



NISSAN

**SERVICE MANUAL
&
TECHNICAL BULLETIN**

**MODEL *K21*
K25 ENGINE SERIES**

The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized UTILEV® distributor. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.

MAINTENANCE

SECTION **MA**

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ENGINE MAINTENANCE

Specifications

INSPECTION AND ADJUSTMENT

- Oil capacity H line: \varnothing (Imp qt)
3.7 (3-1/4)
- Oil capacity L line: \varnothing (Imp qt)
2.7 (2-3/8)
- (Oil filter capacity): \varnothing (Imp pt)
0.3 (1/2)
- Fan belt deflection [When pressed by a force of approximately 10 kg (22 lb)] : mm (in)
Standard 11 - 13 (0.43 - 0.59)
- Compression: kPa (bar, kg/cm², psi)/rpm
Standard 1,275 (12.7, 13.0, 185)/250 (K15)
1,226 (12.3, 12.5, 178)/250 (K21)
1,275 (12.7, 13.0, 185)/250 (K25)
- Difference between each cylinder: kPa (bar, kg/cm², psi)/rpm
Repair limit 98 (0.98, 1.0, 14)/300
- Spark plug gap : mm (in)
Standard 0.8 - 0.9 (0.31 - 0.35)
- Distributor (Full transistor type) air gap : mm (in)
Standard 0.35 - 0.45 (0.0138 - 0.0177)
- Valve clearance (Hot) : mm (in)
Standard Intake: 0.38 (0.0150)
Exhaust: 0.38 (0.0150)
- Thermostat valve opening temperature (STD): °C (°F)
Standard 76.5 (170)
- Idle speed and ignition timing (BTDC°/rpm)
Standard 0/700±50 (K15)
0/700±50 (K21)
0/700±50 (K25)
2/700±50 (K21, carburetor specification)
0/700±50 (other than above)

CYLINDER HEAD

- Cylinder head : mm (in)
Material Aluminum alloy
Distortion limit 0.1 (0.004)

CYLINDER BLOCK

- Block upper surface : mm (in)
Distortion limit 0.1 (0.004)
- Bore diameter dimension : mm (in)
Standard 75.50 - 75.55 (2.9724 - 2.9744) (K15)
89.00 - 89.05 (3.5039 - 3.5059) (K21, K25)
- Bore diameter wear : mm (in)
Repair limit 0.2 (0.008)
- Bore diameter out-of-round : mm (in)
Standard 0.02 (0.008) or less
- Bore diameter taper : mm (in)
Standard 0.02 (0.008) or less
- Bore diameter out-of-round and taper : mm (in)
Repair limit 0.1 (0.004)

ENGINE MAINTENANCE

Specifications (Cont'd)

PISTON

- Piston : mm (in)
 - Type Thermal flow type
 - Material Aluminum alloy
 - Outer diameter Standard 75.465 - 75.515
(2.9711 - 2.9730) (K15)
88.965 - 89.015
(3.5026 - 3.5045) (K21) (K25)
- Gap between piston and cylinder : mm (in)
 - Standard 0.025 - 0.045 (0.0010 - 0.0018)
(Selective fit service parts)
- Piston pin outer diameter : mm (in)
 - Standard 19.993 - 19.998 (0.7871 - 0.7873)
(K15, K21, K25)
- Piston pin fitting quality
 - Standard To a degree allowing movement by hand
- Piston ring end gap : mm (in)
 - Standard Top 0.28 - 0.43
(0.0110 - 0.0169)
 - Second 0.45 - 0.60
(0.0177 - 0.0236)
 - Oil 0.20 - 0.60
(0.0079 - 0.0236)
 - Various limit values 1.00 (0.0394)
- Gap between piston ring and ring groove : mm (in)
 - Standard Top 0.045 - 0.080
(0.0018 - 0.0031)
 - Second 0.030 - 0.070
(0.0012 - 0.0028)
 - Oil 0.65 - 0.135
(0.0256 - 0.0053)
 - Repair limit Top 0.10 (0.0039)
 - Second 0.10 (0.0039)
 - Oil -

CONNECTING ROD

- Distance between both end hole centers : mm (in)
 - Standard 143.970 - 144.030 (5.6681 - 5.6811) (K25)
152.470 - 152.530 (6.0027 - 6.0051)
(K15, K21)
- Large end hole diameter : mm (in)
 - Standard 48.0 - 48.013 (1.8898 - 1.8903)
(K15, K21, K25)
- Small end hole diameter : mm (in)
 - Standard 19.965 - 19.978 (0.7860 - 0.7865)
(K15, K21, K25)
- Bend (per 100 mm) : mm (in)
 - Repair limit 0.05 (0.0020)
- Torsion (per 100 mm) : mm (in)
 - Repair limit 0.05 (0.0020)
- Large end thrust gap
 - Standard 0.2 - 0.3 (0.0079 - 0.0118)
 - Repair limit 0.40 (0.0157)

ENGINE MAINTENANCE

Specifications (Cont'd)

- Large end oil clearance : mm (in)
Standard 0.030 - 0.066 (0.0012 - 0.0026)
(K15, K21, K25)
Repair limit 0.10 (0.0039)
- Difference of weight (Piston combination): g (oz)
Standard 4 (0.14) or less

CRANKSHAFT

- Bend : mm (in)
Repair limit 0.05 (0.0020)
- End play : mm (in)
Standard 0.05 - 0.18 (0.0020 - 0.0071)
Repair limit 0.20 (0.0079)
- Journal dimension : mm (in)
Standard 62.942 - 62.955 (2.4780 - 2.4785)
- Pin standard dimension : mm (in)
Standard 44.961 - 44.974 (1.7701 - 1.7706)
(K15, K21, K25)
- Journal oil clearance : mm (in)
Standard 0.020 - 0.073 (0.0008 - 0.0029)
Repair limit 0.10 (0.0039)
- Pin oil clearance : mm (in)
Standard 0.032 - 0.066 (0.0013 - 0.0026)

FLYWHEEL

- Flywheel surface swing : mm (in)
Repair limit 0.10 (0.0039)
- Ring gear surface swing : mm (in)
Repair limit 0.50 (0.0197)
- Flatness : mm (in)
Repair limit 0.30 (0.0118)

CAMSHAFT

- Bend : mm (in)
Repair limit 0.05 (0.0020)
- Camshaft height : mm (in)
Standard 36.750 - 36.800 (1.4468 - 1.4488)
(For both intake and exhaust)
Size reduction limit 36.5 (1.437)
- Journal dimension : mm (in)
Standard Front 45.434 - 45.447 (1.7887 - 1.7892)
Center 43.897 - 43.910 (1.7318 - 1.7287)
Rear 41.218 - 41.231 (1.6228 - 1.6233)
- End play : mm (in)
Standard 0.025 - 0.255 (0.0010 - 0.0100)
Repair limit 0.40 (0.0157)
- Journal oil clearance : mm (in)
Standard Front 0.025 - 0.051 (0.0010 - 0.0020)
Center 0.038 - 0.064 (0.0015 - 0.0025)
Rear 0.025 - 0.051 (0.0010 - 0.0020)
Repair limit Front 0.10 (0.0039)
Center 0.15 (0.0059)
- Journal oil clearance : mm (in)
Repair limit Rear 0.10 (0.0039)

ENGINE MAINTENANCE

Specifications (Cont'd)

VALVE

- Head outer diameter : mm (in)

Standard	Intake	38.0 - 38.3 (1.496 - 1.508)
	Exhaust	32.0 - 32.3 (1.260 - 1.272)
- Valve stem outer diameter : mm (in)

Standard	Intake	6.97 - 6.985 (0.2744 - 0.2750)
	Exhaust	6.945 - 6.960 (0.2734 - 0.2740)
- Valve guide inner diameter : mm (in)

Standard	Intake	7.0 - 7.018 (0.2756 - 0.2763)
	Exhaust	7.0 - 7.018 (0.2756 - 0.2763)
- Gap between valve stem and valve guide : mm (in)

Standard	Intake	0.020 - 0.053 (0.0008 - 0.0021)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)
Repair limit	Intake	0.10 (0.0039)
	Exhaust	0.10 (0.0039)
- Gap between valve lifter and lifter guide : mm (in)

Standard	0.016 - 0.052 (0.0006 - 0.0020)
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- Gap between crankshaft and flywheel : mm (in)

Standard	0 - 0.038 (0 - 0.0015)
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- Gap between rocker shaft and rocker arm : mm (in)

Standard	0.020 - 0.054 (0.0008 - 0.0021)
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- Valve clearance (Hot) : mm (in)

Intake	0.38±0.03 (0.0150±0.0012)
Exhaust	0.38±0.03 (0.0150±0.0012)

ENGINE MAINTENANCE

Tightening Torque

Upper: Lubricated (Antirust oil is applied to abrasive faces of threads and seating faces)

Lower: No lubrication (Threads and seating faces are completely degreased)

	Thread size		Unit	4T (Bolt)	7T (Bolt)	9T (Bolt)
	Diameter	Pitch				
Hexagon head bolt and nut	M6	1	N·m	3.8 - 4.4	6.4 - 7.5	9.2 - 10.8
			kg·m	0.39 - 0.45	0.65 - 0.76	0.94 - 1.1
			ft·lb, in·lb*	34 - 39*	56 - 66*	82 - 95*
			N·m	5.0 - 6.5	8.4 - 10.8	11.8 - 15.7
			kg·m	0.51 - 0.66	0.86 - 1.1	1.2 - 1.6
			ft·lb, in·lb*	44 - 57*	75 - 95*	9 - 12
	M8	1.25	N·m	9.3 - 10.8	15.7 - 17.7	22.6 - 25.5
			kg·m	0.95 - 1.1	1.6 - 1.8	2.3 - 2.6
			ft·lb, in·lb*	82 - 95*	12 - 13	17 - 19
			N·m	12.7 - 15.7	20.6 - 26.5	29.4 - 37.3
			kg·m	1.3 - 1.6	2.1 - 2.7	3.0 - 3.8
			ft·lb, in·lb*	9 - 12	15 - 20	22 - 19
	M10	1.25	N·m	19.6 - 22.6	32.4 - 38.2	47.1 - 53.9
			kg·m	2.0 - 2.3	3.3 - 3.9	4.8 - 5.5
			ft·lb, in·lb*	14 - 17	24 - 28	35 - 40
			N·m	25.5 - 33.3	43.1 - 54.9	61.8 - 78.5
			kg·m	2.6 - 3.4	4.4 - 5.6	6.3 - 8.0
			ft·lb, in·lb*	19 - 25	32 - 41	46 - 58
1.5		N·m	18.6 - 21.6	30.4 - 36.3	44.1 - 52	
		kg·m	1.9 - 2.2	3.1 - 3.7	4.5 - 5.3	
		ft·lb, in·lb*	14 - 16	22 - 27	33 - 38	
		N·m	24.5 - 31.4	41.2 - 52	58.8 - 74.5	
		kg·m	2.5 - 3.2	4.2 - 5.3	6.0 - 7.6	
		ft·lb, in·lb*	18 - 23	30 - 38	43 - 55	
Flanged bolt	M6	1	N·m	4.9 - 5.69	8.14 - 9.51	11.8 - 13.7
			kg·m	0.5 - 0.58	0.83 - 0.97	1.2 - 1.4
			ft·lb, in·lb*	43 - 50*	72 - 84*	9 - 10
			N·m	5.98 - 7.65	9.81 - 12.7	14.7 - 18.6
			kg·m	0.61 - 0.78	1.0 - 1.3	1.5 - 1.9
			ft·lb, in·lb*	53 - 68*	87 - 113*	11 - 14
	M8	1.25	N·m	11.8 - 13.7	19.6 - 23.5	28.4 - 33.3
			kg·m	1.2 - 1.4	2.0 - 2.4	2.9 - 3.4
			ft·lb, in·lb*	9 - 10	14 - 17	21 - 22
			N·m	14.7 - 18.6	24.5 - 31.4	35.3 - 45.1
			kg·m	1.5 - 1.9	2.5 - 3.2	3.6 - 4.8
			ft·lb, in·lb*	11 - 14	18 - 23	26 - 33
	M10	1.25	N·m	24.5 - 29.4	41.2 - 48.1	59.8 - 69.6
			kg·m	2.5 - 3.0	4.2 - 4.9	6.1 - 7.1
			ft·lb, in·lb*	18 - 22	30 - 35	44 - 51
			N·m	30.4 - 39.2	51.0 - 64.7	73.6 - 93.2
			kg·m	3.1 - 4.0	5.2 - 6.6	7.5 - 9.5
			ft·lb, in·lb*	22 - 29	38 - 48	54 - 69
1.5		N·m	23.5 - 27.5	39.2 - 46.1	56.9 - 65.7	
		kg·m	2.4 - 2.8	4.0 - 4.7	5.8 - 6.7	
		ft·lb, in·lb*	17 - 20	29 - 34	42 - 48	
		N·m	29.4 - 37.3	49.0 - 61.8	69.6 - 89.2	
		kg·m	3.0 - 3.8	5.0 - 6.3	7.1 - 9.1	
		ft·lb, in·lb*	22 - 27	38 - 46	51 - 48	

CAUTION:
Except special nuts and bolts.

The bolts applicable to this table have one of the following marks embossed on their heads.

4T.....4

7T.....7

9T.....9

MA-6

ENGINE MAINTENANCE

Tightening Torque (Cont'd)

Tightening point	Unit	Standard	Max. value
Cylinder head (lubricated)		Refer to MA-10.	
Crankshaft pulley bolt (lubricated)	N·m	220.5	240.1
	kg·m	22.5	24.5
	ft·lb, in·lb*	163	177
Oil filter element	N·m	14.7	20.6
	kg·m	1.5	2.1
	ft·lb, in·lb*	11	15
Spark plug	N·m	19.6	29.4
	kg·m	2.0	3.0
	ft·lb, in·lb*	14	22
Engine slinger bolt	N·m	22.6	25.5
	kg·m	2.31	2.6
	ft·lb, in·lb*	16.7	19
Rocker cover nut	N·m	13.7	15.7
	kg·m	1.4	1.6
	ft·lb, in·lb*	10	12
Water temperature gauge	N·m	15.7	19.6
	kg·m	1.6	2.0
	ft·lb, in·lb*	12	14
Oil pressure switch	N·m	15.7	21.6
	kg·m	1.6	2.2
	ft·lb, in·lb*	12	16
Exhaust manifold nut		Refer to MA-10.	
Oil pan drain plug	N·m	29.4	39.2
	kg·m	3.0	4.0
	ft·lb, in·lb*	22	29
Thermo-housing air relief plug	N·m	6.37	7.45
	kg·m	0.65	0.76
	ft·lb, in·lb*	56*	66*

ENGINE MAINTENANCE

Maintenance Schedule

Make sure to perform *appropriate* maintenance and service work to maintain the initial performances of the NISSAN forklift.

PERFORM INSPECTION

Make sure to perform the periodical inspections at appropriate times, according to the month basis or the operating hour basis, whichever comes first. Inspection period

Refer to the following notes for values in ()

No.	Inspection items	Applicable control system	Engine system inspection (except LPG fuel system)														
			Months of use	1	2	3	4	5	6	7	8	9	10	11	12		
			Operation hours (x 100 hours)	2	4	6	8	10	12	14	16	18	20	22	24		
1	Intake/exhaust valve clearance	carburetor		A		A				A				A			A
2	Engine drive belt tension	carburetor															
3	Cylinder head bolt and manifold nut	carburetor		T													
4	Engine oil	carburetor	(1)	R		R				R				R			R
5	Oil filter	carburetor	(1)	R		R				R				R			R
6	Engine coolant	carburetor															R
7	Fuel filter	carburetor	(1)	C		C				C				C			C
8	Air cleaner element	carburetor		C	C	C	C	C	C	C	C	C	C	C	C	C	C
9	Engine idle speed	carburetor		A	A	A	A	A	A	A	A	A	A	A	A	A	A
10	Ignition timing	carburetor		A	A	A	A	A	A	A	A	A	A	A	A	A	A
11	Spark plug	carburetor															
13	Distributor (point, cap, and rotor)	carburetor															
14	Distributor (inside)	carburetor	(1)														C
15	PCV valve	carburetor	(1)														
16	PCV hose	carburetor															

ENGINE MAINTENANCE

Maintenance Schedule (Cont'd)

Engine system inspection (LPG models)

No.	Inspection items	Applicable control system	Months of use	1	2	3	4	5	6	7	8	9	10	11	12
			Operation hours (x 100 hours)	2	4	6	8	10	12	14	16	18	20	22	24
1	Gas leakage from piping and piping joints	carburetor	(2)												
2	Damage to piping and piping joints	carburetor													

CAUTION:

- (1) The maintenance work should be performed more frequently if the vehicle is being used in dusty and dirty environments.
- (2) Apply soap suds to the piping joints to check for any gas leakage after replacing the LPG tank.

Meanings of symbols:

I = Inspection. Repair or replace if necessary.

R = Replacement

A = Adjustment

C = Cleaning

D = Draining

T = Tightening (Retightening)

R' = Replacement [Every 500 hours (3 months)] Engine oil, oil filter

Oil and Grease, and Capacity

OIL, LLC

Items	Specification	Remarks
Engine oil	Gasoline *10W-30 (Class SJ)	Refer to SAE viscosity index. (SE, SH can be used.)
Antifreeze		Genuine NISSAN long life coolant

* It is the oil for filling in at factory.

FILLING CAPACITY (GUIDELINE)

Unit: ℓ (Imp qt)

Items	Capacity
Engine oil	K15 3.7 (3-1/4) (including filter)
	K21 3.7 (3-1/4) (including filter)
	K25 3.7 (3-1/4) (including filter)

ENGINE MAINTENANCE

Tightening procedure

Tightening torque (Reference)	N·m (kg·m, ft·lb)	Notes
①	19.6 - 23.5 (2.0 - 2.3, 14 - 17)	Tightening for brake-in
②	68.6 (7.0, 51)	
③	0 (0, 0)	Return
④	19.6 - 23.5 (2.0 - 2.3, 14 - 17)	Retightening
⑤	90° - 92°	

Assembly sequence

Precautions before assembling

- Do not allow oil or dust to get on cylinder head, mounting surface of cylinder block, and head gasket.
- Apply anticorrosive oil onto head bolt thread and surface under the head.

MAM0147

On Board Inspection and Service

TIGHTENING OF HEAD BOLT

Tighten head bolts from inside to outside as shown in the figure.

Tighten bolts gradually as shown in the figure.

Tightening torque: 68.6 N·m (7.0 kg·m, 51 ft·lb) (This tightening torque can be used in step (5) as shown in the figure for service.)

CAUTION:

Check tightening angle with an angle wrench (SST) or a protractor. Do not simply estimate tightening angle.

RETIGHTENING OF MANIFOLD NUT AND BOLT

CAUTION:

Do not retighten nut and bolt until manifold components get cold. It may cause to get burned.

Tightening torque for manifold and nut

Models	N·m	kg·m	ft·lb
K15	41.2 - 48.1	4.2 - 4.91	30.4 - 35.5
K21	41.2 - 48.1	4.2 - 4.91	30.4 - 35.5
K25	41.2 - 48.1	4.2 - 4.91	30.4 - 35.5

(Do not use power tools such as air runner to tighten.)

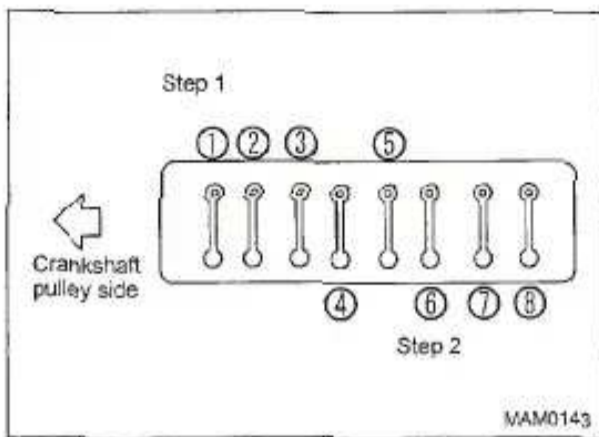
INTAKE/EXHAUST VALVE CLEARANCE ADJUSTMENT

- Adjustment must be made with the vehicle in hot condition.
- Warm up engine until engine coolant temperature gauge shows nearly center, and then stop it.
 - Remove rocker cover.
 - Turn the crankshaft.

CAUTION:

Disconnect high-tension cable from ignition coil when rotating crankshaft with starter motor.

ENGINE MAINTENANCE



On Board Inspection and Service (Cont'd)

4. Set the piston for the No. 1 cylinder to the compression TDC and adjust the valves of (1), (2), (3), and (5) in the figure.
5. Set the piston for the No. 4 cylinder to the compression TDC by rotating crank again and adjust the valves of (4), (6), (7), and (8) in the figure.

Intake/exhaust valve clearance (Hot)

Unit: mm (in)

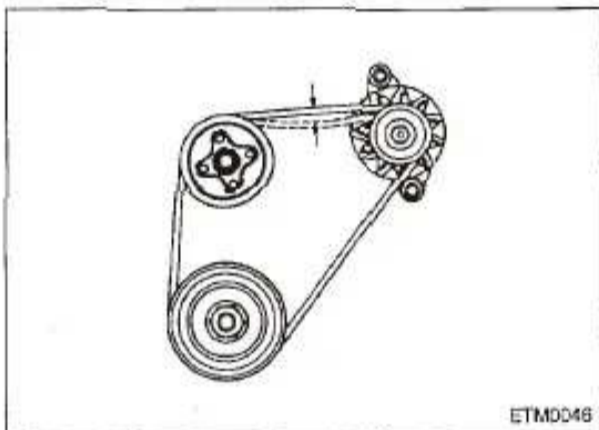
Models	Intake	Exhaust
K15	0.38 (0.015)	0.38 (0.015)
K21	0.38 (0.015)	0.38 (0.015)
K25	0.38 (0.015)	0.38 (0.015)

INSPECTION AND ADJUSTMENT OF ENGINE DRIVE BELT

CAUTION:

Make sure that engine stops. Wash hands.

1. Visually check fan belt for wear, damage, and cracks. Do not contact the belt with pulley groove bottom.
2. Push the belt between pulleys. Check tension.
Belt deflection: 11 - 13 mm (0.43 - 0.51 in)
Force: 98 N (10 kg, 22 lb)



REPLACEMENT OF OIL AND OIL FILTER

1. Warm engine.
2. Remove oil pan drain plug and oil filler cap, and discharge all oil.

CAUTION:

- Be careful not to get burned when engine or engine oil is heated.
- It shows the mixing of coolant so that oil looks like milk. Repair if necessary.
- It shows the mixing of gasoline so that oil viscosity is too lean. Repair if necessary.

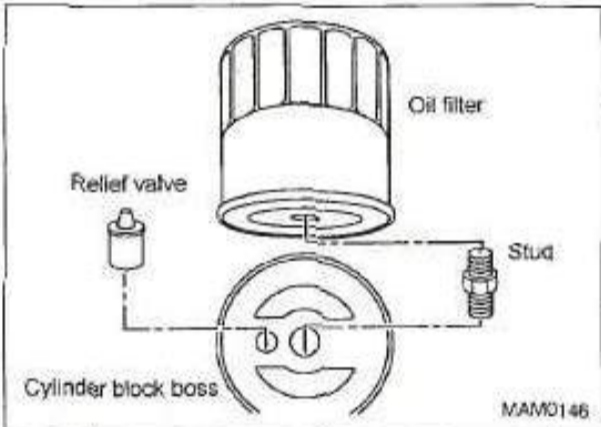
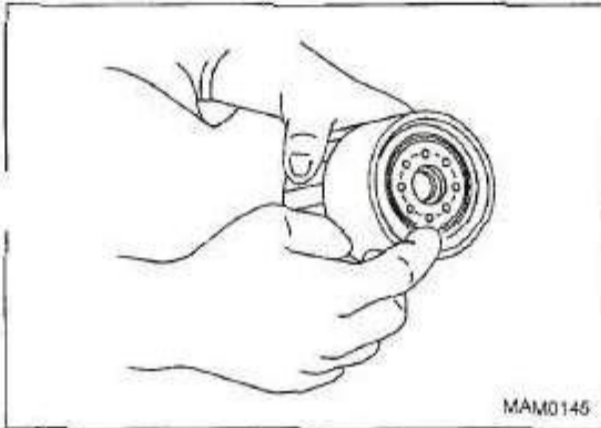
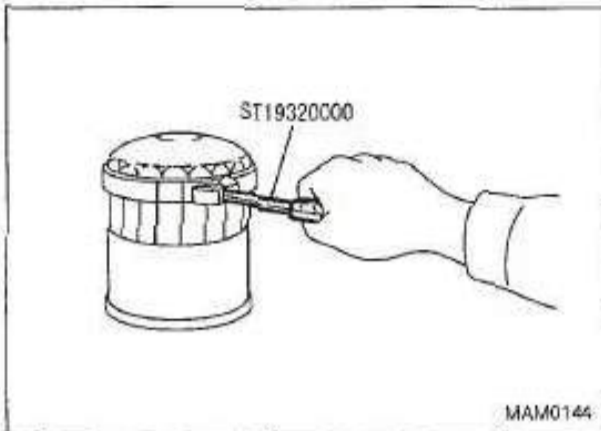
3. Wipe around drain hole. Install drain plug.

Tightening torque for oil pan drain plug:

☞ 29.4 - 39.2 N·m (3.0 - 4.0 kg·m, 22 - 29 ft·lb)

ENGINE MAINTENANCE

On Board Inspection and Service (Cont'd)



4. Replace oil filter.
 - Remove oil filter using an oil filter wrench (SST).
 - Wipe oil filter mounting surface with a clean shop cloth.

- Apply a small amount of engine oil to the lip of the new oil filter.

- Screw in the oil filter by hand until it contacts cylinder block boss, and then screw in another 2/3 of a turn.

5. Fill the oil according to the specified lubricant amount.

Standard oil amount Unit: ℓ (Imp qt)

Including filter	3.7 (3-1/4)
Not including filter	3.4 (3)

6. Start engine, and make sure that there is no leakage around drain plug and oil filter. Replace drain plug and oil filter if there is some leakage.
7. Run engine, and stop it after engine coolant temperature gauge is in nearly center position. Check oil level after waiting for a few minutes. Refill oil if necessary.

ENGINE TUNE-UP

SECTION **ET**

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		SPECIAL SERVICE TOOLS FOR CARBURETOR	
		MODEL	ET-20

SPECIFICATIONS

Items	Engine type	K15	K21	K25
Valve clearance (Hot) mm (in)	Intake	0.38 (0.015)		
	Exhaust			
Fan belt deflection	mm (in)	11 - 13 (0.43 - 0.51)		
Belt push force	N (kg, lb)	98 (10,22)		
Engine oil amount	L (US qt, Imp qt)	3.7 (3-7/8, 3 - 1/4)		
(including oil filter)				
(not including oil filter)		3.4 (3-3/4, 3 - 1/8)		
Compression pressure	kPa (bar, kgf/cm ²)/rpm	1.27 (13.0/250) 1.23 (12.5/250) 1.27 (13.0/250)		
Standard				
Minimum value				
Spark plug type		FR2A-D		
Plug gap	mm (in)	0.9 (0.035)		
Distributor gap	mm (in)	(Carburetor model only) 0.35 - 0.45 (0.0138 - 0.0177)		
High-tension cable resistance	Ω	(Same as above) 30,000 or less		
Ignition timing/idle speed	BTDC deg./rpm	700±50	700±50	
Maximum engine speed without load	rpm (instantaneous)	3,600	3,600	3,600
Maximum engine speed with load	rpm	3,000	3,000	3,000

TIGHTENING TORQUE

Unit : N·m (kgf·m)

Cylinder head bolt	See the figure on the left
Manifold nut	41.2 - 48.1 (4.2 - 4.91)
Oil pan drain plug	29.4 - 39.2 (3.0 - 4.0)
Spark plug	19.6 - 29.9 (2.0 - 3.0)

CYLINDER HEAD

Tightening torque for general service is 68.6 N·m (7.0 kgf·m) in the location of the tightening torque (5) as shown in the figure.

Apply antirust oil or engine oil to the threads and head bottom of each head bolt.

Tightening procedure

Step	Tightening torque (Reference)	Unit	Notes
①	19.6 - 23.52 (2.0 - 2.3)	N·m (kgf·m)	Tightening for brake-in
②	68.6 (7.0)		
③	0.0		Return
④	19.6 - 23.52 (2.0 - 2.3)		Retightening
⑤	90° - 92°		

③ Step

Assembly sequence

← Crankshaft pulley side

Precautions before assembling

- Do not allow oil or dust to get on cylinder head, mounting surface of cylinder block, and head gasket.
- Apply anticorrosive oil onto head bolt thread and surface under the head.

MAM0142

TROUBLE DIAGNOSIS

Condition	Possible causes	Action
No or slow cranking	• Inappropriate engine oil grade	Replace oil with a proper one.
	• Battery is discharged	Charge battery.
	• Battery damage	Replace battery.
	• Loose fan belt	Belt tension adjustment
	• Incident in charge system	Inspection
	• Incident in starter system wiring	Repair
	• Starter switch malfunction	Repair or replace
	• Starter motor malfunction	Repair or replace (Starter circuit <i>diagnosis procedure</i>) If the light turns off or dims when the starter switch is turned to "ON" with the headlights on: a: Inspect the battery b: Inspect the electric <i>connections</i> and wirings c: Inspect the starter motor If the light remains bright when the starter switch is turned to "ON" with the headlights on: a: Inspect the wiring between battery <i>and</i> starter motor b: Inspect the starter switch c: Inspect the starter motor
Engine is cranked but not started.	Such incidents are attributed to the following factors, but most likely, the ignition system or the <i>fuel system</i> is the main cause.	
	• Incident in ignition system	(Diagnosis procedure)
	• Incident in fuel system	Inspect the <i>spark plug</i> following the steps below
	• <i>Dynamic valve</i> system does not operate normally.	Disconnect the high-tension cable from the No.1 plug and keep it 10 mm away from the engine metal portions. Then crank the engine. If a good <i>spark</i> is available: a. Inspect the ignition plugs. b. Inspect the ignition timing c. Inspect the fuel system d. Inspect the <i>compression pressure</i> . If no spark is available: a. Inspect the primary coil current b. If the current level is high, check the primary coil for short circuit
	• Poor compression	

TROUBLE DIAGNOSIS

Condition	Possible causes	Action	Application		
			Common		Carburetor specifications
Incident in ignition system	• Malfunction of low-voltage electronic distribution ignition coil	Replace			
	• Condenser malfunction	Replace	√		
	• Electric leakage from rotor cap and rotor	Clean or replace			√
	• Spark plug malfunction	Clean, adjust gap or replace	√		
	• Inappropriate ignition timing	Adjustment			√
	• Ignition coil malfunction	Replace	√		
	• Open circuit in high-tension cable	Replace			√
	• Loose or open primary wire connection	Repair or replace	√		
Incident in fuel system	• Insufficient fuel	Fill	√		
	• Contaminated fuel filter	Replacement	√		
	• Plugged or contaminated fuel piping	Washing	√		
	• Plugged or contaminated fuel injector	Clean or replace			
	• Fuel pump malfunction	Repair or replace	√		
	• Carburetor choke malfunction	Inspect and adjust			√
	• Inappropriate carburetor float level	Correct			√
	• Inappropriate idling	Adjustment			√
Lowered compression pressure	• Poor tightening of spark plug or inappropriate gasket	Tighten to correct torque or replace	√		
	• Inappropriate engine oil grade or deteriorated viscosity	Replace with appropriate grade of oil	√		
	• Inappropriate valve clearance	Adjustment	√		
	• Compression pressure leakage from valve seat	Remove head and perform fine grinding to valve	√		
	• Stuck valve stem	Repair or replace cylinder head and valve.	√		
	• Broken or chip valve spring	Replace valve spring.	√		
	• Compression pressure leakage from head gasket	Replace head gasket.	√		
	• Worn or stuck piston ring	Replace piston ring.	√		
	• Worn piston ring or cylinder	Engine overhaul (Diagnosis procedure) a. Put a small amount of engine oil from the ignition plug hole and measure the compression pressure. b. If the pressure builds up, a possible cause is in the cylinder or piston ring. c. If the pressure remains unchanged, the leakage can be attributed to the valve, cylinder head or head gasket.	√		

TROUBLE DIAGNOSIS

Condition	Possible causes	Action
Inappropriate idling		
Incident in fuel system	• Plugged or damaged carburetor jet	Clean or replace
	• Inappropriate idle adjustment	Adjustment
	• Plugged air cleaner	Replace element
	• Damaged manifold gasket or carburetor insulator	Replace gasket or insulator.
	• Inappropriate carburetor float level adjustment	Adjustment
Lowered compression pressure		Already described
Engine power does not increase to an appropriate level		Adjustment
Lowered compression pressure		Already described
Incident in ignition system	• <i>Inappropriate ignition timing</i>	Adjustment
	• Spark plug malfunction	Clean, adjust or replace.
Incident in fuel system	• Malfunction of carburetor choke system	Adjustment
	• Plugged fuel piping	Clean
	• Plugged or contaminated fuel filter	Replacement
	• Fuel pump malfunction	Repair or replace
	• Plugged carburetor jet or needle valve	Disassemble and clean.
	• Poor throttle valve opening	Adjustment
	• Fuel pump malfunction	Adjustment
Incident in intake system	• Plugged air cleaner	Replace element
	• Air leakage from electronic throttle insulator	Replace insulator.
	• Air leakage from manifold gasket or carburetor insulator	Replace gasket or insulator.
Engine over temperature (Overheat)	• Insufficient amount of coolant	Fill coolant.
	• Loose fan belt.	Belt tension adjustment
	• Worn or loose fan belt	Replacement
	• Malfunctioning thermostat	Replacement
	• Water pump malfunction	Replacement
	• Plugged or leaking radiator	Wash, repair, or replace
	• Radiator cap damage	Replacement
	• Air in cooling system piping	Retighten cooling system piping, bleed system.
	• Improper engine oil grade	Replace with appropriate grade of engine oil.
	• Inappropriate ignition timing	Adjust.
	• Carburetor malfunction (too lean air-fuel mixture)	Overhaul carburetor
Overcool	Malfunctioning thermostat	Replacement
Other	• Inappropriate octane rating of fuel	Replace with specified octane rating of fuel.
	• Insufficient tire air pressure	Charge to specified air pressure.
	• Brake dragging	Adjustment
	• Clutch slippage	Adjustment

TROUBLE DIAGNOSIS

Condition	Possible causes	Action
Engine noise		
Knocking	• Engine overload	Operation with light load
	• Knocking due to carbon deposits	Remove cylinder head and eliminate carbon deposits
	• Knocking due to inappropriate ignition timing	Adjust ignition timing
	• Knocking due to inappropriate octane rating of fuel	Use specified octane rating of fuel.
	• Too advance ignition (Inappropriate spark plug selection)	Use specified type of spark plug.
Mechanical slapping		
Crankshaft bearing slapping	• Strong and heavy noise from engine during acceleration	A possible cause is in damage/wear of bearing or uneven wear of crankshaft.
	• To identify the noise generation point, attempt to cause misfires at each cylinder.	Need to replace bearing and adjust or replace crankshaft.
	• If misfires at a particular cylinder stop the noise, that cylinder is the noise source.	
Connecting rod bearing slapping	• This noise is also generated during engine acceleration but at a little more rapid pitch than crank slapping.	Take the same action as that for crankshaft bearing.
	• To identify the noise generation point, attempt to cause misfires at each cylinder.	
	• If misfires at a particular cylinder almost stop the noises, that cylinder is the noise source.	
Piston and cylinder slapping	• Mechanical rapping noise, which increases according the engine speed but decreases as the engine is warmed up, is attributed to the pistons and cylinders.	This noise is caused by excessive wear of cylinders and accompanied by engine power deterioration and excessive oil consumption.
	• To identify the noise generation point, attempt to cause misfires at each cylinder.	For a corrective action, engine overhaul is needed
Piston pin slapping	• This noise is generated at piston TDC and BDC positions.	A possible cause is wear of the piston pin hole or piston pin.
	• To identify the noise generation point, attempt to cause misfires at each cylinder.	Need to replace piston and piston pin assembly.
Water pump noise	• This noise is generated from worn or damaged bearing(s) due to the uneven sliding faces.	Replace water pump.
Excessive oil consumption		
Oil leakage	• Worn piston ring groove(s) and ring(s)	Replace piston(s) and piston ring(s).
	• Deteriorated valve oil seal lip(s)	Replace valve oil seal(s).
	• Worn valve stem(s)	Replace valve(s).
Other	• Use of inappropriate quality of oil	Use specified oil.
	• Engine overheat	Already described
Inappropriate fuel consumption		
Refer to description of engine power deterioration. Other	• Excessive idling speed	Adjust to specified level
	• Insufficient throttle return	Adjustment
	• Fuel leakage	Repair fuel piping and additionally tighten connections.

TROUBLE DIAGNOSIS


Condition	Possible causes	Action
Incident due to other factors		
Low oil pressure	• Use of inappropriate quality of oil	Replace specified oil.
	• Engine over temperature (Overheat)	Already described
	• Oil pump regulator valve malfunction	Overhaul or replace oil pump
	• Oil pump malfunction	Overhaul or replace oil pump
	• Oil filter malfunction	Replace with a new one.
	• Enlarged clearance of each sliding component	Disassemble and replace relevant sliding component(s).
	• Clogged oil strainer	Washing
	• Malfunction of oil pressure gauge pressure switch	Replace with a new one.
Excessive wear of sliding part(s)	• Low oil pressure	Already described
	• Poor quality of oil or foreign objects in oil	Replace oil element and oil with <i>appropriate</i> ones.
	• Poor performance of air cleaner	Inspect element
	• Overheat or excessive cooling	Already described
	• Inappropriate air-fuel ratio	Inspect fuel system
Bite of sliding parts	• Low oil pressure	Already described
	• Insufficient clearance	Adjust clearance to specified value.
	• Engine over temperature (Overheat)	Already described
	• Inappropriate air-fuel ratio	Inspect fuel system

ENGINE INSPECTION AND ADJUSTMENT

Engine Body Related


RETIGHTEN CYLINDER HEAD BOLTS

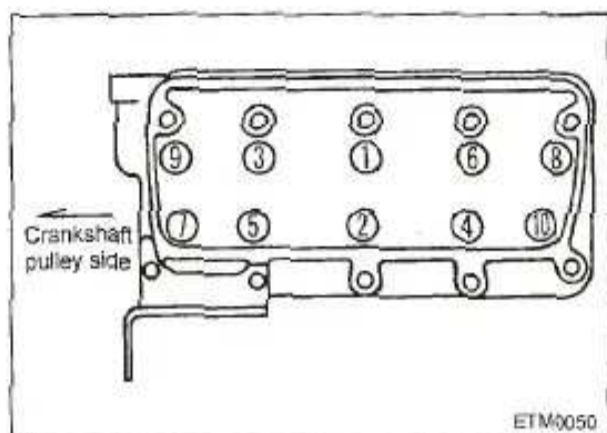
Retighten the bolts in the order shown in the figure on the left while the engine is cold.

 Tightening torque for cylinder head bolt:
68.6 N·m (7.0 kgf-m)

RETIGHTEN MANIFOLD NUTS.

To prevent leakage from intake and exhaust lines
Retighten the intake/exhaust manifold nuts.

 Tightening torque for manifold nut:
41.2 - 48.1 N·m (4.2 - 4.91 kgf-m)
(1 month or 200 operating hours)

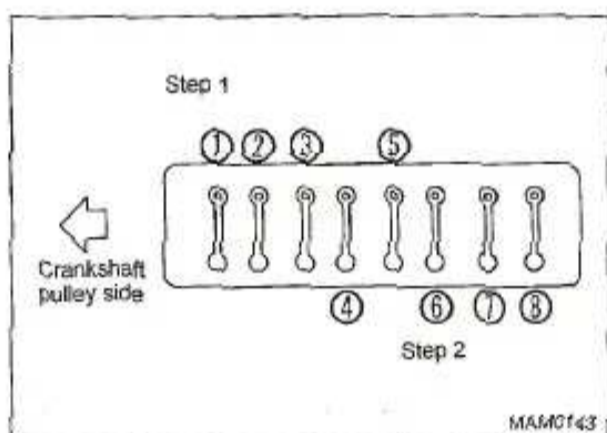


ADJUSTING VALVE CLEARANCE

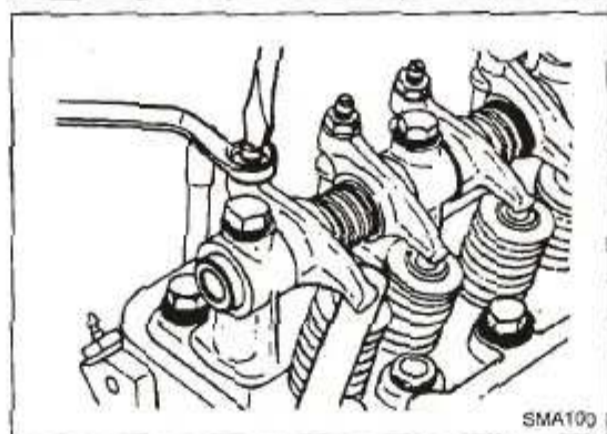
Perform adjustment while engine is hot and in standstill.

1. Start the engine and fully warm it up. Then stop the engine.
2. Remove the rocker cover.
3. Turn the crankshaft.

- (1) Set the piston for the No.1 cylinder to the compression TDC and adjust the valve clearance for (1)(2)(3)(5) in step (1) of the figure on the left.
- (2) Set the piston for the No.4 cylinder to the compression TDC and adjust the valve clearance for (4)(6)(7)(8) in step (2) of the figure on the left.



ADJUST VALVE CLEARANCE WHEN ENGINE IS HOT
Intake and exhaust : 0.38 mm (0.381 mm)



ENGINE INSPECTION AND ADJUSTMENT

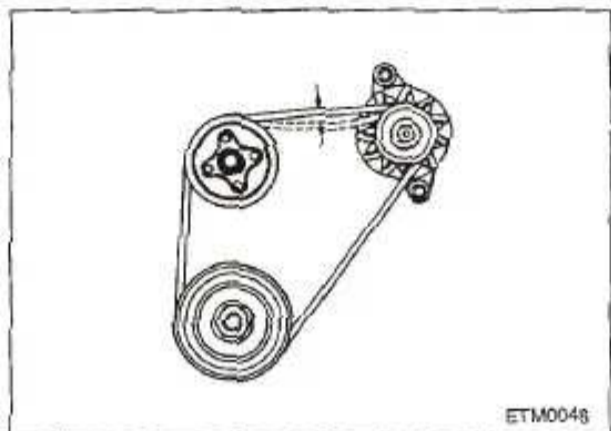
Engine Body Related (Cont'd)

INSPECT AND ADJUST ACCESSORY BELT

1. Visually check for *cracks, wear, and oil smears*.
(The belt must not contact with the bottom of the belt pulley.)
2. Check the belt *deflection by pressing at the center between the pulleys*.

Fan belt deflection: 11 - 13 mm

Force: 98N (10 kgf)




REPLACE OIL AND OIL FILTER

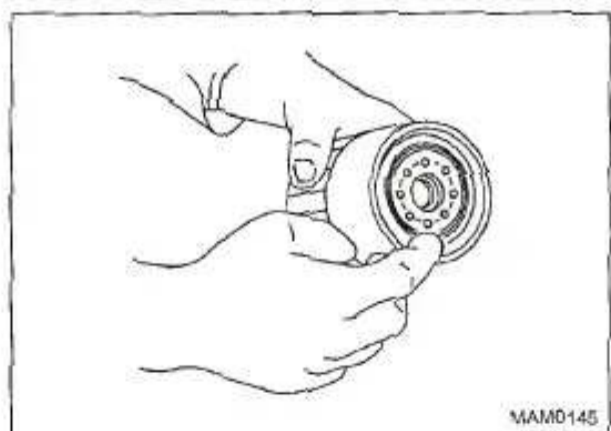
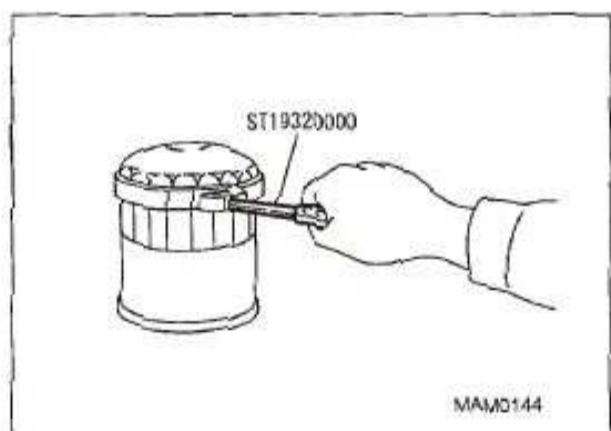
1. Start the engine and fully warm it up. Then stop the engine.
2. Remove the oil filler cap and the oil pan drain plug, and discharge all oil.
3. After discharging oil, install the drain plug with the washer.

CAUTION:

- **Be careful not to get burned when engine or engine oil is heated.**
- **If the oil looks milky, it is contaminated with coolant.**
- **If the viscosity is lower than specified, the oil is mixed with gasoline.**

 **Tightening torque for oil pan drain plug:
29.4 - 39.2 N·m (3.0 - 4.0 kgf·m)**

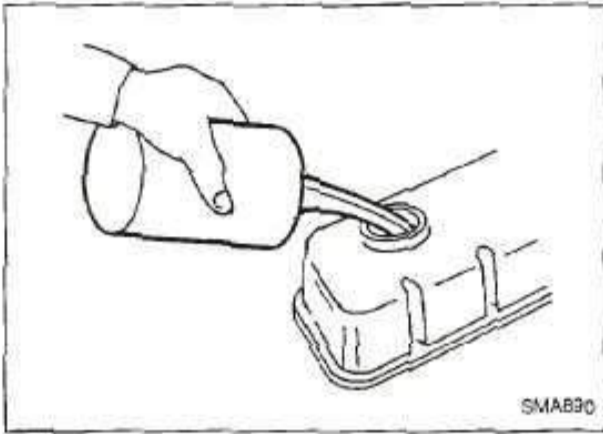
4. Remove the oil filter using an oil filter wrench (SST).
5. Clean the oil filter mounting face *with a clean shop cloth*.



6. Apply a small amount of engine oil to the lip of the new oil filter.
7. Screw in the oil filter by hand until it contacts bracket surface, and then screw in another 2/3 of a turn.

ENGINE INSPECTION AND ADJUSTMENT

Engine Body Related (Cont'd)



8. Fill the engine with oil of the recommended specifications and check the oil level with the oil level gauge.

Engine oil amount

Unit: liter (US qt, Imp qt)

With oil filter	3.7 (4, 3-3/8)
Without oil filter	3.4 (3-3/4, 3-1/8)

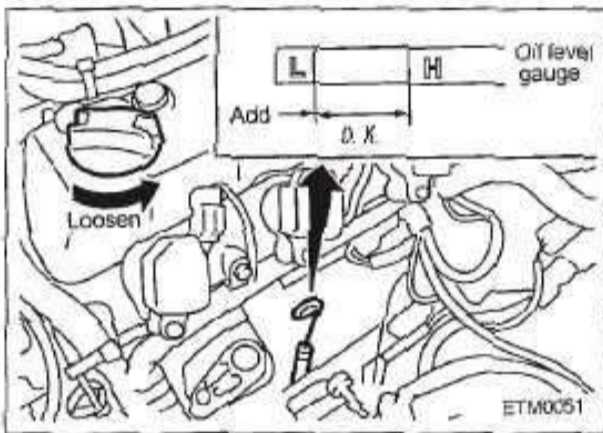
CAUTION:

Verify that the oil pressure warning lamp lights up before the engine starts and turns off after the engine has started.

9. Start the engine and check the area around the drain plug and oil filter for any leaks. If any leaks are found, the relevant part is not installed properly.
10. Warm up the engine sufficiently. Stop the engine and wait for a few minutes. Check the oil level and fill oil as necessary.

CAUTION:

When checking the oil level, ensure that the engine is level.



CHANGING ENGINE COOLANT

WARNING:

Do not drain coolant when engine is still hot. It may be a cause to get burned.

CAUTION:

Before mixing antifreeze with water, carefully read the instructions printed on the antifreeze package.

From the cylinder block plug if the engine is dismantled.

CLEAN RADIATOR OUTER FACE

Apply compressed air to the outer face of the radiator.

CHECK COOLANT HOSES AND CONNECTIONS

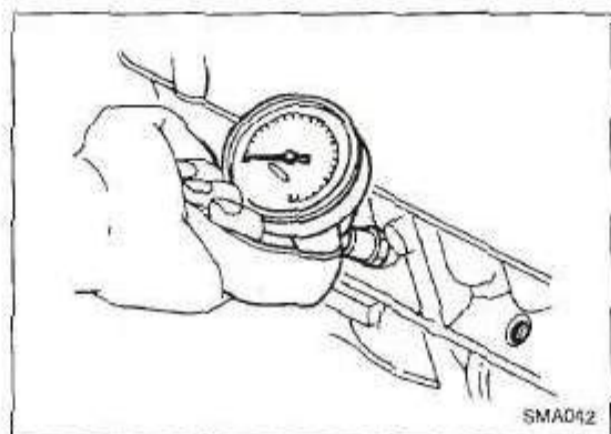
Check the hose connections for looseness and deterioration and retighten or replace the hose clamps as necessary.

ENGINE INSPECTION AND ADJUSTMENT

Engine Body Related (Cont'd)

COMPRESSION PRESSURE INSPECTION

1. Warm up the engine sufficiently and then stop it.
Release the fuel pressure. (Electronic controlled specifications)
2. Remove the spark plug.
3. Apply a compression gauge correctly to the cylinder plug hole to be measured.
4. Set the throttle valve to the fully-open position. Depress the throttle pedal to the fully-open position.
5. Crank the engine and read the gauge.
(The same operations can be used for both the carburetor and electronic control models)
 - Keep the engine speed at approximately 250 rpm.
 - Finish the pressure measurement in as short a time as possible.



Standard compression pressure

K15	1.27 kPa 13.0kgf/cm ² 250 rpm
K21	1.23 kPa 12.5 kgf/cm ² 250 rpm
K25	1.27 kPa 13.0kgf/cm ² 250 rpm

6. The compression pressure differences between cylinders must not exceed 1 kgf/cm²/250 rpm. If any cylinder shows an extremely low compression pressure, put a small amount of oil into the cylinder through the spark plug hole and remeasure the pressure.
 - If the pressure rises after filling oil, the piston ring is worn or damaged.
 - If the pressure remains unchanged even after filling oil, the valve is stuck or inappropriately seated.
 - If low compression pressure is observed in two adjacent cylinders and the pressure is not restored even after filling oil, the head gasket is leaking. In this case, oil and water may enter in the combustion chamber.
 - If the engine RPM is not in the specified range: Measure the battery specific gravity.

ENGINE INSPECTION AND ADJUSTMENT

Ignition and Fuel Systems

CLEANING OR REPLACEMENT OF AIR CLEANER ELEMENT

Dry filter type

It requires periodical cleaning and replacement. *If the engine is used in a heavily contaminated environment, perform maintenance more frequently.*



FUEL FILTER

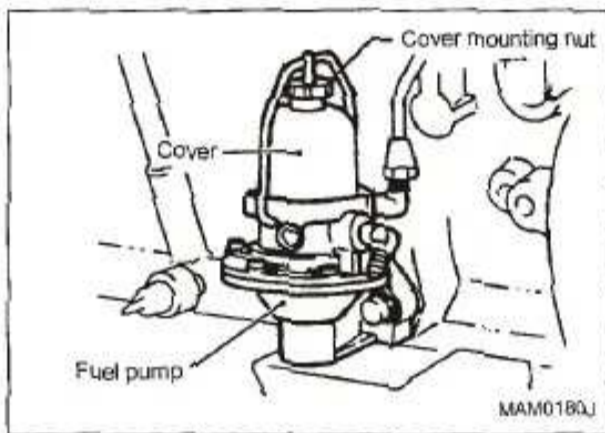
Cleaning and replacement (carburetor model only)

Periodically inspect, clean and replace the fuel filter.

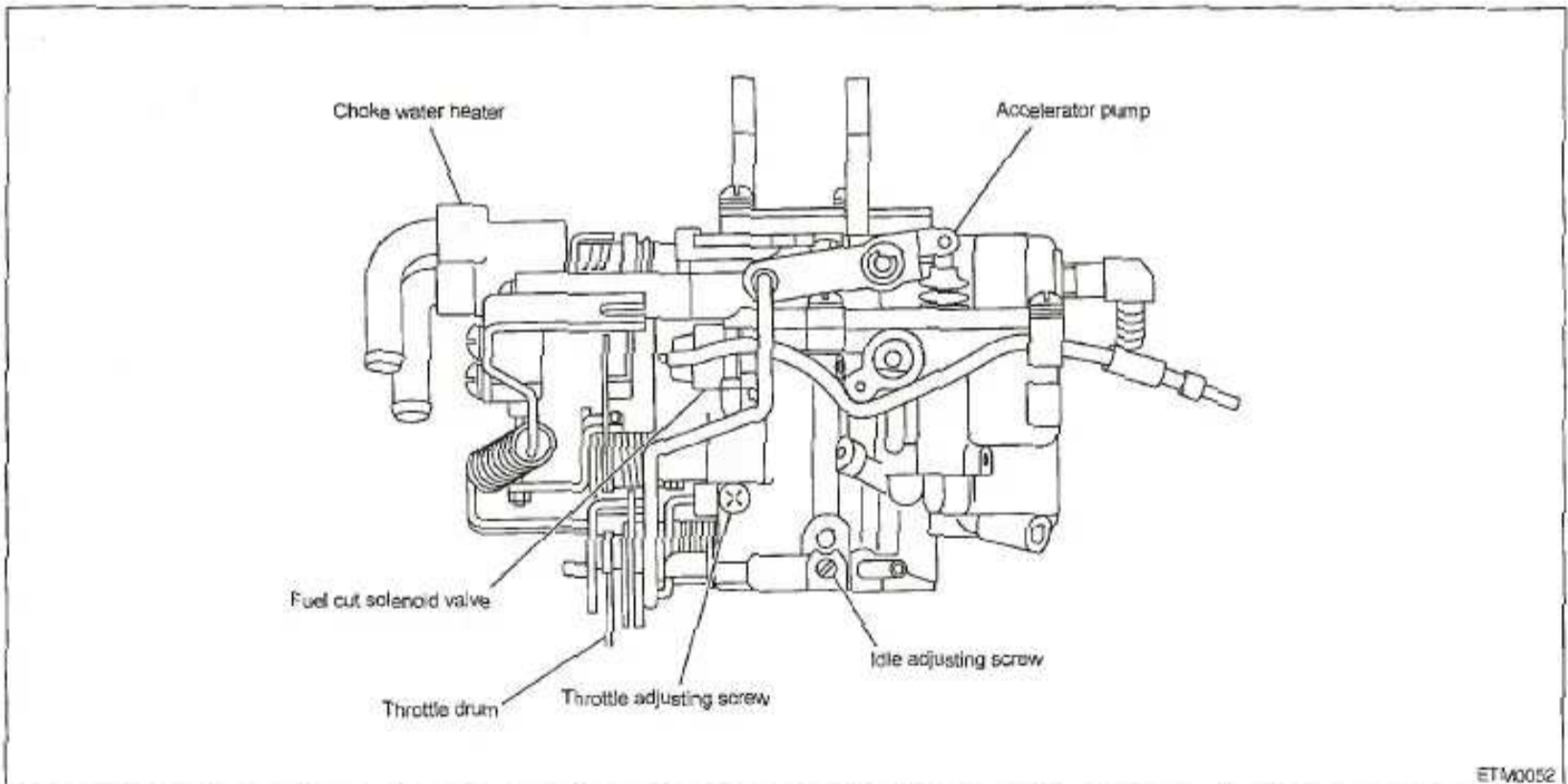
Fuel piping inspection

(Hoses, tubes, fittings)

Check the fuel piping for proper installation as well as leakage, cracks, and loose connections and replace damaged or malfunctioning parts as necessary.



CARBURETOR INSPECTION



Inspecting link mechanism and valves

- Remove the air horn and visually inspect the link system and internal components.
- Check the throttle shaft for wear by attempting to move it by hand. *The throttle shaft must not move.*
- Check the throttle valve and choke valve for proper operation. (Open, close)

ENGINE INSPECTION AND ADJUSTMENT

Ignition and Fuel Systems (Cont'd)

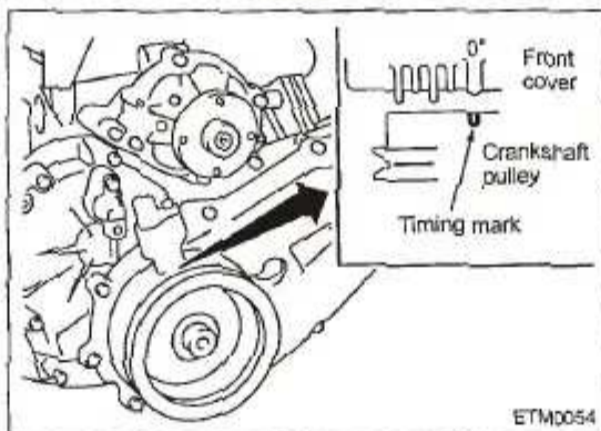
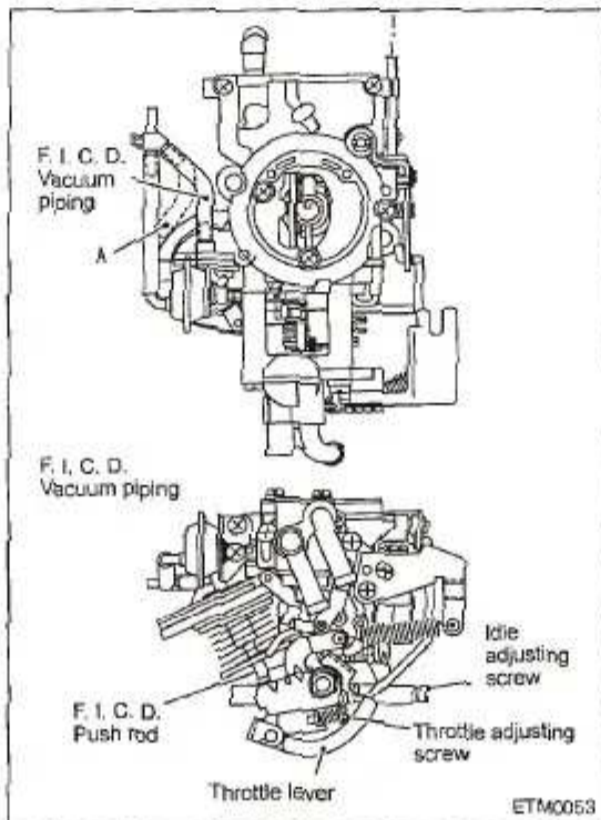
CARBURETOR MAINTENANCE

- If *contaminated heavily*, disassemble and clean the carburetor.
- If the link mechanism is excessively worn or damaged, replace it.
- If the throttle valve shaft is excessively worn or bent, replace it.

FICD (*fast idle control device*) inspection (carburetor model only)

1. Start and warm up the engine sufficiently.
2. Check that the hot water heater is heated.
3. Check that FICD does not contact with the carburetor throttle lever.
4. Adjust the idle speed by using the throttle adjusting screw and idle adjusting screw.

Idle speed: 700 rpm



5. Adjust the ignition timing for idling.

Ignition timing: BTDC

- K15: 0°
- K21: 2°
- K25: 0°

6. Remove the vacuum piping from FICD and plug the pipe openings to prevent air leakage.
7. In this state, the FICD pushrod is pushing the carburetor throttle lever.

Adjust the engine speed to 1,200 to 1,500 rpm with the throttle lever adjusting screw.


8. After adjustment, connect the vacuum piping and verify that an appropriate engine idle speed is obtained.

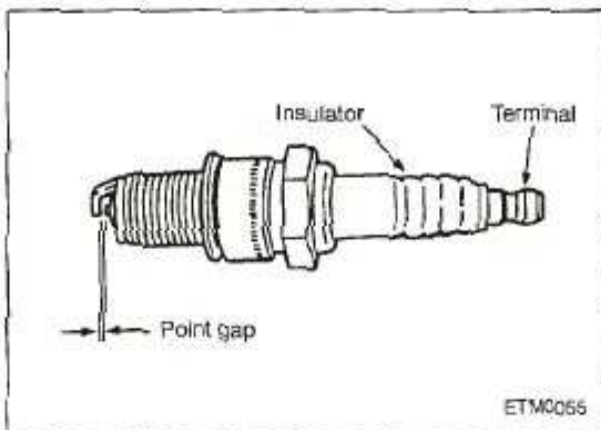
SPARK PLUG INSPECTION AND REPLACEMENT

1. Inspection
 - Visually check electrode for dirt and damage and insulator for burning.
 - Check if the electrode gap is within the standard using a plug gap gauge.

Standard (mm): 0.9

- Adjust if outside the standard.
 - Replace if necessary.
2. Installation
 - Install in the reverse order of removal.

 Tightening torque (N·m (kgf·m)): 19.6 - 29.4 (2.0 - 3.0)



ENGINE INSPECTION AND ADJUSTMENT

Ignition and Fuel Systems (Cont'd)

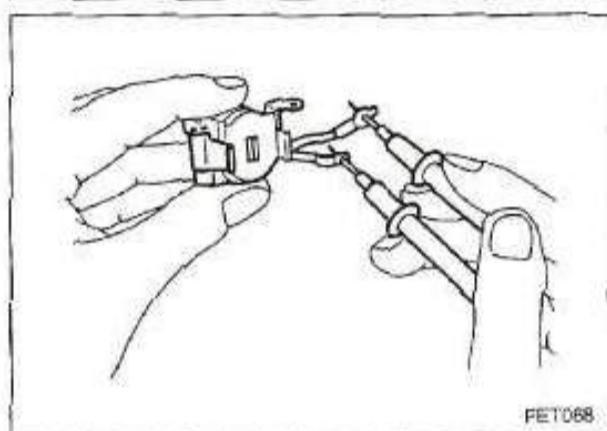
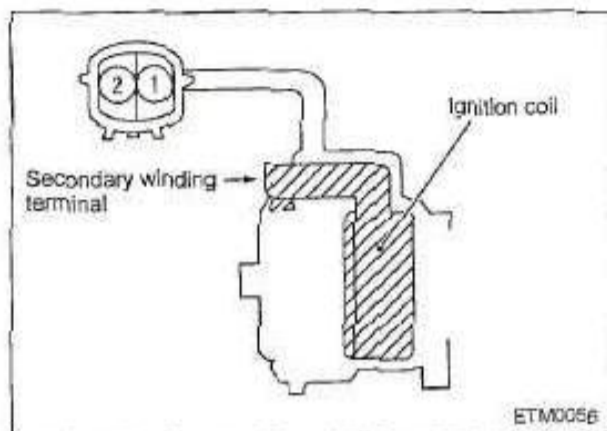
DISTRIBUTOR INSPECTION (CARBURETOR MODEL ONLY)

Ignition coil inspection

- Measure resistance terminals (1) and (2) of the primary coil and those of the secondary coil using a circuit tester.

Primary coil resistance: 0.9 - 1.2Ω

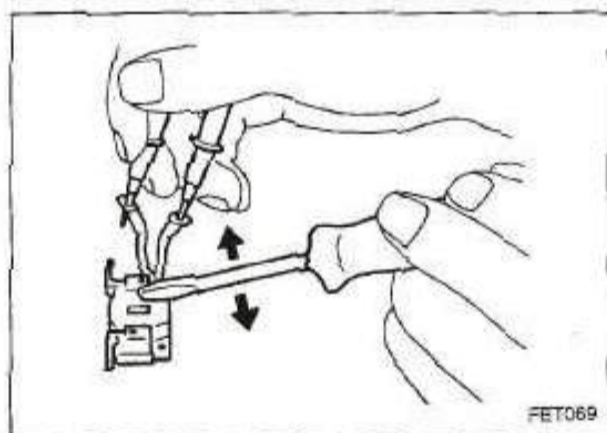
Secondary coil resistance: 20 - 29Ω



Pickup coil inspection

- Measure the pickup coil resistance using a circuit tester.

Resistance: 420 - 540Ω



- Move a screwdriver to and fro near the iron core of the pickup coil and make sure that the tester needle fluctuates.

INSPECTION OF DISTRIBUTOR CAP AND CARBON TERMINALS

- If the hemisphere face of a terminal is worn out, replace the cap.

ROTOR HEAD INSPECTION

- Check for cracks and damages.

SIGNAL CORE ROTOR INSPECTION

- Check for bends or damages.

VACUUM CONTROL SYSTEM INSPECTION

- Apply vacuum to the diaphragm with a vacuum pump and check that the link is drawn.

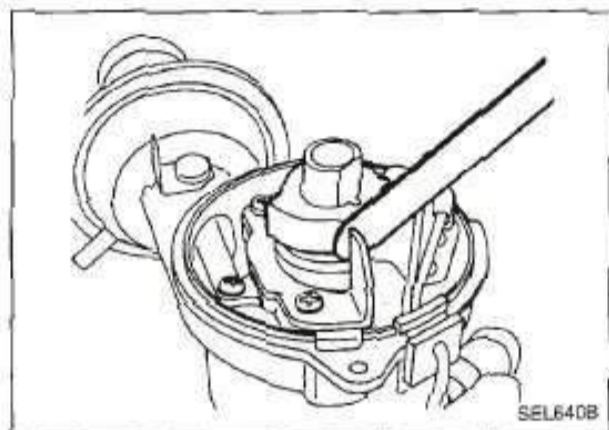
ENGINE INSPECTION AND ADJUSTMENT

Ignition and Fuel Systems (Cont'd)

INSPECTION AFTER REASSEMBLING DISTRIBUTOR

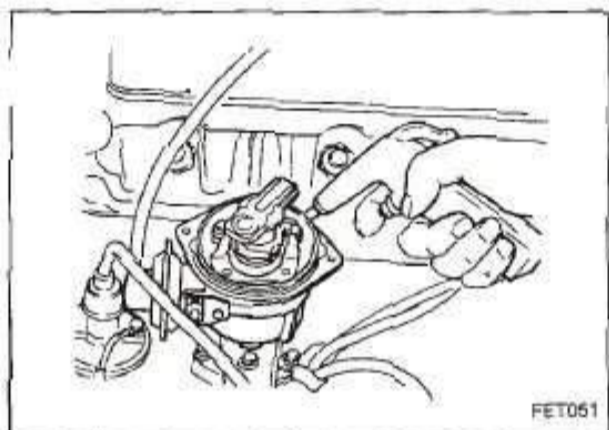
Measure the clearance between the signal core rotor and the pickup coil.

Standard clearance: 0.35 - 0.45 mm



CLEANING INSIDE DISTRIBUTOR

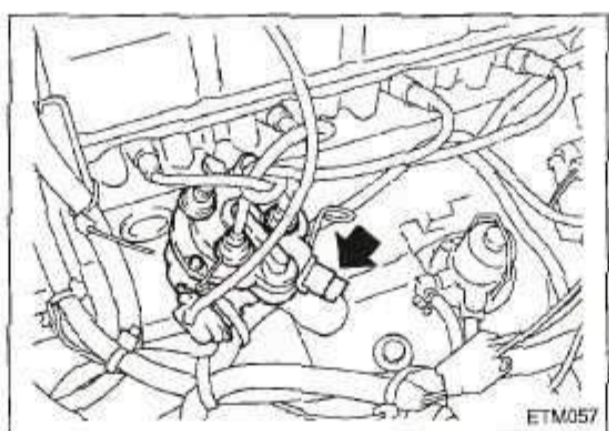
Blow any dust away from inside the distributor with dry compressed air.



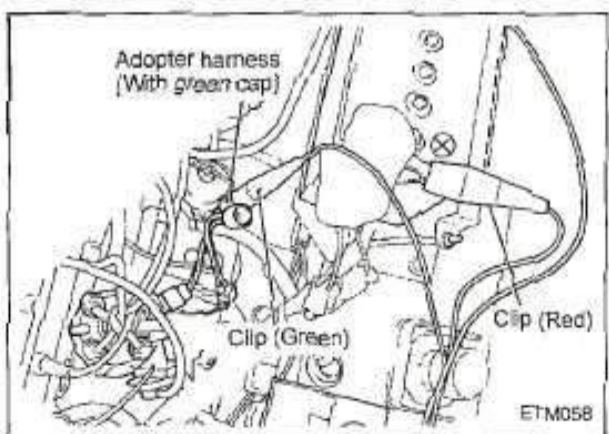
ENGINE SPEED MEASUREMENT (CARBURETOR MODEL ONLY)

The ignition coil-integrating distributor of the K engine provides an adapter harness for engine speed measurement.

1. Remove the distributor connector from the coupling as shown in the figure on the left.



2. Connect the ignition coil adapter harness (SST: EG11140000) between the distributor connector and the coupling. Connect the tachometer power supply terminal (red) to the battery positive terminal and the black terminal to the battery negative terminal. Connect the measurement terminal (green) to the measurement wire in the middle of the adapter harness.



ENGINE INSPECTION AND ADJUSTMENT

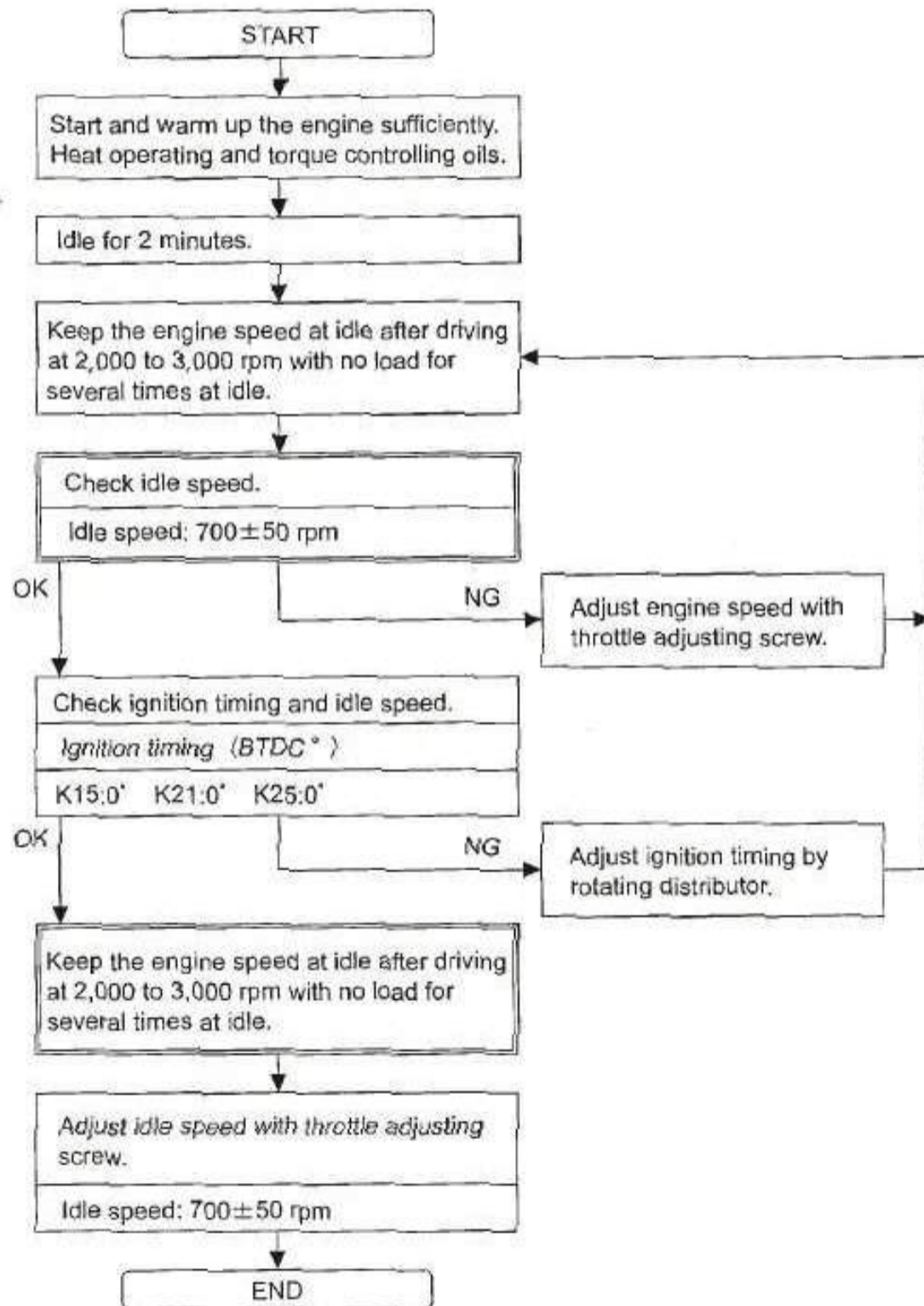
Ignition and Fuel Systems (Cont'd)

INSPECTION AND ADJUSTMENT OF IGNITION TIMING, IDLE SPEED, AIR-FUEL RATIO (CARBURETOR MODEL ONLY)

- In general, the engine requires no idle speed adjustment because it is adjusted properly before shipment. If the idle speed must be adjusted in any means, follow the procedure below.
- Do not fully tighten the idle adjusting screw. Doing so damages the screw end and leads to loss of functionality.

Preparation

- Make sure that the following parts conditions are good.
 - Ignition system
 - Lubricant and coolant levels
 - Valve clearance
 - Fuel level at idle
- Set selector lever to the neutral position.

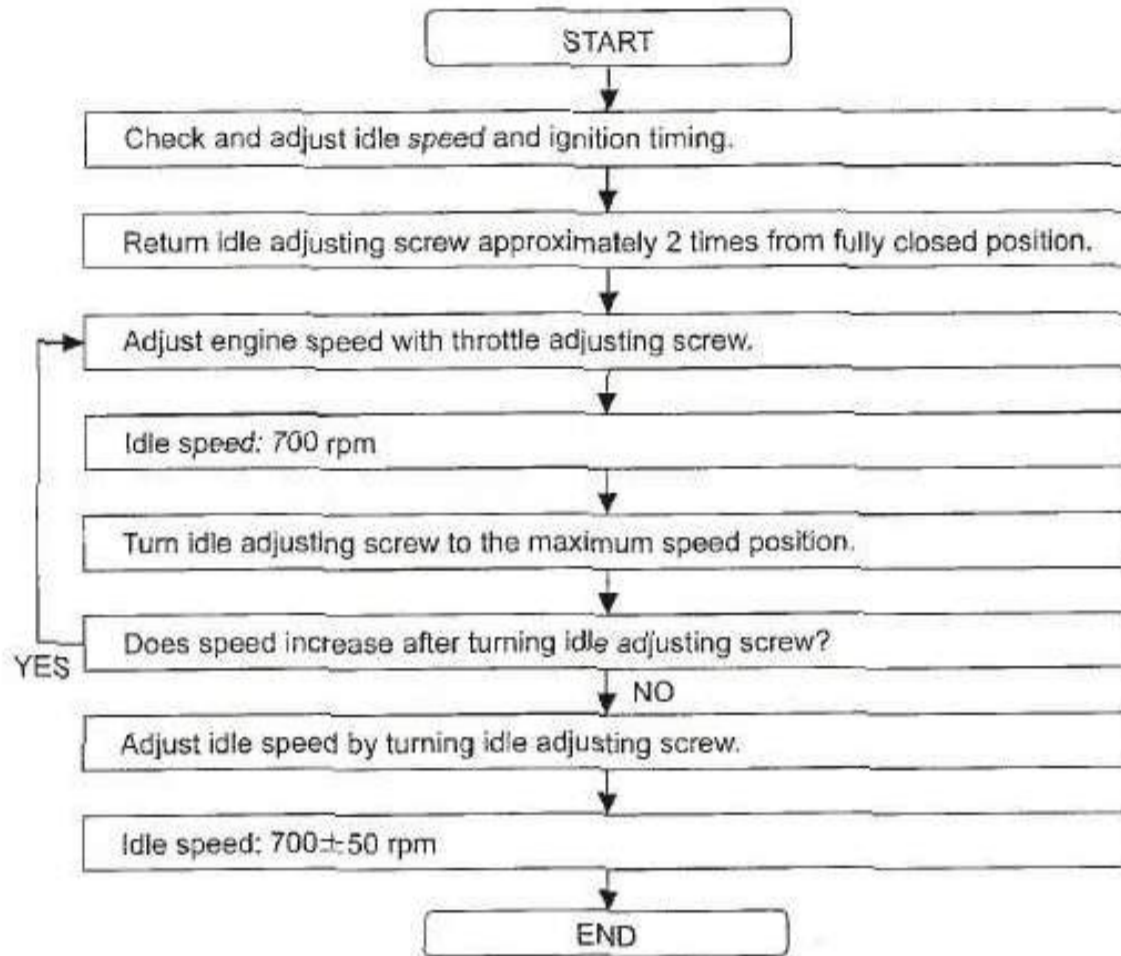


ETM0062

ENGINE INSPECTION AND ADJUSTMENT

Ignition and Fuel Systems (Cont'd)

INSPECTION AND ADJUSTMENT OF AIR-FUEL RATIO (CARBURATOR MODEL ONLY)



ETM0063

GOVERNOR DEVICE

The governor requires no adjustment because it is adjusted properly before shipment.

If it must be adjusted by any means, follow the procedure below.

ADJUSTING MAXIMUM RPM WITH NO LOAD

1. Set the forward/reverse shift lever to the neutral position.
2. Start the engine and fully open the throttle. Monitor the engine speed.

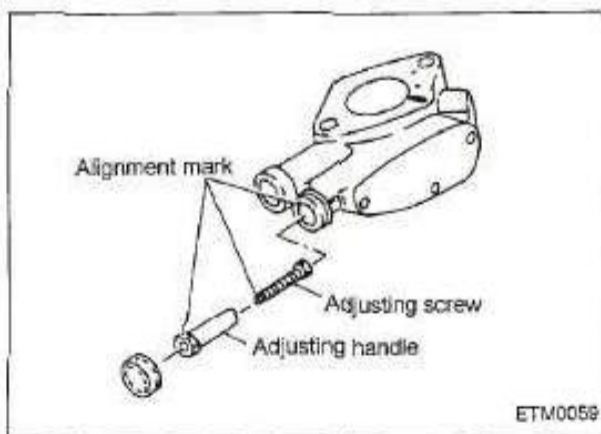
Maximum engine speed with no load (rpm)

K15 3,600

K21 3,600

K25 3,600

3. If the engine speed does not fall in the specified range, adjust by turning the governor adjusting handle.



ENGINE INSPECTION AND ADJUSTMENT

Ignition and Fuel Systems (Cont'd)

ADJUSTING MAXIMUM RPM WITH LOAD

1. Set the forward/reverse shift lever to the neutral position.
2. Start the engine and fully tilt the mast rearward with the tilt lever.
3. Fully open the throttle and monitor the engine speed.

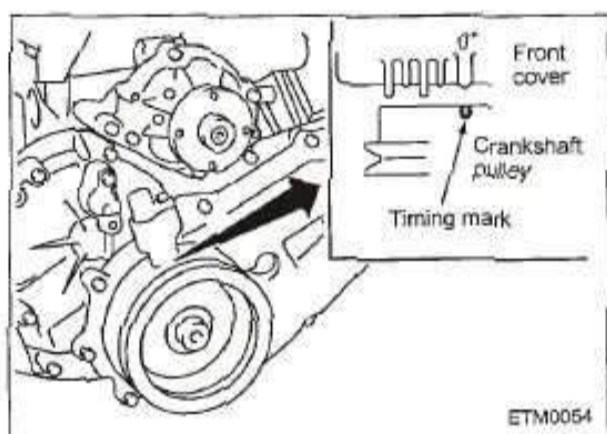
Maximum engine speed with load (rpm)

K15 3,000

K21 3,000

K25 3,000

4. If the engine speed does not fall in the specified range, adjust by turning the governor adjusting handle. In addition, adjust the maximum engine speed with no load.



FICD (FAST IDLE CONTROL DEVICE) INSPECTION (CARBURETOR MODEL ONLY)

1. Start and warm up the engine sufficiently.
2. Check that FICD does not contact the carburetor throttle lever.
3. Adjust the idle speed by using the throttle adjusting screw and idle adjusting screw.

Idle speed: 700±50 rpm

4. Adjust the ignition timing for idling.

Ignition timing: BTDC

K15: 0°

K21: 2°

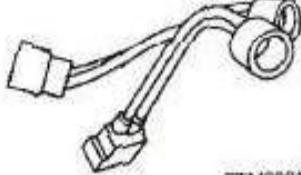
K25: 0°

5. Remove the vacuum piping from FICD and plug the pipe openings to prevent air leakage.
6. In this state, the FICD pushrod is pushing the carburetor throttle lever.

Adjust the engine speed to 1,200 to 1,500 rpm with the throttle lever adjusting screw.

7. After adjustment, connect the vacuum piping and verify that an appropriate engine idle speed is obtained.

SPECIAL SERVICE TOOLS FOR CARBURETOR MODEL

Tool number	Tool name
EG11140000	<p data-bbox="687 531 876 588">Ignition coil Adapter harness</p> <p data-bbox="1439 531 1747 559">For checking engine speed</p>  <p data-bbox="1294 738 1379 757">ETM0000</p>

ENGINE MECHANICAL

SECTION **EM**

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PRECAUTIONS

Precautions for Draining Engine Coolant

- Drain coolant only after the engine has cooled down.

Precautions for Disconnecting Fuel Piping

- Operation should be done in a place free from fire.
- Release fuel pressure before operation. (Electronic controlled specifications): Refer to "Release of Fuel Pressure" in EC section.
- After disconnecting, plug the pipe to prevent fuel from draining.

Precautions for Removing and Disassembling

- Use correct SSTs in the specified position. Always pay attention to safety.
- Be careful not to lose surface accuracy of mating or sliding surfaces.
- To prevent foreign material from entering the engine, close openings with appropriate tape as necessary.
- Arrange disassembled parts in their normal positions in order to simplify locating the cause of damage or excessive wear and to ensure correct reassembly.
- As a rule, nuts and bolts must be tightened in a diagonal manner starting from an outer one. If a particular tightening sequence is provided separately, follow the sequence.

Precautions for Inspection, Correction, and Replacement

- Following the inspection procedure, inspect the parts adequately and repair or replace as necessary. Perform the same inspections even for new parts and replace them if necessary.

Precautions for Assembly and Installation

- Always use a torque wrench when tightening nuts and bolts.
- Unless otherwise specified, tighten bolts and nuts from inside to outside in a crisscross pattern. Tighten them gradually and evenly in 2 to 3 steps.
- Always replace gasket, packing, oil seals, and O-rings with new ones.
- For each part, perform adequate cleaning/washing and drying with a dryer. In particular, ensure that the oil and coolant passages are free from plugging and clogging.
- Remove any dirt and lint on sliding and mating surfaces. Before assembly, apply ample amount of engine oil to sliding surfaces.
- If coolant was drained, bleed air from the system.
- After assembly, start engine and increase the engine speed, then check coolant, fuel, oil, grease, and exhaust gas for leakage.

PRECAUTIONS

Parts Requiring Angle Tightening

- When tightening the following parts, use an angle wrench (SST).
- Cylinder head bolt
Before assembly, verify that no grease/oil and dust are present on the cylinder head, cylinder block mounting face, and head gasket. Then apply antirust oil or engine oil to the threads and head bottoms of the head bolts.

Caution for Use of Power Tools

- The use of power tools such as an air runner are only allowed for disassembly. Do not use them for assembly.

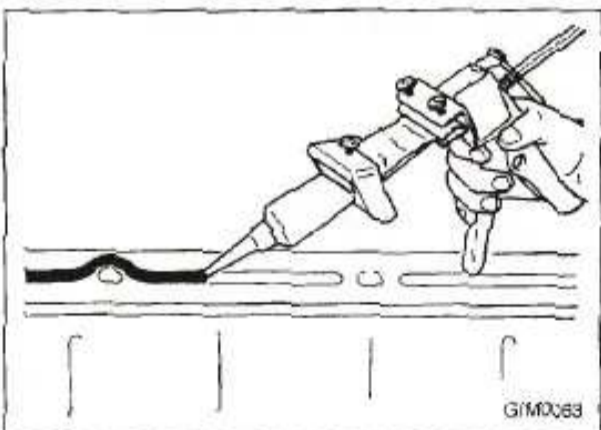
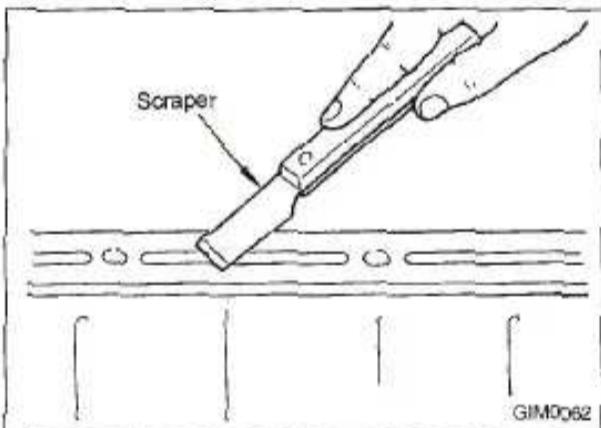
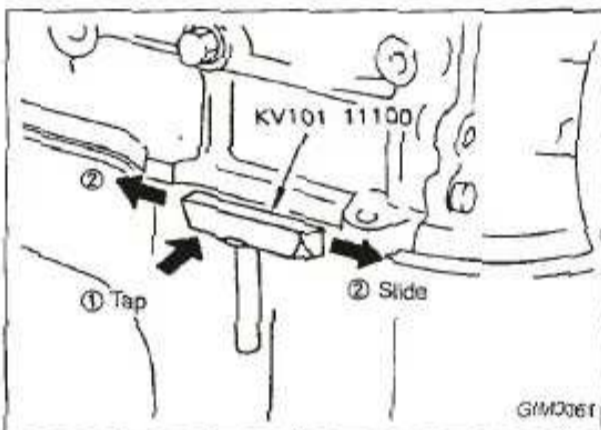
Precautions for Liquid Gasket Application

REMOVING PARTS ATTACHED WITH LIQUID GASKET

- Remove mounting nuts and bolts. Remove liquid gasket using a seal cutter (SST).

CAUTION:

- Be careful not to damage the mating surfaces.
- In positions where a seal cutter is difficult to use, lightly tap with a plastic hammer, and remove.
- Be careful not to scratch the mating surfaces when using a screwdriver.



LIQUID GASKET APPLICATION INSTRUCTION

1. Remove any old liquid gasket remaining on the gasket application surface and its mating surface using a scraper.
 - Remove any old liquid gasket remaining in the gasket application groove and on the threads of bolts and bolt holes.
2. Wipe the gasket application surface and its mating surface using Isozole or any equivalent thinner to remove any moisture, oil, and foreign material.
3. Set genuine liquid gasket to tube presser (commercial service tool).
4. Apply a continuous bead of liquid gasket to the specified position at the specified diameter.
 - Apply liquid gasket in the application groove.
 - Apply liquid gasket inside bolt holes as a rule. Make sure to carefully read the relevant instructions.
 - Attaching should be done within 5 minutes after gasket application.
 - Immediately wipe off any protruding liquid gasket.
 - Do not retighten nuts and bolts after installation.
 - After finishing work, wait at least 30 minutes before refilling engine oil and coolant.

CAUTION:

Follow any directions specified in the text on the following pages.

ADJUSTMENT VALUE

VALVE MECHANISM

- Valve clearance (Hot) : mm (in)

Standard	Intake	0.38 (0.015)
	Exhaust	0.38 (0.015)

VALVE

- Head outer diameter : mm (in)

Standard	Intake	38.0 - 38.3 (1.496 - 1.508)
	Exhaust	32.0 - 32.3 (1.260 - 1.272)
- Valve total length

Intake	98.85 - 99.45 (3.892 - 3.915)
Exhaust	98.95 - 99.55 (3.896 - 3.919)
- Valve stem outer diameter : mm (in)

Standard	Intake	6.97 - 6.985 (0.2744 - 0.2750)
	Exhaust	6.945 - 6.960 (0.2734 - 0.2740)
- Valve spring free length

Intake and exhaust : mm (in)	45.9 (1.807)
------------------------------	--------------

 Valve-opening compressed length
 Intake and exhaust mm/N (mm/kg, in/lb)
 25.0/347.0 - 391.2 (25.0/35.4 - 39.9, 0.984/78.1 - 88.0)
 Valve spring installation length (when closed)
 Intake and exhaust mm/N (mm/kg, in/lb)
 33.8/177.9 - 200.7(33.8/18.1 - 20.5, 1.331/40.0 - 45.1)
 Valve spring slant
 Intake and exhaust : mm (in) 1.5 (0.059)
- Clearance between valve stem and valve guide : mm (in)

Standard	Intake	0.015 - 0.048 (0.0006 - 0.0019)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)
Repair limit	Intake	0.10 (0.0039)
	Exhaust	0.10 (0.0039)

 Valve seat width

Intake	1.1 - 1.4 (0.043 - 0.055)
Exhaust	1.8 - 2.2 (0.071 - 0.087)

 Valve seat angle
 Intake and exhaust. 44°23' ~ 45°07'
 Valve face angle
 Intake 45°15' ~ 45°45'
 Exhaust 44°30' ~ 45°
- *Camshaft*
 - Bend : mm (in)

Repair limit	0.05 (0.0020)
--------------	---------------
 - End play : mm (in)

Standard	0.15 - 0.23 (0.0059 - 0.0091)
Repair limit	0.40 (0.0157)
 - *Journal dimensions : mm (in)*

Standard	Front	45.434 - 45.447 (1.7887 - 1.7892)
	Center	43.897 - 43.910 (1.7282 - 1.7287)
	Rear	41.218 - 41.231 (1.6228 - 1.6233)
 - *Oil clearance at journal : mm (in)*

Standard	Front	0.025 - 0.051 (0.0010 - 0.0020)
	Center	0.038 - 0.064 (0.0015 - 0.0025)
	Rear	0.025 - 0.051 (0.0010 - 0.0051)
Repair limit	Front	0.10 (0.0039)
	Center	0.15 (0.0059)
	Rear	0.10 (0.0039)

ADJUSTMENT VALUE

- *Camshaft height : mm (in)*
Standard 36.750 - 36.800 (1.4468 - 1.4488)
(For both intake and exhaust)
Size reduction limit 36.5 (1.437)

CRANKSHAFT

- *Bend : mm (in)*
Repair limit 0.05 (0.0020)
- *End play : mm (in)*
Standard 0.05 - 0.18 (0.0020 - 0.0071)
Repair limit 0.20 (0.0079)
- *Journal dimensions : mm (in)*
Standard 62.942 - 62.955 (2.4780 - 2.4785)
- *Pin standard dimension : mm (in)*
Standard 44.961 - 44.974 (1.7701 - 1.7706)
(K15, K21, K25)
- *Oil clearance at journal : mm (in)*
Standard 0.020 - 0.073 (0.0008 - 0.0029)
Repair limit 0.10 (0.0039)

FLATNESS OF FLYWHEEL AND DRIVE PLATE

- *Flatness of flywheel : mm (in)*
Repair limit 0.10 (0.0039)
- *Runout of drive plate : mm (in)*
Repair limit 0.20 (0.0079)
- *Flatness of ring gear : mm (in)*
Repair limit 0.50 (0.0197)
- *Flatness : mm (in)*
Repair limit 0.30 (0.0118)

CONNECTING ROD

- *Center distance between both end holes : mm (in)*
Standard 143.970 - 144.030
(5.6681 - 5.6705) (K25)
152.47 - 152.53
(6.0027 - 6.0051) (K15, K21)
- *Large end hole diameter : mm (in)*
Standard 48.0 - 48.013 (0.7807 - 1.8903)
(K15, K21, K25)
- *Small end hole diameter : mm (in)*
Standard 19.965 - 19.978 (0.7860 - 0.7865)
(K15, K21, K25)
- *Bend [per 100 mm (3.94 in)] : mm (in)*
Repair limit 0.05 (0.0020)
- *Twist [per 100 mm (3.94 in)] : mm (in)*
Repair limit 0.05 (0.0020)
- *Large end thrust clearance : mm (in)*
Standard 0.2 - 0.3 (0.008 - 0.012)
Repair limit 0.40 (0.0157)
- *Large end oil clearance : mm (in)*
Standard 0.032 - 0.060 (0.0013 - 0.0024)
(K15, K21, K25)
Repair limit 0.10 (0.0039)
- *Weight difference (piston combination): g (oz)*
Standard 5 (0.18) or less

ADJUSTMENT VALUE

PISTON

- Piston : mm (in)
 - Type Thermal flow type
 - Material Aluminum alloy
 - Outer diameter
 - Standard 75.465 - 75.515 (2.9317 - 2.9730) (K15)
 - 88.965 - 89.015 (3.5026 - 3.5045) (K21, K25)
- Clearance to cylinder : mm (in)
 - Standard 0.025 - 0.045 (0.0010 - 0.0018)
- Piston pin outer diameter : mm (in)
 - Standard 19.993 - 19.998 (0.7871 - 0.7873) (K15, K21, K25)
- Piston pin fitting quality
 - Standard To a degree allowing movement by hand
- Piston ring closed gap : mm (in)
 - Standard
 - Top 0.28 - 0.43 (0.0110 - 0.0169) (K21, K25),
 - 0.25 - 0.35 (0.0098 - 0.0138) (K15)
 - Second 0.45 - 0.60 (0.0177 - 0.0236) (K21, K25),
 - 0.15 - 0.25 (0.0059 - 0.0098) (K15)
 - Oil 0.20 - 0.60 (0.0079 - 0.0236) (K21, K25),
 - 0.2 - 0.6 (0.008 - 0.024) (K15)
 - Various limit values 1.00 (0.0039)
- Clearance between piston ring and ring groove : mm (in)
 - Standard
 - Top 0.04 - 0.08 (0.0016 - 0.0032)
 - Second 0.03 - 0.07 (0.0012 - 0.0028)
 - Oil 0.65 - 0.135 (0.0256 - 0.0053)
 - Repair limit
 - Top 0.10 (0.0039)
 - Second 0.10 (0.0039)
 - Oil —
- Pin outer diameter : mm (in)
 - 19.993 - 19.998 (0.7871 - 0.7873) (K15, K21, K25)

CYLINDER HEAD

- Valve guide : mm (in)
 - Standard 7.000 - 7.018 (0.2756 - 0.2763) (for both intake and exhaust)
- Valve stem-to-valve guide clearance : mm (in)
 - Repair limit 0.10 (0.0039) (for both intake and exhaust)

CYLINDER BLOCK

- Cylinder bore inner diameter : mm (in)
 - Standard 75.5 - 75.55 (2.9724 - 2.9744) (K15)
 - 89.00 - 89.05 (3.5089 - 3.5059) (K21, K25)
- Wear limit 0.2 (0.0079)
- Cylinder bore taper and out-of-round : mm (in)
 - 0.2 (0.0008)
- Top face distortion limit : mm (in) 0.05 (0.0020)
- Distortion limit : mm (in)
 - Intake manifold 0.1 (0.004)
 - Exhaust manifold 0.3 (0.012)
 - Cylinder head 0.1 (0.004)
 - Cylinder block 0.1 (0.004)

TIGHTENING TORQUE

Standard Bolt Tightening Torque

Upper: Lubricated (Antirust oil is applied to abrasive faces of threads and seating faces)

Lower: No lubrication (Threads and seating faces are completely degreased)

	Thread size		Unit	4T (Bolt)	7T (Bolt)	9T (Bolt)
	Diameter	Pitch				
Hexagon head bolt and nut	M6	1	N·m	3.8 - 4.4	6.4 - 7.5	9.2 - 10.8
			kg·m	0.39 - 0.45	0.65 - 0.76	0.94 - 1.1
			ft·lb, in·lb*	34 - 39*	56 - 66*	82 - 95*
			N·m	5.0 - 6.5	8.4 - 10.8	11.8 - 15.7
			kg·m	0.51 - 0.66	0.86 - 1.1	1.2 - 1.6
			ft·lb, in·lb*	44 - 57*	75 - 95*	9 - 12
	M8	1.25	N·m	9.3 - 10.8	15.7 - 17.7	22.8 - 25.5
			kg·m	0.95 - 1.1	1.6 - 1.8	2.3 - 2.6
			ft·lb, in·lb*	82 - 95	12 - 13	17 - 19
			N·m	12.7 - 15.7	20.6 - 26.5	29.4 - 37.3
			kg·m	1.3 - 1.6	2.1 - 2.7	3.0 - 3.8
			ft·lb, in·lb*	9 - 12	15 - 20	22 - 27
	M10	1.25	N·m	19.6 - 22.6	32.4 - 38.2	47.1 - 53.9
			kg·m	2.0 - 2.3	3.3 - 3.9	4.8 - 5.5
			ft·lb, in·lb*	14 - 17	24 - 28	35 - 40
			N·m	25.5 - 33.3	43.1 - 54.9	61.8 - 78.5
			kg·m	2.6 - 3.4	4.4 - 5.6	6.3 - 8.0
			ft·lb, in·lb*	19 - 25	32 - 41	46 - 58
1.5		N·m	18.6 - 21.6	30.4 - 36.3	44.1 - 52	
		kg·m	1.9 - 2.2	3.1 - 3.7	4.5 - 5.3	
		ft·lb, in·lb*	14 - 16	22 - 27	33 - 38	
		N·m	24.5 - 31.4	41.2 - 52	58.8 - 74.5	
		kg·m	2.5 - 3.2	4.2 - 5.3	6.0 - 7.6	
		ft·lb, in·lb*	18 - 23	30 - 38	43 - 55	
Flanged bolt	M6	1	N·m	4.9 - 5.7	8.14 - 9.51	11.8 - 13.7
			kg·m	0.5 - 0.58	0.83 - 0.97	1.2 - 1.4
			ft·lb, in·lb*	43 - 50*	72 - 84*	9 - 10
			N·m	6.0 - 7.7	9.8 - 12.7	14.7 - 18.6
			kg·m	0.61 - 0.78	1.0 - 1.3	1.5 - 1.9
			ft·lb, in·lb*	53 - 68*	87 - 113	11 - 14
	M8	1.25	N·m	11.8 - 13.7	19.6 - 23.5	28.4 - 33.3
			kg·m	1.2 - 1.4	2.0 - 2.4	2.9 - 3.4
			ft·lb, in·lb*	9 - 10	14 - 17	21 - 25
			N·m	14.7 - 18.6	24.5 - 31.4	35.3 - 45.1
			kg·m	1.5 - 1.9	2.5 - 3.2	3.6 - 4.6
			ft·lb, in·lb*	11 - 14	18 - 23	26 - 33
	M10	1.25	N·m	24.5 - 29.4	41.2 - 48.1	59.8 - 69.6
			kg·m	2.5 - 3.0	4.2 - 4.9	6.1 - 7.1
			ft·lb, in·lb*	18 - 22	30 - 35	44 - 51
			N·m	30.4 - 39.2	51.0 - 64.7	73.6 - 93.2
			kg·m	3.1 - 4.0	5.2 - 6.6	7.5 - 9.5
			ft·lb, in·lb*	22 - 29	38 - 48	54 - 69
1.5		N·m	23.5 - 27.5	39.2 - 46.1	56.9 - 65.7	
		kg·m	2.4 - 2.8	4.0 - 4.7	5.8 - 6.7	
		ft·lb, in·lb*	17 - 20	29 - 34	42 - 48	
		N·m	29.4 - 37.3	49.0 - 61.8	69.6 - 89.2	
		kg·m	3.0 - 3.8	5.0 - 6.3	7.1 - 9.1	
		ft·lb, in·lb*	22 - 27	38 - 46	51 - 66	

CAUTION:

- Except special nuts and bolts.
- The bolts applicable to this table have one of the following marks embossed on their heads.

4T.....4
7T.....7
9T.....9

TIGHTENING TORQUE

TAPER SCREW TIGHTENING TORQUE

Allowable materials for tightening Normal size	Unit	Aluminum		Cast iron	
		Standard	Max. value	Standard	Max. value
R1/8	N•m	7.8	11.8	15.7	21.6
	kg-m	0.796	1.2	1.6	2.2
	ft-lb, in-lb*	69*	9	12	16
R1/4	N•m	19.6	29.4	34.3	44.1
	kg-m	2.0	3.0	3.5	4.5
	ft-lb, in-lb*	14	22	25	33
R3/8	N•m	39.2	54.9	53.9	73.5
	kg-m	4.0	5.6	5.5	7.5
	ft-lb, in-lb*	29	41	40	54

Engine Part Tightening Torque

TIGHTENING TORQUE AT VARIOUS POINTS OF ENGINE

Tightening point	Unit	Standard	Max. value
Cylinder head (lubricated)		Separately given	
Main bearing cap (lubricated)		Separately given	
Crankshaft pulley bolt (lubricated)	N•m	220.5	240.1
	kg-m	22.5	24.5
	ft-lb, in-lb*	163	177
Flywheel bolt (lubricated)	N•m	132	142
	kg-m	13.47	14.49
	ft-lb, in-lb*	97	105
Connecting rod nut (lubricated)	N•m	31.4	37.3
	kg-m	3.2	3.81
	ft-lb, in-lb*	23	28
Rear plate bolt	N•m	44.1	58.8
	kg-m	4.5	6.0
	ft-lb, in-lb*	33	43
Camshaft sprocket bolt	N•m	39.2	49
	kg-m	4.0	5.0
	ft-lb, in-lb*	29	36
Oil filter stud	N•m	29.4	39.2
	kg-m	3.0	4.0
	ft-lb, in-lb*	22	29
Oil filter element	N•m	14.7	20.6
	kg-m	1.5	2.1
	ft-lb, in-lb*	11	15
Spark plug	N•m	19.6	29.4
	kg-m	2.0	3.0
	ft-lb, in-lb*	14	22
Engine slinger bolt	N•m	22.6	25.5
	kg-m	2.31	2.6
	ft-lb, in-lb*	17	22
Rocker cover nut	N•m	13.7	15.7
	kg-m	1.4	1.6
	ft-lb, in-lb*	10	12
Water temperature gauge	N•m	15.7	19.6
	kg-m	1.6	2.0
	ft-lb, in-lb*	12	14
Oil pressure switch	N•m	15.7	21.6
	kg-m	1.6	2.2
	ft-lb, in-lb*	12	18
Exhaust manifold nut	N•m	41.2	48.1
	kg-m	4.2	4.91
	ft-lb, in-lb*	30	36
Straight screw plug (For head top face)	N•m	44.1	58.8
	kg-m	4.5	5.5
	ft-lb, in-lb*	33	40
Oil pan drain plug	N•m	29.4	39.2
	kg-m	3.0	4.0
	ft-lb, in-lb*	22	29
Fuel tube flare nut	N•m	18.0	23.0
	kg-m	1.63	2.35
	ft-lb, in-lb*	12	17
Thermo-housing relief plug	N•m	8.37	7.45
	kg-m	0.65	0.76
	ft-lb, in-lb*	56*	66*

TIGHTENING TORQUE

Tightening procedure

Tightening torque (Reference)	N·m (kg·m, ft·lb)	Notes
①	19.6 - 23.5 (2.0 - 2.3, 14 - 17)	Tightening for brake-in
②	68.6 (7.0, 51)	
③	0 (0, 0)	Return
④	19.6 - 23.5 (2.0 - 2.3, 14 - 17)	Retightening
⑤	90° - 92°	

Assembly sequence

Precautions before assembling

- Do not allow oil or dust to get on cylinder head, mounting surface of cylinder block, and head gasket.
- Apply anticorrosive oil onto head bolt thread and surface under the head.

MAM0147

CYLINDER HEAD

Tightening torque for general service is 68.6 N·m (7.0 kg·m, 51 ft·lb) in the place of the tightening torque (5) as shown in the figure.

Assembly sequence

GIM0064

MAIN BEARING CAP

: 83.4 - 93.2 N·m (8.51 - 9.51kg·m, 61.6 - 68.8 ft·lb)

- Apply antirust oil or engine oil to the bolt threads and head bottom.
- Do not use any power tools such as an air runner for assembly.


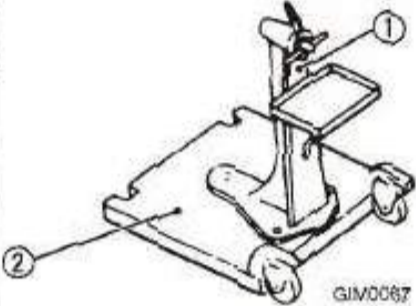
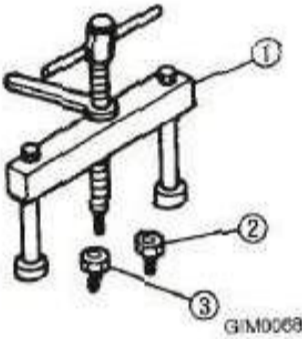

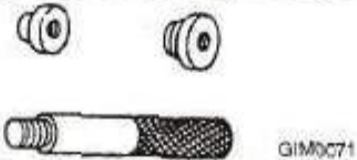
TROUBLE DIAGNOSIS

Condition	Possible causes	Action
1. Engine noise		
Slapping noise of bearing and crankshaft	Bearing looseness	Replace.
	Bearing seizure	Replace.
	Crankshaft bend	Repair or replace.
	Uneven wear of journal	Correct.
	Excessive end play	Replace center bearing.
Slapping noise of piston, connecting rod	Bearing looseness	Replace.
	Bearing seizure	Replace.
	Piston looseness	Replace piston pin(s) or bushing(s).
	Piston looseness relative to cylinder	Reselect.
	Piston ring damage	Replace.
	Poor rod alignment	Realign.
Slapping noise of camshaft	Bearing looseness	Replace.
	Excessive axial looseness	Replace bearing thrust plate(s).
	Rough gear tooth face(s)	Correct.
	Gear damage	Replace.
Timing chain noise	Inappropriate tension	Adjust.
	Damaged or sagged chain	Replace.
	Worn sprocket	Replace.
	Damaged or loose tensioner	Replace.
	Excessive camshaft-to-bearing clearance	Replace.
Slapping noise of valve gear	Inappropriate valve clearance	Adjust.
	Loose adjustment screw(s)	Replace.
	Worn rocker face(s)	Replace.
	Worn valve guide(s)	Replace guide(s).
	Loose valve spring(s)	Replace.
	Valve seizure	Repair or replace.
Slapping noise of water pump	Inappropriate end play	Replace.
	Damaged impeller	Replace.
2. Other mechanical damage		
Stuck valve	Inappropriate clearance	Adjust.
	Valve stem - insufficient guide-to-guide clearance	Clean stem(s), ream guide(s).
	Loose or damaged spring	Replace.
	Seized or damaged valve stem(s)	Replace or clean.
	Poor fuel quality	Use good fuel.
Burnt valve seat(s)	Inappropriate valve clearance	Adjust.
	Deteriorated valve spring(s)	Replace.
	Edged valve end(s)	Replace Buff.
	Too narrow valve seat width	Correct valve seat(s).
	Engine over temperature (Overheat)	Repair or replace.
	Overrun	Operate in optimum speed range.
	Stuck valve guide(s)	Correct.

TROUBLE DIAGNOSIS

Condition	Possible causes	Action
<i>Excessive wear of cylinder piston(s)</i>	Insufficient engine oil	Refill or replace oil.
	Contaminated engine oil	Clean crankcase, replace oil filter.
	Poor quality oil	Use specified oil.
	Engine over temperature (Overheat)	Repair or replace.
	Wrong combination of piston and connecting rod	Repair or replace.
	Inappropriate clearance of piston ring	Reselect and adjust.
	Piston ring damage	Replace.
	Damaged air cleaner	Wash.
	<i>Too rich air-fuel mixture</i>	Adjust.
	Overrun	Operate in optimum speed range.
	Stuck choke valve	Clean and adjust.
	Excessive use of choke valve	Start engine properly.
<i>Poor functioning of connecting rod(s)</i>	Insufficient engine oil	Fill oil.
	Low oil pressure	Repair.
	Use of poor quality oil	Use specified oil.
	Rough crankshaft surface(s)	Grind surface(s), replace bearing(s).
	Plugged oil passage	Clean.
	Wear or damage of bearing	Replace.
	Inappropriate bearing	Correct.
	Bearing looseness	Replace.
Poor connecting rod alignment	Repair or replace.	
<i>Poor functioning of crankshaft bearing(s)</i>	Insufficient engine oil	Fill or replace oil.
	Low oil pressure	Correct.
	Use of poor quality oil	Use specified oil.
	Uneven wear of crankshaft journal(s)	Repair
	Plugged oil passage of crankshaft	Wash.
	Wear or damage of bearing	Replace.
	Inappropriate bearing	Correct.
	Damaged bearing(s)	Replace.

SPECIAL SERVICE TOOLS

Tool number	Tool name	
ST05240001	Engine attachment	 <p style="text-align: center;">GIM0066</p>
ST0501S000 (1) ST05011000 (2) ST05012000	Engine stand assembly Engine stand Stand	 <p style="text-align: center;">GIM0067</p>
KV101041S0 (1) KV10104110 (2) ST16512001 (3) ST16701001	Crankshaft main bearing Crankshaft main bearing cap puller Ring puller Adapter Adapter	 <p style="text-align: center;">GIM0068</p>
ST12070000	Valve lifter	 <p style="text-align: center;">GIM0069</p>
ST1524S000 KV10105500 ST15243000	Front oil seal drift Rear oil seal drift Drift rod	 <p style="text-align: center;">GIM0071</p>

REMOVAL AND INSTALLATION OF ENGINE

CAUTION:

- *Always pay attention to safety.*
- Do not remove engine until exhaust system and engine coolant have completely cooled off.
- Support the vehicle at the specified lift points.
- For operation procedure for components other than engine, refer to appropriate sections.

Removal

[OPERATION DESCRIPTION]

- Remove engine by pulling up after removing transmission.

[PREPARATION WORK]

1. Release the fuel pressure. Refer to "Release of Fuel Pressure" in EC section.
2. Remove radiator drain plug and drain engine coolant.
3. Remove the following parts.
 - Undercover of battery
 - Radiator, shroud, and radiator hose
 - Engine drive belt and cooling fan
4. Disconnect accelerator cable from throttle drum and move it out of position.

[LEFT SIDE OF ENGINE ROOM]

5. Remove air duct and air cleaner case.
6. Disconnect heated oxygen sensor harness connector and ground (between exhaust manifold cover and body).

[RIGHT SIDE OF ENGINE ROOM]

7. Disconnect vacuum hose (for brake booster and for differential lock) on engine side.
8. Remove fuel hose.

CAUTION:

After disconnecting hoses, plug them immediately to prevent fuel from draining.

9. Disconnect all harness connectors on engine side, and then move harnesses to body side.
10. Remove starter motor.
11. Remove transmission.

[REMOVAL]

12. Engage chain block hook in front/rear engine slingers and support.

CAUTION:

Be careful not to contact hook and chain with body and piping when engaging hook in slingers

13. Remove engine mount insulator LH/RH nuts.
14. Pull up and remove engine by adjusting the position diligently.

CAUTION:

- *Make sure that all wires and piping were disconnected while removing.*
- *Be careful not to contact with body side parts.*

REMOVAL AND INSTALLATION OF ENGINE

Installation

Note the following, and install in the reverse order of removal.

- Do not allow oil to get on the engine mount insulator. Be careful not to damage the engine mount insulator.
- Securely insert positioning stopper pin into mating side hole.
- Make sure all mount insulators are seated properly, then tighten mount nuts and bolts.

Inspection

- *Before starting engine, check amount of engine coolant, oil and grease. Refill as necessary.*
- *Start engine and check for any unusual noise and vibration.*
- *Warm up engine, and then check engine coolant, oil and grease, fuel, and exhaust gas for leakage.*

ENGINE SERVICE

Engine Disassembly

Always use appropriate tools and ensure that no parts are damaged. The following tasks can be performed more easily by using the relevant engine attachment (SST) and engine stand (SST).

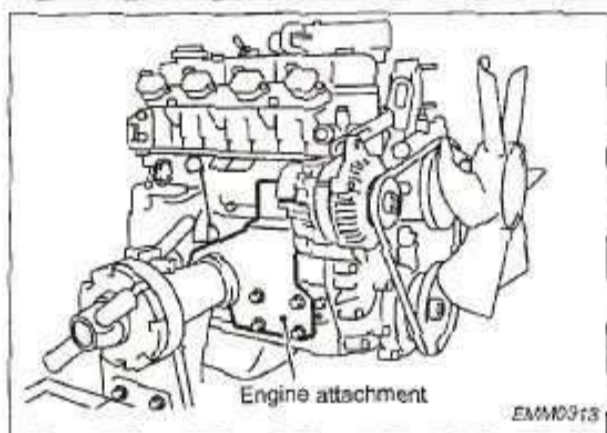
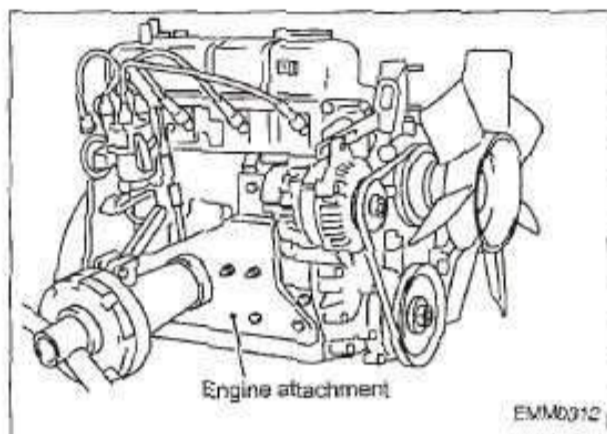
1. Preparation for engine disassembly

- Drain coolant and engine oil.

2. Installation of engine attachment

Remove the following parts from the cylinder block and install the engine attachment (SST).

- Oil filter
- Engine mount bracket (RH)
- Fuel tube (and fuel pump for carburetor model)
- Oil pressure switch
- Release the alternator adjusting lever and remove the alternator.
- Using some of the existing holes on the engine attachment (SST), retain the attachment with the mounting bracket bolts at four points at least.



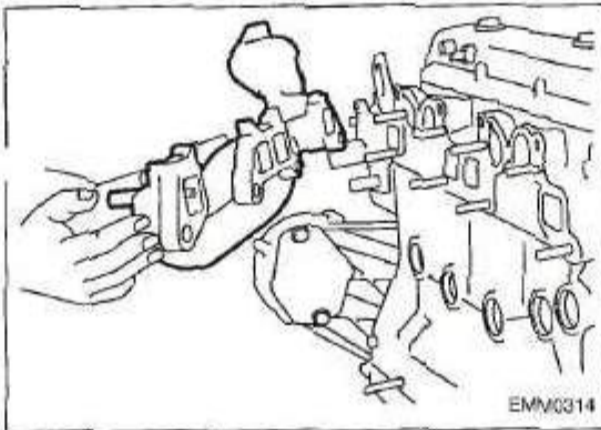
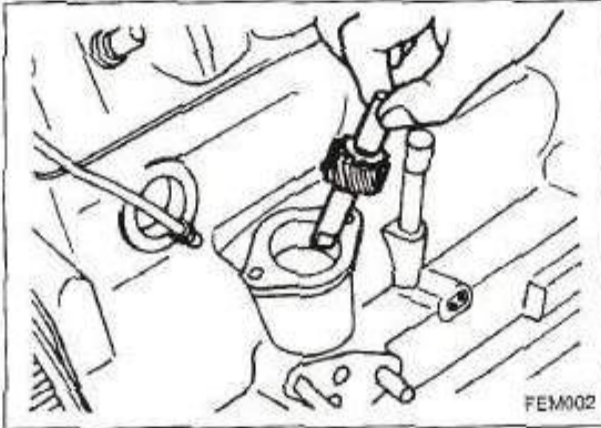
3. Removal of exterior and electrical parts

Set the engine to the engine stand (SST) and remove the following parts.

- Ignition system wiring (or high-tension cords for carburetor model)
- Ignition coil unit (or distributor for carburetor model)
- Spark plug
- Oil level gauge
- Cooling fan and pulley
- Starter motor
- Clutch and flywheel
- Rear plate
- Rocker cover
- Crankshaft pulley
- Remove the injector unit (for LPG, gasoline)
- Remove the electric throttle control unit (or carburetor for carburetor model)
- Remove the oil pump and drive shaft (for carburetor type, also remove the distributor).

ENGINE SERVICE

Engine Disassembly (Cont'd)



4. Removal of manifold
 - Remove the manifold and head retaining bolts.
 - Remove the intake and exhaust manifold assembly.

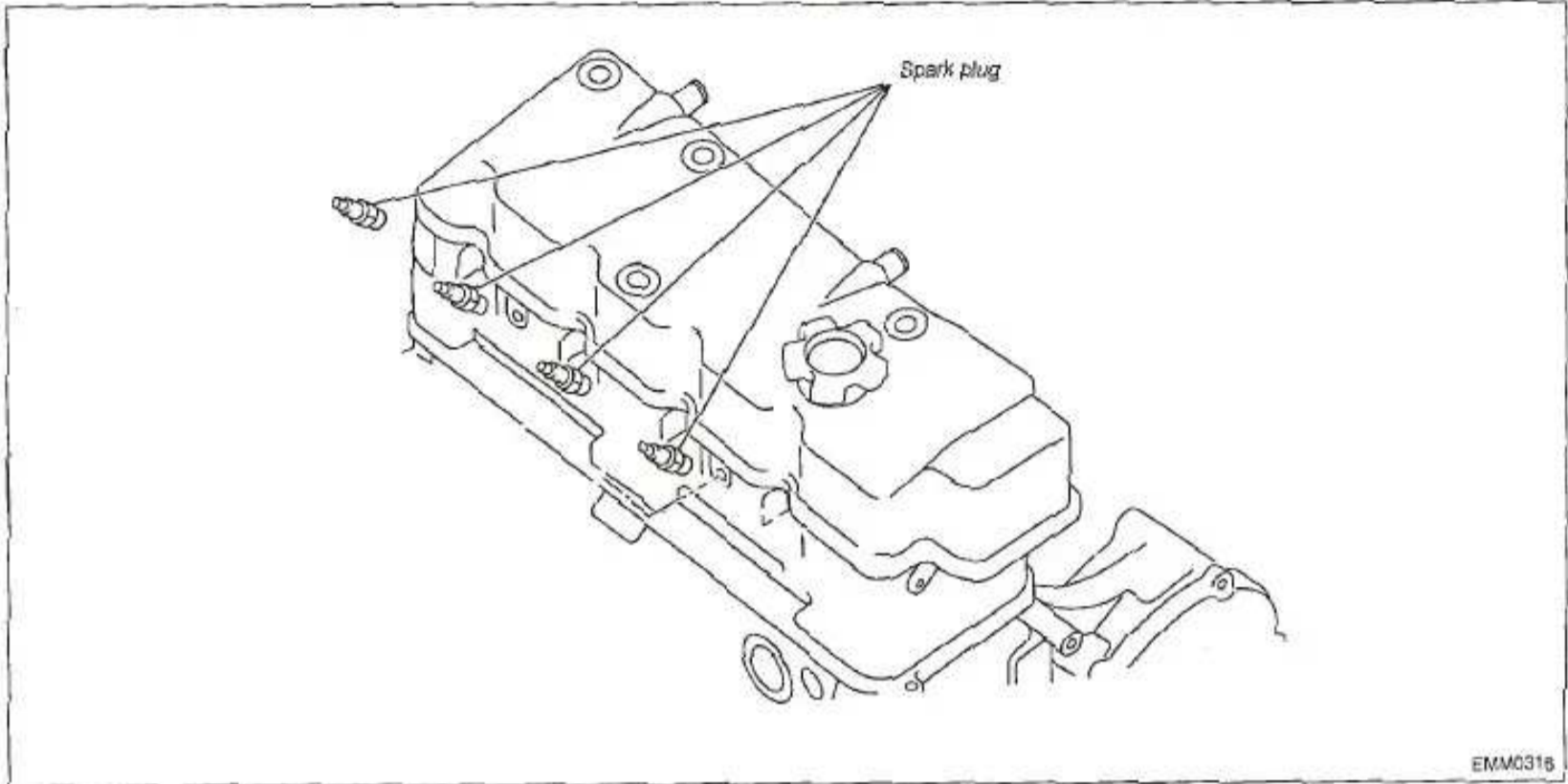
DISASSEMBLY OF INTAKE MANIFOLD

The figure below illustrates Step 3 and Step 4 in the previous page. Remove in the order of (1), (2), (3), (4) and (5). Assemble in the reverse order of disassembly. (Always use new gaskets.)

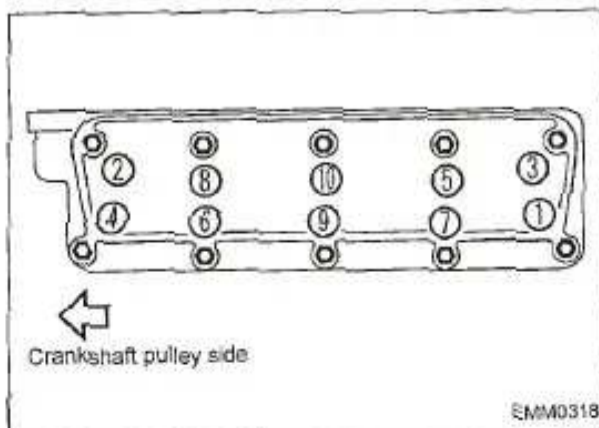
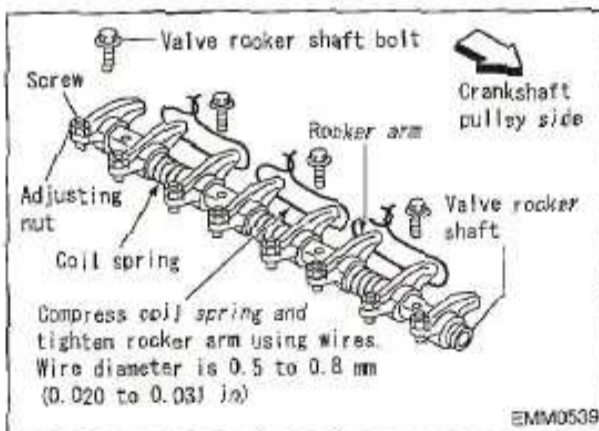
ENGINE SERVICE

Engine Disassembly (Cont'd)

5. Removal of rocker cover and gasket
 - Remove the rocker cover retaining nuts.
 - Remove rocker cover.



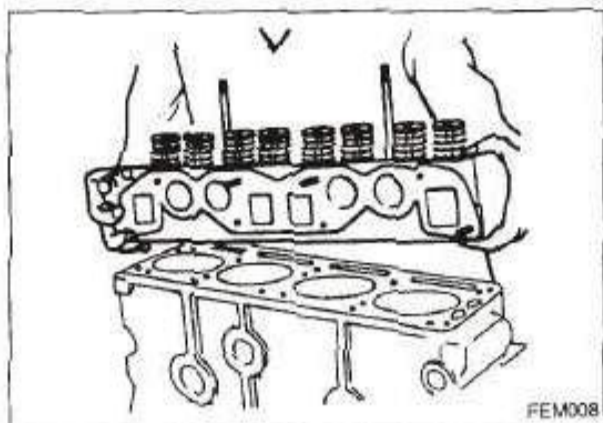
6. Removal of rocker shaft assembly
 - Loosen the four valve rocker shaft bolts to remove the valve rocker shaft.
 - Pull off the push rod.
 - Make sure to remove the push rod and other parts by cylinder and by port (intake or exhaust), and store them in an organized manner so that the part installation locations are easily identifiable.
 - When removing the valve rocker shaft, compress the coil spring slightly and tie the spring with a metal wire, as shown in the figure, before loosening the bolts. This will facilitate the reassembly work later. Or, loosen the four bolts evenly.



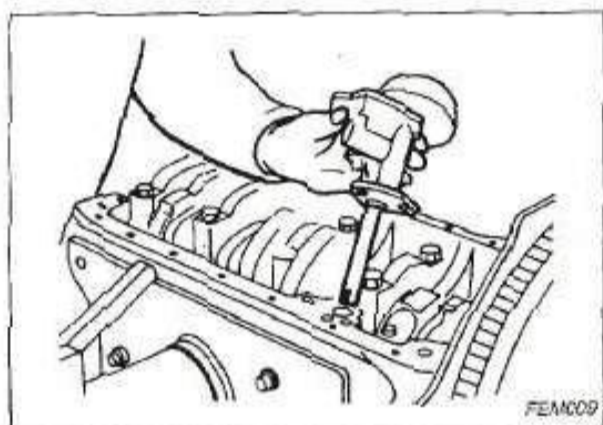
7. Removal of cylinder head assembly
 - Pull off the push rod.
 - Loosen the cylinder head bolts according to the following sequence.
 - Remove cylinder head.

ENGINE SERVICE

Engine Disassembly (Cont'd)

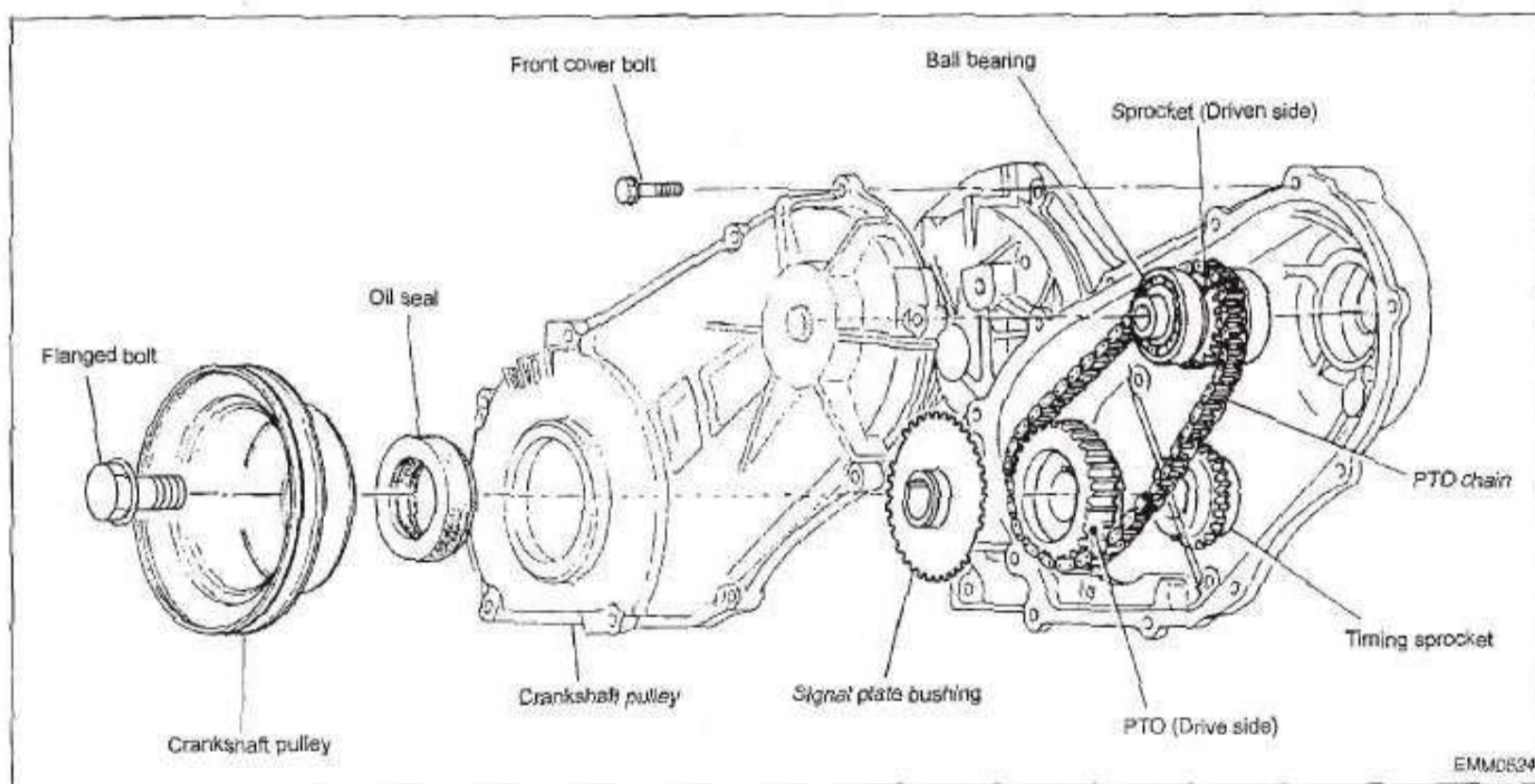


8. Remove oil pan.
Remove any sealant.



9. Remove oil pump with strainer.

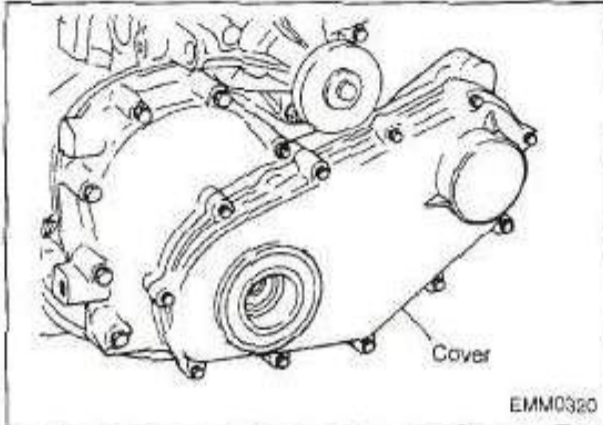
10. Disassembly of PTO device



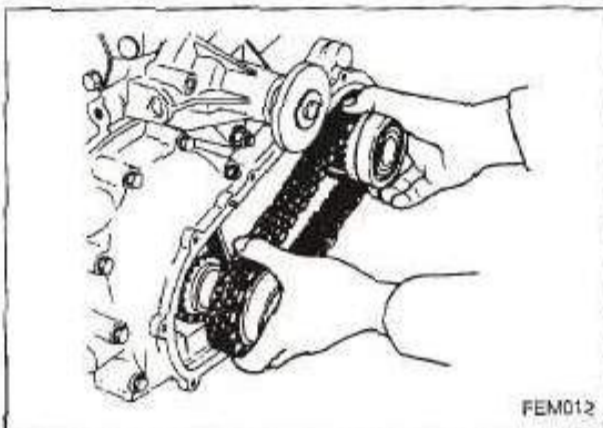
- Remove crankshaft pulley bolt.
- Remove crankshaft pulley.
- Remove the sprocket bushing.

ENGINE SERVICE

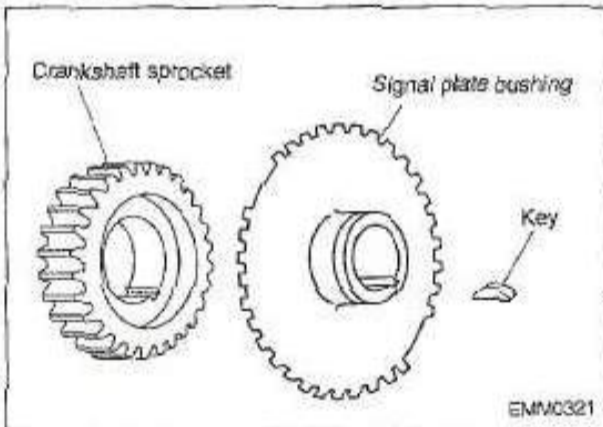
Engine Disassembly (Cont'd)



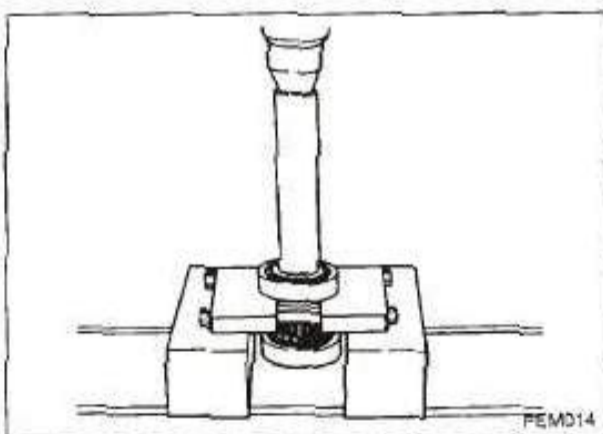
- Remove the front cover.
- To remove the cover, remove the bolts and lightly tap on it with a plastic hammer.
Before installing the cover, apply sealant (liquid packing) to the mounting face.



11. Remove the *PTO sprocket, PTO chain, and bearing* as an assembly from the oil pump side and the crankshaft side.



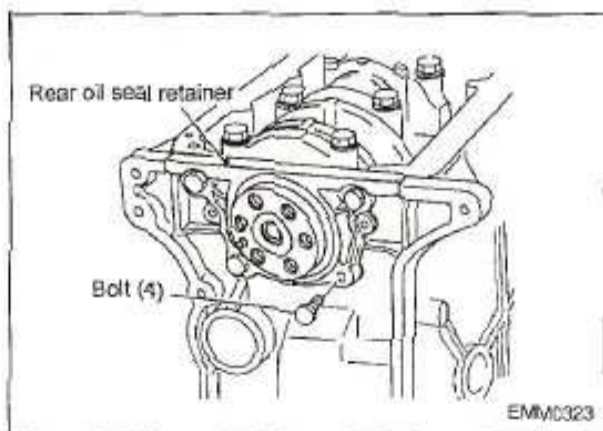
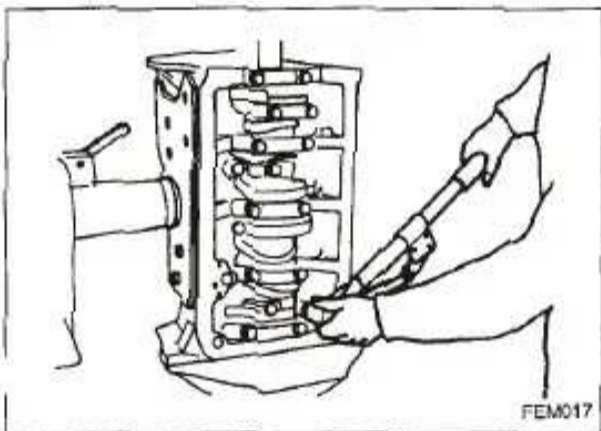
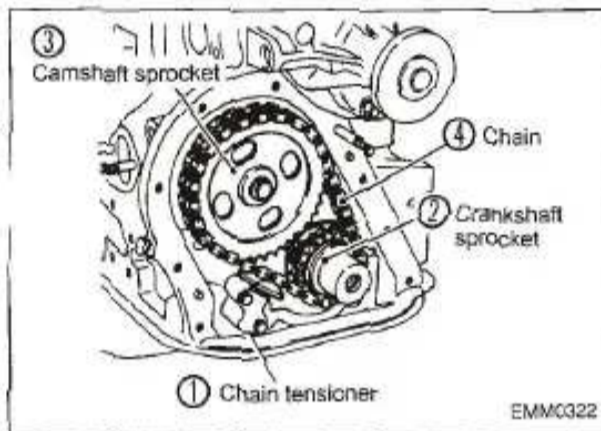
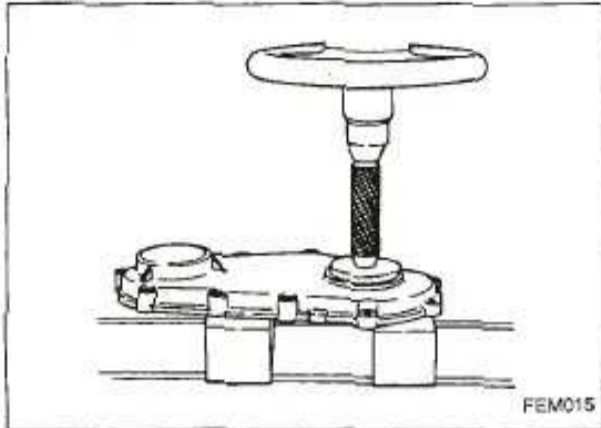
CAUTION:
Ensure that the chain is not damaged.



12. To separate the oil pressure pumpside sprocket and the bearing, use the relevant *Special Service Tool* with a press.
ST3D031000 Bearing puller
ST22360002 Bearing drift

ENGINE SERVICE

Engine Disassembly (Cont'd)



13. Timing chain cover
 - Remove front oil seal.Remove from the front cover using the front oil seal drift (SST).
Special Service Tools (SST): Front oil seal drift ST1524S000
Drift rod ST15243000

14. Remove timing chain cover.
15. Remove chain tensioner (1).
16. Loosen the camshaft sprocket bolts.
17. Remove the camshaft sprocket (3) and crankshaft sprocket (2) along with the chain (4).
18. If shim(s) are attached for the crankshaft gear, also remove them.
19. Removal of camshaft
 - Remove locating plate.
 - Turn over the cylinder block. Lower and pull off the valve lifter.
 - Pull off the two bolts retaining the camshaft locating plate and remove the camshaft. Be careful not to damage the metal faces.Place the parts in the order of cylinder arrangement.
20. Removal of piston and connecting rod
 - Remove connecting rod cap and push the piston out toward cylinder head side with handle of a hammer. Be careful not to drop the pistons.
 - Pull the piston toward the cylinder block top deck and tentatively assemble the rod cap to prevent incorrect assembly.Place the parts in the order of cylinder arrangement.

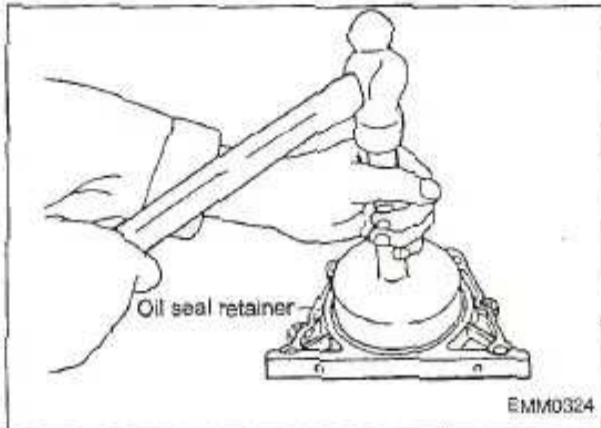
CAUTION:
Store the connecting rod caps and bearings in the order of cylinder arrangement to prevent incorrect assembly.

21. Loosen the flywheel bolts and remove the flywheel.
22. Remove rear plate.
23. Removal of crankshaft
 - Remove the rear oil seal retainer.
 - Remove the main bearing cap bolts. Remove the main bearing cap by lightly tapping on it with a wooden hammer.

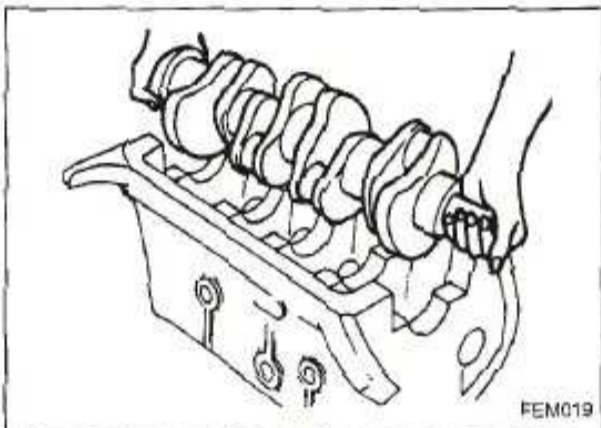
CAUTION:
Store the bearing bushings in an organized manner so that the part installation locations are easily identifiable.

ENGINE SERVICE

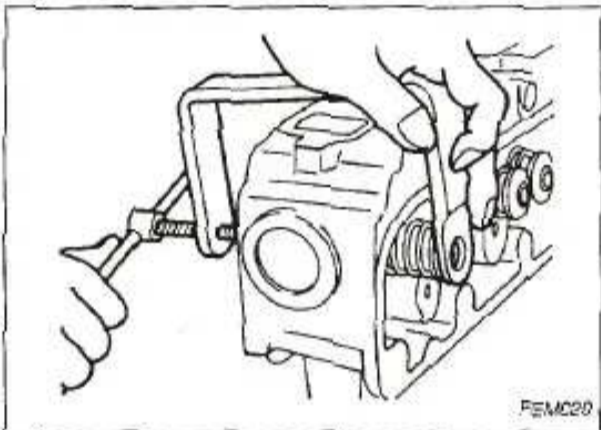
Engine Disassembly (Cont'd)



24. Remove the oil seal from the oil seal retainer using the rear oil seal drift (SST).
SST: KV10105500



25. Remove the crankshaft and bearing.
After removing the bearing, place the corresponding cap at a correct position on the block side face to prevent incorrect assembly.



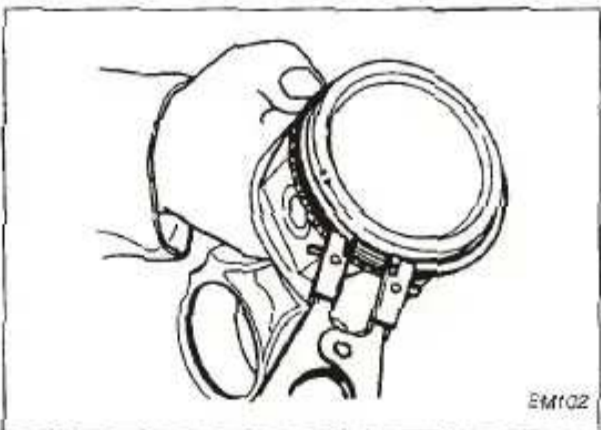
26. Disassembly of cylinder head
- Remove valve spring using a valve lifter (SST).
SST: ST12070000
 - Remove valve lip seal using a lip seal puller (SST) when removing.

CAUTION:
Replace lip seal when removing valve. (Do not reuse.)

- Store the removed valves, valve collets, valve retainers, and valve springs in an organized manner to identify which part combination corresponds to which cylinder.

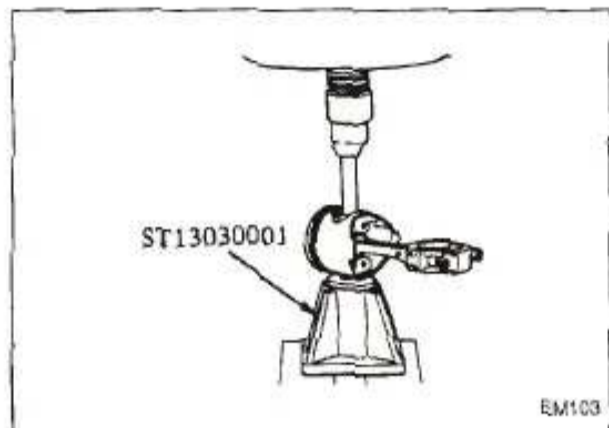
27. Disassembly of piston and connecting rod
- Disassemble the piston and connecting rod.
 - Remove piston rings.
The oil ring is a combined type. To remove it, first remove the upper and lower rails, and then the expander.

CAUTION:
Store the removed pistons, pins, connecting rods and bushings in an organized manner to identify which part combination corresponds to which cylinder.



ENGINE SERVICE

Engine Disassembly (Cont'd)



28. Pull off the piston pin.

The piston pin is press-fit into the connecting rod.

To remove the piston pin, first remove the snap ring, heat the piston to 80°C (176°F), and then pull off the piston pin by using the piston pin press stand (SST).

CAUTION:

Store the removed pistons, piston pins, piston rings and connecting rods in an organized manner to identify which part combination corresponds to which cylinder.

Inspection and Correction

1. General precautions

- Inspect each part for damage, distortion, bend or excessive play and repair/replace the part if the condition is unallowable.
- Before cleaning the cylinder head and block, check for any trace of water leakage.
- Completely remove any water scale, sealant, and carbon from each part.

CAUTION:

Be careful not to damage the sliding faces when using a carbon scraper or brush.

- After cleaning the oil passage of each part, verify that no plugging is present by applying compressed air.
- Make sure that any parts requiring correct combination are identified appropriately.
- For a part that is to be stored for a long time after cleaning, make sure to apply oil to the high-finished surfaces to prevent rust creation.

2. Intake manifold water jacket

- Also inspect the water jacket connector. Repair or replace it if any traces of leakage are found.
- Also inspect the water hoses. If any deterioration or damages are found, replace them. If any leakage is found at the connections, retighten the clamps.

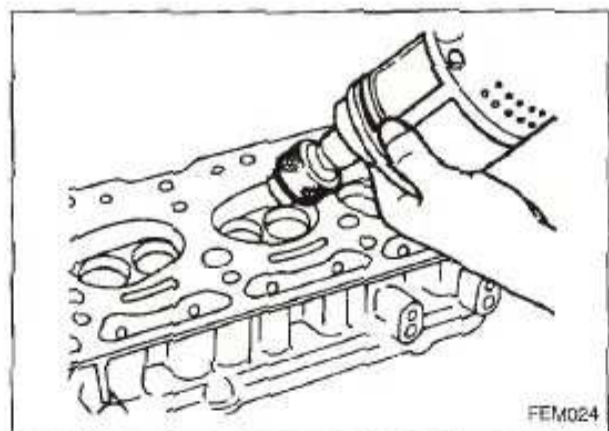
3. Cylinder head

REMOVING CARBONS

- Remove any carbons from the combustion chamber and mounting faces of each cylinder. At that time, also check for scratches and damages.
- Remove oil, scale, gasket, sealant, and carbon deposits from surface of cylinder head using a scraper.

CAUTION:

Do not allow gasket fragments to enter oil or engine coolant passages.



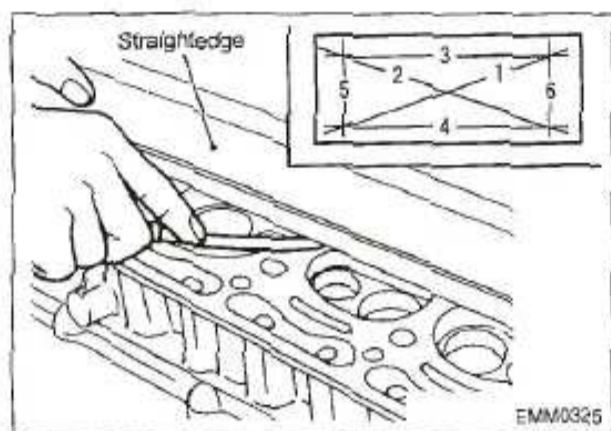
ENGINE SERVICE

Inspection and Correction (Cont'd)

MEASURING CYLINDER HEAD DISTORTION

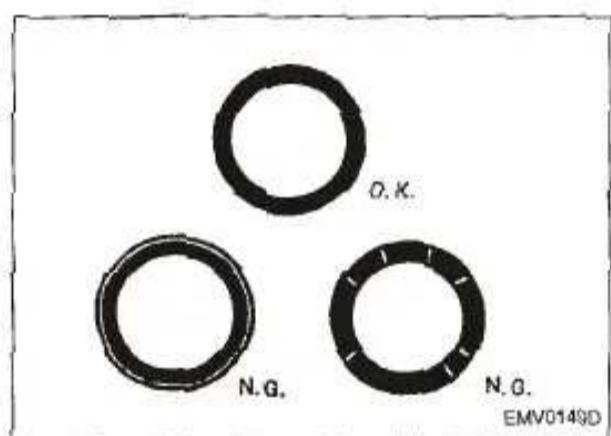
- Visually check for any cracks and damages.
- Measure distortion at six points on the head bottom face. If the measured distortion exceeds the specified limit, correct the head bottom face with a surface grinder or an equivalent tool, or replace the head.

Surface flatness	0.1 mm (0.004 in) or less
Grinding limit	0.2 mm (0.008 in) or less



VALVE SEAT CONTACT

- This inspection must be done after ensuring that the dimensions of the valve guide and the valve are within the standard.
- Check valve contact by applying DICATOL PL-1 to valve seat contact surface.
- Make sure that areas around all connect surfaces are connected.
- If seating condition is not correct, reseal the valve and check again.
If seating condition cannot be corrected by resealing, replace cylinder head.

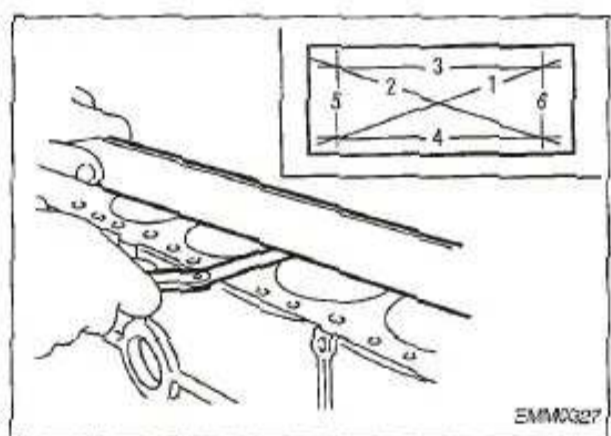


4. Cylinder block

Measure distortion of the cylinder block top face in the longitudinal and lateral directions.

Measuring cylinder block distortion.

- Remove any foreign material deposits such as carbon from the cylinder block.
- (Use a straight ruler and filler gauge for distortion measurement)
- Visually check for any cracks and damages.
- Measure distortion at six points on the head top face. If the measured distortion exceeds the specified limit, correct the head top face with a surface grinder or an equivalent tool, or replace the head.



ENGINE SERVICE

Inspection and Correction (Cont'd)

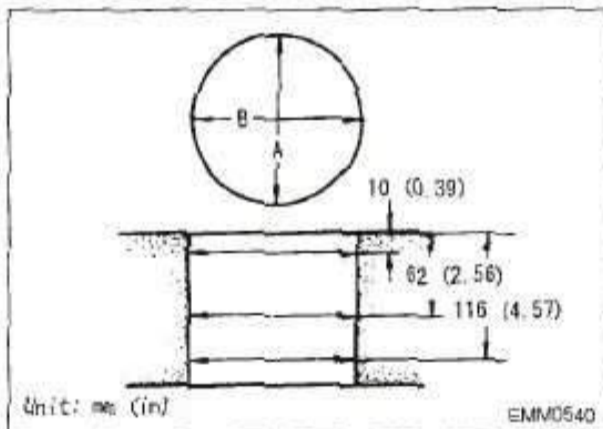
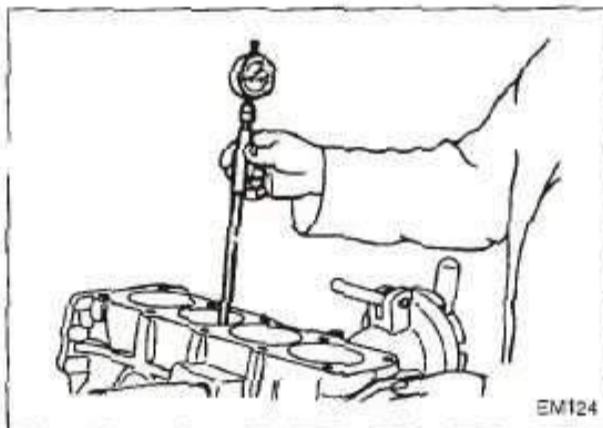
Distortion limit: 0.1 mm (0.004 in)

		Standard	Repair limit
Cylinder block face	Longitudinal mm (in)	0.05 (0.0020)	0.10 (0.0039)
	Lateral mm (in)	0.02 (0.0008)	0.04 (0.0016)

5. Measuring cylinder bore

- Take the following measurements for the directions A and B at three levels using a cylinder bore gauge.

Determine the grade based on the measurement at a point located 65 mm from the top deck in the thrust direction.



Max. difference between A and B
Max. difference among three levels

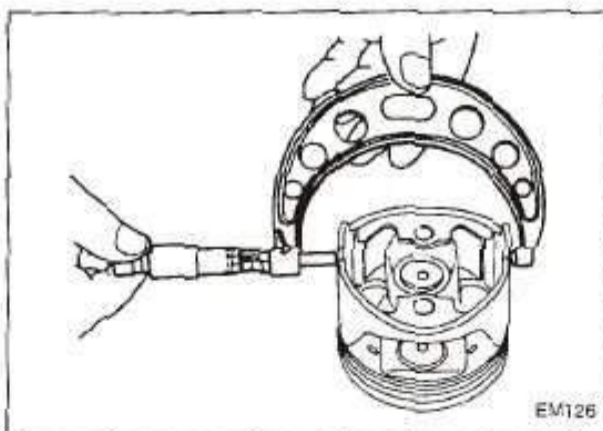
Roundness
Taper
Unit: mm (in)

	Standard	Wear limit
Cylinder bore inner diameter	75.5 - 75.55 (2.9724 - 2.9744) (K15) 89.0 - 89.05 (3.5039 - 3.5059) (K21, K25)	75.7 (2.980) 89.20 (3.5118)
Roundness	-	0.2 (0.008)
Taper	-	0.2 (0.008)
Difference in inner diameter between respective cylinders	-	0.2 (0.008)

6. Baling and honing

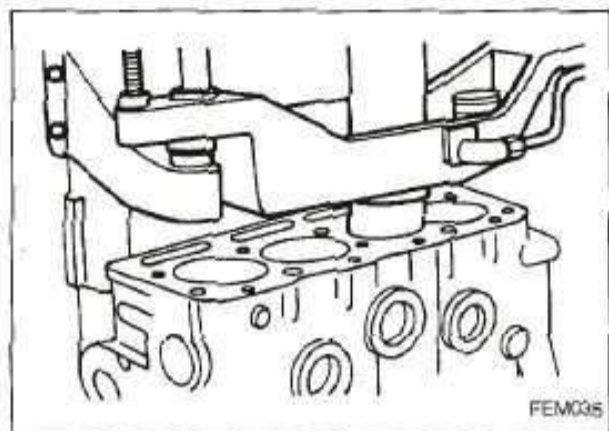
- Select an appropriate oversize piston according to the wear of the cylinder inner surface.

Measure the piston skirt diameter. Bore the cylinder to a diameter 0.02 mm (0.0008 in) larger than the measurement.



ENGINE SERVICE

Inspection and Correction (Cont'd)



- Ensure that the piston-to-cylinder clearance is between 0.025 and 0.045 (0.0010 and 0.0018 in). Make sure to perform measurement in ordinary temperature. If even one cylinder requires boring, all cylinders must be bored at once.

(2) Calculating cylinder inner diameter

- Measure the skirt diameter (dimension H) of the oversize piston.
- Based on the dimension H of the piston, determine the cylinder boring diameter.
 - Boring diameter: $R = H + C - M$
 - Boring margin: $M = 0.02 \text{ mm}$
 - Piston-to-cylinder clearance
 - : $C = 0.025 \text{ to } 0.045 \text{ mm (20°C)}$
 - $\therefore R = H + (0.005 \text{ to } 0.025) \text{ mm}$
- Bore the cylinder to the dimension R.

Piston service part list Unit: mm (in)

Oversize
STD
0.50 (0.0197)
1.00 (0.0394)

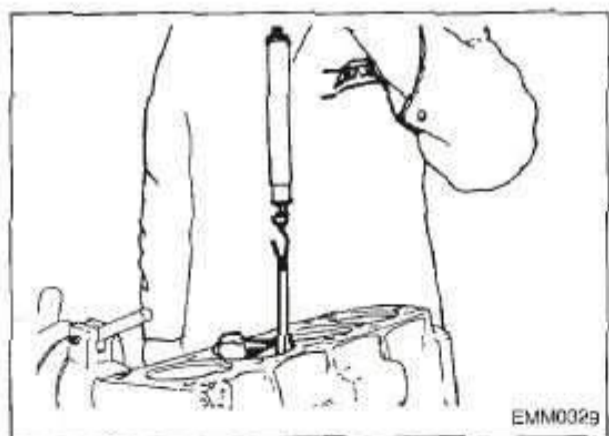
(3) Boring precautions

- Make sure to bore the cylinder step-by-step with the boring depth of each step limited to 0.05 mm (0.0020 in).
- Notice that the cylinder inner diameter is affected by the cutting heat.
- To prevent deformation due to cutting heat, bore the cylinders in the order of No. 2, No. 4, No. 1 and No. 3.
- Apply an appropriate mark to each piston so that which piston is for which cylinder is easily identifiable.

(4) After honing, measure the taper and roundness of the bore.

(5) Measuring piston-to-cylinder clearance

Pull off the piston pin from the piston and put the piston into the cylinder upside down. Insert a filler gauge of 0.04 mm (0.0016 in) in the piston-to-cylinder clearance from the piston sliding side and pull the filler gauge with a spring scale. If the spring scale reads 0.5 kg to 1.5 kg (1.1 to 3.3 lb), the clearance is normal.



ENGINE SERVICE

Inspection and Correction (Cont'd)

Oversize piston

Piston size	Diameter mm (in)	
	K21, K25	K15
STD	88.965 - 89.015 (3.5026 - 3.5045)	75.465 - 75.515 (2.9711 - 2.9730)
0.50 (0.0197) OS	89.465 - 89.515 (3.5222 - 3.5242)	75.965 - 76.015 (2.9907 - 2.9927)
1.00 (0.0394) OS	89.965 - 90.015 (3.5419 - 3.5439)	76.465 - 76.515 (3.0104 - 3.0124)

Standard measurements for piston and cylinder

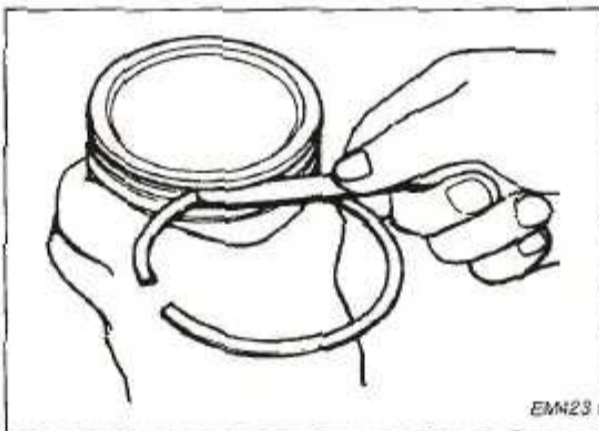
Specified clearance mm (in)	0.025 - 0.045 (0.0010 - 0.0018) [20°C (68°F)]
Filler gauge N (kg, lb) Drawing force	4.9 to 14.7 (0.5 - 1.5, 1.1 - 3.3)
Filler gauge in use Thickness mm (in)	0.04 (0.0016)

7. Measuring piston wear

- Inspect the piston sliding face. Replace it if significant sticking damage or wear is observed.
- Measuring piston ring-to-groove clearance
Measure the clearance between the piston ring groove and the piston ring. If excessive wear is observed, replace the piston ring along with the piston.

Unit: mm (in)

	Standard	Limit
Top	0.045 - 0.080 (0.0018 - 0.0031)	0.1 (0.004)
Second	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
Oil	0.065 - 0.135 (0.0026 - 0.0053)	—



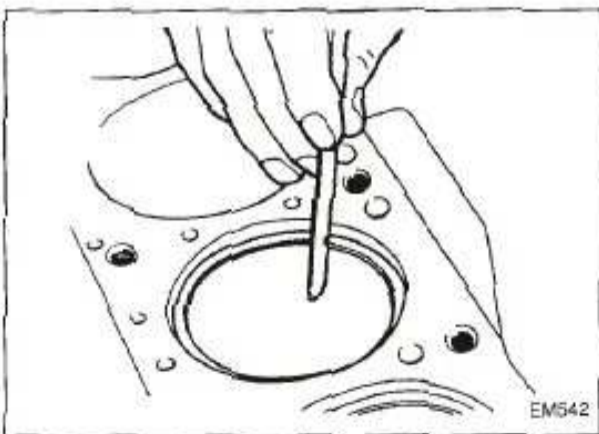
EM423

8. Piston ring

- Measuring piston ring closed gap
- Put the piston ring into the cylinder bore and measure the ring closed gap.

Unit: mm (in)

	Standard		limit
	K15	K21, K25	
Top	0.25 - 0.30 (0.0098 - 0.0118)	0.28 - 0.43 (0.0110 - 0.0169)	1.0 (0.039)
Second	0.15 - 0.25 (0.0059 - 0.0098)	0.45 - 0.80 (0.0177 - 0.0236)	1.0 (0.039)
Combined rail	0.20 - 0.60 (0.0079 - 0.0238)	0.20 - 0.60 (0.0079 - 0.0236)	1.0 (0.039)



EM542

Measure the end gap of the piston ring with a feeler gauge. If the gap exceeds 1 mm, replace the piston ring. If the gap is 0.15 mm or less, correct the ring ends with an oil stone or replace the piston ring.

ENGINE SERVICE

Inspection and Correction (Cont'd)

CAUTION:

Always measure the ring gap near the *bottom* of the cylinder where the wear is relatively small when replacing the piston ring without correcting the cylinder bore.

9. Piston pin

FITTING PISTON PIN TO PISTON

- In ordinary temperatures, the *piston pin* should rotate when turned by hand or the pin should go smoothly when inserted.
- If the piston pin behavior is *unusual*, replace the piston and piston assembly.

Unit : mm (in)

Engine type	K15, K21, K25
Piston pin outer diameter	19.993 - 19.998 (0.7871 - 0.7873)

10. Connecting rod

MEASURING BEND, TWIST

- Measure the bend and twist using a connecting rod aligner. If the measured bend or twist is *excessive*, replace the component.

Usable limit:	Bend	0.05 mm (0.0020 in) [per 100 mm (3.94 in)]
	Twist	0.05 mm (0.0020 in) [per 100 mm (3.94 in)]

CAUTION:

The center distance between both end holes must be

143.97 to 144.03 mm (5.6681 to 5.6705 in). (K25)

152.47 - 152.53 mm (6.0027 to 6.0051 in) (K15, K21)

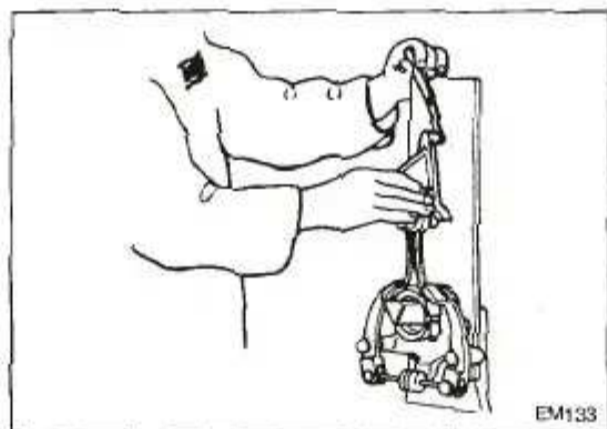
Unit : mm (in)

	Standard	Repair limit
Bend Twist Parallelism [per 100 mm (3.94 in)] for every 100 mm (3.94 in)	0.025 (0.0010)	(B) 0.05 (0.0020) (T) 0.05 (0.0020)

11. Connecting rod weight

WEIGHT ADJUSTMENT

- When replacing the connecting rod assembly, ensure that the maximum difference in the connecting rod *assembly* weight between any two cylinders does not exceed 4 g (0.14 oz).



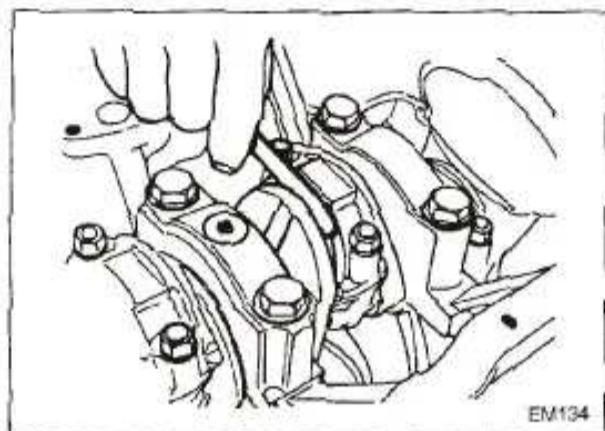
EM133

ENGINE SERVICE

Inspection and Correction (Cont'd)

MEASURING CONNECTING ROD THRUST CLEARANCE

- Measure the thrust clearance using a feeler gauge.
- Measure the connecting rod side clearance. If the clearance exceeds the limit, replace the connecting rod.
Standard clearance: 0.2 - 0.3 mm (0.008 - 0.012 in)
Max. clearance: 0.4 mm (0.016 in)



12. Connecting rod and bushings

- Check the bushings for bend, melting, or tearing and replace them if damaged.
- Measure the oil clearance using a plastigage.

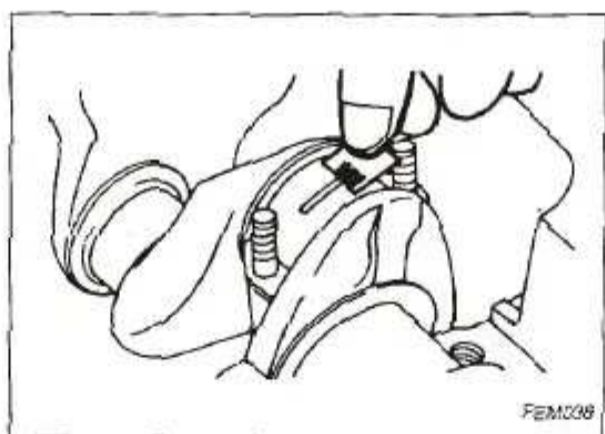
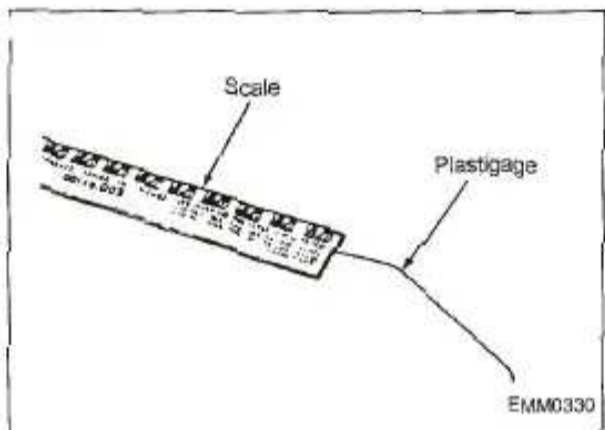
MEASURING OIL CLEARANCE

- The following paragraphs describe how to use a plastigage.
 - Remove any oil and dust from the bearing inner/outer faces and journal faces. Cut off the plastigage to a length slightly shorter than the bearing width. Place the cut plastigage on the journal face so as not to cover any oil holes.
 - Assemble the bearing cap and tighten it to the specified torque.

CAUTION:

Do not turn the crankshaft while the plastigage is in the bearing.

- Remove the cap and read the plastigage width using the scale printed on the bag.
- If the clearance exceeds the limit, use an undersize bearing. At that time, grind the journal or pin.



Standard	Unit: mm (in)		
Items	Oil clearance Standard	Oil clearance Limit	Cap tightening torque
Main bearing	0.02 - 0.073 (0.0008 - 0.0029)	0.1 (0.004)	Lubricated 83.4 - 93.2N•m (8.51 - 9.51kg-m, 62 - 69 ft-lb)
Connecting rod bearing	0.032 - 0.066 (0.0013 - 0.0026)	0.1 (0.004)	Lubricated 31.4 - 37.3N•m (3.2 - 3.81 kg-m, 23 - 28 ft-lb)

- If the oil clearance exceeds the limit, grind the journal or pin with a surface grinder and use an undersize bearing.

ENGINE SERVICE

Inspection and Correction (Cont'd)

Undersize bearing list

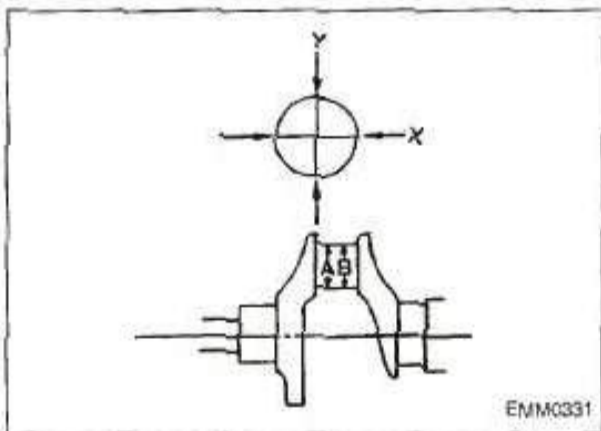
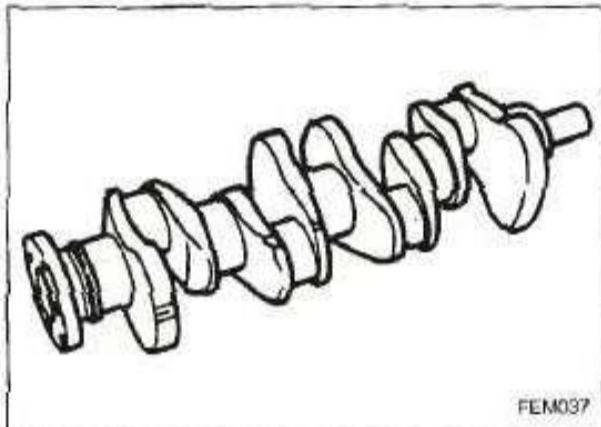
Unit: mm (in)

Main bearing	Connecting rod bearing	
	K15, K21, K25	Pin diameter
STD	STD	44.974 - 44.96 (1.7706 - 1.7701)
	0.08 (0.0031)	44.894 - 44.8 (1.7638 - 1.7638)
0.02 (0.0008)	0.12 (0.0047)	44.854 - 44.89 (1.7659 - 1.7673)
0.25 (0.0098)	0.25 (0.0098)	44.724 - 44.71 (1.7608 - 1.7602)
0.50 (0.0197)		
0.75 (0.0295)		
1.00 (0.0394)		

13. Crankshaft and bearing

CRANKSHAFT INSPECTION

- Inspect the journal and pin for damage or wear and replace them as necessary.



To determine the diameter, measure the journal or pin at a total of four points using a micrometer.

Roundness and taper of journal and pin:

Limit 0.03 mm (0.0012 in)

CAUTION:

The roundness is represented by the difference between the dimensions X and Y in the left figure.

The taper is represented by the difference between the dimensions A and B in the left figure.

Standard	Repair limit	Limit
Roundness and taper mm (in)	0.01 (0.0004)	0.03 (0.0012)

ENGINE SERVICE

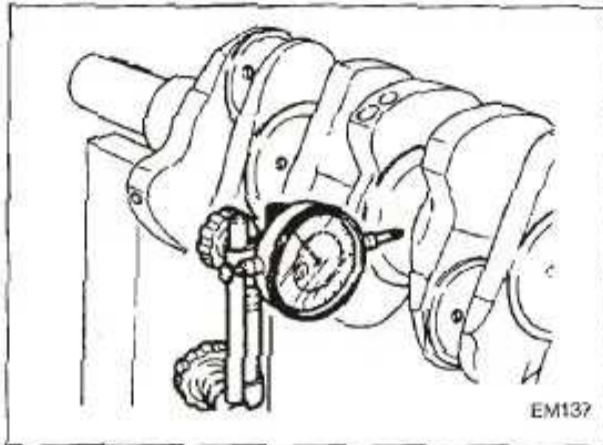
Inspection and Correction (Cont'd)

MEASURING BEND

- Apply the probe of a dial gauge to the center journal and take a reading while turning the crankshaft. Determine half of the reading as the bend. If the bend exceeds the specified limit, replace the crankshaft.

Bend limit: 0.05 mm (0.0020 in)

	Standard mm (in)	Usable limit mm (in)
Crankshaft bend	0.02 (0.0008)	0.05 (0.0020)

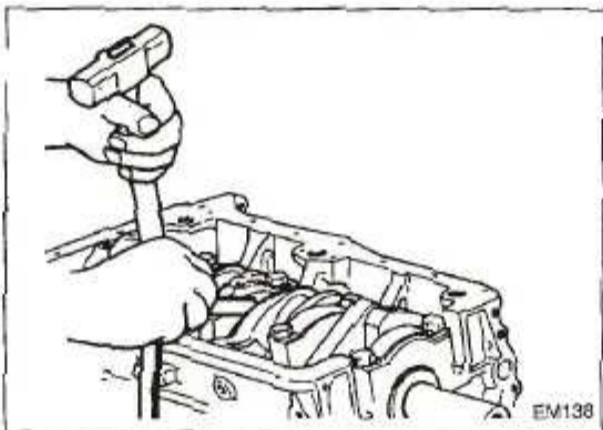


MEASURING CRANKSHAFT END PLAY

- Tighten to the specified torque. After that, measure end play.
- Assemble the crankshaft and measure the end play.
- If the end play exceeds the limit, replace the main bearing center bushing.

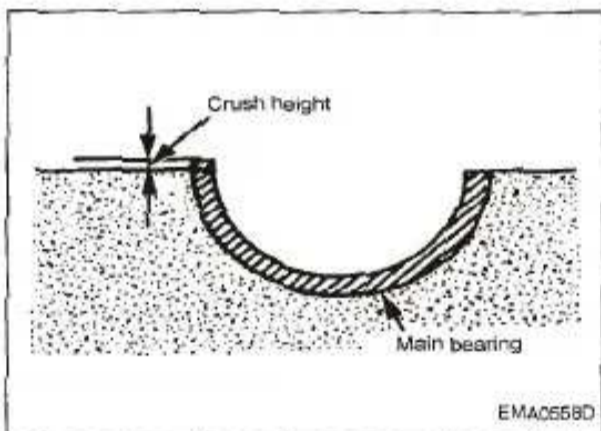
Measuring main bearing end play

	Standard	Limit
End play mm (in)	0.05 - 0.18 (0.0020 - 0.0071)	0.2 (0.0079)



MAIN BEARING CRUSH HEIGHT

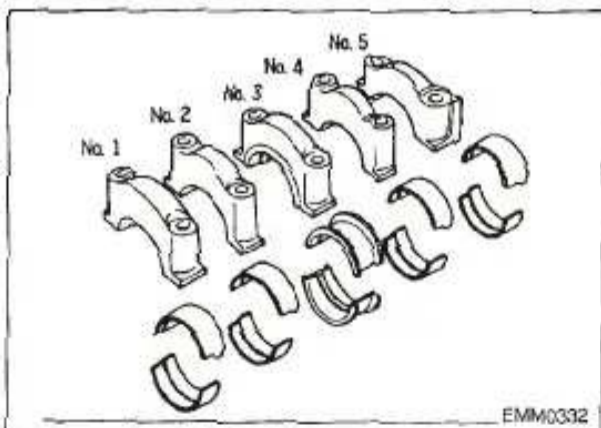
- With main bearing installed, tighten bearing cap to the specified torque. Remove bearing cap and make sure that the main bearing edges protrude. Standard: There must be crush height



CRANKSHAFT MAIN BEARING

- Inspect the main bearing bushing.
- As shown below, the main bearing bushings in use are classified in two types. Nos. 1, 2, 4 and 5 are common. No.3 (center) is provided with a thrust bushing.

Check the bearing for scratch, metal fatigue, peeling or bend and replace the upper and lower bearings together as necessary.



ENGINE SERVICE

Inspection and Correction (Cont'd)

MAIN BEARING CAP AND BEARING

Measuring oil clearance

- (1) Remove the cap and read the plastigage width using the scale printed on the bag.
- (2) If the clearance exceeds the limit, use an undersize bearing. At that time, grind the journal or pin.

Standard

Unit: mm (in)

Items	Oil clearance Standard	Oil clearance Limit	Cap tightening torque
Main bearing	0.02 - 0.06 (0.0008 - 0.0024)	0.1 (0.004)	Lubricated 83.4 - 93.2N•m (8.51 - 9.51 kg•m, 61.6 - 68.8 ft•lb)

Main bearing specifications

Undersize mm (in)	Crankshaft journal diameter mm (in)
0.02 (0.0008)	62.922 - 62.935 (2.4772 - 2.4778)
0.25 (0.0098)	62.692 - 62.705 (2.4682 - 2.4687)
0.50 (0.0197)	62.422 - 62.455 (2.4576 - 2.4589)
0.75 (0.0295)	62.192 - 62.205 (2.4485 - 2.4490)
1.00 (0.0394)	61.942 - 61.955 (2.4387 - 2.4392)

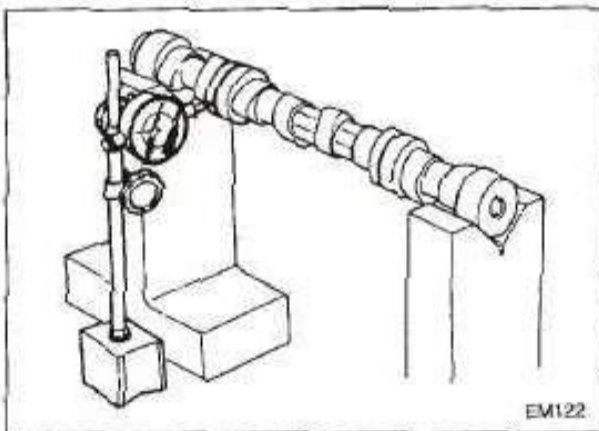
14. Camshaft

INSPECTION OF CAMSHAFT BEND

- Apply the probe of a dial gauge to the center journal and *measure the fluctuation* while turning the camshaft. Determine half of the reading as the camshaft bend.
Bend limit: 0.05 mm (0.0020 in)
- Replace if necessary.

Measuring camshaft bend

	Standard (Shall not exceed the value)	Usable limit
Camshaft bend mm (in)	0.02 (0.0008)	0.05 (0.0020)

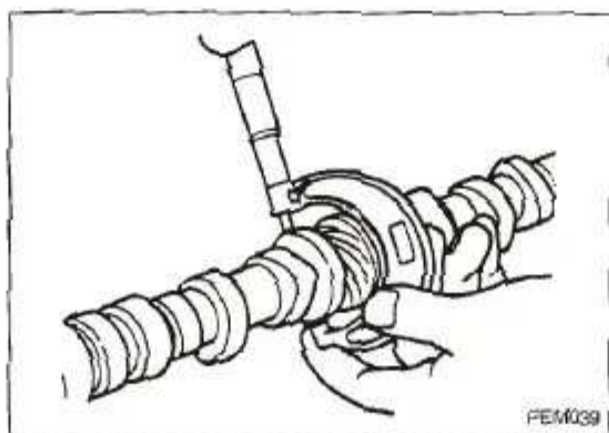


ENGINE SERVICE

Inspection and Correction (Cont'd)

CAMSHAFT JOURNAL INSPECTION

- Inspect the camshaft journal and *replace it if any damage or uneven wear is observed.*
- If the wear is found to *exceed the limit by measurement with a micrometer, replace the camshaft.*



Camshaft journal inspection

Camshaft journal	Standard (Shall not exceed the value)	Usable limit
Taper Out-of-round mm (in)	0.01(0.0004)	0.03 (0.0012)
Journal wear mm (in)		0.05 (0.0020)

MEASURING CAMSHAFT HEIGHT

- Measure the camshaft height by applying calipers to the camshaft nose.

Unit: mm (in)

	Camshaft height
Standard	Intake/exhaust 36.750 - 36.800 (1.4468 - 1.4489)
Usable limit	36.5 (1.437)

- Inspect the oil pump and distributor drive gear. If *excessive wear or damage is observed, replace the camshaft.*

VALVE TIMING

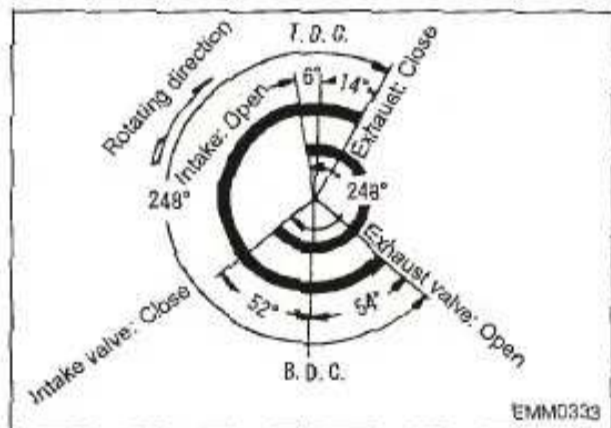
The figure on the left is *applicable to all cylinders.*

If any of the valves deviate from the specifications, the camshaft ridges may be *worn out or damaged.* The camshaft must be replaced.

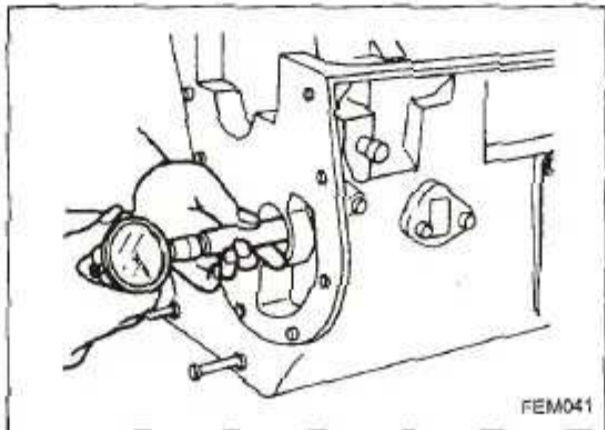
Camshaft bushing inspection

- Check for bend, melting, uneven contact or peeling.
- *If any damage is found, replace the camshaft bushing.*

Measuring camshaft journal clearance



ENGINE SERVICE



Inspection and Correction (Cont'd)

- Measure the inner diameter of the camshaft bushing and the outer diameter of the camshaft journal. If any non-standard condition is found, replace the camshaft bushing.

Unit: mm (in)

	Journal No.	Standard	Usable limit
Clearance	#1	0.025 - 0.051	0.1
	#3	(0.0010 - 0.0020)	(0.004)
	#2	0.038 - 0.064	0.15
		(0.0015 - 0.0025)	(0.0059)
Bushing inner diameter	#1	45.472 - 45.485 (1.7902 - 1.9707)	
	#2	43.948 - 43.961 (1.7302 - 1.7307)	
	#3	41.256 - 41.269 (1.6242 - 1.6248)	
Journal outer diameter	#1	45.434 - 45.447 (1.7887 - 1.7892)	
	#2	43.897 - 43.910 (1.7282 - 1.7287)	
	#3	41.218 - 41.231 (1.6228 - 1.6233)	

- When installing a new *camshaft* bushing, always align the oil holes correctly.

15. Timing sprocket

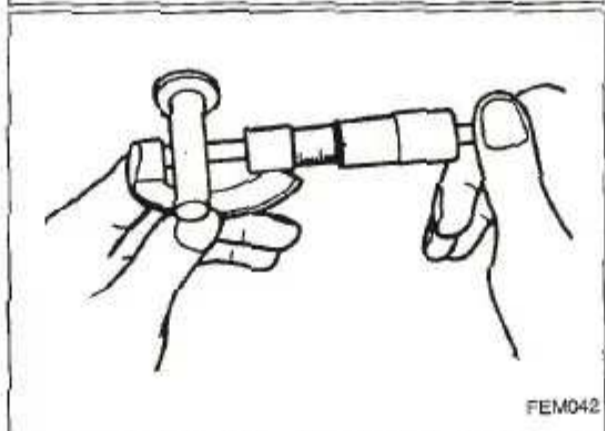
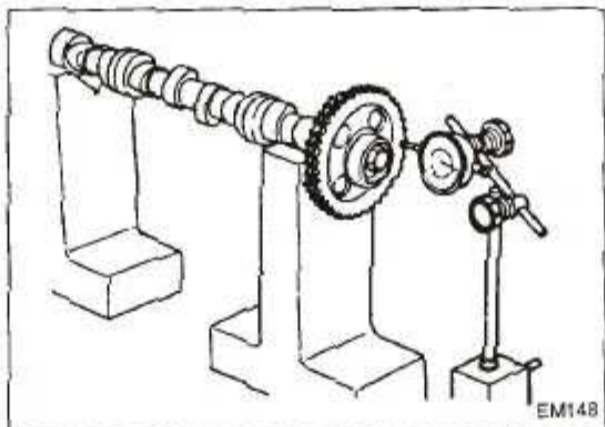
- Check camshaft gear surface for flatness.
- Place the camshaft with camshaft sprocket on a V block and measure the sprocket runout. If the deflection exceeds 0.1 mm, repair or replace the camshaft. Also inspect the gear teeth and bosses. If any excessive wear or damage is observed, replace the camshaft.

16. Front cover and timing chain housing

- Inspect the housing mounting faces and oil seal. If any excessive damage is observed, replace the relevant component(s).

17. Valve lifter

- Inspect the contact face between the valve lifter body and camshaft. If excessive wear, damage or melting is observed, replace the component. Also inspect the installation status to the cylinder block and replace the component.
- The valve lifter, if correctly installed and lubricated, should seat into the hole slowly by its weight.

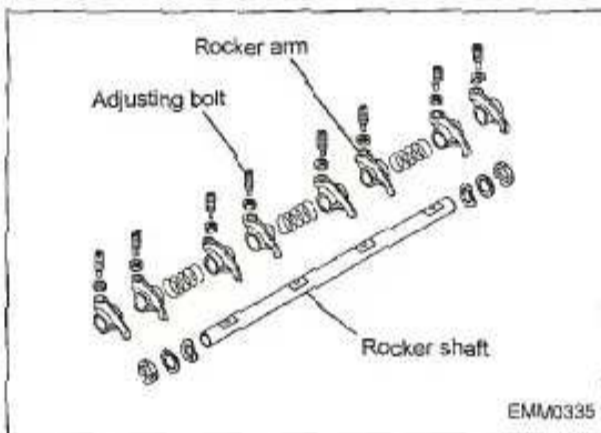
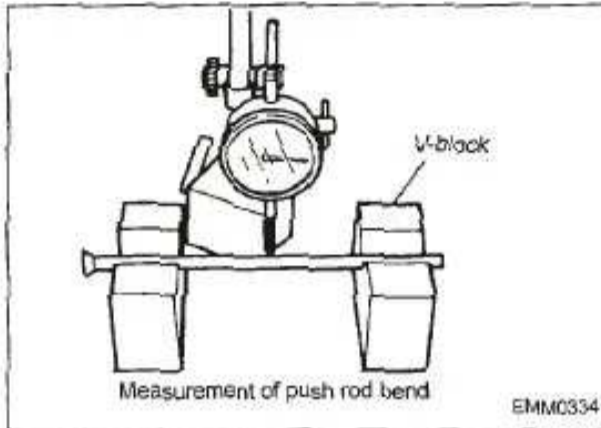


Measuring valve lifter

	Standard (Shall not deviate from the range)	Repair limit
Valve lifter and cylinder block hole Clearance mm (in)	0.016 - 0.052 (0.0006 - 0.0020)	0.1 (0.0039)

ENGINE SERVICE

Inspection and Correction (Cont'd)



18. Push rod

- Inspect the push rod and replace it if excessive wear, twist or damage is observed. If a bend of 0.05 mm (0.0020 in) or more is present, repair or replace the push rod.

19. Rocker shaft

- Check the rocker shaft for wear, damage or bend and replace it if wear of 0.05 mm (0.0020 in) or more is observed.

20. Rocker arm and adjusting bolt

- Inspect the valve stem-to-rocker shaft contact face of the rocker arm and adjusting bolt. If excessive wear is found or the rocker shaft clearance exceeds the specified limit, replace the rocker arm (adjusting bolt).

	Standard	Repair limit
Rock arm/shaft Clearance mm (in)	0.020 - 0.054 (0.0008 - 0.0021)	0.1 (0.0039)

21. Flywheel

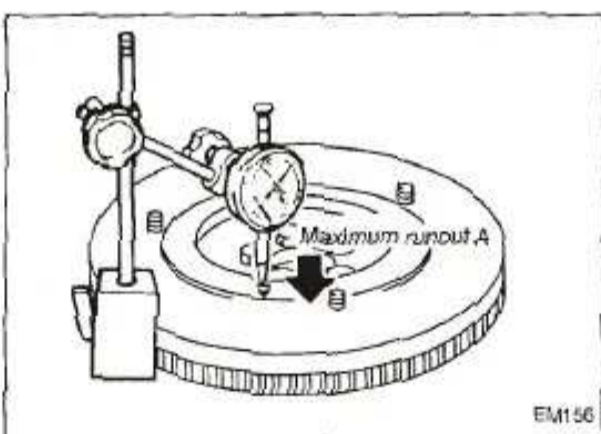
- Inspect the flywheel sliding face and the ring gear teeth.
- If excessive damage or wear is observed, repair or replace the relevant component.
- If the wear of the flywheel ring gear is relatively small, reuse the ring gear by shifting the installation position by 45 degrees.
To install a new ring gear, heat it to 180°C (356°F) and use a compression fitting method.

MEASURING FLATNESS

- Measure the flatness while turning the crankshaft using a dial gauge.
- The flatness limit A is the maximum allowable flatness measured vertically to the flywheel clutch sliding face.

Flywheel flatness limit

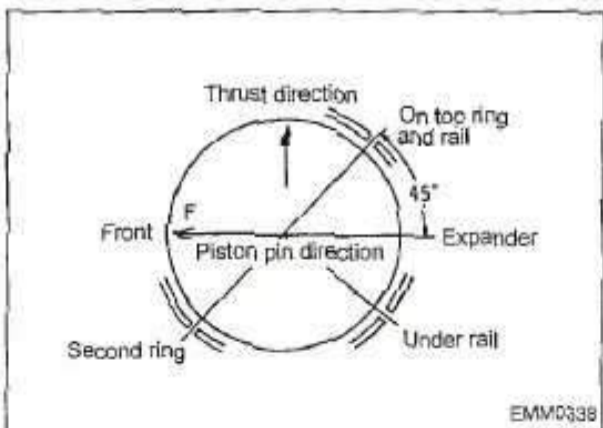
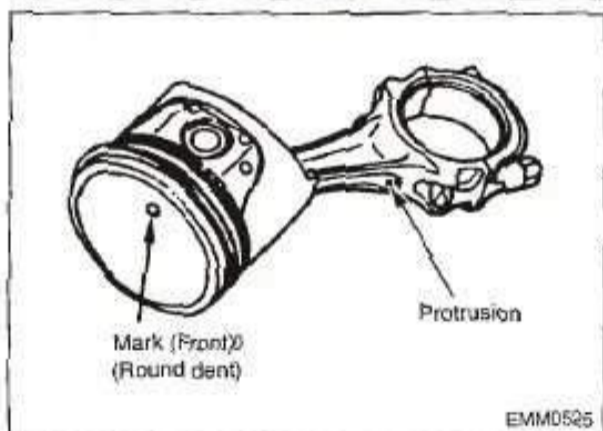
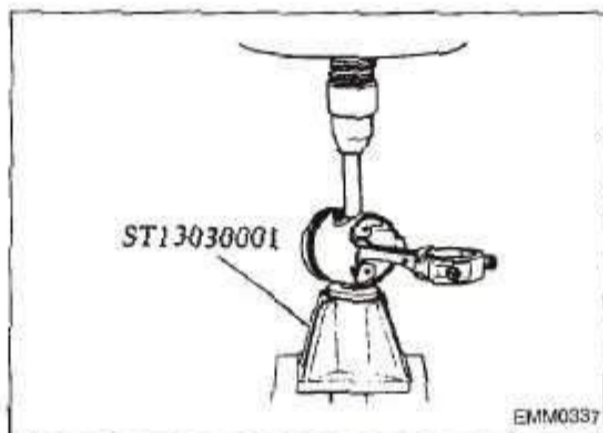
A: 0.1 mm (0.004 in) or less



ENGINE SERVICE

Engine Assembly

1. General assembly precautions
 - Apply an adequate amount of oil to the sliding faces.
 - Clean the part completely. In particular, *ensure* that no oil passages are plugged.
 - As a rule, replace all gaskets, packing and oil seals with new ones.
 - Always replace the lock plates.
 - Always follow the instructions about the tightening torque and tightening order. While tightening, *monitor* the clearance at each critical point.
 - Always install the nuts, bolts and washers to their *original* positions.
 - For sealing, use liquid packing as necessary. Make *sure* to apply liquid packing if so instructed.
 - Always keep the tools and work benches clean from dust, dirt and oil/greases.
2. Assemble the piston and connecting rod.
 - Install the assembled connecting rod and piston to the relevant cylinder.
 - To install the piston pins, press-fit them into the relevant pistons with a force of 0.5 to 1.5 t by using the piston pin press stand (SST). When press-fitting, apply a small amount of oil to the pin and the small end of the rod.
 - A round recess on the piston top is the piston's front mark.



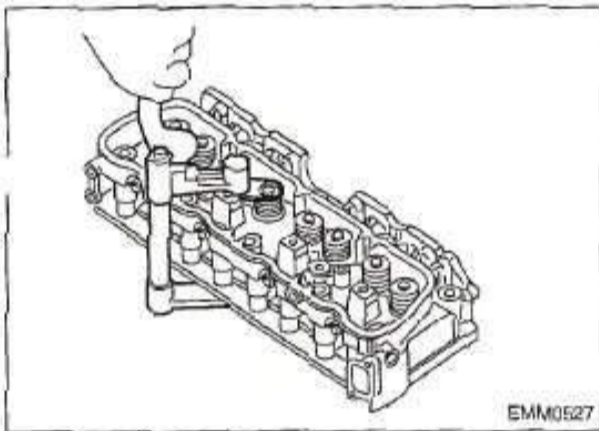
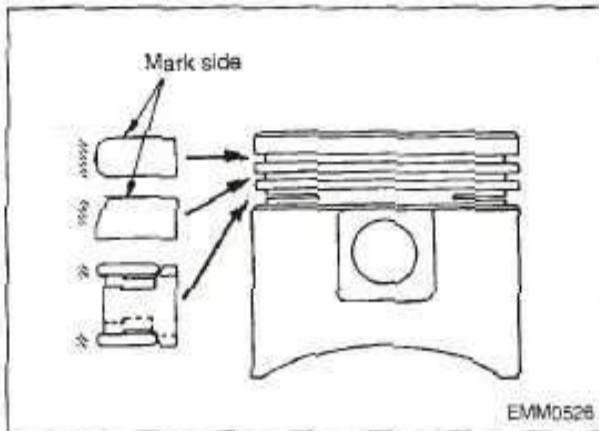
- The front of the connecting rod is determined as follows: When installed to the piston and viewed from the front, the projection should come to the right.

3. Assembly of piston ring

- Securely assemble the top ring, second ring and oil ring to their relevant positions.
- Make *sure* to assemble these parts in the following order: oil ring, second ring, top ring.

ENGINE SERVICE

Engine Assembly (Cont'd)



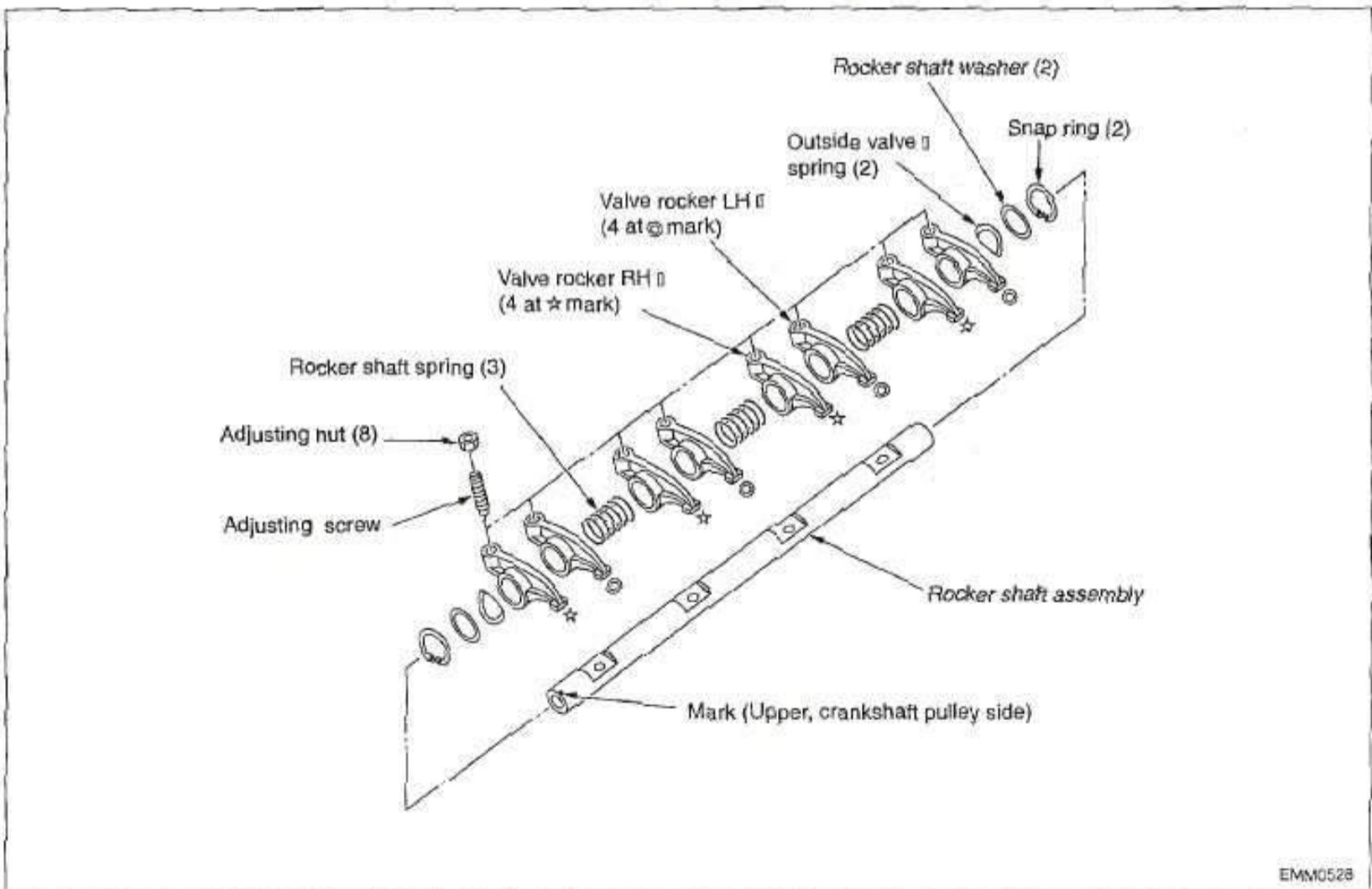
- The top ring is plated with chrome on its sliding face.
- When installing the compression ring, turn the manufacturer marking upward.
- The upper and lower combined rings are identical.

4. Assembly of valve and valve spring

- Set the lip seal with the valve oil seal drift (SST) and insert the valve. Assemble the valve spring and valve spring retainer in order and insert the collet by compressing the spring with the valve lifter (SST).

CAUTION:

- Always assemble the valves to their original cylinders. The wear level of the sliding face differs depending on the cylinder.
- Face the narrower pitch side of valve spring (with identification paint mark) toward cylinder head.
- Verify that the valves are seated securely and no foreign objects are caught inside.



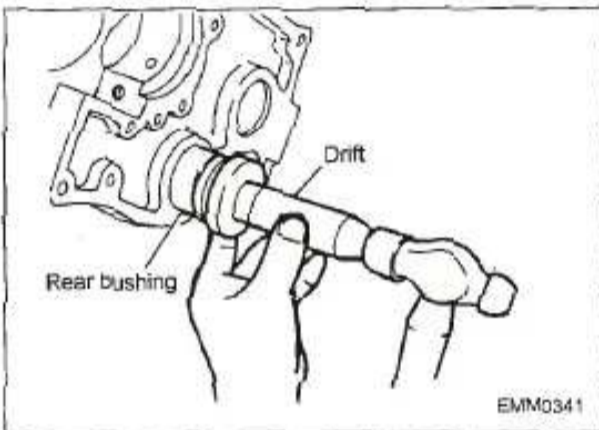
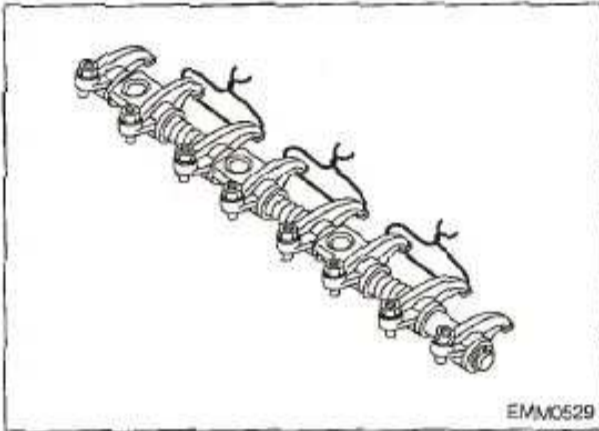
5. Rocker shaft assembly

- Apply engine oil to sliding surfaces with rocker shaft of valve rocker, and assemble it as shown in the figure.

ENGINE SERVICE

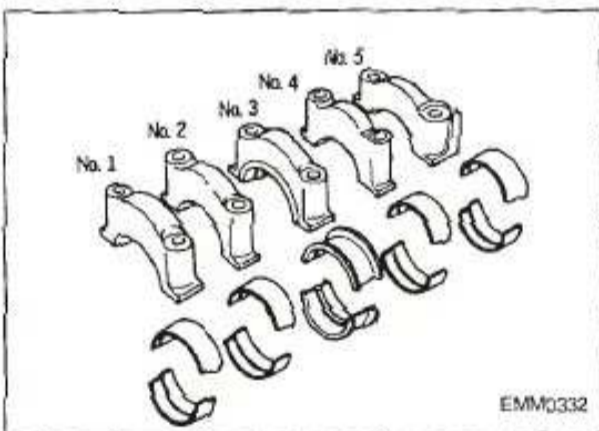
Engine Assembly (Cont'd)

- There are 2 valve rockers. Be careful about the position with the paint mark of rocker shaft.
- Compress the coil spring and tie the spring with a metal wire after assembling. It is easy to assemble to cylinder head. Wire diameter is 0.5 to 0.8 mm (0.020 to 0.031 in).



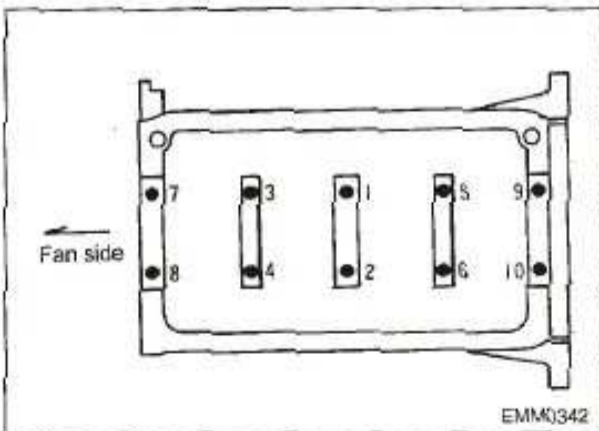
6. Assembly of camshaft bushing

- Assembly of rear bushing
Locate the bushing so that the arrow on the bushing faces upward. Align the bushing to the oil hole on the cylinder block and drive in the bushing as shown.
- The bushing has a slightly larger diameter toward its rear end. This ensures that the bushing is press fit into the cylinder block.



7. Assembly of crankshaft

- Assemble the main bearing bushing to the cap.
- As shown below, the main bearing bushings in use are classified in two types. Nos. 1, 2, 4 and 5 are common. No.3 (center) is provided with a thrust bushing.
- Assemble crankshaft.
- Assemble main bearing caps.
- For the front bearing cap, align the cap to the cylinder block so that they are flush with each other.



- Apply engine oil to the cap bolts and tighten them to the specified torque from inside to outside as shown in the figure on the left.
- Make sure that the crankshaft can be turned with a light force every time one bolt is tightened.

□ : 83.4 - 93.2 N•m (8.5 - 9.5 kg-m, 61 - 69 ft-lb)

NOTE:

Cranking torque 15 N•m (1.5 kg-m, 11 ft-lb) or less

CAUTION:

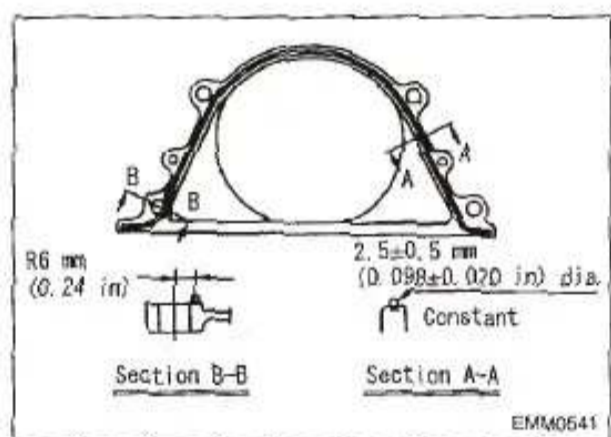
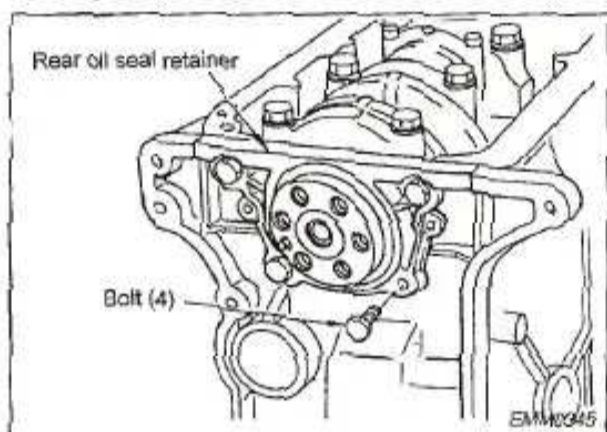
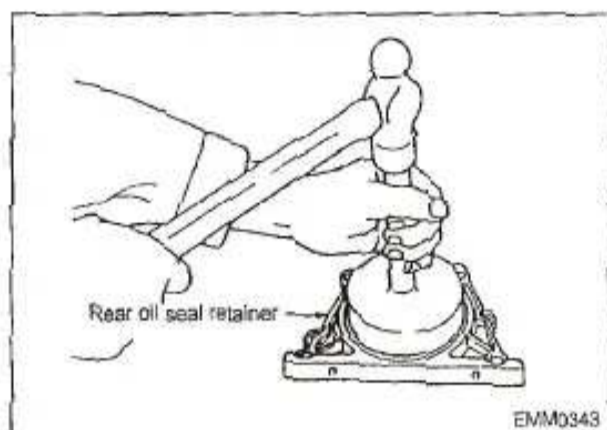
For assembly, see the front of the part. An (embossed) arrow and numbers indicating the assembly position can be seen.

ENGINE SERVICE

Engine Assembly (Cont'd)

8. Assembly of rear oil seal retainer

- Assemble the oil seal to the rear oil seal retainer.
To drive in the oil seal, use the special service tool (KV10105500).



- Install rear oil seal retainer to cylinder block.
Rear oil seal retainer retaining bolt:
⌘ 21 - 36 N•m (2.1 - 3.7 kg-m, 15 - 27 ft-lb)
⌘ 20.6 - 26.5 N•m (2.1 - 2.7 kg-m, 15 - 20 ft-lb)

CAUTION:

- Before installing the rear oil seal retainer, apply liquid packing to the retainer as shown in the figure.
- Once attaching the retainer and tightening the bolts, do not make additional tightening or remove the retainer (and retighten).
- For the mounting face, apply a continuous bead of sealant along the groove. For the bolt holes, apply sealant so that it does not run off the inner edges.
- Make sure to finish the assembly within 5 minutes after sealant application.
- After the assembly, leave the assembled parts as is for 30 minutes or more.

PRECAUTIONS BEFORE APPLICATION:

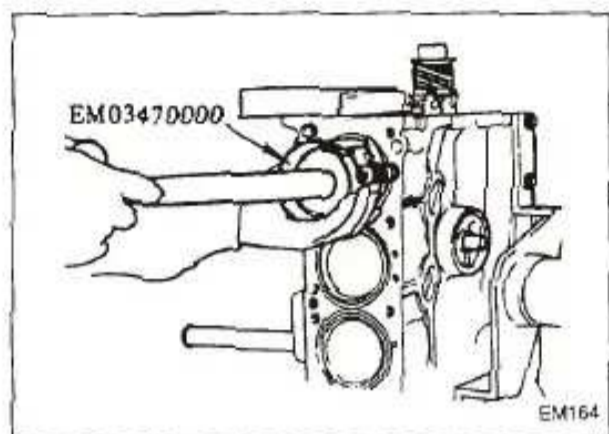
- The mounting faces (both sides) shall be free from moisture, oil, grease, waste, dust and other foreign objects.
- Make sure to remove any sealant from the flange/mounting faces and threads when reassembling the part that has once been attached and disassembled.

9. Assembly of piston

- Assemble the bearing to the connecting rod.
- To each cylinder, assemble the corresponding connecting rod and piston subassembly according to the cylinder number.
- When assembling, turn the front mark of the piston toward the front.
- Set the crankshaft pin positions to TDC or BDC.

ENGINE SERVICE

Engine Assembly (Cont'd)



- (5) Insert the pistons into the cylinder block using the *piston ring compressor (SST)*.

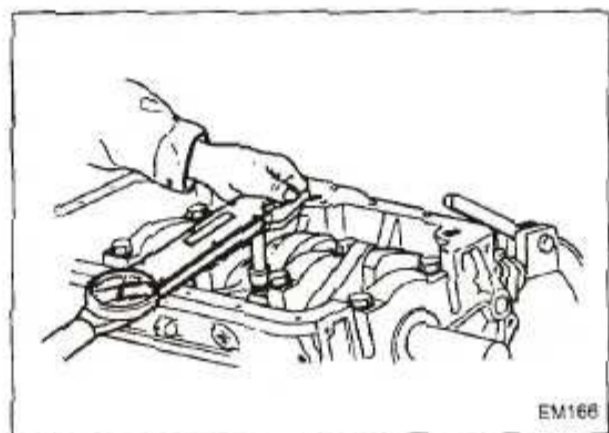
CAUTION:

Do not mistake the piston front.

- (6) Assemble each connecting rod and *connecting rod cap* while *aligning their matching marks*.


CAUTION:

Install silicon rubber tubes to tip of connecting rod bolt to prevent crankshaft pin from being damaged.



- (7) Tighten connecting rod cap.

Connecting rod cap bolt:

 **31 - 37 N·m (3.2 - 3.8 kg-m, 23 - 27 ft-lb) (K15, K21, K25)**


10. Assembly of valve lifter

- Fit the valve lifter in the correct position. Apply a small amount of oil and press the valve lifter into the hole on the cylinder block.

11. Assembly of camshaft

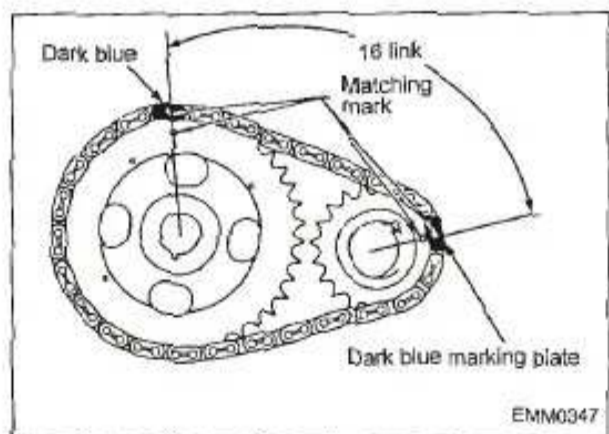
- (1) Gently put the camshaft into the camshaft hole so that the bearing bushings are not damaged.
- (2) Tighten locating plate bolt to the specified torque.

M6 x 16 (thread length) TT bolt:

 **8.43 - 10.8 N·m (0.86 - 1.1 kg-m, 72 -95 in-lb)**

12. Assembly of timing chain/sprocket

- (1) Tighten camshaft bolts.
Tightening torque: 39.2 - 49.0 N·m (4.0 - 5.0 kg-m, 29 - 36 ft-lb)
- (2) Check the height of the camshaft gear and crankshaft gear end faces, and adjust the height by adding shims to the crankshaft side as necessary.
- (3) Assemble the sprocket and timing chain simultaneously while aligning their matching marks.

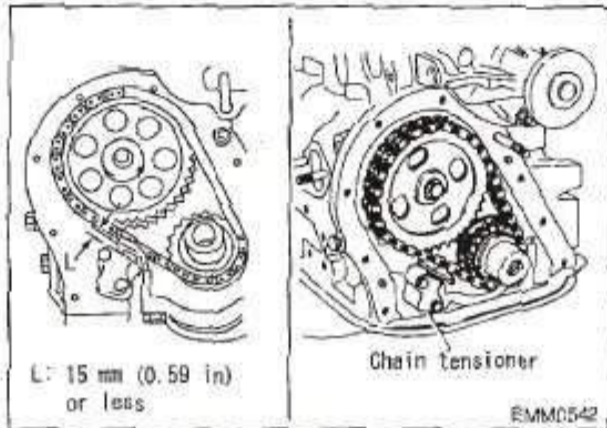


ENGINE SERVICE

Engine Assembly (Cont'd)

13. Installation of timing chain tensioner

- Assemble chain tensioner.
- When installing the chain tensioner, align the oil holes of the tensioner body to those of the cylinder block to ensure that the tensioner spindle shoe (synthetic rubber) is held parallel with the chain.



CAUTION:

Assembling the shoe in the *reverse* position will prevent tightening of the tensioner bolt, resulting in tensioner damage.

M6 x 35 (thread length) bolt:

: 8.43 - 10.8 N·m (0.86 - 1.1 kg-m, 75 - 95 in-lb)

14. Installation of timing chain housing

- Before installing the timing chain housing, apply liquid packing to the housing as shown in the figure.

15. Inspection and installation of oil pump sprocket and chain

PTO DEVICE

Inspection

- Sprocket (Oil pump side)
If the gear teeth have *significant* scratches, excessive wear or stepped wear at the spline, replace the sprocket.
- Sprocket (Crankshaft side)
If the gear teeth have significant scratches or wear, replace the sprocket.
- Ball bearing
If the bearing is *loose* or *drags*, replace the sprocket.
- Chain
If the link has *significant* scratches, stretch (unusual slapping noise is generated when tilt lever is operated) or wear, replace the sprocket.

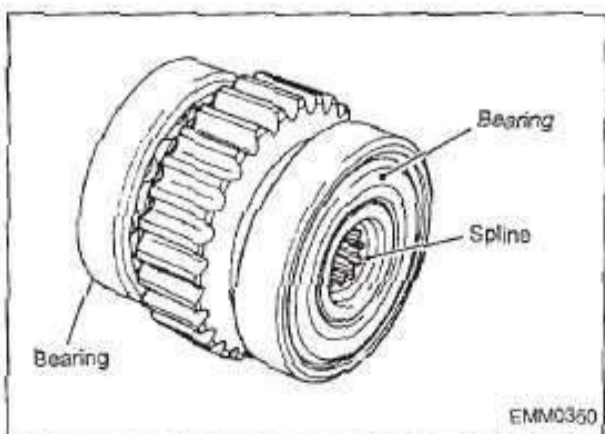
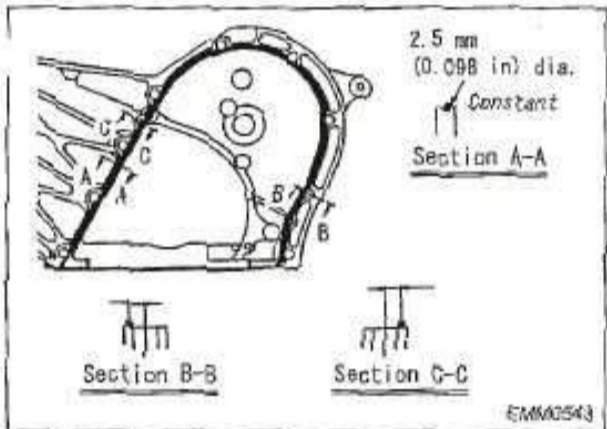
Assembly

- Assemble oil seal to front cover.
Drive in the sprocket using the front oil seal drift (ST1524S000).

CAUTION:

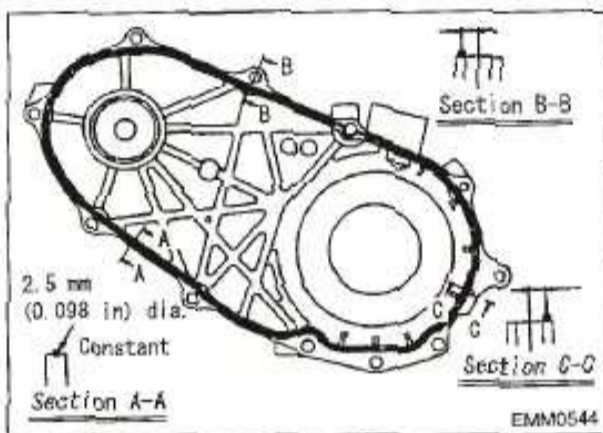
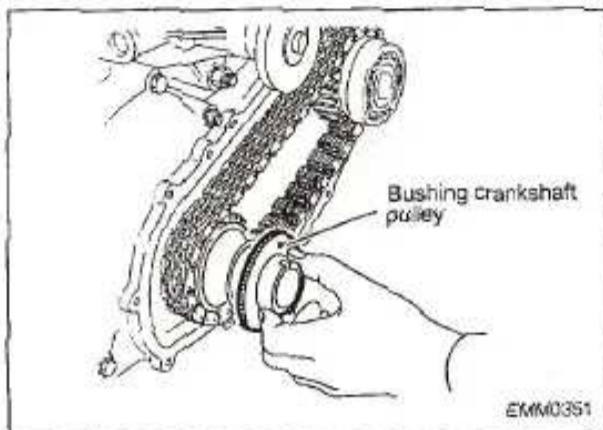
First, apply grease to the lip of the oil seal. When driving in the sprocket, ensure that the sprocket is not inclined.

- Install the bearing to the oil pump-side sprocket.
The bearings before and after the sprocket are identical. To install them, use a press as done for disassembly.



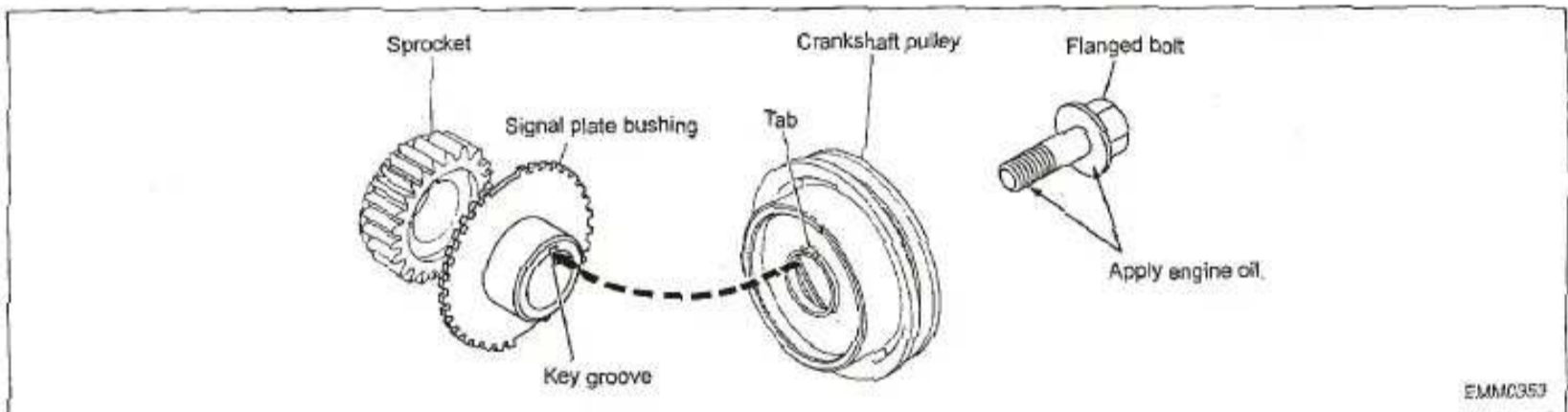
ENGINE SERVICE

Engine Assembly (Cont'd)



- Install the sprocket and chain as an assembly. Install the chain to the sprocket, and then install the chain and sprocket assembly to the crankshaft and timing chain housing.
 - Remove any old grease from the oil pump spline and apply new molybdenum grease.
 - Install front cover.
- Install the bushing crankshaft pulley for the crankshaft position sensor. Before installing the front cover, apply liquid packing to the cover as shown in the figure. (Refer to the rear oil seal retainer installation procedure.)
M8 x 25 (thread length) 7T bolt:
 \square : 20.6 - 26.5 N·m (2.1 - 2.7 kg·m, 15 - 20 ft·lb)

16. Installation of crankshaft pulley



- (1) Set the crankshaft pulley by aligning the pulley claws to the groove of the bushing.
- (2) Attach the washer, apply engine oil to the crankshaft pulley bolt and tighten the bolt.

Crankshaft pulley bolt:

\square : 220.5 - 240.1 N·m (22.5 - 24.5 kg·m, 163 - 177 ft·lb)

17. Installation of cylinder head

- (1) Both ends of cylinder block top
Drive in dowels into the head bolt holes (two positions).
- (2) Place the head gasket on the block top with the copper side facing up.

ENGINE SERVICE

Engine Assembly (Cont'd)

Tightening procedure

Tightening torque (Reference)	N·m (kg-m, ft-lb)	Notes
① 19.6 - 23.5 (2.0 - 2.3, 14 - 17)		Tightening for brake-in
② 68.6 (7.0, 51)		
③ 0 (0, 0)		Return
④ 19.6 - 23.5 (2.0 - 2.3, 14 - 17)		Retightening
⑤ 90° - 92°		

Assembly sequence

Precautions before assembling

- Do not allow oil or dust to get on cylinder head, mounting surface of cylinder block, and head gasket.
- Apply anticorrosive oil onto head bolt thread and surface under the head.

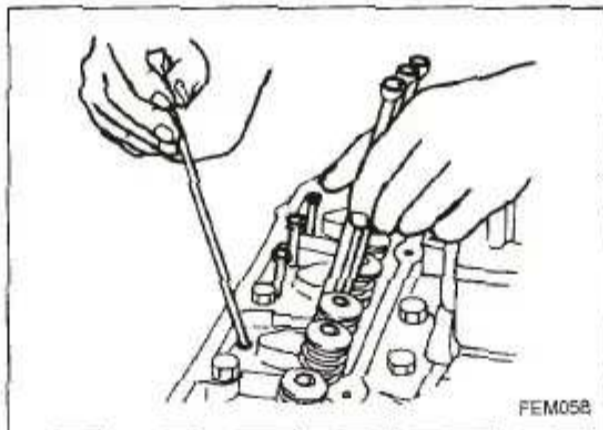
MAM0147

- (3) Set the cylinder head. Apply engine oil to the cylinder bolts and tighten them to the specified torque in the order shown in the left figure.

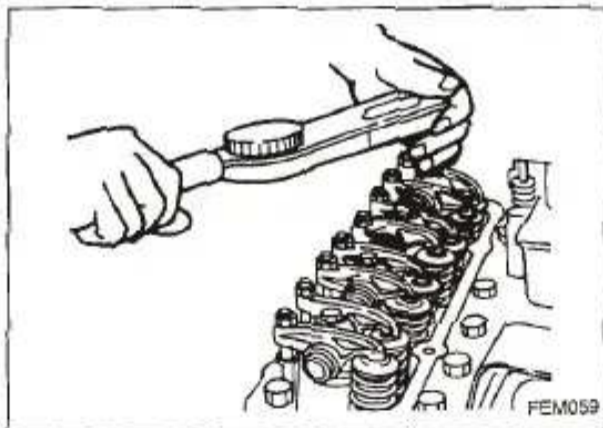
CAUTION:
Check tightening angle with an angle wrench (SST) or a protractor. Do not simply estimate tightening angle.

For the service purposes, the following substitution torque may be used: 68.6 N·m (7.0 kg-m, 51 ft-lb).

- (4) Assembly of push rod
18. Installation of rocker shaft assembly

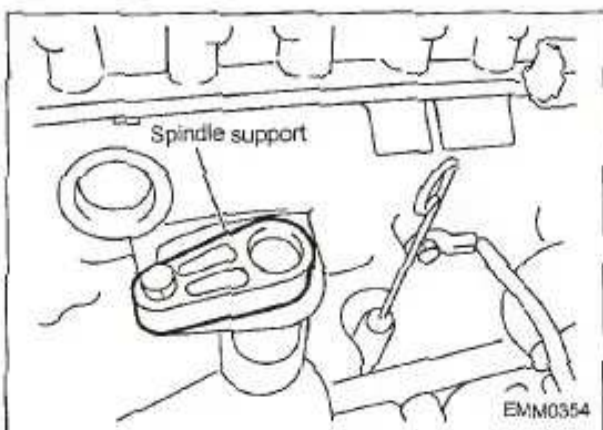


- (1) Securely set the push rod onto the holder of the valve lifter.



- (2) Assemble the rocker shaft assembly.
□: 17.7 - 21.6 N·m (1.8 - 2.2 kg-m, 13 - 16 ft-lb)

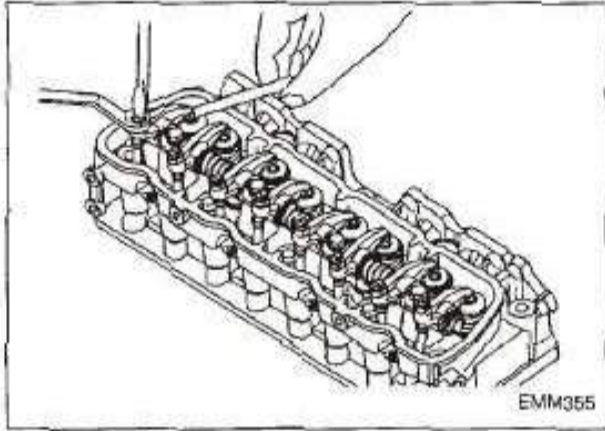
CAUTION:
Tighten the rocker shaft retaining bolts evenly from inside to outside.



- For the electronic control models, install the spindle support (left figure) to the distributor installation holes.

ENGINE SERVICE

Engine Assembly (Cont'd)



- (3) Adjust the valve clearance.

Valve clearance:

Both intake and exhaust
0.38 mm (0.0150 in) (when engine is hot)

CAUTION:

The valve clearance must be finally adjusted when the engine is hot. However, preliminary adjustment in cold state will make the final adjustment easier.

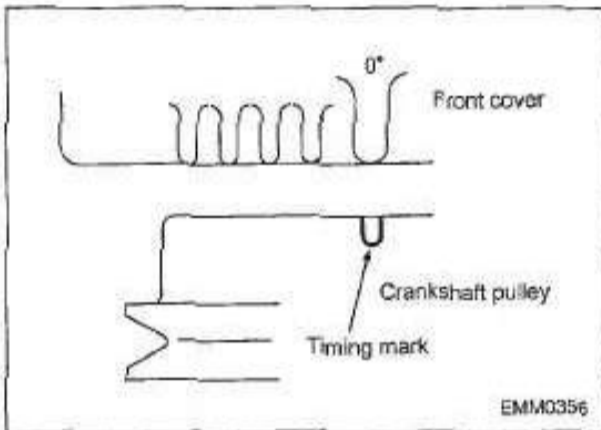
- (4) Assemble the rocker cover.

\square : 13.7 - 15.7 N·m (1.4 - 1.6 kg-m, 10 - 12 ft-lb)

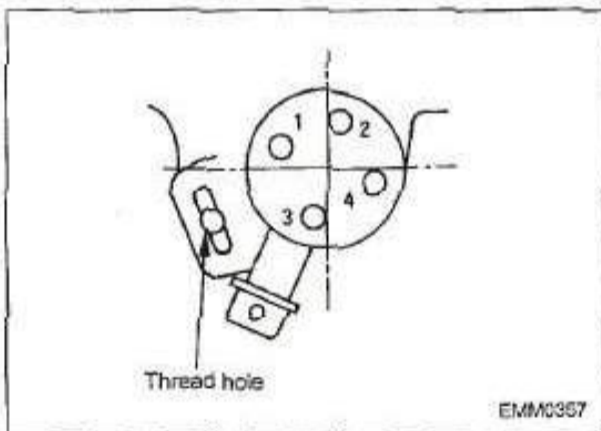
19. Installation of engine accessories

- Install the oil pressure switch.
- Installing oil pump (all models) and distributor (carburetor model)

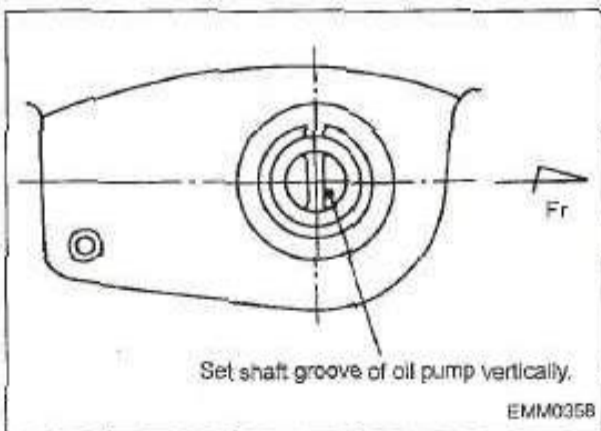
- (1) Set the crankshaft position to the compression TDC for cylinder No. 1.



- (2) Locate the distributor so that the center of its flange long hole aligns to the bolt hole on the cylinder block, and insert the distributor. (Do not turn the distributor to align the holes)

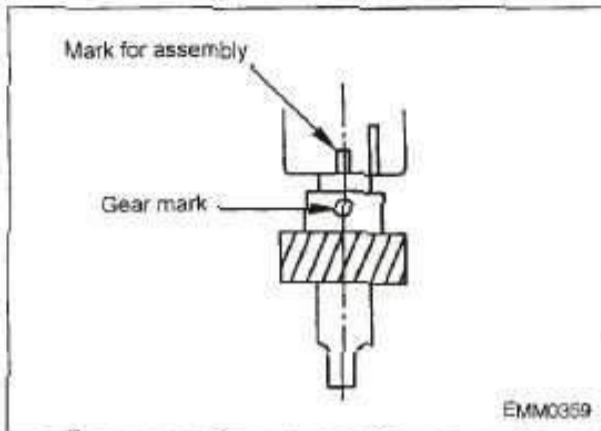


- (3) Align the drive shaft groove of the engine lubricating oil pump.



ENGINE SERVICE

Engine Assembly (Cont'd)



(4) Align the distributor gear mark to the short mark on the housing.

CAUTION:

Do not align the gear mark to the gear installation pin or the long mark.

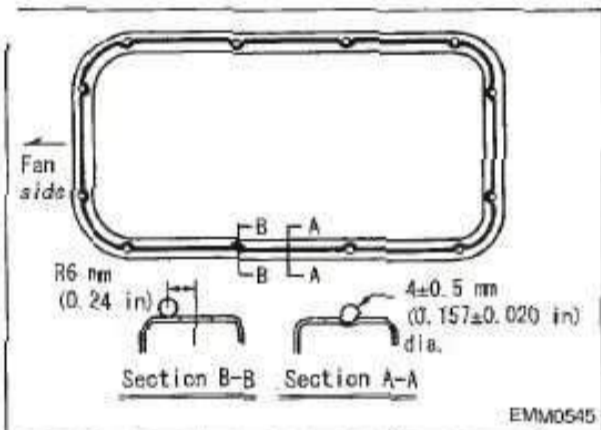
(5) Tentatively tighten the retaining bolts.


(6) After installing the distributor gear, adjust the ignition timing by using a timing light. Then, fully tighten the retaining bolts.

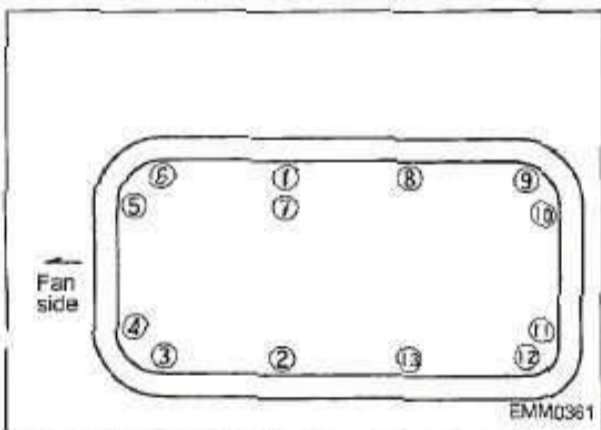
Idle speed and ignition timing (BTDC°/rpm)	Electronic controlled specifications
	0°/700 rpm
	Carburetor specifications
	K15 4°/700 rpm
	K21 2°/700 rpm
	K25 0°/700 rpm

(7) Installation of oil pan


- Before installing the oil pan, apply liquid packing to the oil pan flange as shown in the figure.



- Tighten the oil pan retaining bolts to the specified torque in the order shown in the left figure.
- Tightening torque for oil pan retaining bolt:
 : 8.43 - 10.8 N·m
 (0.86 - 1.1 kg-m, 75 - 95 in-lb)
 M6 x 12 (thread length) 7T bolt

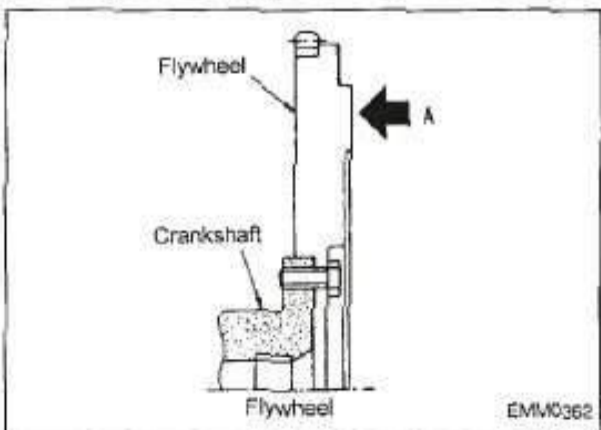


(8) Installation of flywheel housing (or rear plate)

- Install flywheel housing.
- Tightening torque for housing retaining bolt
 : 44.1 - 58.8 N·m (4.5 - 6.0 kg-m, 33 - 43 ft-lb)

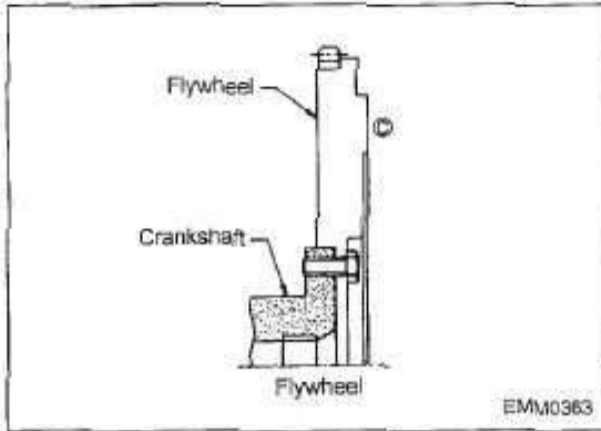
(9) Installation of flywheel

- Install flywheel.



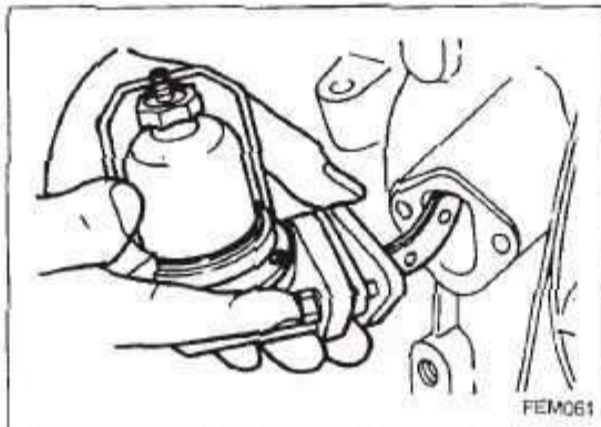
ENGINE SERVICE

Engine Assembly (Cont'd)



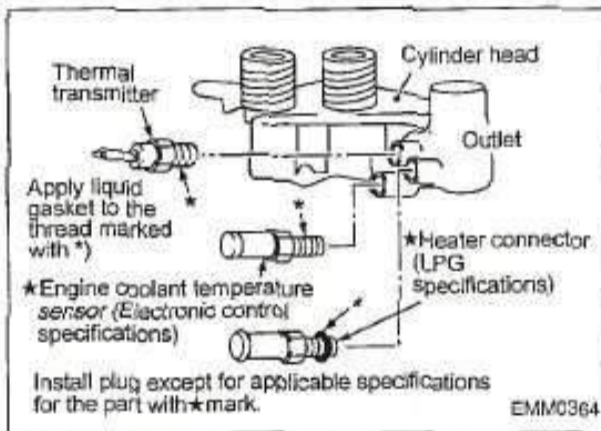
- Tightening torque for flywheel
(Apply engine oil to the bolt seat face and threads)
Ⓜ : 132 - 142 N·m (13.47 - 14.49 kg-m, 97 - 105 ft-lb)
- Check the flywheel runout with a dial gauge by turning the crankshaft.

Measurement position	Repair limit
Section A	0.1 mm (0.004 in)



20. Other parts

- Install the (fuel pump) and piping. (Carburetor model)
- Install the oil filter. For the installation procedure, refer to page MA-10.
- *Install oil level gauge.*
(Carburetor model only)
- Install thermostat.



- Install thermal transmitter, engine coolant temperature sensor, and heater connector.
- Install spark plugs.
Ⓜ : 18 - 24 N·m (1.8 - 2.4 kg-m, 13 - 17 ft-lb)
- Installation of distributor vacuum control tube (carburetor model)
- Installation of high-tension cord (or low-voltage *distribution* cord for electronic control model)
- Remove from the engine attachment.
- Install engine mount bracket LH.
- Install engine mount bracket RH.
- Install the alternator and adjusting bar.
- Install the fan belt and fan.
- Adjust the fan belt. Refer to MA section for the adjustment procedure.

ENGINE LUBRICATION & COOLING SYSTEMS

SECTION **LC**

CONTENTS

LUBRICATION SYSTEM	LC-2	ENGINE COOLANT SYSTEM	LC-6
Specifications	LC-2	Specifications	LC-6
Adjustment Value	LC-2	Adjustment Value	LC-6
Oil Pressure	LC-2	Tightening Torque	LC-6
Tightening Torque	LC-2	Trouble Diagnosis	LC-6
Trouble Diagnosis	LC-3	Cooling System Configuration	LC-7
Lubrication Schematic Diagram	LC-4	Water Pump	LC-8
Oil Pump	LC-5	Thermostat	LC-9

LUBRICATION SYSTEM

Specifications

MAIN SPECIFICATIONS

Lubrication method	Pressured supply
<i>Oil pump</i>	<i>Spur gear type</i>
Oil filter	Total flow, cartridge type

Adjustment Value

OIL PUMP

Unit: mm (in)

Clearance between pump gear and main body	0.4 (0.016) or less
Backlash of pump gear	0.5 (0.020) or less
Pump gear clearance in vertical direction	0.3 (0.012) or less

Oil Pressure

OIL PRESSURE

Unit: kPa (bar, kg/cm², psi)

Discharge pressure	At idle	Oil temperature 80°C (176°F) 98 (0.98, 1.0, 14)
	At 2,000 rpm	275 - 314 (2.75 - 3.14, 2.8 - 3.2, 40 - 46)

Tightening Torque

	N·m	kg·m	ft·lb, in·lb*
Oil pump bolt	15.7 - 17.7	1.6 - 1.81	11.6 - 13.1
<i>Oil pump cover bolt</i>	<i>6.37 - 7.45</i>	<i>0.65 - 0.76</i>	<i>56 - 66*</i>
Oil pan bolt	6.37 - 7.45	0.65 - 0.76	56 - 66*
Oil pan drain plug	29.4 - 39.2	3.0 - 4.0	22 - 29

LUBRICATION SYSTEM

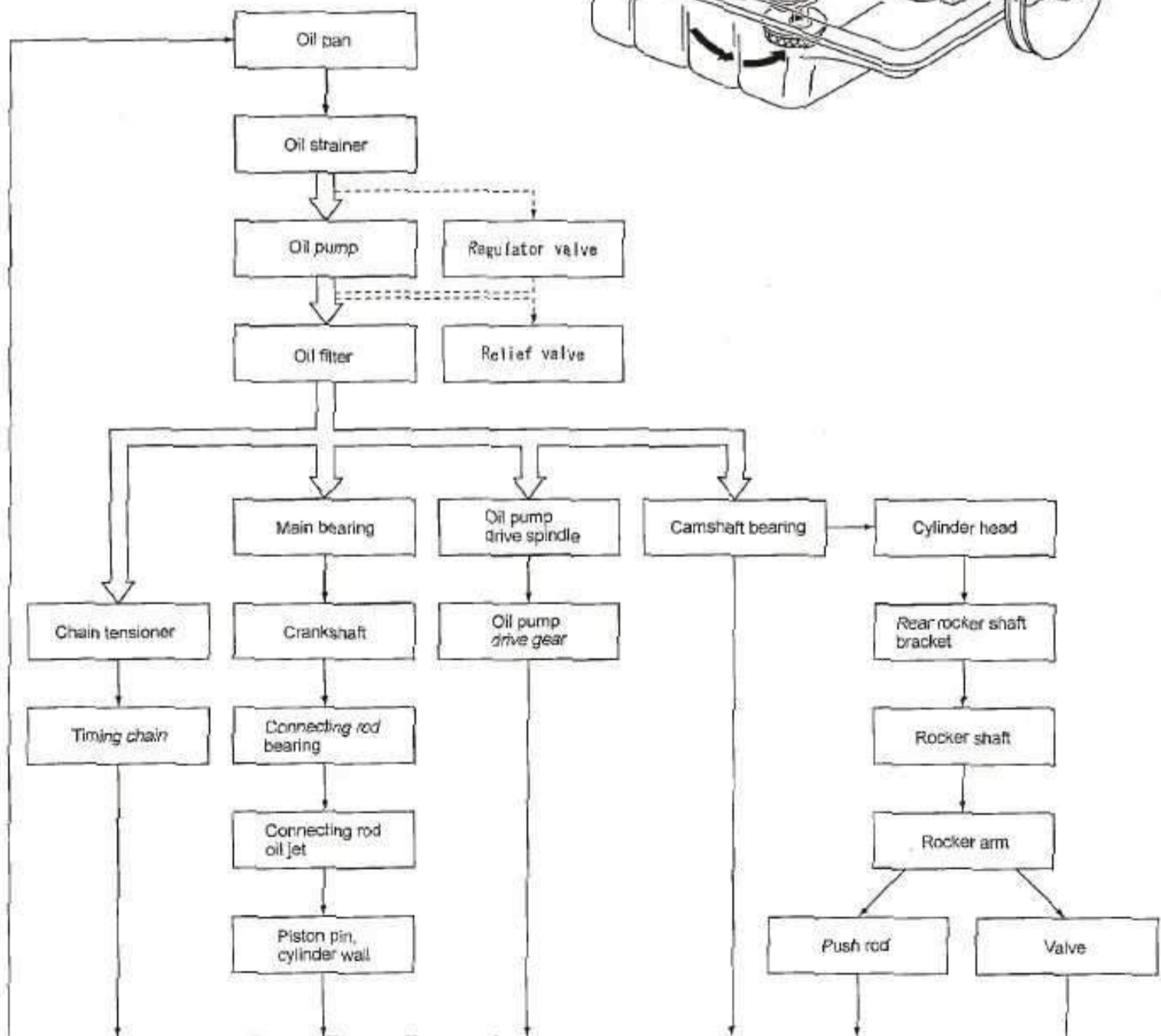
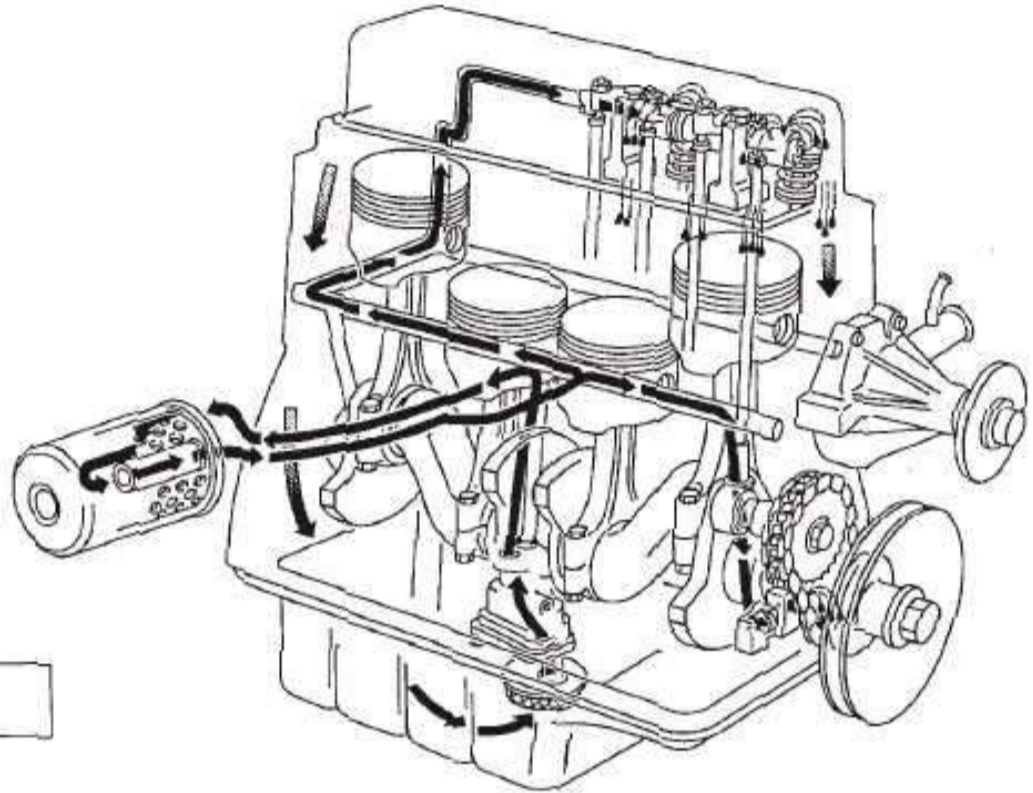
Trouble Diagnosis

Condition	Possible causes	Action
Oil leakage	• Cracks or damages in pump body cover	Replacement
	• Oil leakage from gasket and oil seal	Replacement
	• Oil leakage from near spindle support	Replace the O-ring seals or inspect the pump body and replace it as necessary.
	• Oil leakage from near distributor	Replace the O-ring seals or inspect the pump body and replace it as necessary.
	• Oil leakage between timing chain housing and cylinder block	Disassemble and reassemble/apply liquid packing again.
	• Loose rocker cover retaining nuts and oil leakage.	Additionally tighten.
	• Loose oil pan mounting bolts and oil leakage	Additionally tighten.
	• Oil leakage from crankshaft front oil seal	Replacement
	• Oil leakage from crankshaft rear oil seal	Replacement
	• Oil leakage from regulator valve	Additionally tighten or replace.
	• Oil leakage from plugs in lubrication system	Replace or additionally tighten.
MIL ON	• Loose oil filter	Additionally tighten.
	• Use of inappropriate quality of oil	Replace with specified oil.
	• Engine over temperature (<i>Overheat</i>)	Already described
	• Oil pump regulator valve malfunction	Overhaul or replace the oil pump.
	• Oil pump malfunction	Overhaul or replace the oil pump.
	• Inappropriate oil pump installation	Additionally tighten.
	• Damaged oil pump gasket	Replacement
	• Oil filter malfunction	Replacement
	• Enlarged clearance between sliding parts	Disassemble and replace the relevant sliding parts.
	• Loose mounting of rocker shaft bracket	Tighten bolts.
	• Clogged oil strainer	Wash.
	• Malfunction of oil pressure gauge pressure switch	Replacement
	• Oil pressure switch malfunction	Replacement
	• Insufficient oil in oil pan	Fill oil and identify/repair the factor causing non-standard condition.
	• Loose oil pan drain plug or damaged gasket	Additionally tighten or replace.
• Incident in electrical system	Inspect the electric circuits.	
Noise	• Excessive backlash of pump rotor	Replacement

LUBRICATION SYSTEM

Lubrication Schematic Diagram

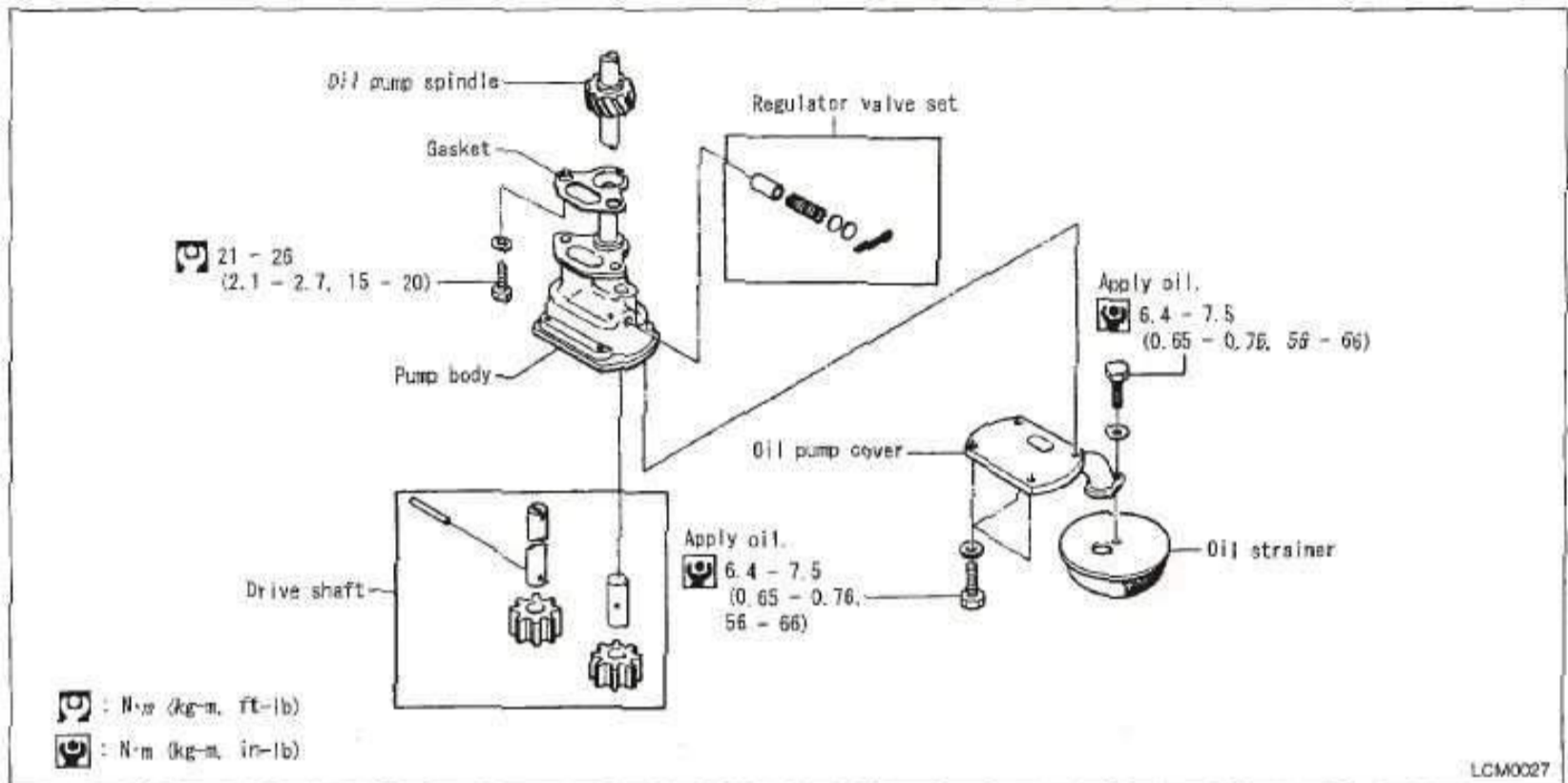
LUBRICATION CIRCUIT



LQM0026

LUBRICATION SYSTEM

Oil Pump COMPONENT PARTS LOCATION



INSPECTION

1. Check the following items for wear or damages.

- Pump body and cover
- Pump gear section
- Driving spindle

The pump gear section and main body have no internal components that can be serviced separately. If the pump gear or main body is worn or damaged, replace the drive shaft assembly or oil pump assembly.

2. Inspect the clearance at the following points using a feeler gauge.

If the clearance exceeds the specified limit, replace the drive shaft assembly or oil pump assembly.

Clearance between pump gear and main body:

0.4 mm (0.016 in) or less

Backlash of pump gear: 0.5 mm (0.020 in) or less

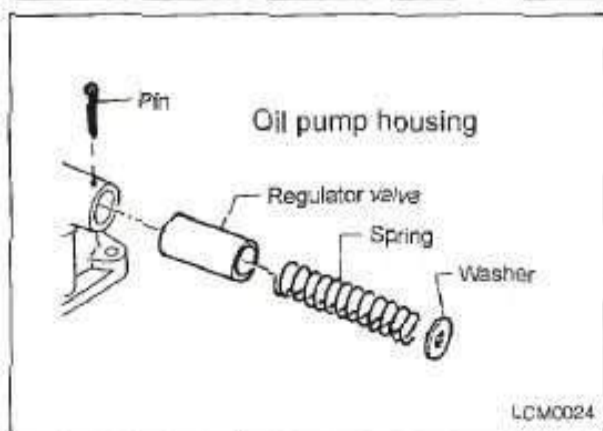
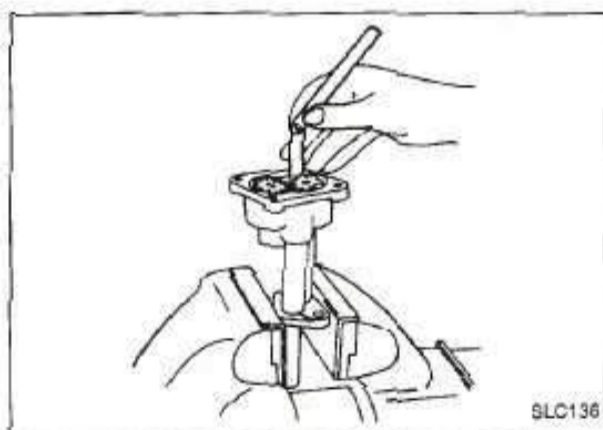
Pump gear clearance in vertical direction:

0.3 mm (0.012 in) or less

3. Inspect the regulator valve spring of the oil pump. If damaged, replace the spring or pump assembly.

Free length 41.5±1 mm (1.634±0.039 in)

Repair limit 40.0 mm (1.575 in)



ENGINE COOLANT SYSTEM

Specifications

Cooling method	Water cooled, controlled circulation
Water pump	Centrifugal
Thermostat	Wax pellet

Adjustment Value

WATER PUMP

Fan belt deflection When pushed with a force of 98N (10 kg, 22 lb) [mm (in)]	11 - 13 (0.43 - 0.51)
--	-----------------------

THERMOSTAT

	Standard specification
Valve opening temperature °C (°F)	78.5 (170)
Maximum lift mm/°C (in/°F)	8/90 (0.31/194)

Tightening Torque

	N·m	kg·m	ft·lb, in·lb*
Water pump retaining bolt M8	15.7 - 17.7	1.6 - 1.81	11.6 - 13.1
Water pump retaining bolt M6	6.37 - 7.45	0.65 - 0.76	56 - 66*
Thermostat housing bolt	15.7 - 17.7	1.6 - 1.81	11.6 - 13.1

Trouble Diagnosis

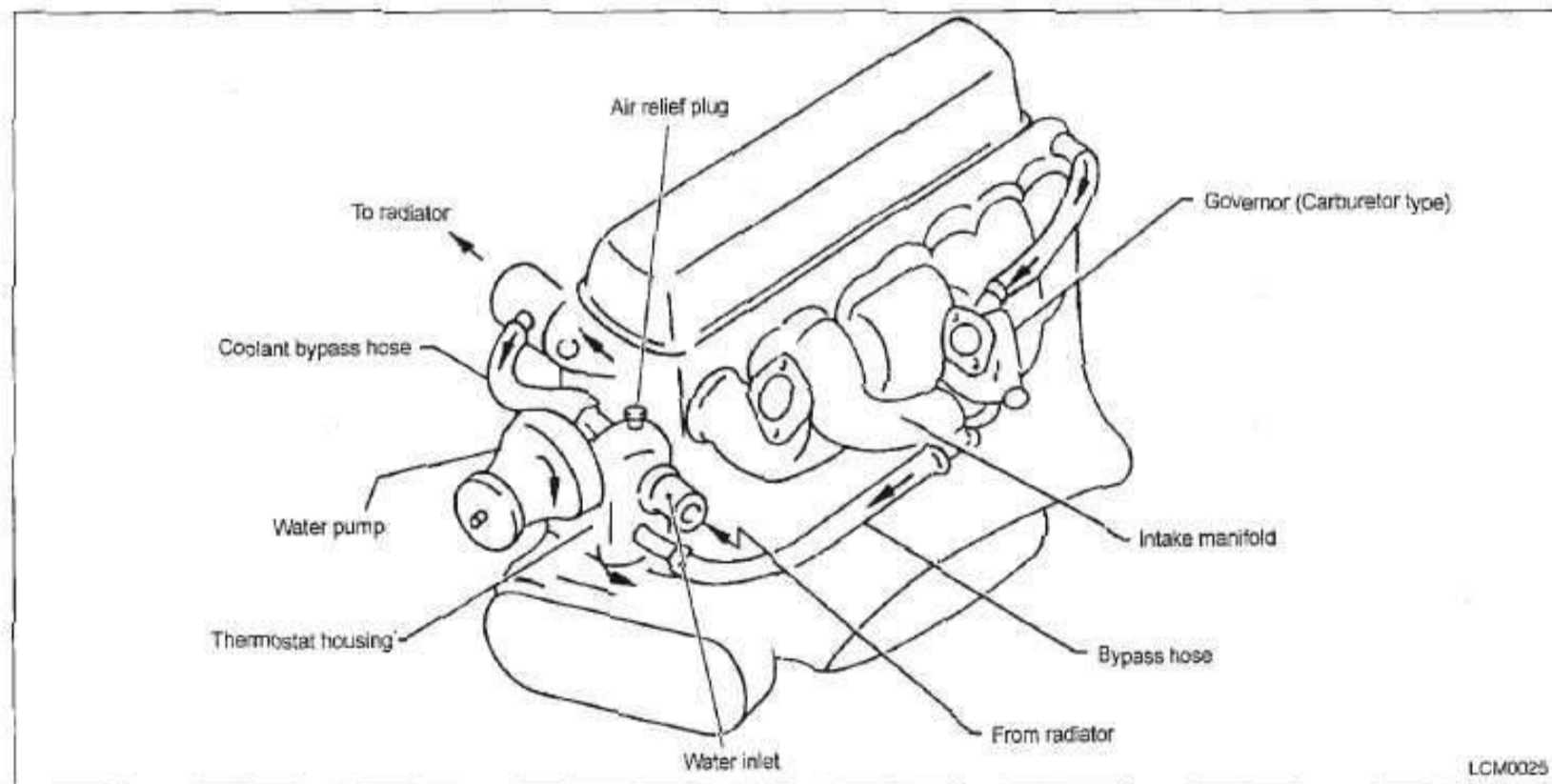
Condition	Possible causes	Action
Water leakage	<ul style="list-style-type: none"> • Water leakage from water pump shaft seal • Water leakage from water pump mounting face packing • Water leakage from radiator cap • Coolant leakage from engine coolant temperature sensor • Loose connection • Damaged head gasket • Cracks in cylinder block • Cracks in cylinder head • Loose head bolt 	Replace the water pump assembly. Additionally tighten. If the leakage still remains, replace the packing. Replace the packing or assembly. Additionally tighten or replace. Additionally tighten. Replace and check engine oil for contamination. Replace and check engine oil for contamination. Replacement Additionally tighten.
Insufficient circulation of coolant	<ul style="list-style-type: none"> • Insufficient flow rate in coolant circuit • Insufficient amount of coolant • Water pump malfunction • Loose fan belt. • Thermostat malfunction 	Remove any contamination and rust from the coolant circuit, and inspect the hose clamps. Fill. Replacement Belt tension adjustment Replacement
Corrosion	<ul style="list-style-type: none"> • Excessive amount of impurities in coolant • Insufficient cleaning of coolant circuit 	Use clean softened water. Perform cleaning/flushing more frequently.

ENGINE COOLANT SYSTEM

Trouble Diagnosis (Cont'd)

Condition	Possible causes	Action
Engine over temperature (Overheat)	<ul style="list-style-type: none"> • Thermostat malfunction • Radiator fins plugged with dirt and dust • Inappropriate ignition timing and valve timings • Contamination and sludge deposits in engine oil • Water pump malfunction • Loose fan belt. • Plugged radiator • Poor accuracy of coolant temperature gauge • Insufficient amount of coolant • Air in coolant circuit • Contaminated engine coolant 	Replacement Clean with compressed air. Adjust the ignition timing and valve clearances. Clean inside the engine and refill it with oil. Replacement Belt tension adjustment Clean inside the radiator. Replacement Fill. Bleeding Use clean softened water.
Overcool	<ul style="list-style-type: none"> • Thermostat malfunction • Malfunctioning coolant temperature sensor 	Replacement Replacement
Noise	<ul style="list-style-type: none"> • Noise from water pump mechanical seal • Wear or damage of water pump bearing 	Replacement Replacement

Cooling System Configuration



ENGINE COOLANT SYSTEM

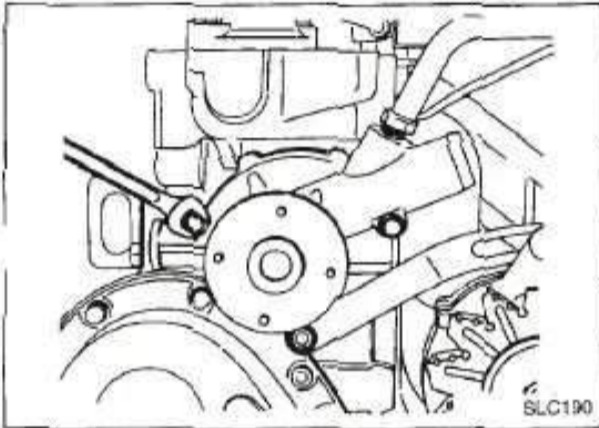
Water Pump

1. Open the drain of the radiator and extract coolant into an appropriate container.

CAUTION:

Do not drain coolant when engine is still hot. It may be a cause to get burned.

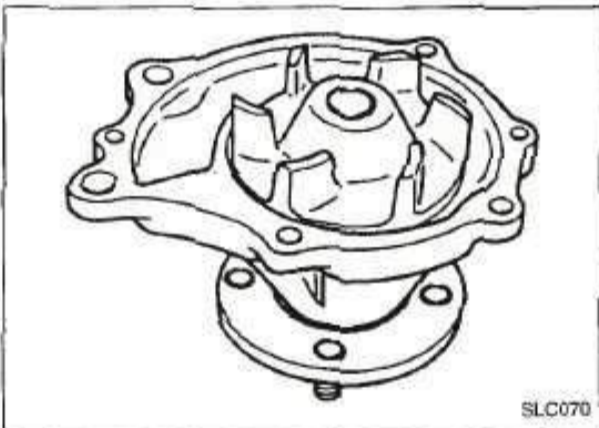
2. Remove the radiator shroud.
3. Loosen the fan belt.
 - Loosen the alternator adjusting bolt.
 - Fully put aside the alternator toward the engine.
 - Remove fan and fan pulley.
 - Remove the water pump together with the gasket.



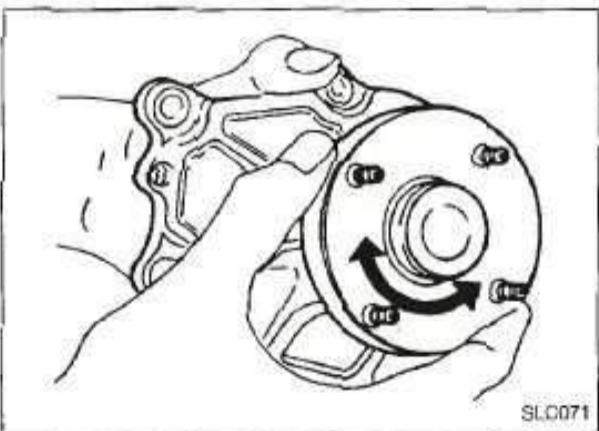
INSPECTION

Do not disassemble water pump. If any non-standard condition is found, replace the water pump.

1. Check the water pump vanes for rust and pitching.



2. Check the water pump bearing for proper end play and smooth operation.



ASSEMBLY

1. Install the water pump in the reverse order of removal. Always use a new gasket.
2. Adjust the fan belt tension. For the adjustment value, refer to MA section.

CAUTION:

- Before filling with coolant, always loosen the air purge plug.
- After refilling, make sure to tighten the plug.

ENGINE COOLANT SYSTEM

Thermostat

REMOVAL

1. Remove the radiator upper hose from the water outlet and extract coolant.

WARNING:

Do not drain coolant when engine is still hot. It may be a cause to get burned.

2. Remove water inlet and remove thermostat.

INSPECTION

Inspect the thermostat as instructed below and replace it as necessary.

1. Inspect valve seating status under ordinary temperature. The valve must be seated firmly.
2. Inspect the opening temperature and maximum valve lift by heating the valve in a container.

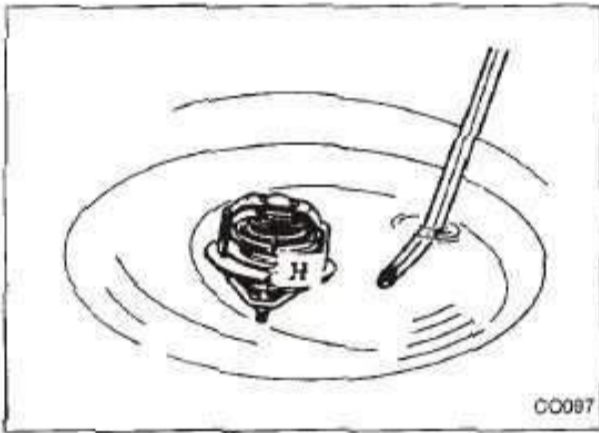
CAUTION:

if may be a cause to get burned. Do not touch the thermostat, container or hot water inside until the temperature lowers sufficiently.

3. make sure that the valve closing temperature is approx. 5°C (41°F) lower than the opening temperature. Also perform the same inspection before installing a new thermostat.

INSTALLATION

Install in the reverse order of removal.
Always use a new water inlet gasket.



ENGINE FUEL

SECTION EF

CONTENTS

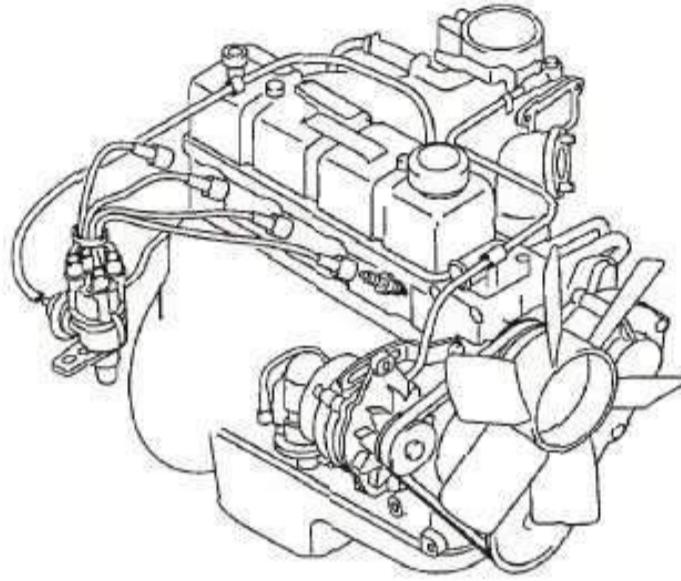
EMISSION CONTROL SYSTEM (ONLY FOR ELECTRONIC CONTROLLED TYPE)	EF-2
UNIT LAYOUT	EF-3
Carburetor Specifications	EF-9
Components Around Carburetor and Pneumatic Governor (Carburetor Specifications)	EF-18
PCV gas recirculation device	

EMISSION CONTROL SYSTEM (ONLY FOR ELECTRONIC CONTROLLED TYPE)

Engine type	K15, K21, K25
PCV gas recirculation device	Closed type

UNIT LAYOUT

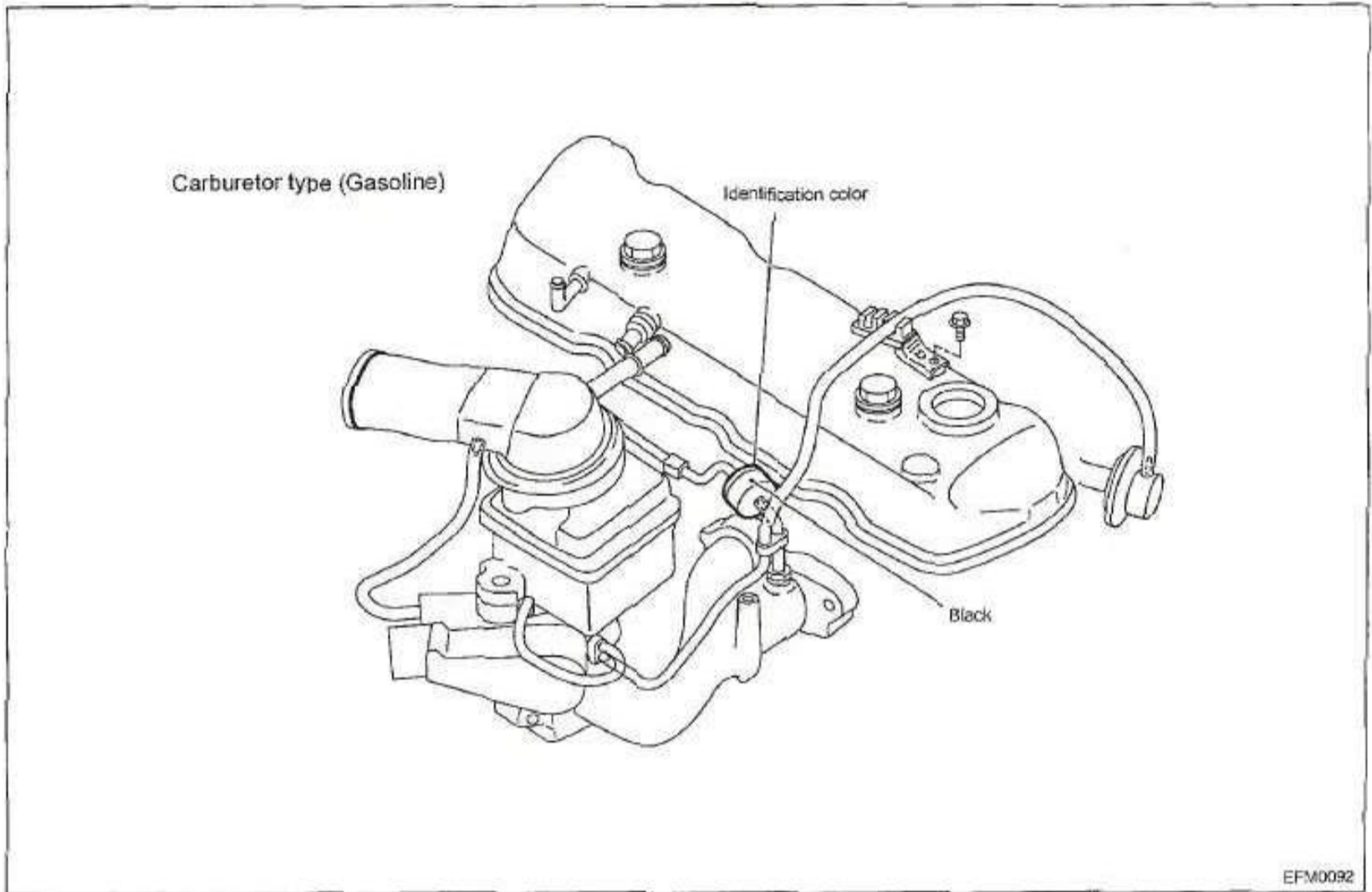
Carburetor type



EFM0089

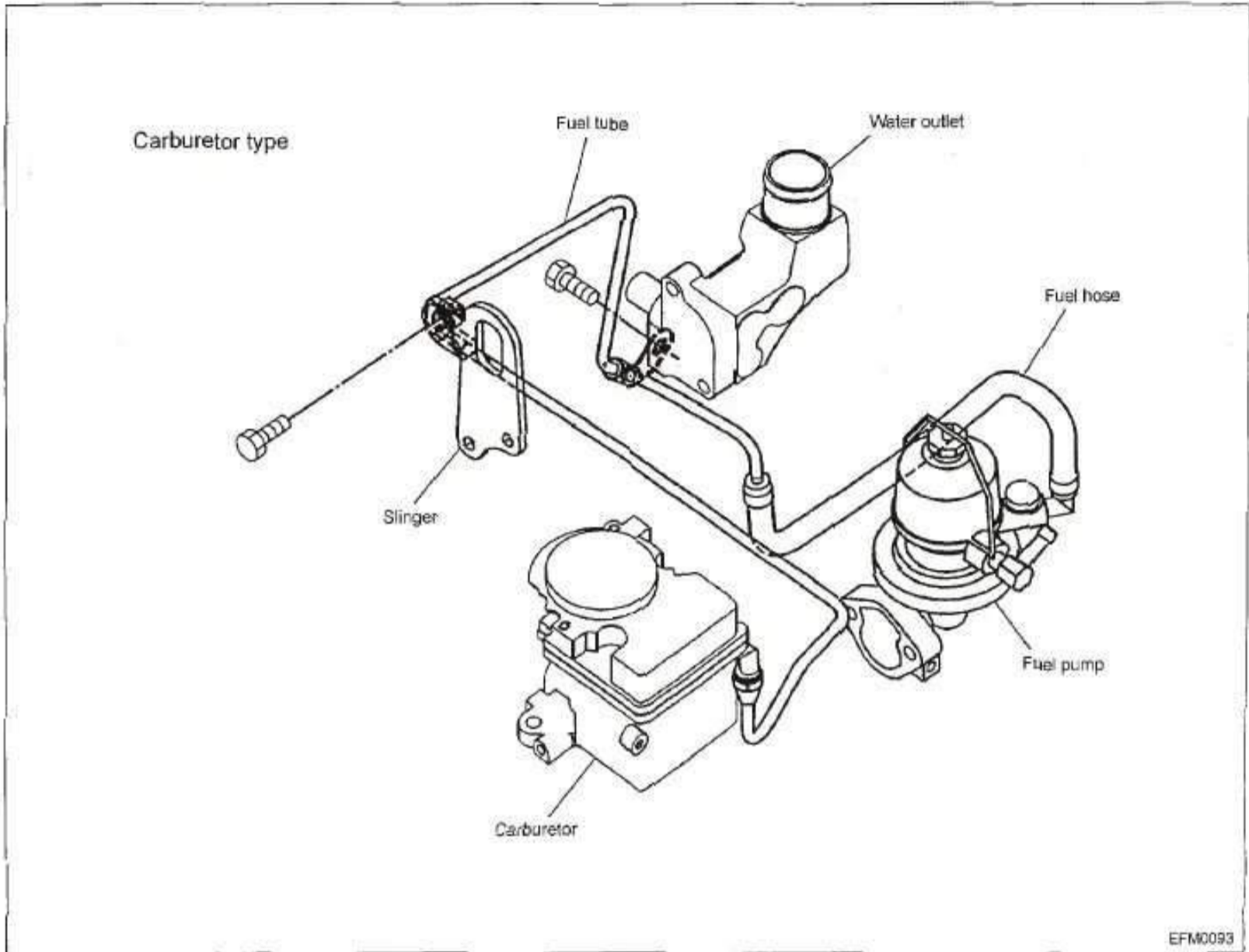
UNIT LAYOUT

VACUUM PIPING DIAGRAM



UNIT LAYOUT

FUEL PIPING DIAGRAM



SERVICE DATA AND SPECIFICATIONS (SDS)

Carburetor Specifications

Fuel pump 1,400 ml or more (at 1,000 rpm)
 Fuel pump discharge pressure 16.7 - 23.5 kPa (0.16 - 0.23 bar, 0.17 - 0.24 kg/cm², 2.4 - 3.4 psi)
 Fuel discharge pressure Atmospheric pressure
 Vaporizer (with secondary room, integrated with water heater)

Carburetor

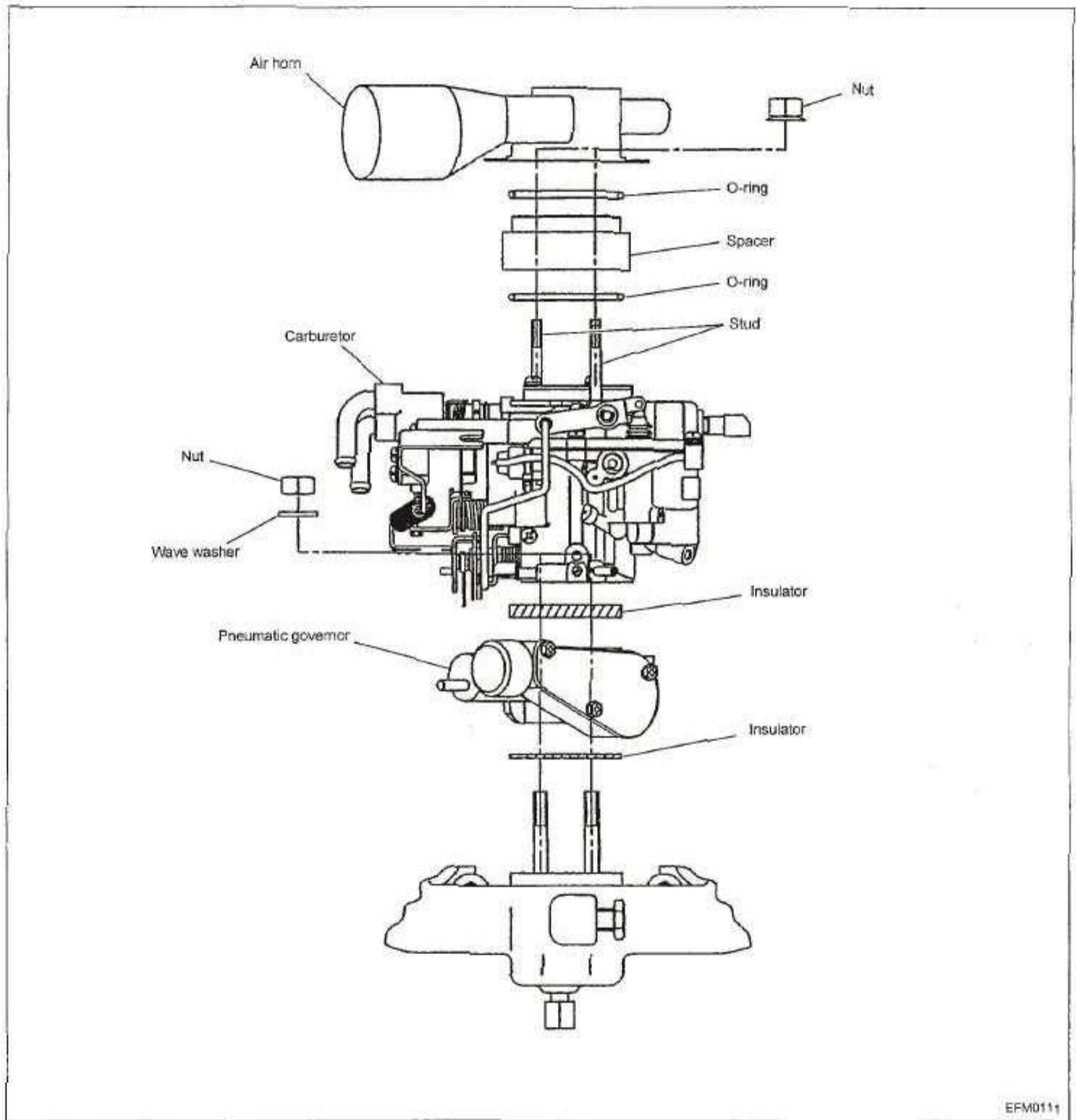
Engine type	K15	K21	K25
Carburetor type	210030-40	210030-41	210030-42
Starting choke type	Auto choke (Hot water auto-automatic-return)	←	←
Inlet diameter mm (in)	57 (2.24)	←	←
Outlet diameter mm (in)	30 (1.18)	←	←
Large mm (in)	22 (0.87)	24 (0.94)	26 (1.02)
Small (Inner diameter - Outer diameter) mm (in)	12 - 16.5 (0.47 - 0.63)	←	←
Main jet	#110	#116	#122
Main air bleed	#80	#60	←
Slow jet	#44	#48	#54
Slow air bleed (1st/2nd)	#80/#240	#80/#140	#80/#150
High position (H1) From upper surface of float room mm (in)	22 (0.87)	←	←
Low position (H2) From lower end of S/V nozzle mm (in)	14.9 (0.587)	←	←

Governor (carburetor specifications)

Type	Pneumatic
Speed control type	Controlled by amount of mixture
Control mechanism	Vacuum type
No load instantaneous allowable maximum engine speed (rpm)	3,600
Vacuum continuous allowable maximum engine speed (rpm)	3,000
Hunting allowable frequency	3 (Max)

DISASSEMBLY AND ASSEMBLY OF FUEL SYSTEM

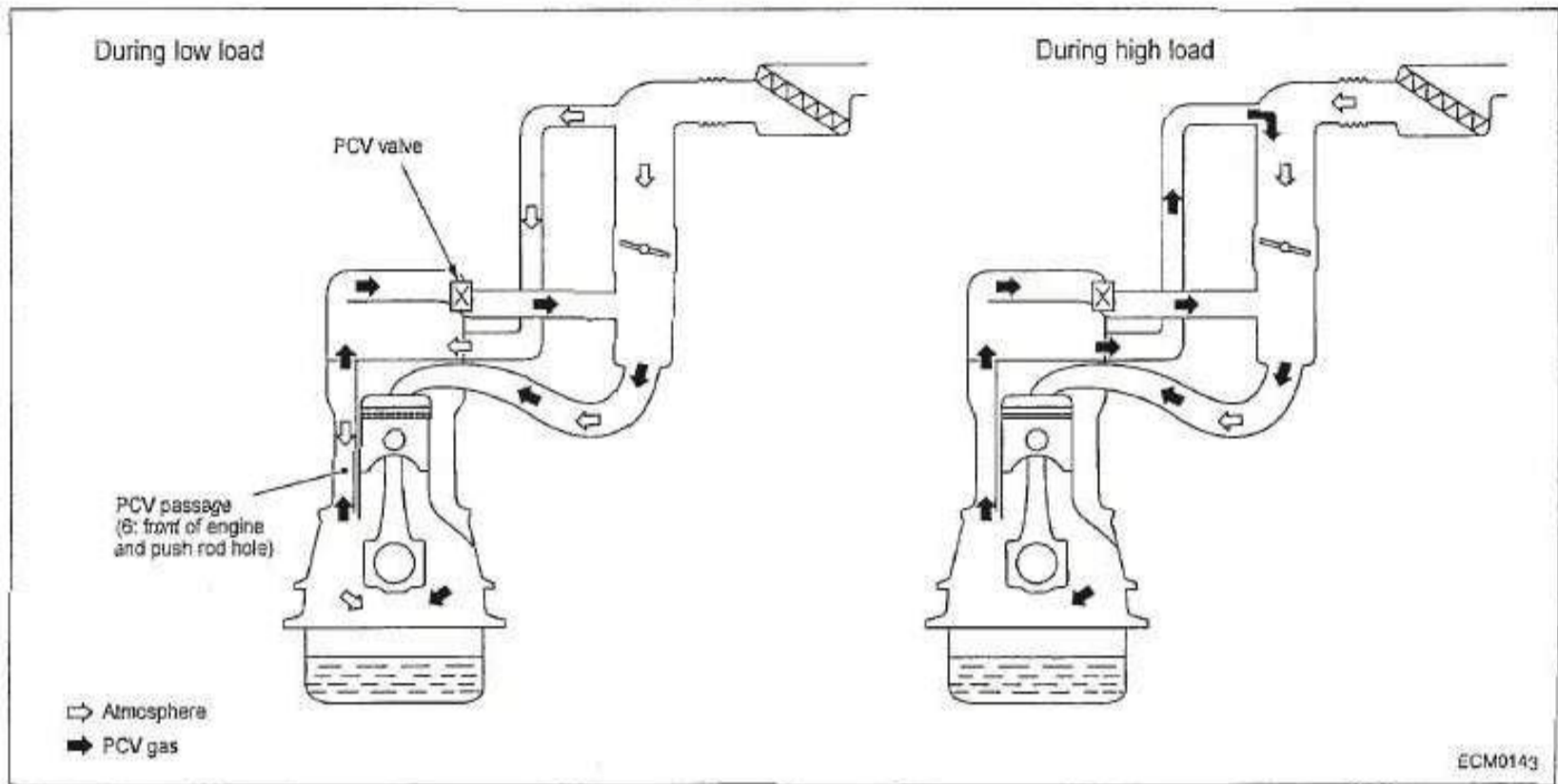
Components Around Carburetor and Pneumatic Governor (Carburetor Specifications)



EPM0111

PCV GAS RECIRCULATION DEVICE

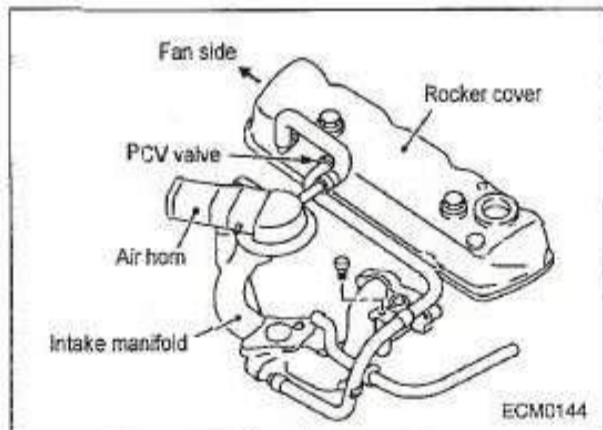
System Diagram



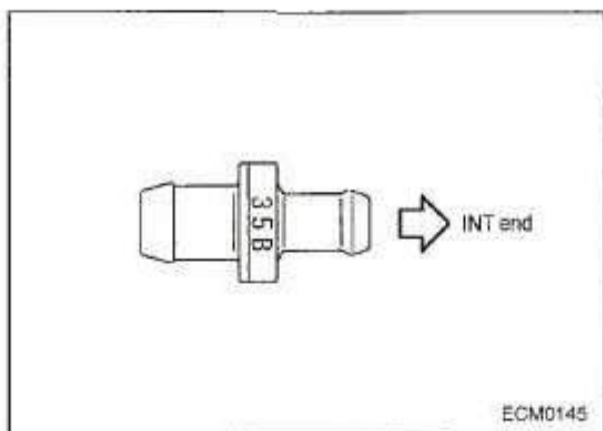
Component Parts Inspection

PCV valve

1. At idle, remove PCV valve together with hoses from rocker cover.
2. Check if hissing sound is heard from the air passage when PCV valve is operating normally.



3. Check air flow through the PCV valve and sucking air to/from the INT end.
 Blowing air: No air flow
 Sucking air: Air flow exists



ENGINE ELECTRICAL SYSTEM

SECTION **EE**

CONTENTS

ADJUSTMENT VALUE	EE-2	STARTER MOTOR	EE-8
TROUBLE DIAGNOSIS	EE-3	Starter Motor Specifications	EE-8
DISTRIBUTOR (CARBURETOR TYPE)	EE-4	Component Parts Location	EE-9
Structure	EE-4	Overhaul	EE-10
Disassembly	EE-5	Assembly Inspection	EE-12
Inspection	EE-6	ALTERNATOR	EE-13
Assembly	EE-6	Components of Alternator	EE-13
Inspection After Assembly	EE-7	Disassembly	EE-14
		Inspection	EE-16

ADJUSTMENT VALUE

Component	Items	Description
Distributor	• Integrated ignition coil	Primary coil resistance: 0.9 - 1.2 Ω Secondary coil resistance: 20 - 29 Ω
	• Pickup assembly	Pickup coil resistance: 420 - 540 Ω
	• Air gap between signal rotor and pickup assembly	0.35 - 0.45 mm
Starter motor	• Brush dimensions	10.0 - 18.0 mm (Wear margin 8 mm)
	• Brush spring pressure	1.4 - 1.8 kg
Alternator	• Stator	Resistance between respective lead wires: 1 Ω or less Resistance between stator core and lead wire: ∞
	• Rotor coil	Standard resistance between slip rings: 2.9 Ω Standard resistance between slip ring and rotor core: ∞
	• Snap ring	Snap ring outer diameter: Standard: 14.4 mm Repair limit: 14.0 mm
	• Brush	Projected length from holder: Standard: 10.0 mm Repair limit: 2.0 mm

TROUBLE DIAGNOSIS

Condition	Possible causes	Action
No or slow cranking	• Battery is discharged	Check and repair the charging system, check and adjust the fan belt for tension, or replace the battery
	• Incident in starter system wiring	Check and repair or replace the starter switch.
	• Starter motor malfunction	Repair or replace. (Starter circuit diagnosis procedure) If the light turns off or dims when the starter switch is turned to "ON" with the headlights on: a: Check the battery. b: Check the electric connections and wiring. c: Check the starter motor. If the light remains bright when the starter switch is turned to "ON" with the headlights on: a: Check the wiring between battery and starter motor. b: Check the starter switch. c: Check the starter motor.
Engine is cranked but not started.	• Incident in ignition system (Another possible cause is an incident in the fuel system. Refer to the section about the fuel system)	(Ignition system diagnosis procedure) Inspect the spark plug following the steps below Disconnect the high-tension cord from the No. 1 plug and keep the cord 10 mm away from the engine metal portions. Then crank the engine. If there is difficulty in identifying a spark, use the following approach: connect the high-tension cord to a new spark plug that is separately prepared, contact the thread of the plug to the engine metal and check for a spark by activating the starter. If a good spark is available: a: Check the spark plug. b: Check the ignition timing. c: Check the fuel system. d: Check the cylinder compression. If no spark is available: a: Check the primary coil current. b: If the current is too large, a short circuit may be present, replace. c: Check coil malfunction, replace. d: If the high-tension cable has an open circuit, Replace.

DISTRIBUTOR (CARBURETOR TYPE)

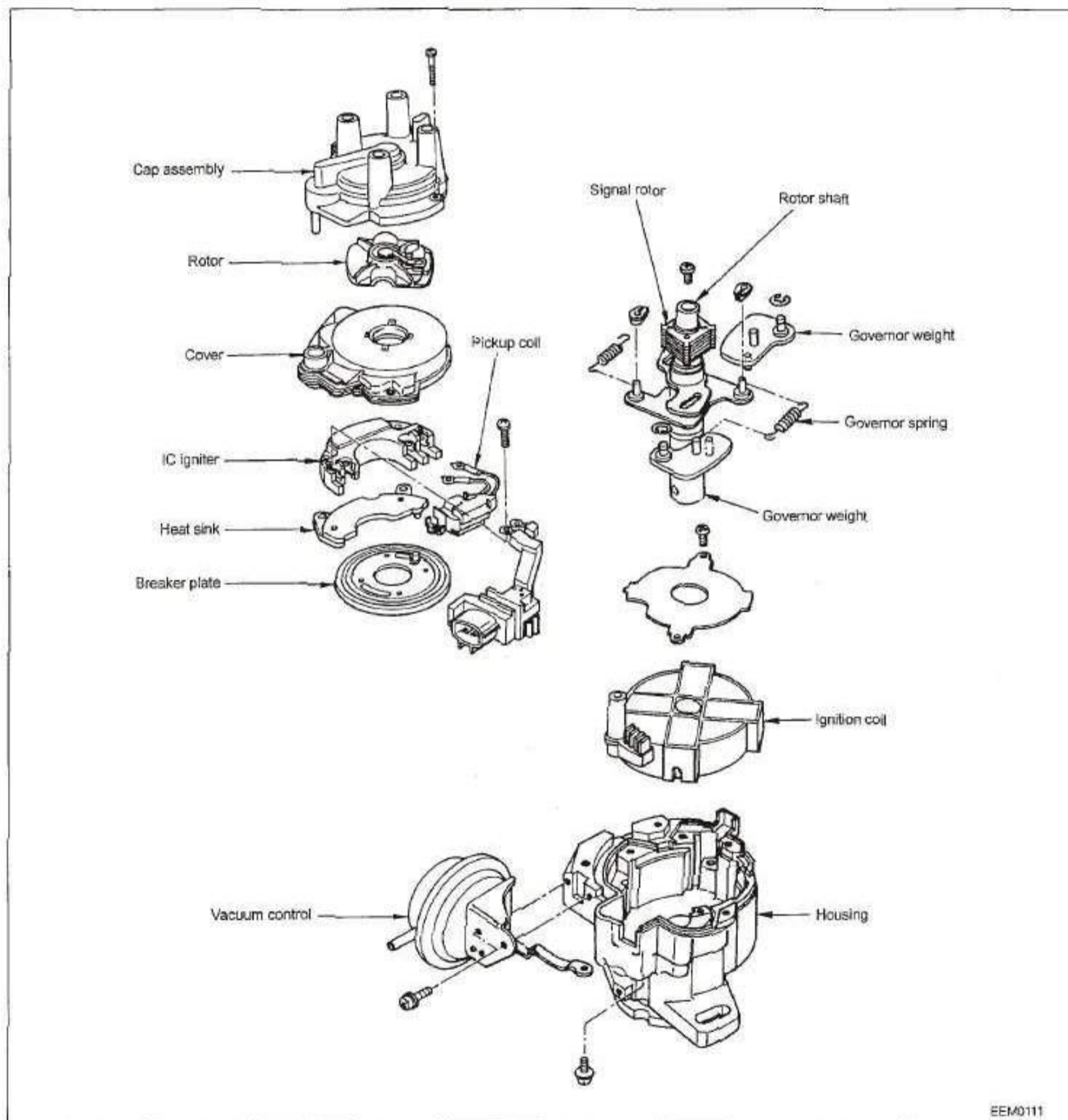
IGNITION SYSTEM

CAUTION:

Before starting the task, turn off the ignition switch and disconnect the battery cable.

Structure

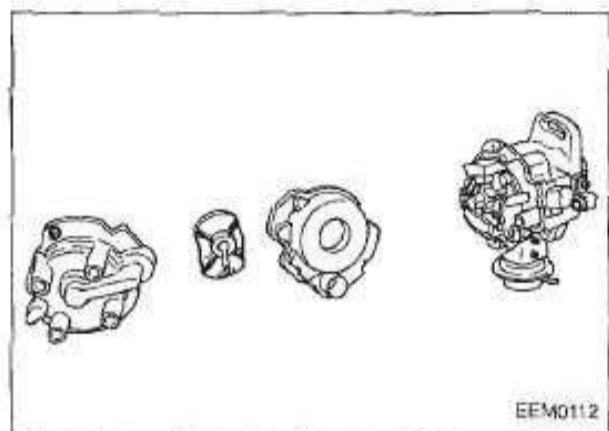
FULL SOLID-STATE TYPE



EEM0111

A low-voltage electronic distribution system is adopted for the electronic control.
Refer to EC section.

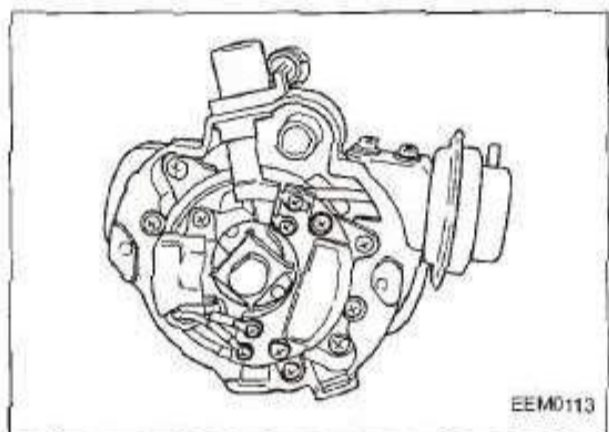
DISTRIBUTOR (CARBURETOR TYPE)



EEM0112

Disassembly

- Remove the cap assembly retaining bolts and remove the rotor cover.

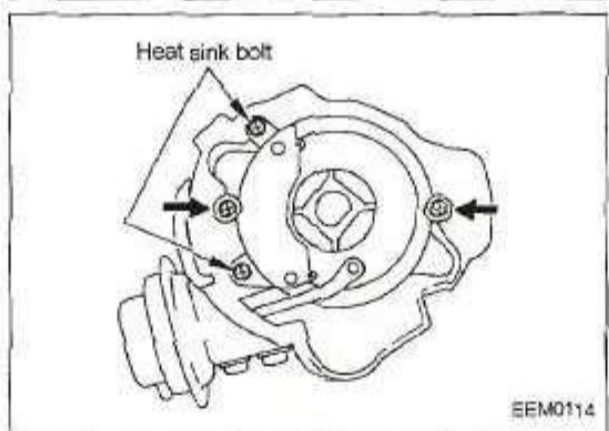


EEM0113

- Disconnect the pickup coil that connects to the IC igniter, and remove the connector terminal screws (two each).
- Remove the retaining screws of the IC igniter and pickup coil (two each).
- To separate the connector from the housing, slide it along the housing.

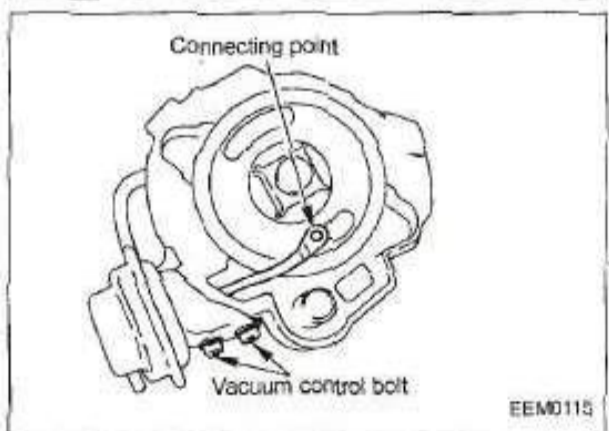
CAUTION:

Do not place the pickup coil at a location where it may collect iron powder.



EEM0114

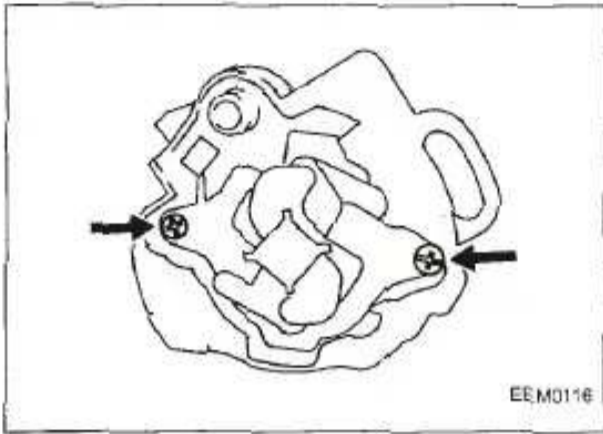
- Remove the heat sink retaining bolts and those retaining the breaker plate indicated by the arrow in the figure, and remove the heat sink.



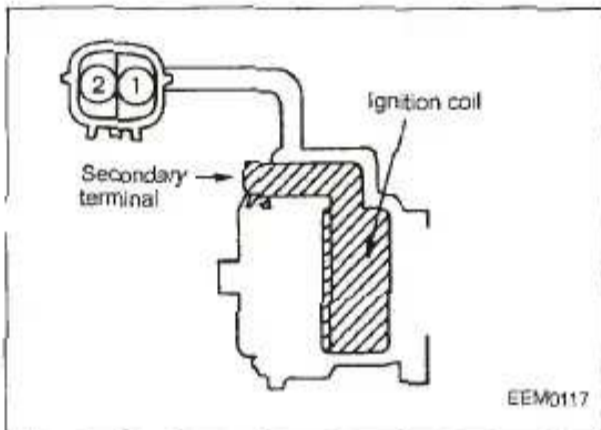
EEM0115

- Remove the vacuum control retaining bolts, separate the connection between the vacuum control link and the breaker plate, and then remove the vacuum control and breaker plate from the housing assembly.

DISTRIBUTOR (CARBURETOR TYPE)



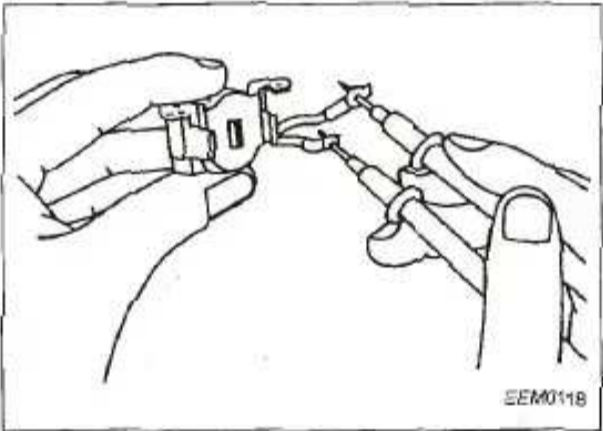
- The figure on the left shows the housing assembly. If you also need to disassemble the governor, first remove the pin located at the lower end of the shaft using a punch and pull off the shaft. If you are removing the ignition coil, additionally remove the bolt indicated by the arrow in the figure and pull out the ignition coil.



Inspection

IGNITION COIL INSPECTION

- Measure the resistance of the primary and secondary coil.
 - Primary coil resistance [between terminals (1) and (2)]
Standard: 0.9 - 1.2 Ω
 - Secondary coil resistance [between terminal (1) or (2) and secondary terminal]
Standard: 20 - 29 Ω



PICKUP ASSEMBLY

- Measure the pickup coil resistance using a circuit tester.
Standard: 420 - 540 Ω
- Move a screwdriver to and fro near the iron core of the pickup assembly and make sure that the tester needle fluctuates.

CARBON CONTACT

- If the entire spherical surface at the tip is worn out, replace the cap assembly.

CAP ROTOR

- Check for any cracks or damages.

SIGNAL ROTOR

- Check for any damages and bends.

VACUUM CONTROL

- Verify that the link is pulled when applying vacuum pressure to the diaphragm with a vacuum pump.

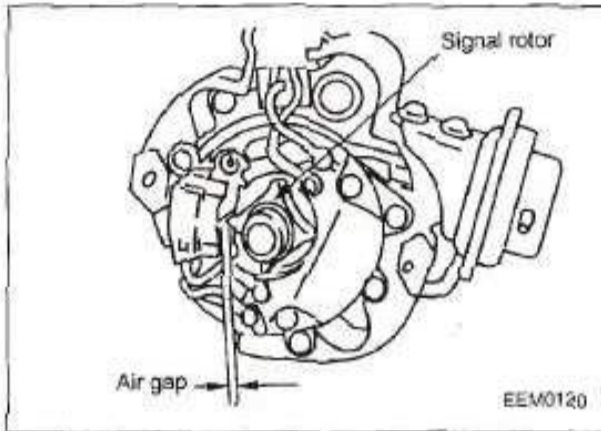
Assembly

- Assemble in the reverse order of disassembly while observing the following instructions.
- Apply grease to the vacuum control link.
- Tighten the M3 screws to 6 to 9 kg-cm and the M4 screws to 16 to 30 kg-cm.
- The shaft must rotate smoothly when turned by hand.

DISTRIBUTOR (CARBURETOR TYPE)

Inspection After Assembly

- Measure the air gap between the signal rotor and the pickup assembly.
Standard: 0.35 - 0.45 mm



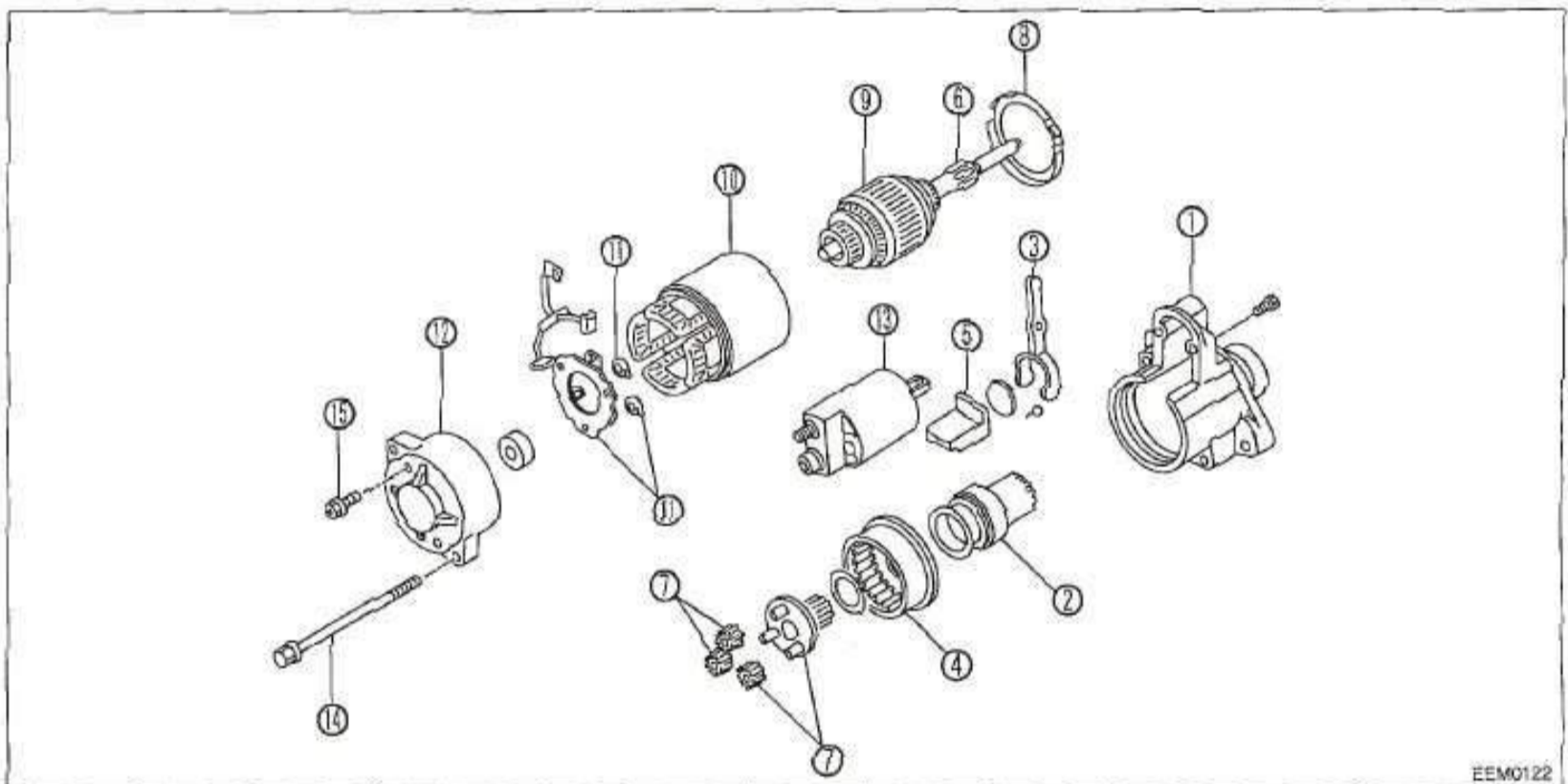
STARTER MOTOR

CAUTION:

Before starting any electrical system service, make sure to turn off the key switch and disconnect the battery cable.

Starter Motor Specifications

Items	Specification
Part type	M000T65381
Type	Integrated reduction gears
Output	1.2 kW



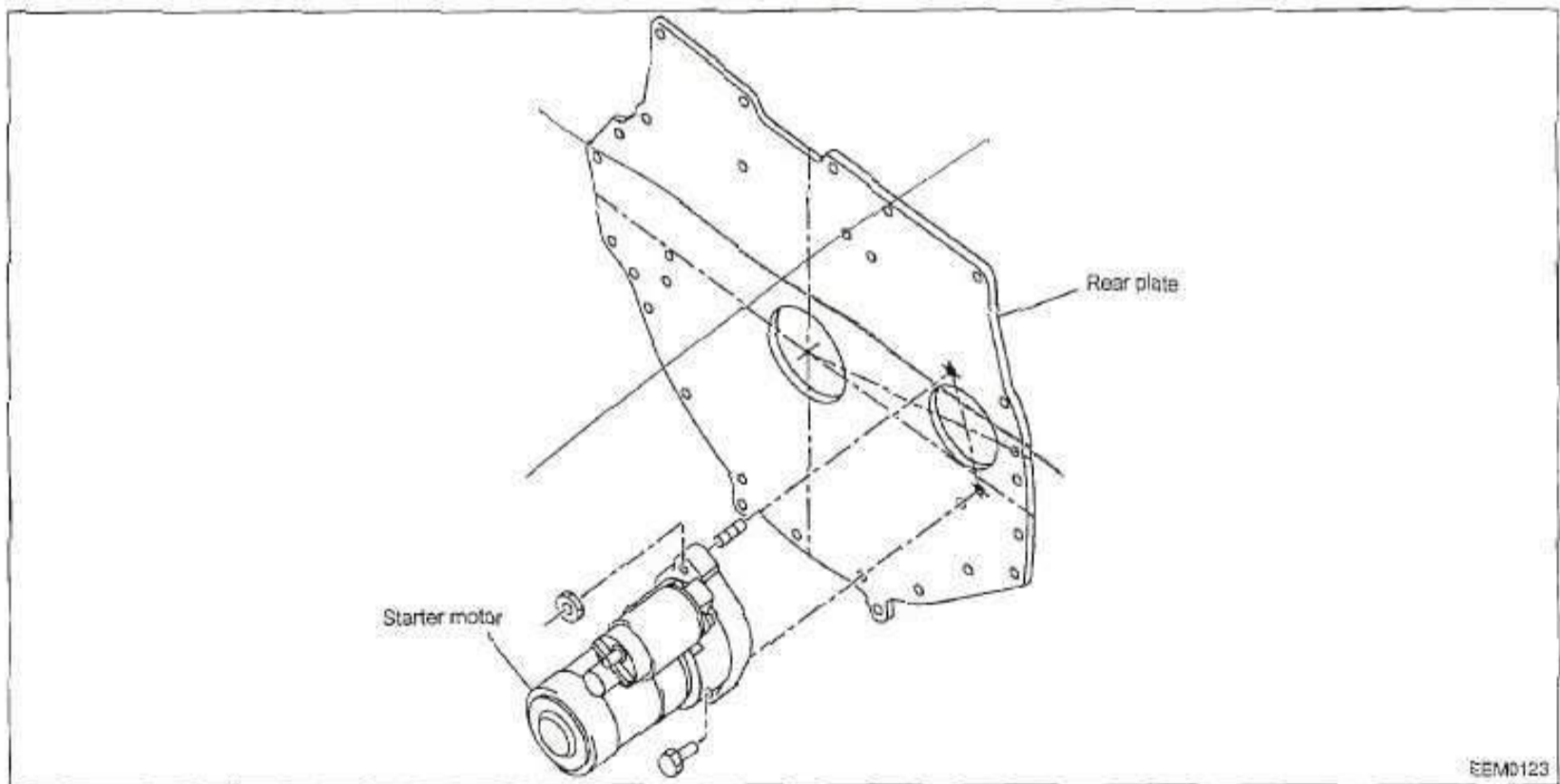
EEM0122

STARTER MOTOR

Component Parts Location

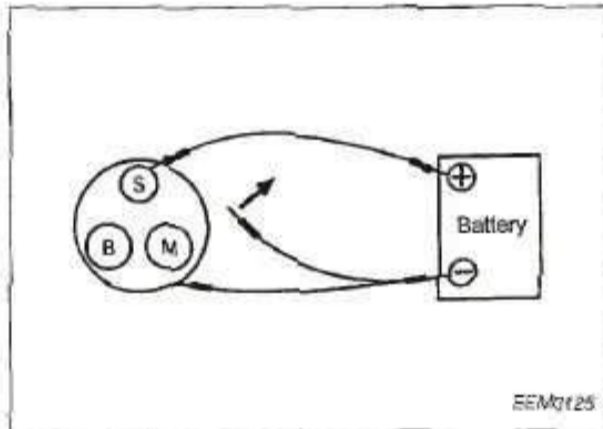
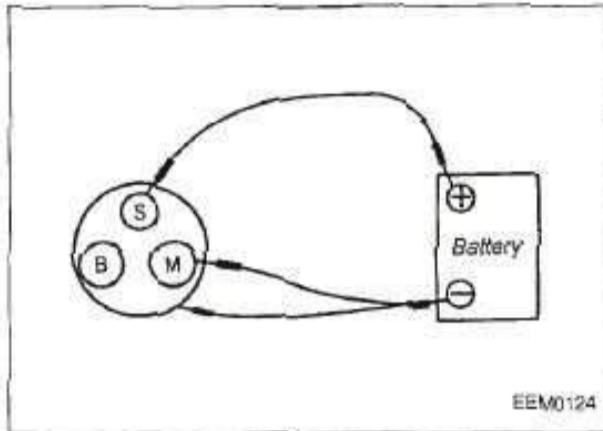
Major components of starter motor

Symbol	Description
(1)	Front bracket
(2)	Overrunning clutch
(3)	Lever
(4)	Internal gear
(5)	Packing
(6)	Shaft gear
(7)	Gear assembly
(8)	Packing
(9)	Armature
(10)	Yoke assembly
(11)	Connector brush holder assembly
(12)	Rear blanket
(13)	Switch assembly
(14)	Hexagon head bolt
(15)	Flange screw



EEM0123

STARTER MOTOR



Overhaul

RELATED TO MAGNET SWITCH

- Plunger sliding face (rust, contamination, deformation)
 - Broken or worn return spring
 - Rough surface of main contact (burnout)
 - Operation check of magnet switch (Proper performance of magnet coil)
1. **Plunger's drawing operation (Series coil operation)**
Wire the plunger as shown in the figure on the left. The plunger should be drawn strongly by the series coil and shunt coil.
 2. **Plunger's holding operation (Shunt coil operation)**
In the above circuit, disconnect the wiring from the terminal M. If the shunt coil is normal, the plunger should be held in place.

PINION MECHANISM

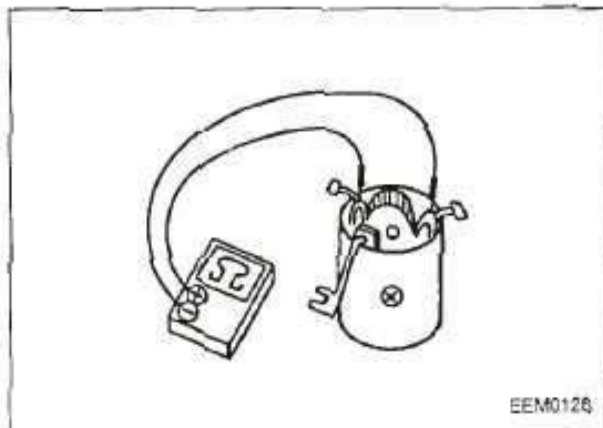
- Damage or wear of pinion gear tooth tops
- *Visually check for damage or wear. Replace the gear if the damage/wear is excessive.*
- Pinion gear sliding face (rust, contamination, damage on spline)
- Check the pinion gear sliding motion. *Replace the gear(s), if the gear(s) drag excessively.*
- Broken or worn pinion spring
- Check the pinion spring(s) and replace them if excessive damage is present.
- Pinion spring (lever fulcrum) sliding motion
- Check the pinion spring(s) and replace them if excessive damage is present.
- Overrunning clutch operation (slippage, seizure)
Turn the pinion gear by hand. If it turns freely in both directions or will not turn in either direction, the overrunning clutch has lost its proper functionality. Replace it.

FIELD COIL

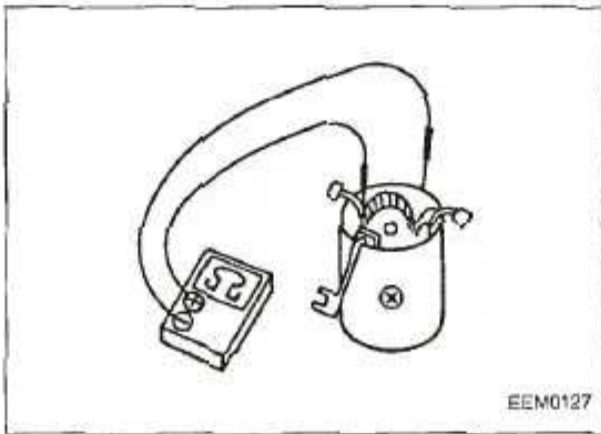
Check the field coil for continuity.

Judgement

If there is continuity, the field coil is normal.
If there is no continuity, the field coil has an open circuit.
Replace it.



STARTER MOTOR



- Check for continuity between the field coil and a ground.

Judgement

If continuity is present, the field coil is shorted. Replace it.
If there is no continuity, the coil is normal.

CAUTION:

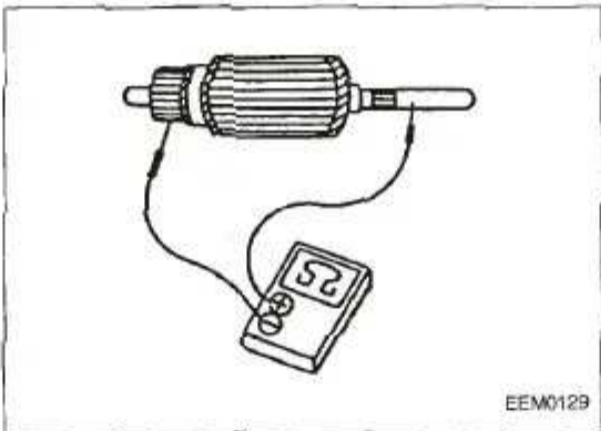
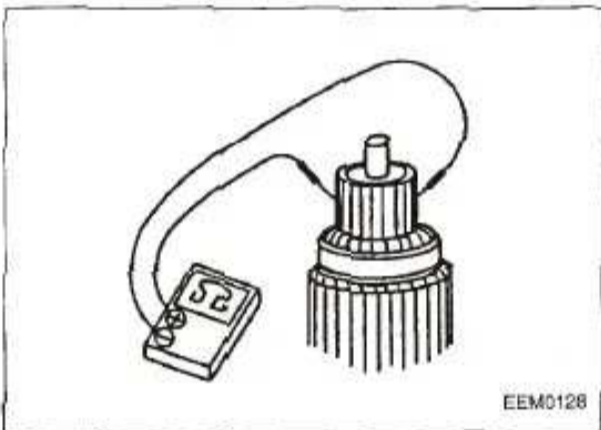
Note that, however, a compound-wound motor structurally grounds the field coil. This means that the tester will show continuity between the field coil and a ground.

ARMATURE COIL

- Check the continuity between the commutators.

Judgement

If there is continuity, the armature coil is normal.
If there is no continuity, the coil has an open circuit. Replace it.



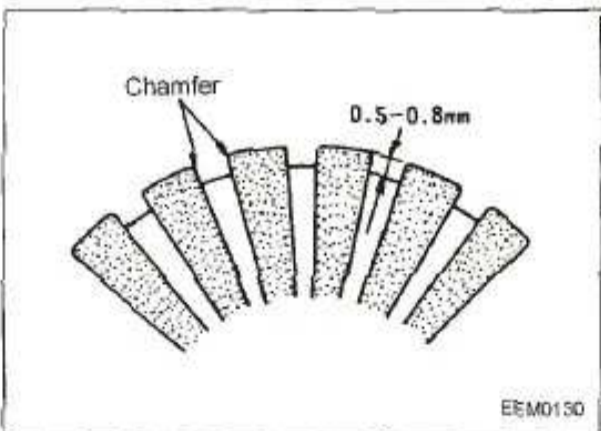
- Check for continuity between the armature coil and a ground.

Judgement

If continuity is present, the field coil is shorted. Replace it.
If there is no continuity, the coil is normal.

BRUSH COMMUTATOR RELATED

Brush wear (mm)	10.0 - 18.0 (Wear margin: 8 max.)
Brush spring pressure (kg)	1.4 - 1.8

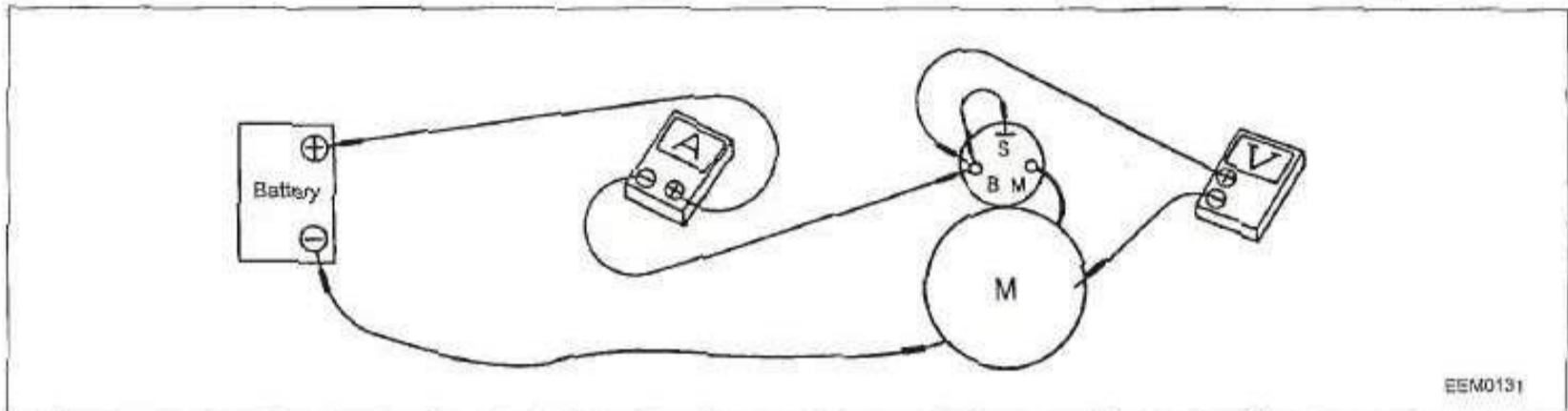


- If the commutator has a rough surface, grind it using sandpaper of #500 or #600.
- If the insulator (high mica) of the commutator is 0.2 mm or less in thickness, replace the commutator.

STARTER MOTOR

Assembly Inspection

- Inspection for abrasion between the armature core and the ball core.
- Starter motor inspection (performance with *no load*)



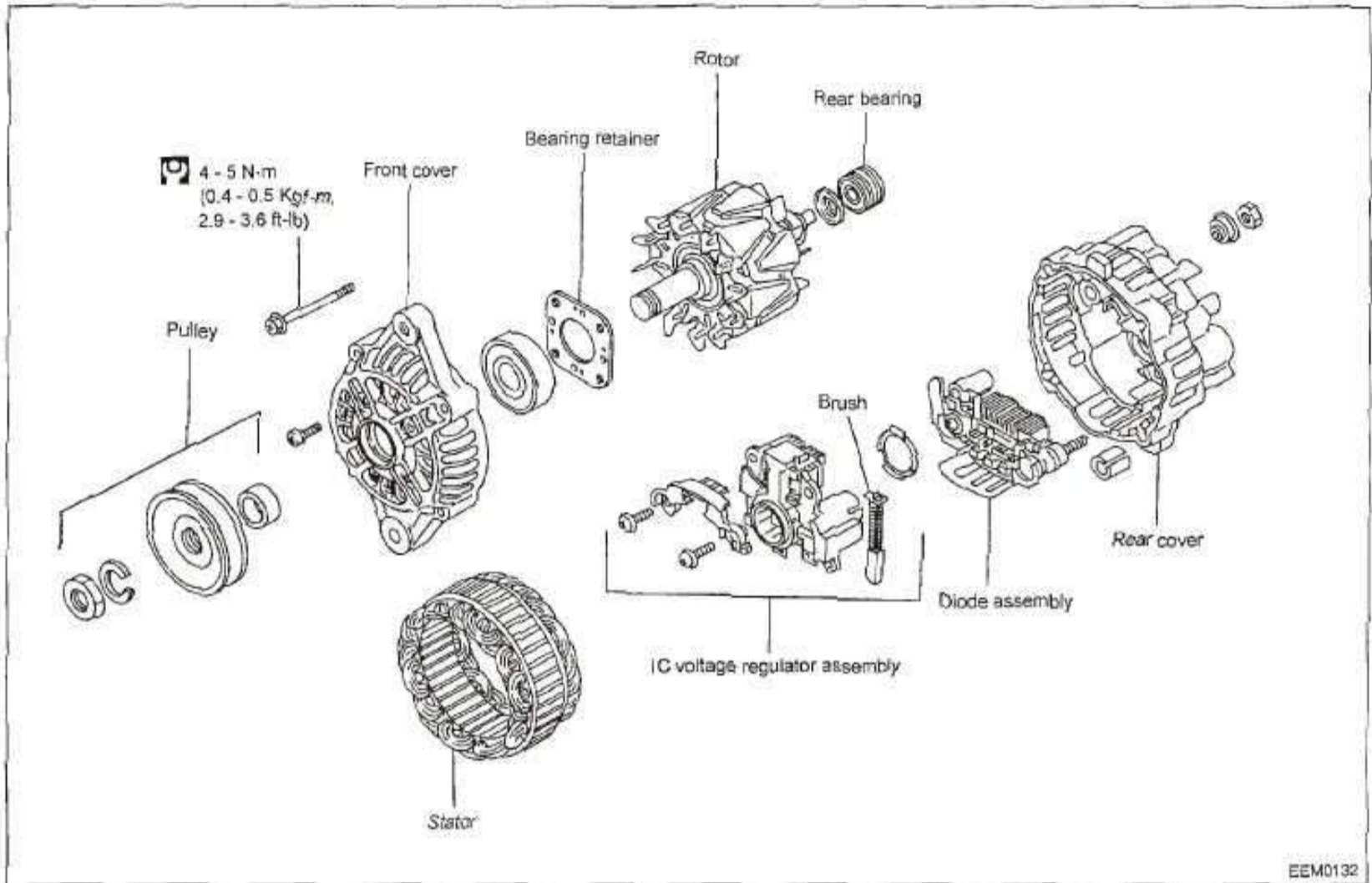
PROCEDURE

- Connect an ammeter to the battery *positive* terminal and the B terminal.
- Connect a test wire to the B terminal and S terminal.
- Connect a voltmeter to the B terminal and the starter motor body.
- Connect a test wire to the battery negative terminal and the starter motor body.

JUDGEMENT

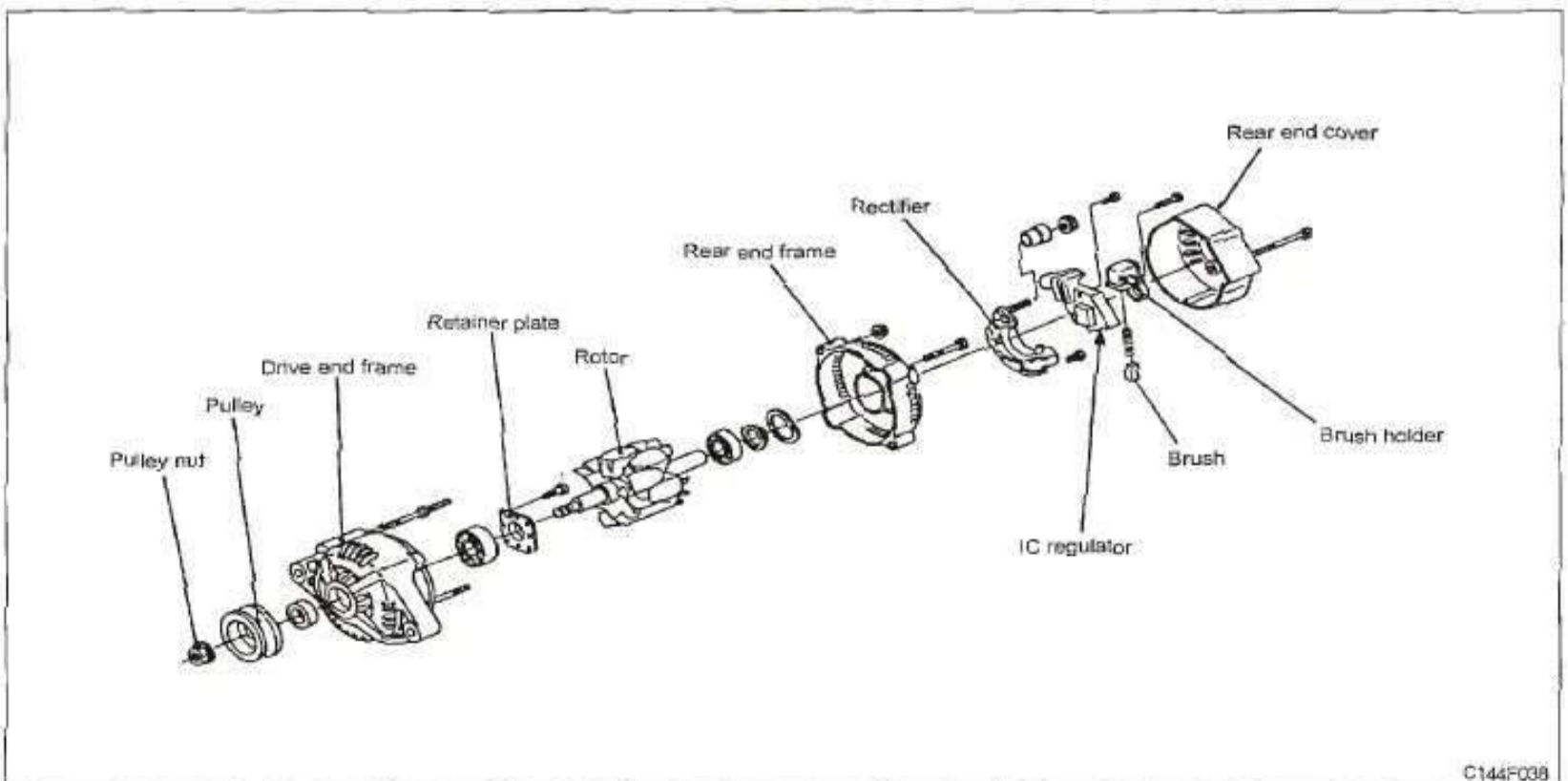
- The pinion gear should pop out and the starter motor should rotate.

ALTERNATOR



23100FF110
Official output 50A (0.079 in)

Components of Alternator



ALTERNATOR

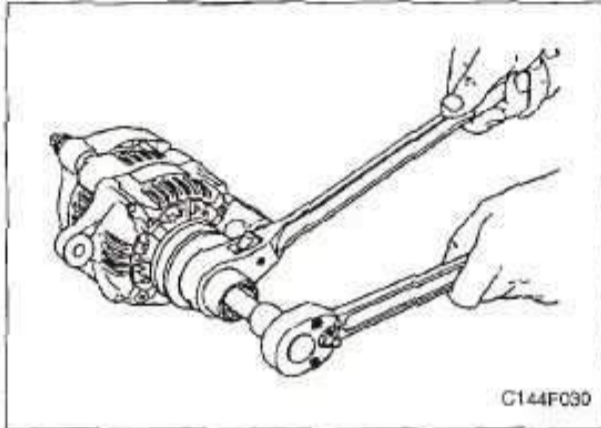
Disassembly

PULLEY

- Secure shaft hexagonal part with a box wrench, loosen pulley nut, and remove pulley.

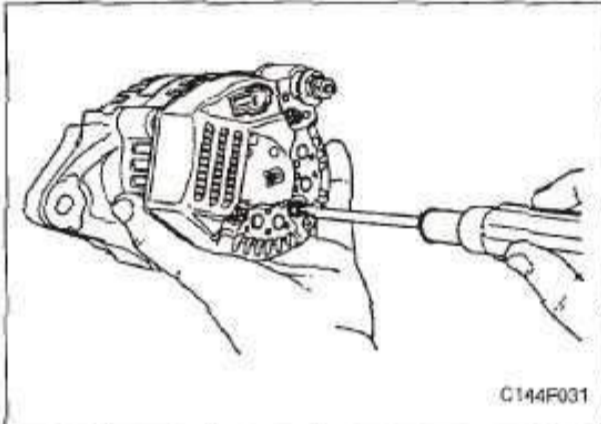
CAUTION:

Hexagonal box wrench must be used. Twelve-fold box wrench may crush shaft head and slip.



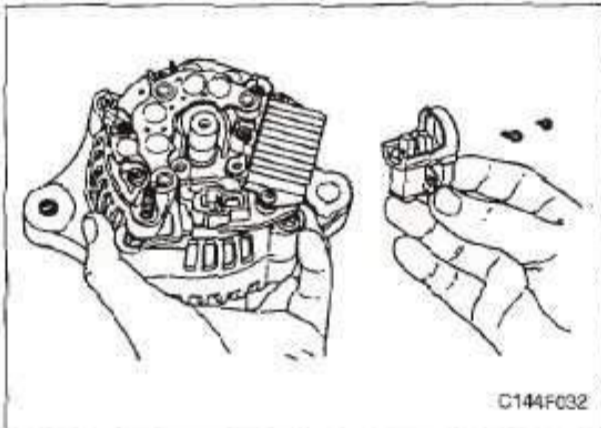
REAR END COVER

- Remove screw and terminal B nut, and then remove rear end cover.



BRUSH HOLDER

- Remove screw, and then remove brush holder.

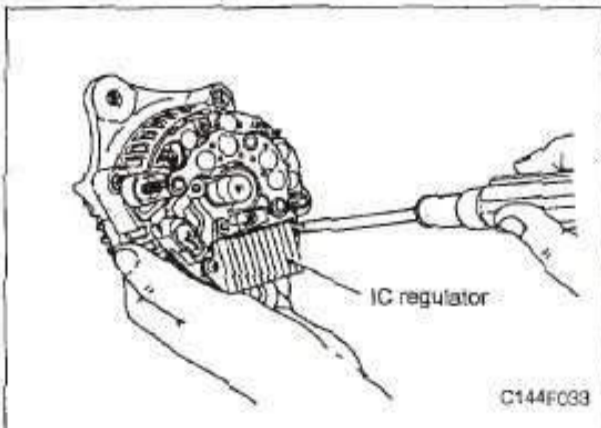


IC REGULATOR

- Remove screw, and then remove IC regulator.

CAUTION:

Lengths of screws are difficult. Arrange removed screws, and securely install them in the original position.

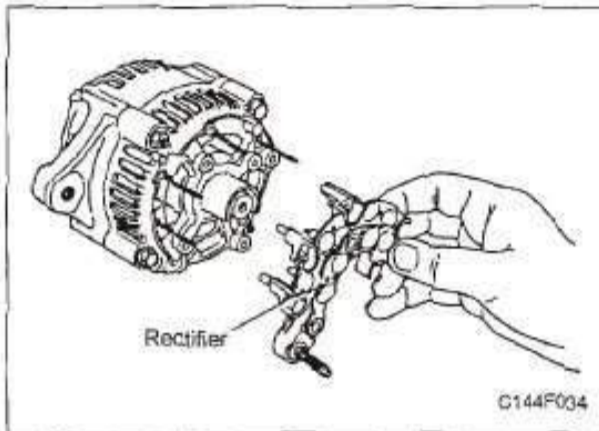


ALTERNATOR

Disassembly (Cont'd)

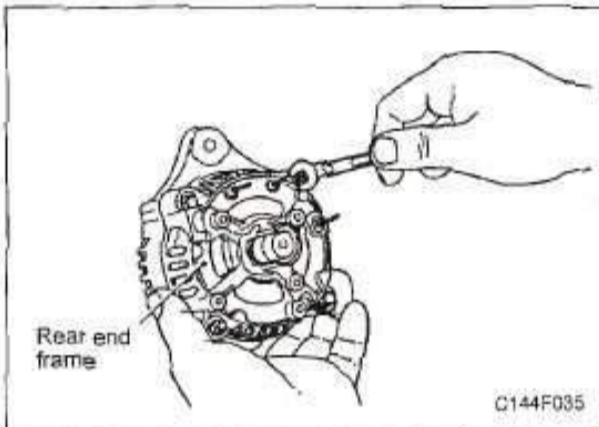
RECTIFIER

- Remove screws securing wires of rectifier and stator, and remove rectifier.



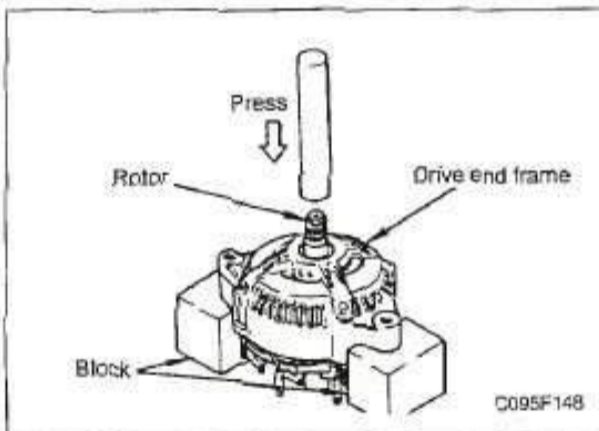
REAR END FRAME

- Remove bolts and nuts, *and then* remove rear end frame.



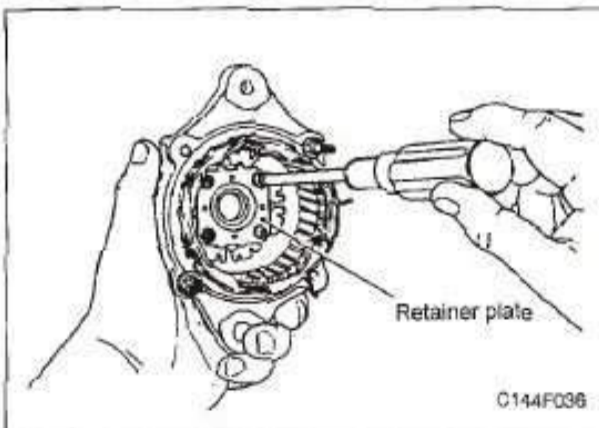
ROTOR

- Keep drive end frame level using blocks, and then press out rotor.



RETAINER PLATE

- Remove screws, and remove *retainer plate*.



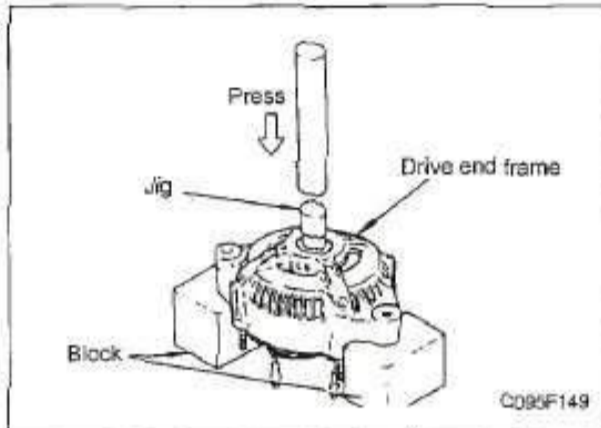
ALTERNATOR

Disassembly (Cont'd)

BEARING

Drive end side

- Keep drive end frame level using blocks, and then press out bearing using a jig.

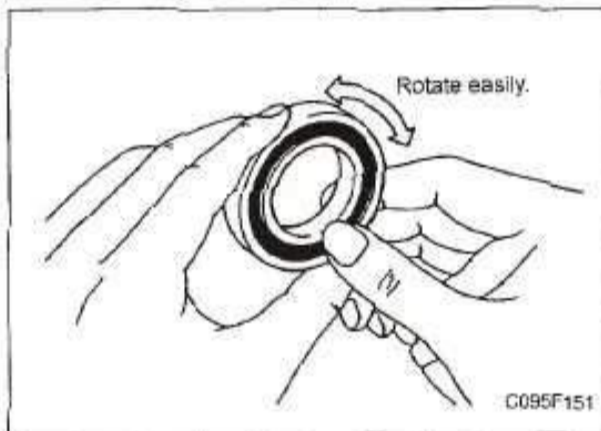
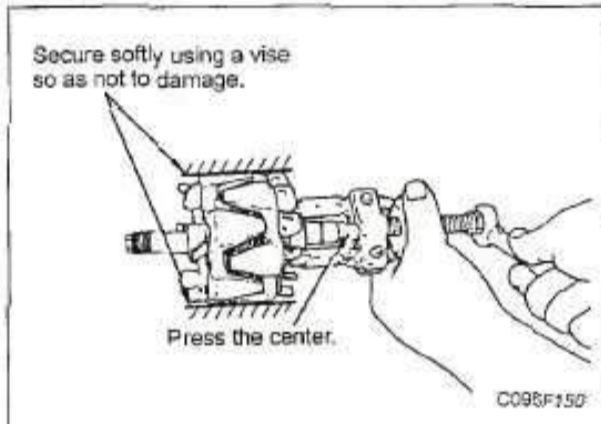


Snap ring side

- Pull out bearing using a puller.

CAUTION:

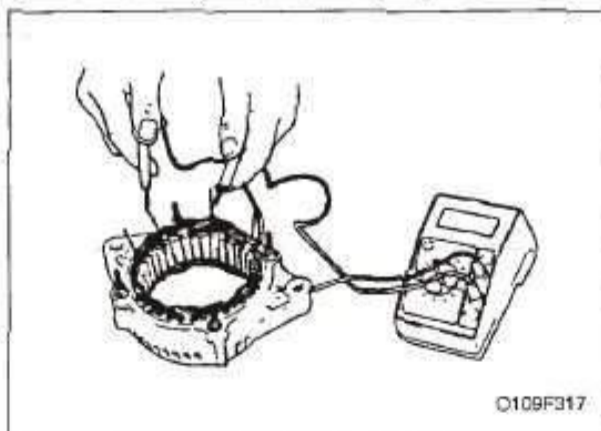
Bearing for high speed is specified to be used. Always use it when replacing, do not impact it.



Inspection

BEARING

- Rotate bearing by hand.
- Check for noise or binding.
- Replace if necessary.



STATOR

- Measure resistance between each lead wire using a circuit tester.
Standard: 1 Ω or less
- Measure resistance between stator core and lead wire.
Standard: ∞
- Replace if necessary.

CAUTION:

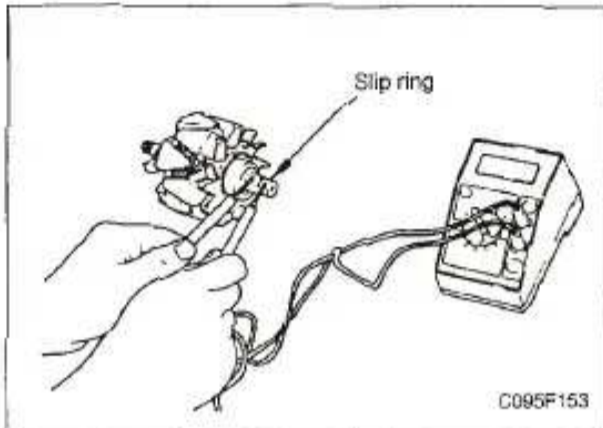
Opening of stator coil itself is not considerable. Check the connection part of wires if continuity should not exist.

ALTERNATOR

Inspection (Cont'd)

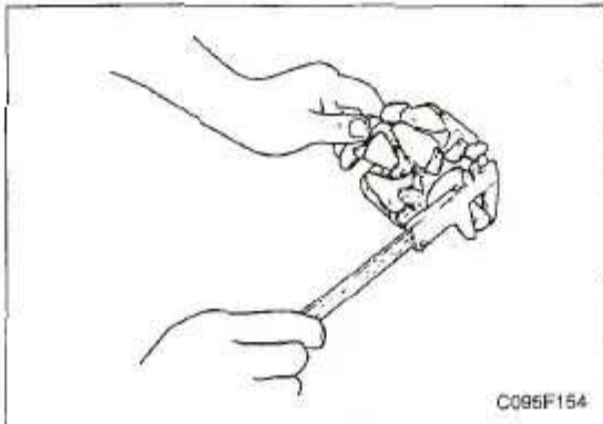
ROTOR COIL

- Measure resistance between each snap ring using a circuit tester.
Standard: 2.9 Ω
- Measure resistance between snap ring and rotor core using a circuit tester.
Standard: ∞
- Replace if necessary.



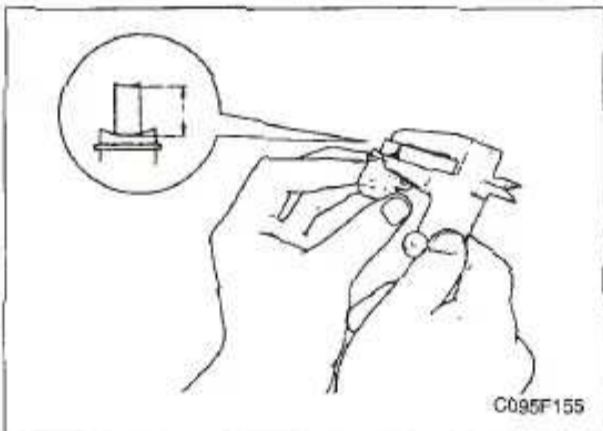
SNAP RING

- Check snap ring for dirt and damage.
- Wipe it clean with a cloth that has been dipped in alcohol if dirty.
- Polish with sandpaper (#500 to 600) if there is slight damage.
- Measure snap ring outer diameter.
Slip ring outer diameter: Standard 14.4 mm
Usable limit 14.4 mm
- Replace if outside the usable limit.



BRUSH

- Measure excessive brush length from brush holder.
Excessive length of brush: Standard 10.0 mm
Usable limit 2.0 mm
- Replace if outside the usable limit.
- Make sure that brush is slightly moving in brush holder.

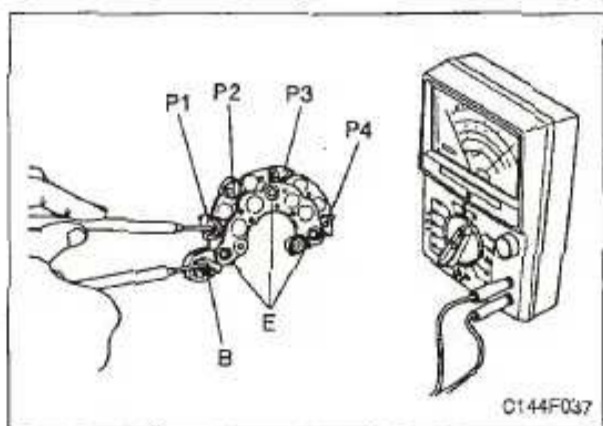


RECTIFIER

- Check continuity between each rectifier diode with circuit tester in k Ω range.
- It is normal that continuity should exist in one side of diode and continuity should not exist in another side of diode.

CAUTION:

Do not use 500V mega tester that breaks rectifier.

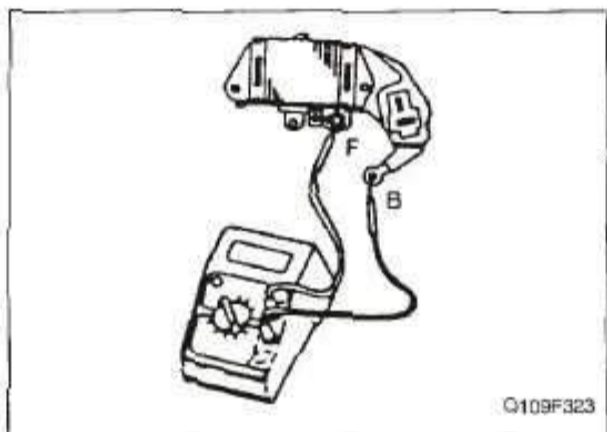
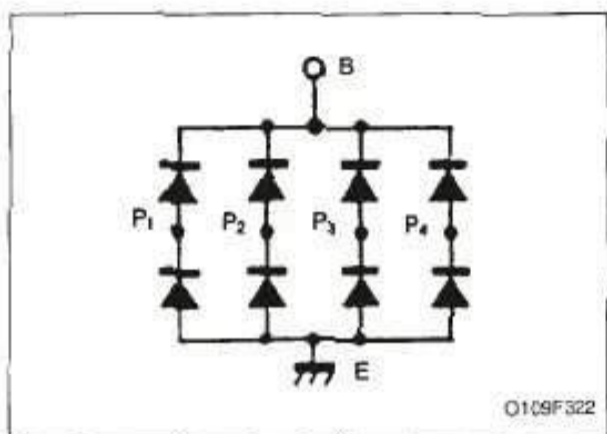


ALTERNATOR

Inspection (Cont'd)

NOTE:

Rectifier condition cannot be judged by forward resistance. One of the characteristics of a diode is that forward current is greatly changed by battery voltage. Indication of tester changes with differences of tester type and resistance range. Rectifier condition is judged by resistance differences between forward and reverse currents.



IC REGULATOR

Check continuity between IC regulator terminal B and F with circuit tester in kΩ range.

- It is normal that continuity should exist in one side and continuity should not exist in another side.

CAUTION:

Do not use 500V mega tester that breaks IC regulator.

NOTE:

IC regulator can be checked with the following procedure if there is constant voltage power supply that can change voltage between 10 to 20V range.

CAUTION:

Regulator may be destroyed if IC regulator misconnects only for a moment. Perform inspection after checking wiring.

- Connect IC regulator unit with constant voltage power supply, circuit tester, and lamps.
- (SW1 and SW2 must remain OFF.)
- Set a power supply voltage to 12V.
- Set SW1 setting to ON. Make sure that L1 turns ON brightly, and L2 turns ON dimly at this time.
- Next, turn SW2 to NO while leaving SW1 at ON. Make sure that L1 turns OFF, and L2 turns ON brightly at this time.
- Raise battery voltage from 12V gradually. Make sure that L2 may turn OFF when battery voltage is approximately $14.5 \pm 0.6V$.

