

## FOREWORD

*This repair manual describes the description, construction, trouble shooting, removal, disassembly, inspection and repair, assembly and installation of the various components of the 11Z, 12Z, 13Z and 14Z model engine equipped on the Toyota Forklift Trucks.*

*You are encouraged to become thoroughly familiar with this manual so as to make the most of the outstanding performance and durability features of these vehicles mounted with the 11Z, 12Z, 13Z, 14Z engine and to perform the proper servicing to maintain them in tip-top running condition.*

*This manual contains the information on the models manufactured in the following periods:*

*11Z, 12Z: December 1990*

*13Z : September 1996*

*14Z : July 1996*

*For any changes thereafter, you are asked to consult the Parts & Service News. Toyota reserves the right to make changes in specifications and descriptions without incurring any obligation and without previous notice.*

**TOYOTA Material Handling Company**

A Division of TOYOTA INDUSTRIES CORPORATION

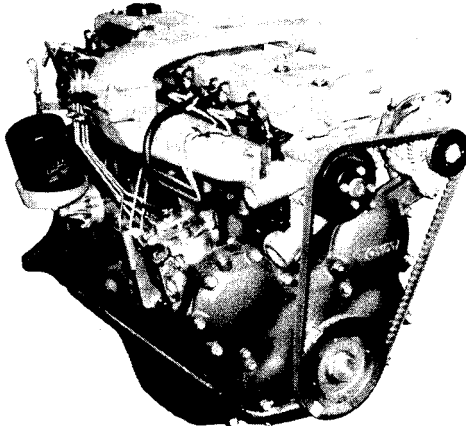
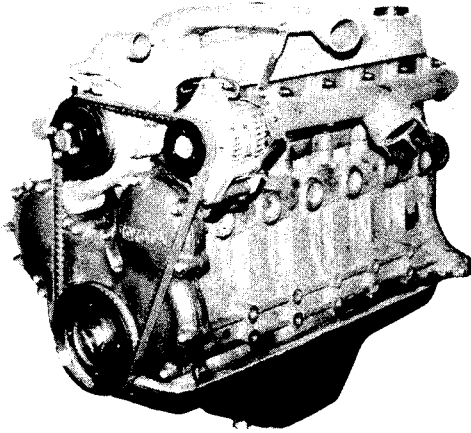
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## GENERAL

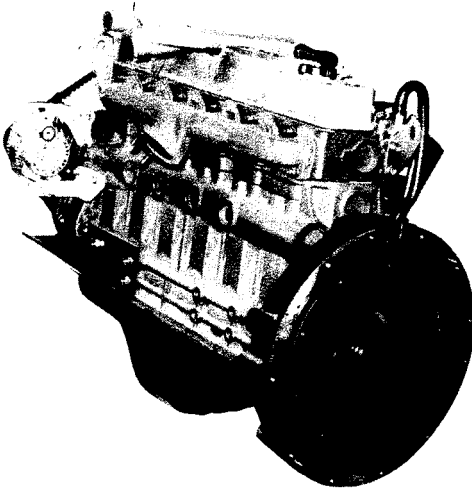
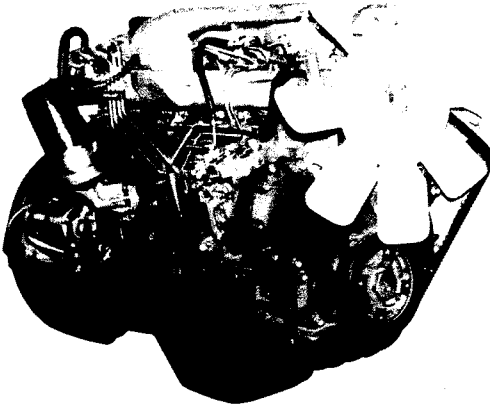
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**ENGINE EXTERIOR VIEWS  
(11Z engine)**



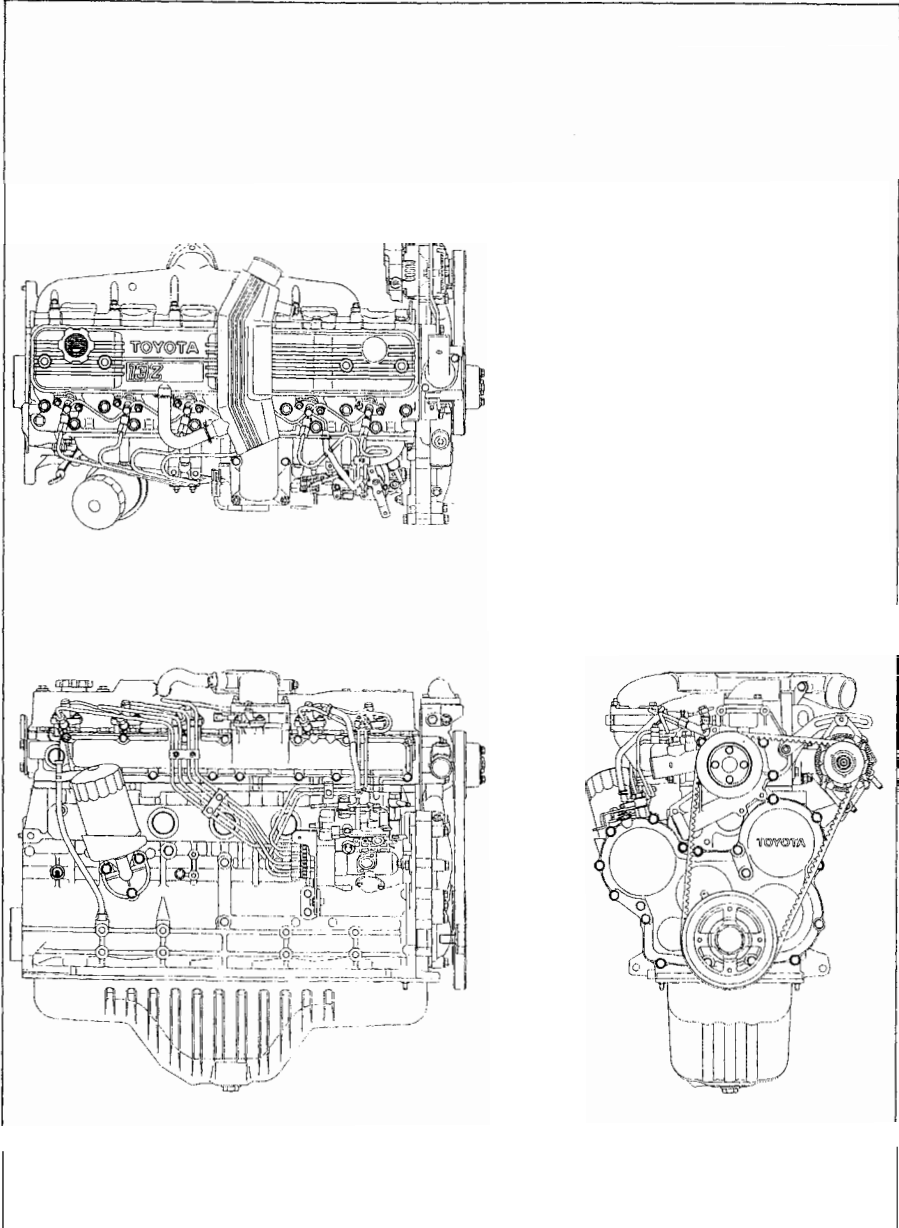
11Z Engine Exterior Views

(12Z engine)



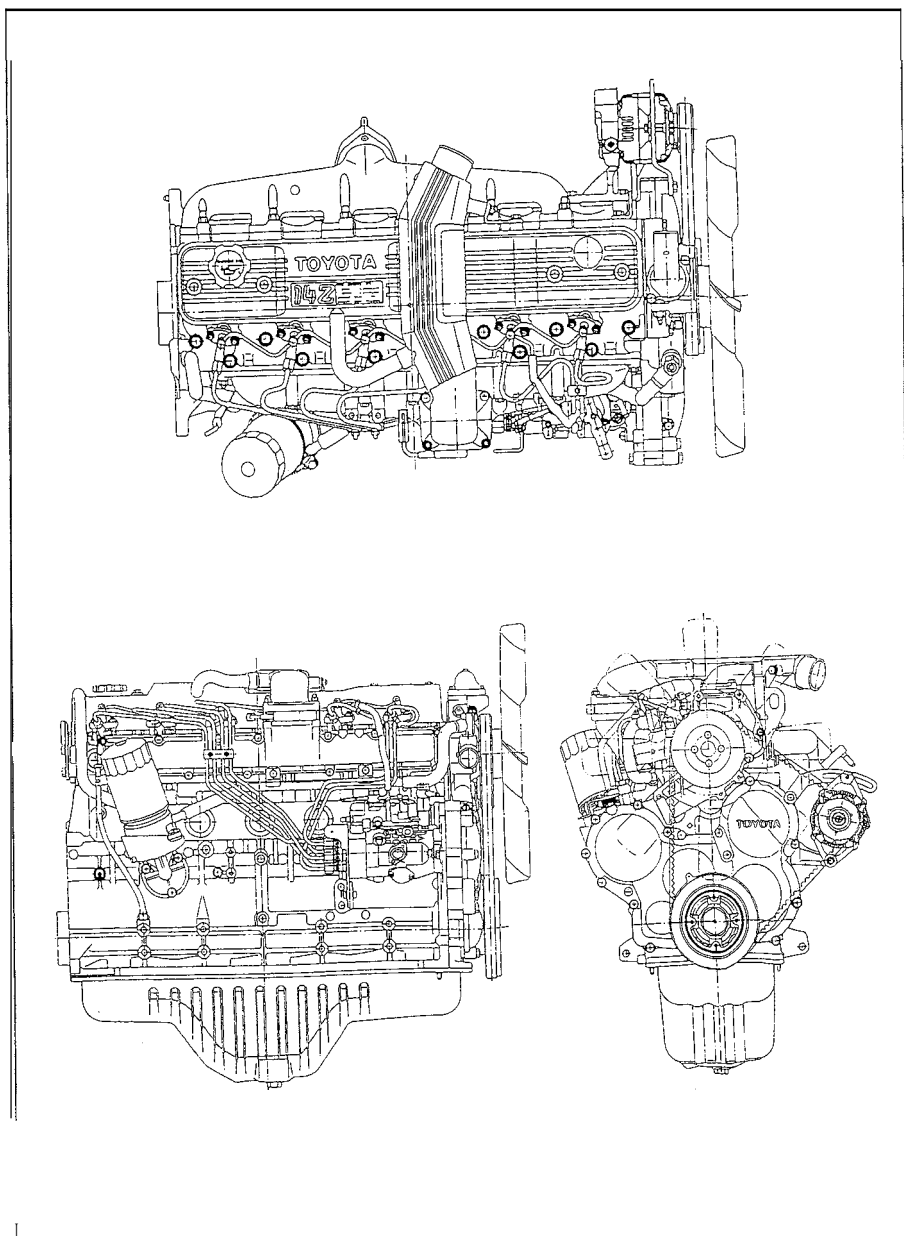
122 Engine Exterior Views

(132 engine)



132 Engine Exterior Views

## (14Z engine)



14Z Engine Exterior Views

## SPECIFICATIONS (11Z, 13Z engine)

Engine model		11Z	13Z
Type		Diesel	+
Cycle		4	←
No. of cylinders and arrangement		In-line 6 cylinders longitudinal arrangement	←
Fuel Injection sequence		1-4-2-6-3-5	←
Starting system		Self-starting	←
Combustion chamber type		Direct injection	←
Valve mechanism		Overhead valve	←
Bore × stroke	mm (in)	96.0 × 102.0 (3.78 × 4.021)	98.0 × 102.0 (3.86 × 4.02)
Total displacement	cc (cub in)	4429 12671	4616 12811
Compression ratio		18.5	←
Compression pressure	kg/cm <sup>2</sup> (psi)/rpm	33 14691 260	←
Engine horsepower	PS/rpm	85.2200	←
Maximum torque	kg-m/rpm	29 1600	←
Minimum fuel consumption at full load	g PS h (rpm)	165 112001	←
Engine dimensions (length × width × height)	mm (in)	875 × 523 × 743 (34.4 × 20.6 × 29.3)	875 × 550 × 760 (34.4 × 21.7 × 29.9)
Engine service weight	kg (lbs)	330 (726)	325 (717)
Number of piston rings	Compression ring	2	←
	Oil ring	1	←
Cylinder liner type		Dry	—
Intake valve timing	Open	16° BTDC	←
	Close	30° ABDC	←
Exhaust valve timing	Open	52° BBDC	←
	Close	14° ATDC	←
Valve clearance (hot engine)	Intake	0.20 (0.0081)	←
	Exhaust	0.36 (0.0141)	←
Idle speed	rpm	See the repair manual for each model	
No-load maximum governed speed	rpm	See the repair manual for each model	
Positive crankcase ventilation type		Closed	←



**(122, 14Z engine)**

Engine model		122	14Z
Type		Diesel	←
Cycle		4	←
No of cylinders and arrangement		In-line 6 cylinders longitudinal arrangement	←
Fuel injection sequence		1-4-2-6-3-5	←
Starting system		Self-starting	←
Combustion chamber type		Direct injection	←
Valve mechanism		Overhead valve gear drive	←
Bore x stroke	mm (in)	96.0 × 115.0 (3.78 × 4.53)	98.0 × 115.0 (3.86 × 4.53)
Total displacement	cc (cub-in)	4994 13011	5204 13171
Compression ratio		18.6	18.5
Compression pressure	kg/cm <sup>2</sup> (psi) rpm	33 14691 260	←
Engine horsepower	PS rpm	95/2200	←
Maximum torque	kg-m/rpm	35 1600	←
Minimum fuel consumption at full load	g/PS-h (rpm)	158/1200	←
Engine dimensions (length × width × height)	mm (in)	911 × 566 × 847 (35.8 × 22.3 × 33.3)	913 × 602 × 832 135.9 × 23.7 × 32.81
Engine service weight	kg (lbs)	332 (730)	327 (721)
Number of piston rings	Compression ring	2	←
	Oil ring	1	←
Cylinder liner type		Dry	—
Intake valve timing	Open	16° BTDC	←
	Close	30° BTDC	←
Exhaust valve timing	Open	52° BTDC	←
	Close	14° ATDC	←
Valve clearance (hot engine)	Intake	0.20 (0.008)	←
	Exhaust	0.36 10 0141	←
Idle speed	rpm	See the repair manual for each model	
No-load maximum governed speed	rpm	See the repair manual for each model	
Positive crankcase ventilation type		Closed	←

## ABBREVIATIONS

Abbreviation (code)	Meaning	Abbreviation (code)	Meaning
ASSY	Assembly	OPT	option
ABDC	After bottom dead center	RH	Righthand
ATDC	After top dead center	rpm	Revolutions per minute
BBDC	Before bottom dead center	SST	Special service tool
BTDC	Before top dead center	STD	Standard
BDC	Bottom dead center	SUB-ASSY	Sub-assembly
EX	Exhaust	T =	Tightening torque
IN	Intake	TDC	Top dead center
LH	Lefthand	UIS	Undersize
O/S	Oversize		

## TIPS FOR OPERATION

### PREPARATION BEFORE DISASSEMBLY

- ① Prepare necessary mechanic tools, measuring tools and SSTs before starting operation.
- ② When disassembling a complex unit, punch or draw matching marks at places not affecting functions to make reassembly easy. When repairing the electrical system, always disconnect the battery negative terminal before starting operation.

### INSPECTION DURING DISASSEMBLY

- ① Whenever a part is removed, inspect the installation state, deformation, damage, roughening state and surface defects of the part.

### NEAT ARRANGEMENT OF DISASSEMBLED PARTS

- ① Arrange removed parts neatly and in good order. Distinguish the parts to be reused from the parts to be replaced.

### WASHING OF DISASSEMBLED PARTS

- ① Thoroughly clean and wash the parts to be reused

### INSPECTION AND MEASUREMENT

- ① If required, carefully inspect and measure the parts to be reused

### ASSEMBLY

- ① Assemble non-defective parts in correct sequence while observing the specified standards (tightening torque and standard values).
- ② Always use genuine Toyota parts for replacement.
- ③ Always use new packings, gaskets and cotter pins for reassembly.
- ④ Coat sealant at necessary places on gaskets, oil on sliding contact surfaces, specified oil or grease on specified sliding contact surfaces, and MP grease on oil seal lips before reassembly.

### ADJUSTMENTS AND OPERATION CHECK

- ① Use gauges and a multimeter and make adjustments to the specified service standard values.

# STANDARD BOLT & NUT TIGHTENING TORQUE

Standard bolt and nut tightening torques are not indicated.


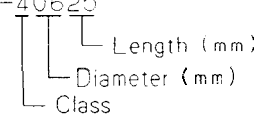
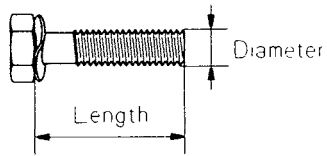






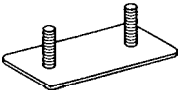
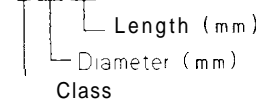
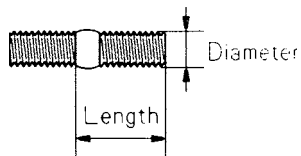
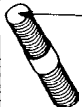

Judge the standard tightening torque as shown below.

- Find out the straight type of bolt from the list below and then find the bolt tightening torque from the table.
- The nut tightening torque can be judged from the mating bolt type.



## BOLT STRENGTH TYPE IDENTIFICATION METHOD

1. Identification by bolt shape

2. Identification by part No.

	Shape and class	Class	Hexagon head bolt
Hexagon head bolt	 Bolt head No. 4	4=4 5=5T 6=6T 7=7T	<b>Parts No.</b> 91611-40625  
	 No mark	4T	
Hexagon flange bolt	 No mark	4T	
Hexagon head bolt	 Two protruding lines	5T	
	 Two protruding lines	6T	
	 Three protruding lines	7T	
Flange head bolt	 Three protruding lines	7T	
Welded bolt		4T	<b>Stud bolt</b> <b>Parts No.</b> 92132-40614  
Stud bolt	 No mark	4T	
	 Grooved	6T	

**STANDARD BOLT TIGHTENING TORQUE**

Class	Diameter mm	Pitch mm	Specified torque					
			Hexagon head bolt 			Hexagon flange bolt 		
			kg-cm	ft-lb	N-m	kg-cm	ft-lb	N-m
4T	6	1.0	55	48 in-lb	5.4	60	52 in-lb	5.9
	8	1.25	130	9	13	145	10	14
	10	1.25	260	19	25	290	21	28
	12	5	480	35	47	540	39	53
	14	1.5	760	55	75	850	61	83
	16	1.5	1150	83	113	—	—	—
5T	6	1.0	65	56 in-lb	6.4	—	—	—
	8	1.25	160	12	16	—	—	—
	10	1.25	330	24	32	—	—	—
	12	1.25	600	43	59	—	—	—
	14	1.5	930	67	91	—	—	—
	16	1.5	1400	101	137	—	—	—
6T	6	1.0	80	69 in-lb	7.8	90	78 in-lb	8.8
	8	1.25	195	14	19	215	16	21
	10	1.25	400	29	39	440	32	43
	12	1.25	730	53	72	810	59	79
	14	1.5	—	—	—	1250	90	123
	16	1.5	—	—	—	—	—	—
7T	6	1.0	110	8	11	120	9	12
	8	1.25	260	19	25	290	21	28
	10	1.25	530	38	52	590	43	58
	12	1.25	970	70	95	1050	76	103
	14	1.5	1500	108	147	1700	123	167
	16	1.5	2300	166	226	—	—	—

BARM88

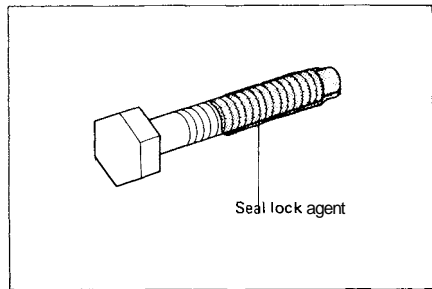
**PRECOATED BOLTS (BOLTS AND NUTS COATED WITH SEAL LOCK AGENT ON THREADED PARTS)**

- Do not use precoated bolts as they are in the following cases,
  - After precoated bolts are removed.
  - When precoated bolts are moved (loosened or tightened) in tightening torque check, etc.

Note:

For torque check, use the lower limit of the allowable range. If a bolt moves, retighten it according to the procedure below.

- Procedure for reuse of precoated bolts
  - Wash the bolt and bolt hole. (Wash the bolt hole also when the bolt is replaced.)
  - Thoroughly dry the washed bolt and bolt hole by air blowing.
  - Coat the specified seal lock agent on the bolt threads.




84460

## ENGINE TUNE-UP

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# ITEMS TO BE PREPARED

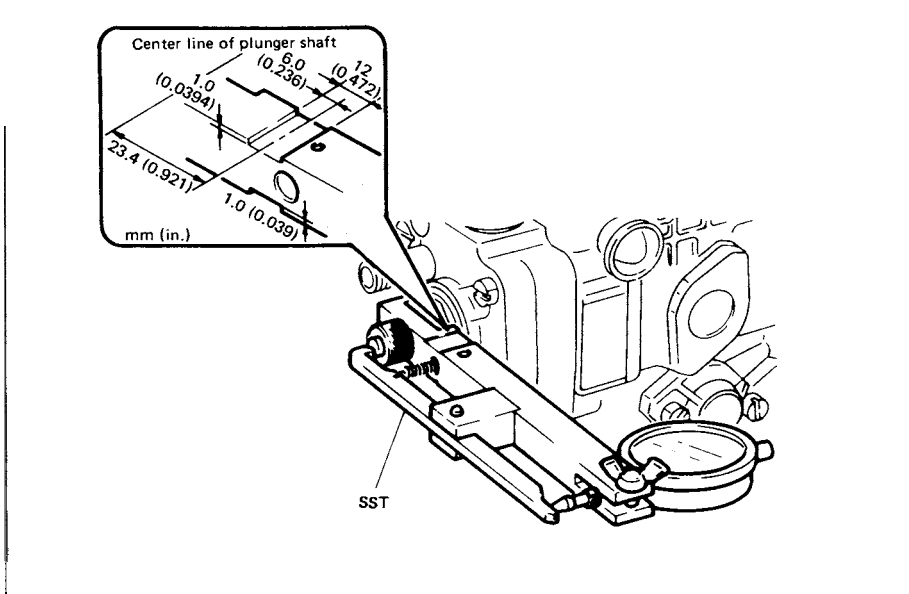
SST		
	SST 09240-32880-71 Tool, plunger stroke	For injection pump timing adjustment
Measuring instruments and tools		
Circuit tester		For checking current conduction in each part
Belt tension gauge		For V belt tension measurement
Straightedge		For V belt tension measurement
Nozzle tester		For injection nozzle measurement
Dial gauge		For valve clearance adjustment
Thickness gauge		For valve clearance adjustment
Torque wrench (10 <sup>mm</sup> 100 kg-cm)		For head cover installation
Compression gauge		For compression measurement

**[SST]**

SST 09240-32880-71 can be prepared by partial machining of SST 09275-76002-71 (SST 09275-54010) (Toyota part No )

The machining dimensions are as shown below.

SST Maching Drawing



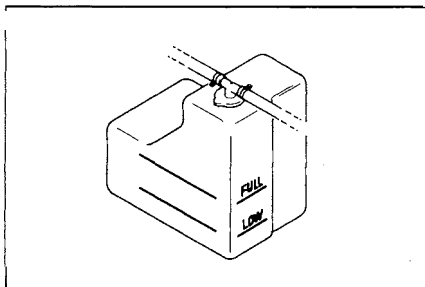
SST Maching Drawing

## COOLANT INSPECTION

See Section 4

### Standard:

The coolant level in the radiator reserve tank shall be between the FULL and LOW lines. The LLC concentration shall be 30% (50% in frigid zone) or more, and the coolant shall not be contaminated with oil, etc.



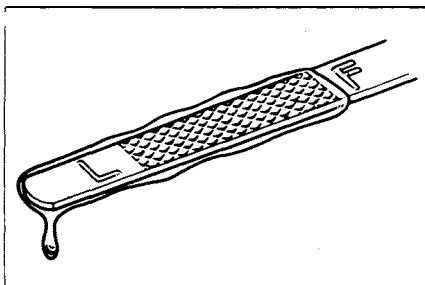
Inspecting the Coolant

KAHS109

## ENGINE OIL INSPECTION

### Standard:

The oil level shall be between F and L on the dipstick. The oil shall not be heavily contaminated, and the viscosity shall be proper. Neither coolant nor light oil shall exist in the engine oil.



Engine Oil

B2320

## BATTERY ELECTROLYTE INSPECTION

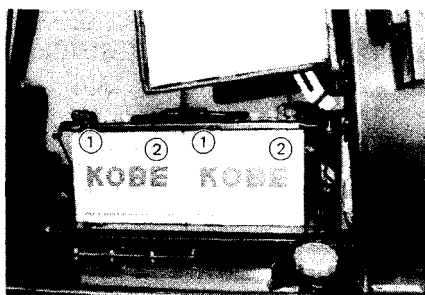
### Standard:

The electrolyte level shall be between 1 UPPER LEVEL and 2 LOWER LEVEL.

*The specific gravity shall be 1.28 (at 20°C).*

### Caution:

If the battery fluid is insufficient, add distilled water.



Battery Electrolyte Level

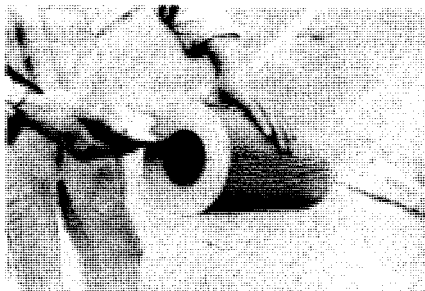
KAL33-2

## AIR CLEANER INSPECTION AND CLEANING

1. Air cleaner element inspection and cleaning
  - (1) Check the air cleaner element for damage, dirt and clogging.
  - (2) Use compressed air to clean the air cleaner element.

### Caution:

The air pressure shall be 7 kg/cm<sup>2</sup> (99 psi) or less.



Air Cleaner Element

LAO190-6

## Air cleaner case cleaning

1. Clean the inner and outer surface of the with cloth.

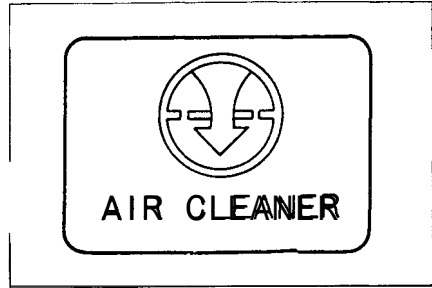
## CLOGGING WARNING SYSTEM INSPECTION

1. Inspection on vehicle  
Check that the air cleaner warning lamp on the Instrument panel comes on when the key switch is set to ON, and that it goes off when the engine starts
2. Individual inspection  
Check current conduction when a negative pressure is applied to the vacuum switch.

Standard:

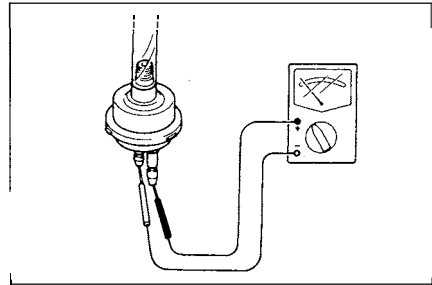
11Z, 13Z: 655 rnm Aq or more

12Z, 14Z: 762 mrn Aq or more



Warning Lamp

LAOS5151



Inspecting the Vacuum Switch

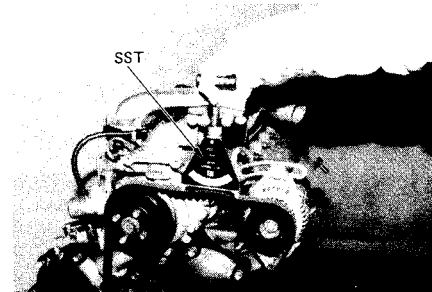
KAHS125

## "V" BELT INSPECTION AND ADJUSTMENT

1. "V" belt inspection
  - (1) Check that the belt is correctly installed.
  - (2) If squealing or slipping exists, check the belt surface in contact with the pulley for wear, damage and scratches, and the pulley for surface defects.
  - (3) Apply SST (belt tension gauge) to the center of the belt between the alternator and water pump, and measure the "V" belt tension  
SST 09216-76001-71 (SST 09216-00020)

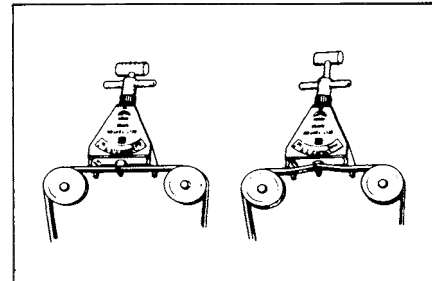
Standard "V" belt tension:

New V belt kg (lb)	11Z, 13Z	38 ~ 62 (84 ~ 137)
	12Z, 14Z	53 ~ 77 (116 ~ 169)
For general inspection kg (lb)	11Z, 13Z	20 ~ 40 (44 ~ 88)
	12Z, 14Z	33 ~ 57 (72 ~ 125)



Inspecting the Belt Tension

KAL29-4



Tension Gauge

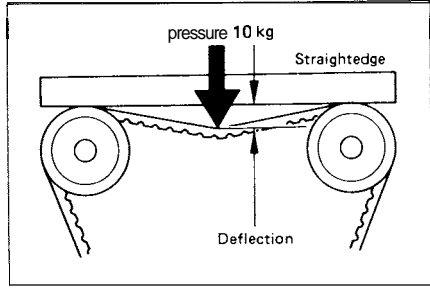
B1669



- (4) When a tension gauge is not available, push the center of the belt between the alternator and water pump with a force of 10 kg (22 lb) and measure the flexure.

Standard "V" belt flexure:

For general inspection (pushed with 10 kg) mm (in)	8 - 13 (0.31 ~ 0.51)
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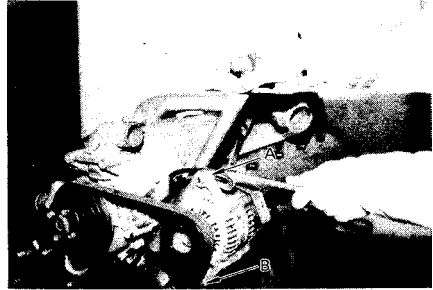


Inspecting the "V" Belt Flexure

B1668

## 2. "V" belt adjustment

- (1) Loosen adjusting bolt A and fixing bolt B.
- (2) Tension the belt by applying a 300 ~ 400 mm (12 ~ 16 in) long lever to the alternator, and tighten adjusting bolt A.
- (3) Tighten fixing bolt B.
- (4) Check the belt tension (tension or flexure).



Adjusting the Fan Belt Tension

KAL29-8

## INTAKE HEATER INSPECTION

1. Disconnect the cables from the intake heater.
2. Check continuity of the intake heater.
  - (1) Check continuity between + terminal and - terminal of the intake heater

## INJECTION NOZZLE INSPECTION

- 1 Injection nozzle injection pressure inspection
  - (1) Remove the injection nozzle.
  - (2) Install the nozzle to the nozzle tester. Operate the tester lever quickly to cause injection a few times to remove the carbon at the injection holes.
  - (3) Slowly lower the tester lever to increase the pressure and read the pressure immediately before the indication drops suddenly.

Standard injection pressure:

11Z, 12Z (2 spring type):

180 ± 5 kg/cm<sup>2</sup> 12560 ± 70 psi  
[17650 ± 490 kPa]

11Z, 12Z (1 spring type):

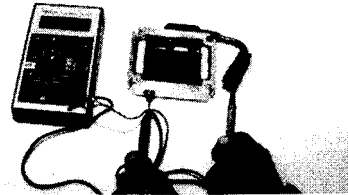
200 <sup>+10</sup>/<sub>0</sub> kg/cm<sup>2</sup> 12840 <sup>+140</sup>/<sub>0</sub> psi  
[19610 <sup>+980</sup>/<sub>0</sub> kPa]

13Z:

180 ± 5 kg/cm<sup>2</sup> 12560 ± 70 psi  
[17650 ± 490 kPa]

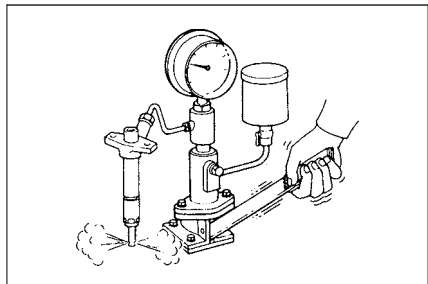
14Z:

230 ± 5 kg/cm<sup>2</sup> (3270 ± 70 psi)  
[22560 ± 490 kPa]



Inspecting the Intake Heater

KAL3-14



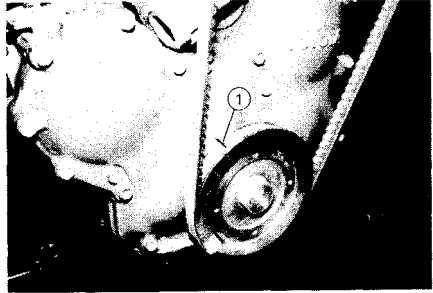
Injection Pressure

F2516

# INJECTION TIMING INSPECTION AND ADJUSTMENT

## INJECTION TIMING INSPECTION

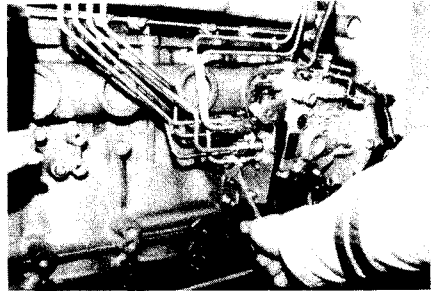
1. Place the No. 1 cylinder at the TDC.
  - (1) Align the crank pulley TDC notch mark with the ① timing pointer



Setting the TDC

KAL29-2

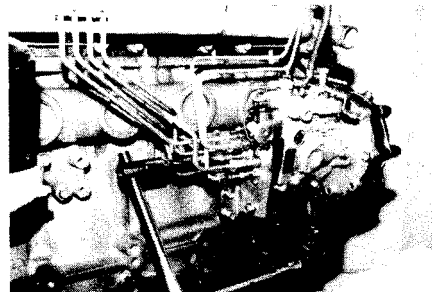
- (2) Remove the fuel pipe No. 1 on injection pump side.



Removing the fuel pipe No. 1

KAL29-13

- (3) Remove the bolt at the rear end of the Injection pump



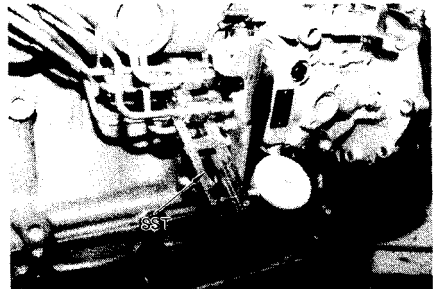
Removing the Bolt

KAL29-12

- (4) Set the SST and dial gauge to the bolt hole  
SST 09240-32880-71

### Caution:

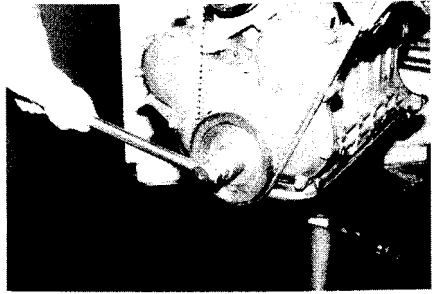
Apply the tip end of the dial gauge to a flat surface. Prevent foreign matter or dust entrance during operation.



Inspecting the Injection Timing

KAL29-15

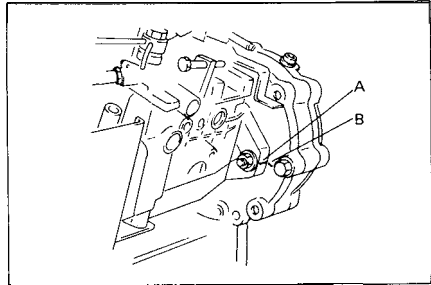
- (5) While observing the dial gauge, rotate the crankshaft in the reverse direction by a crank angle over  $25^{\circ}$  from the TDC of cylinder No. 1. When the dial gauge pointer deflection stops, set the dial gauge to 0.
- (6) Slowly rotate the crankshaft in the forward direction until cylinder No. 1 comes to the TDC.  
Read the dial gauge indication there. If the reading is within the standard, the setting is normal. If not, adjustment is necessary.



Rotating the Crankshaft in Reverse Direction KAL29-3

Standard:

- 112, 122: 1.56 ~ 1.62 mm  
(0.0614 ~ 0.0638 in)
- 132: 1.36 ~ 1.42 mm  
(0.0535 ~ 0.0559 in)
- 142: 1.66 ~ 1.72 mm  
(0.0654 ~ 0.0677 in)

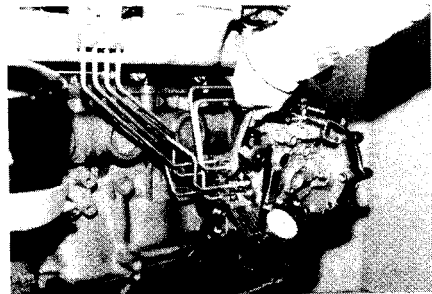


Checking Match Marks

KAL31-14

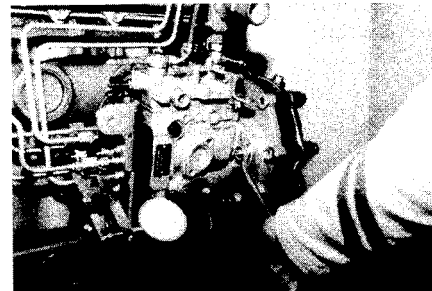
## 2. Injection timing adjustment

- (1) Check alignment of the degree of offset between mark (B) on the timing gear case and mark (A) on the injection pump body. (To use it as the guideline in making adjustment.)
- (2) Loosen the joints of piping with the injection pump
- 1 Fuel inlet pipe
  - 2 Injection pipe
  - 3 Overflow pipe
- (3) Loosen injection pump set nut and the bracket underneath.



Loosening the Piping

KAL30-6



Loosening the Set Nut

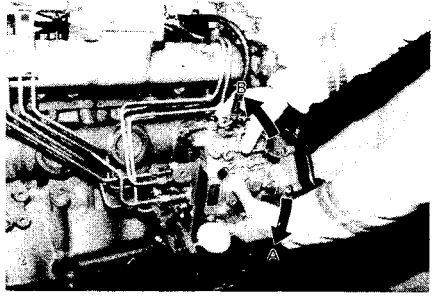
KAL29-19

- (4) Move the pump body for adjustment
- ① If the measured value in step 6 of injection timing inspection is below the lower limit, move the pump in direction A
  - ② If the measured value in step 6 of injection timing inspection exceeds the upper limit move the pump in direction B.
- (5) Tighten the injection pump set nut and the bracket underneath, and inspect the injection timing again.
- (6) Tighten the loosened pipe joints.
- (7) After the injection timing inspection and adjustment, remove the SST and dial gauge and install the bolt at the rear end of the pump.

T = 100 ~ 160 kg-cm (7.23 ~ 11.6 ft-lb)  
[9.8 ~ 15.7 N·m]

**Caution:**

- Use a new copper washer.
- Carefully prevent dust and foreign matter entrance.

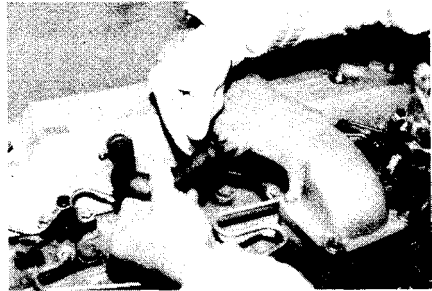


Adjusting the Injection Timing

KAL30-8

## VALVE CLEARANCE INSPECTION AND ADJUSTMENT

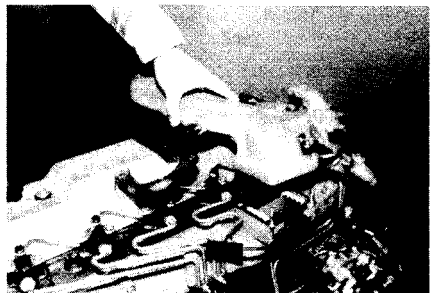
1. Warm up the engine.  
Standard coolant temperature: 75 ~ 85°C
2. Intake pipe removal
  - (1) Ventilation hose



Removing the Ventilation Hole

KAL1-33

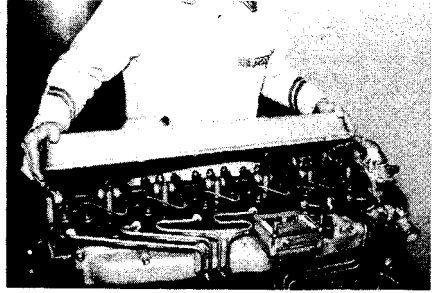
- (2) Intake pipe
  - 1 Set bolt (engine hanger side)
  - 2 Set bolt and set nut (intake heater side)
  - 3 Intake pipe



Removing the Intake Pipe

KAL28-13

3. Cylinder head cover removal
  - (1) Bolts with washers
  - (2) Seal washers
  - (3) Cylinder head cover



Removing the Cylinder Head Cover

KAL27-30

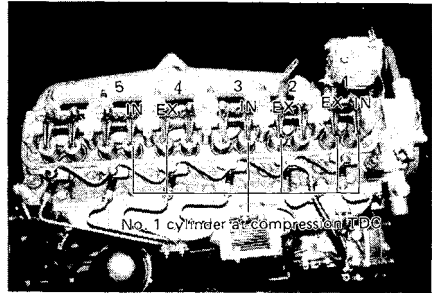
### Valve clearance inspection

4. Rotate the crankshaft in the forward direction to set cylinder No. 1 at the TDC
5. Measure the valve clearance for each of the valves shown in the figure.

#### Standard valve clearance

IN: 0.20 mm (0.008 in) (hot engine)

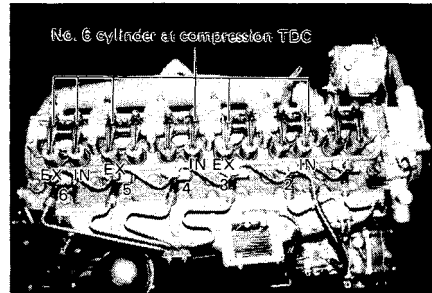
EX: 0.36 mm (0.014 in) (hot engine)



Inspecting the Valve Clearance (1)

KAL28-5

6. Rotate the crankshaft in the forward direction to set cylinder No. 6 at the TDC.
7. Measure the valve clearance of the remaining valves.



Inspecting the Valve Clearance (2)

KAL28-5

### Valve clearance adjustment

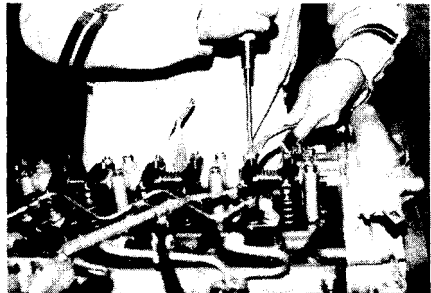
8. Loosen the lock nut and turn the adjusting screw for adjustment. Use an engine feeler gauge for clearance measurement.

#### Standard valve clearance

IN: 0.20 mm (0.008 in) (hot engine)

EX: 0.36 mm (0.014 in) (hot engine)

9. Tighten the lock nut, and inspect the valve clearance again.



Adjusting the Valve Clearance

KAL28-4

#### 10. Cylinder head cover installation

- (1) Cylinder head cover
- (2) Seal washers
- (3) Bolts with washers  
T = 50 ~ 90 kg-cm (3.6 ~ 6.5 ft-lb)  
[4.9 ~ 8.8 N-m]

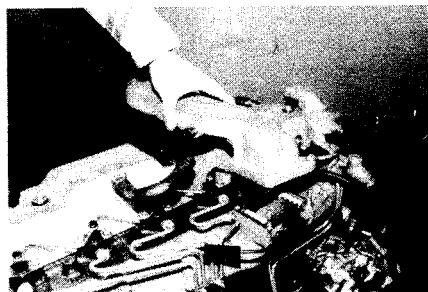


Installing the Cylinder Head Cover

KAL27-22

#### 11. Intake pipe installation

- (1) Intake pipe
- (2) Set bolt and set nut
- (3) Ventilation hose



Installing the Intake Pipe

KAL28-13

## COMPRESSION PRESSURE INSPECTION

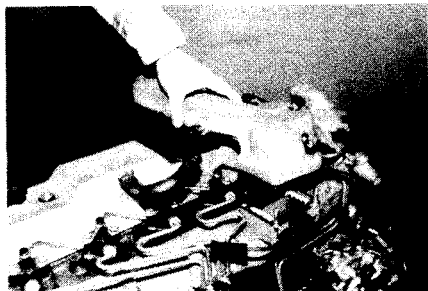
1. Warm up the engine.  
Standard coolant temperature: 75 ~ 85°C
2. Intake pipe removal
  - (1) Ventilation hose



Removing the Ventilation Hose

KAL1-34

- (2) Intake pipe
  - 1 Set bolt and set nut
  - 2 Intake pipe



Removing the Intake Pipe

KAL28-13

3. Injection pipe and nozzle leakage pipe removal
4. Removal of all nozzle holders and nozzles
  - (1) Set nuts
  - (2) Nozzle holders and nozzles
5. Compression measurement

**Caution:**

Run the starting motor to discharge foreign matters in the cylinders before starting compression measurement.

- (1) Install the compression gauge attachment to the nozzle hole, and install the compression gauge.  
Compression gauge set  
SST 09992-76002-71 (SST 09992-00025)
- (2) Crank the engine and measure the compression pressure.  
Standard: 33 kg/cm<sup>2</sup> (469 psi)/260 rpm  
[3236 KPa] /260 rpm  
Limit: 20 kg/cm<sup>2</sup> (284 psi)/260 rpm  
[1961 KPa] /260 rpm

**Note:**

Use a fully charged battery to keep the engine speed at above the specified rpm.

- (3) Repeat steps (1) and (2) above for all cylinders.

Limit of difference between cylinders:

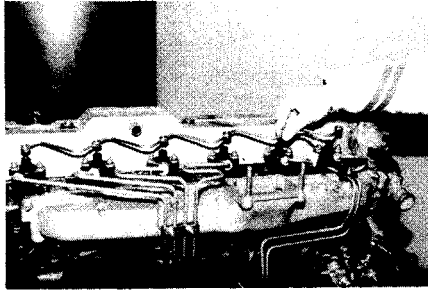
2 kg/cm<sup>2</sup> (28 psi)/260 rpm

[196 KPa] /260 rpm

- (4) If the compression pressure in any cylinder is below the limit or the pressure difference between cylinders is above the limit, add engine oil slightly from the nozzle hole and repeat steps (1) to (3) above.
  - ① If the oil addition raises the pressure, the piston rings and cylinder bore may have been worn.  
If the pressure is still low after the oil addition, valve seizure, valve contact defect or pressure leakage from the gasket may be the cause.

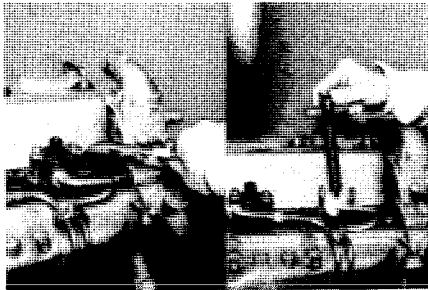
**Caution:**

See page 3-19 for the nozzle holder and nozzle installation method.



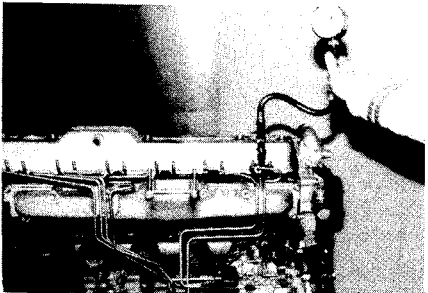
Removing the Nozzle Leakage Pipe

KAL27-5



Removing the Nozzle and Nozzle Holder

KAL26-32



Measuring the Compression Pressure

KAL26-28



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