

# SHOP MANUAL



**3D82AE SERIES**

**3D84E SERIES**

**3D88E SERIES**

**4D88E SERIES**

**4D98E SERIES**

**4D106 SERIES**

**S4D84E SERIES**

**S4D98E SERIES**

**S4D106 SERIES**

**DIESEL ENGINE**

**KOMATSU**  
*Utility*

Sample of manual. Download All 280 pages at:

<https://www.arepairmanual.com/downloads/komatsu-3d4ds4d-series-diesel-engine-shop-manual/>

# SHOP MANUAL



APPLICABLE MACHINE MODEL	ENGINE MODEL	
	YANMAR DESCRIPTION	KOMATSU DESCRIPTION
PC27R-8	3TNV82A-M5FA	3D82AE-5MFA
PC35R-8	3TNV88-N5FA	3D88E-5NFA
PC45R-8	4TNV88-N5FA	4D88E-5NFA
PC75R-2	4TNV98-X2FB	4D98E-2XFB
PW75R-2	4TNV98-X2FB	4D98E-2XFB
PC95R-2	4TNV106-S2FB	4D106-2SFB
PW95R-2	4TNV106-S2FB	4D1062SFB
PC110R-1	4TNV106T-W2FB	S4D106-2WFB
PW110R-1	4TNV106T-W2FB	S4D106-2WFB
SK510-5	3TNV84-K5FD	3D84E-5KFD
SK714-5	4TNV88-K5FD	4D88E-5KFD
SK815-5	4TNV88-K5FD	4D88E-5KFD
SK815-5 turbo	4TNV84T-K5FD	S4D84E-5KFD
SK818-5	4TNV88-K5FD	4D88E-5KFD
SK820-5 turbo	4TNV84T-K5FD	S4D84E-5KFD
SK1020-5	4TNV98-N2FE	4D98E-2NFE
SK1020-5 turbo	4TNV98T-N2FE	S4D98E-2NFE
SK1026-5 turbo	4TNV98T-N2FE	S4D98E-2NFE
WB70A-1	4TNV98-N2FA	4D98E-2NFA
WB98A-2	4TNV106T-S2FC	S4D106-2SFC
WB91R-2	4TNV106-S2FA	4D106-2SFA
WB93R-2	4TNV106T-S2FA	S4D106-2SFA
WB97R-2	4TNV106T-S2FA	S4D106-2SFA
WB97S-2	4TNV106T-S2FA	S4D106-2SFA
WB150AWS-2	4TNV106T-S2FA	S4D106-2SFA

**KOMATSU**

Sample of manual. Download All 280 pages at:

<https://www.arepairmanual.com/downloads/komatsu-3d4ds4d-series-diesel-engine-shop-manual/>



## PREFACE

This manual describes the service procedures for the TNV series engines of indirect injection system that have been certified by the US EPA, California ARB and/or the 97/68/EC Directive for industrial use.

Please use this manual for accurate, quick and safe servicing of the said engine. Since the explanation in this manual assumes the standard type engine, the specifications and components may partially be different from the engine installed on individual work equipment (power generator, pump, compressor, etc.). Please also refer to the service manual for each work equipment for details.

The specifications and components may be subject to change for improvement of the engine quality without notice. If any modification of the contents described herein becomes necessary, it will be notified in the form of correction information each time.

## SAFETY LABELS

- Most accidents are caused by negligence of basic safety rules and precautions. For accident prevention, it is important to avoid such causes before development to accidents.  
Please read this manual carefully before starting repair or maintenance to fully understand safety precautions and appropriate inspection and maintenance procedures.  
Attempting at a repair or maintenance job without sufficient knowledge may cause an unexpected accident.
- It is impossible to cover every possible danger in repair or maintenance in the manual. Sufficient consideration for safety is required in addition to the matters marked **▲ CAUTION**. Especially for safety precautions in a repair or maintenance job not described in this manual, receive instructions from a knowledgeable leader.
- Safety marks used in this manual and their meanings are as follows:



**DANGER**-indicates an imminently hazardous situation, which, if not avoided, WILL result in death or serious injury.



**WARNING**-indicates a potentially hazardous situation, which, if not avoided, COULD result in death or serious injury.



**CAUTION**-indicates a potentially hazardous situation, which, if not avoided, MAY result in minor or moderate injury.

- **NOTICE**-indicates that if not observed, the product performance or quality may not be guaranteed.

## Safety Precautions

### (1) SERVICE AREA

#### **⚠ WARNING**



#### ● Sufficient Ventilation

Inhalation of exhaust fumes and dust particles may be hazardous to ones health. Running engines welding, sanding, painting, and polishing tasks should be only done in well ventilated areas.

#### **⚠ CAUTION**

#### ● Safe / Adequate Work Area

The service area should be clean, spacious, level and free from holes in the floor, to prevent "slip" or "trip and fall" type accidents.

#### **⚠ CAUTION**



#### ● Bright, Safely Illuminated Area

The work area should be well lit or illuminated in a safe manner. For work in enclosed or dark areas, a "drop cord" should be utilized. The drop cord must have a wire cage to prevent bulb breakage and possible ignition of flammable substances.

#### **⚠ CAUTION**



#### ● Safety Equipment

Fire extinguisher(s), first aid kit and eye wash / shower station should be close at hand (or easily accessible) in case of an emergency.

## (2) WORK – WEAR (GARMENTS)

### **⚠ CAUTION**



#### ● Safe Work Clothing

Appropriate safety wear (gloves, special shoes/boots, eye/ear protection, head gear, harness', clothing, etc.) should be used/worn to match the task at hand. Avoid wearing jewelry, unbuttoned cuffs, ties or loose fitting clothes around moving machinery. A serious accident may occur if caught in moving/rotating machinery.

## (3) TOOLS

### **⚠ WARNING**

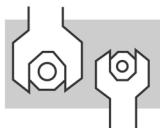
#### ● Appropriate Lifting / Holding

When lifting an engine, use only a lifting device (crane, jack, etc.) with sufficient lifting capacity. Do not overload the device. Use only a chain, cable, or lifting strap as an attaching device. Do not use rope, serious injury may result.

To hold or support an engine, secure the engine to a support stand, test bed or test cart designed to carry the weight of the engine. Do not overload this device, serious injury may result.

Never run an engine without being properly secured to an engine support stand, test bed or test cart, serious injury may result.

### **⚠ CAUTION**



#### ● Appropriate Tools

Always use tools that are designed for the task at hand. Incorrect usage of tools may result in damage to the engine and or serious personal injury.

## (4) GENUINE PARTS and MATERIALS

### **⚠ CAUTION**

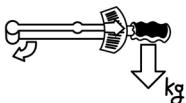


#### ● Genuine Parts

Always use genuine parts or recommended parts and goods. Damage to the engine, shortened engine life and or personal injury may result.

## (5) FASTENER TORQUE

### **⚠ WARNING**



#### ● Torqueing Fasteners

Always follow the torque values and procedures as designated in the service manual. Incorrect values, procedures and or tools may cause damage to the engine and or personal injury.

## (6) Electrical

### **⚠ WARNING**



#### ● Short Circuits

Always disconnect the (-) Negative battery cable before working on the electrical system. An accidental "short circuit" may cause damage, fire and or personal injury. Remember to connect the (-) Negative battery cable (back onto the battery) last. Fasten the terminals tightly.

### **⚠ WARNING**



#### ● Charging Batteries

Charging wet celled batteries produces hydrogen gas. Hydrogen gas is extremely explosive. Keep sparks, open flame and any other form of ignition away. Explosion may occur causing severe personal injury.

### **⚠ WARNING**



#### ● Battery Electrolyte

Batteries contain sulfuric acid. Do NOT allow it to come in contact with clothing, skin and or eyes, severe burns will result.

## (7) WASTE MANAGEMENT

### **⚠ CAUTION**

Observe the following instructions with regard to hazardous waste disposal. Negligence of these will have a serious impact on environmental pollution concerns.

- 1) Waste fluids such as lube oil, fuel and coolant shall be carefully put into separate sealed containers and disposed of properly.
- 2) Do NOT dispose of waste materials irresponsibly by dumping them into the sewer, overland or into natural waterways.
- 3) Waste materials such as oil, fuel, coolant, solvents, filter elements and batteries, must be disposed of properly according to local ordinances. Consult the local authorities or reclamation facility.

## (8) FURTHER PRECAUTIONS

### **⚠ WARNING**



#### ● Fueling / Refueling

Keep sparks, open flames or any other form of ignition (match, cigarette, etc.) away when fueling/refueling the unit. *Fire and or an explosion may result.*

### **⚠ WARNING**



#### ● Hot Surfaces.

Do NOT touch the engine (or any of its components) during running or shortly after shutting it down. *Scalding / serious burns may result.* Allow the engine to cool down before attempting to approach the unit.

### **⚠ WARNING**



#### ● Rotating Parts

Be careful around moving/rotating parts. Loose clothing, jewelry, ties or tools may become entangled causing damage to the engine and or severe personal injury.

### **⚠ WARNING**



#### ● Preventing burns from scalding

- 1) Never open the radiator filler cap shortly after shutting the engine down.  
Steam and hot water will spurt out and seriously burn you. Allow the engine to cool down before attempt to open the filler cap.
- 2) Securely tighten the filler cap after checking the radiator.  
Steam can spurt out during engine running, if tightening loose.

# Precautions for Service Work

## (1) Precautions for Safety

Read the safety precautions given at the beginning of this manual carefully and always mind safety in work.

## (2) Preparation for Service Work

Preparation is necessary for accurate, efficient service work. Check the customer ledger file for the history of the engine.

- Preceding service date
- Period/operation hours after preceding service
- Problems and actions in preceding service
- Replacement parts expected to be required for service
- Recording form/check sheet required for service

## (3) Preparation before Disassembly

- Prepare general tools, special service tools, measuring instruments, oil, grease, non-reusable parts, and parts expected to be required for replacement.
- When disassembling complicated portions, put match-marks and other marks at places not adversely affecting the function for easy reassembly.

## (4) Precautions in Disassembly

- Each time a parts is removed, check the part installed state, deformation, damage, roughening, surface defect, etc.
- Arrange the removed parts orderly with clear distinction between those to be replaced and those to be used again.
- Parts to be used again shall be washed and cleaned sufficiently.
- Select especially clean locations and use clean tools for disassembly of hydraulic units such as the fuel injection pump.

## (5) Precautions for Inspection and Measurement

Inspect and measure parts to be used again as required to determine whether they are reusable or not.

## (6) Precautions for Reassembly

- Reassemble correct parts in correct order according to the specified standards (tightening torques, and adjustment standards). Apply oil important bolts and nuts before tightening when specified.
- Always use genuine parts for replacement.
- Always use new oil seals, O-rings, packing and cotter pins.
- Apply sealant to packing depending on the place where they are used. Apply of grease to sliding contact portions, and apply grease to oil seal lips.

## (7) Precautions for Adjustment and Check

Use measuring instruments for adjustment to the specified service standards.

# How to Read this Manual

## (1) Range of Operation Explanation

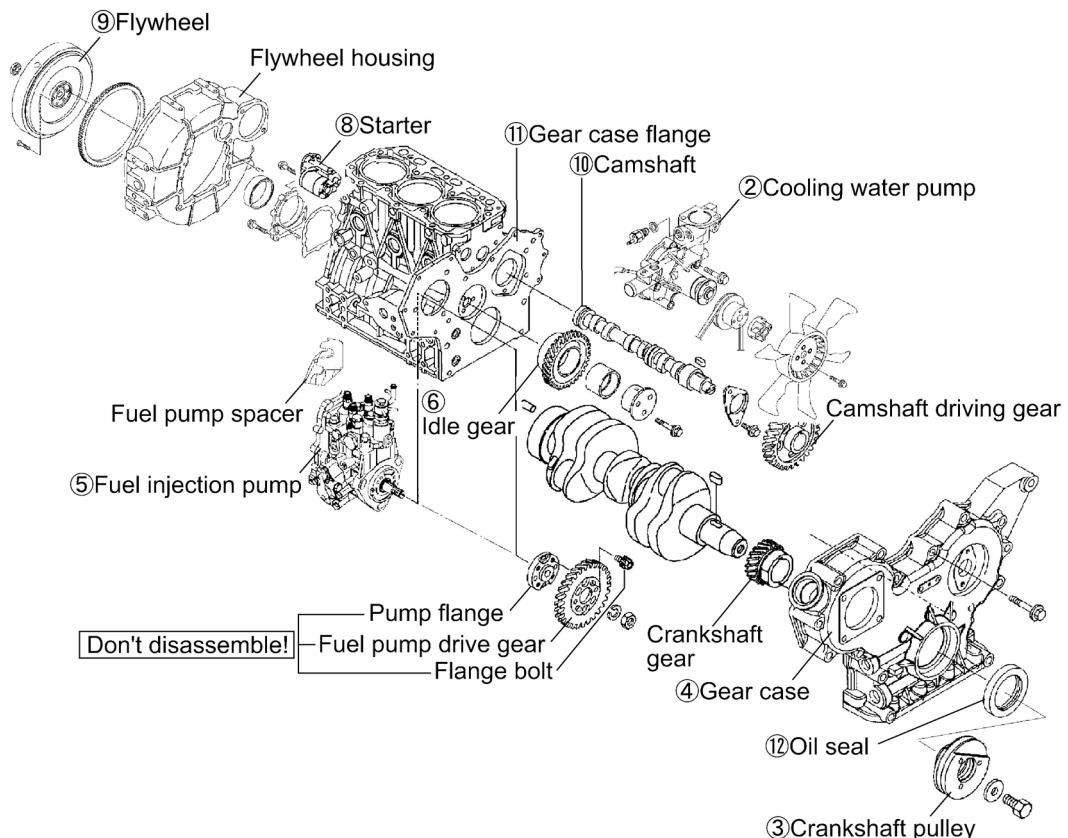
This manual explains the troubleshooting, installation/removal, replacement, disassemble/reassembly, inspection, adjustment and adjusting operation procedures for the TNV series engines with direct injection system.

Refer to the manufacturer's manual for each of the fuel injection pump, governor, starting motor and alternator except for their installation.

## (2) How to Read the Explanations

- An exploded view, sectional views, a system diagram, etc. are shown at the beginning of each section as required for easy understanding of the mounted states of the components.
- For the removal/installation of each part, the procedure is shown with the procedural step No. in the illustration.
- Precautions and key points for disassembly and reassembly of parts are described as **points**. In the explanation for each point, detailed operation method, information, standard and precautions are described.

### Description Example



Note) This figure shows the 3TNV84.

The job contents are described in the disassembly procedure for Nos. not shown in the illustration.

#### ● Disassembly procedure

- 1) Follow steps (1) to (15) of the cylinder head disassembly procedure.
- 2) Remove the cooling water pump.
- 3) Remove the crankshaft pulley. (**Point 1**) ← Operation point to be explained on a later page.

#### ● Operation points

Disassemble: Service point for removal

Reassemble: Service point for installation

Disassemble-Reassemble: Service point required in both removal and installation.

- Contents omitted in this manual

Though the following jobs are omitted in the explanation in this manual, they should be conducted in actual work:

- 3) Jacking up and lifting
- 4) Cleaning and washing of removed parts as required
- 5) Visual inspection

### (3) Definition of Terms

[NOTICE]: Instruction whose negligence is very likely to cause an accident. Always observe it.

Standard: Allowable range for inspection and adjustment.

Limit: The maximum or minimum value that must be satisfied during inspection or adjustment.

### (4) Abbreviations

Abbreviation	Meaning	Abbreviation	Meaning
Assy	assembly	T.D.C.	top dead center
Sub-Assy	sub-assembly	B.D.C.	bottom dead center
a.T.D.C	after top dead center	OS	oversize
b.T.D.C	before top dead center	US	undersize
STD	Standard	Min <sup>-1</sup>	revolutions per minute
IN	Intake	PS	Output (metric horsepower)
EX	Exhaust	T	Bolt/nut tightening torque

# CONTENTS

<b>1. General .....</b>	<b>1</b>
1.1 Engine Nomenclature .....	1
1.2 Specifications.....	1
1.3 Fuel Oil, Lubricating Oil and Cooling Water.....	14
1.3.1 Fuel oil.....	14
1.3.2 Lubricating oil .....	15
1.3.3 Cooling water .....	15
1.4 Engine External Views.....	16
1.5 Structural Description .....	17
1.6 Exhaust gas emission regulation.....	18
1.6.1 The Emission Standard in USA .....	18
1.6.2 Engine identification .....	19
1.6.3 Guarantee Conditions for the EPA Emission Standard .....	20
<b>2. Inspection and Adjustment .....</b>	<b>22</b>
2.1 Periodic Maintenance Schedule .....	22
2.2 Periodic Inspection and Maintenance Procedure .....	23
2.2.1 Check before Daily Operation .....	23
2.2.2 inspection after initial 50 hours operation .....	25
2.2.3 Inspection every 50 hours .....	28
2.2.4 Inspection every 250 hours or 3 months .....	32
2.2.5 Inspection every 500 hours or 6 months .....	35
2.2.6 Inspection every 1,000 hours or one year .....	37
2.2.7 Inspection every 2000 hours or 2 years .....	46
2.3 Adjusting the no-load maximum or minimum speed .....	49
2.4 Sensor Inspection.....	50
2.4.1 Oil pressure switch .....	50
2.4.2 Thermo switch .....	50
2.5 Water leak check in cooling water system.....	50
2.6 Radiator cap inspection .....	51
2.7 Thermostat Inspection .....	51
2.8 Adjusting Operation .....	52
2.9 Long storage.....	52
<b>3. TROUBLESHOOTING .....</b>	<b>53</b>
3.1 Preparation before troubleshooting .....	53
3.2 Quick Reference Table for Troubleshooting .....	54
3.3 Troubleshooting by measuring Compression Pressure.....	57

<b>4. Disassembly, Inspection and Reassembly of Engines .....</b>	<b>59</b>
4.1 Complete disassembly and reassembly .....	59
4.1.1 Introduction .....	59
4.1.2 Special service tools.....	60
4.1.3 Complete disassembly .....	65
4.1.4 Precautions before and during reassembly .....	69
4.1.5 Adjusting operation.....	69
4.2 Cylinder Head: Disassembly, Inspection and Reassembly.....	70
4.2.1 Components (2-valve cylinder head).....	70
4.2.2 Disassembly procedure:.....	70
4.2.3 Reassembly procedure: .....	71
4.2.4 Servicing points .....	72
4.2.5 Parts Inspection and measurement.....	76
4.2.6 Valve seat correction .....	80
4.2.7 Valve guide replacement .....	81
4.2.8 Valve stem seal replacement.....	82
4.3 Gear Train and Camshaft .....	83
4.3.1 Components .....	83
4.3.2 Disassembly procedure:.....	83
4.3.3 Reassembly procedure: .....	83
4.3.4 Servicing points .....	84
4.3.5 Parts inspection and measurement .....	87
4.3.6 Oil seal replacement (Gear case side) .....	89
4.3.7 Camshaft bushing replacement.....	89
4.4 Cylinder Block.....	90
4.4.1 Components .....	90
4.4.2 Disassembly procedure:.....	90
4.4.3 Reassembly procedure: .....	90
4.4.4 Servicing points .....	91
4.4.5 Parts inspection and measurement .....	95
4.4.6 Cylinder bore correction .....	106
4.4.7 Piston pin bushing replacement .....	107
4.4.8 Oil seal replacement (Flywheel housing side) .....	107

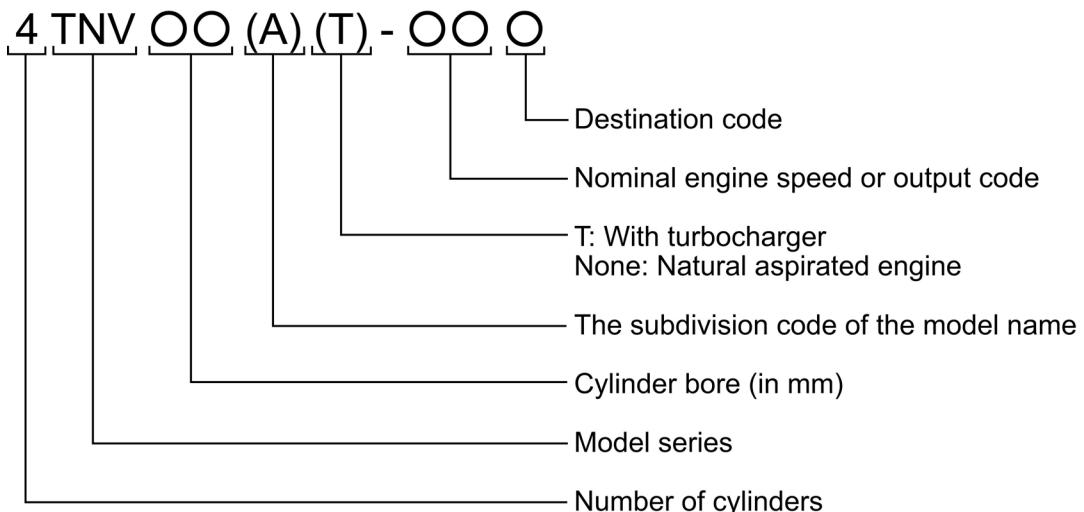
<b>5. LUBRICATION SYSTEM .....</b>	<b>108</b>
5.1 Lubrication System Diagram .....	108
5.2 Trochoid Pump Components .....	109
5.3 Disassembly(Reverse the procedure below for assembly) .....	109
5.4 Servicing Points .....	109
5.5 Parts Inspection and Measurement.....	110
5.5.1 Trochoid pump inspection and measurement.....	110
<b>6. COOLING SYSTEM.....</b>	<b>112</b>
6.1 Cooling Water System .....	112
6.2 Cooling Water Pump Components .....	112
6.3 Disassembly (Reverse the procedure below for assembly) .....	113
6.4 Servicing Points.....	113
<b>7. FUEL INJECTION PUMP/GOVERNOR.....</b>	<b>114</b>
7.1 Introduction .....	114
7.2 Fuel Injection Pump.....	114
7.2.1 Fuel system diagram .....	114
7.2.2 External view and components.....	115
7.2.3 Disassembly procedure:.....	115
7.2.4 Assembly procedure.....	116
7.2.5 Servicing points .....	116
<b>8. TURBOCHAGER: Disassembly, inspection and reassembly.....</b>	<b>118</b>
8.1 Structure and Functions.....	118
8.1.1 Main specifications .....	118
8.1.2 Construction .....	118
8.1.3 Structural and functional outline .....	119
8.1.4 Components .....	120
8.2 Service Standards and Tightening Torque.....	121
8.2.1 Service standards.....	121
8.2.2 Tightening torque.....	122
8.3 Periodic Inspection Procedure.....	123
8.3.1 Periodic inspection intervals .....	123
8.3.2 Inspection procedure .....	124
8.3.3 Waste gate valve adjustment procedure .....	125
8.4 Disassembly Procedure.....	127
8.4.1 Preparation for disassembly .....	127
8.4.2 Inspection before disassembly .....	128
8.4.3 Disassembly .....	128

8.5 Washing and Inspection procedure .....	130
8.5.1 Washing .....	130
8.5.2 Inspection procedure.....	131
8.6 Reassembly Procedure .....	134
8.6.1 Preparation for reassembly.....	134
8.6.2 Reassembly .....	134
8.7 Handling after Disassembly and Reassembly .....	137
8.7.1 Instructions for turbocharger installation.....	137
8.8 Troubleshooting .....	138
8.8.1 Excessively exhaust smoke .....	138
8.8.2 White smoke generation.....	138
8.8.3 Sudden oil decrease.....	139
8.8.4 Decrease in output .....	139
8.8.5 Poor (slow) response (starting) of turbocharger .....	139
8.8.6 Abnormal sound or vibration.....	139
<b>9. STARTING MOTOR.....</b>	<b>140</b>
9.1 For 4TNV94L/ 98 .....	140
9.1.1 Specifications .....	140
9.1.2 Components .....	141
9.1.3 Troubleshooting.....	142
9.1.4 Names of parts and disassembly procedure .....	143
9.1.5 Inspection and Maintenance .....	147
9.1.6 Service standards.....	152
9.1.7 Assembly .....	153
9.1.8 Characteristic test.....	155
9.2 For 4TNV106(T) .....	156
9.2.1 Specifications .....	156
9.2.2 Congiguration drawing .....	156
9.2.3 Troubleshooting .....	157
9.2.4 Component names and disassembly procedure .....	158
9.2.5 Disassembly procedure.....	159
9.2.6 Inspection and maintenance .....	167
9.2.7 Assembly .....	173
9.2.8 Adjustment .....	174
9.2.9 Service standards.....	175

<b>10. ALTERNATOR.....</b>	<b>176</b>
10.1 The 40A Alternator for 3TNV84 and other models.....	176
10.1.1 Components.....	176
10.1.2 Specifications .....	177
10.1.3 Wiring diagram .....	177
10.1.4 Standard output characteristics .....	178
10.1.5 Inspection.....	178
10.2 Troubleshooting .....	179
<b>11. ELECTRIC WIRING .....</b>	<b>180</b>
11.1 Electric Wiring Diagram .....	180
11.2 PRECAUTION ON ELECTRIC WIRING.....	181
11.2.1 Alternator .....	181
11.2.2 Starter.....	182
11.2.3 Current limiter .....	183
11.2.4 Section area and resistance of electric wire .....	184
<b>12. SERVICE STANDARDS .....</b>	<b>185</b>
12.1 Engine Tuning.....	185
12.2 Engine Body .....	186
12.2.1 Cylinder head .....	186
12.2.2 Gear train and camshaft.....	189
12.2.3 Cylinder block.....	190
12.3 Lubricating Oil System (Trochoid Pump).....	195
12.3.1 Outside clearance of outer rotor .....	195
12.3.2 Side clearance of outer rotor .....	195
12.3.3 Inside clearance of inner rotor .....	195
12.3.4 Rotor shaft clearance .....	195
<b>13. TIGHTENING TORQUE for BOLTS and NUTS .....</b>	<b>196</b>
13.1 Tightening Torques for Main Bolts and Nuts .....	196
13.2 Tightening Torques for Standard Bolts and Nuts .....	197

# 1. General

## 1.1 Engine Nomenclature



The engine specification class

Classification	Load	Engine speed	Available engine speed (min <sup>-1</sup> )
CL	Constant load	Constant speed	1500/1800
VM	Variable load	Variable speed	2000-3000

※ The engine specification class (CL or VM) is described in the specifications table.

## 1.2 Specifications

NOTE:

- 1) The information described in the engine specifications tables (the next page and after) is for "standard" engine. To obtain the information for the engine installed in each machine unit, refer to the manual provided by the equipment manufacturer.
- 2) Engine rating conditions are as follows (SAE J1349, ISO 3046/1)
  - Atmospheric condition: Room temp. 25°C, Atmospheric press. 100 kPa (750mm Hg), Relative humidity 30%
  - Fuel temp: 25°C (Fuel injection pump inlet)
  - With cooling fan, air cleaner, exhaust silencer.
  - After running-in hours. Output allowable deviation:  $\pm 3\%$

## (1) 3TNV82A

Engine name		Unit	3TNV82A																
Engine specification class		-	CL		VM														
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine																
Combustion chamber		-	Direct injection																
Number of cylinders		-	3																
Cylinder borexstroke		mmxmm	82x84																
Displacement		L	1.331																
Continuous rating	Revolving speed		Min <sup>-1</sup>	1500	1800	-													
	Output		kW (hp)	9.9 (13.5)	12.0 (16.3)	-													
Rated output	Revolving speed		Min <sup>-1</sup>	1500	1800	2000	2200	2400	2500	2600									
	Output		kW (hp)	11.0 (14.9)	13.2 (17.9)	14.6 (19.9)	16.0 (21.8)	17.5 (23.8)	18.2 (24.8)	19.0 (25.8)									
Max. no-load speed ( $\pm 25$ )		min <sup>-1</sup>	1600	1895	2180	2375	2570	2675	2780	2995									
Ignition order		-	1-3-2-1(No.1 cylinder on flywheel side)																
Power take off		-	Flywheel																
Direction of rotation		-	Counterclockwise (viewed from flywheel)																
Cooling system		-	Radiator																
Lubrication system		-	Forced lubrication with trochoid pump																
Starting system		-	Electric																
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)																
Applicable lubricant		-	API grade class CD or CF																
Lubricant capacity (oil pan) *	Total	L	3.6					5.5											
	Effective	L	1.2					2.2											
Coolant water capacity (engine only)		L	1.8																
Engine Dimensions ** (with flyw Crankshaft V pulley diameter & heel housing)	Overall length	mm	553		528														
	Overall width	mm	489																
	Overall height	mm	565																
Engine mass (dry) ** (with flywheel housing)		kg	138		128														
Cooling fan (std.)		mm	335 mm O/D, 6 blades pusher type																
Fun V pulley diameter (std.)		mm	120x90		110x110														

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## (2) 3TNV84

Engine name		Unit	3TNV84																
Engine specification class		-	CL		VM														
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine																
Combustion chamber		-	Direct injection																
Number of cylinders		-	3																
Cylinder borexstroke		mmxmm	84x90																
Displacement		L	1.496																
Continuous rating	Revolving speed	Min <sup>-1</sup>	1500	1800	-														
	Output	kW (hp)	11.3 (15.3)	13.5 (18.3)	-														
Rated output	Revolving speed	Min <sup>-1</sup>	1500	1800	2000	2200	2400	2500	2600	2800	3000								
	Output	kW (hp)	12.4 (16.8)	14.8 (20.1)	16.4 (22.3)	18.1 (24.6)	19.7 (26.8)	20.5 (27.9)	21.3 (29.0)	23.0 (31.3)	24.6 (33.5)								
Max. no-load speed ( $\pm 25$ )		min <sup>-1</sup>	1600	1895	2180	2400	2590	2690	2810	2995	3210								
Ignition order		-	1-3-2-1(No.1 cylinder on flywheel side)																
Power take off		-	Flywheel																
Direction of rotation		-	Counterclockwise (viewed from flywheel)																
Cooling system		-	Radiator																
Lubrication system		-	Forced lubrication with trochoid pump																
Starting system		-	Electric																
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)																
Applicable lubricant		-	API grade class CD																
Lubricant capacity (oil pan) *	Total	L	6.7																
	Effective	L	1.9																
Coolant water capacity (engine only)		L	1.8																
Engine dimensions ** (with flywheel housing)	Overall length	mm	589	564															
	Overall width	mm	486																
	Overall height	mm	622																
Engine mass (dry) ** (with flywheel housing)		kg	161	155															
Cooling fan (std.)		mm	335 mm O/D, 6 blades pusher type																
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		mm	120x90	110x110															

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## (3) 3TNV84T

Engine name		Unit	3TNV84T														
Engine specification class		-	CL		VM												
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine														
Combustion chamber		-	Direct injection														
Number of cylinders		-	3														
Cylinder borexstroke		mmxmm	84x90														
Displacement		L	1.496														
Continuous rating	Revolving speed	Min <sup>-1</sup>	1500	1800	-												
	Output	kW (hp)	14.0 (19.0)	16.5 (22.5)	-												
Rated output	Revolving speed	Min <sup>-1</sup>	1500	1800	2000	2200	2400	2500	2600	2800	3000						
	Output	kW (hp)	15.8 (21.5)	18.8 (25.5)			25.0 (34.0)	25.9 (35.2)	26.8 (36.5)	29.1 (39.5)	30.9 (42.0)						
Max. no-load speed ( $\pm 25$ )		min <sup>-1</sup>	1600	1895			2590	2700	2810	2995	3210						
Ignition order		-	1-3-2-1(No.1 cylinder on flywheel side)														
Power take off		-	Flywheel														
Direction of rotation		-	Counterclockwise (viewed from flywheel)														
Cooling system		-	Radiator														
Lubrication system		-	Forced lubrication with trochoid pump														
Starting system		-	Electric														
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (cetane No.45 min.)														
Applicable lubricant		-	API grade class CD or CF														
Lubricant capacity (oil pan) *	Total	L	6.7														
	Effective	L	1.9														
Coolant water capacity (engine only)		L	2.0														
Engine dimensions ** (with flywheel housing)	Overall length	mm	589	564													
	Overall width	mm	486														
	Overall height	mm	622														
Engine mass (dry) ** (with flywheel housing)		kg	161	155													
Cooling fan (std.)		mm	350 mm O/D, 6 blades pusher type														
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		mm	120x90	110x110													

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## (4) 3TNV88

Engine name		Unit	3TNV88															
Engine specification class		-	CL		VM													
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine															
Combustion chamber		-	Direct injection															
Number of cylinders		-	3															
Cylinder borexstroke		mm×mm	88×90															
Displacement		L	1.642															
Continuous rating	Revolving speed	Min <sup>-1</sup>	1500	1800	-													
	Output	kW (hp)	12.3 (16.7)	14.8 (20.1)	-													
Rated output	Revolving speed	Min <sup>-1</sup>	1500	1800	2000	2200	2400	2500	2600	2800	3000							
	Output	kW (hp)	13.5 (18.4)	16.3 (22.1)	18.0 (24.5)	19.9 (27.0)	21.6 (29.4)	22.6 (30.7)	23.5 (31.9)	25.2 (34.2)	27.1 (36.8)							
Max. no-load speed (+25)		min <sup>-1</sup>	1600	1895	2180	2400	2590	2700	2810	2995	3210							
Ignition order		-	1-3-2-1(No.1 cylinder on flywheel side)															
Power take off		-	Flywheel															
Direction of rotation		-	Counterclockwise (viewed from flywheel)															
Cooling system		-	Radiator															
Lubrication system		-	Forced lubrication with trochoid pump															
Starting system		-	Electric															
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)															
Applicable lubricant		-	API grade class CD or CF															
Lubricant capacity (oil pan) *	Total	L	4.7						7.2									
	Effective	L	1.8						3.5									
Coolant water capacity (engine only)		L	2.0															
Engine dimensions ** (with flywheel housing)	Overall length	mm	589		564													
	Overall width	mm	486															
	Overall height	mm	622															
Engine mass (dry) ** (with flywheel housing)		kg	155															
Cooling fan (std.)		Mm	350 mm O/D, 6 blades pusher type															
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		Mm	120×90		120×90													

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## (5) 4TNV84

Engine name		Unit	4TNV84													
Engine specification class		-	CL		VM											
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine													
Combustion chamber		-	Direct injection													
Number of cylinders		-	4													
Cylinder borexstroke		mmx mm	84x90													
Displacement		L	1.995													
Continuous Rating	Revolving speed	Min <sup>-1</sup>	1500	1800	-											
	Output	kW (hp)	14.9 (20.3)	17.7 (24.1)	-											
Rated output	Revolving speed	Min <sup>-1</sup>	1500	1800	2000	2200	2400	2500	2600	2800	3000					
	Output	kW (hp)	16.4 (22.3)	19.5 (26.5)	21.9 (29.8)	24.1 (32.8)	26.3 (35.8)	27.4 (37.3)	28.5 (38.7)	30.7 (41.7)	32.9 (44.7)					
Max. no-load speed (+25)		min <sup>-1</sup>	1600	1895	2180	2400	2590	2700	2810	2995	3210					
Ignition order		-	1-3-4-2-1(No.1 cylinder on flywheel side)													
Power take off		-	Flywheel													
Direction of rotation		-	Counterclockwise (viewed from flywheel)													
Cooling system		-	Radiator													
Lubrication system		-	Forced lubrication with trochoid pump													
Starting system		-	Electric													
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (cetane No.45 min.)													
Applicable lubricant		-	API grade class CD or CF													
Lubricant capacity (oil pan) *	Total	L	7.4													
	Effective	L	2.3													
Coolant water capacity (engine only)		L	2.7													
Engine dimensions ** (with flywheel housing)	Overall length	mm	683		658											
	Overall width	mm	498.5													
	Overall height	mm	617													
Engine mass (dry) ** (with flywheel housing)		kg	183		170											
Cooling fan (std.)		mm	370 mm O/D, 6 blades pusher type													
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		mm	120x90		110x110											

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## (6) 4TNV84T

Engine name		Unit	4TNV84T												
Engine specification class		-	CL		VM										
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine												
Combustion chamber		-	Direct injection												
Number of cylinders		-	4												
Cylinder borexstroke		mmxmm	84x90												
Displacement		L	1.995												
Continuous rating	Revolving speed	Min <sup>-1</sup>	1500	1800	-										
	Output	KW (hp)	19.1 (26.0)	24.3 (33.0)	-										
Rated output	Revolving speed	Min <sup>-1</sup>	1500	1800	2000	2200	2400	2600	2800	3000					
	Output	KW (hp)	21.3 (29.0)	26.9 (36.5)	27.9 (38.0)	30.5 (41.5)	33.5 (45.5)	35.7 (48.5)	38.6 (52.5)	41.2 (56.0)					
Max. no-load speed ( $\pm 25$ )		min <sup>-1</sup>	1600	1895	2180	2400	2590	2810	2995	3210					
Ignition order		-	1-3-4-2-1(No.1 cylinder on flywheel side)												
Power take off		-	Flywheel												
Direction of rotation		-	Counterclockwise (viewed from flywheel)												
Cooling system		-	Radiator												
Lubrication system		-	Forced lubrication with trochoid pump												
Starting system		-	Electric												
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)												
Applicable lubricant		-	API grade class CD or CF												
Lubricant capacity (oil pan) *	Total	L	7.4												
	Effective	L	3.4												
Coolant water capacity (engine only)		L	2.7												
Engine dimensions **	Overall length	mm	683	649											
	Overall width	mm	498.5												
	Overall height	mm	713												
Engine mass (dry) ** (with flywheel housing)		kg	183	170											
Cooling fan (std.)		mm	370 mm O/D, 6 blades pusher type												
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		mm	120x90	110x110											

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## (7) 4TNV88

Engine name		Unit	4TNV88															
Engine specification class		-	CL		VM													
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine															
Combustion chamber		-	Direct injection															
Number of cylinders		-	4															
Cylinder borexstroke		mmxmm	88x90															
Displacement		L	2.190															
Continuous rating	Revolving speed	Min <sup>-1</sup>	1500	1800	-													
	Output	kW (hp)	16.4 (22.3)	19.6 (26.7)	-													
Rated output	Revolving speed	Min <sup>-1</sup>	1500	1800	2000	2200	2400	2500	2600	2800	3000							
	Output	kW (hp)	18.0 (24.5)	21.6 (29.4)	24.1 (32.7)	26.5 (36.0)	28.8 (39.2)	30.1 (40.9)	31.3 (42.5)	33.7 (45.8)	35.4 (48.1)							
Max. no-load speed ( $\pm 25$ )		min <sup>-1</sup>	1600	1895	2180	2400	2590	2700	2810	2995	3210							
Ignition order		-	1-3-4-2-1 (No.1 cylinder on flywheel side)															
Power take off		-	Flywheel															
Direction of rotation		-	Counterclockwise (viewed from flywheel)															
Cooling system		-	Radiator															
Lubrication system		-	Forced lubrication with trochoid pump															
Starting system		-	Electric															
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (cetane No.45 min.)															
Applicable lubricant		-	API grade class CD or CF															
Lubricant capacity (oil pan) *	Total	L	5.8						8.6									
	Effective	L	2.3						4.2									
Coolant water capacity (engine only)		L	2.7															
Engine dimensions ** (with wheel housing)	Overall length	mm	683		658													
	Overall width	mm	498.5															
	Overall height	mm	618															
Engine mass (dry) ** (with flywheel housing)		kg	183		170													
Cooling fan (std.)		mm	370 mm O/D, 6 blades pusher type															
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		mm	120x90		110x110													

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## (8) 4TNV94L

Engine name		Unit	4TNV94L										
Engine specification class		-	CL		VM								
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine										
Combustion chamber		-	Direct injection										
Number of cylinders		-	4										
Cylinder borexstroke		mmxmm	94x110										
Displacement		L	3.053										
Continuous rating	Revolving speed	Min <sup>-1</sup>	1500	1800	-								
	Output	kW (hp)	26.1 (35.5)	31.3 (42.5)	-								
Rated output	Revolving speed	Min <sup>-1</sup>	1500	1800	2000	2200	2400	2500					
	Output	kW (hp)	29.1 (39.5)	34.6 (47.0)	35.3 (48.0)	38.2 (52.0)	41.6 (56.5)	43.0 (58.5)					
Max. no-load speed ( $\pm 25$ )		min <sup>-1</sup>	1600	1895	2180	2400	2590	2700					
Ignition order		-	1-3-4-2-1(No.1 cylinder on flywheel side)										
Power take off		-	Flywheel										
Direction of rotation		-	Counterclockwise (viewed from flywheel)										
Cooling system		-	Radiator										
Lubrication system		-	Forced lubrication with trochoid pump										
Starting system		-	Electric										
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)										
Applicable lubricant		-	API grade class CD or CF										
Lubricant capacity (oil pan) *	Total	L	10.2										
	Effective	L	4.5										
Coolant water capacity (engine only)		L	4.2										
Engine dimensions ** (with flywheel housing)	Overall length	mm	719										
	Overall width	mm	498										
	Overall height	mm	717										
Engine mass (dry) ** (with flywheel housing)		kg	245 (equivalent to SAE#3)	235 (equivalent to SAE#4)									
Cooling fan (std.)		mm	410 mm O/D, 6 blades pusher type										
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		mm	130x130										

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## (9) 4TNV98

Engine name		Unit	4TNV98										
Engine specification class		-	CL		VM								
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine										
Combustion chamber		-	Direct injection										
Number of cylinders		-	4										
Cylinder borexstroke		mmxmm	98x110										
Displacement		L	3.318										
Continuous rating	Revolving speed	Min <sup>-1</sup>	1500	1800	-								
	Output	kW (hp)	30.9 (42.0)	36.8 (50.0)	-								
Rated output	Revolving speed	Min <sup>-1</sup>	1500	1800	2000	2200	2400	2500					
	Output	kW (hp)	34.6 (47.0)	41.2 (56.0)	41.9 (57.0)	45.6 (62.0)	49.3 (67.0)	51.1 (69.5)					
Max. no-load speed ( $\pm 25$ )		min <sup>-1</sup>	1600	1895	2180	2400	2590	2700					
Ignition order		-	1-3-4-2-1(No.1 cylinder on flywheel side)										
Power take off		-	Flywheel										
Direction of rotation		-	Counterclockwise (viewed from flywheel)										
Cooling system		-	Radiator										
Lubrication system		-	Forced lubrication with trochoid pump										
Starting system		-	Electric										
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)										
Applicable lubricant		-	API grade class CD or CF										
Lubricant capacity (oil pan) *	Total	L	10.2										
	Effective	L	4.5										
Coolant water capacity (engine only)		L	4.2										
Engine dimensions ** (with flywheel housing)	Overall length	mm	719										
	Overall width	mm	498										
	Overall height	mm	717										
Engine mass (dry) ** (with flywheel housing)		kg	248 (equivalent to SAE#3)	235 (equivalent to SAE#4)									
Cooling fan (std.)		mm	410 mm O/D, 6 blades pusher type										
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		mm	130x130										

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## (10) 4TNV98T

Engine name		Unit	4TNV98T											
Engine specification class		-	CL		VM									
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine											
Combustion chamber		-	Direct injection											
Number of cylinders		-	4											
Cylinder borexstroke		mmxmm	88x110											
Displacement		L	3.318											
Continuous rating	Revolving speed	Min <sup>-1</sup>	1500	1800	-									
	Output	kW (hp)	37.9 (51.5)	45.6 (62.0)	-									
Rated output	Revolving speed	Min <sup>-1</sup>	1500	1800	2000	2200	2400	2500	2600					
	Output	kW (hp)	41.9 (57.0)	50.4 (68.5)	50.7 (69.0)	55.5 (75.5)	60.3 (82.0)	62.5 (85.0)	64.0 (87.0)					
Max. no-load speed ( $\pm 25$ )		min <sup>-1</sup>	1600	1895	2180	2400	2590	2700	2810					
Ignition order		-	1-3-4-2-1(No.1 cylinder on flywheel side)											
Power take off		-	Flywheel											
Direction of rotation		-	Counterclockwise (viewed from flywheel)											
Cooling system		-	Radiator											
Lubrication system		-	Forced lubrication with trochoid pump											
Starting system		-	Electric											
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (cetane No.45 min.)											
Applicable lubricant		-	API grade class CD or CF											
Lubricant capacity (oil pan) *	Total	L	10.2											
	Effective	L	4.5											
Coolant water capacity (engine only)		L	4.2											
Engine dimensions ** (with flywheel housing)	Overall length	mm	715											
	Overall width	mm	575											
	Overall height	mm	779											
Engine mass (dry) ** (with flywheel housing)		kg	258 (equivalent to SAE#3)	245 (equivalent to SAE#4)										
Cooling fan (std.)		mm	430 mm O/D, 8 blades suction type											
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		mm	130x130											

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## (11) 4TNV106

Engine name		Unit	4TNV106									
Engine specification class		-	CL		VM							
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine									
Combustion chamber		-	Direct injection									
Number of cylinders		-	4									
Cylinder borexstroke		mmxmm	106x125									
Displacement		L	4.412									
Continuous rating	Revolving speed	Min <sup>-1</sup>	1500	1800	-							
	Output	kW (hp)	41.2 (56.0)	49.3 (67.0)	-							
Rated output	Revolving speed	Min <sup>-1</sup>	1500	1800	2000	2200	2400	2500				
	Output	kW (hp)	45.6 (62.0)	54.4 (74.0)	56.6 (77.0)	61.4 (83.5)	65.5 (89.0)	67.7 (92.0)				
Max. no-load speed ( $\pm 25$ )		min <sup>-1</sup>	1600	1895	2180	2400	2590	2700				
Ignition order		-	1-3-4-2-1(No.1 cylinder on flywheel side)									
Power take off		-	Flywheel									
Direction of rotation		-	Counterclockwise (viewed from flywheel)									
Cooling system		-	Radiator									
Lubrication system		-	Forced lubrication with trochoid pump									
Starting system		-	Electric									
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)									
Applicable lubricant		-	API grade class CD or CF									
Lubricant capacity (oil pan) *	Total	L	14.0									
	Effective	L	9.0		7.5							
Coolant water capacity (engine only)		L	6.0									
Engine dimensions ** (with flywheel housing)	Overall length	mm	808		776							
	Overall width	mm	629		629							
	Overall height	mm	803		803							
Engine mass (dry) ** (with flywheel housing)		kg	345 (equivalent to SAE#3)		330 (equivalent to SAE#3)							
Cooling fan (std.)		mm	500 mm O/D, 7 blades pusher type		500 mm O/D, 7 blades suction type							
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		mm	150x150									

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## (12) 4TNV106T

Engine name		Unit	4TNV106T		
Engine specification class		-	CL		VM
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine		
Combustion chamber		-	Direct injection		
Number of cylinders		-	4		
Cylinder bore×stroke		mm×mm	106×125		
Displacement		L	4.412		
Continuous rating	Revolving speed	Min <sup>-1</sup>	1500	1800	-
	Output	kW (hp)	51.5 (70.0)	61.8 (84.0)	-
Rated output	Revolving speed	Min <sup>-1</sup>	1500	1800	2000 2200
	Output	kW (hp)	56.8 (77.2)	68.0 (92.5)	69.9 (95.0) 72.0 (97.9)
Max. no-load speed (±25)		min <sup>-1</sup>	1600	1895	2180 2400
Ignition order		-	1-3-4-2-1(No.1 cylinder on flywheel side)		
Power take off		-	Flywheel		
Direction of rotation		-	Counterclockwise (viewed from flywheel)		
Cooling system		-	Radiator		
Lubrication system		-	Forced lubrication with trochoid pump		
Starting system		-	Electric		
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)		
Applicable lubricant		-	API grade class CD or CF		
Lubricant capacity (oil pan) *	Total	L	14.0		
	Effective	L	9.0	7.5	
Coolant water capacity (engine only)		L	6.0		
Engine dimensions ** (with flywheel housing)	Overall length	mm	808	776	
	Overall width	mm	629	628.6	
	Overall height	mm	866	866	
Engine mass (dry) ** (with flywheel housing)		kg	355 (equivalent to SAE#3)	340 (equivalent to SAE#3)	
Cooling fan (std.)		mm	500 mm O/D, 7 blades pusher type	500 mm O/D, 7 blades suction type	
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		mm	150×150		

\* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

\*\* Engine mass and dimensions without radiator

## 1.3 Fuel Oil, Lubricating Oil and Coolant Water

### 1.3.1 Fuel oil

#### IMPORTANT:

Only use the recommended fuel to obtain the best engine performance and prevent damage of parts, also prevent air pollution.

#### (1) Selection of fuel oil

Use the following diesel fuels for best engine performance:

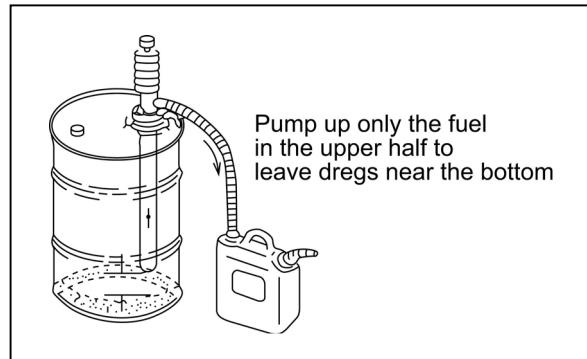
BS 2869 A1 or A2

Fuels equivalent to Japanese Industrial Standard, JIS. No. K2204-2

Fuel cetane number should be 45 or greater

#### (2) Fuel handling

- Water and dust in the fuel oil can cause operation failure. Use containers which are clean inside to store fuel oil. Store the containers away from rain water and dust.
- Before supplying fuel, let the fuel container rest for several hours so that water and dust in the fuel are deposited on the bottom. Pump up only the clean fuel.



#### (3) Fuel tank

Be sure to attach a drain cock, precipitation trap and primary strainer to the fuel tank as shown illustration right.

