Introduction

Thank you for buying and using HYUNDAI WC30D Industrial Diesel Engine.

This operation manual provides check and inspection intervals, service information and warranty required for proper maintenance of engine as well as instructions for safe and proper engine operation, operator maintenance and first aids.

Personnel shall be thoroughly familiar with the contents of this manual to ensure optimal performance and prolonged service life of the engine. Read the followings carefully before operation to prevent engine malfunction which may result in failure or accident.

CAUTION and WARNING

Watch for CAUTION, WARNING and highlighted text.

CAUTION

A CAUTION indicates a situation in which personal injury, perhaps sever, could result if the caution is ignored.

WARNING

A WARNING indicates a situation in which serious bodily injuty or death could result if the warning is ignored.

※ *Failure to use genuine Hyundai Wia parts may result in serious damage to engine.*

Genuine Parts

Genuine Hyundai Wia parts are identical to the parts used in new engine of Hyundai-Kia Motors. The parts undergone a strict inspection for quality assurance.

Contact our local service center or authorized maintenance center when engine malfunction or failure occurs during operation.

Certified Genuine Replacement Parts for Hyundai-Kia Motors

※ Specification and data in this manual are subject to change without prior notice due to design change.

※ This manual shall not be modified or copied in whole or in part without prior permission of HYUNDAI WIA.

Table of Contents

1. Important Safety Information

Periodic inspection

Periodic maintenance and inspection are essential for safe operation and prolonged service life of the engine.
The inspection intervals are described in "Periodic Check and Maintenance Table".

Genuine Hyundai-Kia Parts

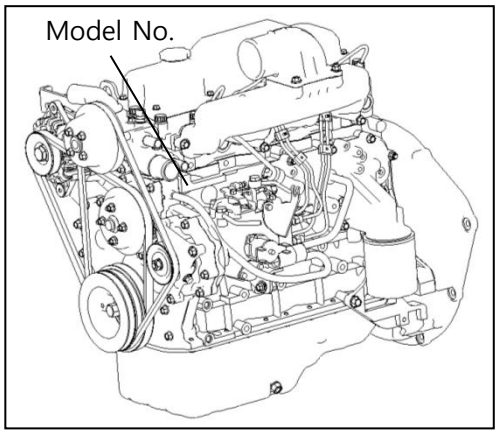
Use only oil, grease specified for genuine Hyundai-Kia parts.

Certificate of inspection as shown in right example is defined on all genuine Hyundai-Kia Motors parts.

Certified Genuine Replacement Parts for Hyundai-Kia Motors

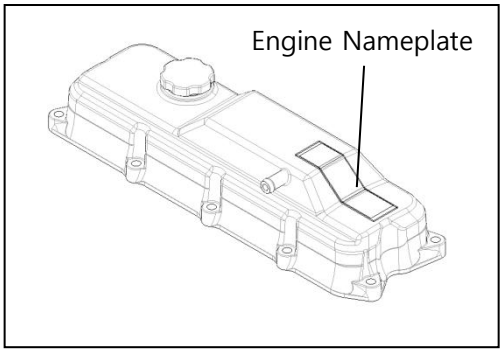
Engine Model Number

Use an engine model number when ordering parts or failure occurs.
The engine model number is engraved on the location shown in the right Figure.



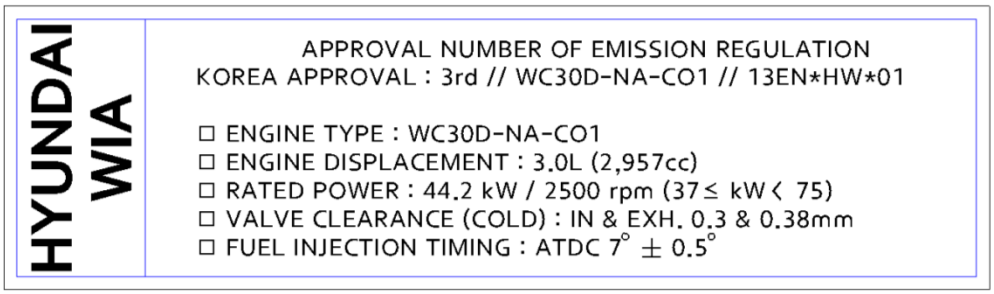
Engine Nameplate

Engine nameplate, located on cylinder head cover, includes the following information.



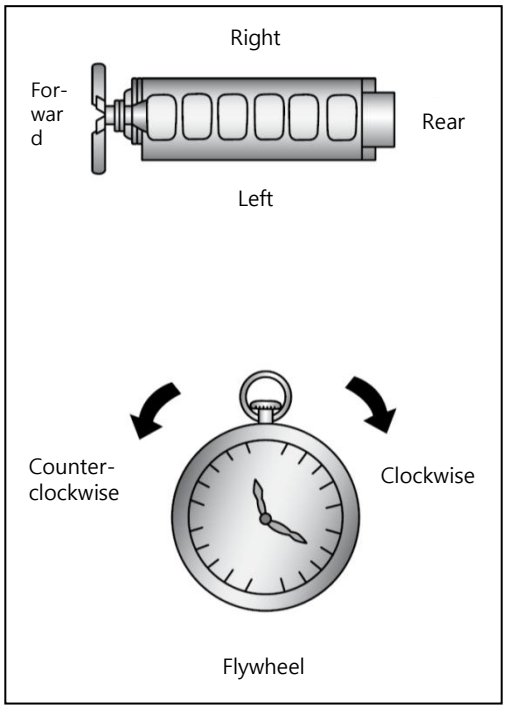
Nameplate Information

1. Engine Type
2. Engine Displacement
3. Rated Power
4. Valve Clearance
5. Fuel Injection Timing

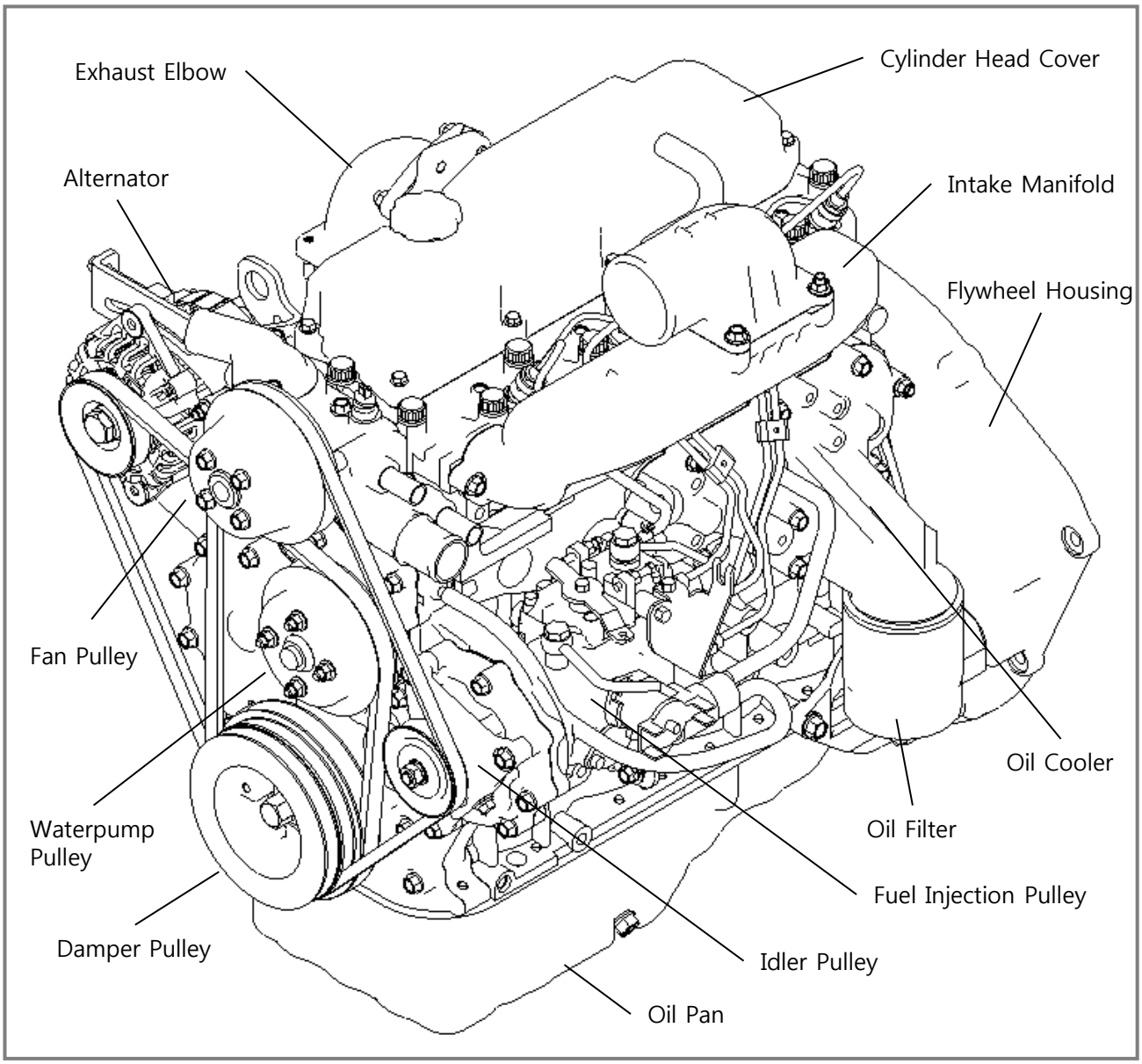


CAUTION

Front/rear, right/left, clockwise/counterclockwise positions discussed in this manual are viewed from the direction shown in the right Figure.



2. External View and Major parts of Engine



3. Engine Start and Operation

Operation of New Engine

To ensure proper service life and performance of new engine, it is important to operate the engine carefully when starting engine for the first time .

Particular attention shall be paid to the following.

Initial Check

Contact our local service center or authorized service shop to check for engine condition when hour meter indicates first 200 hours of operation or 3 months have expired since initial operation of new engine.

Operation of New Engine

Be careful not to operate the new engine improperly during first 60 hours of operation.

Observe the followings to ensure optimal performance of new engine.

1. Allow a sufficient time for the engine to warm up.

2. Do not operate at overspeed.

3. Limit maximum load to 70%.

4. Do not operate load fluctuation rapidly.

Oil Change

For new engine, change oil after first 60 hours, then every 250 hours of operation.

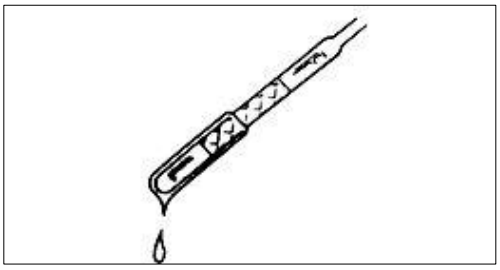
After first 60 hours of operation, change engine oil and oil filter.

After every 250 hours of operation change engine oil and oil filter.

Pre-operation Checks

Perform the following checks daily to operate engine safely and smoothly.

Engine Oil Level Check



Take out dipstick and thoroughly wipe with cloth. Insert the dipstick and remove to check oil level.

Oil levels anywhere within crosshatch (between L and F marks) are considered in the acceptable operating range. If the oil level is below L mark, add oil through oil port, check oil for contamination and viscosity and change it if necessary. Check for oil leakage.

CAUTION

1. Check engine oil level before engine start or approximately 5 minutes after engine stop.

Ensure that engine is level ground.

2. Check oil level 5-6 minutes after adding oil to prevent inaccurate reading.

Fuel Check

Check fuel tank for fuel level and leakage. If engine is not used for long periods or fuel tank is empty, bleed air from the tank prior to operation.

Coolant Level Check

Check coolant level in radiator or coolant tank and add as required.

> ***CAUTION***
>
> *When using coolant containing antifreeze or anti-rust agents, do not add only water to tank. This may decrease the concentration of antifreeze or anti-rust agents. Always add the same ratio of coolant mixture as is already in the tank.*

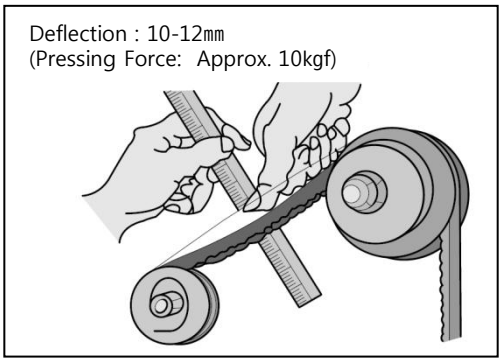
Leakage

Check radiator, radiator hose, and the rest of cooling system for leakage.

Check bottom of the engine for leakage.

V-Belt Tension

Press down the middle of V-belt with your thumb to check the deflection. Check for evidence of oil or grease or damage to V-belt.



It is important to find defects early.

Check defects found in the previous operation and take proper corrective actions. Failure to comply may result in malfunction during operation.

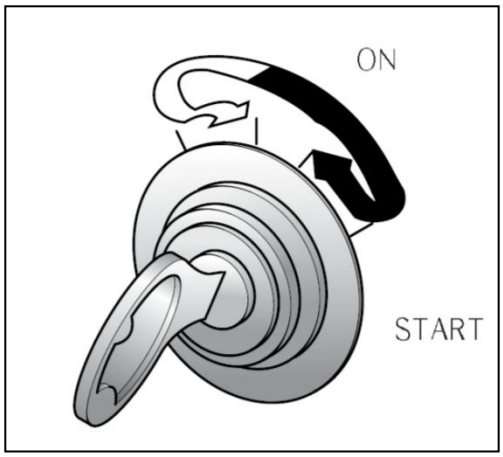
Operation Procedures

Perform pre-checks before starting engine.

Starting the Engine

1. Verify that load side is unloaded.
   For the engine equipped with clutch, disengage the clutch using clutch lever for easy engine starts.

2. Move the battery switch to ON position.



CAUTION

The battery switch shall always be kept ON while the engine is running. If the switch is turned OFF while the engine is running, electric devices could fail or gauges or switches could become inoperative.

3. Insert start key.

4. Move adjusting lever to FULL position if necessary.

5. Turn the key to ON.
   Key should be kept ON until glow plug indicator lamp that shows glow plug is been working is turned off.

CAUTION

1. *Do not attempt to use glow plug continuously. This may consume a lot of electricity and cause damage to battery.*
2. *If glow plug indicator fails to come on red, check glow plug relay for blown fuse.*

6. Turn the key to START position. This will operate the starter, starting the engine.

CAUTION

1. *If the engine fails to start with the first attempt after the starter is turned on for 10-15 seconds, wait at least 10-15 seconds before another attempt. Under no circumstances shall the starter be turned on for more than 30 seconds even if it is winter season.*
2. *If engine is not used for long periods or filter element or oil is changed, turn on the starter for 15 seconds without load and fuel spray. This will help ensure adequate lubrication to engine components before engine start.*
3. *Be sure that the engine has stopped completely before restarting.*
4. *Do not position start key to OFF while the engine is running.*

7. After the engine has started, move adjusting lever slightly beyond the low idle speed to facilitate engine warm-up.

CAUTION

Warm up the engine for more than 5 minutes to ensure adequate lubrication to engine components and proper fuel combustion.

Checks during Warm-up

1. Check for proper engine oil pressure.
   During warm-up, the oil pressure gauge shall read more than 1.5 kg/㎠ (150kPa).
   During idling, verify that warning lamp remains off.

2. Check volt-meter to ensure that the battery is charged.

3. Check the engine for abnormal noise, smell or vibration.

4. Check color of exhaust gas.

5. Check for engine oil leakage, coolant leakage and fuel leakage.

Reverse Rotation and Corrective Actions

Reverse rotation of the engine may result in inadequate lubrication to engine components, causing damage or failure even within minutes. It also may cause exhaust gas to flow out of inlet port, leading to fire hazards.

Signs of Reverse Rotation

1. Tachometer will read 0. Since the oil pressure does not rise, oil pressure gauge also will read 0 or warning light will remain on. Check oil pressure gauge and warning light when starting the engine.

2. Since exhaust gas will be passed to inlet port, engine knock will occur and the gas will flow out of air cleaner. Check the air cleaner for any knocking sound or evidence of exhaust gas at engine starts.

Corrective Actions

1. Immediately shut down the engine using engine shutdown switch.

2. After engine shutdown, check air cleaner and air intake hoses for abnormal condition; and then replace if necessary.

CAUTION

After warm-up, apply load to the engine.

1. Check all engine parts for abnormal noise, smell or vibration.

2. Check color of exhaust gas.

3. Check each gauge frequently.

Pilot lamp shall remain off while engine is running. If any abnormal symptoms are found, check the engine immediately. If it is impossible to determine the cause of symptoms or the symptoms are beyond adjustment, contact our local maintenance center immediately.

Oil Pressure Gauge and Warning Lamp

Check that engine oil pressure is normal and warning lamp goes off. Gauge shall read 3-5 kgf/㎠ (295-490㎪) at the rated speed and above 0.8 kgf/㎠ (80㎪) during idling.

Abnormal oil pressure

Oil pressure falling below 0.5 kgf/㎠(49㎪) during idling and 2.0 kgf/㎠ (200㎪) (indicator in red area) at the rated speed or illumination of warning light indicate abnormal condition.

1. Running the engine under this condition for long periods may damage engine bearings. Stop the engine immediately.

2. Check for leakage. Take corrective actions immediately if necessary.

3. Check engine oil level. Add as required.

4. Check oil filter element for clogging.

5. Check oil pressure gauge, lamp or pipes. Measure accurate oil pressure using the oil pressure gauge.

6. If the abnormal oil pressure condition still exists, contact our local service center or authorized maintenance center.

7. The followings are normal conditions even if oil pressure readings are out of normal range. If these conditions occur, wait sufficient time until the readings return back to normal.
   1) The gauge may read slightly higher pressure than normal when the engine is not sufficiently heated immediately after start. Do not accelerate the engine and run at idle speed until it is sufficiently warmed up.
   2) The gauge may read slightly lower pressure than normal 1 kgf/㎠(98kPa) or more when idling after warming up. This is a normal condition.

Coolant Thermometer and Overheat Warning Lamp

Check that coolant temperature is normal and warning lamp goes off.

Normal indication: 75-95℃ or green area

Overheating

For the engine equipped with radiator, the coolant temperature exceeding 100℃ (or needle in red area) or illumination of warning light indicate engine overheating.

1. Immediately reduce engine speed to idle. Keep idling the engine until the coolant temperature is reduced. Running the engine at high speed for long periods may cause damage.

2. After coolant temperature is reduced, stop the engine and check for any leakage, damaged or loose fan belt or clogged radiator.

3. Check coolant level and add as required.

WARNING

1. Do not remove the radiator cap when coolant is hot. Hot engine coolant will spurt out and cause serious burns. Pull up the pressure relief lever on the radiator cap to reduce the pressure in the radiator.

2. Never pour cold liquid onto a hot engine, as it may cause cracks.

Engine Ignition Off

Shutting down a hot engine without proper cooling may result in sudden rise in coolant temperature, causing moving parts, such as pitons, to break off.

1. Upon completion of operation, allow the engine to idle at low speed for approx. 5 minutes; and then shut down the engine.

2. Turn the key to OFF position.

3. Turn the battery switch to OFF position.

4. Draw the key and keep carefully.

CAUTION

Be sure to move the key to OFF position if the engine will be left unattended for long periods. Battery discharge can occur.

Checks after Engine Ignition Off

After the engine is stopped, clean and check for the followings:

1. Any defects found during operation and repair as required.

2. Check looseness, damage and leakage and repair as required.

3. During the winter season, drain any coolant that contains no antifreeze. Failure to comply may result in coolant freeze-up, causing crank case to break off.

Operation during the Winter and Summer Season

Operation during the Winter Season

In the winter season when the atmosphere temperature is low, the following care shall be taken during operation.

Engine Oil

Engine oil viscosity begins to increase as temperature decreases. This may disrupt engine starts. Select appropriate oil with proper viscosity. Refer to page 20.

Fuel

1. At low temperature, fuel flow and injection will become restricted. Select appropriate fuel based on ambient temperature. Refer to page 21.

2. Fill fuel tank with fuel as much as possible to minimize amount of air and moisture in the tank, preventing freeze-up and corrosion. This will ensure easy engine starts. Tighten cap securely to protect the tank from rain or snow.

3. From time to time, open drain plugs to drain water, preventing water in fuel from freeze-up.

Battery

1. Battery capacity begins to decrease as atmosphere temperature decreases. Be sure to always fully charge a battery.

2. During the winter season, remove battery and store indoor when not in use.

3. To prevent battery freeze-up, charge a battery when battery fluid is added or specific weight is low.

Coolant

Add antifreeze to prevent coolant from freezing.
Refer to page 22.

CAUTION

When using coolant with no antifreeze, open drain plugs on cylinder block and radiator to drain all coolant after operation. Failure to comply may result in damage due to coolant freeze-up.

Precautions during Operation

1. As contaminants increase and performance of battery is degraded, the engine startability is reduced. If the engine fails to start with the first attempt, wait at least 15 seconds before another attempt. Under no circumstances shall the starter be turned on for more than 30 seconds. Warm-up the engine prior to start.

2. In some cases, oil viscosity increases when atmosphere temperature is very low. In such case, heat the oil pan.

3. After startup, allow a sufficient time for the engine to warm up.

Operation during the Summer Season

During operation in hot weather, use extreme care. The engine overheating could occur.

Engine Oil

Select appropriate oil with high viscosity based on ambient temperature.
Refer to page 20.

Battery

Battery fluid level may be suddenly lowered. Check the level frequently and maintain at UPPER mark. (현대중공업 수정/보완 필요)

Cooling System

1. Coolant shall be filled to the specified level. Check for any leakage.

2. Change coolant from time to time to keep the cooling system clean. In hot weather, scales and rust are more likely to build up in the system, especially radiator, resulting in overheating. In such case, clean the cooling system in accordance with procedures on pages 32 through 33.

3. Check looseness of fan belt and adjust belt tension properly.

4. Precautions during operation
   1) Pay attention to thermometer and oil pressure gauge.
   2) In case of engine overheating, idle the engine for a while; then shut the engine down.

WARNING

Do not remove the radiator cap when coolant is hot. Hot engine coolant will spurt out and cause serious burns. Never pour cold liquid onto a hot engine, as it may cause cracks.

4. Functional Checks and Maintenance

Lubrication Oil, Fuel and Coolant

Adding and changing oil and coolant periodically is essential for proper maintenance, optimal performance and prolonged service life of the engine. Please observe the followings:

General Lubrication Instructions

1. Refer to Periodic Checks and Maintenance Table and lubricate all parts requiring lubrication.

2. Select appropriate oil with proper viscosity based on ambient temperature. Using high viscosity oil in cold weather may disrupt engine starts.

3. Clean oil, grease guns, oil fillers, grease nipples prior to lubrication. Replace with new ones if grease nipples or other oil ports are damaged or bent.

4. In case of leakage from oil seals or packings, replace the seals and packings.

Lubrication Oil

Since operation conditions of the high speed diesel engine is harsher than those of the gasoline engine, high quality engine oil is required. Use the engine oil that meets the following requirements.

Item	Specification
Under normal condition	API class: CF-4 or more ACEA class: B2 or B3
Under severe condition	SAE, 5W-30 (-25℃ to 40℃) SAE, 10W-30 (-20℃ to 40℃) SAE, 15W-40 (-15℃ or more) SAE, 20W-40 (-10℃ or more) SAE, #30 (0℃ or more)

Fuel

Characteristics of fuel for the high speed diesel engine (cetane number, specific weight, viscosity, etc) have effect on engine start, power, fuel consumption, function of injection system, knocking noise and exhaust gas.

When using the higher sulfur containing fuel, replace engine oil frequently as the fuel may cause early deterioration of the oil. For the high speed diesel engine, it is recommended to use fuel having a cetane number of 45 or more.

At low temperature, it is recommended to use fuel with low viscosity.

Fuel Handling Precautions

Fuel injection pump and nozzle are precision parts. Since fuel provides lubrication to pump and nozzle, fuel contaminated with dirt and water may cause serious failure. Always use clean fuel and observe the following handling precautions:

1. After operation is completed, fill fuel tank with fuel as much as possible to minimize amount of air in the tank. This will prevent moisture in the air from accumulating in fuel and allow a sufficient time for contaminants in the fuel, such as dirt or water, to sink to the bottom of the tank before the next operation.

2. Before using fuel, fill reservoir with fuel and allow at least 24 hours for contaminants in the fuel, such as dirt or water, to sink to the bottom of the reservoir.

3. When filling fuel from a drum to fuel tank, care shall be taken not to overfill the tank.

4. From time to time, open drain plugs on the bottom of reservoir and fuel tank; then drain water and deposits.

Coolant

Use soft water with little impurities as coolant. Do not use water containing salt or minerals. Failure to comply may facilitate deposit build-up in water jacket, resulting in corrosion. Use coolant containing anti-rust additive during the summer season to prevent rust and coolant containing antifreeze during the winter season to prevent freeze-up.

CAUTION

For coolant containing antifreeze or anti-rust additive, always keep the same rate of coolant as is already in the tank.

Coolant Handling Precautions

1. Use coolant with long life.

2. Clean the cooling system thoroughly before changing coolant.

3. The mixing ratio between coolant and water shall be determined based on the assumption that it is the lowest temperature. Add antifreeze in accordance with Recommended Lubricating Oil List.

Instructions for Prolonged Storage of The Engine

For the engine which will not be used for long periods, store in a dry area and observe the followings:

Storage of the ready-to-use engine

Warm up the engine once a week, allowing engine oil to be circulated through the entire system. Before engine start, crank the engine with starter and check that oil pressure increases on the gauge. During warming-up, keep the speed as slow as possible. Accelerate the engine when coolant reaches proper operating temperature.

Procedures for Prolonged Storage of The Engine

In case of prolonged storage of the engine, please observe the table below. Cover the engine with proper cover. For storage precautions, refer to pages 24 through 25.

Item	Parts to be Pre-checked according to Storage Period			
	Less than 1 month	1-3 months	3-6 months	6-12 months
Internal Parts	-	-	Intake system, cooling system	Intake system, cooling system, lubrication system, fuel system
External Parts		Externally exposed parts, machined surfaces, aluminum parts, plated parts	←	←
Other	Air cleaner, alternator, glow plug, V-belt, battery	←	←	←

CAUTION

1. *If the initial expected storage period is exceeded, follow procedures for the next longer period.*
2. *If the storage period exceeds 12 months, repeat the procedures in the table.*

Internal Parts

1. Intake System

Remove air cleaner. Turn on starter for 15 seconds without fuel spray. Run the engine 3 times at approx. 30 seconds interval, spraying anti-rust oil (MIL-L-644B) through intake manifold using a spray gun.

2. Cooling System

Drain the coolant from the cooling system. Disassemble thermostat and use compressed air to remove any remaining coolant from the cooling system. Spray 2 g of anti-rust additive (MIL-P-3420) to the coolant inlet and outlet; then reassemble the thermostat and drain plug.

3. Lubrication System

Drain oil from oil pan, oil filter, cam housing of fuel injection pump and governor housing; then fill with anti-rust oil (MIL-L-21260). Run the engine for approx. 10 minutes at 800-1,000 rpm with no load using anti-rust fuel specified below. Drain anti-rust oil after engine running.

4. Fuel System

Use anti-rust fuel (diesel fuel to anti-rust oil MIL-L-6448 ratio shall be 1:1) when performing step above. After operation, drain anti-rust fuel.

External Parts

Repaint the peeled area. Apply anti-rust oil (MIL-L-21260) to machined surfaces, aluminum parts and plated part. Seal openings with paper tape.

Peripheral Devices

1. Clean air cleaner and spray anti-rust oil (MIL-L-21260). Seal openings with waterproof tape.

2. Clean the inside surfaces of starter and alternator using dry compressed air. Cover with polyethylene papers.

CAUTION

1. Do not cover with vinyl.

2. Reduce the belt tension.

3. Fill battery with distilled water to a level higher than the normal level.

4. Charge battery. Clean terminals of battery and store in dry and cool place (recharge the battery once a month).

Precautions for Reuse

For normal engine, perform a test run at least once a week during storage unless the engine is stored for long periods (more than 3 months). For the engine stored for more than 3 months, perform the followings without warming up.

1. Apply oil to the upper liner surfaces of piston and rotate the engine by hand several times.

2. Drain oil from oil pan, oil filter, cam housing of fuel injection pump and governor housing; then fill with engine oil to the specified level (add fuel and coolant to the specified level and bleed air from the fuel system).

3. Prior to a trial run, remove cover from cylinder head. Lubricate rocker arm bearings and push rod with oil, checking valve clearance. Crank the engine with starter for 15 seconds at a time and repeat 3 times. Check oil pressure on the gauge. Allow a sufficient time for the engine to warm up to ensure smooth operation of each driving part; then apply load to the engine.

4. During a test run, check gaskets for water and gas leakage due to damage.

Functional Checks and Maintenance

Periodic maintenance and checks are essential for optimal performance and prolonged service life of the engine.

Periodic Checks and Maintenance

1. Simple checks and maintenance are provided below. The detailed inspection and adjustment shall be performed at our local maintenance center in accordance with Periodic Checks and Maintenance Table.

2. The interval of maintenance and checks is determined by operating hours indicated by hour meter. In case of operation under harsh conditions, perform maintenance and checks more frequently than specified in Periodic Checks and Maintenance Table.

CAUTION

After completion of maintenance, check the engine to ensure there are no cloth or tools left around or over the engine.

Safety Precautions

WARNING

1. Do not perform any maintenance while the engine is running.

2. Do not wear unsuitable cloths for work. Always wear safety shoes and goggle.

3. Move the battery switch to OFF position prior to electric device check.

4. Care shall be taken when using inflammable oil for cleaning. Failure to comply may result in fire hazards.

Intake and Exhaust Systems

Exhaust Gas Checks

Allow a sufficient time for the engine to warm up; then check color of exhaust gas.

- Colorless or pale blue: Normal
- Black: Incomplete combustion
- White: Oil combustion

Colorless or pale blue may look like white during the winter season. Observe carefully.

Air Cleaner

A dirty air cleaner can lead to decreased engine output and fuel efficiency, producing a dark exhaust gas.

Lubrication System

Engine Oil Pan

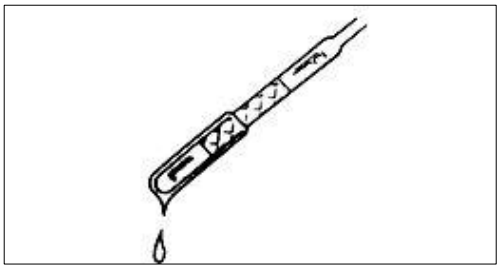
Engine Oil Change

For new engine, change engine oil after first 60 hours, then every 250 hours of operation.

1. Prior to maintenance, shut down the engine and open oil drain plug to drain engine oil before the oil is cooled down. Drain oil from oil filter.

2. Close oil drain plug and fill with new engine oil (at least API CF-4 oil) through oil port until the oil level reaches FULL mark on dipstick.

3. Run the engine at idle speed for several minutes and recheck oil level.



Oil Capacity

Oil pan: 5.8 ℓ

Oil filter: 0.6 ℓ

CAUTION

1. Heavily contaminated or deteriorated oil shall be changed immediately regardless of the specified interval.

2. Replace oil filter element when changing oil.

Oil Filter

Oil filter is a full-flow bypass filter.

Filter Element Change Interval

- Every 250 hours of operation

CAUTION

1. If oil filter warning lamp comes on, change filter element regardless of the specified interval.

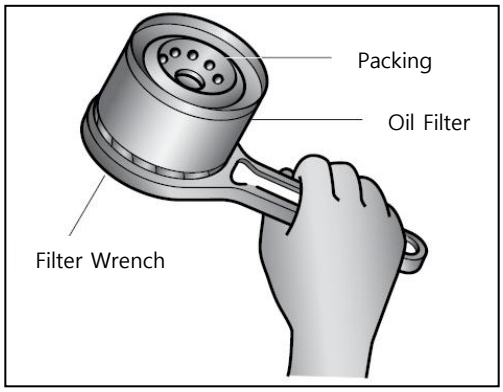
2. Do not clean or reuse filter element.

1. Turn oil filter counterclockwise and remove (use filter wrench if necessary).

2. When changing filter element, apply a thin coating of engine oil to packing; then tighten oil filter.

3. If changing element with a new one without changing engine oil, add 0.6ℓ of engine oil to oil filter and check oil level.

4. Install oil filter. Wipe any residual oil from external surfaces and run the engine to verify that there is no leakage from packing.



CAUTION

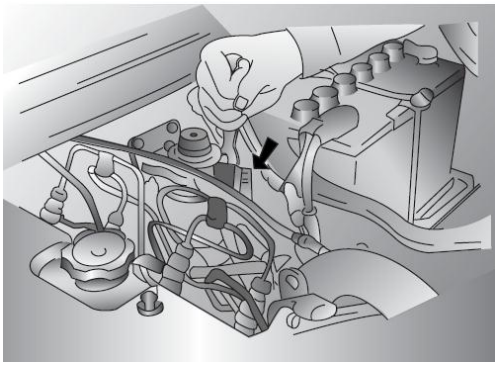
After changing filter element, wipe any spilled oil. Failure to comply may result in fire hazards.

Fuel System

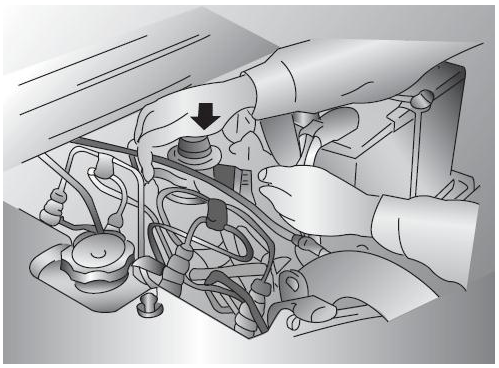
Bleeding the Fuel System

In case of the empty fuel tank, fuel filter change, prolonged storage of the engine, bleed air from the fuel system as follows:

1. Loosen air plug on the top of fuel filter.



2. Operate pump by hand until fuel free from bubbles flows out of air plug. Leave the cloth near the plug to prevent spilled fuel from flowing.



3. After fuel free from bubbles flows out, tighten air plug.

4. Operate pump until resistance is felt.

5. Check for fuel leakage. If any, contact our local maintenance center.

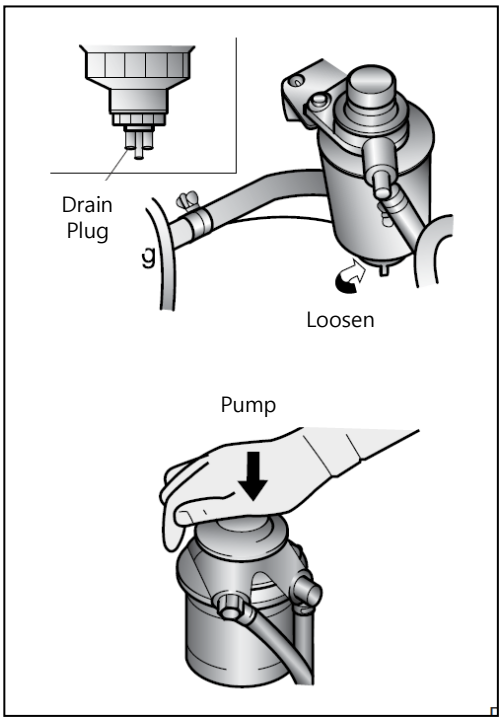
WARNING

1. *During bleeding operation of the fuel system, keep the engine away from flammable materials and smoke.*
2. *Wipe any residual oil from parts around air plug. Failure to comply may result in fire hazards.*

Draining Water from Oil Filter

If fuel filter warning light comes on due to full of water in the filter, drain the water as follows:

1. Loosen drain plug on the bottom of fuel filter.
2. Slowly operate pump 6-7 strokes by hand to drain water through drain plug.
3. After water is fully drained out, tighten drain plug.
4. Loosen and remove air plug.
5. Move ignition switch to ON position and check that warning light comes on. Run the engine and check that warning light goes off. If not, contact our local service center.



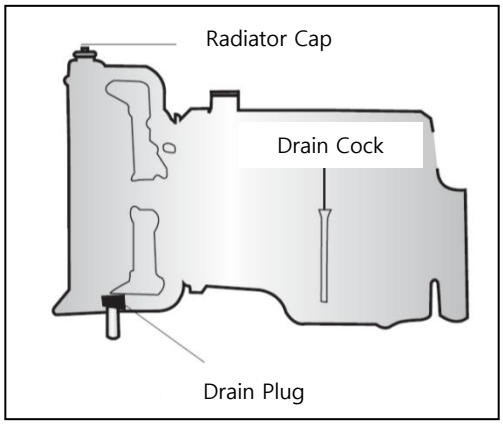
WARNING

1. *During bleeding operation of the fuel system, keep the engine away from flammable materials and smoke.*
2. *Wipe drained water which contains fuel and causes fire hazards.*

Cooling System

Coolant

Coolant change and cleaning intervals:
Every 500 hours of operation



Scales and rust build up in the water jacket and radiator over time, reducing cooling efficiency. Remove them periodically. Verify that the cooling system is clean when using coolant containing anti-rust additive and antifreeze. During cleaning operation, heat the coolant to 80℃ or more; then run the engine.

If the coolant temperature is low, close thermostat to increase the temperature. Failure to comply may result in incomplete cleaning.

1. Open drain cock, radiator cap and drain plug on cylinder block to drain the coolant.

2. Tighten drain cock and plug. Fill with new coolant and heat the coolant to 80℃.

3. If a large amount of scales and rust build up, fill with cleaning fluids and heat the fluids to 80℃.

4. Run the engine at idle speed for approx. 30 minutes.

5. Shut down the engine and drain the coolant from radiator and engine.

6. To clean the cooling system, flush with clean water.

7. Fill the cooling system with coolant until the coolant overflows through overflow pipe. Be sure to use soft water as coolant.

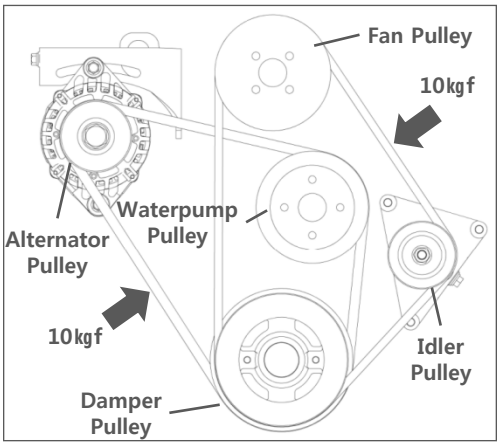
8. Run the engine for several minutes. Shut down the engine and check coolant level. Coolant level may drop as air trapped in coolant tank is bled out. Add as required.

CAUTION

1. *Use soft water as coolant. Spring water or river water may cause scales and rust build-up.*
2. *Use coolant containing anti-rust agents during the summer and coolant containing antifreeze during the winter season.*

Adjustment of V-belt Tension

If the V-belt is slack, adjust tension as follows:



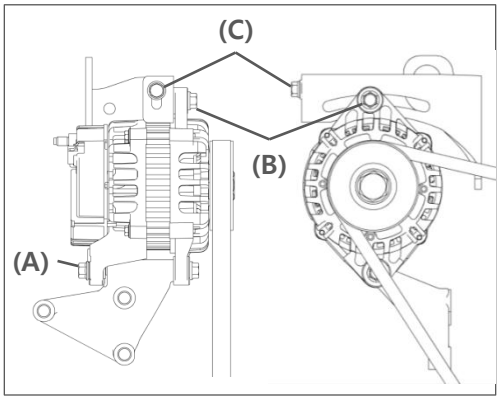
CAUTION

1. After adjustment, tighten bolts and nuts firmly. Do not over-tauten the V-belt. Failure to comply may result in damage to the belt and bearings.

2. Wipe any grease or oil from the V-belt.

Alternator Drive Belt

1. Loosen alternator tightening nut (A) and bolt (B).



2. Adjust bolt (C) until belt deflection is within standard value.

   Belt deflection standard value (at 10kgf force)

Classification	New (㎜)	Used (㎜)
Alternator Belt	8-10	10-12

3. If deflection is within standard value, tighten each bolt. If not, repeat steps above.

Fan Drive Belt

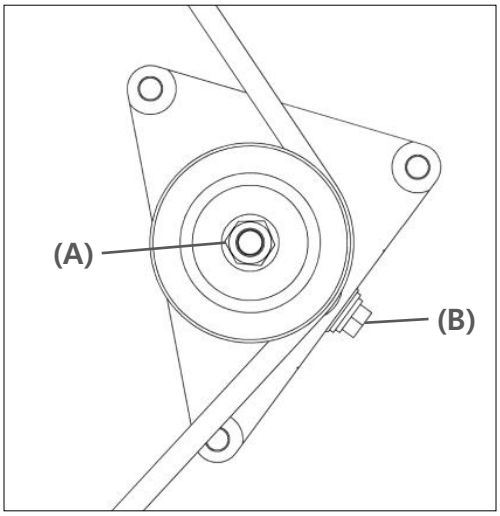
1. Loosen idler pulley mounting bolt (A).

2. Adjust bolt (C) until belt deflection is within standard value.

   Belt deflection standard value (at 10kgf force)

Classification	New (㎜)	Used (㎜)
Fan Pulley Belt	8-10	10-12

3. If deflection is within standard value, tighten each bolt. If not, repeat steps above.



5. Periodic Checks

Routine Checks

Consists of compulsory daily checks to be performed by an engine operator prior to operation. These are the most basic checks to ensure safe operation.

Check Items

Check that

1. Defective parts found in the previous operation are checked or repaired and functioning properly now.

2. The engine oil and coolant levels are normal.

3. There is any water or oil leakage.

4. The tension of drive belt is proper and the belt is damaged.

5. Exhaust gas is colorless and harmful gas is emitted

6. Oil level is normal and the engine starts properly.

Periodic Checks

Engine deterioration occurs in proportion to length of time the engine has been in service. To ensure prolonged service life and safe operation without any failures, perform maintenance in accordance with Periodic Checks and Maintenance Table specified in this manual.

Be sure to perform maintenance using genuine HYUNDAI parts at our local service center or authorized repair shop which has experience, expertise and proper equipments. Any claim resulted from non-genuine parts, or repair by non-designed maintenance or service center is not covered as the warranty repair. For further details, refer to a warranty.

CAUTIOIN

1. *Improper checks/maintenance may cause failures. Be careful that any claim resulted from improper checks/maintenance by the operator is not covered as the warranty repair. This manual contains procedures which allow the operator to perform maintenance without any trouble. If the operator fails to clearly understand contents of this manual, contact our local service center or authorized maintenance center.*
2. *Do not use water when cleaning the engine. Failure to comply may result in damage to electronic system, causing the vehicle to become inoperative.*

WARNING

During checks/maintenance, use extreme care to prevent accidents.

Checks/Maintenance Precautions

1. Perform on a level ground.

2. Key shall be held in LOCK or ACC position.

3. Ignition off the engine unless it is necessary.

4. Perform in a well ventilated area.

5. Prior to checks/maintenance, disconnect negative (-) terminal of battery.

CAUTION

Be careful that live voltage is present at battery and electrical wiring have live voltage. Do not allow fuse to blow.

WARNING

1. *Prior to checks, shut down the engine and allow to cool down. Failure to comply may result in burn injury.*
2. *Performing maintenance in enclosed areas with engine running may result in gas poisoning. Be sure to allow fresh air to circulate.*
3. *Prior to maintenance with engine running, remove rings, watches and jewelry and do not make contact with drive belt or tools.*
4. *Keep fuel system or battery away from open flame. Failure to comply may result in fire hazards.*
5. *Use care when connecting negative (-) terminal of battery. Do not connect (+) cable to negative (-) terminal or (-) cable to positive (+) terminal. This may result in fire hazards.*
6. *Prior to touching battery or electrical wiring, which have live voltage, disconnect negative (-) terminal of battery. Failure to comply may result in electrical shock.*

Periodic Checks

For a further description of periodic checks/maintenance, refer to page 40.

1. Periodic Checks and Maintenance Table on page 40 is available for periodically used engine.

2. The interval of maintenance and checks is determined by operating hours indicated by hour meter. In case of prolonged operation, maintenance and checks shall be performed more frequently than specified since standard maintenance and check interval is based on standard operating conditions.

3. The table does not contain any peripheral devices which are not part of the engine at the time of delivery.

Periodic Checks and Maintenance Table

○ Check ★ Adjust, repair or replace if necessary after checks ● Replace H Hours

Check Items			Every 10H before operation	Every 60H	Every 125H	Every 250H	Every 500H	Every 1000H	Remarks
Engine General	Engine running conditions and noise			○					
	Deceleration and acceleration conditions (rated)			○					
	Exhaust conditions								
	Compression pressure							○	
	Valve clearance			Once at first				★	
Lubrication conditions	Oil leaks			○					
	Damaged hoses							○	
	Engine oil pan	Oil cleanness and level	○						
		Oil change		Once at first		●			
	Oil filter	Replace		Once at first		●			
Fuel system	Oil leaks (signs of damaged/broken hoses)			○					
	Fuel filter	Replace					●		
	Compression pressure and fuel injection nozzle spraying condition						○		
	Injection timing							○	
	Clean and check fuel filter						○		
	Remove water from fuel tank						○		
Cooling system	Leaks (signs of damaged/broken hoses)		○						
	Replace coolant and clean cooling system						○		
	Signs of loose/damaged V-belt		○						
	Damage of cooling fan assembling status						○		
	Radiator	Coolant level	○						
		Functioning of cap					○		
		Clogged or damaged core					○		
Electrical devices	Battery	Electrolyte level			○				
		Electrolyte specific gravity				○			
		Connection of terminal				○			
	Signs of loose connection of electrical wiring/loose and damaged insulators				○				

Troubleshooting

Find and repair faults as early as possible before it becomes major problems. In case of any faults not listed in table below, or repeated after repair or beyond repair, contact our local service center or authorized maintenance center.

Symptom	Possible Cause	Corrective Action
1. Engine fails to start after moving ignition switch (starter fails to move or moves very slowly)	Battery switch held in OFF position	Move switch to ON position
	Blown, loose or corroded battery terminal	Replace terminal
	Lack of battery capacity or dead battery	Charge or replace
	Disconnected ground wire	Connect
	Improper engine oil viscosity	Change
2. Engine fails to start after moving ignition switch (Engine fails to start when starter is turned on successfully)	Lack of fuel	Add
	Clogged fuel filter	Replace
	Air in fuel system	Bleed
	Faulty glow system	Check and repair
	Clogged air cleaner	Replace or clean
3. Engine stops at low speed	Idling at too low speed	Adjust
	Improper valve clearance	Check and repair
	Clogged fuel filter	Replace
	Clogged air cleaner	Replace or clean
4. Lack of power	Clogged air cleaner or air leaks	Replace or repair
	Clogged fuel filter	Replace
	Improper valve clearance	Check and repair
5. Black or dark gray exhaust gas	Clogged air cleaner	Replace or clean
	Improper valve clearance	Check and repair
6. Excessive fuel consumption	Oil leaks	Check and repair
	Clogged air cleaner	Replace or clean
7. Excessive engine oil consumption	Improper oil	Replace
	Too high oil level	Drain
	Oil leaks	Check and repair
	Oil not changed for too long	Replace
	Insufficient warm up time	Warm up until coolant temperature reaches 60℃

Symptom	Possible Cause	Corrective Action
8. Oil pressure too low	Engine oil level too low	Add to FULL mark
	Improper engine oil viscosity	Change
	Broken pipe and leaks from connection	Check and repair
	Clogged oil filter	Replace
	Coolant level too low	Add
	Clogged radiator	Check and repair
9. Engine overheating	Loose or broken V-belt	Check or repair
	Rust or scale build up in coolant	Replace
	Faulty thermostat	Replace
	Blown, loose or corroded battery terminal	Replace terminal
10. Battery inoperative intermittently	Loose or broken V-belt	Check or repair
	Faulty battery	Replace

6. Specification and Maintenance Data

Item	WC30D
Type	4-Cycle Diesel Engine
Number of Cylinders and Arrangement	In-line 4-cylinder, Longitudial
Bore X Stroke	98 X 98 ㎜
Total Displacement	2,957 cc
Combustion Chamber Type	Swirl Chamber Type
Compression Ratio	21.5
Injection Order	1-3-4-2
Direction of Rotation	Counterclockwise (viewed from fly wheel)
Dimension	695 X 519 X 653 (L X W X H) ㎜
Weight (Dry)	235.3 kg (except for engine oil & coolant)
Fuel	Diesel (cetane number of 45 or more)
Fuel Injection Pump	Mechanical Distribution Type
Governor	All Speed
Injection Nozzle	Hole Type
Lubrication System	Force-fed by Gear Pump
Engine Oil	API Class: CF-4 or more or ACEA Class: B2 or B3 or more
Cooling System	Forced Circulation by Centrifugal Pump
Starting Motor	12V-2.2㎾
Alternator	13.5V-75A

CAUTION

Specification is subject to change without prior notice due to design change.

Maintenance Data

Check Items	Normal Value
Oil capacity - Oil pan - Oil filter	7.4 ℓ 5.4 ℓ 0.6 ℓ
Oil pressure - At rated speed - At idling speed	 3.6~4.4 kg/㎠ 0.8 kg/㎠ or more
Coolant capacity - Engine	 Approx. 4.5ℓ
Tension of V-belt - Check deflection by applying force of approx. 10kg (98N) to center of belt	 10~12 ㎜