves, including those on the LNG tank or CNG cylinders.
3. If the vehicle is indoors (as in a service shop), immediately open windows and doors to provide extra ventilation to the area. Do not start the engine or any other type of equipment until the gas leak is corrected and the area cleared of natural gas.
4. Evacuate the area.
5. Check the fuel lines, LNG tank/CNG cylinders, and fittings to locate the leak. After the area is cleared of natural gas and the alarm is no longer active, have the vehicle inspected by a qualified technician.

IMPORTANT: Do not consider the area clear until all alarm indicators are off, and the alarm panel light returns to green.

Sensors

Gas detection sensors are located on the cab overhead console and in the engine compartment on the frontwall. The sensors are located in high areas, where rising gas vapors will pass by or accumulate.

If the system detects that one of the sensors has been disconnected or has malfunctioned, the sensor fault light for that zone will illuminate. A failed sensor may trigger and lock on an alarm. If a fault condition or locked alarm continues after the sensor's connection and wiring integrity has been verified, replace the sensor.

The sensors are sensitive to all hydrocarbon vapors. An alarm may be triggered by the use of chemicals such as cleaners, paint, polish, lacquer, gasoline, silicone, silicone spray, or other harsh chemicals. The sensors will also detect hydrogen fumes from an overcharged battery. If a sensor sends an alarm, but no gas fumes are present, check for recent use of chemicals or a battery charger.

Natural Gas Vehicle

NOTICE

Silicone-based chemicals and cleaners will permanently disable the sensors. When cleaning the vehicle, cover the sensors with a plastic covering. Keep the sensors covered until the area has been cleared of any cleaning fumes.

Harsh chemicals and extremely high temperatures may damage the sensor.

Puncture of or damage to the seal located inside the sensor housing will significantly shorten the sensor life.

Frequent exposure to high concentrations of gas will accelerate sensor deterioration.

Overhead Console

The overhead console consists of an alarm panel on the right side and the control module on the left side.

The alarm panel has a green light, a red light, a buzzer, and a sensor. See [Fig. 16.6](#). It is located within view from outside of the vehicle. The large green light is continuously illuminated during normal operating conditions.

Before entering the vehicle, always verify that the green light is illuminated. If the green light is not illuminated, do not enter the vehicle. Complete the alarm procedure previously outlined.

The alarm panel meets the California Highway Patrol Title 13-2008 and NFPA 52 2010 requirements. All drivers and technicians using it should be trained regarding the red and green lights, and the audible warning.

The control module, located on the left side of the overhead console, contains the status lights and control buttons for the system. The areas that the sensors monitor are defined as Zone 1 (cab) and Zone 2 (engine compartment). The control module has lights assigned to each zone that will illuminate if a sensor detects a trace level leak (between 20% and 30% LFL), a significant level leak (above 50% LFL), or if a sensor is disconnected or malfunctioning.

- **Trace Level:** If either sensor detects gas fumes at a concentration greater than 20% to 30% LFL (1% gas in air by volume), the amber light next to the *Trace* indicator for that zone will flash. There is no buzzer alarm for a trace

level detection, and the large green light on the alarm panel will remain illuminated.

- **Significant Level:** If either sensor detects gas fumes at a concentration greater than 50% to 60% LFL (2.5% gas in air by volume), the small red light next to the *SIGNIFICANT* indicator for that zone will flash. After approximately 15 seconds, the large green light on the alarm panel will switch off, the red light will illuminate, and the buzzer will sound. All alarm indicators will remain on as long as fumes are detected.
- **Sensor Fault:** If the system detects that either of the sensors has been disconnected or has malfunctioned, an amber light next to the *Sensor Fault* indicator for that zone will illuminate.

The control module also has buttons used to test or reset the the control module after an alarm. Red lights next to each button indicate when they are engaged.

- **Shutdown Reset:** If an alarm has been activated and the *Relay Engaged* light is illuminated, the *Shutdown Reset* button will reset the internal relay. Press the *Shutdown Reset* button only after the gas has cleared, the buzzer has turned off, and the alarm panel light has returned to green.
- **Push To Silence:** If an alarm has been activated, the *Push To Silence* button will silence the buzzer.

See [Table 16.2](#) for the functions of all lights and buttons on the overhead console.

Testing

Daimler Trucks North America strongly recommends that all operators follow California Code of Regulations (CCR) inspection requirements, regardless of where the vehicle is operated. Per Title 13 CCR § 935 (2), gas detection systems should be tested three times per calendar year at equal intervals. The testing procedure should simulate the same operating environment in which the vehicle is used, with the same gaseous fuel.

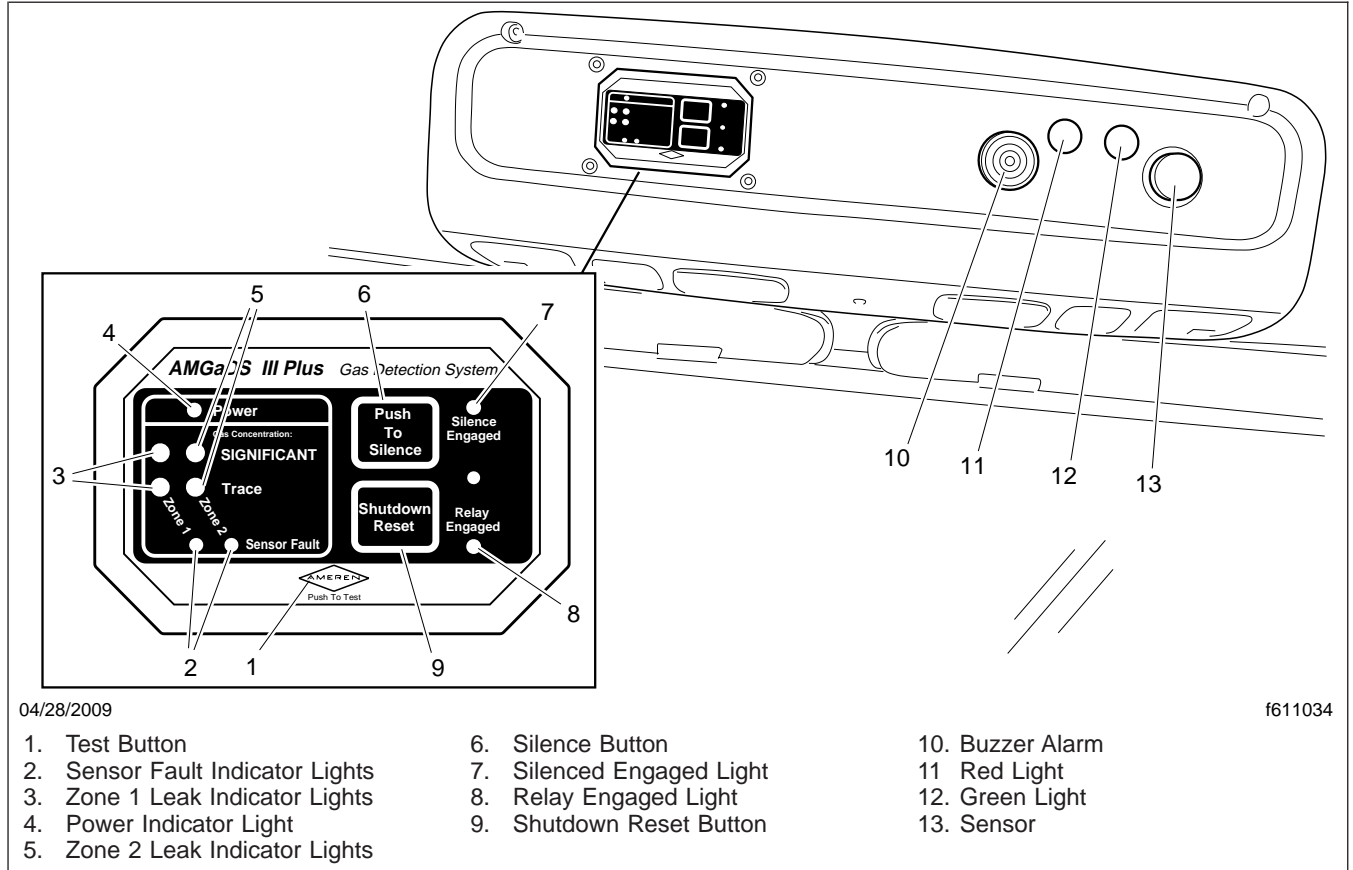


Fig. 16.6, AMGADS III Plus Overhead Console

Control Module Functions			
Item	Display	Function	Action Required
Green Power Light	Illuminated	System is on.	None required.
	Unlit	Detection system is not functioning.	Ensure the batteries are connected and replace any blown fuses. If the gas detection system is still not functioning, replace the system immediately.
SIGNIFICANT Gas Concentration Lights	Red (illuminated)	Dangerous gas concentration detected.	Suspend vehicle operation immediately and follow alarm procedures.
Trace Gas Concentration Lights	Amber (flashing)	Minor gas concentration detected.	Use caution and monitor the system.
Sensor Fault Lights	Off	Sensor is functioning properly.	None required.
	On	Sensor has malfunctioned.	Replace the sensor immediately.

Natural Gas Vehicle

Control Module Functions			
Item	Display	Function	Action Required
Shutdown Reset Button	—	Resets the system after an alarm activation.	Press to reset the system only after the gas has cleared, the buzzer has turned off, and the alarm panel light has returned to green.
Relay Engaged Light	On	Relay is engaged and test or alarm is being cleared.	Press the <i>Shutdown Reset</i> button.
	Off	Normal condition.	None required.
Test Button	—	Tests the overhead console operation and circuitry.	Press and hold for one minute to activate a test of all overhead console components.
Silence Button	—	Silences the alarm buzzer.	Press to silence the alarm buzzer.
Silence Engaged Light	On	Indicates the buzzer is active but silenced.	Suspend vehicle operation immediately and follow alarm procedures.
	Off	Normal condition.	None required.

Table 16.2, Control Module Functions

Test results validating the performance of the gas detection system within the parameters established by the component manufacturer and NFPA 52 2010 should be maintained as a permanent part of the vehicle service records. Use of alcohol, propane, and other harsh liquids or gases are not acceptable methods for testing.

Always test the system and sensors after any component has been replaced, or if the vehicle has been involved in an accident or fire. Ensure that the gas detection system is wired directly to the battery.

It is recommended that the highest level of safety validation be utilized if there are multiple validation requirements in the state or locality where the vehicle is operated or domiciled.

Overhead Console Test

Press and hold the *Push To Test* button for one minute. The system will proceed with a self-diagnostic test that will include illumination of the *Trace* and *SIGNIFICANT* gas concentration lights, and the sensor fault lights. Verify the large red light and buzzer activate, and that all lights illuminate or flash to ensure that all bulbs are operational.

Sensor Test

The gas detection system sensors must be tested using certified test gas, which can be purchased as part of a test kit. Testing with alcohol or heavy gases

such as butane or propane does not satisfy CCR § 935 (2) or NFPA 52 regulations.

Expose each sensor to certified test gas for at least thirty seconds. The system will proceed through the alarm procedure consistent with a significant leak and the buzzer will sound after approximately fifteen seconds. If a sensor fails to respond after exposure to the test gas, replace the sensor.

Natural Gas Engine Starting

NOTE: Before starting the engine, read **Chapter 3** for detailed information on how to read the instruments and **Chapter 4** for detailed information on how to operate the controls. Read the operating instructions in the engine manufacturer's operation manual before starting the engine.

1. Before engine start-up, complete the engine pre-trip and post-trip inspections and maintenance procedures in **Chapter 11**.
2. Ensure the fuel shutoff valve is open.
3. Set the parking brake.
4. Ensure that the transmission shift control is in Neutral (N), Park (P), or the Park Brake (PB) position.

- Without starting the engine, turn the ignition switch to the ON position (Fig. 16.7). The electronic gauges on the instrumentation control unit (ICU) will complete a full sweep of their dials, the warning and indicator lights will illuminate, and the buzzer will sound for three seconds.

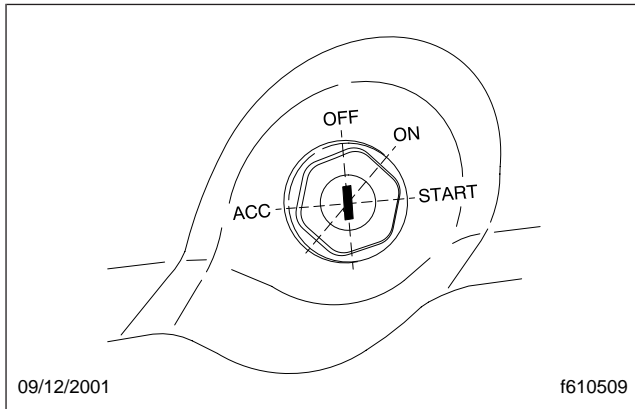


Fig. 16.7, Ignition Switch Positions

- Turn the ignition switch to the START position.
Press down on the clutch pedal, if equipped, but do not press down on the accelerator pedal.
Release the key the moment the engine starts.
- Bring the engine up to operating speed gradually as it warms up and develops stable oil pressure. If the vehicle has not been operated previously in a 24-hour period, allow the vehicle to idle for five minutes.

NOTICE

Do not rev the engine if the oil pressure gauge indicates no oil pressure. Shut down the engine within approximately ten seconds to avoid engine damage.

- Check the oil pressure gauge for any drop in lubricating oil pressure or mechanical malfunction in the lubricating oil system.

Major Repair and Replacement of Natural Gas Components

If a natural-gas-fueled vehicle is involved in an accident, remove the fuel tank or cylinders from service and have them inspected by a qualified technician.

Replace any leaking or damaged fuel tanks/cylinders and fuel lines; repair or replace leaking or damaged fittings. Install parts and components in accordance with the manufacturer's instructions.

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