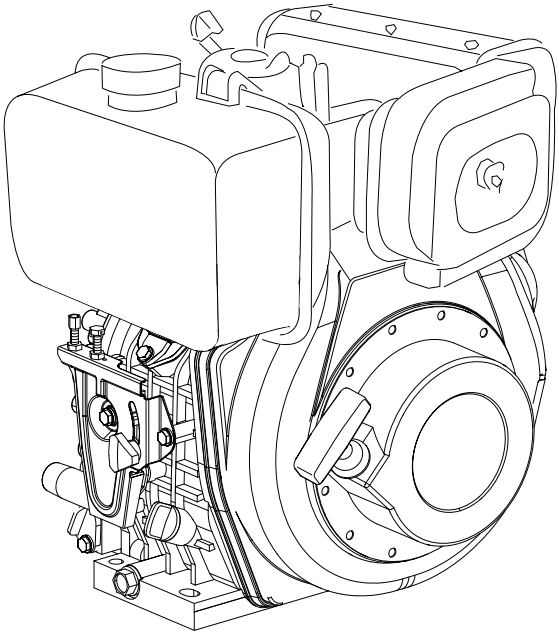
CAMPES

Diesel Engine

Owner's Manual



MODEL: _____

SERIAL: _____

DATE PURCHASED: _____

SAVE THIS MANUAL FOR FUTURE REFERENCE

INTRODUCTION

Welcome to the world of Campes Engines!

At CAMPES, we know a lot about a lot, but we know the most about engines. We take great pride in producing reliable and efficient engines that get the job done every time, without hiccups. Because of the work we put into designing highly efficient machines, you can be sure that the commitment we've made to energy conservation will positively impact your wallet just as much as it positively impacts your carbon footprint. Our engines are true high-performance technology and boast the maximum in engine life – and these words are far from empty. Our engines are tested under extreme conditions. They don't leave our production line until we are sure that they will live up to every aspect of Campes' legendary reputation. Our commitment is reflected in our impressive engine warranties and world-class dealer support network. Since 2007, we have manufactured, with precise craftmanship, over 2.5 million diesel engines ranging from 3.4 to 12.2 horsepower. Our engines can be found across a multitude of landscapes and industries – from agriculture, to industrial, and everything in between.

To help you enjoy Campes Series engine for many years to come, please follow these recommendations:

• Read and understand this Operation Manual before you operate the machine to ensure that you follow safe operating practices and maintenance procedures.

• Keep this Operation Manual in a convenient place for easy access.

• If this Operation Manual is lost or damaged, order a new one from your authorized Campes engine dealer or distributor.

• Make sure this manual is transferred to subsequent owners. This manual should be considered a permanent part of the engine and remain with it.

• Constant efforts are made to improve the quality and performance of Campes products, so some details included in this Operation Manual may differ slightly from your engine. If you have any questions about these differences, please contact your authorized Campes engine dealer or distributor.

• The specifications and components (instrument panel, fuel tank, etc.) described in this manua may differ from ones installed on your machine.

Please refer to the manual provided by the manufacturer of these components.

TABLE OF CONTENT

Section 1 Warranties

What is Covered by this Warranty?

Campes warrants to the original retail purchaser that a new Campes Series Engine will be free from defects in material and / or workmanship for the duration of the warranty period.

THIS WARRANTY IS PROVIDED IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

CAMPES SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, except where such disclaimer is prohibited by law. IF SUCH DISCLAIMER IS PROHIBITED BY LAW, THEN IMPLIED WARRANTIES SHALL BE LIMITED IN DURATION TO THE LIFE OF THE EXPRESS WARRANTY.

The Campes standard limited warranty period begins on the date of the delivery of the Campes Series Engine to the first retail purchaser and extends for a period of twenty-four (12) months or one-thousand (1000) engine operation hours, whichever occurs first.

What the Engine Owner Must Do:

If you believe your Campes engine has experienced a failure due to a defect in material and / or orkmanship, you must contact an authorized Campes engine dealer or distributor within thirty (30) days of discovering the failure. You must provide proof of ownership of the engine, proof of the date of the engine purchase and delivery, and documentation of the Acceptable forms of proof of delivery date include, but are not limited to: the original warranty registration or sales receipts or other documents maintained in the ordinary course of business by Campes dealers and / or distributors, indicating the date of delivery of the Campes product to the original retail purchaser. This information is necessary to establish whether the Campes product is still within the warranty period. Thus, Campes strongly recommends you register your engine as soon as possible after purchase in order to facilitate any future warranty matters.

You are responsible for the transportation of the engine to and from the repair location as designated by Campes.

What Campes Will Do:

Campes warrants to the original retail purchaser of a new Campes engine that Campes will make such repairs and / or replacements at Campes's option, of any part(s) of the Campes product covered by this Warranty found to be defective in material and/or workmanship. Such repairs and / or replacements will be made at a location designated by Campes at no cost to the purchaser for parts or labor.

What is Not Covered by this Warranty?

This Warranty does not cover parts affected by or damaged by any reason other than defective materials or workmanship including, but not limited to, accident, misuse, abuse, "Acts of God," neglect, improper installation, improper maintenance, improper storage, the use of unsuitable attachments or parts, the

use of contaminated fuels, the use of fuels, oils, lubricants, or fluids other than those recommended in your Campes Operation Manual, unauthorized alterations or modifications, ordinary wear and tear, and rust or corrosion. This Warranty does not cover the cost of parts and / or labor required to perform normal / scheduled maintenance on your Camps engine. This Warranty does not cover consumable

parts such as, but not limited to, filters, belts, hoses, fuel injector nozzles, lubricants and cleaning fluids.

This Warranty does not cover the cost of shipping the product to or from the warranty repair facility.

Warranty Modifications:

Except as modified in writing and signed by the parties, this Warranty is and shall remain the complete and exclusive agreement between the parties with respect to warranties, superseding all prior agreements, written and oral, and all other communications between the parties relating to warranties.

No person or entity is authorized to give any other warranty or to assume any other obligation on behalf of Campes, either orally or in writing.

Section 2 Safety

Safety Statements

Campes is concerned for your safety and your machine's condition. Safety statements are one of the primary ways to call your attention to the potential hazards associated with Campes Series engine operation. Follow the precautions listed throughout the manual before operation, during operation and during periodic maintenance procedures for your safety, the safety of others and to protect the performance of your engine. Keep the labels from becoming dirty or torn and replace them if they are lost or damaged. Also, if you need to replace a part that has a label attached to it, make sure you order the new part and label at the same time.

This safety alert symbol appears with most safety statements. It means attention, become alert, your safety is involved! Please read and abide by the message that follows the safety alert symbol.

DANGER

Danger (the word "DANGER" is in white letters with a red rectangle behind it) –indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. Danger is limited to the most extreme situations.

0000001en

WARNING

Warning (the word "WARNING" is in black letters with an orange rectangle behind it) – indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

0000001en

CAUTION

Caution (the word "CAUTION" is in black letters with a yellow rectangle behind it)

– indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

0000001en

CAUTION

Caution without the safety alert symbol

indicates a potentially hazardous situation that can cause damage to the machine, personal property and / or the environment or cause the machine to operate improperly

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Safety Precautions

Before You Operate

CAUTION

NEVER permit anyone to operate the engine or driven machine without proper training.

• Read and understand this Operation Manual before you operate the machine to ensure that you follow safe operating practices and maintenance procedures.

• Machine safety signs and labels are additional reminders for safe operating and maintenance techniques.

• See your authorized Campes engine dealer or distributor for additional training.

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During Operation and Maintenance

DANGER

EXPLOSION HAZARD!

• Keep the area around the battery well ventilated. While the engine is running or the battery is charging, hydrogen gas is produced which can be easily ignited.

• Keep sparks, open flame and any other form of ignition away.

• Failure to comply will result in death or serious injury.

0000003en

DANGER

FIRE AND EXPLOSION HAZARD!

• Only use the key switch or recoil starter to start the engine.

• NEVER jump start the engine. Sparks caused by jumping the battery to the starter terminals may cause a fire or explosion.

• Failure to comply will result in death or serious injury.

0000004en

DANGER

FIRE AND EXPLOSION HAZARD!

• Diesel fuel is extremely flammable and explosive under certain conditions.

• When you remove any fuel system component to perform maintenance (such as changing the fuel filter) place an approved container under the opening to catch the fuel.

• NEVER use a shop rag to catch the fuel. Vapors from the rag are extremely flammable and explosive.

• Wipe up any spills immediately.

• Wear eye protection. The fuel system is under pressure and fuel could spray out when you remove any fuel system component.

• Failure to comply will result in death or serious injury

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DANGER

FIRE AND EXPLOSION HAZARD!

• Diesel fuel is extremely flammable and explosive under certain conditions.

• NEVER use diesel fuel as a cleaning agent.

• Failure to comply will result in death or serious injury.

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DANGER

FIRE AND EXPLOSION HAZARD!

•Diesel fuel is extremely flammable and explosive under certain conditions.

• Only fill the fuel tank with diesel fuel. Filling the fuel tank with gasoline may result in a fire.

• NEVER refuel with the engine running.

• Wipe up all spills immediately.

• Keep sparks, open flames or any other form of ignition (match, cigarette, static electric source) away when fueling/refueling.

• NEVER overfill the fuel tank.

• Fill the fuel tank and store fuel in a well-ventilated area only.

• Failure to comply will result in death or serious injury.

0000005en

DANGER

FIRE AND EXPLOSION HAZARD!

• Diesel fuel is extremely flammable and explosive under certain conditions.

• Before you operate the engine, check for fuel leaks. Replace rubberized fuel hoses every two years or every 2000 hours of engine operation, whichever comes first, even if the engine has been out of service. Rubberized fuel lines tend to dry out and become brittle after two years or 2000 hours of engine operation, whichever comes first.

• Failure to comply will result in death or serious injury.

0000015en

DANGER

FIRE AND EXPLOSION HAZARD!

• Diesel fuel is extremely flammable and explosive under certain conditions.

• Be sure to place the diesel fuel container on the ground when transferring the diesel fuel from the pump to the container. Hold the hose nozzle firmly against the side of the container while filling it. This prevents static electricity build-up which could cause sparks and ignite fuel vapors.

• NEVER place diesel fuel or other flammable material such as oil, hay or dried grass close to the engine during engine operation or shortly after shut down.

• Failure to comply will result in death or serious injury.

0000014en

DANGER

EXPLOSION HAZARD!

• NEVER check the remaining battery charge by shorting out the terminals. This will result in a spark and may cause an explosion or fire. Use a hydrometer to check the remaining battery charge.

• If the electrolyte is frozen, slowly warm the battery before you recharge it.

• Failure to comply will result in death or serious injury

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DANGER

When you need to transport an engine for repair, have a helper assist you to attach it to a hoist and load it on a truck.

• NEVER stand under a hoisted engine. If the hoist mechanism fails, the engine will fall on you, causing serious injury or death.

• Failure to comply will result in death or serious injury.

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WARNING

SEVER HAZARD!

• Keep hands and other body parts away from moving/rotating parts such as the cooling fan/ flywheel.

• Wear tight fitting clothing and keep your hair short or tie it back while the engine is running.

• Remove all jewelry before you operate or service the machine.

• NEVER start the engine in gear. Sudden movement of the engine and/or machine could cause death or serious personal injury.

• NEVER operate the engine without the guards in place.

• Before you start the engine make sure that all bystanders are clear of the area.

• Keep children and pets away while the engine is operating.

• Check before starting the engine that any tools or shop rags used during maintenance have been removed from the area.

• Failure to comply could result in death or serious injury.

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WARNING

EXHAUST HAZARD!

• NEVER operate the engine in an enclosed area such as a garage, tunnel, underground room, manhole or ship's hold without proper ventilation.

• NEVER block windows, vents, or other means of ventilation if the engine is operating in an enclosed area. All internal combustion engines create carbon monoxide gas during operation. Accumulation of this gas within an enclosure could cause illness or even death.

• Make sure that all connections are tightened to specifications after repair is made to the exhaust system.

• Failure to comply could result in death or serious injury.

0000003en

WARNING

ALCOHOL AND DRUG HAZARD!

•NEVER operate the engine while you are under the influence of alcohol or drugs.

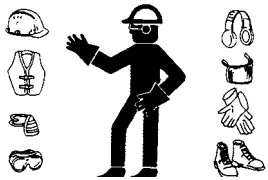
•NEVER operate the engine when you are feeling ill.

•Failure to comply could result in death

or serious injury.

0000004en

WARNING



EXPOSURE HAZARD!

• Wear personal protective equipment such as gloves, work shoes, eye and hearing protection as required by the task at hand.

• NEVER wear jewelry, unbuttoned cuffs, ties or loose fitting clothing when you are working near moving/rotating parts such as the cooling fan, flywheel or PTO shaft.

•ALWAYS tie long hair back when you are working near moving/rotating parts such as a cooling fan, flywheel, or PTO shaft.

•NEVER operate the engine while wearing a headset to listen to music or radio because it will be difficult to hear the warning signals.

•Failure to comply could result in death or serious injury.

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WARNING

BURN HAZARD!

• Batteries contain sulfuric acid. NEVER allow battery fluid to come in contact with clothing, skin or eyes. Severe burns could result. ALWAYS wear safety goggles and protective clothing when servicing the battery. If contact with the skin and/or eyes should occur, flush with a large amount of water and obtain prompt medical treatment.

• Failure to comply could result in death or serious injury.

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WARNING

HIGH PRESSURE HAZARD!

• Avoid skin contact with the high pressure diesel fuel spray caused by a fuel system leak such as a broken fuel injection line. High pressure fuel can penetrate your skin and result in serious injury. If you are exposed to high pressure fuel spray, obtain prompt medical treatment.

• NEVER check for a fuel leak with your hands. ALWAYS use a piece of wood or cardboard. Have your authorized Campes engine dealer or distributor repair the damage.

• Failure to comply could result in death or serious injury.

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WARNING

SHOCK HAZARD!

• Turn off the battery switch (if equipped) or disconnect the negative battery cable before servicing the electrical system.

• Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors. ALWAYS keep the connectors and terminals clean.

• Failure to comply could result in death or serious injury.

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WARNING

SEVER HAZARD!

• Stop the engine before you begin to service it.

• NEVER leave the key in the key switch when you are servicing the engine. Someone may accidentally start the engine and not realize you are servicing it. This could result in a serious injury.

• If you must service the engine while it is operating, remove all jewelry, tie long hair back, and keep your hands, other body parts and clothing away from moving/rotating parts.

•Failure to comply could result in death or serious injury.

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WARNING

BURN HAZARD!

• If you must drain the engine oil while it is still hot, stay clear of the hot engine oil to avoid being scalded. Make sure you wear eye protection.

•Failure to comply could result in death or serious injury.

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WARNING

BURN HAZARD!

• Keep your hands and other body parts away from hot engine surfaces such as the muffler, exhaust pipe, turbocharger (if equipped) and engine block during operation and shortly after you shut the engine down. These surfaces are extremely hot while the engine is operating and could seriously burn you.

•Failure to comply could result in death or serious injury.

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CAUTION

FLYING OBJECT HAZARD!

•ALWAYS wear eye protection when servicing the engine and when using compressed air or high-pressure water. Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.

•Failure to comply may result in minor or moderate injury.

0000003en

CAUTION

Only use diesel fuels recommended by Campes for the best engine performance, to prevent engine damage.

• Only use clean diesel fuel.

• NEVER remove inlet fuel screen from the filler port. If removed, dirt and debris could get into the fuel system causing it to clog.

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CAUTION

NEVER attempt to adjust the low or high idle speed limit screw. This may impair the safety and performance of the machine and shorten its life. If adjustment is ever required, contact your authorized Campes engine dealer or distributor.

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CAUTION

If any problem is noted during the visual check, the necessary corrective action should be taken before you operate the engine.

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CAUTION

NEVER hold the key in the START position for longer than 15 seconds or the starter motor will overheat.

0000007en

CAUTION

The illustrations and descriptions of optional equipment in this manual, such as the operator's console, are for a typical engine installation. Refer to the documentation supplied by the optional equipment manufacturer for specific

operation and maintenance instructions.

0000018en

CAUTION

If any indicator illuminates during engine operation stop the engine immediately. Determine the cause and repair the problem before you continue to operate the engine.

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CAUTION

NEVER allow the recoil handle to snap back against the engine. Return the handle to the starting position gently to prevent damage to the starter.

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CAUTION

Observe the following environmental operating conditions to maintain engine performance and avoid premature engine wear:

- **Avoid operating in extremely dusty conditions.**
- **Avoid operating in the presence of chemical gases or fumes.**
- **Avoid operating in a corrosive atmosphere such as salt water spray.**
- **NEVER install the engine in a floodplain unless proper precautions are taken to avoid being subject to a flood.**
- **NEVER expose the engine to the rain.**

0000003en

CAUTION

Observe the following environmental operating conditions to maintain engine performance and avoid premature engine wear:

- **NEVER run the engine if the ambient temperature is above +40°C or below 10°C If the ambient temperature exceeds +40°C the engine may overheat and cause the engine oil to break down. If the ambient temperature falls below -10°C rubber components such as gaskets and seals will harden causing premature engine wear and damage.**

Contact your authorized Campes engine dealer or distributor if the engine will be operated in either temperature extreme.

- **Contact your authorized Campes engine dealer or distributor if you need to operate the engine at high altitudes. At high altitudes the engine will lose power, run rough, and produce exhaust gases that exceed the design specifications.**

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CAUTION

Only use the engine oil specified. Other engine oils may affect warranty coverage, cause internal engine components to seize, or shorten engine life.

• Prevent dirt and debris from contaminating the engine oil. Carefully clean the oil cap/dipstick and the surrounding area before you remove the cap.

• NEVER mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil.

• NEVER overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

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CAUTION

• NEVER overfill the engine with engine oil.

• ALWAYS keep the oil level between the upper and lower lines on the oil cap/dipstick.

0000015en

CAUTION

For maximum engine life, Campes recommends that when shutting the engine down, you allow the engine to idle, without load, for 5 minutes. This will allow the engine components that operate at high temperatures, such as exhaust system, to cool slightly before the engine itself is shut down.

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CAUTION

NEVER use an engine starting aid such as ether. Engine damage will result.

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CAUTION

NEVER engage the starter motor while the engine is running. This may damage the starter motor pinion and/or ring gear.

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CAUTION

Make sure the engine is installed on a level surface. If a continuously running engine is installed at an angle greater than 20° (in any direction) or if an engine runs for short periods of time (less than 3 minutes) at an angle greater than 25° in any direction, engine oil may enter the combustion chamber causing exessive engine speed and generate white smoke and also may occur unsatisfactory oil pressure. These may cause serious engine damage.

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CAUTION

New Engine Break In:

• On the initial engine start-up, allow the engine to idle for approximately 15 minutes while you check for proper engine oil pressure, diesel fuel leaks, engine oil leaks, and for proper operation of the indicators and/or gauges.

• During the first hour of operation, vary the engine speed and the load on the engine. Short periods of maximum engine speed and load are desirable. Avoid prolonged operation at minimum or maximum engine speeds and loads for the next 100 hours.

• During the break-in period, carefully observe the engine oil pressure and engine temperature.

•During the break-in period, check the engine oil levels frequently.

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CAUTION

NEVER attempt to modify the engine's design or safety features such as defeating the engine speed limit control or the fuel injection quantity control.

• Failure to comply may impair the engine's safety and performance characteristics and shorten the engine's life. Any alterations to this engine may affect the warranty coverage of your engine. See Campes Limited Warrantyon page1.

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CAUTION

Be environmentally responsible. Follow these procedures for hazardous waste disposal. Failure to follow these procedures may seriously harm the environment.

• Follow the guidelines of the governmental agency for the proper disposal of hazardous materials such as engine oil, diesel fuel and engine coolant. Consult the local authorities or reclamation facility.

• NEVER dispose of hazardous materials irresponsibly by dumping them into a sewer, on the ground or into ground water or waterways.

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CAUTION

Protect the air cleaner, and electric components from damage when you use steam or use high-pressure water to clean the engine.

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CAUTION

The tightening torque in the Standard Torque Chart(page 32) should be carefully observed.

• Apply 60% torque to bolts that are not listed.

• Apply 80% torque when tightened to aluminum alloy.

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CAUTION

Establish a periodic maintenance plan according to the engine application and make sure you perform the required periodic maintenance at intervals indicated. Failure to follow these guidelines will impair the engine's safety and performance characteristics, shorten the engine's life and may affect the warranty coverage on your engine. See Campes Limited Warrantyon page1.

Consult your authorized Campes engine dealer or distributor for assistance when checking items marked with a ●

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CAUTION

It is important to perform daily checks. See Daily Checks on page 21.

Periodic maintenance prevents unexpected downtime, reduces the number of accidents due to poor machine performance and helps extend the life of the engine.

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CAUTION

When the engine is operated in dusty conditions, clean the air cleaner element more frequently.

• NEVER operate the engine with the air cleaner or element(s) removed. This may cause foreign material to enter the engine and damage it.

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CAUTION

Tips while starting engine with recoil starter (See Starting The Engine on page 26.):

• Pulling out the recoil starter handle too hard or fast will damage the equipment.

• ALWAYS pull recoil starter handle all the way out or the engine will not start.

• NEVER allow the recoil starter handle to snap back against the engine. Return the handle to the starting position gently to prevent damage to the recoil starter.

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CAUTION

If the engine continues to run after you position the engine speed control to the STOP position, turn the fuel cock to the CLOSED position.

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Section 3 Product Overview

Campes egine features and applications

To achieve the highest performing miniaturized and light-weight diesel engines, Campes Co., Limited developed the series single cylinder, air cooled, diesel engine using the most advanced single cylinder technologies. Especially, the fuel injection pump / line / nozzle direct-injection system has been optimized to reduce emissions.

Campes Series engines are designed to supply power to a wide variety of driven machines including:

•Pumps

•Power Generation

•Construction

•Agriculture

We are sure that you will agree these features provide excellent value in an industrial diesel engine.

These engines are designed to deliver power to driven machines by means of a “direct coupled drive” or “belt drive.” In direct coupled drive engine applications, the engine’s flywheel housing or end plate is coupled directly to the driven machine. In belt drive engine applications, a belt drive is used to power the driven machine. The engine is designed for a wide range of applications. Options are available to customize the application. Since designing the application and installing the engine require special knowledge and skill, always consult your authorized Campes engine dealer or distributor for these services.

They will help you:

• Select optional equipment. Optional equipment should be selected to match the work conditions and environment.

• Maximize engine performance with a minimum amount of downtime and safety related incidents by carefully matching the characteristics of the engine with the driven machine.

• Plan for safe fuel piping, exhaust piping, electrical wiring, ventilation and accurate engine installation.

• Design your applications so they meet requirements of the local authorities.

Component Identification

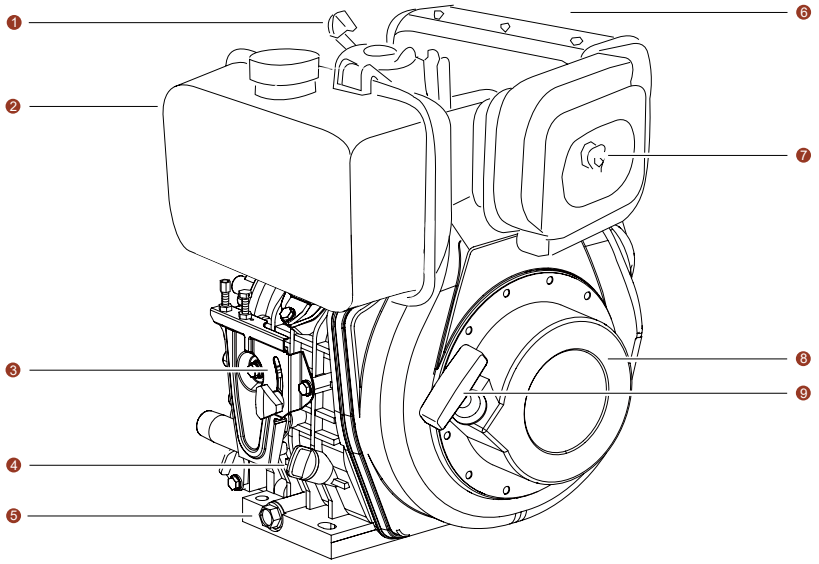

Figure 1

Engine Components

1. Decompression Lever
2. Fuel Tank
3. Engine Speed Control Lever
4. Oil Cap / Dipstick
5. Oil Drain Plugl
6. Muffler
7. Oil Drain Plug
8. Recoil Starter
9. Recoil Starter Handle

Location of lables

Figure2 shows the location of regulatory and safety labels Campes Series engines.

Function of major engine components

Components	Functions
Air Cleaner	The air cleaner prevents airborne contaminants from entering the engine. Periodic replacement of the air cleaner filter element is necessary. See the Periodic Maintenance Schedule on page 33 for the replacement frequency.
Dynamo (Optional)	If the engine is equipped with the electric starting option, a dynamo is located between engine body and flywheel. The dynamo supplies electricity to the engine systems and charges the battery while the engine is running.
Electric Fuel Pump (Optional)	The electric fuel pump (if equipped) makes sure there is a constant supply of diesel fuel to the fuel injection pump. The electric fuel pump is electro-magnetic and runs on 12 VDC.
Engine Oil Filter	The engine oil filter removes contaminants and sediments from the engine oil. Periodic cleaning of the oil filter is necessary. See the Periodic Maintenance Schedule on page 33 for the frequency of cleaning.
Fuel Filters	Two fuel filters are provided to remove contaminants and sediments from the diesel fuel. The inlet fuel screen is located inside the fuel tank filler port. Since it uses a mesh construction, it can be cleaned. The outlet fuel filter is a replaceable cartridge that is located at the outlet of the fuel tank. Periodic cleaning / replacement is required. See Periodic Maintenance Schedule on page 33.
Fuel Tank	The fuel tank is a reservoir that holds diesel fuel. When fuel leaves the fuel tank it goes to the fuel injection pump. Since fuel is used to keep fuel system components cool and lubricated, more fuel than is necessary for combustion enters the fuel system. Any fuel that is not used for combustion is returned to the fuel tank. The fuel tank is a required engine component.
Oil Cap / Dipstick (Engine Oil)	The engine oil cap / dipstick combines the oil cap and dipstick in one assembly. The dipstick part of the assembly is used to determine the amount of engine oil in the crankcase.
Side Filler Ports (Engine Oil)	You can fill the crankcase with engine oil from either side of the engine depending upon which one is most convenient.
Starter Motor (Optional)	If the engine is equipped with the electric starting option, the starter motor is powered by the battery. When you turn the key switch in the operator's console to the START position, the starter motor engages with the ring gear installed on the flywheel and starts the flywheel in motion.

Air cooled engine

The Campes engine is air-cooled by means of a cooling fan. The cooling system consists of a fan attached to the flywheel.

Controls- Recoil starter

A recoil starter allows you to manually start an engine by pulling on the recoil starter handle When you pull on the handle you set the flywheel and crankshaft in motion. The recoil starter is spring loaded so the handle and attached cable automatically return to the recoil starter assembly.

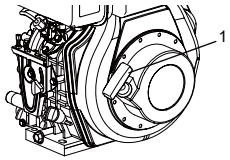

Figure 3

Decompression Lever

The decompression lever (**Figure 4,(1))** helps you start the engine by reducing the effort needed to pull the recoil starter handle. The decompression lever will automatically return to the original position when the engine starts.

Some model engines have an automatic, internal compression release mechanism and do not have the external compression release lever. Refer to the specific instructions for your driven machine.

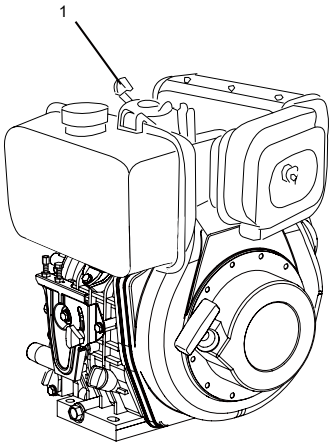

Figure 4

Idicators and controls – Electric Starter

If an Campes series engine is ordered with an electric starter it will include a key switch and may also have indicators to monitor engine functions.

CAUTION

The illustrations and descriptions of optional equipment in this manual, such as the operator's console, are for a typical engine installation. Refer to the documentation supplied by the optional equipment manufacturer for specific operation and maintenance instructions.

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Indicators

Battery - (Figure 5,(1)) - Your driven machine may have a battery indicator that comes on if there is a problem in the charging system. This indicator does not indicate whether the battery is discharged. See Troubleshooting Chart on page 38.

Heat - If your engine has an inlet air heater, it may have a heat indicator that lights when the inlet air heater is activated. Follow the instructions provided by the driven machine manufacturer for the operation of this indicator.

Controls

Key Switch

If your engine is equipped with electric start it may have a three position key switch - OFF, ON, and START. See Figure5 for an illustration of a typical key switch.

CAUTION

For maximum engine life, Campes recommends that when shutting the engine down, you allow the engine to idle, without load, for 5 minutes. This will allow the engine components that operate at high temperatures, such as exhaust system, to cool slightly before the engine itself is shut down.

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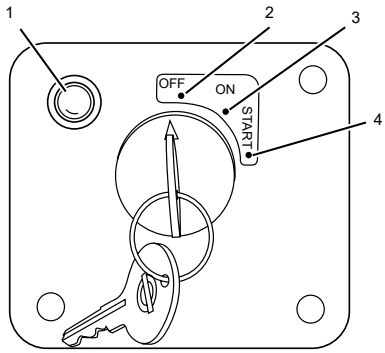

Figure 5

OFF (key straight up and down) **(Figure5,(2))** -

When you turn the key to this position the engine shuts down. Electric current to the battery indicator and other electric devices is shut off. You can insert and remove the key in this position.

ON **(Figure5,(3))** - This is the position the key will be in when the engine is running. When the engine is not running, use this position to energize the optional devices such as indicators or electric fuel pump.

CAUTION

Only hold the key in the START position for 15 seconds or the starter motor will overheat.

0000020en

START **(Figure5,(4))** - Turn the key to this position to start the engine. As soon as the engine starts, release the key and it will automatically return to the ON position. Some key switches may be equipped with a feature that prevents you from turning the key to the START position while the engine is running. In these configurations, you cannot turn the key to the START position without first returning the key to the OFF position.

Inlet Air Heater

Some engines may be equipped with an inlet air heater. Heated inlet air helps the engine to start easier in cold weather. During the engine starting sequence the inlet air heater is activated for several seconds. If the engine is equipped with an air inlet heater timer, after the heat indicator goes out, the engine can be started.

Engine Speed Controls

CAUTION

NEVER attempt to adjust the low or high idle speed limit screw. This may impair the safety and performance of the machine and shorten its life. If adjustment is ever required, contact your authorized Campes engine dealer or distributor.

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Several types of engine speed controls are used in Campes engine applications. This illustration shows a typical example. Refer to the operating instructions for the driven machine.

The speed control lever **(Figure6,(1))** controls the engine speed. The lever could be linked to the engine speed control device.

The low idle speed limit screw **(Figure6,(2))** sets engine speed while it is idling.

The high idle speed limit screw **(Figure6,(3))** restricts the maximum engine speed when the engine is operated without a load.

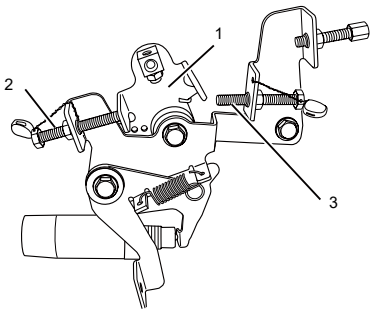

Figure 6

Section 4 Before You Operate

This section of the Operation Manual describes the diesel fuel and engine oil specifications and how to replenish them. It also describes the daily engine checkout.

CAUTION

NEVER permit anyone to operate the engine or driven machine without proper training.

• Read and understand this Operation Manual before you operate the machine to ensure that you follow safe operating practices and maintenance procedures.

• Machine safety signs and labels are additional reminders for safe operating and maintenance techniques.

• See your authorized Campes engine dealer or distributor for additional training.

0000002en

DANGER

FIRE AND EXPLOSION HAZARD!

• Diesel fuel is extremely flammable and explosive under certain conditions.

• Only fill the fuel tank with diesel fuel. Filling the fuel tank with gasoline may result in a fire.

• NEVER refuel with the engine running.

• Wipe up all spills immediately.

• Keep sparks, open flames or any other form of ignition (match, cigarette, static electric source) away when fueling/refueling.

• NEVER overfill the fuel tank.

• Fill the fuel tank and store fuel in a well-ventilated area only.

• Failure to comply will result in death or serious injury.

0000005en

DANGER

FIRE AND EXPLOSION HAZARD!

• Diesel fuel is extremely flammable and explosive under certain conditions.

• Be sure to place the diesel fuel container on the ground when transferring the diesel fuel from the pump to the container. Hold the hose nozzle firmly against the side of the container while filling it. This prevents static electricity build-up which could cause sparks and ignite fuel vapors.

• NEVER place diesel fuel or other flammable material such as oil, hay or dried grass close to the engine during engine operation or shortly after shut down.

• Failure to comply will result in death or serious injury.

0000014en

DANGER

FIRE AND EXPLOSION HAZARD!

• Diesel fuel is extremely flammable and explosive under certain conditions.

• Before you operate the engine, check for fuel leaks. Replace rubberized fuel hoses every two years or every 2000 hours of engine operation, whichever comes first, even if the engine has been out of service. Rubberized fuel lines tend to dry out and become brittle after two years or 2000 hours of engine operation, whichever comes first.

• Failure to comply will result in death or serious injury.

0000015en

WARNING

HIGH PRESSURE HAZARD!

• Avoid skin contact with the high pressure diesel fuel spray caused by a fuel system leak such as a broken fuel injection line. High pressure fuel can penetrate your skin and result in serious injury. If you are exposed to high pressure fuel spray, obtainprompt medical treatment.

• NEVER check for a fuel leak with your hands. ALWAYS use a piece of wood or cardboard. Have your authorized Campes engine dealer or distributor repair the damage.

• Failure to comply could result in death or serious injury.

0000008en

WARNING

BURN HAZARD!

• If you must drain the engine oil while it is still hot, stay clear of the hot engine oil to avoid being scalded. Make sure you wear eye protection.

• Failure to comply could result in death or serious injury.

0000011en

WARNING

BURN HAZARD!

• Keep your hands and other body parts away from hot engine surfaces such as the muffler, exhaust pipe, turbocharger (if equipped) and engine block during operation and shortly after you shut the engine down. These surfaces are extremely hot while the engine is operating and could seriously burn you.

• Failure to comply could result in death or serious injury.

0000015en

CAUTION

Only use diesel fuels recommended by Campes for the best engine performance, to prevent engine damage.

• Only use clean diesel fuel.

• NEVER remove inlet fuel screen from the filler port. If removed, dirt and debris could get into the fuel system causing it to clog.

0000004enLV

CAUTION

• Only use the engine oil specified. Other engine oils may affect warranty coverage, cause internal engine components to seize, or shorten engine life.

• Prevent dirt and debris from contaminating the engine oil. Carefully clean the oil cap/ dipstick and the surrounding area before you remove the cap.

• NEVER mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil.

• NEVER overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

0000005en

CAUTION

If any problem is noted during the visual check, the necessary corrective action should be taken before you operate the engine.

0000021en

Disel Fuel

Diesel Fuel Specifications

Diesel fuel should comply with the following

specifications. The table lists several worldwide specifications for diesel fuels.

Diesel Fuel Specification	Location
No. 2-D, No. 1-D, ASTM D975-94	USA
EN590:96	European Union
ISO 8217 DMX	International
BS 2869-A1 or A2	United Kingdom
JIS K2204 Grade No.2	Japan
KSM-2610	Korea
GB252	China

Additional Technical Fuel Requirements

• The fuel cetane number should be equal to 45 or higher.

• The sulfur content must not exceed 0.5% by volume. Less than 0.05% is preferred.

• Bio-Diesel fuels. See Bio-Diesel Fuels on page 18.

• NEVER mix kerosene, used engine oil, or residual fuels with the diesel fuel.

• Water and sediment in the fuel should not exceed 0.05% by volume.

• Keep the fuel tank and fuel-handling equipment clean at all times.

• Poor quality fuel can reduce engine performance and / or cause engine damage.

• Fuel additives are not recommended. Some fuel additives may cause poor engine performance. Consult your Campes representative for more information.

• Ash content not to exceed 0.01% by volume.

• Carbon residue content not to exceed 0.35% by volume. Less than 0.1% is preferred.

• Total aromatics content should not exceed 35% by volume. Less than 30% is preferred.

• PAH (polycyclic aromatic hydrocarbons) content should be below 10% by volume.

• Metal content of Na, Mg, Si, and Al should be equal to or lower than 1 mass ppm. (Test analysis method JPI-5S-44-95)

• Lubricity: Wear mark of WS1.4 should be Max. 460 µm at HFRR test.

Bio-Diesel Fuels

In Europe and in the United States, as well as

some other countries, non-mineral oil based fuel resources such as RME (Rapeseed Methyl Ester) and SOME (Soybean Methyl Ester), collectively known as FAME (Fatty Acid Methyl Esters), are being used as extenders for mineral oil derived diesel fuels.

Campes approves the use of bio-diesel fuels that do not exceed a blend of 5% (by volume) of FAME with 95% (by volume) of approved mineral oil derived diesel fuel. Such bio-diesel fuels are known in the marketplace as B5 diesel fuels.

These B5 diesel fuels must meet certain

requirements.

1. The bio-fuels must meet the minimum specifications for the country in which they are used.

• In Europe, bio-diesel fuels must comply with the European Standard EN14214.

• In the United States, bio-diesel fuels must comply with the American Standard ASTM D-6751.

2. Bio-fuels should be purchased only from recognized and authorized diesel fuel suppliers.

Precautions and concerns regarding the use

of bio-fuels:

1. Free methanol in FAME may result in corrosion of aluminum and zinc FIE components.

2. Free water in FAME may result in plugging of fuel filters and increased bacterial growth

3. High viscosity at low temperatures may result in fuel delivery problems, injection pump seizures, and poor injection nozzle spray atomization.

4. FAME may have adverse effects on some elastomers (seal materials) and may result in fuel leakage and dilution of the engine lubricating oil.

5. Even bio-diesel fuels that comply with a suitable standard as delivered, will require additional care and attention to maintain the quality of the fuel in the equipment or other fuel tanks. It is important to maintain a supply of clean, fresh fuel. Regular flushing of the fuel system, and/or fuel storage containers, may be necessary.

6. The use of bio-diesel fuels that do not comply with the standards as agreed to by the diesel engine manufacturers and the diesel fuel injection equipment manufacturers, or biodiesel fuels that have degraded as per the precautions and concerns above, may affect the warranty coverage of your engine. See Campes Limited Warrantyon page i.

Filling the Fuel Tank

DANGER

FIRE AND EXPLOSION HAZARD!

• Diesel fuel is extremely flammable and explosive under certain conditions.

• Only fill the fuel tank with diesel fuel. Filling the fuel tank with gasoline may result in a fire.

• NEVER refuel with the engine running.

• Wipe up all spills immediately.

• Keep sparks, open flames or any other form of ignition (match, cigarette, static electric source) away when fueling/refueling.

• NEVER overfill the fuel tank.

• Fill the fuel tank and store fuel in a well-ventilated area only.

• Failure to comply will result in death or serious injury.

0000005en

DANGER

FIRE AND EXPLOSION HAZARD!

• Diesel fuel is extremely flammable and explosive under certain conditions.

• Before you operate the engine, check for fuel leaks. Replace rubberized fuel hoses every two years or every 2000 hours of engine operation, whichever comes first, even if the engine has been out of service. Rubberized fuel lines tend to dry out and become brittle after two years or 2000 hours of engine operation, whichever comes first.

• Failure to comply will result in death or serious injury.

0000015en

CAUTION

• Only use diesel fuels recommended by Campes for the best engine performance, to prevent engine damage.

• Only use clean diesel fuel.

• NEVER remove inlet fuel screen from the filler port. If removed, dirt and debris could get into the fuel system causing it to clog.

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Note that a typical fuel tank is shown. The fuel tank on your engine may be different. **Also note that the inlet fuel screen is shown removed from the fuel tank for clarity. ALWAYS make sure the inlet fuel screen remains inside of the fuel tank while fueling!**

1. Clean the area around the fuel cap **(Figure1,(1)).**

2. Remove the fuel cap **(Figure1,(1))** from the fuel tank **(Figure1,(3)).**

3. Stop fueling when the fuel is at the same level as the red ring **(Figure1,(4))** at the bottom of the inlet fuel screen. NEVER overfill the fuel tank.

4. Replace the fuel cap **(Figure1,(1))** and hand tighten. Over-tightening the fuel cap will damage it.

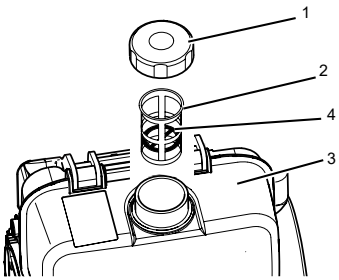

Figure 1

Engine Oil

CAUTION

• Only use the engine oil specified. Other engine oils may affect warranty coverage, cause internal engine components to seize, or shorten engine life.

• Prevent dirt and debris from contaminating the engine oil. Carefully clean the oil cap/dipstick and the surrounding area before you remove the cap.

• NEVER mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil.

• NEVER overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

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Engine Oil Specifications

Use an engine oil that meets or exceeds the following guidelines and classifications:

Service Categories

• API Service Categories CD or higher

• ACEA Service Categories E-3, E-4, and E-5

• JASO Service Category DH-1

Definitions

• API Classification (American Petroleum Institute)

• ACEA Classification (Association des Constructeurs Européens d'Automobiles)

• JASO (Japanese Automobile Standards Organization)

Notes:

1. Be sure the engine oil, engine oil storage containers, and engine oil filling equipment are free of sediments and water.

2. Change the engine oil after the first 50 hours of operation and then at every 200 hours thereafter.

3. Select the oil viscosity based on the ambient temperature where the engine is being operated. See SAE Service Grade Viscosity Chart (Figure2).

4. Campes does not recommend the use of engine oil "additives."

Additional Technical Engine oil Requirements:

The engine oil must be changed when the Total Base Number (TBN) has been reduced to 2.0. TBN (mgKOH/g) test method; JIS K-201-5.2-2 (HCI), ASTM D4739 (HCI)

Engine Oil Viscosity

Select the appropriate engine oil viscosity based on the ambient temperature and use the SAE Service Grade Viscosity Chart in **Figure2.**

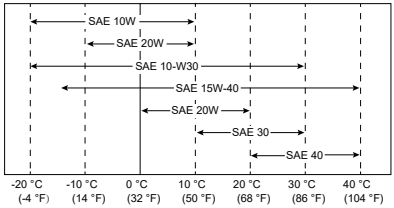


Figure 2

Checking Engine Oil

1. Make sure engine is level.

2. Remove oil cap / dipstick **(Figure3,(1))** from either location and wipe with clean cloth.

3. Fully reinsert oil cap / dipstick **but do not screw in.**

4. Remove oil cap / dipstick. The oil level should be between upper **(Figure3,(2))** and lower **(Figure3,(3))** lines on the oil cap / dipstick.

5. Fully reinsert oil cap / dipstick (Figure3,(1))

and hand tighten. Over-tightening the oil cap / dipstick will damage it.

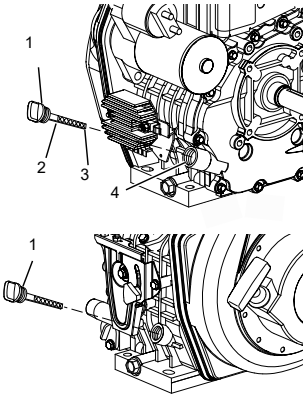


Figure 3

Adding Engine Oil

1. Make sure engine is level.

2. Remove oil cap / dipstick **(Figure3,(1)).**

3. Add indicated amount of engine oil at either one of the engine oil filler ports **(Figure3,(4)).**

4. Wait one minute and check oil level.

5. Add more oil if necessary.

6. Fully reinsert oil cap / dipstick **(Figure3,(1))** and hand tighten. Over-tightening the oil cap / dipstick will damage it.

Engine Oil Capacity (Typical)

The following are the engine oil capacities for various Campes Series engines.

Engine Model	Lubricating Oil Capacity (L)
D170F	0.75
D173F	0.75
D178F	1.1
D180F	1.1
D186F	1.65
D186FA	1.65
D188F	1.65
D192F	1.65
D195F	1.65

Note: Oil capacity will vary depending upon

which optional oil pan is used. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

Daily Check

Before you begin any job, make sure the Campes Series engine is in good operating condition.

Make sure you check the following items before you start your shift and have any repairs completed before you start work.

WARNING

HIGH PRESSURE HAZARD!

• Avoid skin contact with the high pressure diesel fuel spray caused by a fuel system leak such as a broken fuel injection line. High pressure fuel can penetrate your skin and result in serious injury. If you are exposed to high pressure fuel spray, obtain prompt medical treatment.

• NEVER check for a fuel leak with your hands. ALWAYS use a piece of wood or cardboard. Have your authorized Campes engine dealer or distributor repair the damage.

• Failure to comply could result in death or serious injury.

0000008en

Visual Checks

1. Check for engine oil leaks.
2. Check for fuel leaks.
3. Check for damaged or missing parts.
4. Check for loose, missing, or damaged fasteners.
5. Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors.
6. Check hoses for cracks, abrasions, and damaged, loose or corroded clamps. completed before you start work.

CAUTION

If any problem is noted during the visual check, the necessary corrective action should be taken before you operate the engine.

0000021en

Check Diesel Fuel and Engine Oil

Follow the procedures in Diesel Fuel on page 18 and Engine Oil on page 20 to check these levels.

Check Engine Speed Control (First Time Only)

1. Check the engine speed control for smooth operation and lubricate or clean as necessary.
2. Check engine speed control for proper adjustments.

Check Indicators

If your engine has an electric starter, check the battery indicator. Also check any other indicators supplied by the driven machine manufacturer.

Battery - Stays On until the engine is running and the dynamo is supplying charging current. This indicator does not indicate whether the battery is discharged.

Here is a summary of how these indicators function. The table shows what happens when you turn the key in a certain direction (e.g., OFF to ON).

Section 5 Engine Operation

This section of the Operation Manual describes the procedures for starting the engine, checking engine performance during operation, and shutting the engine down.

CAUTION

NEVER permit anyone to operate the engine or driven machine without proper training.

• Read and understand this Operation Manual before you operate the machine to ensure that you follow safe operating practices and maintenance procedures.

• Machine safety signs and labels are additional reminders for safe operating and maintenance techniques.

• See your authorized Campes engine dealer or distributor for additional training.

0000002en

DANGER

EXPLOSION HAZARD!

• Keep the area around the battery well ventilated. While the engine is running or the battery is charging, hydrogen gas is produced which can be easily ignited.

• Keep sparks, open flame and any other form of ignition away.

• Failure to comply will result in death or serious injury.

0000003en

DANGER

FIRE AND EXPLOSION HAZARD!

• Only use the key switch or recoil starter to start the engine.

• NEVER jump start the engine. Sparks caused by jumping the battery to the starter terminals may cause a fire or explosion.

• Failure to comply will result in death or serious injury.

0000004en

DANGER

FIRE AND EXPLOSION HAZARD!

• Diesel fuel is extremely flammable and explosive under certain conditions.

• When you remove any fuel system component to perform maintenance (such as changing the fuel filter) place an approved container under the opening to catch the fuel.

• NEVER use a shop rag to catch the fuel. Vapors from the rag are extremely flammable and explosive.

• Wipe up any spills immediately.

• Wear eye protection. The fuel system is under pressure and fuel could spray out when you remove any fuel system component.

• Failure to comply will result in death or serious injury

0000005en

DANGER

FIRE AND EXPLOSION HAZARD!

- **Diesel fuel is extremely flammable and explosive under certain conditions.**
- **NEVER remove the fuel cap with the engine running.**
- **Failure to comply will result in death or serious injury.**

0000012en

DANGER

FIRE AND EXPLOSION HAZARD!

- **Diesel fuel is extremely flammable and explosive under certain conditions.**
- **Be sure to place the diesel fuel container on the ground when transferring the diesel fuel from the pump to the container. Hold the hose nozzle firmly against the side of the container while filling it. This prevents static electricity build-up which could cause sparks and ignite fuel vapors.**
- **NEVER place diesel fuel or other flammable material such as oil, hay or dried grass close to the engine during engine operation or shortly after shut down.**
- **Failure to comply will result in death or serious injury.**

0000014en

DANGER

FIRE AND EXPLOSION HAZARD!

- **Diesel fuel is extremely flammable and explosive under certain conditions.**
- **Before you operate the engine, check for fuel leaks. Replace rubberized fuel hoses every two years or every 2000 hours of engine operation, whichever comes first, even if the engine has been out of service. Rubberized fuel lines tend to dry out and become brittle after two years or 2000 hours of engine operation, whichever comes first.**
- **Failure to comply will result in death or serious injury.**

0000015en

WARNING

BURN HAZARD!

- **Keep your hands and other body parts away from hot engine surfaces such as the muffler, exhaust pipe, turbocharger (if equipped) and engine block during operation and shortly after you shut the engine down. These surfaces are extremely hot while the engine is operating and could seriously burn you.**
- **Failure to comply could result in death or serious injury.**

0000015en

⚠ WARNING

SEVER HAZARD!

- **Keep hands and other body parts away from moving/rotating parts such as the cooling fan/ flywheel.**
- **Wear tight fitting clothing and keep your hair short or tie it back while the engine is running.**
- **Remove all jewelry before you operate or service the machine.**
- **NEVER start the engine in gear. Sudden movement of the engine and/or machine could cause death or serious personal injury.**
- **NEVER operate the engine without the guards in place.**
- **Before you start the engine make sure that all bystanders are clear of the area.**
- **Keep children and pets away while the engine is operating.**
- **Check before starting the engine that any tools or shop rags used during maintenance have been removed from the area.**
- **Failure to comply could result in death or serious injury.**

0000010en

⚠ WARNING

EXHAUST HAZARD!

- **NEVER operate the engine in an enclosed area such as a garage, tunnel, underground room, manhole or ship's hold without proper ventilation.**
- **NEVER block windows, vents, or other means of ventilation if the engine is operating in an enclosed area. All internal combustion engines create carbon monoxide gas during operation. Accumulation of this gas within an enclosure could cause illness or even death.**
- **Make sure that all connections are tightened to specifications after repair is made to the exhaust system.**
- **Failure to comply could result in death or serious injury.**

0000003en

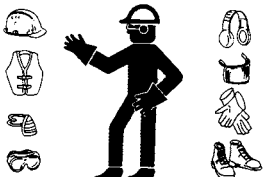
⚠ WARNING

ALCOHOL AND DRUG HAZARD!

- **NEVER operate the engine while you are under the influence of alcohol or drugs.**
- **NEVER operate the engine when you are feeling ill.**
- **Failure to comply could result in death or serious injury.**

0000004en

⚠ WARNING



EXPOSURE HAZARD!

- **Wear personal protective equipment such as gloves, work shoes, eye and hearing protection as required by the task at hand.**
- **NEVER wear jewelry, unbuttoned cuffs, ties or loose fitting clothing when you are working near moving/rotating parts such as the cooling fan, flywheel or PTO shaft.**
- **ALWAYS tie long hair back when you are working near moving/rotating parts such as a cooling fan, flywheel, or PTO shaft.**
- **NEVER operate the engine while wearing a headset to listen to music or radio because it will be difficult to hear the warning signals.**
- **Failure to comply could result in death or serious injury.**

0000005en

CAUTION

NEVER engage the starter motor while the engine is running. This may damage the starter motor pinion and/or ring gear.

0000012en

CAUTION

NEVER use an engine starting aid such as ether. Engine damage will result.

0000009en

CAUTION

For maximum engine life, Campes recommends that when shutting the engine down, you allow the engine to idle, without load, for 5 minutes. This will allow the engine components that operate at high temperatures, such as exhaust system, to cool slightly before the engine itself is shut down.

0000008en

CAUTION

Make sure the engine is installed on a level surface. If a continuously running engine is installed at an angle greater than 20° (in any direction) or if an engine runs for short periods of time (less than 3 minutes) at an angle greater than 25° in any direction, engine oil may enter the combustion chamber causing exessive engine speed and generate white smoke and also may occur unsatisfactory oil pressure. These may cause serious engine damage.

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CAUTION

New Engine Break In:

• On the initial engine start-up, allow the engine to idle for approximately 15 minutes while you check for proper engine oil pressure, diesel fuel leaks, engine oil leaks, and for proper operation of the indicators and/or gauges.

• During the first hour of operation, vary the engine speed and the load on the engine. Short periods of maximum engine speed and load are desirable. Avoid prolonged operation at minimum or maximum engine speeds and loads for the next 100 hours.

• During the break-in period, carefully observe the engine oil pressure and engine temperature.

• During the break-in period, check the engine oil levels frequently.

0000011en

CAUTION

NEVER hold the key in the START position for longer than 15 seconds or the starter motor will overheat.

0000007en

CAUTION

Observe the following environmental operating conditions to maintain engine performance and avoid premature engine wear:

• Avoid operating in extremely dusty conditions.

• Avoid operating in the presence of chemical gases or fumes.

• Avoid operating in a corrosive atmosphere such as salt water spray.

• NEVER install the engine in a floodplain unless proper precautions are taken to avoid being subject to a flood.

• NEVER expose the engine to the rain.

0000003en

CAUTION

Observe the following environmental operating conditions to maintain engine performance and avoid premature engine wear:

• NEVER run the engine if the ambient temperature is above +40°C or below 10°C

If the ambient temperature exceeds +40°C the engine may overheat and cause the engine oil to break down. If the ambient temperature falls below -10°C rubber components such as gaskets and seals will harden causing premature engine wear and damage.

• Contact your authorized Campes engine dealer or distributor if the engine will be operated in either temperature extreme.

• Contact your authorized Campes engine dealer or distributor if you need to operate the engine at high altitudes. At high altitudes the engine will lose power, run rough, and produce exhaust gases that exceed the design specifications.

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Starting the engine

Recoil Start

CAUTION

NEVER use an engine starting aid such as ether. Engine damage will result.

0000009en

Daily Checks

1. Make sure you follow the procedures stated in Daily Check on page 21.

2. Make sure the fuel cock is in the ON position **(Figure1,(1)).**

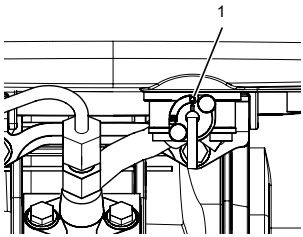

Figure 1

Set Engine Speed Control to START Several types of engine speed controls are used in Campes engine applications. The following procedures are for three typical applications. Refer to the operating instructions for the driven machine.

1. If your engine speed control is similar to **Figure2** slide the engine speed control lever **(Figure2,(1))** to the RUN position **(Figure2,(2)).**

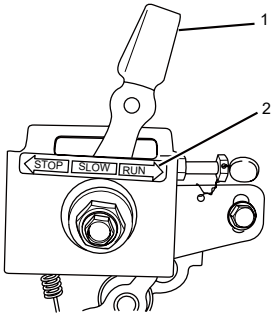

Figure 2

2. If your engine speed control is similar to Figure3 slide the engine speed control lever **(Figure3,(1))** to the RUN position **(Figure3,(2)).**

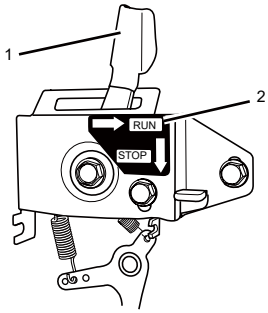

Figure 3

3. If your engine speed control is similar to Figure4:

(a)Turn the engine speed control knob **(Figure4,(1))** to the left **(Figure4,(2))**.

(b)Slide the engine speed control knob to the START position **(Figure4,(3))**.

(c)Turn the engine speed control knob to the right **(Figure4,(4))** to tighten it.

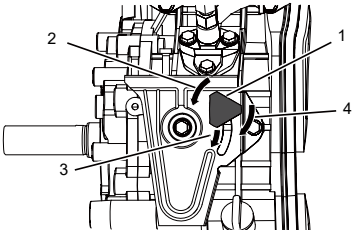

Figure 4

Start The Engine

CAUTION

Tips while starting engine with recoil starter (See Start The Engine on page 26.):

• Pulling out the recoil starter handle too hard or fast will damage the equipment.

• ALWAYS pull recoil starter handle all the way out or the engine will not start.

• NEVER allow the recoil starter handle to snap back against the engine. Return the handle to the starting position gently to prevent damage to the recoil starter.

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CAUTION

NEVER use an engine starting aid such as ether. Engine damage will result.

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1. Grasp the recoil starter handle (Figure,(1)).

2. Pull the handle out slowly until you feel strong resistance.

3. Slowly return the recoil starter handle to the initial position.

4. Push the decompression lever (Figure8,(1)) down and release it. The decompression lever will automatically return to the original position when the engine starts. Some Campes model engines have an automatic, internal compression release mechanism and do not have the external compression release lever. Refer to the specific instructions for your driven machine.

5. Grasp the recoil starter handle (Figure,(1)).

6. Pull the handle all the way out with a strong and even motion. Use two hands if necessary.

7. Slowly return the recoil starter handle to the initial position.

8. If the engine does not start, repeat the Start The Engine procedure from Step 1.

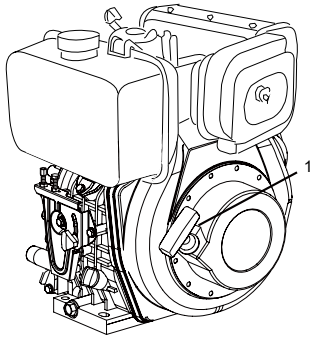

Figure 5

Electric Start

CAUTION

NEVER use an engine starting aid such as ether. Engine damage will result.

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Use the following procedure to start the engine.

Daily Checks

1. Make sure you follow the procedures stated in Daily Check on page 21.

2. Make sure the fuel cock is in the ON position **(Figure 6, (1)).**

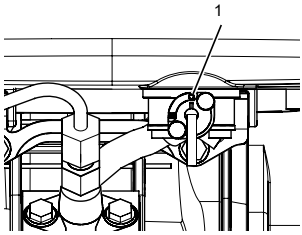

Figure 6

Set Engine Speed Control to START Several types of engine speed controls are used in Campes engine applications. The following procedures are for three typical applications. Refer to the operating instructions for the driven machine.

1. If your engine speed control is similar to **Figure 7** slide the engine speed control lever **(Figure 7,(1))** to the RUN position **(Figure 7,(2)).**

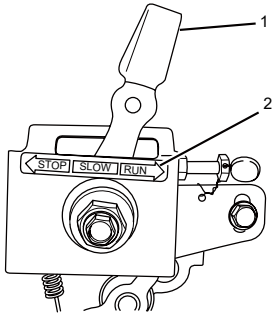

Figure 7

2. If your engine speed control is similar to Figure3 slide the engine speed control lever **(Figure 8,(1))** to the RUN position **(Figure 8,(2)).**

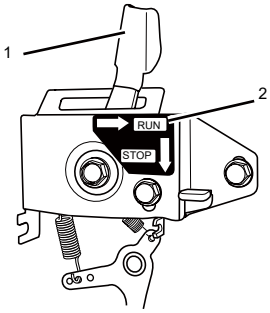

Figure 8

3. If your engine speed control is similar to Figure4:

(a)Turn the engine speed control knob **(Figure 9,(1))** to the left **(Figure 9,(2))**.

(b)Slide the engine speed control knob to the START position **(Figure 9,(3))**.

(c)Turn the engine speed control knob to the right **(Figure 9,(4))** to tighten it.

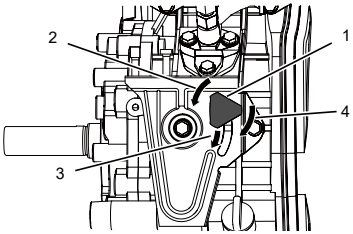

Figure 9

Start The Engine

CAUTION

NEVER use an engine starting aid such as ether. Engine damage will result.

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Use the following procedure to start the engine.

1. Insert the key into the key switch.

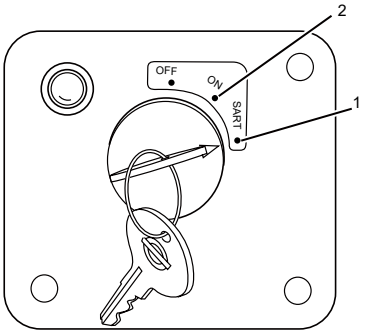

Figure 10

2. Turn the key clockwise to the START position **(Figure 10,(1)).** Release the key as soon as the engine starts. It will return to the ON position **(Figure 10,(2)).**

3. If the engine fails to start:

(a)Wait until the engine comes to a complete stop before you attempt to start it again. Engaging the starter while the engine is still rotating will result in damage to the starter motor and flywheel.

(b)Wait at least 30 seconds before you attempt to start the engine again. This pause will allow the battery voltage to recover to prevent damage to the starter motor due to the low battery voltage.

Check the engine during operation

CAUTION

Make sure the engine is installed on a level surface. If a continuously running engine is installed at an angle greater than 20° (in any direction) or if an engine runs for short periods of time (less than 3 minutes) at an angle greater than 25° in any direction, engine oil may enter the combustion chamber causing exessive engine speed and generate white smoke and also may occur unsatisfactory oil

pressure. These may cause serious engine damage.

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CAUTION

New Engine Break In:

• On the initial engine start-up, allow the engine to idle for approximately 15 minutes while you check for proper engine oil pressure, diesel fuel leaks, engine oil leaks, and for proper operation of the indicators and/or gauges.

• During the first hour of operation, vary the engine speed and the load on the engine. Short periods of maximum engine speed and load are desirable. Avoid prolonged operation at minimum or maximum engine speeds and loads for the next 100 hours.

• During the break-in period, carefully observe the engine oil pressure and engine temperature.

• During the break-in period, check the engine oil levels frequently.

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1. After the engine has reached operating temperature, all of the indicators (if equipped) should be Off. If any of the indicators are On, shut down the engine and have the necessary repairs performed.

WARNING

HIGH PRESSURE HAZARD!

• Avoid skin contact with the high pressure diesel fuel spray caused by a fuel system leak such as a broken fuel injection line. High pressure fuel can penetrate your skin and result in serious injury. If you are exposed to high pressure fuel spray, obtain prompt medical treatment.

• NEVER check for a fuel leak with your hands. ALWAYS use a piece of wood or cardboard. Have your authorized Campes engine dealer or distributor repair the damage.

• Failure to comply could result in death or serious injury.

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2. Check for any fuel or engine oil leaks. If any leaks are found shut down the engine and have the necessary repairs performed.

3. Check for abnormal sounds or vibration. In some applications the engine and its mounting may start to resonate and cause unusual vibrations at certain engine speeds. Avoid running the engine at these speeds. If the abnormal sounds or vibration cannot be resolved, shut down the engine and have the necessary repairs performed.

4. Check for white or black smoke from the exhaust system. A small amount of white exhaust smoke is normal on start-up of a cold engine. Black exhaust smoke could mean the engine is overloaded or being over-fueled. If either of these conditions persists, contact your authorized Campes engine dealer or distributor.

5. Check the fuel level during operation. If the fuel level runs low, stop the engine and refuel.

Ajust engine speed

CAUTION

New Engine Break In:

• On the initial engine start-up, allow the engine to idle for approximately 15 minutes while you check for proper engine oil pressure, diesel fuel leaks, engine oil leaks, and for proper operation of the indicators and/or gauges.

• During the first hour of operation, vary the engine speed and the load on the engine. Short periods of maximum engine speed and load are desirable. Avoid prolonged operation at minimum or maximum engine speeds and loads for the next 100 hours.

• During the break-in period, carefully observe the engine oil pressure and engine temperature.

• During the break-in period, check the engine oil levels frequently.

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Use the engine speed control to adjust the engine speed for the task that will be performed.

Several types of engine speed controls are used in Cames engine applications. The following procedures are for three typical applications.

Refer to the operating instructions for the driven machine.

1. If your engine speed control is similar to Figure 11 slide the engine speed control lever **(Figure 11, (1))** in the direction shown to adjust the engine speed.

Note: This is a friction adjustment. If the speed control will not maintain a given speed, tightening the nut will increase the friction on the speed control lever.

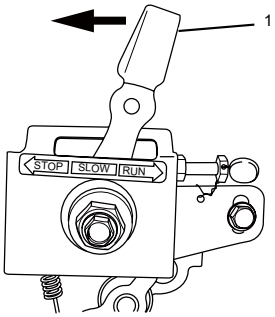

Figure 11

2. If your engine speed control is similar to Figure 12 slide the engine speed control lever **(Figure 12, (1))** in the direction shown to adjust the engine speed.

Note: This type of speed control, typically used on a generator set, has only one speed setting. When you move the lever to the right, it clicks into the RUN position. The speed control lever is spring-loaded so when you push down on the STOP button, the speed control lever moves back to the shut-off position. There is no idle position or intermediate speeds.

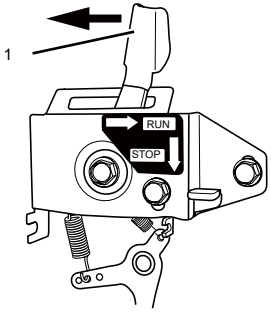

Figure 12

3. If your engine speed control is similar to Figure13:

(a) Turn the engine speed control knob **(Figure 13,(1))** to the left **(Figure 13,(2)).**

(b) Slide the engine speed control knob in the direction shown to adjust the engine speed.

(c) Turn the engine speed control knob to the right **(Figure13,(3))** to tighten it.

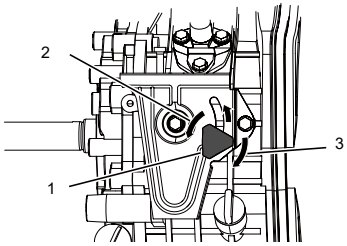

Figure 13

Shut down the engine

CAUTION

For maximum engine life, Campes recommends that when shutting the engine down, you allow the engine to idle, without load, for 5 minutes. This will allow the engine components that operate at high temperatures, such as exhaust system, to cool slightly before the engine itself is shut down.

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Preparing To Stop Engine

Follow these steps to shut down the engine:

1. Disengage the PTO.

2. Set the engine speed control to its lowest setting.

3. Run the engine at low idle speed or run without load for at least five minutes before you shut it down.

Set Engine Speed Control to STOP

CAUTION

If the engine continues to run after you position the engine speed control to the STOP position, turn the fuel cock to the CLOSED position.

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Several types of engine speed controls are used in Campes engine applications. The following procedures are for three typical applications. Refer to the operating instructions for the driven machine.

1. If your engine speed control is similar to **Figure14** slide the engine speed control lever **(Figure14,(1))** to the STOP position **(Figure14,(2)).**

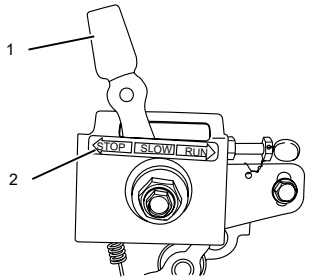

Figure 14

2. If your engine speed control is similar to **Figure15** press the STOP button **(Figure15,(1))** and the engine speed control lever **(Figure15,(2))** will automatically return to the STOP position.

Note: The speed control lever is spring loaded so when you push down on the STOP button, the speed control lever moves back to the shut-off position. There is no idle position or intermediate speeds.

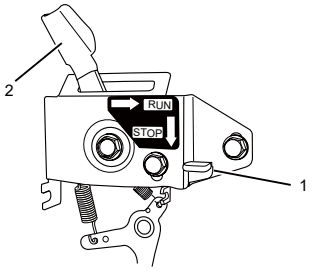

Figure 15

3. If your engine speed control is similar to **Figure16**:

(a) Turn the engine speed control knob **(Figure16,(1))** to the left **(Figure16,(2))**.

(b)Slide the engine speed control knob to the STOP position **(Figure16,(3)).**

(c)Turn the engine speed control knob to the right **(Figure16,(4))** to tighten it.

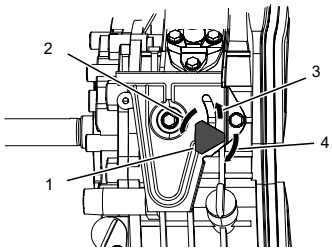

Figure 16

Electric Start Models

Turn the key to the OFF position **(Figure17,(1))** and remove it from the key switch.

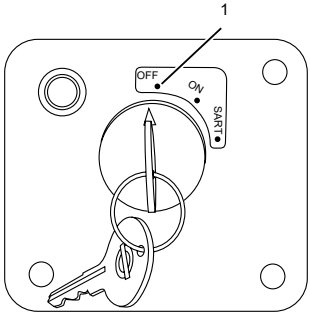

Figure 17

After The Engine Stops

1. Move the fuel cock lever to the closed position **(Figure 18,(1)).**

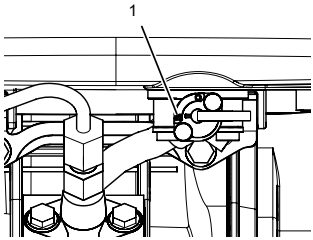

Figure 18

2. Slowly pull the recoil starter handle out to the point of resistance (the point in the compression stroke where the intake and exhaust valves are closed). This helps to prevent rust while the engine is not in use.

3. If the engine will not be used for six months or longer, follow the additional instructions in Long Term Storage on page 40.

Section 6 Periodic Maintenance

This section of the Operation Manual describes the procedures for proper care and maintenance of the engine.

Precautions

The Importance of Periodic Maintenance

Engine deterioration and wear occurs in proportion to length of time the engine has been in service and the conditions the engine is subject to during operation. Periodic maintenance prevents unexpected downtime, reduces the number of accidents due to poor machine performance and helps extend the life of the engine.

Performing Periodic Maintenance

WARNING

EXHAUST HAZARD!

• NEVER operate the engine in an enclosed area such as a garage, tunnel, underground room, manhole or ship's hold without proper ventilation.

• NEVER block windows, vents, or other means of ventilation if the engine is operating in an enclosed area. All internal combustion engines create carbon monoxide gas during operation. Accumulation of this gas within an enclosure could cause illness or even death.

• Make sure that all connections are tightened to specifications after repair is made to the exhaust system.

• Failure to comply could result in death or serious injury.

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Perform periodic maintenance procedures in an open, level area free from traffic. If possible, perform the procedures indoors to prevent environmental conditions, such as rain, wind, or snow, from damaging the machine.

The Importance of Daily Checks

Periodic Maintenance Schedules assume that the daily checks are performed on a regular basis. Make it a habit of performing daily checks before the start of each shift. See Daily Checks on page 21.

Keep a Log of Engine Hours and Daily Checks

Keep a log of the number of hours the engine is run each day and a log of the daily checks performed. Also note the date, type of repair (e.g., replaced alternator), and parts needed for any service needed between the periodic maintenance intervals. Periodic maintenance intervals are every 50, 200, 400, 1000, 1500 and 2000 engine hours. Failure to perform periodic maintenance will shorten the life of the engine.

CAMPES Replacement Parts

CAMPES recommends that you use genuine CAMPES parts when replacement parts are needed. Genuine replacement parts help ensure long engine life.

Tools Required

Before you start any periodic maintenance procedure make sure you have the tools you need to perform all of the required tasks.

Ask Your Authorized CAMPES Industrial Engine Dealer or Distributor For Help

Our professional service technicians have the expertise and skills to help you with any maintenance or service related procedures you need help with.

Tightening Fasteners

Use the correct amount of torque when you tighten fasteners on the machine. Applying excessive torque may damage the fastener or component and not enough torque may cause a leak or component failure.

CAUTION

The tightening torque in the Standard Torque Chart(page 32) should be carefully observed.

• Apply 60% torque to bolts that are not listed.

• Apply 80% torque when tightened to aluminum alloy.

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Standard torque chart

Thread size × Pitch mm		M6×1.0	M8×1.25	M10×1.5	M12×1.75	M14×1.5	M16×1.5
Tightening Torque	N·m	10.8 ± 1.0	25.5 ± 2.9	49.0 ± 4.9	88.3 ± 9.8	137.0 ± 9.8	226.0 ± 9.8
	kgf·m	1.1 ± 0.1	2.6 ± 0.3	5.0 ± 0.5	9.0 ± 1.0	14.0 ± 1.5	23.0 ± 2.0

Periodic maintenance schedule

Daily and periodic maintenance is important to keep the engine in good operating condition. The following is a summary of maintenance items by periodic maintenance intervals. Periodic maintenance intervals vary depending on engine application, loads, diesel fuel and engine oil used and are hard to establish definitively. The following should be treated only as a general guideline.

○ : Check
◇ : Replace
● : Contact your authorized Campes engine dealer or distributor for these maintenance services.

System	Check Item	Daily	Periodic Maintenance Interval					
			Every 50 hours	Every 200 hours	Every 400 hours	Every 1000 hours	Every 1500 hours	Every 2000 hours
Air Intake	Clean or Replace Air Cleaner Element - May Need More Frequent Service in Dusty Conditions			○ 100hours	◇ 500hours			
Cylinder Head	Adjust Intake / Exhaust Valve Clearance				●			
	Check Compression					●		
Electrical Equipment	Check Battery	○ before operation						
	Check Battery Indicator (If Equipped) and Other Driven Machine Indicators (If Equipped)	○ when engine is started						
Fuel Injector	Inspect, Clean & Test Fuel Injection Nozzle						●	
Engine Oil	Check Engine Oil Level & Add Engine Oil As Necessary	○ before operation						
	Drain and Refill Engine Oil		◇ 1st time	◇ 2nd & after				
	Clean Engine Oil Filter - Replace If Damaged							
	Check for Engine Oil Leakage	○ before & after operation		○ 2nd & after				
Engine Speed Control	Check for Proper Operation Verify Adjustment	○ 1st time						
Exhaust System	Check Spark Arrestor for Clogging	○ before operation						
Fuel	Check Fuel Tank Level & Add Fuel As Necessary	○ before operation						
	Drain & Clean Fuel Tank			○				
	Clean Inlet Fuel Screen		○					
	Replace Outlet Fuel Filter			○	◇			
	Check for Fuel Leakage	○ before & after operation						
Hoses	Replace Fuel System Hose(s)							● or every 2 yrs. whichever comes first

CAUTION

Establish a periodic maintenance plan according to the engine application and make sure you perform the required periodic maintenance at intervals indicated. Failure to follow these guidelines will impair the engine's safety and performance characteristics, shorten the engine's life and may affect the warranty coverage on your engine.

See Campes Limited Warrantyon page1.

Consult your authorized Campes engine dealer or distributor for assistance when checking items marked with a ●

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Periodic maintenance procedures

Daily, Before Operation

Perform the following maintenance daily before operation.

- **Check Battery (If Equipped)**
- **Check Engine Oil Level**
- **Check For Engine Oil Leakage**
- **Check Engine Speed Control (First Time Only)**
- **Check Fuel Level**
- **Check For Fuel Leakage**

• Check Battery (If Equipped)

The engine is equipped with a state-of-the-art, maintenance-free battery, sparing users the tasks of watering and electrolyte replenishment. For battery status monitoring, refer to the color-coded indicator: a blue light denotes a well-maintained battery; white indicates a need for recharging; and red calls for a battery replacement due to depleted electrolyte levels.

• Check Engine Oil Level

Before you operate the engine check for any engine oil leaks. If you discover an engine oil leak see your authorized Campes engine dealer or distributor to repair the engine.

• Check Engine Speed Control (First Time Only)

Before you operate the driven machine for the first time check the engine speed control. See the instructions for your driven machine for proper adjustments.

1. Check the engine speed control for smooth operation and lubricate or clean as necessary.

2. Check engine speed control for proper adjustments.

• Check Fuel Level

Before you operate the engine check for any fuel leaks. NEVER use your hands! If you discover a fuel leak see your authorized Campes engine dealer or distributor to repair the engine.

Daily, After Operation

- **Check For Engine Oil Leakage**
- **Check For Fuel Leakage**

• Check Engine Oil Level

After you shut down the engine check for any engine oil leaks. If you discover an engine oil leak see your authorized Campes engine dealer or distributor to repair the engine.

• Check For Fuel Leakage

After you shut down the engine check for any fuel leaks. NEVER use your hands! If you discover a fuel leak see your authorized Campes engine dealer or distributor to repair the engine.

After Initial 50 Hours of Operation

Perform the following maintenance after the initial 50 hours of operation.

- **Replace Engine Oil**
- **Clean / Inspect Engine Oil Filter**

The engine oil on a new engine becomes contaminated from the initial break-in of internal parts. The initial 50 hour oil change and filter cleaning is very important.

Drain the engine oil as follows:

1. Make sure the engine is level.

2. Start the engine and bring it up to operating temperature.

3. Stop the engine.

4. Remove the oil cap / dipstick **(Figure1,(1))** to allow the engine oil to drain more easily.

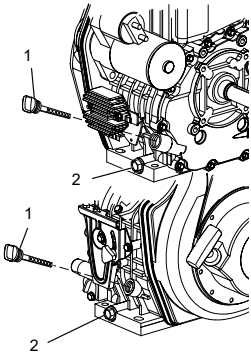

Figure 1

5. Position a container under the engine to collect waste oil.

6. Remove the drain plug located on the bottom of the cylinder block **(Figure 1,(2)).** Allow oil to drain.

7. After all oil has been drained from the engine, install the drain plug **(Figure1,(2))** and tighten to 19.6-23.5 N•m (2.0-2.4 kgf•m).

8. Dispose of used oil properly.

Clean / Inspect Engine Oil Filter

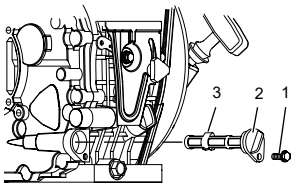

Figure 2

Clean / inspect the engine oil filter as follows:

1. Remove the oil filter retaining bolt **(Figure2,(1))**.

2. Pull the oil filter cap **(Figure2,(2))** out and remove the oil filter **(Figure2,(3)).**

3. Clean the oil filter or replace if damaged.

4. Install the oil filter **(Figure2,(3))**.

5. Make sure the oil filter cap is fully seated **(Figure2,(2)).**

6. Install and tighten the oil filter retaining bolt **(Figure2,(1)).**

7. Add new engine oil to the engine as specified in Adding Engine Oil on page 35.

8. Warm up the engine by running it for 5 minutes and check for any engine oil leaks.

9. After engine is warm, shut it off and let it sit for 10 minutes.

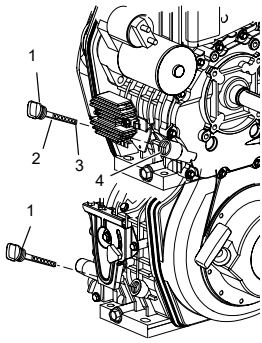

Figure 3

10.Recheck the engine oil level by fully inserting, but not screwing in, the dipstick.

11.Add engine oil **(Figure 3,(4))** as needed until the level is between the upper **(Figure 3,(2))** and lower lines **(Figure 3,(3))** on the oil cap / dipstick **(Figure 3,(1))**.

12.Replace the oil cap / dipstick **(Figure 3,(1))** and tighten by hand. Over-tightening may damage the cap. If any engine oil is spilled, wipe it away with a clean cloth.

Every 50 Hours of Operation

Perform the following maintenance every 50 hours of operation.

• Clean Inlet Fuel Screen

1. Clean the area around the fuel cap **(Figure 4,(1)).**

2. Remove the fuel cap **(Figure 4,(1))** from the fuel tank **(Figure 4,(2)).**

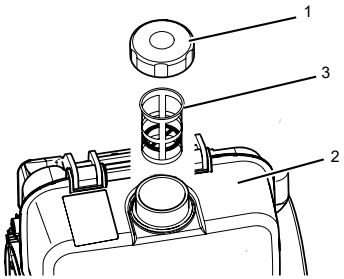

Figure 4

3. Lift out the inlet fuel screen **(Figure 4,(3))**.

4. Clean the inlet fuel screen or replace if damaged.

5. Install the inlet fuel screen **(Figure 4,(3))**.

6. Replace the fuel cap **(Figure 4,(1))** and hand tighten. Overtightening the fuel cap will damage it.

Every 50 Hours of Operation

Perform the following maintenance every 200 hours of operation.

- **Clean Air Cleaner Element**
- **Replace Engine Oil and Clean / Inspect Engine Oil Filter**
- **Check Engine Speed Control**
- **Drain the Fuel Tank and Replace Outlet Fuel Filter**

• Clean Air Cleaner Element

The engine performance is adversely affected when the air cleaner element is clogged with dust. Be sure to clean the air filter element periodically.

1. Remove the wing nut and washer **(Figure 5,(1)).**
2. Remove the air cleaner cover **(Figure 5,(2)).**

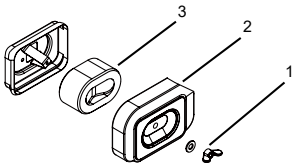

Figure 5

3. Remove the air cleaner element **(Figure 5,(3))** and outer foam element

5. Blow air through both elements using 0.29−0.49MPa (3.0−5.0kgf/cm2) compressed air to remove the particulates. Use the lowest possible air pressure to remove the dust without damaging the elements.

6. If either element is damaged replace both of them (they are not sold individually).

7. Clean the inside of the air cleaner cover **(Figure 5,(2)).**

8. Install the air cleaner element **(Figure 5,(3))** into the air cleaner case.

9. Install the wing nut and washer **(Figure 5,(1))** and hand tighten. Overtightening the wing nut will damage the air cleaner assembly.

Replace Engine Oil and Clean / Inspect Engine Oil Filter

Change the engine oil every 200 hours of operation after the initial change at 50 hours.

Clean and inspect the engine oil filter at the same time. See Replace Engine Oil on page 34.

Check Engine Speed Control

After you operate the engine for 200 hours, check the engine speed control. See the instructions for your driven machine for proper adjustments.

1. Check the engine speed control for smooth operation and lubricate or clean as necessary.
2. Check engine speed control for proper adjustments.

Drain the Fuel Tank and Replace Outlet Fuel Filter

1. Position an approved container under the fuel tank to collect the fuel.
2. Remove the fuel cap **(Figure 6,(1))**.
3. Remove the fuel tank drain plug **(Figure 6,(2))** and gasket **(Figure 6,(3))** to drain the fuel.

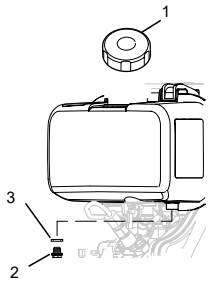

Figure 6

4. Loosen the fuel cock nuts **(Figure 7,(1))** on either side of the fuel cock **(Figure 7,(2))**.
5. Remove and discard the O-ring **(Figure 7,(3)).**
6. Pull the outlet fuel filter **(Figure 7,(4))** and gasket **(Figure 7,(5))** out of the fuel tank filler port **(Figure 7,(6))**.

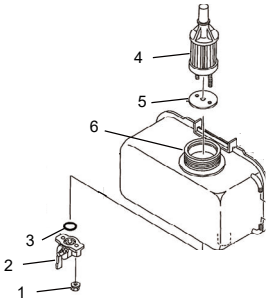

Figure 7

7. Install a new outlet fuel filter **(Figure 7,(4))** and gasket **(Figure 7,(5))** through the fuel tank filler port **(Figure 7,(6))** and seat in the fuel tank.

8. Install a new O-ring **(Figure 7,(3))** on the fuel cock **(Figure 7,(2))** and fasten the assembly to the fuel tank using the fuel cock nuts **(Figure 7,(1))**.

9. Tighten the fuel tank drain plug **(Figure 6,(2))** with new gasket **(Figure 6,(3))**.

10.Replace the fuel cap **(Figure 6,(1))** and hand tighten. Overtightening the fuel cap will damage it. Refill fuel tank. See Filling the Fuel Tankon page 19.

Every 400 Hours of Operation

Perform the following maintenance every 400 hours of operation.

• Adjust Intake and Exhaust Valve Clearance

Proper operation of the intake and exhaust valves is required to obtain optimum engine

performance. See your authorized Campes engine dealer or distributor for this service.

Every 1000 Hours of Operation

Perform the following maintenance every 1000 hours of operation.

• Check Compression

Checking the engine compression is required every 1000 hours to obtain optimum engine performance. See your authorized Campes engine dealer or distributor for this service.

Every 1500 Hours of Operation

Perform the following maintenance every 1500 hours of operation.

• Inspect, Clean and Test Fuel Injection Nozzle

Proper operation of the fuel injectors is required to obtain the optimum injection pattern for full engine performance. The injectors should be inspected, cleaned and tested every 1500 hours. See your authorized Campes engine dealer or distributor for this service.

Every 2000 Hours of Operation

Perform the following maintenance every 2000 hours of operation.

• Check and Replace Fuel Hoses

Regularly check the fuel system hoses. If they are cracked or degraded, replace them. Replace the hoses at least every two years, or 2000 hours, whichever occurs first. Consult your authorized Campes engine dealer or distributor to replace fuel system hoses.

Section 7 Trouble Shooting

If a problem occurs, stop the engine immediately. Refer to the SYMPTOM column in the Troubleshooting Chart to identify the problem.

SYMPTOM	PROBABLE CAUSE	ACTION	REFER TO
Indicator Turns On - Engine Running			
Engine oil pressure indicator (If equipped)	• Low level of engine oil • Too high an oil level	• Check and adjust oil level as necessary	checking engine oil on page 20
	• Clogged engine oil filter	• Replace engine oil filter element	replace engine oil on page 34
Battery Indicator	• Battery failure	• Check battery condition	
	• Faulty dynamo	• See authorized Campes engine dealer or distributor	-
Indicator Does Not Turn On - Key Switch is Turned to ON (OFF → ON)			
	• Faulty electrical wiring or faulty indicator	• See authorized Campes engine dealer or distributor	-
Indicator Stays On - Key Switch is Turned from Start to ON (START → ON)			
• Battery indicator stays On	• Faulty alternator	• See authorized Campes engine dealer or distributor	-
• Engine oil pressure indicator stays On	• Faulty engine oil pressure switch		-
Engine Does Not Start			
• Starter motor operates but engine does not start	• No diesel fuel	• Refuel fuel system	Filling the fuel tank on page 19
	• Improper diesel fuel	• Replace with recommended diesel fuel	Diesel Fuel specification on page 18
	• Clogged fuel filter	• Replace fuel filter	Drain the Fuel Tank and Replace Outlet Fuel Filter on page 36
	• Poor fuel injection	• See authorized Campes engine dealer or distributor	-
	• Compressed air leakage from intake / exhaust valves		-
	• Faulty engine stop solenoid (if equipped)		-
• Starter motor does not operate or rotates too slowly (engine can be turned manually)	• Battery needs charging	• Check electrolyte, recharge	Check Battery(If Equipped on page 34)
	• Faulty cable connection at • battery terminals	• Clean terminals, retighten	-
	• Faulty starter switch	• See authorized Campes engine dealer or distributor	-
	• Faulty starter motor		-
• Engine cannot be manually turned	• Inner parts seized or damaged		-
White or Black Exhaust Smoke			
• Black exhaust smoke	• Engine overloaded	• Reduce load	-
	• Clogged air cleaner element	• Clean element or replace	Clean Air Cleaner Element on page 36
	• Improper diesel fuel	• Replace with recommended diesel fuel	Diesel Fuel specification on page 18
	• Faulty spraying of fuel injection	• See authorized Campes engine dealer or distributor	-
	• Excessive intake / exhaust valve clearance		-
• White exhaust smoke	• Improper diesel fuel	• Replace with recommended diesel fuel	Diesel Fuel specification on page 18
	• Faulty spray pattern of fuel injection	• See authorized Campes engine dealer or distributor	-
	• Fuel injection timing delay		-
	• Engine burning oil		-

If your engine does not operate properly, refer to the troubleshooting chart or consult your authorized Campes engine dealer or distributor. Supply the authorized Campes engine dealer or distributor with the following information:

• Model name and serial number of your engine

• The driven machine type (tractor, generator, skid steer loader), manufacturers name, model and serial number

• How long the engine has been in service (the number of engine hours or the number of calendar months)

• Operating conditions when problem occurs:

Engine rpm

Color of exhaust smoke

Type of diesel fuel

Type of engine oil

Any abnormal noises or vibration

Operating environment such as high altitude or extreme ambient temperatures, etc.

• Engine maintenance history and previous problems

• Other factors that contribute to the problem

Section 8 Long Term Storage

This section of the Operation Manual describes the procedures necessary to place the engine into long term storage (six months or longer) and how to place it back into operation.

Before you place the engine in long term storage

1. Perform the next Periodic Maintenance procedure. For example, if there are 10 hours before the 200 hour maintenance, you should do the maintenance before you place the engine in storage. See the Periodic Maintenance Schedule on page 33 .

2. Start the engine. Allow the engine to idle, or run without load if there is no idle position in your application, for approximately 3 minutes and then stop the engine.

3. Drain the engine oil while the engine is still warm and fill with new oil. See Replace Engine Oil on page 34.

4. Recoil start engines:

(a) Push the decompression lever down and hold it while slowly pulling the recoil starter 2 or 3 times. Do not start the engine.

(b) Pull the decompression lever up. Pull the recoil starter slowly and stop when there is resistance. This procedure closes the intake and exhaust valves in the compression position and helps prevent rust.

5. Electric start engines:

(a) Set the decompression lever at the non compression position. Do not move the speed control lever to the START or RUN position.

(b) Turn the key to the start position and turn the engine for 2 to 3 seconds. Do not start the engine.

(c) Pull the decompression lever up.

6. Drain the fuel tank or make sure it is completely full.

7. Protect the air cleaner, muffler and electrical components (dynamo, starter motor, switches) from water and dust.

8. Disconnect the negative (-) battery cable to prevent the battery from discharging.

9.Charge the battery once a month during storage.

11.Clean the engine and store it in a dry place.

12.Rotate the engine without starting every four to six months.

Return the engine to service

1. Perform the Daily Checks on page 21.

2. Start the engine. Allow the engine to idle, or run without load if there is no idle position in your application, for approximately 5 to 10 minutes while you check for:

(a) proper oil pressure.

(b) fuel, engine oil, or coolant leaks.

(c) proper operation of the indicators and / or gauges (if equipped).

3. Avoid prolonged operation at minimum or maximum engine speeds and loads for the remainder of the first hour of operation.

Section 9 Specifications

Engine Speed Specifications

AVAILABLE ENGINE SPEED	INTENDED USES
2500 ~ 3450 rpm (min-1)	Agricultural, Constructive, Industrial Machines
3600 rpm (min-1)	Generator Sets, Pumps

Engine General Specifications

Type	Vertical, Air Cooled, 4-Cycle Diesel Engine
Combustion System	Direct Injection
Starting System	Electric Starting and/or Recoil Starting
Cooling System	Fan on Flywheel
Lubricating System	Forced Lubrication With Trochoid Pump
Direction of Rotation	Counterclockwise Viewed from PTO Side

Notes:

1. The information described in Principal Engine Specificationsis for a “standard” engine. To obtain the information for the engine installed in your driven machine, please refer to the manual provided by the driven machine manufacturer.

2. Engine rating conditions are as follows (SAE J1349, ISO 3046/1):

• Atmospheric Condition: Room temperature 25°C, Atmospheric pressure 100 kPa (750mm Hg), Relative humidity 30%

• Fuel Temperature at Fuel Injector Pump Inlet: 40°C

• With Cooling Fan, Air Cleaner, Muffler: Campes Standard

• After Engine Break-In Period. Output Allowable Deviation: ± 3%

• 1 PS = 0.7355 kW

Principal engine specifications

Model		D170F		D173F	
Type		4-stroke, vertical cylinder, air cooled diesel engine			
No. of Cylinders		1		1	
Bore × Stroke	mm	Φ70 × 55		Φ73 × 59	
Displacement	liter	0.211		0.247	
Compression Ratio		20:1		19:1	
Rated Output Power @Rated speed	kw	2.5/3000	2.8/3600	3.45/3000	4.05/3600
Rated Output Power @Rated speed	hp	3.4/3000	3.8/3600	4.7/3000	5.5/3600
Idle speed	r/min	1800	1800	1800	1800
Max. Rated Output Power @Rated speed	kw	2.75/3000	3.08/3600	3.8/3000	4.5/3600
Max. Rated Output Power @Rated speed	hp	3.74/3000	4.18/3600	5.17/3000	6.05/3600
Piston average speed /rotation speed	m/s	5.5/3000	6.6/3600	5.9/3000	7.08/3600
Injection advance angle	°	19±1		19±1	
Rotation direction (face to the crankshaft)		Anticlockwise			
Valves clearance (cool status) mm		in 0.1	out 0.15	in 0.1	out 0.15
Max Torque	Nm @ rpm	/		/	
Fuel Tank Capacity	liter	2.4		2.4	
Fuel Consumption g·kw/h	3000 rpm	≤280		≤280	
	3600 rpm	≤288		≤288	
Lubricating Oil Type		SAE 10W-30, 15W-40, API grade CF or higher			
Lubricating Oil Capacity	liter	0.75		0.75	
Oil consumption (kg/h) g/(kW·h)	g/h	≤4		≤4	
	g/h	≤4		≤4	
Oil pressure	Mpa	0.2 ～ 0.6，at the range of 0.06±0.01 alarm			
Starting Motor Capacity *	V-KW	12V 1.2KW		12V 1.2KW	
Charging Dynamo output*	V	18V AC		18V AC	
Charging Voltage Regulator *	V-A-W	13.5V 8.3A 112W		13.5V 8.3A 112W	
Overall Dimension(L × W × H)	mm	332 × 395 × 420		332 × 395 × 420	
Engine Weight (Dry)	without Electric Start(kg)	27		28	
	with Electric Start(kg)	33		33	

Model		D178F		D180F	
Type		4-stroke, vertical cylinder, air cooled diesel engine			
No. of Cylinders		1		1	
Bore × Stroke	mm	Φ78 × 62		Φ80 × 67	
Displacement	liter	0.296		0.337	
Compression Ratio		20:1		20:1	
Rated Output Power @Rated speed	kw	3.68/3000	4.1/3600	4.8/3000	5.6/3600
Rated Output Power@Rated speed	hp	5.0/3000	5.5/3600	6.5/3000	7.6/3600
Idle speed	r/min	1800	1800	1800	1800
Max. Rated Output Power @Rated speed	kw	4/3000	4.5/3600	5.28/3000	6.16/3600
Max. Rated Output Power @Rated speed	hp	5.5/3000	6.05/3600	7.15/3000	8.36/3600
Piston average speed /rotation speed	m/s	6.2/3000	7.4/3600	6.7/3000	8.04/3600
Injection advance angle	°	19±1		19±1	
Rotation direction (face to the crankshaft)		Anticlockwise			
Valves clearance (cool status) mm		in 0.2	out 0.16	in 0.2	out 0.16
Max Torque	Nm @ rpm	/		16.6Nm @ ⩽ 2880rpm	
Fuel Tank Capacity	liter	3.3		3.3	
Fuel Consumption g·kw/h	3000 rpm	≤276.1		≤276.1	
	3600 rpm	≤285.6		≤285.6	
Lubricating Oil Type		SAE 10W-30, 15W-40, API grade CF or higher			
Lubricating Oil Capacity	liter	1.1		1.1	
Oil consumption (kg/h) g/(kW·h)	g/h	≤4		≤4	
	g/h	≤4		≤4	
Oil pressure	Mpa	0.2 ～ 0.6，at the range of 0.06±0.01 alarm			
Starting Motor Capacity *	V-KW	12V 1.2KW		12V 1.2KW	
Charging Dynamo output*	V	18V AC		18V AC	
Charging Voltage Regulator *	V-A-W	13.5V 8.3A 112W		13.5V 8.3A 112W	
Overall Dimension(L × W × H)	mm	420 × 383.8 × 450		442 × 383.8 × 458	
Engine Weight (Dry)	with out Electric Start(kg)	35		36	
	with Electric Start(kg)	40		41	

Principal engine specifications

Model		D186F		D186FA	
Type		4-stroke, vertical cylinder, air cooled diesel engine			
No. of Cylinders		1		1	
Bore × Stroke	mm	Φ86 × 70		Φ86 × 72	
Displacement	liter	0.406		0.418	
Compression Ratio		19:1		19:1	
Rated Output Power @Rated speed	kw	5.7/3000	6.3/3600	6.3/3000	6.6/3600
Rated Output Power@Rated speed	hp	7.6/3000	8.4/3600	8.4/3000	9.0/3600
Idle speed	r/min	1800	1800	1800	1800
Max. Rated Output Power @Rated speed	kw	6.27/3000	6.9/3600	6.9/3000	7.2/3600
Max. Rated Output Power @Rated speed	hp	8.36/3000	9.2/3600	9.2/3000	9.9/3600
Piston average speed /rotation speed	m/s	7.0/3000	8.4/3600	7.2/3000	8.64/3600
Injection advance angle	°	19±1		19±1	
Rotation direction (face to the crankshaft)		Anticlockwise			
Valves clearance (cool status) mm		in 0.3	out 0.17	in 0.3	out 0.17
Max Torque	Nm @ rpm	18.7Nm @ ≤ 2880rpm		18.7Nm @ ≤ 2880rpm	
Fuel Tank Capacity	liter	3.3		4.5	
Fuel Consumption g·kw/h	3000 rpm	≤271.5		≤271.5	
	3600 rpm	≤280		≤280	
Lubricating Oil Type		SAE 10W-30, 15W-40, API grade CF or higher			
Lubricating Oil Capacity	liter	1.65		1.65	
Oil consumption (kg/h) g/(kW·h)	g/h	≤4		≤4	
	g/h	≤4		≤4	
Oil pressure	Mpa	0.2 ～ 0.6，at the range of 0.06±0.01 alarm			
Starting Motor Capacity *	V-KW	12V 1.2KW		12V 1.2KW	
Charging Dynamo output*	V	18V AC		18V AC	
Charging Voltage Regulator *	V-A-W	13.5V 8.3A 112W		13.5V 8.3A 112W	
Overall Dimension(L × W × H)	mm	460 × 417 × 495		460 × 417 × 495	
Engine Weight (Dry)	with out Electric Start(kg)	47		47	
	with Electric Start(kg)	52		52	

Model		D188F		D192F	
Type		4-stroke, vertical cylinder, air cooled diesel engine			
No. of Cylinders		1		1	
Bore × Stroke	mm	Φ88 × 75		Φ92 × 75	
Displacement	liter	0.456		0.498	
Compression Ratio		19:1		19:1	
Rated Output Power @Rated speed	kw	6.8/3000	7.5/3600	7.9/3000	9.2/3600
Rated Output Power@Rated speed	hp	9.5/3000	10.2/3600	10.6/3000	12.2/3600
Idle speed	r/min	1800	1800	1800	1800
Max. Rated Output Power @Rated speed	kw	7.5/3000	8.2/3600	8.6/3000	10.1/3600
Max. Rated Output Power @Rated speed	hp	10.4/3000	11.2/3600	11.6/3000	13.4/3600
Piston average speed /rotation speed	m/s	7.5/3000	9.0/3600	7.5/3000	9.0/3600
Injection advance angle	°	19±1		19±1	
Rotation direction (face to the crankshaft)		Anticlockwise			
Valves clearance (cool status) mm		in 0.4	out 0.18	in 0.4	out 0.18
Max Torque	Nm @ rpm	22.2Nm @ ⩽ 2880rpm		27.3Nm @ ⩽ 2880rpm	
Fuel Tank Capacity	liter	4.5		4.5	
Fuel Consumption g·kw/h	3000 rpm	≤275		≤275	
	3600 rpm	≤280		≤280	
Lubricating Oil Type		SAE 10W-30, 15W-40, API grade CF or higher			
Lubricating Oil Capacity	liter	1.65		1.65	
Oil consumption (kg/h) g/(kW·h)	g/h	≤4		≤4	
	g/h	≤4		≤4	
Oil pressure	Mpa	0.2 ～ 0.6，at the range of 0.06±0.01 alarm			
Starting Motor Capacity *	V-KW	12V 1.2KW		12V 1.2KW	
Charging Dynamo output*	V	18V AC		18V AC	
Charging Voltage Regulator *	V-A-W	13.5V 8.3A 112W		13.5V 8.3A 112W	
Overall Dimension(L × W × H)	mm	460 × 417 × 495		460 × 417 × 500	
Engine Weight (Dry)	with out Electric Start(kg)	47		50	
	with Electric Start(kg)	52		55	

Principal engine specifications

Model		D195F		D1100	
Type		4-stroke, vertical cylinder, air cooled diesel engine			
No. of Cylinders		1		1	
Bore × Stroke	mm	Φ95 × 75		Φ100× 85	
Displacement	liter	0.532		0.668	
Compression Ratio		19:1		19:1	
Rated Output Power @Rated speed	kw	8.5/3000	9.5/3600	10/3000	10/3600
Rated Output Power@Rated speed	hp	11.5/3000	13/3600	13.6/3000	13.6/3000
Idle speed	r/min	1800	1800	1800	1800
Max. Rated Output Power @Rated speed	kw	9.3/3000	10.4/3600	11/3000	11/3600
Max. Rated Output Power @Rated speed	hp	12.6/3000	14.1/3600	14.9/3000	14.9/3000
Piston average speed /rotation speed	m/s	7.5/3000	9.0/3600	8.5/3000	10.2/3600
Injection advance angle	°	19±1		20±1	
Rotation direction (face to the crankshaft)		Anticlockwise			
Valves clearance (cool status) mm		in 0.5	out 0.19	in 0.5	out 0.19
Max Torque	Nm @ rpm	28.2Nm @ ⩽ 2880rpm		29.7Nm @ ⩽ 2880rpm	
Fuel Tank Capacity	liter	4.5		4.5	
Fuel Consumption g·kw/h	3000 rpm	≤275		≤280	
	3600 rpm	≤280		≤280	
Lubricating Oil Type		SAE 10W-30, 15W-40, API grade CF or higher			
Lubricating Oil Capacity	liter	1.65		2.5	
Oil consumption (kg/h) g/(kW·h)	g/h	≤4		≤4	
	g/h	≤4		≤4	
Oil pressure	Mpa	0.2 ～ 0.6，at the range of 0.06±0.01 alarm			
Starting Motor Capacity *	V-KW	12V 1.2KW		12V 1.4KW	
Charging Dynamo output*	V	18V AC		18V AC	
Charging Voltage Regulator *	V-A-W	13.5V 8.3A 112W		13.5V 8.3A 112W	
Overall Dimension(L × W × H)	mm	460 × 417 × 500		510 × 500 × 590	
Engine Weight (Dry)	with out Electric Start(kg)	50		62	
	with Electric Start(kg)	55		68	

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