S2 Chassis Operator's Manual

Models: S2
S2 C
S2 G
S2 RV

STI-479, ()

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1. Foreword

1.01 Customer Assistance Center

Having trouble finding service? Call the Customer Assistance Center at 1-800-385-4357 or 1-800-FTL-HELP. Call night or day, weekdays or weekends, for dealer referral, vehicle information, breakdown coordination, or Fleetpack assistance. For specification requests and all other concerns and inquiries, the Customer Assistance Center is available 5:00 A.M. to 4:00 P.M. PST, Monday through Friday. Our people are knowledgeable, professional, and committed to following through to help you keep your vehicle moving.

1.02 Environmental Concerns and Recommendations

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

IMPORTANT: Modifications to fuel systems, emission related components, or air conditioning systems may constitute a noncompliant EPA or CARB vehicle and such actions are prohibited.

1.03 Data Logging

This vehicle is equipped with a control module that performs data logging capabilities.

This vehicle is equipped with one or more devices that record specific vehicle data and may perform some of the same functionality as a regulated Event Data Recorder but the device(s) are not subject to, nor designed pursuant to, 49 C.F.R. Part 563.

The type and amount of data recorded varies depending on how the vehicle is equipped (such as the brand of engine, if an air bag is installed, or if the vehicle features a collision avoidance system, etc.). GPS location data, fault codes, and other technical data may be recorded.

This data may help provide a better understanding of the circumstances of a crash.

Personal data such as name, gender, and age are not recorded. However, other parties such as law enforcement, could combine the data logger's contents with the type of personally identifying data routinely acquired during a crash investigation.

1.04 Emissions and Fuel Efficiency Compliance

This vehicle must be regularly inspected and maintained as indicated in the **S2 Chassis Maintenance Manual**, and in the **Pre- and Post-Trip Inspections and Maintenance** chapter in this manual, in order to continue satisfactory performance and ensure coverage of the vehicle under the manufacturer’s warranty.

Many maintenance procedures ensure that the vehicle and engine continue to comply with applicable emissions standards. Maintenance procedures, using components engineered to comply with greenhouse gas emissions and fuel efficiency regulations, may be performed by an authorized Daimler Truck North America dealer, an independent outlet, or the vehicle owner or operator.

The vehicle owner is responsible for determining the suitability of replacement components to maintain compliance with federal and local jurisdictional regulations. Components including, but not limited to, low-rolling resistance tires are specifically designed and manufactured to exacting standards for regulatory fuel efficiency and greenhouse gas emissions compliance. It is important that these components are always replaced with components that meet or exceed the performance of the originally installed components.

1.05 Reporting Safety Defects

Vehicles domiciled in the USA that are thought to have a defect which could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying Freightliner Custom Chassis Corporation.

If the NHTSA receives similar complaints, it may open an investigation, and if it finds that a safety defect exists in a group of vehicles, it may order a recall and remedy campaign. However, NHTSA cannot become involved in individual problems between you, your dealer, or Freightliner Custom Chassis Corporation.

To contact NHTSA, call the Vehicle Safety Hotline toll-free at 1-888-327-4236 (TTY: 1-800-424-9153).

To e-mail NHTSA, go to www.safercar.gov .

Contact NHTSA by mail at: Administrator, NHTSA Headquarters, 1200 New Jersey Avenue SE, West Building, Washington, DC 20590.

For more information about motor vehicle safety, go to www.safercar.gov .

To contact Freightliner Custom Chassis Corporation regarding a concern about a specific vehicle, call the Customer Assistance Center at 1-800-385-4357 or 1-800-FTL-HELP.

Vehicles domiciled in Canada that are thought to have a defect that could cause a crash, injury, or death, should immediately be reported to Transport Canada and Freightliner Custom Chassis Corporation.

If Transport Canada receives similar complaints, it may open an investigation; if it finds that a safety defect exists in a group of vehicles, it may order a recall and remedy campaign. However, Transport Canada cannot become involved in individual problems between you, your dealer, or Freightliner Custom Chassis Corporation.

To contact Freightliner Custom Chassis Corporation regarding concerns about a specific vehicle, call the Customer Assistance Center at 1-800-385-4357 or 1-800-FTL-HELP.

To contact Transport Canada, call the Defect Investigations and Recalls Division toll-free in Canada at 1-800-333-0510 or 1-819-994-3328 in the Gatinuau-Ottawa area or internationally.

Contact Transport Canada by mail at: Transport Canada, 330 Sparks Street, Ottawa, Ontario, K1A 0N5 Canada.

The following websites contain more information on Canadian recalls:

English: www.tc.gc.ca/recalls .

French: www.tc.gc.ca/rappels .

For additional road safety information, visit the Road Transportation website:

English: www.tc.gc.ca/en/services/road .

French: www.tc.gc.ca/fr/services/routier .

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1.06 California Lemon Law

Freightliner Custom Chassis Corporation is participating in California's new Lemon Law Arbitration Certification Program (*see* California Code of Civil Procedure 871.20-.30).

Consumers participating in this program may provide the notice required by California Code of Civil Procedure 871.24(a) by:

Email: californiapresuitnotice@daimlertruck.com.

Certified or registered mail:
Freightliner Custom Chassis Corporation
Attn: California Pre-suit Notice
552 Hyatt Street

Gaffney, SC 29341

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2. Vehicle Identification

2.01 Component Information Label

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

The component information label lists the manufacturer, month and year of manufacture, vehicle identification number (VIN), gross vehicle weight rating (GVWR), front and rear gross axle weight ratings (GAWR), and tire and wheel information. It also indicates if the vehicle has been certified as compliant with Federal Motor Vehicle Safety Standard (FMVSS). See Fig.1,Component Information Label.



Fig 1, Component Information Label

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

Incomplete vehicles intended for service in the U.S. have an incomplete vehicle certification label attached by the final-stage manufacturer. This label will be attached to the incomplete vehicle document included with the vehicle, and certifies that the vehicle conforms to all applicable FMVSS regulations in effect on the date of completion.

2.02 Vehicle Identification Number (VIN)

The chassis vehicle identification number is permanently attached to the chassis in the engine compartment (depending on vehicle options, usually on the metal panel where the steering driveline enters the engine compartment). See Fig. 2,Vehicle Identification Number (VIN) Label. The last six digits are the chassis serial number. The chassis number is stamped on the left frame rail, over the front axle. A VIN label is also mounted by the body builder. Mounting locations vary, to include the glove box. See Fig.3,Vehicle Identification Number Label, Typical.



Fig 2, Vehicle Identification Number (VIN) Label

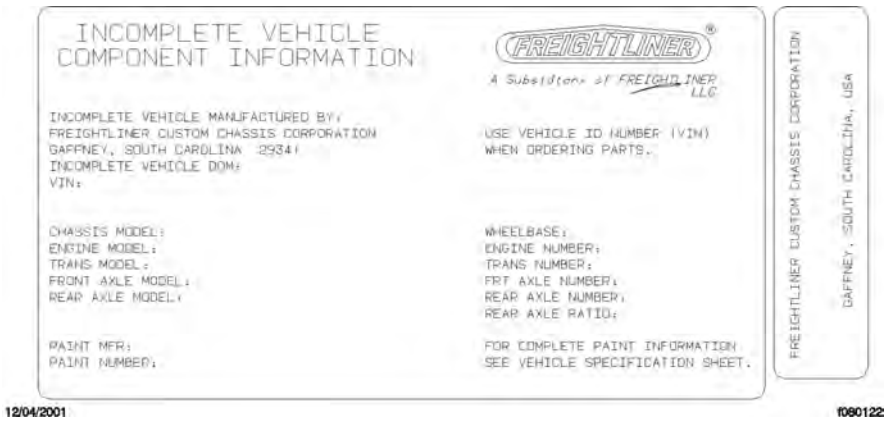


Fig 3, Vehicle Identification Number Label, Typical

NOTE: Always include the chassis serial number (last six digits of the VIN) when communicating with Daimler Truck North America.

2.03 Emissions Labels

2.03.01 Aftertreatment System Indicators Label

Model year 2007 and later diesel engines in vehicles domiciled in the U.S. or Canada are required to meet all EPA exhaust gas emission regulations effective as per the applicable emission model year, and are equipped with an emission aftertreatment system (ATS). Vehicles domiciled outside of the U.S. and Canada may not have aftertreatment equipment, depending upon local statutory emissions guidelines.

A reference label included with the driver's documentation package contains important warning indicators in the instrument cluster that pertain to the ATS. See Fig.4,ATS Indicators. See Table.1,EPA Regulations and Table.2,Emission Regulations by Model Year for additional EPA information.

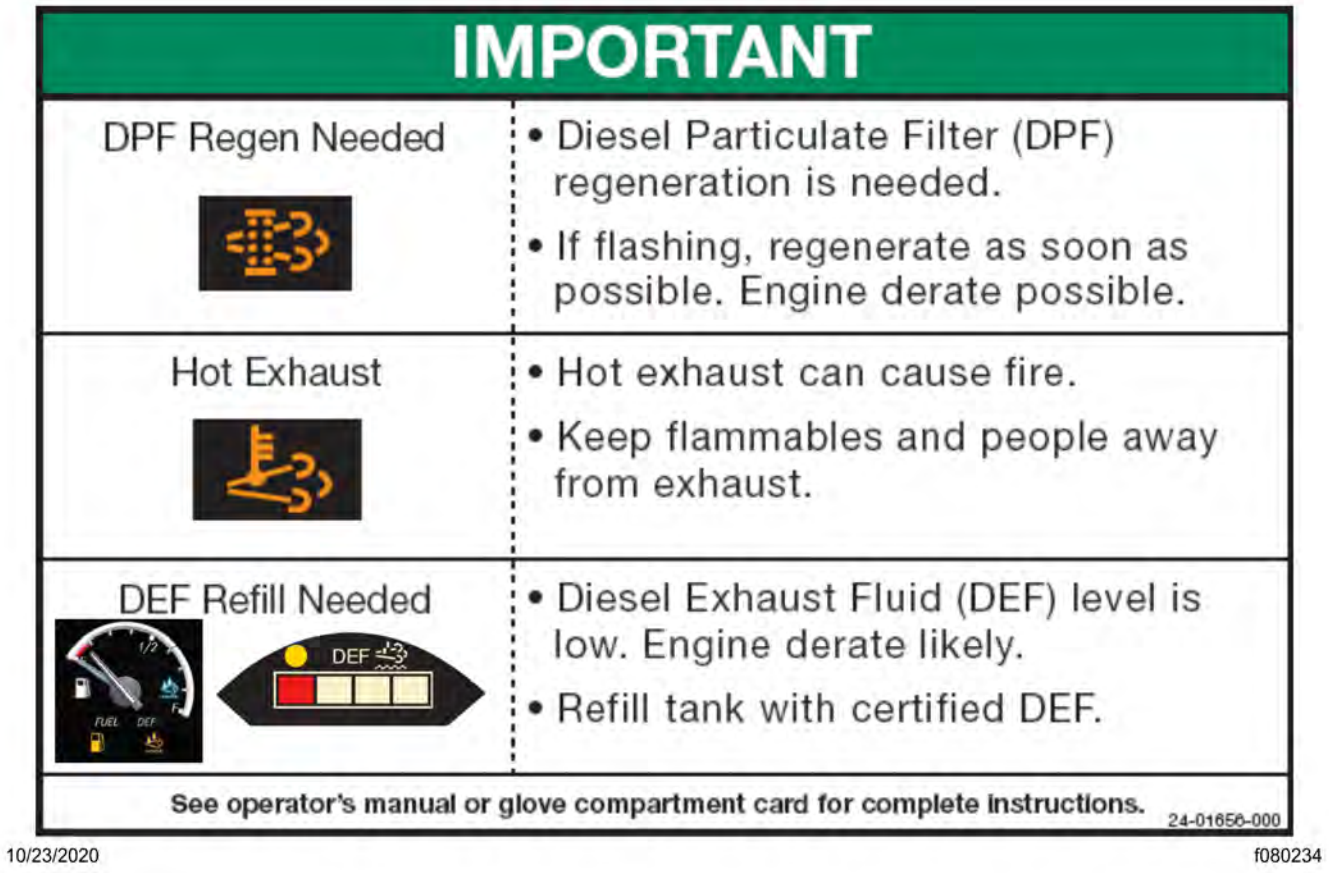


Fig 4, ATS Indicators

Table 1, EPA Regulations

EPA Regulations	
Regulation	**Emissions Components**
EPA07 (Reduction of nitrogen oxides (NOx) emissions to 1.1 g/bhp-hr, and particulate matter emissions to 0.01 g/bhp-hr)	Aftertreatment device (ATD) containing a diesel particulate filter that traps soot and ash.*
EPA10 (Reduction of NOx emissions to 0.2 g/bhp-hr)	EPA07-type ATD, with additional selective catalyst reduction (SCR) technology that utilizes diesel exhaust fluid (DEF) to convert NOx to nitrogen and water vapor.
GHG14 (Reduction of greenhouse gas emissions)	Fuel efficiency components including, but not limited to, engines, tires, aerodynamic components, vehicle speed limiters, and idle reduction timers specifically designed to meet regulatory fuel efficiency and greenhouse gas emissions standards.

GHG17	Fuel efficiency components including, but not limited to, engines, tires, aerodynamic components, vehicle speed limiters, and idle reduction timers specifically designed to meet regulatory fuel efficiency and greenhouse gas emissions standards.
GHG21	GHG14/17 components plus additional components including, but not limited to, transmissions, axles, predictive technologies, idle reduction technologies for vocational vehicles, tire pressure monitoring systems.

Table 1, EPA Regulations

* Cummins, Detroit, and Mercedes-Benz ATD's are also equipped with a diesel oxidation catalyst to break down pollutants.

Table 2, Emission Regulations by Model Year

Emission Regulations by Model Year		
Model Year	**Engine Regulation**	**Vehicle Regulation**
2007–2009	EPA07	N/A
2010–2012	EPA10	N/A
2013–2015	EPA10, GHG14	GHG14
2016	EPA10, GHG17	GHG14
2017–2020	EPA10, GHG17	GHG17
2021–and later	EPA10, GHG21	GHG21

Table 2, Emission Regulations by Model Year

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

2.03.02 Vehicle Emission Control Information Label

Model year 2013 and later vehicles meet requirements as specified by GHG14, GHG17 and GHG21 regulations, respectively. These vehicles are equipped with components that increase fuel efficiency and reduce greenhouse gas (GHG) emissions. Components may include, but are not limited to, low-rolling resistance tires; aerodynamic devices such as hood, vehicle speed limiters; and idle shutdown timers.

A Vehicle Emission Control Information Label indicates compliance with emission regulations. See Fig. 5,Vehicle Emission Control Information Label. Among other GHG relevant information the label indicates the emission model year of the vehicle. It is the owner's responsibility to maintain the vehicle so that it conforms to EPA and National Highway Traffic Safety Administration (NHTSA) regulations.

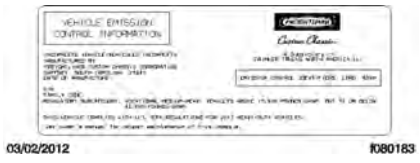


Fig 5, Vehicle Emission Control Information Label

Table 3, EPA Regulations

EPA Regulations	
Regulation	**Emissions Components**
EPA07 (Reduction of nitrogen oxides (NOx) emissions to 1.1 g/bhp-hr, and particulate matter emissions to 0.01 g/bhp-hr)	Aftertreatment device (ATD) containing a diesel particulate filter that traps soot and ash.*
EPA10 (Reduction of NOx emissions to 0.2 g/bhp-hr)	EPA07-type ATD, with additional selective catalyst reduction (SCR) technology that utilizes diesel exhaust fluid (DEF) to convert NOx to nitrogen and water vapor.
GHG14 (Reduction of greenhouse gas emissions)	Fuel efficiency components including, but not limited to, engines, tires, aerodynamic components, vehicle speed limiters, and idle reduction timers specifically designed to meet regulatory fuel efficiency and greenhouse gas emissions standards.
GHG17	Fuel efficiency components including, but not limited to, engines, tires, aerodynamic components, vehicle speed limiters, and idle reduction timers specifically designed to meet regulatory fuel efficiency and greenhouse gas emissions standards.
GHG21	GHG14/17 components plus additional components including, but not limited to, transmissions, axles, predictive technologies, idle reduction technologies for vocational vehicles, tire pressure monitoring systems.

Table 3, EPA Regulations

* Cummins, Detroit, and Mercedes-Benz ATD's are also equipped with a diesel oxidation catalyst to break down pollutants.

Table 4, Emission Regulations by Model Year

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Model Year	**Engine Regulation**	**Vehicle Regulation**
2007–2009	EPA07	N/A
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2013–2015	EPA10, GHG14	GHG14
2016	EPA10, GHG17	GHG14
2017–2020	EPA10, GHG17	GHG17
2021–and later	EPA10, GHG21	GHG21

Table 4, Emission Regulations by Model Year

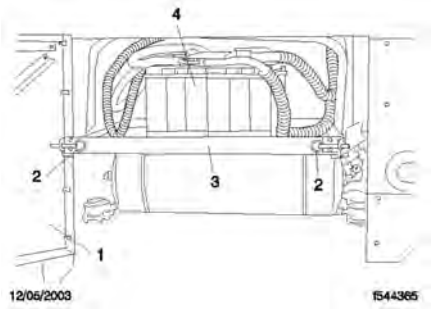
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3. Vehicle Access

3.01 Battery Access

3.01.01 Battery Compartment

The battery compartment is located behind the driver's area, attached to the frame rail. To open the battery access door, insert and turn the key, then pull the access door open. Pull the pull-pin spring latches out to slide the battery tray forward. See Fig.6,Battery Access.



1. Battery Access Door
2. Pull-Pin Spring Latch
3. Battery Tray
4. Battery

Fig 6, Battery Access

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

To return the battery to the compartment, slide the battery tray in until the pin spring latch is in the locked position. Lock the battery access door with the key.

3.01.02 Battery Disconnect Switch, Optional

A battery disconnect switch, if so equipped, cuts off all battery power to the vehicle. It is also used whenever the vehicle is placed out of service for extended periods to prevent battery discharge. The battery disconnect switch is located on the side of the battery box. See Fig.7,Battery Disconnect Switch.

NOTICE:

The batteries must be disconnected if the vehicle is not in use for a period exceeding two weeks, or the vehicle may not start, and permanent battery damage could occur.

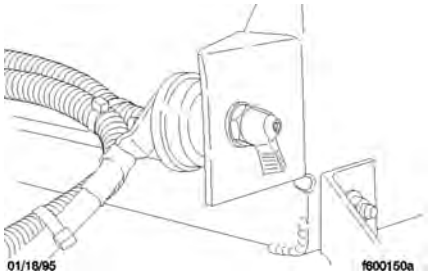


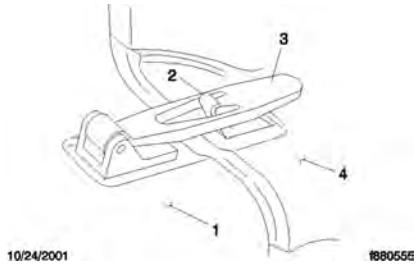
Fig 7, Battery Disconnect Switch

3.02 Opening and Closing of the Hood

3.02.01 Tilting the Hood

A torsion spring helps to raise and lower the hood. Hood restraint cables prevent the hood from overtravel. An optional hood damper limits the closing speed. In the operating position, the hood is secured to the half-fenders by a hold-down latch on each side.

1. Apply the parking brakes.
2. Release both hood hold-down latches by pulling the ends outward. See Fig.8,Hood Hold-Down Latch.



1. Fender
2. Latch Hook
3. Latch Handle
4. Half-Fender

Fig 8, Hood Hold-Down Latch

NOTICE:
Do not let the hood free-fall to the fully open position. To do so could damage the hood or hood straps.

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

3.02.02 Closing the Hood

A torsion spring helps to raise and lower the hood. Hood restraint cables prevent the hood from overtravel. An optional hood damper limits the closing speed. In the operating position, the hood is secured to the half-fenders by a hold-down latch on each side.

1. Push the hood over center.

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

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

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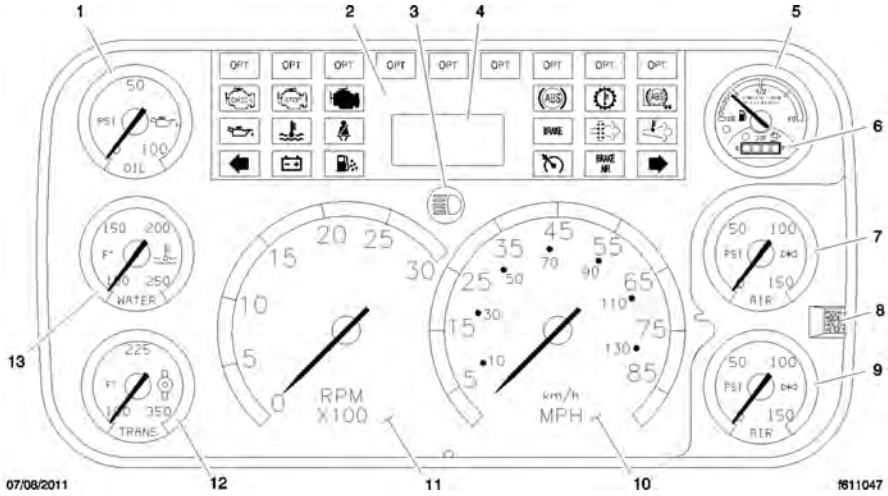
4. Instruments

4.01 Instrumentation Control Unit

4.01.01 General Description

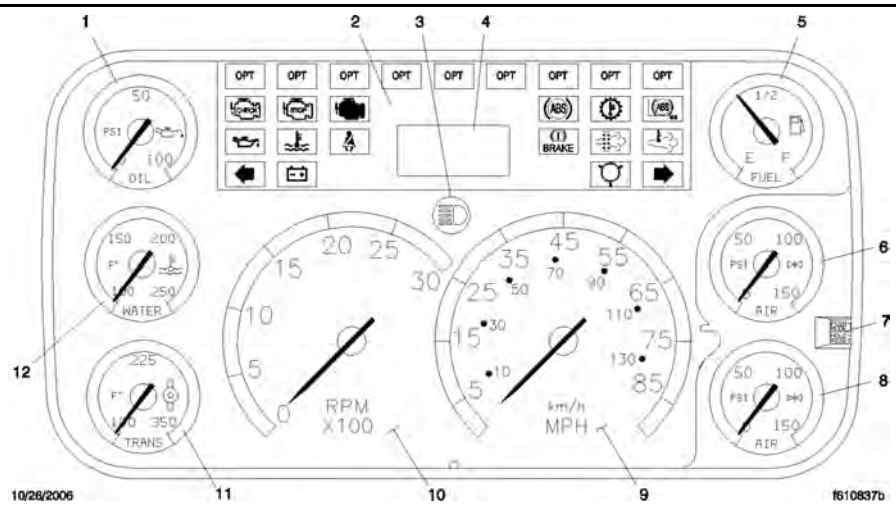
See Fig.9,Gauge Layout (typical, U.S.), EPA10 and Newer Engines and Fig. 10,Gauge Layout (typical, U.S.), EPA07-Compliant for a typical set of instruments for vehicles equipped with the S2 Chassis ICU3 instrument cluster.

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. Dash Message Center
3. Headlight High-Beam Indicator
4. Dash Driver Display Screen
5. Fuel Level Gauge
6. Diesel Exhaust Fluid (DEF) Gauge
7. Primary Air Pressure Gauge
8. Mode/Reset Switch
9. Secondary Air Pressure Gauge
10. Speedometer
11. Tachometer
12. Transmission Temperature Gauge
13. Coolant Temperature Gauge

Fig 9, Gauge Layout (typical, U.S.), EPA10 and Newer Engines



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

Fig 10, Gauge Layout (typical, U.S.), EPA07-Compliant

The ICU3 instrument cluster receives information from the datalink and sensors installed on the vehicle, and sends that information to electronic gauges.

There can be up to eight gauges on the driver's instrument panel (six electronic and two mechanical). Only the air gauges operate mechanically.

The S2 Chassis instrument clusters have the capability to drive independent stand-alone gauges such as those installed on the auxiliary dash panel.

4.01.02 Dash Message Center

The dash message center houses all of the standard and optional warning and indicator lamps. Warning messages and diagnostic fault codes will appear in the driver display screen.

4.01.03 Ignition Sequence

When the ignition is turned on, all the electronic gauges complete a full sweep of their dials, the warning and indicator lamps illuminate, and the buzzer sounds for 3 seconds.

NOTE: The air gauges do not sweep.

The following lamps illuminate during the ignition sequence:

- fasten seat belt warning
- low battery voltage warning
- high coolant temperature warning
- low engine oil pressure warning
- low air pressure warning
- parking brake on indicator
- all engine indicator/warning lights, including check engine and stop engine
- all ABS indicator/warning lights, including wheel spin, and tractor ABS (if installed)

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

When the ignition switch is turned on, the ICU performs a self-test, looking for active faults. During the first half of the self-test, all segments of the display illuminate as follows:

- First line (odometer): 888888.8
- Second line (units): TRIP MI KM HOURS
- Third line (voltmeter): 38.8 VOLTS
- Fourth line: SERVICE ENGINE

During the second half of the self-test, the software revision level is displayed.

If there are no active faults, the driver display screen displays the odometer.

If however, the instrument cluster has received active fault codes from other devices, it displays them one after the other until the parking brake is released, or the ignition switch is turned off. Once the parking brake is released, the dash message center displays the odometer again.

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

If the fault requires immediate attention, the stop engine system will activate. In most cases, the check engine lamp will also illuminate.

Some examples include:

- high coolant temperature
- low air pressure
- low coolant level
- low engine oil pressure

NOTE: The check engine lamp does not illuminate for a low air pressure fault.

The legend SERVICE ENGINE can appear on the driver display screen as an active fault code. If this legend appears, it means the trip miles (or hours) have gone beyond the next required service interval, as set by the vehicle operator.

IMPORTANT: If the legend SERVICE ENGINE does appear on the driver display screen while operating the vehicle, bring the vehicle to an authorized Freightliner service facility when convenient.

4.01.04 Odometer

The odometer is a seven-digit display with a decimal point, until the vehicle has traveled 999,999.9 miles or kilometers (km). At one million miles (km), the odometer resets itself to 1,000,000, without the decimal point, and can continue up to 9,999,999. The odometer only displays significant figures (no leading zeros).

The odometer is set to display in either miles or kilometers, depending on the primary scale of the speedometer. The legend, either MI or KM, illuminates between the odometer and the volts display when the engine is running or the headlights are turned on.

4.01.05 Mode/Reset Switch

The mode/reset switch, shown in Fig.11,Mode/Reset Switch, is located on the right side of the instrument cluster. The mode/reset switch is used to scroll through the displays on the message display screen, and to reset the trip distance and trip hours values to zero.



Fig 11, Mode/Reset Switch

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

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

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

4.02 Warning and Indicator Lamps

4.02.01 General Description

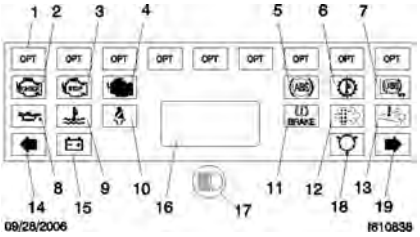
There can be up to 27 warning and indicator lamps (telltales) installed in the dash message center. See Fig. 12,ICU3 Warning and Indicator Lights, EPA10 and Newer Engines and Fig. 13,Warning and Indicator Lights, EPA07-Compliant.

The instrument cluster has an emergency buzzer that sounds when serious conditions that require immediate attention occur.



1. Optional Indicator
2. Check Engine Warning
3. Stop Engine Warning
4. Malfunction Indicator Lamp (MIL)
5. ABS Warning
6. Transmission Overheat Warning
7. Trailer ABS Indicator (not used)
8. Low Oil Pressure Warning
9. High Coolant Temperature Warning
10. Fasten Seat Belt Warning
11. Parking Brake On Warning
12. Diesel Particulate Filter (DPF) Lamp
13. High Exhaust System Temperature (HEST) Lamp
14. Left-Turn Indicator
15. Low Battery Voltage Warning
16. Water In Fuel Indicator
17. Dash Driver Display Screen
18. Headlight High-Beam Indicator
19. Cruise Control Indicator
20. Low Air Pressure Warning
21. Right-Turn Indicator

Fig 12, ICU3 Warning and Indicator Lights, EPA10 and Newer Engines



1. Optional Indicator
2. Check Engine Warning
3. Stop Engine Warning
4. Malfunction Indicator Lamp
5. ABS Warning
6. Transmission Overheat Warning
7. Trailer ABS Indicator (not used)
8. Low Oil Pressure Warning
9. High Coolant Temperature Warning
10. Fasten Seat Belt Warning
11. Parking Brake On Warning
12. Diesel Particulate Filter (DPF) Lamp
13. High Exhaust System Temperature (HEST) Lamp
14. Left-Turn Indicator
15. Low Battery Voltage Warning
16. Dash Driver Display Screen
17. Headlight High-Beam Indicator
18. Low Air Pressure Warning
19. Right-Turn Indicator

Fig 13, Warning and Indicator Lights, EPA07-Compliant

A description of the standard warning and indicator lamps are listed below.

4.02.02 Check Engine Warning

The check engine warning indicator illuminates when certain faults are detected. If a critical engine condition exists (for example, low oil pressure or high coolant temperature), the check engine indicator will illuminate to alert the driver to correct the condition as soon as possible. If the condition gets worse, the stop engine indicator will illuminate.

NOTE: If the check engine indicator illuminates during vehicle operation, take the vehicle directly to an authorized Freightliner service facility.

4.02.03 Stop Engine Warning

The stop engine warning indicator illuminates when the protection system available for the engine has been activated. On some engines, the engine electronic control unit (ECU) will derate the engine, allowing it to run, but at lower rpm and slower vehicle speed. The vehicle may be driven to a safe location.

The engine ECU will derate the engine. The driver must safely bring the vehicle to a stop on the side of the road.

NOTICE:

Because operating the engine when the stop engine indicator is illuminated can lead to severe engine damage, the driver must move the vehicle to a safe location as quickly as possible.

To restart the engine turn the ignition switch to OFF, leave it there a few seconds, and turn the switch to START.

IMPORTANT: Do not attempt to restart the engine while the vehicle is moving. Bring the vehicle to a safe stop and restart the engine with the vehicle stopped.

4.02.04 Malfunction Indicator Lamp (MIL)

The malfunction indicator lamp (MIL) indicates an engine emissions-related fault. See the engine operation manual for details.

4.02.05 ABS Warning

The ABS indicator illuminates when there is a malfunction in the vehicle antilock brake system (ABS).

NOTE: For more information about this indicator and the ABS system, see .

4.02.06 Transmission Overheat Warning

The transmission overheat indicator illuminates when the temperature of the transmission fluid goes above the preset level set by the transmission manufacturer.

For more information, see the transmission manufacturer's manual provided with the vehicle.

4.02.07 Low Oil Pressure Warning

The low oil pressure warning indicator and emergency buzzer activate whenever the engine oil pressure goes below the preset minimum specified by the engine manufacturer. See Table.5,Oil Pressure Specifications.

Table 5, Oil Pressure Specifications

Oil Pressure Specifications [1]		
Engine Model	**Pressure at Idle RPM**	**Pressure at Rated RPM**
Mercedes-Benz MBE900 [2]	50 psi (345 kPa)	50 psi (345 kPa)
Cummins ISB	10 psi (69 kPa)	30 psi (207 kPa)

1. 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.
2. EPA07 MBE900 engines are equipped with an oil pressure switch. When above minimum pressure, the dash gauge will display the values listed in this table. If below minimum oil pressure, the dash gauge will read 0 psi.

Table 5, Oil Pressure Specifications

4.02.08 High Coolant Temperature Warning

The high coolant temperature indicator and emergency buzzer activate whenever the coolant temperature goes above a preset maximum specified by the engine manufacturer. See Table.6,Maximum Coolant Temperature.

Table 6, Maximum Coolant Temperature

Maximum Coolant Temperature	
Engine Model	**°F (°C)**
Mercedes-Benz MBE900	221 (105)
Cummins ISB	220 (104)

Table 6, Maximum Coolant Temperature

4.02.09 Fasten Seat Belt Warning

The fasten seat belt warning indicator (seat belt icon) illuminates for 3 seconds after the ignition switch is turned on.

When the engine is operating, if the driver's seat belt is unfastened and the park brake is not set, the seat belt warning indicator illuminates and a warning chime activates. The warning chime will remain active for 10 seconds. The warning indicator remains illuminated until the driver's seat belt is fastened.

4.02.10 Parking Brake On Warning

The parking brake on indicator activates when the parking brake is engaged.

If the vehicle is moving at a speed of 2 mph (3 km/h) or more, the emergency buzzer will sound until the parking brake is released.

4.02.11 Diesel Particulate Filter (DPF) Lamp

A solid illumination indicates a regeneration is required. Change to a more challenging duty cycle, such as highway driving, to raise exhaust temperatures for at least 20 minutes, or perform a stationary regeneration. See the engine operator's manual for details.

A blinking lamp indicates that a stationary regeneration is required immediately. An engine derate and shutdown will occur. See the instructions in the engine operator's manual to perform a stationary regeneration.

4.02.12 High Exhaust System Temperature (HEST) Lamp

The high exhaust system temperature (HEST) lamp alerts the operator of high exhaust temperature during the regen process when the speed is below 5 mph (8 km/h), or during a manual regen. The HEST lamp does not signify the need for any kind of vehicle or engine service; it only alerts the vehicle operator to high exhaust temperatures.

IMPORTANT: Make sure the engine exhaust pipe outlet is not directed at any person, or at any surface or material that will melt, burn, or explode.

4.02.13 Left-Turn Indicator

The left-turn indicator flashes on and off when the left-turn signal lights are flashing.

Both turn signal indicators flash when the hazard warning flasher is turned on.

4.02.14 Low Battery Voltage Warning

The low battery voltage warning indicator (battery icon) illuminates when the battery voltage drops below 12 volts.

4.02.15 Water In Fuel Indicator

The water in fuel indicator notifies the driver the fuel may contain water. Drain any water collected in the fuel/water separator.



NOTICE:

Water in the fuel/water separator will appear as beads. With the engine off, drain the separator only enough to remove the water; about two teaspoons at a time. Do not drain the separator completely or it will be necessary to prime the fuel system before the vehicle can be started again.

4.02.16 Headlight High-Beam Indicator

The high-beam indicator (sideways beam icon) illuminates when the headlight high beams are on.

4.02.17 Cruise Control Indicator

The cruise control indicator illuminates when the cruise control is activated.

4.02.18 Low Air Pressure Warning

The low air pressure warning indicator (BRAKE icon) and emergency buzzer activate when the engine is turned on if air pressure in the primary or secondary air reservoir is below 65 to 75 psi (448 to 517 kPa), and remain on until air pressure rises above that level in both reservoirs.

4.02.19 Right-Turn Indicator

The right-turn indicator flashes on and off when the right-turn signal lights are flashing.

Both turn signal indicators flash when the hazard warning flasher is turned on.

4.02.20 Emergency Buzzer

The emergency buzzer sounds during the ignition sequence and whenever one of the following conditions exists:

- The engine oil pressure falls below the preset level shown in Table.8,Oil Pressure Specifications.
- The coolant temperature rises above the preset level shown in Table.7,Maximum Coolant Temperature.
- The air pressure falls below the preset level, which is 65 psi (448 kPa).
- The parking brake is set with the vehicle moving at a speed greater than 2 mph (3 km/h).

Table 7, Maximum Coolant Temperature

Maximum Coolant Temperature	
Engine Model	**°F (°C)**
Mercedes-Benz MBE900	221 (105)
Cummins ISB	220 (104)

Table 7, Maximum Coolant Temperature

Table 8, Oil Pressure Specifications

Oil Pressure Specifications [1]		
Engine Model	**Pressure at Idle RPM**	**Pressure at Rated RPM**
Mercedes-Benz MBE900 [2]	50 psi (345 kPa)	50 psi (345 kPa)
Cummins ISB	10 psi (69 kPa)	30 psi (207 kPa)

1. 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.
2. EPA07 MBE900 engines are equipped with an oil pressure switch. When above minimum pressure, the dash gauge will display the values listed in this table. If below minimum oil pressure, the dash gauge will read 0 psi.

Table 8, Oil Pressure Specifications

4.02.21 Optional Warning and Indicator Lamps

A description of some commonly used optional warning and indicator lamps are listed below.

Air Filter Warning

The air filter warning indicator (AIR FILTER legend) illuminates when the air cleaner filter element is clogged, restricting the intake air flow. See Table.9,Air Intake Maximum Restriction Values (inH $_2$O).

If the air filter indicator light is steadily illuminated for any period of time, check the air intake restriction gauge. If needed, replace the air filter, and reset the air intake restriction gauge.

Table 9, Air Intake Maximum Restriction Values (inH ²O)

Air Intake Maximum Restriction Values (inH ²O)		
Engine	**Pre-EPA07 Engines**	**EPA07 and Newer Engines**
Cummins	25	25
Mercedes-Benz	22	22

Table 9, Air Intake Maximum Restriction Values (inH ²O)

IMPORTANT: Never attempt to clean the air filter.

Alternator No Charge Indicator

The alternator no charge indicator lamp (NO CHARGE legend) illuminates when the alternator is not charging properly.

Check Transmission Warning (diesel engine only)

NOTE: Although it appears in the row of optional indicators, the check transmission indicator is a standard indicator.

The check transmission indicator, shown in Fig.14,Check Transmission Indicator, notifies the driver of three things. Any of the following items could be the cause for activating the indicator:

- the oil needs to be changed
- the filter(s) need to be changed
- clutch maintenance is required

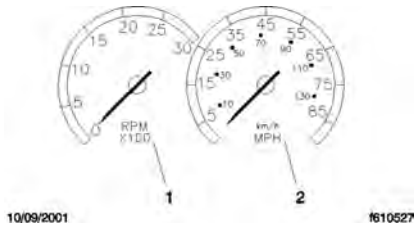


Fig 14, Check Transmission Indicator

When the check transmission indicator illuminates, refer to the **Allison Operator's Manual** or contact customer support at Allison Transmission to determine the specific cause activating the indicator.

4.03 Speedometer

Three kinds of speedometer faces 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. See Fig.15,Speedometer and Tachometer.



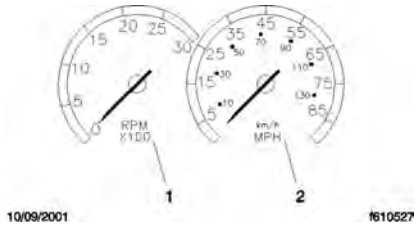
1. Tachometer
2. Speedometer

Fig 15, Speedometer and Tachometer

The NAFTA version (not shown) of the speedometer face reverses this arrangement, with km/h in larger numbers. The metric only version (not shown) shows km/h exclusively.

4.04 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. See Fig.16,Speedometer and Tachometer.



1. Tachometer
2. Speedometer

Fig 16, Speedometer and Tachometer

4.05 Standard Instruments

4.05.01 Engine Oil Pressure Gauge

NOTICE:

A sudden decrease or absence of engine 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.

See Fig.17,Engine Oil Pressure Gauge for an example of the engine oil pressure gauge. If the engine oil pressure falls below the preset levels shown in Table.10,Oil Pressure Specifications, first the check engine lamp will illuminate, and, if the condition does not improve, the stop engine lamp will also illuminate and the buzzer will sound. At this point, the engine will derate or shut down, depending on the type of engine protection system installed.

Table 10, Oil Pressure Specifications

Oil Pressure Specifications [1]		
Engine Model	**Pressure at Idle RPM**	**Pressure at Rated RPM**
Mercedes-Benz MBE900 [2]	50 psi (345 kPa)	50 psi (345 kPa)
Cummins ISB	10 psi (69 kPa)	30 psi (207 kPa)

1. 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.
2. EPA07 MBE900 engines are equipped with an oil pressure switch. When above minimum pressure, the dash gauge will display the values listed in this table. If below minimum oil pressure, the dash gauge will read 0 psi.

Table 10, Oil Pressure Specifications



Fig 17, Engine Oil Pressure Gauge

4.05.02 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 should read 175 to 195°F (79 to 91°C). See Fig. 18,Coolant Temperature Gauge. If the temperature remains below 160°F (71°C), or exceeds the maximum temperature shown in Table.11,Maximum Coolant Temperature, inspect the cooling system to determine the cause. See General Information, Cooling System Troubleshooting of the **S2 Chassis Workshop Manual**.



Fig 18, Coolant Temperature Gauge

Table 11, Maximum Coolant Temperature

Maximum Coolant Temperature	
Engine Model	**°F (°C)**
Mercedes-Benz MBE900	221 (105)
Cummins ISB	220 (104)

Table 11, Maximum Coolant Temperature

If the coolant temperature rises above the preset levels shown in Table.11,Maximum Coolant Temperature, first the check engine warning indicator will illuminate, and, if the condition does not improve, the stop engine warning indicator will also illuminate and the buzzer will sound. At this point, the engine will derate or shut down, depending on the type of engine protection system installed.

4.05.03 Drive Axle Oil Temperature Gauges

NOTICE:

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

During normal operation, the drive axle oil temperature gauges should read as follows:

- 160 to 220°F (71 to 104°C) for Detroit Classic Model 2, 4, and 6 axles.
- 160 to 275°F (71 to 135°C) for Meritor™ drive axles.
- 180 to 200°F (82 to 93°C) for Dana Spicer® drive axles.

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 19, Drive Axle Oil Temperature Gauge (rear drive axle gauge shown)

4.05.04 Fuel/Diesel Exhaust Fluid (DEF) Gauge

For engines that are EPA10-compliant or newer, the fuel and DEF levels are measured in a dual purpose fuel/DEF gauge. See Fig.20,Fuel/DEF Gauge, EPA10.

The diesel fuel level is indicated at the top of the gauge, with a low-level warning lamp that illuminates when the diesel fuel level registers 1/8th of capacity. One fuel gauge is standard. If equipped with a second (optional) fuel gauge, each fuel tank level is indicated on a separate gauge.

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



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 20, Fuel/DEF Gauge, EPA10

Fig.21,Fuel Level Gauge, EPA07 Vehicles shows a fuel gauge installed on EPA07 vehicles.



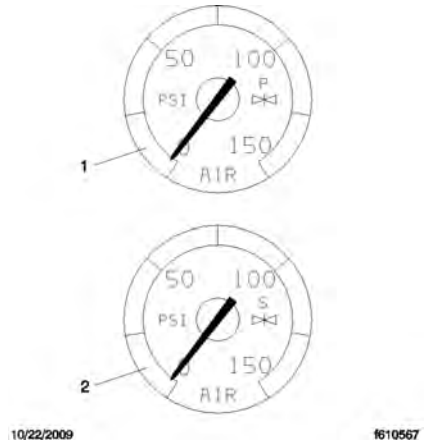
Fig 21, Fuel Level Gauge, EPA07 Vehicles

4.05.05 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 register the pressure in the primary and secondary air systems. Normal pressure with the engine running is 100 to 120 psi (690 to 827 kPa) in both systems. See Fig.22,Air Pressure Gauges.



1. Primary Air Pressure Gauge
2. Secondary Air Pressure Gauge

Fig 22, Air Pressure Gauges

Air pressure gauges are required on all vehicles with air brakes. A low-air-pressure warning lamp and buzzer, connected to both the primary and secondary systems, activate when air pressure in either system drops below a minimum pressure of 65 to 75 psi (448 to 517 kPa).

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

4.05.06 Voltmeter

The voltmeter is a digital readout located on the bottom line of the driver display screen whenever the ignition switch is turned on.

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

The voltmeter will normally show approximately 13.7 to 14.1 volts when the engine is running. The voltage of a fully charged battery is 12.7 to 12.8 volts when the engine is stopped. Battery voltage under 12.0 volts is considered a low battery, and a completely discharged battery will produce only about 11.0 volts. The voltmeter will indicate lower voltage as the vehicle is being started or when electrical devices in the vehicle are being used.

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

4.06 Optional Instruments

4.06.01 Air Intake Restriction Gauge

Optional instruments are not found on every vehicle. They are stand-alones, not driven by the instrument cluster, and are usually located on the auxiliary dash panel. They are listed here in alphabetical order, to make the information easier to find.

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.23,Air Intake Restriction Indicator. As an option for easier viewing, the intake-air restriction indicator can be mounted on the dash, usually on the right-hand control panel.



Fig 23, Air Intake Restriction Indicator

Air intake restriction vacuum is measured in inches of water (in^{H2O}). 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 25 in ^{H2O}, the air cleaner element needs to be replaced.

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

4.06.02 Ammeter

Optional instruments are not found on every vehicle. They are stand-alones, not driven by the instrument cluster, and are usually located on the auxiliary dash panel. They are listed here in alphabetical order, to make the information easier to find.

An optional ammeter measures current flowing to and from the battery. See Fig.24,Ammeter. When the batteries are being charged, the meter needle moves to the plus side of the gauge; when the batteries are being discharged, the needle moves to the minus side. A consistent negative reading when the engine is running indicates a possible problem with the charging system.

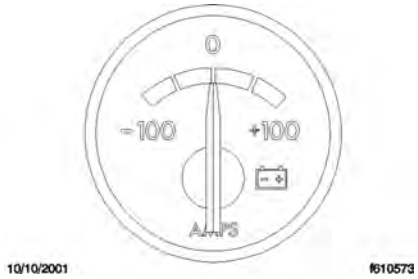


Fig 24, Ammeter

4.06.03 Axle Oil Temperature Gauge, Rear

Optional instruments are not found on every vehicle. They are stand-alones, not driven by the instrument cluster, and are usually located on the auxiliary dash panel. They are listed here in alphabetical order, to make the information easier to find.

NOTICE:

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

During normal operation, the optional rear axle oil temperature gauge should read between 160 and 220°F (71 and 104°C) for Detroit and Meritor drive axles. See Fig.25,Axle Oil Temperature Gauge.



Fig 25, Axle Oil Temperature Gauge

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

4.06.04 Digital Clock

Optional instruments are not found on every vehicle. They are stand-alones, not driven by the instrument cluster, and are usually located on the auxiliary dash panel. They are listed here in alphabetical order, to make the information easier to find.

The optional digital clock has black characters on a constantly backlighted green display, with a brightness that automatically adjusts for day or night. The clock has a 24-hour alarm, with a three-minute snooze feature. See Fig.26,Digital Clock.



Fig 26, Digital Clock

1. To set the time of day:
   1.a Push the Run/Set (lower) switch to the right (TIME-SET position).

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

   1.b Advance the hour setting to the correct number by pushing and releasing the hour button as many times as needed. Or if the button is pressed and held in for longer than 2 seconds, the numbers will continue to advance until the button is released.
   1.c Advance the minute setting by repeatedly pushing, or pushing and holding the minute button as needed.
   1.d Push the Run/Set switch to the middle (RUN) position.
2. To set the alarm time:
   2.a Push the Run/Set switch to the left (ALARM-SET position).
   2.b Set the alarm time by using the same procedure used to set the time of day; remember to set the hour for AM (no letters in the corner of the display), or PM as desired.
   2.c Return the Run/Set switch to the middle (RUN) position; the readout will return to the time-of-day setting.
3. To operate the alarm:
   3.a With the alarm time set, push the alarm (upper) switch to the left. An alarm "wave" symbol and the letters AL will appear in the upper left corner of the display when the alarm is on.
   3.b When the displayed time of day coincides with the alarm time, the alarm will sound. If the SNOOZ button is not pushed or the alarm switch is not moved, the alarm will automatically stop sounding after 1 minute and will not sound again for 24 hours.
   3.c If desired, press the SNOOZ button while the alarm is sounding to shut the alarm off for 3 minutes. The alarm symbol will flash in the display when the button is pushed and will continue to flash until the alarm switch is moved or the alarm has sounded for one minute. The snooze procedure can be done as many times as desired.
   3.d Move the alarm switch to the right when you wish to shut off or cancel the alarm; the alarm symbol will disappear.

4.06.05 Engine Oil Temperature Gauge

Optional instruments are not found on every vehicle. They are stand-alones, not driven by the instrument cluster, and are usually located on the auxiliary dash panel. They are listed here in alphabetical order, to make the information easier to find.

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 should read in the following temperature range:

- 180 to 225°F (82 to 107°C) for Cummins ISB engines
- 177 to 203°F (81 to 95°C) for Mercedes-Benz MBE900 engines

NOTE: 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. See Fig.27,Engine Oil Temperature Gauge.

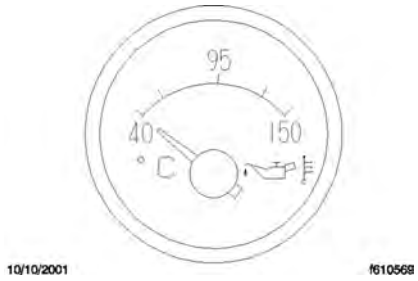


Fig 27, Engine Oil Temperature Gauge

4.06.06 Transmission Fluid Temperature Gauge

Optional instruments are not found on every vehicle. They are stand-alones, not driven by the instrument cluster, and are usually located on the auxiliary dash panel. They are listed here in alphabetical order, to make the information easier to find.

During normal operation, the transmission fluid temperature gauge reading should not exceed 250°F (121°C) at the sump. See Fig.28,Transmission Fluid Temperature Gauge.



Fig 28, 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.

NOTE: Under heavy loads, such as when climbing steep grades, temperatures may climb above those given here for limited periods.

4.06.07 Turbocharger Boost Pressure Gauge

Optional instruments are not found on every vehicle. They are stand-alones, not driven by the instrument cluster, and are usually located on the auxiliary dash panel. They are listed here in alphabetical order, to make the information easier to find.

A turbocharger boost pressure gauge measures the pressure in the intake manifold, in excess of atmospheric pressure, being created by the turbocharger. See Fig.29,Turbo Boost Pressure Gauge.

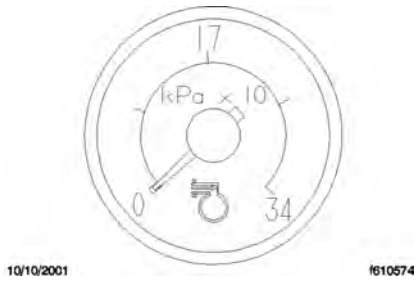


Fig 29, Turbo Boost Pressure Gauge

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5. Controls

5.01 Ignition Switch and Key

The ignition switch can be turned to four positions: ACCESSORY, OFF, ON, and START. See Fig. 30,Ignition Switch Positions.

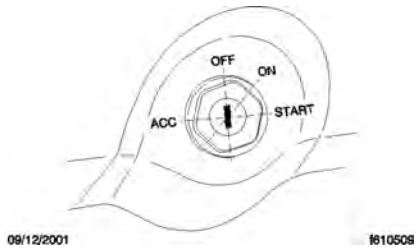


Fig 30, Ignition Switch Positions

The key can be inserted and removed only in the OFF position. The headlights (low beams), taillights, brake lights, road lights, clearance lights, turn signals, hazard warning lights, horn, CB radio, clock, and electric oil pan heater operate with the ignition switch in the OFF position, regardless of whether the key is inserted.

All of the components that are operable in the OFF position are operable in the ACCESSORY position, as well as the radio (if so equipped), mirror heat, air dryer, and backup lights.

Turn the key fully clockwise to the START position to start the engine. When the engine starts, release the key.

All electrical systems are operable in the ON position. The warning lights and the buzzer for low air pressure and low oil pressure operate until minimum pressures are built up.

5.02 Lighting Controls

5.02.01 General Description

The lighting controls are operated with two types of switches located on the dash:

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

5.02.02 Headlight/Parking Light Switch

The headlights and parking lights are operated with a paddle switch, shown in Fig.31,Headlight/Parking Light Switch. When the paddle is lowered, the parking lights (front turn signals, marker and identification lights, and the taillights) illuminate. When the paddle is raised, the low-beam headlights illuminate, along with all of the parking lights. To turn off all lights, return the paddle to the center position.



NOTE: Raise the paddle to illuminate the low-beam headlights.

Lower the paddle to illuminate the parking lights.

Fig 31, 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. A light in the switch backlights either the top icon (for headlights and parking lights) or the bottom icon (for parking lights only).

Daytime Running Lights

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

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

5.02.03 Panel Light Increase/Decrease Switch

When the panel lights are on, they can be brightened or dimmed by using the INCR/DECR switch, just below the headlight switch. When the panel lights are on, both legends of the switch are backlit. See Fig. 32,Panel Light Increase/Decrease Switch. Push the top of the switch to increase the panel brightness. Push the bottom of the switch to dim.



Fig 32, Panel Light Increase/Decrease Switch

5.02.04 Marker Lamp Interrupt Switch

The optional marker lamp interrupt (MRKR INT) paddle switch temporarily deactivates the marker lamps and taillights. See Fig.33,Marker Light Interrupt Switch.



NOTE: Raise the paddle to flash the marker lights.

Fig 33, Marker Light Interrupt Switch

With the vehicle lights on, raise and hold the paddle switch to briefly turn off the marker lamps and taillights. When the paddle switch is released the marker lamps and taillights return to normal operation. With the vehicle lights off, raise the paddle switch to momentarily turn the marker lamps and taillights on.

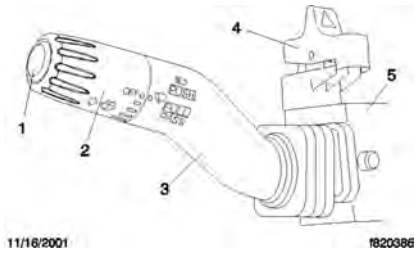
5.03 Multifunction Turn Signal Lever

5.03.01 General Description

The multifunction turn signal lever has the following functions:

- turn signals
- windshield wipers and washers
- high-beam headlights
- hazard warning lights

See Fig.34,Multifunction Turn Signal Lever for the multifunction switch and its component parts.



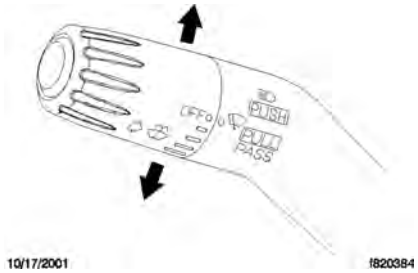
NOTE: Press down on the upper part of the rocker switch to activate the hazard warning lights.

1. Washer Button
2. Wiper Control Dial
3. Turn Signal Lever
4. Hazard Warning Light Rocker Switch (red)
5. Multifunction Switch Module

Fig 34, Multifunction Turn Signal Lever

5.03.02 Turn Signal Lever

Moving the multifunction turn signal lever down activates the left turn signal lights; moving it up activates the right turn signal lights. See Fig.35,Turn Signal Controls for an example of the multifunction turn signal lever.



NOTE: Move the lever down to activate the left turn signals.

Move the lever up to activate the right turn signals.

Fig 35, Turn Signal Controls

When a turn signal is activated, a green indicator arrow flashes at the far left or far right of the instrument 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.

5.03.03 Windshield Wiper/Washer Controls

NOTICE:
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, located on the end of the turn signal lever. See Fig. 36,Wiper/Washer Controls. There are five delay settings, marked on the dial by lines of increasing length, and two steady speed settings, LO and HI.

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

Rotating the control dial in the opposite direction (clockwise) reduces the speed of the wipers. 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 button at the very end of the turn signal lever. To operate the washers, press the button in and hold it.



NOTE: Rotate the control dial forward to turn the wipers on, or increase their speed.

Rotate the control dial backward to decrease the wipers speed, or turn them off.

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

Fig 36, Wiper/Washer Controls

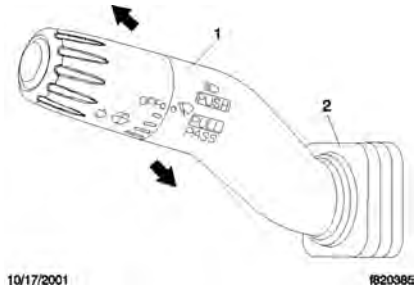
5.03.04 High-Beam Headlights

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

To activate the high-beam headlights, push the turn signal lever forward, towards the windshield. Pull the lever back to its original position to turn the high-beam headlights off. See Fig.37,Headlight High Beams. The low beams remain on during high beam operation.

When the high-beam headlights are on, a blue light illuminates on the instrument panel. For vehicles built for domicile in the United States, the road lights turn off when the high beams are activated.

To flash the high beams momentarily, pull the lever backward, towards the steering wheel.



Move the lever forward to activate the high-beam headlights. Move the lever back to its original position to turn the high-beam headlights off.

Move the lever back toward the steering wheel to flash the high beams momentarily.

1. Turn Signal Lever
2. Boot

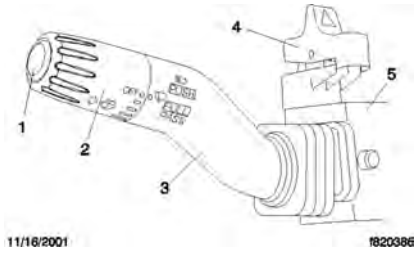
Fig 37, Headlight High Beams

Move the lever forward to activate the high-beam headlights. Move the lever back to its original position to turn the high-beam headlights off.

Move the lever back toward the steering wheel to flash the high beams momentarily.

5.03.05 Hazard Warning Lights

To activate the hazard warning lights, press down on the upper part of the rocker switch located on the top of the multifunction switch module (towards the dash). See Fig.38,Multifunction Turn Signal Lever. When the rocker switch is pushed down, all of the turn control lights will flash. To cancel the hazard warning lights, press down on the lower part of the rocker switch (towards the steering wheel).



NOTE: Press down on the upper part of the rocker switch to activate the hazard warning lights.

1. Washer Button
2. Wiper Control Dial
3. Turn Signal Lever
4. Hazard Warning Light Rocker Switch (red)
5. Multifunction Switch Module

Fig 38, Multifunction Turn Signal Lever

5.04 Aftertreatment System (ATS) Regen Switch

NOTE: Alternative fueled vehicles are not equipped with a regeneration (regen) switch.

A regen switch, located on the dash, allows the driver to control three states. See Fig.39,Regen Switch. These include:

- request regeneration
- default (automatic regeneration)
- inhibit regeneration



Fig 39, Regen Switch

See the engine operation manual for details on operation of the regen switch.

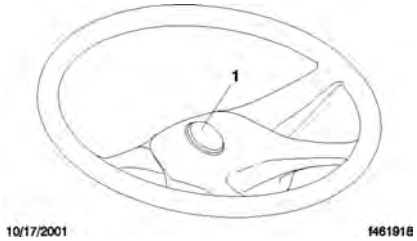
5.05 Horn Controls

5.05.01 Electric Horn

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

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

The button for the horn is located in the center of the steering wheel. To sound the horn, press the center of the steering wheel pad. See Fig.40,Electric Horn Control.



1. Horn Button

Fig 40, Electric Horn Control

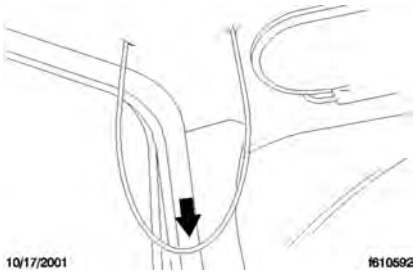
5.05.02 Air Horn

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

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

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.41,Air Horn Control. Pull downward on the lanyard to sound the air horn.



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

Fig 41, Air Horn Control

5.06 Cruise Control

5.06.01 Cruise Control Switch

WARNING:
Do not use the cruise control system when driving conditions do not permit maintaining a constant speed, such as 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.

NOTICE:

If equipped with a manual transmission, 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.

NOTE: Maximum cruise control speed varies according to vehicle specifications, but cannot be higher than 75 mph (121 km/h).



NOTE: To turn the 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 42, Cruise Control Switches, Dash-Mounted

On standard models, cruise control is activated by two dash switches. See Fig.42,Cruise Control Switches, Dash-Mounted. On some models, the 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 the 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.

1. To cruise at a particular speed:
   - 1.a Press the upper half of the On/Off rocker switch.
   - 1.b Hold the accelerator pedal down until the speedometer reaches the desired speed.
   - 1.c Momentarily lower the Set/Resume switch paddle.
2. To disengage the cruise control:
   - 2.a Depress the brake pedal (on automatic or manual transmission) **or**

     Depress the clutch pedal (on manual transmission only)
   - 2.b Press the lower half of the On/Off rocker switch.
3. To resume a preselected cruise speed:
   - 3.a If the On/Off rocker switch is off, turn it on.

3.b Momentarily raise the paddle of the Set/Resume switch to RES/ACC. 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, raise and hold the paddle of the Set/Resume switch to RES/ACC until the vehicle accelerates to the desired speed.
5. To adjust the cruise speed down, lower and hold the paddle of the Set/Resume switch to SET/CST until the vehicle decelerates to the desired speed.

NOTE: For more information about cruise control operation, see the engine manufacturer's service manual.

5.06.02 Fast Idle System

General Description

If the vehicle is equipped with this option, it is available for use only with cruise control. There are three preset speeds available: 800, 900, or 1000 rpm.

The fast idle system can be used to increase engine idle speed whenever the following conditions are met.

- The brake pedal is not pressed.
- The vehicle must not be moving and the throttle must not be pressed.

Operation of the Fast Idle

1. To enable the fast idle system, press and release the cruise control On/Off rocker switch.
2. For the preset fast idle, press and release the cruise control set switch. This will set the preset fast idle speed.

IMPORTANT: The fast idle system does not have any type of light activation in the instrument panel. The only light that will be illuminated is the cruise indicator.

Any of the following actions will turn off the fast idle system:

- Applying the brake.
- Moving the transmission shifter out of Park (P) or Neutral (N); this will engage the transmission.
- Pressing and releasing the cruise control On/Off rocker switch when it is on.

5.07 Powertrain Controls

5.07.01 Automatic Transmissions

General Description

For complete transmission operating instructions see 11.01 Driving Precautions.

Vehicles equipped with a standard Allison On-Highway series automatic transmission, have a T-handle shift selector. See Fig.43,T-Handle Shift Selector.

When the transmission is in D (drive), the vehicle will operate in 4th and 5th gear as needed. To shift down into a lower gear, pull the lower half of the T-handle selector up. Select the gear needed and release the lower half of the T-handle selector.

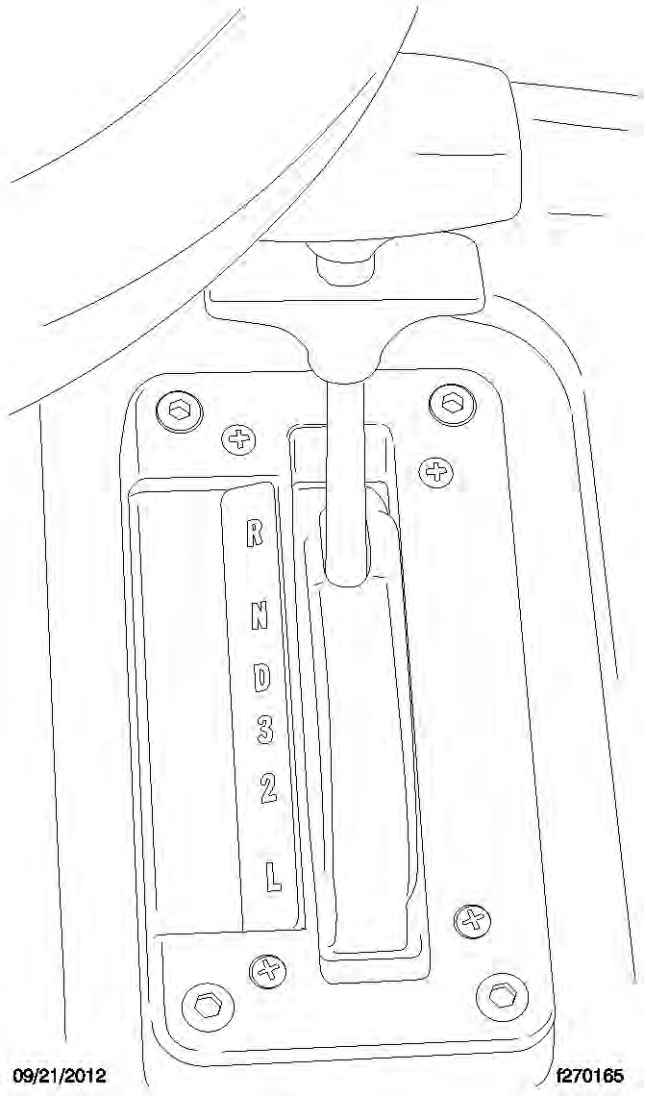
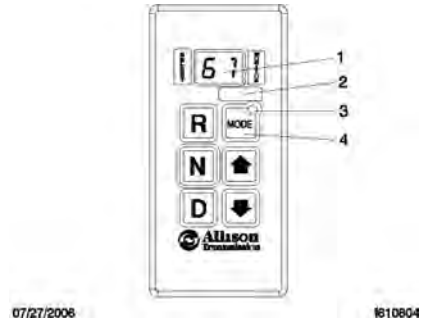


Fig 43, T-Handle Shift Selector

On vehicles with an Allison MD Series automatic transmission or an Eaton Autoshift automated transmission, a push-button shift selector, shown in Fig.44,Push-Button Shift Selector, provides four, five, or six forward ranges and one reverse range. See 11.01 Driving Precautions for more information about the push-button shift selector.



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

Fig 44, Push-Button Shift Selector

Transmission Mode Switch

For complete transmission operating instructions see 11.01 Driving Precautions.

Some vehicles are equipped with a transmission mode switch, shown in Fig.45,Transmission Mode Switch. The transmission mode switch is a fuel conservation option that allows the driver to choose either performance or economy shifting. When the switch is in the on position (the top of the rocker switch is pushed down), the transmission shift pattern changes from primary (performance) shift mode to secondary (economy) shift mode. When the transmission mode switch is in the off position (the bottom of the rocker switch is pushed down), the transmission reverts back to the primary shift mode.

NOTE: Primary and secondary shift mode calibration varies by vehicle.



Fig 45, Transmission Mode Switch

5.07.02 Axle Switches

Differential Lock Switch

All axle switches contain a red LED that illuminates the switch when it 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. For more information on axle switch function, see 12.01.01 Drive Axles With Differential Lock.

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

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

The optional differential lock switch is a two-position guarded rocker switch. It causes the wheels on each axle governed by the switch to rotate together. It is also known as side-to-side wheel lock. See Fig.46,Differential Lock Switch.

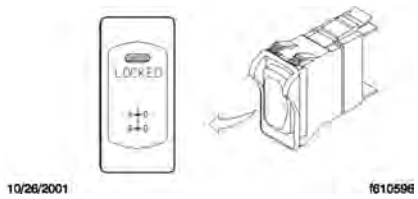


Fig 46, Differential Lock Switch

To lock the wheels together, press the upper half of the rocker switch momentarily. To turn off differential lock, press the upper half of the rocker switch 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. Take the vehicle to an authorized Freightliner dealer as soon as possible.

5.07.03 Rear 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.

NOTE: The vehicle must be moving less than 5 mph (8 km/h) before the rear suspension will deflate.

The rear suspension dump switch is a two-position guarded rocker switch. See Fig.47,Rear Suspension Dump Switch. It allows the air in the vehicle rear air suspension to be quickly exhausted, lowering the rear of the vehicle.

To lower the rear of the vehicle quickly, press the upper half of the rocker switch momentarily; the light-emitting diode (LED) indicator at the top of the dump switch blinks. When conditions are met for the suspension to be dumped the vehicle is moving at a speed less than 5 mph (8 km/h) the LED indicator illuminates steady. To raise the suspension to its normal height, press the upper half of the rocker switch again or drive the vehicle at a speed greater than 5 mph (8 km/h).



Fig 47, Rear Suspension Dump Switch

5.08 Braking Controls

5.08.01 Parking Brake Control Knob

All pneumatic-braked vehicles are equipped with a diamond-shaped parking brake control knob. See Fig. 48,Parking Brake Control Knob. Pull the knob to apply the parking brake. In air brake systems, before the parking brake can be released, the air pressure in either brake system must be at least 65 psi (448 kPa).



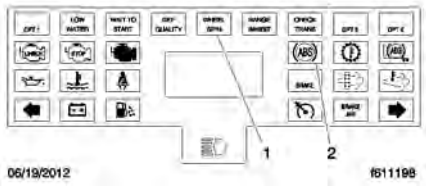
Fig 48, Parking Brake Control Knob

See 14.01.01 Primary Air Brake System for further information about the brake system.

5.08.02 Meritor WABCO ® Antilock Braking System (ABS)

The Meritor WABCO ABS has an indicator lamp (ABS legend) and, if equipped with automatic traction control (ATC), a wheel spin indicator lamp (WHEEL SPIN legend). See Fig.49,ABS Indicator Lights.

See the brake system operating instructions in 14.01.01 Primary Air Brake System for more information about ABS.



1. Wheel Spin Indicator
2. Tractor ABS Indicator

Fig 49, ABS Indicator Lights

5.08.03 Exhaust Brake Switch

An exhaust brake is an optional auxiliary braking system that assists, but does not replace the service brake system. The exhaust brake is controlled by a dash-mounted rocker switch to help slow the vehicle when the accelerator is released.

To enable the exhaust brake, press the upper part of the rocker switch. The engine determines when the exhaust brake is needed (going down a hill for example) and activates the exhaust brake. See Fig.50,Exhaust Brake Switch.



Fig 50, Exhaust Brake Switch

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6. Cab Features

6.01 Windows

Standard windows operate mechanically using a hand crank.

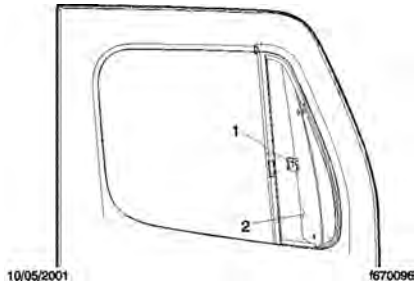
Power windows are optional, and can be installed on one side or both sides. One power window switch (window icon) will be installed on the dash for each window. See Fig.51,Power Window Switch. If your vehicle is equipped with power windows, press up to raise the window; press down to lower the window. Releasing the switch causes the window to stop.



NOTE: Press up to raise the window; press down to lower the window. Releasing the switch causes the window to stop.

Fig 51, Power Window Switch

Standard vent (wing) windows do not open. Operating vent windows are optional. To open the operating vent window, turn the latch on the window and push the window open. See Fig.52,Operating Vent Window (optional).



1. Latch
2. Vent Window

Fig 52, Operating Vent Window (optional)

6.02 Mirrors

6.02.01 Mirror Heat Switch, Optional

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

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

To heat the mirrors, press the upper part of the mirror heat switch (MIRR HEAT) on the dash. See Fig. 53,Mirror Heat Switch. When the mirror heat switch is on, an amber indicator light illuminates inside the switch.



NOTE: To heat the mirrors, press up; press down to turn off the heat.

Fig 53, Mirror Heat Switch

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

6.02.02 Power Mirrors, Optional

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

The main outside mirrors, if heated, can be equipped with an electrical remote control located on the driver's door. See Fig. 54,Power Mirror Switch Pad.

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

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



NOTE: To adjust the mirror position, press the keypad on the door in the direction you want the mirror to move.

1. Mirror Select Switch
2. Keypad

Fig 54, Power Mirror Switch Pad

6.02.03 Down View Mirror, Optional

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

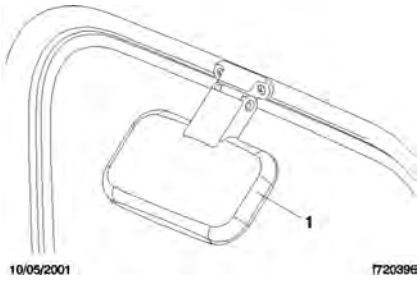
A down view mirror can be installed on the top of the passenger door frame to allow the driver a view of the area adjacent to the right side of the cab. See Fig.56,Down View Mirror (optional).



NOTE: To adjust the mirror position, press the keypad on the door in the direction you want the mirror to move.

1. Mirror Select Switch
2. Keypad

Fig 55, Power Mirror Switch Pad



1. Mirror

Fig 56, Down View Mirror (optional)

6.03 Seats

6.03.01 General Information

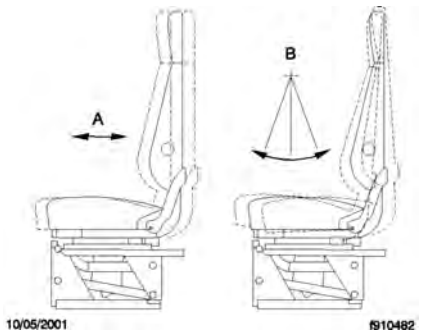
WARNING:
Keep hands, tools, and other objects away from the scissor points under the seats. Failure to do so could cause personal injury.

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

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

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

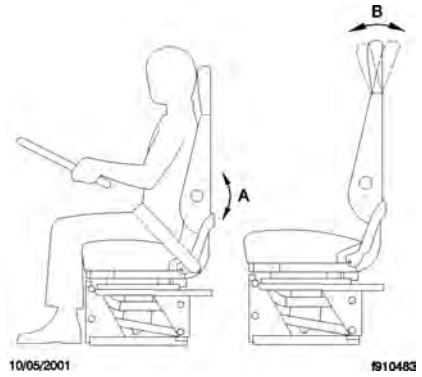
1. Seat Slide (fore-and-aft): When this adjustment is made, the entire seat moves forward or backward on its track. See Fig.57,Seat Slide Adjustment and Isolator Feature.



A. Seat Slide (fore-and-aft) Adjustment B. Isolator Feature

Fig 57, Seat Slide Adjustment and Isolator Feature

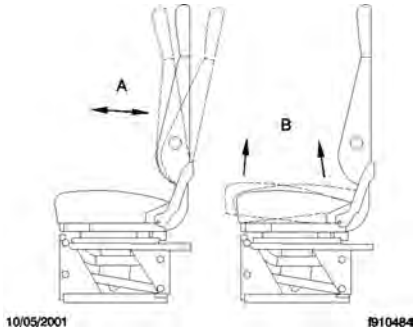
2. Isolator: This feature (also referred to as back-slap isolator or Chugger-Snubber®) reduces the amount of road shock by isolating the occupant from the motion of the vehicle, and allowing the upper seat to move in a simple pendulum motion. Whenever the isolator is not desired, it can be locked out. See Fig. 57,Seat Slide Adjustment and Isolator Feature.
3. Lumbar Support: Lumbar support changes the shape of the seat back to give more or less support to the occupant's lumbar (lower back) area. This adjustment is either mechanical or air controlled, depending on the make and model of the seat. See Fig.58,Lumbar Support and Headrest Adjustment.



A. Lumbar Support B. Headrest Adjustment

Fig 58, Lumbar Support and Headrest Adjustment

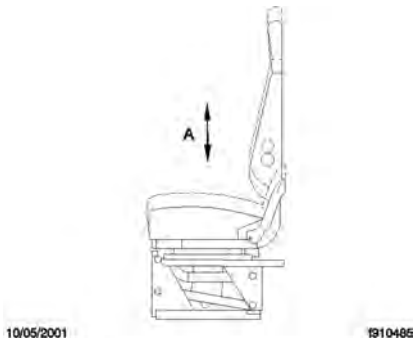
4. Headrest: When this adjustment is made, the upper part of the backrest (back cushion) changes angle to provide head and upper back support as shown in Fig.58,Lumbar Support and Headrest Adjustment.
5. Backrest Tilt: This adjustment pivots the backrest forward or backward as shown in Fig.59,Cushion Tilt Adjustments.



A. Backrest Tilt B. Seat Cushion Tilt

Fig 59, Cushion Tilt Adjustments

6. Seat Cushion Tilt: This adjustment raises or lowers the front and/or back of the seat (bottom) cushion. This adjustment is easier to perform when all weight is removed from the seat. See Fig.59,Cushion Tilt Adjustments.
7. Seat Tilt: When this adjustment is made, the seat assembly, both backrest and seat cushion, tilts forward or backward as shown in Fig.59,Cushion Tilt Adjustments.
8. Ride Height Adjustment: The entire seat moves up or down when adjusting the ride height. The adjustment is either manual or air controlled, depending on the make and model of the seat. See Fig.60,Ride Height Adjustment.



A. Ride Height

Fig 60, Ride Height Adjustment

9. Damper: When you sit on the seat, a leveling valve places you in the center of the ride zone. When the damper is adjusted properly under normal driving conditions, the seat should not top or bottom against the limits of the vertical travel.
10. Ride Firmness: A firmer ride gives a better feel for the road but less protection against unevenness in the road surface. A softer ride smooths out the bumps.

6.03.02 Bostrom Seat

Seat Slide Adjustment

Move the seat slide and isolator lever, shown in Fig.61,Bostrom Seat, to the left and hold it there to slide the seat forward or backward to the desired position.



1. Backrest Tilt Lever
2. Air Lumbar Support Control Valve (optional)
3. Damper Adjustment Switch
4. Height Adjustment Switch
5. Seat Cushion Tilt Knob
6. Seat Slide and Isolator Lever
7. Lumbar Support Knob (standard)

Fig 61, Bostrom Seat

Isolator

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

Lumbar Support

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

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

Seat Cushion Tilt

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

Backrest Tilt

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

Ride Height and Damper Adjustment

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

Press the damper adjustment switch to adjust the damper.

6.03.03 National 2000 Series Seat

Seat Slide Adjustment

Move the seat slide lever, shown in Fig.62,National 2000 Series Seat, to the left and hold it there to slide the seat forward or backward to the desired position. Move the lever back to its original position to lock the seat in place.



1. Backrest Tilt Knob
2. Lumbar Support Switch
3. Height Adjustment Switch
4. Seat Slide Lever
5. Front Cushion Height Adjustment Handle
6. Isolator Handle
7. Rear Cushion Adjustment Knob

Fig 62, National 2000 Series Seat

Isolator

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

Lumbar Support

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

Backrest Tilt

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

Seat Cushion Adjustment

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

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

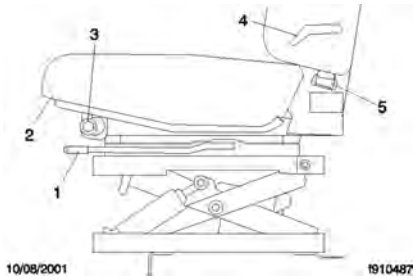
Ride Height Adjustment

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

6.03.04 Sears Seat

Seat Slide Adjustment

Push the seat slide (fore-and-aft adjustment) lever, shown in Fig.63,Sears Low Profile Seat, all the way to the left and slide the seat forward or backward, as desired. Release the lever to lock the seat in the desired position.



1. Seat Slide Lever
2. Seat Cushion Tilt Adjustment
3. Ride Height Knob
4. Lumbar Support Lever
5. Backrest Lever

Fig 63, Sears Low Profile Seat

Isolator

To engage the isolator (if installed), move the seat slide and isolator lever shown in Fig. 64,Sears Fleetmaster Seat (with isolator) all the way to the right. To lock out the isolator, move the isolator lever to the center position.



NOTE: Armrests are optional.

1. Lumbar Support Lever
2. Backrest Lever
3. Ride Height Knob
4. Shock Absorber Bracket (ride firmness)
5. Pin (ride firmness)
6. Snap Ring (ride firmness)
7. Seat Slide and Isolator Lever
8. Seat Cushion Adjustment

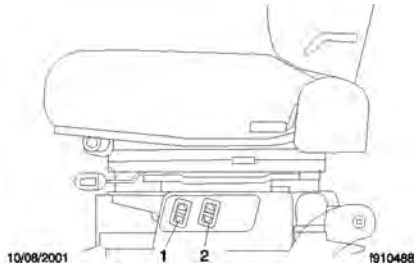
Fig 64, Sears Fleetmaster Seat (with isolator)

Lumbar Support

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

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

For seats with air support, use the aft rocker switch on the control panel on the left-hand side of the seat. See Fig. 65,Air Controls, Sears Seat. Press up to make the seat firmer; press down to make the seat less firm.



1. Ride Height Switch
2. Air Lumbar Support Switch

Fig 65, Air Controls, Sears Seat

Seat Cushion Tilt

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

Backrest Adjustment

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

Ride Height Adjustment

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

For seats with air support, use the forward rocker switch on the control panel on the left-hand side of the seat. See Fig. 65,Air Controls, Sears Seat. Press up to raise the seat; press down to lower the seat.

Ride Firmness Adjustment

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

6.04 Seat Belts and Tether Belts

6.04.01 General Information

Seat belt assemblies are designed to secure persons in the vehicle to help reduce the chance of injury or the amount of injury resulting from accidents or sudden stops. For this reason, Freightliner Custom Chassis Corporation (FCCC) urges that the driver and **all** passengers, regardless of age or physical condition, use seat belts when riding in the vehicle.

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

Seat belt assemblies in FCCC vehicles meet Federal Motor Vehicle Safety Standard 209, "Type 1" and "Type 2" requirements.

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

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

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

6.04.02 Inspection of the Seat Belt

WARNING:

Inspect and maintain seat belts and tethers as instructed below. Seat belts and tethers that were damaged or stressed in an accident must be replaced, and their anchoring points must be checked. When any part of a seat belt system needs replacement, the entire seat belt must be replaced, both the retractor and the buckle side. Do not attempt to modify the seat belt system; doing so could change the effectiveness of the system. Failure to replace damaged or stressed seat belts or any modifications to the system may result in personal injury or death.

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

1. Check the web for fraying, cuts, or extreme wear, especially near the buckle latch plate and in the D-loop guide area.
2. Check the web for extreme dirt or dust, and for severe fading from exposure to sunlight.
3. Check the buckle and latch for operation and for wear or damage.
4. Check the Komfort Latch or the Sliding Komfort Latch (if equipped) for function and cracks or other damage.
5. Check web retractor for function and damage.
6. Check the mounting bolts for tightness and tighten any that are loose.

6.04.03 Operation of the Seat Belt

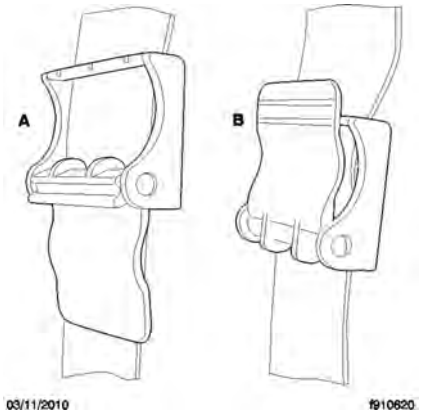
Three-Point Seat Belt With Komfort Latch or Sliding Komfort Latch

WARNING:

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

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

When engaged and used properly, the Komfort Latch and the Sliding Komfort Latch, shown in Fig.66,Komfort Latch and Fig.67,Sliding Komfort Latch respectively, introduce a small amount of slack into the seat belt, resulting in a more comfortable ride.



A. Disengaged B. Engaged

Fig 66, Komfort Latch



Fig 67, Sliding Komfort Latch

1. Slowly pull the latch end of the three-point seat belt out of the retractor and pull it across your lap (from outboard to inboard) far enough to engage the buckle. If the retractor locks too soon, allow the belt to retract slightly, then slowly pull it out again.
2. Fasten the three-point seat belt by pushing the latch into the buckle. Listen for an audible click. See Fig. 68,Fastening the Three-Point Belt.

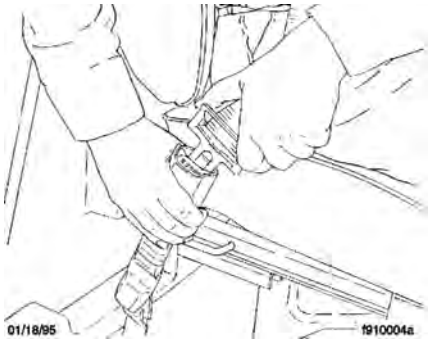
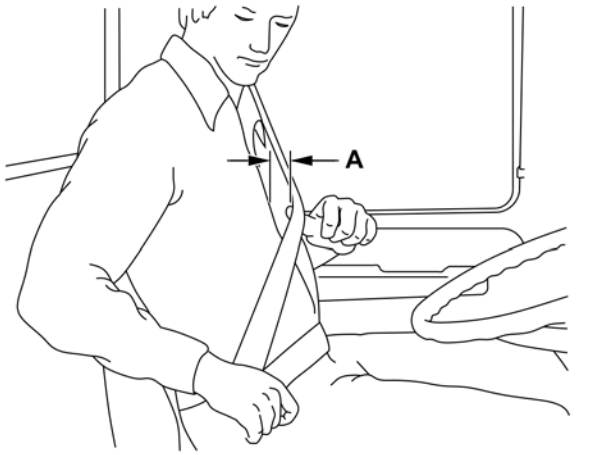


Fig 68, Fastening the Three-Point Belt

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

   If equipped with a Sliding Komfort Latch, make sure that the shoulder strap is snug against your chest. Without loosening the shoulder strap, push the Sliding Komfort Latch switch to the ON position. See Fig. 67,Sliding Komfort Latch. To activate the latch, lean forward until you hear a click. This will allow for approximately 1 inch (2.5 cm) of slack between your chest and the shoulder harness. Once engaged, the latch will allow you to lean forward about 5 inches (13 cm) without having to reset the latch. Leaning forward more than 5 inches (13 cm) will disengage the Sliding Komfort Latch, requiring it to be reset.

   If equipped with a Komfort Latch, pull on the shoulder strap to lessen the pressure of the strap on your shoulder and chest. Allow no more than 1 inch (2.5 cm) of slack between your chest and the shoulder harness. More slack can significantly reduce the seat belt effectiveness in an accident or a sudden stop. While holding the belt slack, press the Komfort Latch lever up, clamping the seat belt webbing. See Fig. 69,Adjusting Shoulder Harness Clearance, Komfort Latch and Fig.70,Locking the Komfort Latch.



A. 1 Inch (2.5 cm) Maximum

Fig 69, Adjusting Shoulder Harness Clearance, Komfort Latch

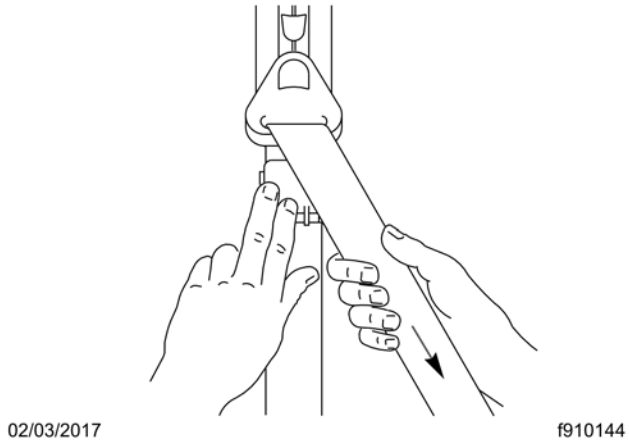


Fig 70, Locking the Komfort Latch

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

   If equipped with a Sliding Komfort Latch, unbuckle the seat belt, then tug on the shoulder belt to release the Sliding Komfort Latch, **or** press the Sliding Komfort latch to the OFF position, then unbuckle the seat belt.

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

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

6.05 Cab Amenities

6.05.01 Cup Holders

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

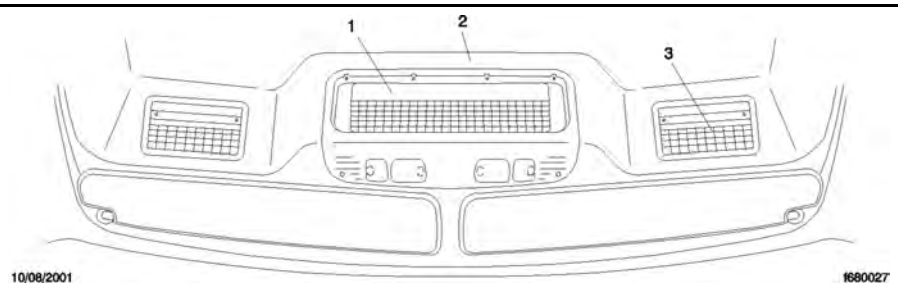
6.05.02 Cab Storage

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

Overhead Storage

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

On vehicles equipped with an overhead console, most vehicles have a storage bin located in the overhead console. See Fig.71,Overhead Storage. The overhead storage bin is often removed and replaced with a CB radio.



1. Overhead Storage Bin
2. Overhead Console
3. Map Holder Netting

Fig 71, Overhead Storage

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

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7. Electrical Systems

7.01 Electrical System General Information

The S2 Chassis uses an electrical system where 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. The information in this chapter is to help familiarize the driver with the basic electrical system. Servicing the electrical system requires special skills and equipment and should be performed only by a qualified technician. Take the vehicle to an authorized Freightliner service facility for repairs.

WARNING:

Do not attempt to modify, add, splice, or remove electrical wiring on this vehicle. Doing so could damage the electrical system and result in a fire that could cause serious personal injury or property damage.

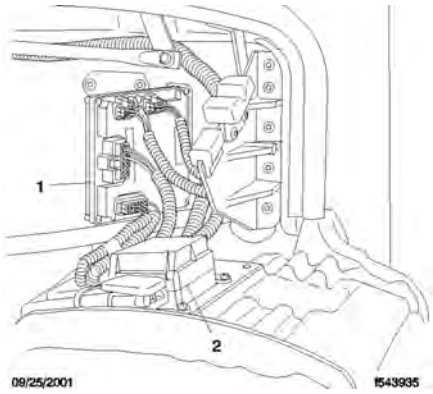
7.02 Power Distribution Modules

There are three electrical modules, a main power distribution module (PDM) located under the hood on the driver's side above the fender, a chassis module located between the frame rails, and a cab module located to the left of the driver under the switch panel.

The main PDM distributes battery power to the vehicle's control modules and contains the fuses required to protect the power feed circuits to the control modules. See Fig72,Location of the Main PDM (under driver side hood, above fender).. While the main PDM provides power to the modules, the modules themselves control power flow and circuit protection to the various components of the vehicle electrical systems. Because of this, traditional PDM devices such as relays and circuit breakers are no longer necessary on the main PDM.

Inside the lid of the fuse box there is a sticker that shows the locations of the fuses and describes the circuit(s) that each fuse protects. Fuse configuration will vary depending on the PDM assembly installed. See Fig.73,Main PDM (top view). See Table.12,Main PDM Fuse Identification for descriptions of a typical set of fuses.

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



1. Bulkhead Module
2. Main PDM

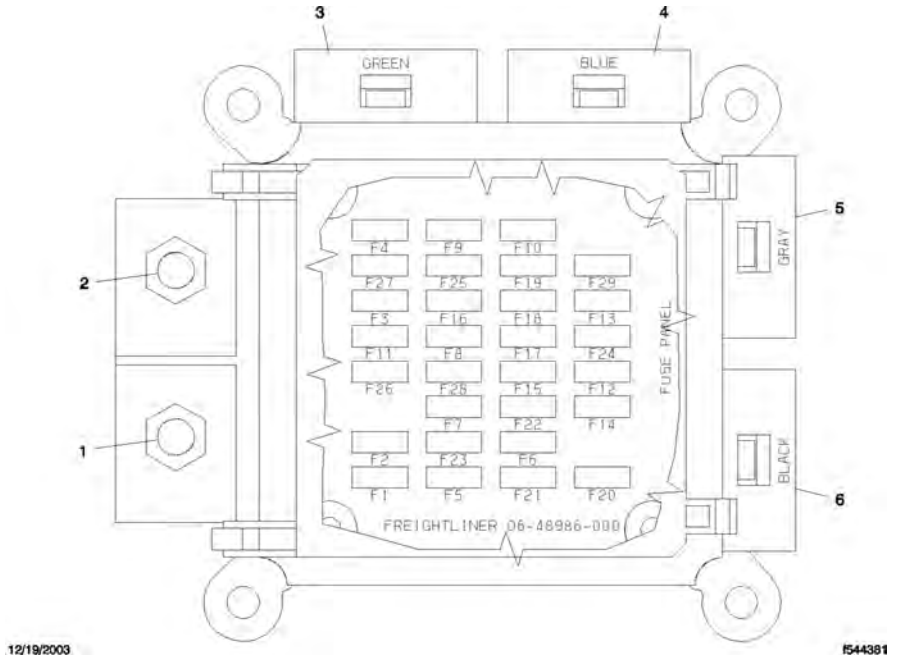
Fig 72, Location of the Main PDM (under driver side hood, above fender)

Table 12, Main PDM Fuse Identification

Main PDM Fuse Identification		
CAV	**Description**	**Fuse**
F1	Engine VCU (spare)	10A
F2	Blower Motor	30A
F3	Engine ECU	20A
F4	Spare	30A
F5	Ignition Switch	5A
F6	HydroMax RLY (if equipped with hydraulic brakes)	30A
F7	Bulkhead Module	30A
F8	ICU3	10A
F9	Transmission ECU	10A
F10	Spare	
F11	Spare	
F12	Radio/Diagnostic	20A
F13	Chassis Module	30A
F14	Spare	
F15	Bulkhead Module	30A
F16	ABS ECU	25A
F17	Chassis Module	30A
F18	Bulkhead Module	30A
F19	Chassis Module	30A
F20	Bulkhead Module	30A
F21	Spare	
F22	Bulkhead Module	30A
F23	Spare	
F24	Hydraulic Pump and RLY (if equipped with hydraulic brakes)	25A

Main PDM Fuse Identification		
CAV	**Description**	**Fuse**
F25	Spare	
F26	Spare	

Table 12, Main PDM Fuse Identification



1. Battery Power Mega Fuse 1
2. Battery Power Mega Fuse 2
3. Engine Harness (green)
4. Forward Chassis Harness (blue)
5. Forward Chassis Harness (gray)
6. Frontwall Harness (black)

Fig 73, Main PDM (top view)

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8. Heater, Ventilating, and Air Conditioner (HVAC)

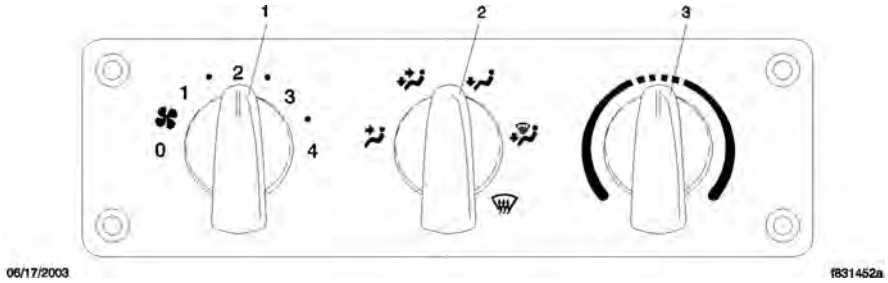
8.01 Climate Control Panel

8.01.01 General Description

The climate control panel controls the HVAC for the driver. The climate control panel without air conditioning is shown in Fig.74,Climate Control Panel Without Air Conditioning. The climate control panel with air conditioning is shown in Fig. 75,Climate Control Panel With Air Conditioning.

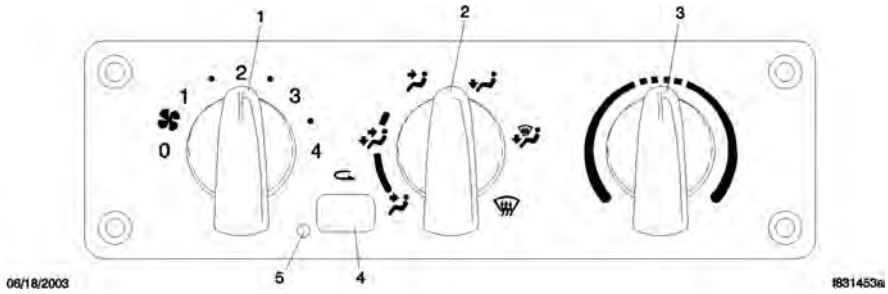
Standard controls consist of an eight-speed fan switch, an air selection switch, and a temperature control switch. See Fig. 75,Climate Control Panel With Air Conditioning. On vehicles with air conditioning, the panel also contains a telltale light emitting diode (LED) and an air recirculation button.

NOTE: The vehicle may be equipped with a Webasto heating system. The Webasto heating system warms the engine prior to starting the vehicle, and also assists in generating additional heat for the passengers during operation. For operating instructions see the Webasto Operator's Manual.



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

Fig 74, Climate Control Panel Without Air Conditioning



1. Fan Switch
2. Air Selection Switch
3. Temperature Control Switch
4. Recirculation Button
5. Recirculation Indicator

Fig 75, Climate Control Panel With Air Conditioning

8.01.02 Fan Switch

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

To increase airflow, turn the fan switch clockwise to a higher number. To decrease the airflow, turn the switch counterclockwise to a lower number.

8.01.03 Air Selection Switch

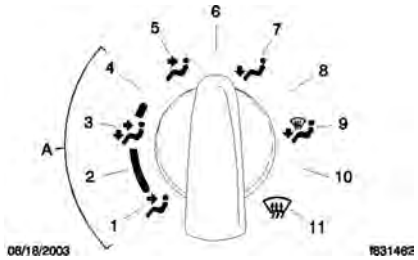
General Description



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

Fig 76, Air Selection Switch Without Air Conditioning

The air selection switch allows the driver to control the flow of air through the face outlets, the floor outlets, the defrost (windshield) outlets, or a combination of these outlets. Nine air selection modes are available on a system without air conditioning. See Fig.76,Air Selection Switch Without Air Conditioning. A system with air conditioning has 11 air selection modes, four of which are air conditioning modes. See Fig.77,Air Selection Switch With Air Conditioning.



A. Air Conditioning Modes
1. Air Conditioning Face Mode
2. Selection Between Air Conditioning Face Mode and Air Conditioning Bi-Level Mode
3. Air Conditioning Bi-Level Mode
4. Selection Between Air Conditioning Bi-Level Mode and Face Mode
5. Face Mode
6. Selection Between Face Mode and Floor Mode
7. Floor Mode
8. Selection between Floor Mode and Floor/Defrost Mode
9. Floor/Defrost Mode
10. Selection between Floor/Defrost Mode and Defrost Mode
11. Defrost Mode

Fig 77, Air Selection Switch With Air Conditioning

Air Selection Switch Without Air Conditioning

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

4. **Selection between Bi-Level Mode and Floor Mode:** Directs 25 percent of the airflow through the face outlets and 75 percent through the floor outlets.
5. **Floor Mode:** Directs all airflow through the floor outlets.
6. **Selection between Floor Mode and Floor/Defrost Mode:** Directs 75 percent of the airflow through the floor outlets and 25 percent through the defrost outlets.
7. **Floor/Defrost Mode:** Directs the airflow equally to the floor outlets and the defrost outlets.
8. **Selection between Floor/Defrost Mode and Defrost Mode:** Directs 75 percent of the airflow through the defrost outlets and 25 percent through the floor outlets.
9. **Defrost Mode:** Directs all airflow through the defrost outlets.

Air Selection Switch With Air Conditioning

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

8.01.04 Temperature Control Switch

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

8.01.05 Fresh Air Mode

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

8.01.06 Recirculation Mode

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

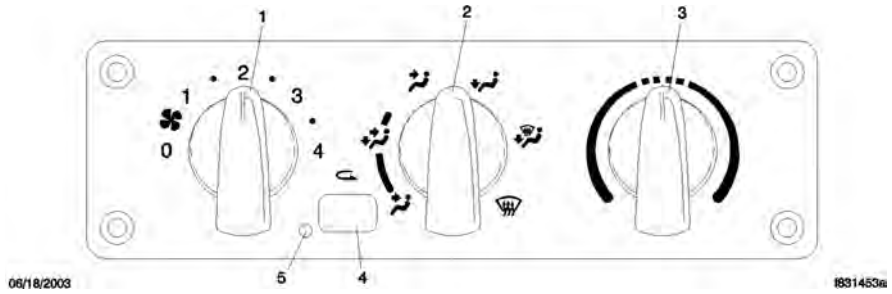
The recirculation mode limits the amount of outside air entering the cab. Press the recirculation button to prevent dusty or smoky air from entering the cab. The recirculation mode can also be used to decrease the time required to cool or heat the cab interior during extreme outside temperature conditions. When the recirculation mode is on, the recirculation indicator will illuminate. See Fig.78,Climate Control Panel With Air Conditioning.

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

- floor/defrost mode

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

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



1. Fan Switch
2. Air Selection Switch
3. Temperature Control Switch
4. Recirculation Button
5. Recirculation Indicator

Fig 78, Climate Control Panel With Air Conditioning

IMPORTANT: The HVAC system enters a partial recirculation mode for five minutes after being in full recirculation mode for 20 minutes. This cycle repeats every 20 minutes.

8.01.07 Defrosting

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

8.01.08 Air Conditioning

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

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

NOTE: The heating and air conditioning system has a brushless blower motor with a protection or shutdown mode to prevent damage due to overheating and overcurrent conditions. If the brushless blower motor goes into a protection mode, the motor will operate at a slower speed. If the overheating or overcurrent condition continues, the motor will shut down and stop completely. The motor will resume proper operation after the motor has cooled or the overcurrent condition has been resolved. It will be necessary to cycle the fan switch off, and then on, to reset the motor. If the problem appears repeatedly, take the vehicle to an authorized Freightliner dealer for repairs.

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9. Engines

9.01 Engine Starting

9.01.01 General Description

For cold-weather starting, refer to the **Cummins Online** website, see https://www.cummins.com/support/manuals or scan the QR code. See Fig.79,Cummins QR Code. For Detroit engine service literature, refer to the **Detroit Diesel** link on the DTNA TechLit website, see https://www.dtnatechlit.com/portal-public or scan the QR code. See Fig.80,TechLit QR Code.



Fig 79, Cummins QR Code



Fig 80, TechLit QR Code

9.01.02 General Information

NOTE: Before starting the engine, read 4.01.01 General Description and 5.01 Ignition Switch and Key in this manual for detailed information on how to read the instruments and operate the controls.

Before operating the vehicle, perform the engine pretrip inspection and daily maintenance checks in 5.01 Ignition Switch and Key and 16.01 Safety Precautions of this manual.

NOTICE:

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

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

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

NOTICE:

Never attempt to start an engine using ether or any other starting fluid. Serious engine damage could result.

1. Set the parking brake.
2. Turn the ignition switch to the ON/RUN position. 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.

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

   NOTE: On vehicles equipped with a neutral start switch, the transmission must be in neutral before the engine can be started.

3. For manual transmissions, place the transmission in neutral and depress the clutch pedal.

   For automatic transmissions, make sure that the transmission shift control is in Neutral (N), or if so equipped, the Park (P) or Park Brake (PB) position.

   IMPORTANT: Do not depress the throttle pedal while starting the engine.

4. Turn the ignition switch to the START position. After the engine starts, release the key.



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

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

5. Bring the engine up to operating speed gradually as it warms up and develops stable oil pressure.

IMPORTANT: When the engine is started, it takes a short time to build up a lubricating oil film between the shafts and bearings, and between the pistons and cylinder walls. The oil pressure gauge indicates any drop in lubricating oil pressure within 15 seconds of engine startup. See the applicable engine manufacturer's operator's manual for minimum idle oil pressure specifications.

9.01.03 Starting After Extended Shutdown or Oil Change

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

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

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

9.02 Operation of the Engine

9.02.01 Engine Operation Procedures

IMPORTANT: For cold-weather starting, engine break-in, and cold-weather operation, refer to the engine manufacturer’s manual for detailed instructions.

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

DANGER:

Do not operate the engine in an area where flammable vapors such as gasoline or diesel fumes are present. Shut down 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.

All diesel engines have been built to comply with the requirements of the Federal (U.S.) Clean Air Act. Once an engine is placed in service, the responsibility for meeting both state and local regulations is with the owner/operator. Good operating practices, regular maintenance, and correct adjustments are factors that will help to stay within the regulations.

Adequate maintenance of the engine, which is the responsibility of the owner/operator, is essential to keep the emission levels low.

The driver should be familiar with the vehicle warning system in order to bring the vehicle to a safe stop if the engine malfunctions. If the driver doesn't understand how the warning system works, an engine shutdown could occur, causing a safety hazard. See 4.01.01 General Description for information on the control panel for the engine.

Follow the directions in the Cummins engine manufacturer's operator's manual and in this manual for trouble-free, economical vehicle engine operation.

NOTICE:

Stop the engine at the first sign of malfunction. Almost all malfunctions give some warning to the operator before significant damage occurs. Many engines are saved because alert operators heed the warning signs (sudden drop in oil pressure, unusual noises, etc.) and immediately shut down the engine.

1. Cummins diesel engines are designed to operate successfully at full throttle under transient conditions down to rated rpm. This is consistent with recommended operating practices.
2. Depending on the vehicle gearing, the posted speed limit can sometimes allow operation in either of the top two gears; however, for improved operating efficiency (fuel economy and engine life), operate in the top gear at reduced rpm rather than in the next lower gear at the maximum rpm.
3. Cruise at partial throttle whenever road conditions and speed requirements permit. This driving technique permits operating within the most economical power range of the engine.
4. When approaching a hill, open the throttle smoothly to start the upgrade at full power, then shift down as desired to maintain the optimum vehicle speed. The high torque of the engine may permit topping some grades without shifting.
5. Engines are designed to operate over a wide speed range. More frequent shifting than necessary does not allow proper utilization of this flexibility. The driver who stays in top gear and uses the wider speed range will achieve the best fuel economy.
6. The Cummins engine is effective as a brake on downhill grades, but take care not to overspeed the engine going downhill. The governor has no control over engine speed when the engine is being pushed by the loaded vehicle.



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

7. Never turn the ignition switch to the OFF position while going downhill. With the engine still in gear, fuel pressure will build up against the shutdown valve and can prevent it from opening when the ignition switch is turned to the ON/RUN position.
8. Use a combination of brakes and gears to keep the vehicle under control at all times, and to keep the engine speed below the rated governed rpm.
9. Check the coolant temperature and oil pressure gauges frequently.



NOTICE:
Continuous operation below 140°F (60°C), above 212°F (100°C), or with the oil pressure below 10 psi (69 kPa), can damage the engine.

10. Do not idle the engine for more than 10 minutes. Long periods at low idle can damage the engine.

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

11. If the engine starts to overheat, reduce the power output of the engine. Do one, or both, of the following: (1) Release pressure on the accelerator pedal; (2) Shift to a lower gear. If the temperature does not return to normal, shut down the engine.

9.02.02 High Idle Options

High Idle with Cruise Control

NOTE: To operate the high idle options listed below, the vehicle must be stopped, the transmission shift lever placed in the Neutral (N) or Park (P) position, and the parking brake set.

IMPORTANT: Do not idle the engine for excessively long periods. The extreme heat can cause the bearings to seize or the oil seals to leak.

1. Place the shift lever in Neutral (N) or Park (P) and set the parking brake.
2. Press the cruise switch located on the dash to the ON position. Press the RESUME switch to accelerate the engine revolutions per minute (rpm) to the minimum set speed. To increase the engine rpm, press and hold the RESUME switch. To decrease the engine rpm, press and hold the SET switch.

NOTE: The rpm can also be increased by depressing the throttle pedal until the desired rpm is met, and then pressing the SET switch.

3. Disengage the cruise control by depressing the service brake pedal, or by moving the ON/OFF switch to the OFF position.

Voltage-Based Auto High Idle

NOTE: To operate the high idle options listed below, the vehicle must be stopped, the transmission shift lever placed in the Neutral (N) or Park (P) position, and the parking brake set.

IMPORTANT: Do not idle the engine for excessively long periods. The extreme heat can cause the bearings to seize or the oil seals to leak.

1. Place the shift lever in Neutral (N) or Park (P) and set the parking brake.
2. The idle rpm will automatically increase when the voltage drops below 12.2 volts. The rpm will incrementally increase every five seconds until 13.4 volts is achieved and maintained.
3. The Voltage-Based Auto High Idle system is disengaged by depressing the service brake pedal.

IMPORTANT: The Voltage-Based Auto High Idle system will not return to normal operation until one of the following occurs: The parking brake is depressed and released, the key switch is turned to the OFF position, or the transmission gears are changed.

9.03 Engine Shutdown

Shut down the engine immediately if:

- the oil pressure gauge needle swings back and forth or falls sharply;
- engine power and rpm fall, even though the accelerator pedal remains steady;
- the exhaust pipe gives off heavy smoke;
- the coolant and/or oil temperature climb abnormally;
- abnormal sounds suddenly occur in the engine or turbocharger.

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).

1. With the vehicle stopped, place the transmission in Neutral (N), or if so equipped, the Park (P) or Park Brake (PB) position.
2. Set the parking brake.
3. Idle the engine for three to five minutes before shutting it down. This allows the lubricating oil and the coolant to carry heat away from the combustion chambers, bearings, shafts, etc. This is especially important with turbocharged engines. The extreme heat can cause bearings to seize or oil seals to leak.



NOTICE:
Do not rev the engine before shutting it down. Revving the engine before shutdown will damage the turbocharger.

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

4. Shut down the engine by turning the ignition switch to the OFF position.

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10. Exhaust Aftertreatment Systems

10.01 Aftertreatment System, EPA10 and Newer Engines

10.01.01 General Description

Model year 2007 and later vehicles and/or engines domiciled in the U.S. or Canada are designed to meet Emission and Fuel Efficiency Standards of the U.S. Federal Environmental Protection Agency (EPA), the National Highway Traffic Safety Administration (NHTSA), Emission Regulations under the Canada Motor Vehicle Safety Act in Canada, and the California Air Resources Board (CARB) effective as per the applicable emission model year. To determine an engine's or vehicle's emission model year, refer to the respective EPA/CARB certification label.

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.

10.01.02 Principles of Operation

To meet EPA guidelines, engines that are compliant with EPA10 and newer regulations use an aftertreatment system (ATS) with an aftertreatment device (ATD) and Selective Catalytic Reduction (SCR) technology to reduce NOx downstream of the engine.



NOTICE:

Follow these guidelines for engines that comply with EPA10 or newer regulations, or damage may occur to the 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 CK-4 oil.**
- **Use only certified diesel exhaust fluid (DEF) in the DEF tank.**



NOTICE:

FA-4 engine lube oil is available, but is not compatible with all engines. See the engine manufacturer's operation manual to determine if FA-4 oil can be used in your vehicle's engine. Failure to do so could lead to engine damage and is not warrantable.

IMPORTANT: Using non-specification fuels or oils can lead to shortened diesel particulate filter (DPF) cleaning or replacement intervals. For example, using CK-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.

After exhaust gasses leave the engine, they flow into the ATS. First they flow into a two-part ATD, comprised of a diesel oxidation catalyst (DOC), and a diesel particulate filter (DPF). The DPF traps soot particles, then exhaust heat converts the soot to ash in the DPF, in a process called regeneration (regen). The harder an engine works, the better it disposes of soot. When the engine is running under load and regen occurs without input, it is called passive regen. 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 before the diesel particulate filter, to superheat the soot trapped in the filter and burn it to ash. Both types of regen occur without driver input.

WARNING:

Active regeneration can occur automatically anytime the vehicle is moving. The exhaust gas temperature could reach 1500°F (816°C), which is hot enough to cause a fire, heat damage to objects or materials, or personal injury to persons near the exhaust outlet. See **Regen-Inhibit Switch** later in this chapter for instructions on preventing automatic regen if necessary.

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, vegetation, flammable materials, and anything else that may be harmed by exposure to high heat.

Operating at reduced engine load will allow soot to accumulate in the DPF. When this occurs, the DPF lamp illuminates, indicating that a regen must be performed, and the driver must either bring the vehicle up to highway speed to increase the load, or park the vehicle and initiate a parked regen. See **Parked Regen**, later in this chapter for instructions.

NOTE: Beginning September 2, 2014 some chassis are equipped with an option that allows a regen to occur at 0 or 1 mph (0 or 2 km/h), instead of the standard 5 mph (8 km/h) threshold. Based on the engine programming parameter, if a regen occurs and vehicle speed is reduced to either 0 or 1 mph (0 or 2 km/h), the regen process will not be cancelled. If the vehicle is programmed for the 0 mph (0 km/h) parameter, vehicle speed can be reduced to 0 mph (0 km/h) and the regen will continue. Vehicles with this option are equipped with a regen inhibit switch to cancel the regen if needed. If the vehicle is programmed for the 1 mph (2 km/h) parameter, vehicle speed can be reduced to 1 mph (2 km/h) and the regen will continue. If vehicle speed is less than 1 mph (2 km/h), the regen will be cancelled.

After the exhaust stream passes through the ATD, it flows through another canister housing the SCR device. A controlled quantity of DEF is injected into the exhaust stream, where heat converts it to ammonia (NH_3) gas. This mixture flows through the SCR device, where the ammonia gas reacts with the NOx in the exhaust, to produce harmless nitrogen (N_2) and water vapor (H_2O), which then exits out of the tailpipe.

10.01.03 ATS Warning Lamps

Warning lamps in the driver's message center alert the driver of situations with the ATS.

- An illuminated DPF lamp indicates a regen is needed. See Fig.81,Diesel Particulate Filter (DPF) Status Lamp.

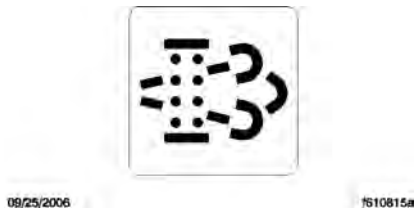


Fig 81, Diesel Particulate Filter (DPF) Status Lamp

- A slow, 10-second flashing of the HEST lamp alerts the driver that a parked regen is in progress, but the exhaust temperatures are still relatively cool. See Fig.82,High Exhaust System Temperature (HEST) Lamp. It also indicates that the high-idle speed is being controlled by the engine software, not the driver.



Fig 82, High Exhaust System Temperature (HEST) Lamp

- A steadily illuminated HEST lamp alerts the operator of high exhaust temperatures when vehicle speed is below 5 mph (8 km/h) while it is performing an automatic regen, and during a parked regen. See Fig. 82,High Exhaust System Temperature (HEST) Lamp.

10.01.04 Parked Regen

DANGER:

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

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

A reference label is included with the driver's documentation package initially in the glove box, that explains the ATS warnings, and actions required to avoid further engine protection sequences. See Fig. 83,Exhaust-Aftertreatment Warnings Reference Label.

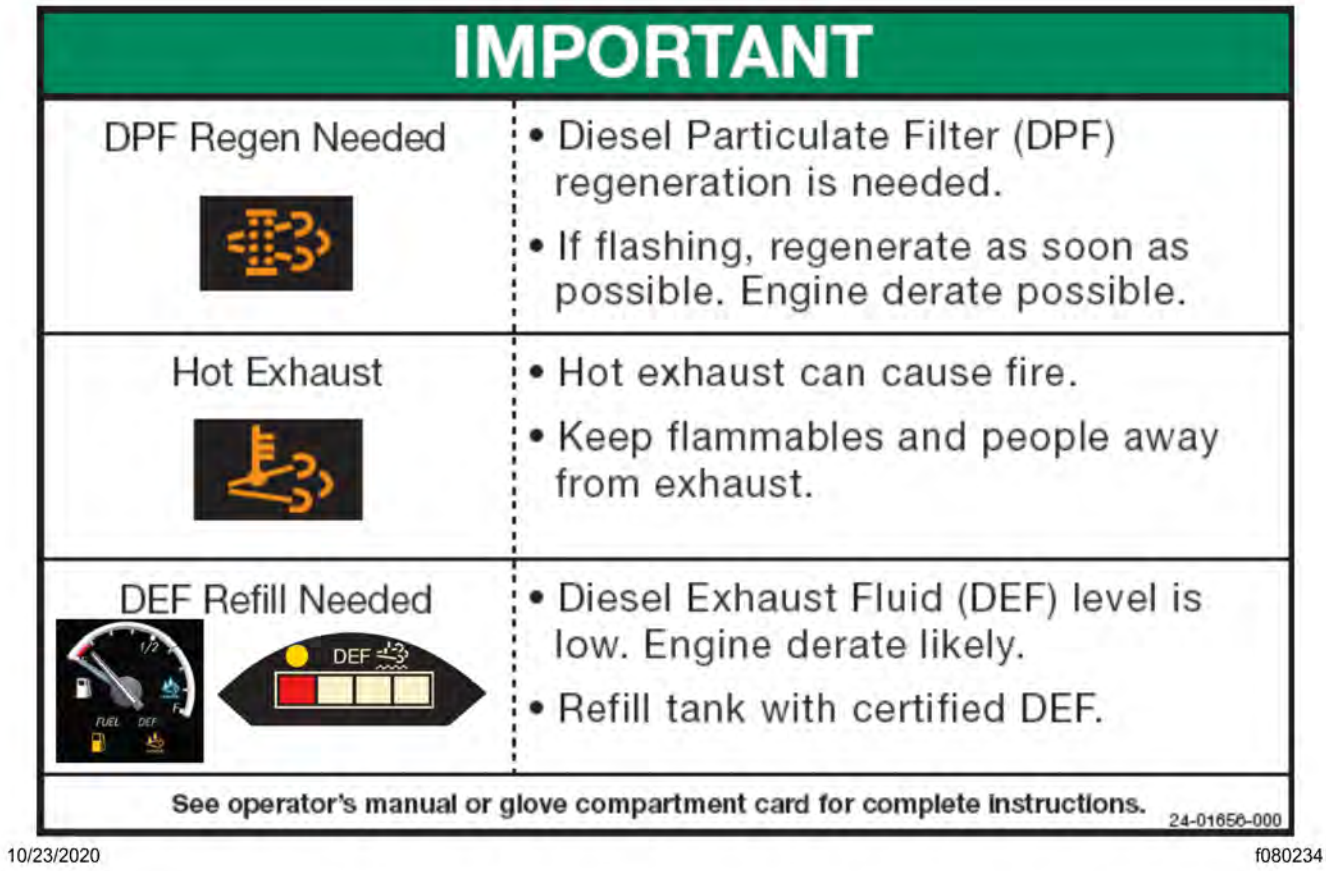


Fig 83, Exhaust-Aftertreatment Warnings Reference Label

The regen switch, located on the dash, is used to initiate a parked regen of the aftertreatment device. See Fig. 84,Regen Switch.



Fig 84, Regen Switch

NOTE: The regen switch can initiate a parked regen only when the DPF lamp is illuminated (because the engine software is signaling for a parked regen).

The regen-inhibit switch (optional when available) provides additional control over the aftertreatment regeneration process. Depressing the regen-inhibit switch will prevent a regen from occurring during a drive cycle. After the vehicle has been shut down and restarted, regens will occur normally unless the inhibit switch is pressed again. See Fig. 85,Regen Inhibit Switch (optional when available).

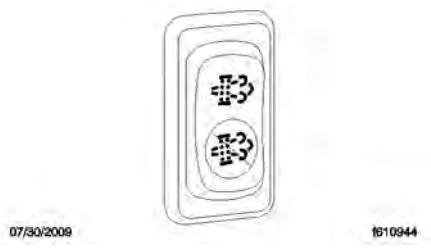


Fig 85, Regen Inhibit Switch (optional when available)

To initiate a parked regeneration, perform the following steps.

1. Park the vehicle away from all combustible and flammable materials. Chock the tires. Start and warm the engine until the coolant temperature is at least 150°F (66°C).
2. Set the parking brake. If the parking brake was already set, you must release it, then set it again.

   For manual transmissions, fully depress the clutch pedal, put the transmission in neutral, then release the pedal.

   If the vehicle has a two-pedal automated transmission, shift it into gear, then back to neutral.

   IMPORTANT: The driver is responsible for ensuring, during the entire regen cycle, that anything that could be harmed by exposure to high heat does not come in contact with the exhaust gases flowing from the outlets.

3. Press and hold the regen switch for 4 seconds. The engine will increase rpm and initiate the regen process.
4. After the parked regen has run for 20 to 40 minutes, the regen cycle is completed. The engine idle speed will drop to normal, and the vehicle may be driven normally. The HEST lamp may be illuminated, but will go out when the 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, engage the clutch, brake, or throttle pedal, or turn off the engine.

10.01.05 Shorting Plug

NOTE: The DPF lamp must be illuminated before the shorting plug will initiate a parked regen. See Fig. 86,Diesel Particulate Filter (DPF) Status Lamp.

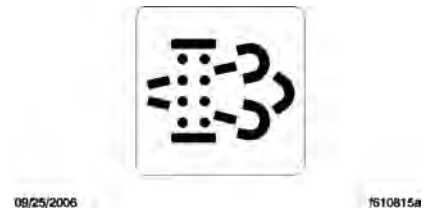
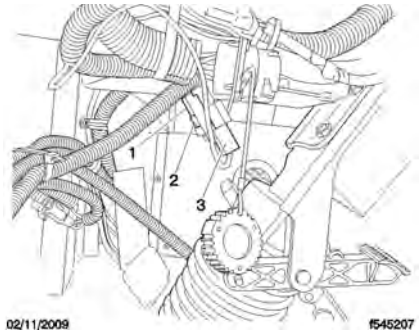


Fig 86, Diesel Particulate Filter (DPF) Status Lamp

The shorting plug is used to initiate a parked regen of the ATD. The shorting plug is located under the dash, next to the steering column. Mounting locations vary. See Fig.87, Shorting Plug.



1. Primary Lock
2. Secondary "Red" Lock
3. Plug

Fig 87, Shorting Plug

To initiate a parked regeneration, perform the following steps.

1. Park the vehicle away from all combustible and flammable materials. Chock the tires. Start and warm the engine until the coolant temperature is at least 150°F (66°C).
2. Set the parking brake. If the parking brake was already set, it must be released, then set again.

   For manual transmissions, fully depress the clutch pedal, put the transmission in neutral, then release the pedal.

   If the vehicle has a two-pedal automated transmission, shift it into gear, then back to neutral.

   IMPORTANT: The driver is responsible for ensuring, during the entire regen cycle, that anything that could be harmed by exposure to high heat does not come in contact with the exhaust gases flowing from the outlets.

3. Disconnect the shorting plug, as follows.
   - 3.a Slide the secondary red lock away from the white cover. See Fig.87, Shorting Plug, Ref. 2.
   - 3.b Push the primary lock in. See Fig.87, Shorting Plug, Ref. 1.
   - 3.c Pull the plug apart. See Fig.87, Shorting Plug, Ref. 3.
4. Wait four seconds.
5. Connect the shorting plug.
6. Engine rpm will rise, and initiate the regen process.
7. The regen cycle will finish after 20 to 60 minutes, at which time engine idle speed will drop to normal and the vehicle can be driven normally. The HEST lamp may be illuminated, but will go out when the vehicle speed exceeds 5 mph (8 km/h), or the system has cooled to normal operating temperature. See Fig. 88,High Exhaust System Temperature (HEST) Lamp. The DPF lamp will shut off.
8. To stop a parked regen at any time during the process, engage the clutch, service brake, or accelerator pedal, or turn off the engine.



Fig 88, High Exhaust System Temperature (HEST) Lamp

10.01.06 DPF Maintenance

Eventually ash will accumulate in the DPF and the filter will require servicing. DPF servicing must be performed by an authorized technician, following the engine manufacturer's instructions. A record must be maintained for warranty purposes, that includes:

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

10.02 Diesel Exhaust Fluid and Tank, EPA10 and Newer Engines

10.02.01 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, 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.

10.02.02 DEF Tank

Engines that are compliant with EPA10 and newer regulations are equipped with a DEF tank located between the ATS and the fuel tank, or an optional location forward of the fuel tank. 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.

The DEF tank will require filling a minimum of approximately every second diesel refuel depending on the DEF tank capacity. The S2 Chassis has an 11.5-gallon tank capacity. DEF consumption is approximately 2% of fuel consumption, dependent on vehicle operation. For every 50 gallons of diesel fuel consumed, approximately 1 gallon of DEF will be consumed.

10.02.03 Fuel/DEF Gauge

The fuel and DEF levels are measured in a dual purpose fuel/DEF gauge. See Fig.89,Fuel/DEF Gauge.

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.



A. Green barsDEF level indicators.
B. One bar illuminated amberDEF low, refill DEF.
C. One bar flashing redDEF empty, refill DEF.

1. Low Fuel Warning Lamp (amber at 1/8 tank of fuel)
2. Low DEF Warning Lamp

Fig 89, Fuel/DEF Gauge

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

- Four bars illuminated greenBetween 75% and 100% full
- Three bars illuminated greenBetween 50% and 75% full
- Two bars illuminated greenBetween 25% and 50% full
- One bar illuminated greenBetween approximately 10% and 25% full
- One bar illuminated amberDEF low, refill DEF
- One bar flashing redDEF empty, refill DEF

10.02.04 DEF Warnings and Engine Limits

IMPORTANT: Ignoring the DEF warning lamps and not refilling the DEF will result in limited engine power with a speed limit of 5 mph (8 km/h) eventually being applied. For Cummins engine service literature, refer to the **Cummins Online** website, see https://www.cummins.com/support/manuals or scan the QR code. See Fig.90,Cummins QR Code. For Detroit engine service literature, refer to the **Detroit Diesel** link on the DTNA TechLit website, see https://www.dtnatechlit.com/portal-public or scan the QR code. See Fig.91,TechLit QR Code.



Fig 90, Cummins QR Code

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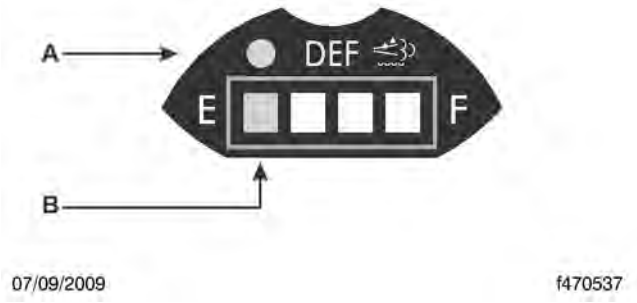
Fig 91, TechLit QR Code

DEF Level LowInitial Warning

When the DEF level reads low the following warnings strongly encourage the driver to refill the DEF tank. See Fig. 92, DEF Level LowInitial Warning.

- The CHECK engine lamp flashes for 30 seconds when the vehicle is started.
- The DEF warning lamp illuminates.
- One bar of the DEF-level lightbar illuminates solid amber.

The DEF tank must be filled to cancel the warning sequence.



07/09/2009 f470537

A. DEF Warning Lamp (illuminates constantly) B. DEF-Level Lightbar (1 bar solid amber)

Fig 92, DEF Level LowInitial Warning

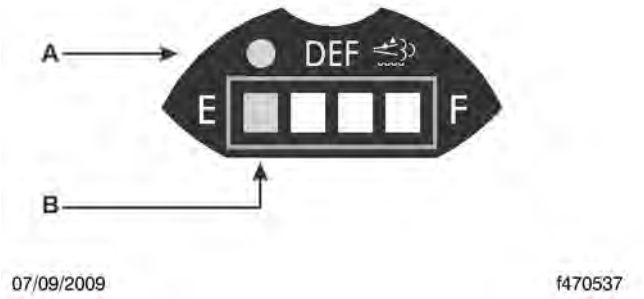
DEF Level LowCritical Warning

When the DEF level reads low, the following warnings are activated. See Fig.93,DEF Level LowCritical Warning.

- The CHECK engine lamp flashes for 30 seconds when the vehicle is started.
- The DEF warning lamp illuminates.
- One bar of the DEF-level lightbar flashes red.

Engine performance is limited, with progressively harsher engine power limits applied.

The DEF tank must be filled to cancel the warning sequence.



A. DEF Warning Lamp (illuminates constantly) B. DEF-Level Lightbar (1 bar flashing red)

Fig 93, DEF Level LowCritical Warning

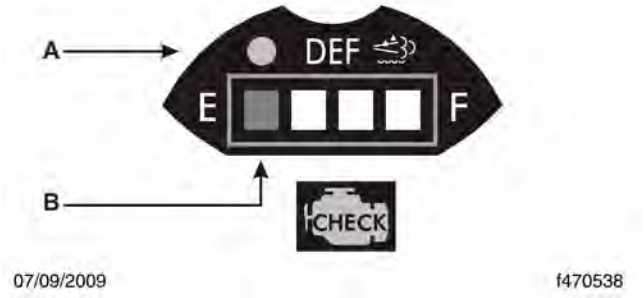
DEF Empty

When the DEF level reads empty, the following warnings are activated. See Fig.94, DEF Empty Warning.

- One bar of the DEF-level lightbar flashes red.
- The DEF warning lamp flashes.
- The CHECK engine lamp illuminates.

Engine performance is limited, with progressively harsher engine power limits applied.

The DEF tank must be filled to cancel the warning sequence.



NOTE: Engine performance is limited.

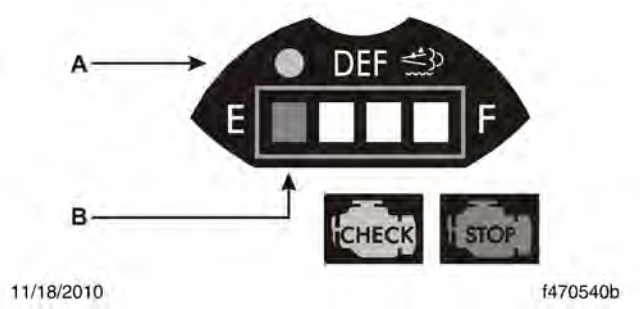
A. DEF Warning Lamp (flashing) B. DEF-Level Lightbar (1 bar flashing red)

Fig 94, DEF Empty Warning

DEF Level Empty and Ignored

If the empty warning is ignored and the DEF is not refilled, the DEF warning lamp flashes, one bar of the DEF-level lightbar flashes red, and the red STOP engine lamp illuminates in addition to the CHECK engine warning lamp. See Fig. 95,DEF Empty and Ignored Warning.

If the DEF tank is not refilled, a 5 mph (8 km/h) speed limit will be applied after the next engine shutdown, or while parked and idling.



NOTE: The STOP engine, CHECK engine, and DEF lamps illuminate, engine power is limited, speed limit of 5 mph (8 km/h).

1. DEF Warning Lamp (flashing)
2. DEF-Level Lightbar (1 bar flashing red)

Fig 95, DEF Empty and Ignored Warning

DEF Quality or SCR Tampering

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

If contaminated DEF or tampering is detected, the DEF warning lamp flashes, and engine power is limited with progressively harsher limits applied. If the fault is not corrected, the STOP engine lamp illuminates and a 5 mph (8 km/h) speed limit is applied after the next engine shutdown, or while parked and idling. See Fig.95,DEF Empty and Ignored Warning.

10.03 EPA07 Aftertreatment System (ATS)

10.03.01 EPA07 Aftertreatment System (ATS) Guideline

All on-road diesel engines built after December 31, 2006, (EPA07 engines) must meet strict new guidelines for reduced exhaust emissions of particulate matter and nitrogen oxides (NOx). NOx is limited to just over 1 gram per brake horsepower hour (g/bhp-hr) and particulate matter cannot exceed 0.01 g/bhp-hr.

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

- Use ultralow-sulfur diesel (ULSD) fuel with 15 ppm sulfur content or less, based on ASTM D2622 test procedure.
- 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 %; meeting the API CJ-4 index specifications.

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

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

IMPORTANT: See your engine operation manual for complete details and operation of the aftertreatment system.

Inside the ATD, the exhaust first passes over the diesel oxidation catalyst (DOC), then it passes through the DPF, which traps soot particles. If exhaust temperature is high enough, the trapped soot is reduced to ash in a process called passive

regeneration (regen). **Passive regeneration** occurs as the vehicle is driven normally under load; the driver is not even aware that it is happening. The harder an EPA07 engine works, the better it disposes of soot, as the exhaust heat alone is enough to burn the soot to ash. Over the course of a workday, however, passive regeneration cannot always keep the ATD filter clean, so the filter must undergo **active regeneration**. In active regeneration, extra fuel is injected into the exhaust stream to superheat the soot trapped in the DPF and turn it to ash. Active regeneration happens only when the vehicle is moving above a certain speed, determined by the engine manufacturer. Consult manufacturers' documentation for details.

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

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

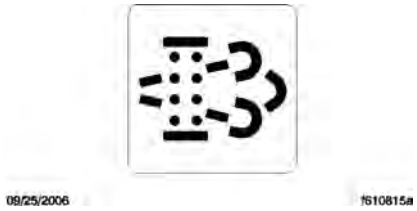


Fig 96, Diesel Particulate Filter (DPF) Status Lamp



Fig 97, High Exhaust System Temperature (HEST) Lamp

DANGER:

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

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

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

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

A steadily illuminated HEST lamp alerts the operator of high exhaust temperature during the regeneration process, if vehicle speed is below 5 mph (8 km/h). See Fig.97,High Exhaust System Temperature (HEST) Lamp. The HEST lamp does not indicate the need for any kind of vehicle or engine service; it only alerts the vehicle operator of high exhaust temperatures. Make sure the engine exhaust pipe outlet is not directed at any person, or at any surface or material that will melt, burn, or combust.

WARNING:

When the HEST lamp is on, be certain that the exhaust pipe outlet is not directed at combustible material or toward anyone. To do so could cause damage to the vehicle and serious personal injury to others.

WARNING:

Active regeneration can occur automatically anytime the vehicle is moving. The exhaust gas temperature could reach 1500°F (816°C), which is hot enough to cause a fire, heat damage to objects or materials, or personal injury to persons near the exhaust outlet. See **Regen-Inhibit Switch** later in this chapter for instructions on preventing automatic regen if necessary.

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, vegetation, flammable materials, and anything else that may be harmed by exposure to high heat.

IMPORTANT: Due to the high exhaust temperature during the regen process, a diffuser is used to reduce the temperature at the exhaust pipe outlet. See Fig.98,Exhaust Diffuser. If the diffuser is damaged, it must be replaced to ensure proper operation of the vehicle and to reduce the possibility of damage or injury.

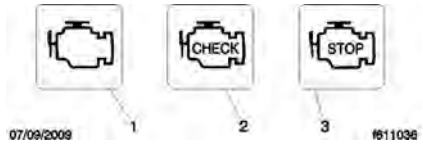


Fig 98, Exhaust Diffuser

A steadily illuminated yellow DPF lamp indicates a regen is required soon. Bring the vehicle to highway speeds to allow for an active regen, or a parked regen should be scheduled for the earliest convenient time. See Fig. 96,Diesel Particulate Filter (DPF) Status Lamp.

IMPORTANT: Failure to regen could cause engine problems, including derate or loss of power. As soon as allowed after the DPF lamp illuminates, maintain highway speeds to allow automatic regeneration, or park the vehicle in a safe location and perform a parked regen.

A DPF lamp blinking at the same time as a steadily illuminated yellow Check Engine lamp indicates that a parked regen must be performed immediately, or an engine derate will occur. If the red Stop Engine lamp illuminates with the blinking DPF lamp and the yellow Check Engine lamp, a parked regen must occur or an engine shutdown will occur. Park the vehicle and perform a parked regen. See Fig.99,Engine Protection Lamps and Fig.100,Regen Switch.



1. Malfunction Indicator Lamp (MIL)
2. Check-Engine Lamp
3. Stop-Engine Lamp

Fig 99, Engine Protection Lamps



Fig 100, Regen Switch

The DPF regen switch, located on the dash, may have three selectable positions:

- Request Regeneration
- Default (can include appropriate normal state conditioneither in an automatic regeneration or inhibit state)
- Inhibit regeneration (optional when available)

NOTE: The regen switch can start a regen only when at least one of two conditions exists: either the DPF lamp is lit, or the engine software calls for it. If neither of those conditions exist, the regen switch cannot cause a regen to happen.

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

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

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

A steadily illuminated Malfunction Indicator Lamp (MIL) indicates an engine fault that affects the emissions. See Fig. .

10.03.02 High-Soot-Load Idle Shutdown

Extended idle operation can cause soot to accumulate in the DPF, which can eventually trigger an ECM fault, cause the Stop Engine lamp to illuminate, and require replacement of the DPF. The High-Soot-Load Idle Shutdown feature (if equipped), determines if the extended engine idling needs to be shut down before there is a triggering of the stop engine warning.

The High-Soot-Load Idle Shutdown feature monitors the soot load during the idle or high-idle operation. If high-soot-load occurs, the DPF lamp will illuminate, then the Check Engine lamp will flash for 30 seconds, before the engine shuts down.

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11. Transmission

11.01 Driving Precautions

The vehicle operator should use care when accelerating or downshifting on slippery road surfaces. Sudden acceleration or engine braking, caused by shifting to a lower gear range, can result in a loss of vehicle control. This is very important on snow or ice covered roads. See 14.01.01 Primary Air Brake System for information on brake operation.

If the vehicle is stuck in sand or mud, do not attempt to pull the vehicle out under its own power. Request professional towing assistance.

NOTICE:

Do not attempt to rock the vehicle. If rocking the vehicle is necessary, even at low speeds, it may cause engine overheating, axle damage, transmission damage or failure, or tire damage.

Do not coast the vehicle in neutral. Severe transmission damage may result and the vehicle will not have the benefit of engine braking.

WARNING:

To reduce the risk of personal injury, before going down a steep or long grade, reduce speed and downshift the transmission. Do not hold the brake pedal down too long or too often while going down a steep or long grade. This could cause the brakes to overheat, reducing their effectiveness. As a result, the vehicle will not slow down at the usual rate. Failure to take these steps could result in loss of vehicle control.

To avoid skidding on slippery roads, do not downshift into **L** (low) at speeds above 20 mph (32 km/h).

On slippery surfaces, avoid quick movements of the steering wheel. Decrease speed and allow for extra stopping distance required by these conditions. For non-ABS brakes, apply the brakes by pumping the pedal steadily and evenly to avoid wheel lock-up and loss of vehicle control.

Avoid driving through flooded areas unless you are sure the water is no higher than the bottom of the wheel rims. Drive through slowly. Allow adequate stopping distance since wet brakes do not grip well. After driving through water, gently apply the brakes several times while the vehicle is moving slowly to dry the brakes.

When driving on icy or graveled surfaces, reduce speed. Avoid sharp turning maneuvers.

11.02 Allison On-Highway Transmissions

11.02.01 General Description

The Allison on-highway transmissions are fully automatic and include the 2100 Series, B210 Series, 2200 Series, B220 Series, 2500 Series, 3000 Series, and B300 Series. For Allison Transmission Operators Manual and Warranty Information for on-highway vehicle applications, see www.allisontransmission.com/my-allison/customer or scan the QR code for additional information. See Fig.101,Allison Transmission QR Code.



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Fig 101, Allison Transmission QR Code

11.02.02 Safety Precautions

2000 and B200 Series Without Auto-Apply Parking Brake

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 Allison 2000 or B200 series transmissions, do the following steps if you have to leave the vehicle with the engine running (for example, when checking the transmission fluid).

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.

2000 and B200 Series With Auto-Apply Parking Brake

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 Allison 2000 or B200 series transmissions, do the following steps if you have to leave the vehicle with the engine running (for example, when checking the transmission fluid).

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 so 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.

11.02.03 Range Inhibit Indicator, 2000 and B200 Series

A RANGE INHIBIT indicator is a standard feature of the 2000 and B200 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 transmission control module (TCM), the controls will lock the transmission in the current operating range.

Shift inhibits occur under the following conditions:

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

11.02.04 Operating Instructions, 2000 and B200 Series Transmissions

2000 and B200 series transmissions are electronically controlled. The shift selector provides four forward ranges and one reverse range. A T-handle shift control is used by the driver to select the ranges. See Fig.102,T-Handle Shifter (standard).

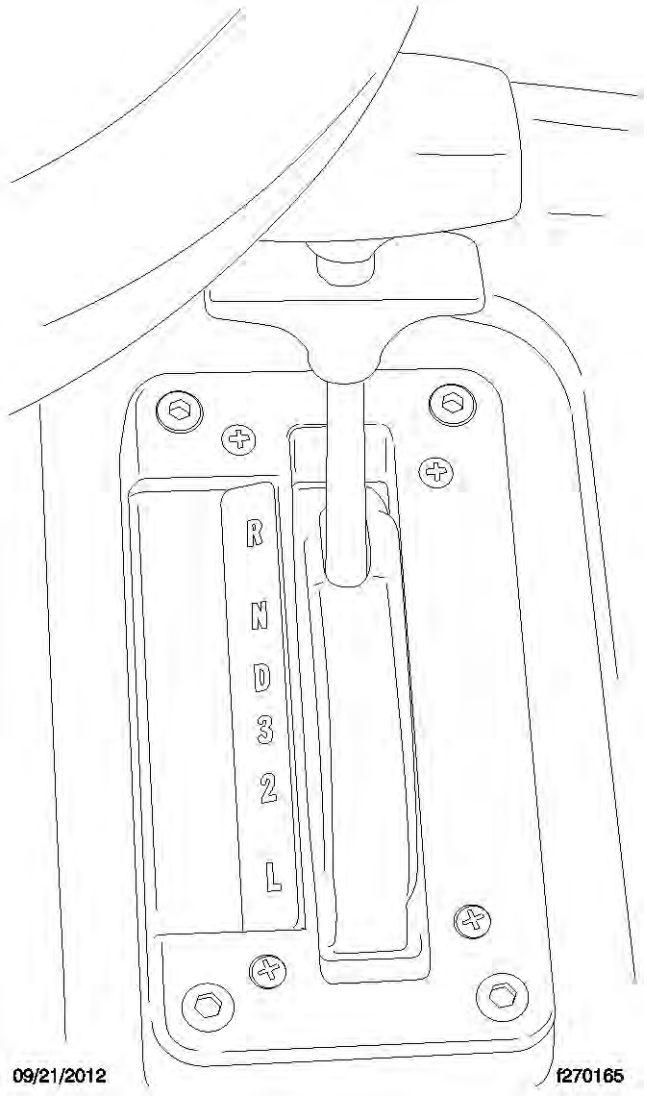


Fig 102, T-Handle Shifter (standard)

P (Park)

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

NOTE: This does not apply the parking brake. The park pawl is standard on the 2200 series transmission. The park pawl effectively grounds the transmission output shaft, thereby preventing rotation of the driveline. Provided the vehicle is stationary, selecting **P** (park) on the shift selector, if so equipped, places the transmission in neutral and engages the park pawl.

PB (Auto-Apply Parking Brake, optional on 2000 and B200 Series)

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

R (Reverse)

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

Do not idle in reverse for more than 5 minutes. When time at idle exceeds 5 minutes, select **N** (neutral), or if so equipped, **P** (park) or **PB** (auto-apply parking brake).

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. 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.

This position is used when starting the engine and for stationary operation. It is also used to shut down the vehicle when **P** (park) or **PB** (auto-apply parking brake) are not available on the shifter. In this case, the parking brake must be applied.

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

D (Drive)

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 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.

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

3 and 2 (Third and Second Ranges)

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

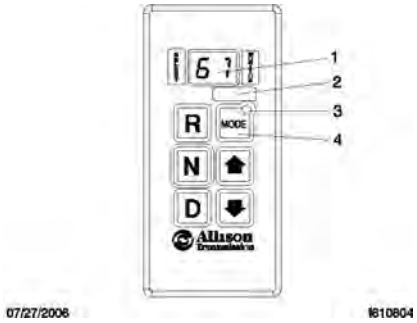
L (Low Range)

Use low range when pulling through mud or deep snow, when maneuvering in tight spaces, or when driving up or down very steep grades. Low 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).

11.02.05 Operating Instructions, 3000 and B300 Series

The Allison 3000 and B300 series transmissions are electronically controlled and have a push-button shift control that provides five or six forward ranges and one reverse range. The push-button shift selector has **R** (reverse), **N** (neutral), and **D** (drive) ranges, up and down arrows, a mode button, and a digital display. See Fig.103,Push-Button Shift Selector.



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

Fig 103, Push-Button Shift Selector

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.

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 show **N** when neutral is selected. It is not necessary to press neutral before starting the vehicle. The electronic control unit (ECU) or TCM automatically places the transmission in neutral at start-up.

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 the driver could lose control of the vehicle.

Always select neutral before turning off the engine.

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 show the selected 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. Continuously pressing the up arrow causes the range position to continue to rise until the button is released or the highest available position is attained.

Continuously 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 selection 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 3000 and B300 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 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.

11.03 Eaton® Fuller® Straight-Shift Transmissions

11.03.01 General Information, Straight-Shift

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

Eaton Fuller 5-speed FS models are fully synchronized. They have five forward speeds and one reverse. See Fig. 104,Shift Pattern, 5-Speed FS Models for the shift pattern.

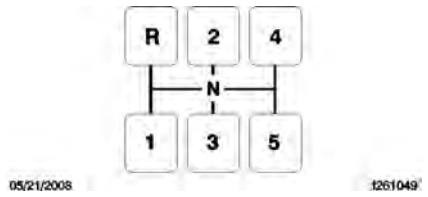


Fig 104, Shift Pattern, 5-Speed FS Models

Eaton Fuller 6-speed FS and FSO models are fully synchronized. They have six forward speeds and one reverse. See Fig. 105,Shift Pattern, 6-Speed FS and FSO Models for the shift pattern.

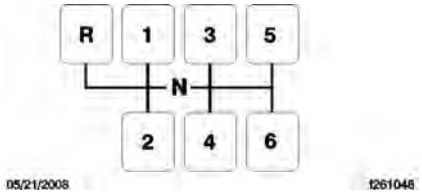


Fig 105, Shift Pattern, 6-Speed FS and FSO Models

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.

11.03.02 Operation, Straight-Shift

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

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

NOTICE:
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, depress the 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.a Accelerate to engine governed speed.
   - 3.b On synchronized models, depress the clutch pedal and move the shift lever to second gear.

     On unsynchronized models, depress the clutch pedal and move the shift lever to neutral. Release the clutch pedal again. With the shift lever in neutral, depress the clutch pedal and move the shift lever to second gear.
   - 3.c Release the clutch pedal and note the drop in engine rpm before accelerating up to engine governed speed again.
   - 3.d 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.a Wait until the engine speed drops to the rpm noted immediately after the upshift.
   - 4.b On synchronized models, depress the clutch pedal and move the shift lever to the next lower gear.

     On unsynchronized models, depress the clutch pedal and move the shift lever to neutral. Release the clutch pedal again. With the shift lever in neutral, depress the clutch pedal and move the shift lever to the next lower gear.

4.c Release the clutch pedal smoothly.

4.d Use the sequence described above to shift progressively down through each successive lower gear, as driving conditions require.

11.04 Clutches

11.04.01 Operation of the Clutch

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 allow the vehicle to coast with the clutch released (pedal down) and the transmission in gear. If the clutch facing is thrown off the disc, flying debris could cause injury to persons in the vehicle.

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

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

Engaging the Clutch While Coasting

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

Report Erratic Clutch Operation Promptly

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



CAUTION:

Operating the vehicle with incorrect clutch pedal free-travel could result in clutch damage. See **Group 25** of the **S2 Chassis 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.

11.04.02 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.

11.04.03 Adjustments of the Clutch

Some clutches have an internal adjustment. See the applicable section in **Group 25** of the **S2 Chassis 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.

11.04.04 Lubrication of the Clutch

The release bearing should be lubricated at frequent intervals. See **Group 25** of the **S2 Chassis 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.

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12. Drive Axles

12.01 Drive Axles, Detroit™ and Meritor™

12.01.01 Drive Axles With Differential Lock

For additional information regarding Meritor axles, visit the Meritor website, see www.meritor.com.

The optional driver-controlled differential lock should only be used under adverse road conditions where greater traction is needed. With the differential lock on, the turning radius is increased and vehicle handling is affected. The red differential lock indicator light illuminates on the dash message center when the differential lock is engaged.

A 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. Do not exceed 25 mph (40 km/h) when the differential lock is engaged.

Under normal traction conditions, do not use the differential lock feature.

12.01.02 Differential Lock Switch

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

A two-position guarded rocker switch controls the differential lock. See Fig.106,Differential Lock Switch, Optional. To lock the wheels together, momentarily press the upper half of the switch. To unlock the wheels, press the upper half of the switch again.

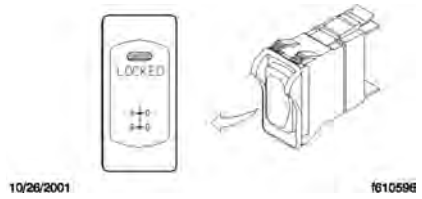


Fig 106, Differential Lock Switch, Optional

IMPORTANT: The differential lock rocker switch is guarded to prevent unintentional switch activation. If the light emitting diode (LED) in the switch begins to blink during normal operation, when the switch has not been activated, an error condition exists. 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 remains illuminated constantly. 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 remains illuminated when the differential lock is engaged.

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.

12.01.03 Operation of the Differential Lock

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.

NOTICE:
The differential lock should be engaged when the vehicle is stopped or moving at a low, constant speed and the wheels are not spinning, slipping, or losing traction. Engagement at high speed or power can damage the axle(s).

Do not permit rear wheels to spin freely for more than ten seconds when traction is lost. Shift into lock to prevent damage to interaxle and main differentials.

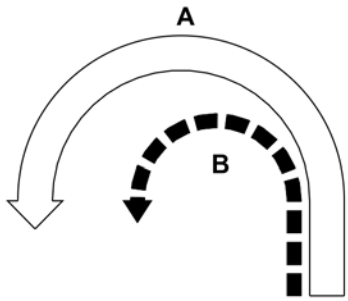
Lock the wheels only when the vehicle is standing still or moving at very low speed, less than 5 mph (8 km/h). Never lock the wheels when the vehicle is traveling down steep grades or when the wheels are slipping.

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.107,Turning Radii. 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 107, Turning Radii

To disengage the differential lock after leaving poor road conditions, press the upper half of the switch, 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.

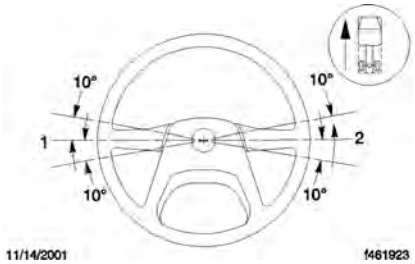
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13. Steering System

13.01 Steering Controls

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

When there is no load on the vehicle and the front tires are pointed straight ahead, the steering wheel spokes should be at the 9 o'clock and 3 o'clock positions, or within 10 degrees to either side as shown in Fig.108,Steering Wheel Centered. See of the **S2 Chassis Workshop Manual** for steering adjustment procedures.

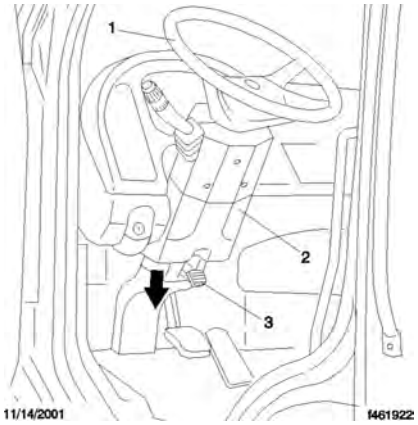


1. 9 o'Clock
2. 3 o'Clock

Fig 108, Steering Wheel Centered

On some vehicles, the steering column may be tilted forward or aft to provide the most comfortable angle for steering the vehicle. The steering column can also be telescoped (raised or lowered) to provide the most comfortable height above the floor.

To tilt the steering column, press down on the foot pedal located below the steering wheel to release the steering column lock. Adjust the column to the desired position. Release the foot pedal to lock the steering column in place. See Fig. 109,Adjustable Steering Column.



NOTE: Push the foot pedal down to adjust the steering column.

1. Steering Wheel
2. Steering Column
3. Foot Pedal

Fig 109, Adjustable Steering Column

To telescope the steering column, press down on the foot pedal to release the steering column lock. Pull the steering wheel upwards or push the steering wheel downwards until it is at the desired height. Release the foot pedal to lock the steering column in place.

NOTE: For safety, the steering column is locked at all times unless the foot pedal is pressed down.

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14. Hydraulic and Air Brake Systems

14.01 Dual Air Brake System

14.01.01 Primary Air Brake System

A dual air brake system consists of two independent air brake systems that use a single set of brake controls. Each system has its own reservoir, plumbing, and brake chambers. The primary air system operates the service brakes on the rear axle; the secondary air system operates the service brakes on the front axle.

Loss of air pressure in the primary air system causes the rear service brakes to become inoperative. The front brakes will continue to be operated by the secondary air system.

14.01.02 Secondary Air Brake System

A dual air brake system consists of two independent air brake systems that use a single set of brake controls. Each system has its own reservoir, plumbing, and brake chambers. The primary air system operates the service brakes on the rear axle; the secondary air system operates the service brakes on the front axle.

Loss of air pressure in the secondary air system causes the front axle brakes to become inoperative. The rear service brakes will continue to be operated by the primary air system.

14.01.03 Emergency Braking System

A dual air brake system consists of two independent air brake systems that use a single set of brake controls. Each system has its own reservoir, plumbing, and brake chambers. The primary air system operates the service brakes on the rear axle; the secondary air system operates the service brakes on the front axle.

When air pressure is lost in one air system, the air compressor will operate, but the air supply in the leaking system will not be replenished. There will be enough air in the working system to stop the vehicle safely. The dual air brake system thus provides emergency braking capability. When the low air pressure warning light and emergency buzzer first come on, stop the vehicle immediately. Do not drive the vehicle until the cause of the problem is corrected.

14.01.04 Parking Brakes

Pulling out the yellow diamond-shaped knob (parking brake control valve) on the auxiliary dash panel applies the parking brakes (spring brakes). See Fig.110,Parking Brake Control Valve.



Fig 110, Parking Brake Control Valve

14.02 Operation of the Air Brake

14.02.01 Parking Brake Interlock, Optional

Parking Brake Interlock Release



WARNING:
Do not operate the vehicle with the front brakes backed off or disconnected. Backing off or disconnecting the front brakes will not improve vehicle handling and may lead to loss of vehicle control, resulting in property damage or personal injury.

Before driving the vehicle, secure all loose items in the vehicle so that they will not fly forward during a full brake application.



NOTICE:
Do not continually press down on the parking brake control valve (yellow knob) without pressing down on the service brake pedal. This will damage the safety interlock.

The service brakes and parking brakes have a safety interlock that prevents the unintentional release of the parking brake. These instructions need to be followed for the appropriately equipped vehicle to release the parking brake interlock.

1. Depress the brake pedal.
2. Push the parking brake control valve in.

Parking Brake and Ignition Key Release



WARNING:
Do not operate the vehicle with the front brakes backed off or disconnected. Backing off or disconnecting the front brakes will not improve vehicle handling and may lead to loss of vehicle control, resulting in property damage or personal injury.

Before driving the vehicle, secure all loose items in the vehicle so that they will not fly forward during a full brake application.



NOTICE:
Do not continually press down on the parking brake control valve (yellow knob) without pressing down on the service brake pedal. This will damage the safety interlock.

The service brakes and parking brakes have a safety interlock that prevents the unintentional release of the parking brake. These instructions need to be followed for the appropriately equipped vehicle to release the parking brake interlock.

1. Turn the ignition key to the ON position.
2. Depress the brake pedal.
3. Push the parking brake control valve in.

Parking Brake, Ignition Key, Wheel Chair Lift Interlock Release



WARNING:

Do not operate the vehicle with the front brakes backed off or disconnected. Backing off or disconnecting the front brakes will not improve vehicle handling and may lead to loss of vehicle control, resulting in property damage or personal injury.

Before driving the vehicle, secure all loose items in the vehicle so that they will not fly forward during a full brake application.



NOTICE:

Do not continually press down on the parking brake control valve (yellow knob) without pressing down on the service brake pedal. This will damage the safety interlock.

The service brakes and parking brakes have a safety interlock that prevents the unintentional release of the parking brake. These instructions need to be followed for the appropriately equipped vehicle to release the parking brake interlock.

1. Turn the ignition key to the ON position.
2. Check to see that the wheel chair lift is in the stowed position.
3. Confirm that the wheel chair lift switch is in the OFF position.
4. Depress the brake pedal.
5. Push the parking brake control valve in.

Transmission Shifter Interlock Release



WARNING:

Do not operate the vehicle with the front brakes backed off or disconnected. Backing off or disconnecting the front brakes will not improve vehicle handling and may lead to loss of vehicle control, resulting in property damage or personal injury.

Before driving the vehicle, secure all loose items in the vehicle so that they will not fly forward during a full brake application.



NOTICE:

Do not continually press down on the parking brake control valve (yellow knob) without pressing down on the service brake pedal. This will damage the safety interlock.

The service brakes and parking brakes have a safety interlock that prevents the unintentional release of the parking brake. These instructions need to be followed for the appropriately equipped vehicle to release the parking brake interlock.

1. If the vehicle is equipped with a wheel chair lift, make sure the lift is in the stowed position, and that the wheel chair lift switch is in the OFF position.
2. Depress the service brake pedal to move the vehicle shifter out of the park position.

Operating the Brakes

WARNING:

Do not operate the vehicle with the front brakes backed off or disconnected. Backing off or disconnecting the front brakes will not improve vehicle handling and may lead to loss of vehicle control, resulting in property damage or personal injury.

Before driving the vehicle, secure all loose items in the vehicle so that they will not fly forward during a full brake application.

NOTICE:

Do not continually press down on the parking brake control valve (yellow knob) without pressing down on the service brake pedal. This will damage the safety interlock.

The service brakes and parking brakes have a safety interlock that prevents the unintentional release of the parking brake. These instructions need to be followed for the appropriately equipped vehicle to release the parking brake interlock.

To ensure safe operation and minimum brake wear, follow the steps below when operating the brakes.

1. When the ignition switch is turned on, the low air pressure warning light (pressure circle icon) illuminates and the emergency buzzer sounds.
   - 1.a Monitor the air pressure system by observing the low air pressure warning light, the emergency buzzer, and both the primary and secondary air pressure gauges.
   - 1.b The warning light and buzzer shut off when air pressure in both systems reaches 65 to 75 psi (448 to 517 kPa).
2. Before driving the vehicle, continue to monitor the air pressure system until the air compressor has built up a minimum pressure of 95 psi (655 kPa) in both the primary and secondary air systems.
3. While driving, the low air pressure warning light and buzzer come on if air pressure drops below 65 to 75 psi (448 to 517 kPa) in either system.
   - 3.a If this happens, check the air system pressure gauges to determine which system has low air pressure.
   - 3.b Although vehicle speed can be reduced using the service brake, either the front or rear service brakes will not be operating, causing a longer stopping distance.
   - 3.c Bring the vehicle to a safe stop and have the air system repaired before continuing.
4. During normal brake stops, depress the service brake until braking action slows down the vehicle. Increase or decrease the pressure on the pedal so that the vehicle comes to a smooth, safe stop.

   IMPORTANT: In the event of a total loss of service brakes, use the parking brake control valve to bring the vehicle to a complete stop in the safest location possible.

5. When the forward speed of the vehicle has decreased almost to the idling speed of the engine, press in the clutch pedal (on manual transmissions) and shift the transmission to neutral. Apply the parking brakes, if the vehicle is to be parked.

NOTICE:

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

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

Caging the Parking Brakes

WARNING:

Do not operate the vehicle with the front brakes backed off or disconnected. Backing off or disconnecting the front brakes will not improve vehicle handling and may lead to loss of vehicle control, resulting in property damage or personal injury.

Before driving the vehicle, secure all loose items in the vehicle so that they will not fly forward during a full brake application.

NOTICE:

Do not continually press down on the parking brake control valve (yellow knob) without pressing down on the service brake pedal. This will damage the safety interlock.

The service brakes and parking brakes have a safety interlock that prevents the unintentional release of the parking brake. These instructions need to be followed for the appropriately equipped vehicle to release the parking brake interlock.

WARNING:

Do not drive the vehicle with the parking brakes caged. If the vehicle is driven with the parking brakes caged, there would be no means of stopping the vehicle if a complete loss of air pressure occurred. This could result in serious personal injury or vehicle damage.

To move a vehicle with insufficient system air pressure, it is necessary to release the parking brake springs.

There are two ways to do this:

- Apply an external air source at the gladhands;
- Cage (manually release) the parking brakes.

IMPORTANT: Before caging the parking brakes, make the connection to a towing vehicle or chock the tires.

After correcting the brake system problem, uncage the parking brakes before resuming normal vehicle operation.

14.03 Bosch Hydraulic Pin Slide Brakes

14.03.01 General Information

The Bosch hydraulic pin slide disc brake is a two-piston sliding caliper brake and is used at both the front and rear wheel locations. Each pin slide caliper disc brake wheel installation is made up of a caliper assembly, anchor plate assembly, and disc brake pads.

Caliper Assembly

The caliper assembly has two hydraulic piston bores. The piston bores contain pistons, piston seals, and piston boots. The caliper assembly attaches and slides on sealed pins located in the anchor plate. The caliper housing is the main component of the caliper assembly. The material of the caliper housing is ductile iron and has a protective coating to provide additional environmental protection. The disc brake caliper housing straddles the rotor, the inner pad, and the outer pad.

Anchor Plate Assembly

The anchor plate assembly includes lubricated floating guide pins sealed by rubber boots. The anchor plate abutments are protected by stainless steel slippers.

Disc Brake Pads

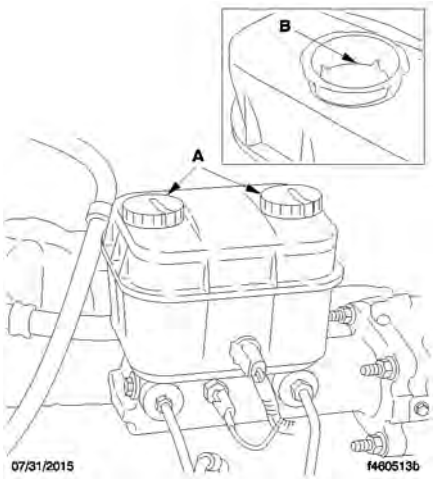
There are two pads per caliper assembly, and they are the inner and outer pads. The inner pad is located between the caliper piston and rotor. The outer pad is located between the rotor and caliper housing legs. The pads are made of friction material and a stamped steel backing plate. The pads are referred to as the shoe and lining assembly. These brake pads can be removed without removing the caliper.

14.03.02 Operation

Before driving the vehicle, secure all loose items in the vehicle so that they will not fly forward during a full brake application. Check that the brake system warning light is off after releasing the hand brake. If the warning light does not go off, correct the problem before continuing operation of the vehicle.

During normal braking stops, depress the foot brake control pedal until braking action slows down the vehicle. Increase or decrease the pressure on the pedal so that the vehicle comes to a smooth, safe stop. Apply the hand parking brake if the vehicle is to be parked.

IMPORTANT: Make sure that the fluid level in the main cylinder reservoirs is at the bottom of the fill-neck. See Fig. 111,Main Cylinder Reservoir. Use only DOT 3 brake fluid in the Bosch hydraulic pin slide brake system.



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

Fig 111, Main Cylinder Reservoir

14.04 Meritor Cam-Main® Q Plus Brakes

14.04.01 General Description

Cam-Main brakes are air-actuated, cam-operated, foundation brakes. The Q Plus increases service life and mileage between relines by providing more lining thickness. A specially designed S-cam and heavy-duty shoe return spring allow additional shoe travel required to fully wear the thicker lining blocks. An improved camshaft bushing contributes to longer service life.

14.04.02 Operation of the Cam-Main Q Plus

When the brake pedal is depressed, compressed air enters the brake chamber, causing the diaphragm to move a pushrod assembly.

The pushrod turns the slack adjuster and brake camshaft. As the camshaft turns, the S-type cam head forces the brake shoes against the brake drum and braking occurs.

When the brakes are released and air is exhausted from the brake chamber, the actuator return spring (within the brake chamber) and the brake shoe return spring return the camshaft, brake shoes, slack adjuster, and pushrod to their released positions.

14.05 Meritor WABCO Pneumatic Antilock Braking System (ABS)

14.05.01 Operation of the Pneumatic ABS

Pneumatic ABS is an electronic wheel speed monitoring and control system that works with the air brake system. It passively monitors vehicle wheel speed at all times, but **controls** wheel speed during an emergency or reduced-traction stop. In normal braking applications, the standard air brake system is in effect.

The Meritor WABCO ABS is a four-sensor system. It combines one front-axle control channel with one rear-axle control channel to form one control circuit.

Example: The sensor and solenoid control valve at the left front wheel form a control circuit with the sensor and solenoid valve at the right rear axle.

ABS includes signal-generating tone wheels and sensors located in the wheel hubs of each sensed axle. The sensors transmit vehicle wheel speed information to an electronic control unit.

IMPORTANT: For proper ABS system operation, do not change tire sizes. The sizes of the tires installed during production are programmed into the electronic control unit. Installing different sized tires could result in a reduced braking force, leading to longer stopping distances.

During emergency or reduced traction stops, fully depress the brake pedal until the vehicle comes to a safe stop. Do **not** pump the brake pedal. With the brake pedal fully depressed, the ABS system will control all wheels to provide steering control and a reduced braking distance.

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

Even if the ABS system is partially or completely inoperative, normal braking ability is usually maintained.

IMPORTANT: If a solenoid control valve (or combination solenoid control valve) is damaged and inoperative, normal braking may be impaired.

14.05.02 Automatic Traction Control

Vehicles with electronic engines and ABS may have Automatic Traction Control (ATC). On these vehicles, the ATC system automatically limits wheel spin during reduced-traction situations. In normal braking applications, the standard air brake system is in effect.

During reduced-traction situations, the ATC solenoid valve controls air pressure to the modulator valves and they in turn increase, hold, or reduce pressure to the appropriate brake chambers to provide better traction whenever wheel spin occurs.

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

ATC may include a deep snow and mud option to increase available traction on extra soft surfaces like snow, mud, or gravel. If so equipped, a momentary contact rocker switch labeled ATC will be located on the dash. Pressing the switch will temporarily allow more wheel spin. The activation of the deep snow and mud option is indicated by a flashing WHEEL SPIN lamp. Pressing the switch again will cycle the system back to normal operation.



NOTICE:

The deep snow and mud option is intended to be used under specific slippery conditions that require momentary increased wheel spin. Using this option for an extended period of time may damage the vehicle brake system.

After the ignition switch is turned on, the ABS indicator light and the WHEEL SPIN indicator light illuminate for about three seconds. After three seconds, the warning lights go out if all of the ABS components are working.

During vehicle operation, solid illumination of the ABS light indicates a problem with the vehicle ABS. Repair the ABS immediately to ensure full braking capability.

If equipped with ATC, an amber WHEEL SPIN indicator light illuminates if one of the drive wheels spins during acceleration. When the light illuminates, partially release the throttle pedal to stop the spinning wheel. The light goes out when the wheel stops spinning.

If slippery road conditions continue, turn on the differential lock switch. See 12.01.01 Drive Axles With Differential Lock for axle switch instructions.



NOTICE:

Do not turn the differential lock switch on while the WHEEL SPIN indicator light is on. To do so could damage the rear axle.

14.05.03 Adjusters of the Automatic Slack



NOTICE:

Manually adjusting an automatic slack adjuster to bring the pushrod stroke within legal limits is likely masking a mechanical problem. Adjustment is not repairing. In fact, continual adjustment of automatic slack adjusters may result in premature wear of the adjuster itself. Further, the improper adjustment of some automatic slack adjusters may cause internal damage to the adjuster, thereby preventing it from properly functioning.

Automatic slack adjusters should never be manually adjusted except during routine maintenance of the foundation brakes (e.g., replacing shoes), during slack adjuster installation, or in an emergency situation.

When the brake pushrod stroke exceeds the legal brake adjustment limit on a vehicle, there is likely a mechanical problem with the foundation brake components or the adjuster is improperly installed.

Visit a repair facility as soon as possible when brakes equipped with automatic slack adjusters are determined to be out of adjustment.

14.06 Exhaust Brake

14.06.01 General Information

An exhaust brake is an optional auxiliary braking system that assists, but does not replace, the service brake system. The driver can use the exhaust brake, in combination with the accelerator and clutch pedal (if so equipped), to make maximum use of the exhaust brake in off-highway and mountain driving as well as in traffic or high-speed highway driving.

The exhaust brake is controlled by a dash-mounted rocker switch, shown in Fig.112,Exhaust Brake 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 switch. When the exhaust brake switch is on, an amber light emitting diode (LED) illuminates inside the switch. When the panel lights are on, the EXHST BRK legend is backlit in green.



Fig 112, Exhaust Brake Switch

The exhaust brake is only active when 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.

14.06.02 Starting the Engine

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.

14.06.03 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.

When you remove your feet from both the accelerator and clutch pedal (if so equipped), and the upper half of the exhaust brake switch is pressed in with the amber LED 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 as 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, the driver 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.

14.06.04 Driving Downhill

While approaching a steep grade, make sure that the upper half of the exhaust brake switch is pressed in, with the amber LED 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.

14.06.05 Shutting Down the Engine

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

14.07 Engine Brake

14.07.01 Engine Brake Switch

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

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

To turn the two-position Hi-Lo Switch on high, raise the paddle. To turn the two-position Hi-Lo Switch on low, lower the paddle. See Fig.113,Engine Brake Switches.



1. On/Off Switch
2. Hi-Lo Switch

Fig 113, Engine Brake Switches

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.

When the panel lights are on, the Hi-Lo icon is backlit in amber on the three-position switch. On both the three-position switch and the two-position switch, the ENG BRK legend is backlit in green when the panel lights are on.

14.07.02 Constant-Throttle Valves

To increase braking performance, Mercedes-Benz engines are equipped with optional constant-throttle valves in each combustion chamber. Small valves built into the cylinder head allow a small amount of compressed air to escape through the exhaust port during the combustion stroke. The constant-throttle valves are open during the entire time that the engine brake is activated. Although some braking ability is lost because the valves are constantly open, constant-throttle braking is quieter in operation than other types of engine brakes.

When both the exhaust brake and the constant throttles are installed, a three-position switch on the dash controls the amount of engine braking delivered. Like the exhaust brake, the constant throttles are deactivated when the accelerator or clutch pedal is depressed. The ABS system, when active, also deactivates constant-throttle braking.

The engine brake will deactivate if the engine speed falls below a preset level. This level is programmable, but is set at the factory at 1100 rpm.

14.08 Brake Burnishing (new vehicle)

IMPORTANT: Check the brake system and ensure that it is in proper operating condition before attempting the brake burnishing procedure.

1. In a safe area, make 10 sharp brake applications or "snubs," slowing the vehicle from 40 to 20 mph (64 to 32 km/h) using light (approximately 10 to 20 psi [69 to 138 kPa]) brake pressure.
2. Make 10 stops from 20 mph (32 km/h) using moderate (20 to 30 psi [138 to 207 kPa]) brake pressure.
3. Make 2 stops from 20 mph (32 km/h) using hard (full application of air pressure) brake applications.

   NOTE: After the hard brake applications, it is normal to notice a hot brake odor.

4. Drive the vehicle 5 to 7 miles (8 to 11 km) allowing the brakes to cool, and then come to a stop.

   NOTE: After performing the burnishing procedure, there should be no brake noise and the brakes should have good stopping ability.

5. If the brakes pull the vehicle to one side or grab after the burnishing procedure, contact a Freightliner dealer for assistance.

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15.02 Daily Pretrip Inspection and Maintenance Checklist 142
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15. Pre- and Post-Trip Checklists

15.01 Pretrip and Post-Trip General Information

Regulations in both Canada and the United States clearly indicate that it is the driver's responsibility to perform an inspection and ensure the complete road-worthiness of a vehicle before placing it into service for the day. Commercial vehicles may be subject to inspection by authorized inspectors, and an unsafe vehicle can be put "out of service" until the driver or owner repairs it.

IMPORTANT: The pre- and post-trip checklists, and inspections and maintenance procedures detailed in this chapter, are **not all-inclusive**. Also refer to other component and body manufacturers' instructions for specific inspection and maintenance instructions.

Use the pretrip inspection checklist to ensure that vehicle components are in good working condition before each trip. Use the weekly and monthly post-trip inspection checklists to note any items that require attention before the next trip. A driver that is familiar with the vehicle, and drives it regularly, can perform the daily inspections, then add the weekly and monthly post-trip inspections as scheduled. If the driver does not operate the vehicle on a consistent basis, all three of the inspection procedures should be performed before the trip.

Pre- and post-trip inspections cannot be done quickly. However, careful inspections save time by eliminating stops later to adjust items overlooked or forgotten.

Numbers in parentheses within each of the checklists reference the corresponding detailed instructions found under "Daily (D), Weekly (W), or Monthly (M) Procedures" in 16.01 Safety Precautions.

If any system or component does not pass this inspection, it must be corrected before operating the vehicle. Whenever equipment requires adjustment, replacement, repair, addition of lubricants, or a change of lubricants, see the **S2 Chassis Workshop Manual** for procedures and specifications, or take the vehicle to an authorized Freightliner dealer.

15.02 Daily Pretrip Inspection and Maintenance Checklist

IMPORTANT: Before performing any of these checks, apply the parking brake and chock the tires.

For the daily pretrip inspection and maintenance checklist see Table.13,Daily Pretrip Inspection and Maintenance Checklist.

Table 13, Daily Pretrip Inspection and Maintenance Checklist

Procedure Performed (check off)	Daily Pretrip Inspections/Checks	Procedure Reference
_____	Drain manually drained air reservoirs (that are not equipped with automatic drain valves)	D1
Check _____	windshield washer reservoir fluid	D2
Inspect _____	wheel seal and hub cap (for leakage)	
Check _____	surge tank coolant level	D3
Inspect _____	radiator and charge air cooler	D4
Check _____	engine for fuel, oil, or coolant leaks	
Inspect _____	engine and chassis wiring	D5
Inspect _____	air intake system	D6

Procedure Performed (check off)	Daily Pretrip Inspections/Checks	Procedure Reference
Check _____	intake-air restriction indicator mounted on air intake	D6
Check _____	engine oil level	D7
Check _____	power steering fluid level	
Inspect _____	fuel tank(s), fuel lines, and connections	D8
Check _____	fuel level	D9
Check _____	fuel/water separator	D10
Inspect _____	front and rear suspension components	D11
Inspect _____	headlights, mirrors, and window glass, and windshield wipers	D12
Check _____	doors (open without difficulty and close securely)	
_____	Adjust driver's seat, then align rearview and downview mirrors	
Check _____	dash-mounted intake-air restriction indicator	D6
Check _____	oil- and air-pressure warning systems	D13
Check _____	ICU fault codes	D14
Check _____	horn, windshield wipers, and windshield washer	D15
Check _____	heater, defroster, and optional mirror heat controls	D16
Check _____	backup alarm	
Check _____	panel lights and interior lights	D17
Check _____	exterior lights and reflectors	D18
Check _____	tire pressure	D19
Inspect _____	tire condition	D20
Inspect _____	rims and wheels	D21
Check _____	automatic transmission fluid level	
Inspect _____	air brake chambers and pushrods	D22
Inspect _____	air brake lines	D23
Inspect _____	slack adjusters	D24
Check _____	air brake system operation	D25

Procedure Performed (check off)	Daily Pretrip Inspections/Checks	Procedure Reference
Check _____	Bendix® Hydro-Max Power Booster	D26
Inspect _____	frame rails (missing bolts), crossmembers (bent or loose)	
Check _____	mud flaps (aren't damaged, at least 10 inches above the ground, and brackets are secure)	
Check _____	exhaust system (mounted securely, connected tightly, no signs of leaks such as soot trails)	
_____	Remove chocks and test service brakes	D27
Inspector_____ Date _____		

Table 13, Daily Pretrip Inspection and Maintenance Checklist

15.03 Weekly Post-Trip Inspection and Maintenance Checklist

IMPORTANT: Before performing any of these checks, apply the parking brake and chock the tires.

For the weekly post-trip inspection and maintenance checklist, see Table.14,Weekly Post-Trip Inspection and Maintenance Checklist.

Table 14, Weekly Post-Trip Inspection and Maintenance Checklist

Procedure Performed (check off)	Weekly Post-Trip Inspections/Checks	Procedure Reference
_____	Manually drain air reservoirs that are equipped with automatic drain valves	
Inspect _____	batteries and battery cables	W1
Check _____	wheel bearing lubricant level	W2
Inspect _____	steering components	W3
Check _____	serpentine drive belt condition	W4
Check _____	drive belt tension	W5
Inspect _____	seat belts and tether belts	W6
Inspector_____ Date _____		

Table 14, Weekly Post-Trip Inspection and Maintenance Checklist

15.04 Monthly Post-Trip Inspection and Maintenance Checklist

IMPORTANT: Before performing any of these checks, apply the parking brake and chock the tires.

For the monthly post-trip inspection and maintenance checklist, see Table.15,Monthly Post-Trip Inspection and Maintenance Checklist.

Table 15, Monthly Post-Trip Inspection and Maintenance Checklist

Procedure Performed (check off)	Monthly Post-Trip Inspections/Checks	Procedure Reference
_____	Clean the battery terminals	M1
Inspect _____	radiator hoses and heater hoses	M2
Check _____	fluid level in the hydraulic clutch reservoir (if applicable, and if necessary, fill with DOT 4 brake fluid)	
Check _____	fluid level in the hydraulic brake reservoir (if applicable, and if necessary, fill with DOT 3 brake fluid)	M3
Check _____	steering wheel play	M4
Check _____	outer surfaces of the hood and body (for visible surface breaks and damage)	
Check _____	hood tilt damper (attached at both ends)	
Inspect _____	brake lining wear	M5
Inspect _____	driveshaft	
Inspector_____ Date _____		

Table 15, Monthly Post-Trip Inspection and Maintenance Checklist

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16. Pre- and Post-Trip Inspections and Maintenance

16.01 Safety Precautions



DANGER:

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

16.02 Daily Pretrip Inspection and Maintenance Procedures

Whenever equipment requires adjustment, replacement, and/or repair, see the **S2 Chassis Workshop Manual** for procedures and specifications. Specific references to the manual will be found where appropriate.

1. **Drain the brake system air reservoirs (reservoirs without automatic drain valves only).**

   Water and oil normally enter the air reservoir in the form of vapor because of the heat generated during compression. After the water and oil condense, drain the resulting emulsion as follows:



WARNING:

When draining the air reservoir, do not look into the air jets or direct them toward anyone. Dirt or sludge particles may be in the airstream and could cause injury.

   1.a Open the wet tank valve. The drain cock or pull chain drain is located on the forward end of the supply air reservoir, which is connected directly to the air compressor. Block the valve open.

   1.b Exhaust the remaining air and moisture from the system by opening the drain cocks on the bottoms of the remaining air reservoirs. Block the valves open.

   1.c Water and oil emulsion often form pockets that will not drain while compressed air is in the reservoirs. Because of these pockets, leave the valves blocked open during the first part of the pretrip inspection.

   1.d If the drained water is cloudy or oily, it may indicate a problem with the compressor. If oil is allowed to contaminate the air dryer, it will not remove the water from the air brake system, which could adversely affect braking.

2. **Check the fluid level in the windshield washer reservoir.**

   Add washer fluid as needed. Unscrew the cap to add fluid.

WARNING:
Washer fluids may be flammable and poisonous. Do not expose washer fluid to an open flame or any burning material, such as a cigarette. Always comply with the washer fluid manufacturer's recommended safety precautions.

3. **Check the coolant level in the surge tank.**

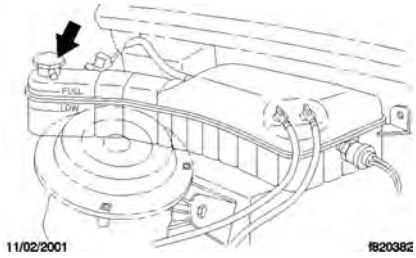
   If the coolant is low, add a 50/50 mixture of water and antifreeze. Refer to the coolant label on the vehicle or the engine manufacturer’s service literature for approved coolants. Coolant used must be compatible with the engine manufacturer’s coolant specifications. For approved coolants, refer to the **Cummins Online** website, see https://www.cummins.com/support/manuals or scan the QR code. See Fig.114,Cummins QR Code. For Detroit engine service literature, refer to the **Detroit Diesel** link on the DTNA TechLit website, see https://www.dtnatechlit.com/portal-public or scan the QR code. See Fig.115,TechLit QR Code.



Fig 114, Cummins QR Code



Fig 115, TechLit QR Code



NOTE: Add coolant here (arrow).

Fig 116, Coolant Level Checking

NOTICE:
Coolant must be filled to the full line of the surge tank. See Fig.116,, page 150. Low coolant could result in engine overheating, which could cause engine damage.

4. **Inspect the radiator and charge air cooler.**
   - 4.a Inspect the radiator and charge air cooler for clogged fins. Use compressed air or water directed from the fan side of the core to backflush any material restricting airflow.
   - 4.b Inspect the radiator and charge air cooler for damage and accumulated debris. Straighten bent or damaged fins to permit airflow across all areas of the cores.

     NOTE: When traveling through areas of high insect concentration, it may be necessary to clean the exterior of the radiator or the charge air cooler core as often as every 200 miles (320 km).

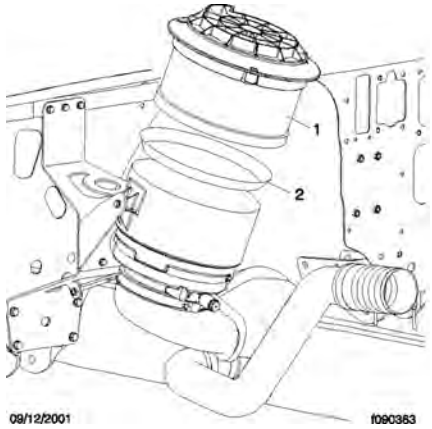
   - 4.c Also inspect and clean the condenser. If clogged, the condenser can restrict airflow through the radiator.
   - 4.d Check the radiator for leaks. If leaks are found, have the radiator repaired or replaced. See General Information, Cooling System Troubleshooting of the **S2 Chassis Workshop Manual** for instructions, or take the vehicle to an authorized Freightliner dealer.
5. **Inspect the engine and chassis wiring.**

   Check for loose wiring, chafed insulation, and damaged or loose hold-down clamps. Tighten loose wires or hold-down clamps; replace damaged wiring or clamps.
6. **Inspect the air intake system for leaks or damage.**

NOTICE:
Failure to maintain a sealed air intake system could allow entry of dirt and contaminants into the engine. This could adversely affect engine performance and result in engine damage.

6.a Check the intake-air restriction indicator.

6.b Replace the primary filter element in the air cleaner if the yellow signal stays locked at 20 in^{H2O} for Mercedes-Benz engines and 25 inH2O for Cummins ISB engines. See Replacement of the Air Intake Duct of the **S2 Chassis Workshop Manual** for filter element replacement instructions, or take the vehicle to an authorized Freightliner dealer. See Fig.117,Air Cleaner Filter Elements.



1. Primary Filter Element
2. Secondary or Safety Filter Element

Fig 117, Air Cleaner Filter Elements

NOTE: After replacing the filter element, reset the restriction indicator by pressing the rubber reset button.

6.c Inspect the secondary or safety filter element in the air cleaner when replacing the primary element, and replace it when clogged or dirty. This element should be replaced with every third primary element replacement.

6.d Check the engine air intake piping from the air cleaner to the engine intake. Inspect the piping for loose connections, cracks, torn or collapsed hoses, punctures, and other damage. Tighten loose connections, and have damaged components replaced. Make sure the piping system is airtight so that all intake air passes through the air cleaner.

IMPORTANT: On engines that comply with EpA07 or newer regulations, use CJ-4 engine oil with less than 1% sulfated ash. Failure to use CJ-4 oil may void the warranty on emission aftertreatment components.

NOTICE:

Operating the engine with the oil level below the minimum fill (or "add") mark or above the maximum fill (or "full") mark could result in engine damage.

7. **Check the engine oil level.**

NOTICE:
Operating the engine with the oil level below the minimum fill (or "add") mark or above the maximum fill (or "full") mark could result in engine damage.

7.a Park the vehicle on a level surface. Allow several minutes for the oil to drain back into the oil pan to ensure an accurate reading.

NOTE: For diesel engines, follow the engine manufacturer's guidelines for engine shutdown time requirements prior to checking the oil level.

7.b Pull out the dipstick and clean it with a paper towel or cloth, then push the dipstick back in all the way. Remove it again, keeping the tip down, and check the oil level.

7.c If the oil is below the cross-hatched area, or the add mark, at the tip of the dipstick, add at least one quart (liter) of the recommended oil. See Fig.118,Oil Dipstick (Cummins engine) and Fig. 119,Oil Dipstick (Mercedes-Benz engine) for diesel engines, and Fig.120,Oil Dipstick (LpG engine) for propane engines.

For diesel engines that comply with EpA07 or newer regulations, use CJ-4 engine oil with less than 1% sulfated ash.

For liquid propane gas (LpG) engines, use SAE 5W30 oil that meets GM standard GM6094M and has the American petroleum Institute (Apl) symbol. **Do not use** SAE 10W40 or 20W50.

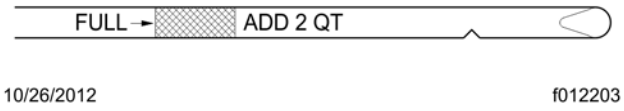
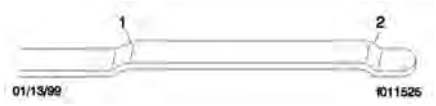


Fig 118, Oil Dipstick (Cummins engine)



1. Maximum Fill Level
2. Minimum Fill Level

Fig 119, Oil Dipstick (Mercedes-Benz engine)



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

Fig 120, Oil Dipstick (LpG engine)

NOTICE:
Failure to use the recommended oil can result in engine or aftertreatment component damage and will void the warranty.

8. **Inspect the fuel tanks, fuel lines, and connections for leaks.**
   - 8.a Check that the fuel tanks are secured to their mounting brackets and that the mounting brackets are secured to the frame.
   - 8.b Replace leaking fuel tanks.
   - 8.c If lines or connections are leaking, have them repaired or replaced.

     For repair and/or replacement procedures, see General Information of the **S2 Chassis Workshop Manual**, or take the vehicle to an authorized Freightliner dealer.
   - 8.d If equipped with fuel tank shutoff valves, be sure the valves are fully open.

WARNING:
Never operate the engine with the fuel tank shutoff valves partly closed. This could damage the fuel pump, causing sudden loss of engine power, possibly resulting in serious personal injury due to reduced vehicle control.

9. **Check the fuel level in the fuel tank(s).**

   To keep condensation to a minimum, fuel tanks should be filled at the end of each day. Federal regulations prohibit filling a fuel tank to more than 95 percent of its liquid capacity. Select the proper grade of fuel as specified by the engine manufacturer.

WARNING:

Do not mix gasoline or alcohol with diesel fuel. This mixture could cause an explosion, possibly resulting in serious personal injury or death. Do not fill the fuel tanks in the presence of sparks, open flames, or intense heat. These could ignite the fuel, possibly causing severe burns.

IMPORTANT: Use ultralow-sulfur diesel (ULSD) fuel with 15 ppm sulfur content or less, based on ASTM D2622 test procedure. Failure to use ultralow-sulfur diesel fuels may void the warranty on emission components.

9.a Fuel should always be strained or filtered before being put into the tanks. This will lengthen the life of the engine fuel filter and reduce the chances of dirt getting into the engine.

9.b Before installing the fuel cap, clean the area with a rag, or if necessary, clean the cap with solvent.

9.c If needed, prime the fuel system. For priming procedures, see the applicable engine manufacturer's manual.

10. **If equipped with a fuel/water separator, check for water.**

Drain any water found. Check the fuel/water separator for leaks and contaminants.

For an Alliance Model, see Fig.121,Alliance Fuel/Water Separator. place a suitable container under the fuel/water separator. Check the water level in the sight bowl, if so equipped. To drain the water, loosen the valve at the bottom and allow the water to run out. Close and tighten the valve finger-tight.

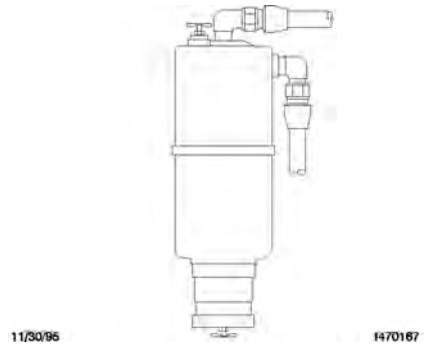


Fig 121, Alliance Fuel/Water Separator

IMPORTANT: When draining fluid from a fuel/water separator, drain the fluid into an appropriate container and dispose of it properly. Many states now issue fines for draining fuel/water separators onto the ground. On all types of separators, stop draining fluid when you see fuel come out of the separator drain valve.

11. **Inspect the front and rear suspension components, including springs, spring hangers, shocks, and suspension brackets.**

    11.a Check for broken spring leaves, loose U-bolts, cracks in the suspension brackets, and loose fasteners in the spring hangers and shackles.

    11.b Inspect the shock absorbers for loose fasteners and leaks.

    11.c Tighten all loose fasteners and have any components replaced that are worn, cracked, or otherwise damaged.

    11.d On vehicles with air suspensions, check for leaks. Check air suspension components for cuts and bulges.

12. **Clean the headlights, mirrors, windshield, side, and rear windows with a long-handled or telescoping window cleaning device and standard cleaning solutions.** Stand only on the ground, on a stepladder, or an elevated walkway. The vehicle entry/exit steps and handholds are not designed for this purpose. The tires, fenders, engine, and other under-hood components do not have adequate gripping surfaces and handholds.

    Check the condition of the windshield wiper arms and blades.

    Be sure the windshield wiper blades are tensioned against the windshield.

    Inspect the wiper blades for damage and deteriorated rubber.

    Replace the wiper arms if the wiper blades are not tensioned against the windshield.

    Replace damaged or deteriorated wiper blades.



WARNING:

When cleaning windshields and windows, always stand on the ground or on a secure ladder or platform. Use a long-handled window cleaner. Do not use the cab steps, tires, fenders, fuel tanks, engine, or under-hood components to access the windshield or windows. Doing so could cause a fall and result in an injury.

Replace wiper arms and blades when necessary to maintain good visibility. poor visibility could interfere with the driver's ability to control the vehicle, possibly resulting in serious personal injury or death.

13. **Check the oil- and air-pressure warning systems.**

    When the engine is started, oil- and air-pressure warnings will come on until the oil and air pressure rise above a preset minimum. After starting the engine, make sure the oil- and air-pressure warning systems are operating and that the buzzer stops sounding when the preset minimum is reached.

    13.a If the warning systems do not come on when the ignition is turned on, have the systems repaired.

    13.b If the air pressure in both systems is above the preset minimum when the engine is started, test the low air pressure warning system by lowering the pressure to below this range, or until the warning system comes on.

NOTE: The air pressure in both the primary and secondary air reservoir systems must be above 65 psi (448 kpa) on most vehicles. For vehicles with an optional Bendix dryer reservoir module (DRM), the cut-out pressure is 130 psi (896 kpa).

14. **Check the instrumentation control unit (ICU) for fault codes.**

    During the ignition sequence, if an active fault is detected in any device that is connected to the datalink, the message display screen will show the active fault codes, one after the other, until the parking brake is released or the ignition switch is turned off. See 4.01.01 General Description for detailed operating instructions for the ICU.

15. **Make sure that the horn, windshield wipers, and windshield washers are operating properly. These devices must be in good working order for safe vehicle operation.**

    15.a Make sure that the horn works. If a horn is not working, have it repaired before trip departure.

    15.b Check the wiper and washer control on the multifunction turn signal switch. If the wipers and/or washers are not working, have them repaired before trip departure.

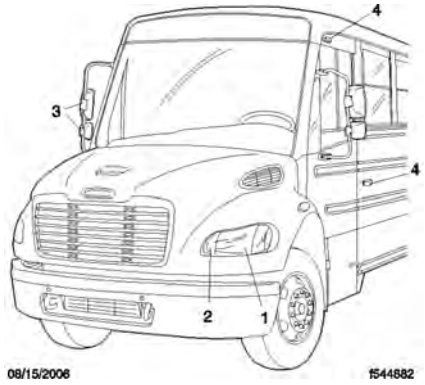
16. **During cold weather, make sure the heater, defroster, and optional mirror heat controls are operating properly. If so equipped, turn on the mirror heat switch and make sure the system is working.**

17. **Check the operation of all the panel lights and interior lights.**

    Turn on the headlights, dash lights, and four-way flashers and leave them on. If any of the gauge bulbs, the dome light bulbs, or the right- and left-turn indicator bulbs are not working, replace them. See **Chapter 19** of this manual for replacement bulb identification.

18. **Make sure all the exterior lights are working properly.**

    Check that all the lights and reflectors are clean. See Fig.122,Exterior Lights.



1. Headlight High Beam
2. Headlight Low Beam
3. Side-View Mirror
4. Marker Light

Fig 122, Exterior Lights

    18.a Check that the brake lights, taillights, headlights, parking lights, turn signals, road lights (if so equipped), and front clearance lights are working properly and are clean.

    18.b Test the high and low beams of the headlights.

    18.c Replace light bulbs or sealed beam units that are not working.

    18.d Be sure all reflectors and lenses are in good condition and are clean. Replace any broken reflectors or lenses.

19. **Check tire inflation pressures using an accurate tire pressure gauge.**

Tires should be checked when cool. For inflation pressures and maximum loads (per tire) see the tire manufacturer's guidelines.

19.a Be sure valve stem caps are on every tire and that they are screwed on finger-tight.

19.b Inflate the tires to the applicable pressures if needed.

19.c If a tire has been run flat or underinflated, check for possible wheel or tire damage before adding air.

Moisture inside a tire can result in body ply separation or a sidewall rupture. During tire inflation, compressed air reservoirs and lines must be kept dry. Use well-maintained inline moisture traps and service them regularly.

WARNING:

Do not operate the vehicle with underinflated or overinflated tires. Incorrect inflation can stress the tires and make the tires and wheels susceptible to damage, possibly leading to wheel or tire failure and loss of vehicle control, resulting in serious personal injury or death.

IMPORTANT: The load and cold inflation pressure must not exceed the wheel manufacturer's recommendations, even though the tire may be approved for a higher load inflation. Some wheels are stamped with a maximum load and maximum cold inflation rating. If they are not stamped, consult the wheel manufacturer for the correct tire inflation pressure for the vehicle load. If the load exceeds the maximum wheel capacity, the load must be adjusted or reduced.

IMPORTANT: Low-rolling resistance (LRR) tires minimize wasted energy as a tire rolls, thereby decreasing rolling effort and improving fuel efficiency. If tire replacement is necessary, replacement tires must meet or exceed the rolling resistance of the originally installed tires in order to maintain compliance with greenhouse gas and fuel efficiency regulations. Contact your tire manufacturer/supplier to determine the rolling resistance of the originally installed tires. Visit www.epa.gov/smartway for additional information and resources.

20. **Inspect each tire for wear, bulges, cracks, cuts, penetrations, and oil contamination.** A weekly pressure loss of 4 psi (28 kpa) or more in a tire may indicate damage. The tire should be inspected and if necessary, repaired or replaced.

20.a Check the tire tread depth. If tread is less than 4/32 inch (3 mm) on any front tire, or less than 2/32 inch (1.5 mm) on any rear tire, replace the tire.

20.b Inspect each tire for bulges, cracks, cuts, and penetrations.

20.c Inspect each tire for oil contamination. Fuel oil, gasoline, and other petroleum derivatives, if allowed to contact the tires, will soften the rubber and destroy the tire.

21. **Check the wheel nuts for indications of looseness. Examine each wheel component.**

21.a Remove all dirt and foreign material from the assembly. Dirt or rust streaks from the stud holes, metal buildup around stud holes, or out-of-round or worn stud holes may be caused by loose wheel nuts. See Fig. 123,Dirt and Rust Streaks from the Stud Holes and Fig.124,Worn Stud Holes.

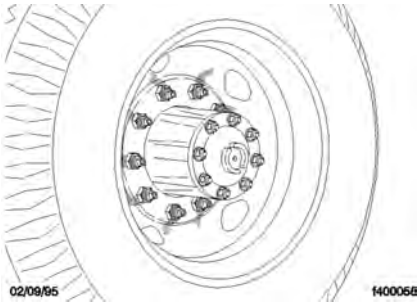


Fig 123, Dirt and Rust Streaks from the Stud Holes

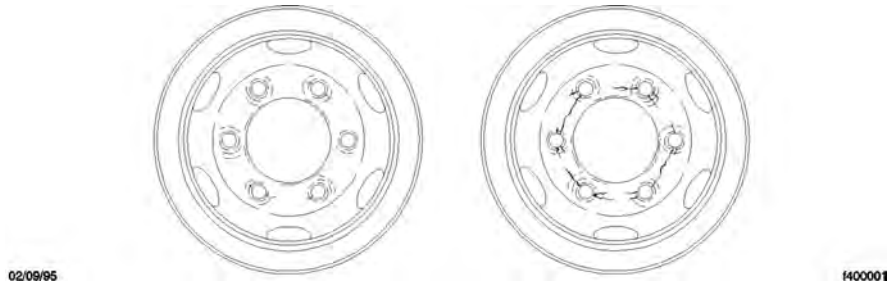


Fig 124, Worn Stud Holes

21.b Examine the wheel components (including studs, and nuts) for cracks, or other damage.

See General Description, Front Axle, Alignment or General Information of the **S2 Chassis Workshop Manual** for service procedures on the studs and hubs, and see General Information, Rear Axle, Wheels and Tires in the same manual for wheel and tire servicing, or take the vehicle to an authorized Freightliner dealer.

WARNING:
Have any worn or damaged wheel components replaced by a qualified person using the wheel manufacturer's instructions and the wheel industry's standard safety precautions and equipment. Otherwise a vehicle or workshop accident could occur, possibly resulting in serious personal injury or death.

21.c Make sure all wheel nuts are tightened 450 to 500 lbf·ft (610 to 678 N·m) for Accuride wheels with unlubricated threads. Use the tightening pattern in Fig.125,Tightening pattern, 10-Hole Wheels for 10-hole wheels and the tightening pattern in Fig.126,Tightening pattern, 8-Hole Wheels for 8-hole wheels. See of the **S2 Chassis Workshop Manual** for more information.

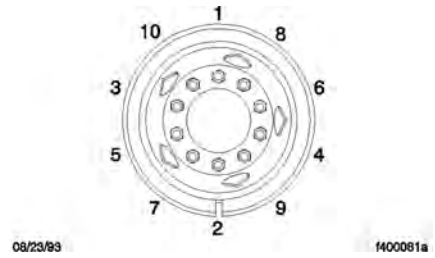


Fig 125, Tightening pattern, 10-Hole Wheels

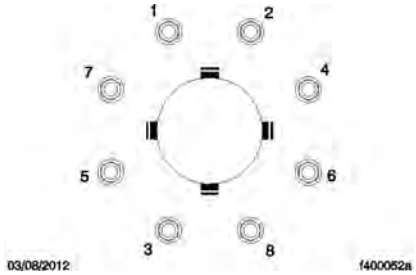


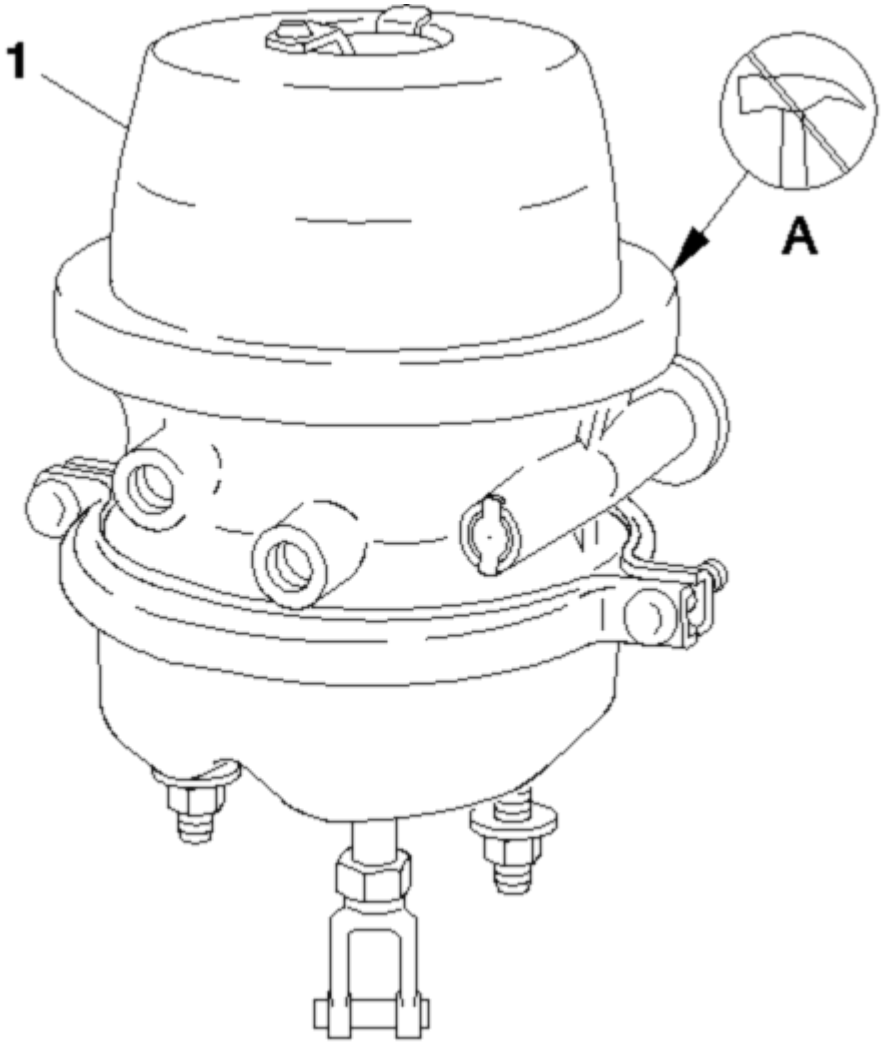
Fig 126, Tightening pattern, 8-Hole Wheels

NOTICE:

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

NOTE: Vehicles operating under severe or adverse conditions should be checked more frequently.

22. **Inspect the air brake chamber and the air brake chamber pushrods.** See Fig.127,Parking Brake Chamber Clamp.



A. Do not remove this clamp ring.

1. MGM TRT (TR Series) Brake Chamber Shown

Fig 127, Parking Brake Chamber Clamp

DANGER:

Do not loosen or remove the parking brake clamp ring for any purpose. See Fig.127,, page 160. The parking/emergency brake section of the brake chamber is not intended to be serviced. Serious injury or death may result from sudden release of the power spring.

Before doing any repairs or adjustments on a service/parking brake chamber, read the applicable warnings and instructions in of the **S2 plus Chassis Workshop Manual**.

WARNING:

Do not operate the vehicle with the front brakes backed off or disconnected. Backing off or disconnecting the front brakes will not improve vehicle handling and may lead to loss of vehicle control resulting in property damage or personal injury.

NOTICE:

If the external breather tube or breather cap is missing or incorrectly installed, road dirt and debris can adversely affect the operation of the brake chamber. Once inside of the chamber, dirt and debris can cause the internal parts of the chamber to deteriorate faster.

22.a Check that the air brake chamber is mounted securely on its mounting bracket, and that there are no loose or missing bolts.

22.b Look for worn clevis pins on brake chamber pushrods, and missing or damaged cotter pins on brake chamber pushrod clevis pins. Replace worn clevis pins and install new cotter pins if necessary.

22.c See if the chamber piston rod is in line with the slack adjuster. Misalignment can cause the piston rod to rub on the non-pressure chamber and cause a dragging brake. See General Description of the **S2 Chassis Workshop Manual**.

22.d Inspect the exterior surfaces of the chamber for damage. Make sure that breather holes in the non-pressure section(s) are open and free of debris. See General Description of the **S2 Chassis Workshop Manual** to replace any damaged parts.

22.e On all parking brake installations, make sure the end cover cap or dust plug is securely snapped into place.

NOTE: On most MGM parking brake chambers equipped with an integral release bolt, an end cover cap is installed over the release bolt.

22.f Check for rusted connections, missing snap rings, and damaged camshaft grease seals. Have damaged or missing parts repaired or replaced.

23. **Inspect the air brake lines.**

23.a Check the clearance between the hoses and the exhaust manifold or other hot spots. Excessive heat will cause material in the hoses to deteriorate rapidly or become brittle. provide at least 6 inches (150 mm) of clearance. More clearance is recommended if the hose is located above the heat source.

23.b Check for kinks, dents, or swelling of the hoses. If damaged, have the hose replaced with the same size and type.

NOTE: Do not route the hose on top of anything likely to be stepped on.

23.c Check for damage to hoses located near moving parts, such as drivelines, kingpins, suspensions, and axles. If moving parts are catching or pinching the lines, correct as needed.

23.d Check for hose damage caused by abrasion. If abraded, have the hose replaced. Check for the cause of abrasion, such as loose or damaged hose clamps. Have the clamps repaired or replaced as needed.

23.e Observe the hose cover condition, especially hoses exposed to water splash and ice. If dried out or ragged (the wire or liner is showing through the cover), have the hose(s) replaced.

23.f Inspect the air tubing, especially tubing made of nylon. In cold weather, nylon tubing is sensitive to damage, such as nicks or cuts. Have nicked or cut tubing replaced, even if it is not leaking.

NOTE: The front brake lines flex continuously in vehicle operation, so they require special examination. Give particular attention to the areas near where they connect to the front air brake chambers.

23.g This inspection requires two people, one in the driver seat, and another to inspect the brake line connections at the wheels.

Both wheel air lines must be inspected with the emergency brake set, engine idling, air pressure at 80 to 90 psi (550 to 620 kpa), and the brake pedal held down.

23.h Turn the wheels to full lock in one direction and inspect both air lines where they connect to the air chambers, then turn the wheels to full lock in the other direction and inspect both lines. If a hose is leaking, have it replaced.

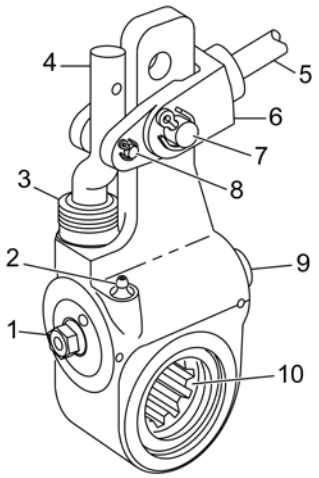
IMPORTANT: ABS-equipped vehicles operating in regions where especially corrosive ice removal chemicals are used may experience higher than normal rotor corrosion. Tone rings should be routinely inspected for corrosion. Severe corrosion of the integral ABS tone ring may cause the ABS warning lamp in the dash to illuminate due to false wheel speed readings. If the ABS warning lamp illuminates at any time other than at vehicle start-up, have the problem repaired immediately.

24. **Inspect the slack adjusters.**

24.a **Meritor Slack Adjusters:** Check the boot for cuts, tears, or other damage. Have it replaced if necessary.

24.b **Gunite Slack Adjusters:** Inspect the slack adjuster for any signs of damage. If damaged, have the slack adjuster replaced.

Inspect the slack adjuster boot for cuts or tears. If the boot is damaged, have it replaced. See Fig. 128,Gunite Automatic Slack Adjuster.



1. 7/16-inch Adjusting Nut
2. Grease Fitting
3. Boot
4. Link
5. Brake Chamber piston Rod
6. Clevis
7. ½-inch Clevis pin
8. 1/4-inch Clevis pin
9. Grease Relief Opening
10. Slack Adjuster Spline

Fig 128, Gunite Automatic Slack Adjuster

24.c **Haldex Slack Adjusters:** Inspect each slack adjuster and anchor strap for damage. Have any damaged components replaced.

25. **Check the air brake system for proper operation.**

25.a Check the air governor cut-in and cut-out pressures as follows:

Run the engine at fast idle. The air governor should cut out the air compressor at approximately 120 psi (827 kpa). With the engine idling, apply the brake pedal several times. The air governor should cut in the air compressor at approximately 100 psi (689 kpa). If the air governor does not cut in and out as described above, it must be adjusted to these specifications. If the air governor cannot be adjusted or repaired, replace it before operating the vehicle.

25.b Check the air pressure buildup time as follows:

With the air system fully charged to 120 psi (827 kpa), make one full brake application and note the air pressure reading on the gauge. Continue to reduce the air pressure by moderate brake applications to a maximum of 90 psi (620 kpa), then run the engine at governed rpm. If the time required to raise the air pressure to 120 psi (827 kpa) (from the pressure noted after one brake application) is more than 30 seconds, eliminate any leaks or replace the air compressor before operating the vehicle.

25.c Check the air pressure reserve as follows:

With the air system fully charged to 120 psi (827 kpa), stop the engine and note the air pressure. Then make one full brake application and observe the pressure drop. If it drops more than 25 psi (172 kpa), all areas of leakage must be eliminated before operating the vehicle.

25.d Check the air leakage in the system as follows:

With the parking brake (spring brake) applied, the transmission out of gear, and the tires chocked, charge the air system until cut-out pressure of 120 psi (827 kpa) is reached.

With the service brakes released, shut down the engine, wait 1 minute and note the air pressure gauge reading. Observe the air pressure drop in psi (kpa) per minute.

Charge the air system until cut-out pressure of 120 psi (827 kpa) is reached. With the parking brakes released and the service brake applied, shut down the engine, wait 1 minute and note the air pressure gauge reading. Observe the air pressure drop in psi (kpa) per minute.

If leakage exceeds the limits shown in Table.16,Maximum Allowable Service Brake Leakage, repair all areas of leakage before driving the vehicle.

Table 16, Maximum Allowable Service Brake Leakage

Maximum Allowable Service Brake Leakage	
Maximum Air Leakage per Minute	
Brakes Released	**Brakes Applied**
2 psi (14 kpa)	3 psi (21 kpa)

Table 16, Maximum Allowable Service Brake Leakage

26. **Check the operation of the Bendix® Hydro-Max brake booster, as follows.**

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

    26.b With the engine running, and the parking brake released, ensure that the BRAKE warning indicator light is **not** on. This is a dual indicator, and indicates that the parking brake is set, and warns if there is a Hydro-Max failure condition other than loss of back-up motor power.

27. **Test the service brakes.**

When starting to move the vehicle and before picking up speed, test the brakes with the foot pedal and parking brake control valve (yellow knob) to be sure they will bring the vehicle to a safe stop.

16.03 Weekly Post-Trip Inspection and Maintenance Procedures

1. **Inspect the batteries and battery cables.**



WARNING:

Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. To prevent possible personal injury, always wash your hands after handling battery parts and related accessories.

1.a Access the batteries. Be sure the battery hold-down is secure. If it is loose, tighten the hold-down bolts; if it is broken, replace it.

1.b If the battery is equipped with a built-in hydrometer, examine the hydrometer. If a green dot shows in the sight glass, the battery is sufficiently charged.

If the sight glass is dark, the charge is low and the battery must be recharged.

If the sight glass is clear, the battery has a low level of electrolyte and must be replaced.

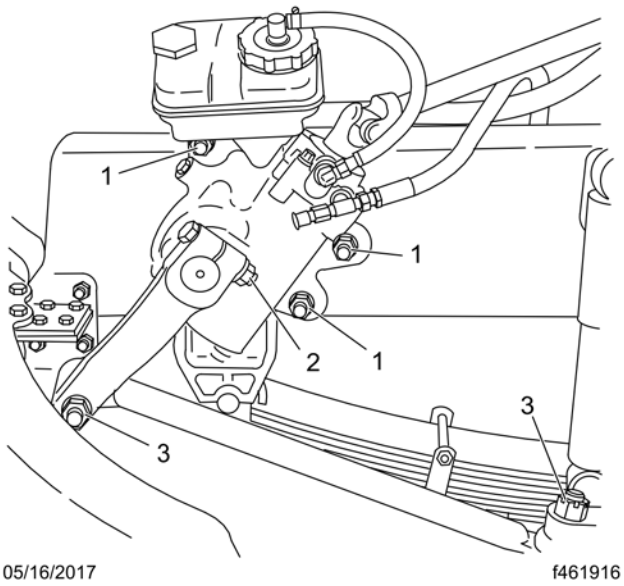
2. **Check the level of the wheel bearing lubricant in the hub cap at each end of the front axle.**

If needed, fill the hubs to the level indicated on the hub cap. See 20.01 General Information, for recommended lubricants.

IMPORTANT: Before removing the fill plug, always clean the hub cap and plug.

3. **Examine the steering components.**

   See Fig.129,Steering Gear Fasteners. If repairs are needed, see Replacement of the Steering Driveline, TRW of the **S2 Chassis Workshop Manual** for instructions, or take the vehicle to an authorized Freightliner dealer.



1. Steering Gear Mounting Bolt
2. Pitman Arm Pinch Bolt Nut
3. Drag Link Nut

Fig 129, Steering Gear Fasteners

3.a Check the mounting bolts and pitman arm nut, for tightness.

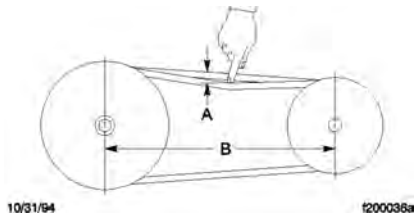
3.b Check the drag link nuts for missing cotter pins.

3.c Inspect the steering drive shaft and steering linkage for excessive looseness, or other damage.

3.d Tighten loose nuts and have damaged parts replaced as needed.

4. **Check the condition of the serpentine drive belt.**

   Look for signs of glazing, wear (frayed edges), damage (breaks or cracks), or oil contamination. If a belt is glazed, worn, damaged, or oil soaked, have the belt replaced, following the instructions in of the **S2 Chassis Workshop Manual.**



A. Deflection
B. Belt Free-Span

Fig 130, Checking Belt Tension

5. **Check the drive belt for proper tension.**

   Use your index finger to apply force at the center of the belt free-span. See Fig.130,Checking Belt Tension. There is no adjustment for belt tension on engines with automatic belt tensioners. If there is not proper tension, have the belt tensioner replaced. See General Information of the **S2 Chassis Workshop Manual** for instructions, or take the vehicle to an authorized Freightliner dealer.

6. **Inspect the seat belts and tether belts.**

WARNING:
Inspect and maintain seat belts as instructed below. Worn or damaged seat belts could fail during a sudden stop or crash, possibly resulting in serious injury or death.

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

NOTE: When any part of a seat belt needs replacement, the entire seat belt must be replaced, both retractor and buckle side.

6.a Check the web for fraying, cuts, or extreme wear, especially near the buckle latch plate and in the D-loop guide area.

6.b Check the web for extreme dirt or dust and for severe fading from exposure to sunlight.

6.c Check the buckle and latch for operation and for wear or damage.

6.d Check the Komfort Latch for function and cracks or other damage.

6.e Check the web retractor for function and damage.

6.f Check the mounting bolts for tightness and tighten any that are loose.

16.04 Monthly Post-Trip Inspection and Maintenance Procedures

WARNING:
Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. To prevent possible personal injury, always wash your hands after handling battery parts and related accessories.

1. **Clean the batteries.**

   1.a Remove any corrosion from the hold-down and the top of the battery.

NOTICE:
Take care to keep the vent plugs tight so that the neutralizing solution does not enter any of the battery cells and damage the battery.

1.b Use a soda solution to neutralize the acid present, then rinse off the soda solution with clean water.

1.c If the battery posts or cable terminals are corroded, disconnect the terminals from the posts. Clean them with a soda solution and a wire brush. After cleaning, connect the terminals to the battery posts, then apply a thin coat of petroleum jelly to the posts and terminals to help retard corrosion.

2. **Inspect the radiator and heater hoses, including the clamps and support brackets.**

2.a Make sure the radiator inlet and outlet hoses are pliable and are not cracking or ballooning. Replace hoses that show signs of cracking, weakening, or ballooning.

2.b Make sure the heater hoses are pliable and are not cracking or ballooning. Replace hoses that show signs of cracking, weakening, or ballooning.

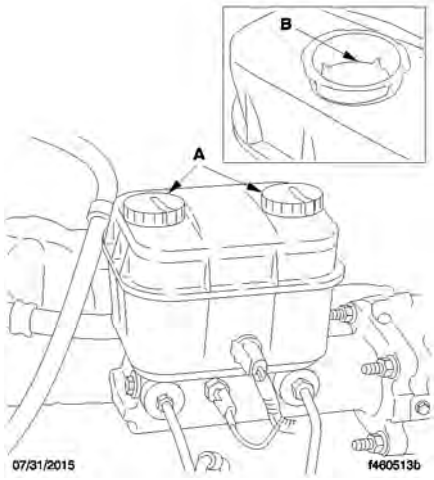
2.c Tighten hose clamps as necessary, but do not overtighten, as hose life can be adversely affected.

2.d Be sure the hose support brackets are securely fastened. Make sure the hoses are not located near sources of wear, abrasion, or high heat.

IMPORTANT: Replace all hoses, including heater hoses, at the same time. Service-type knitted or braided yarn-reinforced neoprene hose is acceptable. Silicone hoses having an extended service life can be substituted for the reinforced neoprene type. See the Freightliner **Service Parts Catalog** or contact your Freightliner dealer.

3. **Check the fluid level in the hydraulic brake fluid reservoir, if so equipped.**

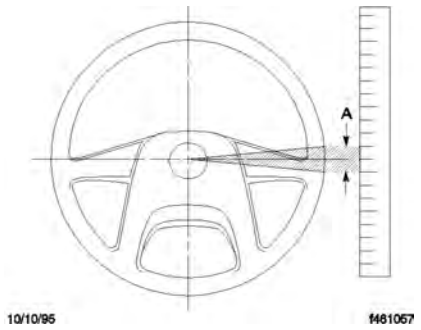
If needed, fill the reservoir to the bottom of the fill-neck with DOT 3 heavy-duty brake fluid. See Fig. 131,Hydraulic Brake Reservoir.



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

Fig 131, Hydraulic Brake Reservoir

4. **Check the steering wheel for excessive play.** See Fig.132,Measuring Lash at the Steering Wheel.



A. Lash Area

Fig 132, Measuring Lash at the Steering Wheel

4.a With the front tires straight ahead, turn the steering wheel until motion is observed at the front wheels.

4.b Align a reference mark on a ruler, then slowly turn the steering wheel in the opposite direction until motion is again detected at the wheels.

4.c Measure the lash (free play) at the rim of the steering wheel. Excessive lash exists if steering wheel movement exceeds 2-1/4 inches (57 mm) with an 18-inch (450-mm) steering wheel.

See local/federal regulations for acceptable ranges of lash.

5. **Check the brake lining wear on all vehicles, including those with automatic slack adjusters. Proper brake operation is dependent on periodic maintenance and inspection of the brake linings.**

5.a Check that brake linings are free of oil and grease.

5.b Inspect the thickness of the brake linings. If the axle assembly is equipped with a dust shield or backing plate, remove the inspection plugs. If **any** brake linings are worn to less than approximately 1/4 inch (6.4 mm) at the thinnest point, have the linings replaced on **all** brake assemblies on that axle. See General Description of the **S2 Chassis Workshop Manual** for lining replacement instructions and camshaft end-play inspection.

5.c Check the brake drums for wear and cracks.

5.d Check that the inspection plugs in the dust shields or backing plates, if so equipped, are installed.

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17. Cleaning and Care

17.01 Washing and Polishing



NOTICE:
When pressure washing the vehicle or leaving the hood open when parked outdoors and subject to rain, cover the air cleaner inlet with a plastic bag to prevent water from entering the air intake system and possibly damaging the engine.

To protect the new vehicle's finish, follow these guidelines carefully:

- During the first 30 days, rinse the vehicle frequently with water. If the vehicle is dirty, use a mild liquid soap. Do not use detergent.
- During the first 30 days, do not use anything abrasive on the vehicle. Brushes, chemicals, and cleaners may scratch the finish.
- During the first 120 days, do not wax the vehicle.

To extend the life of the vehicle's finish, follow these guidelines:

- Avoid washing the vehicle in the hot sun. Always use water. After the vehicle is completely washed, dry it with a towel or chamois.
- Do not dust painted surfaces with a dry cloth, as this will scratch the paint.
- Do not remove ice or snow from a painted surface with a scraper of any sort.
- To prevent damage to the finish, wax it regularly. If the finish has become dull, before waxing, remove oxidized paint using a cleaner specifically designed for this purpose. Remove all road tar and tree sap before waxing. Freightliner recommends the use of a high quality brand of cleaner or cleaner-polish and polishing wax.
- Do not let diesel fuel or antifreeze stand on a painted surface. If either should occur, rinse the surface off with water.
- To prevent corrosion, have any nicks or other damage on the finish touched up as soon as possible.
- Park the vehicle in a sheltered area whenever possible.

17.02 Care of Fiberglass Parts

Wash unpainted fiberglass air fairings and shields monthly with a mild detergent, such as dishwashing liquid. Avoid strong alkaline cleansers.

Apply a wax specifically designed for fiberglass.

17.03 Care of Chrome Parts

To prevent rust, keep chrome parts clean and protected at all times. This is especially important during winter driving and in coastal areas where there is exposure to salt air.

When cleaning chrome parts, use clean water and a soft cloth or sponge. A mild detergent may also be used.

Sponge gently, then rinse. If necessary, use a nonabrasive chrome cleaner to remove stubborn rust or other material. Do not use steel wool.

To help protect the chrome after cleaning, apply a coat of polishing wax to the surface. Never use wax on parts that are exposed to high heat, such as exhaust pipes.

17.04 Care of Exterior Lights

Clean the headlight lenses by hand only, using a flannel cloth with mild, non-caustic soap or detergent, and water.

NOTICE:

Do not use a power buffer, paper towels, chemical solvents, or abrasive cleaners on the headlight lens, all of which can remove the UV coating from the surface, and result in yellowing of the lens.

17.05 Dashboard and Instrument Panel Care

NOTICE:

When cleaning the dashboard, instrument panel, or gauge lens covers, **do not** use Armor-All Protectant®, STP Son-of-a-Gun®, window cleaner, or other equivalent treatments. These cleaners contain vinyl plasticizers which can cause stress crazing in the interior plastic panels and can result in cracking of the panels. Some cleaners can also have an adverse effect on the clear plastic of instrument panels and gauge lens covers, resulting in a foggy or cloudy appearance. This type of damage is not covered by vehicle warranty.

To clean the dashboard, instrument panel, and gauge lens covers, use a cloth dampened with warm soapy water. Make certain to wring the cloth out well before cleaning, as excess water will damage the electrical components.

17.06 Cleaning the Vinyl Upholstery

17.06.01 Ordinary Dirt

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Harsh cleaning agents can cause permanent damage to vinyl upholstery. To preserve the upholstery and prevent damage, carefully review the following sections for recommended cleaning procedures. Waxing or refinishing improves soil resistance and cleanability for all vinyls. Any hard wax, such as that used on automobiles, may be used.

Wash the upholstery with warm water and mild soap, such as saddle or oil soap. Apply soapy water to a large area and allow to soak for a few minutes, then rub briskly with a cloth to remove the dirt. This can be repeated several times as necessary.

If dirt is deeply imbedded, use a soft bristle brush after applying the soap.

If dirt is extremely difficult to remove, wall-washing preparations normally found around the home can be used. Powdered cleaners, such as those used for sinks and tiles, are abrasive and must be used with caution as they can scratch the vinyl or give it a permanent dull appearance.

17.06.02 Chewing Gum

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Harsh cleaning agents can cause permanent damage to vinyl upholstery. To preserve the upholstery and prevent damage, carefully review the following sections for recommended cleaning procedures. Waxing or refinishing improves soil resistance and cleanability for all vinyls. Any hard wax, such as that used on automobiles, may be used.

Harden the gum with an ice cube wrapped in a plastic bag, then scrape it off with a dull knife. Any remaining traces of gum can be removed with an all-purpose light oil (peanut butter will also work) and wiped off.

17.06.03 Tars, Asphalts, and Creosote

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Harsh cleaning agents can cause permanent damage to vinyl upholstery. To preserve the upholstery and prevent damage, carefully review the

following sections for recommended cleaning procedures. Waxing or refinishing improves soil resistance and cleanability for all vinyls. Any hard wax, such as that used on automobiles, may be used.

Tars, asphalts, and creosote stain vinyl after prolonged contact. They should be wiped off immediately and the area carefully cleaned, using a cloth dampened with naphtha.

17.06.04 Paint and Shoe Heel Marks

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Harsh cleaning agents can cause permanent damage to vinyl upholstery. To preserve the upholstery and prevent damage, carefully review the following sections for recommended cleaning procedures. Waxing or refinishing improves soil resistance and cleanability for all vinyls. Any hard wax, such as that used on automobiles, may be used.

Paint should be removed immediately. Do not use paint remover or liquid-type brush cleaner on vinyl. An unprinted cloth, dampened with naphtha or turpentine may be used. Use care to prevent contact with parts of the upholstery that are not vinyl.

17.06.05 Sulfide Stains

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Harsh cleaning agents can cause permanent damage to vinyl upholstery. To preserve the upholstery and prevent damage, carefully review the following sections for recommended cleaning procedures. Waxing or refinishing improves soil resistance and cleanability for all vinyls. Any hard wax, such as that used on automobiles, may be used.

Sulfide compounds, such as those found in eggs and some canned goods, can stain after prolonged contact with vinyl. These stains can be removed by placing a clean, unprinted piece of cloth over the spotted area and pouring a liberal amount of 6 percent hydrogen peroxide onto the cloth. Allow the saturated cloth to remain on the spot for 30 to 60 minutes. For stubborn spots, allow the hydrogen-peroxide saturated cloth to remain on the area overnight. Use caution to prevent the solution from seeping into the seams or it will weaken the cotton thread.

17.06.06 Nail Polish and Nail Polish Remover

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Harsh cleaning agents can cause permanent damage to vinyl upholstery. To preserve the upholstery and prevent damage, carefully review the following sections for recommended cleaning procedures. Waxing or refinishing improves soil resistance and cleanability for all vinyls. Any hard wax, such as that used on automobiles, may be used.

Prolonged contact with these substances causes permanent damage to vinyl. Careful blotting immediately after contact minimizes damage. Do not spread the liquid during removal.

17.06.07 Shoe Polish

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Harsh cleaning agents can cause permanent damage to vinyl upholstery. To preserve the upholstery and prevent damage, carefully review the following sections for recommended cleaning procedures. Waxing or refinishing improves soil resistance and cleanability for all vinyls. Any hard wax, such as that used on automobiles, may be used.

Most shoe polishes contain dyes which penetrate vinyl and stain it permanently. Shoe polish should be wiped off as quickly as possible using naphtha or lighter fluid. If staining occurs, try the procedure used for sulfide stains.

17.06.08 Ball Point Ink

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Harsh cleaning agents can cause permanent damage to vinyl upholstery. To preserve the upholstery and prevent damage, carefully review the following sections for recommended cleaning procedures. Waxing or refinishing improves soil resistance and cleanability for all vinyls. Any hard wax, such as that used on automobiles, may be used.

Ball point ink can sometimes be removed if rubbed immediately with a cloth damp with water or rubbing alcohol. If this does not work, try the procedure used for sulfide stains.

17.06.09 Miscellaneous

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Harsh cleaning agents can cause permanent damage to vinyl upholstery. To preserve the upholstery and prevent damage, carefully review the

following sections for recommended cleaning procedures. Waxing or refinishing improves soil resistance and cleanability for all vinyls. Any hard wax, such as that used on automobiles, may be used.

If stains do not respond to any of the treatments described above, it is sometimes helpful to expose the vinyl to direct sunlight for up to 30 hours. Mustard, ball point ink, certain shoe polishes, and dyes often bleach out in direct sunlight, leaving the vinyl undamaged.

17.07 Cleaning the Velour Upholstery

17.07.01 Grease and Oil-Based Stains

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Spot clean with a mild solvent or an upholstery shampoo, or the foam from a mild detergent. When using a solvent or a dry-cleaning product, follow the instructions carefully and clean only in a well-ventilated area. Avoid any product that contains carbon tetrachloride or other toxic materials. With either method, pretest a small area before proceeding. Use a professional upholstery cleaning service when extensive cleaning is needed.

Dampen a small absorbent cloth with dry-cleaning solvent or spot remover. Apply the cloth carefully to the spot from the outer edge to the center. Pat and blot the spot with a clean, dry cloth. Repeat several times, as necessary, turning the cloths so that the stain does not redeposit on the fabric.

17.07.02 Sugar and Water-Based Stains

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Spot clean with a mild solvent or an upholstery shampoo, or the foam from a mild detergent. When using a solvent or a dry-cleaning product, follow the instructions carefully and clean only in a well-ventilated area. Avoid any product that contains carbon tetrachloride or other toxic materials. With either method, pretest a small area before proceeding. Use a professional upholstery cleaning service when extensive cleaning is needed.

Apply water-based detergent or cleaner, working in circular motions. Pat and blot as dry as possible. Repeat if necessary before drying thoroughly.

17.07.03 Chewing Gum or Wax

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Spot clean with a mild solvent or an upholstery shampoo, or the foam from a mild detergent. When using a solvent or a dry-cleaning product, follow the instructions carefully and clean only in a well-ventilated area. Avoid any product that contains carbon tetrachloride or other toxic materials. With either method, pretest a small area before proceeding. Use a professional upholstery cleaning service when extensive cleaning is needed.

Harden the gum or wax with an ice cube wrapped in a plastic bag, then scrape it off with a dull knife. Excess wax can be absorbed by placing a thick white blotter over the wax and heating with a warm (not hot) iron. Remove the remainder by using the procedure for grease and oil-based stains.

17.07.04 Mildew

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Spot clean with a mild solvent or an upholstery shampoo, or the foam from a mild detergent. When using a solvent or a dry-cleaning product, follow the instructions carefully and clean only in a well-ventilated area. Avoid any product that contains carbon tetrachloride or other toxic materials. With either method, pretest a small area before proceeding. Use a professional upholstery cleaning service when extensive cleaning is needed.

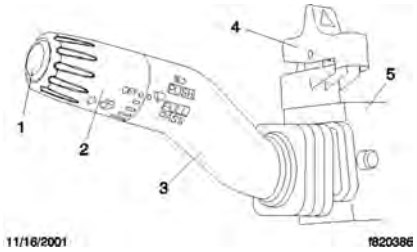
Brush the dry fabric with a soft brush. Sponge with detergent, and blot. If the fabric is colorfast, dilute a teaspoon of bleach in one quart (one liter) of cool water. Apply with a swab, directly on the mildew stain. Dab repeatedly with clear, cool water, and blot dry.

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18. In an Emergency

18.01 Hazard Warning Lights

The hazard warning light switch is part of the multifunction turn signal switch. It is a red rocker switch located on the top of the multifunction switch module. See Fig.133,Multifunction Turn Signal Switch.



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

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

Fig 133, Multifunction Turn Signal Switch

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

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

18.02 Emergency Starting With Jumper Cables

When using jumper cables, follow the instructions below.

WARNING:

Batteries release explosive gas. Do not smoke when working around batteries. Put out all flames and remove all sources of sparks or intense heat in the vicinity of the battery. Do not allow the vehicles to touch each other. Do not lean over the batteries when making connections, and keep all other persons away from the batteries. Failure to follow these precautions could lead to severe personal injury as a result of an explosion or acid burns.

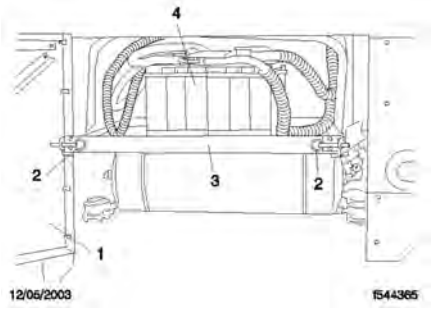
NOTICE:

Make sure that both starting systems are the same voltage. Electronic devices on both vehicles can be damaged when connected to a vehicle with a different operating voltage.

1. Apply the parking brakes and turn off all lights and other electrical devices.

IMPORTANT: Do not attempt to jump start a damaged battery.

2. Open the battery door to access the batteries. Pull both pull-pin spring latches and slide the battery tray out. See Fig. 134,Battery Access.



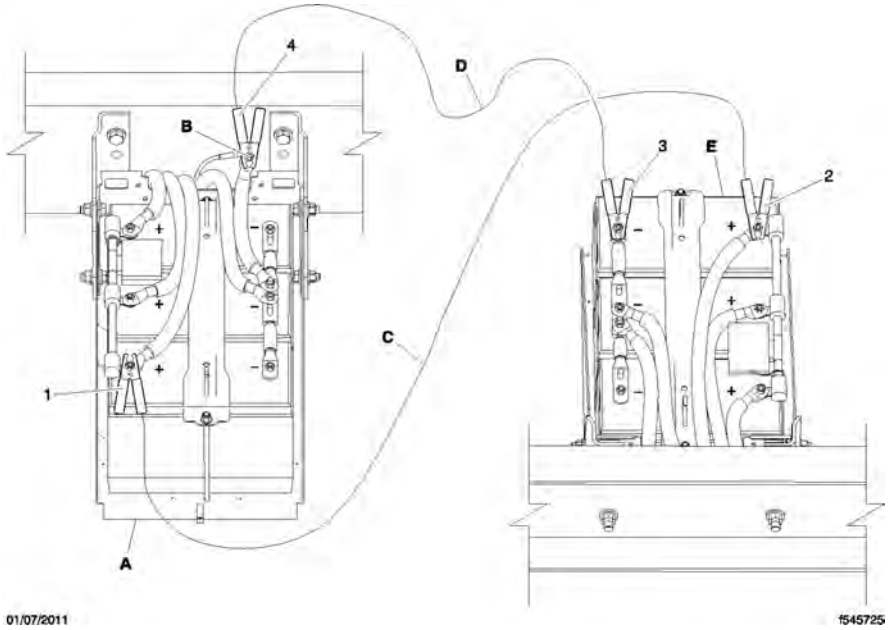
1. Battery Access Door
2. Pull-Pin Spring Latch
3. Battery Tray
4. Battery

Fig 134, Battery Access

NOTICE:

Always connect the batteries and jumper cables correctly (positive-to-positive and negative-to-negative). Connecting a charging device backwards (positive-to-negative) can severely damage the vehicle electrical content and cause non-warrantable failures.

3. Connect the positive (+) jumper cable to the positive terminal on the discharged battery. See Fig. 135,Jumper Connections (three battery system shown for clarity).



Disconnect jumper cables in the REVERSE order that they were connected.

A. Discharged Battery
B. Negative Ground Stud
C. positive Jumper Cable
D. Negative Jumper Cable
E. Booster Battery
1. 1st Connection: positive Jumper Cable to Discharged Battery
2. 2nd Connection: positive Jumper Cable to Booster Battery
3. 3rd Connection: Negative Jumper Cable to Booster Battery
4. 4th Connection: Negative Jumper Cable to Negative Ground Stud (discharged battery)

Fig 135, Jumper Connections (three battery system shown for clarity)

Disconnect jumper cables in the REVERSE order that they were connected.

4. Connect the other end of the positive jumper cable to the positive terminal on the booster battery providing the charge.

WARNING:

Do the next step exactly as instructed and do not allow the clamps of one cable to touch the clamps of the other cable. Otherwise, a spark could occur near a battery, possibly resulting in severe personal injury from explosion or acid burns.

5. Connect the negative (-) jumper cable to the negative terminal on the booster battery.
6. Connect the other end of the negative jumper cable to the negative ground stud on the vehicle requiring the jump start.
7. Start the engine of the vehicle providing the jump start and let the engine run for a few minutes to charge the batteries of the other vehicle.



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

8. Attempt to start the engine of the vehicle with the batteries receiving the charge.
9. When the engine starts, let it idle for a few minutes.



WARNING:
Do the next step exactly as instructed and do not allow the clamps of one cable to touch the clamps of the other cable. Otherwise, a spark could occur near a battery, possibly resulting in severe personal injury from explosion or acid burns.

10. Disconnect the negative jumper cable from the negative cable stud on the jump started vehicle.
11. Disconnect the negative jumper cable from the booster battery.
12. Disconnect the positive cable from the booster battery.
13. Disconnect the other end of the positive jumper cable from the jump started vehicle.
14. pull both pull-pin spring latches and slide the battery tray back into position. Release the pull-pin spring latches to lock the battery tray, then close the battery door.

18.03 Raising and Lowering a Vehicle

18.03.01 Raising a Vehicle without Air Suspension

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



WARNING:
Do not use bottle jacks to raise the vehicle. Always use floor jacks. Bottle jacks can slip, allowing the vehicle to fall, which could result in damage to the vehicle, serious injury, or death.

IMPORTANT: Only lift unloaded vehicles and vehicles disconnected from trailers. Unload vehicles with bodies (drilling rigs, mixers) as much as possible.

2. place a floor jack under the axle housing, the clamp group, or the frame rail.



NOTICE:
Do not place jack stands under any of the suspension components; doing so could cause suspension component damage. Jack stands can be placed at any point below the axle, including the differential area.

3. Raise the vehicle. Add additional jack stands, as needed, to support the vehicle.

18.03.02 Lowering a Vehicle without Air Suspension



WARNING:
Do not use bottle jacks to raise the vehicle. Always use floor jacks. Bottle jacks can slip, allowing the vehicle to fall, which could result in damage to the vehicle, serious injury, or death.



NOTICE:
Do not place jack stands under any of the suspension components; doing so could cause suspension component damage. Jack stands can be placed at any point below the axle, including the differential area.

1. Using the floor jack, raise the vehicle to remove any jack stands used to support the vehicle.
2. Slowly lower the vehicle to the ground.

18.04 Front Towing Hookup

WARNING:
Do not tow an unbraked vehicle if the combined weight of both vehicles is more than the sum of the gross axle weight ratings (GAWR) of the towing vehicle. Otherwise brake capacity will be inadequate, which could result in personal injury or death.

IMPORTANT: When it is necessary to tow the vehicle, make sure the instructions below are closely followed to prevent damage to the vehicle.

NOTICE:
The vehicle should **never** be towed from the rear. The gross axle weight rating (GAWR) of the front axle may not be sufficient to support the increased load when towing from the rear. This could damage the front axle.

NOTE: Towing rules and regulations vary from federal, state, local, and transit authority. These laws must be followed when towing the vehicle.

1. Disconnect the battery ground cables.

NOTICE:
Failure to remove the axle shafts when towing the vehicle with the rear wheels on the ground could result in damage to the transmission and other parts.

2. Remove the drive axle shaft.

IMPORTANT: Cover the ends of the hubs with metal plates or plywood cut to fit the axle opening, and drilled to fit the axle shaft studs. This prevents lubricant from leaking out and will keep contaminants from getting into and damaging the wheel bearings and axle lubricant.

NOTICE:
Failure to protect the frame rails from the chains could cause damage, leading to eventual frame failure.

3. Remove the bumper.

4. Attach the towing device. Due to the many variables that exist in towing, positioning the lifting and towing device is the sole responsibility of the towing-vehicle operator.
5. Lift the vehicle and secure the safety chains. If extra towing clearance is needed, remove the front wheels.
6. Connect the clearance lights, taillights, and signal lights. Connect any special towing lights required by local regulations.



WARNING:

Failure to chock the tires or connect the tow truck's air brake system before releasing the spring parking brakes could allow the disabled vehicle to suddenly roll. This could cause property damage or personal injury.



NOTICE:

Before attempting to tow a vehicle with an air suspension (and during the towing operation), ensure that the air suspension is properly charged. Charge the suspension through the Schrader valve on the air dryer. Attempting to tow a vehicle with an improperly charged air suspension may result in damage to the chassis and body.

7. Chock the tires on the disabled vehicle and connect the towing vehicle's air brake system to the vehicle being towed. Then, release the spring parking brake and remove the chocks.
8. On vehicles equipped with hydraulic disc brakes be sure the parking brake is released before starting the towing process.

18.05 Running Out of Fuel



WARNING:

Do not mix gasoline or alcohol with diesel fuel. This mixture could cause an explosion. When filling fuel tanks, do not smoke or use an open flame near the fuel tanks. Combustion of diesel fuel oil or fuel vapors could result, possibly causing personal injury or property damage.

1. If possible, stop the vehicle on a level surface, away from traffic.
2. Apply the parking brake.

IMPORTANT: Any time the vehicle runs out of fuel, the fuel system should be primed. This will purge any trapped air in the system and allows fuel to fill the fuel filter.

3. See the engine manufacturer's manual for instructions to prime the fuel system.

4. If further assistance is needed, call the Freightliner Customer Assistance Center at 1-800-385-4357 or 1-800-FTL-HELp.



NOTICE:

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

5. Add fuel to the fuel tank.
6. After adding fuel to the fuel tank, start the engine. Once the vehicle is running, let the engine idle until it operates smoothly before driving the vehicle.

18.06 Changing a Flat Tire



DANGER:

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



WARNING:

Wheel lug nut torque is very high and the wheel/tire assemblies are very heavy. Changing a tire could result in back injury. If possible, call a qualified service facility to change a flat tire.

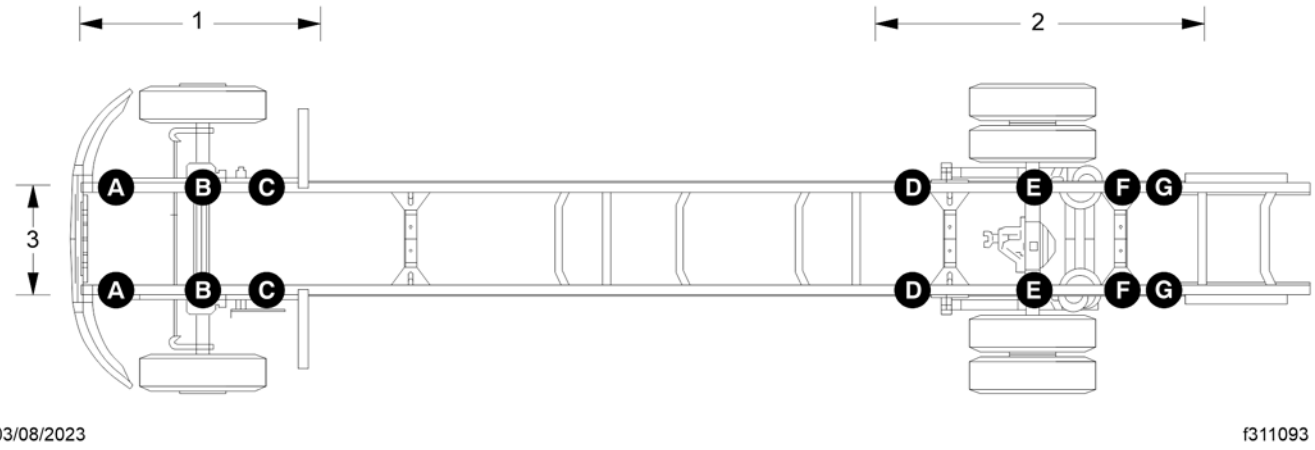
IMPORTANT: If a flat tire occurs while driving, gradually decrease vehicle speed. Holding the steering wheel firmly, move to a safe place on the side of the road.

1. Stop the vehicle on a level surface, away from traffic.
2. Apply the parking brake, place the transmission in neutral (N), and shut down the engine.
3. Turn on the hazard warning lights.
4. Block the wheel diagonally opposite the wheel being changed.
5. Remove the spare wheel, jack, jack handle, and lug wrench from storage.

WARNING:
This vehicle is very heavy. Jacking this vehicle should be done with extreme caution. The vehicle could slip, causing personal injury or death.

IMPORTANT: The jacking point for the front wheels is on the front axle beam and other locations shown in Fig.136,, page 184. The jacking point for rear wheels is on the rear axle and at the locations on the rear suspension H-frame, shown in Fig.136,, page 184. Only use the front bumper locations if the vehicle is equipped with a jackable bumper. When jacking the front bumper, the jacking point(s) must be centered and within the bottom surface of the bumper support as shown in Fig.136,, page 184. Do not position the jack under the dropped frame rails in the center section of the vehicle.

6. place the jack on a solid surface. Insert the jack handle and pump the handle slightly. **Do not raise the wheel off of the ground yet.** Loosen the wheel lug nuts, but do not remove them.



1. Jack LocationsFront Axle
2. Jack LocationsRear Axle
3. Jack LocationsFront Bumper

Fig 136, Jack placement

IMPORTANT: The dual rear wheels are attached using two-element lug nuts. The larger nut retains the outer dual. The inner square stud retains the inner dual. Remove and install these nuts separately. The rear dual outer lug nut must be loosened to check and retighten the inner nut.

7. Raise the vehicle until the wheel is off of the ground. Remove the lug nuts and the wheel.
8. Install the spare wheel and lug nuts. Make sure that the beveled sides of the nuts face inward, or, on hub-piloted wheels, make sure that the hub-pilot pad is centered at the top.

IMPORTANT: When a tire is changed, the vehicle should be taken to a mechanic as soon as possible, to have the lug nuts tightened properly with an impact air gun.

9. In a star pattern, tighten the nuts evenly until snug. See General Information, Rear Axle, Wheels and Tires of the **S2 Workshop Manual** for wheel tightening patterns and torque specifications. Lower the vehicle until the wheel touches the ground. Tighten the nuts.
10. Finish lowering the vehicle to the ground, then remove the jack.
11. Remove the block, then stow the jack, jack handle, and lug wrench.
12. After operating the vehicle for 50 to 100 miles (80 to 161 km), retighten the wheel nuts to the specified torque values.

18.07 Fire Extinguisher

An optional fire extinguisher is located in the front of the cab, between the driver and passenger seats.

18.08 First Aid Kit

An optional first aid kit is mounted to the back of the cab, between the driver and passenger seats.

18.09 Flare Kit

An optional flare kit is located in the center of the cab, between the driver and passenger seats.

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19. Headlight Aiming

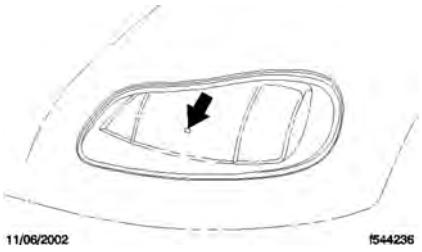
19.01 Preliminary Checks

Before checking or adjusting the headlight aim, do the following:

- Check that the hood is closed and latched.
- Check the suspension for proper functioning of the leveling mechanism. On vehicles with air suspensions, make sure that the height is properly adjusted.
- Remove any large amounts of mud or ice from the underside of the fenders.
- Check the springs for sagging or broken leaves.
- Check for damage to the hood and hinge assembly. Repair as necessary.
- Clean the headlight lenses. Use a soft cloth with mild, non-caustic soap or detergent, and water.
- With the vehicle unloaded, check that the tires are inflated to the recommended air pressure.

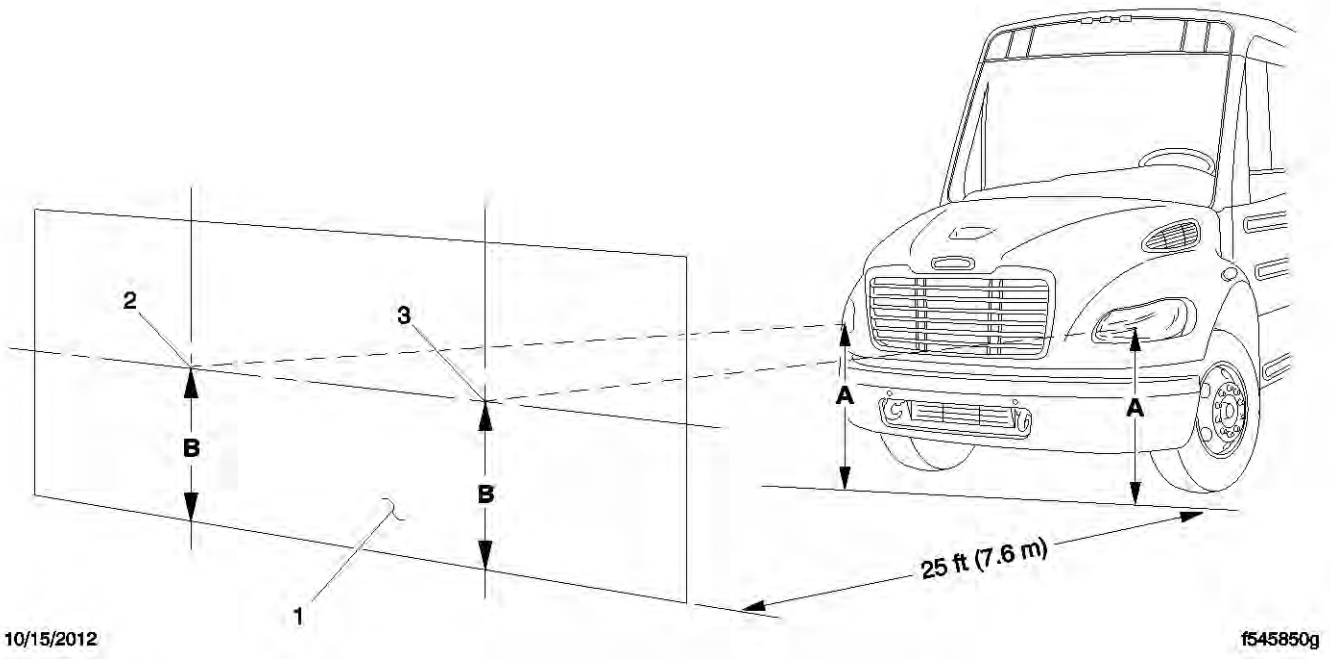
19.02 Checking Headlight Aim

1. park the vehicle on a level surface, 25 ft (7.6 m) away from, and perpendicular to, a vertical screen or wall. Shut down the engine and set the parking brake. Chock the tires.
2. Each headlight has a height adjusting dot. See Fig.137,Headlight Beam Height Adjusting Dot. Measure the distance from the ground to the height adjusting dot on each headlight. Note those distances. See Fig. 138,Headlight Aiming Screen/Wall, Ref. A.



NOTE: Measure beam height from the ground to the small dot roughly in the center of the headlight lens.

Fig 137, Headlight Beam Height Adjusting Dot

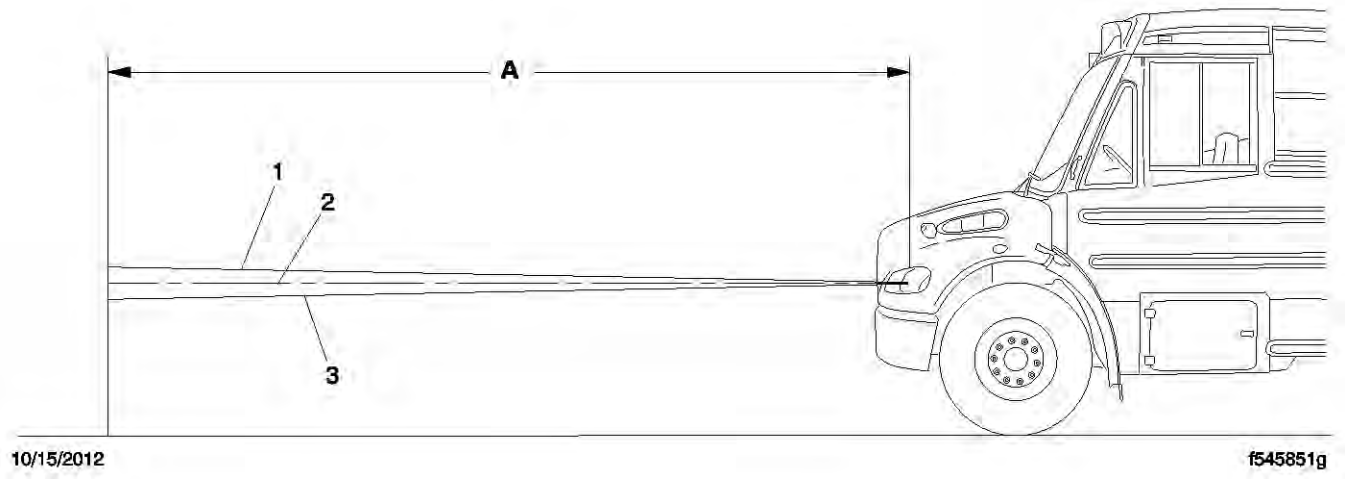


A. Measure the distance from the ground to the center of each headlight bulb.
B. Mark where the center of each headlight projection should appear.

1. Screen or Wall
2. Center of Right-Hand Headlight projection
3. Center of Left-Hand Headlight projection

Fig 138, Headlight Aiming Screen/Wall

3. Mark the vertical distances found in step 2 on the screen or wall, directly in front of the headlights. These marks represent the desired locations of each headlight bulb center in the following steps. See Fig. 138,Headlight Aiming Screen/Wall, Items 2 and 3.
4. Turn on the low-beam headlights.
5. Identify the center of each beam projection by marking the area of brightest intensity on the wall. The area of brightest intensity should fall on or very near the marks made during step 3. See Fig. 139,Vertical Low-Beam Headlight Variation Limits.



1. Low-Beam Angle Upper Limit
2. Ideal Low-Beam projection
3. Low-Beam Angle Lower Limit

Fig 139, Vertical Low-Beam Headlight Variation Limits

6. Use Table.17,Vertical Low-Beam Headlight Variation Limits to determine the maximum vertical distance allowable between the marks made in step 3 and the marks made in step 5. If the vertical distance between the marks made in steps 3 and 5 is greater than the maximum distance given in Table.17,Vertical Low-Beam Headlight Variation Limits, adjust the vertical positioning of that headlight.

Table 17, Vertical Low-Beam Headlight Variation Limits

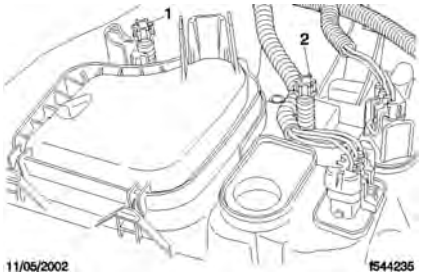
Vertical Low-Beam Headlight Variation Limits			
Distance Between Ground and Headlight: in (mm)	**Desired Variation (Fig. 139,Vertical Low-Beam Headlight Variation Limits, Item 2): in (mm)**	**Upper Limit (Fig. 139,Vertical Low-Beam Headlight Variation Limits, Item 1): in (mm) up**	**Lower Limit (Fig. 139,Vertical Low-Beam Headlight Variation Limits, Item 3): in (mm) down**
2236 (560900)	0	3.9 (100)	3.9 (100)
3648 (9001200)	2 (50) down	2 (50)	6 (150)
4854 (12001400)	2.5 (64) down	1.6 (40)	6.5 (165)

Table 17, Vertical Low-Beam Headlight Variation Limits

19.03 Adjusting Headlight Aim

NOTE: Because of the various headlight assembly options offered, the location of adjustment screws on the vehicle's headlight assembly may vary from what is shown here.

1. Lift the flap over the rear end of the headlight bucket to expose the two plastic adjusting knobs on each headlight. See Fig.140,Headlight Adjusting Knobs.

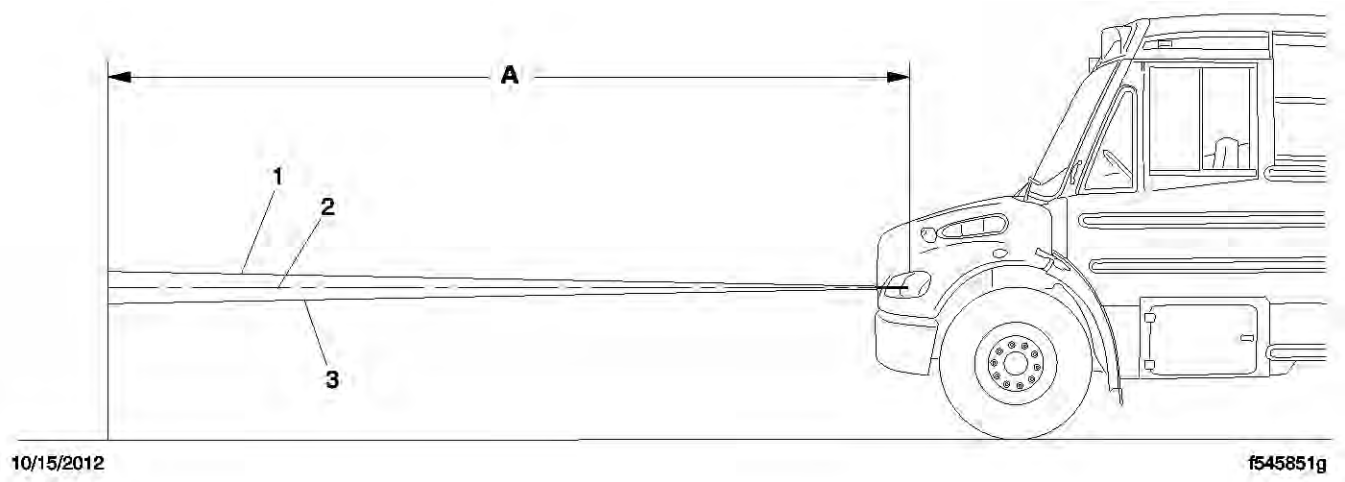


NOTE: The right-hand side headlight bucket is shown. The left-hand side is opposite.

1. Horizontal (inboard) Adjusting Knob
2. Vertical (outboard) Adjusting Knob

Fig 140, Headlight Adjusting Knobs

2. If necessary, adjust the horizontal positioning of the headlights so that each projection points directly forward.
3. Turn the vertical adjustment knob to adjust the headlight beam to meet the desired height. See Table 18,Vertical Low-Beam Headlight Variation Limits Turn the knob clockwise to raise the beam; turn the knob counterclockwise to lower it.



1. Low-Beam Angle Upper Limit
2. Ideal Low-Beam projection
3. Low-Beam Angle Lower Limit

Fig 141, Vertical Low-Beam Headlight Variation Limits

4. Adjust the other headlight.

Table 18, Vertical Low-Beam Headlight Variation Limits

Distance Between Ground and Headlight: in (mm)	Desired Variation (Fig. 141,Vertical Low-Beam Headlight Variation Limits, Item 2): in (mm)	Upper Limit (Fig. 141,Vertical Low-Beam Headlight Variation Limits, Item 1): in (mm) up	Lower Limit (Fig. 141,Vertical Low-Beam Headlight Variation Limits, Item 3): in (mm) down
2236 (560900)	0	3.9 (100)	3.9 (100)
3648 (9001200)	2 (50) down	2 (50)	6 (150)
4854 (12001400)	2.5 (64) down	1.6 (40)	6.5 (165)

Table 18, Vertical Low-Beam Headlight Variation Limits

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20. Propane Fuel System

20.01 General Information

CAUTION:
The propane fuel system requires special tools to make repairs. Service and repair of the propane fuel system should only be performed by trained propane service technicians. To prevent personal injury or damage to the fuel system, do not attempt repairs yourself.

DANGER:
Never cut or weld on the propane storage tank. Severe bodily injury or fire could result.

Propane is highly flammable. Keep sparks and open flames away from propane. Do not smoke when refueling the vehicle. Failure to observe these safety precautions could cause serious bodily injury or death.

The information provided in this chapter is specific to the propane engine, however, other chapters in this manual pertain to the propane operated vehicle. These include, but are not limited to, the controls and pretrip inspection and daily maintenance chapters.

IMPORTANT: For assistance with propane engine related questions, contact Freightliner Custom Chassis Corporation at 1-800-385-4357, option 1.

NOTE: Oil consumption is normal during operation of the propane engine. The rate of consumption is highly dependent on vehicle loading and duty cycles. New engines may experience higher oil consumption during the engine break-in period. For further information, refer to the engine manufacturer's manual.

NOTICE:
If the ignition switch is in the RUN position for more than 15 seconds and the fuel tank is empty, the fuel pump must be unplugged. Failure to follow this procedure will result in damage to the fuel pump. Refer to the propane engine manual for instructions on how to unplug the fuel pump.

HD5 grade propane is recommended for propane engines. HD5 is a heavy duty engine grade propane with a minimum of 90% propane and a maximum of 5% propylene. This grade of propane is 100 plus octane and provides proper performance and emissions control, which the fuel system is designed to deliver.

The engine is designed to operate properly on a wide variety of liquid propane gas (LPG) blends which can fall in the category of HD5, and is not affected by "heavy ends" or other waxy hydrocarbons that have traditionally affected other systems.

NOTICE:
LPG should be free of contaminants including, but not limited to, rust, dirt, sand, water, salt, and brine. These contaminants can cause engine damage that is not covered by the engine warranty.

WARNING:
The propane fuel system operates at pressures up to 312 psi (2151 kPa). A sudden release of propane can cause serious injuries if it contacts the skin or eyes. Always wear protective gloves and eye protection when handling propane.

LPG has no color. A distinctive odorant, similar to sulfur or rotten eggs, is added to LPG to alert anyone nearby in the event of a leak.

20.02 Ignition Switch and Key

The ignition switch can be turned to four positions: ACCESSORY, OFF, ON, and START. See Fig. 142,Ignition Switch Positions.

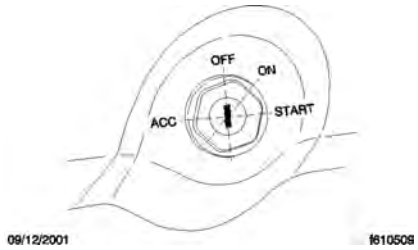


Fig 142, Ignition Switch Positions

The key can be inserted and removed only in the OFF position. The headlights (low beams), taillights, brake lights, road lights, clearance lights, turn signals, hazard warning lights, horn, CB radio, clock, and electric oil pan heater operate with the ignition switch in the OFF position, regardless of whether the key is inserted.

In the ACCESSORY position, the key is turned counterclockwise. All of the components that are operable in the OFF position are operable in the ACCESSORY position, as well as the radio (if so equipped), mirror heat, air dryer, and backup lights.

IMPORTANT: The propane engine is equipped with an amber wait to start indicator. The indicator illuminates when the ignition is in the RUN position prior to engine start-up. Do not crank the engine until the wait to start indicator goes out. See the "Ametek Panel" information in this chapter for the location of the wait to start indicator.

Turn the key fully clockwise to the START position to start the engine. When the engine starts, release the key.

All electrical systems are operable in the ON position. The warning lights and the buzzer for low air pressure and low oil pressure operate until minimum pressures are built up.

20.03 Operation of the Engine

20.03.01 General Information

NOTE: Before starting the engine, read the "Ametek Panel" information in this chapter and 5.01 Ignition Switch and Key for detailed information on how to read the instruments and operate the controls.

Before operating the vehicle, perform the pretrip inspection and daily maintenance checks in 5.01 Ignition Switch and Key and 16.01 Safety Precautions of this manual.

NOTICE:

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

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

20.03.02 Starting the Engine

1. Set the parking brake.
2. Turn the ignition switch to the RUN position.

   The amber wait to start indicator light illuminates when the ignition is in the RUN position prior to engine start-up. Do not crank the engine until the wait to start indicator light goes out.
3. Make sure that the transmission shift control is in Neutral (N), or if so equipped, the park (p) position.

WARNING:

Never start the engine unless the parking brake is applied. Accidental movement of the vehicle could result in property damage, personal injury, or death.

IMPORTANT: Do not depress the throttle pedal while starting the engine.

4. Turn the ignition switch to the START position. After the engine starts, release the key.

NOTICE:

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

5. Bring the engine up to operating speed gradually as it warms up and develops stable oil pressure.

IMPORTANT: When the engine is started, it takes a short time to build up a lubricating oil film between the shafts and bearings, and between the pistons and cylinder walls. The oil pressure gauge indicates any drop in lubricating oil pressure within 15 seconds of engine startup.

20.03.03 Engine Shutdown

Shut down the engine immediately if:

- the oil pressure gauge needle swings back and forth or falls sharply;
- engine power and rpm fall, even though the accelerator pedal remains steady;
- the exhaust pipe gives off heavy smoke;
- the coolant and/or oil temperature climb abnormally;
- abnormal sounds suddenly occur in the engine.

1. With the vehicle stopped, place the transmission in Neutral (N), or if so equipped, the park (p) position.
2. Set the parking brake.
3. Idle the engine for two to three minutes before shutting it down. This allows the lubricating oil and the coolant to carry heat away from the combustion chambers, bearings, shafts, etc.

   NOTE: Long periods of idling are not needed or recommended.

4. Shut down the engine by turning the ignition switch to the OFF position.

20.04 Transmission

20.04.01 T-Handle Shift Selector

The S2 propane chassis is equipped with an Allison 2300 or 2350 Series transmission. A T-handle shift selector is used by the driver to select the transmission ranges. See Fig.143,T-Handle Shift Selector. Refer to www.allisontransmission.com for additional information.

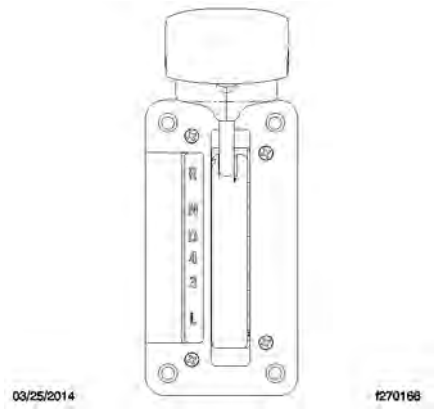


Fig 143, T-Handle Shift Selector

P (Park)

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

NOTE: This does not apply the parking brake. The park pawl is standard on the 2350 series transmission. The park pawl effectively grounds the transmission output shaft, thereby preventing rotation of the driveline. Provided the vehicle is stationary, selecting **P** (park) on the shift selector, if so equipped, places the transmission in neutral and engages the park pawl.

PB (Auto-Apply Parking Brake, optional on 2300 Series)

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

R (Reverse)

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

Do not idle in reverse for more than 5 minutes. When time at idle exceeds 5 minutes, select **N** (neutral), or if so equipped, **P** (park) or **PB** (auto-apply parking brake).

NOTE: The shift into reverse may not succeed if a range inhibitor is active. Check the driver display screen in the instrument panel for a RANGE INHIBIT message.

N (Neutral)

The neutral position places the transmission in neutral. 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.

This position is used when starting the engine and for stationary operation. It is also used to shut down the vehicle when **P** (park) or **PB** (auto-apply parking brake) are not available on the shifter. In this case, the parking brake must be applied.

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

D (Drive)

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 fifth or sixth 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.

NOTE: The shift into drive may not succeed if a range inhibitor is active. Check the driver display screen in the instrument panel for a RANGE INHIBIT message.

4 and 3 (Fourth and Third Ranges)

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

L (Low Range)

Use low range when pulling through mud or deep snow, when maneuvering in tight spaces, or when driving up or down very steep grades. Low 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).

20.04.02 Transmission Mode Switch

Some vehicles are equipped with a transmission mode switch, shown in Fig.144,Transmission Mode Switch. The transmission mode switch is a fuel conservation option that allows the driver to choose either performance or economy shifting. When the switch is in the on position (the top of the rocker switch is pushed down), the transmission shift pattern changes from primary (performance) shift mode to secondary (economy) shift mode. When the transmission mode switch is in the off position (the bottom of the rocker switch is pushed down), the transmission reverts back to the primary shift mode.

NOTE: Primary and secondary shift mode calibration varies by vehicle.



Fig 144, Transmission Mode Switch

20.05 Propane Refueling

20.05.01 General Description

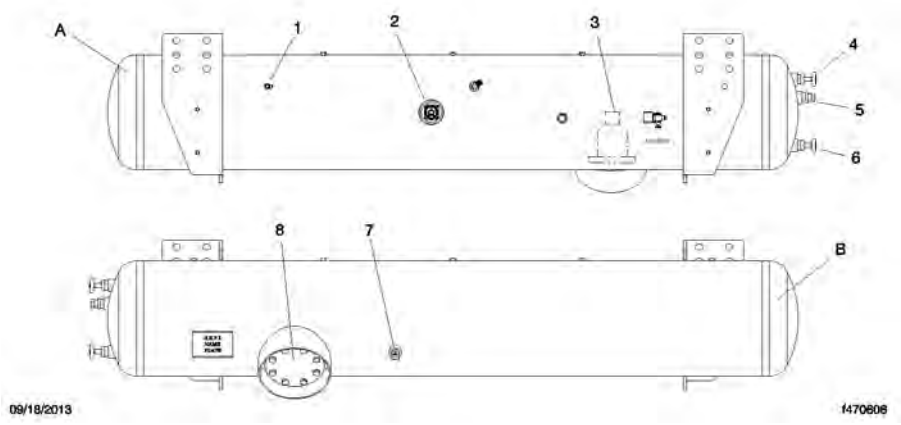
Agility Fuel Systems recommends that the Liquid Propane Injection® (LPI) vehicle be refilled with fuel at stations that are specifically designed for vehicle refueling. For assistance locating LPG fuel stations, contact Agility Fuel Systems, see www.agilityfuelsystems.com or at 1-949-267-7745.

The propane fuel system utilizes a closed system, with fuel supply and return lines. This requires more advanced refueling equipment due to variances in pressure. When refueling the vehicle at a station not specifically designed for dispensing propane (also referred to as autogas), the refueling process may be very slow or the tank may not fill at all. The vehicle propane tank is subjected to heat from the pavement and chassis components, which cause a normal increase in tank pressure. The station pump may not be able to produce pressure high enough to overcome that of the tank on the vehicle. It is recommended that the filling dispenser have a minimum of 90 psi (621 kPa) pump differential boost pressure over the storage tank pressure; most modern stations are designed to 130 psi (896 kPa) differential pressure. It is recommended to refuel the vehicle at a modern station to prevent any customer inconvenience.

LPI fuel tanks are equipped with both an 80% fixed liquid level gauge, and an automatic overfill protection device (OPD). The LPI system is designed to be filled reliably and safely using only the OPD. Therefore, it is not recommended to use the 80% fixed liquid level gauge unless required by the filling station attendant, or for annual OPD verification. For instructions on how to perform the annual OPD verification test, go to www.agilityfuelsystems.com.

Propane is a liquid under pressure and is stored in a pressure vessel unlike a gasoline or diesel tank. A propane tank must never be filled to more than 80% of its actual capacity, to allow room for expansion. 80% is considered "full" for all propane tanks. When the tank is filled to the correct 80% level, the fuel gauge should read full.

The following steps describe a typical refueling procedure. See Fig.145,Propane Tank System for an example of the dual propane tank system.



A. Front Side
B. Back Side
1. Bleeder Valve
2. Fuel Level Gauge
3. Return Valve
4. Fill Valve
5. Service Valve
6. Pressure Relief Valve
7. Access Cover and Collar

Fig 145, Propane Tank System

20.05.02 Propane Refueling Procedures

1. Park the vehicle on level ground to ensure that the tank is properly filled.
2. Turn the vehicle ignition to OFF and set the parking brake. Chock the tires if required.
3. Ensure that there are no open flames or ignition sources in the area.
4. Turn the fuel tank cap counterclockwise and remove it.
5. Inspect the fill valve O-ring, making certain the O-ring is seated in the groove and is not damaged or missing.

CAUTION:

Never connect the propane fill nozzle to the tank fill valve if the O-ring is damaged or missing, as this could result in serious injury. Replace the O-ring before connecting the propane fill nozzle.

6. Connect the propane fill nozzle to the tank fill valve.
7. Rotate the propane fill valve nozzle clockwise until it is firmly attached to the tank fill valve.
8. Close the fill nozzle vent valve if so equipped.
9. Open the 80% bleeder valve only if required. Agility Fuel Systems does not recommend using the bleeder valve. Use of the valve in a low emission fuel station is prohibited.
10. Open the valve on the refueling nozzle.
11. Turn the propane dispenser on to begin refueling.
12. When the OPD stops the flow of fuel into the tank, close the filling valve.

    If use of the 80% bleeder valve is required, stop filling when liquid from the bleeder appears in the form of a white cloudy vapor.
13. Turn the propane dispenser off.

CAUTION:

Never overfill the propane fuel tank. Overfilling the fuel tank can cause a dangerous condition, resulting in serious injury and damage to the vehicle.

After refueling, if a strong smell of propane persists or if a hissing sound is heard, notify the fuel station operator. **Do not** start the vehicle.

14. Disconnect the filling nozzle from the tank fill valve.

    14.a If necessary, first open the vent valve on the nozzle, if so equipped, and release the pressure from the valve for safety.

    14.b Rotate the filling nozzle connector counterclockwise and remove it. Then return it to the dispenser.

15. Install the fuel cap.
16. Check for leaks on the fill valve and connecting piping, and around the 80% bleeder valve.
17. Ensure that all of the fuel tank valves are in the fully-closed position.

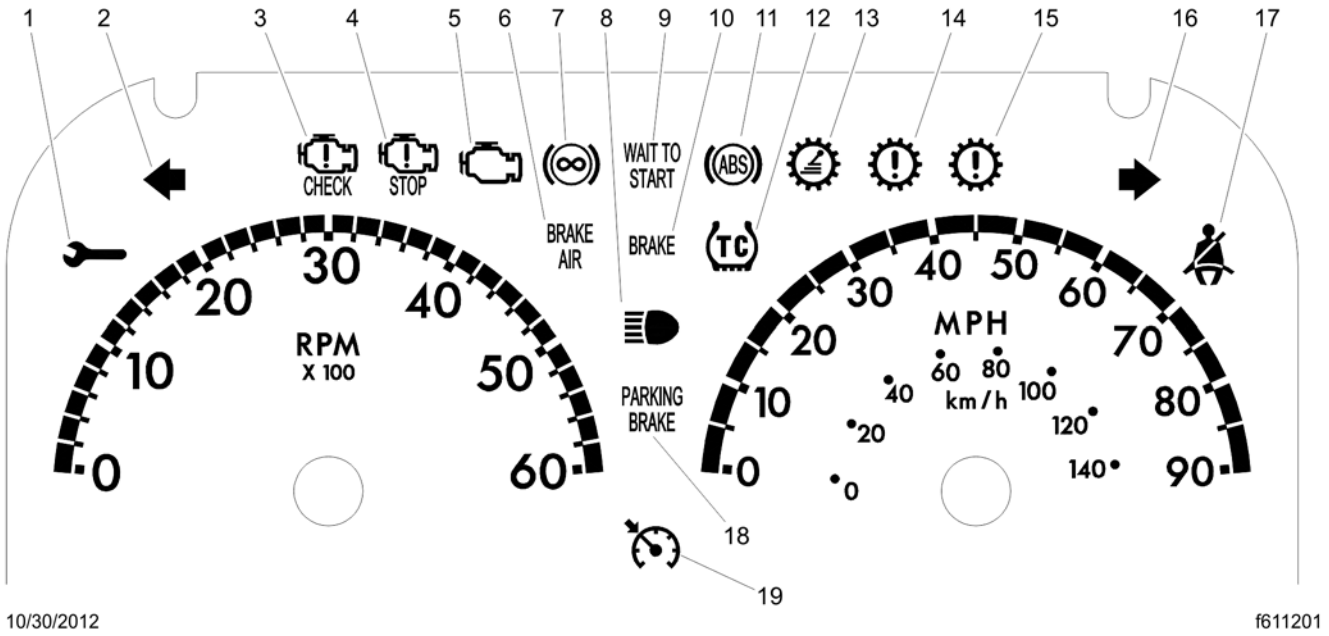
20.06 Warning and Indicator Lamps

20.06.01 General Description

There are 19 warning and indicator lamps (telltales) installed in the dash message center. See Fig. 146,LPG Engine Warning and Indicator Lamps.

The instrument cluster has an emergency buzzer that sounds when serious conditions that require immediate attention occur.

A description of the standard warning and indicator lamps are listed below.



1. Maintenance Warning Lamp
2. Left-Turn Indicator
3. Check Engine Warning
4. Stop Engine Warning
5. Malfunction Indicator Lamp (MIL)
6. Low Air Pressure Warning
7. Engine Brake Light (not used)
8. Headlight High-Beam Indicator
9. Wait to Start Indicator
10. Hydraulic Brake System Warning
11. ABS Warning
12. Traction Control Indicator
13. Shift Inhibit Indicator
14. Check Transmission Indicator
15. Stop Transmission Indicator
16. Right-Turn Indicator
17. Fasten Seat Belt Warning
18. Parking Brake On Warning
19. Cruise Control Indicator

Fig 146, LPG Engine Warning and Indicator Lamps

20.06.02 Maintenance Warning Lamp

When amber maintenance warning lamp illuminates, the message display center alerts the driver as follows:

- Oil Change Requiredalerts the driver that the engine has reached the recommended oil change interval.
- Air Filter Reminderthe air filter requires checking or replacement.
- Transmission Prognostics Warningif the transmission has prognostics enabled.

20.06.03 Left-Turn Indicator

The left-turn indicator flashes on and off when the left-turn signal lights are flashing.

Both turn signal indicators flash when the hazard warning flasher is turned on.

20.06.04 Check Engine Warning

The check engine warning indicator illuminates when certain faults are detected. If a critical engine condition exists (for example, low oil pressure or high coolant temperature), the check engine indicator will illuminate to alert the driver to correct the condition as soon as possible. If the condition gets worse, the stop engine indicator will illuminate.

NOTE: If the check engine indicator illuminates during vehicle operation, take the vehicle directly to an authorized Freightliner service facility.

20.06.05 Stop Engine Warning

WARNING:
When the red STOP engine lamp illuminates, the driver must immediately move the vehicle to a safe location at the side of the road to prevent causing a hazardous situation that could cause bodily injury, property damage, or severe damage to the engine.

The stop engine warning indicator illuminates when the protection system available for the engine has been activated. The engine ECU will derate the engine, allowing it to run, but at lower rpm and slower vehicle speed. The vehicle may be driven to a safe location.

NOTICE:
Because operating the engine when the stop engine indicator is illuminated can lead to severe engine damage, the driver must move the vehicle to a safe location as quickly as possible.

If the engine is shut down while the vehicle is in service, a single restart attempt may be performed. Depending on the nature of the fault condition, a cool-down period may be required before restarting. If, upon restarting, the fault condition still exists the indicator will come on and the engine should be shut down. At this point, the vehicle is unsafe to drive and should be transported to an authorized Freightliner service facility.

IMPORTANT: Do not attempt to restart the engine while the vehicle is moving. Bring the vehicle to a safe stop and restart the engine with the vehicle stopped.

20.06.06 Malfunction Indicator Lamp (MIL)

The malfunction indicator lamp (MIL) indicates an engine emissions-related fault. See the engine operation manual for details.

20.06.07 Low Air Pressure Warning

The low air pressure warning indicator (BRAKE icon) and emergency buzzer activate when the engine is turned on if air pressure in the primary or secondary air reservoir is below 65 to 75 psi (448 to 517 kPa), and remain on until air pressure rises above that level in both reservoirs.

20.06.08 Headlight High-Beam Indicator

The high-beam indicator (sideways beam icon) illuminates when the headlight high beams are on.

20.06.09 Wait to Start Indicator

The wait-to-start indicator illuminates when the intake heater is active. Wait until the indicator goes off to start the engine.

20.06.10 Hydraulic Brake System Warning

The brake system warning lamp illuminates if there is a hydraulic brake system failure, or if the vehicle is powered and the engine is not running.

20.06.11 ABS Warning

The ABS indicator illuminates when there is a malfunction in the vehicle antilock brake system (ABS).

NOTE: For more information about this indicator and the ABS system, see 14.01.01 Primary Air Brake System.

20.06.12 Traction Control Indicator

The traction control indicator illuminates when the wheels lose traction.

20.06.13 Shift Inhibit Indicator

The shift inhibit indicator illuminates when the transmission ECU prohibits shifting.

20.06.14 Check Transmission Indicator

The LPG check transmission indicator has a different icon (exclamation point), and illuminates when the transmission fluid temperature goes above a preset level set by the transmission manufacturer.

For more information, see the transmission manufacturer's manual provided with the vehicle.

20.06.15 Stop Transmission Indicator

The stop transmission indicator illuminates when the transmission control unit senses a malfunction.

20.06.16 Right-Turn Indicator

The right-turn indicator flashes on and off when the right-turn signal lights are flashing.

Both turn signal indicators flash when the hazard warning flasher is turned on.

20.06.17 Fasten Seat Belt Warning

The fasten seat belt warning indicator (seat belt icon) illuminates for 3 seconds after the ignition switch is turned on.

When the engine is operating, if the driver's seat belt is unfastened and the park brake is not set, the seat belt warning indicator illuminates and a warning chime activates. The warning chime will remain active for 15 seconds. The warning indicator remains illuminated until the driver's seat belt is fastened.

20.06.18 Parking Brake On Warning

The parking brake on indicator activates when the parking brake is engaged.

If the vehicle is moving at a speed of 2 mph (3 km/h) or more, the emergency buzzer will sound until the parking brake is released.

20.06.19 Cruise Control Indicator

The cruise control indicator illuminates when the cruise control is activated.

20.06.20 Emergency Buzzer

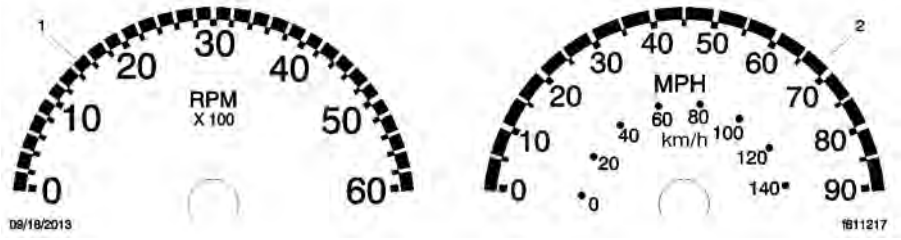
The emergency buzzer sounds during the ignition sequence and whenever one of the following conditions exists:

- The engine oil pressure falls below the preset level which is 6 psi (41 kPa) at 700 rpm, or 18 psi (124 kPa) at 4400 rpm.
- The air pressure falls below the preset level, which is 65 psi (448 kPa).
- The parking brake is set with the vehicle moving at a speed greater than 2 mph (3 km/h).
- The coolant temperature rises above 253°F (123°C) and the check engine and stop engine lamps illuminate. When the coolant temperature falls below 244° (118°C) the emergency buzzer and stop engine lamp turn off.

NOTE: The check engine lamp will remain on until the vehicle is inspected at an authorized Freightliner service facility.

20.07 Speedometer

Three kinds of speedometer faces 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. See Fig. 147,Speedometer and Tachometer (U.S. version).



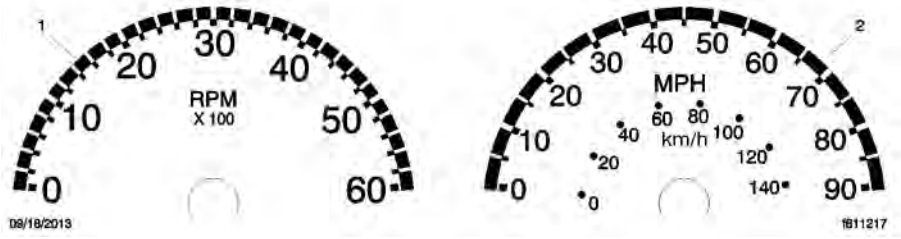
1. Tachometer
2. Speedometer

Fig 147, Speedometer and Tachometer (U.S. version)

The NAFTA version (not shown) of the speedometer face reverses this arrangement, with km/h in larger numbers. The metric-only version (not shown) shows km/h exclusively.

20.08 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. See Fig.148,Speedometer and Tachometer (U.S. version).



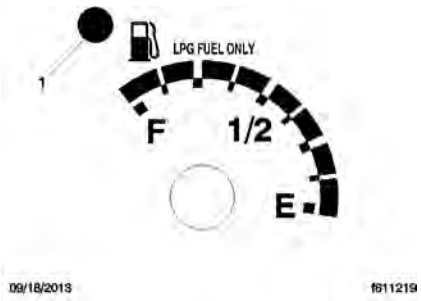
1. Tachometer
2. Speedometer

Fig 148, Speedometer and Tachometer (U.S. version)

20.09 Standard Instruments

20.09.01 Fuel Level Gauge

The fuel level gauge indicates the level of fuel in the fuel tank. See Fig.149,Fuel Level Gauge. A low-level warning lamp illuminates when the diesel fuel level registers 1/8th of capacity.



1. Low-Level Warning Lamp

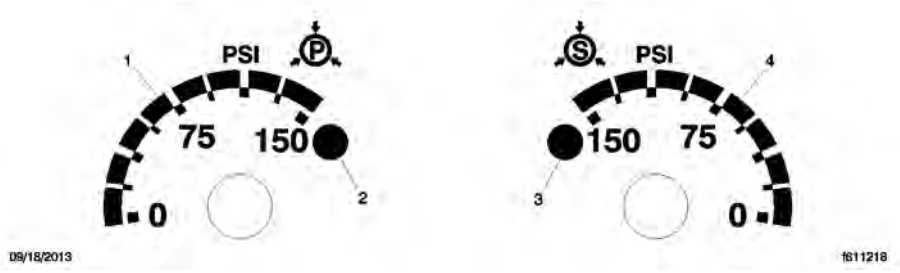
Fig 149, Fuel Level Gauge

20.09.02 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 register the pressure in the primary and secondary air systems. Normal pressure with the engine running is 100 to 120 psi (690 to 827 kPa) in both systems. See Fig.150,Air Pressure Gauges.



1. Primary Air Pressure Gauge
2. Low Primary Air Pressure Warning Lamp
3. Low Secondary Air Pressure Warning Lamp
4. Secondary Air Pressure Gauge

Fig 150, Air Pressure Gauges

Air pressure gauges are required on all vehicles with air brakes. A low-air-pressure warning lamp and buzzer, connected to both the primary and secondary systems, activate when air pressure in either system drops below a minimum pressure of 65 to 75 psi (448 to 517 kPa).

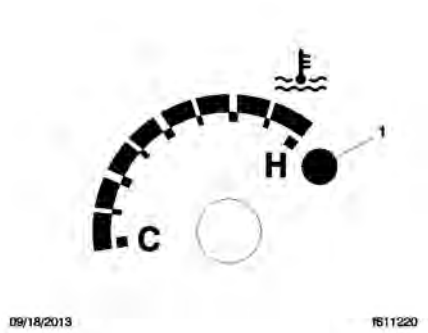
When the engine is started, the warning lamp and buzzer remain on until air pressure in both systems exceeds minimum pressure.

20.09.03 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 should read 200 to 205°F (93 to 96°C). See Fig. 151,Coolant Temperature Gauge. If the temperature remains below 160°F (71°C) or exceeds 235°F (113°C), inspect the cooling system to determine the cause. See the vehicle workshop manual for troubleshooting and repair procedures.



1. High Coolant Temperature Warning Light

Fig 151, Coolant Temperature Gauge

If the coolant temperature rises above 253°F (123°C), the check engine and stop engine warning indicators will illuminate, and the buzzer will sound. At this point, the engine will derate and idle speed will increase, to speed up the cooling fan and water pump to cool the engine.

20.10 Grade Brake

IMPORTANT: The grade brake is an optional auxiliary brake system that works through the transmission. It should not be confused with exhaust brake or engine brake. Furthermore, the grade brake should not be used in place of the service brakes to stop the vehicle.

Chassis equipped with a propane engine may have an optional grade brake. The grade brake is designed to downshift the transmissionwhen going downhill for examplewithout overspeeding the engine. Refer to the **Allison Operator's Manual** for proper operation of the grade brake. See Fig.152,Grade Brake Switch for an example of the grade brake switch. An amber light activates at the top of the switch when the grade brake is activated.

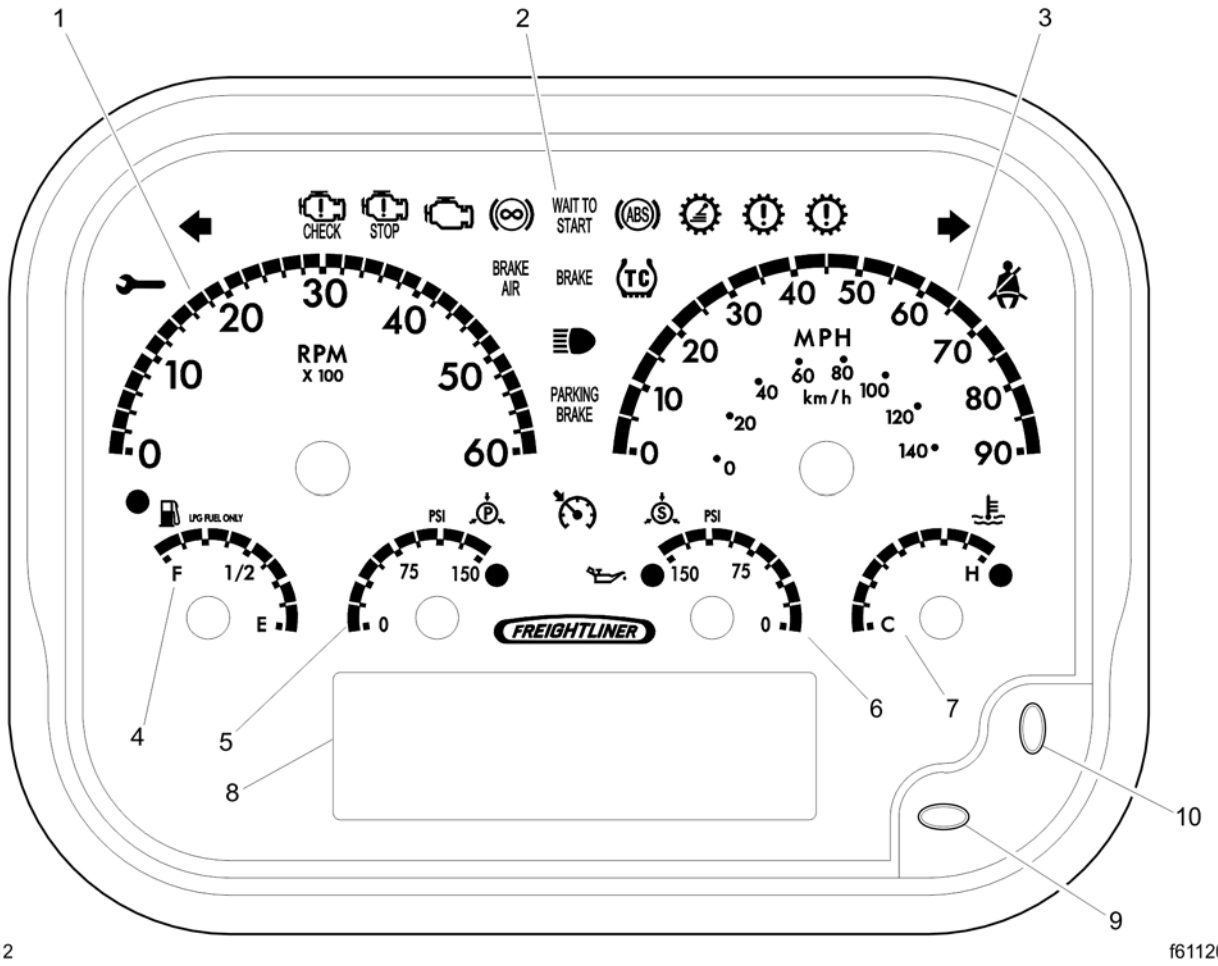


Fig 152, Grade Brake Switch

20.11 Ametek Instrument Panel

20.11.01 General Description

The following information describes the Ametek instrument panel, used with liquid propane gas (LPG) engines. The instrument panel is shown in Fig.153,Gauge Layout (typical, U.S.), LpG Engines.



1. Tachometer
2. Dash Message Center
3. Speedometer
4. Fuel Level Gauge
5. primary Air pressure Gauge
6. Secondary Air pressure Gauge
7. Coolant Temperature Gauge
8. Dash Driver Display Screen
9. Toggle Button, Down
10. Toggle Button, Right

Fig 153, Gauge Layout (typical, U.S.), LpG Engines

NOTE: The instrument panel is shown with a standard U.S. speedometer, which shows miles per hour (mph) more prominently than kilometers per hour (km/h).

20.11.02 Message Display Center

The message display is a graphical, backlit, liquid crystal display (LCD) that relays information to the vehicle operator. The messages displayed include:

- Odometer
- Trip Odometer 1/Trip Odometer 2
- Chassis Battery Voltage
- Instantaneous Fuel Rate
- Average Fuel Rate
- Gear Attained Status

- Transmission Temperature
- Hour Meter
- Boost Pressure
- Engine Oil Pressure
- Coolant Temperature
- Fuel Level
- Percent Engine Load
- Engine RPM

During normal operation, the LCD displays the odometer value and chassis battery voltage on the top line, and driver selected parameters, such as the trip odometer and fuel rate, on the second and third lines.

20.11.03 Priority Messages

Priority messages (including warning messages) are displayed in the LCD due to various inputs or data messages. Unless noted otherwise, the priority message will take over the whole screen, allowing multiple messages to be displayed in five second intervals.

20.11.04 Self-Test

When the ignition is turned on, a required self-test automatically begins. Gauge needles will reset to zero during the self-test, and then immediately move to the position dictated by the data received. During this time, the warning lights, alarm (buzzer), and driver display screen will also perform a self-test.

NOTE: The driver can activate or deactivate the start-up self-test by accessing the setup menu.

20.11.05 Menu System

The menu system is shown on the driver display screen once the self-test is finished. The menu system responds to input from the driver and remains active as long as the ignition is on. In order for the driver to operate the menu system, the ignition must be ON, and the park brake must be set (ON). The main features of the menu system are described below.

- Setupthis is used to set various parameters, which are saved when the ignition is turned off. Setup has select display units, startup screen, LCD contrast, and reset parameters.
- Maintenanceshows various maintenance intervals such as engine oil, air filter, etc.
- Diagnosticsthis is used for setting and reading inputs and outputs and checking the gauges. It also shows the hardware and software version of the instrument panel, and has menus to retrieve active error codes from the engine, transmission, and ABS controllers.

NOTE: No lines can be highlighted in the menu system screen. To get to the sections that can be highlighted, press the right arrow toggle button and hold it for two seconds. The display screen will change and the options shown can then be highlighted. Once a selection has been chosen and changes are made, press the right arrow toggle button to go back to the main message display screen.

Setup Menu

Select Display Units

The set units screen allows the driver to choose between English or metric units of measurement for the displayed values. To navigate to the set units screen, see Fig.154,Setup Menu Screens, screens H, I, and J.

Startup Screen

The startup screen selection allows the driver to turn the startup screen on or off.

LCD Contrast

Select contrast from the menu to set the LCD contrast. Use the down toggle button to set the contrast to the desired level. To navigate to the contrast screen, see Fig.154,Setup Menu Screens, screen M.

Reset Parameters

The reset parameters screen is included with vehicles that have the Allison transmission prognostics feature.

Maintenance Menu

The maintenance menu has the following three sub menus:

- maintenance intervals
- transmission oil life remaining
- transmission oil filter life monitor

Maintenance Intervals

The maintenance intervals menu allows the driver to set the change intervals for engine oil and engine air filter. If the intervals are set to zero, the maintenance warnings must be disabled.

Transmission Oil Life Remaining

If transmission prognostics are enabled, this menu indicates how much useful oil life remains.

Transmission Oil Filter Life Monitor

If transmission prognostics are enabled, the transmission oil filter life monitor tells the driver if the transmission oil filter is clogged and in need of repair. A message will appear on the display screen as TRANS OIL FILTER FUNCTIONAL or TRANS OIL FILTER CLOGGED.

Diagnostic Menu

The diagnostic menu contains the following items:

- engine faults
- transmission faults
- ABS faults
- check outputs
- odometer diagnostics
- check gauges
- check indicators (warning lamps)
- check LCD
- check binary inputs
- check analog inputs
- check datalink
- hardware/software version

All of the items in the diagnostic menu can be accessed by using the toggle buttons and selecting the auxiliary screens. Then navigate to the diagnostic sub-menu. Some of the more frequently used diagnostic menus are described further below.

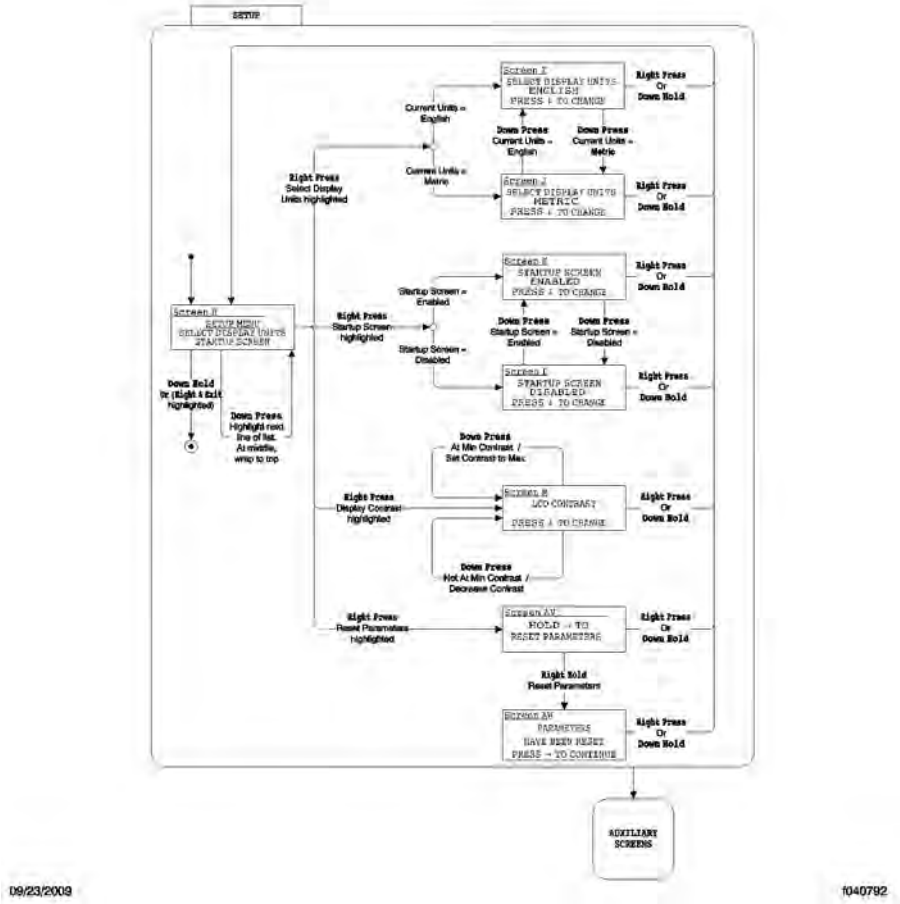


Fig 154, Setup Menu Screens

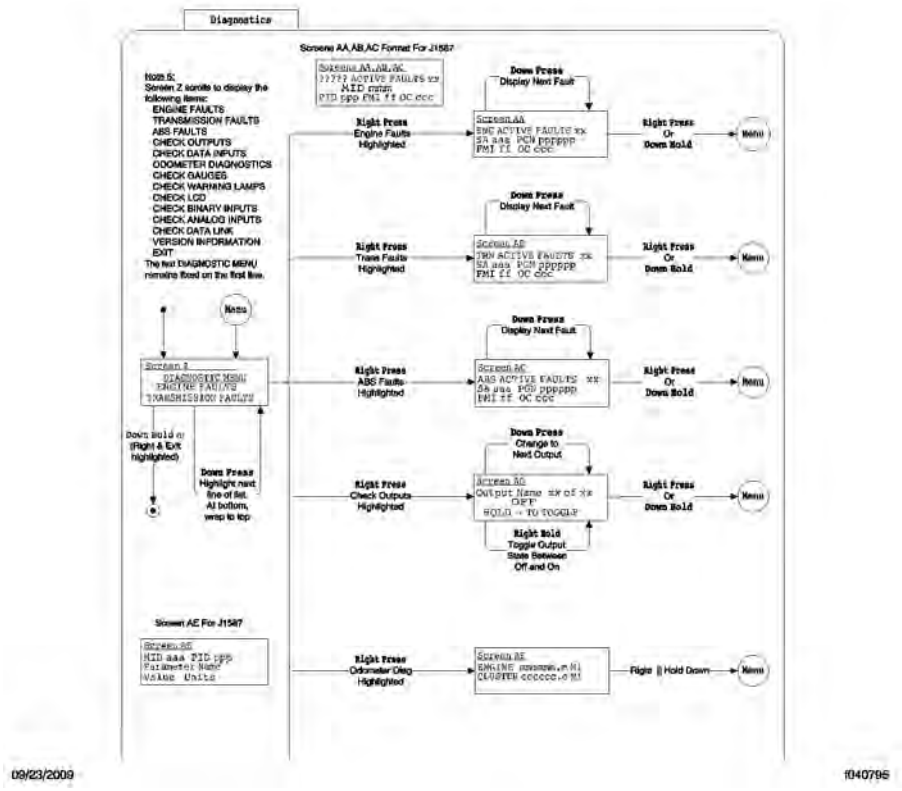


Fig 155, Diagnostic Menu Screens, Screen 1

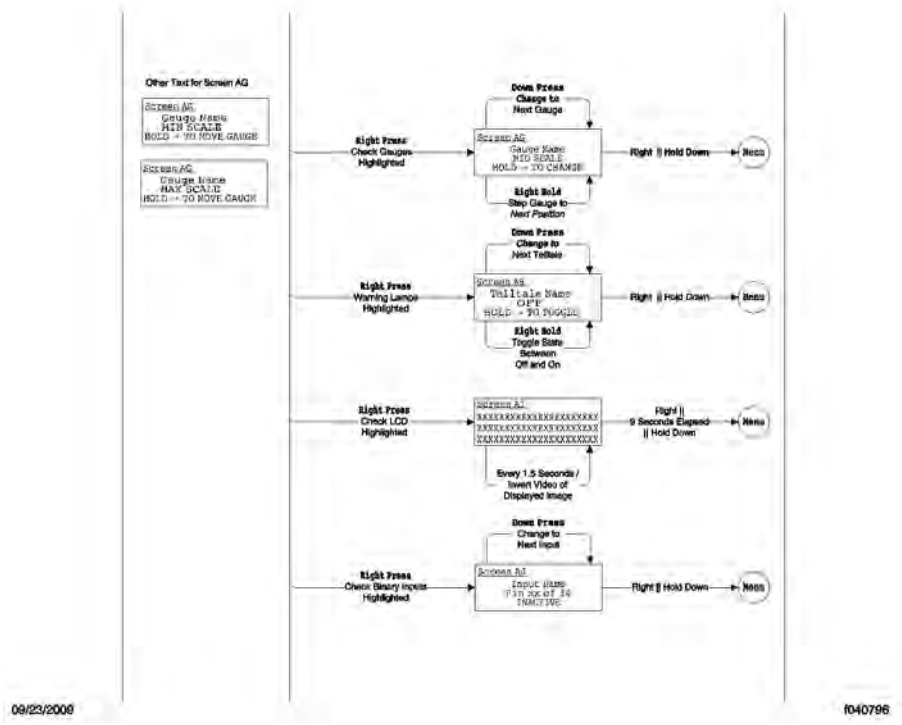


Fig 156, Diagnostic Menu Screens, Screen 2

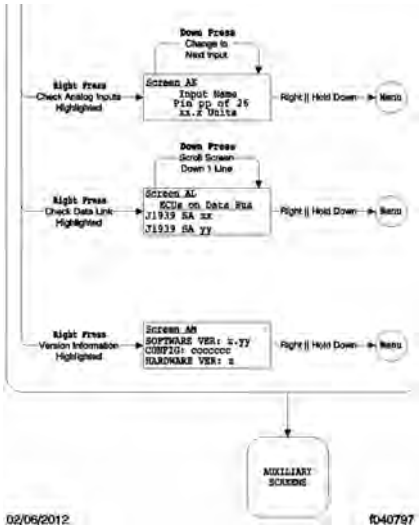


Fig 157, Diagnostic Menu Screens, Screen 3

Engine Faults

This screen displays engine fault codes that are received from the engine electronic control unit (ECU). To navigate to the engine fault screen, see Fig.155,Diagnostic Menu Screens, Screen 1, screen AA.

Transmission Faults

This screen displays transmission fault codes that are received from the transmission ECU. To navigate to the transmission fault screen, see Fig.155,Diagnostic Menu Screens, Screen 1, screen AB.

ABS Diagnostics

This screen displays Antilock Brake System (ABS) fault codes that are received from the ABS ECU. To navigate to the ABS diagnostic screen, see Fig.155,Diagnostic Menu Screens, Screen 1, screen AC.

Check Gauges

The check gauges screen allows the driver to set each gauge as a percentage of scale (either 0, 50, or 100%), as shown in the LCD. To navigate to the check gauges screen, see Fig.156,Diagnostic Menu Screens, Screen 2, AG screens.

Warning Lamp

The warning lamp screen allows the driver to test each warning lamp (not the vehicle load) on and then off, displaying the lamp name and status in the LCD. To navigate to the warning lamp screen, see Fig. 156,Diagnostic Menu Screens, Screen 2, screen AH.

Check LCD

Selecting the check LCD screen displays the Freightliner Custom Chassis Corporation (FCCC) logo in normal and reverse video three times and then returns to the menu. To navigate to the check LCD screen, see Fig. 156,Diagnostic Menu Screens, Screen 2, screen AI.

Check Binary Inputs

The check binary inputs screen displays the pin number and status of each binary input. The toggle buttons allow the driver to select each binary input. This information is continuously updated to assist in troubleshooting. To navigate to the check binary inputs screen, see Fig.156,Diagnostic Menu Screens, Screen 2, screen AJ.

Check Analog Inputs

The check analog inputs screen displays the pin number and actual value of each analog input defined in the system. The toggle buttons allow the driver to select each analog input. This information is continuously updated to assist in troubleshooting. To navigate to the check analog input screen, see Fig.157,Diagnostic Menu Screens, Screen 3, screen AK.

Check Datalink

The check datalink screen allows the driver to view all devices that communicate on the J1939, J1587, and GMLAN datalinks. To navigate to the check datalink screen, see Fig.157,Diagnostic Menu Screens, Screen 3, screen AL.

20.11.06 Menu Navigation

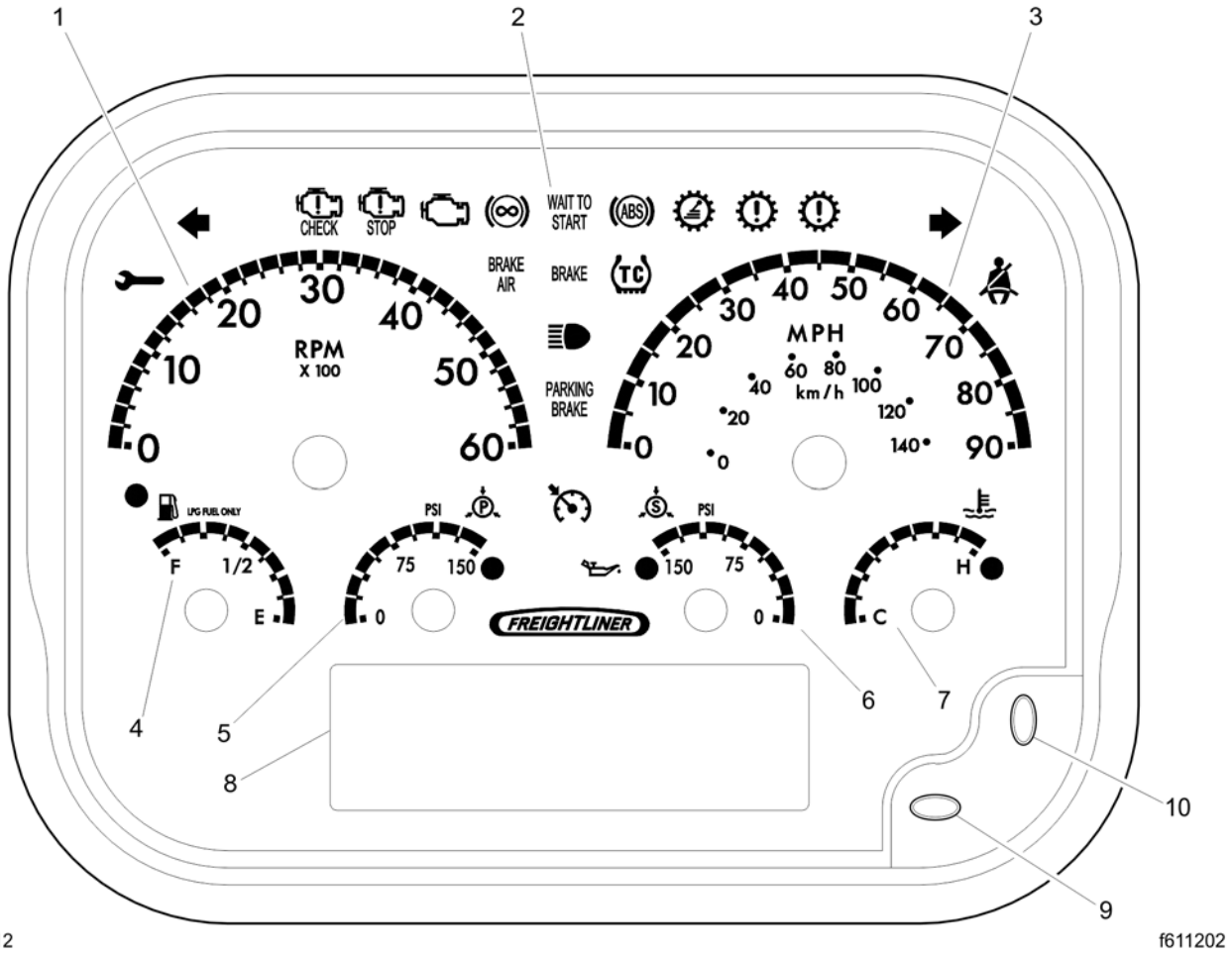
The menu navigation screens are provided to illustrate the menu system. The paths to specific screens are shown, along with instructions for using the toggle buttons to move from one screen to another. See Fig.159,Setup Menu Screens, Fig. 160,Diagnostic Menu Screens, Screen 1, Fig.161,Diagnostic Menu Screens, Screen 2, Fig. 162,Diagnostic Menu Screens, Screen 3, Fig.163,Ignition On, Normal Mode, Fig.164,Self Test, Fig.165,Display Messages, Fig.166,Auxiliary Screens, Fig.167,Maintenance Menu Screens, Screen 1, Fig.168,Maintenance Menu Screens, Screen 2, Fig.169,Trip Data, Fig.170,Warning Messages, and Fig.171,Ignition Off (shown when ignition is keyed OFF).

IMPORTANT: Follow the steps below to change the three items (also known as favorites) shown in the message display center. The message display center is referred to as screen C in Fig.165,Display Messages.

NOTE: The driver can check the pressure of the propane in the fuel rail (pressure of the fuel in both the tank and pump booster), and make this one of the three items shown in the message display center. Select the item with the fuel pump and psi reading, then follow the directions below to make it one of the favorites.

1. With the vehicle in park, turn the ignition to RUN, and allow the self test to complete.
2. press the down toggle button to select an item to change. The selected item will now be highlighted.
3. press the right toggle button once to enter the favorites display menu, shown in Fig.165,Display Messages, as screen D.

4. Use the down toggle button to scroll through the available items.
5. Highlight the new item, then press the right toggle button. The selected item will now appear in the message display center.



1. Tachometer
2. Dash Message Center
3. Speedometer
4. Fuel Level Gauge
5. primary Air pressure Gauge
6. Secondary Air pressure Gauge
7. Coolant Temperature Gauge
8. Dash Driver Display Screen
9. Toggle Button, Down
10. Toggle Button, Right

Fig 158, Gauge Layout (typical, U.S.), LpG Engines

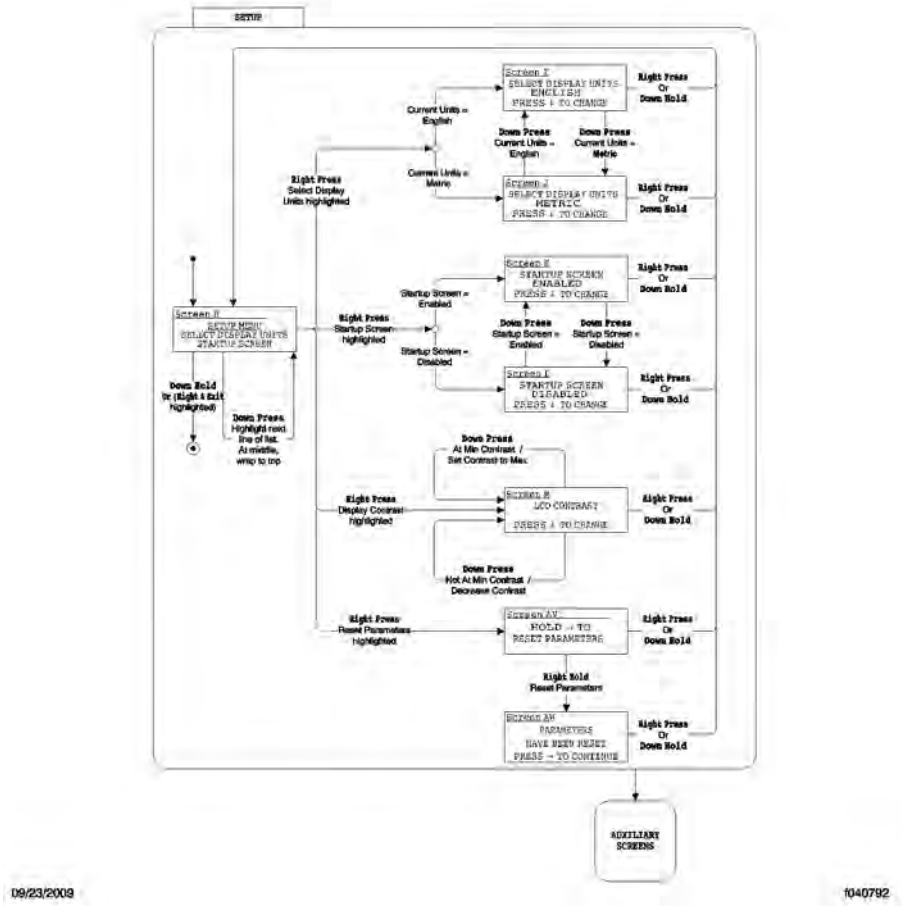


Fig 159, Setup Menu Screens

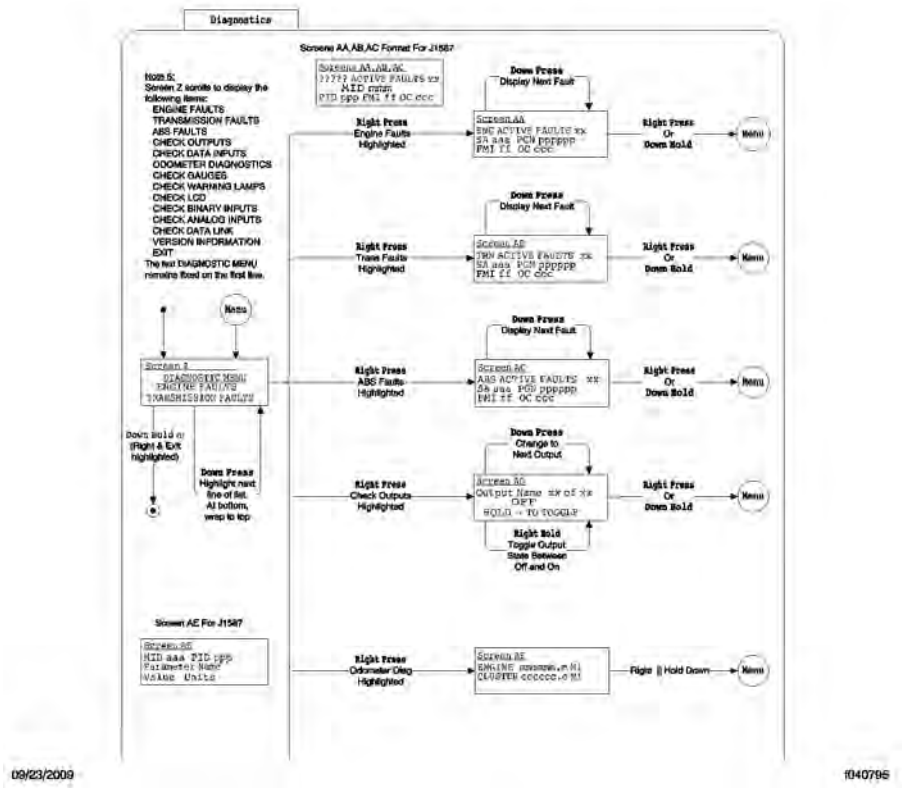


Fig 160, Diagnostic Menu Screens, Screen 1

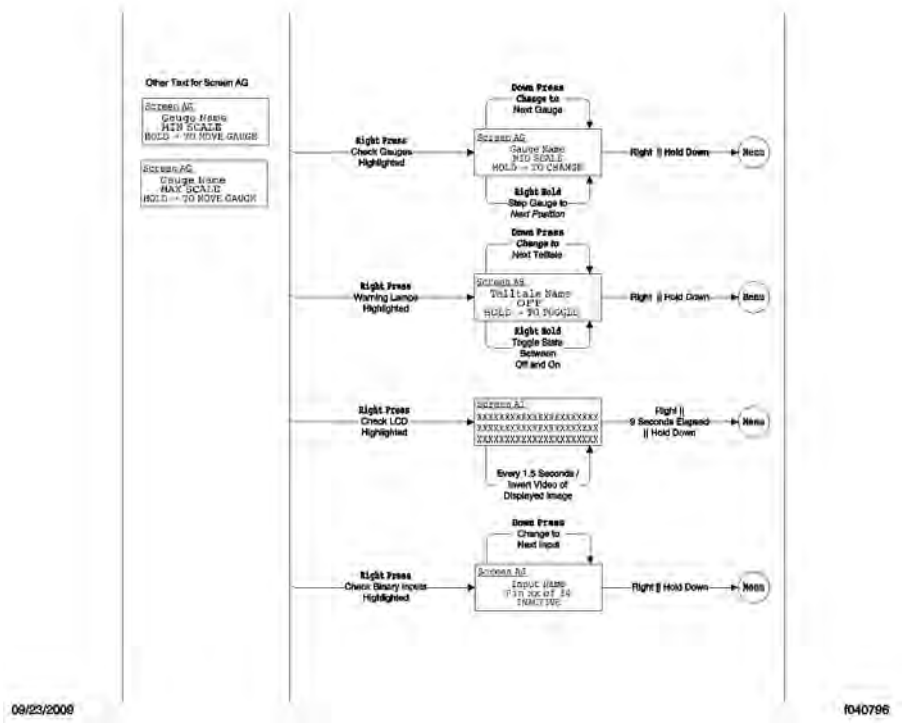


Fig 161, Diagnostic Menu Screens, Screen 2

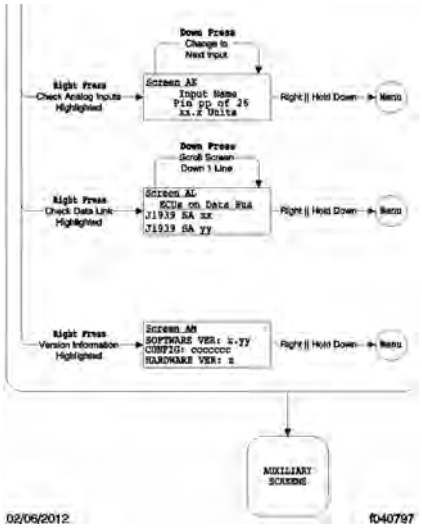


Fig 162, Diagnostic Menu Screens, Screen 3

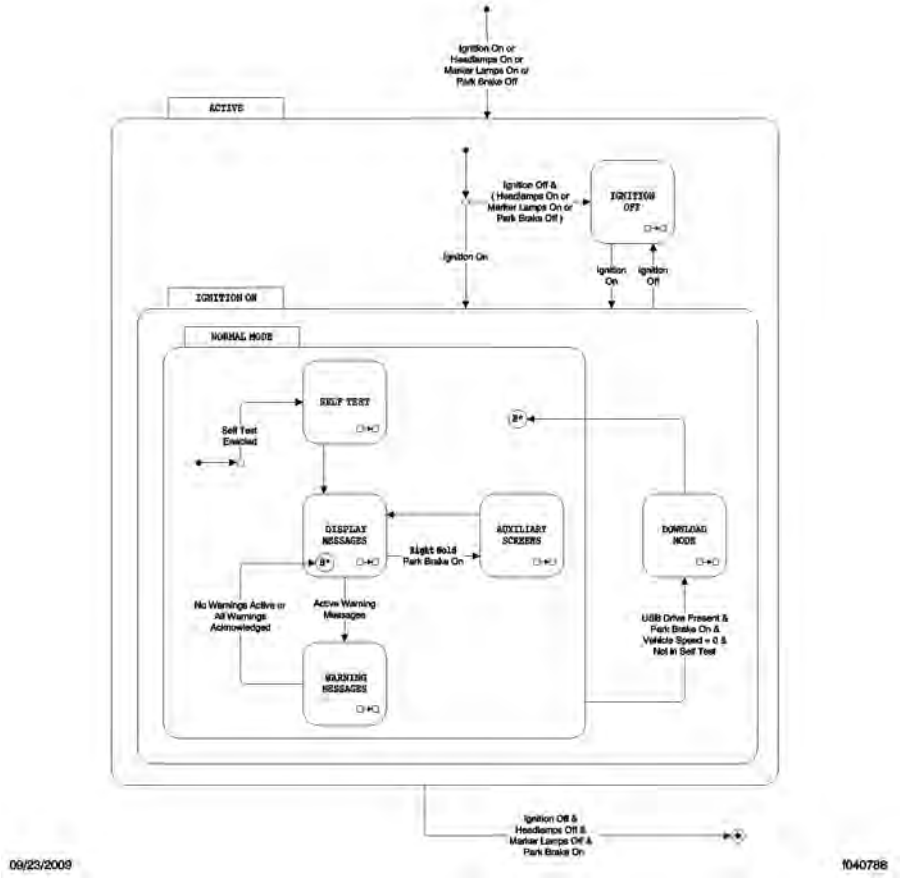


Fig 163, Ignition On, Normal Mode

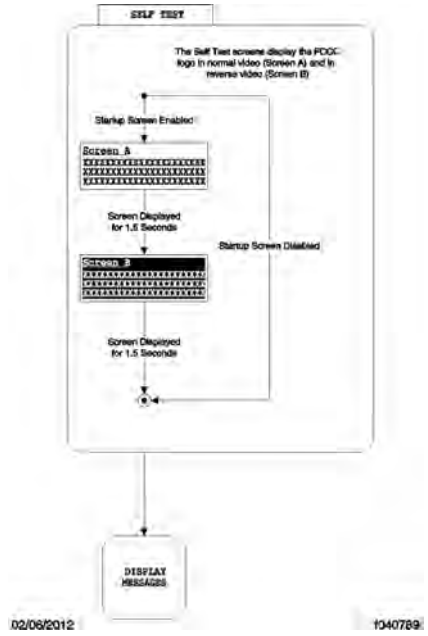


Fig 164, Self Test

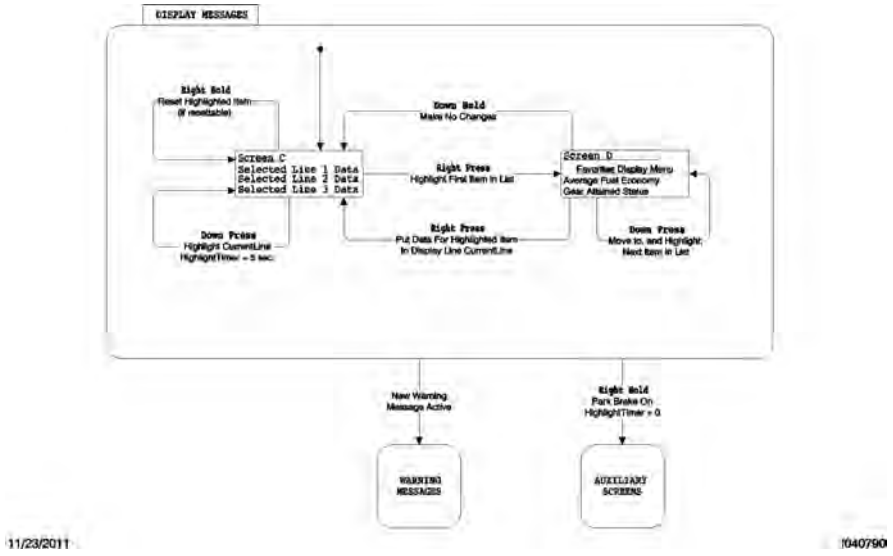


Fig 165, Display Messages

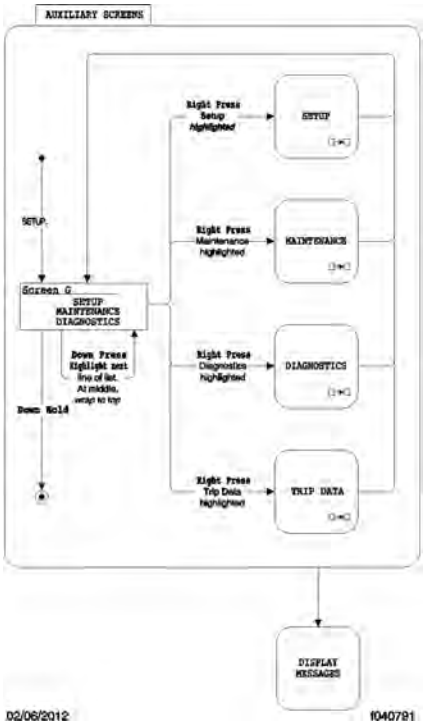


Fig 166, Auxiliary Screens

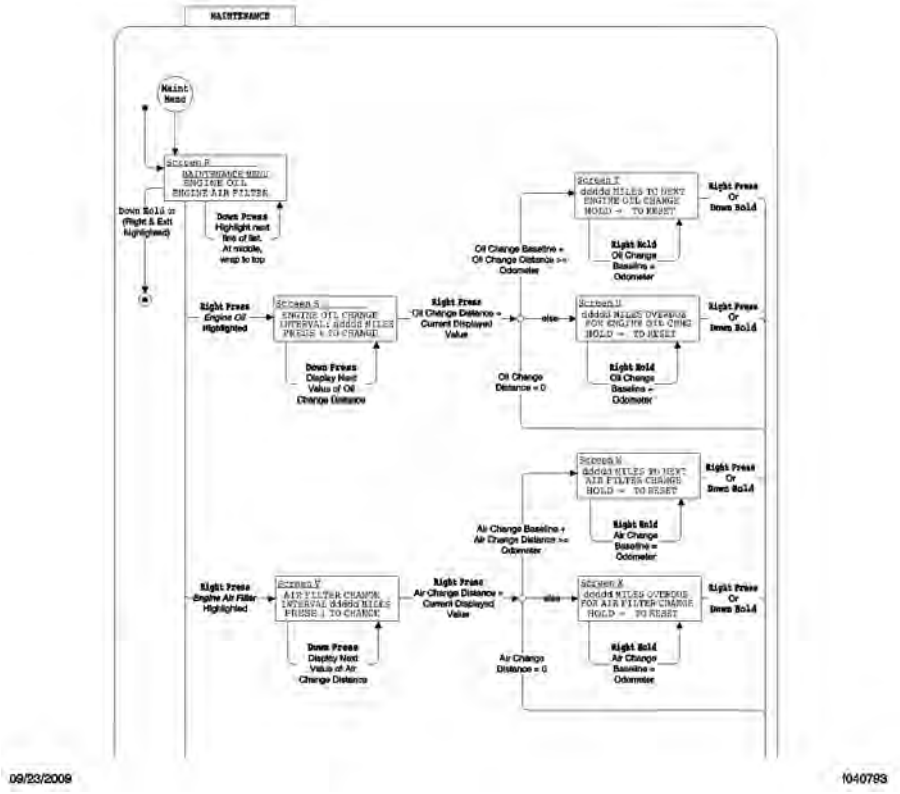


Fig 167, Maintenance Menu Screens, Screen 1

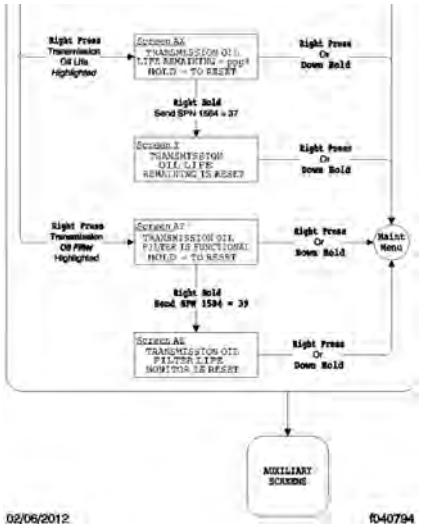


Fig 168, Maintenance Menu Screens, Screen 2

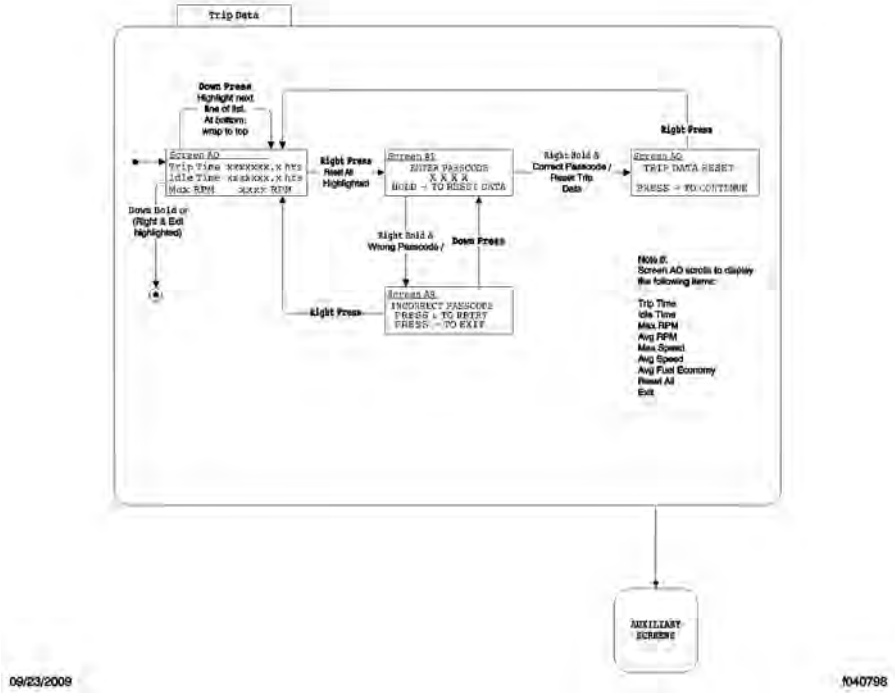


Fig 169, Trip Data

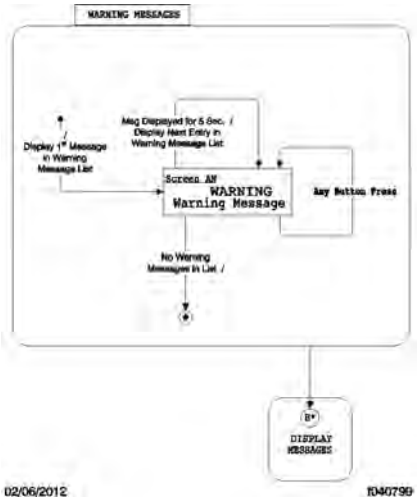


Fig 170, Warning Messages

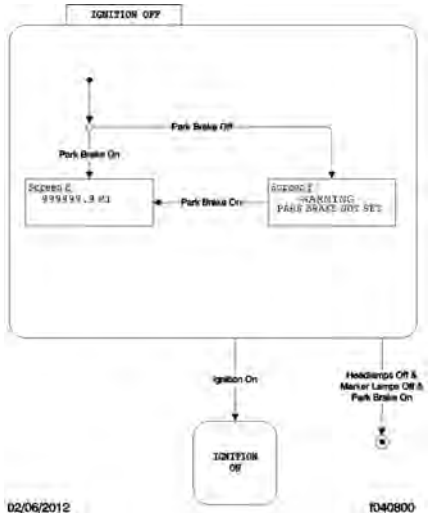


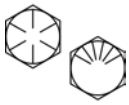
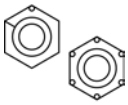
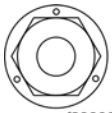
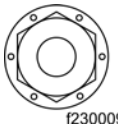
Fig 171, Ignition Off (shown when ignition is keyed OFF)

21.01 Torque Charts 228
21.02 Conversion Charts 231
21.03 Fluids and Lubricants 233
21.04 Fuse Information 233
21.05 Replacement of the Bulb 235

21. Specifications

21.01 Torque Charts

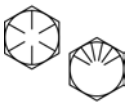
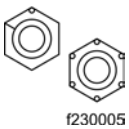
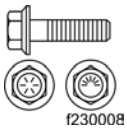
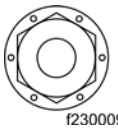
Table 19, Torque Values for U.S. Customary Thread Fasteners With Lubricated or Plated Threads

Torque Values for U.S. Customary Thread Fasteners With Lubricatedor Plated Threads*†								
Thread Diameter—Pitch	Regular Hex				Flanged			
	Grade 5 Bolt	Grade 5 or B Nut	Grade 8 or 8.2 Bolt	Grade 8 or C Nut	Grade 5 Bolt	Grade B Nut	Grade 8 or 8.2 Bolt	Grade G Nut
	Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)	
	 f230002	 f230003	 f230004	 f230005	 f230006	 f230007	 f230008	 f230009
1/4–20	7 (9)		8 (11)		6 (8)		10 (14)	
1/4–28	8 (11)		9 (12)		7 (9)		12 (16)	
5/16–18	15 (20)		16 (22)		13 (18)		21 (28)	
5/16–24	16 (22)		17 (23)		14 (19)		23 (31)	
3/8–16	26 (35)		28 (38)		23 (31)		37 (50)	
3/8–24	30 (41)		32 (43)		25 (34)		42 (57)	
7/16–14	42 (57)		45 (61)		35 (47)		60 (81)	
7/16–20	47 (64)		50 (68)		40 (54)		66 (89)	
1/2–13	64 (87)		68 (92)		55 (75)		91 (123)	
1/2–20	72 (98)		77 (104)		65 (88)		102 (138)	
9/16–12	92 (125)		98 (133)		80 (108)		130 (176)	
9/16–18	103 (140)		110 (149)		90 (122)		146 (198)	
5/8–11	128 (173)		136 (184)		110 (149)		180 (244)	
5/8–18	145 (197)		154 (209)		130 (176)		204 (277)	
3/4–10	226 (306)		241 (327)		200 (271)		320 (434)	
3/4–16	253 (343)		269 (365)		220 (298)		357 (484)	
7/8–9	365 (495)		388 (526)		320 (434)		515 (698)	
7/8–14	402 (545)		427 (579)		350 (475)		568 (770)	

1–8	—	582 (789)	—	—
1–12	—	637 (863)	—	—
1–14	—	652 (884)	—	—

Table 19, Torque Values for U.S. Customary Thread Fasteners With Lubricated or Plated Threads

Table 20, Torque Values for U.S. Customary Thread Fasteners With Dry (Unlubricated) Plain (Unplated) Threads

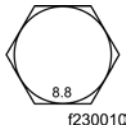
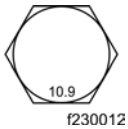
Torque Values for U.S. Customary Thread Fasteners With Dry (Unlubricated) [1] Plain (Unplated) Threads [2]						
Thread Diameter—Pitch	Regular Hex				Flanged	
	Grade 5 Bolt	Grade 5 or B Nut	Grade 8 or 8.2 Bolt	Grade 8 or C Nut	Grade 8 or 8.2 Bolt	Grade G Nut
	Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)	
	 f230002	 f230003	 f230004	 f230005	 f230008	 f230009
1/4–20	8 (11)		10 (14)		—	
1/4–28	9 (12)		12 (16)		—	
5/16–18	15 (20)		22 (30)		22 (30)	
5/16–24	17 (23)		25 (34)		—	
3/8–16	28 (38)		40 (54)		40 (54)	
3/8–24	31 (42)		45 (61)		—	
7/16–14	45 (61)		65 (88)		65 (88)	
7/16–20	50 (68)		70 (95)		—	
1/2–13	70 (95)		95 (129)		95 (129)	
1/2–20	75 (102)		110 (149)		—	
9/16–12	100 (136)		140 (190)		140 (190)	
9/16–18	110 (149)		155 (210)		—	
5/8–11	135 (183)		190 (258)		190 (258)	
5/8–18	155 (210)		215 (292)		—	
3/4–10	240 (325)		340 (461)		340 (461)	
3/4–16	270 (366)		380 (515)		—	

Torque Values for U.S. Customary Thread Fasteners With Dry (Unlubricated) [1] Plain (Unplated) Threads [2]						
Thread Diameter—Pitch	Regular Hex				Flanged	
	Grade 5 Bolt	Grade 5 or B Nut	Grade 8 or 8.2 Bolt	Grade 8 or C Nut	Grade 8 or 8.2 Bolt	Grade G Nut
	Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)	
7/8–9	385 (522)		540 (732)		—	
7/8–14	425 (576)		600 (813)		—	
1–8	580 (786)		820 (1112)		—	
1–12	635 (861)		900 (1220)		—	
1–14	650 (881)		915 (1241)		—	

1. Threads may have residual oil, but will be dry to the touch.
2. Male and female threads (bolt and nut) must both be unlubricated and unplated. If either is plated or lubricated, use Table . FCCC recommends that all plated and unplated fasteners be coated with oil before installation.

Table 20, Torque Values for U.S. Customary Thread Fasteners With Dry (Unlubricated) Plain (Unplated) Threads

Table 21, Torque Values for Metric Thread Fasteners With Lubricated or Plated Threads

Torque Values for Metric Thread Fasteners With Lubricated [1] or Plated Threads [2]				
Thread Diameter—Pitch	Class 8.8 Bolt	Class 8 Nut	Class 10.9 Bolt	Class 10 Nut
	Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)	
				
M6	5 (7)		7 (9)	
M8	12 (16)		17 (23)	
M8 x 1	13 (18)		18 (24)	
M10	24 (33)		34 (46)	
M10 x 1.25	27 (37)		38 (52)	
M12	42 (57)		60 (81)	
M12 x 1.5	43 (58)		62 (84)	
M14	66 (89)		95 (129)	
M14 x 1.5	72 (98)		103 (140)	

Torque Values for Metric Thread Fasteners With Lubricated [1] or Plated Threads [2]				
Thread Diameter—Pitch	Class 8.8 Bolt	Class 8 Nut	Class 10.9 Bolt	Class 10 Nut
	Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)	
M16	103 (140)		148 (201)	
M16 x 1.5	110 (149)		157 (213)	
M18	147 (199)		203 (275)	
M18 x 1.5	165 (224)		229 (310)	
M20	208 (282)		288 (390)	
M20 x 1.5	213 (313)		320 (434)	
M22	283 (384)		392 (531)	
M22 x 1.5	315 (427)		431 (584)	
M24	360 (488)		498 (675)	
M24 x 2	392 (531)		542 (735)	
M27	527 (715)		729 (988)	
M27 x 2	569 (771)		788 (1068)	
M30	715 (969)		990 (1342)	
M30 x 2	792 (1074)		1096 (1486)	

1. FCCC recommends that all plated and unplated fasteners be coated with oil before installation.
2. Use these torque values if either the bolt or nut is lubricated or plated (zinc-phosphate conversion-coated, cadmium-plated, or waxed, Geomet 321XL coated, or waxed).

Table 21, Torque Values for Metric Thread Fasteners With Lubricated or Plated Threads

21.02 Conversion Charts

Table 22, Metric/U.S. Customary Conversion

When You Know U. S. Customary	Multiply By	To Get Metric	When You Know Metric	Multiply By	To Get U.S. Customary
Length					
inches (in)	25.4	millimeters (mm)		0.03937	inches (in)
inches (in)	2.54	centimeters (cm)		0.3937	inches (in)
feet (ft)	0.3048	meters (m)		3.281	feet (ft)

yards (yd)	0.9144	meters (m)	1.094	yards (yd)
miles (mi)	1.609	kilometers (km)	0.6215	miles (mi)
Area				
square inches (in²)	645.16	square millimeters (mm²)	0.00155	square inches (in²)
square inches (in²)	6.452	square centimeters (cm²)	0.155	square inches (in²)
square feet (ft²)	0.0929	square meters (m²)	10.764	square feet (ft²)
Volume				
cubic inches (in³)	16387.0	cubic millimeter (mm³)	0.000061	cubic inches (in³)
cubic inches (in³)	16.387	cubic centimeters (cm³)	0.06102	cubic inches (in³)
cubic inches (in³)	0.01639	liters (L)	61.024	cubic inches (in³)
fluid ounces (fl oz)	29.54	milliliters (mL)	0.03381	fluid ounces (fl oz)
pints (pt)	0.47318	liters (L)	2.1134	pints (pt)
quarts (qt)	0.94635	liters (L)	1.0567	quarts (qt)
gallons (gal)	3.7854	liters (L)	0.2642	gallons (gal)
cubic feet (ft³)	28.317	liters (L)	0.03531	cubic feet (ft³)
cubic feet (ft³)	0.02832	cubic meters (m³)	35.315	cubic feet (ft³)
Weight/Force				
ounces (av) (oz)	28.35	grams (g)	0.03527	ounces (av) (oz)
pounds (av) (lb)	0.454	kilograms (kg)	2.205	pounds (av) (lb)
U.S. tons (t)	907.18	kilograms (kg)	0.001102	U.S. tons (t)
U.S. tons (t)	0.90718	metric tons (t)	1.1023	U.S. tons (t)
Torque/Work Force				
inch–pounds (lbf·in)	11.298	Newton–centimeters (N·cm)	0.08851	inch–pounds (lbf·in)
foot–pounds (lbf·ft)	1.3558	Newton–meters (N·m)	0.7376	foot–pounds (lbf·ft)
Pressure/Vacuum				
inches of mercury (inHg)	3.37685	kilo Pascals (kPa)	0.29613	inches of mercury (inHg)
pounds per square inch (psi)	6.895	kilo Pascals (kPa)	0.14503	pounds per square inch (psi)

Table 22, Metric/U.S. Customary Conversion

Table 23, Temperature Conversion

When You Know	Subtract	Then Divide By	To Get	When You Know	Multiply By	Then Add	To Get
degrees Fahrenheit (°F)	32	1.8	degrees Celsius (°C)		1.8	32	degrees Fahrenheit (°F)

Table 23, Temperature Conversion

21.03 Fluids and Lubricants

See Table.24,Fluid and Lubricant Specifications for fluid and lubricant specifications.

Table 24, Fluid and Lubricant Specifications

Fluid and Lubricant Specifications	
Component	**Recommended Fluid or Lubricant**
Front Axle Spindle Pins, Tie Rods, Drag Link, Intermediate Steering Shaft, Front Brake and Pedal Shafts	Multipurpose Grease Lithium 12 Hydroxy Stearate NLGI No. 2; for temperatures below 0°F (–18°C), use MIL-G-10924B
Hydraulic Brake Main Cylinder	Heavy-Duty DOT 3 Brake Fluid
Brake and Pedal Pivots	Starplex 2 (lithium soap-based grease)
Engine	See Manufacturer's Recommendations*
Fuel	Ultralow-Sulfur Diesel Fuel
	CMS 20067 (CNG Engines)
Disc Brake Caliper Rails	FCCC No. 4JD623 Brake Caliper Slide Grease
Rear Axle Differential	See Manufacturer's Recommendations
Hydraulic Steering System Reservoir	Dexron® III or approved equivalent
Engine Coolant	Refer to the coolant label on the vehicle or the engine manufacturer’s service literature for approved coolant. Coolant used must be compatible with engine manufacturer’s coolant specifications. [1]

1. For Cummins engine service literature refer to **Cummins Online** see https://www.cummins.com/support/manuals. For Detroit™ engine service literature, refer to the **Detroit Diesel** link on the DTNA TechLit website , see https://www.dtnatechlit.com/portal-public.

Table 24, Fluid and Lubricant Specifications

21.04 Fuse Information

See Table.25,Main PDM Fuse Identification for descriptions of a typical set of fuses. Fuse identification varies with options.

Table 25, Main PDM Fuse Identification

Main PDM Fuse Identification		
CAV	**Description**	**Fuse**
F1	Engine VCU (spare)	10A
F2	Blower Motor	30A
F3	Engine ECU	20A
F4	Spare	
F5	Ignition Switch	5A
F6	Hydro-Max RLY (if equipped with hydraulic brakes)	30A
F7	Bulkhead Module	30A
F8	ICU3	10A
F9	Transmission ECU	10A
F10	Spare	
F11	Spare	
F12	Radio/Diagnostic	20A
F13	Chassis Module	30A
F14	Spare	
F15	Bulkhead Module	30A
F16	ABS ECU	25A
F17	Chassis Module	30A
F18	Bulkhead Module	30A
F19	Chassis Module	30A
F20	Bulkhead Module	30A
F21	Spare	
F22	Bulkhead Module	30A
F23	Spare	
F24	Hydraulic Pump and RLY (if equipped with hydraulic brakes)	25A

Main PDM Fuse Identification		
CAV	**Description**	**Fuse**
F25	Spare	
F26	Spare	

Table 25, Main PDM Fuse Identification

21.05 Replacement of the Bulb

See Table.26,Replacement Bulb Part Numbers for bulb replacement information.

Table 26, Replacement Bulb Part Numbers

Replacement Bulb Part Numbers	
Description	**Part Number**
Headlight, Low Beam	WEE 9006
Headlight, High Beam	WEE 9005
Front Turn Signal Light	WEE 3157
Front Fender Marker Light	WEE 194

Table 26, Replacement Bulb Part Numbers

CONTACT INFORMATION

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

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