HINSHI–H8013-R1

T-NE

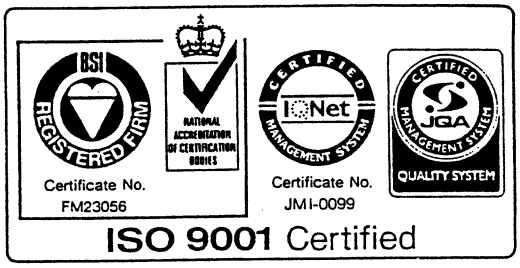
YANMAR

SERVICE MANUAL

INDUSTRIAL DIESEL ENGINE

MODEL 4TNE94·98·106(T)

(Direct Injection System)



YANMAR DIESEL ENGINE CO.,LTD.

Publication No. HINSHI-H8013-R1

History of Correction				Page No.	1
Manual Name:		Yanmar Service Manual for Industrial Diesel Engine			
Engine Model:		Model 4TNE94·98·106(T) (Direct Injection System)			
Number of correction	Data of correction	Cause for correction	Outline of correction	Corrected item number	Corrected by:
	Oct. 21, 1996		First edition		
Rev.1	Mar. 2, 1998	Addition of model 4TNE106(T) with the publication No. changed to HINSHI-H8013-R1			
1st	Dec. 5, 2000	Changed tightening torque	Changed tightening torque for fastening bolt of crankshaft V-pulley	12-7	Quality Assurance Dept.
2nd	Oct., 2001	Improved to keep out of dust	• Applying crankshaft pulley installing tool (Adopting the oil seal with double lips dust seal (For 4TNE94 special version supplying the OEMs)) • Corrected fuel injection timing • Miscellaneous (EPA and/or 97/68/EC Directive certified engine description, etc.)	4-12, 4-16 11-2 1-2, 1-3 1-4, 1-5 2-5, 3-8 0-1, 0-1-2 0-1-3, 3-15 and cover pages	Quality Assurance Dept.

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FOREWORD

This manual describes the service procedures for the 4TNE94·98·106(T) engines (direct injection) that have been certified by the EPA 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. If any modification of the contents described herein becomes necessary, it will be notified in the form of a correction information each time.

California Proposition 65 Warning

Diesel engine exhaust and some of its constitutions 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.

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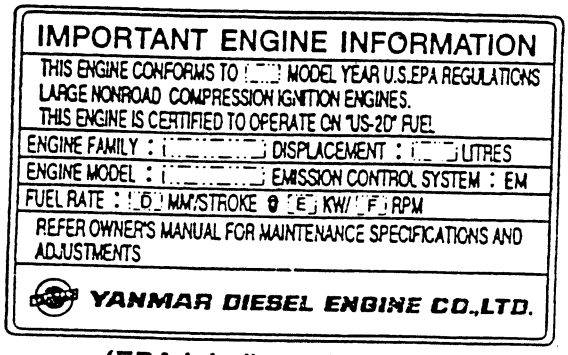
The EPA and/or the 97/68/EC Directive Certified Engines

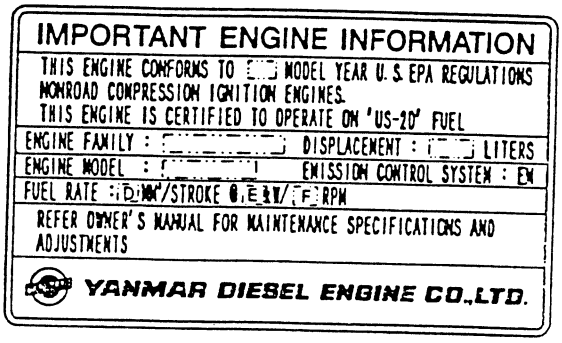
The engines in this manual have been certified by the EPA and/or the 97/68/EC Directive. To identify the engines, the following emission control labels are affixed on the engines.

1. Engine identification

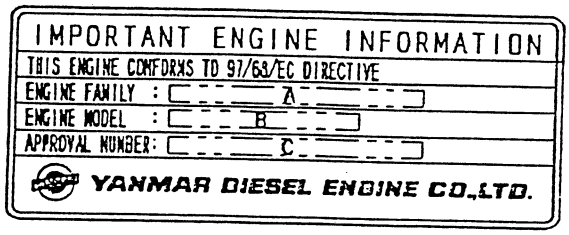
a) Emission control labels



(EPA label) 37kW ≦ Range

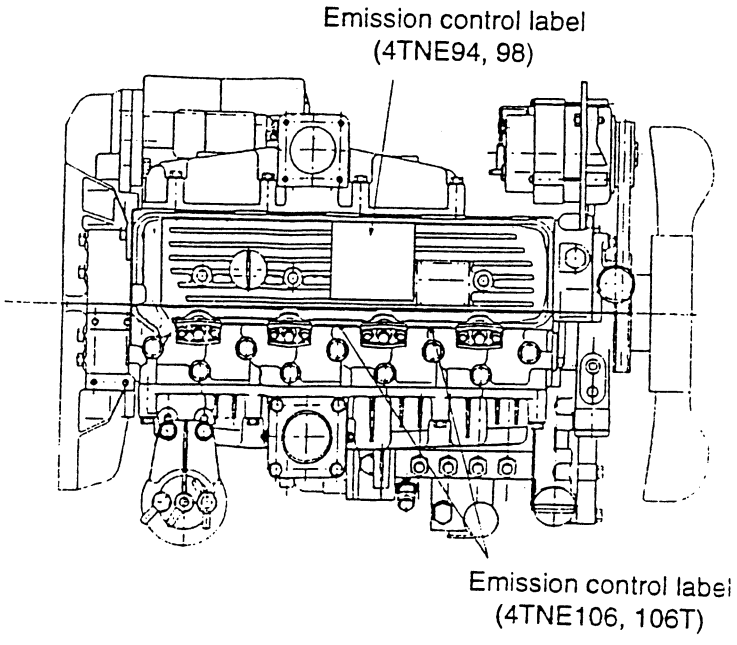


(EPA label) 37kW > Range



(97/68/EC Directive label)

b) Label location



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2. The EPA Emission Standard

*2 Test cycle: ISO 8178-4 C1, D2, G2

Power Range kW (Gross power)	Standard (g/kWh) (Tier 1)				Smoke (US Opacity %) transient mode
	NOx	NMHC	CO	PM	
19 ≦ Range < 37	*2 9.5		5.5	0.80	Acceleration: 20 *1 Lugging: 15 Peak : 50
37 ≦ Range < 75	9.2	*1 not regulated	*1 not regulated	*1 not regulated	
75 ≦ Range < 130	9.2	*1 not regulated	*1 not regulated	*1 not regulated	

Note: *1 --- Lugging means deceleration.
Smoke requirements are not applied for the following engines.
Single-cylinder engines, constant-speed engines, marine propulsion engines.
*2 --- The most appropriate test cycle for each engine family shall be selected.
The standard of NOx and NMHC (non-methane hydrocarbon) for the power range under37 kW is combined. (NOx + NMHC)

3. Guarantee Conditions for the EPA Emission Standard

The following guarantee conditions are set down in the operation manual. In addition to making sure that these conditions are met, check for any deterioration that may occur before the required periodic maintenance times.

- **Requirement on engine installation condition**

(1) Air intake depression

kPa (mmAq)

Permissible
≦ – 6.23 (– 635)

(2) Exhaust gas back pressure

kPa (mmAq)

Permissible
≦ 15.30 (1560) for 4TNE 94, 98, 106, ≦ 5.88 (600) for 4TNE 106T

- **Fuel oil and lubricating oil**

(1) Fuel: The diesel fuel oil [ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No. 45 min.)]
(2) Lube oil: API grade, class CD

- **Do not remove the seals restricting injection quantity and engine speed.**
- **Perform maintenance without fail.**

Note: Inspections to be carried out by the user and by the maker are divided and set down in the "List of Periodic Inspections" on the operation manual and should be checked carefully.

- **Quality guarantee period for exhaust emission related parts**

For exhaust emission related parts, follow the inspections outlined in the "List of Periodic Inspections", on the operation manual, and use the table below to carry out inspections based on operation hours or time in years. Whichever comes first is the guarantee period.

Power Range kW (Gross power)	Other than Constant-speed	Constant-speed	
		Under 3,000 rpm	Greater than or equal to 3,000 rpm
19 ≦ Range < 37	3,000 hours or 5 years		1,500 hours or 2 years
37 ≦ Range	3,000 hours or 5 years		

The specific emissions-related parts: • Fuel injection nozzle • Fuel injection pump • Turbocharger

⚠ For Safe Servicing

- 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**	DANGER-indicates an imminently hazardous situation which, if not avoided, WILL result in death or serious injury.
⚠ **WARNING**	WARNING-indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.
⚠ **CAUTION**	CAUTION-indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

- Any matter marked **[NOTICE]** in this manual is especially important in servicing. If not observed, the product performance and quality may not be guaranteed.

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Precautions for Safe Servicing

(A) Service Shop (Place)

⚠ WARNING

- **Place allowing sufficient ventilation**
  Jobs such as engine running, part welding and polishing the paint with sandpaper should be done in a well-ventilated place.
  [Otherwise]
  Very dangerous for human body due to the possibility of poisonous gas or dust inhalation.

⚠ CAUTION

- **Sufficiently wide and flat place**
  The floor space of the service shop for inspection and maintenance shall be sufficiently wide and flat without any hole.
  [Otherwise]
  An accident such as a violent fall may be caused.

⚠ CAUTION

- **Clean, orderly arranged place**
  No dust, mud, oil or parts shall left uncleaned on the floor surface.
  [Otherwise]
  An unexpected accident may be caused.

⚠ CAUTION

- **Bright, safely illuminated place**
  The working place should be illuminated sufficiently and safely. For a job in a dark position involving difficulty in observation, use a portable safety lamp. The bulb shall be covered with a wire cage.
  [Otherwise]
  The bulb may be broken accidentally to cause ignition of leaking oil.

⚠ CAUTION

- **Place equipped with a fire extinguisher**
  Keep a fast aid kit and fire extinguisher close at hand in preparation for an emergency of fire starting.

(B) Working Wear

⚠ CAUTION

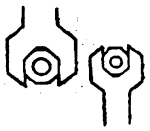
- **Wears for Safe Operation**
  Wear a helmet, working clothes, safety shoes and other safety protectors matching each job. Especially, wear well-fitting working clothes.
  [Otherwise]
  A serious accident such as trapping by a machine may arise.

(C) Tools to Be Used

⚠ WARNING

- **Appropriate holding and lifting**
  Never operate when the engine is supported with blocks or wooden pieces or only with a jack. To lift and hold the engine, always use a crane with a sufficient allowance in limit load or a rigid jack.
  [Otherwise]
  A serious accident may arise.

⚠ WARNING



- **Use of Appropriate Tools**
  Use tools matching the jobs to be done. Use a correctly sized tool for loosening or tightening a machine part.
  [Otherwise]
  A serious injury or engine damage may arise.

(D) Use of Genuine Parts, Oil and Grease

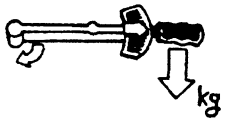
⚠ CAUTION

- **Always use genuine parts.**

  [Otherwise]
  Shortening of engine life or an unexpected accident may arise.

(E) Bolt and Nut Tightening Torques

⚠ WARNING



- **Always tighten to the specified torque if designated in the manual.**

  [Otherwise]
  Loosening or falling may cause parts damage or an injury.

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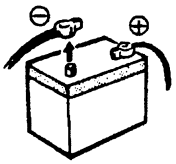
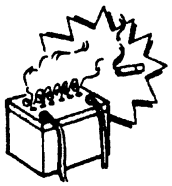
(F) Electrical Parts

⚠ WARNING



- **Harness Short-circuit**
  Disconnect the battery negative (-) terminal before starting the service job.
  [Otherwise]
  Shorting of a harness may occur to start a fire.

⚠ WARNING



- **Battery Charging**
  Since flammable gas is generated during battery charging, keep any fire source away.
  [Otherwise]
  Explosion may arise.

⚠ WARNING

- **Battery Electrolyte**
  Since the electrolyte is diluted sulfuric acid, do not let it be splashed onto clothes or skin.
  [Otherwise]
  The clothes or skin may be burnt.

(G) Waste Treatment

⚠ CAUTION

Observe the following instructions with regard to waste disposal. Negligence of each instruction will cause environmental pollution.

- Waste fluids such as engine oil and cooling water shall be discharged into a container without spillage onto the ground.
- Do not let waste fluids be discharged into the sewerage, a river or the sea.
- Harmful wastes such as oil, fuel, solvents, filter elements and battery shall be treated according to the respective laws and regulations. Ask a qualified collecting company for example.

(H) Handling the Product

⚠ WARNING

- **Supplying the Fuel**
  When supplying the fuel, always keep any fire source like a cigarette or match away.
  [Otherwise]
  A fire or explosion may arise.

⚠ WARNING

- **Pay attention to hot portions.**
  Do not touch the engine during running or immediately after it is stopped.
  [Otherwise]
  Scalding may be caused by a high temperature.

⚠ WARNING

- **Pay attention to the rotating part.**
  Never bring clothes or a tool close to the rotating part during rngine running.
  [Otherwise]
  Injury may be caused by entrapping.

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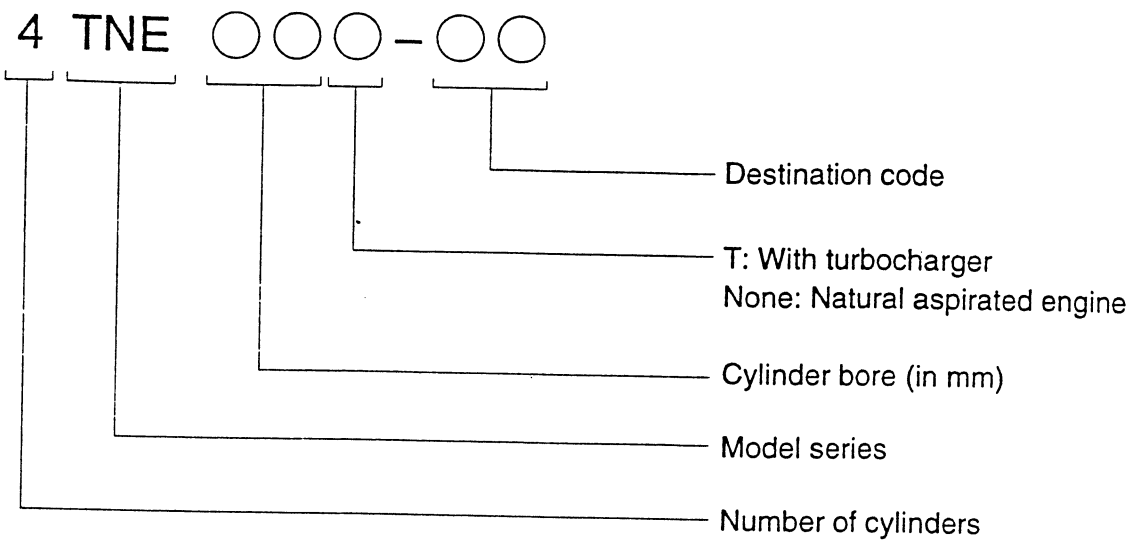
1.1 Engine Nomenclature



• Engine application class

	Application	Revolving speed	Number of revolutions (rpm)
CL	Generator driving	Constant speed	1500/1800
VM	General purpose	Variable speed	2000~2500

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

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1.2 Specifications

(1) 4TNE94

Engine name		Unit	4TNE94					
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	94 × 100					
Displacement		ℓ	2.776					
Continuous rating	Revolving speed	min^{-1}	1500	1800	–			
	Output	kW (hp)	26.1 (35.0)	31.3 (42.0)	–			
Rated output	Revolving speed	min^{-1}	1500	1800	2000	2200	2400	2500
	Output	kW (hp)	29.1 (39.0)	34.6 (46.4)	35.3 (47.3)	38.2 (51.2)	41.6 (55.8)	43.0 (57.7)
Fuel injection timing (FID, bTDC)		deg	9 ± 1		11 ± 1			
Fuel injection pressure		MPa (kgf/cm^2)	21.57~ 22.55 (220~230)					
Ignition order		–	1–3–4–2 (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					
Battery capacity		V-Ah	12–64 (5HR) or above					
Lubricant capacity (oil pan)	Total	ℓ	10.2					
	Effective	ℓ	4.5					
Cooling water capacity (engine only)		ℓ	4.2					
Engine dimensions	Overall length	mm	720					
	Overall width	mm	508					
	Overall height	mm	689					
Engine mass (dry)		kg	223					

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(2) 4TNE98

Engine name		Unit	4TNE98					
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	98 × 110					
Displacement		ℓ	3.319					
Continuous rating	Revolving speed	min^{-1}	1500	1800	–			
	Output	kW (hp)	30.9 (41.4)	36.8 (49.3)	–			
Rated output	Revolving speed	min^{-1}	1500	1800	2000	2200	2400	2500
	Output	kW (hp)	34.6 (46.4)	41.2 (55.3)	41.9 (56.2)	45.6 (61.2)	49.3 (66.1)	51.1 (68.5)
Fuel injection timing (FID, bTDC)		deg	9 ± 1		11 ± 1			
Fuel injection pressure		MPa (kgf/cm^2)	21.57~ 22.55 (220~230)					
Ignition order		–	1–3–4–2 (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					
Battery capacity		V-Ah	12–64 (5HR) or above					
Lubricant capacity (oil pan)	Total	ℓ	10.2					
	Effective	ℓ	4.5					
Cooling water capacity (engine only)		ℓ	4.2					
Engine dimensions	Overall length	mm	720					
	Overall width	mm	508					
	Overall height	mm	689					
Engine mass (dry)		kg	223					

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