SEBU9077-02 (en-us)
February 2023

Perkins®

THE HEART OF EVERY GREAT MACHINE

# Operation and Maintenance Manual

## 4006-23 and 4008-30 Industrial Engines

# Important Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions correctly.

**Incorrect operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.**

**Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.**

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the “Safety Alert Symbol” and followed by a “Signal Word” such as “DANGER”, “WARNING” or “CAUTION”. The Safety Alert “WARNING” label is shown below.

**⚠ WARNING**

The meaning of this safety alert symbol is as follows:

**Attention! Become Alert! Your Safety is Involved.**

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

Operations that may cause product damage are identified by “NOTICE” labels on the product and in this publication.

**Perkins cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. You must not use this product in any manner different from that considered by this manual without first satisfying yourself that you have considered all safety rules and precautions applicable to the operation of the product in the location of use, including site-specific rules and precautions applicable to the worksite. If a tool, procedure, work method or operating technique that is not specifically recommended by Perkins is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that you are authorized to perform this work, and that the product will not be damaged or become unsafe by the operation, lubrication, maintenance or repair procedures that you intend to use.**

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job. Perkins dealers or Perkins distributors have the most current information available.

**⚠ WARNING**

**When replacement parts are required for this product Perkins recommends using Perkins replacement parts.**

**Failure to heed this warning can lead to premature failures, product damage, personal injury or death.**

**In the United States, the maintenance, replacement, or repair of the emission control devices and systems may be performed by any repair establishment or individual of the owner's choosing.**

# Table of Contents

# Foreword

## 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.**

**WARNING – This product can expose you to chemicals including ethylene glycol, which is known to the State of California to cause birth defects or other reproductive harm. For more information go to:**

**www.P65Warnings.ca.gov**

**Do not ingest this chemical. Wash hands after handling to avoid incidental ingestion.**

**WARNING – This product can expose you to chemicals including lead and lead compounds, which are known to the State of California to cause cancer, birth defects, or other reproductive harm. For more information go to:**

**www.P65Warnings.ca.gov**

**Wash hands after handling components that may contain lead.**

## Literature Information

This manual contains safety, operation instructions, lubrication, and maintenance information. This manual should be stored in or near the engine area in a literature holder or literature storage area. Read, study, and keep the manual with the literature and engine information.

English is the primary language for all Perkins publications. The English used facilitates translation and consistency.

Some photographs or illustrations in this manual show details or attachments that may be different from your engine. Guards and covers may have been removed for illustrative purposes. Continuing improvement and advancement of product design may have caused changes to your engine which are not included in this manual. Whenever a question arises regarding your engine, or this manual, please consult with your Perkins dealer or your Perkins distributor for the latest available information.

## Safety

This safety section lists basic safety precautions. In addition, this section identifies hazardous, warning situations. Read and understand the basic precautions listed in the safety section before operating or performing lubrication, maintenance, and repair on this product.

## Operation

Operating techniques outlined in this manual are basic. The operating techniques assist with developing the skills and techniques required to operate the engine more efficiently and economically. Skill and techniques develop as the operator gains knowledge of the engine and the capabilities of the engine.

The operation section is a reference for operators. Photographs and illustrations guide the operator through procedures of inspecting, starting, operating, and stopping the engine. This section also includes a discussion of electronic diagnostic information.

## Maintenance

The maintenance section is a guide to engine care. The illustrated, step-by-step instructions are grouped by service hours and/or calendar time maintenance intervals. Items in the maintenance schedule are referenced to detailed instructions that follow.

Recommended service should be performed at the appropriate intervals as indicated in the Maintenance Interval Schedule. The actual operating environment of the engine also governs the Maintenance Interval Schedule. Therefore, under severe, dusty, wet, or freezing cold operating conditions, more frequent lubrication, and maintenance than is specified in the Maintenance Interval Schedule may be necessary.

The maintenance schedule items are organized for a preventive maintenance management program. If the preventive maintenance program is followed, a periodic tune-up is not required. The implementation of a preventive maintenance management program should minimize operating costs through cost avoidances resulting from reductions in unscheduled downtime and failures.

## Maintenance Intervals

Perform maintenance on items at multiples of the original requirement. Each level and/or individual items in each level should be shifted ahead or back depending upon your specific maintenance practices, operation, and application. Perkins recommends that the maintenance schedules be reproduced and displayed near the engine as a convenient reminder. Perkins also recommends that a maintenance record be maintained as part of the permanent record of the engine.

Your authorized Perkins dealer or your Perkins distributor can assist you in adjusting your maintenance schedule to meet the needs of your operating environment.

## Overhaul

Major engine overhaul details are not covered in the Operation and Maintenance Manual except for the interval and the maintenance items in that interval. Major repairs are best left to trained personnel or an authorized Perkins distributor or dealer. Your Perkins dealer or your Perkins distributor offers various options regarding overhaul programs. If you experience a major engine failure, there are also numerous after failure overhaul options available. Consult with your Perkins dealer or your Perkins distributor for information regarding these options.

# Safety Section

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## Safety Messages

There may be several specific warning signs on your engine. The exact location and a description of the warning signs are reviewed in this section. Become familiar with all warning signs.

Ensure that all the warning signs are legible. Clean the warning signs or replace the warning signs if the words cannot be read or if the illustrations are not visible. Use a cloth, water, and soap to clean the warning signs. Do not use solvents, gasoline, or other harsh chemicals. Solvents, gasoline, or harsh chemicals could loosen the adhesive that secures the warning signs. The warning signs that are loosened could drop off the engine.

Replace any warning sign that is damaged or missing. If a warning sign is attached to a part of the engine that is replaced, install a new warning sign on the replacement part. Your Perkins distributor can provide new warning signs.

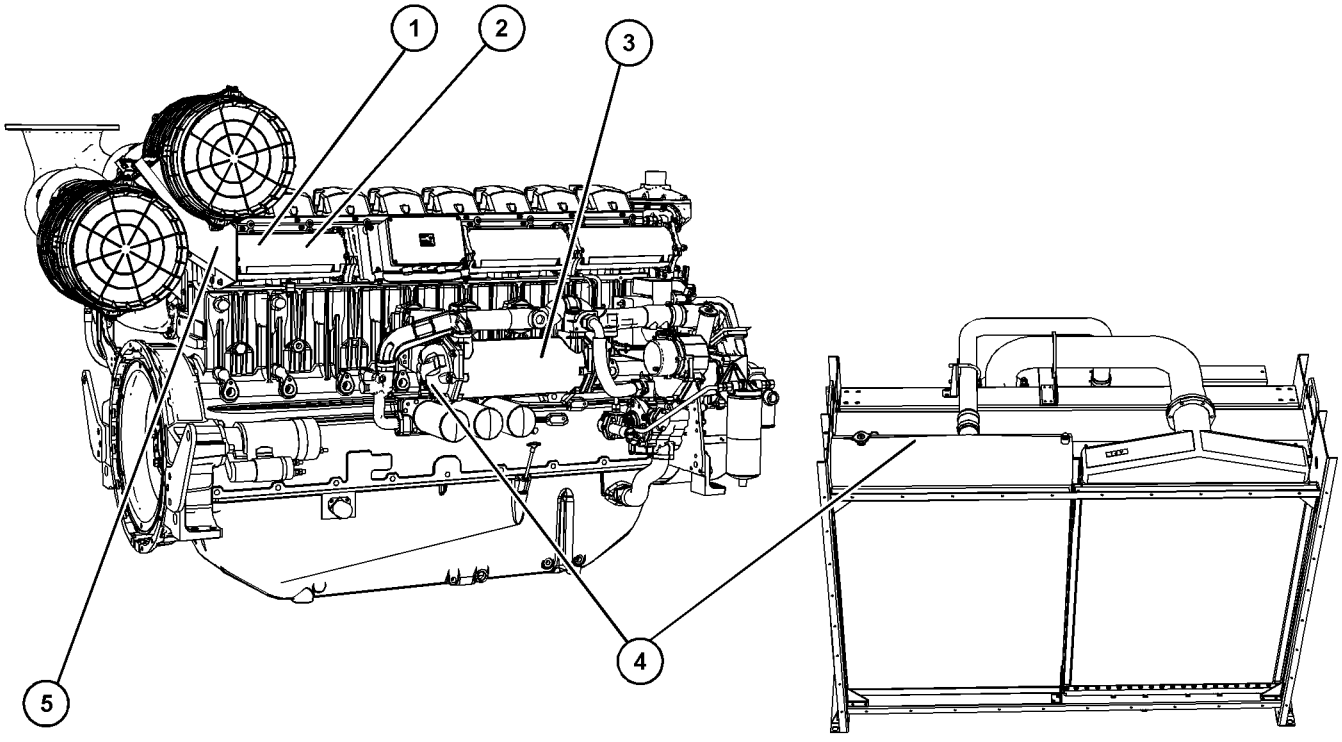


Illustration 1 g06086932

(1) Universal warning label locations
(2) Do not step
(3) Hot surface label location
(4) Hot fluid under pressure label locations
(5) Ether warning label location

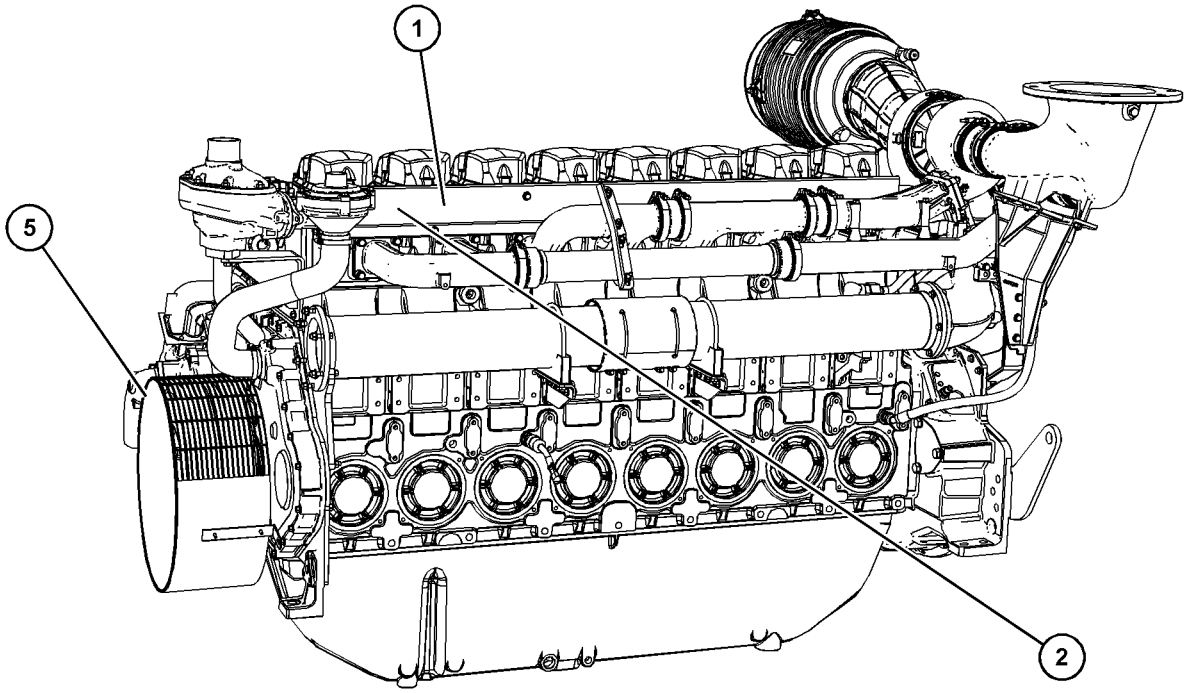


Illustration 2 g06093786

(1) Universal warning label location
(3) Hot surface label location
(6) Rotating shaft hand crush hazard label location

## 1 Universal Warning

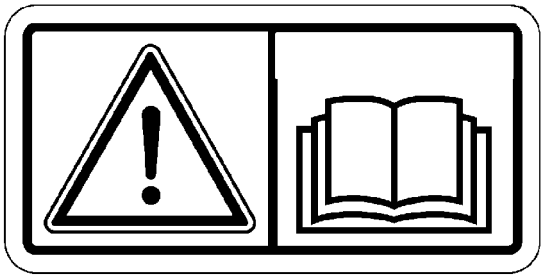

Illustration 3 g06019365

Universal Warning label

**⚠ WARNING**

**Do not operate or work on this equipment unless you have read and understand the instructions and warnings in the Operation and Maintenance Manuals. Failure to follow the instructions or heed the warnings could result in serious injury or death.**

The universal warning labels (1) are installed in two locations. One universal warning label is installed on the coolant rail. The other universal warning label is installed on the control box.

## 2 Do Not Step

This safety message is located in the center of the intake manifold.

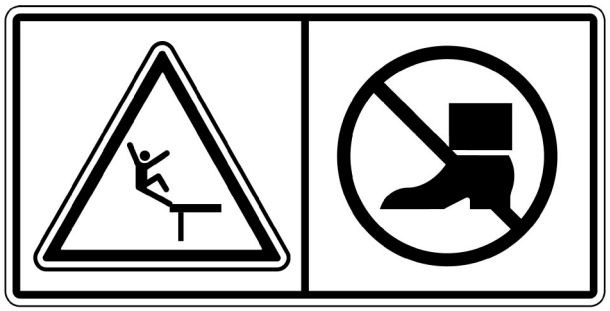

Illustration 4 g01393287

**⚠ WARNING**

**Do not use this surface as a step or platform. This surface may not support additional weight or may be slippery. Serious injury or death could occur from a fall.**

## 3 Hot Surface

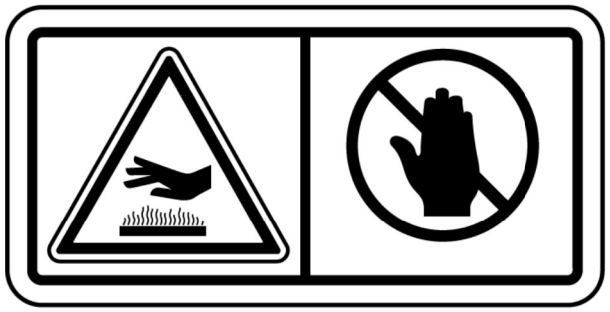

Illustration 5 g01372256

**⚠ WARNING**

**Hot parts or hot components can cause burns or personal injury. Do not allow hot parts or components to contact your skin. Use protective clothing or protective equipment to protect your skin.**

The hot surface warning labels (2) are located in two locations. The oil cooler and heat shield of the coolant rail.

## 4 Hot Fluid Under Pressure

Illustration 6 g01371640

**⚠ WARNING**

**Pressurized system! Hot coolant can cause serious burns, injury or death. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure. Read and understand the Operation and Maintenance Manual before performing any cooling system maintenance.**

The hot fluids under pressure labels (3) have two positions. One label is on the end cover of the oil cooler. Perkins recommends that the other hot fluid under pressure label is installed on the radiator, next to the coolant filler cap.

## 5 Ether Warning

Illustration 7 g01372254

**WARNING**

**Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.**

Ether warning label (4) is on the support bracket for the air cleaners.

## 6 Rotating Shaft Hand Crush Hazard

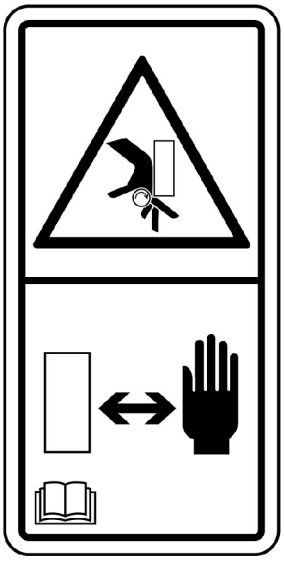

Illustration 8 g02781437

**WARNING**

**Rotating shaft pinch hazard. The shaft under this cover is rotating anytime the engine is running. Contact with a rotating shaft could cause injury or death. Keep hands away.**

The rotating shaft hand crush hazard label (5) is on the cover of the crankshaft vibration damper.

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# Additional Messages

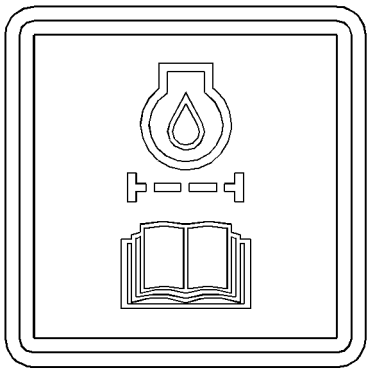

Illustration 9 g06249496

Typical example

The label will be installed on the engine oil cooler. A special starting procedure may be required. Refer to this Operation and Maintenance Manual, Before Starting Engine for the correct procedure.

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# General Hazard Information

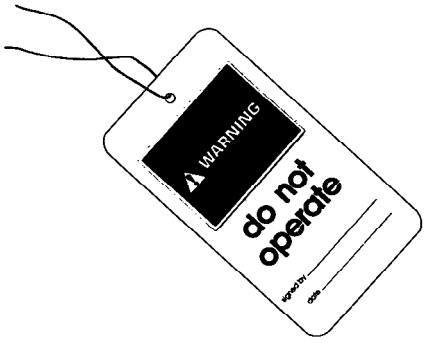


Illustration 10 g00104545

Attach a “Do Not Operate” warning tag or a similar warning tag to the start switch or to the controls before the engine is serviced or before the engine is repaired. Attach the warning tags to the engine and to each operator control station. When appropriate, disconnect the starting controls.

Do not allow unauthorized personnel on the engine, or around the engine when the engine is being serviced.

- Tampering with the engine installation or tampering with the OEM supplied wiring can be dangerous. Personal injury, death and/or engine damage could result.
- Vent the engine exhaust to the outside when the engine is operated in an enclosed area.
- If the engine is not running, do not release the secondary brake or the parking brake systems unless the vehicle is blocked or unless the vehicle is restrained.
- Wear a hard hat, protective glasses, and other protective equipment, as required.
- When work is performed around an engine that is operating, wear protective devices for ears in order to help prevent damage to hearing.
- Do not wear loose clothing or jewelry that can snag on controls or on other parts of the engine.
- Ensure that all protective guards and all covers are secured in place on the engine.
- Never put maintenance fluids into glass containers. Glass containers can break.
- Use all cleaning solutions with care.
- Report all necessary repairs.

Unless other instructions are provided, perform the maintenance under the following conditions:

- The engine is stopped. Ensure that the engine cannot be started.
- The protective locks or the controls are in the applied position.
- Engage the secondary brakes or parking brakes.
- Block the vehicle or restrain the vehicle before maintenance or repairs are performed.
- Disconnect the batteries when maintenance is performed or when the electrical system is serviced. Disconnect the battery ground leads. Tape the leads in order to help prevent sparks. If equipped, allow the diesel exhaust fluid to be purged before disconnecting the battery.
- If equipped, disconnect the connectors for the unit injectors that are located on the valve cover base. This action will help prevent personal injury from the high voltage to the unit injectors. Do not come in contact with the unit injector terminals while the engine is operating.

- Do not attempt any repairs or any adjustments to the engine while the engine is operating.
- Do not attempt any repairs that are not understood. Use the proper tools. Replace any equipment that is damaged or repair the equipment.
- For initial start-up of a new engine or for starting an engine that has been serviced, make provisions to stop the engine if an overspeed occurs. The stopping of the engine may be accomplished by shutting off the fuel supply and/or the air supply to the engine. Ensure that only the fuel supply line is shut off. Ensure that the fuel return line is open.
- Start the engine from the operators station (cab). Never short across the starting motor terminals or the batteries. This action could bypass the engine neutral start system and/or the electrical system could be damaged.

Engine exhaust contains products of combustion which may be harmful to your health. Always start the engine and operate the engine in a well ventilated area. If the engine is in an enclosed area, vent the engine exhaust to the outside.

Cautiously remove the following parts. To help prevent spraying or splashing of pressurized fluids, hold a rag over the part that is being removed.

- Filler caps
- Grease fittings
- Pressure taps
- Breathers
- Drain plugs

Use caution when cover plates are removed. Gradually loosen, but do not remove the last two bolts or nuts that are located at opposite ends of the cover plate or the device. Before removing the last two bolts or nuts, pry the cover loose in order to relieve any spring pressure or other pressure.

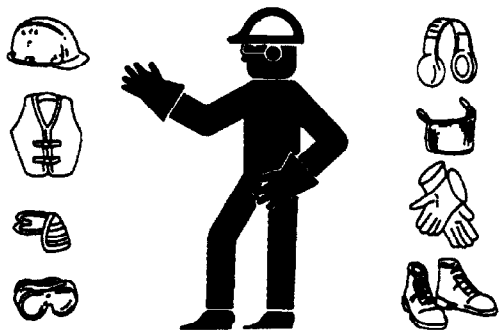

Illustration 11 g00702020

- Wear a hard hat, protective glasses, and other protective equipment, as required.
- When work is performed around an engine that is operating, wear protective devices for ears in order to help prevent damage to hearing.
- Do not wear loose clothing or jewelry that can snag on controls or on other parts of the engine.
- Ensure that all protective guards and all covers are secured in place on the engine.
- Never put maintenance fluids into glass containers. Glass containers can break.
- Use all cleaning solutions with care.
- Report all necessary repairs.

**Unless other instructions are provided, perform the maintenance under the following conditions:**

- The engine is stopped. Ensure that the engine cannot be started.
- Disconnect the batteries when maintenance is performed or when the electrical system is serviced. Disconnect the battery ground leads. Tape the leads in order to help prevent sparks.
- Do not attempt any repairs that are not understood. Use the proper tools. Replace any equipment that is damaged or repair the equipment.

## Pressurized Air and Water

Pressurized air and/or water can cause debris and/or hot water to be blown out. This action could result in personal injury.

When pressurized air and/or pressurized water is used for cleaning, wear protective clothing, protective shoes, and eye protection. Eye protection includes goggles or a protective face shield.

The maximum air pressure for cleaning purposes must be below 205 kPa (30 psi). The maximum water pressure for cleaning purposes must be below 275 kPa (40 psi).

## Fluid Penetration

Pressure can be trapped in the hydraulic circuit long after the engine has been stopped. The pressure can cause hydraulic fluid or items such as pipe plugs to escape rapidly if the pressure is not relieved correctly.

Do not remove any hydraulic components or parts until pressure has been relieved or personal injury may occur. Do not disassemble any hydraulic components or parts until pressure has been relieved or personal injury may occur. Refer to the OEM information for any procedures that are required to relieve the hydraulic pressure.

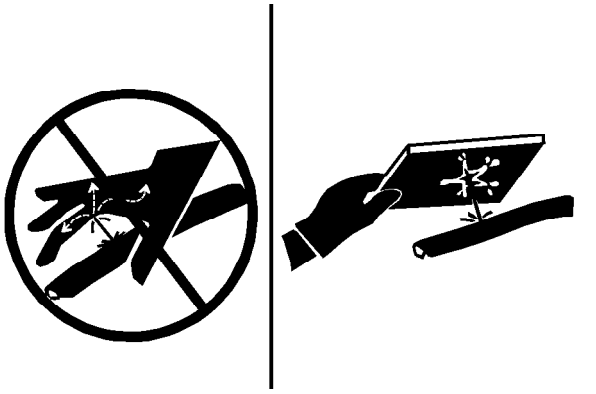

Illustration 12 g00687600

Always use a board or cardboard when you check for a leak. Leaking fluid that is under pressure can penetrate body tissue. Fluid penetration can cause serious injury and possible death. A pin hole leak can cause severe injury. If fluid is injected into your skin, you must get treatment immediately. Seek treatment from a doctor that is familiar with this type of injury.

## Containing Fluid Spillage

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

## Static Electricity Hazard when Fueling with Ultra-low Sulfur Diesel Fuel

The removal of sulfur and other compounds in ultra-low sulfur diesel fuel (ULSD fuel) decreases the conductivity of ULSD and increases the ability of ULSD to store static charge. Refineries may have treated the fuel with a static dissipating additive. Many factors can reduce the effectiveness of the additive over time. Static charges can build up in ULSD fuel while the fuel is flowing through fuel delivery systems. Static electricity discharge when combustible vapors are present could result in a fire or explosion. Ensure that the entire system used to refuel your machine (fuel supply tank, transfer pump, transfer hose, nozzle, and others) is properly grounded and bonded. Consult with your fuel or fuel system supplier to ensure that the delivery system complies with fueling standards for proper grounding and bonding.

**⚠ WARNING**

**Avoid static electricity risk when fueling. Ultra-low sulfur diesel fuel (ULSD fuel) poses a greater static ignition hazard than earlier diesel formulations with a higher sulfur contents. Avoid death or serious injury from fire or explosion. Consult with your fuel or fuel system supplier to ensure the delivery system is in compliance with fueling standards for proper grounding and bonding practices.**

## Inhalation

Illustration 13 g00702022

### Exhaust

Use caution. Exhaust fumes can be hazardous to health. If you operate the equipment in an enclosed area, adequate ventilation is necessary.

### Hexavalent Chromium

Perkins equipment and replacement parts comply with applicable regulations and requirements where originally sold. Perkins recommends the use of only genuine Perkins replacement parts.

Hexavalent chromium has occasionally been detected on exhaust and heat shield systems on Perkins engines. Although laboratory testing is the only accurate way to know if hexavalent chromium is, in fact, present, the presence of a yellow deposit in areas of high heat (for example, exhaust system components or exhaust insulation) may be an indication of the presence of hexavalent chromium.

Use caution if you suspect the presence of hexavalent chromium. Avoid skin contact when handling items that you suspect may contain hexavalent chromium, and avoid inhalation of any dust in the suspect area. Inhalation of, or skin contact with, hexavalent chromium dust may be hazardous to your health.

If such yellow deposits are found on the engine, engine component parts, or associated equipment or packages, Perkins recommends following local health and safety regulations and guidelines, utilizing good hygiene, and adhering to safe work practices when handling the equipment or parts. Perkins also recommends the following:

- Wear appropriate Personal Protective Equipment (PPE)
- Wash your hands and face with soap and water prior to eating, drinking, or smoking, and also during rest room breaks, to prevent ingestion of any yellow powder
- Never use compressed air for cleaning areas suspected of containing hexavalent chromium
- Avoid brushing, grinding, or cutting materials suspected of containing hexavalent chromium
- Obey environmental regulations for the disposal of all materials that may contain or have come into contact with hexavalent chromium
- Stay away from areas that might have hexavalent chromium particles in the air.

### Asbestos Information

Perkins equipment and replacement parts that are shipped from Perkins engine company limited are asbestos free. Perkins recommends the use of only genuine Perkins replacement parts. Use the following guidelines when you handle any replacement parts that contain asbestos or when you handle asbestos debris.

Use caution. Avoid inhaling dust that might be generated when you handle components that contain asbestos fibers. Inhaling this dust can be hazardous to your health. The components that may contain asbestos fibers are brake pads, brake bands, lining material, clutch plates, and some gaskets. The asbestos that is used in these components is usually bound in a resin or sealed in some way. Normal handling is not hazardous unless airborne dust that contains asbestos is generated.

If dust that may contain asbestos is present, there are several guidelines that should be followed:

- Never use compressed air for cleaning.
- Avoid brushing materials that contain asbestos.
- Avoid grinding materials that contain asbestos.
- Use a wet method in order to clean up asbestos materials.
- A vacuum cleaner that is equipped with a high efficiency particulate air filter (HEPA) can also be used.

- Use exhaust ventilation on permanent machining jobs.
- Wear an approved respirator if there is no other way to control the dust.
- Comply with applicable rules and regulations for the work place. In the United States, use Occupational Safety and Health Administration (OSHA) requirements. These OSHA requirements can be found in “29 CFR 1910.1001”.
- Obey environmental regulations for the disposal of asbestos.
- Stay away from areas that might have asbestos particles in the air.

## Dispose of Waste Properly

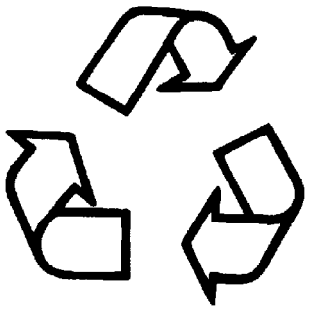

Illustration 14 g00706404

Improperly disposing of waste can threaten the environment. Potentially harmful fluids should be disposed of according to local regulations.

Always use leakproof containers when you drain fluids. Do not pour waste onto the ground, down a drain, or into any source of water.

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# Burn Prevention

## Coolant

When the engine is at operating temperature, the engine coolant is hot. The coolant is also under pressure. The radiator and all lines to the heaters or to the engine contain hot coolant. Any contact with hot coolant or with steam can cause severe burns. Allow cooling system components to cool before the cooling system is drained.

Check that the coolant level after the engine has stopped and the engine has been allowed to cool. Ensure that the filler cap is cool before removing the filler cap. The filler cap must be cool enough to touch with a bare hand. Remove the filler cap slowly to relieve pressure. Refer to this Operation and Maintenance Manual, Cooling System Coolant Level - Check for more information.

Cooling system conditioner contains alkali. Alkali can cause personal injury. Do not allow alkali to contact the skin, the eyes, or the mouth.

## Oils

Skin may be irritated following repeated or prolonged exposure to mineral and synthetic base oils. Refer to your suppliers Material Safety Data Sheets for detailed information. Hot oil and lubricating components can cause personal injury. Do not allow hot oil to contact the skin. Appropriate personal protective equipment should be used.

## Viton Seals

**⚠ WARNING**

**If Viton is burned, a product of this burnt material is an acid which is hazardous. Do not allow burnt material to come into contact with the skin or with the eyes. Use the appropriate set of Personal Protective Equipment to protect your skin and eyes. Failure to follow the instructions or heed the warning could result in serious injury or death.**

If there is need to come into contact with components which have been burnt, ensure that the precautions which follow are used:

- Ensure that the components have cooled.
- Use Neoprene gloves and discard the gloves safely after use.
- Wash the area with calcium hydroxide solution and then with clean water.
- Disposal of components and gloves which are contaminated must be in accordance with local regulations.

If there is contamination of the skin or eyes, wash the affected area with a continuous supply of clean water or with calcium hydroxide solution. Wash the area effected for 15 to 60 minutes and obtain immediate medical attention.

## Diesel Fuel

Diesel may be irritating to the eyes, respiratory system, and skin. Prolonged exposure to diesel may cause various skin conditions. Appropriate personal protective equipment should be used. Refer to supplier Material safety Data sheets for detailed information.

## Batteries

The liquid in a battery is an electrolyte. Electrolyte is an acid that can cause personal injury. Do not allow electrolyte to contact the skin or the eyes.

Do not smoke whilst checking the battery electrolyte levels. Batteries give off flammable fumes which can explode.

Always wear protective glasses when you work with batteries. Wash hands after touching batteries. The use of gloves is recommended.

i06545894

# Fire Prevention and Explosion Prevention

Illustration 15 g00704000

All fuels, most lubricants, and some coolant mixtures are flammable.

Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause a fire. Fire may cause personal injury and property damage.

After the emergency stop button is operated, ensure that you allow 15 minutes, before the engine covers are removed.

Determine whether the engine will be operated in an environment that allows combustible gases to be drawn into the air inlet system. These gases could cause the engine to overspeed. Personal injury, property damage, or engine damage could result.

If the application involves the presence of combustible gases, consult your Perkins dealer and/or your Perkins distributor for additional information about suitable protection devices.

Remove all flammable combustible materials or conductive materials such as fuel, oil, and debris from the engine. Do not allow any flammable combustible materials or conductive materials to accumulate on the engine.

Store fuels and lubricants in correctly marked containers away from unauthorized persons. Store oily rags and any flammable materials in protective containers. Do not smoke in areas that are used for storing flammable materials.

Do not expose the engine to any flame.

Exhaust shields (if equipped) protect hot exhaust components from oil or fuel spray if there was a line, a tube, or a seal failure. Exhaust shields must be installed correctly.

Do not carry out any work on the fuel lines or tanks that could ignite residual fuel. Grinding, welding, cutting, chiseling, and sawing have the potential to create a source of ignition must be avoided.

Do not weld on lines or tanks that contain flammable fluids. Do not flame cut lines or tanks that contain flammable fluid. Clean any such lines or tanks thoroughly with a nonflammable solvent prior to welding or flame cutting.

Wiring must be kept in good condition. Ensure that all electrical wires are correctly installed and securely attached. Check all electrical wires daily. Repair any wires that are loose or frayed before you operate the engine. Clean all electrical connections and tighten all electrical connections.

Eliminate all wiring that is unattached or unnecessary. Do not use any wires or cables that are smaller than the recommended gauge. Do not bypass any fuses and/or circuit breakers.

Arcing or sparking could cause a fire. Secure connections, recommended wiring, and correctly maintained battery cables will help to prevent arcing or sparking.

Ensure that the engine is stopped. Inspect all lines and hoses for wear damage, leakage or for deterioration. Ensure that the hoses are correctly routed. The lines and hoses must have adequate support and secure clamps.

Oil filters and fuel filters must be installed correctly. The filter housings must be tightened to the correct torque. Refer to the Disassembly and Assembly manual for more information.

Illustration 16 g00704059

Use caution when you are refueling an engine. Do not smoke whilst you are refueling an engine. Do not refuel an engine near open flames or sparks. Always stop the engine before refueling.

Avoid static electricity risk when fueling. Ultra-low Sulfur Diesel fuel (ULSD fuel) poses a greater static ignition hazard than earlier diesel formulations with a higher sulfur content. Avoid death or serious injury from fire or explosion. Consult your fuel or fuel system supplier to ensure that the delivery system is in compliance with fueling standards for proper grounding and bonding practices.

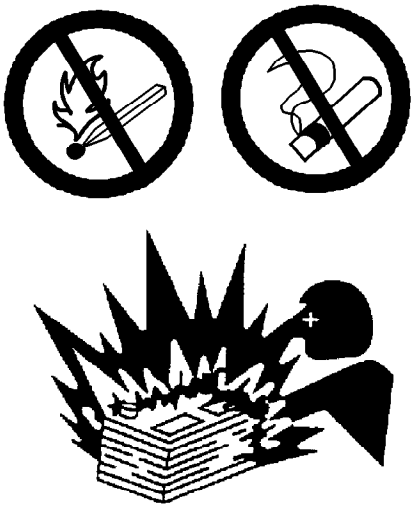

Illustration 17 g00704135

Gases from a battery can explode. Keep any open flames or sparks away from the top of a battery. Do not smoke in battery charging areas.

Never check the battery charge by placing a metal object across the terminal posts. Use a voltmeter or a hydrometer.

Incorrect jumper cable connections can cause an explosion that can result in injury. Refer to the Operation Section of this manual for specific instructions.

Do not charge a frozen battery. A frozen battery may cause an explosion.

The batteries must be kept clean. The covers (if equipped) must be kept on the cells. Use the recommended cables, connections, and battery box covers when the engine is operated.

## Fire Extinguisher

Make sure that a fire extinguisher is available. Be familiar with the operation of the fire extinguisher. Inspect the fire extinguisher and service the fire extinguisher regularly. Obey the recommendations on the instruction plate.

## Ether

Ether is flammable and poisonous.

Do not smoke whilst you are replacing an ether cylinder or whilst you are using an ether spray.

Do not store ether cylinders in living areas or in the engine compartment. Do not store ether cylinders in direct sunlight or in temperatures above 49° C (120° F). Keep ether cylinders away from open flames or sparks.

## Lines, Tubes, and Hoses

Do not bend high-pressure lines. Do not strike high-pressure lines. Do not install any lines that are damaged.

Leaks can cause fires. Consult your Perkins distributor for replacement parts.

Replace the parts if any of the following conditions are present:

- End fittings are damaged or leaking.
- Outer coverings are chafed or cut.
- Wires are exposed.
- Outer coverings are ballooning.
- Flexible parts of the hoses are kinked.
- Outer covers have embedded armoring.
- End fittings are displaced.

Make sure that all clamps, guards, and heat shields are installed correctly. During engine operation, correct installation will help to prevent vibration, rubbing against other parts, and excessive heat.

i02143194

# Crushing Prevention and Cutting Prevention

Support the component correctly when work beneath the component is performed.

Unless other maintenance instructions are provided, never attempt adjustments while the engine is running.

Stay clear of all rotating parts and of all moving parts. Leave the guards in place until maintenance is performed. After the maintenance is performed, reinstall the guards.

Keep objects away from moving fan blades. The fan blades will throw objects or cut objects.

When objects are struck, wear protective glasses in order to avoid injury to the eyes.

Chips or other debris may fly off objects when objects are struck. Before objects are struck, ensure that no one will be injured by flying debris.

i05875651

# Mounting and Dismounting

Do not climb on the engine. The engine has not been designed with mounting or dismounting locations.

Refer to the OEM for the location of foot and hand holds for your specific application.

i04257031

# Before Starting Engine

NOTICE
For initial start-up of a new or rebuilt engine, and for start-up of an engine that has been serviced, make provision to shut the engine off should an overspeed occur. This may be accomplished by shutting off the air and/or fuel supply to the engine.

**⚠ WARNING**

**Engine exhaust contains products of combustion which may be harmful to your health. Always start and operate the engine in a well ventilated area and, if in an enclosed area, vent the exhaust to the outside.**

Inspect the engine for potential hazards.

Do not start the engine or move any of the controls if there is a “DO NOT OPERATE” warning tag or similar warning tag attached to the start switch or to the controls.

Before starting the engine, ensure that no one is on, underneath, or close to the engine. Ensure that the area is free of personnel.

If equipped, ensure that the lighting system for the engine is suitable for the conditions. Ensure that all lights work properly, if equipped.

All protective guards and all protective covers must be installed if the engine must be started in order to perform service procedures. To help prevent an accident that is caused by parts in rotation, work around the parts carefully.

Do not start an engine when the governor linkage is disconnected.

Do not bypass the automatic shutoff circuits. Do not disable the automatic shutoff circuits. The circuits are provided in order to help prevent personal injury. The circuits are also provided in order to help prevent engine damage.

i06545901

# Engine Starting

**⚠ WARNING**

**Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.**

If a warning tag is attached to the engine start switch, or to the controls DO NOT start the engine or move the controls. Consult with the person that attached the warning tag before the engine is started.

All protective guards and all protective covers must be installed if the engine must be started to perform service procedures.

Start the engine from the operators compartment or from the engine start switch.

Always start the engine according to the procedure that is described in the Operation and Maintenance Manual, “Engine Starting” topic in the Operation Section. Knowing the correct procedure will help to prevent major damage to the engine components. Knowing the procedure will also help to prevent personal injury.

Ensure that the jacket water heater (if equipped) is working correctly, check the water temperature reading on the control panel of the original engine manufacture.

Engine exhaust contains products of combustion which can be harmful to your health. Always start the engine and operate the engine in a well ventilated area. If the engine is started in an enclosed area, vent the engine exhaust to the outside.

**Note:** The engine may be equipped with a device for cold starting. If the engine will be operated in cold conditions, then an extra cold starting aid may be required. Normally, the engine will be equipped with the correct type of starting aid for your region of operation.

i09160524

# Engine Stopping

- Remove the load in increments.
- Open the circuit breaker.
- Allow the engine to run for five minutes to cool.
- Stop the engine.
- Ensure 24V is supplied to the dosing cabinet for at least 120 seconds after engine shutdown (engines equipped with SCR systems only).

Use the Emergency Stop Button (if equipped) ONLY in an emergency situation. Do not use the Emergency Stop Button for normal engine stopping. After an emergency stop, DO NOT start the engine until the problem that caused the emergency stop has been corrected.

Stop the engine if an overspeed condition occurs during the initial start-up of a new engine or an engine that has been overhauled. This may be accomplished by shutting off the fuel supply to the engine and/or shutting off the air supply to the engine.

To stop an electronically controlled engine, cut the power to the engine.

i06088340

# Electrical System

Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operating. A spark can cause the combustible gases that are produced by some batteries to ignite.

To help prevent sparks from igniting combustible gases that are produced by some batteries, the negative “−” jump-start cable should be connected last from the external power source to the negative “−” terminal of the starting motor. If the starting motor is not equipped with a negative “−” terminal, connect the jump-start cable to the engine block.

Check the electrical wires daily for wires that are loose or frayed. Tighten all loose electrical wires before the engine is started. Repair all frayed electrical wires before the engine is started. Refer to the “Engine Starting” section of this Operation and Maintenance Manual for specific starting instructions.

## Grounding Practices

Proper grounding for the engine electrical system is necessary for optimum engine performance and reliability. Improper grounding will result in uncontrolled electrical circuit paths and in unreliable electrical circuit paths.

Uncontrolled electrical circuit paths can result in damage to main bearings, to crankshaft bearing journal surfaces, and to aluminum components.

Engines that are installed without engine-to-frame ground straps can be damaged by electrical discharge.

To ensure that the engine and the engine electrical systems function properly, an engine-to-frame ground strap with a direct path to the battery must be used. This path may be provided by way of a starting motor ground, a starting motor ground to the frame, or a direct engine ground to the frame.

All grounds should be tight and free of corrosion. The engine alternator must be grounded to the negative "-" battery terminal with a wire that is adequate to handle the full charging current of the alternator.

i07198825

# Engine Electronics

**⚠ WARNING**

**Tampering with the electronic system installation or the OEM wiring installation can be dangerous and could result in personal injury or death and/or engine damage.**

The engine is controlled by a digital Pandoras governor. The control system includes the following components.

- Control unit
- Actuator
- Setpoint adjusters (if equipped)
- Sensors
- Wiring Harness

## System Description for Engines with Electronic Control Unit

The system is controlled by an Electronic control Unit (ECU). The ECU contains a microprocessor that has an Electronic Programmable Read Only Memory (EPROM). The operating parameters for the governor are stored in the EPROM. The actuator is connected to the fuel injectors via a mechanical linkage.

A laptop computer is used to set the operating parameters of the governor. The laptop computer is connected to the governor via an interface cable. The operating parameters for the governor should only be modified by a trained Perkins representative. Refer to the Special Instruction, "Pandoras Digital Governor" for more information.

## System Description for Engines with Electronic Control Modules

The engine has a comprehensive, programmable Engine Monitoring System. The Electronic Control Module (ECM) will monitor the engine operating conditions. If any of the engine parameters extend outside an allowable range, the ECM will initiate an immediate action.

# Product Information Section

# Model Views

i07109778

## Model View Illustrations
(4006-23 and 4008-30 Industrial Engines)

The following model views show typical features of the engine. Due to individual applications, your engine may appear different from the illustrations.

### 4006-23 Engine Views

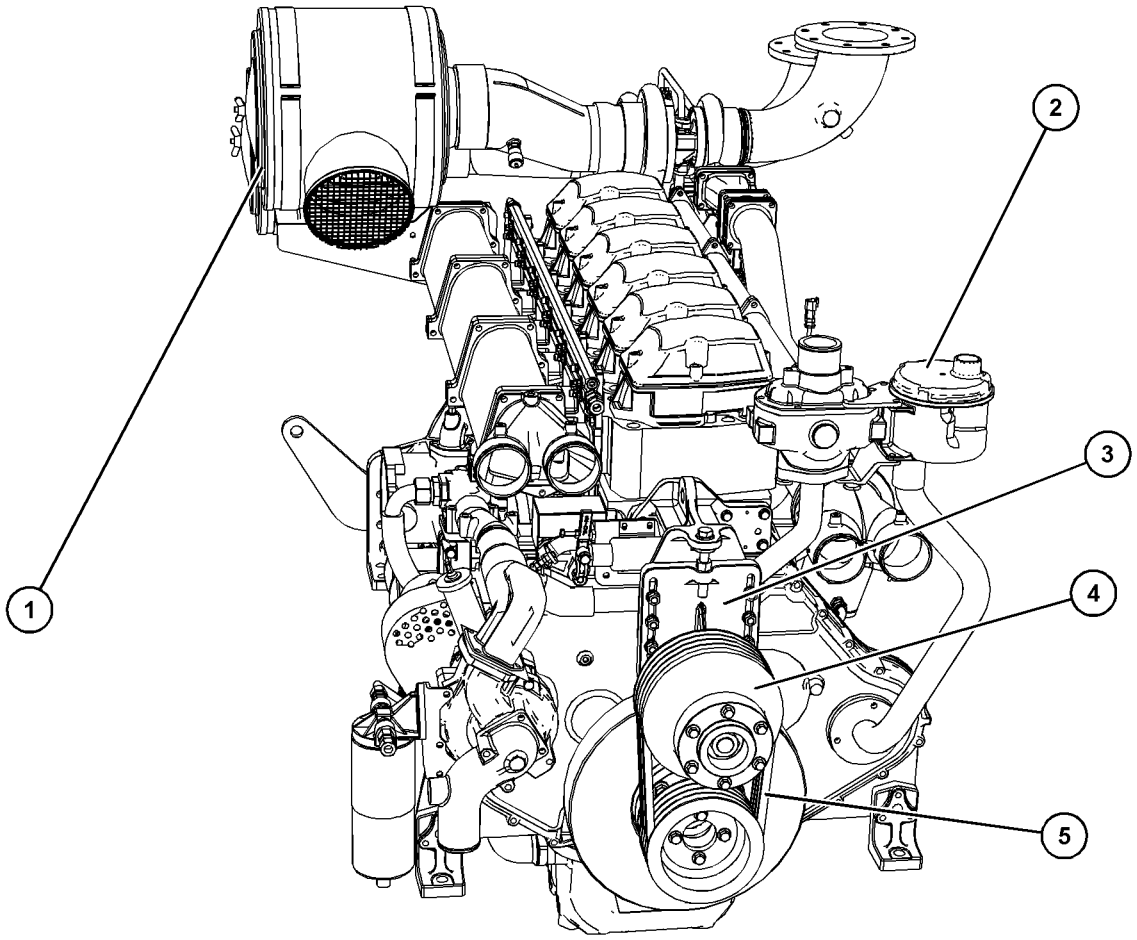


Illustration 18 g06072657
Typical example

(1) Twin air cleaners
(2) Crankcase breather

(3) Adjustment housing (4) Fan hub pulley (5) Belts

The major engine differences on six cylinder engine to an eight cylinder engine are shown in illustration 18 and illustration 20 . These differences are, air cleaner end cap design the crankcase breather design. The adjustment plate. The belts that drive the fan and the belt pulley for the fan drive.

## 4006-23 Radiator

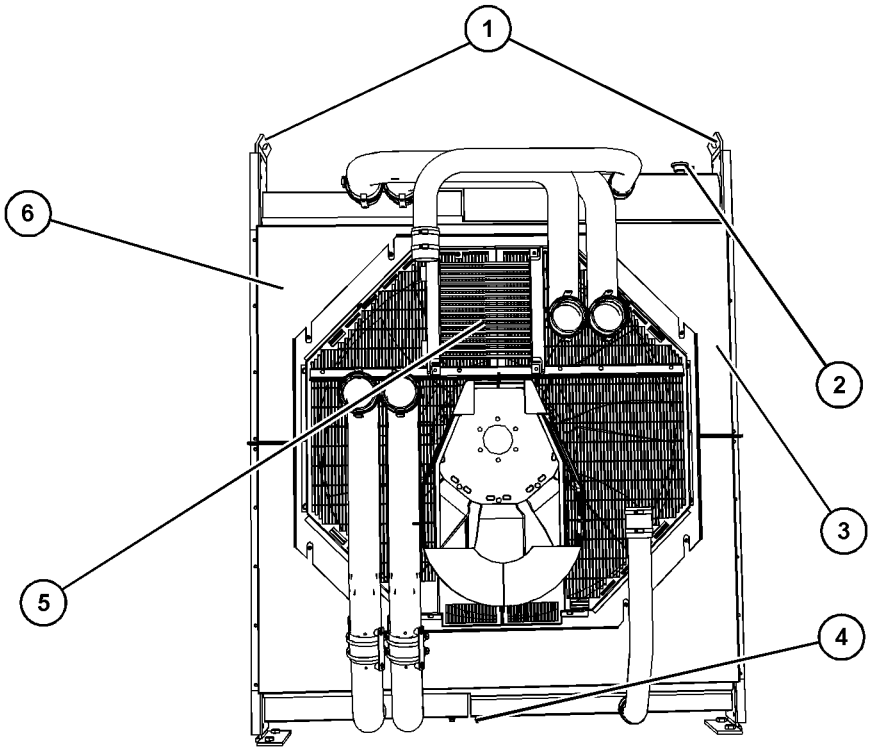


Illustration 19 g06072687

Typical example

(1) Radiator lifting eyes
(2) Radiator pressurized filler cap
(3) Radiator
(4) Radiator drain
(5) Fuel cooler
(6) Air charge cooler

## 4008-30 Engine Views

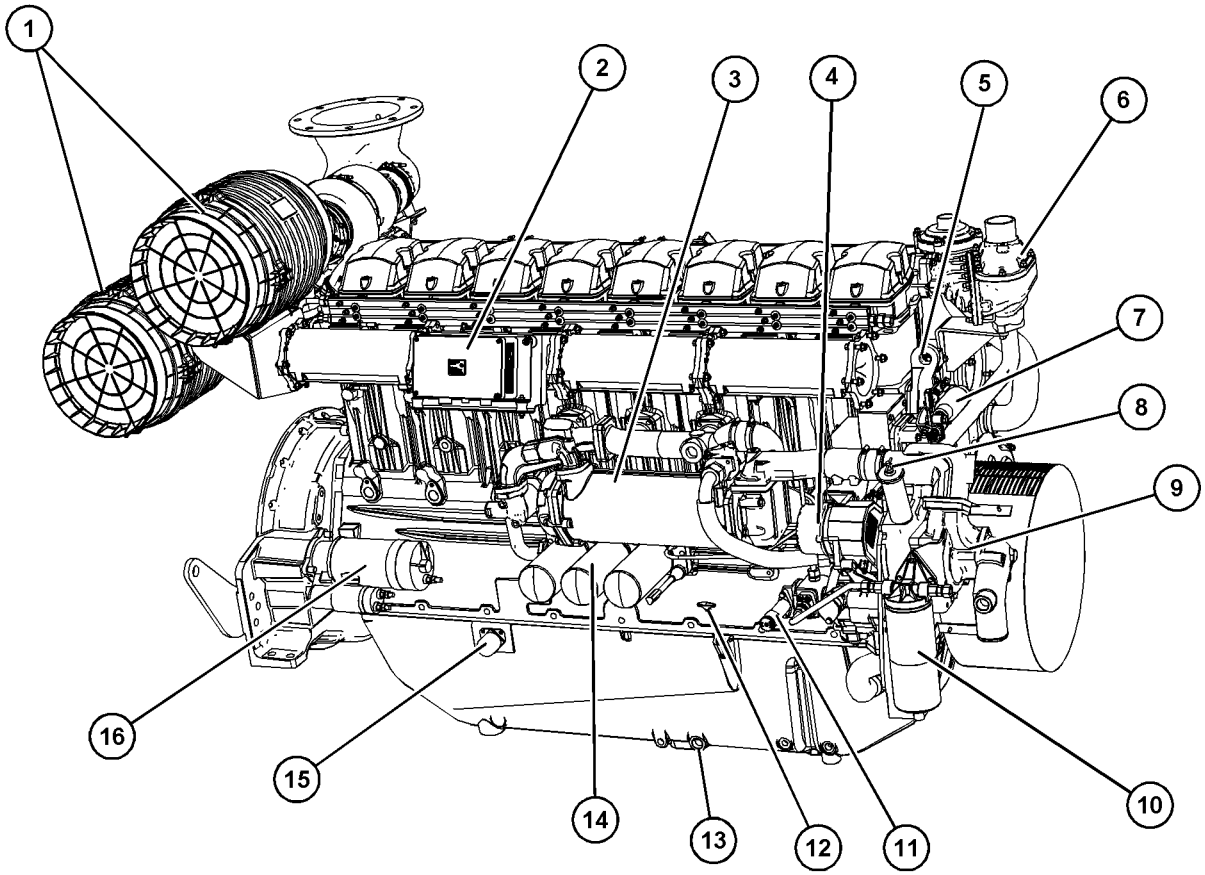


Illustration 20 g06004723

Typical example

(1) Twin air cleaners
(2) Electronic governor control unit
(3) Oil cooler
(4) Alternator
(5) Front lifting eye
(6) Thermostat housing
(7) Stop solenoid
(8) Oil filler cap
(9) Coolant pump
(10) Primary fuel filter
(11) Fuel priming pump
(12) Oil gauge (Dipstick)
(13) Oil drain location
(14) Oil filters
(15) Starter relay
(16) Starting motor

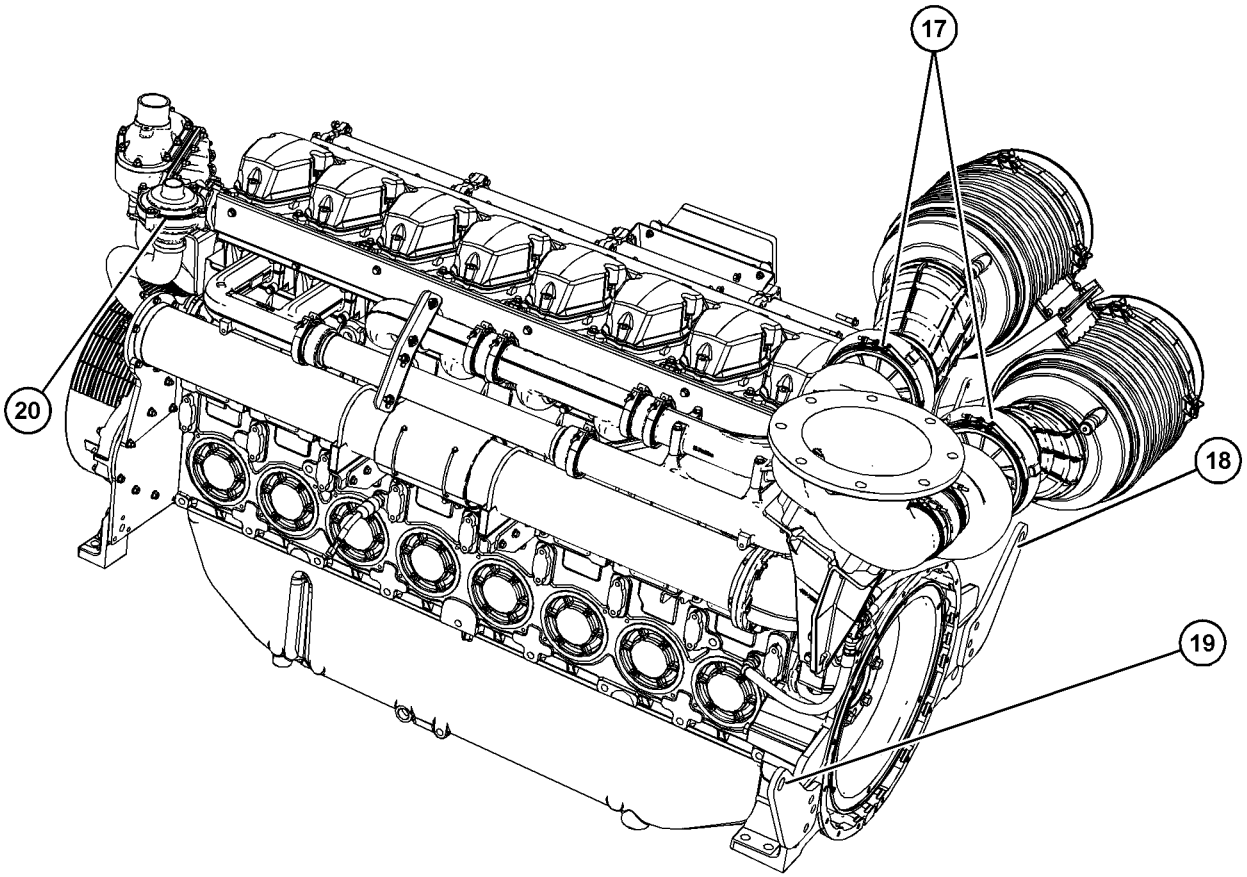


Illustration 21 g06004738

Typical example

(17) Twin turbochargers
(18) Right side rear lifting eye
(19) Left side rear lifting eye
(20) Crankcase breather

## 4008-30 Radiator

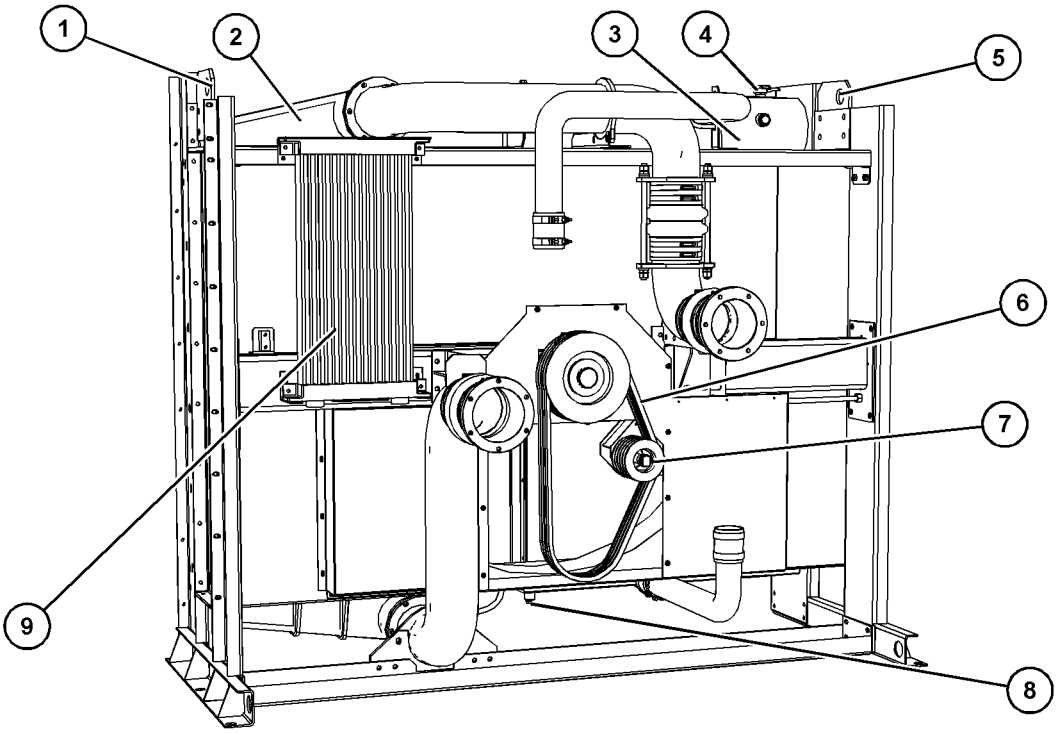


Illustration 22 g06005784

Typical example

(1) Radiator assembly lifting eye
(2) After cooler
(3) Radiator
(4) Coolant filler cap
(5) Radiator assembly lifting eye
(6) Fan belts
(7) Fan belt pulley adjuster
(8) Coolant drain
(9) Fuel cooler

## Engine View with Electronic Control Module

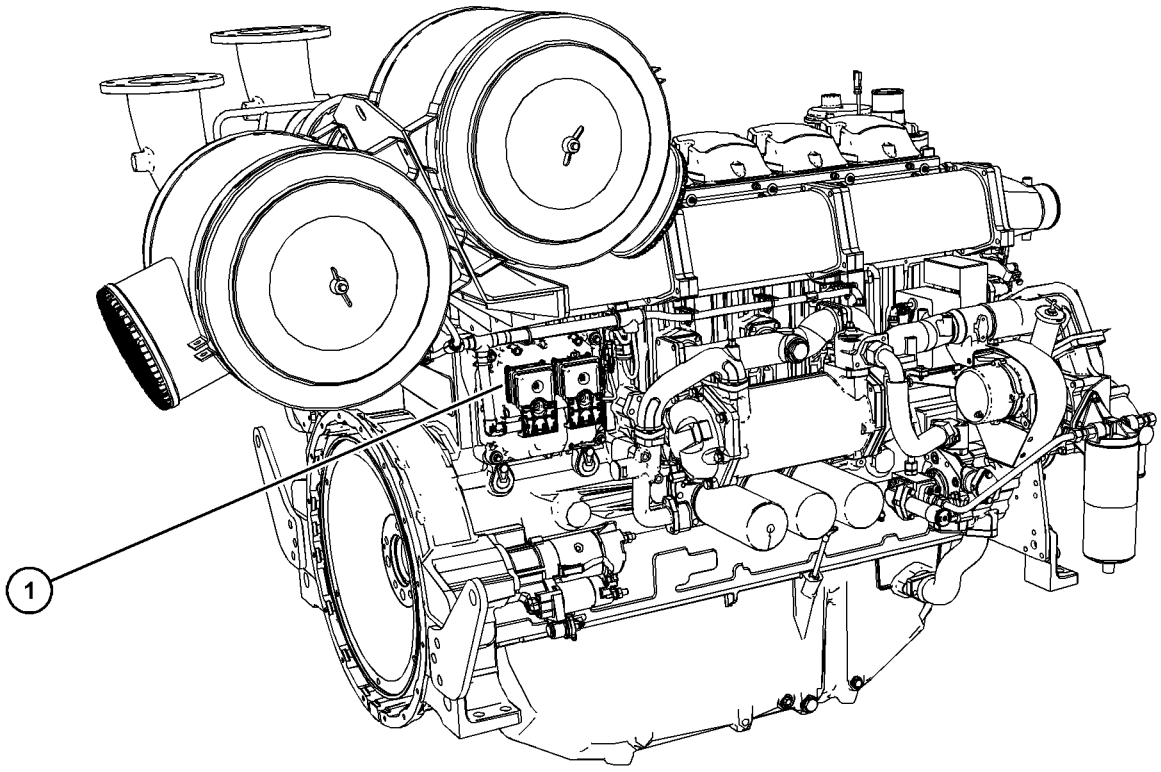


Illustration 23 g06209282

Typical example

(1) Electronic Control Module

i07109781

# Engine Description

The 4006-23 and the 4008-30 engines are available with turbocharged aftercooled aspiration. The 4006-23 and the 4008-30 industrial engines are designed as a constant speed engine.

The 4006-23 and the 4008-30 engines are available with an Electronic Control Module (ECM). The engines are also available with the Pandaros digital governor.

## Engine Specifications

The front end of the engine is opposite the flywheel end of the engine. The left and the right sides of the engine are determined from the flywheel end. The number 1 cylinder is the front cylinder.

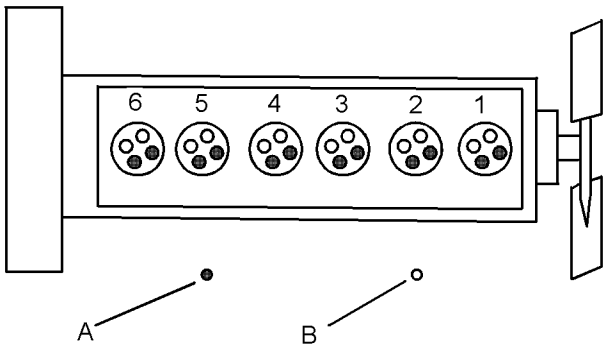


Illustration 24 g01216853

Typical example of a 6 cylinder engine

(A) Inlet valves
(B) Exhaust valves

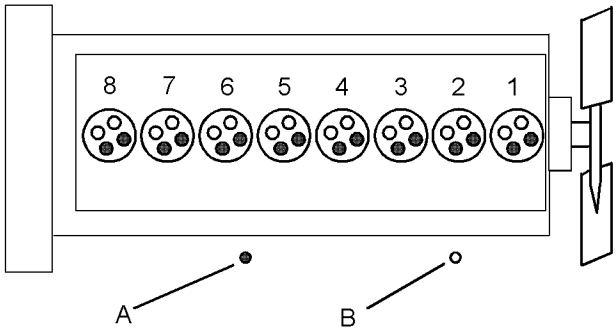


Illustration 25 g03897666

Typical example of an 8 cylinder engine

(A) Inlet valves
(B) Exhaust valves

Table 1

| 4006-23 Engine Specifications | |
|---|---|
| Number of cylinders | In-line 6 cylinder |
| Bore | 160 mm (6.29920 inch) |
| Stroke | 190 mm (7.48030 inch) |
| Displacement | 22.921 L (1398.72514 cubic inch) |
| Compression Ratio | 13.6:1 |
| Firing order | 1-5-3-6-2-4 |
| Aspiration | Turbocharged after cooled |
| Valve seat angle | 20° |
| Valve lash | 0.4 mm (0.01575 inch) Cold |

Table 2

| 4008-30 Engine Specifications | |
|---|---|
| Number of cylinders | In-line 8 cylinder |
| Bore | 160 mm (6.29920 inch) |
| Stroke | 190 mm (7.48030 inch) |
| Displacement | 30.56 L (1864.88549 cubic inch) |
| Compression Ratio | 13.6:1 |
| Firing order | 1-4-7-6-8-5-2-3 |
| Aspiration | Turbo charged after cooled |

(continued)

(Table 2, contd)

| | |
|---|---|
| Valve seat angle | 20° |
| Valve lash | 0.4 mm (0.01575 inch) Cold |

## Engine Cooling and Lubrication

The cooling system consists of the following components:

- Gear-driven water pump
- Water temperature regulators
- Gear-driven oil pump (rotor type)
- Oil cooler

The engine lubricating oil is supplied by a gear-driven pump. The lubrication oil is cooled and filtered. Bypass valves provide unrestricted flow of lubrication oil to the engine parts when oil viscosity is high. Bypass valves can also provide unrestricted flow of lubrication oil to the engine parts if the oil filter element should become plugged.

Engine efficiency, efficiency of emission controls, and engine performance depend on adherence to proper operation and maintenance recommendations. Engine performance and efficiency also depend on the use of recommended fuels, lubrication oils, and coolants. Refer to this Operation and Maintenance Manual for more information.

## ECM Engine Features

The ECM provides an electronic governor to maintain the desired engine speed. The engine ECM has built-in diagnostics to ensure that the engine systems are functioning correctly. The operator may be alerted to the condition by a “Stop” or “Warning” lamp.

Most of the diagnostic codes are logged and stored in the ECM. There are three types of diagnostic codes: active, logged, and event. The electronic service tool may be used to display the diagnostic codes.

## Engine Service Life

Engine efficiency and maximum utilization of engine performance depend on the adherence to proper operation and maintenance recommendations. In addition, use recommended fuels, coolants, and lubricants. Use the Operation and Maintenance Manual as a guide for required engine maintenance.

Expected engine life is predicted by the average power that is demanded. The average power that is demanded is based on fuel consumption of the engine over a time. Reduced hours of operation at full throttle and/or operating at reduced throttle settings result in a lower average power demand. Reduced hours of operation will increase the length of operating time before an engine overhaul is required.

## Aftermarket Products and Perkins Engines

Perkins does not warrant the quality or performance of non-Perkins fluids and filters.

When auxiliary devices, accessories, or consumables (filters, additives, catalysts) which are made by other manufacturers are used on Perkins products, the Perkins warranty is not affected simply because of such use.

**However, failures that result from the installation or use of other manufacturers devices, accessories, or consumables are NOT Perkins defects. Therefore, the defects are NOT covered under the Perkins warranty.**

# Product Identification Information

i06516715

## Plate Locations and Film Locations

The engine serial number plate is on the right side rear of the engine.

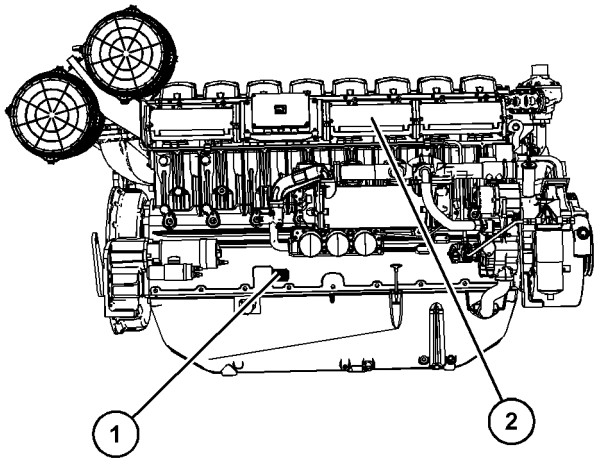


Illustration 26 g06017751

Typical example

(1) Engine serial number plate
(2) Emission label location

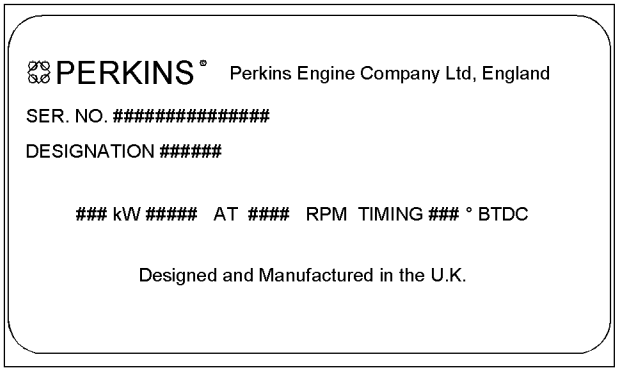


Illustration 27 g06016214

Typical example

(1) Engine serial number plate

Your Perkins distributor needs all the number from the plate when service information is required.

## Emission Label

The emission label (2) is installed on the inlet manifold of the engine.

# Operation Section

# Lifting and Storage

i08253404

## Engine Lifting
(4006-23 and 4008-30 Engines)

### Engine Lifting Only

NOTICE
Always inspect lifting eyebolts and all other lifting equipment for damage before performing any lifting. Never bend the eyebolts and the brackets. Never perform product lifting if components are damaged. Only load the eyebolts and the brackets under tension. Remember that the capacity of an eyebolt is less as the angle between the supporting members and the object becomes less than 90 degrees.

Use a hoist to remove heavy components. Use a lifting beam to lift the engine. All supporting members (chains and cables) should be parallel to each other. The chains and cables should be perpendicular to the top of the object that is being lifted.

To remove the engine ONLY, use the lifting eyes that are on the engine. If necessary, remove engine components to avoid damage from the lifting device.

Lifting eyes are designed and installed for specific engine arrangements. Alterations to the lifting eyes and/or the engine make the lifting eyes and the lifting fixtures obsolete. If alterations are made, ensure that correct lifting devices are provided. Consult your Perkins distributor for information regarding fixtures for correct engine lifting.

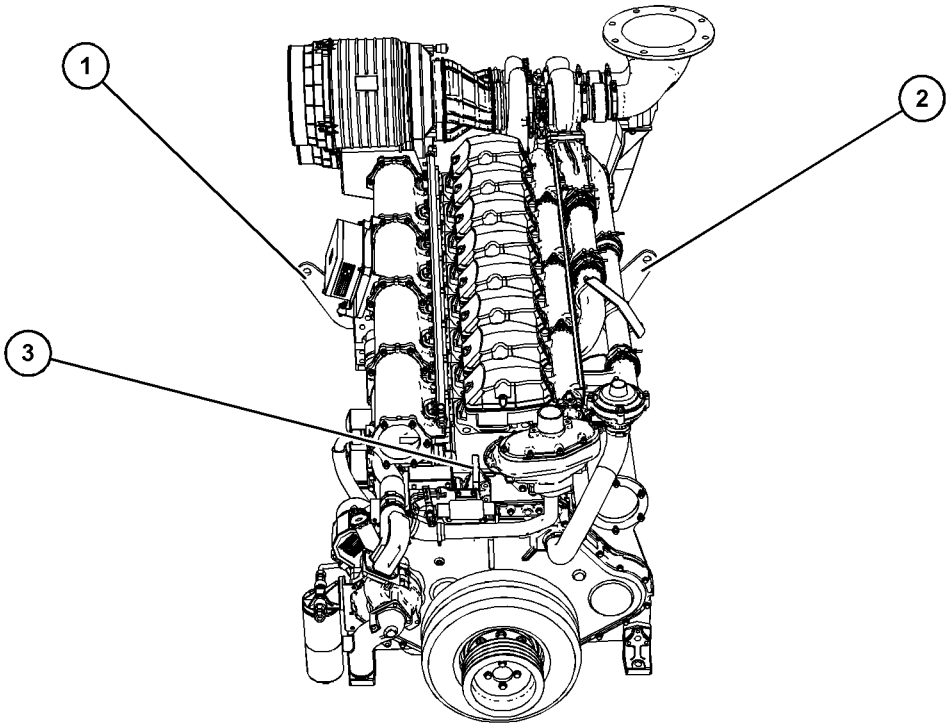


Illustration 28 g06006861

Typical example

(1) Rear lifting eye (2) Rear lifting eye (3) Front lifting eye

## Radiator Lifting Only

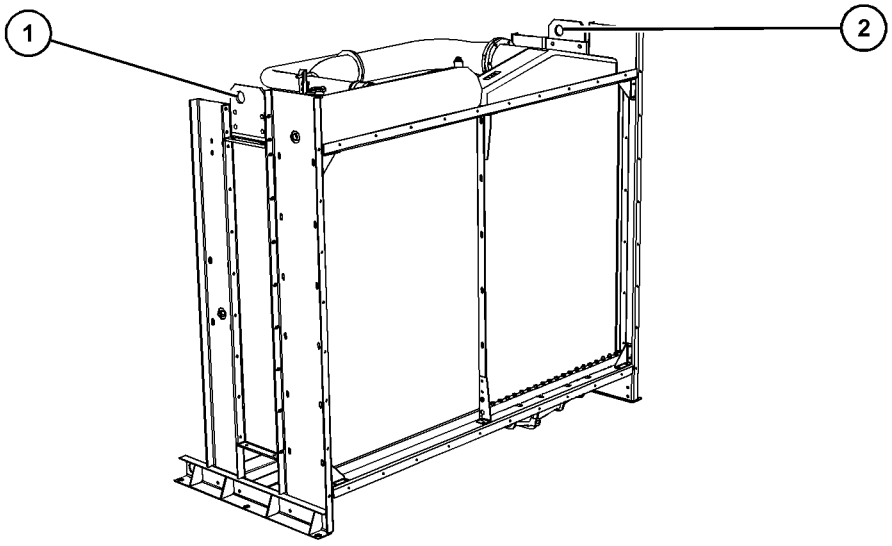


Illustration 29 g06006867

Typical example

(1) Radiator lifting eye (2) Radiator lifting eye

i03781209

# Engine Storage

Refer to Perkins Engine Company Limited, Stafford, ST16 3UB for information on engine storage.

There are three different levels of engine storage. Level “A, B and C” .

## Level “A ”

Level “A” will give protection for 12 months for diesel engines and for gas engines. This level is used for engines that are transported in a container or by a truck.

## Level “B ”

This level is additional to level “A” . Level “B ” will give protection under normal conditions of storage from −15° to +55°C (5° to 99°F) and “90%” relative humidity, for a maximum of 2 year.

## Level “C ”

This level is additional to level “B” . Level “C” will give protection for five years in tropical or in arctic climates. Level “C” also meets MOD NES 724 Level “J” for Europe, when engines are stored in an unheated building or in the open under a waterproof cover.

# Features and Controls

i06518677

## Monitoring System

The engine is equipped with sensors or switches to monitor the following parameters:

- Coolant temperature
- Oil pressure
- Intake manifold boost pressure
- Engine speed
- Engine overspeed

The throttle control is also monitored and controlled.

i07047605

## Sensors and Electrical Components

The 4006-23 and the 4008-30 engines can have the Pandoras Digital Governor, or the Electronic Control Module (ECM) installed. Both systems will operate with the same sensors and switches. The locations for both types of controllers are different.

The illustration within the section shows the typical locations of the sensors and other electrical components on the Industrial engine. Specific engines may appear different due to the application.

# Engine with the Pandoras Digital Governor

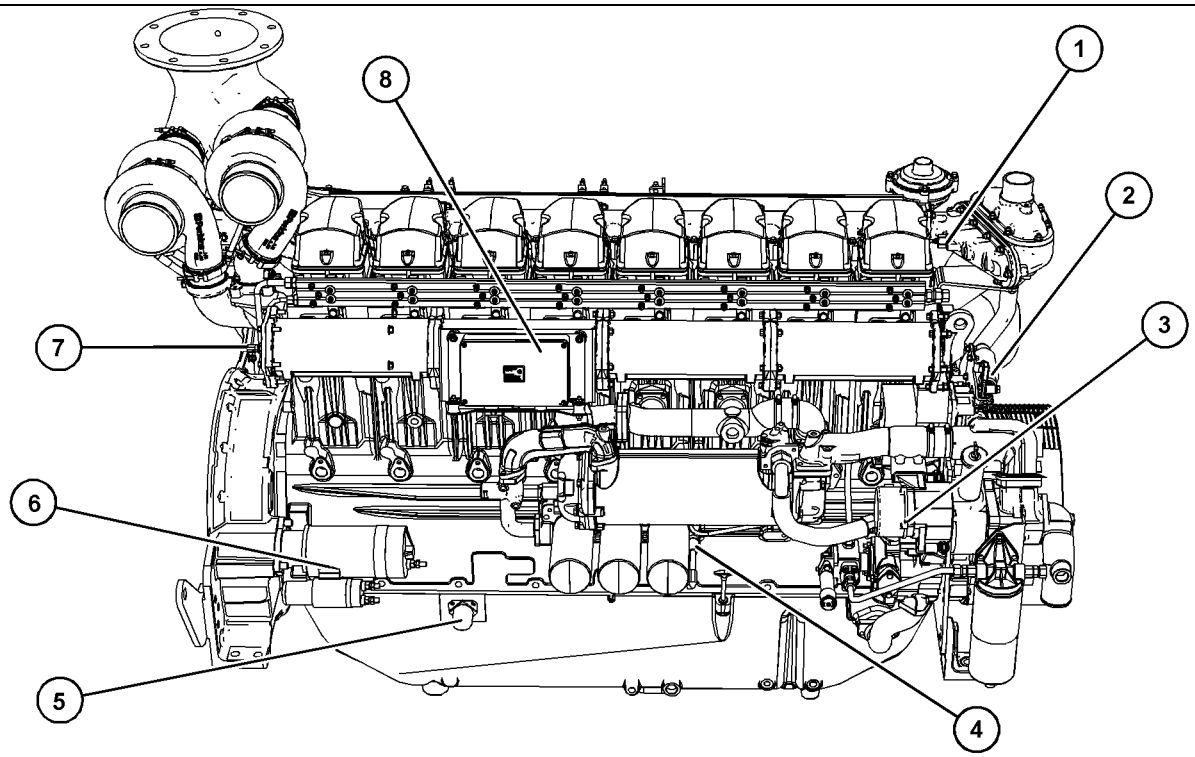


Illustration 30 g06006910

Typical example

(1) Coolant temperature switch
(2) Stop solenoid
(3) Alternator
(4) Oil pressure switch
(5) Starter relay
(6) Starting motor
(7) Inlet manifold air pressure sensor
(8) Electronic governor control unit

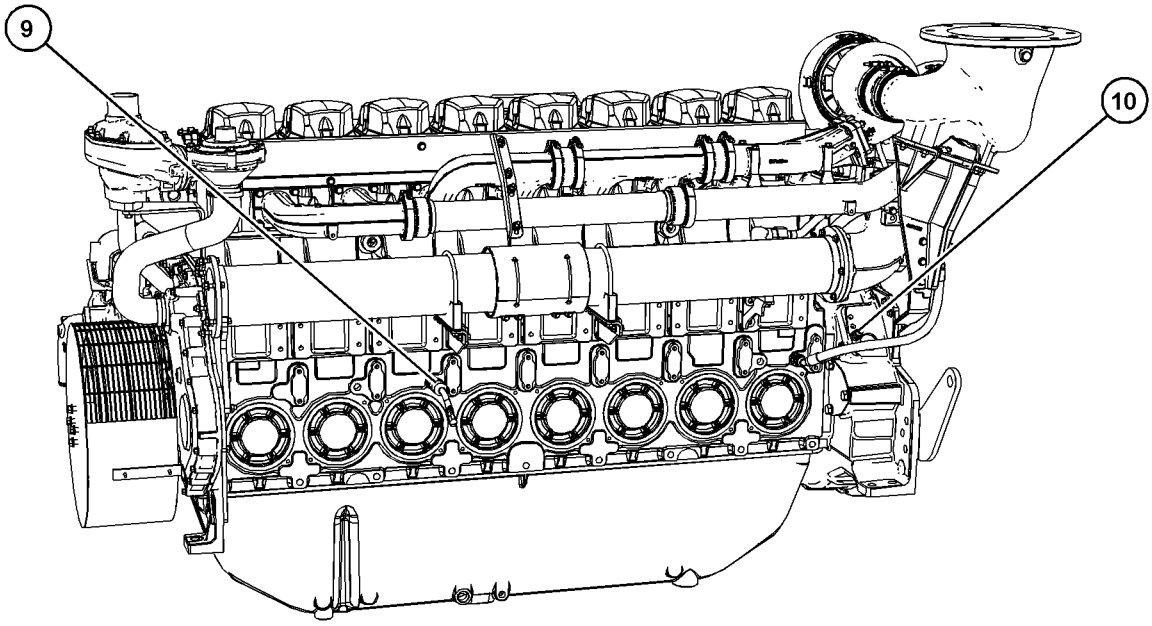


Illustration 31 g06006921

Typical example

(9) Oil pressure switch (10) Overspeed sensor

## Engine with Electronic Control Module

Only the controller of the engine sensors and switches has changed.

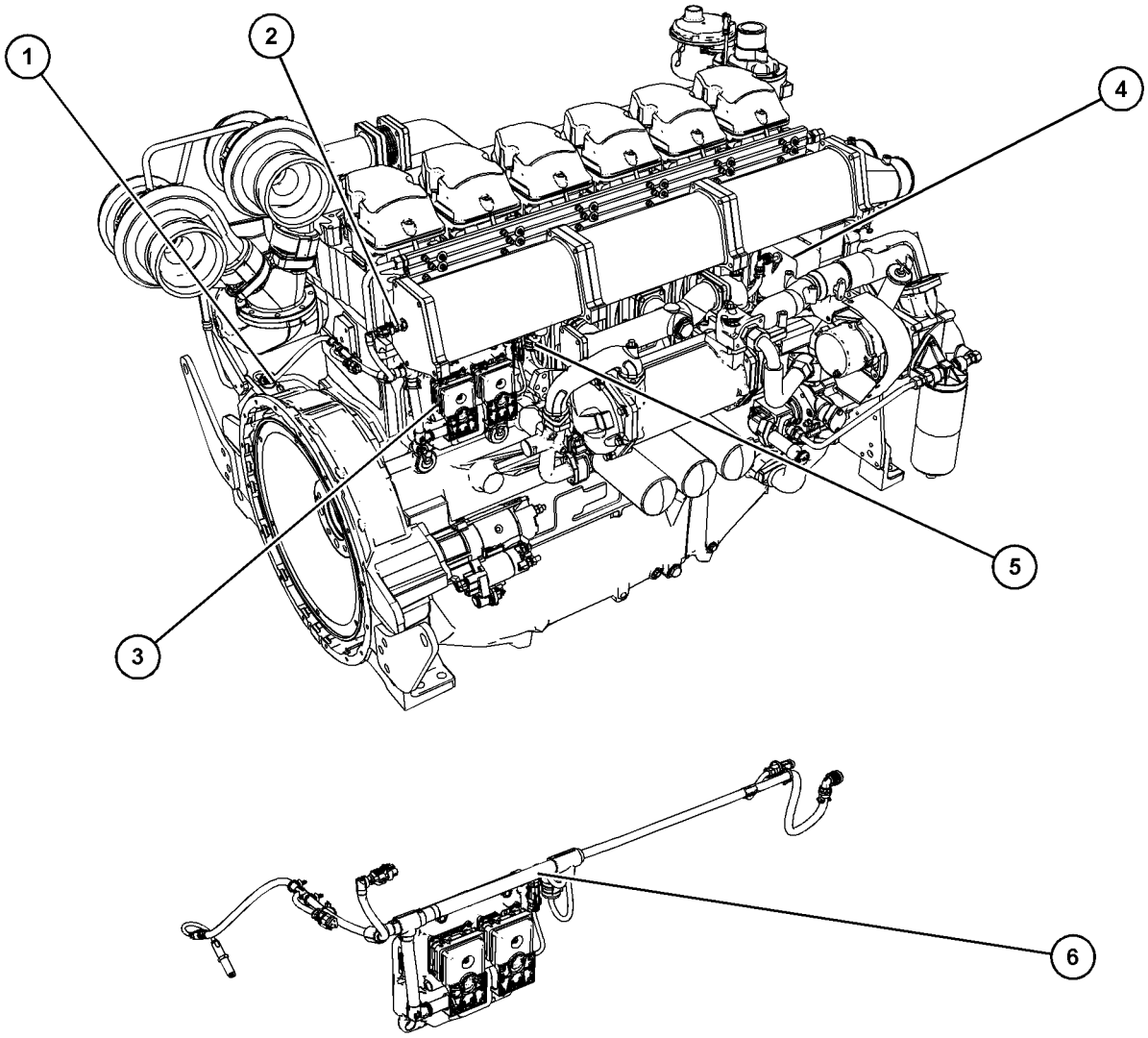


Illustration 32 g06228106

Typical example

(1) Flywheel speed sensor
(2) Inlet manifold pressure sensor
(3) Electronic Control Module (ECM)
(4) Actuator
(5) Diagnostic connector
(6) ECM and harness

# Engine Diagnostics

i07197886

## Self-Diagnostics

### For Engines with Electronic Control Modules Only

Perkins Electronic Engines can perform a self-diagnostics test. When the system detects an active problem, a diagnostic lamp is activated. Diagnostic codes will be stored in permanent memory in the Electronic Control Module (ECM). The diagnostic codes can be retrieved by using the Perkins Electronic Service Tool (EST).

Some installations have electronic displays that provide direct readouts of the engine diagnostic codes. Refer to the manual that is provided by the OEM for more information on retrieving engine diagnostic codes.

Active codes represent problems that currently exist. These problems should be investigated first.

Logged codes represent the following items:

- Intermittent problems
- Recorded events
- Performance history

The problems may have been repaired since the logging of the code. These codes do not indicate that a repair is needed. The codes are guides or signals when a situation exists. Codes may be helpful to troubleshoot problems.

When the problems have been corrected, the corresponding logged fault codes should be cleared.

i07197895

## Diagnostic Lamp

### For Engines with Electronic Control Modules Only

A diagnostic lamp is used to indicate the existence of an active fault. A fault diagnostic code will remain active until the problem is repaired. The diagnostic code may be retrieved by using the electronic service tool.

i07197900

## Fault Logging

### For Engines with Electronic Control Modules Only

The system provides the capability of Fault Logging. When the Electronic Control Module (ECM) generates an active diagnostic code, the code will be logged in the memory of the ECM. The codes that have been logged by the ECM can be identified by the electronic service tool. The active codes that have been logged will be cleared when the fault has been rectified or the fault is no longer active. The following logged faults cannot be cleared from the memory of the ECM without using a factory password: Overspeed, low engine oil pressure, high engine, and coolant temperature.

i07197935

## Engine Operation with Active Diagnostic Codes

### For Engine with Electronic Control Modules Only

If a diagnostic lamp illuminates during normal engine operation, the system has identified a situation that is not within the specification. Use electronic service tools to check the active diagnostic codes.

**Note:** If the customer has selected “DERATE” and there is a low oil pressure condition, engine power will be limited until the problem is corrected. If the oil pressure is within the normal range, the engine may be operated at the rated speed and load. However, maintenance should be performed as soon as possible.

The active diagnostic code should be investigated. The cause of the problem should be corrected as soon as possible. If the cause of the active diagnostic code is repaired and there is only one active diagnostic code, the diagnostic lamp will turn off.

Operation of the engine and performance of the engine can be limited as a result of the active diagnostic code that is generated. Acceleration rates may be lower. Refer to the Troubleshooting for more information on the relationship between these active diagnostic codes and engine performance.

i07197941

# Engine Operation with Intermittent Diagnostic Codes

## For Engines with Electronic Control Modules Only

If a diagnostic lamp illuminates during normal engine operation and the diagnostic lamp shuts off, an intermittent fault may have occurred. If a fault has occurred, the fault will be logged in to the memory of the Electronic Control Module (ECM).

Usually, an intermittent code will not require the engine to be stopped. The operator should retrieve the logged fault codes and reference the appropriate information to identify the nature of the event. The operator should log any observation that could have caused the lamp to light.

- Low power
- Limits of the engine speed
- Excessive smoke

This information can be useful to help troubleshoot the situation. The information can also be used for future reference. For more information on diagnostic codes, refer to the Troubleshooting for this engine.

i08251962

# Configuration Parameters

The engine Electronic Control Module (ECM) has two types of configuration parameters. The system configuration parameters and the customer specified parameters.

The electronic service tool is required to alter the configuration parameters.

## System Configuration Parameters

System configuration parameters affect the emissions of the engine or the power of the engine. System configuration parameters are programmed at the factory. Normally, system configuration parameters would never require changing through the life of the engine. System configuration parameters must be reprogrammed if an ECM is replaced. System configuration parameters do not require reprogrammed if the ECM software is changed. Factory passwords are required to change these parameters.

Table 3

| System Configuration Parameters | |
|---|---|
| **Configuration Parameters** | **Record** |
| Equipment ID | |
| Engine Serial Number | |
| ECM Serial Number | |

(continued)

(Table 3, contd)

| | |
|---|---|
| Software Part Number | |
| Software Release Date | |
| Software Description | |

## Customer Specified Parameters

Customer specified parameters allow the engine to be configured to the exact needs of the application.

The electronic service tool is required to alter the customer configuration parameters.

Customer parameters may be changed repeatedly as operational requirements change.

Table 4

| **Customer Specified Parameters** | |
|---|---|
| **Specified Parameters** | **Record** |
| Rating Number | |
| Rated Power | |
| Rated Engine Speed | |
| Rated Configuration | |
| Low Idle Speed | |
| High Idle Speed | |
| Engine Acceleration Rate | |
| Droop/Isochronous Selection | Enabled |
| Engine Speed Droop | |
| Speed Control Minimum Speed | |
| Speed Control Maximum Speed | |
| Digital Speed Control Ramp Rate | |
| Digital Speed Control Installed | Installed |
| Engine State Control Input Configuration | CAN Input |
| Desired Speed Input Arrangement | CAN Input |
| Droop/Isochronous Switch Installed | Enabled |
| Engine State Control Secondary Input Configuration | Not Installed |
| Governor (Proportional) Gain Percentage | |
| Governor (Integral) Stability Percentage | |
| Governor Transient Response Loop Gain Percentage | |
| Security Access Parameters | |
| Customer Password #1 | |
| Customer Password #2 | |

(continued)

(Table 4, contd)

| | |
|---|---|
| CAN Communication Protocol Write Security | |
| CAN Communication Protocol Read Security | |
| Total Tattletale | |

# Engine Starting

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## Before Starting Engine

Before the engine is started, perform the required daily maintenance and any other periodic maintenance that is due. Refer to the Operation and Maintenance Manual, “Maintenance Interval Schedule” for more information.

- Do not start the engine or move any of the controls if there is a “DO NOT OPERATE” warning tag or similar warning tag attached to the start switch or to the controls.
- Reset all the shutoffs or alarm components.
- Ensure that any driven equipment has been disengaged. Minimize electrical loads or remove any electrical loads.

**1.** Open the fuel supply valve (if equipped).

**2.** If the engine has not been started for several weeks, fuel may have drained from the fuel system. Also, when fuel filters have been changed, some air pockets will be trapped in the engine. In these instances, prime the fuel system. Refer to the Operation and Maintenance Manual, “Fuel System - Prime” for more information.

**3.** If the engine has not been started for more than 3 months, or the engine oil and filter has been changed the engine oil system must be primed. Follow Steps 3a through 3b to prime the engine oil system.

a. Ensure that the governor stays in the STOP position by disconnecting the speed pickup connector on the governor control.

b. Turn the keyswitch to the START position. Hold the keyswitch in this position until the oil pressure gauge indicates 100 kPa (14.5040 psi). Continue to hold the keyswitch in the START position for an extra 10 seconds.

Only crank the engine for a maximum of 30 seconds when building engine oil pressure. After 30 seconds, stop cranking and allow 2 minutes for the starter to cool.

**Note:** The keyswitch is part of the OEM supplied panel. The exact procedure for starting may vary. Refer to OEM supplied instructions for the correct starting procedure.

**4.** Turn the keyswitch to the STOP position. Reconnect the speed pickup connector.

The engine is now ready to run.

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## Starting the Engine

### Normal Engine Starting Procedure

**Note:** When possible, ensure that the engine is not started under load.

**1.** Turn the keyswitch to the START position. The engine should start immediately.

**Note:** The keyswitch is part of the OEM supplied panel. The exact procedure for starting may vary. Refer to OEM supplied instructions for the correct starting procedure.

**2.** Allow the keyswitch to return to the RUN position after the engine starts.

If the engine does not start after 10 seconds, return the keyswitch in the RUN position for 10 seconds. Then repeat Steps 1 and 2.

**Note:** If the engine fails to start after three attempts, investigate the cause.

**3.** After the engine has started follow Steps 3a through 3d.

a. Check the oil pressure.

b. Inspect the engine for leaks.

c. Ensure that the batteries for the engine are receiving a charge.

d. After the engine has run for 5 minutes, check the engine monitoring systems. Ensure that the engine is operating correctly before the load is applied.

### Alternative Engine Starting Procedure

**Note:** For a new engine, or when a long block has been obtained and rebuilt in service, or after a major overall, Perkins recommends following the procedure below:

**Note:** When possible, ensure that the engine is not started under load.

1. After completion of the installation process, prime the fuel system and the lubricating oil system. Refer to Operation and Maintenance Manual for more information.
2. Turn the keyswitch to the START position. Crank the engine. Observe the engine oil pressure. Do not start the engine. Hold the keyswitch in this position until the oil pressure gauge indicates 100 kPa (14.5040 psi).
3. If oil pressure is achieved during cranking the engine, start the engine. Turn the keyswitch to the START position. The engine should start immediately. Operate the engine for 1 minute, continue to monitor the engine oil pressure.
4. Stop the engine. Inspect the engine for leaks from the fuel, coolant, and lubricating oil systems.
   a. If no leaks are present, proceed to step 5.
   b. If leaks are present, repair the leaks. Repeat Step 3 to Step 4.
5. Start the engine. Operate the engine for 1 minute. Monitor the engine oil pressure. Continue to operate the engine with no load applied for 4 minutes. The total time period for this operation is 5 minutes.

**Note:** After the engine has run for 5 minutes, check the engine monitoring systems. Ensure that the engine is operating correctly before the load is applied.

6. Increase the engine load to 50 percent of prime power over a 60 second time period. Operate the engine for 20 minutes at 50 percent engine load.
7. Increase the engine load to 100 percent of prime power over a 90 second time period. Operate the engine for 20 minutes at 100 percent engine load.
8. Gradually remove all the engine load over a 60 second time period.
9. Operate the engine off load for a time period of 4 minutes to reduce the operating temperature of the engine.
10. Stop the engine. Inspect the engine for leaks from the fuel, coolant, and lubricating oil systems.

## Engine Starting Procedure for Engines in Standby Applications or Engines with Low Hours of Operation

**Note:** When possible, ensure that the engine is not started under load.

1. After completion of the installation process, prime the fuel system and the lubricating oil system. Refer to Operation and Maintenance Manual for more information.
2. Turn the keyswitch to the START position. Crank the engine. Observe the engine oil pressure. Do not start the engine. Hold the keyswitch in this position until the oil pressure gauge indicates 100 kPa (14.5040 psi).
3. If oil pressure is achieved during cranking the engine, start the engine. Turn the keyswitch to the START position. The engine should start immediately. Operate the engine for 1 minute, continue to monitor the engine oil pressure.
4. Stop the engine. Inspect the engine for leaks from the fuel, coolant, and lubricating oil systems.
   a. If no leaks are present, proceed to step 5.
   b. If leaks are present, repair the leaks. Repeat Step 3 to Step 4.
5. Start the engine. Operate the engine for 1 minute. Monitor the engine oil pressure. Continue to operate the engine with no load applied for 4 minutes. The total time period for this operation is 5 minutes.

**Note:** After the engine has run for 5 minutes, check the engine monitoring systems. Ensure that the engine is operating correctly before the load is applied.

6. Gradually increase the engine load up to full load over an hour time period. Operate the engine for a minimum of 4 hours at full engine load, to burn off the build-up of carbon in the engine and exhaust system. This may require the use of “test” load.

**Note:** For a six cylinder engine, Perkins recommends a minimum load of 250 kWe is applied. For an eight cylinder engine, Perkins recommends a minimum load of 340 kWe is applied.

7. Gradually remove all the engine load over a 60 second time period.
8. Operate the engine off load for a time period of 4 minutes to reduce the operating temperature of the engine.

**9.** Stop the engine. Inspect the engine for leaks from the fuel, coolant, and lubricating oil systems.

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# Cold Weather Starting

**⚠ WARNING**

**Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.**

**Note:** Perkins does not recommend that the engine is installed in an application where the ambient temperature is below 0° C (32° F), unless the engines are installed in a heated environment.

Follow the recommendations that are detailed below will improve cold starting and reduce white smoke emissions.

Startability will be improved at temperatures below 10 °C (50 °F) from the use of a jacket water heater.

The use of space heaters.

No load operation and or multiple start/stop events in colder ambient conditions can cause the emission of white smoke from the exhaust. The emission of white smoke from the exhaust is a result of partly unburnt fuel due to the low cylinder temperatures. No load operation should be avoided and multiple start/stop events kept to a minimum.

Air filters to pull in air from inside the canopy or enclosure, not outside the canopy or enclosure.

Fully charged batteries of the correct capacity. Electrical cables that meet the recommended specification.

Contact your Perkins distributor or Perkins dealer for more information.

# Engine Operation

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## Engine Operation

Correct operation and maintenance are key factors in obtaining the maximum life and economy of the engine. If the directions in the Operation and Maintenance Manual are followed, costs can be minimized and engine service life can be maximized.

Gauge readings (if equipped) should be observed and the data should be recorded frequently while the engine is operating. Comparing the data over time will help to determine normal readings for each gauge. Comparing data over time will also help detect abnormal operating developments. Significant changes in the readings should be investigated.

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## Fuel Conservation Practices

The efficiency of the engine can affect the fuel economy. Perkins design and technology in manufacturing provides maximum fuel efficiency in all applications. Follow the recommended procedures in order to attain optimum performance for the life of the engine.

- Avoid spilling fuel. Fuel expands when the fuel is warmed up. The fuel may overflow from the fuel tank. Inspect fuel lines for leaks. Repair the fuel lines, as needed.
- Be aware of the properties of the different fuels. Use only the recommended fuels.
- Avoid unnecessary running at a low load. If the engine is not under load, the engine should be shut down.
- Observe the air cleaner service indicator frequently. The air cleaner elements should be replaced when the air cleaner elements are dirty.
- Maintain the electrical systems. One damaged battery cell will overwork the alternator. This will consume excess power and excess fuel.
- Ensure that the drive belts are correctly adjusted. The drive belts should be in good condition.
- Ensure that all of the connections of the hoses are tight. The connections should not leak.
- Ensure that the driven equipment is in good working order.
- Cold engines consume excess fuel. Utilize heat from the jacket water system and the exhaust system, when possible. Keep cooling system components clean and keep cooling system components in good repair. Never operate the engine without water temperature regulators. All of these items will help maintain operating temperatures.

# Engine Stopping

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## Stopping the Engine

**Note:** Individual applications will have different control systems. Ensure that the shutoff procedures are understood. Use the following general guidelines in order to stop the engine.

1. Remove the load from the engine. Allow the engine to run off load for five minutes in order to cool the engine.
2. Stop the engine after the cool down period according to the shutoff system on the engine and turn the ignition key switch to the OFF position. If necessary, refer to the instructions that are provided by the OEM.

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## Emergency Stopping

NOTICE
Emergency shutoff controls are for EMERGENCY use ONLY. DO NOT use emergency shutoff devices or controls for normal stopping procedure.

The engine should be equipped with an emergency stop button. For more information about the emergency stop button, refer to the OEM information.

Ensure that any components for the external system that support the engine operation are secured after the engine is stopped.

In the event of an overspeed condition, the air shutoff valves will operate. After operation, the air shutoff valves must be manually reset.

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## After Stopping Engine

**Note:** Before you check the engine oil, do not operate the engine for at least 10 minutes in order to allow the engine oil to return to the oil pan.

- If the engine is equipped with a service hour meter, note the reading. Perform the maintenance that is in the Operation and Maintenance Manual, “Maintenance Interval Schedule”.
- Check the crankcase oil level. Maintain the oil level between the “MIN” mark and the “MAX” mark on the engine oil level gauge.
- If necessary, perform minor adjustments. Repair any leaks from the low pressure fuel system and from the cooling, lubrication or air systems.
- Fill the fuel tank in order to help prevent accumulation of moisture in the fuel. Do not overfill the fuel tank.

NOTICE
Only use antifreeze/coolant mixtures recommended in this Operation and Maintenance Manual, “Refill Capacities and Recommendations” topic or in this Operation and Maintenance Manual, “Fluid Recommendations” topic. Failure to do so can cause engine damage.

**⚠ WARNING**

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

- Allow the engine to cool. Check the coolant level.
- Check the coolant for correct antifreeze protection and the correct corrosion protection. Add the correct coolant/water mixture, if necessary.
- Perform all required periodic maintenance on all driven equipment. This maintenance is outlined in the instructions from the OEM.

# Maintenance Section

# Refill Capacities

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## Refill Capacities

### Lubrication System

The refill capacities for the engine crankcase reflect the approximate capacity of the crankcase or sump plus standard oil filters. Auxiliary oil filter systems will require more oil. Refer to the Original Equipment Manufacture (OEM) specifications for the capacity of the auxiliary oil filter. Refer to the Operation and Maintenance Manual, “Maintenance Section” for more information on Lubricant Specifications.

Table 5

| Engines Refill Capacities | | | |
|---|---|---|---|
| **Engine Sales Model** | **Compartment or System** | **Minimum (1)** | **Maximum (2)** |
| 4006-23 | Crankcase Oil Sump | 90.7 L (23.9 US gal) | 113.4 L (29.9 US gal) |
| 4008-30 | Crankcase Oil Sump | 127 L (33.5 US gal) | 153 L (40.4 US gal) |

(1) These values are the total capacities for the crankcase oil sump which includes the standard factory installed oil filters and oil coolers. Engines with auxiliary oil filters will require more oil. Refer to the OEM specifications for the capacity of the auxiliary oil filter.

(2) Approximate capacity of the largest crankcase oil sump. Refer to OEM for more information.

### Cooling System

Table 6

| 4006-23 Engine and Engine with Radiator | |
|---|---|
| Engine Only | 36 L (9.5 US gal) |
| Engine and Radiator | 120 L (31.7 US gal) |

Table 7

| 4008-30 Engine and Engine with Radiator | |
|---|---|
| Engine Only | 48 L (10.5 Imp gal) |
| Engine and Radiator | 140 L (30.8 Imp gal) |

### Fuel System

Refer to the OEM specifications for additional information on the capacity of the fuel system.

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# Fluid Recommendations (General Coolant Information)

## General Coolant Information

NOTICE
Never add coolant to an overheated engine. Engine damage could result. Allow the engine to cool first.

NOTICE
If the engine is to be stored in, or shipped to an area with below freezing temperatures, the cooling system must be either protected to the lowest outside temperature or drained completely to prevent damage.

NOTICE
Frequently check the specific gravity of the coolant for proper freeze protection or for anti-boil protection.

NOTICE
Never operate an engine without water temperature regulators in the cooling system. Water temperature regulators help to maintain the engine coolant at the proper operating temperature. Cooling system problems can develop without water temperature regulators.

Clean the cooling system for the following reasons:

- Contamination of the cooling system
- Overheating of the engine
- Foaming of the coolant

Many engine failures are related to the cooling system. The following problems are related to cooling system failures: Overheating, leakage of the water pump and plugged radiators or heat exchangers.

These failures can be avoided with correct cooling system maintenance. Cooling system maintenance is as important as maintenance of the fuel system and the lubrication system. Quality of the coolant is as important as the quality of the fuel and the lubricating oil.

Coolant is normally composed of three elements: Water, additives, and glycol.

Refer to Perkins Diesel Engines Fluids Recommendations, M0113102 for additional information that relates to coolant.

## Water

NOTICE
Never use water alone as coolant. Water alone is corrosive and does not provide any protection against boiling or freezing.

Water is used in the cooling system to transfer heat.

**Distilled water or deionized water is recommended for use in engine cooling systems.**

DO NOT use the following types of water in cooling systems: Hard water, softened water that has been conditioned with salt and sea water.

If distilled water or deionized water is not available, use water with the properties that are listed in Table 8 .

Table 8

| Perkins Minimum Acceptable Water Requirements | | |
|---|---|---|
| Property | Maximum Limit | ASTM Test |
| Chloride (Cl) | 40 mg/L | “D4327” |
| Sulfate ($SO_4$) | 100 mg/L | “D4327” |
| Total Hardness | 170 mg/L | “D1126” |
| Total Solids | 340 mg/L | “Federal Method 2540B”(1) |
| Acidity | pH of 5.5 to 9.0 | “D1293” |

(1) Total dissolved solids dried at 103° C (217° F) - 105° C (221° F), “Standard Method for the Examination of Water and Wastewater”, “American Public Health Association”, “www.apha.org”, “www.aphabookstore.org”, (888) 320-APHA.

For a water analysis, consult one of the following sources:

- Local water utility company
- Agricultural agent
- Independent laboratory

Periodic analysis of water that is used to add to the coolant is recommended. Water quality can be affected by various factors including malfunctioning purification equipment, earthquakes, and droughts.

## Additives

Additives help to protect the metal surfaces of the cooling system. A lack of coolant additives or insufficient amounts of additives enable the following conditions to occur:

- Corrosion
- Formation of mineral deposits
- Rust
- Scale
- Pitting and erosion from cavitation of the cylinder liner
- Foaming of the coolant

Many additives are depleted during engine operation. These additives must be replaced periodically.

Additives must be added at the correct concentration. Over concentration of additives can cause the inhibitors to drop out-of-solution. The deposits can enable the following problems to occur:

- Formation of gel compounds
- Reduction of heat transfer
- Leakage of the water pump seal
- Plugging of radiators, coolers, and small passages

## Glycol

Glycol in the coolant helps to provide protection against the following conditions:

- Boiling
- Freezing
- Cavitation of the water pump

For optimum performance, Perkins recommends a 50 percent by volume of glycol in the finished coolant (also referred to as 1:1 mixture).

**Note:** Use a mixture that will provide protection against the lowest ambient temperature.

**Note:** 100 percent pure glycol will freeze at a temperature of −13 °C (8.6 °F).

Most conventional antifreezes use ethylene glycol. Propylene glycol may also be used. In a 1:1 mixture with water, ethylene and propylene glycol provide similar protection against freezing and boiling. Refer to Table 9 and refer to table 10 .

Table 9

| Ethylene Glycol Concentration | | |
|---|---|---|
| **Concentration** | **Freeze Protection** | **Boil Protection(1)** |
| 50 Percent | −37° C (−29° F) | 106° C (223° F) |
| 60 Percent | −52° C (−62° F) | 111° C (232° F) |

(1) Boiling protection is increased with the use of a pressurized radiator. A system with a 1 bar (14.5 psi) pressure cap at sea level, will increase the final boiling point of 50 percent coolant to 130° C (266° F).

NOTICE
Do not use propylene glycol in concentrations that exceed 50 percent glycol because of the reduced heat transfer capability of propylene glycol. Use ethylene glycol in conditions that require additional protection against boiling or freezing.

Table 10

| Propylene Glycol Concentration | | |
|---|---|---|
| **Concentration** | **Freeze Protection** | **Boil Protection (1)** |
| 50 Percent | −32° C (−26° F) | 106° C (223° F) |

(1) Boiling protection is increased with the use of a pressurized radiator. A system with a 1 bar (14.5 psi) pressure cap at sea level, will increase the final boiling point of 50 percent coolant to 130° C (266° F)

Propylene glycol coolant that is used in the cooling systems for Perkins diesel engines must meet “ASTM D6210”, “Fully Formulated Glycol-Based Engine Coolant for Heavy-Duty Engines”. When propylene glycol coolant is used in heavy-duty diesel engines, a regular addition of SCA is required for protection. Consult your Perkins distributor for additional information.

Ethylene or propylene glycols used in cooling systems for Perkins diesel engines must meet “ASTM E1177”, “Standard Specification for Engine Coolant Grade Glycol”.

To check the concentration of glycol in the coolant, measure the specific gravity of the coolant.

## Coolant Recommendations

- ELC_____Extended Life Coolant. A coolant that relies on organic inhibitors for corrosion and cavitation protection. Also known as Organic Acid Technology (OAT) coolant.
- ELI_____Extended Life Inhibitor
- SCA_____Supplement Coolant Additive, concentrated inorganic inhibitor package
- ASTM_____American Society for Testing and Materials

The following three glycol-based coolants are recommended for use in Perkins diesel engines:

**Preferred** – Perkins ELC

**Acceptable** – A commercial heavy-duty antifreeze that meets “ASTM D6210” specifications. Must be replaced after 2 years.

**Adequate** – A commercial heavy-duty antifreeze that meets “ASTM D4985” specifications. Must be replaced after 1 year.

NOTICE
**Do not use a commercial coolant/antifreeze that only meets the ASTM D3306 specification. This type of coolant/antifreeze is made for light automotive applications.**

NOTICE
A commercial heavy-duty antifreeze that meets “ASTM D4985” specification requires a treatment with an SCA at the initial fill. Read the label or the instructions that are provided by the manufacturer of the product.

NOTICE
A commercial heavy-duty antifreeze that meets either “ASTM D4985” or “ASTM D6210” specification requires the SCA concentration to be checked at 500-hour service intervals.

Perkins recommends a 50 percent volume (1:1) glycol and distilled or deionized water of the correct specification. This mixture will provide optimum performance as a coolant/antifreeze. This ratio can be increased to 60 percent volume ethylene glycol to water if extra freezing protection is required.

For applications not requiring freeze protection, the following can be used:

**Preferred** – Perkins ELI

**Acceptable** – A commercial supplemental coolant additive (SCA) that meets “ASTM D5752” specifications.

A mixture of SCA inhibitor and distilled or deionized water is acceptable but will not provide the same level of corrosion, boiling, and freezing protection as ELC or ELI. Perkins recommends a 6 percent to 8 percent concentration of SCA in those cooling systems. Distilled water or deionized water is preferred. Water which has the recommended properties may be used.

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# Fluid Recommendations
(Engine Oil Specification)

## General Lubricant Information

Because of government regulations regarding the certification of exhaust emissions from the engine, the lubricant recommendations must be followed.

- API American Petroleum Institute
- SAE Society Of Automotive Engineers Inc.
- ECF Engine Crankcase Fluid

### Licensing

The Engine Oil Licensing and Certification System by the American Petroleum Institute (API) is recognized by Perkins. For detailed information about this system, see the latest edition of the “API publication No. 1509”. Engine oils that bear the API symbol are authorized by API.

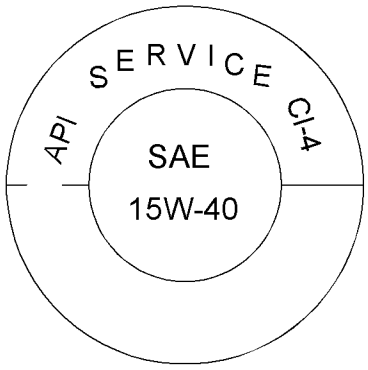


Illustration 33 g03360267
Typical API symbol

### Terminology

Certain abbreviations follow the nomenclature of “SAE J754”. Some classifications follow “SAE J183” abbreviations, and some classifications follow the “EMA Recommended Guideline on Diesel Engine Oil”. In addition to Perkins definitions, there are other definitions that will be of assistance in purchasing lubricants.

Refer to Perkins Diesel Engines Fluids Recommendations, M0113102 for additional information that relates to oil.

## Perkins Diesel Engine Oils

Perkins diesel engine oils have been developed and tested by Perkins to increase the performance and the life of Perkins components. The quality of finished oil depends on the quality of the base stock, the quality of the additives and the compatibility of the base stock and additives. Perkins diesel engine oils are formulated of high-quality refined oil base stocks and additives of optimal chemistry and quantity to provide high performance in engines and machine components.

Perkins engine oils are offered by Perkins distributors for service fills and as aftermarket products. Consult your Perkins distributor for more information on these Perkins engines oil.

Perkins recommends the use of the Perkins diesel engine oil where suitable for Perkins commercial engines.

Perkins offers the following Perkins diesel engine oils:

Table 11

| Perkins Lubricants | | Viscosity Grade |
|---|---|---|
| Diesel Engine Oil (DEO) - Ultra Low Sulfur (ULS) (API CK-4) (1) | Perkins DEO-ULS | SAE 15W-40 |
| Diesel Engine Oil (DEO) (API CI-4 / API CI-4PLUS) | Perkins DEO | SAE 15W-40 |

(1) These oils have changed from API CJ-4 to API CK-4 in early 2017.

**Note:** More Perkins engine oils may be available.

**Note:** Perkins engine oil availability will vary by region.

**Note:** The optimal application of the lubricants depends on the oil quality and the maintenance practices such as contamination control, tank management, and general handling practices.

## Perkins Diesel Engine Oils Recommendations

Perkins DEO-ULS and Perkins DEO multigrade oils are the preferred oils for use in ALL Perkins diesel engines. Commercial alternative diesel engine oils are, as a group, acceptable oils. Refer to table 12 below for information.

Table 12

| Perkins Engine Lubricants Recommendations/Requirements | |
|---|---|
| | Non-Road Pre Tier 4 / China NR4 / EU stage IIIb/IV |
| Preferred | Perkins DEO-ULS (API CK-4) (1)<br>Perkins DEO (API CI-4 / API CI-4 PLUS) |
| Commercial Lubricants | API CK-4 (1)<br>ACEA E9(1)<br>ACEA E7<br>ECF-3 / API CJ-4(1)<br>ECF-2 / API CI-4<br>ECF-1a / API CH-4 |

(1) Use of API CK-4 / API CJ-4 / ACEA E9 oil specification is subject to ULSD / LSD fuel or fuel with a sulphur content of less than 1000 ppm (parts per million) (mg/kg)

**Note:** API engine oil categories are backwards compatible, except for API FA-4 oil specification. Perkins DEO-ULS (API CK-4) oil can be used in all engines with some restrictions related to fuel sulfur level. Perkins DEO (API CI-4 / API CI-4 PLUS) can be used in engines that are Tier 3 emissions certified and prior, and in engines that do not use aftertreatment devices.

**Note:** When the recommended Perkins diesel engine oils are not used, commercial oils that are API CK-4 licensed and/or meet the requirements of the ECF-1-a, ECF-2, and/or the ECF-3 specification are acceptable, but are second choice, for use in Perkins diesel engine.

## Lubricant Viscosity Recommendations for Direct Injection (DI) engines

Refer to the minimum temperature in table 13 to determine the required oil viscosity for starting a cold engine. Refer to the maximum temperature to select the oil viscosity for engine operation at the highest ambient temperature that is anticipated.

**Note:** Use the highest oil viscosity that is available to meet the requirement for the temperature at start-up. If ambient temperature conditions at engine start-up require the use of multigrade SAE 0W oil, SAE 0W-40 viscosity grade is preferred over SAE 0W-30.

**Note:** 10W-30 is the preferred viscosity grade for the following diesel engines when the ambient temperature is above −18° C (0° F) and below 40° C (104° F).

Table 13

**Lubricant Viscosities for Ambient Temperatures for Perkins Diesel Engines(1)**

| Engine Type | Viscosity Grade | °C | | °F | |
|---|---|---|---|---|---|
| | | Min | Max | Min | Max |
| Direct Injection (DI) and Pre Combustion (PC) | SAE 0W-40 | −40 | 40 | −40 | 104 |
| | SAE 5W-40 | −30 | 50 | −22 | 122 |
| | SAE 10W-30 | −18 | 40 | 0 | 104 |
| | SAE 15W-40 | −10 | 50 | 14 | 122 |

(1) Commercial oils of viscosity grades that are not included in this table may be used, if the oils are per ECF specifications. Commercial oils are second choice.

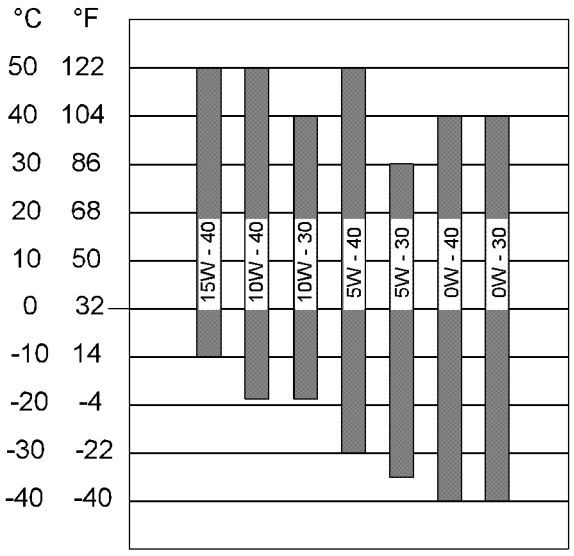


Illustration 34 g06509990

Typical example of Lubricant Viscosities for Ambient Temperatures

Commercial multi-grade oil alternatives must claim at least one of the following Perkins specifications: ECF-1-a, ECF-2, ECF-3, API CK-4. Non-Perkins commercial oils are as a group an acceptable choice of oils.

## Aftermarket Oil Additives

Perkins does not recommend the use of aftermarket additives in oil. Aftermarket additives are not necessary to achieve the maximum service life of the engine or rated performance of the engine. Fully formulated, finished oils consist of base oils and of commercial additive packages. These additive packages are blended into the base oils at precise percentages to help provide performance characteristics that meet industry standards.

There are no industry standard tests that evaluate the performance or the compatibility of aftermarket additives in finished oil. Aftermarket additives may not be compatible with the additive package of the finished oil, which could lower the performance of the finished oil. The aftermarket additive could fail to mix with the finished oil and produce sludge in the crankcase. Perkins discourages the use of aftermarket additives in finished oils.

To achieve the best performance from Perkins engines, conform to the following guidelines:

- At the specified interval, service the engine. Use appropriate new oil and install an appropriate new oil filter.

- Perform maintenance at the intervals that are specified in the engine Operation and Maintenance Manual, “Maintenance Interval Schedule”.

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# Fluid Recommendations (Fuel Specifications)

- **Glossary**
- ISO International Standards Organization
- ASTM American Society for Testing and Materials
- HFRR High Frequency Reciprocating Rig for Lubricity testing of diesel fuels
- FAME Fatty Acid Methyl Esters
- CFR Co-ordinating Fuel Research
- LSD Low Sulfur Diesel
- ULSD Ultra Low Sulfur Diesel
- RME Rape Methyl Ester
- SME Soy Methyl Ester
- EPA Environmental Protection Agency of the United States
- cST Centistokes

## General Information

NOTICE
Every attempt is made to provide accurate, up-to-date information. By use of this document you agree that Perkins Engines Company Limited is not responsible for errors or omissions.

NOTICE
These recommendations are subject to change without notice. Contact your local Perkins distributor for the most up-to-date recommendations.

Perkins is not in a position to evaluate continuously and monitor all worldwide distillate diesel fuel specifications that are published by governments and technological societies.

Refer to Perkins Diesel Engines Fluids Recommendations, M0113102 for additional information that relates to fuel.

## Diesel Fuel Recommendations

Diesel engines may burn a wide variety of fuels. These fuels are divided into two general groups. The two groups are called the preferred fuels and the permissible fuels.

**The preferred fuels provide maximum engine service life and performance.** The preferred fuels are distillate fuels. These fuels are commonly called diesel fuel, furnace oil, gas oil, or kerosene.

The permissible fuels are some crude oils, some blends of crude oil with distillate fuel, and some marine diesel fuel. **These fuels are not suitable for use in all engine applications.** The acceptability of these fuels for use is determined on a case by case basis. A complete fuel analysis is required. Consult your Perkins distributor for further information. Biodiesel fuel is permissible for use in Perkins engines.

NOTICE
Use of permissible fuels can result in higher maintenance costs and reduced engine service life.

**Note:** Use of fuels that do not meet at least the minimum performance recommendations and/or requirements may lead to lower compartment performance and/or compartment failure. Problems/failures that are caused by using fuels that do not meet the minimum recommended and/or required performance level are not Perkins factory defects. The fuel supplier and customer are responsible.

## Aftermarket Fuel Additives

There are many different types of fuel additives that are available to use. Perkins does not generally recommend the use of fuel additives.

In special circumstances, Perkins recognizes the need for fuel additives. Fuel additives need to be used with caution. The additive may not be compatible with the fuel. Some additives may precipitate. This action causes deposits in the fuel system. The deposits may cause seizure. Some additives may plug fuel filters. Some additives may be corrosive, and some additives may be harmful to the elastomers in the fuel system. Some additives may damage emission control systems. Some additives may raise fuel sulfur levels above the maximum allowed by the United States (U.S.) Environmental Protection Agency (EPA) and/or, as appropriate, other regulatory agencies. Consult your fuel supplier for those circumstances when fuel additives are required. Your fuel supplier can make recommendations for additives to use and for the proper level of treatment.

**Note:** Metallic fuel additives can cause fuel system/ injector fouling and after treatment device fouling. Perkins discourages the use of metallic fuel additives in most applications. Metallic fuel additives should only be used in applications, where their use is specifically recommended by Perkins.

**Note:** Diesel fuel additives or conditioners may not improve markedly poor diesel fuel properties enough to make them acceptable for use.

**Note:** For best results, your fuel supplier should treat the fuel when additives are needed.

## Diesel Fuel Conditioner

In case a fuel conditioner is needed to improve certain fuel properties, consult with your fuel supplier or with a reputable provider.

## Perkins Diesel Fuel System Cleaner

**Note:** Perkins Diesel Fuel System Cleaner, part number T400012, is the only fuel system cleaner available to the end user that is tested and approved by Perkins for use in Perkins diesel engines.

Perkins Diesel Fuel System Cleaner is a proven high-performance detergent product specifically designed for cleaning deposits that form in the fuel system. Deposits in the fuel system reduce system performance and can increase fuel consumption. Perkins Diesel Fuel System Cleaner addresses the deposits formed due to the use of degraded diesel fuel, poor quality diesel fuel, and diesel fuel containing high quantities of high molecular weight compounds. Perkins Diesel Fuel System Cleaner addresses deposits formed due to the use of biodiesel, biodiesel blends, and biodiesel that does not meet the appropriate quality specifications. Continued use of Perkins Diesel Fuel System Cleaner is proven to inhibit the growth of new deposits.

Perkins Diesel Fuel System Cleaner can be added directly to diesel fuel, biodiesel, or biodiesel blends. Perkins Diesel Fuel System Cleaner is a United States Environmental Protection Agency registered fuel additive that can be used with Ultra Low Sulfur Diesel Fuel. In addition this cleaner is appropriate for use with other ultra low, low, and higher sulfur diesel fuels around the world.

Perkins Diesel Fuel System Cleaner is a proven high-performance cleaner that is designed to perform the following:

- Clean performance-robbing fuel system deposits
- Restore fuel economy losses resulting from injector deposits
- Restore power losses resulting from injector deposits
- Eliminate visible black exhaust smoke resulting from injector deposits
- Prevent the formation of new fuel-related deposits

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# Maintenance Interval Schedule (Engines in Base Load Applications)

**Note:** The maintenance intervals for major overhaul and top end overhaul depend on when the engine was built or the engine serial number. Contact your Perkins distributor or Perkins dealer for more information.

## When Required



## Daily



## Every 50 Service Hours or Weekly



## Initial 500 Service Hours



## Every 500 Service Hours or 1 Year



## Every 1500 Service Hours



## Every Year

## Every 3000 Service Hours or 2 Years



## Every 6000 Service Hours or 3 Years



## Every 7500 Service Hours



## Every 20 000 Service Hours



## Commissioning

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# Maintenance Interval Schedule (Engines in Standby Applications)

**Note:** The maintenance intervals for major overhaul and top end overhaul depend on when the engine was built or the engine serial number. Contact your Perkins distributor or Perkins dealer for more information.

## When Required



## Daily or Prior to Starting Stand-by Unit



## Every 50 Service Hours or Weekly



## Initial 500 Service Hours or 24 Months



## Every 500 Service Hours or 24 Months



## Every 1500 Service Hours or 24 Months



## Every 2000 Service Hours



## Every Year

## Every 3000 Service Hours or 2 Years



## Every 6000 Service Hours or 3 Years



## Every 5 Years



## Commissioning

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# Maintenance Interval Schedule (Engines in Prime Power Applications)

**Note:** The maintenance intervals for major overhaul and top end overhaul depend on when the engine was built or the engine serial number. Contact your Perkins distributor or Perkins dealer for more information.

## When Required



## Daily



## Every 50 Service Hours or Weekly



## Initial 500 Service Hours



## Every 500 Service Hours or 1 Year



## Every 1500 Service Hours



## Every Year

## Every 3000 Service Hours or 2 Years



## Every 6000 Service Hours or 3 Years



## Every 7500 Service Hours



## Every 15 000 Service Hours



## Commissioning

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# Aftercooler Core - Clean/Test

**⚠ WARNING**

**Personal injury can result from air pressure.**

**Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.**

**Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.**

**Note:** The aftercooler is combined with the radiator. The core of the aftercooler cannot be removed. Perkins recommends that the individual uses the most appropriate cleaning method for the application and location. The core may be cleaned with a suitable cleaner. The core must be dry before the engine is operated.

1. Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the fan's air flow. Hold the nozzle approximately 6 mm (.25 inch) away from the fins. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.
2. Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water to soften mud. Clean the core from both sides.

NOTICE
Do not use a high concentration of caustic cleaner to clean the core. A high concentration of caustic cleaner can attack the internal metals of the core and cause leakage. Only use the recommended concentration of cleaner.

3. Back flush the aftercooler with a suitable cleaner.
4. Steam clean the aftercooler to remove any residue. Flush the fins of the aftercooler core. Remove any other trapped debris.
5. Wash the aftercooler with hot, soapy water. Rinse the aftercooler thoroughly with clean water.

**⚠ WARNING**

**Personal injury can result from air pressure.**

**Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.**

**Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.**

6. Dry the aftercooler with compressed air. Direct the air in the reverse direction of the normal flow. Remove all fluid from the aftercooler. Ensure that the aftercooler is dry.
7. Inspect the aftercooler to ensure cleanliness. Contact your Perkins distributor to pressure test the aftercooler. If necessary, replace the aftercooler. Contact your Perkins distributor for more information.

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# Aftercooler Core - Inspect

The aftercooler is combined with the radiator, inspect the aftercooler after the radiator and aftercooler has been cleaned.

Inspect the aftercooler for damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Bent fins may be opened with a “comb”. Inspect these items for good condition: Welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

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# Alternator - Inspect

Perkins recommends a scheduled inspection of the alternator. Inspect the alternator for loose connections and correct battery charging. Check the ammeter (if equipped) during engine operation in order to ensure correct battery performance and/or correct performance of the electrical system. Make repairs, as required.

Check the alternator and the battery charger for correct operation. If the batteries are correctly charged, the ammeter reading should be very near zero. All batteries should be kept charged. The batteries should be kept warm because temperature affects the cranking power. If the battery is too cold, the battery will not crank the engine. When the engine is not run for long periods of time or if the engine is run for short periods, the batteries may not fully charge. A battery with a low charge will freeze more easily than a battery with a full charge.

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# Alternator Pulley - Check

**1.** Isolate the electrical supply to the engine.

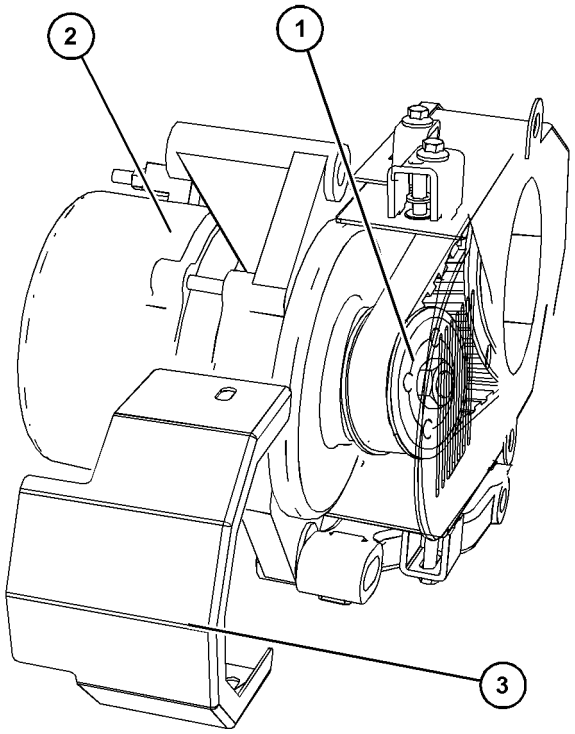


Illustration 35 g06018298
Typical example

**2.** Remove the guard (3) to gain access to the drive pulley (1) for the alternator (2).

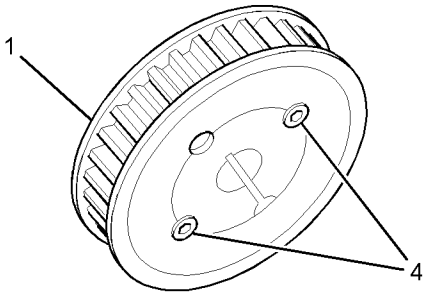


Illustration 36 g01233693
Typical example

**3.** Tighten the grub screws (4) to a torque of 22 N·m (195 lb in).

**4.** Install the guard (3).

**5.** Restore the electrical supply to the engine.

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# Battery - Replace

**WARNING**

**Batteries give off combustible gases which can explode. A spark can cause the combustible gases to ignite. This can result in severe personal injury or death.**

**Ensure proper ventilation for batteries that are in an enclosure. Follow the proper procedures in order to help prevent electrical arcs and/or sparks near batteries. Do not smoke when batteries are serviced.**

**WARNING**

**The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.**

**Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.**

**1.** Check the condition of the battery with a suitable battery tester.

**2.** Switch the engine to the OFF position. Remove all electrical loads.

**3.** Turn off any battery chargers. Disconnect any battery chargers.

**4.** The NEGATIVE “-” cable connects the NEGATIVE “-” battery terminal to the NEGATIVE “-” terminal on the starting motor. Disconnect the cable from the NEGATIVE “-” battery terminal.

**5.** The POSITIVE “+” cable connects the POSITIVE “+” battery terminal to the POSITIVE “+” terminal on the starting motor. Disconnect the cable from the POSITIVE “+” battery terminal.

**Note:** Always recycle a battery. Never discard a battery. Dispose of used batteries to an appropriate recycling facility.

**6.** Remove the used battery.

**7.** Install the new battery.

**Note:** Before the cables are connected, ensure that the engine start switch is OFF.

**8.** Connect the cable from the starting motor to the POSITIVE “+” battery terminal.

**9.** Connect the NEGATIVE “-” cable to the NEGATIVE “-” battery terminal.

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# Battery Electrolyte Level - Check

When the engine is not run for long periods of time or when the engine is run for short periods, the batteries may not fully recharge. Ensure a full charge in order to help prevent the battery from freezing. If batteries are correctly charged, the ammeter reading should be very near zero, when the engine is in operation.

**⚠ WARNING**

**All lead-acid batteries contain sulfuric acid which can burn the skin and clothing. Always wear a face shield and protective clothing when working on or near batteries.**

**1.** Remove the filler caps. Maintain the electrolyte level to the “FULL” mark on the battery.

If the addition of water is necessary, use distilled water. If distilled water is not available use clean water that is low in minerals. Do not use artificially softened water.

**2.** Check the condition of the electrolyte with a suitable battery tester.

**3.** Install the caps.

**4.** Keep the batteries clean.

Clean the battery case with one of the following cleaning solutions:

- Use a solution of 0.1 kg (0.2 lb) baking soda and 1 L (1 qt) of clean water.
- Use a solution of ammonium hydroxide.

Thoroughly rinse the battery case with clean water.

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# Battery or Battery Cable - Disconnect

**⚠ WARNING**

**The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.**

**Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.**

**1.** Turn the start switch to the OFF position. Turn the ignition switch (if equipped) to the OFF position and remove the key and all electrical loads.

**2.** Open the battery isolator. Disconnect the negative battery terminal. Ensure that the cable cannot contact the terminal. When four 12 volt batteries are involved, two negative connections must be disconnected.

**3.** Remove the positive connection.

**4.** Clean all disconnected connection and battery terminals.

**5.** Use a fine grade of sandpaper to clean the terminals and the cable clamps. Clean the items until the surfaces are bright or shiny. DO NOT remove material excessively. Excessive removal of material can cause the clamps to not fit correctly. Coat the clamps and the terminals with a suitable silicone lubricant or petroleum jelly.

**6.** Tape the cable connections to help prevent accidental starting.

**7.** Proceed with necessary system repairs.

**8.** To connect the battery, connect the positive connection before the negative connection.

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# Belts - Inspect/Adjust/Replace (Fan Drive Belts for 4008-30 Only)

## Inspection

**1.** Isolate the electrical supply to the engine.

**2.** Visible inspect fan guards for ware or damage. Repair as necessary.

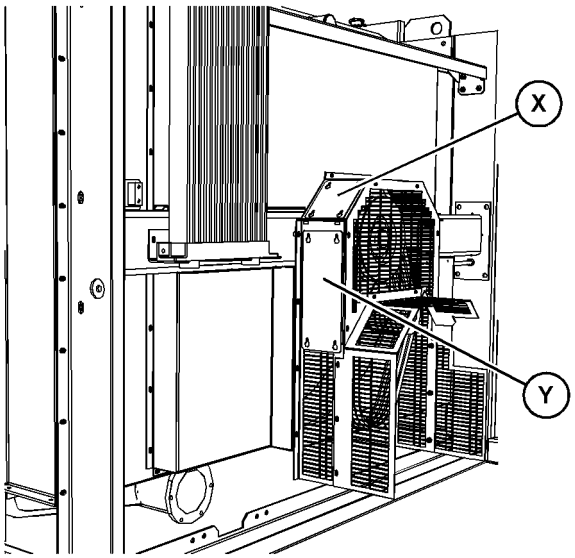


Illustration 37 g06022928
Typical example

**3.** Remove the inspection guard (X) and inspection guard (Y).

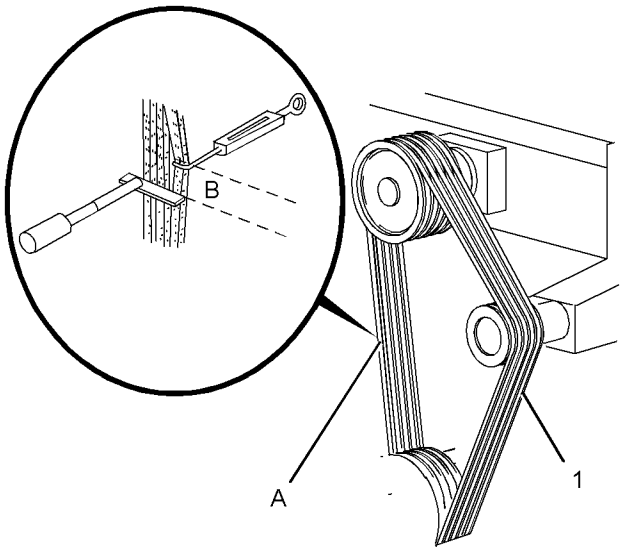


Illustration 38 g02025316
Typical example

**4.** Inspect the belts (1) for cracks. Inspect the belts for contamination. If necessary, replace the belts. Refer to “Replacement” for more information.

**5.** The belt tension must be checked at position A. Use a suitable spring balance and a suitable straight edge to check the belt tension.

**6.** The belt tension should be 62 N (14 lb) with a maximum deflection at position B of 16 mm (0.63 inch).

**7.** Adjust the belts if the belt tension exceeds or is below 62 N (14 lb). Refer to “Adjustment” for more information.

**8.** Install the inspection guard (X) and inspection guard (Y).

**9.** Restore the electrical supply to the engine.

## Adjustment

**1.** Ensure that the electrical supply to the engine is isolated. As required, remove the guards.

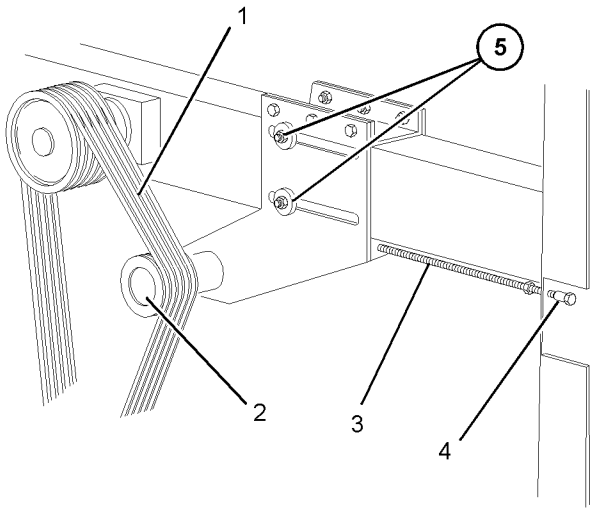


Illustration 39 g06021378
Typical example

**2.** Loosen bolts (5) and loosen the locknut (4).

**3.** Rotate the rod (3) to achieve the correct tension of belts (1). Refer to “Inspection” for the correct specification.

**4.** Tighten the locknut (4) to a torque of 120 N·m (88.5 lb ft). Tighten bolts (5) securely.

**5.** Ensure that the electrical supply to the engine is isolated. Install the guards.

## Replacement

**Note:** Fan drive belts must be replaced as a set. Do not replace individual belts.

### Removal of the Fan Drive Belts

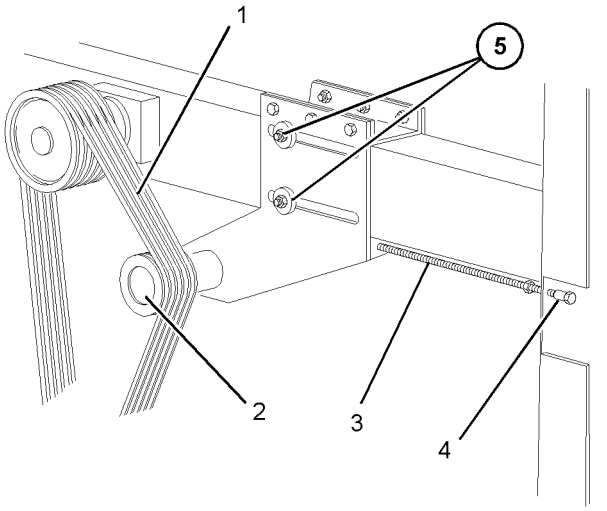


Illustration 40 g06021378
Typical example

**1.** Ensure that the electrical supply to the engine is isolated. As required, remove the guards.

**2.** Loosen bolts (5) and loosen the locknut (4).

**3.** Rotate the rod (3) until the pulley (2) is toward the center of the engine.

**4.** Remove the belts (1).

### Installation of the Fan Drive Belts

**1.** Install new belts (1) over the pulleys.

**2.** Rotate the rod (3) to achieve an initial tension of 77 N (17 lb). The total deflection should not exceed 16 mm (0.63 inch).

**3.** Tighten the locknut (4) to a torque of 120 N·m (88.5 lb ft). Tighten bolts (5) securely.

**4.** Rotate the pulleys for the fan drive belts three to four revolutions to ensure that the fan drive belts are correctly installed. Ensure that the tension is still 77 N (17 lb).

**5.** Restore the electrical supply to the engine. Install the guards.

**6.** Operate the engine for 15 to 20 minutes. Refer to Operation and Maintenance Manual, “Starting the Engine” for the correct procedure.

**7.** Stop the engine. Refer to Operation and Maintenance Manual, “Stopping the Engine” for the correct procedure.

**8.** Isolate the electrical supply to the engine. Remove the guards.

**9.** Loosen bolts (5) and loosen the locknut (4).

**10.** Rotate the rod (3) to achieve a final tension of 62 N (14 lb). The total deflection should not exceed 16 mm (0.63 inch).

**11.** Tighten the locknut (4) to a torque of 120 N·m (88.5 lb ft). Tighten bolts (5) securely.

**12.** Restore the electrical supply to the engine. Install the guards.

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# Belts - Inspect/Adjust/Replace (4006-23 Engine Only)

## Inspect

To maximize the engine performance, inspect the belts for wear and for cracking. Replace belts that are worn or damaged.

To check accurately the belt tension, a suitable gauge should be used.

**1.** Isolate the electrical supply to the engine.

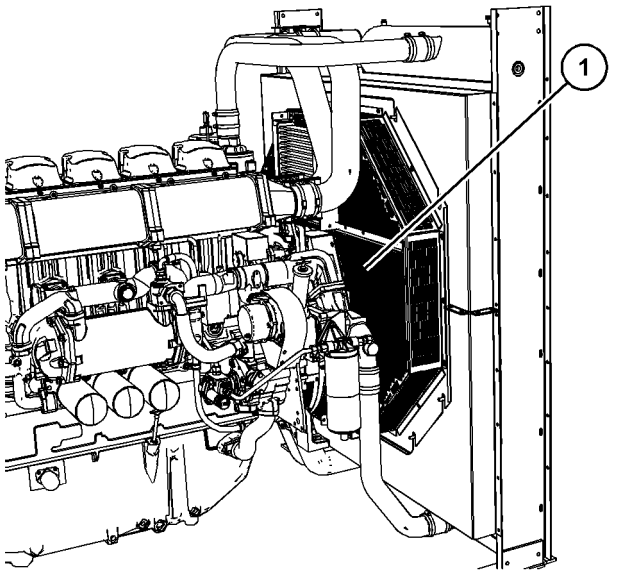


Illustration 41 g06079770

**2.** Visible inspect fan guards for ware or damage. Repair as necessary. Remove the fan guards (1).

**3.** Inspect the belts for cracks, splits, glazing, grease, displacement of the cord and evidence of fluid contamination. If necessary, replace the belts, refer to “Replace” for more information.

## Adjust

**1.** Ensure that the electrical supply to the engine is isolated.

**2.** Using a suitable belt tensioning tool, check the tension of the fan belts. the belt tension should be checked in the middle point between the two pulleys.

- New belt tension should be set to 49 N (11. lb)
- Belt tension range should be from 31 N to 49 N (6.9 lb to 11 lb)
- Belt deflection should be 4.2 mm (0.165 inch)

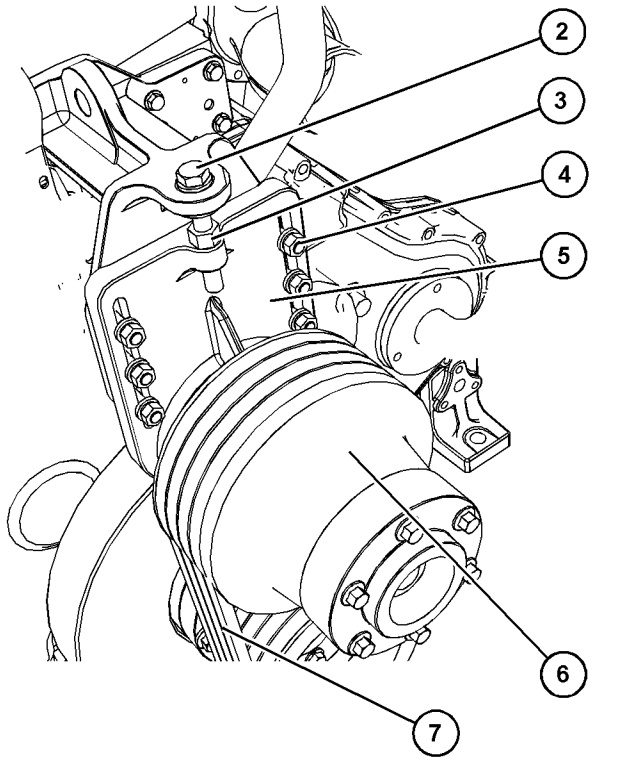


Illustration 42 g06079895

**3.** Each belt must be checked.

**4.** Loosen nuts (4) on fan adjuster plate (5). Loosen lock nut (3).

**5.** Turning bolt (2) counter-clockwise will adjust fan pulley (6) and loosen the fan belts (7).

**6.** Turning bolt (2) clockwise will adjust fan pulley (6) and tighten the fan belts (7).

**7.** When the fan belts (7) are at the required tension, tighten nuts (4) to a torque of 85 N·m (62 lb ft). Then, tighten nut (3) securely.

**8.** Install guards (1) and restore electrical power to the engine.

## Replace

Refer to “Disassembly and Assembly Manual”V-Belts (Fan Drive V-Belts) - Remove and Install for more information.

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# Belts - Inspect/Adjust/Replace (Alternator Belt)

## Inspection

**1.** Isolate the electrical supply to the engine.

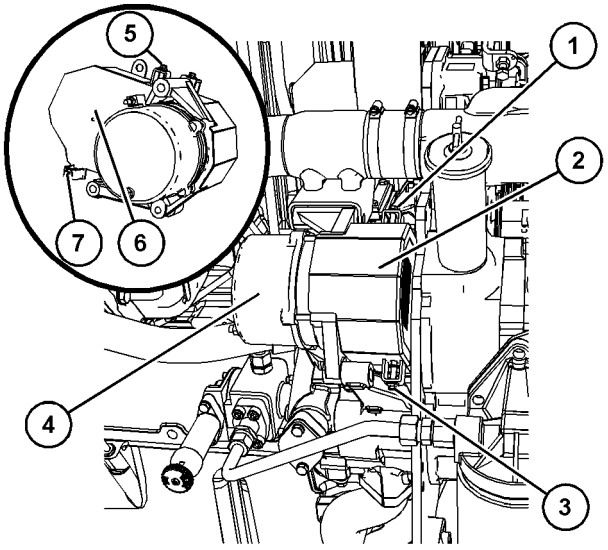


Illustration 43 g06018436

Typical example

**2.** Loosen the bolts (1) and (3). Remove the guard (2) from alternator (4). If necessary, loosen the bolts (5) and (7) remove lower guard (6).

**3.** Inspect the belt (10) for cracks. Inspect the belt for contamination. If necessary, replace the belt. Refer to “Replacement” for more information.

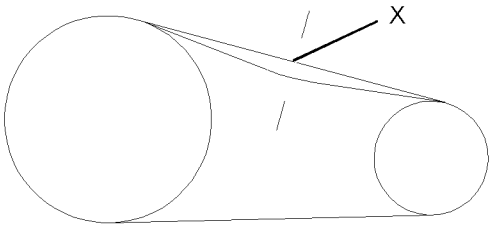


Illustration 44 g01239310

**4.** Apply 4.3 to 8.7 N (1 to 1.9 lb) of pressure at point (X).

The total deflection should not exceed 2.75 mm (0.10 inch).

Replace the belt if the total deflection exceeds 1.5 mm (0.06 inch). Refer to “Replacement” for more information.

**5.** Install the guard (3) and tighten bolts (1) and (3) securely. If necessary, install lower guard (6) and tighten bolts (5) and (7) securely.

**6.** Restore the electrical supply to the engine.

## Adjustment

The alternator belt is a toothed belt. The belt tension is not adjustable. The belt does not require a preload. Light tension will ensure that the belt is a snug fit on the pulleys.

## Replacement

### Removal of the Alternator Belt

**1.** Ensure that the electrical supply to the engine is isolated. Remove the guards, refer to “Inspection” for more information.

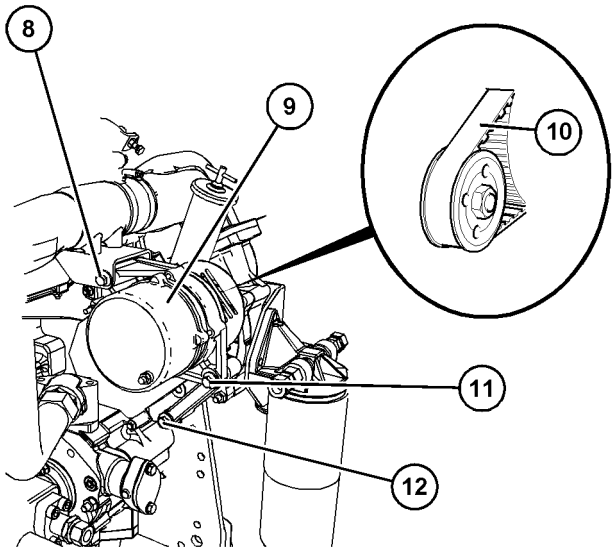


Illustration 45 g06018464
Typical example

**2.** Remove bolt (11) and loosen bolt (12).

**3.** Loosen bolt (8) and push the alternator (9) toward the engine.

**4.** Remove the old belt.

### Installation of the Alternator Belt

**1.** Install new belt (10) over the pulleys.

**Note:** Ensure that the teeth on the belt are engaged with the teeth on the pulleys.

**2.** Pull the alternator (9) away from the engine. Install bolt (11).

**3.** Tighten bolt (12) to a torque of 47 N·m (35 lb ft).

**4.** Tighten bolt (8). Tighten bolt (11) securely.

**5.** Check the tension of the belt. Refer to “Inspection” for the correct procedure.

**6.** Install the guards and restore the electrical supply to the engine.

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## Cooling System Coolant (ELC) - Change

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to Local regulations and mandates.

NOTICE
Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming of the coolant is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

**Note:** When the cooling system is cleaned, only clean water is needed when the Extended Life Coolant (ELC) is drained and replaced.

**Note:** Inspect the water pump and the water temperature regulator after the cooling system has been drained. This inspection is a good opportunity to replace the water pump, the water temperature regulator, and the hoses, if necessary.

## Drain

**⚠ WARNING**

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

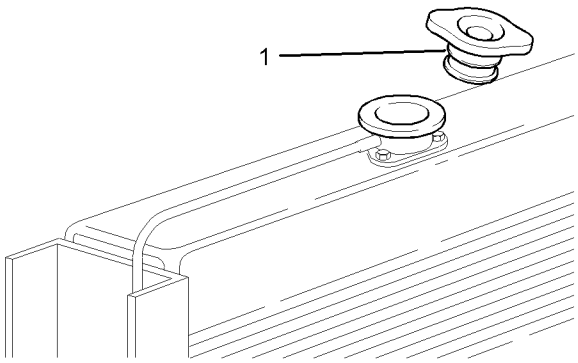


Illustration 46 g01211179
Typical example

**1.** Stop the engine and allow the engine to cool. Isolate the electrical supply to the engine. Loosen the cooling system filler cap (1) slowly to relieve any pressure. Remove the cooling system filler cap.

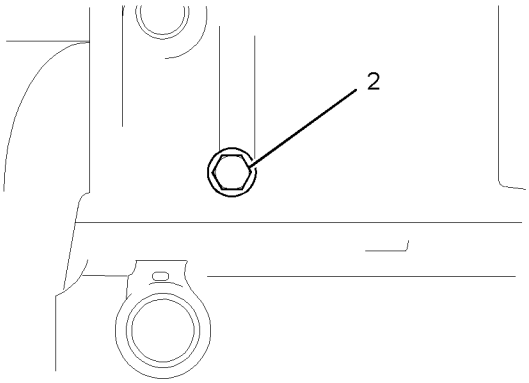


Illustration 47 g01211160
Typical example

**2.** Open the drain cock or remove the drain plug (2) in the cylinder block.

**3.** Open the drain cock or remove the drain plug on the radiator.

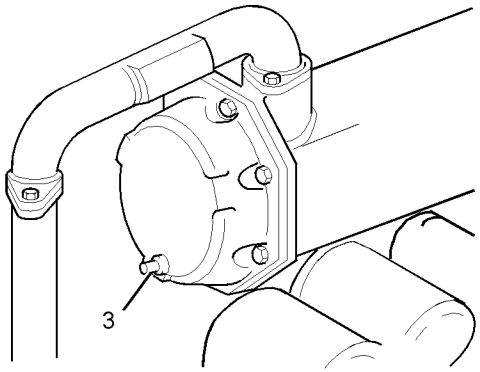


Illustration 48 g01211161
Typical example

**4.** Open the drain cock or remove the drain plug (3) in the oil cooler.

**5.** Allow the coolant to drain.

NOTICE
Dispose of used engine coolant or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Perkins to reclaim the coolant.

For information regarding the disposal and the recycling of used coolant, consult your Perkins distributor.

## Flush

**1.** Flush the cooling system with clean water to remove any debris.

**2.** Close the drain cock or install the drain plug (2) in the cylinder block. Close the drain cock or install the drain plug on the radiator. Close the drain cocks or install the drain plug (3) in the oil cooler. Tighten the plugs securely.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

**3.** Fill the cooling system with clean water.

Install the cooling system filler cap (1).

**4.** Install power to the engine. Start the engine. Operate the engine until the temperature reaches 49 °C to 66 °C (120 °F to 150 °F).

**5.** Stop the engine and allow the engine to cool. Isolate the electrical supply to the engine. Loosen the cooling system filler cap (1) slowly to relieve any pressure. Remove the cooling system filler cap. Open the drain cock or remove the drain plug (2) in the cylinder block. Open the drain cock or remove the drain plug on the radiator. Open the drain cock or remove the drain plug (3) in the oil cooler. Allow the water to drain. Flush the cooling system with clean water.

## Fill

**1.** Close the drain cock or install the drain plug (2) in the cylinder block. Close the drain cock or install the drain plug on the radiator. Close the drain cock or install the drain plug (3) in the oil cooler.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

**2.** Fill the cooling system with Perkins (ELC). Refer to the Operation and Maintenance Manual, “Fluid Recommendations” topic (Maintenance Section) for more information on cooling system specifications.

**Note:** Ensure that the filler cap is installed before operating the engine.

**3.** Install power to the engine. Start the engine. Operate the engine to purge the air from the cavities of the engine block. Use the normal shutdown procedure to stop the engine.

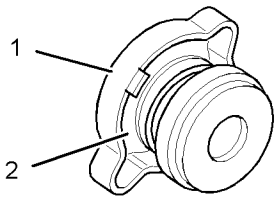


Illustration 49 g01239656
Typical example

**4.** Isolate the electrical supply to the engine. Remove the filler cap. Check that the coolant level is within 25 mm (1.0 inch) of the bottom of the filler pipe. Clean the cooling system filler cap (1) and inspect the seal (2). If the seal is damaged, discard the old filler cap and install a new filler cap. If the seal is not damaged, use a suitable pressurizing pump to pressure test the filler cap. The correct pressure is stamped on the face of the filler cap. If the filler cap does not retain the correct pressure, replace the filler cap.

**5.** Install the cooling system filler cap.

**6.** Install power to the engine. Start the engine and operate the engine. Inspect the cooling system for leaks. Ensure that the cooling system operates at the correct temperature.

i08253526

# Cooling System Coolant - Change

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to Local regulations and mandates.

NOTICE
Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming of the coolant is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

**Note:** Refer to Perkins Diesel Engines Fluids Recommendations, Coolant Recommendations (General Maintenance) for more information on the service life of the recommended coolants.

**Note:** When the cooling system is cleaned, only clean water is needed when the coolant is drained and replaced.

**Note:** Inspect the water pump and the water temperature regulator after the cooling system has been drained. This inspection is a good opportunity to replace the water pump, the water temperature regulator, and the hoses, if necessary.

## Drain

**⚠ WARNING**

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

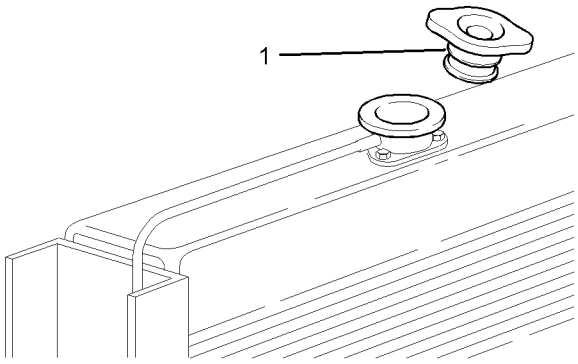


Illustration 50 g01211179
Typical example

**1.** Stop the engine and allow the engine to cool. Isolate the electrical supply to the engine. Loosen the cooling system filler cap (1) slowly to relieve any pressure. Remove the cooling system filler cap.

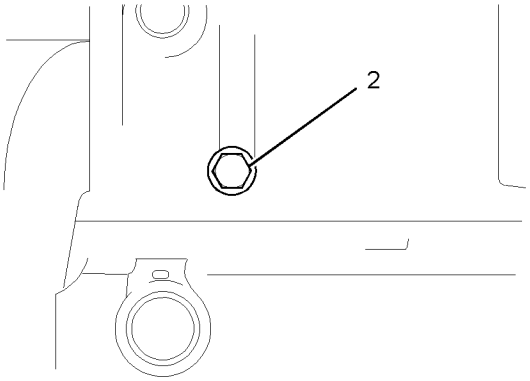


Illustration 51 g01211160
Typical example

**2.** Open the drain cock or remove the drain plug (2) in the cylinder block.

**3.** Open the drain cock or remove the drain plug on the radiator.

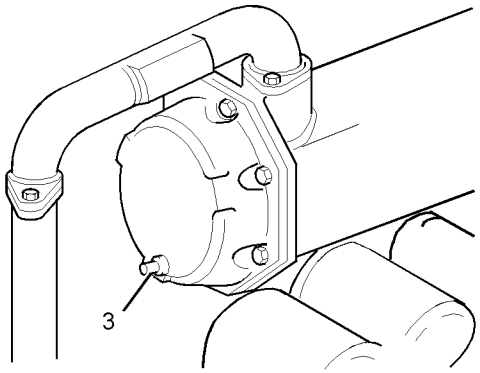


Illustration 52 g01211161
Typical example

**4.** Open the drain cock or remove the drain plug (3) in the oil cooler.

**5.** Allow the coolant to drain.

NOTICE
Dispose of used engine coolant or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Perkins to reclaim the coolant.

For information regarding the disposal and the recycling of used coolant, consult your Perkins distributor.

## Flush

1. Flush the cooling system with clean water to remove any debris.
2. Close the drain cock or install the drain plug (2) in the cylinder block. Close the drain cock or install the drain plug on the radiator. Close the drain cocks or install the drain plug (3) in the oil cooler. Tighten the plugs securely.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

3. Fill the cooling system with clean water.

   Install the cooling system filler cap (1).
4. Install power to the engine. Start the engine. Operate the engine until the temperature reaches 49 °C to 66 °C (120 °F to 150 °F).
5. Stop the engine and allow the engine to cool. Isolate the electrical supply to the engine. Loosen the cooling system filler cap (1) slowly to relieve any pressure. Remove the cooling system filler cap. Open the drain cock or remove the drain plug (2) in the cylinder block. Open the drain cock or remove the drain plug on the radiator. Open the drain cock or remove the drain plug (3) in the oil cooler. Allow the water to drain. Flush the cooling system with clean water.

## Fill

1. Close the drain cock or install the drain plug (2) in the cylinder block. Close the drain cock or install the drain plug on the radiator. Close the drain cock or install the drain plug (3) in the oil cooler.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

2. Fill the cooling system with coolant. Refer to Perkins Diesel Engines Fluids Recommendations for more information on cooling system specifications.

**Note:** Ensure that the filler cap is installed before operating the engine.

3. Install power to the engine. Start the engine. Operate the engine to purge the air from the cavities of the engine block. Use the normal shutdown procedure to stop the engine.

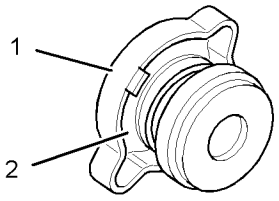


Illustration 53 g01239656
Typical example

4. Isolate the electrical supply to the engine. Remove the filler cap. Check that the coolant level is within 25 mm (1.0 inch) of the bottom of the filler pipe. Clean the cooling system filler cap (1) and inspect the seal (2). If the seal is damaged, discard the old filler cap and install a new filler cap. If the seal is not damaged, use a suitable pressurizing pump to pressure test the filler cap. The correct pressure is stamped on the face of the filler cap. If the filler cap does not retain the correct pressure, replace the filler cap.
5. Install the cooling system filler cap.
6. Install power to the engine. Start the engine and operate the engine. Inspect the cooling system for leaks. Ensure that the cooling system operates at the correct temperature.

i02415245

# Cooling System Coolant Level - Check

**⚠ WARNING**

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

Check the coolant level when the engine is stopped and cool.

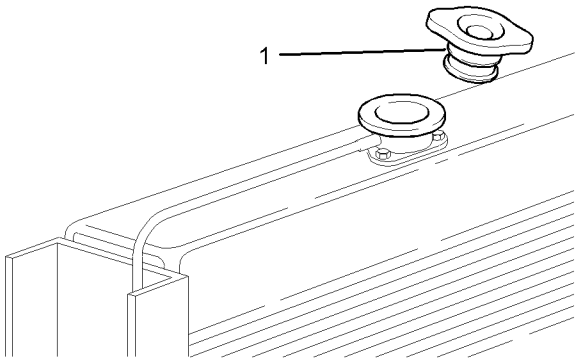


Illustration 54 g01211179

**1.** Remove the cooling system filler cap (1) slowly in order to relieve pressure.

**2.** Maintain the coolant level within 25 mm (1.0 inch) of the bottom of the filler pipe.

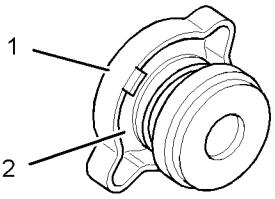


Illustration 55 g01239656

**3.** Clean the cooling system filler cap (1) and inspect the seal (2). If the seal is damaged, discard the old filler cap and install a new filler cap. If the seal is not damaged, use a suitable pressurizing pump in order to pressure test the filler cap. The correct pressure is stamped on the face of the filler cap. If the filler cap does not retain the correct pressure, replace the filler cap.

Install the cooling system filler cap.

**4.** Inspect the cooling system for leaks.

i06683212

# Crankshaft Vibration Damper - Inspect

Depending on the engine variant the engine can be equipped with one or two crankshaft vibration dampers. The crankshaft vibration damper limits the torsional vibration of the crankshaft. Damage to the crankshaft vibration damper can increase torsional vibrations. A damaged vibration damper can result in damage to the crankshaft and to other engine components.

Inspect the dampers for signs of damage, fluid leakage, or heat discoloration.

For more information on inspection the vibration dampers, refer to Systems Operation Testing and Adjusting, Vibration Damper.

i02151646

# Driven Equipment - Check

Refer to the OEM specifications for more information on the following maintenance recommendations for the driven equipment:

- Inspection
- Adjustment
- Lubrication
- Other maintenance recommendations

Perform any maintenance for the driven equipment which is recommended by the OEM.

i06683210

# Engine - Clean

**⚠ WARNING**

**Personal injury or death can result from high voltage.**

**Moisture can create paths of electrical conductivity.**

**Make sure that the electrical system is OFF. Lock out the starting controls and tag the controls “DO NOT OPERATE” .**

NOTICE
Accumulated grease and oil on an engine is a fire hazard. Keep the engine clean. Remove debris and fluid spills whenever a significant quantity accumulates on the engine.

NOTICE
Water or condensation can cause damage to generator components. Protect all electrical components from exposure to water.

NOTICE
Failure to protect some engine components from washing may make your engine warranty invalid. Allow the engine to cool for 1 hour before washing the engine.

Periodic cleaning of the engine is recommended. A clean engine provides the following benefits:

- Easy detection of fluid leaks
- Maximum heat transfer characteristics
- Ease of maintenance

**Note:** Caution must be used to prevent electrical components from being damaged by excessive water when the engine is cleaned. Pressure washers and steam cleaners should not be directed at any electrical connectors or the junction of cables into the rear of the connectors. Avoid electrical components such as the alternator, the starting motors, and the ECU.

Ensure that care is taken that the safety labels, emission label, and any information labels are not removed during engine cleaning.

i06683217

# Engine Air Cleaner Element - Replace

NOTICE
Never run the engine without an air cleaner element installed. Never run the engine with a damaged air cleaner element. Do not use air cleaner elements with damaged pleats, gaskets or seals. Dirt entering the engine causes premature wear and damage to engine components. Air cleaner elements help to prevent airborne debris from entering the air inlet.

NOTICE
Never service the air cleaner element with the engine running since this will allow dirt to enter the engine.

Renew the air filter elements if the service indicators are triggered. Refer to Operation and Maintenance Manual, “Engine Air cleaner Service Indicator - Inspect” for more information.

Some engines are equipped with air intake precleaners. Clean the precleaners before maintenance is performed on the air filters. Ensure that dirt does not enter the housing of the air cleaner.

## 4008-30 Air Cleaner

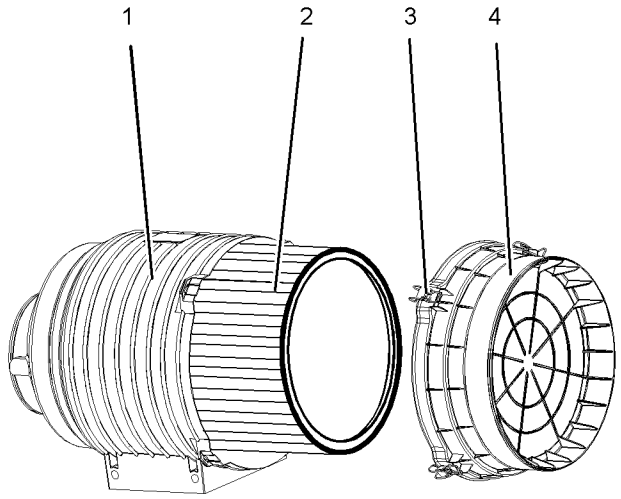


Illustration 56 g02041313
4008-30

**1.** Isolate the electrical supply to the engine.

**2.** Release the clips (3) and remove end cover (4).

**3.** Remove the old element (2) from the housing (1). Discard the old element.

**Note:** Ensure that dirt does not enter the housing.

**4.** Install a new element (2) into the housing (1). Align the end cover (3) to the housing (1). Secure the clips (3). Ensure that both filter elements are replaced at the same time.

### 4006-23 Air Cleaner

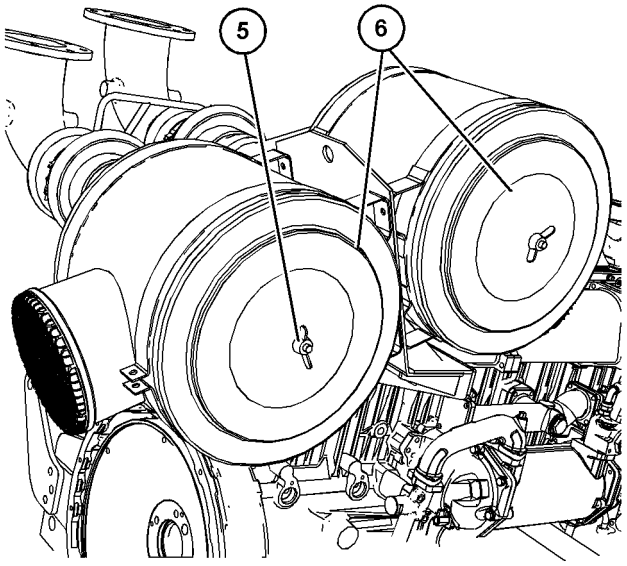


Illustration 57 g06073787

**1.** Both the end caps (6) on the 4006-23 engine are secured by one central nut (5). Ensure that both filter elements (not shown) are replaced at the same time.

**End By:**

**a. Install electrical power to the engine.**

i02415251

# Engine Air Cleaner Service Indicator - Inspect

## Service Indicator Check

Check the service indicators. Replace the air filter elements if one of service indicators has been triggered.

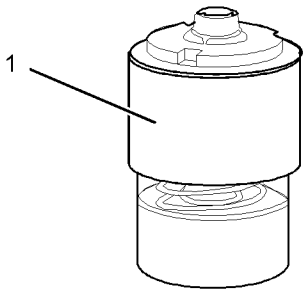


Illustration 58 g01242320

When the air filter element is in a serviceable condition, the center section of the service indicator (1) is clear.

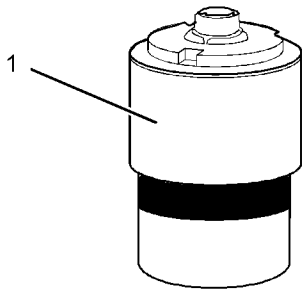


Illustration 59 g01242332

When the air filter element requires replacement, the center section of the service indicator (1) is red.

## Service Indicator Reset

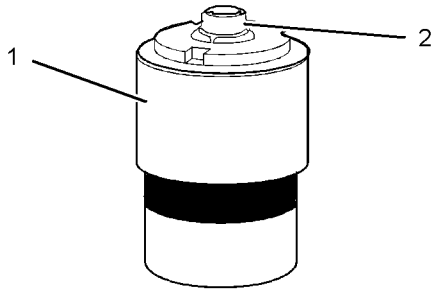


Illustration 60 g01242328

Once the service indicator has been triggered and when the air filter element has been replaced, the service indicator must be reset. In order to reset the service indicator (1), press the button (2).

If the service indicator does not reset easily, the service indicator should be replaced.

**Note:** The service indicator may need to be replaced frequently in environments that are severely dusty.

i06682477

# Engine Crankcase Breather - Clean
(4006-23 Engine Only)

**Note:** The maintenance and maintenance period for the 4006-23 engine is different from the maintenance and maintenance period for the 4008-30 engine.

**1.** Isolate the electrical supply to the engine.

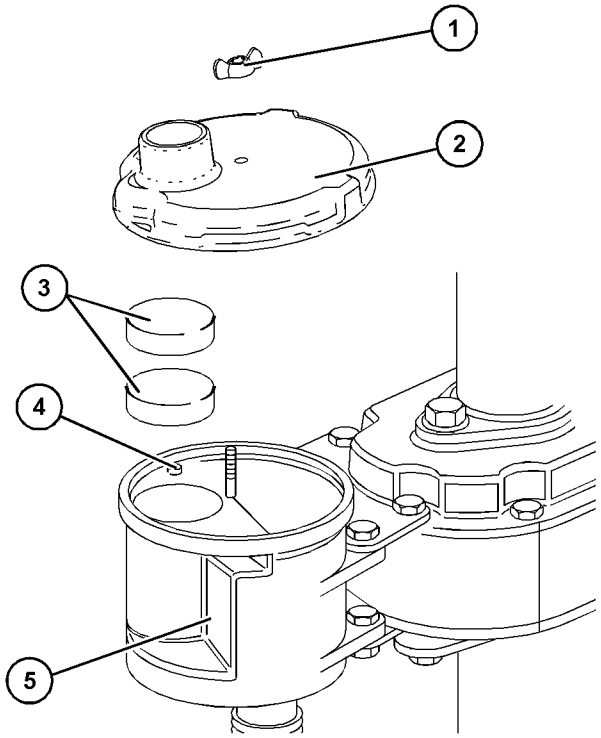


Illustration 61 g06073321
Typical example

**2.** Remove nut (1) and remove breather cap (2) from breather body (5).

**3.** Remove both breather elements (3) from breather body (5). Use a suitable cleaner to clean both breather elements (3). If necessary, replace the breather elements (3).

**4.** Install breather element (3) into breather body (5). Before installing breather cap (2) check seal (not shown) for breather cap (2) and replace if necessary.

**5.** Install breather cap (2) on to breather body (5), insuring that alignment dowel (4) aligns to the breather cap (2). Install nut (1) and tighten nut (1) securely.

**6.** Connect power, start engine, and check for leaks.

i06682626

# Engine Crankcase Breather - Clean
(4008-30 Engine Only)

**Note:** The maintenance and maintenance period for the 4008-30 engine is different from the maintenance and maintenance period for the 4006-23.

The breather has no filter element that needs to be replaced. The breather will only require cleaning.

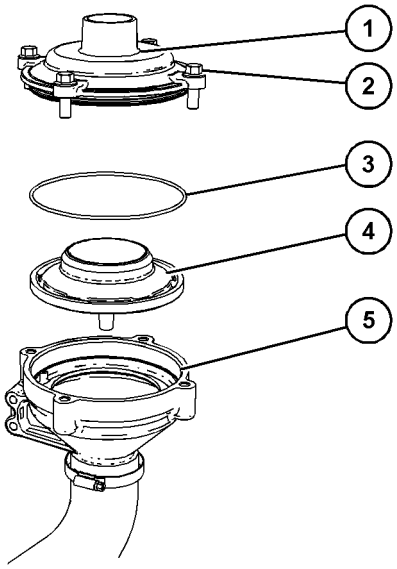


Illustration 62 g06009120

Typical example

**1.** Isolate the electrical supply to the engine.

**2.** Ensure that the outer casing of the breather is clean and free from dirt. Remove the bolts (2) and remove cover (1) from breather body (5).

**3.** Remove O ring seal (3) and discard.

**4.** Remove breather baffle (4) and clean the breather baffle, cover, and breather body.

**5.** Install cleaned breather baffle (4) into clean breather body (5). Install new O ring seal (3) onto cover (1) and install cover to breather body (5).

**6.** Install bolts (1) and tighten bolts to a torque of 50 N·m (36 lb ft). Install power to the engine.

i02415257

# Engine Mounts - Inspect

Misalignment of the engine and the driven equipment will cause extensive damage. Excessive vibration can lead to misalignment. Excessive vibration of the engine and the driven equipment can be caused by the following conditions:

- Improper mounting
- Loose bolts
- Deterioration of the isolators

Ensure that the mounting bolts are tightened to the correct torque.

Ensure that the isolators are free of oil and contamination. Inspect the isolators for deterioration. Ensure that the bolts for the isolators are tightened to the correct torque.

Replace any isolator that shows deterioration. For more information, see the literature that is provided by the OEM of the isolators.

i06523396

# Engine Oil Level - Check

**⚠ WARNING**

**Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.**

NOTICE
Perform this maintenance with the engine stopped.

**Note:** After the engine has been switched OFF, wait for 10 minutes to allow the engine oil to drain to the oil pan. Then check the oil level.

NOTICE
Operating your engine when the oil level is above the “Max” mark could cause your crankshaft to dip into the oil. The air bubbles created from the crankshaft dipping into the oil reduces the oils lubricating characteristics and could result in the loss of power.

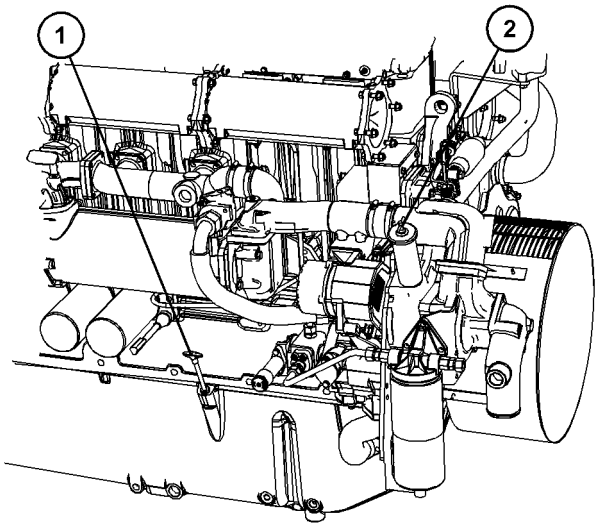


Illustration 63 g06008596

Typical example

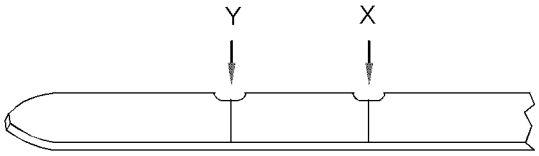


Illustration 64 g01165836

(Y) “Min” mark. (X) “Max” mark.

1. Maintain the oil level between the “Min” mark (Y) and the “Max” mark (X) on the engine oil level gauge (1). Do not fill the oil pan above the “Max” mark (X).
2. If necessary, remove the oil filler cap (2) and add oil. Clean the oil filler cap. Install the oil filler cap.

i03883009

# Engine Oil Pump - Inspect

A failed engine oil pump may result in a seizure of the crankshaft.

Remove the engine oil pump and disassemble the engine oil pump. Replace any components that are worn or damaged. Alternatively, replace the engine oil pump.

i02415262

# Engine Oil Sample - Obtain

The condition of the engine lubricating oil should be checked at regular intervals as part of the preventive maintenance program.

## Initiating an Oil analysis Program

### The First 500 Hours

Oil analysis in the first 500 hours will show higher levels of iron and copper than acceptable parameters. As the engine continues to operate the levels will drop within the specified parameters.

### Every 250 Hours

An oil sample should be obtained at 250 hour intervals.

A trend can be established by analyzing the results of the oil sampling. Each individual operator can develop a service program for the engine.

**Note:** Perkins Engines Stafford must agree to the maintenance schedule.

## Obtain the Sample and the Analysis

**⚠ WARNING**

**Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.**

The oil sample must be taken from the mean level in the engine oil pan. Do not take an oil sample from the drain plug.

In order to help obtain the most accurate analysis, record the following information before an oil sample is taken:

- The date of the sample
- Engine model
- Engine number
- Service hours on the engine

- The number of hours that have accumulated since the last oil change
- The amount of oil that has been added since the last oil change

Ensure that the container for the sample is clean and dry. Also ensure that the container for the sample is clearly labelled.

To ensure that the sample is representative of the oil in the crankcase, obtain a warm, well mixed oil sample.

To avoid contamination of the oil samples, the tools and the supplies that are used for obtaining oil samples must be clean.

The sample can be checked for the following: the quality of the oil, the existence of any coolant in the oil, the existence of any ferrous metal particles in the oil and the existence of any nonferrous metal particles in the oil.

i07198738

# Engine Oil and Filter - Change

**⚠ WARNING**

**Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.**

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

NOTICE
Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Do not drain the engine lubricating oil when the engine is cold. As the engine lubricating oil cools, suspended waste particles settle on the bottom of the oil pan. The waste particles are not removed with draining cold oil. Drain the oil pan with the engine stopped. Drain the oil pan with the oil warm. This draining method allows the waste particles that are suspended in the oil to be drained properly.

Failure to follow this recommended procedure will cause the waste particles to be recirculated through the engine lubrication system with the new oil.

## Oil and Filter Change Intervals

The standard engine oil and filter change period is 500 hours. There are several other factors that can alter the standard engine oil and filter change of 500 hours.

- If the engine is using engine oil analysis to determine oil and filter change period.
- The engine is working in a severe service environment/Load Factor
- Infrequent operation of the engine

Refer to this Operation and Maintenance Manual, “Severe Service Application” for more information on reducing the engine oil and filter change period. For severe service applications the recommended oil and filter change period is 250 hours.

If the engine is operated in severe service conditions, Perkins recommends the use of engine oil sampling. Refer to this Operation and Maintenance Manual, Engine Oil sample - Obtain for more information.

If the engine is operated infrequently less than 500 hours in a 12-month period, then the engine oil and filter change should be conducted yearly.

## Drain the Engine Lubricating Oil

Operate the engine so that the lubricating oil is warm, then stop the engine. Isolate the electrical power to the stater.

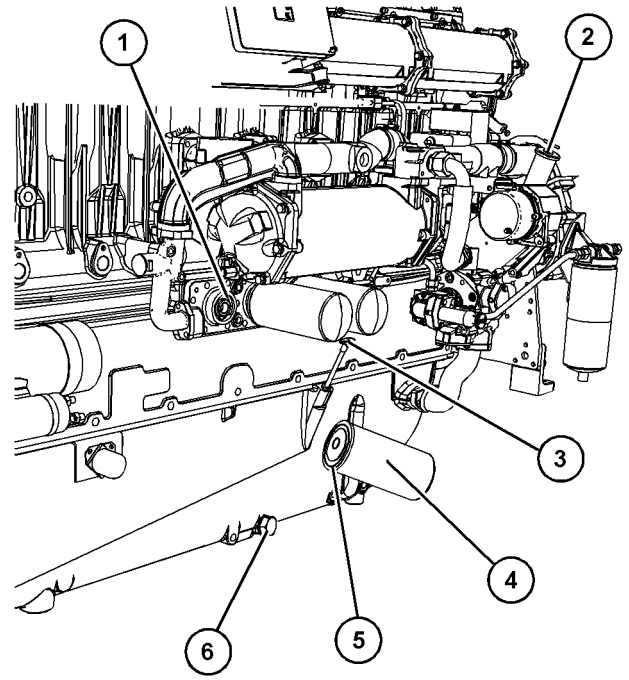


Illustration 65 g06009948
Typical example

**1.** Place a suitable container below the engine oil pan. Remove the drain plug (6). Allow the engine oil to drain.

**Note:** Ensure that the vessel that will be used is large enough to collect the waste oil.

**2.** Remove the sealing washer from the drain plug (6). Discard the sealing washer.

**3.** Install a new sealing washer to the drain plug (6). Install the drain plug to the engine oil pan. Tighten the plug to a torque of 68 N·m (50 lb ft).

## Replace the Oil Filter

Table 14

| Required Tools | | | |
|---|---|---|---|
| **Tool** | **Part Number** | **Part Name** | **Qty** |
| **A** | - | Strap Wrench | 1 |

**Note:** Ensure that all 3 oil filters are changed as a set.

**1.** Use Tooling (A) to remove the oil filters (4) and discard.

**2.** Ensure that the sealing face of the filter base (1) is clean and free from dirt.

**3.** Lubricate the sealing rings (5) with clean engine oil. Install the new oil filter (4).

**Note:** Apply hand pressure only to tighten the oil filters.

**4.** Spin on the oil filter until the O ring seal contacts the sealing surface (1). Then rotate the oil filter ¾ of a full turn. After all the oil filters have been replaced, fill the oil pan.

## Fill the Oil Pan

Refer to Operation and Maintenance Manual, “Fluid Recommendations” for information on suitable oils.

**1.** Remove the oil filler cap (2).

**2.** Fill the oil pan with the correct amount of new engine lubricating oil and install the filler cap. Refer to Operation and Maintenance Manual, “Refill Capacities” for more information. Restore electrical power to the starter.

NOTICE
If equipped with an auxiliary oil filter system or a remote filter system, follow the OEM or the filter manufactures recommendations. Under-filling or over filling the crankcase with oil can cause engine damage.

**Note:** Before starting the engine, the engine oil system must be primed. Refer to Operation and Maintenance Manual, “Before Starting Engine” for the procedure to prime the engine oil system.

**3.** Start the engine and run the engine for 2 minutes. Perform this procedure to ensure that the lubrication system has oil and that the oil filters are filled. Inspect the oil filters for oil leaks.

**4.** Stop the engine and allow the oil to drain back to the oil pan for a minimum of 10 minutes.

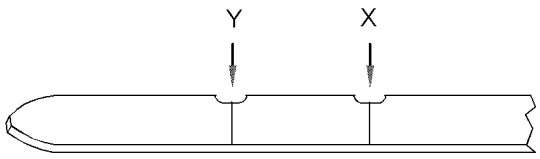


Illustration 66 g01165836

(Y) “Min” mark. (X) “Max” mark.

**5.** Remove the engine oil level gauge (3) to check the oil level. Maintain the oil level between the “MIN” and “MAX” marks on the engine oil level gauge.

i02461963

# Engine Protective Devices - Check

Alarms and shutoffs must function properly. Alarms provide timely warning to the operator. Shutoffs help to prevent damage to the engine. It is impossible to determine if the engine protective devices are in good working order during normal operation. Malfunctions must be simulated in order to test the engine protective devices.

A calibration check of the engine protective devices will ensure that the alarms and shutoffs activate at the setpoints. Ensure that the engine protective devices are functioning properly.

NOTICE
During testing, abnormal operating conditions must be simulated.

The tests must be performed correctly in order to prevent possible damage to the engine.

To prevent damage to the engine, only authorized service personnel or your Perkins dealer should perform the tests.

## Visual Inspection

Visually check the condition of all gauges, sensors and wiring. Look for wiring and components that are loose, broken, or damaged. Damaged wiring or components should be repaired or replaced immediately.

i09415387

# Engine Valve Lash - Inspect/ Adjust
(Valves and Valve Bridges)

**⚠ WARNING**

**Ensure that the engine cannot be started while this maintenance is being performed. To help prevent possible injury, do not use the starting motor to turn the flywheel.**

**Hot engine components can cause burns. Allow additional time for the engine to cool before measuring/adjusting valve lash clearance.**

NOTICE
Only qualified service personel should perform this maintenance. Refer to the Service Manual or your authorized Perkins dealer or your Perkins distributor for the complete valve lash adjustment procedure.

Operation of Perkins engines with incorrect valve lash can reduce engine efficiency, and also reduce engine component life.

**Note: The valve bridges must be equalized before the valve lash is adjusted.**

Record the valve clearance. Refer to Systems Operation, Testing and Adjusting, “Valve Lash - Adjust” for the correct procedure.

**Note:** The valve depth is to be measured at every service. The valve recession can then be calculated. A valve recession tool has been designed to give service personnel a good indication of the cylinder head valve recession or cylinder head valve seat wear without the need to remove the cylinder heads. Refer to Operation and Maintenance Manual, Overhaul (Top End) or contact your Perkins distributor for more information.

i08253393

# Fan Drive Pulley - Check
(4008-30 Engine Only)

**1.** Isolate the electrical supply to the engine.

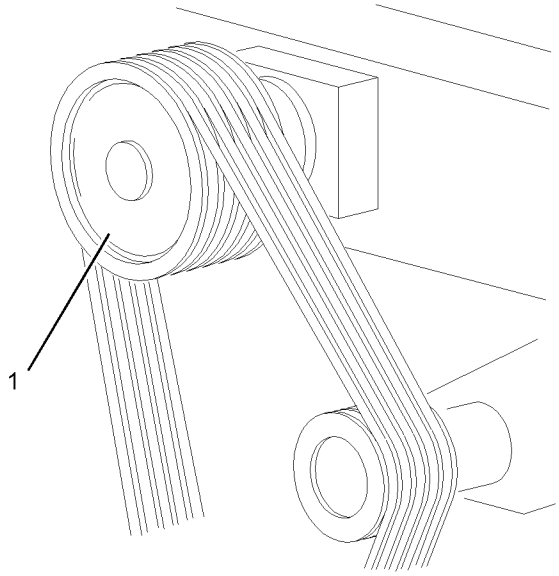


Illustration 67 g01238304
Typical example

**2.** Remove the guards (not shown) to gain access to the fan drive pulley (1).

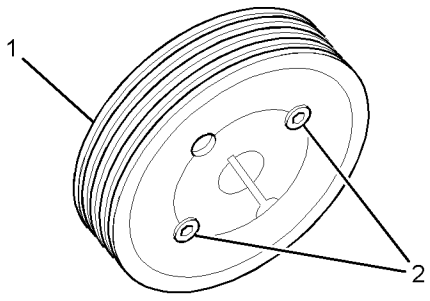


Illustration 68 g01238305

**3.** Tighten the grub screws (2) to a torque of 90 N·m (66 lb ft).

**4.** Lubricate the fan drive bearing.

**5.** Lubricate the jockey pulley/tensioner.

**6.** Install the guards (not shown).

**7.** Restore the electrical supply to the engine.

i03783899

# Fuel Injector - Inspect/Adjust

NOTICE
Only qualified service personnel should perform this maintenance. Refer to the Service Manual or your authorized Perkins distributor for the complete procedure in order to inspect or adjust the fuel injectors.

Operation of Perkins engines with fuel injectors that have not been inspected or adjusted can reduce engine efficiency, and also reduce engine component life.

Refer to Systems Operation, Testing and Adjusting, “Fuel Injector Adjustment” for the correct procedures to inspect and adjust the fuel injectors.

i06530425

# Fuel System - Prime

If air enters the fuel system, the air must be purged from the fuel system before the engine can be started. Air can enter the fuel system when the following events occur:

- The fuel day tank is empty or partially drained
- The low-pressure fuel lines are disconnected
- A leak exists in the low-pressure fuel system
- The fuel filter has been replaced

Use the following procedures to remove air from the fuel system.

NOTICE
Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

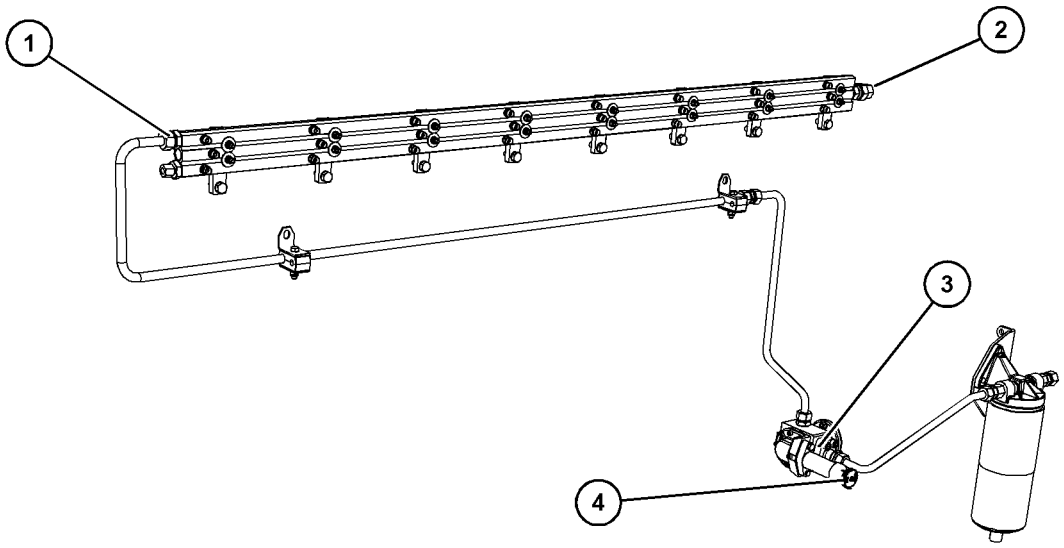


Illustration 69 g06010017

**1.** Ensure that there is an adequate level of fuel in the fuel tank. If equipped, ensure that the fuel supply valve is in the ON position.

**2.** Loosen the connector (1) and unscrew fuel pump handle (4). Operate pump handle until fuel fee from air flows from the connection. Clean up any fuel that is spilled during fuel priming.

**3.** Tighten connection (1) and loosen connection (2). Operate pump handle until fuel fee from air flows from the connection. Tighten connection (2). Clean up any fuel that is spilled during fuel priming. Operate pump handle (4) to increase the pressure in the low-pressure fuel system.

**4.** Push the handle and twist the handle to return the pump handle to the locked position.

**5.** Operate the starting motor and crank the engine. After the engine has started, run the engine for a minimum of 5 minutes to remove any trapped air within the fuel system.

i08253395

# Fuel System Filter - Replace

**⚠ WARNING**

**Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.**

NOTICE
Ensure that the engine is stopped before any servicing or repair is performed.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

NOTICE
Ensure that the battery is isolated, before any servicing or repair is performed.

NOTICE
The water separator can be under suction during normal engine operation. Ensure that the drain valve is tightened securely to help prevent air from entering the fuel system.

## Fuel Filter with Water Separator

Table 15

| Required Tools | | | |
|---|---|---|---|
| **Tool** | **Part Number** | **Part Name** | **Qty** |
| **A** | - | Strap Wrench | 1 |

**1.** Isolate the fuel supply to the engine.

**2.** Place a suitable container under the fuel filter to catch any fuel that might spill.

**Note:** Clean up any spilled fuel immediately.

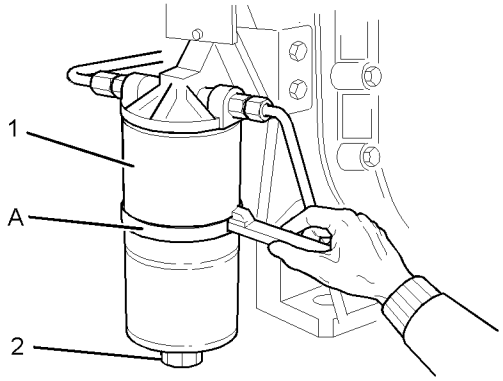


Illustration 70 g02775756

Typical example

**3.** Loosen the drain plug (2). Allow the fluid to drain into the container.

**4.** Clean the outside of the fuel filter. Use Tooling (A) to remove the canister (1). Dispose of the canister in accordance with local regulations.

**5.** Lubricate the O-ring seal on the new canister with clean fuel oil. Install the new canister. Tighten the canister by hand.

**6.** Tighten the drain plug (2) to a torque of 1.5 to 2 N·m (13.3 to 17.7 lb in).

**7.** Restore the fuel supply to the engine.

**8.** Prime the fuel system. Refer to the Operation and Maintenance Manual, “Fuel System - Prime” for more information.

**9.** Start the engine and run the engine. Check the fuel system for leaks.

i08253399

# Fuel System Primary Filter/ Water Separator - Drain

**⚠ WARNING**

**Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.**

NOTICE
Ensure that the engine is stopped before any servicing or repair is performed.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

NOTICE
The water separator can be under suction during normal engine operation. Ensure that the drain valve is tightened securely to help prevent air from entering the fuel system.

**1.** Place a suitable container under the water separator to catch any fuel that might spill.

**Note:** Clean up any spilled fuel immediately.

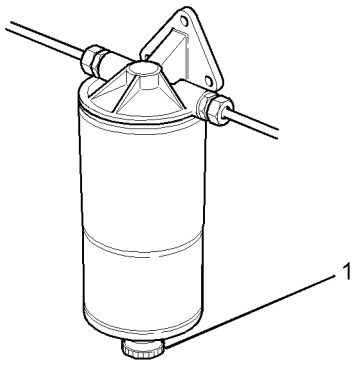


Illustration 71 g01237449
Typical example

**2.** Loosen the drain plug (1). Allow the fluid to drain into the container until clean fuel can be seen.

**3.** Tighten the drain plug (1) to a torque of 1.5 to 2 N·m (13.3 to 17.7 lb in).

i02335436

# Fuel Tank Water and Sediment - Drain

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

## Fuel Tank

Fuel quality is critical to the performance and to the service life of the engine. Water in the fuel can cause excessive wear to the fuel system.

Water can be introduced into the fuel tank when the fuel tank is being filled.

Condensation occurs during the heating and cooling of fuel. The condensation occurs as the fuel passes through the fuel system and the fuel returns to the fuel tank. This causes water to accumulate in fuel tanks. Draining the fuel tank regularly and obtaining fuel from reliable sources can help to eliminate water in the fuel.

## Drain the Water and the Sediment

Fuel tanks should contain some provision for draining water and draining sediment from the bottom of the fuel tanks.

Open the drain valve on the bottom of the fuel tank in order to drain the water and the sediment. Close the drain valve.

Check the fuel daily. Allow five minutes after the fuel tank has been filled before draining water and sediment from the fuel tank.

Fill the fuel tank after operating the engine in order to drive out moist air. This will help prevent condensation. Do not fill the tank to the top. The fuel expands as the fuel gets warm. The tank may overflow.

Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe. Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

## Fuel Storage Tanks

Drain the water and the sediment from the fuel storage tank at the following intervals:

- Weekly
- Service intervals
- Refill of the tank

This will help prevent water or sediment from being pumped from the storage tank into the engine fuel tank.

If a bulk storage tank has been refilled or moved recently, allow adequate time for the sediment to settle before filling the engine fuel tank. Internal baffles in the bulk storage tank will also help trap sediment. Filtering fuel that is pumped from the storage tank helps to ensure the quality of the fuel. When possible, water separators should be used.

i08246207

# Fuel Transfer Pump (Lift Pump) - Inspect

Visually inspect the lift pump for leaks. The lift pump is not a serviceable item.

Replace a lift pump that is faulty. Replace a lift pump that leaks.

Refer to Disassembly and Assembly, Fuel Transfer Pump - Remove and Install (Lift Pump) for the correct procedure.

i02471680

# Governor Actuator - Check

In order for the governor to operate correctly, the control box must be calibrated to the actuator. The feedback parameters from the control box must correspond to the 0% and the 100% positions on the actuator. Carry out a periodic calibration check of the governor system. Refer to Special Instruction, “Pandoras Digital Governor” for more information.

i06756621

# Hoses and Clamps - Inspect/ Replace

**⚠ WARNING**

**Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.**

If you inspect the engine in operation, always use the proper inspection procedure to avoid a fluid penetration hazard. Refer to Operation and Maintenance Manual, “General hazard Information”.

Inspect all hoses for leaks that are caused by the following conditions:

- Cracking
- Softness
- Loose clamps

Replace hoses that are cracked or soft. Tighten any loose clamps.

Check for the following conditions:

- End fittings that are damaged or leaking
- Outer covering that is chafed or cut
- Exposed wire that is used for reinforcement
- Outer covering that is ballooning locally
- Flexible part of the hose that is kinked or crushed
- Armoring that is embedded in the outer covering

A constant torque hose clamp can be used in place of any standard hose clamp. Ensure that the constant torque hose clamp is the same size as the standard clamp.

Due to extreme temperature changes, the hose will harden. Hardening of the hoses will cause hose clamps to loosen. This action can result in leaks. A constant torque hose clamp will help to prevent loose hose clamps.

Each installation application can be different. The differences depend on the following factors:

- Type of hose
- Type of fitting material
- Anticipated expansion and contraction of the hose
- Anticipated expansion and contraction of the fittings

## Replace the Hoses and the Clamps

Refer to the OEM information for further information on removing and replacing fuel hoses (if equipped).

The coolant system and the hoses for the coolant system are not usually supplied by Perkins. The following text describes a typical method of replacing coolant hoses. Refer to the OEM information for further information on the coolant system and the hoses for the coolant system.

**⚠ WARNING**

**Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.**

**1.** Stop the engine. Allow the engine to cool.

**2.** Loosen the cooling system filler cap slowly to relieve any pressure. Remove the cooling system filler cap.

**Note:** Drain the coolant into a suitable, clean container. The coolant can be reused.

**3.** Drain the coolant from the cooling system to a level that is below the hose that is being replaced.

**4.** Remove the hose clamps.

**5.** Disconnect the old hose.

**6.** Replace the old hose with a new hose.

**7.** Install the hose clamps with a torque wrench.

**Note:** For the correct coolant, see this Operation and Maintenance Manual, “Fluid Recommendations”.

**8.** Refill the cooling system. Refer to the OEM information for further information on refilling the cooling system.

**9.** Clean the cooling system filler cap. Inspect the cooling system filler cap seals. Replace the cooling system filler cap if the seals are damaged. Install the cooling system filler cap.

**10.** Start the engine. Inspect the cooling system for leaks.

## Clamps and V-Band Locations

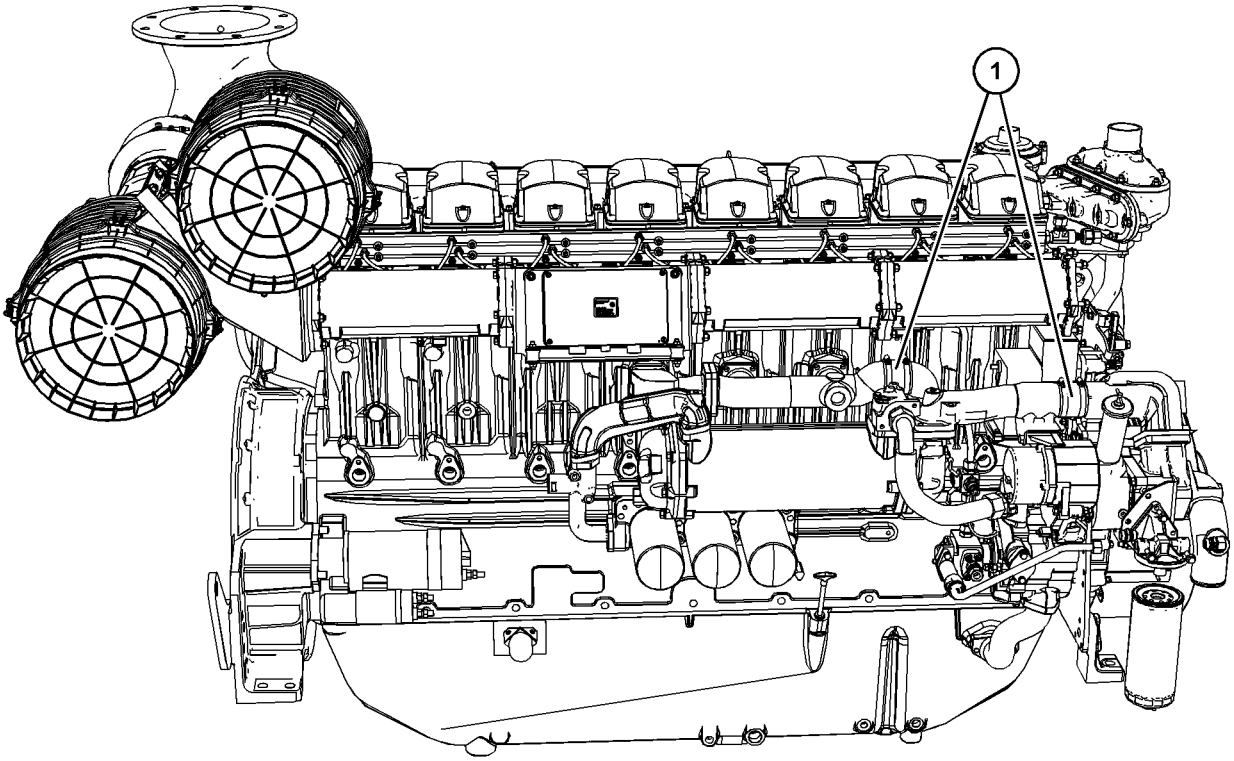


Illustration 72 g06117407

(1) Clamp torque 7 N·m (62 lb in)

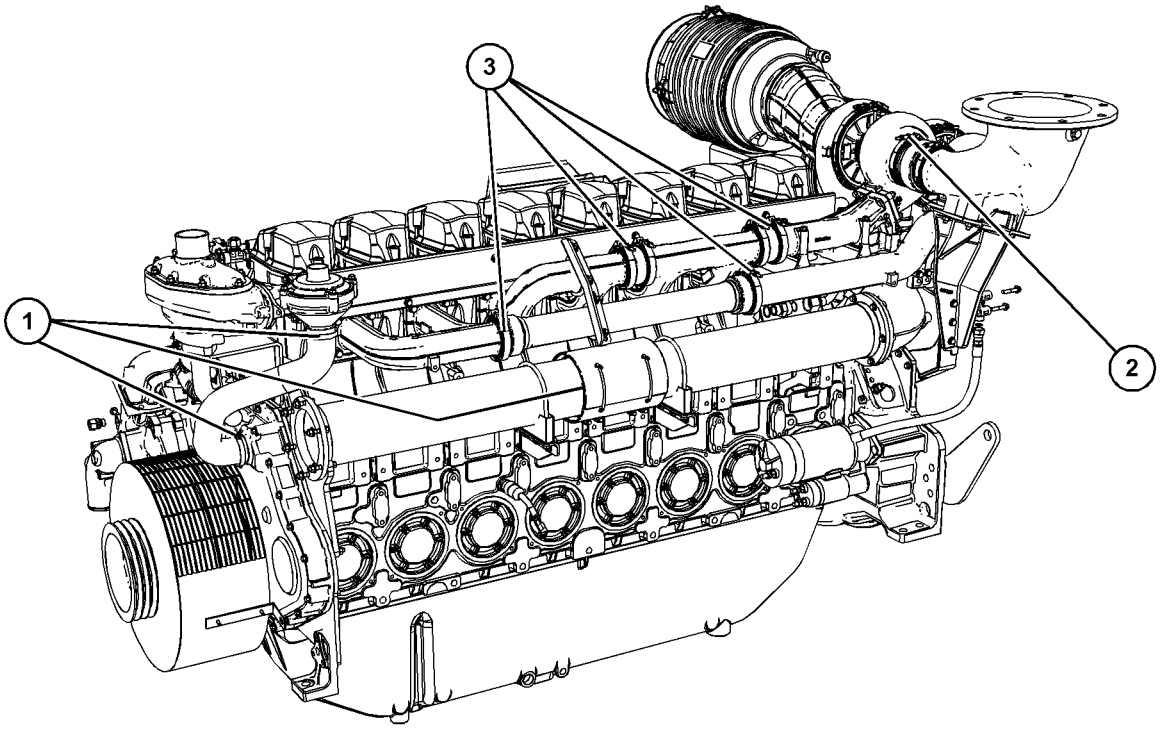


Illustration 73 g06117430

(1) Clamp torque 7 N·m (62 lb in) (2) Clamp torque 9 N·m (79 lb in) (3) Clamp torque 10 N·m (88 lb in)

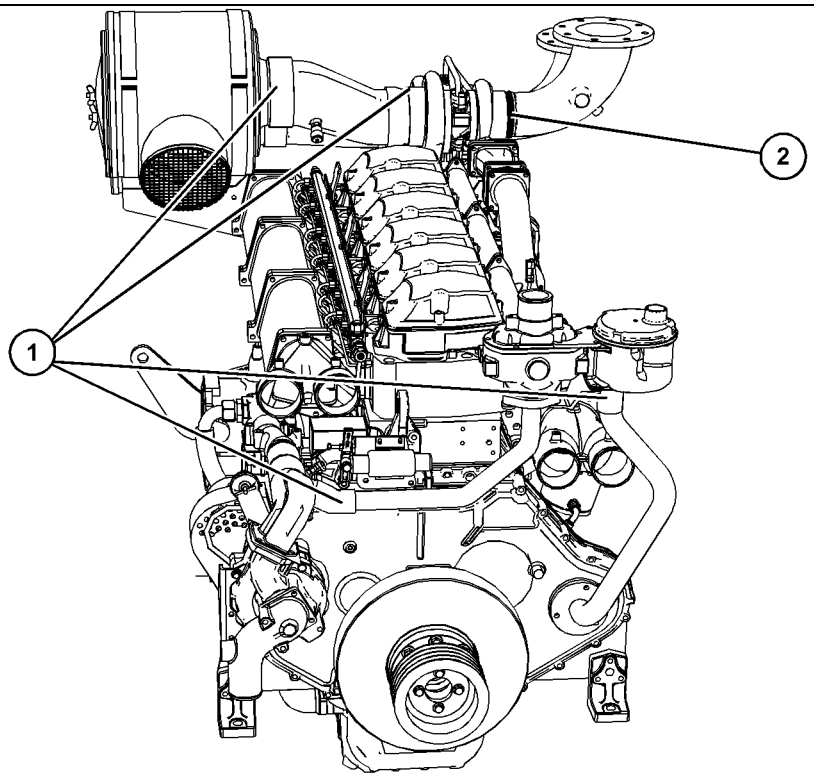


Illustration 74 g06117466

(1) Clamp torque 7 N·m (62 lb in) (2) Clamp torque 9 N·m (79 lb in)

## Clamps and V-Band Clamp Torques

i09664721

Table 16

| Clamps and V-band Clamp Torques | |
|---|---|
| Clamp | Torque |
| 1 | 7 N·m (62 lb in) |
| 2 | 9 N·m (79 lb in) |
| 3 | 10 N·m (88 lb in) |

i08383226

# Jacket Water Heater - Check (If Equipped)

Jacket water heaters help to improve starting in ambient temperatures that are below 21 °C (70 °F). All installations that require automatic starting should have jacket water heaters.

Check the operation of the jacket water heater. Check the operation of the circulation pump, if equipped. For an ambient temperature of 0 °C (32 °F), the heater should maintain the jacket water coolant temperature at approximately 32 °C (90 °F).

# Overhaul (Major)

## Scheduling a Major Overhaul

The need for a major overhaul is determined by several factors:

- An increase of oil consumption
- An increase of crankcase blowby
- A decrease and variation of cylinder compression

Other factors should be considered for determining a major overhaul:

- The service hours of the engine
- The wear metal analysis of the lube oil
- An increase in the levels of noise and vibration

An increase of wear metals in the lube oil indicates that the bearings and the surfaces that wear may need to be serviced. An increase in the levels of noise and vibration indicates that rotating parts require service.

**Note:** It is possible for oil analysis to indicate a decrease of wear metals in the lube oil. The cylinder liners may be worn so that polishing of the bore occurs. Also, the increased use of lube oil will dilute the wear metals.

Monitor the engine as the engine accumulates service hours. Consult Perkins Engines Stafford about scheduling a major overhaul.

Perkins recommends that at 7500 hours for prime power and base load applications or 5 years for standby applications, the following components should be removed from the engine:

- Piston assembly
- Piston rings
- Cylinder liner
- Connecting rod bearings

**Note:** One cylinder should be selected to have the components removed.

Contact your Perkins distributor or Perkins dealer for more information. An inspection of the components by the Perkins distributor or Perkins dealer can help to determine when a major overhaul is required as well as the other factors.

**Note:** The driven equipment may also require service when the engine is overhauled. Refer to the literature that is provided by the OEM of the driven equipment.

## Major Overhaul Information

During a major overhaul, all the bearings, seals, joints, and components that wear should be disassembled. The parts should be cleaned. The parts should then be inspected. If necessary, the parts should be replaced. The crankshaft should be inspected and measured for wear. The crankshaft may require regrinding. Alternatively, the crankshaft may be replaced.

### Inspecting Components

Inspect the following components during a major overhaul.

- Radiator and system
- Camshaft
- Camshaft followers
- Connecting rods and bearings
- Crankshaft and bearings
- Gear train
- Inlet air piping
- Oil cooler
- Pistons and rings
- Cylinder liners

Replace the crankshaft vibration dampers.

i08253506

# Overhaul (Top End)

## Scheduling a Top End Overhaul

Top end overhauls should be scheduled depending on valve recession. Record the valve depth at each service and then calculate the valve recession. This measurement provides an accurate indication of the rate of valve wear. This measurement can be used to predict when a cylinder head must be replaced.

**Note:** Generally, cylinder heads wear out at different rates. Sometimes, servicing the cylinder heads at different times may be the most economic decision. The decision depends on the valve recession of the individual cylinders. However, this decision must include the costs of extra downtime that is caused by this procedure. Perform an economic analysis to determine if cylinder heads should be serviced as a group or divided into smaller groups.

## Top End Overhaul Information

A top end overhaul involves servicing the cylinder heads. During a top end overhaul, one piston should be removed. Inspect the piston, piston rings, and the cylinder liner. The condition of these components will determine the period of the major overhaul.

Contact your Perkins distributor or Perkins dealer for more information.

### Monitoring Valve Seat Wear

At the required service interval, record the valve lash.

**1.** Remove the rocker covers.

**2.** Refer to Systems Operation, Testing and Adjusting, “Valve Lash - Adjust”.

**3.** On all engine cylinders, record the clearance before any adjustments are made.

**4.** Set the valve bridges.

**5.** Adjust the valve lash to 0.4 mm (0.016 inch).

**Note:** After the engine valve lash is recorded, Perkins recommends that the valve depth is measured and recorded.

The valve depth is to be measured at every service. The valve recession can then be calculated. The values can be used to schedule a top end overhaul.

**Note:** Perkins recommends that the valve depth is to be measured before the installation of new cylinder heads or during the commissioning of the engine to obtain a baseline measurement.

The valve recession tool has been designed to give service personnel a good indication of the cylinder head valve recession or cylinder head valve seat wear without the need to remove the cylinder heads. For more information contact Perkins distributor.

**Note:** For earlier engines, the maximum permitted inlet and exhaust valve seat wear is 1.00 mm (0.040 inch).

**Note:** For later engines, the maximum permitted inlet and exhaust valve seat wear is 2 mm (0.080 inch).

Do not allow the recession of the valves to exceed these limits.

i06533861

# Radiator - Clean

**Note:** Adjust the frequency of cleaning according to the effects of the operating environment. The radiator and the aftercooler are a combined unit ensure that the aftercooler is also cleaned and inspected.

Inspect the radiator and aftercooler for these items: Damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the radiator and aftercooler, if necessary.

**⚠ WARNING**

**Personal injury can result from air pressure.**

**Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.**

**Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.**

Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction to the fans air flow. Hold the nozzle approximately 6 mm (0.25 inch) away from the radiator fins. Slowly move the air nozzle in a direction that is parallel with the radiator tube assembly. This action will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water to soften mud. Clean the core from both sides. Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

After cleaning the radiator and aftercooler, start the engine. Run the engine. This action helps remove debris and the drying of the core. Stop the engine. Use a light bulb behind the core to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a “comb”. Inspect these items for good condition: Welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

i06543387

# Severe Service Application - Check

Severe service is the application of an engine that exceeds the current published standards for that engine. Perkins maintains standards for the following engine parameters:

- Performance such as power range, speed range, and fuel consumption
- Fuel quality
- Operational Altitude
- Maintenance intervals
- Oil selection and maintenance
- Coolant type and maintenance
- Environmental qualities
- Installation
- The temperature of the fluid in the engine

Refer to the standards for the engine or consult your Perkins distributor to determine if the engine is operating within the defined parameters.

Severe service operation can accelerate component wear. Engines that operate under severe conditions may need more frequent maintenance intervals to ensure maximum reliability and retention of full service life.

Perkins engines are unable to identify all the factors which can contribute to severe service operation, due to individual applications. Consult your Perkins dealer or your Perkins distributor for the unique maintenance that is necessary for the engine.

The operating environment, incorrect operating procedures, and incorrect maintenance procedures can be factors which contribute to a severe service application.

## Environmental Factors

**Ambient temperatures** – The engine may be exposed to extended operation inextremely cold environments or hot environments. Valve components can be damaged by carbon buildup if the engine is frequently started and stopped invery cold temperatures. Extremely hot intake air reduces engine performance.

**Quality of the air** – The engine may be exposed to extended operation in an environment that is dirty or dusty, unless the equipment is cleaned regularly. Mud, dirt, and dust can encase components. Maintenance can become very difficult. The buildup can contain corrosive chemicals.

**Buildup** – Compounds, elements, corrosive chemicals, and salt can damage some components.

**Altitude** – Problems can arise when the engine is operated at altitudes that are higher than the intended settings for that application. Necessary adjustments should be made.

## Incorrect Operating Procedures

- Frequent hot shutdowns
- Operating at excessive loads
- Operating at excessive speeds
- Operating outside the intended application

## Incorrect Maintenance Procedures

- Extending the maintenance intervals
- Failure to use recommended fuel, lubricants, and coolant/antifreeze

i07110975

# Speed Sensor - Clean/Inspect (Engine Speed Sensor)

When the engine is cranked, small metal particles are produced. These particles will contaminate the magnetic end of the crankshaft speed sensor. Contamination will distort the signals that are produced by the sensors. The sensor should be regularly cleaned and adjusted to ensure a good signal.

Table 17

| Required Tools | | | |
|---|---|---|---|
| **Tool** | **Part Number** | **Part Name** | **Qty** |
| **A** | SE253 | Crankshaft Turning Tool | 1 |

## Type 1 Speed Sensor

The sensor is located in the left-hand side of the flywheel housing.

**1.** Isolate the electrical supply to the engine.

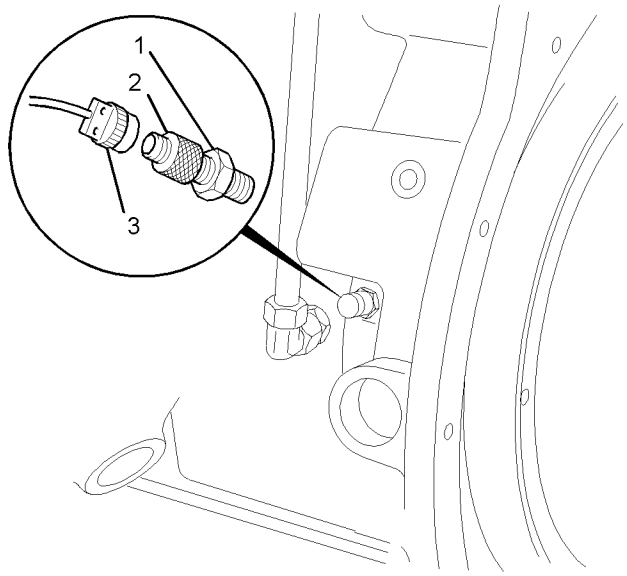


Illustration 75 g01237853
Typical example

**2.** Remove the connection (3). Loosen the locknut (1).

**3.** Remove the sensor (2).

**4.** Use a soft, dry cloth to clean any debris from the sensor (2).

**Note:** Do not use a wire brush to clean the sensor. Do not use abrasive material to clean the sensor.

**5.** Install Tooling (A). Use Tooling (A) to rotate the engine. Rotate the engine to align a tooth on the ring gear with the center of the tapped hole.

**6.** By hand, carefully install the sensor (2) until light contact is made with the ring gear.

**Note:** Do not tighten the sensor.

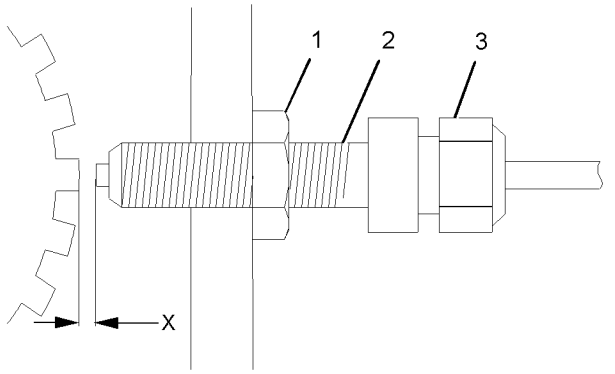


Illustration 76 g01237854

**7.** Unscrew the sensor (2) by one complete turn to obtain a clearance (X) of 0.5 mm to 0.8 mm (0.02 inch to 0.03 inch).

**8.** Tighten the locknut (1). Do not allow the sensor (2) to rotate. Connect the connection (3).

**9.** Remove Tooling (A).

**10.** Restore the electrical supply to the engine.

## Type 2 Speed Sensor

**1.** Isolate the electrical supply to the engine.

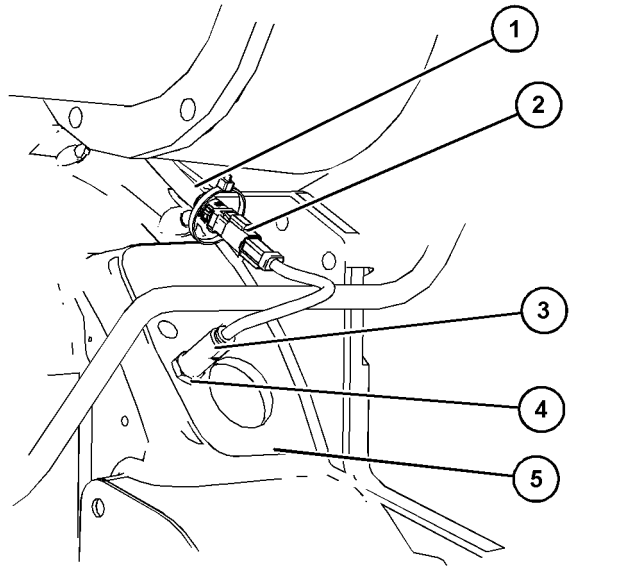


Illustration 77 g06228451
Typical example

**2.** Disconnect connector (2) from harness (1). Remove sensor (3) from flywheel housing (5).

**3.** Use a soft, dry cloth to clean any debris from the sensor (3).

**Note:** Do not use a wire brush to clean the sensor. Do not use abrasive material to clean the sensor.

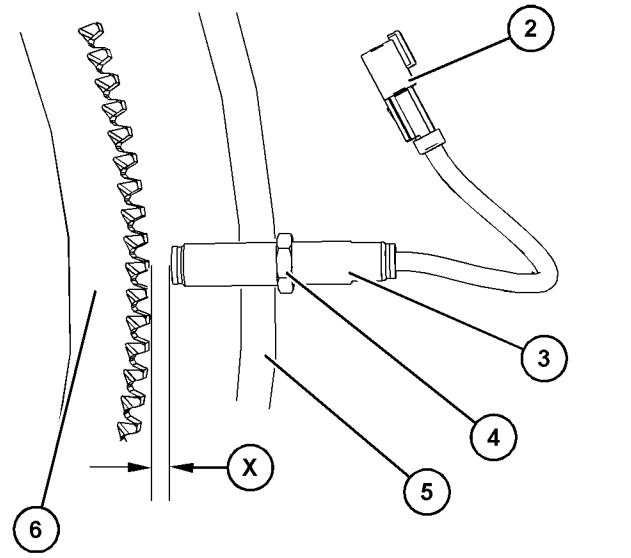


Illustration 78 g06228473
Typical example

**4.** Install Tooling (A). Use Tooling (A) to rotate the engine. Rotate the engine to align a tooth on the ring gear (6) with the center of the tapped hole.

**5.** By hand, carefully install the sensor (3) until light contact is made with the ring gear tooth.

**Note:** Do not tighten the sensor.

**6.** Unscrew the sensor (3) by one complete turn to obtain a clearance (X) of 0.5 mm to 0.8 mm (0.02 inch to 0.03 inch).

**7.** Tighten locknut (4) to a torque of 25 N·m (221 lb in). Do not allow rotation of the sensor (3).

**8.** Remove tooling (A) and connect connection (2) to the harness (1). Restore electrical power to the engine.

i06729778

# Starting Motor - Inspect

If a starting motor fails, the engine may not start in an emergency situation. A scheduled inspection of the starting motors is recommended.

**Note:** Problems with the electric starting motor can be caused by the following conditions: malfunction of the solenoid and malfunction of the electric starting system.

Inspect the electrical system for the following conditions:

- Loose connections
- Corrosion
- Wires that are worn or frayed
- Cleanliness

Make repairs, if necessary.

The starting motor pinion and the flywheel ring gear must be in good condition in order for the engine to start properly. The engine will not start if the starting motor pinion does not engage the flywheel ring gear. The teeth of the starting motor pinion and the flywheel ring gear can be damaged because of irregular engagement.

Inspect the starting motors for proper operation. Listen for grinding when the engine is started. Inspect the teeth of the starting motor pinions and the flywheel ring gear. Look for patterns of wear on the teeth. Look for teeth that are broken or chipped. If damaged teeth are found, the starting motor pinions and the flywheel ring gear must be replaced.

Refer to the Disassembly and Assembly Manual for information on removing the starting motors and installing the starting motors.

i06532154

# Turbocharger - Inspect

Periodic inspection and cleaning are recommended for the turbochargers. Fouling of the turbine wheels can contribute to loss of engine power and overall loss of engine efficiency.

If a turbocharger fails during engine operation, damage to the turbocharger compressor wheel and/or to the engine may occur. Damage to a turbocharger compressor wheel could allow parts from the compressor wheel to enter an engine cylinder. This debris can damage the pistons, the valves, and the cylinder head.

For information on inspection of the turbocharger, refer to “Systems Operation Testing and Adjusting”Turbocharger.

i02415322

# Walk-Around Inspection

A walk-around inspection should only take a few minutes. When the time is taken to perform these checks, costly repairs and accidents can be avoided.

For maximum engine service life, make a thorough inspection of the engine compartment before starting the engine. Look for items such as oil leaks or coolant leaks, loose bolts, worn belts, loose connections and trash buildup. Make repairs, as needed:

- The guards must be in the correct place. Repair damaged guards or replace missing guards.
- Wipe all caps and plugs before the engine is serviced in order to reduce the chance of system contamination.

NOTICE
For any type of leak (coolant, lube, or fuel) clean up the fluid. If leaking is observed, find the source and correct the leak. If leaking is suspected, check the fluid levels more often than recommended until the leak is found or fixed, or until the suspicion of a leak is proved to be unwarranted.

NOTICE
Accumulated grease and/or oil on an engine is a fire hazard. Remove the accumulated grease and oil. Refer to Operation and Maintenance Manual, “Engine - Clean” for more information.

- Ensure that the cooling system hoses are correctly clamped and that the cooling system hoses are tight. Check for leaks. Check the condition of all pipes.
- Inspect the water pumps for coolant leaks.

**Note:** The water pump seal is lubricated by the coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and the parts contract.

Excessive coolant leakage may indicate the need to replace a water pump. Refer to Operation and Maintenance Manual, “Water Pump - Inspect” for more information. If necessary, consult your Perkins dealer or your Perkins distributor.

- Inspect the lubrication system for leaks at the front crankshaft seal, the rear crankshaft seal, the oil pan, the oil filters and the rocker cover.

- Inspect the piping for the air intake system and the elbows for cracks and for loose clamps. Ensure that hoses and tubes are not contacting other hoses, tubes, wiring harnesses, etc.
- Ensure that the areas around the rotating parts are clear.
- Inspect the alternator belt and fan drive belts for cracks, breaks or other damage.
- Inspect the wiring harness for damage.

Belts for multiple groove pulleys must be replaced as matched sets. If only one belt is replaced, the belt will carry more load than the belts that are not replaced. The older belts are stretched. The additional load on the new belt could cause the belt to break.

i04326852

# Water Pump - Inspect

A failed water pump may cause severe engine overheating problems that could result in the following conditions:

- Cracks in the cylinder head
- A piston seizure
- Other potential damage to the engine

**Note:** The water pump seal is lubricated by the coolant in the cooling system. A normal condition is that a small amount of leakage to occur as the engine cools down and parts contract.

Visually inspect the water pumps for leaks. The water pumps are not serviceable items. Replace a leaking water pump. Refer to Disassembly and Assembly for more information.

# Warranty Section

# Warranty Information

i06590874

## Emissions Warranty Information

This engine may be certified to comply with exhaust emission and gaseous emission standards that are prescribed by the law at the time of manufacture. This engine may be covered by an Emissions Warranty. Consult your authorized Perkins dealer or distributor to determine if your engine is emissions certified and if your engine is subject to an Emissions Warranty.

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# Product and Dealer Information

Note: For product identification plate locations, see the section “Product Identification Information” in the Operation and Maintenance Manual.

**Delivery Date:** _____

## Product Information

Model: _____

Product Identification Number: _____

Engine Serial Number: _____

Transmission Serial Number: _____

Generator Serial Number: _____

Attachment Serial Numbers: _____

Attachment Information: _____

Customer Equipment Number: _____

Dealer Equipment Number: _____

## Dealer Information

Name: _____ Branch: _____

Address: _____

_____

_____

| | Dealer Contact | Phone Number | Hours |
|---|---|---|---|
| Sales: | _____ | _____ | _____ |
| Parts: | _____ | _____ | _____ |
| Service: | _____ | _____ | _____ |

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