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# ***YANMAR***

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## ***SERVICE MANUAL***

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### ***INDUSTRIAL DIESEL ENGINE***

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EPA/ARB CERTIFIED ENGINE

MODEL **L48EE·L70EE·L100EE**

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**YANMAR ENGINE CO., LTD.**

# FOREWORD

This service manual outlines procedures for servicing YANMAR construction machinery. It contains specifications, servicing instructions and handling cautions. To obtain the maximum life and performance from YANMAR construction machinery, read this manual carefully and follow its instructions.

Please note that all dimensions and numerical values in this manual are for service reference, and are not inspection standards. Descriptions and specifications in this manual are subject to change without notice due to design improvements, etc.

## 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 hand after handling

[illegible]



# FOREWORD

This manual describes the handling and maintenance for the EPA and ARB certified engine (under 8kW) models L48EE, L70EE, L100EE.

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.

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## 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.



# 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 uncleaner 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

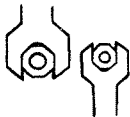
- **Appropriate holding and lifting**

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



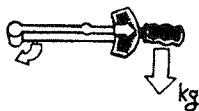
- **Always use genuine parts.**

**[Otherwise]**

Shortening of engine life or an unexpected accident may arise.

## (E) Bolt and Nut Tightening Torques

### WARNING



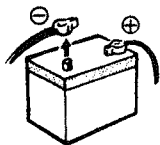
- **Always tighten to the specified torque if designated in the manual.**

**[Otherwise]**

Loosening or falling may cause parts damage or an injury.

## (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 acids, 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**



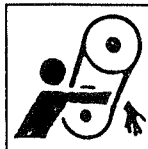
- **Pay attention to hot portions.**

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 engine running.

**[Otherwise]**

**Injury may be caused by entraping.**

# 1. Product Outline

## 1.1 Usage

This diesel engine is suitable for powering machinery used in civil engineering and construction, agricultural machinery, generators, and other industrial use machinery.

## 1.2 Exhaust Gas Regulations

This engine conforms to EPA exhaust gas regulations (under 8kW) for a low emission engine.

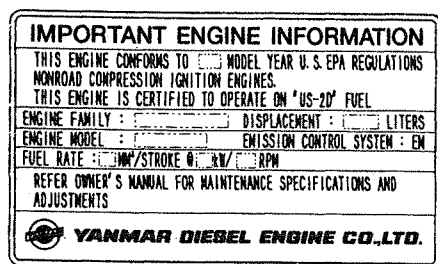
Exhaust emission	Conditions	C1,G2 mode※	remarks
Nox+NMHC	g/kWh	$\leq 10.5$	EPA recommended fuel is used
CO		$\leq 8.0$	
PM		$\leq 1.0$	

※Test cycle : ISO 8178-4 C1, G2 (G2 mode : applied to L100EE-DEV)

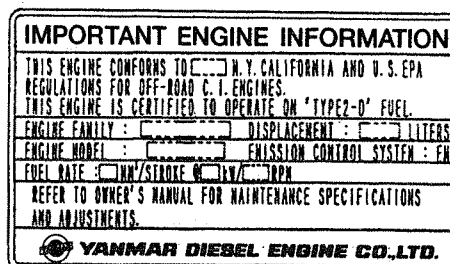
## 1.3 Engine identification

With the regulations on engine emission worldwide, it has become necessary to identify engines in a manner to determine which regulations they comply with, hence

a) Emission control label as shown below which will contain:



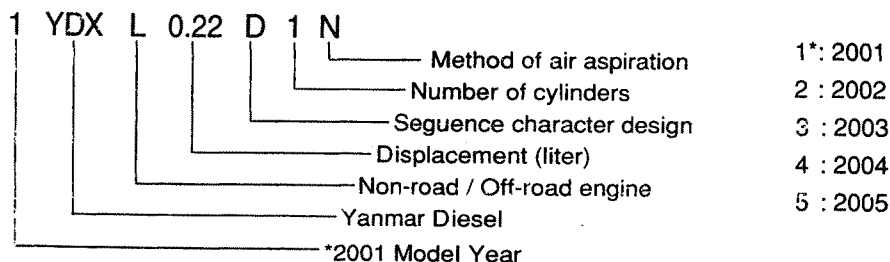
(EPA label)



(EPA & ARB label)

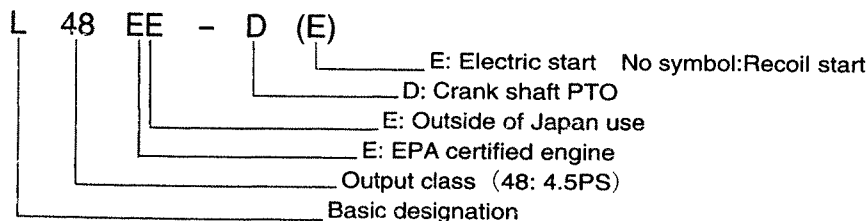
### ● Engine family name as assigned by EPA and ARB identifying engine family group

1YDXL 0.22D1N and this identifies



### b) Label location:

The typical location of this label for each engine is on the "top of fuel tank" or the "flywheel cover". A supplemental label may be used in certain applications for improved visibility.



## 2. Differences with L-A Model

In order to reduce the exhaust gas emission and meeting the EPA/ARB standards, the following changes for improving which have been made.

No	Parts	Detail
1	Fuel injection Nozzle	Adoption VOC nozzle
2	Cylinder Head	Change nozzle setting angle Change swirl ratio
3	Piston	Change combustion chamber Change piston height
4	Rocker arm	Change valve lift
5	Fuel injection pump (L48,70EE)	Change plunger diameter
6	Cam shaft (L48EE)	Change air intake timing
7	Crank shaft	Change stroke
8	Fuel oil limiter	Change working engine speed

## 3. Conditions to Insure Compliance with Emission Standards

### 3.1 Warranty Condition for Emission Standards

The following warranty conditions are set down in the Technical Bulletin attached with the operation manual.

#### <Technical Bulletin Contents>

#### • Requirement on engine installation condition

##### (1) Air intake restriction

kPa (mmAq)

Model name	Permissible
L48EE	- 0.686 (- 70)
L70EE	- 1.373 (- 140)
L100EE	- 1.471 (- 150)

##### (2) Exhaust gas back pressure

kPa (mmAq)

Model name	Permissible
L48EE	3.628 (370)
L70EE	3.727 (380)
L100EE	4.315 (440)

#### • Quality warranty period for exhaust emission related parts

The EPA regulates specific emissions-related parts are warranted for the period in the following table. However, ultimate purchasers are obligated to use and maintain the engine correctly.

Emissions-related parts	Warranty period (Hours/Years)*
	Power range < 8 kW
Fuel injection pump	1500/2
Fuel injection nozzle	

\* Actual hours or years of operation whichever occurs first applied.

### 3.2 Handling of emission related parts

Do not remove the seals limiting the amount of fuel injected and speed.

## 4. Specifications

### 4.1 Specifications

		Unit	L48EE-D(E)	L70EE-D(E)	L100EE-D(E)
Type		—	Single-cylinder, vertical-4cycle diesel		
Cooling system		—	Forced air cooling by flywheel fan		
Combustion system		—	Direct injection system		
Starting system		—	D:Recoil starter DE:Starting motor with recoil starter		
Number of cylinder-BoreXStroke		mm	1-70 X 57	1-78 X 64	1-86 X 72
Displacement		ℓ	0.219	0.306	0.418
Output	Continuous	kW(PS)	3.0(4.1)	4.3(5.9)	6.3(8.6)
	Maximum		3.3(4.5)	4.8(6.5)	7.1(9.6)
Rated engine speed(Crank shaft)		rpm	3600	3600	3600
Idle engine speed at no-load high/low		rpm	3780/1200	3780/1200	3780/1200
Compression ratio		—	20.6	20.2	20.0
PTO shaft	PTO position	—	Crank shaft		
	Direction of rotation	—	Counterclockwise viewed from PTO shaft		
Fuel oil system	Fuel injection pump	—	Bosch type YANMAR PFE-M type		
	Fuel injection timing (FIC: bTDC)	deg	17.5 ± 0.5	15.0 ± 0.5	17.0 ± 0.5
	Fuel injection nozzle	ℓ	VCO nozzle Bosch made		
	Fuel injection pressure	MPa (kgf/cm <sup>2</sup> )	19.6 (200)		
	Fuel oil selection	—	Diesel fuel BS2869A1 or equivalent		
	Fuel oil filter	—	Paper element, FO tank built-in type		
	Fuel oil tank capacity	ℓ	2.4	3.3	5.4
Lubricating oil system	Type of lubrication	—	Forced lubrication via trochoid pump: splash lubrication for valve rocker arm chamber		
	Lubricating oil filter	—	Resin, 60mesh		
	Lubricating oil selection	—	SAE10W30, API grade CC or higher		
	Lubricating oil capacity full/effective	ℓ	0.8/0.25	1.1/0.4	1.65/0.6
Air cleaner		—	Wet type paper element filter		
Exhaust silencer		—	Expansion silencer with cover		
Governor		—	All speed type mechanical		
Engine dimensions (Length X Width X Height)		mm	324 X 410 X 416	358 X 421 X 450	392 X 470 X 494
Dry mass		kg	※26.5 (32.0)	※33.5 (39.0)	※48.5 (54.0)
Permissible angle of inclination		deg	20 (30:operting time 3min. max.)		
Balancer shaft		—	Single shaft		

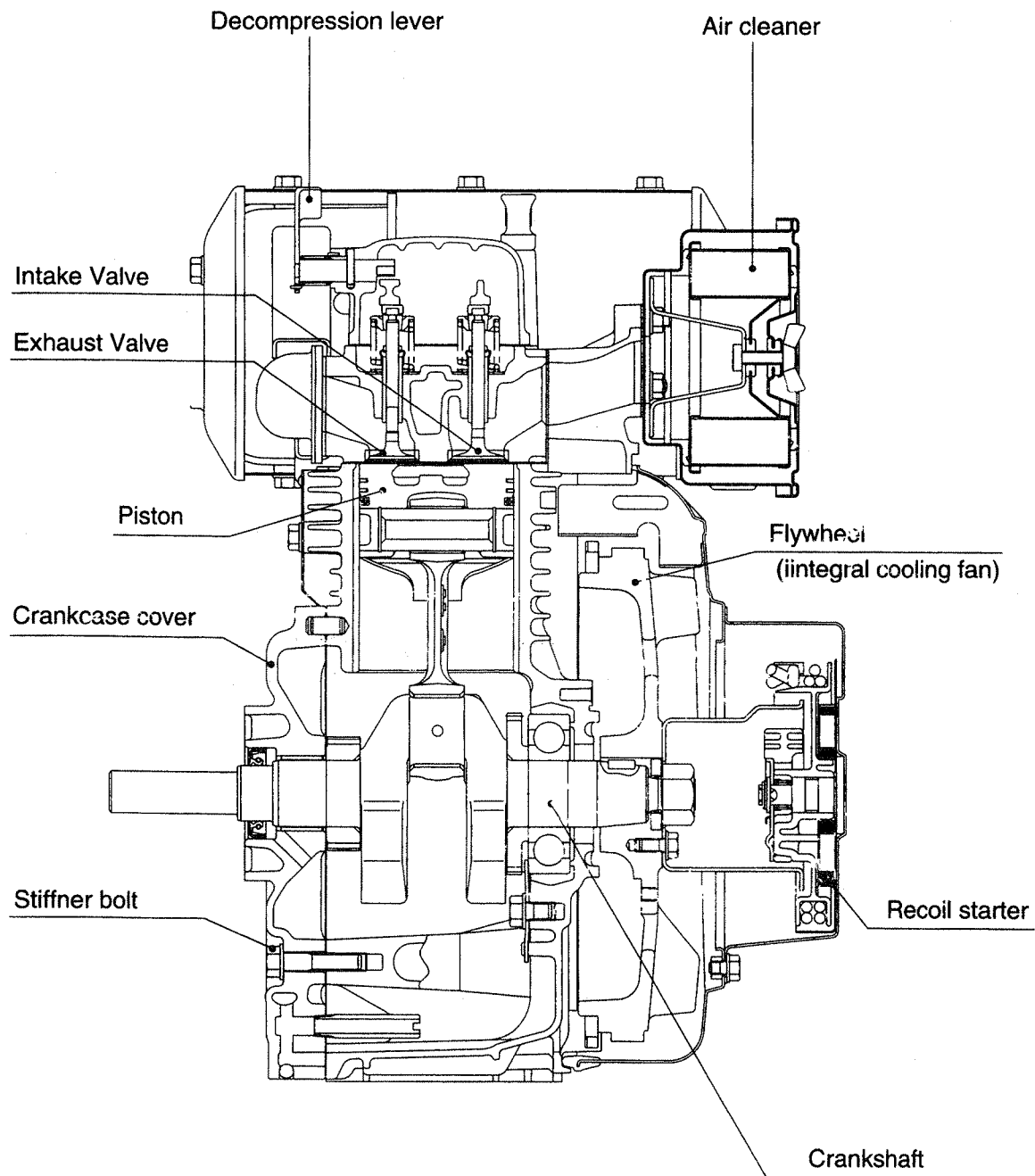
※ ( ) : DE model

### Output setting conditions

Ambient conditions	Room temperature : 25C° Atmospheric pressure : 100kPa (750mmHg) Relative humidity: 30%
Run-in	≥30Hr

## 5. Sectional Views

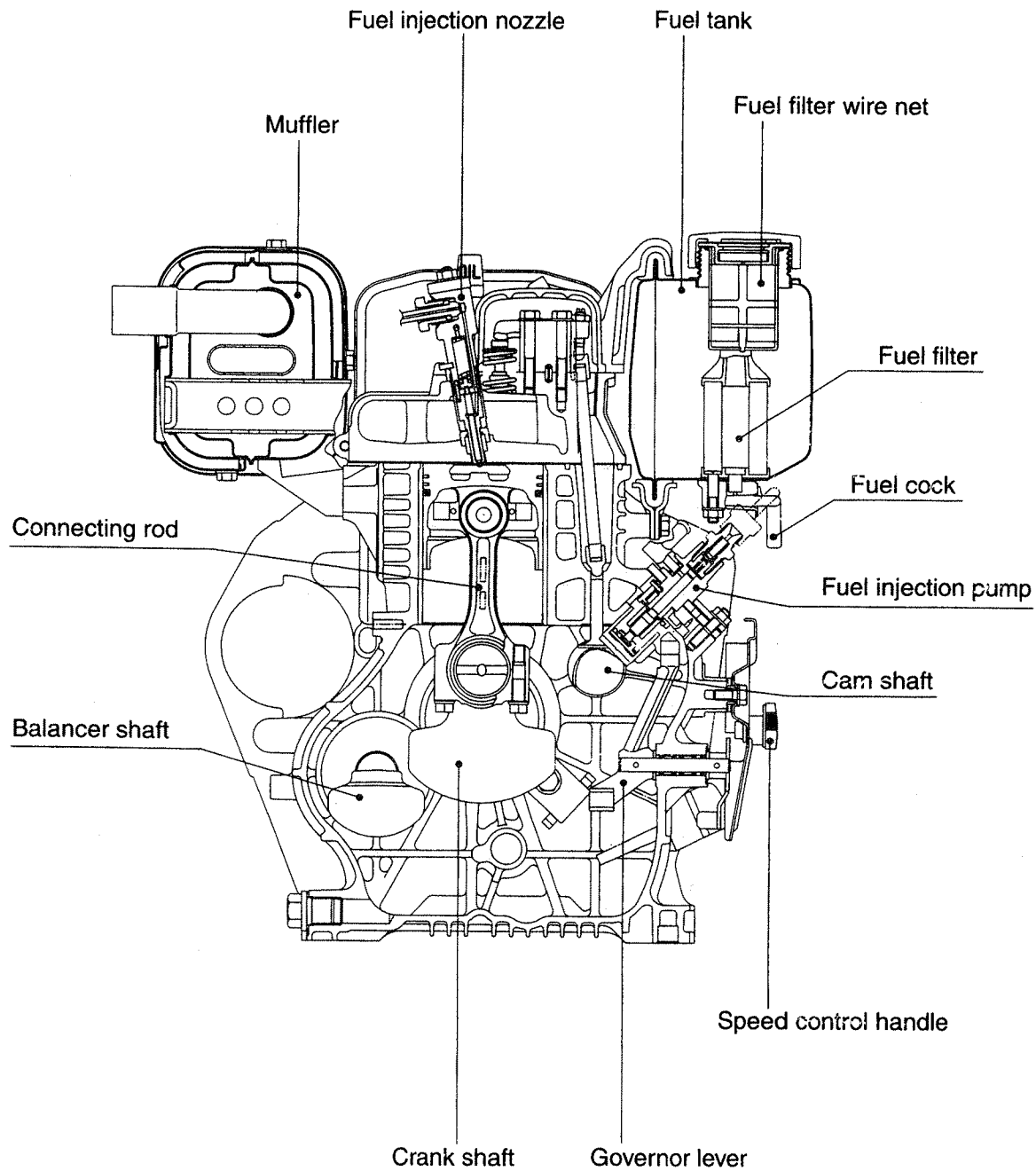
### 5.1 Cross Sectional View



[Note] This illustration shows the L48EE

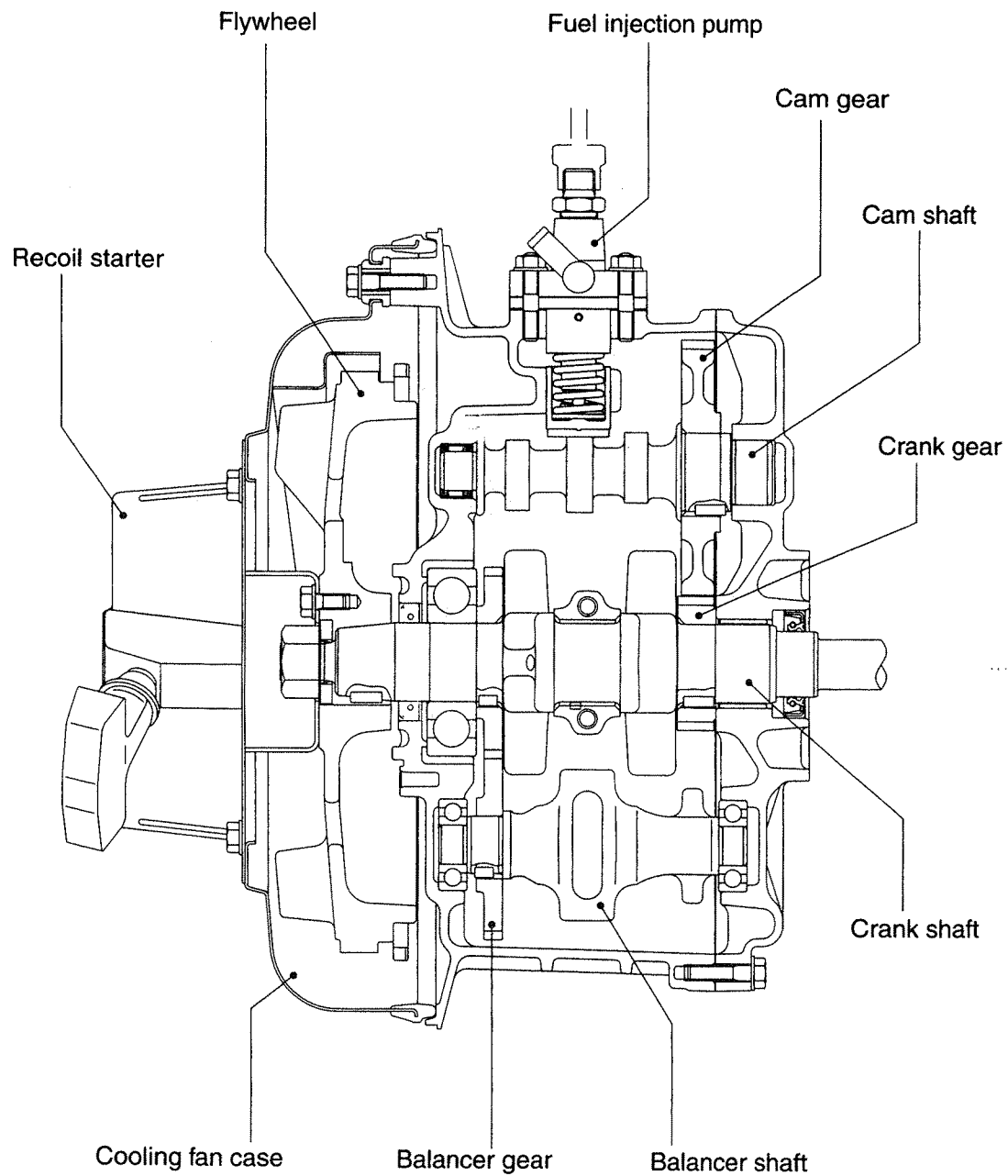


## 5.2 Longitudinal sectional view



[Note] This illustration shows the L48EE

### 5.3 Plane view



[Note] This illustration shows the L48EE

## 6. Service Standards

Parts	Model	Standard	Service limit	Remarks
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### Intake/exhaust valve seats

Seat angle	L48EE L70EE L100EE	90°	—	
Seat width	L48EE	2.55	—	
	L70EE L100EE	1.4		

### Intake/exhaust valves & valve guides

Valve sinkage		L48EE L70EE L100EE	0.4 – 0.8	1.2	
Valve guide I.D.	Intake/ Exhaust	L48EE	5.5 $\begin{smallmatrix} +0.015 \\ 0 \end{smallmatrix}$	5.58	
		L70EE	6 $\begin{smallmatrix} +0.015 \\ 0 \end{smallmatrix}$	6.08	
		L100EE	7 $\begin{smallmatrix} +0.015 \\ 0 \end{smallmatrix}$	7.08	
Valve stem O.D.	Intake	L48EE	5.5 $\begin{smallmatrix} -0.025 \\ -0.035 \end{smallmatrix}$	5.40	
		L70EE	6 $\begin{smallmatrix} -0.025 \\ -0.040 \end{smallmatrix}$	5.90	
		L100EE	7 $\begin{smallmatrix} -0.025 \\ -0.040 \end{smallmatrix}$	6.90	
	Exhaust	L48EE	5.5 $\begin{smallmatrix} -0.025 \\ -0.040 \end{smallmatrix}$	5.40	
		L70EE	6 $\begin{smallmatrix} -0.040 \\ -0.050 \end{smallmatrix}$	5.90	
		L100EE	7 $\begin{smallmatrix} -0.040 \\ -0.055 \end{smallmatrix}$	6.90	

### Valve spring

Free length	L48EE	28	26.5	
	L70EE	33	31.5	
	L100EE	40	39.5	

## 6. Service Standards

Unit : mm

Parts	Model	Standard	Service limit	Remarks
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### Valve spring

Inclination	L48EE	$< 0.75$	—	
	L70EE	$< 0.6$	—	
	L100EE	$< 1.0$	—	
Spring constant N/mm(kgf/mm)	L48EE	$12.5 \pm 1.3$ ( $1.27 \pm 0.13$ )	—	
	L70EE	$13.8 \pm 1.4$ ( $1.41 \pm 0.14$ )	—	
	L100EE	$17.6 \pm 1.8$ ( $1.79 \pm 0.18$ ) $24.6 \pm 2.5$ ( $2.51 \pm 0.25$ )	—	

### Intake / exhaust valve rocker-arm, rocker shaft and push rods

IN/EX valve rocker arm shaft O.D.	L48EE L70EE	$12 \begin{smallmatrix} 0 \\ -0.011 \end{smallmatrix}$	11.90	
	L100EE	$15 \begin{smallmatrix} 0 \\ -0.011 \end{smallmatrix}$	14.90	
IN/EX valve rocker arm I.D.	L48EE L70EE	$12 \begin{smallmatrix} +0.034 \\ +0.016 \end{smallmatrix}$	12.10	
	L100EE	$15 \begin{smallmatrix} +0.045 \\ +0.032 \end{smallmatrix}$	15.10	
Push rod length	L48EE	$130 \pm 0.2$	—	
	L70EE	$162.5 \pm 0.2$	—	
	L100EE	$197 \pm 0.2$	—	
Push rod distortion	L48EE L70EE L100EE	$< 0.05$	0.3	

### Valve clearance

Intake and exhaust	L48EE L70EE L100EE	$0.15 \pm 0.05$	—	
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Unit : mm

Parts	Model	Standard	Service limit	Remarks
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**Valve opening / closing timing**

Intake	Open	L48EE L70EE	24° bT.D.C.	—	
		L100EE	22.3° bT.D.C.	—	
	Closed	L48EE L70EE	54° aB.D.C.	—	
		L100EE	54.7° aB.D.C.	—	
Exhaust	Closed	L48EE L70EE	27° bB.D.C.	—	
		L100EE	21.7° bB.D.C.	—	
	Open	L48EE L70EE	61° aT.D.C.	—	
		L100EE	55.3° aT.D.C.	—	

**Piston**

Piston O.D.	L48EE	69.965	69.70	Refer to Page 50 for measuring position.
	L70EE	77.965	77.70	
	L100EE	85.955	85.70	
Clearance between piston and sleeve	L48EE L70EE	0.04 – 0.06	—	
	L100EE	0.05 – 0.07	—	
Piston pin hole ID	L48EE	19 $\begin{smallmatrix} -0.004 \\ -0.015 \end{smallmatrix}$	19.07	
	L70EE	21 $\begin{smallmatrix} -0.004 \\ -0.017 \end{smallmatrix}$	21.07	
	L100EE	23 $\begin{smallmatrix} -0.004 \\ -0.017 \end{smallmatrix}$	23.07	
Clearance between piston pin hole and piston pin	L48EE	L0.005 – 0.015T	—	L : Loose fit T : Tight fit
	L70EE L100EE	L0.005 – 0.017T	—	

## 6. Service Standards

Unit : mm

Parts	Model	Standard	Service limit	Remarks
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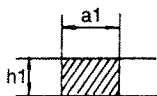
### Piston pin

Piston pin O.D.	L48EE	19 $\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	18.92	
	L70EE	21 $\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	20.91	
	L100EE	23 $\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	22.91	

### Piston and rings

1st ring side clearance (ring width and ring groove)	L48EE L70EE L100EE	0.065 – 0.095	0.15	
2nd ring side clearance (ring width and ring groove)		0.03 – 0.065	0.15	
Oil ring side clearance (ring width and ring groove)		0.02 – 0.055	0.15	

### Piston ring

1st ring	a1 dimensions	L48EE	3.1 ± 0.1	2.77	
		L70EE	3.3 ± 0.1	2.97	
		L100EE	3.7 ± 0.1	3.37	
	h1 dimensions	L48EE L70EE	1.5 $\begin{smallmatrix} -0.015 \\ -0.030 \end{smallmatrix}$	1.36	
		L100EE	2 $\begin{smallmatrix} -0.015 \\ -0.030 \end{smallmatrix}$	1.86	
2nd ring	a1 dimensions	L48EE	3.1 ± 0.1	2.77	
		L70EE	3.3 ± 0.1	2.97	
		L100EE	3.7 ± 0.1	3.37	
	h1 dimensions	L48EE L70EE	1.5 $\begin{smallmatrix} -0.01 \\ -0.03 \end{smallmatrix}$	1.36	
		L100EE	2 $\begin{smallmatrix} -0.01 \\ -0.03 \end{smallmatrix}$	1.86	

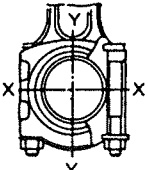
Unit : mm

Parts	Model	Standard	Service limit	Remarks
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**Piston ring**

Oil ring	a1 dimensions	L48EE	$2.2 \pm 0.15$	1.9	
		L70EE	$2.3 \pm 0.15$	2.0	
		L100EE	$2.7 \pm 0.15$	2.4	
	h1 dimensions	L48EE L70EE	$3.5 \begin{smallmatrix} -0.01 \\ -0.03 \end{smallmatrix}$	3.36	
		L100EE	$4 \begin{smallmatrix} -0.01 \\ -0.03 \end{smallmatrix}$	3.86	
End gap	1st ring	L48EE L70EE L100EE	$0.2 - 0.35$	1.0	
	2nd ring		$0.3 - 0.45$	1.0	
	Oil ring		$0.15 - 0.35$	1.0	

**Connecting rod**

Small end hole (piston pin)	ID	L48EE	$19 \begin{smallmatrix} +0.038 \\ +0.025 \end{smallmatrix}$	19.10	
		L70EE	$21 \begin{smallmatrix} +0.038 \\ +0.025 \end{smallmatrix}$	21.10	
		L100EE	$23 \begin{smallmatrix} +0.038 \\ +0.025 \end{smallmatrix}$	23.10	
	Oil clearance	L48EE	$0.021 - 0.053$	—	
		L70EE	$0.021 - 0.055$	—	
		L100EE	$0.021 - 0.055$	—	
Large end hole (Crank pin)	ID (Y-Y direction)	L48EE	$30 \begin{smallmatrix} +0.018 \\ -0.014 \end{smallmatrix}$	30.09	
		L70EE	$36 \begin{smallmatrix} +0.018 \\ -0.014 \end{smallmatrix}$	36.09	
		L100EE	$40 \begin{smallmatrix} +0.042 \\ 0 \end{smallmatrix}$	40.08	
	Oil clearance	L48EE L70EE	$0.004 - 0.053$	—	
		L100EE	$0.018 - 0.077$	—	

Unit : mm

Parts	Model	Standard	Service limit	Remarks
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**Crankshaft and Main bearing**

Crank pin		Pin O.D.	L48EE	$30 \begin{smallmatrix} -0.018 \\ -0.035 \end{smallmatrix}$	29.90	
			L70EE	$36 \begin{smallmatrix} -0.018 \\ -0.035 \end{smallmatrix}$	35.90	
			L100EE	$40 \begin{smallmatrix} -0.018 \\ -0.035 \end{smallmatrix}$	39.90	
		Oil clearance	L48EE L70EE	0.004 – 0.053	—	
			L100EE	0.018 – 0.077		
Crank journal part	Gear cover side	Journal O.D.	L48EE	$30 \begin{smallmatrix} +0.015 \\ +0.002 \end{smallmatrix}$	29.91	
			L70EE	$35 \begin{smallmatrix} +0.018 \\ +0.007 \end{smallmatrix}$	34.91	
			L100EE	$40 \begin{smallmatrix} +0.018 \\ +0.007 \end{smallmatrix}$	39.91	
		Oil clearance	L48EE L70EE	0.025 – 0.058	0.17	
	L100EE		0.025 – 0.056			
	Flywheel side	Journal O.D.	L48EE	$30 \begin{smallmatrix} +0.015 \\ +0.002 \end{smallmatrix}$	—	
			L70EE	$35 \begin{smallmatrix} +0.018 \\ +0.007 \end{smallmatrix}$	—	
			L100EE	$40 \begin{smallmatrix} +0.018 \\ +0.007 \end{smallmatrix}$	—	
Journal part	Flywheel side	Bearing I.D.	L48EE	$30 \begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$	—	
			L70EE	$35 \begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$	—	
			L100EE	$40 \begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$	—	
		Fitting	L48EE	0.002 – 0.025	—	Tight fit
			L70EE	0.007 – 0.030	—	
			L100EE			



Parts	Model	Standard	Service limit	Remarks
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**Camshaft**

Needle bearing on cylinder block side	Shaft O.D.	L48EE L70EE L100EE	$15 \begin{smallmatrix} 0 \\ -0.011 \end{smallmatrix}$	14.92	
	Bearing I.D.		$15 \begin{smallmatrix} +0.034 \\ +0.016 \end{smallmatrix}$	—	
	Oil clearance		0.016 – 0.045	—	
Bearing on crankcase cover side		L48EE	$25 \begin{smallmatrix} -0.007 \\ -0.020 \end{smallmatrix}$	24.90	
	Stem O.D.	L70EE	$30 \begin{smallmatrix} -0.007 \\ -0.020 \end{smallmatrix}$	29.90	
		L100EE	$35 \begin{smallmatrix} -0.007 \\ -0.020 \end{smallmatrix}$	34.90	
Bearing on crankcase cover side	Bearing I.D.	L48EE	$25 \begin{smallmatrix} +0.041 \\ +0.020 \end{smallmatrix}$	—	
		L70EE	$30 \begin{smallmatrix} +0.041 \\ +0.020 \end{smallmatrix}$	—	
		L100EE	$35 \begin{smallmatrix} +0.041 \\ +0.020 \end{smallmatrix}$	—	
	Oil clearance	L48EE	0.027 – 0.061	—	
		L70EE			
		100EE			
Thrust clearance (Gap of axial direction)		L48EE L70EE L100EE	0.040 – 0.280	0.45	

**Tappet**

Tappets for IN/EX.valves	Stem O.D.	L48EE L70EE L100EE	$7 \begin{smallmatrix} -0.020 \\ -0.040 \end{smallmatrix}$	6.87	
	Hole dia. (Cylinder block)		$7 \begin{smallmatrix} +0.015 \\ 0 \end{smallmatrix}$	7.06	
	Oil clearance		0.020 – 0.055	—	
Tappets for fuel injection pump	O.D.	L48EE L70EE L100EE	$24 \begin{smallmatrix} -0.007 \\ -0.028 \end{smallmatrix}$	23.89	
	Hole dia. (Cylinder block)		$24 \begin{smallmatrix} +0.033 \\ 0 \end{smallmatrix}$	24.06	
	Oil clearance		0.007 – 0.061	—	

Unit : mm

Parts	Model	Standard	Service limit	Remarks
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**Crankcase cover**

Crankshaft bearing part	I.D.	L48EE	$34 \begin{smallmatrix} +0.025 \\ 0 \end{smallmatrix}$	—	
		L70EE	$39 \begin{smallmatrix} +0.025 \\ 0 \end{smallmatrix}$	—	
		L100EE	$44 \begin{smallmatrix} +0.025 \\ 0 \end{smallmatrix}$	—	
	Bearing O.D. (Plain)	L48EE	$34 \begin{smallmatrix} +0.105 \\ +0.070 \end{smallmatrix}$	—	
		L70EE	$39 \begin{smallmatrix} +0.105 \\ +0.070 \end{smallmatrix}$	—	
		L100EE	$44 \begin{smallmatrix} +0.120 \\ +0.085 \end{smallmatrix}$	—	
	Fitting	L48EE L70EE	0.045 – 0.105	—	Tight fit
		L100EE	0.060 – 0.120	—	
	Bearing metal I.D. (Plain metal)	L48EE	$30 \begin{smallmatrix} +0.060 \\ +0.040 \end{smallmatrix}$	30.13	
		L70EE	$35 \begin{smallmatrix} +0.063 \\ +0.043 \end{smallmatrix}$	35.13	
		L100EE	$40 \begin{smallmatrix} +0.063 \\ +0.043 \end{smallmatrix}$	40.13	
Camshaft bearing part	I.D.	L48EE	$52 \begin{smallmatrix} -0.035 \\ -0.055 \end{smallmatrix}$	—	
		L70EE	$62 \begin{smallmatrix} -0.040 \\ -0.060 \end{smallmatrix}$	—	
		L100EE	$72 \begin{smallmatrix} -0.045 \\ -0.065 \end{smallmatrix}$	—	
	Ball bearing O.D.	L48EE	$52 \begin{smallmatrix} 0 \\ -0.013 \end{smallmatrix}$	—	Tight fit
		L70EE	$62 \begin{smallmatrix} 0 \\ -0.013 \end{smallmatrix}$	—	
		L100EE	$72 \begin{smallmatrix} 0 \\ -0.013 \end{smallmatrix}$	—	
	Fitting	L48EE	0.022 – 0.055	—	
		L70EE	0.027 – 0.060	—	
		L100EE	0.032 – 0.065	—	

## 6. Service Standards

Unit : mm

Parts	Model	Standard	Service limit	Remarks
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**Cylinder block**

Crankshaft bearing part	I.D.	L48EE	$72 \pm 0.0095$	—	
		L70EE	$80 \begin{smallmatrix} -0.004 \\ -0.020 \end{smallmatrix}$	—	
		L100EE	$90 \begin{smallmatrix} 0 \\ -0.016 \end{smallmatrix}$	—	
	Ball bearing O.D.	L48EE	$72 \begin{smallmatrix} 0 \\ -0.013 \end{smallmatrix}$	—	
		L70EE	$80 \begin{smallmatrix} 0 \\ -0.013 \end{smallmatrix}$	—	
		L100EE	$90 \begin{smallmatrix} 0 \\ -0.015 \end{smallmatrix}$	—	
	Fitting	L48EE	$0.0225 - 0.0095$	—	
		L70EE	$0.009 - 0.020$	—	
		L100EE	$0.015 - 0.016$	—	
Camshaft bearing part	I.D.	L48EE L70EE L100EE	$21 \begin{smallmatrix} -0.022 \\ -0.043 \end{smallmatrix}$	—	
Cylinder sleeve I.D.		L48EE	$70 \begin{smallmatrix} +0.030 \\ 0 \end{smallmatrix}$	70.16	
		L70EE	$78 \begin{smallmatrix} +0.030 \\ 0 \end{smallmatrix}$	78.18	
		L100EE	$86 \begin{smallmatrix} +0.030 \\ 0 \end{smallmatrix}$	86.18	

Unit : mm

Parts	Model	Standard	Service limit	Remarks
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**Oil pump (Trochoid pump)**

Outer	Outer rotor O.D.	L48EE L70EE L100EE	29 $\begin{smallmatrix} -0.02 \\ -0.04 \end{smallmatrix}$	28.90	
	Housing I.D. (Crankcase Cover)		29 $\begin{smallmatrix} +0.121 \\ +0.100 \end{smallmatrix}$	29.18	
	Clearance between housing ID and outer rotor O.D.		0.120 – 0.161	—	
Width	Outer and Inner rotor width	L48EE L70EE L100EE	8 $\begin{smallmatrix} 0 \\ -0.03 \end{smallmatrix}$	7.90	
	Housing depth		8 $\begin{smallmatrix} +0.05 \\ +0.02 \end{smallmatrix}$	8.10	
	Clearance between housing and inner/ outer rotors		0.02 – 0.08	—	
Clearance between the inner and outer rotor		L48EE L70EE L100EE	< 0.14	0.25	
Cylinder compression pressure at 500 rpm engine speed (turn the starter motor)			2942kPa (30kgf/cm <sup>2</sup> )	2452kPa (25kgf/cm <sup>2</sup> )	
Cylinder compression pressure at 500 rpm engine speed (pull the recoil starter)			2452kPa (25kgf/cm <sup>2</sup> )	1961 kPa (20kgf/cm <sup>2</sup> )	

## 7. TIGHTENING TORQUES

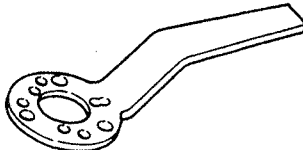
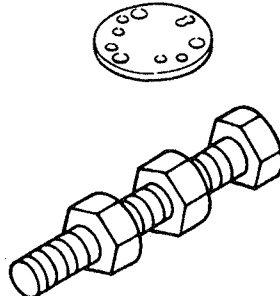
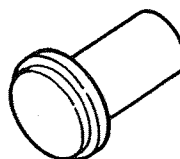
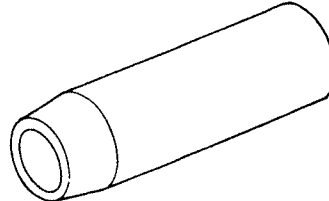

Standard bolts and nuts tightening torque:  
M6 785-980 N·cm (80-100kgf·cm)  
M8 2550-2746 N·cm (260-280kgf·cm)

Where specified torque be applied	Model	Thread No. dia. × pitch	Tightening torque N·cm (kg·cm)	Remarks
Valve rocker arm support	L48EE-L70EE	M8×1.25	1960 – 2256 (200 – 230)	Hexagonal dimension:12
	L100EE	M10×1.5	4217 – 4609 (430 – 470)	Hexagonal dimension:14
Flywheel end nuts*	L48EE-L70EE	M16×1.5	11770 – 12750 (1200 – 1300)	Hexagonal dimension:24
	L100EE	M18×1.5	21570 – 22560 (2200 – 2300)	
Crankcase cover bolts	L48EE	14-M6×1.0	980 – 1177 (100 – 120)	Hexagonal dimension:10
	L70EE-L100EE	13-M8×1.25	1960 – 2256 (200 – 230)	Hexagonal dimension:12
Stiffener bolts on crankcase cover	L48EE, L70EE, L100EE	M8×1.25	1960 – 2256 (200 – 230)	
Head stud bolts (stud side)*	L48EE	4-M8×1.25	1275 – 1471 (130 – 150)	Apply "thread locking agent "
	L70EE	4-M9×1.25		
	L100EE	4-M10×1.5		
Cylinder head nuts*	L48EE	4-M8×1.25	2476 – 3138 (280 – 320)	Apply oil to the face of the threaded part. Hexagonal dimension:12
	L70EE	4-M9×1.25	4119 – 4511 (420 – 460)	Hexagonal dimension:14
	L100EE	4-M10×1.5	5296 – 5688 (540 – 580)	Hexagonal dimension:17
FO nozzle case nut	L48EE L70EE L100EE	1-0.605-40UNS-2B	3923 – 4413 (400 – 450)	Hexagonal dimension:15
FO pump delivery holder		M14×15	2942 – 3432 (300 – 350)	Hexagonal dimension:17
FO pump stud bolts (stud side) *		3-M6×1.0	686 – 980 (70 – 100)	Apply "thread locking agent"
FO pump nuts		3-M6×1.0	980 – 1177 (100 – 120)	980-1177 (100-120)
FO nozzle bolts (stud side) *		2-M6×1.0	686 – 980 (70 – 100)	Apply "thread locking agent "
FO injection nozzle nuts		2-M6×1.0	980 – 1177 (100 – 120)	Hexagonal dimension:10
Connecting rod bolts & nuts*	L48EE-L70EE	2-M7×1.0	2256 – 2746 (230 – 280)	Apply oil to the face of the threaded part. Hexagonal dimension:10
	L100EE	2-M8×1.0	3677 – 4168 (375 – 425)	Hexagonal dimension:13

## Notes:

1. For bolts and nuts marked\*, apply engine oil to the thread and seat.
2. For bolts and nuts marked•, apply thread locking agent to the thread before threading them.

# 9. Tools, Meters and Instruments.


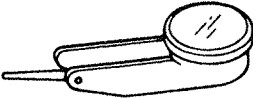




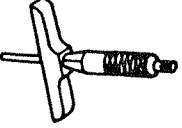
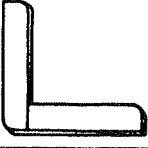
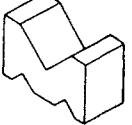
Name of tool	Description (YANMAR Code No.)	Illustration																				
Flywheel end nut wrench*	Special-purpose tool for tightening the crankshaft end nut. (114250-92101)																					
Flywheel extractor*	(114250-92121) <table><tr><th>Model</th><th>Bolt</th><th>pcs</th><th>Nut</th><th>pcs</th></tr><tr><td>L48EE</td><td>26116-060454</td><td>3</td><td>26716-060002</td><td>6</td></tr><tr><td>L70EE</td><td>"</td><td>4</td><td>"</td><td>8</td></tr><tr><td>L100EE</td><td>"</td><td>4</td><td>"</td><td>8</td></tr></table>	Model	Bolt	pcs	Nut	pcs	L48EE	26116-060454	3	26716-060002	6	L70EE	"	4	"	8	L100EE	"	4	"	8	
Model	Bolt	pcs	Nut	pcs																		
L48EE	26116-060454	3	26716-060002	6																		
L70EE	"	4	"	8																		
L100EE	"	4	"	8																		
Oil seal fitting tool*	<table><tr><th></th><th colspan="2">Applicable part</th></tr><tr><th>Code</th><th>Cylinder block (Crankshaft)</th><th>Sidecover (Crank &amp; Cam shaft)</th></tr><tr><td>114250-92311</td><td>—</td><td>L48EE</td></tr><tr><td>114350-92311</td><td>L48EE,L70EE</td><td>L70EE</td></tr><tr><td>114650-92310</td><td colspan="2">L100EE</td></tr></table>		Applicable part		Code	Cylinder block (Crankshaft)	Sidecover (Crank & Cam shaft)	114250-92311	—	L48EE	114350-92311	L48EE,L70EE	L70EE	114650-92310	L100EE							
	Applicable part																					
Code	Cylinder block (Crankshaft)	Sidecover (Crank & Cam shaft)																				
114250-92311	—	L48EE																				
114350-92311	L48EE,L70EE	L70EE																				
114650-92310	L100EE																					
Oil seal fitting guide*	After insertion of seal into crankcase cover, use this tool to install crankcase cover on cylinder block.  Jig for inserting crankshaft and camshaft oil seals <table><tr><th>Code</th><th>Applicable Model</th></tr><tr><td>114250-92301</td><td>L48EE</td></tr><tr><td>114268-92300</td><td>L48EE</td></tr><tr><td>114368-92300</td><td>L70EE</td></tr><tr><td>114668-92300</td><td>L100EE</td></tr></table>	Code	Applicable Model	114250-92301	L48EE	114268-92300	L48EE	114368-92300	L70EE	114668-92300	L100EE											
Code	Applicable Model																					
114250-92301	L48EE																					
114268-92300	L48EE																					
114368-92300	L70EE																					
114668-92300	L100EE																					
Valve stem seal fitting tool*	<table><tr><th>Model</th><th>Code</th></tr><tr><td>L48EE</td><td>114250-92350</td></tr><tr><td>L70EE</td><td>114350-92350</td></tr><tr><td>L100EE</td><td>114650-92350</td></tr></table>	Model	Code	L48EE	114250-92350	L70EE	114350-92350	L100EE	114650-92350													
Model	Code																					
L48EE	114250-92350																					
L70EE	114350-92350																					
L100EE	114650-92350																					

\* Dimensions of oil seal fitting tool, oil seal fitting guide, flywheel tightening handle, flywheel extractor and valve stem seal fitting tool are detailed in Appendix2.

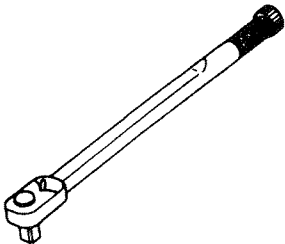

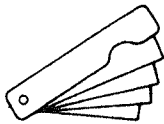
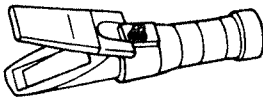
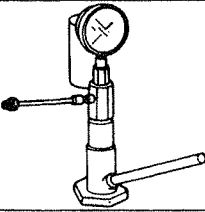
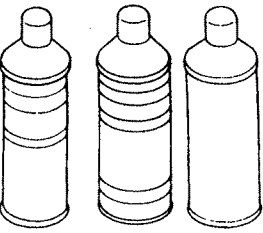
**9.2 Meters, Instruments and service Accessories.**

(Necessary for middle- and small-size engine service shops)

—Typical sizes—

Instrument Name	Description		Illustration
Dial gauge	mm 1 div. 0.01 Range 0-5 0-10	To measure bending and gap of the shaft, surface distortion, etc.	
Test indicator	mm 1 div. 0.01 Range 0-0.8	To measure positions too narrow and too deep for normal dial indicators.	
Magnet stand	mm Main bar (dia. X length) 12X176 Sub bar (dia. X length) 10X165 14X183 12X165	To attach dial indicators to various positions for easy accurate viewing.	
Micrometer	Range mm 0-25 25-50 50-75 75-100	To measure the O.D. of the crankshaft, piston, piston pin, etc.	
Cylinder gauge	Range mm 10-18 18-35 35-60 50-100	To measure the I.D. of the cylinder liners and bearings.	
Vernier calipers	mm 1 div. 0.05 Range 0-150	To measure outside diameter, depth, thickness, width, etc.	
Depth micrometer	mm Range 0-25	To measure valve sinkage and liner projection.	
Square	mm Size 100	To measure the inclination of valve springs and squareness of various parts.	
V-block	mm Size 100X50X55	Use when measuring the bending of a shaft.	

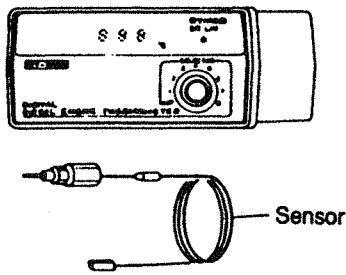
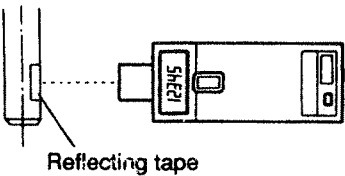
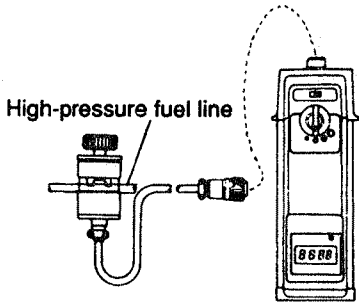
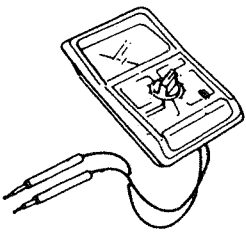
# 9. Tools, Meters and Instruments.

Instrument Name (Yanmar code No.)	Description		Illustration								
Torque wrench	<table><tr><th>Size mm</th><th>Range N·cm (kgf·cm)</th></tr><tr><td rowspan="2">6 – 14</td><td>392 – 2942 (40 – 300) 2942 – 7845 (300 – 800)</td></tr><tr><td>15 17 19 21</td></tr><tr><td></td><td>2942 – 15691 (300 – 1,600)</td></tr></table>	Size mm	Range N·cm (kgf·cm)	6 – 14	392 – 2942 (40 – 300) 2942 – 7845 (300 – 800)	15 17 19 21		2942 – 15691 (300 – 1,600)	Use when tightening bolts and nuts with specified torques.		
Size mm	Range N·cm (kgf·cm)										
6 – 14	392 – 2942 (40 – 300) 2942 – 7845 (300 – 800)										
	15 17 19 21										
	2942 – 15691 (300 – 1,600)										
Plastigage	To measure oil clearance between crankpin and main bearing. <table><tr><th>Type</th><th>Applicable clearance mm</th></tr><tr><td>RG-1 (Green)</td><td>0.025-0.076</td></tr><tr><td>PR-1 (Red)</td><td>0.051-0.152</td></tr><tr><td>PB-1 (Gray)</td><td>0.102-0.229</td></tr></table>		Type	Applicable clearance mm	RG-1 (Green)	0.025-0.076	PR-1 (Red)	0.051-0.152	PB-1 (Gray)	0.102-0.229	
Type	Applicable clearance mm										
RG-1 (Green)	0.025-0.076										
PR-1 (Red)	0.051-0.152										
PB-1 (Gray)	0.102-0.229										
Thickness gauge	To measure clearances between piston rings and piston grooves or between shaft couplings during installation.										
Battery electrolyte tester (955000-00013)	To inspect antifreeze solution and electrolyte for specific gravity, and charging condition.										
Nozzle tester (737600-93502)	Pressure gauge : 0- 49.0 MPa (0-500 kgf/cm²)	To inspect spray condition and the injection pressure of the fuel injection valve.									
High pressure pipe (124233-93400)											
Color check (for flaw detection)	<div>cm³</div> <table><tr><td>Penetrant (97550-00451)</td><td>450</td></tr><tr><td>Developer (97550-004520)</td><td>450</td></tr><tr><td>Cleaning agent (97550-004530)</td><td>450</td></tr></table>		Penetrant (97550-00451)	450	Developer (97550-004520)	450	Cleaning agent (97550-004530)	450	Use in detecting flaws.		
Penetrant (97550-00451)	450										
Developer (97550-004520)	450										
Cleaning agent (97550-004530)	450										
Set product (6 bottles) (975500-004560)											



### 9.3 Instruments

(Select the appropriate thermometer and tachometer from among the following types.)

Instrument Name (Yanmar code No.)		Description	Illustration
Thermometer	Digital type Model: BT-800 (955000 - 08000)	Instantaneously measures temperature in each cylinder using a select switch.	
	Sensor (955000 - 08640)	CA64	
Tachometer	Photoelectric type (non-contacting) Model HT-441 (95500H-T4410)	Reflecting tape is applied to the outside of the rotating parts to measure RPMs. Capable of measuring RPM of reduction gears, step-up gears, and pulleys.	
	Reflecting Tape (10 pieces) (955000-01041)		
	High-pressure fuel pipe clamping type Model : GE-450 (955000-01045)	Measures engine RPMs using pulse system.	
Circuit tester		To measure resistance, DC voltage, AC voltage, DC current, and for continuity testing.	

# 10. Disassembly and Reassembly

## 10.1 Engine

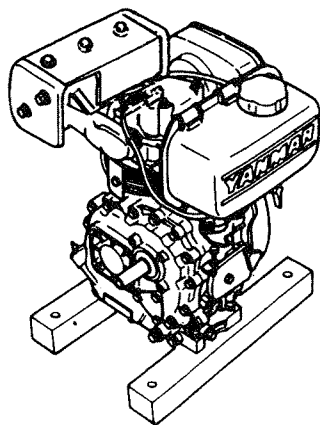
### 10.1.1 Disassembly procedures

#### Basic procedures

- Gather the required tools, jigs and meters.
- Have a notebook, etc. ready for recording service information.
- Fill containers with cleaning solution for cleaning parts.
- Prepare a special place for parts and containers.
- Drain old lubricating oil from engine.
- Arrange disassembled parts.
- Keep all bolts and nuts with their relative parts to make sure they are not reassembled incorrectly.
- Determine exactly what the problem is before disassembly. Never remove unnecessary parts.

#### (1) Fuel tank

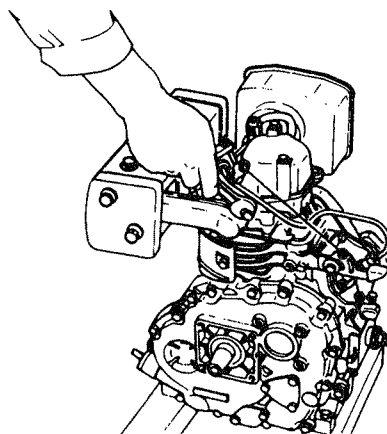
- 1) Pull the overflow pipe out toward the tank.
- 2) Release the hose clamp on the pump side of the fuel pipe.
- 3) Remove the fuel tank stay (upper part).
- 4) Remove the fuel tank. (Pull the oil pipe on the pump side up and out.)
  - Release the hose clamp on the pump side.



Removing the fuel tank

#### (2) Exhaust silencer

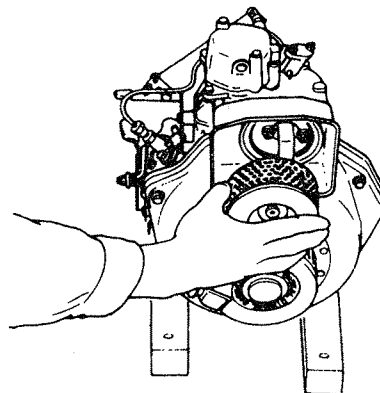
- 1) Remove the flange nuts.
- 2) Remove the stay bolt.



Removing the exhaust silencer

#### (3) Air cleaner

- 1) Remove the air cleaner cover.
- 2) Pull out the filter element.
- 3) Remove the cleaner case.



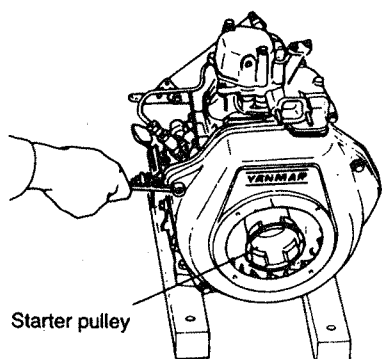
Removing the air cleaner

#### (4) Recoil starter

The recoil starter does not have to be removed every time. Remove only when necessary.

#### (5) Cooling fan case

Remove the cooling fan case.



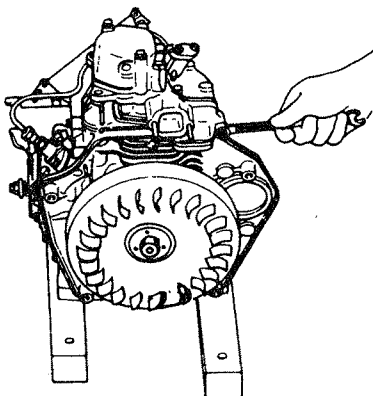
**Removing the cooling fan case**

**(6) Starter pulley**

Remove the starter pulley.

**(7) Air intake bend**

Remove the air intake bend.



**Removing the air intake bend**

**(8) Starting motor**

(Only for starter motor specification.)

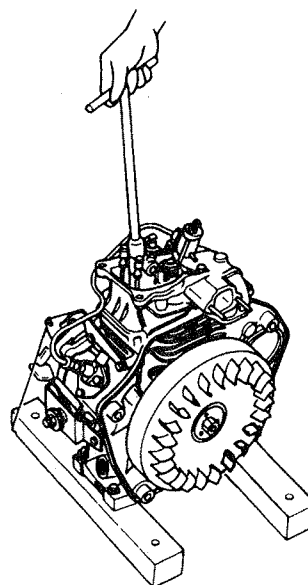
Remove the starting motor.

**(9) Valve rocker arm cover**

Remove the valve rocker arm cover.

**(10) Valve rocker arm assembly**

Remove the valve rocker arm assembly.



**Removing the valve rocker arm assembly**

**(11) Push rods**

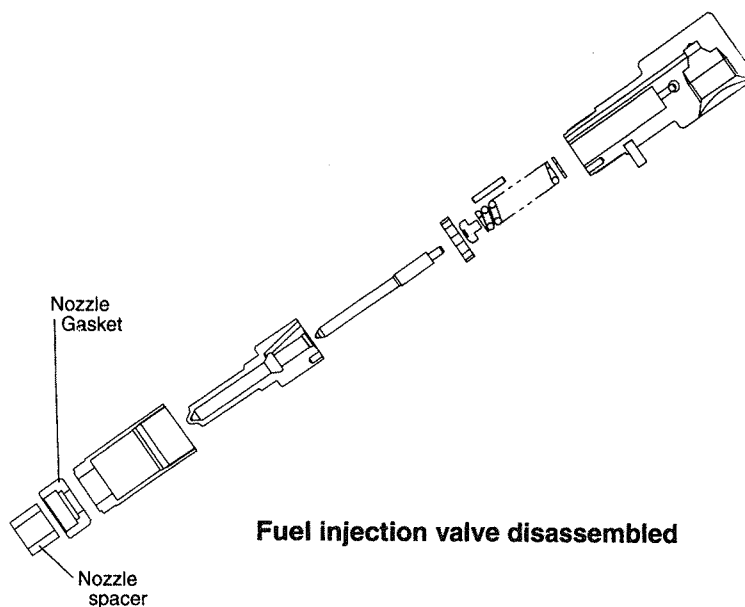
Pull out the push rods.

**(12) Fuel injection valve**

1) Remove the fuel injection pipe.

2) Remove the fuel injection valve.

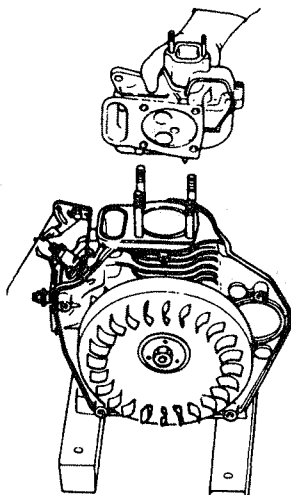
- If the valve is tight, reinsert fuel lime and pry up on pipe nut.
- Be carefully not to damage the nozzle gasket (insulator) and nozzle spacer.



**Fuel injection valve disassembled**

### (13) Cylinder head

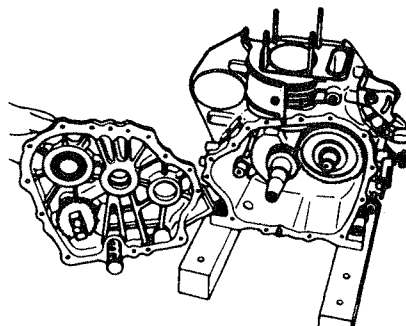
- 1) Remove the cylinder head
  - Keep the combustion surface faced up.



Removing the cylinder head

### (15) Crankcase cover

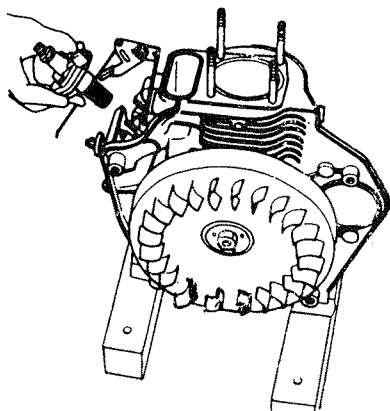
- 1) Remove the oil pump cover.
- 2) Remove the oil filter cover.
- 3) Remove the crankcase cover.
  - Step 1) and 2) should only be done when necessary.
  - Be carefully not to damage the oil seal.



Removing the crankcase cover

### (14) Fuel injection pump

- 1) Remove the fuel injection pump.
  - Remove the pump together with the base plate.
  - Make sure to unhook the control lever in rack before disassembly.
  - Pull out any remaining flat tappet.



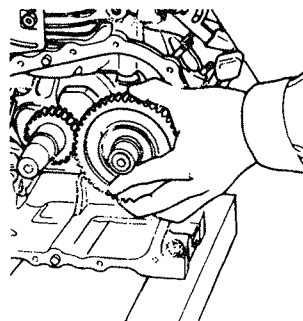
Removing the fuel pump

### (16) Camshaft

Pull out the camshaft

- Check the timing mark.
- Keep exhaust and intake tappets separate.

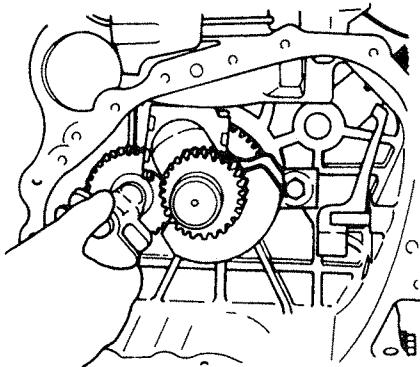
They may fall down when pulling out the camshaft and may be confused.



Removing the camshaft

### (17) Balancer shaft

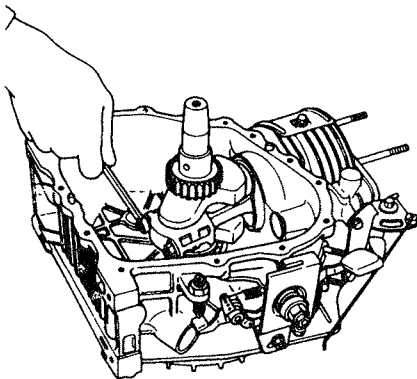
Pull out the balancer shaft.



Removing the balancer shaft

### (18) Piston and connecting rod assembly

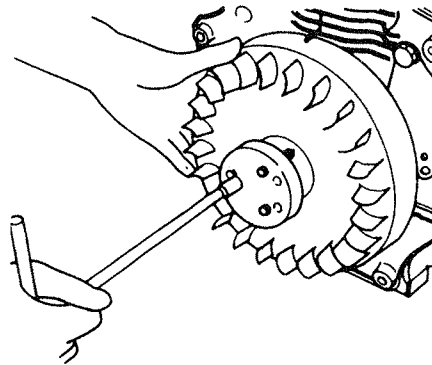
- 1) Remove the connecting rod tightening bolts.
- 2) Remove the big end cap.
- 3) Move the crankshaft to the top of the stroke and pull out the piston.
  - Remove carbon deposited on the upper inside surface of the sleeve (when extracting the piston).
  - Make sure the main bearing is in the proper position.



Removing the rod bolts.

### (19) Flywheel

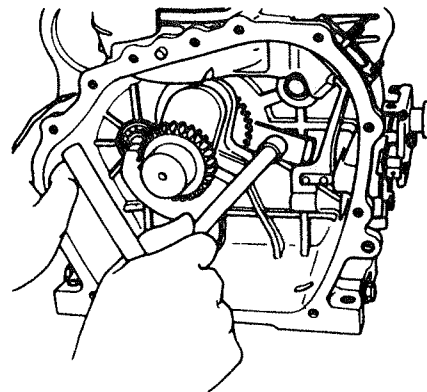
- 1) Loosen the lock nut.
- 2) Remove the flywheel.
  - Use flywheel extractor (special tool).
  - Securely thread in the extractor bolts.



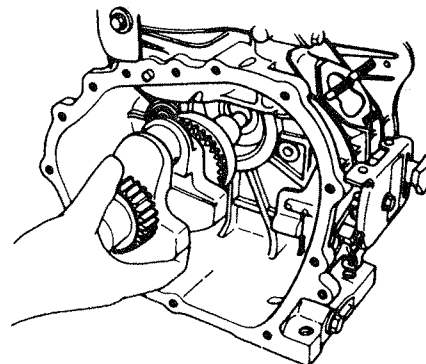
Removing the flywheel

### (20) Crankshaft

- 1) Remove the flywheel key.
- 2) Remove the bearing holder.
- 3) Pull out the crankshaft.
  - Be carefully not to damage the oil seal.



Removing the bearing holder



Pulling out the crankshaft

### (21) Governor or speed control device

Remove the governor or speed control device if necessary.

- Damage or scratches on the governor lever shaft can cause hunting and other troubles. Be sure to check the position to retain the regulator spring before removal.

## 10.1.2 Reassembly procedures

### Before reassembly

- Thoroughly clean and check all parts.
- Apply new engine oil to the sliding and rotating parts.
- Use new packing and O rings.
- Use liquid packing (3 Bond) agents to prevent oil leakage.
- Make sure the clearance between parts (for oil, thrust, etc.) is correct.
- When reassembling, line up matching marks on parts.
- Use the proper bolts, nuts, and washer.  
Tighten the major bolts and nuts to the specified torque. (Be especially careful with aluminum alloy parts. These are easily damaged.)
- Apply engine oil to threaded parts and flange faces, before tightening the major bolts to the specified torque.

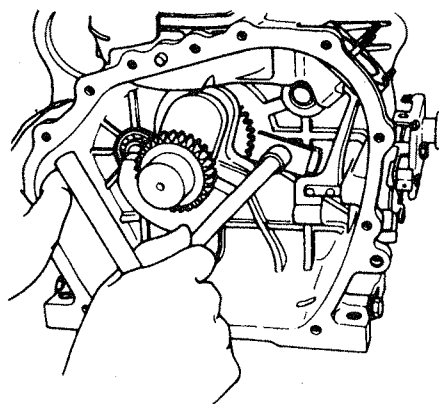
### (1) Governor or speed control device

Reassemble the governor or speed control device, if it has been removed.

### (2) Crankshaft

- 1) Insert the crankshaft.
- 2) Attach the key (flywheel) to the crankshaft.
- 3) Install the bearing holder.
  - Make sure that the crankshaft has been inserted as far as it will go.
  - Grease the oil seal lips.
  - Apply oil to the crankshaft journal and pin.

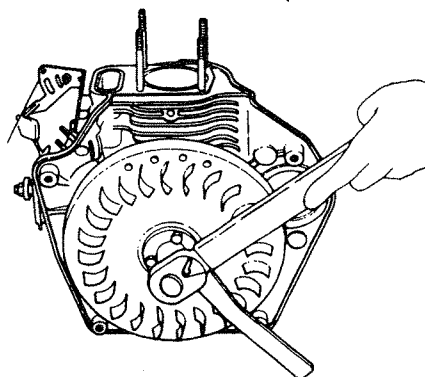
- Damage or scratches on the governor lever shaft can cause hunting and other troubles. Be sure to check the position to retain the regulator spring before removal.



Installing the bearing holder

### (3) Flywheel

Tighten the flywheel with the retaining tool.  
(114250-92101)



Tightening the flywheel

Flywheel Tightening Torque		N-cm (kgf-cm)
L48EE	13729-14710	(1400-1500)
L70EE	15691-16671	(1600-1700)
L100EE	21570-22560	(2200-2300)

### (4) Piston and connecting rod

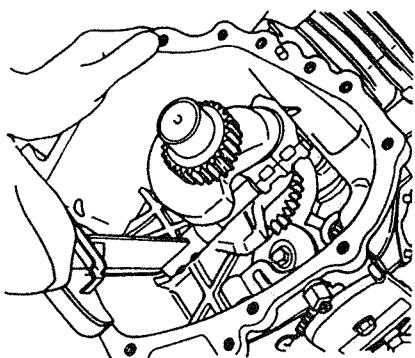
- 1) Insert the piston and connecting rod assembly, move the crankshaft to Top Dead Center. The mark on the piston head should face the crankcase cover side.

2) Install the big end cap.

- Apply oil to the crank pin.
- Install the rings in the proper direction.
- Apply oil to the outer surface of the piston and the inner surface of the sleeve.
- Make sure the main bearing is in the proper position.
- Check whether the rod bolts retainer is in position.

**Connecting Rod Tightening Torque** N-cm (kgf-cm)

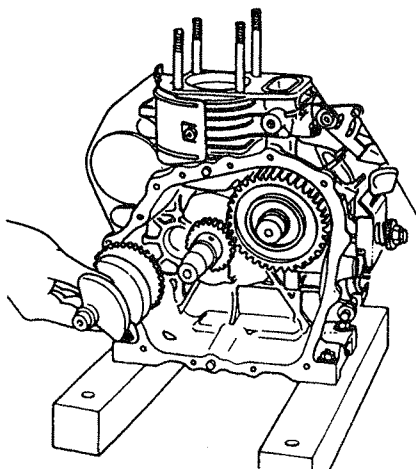
L48EE-L70EE	2256-2746 (230-280)
L100EE	3993-4217 (400-430)



**Installing the connecting rod big-end cap**

**(5) Camshaft, Balancer shaft**

- 1) Insert the tappets.
- 2) Insert the camshaft.
- 3) Insert the balancer shaft.



**Inserting the balancer shaft**

- Do not confuse exhaust and intake tappets.
- Make sure the gears' matching marks are lined up.

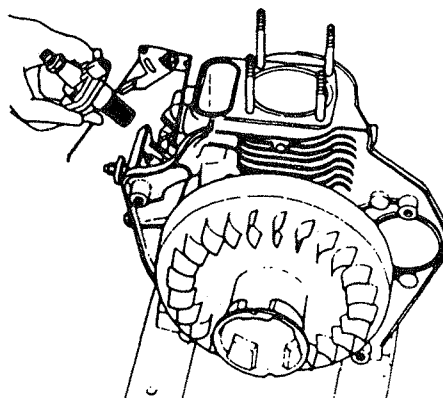
**(6) Fuel injection pump reassembly**

**(Temporarily fix in proper position)**

Line up the injection volume marks (marking-off) and attach the control lever to the governor lever fork.

Reassemble the fuel injection pump with a nut, for positioning purposes only.

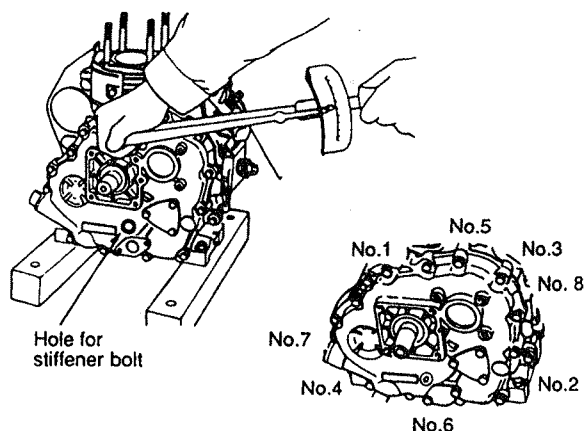
- Make sure the adjusting shims are used correctly.



**Installing the fuel injection pump**

**(7) Crankcase cover**

- 1) Place an aluminum packing between the surface of the crankcase and the crankcase cover.
- 2) Reassemble the crankcase cover.  
(Tighten bolts in the sequence shown in the below figure. Tighten bolts diagonally)
  - To protect the oil seal, attach the jig for inserting the oil seal to the shaft prior to insertion.
  - Apply grease to the lips of the oil seal.
  - Apply oil to the crank and camshaft.
  - Make sure that the oil pump drive gears are properly engaged.



**Attaching the crankcase cover and tightening follow the order.**

**Case Cover Tightening Torque** N-cm (kgf-cm)

L48EE-L70EE	1079-1275 (110-130)
L100EE	2550-2746 (260-280)

- 3) Stiffener bolts have been added on the crankcase cover to reduce vibration and noise. For an engine with stiffener bolts, tighten them after the bolts on the periphery of the crankcase cover are tightened.

**Stiffener Bolts Tightening Torque** N-cm (kgf-cm)

L48EE, L70EE, L100EE	2550-2746 (260-280)
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**(8) Fuel injection pump reassembly (final)**

Tighten the fuel injection pump

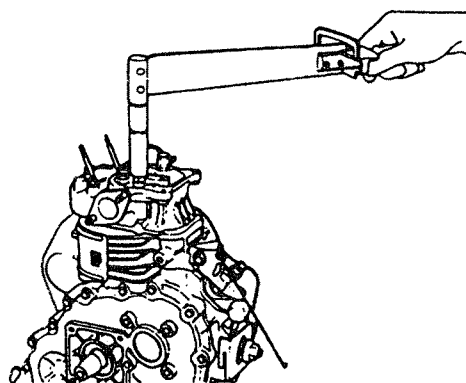
**Fuel Injection Pump Tightening Torque.**

N-cm (kgf-cm)

L48EE, L70EE, L100EE	1079-1275 (110-130)
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**(9) Cylinder head**

- 1) Place a gasket packing on the cylinder block.
- 2) Attach an O-ring.
- 3) Reassemble the cylinder head.
  - Make sure that the nozzle insulation packing and spacer are in position.
  - Before reassembling the valve spring, place its identification mark (white paint) toward the cylinder head. (L100EE)



**Tightening the bolts of the cylinder head**

Tighten separately with two times

**Cylinder Head Tightening Torque** N-cm (kgf-cm)

Model	First	Final
L48EE	1471 (150)	2942-3334 (300-340)
L70EE	2157 (220)	4119-4511 (420-460)
L100EE	2942 (300)	5296-5688 (540-580)

**(10) Push rods**

Insert the push rods.

- Ascertain that the tappets are properly in-sorted.

**(11) Valve rocker arm assembly**

- 1) Reassemble the valve rocker arm assembly.
- 2) Adjust the valve clearance.
 

In./Ex.-valve head clearance : 0.15mm (cold state)

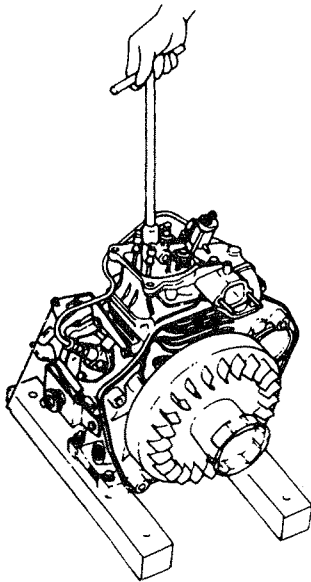
  - Be careful not to lose or damage the knock pin.



### Valve Rocker Arm Tightening Torque

N·cm (kgf·cm)

L48EE-L70EE	1960 - 2256 (200-230)
L100EE	4217 - 4609 (430-470)



**Tightening the valve rocker arm**

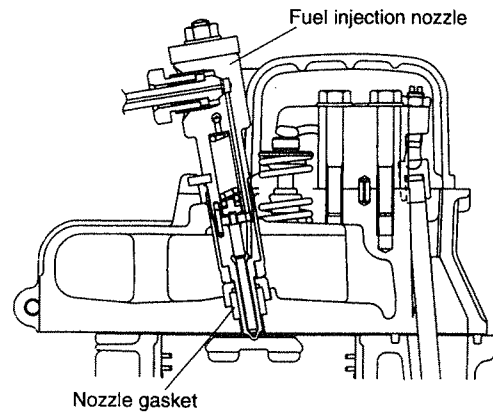
#### (12) Valve rocker arm cover

Install the valve rocker arm cover.

- Make sure the packing is in position.

#### (13) Fuel injection nozzle

- 1) Insert the fuel injection nozzle.
- 2) Install the injection pipe.
- 3) Tighten the injection valve.
  - Make sure the fuel injection valve faces to the proper direction.
  - Replace the nozzle gasket.



**Install the fuel injection valve**

### Fuel Injection Valve Tightening Torque

N·cm (kgf·cm)

L48EE, L70EE, L100EE	1079-1275 (110-130)
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#### (14) Intake bend

Install the intake bend.

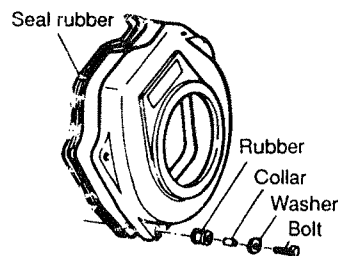
- Make sure the intake bend packing is in position.

#### (15) Cooling fan case

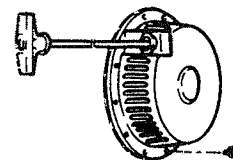
- 1) Install the starter pulley.
- 2) Install the cooling fan case.
 

(Re-attach the recoil if it has been removed.)

  - Attach the seal rubber to the case.
  - Make sure the collar and fan case supporting rubber are in the proper position.



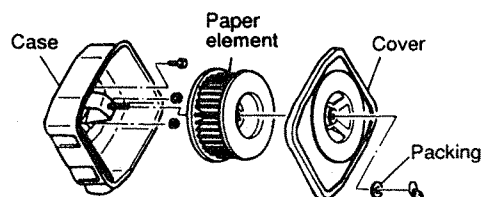
**Cooling fan case**



**Recoil starter**

### (16) Air cleaner

- 1) Attach the air cleaner case.
- 2) Install the element.
- 3) Install the cover.



**Air cleaner**

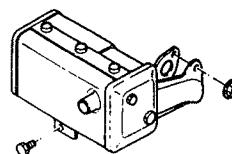
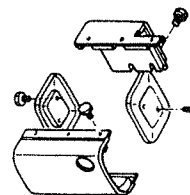
### (17) Starting motor

- (Only for model with starting motor)  
Install the starting motor.

### (18) Exhaust silencer

Install the exhaust silencer.

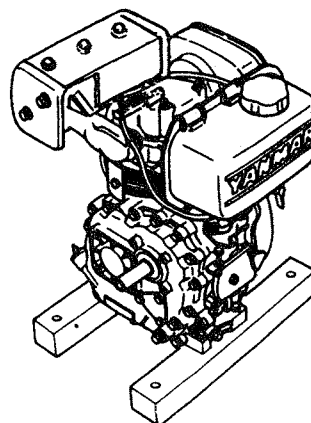
- The silencer cover does not have to be removed.
- Model L100EE does not have a rear cover.



**Exhaust silencer**

### (19) Fuel tank

- 1) Connect the fuel pipe to the fuel injection pump.
  - 2) Attach the fuel tank using the upper stay.
  - 3) Insert the fuel return pipe to the fuel tank.
- Make sure the fuel tank supporting rubber (vibration absorbing rubber) stays in place.



**Installing the fuel tank**