Recreational Vehicle Chassis Operator's Manual

Models: **MC**
MCL
XCL
XCM
XCP
XCR
XCS

STI-425, ()

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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.

Emissions and Fuel Efficiency Compliance

This vehicle must be regularly inspected and maintained as indicated in the *Recreational Vehicle 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.

1.04 Emissions and Fuel Efficiency Compliance

This vehicle must be regularly inspected and maintained as indicated in the *Recreational Vehicle 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.

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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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2.02 Vehicle Identification Number (VIN) 10
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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

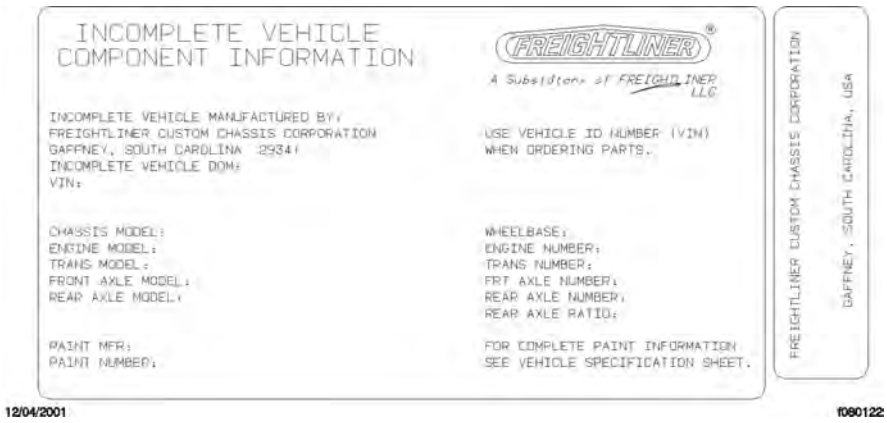

Fig 3, Vehicle Identification Number Label, Typical

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.

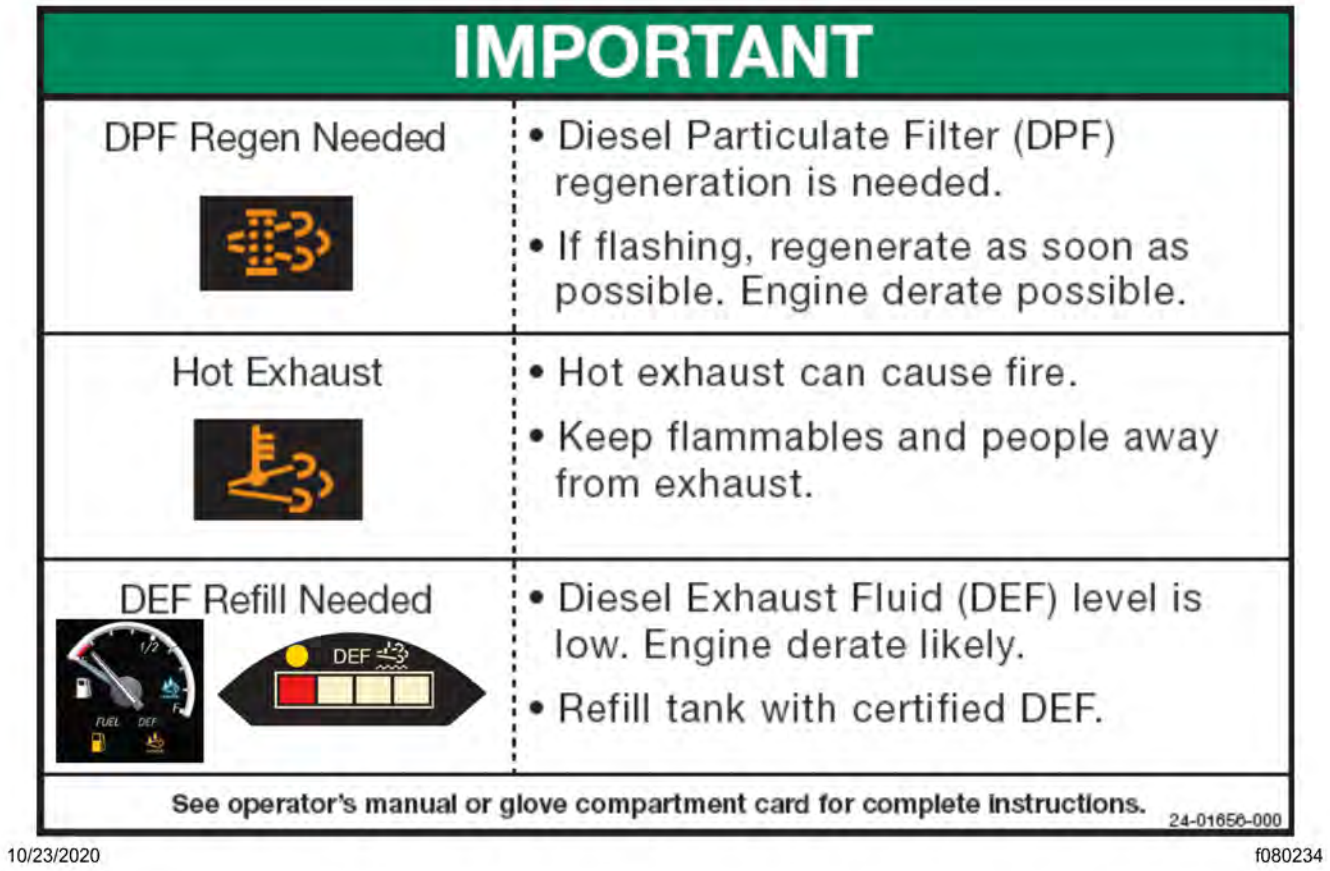

Fig 4, ATS Indicators

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.

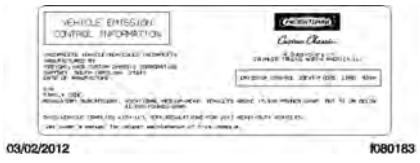

Fig 5, Vehicle Emission Control Information Label

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.
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Table 3, EPA Regulations

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Table 4, 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 4, Emission Regulations by Model Year

2.03.03 Certified Clean Idle Label

The California Air Resources Board (CARB) requires model year 2008 and newer heavy-duty diesel engines to meet CARB's Heavy-Duty Diesel Engine Idling Requirement in order to limit emissions of particulate matter and NOx.

Certified vehicles are equipped with a label placed near the bottom edge of the driver-side door. See Fig. 6,CARB Clean Idle Label.



Fig 6, CARB Clean Idle Label

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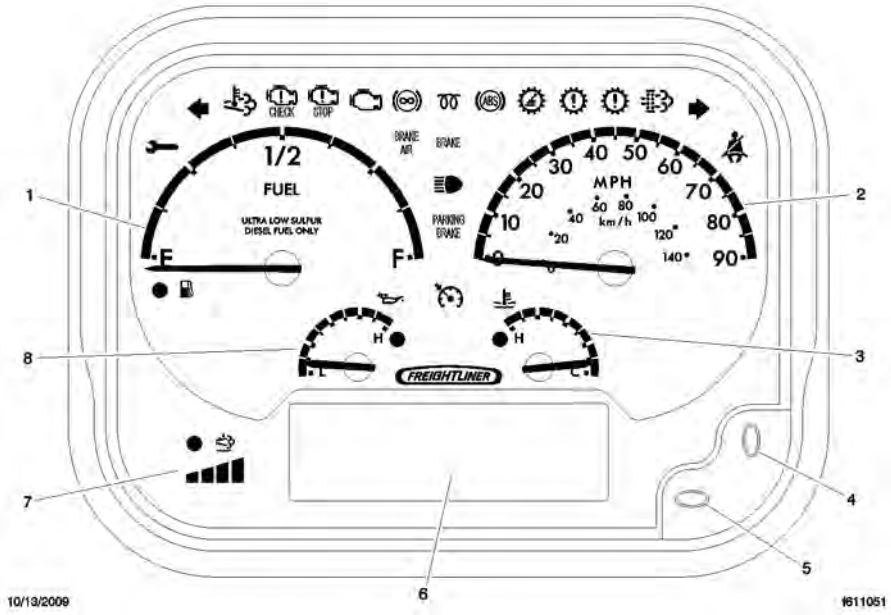
3. Ametek Instrument Panel

3.01 Ametek Instrument Panel

3.01.01 General Description

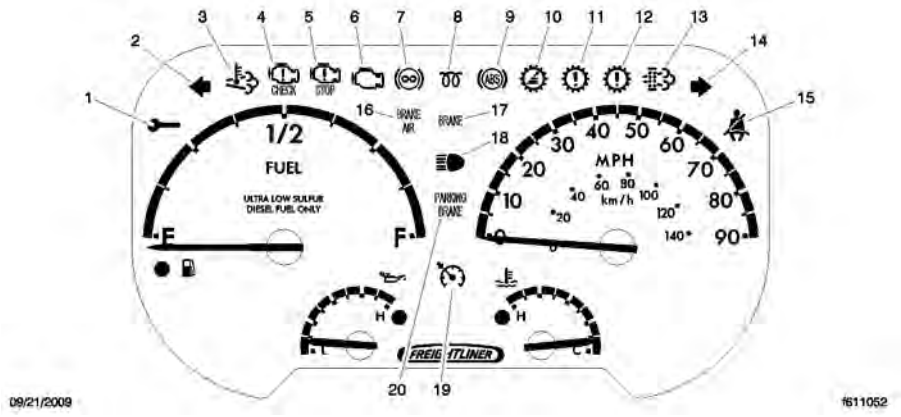
The following information describes a typical instrument panel manufactured by Ametek. See Fig. 7,Typical Ametek Instrument Panel, EPA10 and Newer Engines for a typical instrument gauge panel, and see Fig. 8,Warning Lamps, EPA10 and Newer Enginesfor the Ametek warning lamps. See 5.01.01 General Description for detailed warning lamp descriptions.

NOTE: These instrument panels are shown with a standard U.S. speedometer, which shows miles per hour (mph) more prominently than kilometers per hour (km/h).



1. Fuel Gauge
2. Speedometer
3. Coolant Temperature Gauge
4. Toggle Button, Right
5. Toggle Button, Down
6. Message Display Center
7. Diesel Exhaust Fluid (DEF) Gauge
8. Engine Oil Pressure Gauge

Fig 7, Typical Ametek Instrument Panel, EPA10 and Newer Engines



1. Maintenance Warning
2. Left-Turn Indicator
3. High Exhaust System Temperature (HEST) Lamp
4. Check Engine Warning
5. Stop Engine Warning
6. Malfunction Indicator Lamp (MIL)
7. Engine Brake Indicator
8. Wait to Start Indicator
9. ABS Warning
10. Shift Inhibit Indicator
11. Transmission Warning
12. Stop Transmission (hybrid only)
13. Diesel Particulate Filter (DPF) Lamp
14. Right-Turn Indicator
15. Fasten Seat Belt Warning
16. Air Brake Warning
17. Hydraulic Brake System Warning
18. Headlight High-Beam Indicator
19. Cruise Control Indicator
20. Parking Brake On Warning

Fig 8, Warning Lamps, EPA10 and Newer Engines

3.01.02 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.

3.01.03 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.

3.01.04 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.

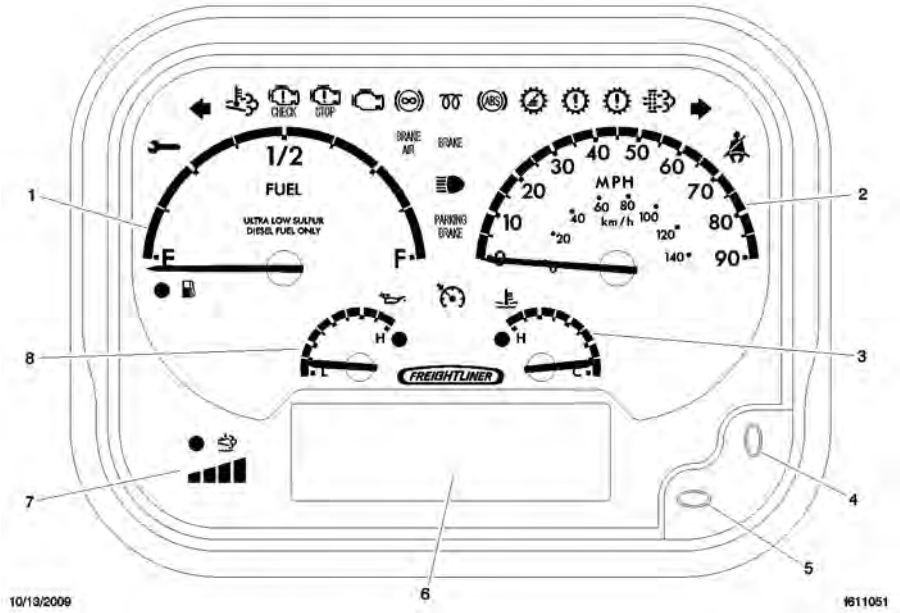
3.01.05 Menu System

Setup Menu

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.

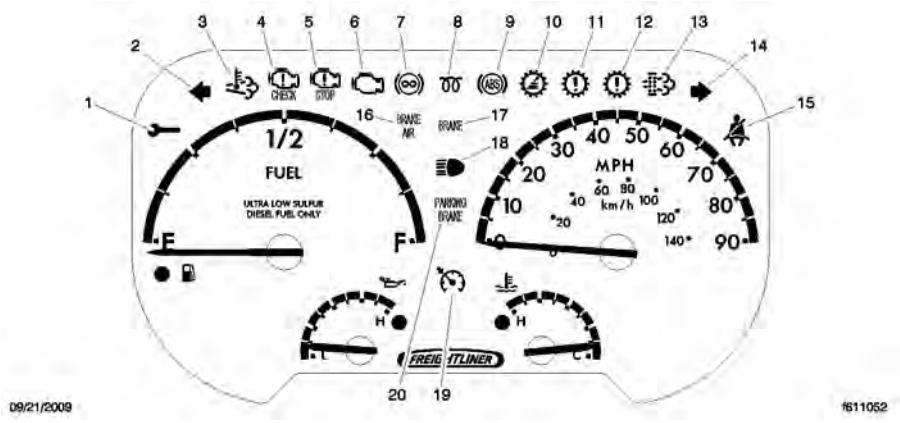
- Setup—this is used to set various parameters, which are saved when the ignition is turned off. Setup has select display units, startup screen, LCD contrast, and reset parameters.
- Maintenance—shows various maintenance intervals such as engine oil, air filter, etc.
- Diagnostics—this is used for setting 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.



1. Fuel Gauge
2. Speedometer
3. Coolant Temperature Gauge
4. Toggle Button, Right
5. Toggle Button, Down
6. Message Display Center
7. Diesel Exhaust Fluid (DEF) Gauge
8. Engine Oil Pressure Gauge

Fig 9, Typical Instrument Panel, EPA10 and Newer Engines



1. Maintenance Warning
2. Left-Turn Indicator
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4. Check Engine Warning
5. Stop Engine Warning
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7. Engine Brake Indicator
8. Wait to Start Indicator
9. ABS Warning
10. Shift Inhibit Indicator
11. Transmission Warning
12. Stop Transmission (hybrid only)
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14. Right-Turn Indicator
15. Fasten Seat Belt Warning
16. Air Brake Warning
17. Hydraulic Brake System Warning
18. Headlight High-Beam Indicator
19. Cruise Control Indicator
20. Parking Brake On Warning

Fig 10, Warning Lamps, EPA10 and Newer Engines

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.11,Setup Menu Screens, screens H, I, and J.

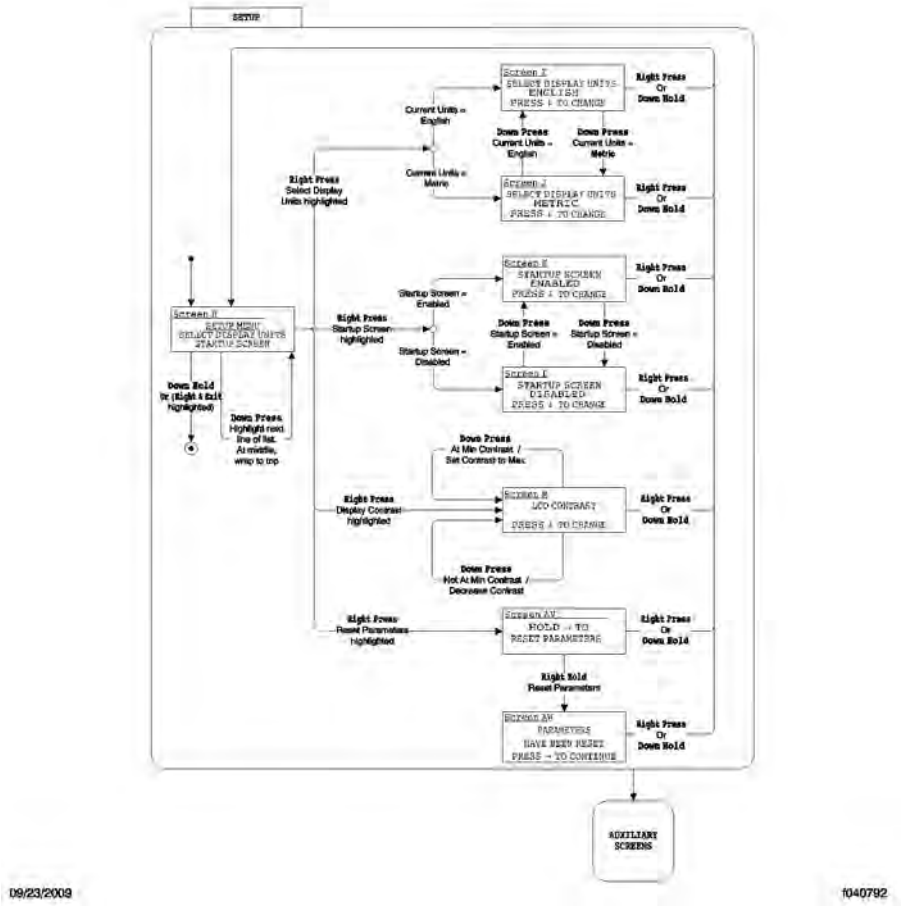

Fig 11, Setup Menu Screens

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.11,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.

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.12,Diagnostic Menu Screens, Screen 1, screen AA.

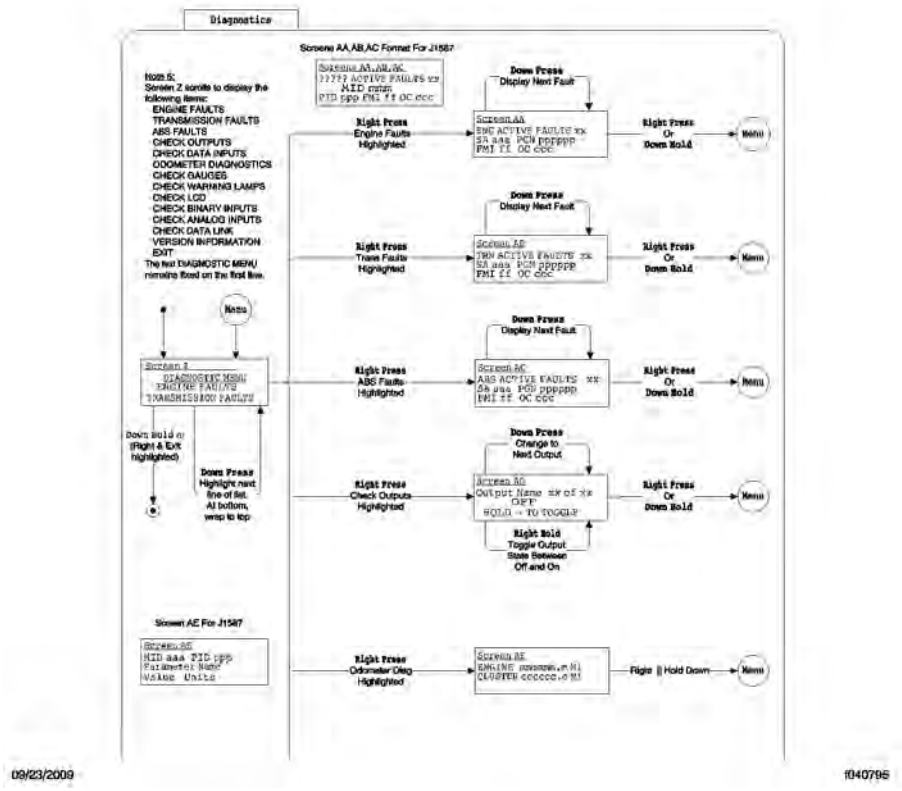

Fig 12, Diagnostic Menu Screens, Screen 1

Transmission Faults

This screen displays transmission fault codes that are received from the transmission ECU. To navigate to the transmission fault screen, see Fig.12,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.12,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.13,Diagnostic Menu Screens, Screen 2, AG screens.

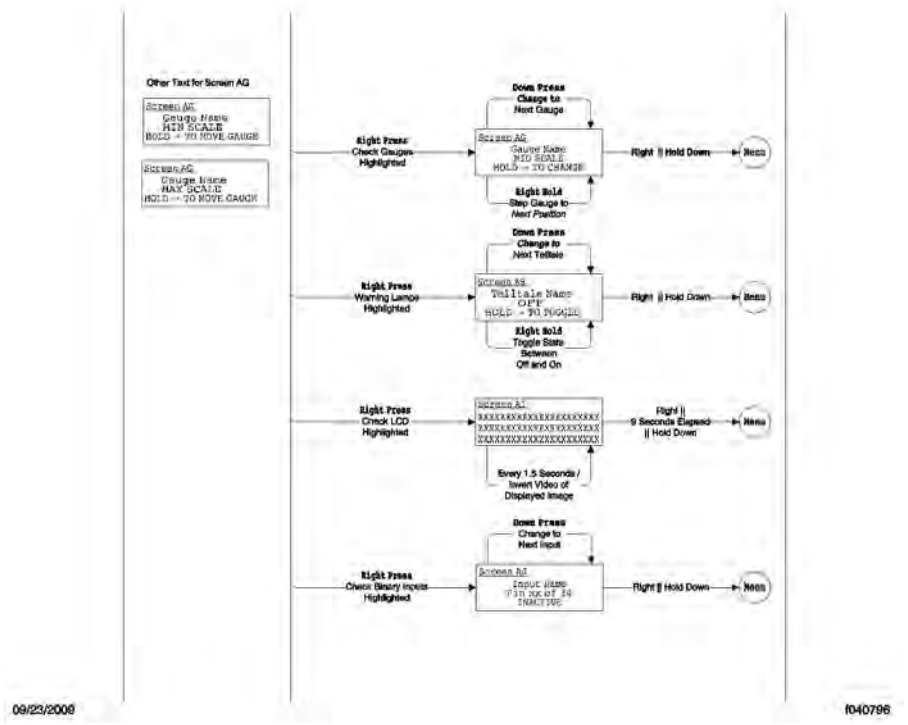

Fig 13, Diagnostic Menu Screens, Screen 2

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.13,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. 13,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.13,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.14,Diagnostic Menu Screens, Screen 3, screen AK.

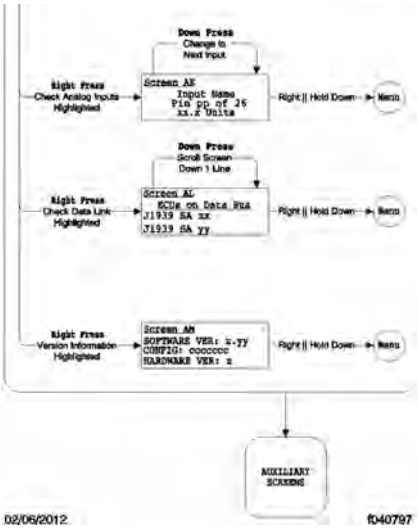

Fig 14, Diagnostic Menu Screens, Screen 3

Check Datalink

The check datalink screen allows the driver to view all devices that communicate on the J1939, J1587, and GMLAN data-links. To navigate to the check datalink screen, see Fig.14,Diagnostic Menu Screens, Screen 3, screen AL.

3.01.06 Menu Navigation

The menu navigation road maps are provided to illustrate the screens that are available in 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. Refer to the road maps to change items shown in lines one, two, and three of the display screen, view the setup screens, diagnostics, etc. See Fig.15,Setup Menu Screens, see Fig.16,Diagnostic Menu Screens, Screen 1, see Fig. 17,Diagnostic Menu Screens, Screen 2, see Fig.18,Diagnostic Menu Screens, Screen 3, see Fig. 19,Ignition On, Normal Mode, see Fig.20,Self Test, see Fig.21,Display Messages, see Fig.22,Auxiliary Screens, see Fig. 23,Maintenance Menu Screens, Screen 1, see Fig.24,Maintenance Menu Screens, Screen 2, see Fig.25,Trip Data, see Fig. 26,Warning Messages and see Fig.27,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.21,Display Messages.

1. With the vehicle in park, turn the ignition to ON, 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.21,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.

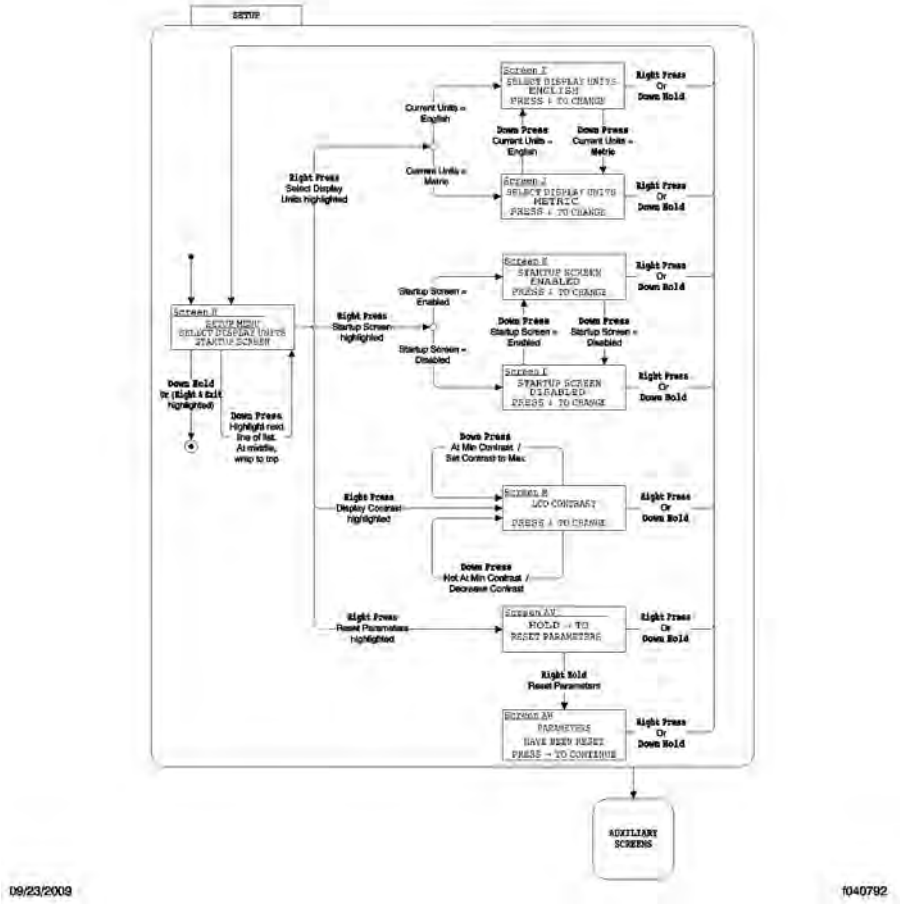

Fig 15, Setup Menu Screens

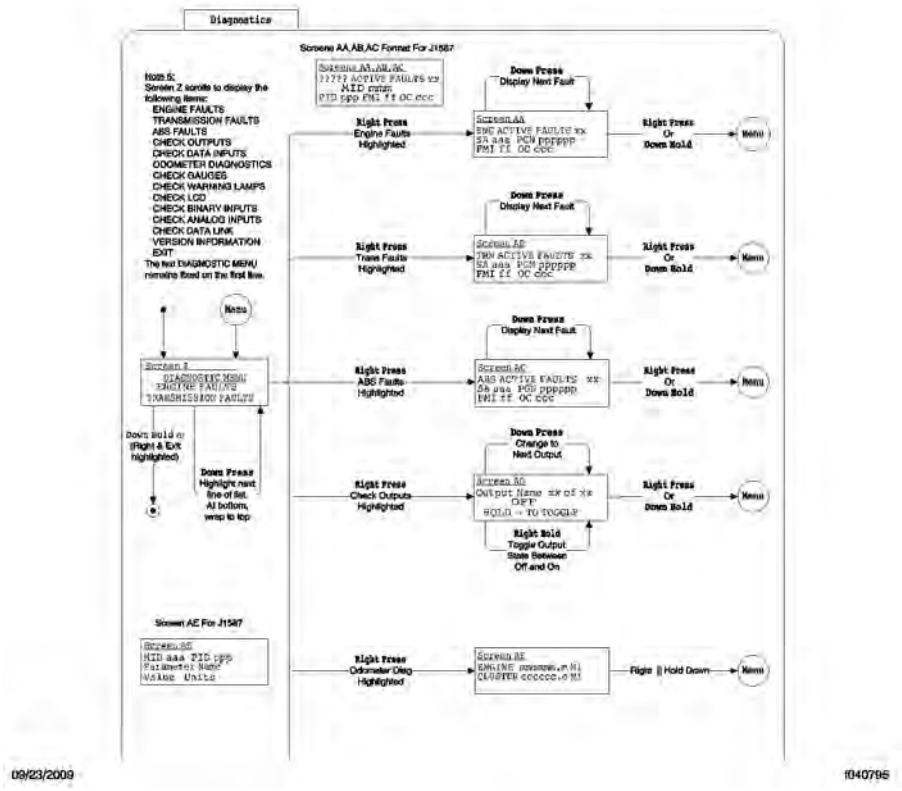

Fig 16, Diagnostic Menu Screens, Screen 1

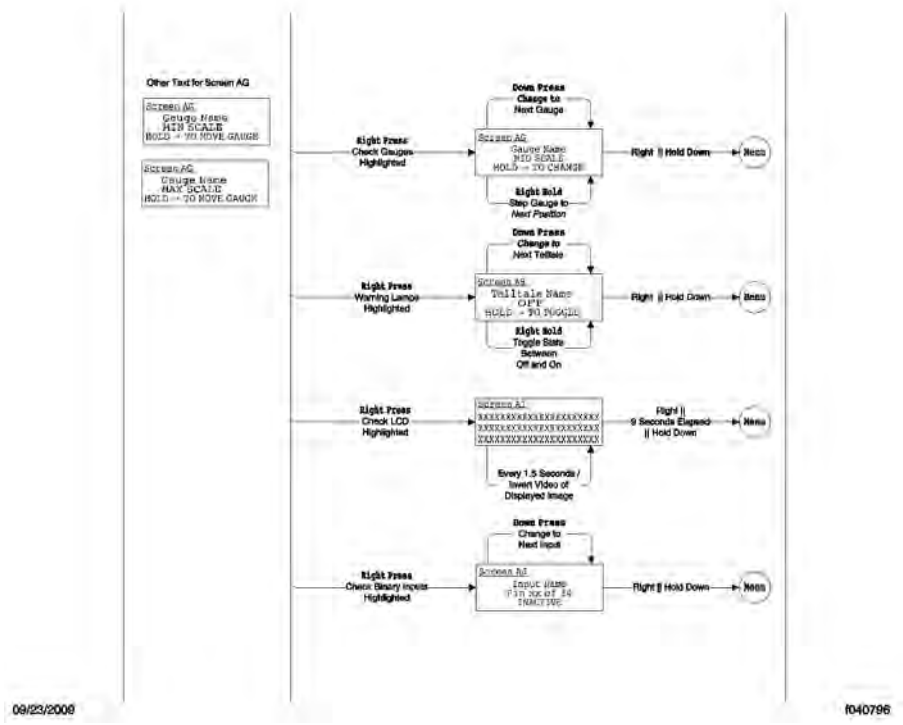

Fig 17, Diagnostic Menu Screens, Screen 2

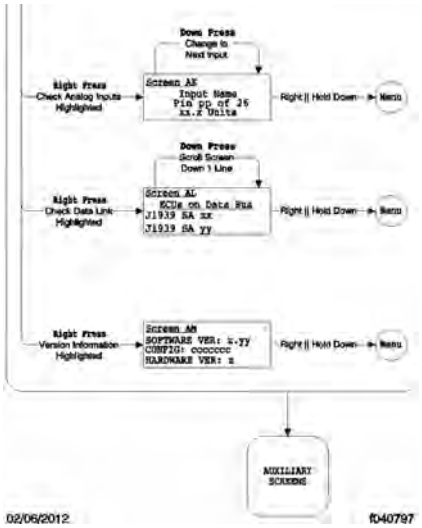

Fig 18, Diagnostic Menu Screens, Screen 3

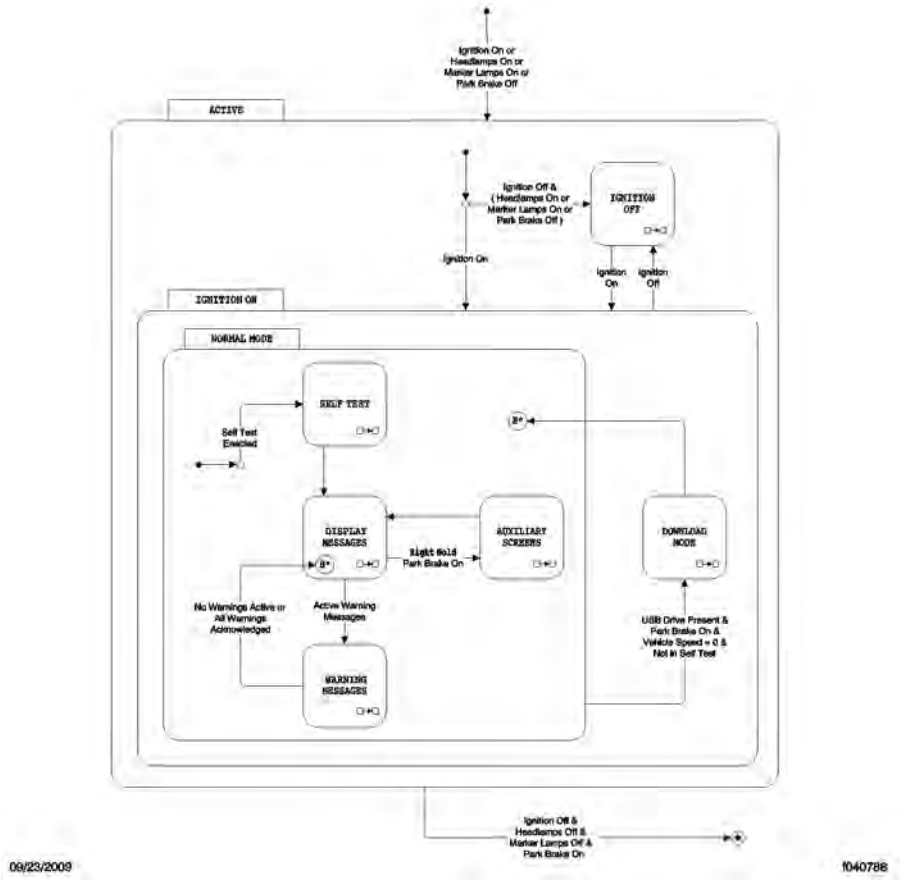

Fig 19, Ignition On, Normal Mode

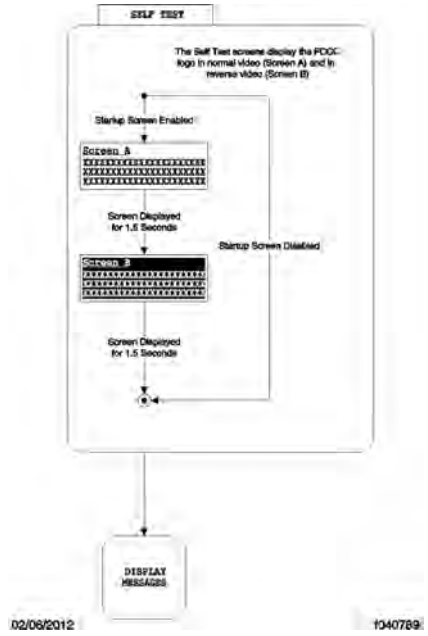

Fig 20, Self Test

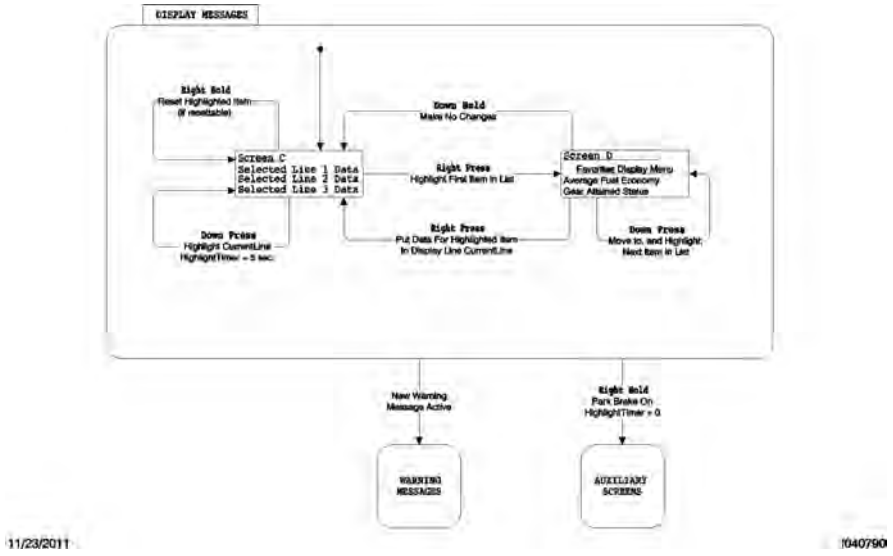

Fig 21, Display Messages

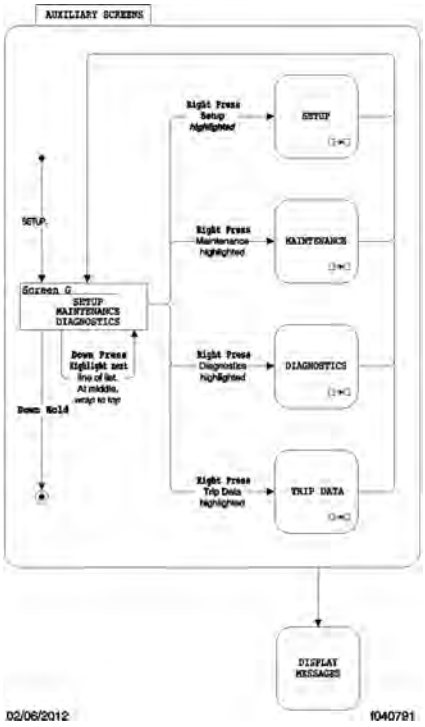

Fig 22, Auxiliary Screens

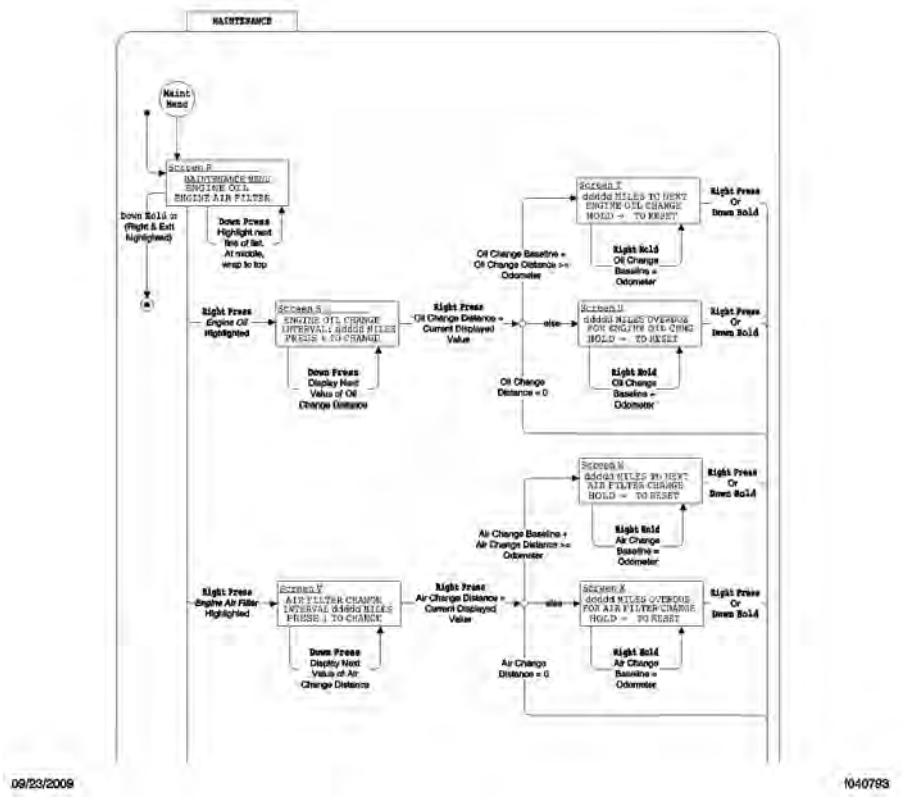

Fig 23, Maintenance Menu Screens, Screen 1

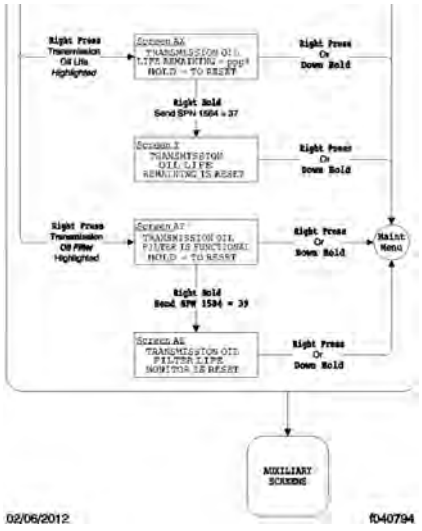

Fig 24, Maintenance Menu Screens, Screen 2

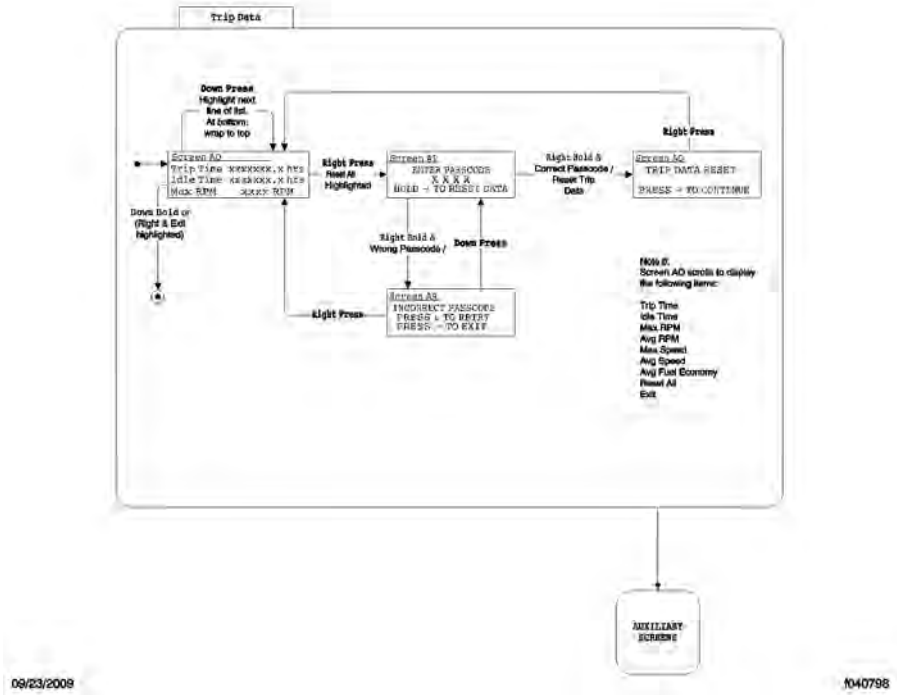

Fig 25, Trip Data

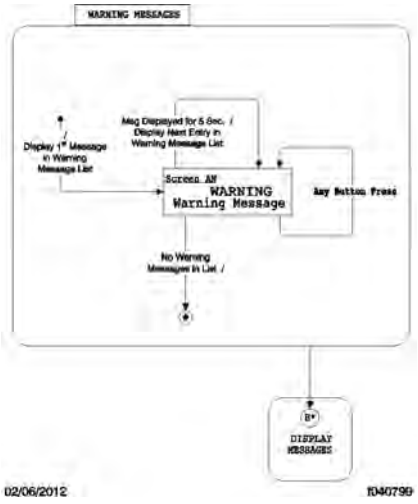

Fig 26, Warning Messages

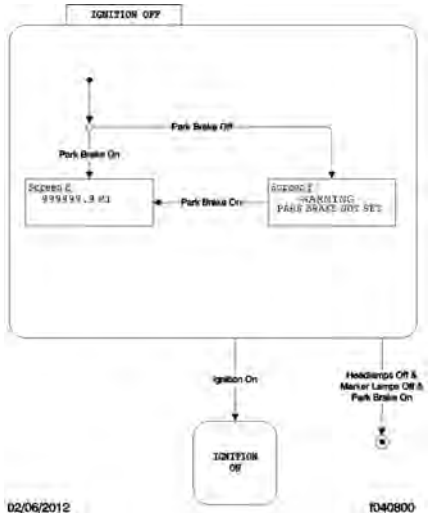

Fig 27, Ignition Off (shown when ignition is keyed OFF)

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4. OptiView Instrument Panel

4.01 OptiView™ Instrument Panel

4.01.01 General Information

NOTE: The OptiView instrument panel can be customized by the body builder. The location of gauges and icons on the instrument panel may vary from what is shown here, but the operation of the instrument panel is the same.

The OptiView instrument panel provides the driver with engine and vehicle information. It is comprised of standard and optional gauges, an audible alarm, a driver message center, information options (menu-structured format), and warning and indicator lamps (also known as telltales). Warning and indicator lamps illuminate in red (danger), amber (caution), green (status advisory), or blue (high-beam headlights active).

See Fig.28,Typical Instrument Panel, EPA10 and Newer Engines for a typical instrument gauge panel and see Fig. 29,Warning Lamps, EPA10 and Newer Engines for the OptiView warning lamps. See 5.01.01 General Description for detailed warning lamp descriptions.



1. Tachometer
2. Engine Oil Pressure Gauge
3. Menu and Driver Message Area
4. Speedometer
5. Primary Air Pressure Gauge
6. Secondary Air Pressure Gauge
7. Low Battery Voltage Warning
8. Diesel Exhaust Fluid (DEF) Level Gauge
9. Fuel Level Gauge
10. Odometer
11. Coolant Temperature Gauge
12. Gear Shift Position Indicator

Fig 28, Typical Instrument Panel, EPA10 and Newer Engines



1. Economy Mode Indicator
2. Service Soon
3. Steerable Tag Axle Warning
4. Malfunction Indicator Lamp (MIL)
5. Check Engine Warning
6. Left-Turn Indicator
7. Stop Engine Warning
8. Right-Turn Indicator
9. Parking Brake On Warning
10. Air Brake Warning
11. Adaptive Cruise Control Indicator
12. Fasten Seat Belt Warning
13. Wait to Start Indicator
14. Pedestrian Collision Warning
15. Low Windshield Washer Fluid Indicator
16. Marker Light Indicator
17. Automatic Traction Control Indicator
18. Headlight/High-Beam/Automatic High-Beam Indicator
19. Fog Lamp Indicator
20. Electronic Stability Control (ESC) Indicator
21. Tire Pressure Monitoring System Indicator
22. Forward Collision System Indicator
23. Lane Departure Warning
24. Low Battery Voltage Warning
25. Low Secondary Air Pressure Warning
26. Engine RPM
27. Cruise Control Indicator
28. Low Primary Air Pressure Warning
29. Speed Limit Indicator
30. Forward Collision Warning
31. Low Diesel Exhaust Fluid (DEF) Warning
32. Low Fuel Indicator
33. Water in Fuel Indicator
34. Low Oil Pressure Warning
35. Diesel Particulate Filter (DPF) Lamp
36. High Exhaust System Temperature (HEST) Lamp
37. High Coolant Temperature Warning
38. Shift Inhibit Indicator
39. Service Transmission Indicator
40. Transmission Overheat Warning
41. Transmission Warning
42. ABS Warning
43. Engine Brake Indicator
44. Bluetooth Smartphone Indicator

Fig 29, Warning Lamps, EPA10 and Newer Engines

4.01.02 Ignition Sequence

When the ignition is turned on, OptiView performs a self-test. Observing the ignition sequence is a good way to ensure the OptiView panel is functioning properly.

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

- When the ignition is in the ON position, the following actions should occur:
- warning and indicator lamps illuminate for approximately three seconds, then are extinguished;

- seatbelt indicator lamp remains on for an additional five seconds after the other indicator lamps are extinguished;
- audible alarm sounds until the self-test is completed;
- if any faults are detected, an error message will display in the menu area of the instrument panel.

When the self-test is complete, all warning lamps and indicators are extinguished.

4.01.03 Audible Alerts

An audible alert sounds during the ignition sequence until the self-test is completed, and whenever one of the following conditions exists:

- Air pressure falls below 65 psi (448 kPa).
- Anytime the low air warning lamp is activated.
- During start-up until air pressure in the tanks reaches approximately 70 to 76 psi (483 to 524 kPa).
- When the parking brake is engaged. The parking brake will not disengage until the air pressure has reached 65 psi (448 kPa).
- Emergency engine shutdown is activated.
- The parking brake is applied and the transmission is not in neutral.
- The transmission is in neutral or the ignition is in the OFF position, and the parking brake is not set and the service brake is not depressed.
- Anytime the ignition is turned OFF and the panel lamps are still illuminated.

4.01.04 Emergency Shutdown

The instrument panel will shut down if the voltage supply is not within the normal operating range of 9 to 16 volts for more than 10 milliseconds. During emergency shutdown, the gauge pointers freeze, the display goes blank, and the lamps turn off. When power is restored to within the normal operating range following an emergency shutdown, a self-test is performed before resuming normal operation.

4.01.05 Gear Shift Position

The highlighted letter shown in the instrument panel indicates the gear shift position; D for drive, N for neutral, and R for reverse. See Fig.30,Typical Instrument Panel, EPA10 and Newer Engines, item 12. If none of the positions are highlighted, a failure mode has occurred and could be due to a communication problem with the transmission.

Drive Modes

When standard automatic transmission mode is used, the current gear position appears next to the D indicator, as shown in Fig.31,Standard Automatic Transmission Mode (drive indicator shown). When manual transmission mode is used, the indicator changes to M with the target gear position next to it; for example M5 5. To the right of the manual indicator, the actual gear position appears in blue.

When the transmission mode is changed by the driver on the transmission multifunction control, a message appears briefly in the tachometer. The message reads either 'performance' or 'economy.' See Fig.32,Transmission Mode Message.

Engine Brake

During engine braking, the gear position indicator changes to 2, representing the target gear. The actual gear position appears to the right in blue. See Fig.33,Gear Position Indicator (shown during engine braking).

When the engine brake is active, a white indicator activates in the instrument panel with the requested level of braking (low, medium, or high) in text to the right. The additional braking level text is only visible on vehicles equipped with varying brake levels.

When the engine brake engages, the indicator and text turn green. See Fig.34,Engine Brake Engaged. While the engine brake is engaged, the driver can adjust the engine brake level using the transmission multifunction control on the right of the steering wheel.



1. Tachometer
2. Engine Oil Pressure Gauge
3. Menu and Driver Message Area
4. Speedometer
5. Primary Air Pressure Gauge
6. Secondary Air Pressure Gauge
7. Low Battery Voltage Warning
8. Diesel Exhaust Fluid (DEF) Level Gauge
9. Fuel Level Gauge
10. Odometer
11. Coolant Temperature Gauge
12. Gear Shift Position Indicator

Fig 30, Typical Instrument Panel, EPA10 and Newer Engines



Fig 31, Standard Automatic Transmission Mode (drive indicator shown)



A. A message appears briefly to indicate the transmission mode.

Fig 32, Transmission Mode Message



Fig 33, Gear Position Indicator (shown during engine braking)



1. Engine Brake Indicator

Fig 34, Engine Brake Engaged

4.01.06 Menu Structure

The OptiView instrument panel is an interactive graphical display that is capable of displaying text messages and graphics to communicate information about the status and performance of the vehicle to the operator. This information is organized in a menu-structured format around the following menu screens:

- Gauges (Additional)
- Steering Effort
- Fuel Economy
- Mobileye®
- RoadWATCH™
- Tire Pressure
- Trip 1
- Trip 2
- Vehicle Settings
- Diagnostics

The menus appear in the center of the instrument panel as shown in Fig.41,Menu Screen. When the instrument panel displays a message to the operator, it appears in the menu area.

Menu Navigation

Navigating through the system menus is done with the buttons on the left side of the steering wheel. See Fig. 42,Steering-Wheel-Mounted Switches. Press the menu up or menu down arrows to highlight a menu, then press the OK button to enter the highlighted menu. Press the 'back' button to go back to the last menu that was displayed. Pressing the menu cycle button displays the next menu options with each button press. Press the 'home' button to return to the menus in their original order.

Gauge Menus

The driver can choose to display up to three gauge menus in the menu area if desired. See Fig. 43,Gauge Menus, Option 1, see Fig.44,Gauge Menus, Option 2, and see Fig.45,Gauge Menus, Option 3. From the main menu, select 'Gauges' and press the OK button. Use the 'down' arrow to highlight one of the three currently viewed gauges, then press the OK button and the highlight will flash. Use the 'up' and 'down' arrows to scroll through the available gauges. Once you have selected the gauge to view, press the OK button again. The highlight stops flashing and that gauge is set. Use the same process to change the other two gauge menus.

Steering Effort

To adjust the steering wheel sensitivity, use the 'down' arrow on the steering wheel to select 'Steering Effort' and press OK. See Fig.46,Steering Effort Menu , for an example of the steering effort menu. The driver can adjust the steering wheel sensitivity by pressing the up arrow on the steering wheel for more (more effort is required to steer) and the down arrow on the steering wheel for less (less effort is required to steer). The default sensitivity is set at 3.5. The steering sensitivity adjusts and is saved by the system in real time to allow the driver to feel the result of the changes. Press the back button to display the main menu.

Fuel Economy Menu

From the main menu, select 'Fuel Economy' and press the OK button. See Fig.47,Fuel Economy Menu, for an example of the fuel economy menu.

Overall fuel economy is represented as a bar gauge while the red pointer indicates instantaneous fuel economy.

Press and hold the OK button to reset the distance to empty value and the average miles per gallon/kilometers per liter.

Mobileye®

Mobileye is a safety system available on some vehicles. The following information describes the various Mobileye features and whether or not the feature can be deactivated. For features that can be deactivated, use the 'down' arrow to select the applicable item for deactivation. See Fig.48,Mobileye Menu, see Fig.49,Headway Warning Distance Menu, see Fig. 50,Intelligent High-Beams Menu, see Fig.51,Lane Departure Warning Menu, see Fig.52,Pedestrian Warning Menu, and see Fig.53,Speed Limit Indicator and Alert Menu.

Headway Warning Distance

Intelligent High-Beams (can be deactivated)

Lane Departure Warning (can be deactivated)

Pedestrian Warning

Speed Limit Indicator and Alert (can be deactivated)

Headway Warning Distance

When a vehicle is detected within a predefined headway (distance), the forward collision icon displays continuously below the numeric speedometer. See Fig.54,Headway Warning Distance and Speed Limit Indicator. If dynamic content is active in the center of the instrument panel, the indicator will be relocated to the bottom of the speedometer gauge. See Fig. 55,Relocated Headway and Speed Limit Indicator. If a lead vehicle is detected, the green headway indicator is displayed and shows the headway time to the lead vehicle. When a lead vehicle’s headway is close, the headway icon will change to

red and provide an audible chime. If the lead vehicle is breaking/approaching, the headway icon enlarges and an audible chime alerts the driver. See Fig.56,Headway Icon Enlarges.

Intelligent High-Beam Control

NOTE: The left-hand stalk switch must be in the high-beam position in order for the intelligent high-beam option to work.

When intelligent high-beam control is enabled and the vehicle is traveling faster than 21 mph (34 km/h), the high-beam headlamps automatically activate and deactivate on dark roads when there is no nearby traffic. The high-beam icon appears blue in the instrument panel when enabled and active; the icon is grey when the intelligent high-beam control is enabled but inactive. See Fig.36,Warning Lamps, EPA10 and Newer Engines. The driver can choose to deactivate this feature in the 'Intelligent High-Beams' menu. See Fig.50,Intelligent High-Beams Menu.

The icon is blue when the intelligent high-beam control is enabled and active; the icon is grey with an 'A' in the center when the intelligent high-beam control is enabled but inactive. A green icon indicates the low-beam headlamps are on.

Lane Departure Warning

An amber lane marker and assistance graphic appears in the center of the instrument panel when the vehicle unintentionally departs (with no turn signal) from the driving lane while traveling over 40 mph (64 km/h). The lane markings appear amber on the side the vehicle is veering toward. See Fig.57,Lane Departure Warning. The driver can choose to deactivate this feature in the 'Lane Departure Warning' menu.

Pedestrian Collision Warning

The pedestrian collision warning is operational during daylight hours when the vehicle is traveling less than 31 mph (50 km/h). It alerts the driver with a red flashing icon and series of beeps when a pedestrian crosses in front of the vehicles path. A green icon activates when a pedestrian is detected in the danger zone but the time to collision is not critical. See Fig. 36,Warning Lamps, EPA10 and Newer Engines.

Speed Limit Indicator and Alert

If detected, a speed limit sign is shown continuously under the numeric speedometer reading. See Fig. 54,Headway Warning Distance and Speed Limit Indicator. The speed limit indicator displays the last detected speed limit sign. If the over-speed threshold has been exceeded, the speed limit indicator flashes on and off. If speed limit data is not available, the speed limit indicator is not active. The driver can choose to deactivate this feature in the 'Speed Limit Indicator & Alert' menu. See Fig.53,Speed Limit Indicator and Alert Menu.

RoadWATCH™

NOTE: Standard cruise control is always available, however to use adaptive cruise control, the driver must select one of the three preset distance options. See Fig.58,Cruise Control Menu, Standard Cruise Control Screen Shown.

See Fig.58,Cruise Control Menu, Standard Cruise Control Screen Shown for the cruise control menu location.

Standard Cruise Control

Standard cruise control automatically maintains a desired vehicle speed. Use the cruise control set button on the steering wheel once a desired speed is reached. Pressing the brake pedal or switching the cruise control button to OFF deactivates the system.

Adaptive Cruise Control

Adaptive cruise control uses radar to detect vehicles ahead and automatically adjusts the vehicle speed to maintain a safe distance.

When another vehicle is detected, a car appears at the top of the driver display screen along with the speed, distance and estimated time to reach that vehicle. See Fig.59,Adaptive Cruise Control Screen. As the other vehicle gets within a set distance, it is highlighted yellow to signal a warning range, and then highlighted red to signal a danger range.

An alarm also activates to notify the driver of the distance between the two vehicles. The driver can select the distance—far, near, or close—when the alarm is triggered. See Fig.59,Adaptive Cruise Control Screen.

To use adaptive cruise control, use the down arrow on the steering wheel to select 'Cruise Control' from the main menu. Then use the down arrow on the steering wheel to select the alarm distance. See Fig.59,Adaptive Cruise Control Screen, items 2, 3, and 4. The adaptive cruise control indicator activates in the instrument panel and 'Use Standard CC' appears in the display below the alarm distance options. If the driver wants to use standard cruise control, they can select 'Use Standard CC' from the cruise control menu.

Trip Menus

From the main menu, highlight 'Trip 1' and press the OK button. The TRIP 1 information appears on the screen. See Fig. 60,TRIP 1 Information. Press the 'down' arrow to view the bottom three items in the TRIP 1 screen. To reset the TRIP 1 information, press and hold the OK button.

The Trip 2 menu functions the same way after highlighting 'Trip 2' and pressing the OK button. See Fig. 61,TRIP 2 Information. To reset the TRIP 2 information, press and hold the OK button.

Tire Pressure Menu

The driver can select tire pressure from the main menu and quickly check tire pressure and temperature. A tire status of OK, LOW, HIGH, or LEAK appears. See Fig.41,Menu Screen.

When tire pressure is selected, an overhead view of the vehicle is displayed with the tire pressure and temperature indicated for each tire; the tire pressure appears in bold above the temperature reading. Tires within a normal pressure range are white. Tires with low or high pressure or a tire with a leak detected are yellow. See Fig.62,Tire Pressure Screen. When the tire pressure monitoring system (TPMS) detects a tow vehicle, the number of tire sensors detected represents its graphic representation. See Fig.63,Tow Vehicle Tire Pressure Screen.

Tire Warning

Vehicles equipped with a TPMS display a warning screen when a fault is detected. An overhead view of the vehicle is shown along with the tire pressure and temperature of each tire and a message—LOW PRESSURE, HIGH PRESSURE, or LEAK DETECTED—at the bottom of the driver display screen. See Fig.64,Tire Warning Screen. To exit the tire warning screen, press the OK button on the left side of the steering wheel.

Vehicle Settings Menu

Selecting 'Vehicle Settings' from the main menu allows the driver to change system settings for bluetooth, dash brightness, fob programming, TPMS, units of measurement, and reset to default. See Fig.65,Vehicle Settings Menu.

Bluetooth

The bluetooth menu is used to connect devices, change the priority of connected devices, and remove a device's connectivity permissions. To set up a device, use the 'down' arrow to select 'Vehicle Settings', then 'Bluetooth' and press OK.

From the bluetooth menu, shown in Fig.66,Bluetooth Menu, choose 'Pair Device.' The information center searches for available devices. See Fig.67,Bluetooth Pairing. When devices are found, the driver can choose which one they want to pair with the information center. Once device pairing is confirmed, press OK on the steering wheel to exit back to the bluetooth menu.

Once a device is paired with the information center, incoming phone calls appear in the center of the display screen. See Fig.68,Incoming Call Status Screenand see Fig.69,Incoming Call With Contact Photo. The driver can accept or decline the incoming call using the phone controls on the steering wheel.

Call status appears in the top left of the display screen while a call is active and shows the call time, shown in Fig. 68,Incoming Call Status Screen, or just after a call ends with a 'call ended' message.

Dash Brightness

To change the dash brightness, use the 'down' arrow to select 'Vehicle Settings', then 'Dash Brightness' and press OK. Press the up arrow on the steering wheel to increase dash brightness or the down arrow to decrease it. See Fig. 70,Dash Brightness.

Fob Programming

To reset the fob programming, use the 'down' arrow to select 'Vehicle Settings,' then 'Fob Programming' and press OK. Use the 'up' arrow to select enable and the 'down' arrow to select disable. See Fig.71,Fob Programming. For additional key fob information, see 6.01.01 Standard Ignition and Key.

TPMS Calibration

The park brake must be set before the system will allow the TPMS values to be updated. A message appears in the upper center over the RV graphic. See Fig.72,Set Park Brake to Calibrate TPMS Screen. Once the park brake is set, the message disappears and is replaced by the 'Hold OK to set TPMS values' message. See Fig.73,Set TPMS Values Screen.

Units of Measurement

After selecting 'Vehicle Settings,' then 'Units of Measurement,' the driver can choose standard or metric. See Fig. 74,Units of Measurement.

Diagnostics

Selecting 'Diagnostics' from the main menu allows the driver to access the following sub-menus—Faults, Internal Diagnostics, Transmission Prognostics, System Information, and Radar Alignment. See Fig.75,Diagnostics Sub-Menu.

Faults

The Faults sub-menu, shown in Fig.76,Faults Sub-Menu, displays the following faults should they occur:

- antilock brake system
- air pressure module
- engine
- instrumentation
- transmission

Press the OK button to view any active faults.

Internal Diagnostics

The Internal Diagnostics sub-menu, shown in Fig.77,Internal Diagnostic Sub-Menu, displays internal diagnostic information with the current value from the OptiView instrument panel.

Transmission Prognostics

The Transmission Prognostics sub-menu, see Fig.78,Transmission Prognostics Sub-Menu, displays the following information:

- oil level
- oil filter
- oil life

System Information

Selecting the System Information sub-menu, shown in Fig.79,System Information Sub-Menu, displays the current system software version.

Radar Alignment

The Radar Alignment sub-menu, shown in Fig.80,Radar Alignment Sub-Menu, displays the radar alignment percentage of completion.

Vision System Fault

Low visibility, no communication, temperature, and error codes from the Mobileye system activate a vision system fault message in the center of the instrument panel.

Vision System Communication Failure

When the Mobileye system experiences a communication failure, a message appears in the center of the instrument panel.

Automatic Traction Control

The automatic traction control system automatically limits wheel spin during reduced-traction situations. ATC applies gentle braking to the spinning wheel, to improve power to the wheel(s) with better traction. If both wheels are spinning, the system will signal the engine to reduce power.

Menu Off

If the driver selects menu off, the menu items no longer appear on the driver display screen. To view the menu items once again, press any of the arrows or the OK button on the left side of the steering wheel.



1. Tachometer
2. Engine Oil Pressure Gauge
3. Menu and Driver Message Area
4. Speedometer
5. Primary Air Pressure Gauge
6. Secondary Air Pressure Gauge
7. Low Battery Voltage Warning
8. Diesel Exhaust Fluid (DEF) Level Gauge
9. Fuel Level Gauge
10. Odometer
11. Coolant Temperature Gauge
12. Gear Shift Position Indicator

Fig 35, Typical Instrument Panel, EPA10 and Newer Engines



1. Economy Mode Indicator
2. Service Soon
3. Steerable Tag Axle Warning
4. Malfunction Indicator Lamp (MIL)
5. Check Engine Warning
6. Left-Turn Indicator
7. Stop Engine Warning
8. Right-Turn Indicator
9. Parking Brake On Warning
10. Air Brake Warning
11. Adaptive Cruise Control Indicator
12. Fasten Seat Belt Warning
13. Wait to Start Indicator
14. Pedestrian Collision Warning
15. Low Windshield Washer Fluid Indicator
16. Marker Light Indicator
17. Automatic Traction Control Indicator
18. Headlight/High-Beam/Automatic High-Beam Indicator
19. Fog Lamp Indicator
20. Electronic Stability Control (ESC) Indicator
21. Tire Pressure Monitoring System Indicator
22. Forward Collision System Indicator
23. Lane Departure Warning
24. Low Battery Voltage Warning
25. Low Secondary Air Pressure Warning
26. Engine RPM
27. Cruise Control Indicator
28. Low Primary Air Pressure Warning
29. Speed Limit Indicator
30. Forward Collision Warning
31. Low Diesel Exhaust Fluid (DEF) Warning
32. Low Fuel Indicator
33. Water in Fuel Indicator
34. Low Oil Pressure Warning
35. Diesel Particulate Filter (DPF) Lamp
36. High Exhaust System Temperature (HEST) Lamp
37. High Coolant Temperature Warning
38. Shift Inhibit Indicator
39. Service Transmission Indicator
40. Transmission Overheat Warning
41. Transmission Warning
42. ABS Warning
43. Engine Brake Indicator
44. Bluetooth Smartphone Indicator

Fig 36, Warning Lamps, EPA10 and Newer Engines



08/04/2022 f612114

Fig 37, Standard Automatic Transmission Mode (drive indicator shown)



08/16/2022 f612106

A. A message appears briefly to indicate the transmission mode.

Fig 38, Transmission Mode Message



07/26/2022 f612108

Fig 39, Gear Position Indicator (shown during engine braking)



1. Engine Brake Indicator

Fig 40, Engine Brake Engaged



Fig 41, Menu Screen



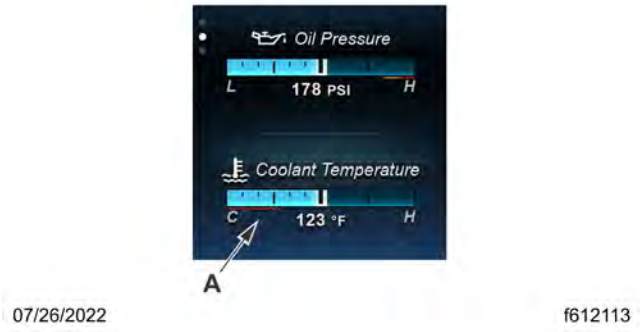
1. Cruise Accelerate/Resume
2. Marker Interrupt
3. Cruise Decelerate/Set
4. Phone Hang-Up/Reject
5. Mute Button
6. Phone Pick-Up
7. Cruise On/Off
8. Cruise Cancel
9. Volume Increment Up
10. Back Button
11. Volume Increment Down
12. Menu Down
13. Menu Cycle
14. Home Button
15. OK Button
16. Menu Up

Fig 42, Steering-Wheel-Mounted Switches



A. Transmission Temperature and Turbo Boost

Fig 43, Gauge Menus, Option 1



A. Oil Pressure and Coolant Temperature

Fig 44, Gauge Menus, Option 2



A. Engine Load and Gear

Fig 45, Gauge Menus, Option 3



NOTE: The default sensitivity is set at 3.5.

Fig 46, Steering Effort Menu

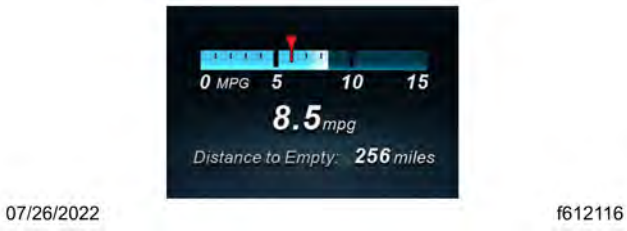


Fig 47, Fuel Economy Menu



Fig 48, Mobileye Menu



Fig 49, Headway Warning Distance Menu



Fig 50, Intelligent High-Beams Menu

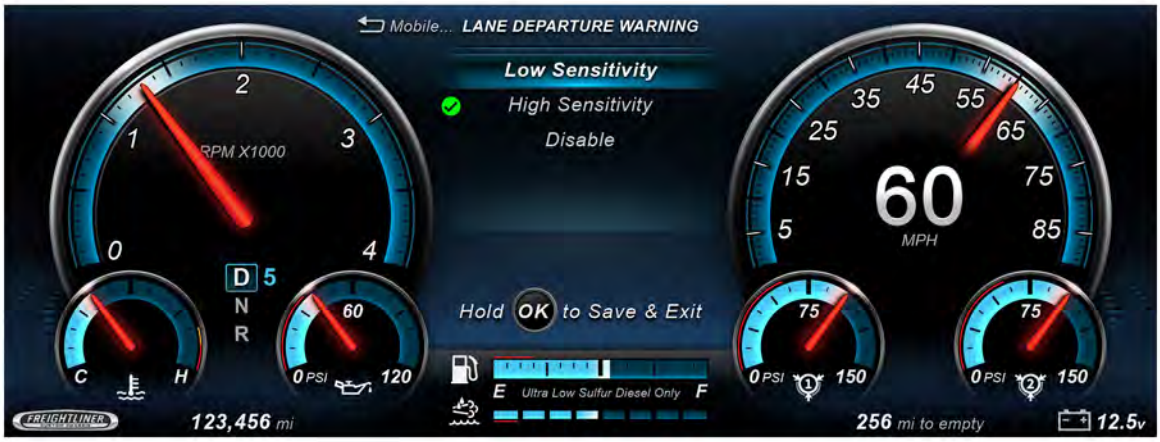


Fig 51, Lane Departure Warning Menu



Fig 52, Pedestrian Warning Menu

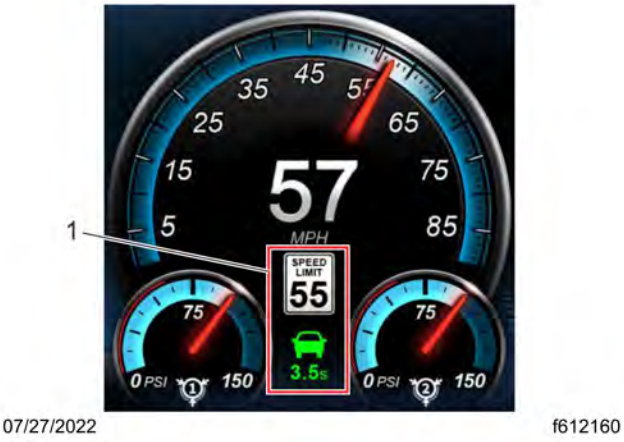


Fig 53, Speed Limit Indicator and Alert Menu



1. Headway Warning Distance Indicator
2. Speed Limit Indicator

Fig 54, Headway Warning Distance and Speed Limit Indicator



A. Headway and Speed Limit Indicators

Fig 55, Relocated Headway and Speed Limit Indicator



Fig 56, Headway Icon Enlarges



A. The lane markings appear amber and a vehicle image is shown veering toward the appropriate lane, either left or right, of departure.

B. Lane departure warning telltale displayed.

Fig 57, Lane Departure Warning



A. Standard cruise control is selected. There is no headway protection (adaptive cruise control) provided when standard cruise control is used.

1. Cruise Control Indicator

Fig 58, Cruise Control Menu, Standard Cruise Control Screen Shown



A. The car image can be highlighted yellow (warning range) or red (danger range). The speed, distance and estimated time to reach the other vehicle are also provided to the driver.

1. Adaptive Cruise Control Icon
2. Alarm Distance, Close
3. Alarm Distance, Near
4. Alarm Distance, Far

Fig 59, Adaptive Cruise Control Screen



Fig 60, TRIP 1 Information



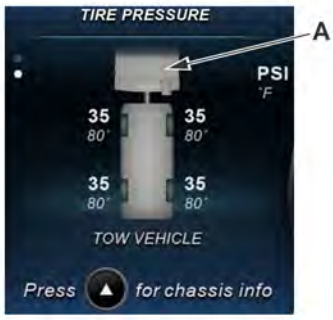
Fig 61, TRIP 2 Information



A. The tire pressure and temperature of each tire are shown.

B. TPMS system detects a tow vehicle.

Fig 62, Tire Pressure Screen



A. Tow vehicle tire pressure and temperature of each tire shown.

Fig 63, Tow Vehicle Tire Pressure Screen



A. The tire warning screen indicates that one tire has low pressure, indicated by the yellow tire and pressure reading on the driver display screen.

1. Low tire pressure and high tire temperature detected.

Fig 64, Tire Warning Screen



Fig 65, Vehicle Settings Menu

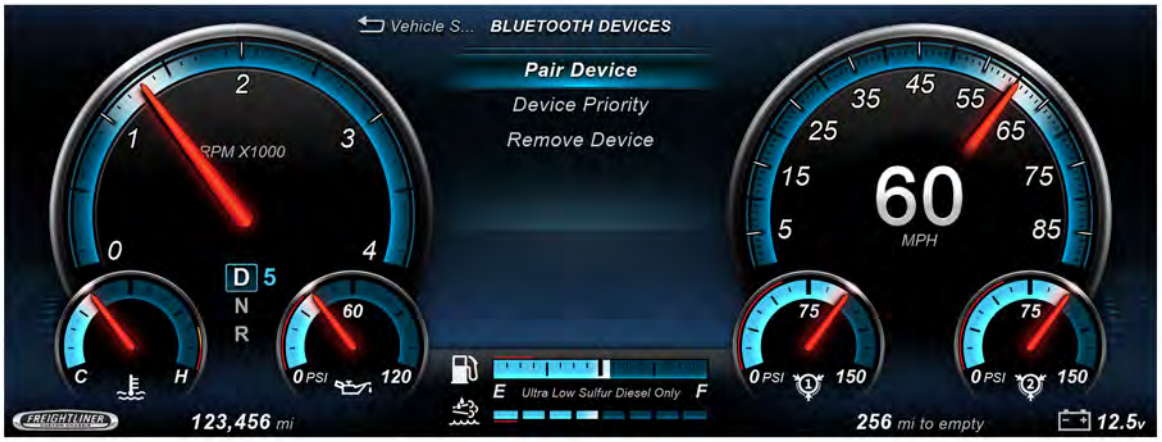
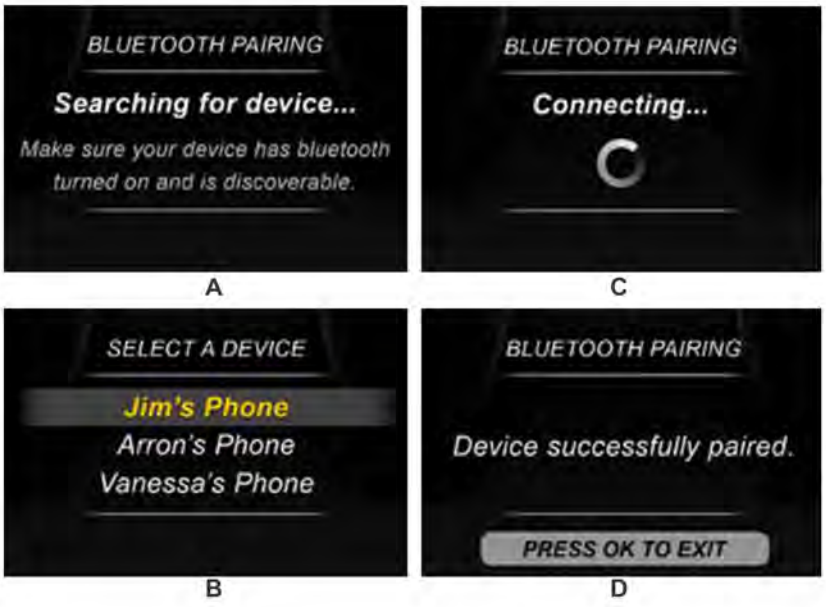


Fig 66, Bluetooth Menu



A. The information center searches for available devices.
B. Select the device to pair with the information center.
C. The information center and device are connecting.
D. A message tells the driver a device is paired.

Fig 67, Bluetooth Pairing



1. Incoming Call Status Shown

Fig 68, Incoming Call Status Screen

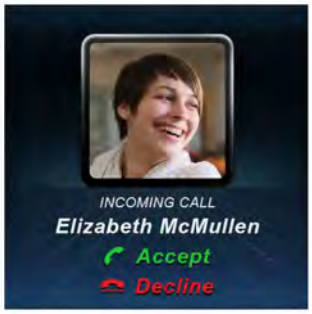


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Fig 69, Incoming Call With Contact Photo



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Fig 70, Dash Brightness

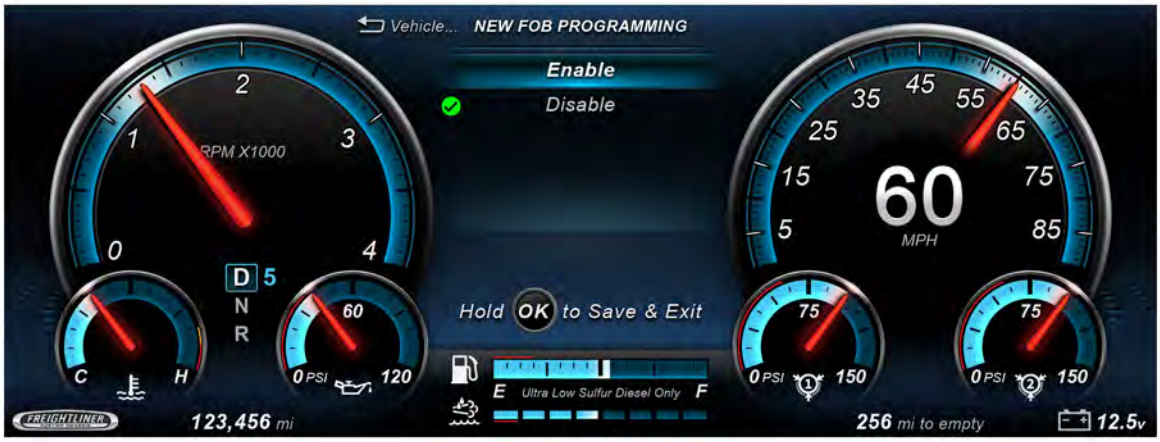

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Fig 71, Fob Programming

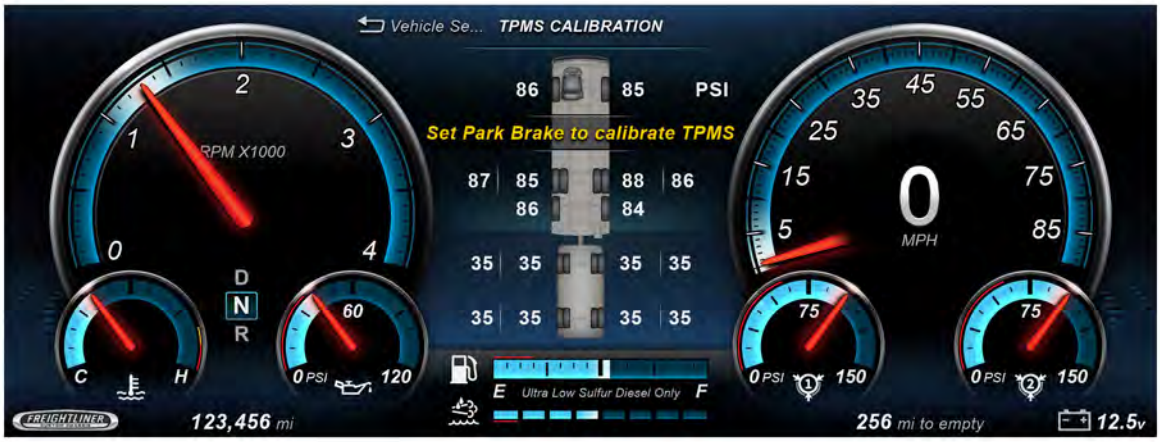

Fig 72, Set Park Brake to Calibrate TPMS Screen

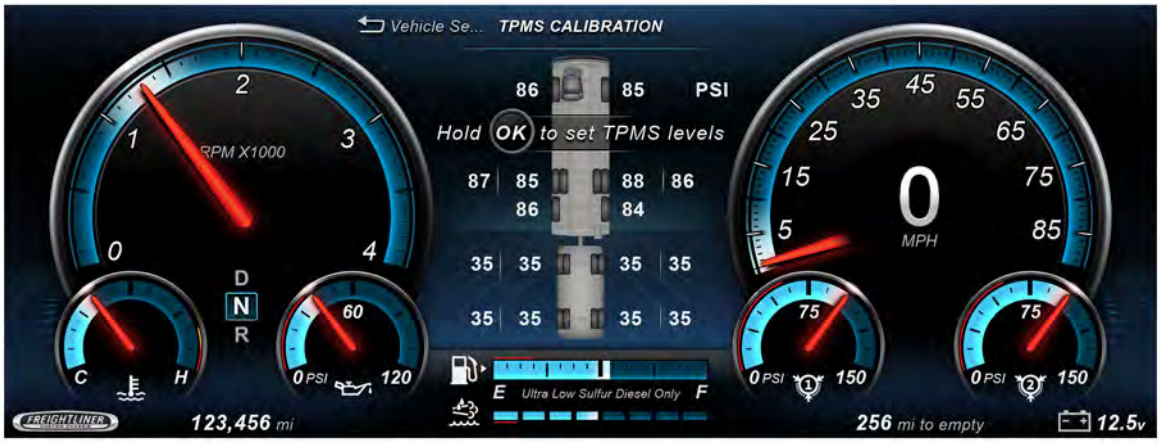

Fig 73, Set TPMS Values Screen

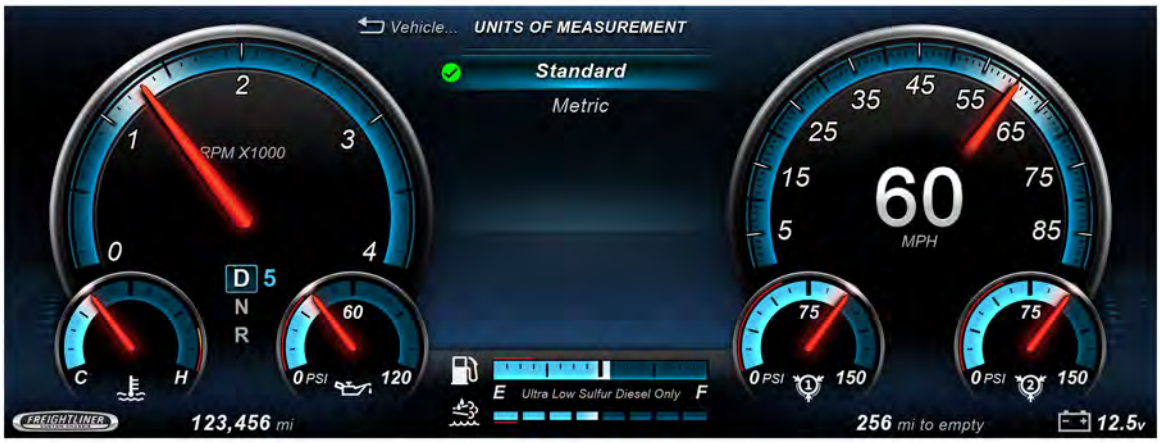

Fig 74, Units of Measurement



Fig 75, Diagnostics Sub-Menu



1. Active Faults

Fig 76, Faults Sub-Menu



1. Current Sub-Menu Values

Fig 77, Internal Diagnostic Sub-Menu



1. Transmission Information

Fig 78, Transmission Prognostics Sub-Menu



1. Software Version

Fig 79, System Information Sub-Menu



1. Radar Alignment Percentage of Completion

Fig 80, Radar Alignment Sub-Menu

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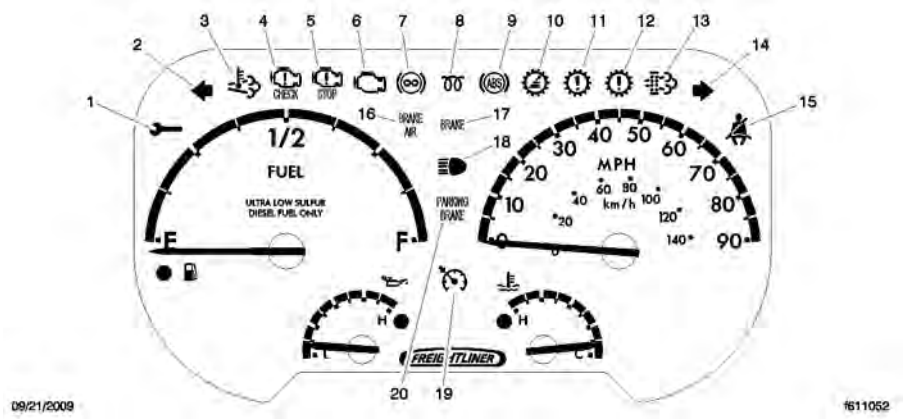
5. Instruments

5.01 Warning and Indicator Lamps

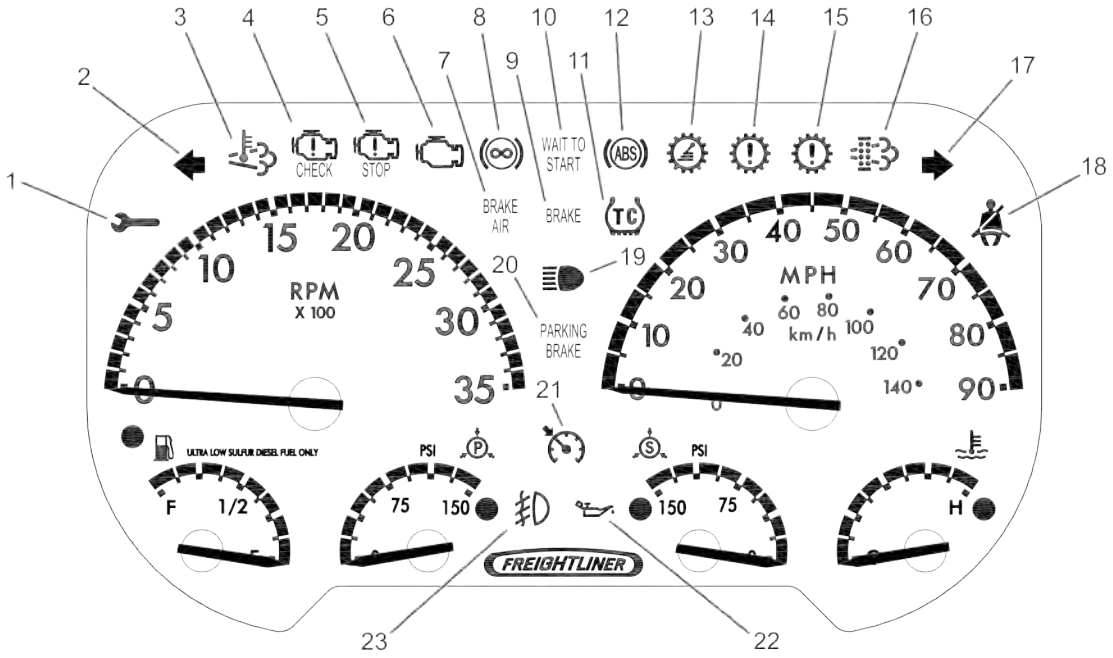
5.01.01 General Description

The following information describes the various warning and indicator lamps found in the Ametek and OptiView™ instrument panels. See Fig.81,Ametek Warning and Indicator Lamps and see Fig. 82,Ametek Warning Lamps Front Engine, EPA10 and Newer Engines for an example of the Ametek warning and indicator lamps and see Fig.83,OptiView Warning Lamps, EPA10 and Newer Engines for an example of the OptiView warning and indicator lamps.



1. Maintenance Warning Lamp
2. Left-Turn Indicator
3. High Exhaust System Temperature (HEST) Lamp
4. Check Engine Warning
5. Stop Engine Warning
6. Malfunction Indicator Lamp (MIL)
7. Engine Brake Indicator
8. Wait to Start Indicator
9. ABS Warning
10. Shift Inhibit Indicator
11. Transmission Overheat Warning
12. Transmission Warning (hybrid only)
13. Diesel Particulate Filter (DPF) Lamp
14. Right-Turn Indicator
15. Fasten Seat Belts Warning
16. Air Brake Warning
17. Hydraulic Brake System Warning
18. Headlight High-Beam Indicator
19. Cruise Control Indicator
20. Parking Brake On Warning

Fig 81, Ametek Warning and Indicator Lamps



1. Maintenance Warning
2. Left-Turn Indicator
3. High Exhaust System Temperature (HEST) Lamp
4. Check Engine Warning
5. Stop Engine Warning
6. Malfunction Indicator Lamp (MIL)
7. Air Brake Warning
8. Engine Brake Indicator
9. Hydraulic Brake System Warning
10. Wait to Start Indicator
11. Automatic Traction Control Indicator
12. ABS Warning
13. Shift Inhibit Indicator
14. Transmission Warning
15. Stop Transmission (hybrid only)
16. Diesel Particulate Filter (DPF) Lamp
17. Right-Turn Indicator
18. Fasten Seat Belt Warning
19. Headlight High-Beam Indicator
20. Parking Brake On Warning
21. Cruise Control Indicator
22. Low Oil Pressure Warning
23. Fog Lamp Indicator

Fig 82, Ametek Warning Lamps Front Engine, EPA10 and Newer Engines



1. Automatic Traction Control Indicator
2. Tire Pressure Monitoring System Indicator
3. Electronic Stability Control (ESC) Indicator
4. ABS Warning
5. Engine Brake Indicator
6. Parking Brake On Warning
7. Air Brake Warning
8. Pedestrian Collision Warning
9. Forward Collision System Indicator
10. Fasten Seat Belt Warning
11. Cruise Control Indicator
12. Adaptive Cruise Control Indicator
13. Marker Light Indicator
14. Fog Lamp Indicator
15. Headlight/High-Beam/Automatic High-Beam Indicator
16. Bluetooth Smartphone Indicator
17. Low Primary Air Pressure Warning
18. Water in Fuel Indicator
19. High Exhaust System Temperature (HEST) Lamp
20. Economy Mode Indicator
21. Check Engine Warning
22. Stop Engine Warning
23. Steerable Tag Axle Warning
24. Malfunction Indicator Lamp (MIL)
25. Left-Turn Indicator
26. Right-Turn Indicator
27. Forward Collision Warning
28. Speed Limit Indicator
29. Shift Inhibit Indicator
30. Transmission Warning
31. Transmission Overheat Warning
32. Wait to Start Indicator
33. Low Windshield Washer Fluid Indicator
34. Service Transmission Indicator
35. Low Secondary Air Pressure Warning
36. High Coolant Temperature Warning
37. Low Fuel Indicator
38. Diesel Particulate Filter (DPF) Lamp
39. Low Diesel Exhaust Fluid (DEF) Warning
40. Low Battery Voltage Warning
41. Low Oil Pressure Warning

Fig 83, OptiView Warning Lamps, EPA10 and Newer Engines

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.

NOTE: The following descriptions apply to each instrument panel where applicable and are listed alphabetically.

5.01.02 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 10.01 Power Steering System.

WARNING:
If the ABS warning lights come on while driving, repair the system immediately to ensure full antilock brake capability. Operating the vehicle when the ABS needs to be serviced could cause an accident, possibly resulting in personal injury or death, or property damage.

5.01.03 Adaptive Cruise Control Indicator

The adaptive cruise control indicator illuminates under the following conditions:

- The adaptive cruise control is activated.
- When a failure is detected, the adaptive cruise control indicator illuminates along with an exclamation (!) point.

5.01.04 Air Brake Warning

The air brake warning lamp activates if the pneumatic brake system air is low, or if the air suspension is low.

5.01.05 Automatic Traction Control (ATC) Indicator

The ATC indicator illuminates during wheel spin and when the ATC system is active. If the ATC system is disabled, the indicator appears on the instrument panel with a line across the letters.

5.01.06 Bluetooth Smartphone Indicator (OptiView only)

The bluetooth smartphone indicator displays reception bars and the battery level of the connected device.

5.01.07 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.

For Cummins engine service literature, refer to *Cummins Online* at [Missing cross reference text] or scan the QR code. See Fig.84,Cummins QR Code. For Detroit™ engine service literature, refer to the *Detroit Diesel* link on the DTNA TechLit website [Missing cross reference text] or scan the QR code. See Fig.85,TechLit QR Code.



Fig 84, Cummins QR Code



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Fig 85, TechLit QR Code

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

5.01.08 Cruise Control Indicator

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

5.01.09 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 *Parked Regen* for details.

A blinking lamp indicates that a stationary regeneration is required immediately. An engine derate and shutdown will occur. See *Parked Regen* for details.

5.01.10 Economy Mode Indicator (OptiView only)

The economy mode indicator displays an E when the driver changes the transmission mode to economy.

5.01.11 Electronic Stability Control (ESC) Indicator

The electronic stability control (ESC) indicator illuminates when the ESC system activates.

5.01.12 Emergency Buzzer

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

- The coolant temperature rises above the preset level specified by the engine manufacturer.
- The engine oil pressure falls below the preset level specified by the engine manufacturer.
- 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).

5.01.13 Engine Brake Indicator

The engine brake indicator illuminates when the engine brake is applied.

5.01.14 Fasten Seat Belt Warning

The fasten seat belts warning indicator illuminates for 30 seconds after the ignition switch is turned on.

5.01.15 Fog Lamp Indicator

The fog lamp indicator illuminates when the fog lamps are on.

5.01.16 Forward Collision System Indicator (OptiView only)

The forward collision system indicator illuminates only when the system is not available.

5.01.17 Forward Collision Warning (OptiView only)

The red forward collision indicator illuminates and a series of high-pitched beeps sound alerting the driver to a possible collision with the vehicle in front.

5.01.18 Headlight/High-Beam/Automatic High-Beam Indicator

Some vehicles have a green headlight indicator that illuminates when the headlights are on.

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

Vehicles equipped with intelligent high-beam headlights have a grey headlight indicator when the intelligent high-beam control is enabled but inactive.

5.01.19 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.

5.01.20 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.

5.01.21 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.

5.01.22 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.

5.01.23 Low Air Pressure Warning

The low air pressure warning indicator 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.

5.01.24 Low Battery Voltage Warning

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

5.01.25 Low Diesel Exhaust Fluid (DEF) Warning

The low diesel exhaust fluid (DEF) warning indicator illuminates when the DEF tank is approximately 10% full. Fill the DEF tank as soon as possible to avoid engine derate (decreased engine power).

5.01.26 Low Fuel Indicator

The low fuel indicator illuminates when the fuel level is approximately 1/8 full.

5.01.27 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.

5.01.28 Low Windshield Washer Fluid Indicator

The low windshield washer fluid indicator illuminates when the washer fluid level is low.

5.01.29 Maintenance Warning Lamp

When the maintenance warning lamp illuminates, the message display center will alert the driver as follows:

- Oil Change Required—alerts the driver that the engine has reached the recommended oil change interval.
- Air Filter Reminder—the air filter requires checking or replacement.
- Transmission Prognostics Warning—if the transmission has prognostics enabled.

5.01.30 Malfunction Indicator Lamp (MIL)

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

5.01.31 Marker Light Indicator (OptiView only)

The marker light indicator activates when the marker lights are on.

5.01.32 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.

5.01.33 Pedestrian Collision Warning (OptiView only)

The pedestrian collision warning illuminates a green icon when a pedestrian is detected in the danger zone but the time to collision is not critical. A red flashing icon and series of beeps alert the driver when a pedestrian crosses in front of the vehicles path and the time to collision is critical.

5.01.34 Right-Turn Indicator

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

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

5.01.35 Service Transmission Indicator

NOTE: This indicator will not activate in the instrument panel on vehicles equipped with an Allison 3000 transmission. The indicator appears in the transmission push-button shifter display screen.

The service transmission indicator activates when the transmission requires service. For example the transmission oil or filter may need to be changed. When the service 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.

5.01.36 Shift Inhibit Indicator

The shift inhibit indicator illuminates when the transmission ECU is prohibiting shifting.

5.01.37 Speed Limit Indicator (OptiView only)

If the system detects a speed limit sign, the speed limit indicator is shown continuously under the numeric speedometer reading. If speed limit data is not available, the speed limit indicator is not active.

5.01.38 Steerable Tag Axle Warning

The steerable tag axle indicator activates when there is a loss of air pressure at the axle. Air pressure is needed to lock and unlock the steerable tag axle.

5.01.39 Stop Engine Warning

The stop engine warning indicator illuminates if a malfunction that could cause engine damage occurs. In most cases, the engine protection warning will illuminate before the stop engine warning. When the stop engine warning indicator

illuminates, immediately park the vehicle in a safe location and shut down the engine. Continued operation with the stop engine warning indicator illuminated will lead to automatic engine shutdown and possible engine damage.

5.01.40 Tire Pressure Monitoring System Indicator

The tire pressure monitoring system indicator illuminates when the system detects an issue with one or more tires such as under or over pressure or over temperature. A warning message also appears in the driver display screen.

5.01.41 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.

5.01.42 Transmission Warning

The transmission warning indicator will activate during vehicle operation (not during start-up) if the electronic control unit (ECU) has signaled a diagnostic code. Diagnostic codes indicate malfunctions in transmission operation. If this indicator stays on continuously during operation, have the transmission serviced as soon as possible.

5.01.43 Wait to Start Indicator

The wait-to-start indicator lamp illuminates when the intake heater is active. Wait until the indicator light goes off to start the engine.

5.01.44 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.

5.02 Speedometer and Tachometer

5.02.01 Speedometer

NOTE: The following gauges apply to the OptiView™ instrument panel. Gauges for the Ametek panel look slightly different, but function the same.

The speedometer indicates vehicle speed in miles per hour (mph) or kilometers per hour (km/h). See Fig.86,Speedometer.



Fig 86, Speedometer

5.02.02 Tachometer

The tachometer indicates the revolutions per minute (rpm) of the engine. See Fig.87,Tachometer.



Fig 87, Tachometer

IMPORTANT: Some vehicles may be equipped (by the body builder) with a battery isolator system and a gel cell battery. On these vehicles, the voltmeter measures the average voltage of all the batteries when the engine is running. When the engine is stopped, the voltmeter shows the voltage of the engine-starting batteries.

5.03 Gauges

5.03.01 Coolant Temperature Gauge

NOTE: 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 in the normal range between cold and hot. If the temperature remains below or exceeds the normal range, inspect the cooling system to determine the cause. See Fig. 88,Coolant Temperature Gauge.



Fig 88, Coolant Temperature Gauge

5.03.02 Engine Oil Pressure Gauge

The oil pressure gauge should read in the normal range, from 2 to 80 psi (14 to 552 kPa). See 89,Engine Oil Pressure Gauge.



Fig 89, 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.

5.03.03 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 90, Drive Axle Oil Temperature Gauge (rear drive axle gauge shown)

5.03.04 Fuel Level Gauge

The fuel gauge indicates the amount of fuel in the fuel tank. See Fig.91,Fuel Level Gauge.



Fig 91, Fuel Level Gauge

5.03.05 Diesel Exhaust Fluid (DEF) Level Gauge

The DEF gauge indicates the amount of diesel exhaust fluid in the DEF tank. See Fig.92,DEF Level Gauge.



Fig 92, DEF Level Gauge

5.03.06 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. See Fig. 93,Primary and Secondary Air Pressure Gauges. Normal pressure with the engine running is 100 to 120 psi (690 to 827 kPa) in both systems.

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).



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

Fig 93, Primary and Secondary Air Pressure Gauges

5.03.07 Air Intake Restriction Gauge

The air intake restriction gauge indicates the vacuum on the engine side of the air cleaner. On standard installations, it is mounted on the air intake duct in the engine compartment. See Fig.94,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.

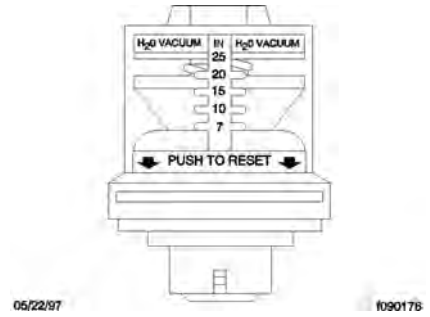


Fig 94, Air Intake Restriction Indicator

Air intake restriction vacuum is measured in inches of water (inH_2O). For vehicles equipped with a graduated indicator or a restriction gauge on the dash, check the gauge with the engine off. If the yellow signal stays locked in the red zone once the engine is shut down, or is at or above the maximum restriction value in Table.5,Air Intake Maximum Restriction Values (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.

Table 5, Air Intake Maximum Restriction Values (inH2O)

Air Intake Maximum Restriction Values (inH2O)		
Engine Make	**EPA07 and EPA10 Engines**	**GHG14, GHG17, and GHG21 Engines**
Cummins	25	25
Detroit	22	18

Table 5, Air Intake Maximum Restriction Values (inH2O)

5.04 Optional Instruments

5.04.01 Turbo Boost 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.

The turbo boost gauge indicates the boost pressure at the turbocharger, from 0 to 50 psi (0 to 345 kPa). See the engine operation and maintenance manual for more information.

5.04.02 Transmission Temperature Gauge

The transmission temperature gauge indicates the temperature of the transmission oil.

NOTICE:
If the transmission continues to overheat during normal operation, have it checked and repaired. Continued operation may cause damage to the transmission.

5.04.03 Tire Pressure Monitoring System (TPMS)

IMPORTANT: Only use temporary resealing or reinflation products that are water soluble and state that they do not adversely affect the operation of the tire pressure sensor(s), if so equipped.

The Tire Pressure Monitoring System (TPMS) constantly monitors the pressure and temperature of each tire on the vehicle, and provides tire status information to warn the driver about a tire-related problem before it becomes dangerous. Tire sensors mounted on each wheel measure tire pressure and temperature every 12 seconds and transmit data every 3 to 5 minutes. If a temperature change or tire pressure change of 3 psi (21 kPa) or greater is detected, the sensor breaks its regular schedule and transmits tire data immediately.

For further information on the TPMS, including operation, TPMS warnings, and proper tire removal/installation, see the Valor TPMS manual.

5.05 Collision Warning System, Eaton VORAD VS-400 (Stand Alone)

5.05.01 General Description

The Eaton VORAD VS-400 is a computerized collision warning system (CWS) that uses forward-looking radar (FLR) to monitor objects ahead, and optional side-mounted sensors to monitor objects alongside the vehicle.

The system performs in fog, rain, snow, dust, smoke, and darkness. To be detected, objects must be within the radar beam field of view and provide a surface area that can reflect back the radar beam.

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

Optional side sensors also transmit and receive radar signals, for a distance of 2 to 10 feet (0.5 to 3 meters) alongside the vehicle. The side sensor can detect unseen objects, moving or stationary, adjacent to the vehicle.

WARNING:

The Eaton VORAD VS–400 Collision Warning System (CWS) is intended solely as an aid for an alert and conscientious driver. It is not intended to be used or relied upon to operate a vehicle. Use the system in conjunction with rearview mirrors and other instrumentation to safely operate the vehicle. Operate this vehicle, equipped with the VS–400 Collision Warning System, in the same safe manner as if the VS–400 Collision Warning System were not present.

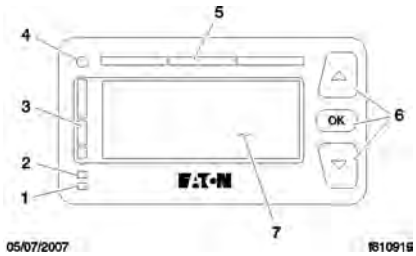
The VS–400 Collision Warning System is not a substitute for safe, normal driving procedures, nor will it compensate for any driver impairment such as drugs, alcohol, or fatigue.

The VS–400 Collision Warning System may provide little or no warning of hazards such as pedestrians, animals, oncoming vehicles, or cross traffic.

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

5.05.02 Driver Display Unit

The VORAD system controls are located in the driver interface unit (DIU). The DIU provides visual and audio warnings and messages. Menu selections are made by pressing the up, down, and OK buttons. See Fig. 95,Driver Interface Unit (DIU), VORAD.



1. Fault Indicator
2. Info Indicator
3. Following Distance Lights
4. Ambient Light Sensor
5. Collision Alert Lights
6. User Interface Keypad
7. Graphic Display

Fig 95, Driver Interface Unit (DIU), VORAD

The DIU has the following features:

- An internal speaker for audio warnings.
- Graphic display for visual warnings, menus, and other information.
- User interface keypad for scrolling up, scrolling down, and selection.
- Ambient light sensor, for auto illumination adjustment for daytime or night-time display.
- Programmable for driver ID with use of a PIN.

The following lights illuminate on the DIU to indicate a message:

- Red LED—illuminates with the collision alert display.

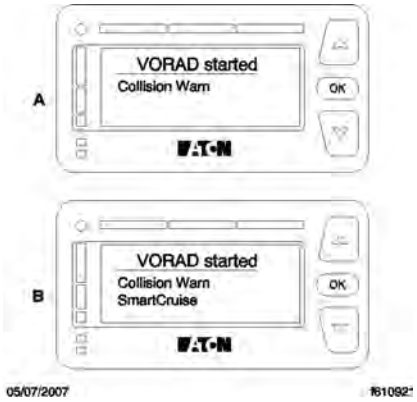
- Yellow LED—illuminates with headway alert display.
- Orange LED—illuminates when a system failure occurs.
- Blue LED—illuminates when information is available.

Immediately after each battery power-on cycle, the DIU initializes by executing self-test routines. During the initialization time, the screen, see Fig.96,Initialization Screen, VORAD is displayed and all the LED lamps are activated (power-on bulb check) for approximately 3 seconds, along with a power-up tone.



Fig 96, Initialization Screen, VORAD

When initialization is complete, the DIU displays the VS-400 system configuration screen. See Fig. 97,System Configuration Screens, VORAD the screens for the VS-400 configured for Collision Warning System (CWS) and SmartCruise™, and for CWS only.



A. Configured for CWS only

B. Configured for CWS and SmartCruise

Fig 97, System Configuration Screens, VORAD

5.05.03 Menu Selections

IMPORTANT: The display of any menu item is overridden whenever conditions require an alert warning, or collision warning, to be displayed.

After initialization, the menu screen is displayed. In this screen, the driver may scroll to the desired item by pressing an arrow button, then pressing the OK button to select the item. See Fig.98,Menu Screen, VORAD. If the driver does not make a selection within 30 seconds, or the vehicle begins to move, the DIU changes to the system status display.

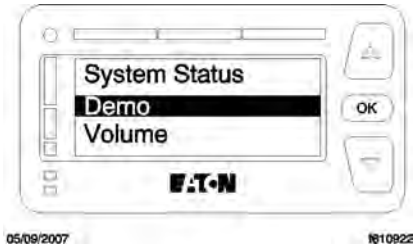


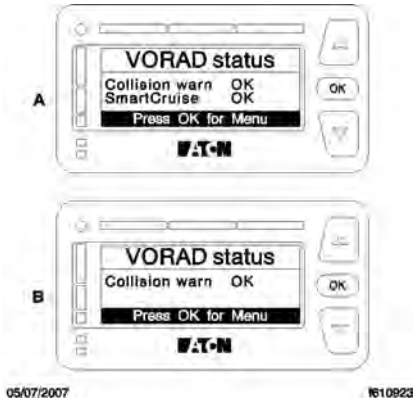
Fig 98, Menu Screen, VORAD

The DIU displays menu items when the menu mode is selected. The display of any menu item is overridden whenever conditions require an alert warning or collision warning to be displayed. The menu items are listed below.

System Status Screen

System status is displayed under normal operating conditions by scrolling to the "System Status" item and then pressing the "OK" button. This screen shows the status of each system, indicating if the system can operate normally. If a system cannot operate normally, the system displays "Failed" beside the system name rather than "OK". "Failed" means a fault is preventing the system from operating and it can not be used until the fault is corrected or acknowledged.

Depending on the VS-400 system installed, one of the following screens will appear unless a system fault is active. Pressing OK exits this menu. See Fig.99,System Status Screens.



A. Status display for CWS and SmartCruise configuration B. Status display for CWS only configuration

Fig 99, System Status Screens

Demo (vehicle must be stationary)

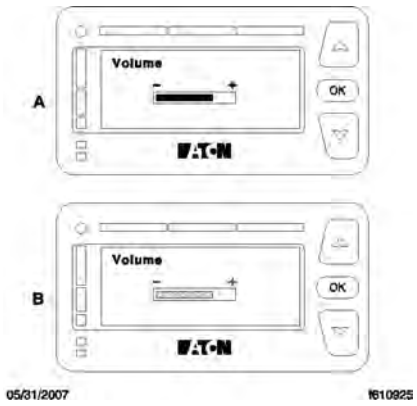
When the vehicle is stationary, and the demo mode is selected, the DIU will demonstrate the meaning of all LED and screen displays, including alert messages and sound warnings. The demo screens are scrolled through by pressing the down arrow. Pressing any other key exits the mode.

Volume

For configurations with adjustable volume, the minimum adjustable volume configuration is 50% of the maximum volume. If the DIU volume is not adjustable, the display screen shows a grayed bar graph whenever volume adjustment is selected. After each ignition switch cycle, the volume will default to 100%.

One of the screens in see Fig.100,Volume Display, VORAD is displayed when volume is selected, if conditions do not require the display of headway alerts or warnings.

NOTE: Headway alert tones (yellow LED), and collision alert tones (red LED), may be suppressed when the brake is applied, if the parameter is configured to do so.



A. Adjustable Volume B. Non-Adjustable Volume

Fig 100, Volume Display, VORAD

Brightness

The up and down arrows are used to change the brightness. This adjustment changes the warning LEDs and graphic display backlight brightness. Pressing the OK button exits this screen. See Fig..

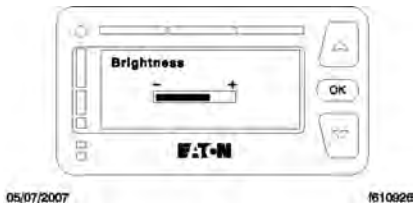


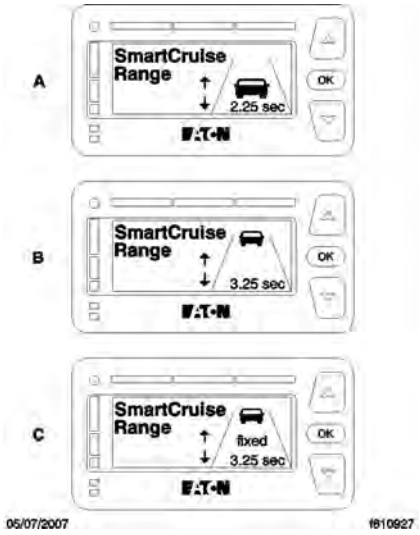
Fig 101, Brightness Screen, VORAD

The ambient light sensor reading determines if the DIU is in daytime or nighttime mode. Menu-adjusted brightness is applied only to the mode the DIU is in at the time of adjustment. The previous brightness settings are repeated after each ignition cycle. However, the graphic display and the warning LED brightness range are constrained such that they are always visible regardless of how low the brightness is adjusted in all driving conditions. Pressing the OK button exits the menu.

SmartCruise® Headway Range

Headway range adjustment is only available in the CWS with SmartCruise version of the VS-400 system, with headway range adjustment enabled. Headway range adjustment is selected from the main menu with the scroll arrow, followed by pressing the OK key to select the screen. Headway range is adjustable between 3.25 and 2.25 seconds, in 0.25 second increments, by pressing the up or down arrows. The headway range setting will default to 3.25 seconds, after each ignition power cycle.

If the headway adjust screen is selected and headway range is not enabled, then only the "3.25 sec" screen is displayed. See Fig.102,Headway Range Display, VORAD for the various headway range screens.



A. Minimum headway adjustment
B. Maximum headway adjustment
C. Headway range not enabled

Fig 102, Headway Range Display, VORAD

Pressing OK exits the menu.

If the headway range is adjusted to 3 seconds or below, and SmartCruise is active, the 3 second collision warning headway alert will not display. All other alerts are not suppressed.

KM/H MPH Screen

The up and down arrows are used to select either km/h or mph units for display of SmartCruise set speed. The previous km/h or mph setting is displayed at the next ignition cycle. See Fig.103,KM/H MPH Selection Display, VORAD.

Pressing OK exits this menu.



Fig 103, KM/H MPH Selection Display, VORAD

Diagnostics

The DIU displays fault codes currently active when this screen is selected. See Fig.104,DIU Diagnostic Display, VORAD. The vehicle must be stationary for the fault codes to display. Contact an authorized Freightliner dealer if fault codes display.



Fig 104, DIU Diagnostic Display, VORAD

5.05.04 Forward-Looking-Radar (FLR) Warning System

If the VS-400 reads any vehicle speed before the forward-looking-radar has time to warm up, a single tone will sound, and one of the following screens will display. See Fig.105,FLR Warm-Up Screens, VORAD. The FLR may require a warm-up period of up to 5 minutes in extreme cold outside temperature conditions.



A. FLR with SmartCruise B. FLR Only

Fig 105, FLR Warm-Up Screens, VORAD

The VS-400 FLR identifies and tracks the nearest object in the lane of travel. This object is classified by the range, and assigned one of the messages see Fig.106,Object Detected Alert, VORAD, see Fig.109,1-Second Alert, VORAD, see Fig. 109,1-Second Alert, VORAD, see Fig.109,1-Second Alert, VORAD, and see Fig.110,Collision Alert, VORAD, and described under the following seven headings.

The alerts given by the VS-400 system are based on the “headway” to the object ahead, whenever vehicle speed is 10 mph (16 km/h) or greater.

Object Detected

When an object is in the lane of travel, the VS-400 system displays the following message and tone. See Fig. 106,Object Detected Alert, VORAD.

- information message: OBJECT DETECTED
- tone sequence: none



Fig 106, Object Detected Alert, VORAD

3-Second Headway Alert

When a moving object is in the lane of travel, and the headway is greater than 2 seconds, up to and including 3 seconds, the DIU displays the following message. See Fig.109,1-Second Alert, VORAD.

- information message: 3 seconds
- tone sequence: none

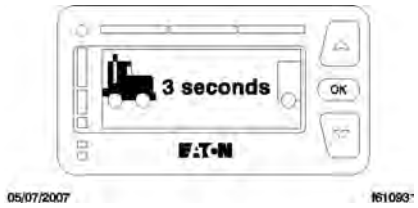


Fig 107, 3-Second Alert, VORAD

2-Second Headway Alert

When the vehicle is closing on a moving object in the lane of travel, and the headway is greater than 1 second, up to and including 2 seconds, the DIU displays the following message and tones. See Fig.109,1-Second Alert, VORAD.

- information message: 2 seconds
- tone sequence: "2-Second closing headway alert" tones are sounded. (Note: This tone sequence is not sounded if the brakes are applied.)

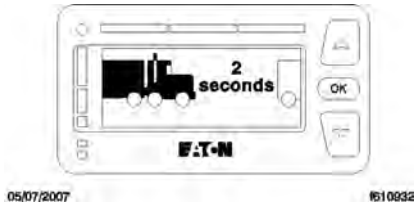


Fig 108, 2-Second Alert, VORAD

1-Second Headway Alert

When the vehicle is closing on a moving object in the lane of travel, and the headway is greater than 0.5 seconds, up to and including 1 second, the DIU displays the following message and tones. See Fig.109,1-Second Alert, VORAD.

- information message: 1 second
- tone sequence: "1-Second closing headway alert" tones are sounded. (Note: This tone sequence is not sounded if the brakes are applied.)

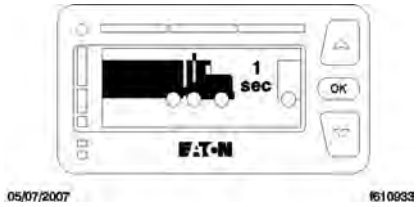


Fig 109, 1-Second Alert, VORAD

Collision Alert: ½-Second Headway

When the vehicle is closing on a moving object in the lane of travel, and the headway is 0.5 second or less, the DIU displays the following message and tones. See Fig.110,Collision Alert, VORAD.

- information message: COLLISION ALERT
- tone sequence: "½-Second closing alert" tones are sounded continuously.



Fig 110, Collision Alert, VORAD

Collision Alert: Slow Moving Object

See Fig.110,Collision Alert, VORAD. If the headway to a slow moving object is 3 seconds or less and the vehicle turn radius is 750 feet or more, the collision alert message is displayed and the "slow moving object tone" is sounded, provided:

- the vehicle speed is greater than 35 mph (56 km/h);
- the speed of the object is greater than 5 ft (1-1/2 m) per second;
- the object is in the lane of travel, and within 220 feet (67 meters) of the vehicle;
- the object speed is less than 80% of the host vehicle speed.

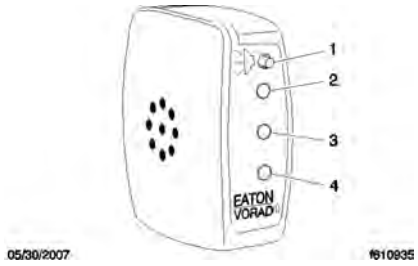
Collision Alert: Stationary Object

See Fig.110,Collision Alert, VORAD. If the headway to a stationary object is 3 seconds or less, and the vehicle turn radius is 750 feet (229 meters) or more, the collision alert message is displayed and the "stationary object tone" is sounded, provided the object is in the lane of travel, and within 220 feet (67 meters) of the vehicle.

5.05.05 Side Sensor Display

The side sensor display is mounted on the A-pillar. See Fig.111,Side Sensor Display, VORAD. The following lights illuminate.

- The red LED illuminates when an object is detected.
- The red LED illuminates and a triple tone is sounded, when objects are detected and the turn signal is activated.
- The ambient light sensor determines if the side sensor display is in daytime or nighttime mode. The display brightness is automatically adjusted for daytime or nighttime operation.
- The yellow LED illuminates when no objects are detected.
- The red and yellow LEDs illuminate together when there is a fault condition.



1. Volume Adjust
2. Red LED–Object detected
3. Ambient light sensor
4. Yellow LED–No object detected

Fig 111, Side Sensor Display, VORAD

5.05.06 Special Road Situations

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

NOTE: A warning may sound when an object is detected in front of the vehicle even though the driver intends to turn away or stop before reaching the object as follows:

- When an object is detected in a very sharp right- or left-hand turn, the audible alarm will not sound.

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

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

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

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

5.05.07 Maintenance

Keep the antenna assembly and side sensor(s) free of buildup of mud, dirt, ice, or other debris that might reduce the system's range.

5.05.08 Failure Display Mode/Fault Codes

The VS-400 performs internal diagnostics at power-up, then continuously monitors system components thereafter.

If a failure is detected, depending on what features are affected, the DIU displays a screen similar, see Fig. 112,Fault Display, VORAD, blinks the orange fault light, and sounds a tone. Press the OK button to acknowledge the fault.



Fig 112, Fault Display, VORAD

After the fault has been acknowledged by the driver pressing the OK button, the DIU will attempt to return to normal operations. The orange LED is continuously illuminated while the fault persists. If the fault disappears, the VS-400 transmits a message to indicate that the fault status has changed to a previously active fault.

In the event the FLR antennae becomes blocked while the vehicle is moving (e.g., snow, mud, ice, tampering, etc.), the system sounds a tone and displays the fault screen, see Fig.113,Antennae Blocked Display, VORAD.



Fig 113, Antennae Blocked Display, VORAD

Previously active fault codes can be reviewed, tested, and cleared using the Eaton Service Ranger diagnostic tool. Contact an authorized Freightliner dealer to review and clear previously active fault codes. See Fig.6,VORAD Fault Codes for common fault codes.

Table 6, VORAD Fault Codes

VORAD Fault Codes				
Device	**SPN**	**FMI**	**Description**	**Notes**
DIU/FLR	639	2	One or more required messages missing from datalink	—
DIU/FLR	639	9	No message being received from datalink	—
DIU/FLR	639	13	Device cannot claim source address on datalink	—
DIU/FLR	639	19	Messages received with incorrect data or marked as error	—
FLR	886	7	FLR misaligned	—
FLR	886	12	FLR internally defective	—
FLR	886	13	FLR not configured properly	—
FLR	886	14	FLR blocked	—
DIU	893	12	DIU internally defective	—
FLR	898	13	Engine not configured for SmartCruise operation	Tested only if SC configured
FLR	898	14	Engine not supported for SmartCruise operation	Tested only if SC configured
DIU/FLR	1563	13	VS-400 component detects incompatibility issue with other VS-400 devices	—

DIU	1703	3	External right speaker shorted high	Tested only if external right speaker configured
DIU	1703	4	External right speaker shorted low	Tested only if external right speaker configured
DIU	1703	5	External right speaker open	Tested only if external right speaker configured
DIU	1704	3	External left speaker shorted high	Tested only if external left speaker configured
DIU	1704	4	External left speaker shorted low	Tested only if external left speaker configured
DIU	1704	5	External left speaker open	Tested only if external left speaker configured

Table 6, VORAD Fault Codes

6.01 Ignition Switch and Key 102
6.01.01 Standard Ignition and Key 102
6.01.02 Push-Button Ignition and Smart Key Fob 102
6.01.03 Programming a New Smart Key Fob 106
6.01.04 Push-Button Ignition and Smart Key Warning Messages 107
6.02 Electrical System Controls 108
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6.02.02 Battery Disconnect Switch 108
6.03 Lighting Controls 108
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6.03.02 Headlights 108
6.03.03 High-Beam Headlights 109
6.03.04 Fog Lights 110
6.03.05 Marker Lights 111
6.03.06 Marker Interrupt 112
6.03.07 Turn Signals 113
6.03.08 Hazard Warning Lights 114
6.04 Windshield Wiper Controls 115
6.05 Cruise Control 116
6.06 Horn Controls 117
6.07 Powertrain Controls 117
6.07.01 Allison Automatic Transmissions 117
6.07.02 Tag-Axle Suspension Dump Switch 119
6.07.03 Engine Brake Switch 121
6.08 Braking Control 122
6.09 Steering Control 122
6.09.01 Standard Tilt/Telescope Steering Column 122
6.09.02 Power Tilt/Telescope Steering Column and Adjustable Pedals 123

6. Driver Controls

6.01 Ignition Switch and Key

6.01.01 Standard Ignition and Key

The ignition switch can be turned to four positions: ACCESSORY, OFF, ON, and START. See Fig. 114,Ignition Switch Positions.



Fig 114, Ignition Switch Positions

The key can be inserted and removed only in the OFF position. The headlights (low beams), brake lights, fog lights, dome lights, clearance lights, turn signals, hazard warning lights, and parking lights 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. The electric gauges will not operate when the key is in the ACCESSORY position.

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

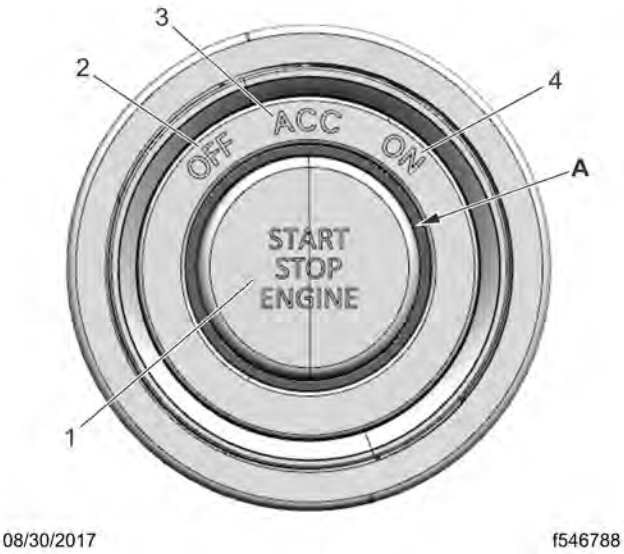
All electrical systems are operable in the ON position. The warning lights and the buzzer for low air pressure and low oil pressure operate until minimum pressures are built up.

6.01.02 Push-Button Ignition and Smart Key Fob

IMPORTANT: If equipped with the 'Welcome Feature,' leaving the smart key fob close to the push-button ignition can lead to battery depletion of the smart key fob. Do not leave the smart key fob near the ignition for long periods of time.

Depending on the body builder and dealer, the push-button ignition may be programmed with a 'Welcome Feature'. This allows the push-button ignition to illuminate—even in the OFF position—when the smart key fob is within approximately 4 to 5 ft (1 to 2 m).

The push-button ignition switch has four positions. See Fig.115,Push-Button Ignition.



A. Blue illumination notifies the driver that the engine is running.
1. Start/Stop Engine Button
2. Off
3. Accessory
4. On

Fig 115, Push-Button Ignition

Starting the Engine

To start the engine, depress the brake pedal and press the START/STOP ENGINE button with the transmission shifter in neutral (N). If the wait to start lamp is active, a second button press is required to start the engine.

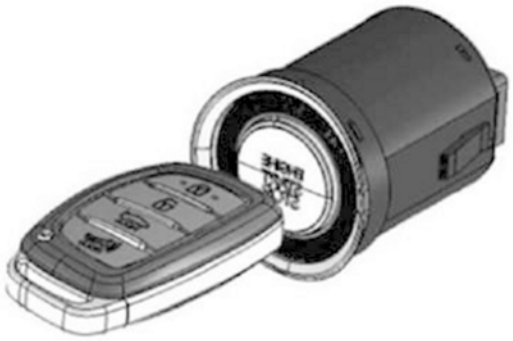
If the START/STOP ENGINE button is pressed without depressing the brake pedal, the engine will not start and the button will change as follows: **OFF → ACC → ON → OFF**

Alternate Starting Method

The primary starting sequence will not operate as previously described when any of the following conditions are true:

- The smart key fob battery is dead.
- The smart key fob is not working correctly.
- The primary brake air tank is empty.

During these conditions, an alternate starting method is required. Use the lock button end of the smart key fob to contact the START/STOP ENGINE button directly. See Fig.116,Alternate Starting Method.



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NOTE: Place the lock button end of the smart key fob directly on the START/STOP ENGINE button.

Fig 116, Alternate Starting Method

One press of the START/STOP ENGINE button with the smart key fob will change as follows: **OFF → ACC → ON → OFF**

IMPORTANT: In the alternate starting method, the engine will start without depressing the brake pedal, however for safety, always depress the brake pedal before starting the engine.

The engine will start when the smart key fob is pressed and held directly on the START/STOP ENGINE button for longer than 1 second.

Accessory (ACC)

NOTE: If the START/STOP ENGINE button is in the ACC position for an extended period of time, the battery may discharge because the engine is not running.

To activate the accessory position, press the START/STOP ENGINE button while the ignition is in the OFF position without depressing the brake pedal. The ACC indicator remains illuminated until the ignition switch moves to the next position.

The headlights (low beams), brake lights, fog lights, dome lights, clearance lights, turn signals, hazard warning lights, and parking lights operate in the ACC position.

ON

NOTE: If the START/STOP ENGINE button is in the ON position for an extended period of time, the battery will discharge because the engine is not running.

To activate the ON position do one of the following:

- Press and hold the START/STOP ENGINE button for more than 1 second while the ignition is in the OFF position without depressing the brake pedal.
- Press the START/STOP ENGINE button while the ignition is in the ACC position without depressing the brake pedal.

The ON indicator remains illuminated until the ignition switch moves to the next position. 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.

OFF

IMPORTANT: Leaving the smart key fob close to the push-button ignition can lead to battery depletion of the smart key fob. Do not leave the smart key fob near the ignition for long periods of time.

To turn off the engine or the vehicle power, press the START/STOP ENGINE button when the vehicle is not in motion. The OFF indicator illuminates for 5 seconds, then deactivates.

All of the components (headlights [low beams], brake lights, fog lights, etc.) that are operable in the ACC position are operable in the OFF position.

IMPORTANT: In an emergency situation while the vehicle is in motion (the engine is running and vehicle speed is more than 3 mph[5 km/h]),the driver can turn the ignition OFF by holding the START/STOP ENGINE button for more than 3 seconds.

Smart Key Fob Control Buttons

NOTE: The smart key fob buttons are operational only when the system is in ACC or OFF modes.

The following is a description of the smart key fob control buttons. For an example of the control buttons, see Fig. 117,Smart Key Fob Control Buttons, Typical.

- One press of the front entry door lock button commands the system to lock the front entry door.
- One press of the front entry door unlock button commands the system to unlock the front entry door.
- One press of the cargo doors lock button commands the system to lock the cargo doors.
- One press of the cargo doors unlock button commands the system to unlock the cargo doors.



NOTE: The function of the smart key fob control buttons can be different for each bodybuilder. The description of the smart key fob control buttons is for a typical fob.

1. Front Entry Door Lock Button
2. Front Entry Door Unlock Button
3. Cargo Doors Lock Button
4. Cargo Doors Unlock Button

Fig 117, Smart Key Fob Control Buttons, Typical

Smart Key Fob Range

The operational range of the smart key fob is affected by the location of the key fob and any metal structure that may prohibit the signal. The smart key fob operates up to the distances shown below, when measured from the center of a given location outward without any object between the smart key fob and the vehicle.

- in front of the vehicle–125 ft (38 m)
- either side of the vehicle–75 ft (23 m)
- behind the vehicle–10 ft (3 m)

Smart Key Fob Interference



NOTICE:

The smart key fob is not completely waterproof. Avoid submerging the smart key fob in water, otherwise damage could occur.

Operational interference of the smart key fob can occur when used near radio transmitting devices such as a radio station, airport, mobile two-way radio system, cell phone or smart phone, or when another vehicle's smart key fob is being operated. Extreme temperatures, either low or high, can also cause operational interference.

If the smart key fob is in close proximity to a cell phone or smart phone, such as a pants or jacket pocket, the signal from the smart key fob could be blocked. This is especially important when the phone is active—making or receiving calls, text messaging, and sending or receiving email. Keep the two devices in separate locations to avoid any interference.

6.01.03 Programming a New Smart Key Fob

NOTE: A maximum of two smart key fobs can be programmed for a vehicle. In the event that all registered smart key fobs are not available or are damaged, the dealership must perform a service routine to program a new smart key fob.

In order to program a new smart key fob for the vehicle, the ignition must be in the ON position, vehicle speed must be under 3 mph (5 km/h), and at least one registered smart key fob (for that vehicle) must be available. Follow the steps below to program the new smart key fob.

1. Activate the vehicle ignition system. See the "ON" section under the "Push-Button Ignition and Smart Key Fob" heading.
2. Using the instrument cluster, navigate to the 'Vehicle Configuration' menu. Enable fob programming in this menu. For navigation instructions, see 3.01.01 General Description or 4.01.01 General Information as applicable to the instrument cluster installed in the vehicle.

   NOTE: Do not depress the service brake pedal when performing the next two steps.

3. Press and hold the front entry door lock button (approximately three seconds) of the registered smart key fob until the instrument cluster displays 'Programming Mode Active'.
4. Press and hold the front entry door lock button (approximately three seconds) of the unregistered (new) smart key fob until the instrument cluster chimes once. The new smart key fob is now registered to the vehicle.
5. Press the service brake pedal or the START/STOP ENGINE button once to exit programming mode.

6.01.04 Push-Button Ignition and Smart Key Warning Messages

Warning messages related to the push-button ignition and smart key fob will appear in the display screen of the instrument cluster. The following is a description of the various messages that could appear.

Check Fob

When the ignition is active and the smart key fob is not within range of the start authorization antenna, the instrument cluster will display 'Check Fob'. This alerts the driver that the smart key is not recognized by the system or is not within a 4 to 5 ft (1 to 2 m) range of the antenna.

NOTE: This message only appears when the vehicle is traveling at 20 mph (32 km/h) or less.

Press Brake to Start

When the ignition is active, the smart key fob is within range of the start authorization antenna, the engine is not running, the service brake pedal is not depressed, and the START/STOP ENGINE button is pressed for more than 1 second, 'Press Brake to Start' will display in the instrument cluster. This alerts the driver of the action required to start the vehicle.

The driver must release the START/STOP ENGINE button and depress the service brake pedal before pressing the START/STOP ENGINE button again to start the vehicle.

Check Battery

When the ignition is active and the smart key fob battery is between 1 to 2.15V, the instrument cluster will display 'Check Battery.' This alerts the driver that the smart key fob battery needs to be replaced.



NOTICE:

When replacing the battery, be aware that static electricity can damage the inner circuit of the smart key fob.

Operational interference of the smart key fob can occur from the use of incorrect batteries. When replacing the battery, use only battery type CR2032. Once the battery is replaced, check the smart key fob for proper operation.

Press Button With Fob

When the ignition is active, the smart key fob is within range of the start authorization antenna, the engine is not running, the service brake pedal is depressed, and the START/STOP ENGINE button is pressed for more than 1 second, 'Press Button w/Fob' will display in the instrument cluster. This alerts the driver of the action required to start the vehicle. See 'Alternate Starting Method' for instructions.

Programming Mode Active

When the ignition is active and the keyless module is in programming mode, the instrument cluster will display 'Programming Mode Active'. This alerts the driver that the system is ready to program a new smart key fob. See 'Programming a New Smart Key Fob' for instructions.

6.02 Electrical System Controls

6.02.01 General Information

Servicing the electrical system requires special skills and equipment, and should only be performed by a qualified technician. Take the vehicle to an authorized Freightliner dealer when service is needed.

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.

Battery Disconnect Switch

6.02.02 Battery Disconnect Switch

IMPORTANT: When the batteries are disconnected (disconnect switch is turned to OFF), the cable to the starter is still hot, as it is not connected through the disconnect switch.

Some chassis may be equipped with a battery disconnect switch that can be used to prevent unwanted drain from the vehicle battery when the vehicle is not in use or is in storage. It can also rapidly disconnect the power supply in the event of an emergency. Mounting locations vary. See Fig.118,Battery Disconnect Switch.



Fig 118, Battery Disconnect Switch

6.03 Lighting Controls

6.03.01 Automatic Ambient Headlight Sensor

IMPORTANT: This optional feature only activates or deactivates the panel lights, headlights and taillights; there is no high-beam headlight sensing function.

The ambient sensor activates the panel lights, headlights and taillights when the brightness of the ambient light drops below a preset value for three seconds. Once activated, these lights remain on and require either a headlight switch cycle (Off/On/Off), or turning the ignition to the OFF position to deactivate them.

6.03.02 Headlights

The headlight switch is a rotary switch located to the left of the steering column. See Fig.119,Headlight Switch.



NOTE: Some vehicles may be equipped with a rocker switch to activate the fog lights. If so equipped, the rocker switch is installed by the body builder and the location will vary.

1. Fog Lights—Activate by pulling the switch out when the marker lights or headlights are on.
2. Automatic Headlights (optional)
3. Off
4. Marker Lights
5. Headlights

Fig 119, Headlight Switch

The headlights automatically turn on if the windshield wipers are on. The headlights can be deactivated by:

- switching the windshield wipers off;
- cycle the headlight switch (Off/On/Off);
- turn the ignition to the OFF position.

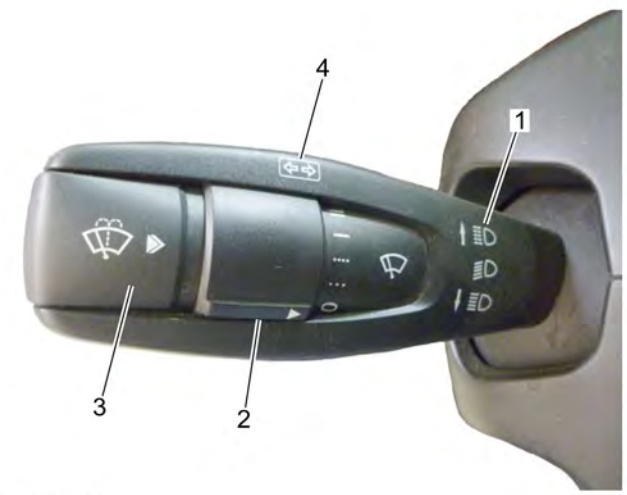
6.03.03 High-Beam Headlights

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

With the low-beam headlights on, push the turn-signal lever away from you to turn on the high-beam headlights. See Fig. 120,Steering Column-Mounted Turn Signal Lever. To turn off the high-beam headlights, pull the lever to the middle position.

With the low-beam headlights on, pull the lever towards you to flash the high-beam headlights momentarily.

When the high-beam headlights are on, a blue telltale illuminates on the instrument cluster.



1. Headlight Control Symbols
2. Windshield Wiper Switch
3. Windshield Washer Switch
4. Turn Signal Symbol

Fig 120, Steering Column-Mounted Turn Signal Lever

6.03.04 Fog Lights

NOTE: Some vehicles may be equipped with a rocker switch to activate the fog lights. If so equipped, the rocker switch is installed by the body builder and the location will vary.

To activate the fog lights, do one of the following based on the vehicle controls:

- Pull the rotary switch out when the marker lights or headlights are on. See Fig.121,Headlight Switch.
- Push the rocker switch (not shown).



NOTE: Some vehicles may be equipped with a rocker switch to activate the fog lights. If so equipped, the rocker switch is installed by the body builder and the location will vary.

1. Fog Lights—Activate by pulling the switch out when the marker lights or headlights are on.
2. Automatic Headlights (optional)
3. Off
4. Marker Lights
5. Headlights

Fig 121, Headlight Switch

6.03.05 Marker Lights

To turn the marker lights on, turn the headlight switch clockwise past the off position. See Fig.122,Headlight Switch.



NOTE: Some vehicles may be equipped with a rocker switch to activate the fog lights. If so equipped, the rocker switch is installed by the body builder and the location will vary.

1. Fog Lights—Activate by pulling the switch out when the marker lights or headlights are on.
2. Automatic Headlights (optional)
3. Off
4. Marker Lights
5. Headlights

Fig 122, Headlight Switch

6.03.06 Marker Interrupt

The marker interrupt switch, located in the right-hand switch pod of the steering wheel, temporarily flashes the marker lights. See Fig.123,Steering-Wheel-Mounted Switches.



1. Cruise Accelerate/Resume
2. Marker Interrupt
3. Cruise Decelerate/Set
4. Phone Hang-Up/Reject
5. Mute Button
6. Phone Pick-Up
7. Cruise On/Off
8. Cruise Cancel
9. Volume Increment Up
10. Back Button
11. Volume Increment Down
12. Down Arrow
13. Menu Cycle
14. Home Button
15. OK Button
16. Up Arrow

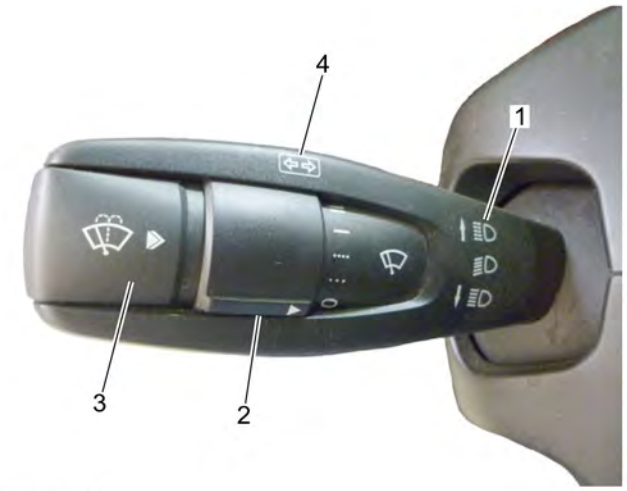
Fig 123, Steering-Wheel-Mounted Switches

6.03.07 Turn Signals

The turn signal lever is mounted on the left-hand side of the steering column. Moving the turn signal lever down activates the left turn signal lights; moving it up activates the right turn signal lights. The lever is a self-canceling combination turn signal, windshield wiper/washer switch, and high-beam headlight control unit. See Fig. 124,Steering Column-Mounted Turn Signal Lever.

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.



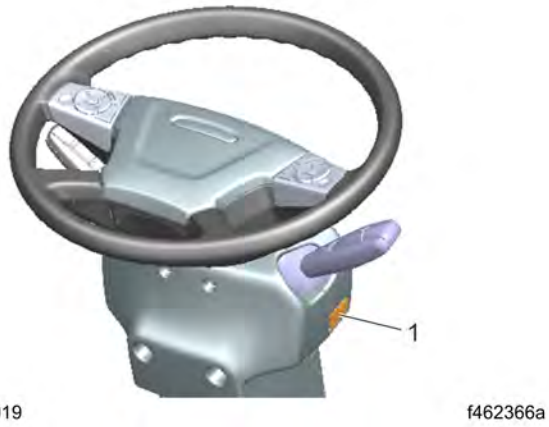
1. Headlight Control Symbols
2. Windshield Wiper Switch
3. Windshield Washer Switch
4. Turn Signal Symbol

Fig 124, Steering Column-Mounted Turn Signal Lever

6.03.08 Hazard Warning Lights

To activate the hazard warning lights, push the hazard warning light switch on the right side of the steering column. See Fig. 125,Hazard Warning Light Switch. When the hazard warning lights are activated, all of the turn signal lights and both of the turn signal indicator lights on the instrument panel will flash.

To cancel the warning lights, push the switch in on the right side of the steering column.



1. Hazard Warning Light Switch

Fig 125, Hazard Warning Light Switch

6.04 Windshield Wiper Controls

NOTICE:

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

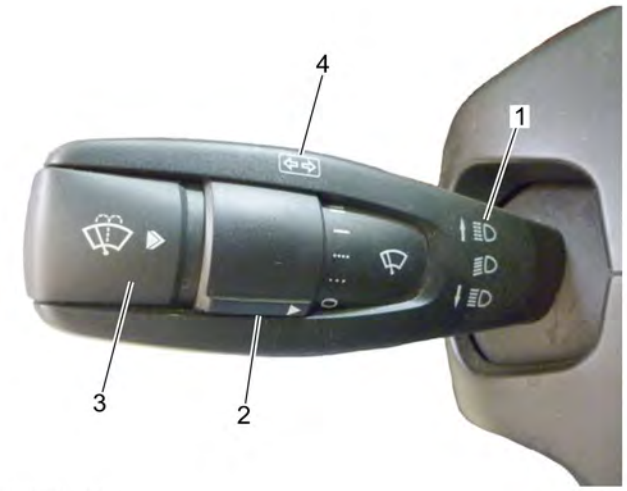
The windshield wipers and washer controls are on the multi-function turn signal lever on the left-hand side of the steering column. See Fig.126,Steering Column-Mounted Turn Signal Lever.

The wipers are operated by a rotary switch on the turn signal lever. There are five settings, marked on the dial by symbols for off, two intermittent settings, and two continuous speeds.

Turn the wipers on by rotating the rotary switch up. Rotate the switch further to increase the speed of the wipers through the two intermittent settings, then to low and high speeds. Rotate the switch down to slow the wipers down. Rotate the switch as far down as it will go to turn the wipers off.

The windshield washer button is located at the end of the turn signal lever. Momentarily press the windshield washer button to initiate a single wipe without activating the washer pump. The wipers will swipe one full cycle and return to the inactive position.

To operate the windshield washers, press and hold the button in. After a short delay, the washer will pump windshield washer fluid onto the windshield for as long as the washer button is pressed. The windshield wipers will turn on at low speed while the washer button is pressed. After the button is released, the wipers will continue to operate for one to several wipe cycles, depending on how long the wash button was pressed initially.



1. Headlight Control Symbols
2. Windshield Wiper Switch
3. Windshield Washer Switch
4. Turn Signal Symbol

Fig 126, Steering Column-Mounted Turn Signal Lever

6.05 Cruise Control

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

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

Cruise control allows the driver to automatically control the speed of the vehicle above 32 mph (51 km/h). The buttons that operate the cruise control system are located on the right-hand switch pod of the steering wheel. See Fig. 127,Steering-Wheel-Mounted Switches.

- Cruise On/Off Button—Press to turn cruise control on or off. When cruise control is on, the ICU message center displays relevant cruise control icons and the set speed. The speed memory will be retained until the cruise control is disabled with the on/off button, or the ignition is turned off.
- Cruise Accelerate/RES Button—Press and hold to increase the set cruise speed. Press to resume the set speed.
- CNCL Button—Press to pause the cruise control, while retaining the speed setting in memory. The cruise control can also be disengaged, while retaining the speed memory, by depressing the brake pedal.
- Cruise Decelerate/SET Button—Press to set the cruise speed while the vehicle is traveling at the desired speed. Press and hold to decrease the set cruise speed.

1. To cruise at a particular speed:
   1.a Press the on/off button to turn cruise control on.
   1.b Depress the accelerator pedal until the speedometer reaches the desired speed.

   NOTE: Cruise control is cancelled if the brake pedal is depressed, or vehicle speed drops below the minimum cruise control speed.

   1.c Press the cruise decelerate/SET button to set the desired speed.

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

2. To disengage the cruise control, do one of the following:
   - Press the CNCL button in the center of the right-hand control pod.
   - Depress the brake pedal.
3. To resume a preselected cruise speed:
   3.a Ensure cruise control is on.
   3.b Press the cruise accelerate/RES button. Cruise will return to the last set speed.

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

4. To increase cruise speed, press the cruise accelerate/RES button until the vehicle accelerates to the desired speed.
5. To decrease cruise speed, press the cruise decelerate/SET button until the vehicle decelerates to the desired speed.



1. Cruise Accelerate/Resume
2. Marker Interrupt
3. Cruise Decelerate/Set
4. Phone Hang-Up/Reject
5. Mute Button
6. Phone Pick-Up
7. Cruise On/Off
8. Cruise Cancel
9. Volume Increment Up
10. Back Button
11. Volume Increment Down
12. Down Arrow
13. Menu Cycle
14. Home Button
15. OK Button
16. Up Arrow

Fig 127, Steering-Wheel-Mounted Switches

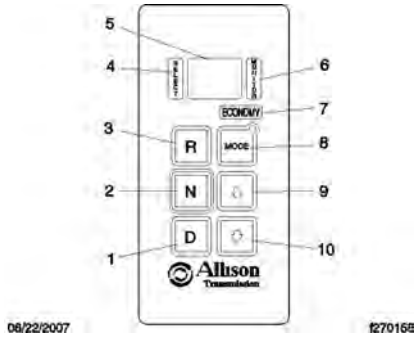
6.06 Horn Controls

The button for the horn is located in the center of steering wheel. To sound the horn, press the center of the steering wheel pad.

6.07 Powertrain Controls

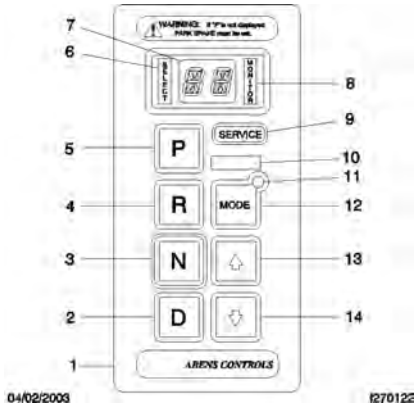
6.07.01 Allison Automatic Transmissions

Allison automatic transmissions are controlled by one of the following shift controls depending on what is installed in the vehicle. See Fig.128,GEN IV Shift Selector, see Fig.129,Shift-By-Wire (SBW) Shift Selector and see Fig. 130,Automated/Automatic Transmission Multifunction Control. For vehicles equipped with the automatic transmission multifunction control, shown in Fig.130,Automated/Automatic Transmission Multifunction Control, the control moves in two directions and has two switches. It is used to request manual shifts, change shift mode, set engine brake levels, and control specialty engine brake functions. See 9.01 Driving Precautions for complete transmission operating instructions.



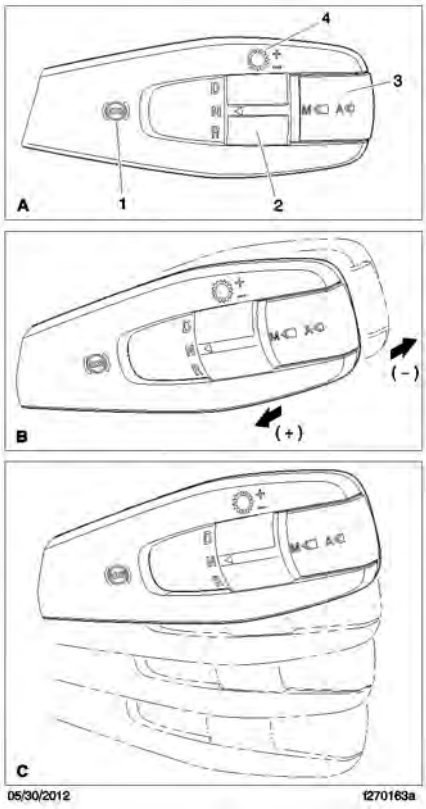
1. Drive (D) Button
2. Neutral (N) Button
3. Reverse (R) Button
4. Select Display
5. Select/Monitor Display Window
6. Monitor Display
7. Service Display
8. Mode Button
9. Upshift Button
10. Downshift Button

Fig 128, GEN IV Shift Selector



1. SBW Shift Selector
2. Drive (D) Button
3. Neutral (N) Button
4. Reverse (R) Button
5. Park (P) Button
6. Select Display
7. Select/Monitor Display Window
8. Monitor Display
9. Service Display
10. Mode Function Label
11. Mode Light
12. Mode Button
13. Upshift Button
14. Downshift Button

Fig 129, Shift-By-Wire (SBW) Shift Selector



A. Front View
B. Shift Up/Down Requests
C. Four positions for engine brake settings
1. Engine Brake Symbol
2. Drive/Neutral/Reverse Switch
3. Shift Mode Switch (Economy/Performance/Manual)
4. Gear Shift Symbol

Fig 130, Automated/Automatic Transmission Multifunction Control

6.07.02 Tag-Axle Suspension Dump Switch

The optional tag-axle suspension is a non-liftable, full-time suspension designed to increase the Gross Vehicle Weight Rating (GVWR). It is used when the rear suspension/axle will be loaded to a weight greater than 20,000 lb (9072 kg). Under certain conditions, air can be exhausted from the air springs to improve maneuverability or traction on the drive axle via the tag-axle suspension dump switch.

The tag-axle suspension dump switch is operated by a three-position, dash-mounted rocker switch. See Fig.. The three positions of the switch operate as follows:

- TAG DUMP AUTO (top position)—The tag axle air bags dump when the vehicle is in reverse.
- DISABLE (middle position)—The tag axle air bags will not dump.
- MANUAL (bottom position)—Pressing the MANUAL switch dumps the tag axle air bags if the transmission is in drive and vehicle speed is 8 mph (13 km/h) or less. Pressing the MANUAL switch a second time changes the air bag mode from dump to fill.



Fig 131, Tag-Axle Suspension Dump Switch

WARNING:
If the vehicle is equipped with an air suspension system, do not move the vehicle with the air suspension deflated. Doing so could result in a loss of vehicle control, possibly causing personal injury and property damage.

NOTE: Chassis built with an air suspension dump option have an automatic feature that does not allow the suspension to be deflated unless the parking brake is set. The suspension automatically inflates when the parking brake is released.

Tag-Axle Suspension—Dump Only

In the TAG DUMP AUTO mode, the axle air bags will deflate when **all** of the following conditions are met. If any of these conditions are not met, the tag-axle air bags will fill:

- The tag-axle suspension dump switch is momentarily pressed to toggle the tag-axle control module into the dump mode.
- The vehicle speed is less than 8 mph (13 km/h).
- The vehicle is in neutral or a forward gear.

If the vehicle exceeds a speed of 8 mph (13 km/h) while the switch is in the TAG DUMP AUTO position, the tag axle suspension dump switch control system will override the TAG DUMP AUTO mode and the tag suspension air bags will refill.

IMPORTANT: The tag-axle suspension dump switch feature must be cycled on and off of the TAG DUMP AUTO position if an override event occurs while the switch is in the TAG DUMP AUTO position.

In the MANUAL mode, the axle air bags will deflate when **all** of the following conditions are met. If any of these conditions are not met, the tag-axle air bags will fill:

- The tag-axle suspension dump switch remains in the MANUAL mode (reverse maintained position).
- The vehicle speed is less than 8 mph (13 km/h).
- The MANUAL mode portion of the switch is pressed a second time to exit MANUAL mode.

Tag-Axle Suspension—Dump and Tag Wheel Steering

IMPORTANT: Before backing up the vehicle, confirm that the tag-axle is locked in the straight ahead position. The vehicle may need to be pulled forward in order to achieve a straight ahead position with the tag-axle.

The tag-axle will be locked in an unsteerable position when **any** of the following conditions are met:

- The vehicle is in reverse.
- The vehicle speed exceeds 20 mph (32 km/h) while accelerating or exceeds 15 mph (24 km/h) while decelerating.

The tag-axle will be unlocked and steerable when **all** of the following conditions are met:

- The vehicle is in a forward gear.
- The vehicle speed is less than 20 mph (32 km/h) while accelerating or less than 15 mph (24 km/h) while decelerating.

6.07.03 Engine Brake Switch

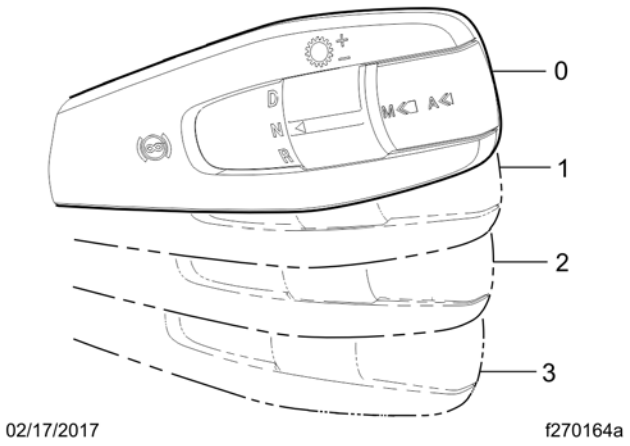
NOTE: See 10.01 Power Steering System for detailed information about engine brake operation.

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

The engine brake control is located on the right-hand steering-column-mounted lever. At the top position, the engine brake is off, and at the three lower positions, the brake is on and the intensity (low, medium, high) increases with each step down. See Fig.132,Engine Brake Positions.

IMPORTANT: On some vehicles, the engine brake only has off and high intensity options.

NOTE: The cruise control system and safety systems may activate the engine brake regardless of the lever position.



NOTE: On some vehicles, the engine brake only has off and high intensity options.

1. Off
2. Low
3. Medium
4. High

Fig 132, Engine Brake Positions

6.08 Braking Control

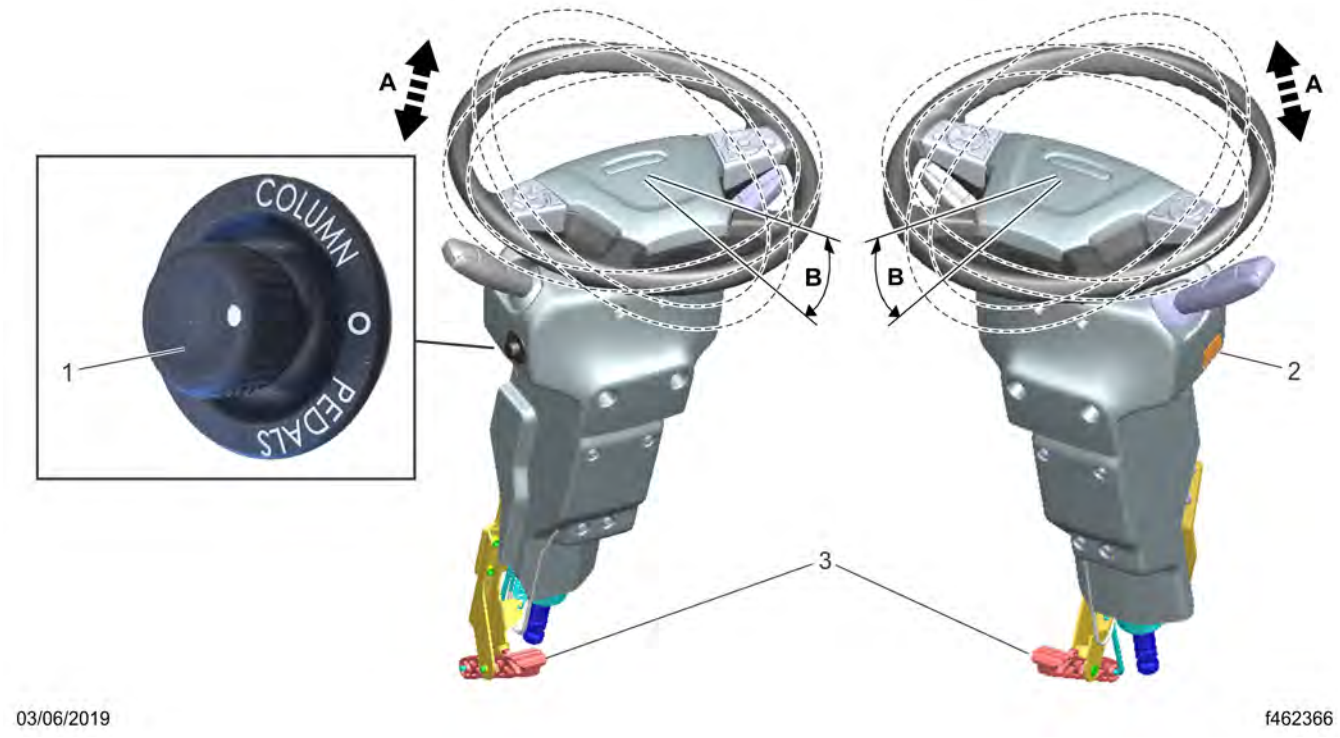
6.09 Steering Control

6.09.01 Standard Tilt/Telescope Steering Column

WARNING:
Never try to tilt or telescope the steering column while driving the vehicle. Doing so could cause loss of vehicle control and result in personal injury, or death, or property damage.

To tilt the steering column or telescope the steering wheel, press down on the foot pedal (located below the steering wheel) to release the steering column lock. Adjust the column and steering wheel to the desired position. Release the foot pedal to lock the steering column and steering wheel in place. See Fig.133,Tilt/Telescope Steering Column.

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



NOTE: Some steering columns are equipped with the toggle switch but it only adjusts the brake and throttle pedals. Use the foot pedal on these vehicles to tilt and telescope the steering wheel.

A. Telescope
B. Tilt
1. Steering Column and Pedal Toggle Switch
2. Hazard Warning Light Switch
3. Foot Pedal (standard column only)

Fig 133, Tilt/Telescope Steering Column

6.09.02 Power Tilt/Telescope Steering Column and Adjustable Pedals

WARNING:
Never try to tilt or telescope the steering column while driving the vehicle. Doing so could cause loss of vehicle control and result in personal injury, or death, or property damage.

Power tilt/telescope steering columns have a toggle switch on the left side of the steering column.

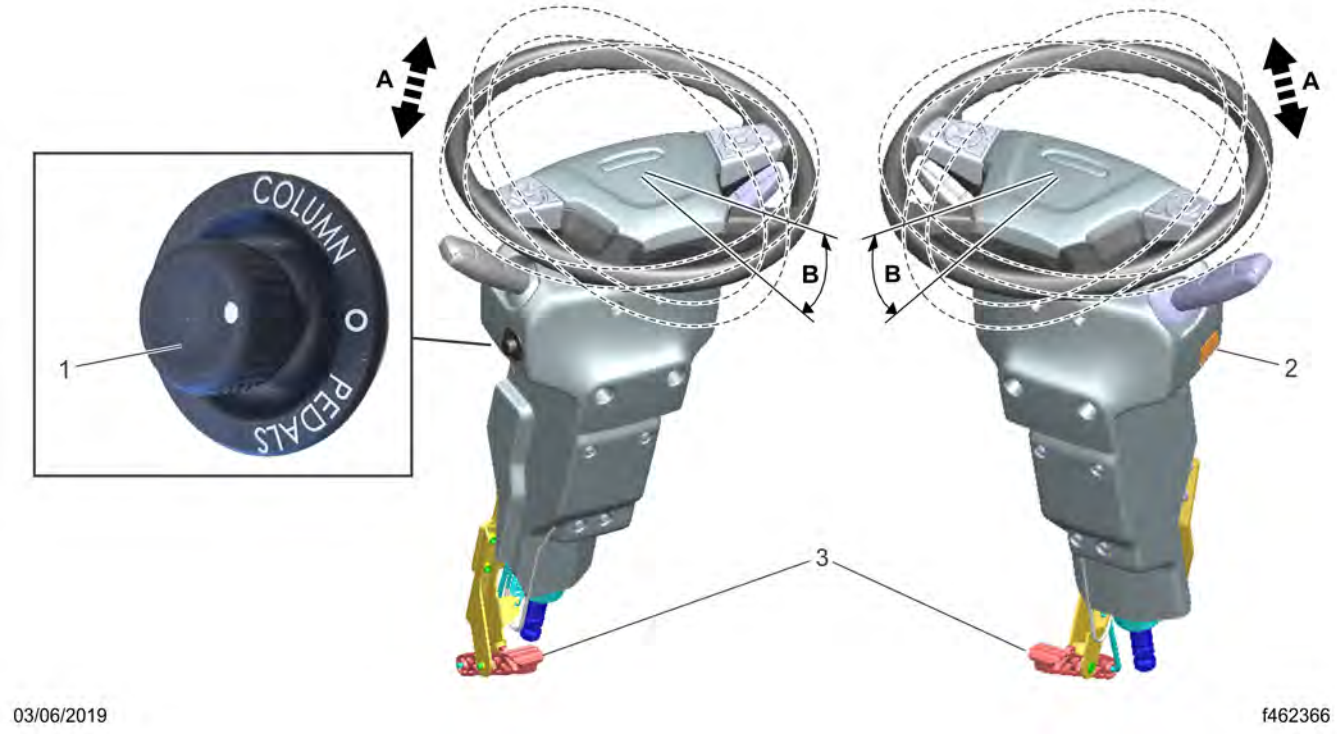
To tilt the steering column and telescope the steering wheel, rotate the toggle switch on the left-side of the steering column to the 'column' position. See Fig.134,Tilt/Telescope Steering Column. Push the toggle switch up or down to adjust the column to the desired height. Push the switch back toward the dash and the steering wheel goes in; pull the switch toward the driver and the steering wheel comes out. Once the column and steering wheel are at the desired position, rotate the toggle switch to the middle (off) position.

NOTE: Both the brake and throttle pedal position are adjusted at the same time.

Some steering columns are equipped with the toggle switch but it only adjusts the brake and throttle pedals. Use the foot pedal on these vehicles to tilt and telescope the steering wheel.

WARNING:
Never try to adjust the brake or throttle pedal position while driving the vehicle. Doing so could cause loss of vehicle control and result in personal injury, or death, or property damage.

To adjust the position of the brake and throttle pedals, rotate the toggle switch on the left-side of the steering column to the 'pedals' position. See Fig.134,Tilt/Telescope Steering Column. Push the toggle switch toward the dash to move the pedals back or pull the toggle switch toward the driver to move the pedals forward. Once the pedals are at the desired position, rotate the toggle switch to the middle (off) position.



NOTE: Some steering columns are equipped with the toggle switch but it only adjusts the brake and throttle pedals. Use the foot pedal on these vehicles to tilt and telescope the steering wheel.

A. Telescope
B. Tilt
1. Steering Column and Pedal Toggle Switch
2. Hazard Warning Light Switch
3. Foot Pedal (standard column only)

Fig 134, Tilt/Telescope Steering Column

NOTE: For safety, the steering column and pedal toggle switch should be in the middle (off) position unless the vehicle transmission is in park (P).

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7. Engines

7.01 Engine Starting

7.01.01 General Information

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

NOTE: Before starting the engine, see 5.01.01 General Description and 6.01.01 Standard Ignition and Key of this manual for detailed information on how to read the instruments and operate the controls.

For Cummins engine service literature, refer to the *Cummins Online* website at https://www.cummins.com/support/manuals or scan the QR code. See Fig.135,Cummins QR Code. For Detroit™ engine service literature, refer to the *Detroit Diesel* link on the DTNA TechLit website https://www.dtnatechlit.com/portal-public or scan the QR code. See Fig.136,TechLit QR Code.



Fig 135, Cummins QR Code



Fig 136, TechLit QR Code

7.01.02 Normal Starting

WARNING:
Do not use any starting aid, such as ether, in engines with an air intake heater. This could cause an explosion and serious personal injury or death.

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

IMPORTANT: Special break-in oils are not recommended for new or rebuilt Cummins engines.

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.

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

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.

NOTICE:

If the engine is equipped with a turbocharger, protect the turbocharger during start-up by not depressing the accelerator pedal until normal engine idle oil pressure registers on the gauge.

1. Before engine start-up, complete the pre- and post-trip inspections and maintenance procedures, see 13.01 Safety Precautions.
2. Set the parking brake.
3. Place the transmission in neutral.
4. Turn the key to the ON position and allow the gauge sweep to complete. The audible alert will sound for approximately four seconds.

   During cold conditions, the WAIT TO START lamp may illuminate. Wait until the lamp goes out before turning the key to START.
5. After the gauge sweep has completed, turn the key to the START position.

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

6. Apply load gradually during the warm-up period.

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

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

7.01.03 Cold-Weather Starting

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

If the unit is equipped with a block heater, start the block heater two to four hours before travel.

7.01.04 Starting After Extended Shutdown

Before engine start-up, complete the pretrip inspections and maintenance procedures, see 13.01 Safety Precautions.

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

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

7.02 Engine Operation

7.02.01 General Operation

A Top Tier™ compliant fuel is recommended. Look for the symbol that denotes a Top Tier compliant fuel; see Fig. 137,Top Tier Fuel Symbol.



Fig 137, Top Tier Fuel Symbol

7.02.02 Normal Operation

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

Engines produce high horsepower and peak torque characteristics at low rpm. Because of this, it is not necessary to operate the engine at high rpm to deliver the required horsepower at the wheels. These characteristics may also result in less shifting and make shifting at lower rpm (to peak torque) more practical.

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. 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.

When approaching a hill, accelerate smoothly to start the upgrade at full power (2000 rpm or higher is recommended), then shift down as desired to maintain the optimum vehicle speed.

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.

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

The engine is effective as a brake on downhill grades, but take care not to overspeed the engine going downhill. 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.

7.02.03 Cold-Weather Operation

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

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

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

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

- Check for cracks in the battery cases, for corrosion of the terminals, and for tightness of the cable clamps at the terminals.
- Charge the batteries to full capacity. Replace damaged batteries.
- If equipped, turn off the battery disconnect switch after the engine is shut down to prevent battery discharge.
- Have the alternator output checked at an authorized Freightliner dealer.
- Check the condition and tension of the drive belts.
- Refer to the engine manufacturer's operation manual for recommended heaters, low-viscosity lubricating oils, winter-grade fuels, and approved coolants. Coolant used must be compatible with the engine manufacturer’s coolant specifications. For Cummins approved lubricants and coolants, refer to the *Cummins Online* website at https://www.cummins.com/support/manuals or scan the QR code. See Fig.135,Cummins QR Code. For Detroit™ engine service literature, refer to the *Detroit Diesel* link on the DTNA TechLit website https://www.dtnatechlit.com/portal-public or scan the QR code. See Fig.136,TechLit QR Code.
- Periodically check the coolant mix ratio (concentration of antifreeze in the coolant). Add more if necessary.
- At temperatures below -4°F (-20°C), a coolant preheater is recommended.

7.02.04 High-Altitude Operation

Engines lose horsepower when operated at high altitude because the air is too thin to burn as much fuel as at sea level. Most turbocharged engines are rated for higher altitudes than naturally aspirated engines. An engine will have smoky exhaust at high altitudes unless a lower gear is used. Shift gears as needed to avoid excessive exhaust smoke.

7.03 Exhaust Brake

IMPORTANT: The exhaust brake is a vehicle slowing device, not a vehicle stopping device. It is not a substitute for the vehicle service brakes. Use of the exhaust brake for vehicle downhill control and slowing down on level terrain will allow the service brakes to remain cool and ready for an emergency.



WARNING:

Do not use the exhaust brake if road surfaces are slippery. Using the exhaust brake on wet, icy, or snow-covered roads could result in loss of vehicle control, possibly causing personal injury or death, or property damage.

The exhaust brake is activated when the following conditions are satisfied.

1. The ON/OFF switch is in the ON position.
2. The accelerator pedal is not depressed.

   The Allison transmission provides for optimum retarding by downshifting when the exhaust brake is selected. When the switch is turned ON and the driver's foot is removed from the accelerator pedal, the transmission will immediately preselect a lower gear. The transmission then starts to downshift through gears to reach the preselected gear. Downshifting occurs at a higher speed than is usual when the exhaust brake is not turned on. This allows the exhaust to provide the maximum retarding power.

7.04 Exhaust Aftertreatment System (ATS)

7.04.01 General Guidelines

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.

NOTICE:

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

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

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.

7.04.02 EPA07 Engines

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

7.04.03 EPA10 and Newer Engines

To meet EPA guidelines, engines that are compliant with EPA10 and newer regulations use an ATS that has, in addition to a DOC/DPF device like that used in an EPA07 ATD, a Selective Catalytic Reduction (SCR) device to reduce NOx downstream of the engine.

After exhaust gases leave the 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. Passive regen occurs when the engine is running under load and regen occurs without input. 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 reduce 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.

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.

After the exhaust stream passes through the ATD, it flows through another canister housing the SCR device. A controlled quantity of diesel exhaust fluid (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.

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.138,Diesel Particulate Filter (DPF) Lamp.

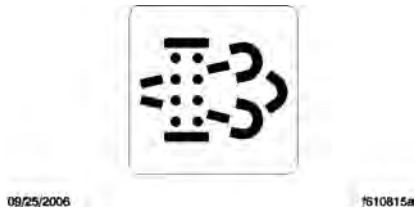


Fig 138, Diesel Particulate Filter (DPF) Lamp

- A slow, 10-second flashing of the high exhaust system temperature (HEST) lamp alerts the driver that a parked regen is in progress, but the exhaust temperatures are still relatively cool. It also indicates that the high-idle speed is being controlled by the engine software, not the driver. See Fig.139,High Exhaust System Temperature (HEST) Lamp.



Fig 139, 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.
- An illuminated DEF warning lamp in the gauge, indicates that the DEF tank should be refilled at the next opportunity.

7.04.04 Parked Regen Procedure

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.

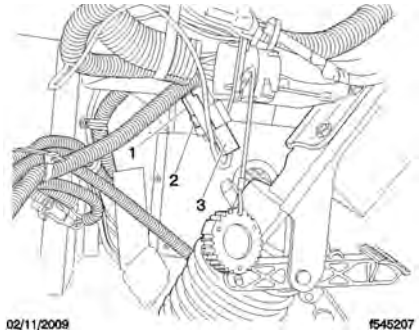
   IMPORTANT: The driver is responsible for ensuring, during the entire regen cycle, that anything that could be harmed by exposure to high heat does not come in contact with the exhaust gases flowing from the outlets.

3. Press and hold the regen switch for 4 seconds. The engine will increase rpm and initiate the regen process.
4. 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.
5. To stop a parked regen at any time during the process, engage the clutch, brake, or accelerator pedal, or turn off the engine.

7.04.05 Shorting Plug

NOTE: The DPF lamp must be illuminated before the shorting plug will initiate a parked regen.

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.140,Shorting Plug.



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

Fig 140, 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 forensuring,during the entire regen cycle, that anything that could be injured or damaged by exposure to high heat does not come in contact with the exhaust gases flowing from theoutlets.

3. Disconnect the shorting plug, as follows.
   3.a Slide the secondary red lock away from the white cover. See Fig.140,Shorting Plug, Ref. 2.
   3.b Push the primary lock in. See Fig.140,Shorting Plug, Ref. 1.
   3.c Pull the plug apart. See Fig.140,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. The DPF light will shut of
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.

7.04.06 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.

7.04.07 Diesel Exhaust Fluid and Tank, EPA10 and Newer Engines

Diesel Exhaust Fluid

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

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

DEF consumption varies depending on ambient conditions and vehicle application.

Freezing Conditions

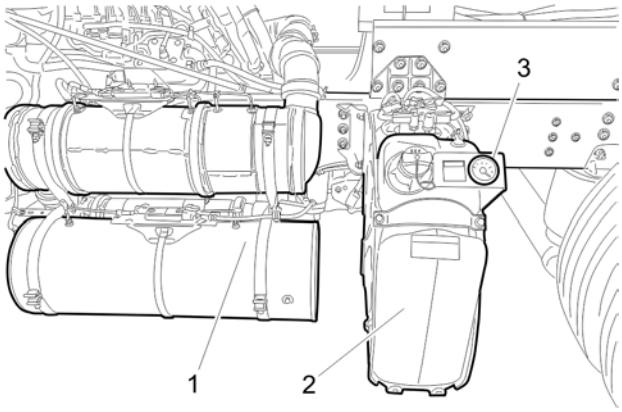
DEF freezes to slush at around 12°F (-11°C). It is not damaged or destroyed if frozen, and is fully usable when thawed. The DEF in the tank is allowed to freeze while a vehicle is non-operational. At start-up, normal operation of the vehicle is not inhibited if the DEF is frozen; an immersion heater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

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

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

DEF Tank

Engines that are compliant with EPA10 and newer regulations are equipped with a DEF tank located forward of the ATS. See Fig.141,DEF Tank With Optional DEF Gauge. 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.



1. ATS
2. DEF Tank
3. DEF Gauge (optional)

Fig 141, DEF Tank With Optional DEF Gauge

The DEF tank will require filling a minimum of approximately every second diesel refuel depending on the DEF tank capacity. 10-, 13-, and 15-gallon tank capacities are available. 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.

Some vehicles are equipped with a remote DEF fill-port. If so equipped, the remote port is directly opposite the DEF tank on the other side of the vehicle, and has a blue cap over the fill-port. See Fig.142,Remote DEF Fill-Port.

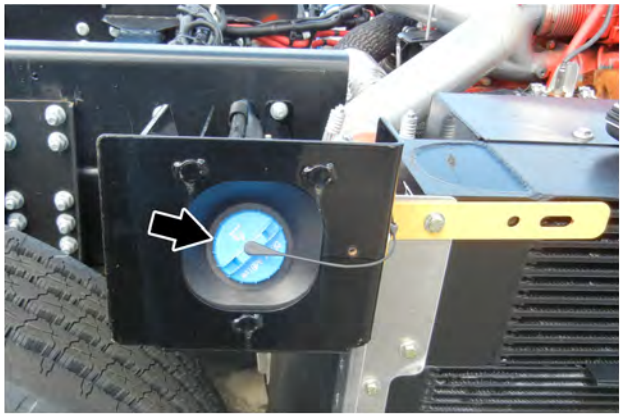


Fig 142, Remote DEF Fill-Port

Ametek DEF Warnings and Engine Limits

The DEF lightbar indicates the level in the DEF tank as follows.

- Four bars illuminated green—Between 75% and 100% full
- Three bars illuminated green—Between 50% and 75% full
- Two bars illuminated green—Between 25% and 50% full
- One bar illuminated green—Between approximately 10% and 25% full
- One bar illuminated amber—DEF low, refill DEF
- One bar flashing red—DEF empty, refill DEF

IMPORTANT: Ignoring the DEF warning lights and not refilling the DEF tank will result in limited engine power with a speed limit of 5 mph (8 km/h) eventually being applied. See the engine manufacturer's operation and maintenance manual for further information.

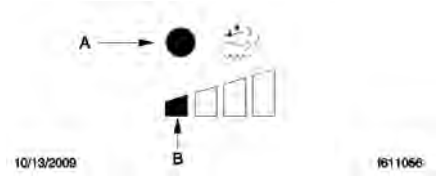
DEF Level Low—Initial and Critical Warnings

When the DEF level reads low the following warnings strongly encourage the driver to refill the DEF tank. See Fig. 143,DEF Level Low Initial and Critical Warnings.

- 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.

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 solid amber)

Fig 143, DEF Level Low Initial and Critical Warnings

DEF Empty

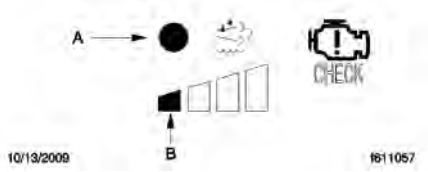
When the DEF level reads empty, the following warnings are activated. See Fig.144,DEF Empty Warning.

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

- A brief audible alert notifies the driver.

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 144, 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. A brief audible alert notifies the driver. See Fig.145, DEF Empty and Ignored Warning.



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

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

Fig 145, 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.

DEF Quality or SCR Tampering

NOTICE:

Once contaminated DEF 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 light and engine limits.

If contaminated DEF or tampering is detected, the DEF warning light flashes, and engine performance is limited with progressively harsher engine power limits applied. If the fault is not corrected, the CHECK engine lamp illuminates, then the

STOP engine lamp illuminates and a 5 mph (8 km/h) speed limit will be applied after the next engine shutdown, or while parked and idling. See Fig.145,DEF Empty and Ignored Warning.

OptiView™ DEF Warnings and Engine Limits

NOTE: The OptiView instrument panel has a DEF gauge that contains a low DEF warning lamp, which activates when the DEF tank needs to be refilled. Along with the DEF warning lamp activation, warning statements appear in the center of the OptiView panel.

DEF Level—Initial Warning

When the DEF level becomes low, the following warning strongly encourages the driver to refill the DEF tank.

- The CHECK engine lamp flashes for 30 seconds when the vehicle is started.
- The DEF warning lamp illuminates.

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

DEF Low

When the DEF level reads low, the following warnings are activated.

- The CHECK engine lamp flashes for 30 seconds when the vehicle is started.
- The DEF warning lamp illuminates.
- A LOW DEF message appears in the center of the instrument panel.
- One bar of the DEF-level lightbar illuminates amber.
- A brief audible alert notifies the driver.

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

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

DEF Empty

When the DEF tank registers empty, the following warnings are activated.

- The DEF warning lamp flashes.
- A VERY LOW DEF message appears in the center of the instrument panel.
- One bar of the DEF-level lightbar flashes red.
- 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.

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. A 5 mph (8 km/h) speed limit is applied after the next engine shutdown or while parked and idling.

DEF Quality or SCR Tampering



NOTICE:

Once contaminated DEF 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 light and engine limits.

If contaminated DEF or tampering is detected, the DEF warning light flashes, and engine performance is limited with progressively harsher engine power limits applied. If the fault is not corrected, the CHECK engine lamp illuminates, then the STOP engine lamp illuminates and a 5 mph (8 km/h) speed limit will be applied after the next engine shutdown, or while parked and idling.

7.05 Engine Shutdown

7.05.01 Engine Shutdown



NOTICE:

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

1. With the vehicle stopped, place the transmission in the neutral (N) position and set the parking brake.
2. It is important to idle an engine for 3 to 5 minutes before shutting it down. This allows the lubricating oil and the coolant to carry heat away from the combustion chambers, bearings, shafts, and seals.

   IMPORTANT: 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 piston rings and may result in stuck valves.

3. Do not idle the engine for excessively long periods.
4. Turn the ignition key to the OFF position and shut down the engine.

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8. Brake System

8.01 Air Brake System

8.01.01 General Information

WARNING:
Freightliner Custom Chassis Corporation (FCCC) neither recommends nor approves connecting a trailer or other towed vehicle's braking system directly to the vehicle braking system. FCCC also neither recommends nor approves tapping into the vehicle air brake system nor operating a towed vehicle or trailer's braking system by means of the vehicle braking system. Failure to observe this warning could result in personal injury or death, or substantial property damage.

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

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.

The parking brake will apply when air pressure drops below 20 to 45 psi (138 to 310 kPa). Do not wait for the brake to apply automatically; when the warning light and buzzer first come on, immediately bring the vehicle to a safe stop. Before continuing operation of the vehicle, correct the cause of the air loss.

Air Brake System With External Fill (Schrader) Valve

Before a vehicle with insufficient brake system air pressure can be moved, the parking brake must be released by applying an external air source. First block the wheels, then turn the ignition switch to the ON position, then fill the appropriate system air reservoir using the Schrader valve on the inlet side of the air dryer. The parking brake will not release until air pressure reaches 65 psi (448 kPa). The low air buzzer will sound until air pressure reaches 65 to 73 psi (448 to 503 kPa) with the ignition switch in the ON position.

IMPORTANT: If the air pressure in the braking system drops below 20 to 45 psi (138 to 310 kPa) the parking brake will reengage.

8.01.02 Operation

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

Allow time for the air compressor to build up a minimum of 95 psi (655 kPa) pressure in both the primary and secondary systems. Monitor the air pressure system by observing the dual system air pressure gauges and the low-air-pressure warning light and buzzer. The warning light and buzzer shut off when the pressure in both systems reaches 65 to 73 psi (448 to 503 kPa).

The warning light and buzzer come on if air pressure drops below 65 to 73 psi (448 to 503 kPa) in either system. If this happens, check the air system pressure gauges to determine which system has low air pressure. Although the vehicle's speed can be reduced using the foot brake control pedal, either the front or the rear service brakes will not be operating, causing a longer stopping distance. Bring the vehicle to a safe stop and have the air system repaired before continuing.

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. When the forward speed of the vehicle

has decreased to almost the idling speed of the engine, push the clutch pedal in (if equipped) and shift the transmission into Neutral (N). Apply the hand parking brake if the vehicle is to be parked.

IMPORTANT: In the event of a total loss of service brakes with full system air pressure, use the parking brake control valve (yellow knob) to bring the vehicle to a complete stop in the safest location possible.

The yellow diamond-shaped knob on the control panel actuates the parking brake valve. Pull out the knob to apply the parking brake. See Fig.146,Parking Brake Control Knob.



Fig 146, Parking Brake Control Knob

WARNING:
If the vehicle is equipped with an air suspension system, do not move the vehicle with the air suspension deflated. Doing so could result in a loss of vehicle control, possibly causing personal injury and property damage.

NOTICE:
Do not use the spring 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 (L) or First (1) gear and lightly apply the brakes to heat and dry them.

Allow hot brakes to cool before using the parking brake. Always chock the tires.

8.01.03 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.

8.01.04 Automatic Slack Adjusters

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

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

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



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.

8.02 Antilock Braking System (ABS)

8.02.01 Meritor WABCO® ABS

WARNING:

Although the ABS improves vehicle control during emergency braking situations, the driver still has the responsibility to change driving styles depending on existing traffic and road conditions. Failure to change driving styles to accommodate existing traffic and road conditions could cause an accident, possibly resulting in personal injury or death, or property damage.

The Meritor WABCO ABS is an electronic wheel speed monitoring and control system that works with the air brake system. ABS 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.

IMPORTANT: For proper ABS operation, do not mismatch tire sizes among any of the tires on the vehicle. Mismatching tire sizes could result in a reduced braking force, leading to longer stopping distances and cause an ABS event to register on the electronic control unit (ECU).

WARNING:

An accumulation of road salt, dirt, and debris on the ABS tone wheels and sensors can cause the ABS warning light to illuminate. If the ABS light illuminates while driving, have the ABS serviced. Operating the vehicle when the ABS needs to be serviced could cause an accident, possibly resulting in personal injury or death, or property damage.

IMPORTANT: During winter months in areas where corrosive materials are used on the highways, periodically clean the underside of the vehicle to ensure proper ABS functioning. The required frequency of cleaning will vary with conditions. In general, do not allow corrosive materials to remain on the underside of the vehicle for extended periods of time.

The electronic control unit monitors the wheel sensors, solenoid control valves, and the electrical circuitry. The ABS warning light illuminates after turning the ignition switch to the ON position. The warning light goes out only if all of the vehicle's ABS components are working properly.

The Meritor WABCO ABS combines one front-axle control channel with the rear axle (four sensor system) to form one control circuit. For example, the sensor and solenoid control valve at the left-front axle form a control circuit with the sensor and solenoid valve on the right-rear axle. If, during vehicle operation, the safety circuit senses a failure in any part of the ABS (a sensor, solenoid control valve, wiring connections, short circuit, etc.), the ABS warning light illuminates and the control circuit where the failure occurred is switched to normal braking action. The remaining control circuit will retain the ABS effect. *Even if the ABS is partially or completely inoperative, normal braking ability is maintained* . An exception would be if a solenoid control valve (or combination solenoid control valve) is damaged and inoperative. As these components are an integral part of the air brake system, normal braking may be impaired or inoperative.

WARNING:

If any of the ABS warning lights do not work as described above or illuminates while driving, repair the ABS immediately to ensure full antilock braking capability. Operating the vehicle when the ABS needs to be serviced could cause an accident, possibly resulting in personal injury or death, or property damage.

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

8.02.02 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 improve 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 TC lamp, shown in Fig.147,ATC Indicator Lamp. Pressing the switch again will cycle the system back to normal operation.



Fig 147, ATC Indicator Lamp

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 lamp and the TC indicator lamp illuminate for about three seconds. After three seconds, the warning lamps go out if all of the ABS components are working.

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

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

8.02.03 Electronic Stability Control

WARNING:

Electronic Stability Control (ESC) is intended only as an aid for a conscientious and alert driver. Carefully read the information in this manual to understand this system and its limitations. ESC is not a substitute for safe driving procedures. Failure to drive safely, and use the system properly, could result in personal injury and/or death and property damage.

Electronic Stability Control (ESC) automatically reduces engine power, applies the engine brake, and/or applies the brakes when the acceleration sensor detects that the vehicle is at risk of rolling over. In addition, ESC offers the added capability of complete directional stability (yaw control) in oversteer and understeer conditions to reduce the likelihood of drift-out. The system determines where the driver is attempting to steer the vehicle and how much brake demand is required in order to more precisely control the vehicle in an emergency situation.

ESC works by constantly comparing the driver’s intention with the vehicle's actual behavior. The system does this by monitoring systems such as wheel speed, steering angle, yaw rate, lateral acceleration, throttle position, and brake application. A central microcomputer analyzes the collected data and triggers a response to keep the vehicle on course when an unstable condition is detected.

The roll stability control system automatically reduces engine power, applies the engine brake, and/or applies the brakes when the acceleration sensor detects that the vehicle is at risk of rolling over. The control can intervene even before an advisory message is displayed.

When the system detects that the vehicle is at risk of oversteering or understeering, it applies individual wheel end brakes, activates the engine brake (if equipped), and/or cuts engine power, depending on the severity. As a result, the driver has full control over the vehicle until the system detects a potential risk and intervenes accordingly. ESC operates automatically; the driver does not monitor or activate the system. When ESC activates, an indicator lamp illuminates on the instrument panel. See Fig.148,ESC Indicator Lamp.



Fig 148, ESC Indicator Lamp

8.03 Engine Brake

8.03.01 General Information

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

WARNING:

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

- on wet or slippery pavement, unless the vehicle is equipped with antilock braking system (ABS) and you have had prior experience driving under these conditions;
- if the drive wheels begin to lock, or there is fishtail motion after the engine brake is activated.

NOTE: When the engine brake is enabled, the engine brake lamp illuminates in the instrument panel.

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

WARNING:

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

Since the engine brake is most effective at rated engine speed, gear selection is very important. Gearing down the vehicle within the limits of the rated engine speed makes the engine brake more effective.

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

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

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

If the engine is equipped with both cruise control and an engine brake, the engine brake can operate automatically while cruise control is activated. The maximum amount of braking is selected with the engine brake control. When the vehicle returns to the set cruise speed, the engine brake will turn off.

The engine brake will only operate when the accelerator pedal is fully released.

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

8.03.02 Engine Brake Operation

NOTICE:

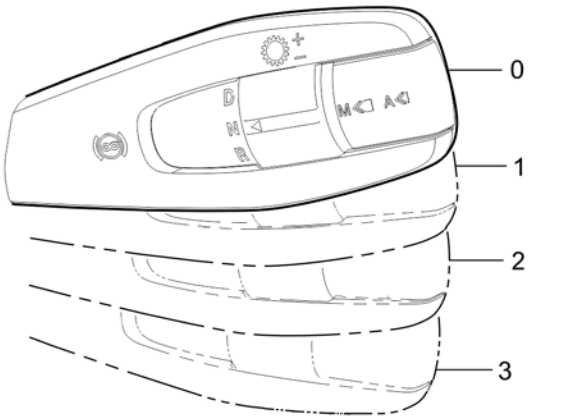
Do not allow the engine to exceed its governed speed, or serious engine damage could result.

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

IMPORTANT: On some vehicles, the engine brake only has off and high intensity options.

The engine brake control is located on the right-hand steering column lever. At the top position, the engine brake is off, and at the three lower positions, the engine brake is on and the intensity (low, medium, high) increases with each step down. See Fig.149,Engine Brake Positions, Right-Hand Steering Column Lever.

NOTE: The cruise control system and safety systems may activate the engine brake regardless of the lever position.



NOTE: On some vehicles, the engine brake only has off and high intensity options.

A. Position 0: Off
B. Position 1: Low
C. Position 2: Medium
D. Position 3: High

Fig 149, Engine Brake Positions, Right-Hand Steering Column Lever

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9. Transmissions

9.01 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 10.01 Power Steering 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 ‘1’ (Low) at speeds above 20 mph (32 km/h).

On slippery surfaces, avoid quick movements of the steering wheel. Decrease your speed and allow for extra stopping distance required by these conditions.

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.

9.02 Allison Automatic Transmissions

9.02.01 General Information

For Allison Transmission Operators Manual and Warranty Information for on-highway vehicle applications, visit or scan the QR code. See Fig.150,Allison Transmission QR Code.



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Fig 150, Allison Transmission QR Code

NOTICE:

Do not allow the vehicle to coast in neutral. This can result in severe transmission damage. Also, no engine braking is available.

WARNING:

Never shift from neutral (N) to drive (D) or reverse (R) at engine speeds above idle. The vehicle will lurch forward or backward, which could cause property damage and personal injury.

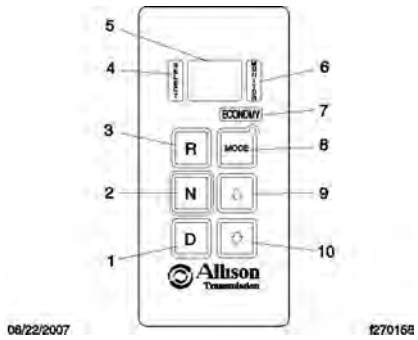
NOTICE:

The engine should never be operated for more than 30 seconds at full throttle with the transmission in gear and the output stalled. Prolonged operation of this type will overheat the transmission fluid and will result in severe damage to the transmission.

9.02.02 2500/3000/4000 MH Models

General Information

2500, 3000, and 4000 MH series automatic transmissions have six forward speeds and one Reverse (R) speed. These transmissions have electronic shift controls that can be programmed to allow the use of different numbers of geared speeds. See Fig.151,GEN IV Shift Selector. For instance the transmission can be programmed to operate as a 4-speed, 5-speed, or 6-speed unit in the "primary" shift mode. If needed, a "secondary" shift mode can be programmed to provide another shift configuration to optimize vehicle use under different operating conditions. To activate a secondary shift mode, or other special function programmed into the electronic control unit (ECU), depress the Mode button. A label just above the Mode button identifies the special function.



NOTE: The number displayed in the Digital Display window is the highest forward range available in the selected position. Visually check to confirm the range selected. If the display is flashing, the shift is inhibited.

1. Drive (D) Button
2. Neutral (N) Button
3. Reverse (R) Button
4. Select Display
5. Select/Monitor Display Window
6. Monitor Display
7. Service Display
8. Mode Button
9. Upshift Button
10. Downshift Button

Fig 151, GEN IV Shift Selector

The 3000 and 4000 MH series transmission systems are designed to warn the driver of transmission malfunctions. The driver of a vehicle equipped with these transmissions should know the extent of the warning system in order to safely operate the vehicle. See 5.01.01 General Description for information on the warning system.

Operation

1. Start the engine.
2. Use Reverse (R) to back the vehicle. Completely stop the vehicle before shifting from a forward gear to Reverse (R) or from Reverse (R) to a forward gear. There is only one Reverse (R) gear.
3. Select Drive (D) for all normal driving conditions. The vehicle will start out in First (1) gear, and as speed increases, the transmission will upshift through each gear automatically. As the vehicle slows down, the transmission will downshift to the correct gear automatically.

   The pressure of your foot on the accelerator pedal influences the automatic shifting. When the pedal is fully depressed, the transmission will automatically upshift near the governed speed of the engine. A partially depressed position of the pedal will cause the upshifts to occur at a lower engine speed.
4. Occasionally the road, load, or traffic conditions make it desirable to restrict the automatic shifting to a lower range. The lower the gear range, the greater the engine braking power.

   Use the up or down arrow buttons on the shift selector to reach the desired gear.

   NOTE: In the lower gear ranges, the transmission will not upshift above the highest gear selected unless the engine governed speed is exceeded.
5. Use Neutral (N) and apply the parking brake when the vehicle is parked with the engine running.

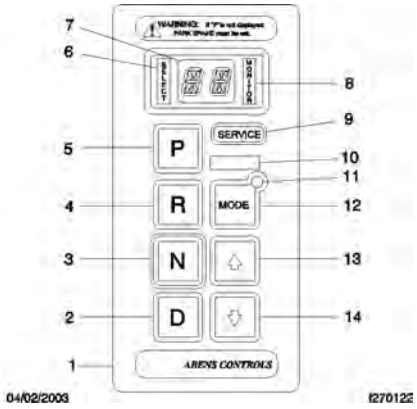
   See the *Allison Transmission Owner's Manual* for more information on 3000 and 4000 MH transmission operation.

9.02.03 2100/2500 Models (Arens SBW)

General Information

The Arens shift-by-wire (SBW) push-button shift selector is part of an electronic shift control system used with Allison series 2100/2500 5-speed automatic transmissions. An electronic actuator is mounted to the transmission.

The 2100/2500 series transmissions have a park pawl and the SBW selector has a Park (P) position. See Fig. 152,SBW Shift Selector (2100/2500 series).



1. SBW Shift Selector
2. Drive (D) Button
3. Neutral (N) Button
4. Reverse (R) Button
5. Park (P) Button
6. Select Display
7. Select/Monitor Display Window
8. Monitor Display
9. Service Display
10. Mode Function Label
11. Mode Light
12. Mode Button
13. Upshift Button
14. Downshift Button

Fig 152, SBW Shift Selector (2100/2500 series)

In case the vehicle needs to be towed and the SBW system cannot be activated to move the transmission out of Park (P), a manual procedure is provided to shift the transmission. At the actuator, on the transmission, a port is provided to insert an Allen wrench to shift the transmission manually.

Calibrating Arens SBW

Calibrating Arens SBW

If the vehicle shuts down in gear and will not start, check the two 10-amp fuses. Then check to see if either one or two Ns appear on the transmission shifter and the vehicle will not start. To reset the transmission shifter, turn the ignition to the "ON" position. On the transmission shifter, go through the following sequence of N-R-N-D-N. This should reset the shifter and allow the vehicle to start.

Transmission Operation

1. At the top left side of the selector, is the select display. On the left side of the display window, an LED character indicates which gear has been selected.
2. At the top right side of the selector, is the monitor display. On the right side of the display window, an LED character indicates which gear is actually engaged.

WARNING:
If the Park (P) position is selected and the letter P does not appear on the monitor side of the display window, the parking brake must be set. Otherwise the vehicle could move unexpectedly and cause an accident, possibly resulting in personal injury and property damage.

NOTE: Only the 1000/2400 series 5-speed transmissions have a park pawl and a Park (P) button

3. The Park (P) button shifts the transmission to Neutral (N) and engages the park pawl. When Park (P) is selected, the monitor side of the display window will show a letter P.

WARNING:
Always place the transmission in the Park (P) or Neutral (N) position and set the parking brake before releasing the service brakes and exiting the vehicle. Otherwise the vehicle could move unexpectedly and cause an accident, possibly resulting in personal injury and property damage.

IMPORTANT: If the ignition switch is turned to the OFF position before selecting Park (P), a buzzer will sound and the monitor display will show the gear that is currently engaged. Select Park (P) to turn off the buzzer and the display. Also, with the engine not running (ignition switch in the ON position and park pawl not engaged), a buzzer will sound and the monitor display will show an N for Neutral (N). Select Park (P) to turn off the buzzer and the display.

4. Select the R button to place the transmission in Reverse (R). An R will appear on both sides of the display window.

WARNING:
Do not leave the vehicle if the transmission is in Neutral (N) without first setting the parking brake. The vehicle could roll or move unexpectedly and cause an accident, possibly resulting in personal injury and property damage.

5. Select the N button to place the transmission in Neutral (N). An N will appear on both sides of the display window. The vehicle may be started in Neutral (N).
6. Select the D button to place the transmission in Drive (D). The transmission will automatically shift through the full range of First (1) through Fifth (5) gears. When Drive (D) is first selected, the display will show D1, indicating that Drive (D) was selected and that First (1) gear is engaged. As the transmission automatically upshifts and downshifts, the display will show the gear currently engaged (D1, D2, D3, D4, or D5).
7. With the transmission in Drive (D), select the downshift (down arrow) button to manually downshift one gear at a time, from Fifth (5) to First (1). The select display will show the selected gear and the monitor display will show the gear currently engaged. From D5 at the top of the Drive (D) range, the display will show 44, 33, 22, and 11 as progressively lower gears are manually selected.

NOTE: The transmission will remain in the manually selected gear until Drive (D) is selected. Select Drive (D) at any time during the manual downshifting sequence (or upshift progressively to Drive [D] using the up arrow button) and the transmission will upshift and downshift automatically.

8. With the transmission in 11, 22, 33, or 44, select the upshift (up arrow) button to manually upshift one gear at a time until Drive (D) is selected. The select display will show the selected gear and the monitor display will show the gear currently engaged. From 11 at the bottom of the Drive (D) range, the display will show 22, 33, 44, and D5 as progressively higher gears are manually selected.

   NOTE: The transmission will remain in the manually selected gear until Drive (D) is selected. Select Drive (D) at any time during the manual upshifting sequence and the transmission will upshift and downshift automatically.

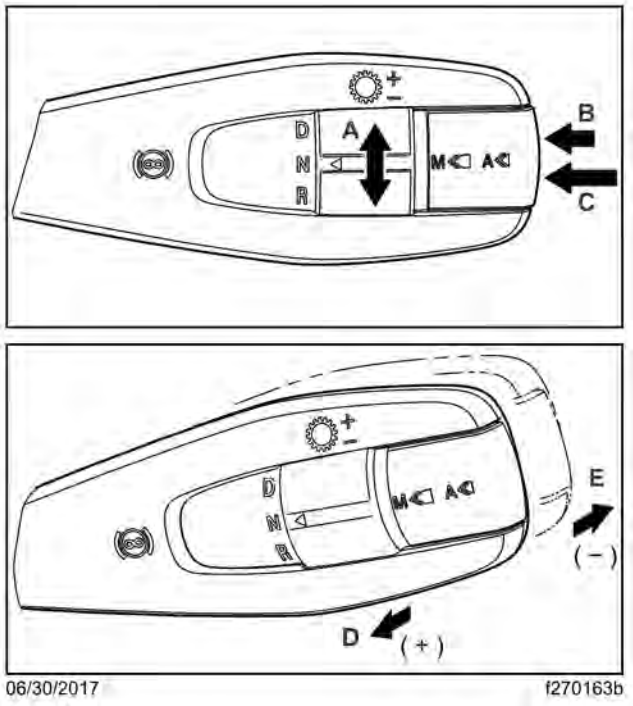
9. The function of the mode button may vary from vehicle to vehicle. The label above the button identifies the function.
10. A light in the upper right-hand corner of the mode button illuminates when the mode function is active.

    IMPORTANT: An illuminated service display may indicate a loss of safety back-up systems. Use extra care when shifting to ensure that the transmission is operating properly.

11. The service display illuminates if a fault is detected in the SBW system. Have a qualified technician inspect the SBW system as soon as possible.
12. A flashing select/monitor display indicates that the transmission (and not the SBW system) has inhibited a selected transmission operation. See the *Allison Transmission Operator's Manual* for more information.

9.02.04 Automatic Transmission Multifunction Stalk Switch

Some vehicles are equipped with a multifunction stalk switch shown in Fig. 153,Automatic Transmission Multifunction Shift Control and see Fig. 154,Engine Brake Positions, Right-Hand Steering Column Lever. This control can be used to request direction, neutral, low, manual shifts, change driving mode, preselect lower ranges, and set engine brake levels. Forward shifts can be made either automatically or by using manual mode. For an overview of control functionality, refer to Table.7,Functionality, Automatic Transmission Shift Control.



NOTE: See Table for a description of control functionality.

A. Rotate for drive (D), neutral (N), or reverse (R).
B. Short press for automatic mode when in manual mode.
C. Long press to switch between economy or performance mode.
D. Pull for upshift (+) request.
E. Push for downshift (-) request.

Fig 153, Automatic Transmission Multifunction Shift Control

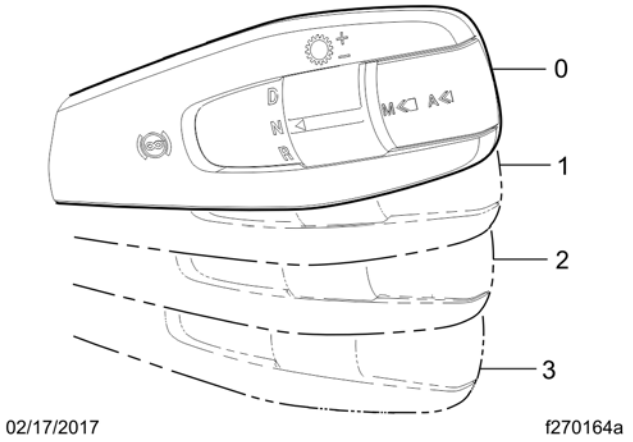


Fig 154, Engine Brake Positions, Right-Hand Steering Column Lever

Table 7, Functionality, Automatic Transmission Shift Control

Functionality, Automatic Transmission Shift Control		
Function/Switch	**Action/Position**	**Request**
Direction	**All Transmissions**	
	D	Forward gears
	N	Neutral
	R	Reverse gears
Mode	Short press	Switch to automatic mode when in manual mode.
	Long press	Switch between economy or performance modes.
Gear	**Allison Automatic Transmissions**	
	Short pull on the lever	Upshift, single gear
	Pull on the lever in quick repetitions	Upshift, multiple gears
	Short push on the lever	Downshift, single gear
	Push on the lever in quick repetitions	Downshift, multiple gears
Engine Brake	**Engine Brake Functions**	
	Lever at position 0 (top)	Engine brake off
	Lever at position 1	Low intensity
	Lever at position 2	Medium intensity
	Lever at position 3 (bottom)	High intensity

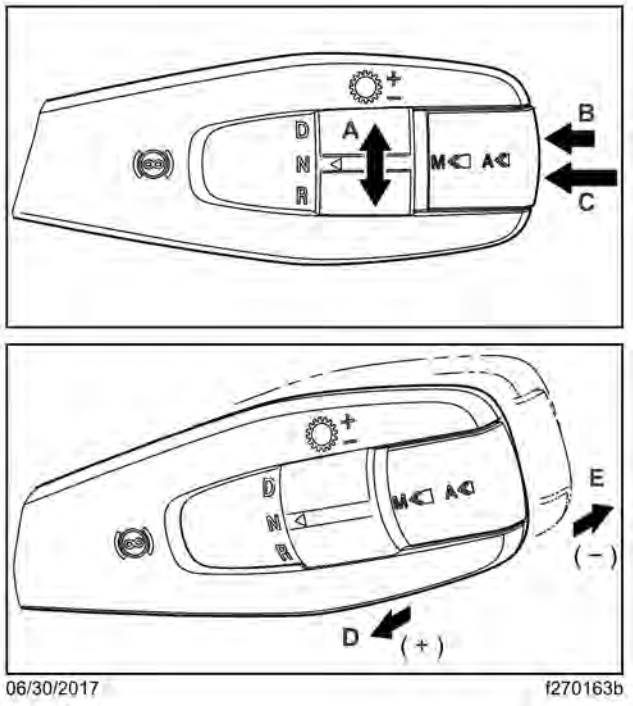
Table 7, Functionality, Automatic Transmission Shift Control

NOTE: On some vehicles, the engine brake only has off and high intensity options.

The transmission has electronic shift controls that can be programmed to allow the use of different numbers of geared speeds. For instance, the transmission can be programmed to operate as a 4-speed, 5-speed, or 6-speed unit in the ‘primary’ shift mode. If needed, a ‘secondary’ shift mode can be programmed to provide another shift configuration to optimize vehicle use under different operating conditions. To activate a secondary shift mode, or other special functions programmed into the electronic control unit (ECU), briefly depress the mode switch on the multifunction stalk switch control. See Fig. 153,Automatic Transmission Multifunction Shift Control, Ref. B and Ref. C.

9.02.05 Direction Switch

Use the direction switch to request drive (D), neutral (N), or reverse (R). See Fig. 155,Automatic Transmission Multifunction Shift Control, Ref. A.



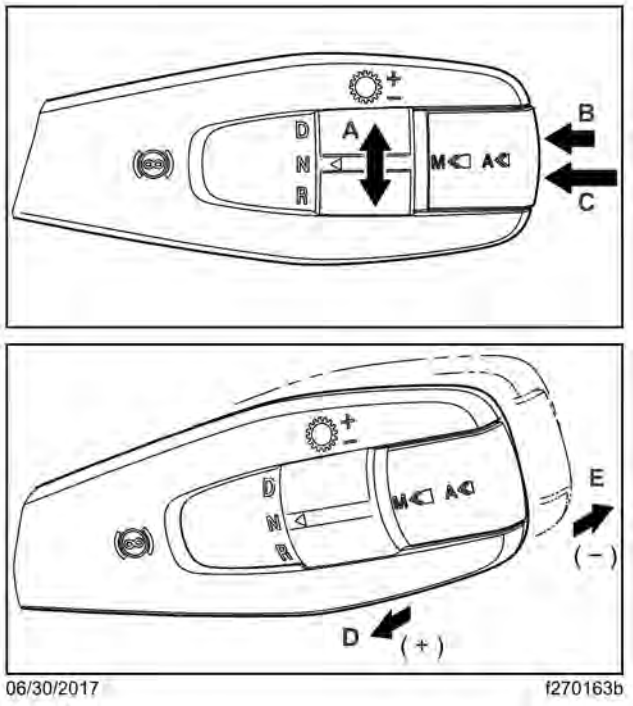
NOTE: See Table for a description of control functionality.

A. Rotate for drive (D), neutral (N), or reverse (R).
B. Short press for automatic mode when in manual mode.
C. Long press to switch between economy or performance mode.
D. Pull for upshift (+) request.
E. Push for downshift (-) request.

Fig 155, Automatic Transmission Multifunction Shift Control

9.02.06 Mode Switch

The driving mode can be changed using the mode switch on the shift control. See Fig. 156,Automatic Transmission Multifunction Shift Control, Ref. B and Ref. C.



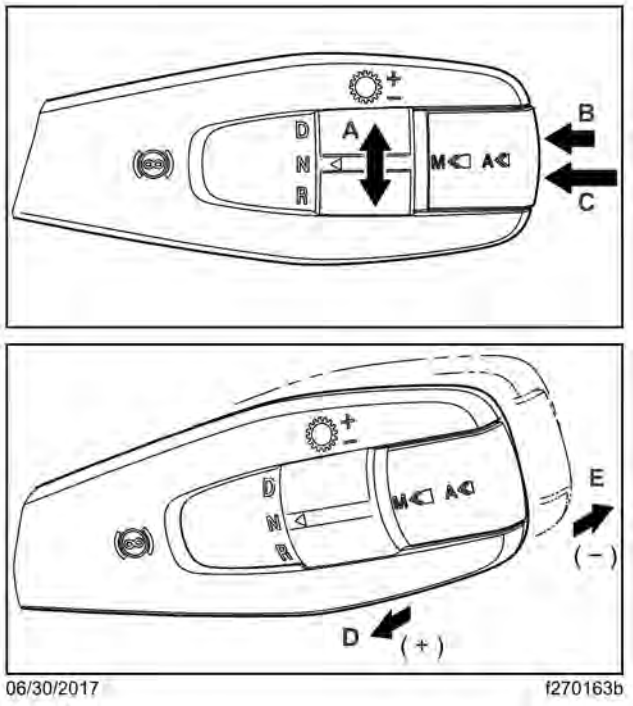
NOTE: See Table for a description of control functionality.

A. Rotate for drive (D), neutral (N), or reverse (R).
B. Short press for automatic mode when in manual mode.
C. Long press to switch between economy or performance mode.
D. Pull for upshift (+) request.
E. Push for downshift (-) request.

Fig 156, Automatic Transmission Multifunction Shift Control

9.02.07 Gear Switch

Gear shifts can be requested manually; push the lever away to request a downshift, or pull the lever toward you to request an upshift. See Fig.157,Automatic Transmission Multifunction Shift Control, Ref. D and E. For more information about upshift and downshift requests, refer to Table.8,Functionality, Automatic Transmission Shift Control.



NOTE: See Table for a description of control functionality.

A. Rotate for drive (D), neutral (N), or reverse (R).
B. Short press for automatic mode when in manual mode.
C. Long press to switch between economy or performance mode.
D. Pull for upshift (+) request.
E. Push for downshift (-) request.

Fig 157, Automatic Transmission Multifunction Shift Control

Table 8, Functionality, Automatic Transmission Shift Control

Functionality, Automatic Transmission Shift Control		
Function/Switch	**Action/Position**	**Request**
Direction	**All Transmissions**	
	D	Forward gears
	N	Neutral
	R	Reverse gears
Mode	Short press	Switch to automatic mode when in manual mode.
	Long press	Switch between economy or performance modes.
Gear	**Allison Automatic Transmissions**	
	Short pull on the lever	Upshift, single gear

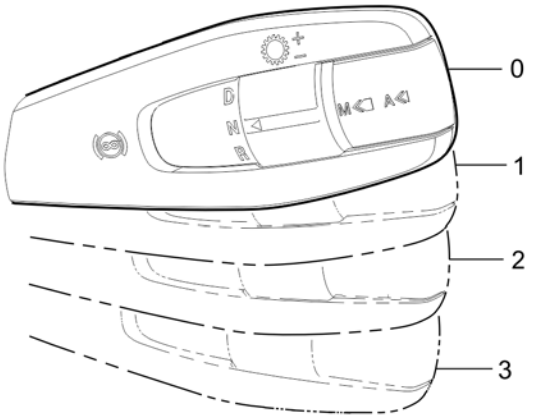
Functionality, Automatic Transmission Shift Control		
Function/Switch	**Action/Position**	**Request**
	Pull on the lever in quick repetitions	Upshift, multiple gears
	Short push on the lever	Downshift, single gear
	Push on the lever in quick repetitions	Downshift, multiple gears
Engine Brake	**Engine Brake Functions**	
	Lever at position 0 (top)	Engine brake off
	Lever at position 1	Low intensity
	Lever at position 2	Medium intensity
	Lever at position 3 (bottom)	High intensity

Table 8, Functionality, Automatic Transmission Shift Control

9.02.08 Engine Brake

NOTE: On some vehicles, the engine brake only has off and the high intensity level option.

The engine brake is controlled by the lever position as shown in Fig. 158,Engine Brake Positions, Right-Hand Steering Column Lever. At the top position, the engine brake is off, and at the three lower positions, the engine brake is on and the intensity (low, medium, high) increases with each step down. For more information about using the engine brake, see chapter 8.03.02 Engine Brake Operation.



NOTE: On some vehicles, the engine brake only has off and high intensity options.

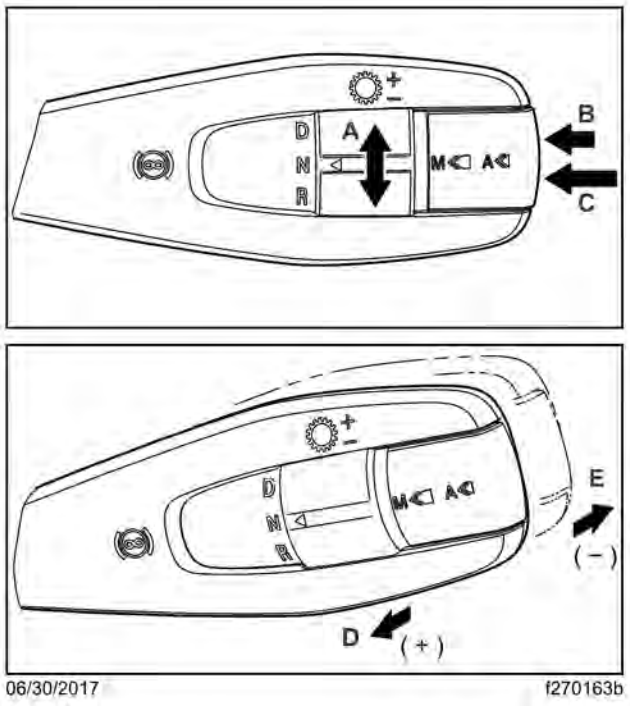
A. Position 0: Off
B. Position 1: Low
C. Position 2: Medium
D. Position 3: High

Fig 158, Engine Brake Positions, Right-Hand Steering Column Lever

9.02.09 Power Up and Shift into Gear

1. Ensure the parking brake is set and neutral (N) is selected on the shift control.

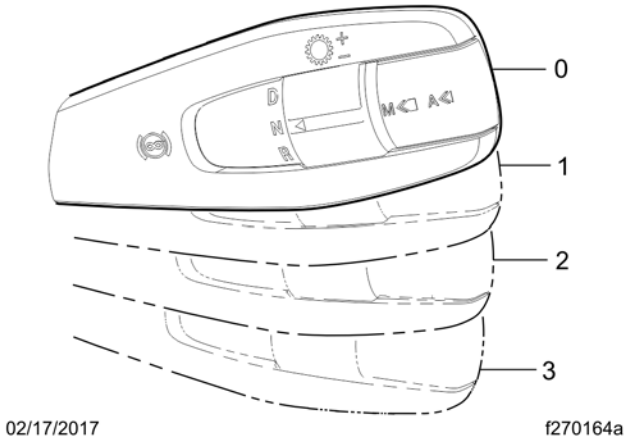
2. Start the engine.
3. Apply the service brake.
4. Select the desired starting gear.
5. Release the parking brake.
6. Release the service brake and apply the accelerator.



NOTE: See Table for a description of control functionality.

A. Rotate for drive (D), neutral (N), or reverse (R).
B. Short press for automatic mode when in manual mode.
C. Long press to switch between economy or performance mode.
D. Pull for upshift (+) request.
E. Push for downshift (-) request.

Fig 159, Automatic Transmission Multifunction Shift Control



NOTE: On some vehicles, the engine brake only has off and high intensity options.

A. Position 0: Off
B. Position 1: Low
C. Position 2: Medium
D. Position 3: High

Fig 160, Engine Brake Positions

9.02.10 Gear Display

The current transmission gear and driving mode are displayed in the instrument panel. See Fig. 161,Gear Display in the Instrument Panel.



Fig 161, Gear Display in the Instrument Panel

9.02.11 Operation Tips

NOTICE:

Do not allow the vehicle to coast in neutral. This can result in severe transmission damage. Also, no engine braking is available.

WARNING:

Never shift from neutral (N) to drive (D) or reverse (R) at engine speeds above idle. The vehicle will lurch forward or backward, which could cause property damage and personal injury.

NOTICE:

The engine should never be operated for more than thirty seconds at full throttle with the transmission in gear and the output stalled. Prolonged operation of this type will overheat the transmission fluid and will result in severe damage to the transmission.

The following tips highlight important operation principles.

- Use reverse (R) to back the vehicle. Completely stop the vehicle before shifting from a forward gear to reverse, or from reverse to forward.
- Select drive (D) for all normal driving conditions. The vehicle will start out in 1st gear (unless the transmission is programmed with 2nd gear start), and as speed increases, the transmission will upshift through each gear automatically. As the vehicle slows down, the transmission will downshift to the correct gear automatically.
- The pressure of your foot on the accelerator pedal influences the automatic shifting. When the pedal is fully depressed, the transmission will automatically upshift at higher engine speeds. A partially-depressed position of the pedal will cause the upshifts to occur at a lower engine speed.
- Occasionally the road, load, or traffic conditions make it desirable to restrict the automatic shifting to a lower range. The lower the gear range, the greater the engine braking power. When in manual mode, push or pull on the multifunction stalk switch to reach the desired gear. In the lower gear ranges, the transmission will not upshift above the highest gear selected unless the hold override upshift speed is exceeded.
- Use neutral and apply the parking brake when the vehicle is parked with the engine running.

9.02.12 Automatic Mode (A)

In automatic drive mode, upshifts and downshifts are made by the transmission without driver intervention.

Automatic mode is the default start mode. If in manual mode, a short push on the shift control mode switch activates the automatic mode (A). Rotate the D/N/R switch to drive (D), and press down on the throttle pedal. The transmission will shift automatically.

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

In drive, the start gear is automatically selected. The transmission automatically performs upshifts and downshifts.

9.02.13 Manual Mode (M)

In manual mode, the driver selects the maximum allowed range. This may be helpful when traversing steep grades, for example.

When in automatic mode and with the D/N/R switch set to drive (D), a long push on the shift control mode switch activates the manual mode (M). To increase selected range, pull the lever up (towards you); to decrease the selected range, push the lever down (away from you). The transmission will not upshift above the selected range unless the hold override upshift speed is exceeded.

When the transmission is in manual mode, the driver display shows the gear with an M. The current gear position appears next to the M with the target gear position next to it; M5 5 for example.

NOTE: The transmission may deny a downshift if the engine speed would fall outside of the acceptable range.

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

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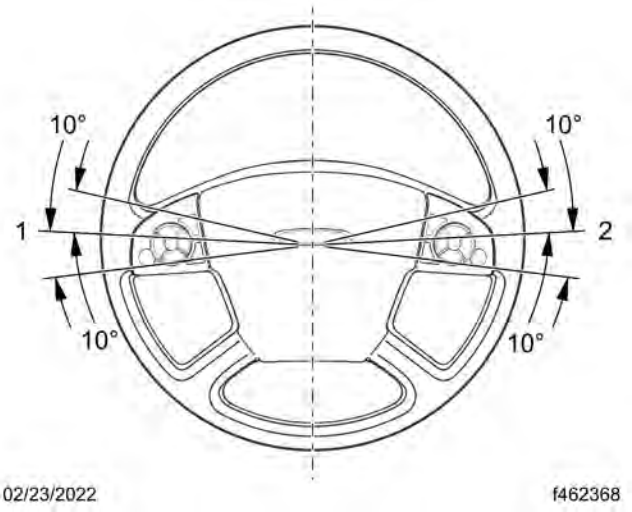
10. Steering System

10.01 Power Steering System

NOTE: 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. See Fig.162,Steering Wheel Centered. See **Group 46** of the Walk-In Van Chassis Workshop Manual for steering adjustment procedures.



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

Fig 162, Steering Wheel Centered

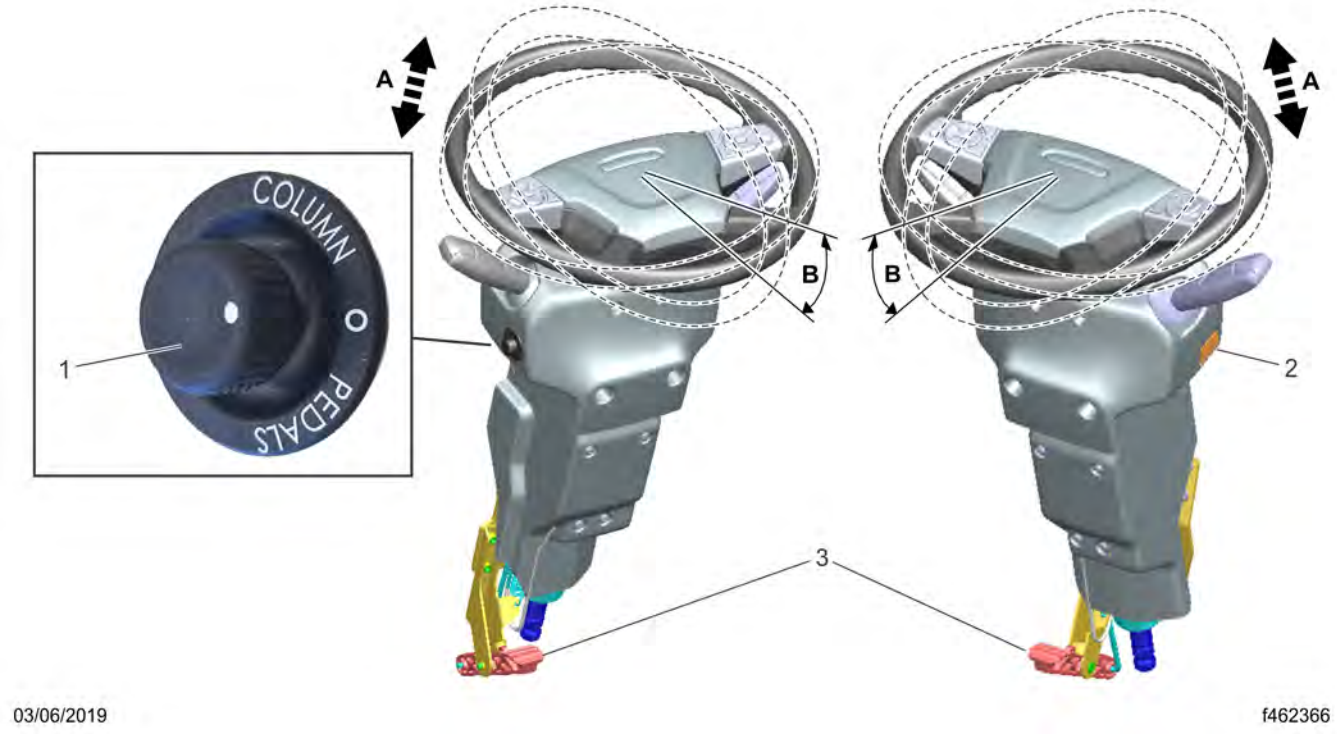
10.02 Steering Column Adjustment

10.02.01 Standard Tilt/Telescope Steering Column

WARNING:

Never try to tilt or telescope the steering column while driving the vehicle. Doing so could cause loss of vehicle control and result in personal injury, or death, or property damage.

To tilt the steering column or telescope the steering wheel, press down on the foot pedal (located below the steering wheel) to release the steering column lock. Adjust the column and steering wheel to the desired position. Release the foot pedal to lock the steering column and steering wheel in place. See Fig.163,Tilt/Telescope Steering Column.



NOTE: Some steering columns are equipped with the toggle switch but it only adjusts the brake and throttle pedals. Use the foot pedal on these vehicles to tilt and telescope the steering wheel.

A. Telescope
B. Tilt
1. Steering Column and Pedal Toggle Switch
2. Hazard Warning Light Switch
3. Foot Pedal (standard column only)

Fig 163, Tilt/Telescope Steering Column

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

10.02.02 Power Tilt/Telescope Steering Column and Adjustable Pedals

WARNING:

Never try to tilt or telescope the steering column while driving the vehicle. Doing so could cause loss of vehicle control and result in personal injury, or death, or property damage.

Power tilt/telescope steering columns have a toggle switch on the left side of the steering column.

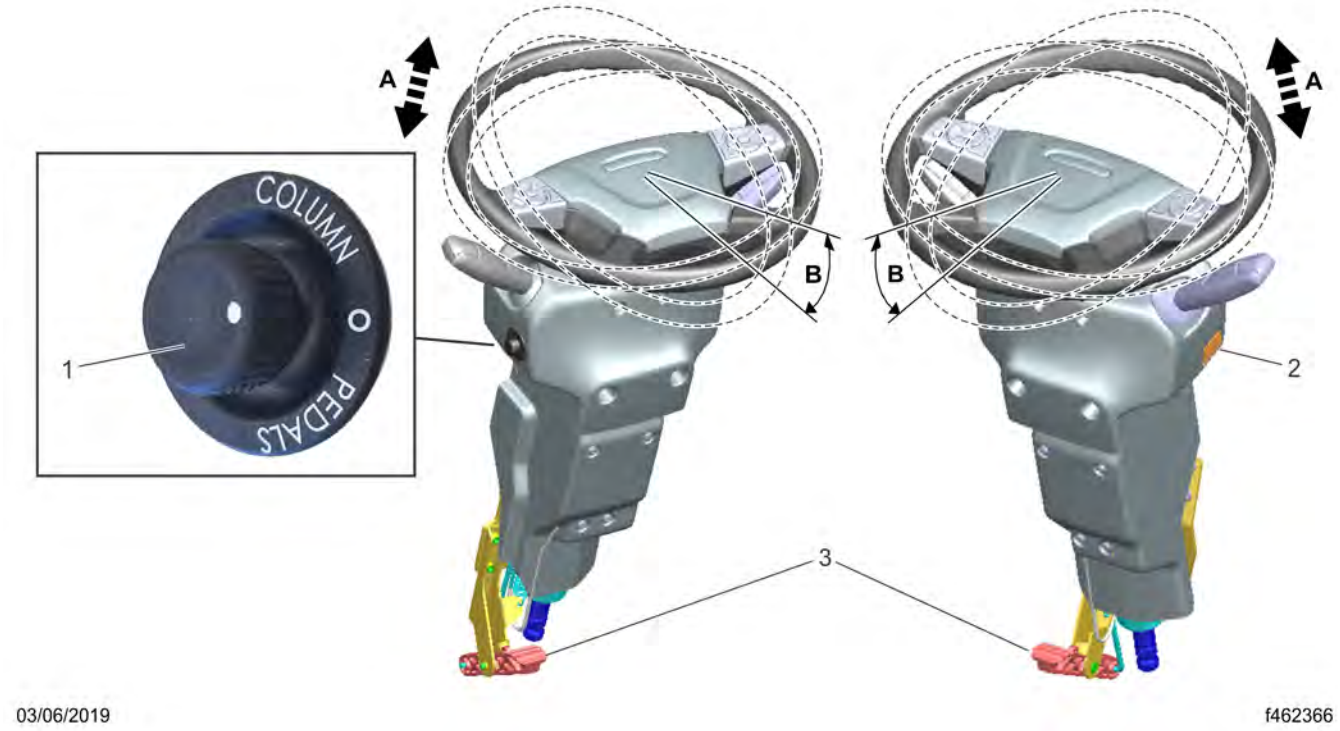
To tilt the steering column and telescope the steering wheel, rotate the toggle switch on the left-side of the steering column to the 'column' position. See Fig.164,Tilt/Telescope Steering Column. Push the toggle switch up or down to adjust the column to the desired height. Push the switch back toward the dash and the steering wheel goes in; pull the switch toward the driver and the steering wheel comes out. Once the column and steering wheel are at the desired position, rotate the toggle switch to the middle (off) position.

NOTE: Both the brake and throttle pedal position are adjusted at the same time.

Some steering columns are equipped with the toggle switch but it only adjusts the brake and throttle pedals. Use the foot pedal on these vehicles to tilt and telescope the steering wheel.

WARNING:
Never try to adjust the brake or throttle pedal position while driving the vehicle. Doing so could cause loss of vehicle control and result in personal injury, or death, or property damage.

To adjust the position of the brake and throttle pedals, rotate the toggle switch on the left-side of the steering column to the 'pedals' position. See Fig.164,Tilt/Telescope Steering Column. Push the toggle switch toward the dash to move the pedals back or pull the toggle switch toward the driver to move the pedals forward. Once the pedals are at the desired position, rotate the toggle switch to the middle (off) position.



NOTE: Some steering columns are equipped with the toggle switch but it only adjusts the brake and throttle pedals. Use the foot pedal on these vehicles to tilt and telescope the steering wheel.

A. Telescope
B. Tilt
1. Steering Column and Pedal Toggle Switch
2. Hazard Warning Light Switch
3. Foot Pedal (standard column only)

Fig 164, Tilt/Telescope Steering Column

NOTE: For safety, the steering column and pedal toggle switch should be in the middle (off) position unless the vehicle transmission is in park (P).

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11. Front-Engine Diesel Chassis

11.01 General Information

NOTE: The information provided in this chapter is specific to the front-engine diesel chassis, however, other chapters in this manual pertain to the front-engine operated vehicle. These include, but are not limited to, the controls and pretrip inspection and daily maintenance chapters.

NOTICE:

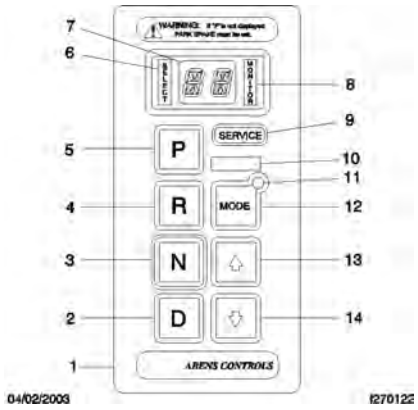
Do not allow the vehicle to coast in neutral. This can result in severe transmission damage. Also, no engine braking is available.

NOTICE:

The engine should never be operated for more than 30 seconds at full throttle with the transmission in gear and the output stalled. Prolonged operation of this type will overheat the transmission fluid and will result in severe damage to the transmission.

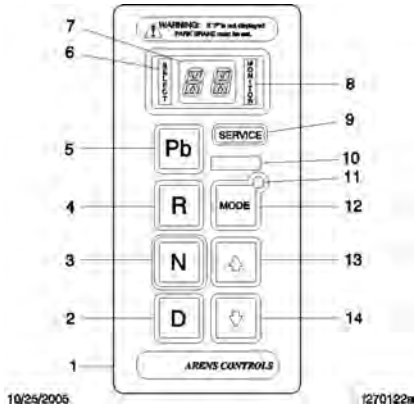
The Arens shift-by-wire (SBW) push-button shift selector is part of an electronic shift control system used with Allison series 1000/2200/2350/2500 5-speed automatic transmissions. An electronic actuator is mounted on the transmission.

The 1000/2200/2350/2500 series transmission has a park pawl and the SBW selector has a Park (P) position. The 2500 series transmission has a park brake (Pb) button. See Fig.165,SBW Shift Selector (1000/2200/2350 series) and see Fig. 166,SBW Pushbutton Shift Selector with Park Brake (Pb) Button (2500 series).



1. SBW Shift Selector
2. Drive (D) Button
3. Neutral (N) Button
4. Reverse ®) Button
5. Park (P) Button
6. Select Display
7. Select/Monitor Display Window
8. Monitor Display
9. Service Display
10. Mode Function Label
11. Mode Light
12. Mode Button
13. Upshift Button
14. Downshift Button

Fig 165, SBW Shift Selector (1000/2200/2350 series)



1. Shift Selector
2. Drive (D) Button
3. Neutral (N) Button
4. Reverse ®) Button
5. Park Brake (Pb) Button
6. Select Display
7. Select/Monitor Display Window
8. Monitor Display
9. Service Display
10. Mode Function Label
11. Mode Light
12. Mode Button
13. Upshift Button
14. Downshift Button

Fig 166, SBW Pushbutton Shift Selector with Park Brake (Pb) Button (2500 series)

In case the vehicle needs to be towed and the SBW system cannot be activated to move the transmission out of Park (P), a manual procedure is provided to shift the transmission. At the actuator, on the transmission, a port is provided to insert an Allen wrench to shift the transmission manually.

11.02 Transmission Operation

1. At the top left side of the selector, is the select display. On the left side of the display window, an LED character indicates which gear has been selected.
2. At the top right side of the selector, is the monitor display. On the right side of the display window, an LED character indicates which gear is actually engaged.

WARNING:

If the Park (P) position is selected and the letter P does not appear on the monitor side of the display window, you must set the parking brake. Otherwise the vehicle could move unexpectedly and cause an accident, possibly resulting in personal injury and property damage.

NOTE: Only the 1000/2200/2350 MH model transmissions have a park pawl and a Park (P) button.

3. The Park (P) button shifts the transmission to Neutral (N) and engages the park pawl. When Park (P) is selected, the monitor side of the display window will show a letter P.



WARNING:

Always place the transmission in the Park (P) or Neutral (N) position and set the parking brake before releasing the service brakes and exiting the vehicle. Otherwise the vehicle could move unexpectedly and cause an accident, possibly resulting in personal injury and property damage.

4. Select the R button to place the transmission in Reverse ®). An R will appear on both sides of the display window.



WARNING:

Do not leave the vehicle if the transmission is in Neutral (N) without first setting the parking brake. The vehicle could roll or move unexpectedly and cause an accident, possibly resulting in personal injury and property damage.

5. Select the N button to place the transmission in Neutral (N). An N will appear on both sides of the display window. The vehicle may be started in Neutral (N).
6. Select the D button to place the transmission in Drive (D). The transmission will automatically shift through the full range of First (1) through Fifth (5) gears. When Drive (D) is first selected, the display will show D1, indicating that Drive (D) was selected and that First (1) gear is engaged. As the transmission automatically upshifts and downshifts, the display will show the gear currently engaged (D1, D2, D3, D4, or D5).
7. With the transmission in Drive (D), select the downshift (down arrow) button to manually downshift one gear at a time, from Fifth (5) to First (1). The select display will show the selected gear and the monitor display will show the gear currently engaged. From D5 at the top of the Drive (D) range, the display will show 44, 33, 22, and 11 as progressively lower gears are manually selected.

   NOTE: The transmission will remain in the manually selected gear until Drive (D) is selected. Select Drive (D) at any time during the manual downshifting sequence (or upshift progressively to Drive (D) using the up arrow button) and the transmission will upshift and downshift automatically.

8. With the transmission in 11, 22, 33, or 44, select the upshift (up arrow) button to manually upshift one gear at a time until Drive (D) is selected. The select display will show the selected gear and the monitor display will show the gear currently engaged. From 11 at the bottom of the Drive (D) range, the display will show 22, 33, 44, and D5 as progressively higher gears are manually selected.

   NOTE: The transmission will remain in the manually selected gear until Drive (D) is selected. Select Drive (D) at any time during the manual upshifting sequence and the transmission will upshift and downshift automatically.

9. The function of the mode button may vary from vehicle to vehicle. The label above the button identifies the function.
10. A light in the upper right-hand corner of the mode button illuminates when the mode function is active.

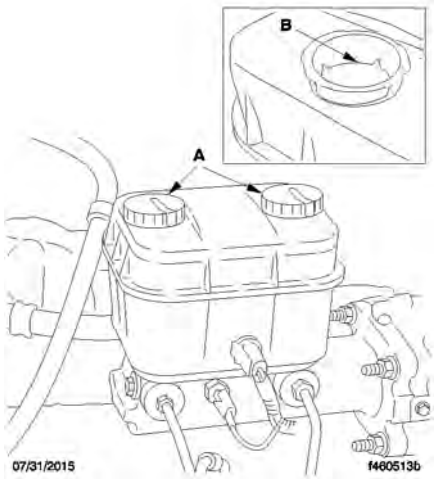
NOTICE:
To prevent transmission and axle damage, make sure the automatic transmission is in high range when performing an axle shift with the vehicle moving.

11. The service display illuminates if a fault is detected in the SBW system. Have a qualified technician inspect the SBW system as soon as possible.
12. A flashing select/monitor display indicates that the transmission (and not the SBW system) has inhibited a selected transmission operation. See the *Allison Transmission Operator's Manual* for more information.

11.03 Hydraulic Brake System

11.03.01 General Information

The hydraulic brake system includes a power booster, main cylinder, reservoir, hydraulic lines, a brake rotor on each wheel hub, and a brake caliper and pad assembly at each rotor. See Fig.167,Hydraulic Brake Reservoir.



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

Fig 167, Hydraulic Brake Reservoir

IMPORTANT: Make sure that the fluid level in the main cylinder reservoirs is at the bottom of the fill-neck. Use only heavy-duty brake fluid, DOT 3, in the hydraulic brake system. Do not mix types and brands of fluid because of possible incompatibility.

The main cylinder controls braking power to the front and rear brakes. The Bendix Hydro-Max® power booster is attached to the rear of the main cylinder and is connected to the power steering system (which provides pressurized power steering fluid). An electrically powered "reserve" pump operates if there is inadequate fluid flow from the power steering pump to the power booster. The brake system warning light comes on if there is a problem within the system. Bring the vehicle to a safe stop and correct the problem before continuing operation of the vehicle.

11.03.02 Meritor WABCO® Antilock Braking System (ABS), Hydraulic Brake Systems

WARNING:
Although the ABS improves vehicle control during emergency braking situations, the driver still has the responsibility to change driving styles depending on existing traffic and road conditions. Failure to change driving styles to accommodate existing traffic and road conditions could cause an accident, possibly resulting in personal injury or death, or property damage.

The Meritor WABCO Antilock Braking System (ABS) is an electronic wheel speed monitoring and control system that works with the hydraulic brake system. ABS 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 hydraulic brake system is in effect.

IMPORTANT: For proper ABS operation, do not mismatch tire sizes among any of the tires on the vehicle. Mismatching tire sizes could result in a reduced braking force, leading to longer stopping distances and cause an ABS event to register on the electronic control unit (ECU).

WARNING:
An accumulation of road salt, dirt, and debris on the ABS tone wheels and sensors can cause the ABS warning light to illuminate. If the ABS light illuminates while driving, have the ABS serviced. Operating the vehicle when the ABS needs to be serviced could cause an accident, possibly resulting in personal injury or death, or property damage.

IMPORTANT: During winter months in areas where corrosive materials are used on the highways, periodically clean the underside of the vehicle to ensure proper ABS functioning. The required frequency of cleaning will vary with conditions. In general, do not allow corrosive materials to remain on the underside of the vehicle for extended periods of time.

The electronic control unit monitors the wheel sensors, solenoid control valves, and the electrical circuitry. The ABS warning light illuminates after turning the ignition switch to the ON position. The warning light goes out only if all of the vehicle's ABS components are working properly.

The Meritor WABCO ABS combines one front-axle control channel with the rear axle (four sensor system) to form one control circuit. For example, the sensor and solenoid control valve at the left-front axle form a control circuit with the sensor and solenoid valve on the right-rear axle. If, during vehicle operation, the safety circuit senses a failure in any part of the ABS (a sensor, solenoid control valve, wiring connections, short circuit, etc.), the ABS warning light illuminates and the control circuit where the failure occurred is switched to normal braking action. The remaining control circuit will retain the ABS effect. *Even if the ABS is partially or completely inoperative, normal braking ability is maintained* . An exception would be if a solenoid control valve (or combination solenoid control valve) is damaged and inoperative. As these components are an integral part of the air brake system, normal braking may be impaired or inoperative.

WARNING:
If any of the ABS warning lights do not work as described above or illuminates while driving, repair the ABS immediately to ensure full antilock braking capability. Operating the vehicle when the ABS needs to be serviced could cause an accident, possibly resulting in personal injury or death, or property damage.

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

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 parking brake. If the warning light does not go off, correct the problem before continuing operation of the vehicle.

During normal brake stops, depress the foot brake control pedal until braking action slows down the vehicle. Increase or decrease the pressure on the pedal so that the vehicle comes to a smooth, safe stop. When the vehicle comes to a complete stop, shift the transmission into park (P) on the shifter and apply the parking brake.

NOTICE:

If the vehicle is equipped with an air suspension system, do not park the vehicle or move the vehicle with the air suspension deflated. This may cause suspension component damage.

11.03.03 Auto-Apply Parking Brake Operation

Use the following instructions to operate the parking brake:

IMPORTANT: The service brake must always be depressed when shifting from the parking brake (Pb) position.

- Set by pressing (Pb) on the shift selector.
- To release the parking brake, depress the service brake and shift from the "Pb" position to any drive gear.
- Shifting from "Pb" to a drive gear and then to neutral (N) releases the parking brake and places the vehicle in neutral. The "BRAKE" warning light will flash when this procedure is performed.
- Shifting directly from "Pb" to "N" does not release the parking brake. "Pb" must be depressed, then a drive gear must be selected to release the parking brake. The "BRAKE" warning light will flash and a chime will sound when this procedure is performed.

11.04 Exhaust Aftertreatment System (ATS)

11.04.01 General Information

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.

NOTICE:

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

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

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.

11.04.02 EPA07 Engines

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

11.04.03 EPA10 and Newer Engines

General Information

To meet EPA guidelines, engines that are compliant with EPA10 and newer regulations use an ATS that has, in addition to a DOC/DPF device like that used in an EPA07 ATD, a Selective Catalytic Reduction (SCR) device to reduce NOx downstream of the engine.

After exhaust gases leave the 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. Passive regen occurs when the engine is running under load and regen occurs without input. 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 reduce 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.

The exhaust temperature can remain high even after the vehicle has stopped. When stopping the vehicle shortly after an automatic regen, ensure the exhaust outlets are directed away from structures, trees, vegetation, flammable materials, and anything else that may be damaged or injured by exposure to high heat.

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.

After the exhaust stream passes through the ATD, it flows through another canister housing the SCR device. A controlled quantity of diesel exhaust fluid (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.

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.168,Diesel Particulate Filter (DPF) Lamp.

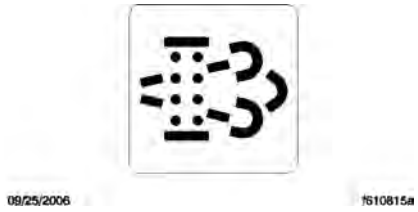


Fig 168, Diesel Particulate Filter (DPF) Lamp

- A slow, 10-second flashing of the high exhaust system temperature (HEST) lamp alerts the driver that a parked regen is in progress, but the exhaust temperatures are still relatively cool. It also indicates that the high-idle speed is being controlled by the engine software, not the driver. See Fig.169,High Exhaust System Temperature (HEST) Lamp.



Fig 169, 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.
- An illuminated DEF warning lamp in the gauge, indicates that the DEF tank should be refilled at the next opportunity.

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. 170,Exhaust-Aftertreatment Warnings Reference Label.

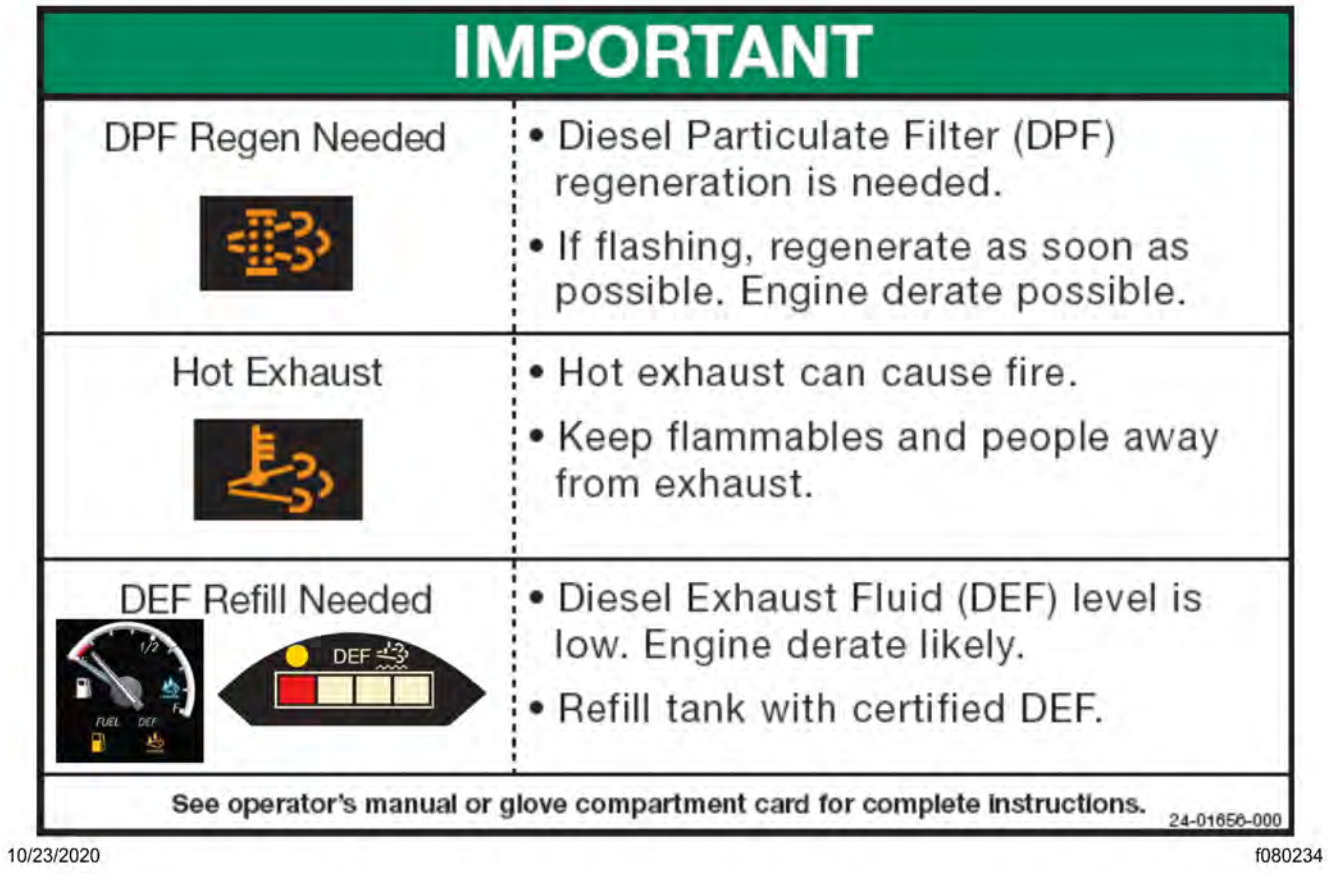


Fig 170, Exhaust-Aftertreatment Warnings Reference Label

IMPORTANT: The vehicle can have two different ways to initiate a parked regen, depending on the body builder. If there is not a regen switch on the dash, go to the *Shorting Plug* section.

The regen switch, located on the dash, is used to initiate a parked regen of the aftertreatment device. See Fig. 171,Regen Switch.



Fig 171, Regen Switch

NOTE: The DPF lamp must be illuminated before the regen switch will initiate a parked regen.

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.

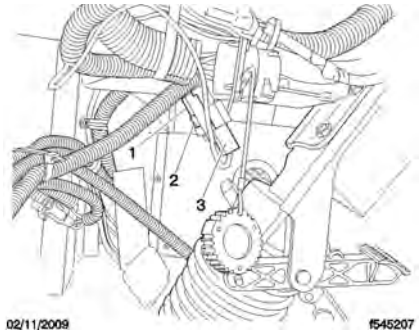
   IMPORTANT: The driver must remain with the vehicle during the entire regen cycle.

3. Press and hold the regen switch for 4 seconds. The engine will increase rpm and initiate the regen process
4. 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.
5. To stop a parked regen at any time during the process, engage the clutch, brake, or accelerator pedal, or turn off the engine.

Shorting Plug

NOTE: The DPF lamp must be illuminated before the shorting plug will initiate a parked regen.

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.172,Shorting Plug.



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

Fig 172, 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.
3. Disconnect the shorting plug, as follows.
   - 3.a Slide the secondary red lock away from the white cover. See Fig.172,Shorting Plug, Item 2.
   - 3.b Push the primary lock in. See Fig.172,Shorting Plug, Item 1.
   - 3.c Pull the plug apart. See Fig.172,Shorting Plug, Item 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. The DPF light 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.

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.

11.04.04 Diesel Exhaust Fluid and Tank, EPA10 and Newer Engines

Diesel Exhaust Fluid

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

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

DEF consumption varies depending on ambient conditions and vehicle application.

Freezing Conditions

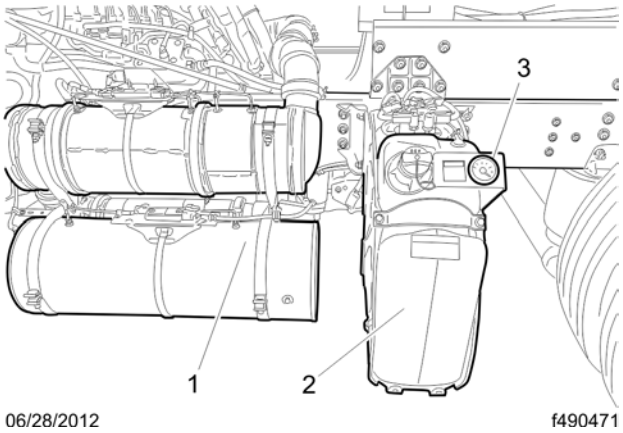
DEF freezes to slush at around 12°F (-11°C). It is not damaged or destroyed if frozen, and is fully usable when thawed. The DEF in the tank is allowed to freeze while a vehicle is non-operational. At start-up, normal operation of the vehicle is not inhibited if the DEF is frozen; an immersion heater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

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

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

DEF Tank

Engines that are compliant with EPA10 and newer regulations are equipped with a DEF tank located forward of the ATS. See Fig.173,DEF Tank With Optional DEF Gauge. 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.



1. ATS
2. DEF Tank
3. DEF Gauge (optional)

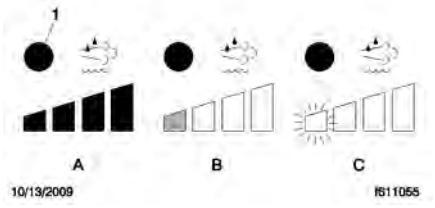
Fig 173, DEF Tank With Optional DEF Gauge

The DEF tank has a 10-gallon capacity and will require filling a minimum of approximately every second diesel refuel. 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.

11.04.05 Fuel/DEF Gauge

The fuel and DEF levels are measured in a dual purpose fuel/DEF gauge. See Fig.174,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 bars—DEF level indicators.
B. One bar illuminated amber—DEF low, refill DEF.
C. One bar flashing red—DEF empty, refill DEF.
1. Low DEF Warning Lamp

Fig 174, 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 green—Between 75% and 100% full
- Three bars illuminated green—Between 50% and 75% full
- Two bars illuminated green—Between 25% and 50% full
- One bar illuminated green—Between approximately 10% and 25% full
- One bar illuminated amber—DEF very low, refill DEF
- One bar flashing red—DEF empty, refill DEF

11.04.06 DEF Warnings and Engine Limits

IMPORTANT: Ignoring the DEF warning lights and not refilling the DEF will result in limited engine power with a speed limit of 5 mph (8 km/h) eventually being applied. See the engine operation manual for further information.

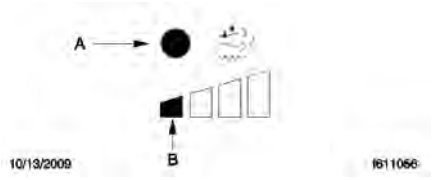
DEF Level Low—Initial and Critical Warnings

When the DEF level reads low the following warnings strongly encourage the driver to refill the DEF tank. See Fig. 175,DEF Level Low Initial and Critical Warnings.

- 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.

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 solid amber)

Fig 175, DEF Level Low Initial and Critical Warnings

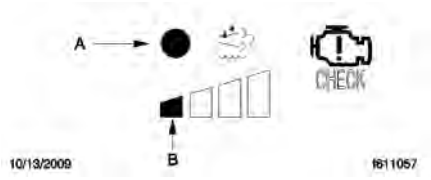
DEF Empty

When the DEF level reads empty, the following lamps notify the driver. See Fig.176,DEF Empty Warning.

- The DEF warning lamp flashes.
- The CHECK engine lamp illuminates.
- One bar of the DEF-level lightbar flashes red.
- A brief audible alert notifies the driver.

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 176, 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. A brief audible alert notifies the driver. See Fig.177,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).

A. DEF Warning Lamp (flashing)

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

Fig 177, DEF Empty and Ignored Warning

DEF Quality or SCR Tampering

NOTICE

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 light and engine limits.

If contaminated DEF or tampering is detected, the DEF warning light flashes, and engine power is limited with progressively harsher limits applied. If the fault is not corrected, the STOP engine light illuminates and a 5 mph (8 km/h) speed limit is applied after the next engine shutdown, or while parked and idling. See Fig.177,DEF Empty and Ignored Warning.

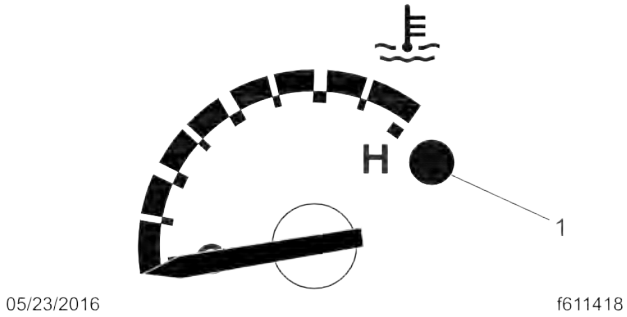
11.05 Gauges

11.05.01 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 in the normal range between cold and hot. See Fig.178,Coolant Temperature Gauge. If the temperature remains below or exceeds the normal range, inspect the cooling system to determine the cause.

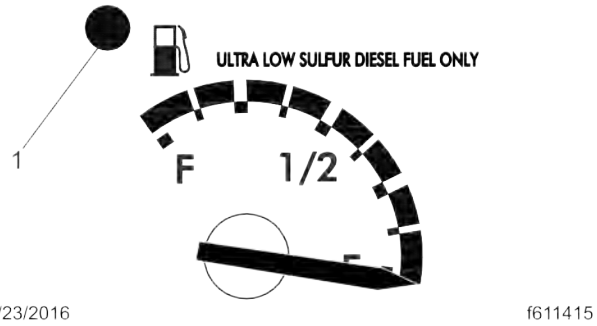


1. High Coolant Temperature Warning Lamp

Fig 178, Coolant Temperature Gauge

11.05.02 Fuel Level Gauge

The fuel level gauge indicates the level of fuel in the fuel tank(s). See Fig.179,Fuel Gauge, EPA10 and Newer Engines. For more detailed information on the fuel gauge used with EPA10 and newer engines, see *Diesel Exhaust Fluid and Tank, EPA10 and Newer Engines* . One fuel gauge is standard. If equipped with a second (optional) fuel gauge, each fuel tank level is indicated on a separate gauge.



1. Low Fuel Level Warning Lamp

Fig 179, Fuel Gauge, EPA10 and Newer Engines

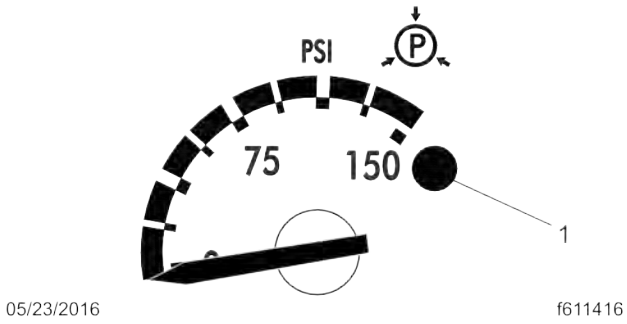
11.05.03 Primary and Secondary Air Pressure Gauges

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.

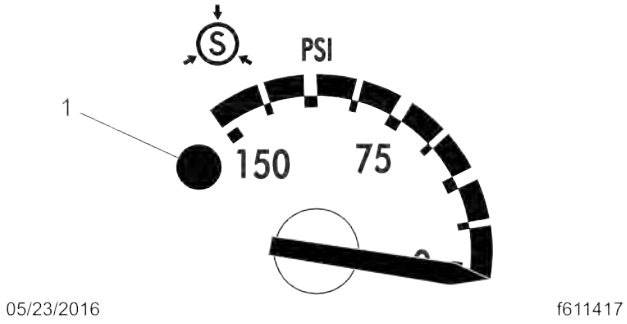
Air pressure gauges register the pressure in the primary and secondary air systems. See Fig. 180,Primary Air Pressure Gauge and see Fig.181,Secondary Air Pressure Gauge. Normal pressure with the engine running is 100 to 120 psi (690 to 827 kPa) in both systems.

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).



1. Low Air Pressure Warning Lamp

Fig 180, Primary Air Pressure Gauge

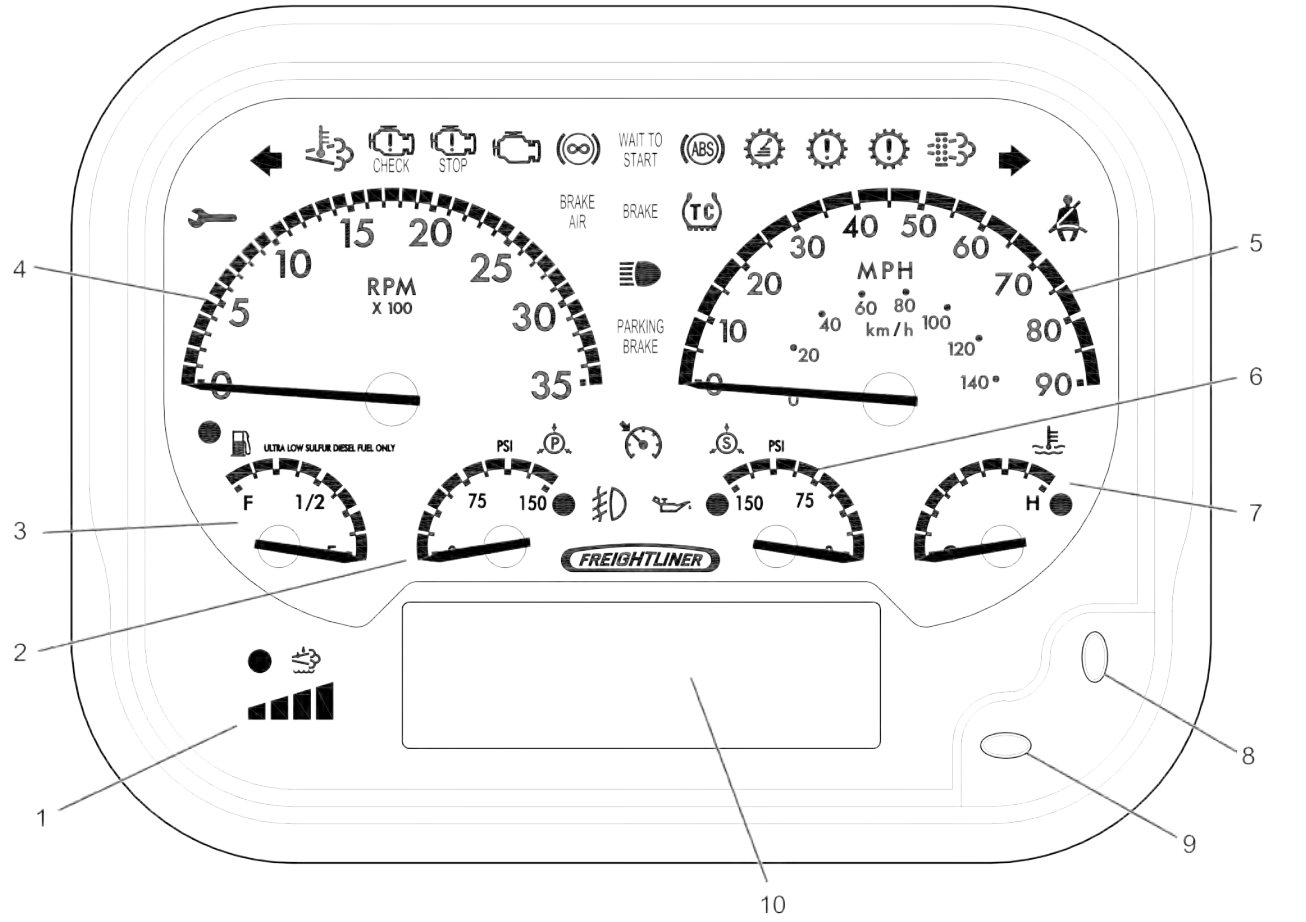


1. Low Air Pressure Warning Lamp

Fig 181, Secondary Air Pressure Gauge

11.05.04 Speedometer

The speedometer indicates vehicle speed in miles per hour (mph) or kilometers per hour (km/h). See Fig. 182,Typical Instrument Panel Front-Engine, EPA10 and Newer Engines, Item 5.

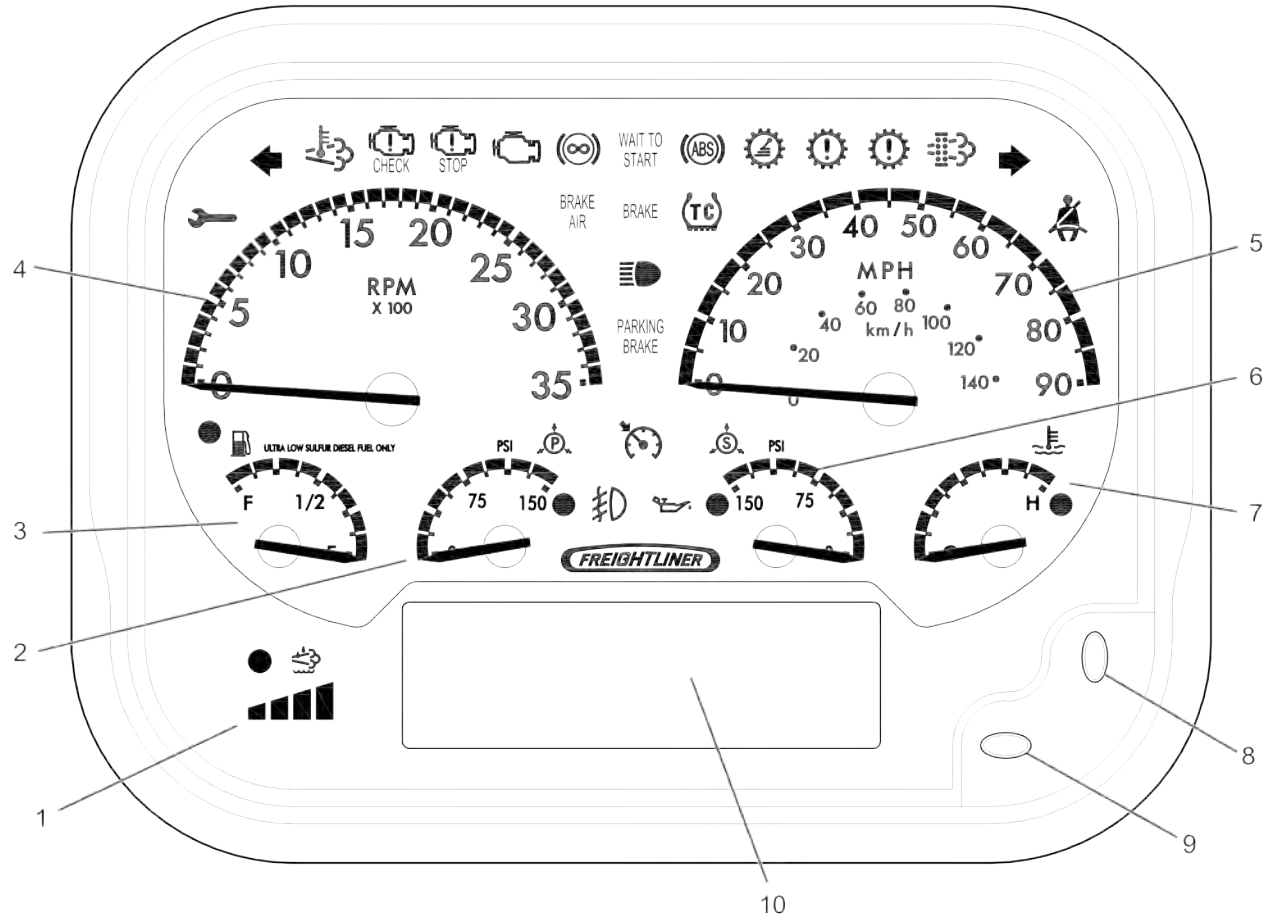


1. Diesel Exhaust Fluid (DEF) Gauge
2. Primary Air Pressure Gauge
3. Fuel Gauge
4. Tachometer
5. Speedometer
6. Secondary Air Pressure Gauge
7. Coolant Temperature Gauge
8. Toggle Button, Right
9. Toggle Button, Down
10. Message Display Center

Fig 182, Typical Instrument Panel Front-Engine, EPA10 and Newer Engines

11.05.05 Tachometer

The tachometer indicates the revolutions per minute (rpm) of the engine. See Fig. 183,Typical Instrument Panel Front-Engine, EPA10 and Newer Engines, Item 4.



1. Diesel Exhaust Fluid (DEF) Gauge
2. Primary Air Pressure Gauge
3. Fuel Gauge
4. Tachometer
5. Speedometer
6. Secondary Air Pressure Gauge
7. Coolant Temperature Gauge
8. Toggle Button, Right
9. Toggle Button, Down
10. Message Display Center

Fig 183, Typical Instrument Panel Front-Engine, EPA10 and Newer Engines

11.05.06 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.

11.06 Optional Instruments

11.06.01 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.

The intake-air restriction indicator measures the vacuum on the engine side of the air cleaner at the air cleaner outlet. See Fig.184,Air Intake Restriction Gauge. On standard installations, it is mounted on the intake air piping in the engine compartment.



Fig 184, Air Intake Restriction Gauge

Air intake restriction vacuum is measured in inches of water (inH_2O). For vehicles equipped with a graduated indicator or a restriction gauge on the dash, check the gauge with the engine off. If the yellow signal stays locked in the red zone once the engine is shut down, or is at or above the maximum restriction value in Table.9,Air Intake Maximum Restriction Values (in-H2O) , replace the air cleaner element.

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

Table 9, Air Intake Maximum Restriction Values (inH2O)

Air Intake Maximum Restriction Values (inH2O)		
Engine Make	**EPA07 and EPA10 Engines**	**GHG14, GHG17, and GHG21 Engines**
Cummins	25	25
Detroit	22	18

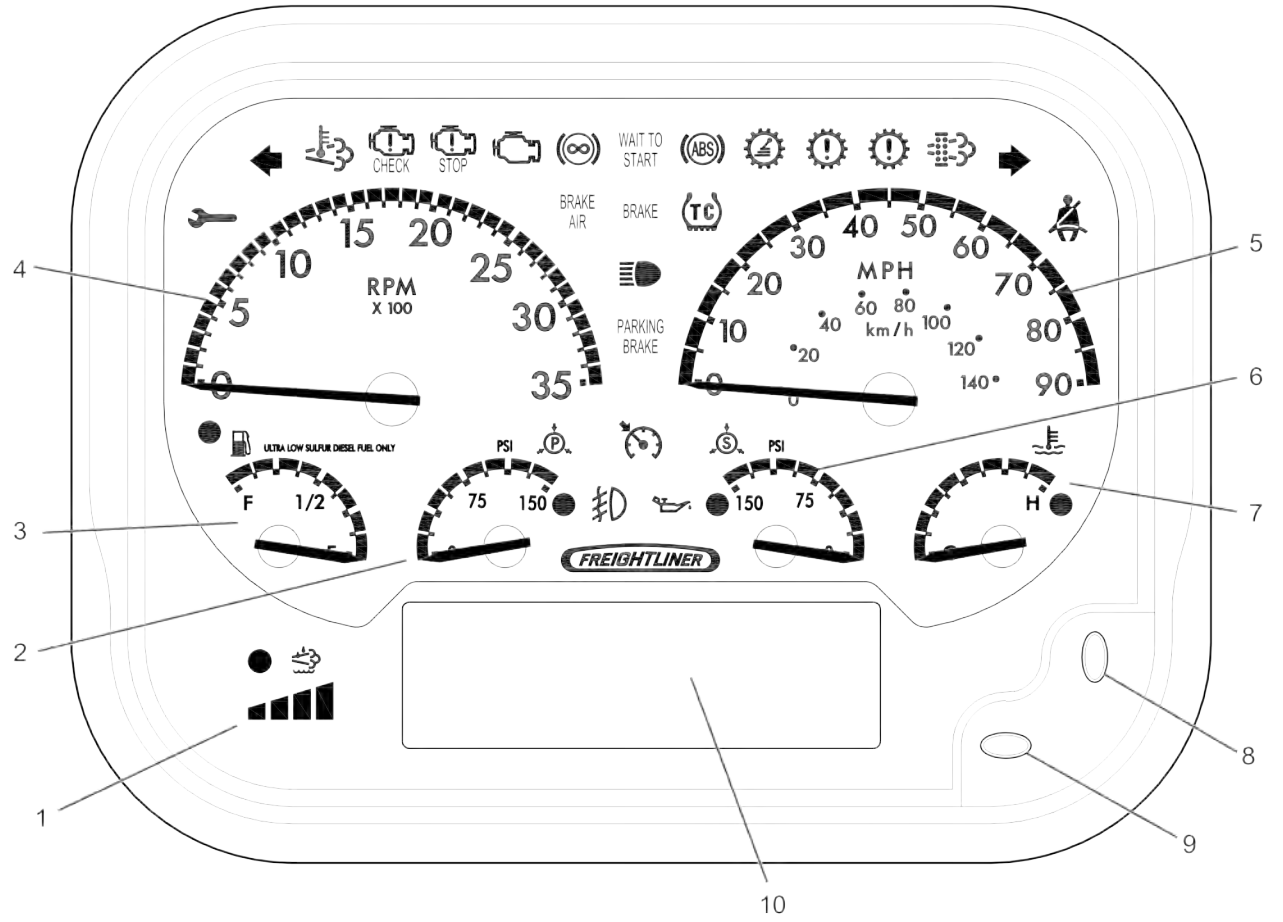
Table 9, Air Intake Maximum Restriction Values (inH2O)

11.07 Ametek Instrument Panel

11.07.01 Message Display Center

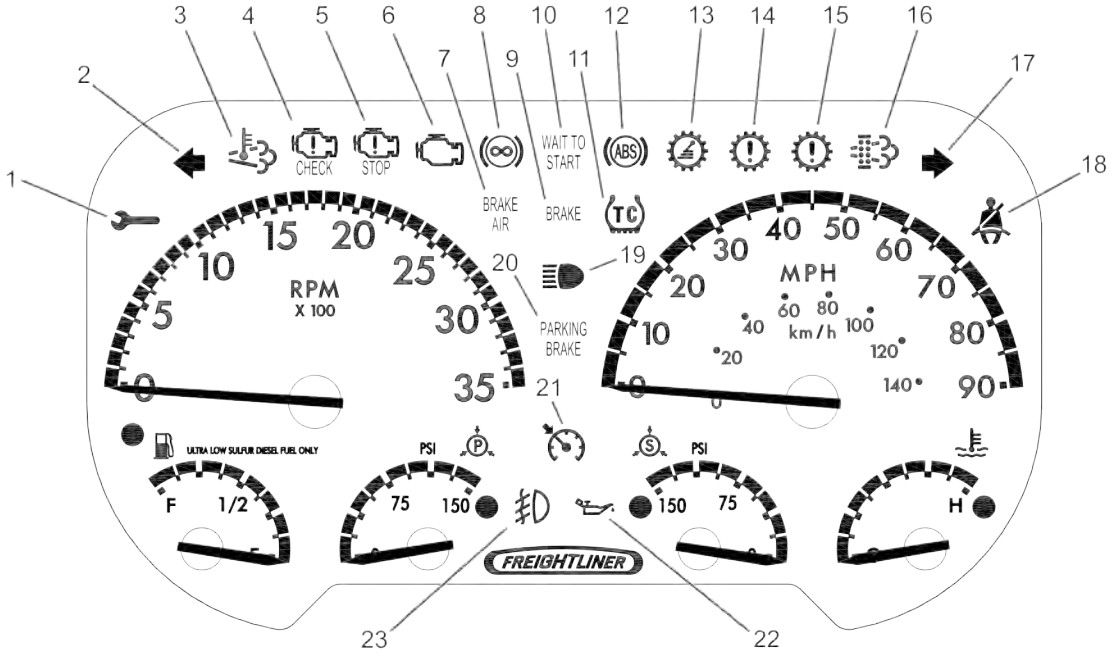
The following information describes a typical instrument panel manufactured by Ametek. See Fig. 185,Typical Instrument Panel Front-Engine, EPA10 and Newer Engines for a typical instrument gauge panel, and see Fig. 186,Ametek Warning Lamps Front-Engine, EPA10 and Newer Engines for the Ametek warning lamps. See 5.01.01 General Description for detailed warning lamp descriptions.

NOTE: These instrument panels are shown with a standard U.S. speedometer, which shows miles per hour (mph) more prominently than kilometers per hour (km/h).



1. Diesel Exhaust Fluid (DEF) Gauge
2. Primary Air Pressure Gauge
3. Fuel Gauge
4. Tachometer
5. Speedometer
6. Secondary Air Pressure Gauge
7. Coolant Temperature Gauge
8. Toggle Button, Right
9. Toggle Button, Down
10. Message Display Center

Fig 185, Typical Instrument Panel Front-Engine, EPA10 and Newer Engines



1. Maintenance Warning
2. Left-Turn Indicator
3. High Exhaust System Temperature (HEST) Lamp
4. Check Engine Warning
5. Stop Engine Warning
6. Malfunction Indicator Lamp (MIL)
7. Air Brake Warning
8. Engine Brake Indicator
9. Hydraulic Brake System Warning
10. Wait to Start Indicator
11. Automatic Traction Control Indicator
12. ABS Warning
13. Shift Inhibit Indicator
14. Transmission Warning
15. Stop Transmission (hybrid only)
16. Diesel Particulate Filter (DPF) Lamp
17. Right-Turn Indicator
18. Fasten Seat Belt Warning
19. Headlight High-Beam Indicator
20. Parking Brake On Warning
21. Cruise Control Indicator
22. Low Oil Pressure Warning
23. Fog Lamp Indicator

Fig 186, Ametek Warning Lamps Front-Engine, EPA10 and Newer Engines

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.

11.07.02 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.

11.07.03 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.

11.07.04 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.

- Setup—this 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.
- Maintenance—shows various maintenance intervals such as engine oil, air filter, etc.
- Diagnostics—this 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.187,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.188,Diagnostic Menu Screens—Screen 2, 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.

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.188,Diagnostic Menu Screens—Screen 2, 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.188,Diagnostic Menu Screens—Screen 2, 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.188,Diagnostic Menu Screens—Screen 2, 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.189,Diagnostic Menu Screens—Screen 3, 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. 189,Diagnostic Menu Screens—Screen 3, 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. 189,Diagnostic Menu Screens—Screen 3, 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.189,Diagnostic Menu Screens—Screen 3, 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 trouble-shooting. To navigate to the check analog input screen, see Fig.190,Ignition On—Normal Mode, screen AK.

Check Datalink

The check datalink screen allows the driver to view all devices that communicate on the J1939, J1587, and GMLAN data-links. To navigate to the check datalink screen, see Fig.190,Ignition On—Normal Mode, screen AL.

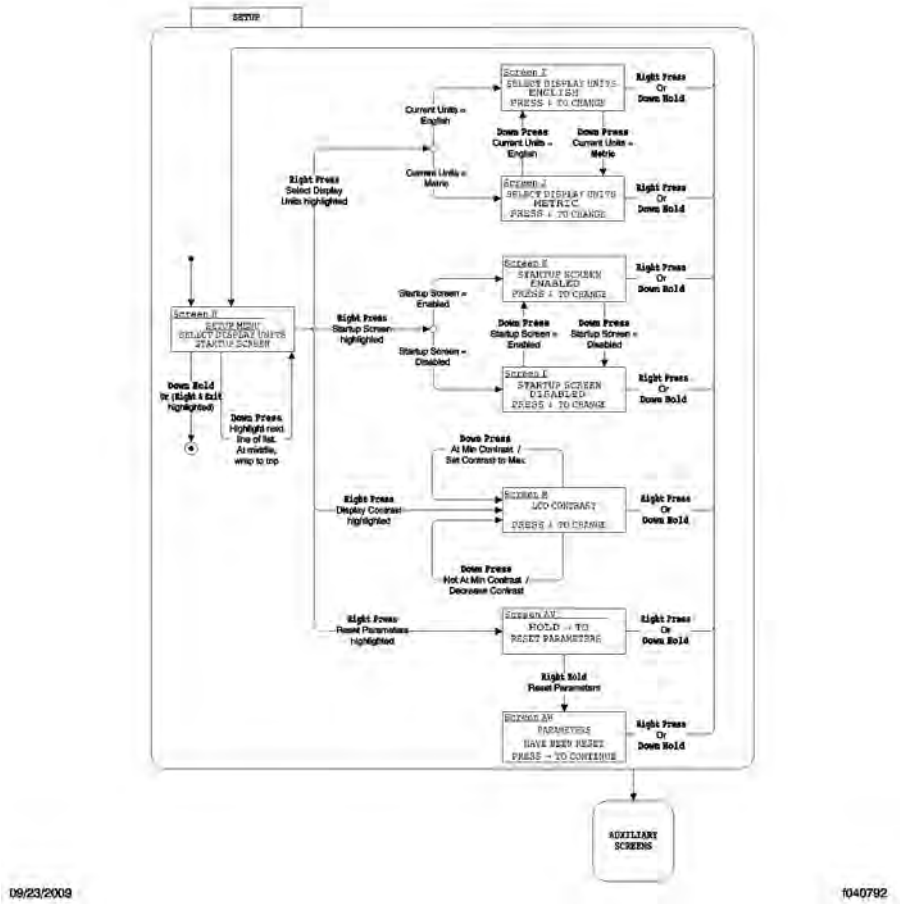


Fig 187, Setup Menu Screens

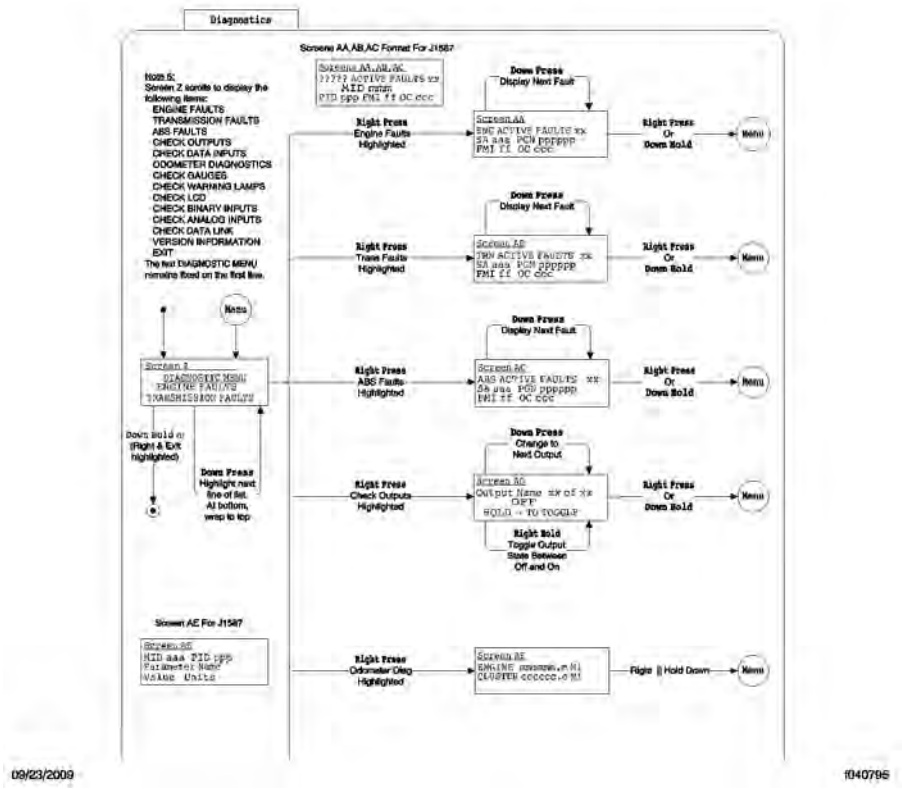


Fig 188, Diagnostic Menu Screens—Screen 2

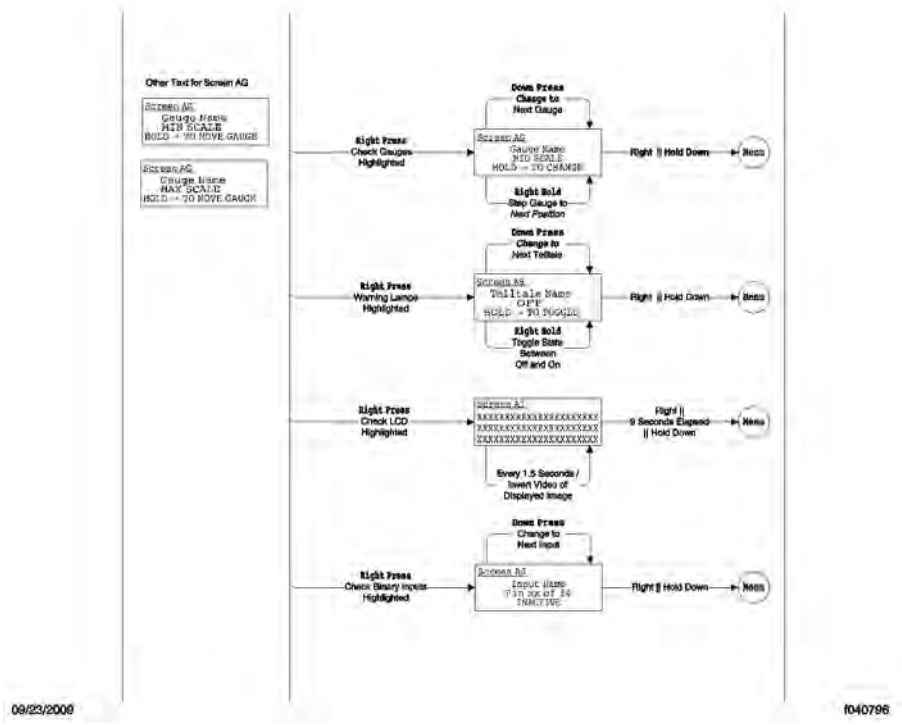


Fig 189, Diagnostic Menu Screens—Screen 3

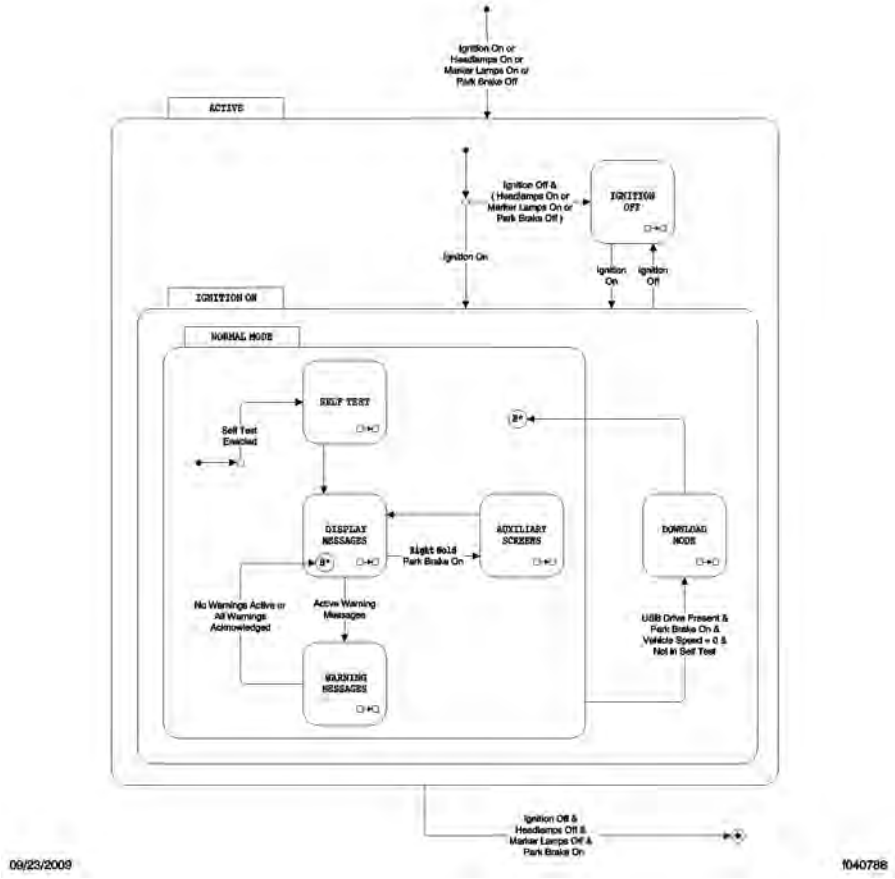


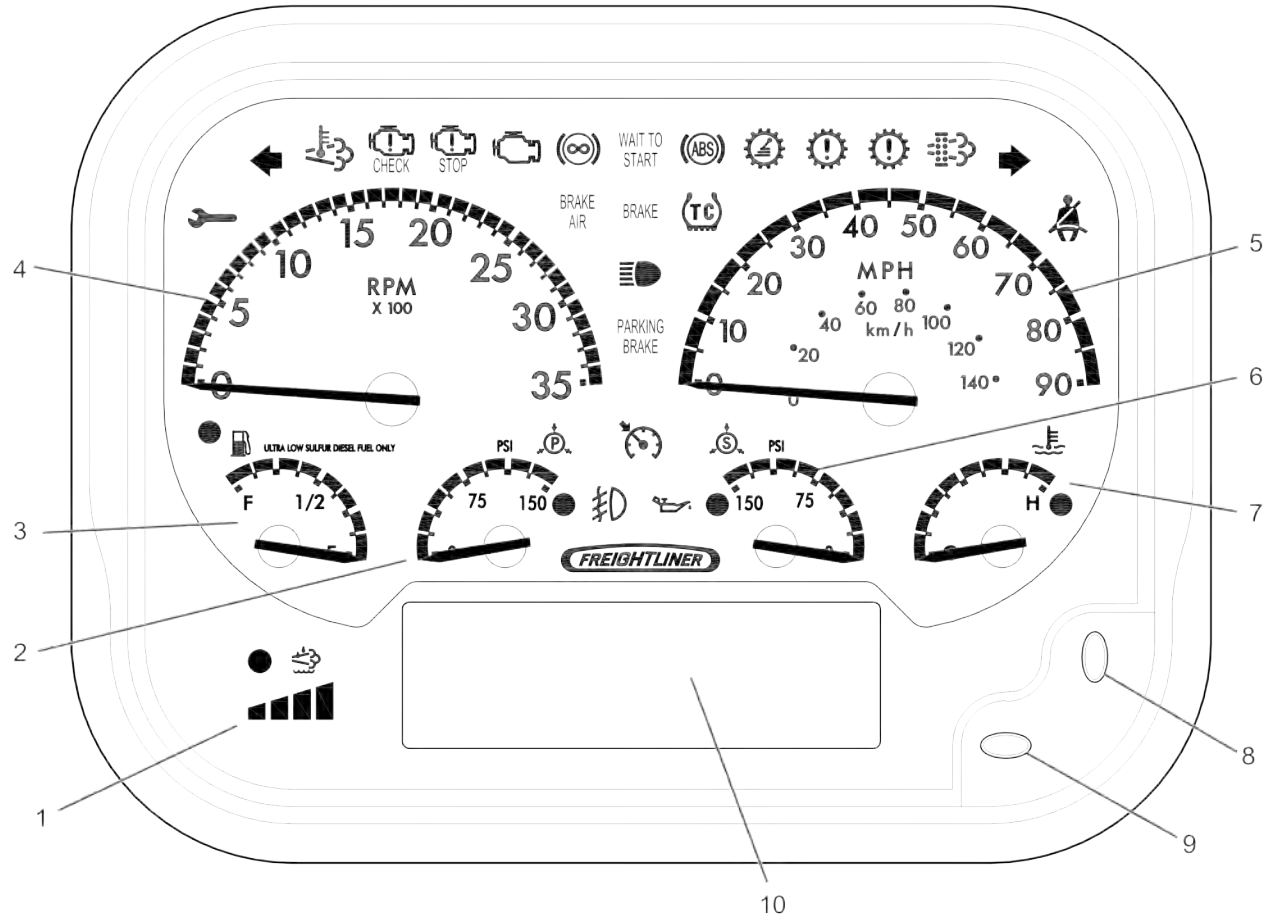
Fig 190, Ignition On—Normal Mode

11.07.05 Menu Navigation

The menu navigation road maps are provided to illustrate the screens that are available in 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. Refer to the road maps to change items shown in lines one, two, and three of the display screen, view the setup screens, diagnostics, etc. See Fig.193,Setup Menu Screens, see Fig.194,Diagnostic Menu Screens—Screen 2, see Fig. 195,Diagnostic Menu Screens—Screen 3, see Fig.196,Ignition On—Normal Mode, see Fig. 197,Self Test, Ametek Panel, see Fig.**Fig. 10.26** , see Fig.198,Display Messages, see Fig.199,Auxiliary Screens, see Fig. 200,Maintenance Menu Screens—Screen 1, see Fig.201,Maintenance Menu Screens—Screen 2, see Fig.202,Trip Data, see Fig.203,Warning Messages and see Fig.204,Ignition Off (shown when ignition is keyed OFF).

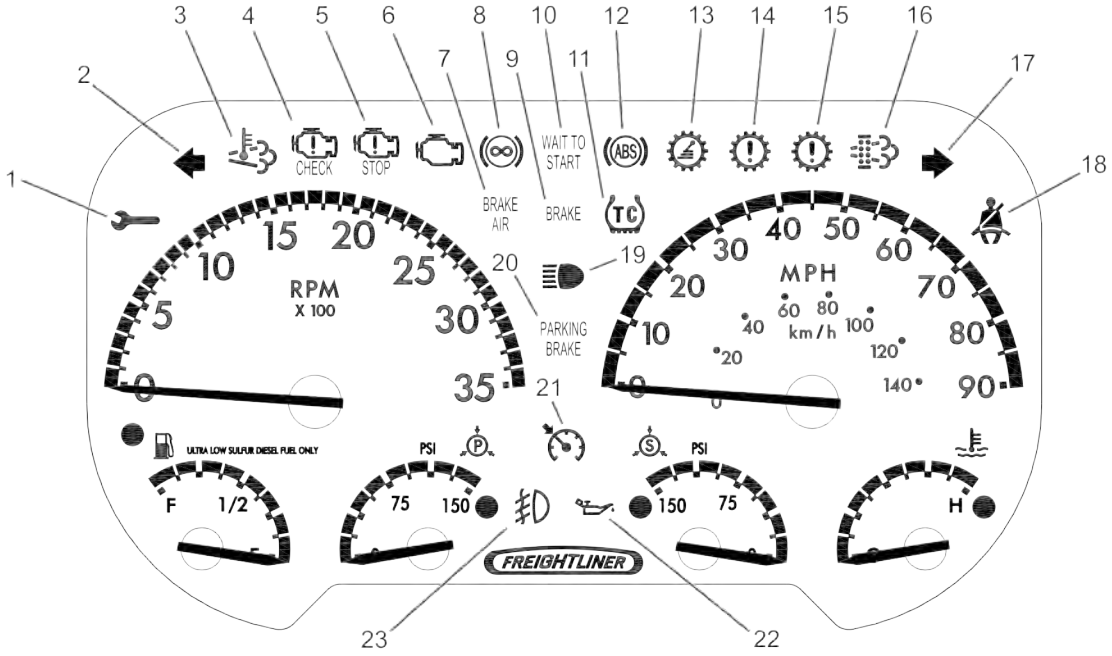
IMPORTANT: Follow the steps below to change the three items (also known as favorites) shown in the message display center. The message display center is referred to as screen C in see Fig.198,Display Messages.

1. With the vehicle in park, turn the ignition to ON, 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, see Fig.198,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. Diesel Exhaust Fluid (DEF) Gauge
2. Primary Air Pressure Gauge
3. Fuel Gauge
4. Tachometer
5. Speedometer
6. Secondary Air Pressure Gauge
7. Coolant Temperature Gauge
8. Toggle Button, Right
9. Toggle Button, Down
10. Message Display Center

Fig 191, Typical Instrument Panel Front-Engine, EPA10 and Newer Engines



1. Maintenance Warning
2. Left-Turn Indicator
3. High Exhaust System Temperature (HEST) Lamp
4. Check Engine Warning
5. Stop Engine Warning
6. Malfunction Indicator Lamp (MIL)
7. Air Brake Warning
8. Engine Brake Indicator
9. Hydraulic Brake System Warning
10. Wait to Start Indicator
11. Automatic Traction Control Indicator
12. ABS Warning
13. Shift Inhibit Indicator
14. Transmission Warning
15. Stop Transmission (hybrid only)
16. Diesel Particulate Filter (DPF) Lamp
17. Right-Turn Indicator
18. Fasten Seat Belt Warning
19. Headlight High-Beam Indicator
20. Parking Brake On Warning
21. Cruise Control Indicator
22. Low Oil Pressure Warning
23. Fog Lamp Indicator

Fig 192, Ametek Warning Lamps Front-Engine, EPA10 and Newer Engines

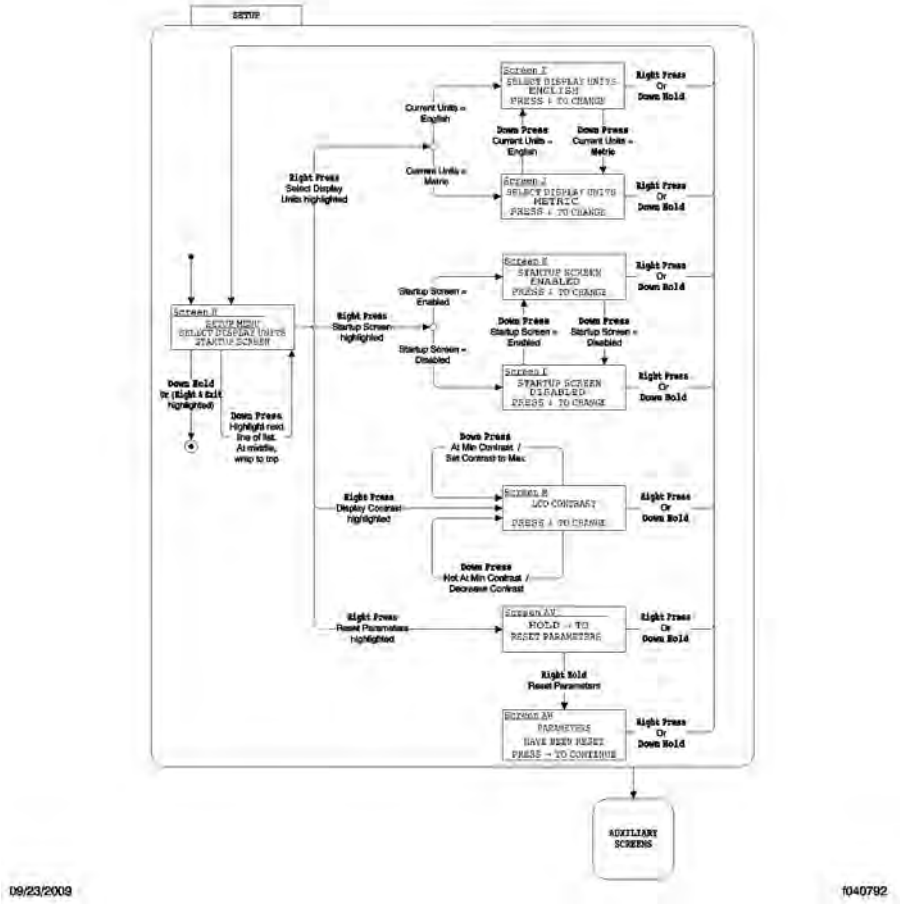


Fig 193, Setup Menu Screens

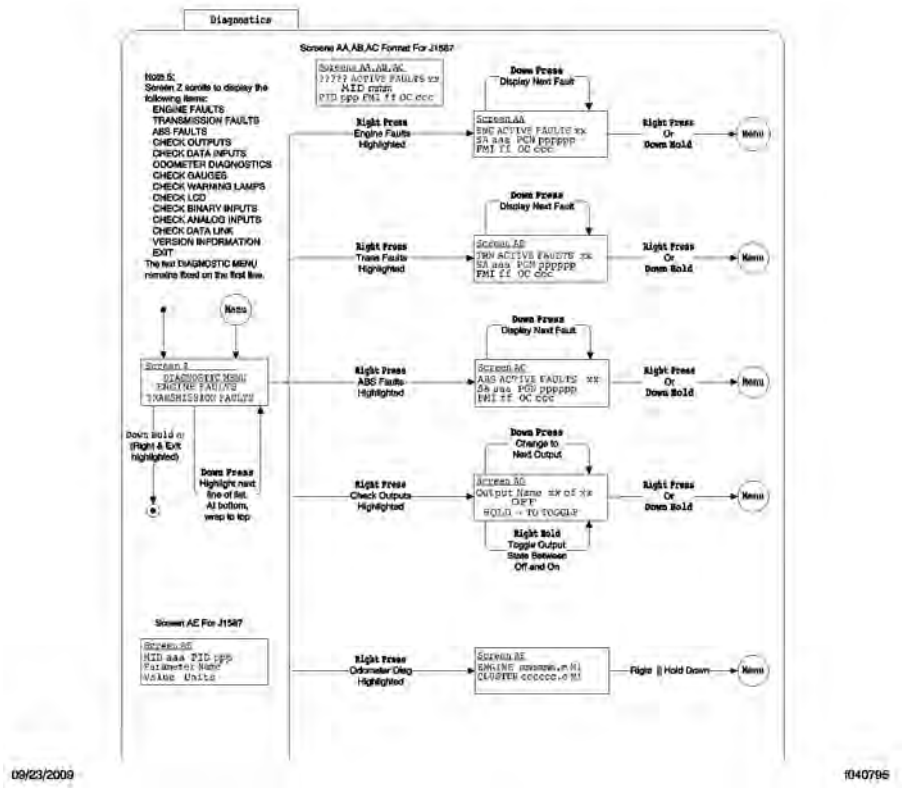


Fig 194, Diagnostic Menu Screens—Screen 2

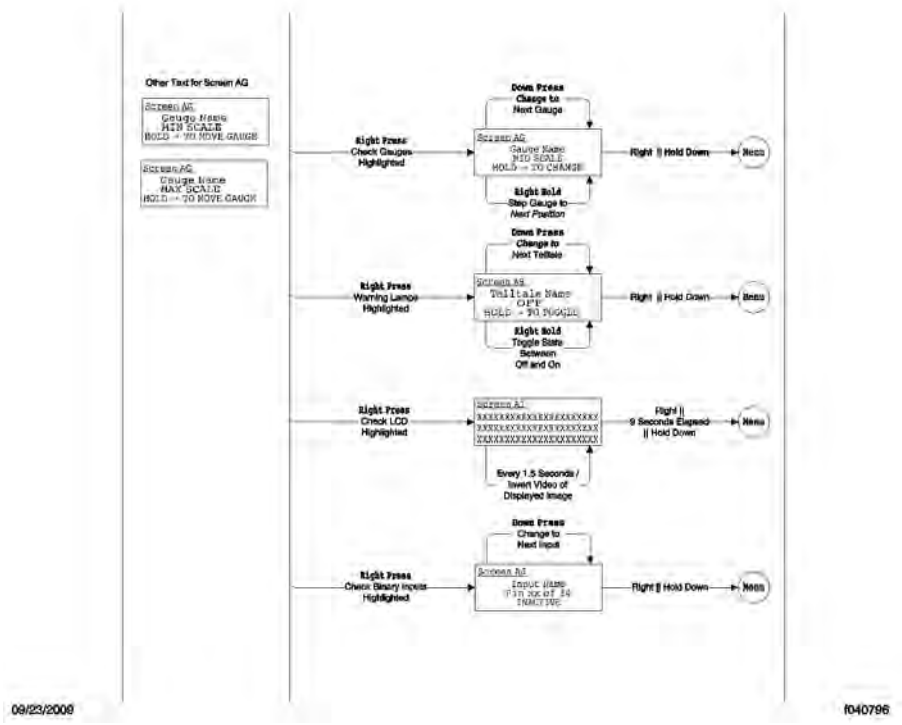


Fig 195, Diagnostic Menu Screens—Screen 3

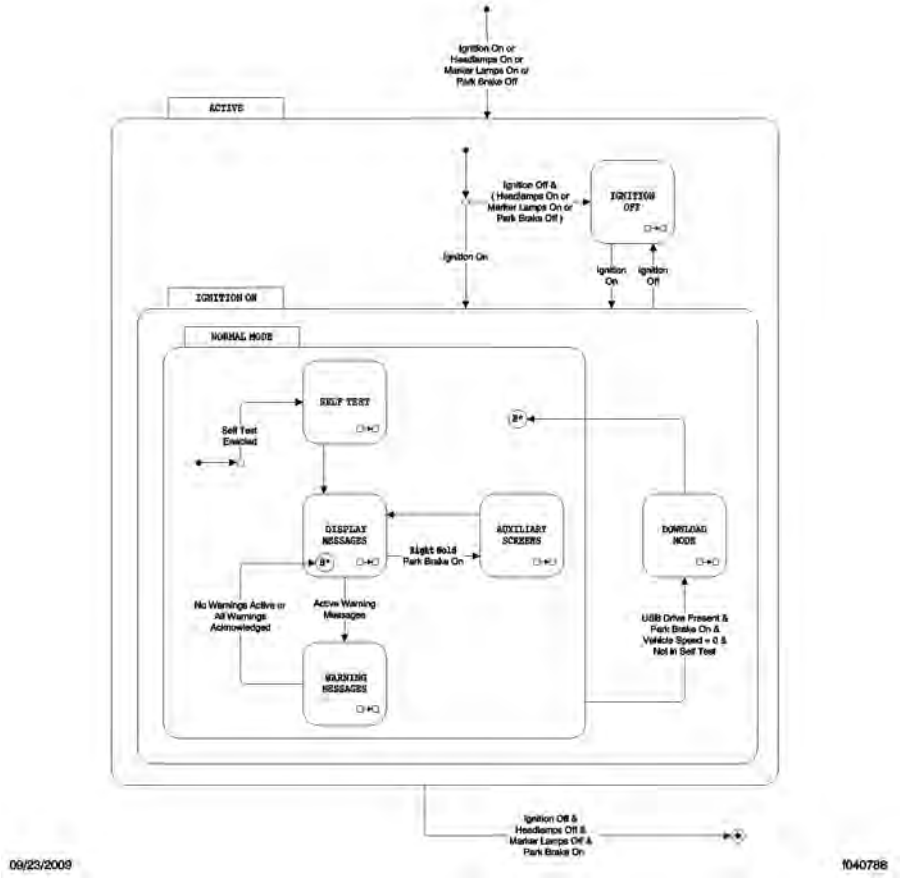


Fig 196, Ignition On—Normal Mode

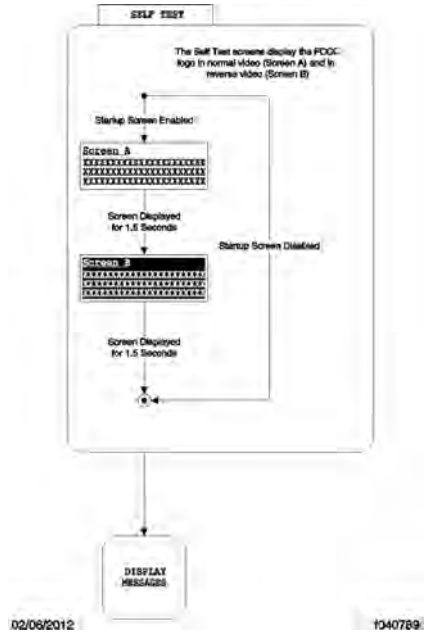


Fig 197, Self Test, Ametek Panel

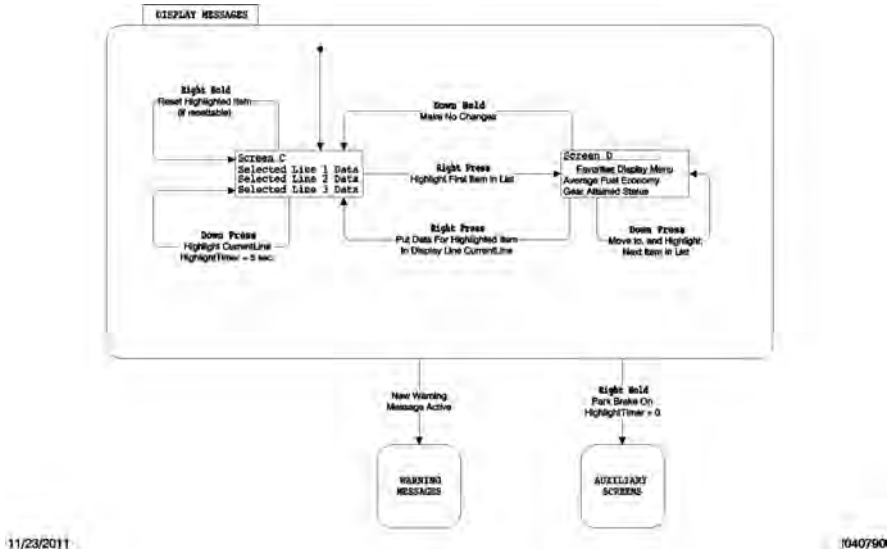


Fig 198, Display Messages

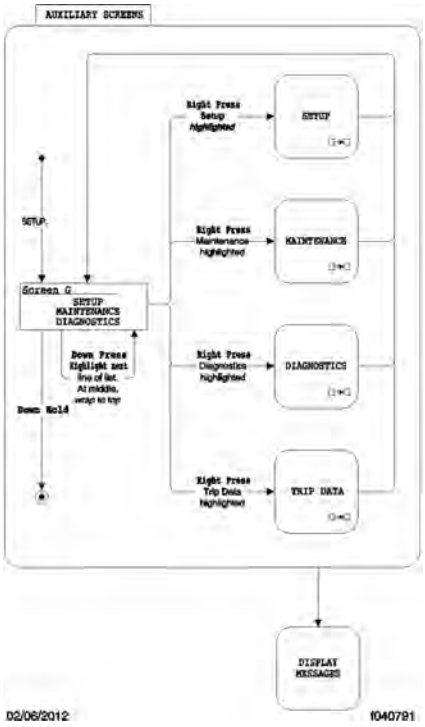


Fig 199, Auxiliary Screens

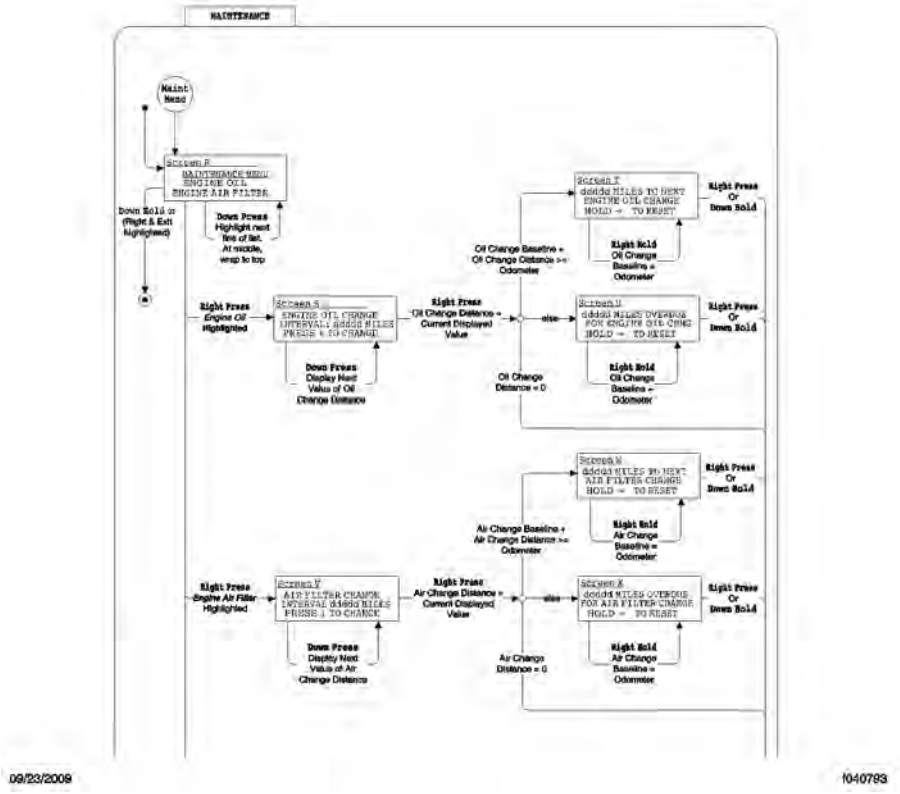


Fig 200, Maintenance Menu Screens—Screen 1

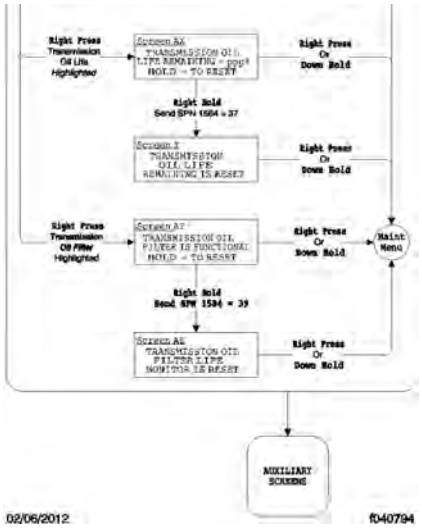


Fig 201, Maintenance Menu Screens—Screen 2

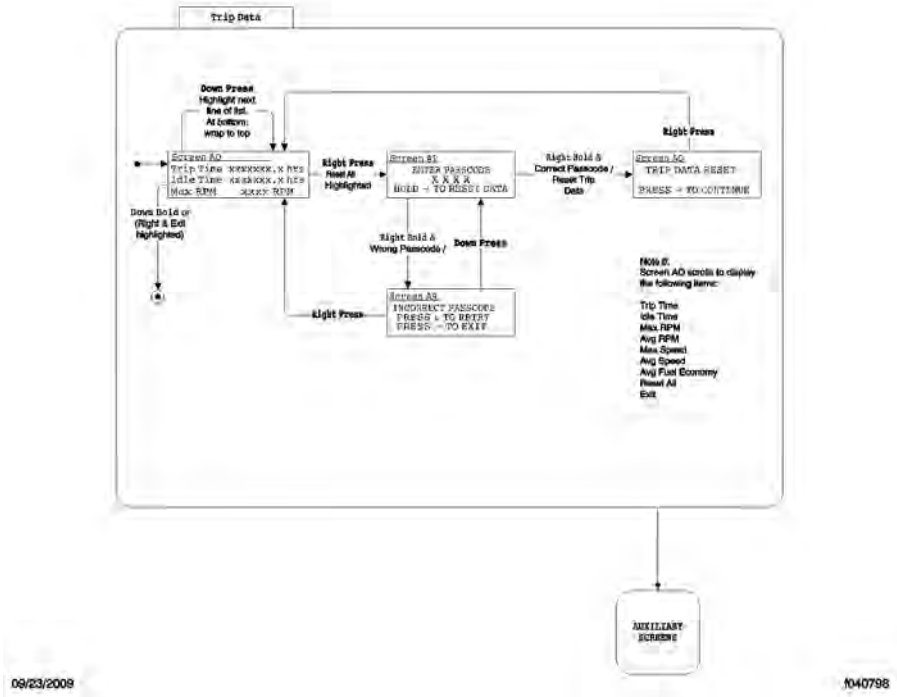


Fig 202, Trip Data

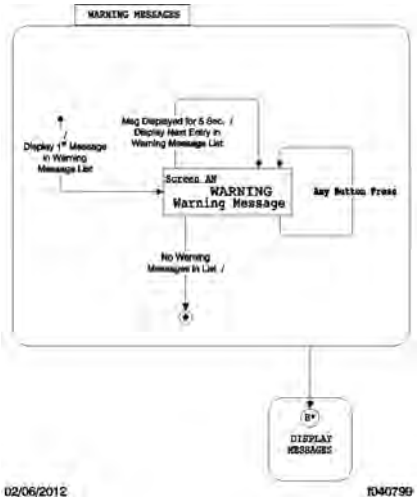


Fig 203, Warning Messages

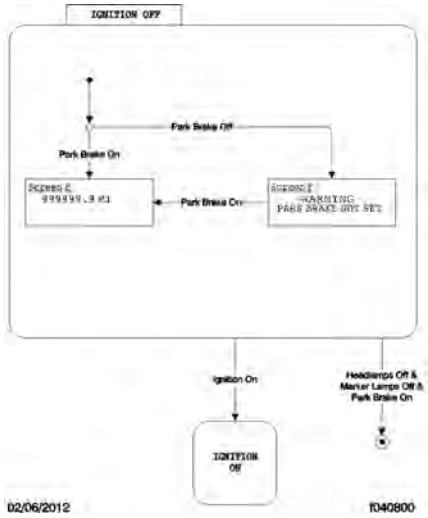


Fig 204, Ignition Off (shown when ignition is keyed OFF)

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12.02 Daily Pretrip Inspection and Maintenance Checklist 214
12.03 Weekly Post-Trip Inspection and Maintenance Checklist 216
12.04 Monthly Post-Trip Inspection and Maintenance Checklist 217

12. Pre- and Post-Trip Checklists

12.01 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 roadworthiness of a vehicle before placing it into service for the day.

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", see 13.01 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, take the vehicle to an authorized Freightliner dealer for assistance.

12.02 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.10,Daily Pretrip Inspection and Maintenance Checklist.

Table 10, 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
Check	_____	radiator and charge air cooler	D4
Inspect	_____	engine and chassis wiring	D5
Inspect	_____	air intake system	D6
Inspect	_____	intake-air restriction indicator mounted on air intake	D6

Check	_____	engine oil level	D7
Check	_____	power steering fluid level	D8
Check	_____	fuel tank(s), fuel lines, and connections	D9
Check	_____	fuel level	D10
Inspect	_____	fuel/water separator	D11
Check	_____	front and rear suspension components	D12
Check	_____	headlights, mirrors, and window glass, and windshield wipers	D13
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	D14
Check	_____	instrument panel warning lights	D15
Check	_____	ICU fault codes (front-engine diesel chassis)	D15
Check	_____	horn, windshield wipers, and windshield washer	D16
Inspect	_____	heater, defroster, and optional mirror heat controls	D17
Check	_____	panel lights and interior lights	D18
Check	_____	exterior lights and reflectors	D19
Check	_____	tire pressure	D20
Check	_____	tire condition	D20
Check	_____	rims and wheels	D21
Check	_____	automatic transmission fluid level	D22
Inspect	_____	air brake chambers and pushrods	D23
Inspect	_____	air brake lines	D24

Inspect	_____	slack adjusters	D25
Inspect	_____	air brake system operation	D26
Check	_____	frame rails (missing bolts), crossmembers (bent or loose)	–
Check	_____	Bendix Hydro-Max® brake booster (front-engine diesel chassis)	D27
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	D28
Inspector_____ Date _____			

Table 10, Daily Pretrip Inspection and Maintenance Checklist

12.03 Weekly Post-Trip Inspection and Maintenance Checklist

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.11,Weekly Post-Trip Inspection and Maintenance Checklist.

Table 11, 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	_____	drive belt condition	W4
Inspector_____ Date _____			

Table 11, Weekly Post-Trip Inspection and Maintenance Checklist

12.04 Monthly Post-Trip Inspection and Maintenance Checklist

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.12,Monthly Post-Trip Inspection and Maintenance Checklist.

Table 12, 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 3 brake fluid)	—
Check	_____	steering wheel play	M3
Check	_____	outer surfaces of the body (for visible surface breaks and damage)	—
Check	_____	hood tilt damper (attached at both ends)	—
Inspect	_____	brake lining wear	M4
Inspect	_____	driveshaft	—
Inspect	_____	(and lubricate if needed) Meritor Roller Pins; inspect the brake shoes	M5
Inspector_____ Date _____			

Table 12, Monthly Post-Trip Inspection and Maintenance Checklist

13.01 Safety Precautions 220
13.02 Daily Pretrip Inspection and Maintenance Procedures 220
13.03 Weekly Post-Trip Inspection and Maintenance Procedures 237
13.04 Monthly Post-Trip Inspection and Maintenance Procedures 238

13. Pre- and Post-Trip Inspections and Maintenance

13.01 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.

13.02 Daily Pretrip Inspection and Maintenance Procedures

Whenever equipment requires adjustment, replacement, and/or repair, take your vehicle to an authorized Freightliner dealer for assistance.

1. Drain manually drained brake system air reservoirs.

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

   1.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.

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.

Failure to drain the air reservoirs as instructed could cause sludge formation in the air brake system. Sludge could adversely affect braking, causing loss of control, which could cause death, personal injury, or property damage.

   1.b Exhaust the remaining air and moisture from the system by opening the drain cocks on the bottoms of the remaining air reservoirs, or pull the lanyard(s) until the air is exhausted.

   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.

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.

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

   Add washer fluid as needed.

3. Check the coolant level in the surge tank.

   If the coolant is low, Slowly add a 50/50 mixture of antifreeze and water to the surge tank; no more than 3.0 gallons per minute (gpm). Fill to the top of the surge tank. For approved coolants, refer to the coolant label on the vehicle or the engine manufacturer's service literature. Coolant used must be compatible with engine manufacturer’s coolant specifications. For Cummins approved coolants, refer to the engine manufacturer's service literature at *Cummins Online* athttps://www.cummins.com/support/manuals or scan the QR code. See Fig.205,Cummins QR Code. For Detroit™ engine service literature, refer to the *Detroit Diesel* link on the DTNA TechLit website https://www.dtnatechlit.com/portal-public or scan the QR code. See Fig.206,TechLit QR Code. Fill the surge tank with coolant to the MAX line when the tank is cool. If the surge tank was empty, start the engine after refilling, then check the level again when the engine is at operating temperature. See Fig.207,Surge Tank Fill Cap.



Fig 205, Cummins QR Code



Fig 206, TechLit QR Code

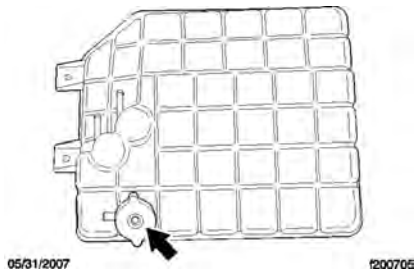


Fig 207, Surge Tank Fill Cap

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

4. Inspect the radiator and charge air cooler.
   - 4.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. Take the vehicle to an authorized Freightliner dealer for assistance.
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 to determine if the air cleaner needs to be changed. See Fig. 208,Air Restriction Indicator.

6.b If the yellow signal stays locked in the red zone once the engine is shut down, or is at or above the maximum restriction value in Table.13,Air Intake Maximum Restriction Values (inH2O) , replace the air cleaner element. Take the vehicle to an authorized Freightliner dealer for assistance.



Fig 208, Air Restriction Indicator

Table 13, Air Intake Maximum Restriction Values (inH2O)

Air Intake Maximum Restriction Values (inH2O)		
Engine Make	**EPA07 and EPA10 Engines**	**GHG14, GHG17 and GHG21 Engines**
Cummins	25	25
Detroit™	22	18

Table 13, Air Intake Maximum Restriction Values (inH2O)

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

6.c Inspect the air cleaner, and replace it when it becomes clogged or dirty.

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. Engine damage can occur if the air intake system is not properly maintained.

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: 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.209,Oil Dipstick .

For diesel engines that comply with EPA07 or newer regulations, use CJ-4 engine oil with less than 1% sulfated ash.

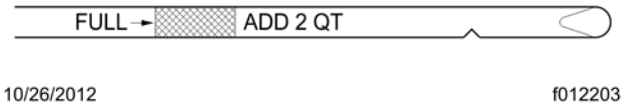


Fig 209, Oil Dipstick

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

8. *Check the fluid level in the steering system hydraulic fluid reservoir. See Fig.* 210,Steering System Hydraulic Fluid Reservoir*.*

If needed, fill the reservoir to a level between the MIN and MAX marks. Use only Dexron® III ATF, or an equivalent.

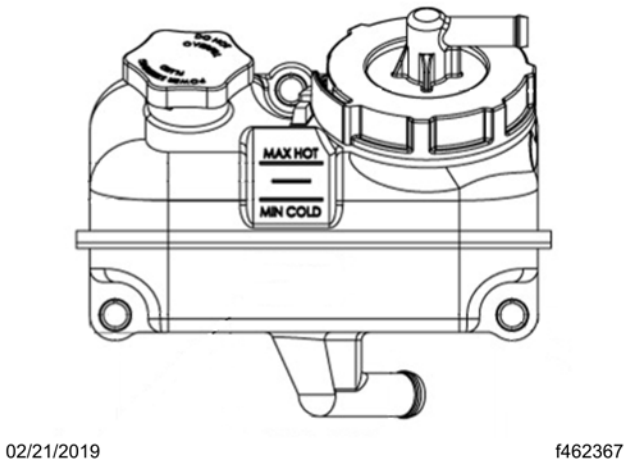


Fig 210, Steering System Hydraulic Fluid Reservoir

IMPORTANT: Do not confuse coolant with hydraulic fluid. Both are pink in color.

9. *Inspect the fuel tanks, fuel lines, and connections for leaks.*

   Replace leaking fuel tanks; repair or replace any mechanisms, lines, or connections that are leaking. Take the vehicle to an authorized Freightliner dealer for assistance.

10. *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:

Never fill fuel tanks to more than 95 percent of their liquid capacity. This could make them more likely to rupture from impact possibly causing fire and resulting in serious personal injury and death by burning. Do not mix gasoline or alcohol with diesel fuel. This mixture could cause an explosion, possibly resulting in serious personal injury or death. Do not fill the fuel tanks in the presence of sparks, open flames, or intense heat. These could ignite the fuel, possibly causing severe burns.

IMPORTANT: Use ultralow-sulfur diesel (ULSD) 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.



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 may be started again.

11. Check the fuel/water separator and drain any water present.

NOTE: The fuel/water separator may be relocated by the body manufacturer and the locations may vary.

- 11.a Shut off the engine.
- 11.b Remove the fuel cap.
- 11.c Open the valve until draining occurs. Drain the filter sump of water until clear fuel is visible.
- 11.d Close the drain and install the fuel cap.
- 11.e Run the engine and check for leaks.

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

- 12.a Check for broken spring leaves, loose U-bolts, cracks in the suspension brackets, and loose fasteners in the spring hangers and shackles.
- 12.b Inspect the shock absorbers for loose fasteners and leaks.
- 12.c Tighten all loose fasteners and have any components replaced that are worn, cracked, or otherwise damaged.
- 12.d On vehicles with air suspensions, check for leaks. Check air suspension components for cuts and bulges.

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

13. Clean the windshield, side, and rear windows with a long-handled or telescoping window cleaning device and standard cleaning solutions. Stand only on the ground, on a stepladder, or an elevated walkway. The 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.

14. *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.

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

    14.b If the air pressure in both systems is above the preset minimum when the engine is started, test the low air pressure 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.

15. *Check the instrument panel warning lights.* During the ignition sequence, if any warning lights remain on, see 5.01.01 General Description for detailed instructions on warning lights.

    For Front-Engine Diesel Chassis, 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 11.01 General Information for detailed operating instructions for the ICU.

16. 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.

    16.a Make sure that the horn works. If a horn is not working, have it repaired before trip departure.

    16.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.

17. 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.

18. 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.

19. Make sure all the exterior lights are working properly. Check that all the lights and reflectors are clean.

    19.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.

    19.b Test the high and low beams of the headlights.

    19.c Replace the light bulbs or sealed beam units that are not working. Refer to the body builder book for light bulb replacement.

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: Tire load limits refer only to individual tires and do not indicate the weights for the entire axle.

20. Check the tire inflation pressures, and inspect each tire for bulges, cracks, cuts, and punctures.

    20.a Check the inflation pressures of the tires before each trip, using an accurate tire pressure gauge. See Fig. 211,Checking Tire Pressures. Check tire pressures when the tires are cool. The maximum inflation pressure for each tire is provided on the outer wall of the tire. Inflate the tires to the applicable pressures, if needed. Be sure that valve stem caps are used on every tire, and that they are screwed on finger-tight.

    See either the Michelin *Recreational Vehicle Tire Guide* or Goodyear *Service Manual* for correct tire inflation pressures for the vehicle load.

    Overinflation gives the treaded surface of the tire a convex shape. See Fig.212,Checking Tire Inflation. This causes premature tire wear in the middle part of the tire since this section is primarily in contact with the road.

    Underinflation gives the tread surface a concave shape. See Fig.212,Checking Tire Inflation. This causes excessive tire wear on the outer edges of the tire since those edges are primarily in contact with the road.

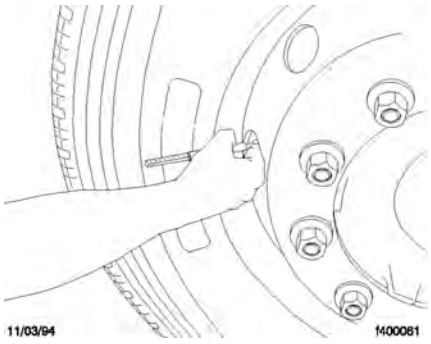


Fig 211, Checking Tire Pressures

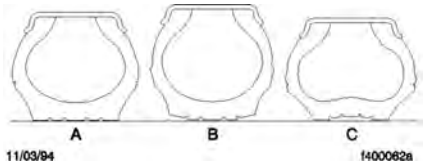


Fig 212, Checking Tire Inflation

WARNING:
Do not operate the vehicle with underinflated or overinflated tires. Incorrect inflation can stress the tires and make the tires and rims more susceptible to damage, possibly leading to rim or tire failure and loss of vehicle control, resulting in serious personal injury or death.

20.b If a tire has been run flat or underinflated, before adding air, check for possible wheel or tire damage.

IMPORTANT: 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. Service inline moisture traps regularly.

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 for additional information and resources.

20.c Inspect the tires for bulges, cracks, cuts, or penetrations. A tire pressure check will assist in uncovering hidden damage; a weekly pressure loss of 4 psi (28 kPa) or more in a tire may indicate damage, and the tire should be inspected and repaired or replaced.

IMPORTANT: Only use temporary resealing or reinflation products that are water soluble and state that they do not adversely affect the operation of the tire pressure sensor(s), if so equipped.

20.d If the tires are wearing irregularly, see the tire manufacturer's recommendations. Have the front axle alignment checked to determine the cause of irregular tire wear.

Government regulations require the removal of front axle tires at 4/32-inch (3-mm) remaining tread depth and rear axle tires at 2/32-inch (1.5-mm) remaining tread depth.

20.e Inspect the tires for oil contamination. Fuel, oil, gasoline, and other petroleum derivatives, if allowed to contact the tires, will soften the rubber and destroy the tire.

IMPORTANT: Do not use tire dressings. These will cause premature wear and deterioration of the tire material. Use only soap and water to clean tires.

WARNING:

On vehicles equipped with ZF independent front suspension (IFS) and ZF SB 7000 front air disc brakes, the only approved front wheels and valve stems are those that come on the chassis as delivered from the FCCC manufacturing plant. These wheels have a special bolt pattern. Valve stems other than those delivered with the chassis may interfere with the brake calipers. The use of unapproved front wheels and/or front wheel valve stems could cause component damage and result in personal injury or death, or property damage.

21. Check the wheel nuts for indications of looseness. Examine each wheel component.

    Check the wheel nuts for indications of looseness. 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. Tighten the wheel nuts to the correct torque specifications in the proper tightening sequences. See **Group 40** of the *Recreational Vehicle Chassis Maintenance Manual* for instructions.

    Examine the wheel assembly components (including studs and nuts) for cracks or other damage.

22. Check the fluid level in the automatic transmission. See Fig.213,Transmission Fluid Level Check and see Fig. 214,Transmission Fluid Level Check (front-engine diesel chassis).

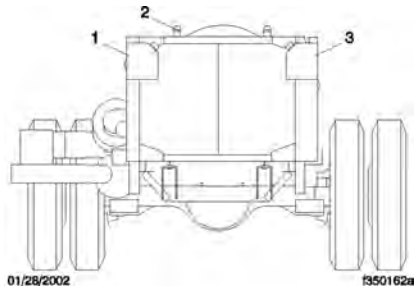


Fig 213, Transmission Fluid Level Check

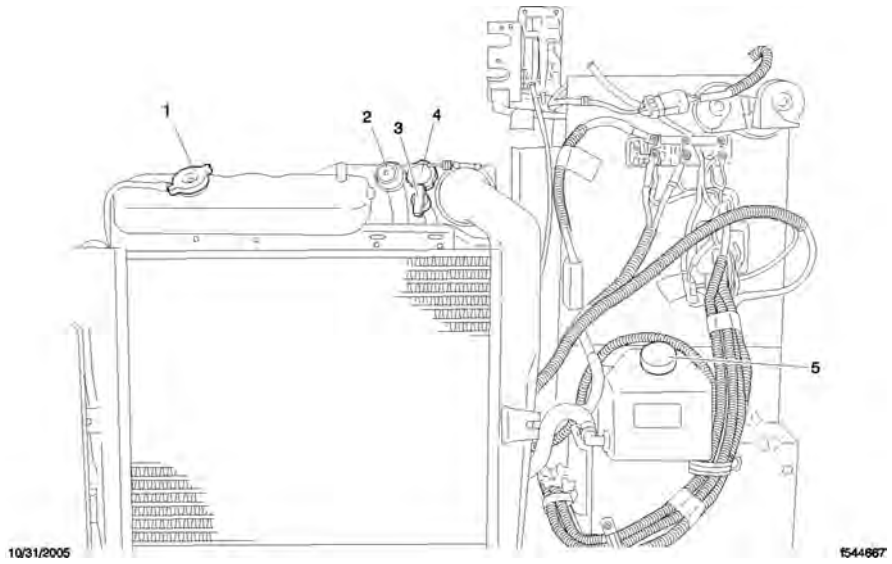


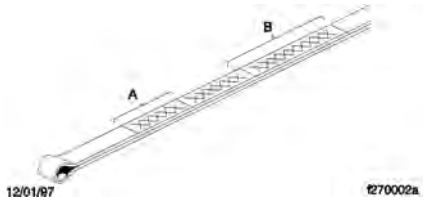
Fig 214, Transmission Fluid Level Check (front-engine diesel chassis)

NOTE: The automatic transmission fluid must be warm to ensure an accurate check. The fluid level rises as temperature increases. Check the transmission fluid with the vehicle on a level surface.

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

22.b Park the vehicle. Set the parking brake, and place the transmission in the Neutral (N) position. Let the engine run at idle.

22.c Wipe the dipstick clean and check the fluid level. A safe operating level is any level within the HOT run (upper) band on the dipstick. See Fig.215,Automatic Transmission Dipstick Markings.



A. Cold Run Band B. Hot Run Band

Fig 215, Automatic Transmission Dipstick Markings

22.d If the fluid is not within this range, add or drain fluid as needed to bring the level to the top of the HOT run band. See Table.14,Transmission Lubricant Capacities for fluid types and capacities.

Table 14, Transmission Lubricant Capacities

Transmission Lubricant Capacities	
Series	**Refill Capacity*†**

1000, 2000	16.0 (15.1)
3000, 4000 MH	17.5 (16.5)

Table 14, Transmission Lubricant Capacities

* Quantities listed are approximate. Add the recommended amount of fluid as listed under refill capacity, then perform a "hot check" and add fluid as needed. Do not overfill.

† Some Allison 3000 MH transmissions have a deeper oil sump than other models. These models require 3 additional quarts (2.8 L) of automatic transmission fluid (ATF).

IMPORTANT: For all transmissions, use TranSynd synthetic automatic transmission fluid (ATF).

NOTE: A cold check may be made when the sump temperature is 60 to 104°F (15 to 40°C). Follow the substeps below.

22.e Run the engine for at least one minute to clear the fluid system of air.

22.f With the engine running, wipe the dipstick clean and check the fluid level. Any level within the COLD run (lower) band is satisfactory for operating the vehicle. If the level is not within the COLD run band, add or drain fluid until it reaches the middle of the COLD run band.

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

23. Inspect the air brake components including the brake chamber pushrod, air reservoirs, and air lines.

Inspect the front air brake lines for leaks at the fitting where they enter the air chamber.

With an assistant at the front wheels to inspect the brake lines, turn the wheels to full lock in one direction. While holding the service brake pedal down, inspect the front brake air lines closely where they enter the air chambers.

Turn the wheels to full lock in the other direction, hold the service brake pedal down, and repeat the inspection.

If there is a leak, the hose should be replaced. Take your vehicle to an authorized Freightliner dealer for assistance.

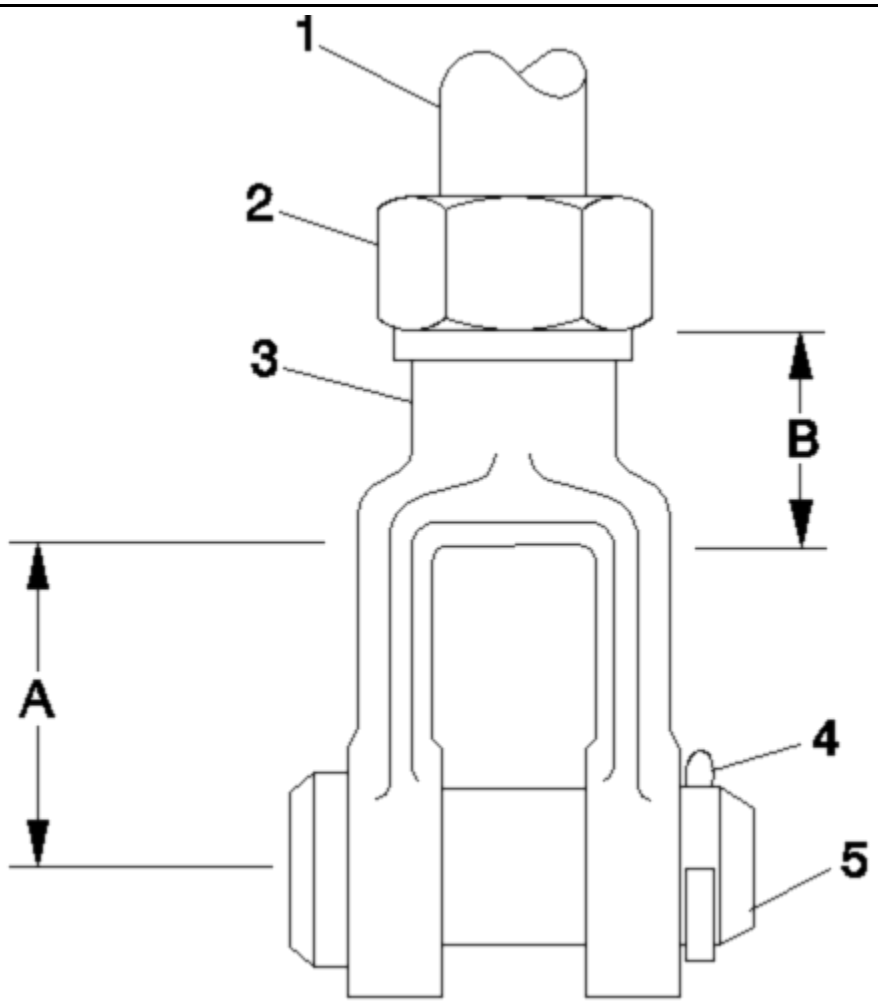
Look for worn clevis pins on brake chamber pushrods and missing or damaged cotter pins on the brake chamber pushrods clevis pins. Replace worn clevis pins and install new cotter pins if necessary.

Visually inspect the piston rod engagement with the clevis. At least 7 threads of engagement are required; there should be 1 inch (25 mm) of clearance from the centerline of the clevis pin hole to the end of the piston rod. See Fig. 216,Piston Rod Engagement With the Clevis. Take your vehicle to an authorized Freightliner dealer for assistance.

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. Take your vehicle to an authorized Freightliner dealer for assistance.

Visually 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. Take your vehicle to an authorized Freightliner dealer for assistance.

Inspect the air lines as follows.



A. Minimum of 1-inch (25-mm) clearance between centerline of clevis pin hole and piston rod end.
B. Minimum of 7 threads engagement.
1. Piston Rod
2. Piston Rod Nut
3. Clevis
4. Cotter Pin
5. Clevis Pin

Fig 216, Piston Rod Engagement With the Clevis

23.a Check the clearance between the hoses, exhaust manifold, and turbocharger, or other hot spots. Excessive heat will cause the material in the hoses to deteriorate rapidly or become brittle. Provide at least 6 inches (152 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 a hose is damaged, replace it with the same size and type.

Do not route the hose on top of anything likely to be stepped on or walked on.

23.c Check for damage to hoses located near moving parts, such as drivelines, suspensions, and axles. If the moving parts are catching or pinching the lines, correct as needed.

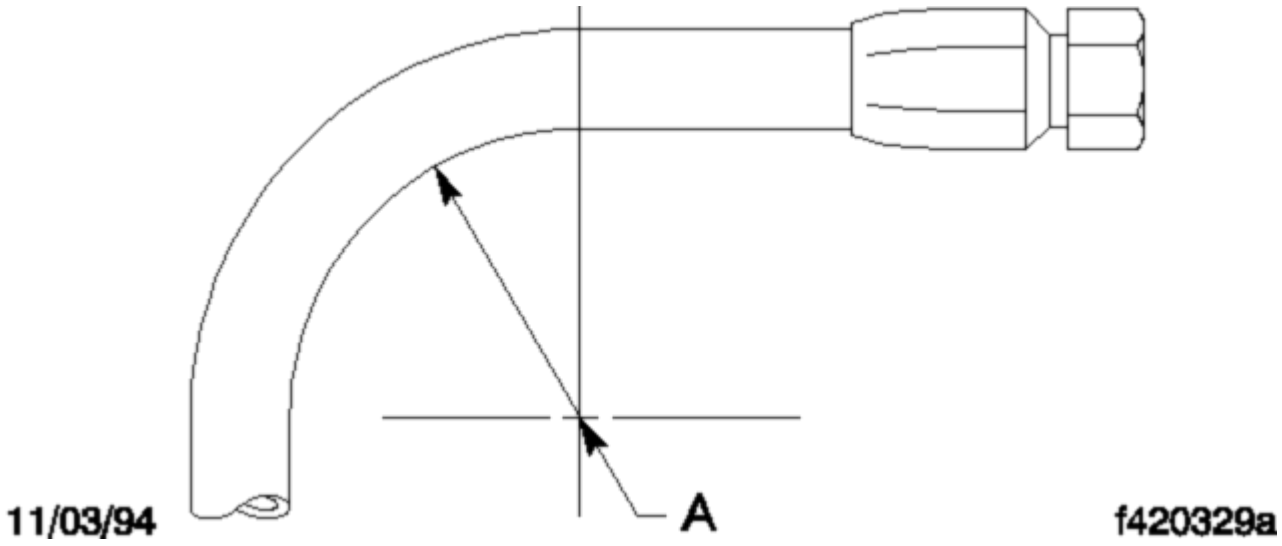
23.d Check for hose damage caused by abrasion. If a hose is abraded, replace it. Check for the cause of abrasion, such as loose or damaged hose clamps. Repair or replace the clamps as needed.

23.e Observe the hose cover condition, especially hoses exposed to water splash and ice. If any hose is dried out or ragged (the wire or liner is showing through the cover), replace the hose.

23.f Inspect air tubing, especially tubing made of nylon. In cold weather, nylon tubing is sensitive to damage, such as nicks or cuts. Replace nicked or cut tubing, even if it is not leaking.

23.g Check the bend radii of all hoses. See Fig.217,Bend Radius. The minimum bend radius of a hose is that bend which the hose will withstand without experiencing damaging stresses or kinking. For minimum bend radius values, take your vehicle to an authorized Freightliner dealer for assistance.

When a rubber hose bend does not meet minimum radius requirements, the outside may appear smooth even if the inner tube is kinked. Reroute the hose or replace it with one of adequate length if the bend radius is not within minimum specifications.



NOTE: Center of the hose bend radius should be well away from the fitting.

A. Bend Radius

Fig 217, Bend Radius

23.h Check straight hose installations (those hoses that do not bend along their routing). Pressure changes can cause a hose to lengthen up to 2 percent, or shorten up to 4 percent. A 100-inch (2540-mm) length of hose, for example, can contract to 96 inches (2440 mm). If the hose has no slack when it is exhausted of air, replace it with one of adequate length to avoid a possible blow-off from the fitting during vehicle operation.

23.i Check for kinked or twisted hoses. A 7 percent twist in the hose can reduce its life by up to 90 percent. Also, a twisted hose under pressure tends to untwist. This could cause it to loosen the fitting. Reconnect hoses that are twisted.

24. Inspect the air brake lines.

24.a Check the clearance between the hoses and the exhaust manifold or other hot spots. Excessive heat will cause material in hoses to deteriorate rapidly or become brittle. Provide at least 6 inches (152 mm) of clearance. More clearance is recommended if the hose is located above the heat source.

24.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.

24.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.

24.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.

24.e Observe the hose cover condition, especially hoses exposed to water splash and ice. If dried out or ragged (the wire is showing through the cover), have the hose(s) replaced.

24.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.

24.g This inspection requires two people, one in the driver's 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.

24.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.

NOTE: 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.

25. Inspect the 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. Take your vehicle to an authorized Freightliner dealer for assistance. See Fig.218,Gunite Automatic Slack Adjuster.

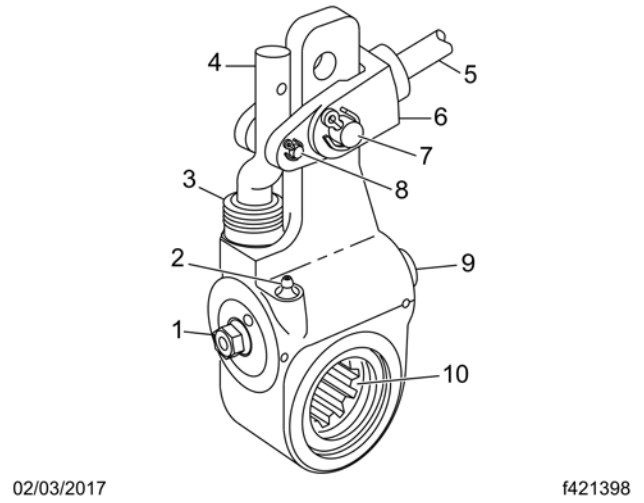


Fig 218, Gunite Automatic Slack Adjuster

IMPORTANT: Brake checking and adjusting is necessary for all vehicles, including those equipped with automatic slack adjusters.

26. *Check the air brake system for proper operation.*

26.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.

26.b Check the air pressure buildup times 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.

26.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.

26.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.15,Maximum Allowable Service Brake Leakage, repair all areas of leakage before driving the vehicle.

Table 15, Maximum Allowable Service Brake Leakage

Maximum Allowable Service Brake Leakage	
Brakes Released	**Brakes Applied**
2 psi/min. (14 kPa)	3 psi/min. (21 kPa)

Table 15, Maximum Allowable Service Brake Leakage

27. Check the operation of the Bendix® Hydro-Max brake booster, as follows.

27.a With ignition off, depress the brake pedal and listen for the back-up motor to engage. Also, note that the pedal force relieves; the pedal should depress easily.

27.b With the ignition off, engine running, 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 other than loss of back-up motor power.

28. *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.

13.03 Weekly Post-Trip Inspection and Maintenance Procedures

1. *Inspect the batteries and battery cables.*

   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.

   Remove any corrosion from the hold-down and the top of the battery. Use diluted ammonia or a soda solution to neutralize the acid present, then rinse off the ammonia or soda solution with clean water.

   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 dielectric grease to the posts and terminals to help retard corrosion.

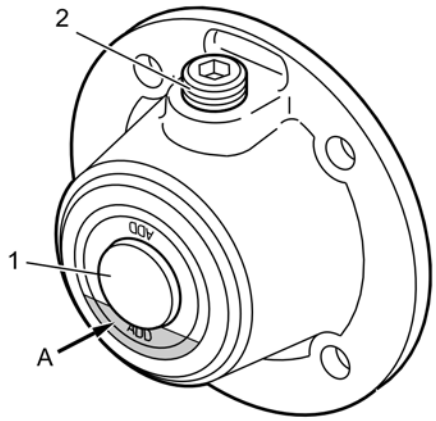
2. Check the level of the wheel bearing lubricant in the hub cap at each end of the front axle. See Fig. 220,Steering Gear Installation.

   If needed, fill the hubs to the level indicated on the hub cap. See 18.01 Torque Charts for recommended lubricants.

   IMPORTANT: Before removing the fill plug, always clean the hub cap and plug.

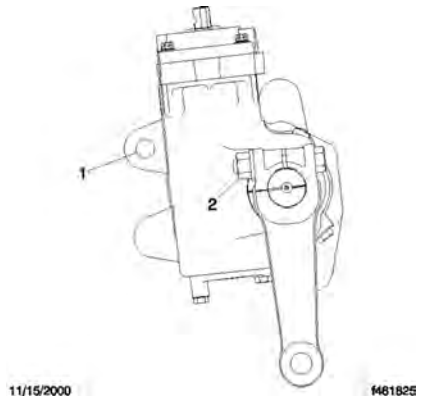
3. *Examine the steering components.*

   See Fig.220,Steering Gear Installation. If repairs are needed, take your vehicle to an authorized Freightliner dealer for assistance.



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

Fig 219, Oil-Filled Hub Cap



1. Steering Gear Mounting Bolt
2. Pitman Arm Pinch Bolt Nut

Fig 220, Steering Gear Installation

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 drive belts.*

Look for signs of wear (frayed edges) and damage (breaks or cracks). If a belt is worn or damaged, have the belt replaced. Take your vehicle to an authorized Freightliner dealer for assistance.

13.04 Monthly Post-Trip Inspection and Maintenance Procedures

1. *Clean the batteries.*

1.a Remove any corrosion from the hold-down and the top of the battery. Use a soda solution to neutralize the acid present, then rinse off the soda solution with clean water.

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.

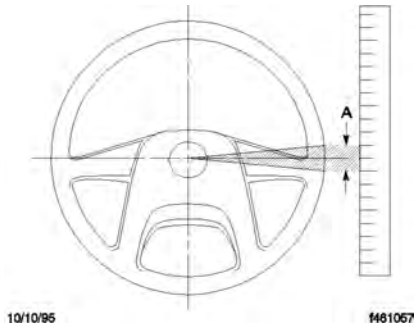
1.b If the battery posts or cable terminals are corroded, disconnect the terminals from the posts. Clean them with a soda solution and a wire brush. After cleaning, connect the terminals to the battery posts, then apply a thin coat of petroleum jelly to the posts and terminals to help retard corrosion.

WARNING:
Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. To prevent possible personal injury, always wash your hands after handling battery parts and related accessories.

2. 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, weakening, 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 steering wheel for excessive play. See Fig.*221,Measuring Lash at the Steering Wheel*.*



A. Lash Area

Fig 221, Measuring Lash at the Steering Wheel

   - 3.a With the front tires straight ahead, turn the steering wheel until motion is observed at the front wheels. Hold the steering wheel in this position.
   - 3.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.
   - 3.c Determine 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.

4. *Check the brake lining wear on all vehicles, including those with automatic slack adjusters. Proper brake operation is dependent on periodic maintenance and inspection of the brake linings.*

4.a Check that brake linings are free of oil and grease.

4.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. Take your vehicle to an authorized Freightliner dealer for assistance.*

4.c Check the brake drums for wear and cracks.

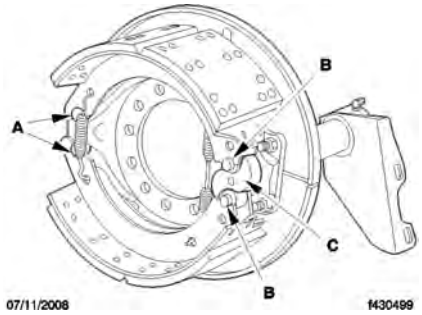
4.d Check that the inspection plugs in the dust shields or backing plates, if so equipped, are installed.

5. Inspect brake shoe components and perform Meritor Roller Pin lubricating, **if needed** , as follows. See Fig. 222,Meritor Roller Pin Lubrication Areas.

5.a Check the anchor pins, rollers and bushing for lubricant and excessive debris.

5.b If the parts are damaged in any way, replace them.

5.c While the brake is disassembled during inspection, apply anchor pin grease with Bentone thickeners, NLGI grade 1, Meritor specification 0-616-A, 0-617-B or equivalent. See Fig.222,Meritor Roller Pin Lubrication Areas for brake lubrication areas..



A. Anchor Pins — lubricate grease fittings.
B. Shoe Rollers— lubricate where pins touch the brake shoes.
C. Bushing — lubricate grease fittings.

Fig 222, Meritor Roller Pin Lubrication Areas

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14. Cleaning and Care

14.01 Washing and Polishing

To protect the finish of your new vehicle, follow these guidelines carefully:

- During the first 30 days, rinse your vehicle frequently with water. If the vehicle is dirty, use a mild liquid soap. Do not use detergent.
- During the first 30 days, do not use anything abrasive on your vehicle. Brushes, chemicals, and cleaners may scratch the finish.
- During the first 120 days, do not wax your vehicle.

To extend the life of your vehicle's finish, follow these guidelines:

- Avoid washing your vehicle in the hot sun. Always use water. After the 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 that a quality brand of cleaner or cleaner-polish and polishing wax be used.
- Do not let diesel fuel or antifreeze stand on a painted surface. If either should occur, rinse the surface off with water.
- To prevent corrosion, have any nicks or other damage on the finish touched up as soon as possible.
- Park your vehicle in a sheltered area whenever possible.

14.02 Wheel Cleaning

Accuride® Machined and Polished Aluminum Wheels

Regular cleaning of Accuride machined or polished aluminum wheels is recommended to keep the wheel finish bright and shiny. The use of an aluminum wheel polish or carnauba wax will protect the polished wheel surfaces, will help prevent corrosion and pitting on the aluminum wheel surfaces caused from natural environmental contamination, and will make future cleaning and polishing easier.

1. Rinse the wheel with high-pressure water to remove any debris, grit, or dirt particles.
2. Use a 100% cotton cloth dipped in a mild soap solution to help remove built up dirt and grease.
3. Rinse the remaining soap residue from the wheel.
4. Dry the wheel thoroughly with a 100% cotton cloth.
5. Use metal cleaner/polish that is compatible with aluminum to remove spots and stains from the surfaces of the wheel as necessary.
6. Apply carnauba wax to the visible wheel surfaces. Carnauba wax should be reapplied on a regular basis to maintain the wheel luster.

14.03 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.

14.04 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.

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15. In an Emergency

15.01 Freightliner Help

In the event of a vehicle emergency, 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, or breakdown coordination.

15.02 Hazard Warning Lights

To activate the hazard warning lights, push the hazard warning light switch on the right side of the steering column. See Fig. 223,Hazard Warning Light Switch. When the hazard warning lights are activated, all of the turn signal lights and both of the turn signal indicator lights on the instrument panel will flash.

To cancel the warning lights, push the switch in on the right side of the steering column.



1. Hazard Warning Light Switch

Fig 223, Hazard Warning Light Switch

15.03 Raising and Lowering a Vehicle

15.03.01 Raising a Vehicle with Air Suspension

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

WARNING:
Remove the air from the suspension. Failure to remove the air from the suspension may cause the vehicle to move or shift on the jack stands as air pressure drains from the system; this could cause the vehicle to fall, resulting in damage to the vehicle, serious injury, or death.

2. Exhaust all air from the 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.

IMPORTANT: Only lift unloaded vehicles and vehicles disconnected from trailers. Unload vehicles with bodies (drilling rigs, mixers) as much as possible.

3. 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.

4. Raise the vehicle. Add additional jack stands, as needed, under the axles to support the vehicle.

15.03.02 Lowering a Vehicle with 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.
3. Inflate the air suspension, and check for proper operation. Refer to **Group 32** in the *Recreational Vehicle Chassis Workshop Manual* for instructions.

15.04 Towing

See 16.01.01 Removing the Transmission from the Park (P) Position for towing information.

15.05 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.

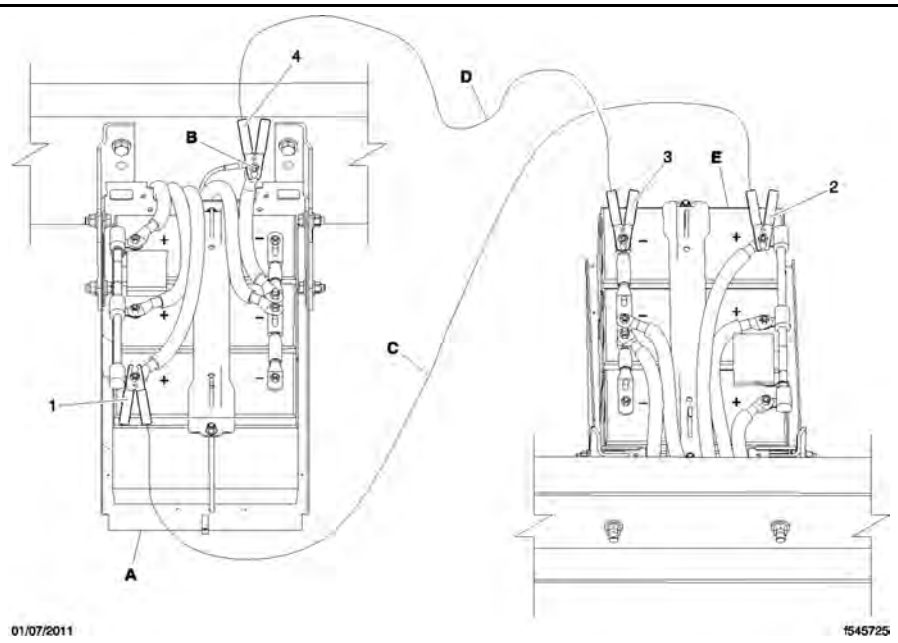
1. Apply the parking brakes and turn off all lights and other electrical devices.

   IMPORTANT: Do not attempt to jump start a damaged battery.

2. Access the batteries under the passenger steps.

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. 224,Jumper Connections (three battery system shown for clarity).



NOTE: 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 224, Jumper Connections (three battery system shown for clarity)

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. Close the battery access door at the passenger steps.

15.06 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 the vehicle to a safe location as quickly as possible.

1. If possible, stop the vehicle on a level surface away from traffic.
2. Apply the parking brake and place the transmission in Park (P). Turn the ignition switch to the OFF position.
3. Turn on the hazard warning lights.
4. Remove the spare wheel, jack, jack handle, and lug wrench (if so equipped) from storage.
5. Block the wheel diagonally opposite the wheel being changed.

WARNING:
This vehicle is very heavy. Jacking this vehicle should be done with extreme caution. The vehicle could slip, causing personal injury or death.

NOTICE:
The jacking point for the front and rear wheels is directly under the axle. See Fig.225,, page 252 and see Fig.226,, page 252 for correct jack placement.

6. Place the jack on a solid surface. Insert the jack handle and pump the handle to slightly raise the vehicle. ***Do not raise the wheel off of the ground.*** Loosen the wheel lug nuts, but do not remove them.

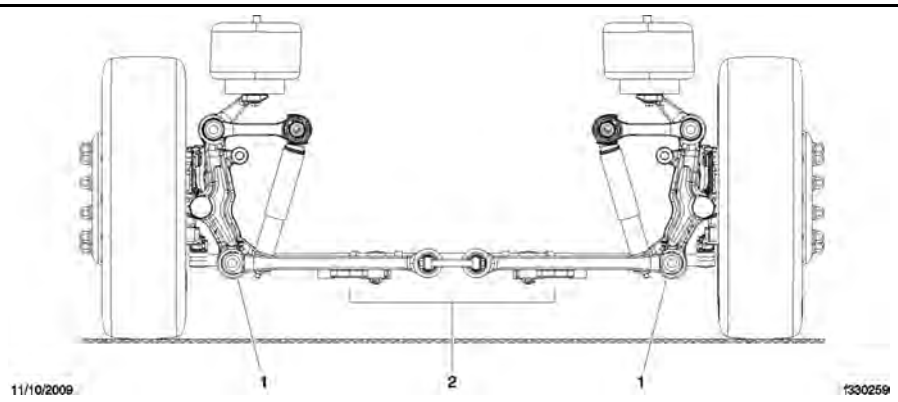


Fig 225, Jack Placement for ZF IFS

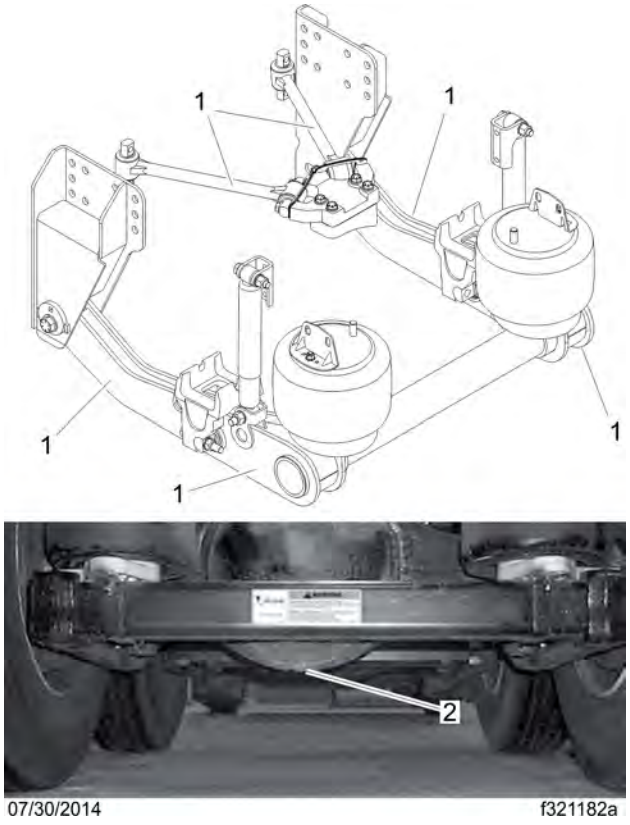


Fig 226, Jack Placement for V-Ride

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.
9. In a star pattern, tighten the nuts evenly until snug.
10. Lower the vehicle until the wheel touches the ground. Tighten the wheel nuts to the correct torque specifications in the proper tightening sequences. See **Group 40** of the *Recreational Vehicle Chassis Maintenance Manual* for instructions.

11. Finish lowering the vehicle to the ground, then remove the jack.
12. Remove the wheel chock (the block), then stow the jack, jack handle, and lug wrench.
13. After operating the vehicle for 50 to 100 miles(80 to 161 km),retighten the nuts. Tighten the wheel nuts to the correct torque specifications in the proper tightening sequences. See **Group 40** of the *Recreational Vehicle Chassis Maintenance Manual* for instructions.

15.07 Running Out of Fuel



WARNING:

Diesel fuel is flammable. When you approach a vehicle and the smell of diesel fuel is present, immediately shut off all engines and ignition sources. Avoid causing sparks and stay away from arcing switches and equipment. Extinguish cigarettes, pilot lights, flames, or other sources of ignition in the area and adjacent areas. Immediately provide extra ventilation to the area. Do not start the vehicle or any other type of equipment until the fuel leak is corrected and the area cleared of fuel. Failure to perform these actions could lead to the ignition of the fuel, which could cause personal injury or death, or severe property damage.

If the vehicle runs out of fuel, try to stop the vehicle on a level location away from traffic. Add at least 2 gallons (8 liters) of fuel to the fuel tank in order to restart the engine. If the vehicle is not level, up to 6 gallons (22 liters) of fuel may be required. Prolonged engine cranking may be required to pump fuel from the fuel tank to the engine before the engine will start.



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.

If the vehicle will not start by cranking the engine, the fuel system may need to be primed. See the applicable engine manufacturer's operation and maintenance manual.

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16. Towing

16.01 Towing the Vehicle

16.01.01 Removing the Transmission from the Park (P) Position

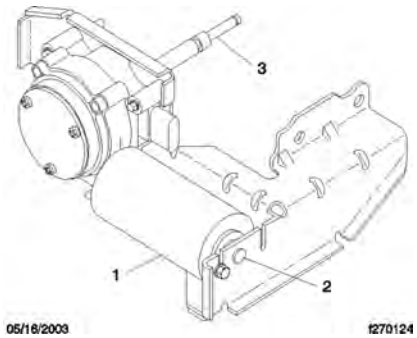
IMPORTANT: When it is necessary to tow the vehicle, follow the instructions below closely to prevent damage to the vehicle.

On vehicles equipped with an independent front suspension, do not tow the vehicle by the suspension assembly. Components of the suspension can be damaged.

When towing or pushing any vehicle equipped with an Allison transmission, disconnect the driveshaft at the rear axle and support it as necessary, regardless of the distance or speed traveled.

If a vehicle with a shift-by-wire (SBW) system needs to be towed and the system cannot be activated to take the transmission out of Park (P), follow the steps in the procedure below.

1. Set the parking brake on the tow vehicle.
2. Chock the tires of the tow vehicle.
3. Set the parking brake on the disabled vehicle.
4. Chock the tires of the disabled vehicle.
5. Underneath the disabled vehicle, at the transmission, remove the access hole plug at the rear of the SBW actuator. See Fig.227,SBW Actuator (at transmission).



1. SBW Actuator
2. Access Hole Plug
3. Shift Selector Shaft (part of Allison transmission)

Fig 227, SBW Actuator (at transmission)

6. Insert a 3/16-inch allen wrench or hex key through the access hole into the rear of the actuator. Turn the allen wrench in a clockwise direction until the transmission comes out of the Park (P) position.
7. Replace the access hole plug.
8. Remove the chocks from the tires of both vehicles.

16.01.02 Front Towing Hookup

1. Disconnect the battery ground cable.
2. If the vehicle is to be lifted and towed, remove the driveshaft.

WARNING:
Due to the many variables that exist in towing, positioning the lifting and towing device is the sole responsibility of the tow vehicle operator. The operator must be familiar with standard towing industry safety measures. Improper procedures could result in personal injury or death.

NOTICE:
Failure to remove the driveshaft when towing the vehicle with the rear wheels on the ground could result in damage to the transmission and other parts.

3. Attach the towing device.
4. Lift the vehicle and secure the safety towing chains. If additional clearance is needed, remove the front wheels.
5. Connect the clearance lights, taillights, and signal lights. Connect any special towing lights required by local regulations.

WARNING:
Before releasing the parking brakes, make the connection to the towing vehicle or chock the tires on the disabled vehicle. Failure to do so could result in hazardous conditions because the vehicle could suddenly roll and injury could occur.

6. Release the parking brake.

NOTICE:
Before attempting to tow a vehicle with air suspension (and during the towing operation), ensure that the air suspension is properly aired. Air the suspension through the Schrader valve on the air dryer. Attempting to tow a vehicle with an improperly aired suspension may result in damage to the chassis and body.

16.01.03 Rear Towing Hookup

1. Position the front tires so that they point straight ahead and secure the steering wheel in this position.
2. Disconnect the battery ground cable.

WARNING:

Due to the many variables that exist in towing, positioning the lifting and towing device is the sole responsibility of the tow vehicle operator. The operator must be familiar with standard towing industry safety measures. Improper procedures could result in personal injury or death.

3. Attach the towing device.
4. Lift the vehicle and secure the safety towing chains. If additional clearance is needed, remove the bumper extension, if so equipped.

NOTICE:

Before attempting to tow a vehicle with air suspension (and during the towing operation), ensure that the air suspension is properly aired. Air the suspension through the Schrader valve on the air dryer. Attempting to tow a vehicle with an improperly aired suspension may result in damage to the chassis and body.

5. Connect the clearance lights, taillights, and signal lights. Also connect any special towing lights required by local regulations.

16.02 Towing With the Vehicle

16.02.01 General Information

WARNING:

Freightliner neither recommends nor approves connecting a trailer or other towed vehicle's braking system directly to the vehicle braking system. Freightliner also neither recommends nor approves tapping into the vehicle air brake system, nor operating a towed vehicle or trailer's braking system by means of the vehicle braking system. Failure to observe this warning could result in severe injury or death, or substantial property damage.

The towing vehicle's brake system is rated for operation at the Gross Vehicle Weight Rating (GVWR) and does not include the towed weight. Separate functional brake systems and chocks must be used for safe control and parking of towed vehicles and trailers weighing more than 1500 lbs (681 kg).

Do not tow unbraked vehicles 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: An auxiliary braking system is strongly recommended when towing. Follow your state's motor vehicle regulations and the body builder's recommendations to determine if an auxiliary system is required for towing.

1. Never load the vehicle over the Gross Vehicle Weight Rating (GVWR). Considerable damage to the drivetrain may result if the vehicle is over its GVWR. Check the GVWR safety compliance certification label (provided by the final manufacturer) to find the GVWR.
2. Use the Gross Combined Weight Rating (GCWR) and Gross Vehicle Weight (GVW) to determine the towing capacity. Refer to the final manufacturer for GCWR. If the GCWR is exceeded, serious damage to the drivetrain and brake system may result. Loading past the GCWR may lead to unsafe operating and braking conditions.
3. Subtract the GVW (which is the actual weight of the vehicle alone) from the GCWR (which is the total weight this vehicle can safely pull) to determine the acceptable weight this vehicle can tow.
4. Make sure that the towing equipment is properly and safely attached to your vehicle.

NOTE: In a high-altitude operating environment, your engine will lose power at the rate of 1 percent per 1000 feet (305 meters) of elevation. For these high-altitude operating conditions, a reduction in gross vehicle weights and gross combination weights is recommended and will result in improved vehicle performance.

5. When descending a steep grade, shift the transmission into the next lower gear or use the exhaust brake to provide additional engine braking.
6. To avoid vehicle damage and handling difficulty, evenly distribute the trailer load. Always tie the load down securely.

16.02.02 7-Pin Connector

The following information lists the amperage (amp) load limits for each of the connections in the 7-pin connector. See Fig. 228,7-Pin Connector for an example of the 7-pin connector.

- Electric Brakes (to brake the system) — A 12 gauge wire interfaces with the 7-pin connector trailer tow plug. See the brake manual for exact specifications.
- RH Stop/Turn — 20 amp
- Back Up Lamps — 10 amp
- LH Stop/Turn — 20 amp
- Running Lamps — 20 amp
- Ignition [+] (to charge the tow vehicle batteries) — 40 amp
- Ground [–] — for all

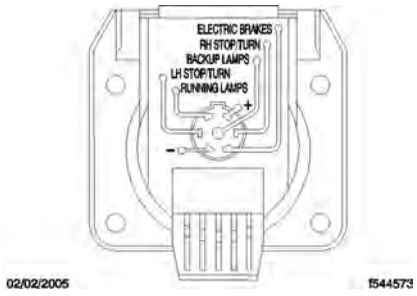


Fig 228, 7-Pin Connector

16.02.03 BrakeSync

BrakeSync is a supplemental air brake system for towing a vehicle. It uses air from the chassis and supplies it to the towed vehicle during brake applications through a coupler. See Fig.229,BrakeSync Coupler for an example of the coupler.

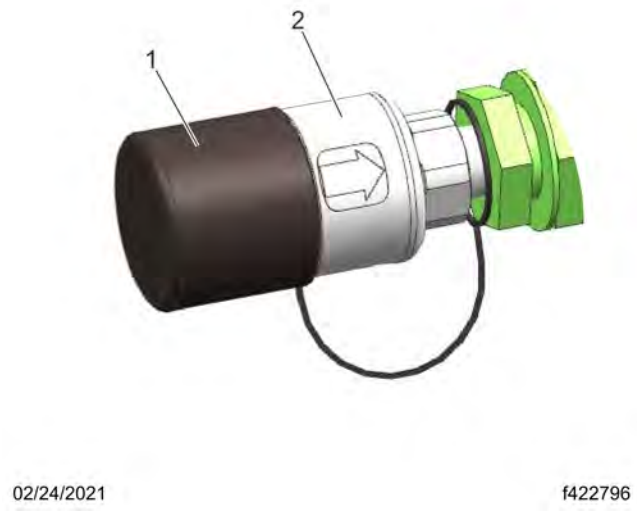


Fig 229, BrakeSync Coupler

1. Coupler Cap
2. Coupler

If the recreational vehicle is equipped with BrakeSync, an Air Force One kit from Demco (that is compatible with the Freightliner Custom Chassis coupler) must be installed on the towed vehicle to use the BrakeSync system.

16.02.04 Hitches

Use a hitch and ball recommended by your vehicle manufacturer or your dealer, and make sure that its location is compatible with that of the trailer. Use a good weight-carrying hitch that uniformly distributes the trailer tongue loads through the bumper and the frame. Do not exceed the recommended towing capacity of the vehicle.

NOTICE:

Always disconnect the battery and the engine electronic control module (ECM) before welding anything to the chassis frame.

Do not use single-clamp bumper hitches or hitches that attach to the vehicle axle. However, multi-clamp bumper hitches for occasional use of a rental trailer are acceptable if properly attached. Follow the towing instructions of a reputable rental agency. Never attach safety chains to the bumper.

Whenever a trailer hitch is removed, be sure to have all mounting holes in the underbody properly sealed to prevent possible entry of exhaust fumes, dirt, or water.

A standard hitch has two ratings depending on the mode of operation; see Table.16,Trailer Weight Ratings.

Table 16, Trailer Weight Ratings

Trailer Weight Ratings*					
Chassis Model	Allison Transmission	Maximum GVWR lbs (kg)	Maximum GCWR lbs (kg)	Hitch Type	Maximum Gross Trailer Weight lbs (kg)
XC, MC	1000 MH	22,000(9988)	26,000(11 804)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
	2100 MH	26,000(11 804)	30,000(13 620)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
	2200 MH	26,000(11 804)	26,000(11 804)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
	2350 MH	30,000(13 620)	30,000(13 620)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
	2500 MH	33,000(14 982)	33,000(14 982)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
	2550 MH	30,000(13 620)	30,000(13 620)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
XC	3000 MH			Weight Carrying	15,000 (6810)
				Weight Distributing	16,000 (7264)
	4000 MH			Weight Carrying	15,000 (6810)
				Weight Distributing	16,000 (7264)

Table 16, Trailer Weight Ratings

* Values shown are the maximum for each model. Actual vehicle weight and tow ratings may be less, depending on the chassis and body manufacturer's equipment options. Refer to the manufacturer's certification labels for the actual vehicle weight ratings.

- Weight Carrying—Requires a draw bar and hitch ball. The draw bar supports all of the vertical tongue load of the trailer.
- Weight Distributing—Requires an aftermarket weight distributing system, consisting of a draw bar, hitch ball, spring bars, and snap-up brackets. The vertical tongue load of the trailer is distributed between the truck and the trailer by this system.

IMPORTANT: The towing vehicle's brake system is rated for operation at the GVWR and does not include the towed weight. Separate functional brake systems and wheel chocks must be used for safe driving control and parking of towed vehicles or trailers weighing more than 1500 lbs (681 kg).

The maximum vehicle weight rating and towing capacities are based on the powertrain and chassis equipment options specified on your vehicle. See Table.16,Trailer Weight Ratings defines the maximum vehicle and trailer weight ratings according to the vehicle transmission options. The actual vehicle weight and towing capacities of your vehicle may be less

due to the chassis and OEM equipment combinations specified by the final stage manufacturer (body builder). Refer to the manufacturer's certification labels for actual vehicle weight ratings.

16.02.05 Trailers

Parking With A Trailer

WARNING:
Always use safety chains between the vehicle and the trailer. Failure to do so could cause personal injury or death if the hitch fails.

IMPORTANT: Before connecting a trailer lighting system directly to the lighting system of the vehicle, see your dealer or rental trailer agency for the correct type of wiring and relays for your trailer and for heavy-duty flashers.

WARNING:
Do not exceed the GVWR or the GAWR specified on the certification label. **Table 15.1** lists the maximum GVWR and GAWR for recreational vehicle chassis. Towing trailers beyond the maximum recommended gross trailer weight exceeds the limit of the vehicle and could result in engine damage, transmission damage, structural damage, or loss of vehicle control. Failure to observe this warning could result in severe injury or death, or substantial property damage.

Park the vehicle on a flat surface. Chock the tires as follows:

1. Select Neutral (N) on the gear shift selector while depressing the service brake.
2. Continue depressing the service brake and have another person place wheel chocks under the trailer wheels.
3. Once the wheel chocks are in place, release the service brake, making sure that the chocks are holding the vehicle and trailer.
4. Apply the park brake.
5. Depending on the series of transmission, select either Neutral (N) or Park (P) on the gear shift selector.

Trailer Towing Tips

Towing a trailer significantly alters the manner in which the towing vehicle performs.

- Before starting on a trip, practice turning, stopping, and backing in an area away from heavy traffic to gain experience in handling the extra weight and length of the trailer. Take enough time to learn the "feel" of the vehicle/trailer combination before starting out on a trip. Make certain you know what clearance is required for the trailer roof.
- Skillful backing requires practice. Back very slowly, with someone outside at the rear of the trailer to guide your efforts. Place your hand at the bottom of the steering wheel and move it in the direction you want the rear of the trailer to swing. Make small corrections instead of exaggerated ones. A slight movement of the steering wheel will result in a much larger movement of the rear of the trailer.

Table 17, Trailer Weight Ratings*

Trailer Weight Ratings*					
Chassis Model	Allison Transmission	Maximum GVWR lbs (kg)	Maximum GCWR lbs (kg)	Hitch Type	Maximum Gross Trailer Weight lbs (kg)

XC, MC	1000 MH	22,000(9988)	26,000(11 804)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
	2100 MH	26,000(11 804)	30,000(13 620)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
	2200 MH	26,000(11 804)	26,000(11 804)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
	2350 MH	30,000(13 620)	30,000(13 620)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
	2500 MH	33,000(14 982)	33,000(14 982)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
	2550 MH	30,000(13 620)	30,000(13 620)	Weight Carrying	10,000 (4540)
				Weight Distributing	12,000 (5448)
XC	3000 MH			Weight Carrying	15,000 (6810)
				Weight Distributing	16,000 (7264)
	4000 MH			Weight Carrying	15,000 (6810)
				Weight Distributing	16,000 (7264)

Table 17, Trailer Weight Ratings*

* Values shown are the maximum for each model. Actual vehicle weight and tow ratings may be less, depending on the chassis and body manufacturer's equipment options. Refer to the manufacturer's certification labels for the actual vehicle weight ratings.

- Allow considerably more room for stopping when the trailer is attached. If you have a manual brake controller, "lead" with the trailer brakes (if so equipped) when approaching a stop, if possible. Trailer brakes are also handy for correcting trailer side-sway. Just touch them for a moment without using your vehicle brakes and the trailer should settle down and track steadily again.
- To assist in attaining good handling of the vehicle trailer combination, it is important that the trailer tongue load be maintained at approximately 10 to 15 percent of the loaded trailer weight.
- Check everything before starting out on the road. After you have traveled about 50 miles (80 km), stop in a protected location and double-check your trailer hitch and electrical connections for security. Also, examine the trailer wheel lug nuts for tightness.
- Because trailer wheels will be closer than the towing vehicle wheels to the inside of the turn, drive slightly beyond the normal turning point to avoid obstructions.
- Allow extra distance for passing other vehicles. Downshift to a lower gear for better acceleration, if necessary. Use caution when passing, as the added weight of the trailer can dramatically decrease the acceleration of the towing vehicle.
- Ahead of the vehicle, allow at least the equivalent of one vehicle and trailer length combined for each 10 mph(16 km/h)of speed.
- If your vehicle begins to lose speed as you climb a hill, downshift to a lower gear for more power at the rear wheels.

- Before descending a steep grade, slow down and shift to a lower gear. Driving with the transmission in a lower gear will assist in reducing downhill speed. If the trailer should begin to sway, touch the trailer brakes (if so equipped), not the vehicle brakes, and the trailer should settle down.
- When possible, do not park on a grade with a trailer. However, when this is necessary, apply the service brakes and hold while someone else places chocks under the trailer's wheels.

To start out when parked on a grade, apply the service brake pedal and with the vehicle either in Neutral (N) or Park (P), start the engine. Shift the transmission into gear and release the parking brake. Then release the brake pedal and move the vehicle uphill to free the chocks. Apply the brake pedal while another person retrieves the chocks.

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17.02 Preparation for Storage 267

17. Vehicle Storage

17.01 Removal from Storage

Follow these steps when the recreational vehicle is removed from storage.

- Remove the covers from the tires and thoroughly inspect the tires for damage. Inflate them to the correct pressure for the actual weight on the tires. Consult the Michelin or Goodyear manual included with your chassis for correct tire pressure. Weigh the vehicle if you do not know how much it weighs.
- Check for fluid leaks. Repair as necessary.
- Change the engine oil and filter after extended storage.
- Check the coolant level in the reservoir and radiator. Add coolant if needed.
- Check the hydraulic fluid level in the reservoir. Add fluid if needed.
- Check the engine belts for wear, damage, or cracking.
- Check the engine fan for damage.
- Check the fuel/water separator. If it is empty, prime the fuel system. For Cummins engine service literature, refer to the *Cummins Online* website at or scan the QR code. See Fig.230,Cummins QR Code. For Detroit™ engine service literature, refer to the *Detroit Diesel* link on the DTNA TechLit website or scan the QR code. See Fig. 231,TechLit QR Code.



Fig 230, Cummins QR Code



Fig 231, TechLit QR Code

- Check the engine compartment for nesting animals. Check for leaks and damage to the hoses and wiring.
- Check the rear axle lubricant level.
- Lubricate all grease fittings on the chassis and drivetrain.

- Check the charge level of the battery. Clean the ends of the battery cables. If the batteries need to be replaced, install a clean and fully charged battery. Always connect the positive cable first, then connect the negative cable. Coat the battery terminals and connectors with a dielectric protectant sealant.
- If the vehicle was stored on safety stands, lower the vehicle at this time and set the parking brake.
- Turn the ignition to the RUN position. Verify that the fuel gauge and voltmeter are working correctly.
- Run the engine until it is warm, then check again for fluid leaks.
- Check the transmission fluid level using the cold check method in the *Allison Operator's Manual* .
- Check all exterior lights and replace as necessary.

17.02 Preparation for Storage

When storing your recreational vehicle for an extended period of time (60 days or more), the following steps should be taken to give it maximum protection. Note the date and mileage on the vehicle when it is placed in storage.

- Fill the fuel tank and add a high-quality fuel stabilizer to the fuel. Never store the vehicle with a partially full tank of fuel.
- The cooling system was originally protected with antifreeze to –34°F (–37°C). If colder temperatures are expected, adjust the mixture. If the coolant has been in the vehicle for five years or 100,000 miles (160 900 km), flush the cooling system and fill it with an appropriate mixture of antifreeze and water, making sure that the coolant contains a rust inhibitor.
- If it has been more than 18 months or 24,000 miles (38 616 km) since the transmission was serviced, change the transmission fluid and filter.
- Service the fuel filters.
- Run the engine until it is fully warmed up.
- Operate the air conditioning.
- If possible, store the vehicle in a dry, well ventilated area, protected from sunlight.
- Check the tires for damage and set the tire pressure to maximum as indicated on the sidewall of the tire. Clean the tires using a mild soap that would be used to clean the vehicle.
- If possible, raise the vehicle onto safety stands. Do not store the vehicle on hydraulic leveling jacks. Hydraulic jacks will bleed pressure over time, lowering the coach back onto the tires.
- Cover the tires to protect them from heat and sunlight.
- If possible, release the parking brake.
- Remove and clean the battery. Always disconnect the negative cable first, then the positive cable. Store the battery in a cool, dry place and keep it charged.
- Lubricate all grease fittings on the chassis and drivetrain.
- Cover all engine and transmission openings with moisture-resistant tape.

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18.05.01 Fuse/Relay/Circuit Breaker Identification (front-engine diesel chassis) 280
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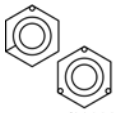
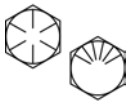
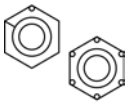
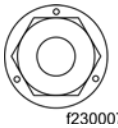
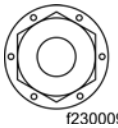
18. Specifications

18.01 Torque Charts

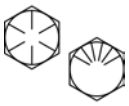
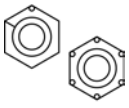
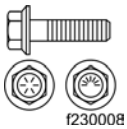
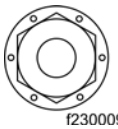
Table 18, Torque Values for U.S. Customary Thread Fasteners With Lubricated or Plated Threads

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 18, Torque Values for U.S. Customary Thread Fasteners With Lubricated or Plated Threads

Table 19, Torque Values for U.S. Customary Thread Fasteners With Dry (Unlubricated) Plain (Unplated) Threads

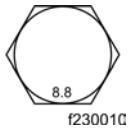
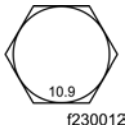
Torque Values for U.S. Customary Thread Fasteners With Dry (Unlubricated) [1] Plain (Unplated) Threads [2]						
Thread Diameter—Pitch	Regular Hex				Flanged	
	Grade 5 Bolt	Grade 5 or B Nut	Grade 8 or 8.2 Bolt	Grade 8 or C Nut	Grade 8 or 8.2 Bolt	Grade G Nut
	Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)		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 19, Torque Values for U.S. Customary Thread Fasteners With Dry (Unlubricated) Plain (Unplated) Threads

Table 20, 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 20, Torque Values for Metric Thread Fasteners With Lubricated or Plated Threads

18.02 Conversion Charts

Table 21, 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 21, Metric/U.S. Customary Conversion

Table 22, 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 22, Temperature Conversion

18.03 Fluids and Lubricants

In the engine cooling system use 50 percent water and 50 percent corrosion-inhibiting antifreeze to protect the engine to –34°F (–37°C) year round.

Table 23, Coolant Capacities*

Coolant Capacities*	
Engine Make	Coolant Volume: qt (L)
Cummins	12 (11)

Table 23, Coolant Capacities*

* The total coolant volume is dependent on the number and location of optional passenger heaters.

Table 24, Approved Coolants

Approved Coolants
Refer to the coolant label on the vehicle or the engine manufacturer's service literature for approved coolant. Coolant used must be compatible with the engine manufacturer's coolant specifications.*

Table 24, Approved Coolants

* For Cummins engine service literature, refer to *Cummins Online* at . For Detroit™ engine service literature, refer to the *Detroit Diesel* link on the DTNA TechLit website .

Table 25, Approved Allison Transmission Lubricants*

Approved Allison Transmission Lubricants*		
TES-295 Approval Number	**Company**	**Product Brand Name**
AN-051005	ExxonMobil Lubricants and Petroleum Specialties Company	Mobil Delvac Synthetic ATF
AN-011001	Castrol Heavy Duty Lubricants	TranSynd
AN-031002	BP	Autran Syn 295
AN-031003	Cognis Corporation	Emgard 2805

AN-031004	International Truck & Engine Company	Fleetrite Synthetic ATF
AN-071006	John Deere & Company	HD SynTran

Table 25, Approved Allison Transmission Lubricants*

* To check the latest Allison approved fluids, go to . Lubricants listed in order of preference. Do not mix types of oil.

Table 26, Allison Transmission Lubricant Capacities

Allison Transmission Lubricant Capacities	
Transmission Model	**Fill Capacity:qt (L)***
1000/2000 Series (standard sump)	14.8 (14)
1000/2000 Series (shallow sump)	12.7 (12)
2100/2200/2500 Series (shallow sump)	13 (12)
3000 Series (4 inch)	29 (27)
3000 Series (2 inch)	26 (25)

Table 26, Allison Transmission Lubricant Capacities

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

Table 27, Approved Front Axle Wheel Bearing Lubricant

Approved Front Axle Wheel Bearing Lubricant
Organic SAE 80/90 front axle lubricant.

Table 27, Approved Front Axle Wheel Bearing Lubricant

Table 28, Approved Driveline Lubricants

Approved Driveline Lubricants	
Lubricant and Specification	**Lubricant Brands**
Universal joint, slip joint, and spline grease must meet ArvinMeritor Specification O–634–B (NLGI Grade No. 2, Lithium 12-Hydroxy Stearate with Molybdenum Disulfide)	Phillips Petroleum Philube MW–EP2 Grease
	Exxon 5160
	Amalie All Purpose Grease with Moly–L1–2M
	Shell Super Duty Special FF
	Marathon Maralube Molycode 529
	Shell Moly Poly Grease
	Kendall L424 Grease

	Amoco Super Chassis Grease
	Ford Specification M1C–75B or part number C1AZ 19590

Table 28, Approved Driveline Lubricants

* Fill the power steering reservoir only with approved clean fluid. Do not mix fluid types. Wear eye protection when changing the fluid and filter.

Table 29, Approved Power Steering Fluids

Approved Power Steering Fluids	
Fluid Type*	**Approved Fluid***
Automatic Transmission Fluid	Dexron® III or equivalent
	Dexron® II

Table 29, Approved Power Steering Fluids

Table 30, Detroit Drive Axle Lubricant Capacity

Detroit Drive Axle Lubricant Capacity	
Differential/Hubs	**Capacity: qt (L)**
Differential Only	5.8 (5.5)
Differential and Hubs	7.4 (7.0)

Table 30, Detroit Drive Axle Lubricant Capacity

Table 31, Meritor Drive Axle Lubricant Capacity

Meritor Drive Axle Lubricant Capacity	
Axle Model	**Capacity: pt (L)***
RS-15-120	16 (7.6)
RS-17-145	33.6 (15.9)
RS-19-145	34.4 (16.3)
RS-21-145	32 (15.1)
RS-23-160	42 (19.9)
RS-23-165	42 (19.9)

Table 31, Meritor Drive Axle Lubricant Capacity

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

18.04 Electric Service Center

The information under this heading is to help familiarize the driver with the basic electrical system. Servicing the electrical system should be done only by qualified technicians. Special skills and equipment are required. Take your vehicle to an authorized Freightliner service facility for repairs. The Recreational Vehicle chassis uses multiple electrical components (and fuel and hydraulic filters). Each component is mounted in varying locations on the chassis. If equipped with an Arens service center, it is mounted in one specific location, and that mounting location will vary. See Fig.232,Arens Controls. See Table.32,Connector 1, see Table.33,Connector 2 and see Table.34,Connector 3 for connector information.

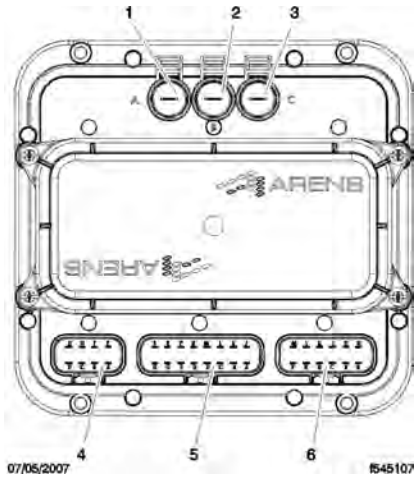


Fig 232, Arens Controls

1. Connector 4, Power Input A
2. Connector 4, Power Input B
3. Connector 4, Power Input C
4. Connector 3, 8 Positions
5. Connector 1, 16 Positions
6. Connector 2, 12 Positions

Table 32, Connector 1

Connector 1	
Connector Position	**Description**
1A	ECU-IGN
1B	FAN-SIG
1C	FAN NO
1D	EXTRA
1E	ECM BATT
1F	SPARE
1G	SPARE NC

1H	DIAG PWR
1J	FAN NC
1K	FAN RTN
1L	MBE ECM BATT
1M	HYD FAN MOD
1N	SPARE COM
1P	IGN
1R	SPARE NO
1S	SPARE SIG

Table 32, Connector 1

Table 33, Connector 2

Connector 2	
Connector Position	**Description**
2A	IGN SW START
2B	TCM BATT
2C	TCM BATT
2D	L TURN SIG
2E	REV LPS SIG
2F	REV LPS OUT
2G	GND
2H	START OUT
2J	NEU START SIG
2K	TCM
2L	MARKER SIG
2M	R TURN SIG

Table 33, Connector 2

Table 34, Connector 3

Connector 3	
Connector Position	**Description**
3A	REV TOW

3B	EXTRA
3C	EXTRA
3D	EXTRA
3E	R TURN OUT
3F	MARKER OUT
3G	L TURN OUT
3H	IGN OUT TOW

Table 34, Connector 3

18.05 Fuse/Relay/Circuit Breaker Identification

18.05.01 Fuse/Relay/Circuit Breaker Identification (front-engine diesel chassis)

Circuit breakers protect against circuit overload. If a circuit becomes overloaded (usually caused by a short to ground), the circuit breaker opens, stopping current flow. The vehicle may be equipped with auto-reset breakers.

The electrical system has five separate power distribution modules (PDMs) containing both fuses and relays. An optional tow power PDM is also available. See Fig.233,Cab PDMs (inside cab) and see Fig. 234,Chassis and Optional Tow Power PDMs (chassis mounted). The PDMs are mounted in two places:

- Two inside the cab area, typically at the base of the steering column.
- Three outside, typically mounted to the right of the operator's station.

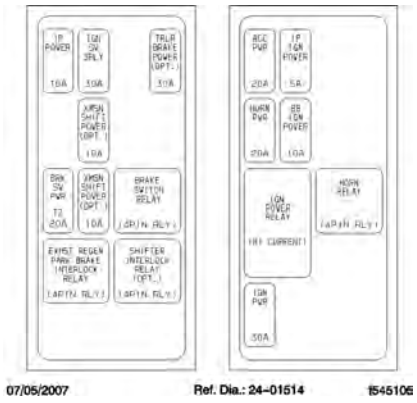


Fig 233, Cab PDMs (inside cab)

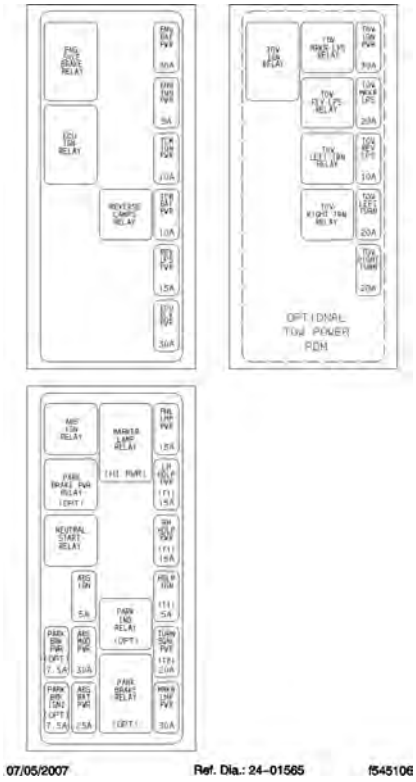


Fig 234, Chassis and Optional Tow Power PDMs (chassis mounted)

18.05.02 Fuse/Relay/Circuit Breaker Identification

The electrical system has a box that contains both fuses and relays. The box is mounted in varying locations (typically in the cab under the dash) depending on the design of the chassis. The fuses and relay boxes shown vary depending on chassis options. See Fig.237,Fuse/Relay (typical install), see Fig.238,Fuse/Relay (typical install), see Fig. 239,Fuse/Relay (typical install) and see Fig.240,Fuse/Relay (typical install).

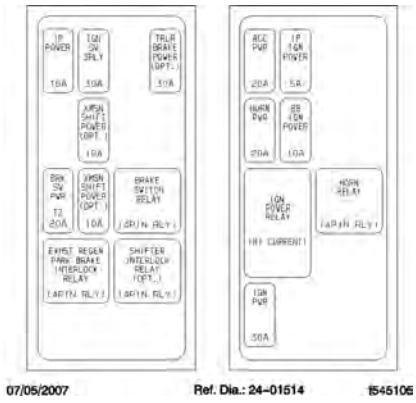


Fig 235, Cab PDMs (inside cab)

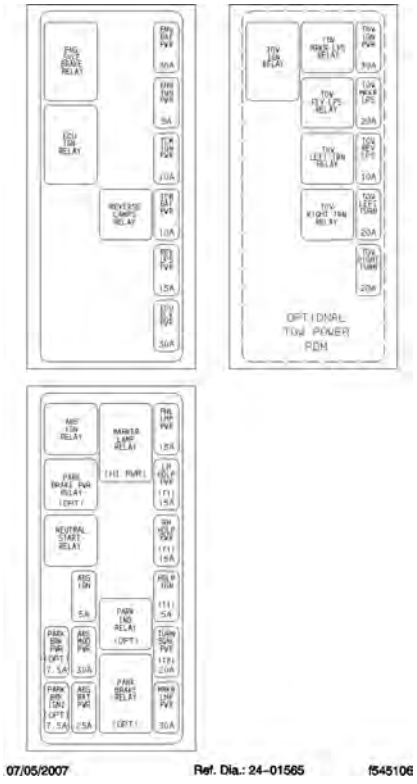


Fig 236, Chassis and Optional Tow Power PDMs (chassis mounted)

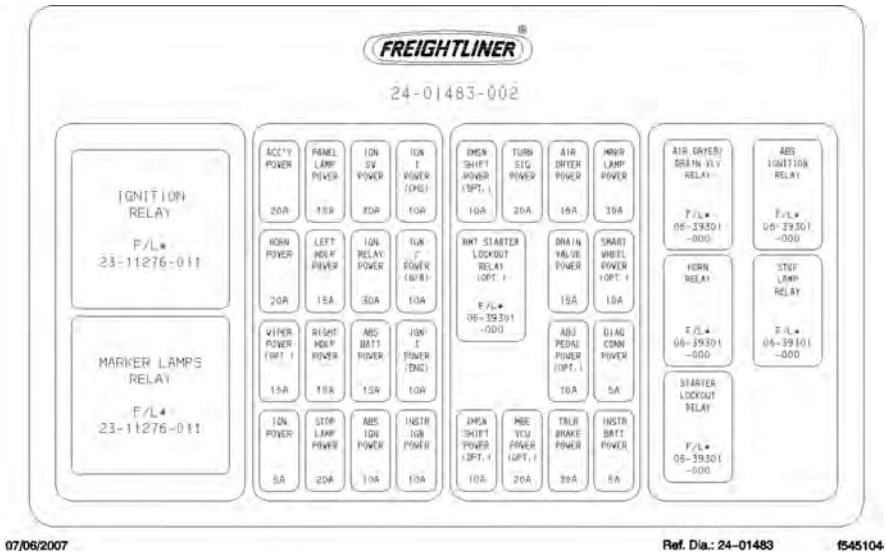


Fig 237, Fuse/Relay (typical install)

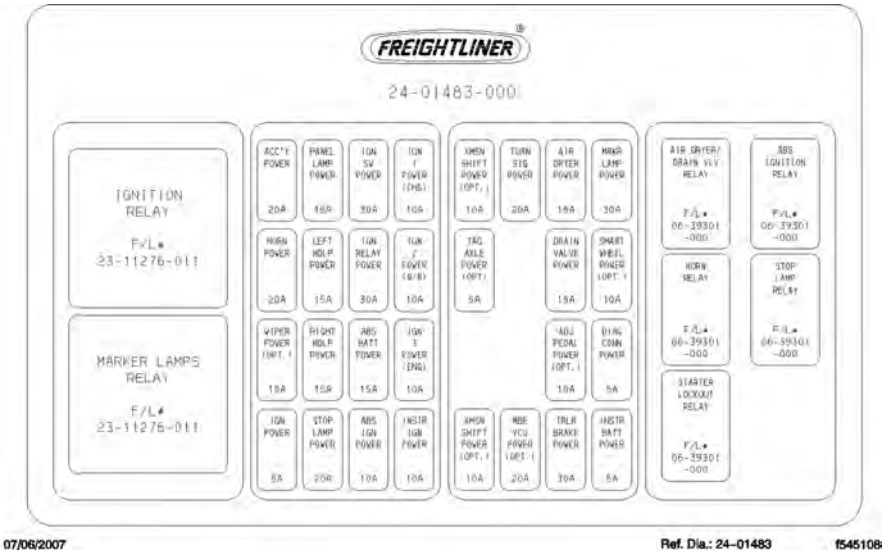


Fig 238, Fuse/Relay (typical install)

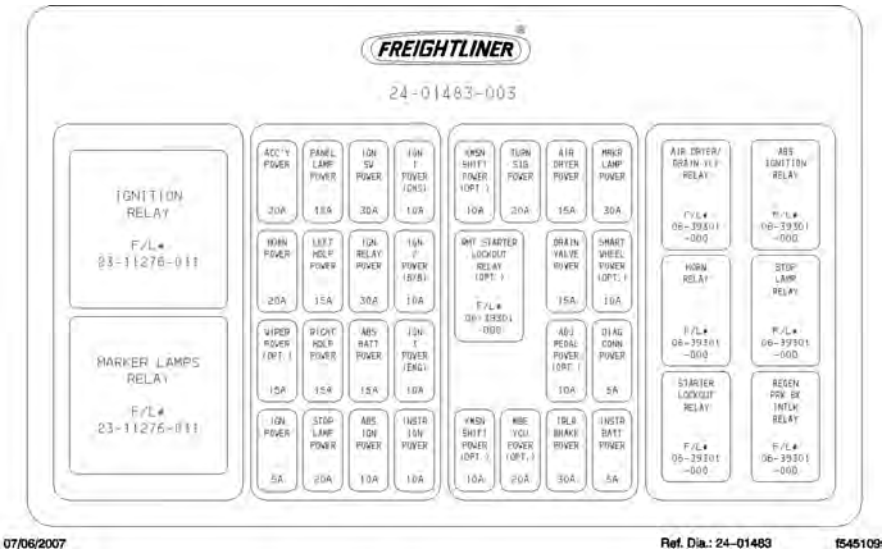


Fig 239, Fuse/Relay (typical install)

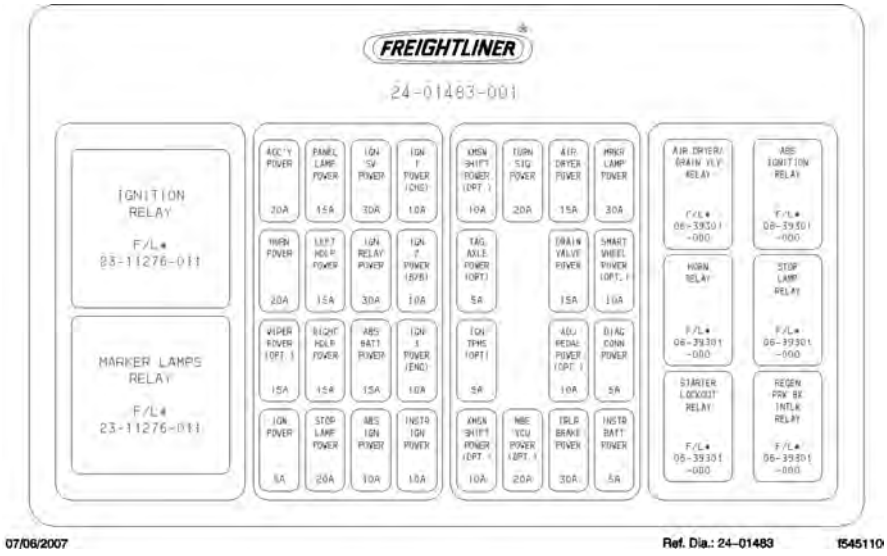


Fig 240, Fuse/Relay (typical install)

CONTACT INFORMATION

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

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