

Operation and Maintenance Manual

4006-23 and 4008-30 Industrial Engines

SD8 (Engine)
SD6 (Engine)
DGBH (Engine)

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 properly.

Improper 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.



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. 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 the product will not be damaged or be made unsafe by the operation, lubrication, maintenance or repair procedures that you choose.

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.



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.

Table of Contents

Foreword	4
----------------	---

Safety Section

Safety Messages	5
-----------------------	---

General Hazard Information	9
----------------------------------	---

Burn Prevention	12
-----------------------	----

Fire Prevention and Explosion Prevention	13
--	----

Crushing Prevention and Cutting Prevention ..	15
---	----

Mounting and Dismounting	15
--------------------------------	----

Before Starting Engine	15
------------------------------	----

Engine Starting	16
-----------------------	----

Engine Stopping	16
-----------------------	----

Electrical System	16
-------------------------	----

Engine Electronics	17
--------------------------	----

Product Information Section

Model Views	18
-------------------	----

Product Identification Information	25
--	----

Operation Section

Lifting and Storage	26
---------------------------	----

Features and Controls	29
-----------------------------	----

Engine Starting	32
-----------------------	----

Engine Operation	33
------------------------	----

Engine Stopping	34
-----------------------	----

Maintenance Section

Refill Capacities	35
-------------------------	----

Maintenance Interval Schedule	50
-------------------------------------	----

Warranty Section

Warranty Information	83
----------------------------	----

Index Section

Index	84
-------------	----

Foreword

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 it 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. They 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 its capabilities.

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 extremely 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. We recommend that the maintenance schedules be reproduced and displayed near the engine as a convenient reminder. We also recommend that a maintenance record be maintained as part of the engine's permanent record.

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 should only be carried out by Perkins authorized personnel. Your Perkins dealer or your Perkins distributor offers a variety of 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.

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. Battery posts, terminals and related accessories contain lead and lead compounds. **Wash hands after handling.**

Safety Section

i06712726

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.

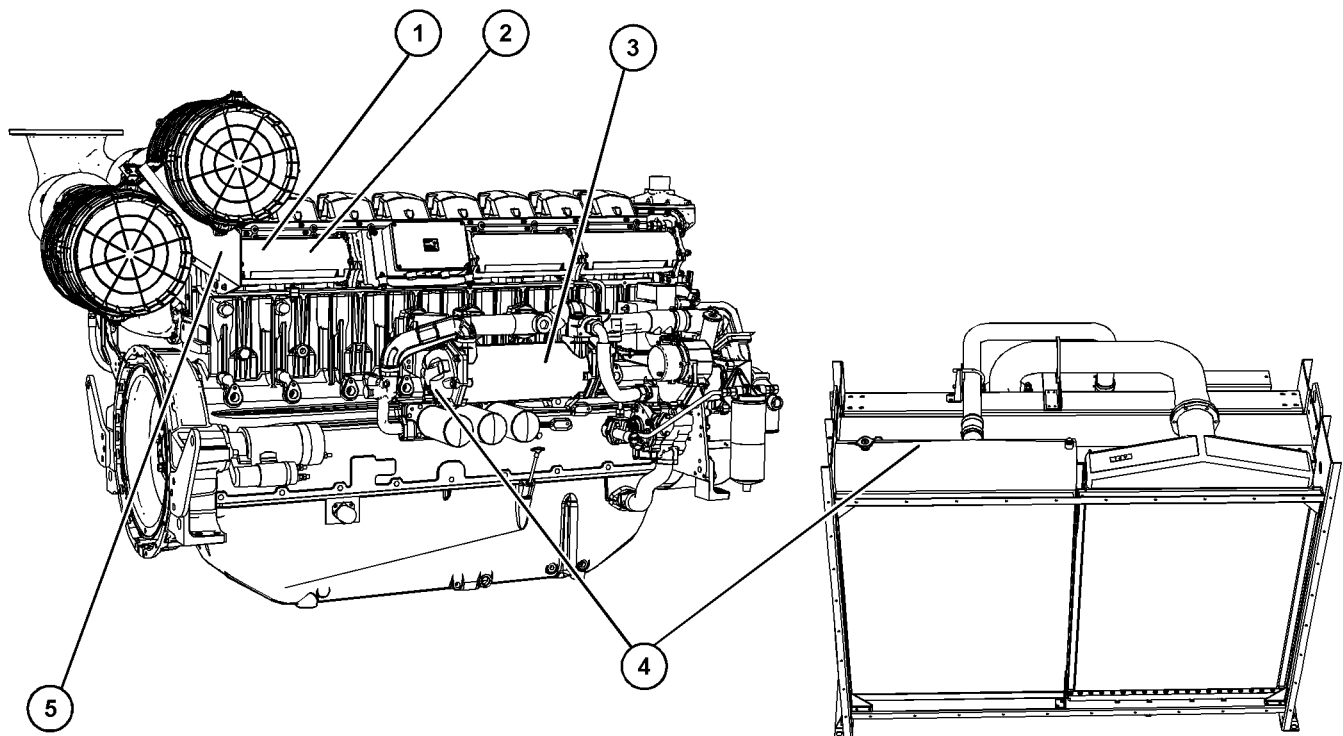


Illustration 1

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

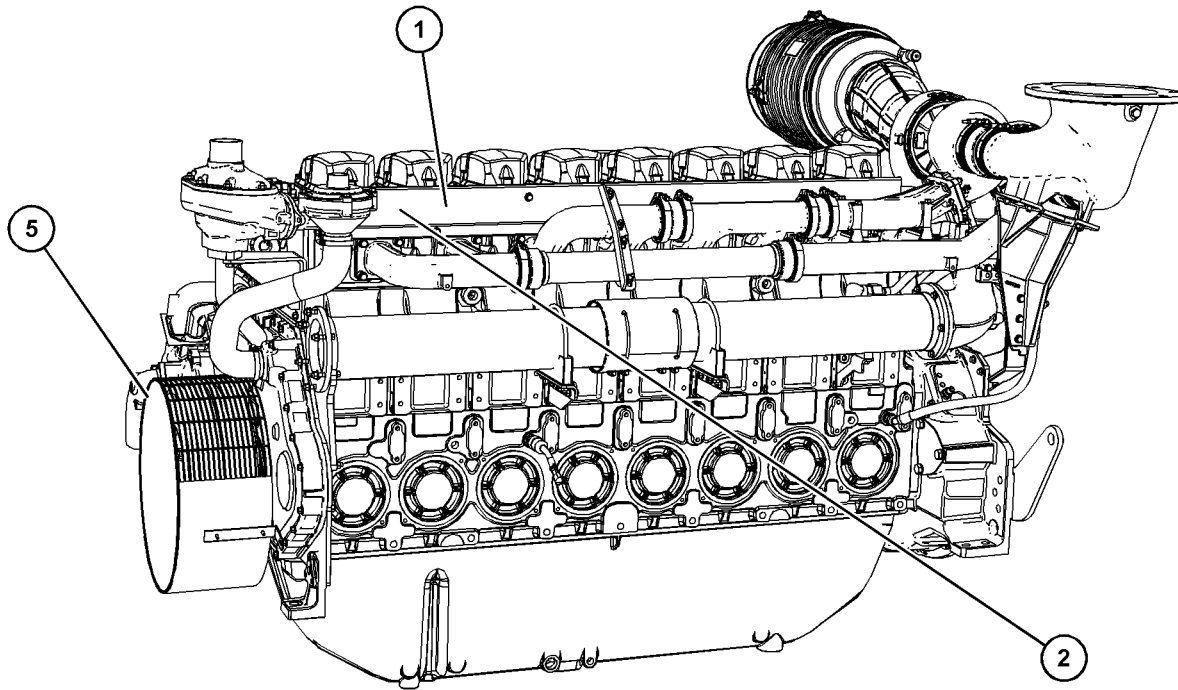


Illustration 2

g06093786

(1) Universal warning label location
(3) Hot surface label location

(6) Rotating shaft hand crush hazard label location

1 Universal Warning

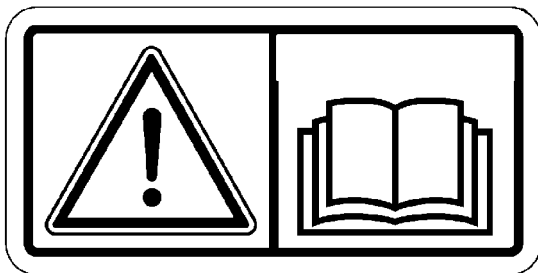


Illustration 3

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.

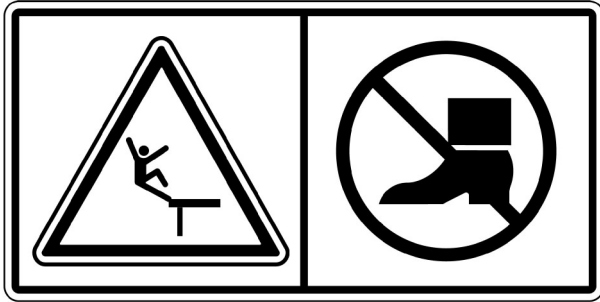


Illustration 4

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

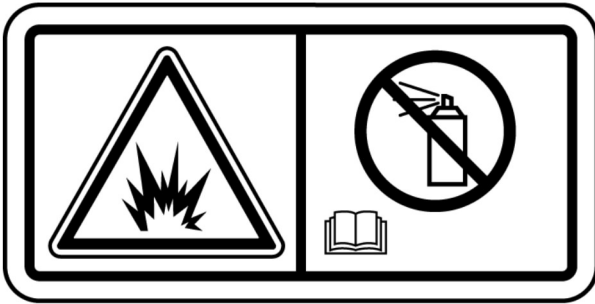


Illustration 7

g01372254

WARNING

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

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

6 Rotating Shaft Hand Crush Hazard

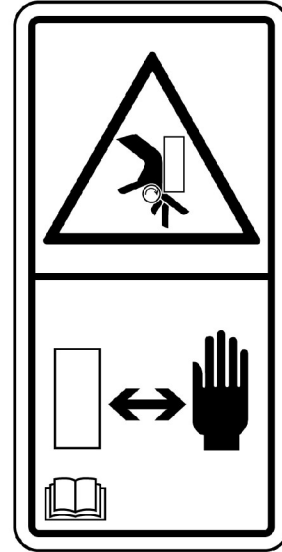


Illustration 8

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.

i06106934

General Hazard Information

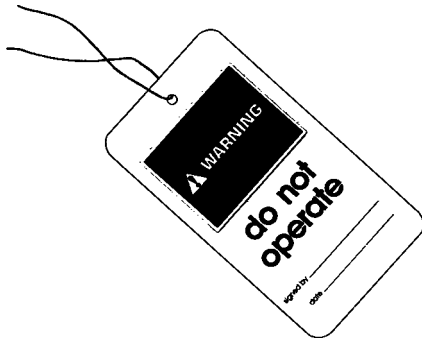


Illustration 9

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.

Safety Section
General Hazard Information

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.

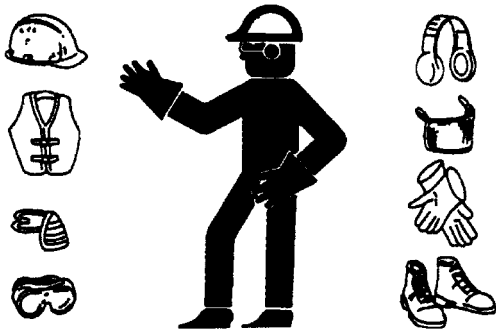


Illustration 10

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.

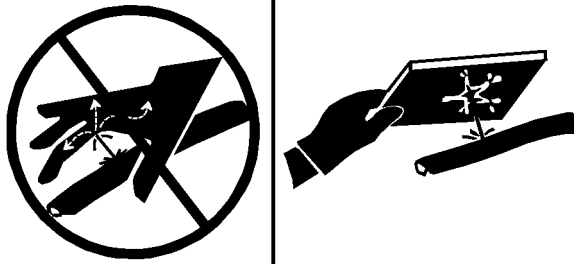


Illustration 11

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

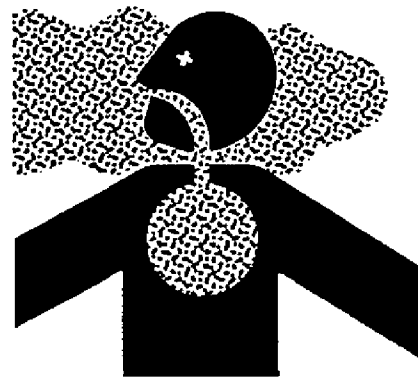


Illustration 12

g00702022

Exhaust

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

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

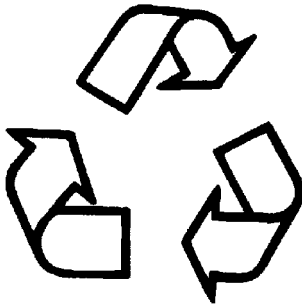


Illustration 13

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.

i06545886

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.

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 14

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 15

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.

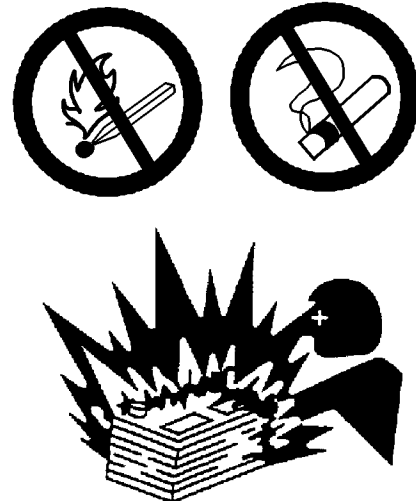


Illustration 16

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.

i05875651

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.

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.

i01462046

Engine Stopping

Stop the engine according to the procedure in the Operation and Maintenance Manual, “Engine Stopping (Operation Section)” in order to avoid overheating of the engine and accelerated wear of the engine components.

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.

i02414684

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

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.

Product Information Section

Model Views

i06681533

Model View Illustrations (Engine Views for the Six and Eight Cylinder 4000 Series Engines)

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

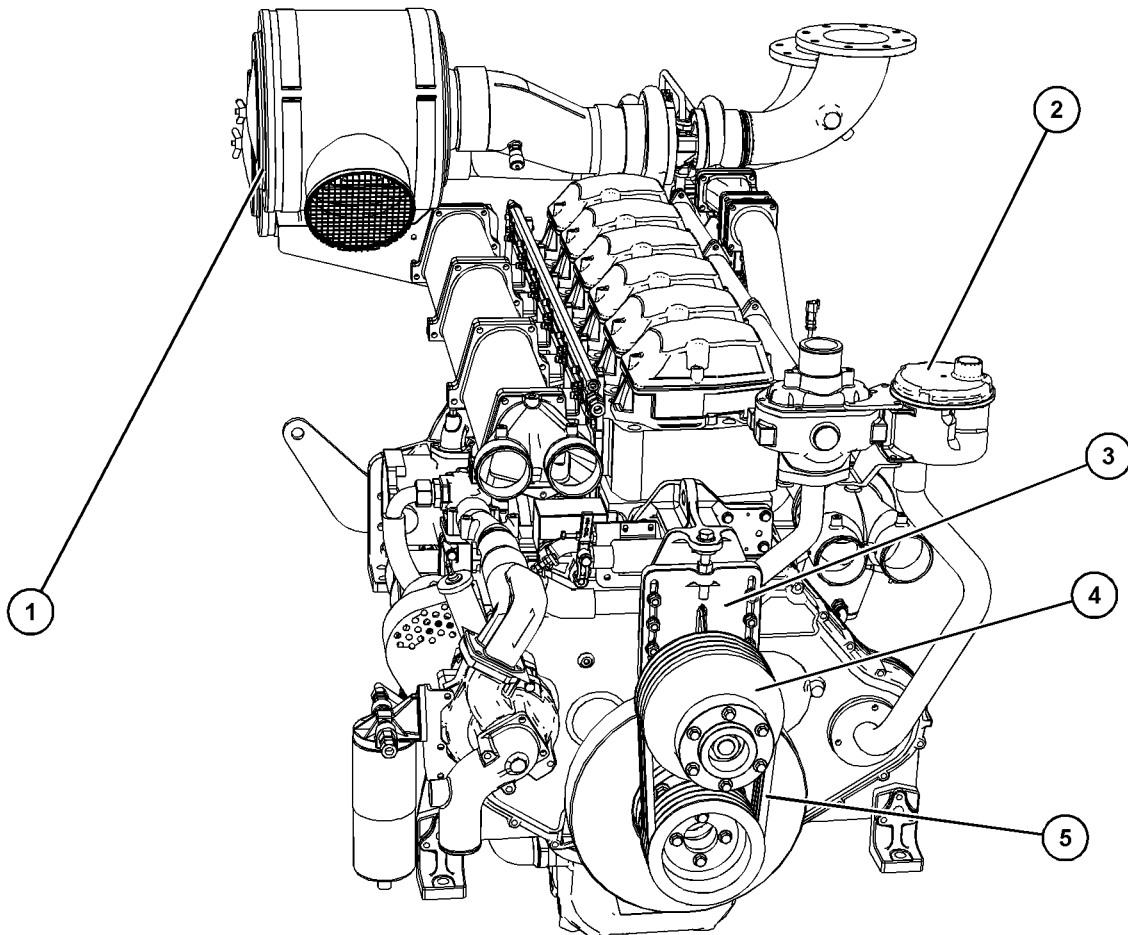
4006-23 Engine Views

Illustration 17

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 17 . 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

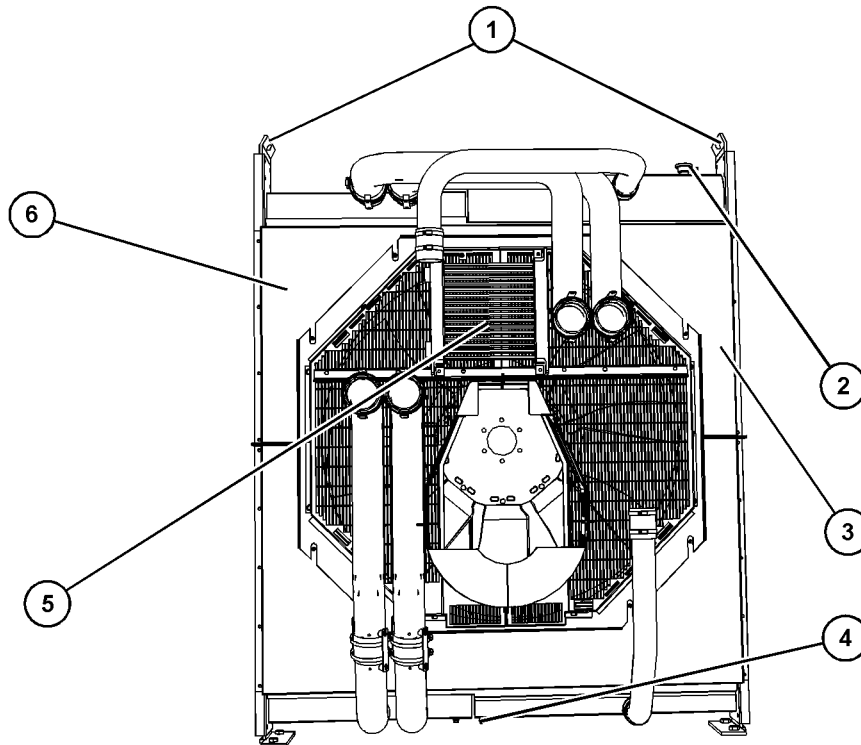


Illustration 18

g06072687

Typical example

(1) Radiator lifting eyes
(2) Radiator pressurized filler cap

(3) Radiator
(4) Radiator drain

(5) Fuel cooler
(6) Air charge cooler

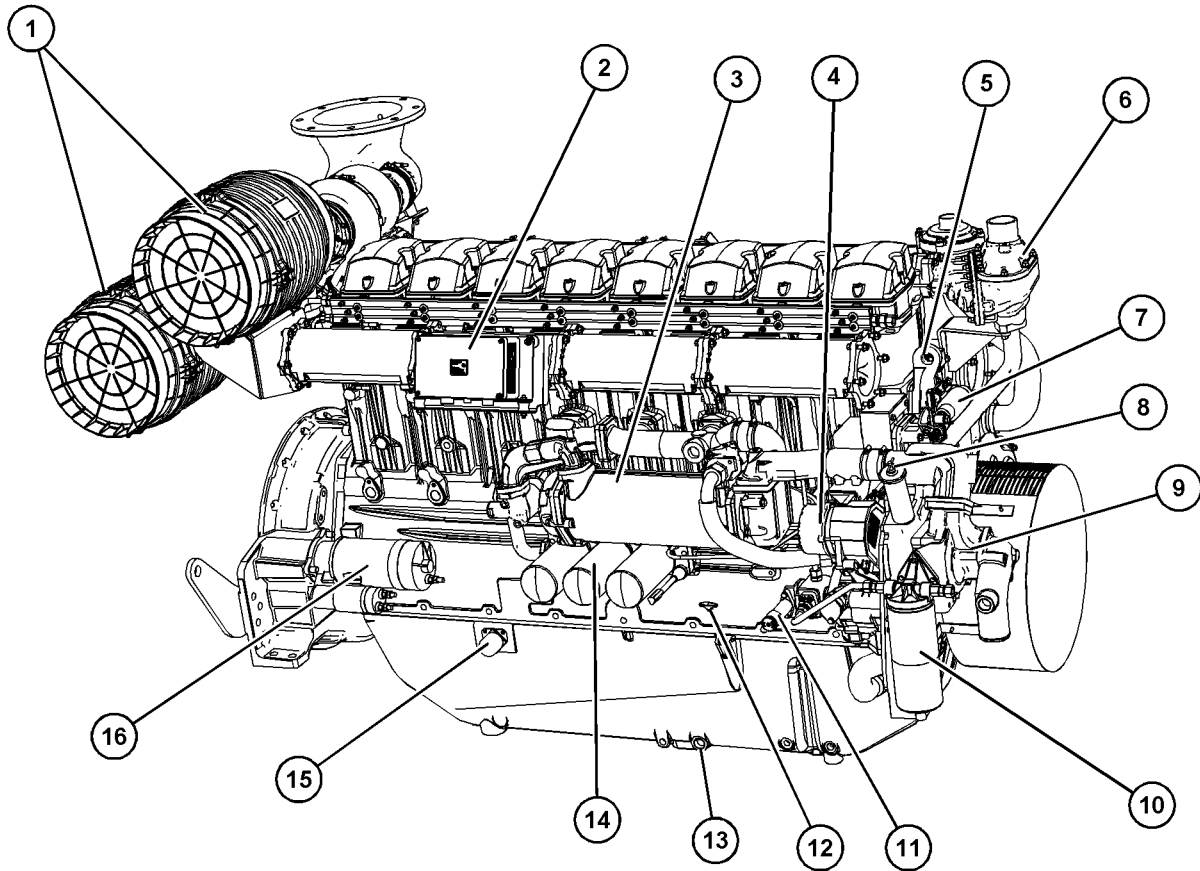
4008-30 Engine Views

Illustration 19

g06004723

Typical example

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

Product Information Section
Engine Views for the Six and Eight Cylinder 4000 Series Engines

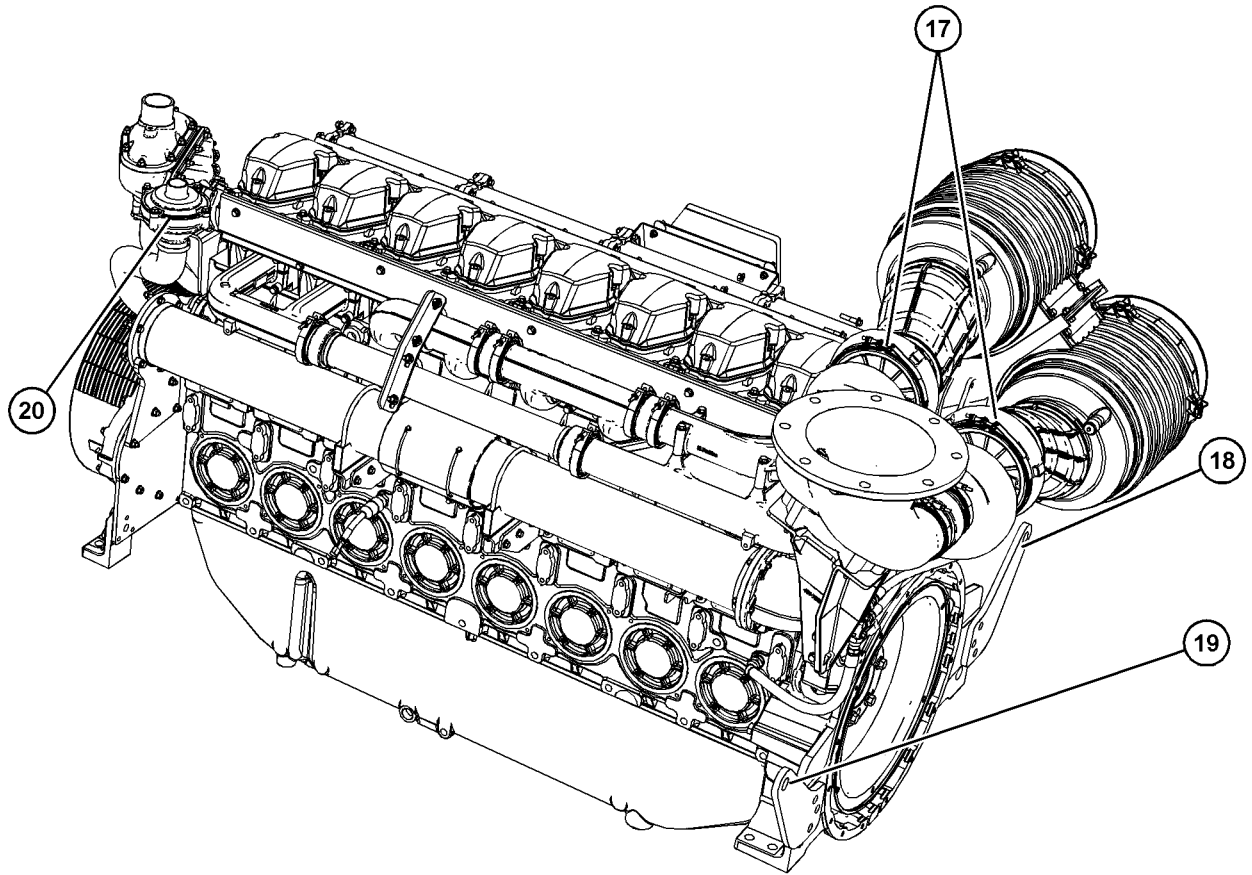


Illustration 20

g06004738

Typical example

(17) Twin turbochargers
(18) Right side rear lifting eye

(19) Left side rear lifting eye
(20) Crankcase breather

4008-30 Radiator

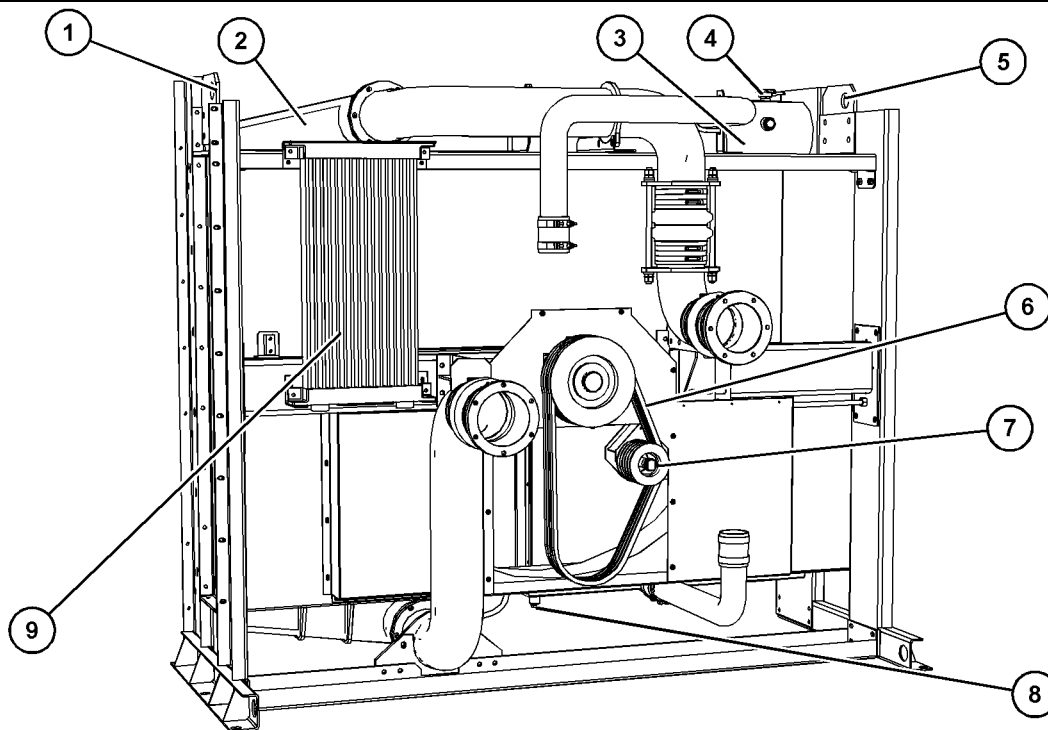


Illustration 21

g06005784

Typical example

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

i06681623

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.

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.

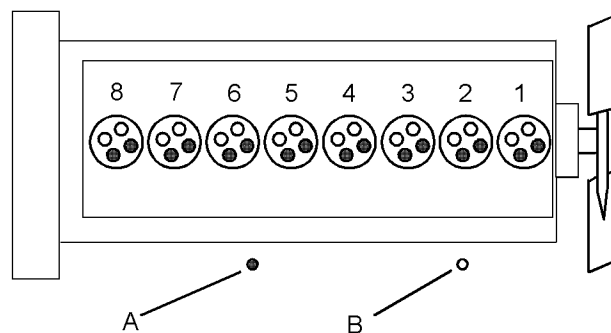


Illustration 22

g03897666

Typical example of an 8 cylinder engine

- (A) Inlet valves
- (B) Exhaust valves

Product Information Section
Engine Description

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 ()
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

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.

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
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.

Product Identification Information

i06516715

Plate Locations and Film Locations

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

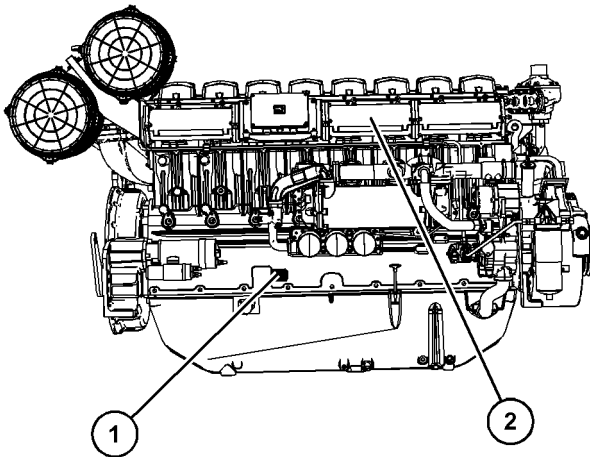


Illustration 23

g06017751

Typical example

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

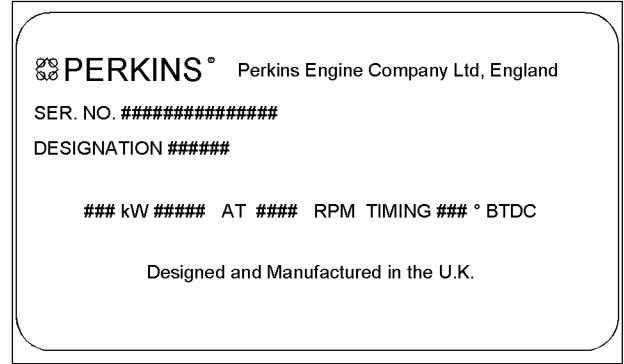


Illustration 24

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

i06700907

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

Engine Lifting Only

NOTICE

Never bend the eyebolts and the brackets. 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.

When it is necessary to remove a component at an angle, only use a link bracket that is properly rated for the weight.

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.

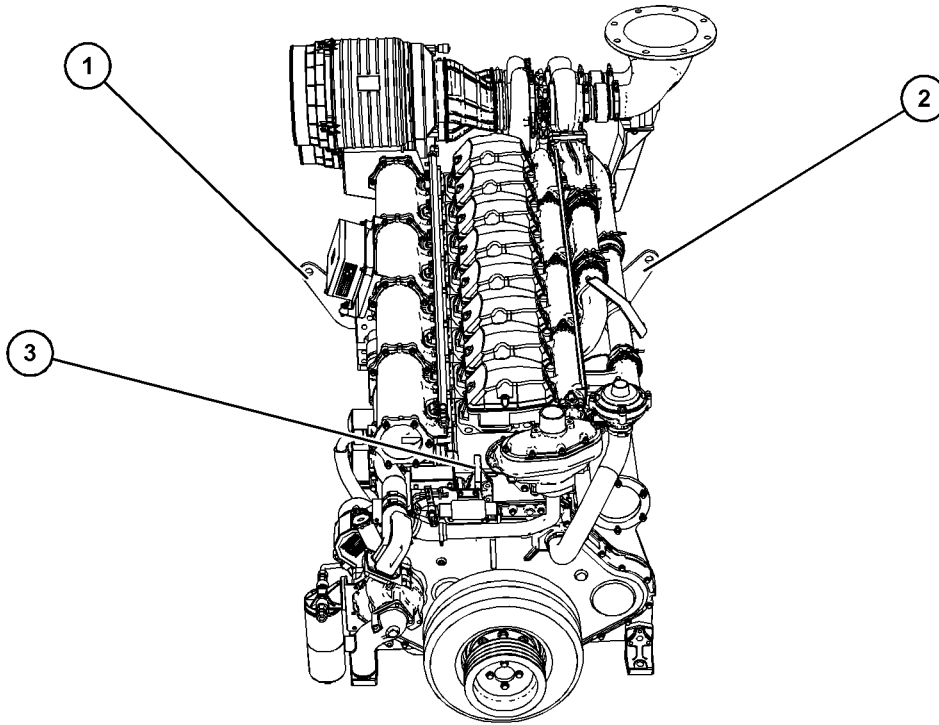


Illustration 25

g06006861

Typical example

(1) Rear lifting eye

(2) Rear lifting eye

(3) Front lifting eye

Radiator Lifting Only

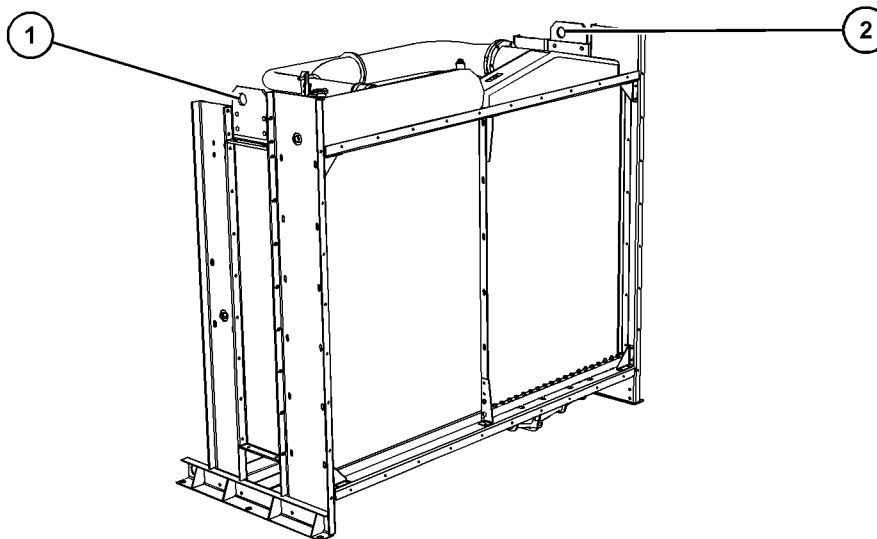


Illustration 26

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 $+55^{\circ}\text{C}$ (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.

i06518694

Sensors and Electrical Components

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.

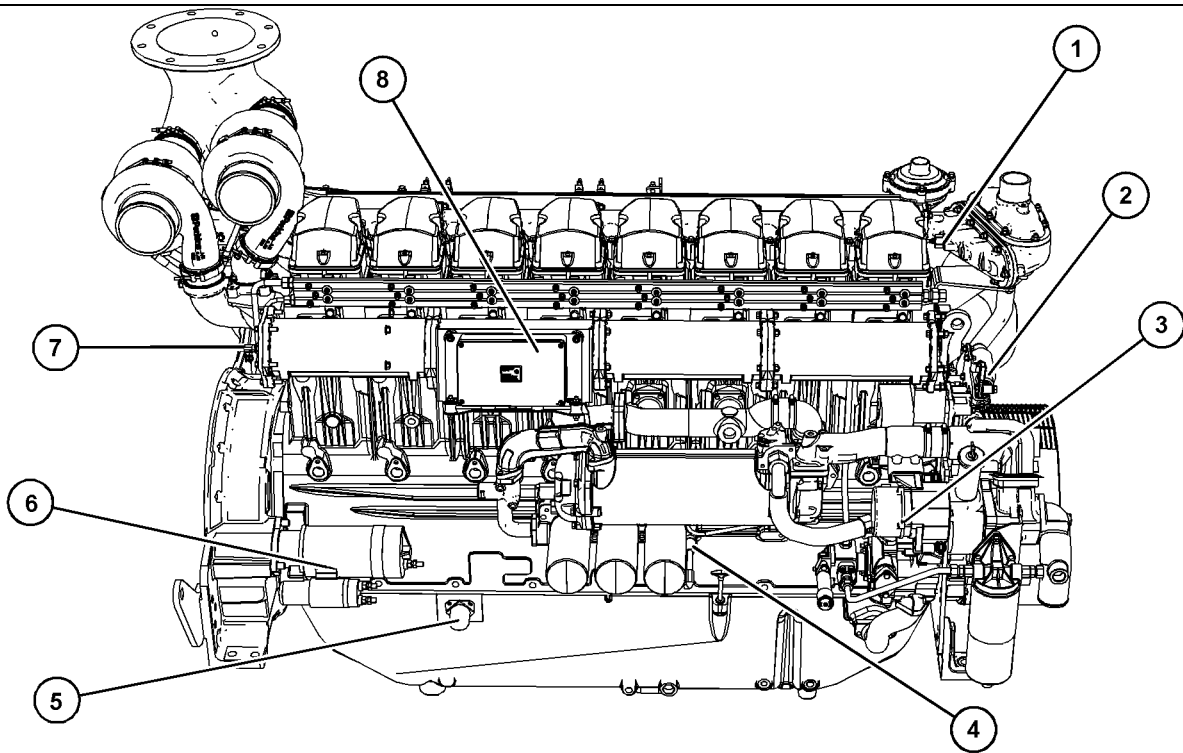


Illustration 27

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

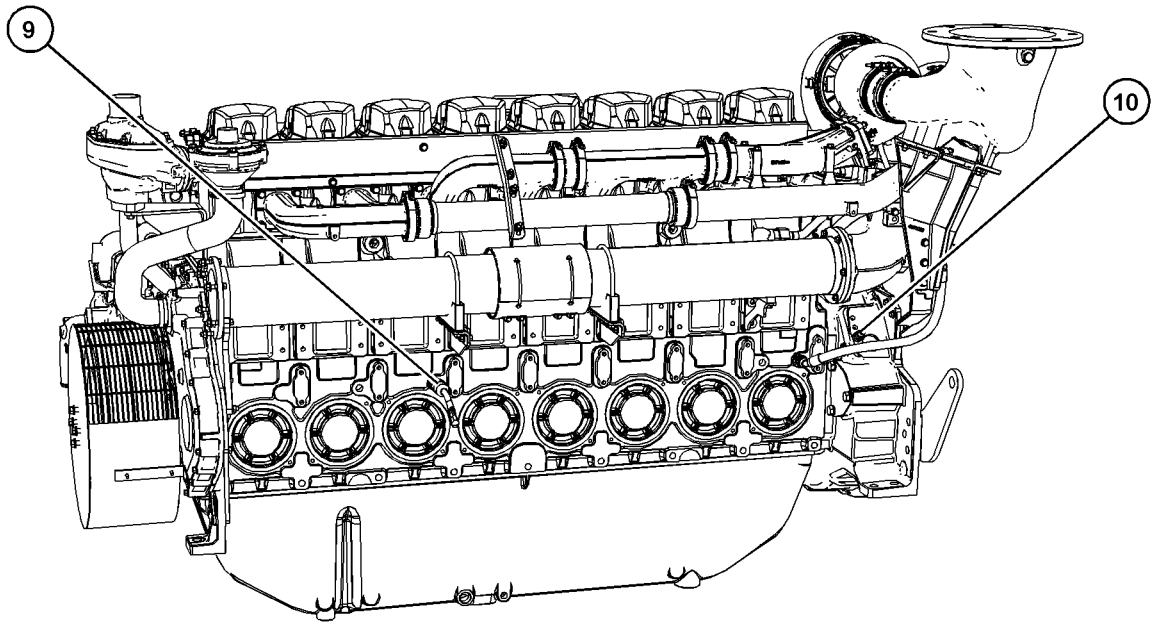


Illustration 28

g06006921

Typical example

(9) Oil pressure switch

(10) Overspeed sensor

Engine Starting

i06520585

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, the engine oil system must be primed. Follow Steps 3.a through 3.b 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 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.

i06521690

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.
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 3.a through 3.d.
 - 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.

i02415223

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.

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

Engine Operation

i02415225

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.

i02415226

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

i02415227

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.

i02415230

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.

i02415231

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 the Coolant Specifications that are in the Operation and Maintenance Manual. 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

i06682398

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 3

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 4

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 5

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.

i06519545

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.

Clean the cooling system for the following reasons:

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

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.

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.

Maintenance Section
General Coolant Information

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.

Water

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 6 .

Table 6

Acceptable Water	
Property	Maximum Limit
Chloride (Cl)	40 mg/L
Sulfate (SO ₄)	100 mg/L
Total Hardness	170 mg/L
Total Solids	340 mg/L
Acidity	pH of 5.5 to 9.0

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

- Local water utility company
- Agricultural agent
- Independent laboratory

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
- 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 1:1 mixture of a water/glycol solution.

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 7 and refer to table 8 .

Table 7

Ethylene Glycol	
Concentration	Freeze Protection
50 Percent	-36°C (-33°F)
60 Percent	-51°C (-60°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 8

Propylene Glycol	
Concentration	Freeze Protection
50 Percent	-29°C (-20°F)

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

Coolant Recommendations

- ELC _____ Extended Life Coolant
- SCA _____ Supplement Coolant Additive
- ASTM _____ American Society for Testing and Materials

The following two coolants are used in Perkins diesel engines:

Preferred – Perkins ELC

Acceptable – A commercial heavy-duty antifreeze that meets “ASTM D6210” specifications

NOTICE

The Perkins industrial engines must be operated with a 1:1 mixture of water and glycol.

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.

Perkins recommends a 1:1 mixture of water and glycol. This mixture of water and glycol will provide optimum heavy-duty performance as an antifreeze. This ratio may be increased to 1:2 water to glycol if extra freezing protection is required.

For applications that do not require freeze protection consult Perkins Engines Stafford Applications department.

Table 9

Coolant Service Life	
Coolant Type	Service Life ⁽¹⁾
Perkins ELC	6,000 Service Hours or Three Years
Commercial Heavy-Duty Antifreeze that meets “ASTM D6210”	3000 Service Hours or Two Year

⁽¹⁾ Use the interval that occurs first. The cooling system must also be flushed out now.

ELC

Perkins provides ELC for use in the following applications:

- Heavy-duty spark ignited gas engines
- Heavy-duty diesel engines
- Automotive applications

The anti-corrosion package for ELC is different from the anti-corrosion package for other coolants. ELC is an ethylene glycol base coolant. However, ELC contains organic corrosion inhibitors and antifoam agents with low amounts of nitrite. Perkins ELC has been formulated with the correct amount of these additives to provide superior corrosion protection for all metals in engine cooling systems.

ELC is available in a premixed cooling solution with distilled water. ELC is a 1:1 mixture. The Premixed ELC provides freeze protection to -36°C (-33°F). The Premixed ELC is recommended for the initial fill of the cooling system. The Premixed ELC is also recommended for topping off the cooling system.

Containers of several sizes are available. Consult your Perkins distributor for the part numbers.

ELC Cooling System Maintenance

Correct Additions to the Extended Life Coolant

NOTICE

Use only Perkins products for pre-mixed or concentrated coolants.

Mixing Extended Life Coolant with other products reduces the Extended Life Coolant service life. Failure to follow the recommendations can reduce cooling system components life unless appropriate corrective action is performed.

To maintain the correct balance between the antifreeze and the additives, you must maintain the recommended concentration of ELC. Lowering the proportion of antifreeze lowers the proportion of additive. Lowering the ability of the coolant to protect the system will form pitting, from cavitation, from erosion, and from deposits.

NOTICE

Do not use a conventional coolant to top-off a cooling system that is filled with Extended Life Coolant (ELC).

Do not use standard supplemental coolant additive (SCA).

When using Perkins ELC, do not use standard SCA's or SCA filters.

ELC Cooling System Cleaning

Note: If the cooling system is already using ELC, cleaning agents are not required to be used at the specified coolant change interval. Cleaning agents are only required if the system has been contaminated by the addition of some other type of coolant or by cooling system damage.

Clean water is the only cleaning agent that is required when ELC is drained from the cooling system.

Before the cooling system is filled, the heater control (if equipped) must be set to the HOT position. Refer to the OEM to set the heater control. After the cooling system is drained and the cooling system is refilled, operate the engine until the coolant level reaches the normal operating temperature and until the coolant level stabilizes. As needed, add the coolant mixture to fill the system to the specified level.

Changing to Perkins ELC

To change from heavy-duty antifreeze to the Perkins ELC, perform the following steps:

NOTICE

Care must be taken to ensure that all fluids are contained during performance of inspection, maintenance, testing, adjusting and the 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.

1. Drain the coolant into a suitable container.
2. Dispose of the coolant according to local regulations.
3. Fill the cooling system with a 33 percent solution of Perkins ELC and operate the engine, ensure that the thermostat opens. Stop the engine and allow the engine to cool. Drain the coolant.

Note: Use distilled or deionized water in the solution.

4. Again, fill the cooling system with a 33 percent solution of Perkins ELC and operate the engine ensure that the thermostat opens. Stop the engine and allow to cool.
 5. Drain the cooling system.
-

NOTICE

Incorrect or incomplete flushing of the cooling system can result in damage to copper and other metal components.

6. Fill the cooling system with the Perkins Premixed ELC. Operate the engine. Ensure that all coolant valves open then stop the engine. When cool check the coolant level.

ELC Cooling System Contamination

NOTICE

Mixing ELC with other products reduces the effectiveness of the ELC and shortens the ELC service life. Use only Perkins Products for premixed or concentrate coolants. Failure to follow these recommendations can result in shortened cooling system component life.

ELC cooling systems can withstand contamination to a maximum of 10 percent of conventional heavy-duty antifreeze or SCA. If the contamination exceeds 10 percent of the total system capacity, perform ONE of the following procedures:

- Drain the cooling system into a suitable container. Dispose of the coolant according to local regulations. Flush the system with a 5 to 10 percent solution of Perkins ELC. Fill the system with the Perkins ELC.
- Drain a portion of the cooling system into a suitable container according to local regulations. Then, fill the cooling system with premixed ELC. This procedure should lower the contamination to less than 10 percent.
- Maintain the system as a conventional Heavy-Duty Coolant. Treat the system with an SCA. Change the coolant at the interval that is recommended for the conventional Heavy-Duty Coolant.

Commercial Heavy-Duty Antifreeze and SCA

NOTICE

Commercial Heavy-Duty Coolant which contains Amine as part of the corrosion protection system must not be used.

NOTICE

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

Check the antifreeze (glycol concentration) to ensure adequate protection against boiling or freezing. Perkins recommends the use of a refractometer for checking the glycol concentration. A hydrometer should not be used.

Perkins engine cooling systems should be tested at 500-hour intervals for the concentration of SCA.

Additions of SCA are based on the results of the test. An SCA that is liquid may be needed at 500-hour intervals.

Adding the SCA to Heavy-Duty Coolant at the Initial Fill

Use the equation that is in Table 10 to determine the amount of SCA that is required when the cooling system is initially filled.

Table 10

Equation For Adding The SCA To The Heavy-Duty Coolant At The Initial Fill
$V \times 0.045 = X$
V is the total volume of the cooling system.
X is the amount of SCA that is required.

Table 13 is an example for using the equation that is in Table 12 .

Table 11

Example Of The Equation For Adding The SCA To The Heavy-Duty Coolant At The Initial Fill		
Total Volume of the Cooling System (V)	Multiplication Factor	Amount of SCA that is Required (X)
15 L (4 US gal)	× 0.045	0.7 L (24 oz)

Adding The SCA to The Heavy-Duty Coolant For Maintenance

Heavy-duty antifreeze of all types REQUIRE periodic additions of an SCA.

Test the antifreeze periodically for the concentration of SCA. For the interval, refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule" (Maintenance Section). Cooling System Supplemental Coolant Additive (SCA) Test/Add.

Additions of SCA are based on the results of the test. The size of the cooling system determines the amount of SCA that is needed.

Use the equation that is in Table 12 to determine the amount of SCA that is required, if necessary:

Table 12

Equation For Adding The SCA To The Heavy-Duty Coolant For Maintenance
$V \times 0.014 = X$
V is the total volume of the cooling system.
X is the amount of SCA that is required.

Table 13 is an example for using the equation that is in Table 12 .

Table 13

Example Of The Equation For Adding The SCA To The Heavy-Duty Coolant For Maintenance		
Total Volume of the Cooling System (V)	Multiplication Factor	Amount of SCA that is Required (X)
15 L (4 US gal)	× 0.014	0.2 L (7 oz)

Cleaning the System of Heavy-Duty Antifreeze

- Clean the cooling system after used coolant is drained or before the cooling system is filled with new coolant.
- Clean the cooling system whenever the coolant is contaminated or whenever the coolant is foaming.

i06521698

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.

Diesel Fuel Requirements

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.

Table 14 provides a known reliable baseline to judge the expected performance of distillate diesel fuels that are derived from conventional sources.

Satisfactory engine performance depends the use of a good quality fuel. The use of a good quality fuel will give the following results: long engine life and acceptable exhaust emissions levels. The fuel must meet the minimum requirements that are stated in Table 14 .

NOTICE

The footnotes are a key part of the Perkins Specification for Distillate Diesel Fuel Table. Read ALL of the footnotes.

Table 14

Perkins Specification for Distillate Diesel Fuel				
Property	UNITS	Requirements	"ASTM Test"	"ISO Test"
Aromatics	%Volume	35% maximum	"D1319"	"ISO 3837"
Ash	%Weight	0.01% maximum	"D482"	"ISO 6245"
Carbon Residue on 10% Bottoms	%Weight	0.35% maximum	"D524"	"ISO 4262"
Cetane Number ⁽¹⁾	-	40 minimum	"D613 or D6890"	"ISO 5165"
Cloud Point	°C	The cloud point must not exceed the lowest expected ambient temperature.	"D2500"	"ISO 3015"
Copper Strip Corrosion	-	No. 3 maximum	"D130"	"ISO 2160"
Distillation	°C	10% at 282 °C (539.6 °F) maximum 90% at 360 °C (680 °F) maximum	"D86"	"ISO 3405"
Density at 15 °C (59 °F) ⁽²⁾	Kg / M ³	800 minimum and 860 maximum	No equivalent test	"ISO 3675" or "ISO 12185"
Flash Point	°C	legal limit	"D93"	"ISO 2719"
Thermal Stability	-	Minimum of 80% reflectance after aging for 180 minutes at 150 °C (302 °F)	"D6468"	No equivalent test

(continued)

(Table 14, contd)

Pour Point	°C	6 °C (10°F) Minimum below ambient temperature	"D97"	"ISO 3016"
Sulfur	%mass	(3)	"D5453 or /D26222"	"ISO 20846" or "ISO 20884"
Kinematic Viscosity (4)	"MM ² /S (cSt)"	The viscosity of the fuel that is delivered to the fuel injec- tion pump. "1.4 minimum and /4.5 maximum"	"D445"	"ISO 3405"
Water and sediment	% weight	0.05% maximum	"D1796"	"ISO 3734"
Water	% weight	0.05% maximum	"D1744"	No equivalent test
Sediment	% weight	0.05% maximum	"D473"	"ISO 3735"
Gums and Resins (5)	mg/100mL	10 mg per 100 mL maximum	"D381"	"ISO 6246"
Lubricity correctedwear scar diameter at 60 °C (140 °F). (6)	mm	0.46 maximum	"D6079"	"ISO 12156-1"
Fuel cleanliness (7)	-	"ISO"18/16/13	"7619"	"ISO 4406"

- (1) In order to insure minimum cetane number of 40 a distillate diesel fuel should have minimum cetane index of 44 when ASTM D4737 test method is used. A fuel with a higher cetane number is recommended to operate at a higher altitude or in cold weather.
- (2) Density range allowed includes summer and winter diesel fuel grades. Fuel density varies depending on the sulfur level where high sulfur fuels have higher densities. Some unblended alternative fuels have lower densities which are acceptable, if all the other properties meet this specification.
- (3) Regional regulations, national regulations, or international regulations can require a fuel with a specific sulfur limit. Consult all applicable regulations before selecting a fuel for a given engine application. LSD fuel with less than 0.05 percent (≤ 500 ppm (mg/kg)) sulfur is strongly recommended for use in these engine models. Diesel fuel with more than 0.05 percent (≥ 500 ppm (mg/kg)) sulphur can be used only where allowed by legislation. Fuel sulfur levels affect exhaust emissions. High sulfur fuels also increase the potential for corrosion of internal components. Fuel sulfur levels above 0.05% may significantly shorten the oil change interval. For additional information, refer to **General Lubricant Information**.
- (4) The values of the fuel viscosity are the values as the fuel is delivered to the fuel injection pumps. Fuel should also meet the minimum viscosity requirement and the fuel should meet the maximum viscosity requirements at 40° C (104° F) of either the "ASTM D445" test method or the "ISO 3104" test method. If a fuel with a low viscosity is used, cooling of the fuel may be required to maintain 1.4 cSt or greater viscosity at the fuel injection pump. Fuels with a high viscosity might require fuel heaters to lower the viscosity to 4.5 cSt at the fuel injection pump.
- (5) Follow the test conditions and procedures for gasoline (motor).
- (6) The lubricity of a fuel is a concern with low sulfur and ultra low sulfur fuel. To determine the lubricity of the fuel, use the "ISO 12156-1 or ASTM D6079 High Frequency Reciprocating Rig (HFRR)" test. If the lubricity of a fuel does not meet the minimum requirements, consult your fuel supplier. Do not treat the fuel without consulting the fuel supplier. Some additives are not compatible. These additives can cause problems in the fuel system.
- (7) Recommended cleanliness level for fuel as dispensed into machine or engine fuel tank is "ISO 18/16/13 or cleaner as per ISO 4406. Refer to the "Contamination Control Recommendations for Fuels" in this chapter.

NOTICE

Operating with fuels that do not meet the Perkins recommendations can cause the following effects: Starting difficulty, poor combustion, deposits in the fuel injectors, will reduce service life of the fuel system. Deposits in the combustion chamber will reduce service life of the engine.

Engines that are manufactured by Perkins are certified with the fuel that is prescribed by the United States Environmental Protection Agency. Engines that are manufactured by Perkins are certified with the fuel that is prescribed by the European Certification and other regulatory agencies. Perkins does not certify diesel engines on any other fuel.

Note: The owner and the operator of the engine has the responsibility of using the fuel that is prescribed by the Environmental Protection Agency (EPA) and other appropriate regulatory agencies.

Diesel Fuel Characteristics

Perkins Recommendations

Cetane Number

Fuel that has a high cetane number will give a shorter ignition delay. A high cetane number will produce a better ignition quality. Cetane numbers are derived for fuels against proportions of cetane and heptamethylnonane in the standard CFR engine. Refer to "ISO 5165" for the test method.

Cetane numbers more than 45 are normally expected from current diesel fuel. However, a cetane number of 40 may be experienced in some territories. The United States of America is one of the territories that can have a low cetane value. A minimum cetane value of 40 is required during average starting conditions. A higher cetane value may be required for operations at high altitudes or in cold-weather operations.

Fuel with a low cetane number can be the root cause of problems during cold start.

Viscosity

Viscosity is the property of a liquid of offering resistance to shear or flow. Viscosity decreases with increasing temperature. This decrease in viscosity follows a logarithmic relationship for normal fossil fuel. The common reference is to kinematic viscosity. Kinematic viscosity is the quotient of the dynamic viscosity that is divided by the density. The determination of kinematic viscosity is normally by readings from gravity flow viscometers at standard temperatures. Refer to "ISO 3104" for the test method.

The viscosity of the fuel is significant because fuel serves as a lubricant for the fuel system components. Fuel must have sufficient viscosity to lubricate the fuel system in both cold temperatures and hot temperatures. If the kinematic viscosity of the fuel is lower than 1.4 cSt at the fuel injection pump, damage to the fuel injection pump can occur. This damage can be excessive scuffing and seizure. Low viscosity may lead to difficult hot restarting, stalling, and loss of performance. High viscosity may result in seizure of the pump.

Perkins recommends kinematic viscosities of 1.4 and 4.5 cSt that is delivered to the fuel injection pump. If a fuel with a low viscosity is used, cooling of the fuel may be required to maintain 1.4 cSt or greater viscosity at the fuel injection pump. Fuels with a high viscosity might require fuel heaters to lower the viscosity to 4.5 cSt at the fuel injection pump.

Density

Density is the mass of the fuel per unit volume at a specific temperature. This parameter has a direct influence on engine performance and a direct influence on emissions. This influence determines the heat output from a given injected volume of fuel. This parameter is quoted in the following kg/m³ at 15 °C (59 °F).

Perkins recommends a value of density of 841 kg/m³ to obtain the correct power output. Lighter fuels are acceptable but these fuels will not produce the rated power.

Sulfur

The level of sulfur is governed by emissions legislations. Regional regulation, national regulations, or international regulations can require a fuel with a specific sulfur limit. The sulfur content of the fuel and the fuel quality must comply with all existing local regulations for emissions.

LSD fuel with less than 0.05 percent (≤ 500 ppm (mg/kg)) sulfur is recommended for use in these engine models.

ULSD less than 0.0015% (≤ 15 PPM (mg/Kg)) sulphur is acceptable to use in these engine models. The lubricity of these fuels must not exceed wear scar diameter of 0.46 mm (0.01811 inch) as per "ISO 12156-1". Refer to "Lubricity" for more information.

Fuels with sulphur content higher than 0.05 percent (500 PPM) can be used where allowed by legislation.

Fuel with a high sulfur content can cause engine wear. High sulfur fuel will have a negative impact on emissions of particulates. High sulfur fuel can be used if the local emissions legislation will allow the use. High sulfur fuel can be used in countries that do not regulate emissions.

When only high sulfur fuels are available, use a high alkaline lubricating oil, or reduce the oil change interval. Refer to Operation and Maintenance Manual, "Fluid Recommendations (Lubricant Information)" for information on sulfur in fuel.

Lubricity

Lubricity is the capability of the fuel to prevent pump wear. The lubricity of the fluid describes the ability of the fluid to reduce the friction between surfaces that are under load. This ability reduces the damage that is caused by friction. Fuel injection systems rely on the lubricating properties of the fuel. Until fuel sulfur limits were mandated, the lubricity of the fuel was believed to be a function of fuel viscosity.

The lubricity has particular significance to the current low viscosity fuel, low sulfur fuel, and low aromatic fossil fuel. These fuels are made to meet stringent exhaust emissions.

The lubricity of these fuels must not exceed wear scar diameter of 0.46 mm (0.01811 inch). The fuel lubricity test must be performed on an HFRR, operated at 60 °C (140 °F). Refer to "ISO 12156-1".

NOTICE

The fuels system has been qualified with fuel having lubricity up to 0.46 mm (0.01811 inch) wear scar diameter as tested by "ISO 12156-1". Fuel with higher wear scar diameter than 0.46 mm (0.01811 inch) will lead to reduced service life and premature failure of the fuel system.

In the fuels which do not meet specified lubricity requirement appropriate lubricity additive can be used to enhance the lubricity of the fuel. Perkins Diesel Fuel Conditioner is the approved additive refer to “Perkins Diesel Fuel Conditioner”.

Contact 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.

Distillation

Distillation will give an indication of the mixture of different hydrocarbons in the fuel. A high ratio of lightweight hydrocarbons can affect the characteristics of combustion.

Classification of the Fuels

Diesel engines have an ability to burn wide variety of fuels. Below is a list of typically encountered fuel specifications that have been assessed as to their acceptability and are divided into following categories:

Group 1: Preferred Fuels

The following fuel specifications are considered acceptable.

- Fuels that meet the requirements that are listed in the Table 14 .
- “EN590 - Grades A to F and class 0 to 4”
- “ASTM D975 Grade No. 1-D and 2-D”
- “JIS K2204 Grades 1, 2 & 3 & Special Grade 3” acceptable provided lubricity wear scar diameter does not exceed of 0.46 mm (0.01811 inch) as per “ISO 12156-1” .
- “BS2869 - Class A2 Off Highway Gas Oil, Red Diesel”

Note: The lubricity of these fuels must not exceed wear scar diameter of 0.46 mm (0.01811 inch) as per “ISO 12156-1” . Refer to “Lubricity”.

Group 2: Aviation Kerosene Fuels

Following kerosene and jet fuel specifications are acceptable alternative fuels, and may be used on a contingency base for emergency or continuous use, where standard diesel fuel is not available and where legislation allows their use:

- “MIL-DTL-83133 NATO F34 (JP-8)”
- “MIL-DTL-83133 NATO F35”
- “MIL-DTL-5624 NATO F44 (JP-5)”

- “MIL-DTL-38219 (USAF) (JP7)”
- “NATO XF63”
- “ASTM D1655 JET A”
- “ASTM D1655 JET A1”

NOTICE

These fuels are only acceptable when used with appropriate lubricity additive and must meet minimum requirements that are listed in Table 14 . The lubricity of these fuels must not exceed wear scar diameter of 0.46 mm (0.01811 inch) as per “ISO 12156-1” . Refer to “Lubricity” and Perkins Diesel Fuel Conditioner.

Note: Minimum cetane number of 40 is recommended otherwise cold starting problems or light load misfire might occur. Since jet fuel specifications do not mention cetane requirements, Perkins recommends that a fuel sample is taken to determine the cetane number.

Note: Fuels must have minimum viscosity of 1.4 cSt delivered to the fuel injection pump. Cooling of the fuel may be required to maintain 1.4 cSt or greater viscosity at the fuel injection pump. Perkins recommends that the actual viscosity of the fuel, be measured to determine if a fuel cooler is needed. Refer to “Viscosity”.

Note: Rated power loss of up to 10 percent is possible due to lower density and lower viscosity of jet fuels compared to diesel fuels.

Biodiesel Fuel

Biodiesel is a fuel that can be defined as mono-alkyl esters of fatty acids. Biodiesel is a fuel that can be made from various feedstocks. The most commonly available biodiesel in Europe is Rape Methyl Ester (REM). This biodiesel is derived from rapeseed oil. Soy Methyl Ester (SME) is the most common biodiesel in the United States. This biodiesel is derived from soybean oil. Soybean oil or rapeseed oil are the primary feedstocks. These fuels are together known as Fatty Acid Methyl Esters (FAME).

Raw pressed vegetable oils are NOT acceptable for use as a fuel in any concentration in compression engines. Without esterification, these oils may gel in the crankcase and the fuel tank. These fuels may not be compatible with many of the elastomers that are used in engines that are manufactured today. In original forms, these oils are not suitable for use as a fuel in compression engines. Alternate base stocks for biodiesel may include animal tallow, waste cooking oils, or various other feedstocks. To use any of the products that are listed as fuel, the oil must be esterified.

Fuel made of 100 percent FAME is generally referred to as B100 biodiesel or neat biodiesel.

Biodiesel can be blended with distillate diesel fuel. The blends can be used as fuel. The most commonly available biodiesel blends are B5, which is 5 percent biodiesel and 95 percent distillate diesel fuel. B20, which is 20 percent biodiesel and 80 percent distillate diesel fuel.

Note: The percentages given are volume-based. The U.S. distillate diesel fuel specification “ASTM D975-09a” includes up to B5 (5 percent) biodiesel.

European distillate diesel fuel specification “EN590:2010” includes up to B7 (7 percent) biodiesel.

Note: Engines that are manufactured by Perkins are certified by use of the prescribed Environmental Protection Agency (EPA) and European Certification fuels. Perkins does not certify engines on any other fuel. The user of the engine has the responsibility of using the correct fuel that is recommended by the manufacturer and allowed by the EPA and other appropriate regulatory agencies.

Specification Requirements

The neat biodiesel must conform to “EN14214” or “ASTM D6751” (in the USA). Neat biodiesel can only be blended in mixture of up to 20 percent, by volume in acceptable mineral diesel fuel meeting requirements that are listed in Table 14 or the latest edition of “EN590” and “ASTM D 975” commercial standards. This blend is commonly known as B20.

Biodiesel blends are denoted as “BXX” with “XX” representing the content of neat biodiesel contained in the blend with mineral diesel fuel (for example B5, B10, B20).

In United States Biodiesel blends of B6 to B20 must meet the requirements listed in the latest edition of “ASTM D7467” (B6 to B20) and must be of an API gravity of 30-45.

In North America biodiesel and biodiesel blends must be purchased from the BQ-9000 accredited producers and BQ-9000 certified distributors.

In other areas of the world, the use of biodiesel that is BQ-9000 accredited and certified, or that is accredited and certified by a comparable biodiesel quality body to meet similar biodiesel quality standards is required.

Engine Service Requirements with B20

Aggressive properties of biodiesel fuel may cause debris in the fuel tank and fuel lines. The aggressive properties of biodiesel will clean the fuel tank and fuel lines. This cleaning of the fuel system can prematurely block the fuel filters. Perkins recommends that after the initial usage of B20 biodiesel blended fuel the fuel filters must be replaced at 50 hours.

Glycerides present in biodiesel fuel will also cause fuel filters to become blocked more quickly. Therefore the regular service interval should be reduced to 250 hours.

When biodiesel fuel is used, crank case oil and aftertreatment systems (if installed) may be influenced. This influence is due to the chemical composition and characteristics of biodiesel fuel, such as density and volatility, and to chemical contaminants that can be present in this fuel, such as alkali and alkaline metals (sodium, potassium, calcium, and magnesium).

- Crankcase oil fuel dilution can be higher when biodiesel or biodiesel blends are used. This increased level of fuel dilution when using biodiesel or biodiesel blends is related to the typically lower volatility of biodiesel. In cylinder emissions control strategies utilized in many of the industrial latest engine designs may lead to a higher level of biodiesel concentration in the engine oil pan. The long-term effect of biodiesel concentration in crankcase oil is unknown.
- Perkins recommends the use of oil analysis to check the quality of the engine oil if biodiesel fuel is used. Ensure that the level of biodiesel in the fuel is noted when the oil sample is taken.

Performance Related Issues with B20

Due to the lower energy content than the standard distillate fuel B20 will cause a power loss in order of 2 to 4 percent. In addition, over time the power may deteriorate further due to deposits in the fuel injectors.

Biodiesel and biodiesel blends are known to cause an increase in fuel system deposits, most significant of which are deposits within the fuel injector. These deposits can cause a loss in power due to restricted or modified fuel injection or cause other functional issues associated with these deposits.

Perkins T400012 Fuel Cleaner is most effective in cleaning and preventing the formation of deposits. Refer to “Perkins Diesel Fuel System Cleaner” for more information. Perkins Diesel Fuel Conditioner helps to limit deposit issues by improving the stability of biodiesel whilst also hindering the production of new deposits. For more information refer to “Perkins Diesel Fuel Conditioner”. Therefore the use of Diesel Fuel Cleaner and or Diesel Fuel Conditioner is recommended when running biodiesel blends, especially B20.

General Requirements

Biodiesel has poor oxidation stability, which can result in long-term problems in the storage of biodiesel. Biodiesel fuel should be used within 6 months of manufacture. Equipment should not be stored with the B20 biodiesel blends in the fuel system for longer than 3 months.

Due to poor oxidation stability and other potential issues, Perkins strongly recommends that engines with limited operational time either do not use biodiesel blends or, whilst accepting some risk, limit biodiesel blend to a maximum of B5. Examples of applications that should limit the use of biodiesel are the following: Standby generator sets and certain emergency vehicles.

If biodiesel must be used, then the quality of the fuel needs to be periodically tested. The test must comply with “EN15751”, commonly known as the Rancimat Test.

Perkins strongly recommends that seasonally operated engines have the fuel systems, including fuel tanks, flashed with conventional diesel fuel before prolonged shutdown periods. An example of an application that should seasonally flush the fuel system is a combine harvester.

Microbial contamination and growth can cause corrosion in the fuel system and premature plugging of the fuel filter. Consult your supplier of fuel for assistance in selecting appropriate antimicrobial additive.

Water accelerates microbial contamination and growth. When biodiesel is compared to distillate fuels, water is naturally more likely to exist in the biodiesel. Frequent checking of the water separator and if necessary, drain the water separator is essential when using biodiesel.

Materials such as brass, bronze, copper, lead, tin, and zinc accelerate the oxidation process of the biodiesel fuel. The oxidation process can cause deposits formation therefore these materials must not be used for fuel tanks and fuel lines.

Fuel for Cold-Weather Operation

The European standard “EN590” contains climate dependant requirements and a range of options. The options can be applied differently in each country. There are five classes that are given to arctic climates and severe winter climates. 0, 1, 2, 3 and 4.

Fuel that complies with “EN590” CLASS 4 can be used at temperatures as low as $-44\text{ }^{\circ}\text{C}$ ($-47.2\text{ }^{\circ}\text{F}$). Refer to “EN590” for a detailed description of the physical properties of the fuel.

The diesel fuel “ASTM D975 1-D” that is used in the United States of America may be used in cold temperatures that are below $-18\text{ }^{\circ}\text{C}$ ($-0.4\text{ }^{\circ}\text{F}$).

In extreme cold ambient conditions, you may use the aviation kerosene fuels that are specified in “Group 1: Preferred Fuels”. These fuels are intended for use in temperatures that can be as low as $-54\text{ }^{\circ}\text{C}$ ($-65.2\text{ }^{\circ}\text{F}$). Refer to “Group 1: Preferred Fuels” for detail and conditions of use of the aviation kerosene fuels.

WARNING

Mixing alcohol or gasoline with diesel fuel can produce an explosive mixture in the engine crankcase or the fuel tank. Alcohol or gasoline must not be used in order to dilute diesel fuel. Failure to follow this instruction may result in death or personal injury.

There are many other diesel fuel specifications that are published by governments and by technological societies. Usually, those specifications do not review all the requirements that are addressed in Table 14 . To ensure optimum engine performance, a complete fuel analysis should be obtained before engine operation. The fuel analysis should include all the properties that are stated in the Table 14 .

Aftermarket Fuel Additives

NOTICE

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

When auxiliary devices, accessories, or consumables (filters, additives) 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.

Supplemental diesel fuel additives are not recommended and is due to potential damage to the fuel system or the engine. Your fuel supplier or the fuel manufacturer will add the appropriate supplemental diesel fuel additives.

Perkins recognizes the fact that additives may be required in some special circumstances. Fuel additives need to be used with caution. Contact your fuel supplier for those circumstances when fuel additives are required. Your fuel supplier can recommend the appropriate fuel additive and the correct level of treatment.

Note: For the best results, your fuel supplier should treat the fuel when additives are required. The treated fuel must meet the requirements that are stated in Table 14 .

Perkins Diesel Fuel System Cleaner

Perkins T400012 Fuel Cleaner is the only fuel cleaner that is recommended by Perkins.

If biodiesel or biodiesel blends of fuel are to be used, Perkins require the use of Perkins fuel cleaner. For more information on the use of biodiesel and biodiesel blends refer to “Biodiesel Fuel”.

Perkins fuel cleaner will remove deposits that can form in the fuel system with the use of biodiesel and biodiesel blends. These deposits can create a loss of power and engine performance.

Once the fuel cleaner has been added to the fuel, the deposits within the fuel system are removed after 30 hours of engine operation. For maximum results, continue to use the fuel cleaner for up to 80 hours. Perkins fuel cleaner can be used on an on-going basis with no adverse impact on engine or fuel system durability.

Detailed instructions on the rate of which the fuel cleaner must be used are on the container.

Perkins Diesel Fuel Conditioner

The Perkins Diesel Fuel Conditioner is the only fuel conditioner recommended by Perkins. The diesel fuel conditioner is a proprietary metal and ash free formulation that has been extensively tested for use with distillate diesel fuels for use in Perkins diesel engines. The diesel fuel conditioner helps address many of the challenges that various fuels worldwide present with regarding fuel life/stability, engine startability, injector deposits, fuel system life, and long-term engine performance.

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

Diesel fuel conditioner is a proven high performance, multipurpose diesel fuel conditioner that is designed to improve:

- Fuel economy (through fuel system cleanup)
- Lubricity
- Oxidation stability
- Detergency/dispersancy
- Moisture dispersancy
- Corrosion protection
- Cetane (typically 2-3 cetane numbers)

The diesel fuel conditioner also reduces the formation of gums, resins, and sludge, and disperses insoluble gums.

For maximum overall benefits, ask your fuel supplier to add the fuel conditioner at the recommended treat rate before fuel delivery. Or you may add the fuel conditioner at the recommended treat rate during the early weeks of fuel storage.

Contamination Control Recommendations for Fuels

Fuels of "ISO 18/16/13" cleanliness level or cleaner as dispensed into the engine or application fuel tank should be used. This recommendation will help to reduce power loss, fuel system failures and related down time of engines. This cleanliness level is important for new fuel system designs such as common rail injection systems and unit injection systems. Injection system designs utilize higher fuel pressures and tight clearances between moving parts to meet required stringent emissions regulations. Peak injection pressures in current fuel injection systems may exceed 30,000 psi. Clearances in these systems are less than 5 µm. As a result, particle contaminants as small as 4 µm can cause scoring and scratching of internal pump and injector surfaces and of injector nozzles.

Water in the fuel causes cavitation, corrosion of fuel system parts, and provides an environment where microbial growth in the fuel can flourish. Other sources of fuel contamination are soaps, gels, or other compounds that may result from undesirable chemical interactions in the fuels, particularly in ULSD. Gels and other compounds can also form in biodiesel fuel at low temperatures or if biodiesel is stored for extended periods. The best indication of microbial contamination, fuel additives, or cold temperature gel is rapid filter plugging of bulk fuel filters or application fuel filters.

To reduce downtime due to contamination, follow these fuel maintenance guidelines.

- Use high-quality fuels per recommended and required specifications
- Fill fuel tanks with fuels of "ISO 18/16/13" cleanliness level or cleaner, in particular for engines with common rail and unit injection systems. When you refuel the tank, filter the fuel through a 4 µm absolute filter (Beta 4 = 75 up to 200) in order to reach the recommended cleanliness level. This filtration should be at the device that dispenses the fuel to the fuel tank. In addition, filtration at the dispensing point should remove water to ensure that fuel is dispensed at 500 ppm water or less.
- Perkins recommends the use of bulk fuel filter / coalescer units which clean the fuel of both particulate contamination and water in a single pass.

- Ensure that you use Perkins Advanced Efficiency Fuel Filters. Change your fuel filters per recommended service requirements or as needed.
- Drain your water separators daily.
- Drain your fuel tanks of sediment and water per the Operation and Maintenance Manual instructions.
- Install and maintain a properly designed bulk filter / coalescer filtration system. Continuous bulk filtration systems may be required to ensure that dispensed fuel meets the cleanliness target. Consult your Perkins distributor for availability of bulk filtration products.
- Centrifugal filters may need to be used as a pre-filter with fuel that is severely contaminated with gross amounts of water and/or large particulate contaminants. Centrifugal filters can effectively remove large contaminants. Centrifugal filters may not be able to remove the small abrasive particles required to achieve the recommended "ISO" cleanliness level. Bulk filter / coalescers are necessary as a final filter to achieve the recommended cleanliness level.
- Install desiccant type breathers of 4 µm or less absolute efficiency with the ability to remove water on bulk storage tanks.
- Follow proper practices of fuel transportation. Filtration from the storage tank to the application promotes the delivery of clean fuel. Fuel filtration can be installed at each transport stage to keep the fuel clean.
- Cover, protect, and ensure cleanliness of all connection hoses, fittings, and dispensing nozzles.

Consult your local Perkins distributor for additional information on Perkins designed and produced filtration products.

i06693368

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.

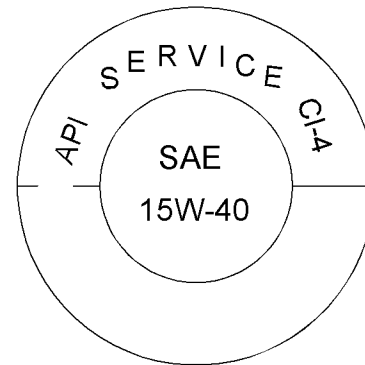


Illustration 29

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. Recommended oil viscosities can be found in this publication, "Fluid Recommendations/ Engine Oil Specification" topic (Maintenance Section).

Engine Oil

Perkins Diesel Engine Oil

Perkins DEO CI-4 oil is the preferred oil. Perkins multi-grade oil has been developed and tested to provide full performance and service life that has been designed and built into Perkins Engines. Consult your Perkins distributors for more information.

Commercial Oils

NOTICE

Perkins require the use of the following specification of engine oil. Failure to use the appropriate specification of engine oil will reduce the life of your engine.

Table 15

Minimum Oil Specification for 4008-30 and the 4006-23 Industrial Engines	
Preferred Oil Specification	API CI-4 ECF-2
Minimum Oil Specification	API CH-4 ECF 1

Lubricant Viscosity Recommendations for Direct Injection (DI) Diesel Engines

The correct SAE viscosity grade of oil is determined by the minimum ambient temperature during cold engine start-up, and the maximum ambient temperature during engine operation.

Refer to illustration 30 (minimum temperature) to determine the required oil viscosity for starting a cold engine.

Refer to illustration 30 (maximum temperature) to select the oil viscosity for engine operation at the highest ambient temperature that is anticipated.

Generally, use the highest oil viscosity that is available to meet the requirement for the temperature at start-up.

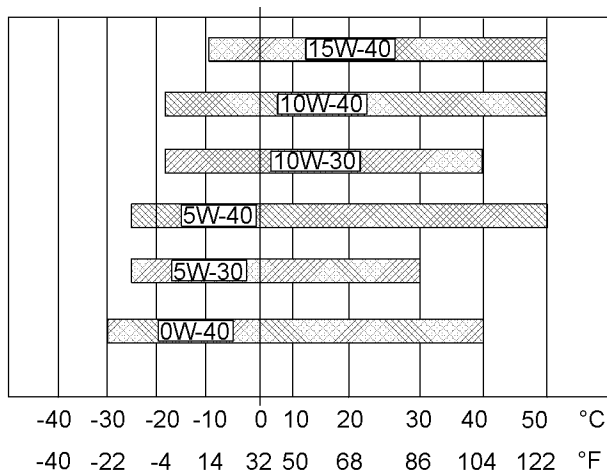


Illustration 30

g03347115

Lubricant Viscosities

Supplemental heat is recommended for cold soaked starts below the minimum ambient temperature. Supplemental heat may be required for cold soaked starts that are above the minimum temperature that is stated, depending on the parasitic load and other factors. Cold soaked starts occur when the engine has not been operated for a period of time. This interval will allow the oil to become more viscous due to cooler ambient temperatures.

Aftermarket Oil Additives

Perkins does not recommend the use of aftermarket additives in oil. It is not necessary to use aftermarket additives to achieve the engines maximum service life or rated performance. 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 finished oils with 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 finished oils additive package, which could lower the performance of the finished oil. The aftermarket additive could fail to mix with the finished oil. This failure could produce sludge in the crankcase. Perkins discourages the use of aftermarket additives in finished oils.

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

- See the appropriate "Lubricant Viscosities". Refer to the illustration 30 to find the correct oil viscosity grade for your engine.
- At the specified interval, service the engine. Use new oil and install a new oil filter.
- Perform maintenance at the intervals that are specified in the Operation and Maintenance Manual, "Maintenance Interval Schedule or Fluid Recommendations Fuel Specification".

Oil analysis

Some engines may be equipped with an oil sampling valve. If oil analysis is required, the oil sampling valve is used to obtain samples of the engine oil. The oil analysis will complement the preventive maintenance program.

The oil analysis is a diagnostic tool that is used to determine oil performance and component wear rates. Contamination can be identified and measured by using oil analysis. The oil analysis includes the following tests:

- The Wear Rate Analysis monitors the wear of the engines metals. The amount of wear metal and type of wear metal that is in the oil is analyzed. The increase in the rate of engine wear metal in the oil is as important as the quantity of engine wear metal in the oil.
- Tests are conducted to detect contamination of the oil by water, glycol, or fuel.
- The Oil Condition Analysis determines the loss of the oils lubricating properties. An infrared analysis is used to compare the properties of new oil to the properties of the used oil sample. This analysis allows technicians to determine the amount of deterioration of the oil during use. This analysis also allows technicians to verify the performance of the oil according to the specification during the entire oil change interval.

i06682467

Maintenance Interval Schedule

When Required

“ Battery - Replace”	52
“ Battery or Battery Cable - Disconnect”	53
“ Engine - Clean”	61
“ Engine Air Cleaner Element - Replace”	61
“ Engine Oil Sample - Obtain”	66
“ Fuel System - Prime”	69
“Overhaul (Major)”	77
“Overhaul (Top End)”	78
“ Severe Service Application - Check”	79

Daily

“ Cooling System Coolant Level - Check”	60
“ Driven Equipment - Check”	61
“ Engine Air Cleaner Service Indicator - Inspect”	62
“ Engine Oil Level - Check”	65
“ Fuel Tank Water and Sediment - Drain”	71
“Walk-Around Inspection”	81

Every 50 Service Hours or Weekly

“ Fuel Tank Water and Sediment - Drain”	71
---	----

Initial 100 Service Hours

“ Alternator Pulley - Check”	51
“ Engine Valve Lash - Inspect/Adjust”	68
“ Fan Drive Pulley - Check”	68

Every 500 Service Hours

“ Engine Oil and Filter - Change”	66
“ Engine Valve Lash - Inspect/Adjust”	68

Every 500 Service Hours or 1 Year

“ Battery Electrolyte Level - Check”	52
“ Belts - Inspect/Adjust/Replace”	53

“ Belts - Inspect/Adjust/Replace”	55
“ Belts - Inspect/Adjust/Replace”	56
“ Engine Crankcase Breather - Clean”	63
“ Fuel System Filter - Replace”	70
“ Hoses and Clamps - Inspect/Replace”	73

Every Year

“ Crankshaft Vibration Damper - Inspect”	60
“ Engine Mounts - Inspect”	65
“ Engine Protective Devices - Check”	68
“ Governor Actuator - Check”	73
“ Speed Sensor - Clean/Inspect”	80

Every 1000 Service Hours

“ Aftercooler Core - Inspect”	51
“ Radiator - Clean”	79

Every 5000 Service Hours

“ Fuel Injector - Inspect/Adjust”	69
-----------------------------------	----

Every 6000 Service Hours or 3 Years

“ Cooling System Coolant Extender (ELC) - Add”	60
--	----

Every 7500 Service Hours

“ Alternator - Inspect”	51
“ Engine Oil Pump - Inspect”	65
“ Fuel Transfer Pump (Lift Pump) - Inspect”	72
“ Starting Motor - Inspect”	81
“ Turbocharger - Inspect”	81
“ Water Pump - Inspect”	82

Every 12 000 Service Hours or 6 Years

“ Cooling System Coolant (ELC) - Change”	58
--	----

Overhaul

“ Engine Crankcase Breather - Clean”	64
--------------------------------------	----

i06533191

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.

i02322311

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.

i06546578

Alternator Pulley - Check

1. Isolate the electrical supply to the engine.

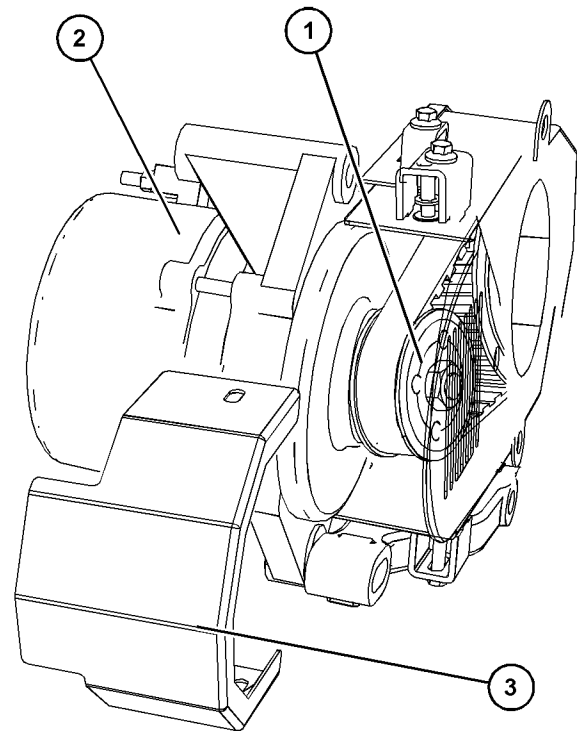


Illustration 31

g06018298

Typical example

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

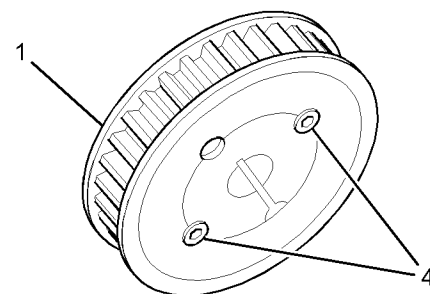


Illustration 32

g01233693

Typical example

3. Tighten the grub screws (4) to a torque of 20 N·m (15 lb ft).

4. Install the guard (3).

5. Restore the electrical supply to the engine.

i02322315

i02747977

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. Switch the engine to the OFF position. Remove all electrical loads.
2. Turn off any battery chargers. Disconnect any battery chargers.
3. The NEGATIVE “-” cable connects the NEGATIVE “-” battery terminal to the NEGATIVE “-” terminal on the starting motor. Disconnect the cable from the NEGATIVE “-” battery terminal.
4. 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.

5. Remove the used battery.
6. Install the new battery.

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

7. Connect the cable from the starting motor to the POSITIVE “+” battery terminal.
8. Connect the NEGATIVE “-” cable to the NEGATIVE “-” battery terminal.

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.

i02323088

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. Disconnect the negative battery terminal. Ensure that the cable cannot contact the terminal. When four 12 volt batteries are involved, two negative connection 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 in order to help prevent accidental starting.
7. Proceed with necessary system repairs.
8. In order to connect the battery, connect the positive connection before the negative connector.

i06683187

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

S/N: SD81-Up

Inspection

1. Isolate the electrical supply to the engine.
2. Visible inspect fan guards for wear or damage. Repair as necessary.

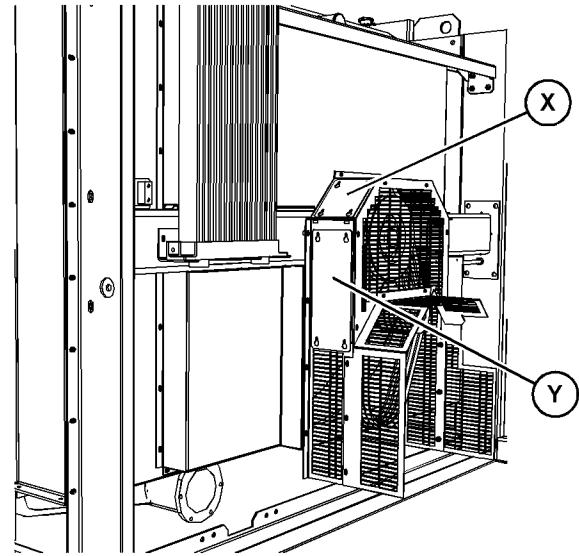


Illustration 33

g06022928

Typical example

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

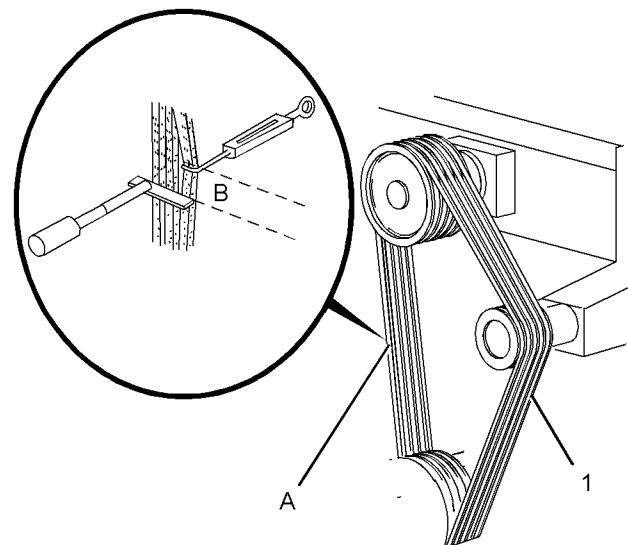


Illustration 34

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.

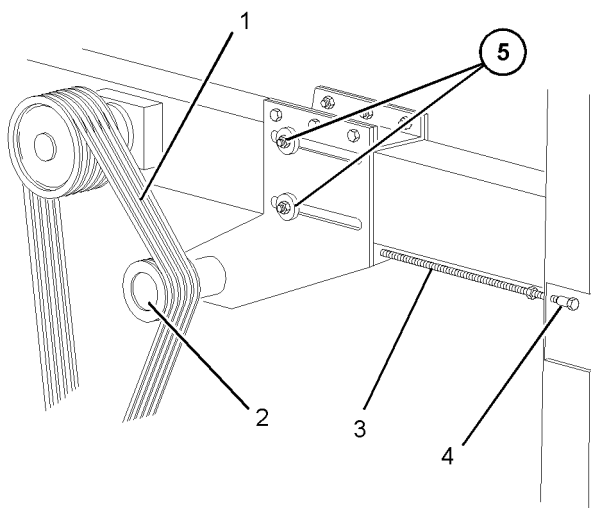


Illustration 35

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

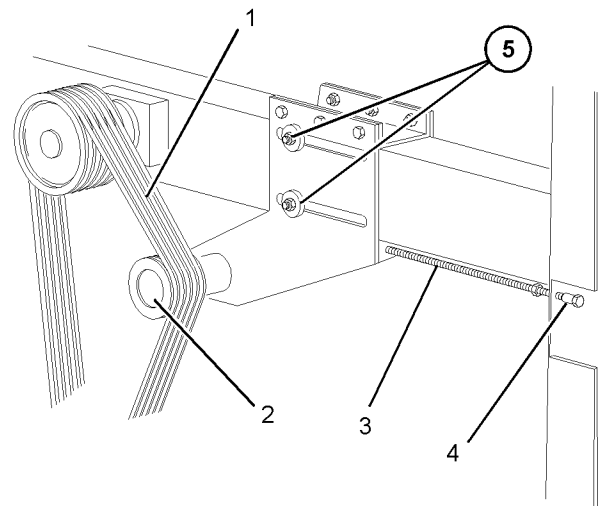


Illustration 36

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.

i06683207

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

S/N: SD61–Up

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.

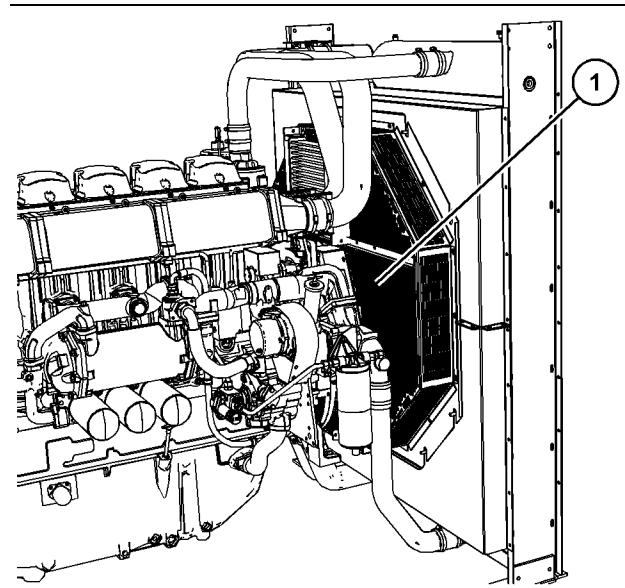


Illustration 37

g06079770

2. Visibly inspect fan guards for wear 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)

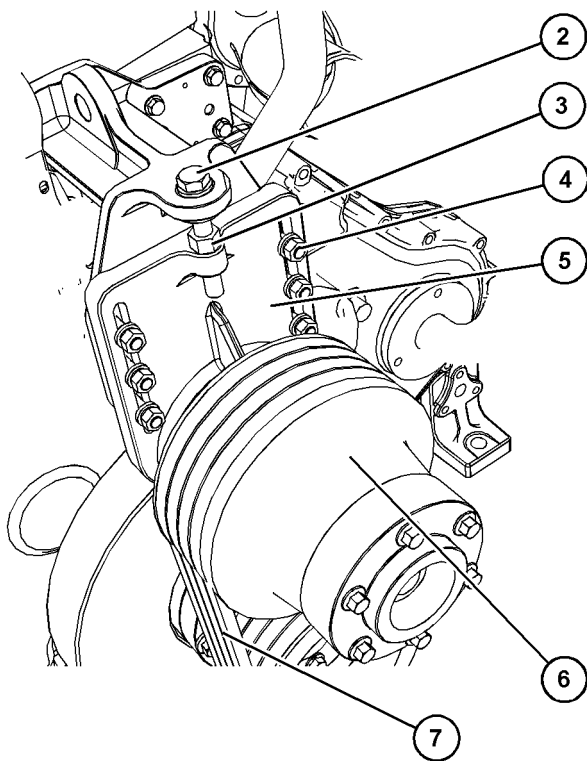


Illustration 38

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.

i06729752

Belts - Inspect/Adjust/Replace (Alternator Belt)

Inspection

1. Isolate the electrical supply to the engine.

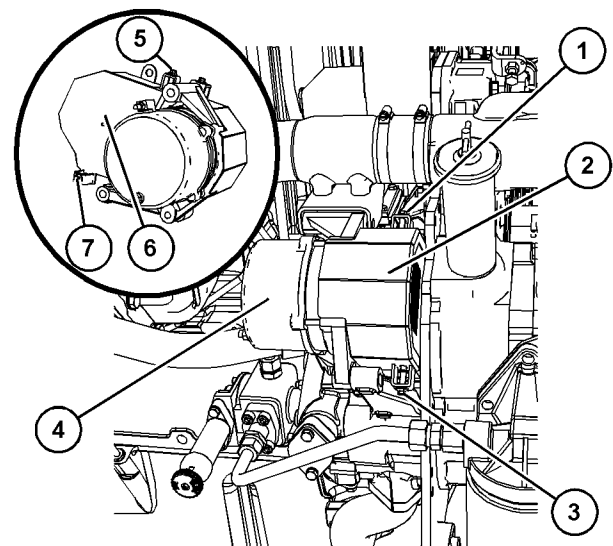


Illustration 39

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) and 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.

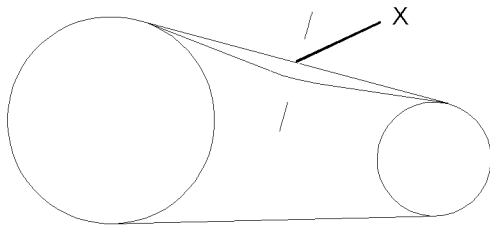


Illustration 40

g01239310

4. Apply 15.6 N (3.5 lb) of pressure at point (X).

The total deflection should not exceed 1.5 mm (0.06 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.

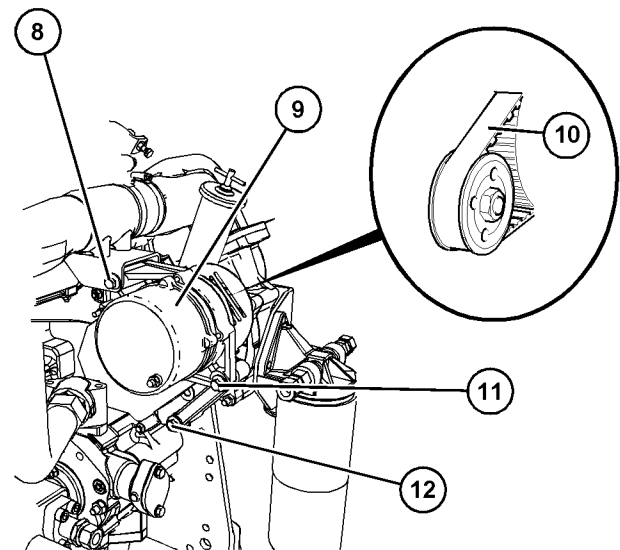


Illustration 41

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 (8). Tighten bolts (11) and (12) securely.
4. Check the tension of the belt. Refer to "Inspection" for the correct procedure.

5. Install the guards and restore the electrical supply to the engine.

i06729765

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.

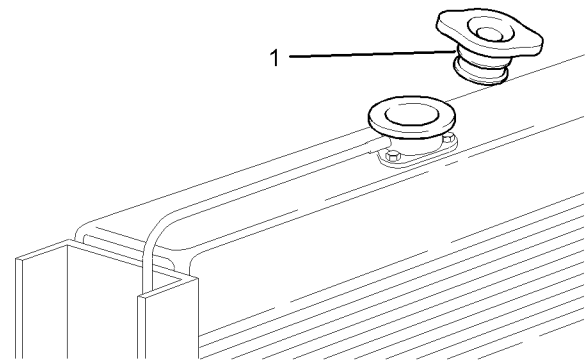


Illustration 42

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.

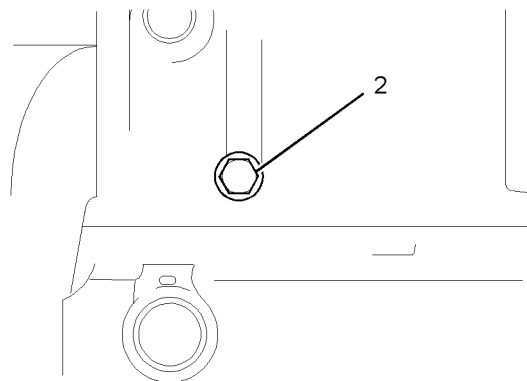


Illustration 43

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.

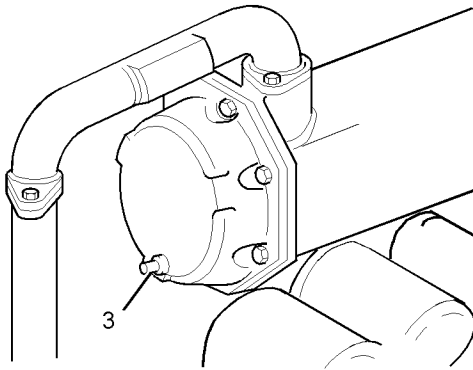


Illustration 44

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.

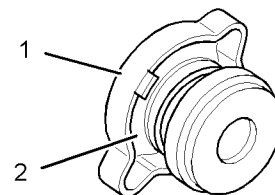


Illustration 45

g01239656

Typical example

Maintenance Section
Cooling System Coolant Extender (ELC) - Add

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.

i06533110

Cooling System Coolant Extender (ELC) - Add

For Perkins ELC to achieve 12000 hours an extender must be added at 6000 hours. For a suitable extender, contact your Perkins distributor.

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.

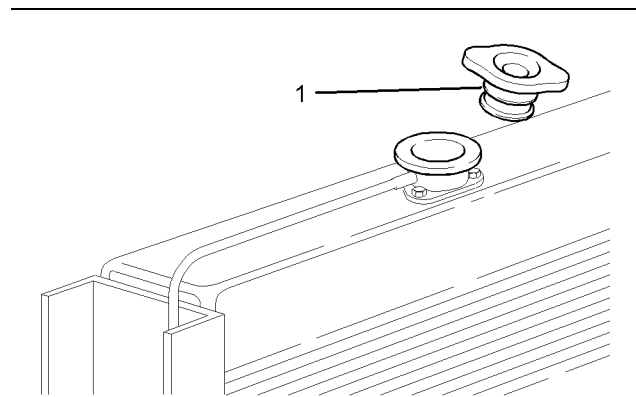


Illustration 46

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.

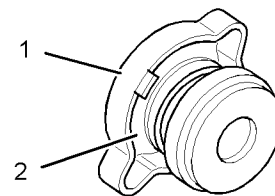


Illustration 47

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

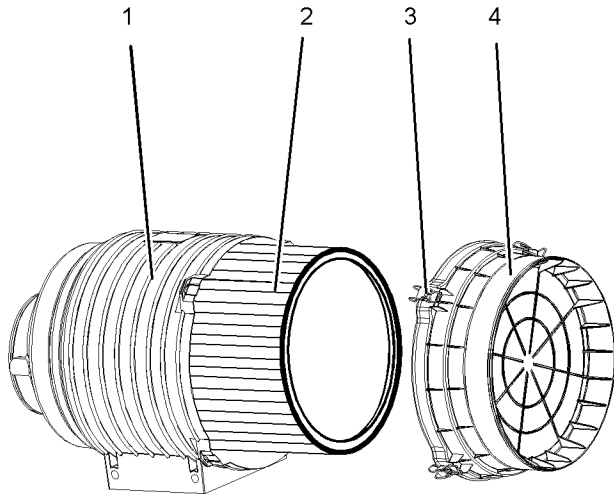


Illustration 48

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

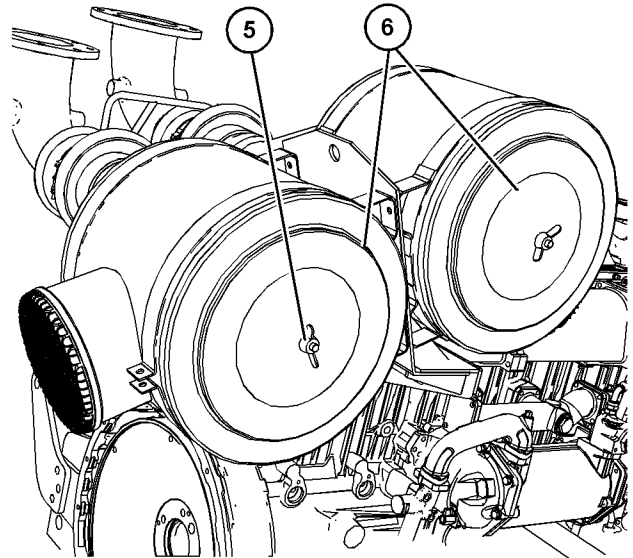


Illustration 49

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.

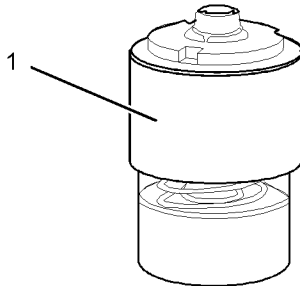


Illustration 50

g01242320

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

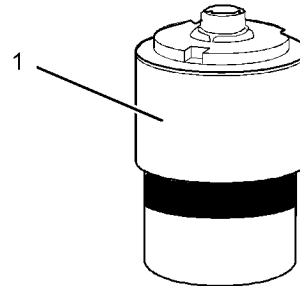


Illustration 51

g01242332

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

Service Indicator Reset

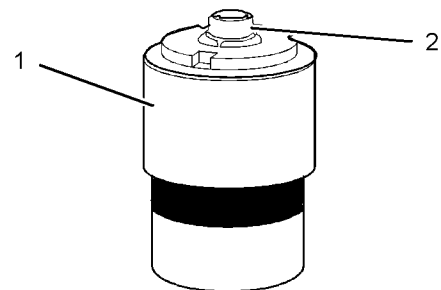


Illustration 52

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)

S/N: SD61-Up

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

i06682626

1. Isolate the electrical supply to the engine.

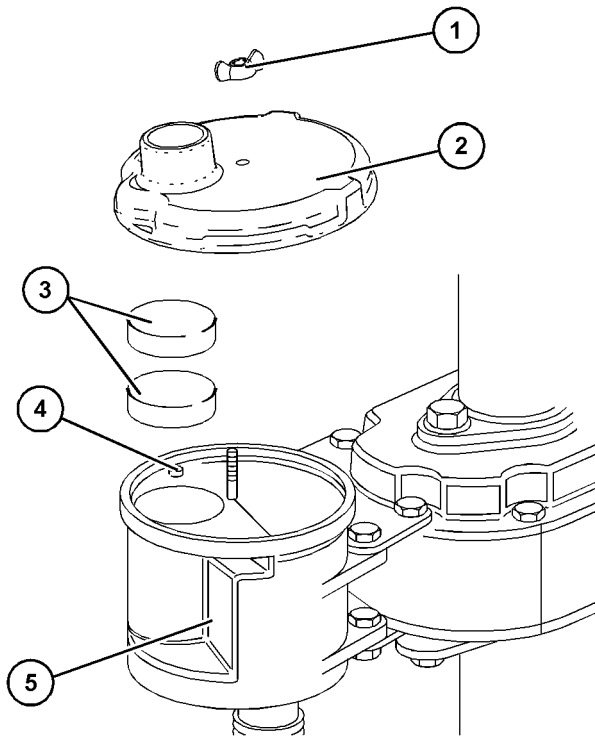


Illustration 53

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.

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

S/N: SD81–Up

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.

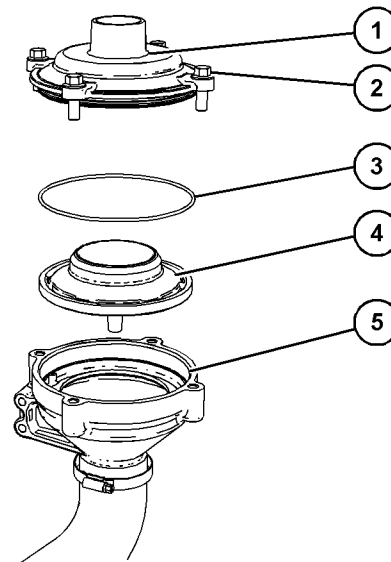


Illustration 54

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.

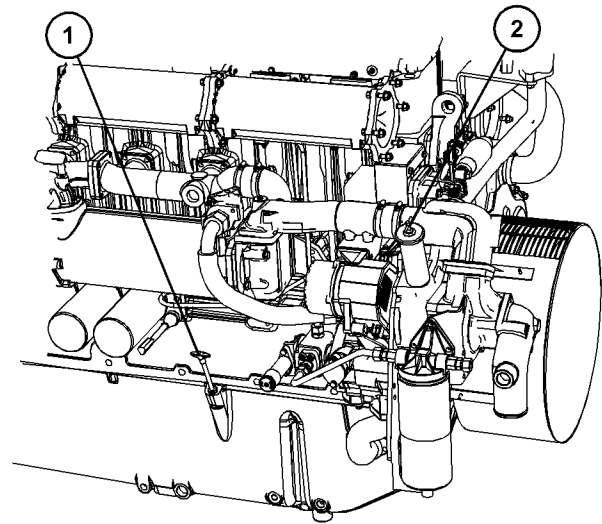


Illustration 55

g06008596

Typical example

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.

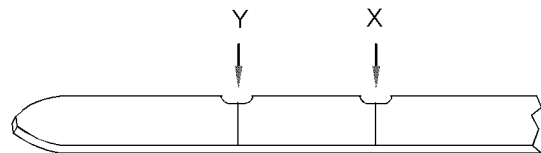


Illustration 56

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.

i06524085

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.

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.

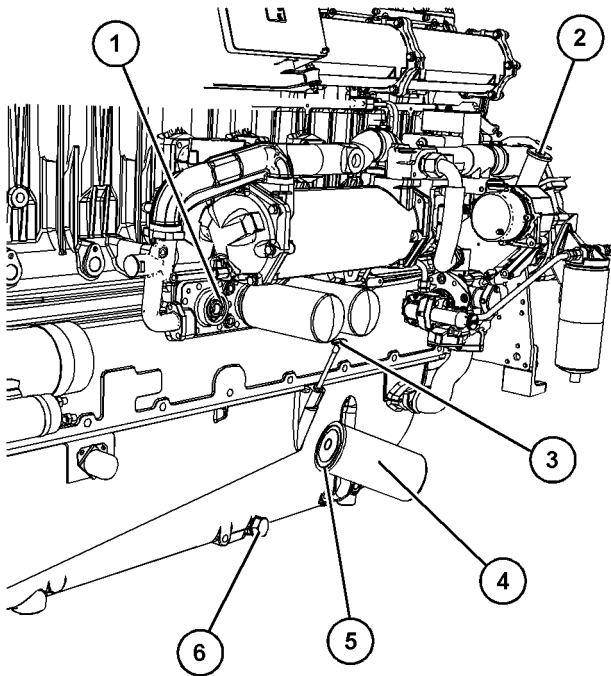


Illustration 57

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 (3). 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 16

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)
2. Ensure 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 $\frac{3}{4}$ 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 manufacturer's recommendations. Under filling or over filling the crankcase with oil can cause engine damage.

Note: Before starting the engine, crank the engine on the starter to obtain oil pressure.

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.

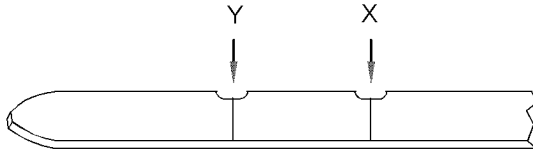


Illustration 58 g01165836
 (Y) "Min" mark. (X) "Max" mark.

- 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.

i03783789

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

NOTICE

Only qualified service personnel 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.

WARNING

Ensure that the engine can not 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.

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

Refer to Systems Operation, Testing and Adjusting, "Valve Lash - Adjust" for the correct procedure.

i06683230

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

S/N: SD81-Up

- Isolate the electrical supply to the engine.

i03783899

Fuel Injector - Inspect/Adjust

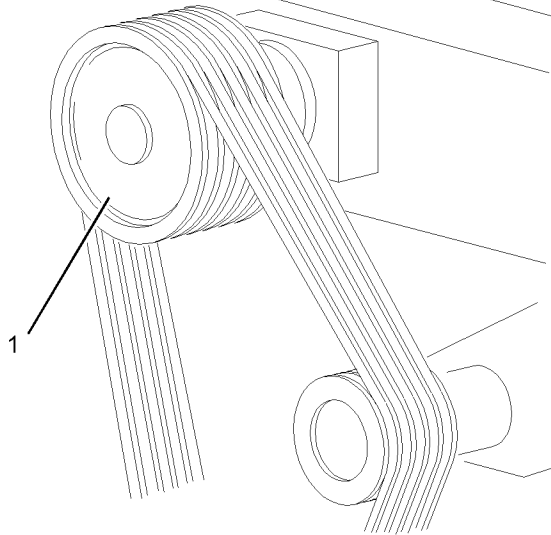


Illustration 59

g01238304

Typical example

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

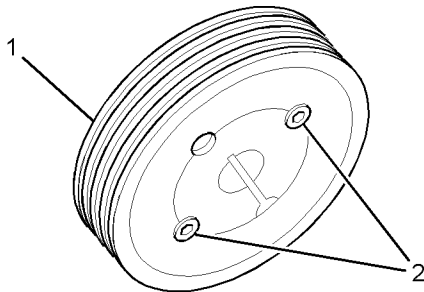


Illustration 60

g01238305

3. Tighten the grub screws (2) to a torque of 90 N·m (66 lb ft).
4. Install the guards (not shown).
5. Restore the electrical supply to the engine.

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.

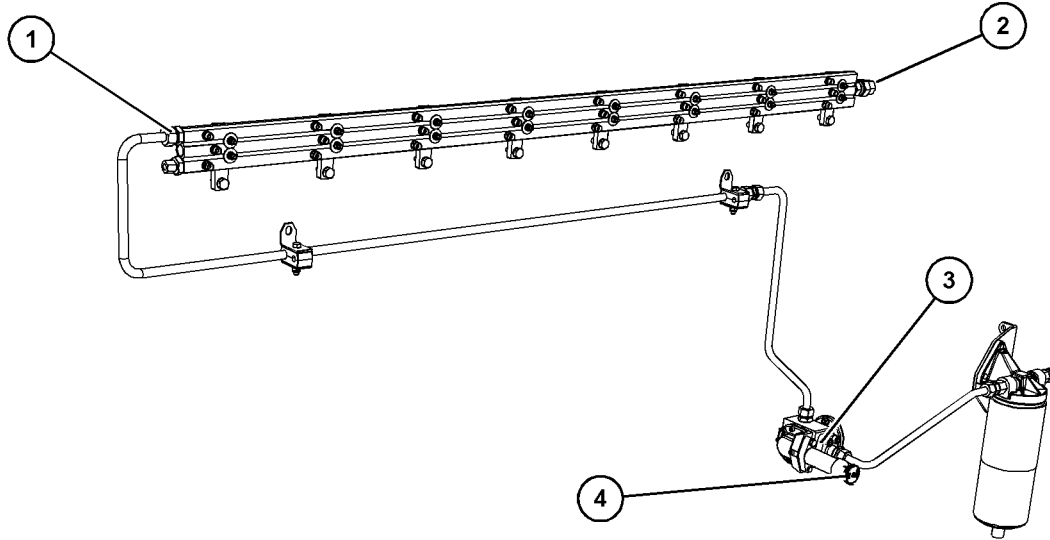


Illustration 61

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 free 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 free 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.

i06559454

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 and the battery is isolated, before any servicing or repair is performed.

Fuel Filter with Water Separator

Table 17

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.

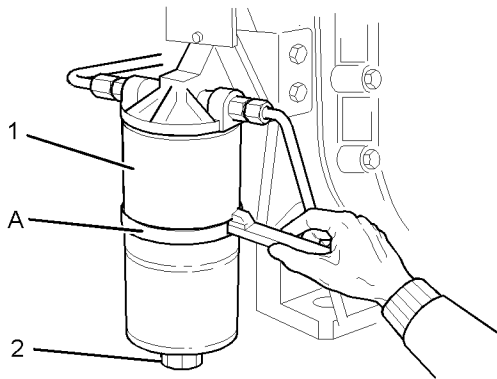


Illustration 62

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). Use hand pressure only.
7. Remove the container and dispose of the fuel in accordance with local regulations.
8. Restore the fuel supply to the engine.
9. Prime the fuel system. Refer to the Operation and Maintenance Manual, "Fuel System - Prime" for more information.
10. Start the engine and run the engine. Check the fuel system for leaks.

i02415268

Fuel System Primary Filter/ Water Separator - Drain

S/N: SD81-Up

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

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 in order to catch any fuel that might spill.

Note: Clean up any spilled fuel immediately.

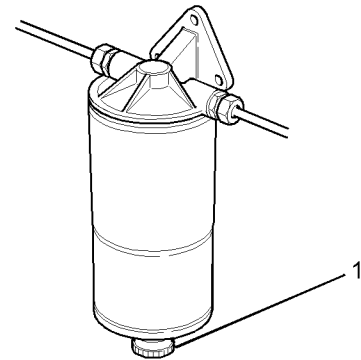


Illustration 63

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). Use hand pressure only. Dispose of the drained fluid in accordance with local regulations.

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.

i02471681

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.

Replacement of the Lift Pump

Removal of the Lift Pump

1. Isolate the fuel supply to the lift pump.
2. Place a suitable container below the lift pump in order to catch any fuel that might be spilled.

Note: Clean up any spillage of fuel immediately.

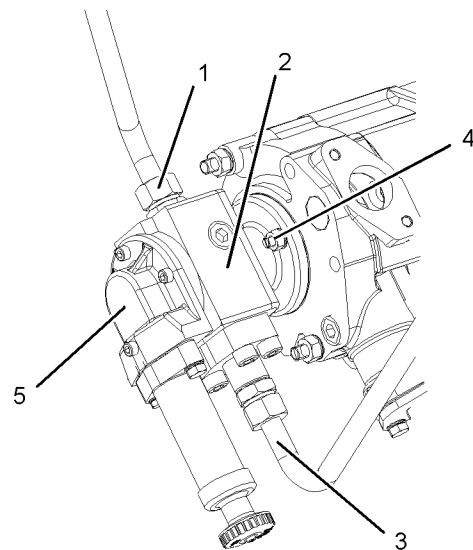


Illustration 64

g01280509

3. Remove the fuel priming pump (5).
4. Disconnect fuel line (3) and the connection (1).
Cap the fuel line with a suitable cap.
5. Remove the two nuts (4).
6. Remove the fuel lift pump (2).

7. Remove the joint from the lift pump (2). Discard the joint.

Installation of the Lift Pump

1. Install a new joint to the lift pump (2).
2. Align the drive for the lift pump (2). Install the lift pump.

Note: Ensure that the oil seal is not damaged as the lift pump is installed.

3. Install the nuts (4). Tighten the nuts to a torque of 25 N·m (18 lb ft).
4. Remove the cap from the fuel line (3). Connect the fuel line and the connection (1). Tighten the fuel line and the connection to a torque of 50 N·m (37 lb ft).
5. Fit the fuel priming pump (5) to the lift pump (2).
6. Restore the fuel supply to the lift pump.
7. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime".

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

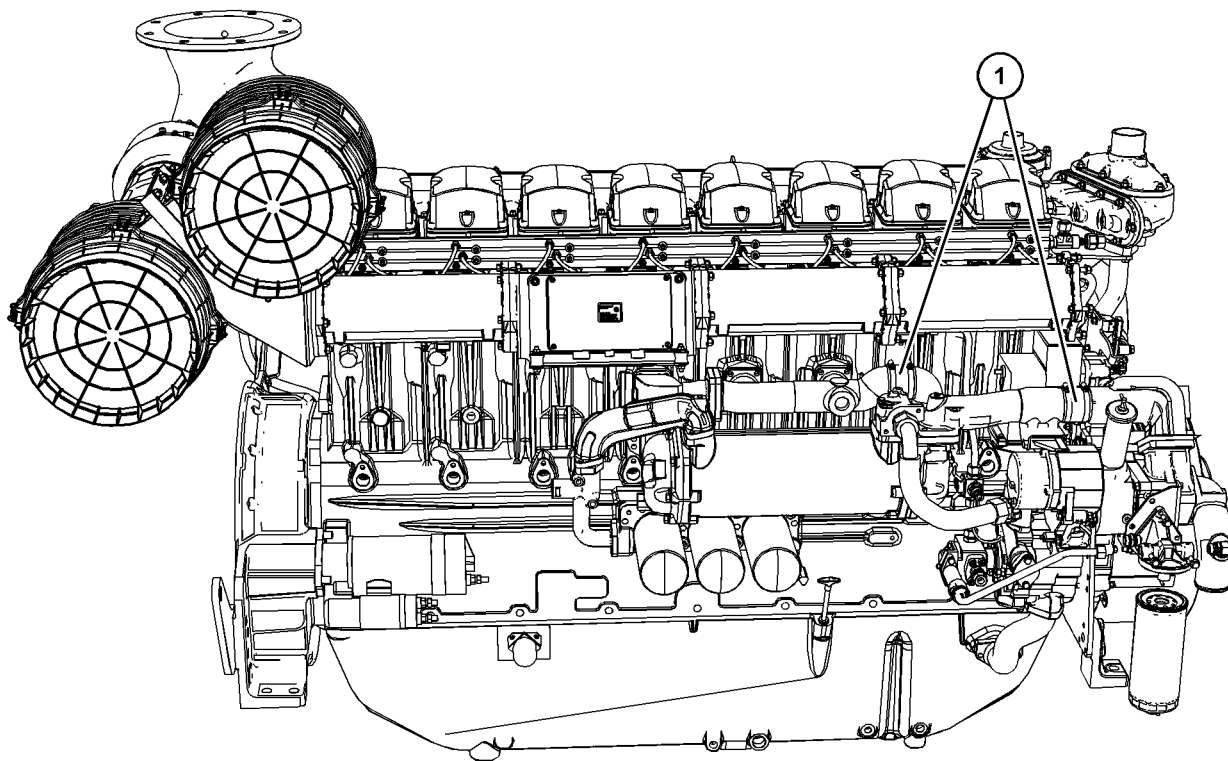


Illustration 65

g06117407

(1) Clamp torque 7 N·m (62 lb in)

Maintenance Section
Hoses and Clamps - Inspect/Replace

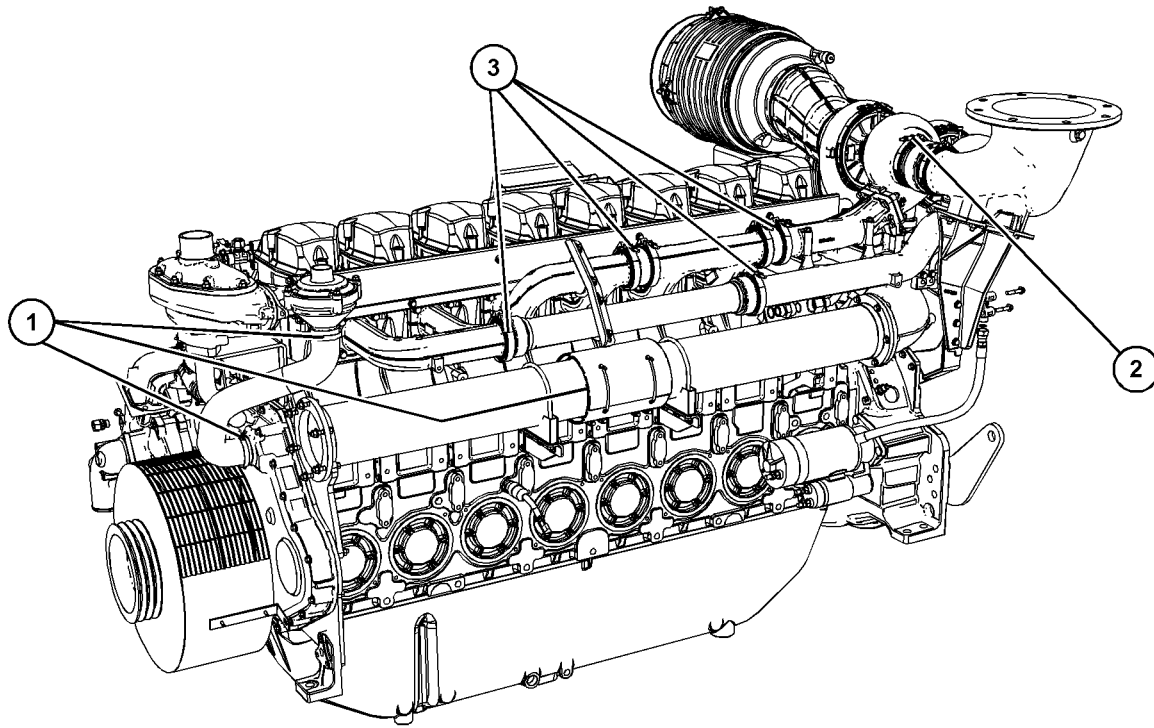


Illustration 66

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)

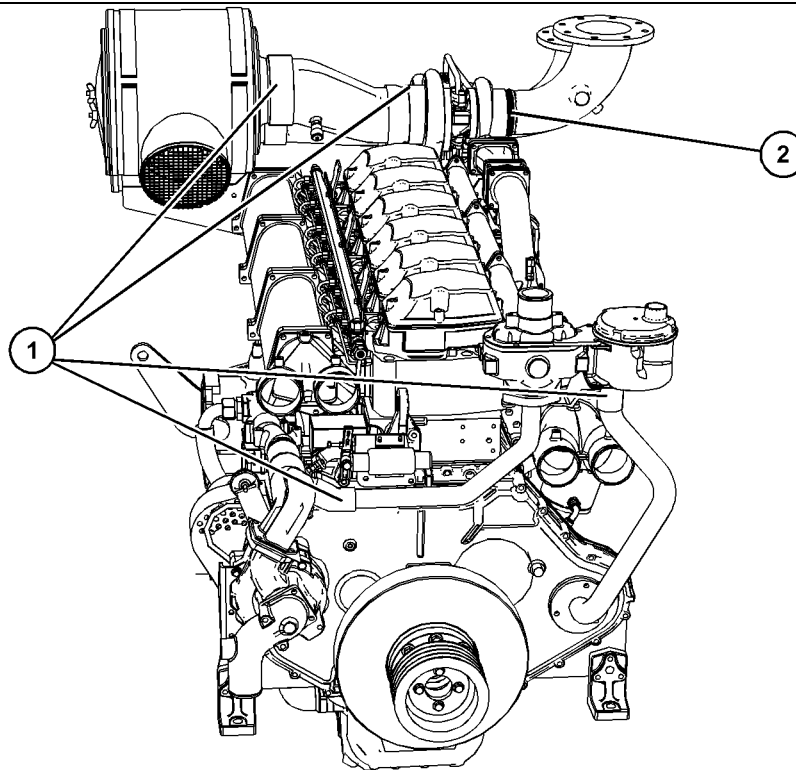


Illustration 67

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

Table 18

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)

i06530584

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 must also 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: Oil analysis can 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.

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
- Cylinder heads
- Inlet and exhaust valves

Replace the crankshaft vibration dampers.

i06546607

Overhaul (Top End)

Scheduling a Top End Overhaul

Top end overhauls should be scheduled according to the recession of the valve stems. This measurement provides an accurate indication of the rate of valve wear. This measurement can be used to predict when a cylinder head requires replacement.

Note: Generally, cylinder heads wear out at different rates. Sometimes, servicing the cylinder heads at different times may be the most economic decision. This action depends on the valve stem projection of the individual cylinders. However, this decision must include the costs of additional 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. Refer to Service Manual for more information.

Monitoring Valve Seat Wear

Every 500 service hours record the valve lash. The monitoring of the valve seat wear should be carried out before any adjustment of 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).

The recorded values can be used to identify any excessive valve seat wear on individual valves. The recorded values can be used to schedule a top end overhaul.

An example of recorded valve lash

Table 19

Hours	Recorded clearances on A1 cylinder		Total valve wear	
	Inlet	Exhaust	Inlet	Exhaust
500	0.4mm	0.4mm	0	0
1000	0.4	0.4	0	0
1500	0.35	0.35	0.05	0.05
2000	0.35	0.35	0.1	0.1
2500	0.3	0.3	0.2	0.2
3000	0.25	0.3	0.35	0.3
3500	0.25	0.35	0.5	0.35
4000	0.25	0.3	0.65	0.45

After 4000 hours running, the valve seat wear on the inlet is 0.65 mm (0.026 inch) and the exhaust is 0.45 mm (0.018 inch).

Note: Maximum permitted valve seat wear is 1.5 mm (0.05906 inch).

In this example, the valves are still serviceable after 4000 hours running.

When the valves approach the maximum wear limit, the rockers can be removed and a measurement from the cylinder head face to the top of the valve stems can be taken. When a new valve is installed, the protrusion of the valve stem would be 29.75 mm (1.171 inch). therefore, a maximum wear limit would be 30.75 mm (1.211 inch).

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 in extremely cold environments or hot environments. Valve components can be damaged by carbon buildup if the engine is frequently started and stopped in very

Maintenance Section
Speed Sensor - Clean/Inspect

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

i06554405

Speed Sensor - Clean/Inspect (Engine Speed Sensor and Overspeed Sensor)

When the engine is cranked, small metal particles are produced. These particles will contaminate the magnetic end of the overspeed 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 20

Required Tools			
Tool	Part Number	Part Name	Qty
A	SE253	Crankshaft Turning Tool	1

Overspeed Sensor

The overspeed sensor is located in the left-hand side of the flywheel housing.

1. Isolate the electrical supply to the engine.

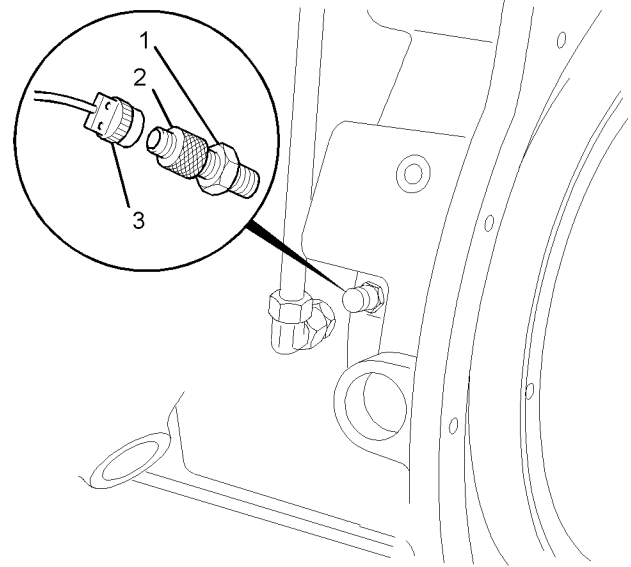


Illustration 68

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.

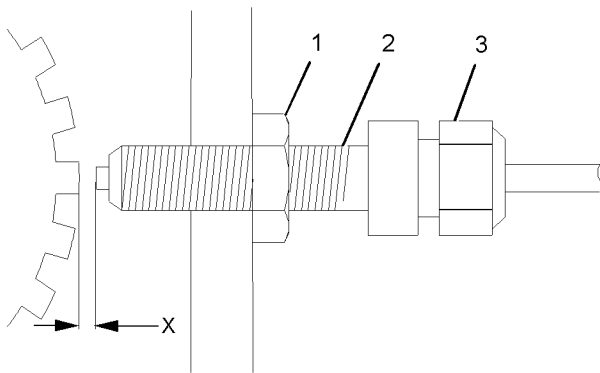


Illustration 69

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.

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.

Index

A

After Stopping Engine	34
Aftercooler Core - Inspect	51
Alternator - Inspect	51
Alternator Pulley - Check.....	51

B

Battery - Replace	52
Battery Electrolyte Level - Check	52
Battery or Battery Cable - Disconnect.....	53
Before Starting Engine	15, 32
Belts - Inspect/Adjust/Replace (4006-23 Engine Only)	55
Adjust	55
Inspect	55
Replace.....	56
Belts - Inspect/Adjust/Replace (Alternator Belt)	56
Adjustment.....	57
Inspection	56
Replacement.....	57
Belts - Inspect/Adjust/Replace (Fan Drive Belts for 4008-30 Only).....	53
Adjustment.....	54
Inspection	53
Replacement.....	54
Burn Prevention.....	12
Batteries.....	12
Coolant	12
Diesel Fuel.....	12
Oils.....	12

C

Cold Weather Starting	32
Cooling System Coolant (ELC) - Change	58
Drain	58
Fill	59
Flush	59
Cooling System Coolant Extender (ELC) - Add	60
Cooling System Coolant Level - Check.....	60
Crankshaft Vibration Damper - Inspect.....	60
Crushing Prevention and Cutting Prevention..	15

D

Driven Equipment - Check	61
--------------------------------	----

E

Electrical System.....	16
Grounding Practices	16
Emergency Stopping	34
Emissions Warranty Information	83
Engine - Clean.....	61
Engine Air Cleaner Element - Replace	61
4008-30 Air Cleaner	62
Engine Air Cleaner Service Indicator - Inspect	62
Service Indicator Check.....	62
Service Indicator Reset	63
Engine Crankcase Breather - Clean (4006- 23 Engine Only).....	63
Engine Crankcase Breather - Clean (4008- 30 Engine Only).....	64
Engine Description	23
Engine Cooling and Lubrication	24
Engine Specifications	23
Engine Electronics.....	17
System Description.....	17
Engine Lifting (4006-23 and 4008-30 Engines)	26
Engine Lifting Only.....	26
Radiator Lifting Only	27
Engine Mounts - Inspect.....	65
Engine Oil and Filter - Change	66
Drain the Engine Lubricating Oil.....	67
Fill the Oil Pan.....	67
Replace the Oil Filter	67
Engine Oil Level - Check.....	65
Engine Oil Pump - Inspect.....	65
Engine Oil Sample - Obtain.....	66
Initiating an Oil analysis Program	66
Obtain the Sample and the Analysis	66
Engine Operation	33
Engine Protective Devices - Check.....	68
Visual Inspection.....	68
Engine Starting.....	16, 32
Engine Stopping	16, 34
Engine Storage.....	28
Level "A"	28
Level "B"	28
Level "C"	28
Engine Valve Lash - Inspect/Adjust (Valves and Valve Bridges)	68

F		Inhalation	11
Fan Drive Pulley - Check (4008-30 Engine Only)	68	Pressurized Air and Water	10
Features and Controls	29	Static Electricity Hazard when Fueling with Ultra-low Sulfur Diesel Fuel	11
Fire Prevention and Explosion Prevention	13	Governor Actuator - Check	73
Ether	14	H	
Fire Extinguisher	14	Hoses and Clamps - Inspect/Replace	73
Lines, Tubes, and Hoses	15	Clamps and V-Band Clamp Torques	77
Fluid Recommendations (Engine Oil Specification)	47	Clamps and V-Band Locations	75
Engine Oil	47	Replace the Hoses and the Clamps	73
General Lubricant Information	47	I	
Fluid Recommendations (Fuel Specifications)	39	Important Safety Information	2
Contamination Control Recommendations for Fuels	46	L	
Diesel Fuel Characteristics	41	Lifting and Storage	26
Diesel Fuel Requirements	40	M	
General Information	39	Maintenance Interval Schedule	50
Fluid Recommendations (General Coolant Information)	35	Daily	50
ELC Cooling System Maintenance	37	Every 1000 Service Hours	50
General Coolant Information	35	Every 12 000 Service Hours or 6 Years	50
Foreword	4	Every 50 Service Hours or Weekly	50
California Proposition 65 Warning	4	Every 500 Service Hours	50
Literature Information	4	Every 500 Service Hours or 1 Year	50
Maintenance	4	Every 5000 Service Hours	50
Maintenance Intervals	4	Every 6000 Service Hours or 3 Years	50
Operation	4	Every 7500 Service Hours	50
Overhaul	4	Every Year	50
Safety	4	Initial 100 Service Hours	50
Fuel Conservation Practices	33	Overhaul	50
Fuel Injector - Inspect/Adjust	69	When Required	50
Fuel System - Prime	69	Maintenance Section	35
Fuel System Filter - Replace	70	Model View Illustrations (Engine Views for the Six and Eight Cylinder 4000 Series Engines)	18
Fuel Filter with Water Separator	70	4006-23 Engine Views	19
Fuel System Primary Filter/Water Separator - Drain	71	4008-30 Engine Views	21
Fuel Tank Water and Sediment - Drain	71	4008-30 Radiator	23
Drain the Water and the Sediment	72	Model Views	18
Fuel Storage Tanks	72	Monitoring System	29
Fuel Tank	72	Mounting and Dismounting	15
Fuel Transfer Pump (Lift Pump) - Inspect	72	O	
Replacement of the Lift Pump	72	Operation Section	26
G		Overhaul (Major)	77
General Hazard Information	9	Major Overhaul Information	78
Containing Fluid Spillage	11		
Dispose of Waste Properly	12		
Fluid Penetration	10		

Scheduling a Major Overhaul	77	Water Pump - Inspect.....	82
Overhaul (Top End)	78		
Scheduling a Top End Overhaul	78		
Top End Overhaul Information.....	78		
P			
Plate Locations and Film Locations	25		
Emission Label	25		
Product Identification Information	25		
Product Information Section.....	18		
R			
Radiator - Clean	79		
Refill Capacities.....	35		
Cooling System	35		
Fuel System	35		
Lubrication System	35		
S			
Safety Messages.....	5		
1 Universal Warning	6		
2 Do Not Step	6		
3 Hot Surface.....	7		
4 Hot Fluid Under Pressure	7		
5 Ether Warning.....	8		
6 Rotating Shaft Hand Crush Hazard	8		
Safety Section	5		
Sensors and Electrical Components.....	29		
Severe Service Application - Check.....	79		
Environmental Factors.....	79		
Incorrect Maintenance Procedures	80		
Incorrect Operating Procedures	80		
Speed Sensor - Clean/Inspect (Engine Speed Sensor and Overspeed Sensor)	80		
Overspeed Sensor.....	80		
Starting Motor - Inspect.....	81		
Starting the Engine.....	32		
Normal Engine Starting Procedure.....	32		
Stopping the Engine	34		
T			
Table of Contents	3		
Turbocharger - Inspect.....	81		
W			
Walk-Around Inspection	81		
Warranty Information.....	83		
Warranty Section.....	83		

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: _____

