YANMAR

OPERATION MANUAL

INDUSTRIAL ENGINES

4TNE92
4TNE94L
4TNE98

California
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.

California
Proposition 65 Warning

Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the state of California to cause cancer and reproductive harm.
Wash hands after handling.

Disclaimers:

All information, illustrations and specifications in this manual are based on the latest information available at the time of publishing. The illustrations used in this manual are intended as representative reference views only. Moreover, because of our continuous product improvement policy, we may modify information, illustrations and/or specifications to explain and/or exemplify a product, service or maintenance improvement. We reserve the right to make any change at any time without notice. YANMAR and **YANMAR** are registered trademarks of YANMAR CO., LTD. in Japan, the United States and/or other countries.

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OPERATION MANUAL	Model	4TNE92, 4TNE94L, 4TNE98
	Code No.	0ATNE-G00102

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INTRODUCTION

Welcome to the world of Yanmar Engines! Yanmar has been the leader in industrial diesel engines for over 90 years. We developed the world's first practical small-sized diesel engine in 1933. Our engineers are continuously developing new technology to keep Yanmar on the leading-edge of the industry. The TNE engine is only one example of the new technology we have developed. We are committed to maintaining our environment, and are proud of our history of innovation, quality and respect for operator safety.

To help you enjoy your Yanmar TNE 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 Yanmar industrial 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 Yanmar 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 Yanmar industrial engine dealer or distributor.
- The specifications and components (instrument panel, fuel tank, etc.) described in this manual may differ from ones installed on your machine. Please refer to the manual provided by the manufacturer of these components.

RECORD OF OWNERSHIP

Take a few moments to record the information you need when you contact Yanmar for service, parts or literature.

Engine Model: _____

Engine Serial No.: _____

Date Purchased: _____

Dealer: _____

Dealer Phone: _____

YANMAR WARRANTIES

YANMAR LIMITED WARRANTY

What is Covered by this Warranty?

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

How Long is the Warranty Period?

The Yanmar standard limited warranty period begins on the date of the delivery of the new Yanmar TNE Series Industrial Engine to the first retail purchaser and extends for a period of **twenty-four (24) months or two-thousand (2000) engine operation hours**, whichever occurs first.

What the Engine Owner Must Do:

If you believe your Yanmar engine has experienced a failure due to a defect in material and / or workmanship, you must contact an authorized Yanmar industrial 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 engine operation hours. You are responsible for the transportation of the engine to and from the repair location as designated by Yanmar.

Yanmar strongly recommends you register your engine as soon as possible after purchase in order to facilitate any future warranty matters.

Yanmar Limited Warranty - Continued

To Locate an Authorized Yanmar Industrial Engine Dealer or Distributor:

You can locate your nearest authorized Yanmar industrial engine dealer or distributor by visiting the Yanmar Corp., Ltd. web site at:

http://www.yanmar.co.jp

- The Japanese language page will be displayed. For English language “click” on “English Page.”
- “Click” on “Network” in the web site heading to view the “Yanmar Worldwide Network.”
- Choose and “Click” on the desired product group.
- “Click” on the Icon closest to your region.
- “Click” on the disired country or Associate company to locate your nearest authorized Yanmar industrial engine dealer or distributor.
- You may also contact Yanmar by clicking on “Inquiry” in the web site heading.

What Yanmar Will Do:

Yanmar warrants to the original retail purchaser of a new Yanmar engine that Yanmar will make such repairs and / or replacements necessary to correct any defects in materials and / or workmanship discovered during the warranty period. Such repairs and / or replacements will be made at a location designated by Yanmar.

What is Not Covered by this Warranty?

This Warranty does not cover parts affected by or damaged by, 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 Yanmar 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 Yanmar engine. This Warranty does not cover consumable parts such as, but not limited to filters, belts, hoses, fuel injector nozzles, lubricants and cleaning fluids.

Warranty Limitations:

The foregoing is Yanmar's only obligation to you and your exclusive remedy for breach of warranty. Failure to follow the requirements for submitting a claim under this Warranty may result in a waiver of all claims for damages and other relief. **In no event shall Yanmar or any authorized industrial engine dealer or distributor be liable for incidental, special or consequential damages.** Such consequential damages may include, but not be limited to, loss of revenue, loan payments, cost of rental of substitute equipment, insurance coverage, storage, lodging, transportation, fuel, mileage and telephone costs. The limitations in this Warranty apply regardless of whether your claims are based on breach of contract, tort (including negligence and strict liability) or any other theory. Any action arising hereunder must be brought within one (1) year after the cause of action accrues or it shall be barred. Some states and countries do not allow certain limitations on warranties or for breach of warranties. **This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state and country to country.** Limitations set forth in this paragraph shall not apply to the extent that they are prohibited by law.

Yanmar Limited Warranty - Continued

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 Yanmar, either orally or in writing.**

Questions:

If you have any questions or concerns regarding this Warranty, please call or write to the nearest authorized Yanmar industrial engine dealer or distributor or other authorized facility.

Customer Registration

Customer registration is very important for the original retail purchaser to enable Yanmar to provide the best support for your engine.

At the time of purchase, Yanmar highly recommends registering the customer's information through website http://www.yanmar.co.jp as soon as possible.

If it is not possible to access the website, please contact the nearest authorized Yanmar industrial engine dealer or distributor.

YANMAR CO., LTD. LIMITED EMISSION CONTROL SYSTEM WARRANTY - USA ONLY

Your Warranty Rights and Obligations:

California

The California Air Resources Board and Yanmar Co., Ltd. ("Yanmar") is pleased to explain the emission control system warranty on your off-road compression-ignition model year 2000 or later engine. In California, new heavy-duty off-road engines must be designed, built and equipped to meet the State's stringent anti-smog standards.

All States

Yanmar warrants that the engine is: (1) designed, built and equipped so as to conform with all applicable emissions regulations, including in California, all applicable regulations adopted by the Air Resources Board; and (2) free from defects in materials and workmanship which cause such engine to fail to conform with applicable emissions regulations for its warranty period.

Yanmar warrants the emission control system on your engine for the periods of time listed in the following table provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the fuel injection system and the air induction system. Also included may be hoses, belts, connectors and other emission-related assemblies.

Where a warrantable condition exists, Yanmar will repair your heavy-duty off-road engine at no charge to you for diagnosis, parts or labor. Warranty services or repairs will be provided at an authorized Yanmar industrial engine dealer or distributor.

Manufacturer's Warranty Period:

The emission related parts on your model year 2000 or later heavy-duty off-road engines are warranted for the periods listed below. If any emission-related part on your engine is found to be defective during the applicable warranty period, the part will be replaced by Yanmar.

If your engine is certified as	And its maximum power is	And its rated speed is	Then its warranty period is
Variable speed or constant speed	kW < 19	Any speed	1,500 hours or two (2) years whichever comes first. In the absence of a device to measure the hours of use, the engine has a warranty period of two (2) years.
Constant speed	19 ≤ kW < 37	3,000 rpm or higher	1,500 hours or two (2) years whichever comes first. In the absence of a device to measure the hours of use, the engine has a warranty period of two (2) years.
Constant speed	19 ≤ kW < 37	Less than 3,000 rpm	3,000 hours or five (5) years whichever comes first. In the absence of a device to measure the hours of use, the engine has a warranty period of five (5) years.
Variable speed	19 ≤ kW < 37	Any speed	3,000 hours or five (5) years whichever comes first. In the absence of a device to measure the hours of use, the engine has a warranty period of five (5) years.
Variable speed or constant speed	kW ≥ 37	Any speed	3,000 hours or five (5) years whichever comes first. In the absence of a device to measure the hours of use, the engine has a warranty period of five (5) years.

Limited Emission Control System Warranty - USA Only - Continued

Warranty Coverage:

This warranty is transferable to each subsequent purchaser for the duration of the warranty period. Repair or replacement of any warranted part will be performed at an authorized Yanmar industrial engine dealer or distributor.

Warranted parts not scheduled for replacement as required maintenance in the Operation Manual shall be warranted for the warranty period. Warranted parts scheduled for replacement as required maintenance in the Operation Manual are warranted for the period of time prior to the first scheduled replacement. Any part repaired or replaced under warranty shall be warranted for the remaining warranty period.

During the warranty period, Yanmar is liable for damages to other engine components caused by the failure of any warranted part during the warranty period.

Any replacement part which is functionally identical to the original equipment part in all respects may be used in the maintenance or repair of your engine, and shall not reduce Yanmar's warranty obligations. Add-on or modified parts that are not exempted may not be used. The use of any non-exempted add-on or modified parts shall be grounds for disallowing a warranty.

Warranted Systems / Parts Covered by this Warranty:

This warranty covers engine components that are a part of the emission control system of the engine as delivered by Yanmar to the original retail purchaser. Such components may include the following:

- Fuel Injection System
- Cold Start Enrichment System
- Intake Manifold
- Turbocharger Systems
- Exhaust Manifold
- Positive Crankshaft Ventilation (PCV) System
- PCV Valve
- Oil Filler Cap

Limited Emission Control System Warranty - USA Only - Continued

Exclusions:

Failures other than those arising from defects in material and / or workmanship are not covered by this warranty. The warranty does not extend to the following: malfunctions caused by abuse, misuse, improper adjustment, modification, alteration, tampering, disconnection, improper or inadequate maintenance, improper storage, or use of non-recommended fuels and lubricating oils; accident-caused damage, and replacement of expendable (and / or consumable) items made in connection with scheduled maintenance. Yanmar disclaims any responsibility for incidental or consequential damages such as loss of time, inconvenience, loss of use of equipment / engine or commercial loss.

Owner's Warranty Responsibilities:

As the heavy-duty off-road engine owner, you are responsible for the performance of the required maintenance listed in your Operation Manual. Yanmar recommends that you retain all documentation, including receipts, covering maintenance on your heavy-duty off-road engine, but Yanmar cannot deny warranty solely for the lack of receipts, or for your failure to ensure the performance of all scheduled maintenance.

Your engine is designed to operate on diesel fuel only. Use of any other fuel may result in your engine no longer operating in compliance with applicable emissions requirements.

You are responsible for initiating the warranty process. You must present your off-road engine to an authorized Yanmar industrial engine dealer or distributor as soon as a problem exists. The warranty repairs should be completed by the dealer or distributor as expeditiously as possible. If you have any questions regarding your warranty rights and responsibilities, or would like information on the nearest authorized Yanmar industrial engine dealer or distributor, you should contact Yanmar America Corp. at 1-800-872-2867.

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SAFETY

SAFETY STATEMENTS

Yanmar 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 Yanmar TNE 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

Indicates a hazardous situation which, if not avoided, *will* result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation which, if not avoided, *could* result in death or serious injury.

⚠ CAUTION

Indicates a hazardous situation which, if not avoided, *could* result in minor or moderate injury.

NOTICE

Indicates a situation which can cause damage to the machine, personal property and / or the environment or cause the equipment to operate improperly.

SAFETY PRECAUTIONS

Before You Operate

NOTICE

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 Yanmar industrial engine dealer or distributor for additional training.

During Operation and Maintenance

⚠ DANGER

SCALD HAZARD!

- **NEVER remove the radiator cap if the engine is hot. Steam and hot engine coolant will spurt out and seriously burn you. Allow the engine to cool down before you attempt to remove the radiator cap.**
- **Securely tighten the radiator cap after you check the radiator. Steam can spurt out during engine operation if the cap is loose.**
- **ALWAYS check the level of engine coolant by observing the reserve tank.**
- **Failure to comply will result in death or serious injury.**

⚠ DANGER (Continued)

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.**
- **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.**

⚠ 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.**
- **NEVER use diesel fuel as a cleaning agent.**
- **NEVER remove the fuel cap with engine running.**

⚠ DANGER (Continued)

- Place an approved container under the air bleed port when you prime the fuel system. Never use a shop rag to catch the fuel. Wipe up any spills immediately. ALWAYS close the air bleed port after you complete priming the system.
- Wear eye protection. The fuel system is under pressure and fuel could spray out when you open the air bleed port.
- If the unit has an electric fuel pump, turn the key switch to the ON position for 10 to 15 seconds, or until the fuel coming out of the air bleed port is free of bubbles, to allow the electric fuel pump to prime the system.
- If the unit has a mechanical fuel pump, operate the fuel priming pump several times until the fuel coming out of the air bleed port is free of bubbles.
- Only use the key switch 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.
- Only fill fuel tank with diesel fuel. Filling fuel tank with gasoline may result in a fire.
- NEVER refuel with engine running.
- 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 fuel tank and store fuel in a well-ventilated area only.
- 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.

⚠ DANGER

CRUSH HAZARD!

- When you need to transport an engine for repair have a helper assist you attach it to a hoist and load it on a truck.
- NEVER stand under 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.

⚠ WARNING

SEVER HAZARD!

- Keep hands and other body parts away from moving / rotating parts such as the cooling fan, flywheel or PTO shaft.
- 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.
- 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 back long hair, and keep your hands, other body parts and clothing away from moving / rotating parts.
- Failure to comply could result in death or serious injury.

⚠ 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.

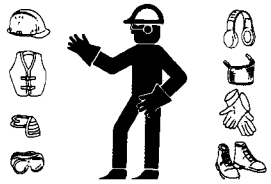
⚠ WARNING

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.

⚠ 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 warning signals.
- Failure to comply could result in death or serious injury.

⚠ 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.

⚠ WARNING

HIGH PRESSURE HAZARD!

- Avoid skin contact with 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 Yanmar industrial engine dealer or distributor repair the damage.
- Failure to comply could result in death or serious injury.

⚠ 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.

⚠ 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.**
- **Wait until the engine cools before you drain the engine coolant. Hot engine coolant may splash and burn you.**
- **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.**

⚠ CAUTION

COOLANT HAZARD!

- **Wear eye protection and rubber gloves when you handle Long Life or Extended Life engine coolant. If contact with the eyes or skin should occur, wash with clean water.**
- **Failure to comply may result in minor or moderate injury.**

⚠ CAUTION

FLYING OBJECT HAZARD!

- **ALWAYS wear eye protection when servicing 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.**

NOTICE

- Only use diesel fuels recommended by Yanmar for the best engine performance, to prevent engine damage and to comply with EPA / ARB warranty requirements.
- Only use clean diesel fuel.
- NEVER remove primary strainer from the fuel tank filler port (if equipped). If removed, dirt and debris could get into the fuel system causing it to clog.

NOTICE

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 Yanmar industrial engine dealer or distributor.

NOTICE

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

NOTICE

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

NOTICE

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.

NOTICE

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.

NOTICE

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.

NOTICE

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 +104°F (+40°C) or below +5°F (-15°C).
  - If the ambient temperature exceeds +104°F (+40°C) the engine may overheat and cause the engine oil to break down.
  - If the ambient temperature falls below +5°F (-15°C) rubber components such as gaskets and seals will harden causing premature engine wear and damage.
  - Contact your authorized Yanmar industrial engine dealer or distributor if the engine will be operated in either temperature extreme.
- Contact your authorized Yanmar industrial 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.

NOTICE

- 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 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.

NOTICE

- Only use the engine coolant specified. Other engine coolants may affect warranty coverage, cause an internal build up of rust and scale and / or shorten engine life.
- Prevent dirt and debris from contaminating engine coolant. Carefully clean the radiator cap and the surrounding area before you remove the cap.
- NEVER mix different types of engine coolants. This may adversely affect the properties of the engine coolant.

NOTICE

- NEVER overfill the engine with engine oil.
- ALWAYS keep the oil level between upper and lower lines on the dipstick.

NOTICE

For maximum engine life, Yanmar 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 the turbocharger (if equipped) and exhaust system, to cool slightly before the engine itself is shut down.

NOTICE

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

NOTICE

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. This may cause serious engine damage.

NOTICE

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, coolant leaks, and for proper operation of the indicators and / or gauges.
- During the first hour of operation, vary the engine speed and 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 4 to 5 hours.
- During the break-in period, carefully observe the engine oil pressure and engine temperature.
- During the break-in period, check the engine oil and coolant levels frequently.

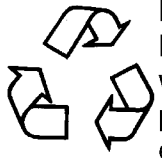
NOTICE

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

NOTICE

- 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 Yanmar Limited Warranty on page iii.*

NOTICE



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

- Follow the guidelines of the EPA or other 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.

NOTICE

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

NOTICE

NEVER use high pressure water or compressed air at greater than 28 psi or a wire brush to clean the radiator fins. Radiator fins damage easily.

NOTICE

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 the idle speed limit screws require adjustment, see your authorized Yanmar industrial engine dealer or distributor.

NOTICE

The tightening torque in the Standard Torque Chart *(page 43)* should be applied only to the bolts with a "7" head. (JIS strength classification: 7T)

- Apply 60% torque to bolts that are not listed.
- Apply 80% torque when tightened to aluminum alloy.

NOTICE

If any indicator fails to illuminate when the key switch is in the ON position, see your authorized Yanmar industrial engine dealer or distributor for service before operating the engine.

NOTICE

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 Yanmar Limited Warranty on page iii.*

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

NOTICE

It is important to perform daily checks *See Daily Checks on page 32.*

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

NOTICE

If no water drips when the fuel filter / water separator drain cock is opened, loosen the air vent screw on the top of the fuel filter / water separator by using a screwdriver to turn it counterclockwise 2-3 turns.

This may occur if the fuel filter / water separator is positioned higher than the fuel level in the fuel tank. After draining the fuel filter / water separator, be sure to tighten the air vent screw.

NOTICE

- 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.

NOTICE

The maximum air intake restriction shall be 0.90 psi (6.23 kPa; 635 mm Aq) or less. Clean or replace the air cleaner element if the air intake restriction exceeds the above mentioned value.

NOTICE

NEVER turn off the battery switch (if equipped) or short the battery cables during operation. Damage to the electric system will result.

PRODUCT OVERVIEW

YANMAR TNE SERIES ENGINE FEATURES AND APPLICATIONS

The TNE series diesel engines have been introduced to meet customer needs while satisfying the need to reduce air pollution.

The TNE series, reduced in size and weight, will surely satisfy every customer with their excellent fuel economy, high output and good startability as well as wide applicability to all kinds of load machines such as generators and pumps.

The low noise level and clean exhaust emissions of the TNE series answers the needs of the times.

Yanmar TNE engines are designed to supply power to a wide variety of driven machines including:

- Construction
- Agriculture
- Power Generation

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. If you have applications that require a belt drive and / or front power take-off (PTO), please contact your authorized Yanmar industrial engine dealer or distributor.

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 Yanmar industrial 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 shows where major engine components are located.

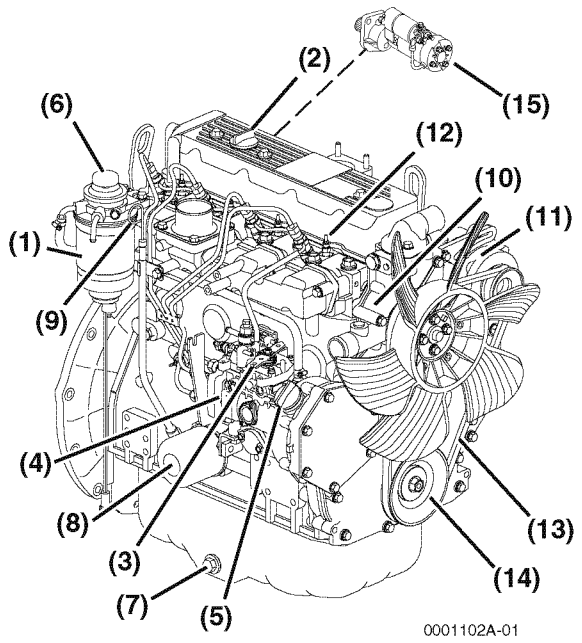


Figure 1

1. Fuel Filter / Water Separator
2. Top Filler Port (Engine Oil)
3. Governor Lever
4. Fuel Injection Pump
5. Side Filler Port (Engine Oil)
6. Fuel Priming Pump
7. Drain Plug (Engine Oil)
8. Engine Oil Filter
9. Dipstick (Engine Oil)
10. Engine Coolant Pump
11. Alternator
12. Glow Plug
13. V-Belt
14. Crankshaft V-Pulley
15. Starter Motor

LOCATION OF LABELS

Figure 2 shows the location of regulatory and safety labels on Yanmar TNE series engines.

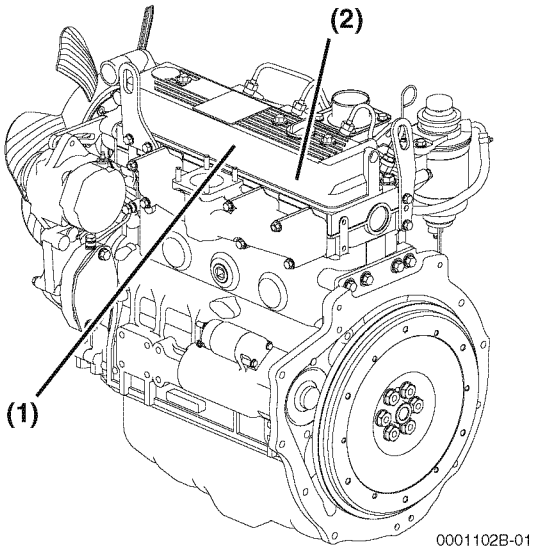
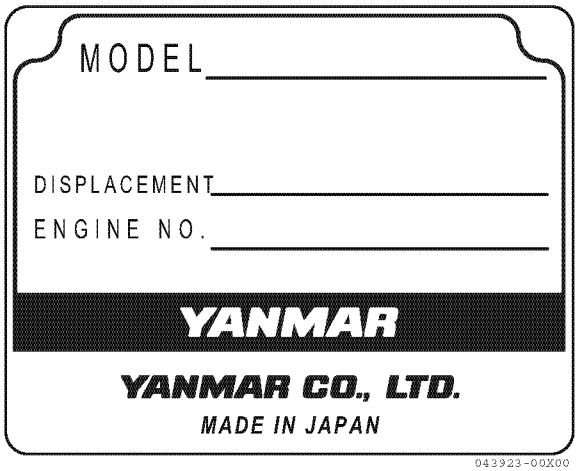


Figure 2

The emission control information label is typically affixed to the exhaust side of the rocker arm cover **(Figure 2, (1))**.

Typical location of the engine nameplate is shown. **(Figure 2, (2))**.

Engine Nameplate (Typical)



EPA / ARB EMISSION CONTROL REGULATIONS - USA ONLY

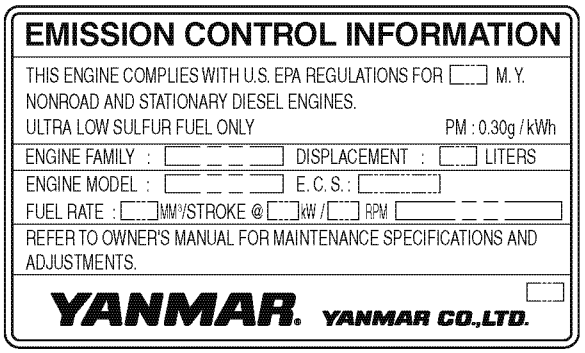
Yanmar TNE engines meet Environmental Protection Agency (EPA) (U. S. Federal) emission control standards as well as the California Air Resources Board (ARB, California) regulations. Only engines that conform to ARB regulations can be sold in the State of California.

Refer to the specific EPA / ARB installation *(page 42)* and maintenance *(page 43)* in the *Periodic Maintenance* section of this manual. Also refer to the *Yanmar Co., Ltd. Limited Emission Control System Warranty - USA Only on page vi.*

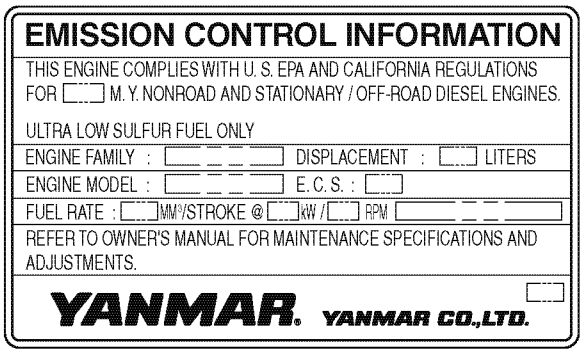
EMISSION CONTROL LABELS - USA ONLY

Since emission control regulations are being issued on a global basis, it is necessary to identify which regulations a particular engine complies with. We have listed several different types of labels you might find on your engine.

EPA / CARB Labels (Typical)


EMISSION CONTROL INFORMATION
THIS ENGINE COMPLIES WITH U.S. EPA REGULATIONS FOR ☐☐ M. Y. NONROAD AND STATIONARY DIESEL ENGINES.
ULTRA LOW SULFUR FUEL ONLY PM : 0.30g / kWh
ENGINE FAMILY : ☐☐☐☐☐☐☐☐ DISPLACEMENT : ☐☐.☐ LITERS
ENGINE MODEL : ☐☐☐☐☐☐☐☐ E. C. S. : ☐☐☐☐☐☐☐☐
FUEL RATE : ☐☐.☐ MM³/STROKE @ ☐☐☐ kW / ☐☐☐☐ RPM ☐☐☐☐☐☐☐☐
REFER TO OWNER'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.
☐☐☐
YANMAR YANMAR CO.,LTD.

(EPA)

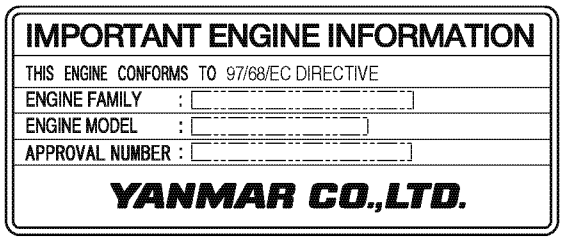

EMISSION CONTROL INFORMATION
THIS ENGINE COMPLIES WITH U. S. EPA AND CALIFORNIA REGULATIONS FOR ☐☐☐☐ M. Y. NONROAD AND STATIONARY / OFF-ROAD DIESEL ENGINES.
ULTRA LOW SULFUR FUEL ONLY
ENGINE FAMILY : ☐☐☐☐☐☐☐☐ DISPLACEMENT : ☐☐.☐ LITERS
ENGINE MODEL : ☐☐☐☐☐☐☐☐ E. C. S. : ☐☐☐☐
FUEL RATE : ☐☐.☐ MM³/STROKE @ ☐☐☐ kW / ☐☐☐☐ RPM ☐☐☐☐☐☐☐☐
REFER TO OWNER'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.
☐☐☐
YANMAR YANMAR CO.,LTD.

(EPA & CARB)

THE 97/68/EC DIRECTIVE CERTIFIED ENGINES

The engines described in this manual have been certified by the 97/68/EC Directive.

To identify the engines that meet this certification, the 97/68/EC emission control label is affixed on the engines.



(97/68/EC)

ENGINE FAMILY

The EPA / ARB labels and the 97/68/EC label all have an *Engine Family* field. The following is an explanation of the *Engine Family* designation:

A YDX L 3.32 M 4 N

- N: Method of air aspiration
- 4: Number of cylinders
- M: Engine speed specifications
- 3.32: Displacement (liter)
- L: Non-road / Off-road engine
- YDX: Yanmar Diesel
- A: *2010 Model Year

A*: 2010

B : 2011

C : 2012

D : 2013

FUNCTION OF MAJOR ENGINE COMPONENTS

Components	Functions
Air Cleaner	The air cleaner prevents airborne contaminants from entering the engine. Since the air cleaner is application specific, it must be carefully selected by an application engineer. It is not part of the basic engine package as shipped from the Yanmar factory. Periodic replacement of the air cleaner filter element is necessary. See the *Periodic Maintenance Schedule on page 43* for the replacement frequency.
Alternator	The alternator is driven by a V-belt which is powered by the crankshaft V-pulley. The alternator supplies electricity to the engine systems and charges the battery while the engine is running.
Dipstick (Engine Oil)	The engine oil dipstick is used to determine the amount of engine oil in the crankcase.
Engine Oil Filter	The engine oil filter removes contaminants and sediments from the engine oil. Periodic replacement of the engine oil filter is necessary. See the *Periodic Maintenance Schedule on page 43* for the replacement frequency.
Fuel Filter / Water Separator	The fuel filter / water separator removes contaminants, sediments and water from diesel fuel. This is a required component of the fuel system. Periodic replacement of the fuel filter is necessary. Periodically drain the water from the fuel filter / water separator using the drain cock at the bottom of the separator.
Fuel Tank	The fuel tank is a reservoir that holds diesel fuel. When fuel leaves the fuel tank it is pumped to the fuel filter / water separator by the fuel pump. Next the fuel goes to the fuel injection pump. Since fuel is used to keep the fuel injection pump cool and lubricated, more fuel than necessary enters the injection pump. When the injection pump pressure reaches a preset value, a relief valve allows excess fuel to be returned back to the fuel tank. The fuel tank is a required engine component.
Glow Plugs	The glow plugs assist engine starting in cold weather conditions. A glow plug is positioned in the pre-combustion (swirl) chamber in the engine cylinder head. There is one glow plug per cylinder. When activated during engine start, the glow plugs heat to approximately 1562°F (850°C) and heat the incoming air charge for faster starting.
Side and Top Filler Port (Engine Oil)	You can fill the crankcase with engine oil from ***either filler port*** depending upon which one is most convenient.
Starter Motor	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.

FUNCTION OF COOLING SYSTEM COMPONENTS

Components	Functions
Cooling System	The TNE engine is liquid-cooled by means of a cooling system. The cooling system consists of a radiator, radiator cap, engine cooling fan, engine coolant pump, thermostat, and reserve tank. ***Note that all cooling system components are required for proper engine operation. Since some of the components are application specific, they must be carefully selected by an application engineer. The application specific items are not part of the basic engine package as shipped from the Yanmar factory.***
• Engine Cooling Fan	The engine cooling fan is driven by a V-belt which is powered by the crankshaft V-pulley. The purpose of the engine cooling fan is to circulate air through the radiator.
• Engine Coolant Pump	The engine coolant pump circulates the engine coolant through the cylinder block and cylinder head and returns the engine coolant to the radiator.
• Radiator	The radiator acts as a heat exchanger. As the engine coolant circulates through the cylinder block it absorbs heat. The heat in the engine coolant is dissipated in the radiator. As the engine cooling fan circulates air through the radiator, the heat is transferred to the air.
• Radiator Cap	The radiator cap controls the cooling system pressure. The cooling system is pressurized to raise the boiling point of the engine coolant. As the engine coolant temperature rises, the system pressure and the coolant volume increases. When the pressure reaches a preset value, the release valve in the radiator cap opens and the excess engine coolant flows into the reserve tank. As the engine coolant temperature is reduced, the system pressure and volume is reduced and the vacuum valve in the radiator cap opens allowing engine coolant to flow from the reserve tank back into the radiator.
• Reserve Tank	The reserve tank contains the overflow of engine coolant from the radiator. If you need to add engine coolant to the system, add it to the reserve tank; not the radiator.
• Thermostat	A thermostat is placed in the cooling system to prevent engine coolant from circulating into the radiator until the engine coolant temperature reaches a preset temperature. When the engine is cold, no engine coolant flows through the radiator. Once the engine reaches its operating temperature the thermostat opens. By letting the engine warm up as quickly as possible, the thermostat reduces engine wear, deposits and emissions.

GAUGES AND INDICATORS

The operator's console provides you with the means to start and stop the unit and a series of gauges and indicators that inform you about the current status of the engine. This is a required engine component. Since the operator's console is application specific, it must be carefully selected by an application engineer. It is not part of the basic engine package as shipped from the Yanmar factory.

NOTICE

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.

Gauges

The following gauges are located on a typical operator's console. Some operator's consoles may not have the gauges described here or may have different gauges.

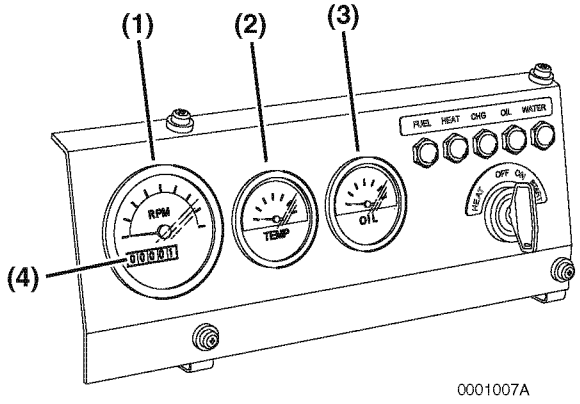


Figure 3

Tachometer - The tachometer display **(Figure 3, (1))** shows the engine speed in Revolutions Per Minute (rpm).

Engine Coolant Temperature - The engine coolant temperature display **(Figure 3, (2))** shows the temperature of the engine coolant.

Engine Oil Pressure - The display **(Figure 3, (3))** shows the pressure of the engine oil.

Hour Meter (Optional) - The hour meter display **(Figure 3, (4))** shows the total number of hours the engine has run. This is useful for planning the *Periodic Maintenance Schedule on page 43*.

Indicators

The following indicators are located on a typical operator's console.

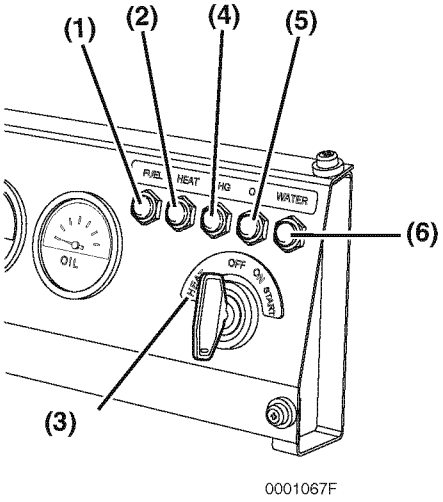


Figure 4

Fuel Filter - (Figure 4, (1)) - This indicator will come on if the fuel filter / water separator senses the presence of water. If the indicator comes on, *see Drain Fuel Filter / Water Separator on page 45*.

Heat - (Figure 4, (2)) - Note that you must turn the key to the HEAT position **(Figure 4, (3))** to activate the glow plugs. The indicator will flash for several seconds when you turn the key to HEAT and when it goes out, you can turn the key switch to START.

Battery - (Figure 4, (4)) - This indicator will come on if there is a problem in the charging system. This indicator does not indicate whether the battery is discharged. *See the Troubleshooting Chart on page 64*.

Engine Oil Pressure - (Figure 4, (5)) - This indicator will come on if the engine oil pressure is below or exceeds normal limits. *See the Troubleshooting Chart on page 64.*

Engine Coolant Temperature - (Figure 4, (6)) - This indicator will come on if the engine coolant temperature exceeds normal limits. *See the Troubleshooting Chart on page 64.*

CONTROLS

Key Switch

The key switch for the operator's console illustrated in **Figure 5** has four positions - OFF, ON, START, and HEAT.

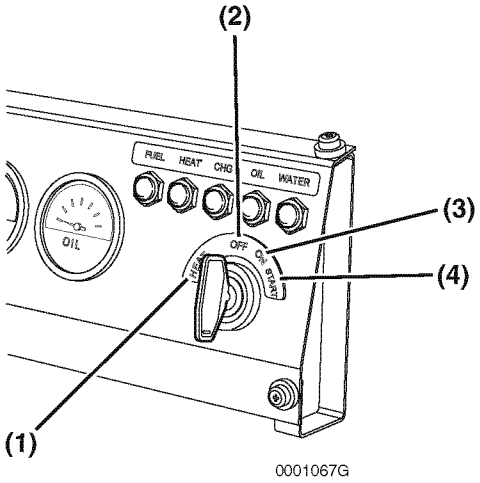


Figure 5

NOTICE

For maximum engine life, Yanmar 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 the turbocharger (if equipped) and exhaust system, to cool slightly before the engine itself is shut down.

HEAT **(Figure 5, (1))** - You must turn the key to the HEAT position to activate the glow plugs. The indicator will flash for several seconds when you turn the key to HEAT. You can turn the key to START when the indicator goes out.

OFF **(Figure 5, (2))** - When you turn the key to this position the engine shuts down. Electric current to the gauges and indicators is shut off. You can insert and remove the key in this position.

ON **(Figure 5, (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 gauges, indicators and auxiliary devices.

NOTICE

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

START **(Figure 5, (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.

Glow Plugs

The glow plugs are located in the cylinder head (swirl) chamber to assist in cold-weather starting. They heat the inside of the pre-combustion chamber. To activate, turn the key to the HEAT position and hold until the heat indicator goes out. Then start the engine.

Governor Lever

NOTICE

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 Yanmar industrial engine dealer or distributor.

The governor lever **(Figure 6, (1))** controls the engine speed. The lever is linked to the engine speed control device in the driven machine.

The low idle speed limit screw **(Figure 6, (2))** sets engine speed while it is idling.

The high idle speed limit screw **(Figure 6, (3))** restricts the maximum engine speed when the engine is operated without a load.

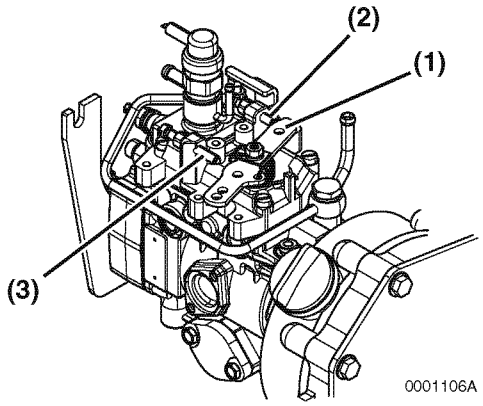


Figure 6

Engine Stop Solenoid (Magnetic Valve)

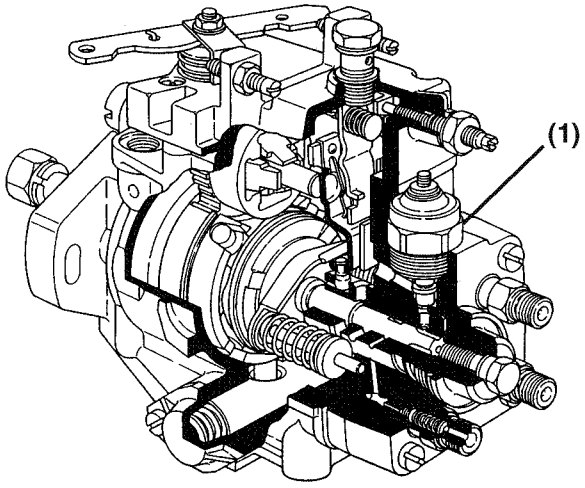


Figure 7

When the key is turned to the ON position, the engine stop solenoid (magnetic valve) **(Figure 7, (1))** is energized and allows the fuel injection pump to deliver fuel to the engine, allowing the engine to be started. When the key is turned to the OFF position, the engine stop solenoid (magnetic valve) is de-energized and shuts off the fuel supply from the fuel injection pump to the engine, causing the engine to stop.

Cold Start Device (CSD)

(Standard for Tertiary Corresponding Machines, Optional for Secondary Corresponding Machines)

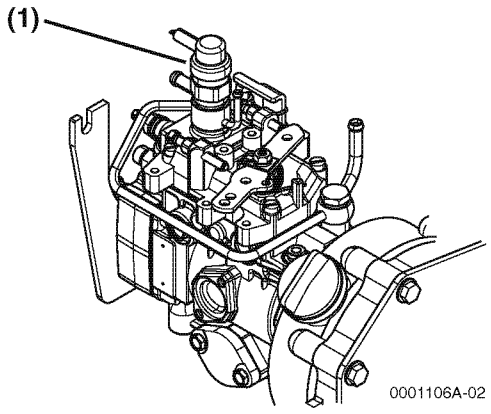


Figure 8

1. Cold Start Device

Necessity of CSD

In order to correspond with the incoming regulation, the fuel injection timing of 4TNE98 is delayed.

By delaying the fuel injection timing, starting at cold-start is deteriorated.

As its countermeasure, CSD is installed on the timing regulation corresponding engine to detect the engine coolant temperature to advance the injection timing when the coolant temperature is low, and return the injection timing to normal when the coolant temperature is over the threshold value.

- Summary

  CSD is an equipment which controls the injection timing of injection pump by turning ON and OFF the switch while the engine is running. CSD is comparable to actuator part, and the separate switch is installed on the engine side (coolant temperature sensor) for turning it ON and OFF.

- Structure

  As shown in **Figure 9**, CSD is structured by the magnet, spring, and piston. When the magnet is in the ON position, the piston is pulled to the counterclockwise direction by the magnet force. Also, the spring inside piston has a force to go to the clockwise direction to return the piston to its original position. There are 2 holes in the piston, and when the magnet is in the OFF position, these holes are matched with the holes in the housing, so that fuel oil inside the pump room can flee to the fuel inlet (the low-pressure side).

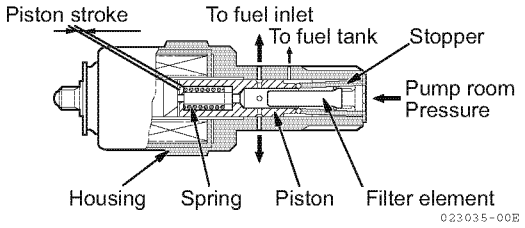


Figure 9

- Actuation

  As a switch to turn ON and OFF the CSD, the coolant temperature sensor is used. At start, when the coolant temperature is below the setting temperature, the thermo switch is turned ON to turn ON the CSD and move it to the advance direction of the injection timing by rapidly increasing the pump room pressure. On the other hand, when the coolant temperature is above the setting temperature, the thermo switch is turned OFF, and the CSD is not actuated and becomes the normal timer advance characteristics.

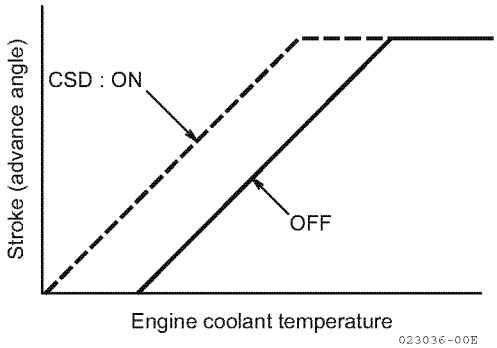


Figure 10

CSD Coupler Shape

As CSD coupler shape is 7319-3311-30 (Yazaki Parts No.), arrange 7318-3311-30 (Yazaki Parts No.) for the automobile body side harness coupler.

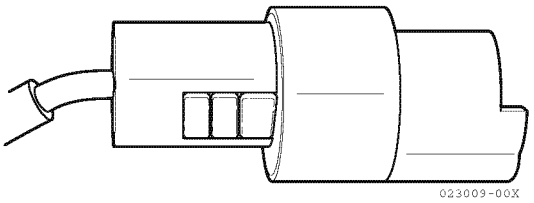


Figure 11

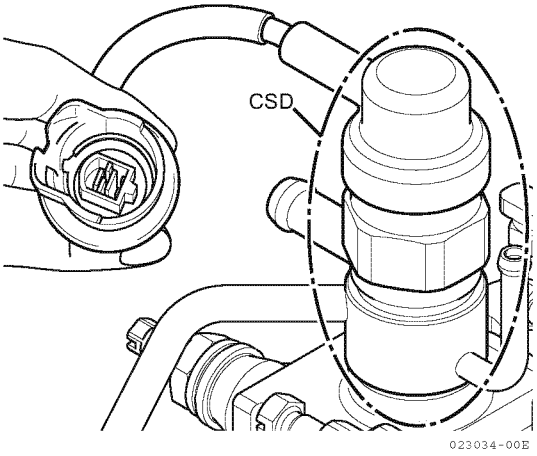


Figure 12

Coolant Temperature Sensor

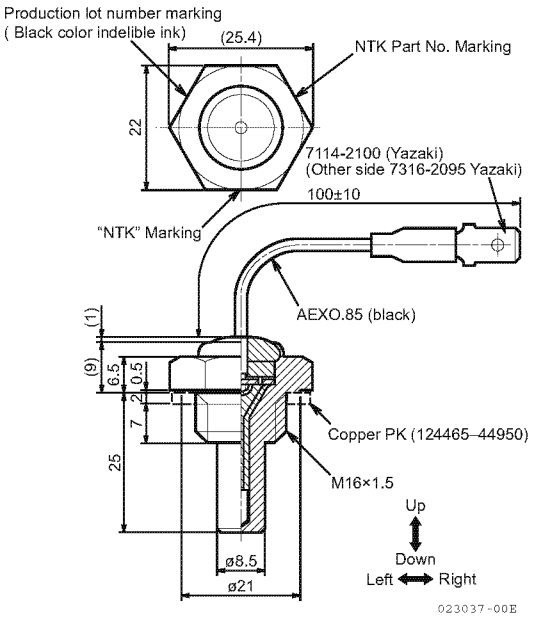


Figure 13

Controller External View (Optional)

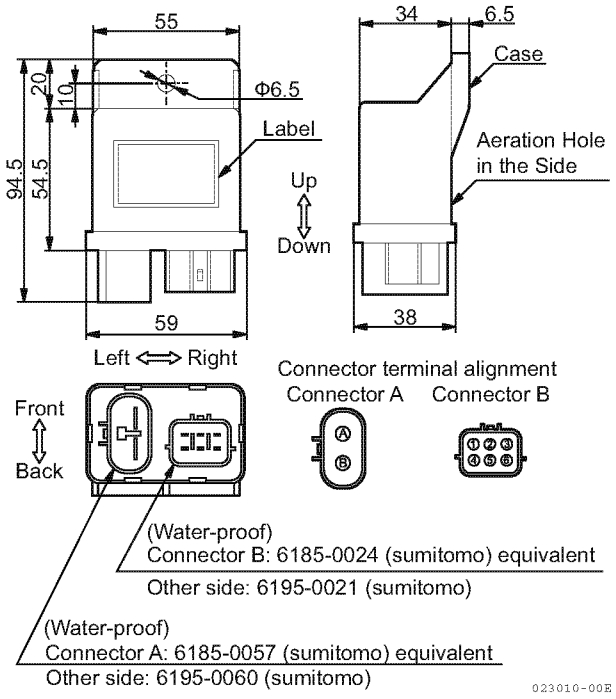


Figure 14

Connecting Diagram

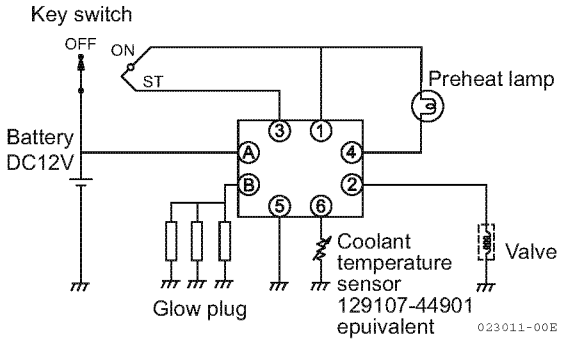


Figure 15

Actuation Chart

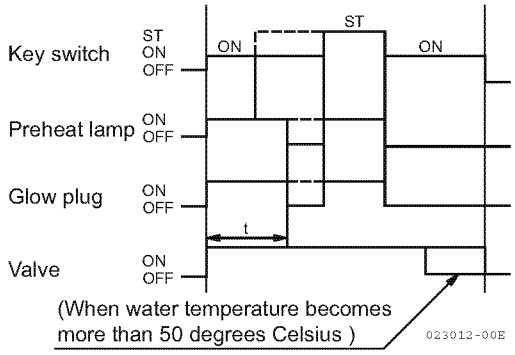


Figure 16

Function

1. Preheat Lamp
   - When turned to the key ON position from the key OFF position, the preheat lamp is lit for a given length of time
   - While in the key START position, the preheat lamp is lit
2. Glow Relay
   - When turned to the key ON position from the key OFF position, the glow relay is turned ON for a given length of time (glow power distribution)
   - While in the key START position, the glow relay is turned ON (glow power distribution)
3. CSD
   - When turned to the key ON position while the coolant temperature is below the setting temperature, the CSD is turned ON
   - However, when the coolant temperature becomes above the separate setting temperature, the CSD is turned OFF

Relay Characteristics

	Item	Standard	Remarks
Char.	Contact Voltage Descent	0.2V or Below	40A, 30 Seconds Later
	Insulation Resistance	Above 1M Ω	DC500V MG

BEFORE YOU OPERATE

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

DIESEL 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
ASTM D975 **No. 1D S15** **No. 2D S15**	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. Especially in U.S.A. and Canada, Ultra Low Sulfur fuel must be used.
- Bio-Diesel fuels. *See Bio-Diesel Fuels on page 24.*
- 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 Yanmar 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. 0.018 in (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.

Yanmar approves the use of bio-diesel fuels that do not exceed a blend of 7% (by volume) of FAME with 93% (by volume) of approved mineral oil derived diesel fuel. Such bio-diesel fuels are known in the marketplace as B7 diesel fuels.

These B7 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 bio-diesel fuels that have degraded as per the precautions and concerns above, may affect the warranty coverage of your engine. *See Yanmar Limited Warranty on page iii.*

Filling the Fuel Tank

⚠ DANGER

FIRE AND EXPLOSION HAZARD!

- **Diesel fuel is extremely flammable and explosive under certain conditions.**

- **Only fill fuel tank with diesel fuel. Filling fuel tank with gasoline may result in a fire.**
- **NEVER refuel with 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 fuel tank and store fuel in a well-ventilated area only.**

⚠ DANGER (Continued)

- **Be sure to place the diesel fuel container on the ground when transferring 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.**
- **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.**

NOTICE

- Only use diesel fuels recommended by Yanmar for the best engine performance, to prevent engine damage and to comply with EPA / ARB warranty requirements.
- Only use clean diesel fuel.
- NEVER remove primary strainer from the fuel tank filler port (if equipped). If removed, dirt and debris could get into the fuel system causing it to clog.

Note that a typical fuel tank is shown. The fuel tank on your equipment may be different.

1. Clean the area around the fuel cap **(Figure 1, (1))**.
2. Remove the fuel cap **(Figure 1, (1))** from the fuel tank **(Figure 1, (2))**.
3. Observe the fuel level sight gauge (optional) **(Figure 1, (3))** and stop fueling when gauge shows fuel tank is full. NEVER overfill the fuel tank.
4. Replace the fuel cap **(Figure 1, (1))** and hand tighten. Over-tightening the fuel cap will damage it.

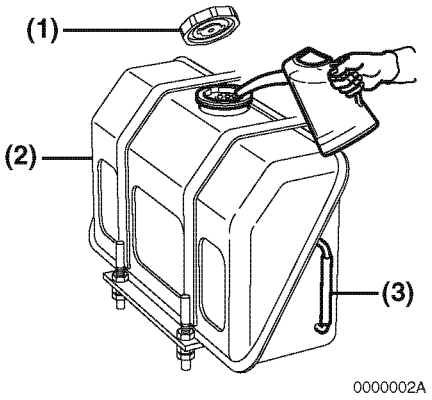


Figure 1

Priming the Fuel System

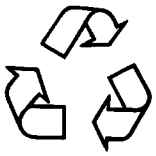
⚠ DANGER

FIRE AND EXPLOSION HAZARD!

- **Diesel fuel is extremely flammable and explosive under certain conditions.**

- **Place an approved container under the air bleed port when you prime the fuel system. Never use a shop rag to catch the fuel. Wipe up any spills immediately. ALWAYS close the air bleed port after you complete priming the system.**
- **Wear eye protection. The fuel system is under pressure and fuel could spray out when you open the air bleed port.**
- **If the unit has an electric fuel pump, turn the key switch to the ON position for 10 to 15 seconds, or until the fuel coming out of the air bleed port is free of bubbles, to allow the electric fuel pump to prime the system.**
- **If the unit has a mechanical fuel pump, operate the fuel priming pump several times until the fuel coming out of the air bleed port is free of bubbles.**
- **Failure to comply will result in death or serious injury.**

NOTICE



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

- Follow the guidelines of the EPA or other 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.

The fuel system needs to be primed under certain conditions.

- Before starting the engine for the first time.
- After running out of fuel and fuel has been added to the fuel tank.
- After fuel system maintenance such as changing the fuel filter and draining the fuel filter / water separator, or replacing a fuel system component.

To prime the fuel system on engines equipped with an electric fuel pump:

1. Place an approved container under the air bleed port.
2. Loosen the air bleed port 2 or 3 turns.
3. Turn the key to the ON position for 10 to 15 seconds or until the fuel coming out of the air bleed port is free of bubbles.
4. Tighten the air bleed port.
5. Wipe up any spills and properly dispose of fuel.
6. NEVER use the starter motor to crank the engine in order to prime the fuel system. This may cause the starter motor to overheat and damage the coils, pinion and / or ring gear.

To prime the fuel system on engines not equipped with an electric fuel system:

1. Place an approved container under the air bleed port.
2. Loosen the air bleed port **(Figure 2, (1))** 2 or 3 turns.
3. Operate the fuel priming pump **(Figure 2, (2))** until the fuel coming out of the air bleed port is free of bubbles.
4. Tighten the air bleed port.
5. Wipe up any spills and properly dispose of fuel.
6. NEVER use the starter motor to crank the engine in order to prime the fuel system. This may cause the starter motor to overheat and damage the coils, pinion and / or ring gear.

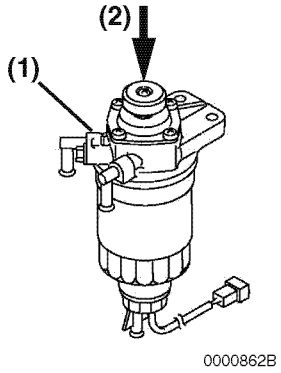


Figure 2

ENGINE OIL

NOTICE

- 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 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.

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'Automobilies)
- 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 250 hours thereafter.
3. Select the oil viscosity based on the ambient temperature where the engine is being operated. See SAE Service Grade Viscosity Chart **(Figure 3)**.
4. Yanmar 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 (HCl), ASTM D4739 (HCl)

Engine Oil Viscosity

Select the appropriate engine oil viscosity based on the ambient temperature and use the SAE Service Grade Viscosity Chart in **Figure 3**.

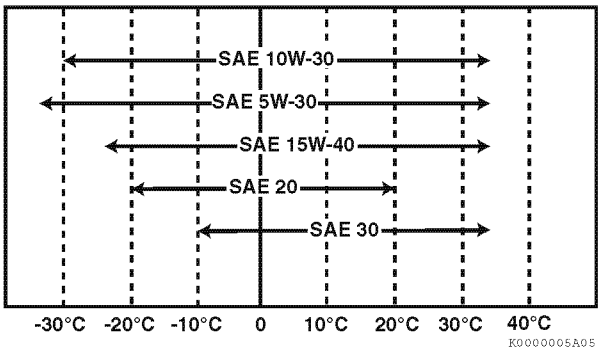


Figure 3

Checking Engine Oil

1. Make sure engine is level.
2. Remove dipstick **(Figure 4, (1))** and wipe with clean cloth.
3. Fully reinsert dipstick.
4. Remove dipstick. The oil level should be between upper **(Figure 4, (2))** and lower **(Figure 4, (3))** lines on the dipstick.
5. Fully reinsert dipstick.

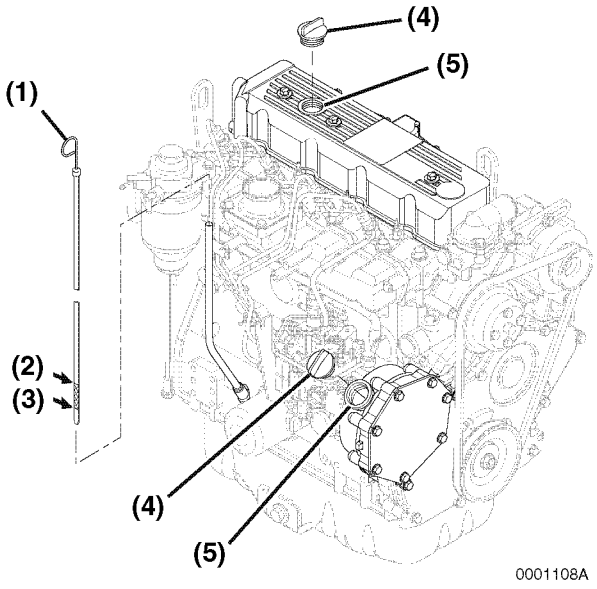


Figure 4

Adding Engine Oil

1. Make sure engine is level.
2. Remove oil cap **(Figure 4, (4))**.
3. Add indicated amount of engine oil at the top or side engine oil filler port **(Figure 4, (5))**.
4. Wait three minutes and check oil level.
5. Add more oil if necessary.
6. Replace oil cap **(Figure 4, (4))** and hand tighten. Over-tightening may damage the cap.

Engine Oil Capacity (Typical)

The following are typical engine oil capacities for 4TNE92, 4TNE94L, and 4TNE98 engines.

Engine Model	Dipstick Upper Limit / Lower Limit
4TNE92 4TNE94L 4TNE98	9.7 / 7.6 qt (9.2 / 7.2 L)

Note: These are the engine oil capacities associated with a "Deep Standard" oil pan. Oil capacity will vary dependant 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.

ENGINE COOLANT

⚠ DANGER

SCALD HAZARD!

- **NEVER remove the radiator cap if the engine is hot. Steam and hot engine coolant will spurt out and seriously burn you. Allow the engine to cool down before you attempt to remove the radiator cap.**
- **Securely tighten the radiator cap after you check the radiator. Steam can spurt out during engine operation if the cap is loose.**
- **ALWAYS check the level of engine coolant by observing the reserve tank.**
- **Failure to comply will result in death or serious injury.**

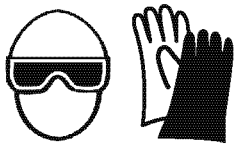
⚠ WARNING

BURN HAZARD!

- **Wait until the engine cools before you drain the engine coolant. Hot engine coolant may splash and burn you.**
- **Failure to comply could result in death or serious injury.**

⚠ CAUTION

COOLANT HAZARD!



- **Wear eye protection and rubber gloves when you handle Long Life or Extended Life engine coolant. If contact with the eyes or skin should occur, wash with clean water.**
- **Failure to comply may result in minor or moderate injury.**

NOTICE

- Only use the engine coolant specified. Other engine coolants may affect warranty coverage, cause an internal build up of rust and scale and / or shorten engine life.
- Prevent dirt and debris from contaminating engine coolant. Carefully clean the radiator cap and the surrounding area before you remove the cap.
- NEVER mix different types of engine coolants. This may adversely affect the properties of the engine coolant.

ENGINE COOLANT SPECIFICATIONS

Use a Long Life Coolant (LLC) or an Extended Life Coolant (ELC) that meets or exceeds the following guidelines and specifications.

Alternative Engine Coolant

If an Extended or Long Life Coolant is not available, alternatively, you may use an ethylene glycol or propylene glycol based conventional coolant (green).

Notes:

1. ALWAYS use a mix of coolant and water. NEVER use water only.
2. Mix coolant and water per the mixing instructions on the coolant container.
3. Water quality is important to coolant performance. Yanmar recommends that soft, distilled, or demineralized water be used to mix with coolants.
4. NEVER mix extended or long life coolants and conventional (green) coolants.
5. NEVER mix different types and / or colors of extended life coolants.
6. Replace the coolant every 1000 engine hours or once a year.

Additional Technical Coolant Specifications:

- ASTM D6210, D4985 (US)
- JIS K-2234 (Japan)
- SAE J814C, J1941, J1034 or J2036 (International)

Filling Radiator With Engine Coolant

Fill the radiator and reserve tank as follows. This procedure is for filling the radiator for the first time or refilling it after it is flushed. Note that a typical radiator is illustrated.

1. Check to be sure the radiator drain plug is installed and tightened or the drain cock **(Figure 5, (1))** is closed. Also make sure the cylinder block drain plug **(Figure 6, (1))** is installed and tightened.

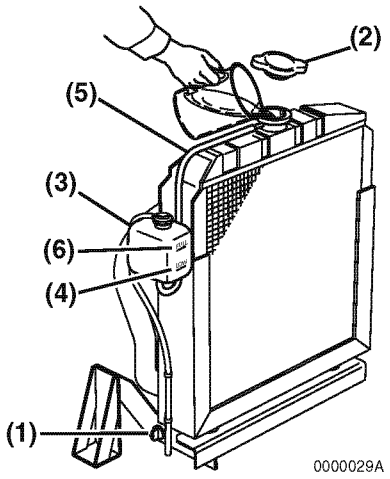


Figure 5

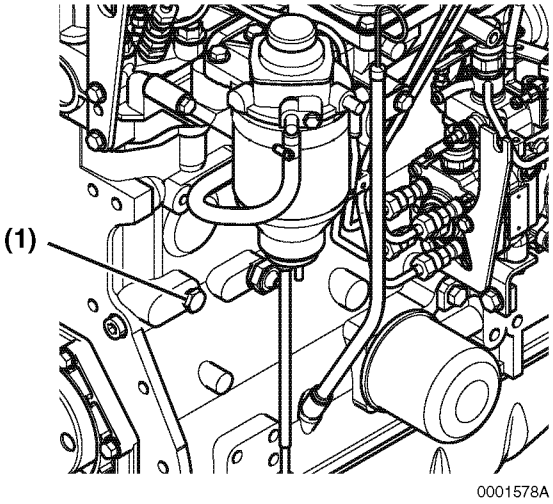


Figure 6

2. Remove the radiator cap **(Figure 5, (2))** by turning it counter-clockwise about 1/3 of a turn.
3. Pour the engine coolant *slowly* into the radiator until it is even with the lip of the engine coolant filler port. Make sure that air bubbles do not develop as you fill the radiator.
4. Reinstall the radiator cap **(Figure 5, (2))**. Align the tabs on the back side of the radiator cap with the notches on the engine coolant filler port. Press down and turn the cap clockwise about 1/3 of a turn.
5. Remove the cap of the reserve tank **(Figure 5, (3))**, and fill it to the LOW (COLD) mark **(Figure 5, (4))** with engine coolant. Reinstall the cap.
6. Check the hose **(Figure 5, (5))** that connects the reserve tank **(Figure 5, (3))** to the radiator. Be sure it is securely connected and there are no cracks or damage. If the hose is damaged, engine coolant will leak out instead of going into the reserve tank.
7. Run the engine until it is at operating temperature. Check the level of engine coolant in the reserve tank. When the engine is running and the engine coolant is at normal temperature, the coolant level in the tank should be at the FULL (HOT) mark **(Figure 5, (6))**. If the engine coolant is not at the FULL (HOT) mark **(Figure 5, (6))**, add additional engine coolant to the reserve tank to bring the level to the FULL (HOT) mark.

Daily Check of the Cooling System

1. Check the level of engine coolant in the reserve tank. When the engine is cold, the level in the tank should be at or slightly above the LOW (COLD) mark **(Figure 5, (4))**.
2. Add additional engine coolant to the reserve tank if necessary.
3. Check the radiator hoses for cracks, abrasions, cuts or other damage. Replace as necessary.

Engine Coolant Capacity (Typical)

The following are typical engine coolant capacities for 4TNE92, 4TNE94L, and 4TNE98 engines.

Engine Model	Engine Coolant Capacity
4TNE92 4TNE94L 4TNE98	1.11 gal. (4.2 L)

Note: Capacities listed are for the engine only without a radiator. Refer to the operation manual provided by the driven machine manufacturer for the total cooling system capacity of your specific machine.

DAILY CHECKS

Before you begin any job, make sure the Yanmar TNE 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 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 Yanmar industrial engine dealer or distributor repair the damage.**
- **Failure to comply could result in death or serious injury.**

Visual Checks

1. Check for engine oil leaks.
2. Check for fuel leaks.
3. Check for engine coolant leaks.
4. Check for damaged or missing parts.
5. Check for loose, missing, or damaged fasteners.
6. Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors.
7. Check hoses for cracks, abrasions, and damaged, loose or corroded clamps.
8. Check and clean radiator fins as necessary. *See Check and Clean Radiator Fins on page 47.*

9. Check the fuel filter / water separator for presence of water and contaminants. If you find any water or contaminants, drain the fuel filter / water separator. *See Drain Fuel Filter / Water Separator on page 45*. If you have to drain the fuel filter / water separator frequently, drain the fuel tank. *See your authorized Yanmar Industrial Engine Dealer or Distributor.*

NOTICE

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

Check Diesel Fuel, Engine Oil, and Engine Coolant Levels

Follow the procedures in *Diesel Fuel on page 23*, *Engine Oil on page 27* and *Engine Coolant on page 29* to check these levels.

Check Engine Speed Control

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

Check Operator's Console

Before you operate the engine you should make sure that all of the indicators are functioning properly.

Check Indicators

Note that Yanmar TNE engines are available with various operator's consoles. A typical operator's console is illustrated here.

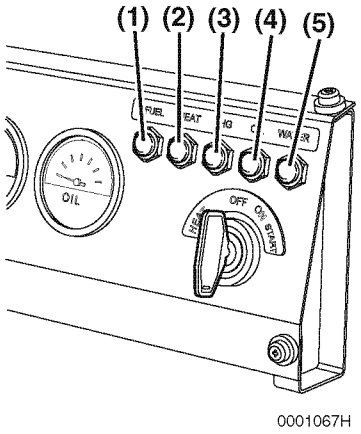


Figure 7

Fuel Filter - (Figure 7, (1)) - Stays On momentarily. Comes back on if water has contaminated the fuel.

Heat - (Figure 7, (2)) - Note that you must turn the key to the HEAT position to activate the glow plugs. The indicator will flash for several seconds when you turn the key to HEAT. You can turn the key to START when the indicator goes out.

Battery - (Figure 7, (3)) - Stays On until the engine is running and the alternator is supplying charging current. This indicator does not indicate whether the battery is discharged.

Engine Oil Pressure - (Figure 7, (4)) - Stays On until the engine is running and the oil pressure is within normal limits.

Engine Coolant Temperature - (Figure 7, (5)) - Stays On momentarily. Comes back On if engine overheats.

The following table 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).

Indicator	OFF to HEAT	OFF to ON	START to ON
Fuel Filter	NA	ON	OFF (Stays On momentarily. Comes back On if there is water in the fuel system.)
Heat	Lights for several seconds then goes out. Only for certain operator's consoles. **(Figure 7)**	NA	OFF
Battery	NA	ON	OFF (Stays On until alternator is supplying charging current. Remains On if there is a problem in the charging system. This indicator does not indicate whether the battery is discharged.)
Engine Oil Pressure	NA	ON	OFF (Stays On until oil pressure reaches normal operating pressure. Remains On, or comes back On, if there is a problem in the lubrication system.)
Engine Coolant Temperature	NA	ON	OFF (Stays On momentarily. Comes back On if there is a problem in the cooling system.)

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.

STARTING ENGINE

Use the following procedure to start the engine. Note that a typical operator's console is shown for illustrative purposes only.

1. Make sure you follow the procedures stated in *Daily Checks on page 32*.
2. Make sure all fuel cocks are in the ON position.
3. Set the transmission (if equipped) in the NEUTRAL position.
4. Disengage the PTO (if equipped).
5. Set the engine speed control to the mid-position.

⚠ DANGER

FIRE AND EXPLOSION HAZARD!

- **Only use the key switch 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.**

6. Insert the key **(Figure 1, (1))** into the key switch.
7. Turn the key to the HEAT position **(Figure 1, (2))**. The Heat indicator **(Figure 1, (3))** flashes for several seconds and then goes out. After the Heat indicator goes out you can start the engine.

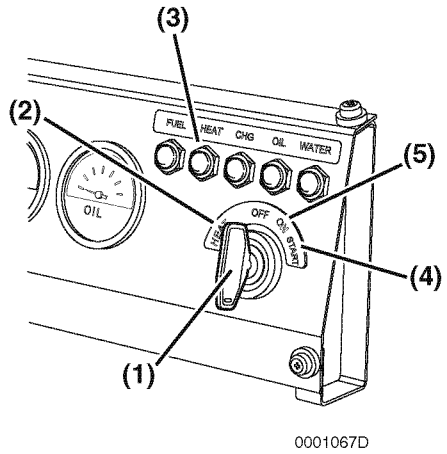


Figure 1

NOTICE

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

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8. Turn the key clockwise to the START position **(Figure 1, (4))**. Release the key as soon as the engine starts. It will return to the ON position **(Figure 1, (5))**.
9. 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 motor while the engine is still rotating will result in damage to the starter 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 and prevent damage to the starter motor due to low battery voltage.

CHECKING THE ENGINE DURING OPERATION

⚠ DANGER

FIRE AND EXPLOSION HAZARD!

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

⚠ 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.**

NOTICE

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. This may cause serious engine damage.

NOTICE

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, coolant leaks, and for proper operation of the indicators and / or gauges.
- During the first hour of operation, vary the engine speed and 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 4 to 5 hours.
- During the break-in period, carefully observe the engine oil pressure and engine temperature.
- During the break-in period, check the engine oil and coolant levels frequently.

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

---

1. While the engine is running, check the gauges for normal indications. The gauges shown in **Figure 2** are provided for illustrative purposes only.

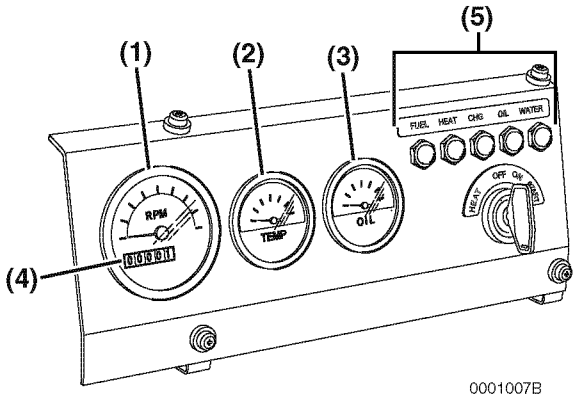

Figure 2

   - **Tachometer** - **(Figure 2, (1))** Make sure the engine speed is within normal limits. *See Engine Speed Specifications on page 69.*
   - **Engine Oil Pressure** - **(Figure 2, (3))** Make sure the engine oil pressure is within normal limits. *See the Principal Engine Specifications starting on page 71.*
   - **Engine Coolant Temperature** - **(Figure 2, (2))** Make sure the engine coolant temperature is within normal limits.
   - **Hour Meter** - **(Figure 2, (4))** The hour meter display shows the total number of hours the engine has run. This is useful for planning periodic maintenance operations. *See Periodic Maintenance Schedule on page 43.*
   - If any of the gauges show an out of normal limits condition, shut down the engine and have the necessary repairs performed.
2. After the engine has reached operating temperature, all of the indicators **(Figure 2, (5))** 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 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 Yanmar industrial engine dealer or distributor repair the damage.**
- **Failure to comply could result in death or serious injury.**

3. Check for any fuel, engine coolant or engine oil leaks. If any leaks are found shut down the engine and have the necessary repairs performed.
4. 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.
5. Check for white or black smoke from the exhaust system. A small amount of white smoke is normal on start-up of a cold engine. Black exhaust smoke may be an indication that the engine is overloaded or is being over-fueled. If either condition persists, contact your authorized Yanmar industrial engine dealer or distributor.
6. Check the fuel level during operation. If the fuel level runs low, stop the engine and refuel.

BATTERY SWITCH

NOTICE

NEVER turn off the battery switch (if equipped) or short the battery cables during operation. Damage to the electric system will result.

If you need to turn the battery switch to the OFF position **(Figure 3, (1))**, stop the engine first to avoid electrical system damage.

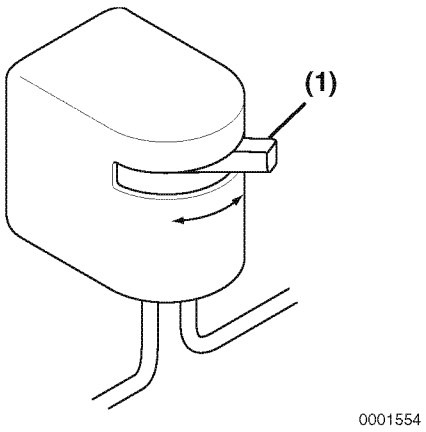

Figure 3

ADJUST ENGINE SPEED

NOTICE

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, coolant leaks, and for proper operation of the indicators and / or gauges.
- During the first hour of operation, vary the engine speed and 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 4 to 5 hours.
- During the break-in period, carefully observe the engine oil pressure and engine temperature.
- During the break-in period, check the engine oil and coolant levels frequently.

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

SHUTTING DOWN THE ENGINE

NOTICE

For maximum engine life, Yanmar 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 the turbocharger (if equipped) and exhaust system, to cool slightly before the engine itself is shut down.

Follow these steps to shut down the engine:

1. Disengage the PTO and / or set the transmission to NEUTRAL.
2. Set the engine speed control to its lowest setting.
3. Run the engine at low idle speed for at least five minutes before you shut it down.
4. Turn the key to the OFF position **(Figure 3, (1))** and remove it from the key switch.
5. If the engine will not be used for six months or longer, follow the additional instructions in *Long Term Storage on page 67*.

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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.**

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 32.*

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, 250, 500, 1000, 1500 and 2000 engine hours. Failure to perform periodic maintenance will shorten the life of the engine.

Yanmar Replacement Parts

Yanmar recommends that you use genuine Yanmar 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 Yanmar 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.

Required EPA / ARB Maintenance - USA Only

To maintain optimum engine performance and compliance with the Environmental Protection Agency (EPA) Regulations Non-road Engines and the California Air Resources Board (ARB, California), it is essential that you follow the *Periodic Maintenance Schedule on page 43* and *Periodic Maintenance Procedures which start on page 45*.

EPA / ARB Installation Requirements - USA Only

The following are the installation requirements for the EPA / ARB. Unless these requirements are met, the exhaust gas emissions will not be within the limits specified by the EPA and ARB.

Maximum Exhaust Gas Restriction -

EPA Tier2 certified
4TNE92: 1.85 psi (12.7 kPa; 1300 mmAq)
4TNE94L: 3.84 psi (26.5 kPa; 2700 mmAq)

EPA Tier3 certified
4TNE92, 4TNE98: 8.53 psi (58.8 kPa; 6000 mmAq)

Maximum Air Intake Restriction - 0.90 psi (6.23kPa; 635mm Aq) or less. Clean or replace the air cleaner element if the air intake restriction exceeds the above mentioned value.

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.

NOTICE

The tightening torque in the Standard Torque Chart *(page 43)* should be applied only to the bolts with a "7" head. (JIS strength classification: 7T)

- Apply 60% torque to bolts that are not listed.
- Apply 80% torque when tightened to aluminum alloy.

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	in lbs	96.0 ± 9.0	-	-	-	-	-
	ft lbs	-	19.0 ± 2.0	36.0 ± 4.0	65.0 ± 7.0	101.0 ± 7.0	167.0 ± 7.0
	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.

NOTICE

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 Yanmar Limited Warranty on page iii.*

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

PERIODIC MAINTENANCE

○: Check ◇: Replace ●: Contact your authorized Yanmar industrial engine dealer or distributor

System	Check Item	Check During Operation	Daily	Periodic Maintenance Interval				
				Every 250 hours	Every 500 hours	Every 1000 hours	Every 2000 hours	Every 4000 hours
Cooling System	Check & Re-fill Engine Coolant		○					
	Check Engine Coolant Temperature Indicator	○						
	Check & Clean Radiator Fins [1]			○ or every 6 weeks				
	Check & Adjust Cooling Fan V-belt	First Check after 50 hours		○ or every 6 weeks				
	Drain, Flush, and Re-fill Cooling System with New Coolant							◇ or every 2 yr. whichever comes first
Cylinder Head	Adjust Intake / Exhaust Valve Clearance					● or every 6 months		
Electrical Equipment	Check Battery			○ or every 6 weeks				
	Check Battery Indicator	○						
Emission Control Warranty	Inspect, Clean & Test Fuel Injectors, if necessary						● or every 1 year	
Engine Oil	Check Engine Oil Level		○					
	Check Engine Oil Pressure Indicator	○						
	Drain & Fill Engine Oil				● or every 3 months			
	Replace Engine Oil Filter				● or every 3 months			
Engine Speed Control	Check & Adjust Governor Lever & Engine Speed Control				○ or every 3 months			
Fuel	Check & Re-fill Fuel Tank Level		○					
	Check Fuel Filter Indicator	○						
	Drain Fuel Filter / Water Separator		○					
	Check Fuel Filter / Water Separator		○					
	Clean Fuel Filter / Water Separator[1]					○ or every 6 months		
	Replace Fuel Filter[1]					◇ or every 6 months		
Hoses	Inspect or Replace Fuel System & Cooling System Hoses		○					○ or every 2 years
Intake & Exhaust	Clean or Replace Air Cleaner Element[1 2]			○ or every 6 weeks			◇ or every 1 year	

1 Very dirty conditions will require daily check and cleaning.
2 In dirty or dusty environments, replace at 1000 hours or as needed.

Note: These procedures are considered normal maintenance and are performed at the owner's expense.

PERIODIC MAINTENANCE PROCEDURES

Daily

Perform the following procedures daily.

- Drain Fuel Filter / Water Separator
- Check Fuel Hoses and Engine Coolant Hoses

Drain Fuel Filter / Water Separator

⚠ 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.**

⚠ WARNING

HIGH PRESSURE HAZARD!

- **Avoid skin contact with 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 Yanmar industrial engine dealer or distributor repair the damage.**
- **Failure to comply could result in death or serious injury.**

NOTICE

If no water drips when the fuel filter / water separator drain cock is opened, loosen the air vent screw on the top of the fuel filter / water separator by using a screwdriver to turn it counterclockwise 2-3 turns.

This may occur if the fuel filter / water separator is positioned higher than the fuel level in the fuel tank. After draining the fuel filter / water separator, be sure to tighten the air vent screw

NOTICE

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

- Follow the guidelines of the EPA or other 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.

NEVER wait until the scheduled periodic maintenance if the fuel filter indicator comes on.

The fuel filter / water separator contains a sensor to detect the amount of water and contaminants. This sensor sends a signal to an indicator to alert the operator.

Drain the fuel filter / water separator as follows:

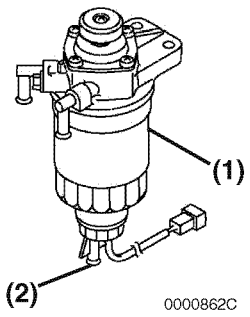


Figure 5-1

1. Position an approved container under the fuel filter / water separator **(Figure 5-1, (1))** to collect the contaminants.
2. Loosen the drain cock **(Figure 5-1, (2))** at the bottom of the fuel filter / water separator. Drain any water collected inside.
3. Hand tighten the drain cock.
4. Be sure to prime the diesel fuel system when you are done. *See Priming the Fuel System on page 26.*

Check Fuel Hoses and Engine Coolant Hoses

Daily check the fuel system and engine coolant system hoses. If they are cracked or degraded, replace them.

Every 250 Hours of Operation

Perform the following maintenance every 250 hours of operation.

- **Check and Clean Radiator Fins**
- **Check and Adjust Cooling Fan V-Belt**
- **Check Battery**
- **Clean Air Cleaner Element**

Check and Clean Radiator Fins

⚠ CAUTION

FLYING OBJECT HAZARD!

- **ALWAYS wear eye protection when servicing 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.**

Dirt and dust adhering to the radiator fins reduce the cooling performance, causing overheating. Make it a rule to check the radiator fins daily and clean as needed.

Note that a typical radiator is shown in **Figure 5-2** for illustrative purposes only.

- Blow off dirt and dust from fins and radiator with 28 psi (0.19MPa, 2kgf/cm^2) or less of compressed air **(Figure 5-2, (1))**. Be careful not to damage the fins with the compressed air.
- If there is a large amount of contamination on the fins, apply detergent, thoroughly clean and rinse with tap water.

NOTICE

NEVER use high pressure water or compressed air at greater than 28 psi or a wire brush to clean the radiator fins. Radiator fins damage easily.

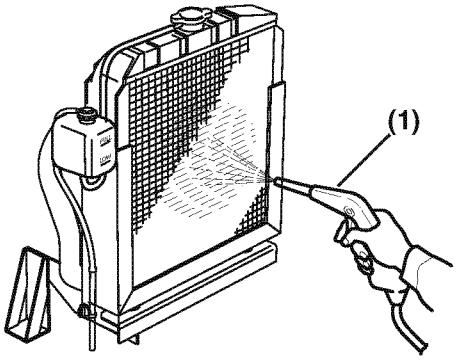


Figure 5-2

Check and Adjust Cooling Fan V-belt

The V-belt will slip if it does not have the proper tension. This will prevent the alternator from generating sufficient power. Also, the engine will overheat due to the engine coolant pump pulley slipping. Be sure to check for proper belt tension after the first 50 hours of operation. Thereafter, check the belt tension every 250 hours of operation.

Check and adjust the V-belt tension (deflection) as follows:

1. Press the V-belt down with your thumb with a force of approximately 22 ft lbs (98 N•m, 10 kgf•m) to check the deflection.

   There are three positions to check for V-belt tension **(Figure 5-3, (A), (B) and (C))**. You can check the tension at whichever position is the most accessible. The proper deflection of a used V-belt at each position is:

Used V-belt Tension		
A	**B**	**C**
3/8 ~1/2 in (10~14 mm)	1/4 ~3/8 in (7~10 mm)	5/16 ~1/2 in (9~13 mm)

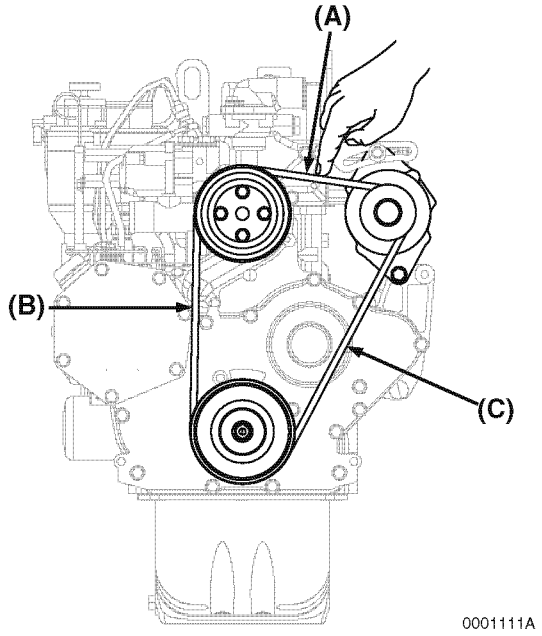


Figure 5-3

2. If necessary, adjust the V-belt tension. Loosen the set bolt **(Figure 5-4, (1))** and move the alternator **(Figure 5-4, (2))** with a pry bar **(Figure 5-4, (3))** to tighten the V-belt.

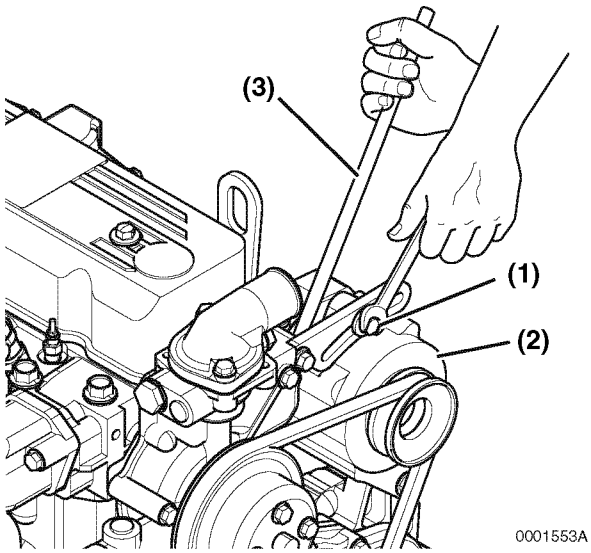


Figure 5-4

3. Check the V-belt for cracks, oil or wear. If any of these conditions exist, replace the V-belt.
   - "New V-belt" refers to a V-belt which has been used less than 5 minutes on a running engine.
   - "Used V-belt" refers to a V-belt which has been used on a running engine for 5 minutes or more.
4. Inspect the condition of the used V-belt. There must be clearance **(Figure 5-5, (1))** between the V-belt and the bottom of the pulley groove. If there is no clearance **(Figure 5-5, (2))** between the V-belt and the bottom of the pulley groove, replace the V-belt.

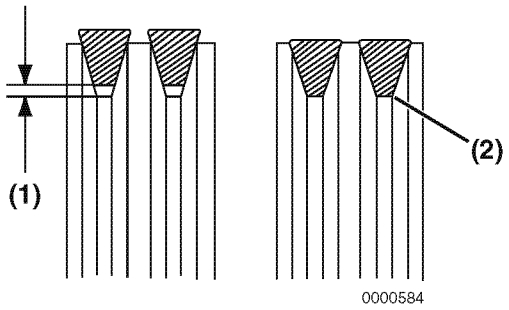


Figure 5-5

5. Install the new V-belt. Refer to the table for proper tension.

New V-belt Tension		
A	B	C
5/16 ~7/16 in (8~12 mm)	3/16 ~5/16 in (5~8 mm)	1/4 ~7/16 in (7~11 mm)

6. After adjusting, run the engine for 5 minutes or more. Check the tension again using the specifications for a used V-belt.

Used V-belt Tension		
A	B	C
3/8 ~1/2 in (10~14 mm)	1/4 ~3/8 in (7~10 mm)	5/16 ~1/2 in (9~13 mm)

Check Battery

⚠ DANGER

EXPLOSION HAZARD!

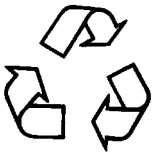
- **NEVER check the remaining battery charge by shorting out the terminals. This will result in a spark and may cause an explosion or fire. Use a hydrometer to check the remaining battery charge.**
- **If the electrolyte is frozen, slowly warm the battery before you recharge it.**
- **Failure to comply will result in death or serious injury.**

⚠ 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.**

NOTICE



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

- Follow the guidelines of the EPA or other 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.

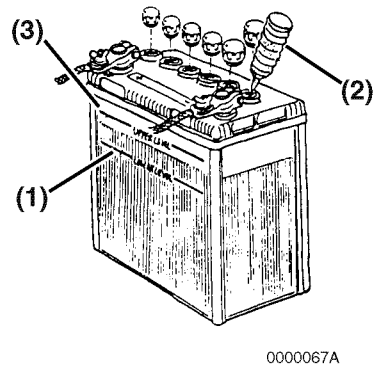


Figure 5-6

- When the amount of fluid nears the lower limit **(Figure 5-6, (1))**, fill with distilled water **(Figure 5-6, (2))** so it is at the upper limit **(Figure 5-6, (3))**. If operation continues with insufficient battery fluid, the battery life is shortened, and the battery may overheat and explode. During the summer, check the fluid level more often than specified.
- If the engine cranking speed is so slow that the engine does not start, recharge the battery.
- If the engine still will not start after charging, have your authorized Yanmar industrial engine dealer or distributor check the battery and the engine's starting system.
- If operating the machine where the ambient temperature could drop to 5°F (-15°C) or less, remove the battery from the machine at the end of the day. Store the battery in a warm place until the next use. This will help start the engine easily at low ambient temperatures.

Clean Air Cleaner Element

Note that a typical air cleaner is shown in **Figure 5-7** and **Figure 5-8** for illustrative purposes only.

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. Unlatch and remove the air cleaner cover **(Figure 5-7, (1))**.
2. Remove the element **(Figure 5-7, (2))** (outer element if equipped with two elements).

⚠ CAUTION

FLYING OBJECT HAZARD!

- **ALWAYS wear eye protection when servicing 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.**

3. Blow air **(Figure 5-7, (3))** through the element from the inside out using 42–71 psi (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 element.

   If the air cleaner is equipped with a double element, *only remove and replace the inner element **(Figure 5-8, (1))** if the engine lacks power or the dust indicator actuates (if equipped).* This is in addition to replacing the outer element.

   The inner element should not be removed when cleaning or replacing the outer element. The inner element it is used to prevent dust from entering the engine while servicing the outer element.

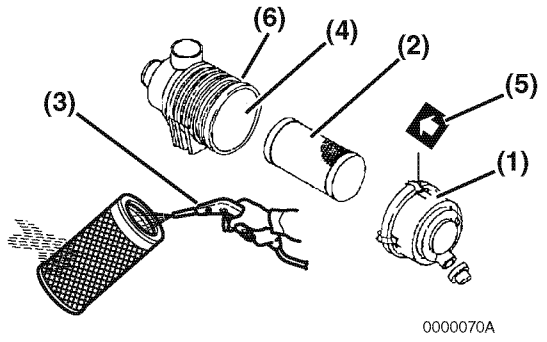


Figure 5-7

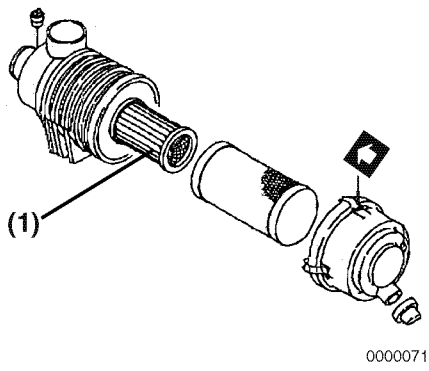


Figure 5-8

4. Replace the element with a new one if the element is damaged, excessively dirty or oily.
5. Clean inside of the air cleaner cover.
6. Install the element into the air cleaner case **(Figure 5-7, (4))**.
7. Install the air cleaner cover making sure you match the arrow **(Figure 5-7, (5))** on the cover with the arrow on the case **(Figure 5-7, (6))**.
8. Latch the air cleaner cover to the case.

NOTICE

- 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.

Every 500 Hours of Operation

Perform the following maintenance every 500 hours of operation.

- **Replace Engine Oil and Engine Oil Filter**
- **Check and Adjust the Governor Lever and Engine Speed Control**

Replace Engine Oil and Engine Oil Filter

⚠ WARNING

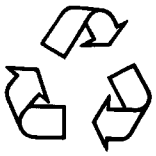
BURN HAZARD!

- **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.**

NOTICE

- 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 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.

NOTICE



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

- Follow the guidelines of the EPA or other 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.

Change the engine oil every 500 hours of operation. Replace the engine oil filter at the same time.

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 filler cap **(Figure 5-9, (1))** to vent the engine crankcase and to allow the engine oil to drain more easily.
5. Position a container **(Figure 5-10, (1))** under the engine to collect waste oil.

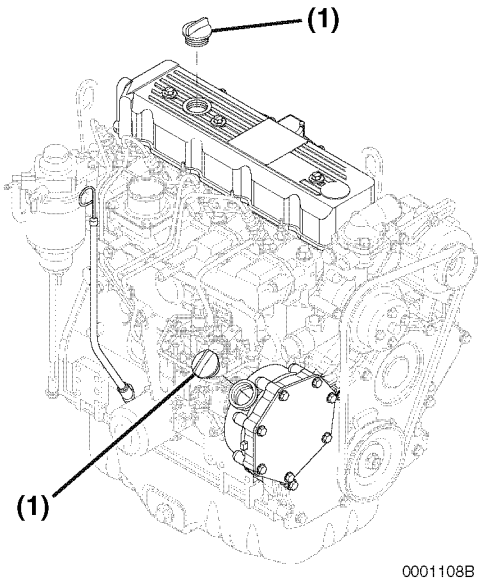


Figure 5-9

6. Remove the drain plug **(Figure 5-10, (2))**. Allow oil to drain.

   After all oil has been drained from the engine, install the drain plug **(Figure 5-10, (2))** and tighten to 14-17 ft lbs (19.6-23.5 N•m, 2.0-2.4 kgf•m).

7. Dispose of used oil properly.

Remove the engine oil filter as follows:

1. Turn the engine oil filter **(Figure 5-11, (1))** counterclockwise **(Figure 5-11, (2))** using a filter wrench.

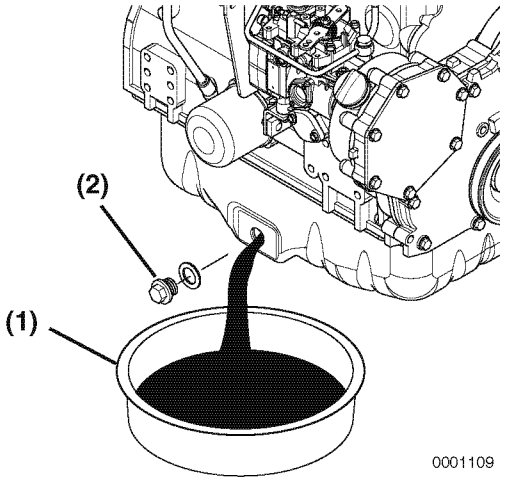


Figure 5-10

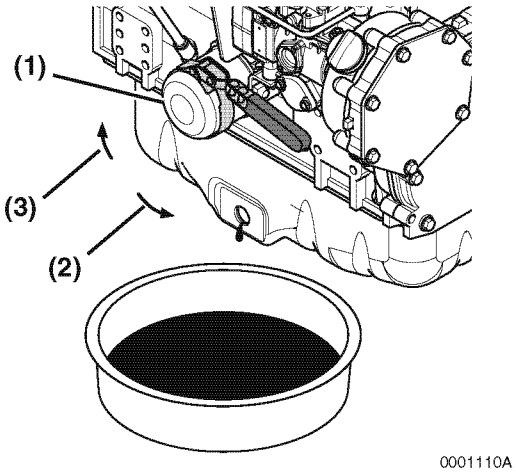


Figure 5-11

2. Clean the engine oil filter mounting face.
3. Lightly coat the gasket on the new oil filter with engine oil. Install the new engine oil filter manually by turning it clockwise **(Figure 5-11, (3))** until it contacts the mounting surface. Tighten an additional 3/4 of a turn using the filter wrench.

Applicable Engine Oil Filter Part No. (Figure 5-11, (1))	
4TNE92 4TNE94L 4TNE98	129150-35153

4. Add new engine oil to the engine as specified in *Adding Engine Oil on page 28*.

Check and Adjust the Governor Lever and Engine Speed Control

The governor lever and engine speed control (accelerator lever, pedal, etc.) of the machine are connected together by an accelerator cable or rod. If the cable becomes stretched, or the connections loosen, the governor lever may not respond to change of engine speed control position. This may make operation of the machine unsafe. Check the cable periodically and adjust if necessary. Consult your authorized Yanmar industrial engine dealer or distributor for the adjustment procedure.

NEVER force the accelerator cable or pedal to move. This may deform the governor lever or stretch the cable and cause irregular operation of the engine speed control.

Checking and adjusting the governor lever:

1. Check that the governor lever **(Figure 5-12, (1))** makes uniform contact with the low idle **(Figure 5-12, (2))** and high idle **(Figure 5-12, (3))** speed limit screws when the engine speed control is in the high idle speed or low idle speed position.
2. If the governor lever does not make contact with the high idle or low idle speed limit screw, adjust the accelerator cable.
3. In some engine speed control applications, loosen the accelerator cable locknut and adjust the cable so the governor lever makes proper contact with the high / low idle speed limit screw.

NOTICE

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 the idle speed limit screws require adjustment, see your authorized Yanmar industrial engine dealer or distributor.

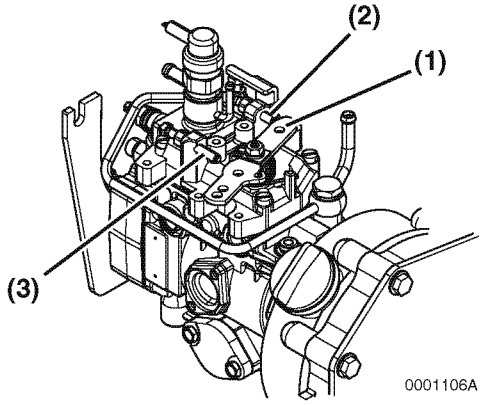


Figure 5-12

Every 1000 Hours of Operation

Perform the following maintenance every 1000 hours of operation.

- **Adjust Intake / Exhaust Valve Clearance**
- **Clean Fuel / Water Separator**
- **Replace Fuel Filter**

Adjust Intake / Exhaust Valve Clearance

Proper adjustment is necessary to maintain the correct timing for opening and closing the valves. Improper adjustment will cause the engine to run noisily, resulting in poor engine performance and engine damage. *See your authorized Yanmar Industrial Engine Dealer or Distributor.*

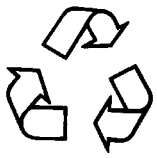
Clean Fuel Filter / Water Separator

⚠ 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.**

NOTICE



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

- Follow the guidelines of the EPA or other 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.

Periodically clean the fuel filter / water separator element and inside cup.

1. Position an approved container under the cup **(Figure 5-13, (1))** of the fuel filter / water separator to collect the contaminants.
2. Close **(Figure 5-13, (2))** the fuel cock **(Figure 5-13, (3))**.
3. Loosen the drain cock **(Figure 5-13, (4))** and drain the contaminants. *See Drain Fuel Filter / Water Separator on page 45.*
4. Turn the retaining ring **(Figure 5-13, (5))** to the left **(Figure 5-13, (10))** and remove the cup **(Figure 5-13, (6)).** If equipped, disconnect the sensor wire **(Figure 5-13, (7))** from the cup before removing the cup.
5. Carefully hold the cup to prevent fuel from spilling. If you spill any fuel, clean up the spill completely.

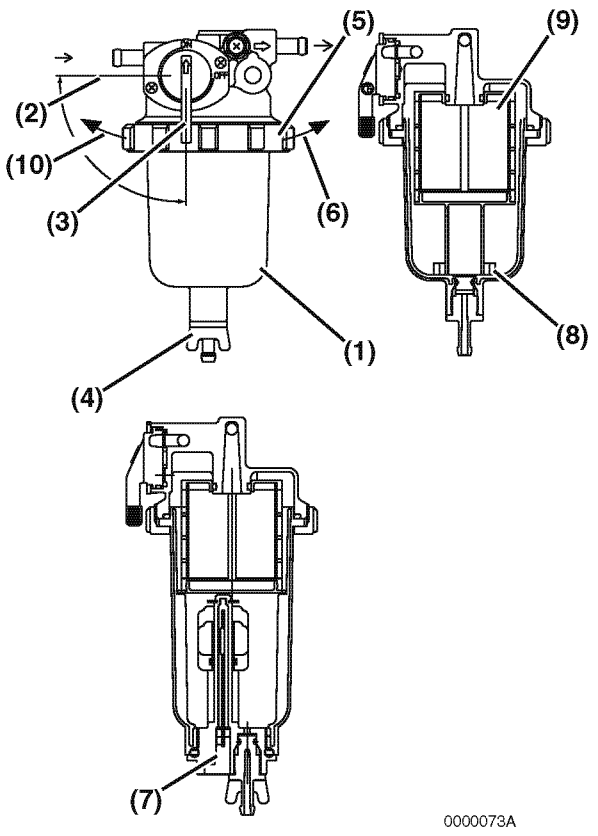


Figure 5-13

6. Remove the float ring **(Figure 5-13, (8))** from the cup. Pour the contaminants into the container and dispose it properly.
7. Clean the element **(Figure 5-13, (9))** and inside cup. Replace the element if it is damaged.

Applicable Element Part No.(Figure 5-13, (9))	
4TNE92 4TNE94L 4TNE98	119802-55710

8. Install the element and O-ring in the bracket.
9. Position the float ring in the cup.
10. Check the O-ring on the cup. Replace if necessary.
11. Install the cup to the bracket by tightening the retaining ring to the right **(Figure 5-13, (6))** to a torque of 11-15 ft lbs (15-20 N•m, 1.5-2.0 kgf•m).
12. Close the drain cock. Reconnect the sensor wire if equipped.
13. Open the fuel cock **(Figure 5-13, (3))**.
14. Prime the fuel system. *See Priming the Fuel System on page 26.*
15. Check for leaks.

Replace Fuel Filter

⚠ DANGER

FIRE AND EXPLOSION HAZARD!

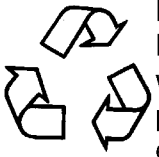
- **Diesel fuel is extremely flammable and explosive under certain conditions.**
- **When you remove any fuel system component to perform maintenance (such as changing the fuel filter) place an approved container under the opening to catch the fuel.**
- **NEVER use a shop rag to catch the fuel. Vapors 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.**

⚠ WARNING

HIGH PRESSURE HAZARD!

- **Avoid skin contact with 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 Yanmar industrial engine dealer or distributor repair the damage.**
- **Failure to comply could result in death or serious injury.**

NOTICE



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

- Follow the guidelines of the EPA or other 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.

NOTICE

For maximum engine life, Yanmar 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 the turbocharger (if equipped) and exhaust system, to cool slightly before the engine itself is shut down.

Replace the fuel filter at specified intervals to prevent contaminants from adversely affecting the diesel fuel flow.

1. Stop the engine and allow it to cool.
2. Close all fuel cocks in fuel line.
3. Disconnect the fuel filter sensor connector **(Figure 5-14, (1))**.

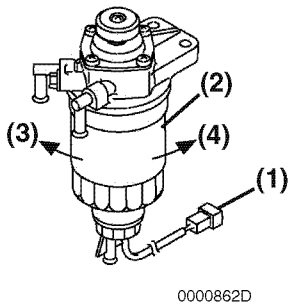


Figure 5-14

4. Place an approved container under fuel filter.
5. Carefully open the drain plug **(Figure 5-15, (1))** to drain fuel from the fuel filter.
6. Remove the fuel filter **(Figure 5-14, (2))** by turning it to the left **(Figure 5-14, (3))**. Wipe up all spilled fuel.
7. Remove the drain plug **(Figure 5-15, (1))** from the fuel filter **(Figure 5-15, (2))** by turning it to the left **(Figure 5-15, (3))**.
8. Check the condition of the drain plug O-ring **(Figure 5-15, (4))**. Replace the O-ring if damaged.

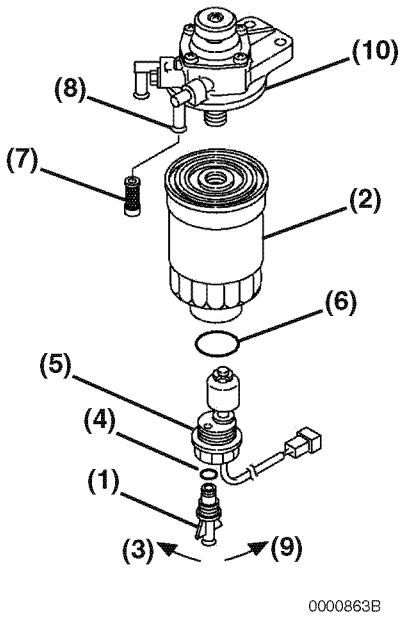


Figure 5-15

9. Set the drain plug aside for reinstallation.
10. Remove the fuel filter sensor assembly **(Figure 5-15, (5))** by turning it to the left **(Figure 5-15, (3))**.
11. Carefully remove the in-line fuel filter **(Figure 5-15, (7))** from the output nipple **(Figure 5-15, (8))** that goes to the fuel injection pump.
12. Dispose of the fuel, fuel filters and O-ring (if replaced) properly. Follow the guidelines of the EPA or other government agency.
13. Carefully install the new in-line fuel filter **(Figure 5-15, (7))** into the output nipple **(Figure 5-15, (8))**.
14. Carefully install the fuel filter sensor assembly **(Figure 5-15, (5))** in the new fuel filter using the new O-ring supplied with the fuel filter **(Figure 5-15, (2))** by turning the fuel filter sensor assembly to the right **(Figure 5-15, (9))**.
15. Install the drain plug **(Figure 5-15, (1))** on the new fuel filter **(Figure 5-15, (3))** by turning the drain plug to the right **(Figure 5-15, (8))**. Hand tighten only.
16. Clean the fuel filter mounting surface **(Figure 5-15, (10))** and apply a small amount of diesel fuel to the gasket of the new filter.
17. Install the new fuel filter **(Figure 5-14, (2))** by turning it to the right **(Figure 5-14, (4))** until it contacts the mounting surface. Tighten one additional turn.
18. Open all fuel cocks in the fuel line.
19. Reconnect the fuel filter sensor connector **(Figure 5-14, (1))**.
20. Prime the fuel system. *See Priming the Fuel System on page 26.*
21. Check for fuel leaks.

Applicable Fuel Filter Part No. (Figure 5-14, (2))	
4TNE92 4TNE94L 4TNE98	129901-55850

Applicable In-Line Fuel Filter Part No. (Figure 5-15, (7))	
4TNE92 4TNE94L 4TNE98	129901-55860

Every 2000 Hours of Operation

Perform the following maintenance every 2000 hours of operation.

- **Replace Air Cleaner Element**
- **Inspect Clean and Test Fuel Injectors, if necessary**

Replace Air Cleaner Element

NOTICE

The maximum air intake restriction shall be 0.90 psi (6.23 kPa; 635 mm Aq) or less. Clean or replace the air cleaner element if the air intake restriction exceeds the above mentioned value.

Replace the air cleaner element **(Figure 5-7, (2))** every 2000 hours even if it is not damaged or dirty.

When replacing the element, clean the inside of the air cleaner case **(Figure 5-7, (4))**.

If the air cleaner is equipped with a double element, *only remove and replace the inner element* **(Figure 5-8, (1))** *if the engine lacks power or the dust indicator actuates (if equipped).* This is in addition to replacing the outer element.

Inspect Clean and Test Fuel Injectors

⚠ WARNING

HIGH PRESSURE HAZARD!

- **Avoid skin contact with 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 Yanmar industrial engine dealer or distributor repair the damage.**
- **Failure to comply could result in death or serious injury.**

Proper operation of the fuel injectors is required to obtain the optimum injection pattern for full engine performance. The EPA / ARB requires that you have the injectors inspected, cleaned and tested every 2000 hours. *See your authorized Yanmar Industrial Engine Dealer or Distributor.*

Every 4000 Hours of Operation

- Drain, Flush, and Re-fill the Coolant System with New Coolant
- Replace Fuel Hoses and Engine Coolant Hoses

Drain, Flush, and Re-fill the Coolant System with New Coolant

⚠ DANGER

SCALD HAZARD!

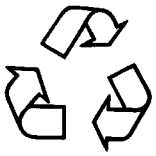
- NEVER remove the radiator cap if the engine is hot. Steam and hot engine coolant will spurt out and seriously burn you. Allow the engine to cool down before you attempt to remove the radiator cap.
- Securely tighten the radiator cap after you check the radiator. Steam can spurt out during engine operation if the cap is loose.
- ALWAYS check the level of engine coolant by observing the reserve tank.
- Failure to comply will result in death or serious injury.

⚠ CAUTION

COOLANT HAZARD!


- Wear eye protection and rubber gloves when you handle Long Life or Extended Life engine coolant. If contact with the eyes or skin should occur, wash with clean water.
- Failure to comply may result in minor or moderate injury.

NOTICE



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

- Follow the guidelines of the EPA or other 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.

Engine coolant contaminated with rust or scale reduces the cooling effect. Even when extended life engine coolant is properly mixed, the engine coolant gets contaminated as its ingredients deteriorate. Drain, flush and re-fill the cooling system with new coolant every 4000 hours or once every 2 years, whichever comes first.

1. Remove the radiator cap **(Figure 5-16, (1))**.
2. Remove the drain plug or open the drain cock **(Figure 5-16, (2))** at the lower portion of the radiator and drain the engine coolant.

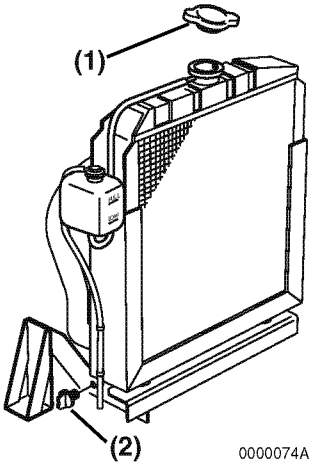


Figure 5-16

3. Remove the coolant drain plug **(Figure 5-17, (1))** from the engine block.

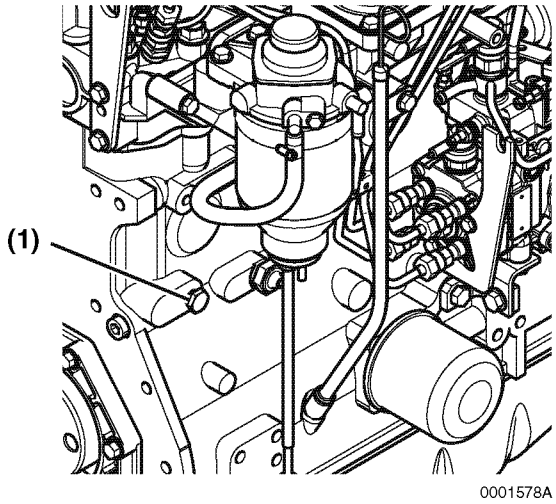


Figure 5-17

4. After draining the engine coolant, flush the radiator and engine block to remove any rust, scale and contaminants. Then reinstall and tighten the drain plug or close the drain cock in the radiator. Reinstall and tighten the engine block drain plug.
5. Fill radiator and engine with engine coolant. *See Filling Radiator With Engine Coolant on page 30.*

Replace Fuel Hoses and Engine Coolant Hoses

Replace the fuel and engine coolant hoses at least every two years. *See your authorized Yanmar Industrial Engine Dealer or Distributor.*

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TROUBLESHOOTING

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

NOTICE

If any indicator fails to illuminate when the key switch is in the ON position, see your authorized Yanmar industrial engine dealer or distributor for service before operating the engine.

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.

TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	ACTION	REFER TO
Indicator Turns On - Engine Running			
Engine oil pressure indicator	• Low level of engine oil • Too high an oil level	• Check and adjust engine oil level as necessary	*Checking Engine Oil on page 28*
	• Clogged engine oil filter	• Replace engine oil filter element	*Replace Engine Oil and Engine Oil Filter on page 52*
Engine coolant indicator	• Low engine coolant level	• Add engine coolant	*Filling Radiator With Engine Coolant on page 30*
	• Dirty radiator fins	• Clean the radiator fins	*Check and Clean Radiator Fins on page 47*
	• Engine coolant leaking	• See authorized Yanmar industrial engine dealer or distributor	—
	• V-belt loose or damaged	• Adjust V-belt or replace	*Check and Adjust Cooling Fan V-belt on page 48*
	• Contaminated engine coolant	• See authorized Yanmar industrial engine dealer or distributor	—
	• Faulty engine coolant pump		—
Battery indicator	• V-belt loose or damaged	• Adjust V-belt or replace	*Check and Adjust Cooling Fan V-belt on page 48*
	• Battery failure	• Check battery condition	*Check Battery on page 49*
Indicator Does Not Turn On - Key Switch is Turned to ON (OFF → ON)			
	• Faulty electrical wiring or faulty indicator	• See authorized Yanmar industrial engine dealer or distributor	—
Indicator Stays On - Key Switch is Turned from Start to ON (START → ON)			
	• Faulty electrical wiring or faulty indicator	• See authorized Yanmar industrial engine dealer or distributor	—
Engine Does Not Start			
• Starter motor operates but engine does not start	• No diesel fuel	• Refuel and prime fuel system	*Priming the Fuel System on page 26*
	• Air in fuel system	• Prime fuel system	*Priming the Fuel System on page 26*
	• Improper diesel fuel	• Replace with recommended diesel fuel	*Diesel Fuel Specifications on page 23*
	• Clogged fuel filter	• Replace fuel filter	*Replace Fuel Filter on page 56*
	• Poor fuel injection	• See authorized Yanmar industrial engine dealer or distributor	—
	• Compressed air leakage from intake / exhaust valves		—
	• Faulty engine stop solenoid		

SYMPTOM	PROBABLE CAUSE	ACTION	REFER TO
• Starter motor does not operate or rotates too slowly (engine can be turned manually)	• Battery needs charging	• Check electrolyte, recharge	*Check Battery on page 49*
	• Faulty cable connection at battery terminals	• Clean terminals, retighten	—
	• Faulty starter switch	• See authorized Yanmar industrial 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 50*
	• Improper diesel fuel	• Replace with recommended diesel fuel	*Diesel Fuel Specifications on page 23*
	• Faulty spraying of fuel injection	• See authorized Yanmar industrial engine dealer or distributor	—
	• Excessive intake / exhaust valve clearance		—
• White exhaust smoke	• Improper diesel fuel	• Replace with recommended diesel fuel	*Diesel Fuel Specifications on page 23*
	• Faulty spray pattern of fuel injection	• See authorized Yanmar industrial engine dealer or distributor	—
	• Fuel injection timing delay		—
	• Engine burning oil		—

TROUBLESHOOTING INFORMATION

If your engine does not operate properly, refer to the troubleshooting chart or consult your authorized Yanmar industrial engine dealer or distributor.

Supply the authorized Yanmar industrial 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), manufacturer's 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 the 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

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

⚠ 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.

⚠ 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.

⚠ CAUTION

FLYING OBJECT HAZARD!

- ALWAYS wear eye protection when servicing 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.

NOTICE

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

1. Perform the next Preventive Maintenance procedure. For example, if there are 10 hours before the 250 hour maintenance, you should do the 250 hour maintenance before you place the engine in storage. *See the Periodic Maintenance Schedule on page 43.*
2. Drain and flush the engine cooling system. Refill with Long Life Engine Coolant. For engine coolant specifications *see Engine Coolant Specifications on page 30* and for the procedure for draining and refilling the cooling system *see Filling Radiator With Engine Coolant on page 30.*
3. Clean the exterior of the engine so it is free of grease and oil.
4. Drain the fuel tank or make sure it is completely full. *See Filling the Fuel Tank on page 25.*
5. Grease exposed parts of the engine speed control system.
6. Protect the air cleaner, muffler and electrical components (alternator, starter motor, switches) from water and dust.
7. Disconnect the negative (-) battery cable to prevent the battery from discharging.
8. Check the battery fluid and add distilled water as required.
9. Charge the battery once a month during storage.

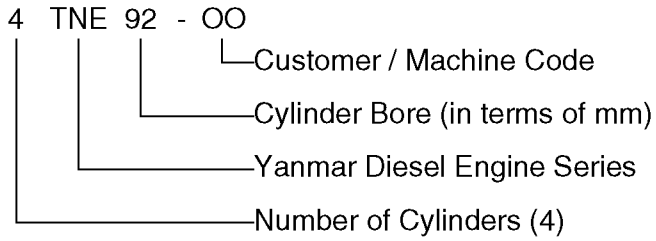
RETURNING THE ENGINE TO SERVICE

1. Perform the *Daily Checks on page 32.*
2. Prime the fuel system. *See Priming the Fuel System on page 26.*
3. Start the engine. Allow the engine to idle for approximately 15 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.
4. Avoid prolonged operation at minimum or maximum engine speeds and loads for the remainder of the first hour of operation.

SPECIFICATIONS

GENERAL

Description of Model Number



Engine Speed Specifications

NOTATION	AVAILABLE ENGINE SPEED	INTENDED USES
VM	*2050 ~ 2450 rpm (min^{-1})	Forklift

* refer to principal engine pecifications

VM: Variable Medium Speed

Engine General Specifications

Type	Vertical Inline, Water Cooled, 4-Cycle Diesel Engine
Combustion System	Indirect Injection
Starting System	Electric Starting
Cooling System	Radiator
Lubricating System	Forced Lubrication With Trochoid Pump
PTO Position	Flywheel End
Direction of Rotation	Counterclockwise Viewed from Flywheel Side

Notes:

1. The information described in *Principal Engine Specifications* is 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 77°F (25°C), Atmospheric pressure 29.53 in Hg (100 kPa, 750mm Hg), Relative humidity 30%
   - Fuel Temperature at Fuel Injector Pump Inlet: 104°F (40°C)
   - With Cooling Fan, Air Cleaner, Muffler: Yanmar Standard
   - After Engine Break-In Period. Output Allowable Deviation: ± 3%
   - 1 PS = 0.7355 kW
   - 1 hp SAE (Society of Automotive Engineers)= 0.7457 kW

PRINCIPAL ENGINE SPECIFICATIONS

4TNE92 EPA Tier2 & Tier3

Engine Model	4TNE92 EPA Tier2 & Tier3	
Version	VM	
Type	Vertical Inline Diesel Engine	
Combustion System	Indirect Injection, No Turbocharger	
Aspiration	Natural	
No. of Cylinders	4	
Bore × Stroke	3.62 x 3.94 in (92 × 100 mm)	
Displacement	162.3 cu in (2.659 L)	
** Max. Rated Output (Gross)	rpm (min^{-1})	2450
	hp SAE	46.5
	kW	34.7
	PS	47.2
High Idle Speed (Bare Engine)	2725 ± 25 rpm	
Low Idle Speed (Bare Engine)	850 ± 25 rpm	
Engine Weight (Dry)*	496 lb (225 kg)	
PTO Position	Flywheel Side	
Direction of Rotation	Counterclockwise Viewed From Flywheel Side	
Cooling System	Liquid-Cooled With Radiator	
Lubricating System	Forced Lubrication With Trochoid Pump At normal operating speeds, oil pressure is: 42 - 57 psi (0.29 - 0.39 MPa; 3.0 - 4.0 kgf/cm^2) At idle, oil pressure is: No less than 18.5 psi (0.13 MPa; 1.3 kgf/cm^2)	
Starting System	Electric Starting - Starter Motor: DC12V, 3.1 hp (2.3 kW)	
	Alternator: DC12V, 40A	
	Recommended Battery Capacity: 12V, 622 CCA (Cold Cranking Amps)	
Dimensions (L × W × H)*	28.0 x 20.3 x 29.8 in (710 x 516 x 758 mm)	
Engine Oil Pan Capacity	9.7 / 7.6 qt (9.2 / 7.2 L) (Dipstick Upper Limit / Lower Limit)	
Engine Coolant Capacity	1.11 gal (4.2 L) Engine Only	

* Engine specifications do not include height of lifting eyes nor dimensions or specifications for the Radiator, Muffler, and Air Cleaner.

** The Intake and Exhaust condition of Max. Rated output are

Air Intake Restriction : 250mmAq

Exhaust Gas Restriction : 1000mmAq

*** The detail specifications are refer to the Specification document which is agreed between both engineering.

4TNE94L EPA Tier2

Engine Model	4TNE94L EPA Tier2	
Version	VM	
Type	Vertical Inline Diesel Engine	
Combustion System	Indirect Injection, No Turbocharger	
Aspiration	Natural	
No. of Cylinders	4	
Bore × Stroke	3.70 x 4.33 in (94 x 110 mm)	
Displacement	186.3 cu in (3.053 L)	
** Max. Rated Output (Gross)	rpm (min^{-1})	2450
	hp SAE	61.0
	kW	45.5
	PS	61.9
High Idle Speed (Bare Engine)	2725 ± 25 rpm	
Low Idle Speed (Bare Engine)	850 ± 25 rpm	
Engine Weight (Dry)*	496 lb (225 kg)	
PTO Position	Flywheel Side	
Direction of Rotation	Counterclockwise Viewed From Flywheel Side	
Cooling System	Liquid-Cooled With Radiator	
Lubricating System	Forced Lubrication With Trochoid Pump At normal operating speeds, oil pressure is: 42 - 57 psi (0.29 - 0.39 MPa; 3.0 - 4.0 kgf/cm^2) At idle, oil pressure is: No less than 18.5 psi (0.13 MPa; 1.3 kgf/cm^2)	
Starting System	Electric Starting - Starter Motor: DC12V, 3.1 hp (2.3 kW)	
	Alternator: DC12V, 40A	
	Recommended Battery Capacity: 12V, 622 CCA (Cold Cranking Amps)	
Dimensions (L × W × H)*	28.0 x 20.3 x 29.8 in (710 x 516 x 758 mm)	
Engine Oil Pan Capacity	9.7 / 7.6 qt (9.2 / 7.2 L) (Dipstick Upper Limit / Lower Limit)	
Engine Coolant Capacity	1.11 gal (4.2 L) Engine Only	

* Engine Specifications Without Radiator, Muffler, and Air Cleaner.

** The Intake and Exhaust condition of Max. Rated output are
Air Intake Restriction : 250mmAq
Exhaust Gas Restriction : 1000mmAq

*** The detail specifications are refer to the Specification document which is agreed between both engineering.

4TNE94L EPA Tier3

Engine Model	4TNE94L EPA Tier3	
Version	VM	
Type	Vertical Inline Diesel Engine	
Combustion System	Indirect Injection, No Turbocharger	
Aspiration	Natural	
No. of Cylinders	4	
Bore × Stroke	3.70 x 4.33 in (94 x 110 mm)	
Displacement	186.3 cu in (3.053 L)	
** Max. Rated Output (Gross)	rpm (min^{-1})	2200
	hp SAE	47.3
	kW	35.3
	PS	48.0
High Idle Speed (Bare Engine)	2450 ± 25 rpm	
Low Idle Speed (Bare Engine)	810 ± 25 rpm	
Engine Weight (Dry)*	496 lb (225 kg)	
PTO Position	Flywheel Side	
Direction of Rotation	Counterclockwise Viewed From Flywheel Side	
Cooling System	Liquid-Cooled With Radiator	
Lubricating System	Forced Lubrication With Trochoid Pump At normal operating speeds, oil pressure is: 42 - 57 psi (0.29 - 0.39 MPa; 3.0 - 4.0 kgf/cm^2) At idle, oil pressure is: No less than 18.5 psi (0.13 MPa; 1.3 kgf/cm^2)	
Starting System	Electric Starting - Starter Motor: DC12V, 3.1 hp (2.3 kW)	
	Alternator: DC12V, 40A	
	Recommended Battery Capacity: 12V, 622 CCA (Cold Cranking Amps)	
Dimensions (L × W × H)*	28.0 x 20.3 x 29.8 in (710 x 516 x 758 mm)	
Engine Oil Pan Capacity	9.7 / 7.6 qt (9.2 / 7.2 L) (Dipstick Upper Limit / Lower Limit)	
Engine Coolant Capacity	1.11 gal (4.2 L) Engine Only	

* Engine Specifications Without Radiator, Muffler, and Air Cleaner.

** The Intake and Exhaust condition of Max. Rated output are

Air Intake Restriction : 250mmAq

Exhaust Gas Restriction : 1000mmAq

*** The detail specifications are refer to the Specification document which is agreed between both engineering.

4TNE98 EPA Tier2

Engine Model	4TNE98 EPA Tier2	
Version	VM	
Type	Vertical Inline Diesel Engine	
Combustion System	Indirect Injection, No Turbocharger	
Aspiration	Natural	
No. of Cylinders	4	
Bore × Stroke	3.86 x 4.33 in (98 x 110 mm)	
Displacement	202.5 cu in (3.319 L)	
** Max. Rated Output (Gross)	rpm (min^{-1})	2400
	hp SAE	63.6
	kW	47.4
	PS	64.4
High Idle Speed (Bare Engine)	2725 ± 25 rpm	
Low Idle Speed (Bare Engine)	850 ± 25 rpm	
Engine Weight (Dry)*	496 lb (225 kg)	
PTO Position	Flywheel Side	
Direction of Rotation	Counterclockwise Viewed From Flywheel Side	
Cooling System	Liquid-Cooled With Radiator	
Lubricating System	Forced Lubrication With Trochoid Pump At normal operating speeds, oil pressure is: 42 - 57 psi (0.29 - 0.39 MPa; 3.0 - 4.0 kgf/cm^2) At idle, oil pressure is: No less than 18.5 psi (0.13 MPa; 1.3 kgf/cm^2)	
Starting System	Electric Starting - Starter Motor: DC12V, 3.1 hp (2.3 kW)	
	Alternator: DC12V, 40A	
	Recommended Battery Capacity: 12V, 622 CCA (Cold Cranking Amps)	
Dimensions (L × W × H)*	28.0 x 20.3 x 29.8 in (710 x 516 x 758 mm)	
Engine Oil Pan Capacity	9.7 / 7.6 qt (9.2 / 7.2 L) (Dipstick Upper Limit / Lower Limit)	
Engine Coolant Capacity	1.11 gal (4.2 L) Engine Only	

* Engine Specifications Without Radiator, Muffler, and Air Cleaner.

** The Intake and Exhaust condition of Max. Rated output are

Air Intake Restriction : 250mmAq

Exhaust Gas Restriction : 1000mmAq

*** The detail specifications are refer to the Specification document which is agreed between both engineering.

4TNE98 EPA Tier3

Engine Model	4TNE98 EPA Tier3	
Version	VM	
Type	Vertical Inline Diesel Engine	
Combustion System	Indirect Injection, No Turbocharger	
Aspiration	Natural	
No. of Cylinders	4	
Bore × Stroke	3.86 x 4.33 in (98 × 110 mm)	
Displacement	202.5 cu in (3.319 L)	
** Max. Rated Output (Gross)	rpm (min^{-1})	2300
	hp SAE	61.7
	kW	46.0
	PS	62.5
High Idle Speed (Bare Engine)	2725 ± 25 rpm	
Low Idle Speed (Bare Engine)	850 ± 25 rpm	
Engine Weight (Dry)*	496 lb (225 kg)	
PTO Position	Flywheel Side	
Direction of Rotation	Counterclockwise Viewed From Flywheel Side	
Cooling System	Liquid-Cooled With Radiator	
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Air Intake Restriction : 250mmAq

Exhaust Gas Restriction : 1000mmAq

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OPERATION MANUAL

4TNE92, 4TNE94L, 4TNE98

1st edition: September 2007
2nd edition: June 2009
3rd edition: September 2012

Issued by: YANMAR CO., LTD.
Edited by: YANMAR TECHNICAL SERVICE CO., LTD.

INDUSTRIAL ENGINES

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0ATNE-G00102
PRINTED IN JAPAN