FREIGHTLINER®

Run Smart℠

BUSINESS CLASS® M2

Driver's Manual

Part Number A24-01238-000
Publication Number STI-455-6

3

Instruments

Instrumentation Control Unit

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

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

- "Warning and Indicator Lights"
- "Instruments"
- "Driver Message Center"

Figure 3.1 shows a typical ICU3 instrument cluster.

Figure 3.2 shows the ICU3S instrument cluster.

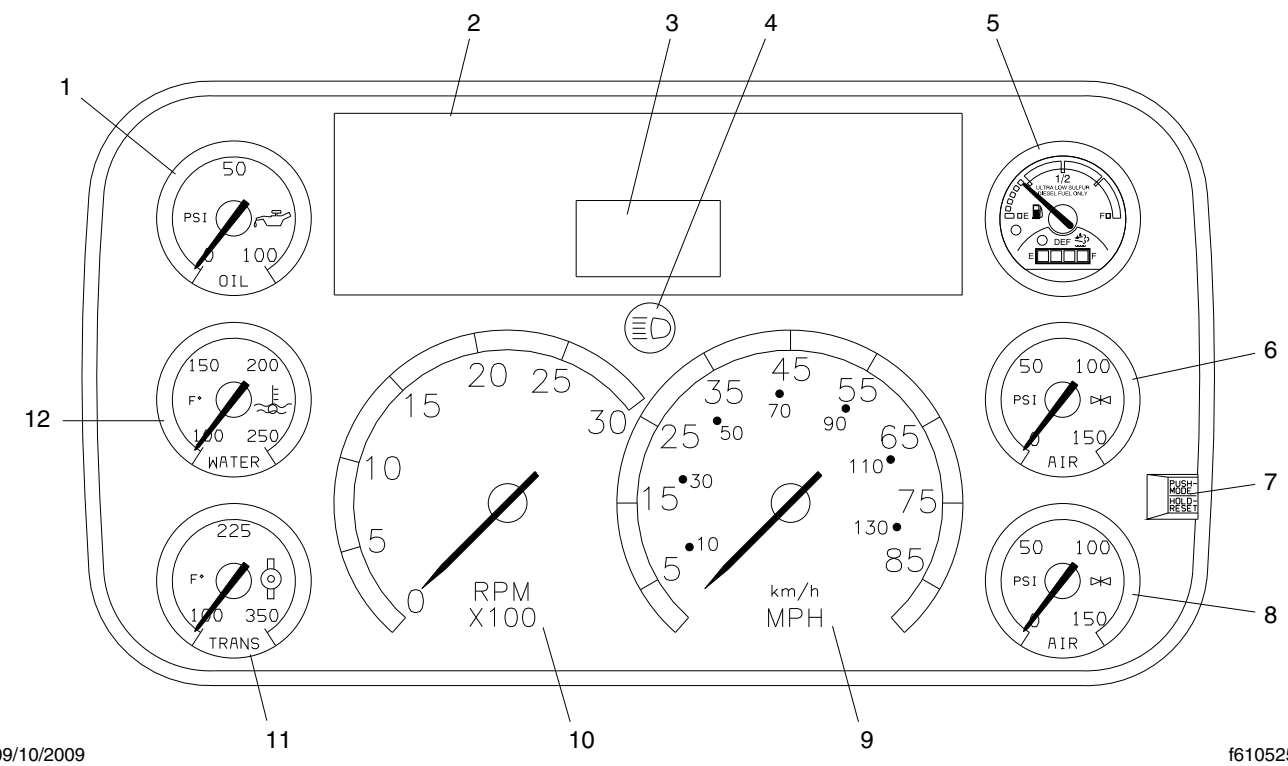
Ignition Sequence

When the ignition is turned on, the ICU runs a self-check. See **Fig. 3.3**. Observing the ignition sequence is a good way to ensure the ICU is functioning properly.

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

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

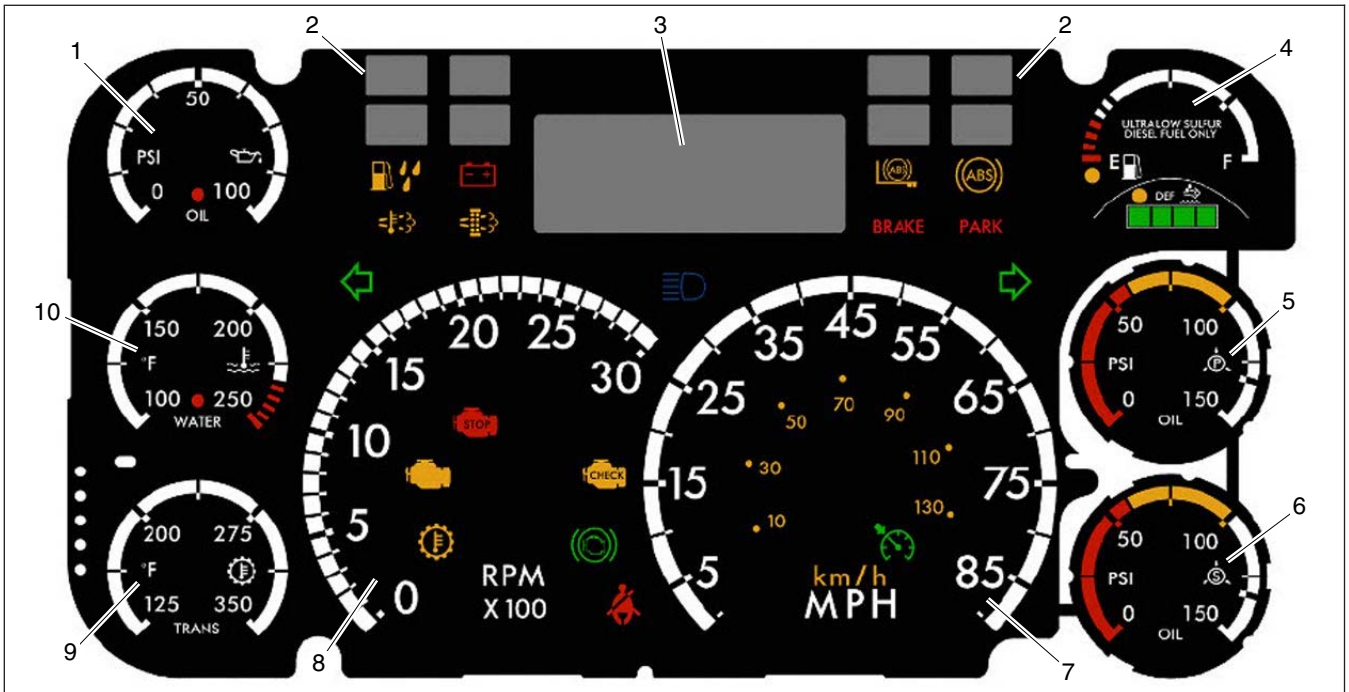
- electronic gauges complete a full sweep of their dials



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

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

Fig. 3.1, ICU3 (EPA10 shown)



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

1. Engine Oil Pressure Gauge
2. Optional Telltales
3. Driver Message Center
4. Fuel/DEF Level Gauge
5. Primary Air Pressure Gauge
6. Secondary Air Pressure Gauge
7. Speedometer (U.S. version)
8. Tachometer
9. Transmission Temperature Gauge
10. Coolant Temperature Gauge

Fig. 3.2, ICU3S (GHG14 and newer shown)

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

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

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

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

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

Audible Alerts

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

- Engine oil pressure falls below the minimum preset value.

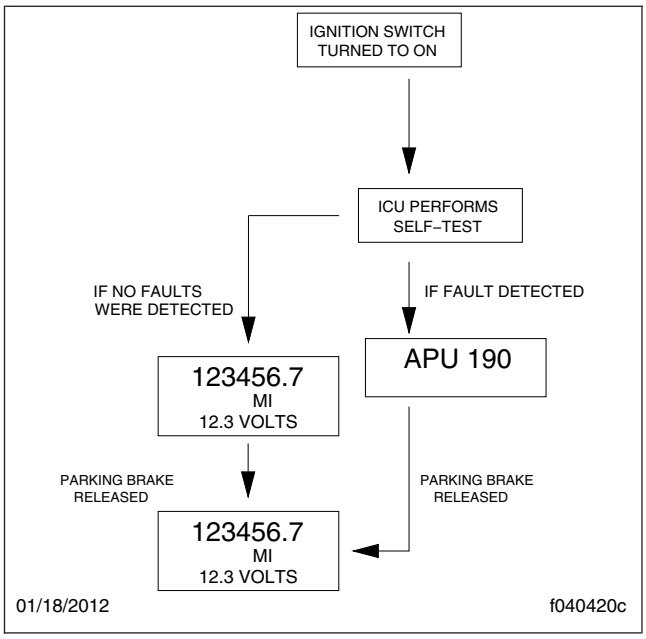


Fig. 3.3, Ignition Sequence

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

Warning and Indicator Lights

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

See **Table 3.1** for a list of standard and commonly used warning and indicator lamps.

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

IMPORTANT: Depending upon local jurisdictional emissions guidelines, vehicles and/or engines that are domiciled outside of the U.S. and Canada may not be compliant with EPA07, EPA10, GHG14, or GHG17 regulations. Non-compliant vehicles may not be equipped with all of the lamps shown in **Table 3.1**.

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

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

Common Warning and Indicator Lamps			
Lamp	Lamp Description		Color
WAIT TO START	Wait To Start (EPA07/ EPA10)	EPA10 Detroit engines: Indicates that the system is preventing the starter from cranking. This can occur when the ignition switch is turned to START before the gauge sweep has completed, or if the starter has overheated. Cummins/Mercedes-Benz engines: Indicates that the intake warmer is active. Turn the ignition switch back to ON, wait for the lamp to go out, then turn the ignition switch to START again.	Amber
START BLOCKED	Start Blocked (GHG14 Detroit engines only)	Indicates that the system is preventing the starter from cranking. This can occur when the ignition switch is turned to START before the gauge sweep has completed, or if the starter has overheated. **NOTE: Illumination of the Start Blocked lamp does not indicate a problem with the starter.** Turn the ignition switch back to ON, wait for the lamp to go out, then turn the ignition switch to START again.	
WHEEL SPIN	Wheel Spin	Flashing indicates the ATC system is active, or the ATC button has been pressed to allow wheel slip. Solid illumination indicates a problem with the ATC system. Repair the ATC system immediately to ensure full braking capability.	
	Roll Stability	Momentary illumination indicates that a stability event has occurred. On vehicles that are also equipped with ATC, flashing indicates the ATC button has been pressed to allow wheel slip.	
	Hill Start Aid (HSA) Override	Indicates the HSA switch has been pressed to override the hill start assist feature.	
	Engine Brake†	Indicates the engine brake is enabled.	Green
	Left-Turn Signal	Flashing indicates the outside left-turn signal lights are activated.	
	Right-Turn Signal	Flashing indicates the outside right-turn signal lights are activated.	
	Cruise Control†	Indicates the cruise control is enabled. NOTE: The ICU3S does not have a green cruise control telltale.	

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

* See **Fig. 3.4** for an explanation of the aftertreatment system (ATS) warning indicators, and actions required to avoid further engine protection steps.
† On vehicles equipped with the ICU3S, this information is displayed on the driver message center.

Table 3.1, Common Warning and Indicator Lamps

Engine Protection System

⚠ WARNING

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

See **Fig. 3.4** for an explanation of the aftertreatment system (ATS) warning indicators, and actions required to avoid further engine protection steps.

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

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

On other engines, the engine protection system will shut down the engine. It will first derate the engine,

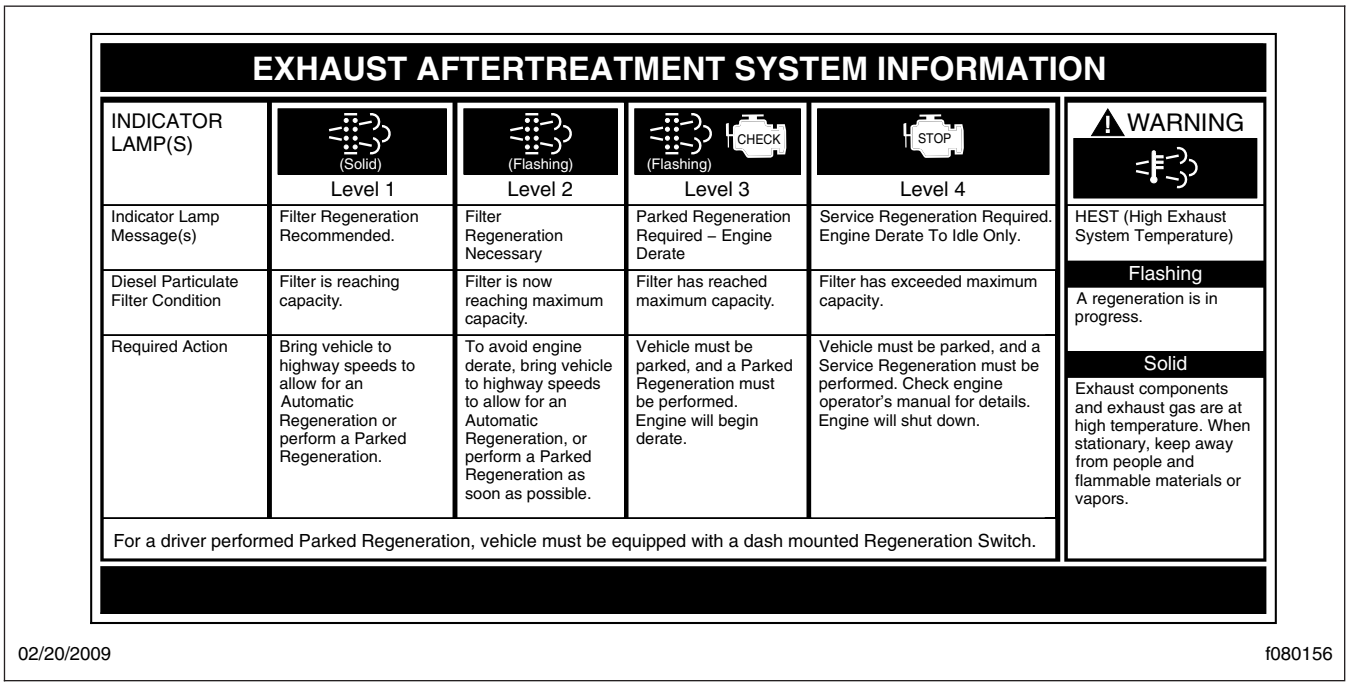


Fig. 3.4, ATS Warning Lamps

then shut it down completely 30 to 60 seconds after the indicator illuminates (depending on the critical fault type) if the condition does not improve. Bring the vehicle to a stop on the side of the road before the engine shuts down.

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

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

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

Driver Message Center

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

Driving Screens

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

i. Odometer

ii. Trip distance

iii. Trip hours

iv. Outside temperature

On the ICU3S, the cruise control and engine brake indicators are displayed on the driver message center. On vehicles equipped with an ICU3, these systems are active when the indicator lamp is illuminated.

Parked Screens/Menus

The parked screens and menus are available when the parking brake is on and no active fault codes are found. See **Fig. 3.5**. Use the mode/reset switch to scroll through the parked screens. To reset any values, press and hold the mode/reset switch. The parked screens appear in the following order:

i. Odometer

ii. Trip distance

iii. Trip hours

iv. Outside temperature

v. Select units

vi. Temperature alert

vii. Diagnostics

viii. Engine miles

ix. Engine hours

x. Setup

Temperature Alert

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

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

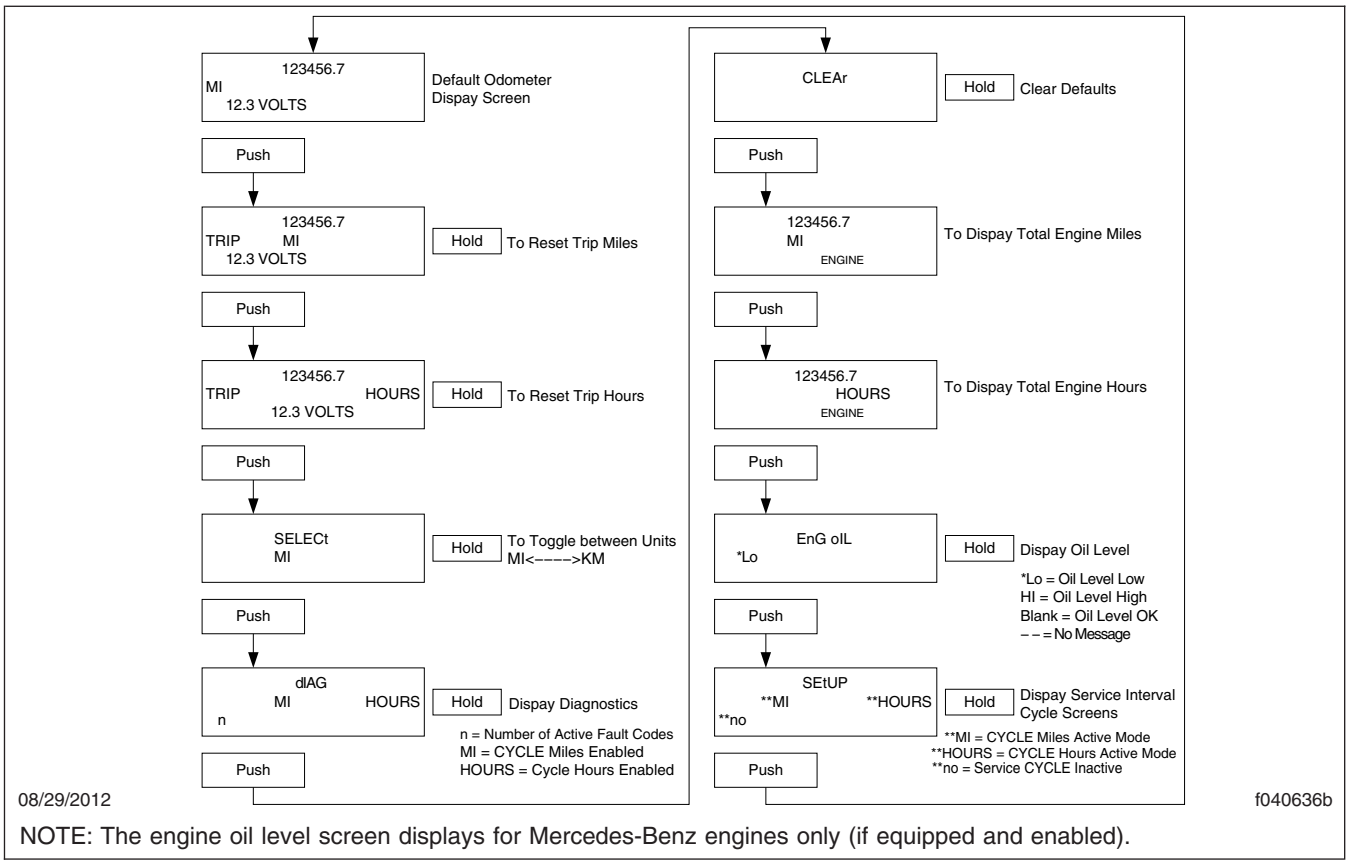
Press and hold the mode/reset switch to toggle between on and off. Release the mode/reset switch, then tap it to select the displayed choice.

Diagnostics

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

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

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



NOTE: The engine oil level screen displays for Mercedes-Benz engines only (if equipped and enabled).

Fig. 3.5, ICU3 Stationary Screens

Engine Miles/Hours

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

Setup

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

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

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

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

Instruments

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

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

Air Intake Restriction Gauge

The air intake restriction gauge indicates the vacuum on the engine side of the air cleaner. On standard installations, it is mounted on the air intake duct in the engine compartment. See **Fig. 3.6**. As an option for easier viewing, the air intake restriction indicator

can be mounted on the dash, usually on the right-hand control panel.

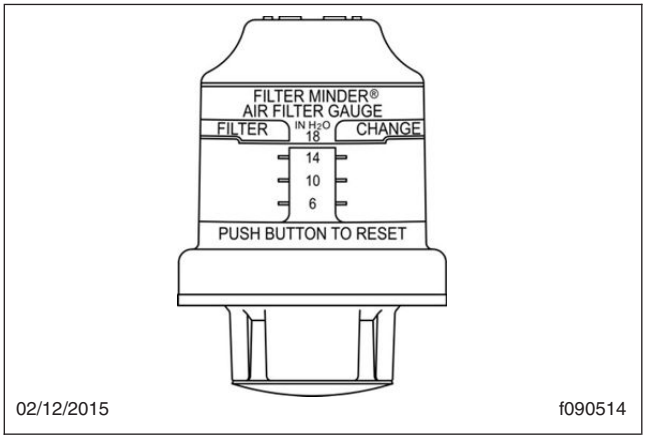


Fig. 3.6, Air Intake Restriction Indicator

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

Air intake restriction vacuum is measured in inches of water (inH_2O). For vehicles equipped with a graduated indicator or a restriction gauge on the dash, check the gauge with the engine off. If the yellow signal stays locked in the red zone once the engine is shut down, or is at or above the values shown in **Table 3.2**, the air cleaner element needs to be replaced.

Vehicles may be equipped with a go/no-go restriction indicator without graduations (see **Fig. 3.7**) instead of a graduated indicator.

Air Intake Maximum Restriction Values (inH_2O)			
Engine Make	**Pre-EPA07 Engines**	**EPA07 and EPA10 Engines**	**GHG14 and GHG17 Engines**
Detroit	20	22	18
Cummins	25	25	25
Mercedes-Benz	22	22	–
Caterpillar	25	–	–

Table 3.2, Air Intake Maximum Restriction Values

Ambient Temperature Gauge

The ambient temperature gauge, shown in **Fig. 3.8**, displays the in-cab or outside temperature, depending on the settings selected.

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

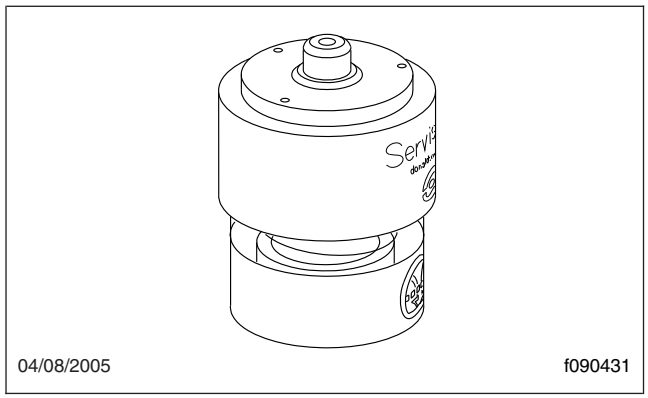


Fig. 3.7, Manual-Reset Air Restriction Indicator, Go/ No-Go

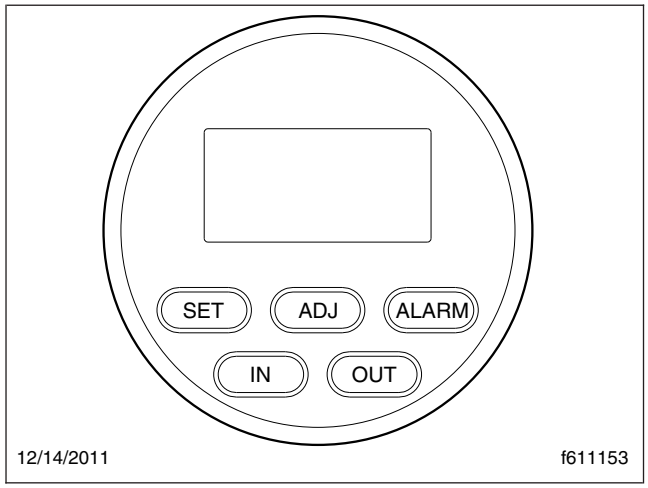


Fig. 3.8, Ambient Temperature Gauge

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

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

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

Coolant Temperature Gauge

NOTICE

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

During normal engine operation, the coolant temperature gauge, as shown in **Fig. 3.9**, should read 175 to 195°F (79 to 91°C). If the temperature remains below 160°F (71°C), inspect the cooling system to determine the cause.

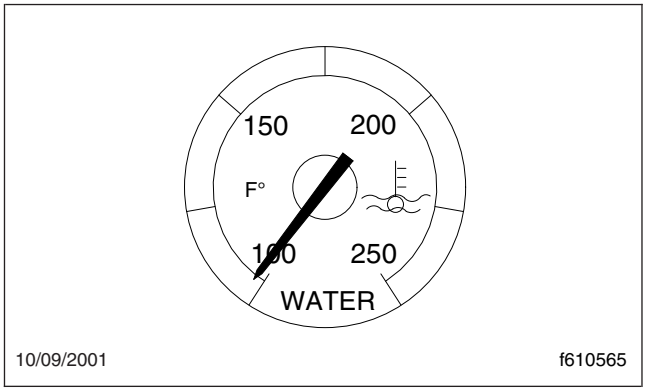


Fig. 3.9, Coolant Temperature Gauge

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

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

Table 3.3, Maximum Coolant Temperature

Engine Oil Pressure Gauge

NOTICE

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

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

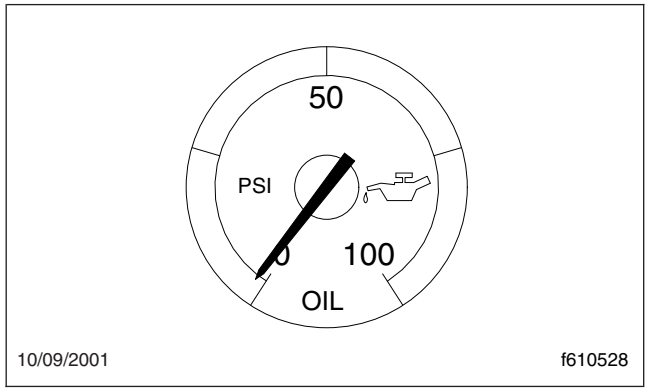


Fig. 3.10, Engine Oil Pressure Gauge

Minimum Oil Pressure*		
Engine Model	**At Idle Speed: psi (kPa)**	**At Rated RPM: psi (kPa)**
Caterpillar	10–20 (69–138)	30–45 (207–310)
Cummins	15 (103)	35 (241)
Detroit	14 (97)	55 (350)
Mercedes-Benz	7 (50)	36 (250)

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

Table 3.4, Minimum Oil Pressure

Engine Oil Temperature Gauge

NOTICE

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

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

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

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

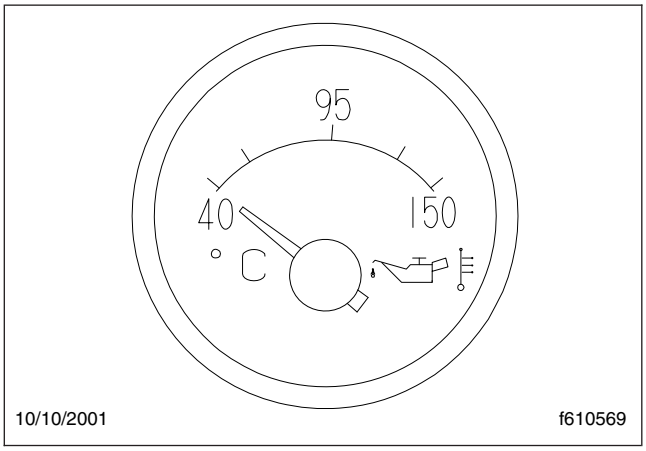


Fig. 3.11, Engine Oil Temperature Gauge

Fuel Gauge, Pre-EPA10

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

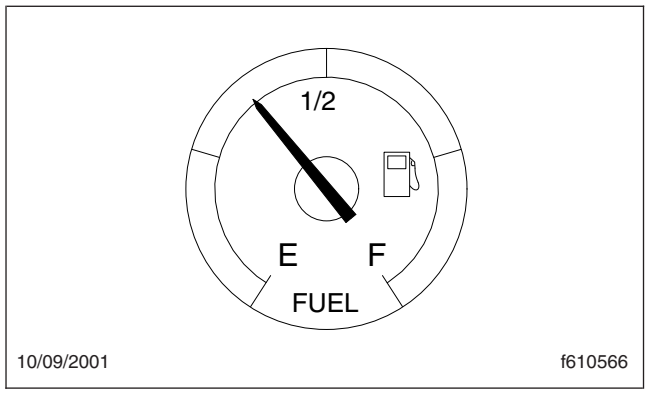
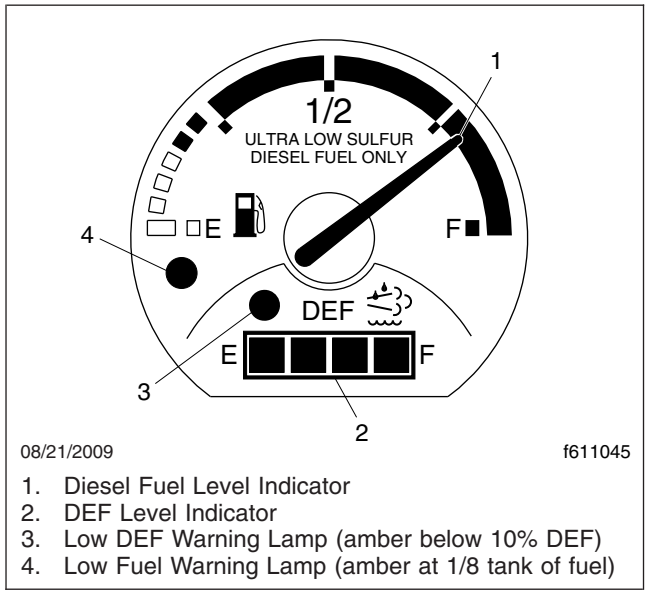


Fig. 3.12, Fuel Level Gauge, Pre-EPA10

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

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



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

Fig. 3.13, Fuel/DEF Gauge, EPA10

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

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

Primary and Secondary Air Pressure Gauges

⚠ WARNING

If air pressure falls below minimum pressure, the braking ability of the vehicle will be limited. Slow the vehicle down and bring it to a gradual stop. Do not attempt to move the vehicle until air pressure has risen above the minimum level. Moving a vehicle without adequate braking power could cause an accident resulting in property damage, personal injury, or death.

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

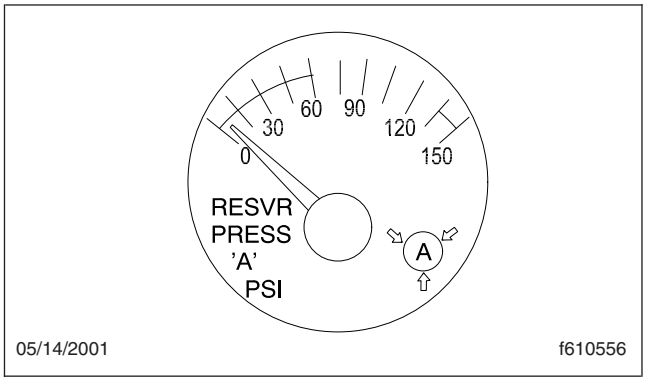


Fig. 3.14, Air Pressure Gauge (reservoir A shown)

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

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

Speedometer

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

Tachometer

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

Transmission Fluid Temperature Gauge

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

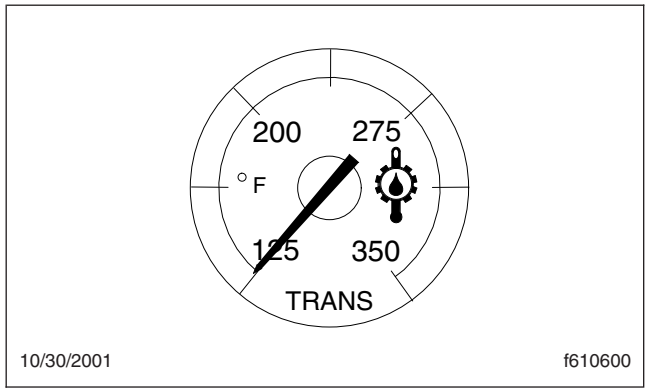


Fig. 3.15, Transmission Fluid Temperature Gauge

NOTICE

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

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

Turbocharger Boost Pressure Gauge

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

Voltmeter

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

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

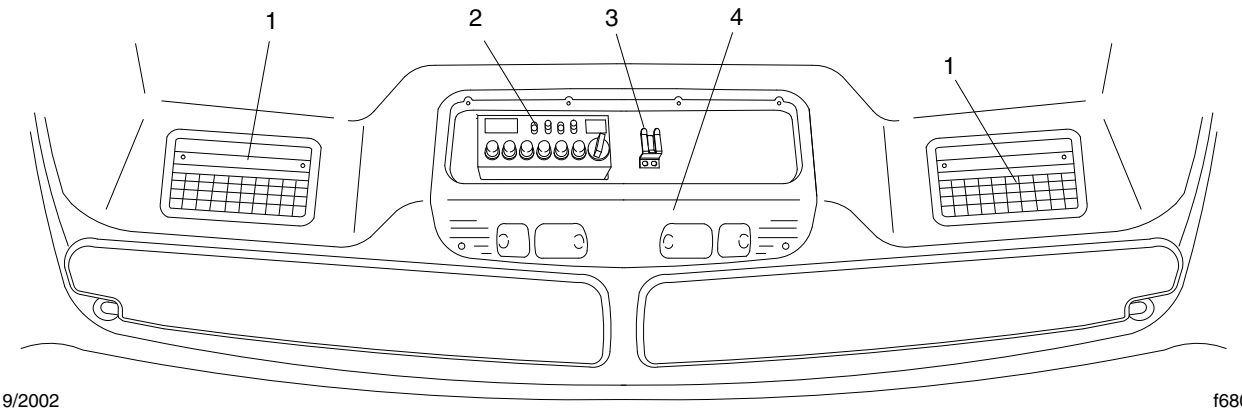
If the voltmeter shows an undercharged or overcharged condition for an extended period, have the charging system and batteries checked at an authorized Freightliner service facility.

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

Overhead Instrument Panel

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

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



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1. Storage Area with Netting
2. C/B Radio
3. Microphone Clip
4. Dome/Reading Light Assembly

Fig. 3.16, Overhead Instrument Panel

4

Controls

Ignition Switch and Key

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

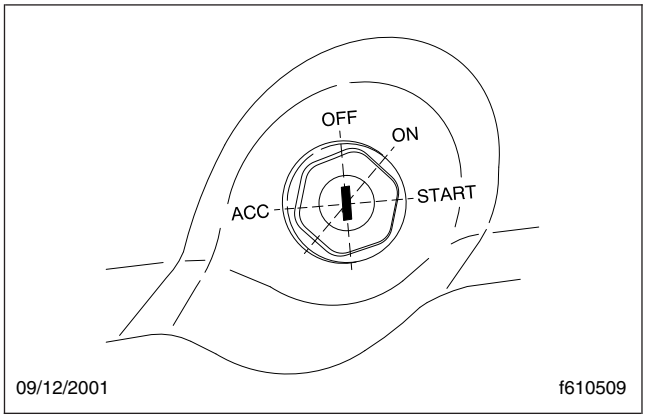


Fig. 4.1, Ignition Switch Positions

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

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

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

Electrical System

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

⚠ WARNING

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

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

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

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

Lighting Controls

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

Two types of dash switches are used:

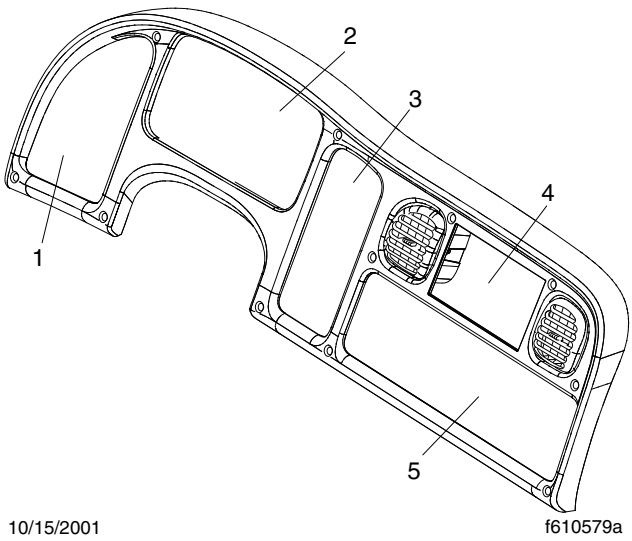
- Paddle switches with a single paddle located in the center of the switch. The paddle can be raised or lowered to perform a function.
- Rocker switches that can be pressed at either the upper or lower end to perform a function. Certain rocker switches are guarded to prevent them from being switched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

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

Control Panels

The left-hand control panel (**Fig. 4.2**) contains a louvered window outlet for the face vents of the heating, ventilation, and air conditioning system (HVAC), and four switches arranged in a vertical line, usually the

headlight, panel light increase/decrease, and the cruise control On/Off and Set/Resume switches.



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1. Left-Hand Control Panel
2. Instrumentation Control Unit
3. Right-Hand Control Panel
4. Radio Panel
5. Auxiliary Dash Panel

Fig. 4.2, Switch and Gauge Panels

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

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

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

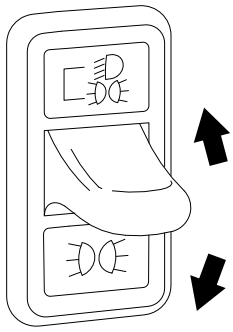
The auxiliary dash panel (**Fig. 4.2**) below the radio panel contains the marker interrupt switch, the air brake valve knobs, the cigarette lighter, and a variety of switch options.

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

Exterior Light Controls

Headlight/Parking Light Switch

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



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Raise the paddle to illuminate the headlights, low beam.

Lower the paddle to illuminate the parking lights.

Fig. 4.3, Headlight/Parking Light Switch

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

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

Panel Light Increase/Decrease Switch

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

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

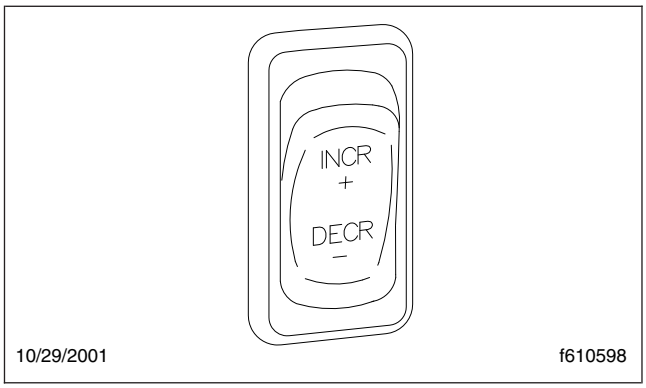

Fig. 4.4, Panel Light Increase/Decrease Switch

Daytime Running Lights

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

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

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

Marker Light Interrupt Switch

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

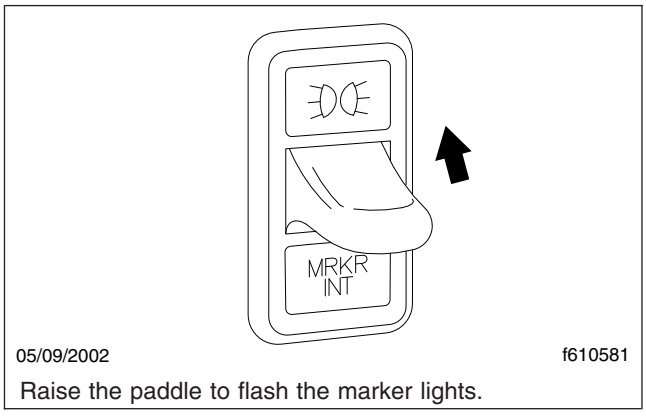

Fig. 4.5, Marker Light Interrupt Switch

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

Road Light Switch, Optional

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

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

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

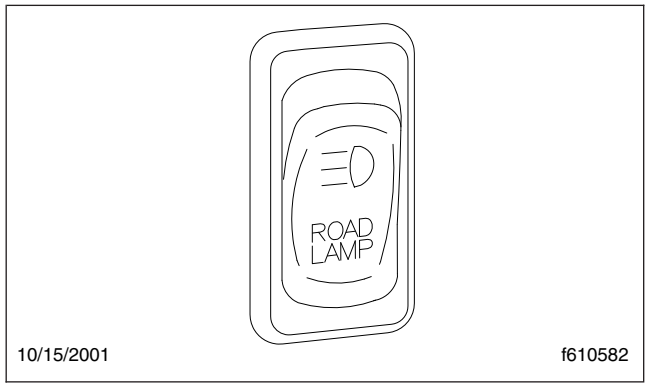

Fig. 4.6, Road Light Switch

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

Utility Light Switch, Optional

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

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

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

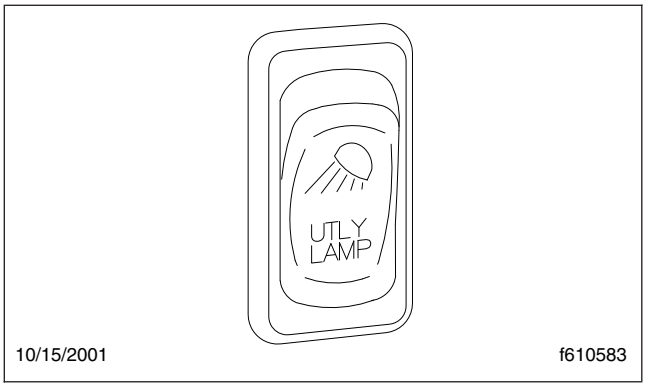

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Fig. 4.7, Utility Light Switch

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

Spotlight, Optional

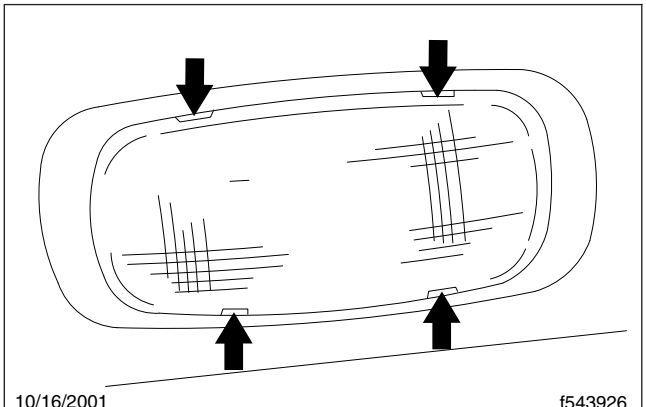
The spotlight switch is located on the pivoting handle of the spotlight. There may be a single spotlight assembly mounted on the driver's door, or one on each door.

Interior Lights and Light Controls

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

Dome Lights

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



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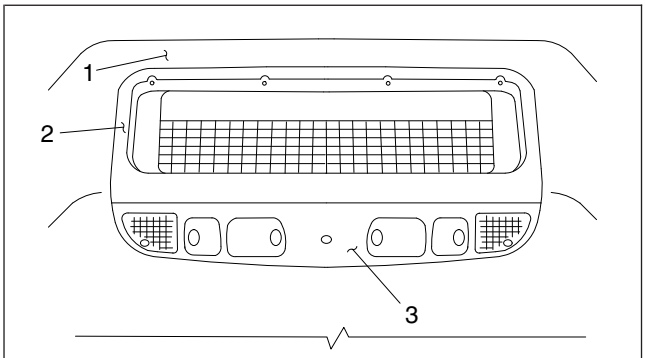
To remove the lens, press in at the mounting tabs (arrows).

Fig. 4.8, Rear Dome Light

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



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1. Overhead Console
2. Trimplate
3. Light Assembly

Fig. 4.9, Overhead Console Dome Lights

Light Replacement

Rear Dome Light

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

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

Overhead Console Dome/Reading Lights

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

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

8. Install the remaining tapping screws.

Dome Light Switches

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

Clear Reading Lights, Optional

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

Multifunction Turn Signal Switch

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

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

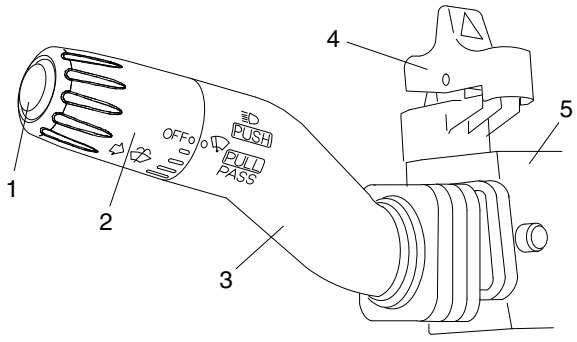
See **Fig. 4.10** for the multifunction switch and its component parts.

Turn-Signal Controls

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

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

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



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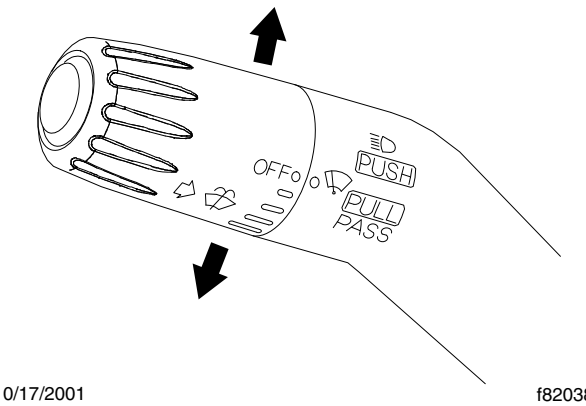
Press down on the upper part of the rocker to activate the hazard warning flashers.

1. Washer Button
2. Wiper Control Dial
3. Turn Signal Lever
4. Hazard Flasher (red rocker switch)
5. Multifunction Switch Module

Fig. 4.10, Multifunction Turn Signal Switch



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Move the lever down to turn on the left turn signals.

Move the lever up to turn on the right turn signals.

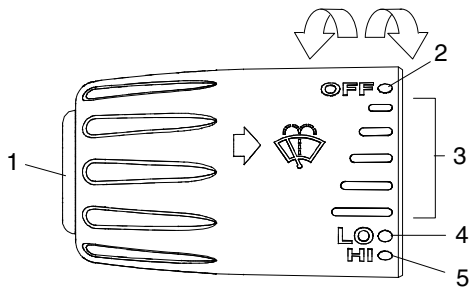
Fig. 4.11, Turn Signal Controls

Windshield Wiper/Washer Controls

⚠ CAUTION

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

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



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Rotate the control dial away from you to turn the wipers on, or speed them up.

Rotate the control dial towards you to slow the wipers down, or turn them off.

1. Washer Button
2. OFF Position
3. Delay Positions
4. Wipers On, Low Speed
5. Wipers On, High Speed

Fig. 4.12, Wiper/Washer Controls

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

Rotating the control dial in the opposite direction (clockwise) causes the wipers to slow down. Rotating the control dial clockwise as far as it will go (to the OFF setting) turns the wipers off.

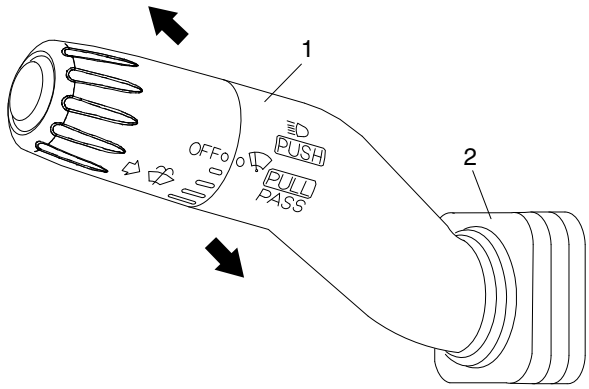
The washers are operated by a yellow button at the very end of the turn signal lever. To operate the washers, press the button in and hold it in until you want the washers to stop.

Headlight High Beams

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

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

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



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Move the lever away from you to turn on the high beams. Move the lever back to its original position to turn them off.

Move the lever towards you to flash the high beams momentarily.

1. Turn Signal Lever 2. Boot

Fig. 4.13, Headlight High Beams

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

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

Hazard Warning Flasher

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

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

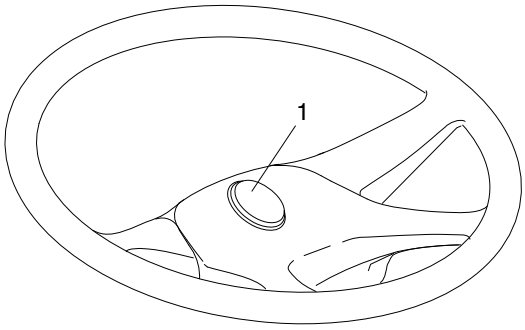
Horn Controls

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

Electric Horn

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

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



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To sound the electric horn, press down on the horn button.

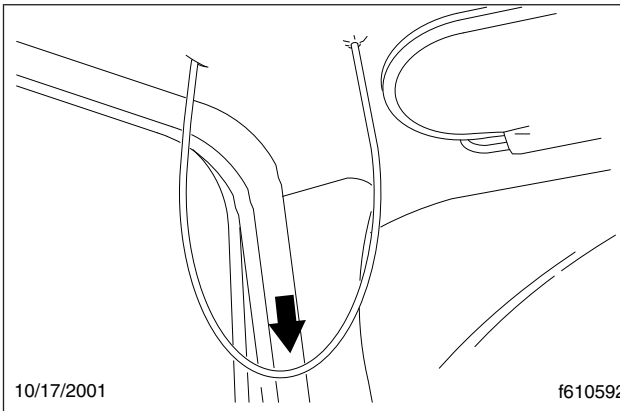
1. Horn Button

Fig. 4.14, Electric Horn Control

Air Horn, Optional

Single and dual air horns are available as options.

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



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To sound the air horn, pull down on the lanyard (arrow).

Fig. 4.15, Air Horn Control

Powertrain Controls

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

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

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

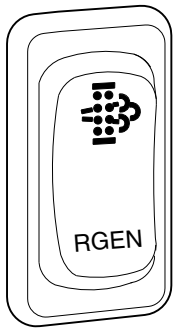

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Fig. 4.16, Request/Inhibit Regen Switch

Cruise Control Switches

CAUTION

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

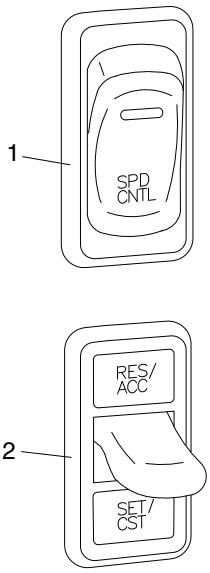
On standard models, cruise control is activated by two dash switches. See **Fig. 4.17**. On some models, cruise control can be activated by a button on the transmission shift knob.

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

NOTE: For more information about cruise control operation, see **Chapter 7**.

Engine Brake Switch, Optional

The engine brake switch controls the degree of engine braking. Normally there are two paddle



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To turn cruise control on, press the upper half of the On/Off (rocker) switch. To turn cruise control off, press the lower half of the On/Off (rocker) switch.

1. Cruise Control On/Off (rocker) Switch
2. Cruise Control Set/Resume (paddle) Switch

Fig. 4.17, Cruise Control Switches, Dash-Mounted

switches, a two-position On/Off Switch to activate the engine brake, and a two-position HI-LO Switch to control the amount of engine braking.

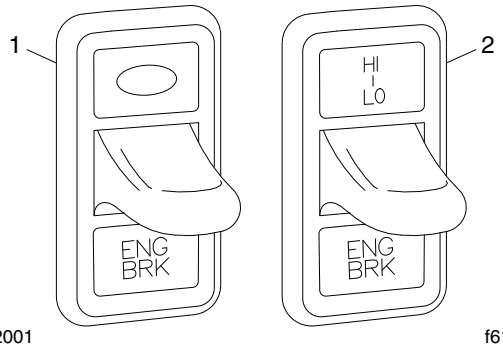
To turn the two-position On/Off Switch on, raise the paddle. When the two-position switch is on, an amber LED (light-emitting diode) illuminates inside the switch.

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

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

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

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



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1. On/Off Switch 2. HI-LO Switch

Fig. 4.18, Engine Brake Switches

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

Exhaust Brake Switch, Optional

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

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

11/28/2001 f610589

Fig. 4.19, Exhaust Brake Switch

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

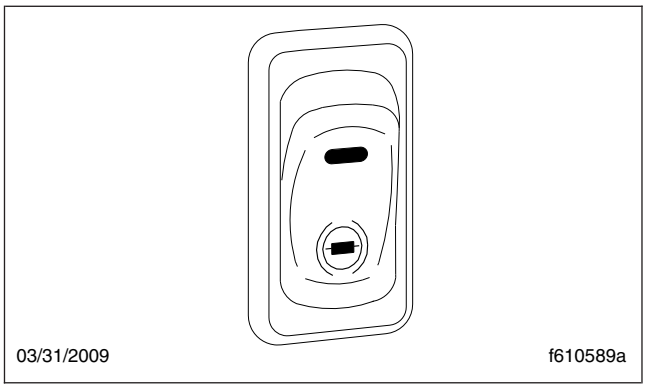


Fig. 4.20, Exhaust Brake Switch

Engine Fan Switch, Optional

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

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

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

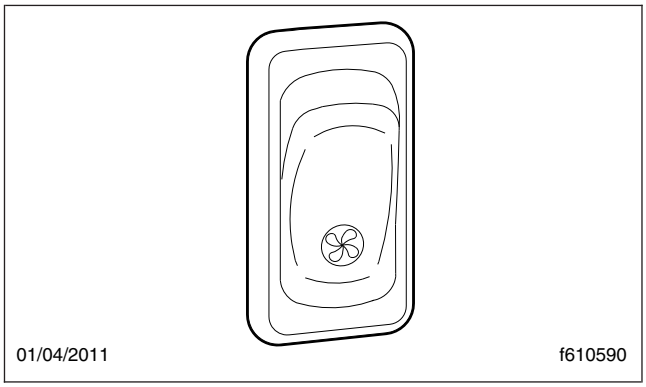
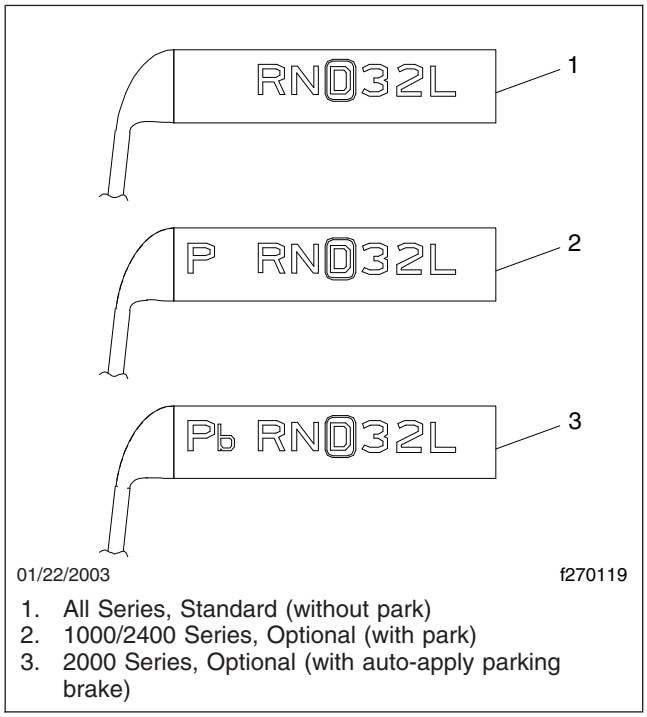


Fig. 4.21, Engine Fan Switch

Transmission Controls

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

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



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

Fig. 4.22, Steering Column-Mounted Shift Controls

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

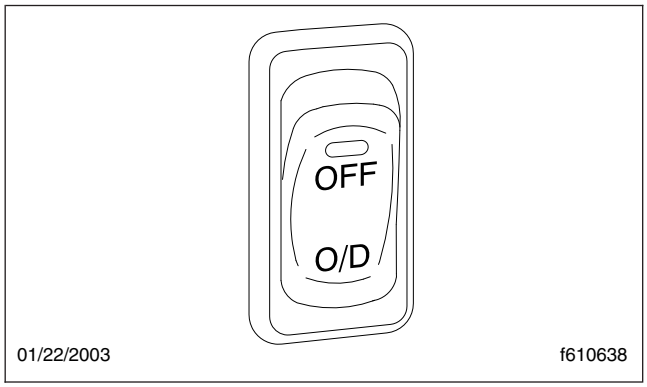


Fig. 4.23, Overdrive Lockout Switch

To shift to fourth gear, press on the upper part of the rocker (at the LED). The LED will come on and stay illuminated until the bottom part of the rocker switch is pressed.

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

Axle Switches

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

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

NOTE: For more information on axle switch function, see **Chapter 8**.

Differential Lock Switch

CAUTION

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

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

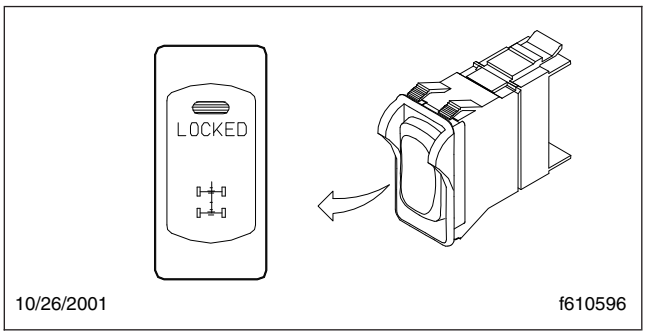


Fig. 4.24, Differential Lock Switch

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

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

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

Interaxle Lock Switch

CAUTION

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

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

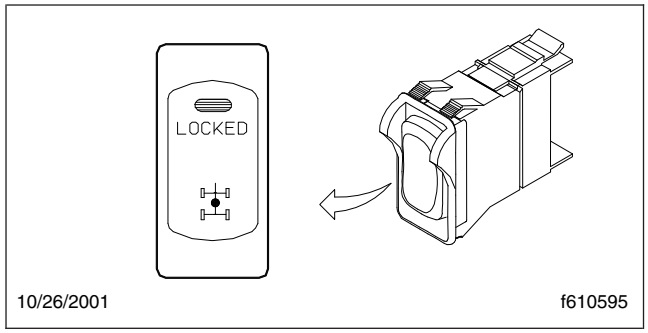


Fig. 4.25, Interaxle Lock Switch

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

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

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

Axle Shift Switch

CAUTION

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

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

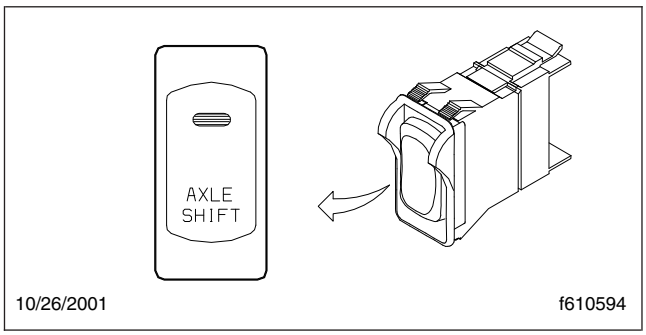


Fig. 4.26, Axle Shift Switch

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

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

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

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

AWD Controls

The AWD switch allows the driver to direct power to the steer axle. For more information about transfer cases and driven steer axles, see **Chapter 8**.

AWD Operation Switch

The AWD operation switch (LOCKED AWD) is a two-position rocker switch. See **Fig. 4.27**.

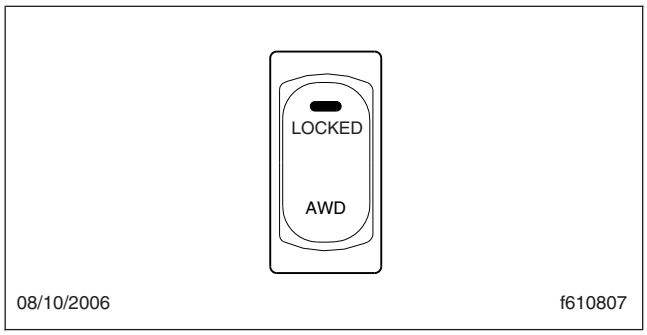


Fig. 4.27, AWD Operation Switch

To engage the steer axle, press the upper half of the rocker switch. To disengage it, press the lower half of the switch.

Transfer Case Range Switch

CAUTION

Before selecting the neutral (N-TRL) position, stop the vehicle and set the parking brake to prevent the vehicle from rolling and causing damage and/or personal injury.

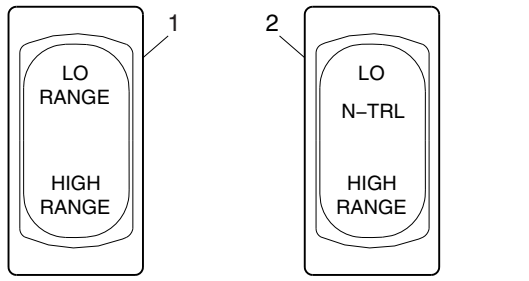
NOTICE

To prevent damage to the transfer case and the driveline, stop the vehicle and put the transmission in neutral before using the range switch.

IMPORTANT: Use this switch only when the steer axle has been engaged.

There are two transfer case range switches: a two-position rocker switch with LO and HIGH RANGE, and a three-position switch that has a neutral (N-TRL) position in the middle for vehicles with a power take-off (PTO) unit. See **Fig. 4.28**.

For operating guidelines for Meritor MTC transfer cases, see **Chapter 8**.



01/06/2015 f610808

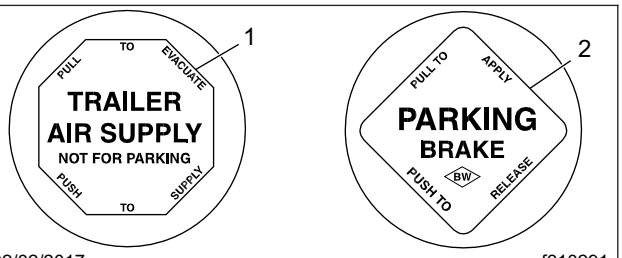
1. Two-Position Switch
2. Three-Position Switch

Fig. 4.28, Transfer Case Range Switches

Braking

Parking Brake Control Valve

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



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1. Trailer Air Supply Valve (red knob)
2. Parking Brake Control Valve (yellow knob)

Fig. 4.29, Brake Valve Control Knobs

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

Trailer Air Supply Valve

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

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

Trailer Brake Lever

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

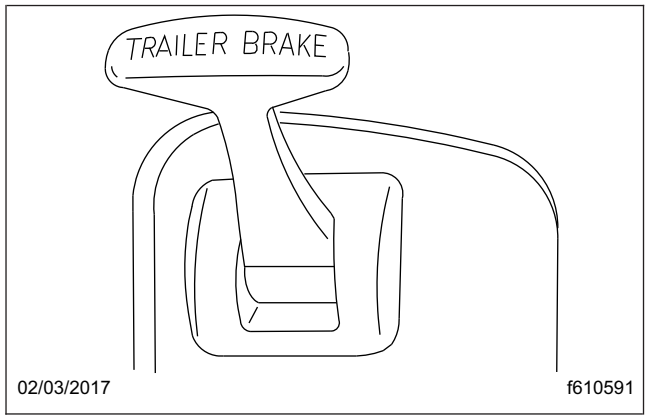

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Fig. 4.30, Trailer Brake Lever

Meritor™ WABCO® Antilock Braking System (ABS)

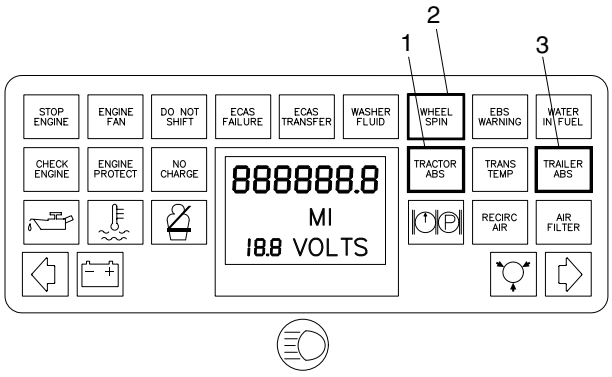
The Meritor WABCO Antilock Braking System (ABS) has an amber tractor indicator light (TRACTOR ABS legend) and, if equipped with automatic traction control (ATC), an amber wheel spin indicator light (WHEEL SPIN legend). See **Fig. 4.31**.

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

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

Adjustable Steering Column

To tilt the steering column, press down on the foot pedal located below the steering column. Tilt the steering column up or down to the desired position.



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1. Tractor ABS Indicator
2. Wheel Spin Indicator (optional)
3. Trailer ABS Indicator

Fig. 4.31, ABS Indicator Lights

Release the foot pedal to lock the steering column in place. See **Fig. 4.32**.

To telescope the steering column, press down on the foot pedal located below the steering column. Pull the steering wheel closer to you or push the steering wheel farther away from you. Release the foot pedal to lock the steering column in place.

Other Dash-Mounted Controls

Windshield-Fan Switches, Optional

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

Cigarette Lighter

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

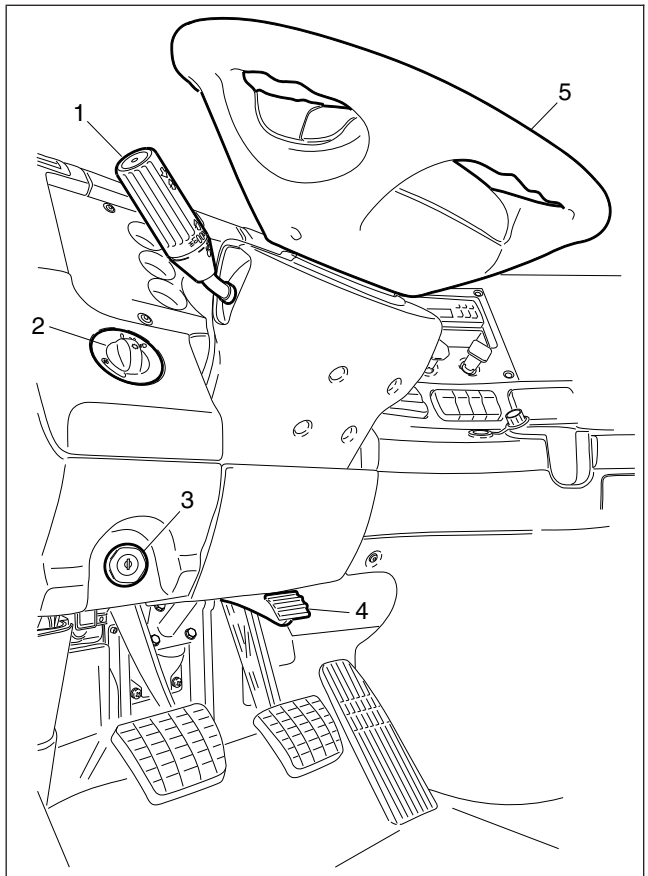
CB Radio Connections

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

Suspension Dump Switch

NOTICE

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



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1. Multifunction Turn Signal Switch
2. Headlight Switch
3. Ignition Switch
4. Adjustable Steering Column foot Pedal
5. Steering Wheel

Fig. 4.32, Adjustable Steering Column

NOTICE

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

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

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

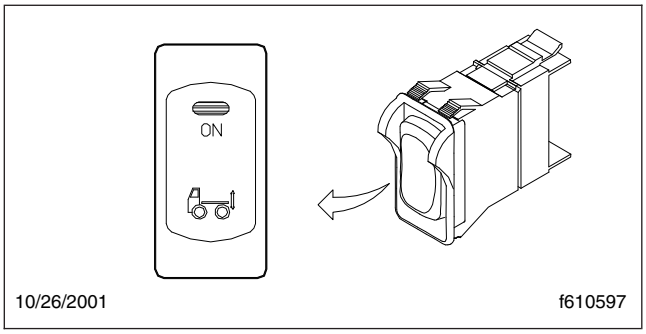


Fig. 4.33, Suspension Dump Switch

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

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

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

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

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

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

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

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

If the ignition is turned off while the vehicle is in dump mode, the power to the dump solenoid is cut off to prevent battery drain, and the suspension system will autofill the rear air springs. The suspension will also autofill if the vehicle is operated with the suspension dumped, and the speed is over 5 mph (e.g. -- driver forgot to inflate the bags or there was a system failure).

Suspension Autofill Override Valve

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

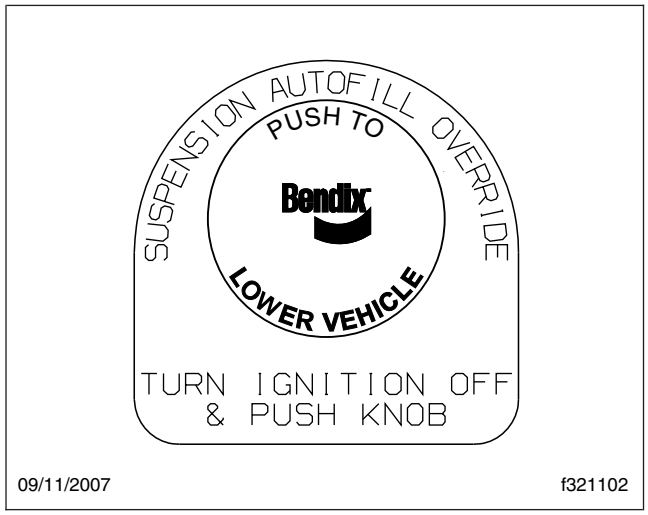


Fig. 4.34, Suspension Autofill Override Valve

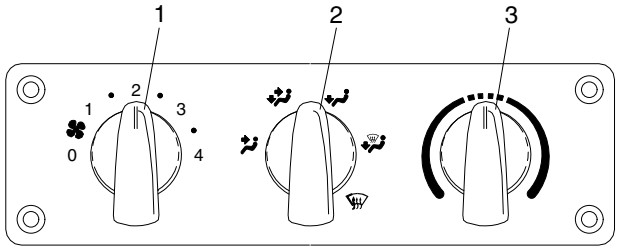
Heater/Air Conditioner Control Panel

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

Seat Controls

Bench Seat Adjustment Controls

The standard bench seat has one control: the seat slide lever. See **Fig. 4.36**. The two-person bench seat and the non-suspended passenger seat have no controls.



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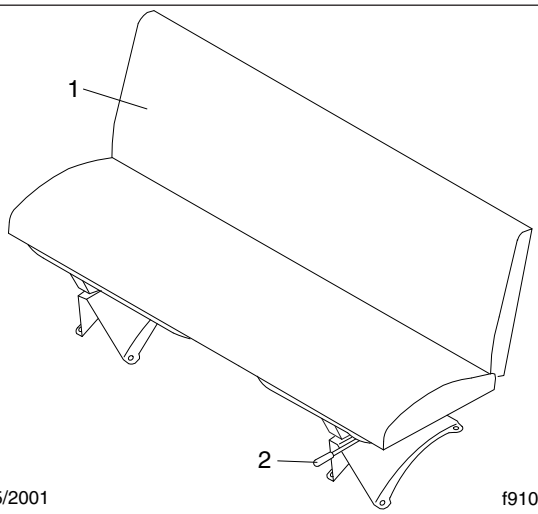
1. Fan Switch
2. Air Selection Switch
3. Temperature Control Switch

Fig. 4.35, HVAC Climate Control Panel, Standard



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1. Three-Person Seat
2. Seat Slide Lever

Fig. 4.36, Full Bench Seat

Suspension Seat Adjustment Controls

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

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

All adjustment controls for a suspension seat are located on the seat base. See **Chapter 5** for complete instructions.

7

Engines

Emissions and Fuel Efficiency

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

NOTICE

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

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

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

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

Greenhouse Gas Emissions and Fuel Consumption Standards

Vehicles and/or engines manufactured after December 31, 2006 and domiciled in the U.S. or Canada are required to meet all EPA and NHTSA regulations effective as of the vehicle build date. Engines manufactured between January 1, 2007 and December 31, 2009 meet EPA07 requirements. Engines manufactured between January 1, 2010 and December 31, 2012 meet EPA10 requirements. Engines manufactured from January 1, 2013 meet NHTSA and EPA 2014 fuel efficiency and greenhouse gas emission standards (GHG14) requirements. Engines manufactured from January 1, 2016 meet NHTSA and EPA 2017 fuel efficiency and greenhouse gas emission standards (GHG17) requirements.

Model year 2013 and later vehicles meet additional requirements as specified by GHG14 requirements. Model year 2017 and later vehicles meet similar requirements as specified by GHG17 requirements. These vehicles are equipped with components that increase fuel efficiency and reduce GHG emissions. Components may include, but are not limited to, low-rolling resistance tires; aerodynamic devices such as hood, cab/sleeper extenders, and fuel tank fairings; vehicle speed limiter; and idle shutdown timer. If replacement of any drag-reducing component is required, the replacement component must meet or exceed the drag reduction performance of the originally installed component in order to maintain compliance with GHG14 and GHG17 requirements.

EPA07 Engines

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

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

EPA10 and Newer Engines

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

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

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

Regeneration

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

⚠ WARNING

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

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

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

Regen Switches

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

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

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

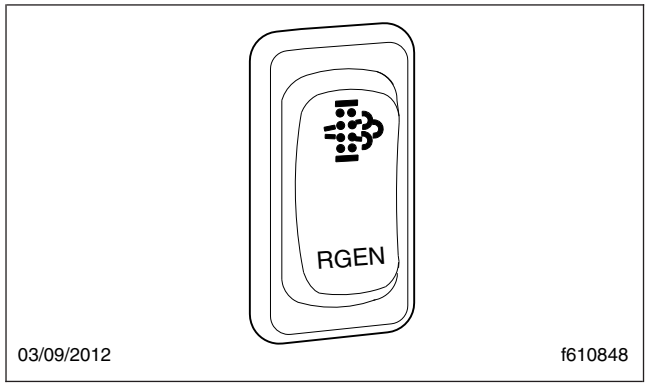

Fig. 7.1, Regen Request Switch

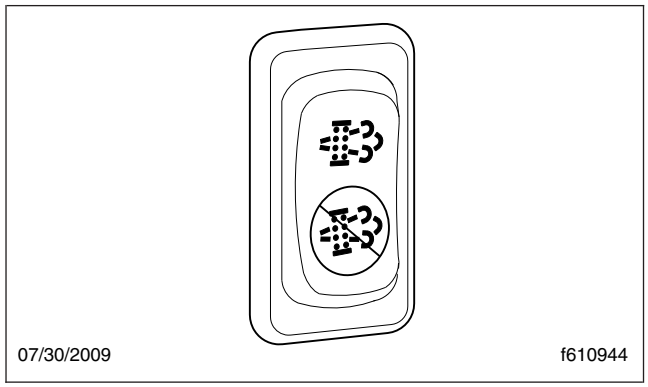

Fig. 7.2, Regen Request/Inhibit Switch

⚠ WARNING

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

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

To initiate a parked regen, perform the following steps.

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

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

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

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

ATS Warning Lamps

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

See **Fig. 7.4** for an explanation of the ATS warnings, and actions required to avoid engine protection sequences.

Malfunction Indicator Lamp (MIL)

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

DPF Status Lamp

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

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

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

High Exhaust System Temperature (HEST) Lamp

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

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

Maintenance

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

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

Diesel Exhaust Fluid and Tank, EPA10 and Newer Engines

Diesel Exhaust Fluid

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

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

DEF consumption varies depending on ambient conditions and vehicle application.

Freezing Conditions

DEF freezes to slush at around 12°F (-11°C). It is not damaged or destroyed if frozen, and is fully usable when thawed. The DEF in the tank is allowed to freeze while a vehicle is non-operational. At start-up,

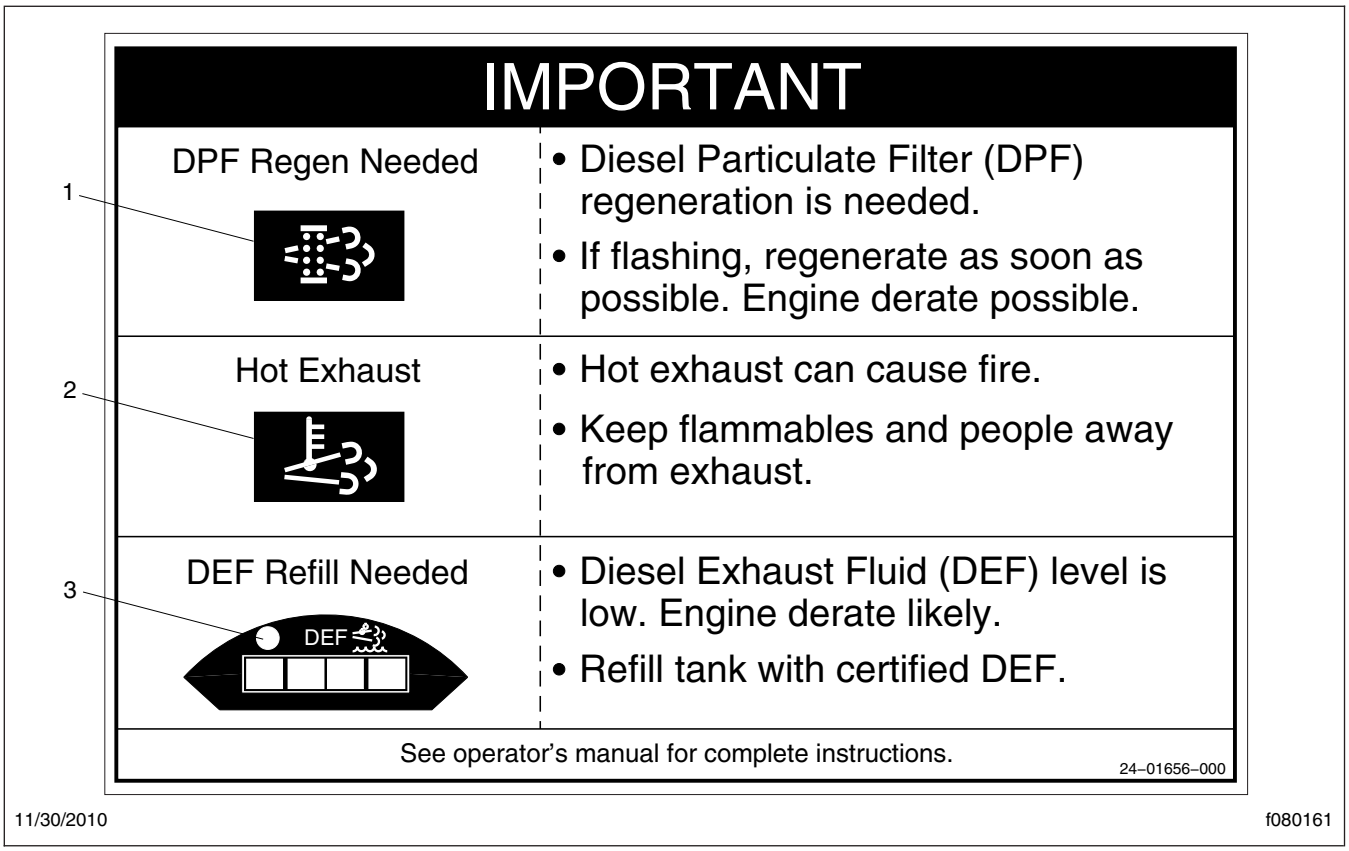

Fig. 7.3, Warning Lamp Decal, Sun Visor

normal operation of the vehicle is not inhibited if the DEF is frozen; an immersion heater with engine coolant flowing through it warms the DEF once the engine is running, allowing the SCR system to operate.

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

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

DEF Tank

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

Fuel/DEF Gauge

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

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

The lower portion of the gauge has a DEF warning lamp that illuminates amber when the DEF tank is near empty, and a lightbar that indicates the level of DEF in the tank. The DEF light bar illuminates as follows:

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

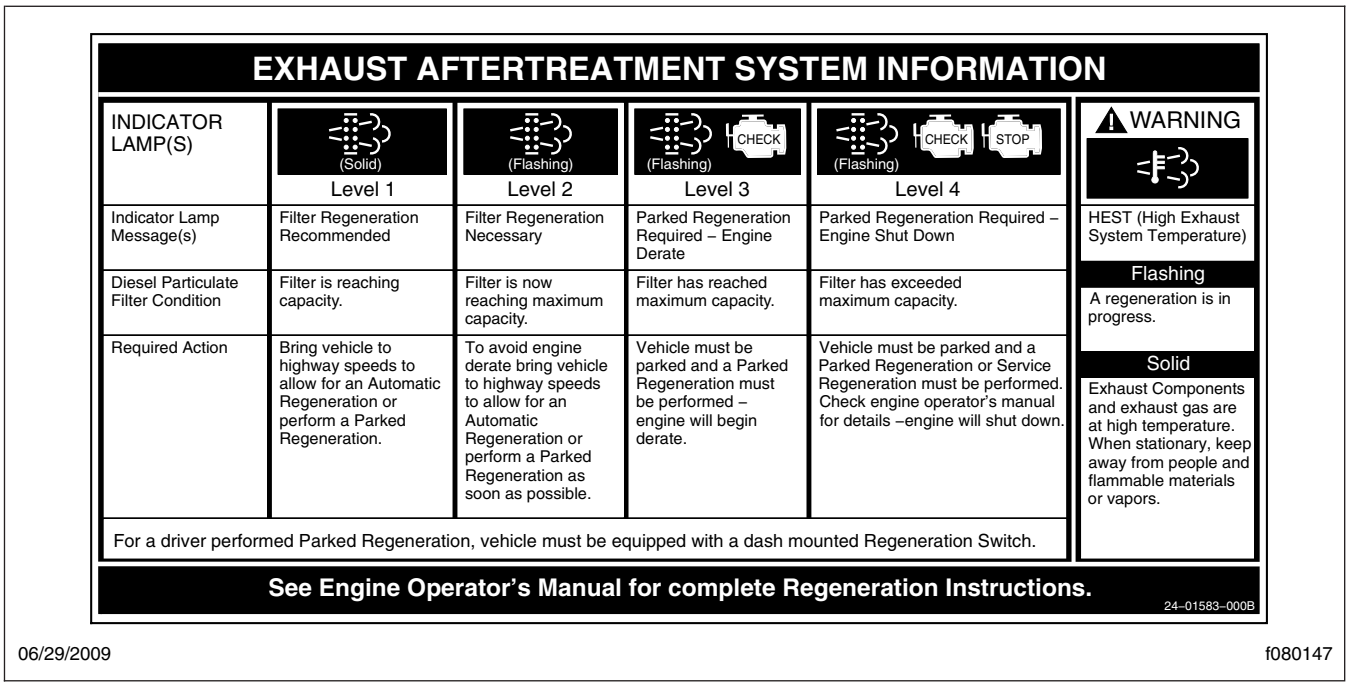

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Fig. 7.4, ATS Warning Lamps

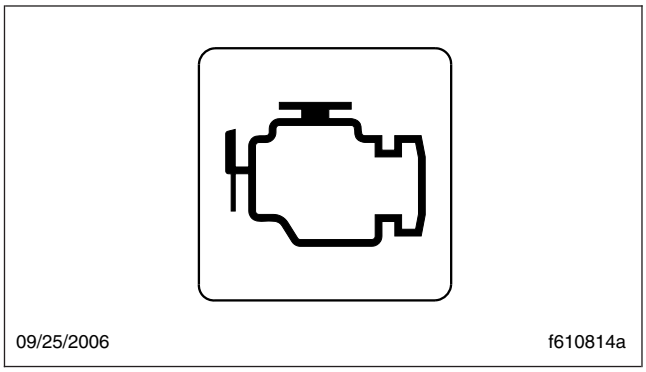

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Fig. 7.5, Malfunction Indicator Lamp (MIL)

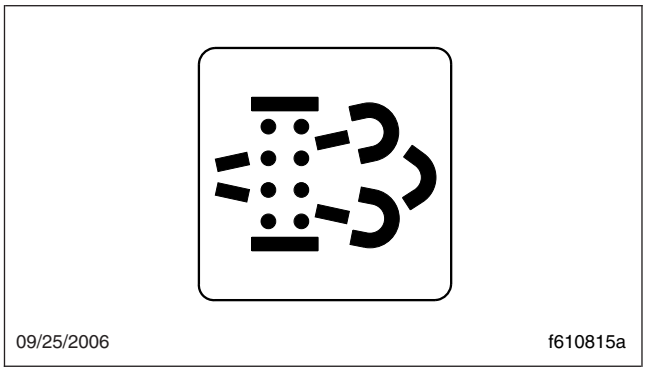

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Fig. 7.6, DPF Status Lamp

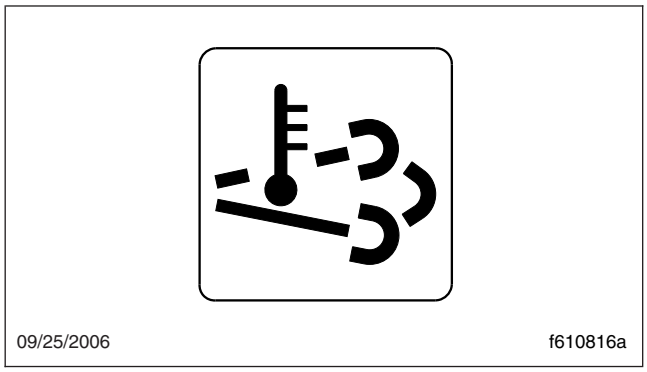

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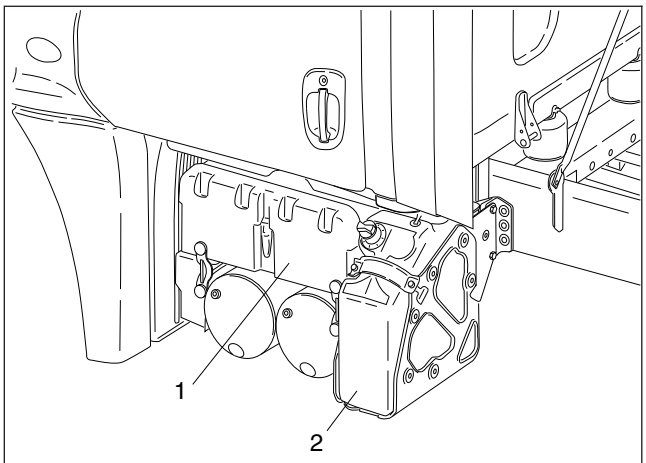
Fig. 7.7, HEST Lamp

- One bar illuminated green—Between approximately 10% and 25% full
- One bar illuminated amber—DEF very low, refill DEF
- One bar flashing red—DEF empty, refill DEF

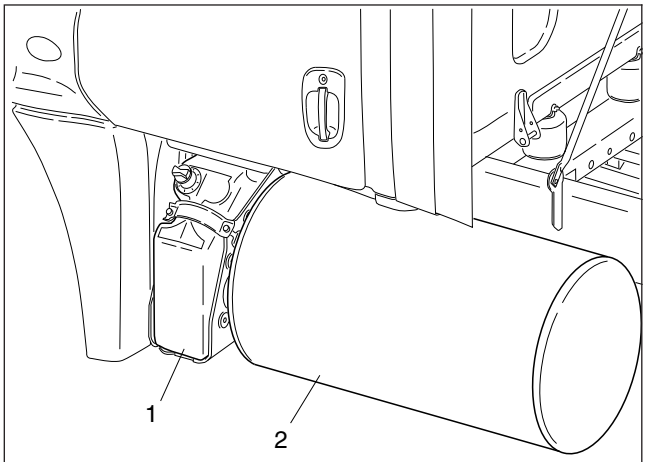
DEF Warnings and Engine Limits

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



1. Batteries 2. DEF Tank

Fig. 7.8, DEF Tank Located Behind the Battery Box



1. DEF Tank 2. Fuel Tank

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

DEF Level Low—Initial Warning

When the DEF level is low, the following lamps notify the driver. See **Fig. 7.11**. Refill the DEF tank in order to cancel the warning sequence.

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

DEF Empty

When the DEF level reads empty, the following lamps notify the drive. See **Fig. 7.12**.

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

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

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

DEF Tank Empty and Ignored

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

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

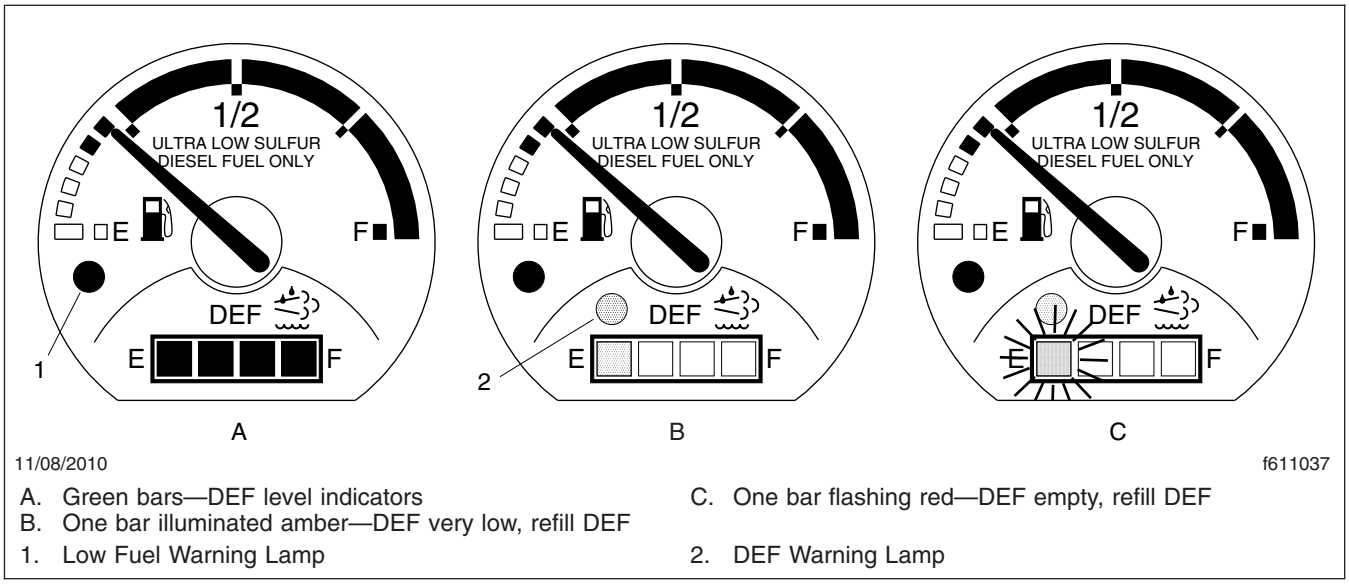
DEF Contamination or SCR Tampering

NOTICE

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

If contaminated DEF or tampering with the ATS is detected, the DEF warning light flashes and the MIL lamp illuminates to warn the driver. The CHECK engine lamp also illuminates on vehicles with a Cummins ISB or ISC/L engine. See **Fig. 7.13**.

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



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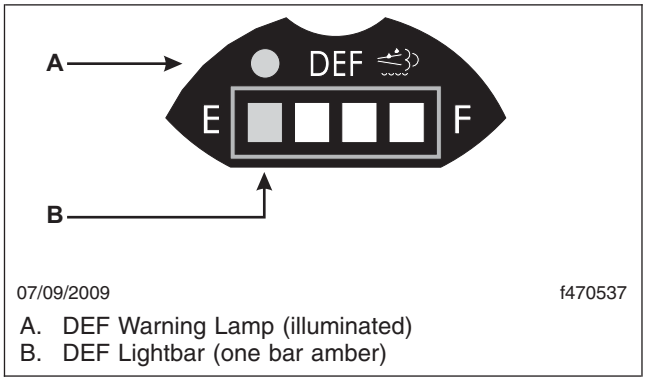
A. Green bars—DEF level indicators
B. One bar illuminated amber—DEF very low, refill DEF
C. One bar flashing red—DEF empty, refill DEF
1. Low Fuel Warning Lamp
2. DEF Warning Lamp

Fig. 7.10, Fuel/DEF Gauge



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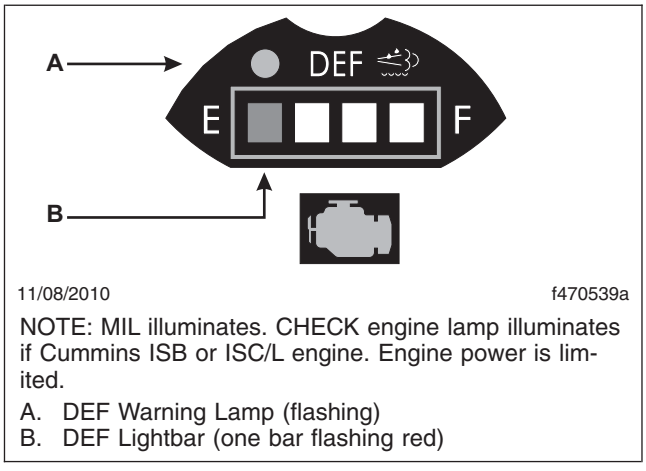
A. DEF Warning Lamp (illuminated)
B. DEF Lightbar (one bar amber)

Fig. 7.11, DEF Level Low Initial Warning



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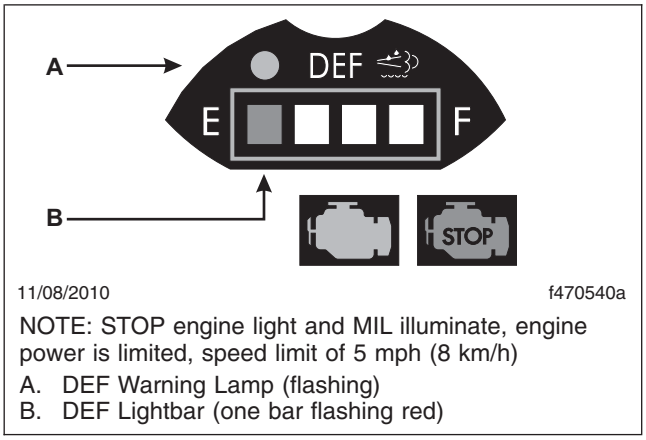
NOTE: MIL illuminates. CHECK engine lamp illuminates if Cummins ISB or ISC/L engine. Engine power is limited.

A. DEF Warning Lamp (flashing)
B. DEF Lightbar (one bar flashing red)

Fig. 7.12, DEF Empty Warning



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NOTE: STOP engine light and MIL illuminate, engine power is limited, speed limit of 5 mph (8 km/h)

A. DEF Warning Lamp (flashing)
B. DEF Lightbar (one bar flashing red)

Fig. 7.13, DEF Empty and Ignored Warning

Engine Starting

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

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

NOTE: Before starting the engine, read **Chapter 3** for detailed information on how to read the

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

⚠ WARNING

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

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

   For automatic transmissions, put the transmission in neutral. Do depress the accelerator pedal.

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

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

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

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

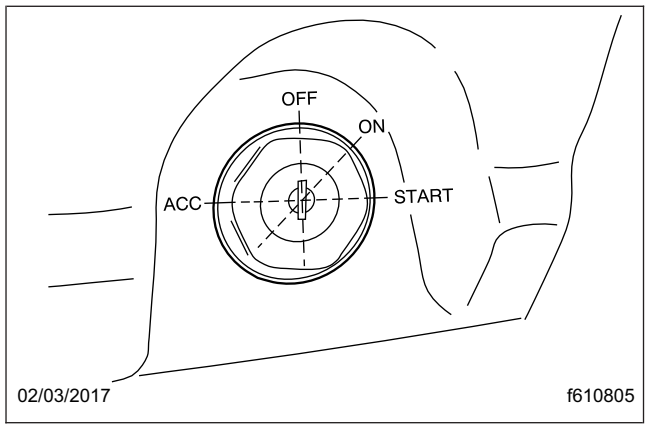


Fig. 7.14, Ignition Switch

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

NOTICE

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

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

NOTICE

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

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

Cold-Weather Starting

Electronic engines do not normally require special starting aids.

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

Starting After Extended Shutdown or Oil Change

Before engine start-up, complete the engine pretrip and post-trip inspections and maintenance procedures in **Chapter 11**.

NOTICE

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

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

Engine Break-In

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

Engine Operation

Safety and Environmental Considerations

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

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

NOTICE

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

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

A Top Tier™ compliant fuel is recommended. Look for the symbol that denotes a Top Tier compliant fuel; see **Fig. 7.15**.

Fig. 7.15, Top Tier Fuel Symbol

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

Normal Operation

⚠ WARNING

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

Every engine has an operating range in which it performs most efficiently. The operating range extends from maximum torque rpm at the low end, to engine rated speed at the high end. Most engines deliver best fuel economy when operated in the low- and mid-speed segments of the efficiency range and produce maximum horsepower at rated speed, which is

also the recommended maximum speed of the engine. For further engine-specific information, refer to the engine manufacturer's operation manual.

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

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

Cold-Weather Operation

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

If satisfactory engine temperature is not maintained, maintenance costs will increase due to greater engine wear. If the engine coolant temperature becomes too low, raw fuel will wash the lubricating oil off the cylinder walls and dilute the crankcase oil, causing all moving parts of the engine to suffer from poor lubrication.

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

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

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

NOTICE

For Detroit engines (EPA07 and newer), use of a winterfront is not recommended, as it can cause false fault codes with the engine and aftertreatment system, and possible emission component failures.

If using a winterfront, leave at least 25% of the grille opening exposed 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 chance of component failure. For engine-specific guidelines, see below:

Cummins and Mercedes-Benz engines: A winterfront may be used to improve cab heating while idling, and only when the ambient temperature remains below 10°F (-12°C).

Detroit engines (EPA07 and newer): Use of a winterfront is not recommended. Using a winterfront can cause excessive fan run time, increased fuel consumption, and failure of the DEF system heaters to operate correctly, resulting in fault codes, poor performance, and power reduction. A winterfront should only be used temporarily in the following situations:

- to improve cab heating while idling in an extremely cold ambient temperature;
- when the ambient temperature remains below -22°F (-30°C) and the engine is unable to maintain a running coolant temperature of 175°F (80°C) during normal over-the-road operation.

High-Altitude Operation

Engines lose horsepower when operated at high altitude because the air is too thin to burn as much fuel as at sea level. This loss is about three percent for

each 1000 feet (300 m) altitude above sea level for a naturally aspirated engine.

All Business Class M2 engines are altitude-compensated by the use of a turbocharger. This reduces smoky exhaust at high altitudes, requires less downshifting, and allows the engine to make better use of its fuel. Nevertheless, shift gears as needed to avoid excessive exhaust smoke.

Engine Shutdown

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

NOTICE

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

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

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

NOTICE

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

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

Cruise Control

⚠ WARNING

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

Dash-Mounted Switches

NOTICE

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

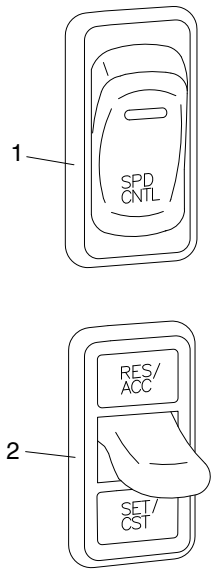
Cruise control is activated by two dash-mounted switches (**Fig. 7.16**).

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

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

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

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



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To turn cruise control on, press the upper half of the On/Off switch. To turn cruise control off, press the lower half of the On/Off switch.

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

1. Cruise Control On/Off Switch
2. Cruise Control Set/Resume Switch

Fig. 7.16, Cruise Control Switches

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

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

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

Shift Knob Controls, Optional

Cruise control can also be activated by the optional PAUSE, RESUME, and SET buttons on the transmission shift knob (**Fig. 7.17**).

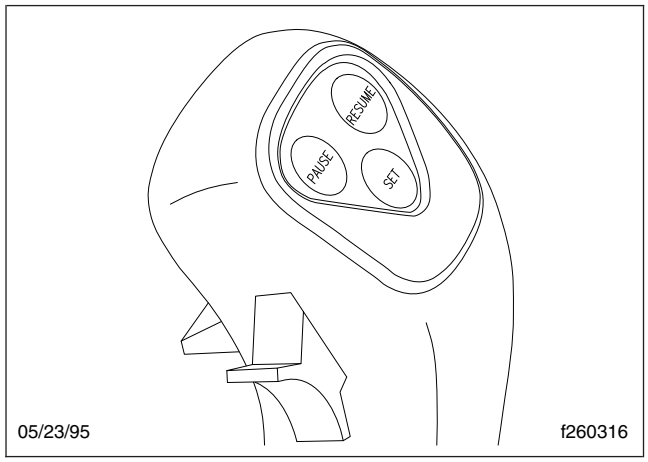

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Fig. 7.17, Cruise Control Buttons on the Transmission Shift Knob

1. To cruise at a particular speed, do these steps:
   - 1.1 Hold the accelerator pedal down until the speedometer reaches the desired speed.
   - 1.2 Push the SET button on the transmission shift knob.
2. To disengage the cruise control, do these steps:
   - 2.1 Press down the brake pedal (on automatic and manual transmission) *or*

     Press down the clutch pedal (on manual transmission only)
   - 2.2 Push the PAUSE button on the transmission shift knob.
3. To resume a preselected cruise speed, push the RESUME button on the transmission shift knob. Cruise will return to the last speed selected.

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

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

Power Takeoff (PTO) Governor

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

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

   When the light is steadily illuminated, the PTO is engaged and ready to operate. In stationary mode, the vehicle must remain in neutral with the parking brake set.
3. To activate the mobile mode, shift from neutral to reverse, 1st, or 2nd gear. The clutch will open and the PTO will disengage for a moment.
4. Touch the throttle pedal to close the clutch and engage the PTO in mobile mode. The PTO may be operated with the transmission in reverse, neutral, 1st, or 2nd gears only.

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

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

Engine Braking

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

⚠ WARNING

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

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

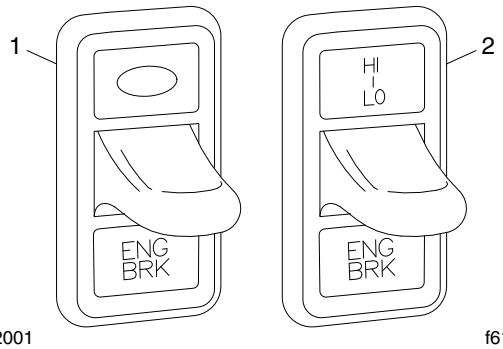
Whenever vehicle braking is required on good road conditions, the engine brake may be used in conjunction with the service brakes. There is no time limit for operation of the engine brake. However, an engine brake does not provide the precise control of, and is not a substitute for, service brakes.

⚠ WARNING

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

Two dash-mounted switches control the engine brake:

- The On/Off switch (ENG BRK), is used to turn the engine brake on and off. See **Fig. 7.18**. When the engine brake is on, an amber light will illuminate behind the switch.
- The engine brake intensity switch (HI/MED/LO or, in some cases, HI/LO) controls the amount of engine braking. When the panel lights are on, the ENG BRK legend is backlit in green.



1. Engine Brake On/Off
2. Engine Brake Intensity Switch

Fig. 7.18, Engine Brake Switches

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.

⚠ WARNING

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

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

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

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

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

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

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

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

Engine Brake Operation

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

NOTICE

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

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

1. Remove your feet from both the clutch and throttle pedals.
2. Press the On/Off switch to toggle the engine brake on. See **Fig. 7.18**. The engine brake will engage at the rate last set on the brake intensity switch.
3. Move the intensity switch to the desired intensity.

   On vehicles with a HI/MED/LO intensity switch, LO will provide 1/3 of the full braking capacity of the engine, MED will provide 2/3 of the full braking capacity, and HI will provide maximum engine braking. On vehicles with a HI/LO intensity switch, LO will provide ½ of the full braking capacity of the engine; HI will provide maximum engine braking.
4. Use the intensity switch set at the LO position when driving on flat, open stretches of road. If the service brakes are still required to slow down on a grade, switch to a higher setting on the dash switch until there is no need for the service brakes. Grade descent speed should be such that the service brakes are used infrequently and remain cool, thus retaining their effectiveness.
5. For maximum retarding, maintain the top governed speed of the engine through the appropriate selection of gears. When shifting gears, the engine brake will disengage when the clutch pedal is depressed, then engage when the clutch pedal is released.
6. To cancel the engine brake application, toggle the On/Off to off.

Exhaust Braking Systems

Exhaust Brake Switch

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

To turn the exhaust brake on, press on the upper part of the rocker (at the light inside the switch). The exhaust brake turns off automatically. See **Fig. 7.19** or **Fig. 7.20**.

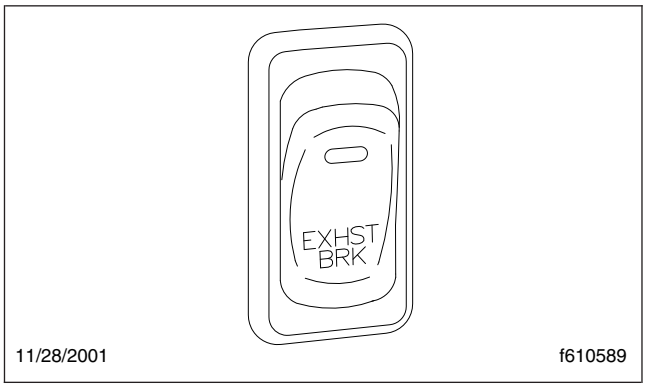


Fig. 7.19, Exhaust Brake Switch

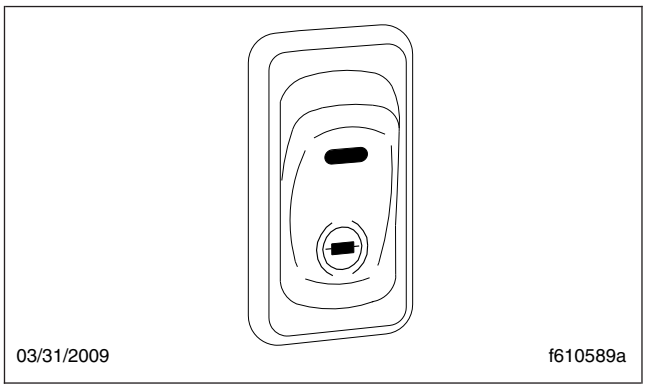


Fig. 7.20, Exhaust Brake Switch

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

Mercedes-Benz Exhaust Brake

An exhaust brake is an optional auxiliary braking system that assists but does not replace the service brake system. The exhaust brake can be used alone or together with the constant-throttle valves for steep or long grades. The exhaust brake switch located on the control panel, in combination with the accelerator and clutch pedals, allows the driver to make maximum use of the exhaust brake in off-highway and mountain driving as well as in traffic or high-speed highway driving.

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

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

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

Operating Characteristics

⚠ 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.

Before starting the engine, make sure that the lower half of the exhaust brake switch is pressed in and the amber light is not illuminated. Do not turn the exhaust brake on until the engine has reached normal operating temperatures.

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

- A slight change in the sound of the engine may be noticed when the exhaust brake is applied.
- Exhaust smoke should appear normal.
- Engine temperature should remain in the normal operating range.

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

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

Driving Downhill

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

NOTICE

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

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

Pacbrake® Exhaust Brake

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

Pacbrake Operation (Caterpillar)

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

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

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

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

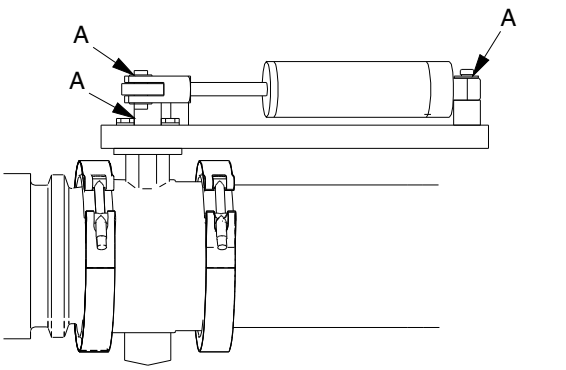
The amount of braking power the engine will develop is related to the speed (rpm) of the engine. The higher the engine rpm, the greater the retarding power.

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

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

1. With the engine shut down, use any oil-free or nonpetroleum-based high-heat lubricant, and spray or coat a sufficient amount on the restricter

valve shaft and the attaching locations at each end of the actuation cylinder. See **Fig. 7.21**.



A. Lubrication Point

Fig. 7.21, Pacbrake Exhaust Brake and Air Cylinder

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

NOTE: Starting the engine and idling for short periods of time is not recommended. During a cold engine start-up, enough moisture is developed within the engine and the exhaust system to create a corrosion hazard that could affect the future operation of the Pacbrake. The brake housing may trap water in the valve shaft bore causing corrosion in an improperly functioning or nonfunctioning brake. If it is necessary to periodically start the engine, it is recommended that normal operating temperatures be attained before shutting down the engine.

Allison World Transmission

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

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

8

Drivetrain

Clutches

Clutch Operation

Applying the Clutch Brake

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

NOTICE

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

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

Vehicle Overload, or Overloading the Clutch

NOTICE

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

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

Riding the Clutch Pedal

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

Holding the Vehicle on an Incline With a Slipping Clutch

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

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

⚠ WARNING

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

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

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

Engaging the Clutch While Coasting

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

Report Erratic Clutch Operation Promptly

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

NOTICE

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

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

Clutch Wear

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

NOTICE

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

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

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

Clutch Adjustments

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

NOTICE

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

Clutch Lubrication

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

NOTICE

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

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

Sachs Hydraulic Clutch

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

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

The clutch hydraulic system consists of three main components:

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

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

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

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

Allison On-Highway Transmissions

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

Safety Precautions

⚠ 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.

1000 Series

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

Without Park Position

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

With Park Position

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

2000 Series

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

Without Auto-Apply Parking Brake

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

With Auto-Apply Parking Brake

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

2400 Series

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

Range Inhibit Indicator, 2000 and 2400 Series

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

Shift inhibits occur under the following conditions:

- Shifts from neutral to reverse or from neutral to a forward range are not permitted when the engine is above idle (greater than 900 rpm).
- Forward/reverse directional shifts are typically not permitted if appreciable output shaft speed is detected.
- When some types of unusual transmission operating conditions are detected by the TCM, the TCM temporarily limits transmission operation until the vehicle can be driven to a service location. When this type of situation is detected, the TCM will lock the transmission in a safe gear range.

- The TCM will prevent shifts from park or neutral to range when auxiliary equipment, such as a power takeoff unit (PTO), is in operation.

Operating Instructions, On-Highway Transmissions

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

P (Park, optional on 1000 and 2400 Series)

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

NOTE: This does not apply the parking brake.

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

⚠ WARNING

Before selecting PB on the shift lever, make sure the ignition switch is not in the OFF position. Selecting PB with the ignition switch in the OFF position places the transmission in neutral, but does not apply the parking brake automatically. The vehicle could roll unexpectedly, possibly causing property damage or personal injury.

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

NOTE: Selecting PB on the shift lever does not engage the park pawl of the transmission.

R (Reverse)

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

NOTICE

Extended idling in reverse may cause transmission overheating and damage.

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

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

N (Neutral)

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

⚠ WARNING

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

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

⚠ WARNING

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

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

NOTICE

Coasting in neutral can cause severe transmission damage.

D (Drive)

⚠ WARNING

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

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

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

NOTICE

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

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

4 and 3 (Fourth and Third Ranges, optional)

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

3 and 2 (Third and Second Ranges, standard)

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

1 (First Range)

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

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

Allison MD Series

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

Safety Precautions

WARNING

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

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

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

Operating Instructions, MD Series

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

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

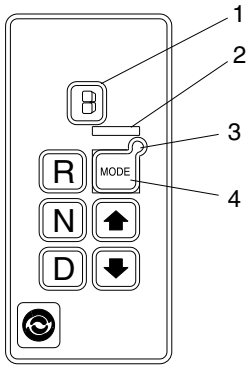
R (Reverse)

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

NOTICE

Extended idling in reverse may cause transmission overheating and damage.

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



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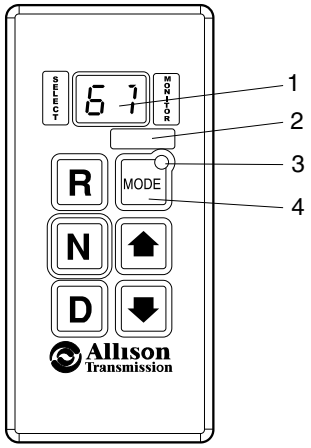
1. Digital Display
2. Mode Identification Label
3. Mode Indicator LED
4. Mode Button

Fig. 8.1, WTEC III Push-Button Shift Selector



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1. Digital Display
2. Mode Identification Label
3. Mode Indicator LED
4. Mode Button

Fig. 8.2, Fourth Generation Push-Button Shift Selector

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

N (Neutral)

⚠ WARNING

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

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

⚠ WARNING

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

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

⚠ WARNING

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

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

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

D (Drive)

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

NOTICE

Do not idle in drive for more than 5 minutes. Extended idling in drive may cause transmission

overheating and damage. Always select neutral if time at idle is longer than 5 minutes.

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

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

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

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

⚠ WARNING

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

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

1 (First Range)

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

Up and Down Arrows

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

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

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

Mode Button

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

Mode Indicator LED

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

Digital Display

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

Oil Level Sensor

Allison MD Series transmissions have an electronic oil level sensor to read fluid level information. The fluid level diagnostic will display whether the oil level is OK, too low, or too high. It will also display a default code and indicate if the preconditions (of receiving the fluid level information) are not met.

IMPORTANT: Maintain the the proper fluid level at all times. If the fluid level is too low, the converter and clutch do not receive an adequate supply of fluid. If the level is too high, the transmission may shift erratically or overheat.

To access the oil level display mode, park the vehicle on a level surface, shift to N (Neutral), apply the

parking brake, and idle the engine. Then simultaneously press both the up and down arrows once. The oil level will display at the end of a two-minute countdown.

Diagnostic Codes

Diagnostic codes are numerical indications relating to a malfunction in transmission operation. These codes are logged in the TCM/ECU memory. The most severe or most recent code is listed first. A maximum of five codes (numbered d1-d5) may be listed in memory at one time. If the mode indicator LED is illuminated, the displayed code is active. If it is not illuminated, the displayed code is not active.

NOTE: During normal operation, an illuminated mode indicator LED signifies the specialized mode operation is in use.

To enter diagnostics mode, first park the vehicle and apply the parking brake. Then simultaneously press both the up and down arrows twice.

Eaton® Fuller® Straight-Shift Transmissions

Refer to the Eaton website for additional information, **www.roadranger.com**.

General Information, Straight-Shift

Eaton Fuller 5-speed FS models are fully synchronized. They have five forward speeds and one reverse. See **Fig. 8.3** for the shift pattern.

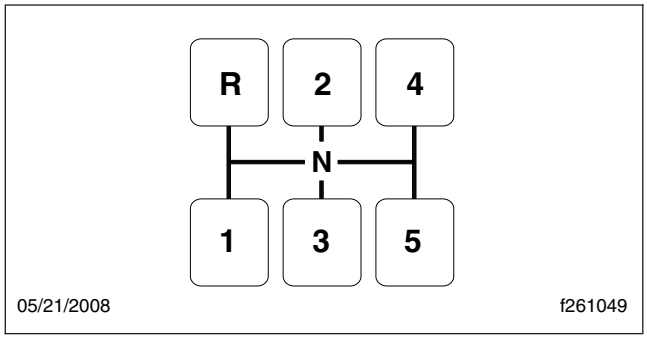


Fig. 8.3, Shift Pattern, 5-Speed FS Models

Eaton Fuller 6-speed FS and FSO models are fully synchronized. They have six forward speeds and one reverse. See **Fig. 8.4** for the shift pattern.

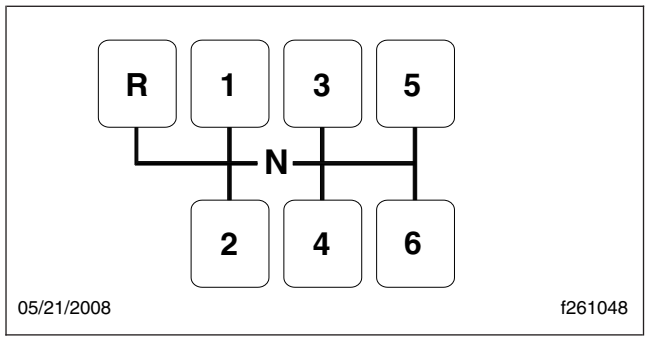


Fig. 8.4, Shift Pattern, 6-Speed FS and FSO Models

Eaton Fuller 7-speed T models are not synchronized. They have seven forward speeds and one reverse. See **Fig. 8.5** for the shift pattern.

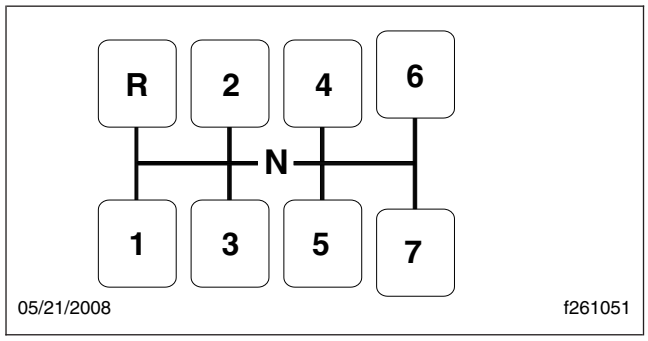


Fig. 8.5, Shift Pattern, 7-Speed T Models

These transmissions are designed for use with on-highway, fuel economy engines where a minimum of shifting is desired and less gear reduction is acceptable.

Operation, Straight-Shift

1. Always use first gear when starting to move the vehicle forward.

IMPORTANT: Do not rest your foot on the clutch pedal while driving. This causes partial clutch disengagement which could cause premature clutch wear.

2. On synchronized models, press the clutch pedal to the floor when shifting gears. Double-clutching is unnecessary.

   On unsynchronized models, press the clutch pedal to the floor to contact the clutch brake only when engaging the first or reverse gears.

NOTE: If the vehicle is moving when shifting, press the clutch pedal just far enough to disengage the clutch. Pressing it to the floor will engage the clutch brake, if so equipped, causing premature clutch brake wear.

3. To upshift, do the following steps:
   - 3.1 Accelerate to engine governed speed.
   - 3.2 On synchronized models, disengage the clutch and move the shift lever to second gear.

     On unsynchronized models, disengage the clutch and move the shift lever to neutral. Engage the clutch again. With the shift lever in neutral, disengage the clutch and move the shift lever to second gear.
   - 3.3 Engage the clutch and note the drop in engine rpm before accelerating up to engine governed speed again.
   - 3.4 Continue upshifting using the same sequence described in the previous step. Follow the pattern on the shift lever.
4. To downshift, do the following steps:
   - 4.1 Wait until the engine speed drops to the rpm noted immediately after the upshift.
   - 4.2 On synchronized models, disengage the clutch and move the shift lever to the next lower gear.

     On unsynchronized models, disengage the clutch and move the shift lever to neutral. Engage the clutch again. With the shift lever in neutral, disengage the clutch and move the shift lever to the next lowest gear.
   - 4.3 Engage the clutch smoothly.
   - 4.4 Use the sequence described above to shift progressively down through each successive lower gear, as driving conditions require.

Eaton Fuller Range-Shift Transmissions

Refer to the Eaton website for additional information, **www.roadranger.com**.

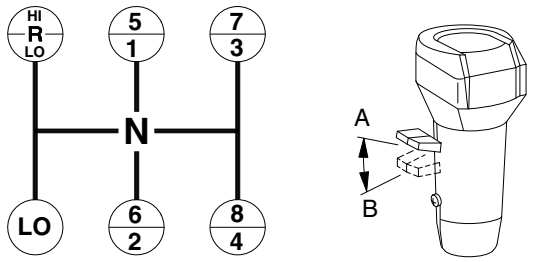
General Information, Range-Shift

Eaton Fuller 9-Speed Models

Eaton Fuller 9-speed range-shift models are not synchronized. They have nine forward speeds and two reverse speeds. The shift lever controls five forward gears and one reverse gear in the transmission front section, and the range lever controls a LO and HI range in the two-speed auxiliary section. The first position in the front section is used only as a starting gear. The other four ratios are used once in LO range and once again in HI range. See **Fig. 8.6** for the shift patterns.

After shifting out of the first gear position, use the Roadranger® "repeat H" shift pattern. Select both LO range and HI range with the range lever (range knob). It is used once during the upshift sequence and once during the downshift sequence.

Always preselect the range shift. After preselection, the transmission will automatically make the synchronizer range shift as the shift lever passes through neutral.



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Move the range lever up for HI range, down for LO range.

A. HI Range B. LO Range

Fig. 8.6, Shift Pattern, 9-Speed Models

Eaton Fuller 10-Speed Models

Eaton Fuller 10-speed range-shift models are not synchronized. They have ten forward speeds and two reverse speeds. The shift lever controls five forward gears and one reverse gear in the transmission front section, and the range lever controls a LO and HI range in the two-speed auxiliary section. The five forward gears selected in LO range are used again in HI range to provide the 10 progressive forward gears. See **Fig. 8.7** for the shift patterns. See **Table 8.1** for the shift progressions.

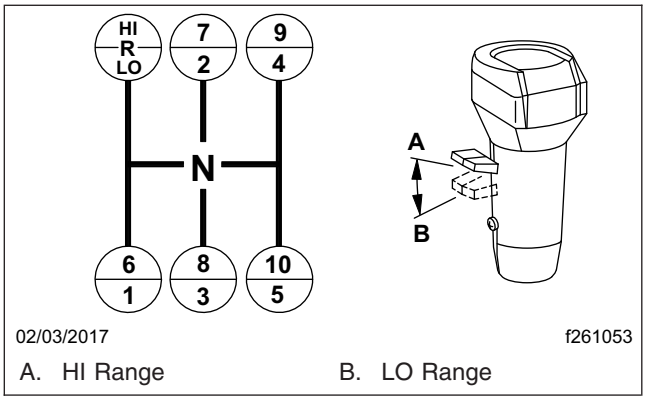


Fig. 8.7, Shift Pattern, 10-Speed Models

Once the highest shift lever position (fifth gear) is reached in LO range, the driver preselects the range shift lever for HI range. The range shift occurs automatically as the shift lever is moved from fifth gear position to the sixth gear position.

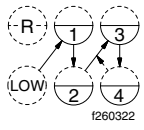
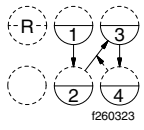
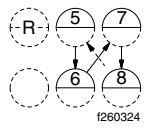
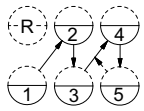
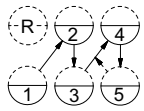
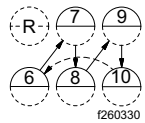
Eaton Fuller Shift Progressions			
Model	LO Range		HI Range
	Off-Highway	On-Highway	
9-Speed Direct or Overdrive	 f260322	 f260323	 f260324
10-Speed Direct or Overdrive	 f260329	 f260329	 f260330

Table 8.1, Eaton Fuller Shift Progressions

When downshifting, the driver preselects the range lever for LO range and the range shift occurs automatically during the shift lever movement to the next gear position.

Eaton Fuller Deep-Reduction Models

Eaton Fuller deep-reduction models are not synchronized. They have a five-speed front section and a two-speed auxiliary section which has an extra deep reduction gear. The LO gear in the front section is used only as a starting gear. The other four ratios are used once in LOW RANGE and once in HIGH RANGE giving eight highway ratios. LO-LO is selected by the DEEP REDUCTION lever on the dashboard. See **Fig. 8.8** for the shift pattern.

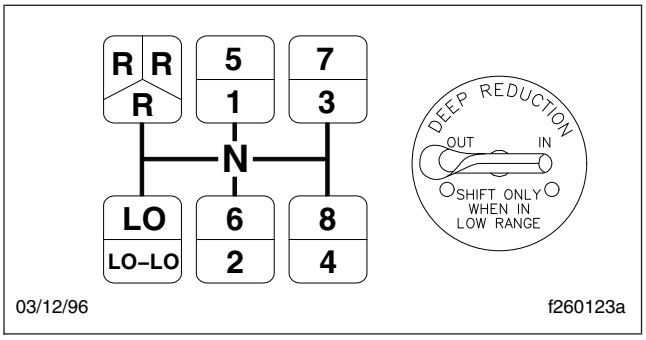


Fig. 8.8, Shift Pattern, Deep Reduction

Operation, Range-Shift

1. When operating off-highway or under adverse conditions, always use low gear when starting to move the vehicle.

   When operating on-highway, with no load or under ideal conditions, use first gear when starting to move the vehicle.

   For all conditions, use the highest gear that is still low enough to start the vehicle moving with the engine idling and without excessively slipping the clutch.

2. Use the clutch brake to stop gear rotation when shifting into low (or first) or reverse when the vehicle is stationary. The clutch brake is applied by pressing the clutch pedal all the way to the floor.

   For normal upshifts and downshifts, only a partial disengagement of the clutch is necessary to break engine torque.

3. Do not make range shifts with the vehicle moving in reverse gear.

4. Never attempt to move the range preselection lever with the gear shift lever in neutral while the vehicle is moving. Preselection with the range preselection lever must be made prior to moving the shift lever out of gear into neutral.

5. Do not shift from high range to low range at high vehicle speeds.

6. Use double-clutching between all upshifts and downshifts.

7. After your shifting ability improves, you may want to skip some of the ratios. This may be done only when operating conditions such as load, grade, and road speed permit.

Upshifting

1. Position the gear shift lever in neutral. Start the engine and bring the air system pressure up to 100 to 120 psi (689 to 827 kPa).
2. Position the range preselection lever down into low range.
3. Press the clutch pedal to the floor. Shift into low or first gear, then engage the clutch with the engine at or near idle speed to start the vehicle moving. Accelerate to 80 percent of engine governed speed.
4. Shift progressively up from low or 1st gear to the top gear in low range, double-clutching between shifts and accelerating to 80 percent of engine governed speed.
5. While in the top gear of the low-range shift pattern and ready for the next upshift, flip the range preselection lever up into high range. Double-clutch through neutral and shift into the bottom gear in high range. As the shift lever passes through neutral, the transmission will automatically shift from low range to high range.
6. With the transmission in high range, shift progressively up through each of the high range gears, double-clutching between shifts.

Downshifting

1. With the transmission in high range, shift progressively down to the bottom gear in high range, double-clutching between shifts.
2. When in the bottom gear of the high-range shift pattern and ready for the next downshift, push the range preselection lever down into low range. Double-clutch through neutral and shift into the top gear of the low-range shift pattern. As the shift lever passes through neutral, the transmission will automatically shift from high range to low range.
3. With the transmission in low range, downshift through the low range gears as conditions require.

   Never use the clutch brake when downshifting or as a brake to slow the vehicle.

Operation, Deep-Reduction Models

Upshifting

1. Position the gear shift lever in neutral. See **Fig. 8.8** for the shift pattern. Start the engine, and bring the air system pressure up to 95 to 125 psi (655 to 862 kPa).
2. Position the range preselection lever down, into low range.

NOTE: If conditions are difficult, start out in LO-LO. Move the DEEP REDUCTION lever on the dashboard to the IN position. Otherwise start out in LO with the DEEP REDUCTION lever in the OUT position.

3. Depress the clutch pedal to the floor. Shift into LO gear; then, engage the clutch, with the engine at or near idle rpm to start the vehicle moving. The vehicle will start in LO or LO-LO depending on the DEEP REDUCTION lever position.
4. To upshift if in LO-LO, move the DEEP REDUCTION lever to the OUT position and *immediately* release the accelerator, depress the clutch pedal once to break torque, and reengage the clutch. The auxiliary section will shift from LO-LO to LO when the gears reach the same speed.
5. Shift progressively upward from LO through 1st, 2nd, 3rd, and 4th gears while the range preselection lever is in LO. Always double-clutch between gears.
6. When in 4th gear and ready for the next upshift, pull up the range preselection lever and move the shift lever, double-clutching, to the 5th gear position. As the shift lever passes through neutral, the auxiliary section will automatically shift from low to high range.

NOTICE

Never move the shift lever into the LO gear position after high range preselection or anytime the auxiliary section is in high range. Transmission damage could result.

7. Continue upshifting from 5th gear through 8th gear, always double-clutching between gears.

Downshifting

1. While in high range, move the gear shift lever from 8th gear through 5th gear as conditions require, always double-clutching between gears.
2. When in 5th gear and ready for the next downshift, push down the range preselection lever and move the shift lever to the 4th gear position, being sure to double-clutch. As the shift lever

passes through neutral, the auxiliary section will automatically shift from high to low range.

3. While in the low range, continue downshifting from 4th through LO as conditions require, always double-clutching between gears.
4. *Do not* downshift into LO-LO from LO unless operating conditions make it necessary. If it is necessary, make sure that the shift lever is in the LO gear position and the auxiliary section is in the low range. Then, move the DEEP REDUCTION lever on the dashboard to the IN position. *Immediately* release the accelerator, depress the clutch pedal once to break torque, engage the clutch, and accelerate. The auxiliary section will automatically shift from LO to LO-LO when the gears reach the same speed.

NOTICE

Never use the clutch brake when downshifting, or as a brake to slow the vehicle. This will cause premature clutch brake wear.

Eaton Fuller AutoShift™ Automated Transmissions

Refer to the Eaton website for additional information, **www.roadranger.com**.

IMPORTANT: Before starting the vehicle, always do the following:

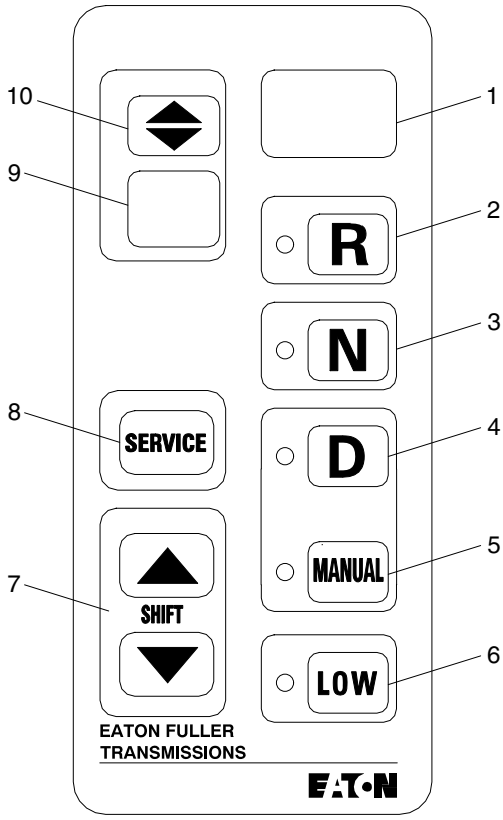
- Be seated in the driver's seat.
- Place the transmission in neutral.
- Set the parking brakes.
- Press the clutch pedal (if equipped) down to the floor.

The AutoShift ASW is an automated 6-speed Eaton Fuller transmission. No clutch is necessary to operate the vehicle.

The AutoShift AS2 is a partially automated 10-speed Eaton Fuller transmission. The driver must use the clutch and put the transmission in neutral to start and stop the vehicle. A push-button shift selector (**Fig. 8.9**) is used with AutoShift AS2 and ASW transmissions.

IMPORTANT: If you have to leave the cab with the engine running:

- Place the transmission in neutral.



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1. Not Used
2. R (reverse)
3. N (neutral)
4. D (drive)
5. MANUAL Mode
6. Low Gear Hold
7. Upshift/Downshift Arrows
8. SERVICE Light
9. Mode Indicator
10. Mode Button

Fig. 8.9, Eaton Push-Button Shift Selector

- Set the parking brakes.
- Chock the tires.

Push-Button Shift Selector

Gear information is presented to the driver on the push-button shift selector, usually mounted on the right-hand control panel. On this display, the information is presented as follows:

- To select neutral, press the N button. When neutral is engaged, the telltale LED will light up next to the N button.

- To select reverse, press the R button. When reverse is engaged, the telltale LED will light up next to the R button.
- To select drive, press the D button. When drive is engaged, the telltale LED will light up next to the D button.
- To select low gear, press the LOW button. When low is engaged, the telltale LED will light up next to the LOW button.
- To change gears manually, press the MANUAL button. When the manual mode is engaged, the telltale LED will light up next to the MANUAL button.
- Use the shift buttons (upshift/downshift) to change the current starting gear selection in R, D, and LOW. In MANUAL, the shift buttons can be used to select gears.
- In automatic mode, the number of the forward gear currently engaged appears continually on the mode indicator when in drive. In MANUAL, the last gear selected appears on the mode indicator.
- If the SERVICE indicator illuminates, take the vehicle as soon as possible to an authorized Freightliner service facility.
- The mode button is reserved for future use.

IMPORTANT: To prevent engine overspeed, the transmission software will override both MANUAL and LOW if necessary. The system will not respond to gear selection requests that will either overspeed or excessively lug the engine.

Automatic Mode

The AutoShift AS2 transmission is normally operated in an automatic mode. To select MANUAL mode, press the MANUAL button on the push-button shift selector.

When the transmission is in automatic mode, the transmission automatically selects and engages the gears, although the transmission will respond to upshift and downshift requests as though in manual mode. See the instructions for shifting under heading "Manual Mode" below.

Manual Mode

When the transmission is in manual mode, the driver must select the appropriate gear, using the shift buttons on the push-button shift selector.

To upshift in MANUAL, press the upshift button (up arrow), and release. The number of the gear will appear on the mode indicator. If the requested gear is available, the transmission will shift up.

NOTICE

Do not attempt to upshift until the vehicle has reached a sufficient speed. The clutch absorbs the speed difference by generating heat, which causes the clutch to wear out too soon.

Many drivers upshift into the next gear or even skip-shift into a higher gear before the vehicle has reached the correct speed. This type of shifting is almost as bad as starting off in a gear that is too high. When the engine speed (rpm) and the vehicle speed (mph or km/h) are too far apart, the clutch must absorb the difference in speed by generating heat.

To downshift in MANUAL, press the downshift button (down arrow), and release. The number of the gear will appear on the mode indicator. If the requested gear is available, the transmission will shift down.

If any requested gear is not available, an audible warning will sound and the digital display will indicate that the gear is not available.

Selecting Gears

R (Reverse)

Reverse (R) is used to back the vehicle. Make sure the vehicle comes to a full stop and the clutch pedal has been pressed before shifting into reverse.

To select reverse, press the clutch pedal to the floor. Then press the R button.

N (Neutral)

Neutral (N) is used for starting, parking, or any stationary operation. No gear is selected. The transmission must be in neutral to start the engine.

IMPORTANT: If the vehicle starts up in any gear but neutral, bring the vehicle to an authorized Freightliner service facility as soon as possible.

To select neutral, press the clutch pedal to the floor. Then press the N button. Set the parking brakes and slowly release the clutch pedal.

NOTE: Neutral is always available during vehicle operation. When in neutral, requests to upshift or to downshift are ignored.

D (Drive)

Drive (D) is used for normal highway driving. In drive, the transmission shifts into the proper gear for starting, and then automatically selects additional gears as needed, in a range between the starting gear and the highest gear.

To select drive, press the clutch pedal to the floor. Then press the D button. Slowly release the clutch pedal and drive the vehicle.

To start up in a gear other than the normal starting gear, push the upshift arrow with D selected, and while the vehicle is stopped.

IMPORTANT: AutoShift will not start up in any gear higher than third gear.

The number of the gear selected will flash on the auxiliary display until the driver presses the clutch pedal. This gear will be stored in memory as the default starting gear until a different starting gear is selected by the driver, or until the engine is shut down.

NOTE: The transmission may be programmed so that it is not possible to select a starting gear other than the preprogrammed starting gear.

L (Low)

LOW is used to hold the transmission in low gear when descending steep hills. If LOW is selected when the vehicle is stopped, the transmission remains in low gear until drive is selected. If LOW is selected while the vehicle is moving, the transmission downshifts at a higher engine speed than normal, in order to maximize the engine braking effect.

To select LOW, press the clutch pedal to the floor. Then press the LOW button. Slowly release the clutch pedal and drive the vehicle.

IMPORTANT: Before parking the vehicle, always do the following:

- Place the transmission in neutral.
- Set the parking brakes.
- Chock the tires, if parking on an incline.

Freightliner SmartShift Shift Control

General Information, SmartShift

The SmartShift transmission control is an electronic transmission control device. It is installed with the following transmissions:

- Eaton Fuller UltraShift™
- Eaton Fuller UltraShift PLUS
- Mercedes-Benz Automated Gear Shift (AGS)

It replaces the typical floor-mounted shift lever or dash-mounted push button control.

SmartShift accepts driver requests for transmission functions and transmits them through hard wiring to the transmission control unit (TCU). SmartShift is a true shift-by-wire system.

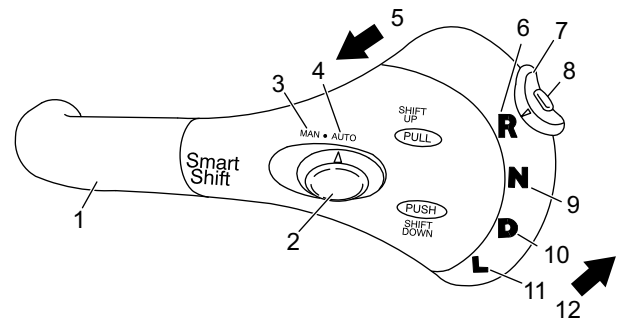
SmartShift offers two main advantages over conventional transmission control devices. Without a floor-mounted shift control, usable cab space is increased. The SmartShift control mounts to the right-hand side of the steering column and is operated by the fingers of the driver's right hand, allowing both hands to remain on the steering wheel.

A two-position slide switch (**Fig. 8.10**) is mounted on the body of the control lever just before the paddle widens out. The slide switch allows the driver to choose automatic (AUTO) or manual (MAN) mode.

In AUTO mode, gears shift automatically, without driver interaction. Manual gearshifts are accomplished by a momentary pull or push on the control in the plane perpendicular to the steering wheel. Pull upward (toward you) on the control to upshift and push downward (away from you) to downshift. The control is spring-loaded and returns to mid-position when released after an upshift or downshift.

For Eaton Fuller UltraShift and UltraShift PLUS (**Fig. 8.10**), a four-position R, N, D, L) selector switch is located at the end of the lever. For the Mercedes-Benz AGS (**Fig. 8.11**), a three-position R, N, D) selector switch is located at the end of the lever.

Embedded in the selector switch is a small neutral lock button to prevent accidental shifts into gear from neutral. Any time you shift through N, press down on the neutral lock button to move the switch from neutral (N) to another gear, such as drive (D), low (L), or reverse (R). When shifting to N, it is not necessary to press the neutral lock button.



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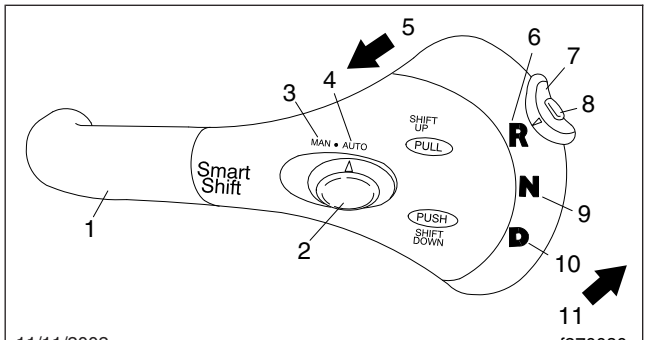
To upshift manually, pull the lever up (towards you). To downshift manually, push the lever down (away from you).

1. SmartShift Control Lever
2. Slide Switch (forward driving mode switch)
3. MAN Mode (of slide switch)
4. AUTO Mode (of slide switch)
5. Upshift Direction
6. Reverse Position (of selector switch)
7. Selector Switch
8. Neutral Lock Button
9. Neutral Position (of selector switch)
10. Drive Position (of selector switch)
11. Low Position (of selector switch)
12. Downshift Direction

Fig. 8.10, SmartShift Control (with Eaton Fuller UltraShift and UltraShift PLUS)



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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
3. MAN Mode (of slide switch)
4. AUTO Mode (of slide switch)
5. Upshift Direction
6. Reverse Position (of selector switch)
7. Selector Switch
8. Neutral Lock Button
9. Neutral Position (of selector switch)
10. Drive Position (of selector switch)
11. Downshift Direction

Fig. 8.11, SmartShift Control (with Mercedes-Benz AGS)

Eaton Fuller UltraShift Automated Transmissions

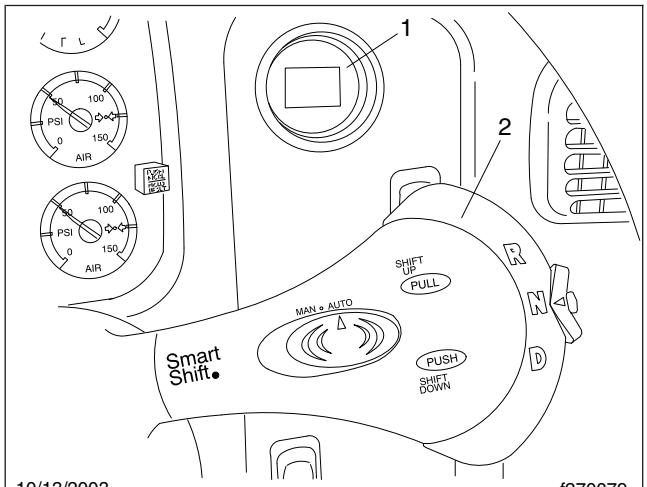
The Eaton® Fuller® UltraShift™ transmission uses the four-position SmartShift control lever on the steering column to change gears, combined with a gear indicator on the right-hand control panel as shown in **Fig. 8.12**. All forward shifts can be made either manually or automatically, at the driver's choice. No clutch pedal is required to operate the vehicle.

General Information, UltraShift ASW

UltraShift ASW is a six-speed medium-duty fully automated transmission used on the M106 only. Six-speed UltraShift ASW uses a "wet" clutch system in which the drive and driven discs rotate in a bath of transmission fluid (Dexron III).

General Information, UltraShift DM

UltraShift DM is a ten-speed heavy-duty fully-automated transmission used on the M112 only. Ten-



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To know what gear the transmission is in, look at the current gear indicator.

1. Gear Indicator
2. SmartShift Control

Fig. 8.12, Shift Controls and Indicators, UltraShift Transmissions

speed UltraShift DM uses a dry clutch system which

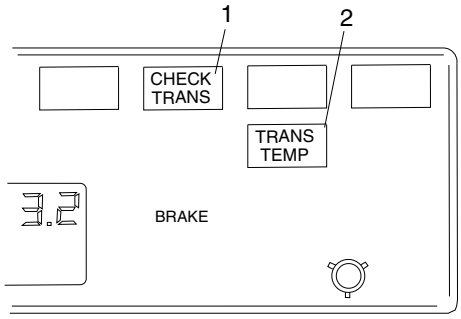
is offered only on this automated transmission system.

Operation, UltraShift

Power Up

NOTE: These operating instructions apply equally to six-speed UltraShift ASW and ten-speed UltraShift DM, with the exceptions explained below.

1. With the parking brake set, select neutral (N) by moving the selector switch to the N position.
2. With the transmission in neutral, turn on the ignition switch. The "CHECK TRANS" and "TRANS TEMP" telltale lights come on and go out again (bulb check). See **Fig. 8.13**.



1. "CHECK TRANS" Light
2. "TRANS TEMP" Light

Fig. 8.13, Telltale Lights, UltraShift Transmission

3. After the ignition is turned on, the current gear indicator shows the dot display, arranged in a square pattern. All dots in the pattern should light up, without gaps or spaces. See **Fig. 8.14**.
4. Wait for the current gear indicator to show a solid "N." When the "N" is solid, rather than flashing, the UltraShift transmission control unit (TCU) is powered up. Apply the service brake and start the engine.
5. Select drive (D) by pressing in the neutral lock button and moving the selector switch downward to the position below neutral. Release the parking brake. The gear is displayed on the current gear indicator.

NOTE: When D is selected, the transmission controller starts up in second gear. On both six-speed Ultrashift ASW and ten-speed Ultrashift DM, the driver can select to start up in first. No other start gear is available.

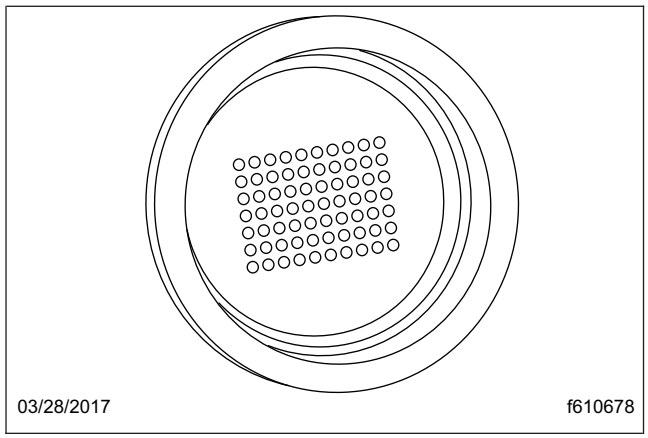


Fig. 8.14, Power-Up Dot Display

6. On a level grade, release the service brake and press down on the throttle pedal to allow the vehicle to move forward.

⚠ WARNING

When starting or stopping on hills and grades, use extra care to prevent the vehicle from rolling back. A rollback accident could cause death, serious personal injury, or property damage.

7. Prevent the vehicle from rolling backward when stopped on a hill or grade, or when the vehicle is starting from a stop on a hill or grade.

   7.1 *To start from a full stop on a hill or grade*, quickly move your foot from the brake pedal and press firmly on the throttle pedal.

   On steep hills, set the parking brake and release it only when there is enough engine power to prevent rollback.

   7.2 *To stop on a hill or grade*, press and hold the brake pedal to keep the vehicle from moving.

   On steep hills, set the parking brake. When parking, chock the tires, front and/or rear. Never hold a hill with the throttle pedal. This will cause the clutch to overheat.

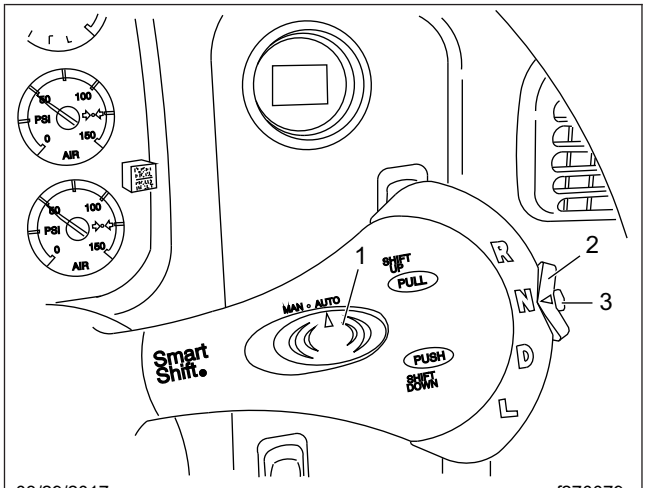
Power Down

1. Apply the service brake.

2. Select neutral (N) by moving the selector switch to the N position. When the "N" on the gear indicator is solid, rather than flashing, the UltraShift TCU is ready to power down. See **Fig. 8.13**.
3. With the transmission in neutral, set the parking brake.
4. Turn off the ignition key and shut down the engine.

Automatic and Manual Modes

The SmartShift control has a slide switch located on the body of the control lever just before the paddle widens out. See **Fig. 8.15**. The slide switch controls the forward driving mode, automatic or manual.



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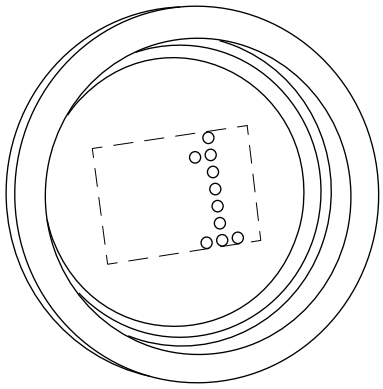
1. Slide Switch (controls forward driving mode)
2. Selector Switch (controls gear selection)
3. Neutral Lock Button (prevents accidental shift into gear)

Fig. 8.15, Switches, Ultrashift Transmission

To change mode at any time, move the slide switch in the desired direction. This allows the driver to respond to a wide range of driving conditions, such as blind corners, tight curves, and steep hills.

IMPORTANT: Whatever the mode, it is always possible to shift manually by moving the lever up or down as needed. When the engine speed is within 75 revolutions per minute (rpm) of the load-based shift point for an automatic shift, the UltraShift TCU will advance the shift.

In either mode, the gear indicator displays the current gear. See **Fig. 8.16**.



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NOTE: The gear indicator displays the current gear. In this example, it displays first gear.

Fig. 8.16, Current Gear Display

At the start of a shift, the current gear continues to display until the transmission has been pulled into neutral. At this point, as the transmission is synchronizing for the new (target) gear, the gear indicator flashes the number of the new gear.

When the shift is complete, the new gear displays solid, without flashing.

Automatic Mode (AUTO)

In automatic drive mode (AUTO), upshifts and downshifts are made by the transmission without driver intervention. Press in the neutral lock button, move the selector switch to drive (D), and press down on the throttle pedal. The transmission will shift automatically.

If driving conditions require, it is still possible to request a manual shift. The transmission will make the shift if the engine speed is within 75 rpm of the load-based shift point for that gear.

If the driver presses down on the throttle pedal after a manual downshift in automatic mode, the transmission will upshift again if the UltraShift TCU requires it.

Manual Mode (MAN)

In manual drive mode (MAN), upshifts and downshifts are made by the driver:

- To shift up, pull the lever up (towards you).
- To shift down, push the lever down (away from you).

The system will hold the current gear until the driver requests a shift. In downhill situations in particular,

the driver must be alert to vehicle speed by downshifting and/or using the service brake.

A shift request will still be refused if the selected gear would cause engine overspeed or excessive lugging.

Selecting Gears

Reverse

Reverse (R) is at the upper end of the four-position selector switch located at the end of the SmartShift control lever. To select R, press in the neutral lock button and move the selector switch upward to the position above neutral.

Six-speed UltraShift ASW has one reverse gear. When reverse is selected, the letter "R" displays on the gear indicator. See **Fig. 8.17**.

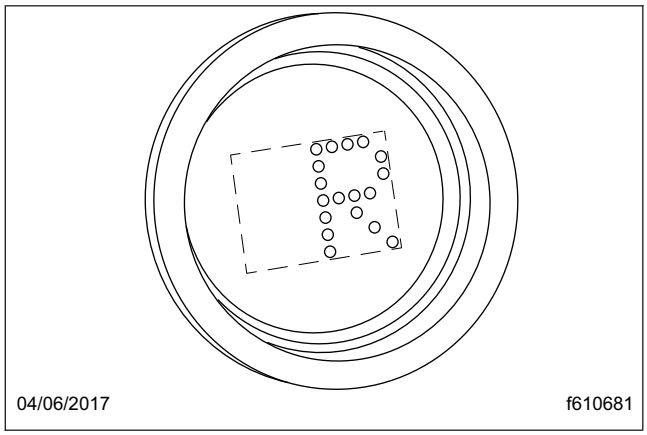


Fig. 8.17, Reverse Gear Display

Ten-speed UltraShift DM has two reverse gears, reverse low and reverse high. To shift manually between them, use the shift lever as described for MAN mode. There is no AUTO mode for reverse.

When reverse low is selected, the letter "R" displays on the current gear indicator. When reverse high is selected, the letter "H" displays on the current gear indicator.

IMPORTANT: Under normal conditions, do not select reverse with the vehicle moving forward.

The vehicle must be moving at less than two miles per hour (3 km/h) before selecting reverse. If reverse is selected when the vehicle is moving faster, an audible alert will sound and continue sounding at three-second intervals until the control lever is returned to the D position. When the vehicle is moving at the proper speed, reverse can be engaged.

On ten-speed UltraShift DM only, if necessary to rock the vehicle, use the selector switch to shift back and forth at low speed between reverse and drive.

Neutral

IMPORTANT: Always start the engine with the transmission in neutral, the parking brake set, and the service brakes applied.

Neutral (N) is directly below R on the four-position selector switch located at the end of the SmartShift control lever. To select N, move the selector switch to the position below R. When neutral is selected, the letter "N" displays on the gear indicator. See **Fig. 8.18**.

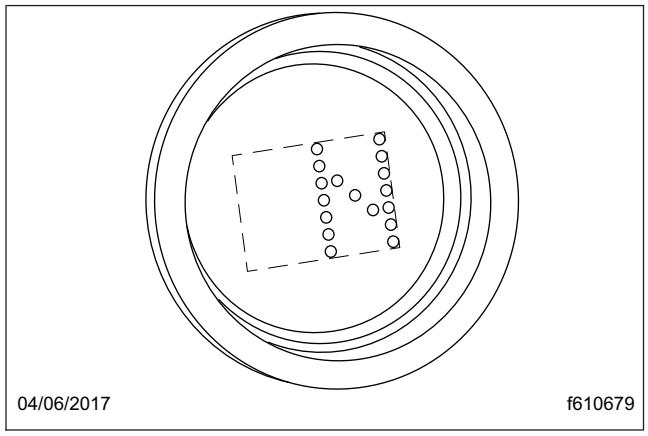


Fig. 8.18, Neutral Display

⚠ WARNING

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

Neutral is always available during operation, whatever the vehicle speed. When in neutral, requests to upshift or downshift are ignored. If the selector switch is moved from neutral to drive while the vehicle is moving, the transmission will shift into a gear within the engine's operating speed range.

When shifting from neutral, always press on the brake pedal. If the brake pedal is not pressed, the transmission will not shift, the current gear display will flash "N," and an audible alert will sound.

NOTE: To reset the transmission, return the selector switch on the SmartShift lever to N and attempt the shift again, this time with the brake pedal pressed.

Before shutting down the engine, return the selector switch to "N." When the ignition is turned off, the transmission will reset to neutral in a few minutes regardless of the position of the shift lever.

Drive

Drive (D) is directly below N on the four-position selector switch located at the end of the SmartShift control lever. To select D, press in the neutral lock button and move the selector switch to the position below N. When drive is selected, the number of the currently selected forward gear (1 through 6 on six-speed UltraShift ASW; 1 through 10 on ten-speed UltraShift DM) displays on the gear indicator. See **Fig. 8.16**.

When in drive, requests to upshift or downshift are enabled. Either manual or automatic mode can be selected on the slide switch.

Two starting gears are available, first and second. The default starting gear is second, but first can be selected by the driver, if desired. To change the starting gear, press the brake pedal and select D with the vehicle stopped. The current gear indicator will display the starting gear. Move the shift lever up or down until the desired starting gear is displayed.

The UltraShift TCU adapts to the working conditions of each vehicle and its driver. After power-up or a load change, it needs to learn the new conditions. While learning, it may hold a gear too long before upshifting. Start the upshift manually. It may take three or four shifts before UltraShift succeeds in learning the new load-based shift points, but after that it will handle the shifting automatically.

Low

Low (L) is located at the lower end of the four-position selector switch located at the end of the SmartShift control lever. To select L, press in the neutral lock button and move the selector switch to the position below D.

When in low, the current gear is maintained. Requests to upshift are not enabled.

IMPORTANT: If the engine is approaching overspeed, the UltraShift TCU will override the current gear setting and upshift to prevent engine damage.

To enhance engine braking, downshifts are performed at higher rpm than normal.

If L is selected from neutral while stopped, the vehicle starts up in first gear and stays there until the engine approaches overspeed.

Upshifting

To request an upshift with the transmission in drive, pull the control lever up (towards you). If the gear is available, the transmission upshifts and the new gear displays on the gear indicator. No skip shifts are available while upshifting.

No upshifts are available in low, except to prevent engine overspeed.

If the transmission does not upshift quickly enough after power-up or a load change, begin the shift manually. The UltraShift TCU will learn the new load-based shift conditions after three or four shifts.

If the gear requested is unavailable, a tone will sound. An unavailable request to upshift is not stored in memory. The upshift must be requested again.

Downshifting

NOTE: The driver can manually downshift at any time, even when the slide switch is set to AUTO mode.

To request a downshift with the transmission in drive or low, push the control lever down (away from you). If the gear is available, the transmission downshifts and the new gear displays on the gear indicator. Skip shifts are available while downshifting.

For best engine braking, select low while moving. In low, downshifts are performed at higher rpm than in drive.

IMPORTANT: If the engine is approaching overspeed, the UltraShift TCU will override the current gear setting and upshift to prevent engine damage.

If the gear requested is unavailable, a tone will sound. An unavailable request to downshift is not stored in memory. The downshift must be requested again.

When coasting to a stop, the UltraShift TCU may not finish the downshift until the driver presses down on the throttle pedal again.

IMPORTANT: A downshift request can never result in a shift into neutral, even if the vehicle is in the drive position in the lowest possible gear.

Before starting down a hill, slow down. Downshift to a speed that you can control without hard pressure on the service brakes.

Before entering a curve, slow down to a safe speed. Downshift if necessary. This lets you use some power through the curve to help the vehicle be more stable on the turn. It also allows you to regain speed faster as you come out of the curve.

UltraShift Diagnostics

Clutch Calibration

NOTE: Clutch calibration only occurs on six-speed UltraShift ASW.

The UltraShift TCU automatically adjusts for clutch wear. The calibration takes place whenever the following conditions are met:

- The engine is at normal operating temperature
- The vehicle is stopped
- The engine is at idle speed
- The selector switch on the control lever is in neutral

Calibration may take up to two minutes to complete. The engine may slow and return to normal idle several times during calibration.

To stop calibration at any time, select one of the drive positions on the selector switch (R, D, or L).

Clutch Protection Fault

Excessive clutch slippage creates heat and reduces the life of the clutch. These are some conditions which lead to clutch abuse:

- Using the throttle to hold the vehicle on a grade
- Starting the vehicle in too high a gear
- Overloading the vehicle
- Using high idle with the vehicle in gear

The UltraShift TCU is programmed to prevent clutch abuse. When the clutch overheats, the following alerts take place:

- The "TRANS TEMP" light comes on
- The gear indicator displays "CA"
- A warning tone sounds at one second intervals

The alerts continue until the clutch cools, the throttle is released, or the clutch is fully engaged.

System Problem

In the event of a problem, do the following steps:

1. Note the driving conditions at the time the problem occurred.
2. Record the status of the transmission at the time of the problem (AUTO or MAN mode, gear setting R, N, D, or L, current gear, engine speed, etc.)
3. Reset the system, using the procedure below.

Reset Procedure

Transmission operation can sometimes be restored by doing the following reset procedure:

1. Stop the vehicle when it is safe to do so.
2. Place the selector switch in neutral and turn off the ignition.
3. Check all harness connectors as described in **Chapter 11**.
4. Wait at least two minutes with the engine shut down.
5. Restart the engine.

If the problem continues, contact an authorized Freightliner or Eaton service facility.

Locked In Gear

If the transmission becomes locked in gear, a dash (–) will appear on the gear indicator when the vehicle is restarted during the reset procedure.

NOTE: If the transmission becomes locked in gear while the vehicle is moving, increased braking effort may be required to stop the vehicle.

If the current gear indicator displays a dash during power-up with the selector switch in neutral, do the following steps:

1. Make sure the parking brake is set.
2. Turn off the ignition and wait at least two minutes.
3. Apply the service brakes.
4. With the service brakes applied, release the parking brake.

5. Make sure the selector switch is in neutral and turn on the ignition key. Do not attempt to start the engine at this time.
6. If necessary to get the transmission to shift into neutral, release the pressure on the brake pedal slightly.
7. Once the UltraShift TCU reaches neutral, a solid "N" will appear on the current gear indicator and the vehicle will start. Make sure the service brakes are applied and the parking brake is set.

If the gear indicator continues to display a dash, contact an authorized Freightliner or Eaton service facility.

Eaton Fuller UltraShift PLUS Automated Transmissions

Eaton Fuller UltraShift PLUS automated transmissions use shift selection software and electric clutch actuation; a clutch pedal is not needed to operate the vehicle. These transmissions use the four-position SmartShift control (see **Fig. 8.10**) on the steering column to select mode, direction, neutral, low, and to make manual shifts. To know what gear the transmission is in, see the current gear indicator on the dash. Forward shifts can be made either manually or automatically.

Power Up

NOTE: Engine cranking is delayed until the transmission power-up is complete and the gear display shows a solid "N".

1. With the parking brake set, turn the ignition switch to the ON position.
2. Start the engine.
3. Apply the service brake.

NOTE: If the service brake is not applied while selecting a starting gear, the initial start gear will not be found and the driver will need to select Neutral and press the service brake while selecting the desired mode.

4. Select the desired mode and starting gear. (Inappropriate start gear selections are ignored to avoid damaging the transmission.)
5. Release the parking brake.
6. Release the service brake and apply the accelerator.

Power Down

1. Select Neutral on the shift control.

NOTE: If the gear display does not show a solid "N", neutral has not yet been obtained. Neutral should always be reached before powering down an UltraShift PLUS, except in cases of emergency.

2. Set the parking brake.
3. Turn off the ignition, and shut down the engine.

Reverse (R)

NOTE: If attempting to select a non-Neutral mode without applying the service brakes, the transmission will not shift into gear. To shift into gear, select Neutral, apply the service brakes, and select the desired mode again. Also, the vehicle will not engage reverse above 2 mph (3 km/h).

Reverse (R) is at the upper end of the four-position selector switch located at the end of the SmartShift control. To select R, press in the neutral lock button and move the selector switch to the position above neutral. The default Reverse gear is engaged.

NOTICE

Avoid launching the vehicle in high range. Launching the vehicle in high range increases the likelihood of clutch abuse and could be detrimental to clutch life.

Automatic Mode (AUTO)

In automatic drive mode (AUTO), upshifts and downshifts are made by the UltraShift PLUS 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.

NOTE: If attempting to select a non-Neutral mode without applying the service brakes, the transmission will not shift into gear. To shift into gear, select Neutral, apply the service brakes, and select the desired mode again.

In Drive, the start gear is automatically selected. The selected start gear can vary depending on several vehicle inputs such as load, grade, and axle/transmission ratio. The start gear can be changed

using the SmartShift control, provided the selected gear would allow the vehicle to launch without damaging the transmission. If the start gear is changed using the SmartShift control, it will be the default until the vehicle is powered down or the selection is changed again manually.

IMPORTANT: Prior to ascending a steep grade, either reduce the default start gear by one (using the SmartShift control) or apply full throttle for the duration of the grade so the vehicle maintains the proper engine and vehicle speed during the entire grade.

In Drive, the transmission automatically performs upshifts and downshifts. However, when the transmission is near the shift point, the shift can be forced using the upshift or downshift function of the SmartShift control.

NOTE: The transmission may deny a shift while ascending or descending a grade if the load of the vehicle and grade of the terrain in combination with the drivetrain ratio and engine torque fall outside of the acceptable range to perform a shift. If the shift is denied, a tone will sound.

Manual Mode (MAN)

In manual mode (MAN), the driver selects upshifts and downshifts instead of letting the UltraShift PLUS select them automatically. Manual shifting may be helpful when traversing a work site, railroad tracks, or steep grades, for example. To drive forward, press in the neutral lock button, move the selector switch to Drive (D), and press down on the throttle pedal. To shift up, pull the lever up (towards you); to shift down, push the lever down (away from you). The system holds the current gear unless a shift is requested or if the system initiates a manual mode override.

NOTE: The transmission may deny a shift while ascending or descending a grade if the load of the vehicle and grade of the terrain in combination with the drivetrain ratio and engine torque fall outside of the acceptable range to perform a shift. If the shift is denied, a tone will sound.

NOTE: If attempting to select a non-Neutral mode without applying the service brakes, the transmission will not shift into gear. To shift into gear, select Neutral, apply the service brakes, and select the desired mode again.

Manual Mode Override

The system is equipped with a manual mode override function. If the vehicle is being "back driven" (for example, descending a grade and vehicle speed exceeds engine speed) and the engine speed is excessively high, the system will upshift automatically. Also, if the start gear is changed and it causes the engine to lug at takeoff, the system will override the current position and select the best available gear.

Low (L)

Low (L) is at the lower end of the four-position selector switch located at the end of the SmartShift control. Use Low when wanting to maximize engine braking and minimize the use of the brake pedal—for example, when driving down long grades or when coming to a stop. To select Low, press in the neutral lock button and move the selector switch to the L position. The lowest available start gear will be selected (the starting gear cannot be changed in Low).

If Low is selected while moving, the transmission will not upshift (unless the system initiates a Low override). The system will downshift at the earliest opportunity to provide maximum engine braking.

NOTE: If attempting to select a non-Neutral mode without applying the service brakes, the transmission will not shift into gear. To shift into gear, select Neutral, apply the service brakes, and select the desired mode again.

Low Override

The system is equipped with a Low override function. If the vehicle is being "back driven" (for example, descending a grade and vehicle speed exceeds engine speed) and the engine speed is excessively high, the system will upshift automatically. Also, if the start gear is changed and it causes the engine to lug at takeoff, the system will override the current position and upshift.

Clutch Abuse Protection

Although a vehicle equipped with an UltraShift PLUS uses an automated clutch, the clutch can still overheat and slip with improper use. The clutch abuse protection feature helps protect the clutch if the automated clutch starts to overheat. When the clutch abuse protection feature initiates and sounds a warning tone, full clutch actuation must be completed quickly. If it is not completed quickly enough, the system will either open the clutch (if the throttle pedal is

not being pressed) or close the clutch (if the throttle pedal is being pressed). If the abuse continues, the system will open the clutch and take away throttle control briefly to allow the clutch to cool down.

To protect the clutch:

- Select the lowest possible start gear for the application.
- Use Creep Mode when appropriate.
- Use the service brakes and the Hill Start Aid when launching on a grade.
- Minimize the time it takes to engage the clutch from rest.
- Do not use the throttle to hold the vehicle on a grade; use the service brakes.
- Do not use the throttle to stop roll back on an incline after Hill Start Aid disengages; use the service brakes, and then relaunch.
- Do not continually start and stop, especially when loaded; use a lower gear or Creep Mode.

Creep Mode

The Creep Mode function allows the vehicle to maintain a constant speed at engine idle without the driver holding the throttle pedal position. This mode is useful for very low-speed maneuvering and applications where steady vehicle speed is required. The vehicle speed is determined by the selected gear ratio operating at governed low engine idle speed. Any available gear may be selected, though the transmission will downshift or exit Creep Mode to prevent stalling if the engine lugs due to load conditions.

By default, Creep Mode can be activated while in Manual Mode or Low. Eaton's ServiceRanger diagnostic software can be used to enable Creep Mode in Automatic Mode and/or Reverse.

Engaging Creep Mode

To engage Creep Mode:

1. Select Low or Manual Mode and the desired gear (while stopped or moving).
2. Apply the throttle pedal to accelerate the vehicle until the clutch is closed (engaged).
3. Release the throttle pedal. The vehicle will continue moving at governed low engine idle speed.

Exiting Creep Mode

To exit Creep Mode, apply the throttle pedal to accelerate temporarily, or select a higher gear in Manual Mode. (Creep Mode can be resumed in the selected gear by releasing the throttle pedal.)

NOTE: The transmission will exit Creep Mode if the engine lugs 150 rpm below the governed low engine idle speed. In this case, a lower gear should be selected if available.

Hill Start Aid

UltraShift PLUS transmissions are equipped with a Hill Start Aid (HSA) feature to prevent the vehicle from rolling while on grades steeper than 3% and allow for a controlled launch. A grade sensor is used to determine when to engage the feature.

HSA is "on" by default. It can be turned off by pressing and releasing the override switch on the dash. HSA will turn back on after the first successful launch.

When the vehicle is stopped on a grade greater than 3% and in a forward mode or reverse, depress the service brakes then release them. The vehicle will begin to move after 3 seconds, and the clutch will perform partial engagements to slow the vehicle motion. Either step on the brake or apply the throttle to continue negotiating the grade.

Engine Overspeed Protection

The system will upshift if necessary to prevent engine overspeed in Drive, Manual, and Low.

Shuttle Shifting

Shuttle shifting from reverse to any forward mode is only allowed if the vehicle speed is approximately zero.

Auto Start Gear Selection and Override

The UltraShift PLUS system uses various inputs to automatically select the best start gear in Drive and Manual. This selection can be changed using the SmartShift control; however, if the selection requested could cause damage or engine lugging, the request will be denied and a tone will sound.

Skip Shifting

When appropriate, the UltraShift PLUS system may skip shift in Drive. When prevailing conditions like load and grade allow, skip shifts can be performed in Manual mode using the SmartShift control.

Auto Neutral

The UltraShift PLUS system will automatically shift to neutral if the vehicle is left in Drive and the parking brake is set. "AN" will show on the gear display. To re-engage the transmission, select Neutral and then either Drive or Reverse on the shift control (it will re-engage regardless of whether the parking brake is released).

Automatic Traction Control

The UltraShift PLUS system requires the Automatic Traction Control (ATC) option to be enabled when driving in soft soil/sand to prevent wheel slippage and shifting issues. The ATC system has two modes: "normal" (for sand and loose road surface) and a mud/snow setting.

ATC Normal Mode

In normal mode, the system will engage the brakes on the wheel or side that the wheel slip is occurring to help the vehicle gain traction. The point at which the traction control will actuate the braking system increases with throttle: low throttle allows the system to brake the wheels earlier; heavy/full throttle raises the point of the acceptable wheel slip.

Adhere to the following points when driving in ATC normal mode:

- If using Automatic mode in soft soil and/or sand, maintain the engine speed between 1000 and 1300 rpm to prevent unnecessary upshifting.
- If using Manual mode in soft soil and/or sand, do not attempt an upshift and try to maintain the current gear.
- If the vehicle comes to a stop in the sand it may be necessary to back up prior to attempting forward movement.

ATC Mud/Snow Mode

To select the mud/snow mode, depress the ATC switch. This mode raises the wheel slip speed that is allowed before the traction control activates. The point at which the traction control will actuate the braking system increases with throttle: low throttle allows the system to brake the wheels earlier; heavy/full throttle raises the point of the acceptable wheel slip.

Load-Based Shifting

The UltraShift PLUS system is adaptive and will change the shift points based on grade, engine RPM, throttle position, and vehicle load. After changing loads or powering up, the system needs to relearn these inputs for the first few shifts to make the proper adjustments.

Coasting

When coasting to a stop on level terrain, the UltraShift PLUS system may not downshift into the lower gears. It will select a gear after the throttle is applied.

Mercedes-Benz Manual Transmissions

NOTICE

Operating a manual transmission with the fluid level higher or lower than recommended can result in transmission damage.

Mercedes-Benz transmissions use a simple 6-speed gear pattern as shown in **Fig. 8.19**.

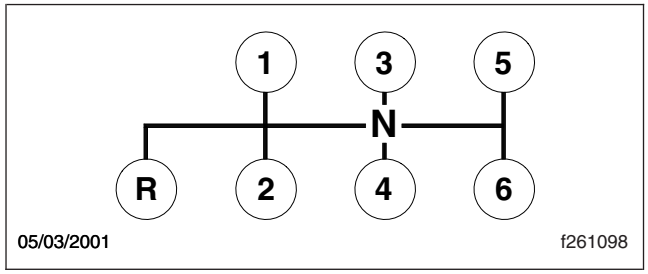


Fig. 8.19, Shift Pattern, M-B Transmissions

Always use first gear when starting to move the vehicle forward.

IMPORTANT: Do not rest your foot on the clutch pedal while driving. This causes partial clutch disengagement which could cause premature clutch wear.

While traveling, check the tachometer regularly to be sure the engine speed is within the most economical range (1400 to 2000 rpm).

On level roads, drive in the highest usable gear, keeping engine speed down.

NOTICE

Do not rest your hand on the gear shift lever while driving. This can cause synchronizer damage.

When approaching an uphill grade, shift down ahead of time to prevent loss of engine rpm. When approaching a downhill grade, shift down ahead of time to prevent runaway speed. For information about shift points and "progressive shifting," see **Chapter 7**.

Change gears only when absolutely necessary. Skip gears if needed.

When shifting, always press the clutch pedal all the way down. Do not force the gear lever.

Before shifting into reverse, be sure the engine is idling and the vehicle is not moving.

NOTICE

If the transmission locks up while driving, making further shifting impossible, continue driving in the gear already selected to reach service assistance, as circumstances allow. Or, safely park the vehicle off the roadway and contact your nearest Freightliner dealer or other qualified service provider for roadside assistance. To prevent further transmission damage, do not move the vehicle from a standing start unless this can be accomplished safely, taking into account the gear that is engaged and the load on the vehicle.

Mercedes-Benz Automated Transmissions

General Information, AGS

The AGS Automated Gear Shift is a fully automated 6-speed medium-duty transmission. The clutch is activated by a hydraulic system that is integral to the transmission. No clutch pedal is needed to operate the vehicle.

AGS transmissions use the SmartShift control lever on the steering column to select gears. A manual shift is possible at any time by moving the SmartShift lever up or down as needed.

The transmission control unit (TCU) can direct all forward shifts in response to driving conditions and the driver's pressure on the brake and throttle pedals. To know which gear the transmission is in, look at the round current gear indicator on the right-hand control panel as shown in **Fig. 8.12**.

The TCU always selects first gear to start the vehicle in motion. It is possible, in manual mode, to start an unloaded or lightly loaded vehicle in second gear. In most cases, second gear is acceptable for downhill starts. In other situations, for best results always start moving in first gear. Loaded vehicles, or vehicles on substantial grades, must start moving only in first gear.

NOTICE

At the first sign of a transmission malfunction, take the vehicle out of service immediately. Depending on the type of problem, further shifting may not be possible, and driveline torque may be interrupted.

Operation, AGS

Power Up

1. With the parking brake set and/or the brake pedal pressed down, select neutral (N) by moving the selector switch to the center position.
2. With the transmission in neutral, turn on the ignition switch. The "CHECK TRANS" and "TRANS TEMP" telltale lights come on and go out again (bulb check). See **Fig. 8.13**.
3. On power up, the current gear indicator shows the dot display, arranged in a square pattern. All dots in the pattern should light up, without gaps or spaces. See **Fig. 8.14**.
4. When the current gear indicator shows "N," start the engine.

NOTE: No matter what the circumstances, do not start the engine unless the current gear indicator shows "N." See **Chapter 13** for jump starting information.

5. Select drive (D) by pressing in the neutral lock button and moving the selector switch downward to the position below neutral. Release the parking brake and/or service brake pedal. The gear is displayed on the current gear indicator.

NOTE: When D is selected, the transmission starts up in first gear. To start up in second gear

(downhill start, vehicle unloaded or lightly loaded), pull up on the SmartShift lever when the current gear indicator displays "1."

6. On a level grade, press down on the throttle pedal to allow the vehicle to move forward. The vehicle will not move until the pedal is depressed.

⚠ WARNING

When starting or stopping on hills and grades, use extra care to prevent the vehicle from rolling back. A rollback accident could cause death, serious personal injury, or property damage.

7. Prevent the vehicle from rolling backwards when stopped on a hill or grade, or when the vehicle is starting from a stop on a hill or grade.

   7.1 *To start from a full stop on a hill or grade*, quickly move your foot from the brake pedal and press firmly on the throttle pedal.

   On steep hills, set the parking brake and release it only when there is enough engine power to prevent rollback.

   7.2 *To stop on a hill or grade*, press and hold the brake pedal to keep the vehicle from moving.

   On steep hills, set the parking brake. Never hold a hill with the throttle pedal. This will cause the clutch to overheat.

Power Down

1. Bring the vehicle to a complete stop.
2. Set the parking brake.
3. Move the selector switch to N. Wait until "N" appears on the current gear indicator.

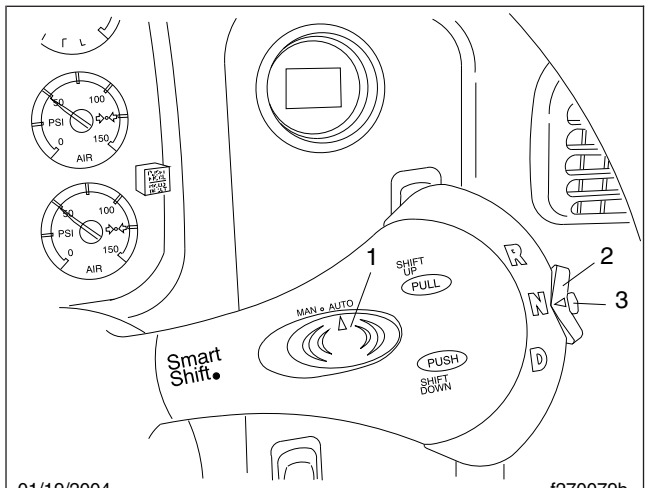
⚠ WARNING

Always apply the parking brake before shutting down the engine. AGS will shift into neutral after shutdown, regardless of the position of the shift lever. If you do not set the parking brake, the vehicle could roll and cause an accident resulting in death, serious personal injury, or property damage.

4. Turn the ignition switch off and shut down the engine.
5. If the current gear indicator flashes "PB" when the engine is shut down, set the parking brake and move the selector switch to "N."

Automatic and Manual Modes

The SmartShift control has a slide switch located on the body of the lever just before the paddle widens out. See **Fig. 8.20**. The slide switch controls the forward driving mode, automatic or manual.



1. Slide Switch (controls forward driving mode)
2. Selector Switch (controls gear selection)
3. Neutral Lock Button (prevents accidental shift into gear)

Fig. 8.20, Switches, AGS Transmissions

To change mode at any time, move the slide switch in the desired direction. This allows the driver to respond to a wide range of driving conditions, such as blind corners, tight curves, and steep hills.

IMPORTANT: Whatever the mode, it is always possible to shift manually by moving the lever up or down as needed.

In either mode, the gear indicator displays the current gear. See **Fig. 8.16**.

Automatic Mode (AUTO)

Automatic drive mode (AUTO) is recommended for most driving conditions. For the best fuel economy, always use AUTO mode.

In AUTO mode, upshifts and downshifts are made by the transmission without driver intervention. Press in the neutral lock button, move the selector switch to drive (D), and press down on the throttle pedal. The

transmission will shift automatically through the forward gears.

If driving conditions require, it is still possible to request a manual shift. The transmission will make the shift unless the selected gear would cause engine overspeed.

If the driver presses down on the throttle pedal after a manual downshift in automatic mode, the transmission will upshift again if the TCU requires it.

On downgrades, the transmission holds the current gear until the driver requests a shift, or presses the throttle pedal.

⚠ WARNING

While driving off-road or with locked differential in AUTO mode, use extra caution. Shifts of the AGS could interrupt power to the drive wheels, causing a rollback accident while climbing steep grades at low speeds. A rollback accident could cause death, serious personal injury, or property damage.

Manual Mode (MAN)

Manual mode may be required under certain conditions, such as:

- In difficult or slippery conditions
- On hills, steep grades, or other situations where driveline torque interruption is not desirable
- During off-road driving or driving with a locked differential
- In downhill driving where control of engine braking is needed
- If necessary to hold a specific gear on a downgrade

In manual drive mode (MAN), upshifts and downshifts are made by the driver:

- To shift up, pull the lever up (towards you).
- To shift down, push the lever down (away from you).

The system will hold the current gear until the driver requests a shift. In downhill situations in particular, the driver must be alert to vehicle speed and maintain vehicle control by downshifting and/or using the service brakes as needed.

When braking or slowing in MAN, downshift as necessary to prevent lugging the engine when speed is resumed. If the vehicle comes to a complete stop, the TCU resets the transmission to neutral.

NOTE: A downshift request will be refused if the selected gear would cause engine overspeed.

Cruise Control

Cruise control is fully functional with AGS transmission in either AUTO or MAN mode.

In AUTO, the TCU will adjust the gear selections to maintain the speed settings as desired. No driver action is necessary.

In MAN, the vehicle speed settings must be within the engine speed range for the gear selected. If the engine cannot maintain set speed due to changes in road grade, the driver must downshift or upshift as necessary.

For vehicles equipped with a power take-off (PTO) unit, two modes of operation are possible, stationary and mobile. For PTO operation, see **Chapter 7**.

Selecting Gears

Reverse

Reverse (R) is at the upper end of the three-position selector switch located at the end of the SmartShift control lever. To select reverse (R), press in the neutral lock button and move the selector switch upward to the position above neutral. When reverse is selected, the letter "R" displays on the gear indicator. See **Fig. 8.17**.

IMPORTANT: The vehicle must come to a complete stop before selecting reverse. If reverse is selected with the vehicle moving forward, an audible alert will sound and continue sounding at three-second intervals until the selector switch is returned to N or D.

Once the vehicle has come to a complete stop, reverse can be engaged.

Neutral

Neutral (N) is in the center of the three-position selector switch located at the end of the SmartShift control lever. Always start the engine in neutral. To select neutral, move the selector switch to the center position. When neutral is selected, the letter "N" displays on the gear indicator. See **Fig. 8.18**.

⚠ WARNING

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

Neutral is always available during operation, whatever the vehicle speed. When in neutral, requests to upshift or downshift are ignored. If the selector switch is moved from neutral to drive while the vehicle is moving, the transmission will shift into a gear within the operating torque range of the engine.

⚠ WARNING

Always apply the parking brake before shutting down the engine. AGS will shift into neutral after shutdown, regardless of the position of the shift lever. If you do not set the parking brake, the vehicle could roll and cause an accident resulting in death, serious personal injury, or property damage.

Before shutting down the engine, return the selector switch to "N." When the ignition is turned off, the transmission will reset to neutral during power down.

Drive

IMPORTANT: The vehicle must come to a complete stop before selecting drive. If drive is selected with the vehicle moving in reverse, an audible alert will sound and continue sounding at three-second intervals until the selector switch is returned to N or R.

Drive (D) is at the lower end of the three-position selector switch located at the end of the SmartShift control lever. To select drive, press in the neutral lock button and move the selector switch to the position below neutral. When drive is selected, the number of the currently selected forward gear (1, 2, 3, 4 , 5, or 6) displays on the gear indicator.

Upshifting

NOTE: The driver can manually upshift at any time, even when the slide switch is set to AUTO mode.

To request an upshift with the transmission in drive, pull the control lever up (towards you). If the gear is available, the transmission upshifts and the new gear displays on the gear indicator.

As in a manual transmission, upshifting too early causes engine lugging and uneven operation.

To achieve smooth operation in MAN mode, upshift when the engine speed reaches approximately 2000 revolutions per minute (rpm). Heavy loads or steep grades require higher rpm; lighter loads require lower rpm.

An unavailable request to upshift is not stored in memory. The upshift must be requested again.

Downshifting

NOTE: The driver can manually downshift at any time, even when the slide switch is set to AUTO mode.

To request a downshift with the transmission in drive, push the control lever down (away from you). If the gear is available, the transmission downshifts and the new gear displays on the gear indicator.

Downshifts are not available if the engine speed after the shift would exceed 2700 rpm. If the gear requested is unavailable, an audible alert will sound. An unavailable request to downshift is not stored in memory. The downshift must be requested again.

To achieve smooth operation in MAN mode, downshift when the engine speed reaches approximately 1200 rpm.

Before starting down a hill, slow down. Downshift to a speed that you can control without hard pressure on the service brakes.

Before entering a curve, slow down to a safe speed. Downshift if necessary. This lets you use some power through the curve to help the vehicle be more stable when turning. It also allows you to regain speed faster as you come out of the curve.

AGS Diagnostics

NOTICE

At the first sign of a transmission malfunction, take the vehicle out of service immediately. Depending on the type of problem, further shifting may not be possible, and driveline torque may be interrupted.

System Malfunction

If the "CHECK TRANS" telltale light comes on while driving, the audible alert sounds, and the current gear indicator begins to flash between the current

gear and "SM" (system malfunction), there is a problem which may or may not be apparent to the driver. Bring the vehicle at once to a safe stopping place and call an authorized Freightliner service facility for assistance.

Clutch Overload

If the "TRANS TEMP" telltale light comes on while driving and the current gear indicator begins to flash between the current gear and "CO" (clutch overload), the clutch has begun to overheat.

The clutch overload may have been caused by improper driving practices such as frequent and rapid start/stop driving, or hillholding with the throttle pedal. In this case, allow the clutch to cool, and continue on, but cease the improper driving practices.

If the clutch overload message returns or continues, the clutch is worn or damaged. Bring the vehicle at once to a safe stopping place and call an authorized Freightliner service facility for assistance.

Low Hydraulic Fluid Level

IMPORTANT: The only hydraulic fluid permitted in this system is Pentosin CHF 11S. No other fluid can be substituted.

If the "CHECK TRANS" telltale light comes on while driving and the current gear indicator begins to flash between the current gear and "FL" (fluid level), there has been an unusual loss of hydraulic fluid. Bring the vehicle at once to a safe stopping place and call an authorized Freightliner service facility for assistance. The hydraulic reservoir holds about 1.05 quarts (one liter) of Pentosin CHF 11S.

NOTE: After hydraulic fluid loss, a special procedure is required to fill the hydraulic reservoir. This procedure must be carried out by an authorized Freightliner service facility.

Meritor™ Drive Axles

Refer to the Meritor website for additional information, **www.meritor.com**.

Drive Axles With Differential Lock

The Meritor driver-controlled differential lock feature (side-to-side wheel lock, traction control, or traction equalizer) is available on single-drive or dual-drive rear axles. It is available on both axles of a dual-drive vehicle, or on one only. It is only available on drive axles. Differential lock must only be used under adverse road conditions where greater traction is needed. With differential lock on, the turning radius is increased and vehicle handling is affected. The differential lock switch (**Fig. 8.21**) allows the driver to lock the wheels on the same axle together. The red differential lock warning light illuminates on the dash message center when differential lock is engaged.

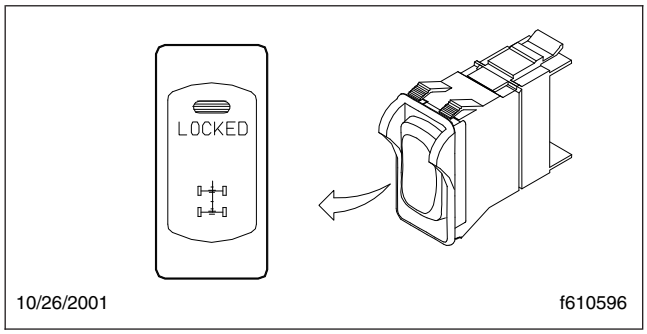


Fig. 8.21, Differential Lock Switch

Differential lock provides maximum traction under slippery conditions. When the differential lock is engaged, the clutch collar completely locks the differential case, gearing, and axle shafts together, maximizing the traction of both wheels and protecting against spinout.

Under normal traction conditions, do not use the differential lock feature.

Differential Lock Switch

NOTICE

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

Normally, when differential lock is available on dual-drive vehicles, one switch activates the lock on both rear drive axles. As an option, it possible to have two differential lock switches, one for the forward rear and one for the rearmost drive axle. It is also possible for some vehicles to have differential lock on only one of the drive axles.

A two-position guarded rocker switch (**Fig. 8.21**) controls differential lock, causing the wheels on each axle governed by the switch to rotate together. To lock the wheels together, press the upper half of the rocker momentarily (at the red LED). To unlock the wheels, press the upper half of the rocker again.

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

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

Normal Response: The LED in the switch blinks until the axle has responded to the request to lock the wheels. At this point, the LED comes on steady and stays illuminated. In normal operation, the wheels may lock so quickly that the blinking of the switch is barely noticeable.

If operation of the switch is not possible for any reason (ignition is turned off, vehicle is moving faster than 25 mph, etc.), the LED will stop blinking and turn off.

Slow Response: If operation of the switch is slowed for any reason (vehicle moving too fast, low air pressure, etc.), the switch will continue to blink until the wheels are able to lock. As in the normal response, the LED comes on steady and stays illuminated once the wheels have locked.

NOTE: If the vehicle is moving too fast, let up slightly on the accelerator. As the vehicle slows, the wheels will lock.

Abnormal Response: If the LED blinks for more than 30 seconds, the lock mechanism may not be fully engaged/disengaged. Bring the vehicle to an authorized Freightliner service facility for testing.

Differential Lock Operation

⚠ WARNING

Locking the wheels when the vehicle is traveling down steep grades or when the wheels are slipping could damage the differential and/or lead to loss of vehicle control, causing personal injury and property damage.

Lock the wheels only when the vehicle is standing still or moving at very low speed, less than 5 mph (8 km/h). Never lock the wheels when the vehicle is traveling down steep grades or when the wheels are slipping.

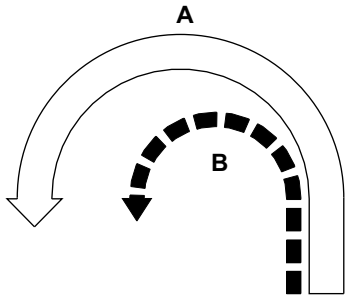
NOTE: On some vehicles, the differential lock system is connected through the low speed range of the transmission. If this system is used, the transmission must be in the low speed range for the wheels to fully lock.

⚠ WARNING

A vehicle with locked wheels can still slip sideways, causing possible loss of vehicle control, personal injury, and property damage.

Be especially careful when driving under slippery conditions with the wheels locked. Though forward traction is improved, the vehicle can still slip sideways.

If the vehicle is moving, maintain a constant vehicle speed when the differential lock is turned on. Briefly let up on the accelerator to relieve torque on the gearing, allowing the wheels to lock completely. When the wheels are fully locked, the turning radius will increase because the vehicle understeers. See **Fig. 8.22**. Drive cautiously and do not exceed 25 mph (40 km/h).



A. Turning Radius When the Differential Lock is Engaged (understeer condition)
B. Turning Radius When the Differential Lock is Disengaged

Fig. 8.22, Turning Radii

To disengage differential lock after leaving poor road conditions, operate the differential lock switch as discussed above while maintaining vehicle speed. Let up momentarily on the accelerator to allow the wheels to fully unlock, then resume driving at normal speed.

NOTE: If the differential lock system is connected with the transmission in its low speed range, shifting out of the low speed range will also disengage the differential lock function. The

switch will blink until the wheels unlock, and then go out.

Tandem Drive Axles With Interaxle Lock

NOTICE

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

Meritor has an interaxle lock (axle lock, interaxle differential lockout) feature that is standard on all dual-drive (tandem-drive) vehicles. Interaxle lock is recommended for use under adverse road conditions where greater traction is needed. See the axle manufacturer's manual provided with the vehicle for more information.

The interaxle lock switch (**Fig. 8.23**) allows the driver to lock both rear axles together. The red interaxle warning light illuminates on the dash message center when interaxle lock is engaged.

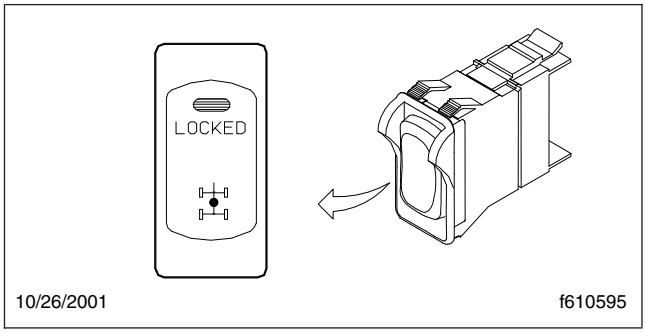


Fig. 8.23, Interaxle Lock Switch

When the interaxle lock is not engaged, there is differential action between the two axles. The differential compensates for different wheel speeds and variations in tire size. Keep the interaxle lock disengaged when driving on roads where traction is good.

When the interaxle lock is engaged, the differential action between the two axles is locked. Both drive axles now share the power. Both axles, and both sets of wheels, turn together at the same speed. The interaxle lock should be used when the vehicle encounters poor traction conditions; however, it also increases drivetrain and tire wear and should be used only when improved traction is required.

Interaxle Lock Switch

A two-position guarded rocker switch (**Fig. 8.23**) controls interaxle lock, causing both axle shafts to rotate together. To lock the axles together, press the upper half of the rocker momentarily (at the red LED). To turn off interaxle lock, press the lower half of the rocker (at the double-axle icon).

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

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

Normal Response: The LED in the switch blinks until the interaxle lock is engaged. At this point, the LED comes on steady and stays illuminated. In normal operation, the interaxle may lock so quickly that the blinking of the switch is barely noticeable.

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

Slow Response: If operation of the switch is slowed for any reason (by cold weather, low air pressure, etc.), the switch will continue to blink until the axles lock together, or for a maximum of 10 seconds. As in the normal response, the LED comes on steady and stays illuminated.

Abnormal Response: If the LED blinks for more than 30 seconds, the lock mechanism may not be fully engaged/disengaged. Bring the vehicle to an authorized Freightliner service facility for testing.

Interaxle Lock Operation

To engage interaxle lock and achieve maximum pulling power in slippery or hazardous road conditions, operate the interaxle lock switch as discussed above, while maintaining vehicle speed. Let up momentarily on the accelerator until the axle lock engages. Proceed over poor road conditions with caution. Do not wait until traction is lost and the tires are spinning before engaging the interaxle lock.

NOTICE

Do not turn on the interaxle lock switch when the tires are slipping. Do not continuously operate the vehicle with the interaxle lock engaged during good road conditions. To do so could result

in damage to the axle gearing and excessive tire wear.

To disengage the interaxle lock after leaving poor road conditions, operate the interaxle lock switch as discussed above while maintaining vehicle speed. Let up momentarily on the accelerator to allow the axles to fully unlock, then resume driving at normal speed.

Axle Shift

NOTICE

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

Axle shift is a function installed on vehicles with two-speed axles to allow the use of the low speed range when greater traction and maximum pulling power is needed at low engine speed (rpm).

Under normal operating conditions, the vehicle is operated using the high-speed gear ratios of the axle. Under extreme weather or off-road conditions, at low speed and rpm and/or to pull heavy loads, the vehicle must be operated using the low-speed, or reduction, gear ratios of the axle.

Axle Shift Switch

The axle shift switch is a two-position guarded rocker switch (**Fig. 8.24**) installed on vehicles with two-speed axles.

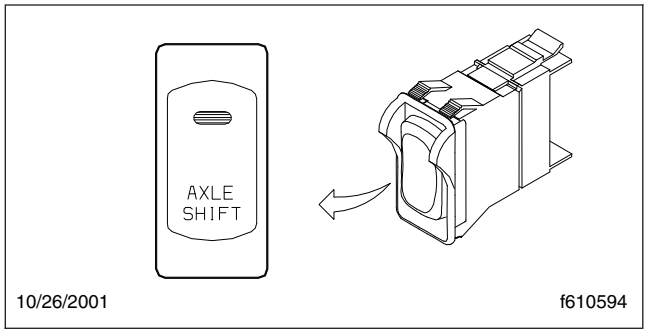


Fig. 8.24, Axle Shift Switch

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

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

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

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

Normal Response: The LED in the switch blinks until the axle shifts speed. At this point, the LED comes on steady and stays illuminated. In normal operation, the axle may shift so quickly that the blinking of the switch is barely noticeable.

If operation of the switch is not possible for any reason (interaxle lock is on, ignition is turned off, etc.), the LED will stop blinking and turn off.

Slow Response: If operation of the switch is slowed for any reason (by cold weather, low air pressure, etc.), the switch will continue to blink until the axle shifts. As in the normal response, the LED comes on steady and stays illuminated.

Abnormal Response: If the LED blinks for more than 30 seconds, the axle shift function/mechanism may not be operating correctly. Bring the vehicle to an authorized Freightliner service facility for testing.

Axle Switch Interlock

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

If the axle shift switch is pressed when the interaxle lock is on, the axle shift will not be completed. The LED does the following:

- If the LED is off, the LED comes on briefly and turns off again.
- If the LED is on, it stays on.

To complete the axle shift, turn off the interaxle lock and press the axle shift switch again. If still needed, the interaxle lock can then be reactivated.

Transfer Cases

Meritor MTC Series

Some vehicles are equipped with a Meritor MTC Series transfer case for part-time 4x4, 6x6, or 8x8 operation. Meritor MTC Series transfer cases have two gear sets: HIGH RANGE and LO RANGE.

⚠ WARNING

Do not engage a Meritor MTC Series transfer case when driving on normal highway conditions. Severe personal injury and/or damage to components can result when the transfer case is misused.

IMPORTANT: Steer axle engagement is limited to 20% or less of annual vehicle mileage.

Follow the operating guidelines in **Table 8.2** when driving a vehicle equipped with a Meritor MTC transfer case.

Engaging and Disengaging the Steer Axle

Dash-mounted switches control the transfer case functions; see **Chapter 4** for more information.

IMPORTANT: The wheels must not slip during engagement of the steer axle driveline.

To engage the steer axle driveline, drive the vehicle at a constant speed below 10 mph (16 km/h) and press the AWD switch. An audible engagement may be heard.

To disengage the steer axle, drive the vehicle at a constant speed below 10 mph (16 km/h) and press the AWD switch. An audible disengagement may be heard. If the steer axle driveline does not disengage, the steer axle driveline coupling may be in a bind. Turn the steering wheel back and forth while driving, or briefly drive the vehicle in reverse.

Range	Disengaged Steer Axle		Engaged Steer Axle	
	Traction Conditions	Applicable Vehicle Speeds	Traction Conditions	Applicable Vehicle Speeds
HIGH RANGE	Most normal driving conditions (such as dry or wet pavement or mixed road surfaces) when moderate to high vehicle speeds are appropriate.	0 mph (0 km/h) to maximum vehicle speed	When more traction is needed at moderate to low vehicle speeds on dirt or gravel surface with shallow to moderate grades (8% maximum), icy or snow-covered roads, or hard-packed sand.	20 mph (32 km/h) or less
LO RANGE	Not applicable. Do not use LO RANGE unless the steer axle is engaged.		When maximum power and maximum traction is needed on steeper grades (15% maximum), deeply rutted tracks, deep mud or snow, extremely rocky surfaces, or soft, loamy sand.	15 mph (24 km/h) or less
IMPORTANT: Engaging the steer axle will increase the turning radius of the vehicle.				

Table 8.2, Operating Guidelines, Meritor MTC Transfer Cases

Shifting Between HIGH RANGE and LO RANGE

MTC Series transfer cases use an air cylinder to shift between HIGH RANGE and LO RANGE. A dash-mounted switch operates the shift mechanism (see **Chapter 4** for more information).

Shift between HIGH RANGE and LO RANGE, as follows:

1. Stop the vehicle.
2. Shift the transmission to NEUTRAL.
3. Apply the parking brake.
4. Move the dash-mounted switch to the HIGH or LO RANGE position to pressurize the shift mechanism in the transfer case. An audible engagement may be heard (which is normal).
5. Shift the transmission to FIRST gear and apply light torque to test the engagement.

If the shifter does not engage when shifting from HIGH RANGE to LO RANGE, shift the transmission into REVERSE, then NEUTRAL, and apply light torque to engage the LO RANGE.

Engaging PTO

Some vehicles are equipped with a PTO mounted to a Meritor MTC transfer case. For these vehicles, engage the PTO only when the transfer case is in neutral, the transmission is in neutral/park, and the parking brake is applied. To begin using the PTO, select the drive gear based on the PTO system operators manual.