



INDUSTRIAL ENGINES

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:

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Date of issue: Nov. 2009

OPERATION MANUAL	Model	TNV Series
	Code	0ATNV-G00102

YANMAR WARRANTIES

YANMAR LIMITED WARRANTY

What is Covered by this Warranty?

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

Note: Yanmar engines may be equipped with external components including, but not limited to: wiring harnesses, electrical devices, control panels, radiators, air filters, fuel filters, and / or exhaust systems that are supplied and / or installed by manufacturers other than Yanmar. For warranty information on such external components, please contact the machine or component manufacturer directly or see your authorized Yanmar dealer or distributor.

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

How Long is the Warranty Period?

The Yanmar standard limited warranty period runs for a period of **twenty-four (24) months or two-thousand (2000) engine operation hours**, whichever occurs first. An extended limited warranty of thirty-six (36) months or three thousand (3000) engine operating hours, whichever occurs first, is provided for these specific parts only: the cylinder block, cylinder head, crankshaft forging, connecting rods, flywheel, flywheel housing, camshaft, timing gear, and gear case. The Warranty Period for both the standard limited warranty and the extended limited warranty (by duration or operation hours) begins on the date of delivery to the original retail purchaser and is valid only until the applicable warranted duration has passed or the operation hours are exceeded, whichever comes first.

YANMAR WARRANTIES

Yanmar Limited Warranty - Continued

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. Acceptable forms of proof of delivery date include, but are not limited to: the original warranty registration or sales receipts or other documents maintained in the ordinary course of business by Yanmar dealers and / or distributors, indicating the date of delivery of the Yanmar product to the original retail purchaser. This information is necessary to establish whether the Yanmar product is still within the warranty period. Thus, Yanmar strongly recommends you register your engine as soon as possible after purchase in order to facilitate any future warranty matters.

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

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. website 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 website 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 desired 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 website heading and typing in your question or comment.

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

TNV Operation Manual

Yanmar Limited Warranty - Continued

What is Not Covered by this Warranty?

This Warranty does not cover parts affected by or damaged by any reason other than defective materials or workmanship, including, but not limited to, accident, misuse, abuse, "Acts of God," neglect, improper installation, improper maintenance, improper storage, the use of unsuitable attachments or parts, the use of contaminated fuels, the use of fuels, oils, lubricants, or fluids other than those recommended in your 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. This Warranty does not cover the cost of shipping the product to or from the Warranty repair facility.

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.

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.

YANMAR WARRANTIES

Yanmar Limited Warranty - Continued

Retail Purchaser Registration

It is very important for the original retail purchaser to register the Yanmar product. Registration enables Yanmar to provide the best support for your Yanmar product.

At the time of purchase, Yanmar highly recommends registering the retail purchaser'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.



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EMISSION SYSTEM WARRANTY

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

Your Warranty Rights and Obligations:

California

The California Air Resources Board (CARB), the Environmental Protection Agency (EPA) and Yanmar Co., Ltd. hereafter referred to as Yanmar, are pleased to explain the **emission control system warranty** on your industrial compression-ignition engine. In California, model year 2000 or later off-road compression-ignition engines must be designed, built and equipped to meet the State's stringent anti-smog standards. In all states, 1998 and later non-road compression-ignition engines must be designed, built and equipped to meet the United States EPA emissions standards. Yanmar warrants the emission control system on your engine for the periods of time listed below 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, the air induction system, the electronic control system and the EGR (Exhaust Gas Recirculation) system. Also included may be hoses, belts, connectors and other emission-related assemblies.

Where a warrantable condition exists, Yanmar will repair your non-road compression-ignition engine at no charge to you including diagnosis, parts and labor.

Manufacturer's Warranty Period:

The model year 1998 or later certified and labeled non-road compression-ignition 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.

Engine Type	Warranty Period by Number of Years or Hours of Operation
Constant speed engines rated at or above 50 hp SAE (37 kW)	The warranty period is five (5) years or 3,000 hours of use, whichever occurs first. In the absence of a device to measure the hours of use, the engine has a warranty period of five (5) years.
Constant speed engines rated under 50 hp SAE (37 kW) with rated speeds greater than or equal to 3,000 rpm	The warranty period is two (2) years or 1,500 hours of use, whichever occurs 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 engines rated under 50 hp SAE (37 kW) and engines rated at or above 26 hp SAE (19 kW) with rated speeds less than 3,000 rpm	The warranty period is five (5) years or 3,000 hours of use, whichever occurs first. In the absence of a device to measure the hours of use, the engine has a warranty period of five (5) years.
Engines rated at or above 26 hp SAE (19 kW)	The warranty period is five (5) years or 3,000 hours of use, whichever occurs first. In the absence of a device to measure the hours of use, the engine has a warranty period of five (5) years.
Engines rated under 26 hp SAE (19 kW)	The warranty period is two (2) years or 1,500 hours of use, whichever occurs first. In the absence of a device to measure the hours of use, the engine has a warranty period of two (2) years.

YANMAR WARRANTIES

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 Parts:

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
- · Electronic Control System
- · Cold Start Enrichment System
- · Intake Manifold
- Turbocharger Systems
- · Exhaust Manifold
- EGR System
- · Positive Crankcase Ventilation System
- Hoses, belts, connectors and assemblies associated with emission control systems

Since emissions-related parts may vary slightly between models, certain models may not contain all of these parts and other models may contain the functional equivalents.

TNV Operation Manual

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 or use of non-recommended fuels and lubricating oils; accident-caused damage, and replacement of expendable 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 engine owner, you are responsible for the performance of the required maintenance listed in your owner's manual. Yanmar recommends that you retain all documentation, including receipts, covering maintenance on your non-road compression-ignition engine, but Yanmar cannot deny warranty solely for the lack of receipts, or for your failure to ensure the performance of all scheduled maintenance.

Yanmar may deny your warranty coverage of your non-road compression-ignition engine if a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

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 engine to a Yanmar dealer as soon as a problem exists. The warranty repairs should be completed by the dealer as expeditiously as possible. If you have any questions regarding your warranty rights and responsibilities, or would like information on the nearest Yanmar dealer or authorized service center, you should contact Yanmar America Corporation at 1-800-872-2867.

EMISSION-RELATED INSTALLATION INSTRUCTIONS (REF)

Failing to follow these instructions when installing a certified engine in a piece of nonroad equipment violates Federal Law (40 CFR1068.105(B)), subject to fines or other penalties as described in the clean air act.

Installation of Nonroad Engines into Equipment

To ensure engines operate under the certified configurations, Yanmar has established defined application requirements when installing any certified engine into a piece of equipment. The instructions outlined below are included in our certification process and any failure to comply will be considered tampering.

Yanmar certifies engines to operate under variable speed or constant speed conditions. Engines certified as constant speed are prohibited from installation into variable speed applications. The emission control information label will identify an engine certified as constant speed.

Allowable Air Intake Restriction and Exhaust Back Pressure

Resistance to intake airflow and exhaust gas flow is generated in the intake and exhaust systems. Exceeding the limitations will affect the operation of an engine and its certified configuration. Refer to the installation requirements and limitations of the TNV Series Application Manual for the engine being equipped with these systems.

Allowable Air Intake Restriction

Engine Model	Allowable Air Intake Restriction ≤ kPa (mmAq)			
Linginie Model	Initial upper limit	Upper limit for air cleaner replacement		
All TNV Models	2.94 (300)	6.23 (635)		

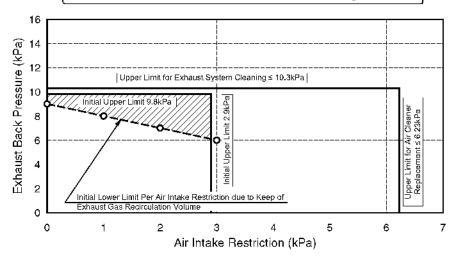
Allowable Exhaust Back Pressure

Engine Model	Allowable Exhaust Back Pressure ≤ kPa (mmAq)					
Eligilie Model	Initial upper limit	Upper limit for exhaust system cleaning				
2TNV70	4.90 (500)	5.88 (600)				
3TNV70, 3TNV76	9.81 (1000)	11.77 (1200)				
3TNV82A, 3TNV84/88, 4TNV84/88, 4TNV94L, 4TNV98, 4TNV106	12.75 (1300)	15.30 (1560)				
3TNV84T	7.85 (800)	9.81 (1000)				
4TNV84T, 4TNV98T, 4TNV106T	9.81 (1000)	11.77 (1200)				
4TNV84T-Z	Figure 1: EGR Equipped Engines					
4TNN/00 E/7	<vm>Figure 2: EGR Equipped Engines</vm>					
4TNV98-E/Z	<cl>Figure 3: EGR Equipped Engines</cl>					
4TNV98T-Z	Figure 4: EGR Equipped Engines					

TNV Operation Manual

Intake/Exhaust Pressure Allowances

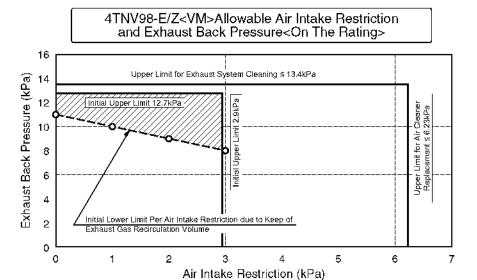
4TNV84T-Z<VM>Allowable Air Intake Restriction and Exhaust Back Pressure<On The Rating>



Lower Limit of Exhaust Back Pressure set by Air Intake Restriction

Air Intake Restriction (kPa)	0	1	2	3	
Exhaust Back Pressure (kPa)	9	8	7	6	002182 013

Figure 1

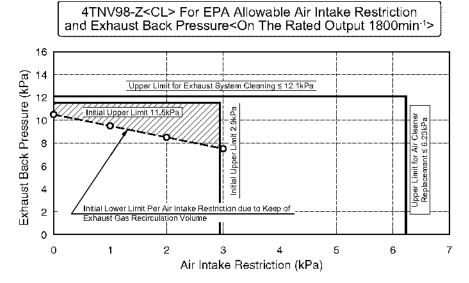


Lower Limit of Exhaust Back Pressure set by Air Intake Restriction

Air Intake Restriction (kPa)	0	1	2	3
Exhaust Back Pressure (kPa)	11	10	9	8

Figure 2

030103-0 B

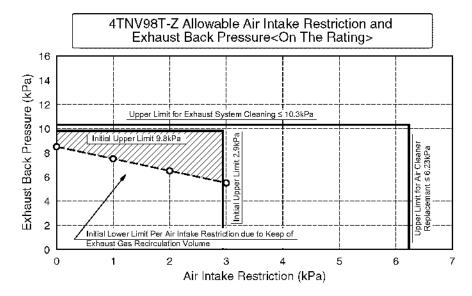


Lower Limit of Exhaust Back Pressure set by Air Intake Restriction

Air Intake Restriction (kPa)	0	1	2	3
Exhaust Back Pressure (kPa)	10.5	9.5	8.5	7.5

8.5 7.5

Figure 3



Lower Limit of Exhaust Back Pressure set by Air Intake Restriction

Air Intake Restriction (kPa)	0	1	2	3
Exhaust Back Pressure (kPa)	8.5	7.5	6.5	5.5

Figure 4

Note: EGR-equipped engines have a range of allowable intake and exhaust restrictions; a minimum and a maximum value. Larger versions of these figures are in the TNV Series Application Manual.

OCE

Breather System

Crankcase breather systems should be designed to return crankcase blow-by gas to the intake manifoldclosed breather system. Yanmar's naturally aspirated engines are produced with the components completing the exhaust breather system. For turbocharged engines (excluding the variable speed 4TNV98T), the breather system components must be installed with the intake system under the following quidelines:

- Route the breather pipe from the valve cover to the return joint; avoid creasing and pitting
- The breather pipe and intake hoses must be made of oil resistant material
- The breather pipe will be installed to avoid any downward slopes that could create oil traps
- The return joint must be elevated above the outlet on the valve cover
- The return joint must be located between the air cleaner and turbocharger; ≤ 300 mm from the air cleaner
- The return joint must meet the following dimensions (mm):

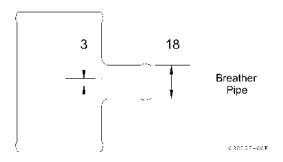


Figure 5

Yanmar offers a line of components compatible for our engines that can be used to install a crankcase blow-by return. Refer to the installation requirements of the TNV Series Application Manual for further explanation regarding application and components.

In-Use Testing Requirements

Exhaust systems should be designed so that a 20 cm (7.87 in) extension can be installed to the end of the exhaust pipe for purposes of sampling emissions. For equipment that does not allow installation of an extension pipe, a connection must be designed into the exhaust system for temporary attachment of exhaust sampling equipment. An example of an approved connection would be internally threaded with standard pipe threads of a size not larger than one-half inch, and shall be closed by a pipe-plug when not in use.

Emission Control Label

If you install the engine in a way that makes the engine's emission control information label hard to read during normal engine maintenance, you must place a duplicate label on the equipment, as described in 40 CFR 1068.105.

YANMAR WARRANTIES

Fuel Inlet Label

Unless otherwise specified, Yanmar will also provide a supplemental fuel inlet label with each certified engine for installation on the equipment. Permanently attach this label to the equipment near the fuel inlet.

Installation Evaluation

Yanmar Co. Ltd. and its regional headquarters will determine approval of applications to the guidelines of the Application Manual, including these Emission-Related Installation Instructions.

To ensure engine performance and exhaust emissions compliance Yanmar will review net rated output based on engine build, intake air restriction, exhaust back pressure, engine heat balance and any other operational characteristic required under the Engine Installation Evaluation process.

Engine Maintenance

Equipment manufacturers are responsible for relaying all emission-related service intervals to the final consumer of the product.

For equipment manufacturers who prepare their own warranty cards, owner's manuals, service manuals, operation manuals and any related documents; they must reference the emission-related service intervals and procedures indicated in Yanmar's technical documents: Warranty Statement, Operation Manual, Service Manual and Application Manual.



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 TNV 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 TNV 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:

SYMBOL EXPLANATION

The following symbols are used throughout this manual to identify specific engine model information



This symbol indicates information pertaining to the following indirect injection engines:

- 2TNV70*
- 3TNV70*
- 3TNV76*

An asterisk (*) indicates the engines conform to the engine emission regulations (EPA 2008 rules).



This symbol indicates information pertaining to the following direct injection engines:

- 3TNV82A
- 3TNV82A-B*
- 3TNV84
- 3TNV84T-Z**
- 3TNV84T
- 3TNV84T-B*
- 3TNV88
- 3TNV88-Z**
- 4TNV84
- 3TNV88-B*
- 4TNV84T
- 3TNV88-U*
- 4TNV88 4TNV94L
- 4TNV84T-Z**
- 4TNV98
- 4TNV84T-B*
- 4TNV88-Z**
- 4TNV98T
- 4TNV88-B*
- 4TNV106
- 4TNV88-U*
- 4TNV106T

- 4TNV98-Z**
- 4TNV98-E**
- 4TNV98T-Z**

An asterisk (*) indicates the engines conform to the engine emission regulations (EPA 2008 rules).

A double asterisk (**) indicates the engines are electronically controlled and conform to the engine emission regulations (EPA 2008 rules).

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

▲ WARNING

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

A CAUTION

Caution (the word "CAUTION" is in black letters with a yellow rectangle behind it) - indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

Caution without the safety alert symbol indicates a potentially hazardous situation that can cause damage to the machine, personal property and / or the environment or cause the machine to operate improperly.

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 or service 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

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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.
- Tighten the radiator cap securely after you check the radiator. Steam can spurt out during engine operation if the cap is loose.
- ALWAYS check the level of the engine coolant by observing the reserve tank.
- Failure to comply will result in death or serious injury.

/iv D/ANCHER

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 while the engine is running or battery is charging.
- Never short out the battery terminals, including when checking the remaining battery charge. 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.

TNV Operation Manual

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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 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.
- Only use the key switch to start the engine.
- NEVER jump-start the engine. Sparks caused by shorting the battery to the starter terminals may cause a fire or explosion.
- If the unit has an electric fuel pump, when you prime the fuel system, turn the key switch to the ON position for 10 to 15 seconds to allow the electric fuel pump to prime the system.
- If the unit has a mechanical fuel pump, when you prime the fuel system, operate the fuel priming lever of the mechanical fuel pump several times until the fuel filter cup is filled with fuel.
- NEVER open the air vent valve while the fuel system is being primed. The fuel filter has an internal air bleed port.
- NEVER use diesel fuel as a cleaning agent.
- NEVER remove the fuel cap with the engine running.
- Only fill the fuel tank with diesel fuel. Filling the fuel tank with gasoline may result in a fire and will damage the engine.
- NEVER refuel with the engine running.

/:\###/.\\@###

(Continued)

- Keep sparks, open flames or any other form of ignition (match, cigarette, static electric source) well away when refueling.
- · NEVER overfill the fuel tank.
- Fill the fuel tank. Store any containers containing fuel in a well-ventilated area, away from any combustibles or sources of ignition.
- Be sure to place the diesel fuel container on the ground when transferring the diesel fuel from the pump to the container. Hold the hose nozzle firmly against the side of the container while filling it. This prevents static electricity buildup 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 shutdown.
- 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.
- When you prime the fuel system, operate the fuel priming lever of the mechanical fuel pump several times until the fuel filter cup is filled with fuel.
- Failure to comply will result in death or serious injury.

ZANDANGER

CRUSH HAZARD!



- When you need to transport an engine for repair, have a helper assist you to attach it to a hoist and load it on a truck.
- NEVER stand under a hoisted engine. If the hoist mechanism fails, the engine will fall on you, causing death or serious injury.
- 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 battery fluid contacts the eyes and / or skin, immediately flush the affected area with a large amount of clean water and obtain prompt medical treatment.
- Failure to comply could 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.
- Failure to comply could result in death or serious injury.

TNV Operation Manual

▲ 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 back long hair when you are working near moving / rotating parts such as a cooling fan, flywheel, or PTO shaft.
- NEVER operate the engine while wearing a headset to listen to music or radio because it will be difficult to hear the alert signals.
- Failure to comply could 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.
- If you must drain the engine oil while it is still hot, stay clear of the hot engine oil to avoid being burned.
- · ALWAYS wear eye protection.
- 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.

A WARNING

HIGH-PRESSURE HAZARD!



- Avoid skin contact with the high-pressure diesel fuel spray caused by a fuel system leak such as a broken fuel injection line. High-pressure fuel can penetrate your skin and result in serious injury. If you are exposed to high-pressure fuel spray, obtain prompt medical treatment.
- NEVER check for a fuel leak with your hands.
 ALWAYS use a piece of wood or cardboard.
 Have your authorized 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 ENTANGLEMENT HAZARD!



 Stop the engine before you begin to service it.

- NEVER leave the key in the key switch when you are servicing the engine. Someone may accidentally start the engine and not realize you are servicing it. This could result in a serious injury.
- If you must service the engine while it is operating, remove all jewelry, tie 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 SUDDEN MOVEMENT HAZARD!

- Engaging the transmission or PTO at an elevated engine speed could result in unexpected movement of the equipment.
- Failure to comply could result in death or serious injury.

TNV Operation Manual

A 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, flush eyes and wash immediately with clean water.
- Failure to comply may result in minor or moderate injury.

A CAUTION

FLYING OBJECT HAZARD!



- ALWAYS wear eye protection when servicing the engine and when using compressed air or high-pressure water. Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.
- Failure to comply may result in minor or moderate injury.

A CAUTION

- When using a 120V system only, push the change-over switch to the right (120V).
- The main switch should always be kept in the ON position during operation.
- Before starting the engine, ALWAYS turn the switches on the working instruments (lighting apparatus, motor, etc.) to their OFF position. If the switches are not OFF, the sudden application of load when the engine is started could be very dangerous.

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

- 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 the primary strainer (if equipped) from the fuel tank filler port. If removed, dirt and debris could get into the fuel system causing it to clog.

NOTICE

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

NOTICE

Make sure the engine is installed on a level surface. If a continuously running engine is installed at an angle greater than (IDI = 25° , DI = 30°) in any direction or if an engine runs for short periods of time (less than three minutes) at an angle greater than (IDI = 30° , DI = 35°) in any direction, engine oil may enter the combustion chamber causing excessive engine speed and white exhaust smoke. This may cause serious engine damage.

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

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:

- The standard range of ambient temperatures for the normal operation of Yanmar engines is from +5°F (-15°C) to +113°F (+45°C).
- If the ambient temperature exceeds +113°F (+45°C) the engine may overheat and cause the engine oil to break down.
- If the ambient temperature is below +5°F (-15°C) the engine will be hard to start and the engine oil may not flow easily.
- Contact your authorized Yanmar industrial engine dealer or distributor if the engine will be operated outside of this standard temperature range.

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.

NOTOE

- · Only use the engine oil specified. Other engine oils may affect warranty coverage, cause internal engine components to seize and / or shorten engine life.
- Prevent dirt and debris from contaminating the engine oil. Carefully clean the oil cap / dipstick and the surrounding area before you remove the cap.
- NEVER mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil.
- NEVER overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

NOTICE

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



- Only use the engine coolant specified. Other engine coolants may affect warranty coverage, cause an internal buildup of rust and scale and / or shorten engine life.
- Prevent dirt and debris from contaminating the 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 the upper and lower lines on the oil cap / dipstick.

NOTICE

For maximum engine life, Yanmar recommends that when shutting the engine down, you allow the engine to idle, without load, for five 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 engage the starter motor while the engine is running. This may damage the starter motor pinion and / or ring gear.

NOTICE



- ALWAYS be environmentally responsible.
- Follow the guidelines of the EPA or other governmental agencies 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.
- Failure to follow these procedures may seriously harm the environment.

Precautions for handling desiccant

Disposal:

This material is disposable as non-flammable. however, the bag is flammable and if it is necessary, then tear the bag and discard the bag and the contents separately.

It is desirable to bury the contents in the bag under ground.

Dispose in accordance with the disposal standards for industrial waste defined by local laws and regulations.

Handling:

The contents of the bag do not leak out in the normal use.

Take the following emergency measures, however, if the contents leak out.

- If the contents get on the skin, rinse thoroughly with running water.
- If the contents get in the eyes, rinse thoroughly with water. Consult with doctors when any abnormalities are found.
- If the contents get in the mouth, rinse thoroughly with water. Drink water to dilute if the content is swallowed, though a small amount is harmless.
 Consult with doctors when any abnormalities are found.

Characteristics of Materials:

Calcium Chloride (CaCl2)	Approx. 57%
Grain Polysaccharide	Approx. 28%
Grain Skins	Approx. 9%
 Ethylene Polymer(Bag) 	Approx. 5%

Hazard Information:

 Explosiveness 	None
 Inflammability 	Inflammable
 Combustibility 	None
 Oxidation 	None

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 in the Warranty Section of this manual.

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

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 the load on the engine. Short periods of maximum engine speed and load are desirable. Avoid prolonged operation at minimum or maximum engine speeds and loads for the next four to five 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

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



NEVER use high-pressure water or compressed air at greater than 28 psi (193 kPa; 19 686 mmAq) or a wire brush to clean the radiator fins. Radiator fins damage easily.

NOTICE

The tightening torque in the Standard Torque Chart in the *Periodic Maintenance Section* of this manual 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



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 element(s) removed. This may allow foreign material to enter the engine and damage it.

NOTICE

The maximum air intake restriction, in terms of differential pressure measurement, must not exceed 0.90 psi (6.23 kPa; 635 mmAq). Clean or replace the air cleaner element if the air intake restriction exceeds the above mentioned value.

NOTICE

Make it a habit to perform daily checks. See Daily Checks in the Before You Operate Section of this manual.

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

NOTICE

- NEVER attempt to modify the engine's design or safety features such as defeating the engine speed limit control or the diesel fuel injection quantity control.
- Modifications may impair the engine's safety and performance characteristics and shorten the engine's life. Any alterations to this engine may void its warranty. Be sure to use Yanmar genuine replacement parts.

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PRODUCT OVERVIEW

YANMAR TNV ENGINE FEATURES AND APPLICATIONS

Yanmar's series of TNV engines are environmentally friendly and are designed to:

- · Lower the amount of exhaust gas emissions.
- Reduce engine noise and vibration.
- Be easy to start thanks to the specially designed fuel injection pump and combustion system.
- Be economical to run because diesel fuel and engine oil consumption are reduced.
- Be easy to operate due to the minimum amount of required maintenance and their compact design.
- Be durable and reliable due in part to the newly designed fuel injection valve and fuel injection pump.

Yanmar TNV 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, such as fuel tank, control panel, indicators, gauges and alarms, 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



2TNV70, 3TNV70, 3TNV76

Figure 1 shows where major indirect injection engine components are located.

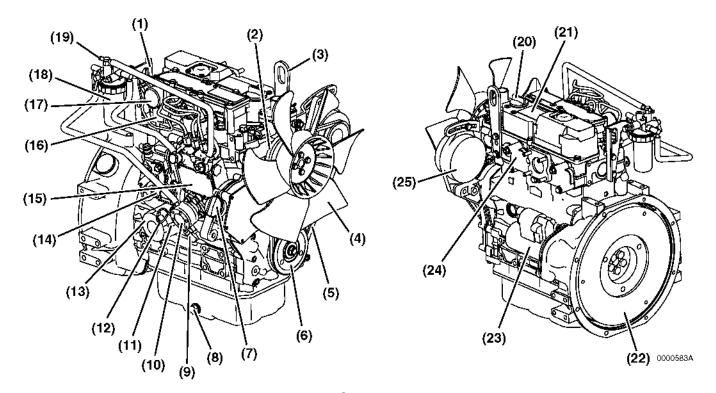


Figure 1

- 1 Lifting Eye (Flywheel End)
- 2 Engine Coolant Pump
- 3 Lifting Eye (Engine Cooling Fan End)
- 4 Engine Cooling Fan
- 5 V-Belt
- 6 Crankshaft V-Pulley
- 7 Side Filler Port (Engine Oil)
- 8 Drain Plug (Engine Oil)*
- 9 Fuel Inlet
- 10 Mechanical Fuel Pump
- 11 Fuel Priming Lever
- 12 Dipstick (Engine Oil)
- 13 Engine Oil Filter

- 14 Governor Lever
- 15-Fuel Injection Pump
- 16-Intake Manifold
- 17 Air Intake Port (From Air Cleaner)
- 18-Fuel Filter
- 19-Fuel Return to Fuel Tank
- 20-Top Filler Port (Engine Oil)
- 21 Rocker Arm Cover
- 22 Flywheel
- 23 Starter Motor
- 24-Exhaust Manifold
- 25 Alternator

^{*} Engine oil drain plug location may vary based on oil pan options.



3TNV82A, 3TNV84, 3TNV84T, 3TNV88, 4TNV84, 4TNV84T, 4TNV88, 4TNV94L, 4TNV98, 4TNV98T, 4TNV106, 4TNV106T, 3TNV82A-B, 3TNV84T-Z, 3TNV84T-B, 3TNV88-Z, 3TNV88-B, 3TNV88-U, 4TNV88-Z, 4TNV88-B, 4TNV88-U

Figure 2 shows where major direct injection engine components are located.

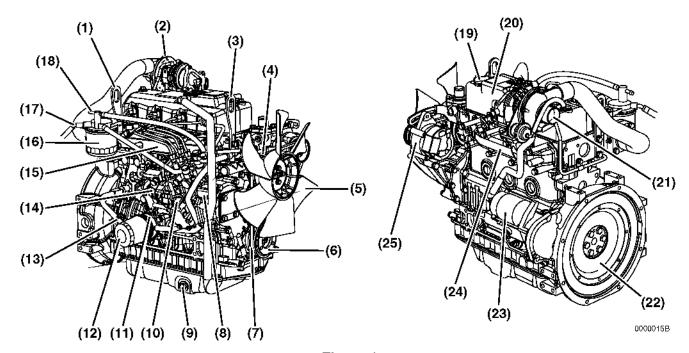


Figure 2

- 1 Lifting Eye (Flywheel End)
- 2 Turbocharger*
- 3 Lifting Eye (Engine Cooling Fan End)
- 4 Engine Coolant Pump
- 5 Engine Cooling Fan
- 6 Crankshaft V-Pulley
- 7 V-Belt
- 8 Side Filler Port (Engine Oil)
- 9 Drain Plug (Engine Oil)**
- 10-Fuel Injection Pump
- 11 Engine Oil Cooler***
- 12 Engine Oil Filter
- 13 Dipstick (Engine Oil)

- 14-Governor Lever
- 15 Intake Manifold
- 16-Fuel Filter
- 17 Fuel Inlet
- 18-Fuel Return to Fuel Tank
- 19-Top Filler Port (Engine Oil)
- 20 Rocker Arm Cover
- 21 Air Intake Port (From Air Cleaner)
- 22 Flywheel
- 23 Starter Motor
- 24 Exhaust Manifold
- 25 Alternator
- * Only applies to 3TNV84T, 4TNV84T, 4TNV98T, 4TNV106T.
- ** Engine oil drain plug location may vary based on oil pan options.
- *** Not standard on all direct injection models.



4TNV84T-Z, 4TNV98-E, 4TNV98-Z, 4TNV98T-Z

Figure 3 shows where major direct injection engine components are located.

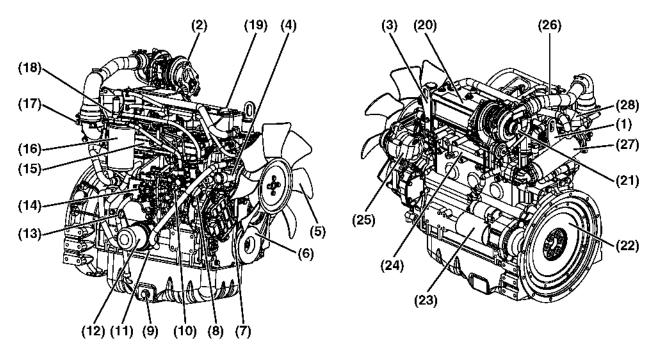


Figure 3

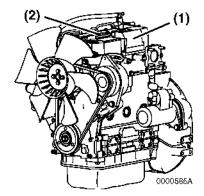
- 1 Lifting Eye (Flywheel End)
- 2 Turbocharger*
- 3 Lifting Eye (Engine Cooling Fan End)
- 4 Engine Coolant Pump
- 5 Engine Cooling Fan
- 6 Crankshaft V-Pulley
- 7 V-Belt
- 8 Side Filler Port (Engine Oil)
- 9 Drain Plug (Engine Oil)**
- 10-Fuel Injection Pump
- 11 Engine Oil Cooler***
- 12 Engine Oil Filter
- 13 Dipstick (Engine Oil)
- 14 Eco-governor

- 15 Intake Manifold
- 16-Fuel Filter
- 17 Fuel Inlet
- 18-Fuel Return to Fuel Tank
- 19-Top Filler Port (Engine Oil)
- 20 Rocker Arm Cover
- 21 Air Intake Port (From Air Cleaner)
- 22 Flywheel
- 23 Starter Motor
- 24-Exhaust Manifold
- 25 Alternator
- 26-EGR valve
- 27-EGR cooler****
- 28-EGR pipe
- * Only applies to 4TNV84T-Z, 4TNV98T-Z.
- ** Engine oil drain plug location may vary based on oil pan options.
- *** Not standard on all direct injection models.
- **** Only applies to 4TNV84T-Z, 4TNV98T-Z.

LOCATION OF LABELS



Figure 4 shows the location of regulatory and safety labels on Yanmar TNV series indirect injection model engines.



The typical location of the emission control information label is shown (Figure 4, (1)).

Typical location of the engine nameplate is shown (Figure 4, (2)).

Figure 4



Figure 5 shows the location of regulatory and safety labels on Yanmar TNV series direct injection model engines.

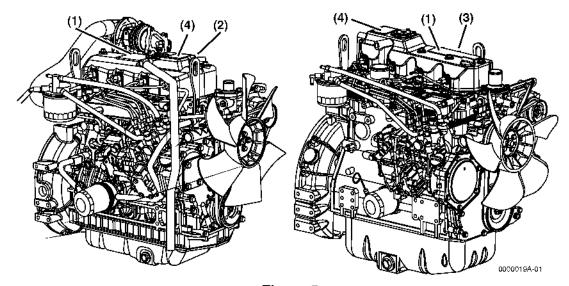
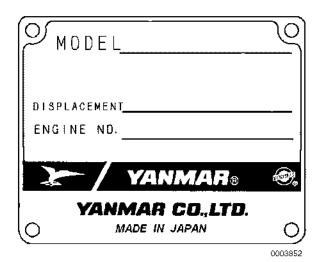


Figure 5

Location of labels/nameplates on direct injection model engines

Model	Engine Nameplate	EPA/ARB Certification Label	97/68/EC Emission Control Label
3TNV82A, 3TNV84, 3TNV84T, 3TNV88 3TNV82A-B, 3TNV88-Z, 3TNV88-B 3TNV88-U, 3TNV84T-B, 3TNV84T-Z	On the top of the locker arm cover(cooling fan end) Figure 5 left, (4)	On the top of the locker arm cover (flywheel end) Figure 5 left, (1)	On the exhaust side of the locker arm cover(near the flywheel) Figure 5 left, (2)
4TNV84, 4TNV88, 4TNV84T 4TNV88-Z, 4TNV88-B, 4TNV88-U 4TNV84T-Z	On the top of the locker arm cover(cooling fan end) Figure 5 left, (4)	On the top of the locker arm cover(flywheel end) Figure 5 left, (1)	On the exhaust side of the locker arm cover(near the flywheel) Figure 5 left, (1)
4TNV94L, 4TNV98, 4TNV98T 4TNV106, 4TNV106T 4TNV98-Z, 4TNV98-E, 4TNV98T-Z	On the top of the locker arm cover(flywheel end) Figure 5 right, (4)	On the top of the locker arm cover(center) Figure 5 right, (1)	On the top of the locker arm cover(fan end) Figure 5 right, (3)

Engine Nameplate (Typical)



EPA / ARB EMISSION CONTROL REGULATIONS - USA ONLY

Yanmar TNV 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 EPA / ARB Installation Requirements USA Only on page 67 and Required EPA / ARB Maintenance USA Only on page 67 in the Periodic Maintenance section of this manual. Also refer to the Yanmar Co., Ltd. Limited Emission Control System Warranty - USA Only on page v.

EMISSION CONTROL LABELS

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
ENGINE FAMILY: DISPLACEMENT: LITERS
ENGINE MODEL: EMISSION CONTROL SYSTEM:
FUEL RATE: STROKE @ STROKE @ FINAL FRM STROKE
REFER TO OWNER'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS
YANMAR. YANMAR CO.,LTD.

001751-00%

(EPA)

EMISSION CONTROL INFORMATION
THIS ENGINE COMPLIES WITH U.S. EPA AND CALIFORNIA REGULATIONS FOR The M.Y. NONROAD/OFF-ROAD DIESEL ENGINES.
LOW SULFUR FUEL OR ULTRA LOW SULFUR FUEL ONLY
ENGINE FAMILY: DISPLACEMENT: DISPLACEMENT: LITERS
ENGINE MODEL: EMISSION CONTROL SYSTEM:
FUEL RATE: MWYSTROKE@[]]WY/[]] FPM []
REFER TO OWNER'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS
YANMAR. YANMAR CO.,LTO.

001750-00X

(EPA & CARB)

THE 97/68/EC DIRECTIVE CERTIFIED ENGINES

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

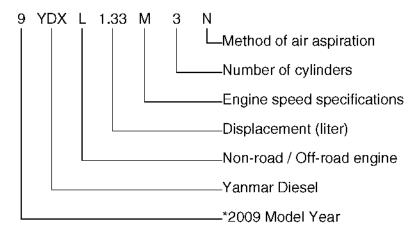
To identify the engines that meet this certification, the 97/68/EC emission control label is affixed on the engines.

IMPORTANT ENGINE INFORMATION
THIS ENGINE CONFORMS TO 97/68/EC DIRECTIVE
ENGINE FAMILY : []
ENGINE MODEL : []
APPROVAL NUMBER : []
YANMAR CO.,LTD.

(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:2010

B:2011

C:2012

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 <i>Periodic Maintenance Schedule on page 69</i> 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.
Electric Fuel Pump	The electric fuel pump makes sure there is a constant supply of diesel fuel to the fuel injection pump. The electric fuel pump is electro-magnetic and runs on 12VDC. An electric fuel pump may be installed as an option or as standard equipment. Standard equipment may vary based on engine model and specification. If an electric fuel pump is installed, turn the key switch to the ON position for 10 to 15 seconds to prime the fuel system.
Engine Oil Filter	The engine oil filter removes contaminants and sediment from the engine oil. Periodic replacement of the engine oil filter is necessary. See the <i>Periodic Maintenance Schedule on page 69</i> for the replacement frequency.
Engine Oil Cooler (If Equipped)	The engine oil cooler helps to keep the engine oil cool. Engine coolant from the cooling system is circulated by the coolant pump through an adapter at the base of the engine to the oil cooler and then to the cylinder block and back to the coolant pump.
Fuel Filter	The fuel filter removes contaminants and sediments from the diesel fuel. Periodic replacement of the fuel filter is necessary. See the Periodic Maintenance Schedule on page 69 for the replacement frequency. Please note that the word "diesel" is implied throughout this manual when the word "fuel" is used.
Fuel Filter / Water Separator	The fuel filter / water separator removes contaminants, sediment and water from diesel fuel going to the fuel filter. This is a required component of the fuel system and is standard equipment with every engine. The separator is installed between the fuel tank and the fuel pump. Periodically drain the water from the fuel filter / water separator using the drain cock at the bottom of the separator.

Components	Functions
Fuel Priming Lever	If the unit has a mechanical fuel pump, a fuel priming lever on the mechanical fuel pump primes the fuel system. The fuel system needs to be primed before you start the engine for the first time, if you run out of fuel, or if fuel system service is performed. To prime the fuel system, operate the fuel priming lever until the cup in the fuel filter is full of fuel.
Fuel Tank	The fuel tank is a reservoir that holds diesel fuel. When fuel leaves the fuel tank it goes to the fuel filter / water separator. Next, fuel is pumped to the fuel filter by the electric or mechanical 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.
Mechanical Fuel Pump	The mechanical fuel pump is a diaphragm-type of pump and is installed on the fuel injection pump body. The mechanical fuel pump is driven by a cam on the camshaft of the fuel injection pump. An electric fuel pump is available as an option. The mechanical fuel pump is not installed on the fuel injection pump if the electric fuel pump option is installed.
Side and Top Filler Port (Engine Oil)	You can fill the crankcase with engine oil from <i>either the side or top filler port</i> 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.
Turbocharger (Only applies to 3TNV84T, 4TNV84T, 4TNV98T, 4TNV106T)	The turbocharger pressurizes the air coming into the engine. It is driven by a turbine that is energized by exhaust gases.

FUNCTION OF COOLING SYSTEM COMPONENTS

Components	Functions			
Cooling System	The TNV 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 and allows engine coolant to flow through the radiator. By letting the engine warm up as quickly as possible, the thermostat reduces engine wear, deposits and emissions.			

ELECTRONIC CONTROL SYSTEM



4TNV84T-Z, 4TNV98-E, 4TNV98-Z, 4TNV98T-Z

▲ WARNING

- Never use the E-ECU for other purposes than intended or in other ways than specified by Yanmar. Doing so could result in the violation of emission control regulations and will void the product warranty.
- Improper use or misuse of the E-ECU may result in death or serious injury due to an abrupt and unexpected increase in engine speed.

A WARNING

- Be sure to use the E-ECU in conjunction with the engines whose models or serial numbers are specified by Yanmar.
 Other E-ECU/engine combinations than specified will void the engine warranty.
- Improper use or misuse of the E-ECU may result in death or serious injury due to an abrupt and unexpected increase in engine speed.

WARNING

- Replacing the fuel injection pump involves rewriting the fuel injection data in the E-ECU.
 Be sure to contact your local Yanmar dealer before replacing the fuel injection pump.
 Failure to rewrite the fuel injection data before replacing the fuel injection pump will void the engine warranty.
- Improper use or misuse of the E-ECU may result in death or serious injury due to an abrupt and unexpected increase in engine speed.

▲ WARNING

- Replacing the E-ECU involves migrating the fuel injection data to the existing E-ECU to the new unit.
 - Be sure to contact your local Yanmar dealer before replacing the E-ECU. Failure to migrate the fuel injection data before replacing the E-ECU will void the engine warranty.
- Improper use or misuse of the E-ECU may result in death or serious injury due to an abrupt and unexpected increase in engine speed.

NOTICE

Shut down the engine if the fault indicator comes

Continuing running the engine with the fault indicator being on may result in a serious malfunction of or damage to the engine, and will void the engine warranty.

NOTICE

Do not energize the starter for a period of longer than 15 seconds.

Take a pause of at least 30 seconds between energization of the starter.

Otherwise the starter could suffer damage.

NOTICE

- · High-pressure washing not recommended.
- · Avoid using high-pressure washing for electronic or electric devices installed in, on or around the engine, including the E-ECU, relays and harness couplers.

Otherwise such devices may suffer malfunction due to water ingress into them.

NOTICE

- . Do not plug or unplug the E-ECU for a period of at least 6 seconds after power to the unit has been turned on or off.
- Do not touch connector pins of the E-ECU with bare hands.
 - Doing so may result in corrosion of the connector pins and/or damage to the internal circuits of the E-ECU due to static electricity.
- Do not force a measuring probe into the female coupler.
 - Doing so may cause contact failure of the connector pins, resulting in malfunction of the E-EÇU.
- Take care to prevent water from entering the couplers when plugging or unplugging the connector.
 - Water inside the couplers may cause corrosion. resulting in malfunction of the E-ECU.
- · Avoid plugging/unplugging the connector more than approx. 10 times. Frequent plugging/unplugging of the connector may cause contact failure of the connector pins. resulting in malfunction of the E-ECU.
- Do not use the E-ECU that has ever suffered drop impact.

NOTICE

Always check the battery for proper charge.

Otherwise the electronically controlled engines may fail to start.

Model 4TNV84T-Z, 4TNV98-E, 4TNV98-Z and 4TNV98T-Z engines come with the Exhaust Gas Recirculation (EGR) system to conform to the engine emission regulations (EPA 2008 rules). The EGR system and an electronic governor (Eco-governor) constitute an electronic engine control system.

The electronic engine control system regulates the exhaust gas recirculation flow rate and the fuel injection volume depending on the engine load and speed signals from the engine controller (E-ECU), so that the exhaust gas is kept clean according to the emission control regulations. **Figure 6** illustrates the electronic engine control system.

Features of the electronic engine control system include:

- Engine speed control schemes
 Droop control / Low-idling speed up / Auto
 deceleration / High-idling speed down / Black
 smoke suppression
- Starting aid Auto preheating / After heating
- · Engine failure detection
- CAN communication with the control system of the driven machine

The above features are detailed in the table on the next pages.

Consult the operation manual for the driven machine for applicability of the features that depends on the machine.

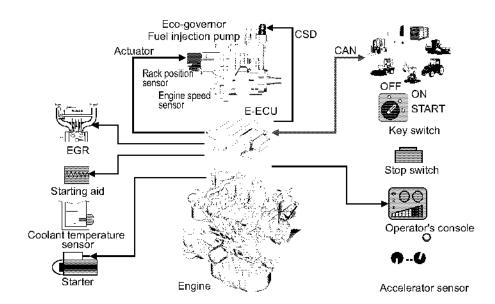


Figure 6

MAIN ELECTRONIC CONTROL COMPONENTS AND FEATURES



4TNV84T-Z, 4TNV98-E, 4TNV98-Z, 4TNV98T-Z

Compoi	nent/Feature	Description
Engine controller (E-ECU)		Adjusts the rack position of the fuel injection pump depending on the speed command signal from the accelerator sensor, thus regulating the engine speed and power. The engine controller also regulates the opening of the EGR valve depending on the engine speed and power. It serves as the master station for the following components/control features.
Electronic governor (Eco-governor)		Consists of the engine speed sensor, rack actuator, etc., and is directly connected to the fuel injection pump in order to regulate the rack position of the fuel injection pump depending on the signals communicated with the E-ECU.
Fuel injection pump (for Eco-governor)		Is of single plunger type and equipped with a CSD solenoid valve that allows the fuel injection timing to advance and the injection quantity to increase, thereby improving the cold start performance of the engine.
EGR valve		Controls the exhaust gas recirculation flow rate depending on the engine speed/load signals from the E-ECU. It is installed on the top of the exhaust manifold.
Accelerator sensor		Unlike mechanical governors, the Eco-governor has no governor lever. The accelerator sensor serves as the governor lever to provide the speed command signal (voltage signal) to the E-ECU for engine speed control. It is installed in the operator cabin of the driven machine. Constant speed engines for e.g. generator use do not require accelerator sensors because the engine speed can be shifted via a switch on the operator's console.
	Optional	CAN communication capability is available as an option.
Fault indicator		Is installed on the operator's console. If a fault occurs in the E-ECU or Eco-governor, the fault indicator flashes alerting the operator to a fault. The number of flashes and/or the flashing pattern vary depending on the type or
	Optional	source of the fault, enabling quick-fix.

Compor	nent/Feature	Description		
		Allows the operator to troubleshoot the cause of a problem based on detailed information regarding the problem occurring in the E-ECU or Eco-governor. This tool can also be used for data maintenance tasks including programming and mapping. See Troubleshooting Chart on page 98.		
Engine coolant temp	erature sensor	Allows the CSD and ERG to be controlled in engine cold-start conditions.		
Glow plugs Air heater Optional		When the key switch is turned to the ON position, the glow plugs/air heater are/is energized for up to 15 seconds (glow plugs) or up to 23 seconds (air heater). The duration of energization depends on the engine coolant temperature. The HEAT indicator is on during energization. When the indicator goes out, turn the key switch to the START position to start the engine.		
After heater	Optional	In extreme cold start conditions, the after heater is energized for up to 80 seconds or until the coolant temperature reaches 10°C after the engine has started, in order to help ensure the engine continues to run without stall. This option is not available for glow plug engines.		
Droop control	Standard with VM series	Reduces the engine speed by a certain percentage from no load to full (rated) load in steady state operation. The same percentage droop is maintained even when the load increases at any no-load speed.		
Isochronous control	Standard with CL series Optional with VM series	Offers a constant engine speed from no load to full load. The engine speed does not decrease even when the load increases at any no-load speed.		
Low-idling speed up		Increases the low-idling speed to up to 1000 rpm depending on the engine coolant temperature. When the coolant temperature reaches a predetermined value, this feature returns the engine speed to the normal low idle setting, thus reducing the warm-up time.		
High-idling speed down	Optional	Decreases the high-idling speed depending on the engine coolant temperature. When the coolant temperature falls to a predetermined value, this feature returns the engine speed to the normal high idle setting, thus minimizing the emission of white smoke at low temperatures.		
Auto deceleration	Optional	Brings the running engine in low idle mode automatically when the accelerator pedal is not operated for a predetermined period of time. When the pedal is operated, i.e., the accelerator sensor is activated, the low idle mode is cancelled.		

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.

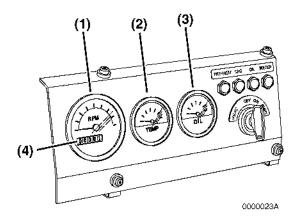


Figure 7

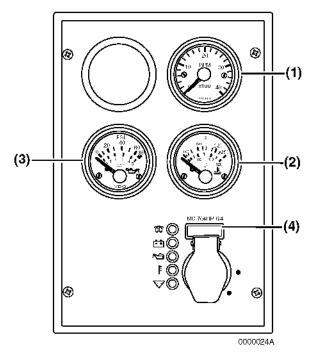


Figure 8

Tachometer - The tachometer display (Figure 7, (1)) or (Figure 8, (1)) shows the engine speed in revolutions per minute (RPM).

Engine Coolant Temperature - The engine coolant temperature display (Figure 7, (2)) or (Figure 8, (2)) shows the temperature of the engine coolant.

Engine Oil Pressure - The engine oil pressure display (Figure 7, (3)) or (Figure 8, (3)) shows the pressure of the engine oil.

Hour Meter - The hour meter display (Figure 7, (4)) or (Figure 8, (4)) shows the total number of hours the engine has run. This is useful for planning the *Periodic Maintenance Procedures* on page 72.

Indicators

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

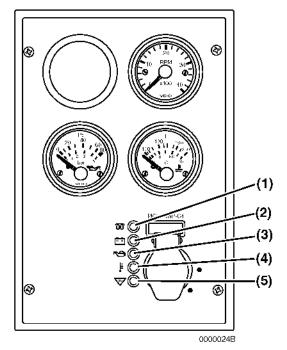


Figure 9

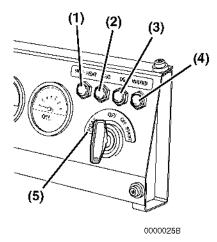


Figure 10

HEAT indicator (Figure 9, (1)) - The pre-heat function is automatically activated when the key switch is turned to the ON position. The indicator flashes for several seconds (4 sec. for IDI models with glow plugs, 15 sec. for DI models with glow plugs or air heater) and when it goes out you can turn the key switch to START.

Some electronically controlled engines have the optional capability of controlling the glow plug/air heater energization time via the key switch. For details, consult the operation manual for the driven machine.

HEAT indicator (Figure 10, (1)) - Note that on this type of panel you must turn the key to the HEAT position (**Figure 10, (5)**) to activate the inlet air heater or glow plugs. The indicator will flash for several seconds (4 sec. for IDI models with glow plugs, 15 sec. for DI models with glow plugs or air heater) when you turn the key to HEAT and when it goes out, you can turn the key switch to START.

Battery Charge (Figure 9, (2)) or (Figure 10, (2)) - This indicator will come on if there is a problem in the charging system. This indicator does not indicate if the battery is discharged. See Troubleshooting Chart on page 98.

Engine Oil Pressure (Figure 9, (3)) or (Figure 10, (3)) - This indicator will come on if the engine oil pressure is below or exceeds normal limits. See Troubleshooting Chart on page 98.

Engine Coolant Temperature (Figure 9, (4)) or (Figure 10, (4)) - This indicator will come on if the engine coolant temperature exceeds normal limits. See Troubleshooting Chart on page 98.

Auxiliary (Figure 9, (5)) - Used for special applications.

GAUGES AND INDICATORS OF ELECTRONIC CONTROL SYSTEM



4TNV84T-Z, 4TNV98-E, 4TNV98-Z, 4TNV98T-Z

Gauges

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

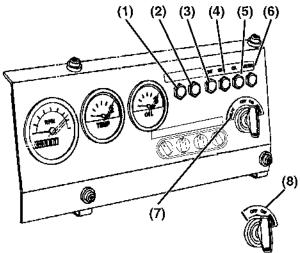
NOTICE

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.

Indicators

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

See the *Gauges and Indicators* section for description of indicators that are not described below.



Optional key switch:Turning it to ON energizes the glow plugs or air heater automatically.

Figure 11

Figure 11 Typical Operator's Console

Fault (Figure 11, (1)) (optional) - This indicator will flash if a fault occurs in the E-ECU or Eco-governor. The number of flashes and/or the flashing pattern vary depending on the type or source of the fault. See Troubleshooting Chart on page 98.

Auxiliary (Figure 11, (2)) - Reserved as an optional fault indicator.

HEAT (Figure 11, (3)) - This indicator will come on when the key switch is turned to the HEAT position (Figure 11, (7)) and stay on as long as the glow plugs (of model 3TN84T-Z only) or air heater are/is energized (15 sec. for models with glow plugs or air heater) during engine cold start. When the indicator goes out, you can turn the key switch to START.

Turning the optional key switch (Figure 11, (8)) to ON allows you to energize the glow plugs for up to 15 sec. or the air heater up to 23 sec. depending on the engine coolant temperature.

When an optional after heater is installed, it is energized for up to 80 sec. after the engine has started, during which, however, the indicator is not on.

Others (optional) - Other optional indicators including those for indicating the air cleaner is clogged or the water separator is filled with water can also be installed on the console. See the operation manual for the driven machine for details.

Machine events including alarms and faults are all stored in memory of the E-ECU and can be loaded into the service tool.

CONTROLS

Key Switch

The key switch for the operator's console illustrated in **Figure 12** has three positions - OFF, ON and START.

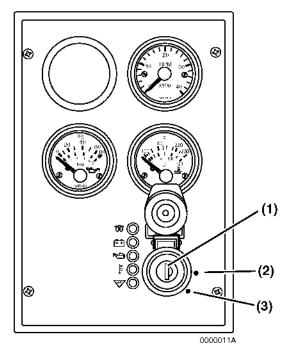


Figure 12

NOTICE

For maximum engine life, Yanmar recommends that when shutting the engine down, you allow the engine to idle, without load, for five 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.

OFF (key straight up and down) (Figure 12, (1)) and (Figure 13, (1)) - 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 12, (2)) and (Figure 13, (2)) - 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, electric fuel pump 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 12, (3)) and (Figure 13, (3)) - 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. When operating a key switch with this feature, you cannot turn the key to the START position without first returning the key to the OFF position.

The key switch for the operator's console illustrated in **Figure 13** has four positions - OFF, ON, START, and HEAT.

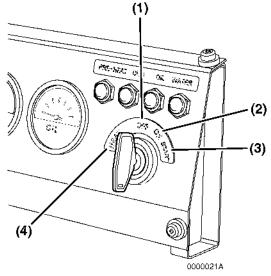


Figure 13

NOTICE

For maximum engine life, Yanmar recommends that when shutting the engine down, you allow the engine to idle, without load, for five 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 hold the key in the START position for longer than 15 seconds or the starter motor will overheat.

HEAT (Figure 13, (4)) - You must turn the key to the HEAT position to activate the inlet air heater. 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.

Glow Plugs



3TNV82A-B, 3TNV88-B, 3TNV88-Z, 3TNV88-U, 4TNV88-Z, 4TNV88-B, 4TNV88-U

Glow plugs help make the engine easy to start at cold temperatures. During the engine starting sequence, the glow plugs are activated for approximately 4 seconds. After the pre-heat indicator goes out, the engine can be started.

These plugs are installed in the cylinder head swirl chambers for IDI engines or in the combustion chambers for DI engines.

Inlet Air Heater



3TNV84T-Z, 3TNV84T-B, 4TNV84T-Z, 4TNV84T-B, 4TNV98-Z, 4TNV98-E, 4TNV98T-Z, 3TNV82A, 3TNV84, 3TNV84T, 3TNV88, 4TNV84, 4TNV84T, 4TNV88, 4TNV94L, 4TNV98, 4TNV98T, 4TNV106, 4TNV106T

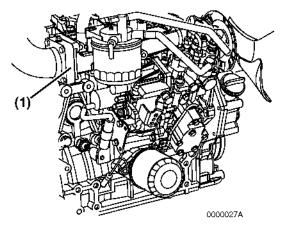
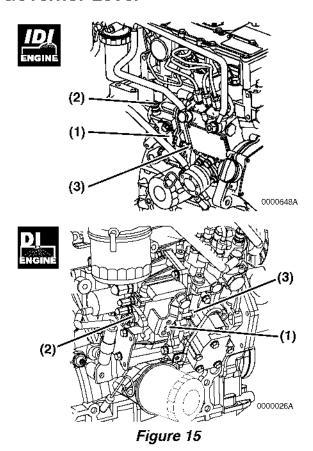


Figure 14

The inlet air heater (Figure 14, (1)) is located on the intake manifold. Heated inlet air helps the engine to start easier in cold weather. During the engine starting sequence the inlet air heater is activated for approximately 15 seconds. After the pre-heat indicator goes out, the engine can be started.

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 15, (1)) controls the engine speed. The lever is linked to the engine speed control device in the driven machine.

The high idle speed limit screw (Figure 15, (2)) restricts the maximum engine speed when the engine is operated without a load.

The low idle speed limit screw (Figure 15, (3)) sets engine speed while it is idling.

Speed Control of Electronically Controlled Engines

3TNV84T-Z, 4TNV84T-Z, 3TNV88-Z, 4TNV88-Z, 4TNV98-E, 4TNV98T-Z

The electronically controlled engines have no governor lever. For these engines, the position signal of the throttle lever or accelerator pedal of the driven machine is converted into an electric signal by the accelerator sensor **Figure 16**, which is then delivered to the rack actuator of the Eco-governor **Figure 18** through the E-ECU **Figure 17**, allowing the engine speed to be controlled.

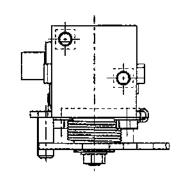


Figure 16

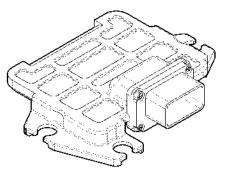


Figure 17

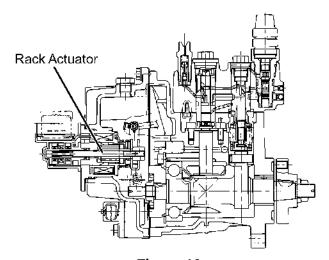


Figure 18

Engine Stop Solenoid

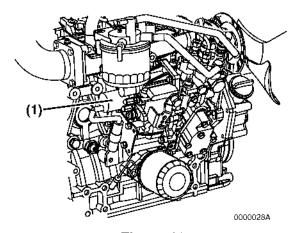


Figure 19

When the key is turned to the ON position, the engine stop solenoid (Figure 19, (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 is de-energized and shuts off the fuel supply from the fuel injection pump to the engine, causing the engine to stop.

The electronically controlled engines have no engine stop solenoid. The E-ECU controls the engine start/stop sequence.

ELECTRONIC ENGINE SPEED CONTROL



3TNV84T-Z, 4TNV84T-Z, 3TNV88-Z, 4TNV88-Z, 4TNV98-Z, 4TNV98-E, 4TNV98T-Z

Engine Speed Curves

Figure 20 shows typical engine speed curves that outline the relationship between engine speed and load.

Droop Control

The VM series engines for general use are designed so that the engine speed is reduced by a certain percentage from 30% load to full rated load. See curves (1) in Figure 20 below. The same percentage droop is maintained at any no-load speed.

Isochronous Control

The CL series consists of isochronous design engines, the speed of which is kept constant from no load to full rated load. See curves (2) in Figure 20 below.

Some VM series engines for general use may be custom-engineered and have the isochronous capability. Consult the operation manual for the driven machine for application details of such engines.

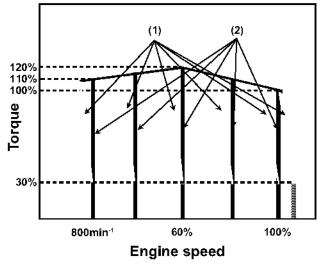


Figure 20

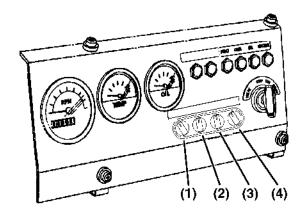


Figure 21

Figure 21 Typical Operator's Console and Switch Arrangement

Low-idling Speed Up

This feature increases the low-idling speed to some extent depending on the engine coolant temperature. When the coolant temperature reaches a predetermined value, this feature returns the engine speed to the normal low idle setting, thus reducing the warm-up time.

Auto Deceleration (optional)

This feature brings the running engine in low idle mode automatically when the accelerator pedal is not operated for a predetermined period of time. When the pedal is operated, i.e., the accelerator sensor is activated, the low idle mode is cancelled.

A certain ON/OFF combination of switches (1) - (4) on the operator's console **Figure 21** will implement this optional feature. For details, see the operation manual for the driven machine.

High-idling Speed Down (optional)

This feature decreases the high-idling speed depending on the engine coolant temperature. When the coolant temperature falls to a predetermined value, this feature returns the engine speed to the normal high idle setting, thus minimizing the emission of white smoke at low temperatures.

A certain ON/OFF combination of switches (1) - (4) on the operator's console **Figure 21** will implement this optional feature. For details, see the operation manual for the driven machine.

Others

Other optional features can be provided by selecting certain ON/OFF combinations of switches (1) - (4) on the operator's console Figure 21 will implement this optional feature. For details, see the operation manual for the driven machine.

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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, S500 No. 2D S15, S500	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. For electronically controlled EGR engines, use fuel with sulfur content of less than 0.1%.
 A higher sulfur content fuel may cause sulfuric acid corrosion in the cylinders of the engines. Especially in U.S.A. and Canada, Low Sulfur (300-500mg/kg sulfur content) or Ultra Low Sulfur fuel should be used.
- Bio-Diesel fuels. See Bio-Diesel Fuels on page 39.
- 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

1. General Description of Biodiesel

- (a) Biodiesel is a renewable, oxygenated fuel made from agricultural and renewable resources such as soybeans or rapeseeds. Biodiesel is a fuel comprised of methyl or ethyl ester-based oxygenates of long chain fatty acids derived from the transesterification of vegetable oils, animal fats, and cooking oils. It contains no petroleum-based diesel fuel but can be blended at any level with petroleum-based diesel fuel. In case it is not blended with petroleum-based diesel fuel such biodiesel is referred to as "B 100", which means that it consists of 100% (pure) biodiesel. However, most common biodiesel is blended with conventional (petroleum-based) diesel fuel. The percentage of the blend can be identified by its name. The most common blends are "B 5" (consisting of 5 % bio- diesel and 95 % conventional petroleum-based diesel fuel) and "B 20" (a blend of 20 % biodiesel and 80 % conventional diesel). Raw pressed vegetable oils are not considered to be biodiesel.
- (b) Advantages of Biodiesel:
 - Biodiesel produces less visible smoke and a lower amount of particulate matter.
 - · Biodiesel is biodegradable and nontoxic.
 - Biodiesel is safer than conventional diesel fuel because of its higher flash point.

Following the increased interest in the reduction of emissions and the reduction of the use of petroleum distillate based fuels; many governments and regulating bodies encourage the use of biodiesel.

(c) Disadvantages of Biodiesel:

Concentrations that are higher than 5% of biodiesel (higher than B5) can have an adverse affect on the engine's performance, its integrity and/ or durability. The risk of problems occurring in the engine increases as the level of biodiesel blend increases. The following negative affects are exemplary and typical for the usage of high concentrated biodiesel blends:

- Biodiesel can accelerate the oxidation of Aluminum, Brass, Bronze, Copper and Zinc.
- Biodiesel damages, and finally seeps through certain seals, gaskets, hoses, glues and plastics.
- Certain natural rubbers, nitride and butyl rubbers will become harder and more brittle as degradation proceeds when used with biodiesel.
- Biodiesel typically creates deposits in the engines.
- Due to its natural characteristic, biodiesel will decrease the engine output by approximately 2 percent (in case of B 20) comparing to conventional (petroleum-based) diesel fuel.
- The fuel consumption ratio will increase by approximately 3 percent (in case of B 20) comparing to conventional diesel fuel.

2. Approved Engines

All of the following engine series of Yanmar can be operated with biodiesel with concentrations up to B 20. In case of using biodiesel fuel up to B5 concentrations, no special preparations etc. have to be made and the original operating conditions and service intervals as stated in the operating manuals apply. In case of running below indicated engines with biodiesel concentrations above B 6 up to B 20, the required operating conditions (see below No. 4) have to be observed.

Other than the following listed engines cannot be run with biodiesel:

- 3TNM68, 3TNM72, 2TNV70, 3TNV70 and 3TNV76 Tier 2 and Tier 4
- 3TNV82A, 3TNV84, 3TNV84T, 3TNV88, 4TNV84, 4TNV84T, 4TNV88, 4TNV94L, 4TNV98 and 4TNV98T Tier 2, Tier 3 and/or interim Tier 4
- 4TNV106 and 4TNV106T Tier 2

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 4TNE92, 4TNE94L and 4TNE98 for forklift application
 Tier 2 and interim Tier 4

3. Approved Fuel

In case of using biodiesel (only concentrations up to B20) such fuel should comply with the below recommended standards. However, raw pressed vegetable oils are not considered to be biodiesel and are not acceptable for use as fuel in any concentration in Yanmar engines.

- (a) EN14214 (European standard) and/or ASTM D-6751 (American standard).
- (b) All applicable engines can be operated with biodiesel fuel up to B20 (20% bio-fuel blend) as a maximum concentration.
 (For your information: In Japan, the legally allowed maximum concentration for on-road applications is B 5.)

4. Conditions for the Operation with Biodiesel (B 6 through B 20)

When operating your applicable Yanmar engine (No. 2) with biodiesel blends concentrated above B5, we seriously recommend observing the following operation, service and maintenance conditions:

- (a) The original service interval of the below stated services as indicated in the respective Yanmar engine standard operation manual, the application manual and the service manual should be halved (please refer to your own manuals for the each service interval):
 - Replacement interval of engine oil filter, engine oil and the fuel filter.
 - Cleaning interval of the water separator
 - · Drain interval of the fuel tank.
- (b) It is required to inspect, clean and adjust the fuel injector every 1000 operating hours.
- (c) Replacement of the following parts before using the recommended biodiesel:
 - Fuel hose
 - Fuel feed pump (Diaphragm type)

- If not already installed, a water separator needs to be built in
- · O-ring of fuel filter
- O-ring of water separator
 Please refer to the attached list of exchange parts for details.
- (d) Please use only biodiesel fuel that is appropriate to the intended operation environment of the engines. This especially applies if the operating ambient temperature falls below 0 degree centigrade.
- (e) Operation with biodiesel requires daily maintenance as follows:
 - Please daily check the engine oil level. If the oil level rises above the oil level of the previous day, the engine oil needs to be immediately replaced.
 - Please daily check the water level of the water separator. If the water level rises above the "max" indicator, an immediate drain of the water separator is required.
- (f) Biodiesel blends up to B 20 can only be used for a limited time of up to 3 months of the date of biodiesel manufacture. Therefore biodiesel needs to be used at latest within 2 months from the time of filling the tank or within 3 months from the time of production by the fuel supplier, whichever comes first.
- (g) Before a long-term storage without operating the engine, the biodiesel needs to be drained out completely and the engine has to be run for 5 hours with conventional diesel fuel as indicated in your operation manual.

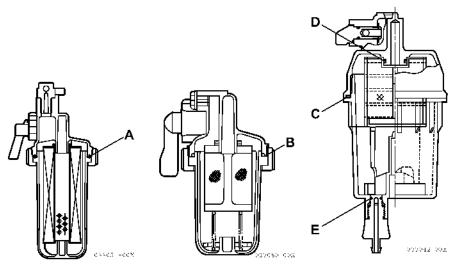
KIT PARTS LIST FOR B20 (All TNV Engines)

		KIT-V270BGS-BI	KIT-V370BGS-BI	KIT-V382BGS-BI	KIT-V384BGS-BI	
		2TNV70	3TNV70,76	3TNV82A	3TNV84(T),88	
	<u> </u>	D19446-59250	D19746-59250	D29283-59250	D29283-59260	
	No.	(1)	(1)	(1)	(1)	
	Length	2000	2000	2000	2000	
FUEL OIL TANK -	Part No.	129946-59050	129946-59050	129946-59050	129946-59050	
/ - FUEL OIL TANK	Part Name	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP	
	Number	2	2	2	2	
	No.	(2)	(3)	(4)	(4)	
	Length	380	450	1000	1000	
FUEL FEED PUMP	Part No.	119546-59030	119546-59020	129946-59040	129946-59040	
- FUEL OIL FILTER	Part Name	CW-T CMP	FO-T CMP	FO-T CMP	FO-T CMP	
	Number	1	1	1	1	
	No.	(5)	(6)	(6)	(5)	
	Length	220	270	270	220	
FUEL OIL FILTER	Part No.	129236-59000	119546-59200	119546-59200	129236-59000	
- FUEL INJECTION PUMP	Part Name	CW-T CMP	FO-T CMP	FO-T CMP	FO-T CMP	
	Number	1	1	1	1	
	No.	(8)	(11)	(9)	(7)	
	Length	320	450	350	300	
FUEL INJECTION PUMP	Part No.	119546-59210	119546-59220	119946-59200	129236-59010	
- FUEL OIL FILTER	Part Name	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP	
	Number	1	1	1	1	
	Part No.		NO NEED	119593-59581 124060-77680	119593-59581 124060-77680	
CAP, FUEL INJECTION NOZZLE	Part Name	NO NEED		CAP CLIP	CAP CLIP	
	Number			1 1	1 1	
	No.		NO NEED	(13)	(13)	
FUEL INJECTION NOZZLE	Length			1 1 5	1 15	
-FUEL INJECTION NOZZLE	Part No.	NO NEED		129486-59581	129486-59581	
-1 OLE INCCOMON NOZZEL	Part Name			FO-T CMP	FO-T CMP	
	Number			2	2	
	No.	(16)	(16)	(17)	(17)	
FUEL INJECTION NOZZLE	Length	150	150	FORMED PIPE	FORMED PIPE	
- FUEL INJECTION NOZZLE	Part No.	119546-59300	119546-59300	129636-59561	129636-59561	
- 1 GEE MOECHON POMP	Part Name	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP	
	Number	1	1	1	1	
FUEL OIL FILTER		NEED TO CHANGE ONLY O-RING. P44: 24316-000440> A		NO NEED (BECAUSE OF CARTRIDGE TYPE)		
WATER SEPARATOR NEED TO CHANGE ONLY 0 P44: 24316-000440			NEED TO CHANGE ONLY O-RING. G75: 24326-000750> C P16: 24316-000160> D P7: 24316-000070> E G65: 24326-000650> C (NEED ONLY FOR TAIYO-GIKEN)			

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		KIT-V484BGS-BI	KIT-V484TBGS-BI	KIT-V494GS-BI	KIT-V498ZGS-BI	KIT-V4106BGS-BI
		4TNV84,88	4TNV84T	4TNV94L,98(T) Tier 2	4TNV98(T) Tier 3	4TNV106(T)
		D29683-59250	D29683-59260	D29946-59250	D29943-59250	D23946-59250
	No.	(1)	(1)	(1)	(1)	(1)
FUEL OIL TANK -	Length	2000	2000	2000	2000	2000
/- FUEL OIL TANK	Part No.	129946-59050	129946-59050	129946-59050	129946-59050	129946-59050
7-10EE OIE TAIN	Part Name	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP
	Number	2	2	2	2	2
	No.	(4)	(4)	(4)	(4)	(4)
FUEL FEED PUMP	Length	1000	1000	1000	1000	1000
- FUEL OIL FILTER	Part No.	129946-59040	129946-59040	129946-59040	129946-59040	129946-59040
- FOLL OIL FILTER	Part Name	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP
	Number	1	1	1	1	1
	No.	(8)	(8)	(9)	(6)	(10)
FUEL OU FU TER	Length	320	320	350	270	400
FUEL OIL FILTER - FUEL INJECTION PUMP	Part No.	119546-59210	119546-59210	119946-59200	119546-59200	129946-59220
- FUEL INJECTION PUMP	Part Name	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP
	Number	1	1	1	1	1
	No.	(11)	(11)	(11)	(9)	(12)
ELIEL IN LEATION BUILD	Length	450	450	450	350	500
FUEL INJECTION PUMP	Part No.	119546-59220	119546-59220	119546-59220	119946-59200	129946-59230
- FUEL OIL FILTER	Part Name	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP
	Number	1	1	1	1	1
	Part No.	119593-59581 124060-77680				
CAP, FUEL INJECTION NOZZLE	Part Name	CAP CLIP	NO NEED	NO NEED	NO NEED	NO NEED
	Number	1 1				
	No.	(13)		NO NEED	NO NEED	NO NEED
FUEL INJECTION NOZZLE	Length	115				
-FUEL INJECTION NOZZLE	Part No.	129486-59581	NO NEED			
	Part Name	FO-T CMP				
	Number	3				
	No.	(17)	(14)	(15)	(15)	(15)
FUEL INJECTION NOZZLE	Length	FORMED PIPE	95	110	1 10	110
- FUEL INJECTION PUMP	Part No.	129636-59561	119946-59100	129946-59300	129946-59300	129946-59300
1 022 1102 0110111 01111	Part Name	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP	FO-T CMP
	Number	1	1	1	1	1
FUEL OIL FILTER NO NEED (BECAUSE OF CARTRIDGE TYPE)						
WATER SEPARATOR		NEED TO CHANGE ONLY O-RING. G75: 24326-000750> C P16: 24316-000160> D P7: 24316-000070> E G65: 24326-000650> C (NEED ONLY FOR TAIYO-GIKEN)				

	KIT-M368GS-FP
	D19125-93100
FUEL FEED PUMP	ELECTRIC FEED PUMP: 119225-52102 COVER ASSY, FEED PUMP: 129255-52000



		Current	Old (TAIYO-GIKEN)
I	Α	24316-000440 (P44) 24316-000440 (P44)	
Ī	В		
	O	24326-000750 (G75)	24326-000650 (G65)
I	D	24316-000160 (P16) 24316-000070 (P7)	
	Е		

Filling the Fuel Tank

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FIRE AND EXPLOSION HAZARD!



· Diesel fuel is flammable and explosive under certain conditions.

- · Only fill the fuel tank with diesel fuel. Filling the fuel tank with gasoline may result in a fire and will damage the engine.
- NEVER refuel with the engine running.
- · Wipe up all spills immediately.
- Keep sparks, open flames or any other form of ignition (match, cigarette, static electric source) well away when refueling.
- NEVER overfill the fuel tank.
- Fill the fuel tank. Store any containers containing fuel in a well-ventilated area, away from any combustibles or sources of ignition.
- · Be sure to place the diesel fuel container on the ground when transferring the diesel fuel from the pump to the container. Hold the hose nozzle firmly against the side of the container while filling it. This prevents static electricity buildup 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 shutdown.
- 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 the primary strainer (if equipped) from the fuel tank filler port. 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 from the fuel tank (Figure 1, (2)).
- 3. Observe the fuel level sight gauge (Figure 1, (3)) and stop filling when gauge shows fuel tank is full. NEVER overfill the fuel tank.
- 4. Replace the fuel cap (Figure 1, (1)), hand tighten. Over tightening the fuel cap will damage it.

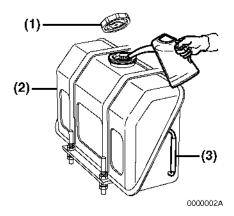


Figure 1

Priming the Fuel System

FIRE AND EXPLOSION HAZARD!



 Diesel fuel is flammable and explosive under certain conditions.

- If the unit has an electric fuel pump, when you prime the fuel system, turn the key switch to the ON position for 10 to 15 seconds to allow the electric fuel pump to prime the system.
- If the unit has a mechanical fuel pump, when you prime the fuel system, operate the fuel priming lever of the mechanical fuel pump several times until the fuel filter cup is filled with fuel.
- Failure to comply will result in death or serious injury.



The fuel system needs to be primed under certain conditions:

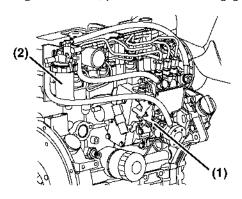
- · Before starting the engine for the first time
- After running out of fuel and fuel has been added to the fuel tank
- After fuel system maintenance such as changing the fuel filter and draining the fuel filter / water separator, or replacing a fuel system component.

To prime the fuel system if an electric fuel pump is installed:

- Turn the key to the ON position for 10 to 15 seconds. This will allow the electric fuel pump to prime the fuel system.
- 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 if a mechanical fuel pump is installed:

- Operate the fuel priming lever (Figure 2, (1)) several times until the fuel filter cup (Figure 2, (2)) is filled with fuel.
- 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.



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Figure 2

BEFORE YOU OPERATE



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:

- Turn the key to the ON position for 10 to 15 seconds. This will allow the electric fuel pump to prime the fuel system.
- 2. 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.

ENGINE OIL

NOTICE

- Only use the engine oil specified. Other engine oils may affect warranty coverage, cause internal engine components to seize and / or shorten engine life.
- Prevent dirt and debris from contaminating the engine oil. Carefully clean the oil cap / dipstick and the surrounding area before you remove the cap.
- NEVER mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil.
- NEVER overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

Engine Oil Specifications

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

Service Categories

- API Service Categories CD, CF, CF-4, CI-4 (Use an API CF or higher quality oil for electronically controlled engines.)
- 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:

- Be sure the engine oil, engine oil storage containers, and engine oil filling equipment are free of sediments and water.
- Change the engine oil after the first 50 hours of operation and then at every 250 hours thereafter.
- Select the oil viscosity based on the ambient temperature where the engine is being operated. See the 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 1.0 mgKOH/g. TBN (mgKOH/g) test method; JIS K-201-5.2-2 (HCI), ASTM D4739 (HCI).

Engine Oil Viscosity

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

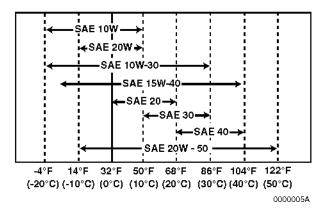


Figure 3

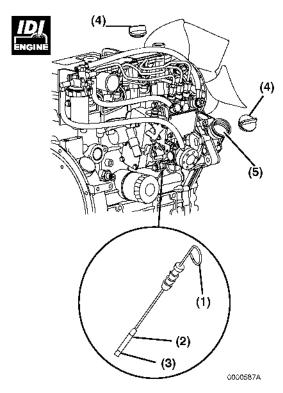
Checking Engine Oil

- 1. Make sure engine is level.
- Remove dipstick (Figure 4, (1)) and wipe with clean cloth.
- 3. Fully reinsert dipstick.

- 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.

Adding Engine Oil

- 1. Make sure engine is level.
- 2. Remove oil cap (Figure 4, (4)).
- 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.
- Reinstall oil cap (Figure 4, (4)) and hand-tighten. Over-tightening may damage the cap.



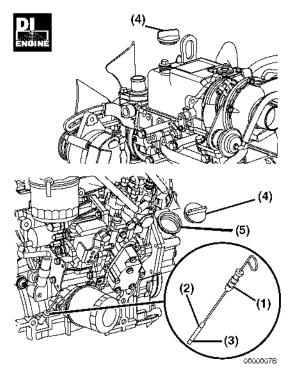


Figure 4

Engine Oil Capacity (Typical)

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

The following are the engine oil capacities for various Yanmar TNV engines.

Engine Oil Capacity (Typical)		
Engine Model	Dipstick Upper Limit/ Lower Limit	
2TNV70(VM) 2TNV70(VH)	1.9 / 1.3 qt (1.8 / 1.2 L)	
2TNV70(CH)	2.3 / 1.3 qt (2.2 / 1.2 L)	

Engine Oil Capacity (Typical)		
Engine Model	Dipstick Upper Limit/ Lower Limit	
3TNV70(CL), 3TNV70(VM) 3TNV70(VH)	3.0 / 1.6 qt (2.8 / 1.5 L)	
3TNV70(CH)	4.0 / 2.2 qt (3.8 / 2.1 L)	
3TNV76(CL), 3TNV76(VM) 3TNV76(VH)	3.6 / 1.9 qt (3.4 / 1.8 L)	
3TNV76(CH)	4.7 / 2.4 qt (4.4 / 2.3 L)	

D] Engine Oil Capacity (Typical)		
Engine Model	Dipstick Upper Limit / Lower Limit	
3TNV82A	5.8 / 3.8 qt (5.5 / 3.6 L)	
3TNV84, 3TNV84T	7.1 / 4.1 qt (6.7 / 3.9 L)	
3TNV88	7.1 / 4.1 qt (6.7 / 3.9 L)	
4TNV84, 4TNV84T	7.8 / 4.2 qt (7.4 / 4.0 L)	
4TNV88	7.8 / 4.2 qt (7.4 / 4.0 L)	
4TNV94L	11.1 / 6.3 qt (10.5 / 6.0 L)	
4TNV98, 4TNV98T	11.1 / 6.3 qt (10.5 / 6.0 L)	
4TNV106(CL), 4TNV106T(CL)	14.8 / 5.3 qt (14.0 / 5.0 L)	
4TNV106(VM), 4TNV106T(VM)	14.8 / 6.9 qt (14.0 / 6.5 L)	

ENGINE COOLANT

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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.
- Tighten the radiator cap securely after you check the radiator. Steam can spurt out during engine operation if the cap is loose.
- ALWAYS check the level of the 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.

NOTICE

- Only use the engine oil specified. Other engine oils may affect warranty coverage, cause internal engine components to seize and / or shorten engine life.
- Prevent dirt and debris from contaminating the engine oil. Carefully clean the oil cap / dipstick and the surrounding area before you remove the cap.
- NEVER mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil.
- NEVER overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

NOTICE

- Only use the engine coolant specified. Other engine coolants may affect warranty coverage, cause an internal buildup of rust and scale and / or shorten engine life.
- Prevent dirt and debris from contaminating the 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.

BEFORE YOU OPERATE

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.
- Mix coolant and water per the mixing instructions on the coolant container.
- 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.

 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 coolant drain plug (Figure 6, (1)) in the cylinder block is closed and the coolant hoses (Figure 7, (1)) are installed at the oil cooler.

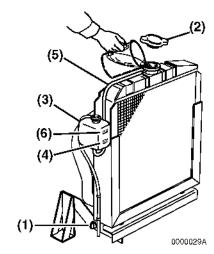


Figure 5

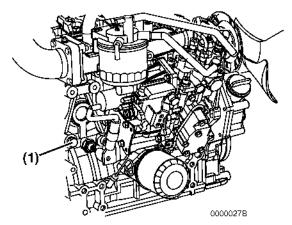
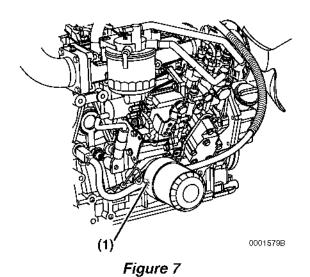


Figure 6



- 2. Remove the radiator cap (Figure 5, (2)) by turning it counterclockwise about 1/3 of a turn.
- 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.
- 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.
- 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 reaches 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 reserve tank should be at or neat the FULL (HOT) mark (Figure 5, (6)). If the coolant is not at the FULL (HOT) mark, add coolant to the reserve tank to bring the coolant level to the FULL (HOT) mark.

Daily Check of the Cooling System

- Check the level of engine coolant in the reserve tank. When the engine is cold, the coolant level in the tank should be at or slightly above the LOW (COLD) mark (Figure 5, (4)) on the coolant reserve tank.
 - If the coolant level is at the FULL (HOT) mark (Figure 5, (6)) when the engine is cold, the coolant will expand when it becomes hot and possibly spray out of the overflow hose.
- 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)

Note: Capacities listed are for the engine only without a radiator. Refer to the operation manual provided by the driven machine manufacturer for actual engine coolant capacity on your machine.

The following are the engine coolant capacities for various Yanmar TNV engines.

Engine Coolant Capacity (Typical)					
Engine Model Engine Coolant Capacity					
2TNV70	0.6 qt (0.6 L)				
3TNV70	1.0 qt (0.9 L)				
3TNV76	1.0 qt (0.9 L)				

Engine Coolant Capacity (Typical)					
Engine Model	Engine Coolant Capacity				
3TNV82A	1.9 qt (1.8 L)				
3TNV84, 3TNV84T	2.1 qt (2.0 L)				
3TNV88	2.1 qt (2.0 L)				
4TNV84, 4TNV84T	2.9 qt (2.7 L)				
4TNV88	2.9 qt (2.7 L)				
4TNV94L	4.4 qt (4.2 L)				
4TNV98, 4TNV98T	4.4 qt (4.2 L)				
4TNV106, 4TNV106T	6.3 qt (6.0 L)				

DAILY CHECKS

Before you begin any job, make sure the Yanmar TNV engine is in good operating condition. Make sure you check the following items before you start your shift and have any repairs completed before you start work.

▲ WARNING HIGH-PRESSURE HAZARD!



- Avoid skin contact with the high-pressure diesel fuel spray caused by a fuel system leak such as a broken fuel injection line.
 High-pressure fuel can penetrate your skin and result in serious injury. If you are exposed to high-pressure fuel spray, obtain prompt medical treatment.
- NEVER check for a fuel leak with your hands.
 ALWAYS use a piece of wood or cardboard.
 Have your authorized Yanmar industrial engine dealer or distributor repair the damage.
- Failure to comply could result in death or serious injury.

NOTICE

Make it a habit to perform daily checks. See Daily Checks in the Before You Operate Section of this manual.

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

Visual Checks

- Check for engine oil leaks.
- 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.
- Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors.
- 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 83.
- 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 / Separator on page 78. If you have to drain the fuel filter / water separator frequently, drain the fuel tank and check for the presence of water in your fuel supply. See Drain Fuel Tank on page 81.

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 38*, *Engine Oil on page 46* and *Engine Coolant on page 49* to check these levels.

Check Engine Speed Control

 Check the engine speed control for smooth operation, adjust and lubricate or clean as necessary. See Check and Adjust the Governor Lever and Engine Speed Control (Except Electronically Controlled Engines) on page 83.

Check Operator's Console

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

Check Indicators

Yanmar TNV engines are available with various operator's consoles. Two typical operator's consoles are shown (Figure 8) or (Figure 9).

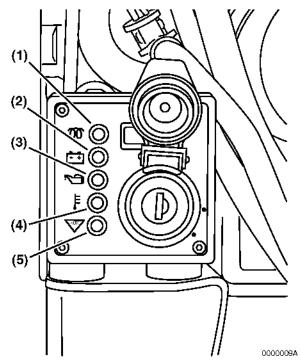


Figure 8

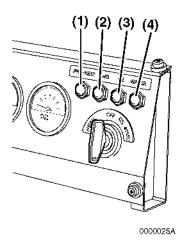


Figure 9

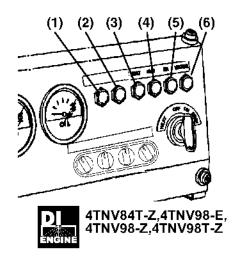


Figure 10

HEAT (Figure 8, (1)) or (Figure 9, (1)) or (Figure 10, (1)) - Figure 9 shows a typical indicator arrangement on the operator's console. When the key switch is turned to the HEAT position, the HEAT indicator comes on indicating the glow plugs or air heater are/is energized, and stays on for 4 sec. for IDI models with glow plugs or 15 sec. for DI models with glow plugs or air heater. When it goes out, turn the key switch to the START position to start the engine.

Figure 8 shows a typical operator's console having the optional key switch. When the optional key switch is turned to the ON position, the indicator comes on indicating the glow plugs or air heater are/is energized, and stays on for 4 sec. for IDI models with glow plugs or 15 sec. for DI models with glow plugs or air heater. When it goes out, turn the key switch to the START position to start the engine.

Figure 10 shows a typical indicator arrangement on the operator's console of electronically controlled engines. The key switch on the console is available in two types: standard and optional. While the standard type has the HEAT position, the optional type omits the HEAT position and has the ON-glow/ON-air heat capability. Consult the operation manual for the driven machine for the applicability of the key switch types.

The following lists the engine models with glow plugs and those with air heater for your reference.

Models with glow plugs:

2TNV70, 3TNV70, 3TNV76, 3TNV82A-B, 3TNV88-B, 3TNV88-U, 3TNV88-Z, 4TNV88-B, 4TNV88-U, 4TNV88-Z

Models with air heater:

3TNV84T-Z, 3TNV84T-B, 4TNV84T-Z, 4TNV84T-B, 4TNV98-Z, 4TNV98-E, 4TNV98T-Z, 3TNV82A, 3TNV84, 3TNV84T, 3TNV88, 4TNV84, 4TNV84T, 4TNV88, 4TNV94L, 4TNV98, 4TNV98T, 4TNV106, 4TNV106T

Battery Charge (Figure 8, (2)) or (Figure 9, (2)) or (Figure 10, (4)) - 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 8, (3)) or (Figure 9, (3)) or (Figure 10, (5)) - Stays on until the engine is running and the oil pressure is within normal limits.

Engine Coolant Temperature (Figure 8, (4)) or (Figure 9, (4)) or (Figure 10, (6)) - Stays on momentarily. Comes back on if engine overheats.

Auxiliary (Figure 8, (5)) or (Figure 10, (2)) - Stays on momentarily. Used for special applications.

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

Fault indicator (Figure 10, (1)) (optional) - Illuminates for approx. 2 sec. when the key switch is turned to ON, and stays off while the engine is running. If a fault occurs in the Eco-governor system or during energization of the E-ECU, this indicator will flash in a certain pattern to indicate what fault has occurred. See the troubleshooting section for details.

BEFORE YOU OPERATE

lı lı	ndicator		OFF to HEAT	OFF to ON	ON to OFF
	ON-glow ON-air heat	glow	NA	Lights for several seconds (IDI = 4 sec., DI = 15 sec.) then goes out.Lights for 1 - 15 sec. for electronically controlled engines depending on the coolant temperature.	OFF
HEAT Figure 8,(1) Figure 9, (1) Figure 10, (3)	HEAT Type Figure 8,(1) Figure 9, (1)			Lights for several 15 seconds then goes out.Lights for 1 - 23 sec. for electronically controlled engines depending on the coolant temperature.	OFF
	HEAT position available on	glow	Lights for several seconds (IDI = 4 sec., DI = 15 sec.) then goes out.	OFF	OFF
	key switch	air heat	Lights for several 15 seconds then goes out.	OFF	OFF
Battery Charge Figure 8,(2) Figure 9, (2) Figure 10, (4)		(2) NA ON		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 Figure 8,(3) Figure 9, (3) Figure 10, (5)		8,(3) 9, (3)		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 Figure 8,(4) Figure 9, (4) Figure 10, (6)		NA	ON	OFF (Stays on momentarily. Comes back on if there is a problem in the cooling system.)	
Auxiliary Figure 8,(5) Figure 10, (2)		NA	ON	OFF	
Fault (optional) Figure 10, (1) 3TNV84T-Z, 4TN 3TNV88-Z, 4TNV 4TNV98-E, 4TN	√88-Z,	BT-Z	NA	Lights for 2 sec. only.	OFF (Flashes or intermittently lights if a fault occurs in the E-ECU or Eco-governor.)

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ENGINE OPERATION

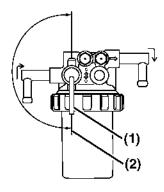
This section of the *Operation Manual* describes the procedures for starting the engine, checking engine performance during operation, and shutting the engine down.

STARTING ENGINE

Use the following procedure to start the engine. Note that two typical operator's consoles are shown for illustrative purposes only.

- 1. Make sure you follow the procedures stated in the *Daily Checks on page 52*.
- 2. Before first starting electronically controlled engines 3TNV84T-Z, 4TNV84T-Z, 3TNV88-Z, 4TNV88-Z, 4TNV98-E, 4TNV98-Z, 4TNV98T-Z: The E-ECU of the electronically controlled engines shown above needs to be initialized at initial power up. When the fault indicator comes on at initial power up, the E-ECU has finished initialization. Then always turn the key switch to the OFF position once before starting the engine. (The E-ECU has usually been initialized before the driven machine is delivered). From the second power up, make sure the fault indicator is on for 2 sec. when turning the key switch to the ON position.
- 3. Make sure the fuel filter / water separator fuel cock (Figure 1, (1)) is in the ON position (Figure 1, (2)).







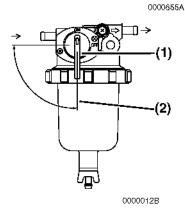


Figure 1

- 4. Set the transmission (if equipped) in the NEUTRAL position.
- 5. Disengage the PTO (if equipped).
- 6. Set the engine speed control to the mid-position.

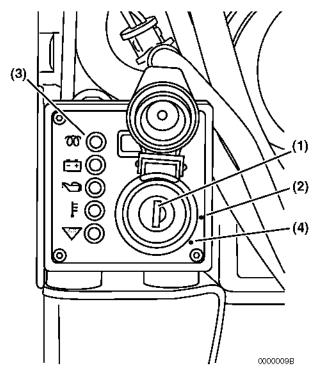


Figure 2

NOTICE

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

7. Insert the key into the key switch (Figure 2, (1)) or (Figure 3, (1)).

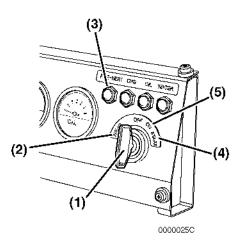


Figure 3

8. Turn the key to the ON position (Figure 2, (2)) or the HEAT position (Figure 3, (2)). The pre-heat indicator (Figure 2, (3)) flashes for several seconds and then goes out. After the pre-heat indicator goes out you can start the engine.

Note: The glow plugs, and the air heater, are used to assist starting in cold weather conditions. If you are operating your engine in normal or warm weather conditions, you may bypass the Pre-Heat / Heat functions and go directly to Start.

NOTICE

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

 Turn the key clockwise to the START position (Figure 2, (4)) or (Figure 3, (4)). Release the key as soon as the engine starts. It will return to the ON position (Figure 2, (2)) or (Figure 3, (5)). Note: The starter of electronically controlled engines 3TNV84T-Z, 4TNV84T-Z, 3TNV88-Z, 4TNV88-Z, 4TNV98-E, 4TNV98-Z, 4TNV98-Z, 4TNV98T-Z will start with a delay of approx. 0.5 sec. after the key switch has been turned to the ON position. This is because the E-ECU self-diagnostics has run and is not a failure.

10. If the engine fails to start:

- (a) Wait until the engine comes to a complete stop before you attempt to start it again. Engaging the starter while the engine is still rotating will result in damage to the starter and flywheel.
- Note: Some key switches are equipped with an interlock that will not allow you to re-engage the starter without first turning the key to the OFF position.
 - (b) Wait at least 30 seconds before you attempt to start the engine again. This procedure will allow the battery voltage to recover and prevent damage to the starter motor due to the low battery voltage.



COLD START DEVICE

▲ WARNING

SUDDEN MOVEMENT HAZARD!

- Engaging the transmission or PTO at an elevated engine speed could result in unexpected movement of the equipment.
- Failure to comply could result in death or serious injury.

The cold start device on direct injection models improves engine starting at lower temperatures.

- If the engine cooling system temperature is below 41°F (5°C), the cold start device automatically advances the fuel injection timing and slightly increases the fuel injection volume.
- The engine idle speed will be slightly elevated for approximately the first 5 minutes of operation.
- When the cold start device is activated, you may notice a slight increase in the amount of exhaust smoke. This is normal.
- NEVER engage the transmission or PTO while the cold start device is activated or unexpected movement of the machine may result.

CHECKING THE ENGINE DURING OPERATION

NOTICE

Make sure the engine is installed on a level surface. If a continuously running engine is installed at an angle greater than (IDI = 25° , DI = 30°) in any direction or if an engine runs for short periods of time (less than three minutes) at an angle greater than (IDI = 30° , DI = 35°) in any direction, engine oil may enter the combustion chamber causing excessive engine speed and white exhaust 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 the load on the engine. Short periods of maximum engine speed and load are desirable. Avoid prolonged operation at minimum or maximum engine speeds and loads for the next four to five 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.

 While the engine is running, check the gauges for normal indications. The gauges shown in Figure 5 and Figure 4 are provided for illustrative purposes only.

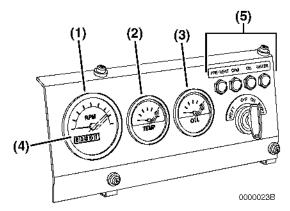


Figure 4

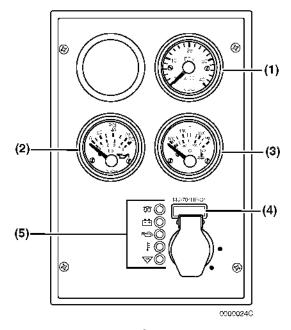


Figure 5

- Tachometer (Figure 5, (1)) or (Figure 4, (1))
 -Make sure the engine speed is within normal limits. See Engine Speed Specifications on page 112.
- Engine Oil Pressure (Figure 5, (2)) or (Figure 4, (3)) Make sure the engine oil pressure is within normal limits. See Principal Engine Specifications on page 113.
- Engine Coolant Temperature (Figure 5, (3)) or (Figure 4, (2)) Make sure the engine coolant temperature is within normal limits.
- Hour Meter The hour meter display (Figure 5, (4)) or (Figure 4, (4)) shows the total number of hours the engine has run. This is useful for planning periodic maintenance operations. See Periodic Maintenance Schedule on page 69.
- If any of the gauges shows an out of normal limits condition, shut down the engine and have the necessary repairs performed.
- After the engine has reached operating temperature, all of the indicators (Figure 5, (5)) or (Figure 4, (5)) should be off. If any of the indicators are on, shut down the engine and have the necessary repairs performed.
- 3. Check for white or black smoke from the exhaust system. A small amount of white exhaust smoke is normal on start-up of a cold engine. Black exhaust smoke could mean the engine is overloaded or is being over-fueled. If either of these conditions persists, contact your authorized Yanmar industrial engine dealer or distributor.
- 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. Contact your authorized Yanmar industrial engine dealer or distributor.

A WARNING

HIGH-PRESSURE HAZARD!



- Avoid skin contact with the high-pressure diesel fuel spray caused by a fuel system leak such as a broken fuel injection line.
 High-pressure fuel can penetrate your skin and result in serious injury. If you are exposed to high-pressure fuel spray, obtain prompt medical treatment.
- NEVER check for a fuel leak with your hands.
 ALWAYS use a piece of wood or cardboard.
 Have your authorized Yanmar industrial engine dealer or distributor repair the damage.
- Failure to comply could result in death or serious injury.
- 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.
- 6. Check the fuel level during operation. If the fuel level runs low, stop the engine and refuel.

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 the load on the engine. Short periods of maximum engine speed and load are desirable. Avoid prolonged operation at minimum or maximum engine speeds and loads for the next four to five 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 five 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 (if equipped).
- 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.

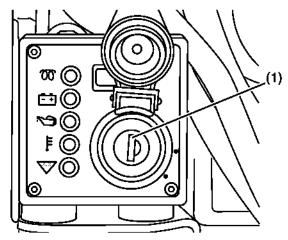


Figure 6

4. Turn the key to the OFF position (Figure 6, (1)) or (Figure 7, (1)) and remove it from the key switch.

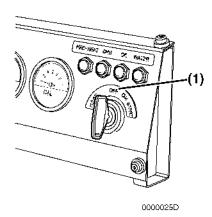


Figure 7

5. If the engine will not be used for six months or longer, follow the additional instructions in Long-Term Storage on page 109.

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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 52.

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 69* and *Periodic Maintenance Procedures on page 72*.

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.

Therefore, periodically perform the maintenance and cleaning of air cleaner and muffler.

Maximum Exhaust Gas Restriction shall be:



- 2TNV70: 0.86 psi (5.9 kPa; 600 mm Aq) or less
- 3TNV70 and 3TNV76: 1.71 psi (11.8 kPa; 1200 mm Ag) or less



- 3TNV84T, 3TNV84T-Z: 1.43 psi (9.83kPa, 1000mmAq) or less
- 4TNV84T, 4TNV98T, 4TNV106T:
 1.71 psi (11.8kPa, 1200mmAq) or less
- 3TNV82A, 3TNV84, 3TNV88, 3TNV88-Z, 4TNV84, 4TNV88, 4TNV88-Z, 4TNV94L, 4TNV98, 4TNV106: 2.22 psi (15.3kPa, 1560mmAq) or less
- 4TNV84T-ZVM, 4TNV98T-ZVM and 4TNV98T-ZCL (With Electronic Control System EGR): 1.49psi (10.3kPa, 1050mmAq) or less
- 4TNV98-Z(E)VM (With Electronic Control System EGR): 1.94 psi (13.4kPa, 1360mmAq) or less
- 4TNV98-ZCL (With Electronic Control System EGR): 1.75 psi (12.1kPa, 1230mmAq) or less

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.

Note: EGR-equipped engines have a range of allowable intake and exhaust restrictions; a minimum and a maximum value.

The figures are available in the TNV Series Application Manual.

PERIODIC MAINTENANCE

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 in the Periodic Maintenance Section of this manual 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 x Pitch mm		M6×1.0	M8×1.25	M10×1.5	M12×1.75	M14×1.5	M16×1.5
	inlb	96.0 ± 9.0	-	-	-	-	-
Tightoning Torque	ft-lb	-	19.0 ± 2.0	36.0 ± 4.0	65.0 ± 7.0	101.0 ± 7.0	167.0 ± 7.0
Tightening Torque	N∙m	10.8 ± 1.0	25.5 ± 2.9	49.0 ± 4.9	88.3 ± 9.8	137.0 ± 9.8	226.0 ± 9.8
	kgf/m	1.1 ± 0.1	2.6 ± 0.3	5.0 ± 0.5	9.0 ± 1.0	14.0 ± 1.5	23.0 ± 2.0

Note: Torque values shown in this manual are for clean, non-lubricated fasteners unless otherwise specified.

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 in the Warranty Section of this manual.

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

.

PERIODIC MAINTENANCE

Periodic Maintenance Chart

				Periodic Maintenance Interval					
System	Check Item	Daily	Every 50 hours	Every 250 hours	Every 500 hours	Every 1000 hours	Every 1500 hours	Every 2000 hours	Every 3000 hours
	Check and Refill Engine Coolant	0							
	Check and Clean Radiator Fins		0						
Cooling	Check and Adjust Cooling Fan V-belt		O 1st time	O 2nd and after					
System	Drain, Flush and Refill Cooling System With New Coolant					or every 1 year which-ever comes first			
Cylinder	Adjust Intake / Exhaust Valve Clearance					•			
Head	Lap Intake / Exhaust Valve Seats (if required)							•	
Electrical	Check Indicators	0							
Equipment	Check Battery		0						
CH	Check Engine Oil Level	0							
Engine Oil	Drain and Fill Engine Oil		\Diamond	\$					
	Replace Engine Oil Filter		1st time	2nd and after					
Engine Speed Control	Check and Adjust Governor Lever and Engine Speed Control	0		0					
	Inspect, Clean And Test Fuel Injectors, if necessary						•		
Emission	Inspect Turbocharger (Blower Wash as Necessary)								•
Control Warranty	Inspect, Clean and Test EGR Valve								•
•	Clean EGR Lead Valve								•
	Clean EGR Cooler (Clean to Blow Water/Air Passages)						•		
	Inspect Crankcase Breather System						•		
	Check and Refill Fuel Tank Level	0							
	Drain Fuel Tank			0					
Fuel	Drain Fuel Filter / Water Separator	0							
uci	Check Fuel Filter / Water Separator	0							
	Clean Fuel Filter / Water Separator				0				
	Replace Fuel Filter				\Q				
Hoses	Replace Fuel System and Cooling System Hoses							or every 2 yrs.	

PERIODIC MAINTENANCE

O: Check 🛇	O: Check ♦: Replace ●: Contact your authorized Yanmar industrial engine dealer or distributor								
			Periodic Maintenance Interval						
System	Check Item	Daily	Every 50 hours	Every 250 hours	Every 500 hours	Every 1000 hours	Every 1500 hours	Every 2000 hours	Every 3000 hours
Intake and Exhaust	Clean or Replace Air Cleaner Element			0	\$				
Complete Engine	Overall Visual Check Daily	0							

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

PERIODIC MAINTENANCE PROCEDURES

After Initial 50 Hours of Operation

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

- · Replace Engine Oil and Engine Oil Filter
- Check and Adjust Cooling Fan V-Belt

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 burned.
- · ALWAYS wear eye protection.
- Failure to comply could result in death or serious injury.

▲ WARNING SUDDEN MOVEMENT HAZARD!

- Engaging the transmission or PTO at an elevated engine speed could result in unexpected movement of the equipment.
- 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 and / or shorten engine life.
- Prevent dirt and debris from contaminating the engine oil. Carefully clean the oil cap / dipstick and the surrounding area before you remove the cap.
- NEVER mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil.
- NEVER overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

NOTICE



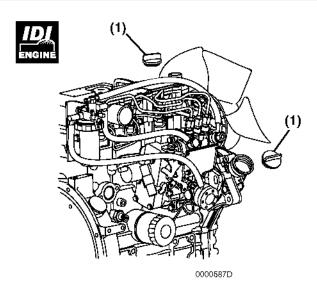
- ALWAYS be environmentally responsible.
- Follow the guidelines of the EPA or other governmental agencies for the proper disposal of hazardous materials such as engine oil, diesel fuel and engine coolant. Consult the local authorities or reclamation facility.
- NEVER dispose of hazardous materials irresponsibly by dumping them into a sewer, on the ground, or into ground water or waterways.
- Failure to follow these procedures may seriously harm the environment.

The engine oil on a new engine becomes contaminated from the initial break-in of internal parts. It is very important that the initial oil change is performed as scheduled.

Note: The oil drain plug may be in another location if an optional oil pan is used.

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.
- Remove one of the oil filler caps (Figure 1, (1)) to vent the engine crankcase and allow the engine oil to drain more easily.
- 5. Position a container under the engine to collect waste oil.



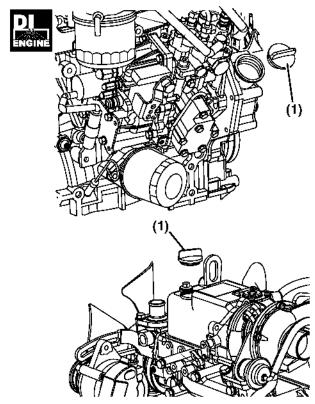


Figure 1

0000084A

PERIODIC MAINTENANCE

- 6. Remove the oil drain plug (Figure 2, (1)) from the engine oil pan. Allow oil to drain.
- After all oil has been drained from the engine, reinstall the oil drain plug (Figure 2, (1)) and tighten to 40-47 ft-lb (53.9-63.7 N·m, 5.5-6.5 kgf/m).
- 8. Dispose of used oil properly.

Remove the engine oil filter as follows:

- Turn the engine oil filter (Figure 2, (2))
 counterclockwise (Figure 2, (3)) using an oil
 filter wrench.
- 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 2, (4)) until it contacts the mounting surface. Tighten to 14-17 ft-lb (19.6-23.5 N·m, 2.0-2.4 kgf/m) or one additional turn using the oil filter wrench.



Engine Oil Filter Part No.

2TNV70, 3TNV70, 3TNV76 119305-35151



Engine Oil Filter Part No.

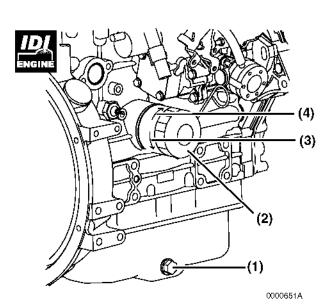
	Standard	Dust proof *
3TNV82A 3TNV84 - 4TNV98 3TNV82A-B 3TNV88-B - 4TNV98-Z 4TNV98-E	129150-35153	119005-35151
4TNV98T 4TNV98T-Z 4TNV106, 4TNV106T	119005-35151	

* Consult the operation manual for the driven machine for applicability of the dust proof filter.

4. Add new engine oil to the engine through either of the oil filler ports as specified in *Adding Engine Oil on page 47*.

NOTICE

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



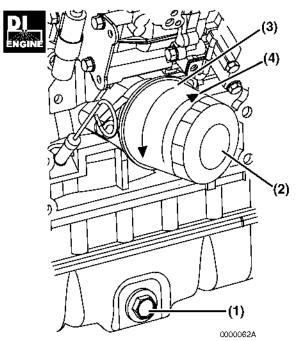


Figure 2

- 5. Warm up the engine by running it for 5 minutes and check for any engine oil leaks.
- 6. After engine is warm, shut it off and let it sit for 10 minutes.
- 7. Recheck the engine oil level.
- 8. Add engine oil to engine oil filler port (Figure 3, (5)) as needed until the level is between the upper (Figure 3, (2)) and lower lines (Figure 3, (3)) shown on the dipstick (Figure 3, (1)).
- 9. Reinstall the oil filler cap (Figure 3, (4)). If any engine oil is spilled, wipe it away with a clean cloth.

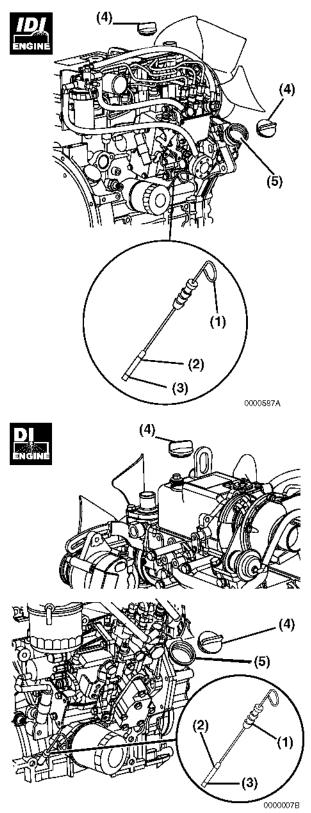


Figure 3

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.

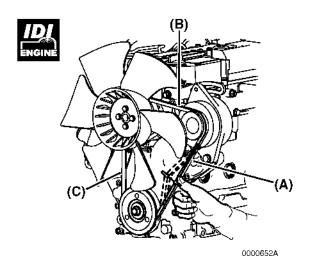
Check and adjust the V-belt tension (deflection) as follows:

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

There are three positions to check for V-belt tension (Figure 4, (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)			

Note: A "Used V-Belt" refers to a V-belt which has been used on a running engine for five minutes or more.



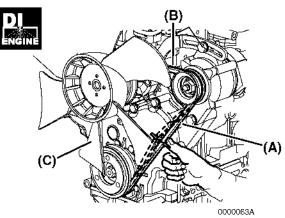
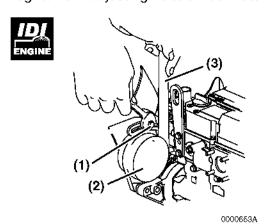


Figure 4

If necessary, adjust the V-belt tension. Loosen the adjusting bolt (Figure 5, (1)) and related bolts and/or nuts, then move the alternator (Figure 5, (2)) with a pry bar (Figure 5, (3)) to tighten the V-belt to the desired tension. Then tighten the adjusting bolts and/or nuts.



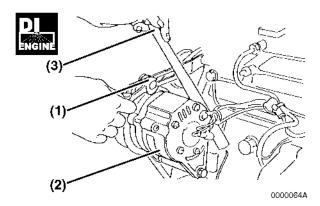


Figure 5

Tighten the V-belt to the proper tension. There
must be clearance (Figure 6, (1)) between the
V-belt and the bottom of the pulley groove. If
there is no clearance (Figure 6, (2)) between
the V-belt and the bottom of the pulley groove,
replace the V-belt.

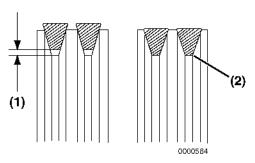


Figure 6

- 4. Check the V-belt for cracks, oil or wear. If any of these conditions exist, replace the V-belt.
- 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.	3/16 - 5/16 in.					
(8 - 12 mm)	(5 - 8 mm)	(7 - 11 mm)				

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)				

Every 50 Hours of Operation

After you complete the initial 50 hour maintenance procedures, perform the following procedures every 50 hours thereafter.

- Drain Fuel Filter / Water Separator
- Check Battery

Drain Fuel Filter / Separator

ZÍNDZNGER

FIRE AND EXPLOSION HAZARD!



- Diesel fuel is 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 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



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



ALWAYS be environmentally responsible.

- Follow the guidelines of the EPA or other governmental agencies 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.
- Failure to follow these procedures may seriously harm the environment.

Drain the fuel filter / water separator whenever there are contaminants, such as water, collected in the bottom of the cup. NEVER wait until the scheduled periodic maintenance if contaminants are discovered.

The separator cup is made from semi-transparent material. In the cup is a red-colored float ring. The float ring will rise to the surface of the water to show how much needs to be drained. Also, some optional fuel filter / water separators are equipped with a sensor to detect the amount of contaminants. This sensor sends a signal to an indicator to alert the operator.



Drain the fuel filter / water separator as follows:

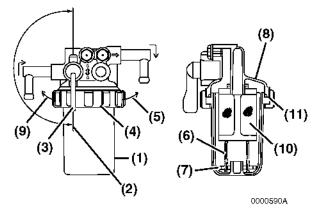


Figure 7

- Position an approved container under the fuel filter / water separator (Figure 7, (1)) to collect the contaminants.
- 2. Close (Figure 7, (2)) the fuel cock (Figure 7, (3)).
- 3. Turn the retaining ring (Figure 7, (4)) to the left (Figure 7, (9)).
- 4. Carefully remove the cup (Figure 7, (1)). Remove the retaining spring (Figure 7, (6)) and float (Figure 7, (7)) from the cup. Pour the fuel into an approved container and dispose of waste properly. Hold the bottom of the cup with a shop towel to prevent the fuel from dripping. Wipe up any spills immediately.
- 5. Clean the inside of the cup.
- Inspect the condition of the mesh filter (Figure 7, (10)). Clean the mesh filter if necessary.

- Inspect the condition of the O-ring (Figure 7, (11)). Replace the O-ring if necessary.
- 8. Put the float (Figure 7, (7)) and retaining spring (Figure 7, (6)) inside the cup.
- Reinstall the cup to the mounting flange (Figure 7, (8)) and turn the retaining ring (Figure 7, (4)) to the right (Figure 7, (5)). hand-tighten only.
- 10. Open the fuel cock (Figure 7, (3)).
- 11. Be sure to prime the diesel fuel system when you are done. See Priming the Fuel System on page 45.
- 12. Check for fuel leaks.



Drain the fuel filter / water separator as follows:

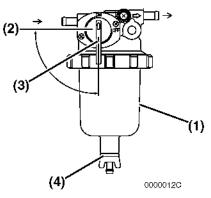


Figure 8

- Position an approved container under the fuel filter / water separator (Figure 8, (1)) to collect the contaminants.
- 2. Close (Figure 8, (2)) the fuel cock (Figure 8, (3)).
- Loosen the drain cock (Figure 8, (4)) at the bottom of the fuel filter / water separator. Drain any water collected inside.
- 4. Hand-tighten the drain cock.
- 5. Open the fuel cock (Figure 8, (3)).

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.

- 6. Be sure to prime the diesel fuel system when you are done. See Priming the Fuel System on page 45.
- 7. Check for fuel leaks.

Check Battery

#/?WBZANCHEE

EXPLOSION HAZARD!



- Never short out the battery terminals, including when checking the remaining battery charge. 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.

A 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 battery fluid contacts the eyes and / or skin, immediately flush the affected area with a large amount of clean water and obtain prompt medical treatment.
- Failure to comply could result in death or serious injury.

NOTICE



- ALWAYS be environmentally responsible.
- Follow the guidelines of the EPA or other governmental agencies 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.
- Failure to follow these procedures may seriously harm the environment.

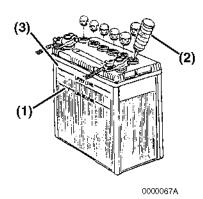


Figure 9

- When the amount of fluid nears the lower limit (Figure 9, (1)), fill with distilled water (Figure 9, (2)) so it is at the upper limit (Figure 9, (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.

Every 250 Hours of Operation

Perform the following maintenance every 250 hours of operation.

- Drain Fuel Tank
- Replace Engine Oil and Engine Oil Filter
- . Check and Clean Radiator Fins
- . Check and Adjust Cooling Fan V-Belt
- Check and Adjust the Governor Lever and Engine Speed Control
- Clean Air Cleaner Element

Drain Fuel Tank

FIRE AND EXPLOSION HAZARD!



- Diesel fuel is 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 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



ALWAYS be environmentally responsible.

- Follow the guidelines of the EPA or other governmental agencies 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.
- Failure to follow these procedures may seriously harm the environment.

Note that a typical fuel tank is illustrated.

 Position an approved container under the diesel fuel tank (Figure 10, (1)) to collect the contaminants.

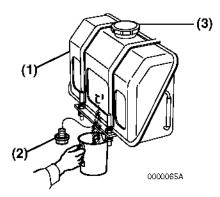


Figure 10

- 2. Remove the fuel cap (Figure 10, (3)).
- 3. Remove the drain plug (Figure 10, (2)) to drain the contaminants (water, dirt, etc.) from the bottom of the tank.
- Drain the tank until clean diesel fuel with no water or dirt flows out. Reinstall and tighten the drain plug firmly.
- 5. Reinstall the fuel cap.
- Check for leaks.

Replace Engine Oil and Engine Oil Filter

NOTICE

- Only use the engine oil specified. Other engine oils may affect warranty coverage, cause internal engine components to seize and / or shorten engine life.
- Prevent dirt and debris from contaminating the engine oil. Carefully clean the oil cap / dipstick and the surrounding area before you remove the cap.
- NEVER mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil.
- NEVER overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

NOTICE



ALWAYS be environmentally responsible.

- Follow the guidelines of the EPA or other governmental agencies 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.
- Failure to follow these procedures may seriously harm the environment.

Change the engine oil every 250 hours of operation after the initial change at 50 hours. Replace the engine oil filter at the same time.

See Replace Engine Oil and Engine Oil Filter on page 72.

Check and Clean Radiator Fins

A CAUTION

FLYING OBJECT HAZARD!



- ALWAYS wear eye protection when servicing the engine and when using compressed air or high-pressure water. Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.
- Failure to comply may result in minor or moderate injury.

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 11** for illustrative purposes only.

 Blow off dirt and dust from fins and radiator with 28 psi (0.19 MPa, 2 kgf/cm²) or less of compressed air (Figure 11, (1)). Be careful not to damage the fins with the compressed air.

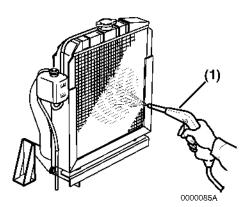


Figure 11

 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 (193 kPa; 19 686 mmAq) or a wire brush to clean the radiator fins. Radiator fins damage easily.

Check and Adjust Cooling Fan V-Belt

Check and adjust the cooling fan V-belt every 250 hours of operation after the initial 50 hour V-belt maintenance. See Check and Adjust Cooling Fan V-Belt on page 76.

Check and Adjust the Governor Lever and Engine Speed Control (Except Electronically Controlled Engines)

The governor lever and engine speed control (throttle lever, accelerator pedal etc.), are connected together by a cable or linkage. If the cable becomes stretched, or the linkage wears or loosens, the governor lever may not respond to a change in the position of the engine speed control.

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.

- Check that the governor lever (Figure 12, (1)) makes firm contact with the high idle stop (Figure 12, (2)) and the low idle speed limit screw (Figure 12, (3)) when the engine speed control is in the full speed or low idle speed positions.
- If the governor lever does not make proper contact with the high idle stop or the low idle speed limit screw, adjust the throttle cable or linkage as necessary.

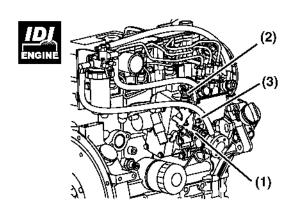
PERIODIC MAINTENANCE

Note: DO NOT FORCE the throttle cable or linkage to move. This may damage the the governor lever, the throttle cable or linkage and cause irregular operation of the engine speed control.

IMPORTANT

The engine speed control (throttle lever, accelerator pedal etc.), should be equipped with stops to prevent the application of excessive pressure by the governor lever to either the high idle stop or low idle speed limit screw.

See your authorized Yanmar industrial dealer or distributor for the adjustment procedures for your specific engine or machine.



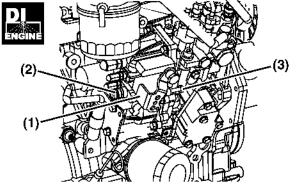


Figure 12

Clean Air Cleaner Element

Note that a typical air cleaner is shown in **Figure 13** and **Figure 14** for illustrative purposes only.

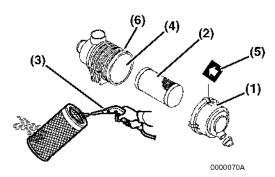


Figure 13

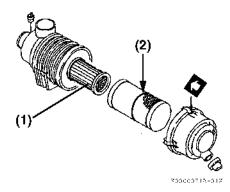


Figure 14

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 13, (1)).
- 2. Remove the element (Figure 13, (2)) (outer element if equipped with two elements).

A CAUTION

FLYING OBJECT HAZARD!



- ALWAYS wear eye protection when servicing the engine and when using compressed air or high-pressure water. Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.
- Failure to comply may result in minor or moderate injury.
- 3. Blow air (Figure 13, (3)) through the element from the inside out using 42-71 psi (0.29-0.49 MPa, 3.0-5.0 kgf/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 14, (1)) if the engine lacks power or the dust indicator actuates (if equipped).

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

- 5. Replace the element with a new one if the element is damaged, excessively dirty or oily.
- 6. Clean inside of the air cleaner cover.
- 7. Reinstall the element into the air cleaner case (Figure 13, (4)).

Note: If there is a red line (Figure 14, (2)) in the outer element, reinsert the element until the overlap position of red line and end face of the air cleaner case.

- 8. Reinstall the air cleaner cover making sure you match the arrow (Figure 13, (5)) on the cover with the arrow on the case (Figure 13, (6)).
- 9. 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 element(s) removed. This may allow foreign material to enter the engine and damage it.

Every 500 Hours of Operation

Perform the following maintenance every 500 hours of operation.

- Replace Air Cleaner Element
- Replace Fuel Filter
- Clean Fuel Filter / Water Separator

Replace Air Cleaner Element

NOTICE

The maximum air intake restriction, in terms of differential pressure measurement, must not exceed 0.90 psi (6.23 kPa; 635 mmAq). Clean or replace the air cleaner element if the air intake restriction exceeds the above mentioned value.

Replace the air cleaner element (Figure 13, (2)) every 500 hours even if it is not damaged or dirty.

When replacing the element, clean the inside of the air cleaner case (Figure 13, (4)).

If the air cleaner is equipped with a double element, only remove and replace the inner element (Figure 14, (1)) if the engine lacks power or the dust indicator actuates (if equipped). This is in addition to replacing the outer element.

Replace Fuel Filter

ZIN DANGEE

FIRE AND EXPLOSION HAZARD!



 Diesel fuel is 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 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

For maximum engine life, Yanmar recommends that when shutting the engine down, you allow the engine to idle, without load, for five 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



ALWAYS be environmentally responsible.

- Follow the guidelines of the EPA or other governmental agencies 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.
- Failure to follow these procedures may seriously harm the environment.

Replace Fuel Filter (Continued)



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 the fuel cock of the fuel filter / water separator.
- Turn the retaining ring (Figure 15, (1)) to the left (Figure 15, (5)).

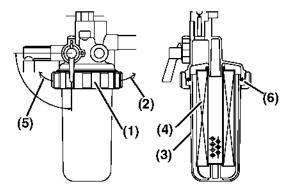


Figure 15

- 4. Carefully remove the cup (Figure 15, (3)). Pour the fuel into an approved container and dispose of waste properly. Hold the bottom of the cup with a shop towel to prevent the fuel from dripping. Wipe up any spills immediately.
- 5. Remove the fuel filter (Figure 15, (4)) by pulling it down.
- 6. Replace the fuel filter with a new one.

Applicable Fuel Filter Part No.											
	Standard Dust proof *										
2TNV70 3TNV70 3TNV76	119833-55620	119802-55801									

- * Consult the operation manual for the driven machine for applicability of the dust proof filter.
- 7. Wash the inside of the cup.
- 8. Check the condition of the O-ring (Figure 15, (6)). Replace if necessary.

PERIODIC MAINTENANCE

- 9. Install the cup to the mounting flange and turn the retaining ring (Figure 15, (1)) to the right (Figure 15, (2)). Hand-tighten only.
- Open the fuel cock of the fuel filter / water separator.
- 11. Prime the fuel system. See Priming the Fuel System on page 45.
- 12. Check for fuel leaks.



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 the fuel cock of the fuel filter / water separator.
- 3. Remove the fuel filter using a filter wrench to turn it to the left (Figure 16, (1)). When removing the fuel filter, carefully hold it to prevent the fuel from spilling. Wipe up all spilled fuel.

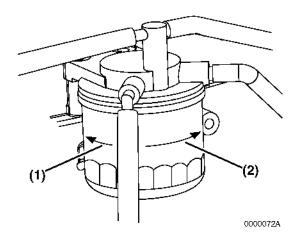


Figure 16

- Clean the filter mounting surface and apply a small amount of diesel fuel to the gasket of the new fuel filter.
- 5. Install the new fuel filter. Hand-tighten it to the right (Figure 16, (2)) until it comes in contact with the mounting surface. Use a filter wrench and tighten to 14-17 ft-lb (19.6-23.5 N•m, 2.0-2.4 kgf/m) or one additional turn using the filter wrench.

Appli	Applicable Fuel Filter Part No.								
	Standard	Dust proof *							
3TNV82A, -4TNV98 3TNV82A-B, -4TNV98-B	119802-55801	129907-55801							
4TNV98T, 4TNV98T-Z, -4TNV106T	123907-55801								

- * Consult the operation manual for the driven machine for applicability of the dust proof filter.
- 6. Open the fuel cock of the fuel filter / water separator.
- 7. Prime the fuel system. See Priming the Fuel System on page 45.
- 8. Check for fuel leaks.

Clean Fuel Filter / Water Separator

V:\Byanighti

FIRE AND EXPLOSION HAZARD!



 Diesel fuel is flammable and explosive under certain conditions.

- · NEVER use diesel fuel as a cleaning agent.
- 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 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



ALWAYS be environmentally responsible.

- Follow the guidelines of the EPA or other governmental agencies 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.
- Failure to follow these procedures may seriously harm the environment.



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

 Position an approved container under the cup (Figure 17, (1)) of the fuel filter / water separator to collect the contaminants.

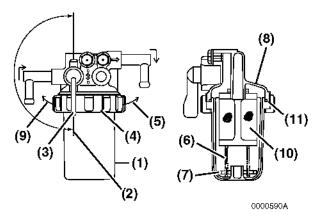


Figure 17

- Close (Figure 17, (2)) the fuel cock (Figure 17, (3)).
- 3. Turn the retaining ring (Figure 17, (4)) to the left (Figure 17, (9)).
- 4. Carefully remove the cup (Figure 17, (1)). Remove the retaining spring (Figure 17, (6)) and float (Figure 17, (7)) from the cup. Pour the fuel into an approved container and dispose of waste properly. Hold the bottom of the cup with a shop towel to prevent the fuel from dripping. Wipe up any spills immediately.
- 5. Clean the inside of the cup.
- Remove the mesh filter (Figure 17, (10)) by pulling it down.
- 7. Replace the mesh filter with a new one.

Applicable Mesh Filter Part No.						
2TN V 70						
3TN V 70	171081-55910					
3TNV76						

- Inspect condition of the O-ring (Figure 17, (11)). Replace if necessary.
- 9. Put the float (Figure 17, (7)) and retaining spring (Figure 17, (6)) inside the cup.

PERIODIC MAINTENANCE

- Install the cup to the mounting flange (Figure 17, (8)) and turn the retaining ring (Figure 17, (4)) to the right (Figure 17, (5)). Hand-tighten only.
- 11. Open the fuel cock (Figure 17, (3)).
- 12. Prime the fuel system. See Priming the Fuel System on page 45.
- 13. Check for fuel leaks.



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

- Position an approved container under the cup (Figure 18, (1)) of the fuel filter / water separator to collect the contaminants.
- 2. Close (Figure 18, (2)) the fuel cock (Figure 18, (3)).
- 3. Loosen the drain cock (Figure 18, (4)) and drain the contaminants. See Drain Fuel Filter / Separator on page 78.
- Turn the retaining ring (Figure 18, (5)) to the left (Figure 18, (10)) and remove the cup (Figure 18, (1)). If equipped, disconnect the sensor wire (Figure 18, (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.

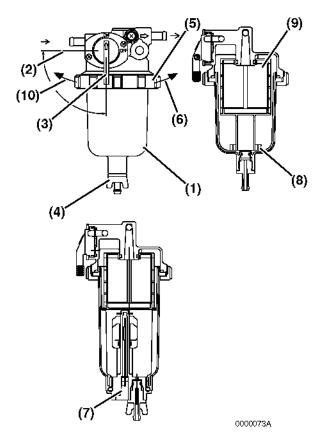


Figure 18

- Remove the float ring (Figure 18, (8)) from the cup. Pour the contaminants into the container and dispose of it properly.
- 7. Clean the element (Figure 18, (9)) and inside cup. Replace the element if it is damaged.

Applicable Element Part No.						
All Models	119802-55710					

- 8. Install the element and O-ring in the bracket.
- 9. Position the float ring in the cup.
- Check the condition of the O-ring. Replace if necessary.
- 11. Install the cup to the bracket by tightening the retaining ring to the right (Figure 18, (6)) to 11-15 ft-lb (15-20 N⋅m, 1.5-2.0 kfg/m).
- Close the drain cock. Reconnect the sensor wire if equipped.
- 13. Open the fuel cock (Figure 18, (3)).

- 14. Prime the fuel system. See Priming the Fuel System on page 45.
- 15. Check for leaks.

Every 1000 Hours of Operation

Perform the following maintenance every 1000 hours of operation.

- Drain, Flush and Refill Cooling System With New Coolant
- Adjust Intake / Exhaust Valve Clearance if required

Drain, Flush and Refill Cooling System With New Coolant

ZINEDZANNE:EE

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.
- Tighten the radiator cap securely after you check the radiator. Steam can spurt out during engine operation if the cap is loose.
- ALWAYS check the level of the engine coolant by observing the reserve tank.
- Failure to comply will result in death or serious injury.

A 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.

A 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, flush eyes and wash immediately with clean water.
- · Failure to comply may result in minor or moderate injury.

NOTICE



 ALWAYS be environmentally responsible.

- Follow the guidelines of the EPA or other governmental agencies 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.
- · Failure to follow these procedures may seriously harm the environment.

Engine coolant contaminated with rust or water 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 refill the cooling system with new coolant every 1000 hours or once a year, whichever comes first.

- 1. Allow engine and coolant to cool.
- Remove the radiator cap (Figure 19, (1)).
- Remove the drain plug or open the drain cock (Figure 19, (2)) at the bottom of the radiator and drain the engine coolant.

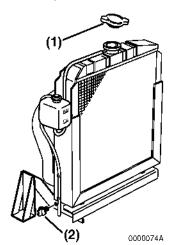


Figure 19

- 4. Drain the coolant from the engine block.
 - On models not equipped with an oil cooler, remove the coolant drain plug (Figure 20, (1)) from the engine block.

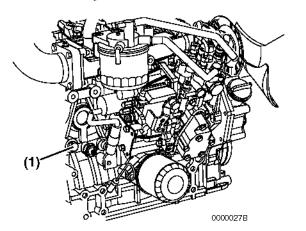


Figure 20

 On models equipped with an oil cooler, remove the coolant hose (Figure 21, (1)) at the oil cooler.

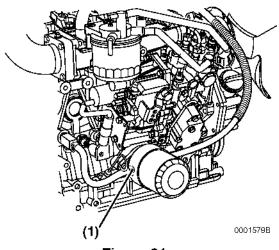


Figure 21

- 5. 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 or reconnect the coolant hose at the oil cooler.
- 6. Fill radiator and engine with engine coolant. See Filling Radiator With Engine Coolant on page 50.

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 to adjust the intake / exhaust valve clearance.

Every 1500 Hours of Operation

Perform the following maintenance every 1500 hours of operation.

- Inspect, Clean and Test Fuel Injectors, if necessary
- Clean EGR Cooler 4TNV84T-Z, 4TNV98T-Z
- Inspect Crankcase Breather System

Inspect, Clean and Test Fuel Injectors

▲ WARNING

HIGH-PRESSURE HAZARD!



- Avoid skin contact with the high-pressure diesel fuel spray caused by a fuel system leak such as a broken fuel injection line. High-pressure fuel can penetrate your skin and result in serious injury. If you are exposed to high-pressure fuel spray, obtain prompt medical treatment.
- NEVER check for a fuel leak with your hands. ALWAYS use a piece of wood or cardboard. Have your authorized 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 1500 hours. See your authorized Yanmar industrial engine dealer or distributor for this service.

This procedure is considered normal maintenance and is performed at the owner's expense. This procedures is not covered by the Yanmar Limited Warranty.

Clean EGR Cooler

4TNV84T-Z, 4TNV98T-Z

The EGR cooler is apt to be contaminated with rust and scale that deteriorate the cooling performance. Carbon accumulation in the exhaust gas passage of the cooler hinders circulation of exhaust gas, resulting in deterioration in exhaust gas cleanup performance.

To prevent such a problem, clean the cooler at least every 1500 hours.

Consult your local Yanmar dealer for this service.

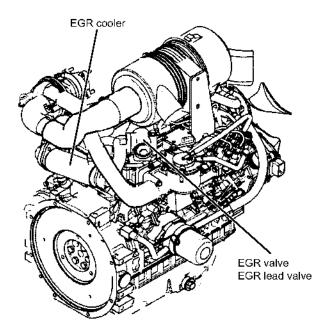


Figure 22

Inspect Crankcase Breather System

Proper operation of the crankcase breather system is required to maintain the emission requirements of the engine. The EPA / ARB requires that you have the crankcase breather system inspected every 1500 hours. See your authorized Yanmar industrial engine dealer or distributor for this service.

Every 2000 Hours of Operation

Perform the following maintenance every 2000 hours of operation.

- Check and Replace Fuel Hoses and Engine Coolant Hoses
- Lap the Intake and Exhaust Valves

Check and Replace Fuel Hoses and Engine Coolant Hoses

NOTICE



- ALWAYS be environmentally responsible.
- Follow the guidelines of the EPA or other governmental agencies 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.
- Failure to follow these procedures may seriously harm the environment.

Regularly check the fuel system and engine coolant system hoses. If they are cracked or degraded, replace them. Replace the hoses at least every two years. See your authorized Yanmar industrial engine dealer or distributor to replace fuel hoses and engine coolant system hoses.

Lap the Intake and Exhaust Valves

Adjustment is necessary to maintain proper contact of the valves and seats. See your authorized Yanmar industrial engine dealer or distributor to lap the valve seats.

Every 3000 Hours of Operation

Perform the following maintenance every 3000 hours of operation.

- Inspect Turbocharger (Blower Wash as Necessary) 3TNV84T, 4TNV84T, 4TNV98T, 4TNV106T
- Inspect, Clean and Test EGR Valve 4TNV84T-Z, 4TNV98T-E, 4TNV98-Z, 4TNV98T-Z
- Inspect and Clean EGR Lead Valve 4TNV84T-Z, 4TNV98T-Z

Inspect Turbocharger (Blower Wash as Necessary)

3TNV84T, 4TNV84T, 4TNV98T, 4TNV106T

Turbocharger service is required by the EPA / ARB every 3000 hours. Your authorized Yanmar industrial engine dealer or distributor will inspect and blower wash the unit if necessary. If you notice that the engine seems sluggish or the exhaust color is abnormal NEVER wait until the next periodic interval. Have your authorized Yanmar industrial engine dealer or distributor service the turbocharger soon.

Inspect, Clean and Test EGR Valve 4TNV84T-Z, 4TNV98T-E, 4TNV98-Z, 4TNV98T-Z

The EGR valve is a key component for cleaning exhaust gas.

To prevent the valve from deteriorating in exhaust gas recirculation performance due to carbon accumulation, inspect, clean and test the valve at least every 3000 hours.

Consult your local Yanmar dealer for this service.

Inspect and Clean EGR Lead Valve 4TNV84T-Z, 4TNV98T-Z

The EGR lead valve is located in the passage of recirculated gas.

To prevent carbon accumulation in or clogging of the lead valve, inspect and clean the lead valve at regular intervals.

Consult your local Yanmar dealer for this service.

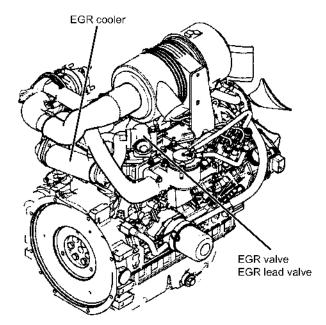


Figure 23

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 proceure indicator	Low level of engine oil Too high an oil level	Check and adjust oil level as necessary	Checking Engine Oil on page 47	
Engine on pressure indicator	Clogged engine oil filter	of engine oil n oil level necessary Replace engine oil filter Replace Engine Oil Add engine coolant Replace Engine Oil Engine Oil Filter on Engine Oil Engine Oil Filter on Engine Oil	Replace Engine Oil and Engine Oil Filter on page 72	
	Low engine coolant level	Add engine coolant	Filling Radiator With Engine Coolant on page 50	
	Dirty radiator fins	Clean the radiator fins	Check and Clean Radiator Fins on page 83	
Engine coolant indicator	Engine coolant leaking	avel necessary 47 oil filter Replace engine oil filter Replace Engine Oil and Engine Oil Filter on page 72 ant level Add engine coolant Filling Radiator With Engine Coolant on page 50 Clean the radiator fins Check and Clean Radiator Fins on page 83 See authorized Yanmar industrial engine dealer or distributor amaged Adjust V-belt or replace Check and Adjust Cooling Fan V-Belt on page 76 Industrial engine dealer or distributor amaged Adjust V-belt or replace Check and Adjust Cooling Fan V-Belt on page 76 Check battery condition Check Battery on page 80 See authorized Yanmar industrial engine dealer or distributor furned to ON (OFF→ ON) - Engine Not Running See authorized Yanmar industrial engine dealer or distributor See authorized Yanmar industrial engine dealer or distributor Furned to ON (START → ON) - Engine Not Running See authorized Yanmar industrial engine dealer or distributor Check and adjust oil level as for engine Oil on page 47 Replace Engine Oil and		
	V-belt loose or damaged	Adjust V-belt or replace		
	Contaminated engine coolant		_	
	Faulty engine coolant pump	, ,	_	
	V-belt loose or damaged	Adjust V-belt or replace		
Battery Indicator	Faulty engine coolant pump industrial engine dealer or distributor — — — — — — — — — — — — — — — — — — —			
Daniery maission	Faulty alternator	industrial engine dealer or	_	
Indicator Does Not Turn ON	- Key Switch is Turned to ON	(OFF→ ON) - Engine Not Runi	ning	
	Faulty electrical wiring or faulty indicator	industrial engine dealer or	_	
Indicator Stays On - Key Sw	itch is Turned from Start to Of	N (START $ ightarrow$ ON) - Engine Not	Running	
Battery indicator stays ON	Faulty alternator	1	_	
	Faulty engine oil pressure switch	_	_	
Engine oil pressure indicator stays ON	Too high an oil level Clogged engine oil filter Replace engine oil filter Low engine coolant level Add engine coolant Dirty radiator fins Clean the radiator fins Engine coolant leaking Coolant indicator V-belt loose or damaged Contaminated engine coolant Faulty engine coolant pump V-belt loose or damaged Adjust V-belt or replace Contaminated engine coolant Faulty engine coolant pump V-belt loose or damaged Adjust V-belt or replace Check battery condition Battery failure Check battery condition Check authorized Yanmar industrial engine dealer or distributor Check and adjust oil level as checked and condition of industrial engine dealer or distributor Check and adjust oil level as checked and condition of industrial engine dealer or distributor Check and adjust oil level as checked and condition of industrial engine dealer or distributor Check and adjust oil level as checked and condition of industrial engine dealer or distributor Check and adjust oil level as checked and condition of industrial engine dealer or distributor Check and adjust oil level as checked and condition of industrial engine dealer or distributor Check and adjust oil level as checked and condition of industrial engine dealer or distributor Check and adjust oil level as checked and condition of the c			
	Clogged engine oil filter	Replace engine oil filter		

SYMPTOM	PROBABLE CAUSE	ACTION	REFER TO
Engine Does Not Start			
	No diesel fuel	Refuel and prime fuel system	Filling the Fuel Tank on page 44
rarter motor operates but agine does not start carter motor does not perate or rotates too slowly angine can be turned anually) ingine cannot be manually rined chite or Black Exhaust Smotor ack exhaust smoke	Air in fuel system	Prime fuel system	Priming the Fuel System on page 45
Starter motor operates but	No diesel fuel Air in fuel system Improper diesel fuel Clogged fuel filter Poor fuel injection Compressed air leakage from intake / exhaust valves Faulty engine stop solenoid Battery needs charging Faulty cable connection at battery terminals Faulty starter switch Faulty starter motor Inner parts seized or damaged	Replace with recommended diesel fuel	Diesel Fuel Specifications on page 38
engine does not start	Clogged fuel filter	Replace fuel filter	Replace Fuel Filter on page 86
	Poor fuel injection	Refuel and prime fuel system Prime fuel system Priming the page 45 Replace with recommended diesel fuel Replace fuel filter Replace Filte	_
		industrial engine dealer or	_
	Faulty engine stop solenoid	distributor	_
	Battery needs charging	Check electrolyte, recharge	Check Battery on page 80
Starter motor does not operate or rotates too slowly		Clean terminals, retighten	_
(engine can be turned manually)	Faulty starter switch		_
nanually) Fault Ingine cannot be manually Inner	Faulty starter motor		_
Engine cannot be manually turned			— — — — — — — — — — — — — — — — — — —
White or Black Exhaust Smo	ke	•	
	Engine overloaded	Reduce load	_
	Clogged air cleaner element	Clean element or replace	Clean Air Cleaner Element on page 84
Planta automata anala	Improper diesel fuel		Diesel Fuel Specifications on page 38
black extraust smoke		See authorized Yanmar	_
	Poor fuel injection Compressed air leakage from intake / exhaust valves Faulty engine stop solenoid Battery needs charging Faulty cable connection at battery terminals Faulty starter switch Faulty starter motor Innually Inner parts seized or damaged Clogged air cleaner element Improper diesel fuel Faulty spraying of fuel injection Excessive intake / exhaust valve clearance Faulty sgray pattern of fuel injection Faulty spray pattern of fuel injection Faulty spray pattern of fuel injection	industrial engine dealer or	_
	Faulty EGR valve		_
	Air in fuel system Improper diesel fuel Clogged fuel filter Poor fuel injection Compressed air leakage from intake / exhaust valves Faulty engine stop solenoid Battery needs charging Faulty starter switch Faulty starter motor ally Inner parts seized or damaged Clogged air cleaner element Improper diesel fuel Faulty spraying of fuel injection Excessive intake / exhaust valve Improper diesel fuel Faulty EGR valve Replace with recommended diesel fuel See authorized Yanmar industrial engine dealer or distributor See authorized Yanmar industrial engine dealer or distributor Replace with recommended diesel fuel See authorized Yanmar industrial engine dealer or distributor See authorized Yanmar industrial engine dealer or distributor	Diesel Fuel Specifications on page 38	
White exhaust smoke			_
	Fuel injection timing delay		_
	Engine burning oil		_

TROUBLESHOOTING OF ELECTRONIC CONTROL SYSTEM



4TNV84T-Z, 4TNV98-E, 4TNV98-Z, 4TNV98T-Z

A WARNING

- Never use the E-ECU for other purposes than intended or in other ways than specified by Yanmar. Doing so could result in the violation of emission control regulations and will void the product warranty.
- Replacing the fuel injection pump involves rewriting the fuel injection data in the E-ECU.
 Be sure to contact your local Yanmar dealer before replacing the fuel injection pump.
 Failure to rewrite the fuel injection data before replacing the fuel injection pump will void the engine warranty.
- Replacing the E-ECU involves migrating the fuel injection data to the existing E-ECU to the new unit.
 - Be sure to contact your local Yanmar dealer before replacing the E-ECU. Failure to migrate the fuel injection data
 - before replacing the E-ECU will void the engine warranty.
- Improper use or misuse of the E-ECU may result in death or serious injury due to an abrupt and unexpected increase in engine speed.

Fault Detection Capability

The E-ECU has a fault detection capability. See TROUBLESHOOTING OF ELECTRONIC CONTROL SYSTEM on page 100.

A fault indicator (Optional) is located on the operator's console as shown in **Figure 1**.

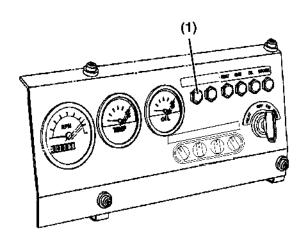
This indicator comes on at power up of the E-ECU and goes out after 2 sec.

Once a fault is detected, then the indicator flashes in certain patterns, providing fault information to the operator.

NOTICE

Shut down the engine if the fault indicator comes

Continuing running the engine with the fault indicator being on may result in a serious malfunction of or damage to the engine, and will void the engine warranty.



1 - Fault indicator

Figure 1

Figure 1 Typical Operator's Console

Figure 2 exemplifies flashing patterns that represent an accelerator fault (5 flashes) or EGR valve fault (1 to 3 flashes) occurring at power up. If multiple faults occur simultaneously, the indicator indicates all the faults in order of smaller to larger number of flashes.

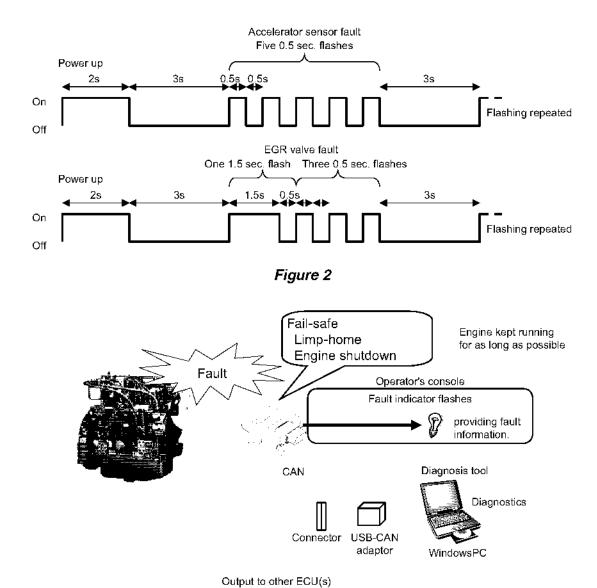


Figure 3

NOTICE

If the fault indicator comes on, check and note the flashing pattern, shut down the engine without delay and contact your local Yanmar dealer.

The Yanmar genuine diagnosis tool allows reviewing detailed fault information, historical fault/alarm logs and freeze frame data, monitoring the engine status and carrying out the fault diagnosis. See **Figure 3**.

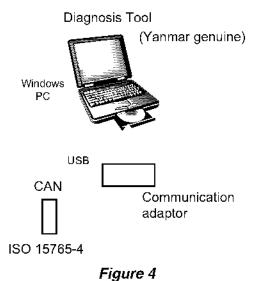
Events in the fault/alarm logs can be time stamped.

Diagnosis Tool

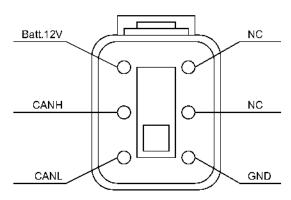
A connector is provided at an end of the harness of the driven machine so that the Yanmar genuine diagnosis tool can be loaded with data from the E-ECU. See **Figure 4** and **Figure 5**.

When the fuel injection pump is replaced, data in the E-ECU must also be replaced for accommodating the new pump. When the E-ECU is replaced, the fuel injection data in the existing unit must be migrated to the new unit. The diagnosis tool can be used for the data replacement or migration. Contact your local Yanmar dealer for replacement of the fuel injection pump or E-ECU.

For operation of the diagnosis tool, see the manual for the tool.



DEUTSCH DTM06-06S-E007



Mating connector (Tool side)
DEUTSCH
DTM04-06P-E003

Figure 5

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 problem occurs:
 - Engine RPM
 - · Color of exhaust smoke
 - · Type of diesel fuel
 - · Type of engine oil
 - Flashing patterns of indicators (When an electronically controlled engine and the fault indicator are used)
 - · 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

LIST OF POSSIBLE FAULTS OF ELECTRONICALLY CONTROLLED ENGINES



4TNV84T-Z, 4TNV98-E, 4TNV98-Z, 4TNV98T-Z

No.	Fault (alarm) location	Fault/alarm condition	Engine status	Reset condition	Availability of detection features	No. of flashes/flashing pattern of fault indicator	
1	Coolant temperature sensor	Sensor voltage is over 4.8V or under 0.2V	Continues to run at a coolant temperature of 30°C.	Voltage returns to normal.	Standard	4	
2	Accelerator sensor	Sensor voltage is over 4.8V or under 0.2V.	Continues to run at 1500 rpm.	Voltage returns to normal.	Default	5	
		Engine start switch (E8) is on, but engine speed is zero.	Is shut down. (When optional auxiliary speed sensor is				
3	Speed sensor	Engine speed momentarily decreased to lower than specified lower limit.	equipped:Auxiliary speed senor works in place of faulty speed sensor and engine continues to run at up to 1800 rpm. If auxiliary sensor also fails, engine is shut down.	Key switch is turned to OFF.	Standard	6	
4	Rack position sensor	Rack position relative to rack actuator is without specified limits.	Continues to run without rack position sensing at up to 150% of low idling speed or 80% of high idling speed, whichever is lower.	Key switch is turned to OFF.	Standard	7	
		Rack actuator output is without specified limits.		Key switch is turned to OFF.	Standard		
5	Rack actuator	Engine accelerates even though rack actuator output is minimized.	Is shut down.			8	
		Engine stalls while rack position sensor fails.					
6	EGR valve	LOW status was detected even though port was off.	Continues to run at up to 92% of	Key switch is	Default	1-3	
ь	EGH Valve	HIGH status was detected even though port was on.	rated power output and up to 1800 rpm.	turned to OFF.	Derault	1-3	
7	CSD solenoid	LOW status was detected even though port was on.	Continues to run while CSD	Key switch is	Standard	1.4	
′	valve	HIGH status was detected even though port was off.	feature is canceled.	turned to OFF.	Standard	1-4	
	Starting aid	LOW status was detected even though port was off.	Continues to run while starting	Key switch is		4.5	
8	relay	HIGH status was detected even though port was on.	aid relay is off.	turned to OFF.	Optional	1-5	

No.	Fault (alarm) location	Fault/alarm condition	Engine status	Reset condition	Availability of detection features	No. of flashes/flashing pattern of fault indicator
9	Main relay	Power cannot be turned off even though main relay is off.	Continues to run normally.	Relay returns to normal. This fault will persist even if key switch is turned to OFF.	Default	1-6
10	Rack actuator relay	LOW status was detected even though port was off. HIGH status was detected even though port was on.	ls shut down.	Key switch is turned to OFF.	Standard	1-7
11	Oil pressure switch	Oil pressure switch is not turned on while engine is stopped.	Continues to run normally. (Other option can be selected).	Key switch is turned to OFF.	Optional	2-1
12	An ECU supply voltage of		Continues to run normally.	Voltage returns to normal.	Standard	2-3
13	ECU ECI temperature is over		Continues to run normally. (Other option can be selected).	Temperature returns to normal; under 100°C (other optional setting is allowed).	Optional	2-5
14	Oil pressure	Oil pressure switch is not Continues to run normally.		Pressure returns to normal.	Optional	3-1
15	Battery charge (alarm)			Key switch is turned to OFF.	Optional	3-2
16	Battery charging switch	Battery changing switch is not turned off while engine is running.	Continues to run normally.	Key switch is turned to OFF.	Optional	2-2
17	Coolant temperature (alarm)	Coolant temperature is over 110°C.	Continues to run normally. (Other option can be selected).	Temperature returns to normal; under 105°C (other optional setting is allowed).	Standard	3-6

No.	Fault (alarm) location	Fault/alarm condition	Engine status	Reset condition	Availability of detection features	No. of flashes/flashing pattern of fault indicator
18	ECU-ROM	Flash ROM checksum error occurred.	Is shut down.			
19	ECU-EEPROM	Reading/writing error occurred.	Continues to run normally.			
	Checksum error occurred.			Key switch is turned to OFF.		
21	ECU-sub CPU	Communication with sub microcomputer failed.	Continues to run normally.		Standard	4 -1
22	ECU-mapping format	Mapping format is invalid.	ls shut down.			
23	ECU-temperat ure sensor	Sensor voltage is over 4.6V or under 1.0V.	Continues to run normally.	Temperature returns to normal.		

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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

Z!WBZANKSIES

EXPLOSION HAZARD!



- Never short out the battery terminals, including when checking the remaining battery charge. 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 battery fluid contacts the eyes and / or skin, immediately flush the affected area with a large amount of clean 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 the engine and when using compressed air or high-pressure water. Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.
- Failure to comply may result in minor or moderate injury.

NOTICE

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

Perform the next Preventive Maintenance procedure. For example, if there are 10 hours remaining before the 250 hour maintenance, you should do the maintenance before you place the engine in storage.

See Periodic Maintenance Schedule on page 69.

- Flush the radiator and refill with Long Life Engine Coolant. See Engine Coolant Specifications on page 50 for engine coolant specifications and See Filling Radiator With Engine Coolant on page 50 for the procedure for draining and refilling the cooling system.
- 2. Clean the exterior of the engine so it is free of grease and oil.
- 3. Drain the fuel tank or make sure it is completely full. See Filling the Fuel Tank on page 44.
- 4. Lubricate exposed parts of the engine speed control system.
- Protect the air cleaner, muffler and electrical components (alternator, starter motor, switches, EGR valve, controller) from water and dust.
- Disconnect the negative (-) battery cable to prevent the battery from discharging.

- 7. Check the battery fluid and add distilled water as required. See Check Battery on page 80.
- Charge the battery once a month during storage.
- 9. Rotate the engine without starting, every four to six months.

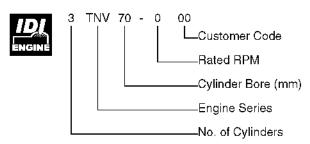
RETURNING THE ENGINE TO SERVICE

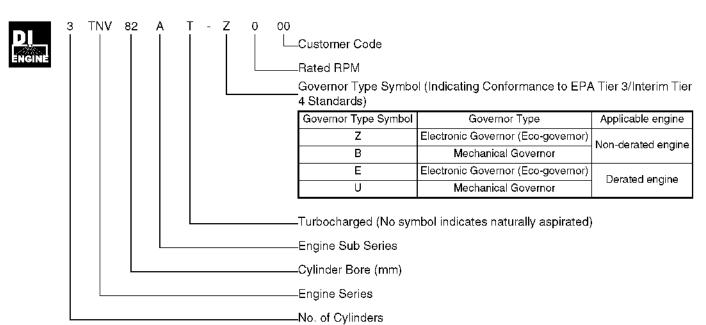
- 1. Perform the Daily Checks on page 52.
- The engine should be pre-oiled before startup.
 Crank the engine, leaving the fuel system shut
 off so the engine will not start, for 15 seconds.
 Then pause for 30 seconds. Repeat the
 procedure until you have cranked the engine for
 a total of one minute. This will circulate the oil in
 the engine's lubrication system.
- 3. Prime the fuel system. See Priming the Fuel System on page 45.
- 4. Start the engine. Allow the engine to idle for approximately 15 minutes while you check for:
 - · Proper oil pressure
 - · Fuel, engine oil, or coolant leaks
 - Proper operation of the indicators and / or gauges.
- 5. 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
VH	3200 - 3600 RPM (min ⁻¹)	Lawn Mower, Construction, Industrial Machine
VM	2000 - 3000 RPM (min ⁻¹)	Agricultural, Construction, Industrial Machines
CH	3000 - 3600 RPM (min ⁻¹)	2-pole Generator Sets, Irrigation Pumps
CL	1500 or 1800 RPM (min ⁻¹)	4-pole Generator Sets, Irrigation Pumps

VH: Variable High Speed CH: Constant High Speed VM: Variable Medium Speed CL: Constant Low Speed

Engine General Specifications

Туре	Vertical In-line, Water Cooled, 4-Cycle Diesel Engine					
Combustion System	Direct Injection Models Direct Injection					
Compustion System	Indirect Injection Models Swirl Chamber (Ball-Type)					
Starting System	Electric Starting					
Cooling System	Radiator					
Lubricating System	Forced Lubrication with Trochoid Pump					
PTO Position	Flywheel End					
Direction of Rotation	Counterclockwise Viewed from Fly	ywheel End				

Notes:

- 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, 750 mm Hg), Relative humidity 30%
 - Fuel Temperature at Fuel Injector Pump Inlet: 104°F (40°C)
 - Fuel Feeding Pressure: 20 ± 10 kPa (net) after engine break-in has been performed with the cooling fan, air cleaner and muffler installed to the engine.
 - · With Cooling Fan, Air Cleaner, Muffler: Yanmar Standard
 - After the 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

IDI ENGINE

2TNV70 (~ EPA Tier4)

Engine Model	2TNV70											
Version		VM CH VH										
Туре		Vertical In-line Diesel Engine										
Combustion System		Ball-Type Swirl Chamber										
Aspiration						Natu	ıral					
No. of Cylinders						2						
Bore × Stroke						70 x 7	4mm					
Displacement						0.57	OL.					
	min-1							3000	3600			
Continuous Rated Output	kW	1						8.16	9.76	1		
	PS	1						1 1.1	13.3	1		
	min-1	2000	2200	2400	2600	2800	3000	3000	3600	3200	3400	3600
Max. Rated Output (Net)	kW	5.96	6.62	7.28	7.87	8.53	9.12	8.97	10.7	9.34	9.78	10.3
	PS	8.10	9.00	9.90	10.7	11.6	12.4	12.2	14.6	12.7	13.3	14.0
High Idling	min ⁻¹	2160 ± 25	2375 ± 25	2570 ± 25	2780 ± 25	2995 ± 25	3210 ± 25	3165 ± 25	3800 ± 25	3400 ± 25	3600 ± 25	3815 ± 25
Engine Weight (Dry) *with Flywheel Housing	84 kg											
PTO Position						Flywher	el End					
Direction of Rotation				Cour	iterclocky	vise View	ed From	Flywheel	End			
Cooling System					Liquid	d-Cooled	with Radi	iator				
Lubricating System				F	orced Lub	rication v	vith Troch	oid Pump)			
Normal Oil Pressure at Rated Engine Speed						0.29 -0.4	I4 MPa					
Normal Oil Pressure at Low Idle Speed						0.061						
				Electric	Starting				kW***			
Starting System						amo: DC						
			Re	ecommen	ded Batte	ery Capac	ity: 12V,	36Ah (5h	rating) **	*		
Dimensions $(L \times W \times H)^*$			415×	4 27 × 48	4mm				427 × mm	415 ×	427 × 48	34mm
Engine Oil Pan Capacity**	1.8/1.2L (Dipstick Upper Limit / Lower Limit) 2.4/1.2L (Dipstick Upper Limit / Lower Limit / Lower Limit) (Dipstick Upper Limit / Lower Limit)											
Engine Coolant Capacity						0.6L Engi	ine Only	•	·			
Standard Cooling Fan				2	60mm O.	D., 5 Blac	de Pushe	r-Type ***	•			
Crank V-pulley dia./ Fan V-pulley dia.					(φ110/ φ11	0mm ***					
Top Clearance					($0.768 \pm 0.$.072 mm					

- * Engine specifications without radiator.
- ** Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.
- *** May vary depending on application.



3TNV70 (~ EPA Tier4)

Engine Model		3TNV70												
Version		CL				V	M			C	Н		VH	
Туре						Vertical	In-line D	Diesel E	ngine					
Combustion System		Ball-Type Swirl Chamber												
Aspiration		Natural												
No. of Cylinders		3												
Bore × Stroke		70 × 74mm												
Displacement		0.854 L												
	min-1	1 1500 1800 3000 3600												
Continuous Rated Output	k₩	6.09	7.29	1						8.16	9.76	1		
	PS	8.27	9.91							16.5	19.7	1		
	min-1	1500	1800	2000	2200	2400	2600	2800	3000	3000	3600	3200	3400	3600
Max. Rated Output (Net)	k₩	6.69	8.02	8.97	9.93	11.0	11.8	12.8	13.7	13.3	16.0	14.0	14.7	15.4
	PS	9.10	10.9	12.2	13.5	14.9	16.1	17.4	18.6	18.1	21.7	19.0	20.0	21.0
High Idling	min-1	in-1 1600 1895 2160 2375 2570 2780 2995 3210 3165 3800 3400 3600 3											3815 ± 25	
Engine Weight (Dry) *with Flywheel Housing		98 kg												
PTO Position		Flywheel End												
Direction of Rotation				(Counter	clockwis	e Viewe	d From	Flywhe	el End				
Cooling System						Liquid-0	Cooled v	with Rac	liator					
Lubricating System					Force	ed Lubric	cation w	ith Troc	hoid Pui	mp				
Normal Oil Pressure at Rated Engine Speed	0.24	-0.35 M	Pa					0.29	9 -0.44 1	MPa				
Normal Oil Pressure at Low Idle Speed				•			0.06 N	1 Pa						
				Ele	ctric Sta	arting - S	Starter M	lotor: D	C12V, 1	.0 kW**	*			
Starting System						Dynar	no: DC1	2V, 20	·**					
				Recom	mende	Batter	/ Capac	ity: 12V	, 36Ah**	'* (5h ra	ting)			
Dimensions $(L \times W \times H)^*$	548 × 4	27 × 506	3 m m		50	4 × 427	× 506 n	nm			427 × 6mm		i04 × 42 < 506mr	
Engine Oil Pan Capacity**		2.8/1.5L												
Engine Coolant Capacity						0.	9L Engir	ne Only						
Standard Cooling Fan					310n	nm O.D.	, 5 Blad	e Pushe	r-Type	***				
Crank V-pulley dia./ Fan V-pulley dia.						ф1	10/ ø100	0mm ***						
Top Clearance						0.7	768 ± 0.0	07 2 mm						

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



3TNV76 (~ EPA Tier4)

Engine Model		3TNV76													
Version		CL					VM				С	Н		VH	
Туре				1		Vertic	al In-lir	ne Dies	el Engii	ne					
Combustion System						Bal	I-Type :	Swirl C	hamber	,					
Aspiration							N	atural							
No. of Cylinders								3							
Bore × Stroke		76 × 82mm													
Displacement		1.116L													
	min-1	r-1 1500 1800													
Continuous Rated Output	kW	8.2	9.8								15.1	17.7]		
	PS	11.1	13.3								20.5	24.1]		
	min-1	1500	1800	2000	2200	2400	2500	2600	2800	3000	3000	3600	3200	3400	3600
Max. Rated Output (Net)	kW	9	10.7	11.8	13.2	14.3	14.9	15.5	16.7	17.9	16.5	19.5	18.2	19.3	19.5
	PS	12.2	14.5	16.1	17.9	19.5	20.3	21.1	22.7	24.3	22.4	26.5	24.7	26.2	26.5
High Idling	min ⁻¹												3815 ±25		
Engine Weight (Dry) *with Flywheel Housing		112kg													
PTO Position		Flywheel End													
Direction of Rotation					Count	erclock	vise Vie	ewed F	rom Fly	wheel E	End				
Cooling System						Liqui	d-Coole	ed with	Radiate	or					
Lubricating System					Foi	ced Lul	orication	n with T	Frochoid	d Pump					
Normal Oil Pressure at Rated Engine Speed	0.24 -	0.35 M	Pa					ı	0.29 -0.	44 MPa	a				
Normal Oil Pressure at Low Idle Speed				•			0.0	6 MPa							
				Ek	ectric S	_			DC12\		W)) ***				
Starting System									', 40 A **						
				Reco	mmenc	led Batt	ery Cap	pacity:	12V, 36	Ah*** (
Dimensions $(L \times W \times H)^*$	567 × 42	27 × 53	2mm			523 ×	427 × 5	32mm			523 × 559	427 × mm	523 ×	427 × 5	32m m
Engine Oil Pan Capacity**				•	(Dipstick	3.4 Upper	4/1.8L Limit /	Lower I	Limit)					
Engine Coolant Capacity							0.9L E	-	•						
Standard Cooling Fan					33	5mm O	D., 6 B	lade Pu	usher-T	ype ***					
Crank V-pulley dia./ Fan V-pulley dia.		φ110/ φ100mm ***													
Top Clearance							0.819 ±	0.072	mm						

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



3TNV82A (~ EPA Tier2)

Engine Model		3TNV82A										
Version		CL VM										
Туре		Vertical In-line Diesel Engine										
Combustion System		Direct Injection										
Aspiration		Natural										
No. of Cylinders		3										
Bore x Stroke		82 x 84mm										
Displacement		1.331L										
	min-1	1										
Continuous Rated Output	kW											
	PS	S 13.5 16.3										
	min ⁻¹	1500	1800	2000	2200	2400	2600	2800	3000			
Max. Rated Output (Net)	kW	11.0	13.2	14.6	16.0	17.5	19.0	20.4	21.9			
	PS	14.9	17.9	19.9	21.8	23.8	25.8	27.8	29.8			
High Idling	min ⁻¹	nin ⁻¹										
Engine Weight (Dry) *with Flywheel Housing		138kg 128 kg										
PTO Position					Flywheel En	d						
Direction of Rotation			Co	unterclockwi	se Viewed Fr	om Flywhee	l End					
Cooling System				Liquid-	Cooled with	Radiator						
Lubricating System				Forced Lubr	ication with T	rochoid Pun	ηp					
Normal Oil Pressure at Rated Engine Speed			(0.34 - 0.49 M	Pa			0.39 - 0	.54 MPa			
Normal Oil Pressure at Low Idle Speed					0.06 MPa							
			Electr	ic Starting (S	tarter Motor:	DC12V (1.2	kW)) ***					
Starting System				Altern	ator: DC12V	40A***						
			Recomm	ended Batte	y Capacity:	12V, 55Ah***	(5h rating)					
Dimensions $(L \times W \times H)^*$	553	$3 \times 489 \times 569$	5 mm			528 × 489	× 565 mm					
Engine Oil Pan Capacity**				(Dipstick U	5.5/3.6L Jpper Limit /	Lower Limit)						
Engine Coolant Capacity		(Dipstick Upper Limit / Lower Limit) 1.8L Engine Only										
Standard Cooling Fan				335mm O.D	., 6 Blade Pu	sher-Type *	**					
Crank V-pulley dia./ Fan V-pulley dia.	ф	120/ ф90mm	***			φ110/φ1	10mm ***					
Top Clearance				. (0.64 ± 0.06 m	ım						

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



3TNV84 (~ EPA Tier2)

Engine Model		3TNV84										
Version		CL VM										
Туре				Vertica	l In-line Dies	el Engine						
Combustion System		Direct Injection										
Aspiration		Natural										
No. of Cylinders		3										
Bore × Stroke		84 × 90mm										
Displacement		1.496L										
	min-1											
Continuous Rated Output	kW	11.3	13.5									
	PS	15.3	18.3									
	min-1	1500	1800	2000	2200	2400	2600	2800	3000			
Max. Rated Output (Net)	kW	12.4	14.8	16.4	18.1	19.7	21.3	23.0	24.6			
	PS	16.8	20.1	22.3	24.6	26.8	29.0	31.3	33.5			
High Idling	min-1	nin ⁻¹ 1600 1895 2180 2400 2590 2810 2995 3 ±25 ±25 ±25 ±25 ±25 ±25 ±25 ±25 ±25										
Engine Weight (Dry) *with Flywheel Housing		161kg 155kg										
PTO Position					Flywheel En	d						
Direction of Rotation			Co	unterclockwi	se Viewed F	om Flywhee	l End					
Cooling System				Liquid	Cooled with	Radiator						
Lubricating System				Forced Lubr	ication with T	rochoid Pun	пр					
Normal Oil Pressure at Rated Engine Speed	C	.34 - 0.49 M	Pa			0.39 - 0	.54 MPa					
Normal Oil Pressure at Low Idle Speed					0.06 MPa							
			Electr	ic Starting (S	tarter Motor:	DC12V (1.2	kW)) ***					
Starting System				Altern	ator: DC12V	, 40A***						
			Recomm	ended Batter	y Capacity: 1	2V, 55 Ah**	* (5h rating)					
Dimensions $(L \times W \times H)^*$	589	$9 \times 486 \times 62$	2mm			564 × 486	8 × 622mm					
Engine Oil Pan Capacity**				(Dipstick U	6.7/3.9L Jpper Li mit /	Lower Limit)						
Engine Coolant Capacity				2	.0L Engine C	nly						
Standard Cooling Fan				335mm O.D	., 6 Blade Pu	sher-Type *	**					
Crank V-pulley dia./ Fan V-pulley dia.	ф	120/	***			φ110/φ1	10mm ***					
Top Clearance					0.72 ± 0.06 n	nm						

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



3TNV84T (~ EPA Tier2)

Engine Model		3TNV84T										
Version		CL VM Vertical In-line Diesel Engine										
Туре		Vertical In-line Diesel Engine										
Combustion System		Direct Injection										
Aspiration		Turbocharged										
No. of Cylinders		3										
Bore × Stroke		84 × 90mm										
Displacement		1.496L										
	min-1											
Continuous Rated Output	kW	14.0	16.5									
	PS	19.0	22.5									
	min-1											
Max. Rated Output (Net)	kW	15.8	18.8	25.0	26.8	29.1	30.9					
	PS	S 21.5 25.5 34.0 36.5 39.5										
High Idling	min-1	nin ⁻¹ 1600 1895 2590 2810 2995 ± 25 ± 25 ± 25 ± 25 ± 25										
Engine Weight (Dry) *with Flywheel Housing		161 kg			155	kg						
PTO Position				Flywheel En	d							
Direction of Rotation			Counterclo	ckwise Viewed Fr	om Flywheel End	i						
Cooling System				quid-Cooled with								
Lubricating System			Forced	Lubrication with T	rochoid Pump							
Normal Oil Pressure at Rated Engine Speed		0.29 - 0.44 N	1Pa	0.34 - 0.	49 MPa	0.39 - 0	.54 MPa					
Normal Oil Pressure at Low Idle Speed				0.06 MP a								
				g (Starter Motor:) ***						
Starting System				lternator: DC12V								
			Recommended B	attery Capacity:	12V,55 Ah*** (5h	rating)						
Dimensions $(L \times W \times H)^*$		$589 \times 486 \times 62$	2mm		564 × 486	\times 622mm						
Engine Oil Pan Capacity**			(Dipst	6.7/3.9L ick Upper Limit /								
Engine Coolant Capacity				2.0L Engine C	•							
Standard Cooling Fan			350mm	O.D., 6 Blade Pu	sher-Type ***							
Crank V-pulley dia./ Fan V-pulley dia.		φ120/ φ90mm	1 ***		φ110/φ1	10mm ***						
Top Clearance				$0.72 \pm 0.06 \mathrm{m}$	nm							

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



3TNV88 (~ EPA Tier2)

Engine Model		3TNV88										
Version		CL VM										
Туре		Vertical In-line Diesel Engine										
Combustion System		Direct Injection										
Aspiration		Natural										
No. of Cylinders		3										
Bore × Stroke		88 × 90mm										
Displacement		1.642L										
	min-1											
Continuous Rated Output	kW	12.3 14.8										
	PS	16.7	20.1									
	min ⁻¹	1500	1800	2000	2200	2400	2600	2800	3000			
Max. Rated Output (Net)	kW	13.5	16.3	18.0	19.9	21.6	23.5	25.2	27.1			
	PS	18.4	22.1	24.5	27.0	29.4	31.9	34.2	36.8			
High Idling	min ⁻¹	nin ⁻¹										
Engine Weight (Dry) *with Flywheel Housing	,	161kg 155kg										
PTO Position					Flywheel En	id						
Direction of Rotation			Co	unterclockwi	se Viewed Fi	rom Flywhee	l End					
Cooling System				Liquid	Cooled with	Radiator						
Lubricating System				Forced Lubr	ication with T	rochoid Pun	ηp					
Normal Oil Pressure at Rated Engine Speed	0	.34 - 0.49 M	Pa			0.39 - 0	.54 MPa					
Normal Oil Pressure at Low Idle Speed					0.06 MPa							
			Electr	ic Starting (S	tarter Motor:	DC12V (1.2	kW)) ***					
Starting System					ator: DC12V	,						
			Recomm	ended Batter	y Capacity: 1	I2V, 55Ah **	* (5h rating)					
Dimensions $(L \times W \times H)^*$	589	9 × 486 × 62	2mm			564 × 486	× 622mm					
Engine Oil Pan Capacity**				(Dipstick U	6.7/3.9L Jpper Limit /	Lower Limit)						
Engine Coolant Capacity					.0L Engine C	•						
Standard Cooling Fan				335mm O.D	., 6 Blade Pu	ısher-Type *	**					
Crank V-pulley dia./ Fan V-pulley dia.	φ.	120/	***			φ110/φ1	10mm ***					
Top Clearance					0.73 ± 0.06 n	nm						

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



4TNV84 (~ EPA Tier2)

Engine Model		4TNV84										
Version		CL VM										
Туре		Vertical In-line Diesel Engine										
Combustion System		Direct Injection										
Aspiration		Natural										
No. of Cylinders		4										
Bore × Stroke		84 × 90mm										
Displacement		1.995L										
	min-1											
Continuous Rated Output	kW	W 14.9 17.7										
	PS	PS 20.3 24.1										
	min ⁻¹	1500	1800	2000	2200	2400	2600	2800	3000			
Max. Rated Output (Net)	kW	16.4	19.5	21.9	24.1	26.3	28.5	30.7	32.9			
	PS	22.3	26.5	29.8	32.8	35.8	38.7	41.7	44.7			
High Idling	min ⁻¹	min ⁻¹										
Engine Weight (Dry) *with Flywheel Housing		183kg 170kg										
PTO Position				•	Flywheel End	<u> </u>						
Direction of Rotation			Col	unterclockwis	e Viewed Fro	om Flywheel	End					
Cooling System				Liquid-	Cooled with F	Radiator						
Lubricating System				Forced Lubri	cation with T	rochoid Pum	p					
Normal Oil Pressure at Rated Engine Speed	0	.34 - 0.49 M F	⊃a			0.39 - 0	.54 M Pa					
Normal Oil Pressure at Low Idle Speed				•	0.06 MPa							
			Electri	c Starting (St			(W)) ***					
Starting System				Alterna	ator: DC12V,	40A***						
			Recomme	ended Batter	y Capacity: 1	2V, 64Ah***	(5h rating)					
Dimensions $(L \times W \times H)^*$	683	× 498.5 × 61	7 mm			658 × 498.	5 × 617mm					
Engine Oil Pan Capacity**				, ,	7.4/4.0L pper Limit / L	,						
Engine Coolant Capacity					7L Engine O	•						
Standard Cooling Fan				370mm O.D.	, 6 Blade Pu	sher-Type **	*					
Crank V-pulley dia./ Fan V-pulley dia.	φ1	120/ _{\$} 90mm	***			φ110/φ1	10mm ***					
Top Clearance				0	.72 ± 0.06 m	m						

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



4TNV84T (~ EPA Tier2)

Engine Model		4TNV84T										
Version		CL VM										
Туре		Vertical In-line Diesel Engine										
Combustion System		Direct Injection										
Aspiration		Turbocharged										
No. of Cylinders		4										
Bore × Stroke		84 × 90mm										
Displacement		1.995L										
	min ⁻¹											
Continuous Rated Output	kW	19.1 24.3										
	PS	S 26.0 33.0										
	min-1	1500	1800	2000	2200	2400	2600	2800	3000			
Max. Rated Output (Net)	kW	21.3	26.9	27.9	30.5	33.5	35.7	38.6	41.2			
	PS	29.0	36.5	38.0	41.5	4 5.5	48.5	52.5	56.0			
High Idling	min ⁻¹	nin ⁻¹										
Engine Weight (Dry) *with Flywheel Housing	'	183 kg 170 kg										
PTO Position					Flywheel En	d						
Direction of Rotation			Co	unterclockwi	se Viewed Fr	om Flywhee	l End					
Cooling System				Liquid	Cooled with	Radiator						
Lubricating System				Forced Lubr	ication with T	rochoid Pun	np					
Normal Oil Pressure at Rated Engine Speed	0	.29 - 0.44 M	Pa			0.36 - 0).5 M Pa					
Normal Oil Pressure at Low Idle Speed					0.06 MPa							
			Electr	ic Starting (S	tarter Motor:	DC12V (1.4	kW)) ***					
Starting System				Altern	ator: DC12V	, 40A***						
			Recomm	ended Batter	y Capacity: 1	2V, 64 Ah**	* (5h rating)					
Dimensions $(L \times W \times H)^*$	683	× 498.5 × 71	3 mm			649 × 498.	5 × 713 mm					
Engine Oil Pan Capacity**				(Dipstick U	7.4/4.0L Jpper Limit /	Lower Limit)						
Engine Coolant Capacity				2	.7L Engine C	nly						
Standard Cooling Fan				370mm O.D	., 6 Blade Pu	ısher-Type *	**					
Crank V-pulley dia./ Fan V-pulley dia.	φ.	120/	***			φ110/φ1	10mm ***					
Top Clearance					0.73 ± 0.06 m	nm						

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



4TNV88 (~ EPA Tier2)

Engine Model		4TNV88										
Version		CL VM										
Туре		Vertical In-line Diesel Engine										
Combustion System		Direct Injection										
Aspiration		Natural										
No. of Cylinders		4										
Bore x Stroke		88 x 90mm										
Displacement		2.190L										
	min-1											
Continuous Rated Output	kW	16.4 19.6										
	PS	S 22.3 26.7										
	min-1	1500	1800	2000	2200	2400	2600	2800	3000			
Max. Rated Output (Net)	kW	18.0	21.6	24.1	26.5	28.8	31.3	33.7	35.4			
	PS	24.5	29.4	32.7	36.0	39.2	42.5	45.8	48.1			
High Idling	min ⁻¹	min ⁻¹										
Engine Weight (Dry) *with Flywheel Housing	•	183 kg 170 kg										
PTO Position					Flywheel En	d						
Direction of Rotation			Co	unterclockwi	se Viewed Fr	om Flywhee	l End					
Cooling System				Liquid-	Cooled with	Radiator						
Lubricating System				Forced Lubr	ication with T	rochoid Pun	np					
Normal Oil Pressure at Rated Engine Speed	0	0.34 - 0.49 M	Pa			0.39 - 0	.54 MPa					
Normal Oil Pressure at Low Idle Speed					0.06 MPa							
			Electr	ic Starting (S	tarter Motor:	DC12V (1.4	kW)) ***					
Starting System				Altern	ator: DC12V	, 40A***						
			Recomme	nded Battery	Capacity: 12	V, 64 Ah***	(5h rating) ***	k				
Dimensions $(L \times W \times H)^*$	683	× 498.5 × 61	8 mm			658 × 498.	5 × 618 mm					
Engine Oil Pan Capacity**				(Dipstick U	7.4 / 4.0 L Jpper Limit / I	Lower Limit)						
Engine Coolant Capacity					.7L Engine C							
Standard Cooling Fan				370mm O.D	., 6 Blade Pu	sher-Type *	**					
Crank V-pulley dia./ Fan V-pulley dia.	ф	120/ _{\$} 90mm	***			φ110/φ1	10mm ***					
Top Clearance				. (0.73 ± 0.06 m	ım						

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



4TNV94L (~ EPA Tier2)

Engine Model				4TNV94L						
Version		CL			V	М				
Туре			Ve	rtical In-line Dies	el Engine					
Combustion System				Direct Injecti	on					
Aspiration				Natural						
No. of Cylinders				4						
Bore × Stroke				94 × 110mr	n					
Displacement				3.054L						
	min-1	1500	1800							
Continuous Rated Output	kW	26.1	31.3							
	PS	35.5	42.5							
	min-1	1500	1800	2000	2200	2400	2500			
Max. Rated Output (Net)	kW	29.1	34.6	35.3	38.2	41.6	43.0			
	PS	39.5	47.0	48.0	52.0	56.5	58.5			
High Idling	min-1	1600 ± 25	1895 ± 25	2180 ± 25	2400 ± 25	2590 ± 25	2700 ± 25			
Engine Weight (Dry) *with Flywheel Housing		245 kg	•		235	s kg	1			
PTO Position				Flywheel Er	ıd					
Direction of Rotation			Counterclo	ckwise Viewed F	rom Flywheel End	d				
Cooling System			Lie	quid-Cooled with	Radiator					
Lubricating System			Forced	Lubrication with Trochoid Pump						
Normal Oil Pressure at Rated Engine Speed				0.29 - 0.39 M	Pa					
Normal Oil Pressure at Low Idle Speed				0.06 MPa						
			Electric Startin	g (Starter Motor:	DC12V (2.3 kW)) ***				
Starting System			А	lternator: DC12V	, 40A***					
			Recommended E	Sattery Capacity:	12V, 64Ah*** (5h	rating)				
Dimensions $(L \times W \times H)^*$				$719 \times 498 \times 742$	2 mm					
Engine Oil Pan Capacity**			(Dipst	10.5/6.0L tick Upper Limit /	Lower Limit)					
Engine Coolant Capacity				4.2L Engine C	Only					
Standard Cooling Fan			4 10m m	O.D., 6 Blade Po	usher-Type ***					
Crank V-pulley dia./ Fan V-pulley dia.				φ130/ φ130mn	1 ***					
Top Clearance				0.793 ± 0.063	mm					

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



4TNV98 (~ EPA Tier2)

Engine Model				4TNV98			
Version		CL			V	M	
Туре			Ve	rtical In-line Dies	el Engine		
Combustion System				Direct Injecti	on		
Aspiration				Natural			
No. of Cylinders				4			
Bore × Stroke				98 × 110mr	n		
Displacement				3.319L			
	min-1	1500	1800				
Continuous Rated Output	k₩	30.9	36.8				
	PS	42.0	50.0				
	min-1	1500	1800	2000	2200	2400	2500
Max. Rated Output (Net)	k₩	34.6	41.2	41.9	45.6	49.3	51.1
	PS	47.0	56.0	57.0	62.0	67.0	69.5
High Idling	min-1	1600 ± 25	1895 ±25	2180 ± 25	2400 ± 25	2590 ± 25	2700 ± 25
Engine Weight (Dry) *with Flywheel Housing		248 kg			235	ī kg	
PTO Position				Flywheel Er	d		
Direction of Rotation			Counterclo	ckwise Viewed F	om Flywheel End	Ė	
Cooling System			Li	quid-Cooled with	Radiator		
Lubricating System			Forced	Lubrication with T	rochoid Pump		
Normal Oil Pressure at Rated Engine Speed				0.29 - 0.39 M	Pa		
Normal Oil Pressure at Low Idle Speed				0.06 M Pa			
				ig (Starter Motor:) ***	
Starting System				lternator: DC12V	•		
			Recommended E	Battery Capacity:	12V, 64Ah*** (5h	rating)	
Dimensions $(L \times W \times H)^*$				$719 \times 498 \times 742$	2 mm		
Engine Oil Pan Capacity**			(Dips	10.5/6.0L tick Upper Limit /	Lower Limit)		
Engine Coolant Capacity				4.2L Engine C	•		
Standard Cooling Fan			410mm	O.D., 6 Blade Pu	ısher-Type ***		
Crank V-pulley dia./ Fan V-pulley dia.				φ130/ φ130mm	ן ***		
Top Clearance				0.793 ± 0.063	mm		

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



4TNV98T (~ EPA Tier2)

Engine Model				4⊺NV98T			
Version		CL			V	М	
Туре			Ve	rtical In-line Dies	el Engine		
Combustion System				Direct Injecti	on		
Aspiration				Turbocharge	ed		
No. of Cylinders				4			
Bore × Stroke				98 × 110mr	n		
Displacement				3.319L			
	min-1	1500	1800				
Continuous Rated Output	kW	37.9	45.6				
	PS	5 1 .5	62.0				
	min ⁻¹	1500	1800	2000	2200	2400	2500
Max. Rated Output (Net)	kW	41.9	50.4	50.7	55.5	60.3	62.5
	PS	57.0	68.5	69.0	75.5	82.0	85.0
High Idling	min ⁻¹	1600 ± 25	1895 ± 25	2180 ± 25	2400 ± 25	2590 ± 25	2700 ± 25
Engine Weight (Dry) *with Flywheel Housing		258 kg	•		24	5 kg	1
PTO Position				Flywheel Er	ıd		
Direction of Rotation			Counterclo	ckwise Viewed F	rom Flywheel End	d	
Cooling System			Li	quid-Cooled with	Radiator		
Lubricating System			Forced	Lubrication with T	rochoid Pump		
Normal Oil Pressure at Rated Engine Speed				0.29 - 0.39 M	Pa		
Normal Oil Pressure at Low Idle Speed				0.06 MPa			
				g (Starter Motor:) ***	
Starting System			Δ	lternator: DC12V	, 40A***		
			Recommend	ded Battery Capa	city: 12V, 64Ah *	**	
Dimensions $(L \times W \times H)^*$				$719 \times 575 \times 80$	4mm		
Engine Oil Pan Capacity**			(Dipsi	10.5/6.0L tick Upper Limit /	Lower Limit)		
Engine Coolant Capacity				4.2L Engine C	nly		
Standard Cooling Fan			430 mm	O.D., 8 Blade Su	iction-Type ***		
Crank V-pulley dia./ Fan V-pulley dia.				φ130/ φ130mn	ו ***		
Top Clearance				0.793 ± 0.063	mm		

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



4TNV106 (~ EPA Tier2)

Engine Model				4TNV106						
Version		CL			V	M				
Туре			Ve	rtical In-line Dies	el Engine					
Combustion System				Direct Injecti	on					
Aspiration				Natural						
No. of Cylinders				4						
Bore × Stroke				106 × 125m	m					
Displacement				4.412L						
	min-1	1500	1800							
Continuous Rated Output	kW	41.2	49.3							
	PS	56.0	67.0							
	min-1	1500	1800	2000	2200	2400	2500			
Max. Rated Output (Net)	k₩	45.6	54.4	56.6	61.4	65.5	67.7			
	PS	62.0	74.0	77.0	83.5	89.0	92.0			
High Idling	min-1	1600 ± 25	1895 ± 25	2205 ± 25	2420 ± 25	2615 ± 25	2725 ± 25			
Engine Weight (Dry) *with Flywheel Housing		345kg			330	Okg				
PTO Position		Flywheel End								
Direction of Rotation			Counterclo	ckwise Viewed F	om Flywheel End	<u>.</u>				
Cooling System			Li	quid-Cooled with	Radiator					
Lubricating System			Forced	Lubrication with T	rochoid Pump					
Normal Oil Pressure at Rated Engine Speed		0.31 - 0.49 N	1Pa			0.34-0.44 MPa r: 0.39-0.49 MPa				
Normal Oil Pressure at Low Idle Speed				0.06 M Pa						
				g (Starter Motor:) ***				
Starting System				lternator: DC12V						
			Recommend	ded Battery Capa	city: 12V, 88 Ah*	**				
Dimensions $(L \times W \times H)^*$		808 × 629 × 80	3 mm		776 × 629	× 803 mm				
Engine Oil Pan Capacity**	(Dipst	14.0/5.0L ick Upper Limit /	Lower Limit)	(/6.5 <mark>L</mark> imit / Lower Limit	t)			
Engine Coolant Capacity				6L Engine O	nly					
Standard Cooling Fan	500mm	O.D. 7 Blade Pu	ısher-Type ***	50	0mm O.D. 7 Bla	de Suction-Type	***			
Crank V-pulley dia./ Fan V-pulley dia.				φ150/ φ150mm	1 ***					
Top Clearance				0.906 ± 0.059	mm					

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



4TNV106T (~ EPA Tier2)

Engine Model			4TNV106T	-	
Version		CL		V	M
Туре			Vertical In-line Dies	el Engine	
Combustion System			Direct Injecti	on	
Aspiration			Turbocharge	ed	
No. of Cylinders			4		
Bore × Stroke			106 × 125m	m	
Displacement			4.412L		
	min-1	1500	1800		
Continuous Rated Output	kW	51.5	61.8		
	PS	70.0	84.0		
	min-1	1500	1800	2000	2200
Max. Rated Output (Net)	kW	56.8	68.0	69.9	72.0
	PS	77.2	92.5	95.0	97.9
High Idling	min-1	1600 ± 25	1875 ± 25	2205 ± 25	2420 ± 25
Engine Weight (Dry) *with Flywheel Housing	, 	355 kg		340	kg
PTO Position			Flywheel Er	nd	
Direction of Rotation		Co	unterclockwise Viewed F	rom Flywheel End	
Cooling System			Liquid-Cooled with	Radiator	
Lubricating System			Forced Lubrication with 1	rochoid Pump	
Normal Oil Pressure at Rated Engine Speed		0.31 - 0.49 M	Pa		0.34-0.44 MPa r: 0.39-0.49 MPa
Normal Oil Pressure at Low Idle Speed			0.06 MPa		
		Electr	ic Starting (Starter Motor		
Starting System			Alternator: DC12V	*	
		Red	ommended Battery Capa	city: 12V, 88 Ah***	
Dimensions $(L \times W \times H)^*$		808 × 629 × 866	3 mm	776 × 629	× 866 mm
Engine Oil Pan Capacity**		14.0/5.0L (Dipstick Upper Limit /	Lower Limit)	14.0. (Dipstick Upper L	/6.5L imit / Lower Limit)
Engine Coolant Capacity			6L Engine O	nly	
Standard Cooling Fan	5	00mm O.D. 7 Blade Pu	isher-Type ***	500mm O.D.7 Blac	de Suction-Type***
Crank V-pulley dia./ Fan V-pulley dia.			φ150/ φ150mn) ***	
Top Clearance			0.906 ± 0.059	mm	

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



3TNV82A-B (complies with EPA Interim Tier4)

Engine Mode	· l							3	TNV82A	·B					
Version			CL							VM					
Туре					•		Vertical,	4-cycle v	water-cod	oled dies	el engine)			
Combustion 9	System							Dir	ect Inject	tion					
Aspiration								Natu	ıral aspir	ation					
No. of Cylind	ers								3						
Bore × Stroke	9							φί	32 × 84m	m					
Displacemen	t								1.331L						
Continuous F	Rated	min-1													
Output	ialeu	kW													
<u> </u>		PS			<u> </u>							_			
		min-1			<u> </u>		2200	2300	2400	2500	2600	2700	2800		3000
Max. Rated C	Dutput	kW			<u> </u>		16.0	16.8	17.5	18.2	19.0	19.7	20.4		21.9
(Net)		PS					21.8	22.8	23.8	24.8	25.8	26.8	27.8		29.8
					<u> </u>										23.0
High Idling		min-1					2375 ±25	2485 ±25	2570 ±25	2675 ±25	2780 ±25	2890 ±25	2995 ±25		3180 ±25
Engine Weigl *with Flywhee	ht (dry) el Housi	ng	·				•			128kg		•			
PTO Position	th Flywheel Housing O Position			Flywheel End											
Direction of F	Rotation		Counterclockwise Viewed From Flywheel End Mechanical governor (All-speed governor)												
Governor							Mechan	ical gove	ernor (All-	-speed g	overnor)				
Cooling Syste	em						L	_iquid-Co	oled with	Radiato	r				
Lubricating S	ystem						Forced	d Lubrica	tion with	Trochoid	Pump				
Normal Oil	Rated Speed	Engine						0.31-0.	46 (3.2-4	.7) MPa					6-0.51 5.2) MPa
Pressure	Low Id							≥ 0.0	06 (≥ 0.6)	MPa					
Starting Syste	em					Е	lectric Star	ting (Star	ter Moto	r: DC12\	/ (1.7kW)) ***			
Charging sys	tem							Alternato	r (DC12\	//40A) **	*				
Recommende Capacity	ed Batte	ry						12V-55	Ah*** (5h	rating)					
Starting aid d	levice						Sı	per-quic	k Heating	Glow p	lug				
Dimensions ($L \times W \times$	H)*			1					492 × 5					
Engine Oil Pa	an Capa	city**					(Dip		5.5L/3.6L per Limit		_imit)				
Engine Coola	ant Capa	acity							Engine						
Standard Cod	oling Fa	n T					Resin	F type p	usher fan	- ¢335(I	VF) × 6				
Crank V-pulle Fan V-pulley	v dia./							'	ф 1 1	ΙΟ/ φ110	mm				
Top Clearance								0.6	4 ± 0.06	mm					
	-														

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



3TNV84T-Z (complies with EPA DI 3TNV841-2 (0.

Engine Model	l				3	TNV84T	·Z					
Version			CL				VM					
Туре					Vertical, 4-cycle	water-cod	led dies	el engine)			
Combustion 9	System				Dir	ect Inject	ion					
Aspiration					Tι	ırbocharç	jed					
No. of Cylinde	ers					3						
Bore x Stroke)				ф	84×90 m	m					
Displacement	t					1.496L						
Continuous R Output	Rated	min-1 kW PS										
		min-1			1	2400	2500	2600	2700	2800	П	
Max. Rated C	Output	kW				25.0	26.0	26.8	27.9	29.1		
(Net)		PS				34.0	35.3	36.5	38.0	39.5		
						2590	2700	2810	2920	2995		
High Idling		min-1				±25	±25	±25	±25	±25		
Engine Weigh *with Flywhee	nt (dry) el Housin	g					155kg					
PTO Position				•	Fl	ywheel E	nd					
Direction of R	lotation			C	Counterclockwise	Viewed F	rom Fly	wheel Er	nd			
Governor					Electronic gove							
Cooling Syste					Liquid-Co							
Lubricating Sy					Forced Lubrica	tion with	Trochoid	Pump				
Normal Oil	Rated E Speed	ngine				0.3	4-0.49 (3	3.5-5.0) N	/IPa	0.39-0.54	l (4 .0- 5.	5) MPa
Pressure	Low Idle Speed	е				6 (≥ 0.6)						
Starting Syste				Elec	ctric Starting (Stai)) ***			
Charging syst					Alternato	r (DC12\	//40A) **	*				
Recommende Capacity		У			12V-55	Ah*** (5h	rating)					
Starting aid d	evice				Air heate	er (12V D	C 400W)				
Dimensions (L×W×	H)*	589 × 486 × 622mm			564 ×	486 × 6	22mm				
Engine Oil Pa	an Capac	ity**			(Dipstick Upp		Lowerl	_imit)				
Engine Coola						. Engine						
Standard Coo					Resin	F type pu	ısher fan	- ф 350(0	ΩF) × 6			
Crank V-pulle Fan V-pulley	y dia./ dia.					φ1	ΙΟ/ φ110ι	mm				
Top Clearanc	e			•	0.7	2 ± 0.06	mm					

- * Engine specifications without radiator.
- ** Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.
- *** May vary depending on application.



3TNV84T-B (complies with EPA Interim Tier4)

Engine Mode	:				3	TNV84T	-В							
Version			CL				VM							
Туре				•	Vertical, 4-cycle	water-cod	oled dies	el engine	,					
Combustion S	System				Dir	ect Inject	tion							
Aspiration					Tu	ırbocharç	jed							
No. of Cylinde	ers					3								
Bore × Stroke	9				ф	84 × 90m	ım							
Displacement	t					1.496L								
Continuous F	latad	min-1												
Output	rated	k₩												
		PS												
May Dated C	3aa	min-1				2400	2500	2600	2700	2800				
Max. Rated C (Net)	zutput	kW				25.0	26.0	26.8	27.9	29.1				
(**		PS				34.0	35.3	36.5	38.0	39.5				
High Idling		min-1				2590 ±25	2700 ±25	2810 ±25	2920 ±25	2995 ±25				
Engine Weight *with Flywhee	ht (dry) el Housii	ng					155kg		•					
PTO Position		_		I	FI	ywheel E	ind							
Direction of F	otation			(Counterclockwise	Viewed F	rom Fly	wheel Er	nd					
Governor			Mechanical governor (All-speed governor)											
Cooling Syste	em				Liquid-Co	oled with	n Radiato	r						
Lubricating S	ystem				Forced Lubrica	tion with	Trochoid	Pump						
Normal Oil	Rated Speed	Engine				0.3	4-0.49 (3	3.5-5.0) N	/IPa	0.39-0.5	4 (4.0-	5.5) MPa		
Pressure	Low Id Speed	le			≥ 0.0	06 (≥ 0.6)	MPa							
Starting Syste	em			Ele	ctric Starting (Star	ter Moto	r: DC12V	/ (1.7kW))) ***					
Charging sys	tem				Alternato	r (DC12\	//40A) **	*						
Recommende Capacity	ed Batte	ry			12V-55	Ah*** (5h	rating)							
Starting aid d	levice				Air heate	er (12V D	C 400W)						
Dimensions (L×W×	H)*	589 × 486 × 622mm			564 ×	486 × 6	22mm						
Engine Oil Pa	an Capa	city**			(Dipstick Upp	6.7L/3.9L per Limit		_imit)						
Engine Coola	nt Capa	city			2.01	Engine	Only							
Standard Cod	oling Far	n			Resin	F type pu	ısher fan	- ¢350(0	QF) × 6					
Crank V-pulle Fan V-pulley	ey dia./ dia.					φ1	10/ ф110i	mm						
Top Clearand				<u> </u>	0.7	2 ± 0.06	mm							

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



3TNV88-Z (complies with EPA Interim Tier4)

Engine Mode	e l				3	TNV88-Z				
Version			CL			VI	И			
Туре				٧	ertical, 4-cycle w	ater-cooled	diesel engine			
Combustion S	System				Dire	ct Injection				
Aspiration					Natui	ral aspiration				
No. of Cylinde	ers					3				
Bore x Stroke	9				ф8	8 × 90mm				
Displacement	t					1.642L				
Continuous F	1-4-d	nin-1								
Output		kW								
		PS								
Max. Rated C	N	nin-1					2600	2800		3000
(Net)	· L	kW					23.5	25.2		27.1
(*****)		PS					31.9	34.2		36.8
High Idling	n	ni n -1					2810 ±25	2995 ±25		3210 ±25
Engine Weight *with Flywhee	ht (dry) el Housing		•	<u> </u>		155	ikg	'		
PTO Position					Fly	wheel End				
Direction of F	Rotation			Co	ounterclockwise \		Flywheel End			
Governor					Electronic govern	nor (All-spee	d governor)			
Cooling Syste	em				Liquid-Cod	oled with Rad	diator			
Lubricating S	ystem				Forced Lubricati	ion with Troc	hoid Pump			
Normal Oil	Rated En Speed	gine			0.34-0.4	9 (3.5-5.0) M	IPa		0.39- (4.0-5.5	
Pressure	Low Idle Speed		'		≥ 0.06	6 (≥ 0.6) MPa	a			
Starting Syste	em			Elect	ric Starting (Start	er Motor: DC	12V (1.7kW)) ***			
Charging sys	tem				Alternator	(DC12V/40A	A) ***			
Recommends Capacity	ed Battery				12V-55/	\h*** (5h ratir	ng)			
Starting aid d	levice				Super-quick	Heating Glo	w plug			
Dimensions ($L \times W \times H$	*				568 × 514	× 622mm			
Engine Oil Pa	an Capacity	/**			6 (Dipstick Uppe	i.7L/3.9L er Limit / Low	/er Limit)			
Engine Coola	ant Capacit	У				Engine Only	· · · · · · · · · · · · · · · · · · ·			
Standard Cod					Resin F type pu	sher fan - ø3	35(NF) × 6			
Crank V-pulle Fan V-pulley	ev dia./					φ110/φ				
Top Clearance					0.73	± 0.06 mm				

- Engine specifications without radiator.
- Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.
- *** May vary depending on application.



3TNV88-U (complies with EPA Interim Tier4)

Engine Mode							3	I-88VNT	J					
Version			CL						VM					
Туре				•	V	ertical,	4-cycle v	vater-coo	oled dies	el engine	,			
Combustion S	System						Dir	ect Inject	tion					
Aspiration							Natu	ıral aspir	ation					
No. of Cylinde	ers							3						
Bore × Stroke	9						φδ	38×90 m	m					
Displacement	t							1.642L						
Continuous R	lotad	min-1												
Output	ialeu	kW												
		PS												
Max. Rated C	Nutra it	min-1				2200	2300	2400	2500	2600	2700	2800		3000
(Net)	zutput	kW				18.1	18.9	19.7	20.5	21.3	22.2	23.0		24.6
` ′		PS				24.6	25.7	26.8	27.9	29.0	30.2	31.3		33.5
High Idling		min-1				2400 ±25	2510 ±25	2590 ±25	2700 ±25	2810 ±25	2920 ±25	2995 ±25		3210 ±25
Engine Weigh *with Flywhee	nt (dry) el Housii	ng	•					155kg					•	•
PTO Position		_					Fly	/wheel E	nd					
Direction of R	otation				Co	untercl	ockwise	Viewed F	rom Fly	wheel Er	nd			
Governor					N	vi echan	ical gove	rnor (All-	speed g	overnor)				
Cooling Syste	em					L	iquid-Co	oled with	Radiato	r				
Lubricating St	ystem					Forced	Lubrica	tion with	Trochoid	Pump				
Normal Oil	Rated Speed	Engine					0.34-0.4	19 (3.5-5	.0) MPa					9-0.54 .5) MPa
Pressure	Low Id Speed	le					≥ 0.0	6 (≥ 0.6)	MPa					
Starting Syste	em				Electr	ric Start	ing (Star	ter Moto	r: DC12V	(1.7kW))) ***			
Charging syst	tem						Alternato	r (DC12\	//40A) **	*				
Recommende Capacity	ed Batte	ry					12V-55	Ah*** (5h	rating)					
Starting aid d	evice					Su	per-quic	k Heating	Glow p	lug				
Dimensions (I	$L \times W \times$	H)*						568 ×	514 × 6	22mm				
Engine Oil Pa	an Capa	city**				(Dip:		6.7L/3.9L er Limit		_imit)				
Engine Coola	nt Capa	city						Engine		•				
Standard Cod		1				Resin	F type pu	ısher fan	- ¢335(l	VF) × 6				
Crank V-pulle Fan V-pulley	y dia./ dia.							φ1	10/ ф110i	mm				
Top Clearance				<u>'</u>			0.7	3 ± 0.06	mm					

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



3TNV88-B (complies with EPA DI 3TNV88-ם (ככּ Interim Tier4)

Max. Rated Output (Net) kW 13.5 16.3 19.9 20.7 21.6 22.6 23.5 24.3 25.2 27.1 PS 18.4 22.1 27.0 28.2 29.4 30.7 31.9 33.1 34.2 36.8	Engine Mode								3	TNV88-I	В					
Direct Injection Natural aspiration Natural A	Version			C	;L						VM					
Aspiration No. of Cylinders Sabre x Stroke 688 x 90mm 1.642L	Туре						Ve	ertical,	4-cycle v	water-cod	oled dies	el engine	9			
No. of Cylinders	Combustion S	3ystem							Dir	ect Inject	tion					
Displacement	Aspiration								Natu	ıral aspira	ation					
Displacement	No. of Cylinde	ers								3						
Max. Rated Output	Bore x Stroke)							ф8	38 × 90m	m					
Continuous Rated Output	Displacement	t							·	1.642L						
Output RW 12.3 14.8 PS 16.7 20.1 Max. Rated Output (Net) min¹ 1500 1800 2200 2300 2400 2500 2600 2700 2800 3000 Max. Rated Output (Net) kW 13.5 16.3 19.9 20.7 21.6 22.6 23.5 24.3 25.2 27.1 FS 18.4 22.1 27.0 28.2 29.4 30.7 31.9 33.1 34.2 36.8 High Idling min¹ 1500 1895 2400 2510 2590 2700 2810 2920 2995 3210 Engine Weight (dry)** with Flywheel Housing 161kg 155kg PTO Position Flywheel End 155kg Direction of Rotation Counterclockwise Viewed From Flywheel End Governor Mechanical governor (All-speed governor) Cooling System Liquid-Cooled with Radiator Lubricating System Forced Lubrication with Trochoid Pump Normal Oil Pressure Speed (3.0-4.5) MPa 0.34-0.49 (3.5-5.0) MPa 0.39-0.54 Starting System Electric Starting (Starter Motor: DC12V (1.7kW))*** Charging system Alternator (DC12V/40A)**** Fleed Public Publi			min-1	1500	1800											
PS		lated	kW	12.3	14.8											
Max. Rated Output (Net) kW 13.5 16.3 19.9 20.7 21.6 22.6 23.5 24.3 25.2 27.1 PS 18.4 22.1 27.0 28.2 29.4 30.7 31.9 33.1 34.2 36.8 High Idling min¹¹ 1600 1895 2400 2510 2590 2700 2810 2920 2995 3210 Fingine Weight (dry with Flywheel Housing 161kg 155kg 161kg 155kg 156kg 156kg 156kg 156kg 156kg 156kg 156kg 156kg 156kg <td>Carpar</td> <td></td> <td>PS</td> <td>16.7</td> <td>20.1</td> <td></td>	Carpar		PS	16.7	20.1											
Net PS 18.4 22.1 27.0 28.2 29.4 30.7 31.9 33.1 34.2 36.8 High Idling			min-1	1500	1800			2200	2300	2400	2500	2600	2700	2800		3000
PS		output	kW	13.5	16.3			19.9	20.7	21.6	22.6	23.5	24.3	25.2		27.1
Engine Weight (dry) **with Flywheel Housing PTO Position Direction of Rotation Counterclockwise Viewed From Flywheel End Governor Cooling System Lubricating System Normal Oil Pressure Charging system Alternator (DC12V (1.7kW)) **** 12V-55Ah*** (5h rating) Super-quick Heating Glow plug Super-quick Heating Glow plug Charging system Charging system Charging system Charging system Charging system Charging system Alternator (DC12V/40A) **** 12V-55Ah*** (5h rating) Super-quick Heating Glow plug Charging system	(Net)		PS	18.4	22.1			27.0	28.2	29.4	30.7	31.9	33.1	34.2		36.8
*with Flywheel Housing PTO Position Flywheel End Direction of Rotation Counterclockwise Viewed From Flywheel End Governor Mechanical governor (All-speed governor) Cooling System Liquid-Cooled with Radiator Lubricating System Forced Lubrication with Trochoid Pump Normal Oil Pressure Speed (3.0-4.5) MPa 0.34-0.49 (3.5-5.0) MPa 0.39-0.54 (4.0-5.5) MPa Starting System Electric Starting (Starter Motor: DC12V (1.7kW)) *** Charging system Electric Starting (Starter Motor: DC12V (1.7kW)) *** Recommended Battery Capacity 12V-55Ah*** (5h rating) Starting aid device Super-quick Heating Glow plug Dimensions (L × W × H)* 583 × 514 × 622mm 6.7L/3.9L Engine Oil Pan Capacity** Engine Coolant Capacity 1410/4410mm Resin F type pusher fan - ∲335(NF) × 6 Crank V-pulley dia./ 4130/4400mm	High Idling		min-1													3210 ±25
Direction of Rotation Governor Cooling System Liquid-Cooled with Radiator Lubricating System Rated Engine Speed Normal Oil Pressure Speed Counterclockwise Viewed From Flywheel End Mechanical governor (All-speed governor) Liquid-Cooled with Radiator Liquid-Cooled with Radiator Liquid-Cooled with Radiator Rated Engine Speed O.29-0.44 (3.0-4.5) MPa Counterclockwise Viewed From Flywheel End Mechanical governor (All-speed governor) Liquid-Cooled with Radiator Liquid-Cooled with Radiator Forced Lubrication with Trochoid Pump 0.39-0.54 (4.0-5.5) MPa 2.0.6 (≥ 0.6) MPa Starting System Electric Starting (Starter Motor: DC12V (1.7kW))*** Recommended Battery Capacity 12V-55Ah*** (5h rating) Starting aid device Super-quick Heating Glow plug Dimensions (L × W × H)* 583 × 514 × 622mm 6.7L/3.9L Engine Coll Pan Capacity** (Dipstick Upper Limit / Lower Limit) Engine Coolant Capacity Standard Cooling Fan Resin F type pusher fan - \$335(NF) × 6 Crank V-pulley dia./	Engine Weight *with Flywhee	nt (dry) el Housir	ng	16	1kg		•				155kg	'	•		'	•
Governor Cooling System Lubricating System Rated Engine Speed Low Idle Speed Starting System Charging system Recommended Battery Capacity Starting aid device Dimensions (L × W × H)* Engine Coolant Capacity** Engine Coolant Capacity Standard Cooling Fan Crank V-pulley dia./ Mechanical governor (All-speed governor) Liquid-Cooled with Radiator Liquid-Cooled with Radiator 10.39-0.54 (4.0-5.5) MPa 0.39-0.54 (4.0-5.5) MPa 0.34-0.49 (3.5-5.0) MPa 0.34-0.49 (3.5-5.0) MPa Electric Starting (Starter Motor: DC12V (1.7kW)) **** Alternator (DC12V/40A) **** 12V-55Ah*** (5h rating) Super-quick Heating Glow plug 6.7L/3.9L (Dipstick Upper Limit / Lower Limit) Engine Coolant Capacity 120/4410mm 1410/4410mm	PTO Position					ı			Fly	wheel E	nd					
Cooling System	Direction of R	otation					Co	untercl	ockwise	Viewed F	rom Fly	wheel Er	nd			
Lubricating System Rated Engine O.29-0.44 (3.0-4.5) MPa Normal Oil Pressure Charging system Ch	Governor						٨	/lechan	ical gove	rnor (All-	speed g	overnor)				
Rated Engine 0.29-0.44 (3.0-4.5) MPa 0.34-0.49 (3.5-5.0) MPa (4.0-5.5) MPa	Cooling Syste	em						L	.iquid-Co	oled with	n Radiato	or				
Normal Oil Pressure Speed Low Idle Speed (3.0-4.5) MPa (4.0-5.5) MPa Starting System Electric Starting (Starter Motor: DC12V (1.7kW)) **** Charging system Alternator (DC12V/40A) **** Recommended Battery Capacity 12V-55Ah*** (5h rating) Starting aid device Super-quick Heating Glow plug Dimensions (L × W × H)* 583 × 514 × 622mm Engine Oil Pan Capacity** 6.7L/3.9L (Dipstick Upper Limit / Lower Limit) Engine Coolant Capacity 2.0L Engine Only Standard Cooling Fan Resin F type pusher fan - \$335(NF) × 6 Crank V-pulley dia./ +140/+140mm	Lubricating S	ystem						Forced	Lubrica	tion with	Trochoid	d Pump				
Speed ≥ 0.06 (≥ 0.6) MPa Starting System Electric Starting (Starter Motor: DC12V (1.7kW)) *** Charging system Alternator (DC12V/40A) *** Recommended Battery Capacity 12V-55Ah*** (5h rating) Starting aid device Super-quick Heating Glow plug Dimensions (L × W × H)* 583 × 514 × 622mm Engine Oil Pan Capacity** Engine Coolant Capacity (Dipstick Upper Limit / Lower Limit) Engine Coolant Capacity 2.0L Engine Only Standard Cooling Fan Resin F type pusher fan - ∮335(NF) × 6 Crank V-pulley dia./ (1400/+110mm)	Normal Oil								0.34-0.4	49 (3.5-5	.0) MPa					
Charging system Recommended Battery Capacity Starting aid device Dimensions (L × W × H)* Engine Oil Pan Capacity* Engine Coolant Capacity Standard Cooling Fan Crank V-pulley dia./	Pressure		le			•			≥ 0.0	6 (≥ 0.6)	MPa					
Recommended Battery Capacity Starting aid device Super-quick Heating Glow plug Dimensions (L × W × H)* 583 × 514 × 622mm 568 × 514 × 622mm 6.7L/3.9L (Dipstick Upper Limit / Lower Limit) Engine Coolant Capacity Standard Cooling Fan Resin F type pusher fan - \$335(NF) × 6 Crank V-pulley dia./	Starting Syste	em					Electr	ic Start	ing (Star	ter Moto	r: DC12\	/ (1.7kW)) ***			
Capacity Starting aid device Super-quick Heating Glow plug Dimensions (L × W × H)* Engine Oil Pan Capacity** Engine Coolant Capacity Standard Cooling Fan Crank V-pulley dia./ Super-quick Heating Glow plug Super-quick Heating Glow plug 568 × 514 × 622mm 6.7L/3.9L (Dipstick Upper Limit / Lower Limit) 2.0L Engine Only Standard Cooling Fan Resin F type pusher fan - \$335(NF) × 6	Charging sys	tem						,	Alternato	r (DC12\	//40A) **	*				
Dimensions (L × W × H)* 588 × 514 × 622mm 568 × 514 × 622mm 6.7L/3.9L (Dipstick Upper Limit / Lower Limit) Engine Coolant Capacity 588 × 514 × 622mm 6.7L/3.9L (Dipstick Upper Limit / Lower Limit) 2.0L Engine Only Standard Cooling Fan Resin F type pusher fan - \$335(NF) × 6 Crank V-pulley dia./		ed Batte	ry						12V-55	Ah*** (5h	rating)					
Engine Oil Pan Capacity** Engine Coolant Capacity Engine Cooling Fan Crank V-pulley dia./ Engine Oil Pan Capacity 622mm 624mm 62		evice						Su	per-quic	k Heating	g Glow p	lug				
Engine Oil Pan Capacity (Dipstick Upper Limit / Lower Limit) Engine Coolant Capacity 2.0L Engine Only Standard Cooling Fan Resin F type pusher fan - \$335(NF) × 6 Crank V-pulley dia./	Dimensions (L×W×	H)*						· · · · ·	568 x	514×6	22mm				
Standard Cooling Fan Resin F type pusher fan - \$335(NF) × 6 Crank V-pulley dia./	Engine Oil Pa	an Capa	city**					(Dips				_imit)				
Crank V-pulley dia./	Engine Coola	int Capa	city						2.0L	. Engine	Only					
Crank V-pulley dia./ Fan V-pulley dia.	Standard Cod	oling Far	n					Resin	F type pu	ısher fan	- ∳335(I	VF)×6				
	Crank V-pulle Fan V-pulley	ey dia./ dia.		φ120/ ¢	∮90mm					ф11	10/ ф110	mm				
Top Clearance 0.73 ± 0.06 mm									0.73	3 ± 0.06	mm					

- * Engine specifications without radiator.
- ** Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.
- *** May vary depending on application.



4TNV84T-B / 4TNV84T-Z (complies with EPA Interim Tier4)

Version CL	3000 41.2 56.0 3150 ±25
Direct Injection Aspiration Turbocharged	41.2 56.0 3150
Aspiration Turbocharged	41.2 56.0 3150
No. of Cylinders	41.2 56.0 3150
Bore × Stroke #84 × 90mm	41.2 56.0 3150
Displacement	41.2 56.0 3150
Max. Rated Output	41.2 56.0 3150
Continuous Rated Output	41.2 56.0 3150
Output RW 19.1 24.3 PS 26.0 33.0 26.0 33.0 33.0 2400 2500 2600 2700 2800 2800 2800	41.2 56.0 3150
PS 26.0 33.0	41.2 56.0 3150
Max. Rated Output (Net) kW 21.3 26.9 33.5 34.5 35.0 37.1 38.6 High Idling min-1 1600 1895 ±25 2590 2700 2810 2850 2950 ±25 2950 2950 ±25 2950 2700 2810 2850 2950 2950 2950 2950 2950 2950 2950 29	41.2 56.0 3150
Net	56.0 3150
PS 29.0 36.5 45.5 47.0 47.6 50.5 52.5	3150
Engine Weight (dry) *with Flywheel Housing* PTO Position Direction of Rotation Governor Mechanical governor (All-speed governor) Electronic governor (All-speed governor) Counter Co	
*with Flywheel Housing PTO Position Flywheel End Direction of Rotation Counterclockwise Viewed From Flywheel End Governor Mechanical governor (All-speed governor) Electronic governor (All-speed governor)	
Direction of Rotation Counterclockwise Viewed From Flywheel End Governor Mechanical governor (All-speed governor) Electronic governor (All-speed governor)	
Governor Mechanical governor Electronic governor (All-speed governor) (All-speed governor)	
(All-speed governor) (All-speed governor)	2
Cooling Overtons	r r)
Cooling System Liquid-Cooled with Radiator	
Lubricating System Forced Lubrication with Trochoid Pump	
Rated Engine 0.29-0.44 0.36-0.51 (3.7-5.2) MPa	
Pressure Low Idle Speed ≥ 0.06 (≥ 0.6) MPa	
Starting System Electric Starting (Starter Motor: DC12V (1.7kW) ***	
Charging system Alternator (DC12V/40A) ***	
Recommended Battery Capacity 12V-64Ah*** (5h rating)	
Starting aid device Air heater (12V DC 400W)	
Dimensions (L × W × H)* 683 × 499 × 713mm 649 × 499 × 713mm	
Engine Oil Pan Capacity** 7.4L/4.0L (Dipstick Upper Limit / Lower Limit)	
Engine Coolant Capacity 2.7L Engine Only	
Standard Cooling Fan Resin F type pusher fan - \$\phi 370(EF) \times 6	
Crank V-pulley dia./ Fan V-pulley dia.	
Top Clearance 0.73 ± 0.06 mm	

Engine specifications without radiator.

Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

May vary depending on application.



4TNV88-Z (complies with EPA Interim Tier4)

Engine Model			4TNV88-Z										
Version	Version			CL VM									
Туре			Vertical, 4-cycle water-cooled diesel engine										
Combustion	System		Direct Injection										
Aspiration			Natural aspiration										
No. of Cylind	ers		4										
Bore x Stroke	e		ф88 × 90mm										
Displacemen	t				2	2.190L							
a .: -		min-1											
Continuous F Output	rated	kW											
Capar	Ī	PS											
Maria Batarda		min-1					2600	2800	3000				
Max. Rated ((Net)	output	kW					31.3	33.7	35.4				
(1.6.7	[PS					42.5	45.8	48.1				
High Idling		min-1					2810 ±25	2995 ±25	3210 ±25				
Engine Weigl *with Flywhee	ht (dry) el Housind	a	170kg										
PTO Position			Flywheel End										
Direction of F	Rotation		Counterclockwise Viewed From Flywheel End										
Governor			Electronic governor (All-speed governor)										
Cooling Syste	em		Liquid-Cooled with Radiator										
Lubricating S	System		Forced Lubrication with Trochoid Pump										
Normal Oil	Rated E Speed	ngine			3-4.8) MPa								
Pressure	Low Idle Speed)	<u>'</u>	≥ 0.06 (≥ 0.6) MPa									
Starting Syst	em		Electric Starting (Starter Motor: DC12V (1.7kW)) ***										
Charging sys	tem		Alternator (DC12V/40A) ***										
Recommend Capacity	ed Batter	У	12V-64Ah*** (5h rating)										
Starting aid o	levice		Super-quick Heating Glow plug										
Dimensions (Dimensions $(L \times W \times H)^*$					659 × 52	3 × 617						
Engine Oil Pan Capacity**		ity**	7.4L/4.0L (Dipstick Upper Limit / Lower Limit)										
Engine Coolant Capacity		ity	2.7L Engine Only										
Standard Cooling Fan		-	Resin F type pusher fan - ∳370(EF) × 6										
Crank V-pulle Fan V-pullev	Crank V-pulley dia./ Fan V-pulley dia.					φ110/	φ110						
Top Clearand			0.73 ± 0.06 mm										

- Engine specifications without radiator.
- Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.
- *** May vary depending on application.



4TNV88-U (complies with EPA Interim Tier4)

Engine Model			4TNV88-U									
Version			CL VM									
Туре			Vertical, 4-cycle water-cooled diesel engine									
Combustion S	Combustion System			Direct Injection								
Aspiration			Natural aspiration									
No. of Cylinde	ers		4									
Bore × Stroke)		φ88 × 90mm									
Displacement	!					2.	190L					
Continuous R	-4	min-1										
Output	aled	kW										
		PS										
Max. Rated O	Na remarke	min-1							2700	2800		
(Net)	utput [kW							29.6	30.7		
(* *- */		PS							(40.2)	(41.7)		
High Idling		min-1							2920 ±25	2995 ±25		
Engine Weigh *with Flywhee	nt (dry) el Housin	a	170kg									
PTO Position			Flywheel End									
Direction of R	otation		Counterclockwise Viewed From Flywheel End									
Governor			Mechanical governor (All-speed governor)									
Cooling Syste	m		Liquid-Cooled with Radiator									
Lubricating Sy	ystem		Forced Lubrication with Trochoid Pump									
Normal Oil	Rated E Speed	ngine		0.32-0.47 (3.3-4.8) MPa								
Pressure	Low Idle Speed	€	≥ 0.06 (≥ 0.6) MPa									
Starting Syste	m		Electric Starting (Starter Motor: DC12V (1.7kW)) ***									
Charging syst			Alternator (DC12V/40A) ***									
Recommende Capacity	ed Batter	У	12V-64Ah*** (5h rating)									
Starting aid device			Super-quick Heating Glow plug									
Dimensions $(L \times W \times H)^*$		684 × 523 × 617										
Engine Oil Pan Capacity**		7.4L/4.0L (Dipstick Upper Limit / Lower Limit)										
Engine Coolant Capacity		2.7L Engine Only										
Standard Cooling Fan		Resin F type pusher fan - ∳370(EF) × 6										
Crank V-pulley dia./ Fan V-pulley dia.		φ120/φ90mm				φ 110 / φ11	10mm					
Top Clearance		0.73 ± 0.06 mm										

Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



4TNV88-B (complies with EPA Interim Tier4)

Vertical, 4-cycle water-cocoled diesel engine	Engine Model			4TNV88-B											
Direct Injection	Version			С											
Aspiration No. of Cylinders 4	Туре	Vertical, 4-cycle water-cooled diesel engine													
No. of Cylinders 4 88 x 90mm 50ps 50ps 50ps 684 x 523 x 617 50ps 68ps 68p	Combustion S	System													
Displacement	Aspiration				Natural aspiration										
Displacement	No. of Cylinde	ers								4					
Continuous Rated Output	Bore x Stroke)							ф8	38 × 90m	m				
Continuous Rated Output KW 16.4 19.6 PS 22.3 26.7 Max. Rated Output (Net) 1800 2000 2100 2200 2300 2400 2500 2600 2700 2800 3000 Max. Rated Output (Net) 1800 1800 2001 2201 2201 2301 240.9 42.5 44.2 45.8 48.1 High Idling	Displacement	t								2.190L					
Output PS 22.3 26.7	0	\	min-1	1500	1800										
PS 22.3 26.7		ated	kW	16.4	19.6										
Max. Rated Output (Net) kW 18.0 21.6 24.1 25.3 26.5 27.7 28.8 30.1 31.3 32.5 33.7 35.4 High Idling min·1 ±25 29.4 32.7 34.4 36.0 37.6 39.2 40.9 42.5 44.2 45.8 48.1 High Idling min·1 ±600 1895 2180 2290 2400 2510 2590 2700 2810 2920 2995 3210 Fingine Weight (dry) 183kg 170kg Forestion Flywheel End Direction of Rotation Counterclockwise Viewed From Flywheel End Governor Mechanical governor (All-speed governor) Cooling System Liquid-Cooled with Raciator Lubricating System Engline Engline 0.29-0.44 (3.0-4.5) MPa Starting System Electric Starting (Starter Motor: DC12V (1.7kW))*** Charging system Electric S	Carpar		PS	22.3	26.7										
Normal Oil Pressure Speed Spee	Maria Bassal G	N	min-1	1500	1800	2000	2100	2200	2300	2400	2500	2600	2700	2800	3000
PS		Jutput	kW	18.0	21.6	24.1	25.3	26.5	27.7	28.8	30.1	31.3	32.5	33.7	35.4
Engine Weight (dry) with Flywheel Housing PTO Position Direction of Rotation Governor Cooling System Lubricating System Normal Oil Pressure Starting System Charging system Charging system Recommended Battery Capacity Starting aid device Dimensions (L × W × H)* Engine Oil Pan Capacity* Engine Coolant Capacity Standard Cooling Fan Crank V-pulley dia. pto 183kg 170kg	(Net/		PS	24.5	29.4	32.7	34.4	36.0	37.6	39.2	40.9	42.5	44.2	45.8	48.1
Flywheel Housing	High Idling		min-1												
PTO Position Flywheel End	Engine Weigh	nt (dry) el Housir	ng	183	183kg 170kg										
Mechanical governor (All-speed governor) Cooling System	PTO Position			Flywheel End											
Liquid-Cooled with Radiator	Direction of F	otation		Counterclockwise Viewed From Flywheel End											
Dubricating System	Governor														
Rated Engine Speed (3.0-4.5) MPa D.32-0.47 (3.3-4.8) MPa	Cooling Syste	em		Liquid-Cooled with Radiator											
Normal Oil Pressure Speed (3.0-4.5) MPa 0.32-0.47 (3.3-4.8) MPa Starting System Electric Starting (Starter Motor: DC12V (1.7kW)) **** Charging system Alternator (DC12V/40A) **** Recommended Battery Capacity 12V-64Ah*** (5h rating) Starting aid device Super-quick Heating Glow plug Dimensions (L × W × H)* 684 × 523 × 617 Engine Oil Pan Capacity** (Dipstick Upper Limit / Lower Limit) Engine Coolant Capacity 2.7L Engine Only Standard Cooling Fan Resin F type pusher fan - ∮370(EF) × 6 Crank V-pulley dia. ∮120/ ∮90	Lubricating S	ystem		Forced Lubrication with Trochoid Pump											
Speed Starting (Starter Motor: DC12V (1.7kW)) **** Charging system	Normal Oil		Engine												
Charging system Recommended Battery Capacity Starting aid device Dimensions (L × W × H)* Engine Oil Pan Capacity* Engine Coolant Capacity Standard Cooling Fan Crank V-pulley dia. Alternator (DC12V/40A) *** Alternator (DC12V/40A) *** 12V-64Ah*** (5h rating) Super-quick Heating Glow plug 659 × 523 × 617 7.4L/4.0L (Dipstick Upper Limit / Lower Limit) 2.7L Engine Only Resin F type pusher fan - \$370(EF) × 6 \$\frac{1}{2}\$\$ \text{Crank V-pulley dia.} \text{\$\frac{1}{2}}\$\$ \text{\$\frac{1}{2}\$	Pressure		le		≥0.06 (≥ 0.6) MPa										
Recommended Battery Capacity Starting aid device Super-quick Heating Glow plug Dimensions (L × W × H)* Engine Oil Pan Capacity** Engine Coolant Capacity Standard Cooling Fan Crank V-pulley dia. Recommended Battery 12V-64Ah*** (5h rating) Super-quick Heating Glow plug 659 × 523 × 617 7.4L/4.0L (Dipstick Upper Limit / Lower Limit) 2.7L Engine Only Resin F type pusher fan - \$370(EF) × 6 \$\frac{1}{2}\$\$ \text{Crank V-pulley dia.} \text{\$\frac{1}{2}}\$\$ \text{\$\frac{1}{2}\$\$ \text{\$\frac{1}{2}}\$\$ \text{\$\frac{1}{2}\$\$ \text{\$\frac{1}{2}\$	Starting Syste	em		Electric Starting (Starter Motor: DC12V (1.7kW)) ***											
Capacity Starting aid device Super-quick Heating Glow plug Dimensions (L × W × H)* Engine Oil Pan Capacity** Engine Coolant Capacity Standard Cooling Fan Crank V-pulley dia. Capacity Super-quick Heating Glow plug 659 × 523 × 617 7.4L/4.0L (Dipstick Upper Limit / Lower Limit) 2.7L Engine Only Resin F type pusher fan - \$370(EF) × 6 \$\frac{1}{2}\$\$ \$\text{\$\tex				Alternator (DC12V/40A) ***											
Dimensions (L × W × H)* 684 × 523 × 617 Engine Oil Pan Capacity** 7.4L/4.0L Engine Coolant Capacity (Dipstick Upper Limit / Lower Limit) Engine Cooling Fan 2.7L Engine Only Standard Cooling Fan Resin F type pusher fan - φ370(EF) × 6 Crank V-pulley dia. φ120/ φ90 Φ110/ φ110	Recommende Capacity	ed Batte	ry		12V-64Ah*** (5h rating)										
Fingine Oil Pan Capacity** T,4L/4.0L (Dipstick Upper Limit / Lower Limit) Engine Coolant Capacity 2.7L Engine Only Standard Cooling Fan Resin F type pusher fan - \$370(EF) × 6 Crank V-pulley dia./ Fan V-pulley dia. \$120/\$\phi\$90 \$110/\$\phi\$110	Starting aid d	evice						Su	per-quic	k Heating	g Glow p	lug			
Engine Oil Pan Capacity (Dipstick Upper Limit / Lower Limit) Engine Coolant Capacity 2.7L Engine Only Standard Cooling Fan Resin F type pusher fan - \$370(EF) × 6 Crank V-pulley dia./ Fan V-pulley dia. \$120/\$\phi90\$ \$\phi120/\$\phi90\$ \$\phi110/\$\phi110\$	Dimensions $(L \times W \times H)^*$		684 × 52	23×617					659	× 523 ×	617				
Standard Cooling Fan Resin F type pusher fan - φ370(EF) × 6 Crank V-pulley dia./ Fan V-pulley dia. φ120/ φ90 φ110/ φ110	Engine Oil Pan Capacity**				•		(Dip:				_imit)				
Crank V-pulley dia./ Fan V-pulley dia.	Engine Coolant Capacity							2.7L	Engine (Only					
Fan V-pulley dia.	Standard Cooling Fan						Resin	F type pu	ısher fan	- ø370(l	EF) × 6				
	Crank V-pulle Fan V-pullev	ey dia./ dia.		φ120	/ ∮90				<u> </u>	ф	1 10 / \phi1 1	0			
100 0104141100 0.10 ± 0.00 Hilli	Top Clearance					I			0.73	3 ± 0.06	mm				

- Engine specifications without radiator.
- Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.
- *** May vary depending on application.



4TNV98-E (complies with EPA Interim Tier4)

Engine Model			4TNV98-E										
Version			CL VM										
Type			Vertical, 4-cycle water-cooled diesel engine										
Combustion	System		Direct Injection										
Aspiration			Natural aspiration										
No. of Cylind	lers		4										
Bore × Strok	e		98 x 110mm										
Displacemen	ıt		3.319L										
		min-1											
Continuous F Output	Rated	kW											
Capat		PS											
Maria Bata da	3	min-1				2100	2200	2300	2400	2500			
Max. Rated ((Net)	Jutput	kW				36.8	38.2	39.7	41.6	43.0			
(1161)		PS				50.0	52.0	54.0	56.5	58.5			
High Idling		min-1				2250 ± 25	2350 ± 25	2450 ± 25	2550 ± 25	2650 ± 25			
Engine Weig *with Flywhe	ht (dry) el Housir	ng		240kg									
PTO Position	ו		Flywheel End										
Direction of F	Rotation		Counterclockwise Viewed From Flywheel End										
Governor			Electronic governor (All-speed governor)										
Cooling Syst	em		Liquid-Cooled with Radiator										
Lubricating S	System		Forced Lubrication with Trochoid Pump										
Normal Oil	Rated Speed	Engine	0.29-0.39 (3.0-4.0) MPa										
Pressure	Low Id Speed	le			0.06 (0.6) MPa								
Starting Syst	em		Electric Starting (Starter Motor: DC12V (2.3kW)) ***										
Charging sys			Alternator (DC12V/40A) ***										
Recommend Capacity	ed Batte	ry	12V-64Ah*** (5h rating)										
Starting aid device		Air heater (12VDC/500W)											
Dimensions $(L \times W \times H)^*$					719 × 5 4 0	× 721mm							
Engine Oil Pan Capacity**		10.2L/5.7L (Dipstick Upper Limit / Lower Limit)											
Engine Coolant Capacity		4.2L Engine Only											
Standard Cooling Fan			Resin F type pusher fan -										
Crank V-pull Fan V-pulley	ey dia./ dia.					ф130/ф	130mm						
Top Clearan			0.793 ± 0.063 mm										
			5.7 55 2 5.5555 Mill										

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



4TNV98-Z (complies with EPA Interim Tier4)

Engine Model			4TNV98-Z									
Version			CL VM									
Туре			Vertical, 4-cycle water-cooled diesel engine									
Combustion S	System		Direct Injection									
Aspiration						Natural a	aspiration					
No. of Cylinde	ers		4									
Bore × Stroke)		98 x 110mm									
Displacemen	t		3.319∟									
Continuous F)otod	min-1	1500									
Output	ialeu	kW	30.9	36.8								
		PS	42.0	50.0								
Max. Rated C)tm.i.t	min-1	1500	1800	2000	2100	2200	2300	2400	2500		
(Net)	Jutput	kW	34.6	41.2	41.9	43.8	45.6	47.4	49.3	51.1		
(*****)		PS	47.0	56.0	57.0	59.5	62.0	64.5	67.0	69.5		
High Idling		min-1	1530 ± 25	1830 ± 25	2150 ± 25	2250 ± 25	2350 ± 25	2450 ± 25	2550 ± 25	2650 ± 25		
Engine Weigl *with Flywhee	ht (dry) el Housir	ng	248	3kg			23	5kg				
PTO Position	I		Flywheel End									
Direction of F	otation		Counterclockwise Viewed From Flywheel End									
Governor			Electronic governor (All-speed governor)									
Cooling Syste			Liquid-Cooled with Radiator									
Lubricating S	ystem		Forced Lubrication with Trochoid Pump									
Normal Oil	Rated I Speed	Engine	0.29-0.39 (3.0-4.0) MPa									
Pressure	Low Idl Speed	e	0.06 (0.6) MPa									
Starting Syste	em		Electric Starting (Starter Motor: DC12V (2.3kW)) ***									
Charging sys	tem		Alternator (DC12V/40A) ***									
Recommende Capacity	ed Batter	ry	12V-64Ah*** (5h rating)									
Starting aid d	evice		Air heater (12VDC/500W)									
Dimensions (L × W × H)*						719×540	× 721mm					
Engine Oil Pan Capacity**			10.2L/5.7L (Dipstick Upper Limit / Lower Limit)									
Engine Coolant Capacity			4.2L Engine Only									
Standard Cooling Fan			Resin F type pusher fan -									
Crank V-pulle Fan V-pulley	y dia./ dia.					φ130/φ	130mm					
Top Clearand	e					0.793 ± 0	0.063 mm					

Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



4TNV98T-Z (complies with EPA Interim Tier4)

Engine Model			4TNV98T-Z									
Version			CL VM									
Туре			Vertical, 4-cycle water-cooled diesel engine									
Combustion System						Direct I	njection					
Aspiration						Turboo	charged					
No. of Cylinde							4					
Bore × Stroke)					98 x 1	10mm					
Displacement	t					3.3	119L					
Continuous F	atod	min-1	1500	1800								
Output	ialeu	kW	37.9	45.6								
'		PS	51.5	62.0								
Max. Rated C	No removie	min-1	1500	1800			2200	2300	2400	2500		
(Net)	Juiput	kW	41.9	50.4			55.5	58.0	60.3	62.5		
,		PS	57.0	68.5			75.5	78.8	82.0	85.0		
High Idling		min-1	1530 ± 25	1830 ± 25			2350 ± 25	2450 ± 25	2550 ± 25	2650 ± 25		
Engine Weight *with Flywhee	nt (dry) el Housir	ng	258	3kg		245kg						
PTO Position			Flywheel End									
Direction of F	lotation		Counterclockwise Viewed From Flywheel End									
Governor			Electronic governor (All-speed governor)									
Cooling Syste	∍m		Liquid-Cooled with Radiator									
Lubricating S	ystem		Forced Lubrication with Trochoid Pump									
Normal Oil	Rated I Speed	Engine	0.29-0.39 (3.0-4.0) MPa									
Pressure	Low Id	le	≥ 0.06 (≥ 0.6) MPa									
Starting Syste	∍m		Electric Starting (Starter Motor: DC12V (2.3kW)) ***									
Charging sys	tem		Alternator (DC12V/40A) ***									
Recommende Capacity	ed Batte	ry	12V-64Ah*** (5h rating)									
	Starting aid device			Air heater (12VDC/500W)								
Engine Oil Pan Capacity**			10.2L/5.7L (Dipstick Upper Limit / Lower Limit)									
Engine Coolant Capacity			4.2L Engine Only									
Standard Cooling Fan			Resin F type pusher fan - ∳430(UX) × 6									
Crank V-pulle Fan V-pulley	y dia./ dia.		φ130/ φ130mm									
Top Clearand						0.793 ± (0.063 mm					
10p Giodranos												

^{*} Engine specifications without radiator.

^{**} Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.

^{***} May vary depending on application.



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TNV Series

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