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.).

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 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/menu.htm.

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Foreword

Contents

1

Vehicle Identification

Vehicle Identification

Vehicle Specification Decal

The vehicle specification decal lists the vehicle model, identification number, and major component models. It also recaps the major assemblies and installations shown on the chassis specification sheet. One copy of the specification decal is attached to the inside of the sliding storage/waste drawer; another copy is inside the rear cover of the *Owner's Warranty Information for North America* booklet. An illustration of the decal is shown in **Fig. 1.1**.

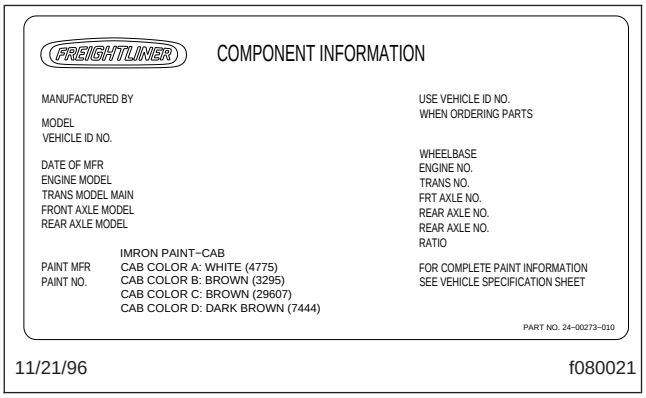


Fig. 1.1, Vehicle Specification Decal (U.S.-built vehicle shown)

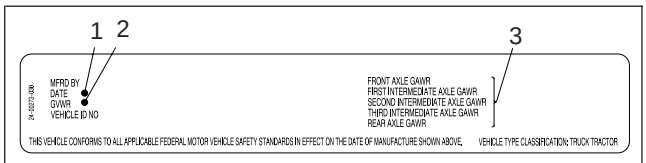
NOTE: Labels shown in this chapter are examples only. Actual specifications may vary from vehicle to vehicle.

Federal Motor Vehicle Safety Standard (FMVSS) Labels

NOTE: Due to the variety of FMVSS certification requirements, not all of the labels shown will apply to your vehicle.

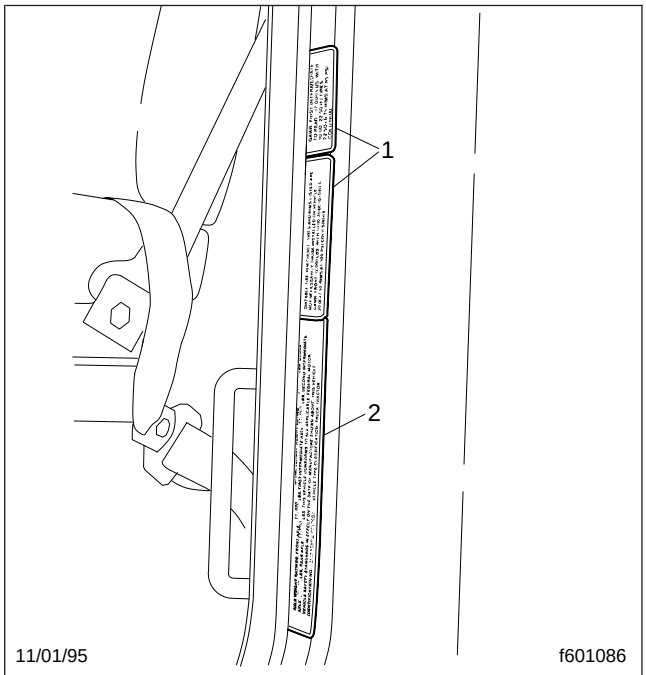
Tractors with or without fifth wheels purchased in the U.S. are certified by means of a certification label (**Fig. 1.2**) and the tire and rim labels. These labels are attached to the left rear door post, as shown in **Fig. 1.3**.

If purchased for service in the U.S., trucks built without a cargo body have a certification label (**Fig. 1.4**) attached to the left rear door post. See **Fig. 1.3**. In addition, after completion of the vehicle, a certification label similar to that shown in **Fig. 1.2** must be attached by the final-stage manufacturer. This label will be located on the left rear door post and certifies



1. Date of Manufacture: by month and year
2. Gross Vehicle Weight Rating: developed by taking the sum of all the vehicle's gross axle ratings
3. Gross Axle Weight Ratings: developed by considering each component in an axle system - including suspension, axle, wheels, and tires - and using the lowest component capacity as the value for the system

Fig. 1.2, Certification Label, U.S.



1. Tire and Rim Labels 2. Certification Label

Fig. 1.3, Labels Location

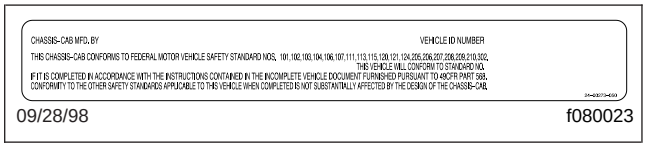


Fig. 1.4, Incomplete Vehicle Certification Label, U.S.

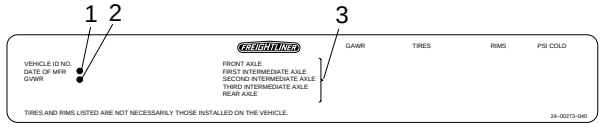
that the vehicle conforms to all applicable FMVSS regulations in effect on the date of completion.

Canadian Motor Vehicle Safety Standard (CMVSS) Labels

In Canada, tractors with fifth wheels are certified by means of a "Statement of Compliance" label and the Canadian National Safety Mark (**Fig. 1.5**), which are attached to the left rear door post. In addition, tire and rim labels (**Fig. 1.6**) are also attached to the left rear door post.

10/10/2006 f080024

Fig. 1.5, Canadian National Safety Mark



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1. Date of Manufacture: by month and year
2. Gross Vehicle Weight Rating: developed by taking the sum of all the vehicle's gross axle ratings
3. Gross Axle Weight Ratings: developed by considering each component in an axle system — including suspension, axle, wheels, and tires — and using the lowest component capacity as the value for the system

Fig. 1.6, Tire and Rim Label

If purchased for service in Canada, trucks built without a cargo body and tractors built without a fifth wheel are certified by a "Statement of Compliance" label, similar to **Fig. 1.2**. This label must be attached by the final-stage manufacturer after completion of the vehicle. The label is located on the left rear door post, and certifies that the vehicle conforms to all applicable CMVSS regulations in effect on the date of completion.

Tire and Rim Labels

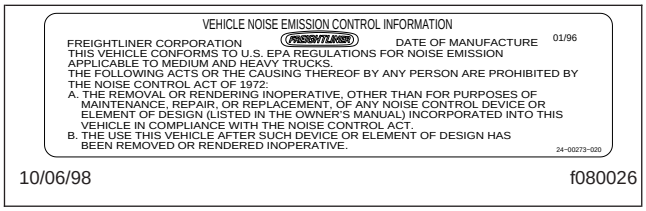
Tire and rim labels certify suitable tire and rim combinations that can be installed on the vehicle, for the given gross axle weight rating. Tires and rims installed on the vehicle at the time of manufacture may have a higher load capacity than that certified by the tire and rim label. If the tires and 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.

See **Fig. 1.6** for U.S. and Canadian tire and rim labels.

EPA Emission Control

Vehicle Noise Emission Control Label

A vehicle noise emission control label (**Fig. 1.7**) is attached either to the left side of the dashboard or to the top-right surface of the frontwall between the dash and the windshield.



10/06/98 f080026

Fig. 1.7, Vehicle Noise Emission Control Label

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

EPA07 Exhaust Emissions

To meet January 2007 emissions regulations, vehicles with engines manufactured after January 1, 2007, are equipped with an emission aftertreatment device. There is a warning label on the driver's sunvisor, explaining important new warning indicators in the driver's message display, that pertain to the aftertreatment system. See **Fig. 1.8**.

Vehicle Identification

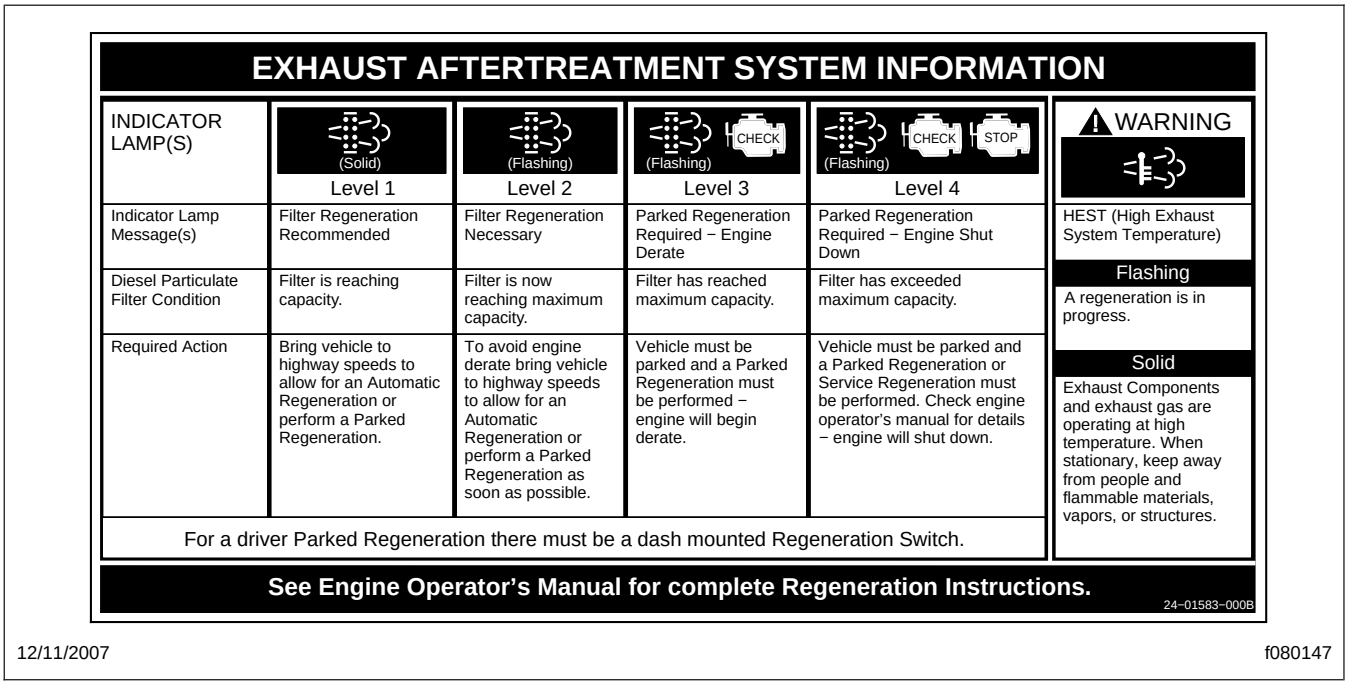


Fig. 1.8, Sunvisor Warning Label

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

2

Instruments and Controls Identification

Instrument and Control Panel

Engine Protection—Warning and Shutdown Process

⚠ WARNING

When the red stop engine, or engine protection light 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.

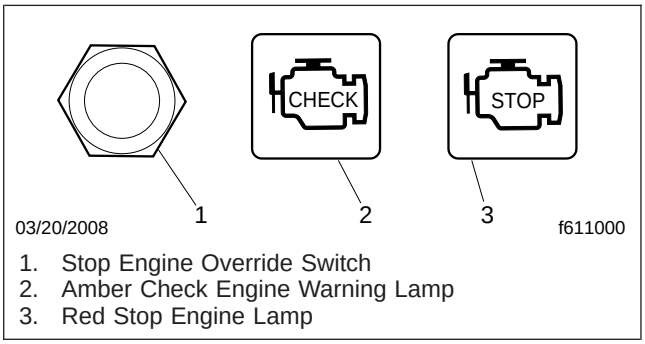
The driver should be familiar with the vehicle warning system, in order to bring the vehicle to a safe stop if the engine malfunctions. If the driver doesn't understand how the warning system works, an engine shutdown could occur, causing a safety hazard.

If the engine coolant temperature, the coolant level, the engine oil pressure, or the diesel particulate filter for the exhaust aftertreatment system, (on some engines, the engine oil temperature, or the intake air temperature also,) reach preset levels, the engine will begin a warning and shutdown process. See the engine manufacturer's engine operation manual for your vehicle, for specific details. See the "EPA07 Aftertreatment System" information in **Chapter 7** in this manual, for a description of the warning and shutdown modes associated with the exhaust aftertreatment system.

There are four customer-programmable levels for electronic engine protection: OFF, WARNING, DERATE, and SHUTDOWN (factory default).

In the engine monitoring OFF mode, the individual sensor indicator lights will illuminate if a problem exists, but no shutdown action will be started, and the event will not be recorded.

The WARNING mode warns the driver, and the engine electronics will log the event for diagnostic purposes. The amber Check Engine lamp will flash, and the buzzer will sound. The amber Check Engine lamp will go out if the problem stops. See **Fig. 2.1**



1. Stop Engine Override Switch
2. Amber Check Engine Warning Lamp
3. Red Stop Engine Lamp

Fig. 2.1, Engine Lamps

The DERATE and SHUTDOWN modes will reduce the power to the engine, then shutdown the engine, to avoid engine damage. The red Stop Engine light, (ENG PROT or SHUT DOWN for older vehicles), will illuminate when the problem is serious enough to reduce the power or speed. The engine power will ramp down, then shut down, if the problem continues.

The driver has about 30 seconds, after the red Stop Engine light illuminates, to move the vehicle safely off the road. If the vehicle cannot be moved to a safe location within that time, the engine can be restarted by turning the ignition switch to the OFF position for at least 5 seconds, then back ON, or by pushing the stop-engine-overide button if the vehicle is equipped with one. This action can be repeated until the vehicle is safely off the road. Do not operate the vehicle until the problem has been corrected.

Warning and Indicator Lights

The dash lightbars have warning and indicator lights that may be lettering or icons. Up until December 31, 2006, the warning and indicator lights are a mixture of ISO icons, and lettering. Since January 2007, ISO icons are used for all standard warning and indicator lights on the dash lightbar. See the following table for a full description of the icons used.

Warning and Indicator Lights		
	Check Engine Lamp (amber)	Indicates an undesirable engine condition is detected or recorded. If the condition gets worse, the stop engine or engine protection light will illuminate.

Warning and Indicator Lights		
	Stop Engine or Engine Protect Lamp (red)	Indicates a serious fault that requires the engine shut down immediately. The engine ECU will reduce the maximum engine torque and speed, and, if the condition does not improve, will shut down the engine within 30 seconds of the light illuminating. The driver must 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, the engine can be restarted after turning the key to the OFF position for a few seconds.
	High Exhaust System Temperature (HEST) Lamp (amber)	Slow (10-second) flash, indicates a regeneration is in progress, and the driver is not controlling the engine idle speed. Steadily illuminated indicates a regeneration is in progress, with high exhaust temperatures at the outlet of the tail pipe, if the speed is below 5 mph (8 km/h). It does not signify the need for service; it only alerts the vehicle operator of high exhaust temperatures. See the engine operation manual for details.
	Diesel Particulate Filter (DPF) Status Lamp (amber)	Steadily illuminated indicates a regeneration is required. Change to a more challenging duty cycle, such as highway driving, to raise exhaust temperatures for at least 20 minutes, or perform a parked regeneration. See the engine operation manual for details. Blinking indicates that a parked regeneration is required immediately. An engine derate and shutdown will occur. See the instructions in the manufacturer's *engine operation manual* for instructions to perform a stationary regeneration.
	Malfunction Indicator Lamp (MIL) (amber)	Indicates an engine emissions-related fault, including, but not limited to the aftertreatment system. See the engine operation manual for details.
	Tractor ABS Lamp (amber)	Indicates a problem with the ABS is detected. Repair the tractor ABS immediately to ensure full antilock braking capability.
	Trailer ABS Lamp (amber)	Indicates a fault is detected with the trailer ABS.
	Left-Turn Signal (green)	Flashes on and off whenever the outside turn signal lights are flashing.
	Right-Turn Signal (green)	Flashes on and off whenever the outside turn signal lights are flashing.
	High-Beam Indicator (blue)	Indicates the headlights are on high beam.

Instruments and Controls Identification

Warning and Indicator Lights		
	Low Air Pressure Warning Lamp (red)	Activates with a buzzer when air pressure in the primary or secondary air reservoir falls below 64 to 76 psi (440 to 525 kPa).
	High Coolant Temperature Warning Lamp (red)	Activates with a buzzer when the coolant temperature goes above a maximum level specified by the engine manufacturer (see the engine manual).
	Low Engine Oil Pressure Warning Lamp (red)	Activates with a buzzer when engine oil pressure goes below a minimum level specified by the engine manufacturer (see the engine manual).
	Parking/Emergency Brake Lamp (BRAKE!) (red)	Indicates the parking brake is engaged, or hydraulic brake fluid pressure is low. A buzzer activates when the vehicle is moving over 2 mph (3 km/h) with the parking brake set.
	Fasten Seat Belt Warning Lamp (red)	Illuminates for 15 seconds when the ignition key is turned to the ON position.
	Intake Heater Warning Lamp (amber)	Indicates the intake air heater is active.
	Water in Fuel Warning Lamp (amber)	Indicates that the fuel could contain water.
	Low Battery Voltage Warning Lamp (red)	Indicates battery voltage is 11.9 volts or less.
	No Charge Warning Lamp (amber)	Indicates an alternator charge output failure.

Instrumentation Control Unit 4 (ICU4 and ICU4-2)

The ICU4 and ICU4-2 instrument clusters are individual-gauge clusters, with intelligent lightbars (ILB) and integrated warning and indicator lights. See **Fig. 2.2** for a typical layout of the gauges. The ICU4 is on vehicles with engines that were manufactured up until December 31, 2006, and the ICU4-2 is on vehicles with engines that were manufactured January 1, 2007 or later, that are EPA07 compliant. They can be differentiated by the ISO icons on the ICU4-2. See **Fig. 2.3** and **Fig. 2.4**. Also, on the ICU4, the message display shows voltmeter readings.

Standard gauges are:

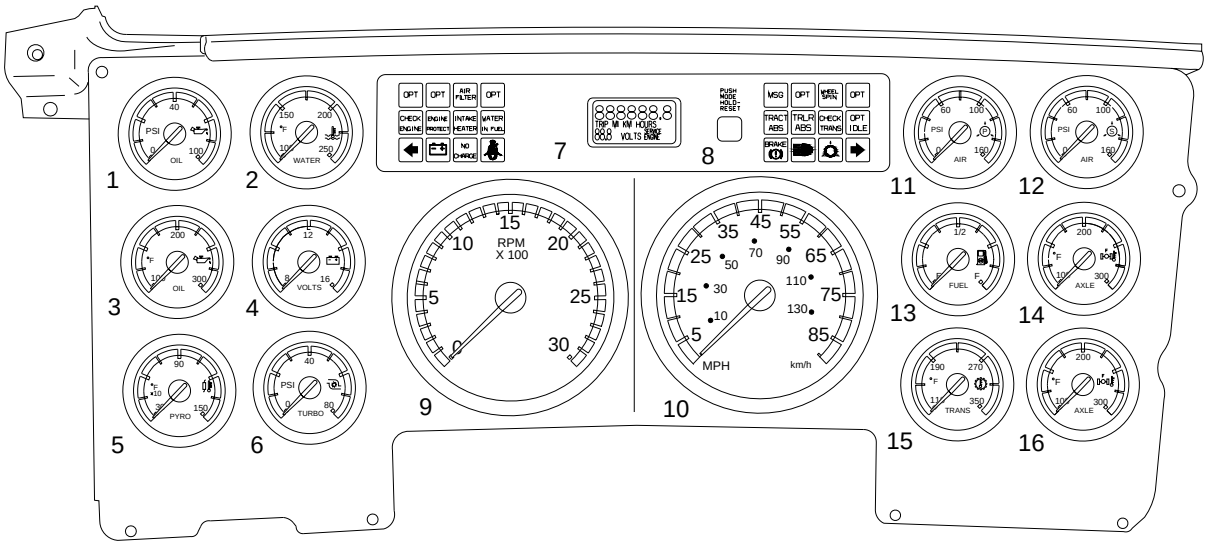
- speedometer
- engine coolant temperature
- engine oil pressure
- battery voltmeter
- fuel level

Gauges with a warning light on the gauge are listed below, with an indication of how the warning light is activated:

- engine coolant temperature (high)
- engine oil pressure (low)
- fuel level (low)
- transmission oil temperature (high)

Other available gauges include:

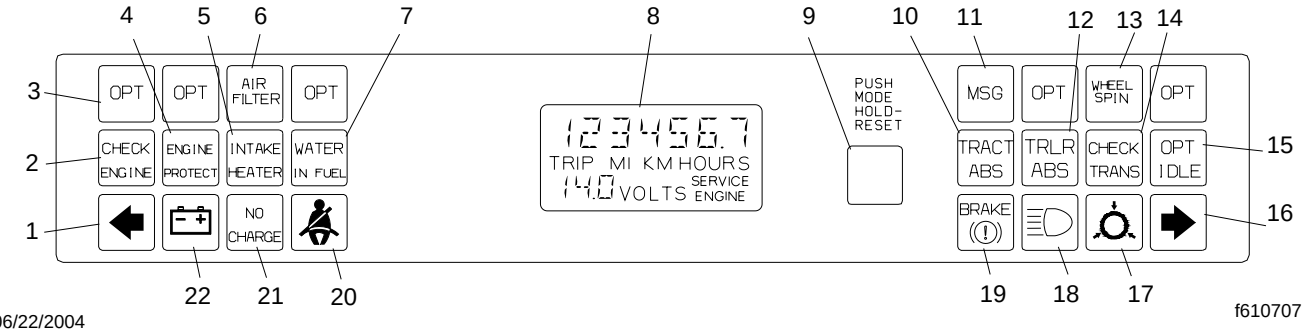
- tachometer
- engine oil temperature



04/01/2004 f610706

1. Engine Oil Pressure Gauge
2. Engine Coolant Temperature Gauge
3. Engine Oil Temperature Gauge
4. Battery Voltage Gauge
5. Pyrometer
6. Turbo Boost Air Pressure Gauge
7. Dash Message Center
8. Mode/Reset Switch
9. Tachometer
10. Speedometer
11. Primary Air Pressure Gauge
12. Secondary Air Pressure Gauge
13. Fuel Level Gauge
14. Axle Temperature Gauge
15. Transmission Oil Temperature Gauge
16. Axle Temperature Gauge

Fig. 2.2, ICU4/ICU4-2 Instrument Cluster (ICU4 shown)



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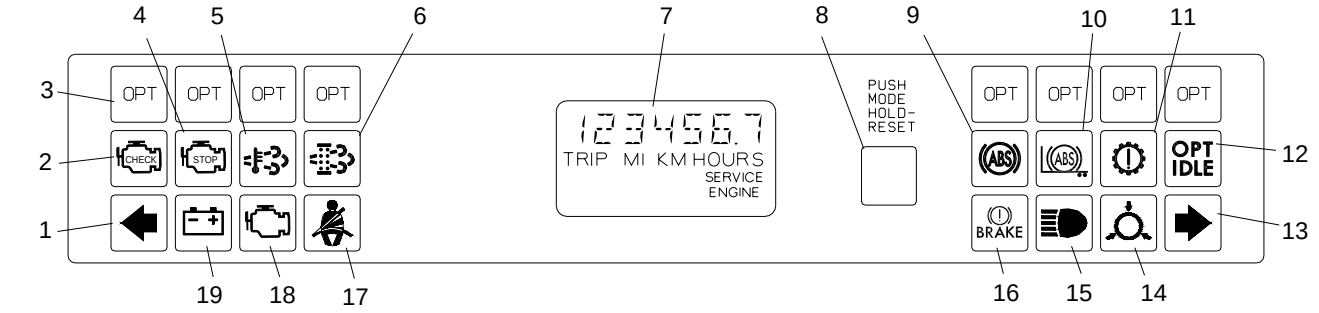
1. Left-Turn Signal
2. Check Engine Indicator
3. Optional Indicator
4. Engine Protection Indicator
5. Intake Heater Indicator
6. Air Filter Indicator
7. Water in Fuel Indicator
8. Message Display Screen
9. Mode/Reset Switch
10. Tractor ABS Indicator
11. Message Indicator
12. Trailer ABS Indicator
13. Wheel Spin Indicator
14. Check Transmission Indicator
15. Optimized Idle Indicator
16. Right-Turn Signal
17. Low Air System Pressure Warning
18. High-Beam Indicator
19. Parking/Emergency Brake Warning
20. Fasten Seat Belt Warning
21. No Charge Indicator (alternator)
22. Low Vehicle Battery Voltage

Fig. 2.3, ICU4 Dash Message Center (typical), Pre-2007

Instruments and Controls Identification



1. Left-Turn Signal
2. Check Engine Indicator
3. Optional Indicator
4. Stop Engine Warning
5. High Exhaust System Temperature (HEST) Warning
6. Diesel Particulate Filter Status Lamp (DPF)
7. Message Display Screen
8. Mode/Reset Switch
9. Tractor ABS Indicator
10. Trailer ABS Indicator
11. Check Transmission Indicator
12. Optimized Idle Indicator
13. Right-Turn Signal
14. Low Air System Pressure Warning
15. High-Beam Indicator
16. Parking/Emergency Brake Warning
17. Fasten Seat Belt Warning
18. Malfunction Indicator Light (MIL)
19. Low Vehicle Battery Voltage

Fig. 2.4, ICU4-2 Dash Message Center (typical), EPA07 Compliant

- transmission oil temperature
- axle temperature; forward-rear, and rear-rear
- ammeter
- air pressure; primary, secondary, application, and suspension
- pyrometer
- turbo boost

Buzzer and Chime

A buzzer sounds for three seconds during the self-test at start-up, and when the following conditions exist:

- low air pressure
- low oil pressure
- high coolant temperature
- the parking brake is applied and the vehicle is moving at a speed of at least 2 mph (3 km/h)

A chime sounds when the parking brake is off and the door is open, or when the headlights are on and the door is open.

Ignition Sequence

When the ignition key is turned on, the ICU4/ICU4-2 begins a self-test. During this process, all gauges controlled by the cluster sweep to full scale and return, the buzzer sounds for three seconds, the fasten seat belt warning light illuminates for 15 seconds, and the battery voltage, low air pressure, and parking brake warning lights illuminate then turn off. Then the software revision level of the ICU4/ICU4-2 is displayed, followed by active faults, if any, then the odometer display.

Mode/Reset Switch Functions

The mode/reset switch controls the display of the odometer, trip miles and hours, engine miles and hours, service cycle screens, fault code screens, and oil level screens (on some Mercedes-Benz engines; if equipped and enabled).

Push the switch to scroll through mode selections, and hold the switch to reset trip miles or hours while they are displayed. See **Fig. 2.5**. With the parking brake released, only the odometer, trip miles, and trip hours can be accessed. Park the vehicle and set the parking brake to access additional screen functions. See **Fig. 2.6**.

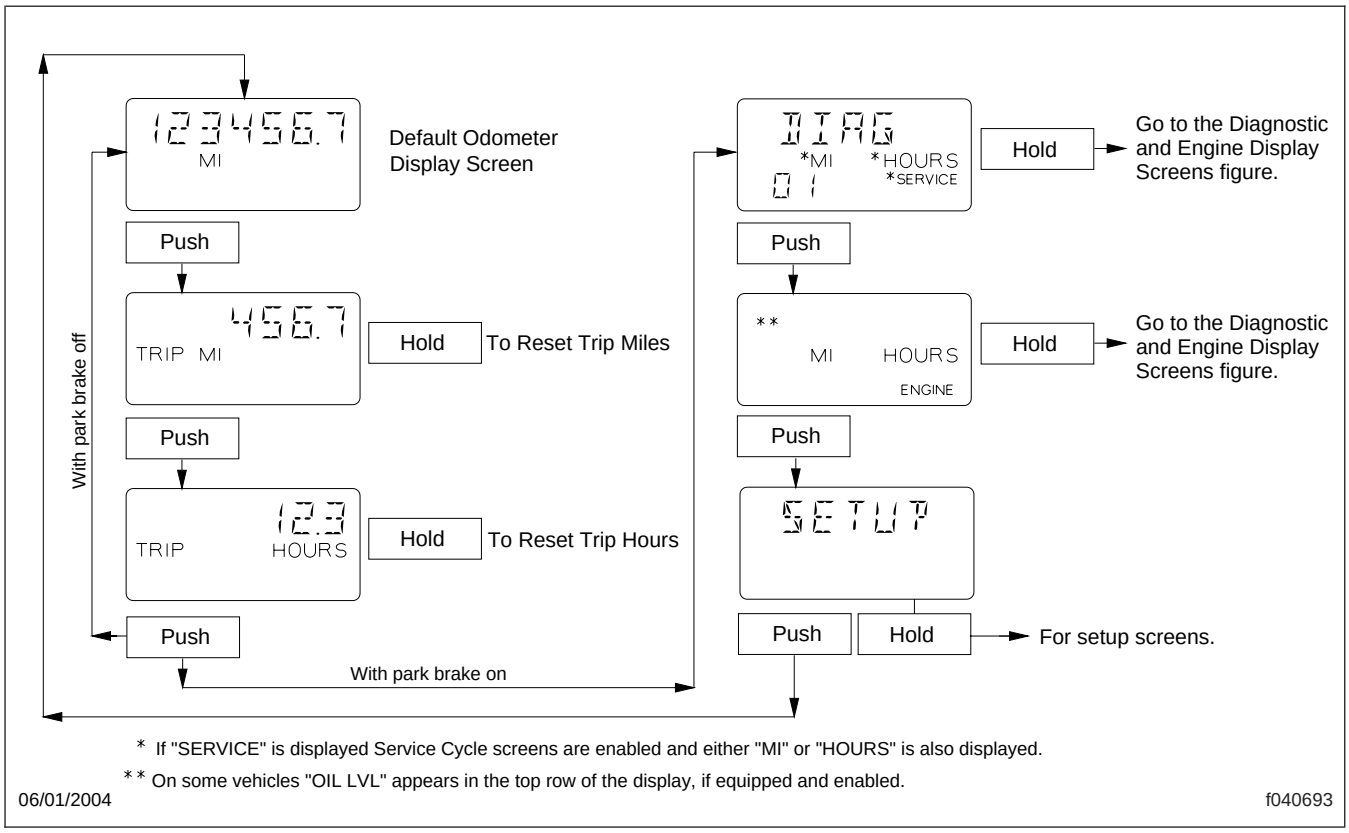


Fig. 2.5, ICU4/ICU4-2 Mode/Reset Switch Basic Functions

Trip Miles, Trip Hours

When the odometer is displayed, push the mode/reset switch once to display trip distance. Push it again to display trip hours. Both numbers are calculated from the last time the value was reset. Hold the switch when each number is displayed to reset trip miles or hours to zero.

Diagnostic Screens

During vehicle start-up, with the parking brake on, the ICU4 or ICU4-2 display any active fault codes for three seconds each until the parking brake is released. With active fault codes on display, push the mode/reset switch once to display the initial diagnostic screen (DIAG) and the total number of active faults. If service cycle screens are enabled, and service distance or time has been exceeded, the text SERVICE will be displayed with the other fault messages. This will inform the vehicle operator that the service interval has been exceeded and vehicle service is required.

Specific fault code information can be displayed only with the vehicle parked and the parking brake set. If the odometer screen is displayed, push the mode/reset switch until the DIAG screen is displayed, then hold the switch to enter the fault code screen sequence. Once the initial fault code is displayed, push the switch to cycle through additional diagnostic codes relating to the first fault. Hold the switch to display additional faults or return to the DIAG screen. If service cycle screens are enabled, service interval information is displayed before fault code information is displayed.

If the word SERVICE appears on the DIAG message display screen, service cycle screens are enabled. Hold the mode/reset switch at the DIAG screen to display miles or hours remaining until the next scheduled service. If MI appears on the DIAG screen, service miles are enabled; if HOURS appears on the screen, service hours are enabled. Either service

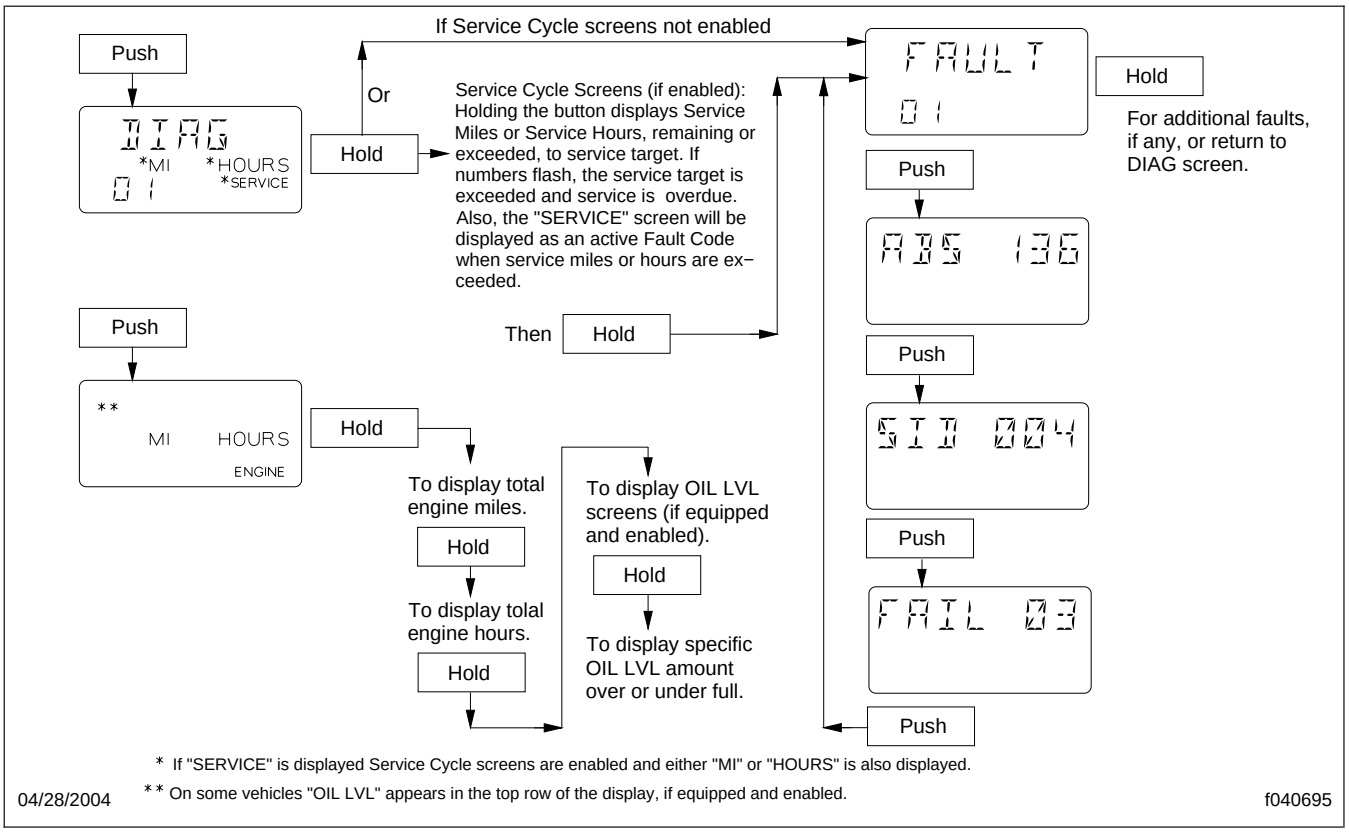


Fig. 2.6, ICU4/ICU4-2 Mode/Reset Switch Diagnostic and Engine Display Screens

miles or hours can be enabled, but not both. If service miles or hours has been exceeded, the number flashes to indicate service is overdue.

Engine Screens

Push the mode/reset switch once following the DIAG screen and the word ENGINE is displayed in the lower right corner of the digital display. Hold the switch to display total engine miles. Hold it again to display total engine hours. If OIL LVL is displayed earlier with ENGINE (only on vehicles with Mercedes-Benz engines; if equipped and enabled) hold the switch again to access oil level screens.

Instrumentation Control Unit 3 (ICU3 and ICU3 ’07)

Figure 2.7 shows the instrument panel for Columbia vehicles equipped with the ICU3 and ICU3 ’07. The ICU3 is on vehicles with engines that were manufactured up until December 31, 2006, and the ICU3 ’07 is on vehicles with engines that were manufactured January 1, 2007 or later. They can be differentiated by the ISO icons used on the ICU3 ’07.

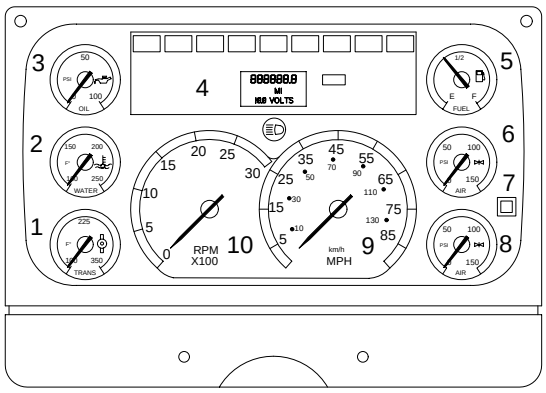
The ICU3 and ICU3 ’07 electronic dashboards can accept information from the various sensors installed on the vehicle and feed it to electronic gauges. Only air gauges operate mechanically.

There can be up to eight gauges on the driver’s instrument panel (six electronic and two mechanical). The ICU3 or ICU3 ’07 can not drive gauges located on the auxiliary instrument panel.

The dash message center is the heart of the ICU3 and ICU3 ’07. It has a set of warning and indicator lights, and a driver display screen. The driver display screen is a one-line by seven-character liquid crystal display (LCD) that normally shows odometer readings.

There are four rows of lights in the dash message center. Lights installed in the top row are optional and their positions may vary. The lights in the bottom

three rows are installed in fixed positions on all vehicles. Most are standard, but a few are optional. See **Fig. 2.8** and **Fig. 2.9**.



06/02/99 f610205b

1. Transmission Temperature Gauge
2. Water Temperature Gauge
3. Engine Oil Pressure Gauge
4. Dash Message Center
5. Fuel Gauge
6. Primary Air Pressure Gauge
7. Optional Mode/Reset Push Button
8. Secondary Air Pressure Gauge
9. Speedometer
10. Tachometer

Fig. 2.7, ICU3/ICU3 ’07 Gauge Layout (ICU3 shown)

NOTE: The functions of the ABS/ATC warning lights are explained under "Meritor WABCO Antilock Braking System (ABS)", later in this chapter.

NOTE: The amber LANE SRCHNG warning light for the optional Lane Guidance™ System is explained later in this chapter.

Buzzer

A buzzer sounds for three seconds during the self-test at start-up, and when the following conditions exist:

- low air pressure
- low oil pressure
- high coolant temperature
- the parking brake is applied and the vehicle is moving at a speed of at least 2 mph (3 km/h)

ICU3/ICU3 ’07 Ignition Sequence

If the headlights are turned on, the screen displays the odometer and waits for the ignition to be turned on.

When the ignition is turned on, all the electronic gauges complete a full sweep of their dials, the warning and indicator lights light up, and the buzzer sounds for three seconds.

NOTE: The air gauges do not sweep.

The following lights illuminate during the ignition sequence:

- Fasten Seat Belt Warning
- Low Battery Voltage Warning
- High Coolant Temperature Warning
- Low Engine Oil Pressure Warning
- Low Air Pressure Warning
- Parking Brake On Indicator
- All engine warning lights, including engine protection, check engine, and (Cummins only) stop engine
- All ABS warning lights, including wheel spin, tractor ABS, and (if installed) trailer ABS

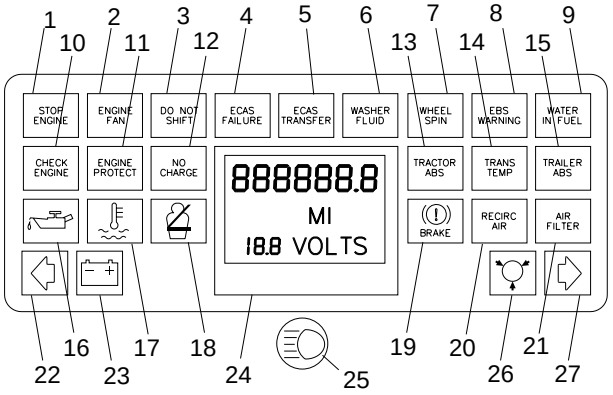
See **Fig. 2.10** for the ICU3/ICU3 ’07 ignition sequence.

NOTE: Although the engine and ABS warning lights illuminate during the ignition sequence, they are not controlled by the ICU, but by their own system ECU (electronic control unit).

When the ignition switch has been turned on, the ICU3 performs a self-test, looking for active faults. During the first half of the self-test, all segments of the display illuminate as follows: 888888.8. The ICU3 voltmeter display also illuminates, but with the value 18.8. During the second half of the self-test, the software revision level is displayed.

If there are no active faults, the ICU3/ICU3 ’07 displays the odometer. However, if the ICU3/ICU3 ’07 has received active fault codes from other devices, it displays them one after the other until the parking brake is released or the ignition switch is turned off. Once the parking brake is released, the ICU3/ICU3 ’07 displays the odometer again.

Instruments and Controls Identification



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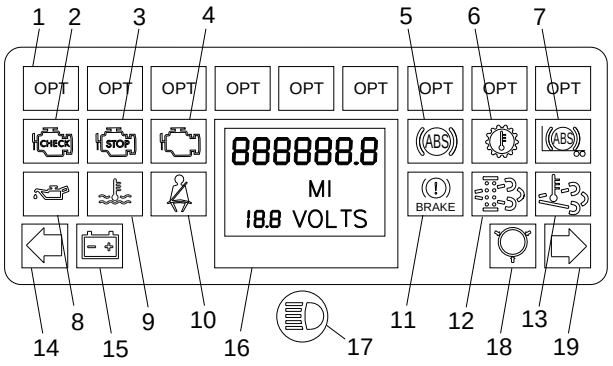
1. Stop Engine Warning
2. Engine Fan On Indicator (optional)
3. Do Not Shift Indicator (optional)
4. ECAS Failure Warning (optional)
5. ECAS Transfer Indicator (optional)
6. Low Washer Fluid Indicator (optional)
7. Wheel Spin Indicator (optional)
8. EBS Warning (optional)
9. Water In Fuel Indicator (optional)
10. Check Engine Indicator
11. Engine Protection Warning (optional)
12. No Charge Indicator (optional)
13. Tractor ABS Warning
14. Transmission Temperature Warning (optional)
15. Trailer ABS Warning
16. Low Oil Pressure Warning
17. High Coolant Temperature Warning
18. Fasten Seat Belt Warning
19. Parking Brake On Warning
20. Recirculated Air Indicator (optional)
21. Air Restriction Indicator (optional)
22. Left-Turn Signal
23. Low Battery Voltage Warning
24. Dash Driver Display Screen
25. High Beams On Indicator
26. Low Air Pressure Warning
27. Right-Turn Signal

Fig. 2.8, ICU3 Dash Message Center, Pre-2007



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1. Optional Indicator
2. Check Engine Indicator
3. Stop Engine Indicator
4. Malfunction Indicator Light (MIL)
5. Tractor ABS Indicator
6. Transmission Temperature Indicator
7. Trailer ABS Indicator
8. Low Oil Pressure Warning
9. High Coolant Temperature
10. Fasten Seat Belt Warning
11. Parking Brake On Warning
12. Diesel Particulate Filter (DPF) Status Lamp
13. High Exhaust System Temperature (HEST) Warning
14. Left-Turn Signal
15. Low Battery Voltage Warning
16. Driver Display Screen
17. High Beams On Indicator
18. Low Air Pressure Warning
19. Right-Turn Signal

Fig. 2.9, ICU3 ’07 Dash Message Center, EPA07 Compliant

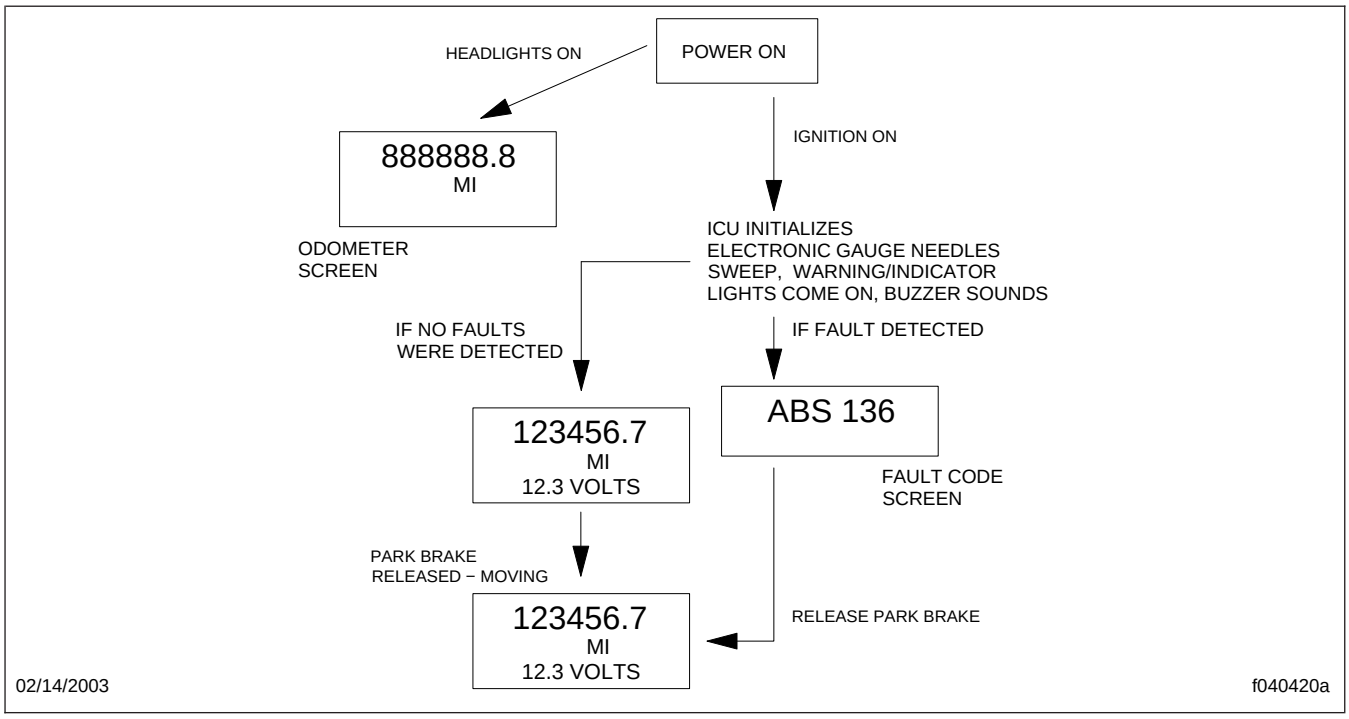


Fig. 2.10, ICU3/ICU3 ’07 Ignition Sequence

Mode/Reset Switch

The mode/reset switch (**Fig. 2.11**) is located on the right side of the instrument cluster. The mode/reset switch is used to scroll through the displays on the message display screen, and to reset the trip distance and trip hours values to zero.

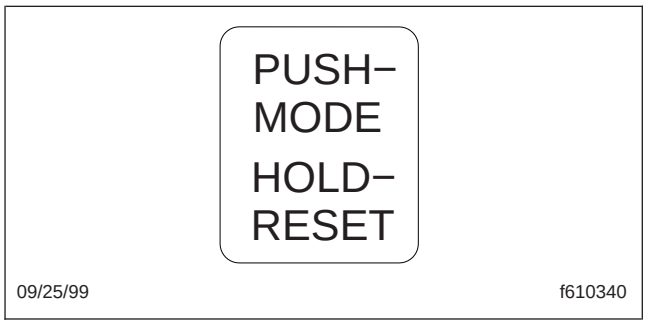


Fig. 2.11, ICU3/ICU3 ’07 Mode/Reset Switch

See **Fig. 2.12** for the state diagram for the LCD display cycle.

NOTE: The systems diagnostics test is used by trained personnel to retrieve fault codes and other diagnostic information pertaining to the vehicle.

When the odometer reading is displayed and the parking brake is applied:

- Press the mode/reset switch once and the trip distance will display.
- Press the mode/reset switch a second time and the trip hours (engine hours) will display.
- Press the mode/reset switch a third time and the SELECT screen and the current units, MI or KM, will display.
- Press the mode/reset switch a fourth time to return to the odometer reading.

To reset trip miles and/or trip hours to zero, press the mode/reset switch for 1 second or longer. To toggle between MI (miles) and KM (kilometers), press the mode/reset switch while in the SELECT screen.

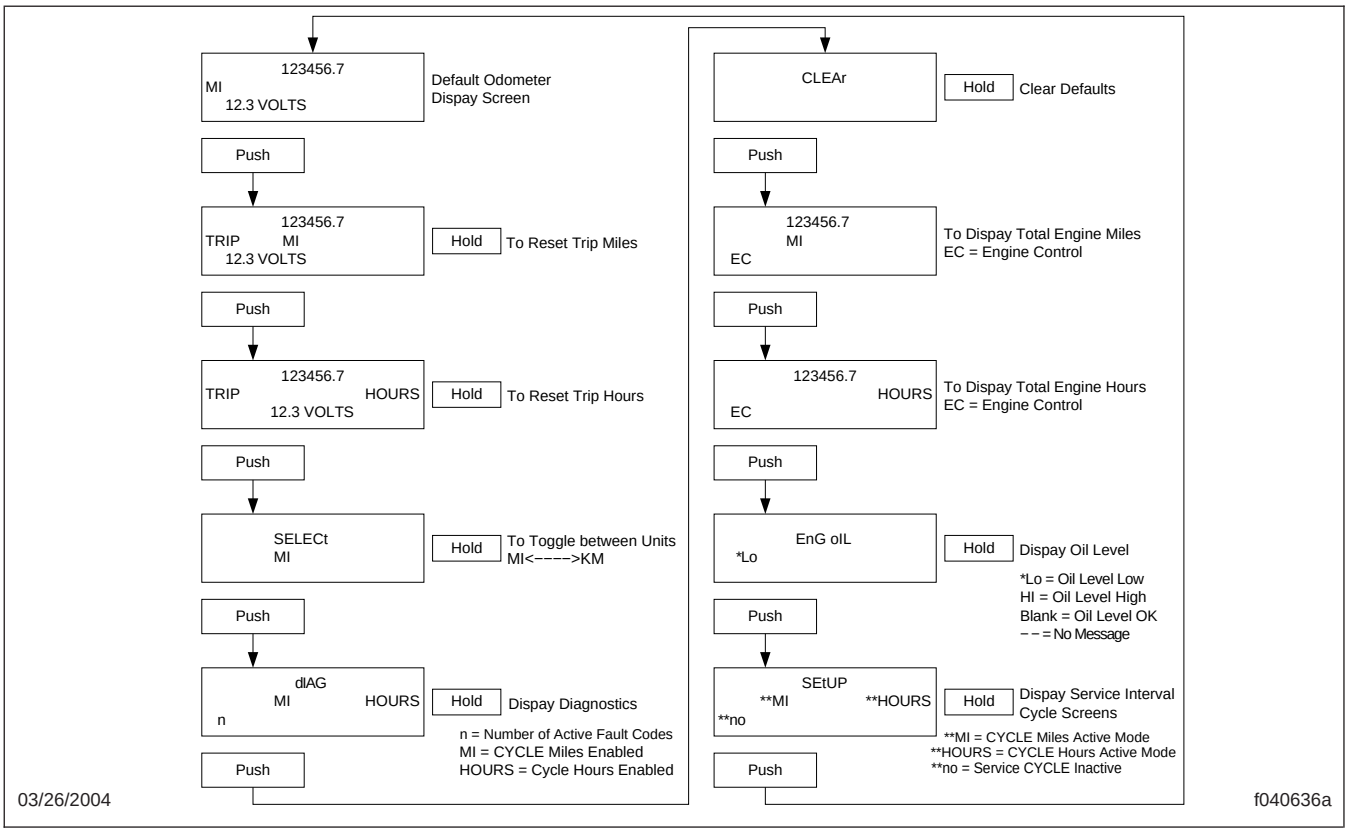


Fig. 2.12, ICU3/ICU3 ’07 Mode Reset LCD Display Cycle

Instrumentation Control Unit 2L (ICU2L)

The ICU2L is a basic electronic dashboard. It can accept information from the various sensors installed on the vehicle and feed it to electronic gauges. Only air gauges operate mechanically.

There can be up to 14 removable gauges on the driver’s instrument panel (11 electronic, one electro-mechanical, and two mechanical). The ICU2L can not drive gauges located on the auxiliary instrument panel.

The dash message center is the heart of the ICU2L. It has a set of 18 warning and indicator lights, and a message display screen. The message display screen is a one-line by six-character vacuum fluorescent display.

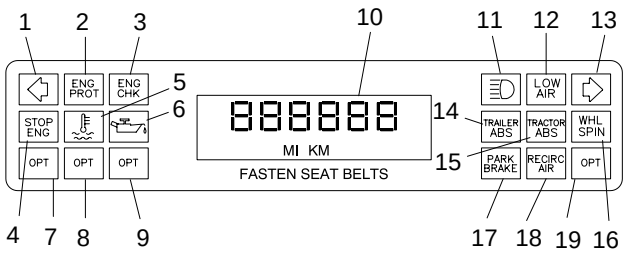
Warning and Indicator Lights

There can be up to 18 warning and indicator lights installed in the ICU2L. See **Fig. 2.13**.

⚠ WARNING

When the red stop engine light 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.

NOTE: The functions of the ABS/ATC warning lights are explained under "Meritor WABCO Antilock Braking System (ABS)", later in this chapter.



Typical installation shown. Location and function of optional lights may vary.

1. Left-Turn Indicator
2. Engine Protection Warning and Indicator
3. Check Eng. Indicator
4. Stop Engine Warning
5. High Coolant Temp. Warning (optional)
6. Low Oil Pressure Warning (optional)
7. Optional Indicator 3
8. Optional Indicator 2
9. Optional Indicator 1
10. Message Display Screen
11. High-Beam Indicator
12. Low Air Warning
13. Right-Turn Indicator
14. Trailer ABS Warning
15. Tractor ABS Warning
16. Wheel Spin Warning
17. Park Brake On Indicator
18. Recirc Air Warning (optional)
19. Optional Indicator 4

Fig. 2.13, Dash Message Center, ICU2L

NOTE: The amber LANE SRCHNG warning light for the optional Lane Guidance™ System is explained later in this chapter.

Ignition Sequence

If the headlights are turned on, the screen displays the odometer and waits for the ignition to be turned on. See **Fig. 2.14**.

When the ignition is turned on, all the electronic gauges complete a full sweep of their dials, the warning and indicator lights light up, and the buzzer sounds for three seconds.

NOTE: The air gauges do not sweep.

The following lights illuminate during the ignition sequence:

- Fasten Seat Belt Warning
- Low Battery Voltage Warning
- High Coolant Temperature Warning
- Low Engine Oil Pressure Warning
- Low Air Pressure Warning
- Parking Brake On Indicator
- All engine warning lights, including engine protection, check engine, and (Cummins only) stop engine
- All ABS warning lights, including wheel spin, tractor ABS, and (if installed) trailer ABS

NOTE: Although the engine and ABS warning lights illuminate during the ignition sequence, they are not controlled by the ICU but by their own system ECU (electronic control unit).

When the ignition switch has been turned on, the ICU performs a self-test, looking for active faults. During the first half of the self-test, all segments of the display illuminate as follows: 888888.8. During the second half of the self-test, the software revision level is displayed.

Instruments

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. The green band on the tachometer indicates the best fuel economy range. The yellow band indicates lower fuel economy, the orange band indicates much lower fuel economy, and the red band indicates poor fuel economy. See **Fig. 2.15**.

Speedometer

The speedometer registers speed in both miles per hour (mph) and kilometers per hour (km/h). See **Fig. 2.15**.

Engine Oil Pressure Gauge

The oil pressure gauge should read as shown in **Table 2.1**. See **Fig. 2.16**.

⚠ CAUTION

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

Instruments and Controls Identification

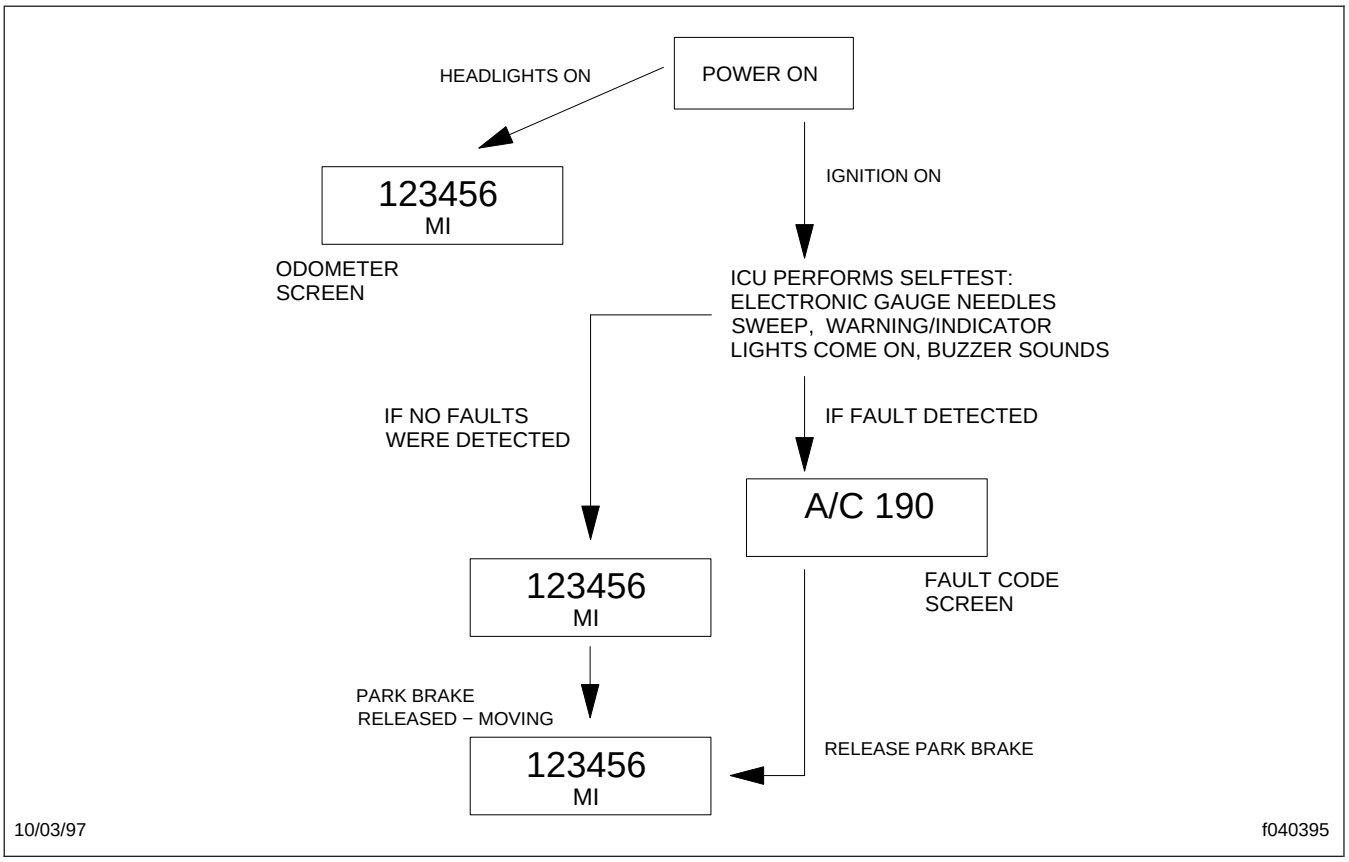


Fig. 2.14, ICU2L Ignition Sequence

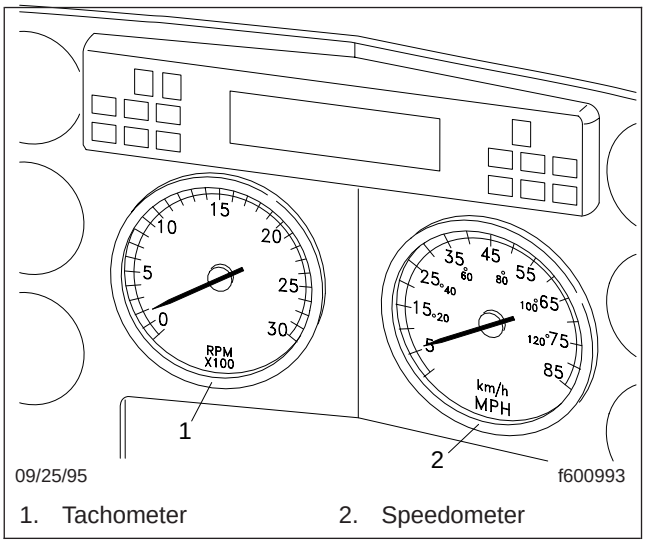
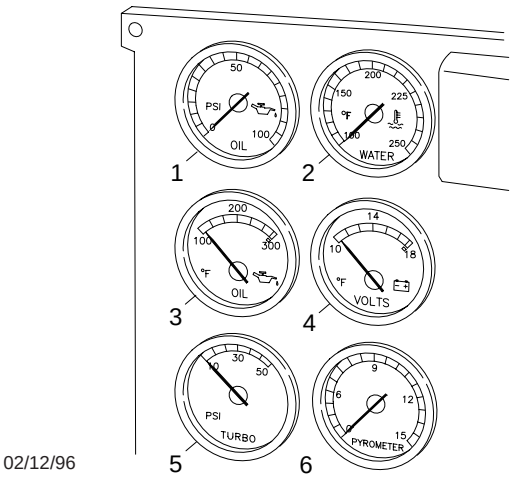


Fig. 2.15, Instrument Panel, Level II (center)

until the cause has been determined and corrected.

Coolant Temperature Gauge

During normal engine operation, the coolant temperature gauge should read 175 to 195°F (79 to 91°C). See **Fig. 2.16**. If the temperature remains below 160°F (71°C) or exceeds the maximum temperature shown in **Table 2.2**, inspect the cooling system to determine the cause. See the *Columbia® Workshop Manual* for troubleshooting and repair procedures.



1. Engine Oil Pressure Gauge
2. Coolant Temperature Gauge
3. Engine Oil Temperature Gauge (optional)
4. Voltmeter
5. Turbocharger Boost Pressure Gauge (optional)
6. Pyrometer (optional)

Fig. 2.16, Instrument Panel Gauges (left side)

Oil Pressure*		
Engine Model	**At Idle Speed: psi (kPa)**	**At Rated RPM: psi (kPa)**
Caterpillar C–10	10–20 (69–138)	30–45 (207–310)
Caterpillar C–12	10–20 (69–138)	30–45 (207–310)
Caterpillar 3406E	15 (100) min.	40 (275) min.
Cummins ISX	10 (69) min.	35–45 (241–310)
Cummins ISM	10 (69) min.	35–45 (241–310)
Cummins N14	10 (69) min.	35–45 (241–310)
Detroit Diesel S60	12 (83) min.	50 (345) min.
MBE4000	7 (50)	36 (250) min.

* 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 2.1, Oil Pressure Specifications

Maximum Coolant Temperature	
Engine Make	**Temperature: °F (°C)**
Caterpillar	215 (101)
Cummins	220 (104)
Detroit Diesel	215 (101)
Mercedes-Benz	221 (105)

Table 2.2, Maximum Coolant Temperature

Engine Oil Temperature Gauge, Optional

During normal operation, the engine oil temperature gauge should read:

- 190 to 220°F (88 to 104°C) for Caterpillar engines;
- 180 to 225°F (82 to 107°C) for Cummins engines;
- 200 to 230°F (93 to 110°C) for Detroit Diesel engines;
- 181 to 203°F (83 to 95°C) for Mercedes-Benz diesel 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. See **Fig. 2.16**.

⚠ CAUTION

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.

Voltmeter

The voltmeter indicates the vehicle charging system voltage when the engine is running and the battery voltage when the engine is stopped. By monitoring the voltmeter, the driver can be aware of potential charging system problems and have them fixed before the batteries discharge enough to create starting difficulties. See **Fig. 2.16**.

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 stopped. A completely discharged battery will produce only about 12.0 volts. The voltmeter will indicate lower voltage as the vehicle is being started or when electrical devices in the vehicle are being used.

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

NOTE: Some vehicles may be equipped with a digital display voltmeter integrated into the message display screen, instead of a voltmeter gauge.

Turbocharger Boost Pressure Gauge, Optional

A turbocharger boost pressure gauge measures the pressure in the intake manifold, in excess of atmospheric pressure, being created by the turbocharger. See **Fig. 2.16**.

Pyrometer, Optional

A pyrometer registers the exhaust temperature near the turbocharger. See **Fig. 2.16**. Normal exhaust temperatures are listed in **Table 2.3**.

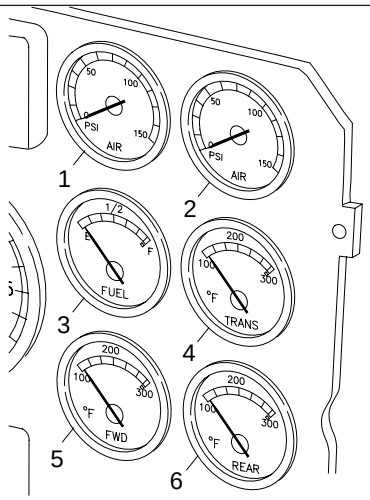
Variations in engine load can cause exhaust temperatures to vary. If the pyrometer reading shows that exhaust temperature exceeds normal, reduce fuel to the engine until the exhaust temperature is reduced. Shift to a lower gear if the engine is overloaded.

Exhaust Temperature	
Engine Model	**Exhaust Temperature: °F (°C)**
Caterpillar C–10, C–12	935–1290 (500–700)
Caterpillar 3406E	900–1100 (480–595)
Cummins M11	800–1000 (430–540)
Cummins N14	750–950 (400–510)
Detroit Diesel S60	700–950 (370–510)
MBE4000	750–1022 (400–550)

Table 2.3, Typical Pyrometer Exhaust Temperature Readings

Primary and Secondary Air Pressure Gauges

Air pressure gauges register the pressure in the primary and secondary air systems. See **Fig. 2.17**. Normal pressure, with the engine running, is 100 to 120 psi (689 to 827 kPa) in both systems. A low-air-pressure warning light and buzzer, connected to both the primary and secondary systems, activate when air pressure in either system drops below a minimum pressure of 64 to 76 psi (441 to 524 kPa). When the engine is started, the warning light and buzzer remain on until air pressure in both systems exceeds minimum pressure.



1. Primary Air Pressure Gauge
2. Secondary Air Pressure Gauge
3. Fuel Gauge
4. Transmission Oil Temperature Gauge (optional)
5. Forward Axle Oil Temperature Gauge (optional)
6. Rear Axle Oil Temperature Gauge (optional)

Fig. 2.17, Instrument Panel Gauges (right side)

Fuel Gauge

The fuel gauge indicates the level of fuel in the fuel tank(s). See **Fig. 2.17**. If equipped with a second (optional) fuel gauge, each fuel tank level is indicated on a separate gauge.

Transmission Oil Temperature Gauge, Optional

During normal operation, the transmission oil temperature gauge reading should not exceed 250°F (121°C) for Eaton® Fuller® transmissions. See **Fig. 2.17**.

⚠ CAUTION

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.

Forward and Rear Axle Oil Temperature Gauges, Optional

During normal operation, forward and rear axle oil temperature gauges should read between:

- 160 and 220°F (71 and 104°C) for Meritor™ drive axles;
- 180 and 200°F (82 and 93°C) for Dana Spicer® drive axles.

Under heavy loads, such as when climbing steep grades, temperatures up to a maximum of 250°F (121°C) are not unusual. See **Fig. 2.17**.

⚠ CAUTION

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.

Application Air Pressure Gauge, Optional

An application air pressure gauge registers the air pressure being used to apply the brakes and should be used for reference only. The gauge will not register air pressure until the foot brake pedal is depressed or the trailer hand brake is applied.

Intake-Air Restriction Gauge, Optional

An intake-air restriction gauge measures the vacuum on the engine side of the air cleaner at the air cleaner outlet. Vacuum is measured in inH_2O (inches of water). When the vacuum reading in normal operation equals the applicable level shown under *Service inH_2O*, in **Table 2.4**, the air cleaner needs to be replaced.

NOTE: Rain or snow can wet the filter and cause a higher than normal reading temporarily.

Intake-Air Restriction Indicator

An intake-air restriction indicator measures the vacuum on the engine side of the air cleaner at the air cleaner outlet. See **Fig. 2.18**. If the yellow signal stays locked at or above the values shown in **Table 2.4** after the engine is shut down, the air cleaner needs to be serviced. The indicator then needs to be reset by pressing the yellow button.

Intake-Air Restriction Vacuum Readings		
Engine Make*	**Initial inH_2O**	**Service inH_2O**
Cummins	12	25
Detroit Diesel	12	20
Caterpillar	15	25
Mercedes-Benz	10	22

* Turbocharged engines must be checked at full load and governed engine speed.

Table 2.4, Intake-Air Restriction Vacuum Readings

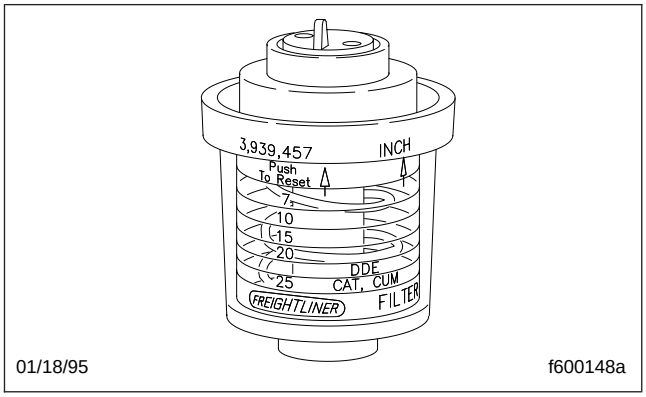


Fig. 2.18, Intake-Air Restriction Indicator

NOTE: Rain or snow can wet the filter and cause a higher than normal reading temporarily.

Ammeter, Optional

An ammeter measures current flowing to and from the battery. When the batteries are being charged, the meter needle moves to the plus side of the gauge; when the batteries are being discharged, the needle moves to the minus side. A consistent negative reading when the engine is running indicates a possible problem with the charging system.

Analog Clock

The analog clock features electronic setting. Do not pull the set knob. The time can be set either forward (turn knob to the right) or backward (turn the knob to the left). A slight turn of the knob either right or left will change the setting of the clock one minute at a time. Holding the knob to either the right or the left will allow accelerated sweeping of the hands for setting the hour.

Digital Clock, Optional

The digital clock has black characters on a constantly backlighted green display, with a brightness that automatically adjusts for day or night. The clock has a 24-hour alarm with a three-minute snooze feature.

1. To set the time of day:

   1.1 Push the run/set (lower) switch to the right (TIME-SET position).

   NOTE: When the hour setting is for a time between noon and midnight, the small letters PM will appear in the lower left corner of the display; no PM indicates an a.m. setting.

   1.2 Advance the hour setting to the correct number by pushing and releasing the hour button as many times as needed. Or if the button is pressed and held in for longer than two seconds, the numbers will continue to advance until the button is released.

   1.3 Advance the minute setting by repeatedly pushing, or pushing and holding the minute button as needed.

   1.4 Push the run/set switch to the middle (RUN) position.

2. To set the alarm time:

   2.1 Push the run/set switch to the left (ALARM-SET position).

   2.2 Set the alarm time by using the same procedure that you used to set the time of day. Remember to set the hour for a.m. (no letters in the corner of the display) or p.m. as desired.

   2.3 Return the run/set switch to the middle (RUN) position. The readout will return to the time-of-day setting.

3. To operate the alarm:

   3.1 With the alarm time set, push the alarm (upper) switch to the left. An alarm *wave* symbol, and the letters AL, will appear in the upper left corner of the display when the alarm is on.

   3.2 When the displayed time of day coincides with the alarm time, the alarm will sound. If the SNOOZ button is not pushed or the alarm switch is not moved, the alarm will automatically stop sounding after one minute and will not sound again for 24 hours.

   3.3 If desired, press the SNOOZ button while the alarm is sounding to shut the alarm off for three minutes. The alarm symbol will flash in the display when the button is pushed and will continue to flash until the alarm switch is moved or the alarm has sounded for one minute. The snooze procedure can be done as many times as desired.

   3.4 Move the alarm switch to the right when you wish to shut off or cancel the alarm; the alarm symbol will disappear.

Controls

Ignition Switch and Key

The ignition switch has four positions: ACCESSORY, OFF, ON, and START. The ignition key locks and unlocks the cab doors, baggage door(s), and if equipped, the bunk door(s).

In the OFF position, the key slot is vertical; the key can be inserted and removed only in this position. The low-beam headlights, taillights, brake lights, road lights, dome lights, clearance lights, turn signals, hazard lights, refrigerator, fuel heater, electric oil pan heater, and electric or diesel-fired engine-coolant preheaters can be operated in the off position (regardless of whether the key is inserted).

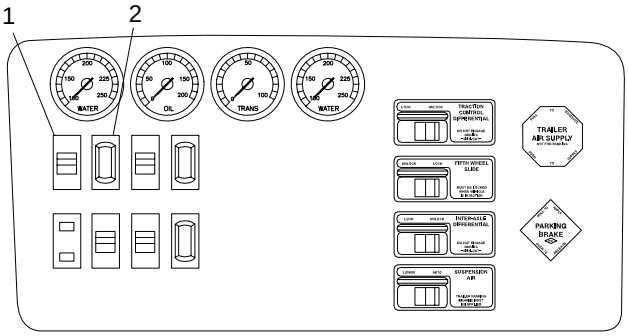
In the ACCESSORY position, the key is turned counterclockwise. The auxiliary (bunk) fan, windshield fan(s), radio or stereo system, mirror heat, ether start system, air dryer, backup lights, and all of the electrical systems that are operable in the off position are operable in the accessory position.

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.

Cruise Control

IMPORTANT: On vehicles with Eaton VORAD Collision Warning System (CWS) with Smart-Cruise, see the "Collision Warning System" headings in this chapter before operating cruise control.

The cruise control is activated by the SPD CNTL (on/off) and RSM/ACC–SET/CST switches on the dash (**Fig. 2.19**), *or* by optional PAUSE, RESUME, and SET buttons on the transmission shift knob (**Fig. 2.20**). The minimum speed at which cruise control can be used is 30 mph (48 km/h). The minimum and maximum speed cruise control set limits can be programmed, by authorized personnel, into the engine electronics.



1. RSM/ACC–SET/CST Switch
2. SPD CNTL (On/Off) Switch

Fig. 2.19, Cruise Control Switches, Dash-Mounted

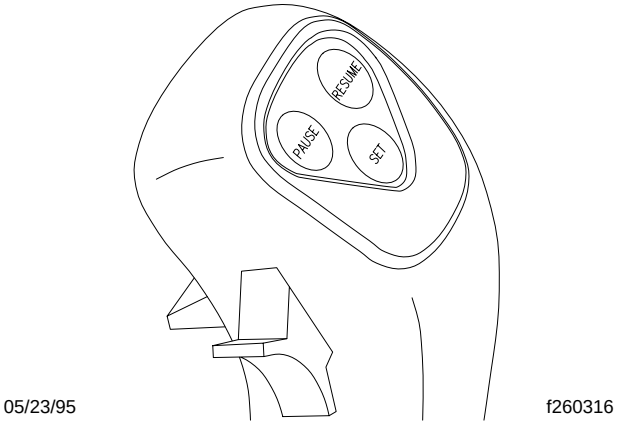


Fig. 2.20, Cruise Control, Transmission Shift Knob Buttons

⚠ 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.

⚠ 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.

1. To cruise at a particular speed:
   - 1.1 Press the upper half of the SPD CNTL (on/off) rocker switch on the instrument control panel.
   - 1.2 Hold the throttle down until the speedometer reaches the desired speed.
   - 1.3 Momentarily flip the RSM/ACC–SET/CST paddle switch on the instrument control panel down to SET/CST.
   - 1.4 *or*—Push the SET button on the transmission shift knob.
2. To disengage the cruise control:
   - 2.1 Depress the brake pedal or clutch pedal.
   - 2.2 *or*—Press the lower half of the SPD CNTL rocker switch on the instrument control panel.
   - 2.3 *or*—Push the PAUSE button on the transmission shift knob.
3. To resume a preselected cruise speed:
   - 3.1 If the SPD CNTL rocker switch on the instrument control panel is off, turn it on.
   - 3.2 Momentarily flip the RSM/ACC–SET/CST paddle switch on the instrument control panel to RSM/ACC.

3.3 *or*—Push the RESUME button on the transmission shift knob. Cruise will return to the last speed selected.

NOTE: The resume vehicle speed memory is not maintained if the ignition is shut off.

4. To adjust cruise speed up or down:

   4.1 Hold the paddle switch on the instrument control panel at RSM/ACC to accelerate, or at SET/CST to decelerate, until the desired speed is reached.

   4.2 *or*—Press the SET button on the transmission shift knob to accelerate, or the RESUME button to decelerate, until the desired speed is reached.

Power Takeoff (PTO) Governor

Caterpillar electronic engines may be equipped with a PTO governor. This mode is used only when the vehicle is parked. The PTO mode is activated by the SPD CNTL and RSM/ACC–SET/CST switches on the dash (**Fig. 2.19**) or by optional PAUSE, RESUME, and SET buttons on the transmission shift knob (**Fig. 2.20**).

1. To engage the PTO:

   1.1 Press the upper half of the SPD CNTL rocker switch on the instrument control panel.

   1.2 Hold the throttle down until the tachometer reaches the desired engine speed.

   1.3 Momentarily flip the paddle switch on the instrument control panel down to SET/CST.

   1.4 *or*—Push the SET button on the transmission shift knob.

2. To disengage the PTO:

   2.1 Depress the brake pedal or clutch pedal.

   2.2 *or*—Press the lower half of the SPD CNTL rocker switch on the instrument control panel.

   2.3 *or*—Press the PAUSE button on the shift knob.

3. To resume a previously selected engine speed:

   3.1 If the SPD CNTL switch on the instrument control panel is turned off, turn it on.

   3.2 Momentarily flip the paddle switch on the instrument control panel up to RSM/ACC.

   3.3 *or*—Press the RESUME button on the transmission shift knob.

4. To adjust engine speed up or down:

   4.1 Hold the RSM/ACC–SET/CST paddle switch up to accelerate, or down to decelerate, until the desired speed is reached.

   4.2 *or*—Press the SET button on the transmission shift knob to accelerate, or the RESUME button to decelerate, until the desired speed is reached.

NOTE: The resume engine speed memory is not maintained if the ignition is shut off.

Detroit Diesel Electronic Engine Control (DDEC IV®) Operator Control

IMPORTANT: This vehicle is equipped with an Instrumentation Control Unit (ICU) that provides warning messages and diagnostic fault codes. See "Instrumentation Control Unit", depending on the type of unit installed in your vehicle.

The DDEC IV system uses a computer that is programmed to automatically control engine timing and fuel injection.

DDEC IV systems will shut down the engine if sensors indicate an emergency engine condition such as low coolant level, high coolant temperature, or high oil temperature. If such a condition occurs, the yellow Check Engine light on the dash will illuminate. If the problem gets bad enough to cause possible engine damage, the DDEC IV will gradually cut engine power down to 70 percent of original power. At that point, the red Engine Protection (ENG PROT) light will turn on and thirty seconds later, DDEC IV will shut down the engine (if programmed). If DDEC IV detects low oil pressure, both the Check Engine and Engine Protection lights will come on, and the engine will shut down in thirty seconds (if programmed). See "Engine Protection—Warning and Shutdown Process" at the beginning of this chapter, for more information.

Optimized Idle®

The Optimized Idle option on DDEC IV-equipped vehicles is a system that automatically stops and restarts the engine to accomplish the following:

- Keep the engine oil temperature between 60 to 104°F (16 to 40°C)
- Keep the battery charged
- Keep the cab or sleeper at a constant, desired temperature (if equipped with a thermostat)

The benefits of the system include reduced engine idle time, fuel savings, reduction of exhaust emissions and noise, increased starter and engine life, and less chance of dead batteries due to electrical loads.

Optimized Idle operates in two modes. They are the engine mode or the thermostat mode. The engine mode keeps the battery charged and the engine oil temperature within factory set limits. The thermostat mode is the same as the engine mode, but also keeps the cab and sleeper at a constant preset temperature.

The engine mode is always activated when the system is operated. The thermostat mode is activated when the thermostat is turned on.

The thermostat mode controls the set point, which is the desired temperature of the cab and sleeper, and the comfort zone, which is the number of degrees from the set point before the engine needs to heat or cool the cab. There are three comfort zones: 4°F (2°C), 7°F (4°C), or 10°F (6°C).

Vehicles equipped with Optimized Idle have a label and a dash light. The dash light is on the dash message center or the Driver Message Center, on the A panel. See **Fig. 2.21**. See **Fig. 2.22** for the dash label detail. If equipped with the thermostat mode, a thermostat is located in the sleeper, above the bunk. See **Fig. 2.23**.

The thermostat consists of an LCD readout and four buttons.

The display normally shows the temperature of the sleeper, but changes accordingly as the buttons are pressed.

The button functions are as follows:

- Up button: increases the set point and comfort zone.

1. Optimized Idle Light

Fig. 2.21, Optimized Idle Light Location

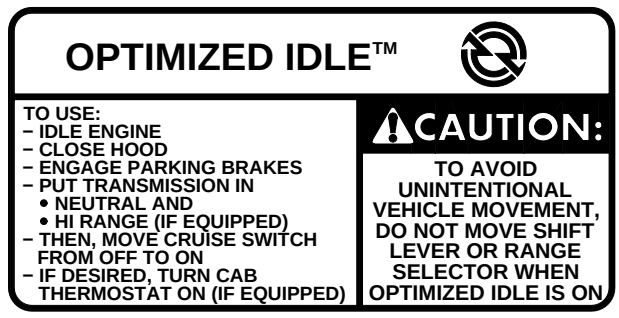
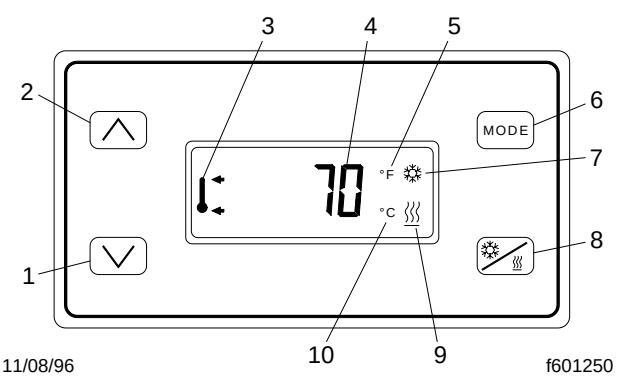


Fig. 2.22, Optimized Idle Dash Label



1. Down Button
2. Up Button
3. Upper/Lower Temperature Icon
4. Temperature Display
5. Degrees Fahrenheit Indicator
6. Mode Button
7. Cooling Icon
8. Cool/Heat Selection Button
9. Heating Icon
10. Degrees Celsius Indicator

Fig. 2.23, Optimized Idle Thermostat

- Down button: decreases the set point and comfort zone.
- Cool/heat button: detects either cooling or heating operation.
- Mode button: scrolls through the various functions. It can also be used to set desired temperature values.

1. Activate Optimized Idle (engine mode) as follows:

   1.1 Set the parking brake.

   1.2 If it is tilted, close and secure the hood.

   1.3 Start the engine and let it idle.

   1.4 Put the transmission in neutral.

   1.5 Turn on the cruise control.

   IMPORTANT: The cruise control must be turned on *after* the engine is idling. If it was previously turned on, turn off the cruise control, then turn it on again.

   1.6 The dash light will begin blinking, indicating that Optimized Idle is active. The system is now in the engine mode and after an initial phase, in which the idle speeds up to 1000 or 1500 rpm (depending on the outside temperature), the engine will stop and start automatically to keep the battery charged and the engine oil warm. The dash light stays on and shines steadily at this point.

2. Activate the thermostat mode (if so equipped) as follows:

   NOTE: When the system is in the thermostat mode, it is also in the engine mode. It will continue to operate in the engine mode even if the thermostat mode is turned off.

   2.1 With the system in the engine mode, set the cab and sleeper heater or air conditioner controls to the highest setting.

   2.2 Turn on the thermostat by touching any of the four buttons. See **Fig. 2.23**. The display will flash the current sleeper temperature and the previous mode (cooling or heating) selected. If the cab needs to be cooled or heated, the cool/heat icon will flash.

   2.3 Choose either cool or heat by pressing the *Cool/Heat* button. Make sure the selection matches that of the cab controls.

   IMPORTANT: If the heat or cool selection of the thermostat does not match that of the cab, the system will idle and cycle excessively.

   2.4 Select Fahrenheit or Celsius by pressing and holding the *Mode* button until either the °F or °C is displayed.

   2.5 Select the temperature set point by pressing either the *UP* button or the *DOWN* button, as applicable. Holding the button will cause the display to count up or down rapidly. When the desired set point is displayed, release the button. The set point is stored in memory.

   2.6 Select the temperature comfort zone by pressing the *MODE* button until the upper and lower temperature limit icon is displayed. Then use the *UP* or *DOWN* button to select one of the three comfort zones of 4°F (2°C), 7°F (4°C), or 10°F (6°C).

3. To change the display to either Fahrenheit or Celsius, press the *MODE* button until only the *°F* or *°C* icon is flashing. Press the *UP* or *DOWN* button to change to the desired value. The main display will appear 5 seconds after the button is released.

4. To deactivate the thermostat mode and return to just the engine mode, press the *MODE* button and hold it for 3 seconds.

5. To shut down Optimized Idle completely, either turn off the ignition or use the drive away feature.

   The drive away feature allows the use of all the DDEC features. Use the drive away feature as follows:

   5.1 *If the engine is running:* Release the parking brakes or put the transmission in gear.

If the engine is not running: Start the engine. Release the parking brakes or put the transmission into gear.

5.2 Let the engine return to base idle. The active light will turn off. Optimized Idle is now disabled and all the DDEC features are available.

Detroit Diesel Electronic Engine Control (DDEC VI®) Operator Control

Because the DDEC VI system is electronic, vehicle battery power must be available to operate the computer. The system operates at 12 volts, however, in the event of a power supply malfunction, the system will continue to operate at reduced voltage. When this occurs, the amber warning lamp (Check Engine) will come on. The engine will operate only at reduced rpm. When the battery reaches a point where the Motor Control Module (MCM) hasn't enough power to function, the engine will shut down.

Besides the engine and its related sensors, the DDEC VI system has two control modules:

- a Motor Control Module (MCM) located on the engine;
- a Common Powertrain Controller (CPC) located in the vehicle cab.

The two control units are connected by a proprietary datalink, through which all necessary data and information is exchanged. The CPC broadcasts information on the J1587 and J1939 datalinks, where it is read by the diagnostic tool. The MCM monitors both the engine and datalink. When a malfunction is detected, the system selects an appropriate response; for example the emergency-running mode may be activated.

Motor Control Module (MCM)

The MCM is located on the left-hand side of the engine. See **Fig. 2.24**.

The MCM processes the data received from the CPC; for example, the position of the accelerator pedal, engine brake, etc. This data is evaluated together with the data from the sensors on the engine, such as coolant and fuel temperature, and oil and charge pressure. The data is then compared to the characteristic maps stored in the MCM. From this data, the quantity and timing of fuel injection are calculated.

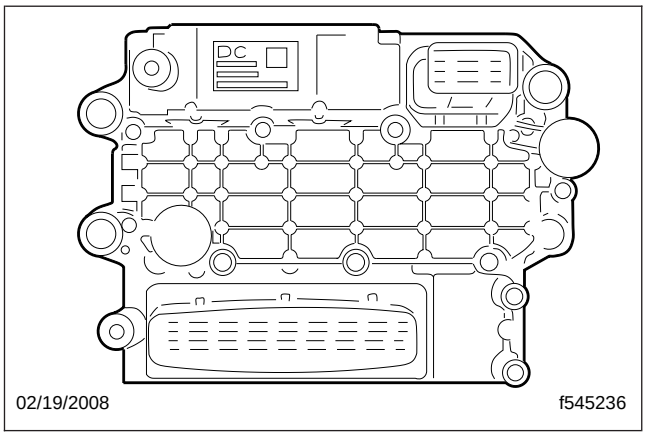


Fig. 2.24, Motor Control Module (MCM)

Common Powertrain Controller (CPC)

The CPC is located in the vehicle cab. See **Fig. 2.25**. The CPC communicates with the MCM, over the J1939 datalink. Data for specific applications is stored in the CPC. These include idle speed, maximum running speed, and speed limitation.

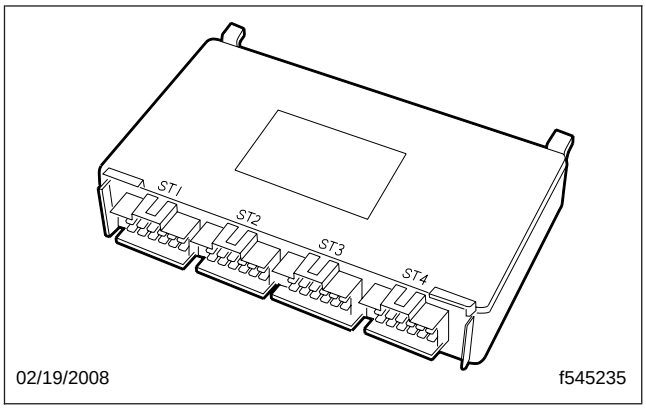


Fig. 2.25, Common Powertrain Controller (CPC)

The CPC receives data from the following sources:

- the operator (accelerator pedal position, engine brake switch, etc.);
- other electronic control units (for example, the antilock brake system);
- the MCM (oil pressure, coolant temperature, etc.).

California Engine Idle Limiting

In order to meet the California engine idle limiting standard, an engine idle shutdown feature has been built into the DDEC VI engine control strategy. When the California engine idle limiting feature is enabled, the engine will generally shut down after 5 minutes of continuous idling when the transmission is in neutral or park, and the parking brake is set, or after fifteen minutes when the transmission is in neutral or park, and the parking brake is not set.

Pressing the service-brake pedal, clutch pedal, stop-engine override switch, and accelerator pedal, or changing the parking brake status, during the final 30 seconds before a shutdown would otherwise occur, will prevent the engine from shutting down, and reset the shutdown timer. After an automatic shutdown, the engine may be restarted and operated normally.

If a parked regen of the aftertreatment system is initiated, it will override the five-minute idle shutdown. The HEST lamp will flash every ten seconds, indicating a regeneration is in progress, and the driver is not controlling the engine idle.

The automatic shutdown feature is generally disabled on engines certified by the U.S. EPA for use outside California.

Idle Shutdown Timer

This feature is an optional 1-to-100 minute idle shutdown system. Its purpose is to conserve fuel by eliminating excessive idling, and allowing a turbocharger cool-down period. To activate the shutdown, the transmission must be in neutral with the vehicle parking brakes set and the engine in idle or fast-idle mode.

Data Recording Capability

DDEC VI contains the ability to extract detailed data on the engine use and performance, using DDEC Reports software. This data, known as DDEC Data, is stored in the CPC and contains information on engine performance (such as fuel economy, idle time, time in top gear), and critical incidents (such as detailed diagnostic data records and hard braking events). DDEC Data can be downloaded using DDEC Reports software to produce reports. See the *Detroit Diesel DD15 Engine Operator's Guide* for complete details.

Flashing Malfunction Codes

All malfunction codes are four digits. The malfunction code recorded in the computer memory will remain until it is erased by a technician. The flashing malfunction code can also be obtained by the operator. See the *Detroit Diesel DD15 Engine Operator's Guide* for complete details.

Engine Brake

The engine brake is enabled by an ON/OFF switch, with a separate intensity switch to select low, medium, or high braking power.

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

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 miles-per-hour (kilometers-per-hour) above the cruise set speed. The maximum amount of braking (low, medium, high) 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. Disengaging the clutch will prevent the engine brake from operating.

Vehicles equipped with antilock braking systems (ABS) have the ability to turn the engine brake off if a wheel-slip condition is detected. The engine brake will automatically turn itself back on once the wheel slip is no longer detected. The DDEC VI system will deactivate the engine brake system 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.

For safety reasons, do not use cruise control when it is not possible to keep the vehicle at constant speed due to:

- Winding roads
- Heavy traffic
- Slippery pavement
- Descending grades calling for engine brake assistance

For a detailed explanation of the engine brake operation, see the *Detroit Diesel DD15 Engine Operator's Guide*.

Caterpillar C–10, C–12, and 3406E Electronic Engine Operator Control

IMPORTANT: This vehicle is equipped with an Instrumentation Control Unit (ICU) that provides warning messages and diagnostic fault codes. See "Instrumentation Control Unit", depending on the type of unit installed in your vehicle.

The Caterpillar C–10, C–12, and 3406E electronic engines use a computer (electronic control module) to automatically control engine timing and fuel injection. The electronic features of these engines include an electronic governor, fuel-to-air ratio control, programmable engine ratings, injection timing control, fault analysis and recording, and a datalink used for programming the electronic control module and troubleshooting the system.

All Caterpillar electronic engines have an engine check light located above the speedometer and tachometer. This warning light comes on or flashes if the engine oil pressure is low, the coolant temperature is high, the intake manifold air temperature is high, the coolant is low (optional), or whenever there is a problem within the electronic engine system. Some vehicles equipped with Caterpillar electronic engines have an automatic engine shutdown option. This option will shut off fuel to the engine if potentially damaging conditions are detected. See "Engine Protection—Warning and Shutdown Process" at the beginning of this chapter, for more information. See the Caterpillar electronic engine troubleshooting manual for troubleshooting procedures.

BrakeSaver Control, Optional

The BrakeSaver (optional on Caterpillar 3406E engines) is operated by a lever mounted in the cab. The lever controls the amount of oil being directed through the BrakeSaver. The time required to fill the BrakeSaver with oil pressure to the point of maximum braking in the BrakeSaver is approximately 1.8 seconds.

Cummins CELECT™ Plus Electronic Engines Operator Control

IMPORTANT: This vehicle is equipped with an Instrumentation Control Unit (ICU) that provides warning messages and diagnostic fault codes. See "Instrumentation Control Unit", depending on the type of unit installed in your vehicle.

Cummins CELECT Plus is an electronic fuel control system. These electronic engines are controlled by a microprocessor-based computer. This computer controls specific engine and vehicle speed modes of operation to maximize vehicle fuel economy and performance.

Vehicles with these engine systems have three indicator lights: a yellow check engine light, a red stop engine light, and an engine protection (engine fluids) light. These indicators are located in the lightbar above the speedometer and tachometer. With the ignition switch on, the indicator lights come on for about two seconds; then, if there is no problem with the engine system, the lights will go out. Whenever there is a problem within the electronic engine system, one of the lights will come on and stay on as long as the problem exists. See "Engine Protection—Warning and Shutdown Process" at the beginning of this chapter, for more information.

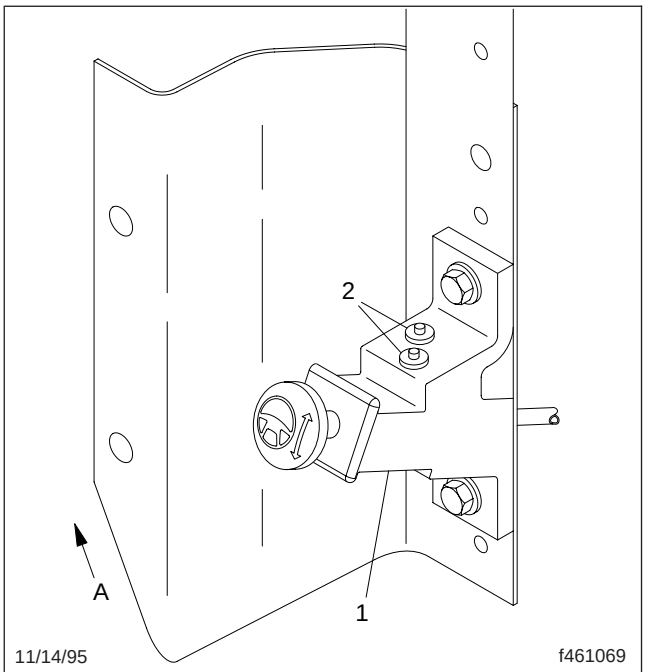
Suspension Seat Adjustment Controls

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 backwall. 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.

Tilt Steering Wheel, Optional

The optional tilt steering wheel control pedal is located to the left of the clutch pedal. See **Fig. 2.26**.



A. Driver's Door Opening
1. Adjustment Valve
2. Air Line Connections

Fig. 2.26, Tilt Steering Wheel Control Pedal

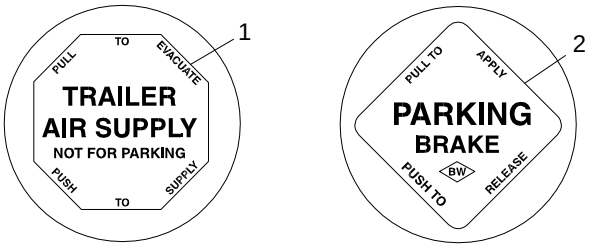
After adjusting the seat to the desired ride position, unlock the steering column by pushing and holding the control pedal all the way down. Tilt the steering column to the desired position, then release the control pedal to lock the steering column in place.

⚠ WARNING

Make sure that the control pedal is released and the steering column is locked before driving the vehicle. Never tilt the column while driving the vehicle. Doing so could cause loss of vehicle control, personal injury, and property damage.

Parking Brake Control Valve and Trailer Air Supply Valve

The yellow diamond-shaped knob operates the parking brake valve. Pulling the knob applies both the tractor and the trailer spring parking brakes. See **Fig. 2.27**. Pushing the knob in releases the tractor spring parking brakes. Before the spring parking brakes can be released, the air pressure in either air brake system must be at least 65 psi (447 kPa).



1. Trailer Air Supply Valve Knob
2. Parking Brake Control Valve Knob

Fig. 2.27, Brake Valve Knobs

⚠ CAUTION

Do not step on the service brake pedal while the parking brakes are applied. To do so can cause damage to the brake mechanisms.

The red octagonal-shaped knob operates the trailer air supply valve. See **Fig. 2.27**. After the vehicle and its air hoses are connected to a trailer and the pressure in the air system is at least 65 psi (447 kPa), the trailer air supply valve 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 trailer air supply valve knob must be pulled out.

See **Chapter 6** under the heading "Brake System" for instructions regarding use of the trailer air supply valve and parking brake valve.

Power Mirrors

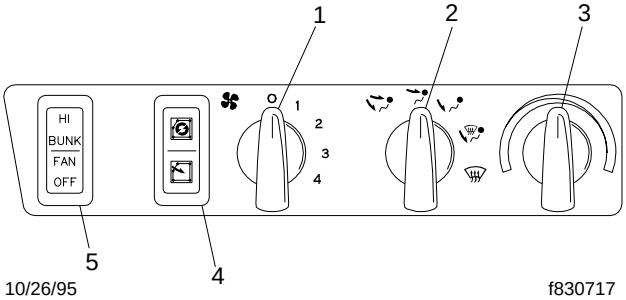
Both outside mirrors can be equipped with an electrical remote control. Operate the driver door-mounted switch to adjust the mirror.

Mirror Heat Switch, Optional

One or both outside door mirrors can be heated to keep them defrosted. When the mirror heat (MIRR HEAT) switch is on, an amber indicator light illuminates in the switch.

Heater/Air-Conditioner Controls

Heater/air conditioner controls consist of a four-speed fan switch, an air selection switch, a temperature control switch, and a fresh-air/recirculation switch. See **Fig. 2.28**. See **Chapter 4** for detailed operating instructions of the heater/air conditioner.



1. Fan Switch
2. Air Selection Switch
3. Temperature Control Switch
4. Fresh-Air/Recirculation Switch
5. Auxiliary (sleeper bunk) Switch

Fig. 2.28, Heater/Air Conditioner Controls

Left and Right Windshield-Fan Switches, Optional Ceiling-Mounted Fans

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

Cigarette Lighter

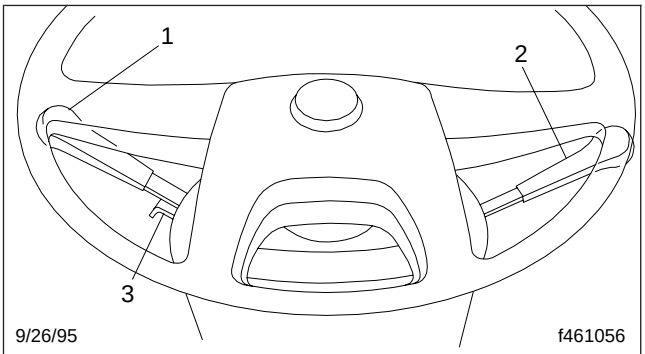
Push in the lighter to heat the element. The lighter will stay in and will automatically pop out when the element is hot.

CB Radio Connections

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

Turn Signal Lever

The turn signal lever is mounted on the steering column. See **Fig. 2.29**. Moving the lever counterclockwise turns on the left-turn signal lights; moving it clockwise turns on the right-turn signal lights. When one of the turn signal lights is on, a green indicator light flashes at the far left or far right of the warning and indicator light panel. To cancel the signal, move the lever to the neutral position. Some style levers may have automatic cancelling, and the turn signal lever automatically returns to the neutral position when the steering wheel returns to the straight-ahead position after a turn.



1. Turn Signal Lever
2. Trailer Brake Hand Control Valve Lever
3. Hazard Warning Light Switch Tab

Fig. 2.29, Steering Column-Mounted Controls

Ether Start, Optional

For cold-weather starting, the vehicle may be equipped with an automatic ether start system. Always see the instructions in the manufacturer's engine operation manual for information before using ether. Some electronic engines do not allow the use of ether.

Trailer Brake Hand Control Valve Lever

The trailer brake hand control valve lever is used for applying the trailer brakes without applying the truck or tractor brakes and is mounted on the steering column. See **Fig. 2.29**. See **Chapter 6** under the heading "Brake System" for operating instructions.

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. For control of the automated mechanical transmissions, use the Freightliner SmartShift™ Transmission Shift Control mounted on the steering column. See **Chapter 8** for complete transmission operating instructions.

Freightliner SmartShift™ Transmission Shift Control

The SmartShift transmission shift control is an electronic transmission control device. It is applicable to both automated mechanical and automatic transmissions but must be mated to an Eaton® Fuller® AutoShift or Meritor™ Engine Synchro Shift (ESS) transmission. It replaces either the typical floor-mounted shift lever or dash-mounted push button control. The SmartShift control mounts to the right-hand side of the steering column and is operated by the driver's right hand. See **Fig. 2.30** and **Fig. 2.31**. SmartShift accepts driver requests for transmission functions and transmits them through hard wiring to the transmission control unit (TCU).

SmartShift offers advantages over conventional transmission control devices; usable cab space is increased and access to the sleeper is improved by removing the shift lever from the floor. Also, because of the steering column mounting, the transmission control is within fingertip reach of the steering wheel, which enhances safety.

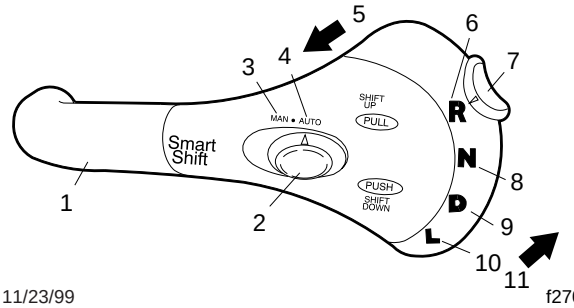
SmartShift is a true shift-by-wire system. Manual gearshifts (all ESS and AutoShift when in manual mode) are accomplished by a momentary pull or push on the control in the plane perpendicular to the steering wheel. See **Fig. 2.32**. Pull upward (toward you) on the control to upshift and push downward (away from you) to downshift. For the Eaton Fuller AutoShift transmission, a four-position (R, N, D, L) linear mode selector switch is located at the end of the control. See **Fig. 2.30**. For the Meritor ESS transmission, a three-position (R, N, F) linear mode selector switch is located at the end of the control. See **Fig. 2.31**. The control is spring-loaded and returns to mid-position when released after an upshift or downshift.

Engine Brake Switch, Optional

The engine brake (ENG BRK) switch controls the degree of engine braking. See **Chapter 7** under the heading "Engine Braking Systems" for additional information.

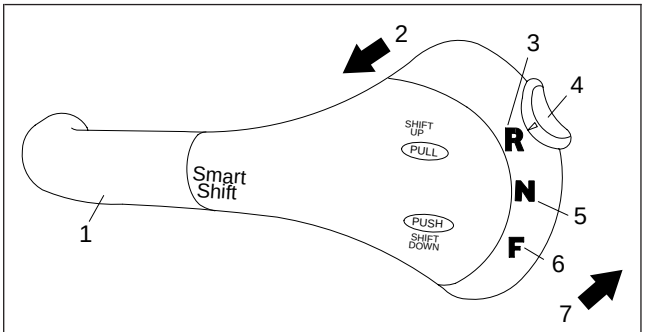
Exhaust Brake Switch, Optional

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



1. SmartShift Control
2. Forward Driving Mode Switch (slide switch)
3. MAN Switch Position
4. AUTO Switch Position
5. Upshift Direction (in manual mode, pull upward)
6. Reverse Selector Position
7. Mode Selector Switch
8. Neutral Selector Position
9. Drive Selector Position
10. Low Selector Position
11. Downshift Direction (in manual mode, push downward)

Fig. 2.30, SmartShift Control (for Eaton Fuller AutoShift transmission)

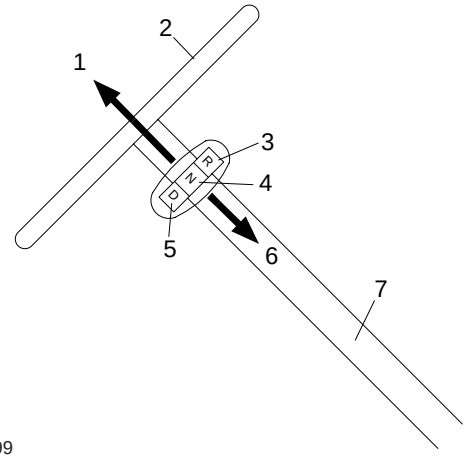


1. SmartShift Control
2. Upshift Direction (pull upward)
3. Reverse Selector Position
4. Mode Selector Switch
5. Neutral Selector Position
6. Forward Selector Position
7. Downshift Direction (push downward)

Fig. 2.31, SmartShift Control (for Meritor Engine Synchro Shift transmissions)

Engine Fan Switch, Optional

The engine cooling fan can be turned on by the engine fan (ENG FAN) switch. The fan will continue to



1. Upshift (in manual mode, pull upward)
2. Steering Wheel
3. Reverse Position
4. Neutral Position
5. Drive Position
6. Downshift (in manual mode, push downward)
7. Steering Column

Fig. 2.32, SmartShift Control Operation (Eaton Fuller AutoShift control, showing only R, N, D positions)

operate for a set amount of time and then turn off unless the coolant temperature is high enough to continue the fan operation.

Aftertreatment 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. 2.33.**

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

Controlled Traction Differential Control Valve Switch

A controlled traction differential feature is included or available as an option on some rear axles. A control valve switch engages and disengages the controlled traction feature to cause the axle shafts to rotate together. See **Fig. 2.34**. The controlled traction, or differential lock, should only be engaged when the vehicle is moving slowly at low throttle to avoid causing internal axle damage. The differential lock must only

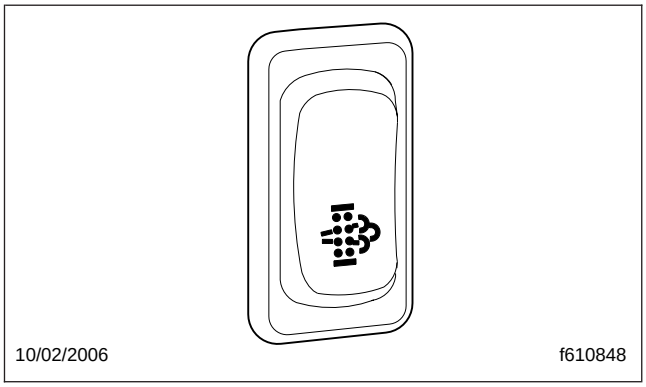


Fig. 2.33, Request/Inhibit Regen Switch

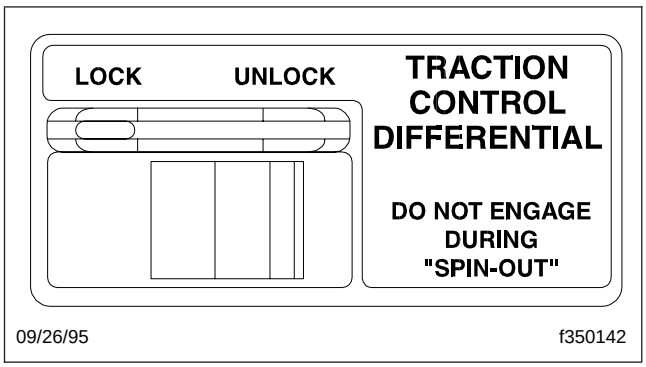


Fig. 2.34, Controlled Traction Differential Switch

be used for adverse road conditions. The use of the lock increases the turning radius and affects the vehicle handling. A guard is positioned around the switch to minimize accidental activation. See **Chapter 9** for complete operating instructions.

Interaxle Differential Lockout Control Valve Switch

⚠ CAUTION

The interaxle lock should only be engaged when the vehicle is moving slowly at low throttle. Engagement at high speed or power can damage the axle(s).

The interaxle lock, standard on all dual-drive vehicles, is driver-actuated by means of a LOCK/UNLOCK control valve switch mounted on the control panel. See **Fig. 2.35**. A red indicator light comes on whenever the interaxle differential is locked out (switch is in the lock position; no differential action

between the drive axles). A guard around the switch minimizes accidental activation.

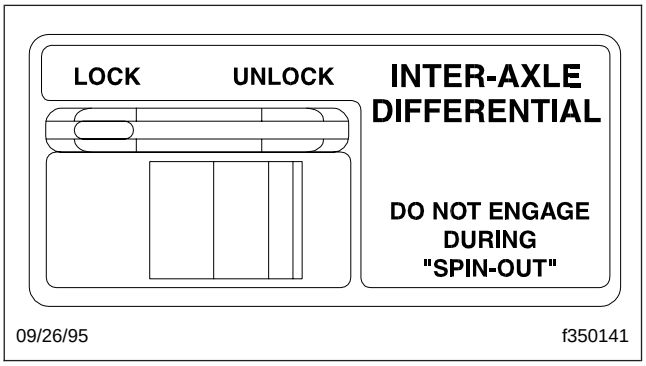


Fig. 2.35, Interaxle Differential Lockout Switch

Fifth Wheel Air Slide Control Valve Switch, Optional Air-Operated Sliding Fifth Wheel

The fifth wheel air slide valve permits repositioning of the sliding fifth wheel from inside the cab. Moving the air slide control valve switch to the lock position deactivates the control valve and locks the fifth wheel to the baseplate. See **Fig. 2.36**. Moving the switch to the unlock position activates the control valve and unlocks the fifth wheel slide mechanism, allowing changes to the total length of the tractor-trailer and changes to axle loads to comply with varying state or provincial laws. A red indicator light, if so equipped, is illuminated whenever the fifth wheel slide is unlocked. A guard is positioned around the switch to minimize accidental activation.

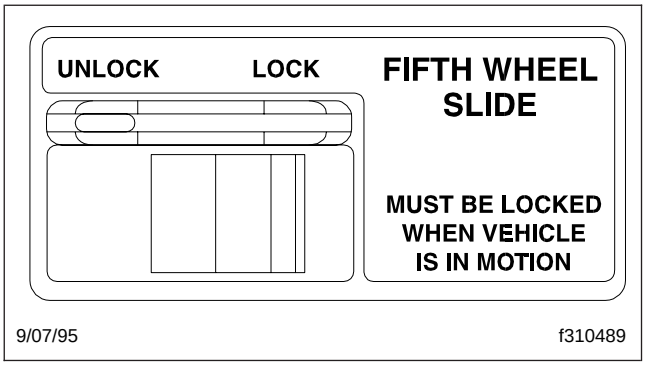


Fig. 2.36, Fifth Wheel Air Slide Switch

CAUTION

Do not activate the fifth wheel slide control valve while the vehicle is in motion. To do so could cause damage to the fifth wheel member, the kingpin, the cab or trailer, and ultimately to the drivetrain.

Air Suspension Dump Valve, Optional

The air suspension dump valve 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 exhaust air from the suspension, move the switch to LOWER. When the switch is moved back to the normal position, the suspension will return to the correct ride height. A guard is positioned around the switch to minimize accidental activation. See **Fig. 2.37**.

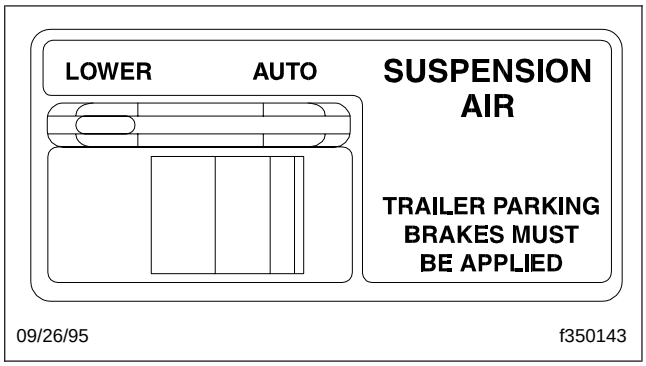


Fig. 2.37, Air Suspension Dump Valve

CAUTION

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

Windshield Wiper/Washer Controls

The wipers are operated by a double-paddle WIPER/WASH switch mounted on the auxiliary instrument panel. The top paddle, when pushed in, turns the wipers on (if they are off) or off (if they are on). When it is pushed up, the top paddle switches the wipers to high speed; when it is pushed down, it switches them to low speed.

The bottom paddle, when pushed in, turns the washers on. When pressed for less than 1/2-second, the wipers will perform a single, low speed dry wipe (mist function). When pressed for more than 1/2-second, the wash cycle begins and continues for three cycles or until the paddle is released. When the bottom paddle is pushed up, the wipers operate in fast delay. When the bottom paddle is pushed down, the wipers operate in slow delay. With the wipers in delay mode (fast or slow), push the bottom paddle up to shorten the delay period or push the paddle down to lengthen it.

⚠ CAUTION

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

Headlight Switch and Daytime Running Lights

A three-position headlight switch is used to operate the exterior lights. When the switch is up, the headlights and all other vehicle lights are on. All vehicle lighting is off when the switch is in the middle position. When down, the switch activates only the clearance, instrument panel, marker lights, and the taillights. The switch for the headlight high beams is built into the turn signal lever. When the headlights are on high beam, a blue light in the warning and indicator light module goes on. The ignition switch must be on for the high beams to operate.

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.

Headlight Dimmer

Pull the turn signal lever toward the steering wheel to change from low-beam to high-beam headlights or from high beam back to low beam.

When the headlights are on high beam, a blue light on the indicator light panel comes on. For vehicles built to operate in the United States, switching from low beams to high beams will switch off the road lights.

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

Hazard Warning Light Switch Tab

The hazard warning light switch tab is located underneath the turn signal lever. See **Fig. 2.29**. Hazard warning lights are operated by pulling the tab out. When the hazard warning light switch tab is pulled out, all of the turn signal lights and both of the indicator lights on the control panel will flash. To cancel the warning lights, move the turn signal lever up or down.

Marker Lights Interrupt Switch

The marker lights interrupt (MRKR INT) switch temporarily deactivates the marker lights and taillights. With the vehicle lights on, raise and release the interrupt switch to briefly turn off the marker lights and taillights. To alert the driver that the switch is functioning, the dash lights will flash with the marker lights when the switch is actuated.

Road Light Switch, Optional

The road light (ROAD LAMP) switch operates the road lights mounted on the bottom edge of the front bumper or recessed in the front bumper.

For vehicles built to operate in the United States, 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.

For vehicles built to operate in Canada, the marker lights must be on before the road lights can be turned on.

Utility Light Switch, Optional

Utility lights can be swivel-mounted on top of the cab, mounted on the intake/exhaust support, or flush-mounted in the back of the cab or sleeper box. They are operated by the utility light (UTLY LAMP) switch which, when turned on, also illuminates a red indicator light in the switch (if equipped).

Panel Lamp Control Switch

The circuit to the panel lamps is activated by the headlight switch. When the headlights are on, the panel lamp switch controls the intensity of the instrument panel lamps. Slide the switch up to brighten them and down to dim them.

Interior Light Controls

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

SleeperCabs have additional lights in the bunk area, including bunk reading lights, under-bunk lights (baggage compartment lights), and fluorescent lights.

Dome Light Switches

Diffuse dome lights are installed on all cabs. See **Fig. 2.38** and **Fig. 2.39**. The dome lights are located either on the overhead console, or on the cab roof (if no overhead console is installed). Both dome lights turn on when either the driver's or passenger's door is opened. The dome lights can also be turned on by pressing in on the light lens.

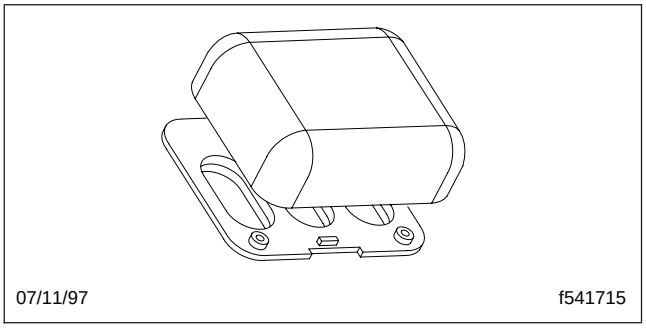


Fig. 2.38, Dome/Tray, Red Map, and Clear Reading Lights (SleeperCab)

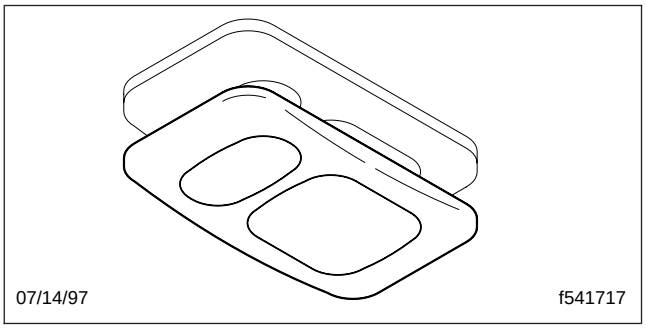


Fig. 2.39, Dome Light with Red Map Light

Red Map Light Switches

Red map lights are available on all cabs. See **Fig. 2.38** and **Fig. 2.39**. They are located next to the dome lights in the same fixture. Like the dome lights, the map lights can be turned on by pressing in on the light lens.

Clear Reading Light Switches, Optional—SleeperCabs Only

Clear reading lights are available on SleeperCabs only. See **Fig. 2.38**. They are located next to the dome lights in the same fixture. Like the dome lights, the reading lights can be turned on by pressing in on the light lens.

Courtesy Light Switch, Optional

Courtesy lights are available on all cabs. They illuminate the footwell area on both sides of the cab. The driver's courtesy light is attached to the steering column and the passenger's footwell light is located on the lower right dash panel. To turn on the courtesy lights, press the rocker switch on the dash. When the lights are on, the switch is illuminated by a light inside it. See **Fig. 2.40** and **Fig. 2.41**.

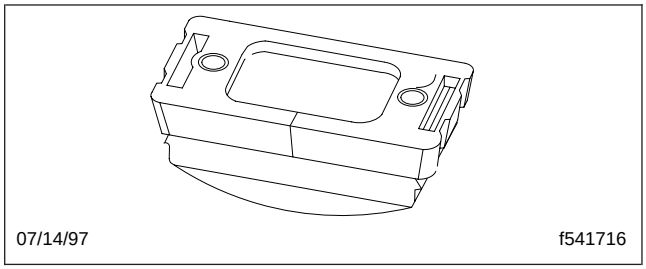


Fig. 2.40, Driver's Floor Courtesy Light

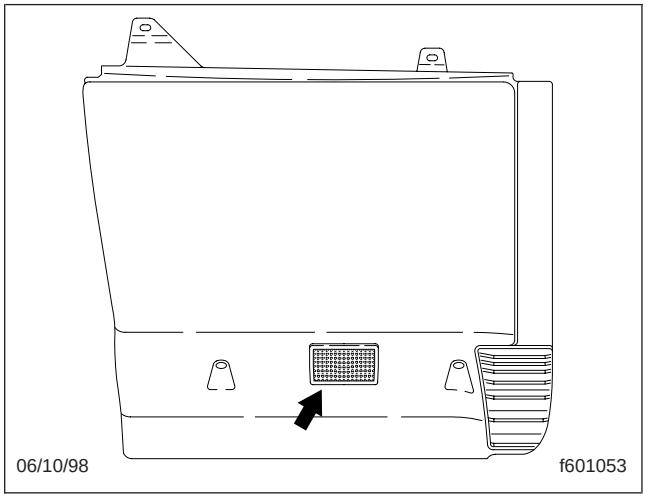


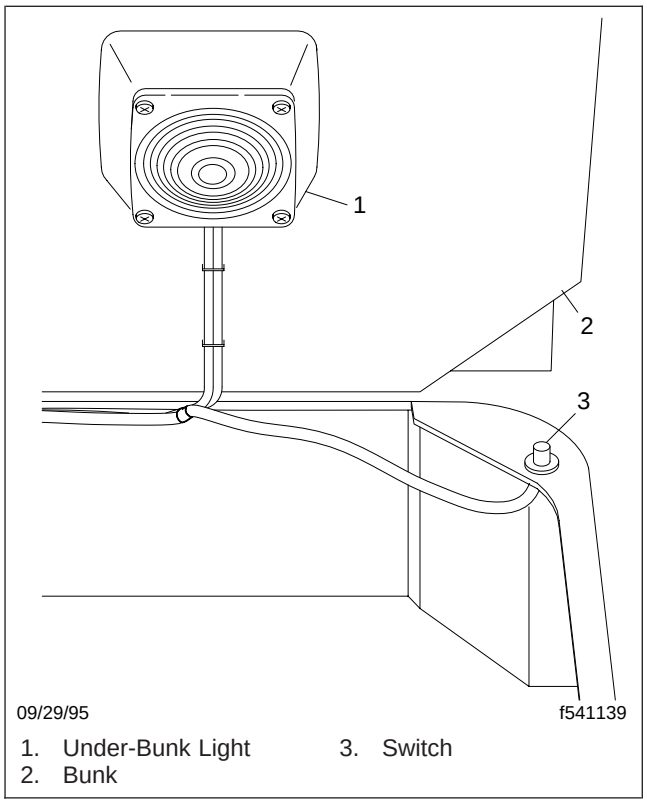
Fig. 2.41, Passenger's Footwell Courtesy Light

Bunk Reading Light Switches, Optional—SleeperCabs Only

Bunk reading lights are high-intensity reading lights for use when reading in the bunk. They are located on the bunk control panel for each bunk. To turn on the bunk reading lights, press the rocker switch on the bunk control panel that holds the light.

Baggage Compartment Light Switches (SleeperCabs Only)

Baggage compartment lights are on all cabs. One light is located on each side of the cab on the underside of the lower bunk and illuminates the baggage compartment. Both lights turn on when either baggage compartment door is opened. The lights also come on when the lower bunk is raised. See **Fig. 2.42**.



1. Under-Bunk Light
2. Bunk
3. Switch

Fig. 2.42, Baggage Compartment Light

Battery Disconnect Switch, Optional

An external battery disconnect switch cuts off all battery power to the vehicle. The switch is used whenever service operations require that the batteries be disconnected. It is also used whenever the vehicle is placed out of service for extended periods to prevent battery discharge. See **Fig. 2.43**.

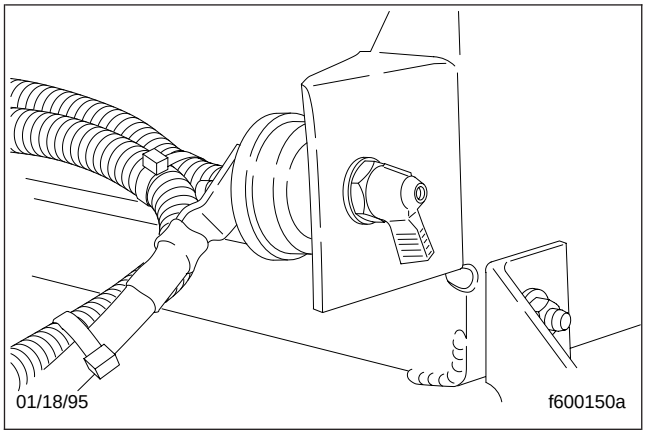


Fig. 2.43, Battery Disconnect Switch

Low Voltage Disconnect, Optional

The optional Sure Power Low Voltage Disconnect (LVD) system monitors battery power when accessories are being used while the engine is shut down. The system automatically turns off cab and sleeper accessories when voltage drops to 12.3 volts to ensure that there is enough battery power to start the vehicle. An alarm sounds for one minute before accessories are turned off. If no action is taken within that minute, the LVD module will shut off power to predetermined cab and sleeper circuits. These circuits will remain off until the LVD measures 13.0 volts applied to the system, which can be done by starting the engine. After the engine is started, the system will reset.

All vehicles equipped with LVD have a sticker on the dash indicating the presence of the system. Another sticker is located inside the right-hand door frame behind the seat, along with the LVD module. The LVD module is located on the engine tunnel, behind the lower right-hand dash panel.

Automatic Engine Idler/Timer, Optional

A Henke automatic engine idler/timer allows the driver to select the idle time required for engine shutdown. The driver can turn off the ignition, remove the ignition key, lock the vehicle, and leave it with the

engine idling; the automatic timer will shut the engine off at the end of the selected time.

Meritor™ WABCO® Antilock Braking System (ABS)

The Meritor WABCO Antilock Braking System (ABS) has a tractor warning light (TRACTOR ABS) and, if equipped with automatic traction control (ATC), a wheel spin indicator light (WHEEL SPIN). See **Fig. 2.44**.

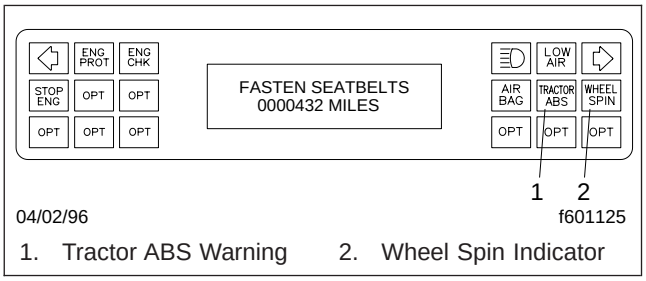


Fig. 2.44, ABS Warning and Indicator Lights (standard)

After the ignition switch is turned on, the tractor warning light (TRACTOR ABS) and (if equipped) the wheel spin (WHEEL SPN) indicator light come on for about three seconds. After three seconds, the lights go out only 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 come on while driving, repair the ABS system immediately to ensure full antilock braking capability.

Vehicles with ABS may also have automatic traction control (ATC). On these vehicles, the ATC system automatically limits wheel spin when power is applied to the drive axles during reduced-traction situations.

If the vehicle has ATC, there will be a momentary contact rocker switch on the dash labeled NORM/SPIN and ATC.

When the ATC system is in the NORMAL mode, it will apply gentle braking to the spinning wheel, to force power to the wheel(s) with better traction. If both wheels are spinning, the system will signal the electronic engine to reduce power.

Pressing NORM/SPIN will temporarily allow more drive wheel spin to help burn through a thin layer of ice or to help throw off accumulated mud or snow. SPIN mode is indicated by a flashing WHEEL SPIN light. Pressing NORM/SPIN again will cycle the system back to normal operation.

See the brake system operating instructions in **Chapter 6** for more information.

Lane Guidance™ System Rocker Switch, Optional

The lane departure warning system is controlled by a dash-mounted rocker switch that toggles the system on and off. Additional information is detailed later in this chapter.

Collision Warning System (CWS), Eaton VORAD EVT–300, Optional

The Eaton VORAD EVT–300 is a computerized collision warning system (CWS) that uses front-mounted and side-mounted (optional) radar to continuously monitor vehicles ahead and alongside your vehicle.

The system warns of potentially dangerous situations by means of visual and audible alerts. The system performs in fog, rain, snow, dust, smoke, and darkness. To be detected, objects must be within the radar beam's field of view and provide a surface area that can reflect back the radar beam.

The front-looking antenna assembly transmits radar signals to and receives them back from vehicles and objects ahead. This allows the determination of the distance to, relative speed of, and angle to the target of vehicles and objects ahead. The system uses this information to warn the driver of potentially dangerous situations.

An optional side sensor(s), mounted on the side of the vehicle, also transmits and receives radar signals for a distance of 2 to 10 feet (0.5 to 3 meters) alongside your vehicle. The side sensor can detect unseen vehicles and objects, moving and stationary, adjacent to your vehicle.

⚠ WARNING

The Eaton VORAD EVT–300 Collision Warning System (CWS) is intended solely as an aid for an alert and conscientious professional driver. It is not intended to be used or relied on to operate a vehicle. Use the system in conjunction with rearview mirrors and other instrumentation to safely

operate the vehicle. Operate this vehicle, equipped with the EVT–300 Collision Warning System, in the same safe manner as if the EVT–300 Collision Warning System were not present.

The EVT–300 Collision Warning System is not a substitute for safe, normal driving procedures, nor will it compensate for any driver impairment, such as drugs, alcohol, or fatigue.

The EVT–300 Collision Warning System may provide little or no warning of hazards such as pedestrians, animals, oncoming vehicles, or cross traffic.

Failure to drive safely and use the system properly could result in personal injury and/or death and severe property damage.

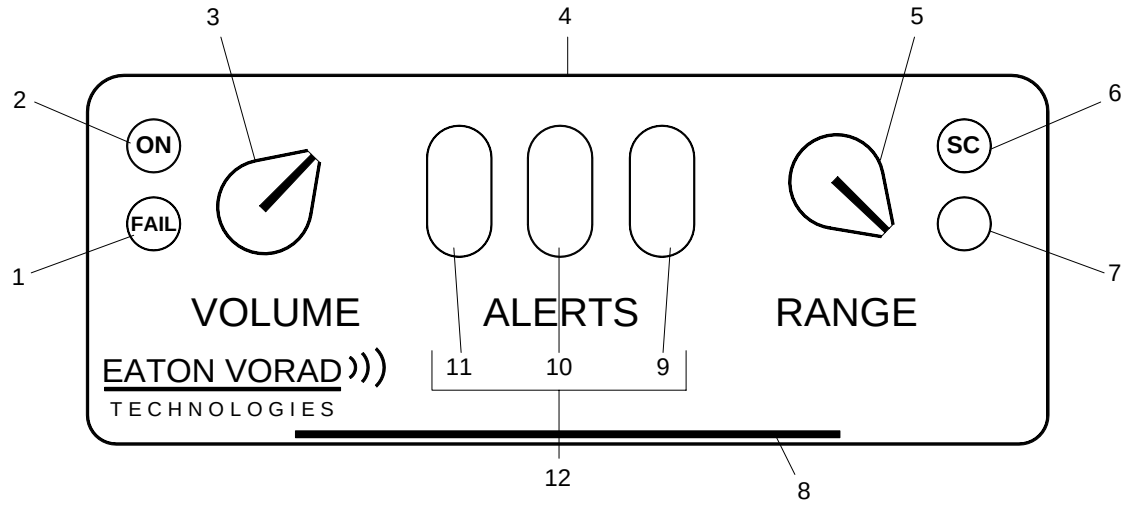
EVT–300 Driver Display Unit

NOTE: All system controls are located on the Driver Display Unit (DDU). See **Fig. 2.45**. Indicators to inform the driver about the system's operation are located on both the DDU and the optional side sensor display.

The DDU controls system power, range for vehicle warnings, and speaker volume. At the lower front edge of the DDU, a slot is provided to insert the optional driver's identification card. Alert and indicator lights advise of multiple warning levels, system power, system failure, and if so configured, failure of the driver to enter the identification card.

A light sensor automatically adjusts alert and indicator light brightness depending on lighting conditions. A small speaker provides audible alert tones to warn of closing on an object ahead and, when equipped with an optional side sensor, of objects alongside when the turn signal is activated in preparation for a lane change. Additional tones indicate speaker volume, system failure, driver's card status, and data extraction pass or fail.

1. The green power-on/driver's card (optional) status indicator light illuminates when the system is activated and the power-on LED test is complete. If the system is configured to require that the driver's card be read, and it is not, the ON light blinks continuously.



1. Red System Failure Indicator Light
2. Green Power ON/Driver's Card Status Indicator Light
3. Volume Control and Power ON/OFF Knob
4. Speaker
5. Range Knob
6. Green SC Indicator Light
7. Ambient Light Sensor
8. Driver's Identification Card Slot
9. Red Alert Light
10. Orange Alert Light
11. Yellow Alert Light
12. Distance/Danger Alert Lights

Fig. 2.45, Driver Display Unit (EVT-300)

2. Push in the volume control and power ON/OFF knob to turn power on or off. Turn the knob left or right to increase or decrease speaker volume. Press and hold the knob for five seconds and then release it to activate the failure display mode.

NOTE: The system may be configured to have no on/off capability.

3. The speaker is located under the top cover of the DDU. It sounds audible tones to alert the driver to potential hazards. Volume may be restricted to a range above a minimum level.

NOTE: This is a configurable electronic parameter.

4. Rotate the range knob to adjust the first alert detection range to between 3 and 2.25 seconds. Push and hold the knob for 5 seconds to activate the accident reconstruction function and freeze the most recent data in half of the allocated memory.

NOTE: The system may be configured to prevent adjustment of the range levels.

5. The red system failure indicator light illuminates if a system problem is detected. Press and hold the volume control knob for five seconds to display fault codes. The fault codes will be blinked out as a pattern of flashes on this indicator light. See **Table 2.5** for fault codes.

6. The green SC indicator light will flash eight times if the range knob is pressed to store accident reconstruction information. It will also flash eight times after the system is activated, after the power-on LED test is finished, and if accident reconstruction data was previously stored.

7. The ambient light sensor senses lighting conditions and automatically adjusts the intensity of the indicator and alert lights.

8. If the system's configuration requires, insert the driver's identification card in the slot at the lower front edge of the DDU. A high-pitched tone will sound when the driver's identification card has been successfully read. One low tone will sound if the driver's card has been unsuccessfully read. If so configured, a repeated low tone will sound if the system is on and the requested driver's card has not been inserted.

Fault Codes	
Fault Code	**Suspect Failure**
11	Central Processing Unit (CPU)
12	CyberCard
13	Driver Display Unit (DDU)
14	Antenna Assembly
15	Right Side Sensor
16	Left Side Sensor
21	Right-Turn Signal
22	Left-Turn Signal
23	Brake
24	Speed
25	Cruise
31	J1587
32	J1939
33	VBUS
34	DDU Communications
35	Antenna Assembly Communications
41	No Fault or End of Fault Codes

Table 2.5, Fault Codes (EVT-300)

9. The yellow alert light illuminates when an object is detected within the system's maximum range of 350 feet (107 meters) on a straight road. Range is reduced in curves by the turn radius of the curve. This light also illuminates when the proximity alarm threshold is crossed.

10. The orange alert light illuminates, along with the yellow alert light, when your vehicle is within a two- to three-second following interval behind another vehicle in the same lane. If you are within a two-second following interval and closing on the vehicle ahead, a warning tone will also sound.

11. The red alert light illuminates, along with the yellow and orange alert lights, when you are less than one second behind a vehicle. If the vehicle ahead is opening the interval, no tone will sound. If you are closing the interval, double tones will sound. Within a 1/2-second or less following interval, opening or closing, the tones will repeat twice per second.

12. If a stationary vehicle or object, or an object moving at least 20 percent slower than your vehicle is detected within 220 feet (67 meters) and within three seconds, all three alert lights will illuminate and the double tones will sound. This

warning overrides all others and is not affected by the range control knob setting.

IMPORTANT: The detection range will be reduced during a sharp turn.

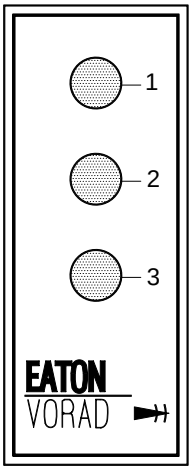
13. If your vehicle is traveling less than 5 mph (8 km/h) and an object is detected less than 15 feet (4.5 meters) in front of your vehicle and the closing rate is less than 2 mph (3 km/h) but more than 1/2 mph (1 km/h), the yellow alert light will illuminate and a low-frequency double tone will sound.

NOTE: All warnings apply only to objects within the maximum detection range and in your lane. Proximity alert tones and vehicle-closing one- to two-second following interval tones are configured items. All tones are disabled in sharp turns or when the brakes are applied. If the configuration permits, the three-second alert level may be adjusted with the range control knob. A single low-frequency tone sounds when a system failure is detected. A medium-frequency tone sounds when the volume control level is changed. Successful downloading of Vehicle Information Management System (VIMS) data will cause a double tone to sound. Unsuccessful downloading will cause a low-frequency tone to sound.

14. A failure of the optional side sensor(s) will cause a continuous red light on the side sensor display to appear.

EVT–300 Side Sensor Display

1. The yellow indicator light illuminates continuously when no vehicle is detected by the side sensor(s). See **Fig. 2.46**.
2. The ambient light sensor senses lighting conditions and automatically adjusts the intensity of indicator and alert lights.
3. The red alert light illuminates when objects are detected by the side sensor(s). If the right turn signal is activated and the side sensor detects an object, the red alert light will illuminate and the DDU speaker will sound a high-frequency double tone. This tone is sounded only once per activation of the turn signal. The red light will also illuminate and stay on if a failure of the side sensor is detected. If objects are temporarily unable to be detected during heavy rain, both the red and yellow lights will illuminate.



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1. Red Alert Light (vehicle or object detected)
2. Ambient Light Sensor
3. Yellow Indicator Light (no vehicle or object detected)

Fig. 2.46, Side Sensor Display (EVT-300)

EVT–300 Special Road Situations

⚠ WARNING

The Eaton VORAD EVT–300 Collision Warning System (CWS) is intended solely as an aid for an alert and conscientious professional driver. It is not intended to be used or relied on to operate a vehicle. Use the system in conjunction with rearview mirrors and other instrumentation to safely operate the vehicle. This system will not warn of many possible hazards. Do not assume it is "all clear" if no alert lights are illuminated.

Failure to drive safely and use the system properly could result in personal injury and/or death and severe property damage.

Certain special road situations may affect the system's ability to detect objects. These situations include the effects of curves, dips, and hills that may provide an unexpected result:

NOTE: A warning may sound when an object is detected in front of the vehicle even though the

driver intends to turn away or stop before reaching the object.

- When an object is detected in a very sharp right- or left-hand turn, the audible alarm will not sound.
- When approaching a curve, before turning into it, alarms may sound and lights illuminate because of an object off the road directly in line with your vehicle. This will not occur when the brakes are applied.
- Elevated obstacles such as overpasses and overhead signs may be detected when approaching a roadway descending to a lower elevation.
- Vehicles cannot be detected on the other side of a hill. An alarm will not sound until the object is within the antenna assembly's field of view.
- On approaching a steep hill, objects above the beam cannot be detected. Generally, the beam hitting the road surface does not cause an alarm.
- The side sensor only detects objects within its field of view, next to the tractor. A vehicle farther back, behind the field of view, will not be detected.
- The side sensor range is set to detect average sized vehicles, 2 to 10 feet (0.5 to 3 meters) away, in the adjacent lane.
- The radar beam of the CWS will detect near range cut-ins of approximately 30 feet (9 meters) or less, depending on the angle of entrance into the lane in front of your vehicle.

⚠ WARNING

Heavy rain or water spray at the side sensor may cause both the yellow and red lights on the side sensor display to illuminate at the same time. Under these conditions the system is temporarily unable to provide adequate warnings.

Failure to drive safely and use the system properly could result in personal injury and/or death and severe property damage.

NOTE: A continuous fixed object on the right side of the vehicle such as a guard rail, wall, tunnel, or bridge may cause the side sensor alert light to stay on.

EVT–300 Accident Reconstruction

The optional accident reconstruction capability provides two segments of system data, one of which can be stored in system memory. Push and hold the DDU range knob for about 5 seconds to store the first segment. Within 6 seconds, the green SC indicator light will blink rapidly 8 times confirming that the data has been saved. If the range knob is pushed again, a fail tone will sound. After the first segment is saved, the second segment runs continuously but only contains the last 10 minutes (approximately) of system data.

NOTE: Once the first memory segment is frozen, the other can't be frozen. Only by disconnecting the main CPU connector can the second memory segment be preserved. You must return the CPU to Eaton VORAD for downloading and interpretation of accident reconstruction data.

EVT–300 Maintenance and Diagnostics

1. Keep the antenna assembly and side sensor(s) free of a buildup of mud, dirt, ice, or other debris that might reduce the system's range.
2. The system tests itself continuously and evaluates the results every 15 seconds. If a problem is detected with the front radar system, the red FAIL light on the DDU illuminates continuously as long as the failure is active. The corresponding fault code is stored in the CPU's memory.
3. Both active and inactive fault codes can be indicated by the DDU when the system is placed in failure display mode. Inactive faults are those that have occurred and have cleared. Active faults are still present. Fault codes provide the driver the ability to record the system faults during a trip and to notify his/her maintenance department or Eaton VORAD. See "EVT–300 Failure Display Mode/Fault Codes" below. In this mode, specific fault codes are indicated by the pattern of blinks of the driver display unit red FAIL light.

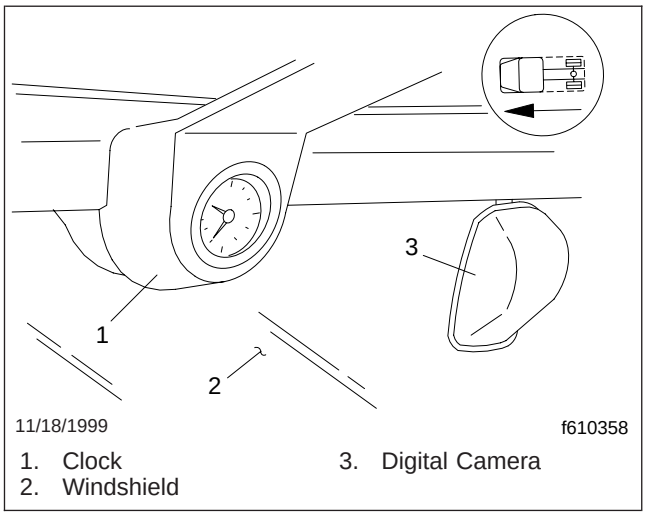
4. Each fault code is a two-digit number, as shown in **Table 2.5**. The red FAIL light blinks the same number of times as the first digit, a pause of approximately 3/4 of a second follows, then the light blinks the same number of times as the second digit.
5. Additional fault codes are blinked out at intervals of approximately eight seconds. After all the fault codes have been displayed, a code 41 will be flashed.

EVT–300 Failure Display Mode/Fault Codes

1. Press and hold the DDU volume control and power ON/OFF knob. Continue pressing the knob until the FAIL light begins to blink in approximately five seconds. If so configured, the system will turn off if you release the knob before five seconds. After five seconds, the DDU FAIL light begins to blink out the failure flash codes. A code 41 will be displayed either if no faults are found or when all fault codes have been displayed.
2. Position the DDU range knob to the left to blink active fault codes and to the right to blink inactive codes.
3. Fault codes can only be reviewed, tested, and cleared by using a Pro-Link® 9000 diagnostic tool.

Lane Guidance™ System, Optional

The Lane Guidance lane departure warning system monitors the vehicle's position within the roadway lane markings and sounds a warning in the cab when the vehicle is about to stray outside its lane, provided the turn signal is not on and the vehicle is traveling at least 40 mph (64 km/h). The system includes a digital camera mounted high near the center of the windshield inside the cab, a central processing unit in the overhead console, and a stereo speaker above and behind each door that emits a sound similar to a rumble strip. See **Fig. 2.47**. The sound is made on the side of the vehicle it's straying toward, prompting the driver to respond and steer away from the sound and back into the center of the correct lane.



1. Clock
2. Windshield
3. Digital Camera

Fig. 2.47, Lane Departure Warning System Camera

⚠ WARNING

The lane departure warning system is intended only as an aid for a conscientious and alert driver. The system may not indicate lane departures under certain conditions. Read carefully the information in this manual to understand the circumstances under which this system may not provide adequate lane departure warnings. Do not rely solely on the system to safely operate the vehicle. The system does not warn of all possible hazards. For example, the system cannot prevent an accident if the driver is impaired or not driving safely.

The lane departure warning system 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 severe property damage.

IMPORTANT: It is still the responsibility of the driver to change driving styles depending on existing traffic and road conditions.

Starting the vehicle activates the system. On start-up, the system performs a self-test, then sounds two chirps through the speakers to indicate the system is ready. The rocker switch on the B instrument panel turns the system on and off. Once the vehicle is started and the system is ready, the ON light at the bottom of the switch illuminates. Pushing the top of the rocker switch turns the system off; pushing the

switch again turns the system on. The top portion of the switch reads LANE ALERT and is backlit with the dash lights on.

The LANE SRCHNG amber warning light illuminates to indicate the system is not fully functional. When the warning light is on, the system audible alert may not indicate a lane departure. Conditions that can cause the warning light to come on include:

- The system is unable to detect lane markings.
- Vehicle speed is less than 40 mph (64 km/h).
- Lane width is greater than 13 feet (4 m).
- A dirty windshield or a similar problem is obscuring the camera.
- A system problem is detected.

While the system is capable of detecting a number of different types of lane markers, its performance may be compromised or degraded by certain conditions, including the following:

- Weather conditions such as snow, heavy rain, ice, or standing water.
- Damaged, worn, or faded lane markings.
- Broken pavement, dirt, sand, salt, gravel, or skid marks.
- Poor lighting, such as heavy glare or an inoperable headlight.
- A cracked, dirty, or streaked windshield.

The lane guidance system is not meant for use in city traffic or in heavy highway traffic. System alerts are automatically disabled when vehicle speed drops below 40 mph (64 km/h). The system may be manually turned off with the instrument panel rocker switch if an unacceptable level of false alerts is reached.

NOTE: If the green light on the LANE ALERT rocker switch remains off despite depressing the switch and the LANE SRCHNG amber warning light remains on, the system is not fully functional and needs service at a dealer or authorized service facility.

Roll Stability Control

Roll Stability Control is an onboard system capable of automatically slowing the vehicle to reduce the risk of rollover. The goal of the system is to reduce rollover accidents by reducing vehicle speed.

The system uses a lateral acceleration sensor that monitors rollover risk. If the sensor detects the vehicle is at risk of rolling over, Roll Stability Control intervenes and attempts to reduce vehicle speed by reducing engine power, applying the engine brake, and/or applying the tractor and trailer brakes.

⚠ WARNING

The Roll Stability Control system is intended only as an aid for a conscientious and alert driver. Read carefully the information in this manual to understand this system and its limitations. Do not rely solely on the system to safely operate the vehicle. The system cannot prevent an accident if the driver is impaired or not driving safely.

The Roll Stability Control system 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.

A decal (**Fig. 2.48**) on the auxiliary dash panel and an amber-colored dash indicator light (**Fig. 2.49**) indicate that the vehicle is equipped with the Roll Stability Control system. The dash indicator light illuminates whenever the Roll Stability Control system intervenes.

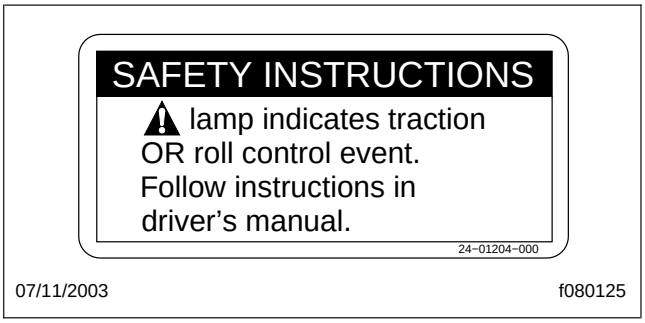


Fig. 2.48, Roll Stability Control Dash Decal

Fig. 2.49, Roll Stability Control Dash Indicator Light

3

Vehicle Access

Vehicle Access

Ignition and Lock Key

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

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

Cab Door Locks and Handles

To unlock the driver's door from outside the cab, insert the key in the lockset and turn it one-quarter turn clockwise (**Fig. 3.1**). Turn the key counterclockwise to the original position to remove it. Pull out on the paddle handle to open the door (**Fig. 3.1**).

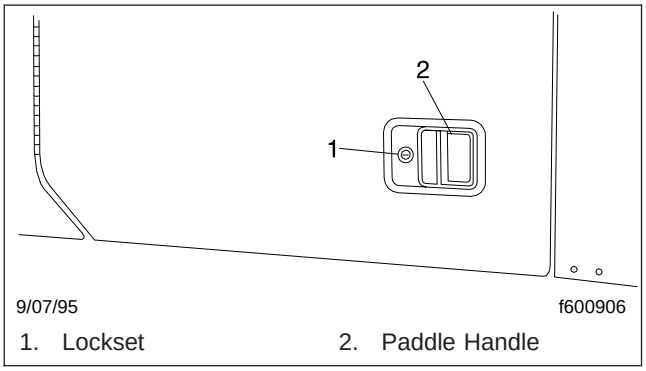


Fig. 3.1, Exterior Door Handle

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 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, insert the key in the lockset and turn it opposite the unlocking direction, then close the door if it is open. Or, push down the inside lock button (**Fig. 3.2**), then close the door.

To lock either door from inside the cab, push down the lock button (**Fig. 3.2**), then close the door if it is open. Pull the integral grab bar (**Fig. 3.2**) when closing the door.

To open the door from the inside, pull the door handle toward you (**Fig. 3.2**). This will unlatch the door whether or not it is locked. To unlock the door without unlatching it, pull the lock button up.

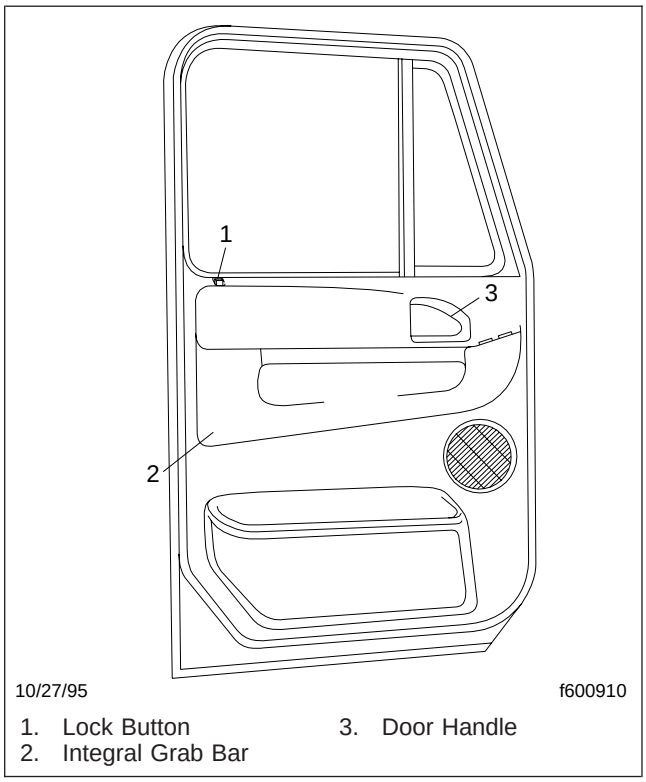


Fig. 3.2, Door Interior

Grab Handles and Access Steps

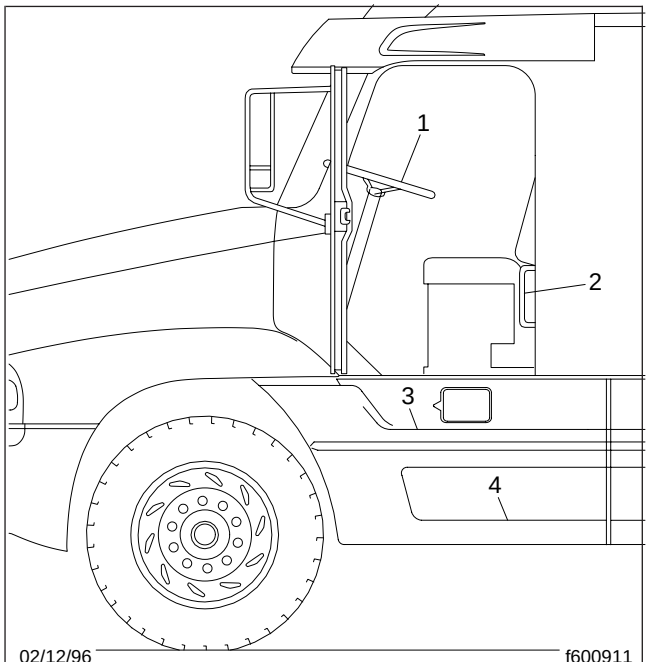
WARNING

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 leaving, 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.

Entering the Driver's Side (Fig. 3.3)



1. Steering Wheel
2. Grab Handle
3. Top Step
4. Bottom Step

Fig. 3.3, Driver's Side Steps and Grab Handle

When entering the cab from the driver's side, use the grab handle and access steps as follows:

1. Open the driver's door, and place anything that you are carrying in the cab.
2. Grasp the 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.

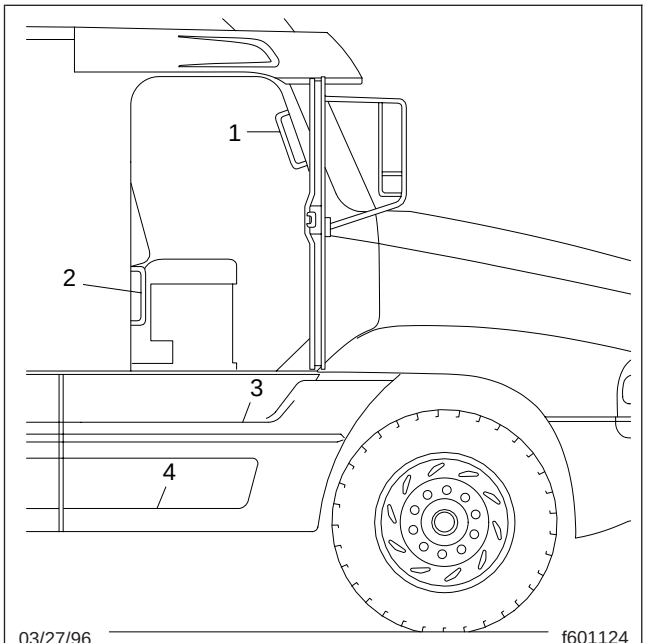
Exiting the Driver's Side (Fig. 3.3)

Exit the cab from the driver's side as follows:

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

1. Grasp the steering wheel with both hands, place your left foot on the top step, and stand on the threshold, facing into the cab.
2. Grasp the grab handle at the aft edge of the door opening with your right hand.
3. Move your right foot to the bottom step.
4. Move your left hand to the grab handle.
5. Step to the ground with your left foot first.

Entering the Passenger's Side (Fig. 3.4)



1. Upper Grab Handle
2. Lower Grab Handle
3. Top Step
4. Bottom Step

Fig. 3.4, Passenger's Side Steps and Grab Handles

When entering the cab from the passenger's side, use the grab handles and access steps as follows:

1. Open the passenger's door, and place anything that you are carrying in the cab.

2. Grasp the grab handle at the aft edge of the door opening with your left hand.
3. Grasp the handle on the door (**Fig. 3.4**) with your right hand.
4. Place your right foot on the bottom step and step up to the upper step with your left foot.
5. With your left hand, grasp the upper grab handle on the windshield post.
6. Place your right foot on the top step and step up.
7. Move your right hand to the upper grab handle on the windshield post.
8. Step into the cab with your left foot first.

Exiting the Passenger's Side (Fig. 3.4)

Exit the cab from the passenger's side as follows:

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

1. Grasp the grab handle on the windshield post with both hands, and place your right foot on the top step while standing up from the seat facing inward.
2. Place your left foot on the bottom step.
3. Move your left hand to the grab handle at the aft edge of the door opening.
4. Move your right hand to the grab handle on the door.
5. Step to the ground with your right foot first.

Door Windows

The windows in both doors operate electrically (if so equipped). Use the appropriate switch to raise or lower a door window.

Sleeper Compartment Vents

To open any sleeper compartment vent, push the vent handle outward and forward with your fingertips. To close the vent, turn your hand so that your fingers are pulling on the handle from the front edge, then pull in and back on the handle. Use care to avoid pinching your fingers.

Circuit Breaker/Relay Panel

The circuit breaker/relay panel is located in front of the passenger's seat under the top cover of the instrument panel. To access the compartment, first remove the vertical panel located immediately below the right hand adjustable louvers. Gently pry up the lower edge by using your fingertips or a flat-bladed screwdriver in the slots provided. Rotate the exposed fastener one-quarter turn and lift off the cover. Removal of the smaller exposed duct might also be required.

Cab-to-Sleeper Access

⚠ WARNING

Place rigid or heavy objects in storage areas on the floor or under the bunk. Sudden stops or swerves could cause personal injury if items fall from overhead storage shelves.

To open the sleeper access on vehicles with vinyl sleeper curtains, unzip the sleeper curtains. If desired, unsnap the curtains all the way around the sides and top and remove the curtains.

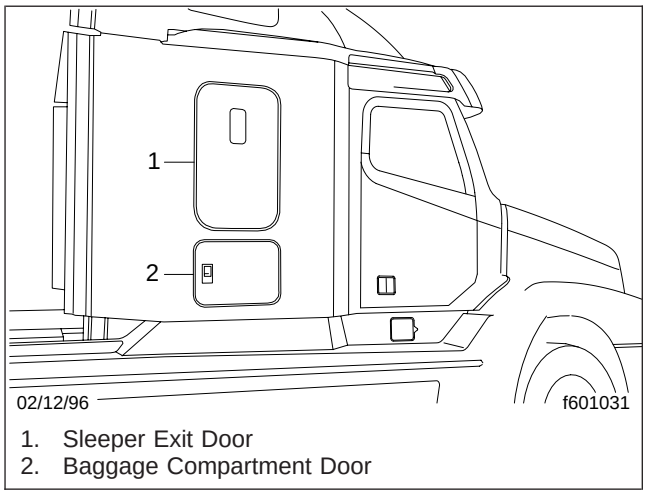
To open the sleeper access on vehicles with velour sleeper curtains, unfasten the snaps at one side, then push the curtain to the opposite side.

Sleeper Bunk Latches

To move the lower or upper sleeper bunk (if equipped), disengage the latch at the front of the lower bunk, or the latches on both sides of the upper bunk. Lock the bunks into operating position, down for the lower bunk and up or down for the upper bunk, by engaging both the primary and secondary latches.

Sleeper Compartment Exit Door

The sleeper compartment exit door (**Fig. 3.5**) is intended for use as an emergency exit only. The door can not be opened from outside the sleeper. To open the door from the inside, push down on the lever handle located inside the sleeper compartment to the right of the door. To close the door, push it closed until it latches.



1. Sleeper Exit Door
2. Baggage Compartment Door

Fig. 3.5, Passenger's Side Doors

Baggage Compartment Doors

To unlock the baggage compartment door on the passenger's side, insert the ignition key in the lockset, and turn it one-quarter turn clockwise. See **Fig. 3.5**. Turn the key to the original position to remove it. Pull up and outward on the baggage door handle to open the door. To close the door, push it closed until it latches. To lock the door, insert the ignition key in the lockset and turn it one-quarter turn counterclockwise.

Use the same procedure to open the baggage compartment door on the driver's side, but turn the key counterclockwise to unlock the door and clockwise to lock it.

Back-of-Cab Grab Handles, Steps, and Deck Plate

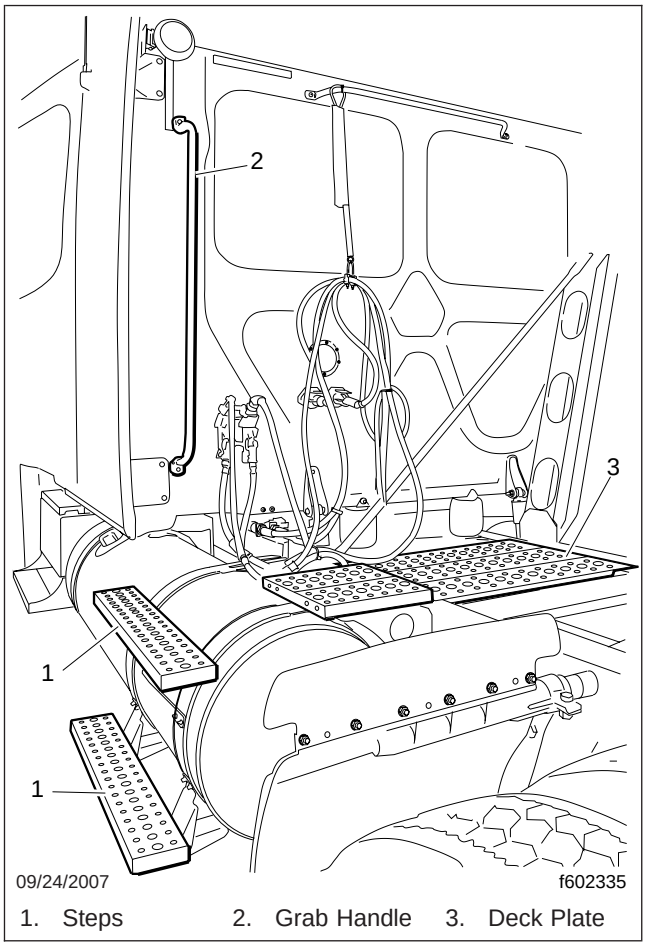
⚠ WARNING

External surfaces of the exhaust system remain hot after the engine has been shut down. When accessing the back of the cab or sleeper, do not touch any part of the exhaust system, or severe burns could occur.

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 supports.

Optional grab handles are mounted either on both cab sidewalls, or on the left sidewall only. See **Fig. 3.6**. 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.



1. Steps 2. Grab Handle 3. Deck Plate

Fig. 3.6, Back-of-Cab Access

⚠ 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 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 Box Cover

To remove the cover from the frame rail-mounted battery box, release the latches that attach the left chassis fairing panel (if equipped) in front of the battery box. Remove the air fairing panel. See **Group 60** of the *Columbia® Workshop Manual* for instructions. If no air fairing panel is installed, remove the step plate. Pull on the end of each hold-down latch until the end clears the cover-mounted catch. Pivot the latches out of the way, then lift off the cover. When installing the cover, be sure it is positioned properly before fastening the latches.

To remove the cover from the battery box mounted between the frame rails, remove the deck plate and lift the handle on the top of the battery box cover. If equipped, remove the spring pin.

Hood Tilting

The hood can be tilted to a full-open position. A grab handle at the front of the hood provides a hand-hold for hood tilting. A torsion bar helps you to tilt the hood open, and to return it to the operating position. A damper controls the closing rate of the hood and hood straps prevent the hood from overtravel. In the operating position, the hood is secured to the lower cab side panels by a hold-down latch on each side of the hood.

To Tilt the Hood

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

⚠ 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. Using the bumper step and grab handle, slowly tilt the hood until the straps support it. See **Fig. 3.7**.

To Return the Hood

1. Grasp the grab handle, and lift the hood to the 45-degree position.
2. As the hood goes over center, the hood damper controls the rate of descent to the operating position.
3. Make sure the hood is flush with the cowl, then secure the hood by engaging both hood hold-down latches.

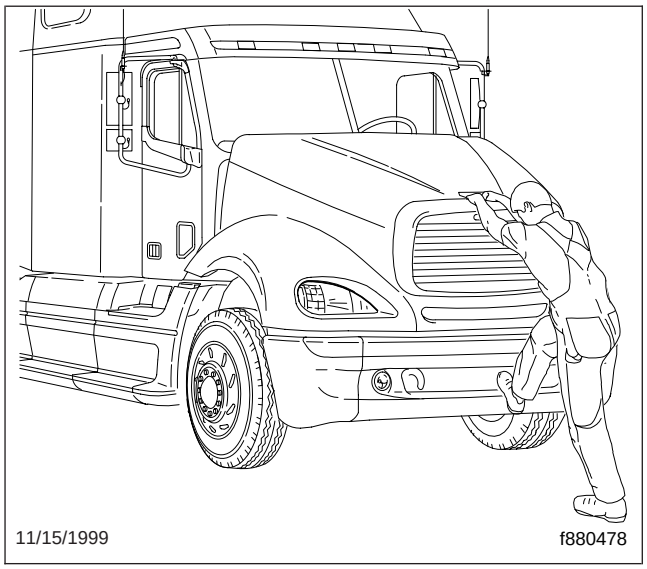


Fig. 3.7, Hood Tilting

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

Cab Amenities

Waste Bin

To remove the waste bin, slide the waste bin out as far as it will go. Reach in behind the bin and release the bin from the stops on the bin sides. Remove the bin. To install the bin, insert the bin onto the slides, and then slide the bin into place.

Cup Holders

The Columbia vehicle features two cup holders above the ash tray and waste bin on the center panel.

Ash Tray and Cigar Lighter

The driver's ash tray and cigar lighter assembly is on the center panel. The tray is removable.

Dash Storage Bin

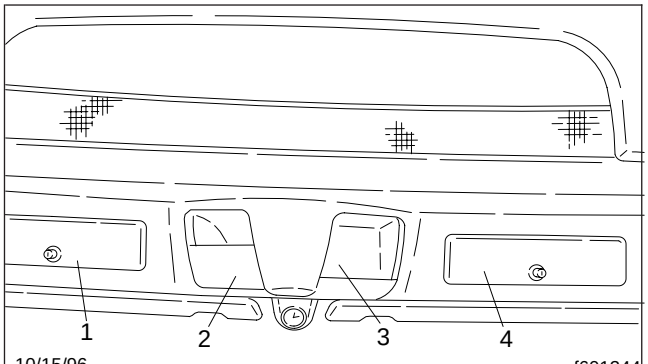
The dash storage bin is located under the cup holders on the center panel. The bin has a hinged cover and can be used to store sunglasses.

Map Holder

An elastic-topped pouch is located above each door. These are intended for holding maps and other items.

Glove Box

Some vehicles have two glove boxes and two small overhead bins, all located in the overhead console assembly. See **Fig. 3.8**. Above the sun visors on both the driver's and the passenger's sides are the glove boxes with latched doors or netted openings. In the middle section of the console assembly are two small bins. The driver's-side bin is often removed and replaced with a CB radio. The grille underneath this portion of the console allows the radio's speaker to be heard.



1. Driver's Glove Box
2. Driver's Overhead Storage Bin
3. Passenger's Overhead Storage Bin
4. Passenger's Glove Box

Fig. 3.8, Glove Boxes and Overhead Storage

Overhead Lights

Above both the driver's and the passenger's seats are three oval-shaped lights mounted to the bottom of the overhead console: a red light and two white lights. The red light is mounted nearest to the windshield. Each light is activated by pushing on the lens cover. Also, the center light, a white light, activates when the doors to the vehicle are opened.

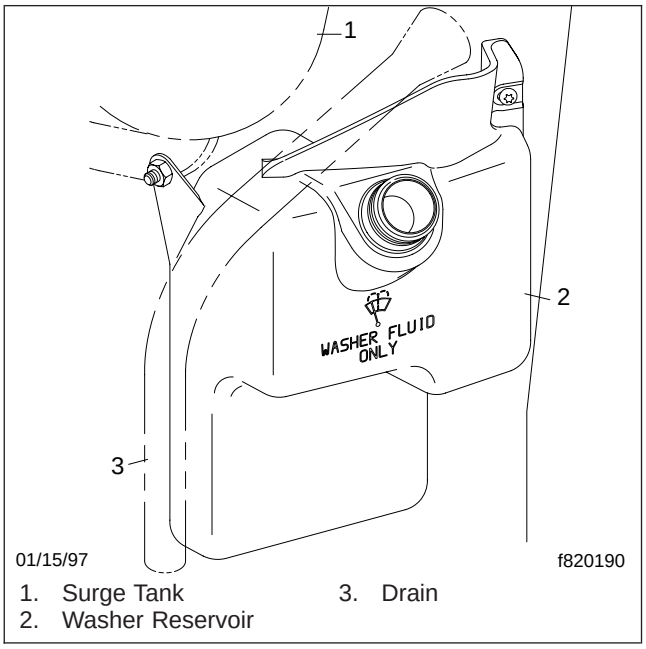
Footwell Lights

There are optional red lights mounted underneath the dash on the driver's and the passenger's sides of the vehicle. These lights are activated by a rocker switch

on the lower dash panel next to the climate control switches.

Windshield Washer Reservoir

The windshield washer reservoir is located on the left-hand side of the frontwall between the surge tank and the hood. See **Fig. 3.9**.



1. Surge Tank
2. Washer Reservoir
3. Drain

Fig. 3.9, Windshield Washer Reservoir

4

Heater and Air Conditioner

Constant Discharge Temperature Control

The cab heater and air conditioner system is a Constant Discharge Temperature Control (CDTC) system. The CDTC maintains a constant temperature of airflow in the cab regardless of outside air temperature, selected fan speed, engine coolant temperature, or engine coolant flow. Once the temperature control switch is turned to the desired temperature, no other adjustments are necessary. The CDTC system is disabled when the temperature control switch is in the maximum cool or maximum warm position.

Cab Climate Control Panel

The climate control panel allows you to control the heating and air conditioning functions of the heater and air conditioner. See **Fig. 4.1**.

Fan Switch

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

To increase airflow, turn the switch clockwise or to a higher number. To decrease the airflow, turn the switch counterclockwise or to a lower number. Setting the fan switch to the off position disables the air conditioner and places the air source in the fresh air mode.

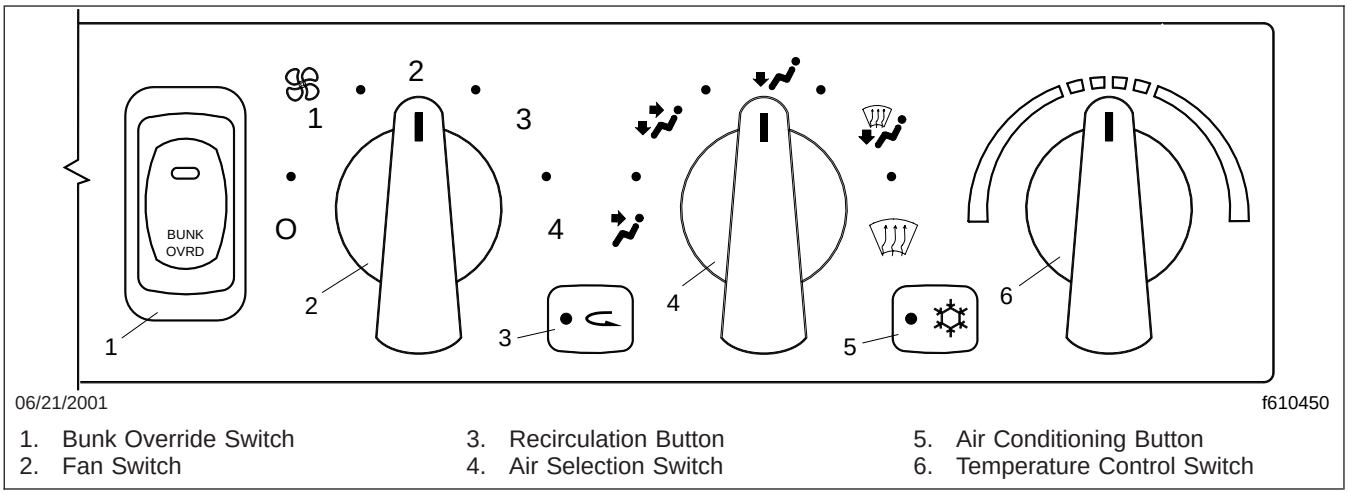
NOTE: When the fan switch on the cab climate control panel is off and the sleeper air conditioner is on, the cab fan will operate at low speed even though the cab fan switch is in the off position. This is necessary to protect the evaporator in the cab heater and air conditioner system from freezing.

There is a two-second delay between the time the engine is started and the blower is operational. It can take an additional four seconds for the blower to reach high speed. The blower motor performs a self-test immediately after the engine is started, which causes the delay.

Air Selection Switch

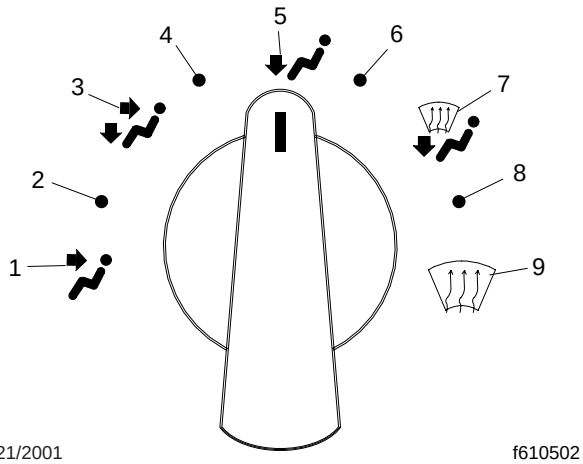
The air selection switch allows you to control the flow of air through the face outlets, the floor outlets, the defrost (windshield) outlets, or a combination of these outlets to give you nine air selection modes. See **Fig. 4.2**.

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 floor outlets.



1. Bunk Override Switch
2. Fan Switch
3. Recirculation Button
4. Air Selection Switch
5. Air Conditioning Button
6. Temperature Control Switch

Fig. 4.1, Cab Climate Control Panel



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1. Face Mode
2. Selection Between Face Mode and Bi-Level Mode
3. Bi-Level Mode
4. Selection Between Bi-Level Mode and Floor Mode
5. Floor Mode
6. Selection Between Floor Mode and Floor/Defog Mode
7. Defog Mode
8. Selection Between Defog Mode and Defrost Mode
9. Defrost Mode

Fig. 4.2, Air Selection Switch Modes

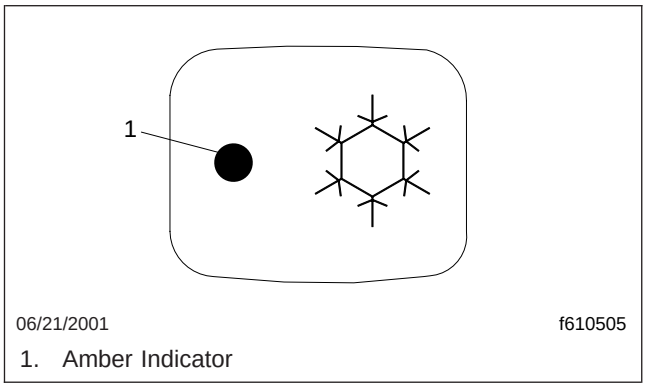
4. **Selection between Bi-Level Mode and Floor Mode:** Directs 25 percent of the airflow through the face outlets and 75 percent through the floor outlets.
5. **Floor Mode:** Directs all airflow through the floor outlets.
6. **Selection between Floor Mode and Floor/ Defog Mode:** Directs 75 percent of the airflow through the floor outlets and 25 percent through the defrost outlets.
7. **Defog Mode:** Directs the airflow equally to the floor outlets and the defrost outlets. The air conditioner automatically turns on in this mode. The recirculation button will not work in this mode.
8. **Selection between Defog Mode and Defrost Mode:** Directs 75 percent of the airflow through the defrost outlets and 25 percent through the floor outlets. The air conditioner automatically turns on in this mode. The recirculation button will not work in this mode.
9. **Defrost Mode:** Directs all airflow through the defrost outlets. The air conditioner automatically turns on in this mode. The recirculation button will not work in this mode.

Temperature Control Switch

The temperature control switch is used to select the desired temperature. On the manual and CDTC climate control panel, turn the switch clockwise or to the red area for warm air. Turn the switch counterclockwise or to the blue area for cool air.

Air Conditioning

The air conditioner cools and dehumidifies the air inside the cab. Press the air conditioning button to turn the air conditioner on and off. See **Fig. 4.3**.



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1. Amber Indicator

Fig. 4.3, Air Conditioning Button

When the air conditioner is operating, the amber indicator on the air conditioning button will be on whether the request for air conditioning comes from the cab climate control panel or the sleeper climate control panel. When the instrument panel lights are on, the snowflake indicator on the air conditioning button will be on.

The air conditioner will be automatically disabled when:

- The outside air temperature is low enough to make air conditioning ineffective;
- The engine is running at low rpm;
- Specific conditions exist that result in the heater and air conditioner system going into protection mode.

Recirculation

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. See **Fig. 4.4**. The recirculation mode can also decrease the time required to cool or heat the cab interior during extreme outside temperature conditions. When the recirculation mode is on, the amber indicator on the recirculation button will be on.

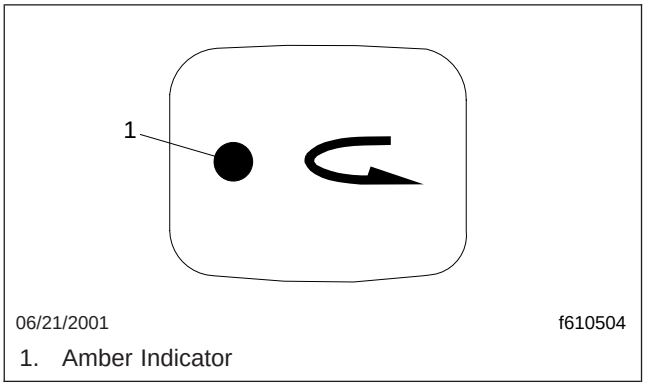


Fig. 4.4, Recirculation Button

The recirculation button will not work when the air selection switch is in one of the following modes:

- defog mode
- the selection between defog mode and defrost mode
- defrost mode

NOTE: To prevent the buildup of fumes or odors and to prevent oxygen depletion inside the cab, the system switches from full recirculation mode to partial recirculation mode after 20 minutes. In extremely dusty or smoky conditions, the partial recirculation mode can be overridden by pressing the recirculation button twice to obtain full recirculation mode. This resets the 20-minute timer.

Bunk Override Switch, Optional

The bunk override (BUNK OVRD) switch allows the driver to remotely control the fan speed and temperature settings in the sleeper. See **Fig. 4.1**. Press the upper half of the bunk override switch to override the sleeper settings with the cab settings. The amber indicator on the switch is on when the bunk override mode is on. If the fan speed or temperature setting on the sleeper climate control panel is adjusted when the bunk override mode is on, the bunk override mode will be canceled.

When the heating and air conditioning system is in the bunk override mode, the cab climate control panel can be adjusted without affecting the sleeper settings. To reset the sleeper settings, set the fan speed and temperature settings on the cab climate control panel to the desired sleeper settings and press the upper half of the bunk override switch again. The cab climate control panel can again be adjusted without affecting the sleeper settings.

Press the lower half of the bunk override switch to cancel the override mode. After the override mode is canceled, the sleeper heater and air conditioner system will operate from the sleeper fan speed and temperature settings and the amber indicator will be off.

Sleeper Climate Control Panel

The sleeper heater and air conditioner system features Constant Discharge Temperature Control (CDTC). The sleeper climate control panel is shown in **Fig. 4.5**. The CDTC maintains a constant temperature of airflow in the sleeper regardless of outside air temperature, selected fan speed, engine coolant temperature, or engine coolant flow. Once the temperature control switch is turned to the desired temperature, no other adjustments are necessary.

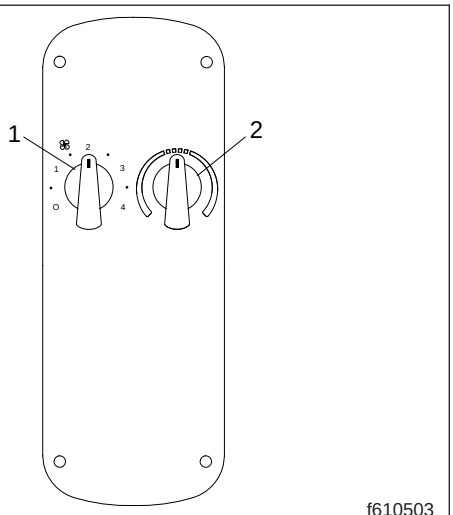
Fan Switch

The fan switch controls the sleeper heater and air conditioner system fan speed. The sleeper climate control panel has eight fan speeds and an off position. To increase airflow, turn the switch clockwise or to a higher number. To decrease the airflow, turn the switch counterclockwise or to a lower number.

NOTE: When the cab air conditioner is on, the sleeper fan will operate at low speed even though the sleeper fan switch is in the off position. This is necessary to protect the evaporator in the sleeper heater and air conditioner system from freezing.

Temperature Control Switch

The temperature control switch is used to select the desired temperature in the sleeper. Turn the switch clockwise or to the red area for warm air. Turn the



1. Fan Switch
2. Temperature Control Switch

Fig. 4.5, Sleeper Climate Control Panel

switch counterclockwise or to the blue area for cool air.

The air conditioner automatically turns on when necessary to maintain the selected temperature in the sleeper. If the sleeper air conditioner automatically turns on when the cab air conditioner is on, the cab air conditioner fan speed and temperature settings will override the sleeper air conditioner settings.

The CDTC system is disabled when the temperature control switch is in the maximum cool or maximum warm positions.

The bunk override switch allows the driver to remotely control the temperature and fan speed settings in the sleeper. The bunk override mode can be canceled by changing the sleeper fan speed or temperature setting. After the override mode is canceled, the sleeper heater and air conditioner system will operate from the sleeper fan speed and temperature settings and the amber indicator on the switch will be off.

Parked HVAC

The parked HVAC system consists of a compact electrical 3000-BTU air conditioning system, and a diesel-fired heater unit.

Overview

The Bergstrom NITE (No Idle Thermal Environment) parked, or no-idle, air conditioning system is a compact, electrically powered, 3000-BTU system. It is designed to provide a means of air conditioning to the sleeper area without having the engine running. It is completely self-contained, and runs on 12-volt deep-cycle batteries. The system is designed to maintain cool air in the sleeper interior. For optimal operation, the curtain between the cab and the sleeper must be closed when using the A/C system. The parked A/C unit will not cool down a hot sleeper that has been sitting in the sun without the vehicle A/C running. If the interior temperature is higher than desired, start the engine and run the vehicle A/C system until the desired sleeper temperature is achieved. This will help cool the sleeper to a temperature that the parked A/C system can maintain. Once the sleeper temperature is lowered, the system will maintain a comfortable setting.

The A/C unit is located under the lower bunk in the sleeper compartment. The unit gets its intake air from the under-bunk area through a grate in the top panel. An air intake grille is located on the front panel of the lower bunk. The outlet ducting runs from the left side of the unit to an outlet near the bunk occupant’s face on the back wall of the sleeper. It is important to keep the air intake grille, and the area under the bunk, free of objects that might block air flow or put objectionable odors into the cooling air. Air for the condenser is taken in from under the cab and exhausted through another opening in the cab floor.

The system receives power from four deep-cycle batteries located between the frame rails. These batteries are completely isolated from the starting batteries to keep the starting batteries from being drawn down during operation.

The heater unit is located under the lower bunk in the sleeper compartment next to the A/C unit. The unit gets its intake air through a duct attached to a grille located on the right side of the front panel of the lower bunk. The outlet ducting runs from the back of the unit to a grille on the left side of the front panel of the lower bunk.

Operation

IMPORTANT: Before operating the Parked HVAC system, make sure that the intake and

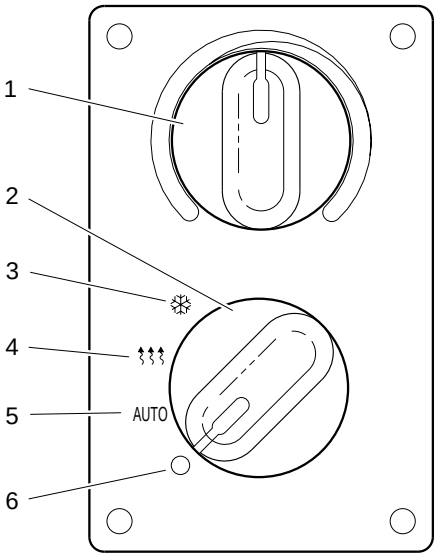
outlet vents for the A/C and heater units are clear. Blocked vents will hamper the operation of the unit.

The control panel for the parked A/C and heater is located on the back wall of the sleeper near the left side. It has a temperature control dial, and a four-position mode selector switch. Turn the temperature control dial to the left for cooling, and to the right for heat. See **Fig. 4.6**. See **Table 4.1** for a description of the function of the mode switch.

The system must be turned off whenever it is not in use, or the batteries may not charge properly. After using the system, turn the mode switch to the OFF position, even if the unit is not running.

Parked A/C and Heater Mode Switch Operation	
Mode	**Function**
Off	Turns the unit off.
AUTO	Allows the unit to automatically heat or cool the sleeper, depending on the temperature setting and the sleeper temperature. Adjusts the compressor, heater, and fans to keep temperature constant.
Heat Only	Allows only the heat portion of the system to run. Adjusts the heater only to keep the temperature constant.
A/C Only	Allows only the A/C portion of the system to run. Adjusts compressor and fans only to keep the temperature constant.

Table 4.1, Parked A/C and Heater Mode Switch Operation



1. Temperature Control Dial
2. Mode Switch
3. A/C Only
4. Heat Only
5. AUTO
6. Off

Fig. 4.6, Parked A/C and Heater Control Panel

Air Outlets

The face outlets on the instrument panel have louvers that can be moved right and left, and up and down. Move the louvers to the desired location or to close the outlet. The defrost (windshield) outlets and the outlets that are directed at the doors are not adjustable.

The sleeper has one or two air outlets on the right side of the cab, depending on the height of the cab. The sleeper air outlet pivots from side to side and has louvers that can be moved up and down or closed.

5

Seats and Seat Belts

Seats

General Information

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

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 backwall. It is the responsibility of the driver to adjust the seat to prevent damage to the seat and the cab interior.

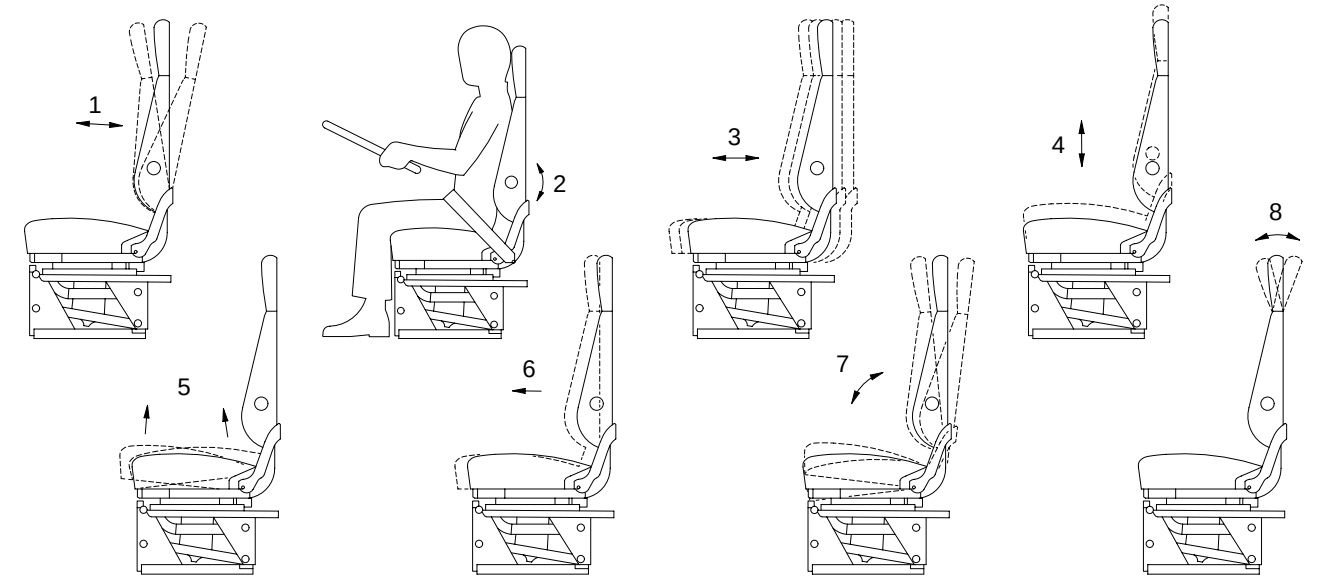
⚠ WARNING

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

Seat Adjustment

The following is a description of adjustments that can be made to various Freightliner-installed seats. Not all seats have all of the adjustments listed below. See **Fig. 5.1**.

1. Back Cushion Tilt: This adjustment enables the back cushion to pivot forward or backward.
2. 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. This adjustment is either mechanical or air controlled, depending on make and model of the seat.
3. 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. A lockout feature is used whenever the isolator is not desired.



1. Back Cushion Tilt
2. Lumbar Support
3. Isolator Feature
4. Height Adjustment
5. Bottom Cushion Angle (fore and aft cushion height)
6. Fore and Aft Seat Adjustment (seat track adjustment)
7. Seat Tilt
8. Upper Back Cushion

Fig. 5.1, Seat Adjustments

4. Height Adjustment: The entire seat moves up or down when adjusting the height. The adjustment is either manually or air controlled, depending on the make of the seat.
5. Bottom Cushion Angle or Fore and Aft Bottom Cushion Height: This feature enables the occupant to raise or lower the front or back of the bottom cushion. This adjustment is easier to perform when all weight is removed from the seat.
6. Fore and Aft Seat or Seat Track Adjustment: The entire seat moves forward or backward when this adjustment is made.
7. Seat Tilt: When this adjustment is made, the seat assembly (back and bottom cushions) tilts forward or backward.
8. Upper Back Cushion Adjustment: When this adjustment is made, the upper back cushion changes angle to provide upper back support.
9. Weight Adjustment: On those seats with weight adjustment, the feature is fully automatic. When you sit on the seat, a leveling valve places you in the center of the ride zone. Additional adjustments are possible by using the height adjustment feature.

EzyRider® Seat

For seat adjustment controls on vehicles built before November 28, 2005, see **Fig. 5.2**. For seat adjustment controls on vehicles built on or after November 28, 2005, see **Fig. 5.3**.

Back Cushion Tilt

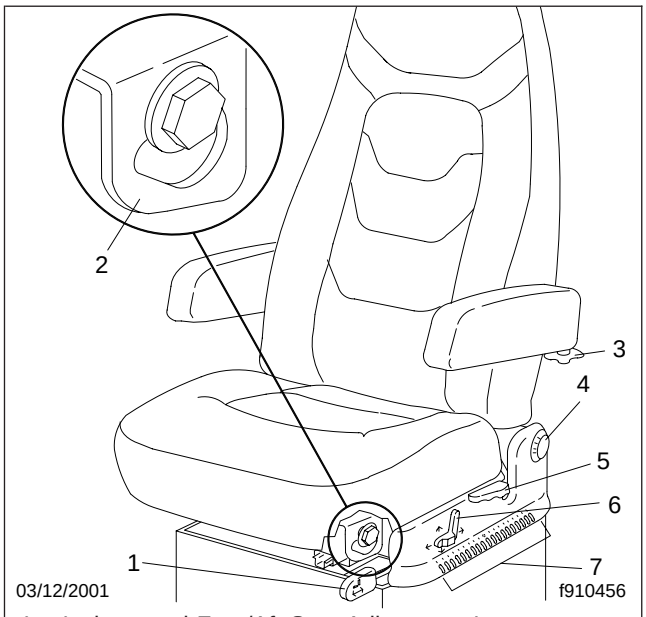
To tilt the back cushion, raise the back cushion tilt lever and lean forward or backward. Release the lever to lock the cushion in place.

Lumbar Support

To adjust the amount of support for your lower back, use the lumbar support switch or lever on the side of the seat.

Isolator

To engage the isolator, push in on the isolator lever. To lock out the isolator, pull the isolator lever out to the first stop.



1. Isolator and Fore/Aft Seat Adjustment Lever
2. Bottom Cushion Angle Guide
3. Armrest Adjustment Knob
4. Back Cushion Tilt Position Indicator
5. Back Cushion Tilt Lever
6. Height Adjustment and Lumbar Support Lever
7. Fore/Aft Seat Position Indicator

Fig. 5.2, EzyRider Seat Adjustment Controls (Vehicles Built Before November 28, 2005)

Fore and Aft Seat Adjustment

Pull the fore and aft seat adjustment lever out to the second stop and slide the seat forward or backward to the desired position.

Height Adjustment

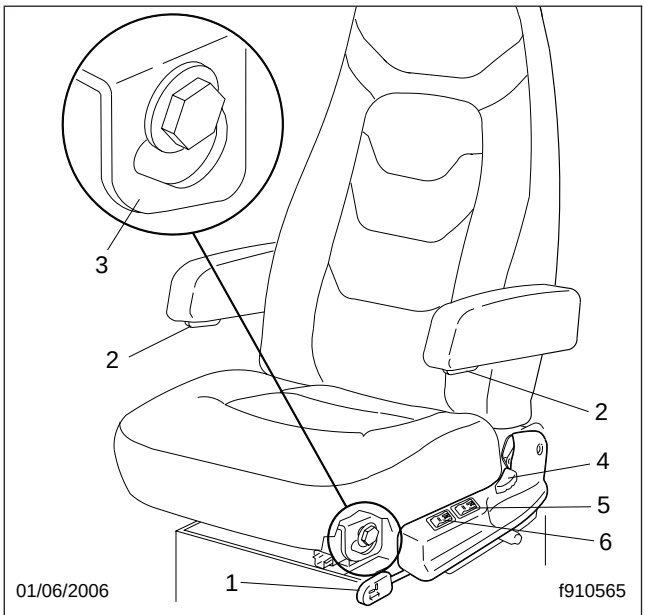
To raise or lower the seat, use the height adjustment switch or lever on the side of the seat.

Bottom Cushion Angle

To adjust the bottom cushion angle, pull the bottom cushion up and forward or down and back. The bottom cushion angle is controlled by the guides on each side of the seat.

Seat Position Indicators

Seats installed in vehicles built before November 28, 2005 are equipped with seat position indicators. A back cushion tilt position indicator and a fore/aft seat



1. Isolator and Fore/Aft Seat Adjustment Lever
2. Armrest Adjustment Knob
3. Bottom Cushion Angle Guide
4. Back Cushion Tilt Lever
5. Lumbar Support Switch
6. Height Adjustment Switch

Fig. 5.3, EzyRider Seat Adjustment Controls (Vehicles Built on or After November 28, 2005)

position indicator allow the driver to see where the seat is adjusted within the adjustment ranges.

Armrest Angle (optional armrests)

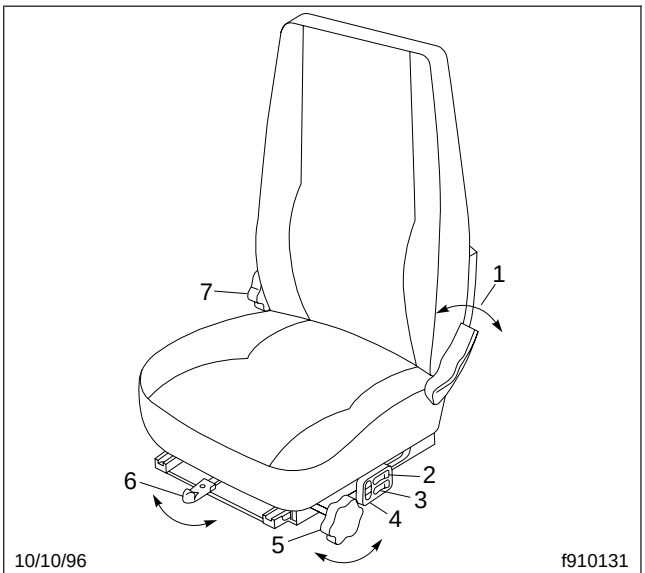
To adjust the vertical angle of the armrest, turn the adjustment knob on the underside of the armrest.

Freightliner/Bostrom Seat

See **Fig. 5.4** for seat adjustment controls.

Back Cushion Tilt

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



1. Back Cushion Tilt Lever
2. Lumbar Support Switch (LSO models)
3. Damper Adjustment Switch
4. Weight and Height Adjustment Switch
5. Bottom Cushion Tilt Knob
6. Fore and Aft Adjustment and Isolator Lever
7. Lumbar Support Knob (non-LSO models)

Fig. 5.4, Freightliner/Bostrom Seat Adjustment Controls

Weight and Height Adjustment

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

Isolator

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

Fore and Aft Seat Adjustment

Hold the fore and aft adjustment lever to the left and slide the seat forward or backward to the desired position.

Bottom Cushion Tilt Adjustment

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

Lumbar Support

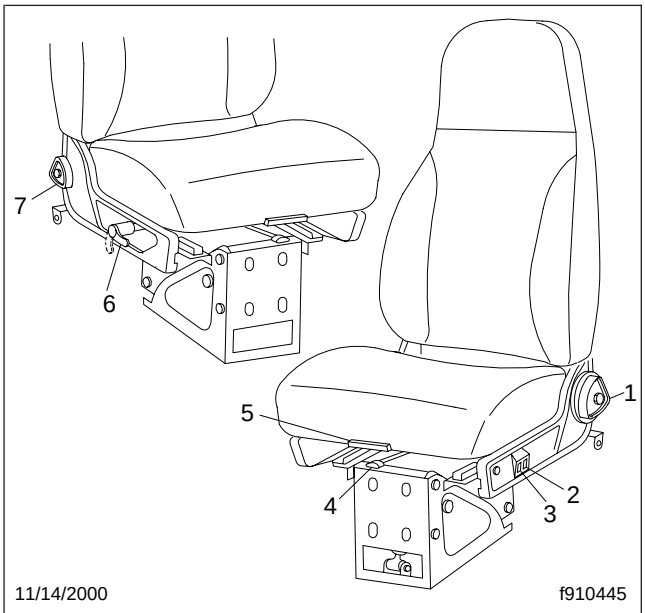
To increase lumbar support on LSO models, press the plus sign on the lumbar support switch. To decrease lumbar support on LSO models, press the minus sign on the switch. To increase lumbar support on non-LSO models, rotate the lumbar support knob forward. To decrease lumbar support on non-LSO models, rotate the knob rearward.

Damper Adjustment

Press the damper adjustment switch to adjust the damper.

National 2000 Series Seat

See **Fig. 5.5** for seat adjustment controls.



1. Back Cushion Tilt Knob
2. Lumbar Support Switch
3. Height Adjustment Switch
4. Fore and Aft Seat Adjustment Lever
5. Bottom Cushion Front Height Adjustment Handle
6. Isolator Handle
7. Rear Cushion Adjustment Knob

Fig. 5.5, National 2000 Series Seat Adjustment Controls

Back Cushion Tilt

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

Height Adjustment

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

Fore and Aft Seat Adjustment

To adjust the fore and aft position of the entire seat, move the fore and aft seat adjustment lever to the left and slide the seat forward or backward to the desired position. Move the lever back to its original position to lock the seat in place.

Rear Cushion Adjustment

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.

Isolator

Also called a Chugger Snubber®, the isolator reduces the amount of road shock by isolating the occupant from the motion of the vehicle and allowing the seat to move in a simple pendulum motion. To use the isolator feature, turn the isolator handle to the horizontal position. Turn the isolator handle down when the isolator feature is not desired.

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.

Bottom Cushion Front Height

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

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 Freightliner vehicles meet Federal Motor Vehicle Safety Standard 209, "Type 1," and "Type 2" requirements. They are recommended for all persons weighing over 50 pounds (23 kg).

A child restraint system should also be provided for each child weighing 50 pounds (23 kg) or less. It should meet the requirements of Federal Motor Vehicle Safety Standard 213, "Child Restraint Systems." When providing such a restraint system, 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 and tethers as instructed below. Seat belts and tethers that were damaged or highly stressed in an accident must be replaced, and their anchoring points must be checked. When any part of a seat belt system needs replacement, the entire seat belt must be replaced, both the retractor and the buckle side. Do not attempt to modify the seat belt system; doing so could change the effectiveness of the system. Failure to replace damaged or stressed seat belts or 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, or extreme wear, especially near the buckle latch plate and in the D-loop guide area.
2. Check the web for extreme dirt or dust, and for severe fading from exposure to sunlight.
3. Check the buckle and latch for operation and for wear or damage.
4. Check the Komfort Latch for function and cracks or other damage.
5. Check web retractor for function and damage.
6. Check the mounting bolts for tightness and tighten any that are loose.

Seat Belt Operation

Three-Point Seat Belt With 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.

⚠ WARNING

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

1. Slowly pull the link 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 link into the buckle until it latches (**Fig. 5.6**). Give the belt a tug at the buckle. If the buckle unlatches, repeat this step. If the problem continues, replace the three-point seat belt.
3. Position the shoulder strap diagonally across your chest with the adjustable D-loop bracket. If desired, engage the Komfort Latch as follows:

   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

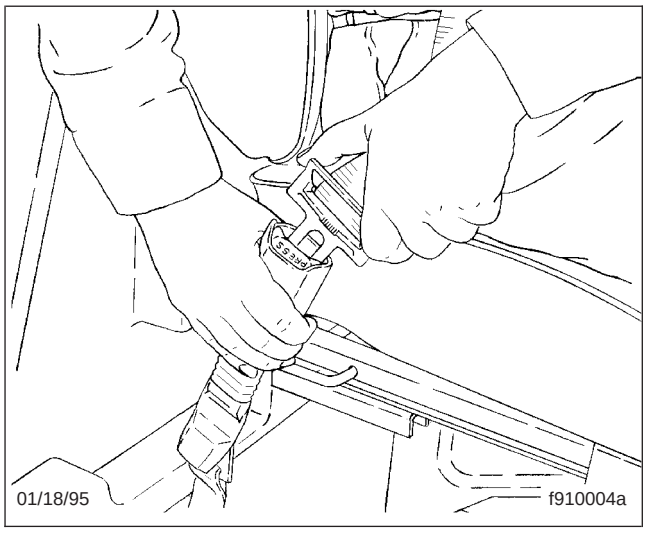
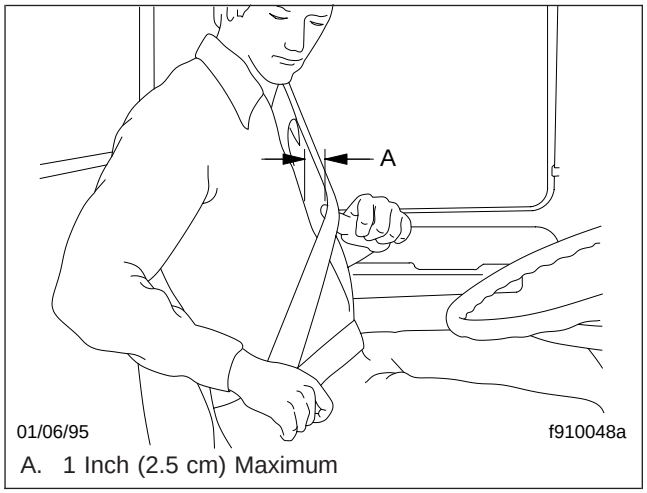


Fig. 5.6, Fastening the Three-Point Belt

chest and the shoulder harness. More slack can significantly reduce the seat belt's 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. 5.7** and **Fig. 5.8**).



A. 1 Inch (2.5 cm) Maximum

Fig. 5.7, Adjusting Shoulder Harness Clearance

4. To unbuckle the three-point seat belt, push the button on the buckle as shown in **Fig. 5.9**. If the Komfort Latch was used, release it 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.

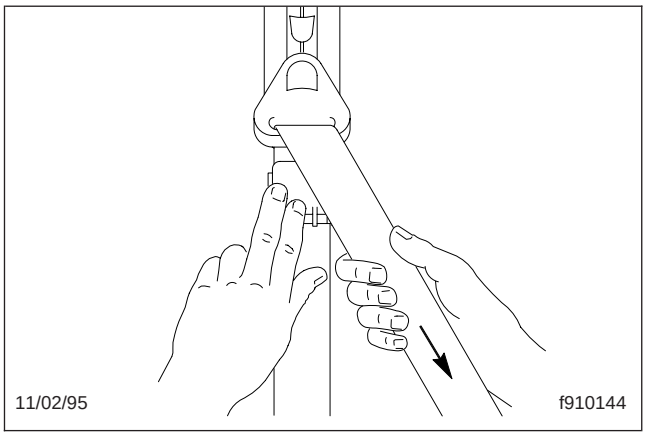


Fig. 5.8, Locking Komfort Latch

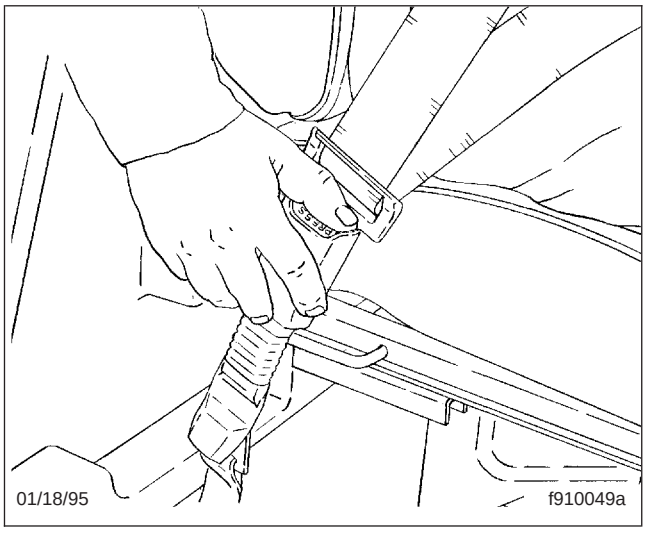


Fig. 5.9, Releasing the Three-Point Seat Belt

NOTE: The Komfort Latch does not have to be released in an emergency situation. The Komfort Latch 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.

Sleeper Compartment Restraints

General Information

On vehicles equipped with a sleeper compartment, bunk restraints should be used whenever the sleeper compartment is occupied and the vehicle is moving.

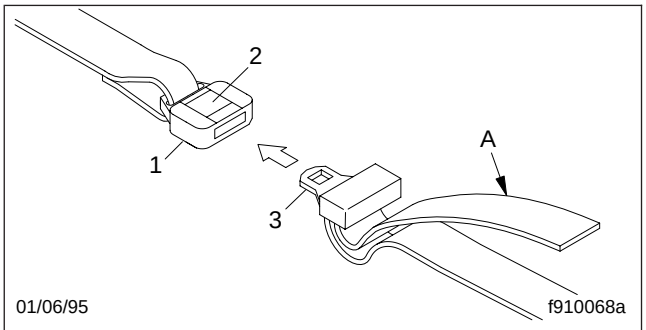
Restraints are designed to lessen the chance of injury or the amount of injury resulting from accidents or sudden stops. For this reason, Daimler Trucks North America LLC urges the use of bunk restraints when the sleeper compartment is occupied in a moving vehicle.

⚠ WARNING

Do not use the sleeper compartment while the vehicle is in motion unless a bunk restraint is installed and used. Not using the bunk restraint increases the chance of injury, or the degree of injury, from accidents or sudden stops to all occupants of the vehicle.

Bunk Restraint Adjustment

1. Make sure the belt is attached to the bunk support and sleeper wall.
2. To lengthen the belt, tip the link end downward and pull the link until it connects with the buckle.
3. After the belt is connected, shorten it by pulling on the loose end until the belt is snug, but comfortable. Be sure the belts are not twisted. See **Fig. 5.10**.



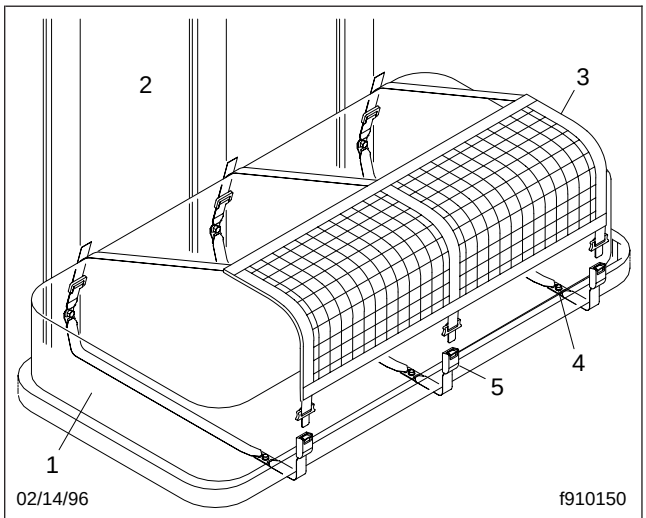
A. Pull on the loose end to shorten the belt.
1. Buckle
2. Belt Release Button
3. Link

Fig. 5.10, Bunk Restraint Adjustment

Bunk Restraint Operation

1. Starting at the foot of the bunk, pull up the link end of the belt far enough to engage the buckle. See **Fig. 5.11**.
2. Fasten the belt by pushing the link end into the buckle until they latch. Make sure that the belt is not twisted. Check the engagement by trying to pull the link out of the buckle. If they come apart, repeat this step. If the problem continues, replace the belt. Repeat steps 1 and 2 for the other two belts located in the middle and upper portion of the bunk to lock the restraint in place.
3. To release the bunk restraint, push the release button on the buckle at the head of the bunk and pull the link from the buckle.

   Repeat this step for the other two buckles to completely release the bunk restraint.



1. Mattress
2. Sleeper Wall
3. Restraint
4. Belt Anchor
5. Buckle

Fig. 5.11, Bunk Restraint

Supplemental Restraint System, Optional

The supplemental restraint system can consist of an air bag and SPACE system, or an air bag only system. Your vehicle may or may not have a supplemental restraint system.

Air Bag, Optional

The air bag, when used with seat belts, provides additional protection to the driver in severe frontal collisions. The operational readiness of the air bag system is indicated by the supplemental restraint system (SRS) indicator on the dash. The SRS indicator comes on when the engine is started and then goes

off. The indicator will remain on if there is a problem with the air bag system. The vehicle should be serviced if the SRS indicator does not come on when the engine is started or if the SRS indicator remains on.

⚠ WARNING

Air bags are designed to inflate only in severe frontal collisions. The driver and the passenger should always wear seat belts. For maximum protection in a collision or rollover, always be in a normal seated position with your back against the seat back and your head upright. Fasten your seat belt and ensure that it is properly positioned on your body as described under the "Seat Belt Operation" heading. Since the air bag inflates with considerable speed and force, a proper seat position will keep you a safe distance from the inflating air bag.

Do not place objects on the steering wheel or between you and the steering wheel. Keep your hands on the sides and lower portion of the steering wheel. Any objects may cause harm during an accident.

Failure to follow these instructions may result in death or personal injury.

Air Bag Safety Guidelines

The air bag system contains components that use combustible chemicals. Because these chemicals are combustible, care must be taken when replacing or handling system components.

⚠ WARNING

Consider undeployed air bags to be dangerous and capable of deploying at any time. Do not attempt to service the air bag system unless trained to do so. Damaged air bag systems should be examined by qualified personnel before any attempt is made to remove or to deploy the air bag. All intentional deployments and testing of the system should be performed by trained personnel. Unintentional or improper air bag deployment could cause severe bodily injury or death.

Do not attempt to disassemble the air bag inflator unit or breach the integrity of the sealed metallic inflator case. Doing so could cause severe bodily injury or death.

Do not allow system chemicals to contact other liquids, combustibles, and flammable materials. Doing so could cause chemical burns or personal injury.

The surface of the deployed air bag may contain small amounts of sodium hydroxide (which is a by-product of the gas generant combustion) and metallic sodium. Sodium hydroxide may be irritating to the skin and eyes. Always wear rubber gloves and safety glasses when handling a deployed air bag. Immediately wash your hands and exposed skin areas with a mild soap and water. Flush your eyes immediately if exposed to sodium hydroxide.

Review and comply with the following list of warnings. Failure to do so could result in severe injury or death.

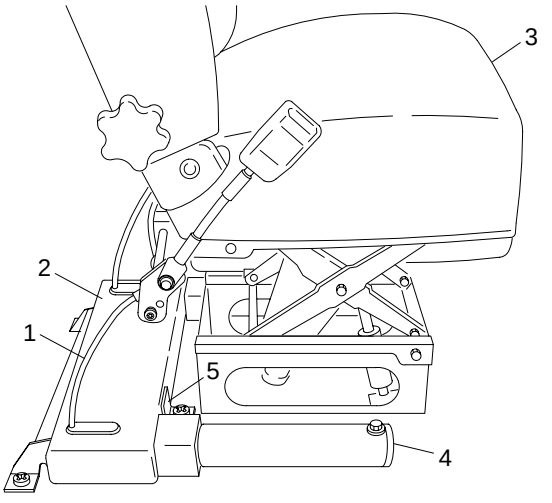
- **Keep all liquids, acids, halogens, heavy metals, and heavy salts away from the air bag system.**
- **Do not cut, drill, braze, solder, weld, strike, or probe any part of the air bag system.**
- **Do not expose the air bag module to electricity. Never probe a circuit.**
- **Do not attempt to adapt, reuse, or install an air bag system in any vehicle other than the specific vehicle for which it is designed.**
- **Do not cut wires or tamper with the connector between the vehicle wiring harness and the air bag module. Cutting or removing the connector from the system will disable the safety shunt and could cause unintentional deployment.**
- **Allow deployed air bag systems to cool after deployment.**
- **Wear rubber gloves and safety glasses when handling a deployed air bag.**
- **Wash your hands and exposed skin surface areas immediately after handling a deployed system.**
- **Store, transport, dispose of, and recycle deployed air bag system components in accordance with all applicable federal, state, and local regulations.**

- **The air bag module may contain perchlorate material: special handling may apply, see www.dtsc.ca.gov/hazardouswaste/perchlorate.**
- **Keep all heavy objects in the cab secured.**

SPACE System, Optional

The Seat Pretensioner Activation for Crash survival Enhancement (SPACE) system, when used with seat belts, provides additional protection to the driver and/or passenger in severe frontal collisions.

The SPACE system provides a significant increase in seat stability during a severe, frontal collision. When the SPACE module senses a severe, life-threatening frontal impact, the module triggers two gas-cylinders mounted at the base of the seat. See **Fig. 5.12**. The gas cylinders activate the power cinches that then tighten the lap and shoulder belts against the occupant of the seat and lower the seat suspension, moving the occupant down and away from the steering wheel and ceiling. See **Fig. 5.13**. The air bag is activated simultaneously. This sequence of actions occurs in about a tenth of a second.



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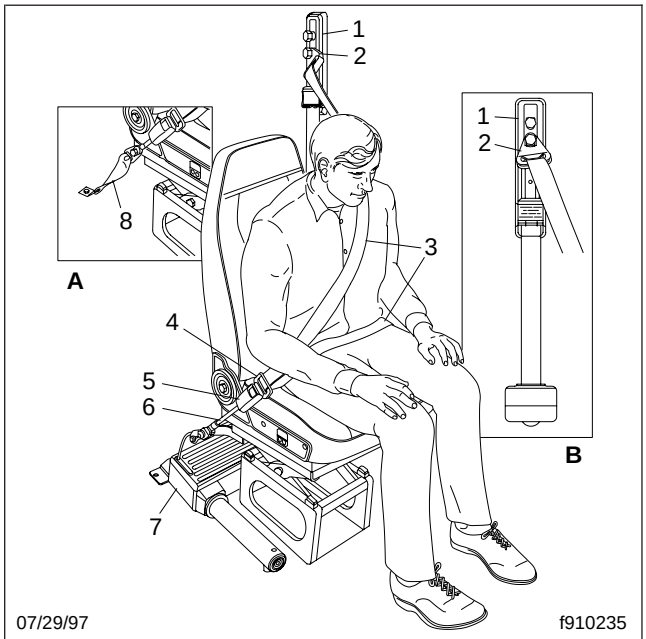
1. Pretensioning Cable Tether
2. SPACE Module
3. Suspension Seat
4. Gas Cylinder
5. Sensor Bracket

Fig. 5.12, SPACE System Components



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A. Seat Tether Without the SPACE System
B. Seat Belt Assembly B-Pillar Components

1. Height Adjuster
2. Shoulder Loop
3. Seat Belt
4. Latch
5. Buckle
6. Buckle Cable
7. SPACE Module
8. Seat Tether

Fig. 5.13, SPACE System Seat Belt Assembly

⚠ WARNING

The SPACE system will activate during a severe, frontal collision even if the seat belts are not fastened, but the SPACE system only provides protection to the occupant when the seat belts are fastened. Always use the seat belts when operating the vehicle. Failure to do so can result in severe personal injury or death.

⚠ WARNING

Damaged seat belts or seat belts that were worn in an accident must be replaced and their anchoring points must be checked. Do not attempt to modify the SPACE system. Doing so could change the effectiveness of the system. The SPACE system must be replaced after being activated. Failure to do so may result in personal injury or death.

Infants and children must not be placed in seats equipped with the SPACE system. The SPACE system is designed for adults only. Failure to follow these instructions may result in personal injury or death.

The operational readiness of the SPACE system is indicated by the supplemental restraint system (SRS) indicator on the dash. The SRS indicator comes on when the engine is started and then goes off. The indicator will remain on if there is a problem with the air bag or SPACE system. The vehicle should be serviced if the SRS indicator does not come on when the engine is started or if the SRS indicator remains on.

Safety Guidelines for the SPACE System

The SPACE system contains components that use combustible chemicals. Because these chemicals are combustible, care must be taken when replacing or handling system components.

⚠ WARNING

Do not attempt to service the air bag/SPACE system. Damaged or deployed air bag/SPACE systems should be examined only by qualified personnel before any attempt is made to remove, replace, or handle the air bag/SPACE system components. All intentional deployments and testing of the system should be performed by trained personnel. Unintentional or improper deployment of the air bag/SPACE system could cause severe bodily injury or death.

Do not attempt to service or to disassemble the SPACE module. The SPACE module cannot be serviced. Doing so could result in severe bodily injury or death.

Although the air bag/SPACE system components will not likely explode, self-deploy, or produce shrapnel, care must be taken when it is necessary to replace or perform work around the air bag/SPACE system components. Review and comply with the following list of warnings. Failure to do so could result in severe injury or death.

- **Do not cut, drill, braze, solder, weld, strike, or probe any part of the air bag/SPACE system.**
- **Keep all liquids, acids, halogens, heavy metals, and heavy salts away from the air bag/SPACE system.**
- **Do not expose the air bag/SPACE system components to electricity.**
- **Do not attempt to adapt, reuse, or install an air bag/SPACE system in any vehicle other than the specific vehicle for which it is designed.**
- **Keep hands and tools away from the scissor points under the seats.**
- **Do not cut wires or tamper with the connectors between the vehicle wiring harness and the air bag/SPACE system. Cutting or removing the electrical connectors could cause unintentional deployment.**
- **Do not expose the air bag/SPACE system to electricity. Never probe a circuit.**
- **Store, transport, dispose, and recycle deployed air bag/SPACE system components in accordance with all applicable federal, state, and local regulations.**
- **Replace damaged seat belts or seat belts that were worn in an accident, and check all anchoring points. Only qualified personnel familiar with air bag/SPACE systems should replace the seat belts used in a vehicle with an air bag/SPACE system.**
- **The air bag/SPACE system requires a special seat belt. Care must be taken to be sure the correct seat belt is used.**
- **Keep all heavy objects in the cab secured.**

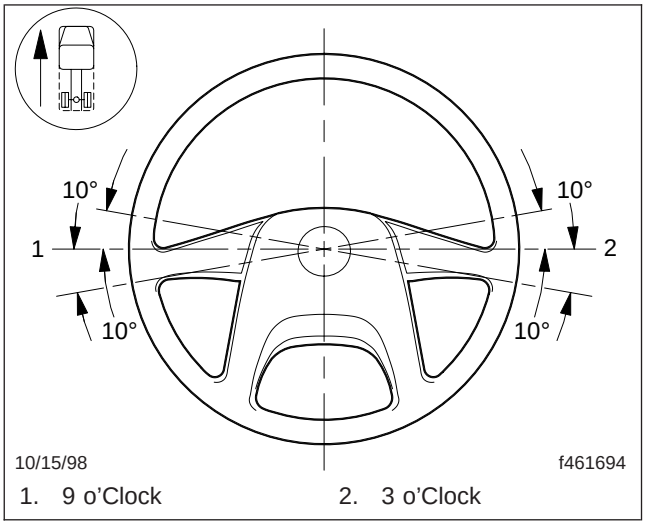
6

Steering and Brake Systems

Steering System

General Information

When there is no load on the vehicle, and the front tires are pointed straight ahead, the steering wheel spokes should be centered, ±10 degrees, as shown in **Fig. 6.1**. See **Group 46** of the *Columbia® Workshop Manual* for steering adjustment procedures.



1. 9 o'Clock 2. 3 o'Clock

Fig. 6.1, Proper Steering Wheel Position (with tires pointed straight ahead)

⚠ CAUTION

Never steam clean or high-pressure wash the steering gear. Internal damage to gear seals, and ultimately the steering gear, can result.

Power Steering System

The power steering system consists of an integral steering gear (which includes a manual steering mechanism, a hydraulic control valve, and a hydraulic power cylinder), hydraulic hoses, power steering pump, reservoir, and other components. Some models are also equipped with a separate hydraulic power cylinder on the right side of the front axle. 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 some other 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.

Drivers should carefully use the power available with a power steering system. If the front tires become lodged in a deep chuckhole or rut, drive the vehicle out, instead of using the steering system to lift the tires from the hole. Also, avoid turning the tires when they are against a curb, as this places a heavy load on steering components and could damage them.

Brake System

General Information

A dual air brake system consists of two independent air brake 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.

IMPORTANT: On TRACTORS, loss of air pressure in the primary system causes the rear service brakes to become inoperative; front brakes will continue to be operated by secondary system air pressure. On TRUCKS, loss of air pressure in the primary system causes the rear spring brakes to get modulated, controlled by a secondary air signal. In addition, on TRACTORS and TRUCKS, trailer brakes will be operated by the secondary system.

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).

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 foot brake control pedal, either the front or rear service brakes will not be operating, 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.

On tractor-trailer vehicles, if both the primary and secondary systems become inoperative, the trailer service brakes or spring parking brakes will automatically apply when air pressure drops below 35 to 45 psi (242 to 310 kPa). The tractor spring parking brakes will automatically apply when air pressure drops below 20 to 30 psi (138 to 207 kPa). On straight trucks, spring parking brakes will apply when air pressure drops below 20 to 30 psi (138 to 207 kPa). Do not wait for the brakes to apply automatically. When the warning light and buzzer first come on, immediately bring the vehicle to a safe stop. Before continuing operation of the vehicle, correct the cause of the air loss.

Before the vehicle 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.

Brake System Operation

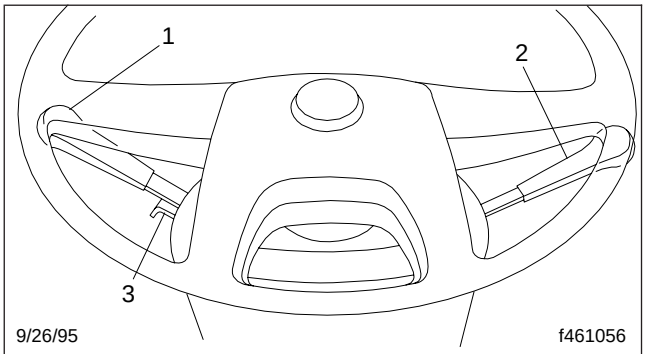
IMPORTANT: Before driving the vehicle, secure all loose items in the cab so that they will not fly forward during a full brake application. Make sure all passengers are wearing seat belts.

During normal brake stops, depress the foot brake control 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 spring parking brakes if the vehicle is to be parked.

IMPORTANT: An air brake proportioning system is used in tractor air brake systems when the vehicle is not equipped with ABS. When operating in bobtail mode, the rear brake chambers (whose axle load has been greatly reduced) receive reduced or 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 the bobtail mode of operation. When the tractor is towing a trailer, the rear brake chambers will receive full (normal) application air pressure.

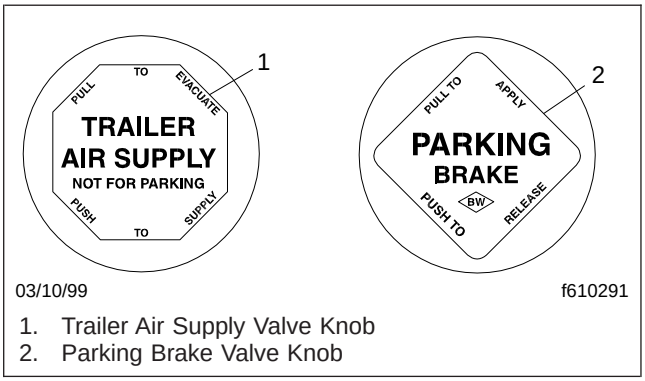
NOTE: If equipped with main and auxiliary transmissions, do not shift both transmissions into neutral while the vehicle is rolling. Shifting both transmissions back into gear would be difficult while the vehicle is rolling.

The trailer brake hand control valve (**Fig. 6.2**) actuates the trailer service brakes independently from the vehicle chassis service brakes. The valve can be partially or fully applied, but in any partially-on position it will be overridden by a full application of the foot brake control pedal. Moving the valve handle clockwise actuates the trailer brakes, while moving it counterclockwise releases the trailer brakes. The valve handle is spring-loaded and returns to it's original, no-air application position when released.



1. Turn Signal Lever
2. Trailer Brake Hand Control Valve
3. Hazard Warning Light Tab

Fig. 6.2, Steering Column-Mounted Controls (left-hand drive shown)



1. Trailer Air Supply Valve Knob
2. Parking Brake Valve Knob

Fig. 6.3, Brake Valve Knobs

⚠ 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.

The red octagonal-shaped knob (**Fig. 6.3**) in the control panel actuates the trailer air supply valve. 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 red knob must be pushed in. It should stay in, to charge the trailer air supply system and to release the trailer spring parking brakes. It must be pulled out before disconnecting a trailer. It must also be pulled out when operating a vehicle without a trailer. If pressure in both air systems drops to 35 to 45 psi (242 to 310 kPa), the red knob automatically pops out, exhausting the trailer air supply, and applying the trailer service or spring parking brakes.

The yellow diamond-shaped knob (**Fig. 6.3**) in the control panel actuates the parking brake valve. Pulling out the knob applies both the tractor and trailer spring parking brakes and automatically causes the trailer air supply valve knob to pop out.

⚠ CAUTION

Do not use the spring parking brakes if the service brakes are hot, such as after descending a steep grade. Also, do not use the spring parking brakes during freezing temperatures if the service brakes are wet. To do so could damage the brakes if hot, or cause them to freeze during cold weather.

If the brakes are wet, drive the vehicle in low gear and lightly apply the brakes to heat and dry them. Allow hot brakes to cool before using the spring parking brakes. Always chock the tires.

If the trailer is not equipped with spring parking brakes, pulling out the yellow knob applies the tractor spring parking brakes 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 red knob, leaving the tractor parking brakes applied. Air pressure in the primary or secondary reservoir must be at least 65 psi (447 kPa) before the tractor spring parking brakes, or the trailer service or spring parking brakes, can be released.

On trailers not equipped with spring parking brakes, chock the trailer tires before disconnecting the truck or tractor when parking just the trailer.

When parking a truck or tractor with a trailer (combination vehicle), and the trailer is not equipped with spring parking brakes, apply the truck or tractor spring parking brakes.

⚠ WARNING

If a trailer is not equipped with spring parking brakes, do not park it or a combination vehicle 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, the trailer brakes would release, possibly causing an unattended runaway vehicle.

⚠ CAUTION

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.

Meritor WABCO® Antilock Braking System (ABS)

The Meritor WABCO Antilock Braking System (ABS) is an electronic wheel speed monitoring and control system that works with the standard air brake system. ABS passively monitors vehicle wheel speed at all times, and *controls* wheel speed during emergency stops. If equipped with Automatic Traction Control, wheel spin is controlled during reduced-traction situations. In normal braking applications, the standard air brake system is in effect.

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. Installing different-sized tires could result in a reduced braking force, leading to longer stopping distances.

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 (located on the frame rail). The control unit'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 solenoid control valve to reduce braking pressure. During emergency braking, the solenoid control valve alternately reduces, increases, or maintains air pressure supply in the brake chamber to prevent front and rear wheel lockup.

If equipped with Automatic Traction Control, an additional solenoid valve is installed. During reduced-traction situations, the valve increases or reduces air pressure supply in the brake chamber to provide better traction whenever wheel spin occurs.

The electronic control unit also has a safety circuit that constantly monitors the wheel sensors, traction control valve (if equipped), solenoid control valves, and the electrical circuitry.

After the ignition switch is turned on, the tractor warning light (TRACTOR ABS) and, if equipped with Automatic Traction Control, the wheel spin (WHEEL SPIN) indicator light come on for about three seconds. After three seconds, the warning lights go out only if all of the tractor's ABS components are working.

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.

If the vehicle has ATC, there will be a momentary contact rocker switch on the dash labeled NORM/SPIN and ATC.

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 electronic engine to reduce power.

Pressing NORM/SPIN will temporarily allow more drive wheel spin to help burn through a thin layer of ice, or to help throw off accumulated mud or snow. SPIN mode is indicated by a flashing WHEEL SPIN light. Pressing NORM/SPIN again will cycle the system back to normal operation.

The Meritor WABCO ABS system combines one front-axle control channel with one rear axle to form one control circuit. For example, the sensor and solenoid control valve on the left-front axle form a control circuit with the sensor and solenoid control valve on the right rear axle. If, during vehicle operation, the safety circuit senses a failure in any part of the ABS system (a sensor, solenoid control valve, wiring connection, short circuit, etc.), the tractor warning light (TRACTOR ABS) comes on 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 system is completely inoperative, normal braking ability is maintained. An exception would be if a solenoid control valve (or combination solenoid control valve) is damaged and inoperative. As these components are an integral part of the air brake system, normal braking may be impaired or inoperative.

IMPORTANT: If any of the ABS warning lights do not work as described above, or come on while driving, repair the ABS system immediately to ensure full antilock braking capability.

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 system will control all wheels to provide steering control and a reduced braking distance.

Although the ABS system improves vehicle control during emergency braking situations, the driver still has the responsibility to change driving styles depending on the existing traffic and road conditions. For example, the ABS system cannot prevent an accident if the driver is speeding or following too closely.

Trailer ABS Lamp Operation

Antilock Braking Systems (ABS) on tractors are designed to communicate with trailer ABS systems, if they are compatible. Compatibility will result in the illumination of the trailer ABS lamp during vehicle start-up and fault detection.

The dash-mounted lamp will operate as follows when a compatible trailer is properly connected to a tractor:

- When the ignition key is turned to the ON position, the trailer ABS lamp will illuminate momentarily, then turn off.
- If the lamp comes on momentarily during vehicle operation, then shuts off, a fault was detected and corrected.
- If the lamp comes on 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.

The Trailer ABS lamp will not illuminate unless a compatible trailer is connected to the tractor.

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.

Meritor WABCO Electronic Braking System (EBS)

The Meritor WABCO Electronic Braking System (EBS) is designed to continuously monitor and coordinate all aspects of service braking.

The EBS pairs an electronic control system with a pneumatic application system. Key braking data such as driver brake demand, wheel speed, and vehicle load is gathered by a network of electronic sensing devices (including load sensors, and signal generating tone wheels and sensors located in the wheel hubs of each sensing axle).

An electronic control unit, the central module, oversees the translation of electronic signals into pneumatic actuation. During a braking application, electronic-pneumatic modulators control the brake pressure of each wheel, as well as at the trailer coupling head. As a result, the same amount of vehicle deceleration will occur for a given brake pedal travel, regardless of vehicle load. During emergency stops (i.e. wheel lockup), the EBS also activates the Antilock Braking System (ABS).

The EBS includes a system check for all modulators, sensors, brake system electric circuits and data lines and is thereby able to detect malfunctions in the braking system. When a fault is detected, the central module will disable the affected part of the EBS. Under this safe status (i.e. fail-safe) mode, the nonaffected parts will continue to function. For example, in the case of a sensor malfunction, the system works without the sensor information but at a reduced performance level.

If a serious malfunction causes a total loss of one or more electronic braking circuits, a pure pneumatic backup system is available.

The following functions can be deactivated in the event of a malfunction:

- ABS can be deactivated at one individual wheel, at one axle, or for the whole vehicle.
- ATC control can be deactivated. If it is shut down, then both the ATC brake control and the ATC engine control will be shut down.
- If electrical control is lost, the affected axle is braked by means of the pneumatic redundancy pressure. The driver must compensate by exerting more force on the brake pedal to stop the vehicle.

This system has built-in diagnostics to ensure that all components are operating properly. Under normal conditions, the system performs a three second self-check when the ignition is turned on. The two warning lamps (EBS, ABS) and the information lamp (ATC) should illuminate for three seconds and then go out if all EBS components are working properly. If all three lamps do not switch on or if all three lamps

do not switch off after three seconds, the system should be checked.

NOTE: If there is no bulb check and no displayed fault, most likely the brake pedal is partially depressed, either by the driver or by something holding the pedal down. This safety feature alerts the driver that the brake pedal is not fully in the released position.

Automatic Slack Adjusters

Automatic slack adjusters are required on all vehicles equipped with air brakes manufactured after October 20, 1994. 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. In fact, continual adjustment of automatic slack adjusters may result in premature wear of the adjuster itself. Further, the improper adjustment of some automatic slack adjusters may cause internal damage to the adjuster, thereby preventing it from properly functioning.

7

Engines and Clutches

EPA07 Aftertreatment System (ATS)

On-road diesel engines built after December 31, 2006, 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.

EPA07-compliant engines require ultralow-sulfur diesel (ULSD) fuel, and they should never be run on fuel with sulfur content higher than 15 ppm. In addition, they require low-ash engine oil. The following guidelines must be followed, or the warranty may be compromised.

- Use ultralow-sulfur diesel (ULSD) with 15 ppm sulfur content or less, based on ASTM D2622 test procedure.
- Do not use fuel blended with used engine lube oil.
- Engine lube oil must have a sulfated ash level less than 1.0 wt %, meeting the API CJ-4 index specifications.

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

The "exhaust system" in EPA07-compliant vehicles is called the aftertreatment system (ATS). The ATS varies according to engine manufacturer and vehicle configuration, but instead of a muffler, an aftertreatment system has a device that outwardly resembles a muffler, called the aftertreatment device (ATD).

IMPORTANT: See the manufacturer’s engine operation manual for complete details and operation of the aftertreatment system.

Inside the ATD on Mercedes-Benz, Detroit Diesel, and Cummins engines, the exhaust first passes over the diesel oxidation catalyst (DOC), then it passes through the DPF, which traps soot particles. If exhaust temperature is high enough, the trapped soot is reduced to ash, in a process called passive regeneration (regen). **Passive regeneration** occurs as the vehicle is driven normally under load; the driver is not even aware that it is happening. The harder an EPA07 engine works, the better it disposes of soot, as the exhaust heat alone is enough to burn the soot to ash. Over the course of a workday, however, passive regeneration cannot always keep the ATD filter clean, so the filter must undergo **active regeneration**. In active regeneration, extra fuel is injected into the exhaust stream to superheat the soot trapped in the DPF and turn it to ash. Active regeneration happens only when the vehicle is moving above a certain speed, determined by the engine manufacturer. Consult manufacturers’ documentation for details.

Both active and passive regeneration happen automatically, without driver input.

NOTE: Caterpillar engines do not use a DOC; CAT engines burn diesel fuel at the regeneration head to superheat the exhaust and burn the trapped soot to ash. Engine software monitors and controls this process.

Only when operating conditions do not allow for ATD filter cleaning by at-speed active or passive regeneration, the vehicle may require a **parked regeneration**. The vehicle must be standing still, and the driver must initiate the parked regen. Completing a parked regen takes 20 minutes to an hour, depending on ambient conditions.

⚠ DANGER

During parked regeneration, 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 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.

The warning lamps in the driver message center alert the driver of a regen in progress, high exhaust temperatures, the need to perform a parked regen either soon or immediately, and of an engine fault that affects the emissions.

A slow (10-second) flashing of the high exhaust system temperature (HEST) lamp indicates that a parked regeneration is in progress, and the engine’s

high idle speed is being controlled by the engine software, not the driver.

A steadily illuminated high temperature (HEST) lamp alerts the operator of high exhaust temperature during the regeneration process, if vehicle speed is below 5 mph (8 km/h). See **Fig. 7.1**. The HEST lamp does not signify the need for any kind of vehicle or engine service; it only alerts the vehicle operator of high exhaust temperatures. Make sure the engine exhaust pipe outlet is not directed at any person, or at any surface or material that will melt, burn, or explode.

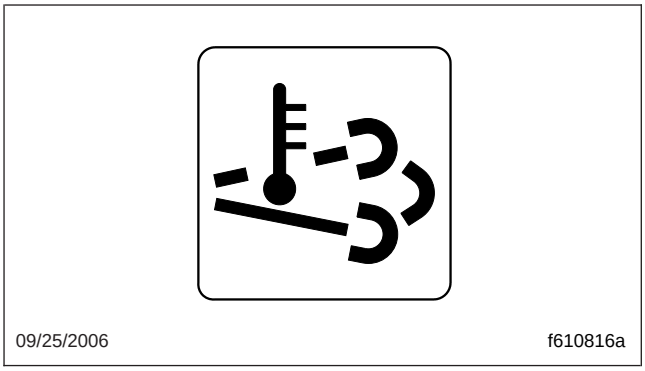


Fig. 7.1, High Exhaust System Temperature (HEST) Lamp

⚠ WARNING

Automatic regeneration can occur any time the vehicle is moving, and the exhaust can remain hot after the vehicle has stopped moving. The exhaust gas temperature could reach 1500°F (800°C), which is hot enough to ignite or melt common materials, and to burn people.

A steadily illuminated yellow diesel particulate filter (DPF) lamp indicates that a regen may be required soon. Bring the vehicle to highway speeds to allow for an active regen, or a parked regen should be scheduled for the earliest convenient time. See **Fig. 7.2**. A DPF lamp blinking at the same time as a steadily illuminated yellow Check Engine lamp, indicates that a parked regen must be performed immediately, or an engine derate will occur. If the red Stop Engine lamp illuminates with the blinking DPF lamp and the Check Engine lamp, a parked regen must occur or an engine shutdown will occur. Park the vehicle and perform a parked regen. See **Fig. 7.3**.

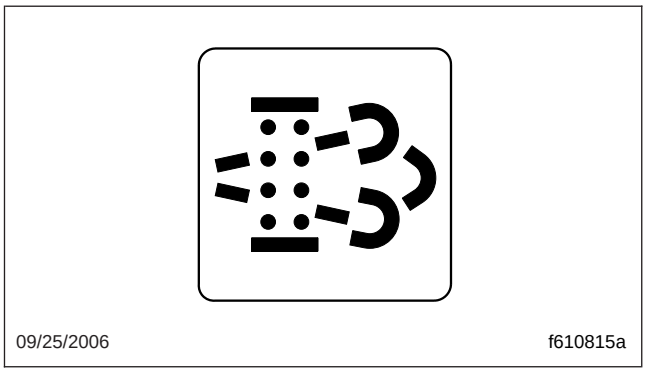
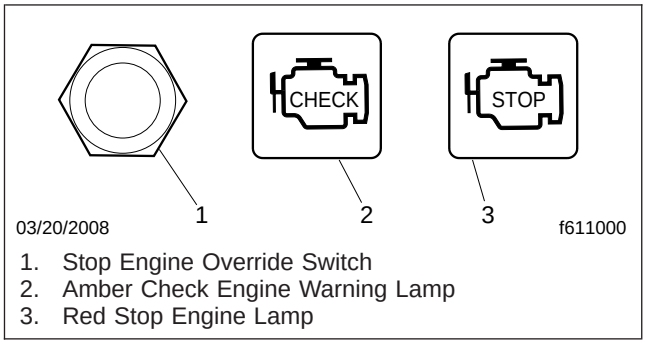


Fig. 7.2, Diesel Particulate Filter (DPF) Status Lamp



1. Stop Engine Override Switch
2. Amber Check Engine Warning Lamp
3. Red Stop Engine Lamp

Fig. 7.3, Engine Lamps

A solid yellow malfunction indicator lamp (MIL) indicates an engine fault that affects the emissions. See **Fig. 7.4**.

When diesel particulate filter servicing is needed, it must be performed by an authorized technician, and a record must be maintained for warranty purposes. The record must include:

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

The request/inhibit regen switch (**Fig. 7.5**), located on the dash, may have three selectable positions:

- request regeneration;
- default (can include appropriate normal state condition—either in an automatic regeneration or inhibit state);
- inhibit regeneration.

NOTE: The regen switch can start a parked regen only when at least one of two conditions

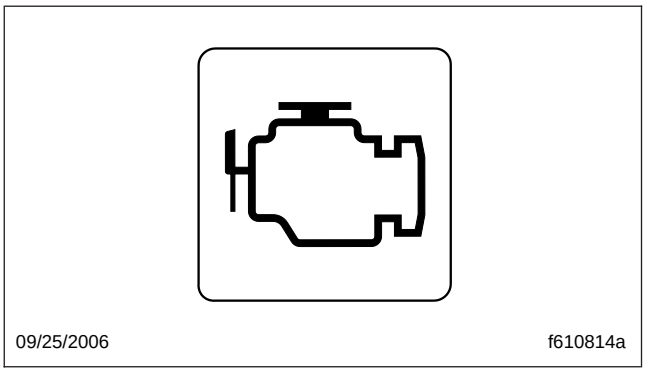


Fig. 7.4, Malfunction Indicator Lamp (MIL)

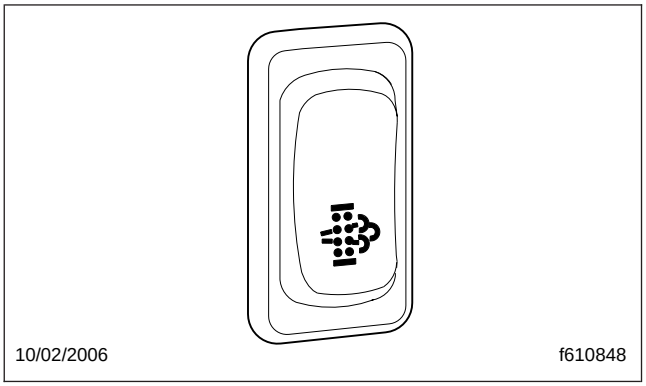


Fig. 7.5, Request/Inhibit Regen Switch

exists: either the DPF light is illuminated, or the engine software calls for it. If neither of those conditions exist, the regen switch cannot cause a regeneration to happen.

The function of the switch will vary by the engine make and model in the vehicle. See the manufacturer's engine operation manual for switch operation details.

DD15 Heavy-Duty Engine

See **Chapter 2** of this manual for information on the DDEC VI operator controls. See the *Detroit Diesel DD15 Engine Operator's Guide* for complete details of engine operation.

Engine Protection

An engine protection system monitors all engine sensors and electronic components, and recognizes system malfunctions. If a critical fault is detected, an amber Check Engine warning lamp and a red Stop Engine lamp illuminate. See **Fig. 7.3**.

The standard parameters that are monitored for engine protection are: low coolant level, high coolant temperature, low oil pressure, and high oil temperature.

Amber Check Engine Warning Lamp

When the amber Check Engine warning lamp comes on for any reason, the vehicle can still be operated, and the driver can proceed to the required destination. See **Fig. 7.3**. This condition should be reported to an authorized service center as soon as possible.

Red Stop Engine Lamp

When the red Stop Engine lamp comes on, the computer has detected a major malfunction in the engine that requires immediate attention. See **Fig. 7.3**. **It is the operator's responsibility to shut down the engine to avoid serious damage.**This system features a 30-second, stepped-down power-shutdown sequence, or an immediate emergency-running mode, in the event that a major engine malfunction occurs. The conditions that will cause the red Stop Engine lamp to come on are:

- high coolant temperature
- loss of coolant
- high oil temperature
- low oil pressure
- auxiliary shutdown

Stop Engine Override Switch

In the event that the vehicle is operating in a critical location when a shutdown is initiated, a Stop Engine Override (SEO) switch can be used to override the shutdown sequence. See **Fig. 7.3**. This override resets the shutdown timer, restoring power to the level when the red stop engine lamp was illuminated. The switch must be recycled after five seconds to obtain a subsequent override.

⚠ CAUTION

Using the override button so the engine operates for an extended period may result in engine damage. The operator has the responsibility to take action to avoid engine damage.

DDEC VI Driving Tips

Accelerating the Vehicle

The accelerator pedal was designed to communicate "percentage" of accelerator pedal travel to the engine MCM. A throttle characteristic you may need time to get used to, is the DDEC limiting speed governor. This allows the driver to command total engine response between idle and rated speed, such as accelerating at half throttle—an advantage when driving under slippery conditions. To obtain 100 percent fueling at any speed, the accelerator pedal must be depressed to the fully pressed position.

Shifting

Depending on your transmission model, the gear split may vary from 400 to 500 rpm. The electronic governor provides almost no overrun capability; if the transmission is downshifted too early, you will experience a temporary loss of pulling power until the engine speed falls below rated speed. In general, when using a 9-speed transmission, you should always downshift between 1000 and 1100 rpm. This is true even on steep grades with heavy loads. When using an 18-, 15-, or 13-speed transmission, you will need to downshift at an rpm that allows "less than rated" rpm, before throttle application in the next gear down. You may want to limit engine speed to 1900 rpm in all gears.

The DD15 engine provides horsepower through 2100 rpm, but fuel economy is not as efficient above 1800 rpm. If you decide to drive at lower rpm for improved fuel economy, don’t let different engine noises throw you off guard. The DD15 engine sounds quiet at 1400 rpm, almost as if it had quit pulling. If you had a boost gauge to look at while driving, you would notice the turbocharger maintaining steady intake manifold pressure, even as rpm falls. Depending on the air intake arrangement, you may also hear a "chuffing" sound as the engine starts to pull hard at lower rpm. This is normal, and caused by the velocity changes of the air flow within the air intake plumbing. Electronic engines can actually deliver more fuel at lower engine speeds than at rated speed.

The DD15 engine has been designed for a very quiet operation, but the air flow may be noticeable to the tuned attentive ear. The turbocharger operates at higher boost pressure, forcing exhaust to flow through the exhaust gas recirculation plumbing. In some situations the driver may believe they have experienced a charge air cooler system leak. Even while connecting trailer lights and air hoses, the driver may hear a different tone (exhaust and under hood with the engine idling). If equipped with a turbo boost gauge, the driver may occasionally note the intake manifold pressure exceeds 35 psi (241 kPa).

Idling

The common belief that idling a diesel engine causes no engine damage is wrong. 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, the high idle function of the cruise control switches should be used. An idle speed of 900 rpm should be enough to provide cab heat in above freezing ambient temperatures.

Cold-Weather Operation

Precautions must be taken during cold weather to protect your engine. Special cold-weather handling is required for fuel, engine oil, coolant, and batteries. The engine does not require starting aids down to 50°F (10°C). A grid heater is included for temperatures between 50°F (10°C) and –4°F (–20°C). Temperatures below –4°F (–20°C), will require a grid heater, block heater, and oil pan heater.

⚠ CAUTION

NEVER use ether as a starting aid to run a DD15 engine. Doing so will result in injector damage.

A winterfront may be used to improve cab heating. At least 25 percent of the grill opening should remain open in sectioned stripes that run perpendicular to the charge air cooler tube flow direction. 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).

Driving on Flat, Dry Pavement

Use the following guidelines when driving on flat, dry pavement.

- If driving on flat, dry, open stretches, with a light load, place the progressive braking switch in the LOW position.
- If you find you are still using the service brakes, move the switch to a higher position

until you do not need to use the service brakes to slow the vehicle.

- If you are carrying a heavier load and road traction is good, move the progressive braking switch to the HIGH position.
- Check your progressive braking switch often for proper position, since road conditions can change quickly. Never skip a step when operating the progressive braking switch. Always go from OFF to LOW, and then to a higher position.

Descending a Long, Steep Grade

An explanation of "control speed" may be helpful in understanding how to use the engine brake system while descending a grade. Control speed is the constant speed at which the forces pushing the vehicle forward on a grade, are equal to the forces holding it back, without using the vehicle service brakes. In other words, this is the speed the vehicle will maintain without using the service brakes or throttle.

⚠ CAUTION

Do not over apply the vehicle service brakes when descending a long, steep grade. Excessive use of the vehicle brakes will cause them to heat up, reducing their stopping ability. This condition, referred to as “brake fade”, may result in loss of braking, which could lead to loss of control of the vehicle, resulting in personal injury or property damage.

Use the following guidelines when descending a long, steep grade.

- Before beginning the descent, determine if your engine brake system is operating properly, by lifting your foot briefly off the accelerator pedal. You should feel the system activate.
- Ensure the progressive braking switch is in the appropriate power position. Check your progressive braking switch often for proper position, since road conditions can change quickly. Never skip a step when operating the progressive braking switch. Always go from OFF to LOW and then to a higher position when on slippery roads.
- Do not exceed the safe control speed of your vehicle. Example: You could descend a 6 percent grade, under control at 10 mph (16 km/h) without an engine brake, but at 25 mph (40 km/h) it requires an engine brake. You could not descend that same hill at 50 mph (80 km/h) and still expect to remain under control. Know how much slowing power your engine brake can provide before descending hills, and do not exceed a safe control speed.

Driving on Wet or Slippery Pavement

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

NOTE: On single trailers or combinations, a light air application of the trailer brakes may be desirable to help keep the trailer stretched out. Follow the manufacturer’s recommended operating procedure when using the trailer brakes.

On wet or slippery pavement, start with the master switch in the OFF position and use the gear you would normally use under these conditions. If the vehicle is maintaining traction, place the selective braking switch in the LOW position and turn ON the engine brake system. If the drive wheels are maintaining traction and you desire greater slowing power, move the braking switch to the next higher position. However, if the tractor drive-wheels begin to lock, or there is a fishtail motion, turn the engine brake system OFF immediately and do not activate it until road conditions improve.

Check your progressive engine braking switch often for proper position, since road conditions can change quickly. Never skip a step when operating the progressive braking system. Always go from OFF to LOW and then to a higher position. See **Chapter 2** for the proper operation of the engine brake.

Engine Starting—CAT, Cummins, DDE S60, M-B

Normal Starting

NOTE: Before starting the engine, read **Chapter 2** for detailed information on how to read the instruments and operate the controls. Read the operating instructions in the engine manufacturer's operating manual before starting the engine.

IMPORTANT: Ring gear and starter pinion damage caused by improper starting procedures is not warrantable.

⚠ CAUTION

When starting a vehicle equipped with a manual transmission and clutch lockout switch, the clutch pedal must be fully depressed during the entire start sequence. Failure to do so can cause the pinion to release and re-engage, which could cause ring gear and starter pinion damage.

If a vehicle does not start on the first attempt, make sure that the engine has completely stopped rotating before reapplying the starter switch. Failure to do so can cause the pinion to release and re-engage, which could cause ring gear and starter pinion damage.

Moving a vehicle with the starter and/or using the starter to bump the engine for maintenance procedures is strictly prohibited. Use of these methods to bump the engine over or move the vehicle can cause the pinion to release and re-engage, which could cause ring gear and starter pinion damage.

Prestart

NOTE: These prestart steps apply to all the following engines.

1. Before engine start-up, perform the engine pretrip inspection and daily maintenance checks in **Chapter 11**.
2. Apply the parking brake.
3. For manual transmissions, place the transmission in neutral and step on the clutch pedal. Do not push the accelerator pedal.

   NOTE: On vehicles equipped with a neutral start switch, the transmission must be in neutral before the engine can be started. For air start systems, check the air supply before starting the engine. There must be 100 psi (689 kPa) of air pressure available.

Starting Precautions

⚠ CAUTION

Do not crank the engine for more than 30 seconds at a time. Wait two minutes after each try to allow the starter to cool. Failure to do so could cause starter damage.

NOTE: Some starters are equipped with optional overcrank protection. If overcranking occurs, a thermostat breaks the electrical circuit to the starter motor until the motor has cooled.

⚠ CAUTION

Protect the turbocharger during the start-up by not opening the throttle or accelerating the engine above 1000 rpm until normal engine idle oil pressure registers on the gauge.

⚠ 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.

Caterpillar

NOTE: Before doing these steps, do the steps in "Prestart."

1. Turn the ignition switch to the on position. See **Fig. 7.6**. All the electronic gauges on the ICU (instrumentation control unit) complete a full sweep of their dials, the warning and indicator lights light up, and the buzzer sounds for 3 seconds.

NOTE: The engine electronics supply the correct amount of fuel for starting the engine. Pedal pressure is unnecessary.

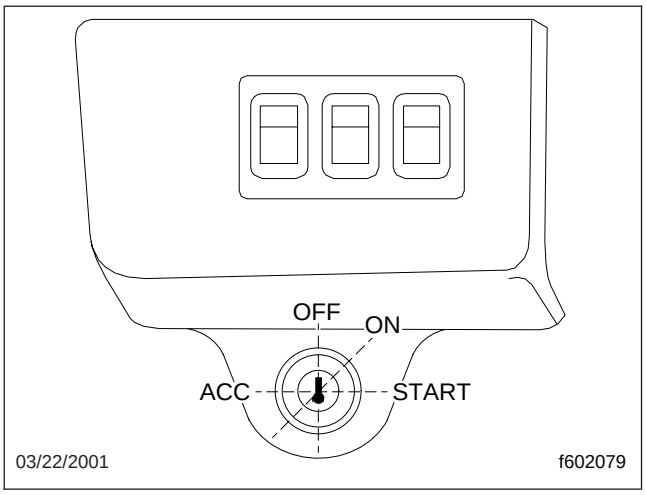


Fig. 7.6, Ignition Switch Positions

2. Turn the ignition switch to the start position. Do not press down on the throttle pedal. Release the switch the moment the engine starts.

   2.1 If the engine does not start after 30 seconds of cranking, turn the ignition switch off.

   NOTE: Some starters are equipped with optional overcrank protection. If overcranking occurs, a thermostat breaks the electrical circuit to the starter motor until the motor has cooled.

   2.2 Wait two minutes to allow the starter motor to cool. Turn the ignition switch back to the on position and try again to start the engine.

   2.3 As soon as the engine starts, release the ignition switch, allowing the engine to run at a slow idle.

⚠ CAUTION

If the oil pressure is less than 5 psi (35 kPa), shut down the engine immediately to prevent serious damage. If the vehicle is equipped with an automatic shutdown system, the engine will shut down after 30 seconds.

3. Caterpillar C–10/C–12/C–15/C–16 engines may be operated at low load and speed once the engine oil pressure has reached 10 to 20 psi (69 to 138 kPa). Caterpillar 3406E engines may be operated at low load and speed once the engine oil pressure has reached 18 psi (124 kPa).
4. When the engine has reached the normal operating temperature of 189°F (87°C), the engine may be operated at full load.

Detroit Diesel S60

NOTE: Before doing these steps, do the steps in "Prestart."

1. Turn the ignition switch to the on position. See **Fig. 7.6**. All the electronic gauges on the ICU (instrumentation control unit) complete a full sweep of their dials, the warning and indicator lights light up, and the buzzer sounds for three seconds.
2. When all the indicators go out, turn the ignition switch to the start position. Without touching the throttle pedal, start the engine. If the engine won't start within 15 seconds, release the ignition switch and allow the starter motor to cool.

IMPORTANT: If the engine won't start, check the main engine power fuses. The fuses are located along the main engine electrical harness on the left frame rail, near the batteries. If the fuses are blown, replace the fuses. Be sure to find the cause of the blown fuses as soon as possible.

NOTE: Some starters are equipped with optional overcrank protection. If overcranking occurs, a thermostat breaks the electrical circuit to the starter motor until the motor has cooled.

⚠ 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.

3. Check the oil pressure gauge immediately after starting the engine.
4. If no pressure registers within 10 to 15 seconds or the ENGINE PROTECT indicator comes on, shut down the engine and check the lubricating oil system.

CAUTION

Protect the turbocharger during the start-up by not opening the throttle or accelerating the engine above 1000 rpm until minimum engine idle oil pressure of 12 psi (83 kPa) registers on the gauge.

5. Idle the engine for about five minutes at 1000 rpm before operating the engine under load.

Mercedes-Benz

NOTE: Before doing these steps, do the steps in "Prestart."

CAUTION

Never attempt to start any Mercedes-Benz electronic engine using ether or any other starting fluid. Serious engine damage could result.

1. Turn the ignition switch to the on position. See **Fig. 7.6**. All the electronic gauges on the ICU (instrumentation control unit) complete a full sweep of their dials, the warning and indicator lights light up, and the buzzer sounds for three seconds.

IMPORTANT: On vehicles equipped with an intake air preheater, the INTAKE HEATER indicator stays on for a minimum of two seconds, regardless of coolant temperature. Wait until the INTAKE HEATER indicator goes out before attempting to start the engine.

2. Turn the ignition switch to the start position. Without touching the throttle pedal, start the engine.

NOTE: Some starters are equipped with optional overcrank protection. If overcranking occurs, a thermostat breaks the electrical circuit to the starter motor until the motor has cooled.

3. 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).
4. 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).

CAUTION

Do not rev the engine if the oil pressure gauge indicates no oil pressure. Shut down the engine if no oil pressure appears within approximately ten seconds. Check to determine the cause of the problem. Operating the engine with no oil pressure will damage the engine.

Cold-Weather Starting

Modern electronic engines do not normally require special starting aids. At low temperatures, oil pan heaters or water jacket heaters are sometimes used to assist in starting.

Caterpillar

WARNING

If using a cold-weather-start system, be sure to follow the manufacturer's instructions regarding its use, handling, and storage. Many starting fluids are in capsules or pressure cans, and improper usage can be dangerous.

Do not attempt to use any type of vapor-compound start system near heat or open flame. Engine damage due to an explosion or fire in the intake manifold could result.

Do not breathe the ether fumes; doing so could result in personal injury.

Turn the ignition switch to the on position. See **Fig. 7.6**.

If the engine doesn't start after 30 seconds of cranking, turn the key to the off position and wait two minutes; then repeat the starting procedure.

If the coolant temperature is less than 64°F (18°C), the engine will start up in the cold-start strategy. This reduces the amount of fuel available to the injectors, advances the timing, and controls white smoke emissions. The engine remains in the cold-start strategy until the coolant temperature rises above 64°F (18°C), or until it has been running for 12 minutes.

IMPORTANT: Do not move the vehicle when it is in the cold-start strategy. Power will be noticeably reduced.

After a cold engine start of less than 64°F (18°C), Caterpillar electronic engines automatically idle at 800 rpm (for C–10 and C–12 engines), or 600 rpm (for 3406E, C–15, and C–16 engines). These electronic engine systems will adjust the idle speed to 700 to 750 rpm when the engine is warm enough to drive the vehicle.

Detroit Diesel S60

The engine may require the use of a cold-weather starting aid if the outside temperature falls below 40°F (4°C).

Turn the ignition switch to the on position and start the engine.

If the engine doesn't start after 30 seconds of cranking, turn the key to the off position and wait two minutes; then repeat the starting procedure.

Run the engine slightly above idle until oil pressure shows on the gauge. If oil pressure doesn't show on the gauge within 30 seconds of starting, turn the key to the off position and wait one minute; then repeat the starting procedure.

Mercedes-Benz

⚠ CAUTION

Never attempt to start any Mercedes-Benz electronic engine using ether or any other starting fluid. Serious engine damage could result.

The intake air preheater is activated by turning the ignition switch to the on position. See **Fig. 7.6**. If the engine is at normal temperature, the INTAKE HEATER indicator goes out after two seconds.

If the temperature is low enough to require the heater, the INTAKE HEATER indicator stays on while the intake air preheater warms up. After the indicator goes out, start the engine. If the engine doesn't start after about 30 seconds of cranking, turn the key to the off position and wait two minutes; then repeat the starting procedure.

NOTE: If the engine doesn't start on the second try, wait at least five minutes before using the intake air preheater again.

Starting After Extended Shutdown or Oil Change—CAT, Cummins, DDE S60, M-B

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

Do the following steps after an oil change or after the engine has been shut down for more than three days:

1. Make sure the transmission is filled with the correct type of fluid, as recommended by the transmission manufacturer.
2. Make sure the fuel tank is full. If air has entered the fuel system, prime the fuel system, using the engine manufacturer's instructions.
3. If the engine is equipped with a fuel/water separator, drain off any accumulated water.
4. Check the drive belts to make sure they are in good condition and properly adjusted. Replace any drive belts that are cracked, worn, or glazed.
5. Check the turbocharger for signs of oil or exhaust leaks. Correct any problems before starting the engine.
6. Check the engine mounting bolts for tightness. Retighten them if necessary.
7. Make sure the battery cable connections are clean and tight. Check that the batteries are charged.
8. Start the engine. See "Engine Starting".

Engine Break-In—CAT, Cummins, DDE S60, M-B

Caterpillar

Every Caterpillar engine must pass a full-load operation test on a dynamometer before shipment, eliminating the need for a break-in period. Only an initial operational check is necessary.

Cummins

Cummins engines are run on a dynamometer before being shipped from the factory. They do not require a break-in period.

Detroit Diesel S60

Detroit Diesel S60 engines can be put to work upon delivery without having to follow a formal break-in schedule. The engine has been "run-in" on a factory dynamometer during performance and quality assurance tests prior to shipment.

Mercedes-Benz

Each Mercedes-Benz 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 Chapter 2 of the *MBE4000 Engine Operator's Manual*.

Engine Operation—CAT, Cummins, DDE S60, M-B

Safety and Environmental Considerations

⚠ 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.

Operating vehicles with diesel engines in areas where there are concentrated flammable vapors (such as diesel, gasoline, natural gas, or propane fumes) can create a hazardous situation. These vapors can be drawn into the engine through the air intake, and cause engine overspeed. Be especially cautious of low-lying or closed-in areas, and always check for signs posted where flammable vapors may be present.

All diesel engines for these vehicles have been built to comply with the requirements of the Federal (U.S.) Clean Air Act. Once an engine is placed in service, the responsibility for meeting both state and local regulations is with the owner/operator.

It is extremely important to use the correct fuel for EPA07-compliant engines. The following requirements must be met, otherwise damage can occur to the aftertreatment device, and the warranty may be compromised.

- Use ultralow-sulfur diesel (ULSD) with 15 ppm sulfur content or less, based on ASTM D2622 test procedure.
- Do not use fuel blended with used engine lube oil.
- Engine lube oil must have a sulfated ash level less than 1.0 wt %, meeting the API CJ-4 index specifications.

Adequate maintenance of the engine and the diesel particulate filter 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 to stay within the regulations.

General Information

See the manufacturer's **engine operation manual** for specific reccomendations for your engine.

1. Operate the engine at low load when the engine is first started. After normal oil pressure is reached and the temperature gauge needle begins to move, the engine may be operated at full load.

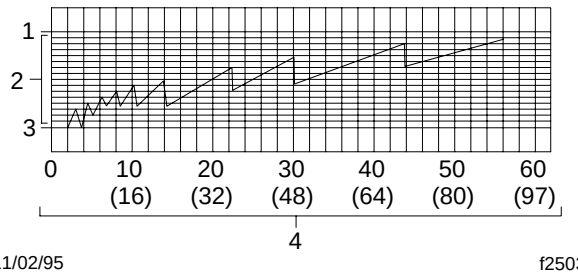
   Electronic engines automatically idle at a slightly higher speed for the correct warm up time after a cold engine start. These electronic engine systems will reduce the idle speed to normal rpm when the engine has warmed sufficiently to operate the vehicle.

2. Select a gear that allows a smooth, easy start without increasing engine speed above low idle or slipping the clutch. Engage the clutch smoothly. Jerky starts waste fuel and put stress on the drivetrain.

3. It is seldom necessary to accelerate the engine to governed speed in the lower gears to get the vehicle moving, except in a high-power-demand situation such as starting on a grade. To conserve fuel, start off in low gear, and develop only the engine speed needed to get rolling. Then, increase engine speed gradually as upward gear shifting progresses. This technique will get the

vehicle up to the desired cruising speed while minimizing noise emission and maximizing fuel economy. A progressive shift pattern is illustrated in **Fig. 7.7**.

Electronic engines can be programmed to limit engine rpm while the vehicle is operated in the lower and higher gears. This feature assists the driver in following "progressive shifting" techniques.



1. Governed RPM
2. Engine RPM
3. Idle RPM
4. Miles (kilometers) per Hour

Fig. 7.7, Progressive Shift Pattern

4. For highway cruising, and for best fuel economy, run the engine at 80 to 90 percent of rated rpm to maintain highway speed. Proper gear selection should permit cruising in the economy range with no appreciable sacrifice in desired highway speed.

   It is okay to operate below rated rpm at full throttle if you are satisfied with the way the vehicle performs. However, there are times when hilly terrain, high winds, or other conditions make it impractical to operate without reserve power. Such conditions are better met if the vehicle is operated in a lower gear with reserve power available for changes in terrain, wind, etc.

Driving on Hills

1. When approaching a hill, open the throttle smoothly to start the upgrade at full power, then shift down as desired, to maintain the optimum vehicle speed.

   NOTE: A momentary hesitation in throttle response will occur when a vehicle with a turbocharged engine is started on a grade. *Do not* disengage the clutch. The rpm will recover, and the vehicle will accelerate up the grade.

2. On uphill grades, begin downshifting when the engine rpm falls to 1200 rpm. Fuel economy will be best if you let the engine lug back to around this speed before you downshift. Downshift until a gear is reached in which the engine will pull the load. Let the engine lug down if you can make it to the top of a hill without downshifting.

3. If going up a hill causes a steady decline in engine rpm, downshift as required until the engine can maintain a stable uphill speed. Make full use of each gear before going to a lower gear. By remaining in a gear until arriving at the speed of the next lower gear, the vehicle will top the grade in the best possible time on less fuel and fewer shifts.

4. The driver can greatly improve driving skill by learning the vehicle's shift points for all gears. By knowing rather than guessing where the shift points are, it is possible to avoid overspeeding the engine when downshifting too soon or missing the full use of a gear by downshifting too late. The shift points of any vehicle can be determined by a simple road-test method. Run the vehicle, and determine the maximum road speed possible in every gear at the engine governed full-load speed setting.

   The top road speed possible in a gear would be the shift point for that gear. The results should be recorded in the proper order of shifting and displayed inside the cab.

5. For improved operating efficiency (fuel economy and engine life), operate in the higher gear at reduced rpm, rather than in the next lower gear at the maximum rpm.

6. Cruise at partial throttle whenever road conditions and speed requirements permit. This driving technique permits operating within the most economical power range of the engine.

7. The diesel engine is effective as a brake on downhill grades, but care must be used not to overspeed the engine going downhill. The governor has no control over engine speed when the engine is being turned by the loaded vehicle. A simple rule to follow for engine braking is to select the same gear (or one gear lower) that would be needed to go up the grade.

Never turn off the ignition switch while going downhill.

IMPORTANT: Do not let Caterpillar C–10, C–12, C–15, C–16, and 3406E electronic engines exceed 2300 rpm (2100 rpm if equipped with an exhaust brake).

⚠ CAUTION

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

8. To slow the vehicle on downgrades and curves (using the engine), shift to a lower gear, and allow the vehicle to decelerate in that gear. The engine provides maximum braking effect when running at the top end of the operating range, but it must not be allowed to exceed its full-load rated rpm.

IMPORTANT: For Mercedes-Benz engines, the maximum speed in regular operation is 2000 rpm. However, during engine braking only, a higher rpm can be used to increase retarding power, if necessary. When using the engine brake it is recommended to use engine speeds up to 2300 rpm. The engine provides maximum braking effect when running at 2500 rpm, but it must not be allowed to exceed this speed.

9. Continue to downshift as further reduction in vehicle speed is required. If the vehicle is above the allowable maximum speed of a lower gear, use the service brakes to slow the vehicle to an acceptable speed where the transmission may be downshifted safely. Again, the importance of knowing the shift points is demonstrated.

Idling

⚠ CAUTION

Do not idle the engine for excessively long periods. Long periods of idling are not good for an engine because the combustion chamber temperatures drop so low the fuel may not burn completely. This will cause carbon to clog the injector spray holes and piston rings, and may result in stuck valves.

The common belief that idling a diesel engine causes no engine damage is wrong. Idling produces sulfuric acid, which breaks down the oil and eats into bearings, rings, valve stems, and engine surfaces. If you must idle the engine for cab heat or cooling, the high idle function of the cruise control switches should be used. An idle speed of 900 rpm should be enough to provide cab heat in above 32°F (0°C) ambients.

⚠ 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.

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 (CHECK ENGINE lamp flashing) the idle shutdown timer will be disabled until it is reset.

Cold-Weather Operation—CAT, Cummins, DDE S60, M-B

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 temperatures, the greater the amount of modification required; and yet with the modifications applied, the engines must still be capable of operation in warmer climates without extensive changes.

The following information is provided to engine owners, operators, and maintenance personnel on how the modifications can be applied to get satisfactory performance from their diesel engines.

There are three basic objectives:

- Reasonable starting characteristics followed by practical and dependable warm-up of the engine and equipment.
- A unit or installation that is as independent as possible from external influences.
- Modifications that maintain satisfactory operating temperatures with a minimum increase in maintenance of the equipment and accessories.

If satisfactory engine temperature is not maintained, higher maintenance cost will result due to increased engine wear. Special provisions to overcome low temperatures are definitely necessary, whereas a change to a warmer climate normally requires only a minimum of revision. Most of the accessories should be designed in such a way that they can be disconnected so there is little effect on the engine when they are not in use.

IMPORTANT: If a winterfront is used on a vehicle with an electronic engine equipped with a charge air cooler, make sure that there are slit openings distributed across the face of the winterfront to allow airflow through the entire charge-air-cooler core. Do not use a winterfront with closed areas that block uniform air flow across any sections of the charge-air-cooler crossflow tubes. This will adversely affect the operation and durability of the charge air cooler.

On all engines, the following steps are necessary when operating in cold weather:

1. Check for cracks in the battery cases, for corrosion of the terminals, and for tightness of the cable clamps at the terminals.
2. Charge the batteries to full capacity. Replace any battery that is unable to hold full charge or is physically damaged.
3. Check the alternator output.
4. Check the condition and tension of the drive belts.

Caterpillar

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.

If the engine does not start, prime the fuel system.

When the use of unblended No. 2 diesel fuel in winter cannot be avoided, install a thermostatically controlled fuel heater. Fuel heaters can prevent wax from clogging the fuel filters and formation of ice crystals from water in the fuel.

IMPORTANT: If a fuel heater is used, make sure it has thermostatic controls to prevent excessive heating of the fuel in warm weather. Excessive heating of fuel can cause a loss of engine power.

For cold weather operation, use the following guidelines:

1. When starting the engine in temperatures below 32°F (0°C), use engine lubricants of lower viscosity. Refer to the Caterpillar *Operation and Maintenance Manual* for specifications.
2. When the temperature is below freezing, use sufficient antifreeze solution in the cooling system to prevent freezing.
3. During cold weather, give more attention to the condition of the batteries. Test them frequently to ensure sufficient power for starting. See **Group 15** of the *Century Class Trucks Workshop Manual* for detailed information.
4. If so equipped, turn off the battery disconnect switch after the engine is shut down, to prevent battery discharge.

   For starting below 0°F (–18°C), an optional cold-weather starting assist is recommended. For temperatures below –10°F (–23°C), consult your Caterpillar dealer for recommendations.
5. When customer parameters include cold-mode operation and the coolant temperature is below 82°F (28°C), the system puts the engine into cold mode. It adjusts the low idle to 600 rpm for the 3406E, C–15, and C–16 engines, and 800 rpm for the C–10 and C–12 engines. It also advances the timing, to reduce white smoke emissions and improve warm-up time. The system will keep the engine in cold mode until the coolant temperature rises above 82°F (28°C). After cold mode has been completed, operate the vehicle at low load and low rpm until the engine coolant reaches normal operating temperature of 189°F (87°C).
6. Fuel cloud point is the temperature at which wax crystals become visible, which is generally above the pour point of the fuel. To keep the fuel filter elements from plugging with wax crystals, the cloud point should be no higher than the lowest ambient temperature at which the engine must start.

Cummins

The two most commonly used terms associated with preparation of equipment for low-temperature operation are "winterization" and "arctic specifications."

Winterization of the engine and/or components, so that starting and operating are possible in the lowest temperature to be encountered, requires:

- Proper lubrication with low-temperature lubricating oils.
- Protection from the low-temperature air. The metal temperature does not change, but the rate of heat dissipation is affected.
- Fuel of the proper grade for the lowest temperature.
- Heat to raise the engine block and component temperatures to at least –25°F (–32°C) for starting in lower temperatures.
- Electrical equipment capable of operating in the lowest expected temperature. All switches, connections, and batteries in the electrical system should be inspected and kept in good condition to prevent losses through poor contacts.

Arctic specifications refer to the design of material and specifications of components necessary for satisfactory engine operation in extremely low temperatures to –65°F (–54°C). Contact the nearest Freightliner dealer or Cummins engine dealer, to obtain the special items required.

⚠ CAUTION

"Antileak" antifreezes are not recommended for use in Cummins engines. Although these antifreezes are chemically compatible with DCA water treatment, the "antileak" agents may clog the coolant filters.

IMPORTANT: Fuel heaters used on vehicles with Cummins CELECT Plus engine systems could cause high fuel temperatures that affect engine performance and operation of the electronic engine controls. If a fuel heater is used, make sure it has thermostatic controls. If the fuel heater has a timer, set the timer to activate only for a limited period of time before the engine starts. Make sure the fuel heater is used only for starting the engine.

For more information, see the Cummins *Operation and Maintenance Manual*.

DDE S60

Preparations made in advance of winter and maintenance performed during the cold months will help to ensure efficient engine starting and operation.

- Engine oil thickens as it gets colder, slowing cranking speed. When cold, multi-grade oil offers less resistance to the cranking effort of the engine and permits sufficient rpm to be developed to start the engine. See "How to Select Lubricating Oil" in the Detroit Diesel *Engine Operator's Guide* for specific recommendations.
- When an engine equipped with a DDEC system is started at temperatures below 25°F (–4°C), the idle speed automatically increases to 900 rpm. The injection timing is also advanced to decrease white smoke. As the engine oil warms up, the idle speed gradually decreases. When the oil temperature reaches 122°F (50°C), both the idle speed and the injection timing return to normal.
- A winterfront may be used to improve cab heating while idling. At least 25% of the grille opening should remain open in sectioned stripes that run perpendicular to the charge air cooler tube flow direction. 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).
- During cold weather, the batteries should be tested more frequently to ensure ample power for starting. All electrical connections should be tight and in good condition to prevent losses through loose or corroded connections.
- Ethylene-glycol-base antifreeze is recommended. An inhibitor system is included in this type of antifreeze, and the corrosion protection is sufficient as long as the recommended concentration range of 30 to 67 percent (antifreeze to water by volume) is employed.
- If the engine is to be operated in arctic temperatures, consult the nearest Freightliner dealer or an authorized Detroit Diesel engine

dealer for information regarding availability of special cold-weather equipment.

Mercedes-Benz

Special precautions must be taken during cold weather. For service products to use in cold weather, see **Chapter 5** of the *MBE4000 Engine Operator's Manual*.

IMPORTANT: At outside temperatures below –4°F (–20°C), a coolant preheater is recommended.

1. Periodically check the coolant mixing ratio (concentration of antifreeze in the coolant). Add more if necessary. The coolant mixing ratio should never rise above 60 percent antifreeze.
2. Use low-viscosity lubricating oils for adequate lubrication.
3. At temperatures below 32°F (0°C), do not use summer-grade (2-D) diesel fuel. To avoid fuel problems due to paraffin separation, use winter-grade (1-D or winterized 2-D) diesel fuel only.

⚠ WARNING

The addition of kerosene lowers the flash point of diesel fuel. To prevent fire and risk of injuries due to burning, do not smoke or use open flames around fuel mixed with kerosene. Comply with all appropriate safety regulations.

4. When winter-grade diesel fuel is not adequate, it is possible to mix kerosene with the diesel fuel. If it is an EPA07 engine, ultralow-sulphur kerosene must be used. Add the kerosene only when refilling the tank, and before adding the diesel fuel.

NOTE: Engine power may drop according to the proportion of kerosene. For this reason, never add more than 50 percent kerosene to the fuel.

High-Altitude Operation—CAT, Cummins, DDE S60, M-B

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. Most turbocharged engines are rated for higher altitudes than naturally aspirated engines.

An engine will have smoky exhaust at high altitudes unless a lower gear is used. The engine will not demand full fuel from the fuel system unless the engine is altitude-compensated by the use of a turbocharger. Shift gears as needed to avoid excessive exhaust smoke.

There is no restriction with respect to altitude operation for Mercedes-Benz MBE4000 engines. These engines will perform properly between sea level and 13,000 ft (4000 m) above sea level.

Engine Shutdown—CAT, Cummins, DDE S60, M-B

Caterpillar

⚠ CAUTION

Stopping the engine immediately after it has been working under load can result in overheating and accelerated wear of the engine components. Excessive temperatures in the turbocharger center-housing will cause oil coking problems. Follow the procedure, outlined below, to allow the engine to cool.

1. With the vehicle stopped, apply the parking brakes. Reduce the engine speed to low idle.
2. Place the transmission shift lever in neutral.

NOTE: If the engine has been operating at low loads, run it at low idle for 30 seconds before stopping. If the engine has been operating at highway speed or at high loads, run it at low idle for three minutes to reduce and stabilize internal engine temperatures before stopping.

3. Turn off the ignition switch and shut down the engine.
4. After engine shutdown, fill the fuel tank.
5. Check the crankcase oil level. Maintain the oil level between the add and full marks on the dipstick.
6. If equipped with an idle shutdown timer, it can be set to shut the engine down after a preset amount of time. Ninety seconds before the preset shutdown time, the CHECK ENGINE light will

begin to flash at a rapid rate. If the clutch pedal or service brake indicate a position change during this final ninety seconds (diagnostic lamp flashing), the idle shutdown timer will be disabled until reset.

7. If freezing temperatures are expected, allow the engine jacket water expansion tank to cool, then check the coolant for proper antifreeze protection. The cooling system must be protected against freezing to the lowest expected outside temperature. Add permanent-type antifreeze, if required.
8. Repair any leaks, perform minor adjustments, tighten loose bolts, etc. Observe the vehicle mileage or the service meter reading, if so equipped. Perform periodic maintenance as instructed in the Maintenance Interval Schedule in the Caterpillar *Operation and Maintenance Manual*.

Detroit Diesel S60

1. With the vehicle stopped, apply the parking brakes, and place the transmission in neutral.
2. Allow the engine to run at idle for four to five minutes. This allows the engine to cool and the turbocharger to slow down.

⚠ CAUTION

After high-speed operation, shutting down the engine without idling may cause damage to the turbocharger, as it will continue to turn without an oil supply to the bearings.

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

Mercedes-Benz

1. With the vehicle stopped, apply the parking brakes and put the transmission in neutral.
2. Allow the engine to idle for one to 2 minutes before shutting it down.
3. Shut down the engine by turning off the ignition.

Engine Braking Systems—CAT, Cummins, DDE S60, M-B

Several types of engine braking systems are optionally available. Each of these systems uses the engine to retard the vehicle on downgrades and reduces the heat load on the service brakes. The engine brakes are meant to be auxiliary vehicle braking systems in addition to the regular service brakes.

Jacobs® Engine Brake

A Jacobs engine brake is a hydraulic-electric engine attachment that converts a diesel engine into an air compressor. This is done by changing engine exhaust valve operation. An engine brake is not a substitute for a service braking system, except in emergencies, because it does not provide the precise control available from the service brakes.

The Jake® Brake is controlled by a single, dash-mounted paddle switch with three positions: OFF, LO, and HI.

Jacobs Engine Brake Operation

⚠ WARNING

Do not use the engine brake if road surfaces are slippery. Using the engine brake on wet, icy, or snow-covered roads could result in loss of vehicle control, possibly causing personal injury and property damage.

If the engine brake is engaged when the transmission is in neutral, the braking power of the engine brake can stall the engine and result in loss of vehicle control, possibly causing personal injury and property damage.

To engage the engine brake, the dash switch must be in the LO or HI position and both the clutch and throttle pedals must be fully released. To disengage the engine brake, depress the throttle or clutch pedal, or move the dash switch to OFF. Use the LO position when driving on flat, open stretches of road. If you need to use the service brakes to slow down, switch to a higher position until there is no need for the service brakes.

⚠ WARNING

The engine brake must be disengaged when shifting gears. The clutch must be used if the dash switch is in the LO or HI position. 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.

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.

IMPORTANT: Maximum retarder performance is obtained when you use the lowest possible gear without exceeding the recommended engine braking speed.

"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.

Below a set engine speed (set at the factory to 700 rpm), the engine control unit (ECU) will not engage the engine brake. The engine brake will not work below the set engine speed.

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.

IMPORTANT: When descending a grade, remember that frequent use of service brakes causes them to become hot, which results in a reduction of their stopping ability. Grade descent speed should be such that the service brakes are used infrequently and that they remain cool, thus retaining their effectiveness.

A driver may descend slower than control speed by selecting a lower gear, one that will not overspeed the engine. The engine brake retarding force will then be sufficient to cause vehicle deceleration. Occasional deactivation of the engine brake may be necessary to maintain the designated road speed under these conditions.

⚠ WARNING

Using the engine brake as a primary braking system when the service brakes are operable is dangerous. This can cause long, unpredictable stopping distances, possibly resulting in personal injury or property damage.

Whenever vehicle braking is required, the engine brake may be used with the service brakes. There is no time limit for operation of the engine brake.

1. After the engine is warmed up and the vehicle is in motion, move the paddle switch to the desired position, LO or HI. Depending on the engine model, LO will provide 1/3 or 1/2 of the full braking capacity of the engine. HI will provide maximum engine braking.
2. The engine brake activates when the dash switch is in LO or HI position and the driver's feet are removed from both the clutch and throttle pedals. If it fails to activate, take the vehicle to an authorized Freightliner dealer for service.
3. To obtain maximum retarding, maintain the top governed speed of the engine through appropriate selection of gears when the engine brake is in use.

⚠ CAUTION

If the engine brake fails to shut off when either the throttle or clutch pedal is depressed, place the dash switch in the OFF position and do not use the engine brake until the throttle or clutch switch system is repaired. If the engine brake fails to shut off when the dash switch is turned off, the engine should be shut down and the engine brake repaired before continuing operation. Failure to do so could result in damage to the engine.

4. When either the clutch or throttle pedal is depressed, the engine brake is deactivated.

BrakeSaver

The BrakeSaver (optional on 3406E engines) permits the operator to control the speed reduction of the vehicle on grades, curves, or anytime speed reduction is necessary but long applications of the service brakes are not desired.

During downhill operation, the crankshaft is turned by the rear wheels (through the drivetrain). To reduce the speed of the vehicle, an application of braking force can be made to the crankshaft. The BrakeSaver does this by converting rotation energy into heat, which is removed by the engine cooling system. The BrakeSaver is controlled by the driver, as necessary, by operating a lever on the instrument

panel. Braking force increases as the lever is moved toward the ON position. An air pressure gauge provides a relative indication of the braking force. An oil temperature gauge indicates the heat in the BrakeSaver during its operation. If the temperature gauge indicates HOT, the BrakeSaver control lever must be moved to the OFF position. The oil temperature will decrease rapidly with the BrakeSaver off. When the temperature reaches normal, the BrakeSaver can be used.

⚠ CAUTION

Do not engage the BrakeSaver and control the wheel speed with the accelerator. The design of the cooling system is for the control of the temperature of the oil at full engine power or full BrakeSaver capacity, but not both at the same time.

Turbo Brake (MBE4000 only)

For high braking output, the Mercedes-Benz MBE4000 engine can be equipped with an optional turbo brake.

The turbo brake can be operated either manually or automatically, through the cruise control function. If the turbo brake is operated manually, there is a four-position switch on the dashboard: *OFF/ LOW/ MED/ HIGH.*

The turbo brake provides 600 brake horsepower at 2500 engine rpm. In the braking condition, the MBE4000 turbo brake engine operates as a turbocharged compressor, resulting in high braking output. It is recommended to operate the turbo brake up to the 2300 rpm level. This provides approximately 550 brake horsepower which should cover most situations. If additional braking power is required, engine speed can be increased to 2500 rpm maximum, resulting in 600 brake horsepower.

⚠ CAUTION

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

Because the charge air pressure is maintained at a high level during braking, full throttle response is available immediately, if the operator desires it, without any turbo lag.

⚠ CAUTION

The turbo brake should only be operated when the engine coolant temperature exceeds 140°F (60°C). It cannot be engaged below this level. Be aware that no engine retarding system is available during engine warm-up.

The MBE4000 turbo brake is combined with Mercedes-Benz constant throttle technology, but an exhaust flap is not used. The turbo brake emits very low levels of noise, making it an environmentally friendly system. It is maintenance-free, highly reliable, and adds virtually no weight to the engine.

Constant-Throttle Engine Brake (MBE4000 only)

The standard engine braking system is the constant-throttle system combined with an exhaust flap. To increase braking performance, each cylinder is equipped with a small valve built into the cylinder head. This valve is always open during engine brake activation, and it allows compressed air to exhaust when the piston is at top dead center. This removes pressure from the piston as it moves to the bottom dead center position.

The standard constant-throttle engine brake is equipped with an exhaust flap. During engine brake operation, the six constant throttle valves are open in parallel and the exhaust flap is closed. For normal engine brake use, operate the engine up to 2300 rpm. If increased retarding power is required, the maximum 2500 engine rpm can be used.

⚠ CAUTION

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

A two-position switch on the dash controls the engine braking system. Like the exhaust flap, the constant throttles are deactivated when the accelerator or clutch pedal is depressed. The ABS system, when active, also deactivates constant-throttle braking.

Exhaust Brake System—CAT, Cummins, DDE S60, M-B

General Information

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. It cannot be used at the same time as a Jake® brake.

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 900 and 2500 rpm. Depressing the accelerator or clutch pedal deactivates the exhaust brake. The ABS system, when active, also deactivates the exhaust brake.

The exhaust brake switch located on the control panel, in combination with the accelerator and clutch pedals, allows the driver to make maximum use of the exhaust brake in off-highway and mountain driving as well as in traffic or high-speed highway driving.

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 exhaust brake switch is in the on position, 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.

Starting the Engine

Before starting the engine, make sure that the exhaust brake switch is in the off position. Do not turn the exhaust brake on until the engine has reached normal operating temperatures.

Driving Downhill

While approaching a steep grade, make sure that the exhaust brake switch is in the on position. 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.

⚠ CAUTION

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.

⚠ WARNING

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.

Exhaust Brake Operating Characteristics

When you remove your feet from both the accelerator and clutch pedals and the exhaust brake switch is in the on position, 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 off the engine.

Clutches

General Information

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 asked 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.

Heat and wear 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 improperly adjusted or slipping clutch will rapidly generate sufficient heat to destroy itself.

To ensure long service life of the clutch; start in the right gear, be alert to clutch malfunctions, and know when to adjust the clutch.

Clutch Operation

Clutch Break-In

With a new or newly installed clutch, the clutch may slip for a short time while the friction surfaces break-in. However, allowing the clutch to slip for more than two seconds can severely damage the clutch disc, pressure plate, and the flywheel.

During initial operation of a new vehicle or a vehicle with a new clutch, check for clutch slippage during acceleration. If the clutch slips, decelerate until the clutch does not slip. Allow the clutch to cool 15 to 30 seconds, and then gradually accelerate again. If the clutch continues to slip, repeat the procedure. If necessary, repeat the procedure up to five times. If the clutch slips after five attempts, stop the vehicle. Allow the clutch to cool for at least one hour. Notify your Freightliner dealer of the problem.

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.

Moving the Vehicle in the Proper Gear

An empty truck can be started in a higher transmission gear than can a partially or fully loaded truck. A good rule of thumb for the driver to follow is to select the gear combination that allows the vehicle to start moving with an idling engine, or, if necessary, just enough throttle to prevent stalling the engine. After the clutch is fully engaged, the engine can be accelerated to the correct rpm for the upshift into the next higher gear.

Gear Shifting Techniques

Shift into the next higher gear when the vehicle speed allows the transmission input shaft speed to match the flywheel speed when engaging the clutch. This technique results in the smallest speed difference between the clutch disc and the flywheel and causes the least heat and wear on the clutch assembly. When downshifting, the input shaft speed must be increased by slightly revving the engine to match the flywheel speed for smooth clutch engagement. For transmission operating instructions, refer to **Chapter 8** in this manual.

Vehicle Loading

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

CAUTION

Exceeding vehicle load limits can not only result in damage to the clutch, but can also damage the entire powertrain.

Using the Clutch

The clutch pedal must be used only to start the vehicle moving or while shifting. To start the vehicle moving, depress the clutch pedal all the way to the floor plate (see "Using the Clutch Brake") and shift from neutral to a low gear. Slowly raise your foot until the clutch starts to engage. In this position the clutch is starting to connect the transmission input shaft to the flywheel and is causing the most heat and wear. Slightly increase the engine speed and smoothly allow the clutch pedal to return to its at-rest position.

Do not allow the clutch to remain in the partially engaged position any longer than necessary to obtain a smooth start.

To shift gears while the vehicle is moving, push the clutch pedal most of the way (but not all of the way) to the floor plate. Shift the transmission into neutral and fully release the clutch pedal. If upshifting, wait long enough for the engine speed to decrease to the road speed. If downshifting, increase the engine speed to match the road speed. Again, push down the clutch pedal part way and then move the shift lever to the next gear position. Fully release the clutch pedal after completing the shift.

Slightly depressing the clutch pedal while driving is damaging to the clutch, because partial clutch engagement causes slippage and heat. Resting your foot on the clutch pedal will also put a constant thrust load on the release bearing, thinning the bearing lubricant and increasing the wear on the bearing.

Using the Clutch Brake

The clutch brake is applied by depressing the clutch pedal past the fully released clutch position, almost to the floor plate. The last part of the clutch pedal travel will compress the clutch brake plates together, stopping the transmission input shaft. The purpose of the clutch brake is to stop the transmission gears from rotating in order to quickly engage a transmission gear after idling in neutral.

⚠ CAUTION

Never apply the clutch brake when the vehicle is moving. If the clutch brake is applied when the vehicle is moving, the clutch brake will try to stop or decelerate the vehicle, causing rapid wear of the clutch brake friction discs. Considerable heat will be generated, causing damage to the release bearings and the transmission front bearings.

Holding the Vehicle on an Incline

Always use the vehicle service brakes to prevent the vehicle from rolling backwards while stopped on a hill. Slipping the clutch on a hill to maintain the vehicle position will quickly damage the clutch assembly.

Coasting

Coasting with the clutch pedal depressed and the transmission in a low gear can cause high driven disc speed. The clutch speed can be much higher under these conditions than when the engine is driving the clutch. This condition creates a hazardous situation due to the lack of vehicle control and due to the high clutch disc speed. Engaging the clutch under these conditions can cause component damage because of the shock loads to the clutch and drivetrain.

⚠ WARNING

Always shift into the gear that is correct for the traveling speed of the vehicle and engage the clutch. Coasting with the clutch disengaged can prevent engagement of the correct transmission gear which can cause loss of vehicle control, possibly resulting in personal injury or property damage.

High clutch disc speeds while coasting can also cause the clutch facing to be thrown off the disc. Flying debris from the clutch can cause injury to persons in the cab.

Clutch Maintenance

Checking the Clutch Adjustment

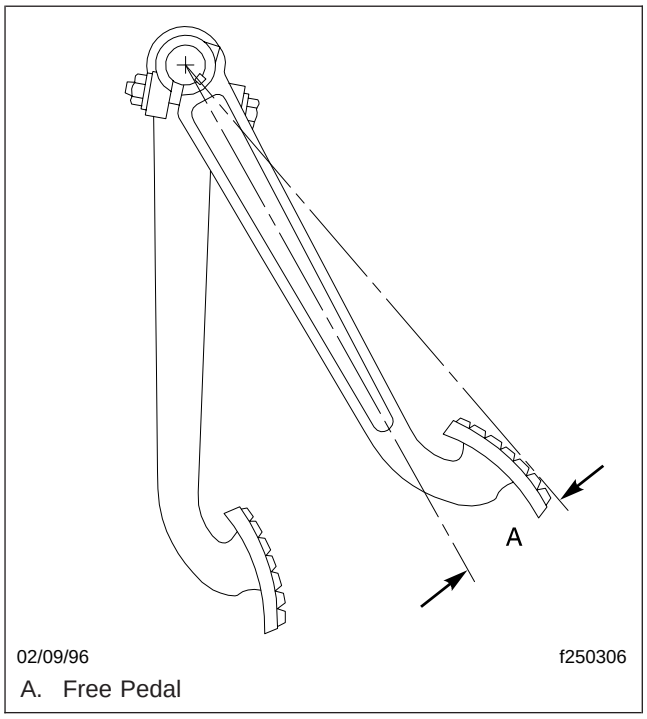
Reporting erratic clutch operation as soon as possible gives maintenance personnel a chance to inspect, lubricate, and adjust the clutch components. The driver can be aware of clutch wear by noticing the gradual decrease in the distance the clutch pedal moves before resistance is felt. A correctly adjusted clutch must have about 3/4 inch (19 mm) of travel at the top of its stroke before a stronger resistance can be felt. See **Fig. 7.8**. If the free pedal travel is less than this distance, have the clutch adjusted.

The clutch pedal free travel should be checked and commented on daily in the driver's report.

See **Group 25** of the *Columbia® Workshop Manual* for clutch adjustment procedures and specifications.

⚠ CAUTION

Operating the vehicle with incorrect free pedal could result in clutch damage.



A. Free Pedal

Fig. 7.8, Clutch Free Pedal Travel

Checking the Clutch Brake Operation

Clutch brake operation can be felt as an increased resistance as the clutch pedal approaches the bottom of its stroke. If the gears grind when shifting into first or reverse gear from neutral with the clutch pedal fully depressed, the clutch pedal is out of adjustment or the clutch brake is worn and needs to be replaced.

Adjusting the Clutch

Clutches have an internal adjustment and external linkage adjustment. See **Group 25** of the *Columbia® 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.

Lubricating the Clutch Linkage and Bearing

On vehicles equipped with a greaseable release bearing, the release bearing and linkage should be lubricated at frequent intervals. See **Group 25** of the *Columbia® Maintenance Manual* for intervals and procedures.

⚠ CAUTION

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

8

Transmissions

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® AutoShift™
- Eaton Fuller UltraShift™ DM
- ZF-FreedomLine

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. Access to the sleeper is improved by removing the shift lever from the floor.

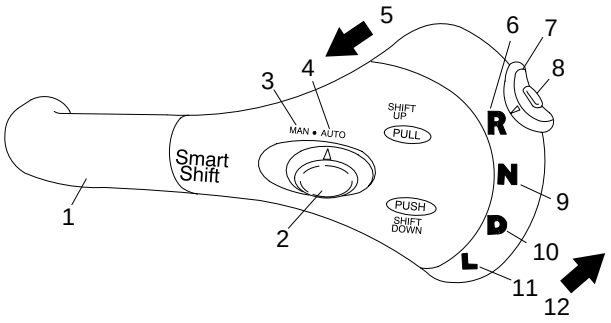
The SmartShift control mounts to the right-hand side of the steering column and is operated by the fingers of the driver's right hand, allowing both hands to remain on the steering wheel.

A two-position slide switch 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) mode or manual (MAN) mode.

In AUTO mode, gears shift automatically, without driver interaction. Manual gear shifts 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 the Eaton Fuller automated transmissions, a four-position (R, N, D, L) selector switch (**Fig. 8.1**) is located at the end of the lever. For the FreedomLine transmission, a three-position (R, N, D) selector switch (**Fig. 8.2**) 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.



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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 Position (of slide switch)
4. AUTO Position (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. 8.1, Four-Position SmartShift Control (with Eaton Fuller transmissions)

Eaton Fuller AutoShift Automated Transmissions

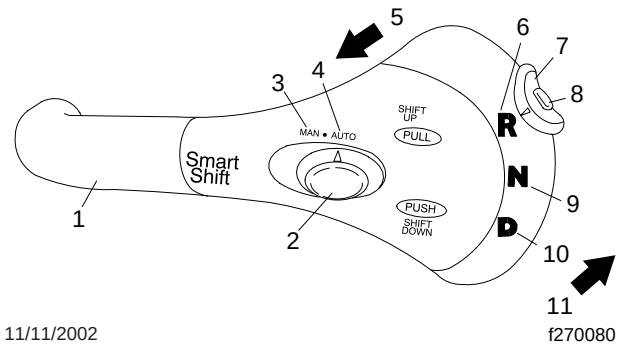
Refer to the Eaton website for additional information, www.roadranger.com.

General Information, AutoShift

10-Speed RT/RTO Models

Eaton Fuller 10-speed AutoShift transmissions have 10 forward speeds and two reverse speeds. The transmission consists of a 5-speed front section and a 2-speed rear section. The driver must use the clutch to start and stop the vehicle.

The driver does not need to break torque or increase or decrease engine speed to synchronize the shift. The transmission signals the engine controller when



To upshift manually, pull the lever up (towards you). To downshift manually, push the lever down (away from you).

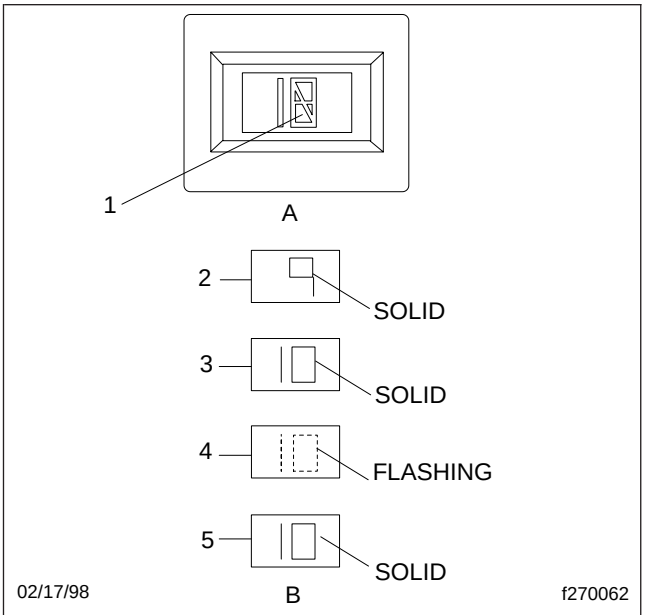
1. SmartShift Control Lever
2. Slide Switch
3. MAN Position (of slide switch)
4. AUTO Position (of slide switch)
5. Upshift Direction
6. Reverse Position (of selector switch)
7. Selector Switch
8. Neutral Lock Button
9. Neutral Position (of selector switch)
10. Drive Position (of selector switch)
11. Downshift Direction

Fig. 8.2, Three-Position SmartShift Control (with FreedomLine transmission)

to break torque and the engine controller automatically increases or decreases engine speed. When engine speed is correct, the transmission engages the next gear and signals the engine controller to resume operation.

The AutoShift system consists of the following components:

- The SmartShift control paddle on the steering column. See **Fig. 8.1**.
- The gear display module (**Fig. 8.3**) mounted on the dashboard indicates the current gear position or transmission status. The display also flashes the next gear to be engaged while the transmission is in neutral during a gear change.
- The shifter mechanism performs shifts at the front portion of the transmission. It preselects the shift to neutral and completes the gear change after driver input.
- The Electronic Control Unit (ECU) includes two controllers: a transmission ECU and a system ECU. The transmission ECU controls all transmission shift functions and the system ECU manages all vehicle interfaces for transmission shift functions.
- An electronic range valve, controlled by the transmission ECU, is used to perform range shifts.



A. Gear Display Module B. Module Detail

1. Current Gear
2. 9th Gear Engaged
3. In 9th Gear, Preselected Toward 10th
4. Out Of Gear, Waiting For Engine/Transmission RPM To Synchronize
5. 10th Gear Engaged

Fig. 8.3, Gear Display Module

Operation, AutoShift with SmartShift

Automatic and Manual Modes

A two-position slide switch (forward driving mode switch) is located near the end of the control (**Fig. 8.1**). The switch positions are labelled MAN (manual shift mode) and AUTO (automatic drive mode).

NOTE: In automatic drive mode, upshifts and downshifts require no driver interaction. Move the selector switch to the drive (D) position, disengage the clutch to engage the gear selected, engage the clutch and drive the vehicle. In

manual shift mode, upshifts and downshifts require either a pull upward or push downward on the control.

Driver Message Center

Gear information is presented to the driver via a LCD display on the dash. In automatic drive mode, the number of the forward gear currently engaged appears continually on the message display screen when in drive (D). In manual shift mode, the current gear is displayed until a new gear is requested. When neutral (N) is engaged, "N" will appear on the message display screen. When reverse (R) is engaged, either "RL" or "RH" will appear on the message display screen.

IMPORTANT: The information shown on the message display screen indicates the state of the transmission only, not the state of the SmartShift control.

Neutral Position

Select neutral by sliding the selector switch to the "N" position.

NOTE: Neutral is always available during operation. When in neutral, upshift and downshift requests are ignored. If the mode selector switch is moved from neutral (N) to drive (D) while the vehicle is moving, the transmission will shift into a gear causing the engine to go to a high torque level, under the engine's rated torque.

Selecting a Starting Gear

1. In automatic mode, select drive (D) by sliding the selector switch downward to the next position below the neutral position.
2. Disengage the clutch to engage the gear selected. Engage the clutch and drive the vehicle.

Changing the Default Starting Gear

To select a starting gear other than the default starting gear, follow the instructions below.

1. Make sure the vehicle is stopped and in drive.
2. In either automatic or manual mode, pull upward on the control (to increase), or push downward (to decrease). Each pull upward on the control increases the starting gear by one gear, but no higher than fourth gear.
3. The number of the gear selected will flash on the message display screen until the driver engages the clutch. This gear will be stored in memory as the default starting gear until either a different starting gear is selected by the driver or the engine is shut down.

NOTE: The transmission may also be programmed so that it is not possible to select a starting gear other than the preprogrammed default starting gear.

Upshifting

NOTE: With the transmission in drive (D) in the automatic mode, upshifts require no driver interaction.

1. With the transmission in drive in the manual mode, request an upshift by pulling upward on the control. If the requested gear is available, the transmission will upshift.

NOTE: A single, momentary pull upward on the control selects the next higher gear when it is available. Two consecutive, momentary upward pulls will cause a skip shift when the next two higher gears are available and conditions are right.

2. To skip shift, move the control two times in less than 1/2 second. The number of the gear engaged will appear on the message display screen.

NOTE: The Eaton Fuller AutoShift 18-speed transmission is able to perform triple upshifts when the next three higher gears are available and conditions are right. To triple-shift this transmission, move the control three times in less than 1/2 second.

If a requested gear is not available, an audible warning will sound and the gear display module will indicate that the gear is not available. An unavailable requested upshift is not stored in memory. The upshift must be requested again.

Downshifting

NOTE: With the transmission in drive (D) in the automatic mode, downshifts require no driver interaction.

1. With the transmission in drive in the manual mode, request a downshift by pushing downward on the control. If the requested gear is available, the transmission will downshift.

NOTE: A single, momentary push downward on the control selects the next lower gear when it is available. Two consecutive, momentary downward pushes will cause a skip shift, when the next two lower gears are available and conditions are right.

2. To skip shift, move the control two times in less than 1/2 second. The number of the gear engaged will appear on the message display screen.

NOTE: The Eaton Fuller AutoShift 18-speed transmission is able to perform triple downshifts when the next three lower gears are available and conditions are right. To triple shift this transmission, move the control three times in less than 1/2 second.

If a requested gear is not available, an audible warning will sound and the gear display module will indicate that the requested gear is not available. Unlike upshifting, an unavailable requested downshift is stored in memory and the shift will be made when the gear is available. The time limit for this memory is a programmable parameter.

Start-Up

1. With the parking brake applied, press the clutch all the way down to the floor.
2. Start the engine.
3. Check to make sure the transmission is in neutral.
4. With the transmission in neutral, release the clutch.

NOTE: This allows the speed sensor on the input shaft to get a reading.

5. Press down on the clutch again and release the parking brake.
6. Select the desired starting gear.
7. Release the clutch.

Reverse

1. To engage reverse (R), slide the selector switch upward to the next position above the neutral position and disengage the clutch.

NOTE: AutoShift 10- and 18-speed transmissions have a dual-range reverse. Reverse low (RL) is the default reverse gear.

2. Select reverse high (RH) by pulling upward on the control.

NOTE: Reverse may be engaged below a programmable forward speed in order to rock the vehicle. If reverse is selected above the programmed forward speed, an audible warning will sound and a message indicating that the gear is not available will appear on the message display screen.

Low Gear Operation

Use low (L) when descending steep hills and using compression braking. Engine speed will be increased by 200 rpm and shift points will be offset by 200 rpm. The efficiency of the exhaust brake will be maximized.

Using the Clutch

Use the clutch to start and stop the vehicle.

ZF-FreedomLine Automated Transmissions

Refer to the Meritor website for additional information, www.arvinmeritor.com.

General Information, FreedomLine

FreedomLine is a fully-automated manual transmission that features only an accelerator and brake pedal in the cab. Clutch actuation is fully automated. On Freightliner vehicles, it will be operated by a custom version of the SmartShift controller. On Columbia vehicles, dash messages will appear on the round Meritor message center display.

This transmission requires an additional 10-liter air reservoir. After any transmission service, it will be necessary to charge this tank with air before the vehicle can be operated.

Operation, FreedomLine

1. With the parking brake engaged and/or the brake pedal pressed down, select neutral (N) by pressing in the safety release and moving the selector switch to the center position. See **Fig. 8.2**.
2. With the transmission in neutral, start the engine. Allow the air pressure to build to 100 psi (689 kPa) to ensure clutch engagement before moving the vehicle.
3. With air pressure built up, select drive (D) by by pressing in the safety release and moving the selector switch downward to the position below neutral. Release the parking brake and/or pedal.

NOTE: When D is selected, the transmission controller starts up in the default starting gear.

4. Press down on the accelerator pedal to allow the vehicle to move forward. The vehicle will not move until the pedal is depressed.

⚠ WARNING

A vehicle equipped with the FreedomLine fully-automated transmission can roll backwards when stopped on a hill or grade, or when the vehicle is starting from a stop on a hill or grade. This can result in serious personal injury or property damage.

5. *To stop on a hill or grade*, press and hold the brake pedal to keep the vehicle from moving.
6. *To start from a full stop on hill or grade*, quickly move your foot from the brake pedal and press firmly on the accelerator pedal.

Automatic and Manual Modes

The SmartShift selector has a slide switch located on the body of the control lever just before the paddle widens out. The slide switch controls the forward driving mode, automatic or manual.

In automatic drive mode, upshifts and downshifts are made by the transmission without driver intervention. Press in the safety release, move the selector switch to drive (D), and press down on the accelerator pedal. On the driver message center display, the first character is a special character to indicate automatic mode.

In manual drive mode, 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).

On the driver message center display, the first character is blank to indicate manual mode.

NOTE: Automatic shifting is possible only in forward gear. When the selector switch is in reverse (R), all shifts are done manually, regardless of the position of the slide switch.

Gear Positions

Neutral

Neutral (N) is in the center of the three-position selector switch located at the end of the SmartShift control lever. To select neutral, press in the safety release and move the selector switch to the center position.

Neutral is always available during operation. 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 torque range.

Reverse

To select reverse (R), press in the safety release and move the selector switch upward to the position above neutral.

NOTE: When the selector switch is in reverse (R), all shifts are done manually, regardless of the position of the slide switch.

The vehicle must come to a complete stop before selecting reverse. If reverse is selected with the vehicle moving, an audible warning will sound. Once the vehicle has come to a complete stop, reverse low can be engaged.

There are two reverse gears. Reverse low (RL) is the default reverse gear. To select reverse high (RH), pull the control lever up (towards you). You can shift between RL and RH "on the fly," without stopping first.

Upshifting

NOTE: A request to upshift or downshift can only be accepted in the manual mode.

With the transmission in drive, to request an upshift, pull the control lever up (towards you). If the gear is available, the transmission will upshift.

An unavailable request to upshift is not stored in memory. The upshift must be requested again. Skip shifting in manual mode is not available with the ZF Meritor version of SmartShift.

Downshifting

NOTE: A request to upshift or downshift can only be accepted in the manual mode.

With the transmission in drive, to request a downshift, push the control lever down (away from you). If the gear is available, the transmission will downshift.

An unavailable request to downshift is not stored in memory. The downshift must be requested again. Skip shifting in manual mode is not available with the FreedomLine version of SmartShift.

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.

Selecting A Nondefault Starting Gear

NOTE: For the clutch to engage, pressure in the primary air system must be at least 100 psi (689 kPa).

1. Select drive (D) by pressing in the safety release and moving the selector switch downward to the position below neutral.
2. Select manual mode (MAN) by moving the two-position slide switch towards the steering column until it is in the manual position.
3. To increase the starting gear, pull the lever up (towards you). To decrease the starting gear, push the lever down (away from you).
4. Select automatic mode (AUTO), if desired, by moving the two-position slide switch away from the steering column until it is in the automatic position.

Driver Message Center

On the Columbia, the gear is displayed on the round Meritor message center display. See **Fig. 8.4**.

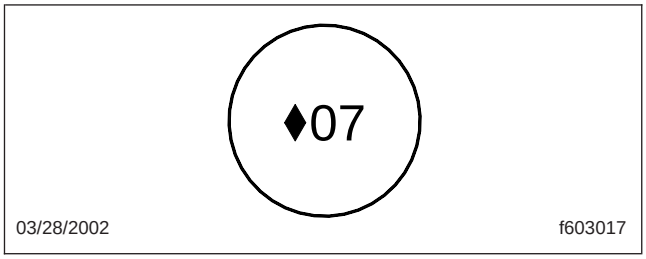


Fig. 8.4, Round Meritor Display

The first character of the display is either blank, to indicate the transmission is in manual mode, or an up-and-down arrow to indicate the transmission is in automatic mode.

NOTE: Pre-production vehicles will have a small numeric "10" in place of the up-and-down arrow when in automatic mode.

The next two characters indicate the current gear. For forward drive gears, this appears as a two-digit number (*Examples*: "03, "11"). For reverse, two letters appear, either "RL" for low reverse (the default), or "RH" for high reverse. For neutral, a single letter "N" appears.

Eaton Fuller Range-Shift Transmissions

Refer to the Eaton website for additional information, www.roadranger.com.

General Information, Eaton Fuller Range-Shift

To operate a range-shift transmission, move the shift lever through all the low gear positions and then activate a range switch to provide an additional set of ratios in the high range. Using the same shift lever positions as in low range, move the shift lever through each position as before. On some models, the initial low gear is often used only in low range.

IMPORTANT: Not all lever positions are used in each range and the shift patterns vary between transmissions. Be sure to read the shift pattern decal on the

dash for the operating instructions for the specific transmission installed in your vehicle.

9-Speed RT/RTX Models

Eaton Fuller 9-speed transmissions have a 5-speed front section and a 2-speed rear range section. The low gear in the front sections of the RT and RTX transmissions is used only as a starting ratio. The remaining gear positions of the above transmissions are used once in the low range and once in the high range.

See **Fig. 8.5** for the 9-speed range-shift shift patterns.

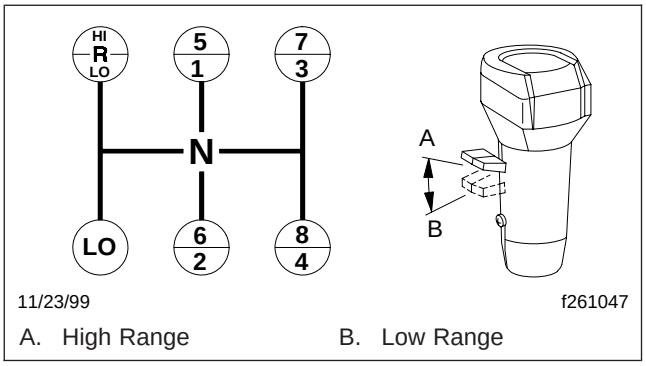


Fig. 8.5, Eaton Fuller 9-Speed Transmission Shift Patterns

10-Speed FR/FRO and RT/RTO/RTX Models

Eaton Fuller 10-speed transmissions have 10 selective, evenly-spaced forward ratios. Each transmission has a 5-speed front section and a 2-speed rear range section. The 10 forward speeds are obtained by twice using a 5-speed shift pattern: the first time in low range, the second time in high range. See **Fig. 8.6** for the shift patterns.

NOTE: The 4th/9th and the 5th/10th shift positions in the RT (direct ratio) and RTX (overdrive ratio) transmissions are directly opposite in the RTO (overdrive ratio) transmissions

Operation, Eaton Fuller Range-Shift

1. When operating off-highway, or under adverse conditions, always use low gear (if so equipped) when starting to move the vehicle.

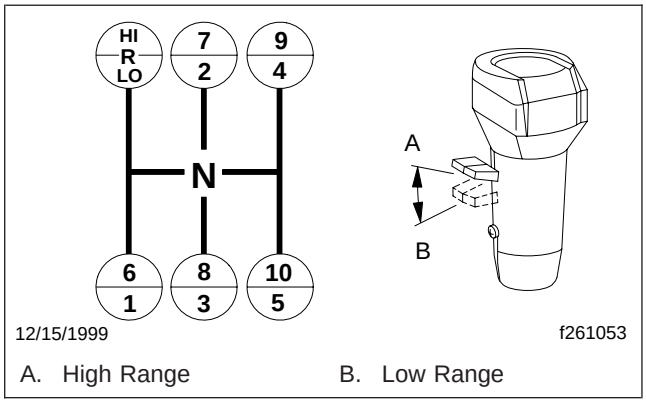


Fig. 8.6, Eaton Fuller 10-Speed Transmission Shift Patterns

When operating on-highway, with no load, or under ideal conditions, use 1st gear when starting to move the vehicle (except when equipped with a 9-speed RTO transmission, then always start in low gear).

For all conditions, use the highest gear that is still low enough to start the vehicle moving with engine idling, and without slipping the clutch excessively.

2. Use the clutch brake to stop gear rotation when shifting into low (or 1st) or reverse when the vehicle is stationary. The clutch brake is actuated by depressing 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. Double-clutch 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 permit, depending on the load, grade, and road speed.

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 1st gear (**Table 8.1**), 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.

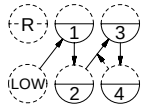
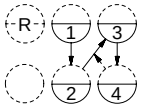
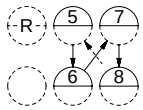
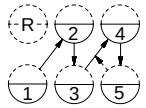
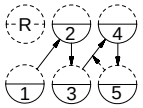
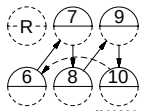
Eaton Fuller Shift Progressions			
TRANS. MODEL	LOW RANGE		HIGH RANGE
	Off-Highway	On-Highway	
9-Speed Direct or Overdrive (RT or RTX)	 f260322	 f260323	 f260324
10-Speed Direct or Overdrive (RT or RTX)	 f260329	 f260329	 f260330

Table 8.1, Eaton Fuller Range-Shift Shift Progressions

4. Shift progressively upward from low or 1st gear, to the top gear in low range (**Table 8.1**), 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 (**Table 8.1**). 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 upward through each of the high range gears (**Table 8.1**), double-clutching between shifts.

Downshifting

1. With the transmission in high range, shift progressively downward 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.

IMPORTANT: Never use the clutch brake when downshifting, or as a brake to slow the vehicle.

Eaton Fuller Splitter and Range-Shift Transmissions

Refer to the Eaton website for additional information, www.roadranger.com.

General Information, Eaton Fuller Splitter and Range-Shift

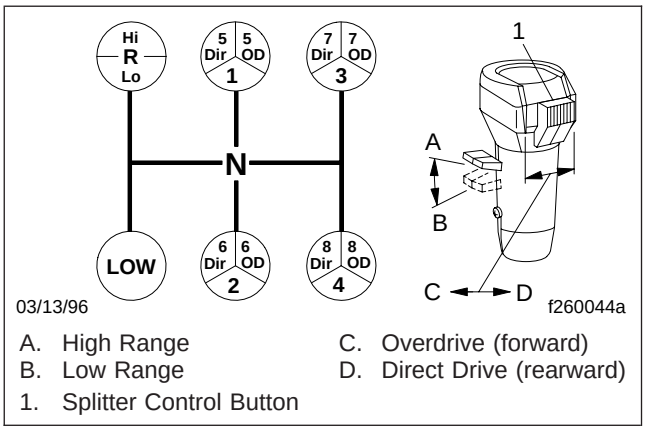
Combination splitter and range-shift transmissions allow the choice of two splitter ratios in each lever position as well as the additional ratio provided in each lever position after shifting to the other range.

IMPORTANT: Not all lever positions are used in each range and the shift patterns vary between transmissions. Be sure to read the shift pattern decal on the dash for the operating instructions for the specific transmission installed in your vehicle.

13-Speed RTLO Models

Eaton Fuller 13-speed transmissions have thirteen forward speeds and two reverse speeds. Each transmission consists of a 5-speed front section, and a 3-speed auxiliary section. The auxiliary section contains low- and high-range ratios, plus an overdrive splitter gear. See **Fig. 8.7** for the shift pattern.

All of the 13 speeds are controlled with one shift lever. A range preselection lever and a splitter control



A. High Range
B. Low Range
C. Overdrive (forward)
D. Direct Drive (rearward)
1. Splitter Control Button

Fig. 8.7, Eaton Fuller 13-Speed Transmission Shift Pattern

button are built into the shift knob. The range preselection lever controls range selection and the splitter control button (located on the side of the shift knob) controls gear splits.

Low gear in the front section is used only as a starting ratio. The remaining four forward positions are used once in the low range and once in the high range. However, each of the four high range gear positions can be split with the underdrive ratio (RT models), or overdrive ratio (RTO models) of the splitter gear. Ratios cannot be split while the transmission is in low range.

18-Speed RTLO Splitter and Range-Shift Models

Eaton Fuller 18-speed transmissions have 18 forward speeds and four reverse speeds. These transmissions consisting of a 5-speed front section and a 3-speed auxiliary section. The auxiliary section contains low and high range ratios, plus an overdrive splitter gear.

One ratio in the front section (low) is used as a starting ratio; it is never used when the transmission is in high range. Low gear can be split to provide both a direct and an overdrive ratio.

The other four ratios in the front section are used once in low range and once again in high range; however, each of the five ratios (low–1–2–3–4) in low range and each of the four ratios (5–6–7–8) in high range can be split with the overdrive splitter gear.

All of the 18 speeds are controlled with one shift lever. A range preselection lever and a splitter control button are built into the shift knob. The range preselection lever controls range selection and the splitter control button (located on the side of the shift knob) controls gear splits.

Operation, Eaton Fuller Splitter and Range-Shift

IMPORTANT: The shifter knob has an interlock feature that prevents the splitter control button from being moved forward when the range preselection lever is down (in low range); when in high range and the splitter control button is in the forward position, the range preselection lever cannot be moved down.

1. When operating off-road, or under adverse conditions, always use low gear when starting to move the vehicle forward.

   When operating on-highway, with no load, or under ideal conditions, use 1st gear when starting to move the vehicle forward.

   For all conditions, use the highest gear that is still low enough to start the vehicle moving with the engine at or near idle speed, and without slipping the clutch excessively.

2. Use the clutch brake to stop gear rotation when shifting into low (or 1st) or reverse when the vehicle is stationary. The clutch brake is actuated by depressing 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. Use double-clutching between all upshifts and downshifts that require movement of the shift lever. Splitting of the high range gears does not require movement of the shift lever.

4. Never move the shift lever into low gear while in high range.

5. Never move the splitter control button while in neutral.

6. Do not preselect with the splitter control button; after moving the control button, complete the shift immediately.

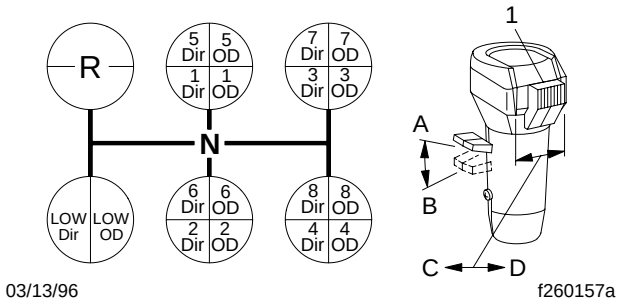
7. Except when downshifting from 5th direct to 4th gear, never push the range preselection lever

down into low range while operating in high range—the splitter will become inoperative.

8. Do not shift from high range to low range at high vehicle speeds.
9. Do not make range shifts with the vehicle moving in reverse gear.
10. 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.
11. After your shifting ability improves, you may want to skip some of the ratios. This may be done *only* when operating conditions permit, depending on the load, grade, and road speed.

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. See **Fig. 8.7** or **Fig. 8.8**.



A. High Range
B. Low Range
C. Overdrive (forward)
D. Direct Drive (rearward)
1. Splitter Control Button

Fig. 8.8, Eaton Fuller 18-Speed Transmission Shift Pattern

3. Make sure the splitter control button is in the direct (rearward) position. See **Fig. 8.7** or **Fig. 8.8**.
4. For 13-speed transmissions:

   Press the clutch to the floor, shift into low or 1st 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.

   For 18-speed transmissions:

   Press the clutch to the floor, shift into low; then engage the clutch, with the engine at or near idle speed, to start the vehicle moving.

   To shift from low direct to low overdrive, move the splitter control button (**Fig. 8.8**) into the overdrive (forward) position, then immediately release the accelerator. Press and release the clutch pedal. After releasing the clutch, accelerate again.

5. For 13-speed transmissions:

   Shift upward from low to 1st gear, 2nd, etc. until 4th gear, double-clutching between shifts, and accelerating to 80 percent of engine governed speed. See **Fig. 8.7**.

   For 18-speed transmissions:

   Shift upward from low overdrive to 1st direct by first moving the splitter control button into the direct (rearward) position (**Fig. 8.8**). Move the shift lever, double-clutching, to the 1st gear position.

   Continue upshifting through the shift pattern. Double-clutch during lever shifts (1st to 2nd to 3rd to 4th); single-clutch during split shifts (1st direct to 1st overdrive, etc.).

6. When in 4th gear (13-speed transmissions) or 4th overdrive (18-speed transmissions) and ready to shift up to 5th gear, use the range shift lever as follows:

   For 13-speed transmissions:

   While in 4th gear, pull the range shift preselection lever up, into high range. The transmission will automatically shift from low to high range as the shift lever passes through neutral. Then, disengage the clutch; double-clutch through neutral; move the shift lever to 5th gear; engage the clutch, and accelerate the engine.

   For 18-speed transmissions:

   While in 4th overdrive, pull the range shift preselection lever up, into high range. The transmission will automatically shift from low to high range as the shift lever passes through neutral.

   Move the shift lever, double-clutching, to the 5th gear position. Just before making final clutch engagement, move the splitter control button to the direct (rearward) position; then engage the clutch

and accelerate. Do not move the control button while the shift lever is in neutral.

7. Shift up through the high range gears as follows:

   For 13-speed transmissions:

   To shift from 5th direct to 5th overdrive, move the splitter control button (**Fig. 8.7**) into the overdrive (forward) position, then immediately release the accelerator. Press and release the clutch pedal. After releasing the clutch, accelerate again.

   Continue upshifting through the shift pattern. Double-clutch during lever shifts (6th to 7th to 8th); single-clutch during split shifts (6th direct to 6th overdrive, etc.).

   For 18-speed transmissions:

   To shift from 5th direct to 5th overdrive, move the splitter control button (**Fig. 8.8**) into the overdrive (forward) position, then immediately release the accelerator. Press and release the clutch pedal. After releasing the clutch, accelerate again.

   Continue upshifting through the shift pattern. Double-clutch during lever shifts (6th to 7th to 8th); single-clutch during split shifts (6th direct to 6th overdrive, etc.).

Downshifting

1. Downshift from 8th overdrive to 8th direct without moving the shift lever. Flip the splitter control button to the direct (rearward) position, then immediately release the accelerator, and disengage the clutch. Engage the clutch, and accelerate the engine only after the transmission has shifted.
2. Start the downshift from 8th direct to 7th overdrive by flipping the splitter control button to the overdrive (forward) position; then, immediately double-clutch through neutral, moving the shift lever from 8th to 7th gear.
3. Shift downward through each of the high range gears, alternating the procedures in steps 1 and 2, above, until reaching 5th direct.
4. While in 5th direct and ready for the downshift to 4th (13-speed transmissions) or 4th overdrive (18-speed transmissions), push the range preselection lever down. Then, double-clutch through neutral and move the shift lever to the 4th gear position. On 18-speed transmissions, move the splitter control button to the overdrive (forward) position *before* engaging the clutch. Do not move the control button while the shift lever is in neutral.
5. Continue downshifting from 4th to 1st as follows:

   For 13-speed transmissions:

   Downshift through the low range gears as conditions require.

   For 18-speed transmissions:

   Continue downshifting from 4th overdrive to 4th direct, then 4th direct to 3rd overdrive, 3rd overdrive to 3rd direct, etc. Single-clutch when split shifting (direct to overdrive, overdrive to direct). Double-clutch when making lever shifts (4th to 3rd, 3rd to 2nd, etc.).

IMPORTANT: Never use the clutch brake when downshifting, or as a brake to slow the vehicle.

Eaton Fuller Deep-Reduction Transmissions

Refer to the Eaton website for additional information, www.roadranger.com.

General Information, Deep Reduction

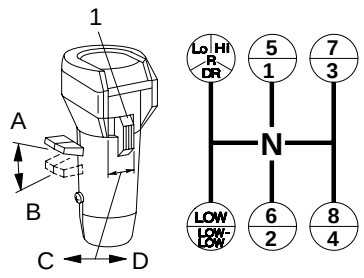
IMPORTANT: Not all lever positions are used in each range and the shift patterns vary between transmissions. Be sure to read the shift pattern decal on the dash for the operating instructions for the specific transmission installed in your vehicle.

9-Speed RTO–LL Models

Eaton Fuller 9-speed deep-reduction transmissions have a 5-speed front section, and a 2-speed rear-range section, with a deep reduction gear. The deep reduction (low-low) gear is used only when operating under adverse conditions. Low gear in the front section is used only for rough, off-highway conditions, as a starting ratio. Both the low gear and 1st gear in the low range can be split, using the deep reduction button, for another reduction ratio in those shift lever positions. The remaining four forward positions are used once in the low range and once in the high range. Reverse in the low range can also be split with the deep reduction button for a lower ratio.

10-Speed RT–LL, RTO–LL and RTX–LL Models

Eaton Fuller 10-speed deep-reduction transmissions have a 5-speed front section, and a 2-speed rear range section, with a deep reduction button. The low-low, deep reduction gear is used only when operating under adverse conditions. Low gear in the front section is used only for rough, off-highway conditions, as a starting ratio. The remaining four forward positions are used once in the low range and once in the high range. See **Fig. 8.9** for the shift pattern.



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A. High Range
B. Low Range
C. Deep Reduction IN (forward)
D. Deep Reduction OUT (rearward)
1. Deep Reduction Button

Fig. 8.9, Eaton Fuller 10-Speed Deep-Reduction Transmission Shift Patterns

NOTE: The 3rd/7th and 4th/8th shift positions in the RT and RTX-LL transmissions are opposite of the RTO-LL transmissions.

15-Speed RT/RTO Deep-Reduction Models

Eaton Fuller 15-speed deep-reduction transmissions have a 5-speed front section, and a 2-speed rear range section. They also have five additional deep reduction ratios. The 5-speed front section, and the low and high range sections provide 10 evenly and progressively spaced forward speeds. The five deep reduction ratios are also evenly and progressively spaced; however, they do overlap the low range ratios, and should be used only when operating under adverse conditions. See **Fig. 8.10** for the shift patterns.

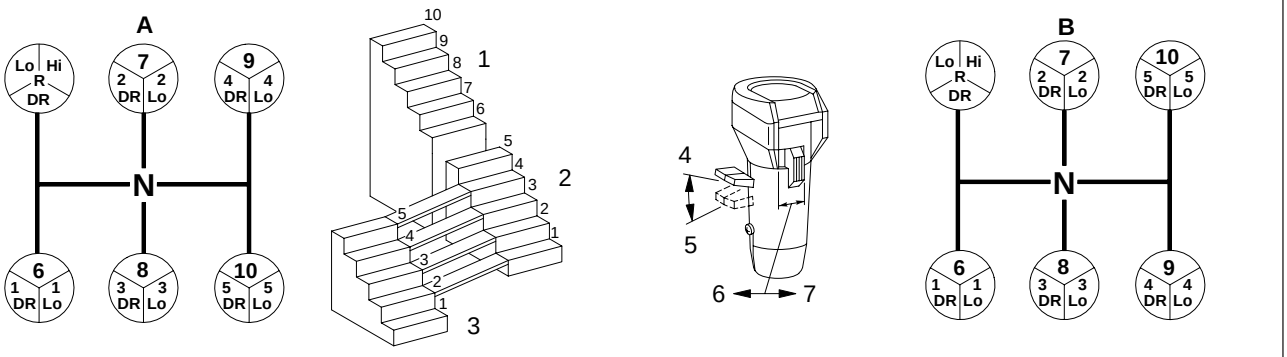
NOTE: The 4th/9th, and the 5th/10th shift positions in the RT (direct ratio) transmissions are directly opposite in the RTO (overdrive ratio) transmissions.

Operation, Deep Reduction

IMPORTANT: The shifter knob has an interlock feature that prevents the deep reduction button from being moved forward when the range preselection lever is up (in high range); when in low range and the deep reduction button is in the forward position, the range preselection lever cannot be moved up.

1. For all driving conditions, use the highest gear that is still low enough to start the vehicle moving with the engine idling, and without slipping the clutch excessively.
2. Use the clutch brake to stop gear rotation when shifting into low-low, low-1st (whichever is used as a starting ratio) or reverse, when the vehicle is stationary. The clutch brake is actuated by depressing 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. Double-clutch between all upshifts and downshifts.
4. Never move the shift lever into low gear while in high range.
5. Do not preselect with the deep reduction button. When making the shift from a deep reduction ratio to a low range ratio, move the deep reduction button from a forward position to a rearward position, then complete the shift immediately.
6. Never move the deep reduction button from a rearward position to a forward position when the transmission is in high range.
7. Do not shift from high range to low range at high vehicle speeds.
8. Do not make range shifts with the vehicle moving in reverse gear.
9. 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.



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A. RT Models
1. High Range
2. Low Range
3. Deep Reduction
4. High Range
5. Low Range

B. RTO Models
6. Forward for IN
7. Rearward for OUT

Fig. 8.10, Eaton Fuller 15-Speed Deep-Reduction Transmission Shift Patterns

10. After your shifting ability improves, you may want to skip some of the ratios. This may be done *only* when operating conditions permit, depending on the load, grade, and road speed.

Upshifting

There are several patterns of upshifting, depending on the vehicle load and the road conditions. See **Table 8.2** for suggested shifting sequences. Deep reduction gears are best suited for heavy loads and steep inclines. Low gear (in 10-speed transmissions) is best suited for off-highway use.

The following instructions are recommended for starting a loaded vehicle moving, under adverse conditions.

1. Position the gear shift lever in neutral. Start the engine, and bring the vehicle air system pressure up to 100 to 120 psi (689 to 827 kPa).
2. Position the range preselection lever down, into low range.
3. Move the deep reduction button to the forward position, to engage the deep reduction gears.
4. Depress the clutch pedal to the floor; shift into low-low gear (9/10-speed transmissions) or 1st gear of deep reduction (15-speed transmissions); 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.
5. For 9/10-speed transmissions:

   When ready for the next upshift, move the deep reduction button rearward, then break the torque on the gears by momentarily releasing the accelerator or depressing the clutch pedal. Do not move the shift lever.

   For 15-speed transmissions:

   Shift upward from 1st gear of deep reduction to 5th gear of deep reduction, double-clutching between shifts and accelerating to 80 percent of engine governed speed. See **Table 8.2**.

   When ready for the next upshift, move the deep reduction button from the forward position to the rearward position, then double-clutch through neutral, and move the shift lever to the 4th gear position in the low range.
6. Shift upward from low gear (9/10-speed transmissions) or 4th gear (15-speed transmissions), to the top gear in low range (**Table 8.2**), double-clutching between shifts, and accelerating to 80 percent of engine governed speed.
7. 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 (**Table 8.2**). As the shift lever passes through neutral, the transmission will automatically shift from low range to high range.

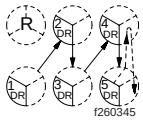
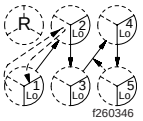
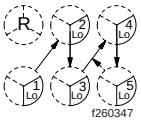
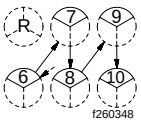
Eaton Fuller Deep-Reduction and Range-Shift Shift Progressions				
TRANSMISSION MODEL	DEEP REDUCTION	LOW RANGE		HIGH RANGE
	Adverse Conditions Only	Off-Highway and Adverse Conditions	On-Highway and Ideal Conditions	All Conditions
15-Speed RT and RTX	 f260345	 f260346	 f260347	 f260348

Table 8.2, Eaton Fuller Deep-Reduction and Range-Shift Shift Progressions

8. With the transmission in high range, shift progressively upward through each of the high range gears (**Table 8.2**), double-clutching between shifts.

Alternate Upshifting Procedures (15-Speed Transmissions Only)

The shift from deep reduction to low range can also be made from 2nd, 3rd, or 4th gear of deep reduction, but must be made to the next gear lower in the low range. The shift from 2nd gear of deep reduction to 1st gear in low range (or 3rd gear of deep reduction to 2nd gear in low range, and 4th gear of deep reduction to 3rd gear in low range), is an upshift, and the same procedure should be followed as that shown for shifting from 5th gear of deep reduction to 4th gear in low range. See step 5, under "Upshifting."

Downshifting

1. With the transmission in high range, shift progressively downward 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.

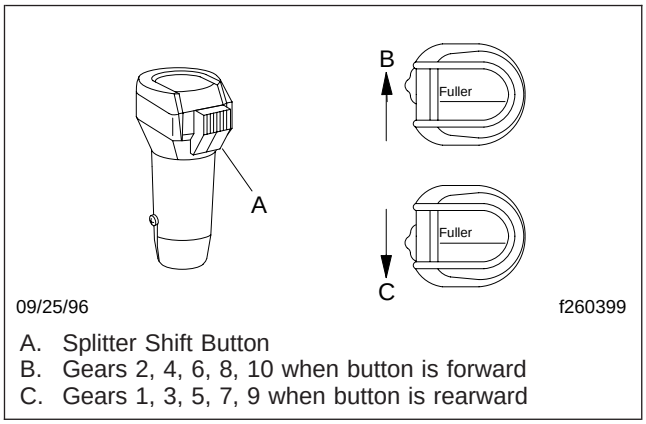
IMPORTANT: Never use the clutch brake when downshifting, or as a brake to slow the vehicle.

Eaton Fuller Super 10, Top 2, and Lightning Semi-Automated Transmissions

Refer to the Eaton website for additional information, www.roadranger.com.

General Information, Super 10/Top 2/Lightning

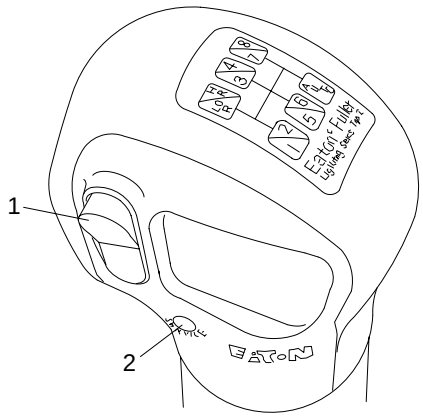
Super 10, Top 2, and Lightning transmissions have 10 selective forward ratios and a 2-speed rear splitter section. Half of the 10 speed ratios are shifted with the shift lever and the other half are shifted by moving the shift button. See **Fig. 8.11** for the Super 10 and Top 2 shift knob, and **Fig. 8.12** for the Lightning shift knob.



A. Splitter Shift Button
B. Gears 2, 4, 6, 8, 10 when button is forward
C. Gears 1, 3, 5, 7, 9 when button is rearward

Fig. 8.11, Super 10 and Top 2 Shift Knob

There are three types of shifts used with these transmissions. Button-only and combination button/lever shifts are both full gear changes. The lever-only shift skips a gear.



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1. Shift Button 2. Service Light

Fig. 8.12, Lightning Shift Knob

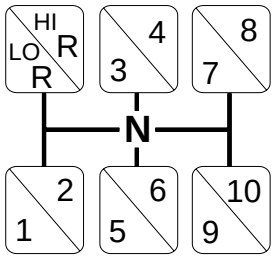
- The button-only shift is a gear split shift that occurs by moving the shift button.
- The lever-only shift occurs when the shift lever is moved without moving the shift button.
- The combination button/lever shift is a gear ratio change that occurs when both the shift button and the shift lever are moved.

The small red service light on the Lightning shift knob illuminates for a few seconds when the engine is turned on. This confirms that the transmission electronics are operating properly.

NOTE: If the service light stays on or flashes, or does not illuminate when the engine starts, take the vehicle to an authorized Freightliner or Eaton service facility as soon as possible.

See **Fig. 8.13** for the Super 10 shift pattern, which is also used by Top 2 and Lightning when the cruise control is off. Top 2 and Lightning transmissions are equipped with the Top 2 feature that allows the transmission, with cruise control on, to automatically shift between the top two gears (9th-10th) without the need for a button-only shift. See **Fig. 8.14**.

IMPORTANT: Not all lever positions are used in each range and the shift patterns vary between transmissions. Be sure to read the shift pattern decal on the dash for the operating instructions for the specific transmission installed in your vehicle.



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NOTE: The Top 2 and Lightning transmissions use the Super 10 shift pattern when cruise control is off.

Fig. 8.13, Super 10 Shift Pattern

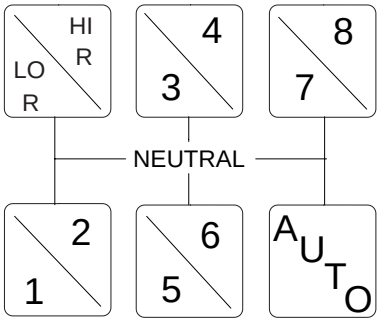

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Fig. 8.14, Top 2 and Lightning Shift Patterns (with cruise control on)

Operation, Super 10/Top 2/Lightning

⚠ CAUTION

Keep the transmission in gear at all times while the vehicle in motion. Coasting in neutral could lead to transmission damage.

1. When operating off-highway, or under adverse conditions, always use low gear (if so equipped) when starting to move the vehicle.

   When operating on-highway, with no load, or under ideal conditions, use 1st 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 engine idling, and without slipping the clutch excessively.

2. Use the clutch brake to stop gear rotation when shifting into 1st or reverse when the vehicle is stationary. The clutch brake is actuated by depressing 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 splitter shifts with the vehicle moving in reverse gear.

4. The shift lever should not be moved to the center or left rail positions at vehicle speeds above 40 mph (65 km/h).

5. Double-clutch between all upshifts and downshifts.

6. After your shifting ability improves, you may want to skip some of the ratios. This may be done *only* when operating conditions permit, depending on the load, grade, and road speed.

7. Avoid hunting for neutral by moving the gear shift lever from the left rail to right rail. This action can cause excessive transmission wear.

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. Press the clutch pedal to the floor. Shift into 1st gear, then engage the clutch, with the engine at or near idle speed, to start the vehicle moving.

3. Button-only shift—Preselect the next gear by sliding the shift button forward. Break torque by releasing the throttle or by depressing the clutch pedal. Decrease engine speed to synchronize the engine speed with the transmission speed. The shift will complete when the engine rpm has decreased to the proper speed.

   The button-only shift is used for gear changes from 1st to 2nd, 3rd to 4th, 5th to 6th, 7th to 8th, and 9th to 10th.

4. Lever-only shift—Break torque by releasing the throttle and depressing the clutch pedal. Double-clutching, move the shift lever to the next desired gear position. Decrease engine speed to synchronize the engine speed with the transmission speed. The shift will complete when the engine rpm has decreased to the proper speed.

   The lever-only shift is used to skip a full gear. With the shift button rearward—1st to 3rd, 3rd to 5th, 5th to 7th, and 7th to 9th. With the shift button forward—2nd to 4th, 4th to 6th, 6th to 8th, 8th to 10th.

NOTE: Lever-only shifts skip an entire gear ratio and will require the engine rpm to decrease twice the amount of a normal shift.

5. Combination button/lever shift—Preselect the next gear by sliding the shift button rearward. Break torque by releasing the throttle and depressing the clutch pedal. Double-clutch and move the shift lever to the next desired gear position.

   The combination button/lever shift is used for gear changes from 2nd to 3rd, 4th to 5th, 6th to 7th and 8th to 9th.

Downshifting

⚠ CAUTION

Do not attempt a button-only downshift at too high an engine speed (generally above 1400 rpm). Doing so could result in damage to the engine, transmission, and/or driveline.

1. Button-only shift—With the throttle still applied, preselect the next gear by sliding the shift button rearward. Break torque by releasing the throttle or by depressing the clutch pedal. Increase engine speed to synchronize the engine speed with the transmission speed. The shift will complete when the engine rpm has increased to the proper speed.

   The button-only shift is used for gear changes from 10th to 9th, 8th to 7th, 6th to 5th, 4th to 3rd, and 2nd to 1st.

⚠ CAUTION

Do not attempt a lever-only downshift at too high an engine speed (generally above 1000 rpm). Doing so could result in damage to the engine, transmission, and/or driveline.

2. Lever-only shift—Break torque by releasing the throttle and depressing the clutch pedal. Double-clutching, move the shift lever to the next desired gear position.

The lever-only shift is used to skip a full gear. With the shift button rearward—9th to 7th, 7th to 5th, 5th to 3rd, and 3rd to 1st. With the shift button forward—10th to 8th, 8th to 6th, 6th to 4th and 4th to 2nd.

IMPORTANT: Never use the clutch brake when downshifting, or as a brake to slow the vehicle.

CAUTION

Do not attempt a combination button/lever downshift at too high an engine speed (generally above 1400 rpm). Doing so could result in damage to the engine, transmission, and/or driveline.

3. Combination button/lever shift—With the throttle still applied, preselect the next gear by sliding the shift button forward. Break torque by releasing the throttle and depressing the clutch pedal. Double-clutch and move the shift lever to the next desired gear position.

   The combination button/lever shift is used for gear changes from 9th to 8th, 7th to 6th, 5th to 4th, and 3rd to 2nd.

Meritor Range-Shift Transmissions

Refer to the Meritor website for additional information, www.arvinmeritor.com.

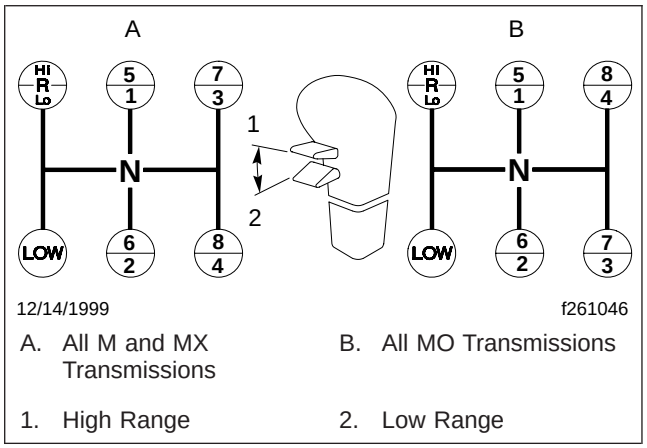
General Information, Meritor Range-Shift

To operate a range-shift transmission, move the shift lever through all the low gear positions and then activate a range switch to provide an additional set of ratios in the high range. Using the same shift lever positions as in low range, move the shift lever through each position as before. On some models, the initial low gear is often used only in low range.

IMPORTANT: Not all lever positions are used in each range and the shift patterns vary between transmissions. Be sure to read the shift pattern decal on the dash for the operating instructions for the specific transmission installed in your vehicle.

9-Speed M and MO Models

Meritor 9-speed transmissions have a 5-speed front section, and a 2-speed auxiliary section. The low gear in the front sections of the "A" and "B" ratio transmissions is used only as a starting ratio. The high gear in the front section of the "R" ratio transmissions is used only as the top gear. The remaining gear positions of the above transmissions are used once in the low range and once in the high range. See **Fig. 8.15** for the shift patterns.



A. All M and MX Transmissions
B. All MO Transmissions
1. High Range
2. Low Range

Fig. 8.15, Meritor 9-Speed Transmission Shift Patterns

NOTE: The 3rd/7th and 4th/8th shift positions in the M and MX (direct ratio) are opposite of the MO (overdrive ratio) transmissions. The MX-R ratio transmissions have the 1st/5th shift positions where low is in the A and B ratio transmissions. The top gear in the MX-R ratio transmissions is called 9th gear.

10-Speed M Models

Meritor 10-speed transmissions have 10 evenly-spaced forward ratios. Each transmission consists of a 5-speed front section, and a 2-speed auxiliary section. The 10 forward speeds are obtained by twice using a 5-speed shift pattern: the first time in low range; the second time in high range. See **Fig. 8.16** for the shift pattern.

Operation, Meritor Range-Shift

Reverse

To drive in reverse, push the range selector lever down to put the transmission in the low range. Push the clutch pedal to the bottom of travel so the clutch brake slows the transmission for initial gear engagement. Holding the clutch pedal at the bottom of travel, shift into reverse.

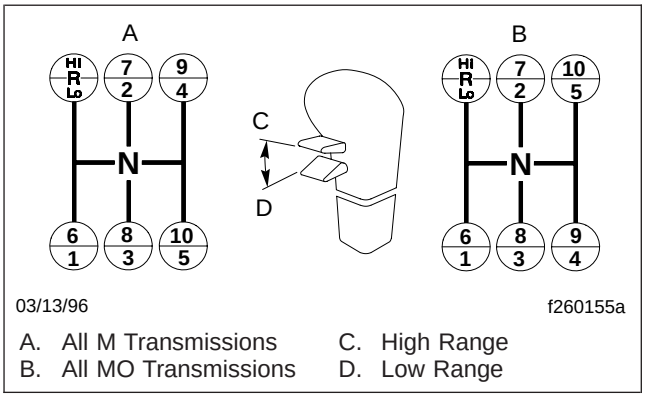


Fig. 8.16, Meritor 10-Speed Transmission Shift Patterns

Slowly release the clutch pedal to move the vehicle in reverse.

Upshifting

1. To drive forward, make sure the vehicle is completely stopped and the range selector lever is pushed down to put the transmission in the low range.

   Push the clutch pedal to the bottom of travel so the clutch brake slows the transmission for initial gear engagement; holding the clutch pedal at the bottom of travel, shift into low.

2. Slowly release the clutch pedal to begin moving the vehicle forward.

3. To upshift into 1st gear, only partial depression of the clutch pedal is needed. Do not push the clutch pedal all the way to the floor and engage the clutch brake; instead, partially depress the clutch pedal, and move the shift lever into neutral.

4. Release the clutch, and allow the engine to decelerate until the road speed and the engine rpm match.

5. Partially depress the clutch pedal, and move the shift lever into first gear.

6. Double-clutch and continue upshifting until you reach the top gear in the low range, 4th gear in 9-speed models and 5th gear in 10-speed models. See **Table 8.3**.

Meritor Range-Shift Shift Progressions

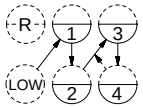
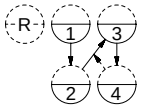
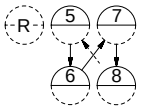
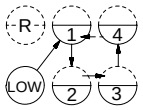
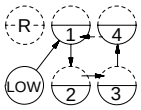
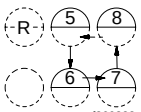
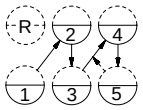
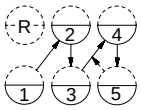
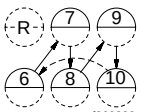
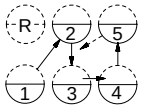
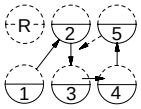
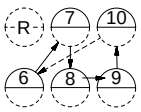
TRANS. MODEL	LOW RANGE		HIGH RANGE
	Off-Highway	On-Highway	
9-Speed Direct (M)	 f260322	 f260321	 f260320
9-Speed Overdrive (MO)	 f260327	 f260327	 f260328
10-Speed Direct or Overdrive (M)	 f260329	 f260329	 f260330
10-Speed Overdrive (MO)	 f260331	 f260331	 f260332

Table 8.3, Meritor Range-Shift Shift Progressions

7. To upshift into high range—with the transmission still in the highest low range gear—move the range selector lever up to put the transmission into high range, then partially depress the clutch pedal and move the shift lever into neutral. As the shift lever passes through neutral, the transmission will automatically shift from low range to high range.

8. Release the clutch pedal, and let the engine slow until the road speed and engine rpm match.

9. Partially depress the clutch pedal, and move the shift lever into the lowest gear in the high range, 5th gear in 9-speed models and 6th gear in 10-speed models.

10. Double-clutch to continue upshifting.

Downshifting

1. With the transmission in high range, shift progressively downward to the bottom gear in high range, 5th gear in 9-speed models and 6th gear in 10-speed models. Double-clutch between shifts. See **Table 8.3**.

2. When in the bottom gear of the high range shift pattern, and ready for the next downshift, push the range selection 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.

IMPORTANT: Never use the clutch brake when downshifting, or as a brake to slow the vehicle.

Meritor Splitter and Range-Shift Transmissions

Refer to the Meritor website for additional information, www.arvinmeritor.com.

General Information, Meritor Splitter and Range-Shift

Combination splitter and range-shift transmissions allow the choice of two splitter ratios in each lever position as well as the additional ratio provided in each lever position in high range after shifting to the other range.

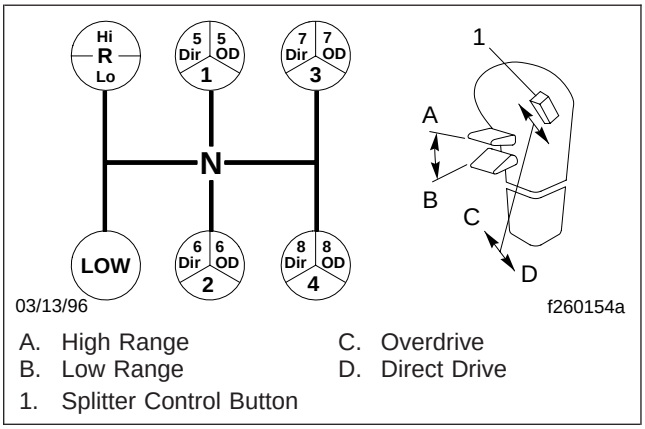
IMPORTANT: Not all lever positions are used in each range and the shift patterns vary between transmissions. Be sure to read the shift pattern decal on the dash for the operating instructions for the specific transmission installed in your vehicle.

13-Speed MO Models

Meritor 13-speed transmissions have 13 forward speeds and two reverse speeds. Each transmission consists of a 5-speed front section, and a 3-speed auxiliary section. The auxiliary section contains low and high range ratios, plus an overdrive splitter gear for high range. See **Fig. 8.17**.

All of the thirteen speeds are controlled with one shift lever. Low gear in the front section is used only as a starting ratio. The remaining four forward positions are used once in the low range and once in the high range.

The range selection lever is on the back of the shift knob. When in the top gear position of the low range, toggle the range lever up just before shifting into the lowest gear position in the high range.



A. High Range
B. Low Range
C. Overdrive
D. Direct Drive
1. Splitter Control Button

Fig. 8.17, Meritor 13-Speed Transmission Shift Pattern

The splitter control button is on the side of the shift knob. Each of the four high range gear positions can be split with the overdrive ratio of the splitter gear. Ratios cannot be split while the transmission is in low range.

Operation, Meritor Splitter and Range-Shift

IMPORTANT: The shifter knob has an interlock feature that prevents the splitter control button from being moved up when the range selection lever is down (in the low range); when the transmission is in the high range, and the splitter control button is up, the range selection lever cannot be moved down.

Reverse

To drive in reverse, push the range selector lever down to put the transmission in the low range. Push the clutch pedal to the bottom of travel so the clutch brake slows the transmission for initial gear engagement; holding the clutch pedal at the bottom of travel, shift into reverse.

Slowly release the clutch pedal to move the vehicle in reverse.

Upshifting

1. To drive forward, make sure the vehicle is completely stopped and the range selector lever is pushed down to put the transmission in the low range.

Push the clutch pedal to the bottom of travel so the clutch brake slows the transmission for initial gear engagement; holding the clutch pedal at the bottom of travel, shift into low.

2. Slowly release the clutch pedal to begin moving the vehicle forward.
3. To upshift into 1st gear, only partial depression of the clutch pedal is needed. Do not push the clutch pedal all the way to the floor and engage the clutch brake; instead, partially depress the clutch pedal, and move the shift lever into neutral.
4. Release the clutch pedal, and allow the engine to decelerate until the road speed and the engine rpm match.
5. Partially depress the clutch pedal, and move the shift lever into 1st gear.
6. Double-clutch to continue upshifting until in fourth gear. See **Table 8.3**.
7. To upshift into high range—with the transmission still in 4th gear—push the range selection lever up to put the transmission into high range, then partially depress the clutch pedal and move the shift lever into neutral. As the shift lever passes through neutral, the transmission will automatically shift from low range to high range.
8. Release the clutch pedal, and let the engine slow until the road speed and engine rpm match.
9. Partially disengage the clutch, and move the shift lever into 5th gear.
10. To upshift from 5th gear into 5th overdrive, flip the splitter control button up to the overdrive position; then, immediately release the accelerator, and press and release the clutch pedal. It is not necessary to move the shift lever when shifting from direct to overdrive; the transmission will shift when synchronization with the engine's speed is reached. Accelerate the engine only after the transmission has shifted.
11. To shift from 5th overdrive to 6th direct, partially disengage the clutch, shift into 6th—but before engaging the clutch—flip the splitter control button down into the direct drive position; then engage the clutch, and accelerate the engine.

    Do not move the control button while the shift lever is in neutral.
12. Shift upward through each of the high range gears, alternating the procedures in steps 10 and 11, above.

Downshifting

1. Downshift from 8th overdrive to 8th direct without moving the shift lever. Flip the splitter control button down to the direct drive position, then immediately release the accelerator, and press and release the clutch pedal. Accelerate the engine only after the transmission has shifted.
2. To downshift from 8th direct to 7th overdrive, flip the splitter control button up to the overdrive position, then immediately double-clutch through neutral, moving the shift lever from 8th to 7th gear.
3. Downshift through each of the high range gears alternating the procedures in steps 1 and 2, above, until reaching 5th direct.
4. While in 5th direct, and ready for the next downshift, push the range selection lever down into low range. Double-clutch through neutral, and shift into 4th gear. See **Fig. 8.17**. As the shift lever passes through neutral, the transmission will automatically shift from high range to low range.
5. With the transmission in low range, downshift through the low range gears as conditions require.

IMPORTANT: Never use the clutch brake when downshifting, or as a brake to slow the vehicle.

Meritor Engine Synchro Shift (ESS) Automated Models

General Information, ESS

9–Speed and 10–Speed M, MO, RS, and RSX Models

Meritor 9-speed and 10-speed automated transmissions do not require use of the clutch except to start and stop the vehicle.

NOTE: Meritor M and MO series ESS transmissions are available only on vehicles equipped with either Caterpillar or Cummins electronic

engines. Meritor RS and RSX series ESS transmissions are only available on vehicles equipped with Detroit Diesel electronic engines.

The ESS system works with the engine fuel control system to automatically synchronize engine rpm to road speed during gear changes. Use the clutch only to start and stop the vehicle and to shift into forward or reverse. The HI and LO ranges are automated, so the driver does not have to select ranges. A "break torque" feature allows the driver to move the shift lever and take the transmission out of gear without changing throttle position. Throttle position can be maintained while braking and downshifting through the gears when stopping the vehicle, as well as on steep grades.

The major components of the ESS system are the system switch, shift-intent switch, input and output shaft speed sensors, a Neutral position sensor, and an electro-pneumatic solenoid.

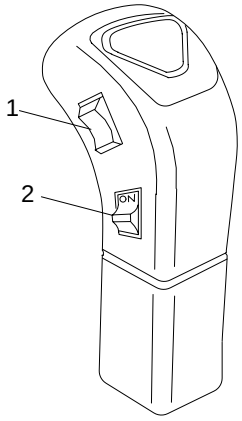
Operation, ESS

The ESS system collects and relays information pertaining to the positions of the shift-intent and system switches (**Fig. 8.18**), transmission input and output shaft speeds, and shift lever position. The information is received by the engine Electronic Control Module (ECM) which signals the fuel control system to increase or decrease engine rpm to match road speed. The ECM also controls HI and LO range selection in the auxiliary case on the rear of the transmission.

The system switch (**Fig. 8.18**) is the lower switch located on the driver's side of the shift handle. It controls ESS system operation. When in the down position, the system is operating and the word ON is visible on the switch. In the up position, the word OFF is visible, the system is not operating, and the transmission can be shifted manually.

The shift-intent switch (**Fig. 8.18**) is the upper switch on the driver's side of the shift handle. It has four positions and controls upshifting and downshifting by communicating to the ECM the driver's intention of changing gears.

NOTE: If the system switch is OFF, use the shift-intent switch to select between ranges. Push the top of the switch (**Fig. 8.19**) to select the HI range on upshifts and the bottom of the switch (**Fig. 8.20**) to select the LO range on downshifts.



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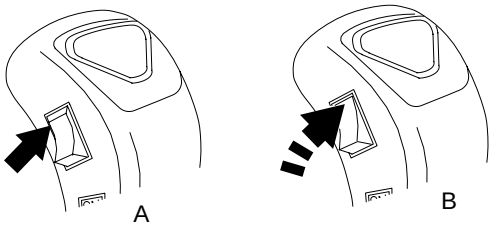
1. Shift-Intent Switch
2. System Switch

Fig. 8.18, ESS Shift Handle



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A. Press the top portion (engage the first position) of the shift-intent switch to begin an upshift.
B. Press the top portion again (engage the second position) to break torque.

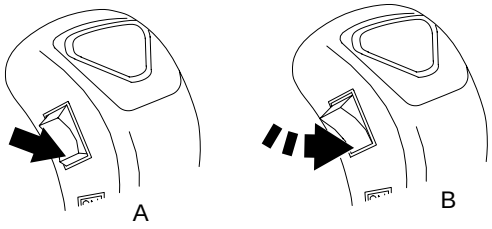
Fig. 8.19, ESS Upshifting Using the Shift-Intent Switch

⚠ WARNING

Ensure that the transmission is in neutral (N) when you start the vehicle. If the vehicle is started in gear, it will suddenly move forward or backward which could result in personal injury and damage to property and the transmission.

Starting the Vehicle

1. Ensure that the shift lever is in the neutral (N) position.



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A. Press the bottom portion (engage the first position) of the shift-intent switch to begin a downshift.
B. Press the bottom portion again (engage the second position) to break torque.

Fig. 8.20, ESS Downshifting Using the Shift-Intent Switch

2. Push the clutch pedal to the bottom of its travel to engage the clutch brake.
3. Start the engine.
4. Slowly release the clutch pedal.
5. Allow the system air to build up to the range specified on the gauge.
6. Release the parking brake.

Shifting Into a Starting Gear

CAUTION

Always use the proper starting gear. Do not shift into neutral and coast, as this will result in damage to the transmission.

1. Press the system switch down, into the ON position, to activate the ESS system.
2. Press the top portion of the shift-intent switch.

IMPORTANT: Use the clutch brake only when initially engaging a gear with the vehicle standing still.

3. Push the clutch pedal to the bottom of its travel so that the clutch brake stops the transmission input shaft from rotating.
4. Move the shift lever and engage a starting gear.
5. Slowly release the clutch pedal.

NOTE: If you do not shift the transmission out of neutral into a gear within two seconds, the ESS system will "time out" and deactivate. The transmission returns to manual operation. To reactivate the ESS system, press the shift-intent switch again. See the following procedures for upshifting and downshifting for instructions on how to use the shift-intent switch.

Upshifting

1. To upshift into the next higher gear:
   - 1.1 Press the top portion of the shift-intent switch.
   - 1.2 Apply pressure with the shift lever toward the neutral position.
   - 1.3 Press the top portion of the shift-intent switch again, far enough so that the switch goes into a second position inside the body of the shift handle. Then release the switch. See **Fig. 8.19**. This will break torque.
   - 1.4 Immediately move the shift lever to the neutral position.
   - 1.5 Allow engine rpm to slow down enough to synchronize with road speed.
   - 1.6 Move the shift lever to the next higher gear.
2. To upshift through the rest of the gears, repeat the substeps above. Before each upshift, push the top of the shift-intent switch into the shift handle body to break torque. The range shift is automatic.
3. To skip a gear, press the shift-intent switch into the shift handle body, while in Neutral, one time for every gear that is skipped.

Downshifting

1. To downshift into the next lower gear.
   - 1.1 Press the bottom portion of the shift-intent switch.
   - 1.2 Apply pressure with the shift lever toward the neutral position.
   - 1.3 Press the bottom portion of the shift-intent switch again, far enough so that the switch goes into a second position inside the body of the shift knob. Then release the switch. See **Fig. 8.20**. This will break torque.

1.4 Immediately move the shift lever to the neutral position.

1.5 Allow engine rpm to speed up enough to synchronize with road speed.

1.6 Move the shift lever to the next lower gear.

2. To downshift through the rest of the gears, repeat the substeps above. Before each downshift, push the bottom of the shift-intent switch into the shift handle body to break torque. The range shift is automatic.
3. To skip a gear, press the shift-intent switch into the shift handle, while in neutral, one time for every gear that is skipped.

Reverse

1. Press the system switch on the shift handle so that it is in the ON position and the ESS system is activated.
2. Push the clutch pedal to the bottom of its travel so that the clutch brake stops the transmission input shaft from rotating.
3. Move the shift lever and engage reverse.
4. Slowly release the clutch pedal and move the vehicle in the reverse direction.

NOTE: If a HI reverse range is required, follow the steps below.

5. Press the system switch on the shift handle so that it is in the OFF position and the ESS system is deactivated.
6. Press the top portion of the shift-intent switch to engage the HI range.
7. Push the clutch pedal to the bottom of its travel so that the clutch brake stops the transmission input shaft from rotating.
8. Move the shift lever and engage reverse.
9. Slowly release the clutch pedal and move the vehicle in the reverse direction.

See **Fig. 8.21** for two ESS 9-speed shift patterns and one ESS 10-speed shift pattern.

Eaton UltraShift DM

General Information, UltraShift DM

Eaton® Fuller® UltraShift™ DM is a ten-speed heavy-duty fully automated transmission. No clutch pedal is required to operate the vehicle.

UltraShift DM uses a dry clutch system which is offered only on this automated transmission system.

The UltraShift transmission uses the four-position SmartShift lever on the steering column to select gears. To know what gear the transmission is in, look at the round current gear indicator on the right-hand control panel as shown in **Fig. 8.22**. All forward shifts can be made either manually or automatically, at the driver's choice.

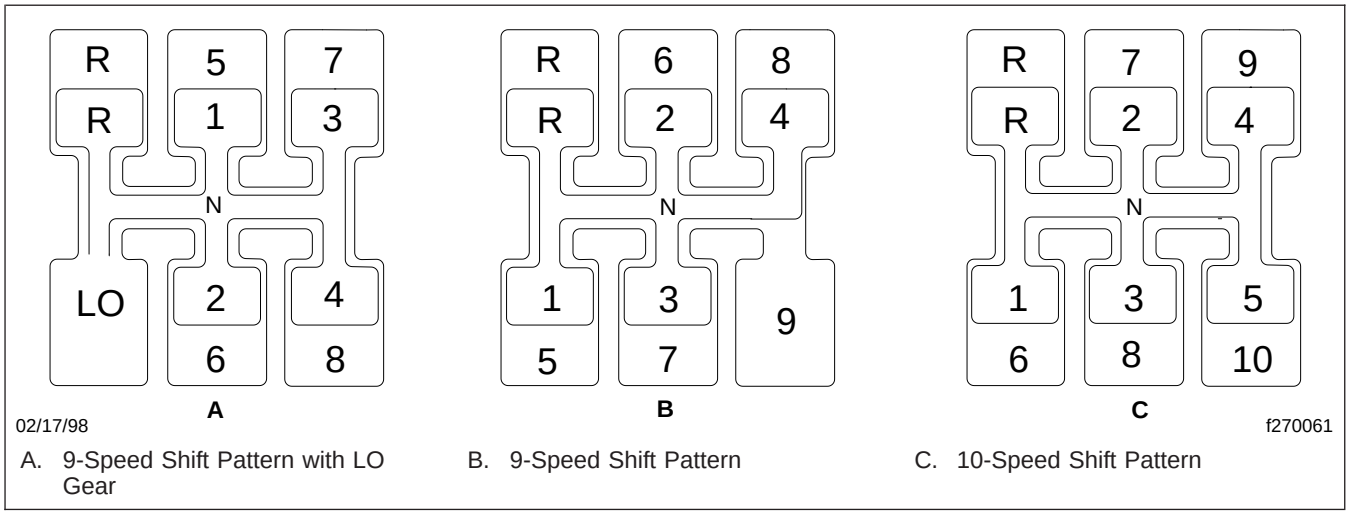
Operation, UltraShift DM

Power Up

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. 8.23**.
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. 8.24**.
4. Wait for the current gear indicator to show a solid "N." When the "N" is solid, rather than flashing, the UltraShift DM 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.

NOTE: When D is selected, the transmission controller starts up in second gear. If desired, 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. The vehicle will not move until the pedal is depressed.

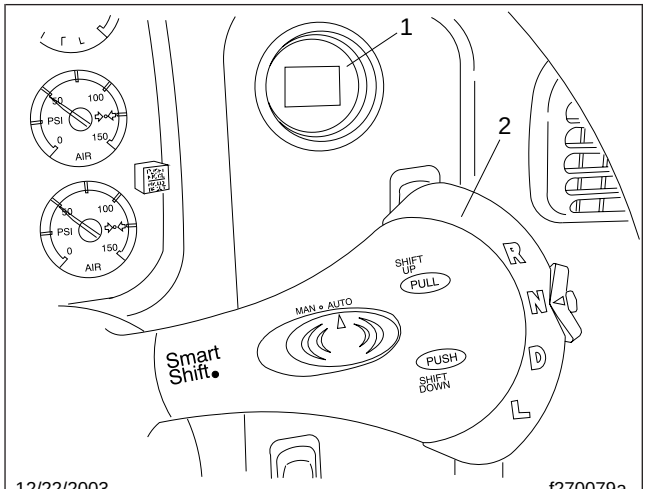


A. 9-Speed Shift Pattern with LO Gear

B. 9-Speed Shift Pattern

C. 10-Speed Shift Pattern

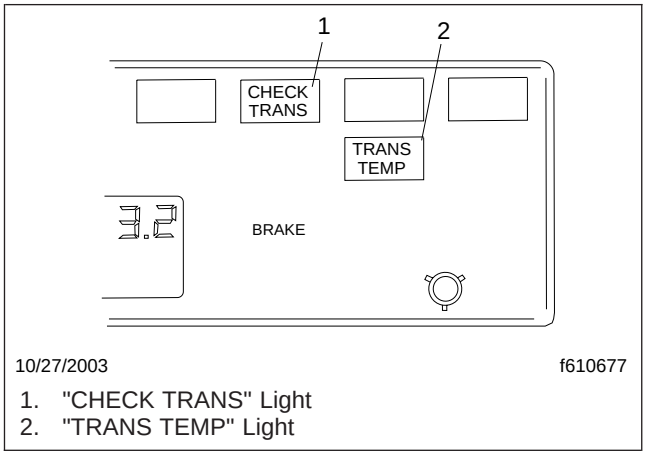
Fig. 8.21, Meritor ESS 9- and 10-Speed Shift Patterns



To know what gear the transmission is in, look at the current gear indicator.

1. Current Gear Indicator
2. SmartShift Control

Fig. 8.22, Shift Controls and Indicators, UltraShift Transmissions



1. "CHECK TRANS" Light
2. "TRANS TEMP" Light

Fig. 8.23, Telltale Lights

⚠ 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.

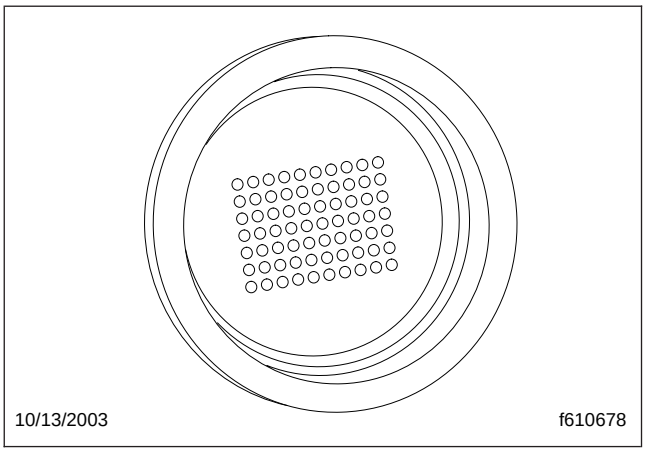


Fig. 8.24, Power-Up Dot Display

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 overheat.

Power Down

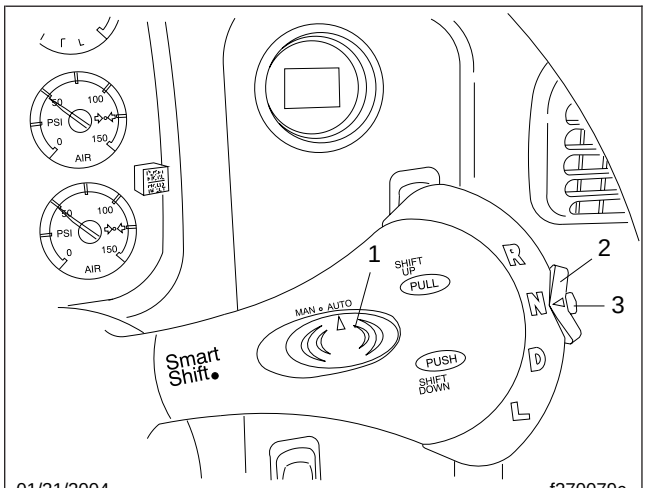
1. Apply the service brakes.
2. Select neutral (N) by pressing in the neutral lock button and moving the selector switch to N. When the "N" on the current gear indicator is solid, rather than flashing, the UltraShift DM TCU is ready to power down.
3. With the transmission in neutral, set the parking 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. 8.25**. The slide switch controls the forward driving mode, automatic or manual.

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

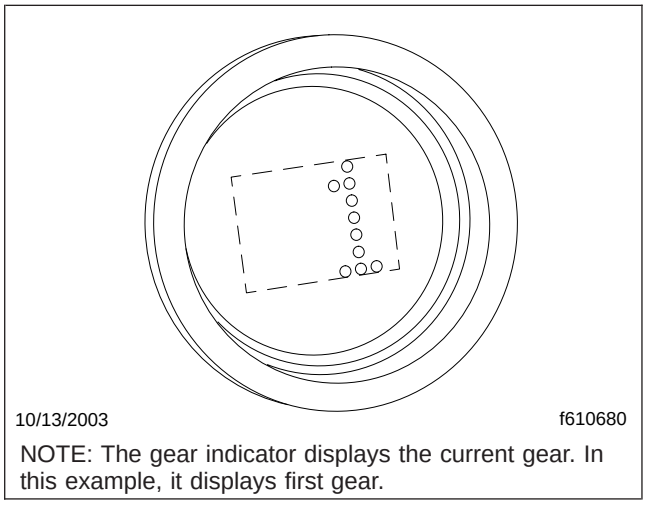


1. Slide Switch (controls forward driving mode)
2. Selector Switch (controls gear selection)
3. Neutral Lock Button (prevents accidental shift into gear)

Fig. 8.25, Switches, UltraShift Transmissions

load-based shift point for an automatic shift, the UltraShift DM TCU will advance the shift.

In either mode, the gear indicator displays the current gear. See **Fig. 8.26**.



NOTE: The gear indicator displays the current gear. In this example, it displays first gear.

Fig. 8.26, 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 DM 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 brakes as needed.

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.

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. See **Fig. 8.27**.

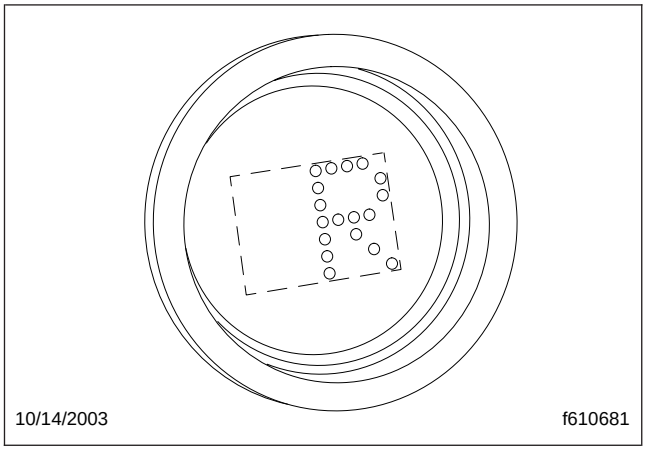


Fig. 8.27, Reverse Gear Display

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 or the vehicle slows to the proper speed.

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, press in the neutral lock button and move the selector switch to the position below R. When neutral is selected, the letter "N" displays on the current gear indicator. See **Fig. 8.28**.

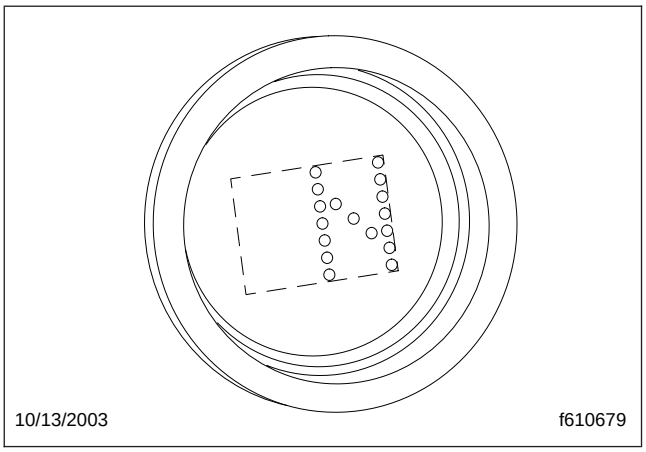


Fig. 8.28, Neutral Display

⚠ 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 10) displays on the gear indicator. See **Fig. 8.26**.

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 DM 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 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 DM 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 DM 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 DM 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 DM 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 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 DM TCU is programmed to prevent clutch abuse. When the clutch overheats, the following alerts take place:

- The "TRANS TEMP" light comes on
- The current 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. Set the parking brake.
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 current 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 DM 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 current gear indicator continues to display a dash, contact an authorized Freightliner or Eaton service facility.

9

Rear Axles

Meritor™ Single Drive Axles with Traction Equalizer

Some Meritor single drive axles are equipped with a traction equalizer that is a load sensing, self-actuating feature. A traction equalizer provides normal differential action where traction is good. When one wheel begins to spin faster than the other, clutch plates in the differential housing automatically engage, delivering power to both wheels. There is no operator control with this feature.

A traction equalizer occasionally tends to slip in a jerking motion, producing irregular intervals of sharp noises. This generally occurs when the vehicle is operating at low speeds on fairly sharp turns. This condition is corrected by adding a friction modifier to the axle lubricant. This additive tends to reduce the static coefficient of friction to a value equal to, or lower than, the sliding coefficient.

See **Group 35** of the *Columbia® Maintenance Manual* for additional information on friction modifiers and when to add them to axle lubricants.

⚠ CAUTION

Tire sizes on both rear wheels should be the same on axles equipped with a traction equalizer. If not, excessive wear may occur in the traction equalizer.

Meritor™ Drive Axles with Main Differential Lock

The Meritor main differential lock is a driver-controlled traction device operated from the vehicle cab. A switch allows the driver to lock or unlock the differential. An indicator light comes on when the differential lock is engaged. An optional buzzer can also be used to indicate differential lock engagement.

The main 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 traction of both wheels and protecting against spinout. Under normal traction conditions, do not engage the differential lock. Operate the axle with differential action between both wheels.

⚠ WARNING

Be especially careful when driving under slippery conditions with the differential locked. Though forward traction is improved, the vehicle can still slip sideways, causing possible loss of vehicle control, personal injury, and property damage.

Meritor™ Main Differential Lock Operation

To lock the main differential and obtain maximum traction under slippery conditions, move the control switch to the lock position.

⚠ WARNING

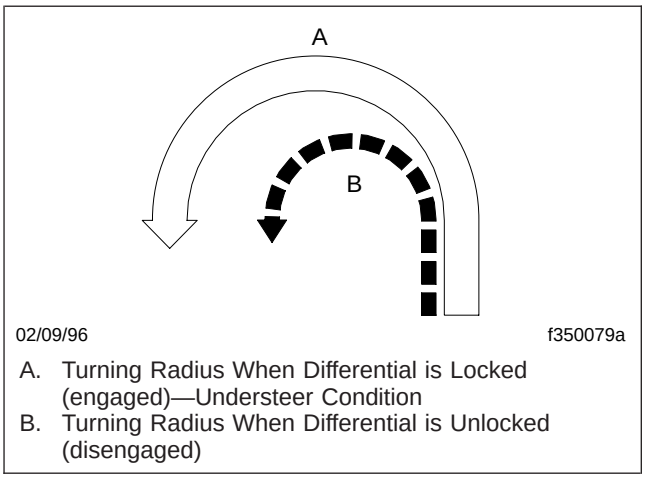
Lock the main differential only when the vehicle is standing still or moving less than 25 mph (40 km/h). Never lock the main differential when the vehicle is traveling down steep grades or when the wheels are slipping. This could damage the differential or lead to loss of vehicle control, causing personal injury and property damage.

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 differential to fully lock.

If the vehicle is moving, maintain a constant vehicle speed while engaging the differential lock. Briefly let up on the accelerator to relieve torque on the gearing, allowing the differential to fully lock. The indicator light should come on and the buzzer should sound on vehicles so equipped. When the differential is fully locked, the turning radius will increase because the vehicle understeers. See **Fig. 9.1**. Drive cautiously and do not exceed 25 mph (40 km/h).

To unlock the main differential, move the control switch to the unlock position. Briefly let up on the accelerator to relieve torque on the gearing, allowing the differential to fully unlock.

NOTE: If the differential lock system is connected through the low speed range of the transmission, shifting out of low speed range will also unlock the differential.



A. Turning Radius When Differential is Locked (engaged)—Understeer Condition
B. Turning Radius When Differential is Unlocked (disengaged)

Fig. 9.1, Turning Radius

When the differential lock disengages, the indicator light will go off and the buzzer will stop.

Meritor™ Tandem Drive Axles with Interaxle Differential

Meritor tandem drive axles with an interaxle differential have a lockout feature. Differential lockout is controlled by a switch (**Fig. 9.2**) on the control panel.

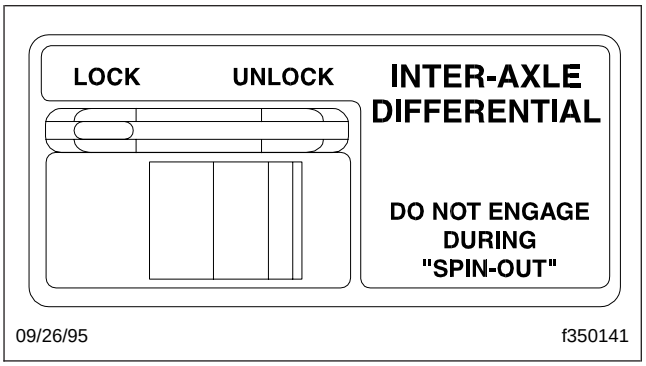


Fig. 9.2, Interaxle Differential Control

In the UNLOCK position, there is differential action between the two axles. The differential compensates for different wheel speeds and variations in tire size. Keep the interaxle differential unlocked for normal driving on roads where traction is good.

In the LOCK position, the interaxle differential is locked out and the driveshaft becomes a solid connection between the two axles. Power entering the forward axle is also transmitted straight through to the rear axle, so both axles turn together at the same speed. The LOCK position 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.

Meritor™ Interaxle Differential Lockout Operation

To lock the interaxle differential and achieve maximum pulling power when approaching slippery or poor road conditions, move the lockout control valve to LOCK while maintaining vehicle speed, before encountering the poor road conditions. Let up momentarily on the accelerator to engage the differential lock. Proceed over poor road conditions with caution. Do not wait until traction is lost and the tires are spinning before locking the interaxle differential.

⚠ CAUTION

Do not actuate the interaxle differential control valve while the tires are slipping. Do not operate the vehicle continuously with the interaxle differential locked during extended good road conditions. To do so could result in damage to the axle gearing and excessive tire wear.

To unlock the interaxle differential, move the lockout control valve to UNLOCK while maintaining vehicle speed, after leaving the poor road conditions. Let up momentarily on the accelerator to allow the shift, then resume driving at normal speed.

Dana Spicer® Axles with Controlled Traction Differential

The controlled traction differential system is a differential assembly designed to transfer torque from the slipping wheel to the one with traction.

A control valve (**Fig. 9.3**) in the cab is actuated by the driver to engage and disengage the controlled traction feature.

Disengaged, the axle has differential action all the time. One wheel will spin independently of the other, if slippery conditions are encountered.

Engaged, wheel slippage and spinout are minimized.

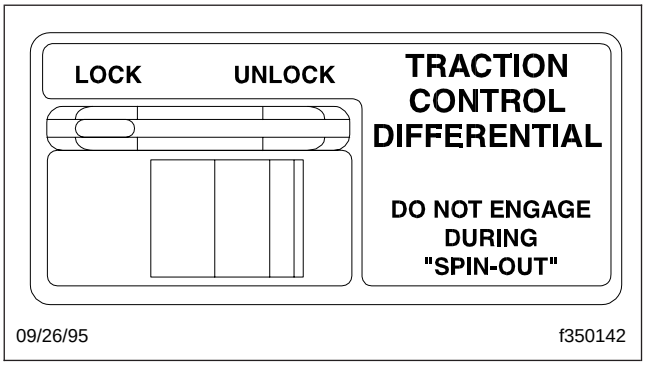


Fig. 9.3, Traction Control Differential Control

NOTE: The controlled traction differential can be engaged at any speed, except when one wheel is spinning.

Dana Spicer® Interaxle Differential Lockout Operation

Interaxle differential lockout systems include a lockout control valve (**Fig. 9.4**) located in the cab, and an air-operated shift unit mounted on the forward rear axle.

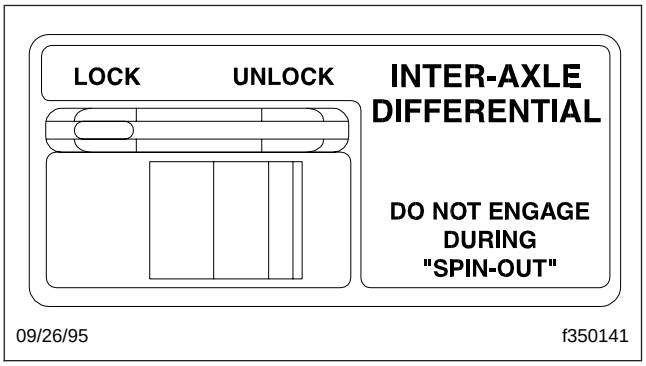


Fig. 9.4, Interaxle Differential Control

When the interaxle differential lockout control valve is in the LOCK position, the interaxle differential is locked out and the driveshaft becomes a solid connection between the two axles. Power entering the forward axle is also transmitted straight through to the rear axle, so both axles turn together at the same speed. The LOCK position should be used only when additional traction is needed.

⚠ CAUTION

Engage the lockout only when stopped or at slow speeds and never when the wheels are spinning. Do not operate the axles on dry pavement with the lockout engaged for prolonged periods. Use only when additional traction is needed under adverse road conditions. Disengage the interaxle differential lockout before shifting the axle to a higher range.

When the interaxle differential lockout control valve is in the UNLOCK position, the interaxle differential allows differential action between the axles thereby compensating for different wheel speeds and variations in tire size. Keep the interaxle differential lockout in the UNLOCK position for normal driving on roads where traction is good.

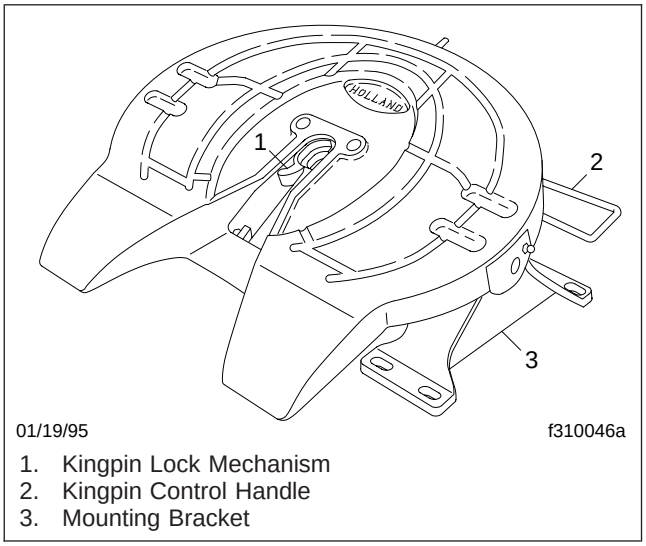
10

Fifth Wheels and Trailer Couplings

Holland Fifth Wheels

General Information

The 2535 sliding fifth wheel models incorporate a Model 3500 fifth wheel (**Fig. 10.1**), equipped with either an air-operated release slide, or a manual release slide. Sliding fifth wheel assemblies are mounted on a baseplate that permits forward and rear movement along notched rails. Plungers are meshed into teeth on the baseplate to lock the sliding mechanism. Disengagement of the sliding member is accomplished when the plungers are withdrawn (manually or air-operated), releasing the fifth wheel assembly so that it can be positioned for optimum weight distribution over the tractor axles.



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1. Kingpin Lock Mechanism
2. Kingpin Control Handle
3. Mounting Bracket

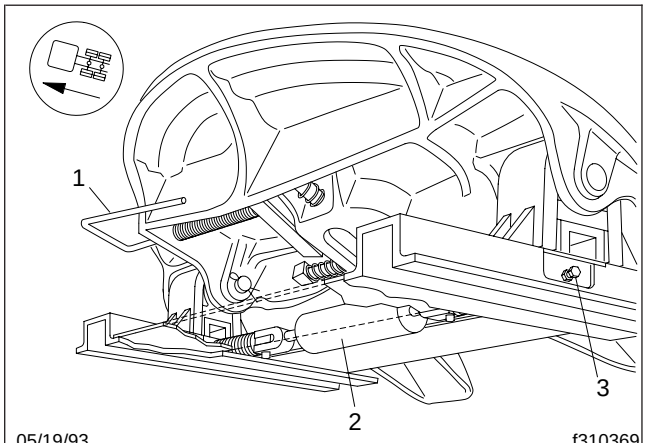
Fig. 10.1, Holland Fifth Wheel

The air-operated release slide assembly (**Fig. 10.2**) contains a double-ended air cylinder which locks and unlocks both sides of the sliding member at the same time. The air cylinder is activated by a two-position air-control valve in the tractor cab.

The manual release slide assembly (**Fig. 10.3**) is equipped with a single release lever. Pulling on the release lever unlocks both plungers.

Type "B" Kingpin Lock Mechanism

The Type "B" kingpin lock mechanism (**Fig. 10.4**) utilizes two spring-loaded lock halves. The final forward motion of the kingpin into the open lock halves forces the locks to close in a 360-degree grip around



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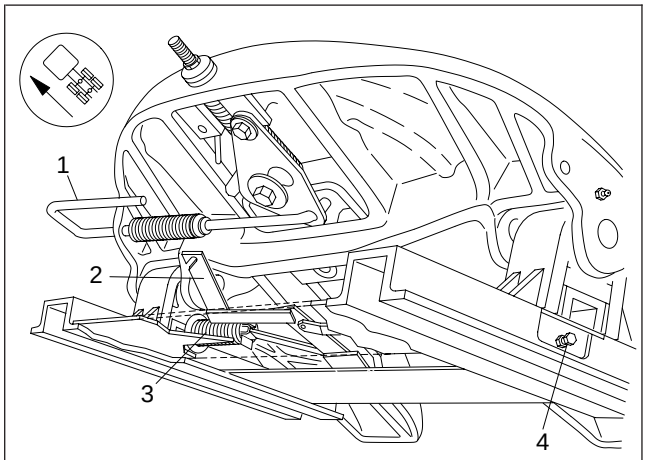
NOTE: Baseplate rails not shown.

1. Kingpin Lock Control Handle
2. Double-Ended Air Cylinder
3. Slide Plunger Release

Fig. 10.2, Air-Operated Release Slide Assembly



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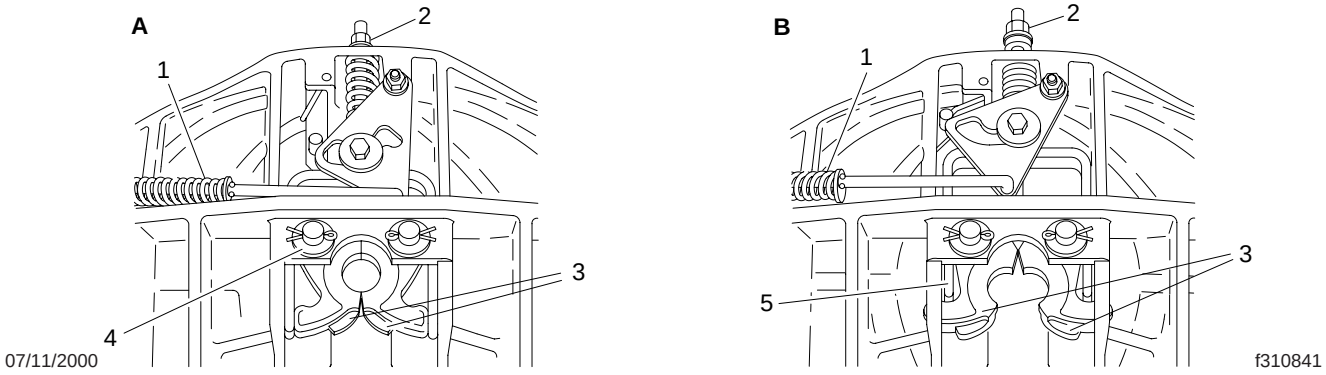
NOTE: Baseplate rails not shown.

1. Kingpin Lock Control Handle
2. Plunger Release Handle
3. Plunger Release Spring
4. Plunger

Fig. 10.3, Manual Release Slide

the shoulder and neck of the kingpin, positioning sliding yokes between the lock halves and tapered rib members of the fifth wheel understructure. The kingpin can be released only by manually operating the



A. Closed Position, Locked
1. Release Handle and Spring
2. Adjustment Nut
3. Lock Halves
4. Lock Pivot

B. Open Position, Unlocked
5. Sliding Yoke

Fig. 10.4, Type "B" Kingpin Lock Mechanism (bottom view)

kingpin lock control handle. The adjustment nut will compensate for wear on the lock or kingpin.

Lockguard

The Holland lockguard (**Fig. 10.5**) is a device that prevents a false lockup, and is used on all models. The Lockguard is a spring-tensioned, smooth-surfaced tongue that the kingpin passes over and depresses when entering the lock mechanism. The Lockguard will prevent the locks from engaging before the kingpin fully enters the locks. If the kingpin enters the fifth wheel incorrectly and does not depress the tongue, the locks are unable to close.

Fifth Wheel Locking Operation

Locking the Fifth Wheel Mechanism

⚠ CAUTION

Before attempting to lock or unlock the fifth wheel lock mechanism of a sliding type fifth wheel, the slide release plungers must be in the locked position. This prevents the sliding member from moving rapidly to the far forward or rearward position, which could damage the fifth wheel or kingpin.

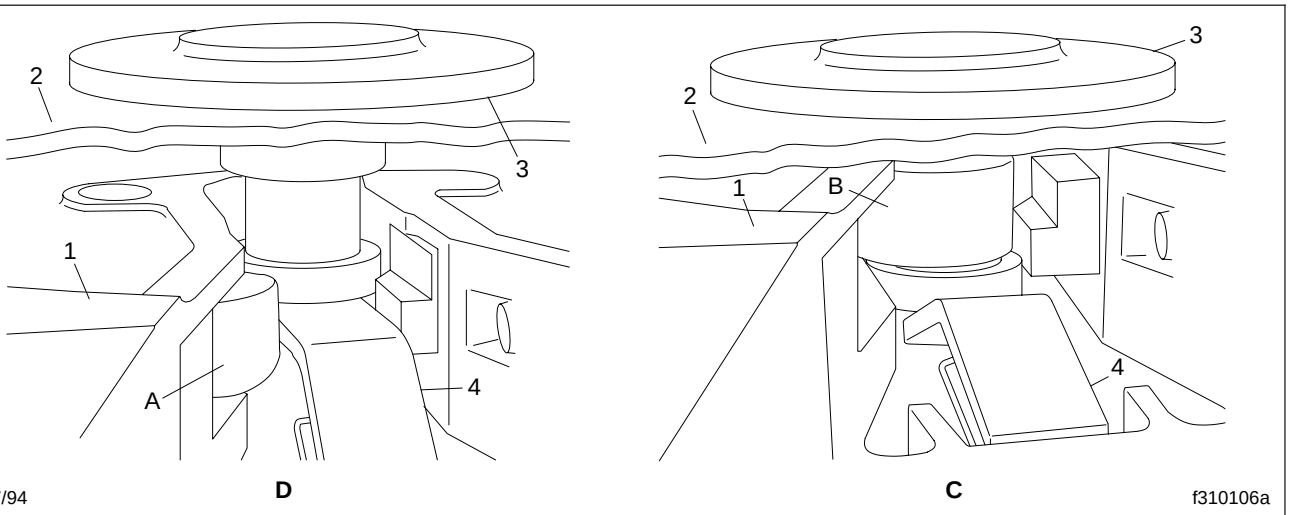
1. Chock the front and rear of the trailer tires to prevent the trailer from moving.

⚠ 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 serious personal injury or death.

2. The kingpin lock mechanism must be fully open, and the fifth wheel plate must be completely lubricated with chassis grease. For lubrication instructions, see **Group 31** of the *Columbia® Maintenance Manual*.
3. Position the tractor so that the fifth wheel lock opening is in line (both vertically and horizontally) with the trailer kingpin. The kingpin should be in a position to enter the throat of the locking mechanism, to prevent a false lockup. See **Fig. 10.5**. Adjust the trailer landing gear to give enough alignment height so that the fifth wheel picks up the trailer on the fifth wheel ramps.
4. With the fifth wheel lock opening aligned with the trailer kingpin, back the tractor slowly toward the trailer, making sure that the kingpin correctly enters the throat of the locking mechanism. When the trailer is picked up by the fifth wheel, stop the tractor, then continue slow backward motion until positive lockup occurs.
5. Apply the tractor parking brakes.

Fifth Wheels and Trailer Couplings



A. Locks open.
B. Locks closed.
C. Kingpin correctly entering the lock. Note how the depressed tongue allows lock halves to close completely around the neck and shoulder of the kingpin.
D. Kingpin incorrectly entering the lock. Note how the steel tongue prevents lock halves from closing, preventing false lockup.

1. Fifth Wheel Plate
2. Trailer
3. Kingpin
4. Lockguard

Fig. 10.5, Lockguard Mechanism (rear view)

⚠ WARNING

Adjust the locks correctly to a maximum clearance of 1/8 inch (3 mm). Incorrect adjustment of the lock could cause the trailer to disconnect, possibly resulting in serious personal injury or death.

6. Make a visual check for proper kingpin lockup. Release the tractor parking brakes. Test for kingpin lockup by pulling on the trailer against the chocks. Check for correct maximum clearance between the lock halves. If more than 1/8-inch (3.2-mm) clearance exists between the lock halves, the lock must be adjusted. See **Group 31** of the *Columbia® Workshop Manual* for adjustment procedures.
7. After lockup is completed, connect the tractor-to-trailer air system lines and electrical cable to the trailer. Take care to prevent dirt or foreign material from entering the air lines.
8. Charge the air brake system with air. Make sure that the air connections do not leak.
9. Retract the trailer landing gear and secure the ratchet handle.
10. Remove the chocks from the trailer tires.
11. The 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.

⚠ WARNING

Do not overload any tractor axle by improperly loading the trailer. This could cause erratic steering and loss of vehicle control, possibly resulting in serious personal injury or death.

Unlocking the Fifth Wheel Lock Mechanism

1. Apply the tractor parking brakes.
2. Pull the trailer air supply valve to cut off the air supply to the trailer.
3. Chock the front and rear of the trailer tires to prevent the trailer from moving.

⚠ WARNING

Do not use the trailer air supply for parking trailers not equipped with spring parking brakes. This applies the trailer service brakes only. As air bleeds from the trailer brake system, brake application is lost. This could allow the unattended vehicle to roll away, possibly resulting in serious personal injury or death.

4. Lower the trailer landing gear until the weight is removed from the fifth wheel.
5. 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.

⚠ CAUTION

Before attempting to lock or unlock the fifth wheel lock mechanism of a sliding type fifth wheel, the slide release plungers must be in the locked position. This prevents the sliding member from moving rapidly to the far forward or rearward position, which could damage the fifth wheel or kingpin.

6. Release the kingpin locking mechanism by pulling the kingpin lock control handle (**Fig. 10.1**) to the outward position.
7. Slowly drive the tractor away from the trailer.

Fifth Wheel Slide Operation

1. Connect the trailer kingpin to the tractor fifth wheel. For instructions, refer to Holland "Fifth Wheel Locking Operation" in this chapter.
2. After positive lockup of the fifth wheel lock mechanism has been accomplished, release the sliding member using one of the following methods:

   2.1 For air-operated models, set the cab-operated control switch (**Fig. 10.6**) to UNLOCK.

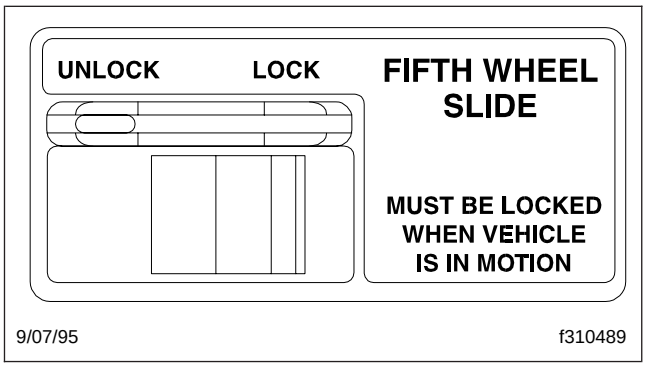


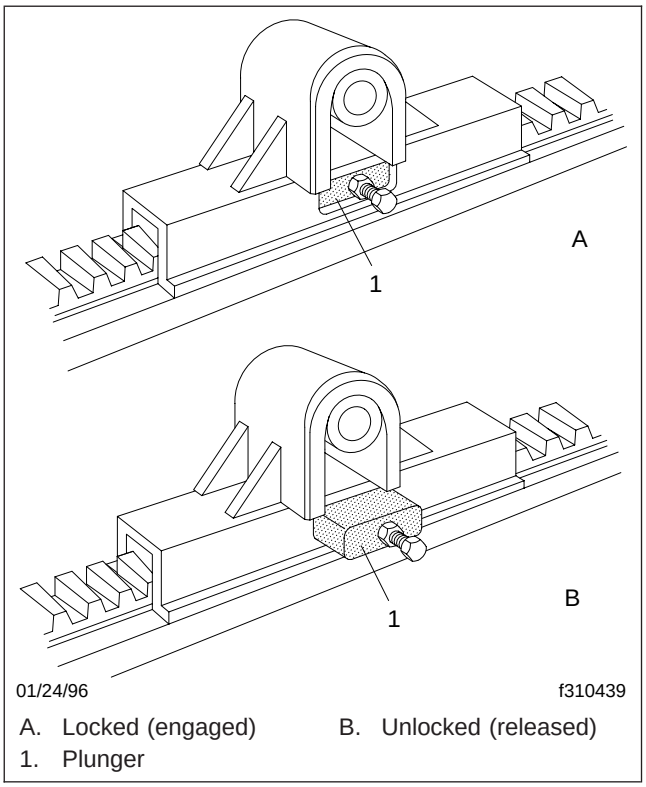
Fig. 10.6, Cab Control, Fifth Wheel Slide

   2.2 For manual release models, pull the release lever (**Fig. 10.3**) using a release hook, or other suitable tool. Make sure both slide plungers have released. See **Fig. 10.7**. If the plungers haven't released (haven't come out), lower the trailer landing gear to relieve pressure on the plungers.

3. Lower the trailer landing gear just enough to remove the weight from the tractor.
4. Pull the trailer air supply valve to cut off the air supply to the trailer.
5. Chock the front and rear of the trailer tires to prevent the trailer from moving.

⚠ WARNING

Do not use the trailer air supply for parking trailers not equipped with spring parking brakes. This applies the trailer service brakes only. As air bleeds from the trailer brake system, brake application is lost. This could allow the unattended



A. Locked (engaged) B. Unlocked (released)
1. Plunger

Fig. 10.7, Plunger Positions

vehicle to roll away, possibly resulting in serious personal injury or death.

⚠ CAUTION

After 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.

6. Slowly move the tractor forward or backward until the fifth wheel is in the desired location.
7. Apply the tractor parking brakes.

NOTE: The fifth wheel may have to be moved slightly to enable the locking plungers to enter the fully locked position.

8. Lock the sliding member into position using one of the following methods:

⚠ WARNING

Check to be sure that the slide plungers are in the locked position. Failure to achieve complete lockup may allow disengagement of the tractor from the trailer, possibly resulting in serious personal injury or death.

8.1 For air-operated models, set the cab-operated control switch to LOCK. Visually check the slide plungers to make sure they are engaged in the fully locked position. See **Fig. 10.7**.

8.2 For manual release models, trip the release lever (**Fig. 10.3**) using a release hook or other suitable tool. Make sure that both plungers have locked (retracted into their pockets), and are fully engaged in the rack teeth. See **Fig. 10.7**. It may be necessary to move the tractor slightly while keeping the trailer brakes locked.

9. 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.

⚠ WARNING

Do not overload any tractor axle by improperly loading the trailer. This could cause erratic steering and loss of vehicle control, possibly resulting in serious personal injury or death.

Fifth Wheel Lubrication

⚠ WARNING

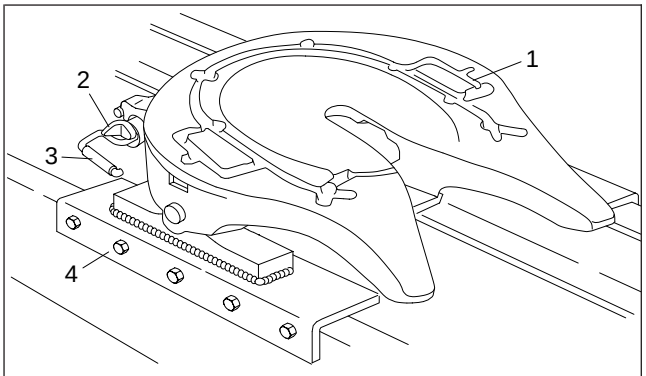
Keep the fifth wheel plate lubricated to prevent binding between the tractor and trailer. A binding fifth wheel could cause erratic steering and loss of vehicle control, possibly resulting in serious personal injury or death.

For lubrication instructions, see **Group 31** of the *Columbia® Maintenance Manual*.

ASF Simplex Series Fifth Wheels

General Information

The ASF Simplex series fifth wheels are used for pulling trailers having the standard 2-inch (51-mm) diameter kingpin. When installed as a stationary fifth wheel (**Fig. 10.8**), they are bracket-mounted to the tractor frame in a position that best distributes the trailer load over the tractor axles. When used as a sliding fifth wheel (**Fig. 10.9**), they are mounted on the Taperloc® sliding mount (air-operated or manual release).



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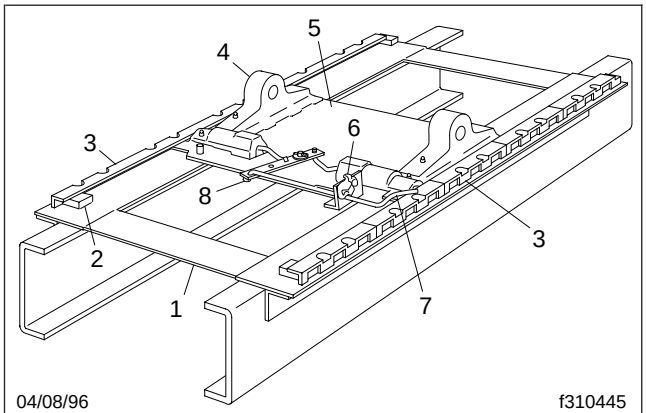
1. Lubricant Grooves
2. Safety Latch
3. Operating Rod
4. Mounting Bracket

Fig. 10.8, Simplex Stationary Fifth Wheel

The fifth wheel lock mechanism for the trailer kingpin consists of a rotating jaw that grips the trailer kingpin and a spring-actuated lock. The jaw rotates on a jaw pin during coupling and uncoupling operations. Kingpin lockup occurs when the kingpin is forced into the jaw and the operating rod handle moves to the locked position. The kingpin is released either by activating a manual operating rod, or if equipped with Touchloc®, by a dash-mounted release knob that activates an air cylinder underneath the top plate. The air cylinder activates the operating rod. The operating rod is located on the left side of the fifth wheel for Simplex II fifth wheels, and on the right side for the Simplex fifth wheel assembly.



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1. Baseplate
2. Bolted Stop
3. Baseplate Rail
4. Fifth Wheel Mount
5. Slider Saddle Plate
6. Safety Latch
7. Operating Rod
8. Operating Lever

Fig. 10.9, Taperloc Slide, Manually Operated Release

On sliding fifth wheels, the top plate is mounted on a sliding saddle plate that slides along the baseplate attached to the tractor frame. The baseplate rails allow forward and rear movement of the slide assembly, for optimum weight distribution over the tractor axles.

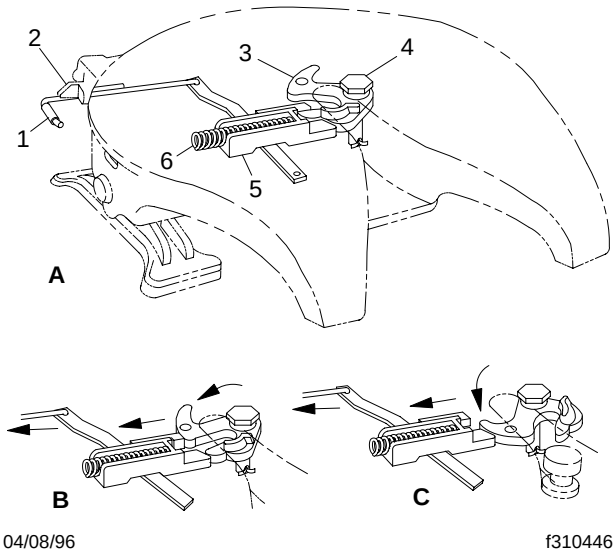
Tapered slots in the baseplate rails, aligned in 4-inch (102-mm) increments, provide for location of the fifth wheel along the baseplate. Retractable, spring-actuated lockpins are positioned through the slots to hold the fifth wheel in the desired position. The lockpins are retracted either manually or by an air-operated cylinder controlled from the cab.

The manually operated slide contains an operating rod (**Fig. 10.9**) that unlocks both sides of the plate at the same time.

The air-operated sliding saddle plate contains an air cylinder that moves the operating lever to unlock both sides of the plate at the same time. The air cylinder is activated by a two-position air-control valve in the tractor cab.

Fifth Wheel Lock Mechanism for Trailer Kingpin

The Simplex Series fifth wheel lock mechanism (**Fig. 10.10**) consists of a rotating jaw and a spring-actuated lock that grips the trailer kingpin. The jaw rotates on an eccentric pin during coupling and uncoupling operations. The spring-actuated lock holds the jaw in the locked position once kingpin lockup has occurred.



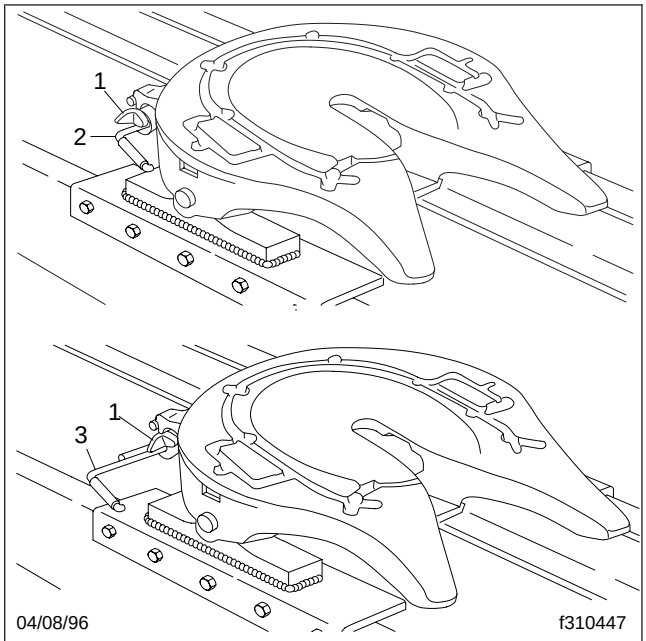
A. Locked Position
B. Jaw movement compresses spring
C. Fully open

1. Operating Lever
2. Safety Latch
3. Jaw
4. Jaw Eccentric Pin
5. Lock
6. Spring

Fig. 10.10, ASF Simplex Series Kingpin Locking Mechanism Operation

In the locked position, there is approximately 1/16-inch (1.6-mm) clearance between the jaw and kingpin. The jaw eccentric pin can be removed and rotated to compensate for wear and maintain an approximate 1/16-inch (1.6-mm) clearance during service.

Placing the operating rod in the lockset position moves the lock away from the jaw. This action unlocks the jaw so that it can be rotated by movement of the kingpin. When the tractor is moved out from under the trailer, the kingpin will rotate the jaw until the jaw is in the unlocked position, allowing the kingpin to move out of the mechanism. With the jaw in the fully open position, the operating rod drops out of the lockset position, and the fifth wheel is ready for coupling. See **Fig. 10.11**.



1. Safety Latch
2. Operating Rod (locked)
3. Operating Rod (unlocked)

Fig. 10.11, Simplex Kingpin Locking Mechanism, Locking and Unlocking

During coupling, the kingpin contacts and rotates the jaw into the locked position. This action automatically moves the operating rod into the locked position. This securely locks the jaw around the kingpin. In the locked position the safety latch swings freely over the operating rod. See **Fig. 10.12**.

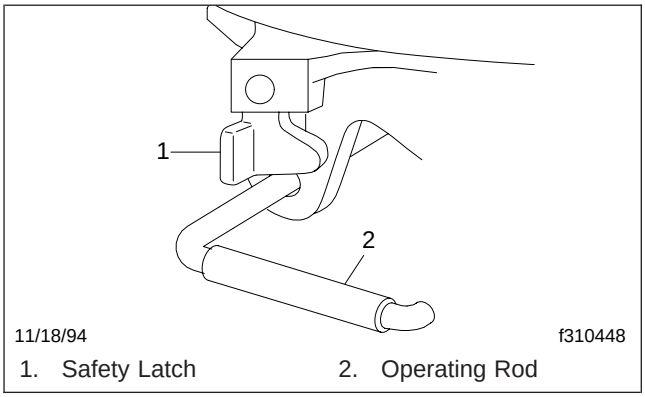
Fifth Wheel Locking and Unlocking

Locking the Fifth Wheel Lock Mechanism

1. Chock the front and rear of the trailer tires to prevent the trailer from moving.

⚠ CAUTION

Before attempting to lock the fifth wheel lock mechanism of a sliding type fifth wheel, the slide locking handle must be in the locked position. This prevents the sliding member from moving



1. Safety Latch 2. Operating Rod

Fig. 10.12, Simplex Kingpin Locking Mechanism, Safety Latch (locked position)

rapidly to the far forward or rearward position, which could damage the fifth wheel member or kingpin.

2. The fifth wheel jaw must be fully open. Make sure that the operating rod is in the unlocked position. The fifth wheel must be completely lubricated with chassis or multi-purpose grease. For lubrication instructions, see **Group 31** of the *Columbia® Maintenance Manual*.

⚠ 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 serious personal injury or death.

3. Make sure the fifth wheel top plate is tilted so the ramps are as low as possible. If equipped with an air suspension, make sure the air bags are completely inflated.
4. 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. See **Fig. 10.10**. Adjust the trailer landing gear so that the lower front trailer edge contacts the top surface of the tilted fifth wheel plate, approximately 8 inches (20 cm) before the fifth wheel center.
5. With the fifth wheel lock opening aligned with the trailer kingpin, back the tractor slowly toward the trailer, making sure that the kingpin enters the throat of the locking mechanism. Continue backward motion until positive lockup occurs.
6. Apply the tractor parking brakes.
7. Make a visual check (even if equipped with the Touchloc air-operated system) for positive kingpin lockup. The trailer bed plate must be flush on the fifth wheel plate surface. When positive lockup has occurred, the fifth wheel operating rod will have moved inward to the locked position, and the safety latch will swing freely over the operating rod. See **Fig. 10.12**.

NOTE: Only when the operating rod is fully retracted in the locked position will the safety latch be freely rotated down.

8. Release the tractor parking brakes. Test for kingpin lockup by pulling on the trailer against the chocks.
9. After lockup is completed, connect the tractor-to-trailer air system lines and electrical cable to the trailer. Take care to prevent dirt or foreign material from entering the air system lines.
10. Charge the air brake system with air. Make sure that the air connections do not leak.

⚠ WARNING

Adjust the jaw pin if there is more than 1/8-inch (3-mm) clearance between the kingpin and the lock. Incorrect adjustment could cause the trailer to disconnect, possibly resulting in serious personal injury or death.

11. 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. A clearance of approximately 1/16 inch (1.6 mm) between the jaw and kingpin is allowable. When clearance between the jaw and kingpin exceeds 1/8 inch (3 mm), adjust the jaw to restore the 1/16-inch (1.6-mm) clearance between the jaw and kingpin. For instructions, see **Group 31** of the *Columbia® Workshop Manual*.
12. Retract the trailer landing gear, and secure the ratchet handle.
13. Remove the chocks from the trailer tires.

14. The 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 ratings given on the FMVSS or CMVSS label.

⚠ WARNING

Do not overload any tractor axle by improperly loading the trailer. This could cause erratic steering and loss of vehicle control, possibly resulting in serious personal injury or death.

Unlocking the Fifth Wheel Lock Mechanism

1. Apply the tractor parking brakes.
2. Pull the trailer air supply valve to cut off the air supply to the trailer.

⚠ WARNING

Do not use the trailer air supply for parking trailers not equipped with spring parking brakes. This applies the trailer service brakes only. As air bleeds from the trailer brake system, brake application is lost. This could allow the unattended vehicle to roll away, possibly resulting in serious personal injury or death.

3. Chock the front and rear of the trailer tires to prevent the trailer from moving.
4. Lower the trailer landing gear until the trailer rises about 1/2 inch (13 mm).
5. 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.

⚠ CAUTION

Before attempting to unlock the fifth wheel lock mechanism of a sliding type fifth wheel, the slide operating rod must be in the locked position, and the slide lockpins must be in the locked position (fully inserted in baseplate rail slots). This prevents the sliding member from moving rapidly to the far forward or rearward position, which could damage the fifth wheel member or kingpin.

6. *If equipped with a manual kingpin lock release:* Release the kingpin lock mechanism by raising the safety latch to the rear and pulling the lock operating rod out and up into the lockset position. See **Fig. 10.11**. The offset of the lock control upper rod should bottom against the plate casting above the hole. If the operating rod cannot be pulled to the lockset position, back the tractor slightly to release the kingpin force against the jaw.

   If equipped with an air-operated kingpin lock release: Pull the air-release knob on the dash. *From outside the cab,* visually check that the operating rod has bottomed out against the plate casting above the hole. See **Fig. 10.11**. If the operating rod isn't in the unlocked position, back the tractor slightly to release the kingpin force against the jaw.

IMPORTANT: If equipped with an air-operated lock release, you still must make a visual check of the operating rod to make sure it is in the unlocked position

7. Slowly drive the tractor away from the trailer.

Fifth Wheel Slide Operation

1. Chock the front and rear of the trailer tires to prevent the trailer from moving.
2. Connect the trailer kingpin to the tractor fifth wheel. For instructions, refer to "Fifth Wheel Locking Operation," in this chapter.
3. After positive lockup of the fifth wheel lock mechanism has been accomplished, release the slide using one of the following methods:

   3.1 For air-operated models, set the cab-operated control switch (**Fig. 10.13**) to UNLOCK.

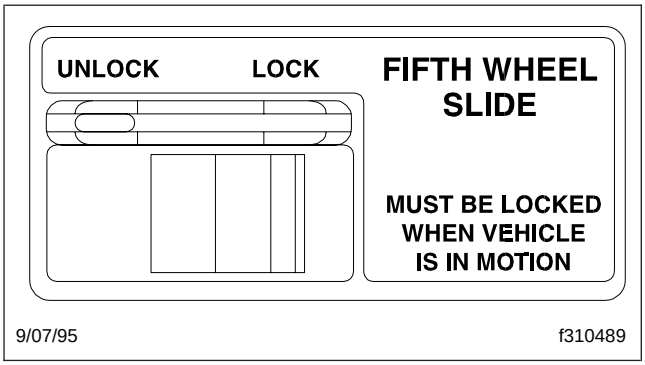


Fig. 10.13, Cab Control, Fifth Wheel Slide

3.2 For manually operated models, raise the safety latch and pull the slide operating rod (**Fig. 10.9**) outward until the shoulder is outside of the operating rod support, then lower the operating rod as far as it will go.

4. Lower the trailer landing gear just enough to remove the weight from the tractor.

5. Pull the trailer air supply valve to cut off the air supply to the trailer.

⚠ CAUTION

After 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.

6. Slowly move the tractor forward or backward until the fifth wheel is in the desired location.

7. Apply the tractor parking brakes.

⚠ WARNING

Check to be sure that the lockpins are seated in the holes and that the operating rod is in the locked position with the safety latch securing the operating rod. Failure to achieve complete lockup may cause the trailer to detach from the tractor, possibly resulting in serious personal injury or death.

NOTE: The fifth wheel may have to be moved slightly to enable the locking pins to enter the fully locked position.

8. Lock the sliding member into position using one of the following methods:

   For air-operated models: Set the cab-operated control switch to LOCK. Visually inspect the lockpins to make sure they have seated in the baseplate rail holes.

   For manually operated models: Raise the operating rod so that it is free to move inward. Make sure that the lockpins have seated in the baseplate rail holes and the operating rod moves into the locked position. Also, the safety latch must drop downward so that it holds the operating rod in the locked position.

9. 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.

⚠ 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.

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 serious personal injury or death.

The 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 lubrication instructions, see **Group 31** of the *Columbia® Maintenance Manual*.

Fontaine Fifth Wheels

General Information

The Fontaine sliding fifth wheel mount is designed to provide optimum axle loading for maximum tractor use with different lengths and types of trailers. The sliding fifth wheel mount is used with the Fontaine H5092 series fifth wheel and the Fontaine 6000/7000 No-Slack II series, and is equipped with either an air-operated release slide (HAWB or AWB model), or a manual release slide (HMWS or MWS model).

On Fontaine fifth wheels, kingpin release is accomplished by activating a manual lock control handle located on either the right side or left side of the fifth wheel. Kingpin lockup occurs when the kingpin is forced into the jaws and the lock control handle moves to the locked position.

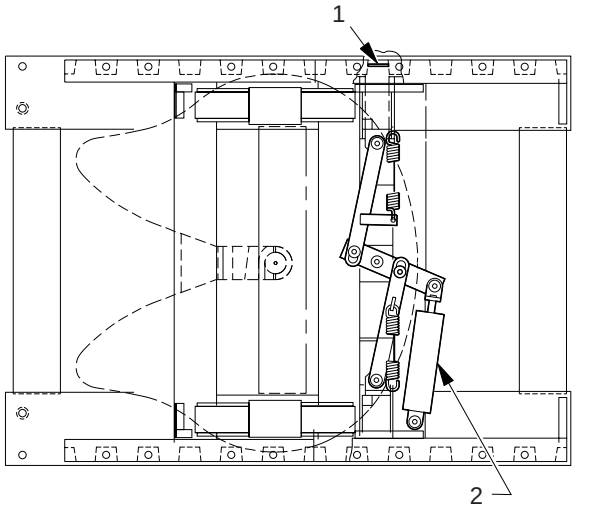
The fifth wheel top plate is mounted on a slide assembly, which is attached to slide rails that are mounted on the vehicle frame. The slide rails permit forward and rearward movement of the slide assembly, allowing for optimum weight distribution over the tractor axles.

Slots are evenly spaced along the slide rails, and retractable tapered wedges are positioned through the slots to hold the fifth wheel in the desired position. See **Fig. 10.14** or **Fig. 10.15**.

The slide portion of the sliding model may be attached to either an air-operated release slide, or a manual release slide.

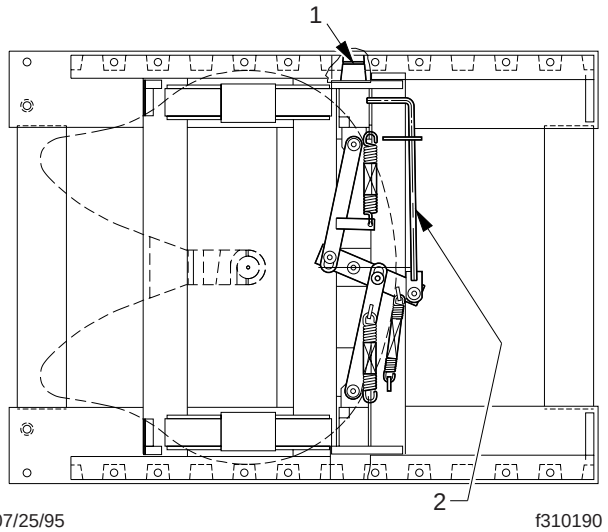
The air-operated release slide contains an air cylinder that locks and unlocks the fifth wheel slide. See **Fig. 10.14**. The air cylinder is activated by a two-position air-control valve in the tractor cab.

The manual release slide contains a slide release pull handle, located on the left side of the fifth wheel, which locks or unlocks the fifth wheel slide. See **Fig. 10.15**.



1. Locking Wedge
2. Air Cylinder

Fig. 10.14, Air-Operated Sliding Fifth Wheel Mount, AWB Model



1. Locking Wedge
2. Slide Release Pull Handle

Fig. 10.15, Manual Release Sliding Fifth Wheel Mount, MWS Model

Fifth Wheel Lock Mechanism for Trailer Kingpin

The Fontaine fifth wheel lock mechanism for the trailer kingpin (**Fig. 10.16**) consists of a spring-loaded jaw and a sliding wedge.

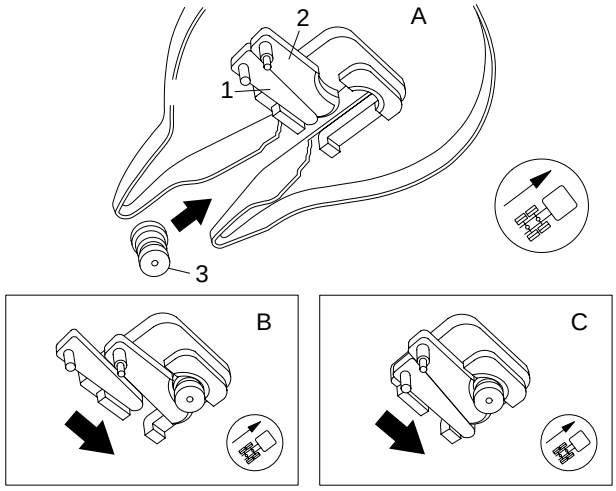


Fig. 10.16, Fontaine Kingpin Lock Mechanism

The jaw and wedge each have a pin permanently attached. The pin on the jaw and the pin on the wedge fit into elongated notches in the lock control handle. The notches in the handle control the limit of movement for both the jaw and wedge. The notches are arranged so that the wedge is actuated first during release of the kingpin.

During lockup, the jaw is moved first with the spring-loaded wedge being allowed to slip in place against the jaw. A timing bracket ensures that the wedge and jaw are moved at the proper time.

Placing the lock control handle in the unlocked position moves the wedge away from the jaw. This action unlocks the jaw so that it can be moved by the trailer kingpin. When the tractor is moved out from under the trailer, the kingpin moves the jaw until the kingpin is out of the mechanism. With the jaw in the unlocked position, the lock control handle will remain in the unlocked position until manually moved by the operator.

During coupling (**Fig. 10.16**), the motion of the kingpin entering the jaw will actuate the jaw and wedge. The jaw will move behind the kingpin, followed by the wedge. The purpose of the wedge is to reinforce the jaw and take up slack around the pin. Any wear on the jaw is immediately taken up by the wedge so there is no slack in the connection.

Fifth Wheel Locking Operation

Locking the Fifth Wheel Lock Mechanism

CAUTION

Before attempting to lock or unlock the fifth wheel lock mechanism of a sliding type fifth wheel, the slide release pull handle, if so equipped, and the slide locking wedges must be in the locked position. This prevents the sliding member from moving rapidly to the far forward or rearward position, which could damage the fifth wheel member or kingpin.

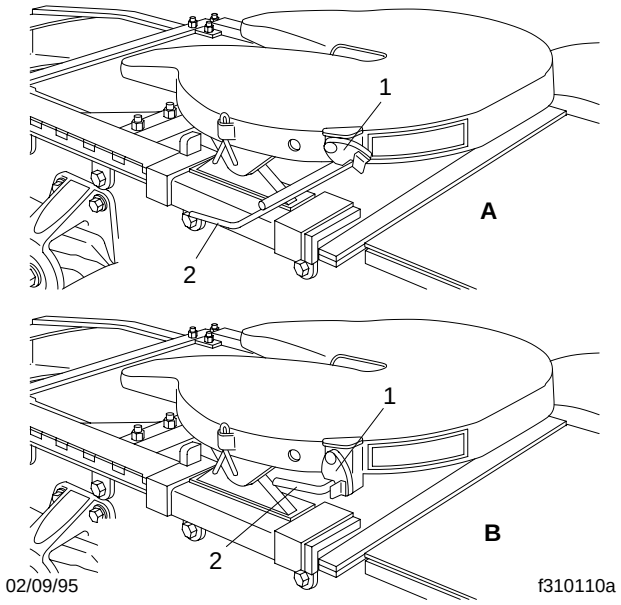
1. Chock the front and rear of the trailer tires to prevent the trailer from moving.

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 serious personal injury or death.

2. The kingpin lock mechanism must be fully open, the fifth wheel plate must be completely lubricated with chassis grease. For lubrication instructions, see **Group 31** of the *Columbia® Maintenance Manual*.
3. Position the tractor so that the fifth wheel lock opening is in line (both vertically and horizontally) with the trailer kingpin. The kingpin should be in a position to enter the throat of the locking mechanism (**Fig. 10.16**). Adjust the trailer landing gear to give enough alignment height for positive kingpin lockup.
4. With the fifth wheel lock opening aligned with the trailer kingpin, back the tractor slowly toward the trailer, making sure that the kingpin enters the throat of the locking mechanism. Continue backward motion until positive lockup occurs.
5. Apply the tractor parking brakes.
6. Make a visual and physical check for positive kingpin lockup. When lockup has occurred, the fifth wheel control handle will have moved to the locked position. Make sure that the safety latch

is down over the lock control handle. See **Fig. 10.17**. This will hold the control handle in the locked position.



NOTE: Make sure the safety latch is down when the control handle is locked.

A. Unlocked
B. Locked
1. Safety Latch
2. Lock Control Handle

Fig. 10.17, Fontaine Fifth Wheel, Locking and Unlocking

7. Release the tractor parking brakes. Test for kingpin lockup by pulling on the trailer against the chocks.
8. 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.
9. Charge the air brake system with air. Make sure that the air connections do not leak.

⚠ WARNING

Eliminate slack between the trailer and the tractor. Incorrect fifth wheel adjustment could cause the trailer to disconnect, possibly resulting in serious personal injury or death.

10. 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. There should be no slack between the tractor and the trailer. If slack is present, uncouple the trailer.

    For adjustment instructions, refer to the applicable manufacturer's service information.
11. Retract the trailer landing gear, and secure the ratchet handle. Remove the chocks from the trailer tires.
12. The 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 given 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.

⚠ WARNING

Do not overload any tractor axle by improperly loading the trailer. This could cause erratic steering and loss of vehicle control, possibly resulting in serious personal injury or death.

Unlocking the Fifth Wheel Lock Mechanism

1. Apply the tractor parking brakes.
2. Pull the trailer air supply valve to cut off the air supply to the trailer.

⚠ WARNING

Do not use the trailer air supply for parking trailers not equipped with spring parking brakes. This applies the trailer service brakes only. As air bleeds from the trailer brake system, brake application is lost. This could allow the unattended vehicle to roll away, possibly resulting in serious personal injury or death.

3. Chock the front and rear of the trailer tires to prevent the trailer from moving.
4. Lower the trailer landing gear until the weight is removed from the fifth wheel.
5. 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.

⚠ CAUTION

Before attempting to lock or unlock the fifth wheel lock mechanism of a sliding type fifth wheel, the slide release pull handle, if so equipped, and the slide locking wedges must be in the locked position. This prevents the sliding member from moving rapidly to the far forward or rearward position, which could damage the fifth wheel member or kingpin.

6. Release the kingpin locking mechanism by lifting the safety latch and pulling the lock control handle to the unlocked position. See **Fig. 10.17**.
7. Slowly drive the tractor away from the trailer.

Fifth Wheel Slide Operation

1. Connect the trailer kingpin to the tractor fifth wheel. For instructions, refer to Fontaine "Fifth Wheel Locking Operation," in this chapter.
2. After positive lockup of the fifth wheel lock mechanism has been accomplished, release the slide using one of the following methods:

   2.1 For air-operated release models, set the cab-operated control switch (**Fig. 10.18**) to UNLOCK.

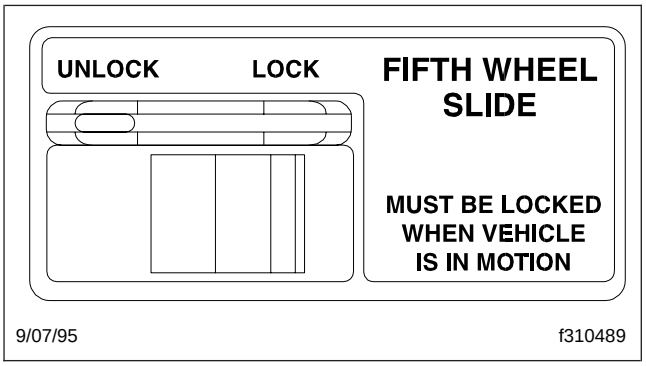


Fig. 10.18, Cab Control, Fifth Wheel Slide

   2.2 For manual release models, lift the slide release pull handle to disengage it from the guide plate. Then, pull out the handle (**Fig. 10.19**) until it is in the unlocked position and can be positioned against the guide plate to hold it out. The slide release pull handle will stay in the unlocked position until it is manually disengaged from the guide plate.

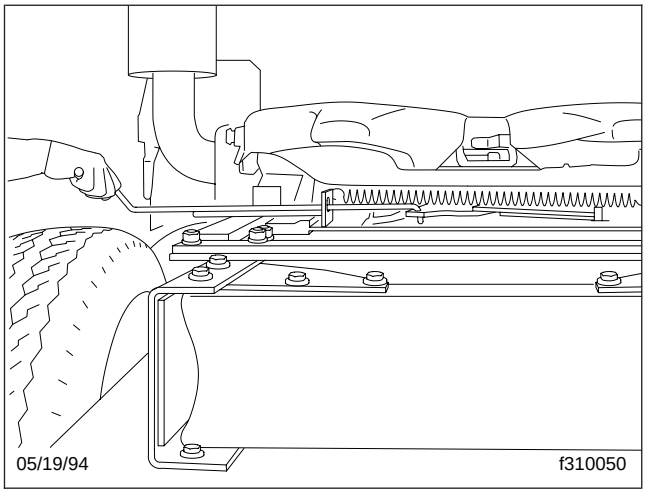


Fig. 10.19, Fontaine Sliding Fifth Wheel Manual Release

3. Lower the trailer landing gear just enough to remove the weight from the tractor.
4. Pull the trailer air supply valve to cut off the air supply to the trailer.

⚠ WARNING

Do not use the trailer air supply for parking trailers not equipped with spring parking brakes. This applies the trailer service brakes only. As air bleeds from the trailer brake system, brake application is lost. This could allow the unattended vehicle to roll away, possibly resulting in serious personal injury or death.

5. Chock the front and rear of the trailer tires to prevent the trailer from moving.

⚠ CAUTION

After 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.

6. Slowly move the tractor forward or backward until the fifth wheel is in the desired location.
7. Apply the tractor parking brakes.

NOTE: The fifth wheel may have to be moved slightly to enable the locking wedges to enter the fully locked position.

8. Lock the sliding member in position using one of the following methods:

⚠ WARNING

Check to be sure 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.

8.1 For air-operated release models, set the cab-operated slide control switch to LOCK. Visually inspect the locking wedges to make sure that they are fully inserted in the slide rail slots.

8.2 For manual release models, 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. The fifth wheel may have to be moved slightly to enable the locking wedges to fully enter the locked position. When 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 slide release pull handle is locked in position against the guide plate.

9. 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 given 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.

⚠ 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.

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 serious personal injury or death.

For lubrication instructions, see **Group 31** of the *Columbia® Maintenance Manual*.

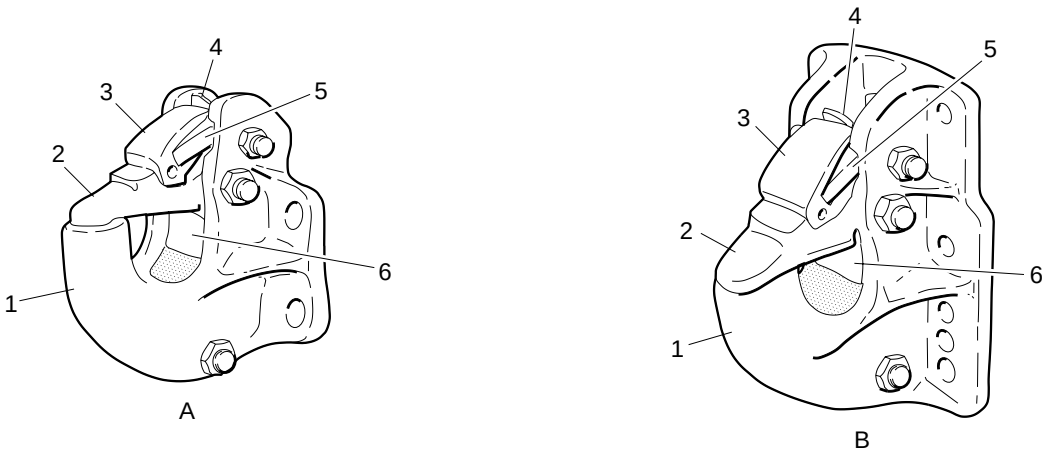
Premier Trailer Couplings

General Information

Trailer couplings, used only on trucks, are attached to the rear closing crossmember.

The Premier 260 and 460 trailer couplings (**Fig. 10.20**) have a rigid pintle hook, and are air-adjusted. An air chamber, mounted forward of the coupling, operates a pushrod, which pushes against a shoe inside the coupling. The shoe maintains constant pressure on the eye of the trailer drawbar when it's over the pintle hook. This takes up any slack in the trailer connection, providing smoother towing and less wear on the pintle hook. The air pressure is activated when the trailer brakes are released.

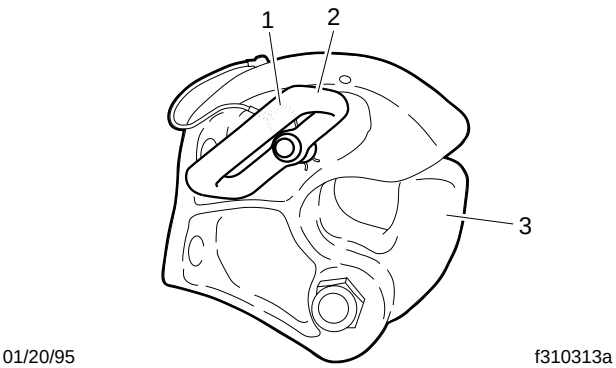
The Premier 690 trailer coupling (**Fig. 10.21**) has a moveable pintle hook, and is non-air adjusted. It is used for heavy-duty applications.



A. Model 260
B. Model 460

1. Pintle Hook
2. Latch
3. Pawl Assembly
4. Pawl Lock
5. Pawl Wedge
6. Shoe

Fig. 10.20, Premier 260 and 460 Trailer Couplings



1. Linch Pin
2. Handle
3. Pintle Hook

Fig. 10.21, Premier 690 Trailer Coupling

Operation

Trailer Hookup

1. Chock the front and rear tires of the trailer.
2. Open the coupling.

   Models 260 and 460 (**Fig. 10.20**): Pull up on the pawl lock; then, while squeezing the pawl wedges together, lift up the pawl assembly. Lift up the latch, and push it up against the pawl assembly, locking the latch in place.

   Model 690 (**Fig. 10.21**): Remove the linch pin from the handle, then push in on the handle and turn it toward you. Open the pintle hook by pulling it down and toward you. Release the handle, locking the pintle hook open.
3. *Models 260 and 460:* Back up the vehicle until the drawbar eye is over the pintle hook, then lower the trailer.

   Model 690: Back up the vehicle until the drawbar eye enters the open jaw, contacts the back of the pintle hook, and closes the coupling.
4. Close the coupling.

   Models 260 and 460: Push in on the pawl wedges and lift the pawl assembly. The latch will drop into the closed position. Lock the latch by lowering the pawl assembly.

   Model 690: The pintle hook will automatically close and lock from the pressure of the drawbar eye against it. Install the linch pin.
5. Hook up the trailer's electrical and air lines.
6. Remove the chocks from the trailer's tires.

Trailer Release

1. Apply the truck and trailer parking brakes.

⚠ WARNING

Do not use the trailer air supply for parking trailers not equipped with spring parking brakes. This applies the trailer service brakes only. As air bleeds from the trailer brake system, brake application is lost. This could allow the unattended vehicle to roll away, possibly resulting in serious personal injury or death.

2. Chock the front and rear tires of the trailer.
3. Disconnect the trailer air and electrical lines. Plug the air lines to keep out dirt.
4. Take the weight of the trailer drawbar eye off the pintle hook.
5. Open the coupling.

   Models 260 and 460: Pull up on the pawl lock; then, while squeezing the pawl wedges together, lift up the pawl assembly. Lift up the latch, and push it up against the pawl, locking the latch in place.

   Model 690: Remove the linch pin from the handle, then push in on the handle and turn it toward you. Open the pintle hook by pulling it down and toward you. Release the handle, locking the pintle hook open.
6. Slowly drive the vehicle away from the trailer.

Holland Trailer Coupling

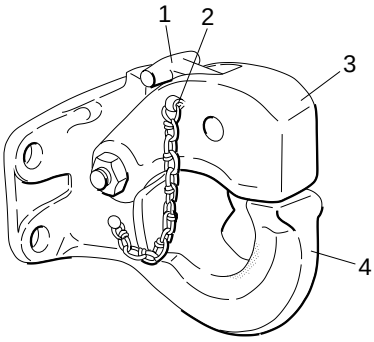
General Information

The Holland PH–T–60–AL trailer coupling is designed for use with trailers having a maximum gross weight of 10,000 lbs. See **Fig. 10.22**. It is a rigid type pintle hook, used only on truck applications, and is fastened to the rear closing crossmember of the vehicle. It is a non-air adjusted coupling.

Operation

Trailer Hookup

1. Chock the front and rear tires of the trailer.
2. Remove the cotter pin, then lift the lock and raise the latch.
3. Back up the vehicle until the drawbar eye is over the pintle hook.



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1. Lock
2. Cotter Pin
3. Latch
4. Pintle Hook

Fig. 10.22, Holland PH-T-60-AL Trailer Coupling

4. Lower the trailer until the drawbar eye rests on the pintle hook.
5. Close the latch, then insert the cotter pin.
6. Hook up the trailer's electrical and air lines.
7. Remove the chocks from the trailer's tires.

Trailer Release

1. Apply the truck and trailer parking brakes.

⚠ WARNING

Do not use the trailer air supply for parking trailers not equipped with spring parking brakes. This applies the trailer service brakes only. As air bleeds from the trailer brake system, brake application is lost. This could allow the unattended vehicle to roll away, possibly resulting in serious personal injury or death.

2. Chock the front and rear tires of the trailer.
3. Disconnect the trailer air and electrical lines. Plug the air lines to keep out dirt.
4. Take the weight of the trailer drawbar off the pintle hook.
5. Open the latch by first removing the cotter pin; then lift up the lock and raise the latch.
6. Slowly drive the vehicle away from the trailer.

11

Pretrip and Post-Trip Inspections and Maintenance

Pretrip and Post-Trip Inspections and Maintenance

Pretrip and Post-Trip Inspection Checklists

Regulations in both Canada and the United States clearly indicate that it is the driver's responsibility to perform an inspection and ensure the complete roadworthiness of a vehicle before placing it into service for the day. Commercial vehicles may be subject to inspection by authorized inspectors, and an unsafe vehicle can be put "out of service" until the driver or owner repairs it.

Use the inspection checklists to ensure that vehicle components are in good working condition before each trip. A driver that 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 three of the inspection procedures should be performed before the trip.

NOTE: Procedure reference numbers in the checklists reference the corresponding detailed instructions found under the pretrip and post-trip maintenance procedures.

Pre- and post-trip inspections cannot be done quickly. However, careful inspections save time by eliminating stops later to adjust items overlooked or forgotten.

If any system or component does not pass this inspection, it must be corrected before operating the vehicle. Whenever equipment requires adjustment, replacement, repair, addition of lubricants, or a change of lubricants, see the *Columbia® Workshop Manual* for procedures and specifications, and see the *Columbia® Maintenance Manual* for lubricant recommendations, specifications, and maintenance intervals.

IMPORTANT: The pre- and post-trip checklists, and inspections and maintenance procedures detailed in this chapter, are **not all-inclusive**. Also refer to other component and body manufacturers' instructions for specific inspection and maintenance instructions.

See **Table 11.1** for a list of procedures that should be preformed daily, before the first trip.

See **Table 11.2** for a list of procedures that should be performed weekly, post-trip.

See **Table 11.3** for a list of procedures that should be performed monthly, post-trip.

IMPORTANT: Before performing any checks, apply the parking brake and chock the tires.

Procedure Performed (check off)	Daily Pretrip Inspections/Checks	Procedure Reference
_____	Drain manually drained air reservoirs (that are not equipped with automatic drain valves)	D1
Check _____	windshield washer reservoir fluid	D2
Inspect _____	wheel seal and hub cap (for leakage)	—
Check _____	surge tank coolant level	D3
Inspect _____	radiator and charge air cooler	D4
Check _____	engine for fuel, oil, or coolant leaks	—
Inspect _____	engine and chassis wiring	D5
Inspect _____	air intake system	D6
Check _____	intake-air restriction indicator mounted on air intake	D6
Check _____	engine oil level	D7
Check _____	power steering fluid level	—
Inspect _____	fuel tank(s), fuel lines, and connections	D8
Check _____	fuel level	D9
Check _____	fuel/water separator	D10
Inspect _____	front and rear suspension components	D11
Inspect _____	headlights, mirrors, and window glass, and windshield wipers	D12
Check _____	doors (open without difficulty and close securely)	—
_____	Adjust driver's seat, then align rearview and downview mirrors	—
Check _____	dash-mounted intake-air restriction indicator	D6
Check _____	oil- and air-pressure warning systems	D13
Check _____	ICU fault codes	D14
Check _____	horn, windshield wipers, and windshield washer	D15
Check _____	heater, defroster, and optional mirror heat controls	D16
Check _____	backup alarm	—
Check _____	panel lights and interior lights	D17
Check _____	exterior lights and reflectors	D18
Check _____	tire pressure	D19
Inspect _____	tire condition	D20
Inspect _____	rims and wheels	D21
Check _____	automatic transmission fluid level	—
Inspect _____	air brake chambers and pushrods	D22
Inspect _____	air brake lines	D23
Inspect _____	slack adjusters	D24
Check _____	air brake system operation	D25
Inspect _____	frame rails (missing bolts), crossmembers (bent or loose)	—
Check _____	mud flaps (aren't damaged, at least 10 inches above the ground, and brackets are secure)	—
Check _____	exhaust system (mounted securely, connected tightly, no signs of leaks such as soot trails)	—
_____	Remove chocks and test service brakes	D26
Inspector_____ Date _____		

Table 11.1, Daily Pretrip Inspection and Maintenance Checklist

Procedure Performed (check off)	Weekly Post-Trip Inspections/Checks	Procedure Reference
_____	Manually drain air reservoirs that are equipped with automatic drain valves	—
Inspect _____	batteries and battery cables	W1
Check _____	wheel bearing lubricant level	W2
Inspect _____	steering components	W3
Check _____	serpentine drive belt condition	W4
Check _____	V-belt tension	W5
Inspect _____	seat belts and tether belts	W6
Inspector_____ Date _____		

Table 11.2, Weekly Post-Trip Inspection and Maintenance Checklist

Procedure Performed (check off)	Monthly Post-Trip Inspections/Checks	Procedure Reference
_____	Clean the battery terminals	M1
Inspect _____	radiator hoses and heater hoses	M2
Check _____	fluid level in the hydraulic clutch reservoir (if applicable, and if necessary, fill with DOT 4 brake fluid)	—
Check _____	steering wheel play	M3
Check _____	outer surfaces of the hood and body (for visible surface breaks and damage)	—
Check _____	hood tilt damper (attached at both ends)	—
Inspect _____	brake lining wear	M4
Inspect _____	driveshaft	—
Inspector_____ Date _____		

Table 11.3, Monthly Post-Trip Inspection and Maintenance Checklist

Pretrip and Post-Trip Maintenance Procedures

Daily Pretrip Inspection and Maintenance

Whenever equipment requires adjustment, replacement, and/or repair, see the *Columbia® Workshop Manual* for procedures and specifications. Specific references to the manual will be found where appropriate.

1. *Drain manually drained air reservoirs.*

   Water and oil normally enter the air reservoir in the form of vapor because of the heat generated during compression. After the water and oil condense, drain the resulting emulsion as follows:

   1.1 Open the wet tank valve. The drain cock or pull chain drain is located on the forward end of the supply air reservoir, which is connected directly to the air compressor. Block the valve open.

⚠ 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.

   1.2 Exhaust the remaining air and moisture from the system by opening the drain cocks on the bottoms of the remaining air reservoirs. Block the valves open.

1.3 Water and oil emulsion often form pockets that will not drain while compressed air is in the reservoirs. Because of these pockets, leave the valves blocked open during the first part of the pretrip inspection.

1.4 If the drained water 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.

2. *Check the fluid level in the windshield washer reservoir.*

   Add washer fluid as needed. Unscrew the cap to add fluid.

⚠ 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.

3. *While the surge tank is cool, check the coolant level.*

   In hot operation, the upper chamber will be completely full, and there will be some coolant in the bottom chamber. When the tank has cooled, there will be no coolant in the bottom chamber, and an air gap in the upper chamber.

   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.

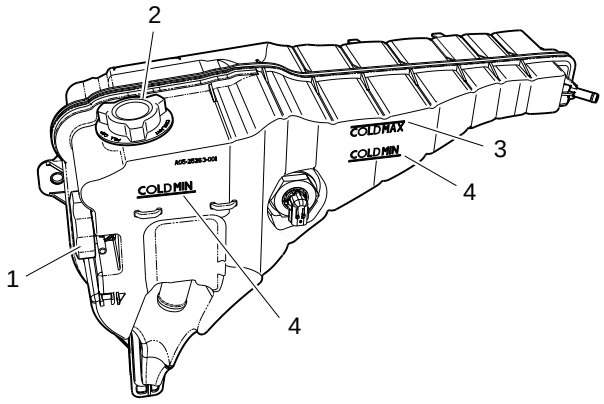
   See **Fig. 11.1**.

⚠ CAUTION

Coolant must be filled to the full line of the surge tank. Low coolant could result in engine overheating, which could cause engine damage.

4. *Inspect the radiator and charge air cooler.*

   4.1 Inspect the radiator and charge air cooler for clogged fins. Use compressed air or water directed from the fan side of the core to backflush any material restricting airflow.



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1. Pressure Relief Cap
2. Filler Cap
3. COLD MAX Fill Line
4. COLD MIN Fill Line

Fig. 11.1, Coolant Surge Tank

   4.2 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).

   4.3 On vehicles equipped with air conditioning, also inspect and clean the condenser. If clogged, the condenser can restrict airflow through the radiator.

   4.4 Check the radiator for leaks. If leaks are found, have the radiator repaired or replaced. See **Group 20** of the *Columbia® Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.

5. *Inspect the engine and chassis wiring.*

   Check for loose wiring, chafed insulation, and damaged or loose hold-down clamps. Tighten loose wires or hold-down clamps; replace damaged wiring or clamps.

6. *Inspect the air intake system for leaks or damage.*

CAUTION

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.

6.1 Check the intake-air restriction indicator.

6.2 Replace the primary filter element in the air cleaner if the yellow signal stays locked at 25 inH_2O (635 mmH_2O) for Caterpillar engines or 20 inH_2O (508 mmH_2O) for Mercedes-Benz or Detroit Diesel engines. See **Group 09** of the *Columbia® Workshop Manual* for filter element replacement instructions, or take the vehicle to an authorized Freightliner dealer.

NOTE: After replacing the filter element, reset the restriction indicator by pressing the rubber reset button.

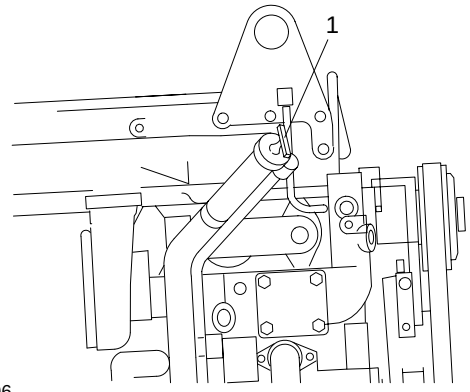
6.3 Inspect the secondary or safety filter element in the air cleaner when replacing the primary element, and replace it when clogged or dirty. This element should be replaced with every third primary element replacement.

6.4 Check the engine air intake piping from the air cleaner to the engine intake. Inspect the piping for loose connections, cracks, torn or collapsed hoses, punctures, and other damage. Tighten loose connections, and have damaged components replaced. Make sure the piping system is airtight so that all intake air passes through the air cleaner.

7. *Check the oil level with the vehicle parked on a level surface, and turned off for at least 20 minutes, for most engines.*

For the DD15 engine, the engine must be shut down for 60 minutes and on a level surface for an accurate oil level reading. Otherwise the engine must be brought up to an operating temperature of 176°F (80°C), shut down, and allowed to sit for 5 minutes on a level surface. Failure to allow the oil to drain back properly as just described, can result in a low oil level reading.

If the oil level is at or below the minimum fill (ADD) mark on the dipstick, add enough oil to maintain the level between the minimum fill (ADD) and the maximum fill (FULL) marks on the dipstick. See **Fig. 11.2**. Engine lube oil must have a sulfated ash level less than 1.0 wt %; currently referred to as CJ-4 oil. Use the proper SAE viscosity rating for the temperature and time of year.



1. Dipstick

Fig. 11.2, Oil Level Checking

CAUTION

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.

8. *Inspect the fuel tanks, fuel lines, and connections for leaks.*

8.1 Check that the fuel tanks are secured to their mounting brackets and that the mounting brackets are secured to the frame.

8.2 Replace leaking fuel tanks.

8.3 If lines or connections are leaking, have them repaired or replaced.

For repair and/or replacement procedures, see **Group 47** of the *Columbia® Workshop Manual*, or take the vehicle in to an authorized Freightliner dealer.

8.4 If equipped with fuel tank shutoff valves, be sure the valves are fully open.

⚠ WARNING

Never operate the engine with the fuel tank shut-off valves partly closed. This could damage the fuel pump, causing sudden loss of engine power, possibly resulting in serious personal injury due to reduced vehicle control.

9. *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. Federal regulations prohibit filling a fuel tank to more than 95 percent of its liquid capacity.

⚠ 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: Use ultralow-sulfur diesel (ULSD) with 15 ppm sulfur content or less, based on ASTM D2622 test procedure. Failure to use ultralow-sulfur diesel fuels may void the warranty on emission components.

9.1 Fuel should always be strained or filtered before being put into the tanks. This will lengthen the life of the engine fuel filter and reduce the chances of dirt getting into the engine.

9.2 Before installing the fuel cap, clean the area with a rag, or if necessary, clean the cap with solvent.

9.3 If needed, prime the fuel system. For priming procedures, see the applicable engine manufacturer's manual.

10. *If equipped with a fuel/water separator, check for water.*

    If the engine is equipped with a built-in water separator, place a suitable container under the drain hose, loosen the drain valve, and allow the water to run out. Close the drain valve, taking care not to overtighten it.

    For a ConMet Model see **Fig. 11.3**. Place a suitable container under the fuel/water separator. Check the water level in the sight bowl, if so equipped. To drain the water, loosen the valve at the bottom and allow the water to run out. Close and tighten the valve finger-tight.

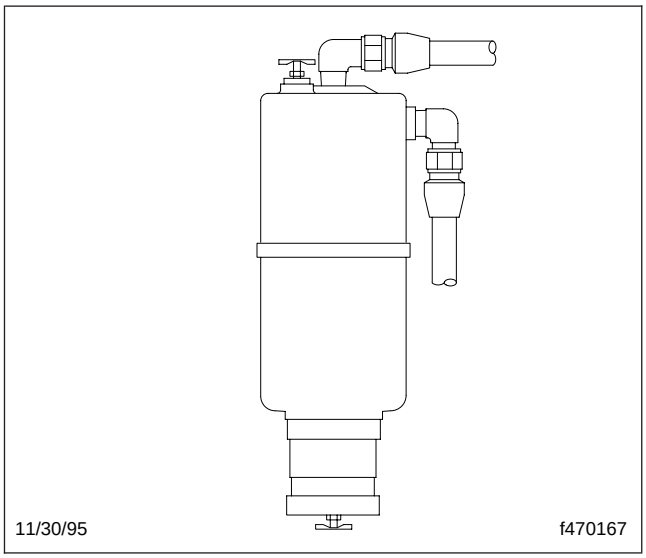


Fig. 11.3, ConMet Fuel/Water Separator

IMPORTANT: When draining fluid from a fuel/water separator, drain the fluid into an appropriate container and dispose of it properly. Many states now issue fines for draining fuel/water separators onto the ground. On all types of separators, stop draining fluid when you see fuel come out of the separator drain valve.

11. *Inspect the front and rear suspension components, including springs, spring hangers, shocks, and suspension brackets.*

11.1 Check for broken spring leaves, loose U-bolts, cracks in the suspension brackets, and loose fasteners in the spring hangers and shackles.

11.2 Inspect the shock absorbers for loose fasteners and leaks.

11.3 Tighten all loose fasteners and have any component(s) replaced that are worn, cracked, or otherwise damaged.

11.4 On vehicles with air suspensions, check for leaks. Check air suspension components for cuts and bulges.

12. Clean the windshield, side, and rear windows with a long-handled or telescoping window cleaning device and standard cleaning solutions. Stand only on the ground, on a stepladder, or an elevated walkway. The cab entry/exit steps and handholds are not designed for this purpose. The tires, fenders, engine, and other under-hood components do not have adequate gripping surfaces and handholds.

    Check the condition of the windshield wiper arms and blades.

    Be sure the windshield wiper blades are tensioned against the windshield.

    Inspect the wiper blades for damage and deteriorated rubber.

    Replace the wiper arms if the wiper blades are not tensioned against the windshield.

    Replace damaged or deteriorated wiper blades.

⚠ 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.

13. After starting the engine, make sure the oil- and air-pressure warning systems are operating and that the buzzer stops sounding when the preset minimum is reached.

    If the warning systems do not come on when the ignition is turned on, have the systems repaired.

    The air pressure in both the primary and secondary air reservoir systems must be above 65 psi (448 kPa) on most vehicles. For vehicles with an optional Bendix dryer reservoir module (DRM), the cut-out pressure is 130 psi (896 kPa).

NOTE: If the air pressure in both systems is above the preset minimum when the engine is started, test the low air pressure warning system by lowering the pressure to below this range, or until the warning system comes on.

14. *Check the instrumentation control unit (ICU) for fault codes.*

    During the ignition sequence, if an active fault is detected in any device that is connected to the ECU, the message display screen will show the active fault codes, one after the other, until the parking brake is released or the ignition switch is turned off. See **Chapter 2** for detailed operating instructions for the ICU.

15. *Make sure that the horn, windshield wipers, and windshield washers are operating properly. These devices must be in good working order for safe vehicle operation.*

    15.1 Make sure that the horn works. If a horn is not working, have it repaired before trip departure.

    15.2 Check the wiper and washer control on the multifunction turn signal switch. If the wipers and/or washers are not working, have them repaired before trip departure.

16. *During cold weather, make sure the heater, defroster, and optional mirror heat controls are operating properly. If so equipped, turn on the mirror heat switch and make sure the system is working.*

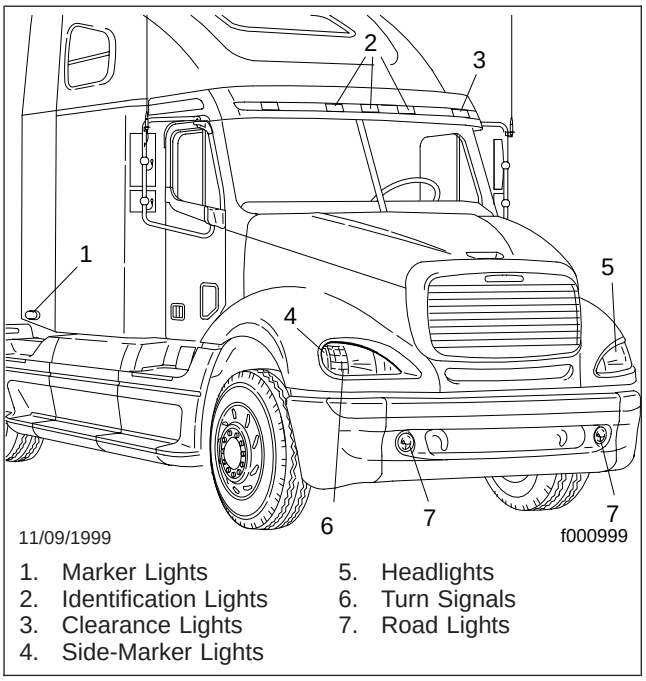
17. *Check the operation of all the panel lights and interior lights.*

    Turn on the headlights, dash lights, and four-way flashers and leave them on. If any of the gauge bulbs, the dome light bulbs, or the right- and left-turn indicator bulbs are not working, replace them.

18. *Make sure all the exterior lights are working properly.*

    Check that all the lights and reflectors are clean. See **Fig. 11.4**.

    18.1 Check that the brake lights, taillights, headlights, parking lights, turn signals, marker lights, identification lights, road lights (if so equipped), and front clearance lights are working properly and are clean.



1. Marker Lights
2. Identification Lights
3. Clearance Lights
4. Side-Marker Lights
5. Headlights
6. Turn Signals
7. Road Lights

Fig. 11.4, Exterior Lights

18.2 Test the high and low beams of the headlights.

18.3 Replace light bulbs or sealed beam units that are not working.

18.4 Be sure all reflectors and lenses are in good condition and are clean. Replace any broken reflectors or lenses.

19. *Check tire inflation pressures using an accurate tire pressure gauge.*

Tires should be checked when cool. For inflation pressures and maximum loads (per tire) see the tire manufacturer's guidelines.

19.1 Be sure valve stem caps are on every tire and that they are screwed on finger-tight.

19.2 Inflate the tires to the applicable pressures if needed.

19.3 If a tire has been run flat or underinflated, check the wheel and tire for damage before adding air.

Moisture inside a tire can result in body ply separation or a sidewall rupture. During tire inflation, compressed air reservoirs and lines must be kept dry. 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.

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. Some rims and wheels are stamped with a maximum load and maximum cold inflation rating. If they are not stamped, consult the rim or wheel manufacturer for the correct tire inflation pressure for the vehicle load. If the load exceeds the maximum rim or wheel capacity, the load must be adjusted or reduced.

⚠ CAUTION

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.

20. *Inspect each tire for wear, bulges, cracks, cuts, penetrations, and oil contamination.*

20.1 Check the tire 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.

20.2 Inspect each tire for bulges, cracks, cuts, and penetrations.

20.3 Inspect each tire for oil contamination. Fuel oil, gasoline, and other petroleum derivatives, if allowed to contact the tires, will soften the rubber and destroy the tire.

21. *Check the wheel nuts or rim nuts for indications of looseness. Examine each rim and wheel component.*

21.1 Remove all dirt and foreign material from the assembly. Dirt or rust streaks from the stud holes, metal buildup around stud

holes, or out-of-round or worn stud holes may be caused by loose wheel nuts. See **Fig. 11.5** and **Fig. 11.6**.

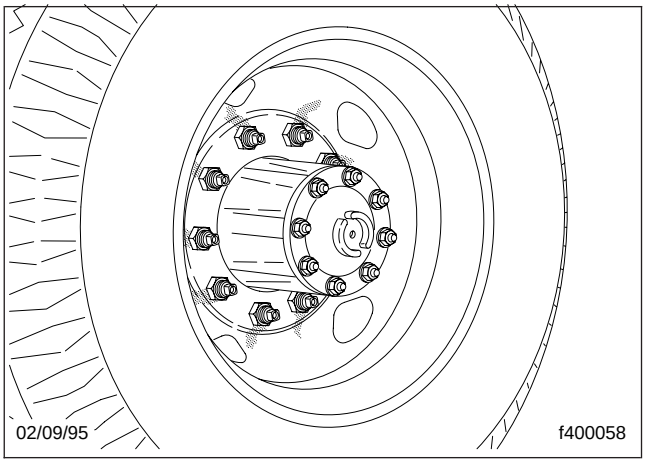


Fig. 11.5, Dirt and Rust Streaks from the Stud Holes

21.2 Examine the rim and wheel assembly components (including rims, rings, flanges, studs, and nuts) for cracks, or other damage.

See **Group 33** or **Group 35** of the *Columbia® Workshop Manual* for service procedures on the studs and hubs, and see **Group 40** in the same manual for wheel and tire servicing, or take the vehicle to an authorized Freightliner dealer.

⚠ 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.

21.3 Have broken, cracked, badly worn, bent, rusty, or sprung rings and rims replaced. Be sure that the rim base, lockring, and side ring are matched according to size and type.

21.4 Make sure all wheel nuts are tightened 450 to 500 lbf·ft (610 to 678 N·m) for Accuride wheels with unlubricated threads. Use the tightening pattern in **Fig. 11.7** for 10-hole wheels and the tightening pattern in **Fig. 11.8** for 8-hole wheels. See **Group 40** of the *Columbia® Workshop Manual* for more information.

⚠ CAUTION

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

NOTE: Vehicles operating under severe or adverse conditions should be checked more frequently.

22. *Inspect the air brake chamber and the air brake chamber pushrods.*

⚠ 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.

22.1 Check that the air brake chamber is mounted securely on its mounting bracket, and that there are no loose or missing bolts.

22.2 Look for worn clevis pins on brake chamber pushrods, and missing or damaged cotter pins on brake chamber pushrod clevis pins. Replace worn clevis pins and install new cotter pins if necessary.

22.3 See if the chamber piston rod is in line with the slack adjuster. Misalignment can cause the piston rod to rub on the non-pressure chamber and cause a dragging brake. See **Group 42** of the *Columbia® Workshop Manual*.

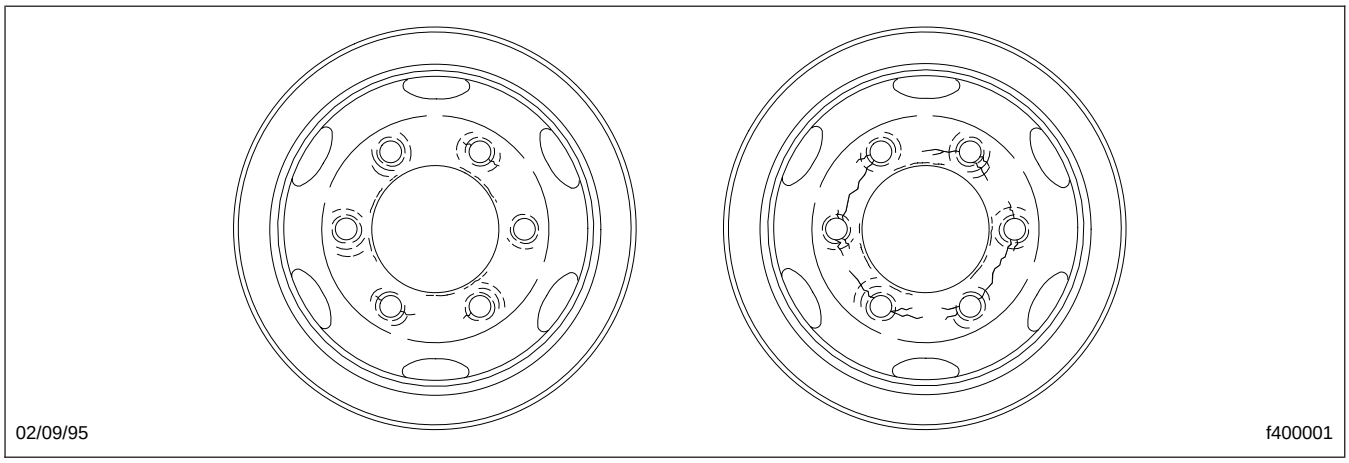


Fig. 11.6, Worn Stud Holes

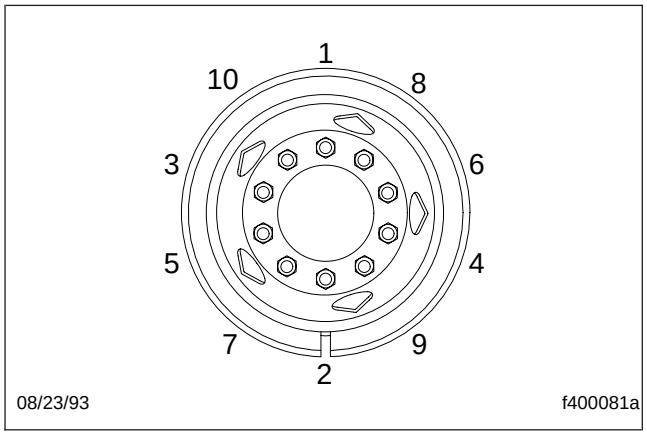


Fig. 11.7, Tightening Pattern, 10-Hole Wheels

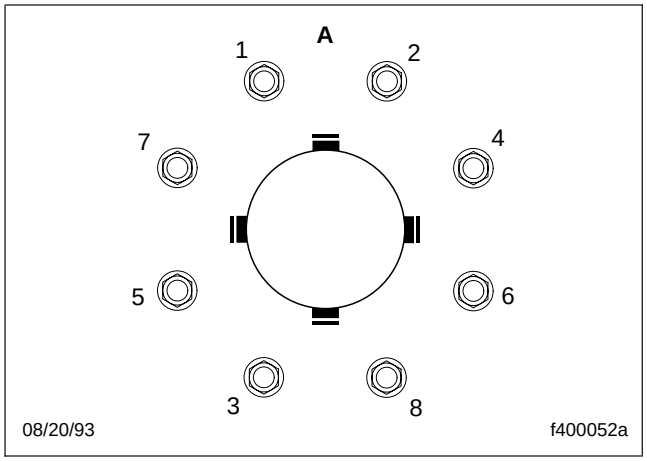


Fig. 11.8, Tightening Pattern, 8-Hole Wheels

⚠ CAUTION

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.

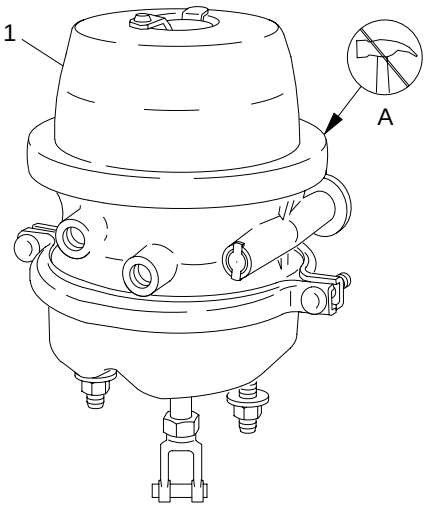
22.4 Inspect the exterior surfaces of the chamber for damage. Make sure that breather holes in the non-pressure section(s) are open and free of debris. See **Group 42** of the *Columbia® Workshop Manual* to replace any damaged parts.

⚠ DANGER

Do not loosen or remove the parking brake clamp ring for any purpose. The parking/emergency brake section of the brake chamber is not intended to be serviced. Serious injury or death may result from sudden release of the power spring.

22.5 On all parking brake installations, make sure the end cover cap or dust plug is securely snapped into place. See **Fig. 11.9**.

NOTE: On most MGM parking brake chambers equipped with an integral release bolt, an end cover cap is installed over the release bolt.



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A. Do not remove this clamp ring.
1. MGM TR–T (TR Series) Brake Chamber shown

Fig. 11.9, Parking Brake Chamber Clamp

22.6 Check for rusted connections, missing snap rings, and damaged camshaft grease seals. Have damaged or missing parts repaired or replaced.

23. *Inspect the air brake lines.*

23.1 Check the clearance between the hoses and the exhaust manifold or other hot spots. Excessive heat will cause material in the hoses to deteriorate rapidly or become brittle. Provide at least 6 inches (150 mm) of clearance. More clearance is recommended if the hose is located above the heat source.

23.2 Check for kinks, dents, or swelling of the hoses. If damaged, have the hose replaced with the same size and type.

NOTE: Do not route the hose on top of anything likely to be stepped on.

23.3 Check for damage to hoses located near moving parts, such as drivelines, kingpins, suspensions, and axles. If moving parts are catching or pinching the lines, correct as needed.

23.4 Check for hose damage caused by abrasion. If abraded, have the hose replaced. Check for the cause of abrasion, such as loose or damaged hose clamps. Have the clamps repaired or replaced as needed.

23.5 Observe the hose cover condition, especially hoses exposed to water splash and ice. If dried out or ragged (the wire or liner is showing through the cover), have the hose(s) replaced.

23.6 Inspect the air tubing, especially tubing made of nylon. In cold weather, nylon tubing is sensitive to damage, such as nicks or cuts. Have nicked or cut tubing replaced, even if it is not leaking.

23.7 Check for kinked or twisted hoses. A seven-percent twist in the hose can reduce its life by up to 90 percent. A twisted hose under pressure tends to untwist, which may loosen the fitting. Reconnect hoses that are twisted.

NOTE: The front brake lines flex continuously in vehicle operation, so they require special examination. Give particular attention to the areas near where they connect to the front air brake chambers. This inspection requires two people, one in the driver seat and another to inspect the brake line connections at the wheels.

23.8 Both wheel air lines must be inspected with the emergency brake set, engine idling, air pressure at 80 to 90 psi (550 to 620 kPa), and the brake pedal held down.

23.9 Turn the wheels to full lock in one direction and inspect both air lines where they connect to the air chambers, then turn the wheels to full lock in the other direction and inspect both lines. If a hose is leaking, have it replaced.

IMPORTANT: ABS-equipped vehicles operating in regions where especially corrosive ice removal chemicals are used may experience higher than normal rotor corrosion. Tone rings should be routinely inspected for corrosion. Severe corrosion of the integral ABS tone ring may cause the ABS warning lamp in the dash to illuminate due to false wheel

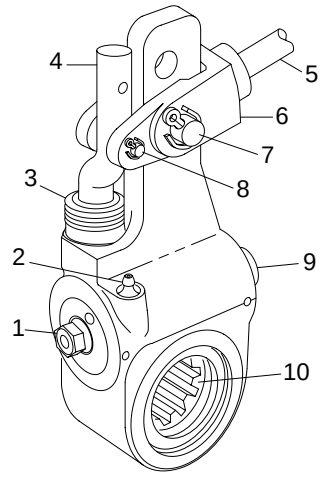
speed readings. If the ABS warning lamp illuminates at any time other than at vehicle start-up, have the problem repaired immediately.

24. *Inspect the slack adjusters.*

    24.1 *Meritor Slack Adjusters:* Check the boot for cuts, tears, or other damage. Have it replaced if necessary.

    24.2 *Gunite Slack Adjusters:* Inspect the slack adjuster for any signs of damage. If damaged, have the slack adjuster replaced.

    Inspect the slack adjuster boot for cuts or tears. If the boot is damaged, have it replaced. See **Fig. 11.10**.



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1. 7/16-inch Adjusting Nut
2. Grease Fitting
3. Boot
4. Link
5. Brake Chamber Piston Rod
6. Clevis
7. 1/2-inch Clevis Pin
8. 1/4-inch Clevis Pin
9. Grease Relief Opening
10. Slack Adjuster Spline

Fig. 11.10, Gunite Automatic Slack Adjuster

    24.3 *Haldex Slack Adjusters:* Inspect each slack adjuster and anchor strap for damage. See **Fig. 11.11**. Have any damaged components replaced.

25. *Check the air brake system for proper operation.*

    25.1 Check the air governor cut-in and cut-out pressures as follows.

    Run the engine at fast idle. The air governor should cut out the air compressor at approximately 120 psi (827 kPa). With the engine idling, apply the brake pedal several times. The air governor should cut in the air compressor at approximately 100 psi (689 kPa). If the air governor does not cut in and out as described above, it must be adjusted to these specifications. If the air governor cannot be adjusted or repaired, replace it before operating the vehicle.

    25.2 Check the air pressure buildup time as follows.

    With the air system fully charged to 120 psi (827 kPa), make one full brake application and note the air pressure reading on the gauge. Continue to reduce the air pressure by moderate brake applications to a maximum of 90 psi (620 kPa), then run the engine at governed rpm. If the time required to raise the air pressure to 120 psi (827 kPa) (from the pressure noted after one brake application) is more than 30 seconds, eliminate any leaks or replace the air compressor before operating the vehicle.

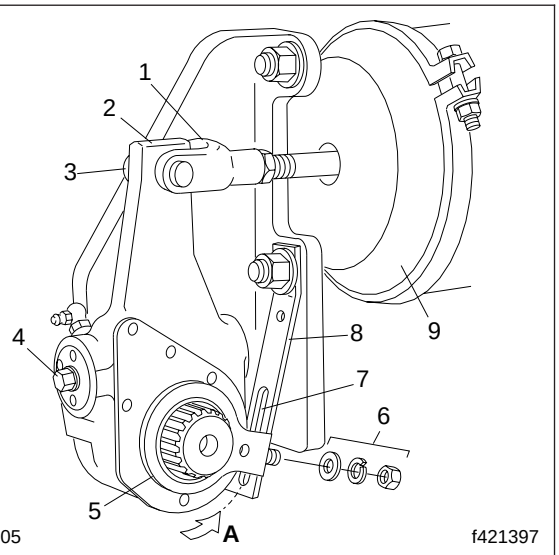
    25.3 Check the air pressure reserve as follows.

    With the air system fully charged to 120 psi (827 kPa), stop the engine and note the air pressure. Then make one full brake application and observe the pressure drop. If it drops more than 25 psi (172 kPa), all areas of leakage must be eliminated before operating the vehicle.

    25.4 Check the air leakage in the system as follows.

    With the parking brake (spring brake) applied, the transmission out of gear, and the tires chocked, charge the air system until cut-out pressure of 120 psi (827 kPa) is reached.

    With the service brakes released, shut down the engine, wait 1 minute and note the air pressure gauge reading. Observe the air pressure drop in psi (kPa) per minute.



A. Rotate the control arm toward the brake chamber until you can feel it contacting the internal stop.

1. Clevis
2. Slack Adjuster
3. Clevis Pin
4. Manual Adjusting Nut
5. Control Arm
6. Control-Arm Washers and Nut
7. Anchor Strap Slot
8. Anchor Strap
9. Brake Chamber

Fig. 11.11, Haldex Automatic Slack Adjuster

Charge the air system until cut-out pressure of 120 psi (827 kPa) is reached. With the parking brakes released and the service brake applied, shut down the engine, wait 1 minute and note the air pressure gauge reading. Observe the air pressure drop in psi (kPa) per minute.

If leakage exceeds the limits shown in **Table 11.4**, repair all areas of leakage before driving the vehicle.

Maximum Allowable Service Brake Air Leakage		
Description	**Air Leakage in psi (kPa) Per Minute**	
	Released	**Applied**
Truck or Tractor Only	2 (14)	3 (21)
Truck or Tractor w/Single Trailer	3 (21)	4 (28)
Truck or Tractor w/Two Trailers	5 (35)	6 (42)

Table 11.4, Maximum Allowable Service Brake Air Leakage

26. *Test the service brakes.*

When starting to move the vehicle and before picking up speed, test the brakes with the foot pedal and parking brake control valve (yellow knob) to be sure they will bring the vehicle to a safe stop.

Weekly Post-Trip Inspection and Maintenance

⚠ 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.

1. *Inspect the batteries and battery cables.*

   1.1 Access the batteries. Be sure the battery hold-down is secure. If it is loose, tighten the hold-down bolts; if it is broken, replace it.

   1.2 If the battery is equipped with a built-in hydrometer, examine the hydrometer. If a green dot shows in the sight glass, the battery is sufficiently charged.

   If the sight glass is dark, the charge is low and the battery must be recharged.

   If the sight glass is clear, the battery has a low level of electrolyte and must be replaced.

2. *Check the level of the wheel bearing lubricant in the hub cap at each end of the front axle.*

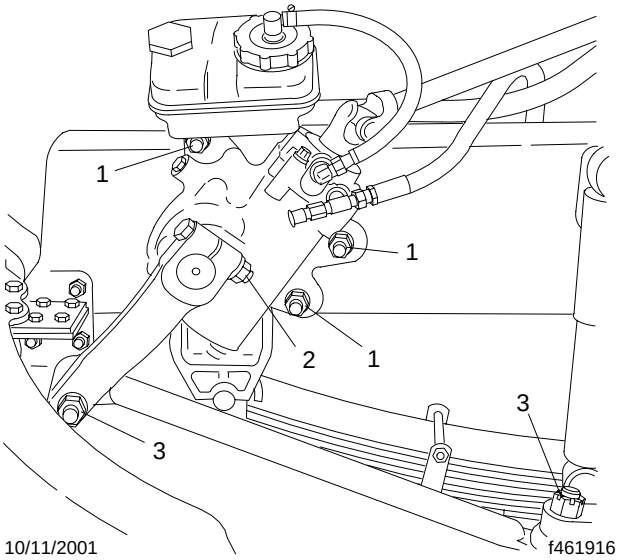
   If needed, fill the hubs to the level indicated on the hub cap. See **Group 35**of the *Columbia Maintenance Manual*, for recommended lubricants.

IMPORTANT: Before removing the fill plug, always clean the hub cap and plug.

3. *Examine the steering components.*

   See **Fig. 11.12**. If repairs are needed, see **Group 46** of the *Columbia® Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.

   3.1 Check the mounting bolts and pitman arm nut for tightness.



1. Steering Gear Mounting Bolt
2. Pitman Arm Pinch Bolt Nut
3. Drag Link Nut

Fig. 11.12, Steering Gear Fasteners

3.2 Check the drag link nuts for missing cotter pins.

3.3 Inspect the steering drive shaft and steering linkage for excessive looseness, or other damage.

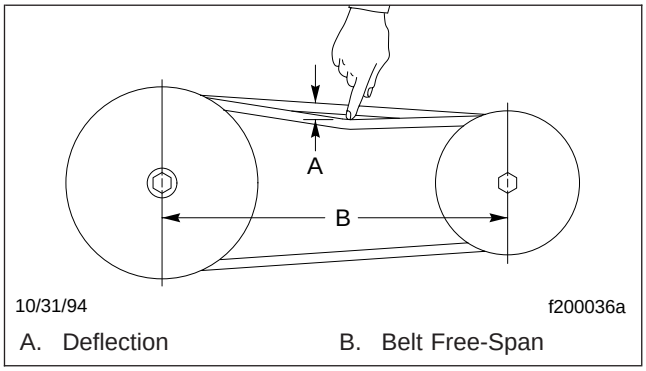
3.4 Tighten loose nuts and have damaged parts replaced as needed.

4. *Check the condition of the serpentine drive belt.*

   Look for signs of glazing, wear (frayed edges), damage (breaks or cracks), or oil contamination. If a belt is glazed, worn, damaged, or oil soaked, have the belt replaced, following the instructions in **Group 01** of the *Columbia® Workshop Manual.*

5. *Check the drive belt for proper tension.*

   Use your index finger to apply force at the center of the belt free-span. See **Fig. 11.13**. There is no adjustment for belt tension on engines with automatic belt tensioners. If there is not proper tension, have the belt tensioner replaced. See **Group 01** of the *Columbia® Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.



A. Deflection B. Belt Free-Span

Fig. 11.13, Checking Belt Tension

6. *Inspect the seat belts and tether belts.*

WARNING

Inspect and maintain seat belts as instructed below. Worn or damaged seat belts could fail during a sudden stop or crash, possibly resulting in serious injury or death.

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.

NOTE: When any part of a seat belt needs replacement, the entire seat belt must be replaced, both retractor and buckle side.

6.1 Check the web for fraying, cuts, or extreme wear, especially near the buckle latch plate and in the D-loop guide area.

6.2 Check the web for extreme dirt or dust and for severe fading from exposure to sunlight.

6.3 Check the buckle and latch for operation and for wear or damage.

6.4 Check the Komfort Latch for function and cracks or other damage.

6.5 Check the web retractor for function and damage.

6.6 Check the mounting bolts for tightness and tighten any that are loose.

Monthly Post-Trip Inspection and Maintenance

⚠ 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.

1. *Clean the batteries.*

   1.1 Remove any corrosion from the hold-down and the top of the battery.

⚠ CAUTION

Take care to keep the vent plugs tight so that the neutralizing solution does not enter any of the battery cells and damage the battery.

   1.2 Use a soda solution to neutralize the acid present, then rinse off the soda solution with clean water.

   1.3 If the battery posts or cable terminals are corroded, disconnect the terminals from the posts. Clean them with a soda solution and a wire brush. After cleaning, connect the terminals to the battery posts, then apply a thin coat of petroleum jelly to the posts and terminals to help retard corrosion.

2. *Inspect the radiator and heater hoses, including the clamps and support brackets.*

   2.1 Make sure the radiator inlet and outlet hoses are pliable and are not cracking or ballooning. Replace hoses that show signs of cracking, weakening, or ballooning.

   2.2 Make sure the heater hoses are pliable and are not cracking or ballooning. Replace hoses that show signs of cracking, weakening, or ballooning.

   2.3 Tighten hose clamps as necessary, but do not overtighten, as hose life can be adversely affected.

   2.4 Be sure the hose support brackets are securely fastened. Make sure the hoses are not located near sources of wear, abrasion, or high heat.

IMPORTANT: Replace all hoses, including heater hoses, at the same time. Service-type knitted or braided yarn-reinforced neoprene hose is acceptable. Silicone hoses having an extended service life can be substituted for the reinforced neoprene type. See the Freightliner *Service Parts Catalog* or contact your Freightliner Dealer.

3. *Check the steering wheel for excessive play.*

   3.1 Start the engine. With the front tires straight ahead, turn the steering wheel until motion is observed at the front wheels.

   3.2 Align a reference mark on a ruler, then slowly turn the steering wheel in the opposite direction until motion is again detected at the wheels.

   3.3 Check the lash (free play) at the rim of the steering wheel. See local/federal regulations for acceptable ranges of lash.

   If there is excessive lash, check the steering system for wear or incorrect adjustment of the linkage and steering gear before operating the vehicle.

4. *Check the brake lining wear on all vehicles, including those with automatic slack adjusters. Proper brake operation is dependent on periodic maintenance and inspection of the brake linings.*

   4.1 Check that brake linings are free of oil and grease.

   4.2 Inspect the thickness of the brake linings. If the axle assembly is equipped with a dust shield or backing plate, remove the inspection plugs. If *any* brake linings are worn to less than approximately 1/4 inch (6.4 mm) at the thinnest point, have the linings replaced on *all* brake assemblies on that axle. See **Group 42** of the *Columbia® Workshop Manual* for lining replacement instructions and camshaft end-play inspection.

4.3 Check the brake drums for wear and cracks.

4.4 Check that the inspection plugs in the dust shields or backing plates, if so equipped, are installed.

12

Cab Appearance

Cab Appearance

Cab Washing and Polishing

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. Before waxing, if the finish has become dull, 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 rust, 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.

⚠ CAUTION

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.

⚠ CAUTION

Do not use Armor-All Protectant®, STP Son-of-a-Gun®, or other equivalent treatments. These cleaners contain vinyl plasticizers which 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

Each of these items stains 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 turpentine 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, 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.

Cab Appearance

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

The hazard warning light switch tab is located on the turn signal control lever. See **Fig. 13.1**.To operate the hazard lights, pull the tab out. All of the turn signal lights and both of the indicator lights on the control panel will flash.

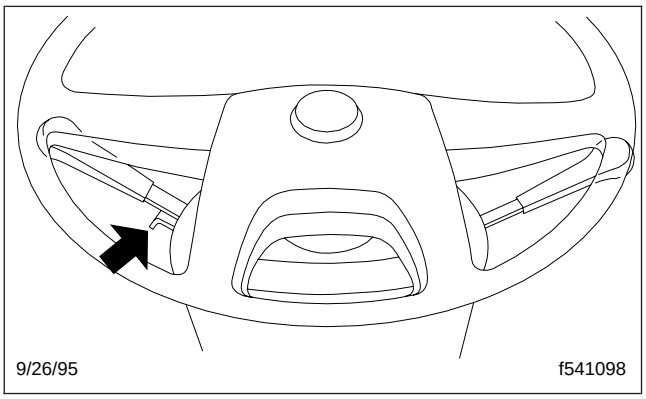


Fig. 13.1, Hazard Warning Light Switch Tab (left-hand drive shown)

To cancel the hazard warning lights, push the turn signal control lever either up or down, then return the lever to its neutral position.

Fire Extinguisher

A fire extinguisher is located in the cab by the driver's door.

Emergency Kit, Optional

An optional emergency kit package is located between the seats, at the front of the center console, if the vehicle does not have a sleeper compartment. If there is a sleeper compartment, the emergency kit is located elsewhere, depending on vehicle configuration. The package includes one or more of each of the following: first aid kit, a reflective vest, and a triangular reflector and flare kit.

If there is an emergency while driving, cautiously pull off the road, paying attention to other traffic. 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.

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.

⚠ CAUTION

If the vehicle is equipped with the AirLiner front suspension or the Hendrickson STEERTEK axle, it is required that tow straps be used when towing the vehicle. A tow strap should be connected to the tow hooks, if equipped, or wrapped around the front axle. Using a tow chain around the front axle will damage the axle.

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 extension and chrome bumper, if so equipped. Remove the bumper fairing, if so equipped.
6. On vehicles equipped with an air fairing, adjust the trim tab to the lowest position.

CAUTION

Do not pass a sling (for example, a rope or chain) from one tow hook to another to fasten for towing (see Fig. 13.2). 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.

7. 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.
8. On vehicles equipped with an air fairing, measure the distance from the ground to the bumper, or from the ground to a frame bracket.
9. Lift the vehicle, and secure the safety chains. If extra towing clearance is needed, remove the front wheels.

WARNING

Failure to lower the vehicle could result in the air fairing striking an overhead obstruction, such as a bridge or overpass, and causing vehicle damage or personal injury.

10. On vehicles equipped with an air fairing, repeat the measurement taken in step 8. The difference between the two measurements must not exceed 14 inches (36 cm). If necessary, lower the vehicle.
11. 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.

12. Chock the disabled vehicle's tires, 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

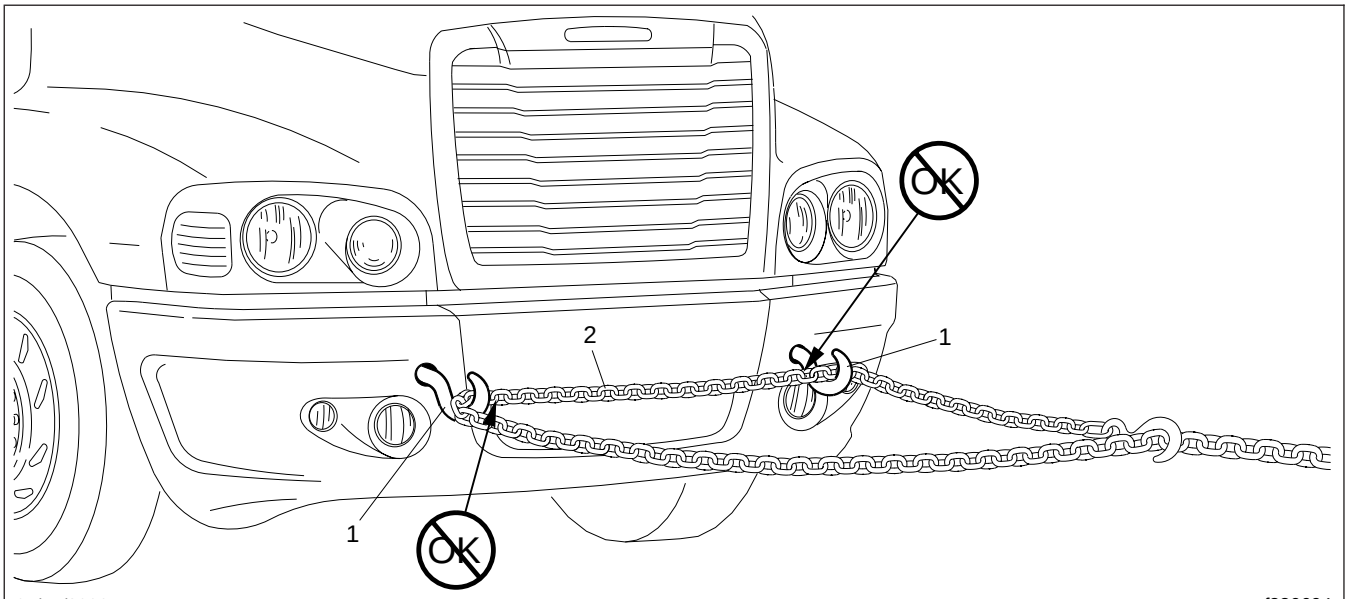
Using a rear towing hookup on a vehicle equipped with a cab-mounted aerodynamic device could cause damage to the cab structure because of the possibility of excessive wind force.

1. Place the front tires straight forward, and secure the steering wheel in this position.
2. Disconnect the battery ground cables.

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.



IMPORTANT: Do not reeve when towing.

1. Tow Hook
2. Chain

Fig. 13.2, Reeving

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.

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.

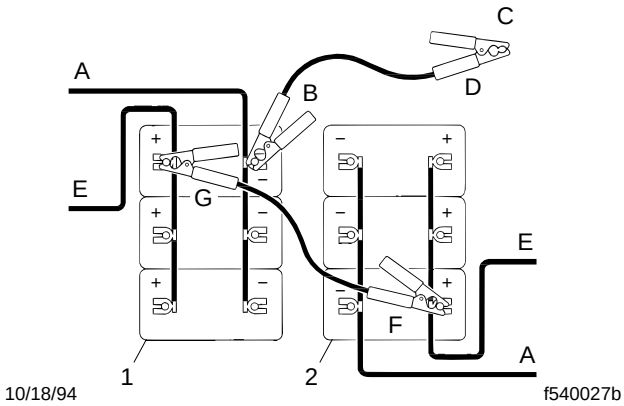
NOTE: On vehicles equipped with an optional jump-start post, attach the positive cable clamp to that post instead of to the battery.

1. Apply the parking brakes and turn off the lights and all other electrical loads.
2. 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. 13.3**.

⚠ 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 and acid burns.

3. 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



A. To Ground
B. Connect 3rd
C. To Frame (ground)
D. Connect Last
E. To Starter
F. Connect 2nd
G. Connect 1st
1. Booster Battery
2. Discharged Battery

Fig. 13.3, Jumper Connections

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.

4. 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.
5. 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.
6. 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 and acid burns.

7. Disconnect the grounded cable from the frame or other non-battery location, then disconnect the other end of the cable.
8. Disconnect the remaining cable from the newly charged battery (or jump-start post, if equipped) first, then disconnect the other end.

Fire in the Cab

The incidence of fire in heavy- and 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 flammable.

⚠ 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

Headlight Aiming

Preliminary Checks

Before checking or adjusting the headlight aim, do the following:

- Remove large amounts of mud or ice from the underside of the fenders.
- Check the springs for sagging or broken leaves.
- Check the suspension for proper functioning of the leveling mechanism. On cabs with air suspensions, make sure that the height is properly adjusted.
- 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. Clean by hand only, using a flannel cloth with mild, non-caustic soap or detergent, and water.

⚠ CAUTION

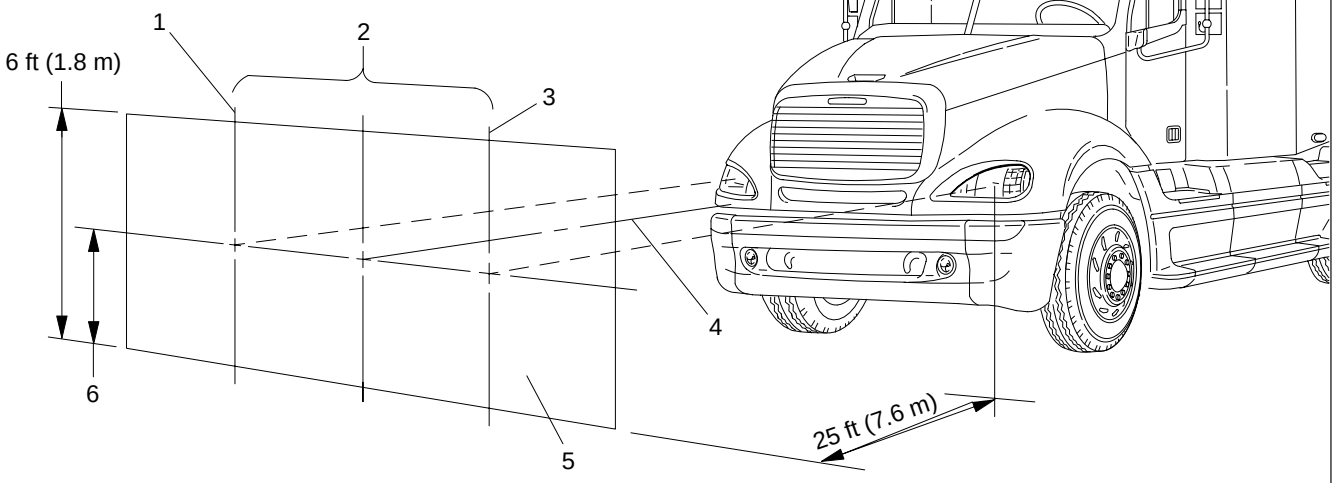
Do not use a power buffer, paper towels, chemical solvents, or abrasive cleaners on the headlight lens, all of which can remove the UV coating from the surface, and result in yellowing of the lens.

Checking Headlight Aim

1. Park the vehicle on a level surface 25 ft (7.6 m) from a screen or wall that can be used for aiming the headlights. Shut down the engine, apply the parking brake, and chock the front tires. See **Fig. 14.1**.

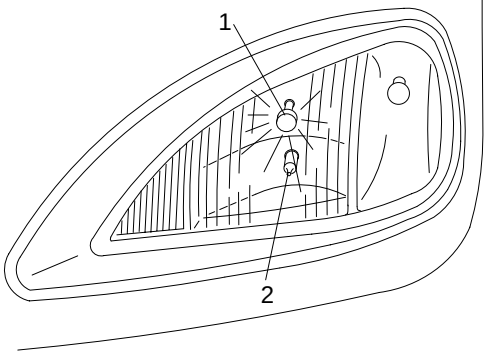
NOTE: The low-beam headlight is the top bulb in the dual-beam assembly.

2. On each headlight, find the bulb center. See **Fig. 14.2**.



1. Vertical Centerline of Right Headlight
2. Distance Between Headlights
3. Vertical Centerline of Left Headlight
4. Projected Vehicle Centerline
5. Screen or Wall
6. Height of Lamp Centers

Fig. 14.1, Headlight Aiming Screen or Wall



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Measure beam height from the ground to the center of the low-beam bulb.

1. Low-Beam Bulb and Reflector
2. High-Beam Bulb

Fig. 14.2, Headlight Beam Height

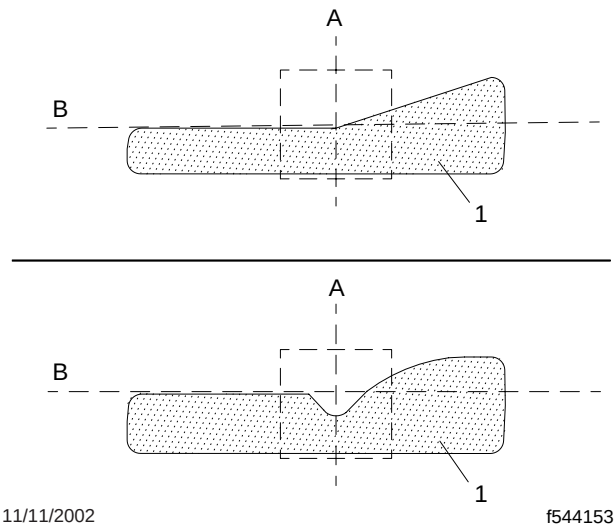
3. Measure the distance from the ground to the center of each low-beam bulb. Note those distances.
4. On the screen or wall 25 ft (7.6 m) away, make the appropriate markings directly across from each headlight and at the same height as measured for the headlight.
5. Turn on the headlights to the low-beam setting. See **Fig. 14.3** for the ideal and acceptable patterns for both headlights.
   - If either or both headlights do not aim into the inner edges of the centerline, follow the adjusting procedure below.
   - If both headlights come close to the inside of each headlight centerline (as shown), no further work is needed. Turn off the headlights and remove the chocks from the front tires.

Adjusting Headlight Aim

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**.

NOTE: Horizontal aim should not be adjusted in the field.

2. With the vehicle parked 25 ft (7.6 m) from the screen or wall, put the headlights on low beams,



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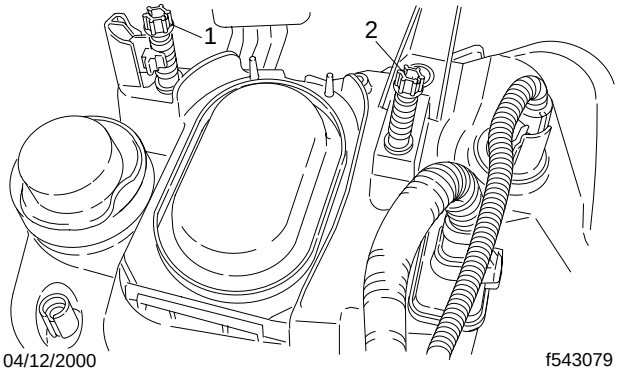
NOTE: The top view shows the ideal beam pattern; the bottom view shows an acceptable standard.

A. Vertical Centerline B. Horizontal Centerline
1. Bright Area

Fig. 14.3, Headlight Beam Patterns



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NOTE: The right-hand side headlight bucket is shown. The left-hand side is opposite.

1. Inboard Adjusting Knob
2. Outboard Adjusting Knob

Fig. 14.4, Headlight Adjusting Knobs

and turn both adjusting knobs the same amount, as needed to adjust the lights until the beam pattern meets the acceptable standard in **Fig. 14.3**. Turn the knobs clockwise to raise the beam and counterclockwise to lower it.

Headlight Aiming

NOTE: Blocking off each light is not necessary, but it can help to present a clearer beam pattern.

3. Remove the chocks from the front tires.

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