

PACCAR ENGINES

MX-13

Operator's Manual



2026 Emissions
2026 Model Year Warranty

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This manual illustrates and describes the operation of features or equipment which may be either standard or optional on this vehicle. This manual may also include a description of features and equipment which are no longer available or were not ordered on this vehicle. Please disregard any illustrations or descriptions relating to features or equipment which are not on this vehicle. PACCAR reserves the right to discontinue, change specifications, or change the design of its vehicles at any time without notice and without incurring any obligation. The information contained in this manual is proprietary to PACCAR. Reproduction, in whole or in part, by any means is strictly prohibited without prior written authorization from PACCAR Inc.

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CHAPTER 1: ENGINE OPERATION

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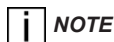
1 SAFETY - INTRODUCTION

1.1 Using This Manual

Please take the time to get acquainted with your vehicle by reading this Operator's Manual. We recommend that you read and understand this manual from beginning to end before you operate this equipment.

This manual contains useful information for the safe and efficient operation of this equipment. It also provides maintenance information, with an outline for performing safety checks and basic preventive maintenance inspections. When replacement parts are needed, we recommend using only genuine PACCAR parts.

We have tried to present the information needed to learn about functions, controls, and operation—and to present it as clearly as possible. Occasionally, you may need to reference this manual, and we hope you find it easy to use.



After you have read this manual, it should be stored in the cab for convenient reference and remain with this vehicle when sold.

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Your vehicle may not have all the features or options mentioned in this manual. Therefore, you should pay careful attention to the instructions that pertain to just your vehicle. In addition, if your vehicle is equipped with special equipment or options not discussed in this manual, consult your dealer or the manufacturer of the equipment.

There are several tools built into this manual to help you find what you need quickly and easily; first is the Table of Contents. Located at the front of the manual, this table arranges the subject matter into chapters, which can be quickly referenced using the numbers shown in the outer margin. The first page of each chapter presents a list of the major subjects contained in that chapter. Cross-referenced citations can also help you find information. If more information on the current subject is located elsewhere in the manual, a cross-reference may be provided, such as "see Safety Messages and Notes." Finally, you will find a helpful index at the back of the manual which lists the subjects covered alphabetically.

All information contained in this manual is based on the latest production information available at the time of publication. If you find differences between your instruments and the information in this manual, contact an authorized Kenworth or Peterbilt dealer. Kenworth Truck Company and Peterbilt Motors Company reserve the right to make changes at any time without notice.

1.2 Safety Messages and Notes

Read and follow ALL safety messages in this manual. When followed, injury to yourself and others, damage to equipment and/or property, or other unknown hazards are reduced. Both safety messages and notes are emphasized using a safety message symbol and one of three signal words: WARNING, CAUTION, or NOTE. **Do not** ignore any of these messages.

Warnings



Safety messages that follow this symbol and signal word provide a warning against operating procedures, actions, or a lack of action that could result in death or injury.

An unheeded warning may also result in damage to equipment, property, or the environment. Warning messages will identify the hazard, how to avoid it, and the probable consequence of not avoiding the hazard.

Example:



WARNING

DO NOT change hot engine oil as you could be burned. Let the engine cool down before changing the engine oil. Failure to comply may result in death, personal injury, equipment damage, or property damage.

Cautions



Safety messages that follow this symbol and signal word provide a caution against operating procedures, actions, or a lack of action that could result in equipment, property, or environmental damage. Caution messages will identify the hazard, how to avoid it, and the probable consequence of not avoiding the hazard.

Example:



CAUTION

DO NOT operate your vehicle with insufficient oil pressure as this will cause serious engine damage. Failure to comply may result in equipment or property damage.

Notes



Messages that follow this symbol and signal word provide important information that, while not safety related, should still be followed. A note will provide information that may be useful to the reader: clarifying the topic, providing valuable insight into the topic or process, or saving the reader time and effort.

Example:



NOTE

Pumping the accelerator pedal will not assist in starting the engine.

1.3 Forward

This manual contains information for the correct operation and maintenance of your PACCAR engine. Read and follow all safety instructions. Read the General Safety Instructions before operating your engine. Keep this manual with the equipment. If the equipment is traded or sold, give the manual to the new owner.

The information, specifications, and recommended maintenance guidelines in this manual are based on information in effect at the time of printing. PACCAR reserves the right to make changes at any time without obligation. If you find differences between your engine and the information in this manual, contact your local PACCAR Authorized Repair Location or write to:

PACCAR c/o PACCAR Engines
PO Box 1518 Bellevue, WA 98009

The latest technology and the highest quality components were used to produce this engine. When replacement parts are needed, we recommend using only genuine parts from PACCAR.

i NOTE

Warranty information including the EPA and California Emission Warranty is located in the section entitled 'Engine Warranty.' Make sure you are familiar with the warranty or warranties applicable to your engine.

1.4 Illustrations

Some of the illustrations found in this manual are generic. They will not look exactly like the parts or assemblies you find installed on the vehicle.

When an illustration differs from what you see physically present on the vehicle, the language describing the procedure is still correct for the application.

1.5 General Safety Instructions

! WARNING

Improper practices, carelessness, or ignoring safety messages – Warnings and Cautions – may cause death, per-

sonal injury, equipment damage, or property damage.

! WARNING

Improper practices, carelessness, or ignoring safety messages – Warnings and Cautions – may result in death, personal injury, equipment damage, or property damage.

Before performing any repair, read and understand all of the safety precautions and warnings. The following is a list of general safety precautions that must be followed to provide personal safety. Failure to follow these instructions may cause death or injury. Special safety precautions are included in the procedures when they apply.

Keep in mind that even a well-maintained vehicle must be operated within the range of its mechanical capabilities and the limits of its load ratings. See the Weight Ratings label on the driver's door edge.

Every new vehicle is designed to conform to all Federal Motor Vehicle Safety Standards applicable at the time of manufacture. Even with these safety features, continued safe and reliable operation depends upon regular vehicle maintenance. Fol-

low the maintenance recommendations found in the Maintenance section. Following maintenance recommendations will help your vehicle maintain quality conditions.

Make sure your vehicle is in top working condition before heading out on the road, it is the driver's duty to do so. Inspect the vehicle according to the Driver's Check List:

- Work areas should be dry, well lit, well ventilated; free from clutter, loose tools, parts, ignition sources, and hazardous substances.
- Wear protective glasses and protective shoes when working.
- Wear protective gloves when working with hot liquids or surfaces, and when working with components that have sharp edges.
- DO NOT wear loose-fitting or torn clothing. Tie back and/or tuck in long hair. Remove all jewelry when working.
- Before beginning any repair, disconnect the battery (negative [-] cable) and discharge any capacitors.
- Put a "DO NOT OPERATE" tag in the operator's compartment or on the controls.
- Allow the engine to cool before slowly

loosening the coolant fill cap to relieve the pressure from the cooling system.



WARNING

DO NOT remove the coolant fill cap while the engine is hot. Wait until coolant temperature is below 120°F (50°C). Scalding steam and fluid under pressure may escape and cause serious burns. Failure to comply may result in death, personal injury, equipment damage, or property damage.



WARNING

DO NOT attempt to service the high-pressure fuel system unless you are a certified technician. Escaping high-pressure fuel is dangerous. Failure to comply may result in death, personal injury, equipment damage, or property damage.



WARNING

DO NOT attempt to service the high-pressure fuel system unless you are a certified technician. Escaping high-pressure fuel is dangerous. Failure to com-

ply may result in death, personal injury, equipment damage, or property damage.

- Always use wheel chocks or proper jack stands to support the vehicle or vehicle components before performing any service work. DO NOT work on anything that is supported only by lifting jacks or a hoist. Before resting a vehicle on jack stands, be sure the stands are rated for the load you will be placing on them.
 - Before loosening or disconnecting lines, fittings, or related items, always release line pressure in the system. Make sure to use the approved system point and method for the specific system (fuel, oil). Escaping high-pressure fluids can cause severe injury. PACCAR does not provide the approved system points and methods in operator's manuals. The service literature provides this information. You can obtain service literature through a certified service center.
 - Always wear protective clothing when working on any refrigerant lines and make sure that the workplace is well ventilated. Inhalation of fumes can cause death or personal injury.
- To protect the environment, liquid refrigerant systems must be properly emptied and filled using equipment that prevents the release of refrigerant gas. Federal law requires capturing and recycling refrigerant.
- When moving or lifting any heavy equipment or parts, make sure to use proper techniques and assistance. Ensure all lifting devices such as chains, hooks, or slings are in good condition and are rated for the correct load capacity. Make sure all lifting devices are positioned correctly.
 - Corrosion inhibitors and lubricating oils may contain alkali. DO NOT get the substance in eyes and avoid prolonged or repeated contact with skin. DO NOT swallow. If ingested, seek immediate medical attention. DO NOT induce vomiting. In case of contact, immediately wash skin with soap and water. In case of harmful contact, immediately contact a physician. Always keep any chemicals OUT OF REACH OF CHILDREN.
 - When working on the vehicle, be alert for hot parts on systems that have just been turned off, exhaust gas flow, and hot fluids in lines, tubes, and compartments. Contact with any hot surface may cause burns.

- Always use tools that are in good condition. Make sure you have the proper understanding of how to use the tools before performing any service work. Use only genuine replacement parts from PACCAR.
- Always use the same fastener part number (or equivalent) when replacing items. DO NOT use a fastener of lesser quality if replacements are necessary. (e.g., DO NOT replace a Metric 10.9 grade with 8.8 grade fastener).
- Always torque fasteners and fuel connections to the required specifications. Overtightening or undertightening can allow leakage.
- Close the manual fuel valves prior to performing maintenance and repairs, and when storing the vehicle inside.
- DO NOT perform any repair when impaired, tired, fatigued, or after consuming alcohol or drugs that can impair your functioning.
- Some state and federal agencies in the United States of America have determined that used engine or transmission oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine or transmission oil.

- Coolant is toxic. If not reused, dispose of coolant in accordance with local environmental regulations.

CAUTION

DO NOT use corrosive chemicals on any part of the vehicle unless expressly directed. Corrosive chemicals can damage vehicle components. Failure to comply may result in equipment or property damage.

California Proposition 65 Warning

- Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.
- The catalyst substrate located in the Diesel Particulate Filter (DPF) contains vanadium pentoxide, which has been determined by the State of California to cause cancer. Always wear protective clothing and eye protection when handling the catalyst assembly. Dispose of the catalyst in accordance with local regulations. If catalyst material gets into the eyes, immediately flood eyes with water for a minimum of 15 minutes. Avoid prolonged contact with skin. In

case of contact, immediately wash skin with soap and water. In case of harmful contact, immediately contact a physician.

- Other chemicals in this vehicle are also known to the State of California to cause cancer, birth defects, or other reproductive harm.
- Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.

1.6 Emergency - What To Do If

ROADSIDE ASSISTANCE

Open 24 hours a day, 365 days a year, call toll-free to talk to someone at the PACCAR Vehicle Support Center:

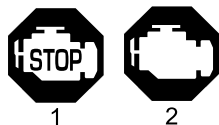
- Kenworth customers

**1-800-KW-Assist
(1-800-592-7747)**

- Peterbilt customers

1-800-4Peterbilt**(1-800-473-8372)****The PACCAR Vehicle Support Center**

- Uses a custom mapping system that locates PACCAR Powertrain distributors and Independent Service Providers (ISPs) near you, listing services offered, hours of operation, and contact information.
- Assists with jump and pull starts, tires, trailers, fines and permits, chains, towing, hazardous clean-up, out of fuel (roadside), mechanical repairs and preventive maintenance services.
- Employs multilingual agents and has access to a translation service, ensuring quality assistance for customers in many languages.
- Places you in contact with a PACCAR Powertrain distributor who can answer your warranty questions.
- Provides these services for FREE.

STOP ENGINE LAMP

The stop engine warning lamp will illuminate, and an audible tone will sound, when a major engine problem exists. Your vehicle will be equipped with one of the indicators above, 1 or 2, depending on the engine model.

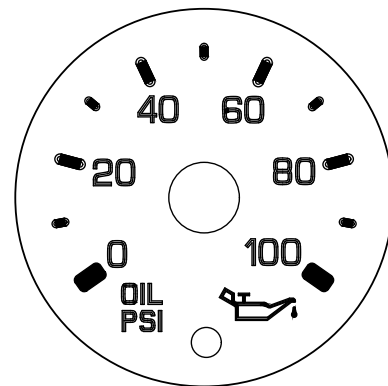
**WARNING**

If the stop engine warning light turns on, a serious engine system problem has occurred. Safely stop the vehicle and turn OFF the engine. DO NOT drive the vehicle until the vehicle has been serviced. Failure to comply may result in death, personal injury, equipment damage, or property damage.

For engines with the engine-protection shutdown feature enabled, the stop engine lamp will begin to flash 30 seconds before the engine automatically shuts down. The warning lamp alerts the operator to the impending shutdown.

The lamp will also illuminate when the DEF tank is almost empty or the soot level in the DPF is at full capacity. At this level warning, regeneration cannot be performed and engine power will be derated.

Engine may automatically shut down if the check engine lamp and stop engine lamp are illuminated and the operator does not correct the condition.

ENGINE OIL PRESSURE LAMP TURNS ON

It is important to maintain oil pressure within acceptable limits. If oil pressure drops below the minimum psi a red warning lamp on the oil pressure gauge and the Stop Engine Lamp will come ON.

**CAUTION**

DO NOT operate your vehicle with insufficient oil pressure as this will cause serious engine damage. Failure to comply may result in equipment or property damage.

- If the oil pressure fails to rise within 10 seconds after the engine starts, stop the engine and determine the cause.
- See Engine Oil Specification for the correct oil pressure ranges for your vehicle's engine.
- If the oil pressure suddenly drops, or the audible alarm and engine oil pressure warning light come on while driving, do the following:
 1. Slow down carefully.
 2. Move a safe distance off the road and stop.
 3. Place the transmission in neutral (N) and set the parking brake. (See Parking Brake Valve and Operating the Transmission in your vehicle Operator's Manual, for transmission shifting and parking brake information.)
 4. Turn OFF the engine.
 5. Turn ON the emergency flasher and

use other warning devices to alert other motorists.

6. Wait 15-20 minutes to allow oil to drain into the engine oil pan, and then check the oil level. See Engine Oil Level.
7. Add oil if necessary. If the problem persists, contact an authorized PACCAR engine dealer as soon as possible.

CHECK ENGINE LAMP TURNS ON



Or



Check Engine Lamp - Turns on when a problem exists, but the vehicle can still be safely driven. Vehicle should be serviced to correct the problem but the situation should not be considered an emergency. The lamp will also illuminate when a DPF regeneration or addition of diesel exhaust fluid (DEF) is required. Another function of the check engine lamp is to warn the

operator of an impending idle shutdown. When the idle shutdown timer is 30 seconds from expiring, the ECM begins flashing the check engine warning lamp once per second. When the timer expires, the ECM will turn off the warning lamp and shut down the engine.

ENGINE IS OVERHEATING

**CAUTION**

Routinely inspect cooling system hoses and clamps for damage. A cracked, split, worn, or loose hose or clamp could result in a leak, leading to a sudden loss of coolant resulting in an overheat condition. Failure to comply may result in equipment damage or property damage.

**NOTE**

The system may also temporarily overheat during severe operating conditions such as:

- Climbing a hill on a hot day

- Stopping after high-speed/high-load driving
- Debris blocking air flow through the cooling module (radiator)

If the engine overheats, DO NOT TURN THE ENGINE OFF UNLESS a low water warning device indicates a loss of coolant. The following applies if the engine coolant temperature rises, or is already above normal: (Also, there cannot be any other warning alarms displayed in the instrument cluster.) If so, complete the following steps:

1.



WARNING

DO NOT remove the coolant fill cap while the engine is hot. Wait until coolant temperature is below 120°F (50°C). Scalding steam and fluid under pressure may escape and cause serious burns. Failure to comply may result in death, personal injury, equipment damage, or property damage.



WARNING

DO NOT leave the engine idling without an alert driver present. If the engine overheats, as indicated by the coolant temperature light, take immediate action. Continued unattended operation, even briefly, may cause serious engine damage or a fire. Failure to comply may result in death, personal injury, equipment damage, or property damage.

Reduce the engine speed. You can also stop the vehicle. If stopped, place the transmission in neutral (N). Set the parking brake. Keep the engine running.



NOTE

Keep the engine running at idle speed. Only shut off the engine if a warning icon indicates to do so.

2. Check to make sure that the oil pressure gauge reads normal.
3. Make sure that the engine fan rotates by switching the **Engine Fan**

Switch (if equipped) from AUTO to MAN (Manual).

4. Idle the engine to reduce the coolant temperature. If the temperature does not begin to drop, shut off the engine. Then contact the nearest authorized dealer.
5. If the temperature begins to return to normal, allow the engine to idle for 3 to 5 minutes. Shut it off only after the temperature returns to normal. Idling the engine allows the engine to cool gradually and uniformly.
6. If overheating came from severe operating conditions, the temperature must drop while parked. If it has not, stop the engine. Let it cool before checking to see if the coolant is low.
7. Park on level ground to receive accurate readings. Check the coolant level at the coolant surge tank.

Result:

Check the coolant level after each trip when the engine is cool. The coolant level must be visible within the surge tank. If necessary, add coolant.

2 OPERATING INSTRUCTIONS

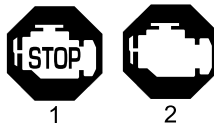
2.1 Engine Warning Lamps

The following engine warning lamps section covers only the lamps controlled by the engine's Electronic Control Module (ECM). Please refer to the vehicle "Operator's Manual" and "Engine Aftertreatment Systems" manuals for additional warning lamp information.

CAUTION

The installation of electronic devices to the On-board Diagnostics (OBD) connector, the vehicle Controller Area Network (CAN), or their associated wiring is not permitted. Doing so can adversely affect vehicle performance and/or cause fault codes to be recorded. The OBD connector is provided for temporary connection of service tools and for diagnostic purposes only. Failure to comply may result in equipment or property damage.

2.2 Stop Engine Lamp



The stop engine warning lamp will illuminate, and an audible tone will sound, when a major engine problem exists. Your vehicle will be equipped with one of the indicators above, 1 or 2, depending on the engine model.

WARNING

If the stop engine warning light turns on, a serious engine system problem has occurred. Safely stop the vehicle and turn OFF the engine. DO NOT drive the vehicle until the vehicle has been serviced. Failure to comply may result in death, personal injury, equipment damage, or property damage.

For engines with the engine-protection shutdown feature enabled, the stop engine lamp will begin to flash 30 seconds before

the engine automatically shuts down. The warning lamp alerts the operator to the impending shutdown.

The lamp will also illuminate when the DEF tank is almost empty or the soot level in the DPF is at full capacity. At this level warning, regeneration cannot be performed and engine power will be derated.

Engine may automatically shut down if the check engine lamp and stop engine lamp are illuminated and the operator does not correct the condition.

2.3 Engine, Check Engine



Or



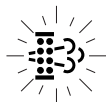
Illuminates when a non-emissions related problem exists, but the vehicle can still be safely driven. Vehicle should be serviced to correct the problem but the situation should not be considered an emergency.

2.4 Water-In-Fuel (WIF) Lamp



If the WIF notification is present, manually drain the water at the engine mounted primary fuel filter as soon as possible. Failure to drain the water and then continuing to operate the engine could cause the water to be sent back to the fuel tank. If this happens, draining the fuel tank may become necessary. This procedure can be avoided if the operator or technician drains the water from the fuel filter module frequently at the primary fuel filter.

2.5 Diesel Particulate Filter (DPF)



This warning means that the DPF needs to be regenerated and appears when soot in the DPF exceeds an acceptable amount or a significant amount of hydrocarbons (HC) are detected.

This warning may also appear if the system is attempting to regenerate automatically while the vehicle is in Power Take-off (PTO) mode.

For more information about this warning, consult the Engine Aftertreatment System operator's manual.

NOTE

This manual describes only the most basic aftertreatment information essential for a driver to operate the vehicle safely. For a more thorough explanation of the emissions system is available in the video linked to the QR code below

or in the Engine Aftertreatment Systems Operator's Manual.



2.6 High Exhaust System Temperature (HEST)



WARNING

If the High Exhaust System Temperature (HEST) warning light is on, DO NOT park near people, combustible materials, or combustible vapors. A person coming within 5 ft. (1.5 m) of the exhaust (outlet) stream or into contact with an engine aftertreatment system (EAS) component may incur serious burns. Combustibles need to be at least 5 ft. (1.5 m) away from the exhaust stream as it exits the tail pipe. Failure to maintain this margin could ignite the material or cause an explosion. Failure

to comply may result in death, personal injury, equipment damage, or property damage.

WARNING

When the High Exhaust System Temperature (HEST) warning light is on, allow adequate cooling time before attempting to approach or work on any part of the exhaust system or surrounding components. When the HEST warning light is on, the temperature of the exhaust system is elevated and can cause serious burns. This system includes the tailpipe, exhaust pipes, diesel particulate filter (DPF)/selective catalytic reduction (SCR) device, and surrounding components, including enclosures and steps. Failure to comply may result in death, personal injury, equipment damage, or property damage.

The purpose of the High Exhaust System Temperature (HEST) warning light is to notify the operator to high temperatures in the vicinity of the tail pipe, diesel particulate filter (DPF), and surrounding components during a regeneration. The HEST warning

light turns on only when the vehicle is stationary or moving slowly: less than 5 mph (8 kph).

During a regeneration, some EAS components can reach temperatures greater than 1202°F (650°C). Therefore, it is important to pay attention to HEST warnings prior to, during, and immediately following a regeneration.

2.7 Diesel Exhaust Fluid (DEF) Lamp

The engine aftertreatment system includes a diesel exhaust fluid (DEF) warning lamp on the DEF gauge and additional warning lamps or notification messages in the instrument cluster. Refer to the operator manual for more details.

Figure 1: DEF Warning Lamp in Instrument Cluster



The system will alert the operator when the fluid in the DEF tank reaches a low level. Refer to the operator manual for more details. If the lamp illuminates but the level is full, seek service immediately for DEF fluid quality or DEF equipment repair.

2.8 Engine Braking System

ENGINE BRAKING SYSTEM

An engine compression brake is standard on the MX-13 engines. Optionally, this engine may be equipped with an exhaust brake. When activated, these devices supplement the service brakes by creating a braking effect on the drive wheels, helping keep your vehicle's service brakes from overheating and/or from additional wear and tear. The engine compression brake or exhaust brake is not an emergency brake nor intended to replace the service brakes.

WARNING

DO NOT use a retarder (such as the engine brake, exhaust brake, transmission retarder, or regenerative braking) when operating your vehicle bobtail or with an unloaded trailer. There may not be enough weight on the rear axle to provide traction, causing a loss of vehicle control, resulting in an accident. Make sure the engine brake is switched "OFF" when bobtailing or operating with an unloaded trailer. Failure to comply may result in death, personal injury,

equipment damage, or property damage.

⚠ WARNING

The service brakes must be used in an emergency. Retarders alone (such as the engine brake, exhaust brake, transmission retarder, or regenerative braking) might not stop the vehicle fast enough to prevent an accident. Failure to comply may result in death, personal injury, equipment damage, or property damage.

⚠ CAUTION

DO NOT operate the engine compression brake or exhaust brake until the engine oil temperature is above 86°F (30°C). Operation below 86°F (30°C) could cause severe damage to the engine. Idle the engine four minutes at approximately 1,000 rpm to warm the engine before activating the engine brakes.

i NOTE

If your vehicle is equipped with anti-lock brakes (ABS), operation of the engine compression brake or exhaust brake (if turned ON) may be interrupted if the ABS system detects wheel-slip due to operation on slippery surfaces.

Ideally (on normal road surfaces), you should slow your vehicle with the engine compression brake or exhaust brake (where permitted by law) and use the service brakes only for stopping completely. Operating this way will greatly prolong the life of the service brakes.

ENGINE COMPRESSION BRAKE LEVEL SWITCH OPERATION

For the three-position engine compression brake level switch, there will be 100 percent engine braking when the switch is in the up (HIGH) position. In the middle (MEDIUM) position, there will be 66 percent engine braking. In the down (LOW) position there will be 33 percent engine braking.

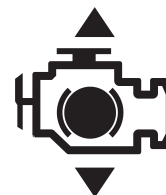
With the engine compression brake switch ON, the engine compression brake will be engaged when the service brake is applied.

If the cruise control is operated in conjunction with the engine compression brake, the engine compression brake will engage to maintain the cruise set speed.

Figure 2: Engine Compression Brake on \off



Figure 3: Engine Compression Brake setting



ENGINE COMPRESSION BRAKE

With the engine compression brake switch ON, the brake automatically creates its braking effect when you remove your foot from the accelerator pedal.

The brake switch is located on the accessory dash panel. It controls whether the

brake is ON (ready to slow the vehicle down) or OFF (no braking action).

1. Do not use the engine compression brake to slow the vehicle down when you are bobtailing or pulling an empty trailer.
2. Make sure the brake is OFF before starting the engine.
3. After the engine is started, warmed up and you are ready to get under way, turn the engine compression brake switch ON for added braking effect.



NOTE

If your vehicle is equipped with the Eaton Vorad® system, operation of the compression brake may be automatically activated.

ENGINE COMPRESSION BRAKE CONTROLS

There are two switches on the dash panel that control the engine compression brake. A master switch turns the system ON or OFF. A second switch, located next to the master switch, controls the braking effect.

This switch allows you to choose progressively stronger braking to slow the vehicle down.

Engine compression brake controls include:

- ON/OFF switch
- Three-position selector switch
- Clutch switch
- Throttle sensor
- Service brake pressure switch
- Eaton Vorad® Anti-Lock Braking System

Engaging conditions for the engine compression brake:

- Engine speed must be above 1,000 rpm.
- Coolant temperature must be above 59°F (15°C).

Deactivation conditions for the engine compression brake:

- Accelerator pedal is depressed.
- Clutch pedal is depressed.
- Engine speed falls below 800 rpm.
- ABS control is active.
- ECM recognizes a system problem.



CAUTION

Operating the engine with a compression brake that will not automatically deactivate (i.e. when the dash switch is OFF, clutch pedal is depressed or throttle is applied) will cause severe internal engine damage. DO NOT operate the engine if the compression brake will not deactivate. Failure to comply may result in equipment or property damage.

ENGINE COMPRESSION BRAKE LEVEL SWITCH OPERATION

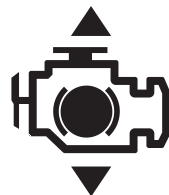
For the three-position engine compression brake level switch, there will be 100 percent engine braking when the switch is in the up (HIGH) position. In the middle (MEDIUM) position, there will be 66 percent engine braking. In the down (LOW) position there will be 33 percent engine braking.

With the engine compression brake switch ON, the engine compression brake will be engaged when the service brake is applied. If the cruise control is operated in conjunction with the engine compression brake, the engine compression brake will engage to maintain the cruise set speed.

Figure 4: Engine Compression Brake on /off



Figure 5: Engine Compression Brake setting



2.9 Operation

DRIVING

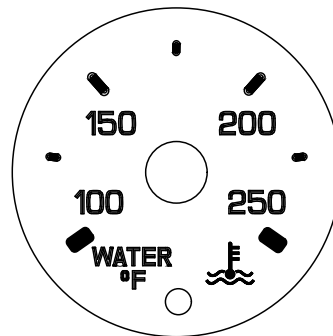
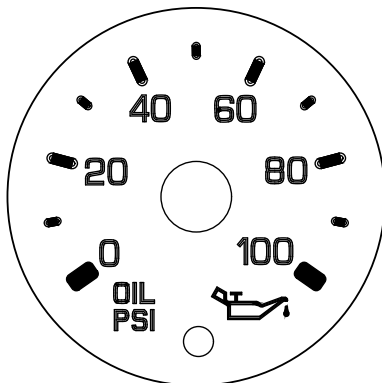
Correct care of your engine will result in longer life, better performance, and more economical operation.

Follow the daily maintenance checks listed in [Engine Maintenance](#).

Check the engine oil pressure and engine coolant gauges, warning lamps, and other gauges daily to make sure they are operational. Normally each gauge will make a

full sweep when ignition key is cycled ON to indicate that the gauge is operating correctly.

Figure 6: Generic gauges. Your gauges may differ.



i NOTE

If the engine is running, do not increase engine speed (rpm) or operate the vehicle until the low oil pressure warning lamp turns off.

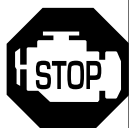
⚠ CAUTION

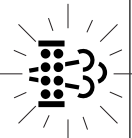
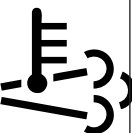
Engaging the starter motor for more than 30 seconds in any 5 minute period may cause it to overheat and can damage the starter motor. If starter is engaged continuously for 30 seconds, you must wait 5 minutes before trying

to start the engine. This will allow the starter motor time to cool down.

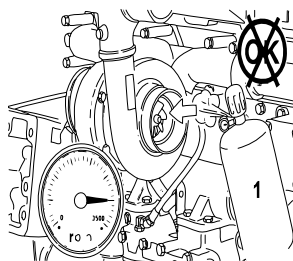
With the key in the ON position, the engine warning lamps will come on momentarily and then go out. The engine warning lamps include:

Engine Operation Symbols

Description	Icon	Color
Check engine lamp		Amber
	or	
		
Stop engine lamp		Red

Description	Icon	Color
Diesel particulate filter (DPF) status indicator lamp		Amber
High exhaust system temperature (HEST) indicator lamp		Amber

Combustible Vapors



1

DO NOT use combustible gas in turbo.

WARNING

DO NOT operate your vehicle in an area where combustible chemicals or vapors may be present. Combustible vapors near the air intake system could be ingested into the engine, causing the engine to suddenly accelerate and overspeed. This condition could result in the operator losing control of the vehicle if an unexpected increase in engine rpm occurs. Combustible vapors could also cause a fire. Failure to comply may result in death, personal injury, equipment damage, or property damage.

NOTE

IT IS THE RESPONSIBILITY OF THE OWNER AND OPERATOR TO OPERATE THE VEHICLE IN A SAFE ENVIRONMENT.

NORMAL STARTING PROCEDURE

Follow this engine starting procedure when the outside temperature is above 50°F (10°C).

1. Ensure the parking brake is set ON and the transmission shift lever is in neutral. For automatic transmissions, be sure the shift lever is in the neutral position (N). For automatic transmissions that have park (P) position, place the shift lever in park.

NOTE

If outside temperature is below 50°F (10°C) go to the Cold Weather Starting Procedure. Start at step 2 and follow the directions until it directs you back to step 2 of this procedure.

2. With the accelerator pedal in the idle position, turn the ignition key to the START position to start the engine.
3. If the engine does not start after 10 seconds, release the key. Wait an additional 10 seconds to allow the starter motor to cool, then try starting the engine again.

4. Once the engine has started, wait for the oil pressure to rise, and the low oil pressure warning lamp to turn off, before increasing rpm.
If the engine does not start, or runs erratically, see Priming the Fuel System.

COLD WEATHER STARTING

Follow this engine starting procedure when the outside temperature is below 50°F (10°C).



CAUTION

To reduce the possibility of damage to the lubricating oil pan, due to the materials used in the manufacture of the lubricating oil pan, under no circumstances should an external heat source be applied directly or indirectly to the lubricating oil pan.

1. If you have not already, begin by following the Normal Starting Procedure until it directs you back to step 2 in this cold weather procedure. Refer to the vehicle operator's manual instructions for any additional cold weather starting procedures.

2. Allow the 12 volt fuel module pre-heater to heat the fuel. Leave the key in the ON position for two full minutes, before engaging the starter. During cold weather, the use of winter fuel blends can significantly improve the ease of starting performance, and overall dependability of your vehicle. Winter fuel blends are designed to reduce wax gelling in the fuel filter and lines.

If Starting a cold engine, remember to slowly increase the engine speed. This provides adequate lubrication to the bearings and gives ample time to allow the oil pressure to stabilize. Also, for coolant temperatures below 150°F (70°C), use a low gear and drive at moderate engine speed until the engine coolant has reached operating temperature. Do not let the engine idle longer than necessary. If the vehicle cannot be driven, an elevated idle speed may be used instead to warm the engine.

3. Return to step 2 in the Normal Starting Procedure

 CAUTION

The use of starting aids, such as ether, may result in damage to the engine and engine aftertreatment system.

STARTING PROCEDURE AFTER EXTENDED SHUTDOWN OR OIL CHANGE

After extended shutdown or an oil change follow the Normal Starting Procedure.

OPERATING THE ENGINE

Monitor the oil pressure and coolant temperature gauges frequently. Refer to Engine Oil Capacities and Pressures and Engine Coolant Specifications for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature does NOT meet the specifications.

Manual Transmission Variable Idle Control

 NOTE

If your truck is equipped with a manual transmission, your engine idle RPM may vary under certain conditions. The engine control module will control the RPM based on various inputs such as vehicle weight, rear axle ratio, road grade and altitude. When starting from a stop, depending on these conditions, the engine RPM may increase to compensate for load in order to ensure a smooth transition into motion.

ENGINE OPERATING RANGE

1. Full throttle rpm
2. Peak torque

 CAUTION

Operating the engine at full throttle below peak torque will shorten engine life to overhaul, can cause serious engine damage, and is considered engine abuse. DO NOT operate the engine at full throttle operation below peak torque rpm for more than 30 sec-

onds. Failure to comply may result in equipment or property damage.

PACCAR engines are designed to operate at full throttle under momentary conditions down to peak torque engine speed. This is consistent with recommended operating practices.

 CAUTION

Operating the engine beyond the maximum engine speed can cause severe engine damage. Use proper operating techniques for the vehicle to prevent engine overspeed. See Engine Specifications for maximum engine speed. Failure to comply may result in equipment or property damage.

EXTENDED IDLING

 CAUTION

DO NOT idle engine longer than five minutes at low rpm (400-600 rpm). DO NOT allow the engine to operate at idle for extended periods at temperatures at or below 160°F (71°C). Long idle periods after the engine has reached

operating temperatures can result in gummed piston rings, clogged injectors, and break down engine lubrication resulting in engine damage. Torsional vibrations at low idle can cause transmission wear. Failure to comply can result in equipment or property damage.

CAUTION

If the truck is equipped with Power Take-off (PTO) equipment, the engine shutdown system can be deactivated when the PTO is operational; however, engine idle periods should not exceed five minutes whenever possible. Failure to comply may result in equipment or property damage.

Long periods of idle time (3 hours or more) may accelerate the build-up of soot in the diesel particulate filter (DPF), especially in cold weather. The system will illuminate the DPF indicator and present a message to indicate that the DPF requires regeneration. Refer to the operator manual for more details.

This is not a problem with the vehicle; however, it indicates that the driver needs to start a parked DPF regeneration to prevent equipment damage caused by soot build

up. If the DPF lamp turns ON and the driver is prompted to through driver notifications, perform a parked DPF Regeneration.

CAUTION

Do not ignore the diesel particulate filter (DPF) warning light. The warning light alerts the operator that the DPF should be regenerated. If soot is allowed to fill the DPF and a regeneration is not performed, the DPF will become clogged, requiring it to be removed and cleaned. Failure to comply may result in equipment or property damage.

If an engine must idle for an extended period of time, idle the engine at the lowest rpm that maintains the engine coolant at 150°F (70°C), or above. Following these guidelines will help reduce engine wear during idling and the frequency of DPF regenerations.

ENGINE SHUTDOWN

CAUTION

DO NOT shut off the engine immediately after use, especially after a long trip or if the engine has been subject to

high load. The engine is hot and must be cooled. Idle the engine at 1000 rpm for at least 4 minutes, then low idle for an additional 30 seconds before shutting off the engine. Failure to comply may result in engine damage, reducing its service life.

Idle the engine at 1,000 rpm for four minutes. Then low idle for 30 seconds before shutdown. This will allow circulating coolant and lubricating oil to carry heat away from the cylinder head, valves, pistons, cylinder liners, turbocharger, and bearings. This way you can prevent engine damage that may result from uneven cooling.

Turn the ignition switch to the OFF position. If the engine does **not** shut down, contact your dealer.

ELECTROMAGNETIC INTERFERENCE

Some aftermarket accessories (CB radios, mobile transmitters, and so on) can generate radio frequency energy that can cause electromagnetic interference (EMI). This interference can disrupt the electronically controlled fuel system. Under these conditions, PACCAR is not liable for any performance problems with either the fuel system

or the accessory. PACCAR does not consider EMI an engine failure and therefore is not warrantable.

System EMI Susceptibility

PACCAR designs products for minimum sensitivity to incoming electromagnetic energy. The fuel system EMI has a high tolerance against EMI against electromagnetic energy-emitting devices. This statement assumes that a device meets the Federal Communications Commission legal requirements.

System EMI Radiation Levels

PACCAR requires that electronic components pass various PACCAR and industry EMI specifications. When properly installed and maintained, testing shows that the engine does not cause interference.

If you notice any interference condition, follow these suggestions to reduce the amount of EMI:

1. Locate the accessory receiving antenna further away.
2. Check with an accessory supplier in the area to:
 - Accurately calibrate the accessory for proper frequency, power output, and sensitivity.
 - Determine the optimum

antenna location by obtaining antenna reflective energy data measurements.

- Use the optimum antenna type and mounting arrangement.

OPERATING ON LEVEL AND DRY PAVEMENT

WARNING

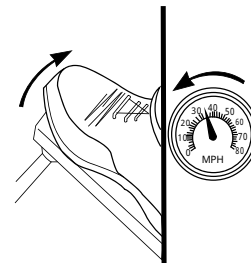
DO NOT use a retarder (such as the engine brake, exhaust brake, transmission retarder, or regenerative braking) when operating on road surfaces with poor traction (such as wet, icy, or snow covered roads, or gravel). Retarders can cause the wheels to skid on a slippery surface. You could lose control of the vehicle or jackknife if the wheels begin to skid, resulting in an accident. Failure to comply may result in death, personal injury, equipment damage, or property damage.

WARNING

DO NOT use a retarder (such as the engine brake, exhaust brake, transmission retarder, or regenerative braking)

when operating your vehicle bobtail or with an unloaded trailer. There may not be enough weight on the rear axle to provide traction, causing a loss of vehicle control, resulting in an accident. Make sure the engine brake is switched "OFF" when bobtailing or operating with an unloaded trailer. Failure to comply may result in death, personal injury, equipment damage, or property damage.

Figure 7: Remove Foot from Accelerator



To reduce vehicle speed, put the engine brake or exhaust brake ON/OFF switch in the "ON" position. Remove your foot from

the accelerator pedal and clutch pedal. The engine brake or exhaust brake will immediately begin to operate, slowing the vehicle.

For operation on dry and flat surfaces, when greater braking power is not required, put the two-position selector switch in the "LOW" position.

For operation on dry pavement when maximum braking power is required, put the three-position selector switch in the "HI" position.

OPERATING ON GRADES AND DRY PAVEMENT

WARNING

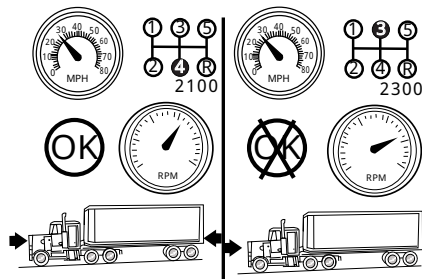
The service brakes must be used in an emergency. Retarders alone (such as the engine brake, exhaust brake, transmission retarder, or regenerative braking) might not stop the vehicle fast enough to prevent an accident. Failure to comply may result in death, personal injury, equipment damage, or property damage.

WARNING

DO NOT rely only on a retarder (such as the engine brake, exhaust brake, transmission retarder, or regenerative braking) to stop your vehicle. If your engine shuts down, the retarder will cease to operate. Always be ready to apply the service brakes. Failure to comply may result in death, personal injury, equipment damage, or property damage.

"Control speed" is the speed at which the forces pushing a vehicle down a grade are equal to the forces holding it back.

Figure 8: Do Not Exceed Governed Engine Speed



WARNING

DO NOT use a retarder (such as the engine brake, exhaust brake, transmission retarder, or regenerative braking) when operating on road surfaces with poor traction (such as wet, icy, or snow covered roads, or gravel). Retarders can cause the wheels to skid on a slippery surface. You could lose control of the vehicle or jackknife if the wheels begin to skid, resulting in an accident. Failure to comply may result in death, personal injury, equipment damage, or property damage.

CAUTION

The engine ECM maintains a record of maximum rpm. Exceeding the maximum rpm will be considered driver abuse and will affect the engine warranty. See Engine Specifications. Failure to comply may result in equipment or property damage.

WARNING

DO NOT use a retarder (such as the engine brake, exhaust brake, transmis-

sion retarder, or regenerative braking) when operating your vehicle bobtail or with an unloaded trailer. There may not be enough weight on the rear axle to provide traction, causing a loss of vehicle control, resulting in an accident. Make sure the engine brake is switched "OFF" when bobtailing or operating with an unloaded trailer. Failure to comply may result in death, personal injury, equipment damage, or property damage.

CAUTION

Never exceed governed engine speed because engine damage can occur. Operating the engine beyond the governed speed causes additional strain on valve train and internal engine components. Operate the engine within governed engine speed.

NOTE

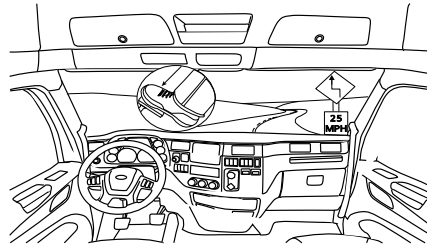
After you have determined what the safe speed is for your vehicle, operate the engine compression brake or exhaust brake with the transmission in the lowest gear that will not cause

the engine speed to exceed the rated engine speed. The optimum braking power of the engine compression brake or exhaust brake is reached at rated engine speed. Correct gear selection, therefore, is critical.

The engine brake selector switch can be used to vary braking power as road conditions change.

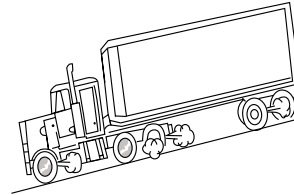
Vehicle service brakes must be used when additional braking power is required.

Figure 9: Slow Down Around Curves



The engine compression brake or exhaust brake is **NOT** intended as the primary brake for the vehicle, nor is it an emergency brake. The engine compression brake only helps the service brakes by using pressure to slow the drivetrain. Use the service brakes for quick stops.

Figure 10: Braking Truck on Grade

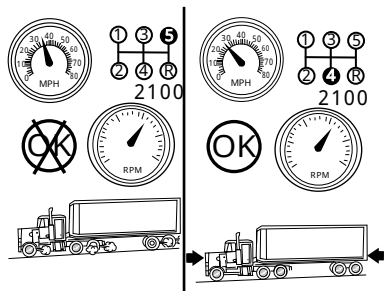


WARNING

DO NOT frequently or continuously use the service brakes. Reduce speed before descending a long or steep grade, shift to a lower gear, and turn on the retarder. Frequent or continuous braking can overheat the brakes, reducing their effectiveness and increase vehicle stopping distance. This can lead to an accident. Failure to comply may result in death, personal injury, equipment damage, or property damage.

NOTE

On longer or steeper the hills, it is essential to use your engine brake. Make maximum use of your engine brake by gearing down and letting the engine brake do the work.

Figure 11: Shift to a Lower Gear on Grade

If frequent use of the vehicle service brakes is required, it is recommended that a slower control speed be used by selecting a lower transmission gear.

TIPS FOR OPERATION ON SLICK ROADS

! WARNING

To reduce the possibility of personal injury or property damage, always allow for extra distance between your vehicle and other objects when using the service brakes or engine brakes on slick roads. Failure to comply may result in death, personal injury, equipment damage, or property damage.

The operation of any vehicle is difficult to predict on slick roads. The first 10 to 15 minutes of rainfall are the most dangerous, as road dirt and oil mixed with rain create a very slippery surface.

! WARNING

The service brakes must be used in an emergency. Retarders alone (such as the engine brake, exhaust brake, transmission retarder, or regenerative braking) might not stop the vehicle fast enough to prevent an accident. Failure to comply may result in death, personal injury, equipment damage, or property damage.

! WARNING

DO NOT use a retarder (such as the engine brake, exhaust brake, transmission retarder, or regenerative braking) when operating on road surfaces with poor traction (such as wet, icy, or snow covered roads, or gravel). Retarders can cause the wheels to skid on a slippery surface. You could lose control of the vehicle or jackknife if the wheels begin to skid, resulting in an accident. Failure to comply may result in death,

personal injury, equipment damage, or property damage.

When driving on slick roads, start with the engine brake selector switch in the "OFF" position and the two-position selector switch in the "LOW" position. If your tractor is equipped with a twin-screw rear axle, position the power divider switch in the "unlocked" position. Remove your foot from the accelerator pedal to make sure the vehicle will maintain traction with the braking power of the engine alone. If the vehicle drive wheels begin to skid or if there is a fishtailing motion, DO NOT activate the engine compression brake or exhaust brake. If traction is maintained using the braking power of the engine alone and more braking power is required, switch the two-position selector switch to the "LOW" position and activate the engine compression brake or exhaust brake by switching the "ON/OFF" switch to the "ON" position. If the vehicle's drive wheels begin to skid or there is a fishtailing motion, switch the "ON/OFF" switch to the "OFF" position. If traction is maintained when the engine compression brake or exhaust brake is activated and more braking power is required, move the two-position selector switch to the "HI" position. Again, if the vehicle has lost traction or if there is a fishtailing

motion, switch the "ON/OFF" switch to the "OFF" position. DO NOT attempt to use the engine compression brake or exhaust brake in the "HI" position.

be brought in for service at the earliest opportunity.

2.10 Malfunction Indicator Light (MIL)



This warning light turns on when an engine emissions failure occurs. An emissions failure is not an emergency, and the vehicle can be safely driven, but should be serviced to correct the problem. In some cases, the MIL will activate in conjunction with the High Exhaust System Temperature (HEST), diesel particulate filter (DPF), and Diesel Exhaust Fluid (DEF) warning lights.



NOTE

The Malfunction Indicator Light (MIL) turns on if the on-board diagnostics (OBD) system detects a possible emissions system failure. To ensure the condition is corrected, the vehicle should

CHAPTER 2: ENGINE MAINTENANCE

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1 ENGINE MAINTENANCE

PACCAR recommends that the engine be maintained according to the maintenance schedule in this section.

If the engine is operating in ambient temperatures below 0°F (-18°C) or above 100°F (38°C), perform maintenance at shorter intervals. Shorter maintenance intervals are also required if the engine is operated in a dusty environment or if frequent stops are made.

Some of these maintenance procedures require special tools or must be completed by qualified personnel. Contact your local PACCAR authorized repair location for detailed information.

If your engine is equipped with a component or accessory not manufactured by PACCAR Inc, refer to the component manufacturer's maintenance recommendations.



WARNING

DO NOT breathe engine exhaust. Engine exhaust fumes contain carbon monoxide, a poisonous, colorless, odorless gas. Exhaust fumes can enter the cab from a poorly maintained exhaust system or from nearby vehicles. Failure

to comply may result in death, personal injury, equipment damage, or property damage.



WARNING

Never idle your vehicle for prolonged periods of time if you sense that exhaust fumes are entering the cabin. Investigate the cause of the fumes and correct it as soon as possible. If the vehicle must be driven under these conditions, drive only with the windows open. Failure to comply may result in death, personal injury, equipment damage, or property damage.



WARNING

Routinely inspect and maintain your vehicle exhaust system. A poorly maintained, damaged, or corroded exhaust system can allow exhaust fumes to enter the cab. Engine exhaust fumes contain carbon monoxide, a poisonous, colorless, odorless gas. Failure to comply may result in death, personal injury, equipment damage, or property damage.

2 CLEANING THE ENGINE

You must clean the undercarriage, engine compartment, and engine as needed, but at least annually. Cleaning removes road salt and debris that can be corrosive or otherwise harmful to the electrical system. Failure to properly clean the undercarriage of the truck can increase the risk of an electrical fire. When cleaning the engine, follow the instructions from the vehicle manufacturer's operator's manual and observe all environmental protection regulations.



WARNING

DO NOT direct high pressure water onto electrical components, plug connectors, seals, or flexible hoses. High pressure water is more likely to affect components or be introduced into closed systems. This can accelerate corrosion, degrade electrical components, or contaminate system lubricants and fluids. Failure to comply may result in death, personal injury, equipment damage, or property damage.

3 DAILY OR REFUELING MAINTENANCE CHECKS

3.1 Fuel Filter / Water Separator

This procedure should be followed as part of daily and refueling maintenance checks.

1. Drain trapped water (if equipped). Refer to the Fuel Filter Water Draining Procedure.

3.2 Air Intake Piping

This procedure should be followed as part of daily and refueling maintenance checks.

1. Inspect hose/pipe condition – deterioration/signs of leaking.
2. Inspect hose clamps for tightness and pinching/cutting of hoses.
3. Inspect clearance to other components.
4. Check air restriction gauge.

3.3 Aftertreatment Exhaust Piping

This procedure should be followed as part of daily and refueling maintenance checks.

1. Inspect for cracks.
2. Inspect for clearance to other components (i.e. electrical harnesses, etc.).
3. Inspect hose/pipe condition – deterioration/signs of leaking.

3.4 Cooling Fan

This procedure should be followed as part of daily and refueling maintenance checks.

1. Inspect for cracks.
2. Inspect for clearance to other components.

3.5 Coolant Level

Perform the following steps to check the coolant level:

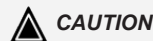
Replacement or top up coolant should have the same antifreeze concentration and corrosion inhibitor content as the original coolant in the cooling system. If operating

in sub-freezing conditions, a 60/40 mix of antifreeze and distilled water may be substituted.

Always dilute antifreeze to the correct concentration based on freeze protection before adding it to the cooling system. Adding or using 100% antifreeze in a cooling system may result in cooling system plugging and overheating problems.

This procedure should be followed as part of daily and refueling maintenance checks.

1. Check that vehicle is on a level surface.
2. Ensure engine has not been run for several hours.



Due to thermal expansion the coolant level CANNOT be checked if the coolant is above ambient temperature or the engine has not completely cooled. The coolant level indicated on a warmed system will be inaccurate and can lead to low coolant conditions during cold-starts. Failure to comply could result in equipment damage.

3. Check coolant level. It should be visible through the clear plastic surge tank.
4. Add coolant as necessary until proper level is reached; see special fill instruction if filling from empty.

i NOTE

The pressure cap (on the rear-top of the surge tank) should NEVER be removed. The fill cap (on the ergonomic fill neck, not on the surge tank) is the correct fill point.

3.6 Diesel Exhaust Fluid

This procedure should be followed as part of daily and refueling maintenance checks.

1. Check level of diesel exhaust fluid.

i NOTE

It is recommended to top up DEF when refueling. See Engine Aftertreatment Systems Operator's Manual for DEF information.

3.7 Visual Inspection of Engine

This procedure should be followed as part of daily and refueling maintenance checks.

1. Check for any signs of fluid leaks.
2. Ensure all access caps/covers are installed and tight.

4 BI-WEEKLY MAINTENANCE CHECK

4.1 Engine Oil Level Check

This procedure should be followed as part of routine maintenance checks.

1. See Engine Oil Level.

5 MX PREVENTATIVE MAINTENANCE INTERVALS

5.1 Preventative Maintenance Schedule Intervals

Perform maintenance at whichever interval occurs first. At Maintenance Schedule Intervals, perform all previous maintenance checks that are due for scheduled maintenance.

⚠ CAUTION

The oil change process must be completed, the engine restarted, and idled for five minutes before beginning the fuel filter change process. Failure to comply could result in a non-warrantable engine failure.

i NOTE

This maintenance schedule is for a normal duty cycle engine operation. Severe duty/vocational applications will need to

adjust mileage, kilometer, hour, or time interval based on the Engine Lubrication and Filter Intervals.

5.2 Use Category Definitions

It is possible for the vehicle to fall into more than one "use-category." Always use the most frequent of two possible maintenance intervals for a given task.

When referring to the maintenance schedule, know the use-categories. Refer to ALL that are applicable to the vehicle.

NORMAL DUTY LINE HAUL (Two categories >20% idle time <20% idle time. Each has unique maintenance scheduling):

- Fuel economy greater than 6 mpg (2.6 km/l).
- Gross vehicle weight less than 80,000 lbs/36,300 kg.

PICKUP/DELIVERY/REFUSE

- Fuel economy is less than 6 mpg (2.6 km/l).
- Gross vehicle weight more than 80,000 lbs/36,300 kg.

SEVERE DUTY/VOCATIONAL

- Fuel economy is less than 6 mpg (2.6 km/l)
- Gross vehicle weight more than 80,000 lbs/36,300 kg
- Vocational vehicle applications include:
 - agriculture
 - concrete mixers
 - construction
 - cranes
 - Dump trucks
 - emergency and fire
 - heavy equipment
 - loggers
 - mining
 - oil fields
 - snowplows and wreckers

5.3 MX Preventative Maintenance Intervals - Normal Duty/Line Haul

NORMAL DUTY/LINE HAUL

Follow the manufacturers' recommended maintenance procedures for the starter, alternator, batteries, electrical components, exhaust brake, charge-air cooler, radiator, air compressor, air cleaner, refrigerant compressor, and fan clutch.

GREATER THAN 20% IDLE TIME - VALVE ADJUSTMENT

Valve Adjustment	
Initial Valve Adjustment	150,00 mi / 96,000 km
	4,500 Hrs. (24 Months)/ 2 Years
Valve Adjustment - Next	300,000 Miles/480,000 KM
	6,750 Hrs. (36 Months)/ 3 Years

INTERVAL A - GREATER THAN 20% IDLE TIME - EVERY 25,000 MI / 40,000 KM / 750 HRS / 6 MO

Greater than 20% Idle Time - 25,000 mi / 40,000 km / 750 hrs / 6 mo ¹
Air System & Compressor - Refer to <u>Air Compressor</u> for maintenance instructions. - Refer to vehicle operator's manual for air filter maintenance instructions.
Charge Air System - Refer to <u>Charge Air Piping</u> for maintenance instructions. - Refer to <u>Charge Air Cooler</u> for maintenance instructions.
Charging / Cranking System Refer to <u>Electrical Harness / Cables</u> for maintenance instructions.
Cooling System Refer to <u>Coolant/Antifreeze Condition</u> for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL B - GREATER THAN 20% IDLE TIME - EVERY 50,000 MI / 80,000 KM / 1,500 HRS / 12 MO (1 YR)

Greater than 20% Idle Time - 50,000 mi / 80,000 km / 1,500 hrs / 12 mo (1 yr) ¹
Charging / Cranking System Refer to <u>Batteries, Cables, and Connections</u> for maintenance instructions.
Drive Belts - Refer to <u>Engine Belt Checks</u> for maintenance instructions. - Refer to <u>Fan Belt Tensioner (If So Equipped)</u> for maintenance instructions.
Engine Lubrication Refer to <u>Engine Lubrication and Filter Intervals</u> for maintenance instructions.
Fuel System Refer to <u>Fuel Filter - Replace</u>²

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

² Use of poor quality fuel may require more frequent fuel filter element service.

INTERVAL C - GREATER THAN 20% IDLE TIME - EVERY 150,000 MI / 240,000 KM / 4,500 HRS / 24 MO (2 YRS)

Greater than 20% Idle Time - 150,000 mi / 240,000 km / 4,500 hrs / 24 mo (2 yrs) ¹	
Cooling System	Refer to <u>Radiator Hoses Inspection</u> for maintenance instructions.
Crankshaft	Refer to <u>Crankshaft - Vibration Damper</u> for maintenance instructions.
Mounting Bolts	Refer to <u>Engine Mounting Bolts</u> for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL E AND F - GREATER THAN 20% IDLE TIME - EVERY 300,000 MI / 480,000 KM / 6,750 HRS / 36 MO (3 YRS)

Greater than 20% Idle Time - 300,000 mi / 480,000 km / 6,750 hrs / 36 mo (3 yrs) ¹

Aftertreatment System

- Refer to Diesel Particulate Filter (DPF) Service Strategy - Dry Cleaning Strategy.
- Refer to Diesel Exhaust Fluid (DEF) Filter Access for maintenance instructions.

Cooling System

- Refer to Replace Coolant Filter for maintenance instructions.

Valve Adjustment

- Please inquire with an authorized PACCAR dealer or service provider about this procedure. ²

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

² C-Service for Normal Duty (Line Haul) - less and more than 20% idle time: Initial adjust at 150,000 miles (240,000 km / 6,750 hours), then every 300,000 miles (480,000km) thereafter.

INTERVAL G - GREATER THAN 20% IDLE TIME - EVERY 450,000 MI / 725,000 KM / 13,500 HRS / 48 MO (4 YRS)

Greater than 20% Idle Time - 450,000 mi / 725,000 km / 13,500 hrs / 48 mo (4 yrs) ¹

Drive Belts

- Refer to Fan Belt Removal - If so equipped - Replace for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL J - GREATER THAN 20% IDLE TIME - EVERY 750,000 MI / 1,200,000 KM / 24,000 HRS / 96 MO (8 YRS)

Greater than 20% Idle Time - 750,000 mi / 1,200,000 km / 24,000 hrs / 96 mo (8 yrs) ¹	
Cooling System	
Refer to Change <u>Extended Life Coolant</u> for maintenance instructions.	

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

LESS THAN 20% IDLE TIME - VALVE ADJUSTMENT

Valve Adjustment	
Initial Valve Adjustment	150,00 mi / 96,000 km
	4,500 Hrs. (24 Months)/ 2 Years
Valve Adjustment - Next	300,000 Miles/480,000 KM
	6,750 Hrs. (36 Months)/ 3 Years

INTERVAL A - LESS THAN 20% IDLE TIME - EVERY 37,000 MI / 60,000 KM / 1,125 HRS / 6 MO**Less than 20% Idle Time - 37,000 mi / 60,000 km / 1,125 hrs / 6 mo ¹**

Air system and compressor

- Refer to Air Compressor for maintenance instructions.
- Refer to vehicle operator's manual for air filter maintenance instructions.

Charge Air System

- Refer to Charge Air Piping for maintenance instructions.
- Refer to Charge Air Cooler for maintenance instructions.

Charging/Cranking System

- Refer to Electrical Harness / Cables for maintenance instructions.

Cooling System

- Refer to Coolant/Antifreeze Condition for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL B - LESS THAN 20% IDLE TIME - EVERY 75,000 MI / 120,000 KM / 2,250 HRS / 12 MO (1 YR)**Less than 20% Idle Time - 75,000 mi / 120,000 km / 2,250 hrs / 12 mo (1 yr) ¹**

Charging / Cranking System

- Refer to Batteries, Cables, and Connections for maintenance instructions.

Drive Belts

- Refer to Engine Belt Checks for maintenance instructions.
- Refer to Fan Belt Tensioner (If So Equipped) for maintenance instructions.

Less than 20% Idle Time - 75,000 mi / 120,000 km / 2,250 hrs / 12 mo (1 yr)¹

Engine Lubrication

- Refer to [Engine Lubrication and Filter Intervals](#) for maintenance instructions.

Fuel System

- Refer to [Fuel Filter](#) - Replace²

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

² Use of poor quality fuel may require more frequent fuel filter element service.

INTERVAL C - LESS THAN 20% IDLE TIME - EVERY 150,000 MI / 240,000 KM / 4,500 HRS / 24 MO (2 YRS)**Less than 20% Idle Time - 150,000 mi / 240,000 km / 4,500 hrs / 24 mo (2 yrs)¹**

Cooling System

- Refer to [Radiator Hoses Inspection](#) for maintenance instructions.

Crankshaft

- Refer to [Crankshaft - Vibration Damper](#) for maintenance instructions.

Mounting Bolts

- Refer to [Engine Mounting Bolts](#) for maintenance instructions.

Valve Adjustment

- Please inquire with an authorized PACCAR dealer or service provider about this procedure.²

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

² C-Service for Normal Duty (Line Haul) - less and more than 20% idle time: Initial adjust at 150,000 miles (240,000 km / 6,750 hours), then every 300,000 miles (480,000km) thereafter.

INTERVALS E AND F - LESS THAN 20% IDLE TIME - EVERY 300,000 MI / 480,000 KM / 6,750 HRS / 36 MO (3 YRS)

Less than 20% Idle Time - 300,000 mi / 480,000 km / 6,750 hrs / 36 mo (3 yrs) ¹
Aftertreatment System - Refer to <u>Diesel Particulate Filter (DPF) Service Strategy</u> - Dry Cleaning Strategy. - Refer to <u>Diesel Exhaust Fluid (DEF) Filter Access</u> for maintenance instructions.
Cooling System Refer to <u>Replace Coolant Filter</u> for maintenance instructions.
Valve Adjustment Please inquire with an authorized PACCAR dealer or service provider about this procedure. ²

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

² C-Service for Normal Duty (Line Haul) - less and more than 20% idle time: Initial adjust at 150,000 miles (240,000 km / 6,750 hours), then every 300,000 miles (480,000km) thereafter.

INTERVAL G - LESS THAN 20% IDLE TIME - EVERY 450,000 MI / 725,000 KM / 13,500 HRS / 48 MO (4 YRS)

Less than 20% Idle Time - 450,000 mi / 725,000 km / 13,500 hrs / 48 mo (4 yrs) ¹
Drive Belts Refer to <u>Fan Belt Removal - If so equipped</u> - Replace for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL J - LESS THAN 20% IDLE TIME - EVERY 750,000 MI / 1,200,000 KM / 24,000 HRS / 96 MO (8 YRS)

Less than 20% Idle Time - 750,000 mi / 1,200,000 km / 24,000 hrs / 96 mo (8 yrs) ¹
Cooling System Refer to Change <u>Extended Life Coolant</u> for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

5.4 MX Preventative Maintenance Intervals - Severe Duty/Vocational

SEVERE DUTY/VOCATIONAL - VALVE ADJUSTMENT

Vocational vehicle applications include: Agriculture, Concrete Mixers, Construction, Crane, Dumps, Emergency/Fire, Heavy Equipment, Loggers, Mining, Oil Field, Snowplows, and Wrecker.

Valve Adjustment	
Initial Valve Adjustment	60,000 Miles/96,000 KM
	1,600 Hrs. (12 Months)/ 1 Year
Valve Adjustment - Next	300,000 Miles/480,000 KM
	9,000 Hrs. (36 Months)/ 3 Years

INTERVAL A - SEVERE DUTY/VOCATIONAL - EVERY 15,000 MI / 24,000 KM / 400 HRS / 6 MO

Severe Duty/Vocational - 15,000 mi / 24,000 km / 400 hrs / 6 mo ¹
Air system and compressor - Refer to <u>Air Compressor</u> for maintenance instructions. - Refer to vehicle operator's manual for air filter maintenance instructions.
Charge Air System - Refer to <u>Charge Air Piping</u> for maintenance instructions. - Refer to <u>Charge Air Cooler</u> for maintenance instructions.

Severe Duty/Vocational - 15,000 mi / 24,000 km / 400 hrs / 6 mo¹

Charging/Cranking System

- Refer to Electrical Harness / Cables for maintenance instructions.

Cooling System

- Refer to Coolant/Antifreeze Condition for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL B - SEVERE DUTY/VOCATIONAL - EVERY 30,000 MI / 48,000 KM / 800 HRS / 12 MO (1 YR)**Severe Duty/Vocational - 30,000 mi / 48,000 km / 800 hrs / 12 mo (1 yr)¹**

Charging / Cranking System

- Refer to Batteries, Cables, and Connections for maintenance instructions.

Drive Belts

- Refer to Engine Belt Checks for maintenance instructions.
- Refer to Fan Belt Tensioner (If So Equipped) for maintenance instructions.

Engine Lubrication

- Refer to Engine Lubrication and Filter Intervals for maintenance instructions.

Fuel System

- Refer to Fuel Filter - Replace²

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

² Use of poor quality fuel may require more frequent fuel filter element service.

INTERVAL C - SEVERE DUTY/VOCATIONAL - EVERY 60,000 MI / 96,000 KM / 1,600 HRS / 24 MO (2 YRS)

Severe Duty/Vocational - 60,000 mi / 96,000 km / 1,600 hrs / 24 mo (2 yrs) ¹
Cooling System Refer to <u>Radiator Hoses Inspection</u> for maintenance instructions.
Crankshaft Refer to <u>Crankshaft - Vibration Damper</u> for maintenance instructions.
Valve Adjustment Please inquire with an authorized PACCAR dealer or service provider about this procedure. ²

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

² C-Service for Normal Duty (Line Haul) - less and more than 20% idle time: Initial adjust at 150,000 miles (240,000 km / 6,750 hours), then every 300,000 miles (480,000km) thereafter.

INTERVAL E - SEVERE DUTY/VOCATIONAL - EVERY 150,000 MI / 240,000 KM / 4,500 HRS / 24 MO (2 YRS)

Severe Duty/Vocational - 150,000 mi / 240,000 km / 4,500 hrs / 24 mo (2 yrs) ¹
Aftertreatment System Refer to <u>Diesel Particulate Filter (DPF) Service Strategy</u> - Dry Cleaning Strategy.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL F - SEVERE DUTY/VOCATIONAL - EVERY 300,000 MI / 480,000 KM / 9,000 HRS / 36 MO (3 YRS)**Severe Duty/Vocational - 300,000 mi / 480,000 km / 9,000 hrs / 36 mo (3 yrs) ¹**

Aftertreatment System

- Refer to Diesel Exhaust Fluid (DEF) Filter Access for maintenance instructions.

Cooling System

- Refer to Replace Coolant Filter for maintenance instructions.

Valve Adjustment

- Please inquire with an authorized PACCAR dealer or service provider about this procedure. ²

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

² C-Service for Normal Duty (Line Haul) - less and more than 20% idle time: Initial adjust at 150,000 miles (240,000 km / 6,750 hours), then every 300,000 miles (480,000km) thereafter.

INTERVAL G - SEVERE DUTY/VOCATIONAL - EVERY 450,000 MI / 725,000 KM / 13,500 HRS / 48 MO (4 YRS)**Severe Duty/Vocational - 450,000 mi / 725,000 km / 13,500 hrs / 48 mo (4 yrs) ¹**

Drive Belts

- Refer to Fan Belt Removal - If so equipped - Replace for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL J - SEVERE DUTY/VOCATIONAL - EVERY 750,000 MI / 1,200,000 KM / 24,000 HRS / 96 (8 YRS)**Severe Duty/Vocational - 750,000 mi / 1,200,000 km / 24,000 hrs / 96 (8 yrs) ¹**

Cooling System

- Refer to Change Extended Life Coolant for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

5.5 MX Preventative Maintenance Intervals - Pick-up/Delivery/Refuse

PICK-UP/DELIVERY/REFUSE - VALVE ADJUSTMENT

Valve Adjustment	
Initial Valve Adjustment	60,000 Miles/96,000 KM
	1,600 Hrs. (12 Months)/ 1 Year
Valve Adjustment - Next	300,000 Miles/480,000 KM
	9,000 Hrs. (36 Months)/ 3 Years

INTERVAL A - PICK-UP/DELIVERY/REFUSE - EVERY 15,000 MI / 24,000 KM / 400 HRS / 6 MO

Pick-up/Delivery/Refuse - 15,000 mi / 24,000 km / 400 hrs / 6 mo ¹
Air system and compressor - Refer to <u>Air Compressor</u> for maintenance instructions. - Refer to vehicle operator's manual for air filter maintenance instructions.
Charge Air System - Refer to <u>Charge Air Piping</u> for maintenance instructions. - Refer to <u>Charge Air Cooler</u> for maintenance instructions.

Pick-up/Delivery/Refuse - 15,000 mi / 24,000 km / 400 hrs / 6 mo ¹

Charging/Cranking System

- Refer to Electrical Harness / Cables for maintenance instructions.

Cooling System

- Refer to Coolant/Antifreeze Condition for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL B - PICK-UP/DELIVERY/REFUSE - EVERY 30,000 MI / 48,000 KM / 800 HRS / 12 MO (1YR)**Pick-up/Delivery/Refuse - 30,000 mi / 48,000 km / 800 hrs / 12 mo (1yr) ¹**

Charging / Cranking System

- Refer to Batteries, Cables, and Connections for maintenance instructions.

Drive Belts

- Refer to Engine Belt Checks for maintenance instructions.
- Refer to Fan Belt Tensioner (If So Equipped) for maintenance instructions.

Engine Lubrication

- Refer to Engine Lubrication and Filter Intervals for maintenance instructions.

Fuel System

- Refer to Fuel Filter - Replace²

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

² Use of poor quality fuel may require more frequent fuel filter element service.

INTERVAL C - PICK-UP/DELIVERY/REFUSE - EVERY 60,000 MI / 96,000 KM / 1,600 HRS / 12 MO (1 YR)**Pick-up/Delivery/Refuse - 60,000 mi / 96,000 km / 1,600 hrs / 12 mo (1 yr) ¹**

Cooling System

- Refer to Radiator Hoses Inspection for maintenance instructions.

Crankshaft

- Refer to Crankshaft - Vibration Damper for maintenance instructions.

Mounting Bolts

- Refer to Engine Mounting Bolts for maintenance instructions.

Valve Adjustment

- Please inquire with an authorized PACCAR dealer or service provider about this procedure. ²

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

² C-Service for Normal Duty (Line Haul) - less and more than 20% idle time: Initial adjust at 150,000 miles (240,000 km / 6,750 hours), then every 300,000 miles (480,000km) thereafter.

INTERVAL E - PICK-UP/DELIVERY/REFUSE - EVERY 150,000 MI / 240,000 KM / 4,500 HRS / 24 MO (2 YR)**Pick-up/Delivery/Refuse - 150,000 mi / 240,000 km / 4,500 hrs / 24 mo (2 yr) ¹**

Aftertreatment System

- Refer to Diesel Particulate Filter (DPF) Service Strategy - Dry Cleaning Strategy.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL F - PICK-UP/DELIVERY/REFUSE - EVERY 300,000 MI / 480,000 KM / 9,000 HRS / 36 MO (3YRS)

Pick-up/Delivery/Refuse - 300,000 mi / 480,000 km / 9,000 hrs / 36 mo (3yrs) ¹

Aftertreatment System

- Refer to Diesel Exhaust Fluid (DEF) Filter Access for maintenance instructions.

Cooling System

- Refer to Replace Coolant Filter for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL G - PICK-UP/DELIVERY/REFUSE - EVERY 450,000 MI / 725,000 KM / 13,500 HRS / 48 MO (4YRS)

Pick-up/Delivery/Refuse - 450,000 mi / 725,000 km / 13,500 hrs / 48 mo (4yrs) ¹

Drive Belts

- Refer to Fan Belt Removal - If so equipped - Replace for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

INTERVAL J - PICK-UP/DELIVERY/REFUSE - EVERY 750,000 MI / 1,200,000 KM / 24,000 HRS / 96 (8 YRS)

Pick-up/Delivery/Refuse - 750,000 mi / 1,200,000 km / 24,000 hrs / 96 (8 yrs) ¹

Cooling System

- Refer to Change Extended Life Coolant for maintenance instructions.

¹ Ensure that all maintenance intervals leading up to this point are repeated during this interval prior to the completion of those listed here.

6 PACCAR ENGINE SPECIFICATIONS

6.1 Engine Specifications

Table 1: PACCAR MX-13 Engine Specifications

Horsepower	See the EPA label on top of the valve cover or on the mixer manifold.
Firing Order	1, 5, 3, 6, 2, 4
Crankshaft Rotation (viewed from front of engine)	Clockwise
Displacement	787 CID (12.9 liters)
Bore and Stroke	5.12 in. (130 mm) × 6.38 in. (162 mm)
Dry Weight (excludes Flywheel and Air Compressor)	2,500 lb (1,134 kg)
Idle Speed	Approximately 550-650 rpm
High Idle speed (low hp/high hp)	2,100/2,200 rpm
Maximum continuous engine speed with engine brake active	2,100 rpm
Fault code registers with engine brake active	2,300 rpm
Maximum Continuous No Load Governed Speed	2,200 rpm
Engine Over Speed	2,301 to 2,499 rpm
Misuse	2,300 rpm or greater
REPTO Rotation and Ratio	Clockwise, 1.2:1

Table 1: PACCAR MX-13 Engine Specifications

REPTO Torque Limit	613 lb-ft (continuous)
FEPTO Torque Limit	515 lb-ft (continuous)

6.2 Filter Specifications

PACCAR is not responsible for problems caused by non-genuine filters that do not meet PACCAR performance or durability requirements.

Contact your local PACCAR authorized repair location for specific part numbers.



CAUTION

PACCAR approved filters must be used. Failure to comply may cause severe engine damage.

6.3 Engine Lubrication

ENGINE LUBRICATING OIL RECOMMENDATIONS AND SPECIFICATIONS

A major factor in maintaining engine performance and durability is the proper use of quality engine lubricating oils used in conjunction with the appropriate oil drain and filter change intervals. Attempting to extend the oil and filter change interval beyond the manufacturer's recommendations may decrease engine life due to factors such as corrosion, deposits, and wear.

See Engine Lubrication and Filter Intervals to determine which oil drain interval to use for an application.

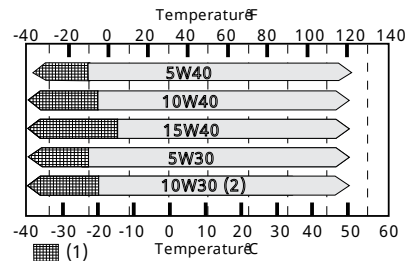
NOTE

It is the operator's responsibility to follow these recommendations to ensure that the engine warranty is not affected.

PACCAR recommends the use of high-quality SAE 10W-30 API CK-4 heavy-duty engine oil.

The primary PACCAR recommendation is for the use of 10W-30 multigrade lubricating oil for normal operation at ambient temperatures above 5°F (-15°C). For ambient temperatures below 5°F (-15°C) SAE 5W-30 may be used, provided it meets API CK-4 oil specifications and biodiesel or biodiesel blended fuel is not used as fuel for the engine. Using a multigrade oil helps improve engine cranking in low-temperature conditions, reduces deposit formation, increases engine durability and increases fuel economy.

Figure 12: Engine Oil Viscosity Chart



1. Requires use of an active oil pan heater before engine start.
2. Initial factory oil fill: API CK-4 10W-30
3. Future Service Fills: API CK-4 10W-30

NOTE

Any of the oil weights listed in the chart above are acceptable to use as long as the oil meets API CK-4 oil specifications.

New Engine Break-In Oils

PACCAR does not approve the use of special "break-in" engine lubricating oils for new or rebuilt PACCAR engines. It is rec-

ommended to use the same lubricating oil for engine break-in that will be used during normal operation.

Aftermarket Oil Additive Usage

PACCAR does not recommend the use of aftermarket oil additives. Today's high-quality engine lubricating oils are very sophis-

ticated. Most oils already contain precise amounts of additives blended into the lubricating oil to meet stringent performance requirements.

These oils meet performance characteristics that conform to the lubricant industry standards and are sufficient protection

when used according to the recommendations. Aftermarket lubricating oil additives are not necessary to enhance engine oil performance and may in some cases reduce the oil's capability to protect the engine.

ENGINE OIL CAPACITIES AND PRESSURES

Table 2: Engine Oil Capacity and Acceptable Pressures

PACCAR MX-13 - High and Low Horsepower Ratings	
Oil Pressure at low idle (min. allowable) 650 ± 50 rpm	14.5 psi at 239°F (100 kPa at 115°C) oil temperature
At road speed 900-1,200 rpm (min. allowable)	20-29 psi at 239°F (140-200 kPa at 115°C) oil temperature
At road speed 1,200-2,100 rpm (min. allowable)	29 psi at 239°F (200 kPa at 115°C) oil temperature
Regulated oil pressure (nominal)	33 psi at 239°F (230 kPa at 115°C) oil temperature
Total system capacity (oil pan and new oil filters)	42 U.S. qts. (40.0 liters)

ENGINE LUBRICATION AND FILTER INTERVALS

Oil drain interval recommendations are based on vehicle application or engine duty cycle. PACCAR recommends the use of high quality lubricating oil as indicated in the Engine Lubricating Oil Recommendations and Specifications section.

Perform these maintenance procedures according to the Preventive Maintenance Schedule.



CAUTION

Extending the oil and filter change interval beyond the recommendations will decrease the engine life due to fac-

tors such as corrosion, deposits, and wear. Engine oil filters capture dirt and remove deposits from the oil to prolong the life of internal moving components. Follow the oil and filter change intervals as recommended in this section of the manual. Failure to comply may result in equipment or property damage.

Table 3: Determining Type of Vehicle Application for Engine Oil Drain Intervals

	Severe Duty - Vocational *	Normal Duty - Line Haul
Fuel Consumption	Less than 6 MPG (2.6 km/L)	6 MPG (2.6 km/L) or greater
Gross Vehicle Weight	Greater than 80,000 lb. (36,300 kg)	80,000 lb. (36,300 kg) or less
* Vocational vehicle applications include: Agriculture, Concrete Mixers, Construction, Crane, Dumps, Emergency/Fire, Heavy Equipment, Loggers, Mining, Oil Field, Snowplows, and Wrecker.		

Table 4: Engine Oil and Filter Change Intervals

	Vehicle Application	Change Interval
Oil Drain and Filter Replacement Interval	Normal Duty (Line Haul) - less than 20% idle time	75,000 miles (120,000 km) 2,250 hours or 12 months
	Normal Duty (Line Haul) - more than 20% idle time	50,000 miles (80,000 km) 1,500 hours or 12 months
	Pick-up / Delivery / Refuse	30,000 miles (48,000 km) 800 hours, or 12 months
	Severe Duty (Vocational*)	30,000 miles (48,000 km) 800 hours, or 12 months
Vocational vehicle applications include: Agriculture, Concrete Mixers, Construction, Crane, Dumps, Emergency/Fire, Heavy Equipment, Loggers, Mining, Oil Field, Snowplows, and Wrecker.		

i NOTE

If B6-B20 biodiesel fuel is used, the oil and filter must be changed every

40,000 mi (64,000 km) for line haul applications; every 20,000 mi (32,000 km) for severe duty, or every six months.

6.4 Engine Cooling

COOLING SYSTEM MAINTENANCE

The cooling system in your vehicle was factory filled with extended life coolant that meets or exceeds ASTM D6210, Cummins Engineering Standard 14603 for ISX and PX series engines, and MAT74002 Standard when equipped with an MX series engine. PACCAR recommends only using a 50/50 mixture of distilled water and ELC when cooling system service is required.

A 50/50 mixture of ELC and distilled water will provide freeze protection down to -34°F (-36.7°C), which is adequate for most locations in North America. For extremely cold operating conditions, a 60/40 mixture (coolant/water ratio) can be used to provide freeze protection down to -62°F (-52.2°C).

Unless otherwise optioned, factory fill coolant is an ethylene glycol, nitrated organic acid technology (NOAT) extended life coolant (ELC) formulation at a 50:50 coolant-to-distilled water mixture. The factory fill meets or exceeds ASTM D6210 and Cummins Engineering Standard 14603 for ISX and PX engines, and MAT74002 for PACCAR MX-11 and MX-13 engine requirements. Maintaining coolant chem-

istry and freeze protection is critical to engine and cooling system component health and longevity.



WARNING

DO NOT touch, inhale, or consume antifreeze or coolant. If antifreeze/coolant comes into contact with eyes, rinse thoroughly with water for 15 minutes. If there is prolonged or repeated contact with skin, immediately wash skin with soap and water. If antifreeze/coolant is consumed, seek immediate medical attention. DO NOT induce vomiting. Failure to comply may result in death, personal injury, equipment damage, or property damage.



CAUTION

The engine cooling system has very specific maintenance and inspection requirements. Failure to follow requirements can damage the engine. Engine damage can include but is not limited to freezing, boiling, corrosion, pitted cylinder liners. This information is found in the engine manufacturers owner's manual. It is the owner's responsibility to follow all requirements listed in the engine

manufacturer's owner's manual. Failure to comply may result in engine damage.



CAUTION

Always use a genuine PACCAR coolant filter. Genuine PACCAR filters comply with component specifications and will optimize coolant system operation. Use of non-genuine PACCAR coolant filter can cause severe damage to vehicle components. Failure to comply may result in equipment or property damage.



NOTE

Coolant is harmful to the environment. Unused coolant must be stored as a toxic hazardous material in leak-proof containers. Used coolant must be processed as industrial chemical waste. Please follow HAZMAT guidelines with both used and unused coolants.

Concentration

Check the level of freeze/boil over protection, which is determined by the glycol concentration. Use a glycol refractometer to determine glycol level. Add coolant to

obtain the coolant/water ratio required to provide the protection you need. A 50/50 mix of coolant and water is adequate for most applications. For extremely cold operating conditions, the ratio can be adjusted to a higher concentration of coolant.

**NOTE**

Maximum recommended ELC concentration is 60% ELC and 40% water by volume (a 60/40 coolant mixture). The minimum recommended concentration is 40% ELC and 60% water by volume (a 40/60 coolant mixture).

Table 5: Glycol Concentration Level

Level	Desired Coolant/ Water Ratio	Freeze Point °F (°C)
Recommended Levels	40%	-12 (-24)
	45%	-23 (-31)
	50%	-34 (-37)
	55%	-50 (-46)
	60%	-62 (-52)

Condition

Perform a visual inspection of the coolant. It should have no cloudiness or floating debris. Determine the chemical inhibitor concentration level by using an extended life coolant specific test kit or test strips. Inhibitor concentration level determines corrosion protection. If you are concerned about possible coolant quality, contamination, or mechanical problems, submit a coolant sample for analysis. Improper maintenance may cause coolant degradation and could result in damage to the cooling system and engine components. Consult your dealer or the coolant manufacturer's representative for recommended extended life coolant test kits, test strips, and laboratory sample procedures.

Coolant Extender

Add extended life coolant extender, if necessary, according to the corrosion inhibitor concentration required. DO NOT add coolant extender to nitrite-free coolant.

Checking Coolant Level

Check the coolant level daily. See [Coolant Level](#).

**CAUTION**

When adding coolant, avoid mixing different brands and formulations. If the coolant is mixed with more than 25% of a different formulation (for example, mixing OAT and NOAT coolants), engine corrosion damage could occur. If mixing exceeds 25% of total system volume, it is recommended to flush and refill the system completely with one type of coolant. Failure to comply may result in equipment or property damage.

Coolant Filter

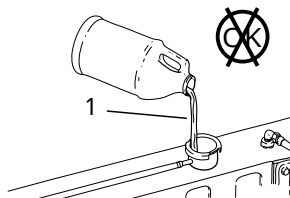
Your engine is equipped with a coolant filter designed to capture and remove harmful deposits from the cooling system to help prolong system life. It is a "blank filter" and does not contain chemicals or time-release additives. Replace it only with a blank filter at the interval specified in the Preventative Maintenance Schedule. NEVER use filters that contain supplemental coolant additives (SCAs) in an ELC-filled system.

**CAUTION**

Always use a genuine PACCAR coolant filter. Genuine PACCAR filters comply

with component specifications and will optimize coolant system operation. Use of non-genuine PACCAR coolant filter can cause severe damage to vehicle components. Failure to comply may result in equipment or property damage.

Cooling System Sealing Additives and Soluble Oils



1 Do not use soluble oils or sealing additives.



CAUTION

The use of sealing additives or soluble oils in the cooling system can cause damage to the engine. These additives can plug various areas of the radiator, EGR system, and oil cooler. Plugging the cooling system can prevent or slow heat transfers, causing internal engine damage. DO NOT use sealing additives

or soluble oils in the cooling system. The use of sealing additives can

- Build up in coolant low-flow areas
- Plug the radiator and oil cooler
- Damage the water pump seal
- Damage heat transfer surfaces
- Damage seals and hoses
- Corrode brass and copper

Failure to comply may result in equipment or property damage.

ENGINE COOLANT SPECIFICATIONS

Table 6: Engine Coolant Specifications for PACCAR MX-13

Coolant Capacity	Approx. 13 gallons ¹ (49 liters) ²
Minimum Recommended Pressure Cap	15 psi (1.03 bar/103 kPa)
Maximum Engine Coolant Outlet Temperature	223°F (106°C)

¹ Varies with vehicle equipment

² Vehicles with CARB compliant aftertreatment emissions systems require an additional 2.5L of coolant.



NOTE

Coolant volumes are dependent on chassis model and cab/sleeper heater options.

EXTENDED LIFE COOLANT

Perform these maintenance procedures according to the Preventative Maintenance Schedule.

- Conduct coolant maintenance checks including freeze point, pH, nitrite and carboxylate tests at least twice annually to maintain engine protection.

Nitrited Extended Life Coolant

For nitrited formulations (NOAT), a heavy-duty extended life coolant that meets ASTM D6210, Cummins Engineering Standard 14603 for ISX and PX engines and MAT74002 for PACCAR MX-11 and MX-13 engines, must be used.

Unless otherwise optioned, factory fill coolant is an ethylene glycol, nitrited organic acid technology (NOAT) extended life coolant (ELC) formulation at a 50:50

coolant-to-distilled water mixture. The factory fill meets or exceeds ASTM D6210 and Cummins Engineering Standard 14603 for ISX and PX engines, and MAT74002 for PACCAR MX-11 and MX-13 engine requirements. Maintaining coolant chemistry and freeze protection is critical to engine and cooling system component health and longevity.

The change interval for extended-life coolant containing nitrite and molybdate is 750,000 miles (1,200,000 km) or 12,000 hours of on-road use (8 years or 15,000 hours of off-highway use) on initial fill with no extender added. The change interval is 1,000,000 miles (1,600,000 km)/20,000 hours/8 years with an extender addition at 500,000 miles (800,000 km)/10,000 hours/4 years.

Nitrite-Free Extended Life Coolant

Nitrite-free organic acid technology coolant (OAT) may be used if it meets DAF 74002. The change interval for nitrite free coolant is 600,000 miles (1,000,000 km) or 6 years, with no extender needed. DO NOT add coolant extender to nitrite-free coolant. Follow the coolant supplier's drain/flush/fill/diluting percentages when servicing a vehicle filled with nitrite-free coolant.

Additional Recommendations:

- Antifreeze is essential for freeze, overheat, and corrosion protection. The use of supplemental coolant additives (SCAs) is not recommended for extended-life coolants.

Recommended Extended Life Coolant Suppliers



6.5 Fuel

FUEL RECOMMENDATIONS

WARNING

DO NOT use mixed fuels in the engine. Only use the fuel type specified in your engine operator's manual. Mixing gasoline, diesel, alcohol, or gasohol can cause an explosion. Failure to comply may result in death, personal injury, equipment damage, or property damage.

CAUTION

Dirt or water in the fuel system can cause severe damage to both the fuel pump and the fuel injectors. Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Know your fuel source and make sure all steps are taken for dispensing or using clean fuel in your vehicle. Failure to comply may result in equipment or property damage.

CAUTION

Unapproved fuel can reduce economy or possibly damage fuel system components. Unapproved fuels typically do not have enough lubricity elements in the fuel to properly lubricate the fuel injection system. Be sure you follow the fuel recommendations as indicated in this section of the manual. Failure to comply may result in equipment or property damage.

**CAUTION**

Using diesel fuels blended with lubricants may cause damage to your engine aftertreatment system. Service intervals for engine aftertreatment systems will be reduced. DO NOT use diesel fuel blended with lubricating oil in engines equipped with an engine aftertreatment system. Failure to comply may result in equipment or property damage.

has been optimized for use with an aftertreatment system together with ULSD fuel to meet the 2013 U.S. Environmental Protection Agency regulations.

**NOTE**

PACCAR recommends that the cetane number of diesel fuel be a minimum of 45 for engines that are expected to operate at temperatures below 32°F (0°C) and a minimum of 42 for engines that are operated at temperatures above 32°F (0°C).

Using diesel fuel with a lower-than-recommended cetane number can cause hard starting instability, and excessive white smoke. To maintain satisfactory operation at low ambient temperatures, it is important to specify diesel fuel of the correct cetane number.

PACCAR requires all permissible fuels to have adequate fuel lubricity. Lubricity can be determined by ASTM, specification D6079, ISO 12156, High Frequency Reciprocating Rig (HFRR) in which the fuel must have a wear scar diameter of 0.02 in. (0.5 mm) or less.

The use of Ultra-low-sulfur diesel (ULSD) fuel is required for this engine in order to meet emission regulations and to prevent damage to the engine and exhaust system. The use of other grades of diesel fuels other than ULSD fuel will be considered a use of incorrect fuel for the engine. PACCAR is not responsible for failures caused by the use of incorrect fuel, oil or DEF or by water, dirt or other contaminants in the fuel or DEF.

WARRANTY AND THE USE OF RENEWABLE AND OTHER PARAFFINIC DIESEL FUELS

PACCAR Inc. approves the use of paraffinic diesel at any blend level or as a stand-alone fuel, providing that the following conditions are met:

- The paraffinic diesel in the fuel meets EN 15940 specifications, and
- The finished fuel meets the properties of ASTM Standard D975

The use of approved paraffinic diesel fuel does not affect the PACCAR engine warranty, or its maintenance intervals. Failures caused by the use of fuels that are not approved, are of unacceptable quality, or do not meet specified industry standards are not considered as defects of parts or

**CAUTION**

For diesel vehicles, use only Ultra Low Sulfur Diesel (ULSD) fuel as recommended by engine manufacturers. High-sulfur diesel fuel can damage the aftertreatment system and affect engine emissions, leading to non-compliance with emission regulations. Failure to comply may result in equipment or property damage.

**NOTE**

Ultra Low Sulfur Diesel (ULSD) fuel is required for correct operation of the aftertreatment system. The engine

workmanship by PACCAR and therefore will not be covered by the PACCAR engine warranty. Specifically, raw or unprocessed vegetable oils differ heavily from paraffinic diesel and are not approved.

PACCAR recommends that customers intending to use paraffinic diesel become familiar with the properties of these fuels. Please reference the fuel supplier's technical information and request a copy of the certificate of analysis if it is unclear whether the fuel meets specifications. In particular, operators should be aware that paraffinic fuels are more prone to cold flow (gelling) and filter plugging issues if not formulated to meet climate-dependent requirements for the region. Operators should also be aware that paraffinic diesel energy content (by volume) is lower than that of petroleum diesel, which can reduce fuel economy by up to four percent as a stand-alone fuel.

WARRANTY AND THE USE OF BIODIESEL FUEL

PACCAR Inc. approves the use of biodiesel fuel blends up to 20 percent by volume in diesel fuel providing that the following conditions are met:

- The biodiesel used in the blend meets ASTM Standard D6751 or EN 14214 specifications.

- The biodiesel used in the blend is sourced from a BQ-9000 Accredited Producer.
- The finished blend meets the fuel properties of the ASTM Standard D975 (up to B5 blend) or D7467 (B6 to B20 blend).
- If using B6-B20 the engine oil and oil filter are changed per the modified schedule. See the Preventative Maintenance Schedule.
- If using B6-B20 the fuel filter is changed every 25,000 miles (40,000 km).

The use of approved biodiesel fuel does not affect the PACCAR engine warranty. Failures caused by the use of non-approved biodiesel fuels or other fuel additives that are of unacceptable quality or do not meet specified industry standards are not considered as defects of parts or workmanship by PACCAR and therefore will not be covered by the PACCAR engine warranty.

PACCAR recommends that customers intending to use biodiesel blends become familiar with the additional handling considerations of these fuels such as aging, metal compatibility and tendency to absorb water. Please reference the fuel supplier's technical information or industry guidelines

such as the American Trucking Association Truck Maintenance Council document RP 357.

In particular, operators should be aware that biodiesel blends are more prone to cold flow (gelling) and filter plugging issues compared to conventional diesel fuel. If vehicles are expected to be operated in temperatures below freezing, care should be taken to ensure that both the biodiesel fuel used and the appropriate vehicle fuel system accessory heaters are utilized.

Operators should also be aware that biodiesel energy content (by volume) is lower than diesel which can reduce fuel economy by up to two percent.

RECOMMENDATIONS TO AVOID FUEL GELLING

To avoid fuel gelling in cold weather:

- Use appropriate fuel grade/blend for conditions
- Spec your vehicle with proper cold weather equipment (12V electric pre-heater, fuel/coolant heater, 12V fuel line heaters and fuel tank heaters)

PACCAR does not recommend the use of fuel additives, however, if a customer needs a winter fuel additive, PACCAR offers the following guidance:

- Use an industry known, high quality product (EPA-approved)
- Check the product label to ensure it is compatible with ultra-low sulfur diesel fuel and aftertreatment systems
- Only use the additive for the minimum time needed
- Follow the additive manufacturer's instructions exactly

7 MAINTENANCE PROCEDURES

7.1 Engine Oil Level

ENGINE OIL LEVEL

This procedure should be followed as part of routine maintenance checks.

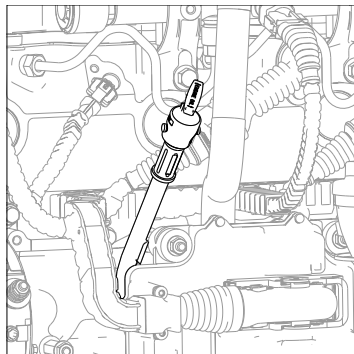
To check engine oil level, park vehicle on level ground and wait 15 minutes after shutting off engine. After the engine is shut off it will take at least 15 minutes for all the engine oil to return to the sump.

i NOTE

It takes approximately 15 minutes for all the oil to run into the sump when the engine is warm. If the level is checked immediately after switching off the engine, the dipstick will show a low oil level.

Make sure that the vehicle suspension is sitting flat, both lengthwise and crosswise. Check this carefully on a vehicle with air suspension.

1. Twist the dipstick handle to unlock it, then pull the dipstick out of the holder.



2. Wipe the dipstick clean with a lint-free cloth.
3. Reinsert the dipstick into the holder.
4. Remove the dipstick from the holder and check the oil level. The oil level should always be between the two marks on the dipstick.
5. Reinstall the dipstick and twist to lock it in place.

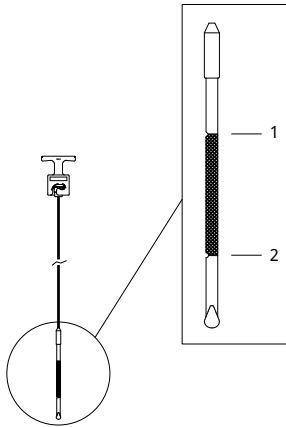
OIL LEVEL INDICATION ON DIPSTICK

i NOTE

On the engine oil dipstick, the difference between the low oil level mark (2) and

high oil level mark (1) is 6.3 US quarts (6 liters).

Figure 13: Engine Oil Dip Stick Markings



- 1 High oil level (1)
- 2 Low oil level (2)

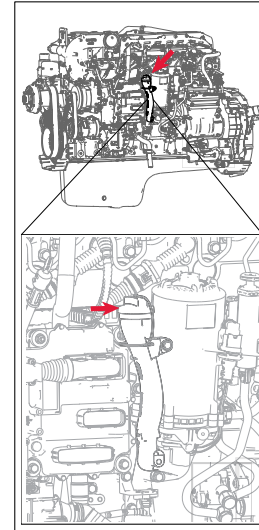
TOPPING UP THE ENGINE OIL

This procedure should be followed when oil level is low and more oil needs to be added.

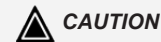
If checking the engine oil just after stopping the engine, wait 15 minutes for the oil to drain back into the oil pan before checking the fluid level.

1. Top up with oil, if necessary, via the filler opening. Use the correct grade in the correct quantity.
2. After topping up, wait one minute and check the oil level again.
3. Reinstall the oil fill cap and twist to lock it in place.

Figure 14: Engine Oil Fill Location



OIL DRAIN PLUG FOR COMPOSITE PAN



CAUTION

The drain plug is on the bottom of the oil pan. Do not use any other plug on the pan as a drain. Doing so may dam-

age the pan, leak oil and damage the engine.

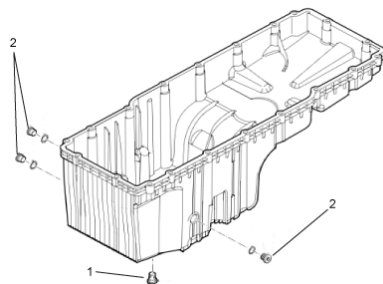
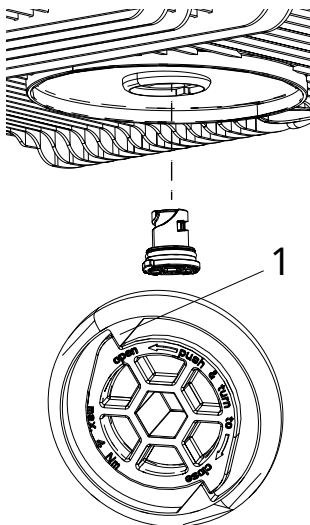


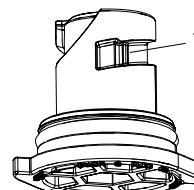
Figure 15: Oil Pan Drain Plug Installation



1 Stop

Torque the drain plug to its stop.

Figure 16: Oil Drain Plug Detent



1 Detent

i NOTE

This engine is equipped with a composite oil pan and drain plug. Care should be taken to avoid over-torquing the drain plug.

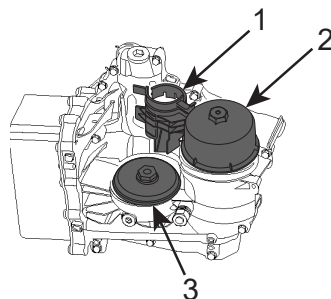
Replace the drain plug if:

- The plug is leaking
- The O-ring is missing
- The plug/O-ring assembly is damaged
- The retention detent cannot be felt during installation

7.2 Engine Oil Filter

ENGINE OIL FILTER

Figure 17: Oil Filter Module



- 1 Lock
- 2 Filter Cap
- 3 Cap

Your engine is equipped with a full-flow oil filter that is designed to capture contaminants and remove deposits from the oil to prolong the life of internal moving components.

Always use quality engine lubricating oils in conjunction with the appropriate oil drain and filter change intervals. Refer to the

Engine Lubrication and Filter Intervals for the recommended oil and filter change service interval.

CAUTION

Use of non-genuine PACCAR oil filters can cause severe engine damage.

OIL FILTER REMOVAL PREPARATION

CAUTION

The oil change process must be completed, the engine restarted, and idled for five minutes before beginning the fuel filter change process. Failure to comply could result in a non-warrantable engine failure.

CAUTION

Before beginning to remove and/or disconnect any components, wait at least 5 minutes after the key switch is turned OFF for the aftertreatment DEF dosing system to purge the DEF from the system. The DEF system purges to prevent damage from freezing. Failure to com-

ply may result in equipment or property damage.

WARNING

Turn off the engine and place the ignition switch in the OFF position before disconnecting the battery clamps. DO NOT place any tools or other materials on top of or close to the batteries. This can cause a dangerous high current short circuit and, in the worst case, a battery explosion. Keep all objects away from the battery terminals. Always break the contact between the battery clamp and the negative terminal before working on the vehicle. Working on a vehicle while the battery is connected may result in electrical injury or damage. Always disconnect the battery at the negative terminal when performing service procedures. Failure to comply may result in death, personal injury or equipment damage.

WARNING

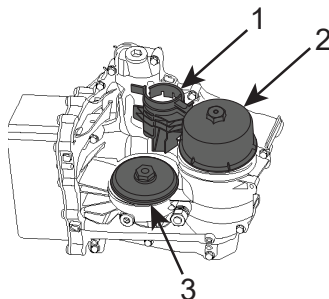
Electrical shock hazard: Never disconnect the battery clamp when the engine is running. Disconnecting the battery

clamps while the engine is running may result in death, personal injury or equipment damage from electrical arcing or damage to electrical components.

1. Disconnect the chassis battery cable at the negative battery terminal.
2. Place an oil collection pan directly under the oil filter.

FULL-FLOW OIL FILTER REMOVAL

Follow the procedure below after reading "Oil Filter Removal Preparation."



- | | |
|---|------------|
| 1 | Lock |
| 2 | Filter Cap |
| 3 | Cap |

1. Thoroughly clean the filter cap (2) and surrounding areas.
2. Lift up the lock (1) to remove the filter cap (2).
3. Unscrew the filter cap (2) a few turns to drain the filter housing. Use a hexagonal socket, or box wrench, to avoid damaging the oil filter cap.
4. Remove the cap with filter element from the filter housing.
5. Remove the oil filter cartridge from the cap.
6. Remove the O-ring from the screw cap.

7. Inspect the O-ring groove for damage.

WARNING

Wear protective clothing, eye protection, and gloves to avoid contact with lubricants and brake fluid. These substances can be toxic and corrosive to the eyes and skin. Failure to comply may result in death, personal injury, property damage, or equipment damage.

FULL-FLOW OIL FILTER INSTALLATION

NOTE

If the PACCAR part you are installing includes instructions or drawings that appear to conflict with this manual, follow the instructions included with the part. The instructions found with your part supersede this manual. Always refer to online service instructions for up-to-date service instructions.

Use the following procedure to install full-flow oil filters.

1. Check the new O-ring for damage. If damaged, discard.
2. Sufficiently lubricate with engine oil:
 - The new O-ring
 - The O-ring groove in the filter cap
3. Install the new O-ring onto the filter cap using the installation sleeve. Do not twist the O-ring during installation.
4. Install the new oil filter element into the filter cap.
5. Sufficiently oil all sealing surfaces and threads of the oil module.
6. Install the screw cap, with filter element onto the filter housing. Tighten the screw cap to 70 N·m (354 lb-in). Use a hexagonal socket to avoid damaging the oil filter cap.

AFTER REPLACING ENGINE OIL FILTER(S)

Follow the steps below after installing new oil filters:

1. Reconnect the chassis battery cable at the negative battery terminal. See

Oil Filter Removal Preparation.

2. Add SAE-approved CK-4 engine oil to the maximum level marked on the dipstick. If the engine is running a different weight of oil, be sure to top-off the engine oil with the same brand and viscosity of oil.
3. Make sure that all electrical components are switched OFF and the vehicle's transmission is in the neutral gear position before starting the engine.
4. Start and run the engine at idle speed for at least one minute to allow oil to reach all necessary components. Check for oil leaks.



CAUTION

Increasing the engine speed directly after maintenance or repairs to the lubrication system may cause damage to various engine components.



CAUTION

The red oil pressure warning in the instrument panel should disappear within ten seconds of the

engine starting. If not, shut the engine OFF and investigate the problem. Failure to do so may cause damage to various engine components.

5. Remove oil collection pan and dispose of any spillage properly.
6. Shut down the engine and allow at least 15 minutes for the oil to drain back into the oil pan. Check the oil level and top up as necessary. See Engine Oil Level.

7.3 Fuel Filter

FUEL FILTER

Perform these maintenance procedures when indicated by the Preventative Maintenance Schedule.



WARNING

DO NOT smoke or allow an open flame in close proximity to the fuel filter. When removing the fuel filter, some fuel will escape, so it could start a fire or cause an explosion. Failure to comply may

result in death, personal injury, equipment damage, or property damage.

CAUTION

Replace fuel filters with parts of the same part number. PACCAR periodically changes its filter design, and filters of different part numbers are not interchangeable. Use of incorrect filter part numbers or non-genuine filters can result in low pressure fuel fault codes and/or severe engine damage. Contact a Kenworth or Peterbilt dealer to verify the correct fuel filter part numbers.

NOTE

The fuel filter and the hand pump are located on the left-hand side of the engine, as viewed from the driver's seat.

NOTE

Use of poor quality fuel may require more frequent fuel filter element service.

Description

The fuel filter/water separator module provides fine-particle filtration, water separation, water-in-fuel sensing, 12V preheating and system manual priming in a singular easy to service module.

Biodiesel

For information on alternative fuels, such as biodiesel, and additional information for fuel recommendations and specifications, see Warranty and the Use of Biodiesel Fuel.

FUEL FILTER REMOVAL (PRIMARY AND SECONDARY)

Refer to replace fuel filter element set (Fuel system).

CAUTION

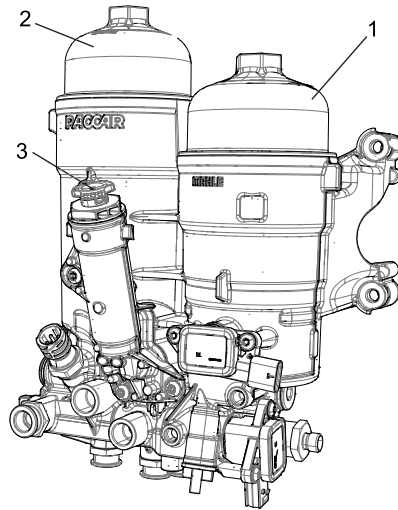
DO NOT replace engine oil and fuel filters at the same time. After completing the oil change, let the engine idle for at least five minutes to ensure proper oil circulation before replacing fuel filters. Failure to comply may result in non-warrantable engine failure due to engine components having inadequate oil pressure.

CAUTION

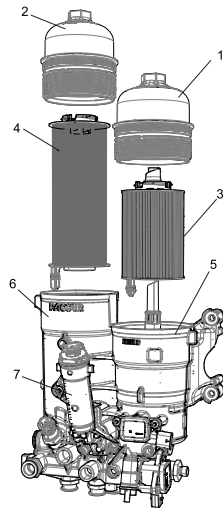
Do NOT use brake cleaner or any other acetone-based cleaner on the clear plastic fuel filter caps (if so equipped). Doing so causes them to fog up, which is irreparable, and requires their replacement. If necessary, use soap and water or rubbing alcohol to clean the plastic fuel filter caps. Failure to comply may result in non-warrantable equipment damage.

CAUTION

Only add fuel through the fuel tank. **Never add fuel** to the fuel system at any other place, or by any other means. Failure to comply may result in non-warrantable equipment damage.

Figure 18: Fuel Filter Module

- 1 Primary filter housing (cap installed)
- 2 Secondary filter housing (cap installed)
- 3 Primary pump handle

Figure 19: Fuel Filter Module - Exploded

- 1 Primary filter cap
- 2 Secondary filter cap
- 3 Primary filter
- 4 Secondary filter
- 5 Primary filter housing
- 6 Secondary filter housing
- 7 Manual priming pump

Complete the following steps to remove the fuel filters:

1.

WARNING

Remove dirt from the fuel system whenever possible (like, but not limited to, when replacing fuel filters). Dirt in the fuel can lead to significant damage to fuel system components and lead to unpredictable engine stalling. Failure to comply may result in unwarrantable equipment damage, general property damage, personal injury or death.

CAUTION

After installing new filter cartridges and before starting the engine, refer to the priming procedure and follow it carefully. Failure to prime any new (dry) fuel filter can cause severe engine damage due to dry starting the engine. Failure to comply may result in unwarrantable engine failure.

⚠ WARNING

Drain the fuel-filter module during service. If not thoroughly drained, cross-contamination of dirty fuel into the clean side of the module may result. Unpredictable engine stalling may occur. Failure to comply may result in unwarrantable equipment damage, general property damage, personal injury or death.

i NOTE

The fuel filter cartridge is a disposable filter and must not be cleaned and reused. Dispose of the filter as chemical waste.

Clean the fuel filter caps and surrounding area with a clean rag.

2. Loosen the fuel tank cap to relieve any pressure in the fuel tank.

3.

⚠ WARNING

Loosen the primary housing cap until the o-ring is visible within 30 s of loosening the primary. This prevents cross contamination of the filtered fuel from the unfiltered. Failure to comply may result in unwarrantable equipment damage, general property damage, personal injury or death.

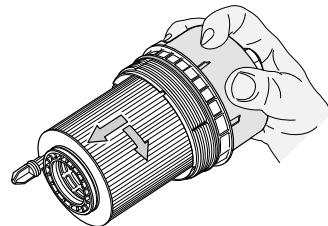
⚠ CAUTION

Do not use power tools to remove the filter caps from the housings. The caps are plastic and power tools can badly damage them. Failure to comply may result in unwarrantable equipment damage.

4. Within 30 s of loosening the secondary cap, loosen the primary fuel-filter housing cap (2) until the O-ring is visible.
5. Wait 2 minutes for the fuel to drain

completely to prevent fuel from leaking or dripping on the starter motor.

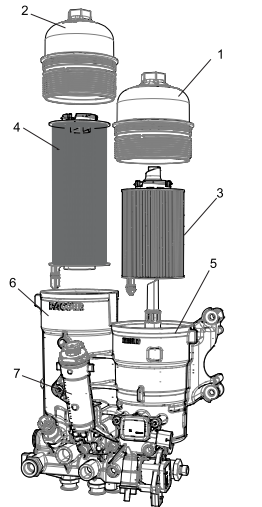
6. Remove fuel filter caps completely (fuel filter elements come out with the caps because the paper elements are attached to the caps).
7. Remove the fuel filter elements from their caps (2) by turning a filter element CLOCKWISE in the cap while pulling on the filter. Discard the used filters by adhering to an environmentally friendly process according to state and federal law.



8. Clean the fuel bowls and filter housing of any sediment or debris. Look directly down into the filter housings from above for any signs of dirt or debris. If necessary, use a light. Remove any debris that can be seen.

FUEL FILTER INSTALLATION (PRIMARY AND SECONDARY)

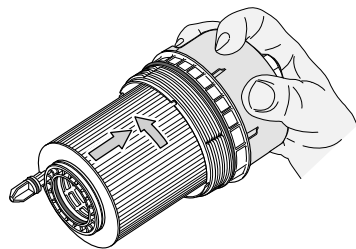
Figure 20: Fuel Filter Module - Exploded



- | | |
|---|--------------------------|
| 1 | Primary filter cap |
| 2 | Secondary filter cap |
| 3 | Primary filter |
| 4 | Secondary filter |
| 5 | Primary filter housing |
| 6 | Secondary filter housing |
| 7 | Manual priming pump |

Follow the steps below to install a new primary or secondary fuel filter:

1. Remove the old O-rings with a pick-hook. Do not cut O-rings free. Using a blade can damage the O-ring groove and prevent the O-ring from sealing.
2. Lubricate the O-ring grooves with clean engine oil.
3. Install the new O-rings onto the primary and secondary fuel filter caps (1)(2). The new rings come with the filters (3)(4). Do not reuse old O-rings.
4. Lightly coat the O-rings with clean engine oil.
5. Install the new filter elements into the fuel filter housing caps (5)(6). Press a filter element into a housing cap. Then rotate the element COUNTERCLOCKWISE until it latches. Latch the filter to the cap before handling it or attempting to reinstall the filter cap assembly (1)(2). Install the filter into the fuel filter housing (5)(6).
6. Reinstall the filter cap assembly (1)(2) into the fuel filter housing (5)(6). Rotate (thread) the cap clockwise until the O-ring on the cap contacts the housing.



7. Torque the caps to 80 N·m lb-ft + 5 (708 lb-in +44) as specified on the caps (1)(2).
8. Prime the fuel system thoroughly using the manual primer pump (7) (see [Priming the Fuel System](#) and follow the procedure carefully. This step includes starting the engine.
9. Reinstall the fuel tank filler cap (1) (2).

i NOTE

Make sure the diesel fuel and your hands are clean.

i NOTE

Depending on the vehicle's fuel system configuration, the fuel filter housing may not completely drain of fuel. When fuel remains in the housing, take care to prevent fuel spill when installing the new filter.

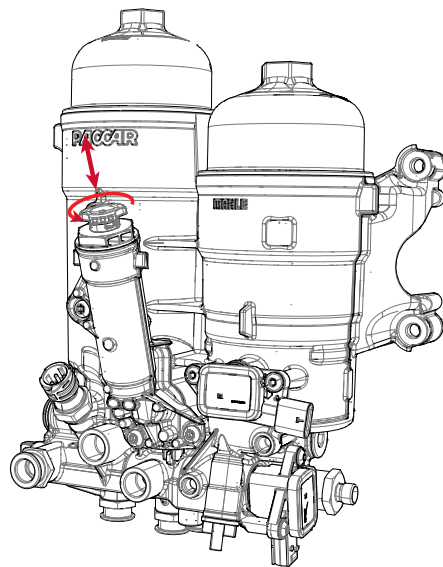
PRIMING THE FUEL SYSTEM

To start the engine after the fuel tank runs dry, or after the fuel system service, complete the following steps:

⚠ CAUTION

Follow these instructions in emergency situations. Also use them when the fuel tank runs dry. They also apply for the fuel system service. Failure to comply may result in equipment damage or property damage.

Figure 21: EPA2021 Fuel Filter Module, Priming Pump - MX-13



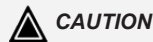
i NOTE

For engines not equipped with PACCAR fuel filters, refer to the engine and/or fil-

ter manufacturer instructions for priming the engine.

1. Loosen the fuel primer pump knob by rotating it counterclockwise.

2.



CAUTION

Operate the priming pump at a maximum rate of 100 strokes per minute to prevent damage to the pump.

Operate the priming pump by moving the knob in and out for 150 seconds. During this time, the pumping resistance increases. This resistance indicates air purging from the system. It still requires a full 150 seconds to fully prime the fuel system.

3.



WARNING

DO NOT smoke or allow an open flame in close proximity to the fuel filter. When removing the fuel filter, some fuel will escape, so it could start a fire or cause an explosion. Failure to comply may result in death, personal injury,

equipment damage, or property damage.

Check for leakage at the fuel filter cap. If necessary, tighten.

4. Tighten the fuel primer pump knob by rotating it clockwise.

5.



NOTE

Cranking the engine excessively triggers Starter Protection. This feature restricts starter engagement for 10 minutes.

Start the engine. Allow it to idle for 2 to 3 minutes. It could take up to 15 seconds of cranking for the engine to start. Engaging the starter for longer than 20 seconds without starting requires additional priming.

6. Check the system for leakage while idling. Then turn the engine OFF and check the system again for leakage.

7.



WARNING

DO NOT loosen any fuel line fittings in order to bleed the fuel system of air. The system is

under high pressure which, when relieved, could cause death, personal injury, equipment or property damage.

If the engine does not start within this time, repeat steps two and three. Try to restart the engine. If the engine still does not start, allow the starter to cool down for at least 5 minutes. Try to restart the engine.

FUEL FILTER WATER DRAINING PROCEDURE

Follow the steps below to drain water from the primary fuel filter housing. Wear fuel-safe gloves. Have a one L or larger jar or canister available, and a place to dispose of contaminated water responsibly.

1. Locate the drain-spigot on the bottom of the fuel-filter housing. It is a hand-operated butterfly valve. The valve is plastic, and misuse with a tool can damage it.



NOTE

You can place a ¼ inches (in) (6 mm) hose over the opening of the drain-spigot. The spigot has

a provision for hose attachment. This feature can aid in placing the catch-vessel in a more convenient location.

2.

CAUTION

Always catch the fuel or water in a container. If you do NOT use a container to catch the fuel or water, the fluid can fall directly onto the starter motor, and eventually, the ground. Failure to comply may result in equipment failure and/or cause an environmental hazard.

Place a can, or preferably, a transparent jar, below the drain or hose to catch the fuel-water.

3. While watching the drain or hose end, open the drain-spigot until the fluid starts to drain (about four turns).
4. When you can no longer see water in the exiting fuel, close the drain.
5. Discard of the waste fuel-water appropriately.

7.4 Cooling System

COOLING SYSTEM

Your engine may be equipped with a coolant filter designed to capture and remove harmful deposits from the cooling system to help prolong system life. Refer to the Preventative Maintenance Schedule for the recommended coolant filter change service interval.

WARNING

DO NOT remove the coolant fill cap while the engine is hot. Wait until coolant temperature is below 120°F (50°C). Scalding steam and fluid under pressure may escape and cause serious burns. Failure to comply may result in death, personal injury, equipment damage, or property damage.

WARNING

DO NOT remove the coolant fill cap while the engine is hot. Wait until coolant temperature is below 120°F (50°C). Scalding steam and fluid under pressure may escape and cause seri-

ous burns. Failure to comply may result in death, personal injury, equipment damage, or property damage.

WARNING

Only use the fill port to fill the surge tank. DO NOT attempt to fill the tank using the pressure port. Scalding steam and fluid under pressure may escape and cause serious personal injuries. Failure to comply may result in death, personal injury, equipment damage, or property damage.

WARNING

DO NOT touch, inhale, or consume antifreeze or coolant. If antifreeze/coolant comes into contact with eyes, rinse thoroughly with water for 15 minutes. If there is prolonged or repeated contact with skin, immediately wash skin with soap and water. If antifreeze/coolant is consumed, seek immediate medical attention. DO NOT induce vomiting. Failure to comply may result in death, personal injury, equipment damage, or property damage.

i NOTE

Store coolant and antifreeze carefully. Keep only in a dedicated, sealable container (ideally, the original packaging). Dispose of coolant/antifreeze responsibly.

COOLANT FILL

You can find coolant checking and fill instructions specific to the vehicle in the vehicle operator's manual.

COOLANT/ANTIFREEZE CONDITION

Perform these maintenance procedures when indicated by the Preventative Maintenance Schedule.

i NOTE

Test the engine coolant at least twice per year to determine if the coolant must be replaced. If it is determined that the coolant should be replaced, make sure to flush the coolant system. Contact a PACCAR® Authorized Repair

Location for flushing the coolant system.

1. Check the following anti-freeze conditions:
 - Coolant level
 - Freeze point
 - pH level
 - Nitrite level
 - Carboxylate level

CHECKING COOLANT CONDITION

To ensure the Extended Life Coolant (ELC) in your vehicle always provides maximum protection, perform the following tests:

1. Check the coolant color at every maintenance interval. It should have no cloudiness, floating debris, or oils.
2. Test the freeze point at least twice a year. A refractometer or test strips can be used to measure the protection level.
3. Determine the pH and chemical inhibitor concentration level by using an ELC-specific test kit or test strips.
4. Keep the cooling system full by topping-up using ELC pre-diluted

to a 50/50 blend, unless a different ratio of water/antifreeze has been substituted (depending on operating conditions).

⚠ CAUTION

Inhibitor concentration level determines corrosion protection. If you are concerned about possible coolant quality, contamination, or mechanical problems, submit a coolant sample to your dealer for analysis. Improper maintenance may cause coolant degradation and could result in damage to the cooling system and engine components. Consult your dealer or the coolant manufacturer's representative for recommended extended life coolant test kits, test strips, and laboratory sample procedures.

RADIATOR HOSES INSPECTION

Perform this procedure for radiator hoses inspection.

1. Check the following radiator hose conditions:
 - Deterioration/signs of leaking

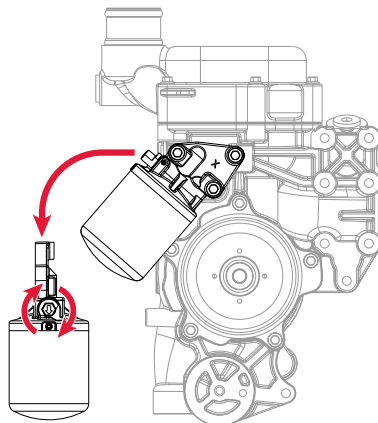
- Hose clamp torque

REPLACE COOLANT FILTER

Refer to replace coolant filter element (Cooling system).

Perform these maintenance procedures when indicated by the preventative maintenance schedule.

Figure 22: Coolant Shut-off Valve



1. Slowly loosen the radiator cap to relieve any pressure in the cooling system.

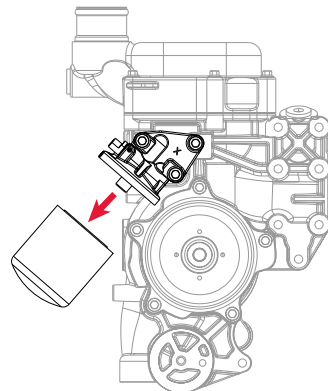
2. Close the coolant filter shut-off valve by rotating the hex key clockwise and away from the "O" position.
3. Clean the coolant filter and surrounding area.
4. Use a suitable container for possible coolant leaks when the filter is loosened.
5. Use a filter wrench to remove the coolant filter by rotating it counterclockwise.

NOTE

The coolant filter cartridge is a disposable filter and may not be cleaned and reused. Dispose of the filter as chemical waste.

6. Remove the O-ring from the coolant filter housing if it has not been removed already.

Figure 23: Coolant Filter Removal



COOLANT FILTER INSTALLATION

Follow the steps below to install the engine coolant filter:

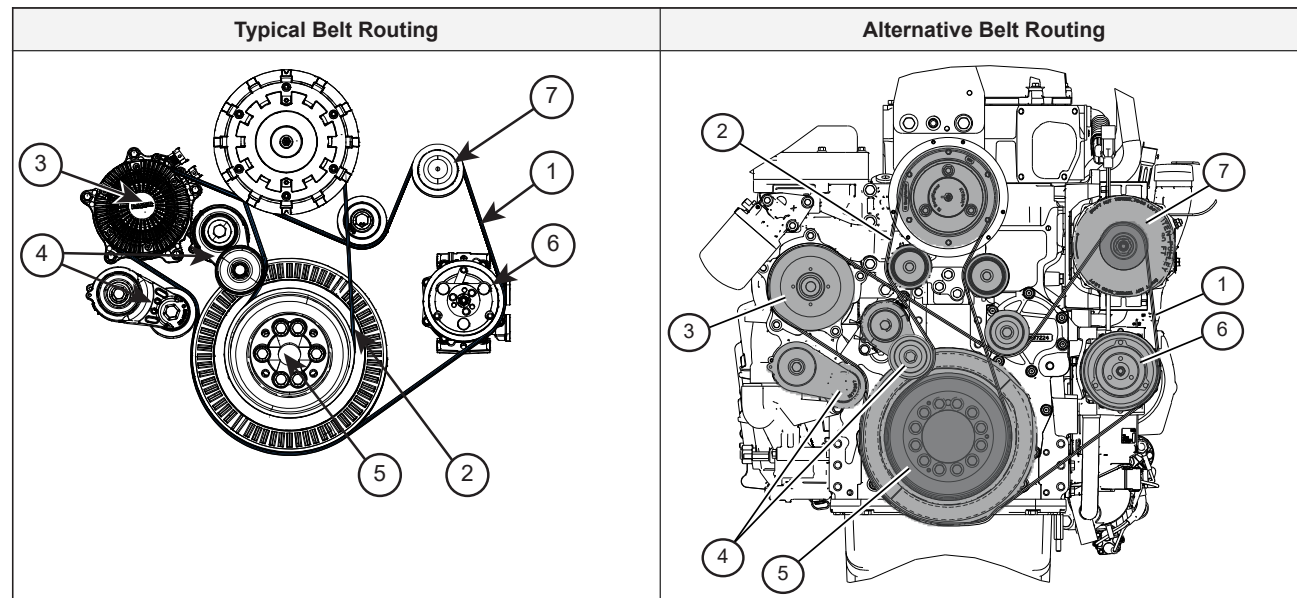
1. Apply a small amount of coolant to the sealing ring of the new coolant filter.
2. Install the filter, rotating it clockwise until the sealing ring makes contact with the filter housing. Then tighten by hand 1/2 - 3/4 of a turn.
3. Turn the shutoff valve to the OPEN position.

4. Reinstall the radiator fill cap.
5. Start the engine and run at idle speed for several minutes. Check for leaks.

7.5 Drive Belts

DRIVE BELTS

Table 7:



1. Accessory belt
2. Fan belt (No fan belt with T680MLU MX-11 and LHP MX-13).

3. Water pump
4. Tensioners
5. Engine dampener
6. A/C compressor
7. Alternator

**NOTE**

Always fit the same type of belts as the ones replaced.

ENGINE BELT CHECKS

Perform this maintenance procedure at the mileage or engine hours specified in the Preventative Maintenance Schedule.

1. Inspect the engine belts for the following conditions:
 - Excessive play indicating a seized or failing belt tensioner
 - Cracks, crazing, discoloration, or signs of overheating that may indicate slippage
 - Belt dust or shavings indicating rubbing
 - Frayed or exposed belt threads
 - Signs of animal activity - gnaw marks
 - Belt to pulley misalignment
 - Oil, grease, or coolant contamination
 - Foreign matter pinched between the belt and pulleys or signs of this condition previously like debris in belt or pulley grooves
2. Listen to the engine on start up or acceleration for any squealing. This is an indication that a belt may be slipping.

If you find signs of premature belt failure, identify, and address the underlying problem as soon as possible and replace the belt making sure that it is installed, aligned, and that the tensioner is working, properly (belt should be taut).

FAN BELT TENSIONER (IF SO EQUIPPED)

NOTE

There is NO fan belt on T680 Next Generation chassis equipped with LHP MX-13 engines and crank mounted fans.

Perform this maintenance procedure at the mileage or engine hours specified in the Preventative Maintenance Schedule.

1. Check and correct fan belt tensioner.
 - Mounting bolt torque. Correct torque is 60 N•m (44.25 lb-ft)
 - Tensioner maintains proper belt tension

ENGINE FAN

WARNING

DO NOT work on or near the engine fan while the engine is running. The fan can start at any time without warning, and anyone near the fan when it turns on could be injured. If the manual fan switch is set to MANUAL, the fan will turn on when the start key switch is turned to the ON position. If the switch is set to AUTO, it could engage suddenly at any time without warning. Before starting the engine or switching the manual fan switch from AUTO to MANUAL, make sure no one is near the fan. Failure to comply may result in death, personal injury, equipment damage or property damage.

Follow these guidelines to check your engine fan:

- With the engine shut off, check the fan hub bearings for looseness, loss of lubricant, and any abnormal conditions (e.g. fan belt misaligned or excessive wear/damage, etc.).
- With the engine idling and the hood open, stand at the front of the vehicle. Listen for any noises coming from

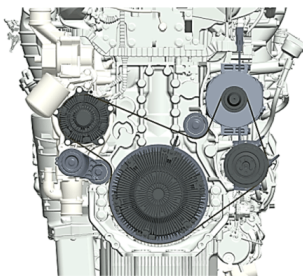
the fan hub. Bearings that have lost lubricant and are dry will typically emit a squeal or a growl when the engine is at operating temperature and the fan clutch is engaged. If noise is detected, have the fan bearings inspected by an authorized dealership.

Engine Fan Blade

Verify that there is enough fan blade clearance with the fan shroud. The recommended distance around the fan shroud is 1 in. (25 mm) from front edge of any fan blade-to-radiator side member. Minimum clearance is 3/4 in. (19 mm).

- Rear edge of any blade must be no closer than 3/8 in. (9 mm) to the nearest engine component. If this cannot be obtained, the fan spacer or fan is incorrectly placed.
- The leading edge of any fan blade must be 1 in. (25 mm) from the inside edge of the shroud.

BELT ROUTING WITH CRANK MOUNTED FANS



There is NO fan belt with T680 Next Generation vehicles equipped with LHP MX-13 engines and crank mounted fans.

FAN BELT REMOVAL - IF SO EQUIPPED

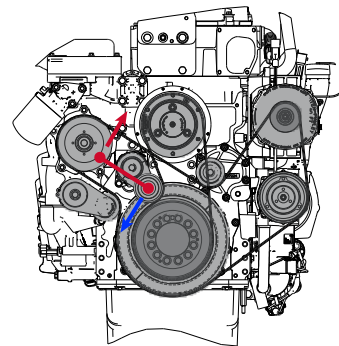
NOTE

There is NO fan belt on T680 Next Generation chassis equipped with LHP MX-13 engines and crank mounted fans.

Perform this maintenance procedure at the mileage or engine hours specified in the Preventative Maintenance Schedule.

1. Disconnect the electrical ground wire from the battery.
2. Reach between the fan blades and remove the fan blade mounting bolts using a 9/16 in. socket. Remove the fan and store it temporarily where it cannot be damaged.
3. Place a flex-bar with a 15 mm socket on the fastener securing the automatic belt tensioner's roller, as shown in the image.

Figure 24: Flex Bar on Tensioner - V-belt and Fan Drive Belt



4. Rotate the flex-bar as shown in the

diagram to relieve belt tension.

5. With the belt tensioner pressure relieved, remove the poly V-belt from the pulleys.
 - The tensioner can be temporarily blocked with a 0.16-0.2 in. (4-5 mm) thick pin (bore). This facilitates removal and installation of the poly V-belt.
6. After removing the belt, carefully allow the belt tensioner to spring back to the stop (if it had not been temporarily blocked).
7. Inspect the pulleys for damage, rust, and grease deposits. Clean or replace as necessary.

FAN BELT INSTALLATION - IF SO EQUIPPED

Follow the steps below to install the fan belt:

NOTE

There is NO fan belt on T680 Next Generation chassis equipped with LHP

MX-13 engines and crank mounted fans.

1. Place a new poly V-belt over the pulleys, making certain the belt falls into all the belt pulley grooves. This will ensure proper alignment.

NOTE

When installing the belts do not wrap belt around the tensioner until after the belt has been wrapped around all other pulleys and idlers.

2. After installing the belt, carefully allow the belt tensioner to spring back to its normal position. If the tensioner had been temporarily blocked, relieve tensioner pressure enough to remove the locking pin, then allow the tensioner to spring back to its normal position.

NOTE

Do not reuse nylon patch lock nuts. Replace with new lock nuts when reinstalling parts.

3. Reinstall fan blade using NEW 5/16-18 UNC-2A on Horton fans, or 3/8-24UNF-2A on Borg-Warner fans, with nylon patch lock nuts.
4. Reconnect the electrical ground wire to the battery.

ACCESSORIES BELT REMOVAL

A single poly-V serpentine belt drives the alternator, air-conditioning compressor, and coolant pump and is referred to as the "Accessories Belt". Follow the instructions below to remove it:

1. Depending upon your specific vehicle model and engine options, it MAY first be necessary to remove the fan belt as described in "Fan Belt Removal - If so equipped."

NOTE

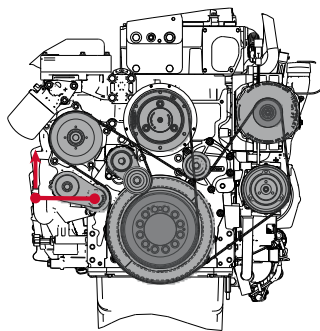
There is NO fan belt on T680 chassis equipped with LHP MX-13 engines and crank mounted fans.

i NOTE

Removing the fan blade is not necessary if only the accessory belt is removed. After removing the fan drive belt from its pulleys the accessory belt can be removed over the fan blade.

- Place a flex-bar with a 15 mm socket on the alternator and air conditioning compressor drive belt tensioner roller fastener as shown. Move the bar in the direction shown to relieve pressure on the belt tensioner.

Figure 25: Flex Bar on Tensioner - Compressor and Coolant Pump Belt



- With the belt tensioner pressure relieved, remove the poly V-belt from the pulleys.
 - The tensioner can be temporarily blocked with a 0.16-0.2 inch (4-5 mm) thick pin (bore). This facilitates removal and installation of the poly V-belt.
- After removing the belt, carefully allow the belt tensioner to spring back to the stop (if it had not been temporarily blocked).
- Inspect the pulleys for damage, rust and grease deposits. Clean or replace as necessary.

ACCESSORIES BELT INSTALLATION

A single poly-V serpentine belt drives the alternator, air-conditioning compressor, and coolant pump and is referred to as the "Accessories Belt".

- Place the new poly V-belt over the pulleys, positioning the new belt so that it falls into all the belt pulley grooves ensuring proper alignment.

i NOTE

When installing the belts do not wrap belt around the tensioner until after the belt has been wrapped around all other pulleys and idlers.

- After installing the belt, carefully allow the belt tensioner to spring back to its normal position. If the tensioner had been temporarily blocked, relieve tensioner pressure enough to remove the locking pin, then allow the tensioner to spring back to its normal position.
- Reinstall the fan drive poly V-belt as previously described in [Fan Belt Installation](#) - If so equipped.
- Reconnect the electrical ground wire to the battery.

7.6 Aftertreatment System

DIESEL PARTICULATE FILTER (DPF) SERVICE STRATEGY

There are two DPF service strategies:

- Dry cleaning

- DPF replacement

**NOTE**

The DPF cleaning intervals are based on the use of lubricating oils that meet the SAE 10W-30 API CK-4 oil specification.

Dry Cleaning

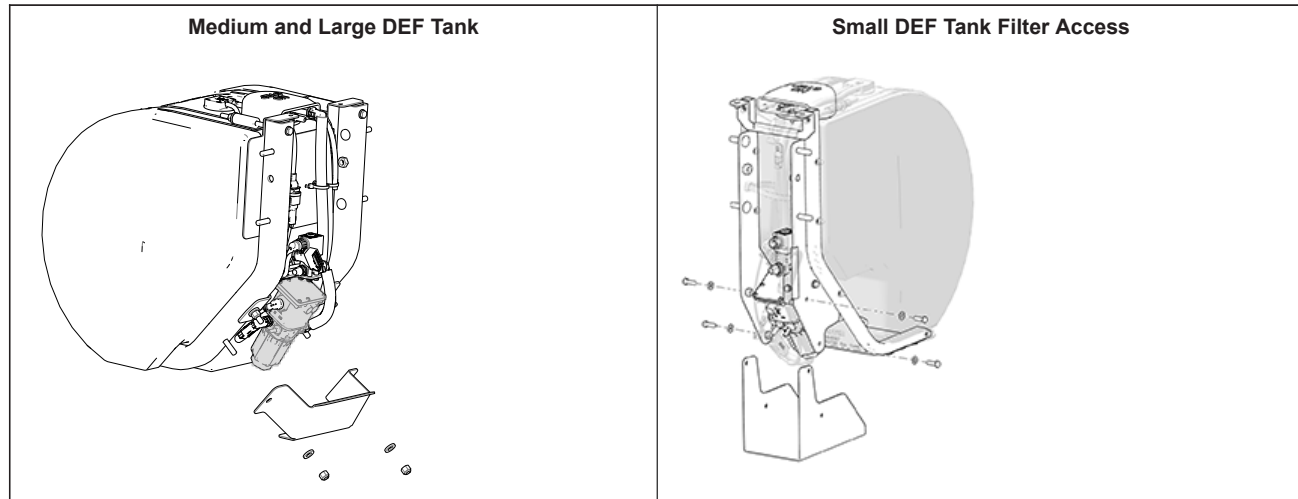
The dry cleaning strategy (using an FSX or equivalent machine) uses high pressure air and/or heat to remove impacted ash from the filter media. Dry cleaning can be performed at an authorized PACCAR dealer. A filter that has been cleaned using a method other than the prescribed dry cleaning will need to be replaced.

DPF Replacement

If the DPF has been compromised, the DPF element will need to be replaced with new parts.

DIESEL EXHAUST FLUID (DEF) FILTER ACCESS

Perform these maintenance procedures according to the Preventative Maintenance Schedule.



1. Replace the aftertreatment DEF dosing unit (DEF module) filter according to the maintenance schedule.
2. From the bottom of the tank, remove the cover plate by removing the various fasteners holding it on, then allow the cover plate to drop down.

7.7 Air System

AIR INTAKE SYSTEM

Engine heat, vibration, and age combine to loosen air intake connections and cause cracks in the tubing and elbows. Leaks in the intake system allow abrasive dust to enter the engine and quickly cause expensive damage. During your daily walk-around inspection, carefully check all tubing, elbows, clamps, supports, and fasteners for condition and tightness.

Check the charge-air-cooler for air leaks annually. The air leaks can be caused by cracked tubes or header. For service see your authorized dealer.



CAUTION

DO NOT use air intake pipes and connections as a step or to pull yourself up. This could loosen the connections and open the system to unfiltered air which could damage the engine. Failure to comply may result in equipment or property damage.

AIR COMPRESSOR



WARNING

Failure to carefully complete air brake water draining procedure(s) may leave moisture in the air brake system. Any remaining moisture may degrade or disable brake operation. Failure to comply may result in unwarrantable equipment damage, property damage, injury, or death.



NOTE

If your vehicle is optioned with two air tanks, drain both. Also drain any reservoirs.

Perform these maintenance procedures according to the Preventative Maintenance Schedule.

1. Bring the engine to operating temperature and allow the air system to fill to air compressor governor cut-out pressure (120-130 psi is typical).
2. If the vehicle has air suspension, make sure that it is at normal driving height.
3. Drain the wet tank, or the first reservoir found in line with the air

dryer output, if so equipped.

CHARGE AIR PIPING

Perform these maintenance procedures according to the Preventative Maintenance Schedule.

1. Check and correct the following charge air piping components:
 - Hose/pipe condition – deterioration/signs of leaking
 - Hose clamps for tightness
 - Clearance to other components

CHARGE AIR COOLER

Perform these maintenance procedures according to the Preventative Maintenance Schedule.

1. Check and correct the following components of the charge air cooler:
 - Cracked tubes or header
 - Clogged fins/tubes
 - Hose/pipe condition – deterioration/signs of leaking
 - Hose clamp torque

ENGINE AIR FILTERS

The following service information is basic to all engine air filter makes and models.



WARNING

DO NOT use air filter housings as grab handles. These components may break if you are using them to support your weight. Failure to comply may result in death, personal injury, equipment damage, or property damage.



WARNING

DO NOT push on the under hood air door with hands. This door is held closed with a spring which may shut close unexpectedly. Failure to comply may result in personal injury.



CAUTION

Replace the air filter at recommended intervals to prevent dirt and debris from entering the engine. Contaminants can cause internal "dusting," leading to accelerated wear and reduced perfor-

mance. Failure to comply may result in equipment or property damage.

Your vehicle is equipped with an air inlet restriction indicator as standard equipment on the air filter housing (an in-cab restriction gauge is optional in some models). Service the filter elements when the air inlet restriction indicator indicates that service is needed. Paper elements require care and proper handling because they are critical to engine service life.

The engine air filter is located on the top of the engine just below the hood. There are four fasteners that hold the cover to the filter housing.

If the vehicle has the under hood air intake option, the air intake solenoid and the airline may need to be removed to access the air filter.



NOTE

Be sure to check your vehicle for an ember pack or pre-cleaner filter when servicing the engine air filter.

Perform the following maintenance procedures when indicated by the Preventative Maintenance Schedule.

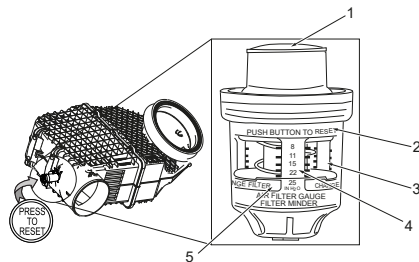
Check and correct for restriction:

- Service air filter element when air inlet restriction gauge indicates service is needed. See the vehicle operator's manual for additional instruction.
- Check hose/pipe condition – deterioration/signs of leaking
- Check hose clamp torque

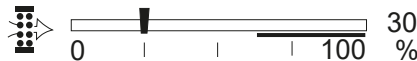
AIR FILTER RESTRICTION INDICATOR (OPTION)

An Air Filter Restriction Indicator may be installed on the air filter housing or air induction piping for access to clean, filtered air.

As the filter plugs and restriction increases, a red indicator appears in a window on the indicator. When the indicator turns on, the air filter should be replaced. The indicator can be reset by pressing the button at the end of the indicator.

Figure 26: Air Filter Restriction Minder

- 1 Reset push button
- 2 Air filter restriction indicator housing
- 3 Measurement window
- 4 Measurement scale (H₂O Inches)
- 5 Red indicator scale (change filter)

Figure 27: Air Filter Restriction Indicator

The Single Air filter Restriction Gauge is an optional indicator, and represents the restriction specification in a single bar with the value of restriction in percentage (0 - 100 %) with the indicator, that is the restricted value of contaminated air entering into the engine system and indicates

how clean the air that is entering to the combustion is. The following are the main specifications this indicator represents:

- Range: 0 - 100 %
- Warning Threshold: 60 - 100 %
- Data Error: N/A

7.8 Turbocharger



WARNING

DO NOT operate engine with turbocharger intake piping disconnected. A suction is created when the engine is running. This suction could draw your hand or anything else near it into the impeller fan. You could be injured. Always keep the intake piping connected when you will be running the engine. Failure to comply may result in death, personal injury, equipment damage, or property damage.

When servicing the air intake and exhaust systems on a turbocharged engine, check the items listed below:

Lubricating System

Check the oil lines, housing, and connections. Look for leaks, damage, or deterioration. Leaks could mean you have damaged oil lines or oil seals.

Manifold

With the engine operating, check for leaking manifold or flange gaskets.

High Frequency Vibration

Vibration may indicate turbo rotor imbalance. Have your dealer investigate this immediately. If you detect any deficiencies, take the vehicle to an authorized dealer for servicing. Delay could lead to severe and expensive damage to your vehicle.

7.9 Exhaust System

The exhaust system is part of the noise and emission control system. Periodically check the exhaust system for wear, exhaust leaks, and loose or missing parts. For details on how to maintain the emissions components in the exhaust system, see "Noise and Emission Control" in your vehicle operator's manual. Please refer to the engine operator's manual for more details on how to maintain the emissions components in the exhaust system.

If your vehicle is equipped with a 48 V generator, please refer to Engine Aftertreatment System Operator's Manual for more details.

7.10 Charging - Cranking System

ELECTRICAL HARNESS / CABLES

Perform these maintenance procedures according to the Preventative Maintenance Schedule.

1. Check the following electrical components:
 - Inspect for loose connections, corrosion, chafing, and broken retention clips

BATTERIES, CABLES, AND CONNECTIONS

Perform these maintenance procedures according to the Preventative Maintenance Schedule.

1. Check the following electrical components:
 - Condition – electrolyte level,

cracks, signs of leaking, overcharging

- Hold-downs – tightness
- Battery box mounting bolt – torque

7.11 Crankshaft - Vibration Damper

Perform these maintenance procedures according to the Preventative Maintenance Schedule.

1. Inspect for cracks, nicks, or other physical damage.
2. Inspect for loose or missing fasteners.
3. For rubber dampers, inspect for damage to the rubber ring.
4. For viscous dampers, inspect for leaks.

7.12 Engine Mounting Bolts

Perform these maintenance procedures when indicated by the Preventative Maintenance Schedule. Check for the following:

- Inspect both mount and leg fasteners.

Check for loose or broken bolts. Replace as necessary.

- Check mount and leg for fractures, breaks or deformation. Replace as necessary.
- Check for complete insertion of engine mount. Replace as necessary.

CAUTION

DO NOT retorque or reuse existing flange head bolts. These bolts are factory set to the specified torque. If bolts are loose or damaged, they must be replaced with new bolts. Failure to comply may result in equipment or property damage.

7.13 Engine Valves

NOTE

Adjusting your engines valves is a complex task that requires specialized tools and training. Please inquire with an authorized PAC-CAR dealer or service provider about this procedure.

Have the valve clearance maintenance procedures done according to the following intervals.

Table 8: Engine Valve Adjust Intervals

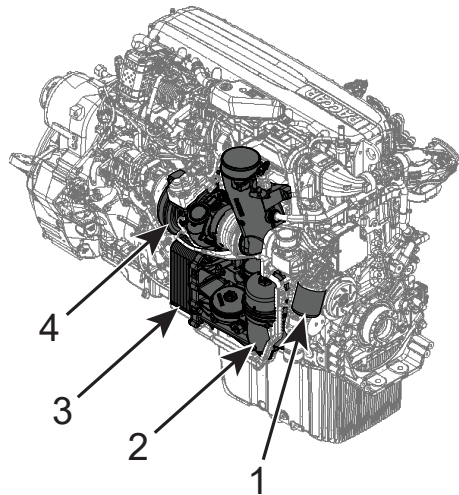
	Vehicle Application	Interval
Valve Adjust Interval	Normal Duty (Line Haul) - less than 20% idle time	Initial adjust at 150,000 mi (240,000 km, 6,750 hours), at 450,000 mi (725,000 km, 13,500 hours), then every 300,000 mi (480,000 km) thereafter
	Normal Duty (Line Haul) - more than 20% idle time	
	Severe Duty (Vocational) ¹	Initial adjust at 60,000 mi (96,000 km, 1,600 hours), at 360,000 mi (576,000 km, 9,600 hours), then every 300,000 mi (480,000 km) thereafter
	Pick-up/Delivery/Refuse	

¹ Vocational vehicle applications include: Agriculture, Concrete Mixers, Construction, Crane, Dumps, Emergency/Fire, Heavy Equipment, Loggers, Mining, Oil Field, Snowplows, and Wrecker.

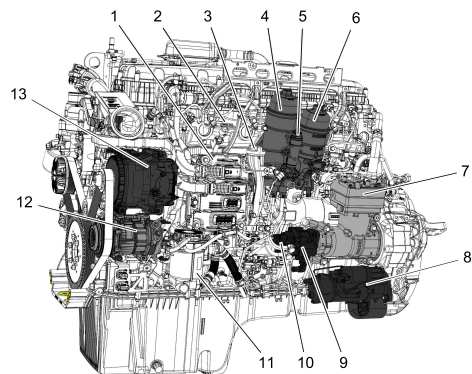
8 ENGINE IDENTIFICATION

8.1 Component Locations

Table 9: Engine - Right Side



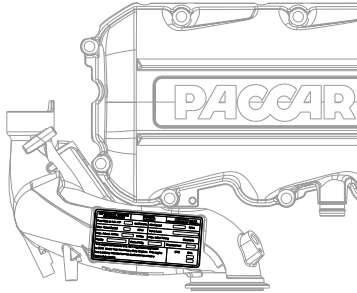
1. Coolant filter
2. Full-flow oil filter
3. Oil cooler
4. Turbo Charger

Table 10: Engine - Left Side

1. Electronic Control Module (ECM)
2. Dipstick
3. Oil fill
4. Secondary fuel filter housing
5. Fuel priming pump
6. Primary fuel filter housing
7. Air Compressor - Brakes
8. Starter
9. Power Steering Pump
10. Low pressure fuel pump
11. Open crankcase ventilation module
12. A/C compressor
13. Alternator

8.2 Engine Label

The Engine label provides important facts about the engine. This label is located on top of the engine valve cover or on the mixer manifold. The engine label must not be changed unless approved by PACCAR.

PACCAR MX Engine Label Location

The engine label provides many details regarding the engine. Some facts that are found on the EPA label include the following:

- Fuel rate
- Idle speed
- Maximum rated speed
- Valve lash
- Maximum power rating
- Date of manufacture
- Engine displacement

MX engine label. Data will match engine optioned.

IMPORTANT ENGINE INFORMATION		Engine No. XXXXXXX		MANUFACTURED BY DACOR MX-00	
Fuel Rate at Adv. HP	XXX.X mm³/stroke	Idle Speed	600 - 600 RPM		
Rated Speed at Adv. HP	1000 RPM	Valve Lash (mm)	0.40 Int. 0.65 exh.		
Max. Advert. kW/hp	XXX/XXX kW/hp	Initial Injection Timing	Electronic		
Family	Date of Mfg. mm / yyyy	Displacement	NR		
This legacy engine is certified under the provisions of 18 CCR1005.1(a)(2)(C) applicable to 2011 model year. This engine conforms to US EPA and California regulations applicable to 2011 Model Year New Heavy-Duty Diesel Engines. This engine has primary intended service applications on heavy legacy-duty engines. This engine certified to operate on ultra-low sulfur diesel fuel only. Exhaust Aftertreatment Control System: DOLTC, CAC, BOM, EGR, C-OC, BCR, APT, CCMOX 2418004			EPA STD	CARB FEL	
			NOx	XX	XX
			PM	XX	XX

1. Engine serial number
2. Engine manufacturer
3. Emissions applicability:

Legacy Engine Definition: The legacy provision was added to certify HDDE's to the current, less stringent, federal exhaust emission standard.

NR: CA: Engine with federal exhaust emissions standard approved for sale in California

NR: MA: Engine with federal exhaust emissions standard approved for sale in Massachusetts

NR: OR : Engine with federal exhaust emissions standard approved for sale in Oregon

NR: - : Engine with federal exhaust emissions standard approved for sale in the United States, other than in the states of California, Oregon, or Massachusetts

4. Date the engine was manufactured
5. Statement identifying the specific emissions regulations the engine is compliant with. This statement will vary depending on the specific emissions compliance of the engine.
6. Engine family.
7. Emission Limits for Engine Optioned.
8. Liter Specification (11 or 13).

CHAPTER 3: ENGINE WARRANTY

1	United States and Canada Engine Warranty.....	98
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1 UNITED STATES AND CANADA ENGINE WARRANTY

1.1 Engine Warranty for Standard Duty Applications

ENGINE WARRANTY FOR STANDARD DUTY APPLICATIONS

Products Warranted

This warranty applies to new MX-13 engines sold and used in the United States (includes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico, and the U.S. Virgin Islands) or Canada and operated in on-highway applications with one exception – there is different warranty coverage for engines used in the fire apparatus truck applications.

The MX-13 engine is warranted directly to the first purchaser or first lessee by PACCAR.

Base Engine Warranty

This warranty covers any failures of the engine which result, under normal use and service, from a defect in material or factory workmanship (warrantable failure). This coverage begins on the date of delivery and ends two years or 250,000 miles (400,000 kilometers) or 6,250 hours, whichever occurs first, after the date of delivery of the engine to the first purchaser or first lessee.

Additional coverage is outlined in Emissions Systems Warranties.

MAJOR ENGINE COMPONENTS WARRANTY

There is an Engine Warranty period of 60 months, 500,000 miles (800,000 kilometers) or 12,500 hours, whichever occurs first, after the date of delivery of the engine to the first purchaser or first lessee for the following engine parts:

- Cam Follower Assemblies
- Camshaft
- Camshaft Gear
- Camshaft Idle Gear
- Connecting Rod Assemblies
- Crankshaft

- Crankshaft Gear
- Cylinder Block Casting
- Cylinder Head Bolts
- Cylinder Head Casting
- Flywheel Housing
- Lube Pump Gear
- Main Bearing Bolts
- Thermostat Housing
- Water Pump Housing

PACCAR AND OWNER RESPONSIBILITIES

PACCAR Responsibilities

PACCAR will pay for all parts and labor needed to repair the damage to the engine resulting from a warrantable failure.

PACCAR will pay for the lubricating oil, antifreeze, filter elements, belts, hoses, and other maintenance items that are not reusable due to the warrantable failure.

PACCAR will pay for reasonable labor costs for engine removal and reinstallation when necessary to repair a warrantable failure.

PACCAR will pay during the base engine warranty period; reasonable costs for towing a vehicle disabled by a warrantable failure to the nearest authorized repair loca-

tion. In lieu of the towing expense and in its sole discretion, PACCAR may pay reasonable costs for a mechanic to travel to and from the location of the vehicle when an engine repair is performed at the site of the failure.

Owner Responsibilities

You are responsible for the operation and maintenance of the engine as specified in the applicable PACCAR Operator's Manual. You are responsible for ensuring that all manufacturer campaigns and federal recalls related to the Vehicle are complete. You are also responsible for providing proof that all recommended maintenance has been performed. This includes, but is not limited to, routine service checks, oil changes, tire rotations, and any other preventative maintenance tasks specified in the operator/owners manuals. Failure to provide preventative maintenance documentation may affect the validity of the warranty. PACCAR reserves the right to require proof of compliance with maintenance requirements before processing a claim. Inadequate or missing documentation may result in denial of warranty coverage for repair or services related to the Vehicle.

Before the expiration of the applicable warranty, you must notify a PACCAR authorized engine dealer of any warrantable failure and make the engine available for repair by such facility. The warrantable failure must be brought to the attention of a PACCAR authorized engine dealer within 30 days of discovery. Except for engines disabled by a warrantable failure, you must also deliver the engine to the repair facility.

You are responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items provided during warranty repairs unless such items are not reusable due to the warrantable failure. You are responsible for communication expenses, meals, lodging and similar costs incurred as a result of a warrantable failure. You are responsible for non-engine repairs and for "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs and other losses resulting from a warrantable failure.

WARRANTY LIMITATIONS - STANDARD DUTY APPLICATIONS

Your sole and exclusive remedy against PACCAR and the selling dealer arising from your purchase and use of this engine is limited to the repair or replacement

of "warrantable failures" at authorized United States and Canadian PACCAR engine dealers, or an authorized PACCAR engine facility where applicable, subject to PACCAR's time, mileage, and hour limitations of the engine warranty. The maximum time, mileage and hour limitations of the engine warranty begin running on the date of delivery to the first purchaser or first lessee. The accrued time, mileage, or hours is calculated when the engine is brought into an authorized dealer for correction of warrantable failures.

Failures, other than those resulting from defects in material or factory workmanship, are not covered by this warranty. PACCAR is not responsible for failures or damage resulting from what PACCAR determines to be abuse or neglect, including, but not limited to: damage due to accident; operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; failure to perform regeneration in a timely manner; unauthorized modifications of the engine. PACCAR is also not responsible for failures caused by incorrect oil or fuel or diesel exhaust fluid or by water, dirt or other contaminants in the fuel, oil, or diesel exhaust

fluid. Failure of replacement parts used in repairs due to the above non-warrantable conditions is not warrantable.

This warranty does not apply to accessories supplied by the vehicle original equipment manufacturer (OEM) which are covered by the OEM vehicle warranty.

Failures resulting in excessive oil consumption are covered for the duration of the coverage or 250,000 miles (400,000 kilometers) or 6,250 hours from the date of delivery of the engine to the first purchaser or first lessee, whichever occurs first. Before a claim for excessive oil consumption will be considered, the owner must submit adequate documentation to show that consumption exceeds PACCAR published standards.

Failures of belts supplied by PACCAR are covered for the first 90 days/25,000 miles from the date of delivery of the engine to the first purchaser or first lessee.

Parts used to repair a warrantable failure may be new parts, approved rebuilt parts, or repaired parts. PACCAR is not responsible for failures resulting from the use of parts not approved by PACCAR. A new approved or rebuilt part used to repair a warrantable failure assumes the identity of the part it replaced and is entitled to the remaining coverage hereunder.

PACCAR is not responsible for damage or loss resulting from engine horsepower/torque upgrades.

PACCAR reserves the right to interrogate electronic control module (ECM) data for purposes of failure analysis.

PACCAR does not warrant antifreeze, lubricants, filters, filter elements, or any other part which is considered a maintenance item. PACCAR does not warrant services to remove ash from the DPF either at or before a regular service interval as indicated in the maintenance schedule or when the system indicates that the DPF requires cleaning unless the service is required as part of a warrantable repair.

PACCAR DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

THIS WARRANTY AND THE EMISSION WARRANTY SET FORTH HEREINAFTER ARE THE SOLE WARRANTIES MADE BY PACCAR IN REGARD TO THESE ENGINES.

THIS LIMITED WARRANTY IS THE SOLE WARRANTY MADE BY PACCAR AND THE SELLING DEALER. EXCEPT FOR THE ABOVE LIMITED WARRANTY, PACCAR AND THE SELLING DEALER MAKE NO OTHER WARRANTIES, EXPRESS OR IMPLIED. PACCAR AND THE SELLING DEALER EXPRESSLY

DISCLAIM ANY WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

PACCAR AND THE SELLING DEALER SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO: LOSS OF INCOME OR LOST PROFITS; ENGINE OR VEHICLE DOWNTIME; THIRD PARTY DAMAGE, INCLUDING DAMAGE OR LOSS TO OTHER ENGINES, VEHICLES OR PROPERTY, ATTACHMENTS, TRAILERS AND CARGO; LOSS OR DAMAGE TO PERSONAL CONTENTS; COMMUNICATION EXPENSES; LODGING AND/OR MEAL EXPENSES; FINES; APPLICABLE TAXES OR BUSINESS COSTS OR LOSSES; ATTORNEYS' FEES; AND ANY LIABILITY YOU MAY HAVE IN RESPECT TO ANY OTHER PERSON OR ENTITY.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

1.2 Engine Warranty for Fire Apparatus Truck Applications

ENGINE WARRANTY FOR FIRE APPARATUS TRUCK APPLICATIONS

This warranty applies to new MX-13 engines sold and used in the United States (includes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico, and the U.S. Virgin Islands) or Canada and operated in fire apparatus truck applications.

The MX-13 engine is warranted directly to the first purchaser or first lessee by PACCAR.

Base Engine Warranty

The base engine warranty covers any failures of the engine which result, under normal use and service, from a defect in material or factory workmanship (warrantable failure). This coverage begins on the date of delivery to the first purchaser or first lessee and ends after five years or 100,000 miles (160,000 kilometers), whichever occurs first.

PACCAR AND OWNER RESPONSIBILITIES

PACCAR Responsibilities

PACCAR will pay for all parts and labor needed to repair the damage to the engine resulting from a warrantable failure.

PACCAR will pay for the lubricating oil, antifreeze, filter elements, belts, hoses, and other maintenance items that are not reusable due to the warrantable failure.

PACCAR will pay for reasonable labor costs for engine removal and reinstallation when necessary to repair a warrantable failure.

PACCAR will pay during the base engine warranty period; reasonable costs for towing a vehicle disabled by a warrantable failure to the nearest authorized repair location. In lieu of the towing expense and in its sole discretion, PACCAR may pay reasonable costs for a mechanic to travel to and from the location of the vehicle when an engine repair is performed at the site of the failure.

Owner Responsibilities

You are responsible for the operation and maintenance of the engine as specified in the applicable PACCAR Operator's Manual. You are responsible for ensuring that

all manufacturer campaigns and federal recalls related to the Vehicle are complete. You are also responsible for providing proof that all recommended maintenance has been performed. This includes, but is not limited to, routine service checks, oil changes, tire rotations, and any other preventative maintenance tasks specified in the operator/owners manuals. Failure to provide preventative maintenance documentation may affect the validity of the warranty. PACCAR reserves the right to require proof of compliance with maintenance requirements before processing a claim. Inadequate or missing documentation may result in denial of warranty coverage for repair or services related to the Vehicle.

Before the expiration of the applicable warranty, you must notify a PACCAR authorized engine dealer of any warrantable failure and make the engine available for repair by such facility. The warrantable failure must be brought to the attention of a PACCAR authorized engine dealer within 30 days of discovery. Except for engines disabled by a warrantable failure, you must also deliver the engine to the repair facility.

You are responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items provided during warranty repairs unless such items are not

reusable due to the warrantable failure. You are responsible for communication expenses, meals, lodging and similar costs incurred as a result of a warrantable failure. You are responsible for non-engine repairs and for "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs and other losses resulting from a warrantable failure.

WARRANTY LIMITATIONS - FIRE TRUCK

Your sole and exclusive remedy against PACCAR and the selling dealer arising from your purchase and use of this engine is limited to the repair or replacement of "warrantable failures" at authorized United States and Canadian PACCAR engine dealers, or an authorized PACCAR engine facility where applicable, subject to PACCAR's time, mileage, and hour limitations of the engine warranty. The maximum time, mileage and hour limitations of the engine warranty begin running on the date of delivery to the first purchaser or first lessee. The accrued time, mileage, or hours is calculated when the engine is brought into an authorized dealer for correction of warrantable failures.

Failures, other than those resulting from defects in material or factory workmanship, are not covered by this warranty. PACCAR is not responsible for failures or damage resulting from what PACCAR determines to be abuse or neglect, including, but not limited to: damage due to accident; operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; failure to perform regeneration in a timely manner; unauthorized modifications of the engine. PACCAR is also not responsible for failures caused by incorrect oil or fuel or diesel exhaust fluid or by water, dirt or other contaminants in the fuel, oil, or diesel exhaust fluid. Failure of replacement parts used in repairs due to the above non-warrantable conditions is not warrantable.

This warranty does not apply to accessories supplied by the vehicle original equipment manufacturer (OEM) which are covered by the OEM vehicle warranty.

Failures resulting in excessive oil consumption are covered for the base engine warranty coverage from the date of delivery of the engine to the first purchaser or first lessee. Before a claim for excessive oil consumption will be considered, the owner

must submit adequate documentation to show that consumption exceeds PACCAR published standards.

Failures of belts supplied by PACCAR are covered for the first 90 days/25,000 miles from the date of delivery of the engine to the first purchaser or first lessee.

Parts used to repair a warrantable failure may be new parts, approved rebuilt parts, or repaired parts. PACCAR is not responsible for failures resulting from the use of parts not approved by PACCAR. A new approved or rebuilt part used to repair a warrantable failure assumes the identity of the part it replaced and is entitled to the remaining coverage hereunder.

PACCAR is not responsible for damage or loss resulting from engine horsepower/torque upgrades.

PACCAR reserves the right to interrogate electronic control module (ECM) data for purposes of failure analysis.

PACCAR does not warrant antifreeze, lubricants, filters, filter elements, or any other part which is considered a maintenance item. PACCAR does not warrant services to remove ash from the DPF either at or before a regular service interval as indicated in the maintenance schedule or when

the system indicates that the DPF requires cleaning unless the service is required as part of a warrantable repair.

PACCAR DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

THIS WARRANTY AND THE EMISSION WARRANTY SET FORTH HEREINAFTER ARE THE SOLE WARRANTIES MADE BY PACCAR IN REGARD TO THESE ENGINES.

THIS LIMITED WARRANTY IS THE SOLE WARRANTY MADE BY PACCAR AND THE SELLING DEALER. EXCEPT FOR THE ABOVE LIMITED WARRANTY, PACCAR AND THE SELLING DEALER MAKE NO OTHER WARRANTIES, EXPRESS OR IMPLIED. PACCAR AND THE SELLING DEALER EXPRESSLY DISCLAIM ANY WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. PACCAR AND THE SELLING DEALER SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO: LOSS OF INCOME OR LOST PROFITS; ENGINE OR VEHICLE DOWNTIME; THIRD PARTY DAMAGE, INCLUDING DAMAGE OR LOSS TO OTHER ENGINES, VEHICLES OR PROPERTY, ATTACHMENTS, TRAILERS AND CARGO; LOSS OR DAMAGE TO

PERSONAL CONTENTS; COMMUNICATION EXPENSES; LODGING AND/OR MEAL EXPENSES; FINES; APPLICABLE TAXES OR BUSINESS COSTS OR LOSSES; ATTORNEYS' FEES; AND ANY LIABILITY YOU MAY HAVE IN RESPECT TO ANY OTHER PERSON OR ENTITY.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

1.3 Emissions Systems Warranties

EMISSIONS SYSTEMS WARRANTIES

The following emissions system warranties apply to new PACCAR engines marketed by PACCAR that are used in the United States (includes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico, and the U.S. Virgin Islands) and Canada in vehicles designed for transporting persons or property on a street or highway.

Your coverage differs by emissions certification

The emission system warranty applicable to your vehicle will vary depending upon which emissions certification was optioned at the time of purchase (PACCAR 50-State, CARB Low NOx, or CARB Legacy). The equipment and maintenance required to meet the differing regulation sets will vary accordingly, and with them - your warranty. The three regulatory standards the states apply are

- Legacy engines
- the California Air Resources Board (CARB)
- the Federal Environmental Protection Agency (EPA)

i NOTE

Legacy engines are a provision intended to provide short term flexibilities for manufacturers to certify Heavy Duty Diesel Engines to the current less stringent federal exhaust emission standard for NOx and PM. The engine ID label will indicate which emissions regulation the engine is in compliance with (PACCAR 50-State, CARB Low NOx, or CARB Legacy).

Note that the CARB standard contains all laws and regulations encompassed within the EPA standard as well.

Base Emissions Warranty Limits			
Model Year	2026	2026	2026
Engine Model	MX-13	MX-13	MX-13
Family	TPCRH1 2.9C01	TPCRH1 2.9C21	TPCRH1 2.9M21
Scope	(CARB + EPA) Low Nox	(CARB + EPA) Legacy	(CARB + EPA) PACCAR 50-State
Emission Warranty	5 years / 350,000 MI / 560,000 KM	5 years / 350,000 MI / 560,000 KM	5 years / 100,000 MI / 160,000 KM

Coverage - EPA and Canada

PACCAR warrants to the first purchaser or first lessee and each subsequent purchaser that the engine is designed, built and equipped so as to conform at the time of sale by PACCAR with all U.S. Federal emission regulations applicable at the time of manufacture and that it is free from

defects in material or factory workmanship which would cause it not to meet these regulations within the longer of the following periods: (A) Five years or 100,000 miles (160,000 kilometers) of operation, whichever occurs first, as measured from the date of delivery of the engine to the first purchaser or first lessee or (B) The base engine warranty.

If the vehicle in which the engine is installed is registered in the state of California, a separate California Emissions Control Warranty Statement also applies. See California Emissions Warranty.

REPLACING EMISSIONS RELATED PARTS

PACCAR recommends that any service parts used for maintenance, repair, or replacement of emission control systems be new or genuine-approved rebuilt parts and assemblies, and that the engine be serviced by an authorized PACCAR engine dealer. Your vehicle contains air, fuel, and electrical components that may affect engine emission controls. The use of non-genuine aftermarket parts, auxiliary devices or consumables (such as filters, oils, catalysts, additives, and fuels) may result in failures, which will not be covered under the manufacturer's warranty. PACCAR

does not evaluate all aftermarket auxiliary devices, accessories or consumables promoted by other manufacturers and their effect on PACCAR Products. Customers who use such items assume ALL risks related to the effects that result from this usage.

WARRANTY LIMITATIONS - EMISSIONS

Your sole and exclusive remedy against PACCAR and the selling dealer arising from your purchase and use of this engine is limited to the repair or replacement of "warrantable failures" at authorized United States and Canadian PACCAR engine dealers, or an authorized PACCAR engine facility where applicable, subject to PACCAR's time, mileage, and hour limitations of the engine warranty. The maximum time, mileage and hour limitations of the engine warranty begin running on the date of delivery to the first purchaser or first lessee. The accrued time, mileage, or hours is calculated when the engine is brought into an authorized dealer for correction of warrantable failures.

Failures, other than those resulting from defects in material or factory workmanship, are not covered by this warranty. PACCAR is not responsible for failures or damage

resulting from what PACCAR determines to be abuse or neglect, including, but not limited to: damage due to accident; operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; failure to perform regeneration in a timely manner; unauthorized modifications of the engine. PACCAR is also not responsible for failures caused by incorrect oil or fuel or diesel exhaust fluid or by water, dirt or other contaminants in the fuel, oil, or diesel exhaust fluid. Failure of replacement parts used in repairs due to the above non-warrantable conditions is not warrantable.

PACCAR is not responsible for non-engine repairs, downtime expenses, cargo damage, fines, all applicable taxes, all business costs or other losses resulting from a warrantable failure.

PACCAR does not warrant antifreeze, lubricants, filters, filter elements, or any other part which is considered a maintenance item. PACCAR does not warrant services to remove ash from the DPF either at or before a regular service interval as indicated in the maintenance schedule or when the system indicates that the DPF requires cleaning unless the service is required as part of a warrantable repair.

THIS LIMITED EMISSION WARRANTY IS THE SOLE WARRANTY MADE BY PACCAR RELATING TO THE EMISSION EQUIPMENT. EXCEPT FOR THE ABOVE LIMITED WARRANTY, PACCAR MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED. PACCAR EXPRESSLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. PACCAR AND THE SELLING DEALER SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO: LOSS OF INCOME OR LOST PROFITS; ENGINE OR VEHICLE DOWNTIME; THIRD PARTY DAMAGE, INCLUDING DAMAGE OR LOSS TO OTHER ENGINES, VEHICLES OR PROPERTY, ATTACHMENTS, TRAILERS AND CARGO; LOSS OR DAMAGE TO PERSONAL CONTENTS; COMMUNICATION EXPENSES; LODGING AND/OR MEAL EXPENSES; FINES; APPLICABLE TAXES OR BUSINESS COSTS OR LOSSES; ATTORNEYS' FEES; AND ANY LIABILITY YOU MAY HAVE IN RESPECT TO ANY OTHER PERSON OR ENTITY.

1.4 California Emissions Control Warranty Statement

Your Warranty Rights and Obligations

The California Air Resources Board and PACCAR are pleased to explain the emission control system warranty on your 2026 model year diesel engine. In California, new motor-vehicle engines must be designed, built, and equipped to meet the State's stringent anti-smog standards. PACCAR must warrant the emission control system on your diesel engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your diesel engine.

Your emission control system may include parts such as the carburetor or fuel-injection system, the ignition system, catalytic converter, and engine computer. Also included may be hoses, belts, connectors and other emission-related assemblies. Where a warrantable condition exists, PACCAR will repair your emissions system at no cost to you including diagnosis, parts and labor.

Emissions coverage for on-highway applications in the State of California

This emission control system warranty applies to diesel engines (hereafter, engines) certified with the California Air Resources Board beginning with the year 2013, marketed by PACCAR, and registered in California for use in on-highway applications.

Manufacturer's Warranty Coverage

This warranty coverage is provided for five years or 350,000 mi (560,000 km) for Low NOx and Legacy engines, and five years or 100,000 mi (160,000 km) for PACCAR 50-State engines, whichever occurs first from the date of delivery of the engine to the first purchaser or lessee. Where a warrantable condition exists, PACCAR will repair your engine at no cost to you including diagnosis, parts, and labor.

Owner's Warranty Responsibilities

As the engine owner, you are responsible for the performance of the required maintenance listed in your PACCAR operator's manual. You are responsible for presenting your engine to an authorized PACCAR engine dealer as soon as a problem exists. The warranty repairs should be completed in a reasonable amount of time, not to exceed 30 days.

PACCAR recommends you retain all maintenance and service receipts.

As the engine owner, you should also be aware that PACCAR may deny you warranty coverage if your engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

If you have any questions regarding your warranty rights and responsibilities, you should contact Kenworth Truck Company 1-425-828-5000, Peterbilt Motor Company at 1-940-591-4220, or the California Air Resources Board at:

California Air Resources Board, 4001
Iowa Avenue, Riverside, CA 92507

A warranted part which is scheduled for replacement as required maintenance is warranted up to the first scheduled replacement point.

Prior to the expiration of the applicable warranty, the owner must give notice of any warranted emission control failure to an authorized PACCAR engine dealer and deliver the engine to such facility for repair.

The owner is responsible for incidental costs such as: communication expenses, meals, lodging incurred by owner or employees of owner as a result of a warrantable condition.

The owner is responsible for downtime expenses, cargo damage, fines, all applicable taxes, all business costs, and other losses resulting from a warrantable condition.

1.5 Replacement Parts

PACCAR recommends that any service parts used for maintenance, repair or replacement of emission control systems be new or genuine PACCAR approved rebuilt parts and assemblies, and that the engine be serviced by an authorized PACCAR engine dealer. Your vehicle contains air, fuel, and electrical components that may affect engine emission controls. The use of non-genuine engine or vehicle replacement parts that are not equivalent to the PACCAR engine or OEM vehicle manufacturer's original part may impair the engine and vehicle emissions control system from working or functioning effectively, and may jeopardize your emissions warranty coverage.

The owner may elect to have maintenance, replacement or repair of the emission control parts performed by a facility other than an authorized PACCAR engine dealer and may elect to use parts other than new or genuine approved rebuilt parts and assemblies for such maintenance, replacement

or repair; however, the cost of such service or parts and subsequent failures resulting from such service or parts will not be covered under this emission control system warranty, except for Emergency Repairs

1.6 PACCAR Responsibilities

The warranty coverage begins when the engine is delivered to the first purchaser or first lessee. Repairs and service will be performed by any authorized PACCAR engine dealer using new or genuine PACCAR approved rebuilt parts and assemblies. PACCAR will repair any of the emission control parts found by PACCAR to be defective without charge for parts or labor (including diagnosis which results in determination that there has been a failure of a warranted emission control part).

1.7 Emergency Repairs

In the case of an emergency where an authorized PACCAR engine dealer is not available, repairs may be performed by any available repair location or by any individual using any replacement parts. A part not being available within 30 days or a repair not being complete within 30 days consti-

tutes an emergency. PACCAR will reimburse the owner for expenses (including diagnosis), not to exceed the manufacturers suggested retail price for all warranted parts replaced and labor charges based on the manufacturers recommended time allowance for the warranty repair and the geographically appropriate hourly labor rate.

Replaced parts and paid invoices must be presented at an authorized PACCAR engine dealer as a condition of reimbursement for emergency repairs not performed by an authorized PACCAR engine dealer.

1.8 Warranty Limitations

Your sole and exclusive remedy against PACCAR and the selling dealer arising from your purchase and use of this engine is limited to the repair or replacement of "warrantable failures" at authorized United States and Canadian PACCAR engine dealers, or an authorized PACCAR engine facility where applicable, subject to PACCAR's time, mileage, and hour limitations of the engine warranty. The maximum time, mileage and hour limitations of the engine warranty begin running on the date of delivery to the first purchaser or first lessee. The accrued time, mileage,

or hours is calculated when the engine is brought into an authorized dealer for correction of warrantable failures.

Failures, other than those resulting from defects in material or factory workmanship, are not covered by this warranty. PACCAR is not responsible for failures or damage resulting from what PACCAR determines to be abuse or neglect, including, but not limited to: damage due to accident; operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; failure to perform regeneration in a timely manner; unauthorized modifications of the engine. PACCAR is also not responsible for failures caused by incorrect oil or fuel or diesel exhaust fluid or by water, dirt or other contaminants in the fuel, oil, or diesel exhaust fluid. Failure of replacement parts used in repairs due to the above non-warrantable conditions is not warrantable.

PACCAR is not responsible for failures resulting from improper repair or the use of parts which are not genuine PACCAR approved parts.

PACCAR is not responsible for the material and labor costs of emission control parts and assemblies replaced during Scheduled Maintenance of the engine as specified in PACCAR Operator's Manuals.

PACCAR does not warrant antifreeze, lubricants, filters, filter elements, or any other part which is considered a maintenance item. PACCAR does not warrant services to remove ash from the DPF either at or before a regular service interval as indicated in the maintenance schedule or when the system indicates that the DPF requires cleaning unless the service is required as part of a warrantable repair.

THIS WARRANTY, TOGETHER WITH THE EXPRESS COMMERCIAL WARRANTIES ARE THE SOLE WARRANTIES MADE BY PACCAR IN REGARD TO THESE ENGINES.

THIS LIMITED EMISSIONS WARRANTY IS THE SOLE WARRANTY MADE BY PACCAR AND THE SELLING DEALER. EXCEPT FOR THE ABOVE LIMITED WARRANTY, PACCAR AND THE SELLING DEALER MAKE NO OTHER WARRANTIES, EXPRESS OR IMPLIED. PACCAR AND THE SELLING DEALER EXPRESSLY DISCLAIM ANY WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

PACCAR AND THE SELLING DEALER SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO: LOSS OF INCOME OR LOST PROFITS; ENGINE OR VEHICLE DOWNTIME; THIRD PARTY DAMAGE, INCLUDING DAMAGE OR LOSS TO OTHER ENGINES, VEHICLES OR PROPERTY, ATTACHMENTS, TRAILERS AND CARGO; LOSS OR DAMAGE TO PERSONAL CONTENTS; COMMUNICATION EXPENSES; LODGING AND/OR MEAL EXPENSES; FINES; APPLICABLE TAXES OR BUSINESS COSTS OR LOSSES; ATTORNEYS' FEES; AND ANY LIABILITY YOU MAY HAVE IN RESPECT TO ANY OTHER PERSON OR ENTITY.

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WARNING

Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to www.P65warnings.ca.gov/diesel.

PACCAR_{inc}

P.O. Box 1518
Bellevue, WA 98009

Y53-1100-1F1