

Preface

This maintenance manual goes with Lifan 7160L1 sedan. This manual introduces only the maintenance instruction of the 1.6L engine and the transmission system applied by the model Lifan 7160L1. Regarding the maintenance instruction on the vehicle body, electricity, air conditioner and chassis, please refer to Maintenance Manual of Lifan 7160L1 Sedan.

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Chapter 1 Mechanical Part

Section 1 LF481Q3 engine main character

item		unit	parameter
Type			LF481Q3, 4 strokes, water cooled, in-line 4 cylinders, 16 valves, double overhead camshaft, multi point fuel injection
Type of combustion chamber			wedge-section combustion chamber
Bore		mm	81.02
Stroke		mm	77
Total displacement		L	1.587
Compression rate			9.5
Compress press(250r/min)		kpa	≥1000
difference-press in different cylinder		kpa	≤100
Press of lubricant	Idle speed	kpa	100~300
	3000 r/min	kpa	280~450
	Rated speed	kpa	350~500
Lubricant capacity		L	4
Fuel (GB17930)			93# no lead petrol
Coolant			Use soft water, should add the eligibility anti-freeze coolant
Oil			above SG grade
Ignition sequence			1-3-4-2
Direction of rotation (from front)			clockwise
Start form			by electric
Lubricate form			By press with splash
Cool form			by compulsoury cycle water
Open temperature of thermostat		°c	83
Full open temperature of thermostat		°c	95
Declared speed		R/min	6000
Declared power		Kw	78
Max torque (3000—5000r/min)		N·m	135
Min fuel consumption		g/kw·h	≤270
Min unload stability speed (idle)		R/min	800±50
Ignition advance angle (idle)		°	5°±3°
Idle exhaust	Co slow idle / high idle	%	≤0.5/0.3
	Hc slow idle / high idle	ppm	≤100
Intake valve clearance (cold)		mm	0.2~0.25
Exhaust valve clearance (cold)		mm	0.2~0.25
Dimension	Without transmission	mm	650 × 605 × 640
Dimension	With transmission	mm	1010 × 605 × 640
Net weight	Without transmission	Kg	104
Net weight	With transmission	Kg	130.5

Section 2 Compression pressure inspection

Hint: If the engine power is not sufficient, the fuel consumption too high or the fuel economy is bad, measure cylinder compression pressure.

1. Preheat engine then stop

Preheat engine to normal working temperature.

2. Disconnect bobbin connector

3. Remove high voltage conductor from spark plugs

Dismantle high voltage conductor from rubber protective sleeve, do not pull conductor directly.
Note: Pull or bend conductor may damage inner conductor(pic. 1-3)

4. Remove spark plugs

Use spark plug socket and spanner to remove 4 spark plugs

5. Remove 4 fuel injector connectors, make it don't injective.

6. Check cylinder compression pressure

(a) Insert compression pressure meter into spark plug holes

(b) Turn on choke valve to full open

(c) When the engine is started, measure compression pressure (pic. 1-4)

Hint: Use full charged battery to speed up engine to over 250 rpm.

(d) Repeat step (a)~(c) for each cylinder

Note: This test shall be completed as fast as possible

Compression pressure: 1100Kpa (11.0kgf/cm²) or higher

Min. pressure: 1000Kpa Kpa (10.0kgf/cm²)

Pressure differential between each cylinder: ≤100Kpa Kpa (1.0kgf/m²) or lesser

(e) If one or more cylinder compression pressure is low, fill small amount of engine oil into cylinder via spark plug hole, and repeat step (a)~(c) for cylinders with low compression pressure.

.If the engine oil may help meliorate compression pressure, it indicates possible piston ring and/or cylinder wall abrasion or damage

. If the pressure is still low, it might because of valve jammed or close not sealed, or there is gas leakage at the cylinder gasket

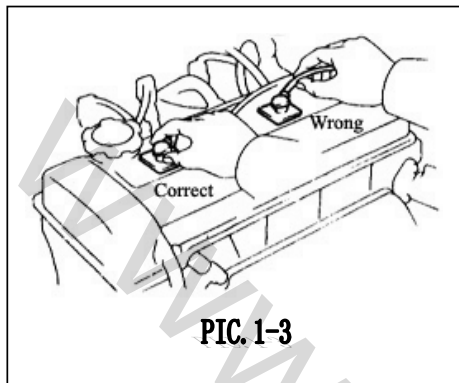
7. Re-install spark plug

Use spark plug socket and spanner to install 4 spark plugs

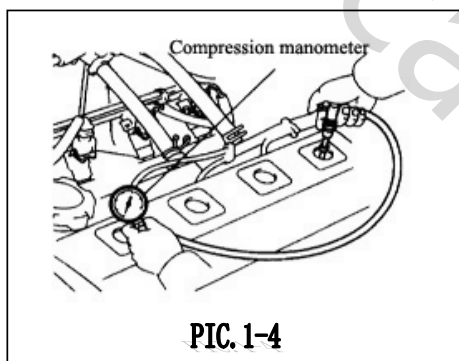
8. Re-connect high voltage conductors to spark plugs

9. Re-connect bobbin connectors

10. Re-connect fuel injector connectors

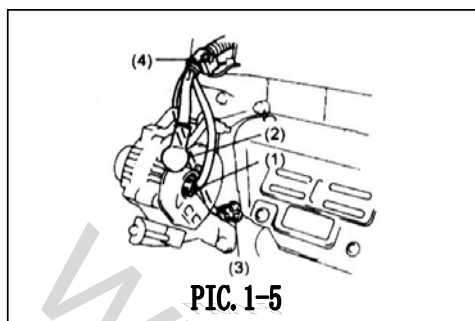


PIC. 1-3



PIC. 1-4

Section 3 Valve clearance inspection & adjustment



Hint: Check and adjust valve clearance when engine is cold

1. Remove high voltage conductor from spark plug

2. Remove cylinder head cover

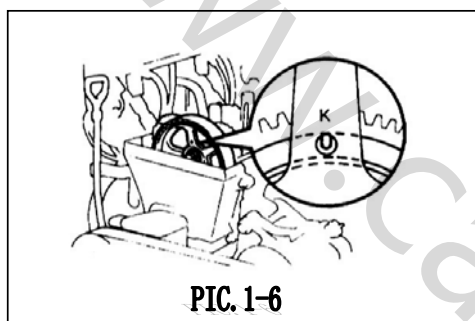
(a) Dismantle following conductor and grommet (pic. 1-5)

- (1) Generator connector
- (2) Generator wire
- (3) Oil pressurized switch connector
- (4) Wire grommet

(b) Remove conductor harness from cylinder head cover

(c) Dismantle 2 positive crankcase ventilation (PCV) hose from cylinder head cover

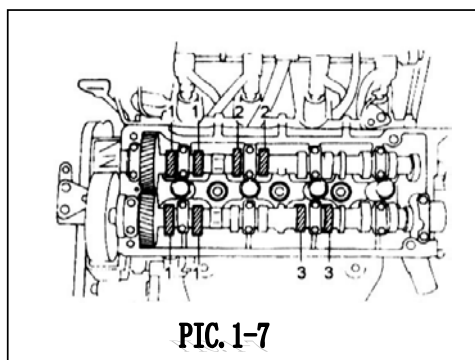
(d) Remove 4 lock nuts, gaskets, cylinder head cover and gaskets



3. Set #1 cylinder as top dead center (TDC) of compression stroke

(a) Rotate crankshaft belt pulley, align notch on belt pulley with timing mark on belt hood

(b) Check if "K" mark on camshaft spindle timing belt pulley is aligned with timing mark on bearing cap. If not, rotate crankshaft one turn (pic. 1-6)



4. Check valve clearance

(a) Check only valves indicated in figure (pic. 1-7)

.Use feeler gage to measure the clearance between valve tappet and camshaft

.Record valve clearance measure results that are disaccord with specification. These date will used in the future to determine shims to be changed

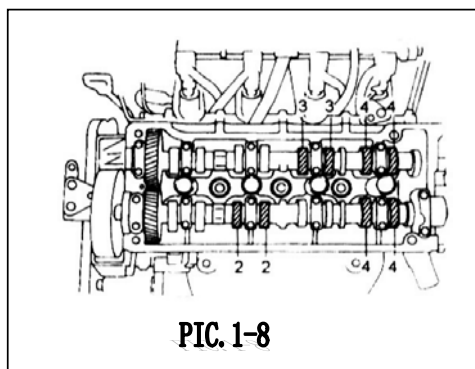
Valve clearance (cold state):

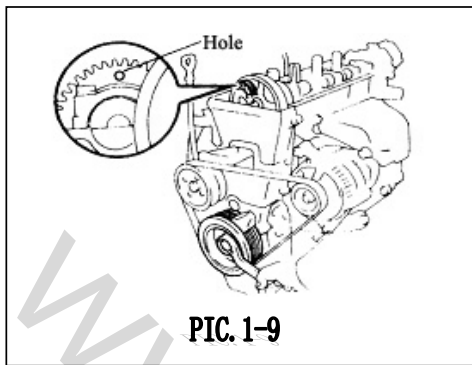
Inlet: 0.20-0.25mm

Outlet: 0.30-0.35mm

(b) Rotate crankshaft belt pulley one turn, align notch on belt pulley with timing mark with timing mark on #1 timing belt hood

(c) Check only valves indicated in figure, measure valve (pic. 1-8) Refer to method in step (a))





5. Air inlet:

Adjust valve clearance

A. Dismantle air inlet camshaft

Note: Due to small axial clearance on camshaft, keep camshaft in horizontal when dismantle. If failed, the part of cylinder head that bears axial thrust may crack or damage, and cause consequently camshaft jammed or break. Following steps shall be carried out to prevent this situations.

- (a) Rotate camshaft pulley, keep holes on pinion upwards (make pinion and driving gear gearing (pic. 1-9))

Hint: Above state allows the #1 and #3 cylinder cam noses of air inlet camshaft evenly pressed on their valve tappets

- (b) Dismantle two bolts and #1 bearing cap

- (c) Fix the air inlet camshaft pinion onto driving gear with a service bolt (pic. 1-10)

Service bolt recommended:

Thread dia.: 6mm

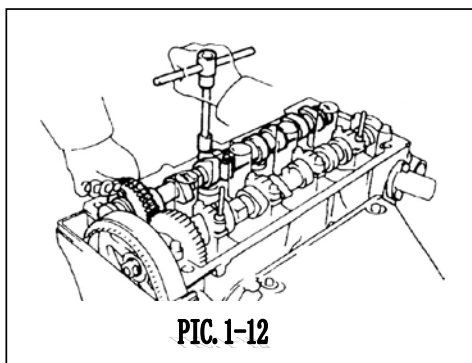
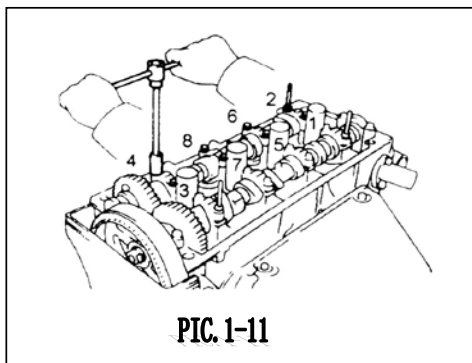
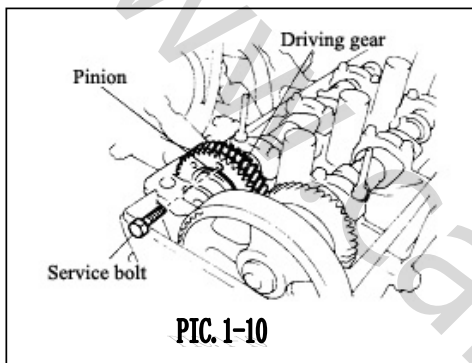
Pitch : 1.0mm

Bolt length : 16-20mm

Hint: When dismantle camshaft, make sure torsion spring force on pinion is eliminated with above operation

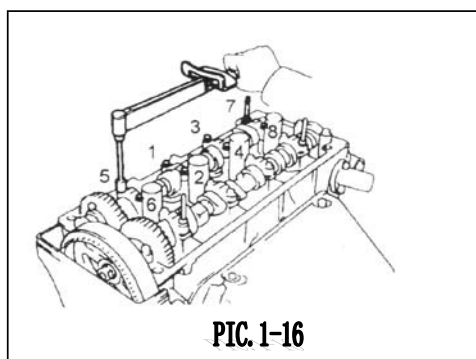
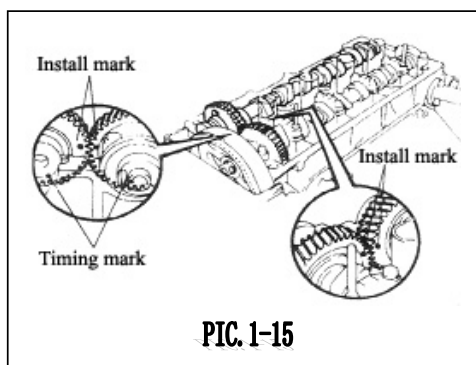
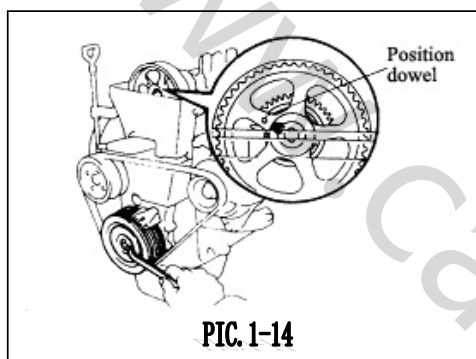
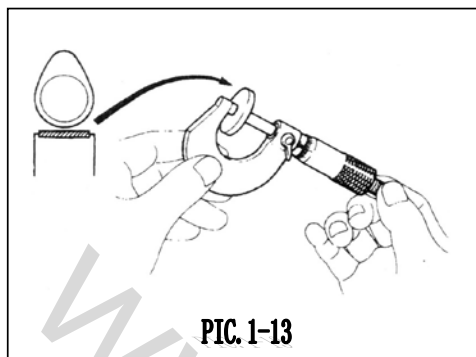
- (d) Evenly unscrew and remove 8 bearing cap bolt as illustrated sequence (pic. 1-11)

- (e) Remove 4 bearing caps and camshafts



Hint: If the camshaft was not lifted in horizontal, use 2 bolts to re-install #3 bearing cap. Then lift up camshaft gear, unscrew and remove bearing cap bolt alternatively (pic. 1-12)

Note: Do not use other tools to pry or forcing the camshaft.



B. Remove shims

Remove adjust shims with small screwdriver.

C. Determine change shims size

- Measure thickness of shims removed with screw micrometer. (pic. 1-13)
- Calculate new shim thickness, make valve clearance within specified range.
Cold state clearance value: 0.20~0.25mm
- Try select new shims with thickness similar with calculated value.

Hint: There are 16 different thickness shims, the thickness are from 2.50mm to 3.30mm at the gradation of 0.05mm

D. Install new shims

Install new shims onto valve tappet.

E. Install air inlet camshaft

Note: Due to small axial clearance on camshaft, keep camshaft in horizontal when dismantle. If failed, the part of cylinder head that bears axial thrust may crack or damage, and cause consequently camshaft jammed or break. Following steps shall be carried out to prevent this situations.

- Rotate crankshaft belt pulley, fix exhaust camshaft to allow locating dowel slightly higher than upper face of cylinder head. (pic. 1-14)
- Apply grease on anti-thrust part of camshaft.
- Align assembling mark of each gear, make camshaft gear gears with exhaust camshaft gears. (pic. 1-15)

Note: As shown in figure, each gear has timing marks (for TDC), do not use these marks.

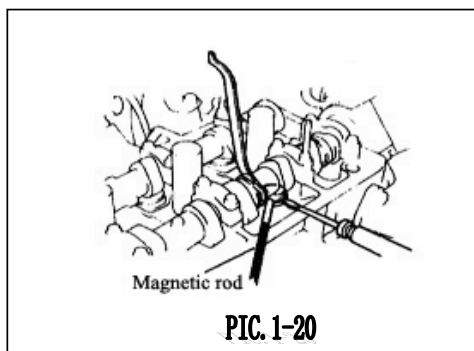
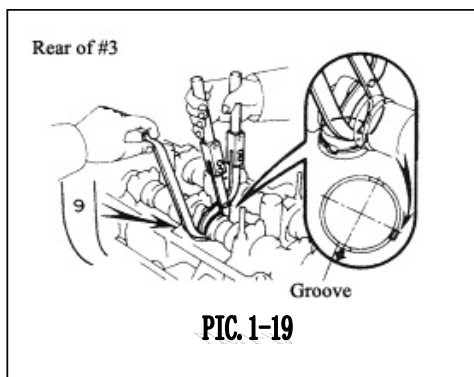
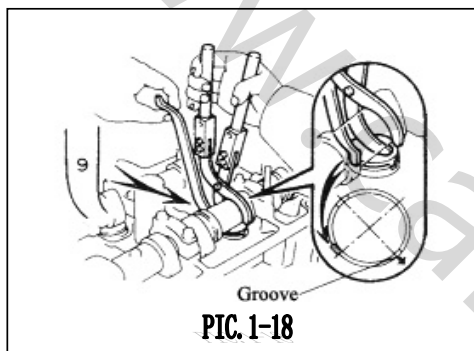
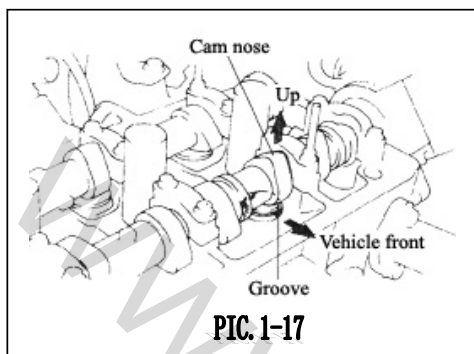
- Fix air inlet camshaft to bearing shaft and make gears gearing.

Hint: Above angle allows #1 and #3 cylinder cam nose of air inlet camshaft evenly push their valve tappets.

- Install 4 bearing caps respectively onto their positions.
- Apply a thin layer of engine oil onto bottom and thread of bearing cap bolt.
- Tighten 8 bearing cap bolts evenly as per illustrated sequence. (pic. 1-16)

Torque: 11±0.5N.m

- Remove service bolt.



- (i) When install #1 bearing cap, keep arrow mark forward.

Note: If the #1 bearing cap is not well matched, pry and split cylinder head and camshaft gear with screwdriver, then push camshaft backwards.

- (j) Apply a thin layer of engine oil onto bottom and thread of bearing cap bolt.
 (k) Install and tighten 2 bearing cap bolts alternatively.

Torque: $11 \pm 0.5 \text{ N.m}$

F. Recheck valve clearance

6. Air exhaust:

Adjust valve clearance

A. Remove shims

- (a) Rotate crankshaft and make cam nose on camshaft of adjust valve upwards. (pic. 1-17)
 (b) Make notch on valve tappet facing forwards.
 (c) Use special service tool (A) to press down valve tappet and place special service tool (B) in between camshaft and valve tappet. Remove special service tool (A) (pic. 1-18).

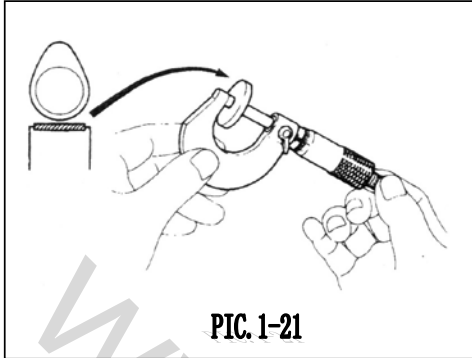
Hint:

. Use service tool (B) with small angle at the side marked with a "9", position as illustrated (pic. 1-19).

. When special service tool (B) goes too deep, it will be jammed by shims. To avoid, insert it slowly from the air inlet side at a small angle.

. Shape of cam makes the special service tool (B) hard to be inserted from air inlet side to the rear part of #3. This shim should be inserted from air outlet side.

- (d) Remove shims with small screwdriver and magnetic rod. (pic. 1-20)



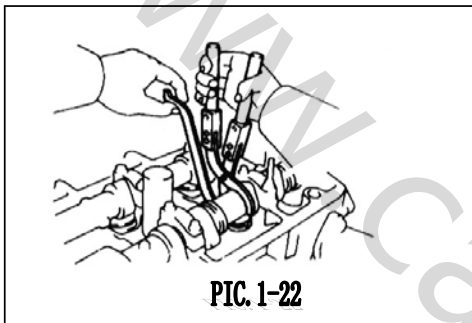
B. Determine dimension of changed shims.

- (a) Measure thickness of shims with screw micrometer. (pic. 1-21)
- (b) Calculate new shim thickness, make valve clearance within specified range.

**Outlet valve clearance at cold state:
0.30~0.35mm**

- (c) Try select new shims with thickness similar with calculated value.

Hint: There are 16 different thickness shims, the thickness are from 2.50mm to 3.30mm at the gradation of 0.05mm



C. Install new shims

- (a) Place a new shim on valve tappet
- (b) Use special service tool (A) to press down valve tappet, and then remove special service tool (B) (pic. 1-22)

D. Recheck valve clearance

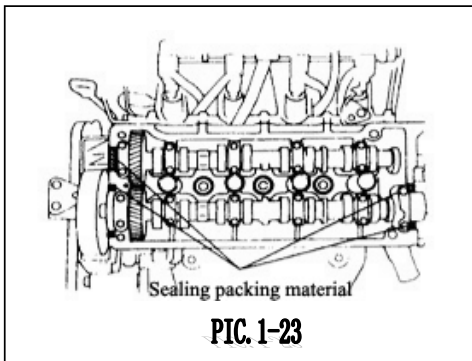
7. Install cylinder head

- (a) Remove all old packing material
- (b) Apply sealing packing material on cylinder head as illustrated (pic. 1-23)
- (c) Install gasket for cylinder cover
- (d) Use 4 gasket for respectively lock nut, install cylinder head cover

Torque: 10.8N.m

- (e) Connect 2 PCV hose onto cylinder head cover
- (f) Use 2 bolts to install engine conductor harness and protective hood
- (g) Connect following conductors and grommets
 - (1) Generator connector
 - (2) Generator wire
 - (3) Oil pressurized switch connector
 - (4) 2 Wire grommet

8. Re-connect high voltage conductor to spark plug



Section 4 Inspection & adjustment to idle speed

1. Start up conditions

- (a) Engine in normal working temperature
- (b) Air filter installed
- (c) All pipe and hose for air inlet system connected
- (d) All vacuum pipes correctly connected
- (e) EFI system conductor completed inserted
- (f) All working accessories turned off
- (g) Shift in neutral position

2. Connect Tachometer

3. Check idle speed

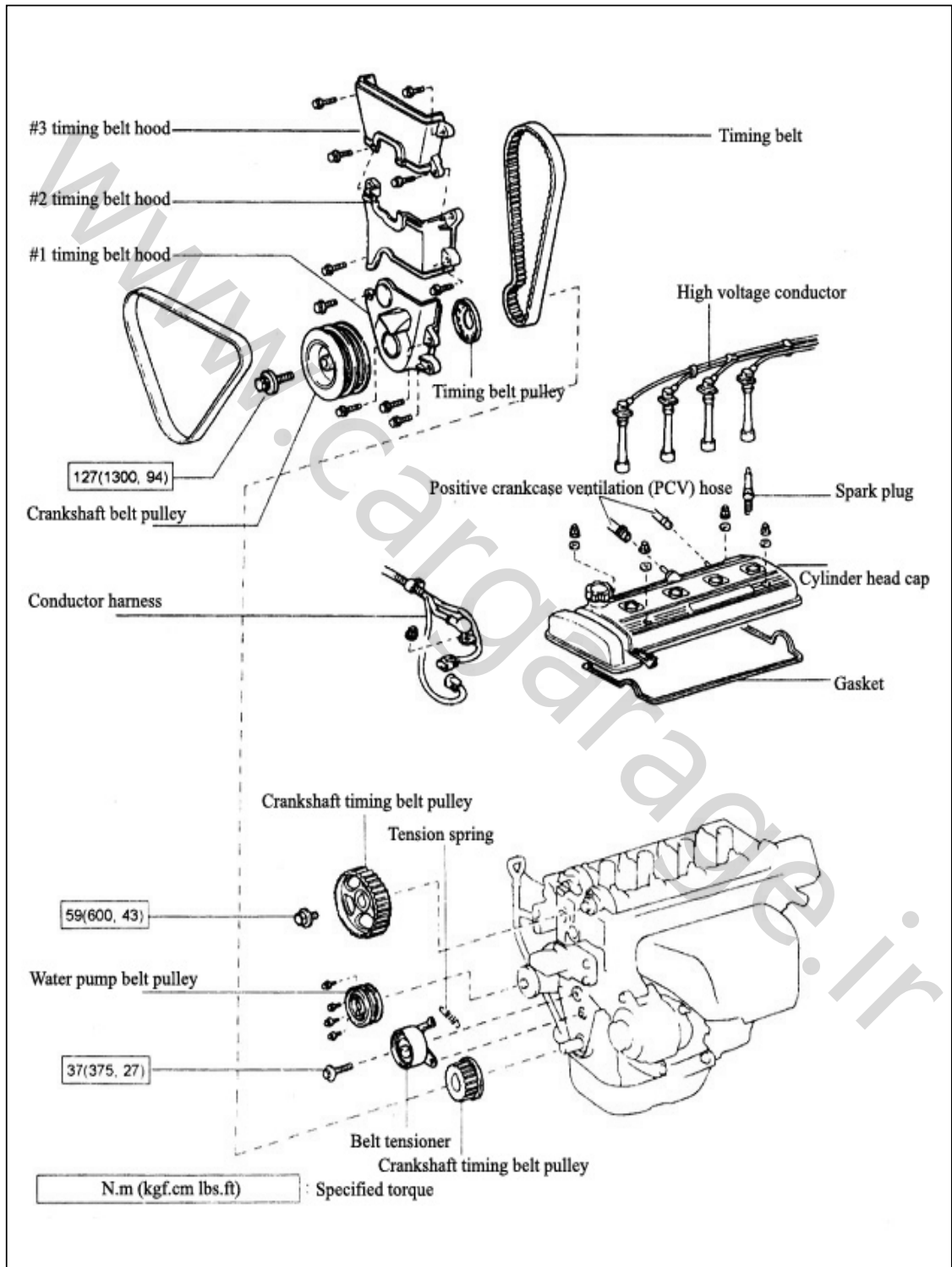
Idle speed (cooling fan turned off): 800 ± 50 rpm

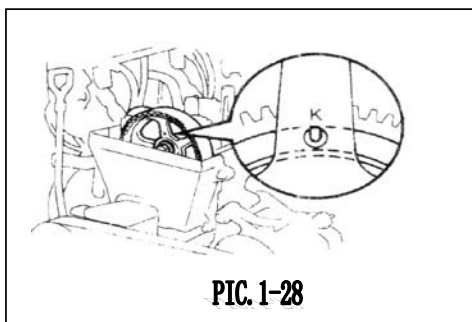
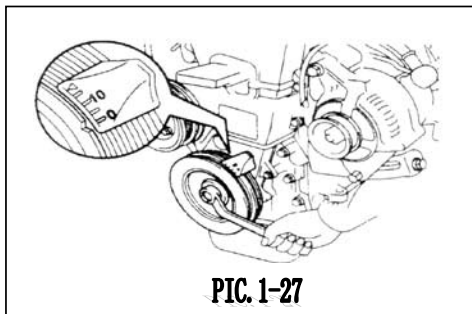
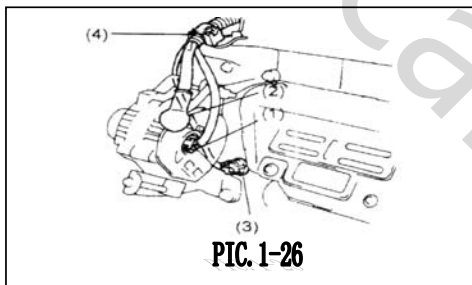
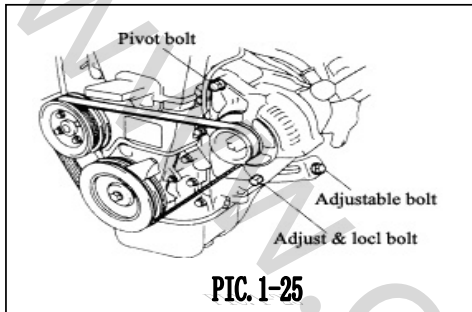
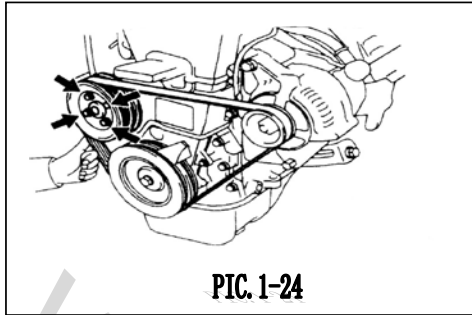
If idle speed does not meet with specification,
check idle speed control valve (ISC) system

4. Dismantle Tachometer

Section 5 Timing belt inspection & adjustment

Timing belt part exploded view





I. Dismantle

1. Dismantle AC motor driving belt and water pump belt pulley (pic. 1-24, pic. 1-25)

(a) Unscrew 4 bolt from water pump belt pulley

(b) Unscrew pivot bolt and adjust locking bolt.

(c) Unscrew set bolt, remove driving belt.

(d) Remove 4 bolts and water pump pulley.

2. Dismantle spark plug

3. Dismantle cylinder head cover

(a) Dismantle following conductor and grommet (pic. 1-26)

(1) AC generator connector

(2) AC generator wire

(3) Oil pressurized switch connector

(4) Conductor grommet

(b) Remove conductor harness from cylinder head cover.

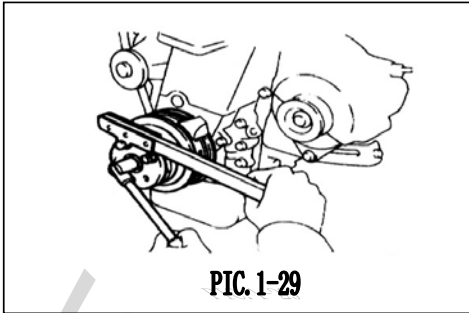
(c) Remove 2 PCV hoses from cylinder head cover.

(d) Remove 4 lock nuts, gaskets, cylinder head cover and shims.

4. Set #1 cylinder as top dead center (TDC) of compression stroke

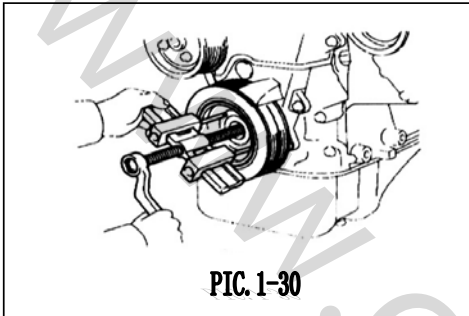
(a) Rotate crankshaft belt pulley, align notch on belt pulley with timing mark "O" on #1 timing belt hood (pic. 1-27)

(b) Check if "K" mark on camshaft spindle timing belt pulley is aligned with timing mark on #2 bearing cap (pic. 1-28). If not, rotate crankshaft one turn (360°)

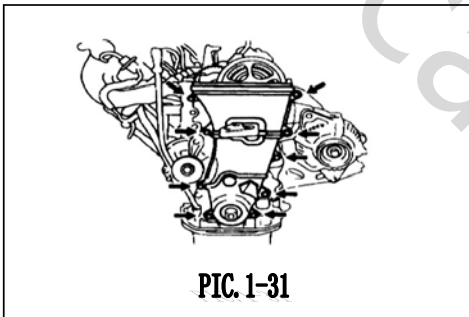


5. Dismantle crankshaft belt pulley

(a) Use special service tool to dismantle belt pulley bolts. (pic. 1-29)



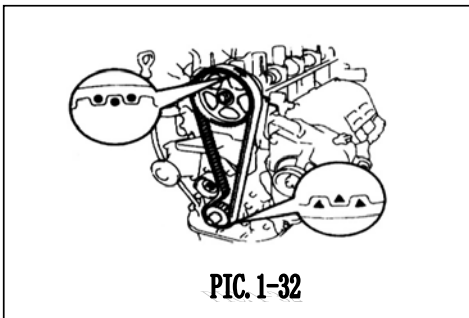
(b) Use special service tool to dismantle belt pulley. (pic. 1-30)



6. Dismantle timing belt hood

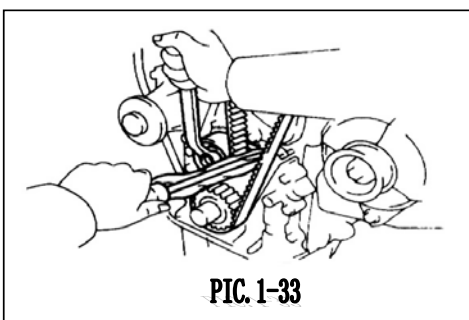
Dismantle 9 bolts and timing belt hood. (pic. 1-31)

7. Dismantle timing belt guide pulley



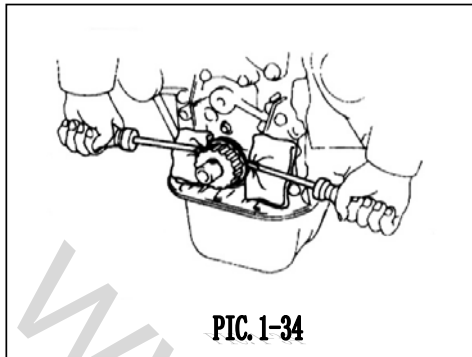
8. Remove timing belt

Hint: If the timing belt is to be used, drawing a direction arrow on belt (engine rotate direction), then make matching marks on belt pulley and belt as illustrated. (pic. 1-32)



(a) Unscrew belt tensioner erection bolts, try push this belt pulley leftwise as much as possible and then temporarily fixed. (pic. 1-33)

(b) Dismantle belt .



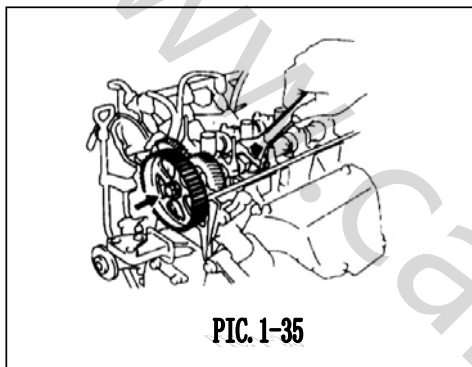
9. Dismantle belt tensioner and tension spring

Dismantle bolts, belt pulley and tension spring.

10. Dismantle crankshaft timing belt pulley

If the belt pulley can be removed by hand, use 2 screwdrivers. (pic. 1-34)

Note: Apply rag as illustrated to avoid damage components.

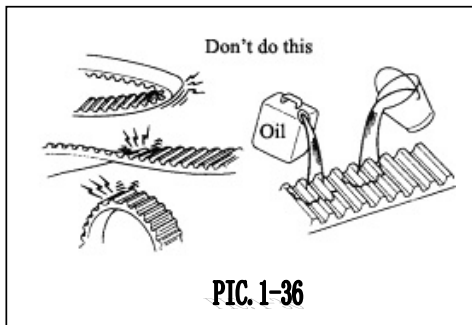


11. Dismantle crankshaft timing belt pulley

12. Dismantle camshaft timing belt pulley

Fix hexagon head of camshaft with spanner, in the same time dismantle bolts and timing belt pulley. (pic. 1-35)

Note: Do not damage cylinder head with spanner.



II. Inspection

1. Inspect timing belt

Note: (pic. 1-36)

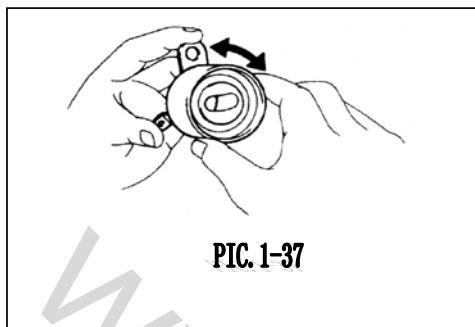
• Do not bend, distort or neck out timing belt .

• Keep timing belt from engine oil, water or vapor.

• When dismantle erection bolts of camshaft timing belt pulley, do not use tension of timing belt.

If defect existed as illustrated, check following items:

- (a) Premature disengage
 - Check installation for correctness.
 - Check timing hood liner for damage, if the installation is correct.
- (b) If there is crack or damage on belt teeth, check if the camshaft or water pump were jammed.
- (c) If there are obvious abrasion or crack on surface of belt, check belt tensioner lock pin side for crack.



- (c) If abrasion or damage occurs only on one side of belt, check belt guide pulley and position of each pulley.
- (e) If there is obvious abrasion on belt teeth, then check timing belt hood for damage, or if the gasket installation is correct. There shall be no foreign subjects on belt pulley teeth. If necessary, change timing belt.

2. Check belt tensioner

Check if rotate of belt tensioner flexible and smooth. (pic. 1-37)

Change belt tensioner if necessary.

3. Check tension spring

- (a) Measure free length of tension spring. (pic. 1-38)

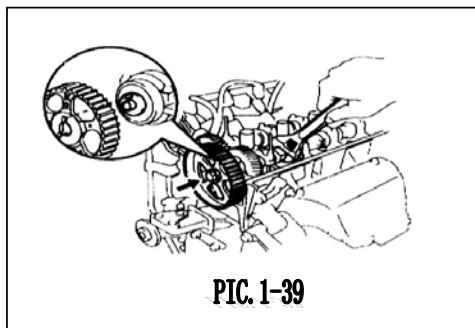
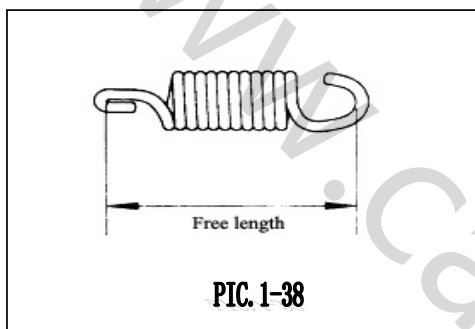
Free length: 36.9mm

If the free length disagrees with specification, change tension spring

- (b) Measure spring tension at specified erection length

Erection tension: When length is 43.6mm, the tension is 34 -38N.

If erection tension disagrees with specification, change tension spring



III. Installation

1. Install camshaft timing belt pulley

- (a) Align camshaft locating dowel with locating dowel notch on "K" mark site of belt pulley (with 2 locating dowels), and slide into timing belt pulley.

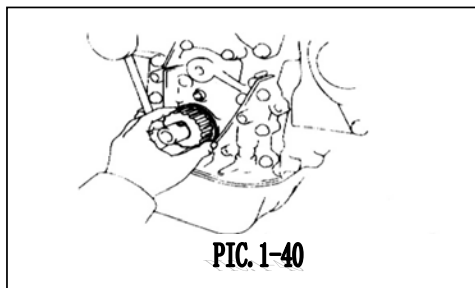
Hint: There are two kinds of camshaft timing belt pulleys, there are respectively with 1 or 2 locating dowel notches.

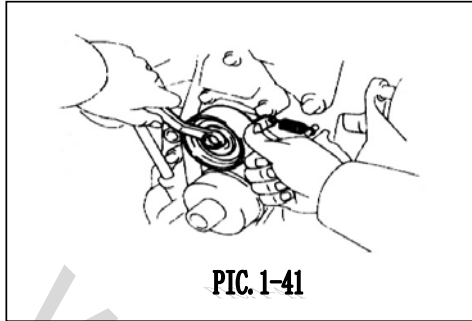
- (b) Temporarily install timing belt pulley bolts.
- (c) Fix camshaft hexagon head with spanner, tighten timing belt pulley bolts. (pic. 1-39)

Torque: 59N.m

2. Install crankshaft timing belt pulley and its retainer

- (a) Install timing belt pulley retainer, align positioning slot with its key way, and the taper is facing outwards
- (b) Align belt pulley positioning key with belt pulley key way. (pic. 1-40)
- (c) Slide in and install timing belt pulley, the flange side facing inwards.

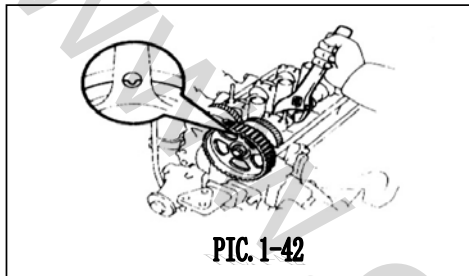




PIC. 1-41

3. Temporarily install belt tensioner and tension spring

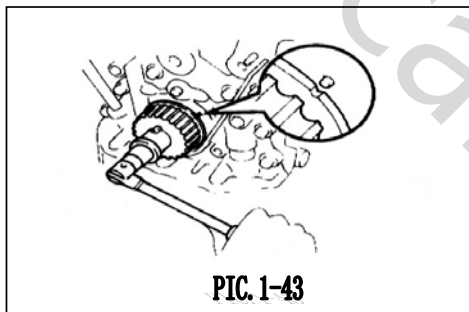
- (a) Install belt tensioner with bolts, but do not tighten. (pic. 1-41)
- (b) Install tension spring.
- (c) Push belt pulley leftmost, tighten bolts.



PIC. 1-42

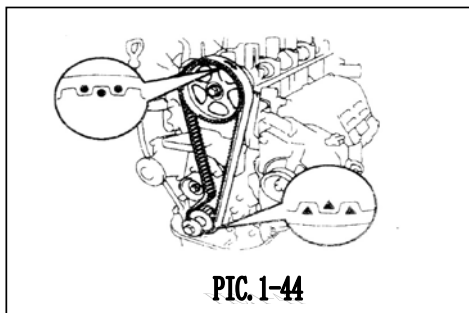
4. Set #1 cylinder as top dead center of compression stroke

- (a) Rotate hexagon head of camshaft, align "K" mark of camshaft timing belt pulley with timing mark on bearing cap. (pic. 1-42)



PIC. 1-43

- (b) Use crankshaft belt pulley bolt to rotate crankshaft, align timing mark on crankshaft timing belt pulley with oil pump body. (pic. 1-43)

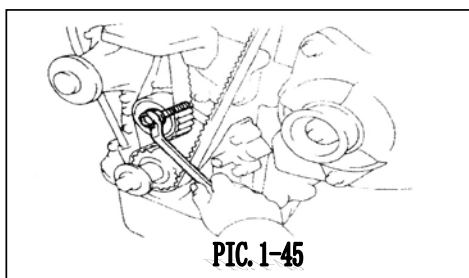


PIC. 1-44

5. Install timing belt

Note: Engine shall be in cold state.

Hint: If the just dismantled timing belt is to be used, align the mark make during dismantling, when install belt, the arrow shall point at the engine rotate direction. Install timing belt, check tension between crankshaft timing belt pulley and camshaft timing belt pulley. (pic. 1-44)

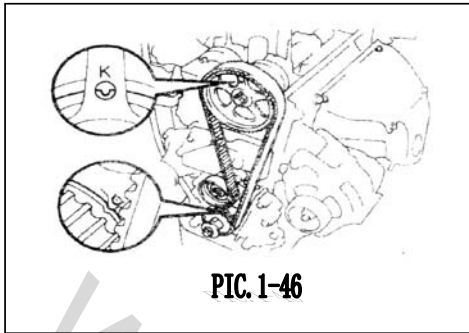


PIC. 1-45

6. Check valve timing

- (a) Unscrew belt tensioner bolts. (pic. 1-45)
- (b) Slowly rotate crankshaft 2 turns, from TDC to TDC.

Hint: Make sure rotate crankshaft along CW direction.

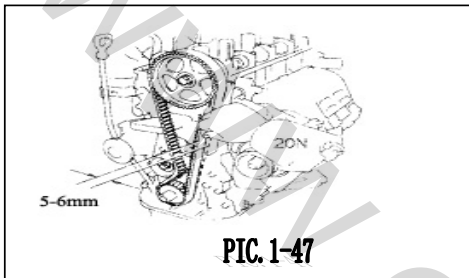


(c) Check if every belt pulley is aligned with timing mark as illustrated. If the timing mark was not aligned, remove timing belt and re-install. (pic. 1-46)

(d) Tighten belt tensioner bolt.

Torque: $33 \pm 1 \text{ N.m}$

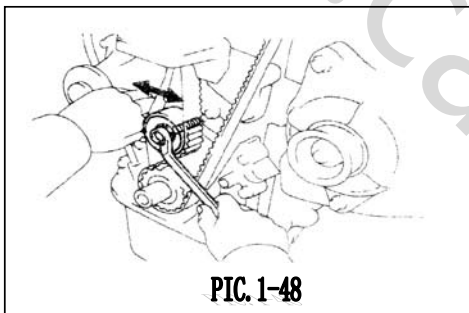
(e) Dismantle temporarily installed crankshaft belt pulley bolt.



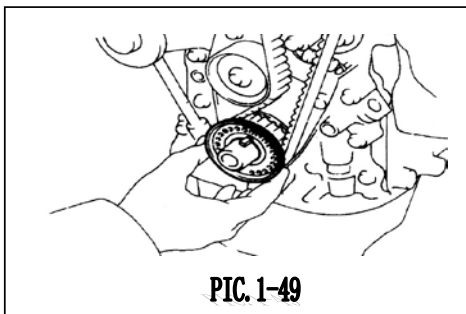
7. Check timing belt flexibility

Check illustrated position for certain belt flexibility. (pic. 1-47)

Belt flexibility: 8-10mm at 28N



If the flexibility disaccords with specification, re-adjust belt tensioner. (pic. 1-48)



8. Install timing belt guide pulley

Install timing belt guide pulley, face the outer ring outwards. (pic. 1-49)

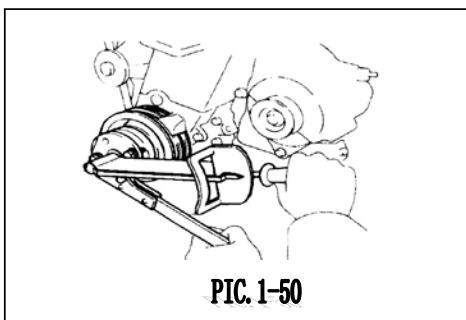
9. Install timing belt hood

(a) Install #1 timing belt hood with 3 bolts.

Torque: 11N.m

(b) Install #2 & #3 timing belt hood with 6 bolts.

Torque: 11N.m

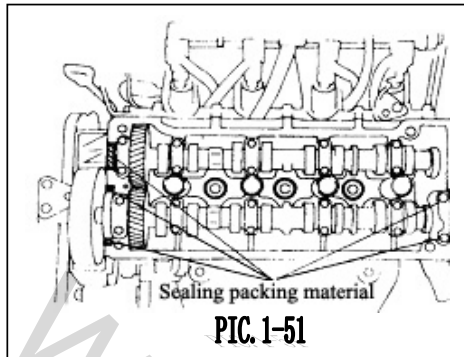


10. Install crankshaft belt pulley

(a) Align belt pulley positioning key with key way on belt pulley, push in belt pulley smoothly. (pic. 1-50)

(b) Use special service tool to install belt pulley bolt.

Torque: 80N.m



11. Install cylinder head cover

- (a) Clear old packing material.
- (b) Apply sealing packing material for cylinder head as illustrated. (pic. 1-51)
- (c) Install gaskets on cylinder head cover.
- (d) Use 4 gaskets and lock nuts to install cylinder head cover.

Torque: 12N.m

- (e) Connect 2 positive crankcase ventilation (PCV) hose onto cylinder head cover.
- (f) Dismantle following conductor and grommet
 - (1) AC generator connector
 - (2) AC generator wire
 - (3) Oil pressurized switch connector
 - (4) 2 Conductor grommets

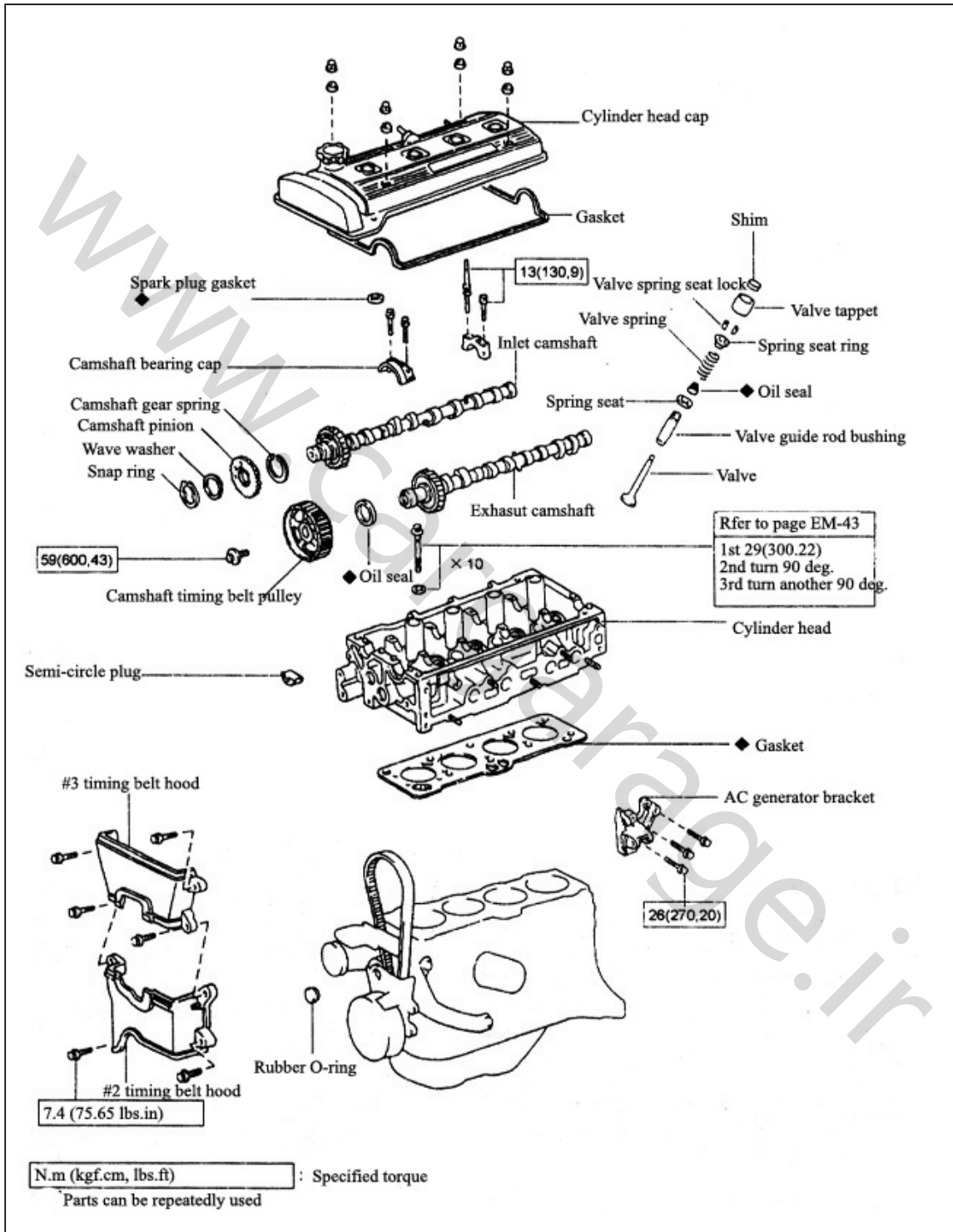
12. Install spark plug

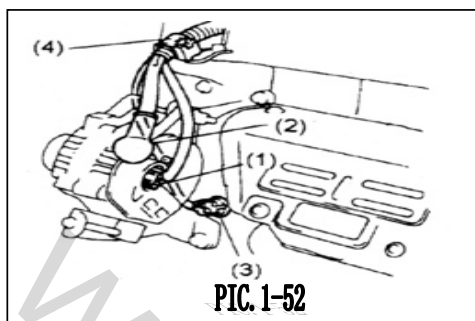
13. Install water pump belt pulley and generator driving belt

- (a) Use 4 bolts to install water pump belt pulley temporarily.
- (b) Install driving belt with adjustable bolts and pivot bolts.
- (c) Tighten 4 water pump belt pulley bolt.

14. Adjust driving belt

Section 6 Cylinder head Cylinder head parts exploded view





I. Dismantle

1. Drain out engine coolant

2. Dismantle AC generator driving belt and water pump belt pulley

3. Dismantle engine conductor harness

(a) Dismantle following conductor and grommet:

(pic. 1-52)

(1) AC generator connector

(2) AC generator wire

(3) Oil pressure switch connector

(4) Conductor grommet

(b) Dismantle bolt and harness seat.

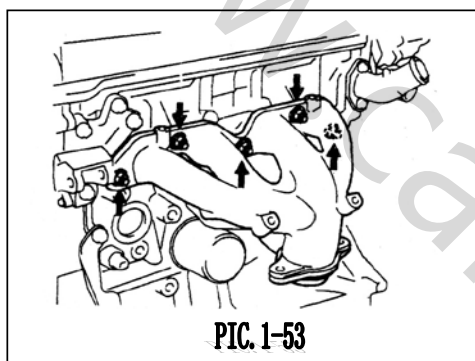
(c) Dismantle engine harness from cylinder head.

4. Dismantle alternator

(a) Release pivot bolt and release adjustment bolt

(b) Release adjustment bolt, and remove drive belt

(c) Dismantle alternator.



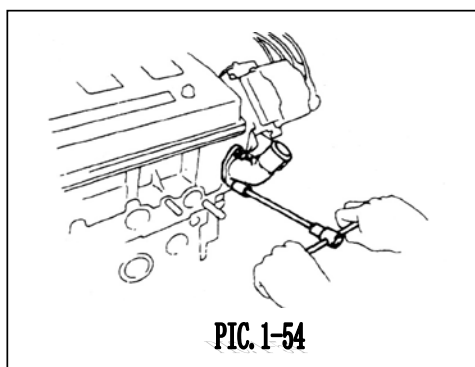
5. Dismantle exhaust manifold (pic. 1-53)

(a) Dismantle 4 bolts and upper thermal shield.

(b) Dismantle 2 bolts and exhaust manifold brace.

(c) Dismantle 5 bolts, exhaust manifold and washer.

(d) Dismantle 2 bolts and remove thermal shield from exhaust manifold.



6. Dismantle water outlet

Dismantle 2 bolts and water outlet. (pic. 1-54)

7. Dismantle bobbin bracket

8. Dismantle engine right suspension

9. Dismantle water inlet and thermostat seat

(a) Dismantle water temperature sensor connector.

(b) Dismantle 2 cooling water bypass hose.

(c) Dismantle bolt, 2 nuts, water inlet and thermostat seat.

10. Dismantle choke valve body

11. Dismantle air inlet manifold brace

Dismantle 2 bolts and air inlet manifold brace.

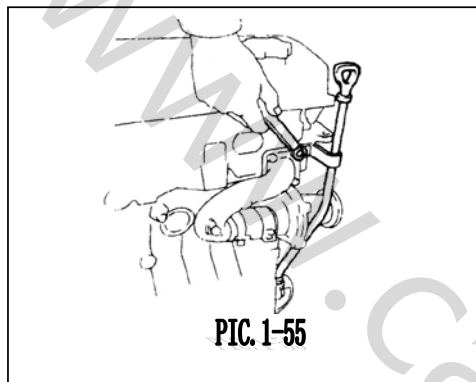
12. Dismantle cooling water bypass hose

13. Dismantle engine harness

Dismantle 2 nuts, and remove engine harness.

14. Dismantle fuel distribution pipe and fuel injection nozzle

15. Dismantle fuel injection hose from fuel distribution pipe



16. Dismantle air inlet manifold

Dismantle 7 bolts, 2 nuts, earthing conductor, air inlet manifold and washer.

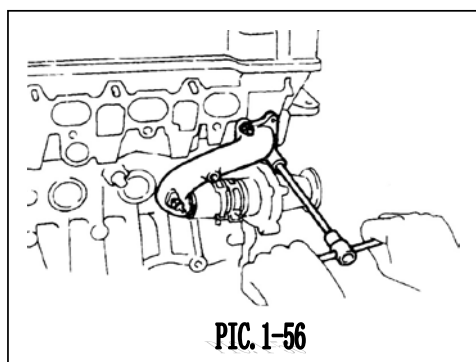
17. Dismantle oil level meter and its conduit

(pic. 1-55)

(a) Dismantle fastening bolt.

(b) Pull out oil level meter and its conduit.

(c) Dismantle O-ring from oil level meter conduit.



18. Dismantle water pump

(a) Dismantle 2 nuts which fix water pump inlet pipe onto cylinder head. (pic. 1-56)

(b) Disconnect water inlet hose from water pump, and dismantle water pump inlet pipe and its washer.

19. Dismantle spark plug

20. Dismantle cylinder head cover

Dismantle 4 lock nuts, bell washer, cylinder head cover and its gasket.

21. Dismantle #3 & #2 timing belt hood

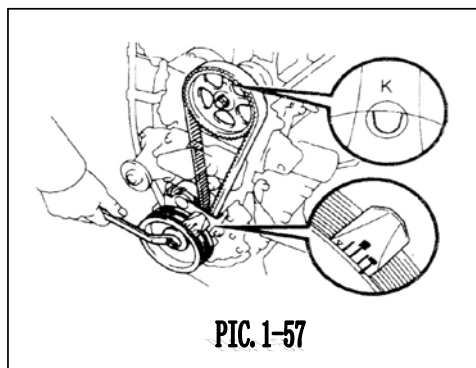
Dismantle 6 bolts 与 timing belt hood.

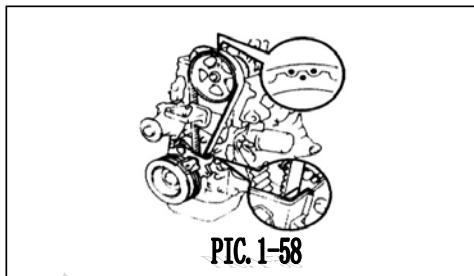
22. Set #1 cylinder as TDC of compression stroke

(a) Rotate crankshaft belt pulley and align belt pulley notch with timing mark "0" on #1 timing belt hood.

(b) Check if the "K" mark on camshaft timing belt pulley aligns with timing mark on bearing cap. (pic. 1-57)

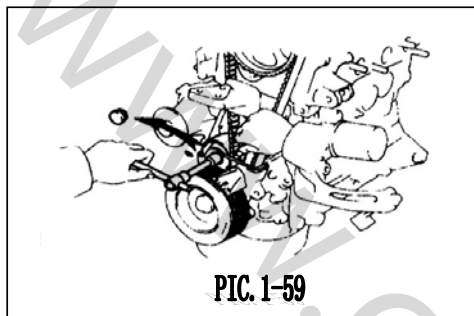
If not, rotate crankshaft 1 turn (360°).





23. Dismantle timing belt from camshaft timing belt pulley

(a) Align marks on timing belt and camshaft belt pulley. Align matching mark on timing belt with end of #1 timing belt hood. (pic. 1-58)



(b) Remove rubber O-ring from #1 timing belt hood.

(c) Unscrew tightening bolt on belt tensioner and move tensioner leftmost, and fix temporarily.

(pic. 1-59)

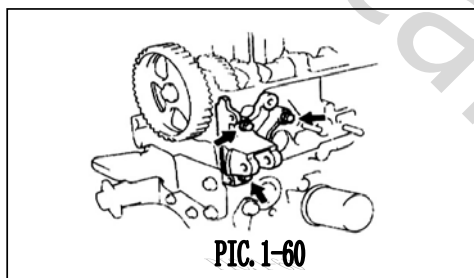
(d) Dismantle belt from camshaft timing belt pulley.

Note:

- . Support timing belt, avoid gearing between crankshaft timing belt pulley and timing belt from displacement.

- . Pay attention to avoid any objects falling into #1 timing belt hood.

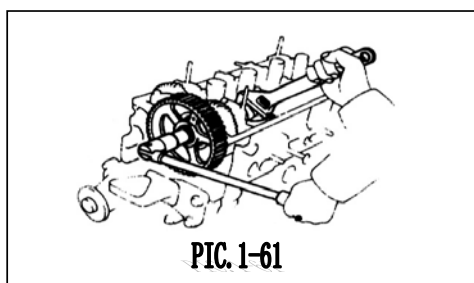
- . Keep belt from contacting oil, water or dust.



24. Dismantle generator bracket

Dismantle 3 bolts and generator bracket. (pic. 1-60)

25. Dismantle camshaft timing belt pulley



Fix hexagon part of camshaft with spanner, then dismantle bolt and timing belt pulley. (pic. 1-61)

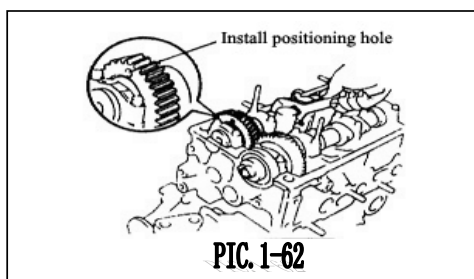
Note: Pay attention avoid damaging cylinder head with spanner.

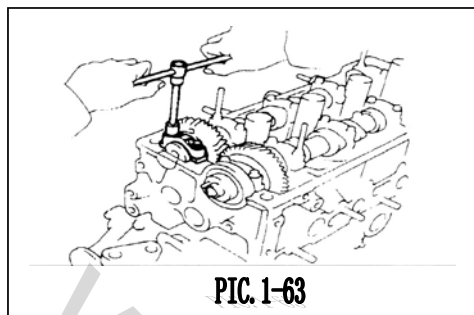
26. Dismantle camshaft

Note: Due to small axial clearance on camshaft, keep camshaft in horizontal when dismantle. If failed, the part of cylinder head that bears axial thrust may crack or damage, and cause consequently camshaft jammed or break. Following steps shall be carried out to prevent this situations.

A. Dismantle air inlet camshaft

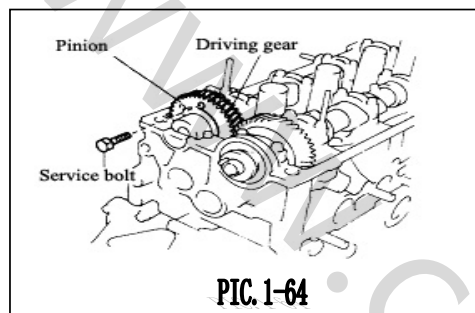
(a) Rotate camshaft pulley, keep holes on pinion upwards (make pinion and driving gear gearing) (pic. 1-62)





Hint: Above state allows the #1 and #3 cylinder cam noses of air inlet camshaft evenly pressed on their valve tappets

- (b) Dismantle two bolts and #1 bearing cap (pic. 1-63)



- (c) Use a service bolt to position pinion of air inlet camshaft against driving gear. (pic. 1-64)

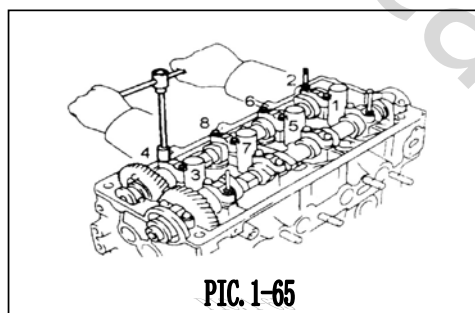
Recommended service bolt:

Thread dia.: 6mm

Pitch : 1.0mm

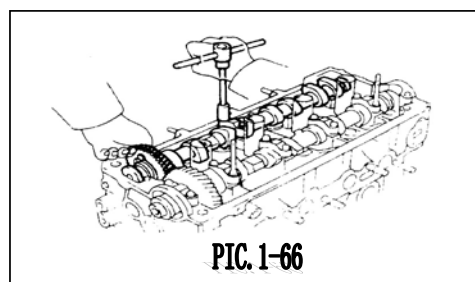
Bolt Length: 16-20mm

Hint: When dismantle camshaft, make sure torsion spring force on pinion is eliminated with above operation



- (d) Evenly unscrew and remove 8 bearing cap bolt as illustrated sequence. (pic. 1-65)

- (e) Remove 4 bearing caps and air inlet camshafts.

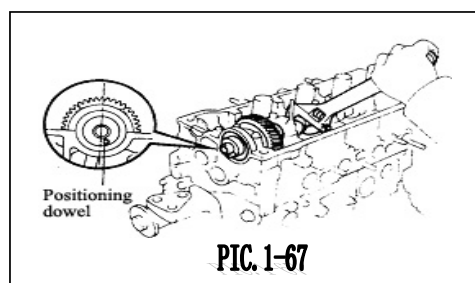


Hint: If the camshaft was not lifted in horizontal, use 2 bolts to re-install #3 bearing cap. Then lift up camshaft gear, unscrew and remove bearing cap bolt alternatively.

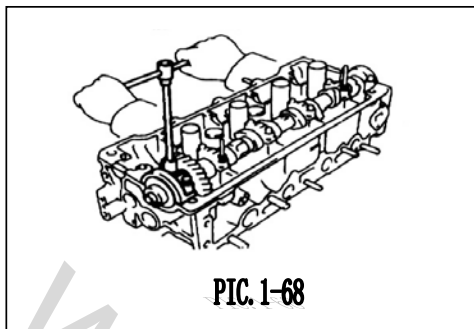
Note: Do not use other tools to pry or forcing the camshaft. (pic. 1-66)

B. Dismantle air outlet camshaft

- (a) Position air outlet camshaft, make its locating dowel the position slightly CCW to the vertical axis of camshaft. (pic. 1-67)

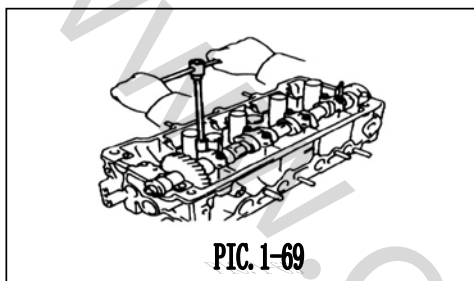


Hint: Above angle allows the #1 and #3 cylinder cam noses of air outlet camshaft evenly push their valve tappets.

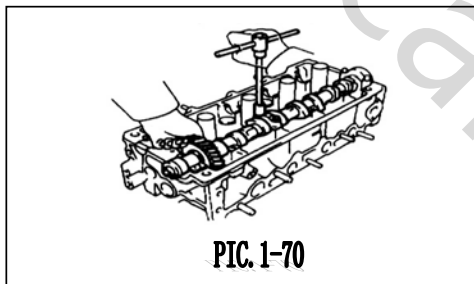


- (b) Dismantle 2 bolts, #1 bearing cap and oil seal.
(pic. 1-68)

Note: If #1 bearing cap can not be dismantled by hand, please do not dismantle it with strong force, keep it there without bolt.

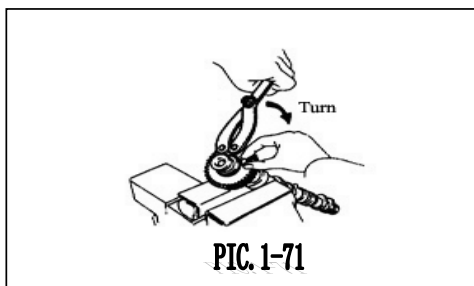


- (c) Unscrew and dismantle 8 bearing cap bolts evenly in different time as illustrated sequence.
(pic. 1-65)
- (d) Dismantle 4 bearing caps and air outlet camshaft.
(pic. 1-69)



Hint: If the camshaft was not lifted in horizontal, use 2 bolts to re-install #3 bearing cap. Then lift up camshaft gear, unscrew and remove 2 bearing cap bolts alternatively.

Note: Do not use other tools to pry or forcing the camshaft. (pic. 1-70)



27. Dismantle air inlet camshaft

- (a) Clamp hexagon part of camshaft on vice. (pic. 1-71)

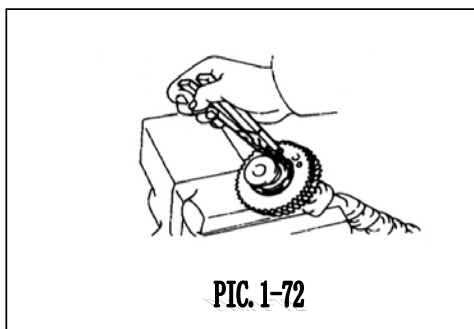
Note: Do not damage camshaft.

- (b) Use special service tool to rotate pinion CW, then dismantle service bolt. (pic. 1-71)

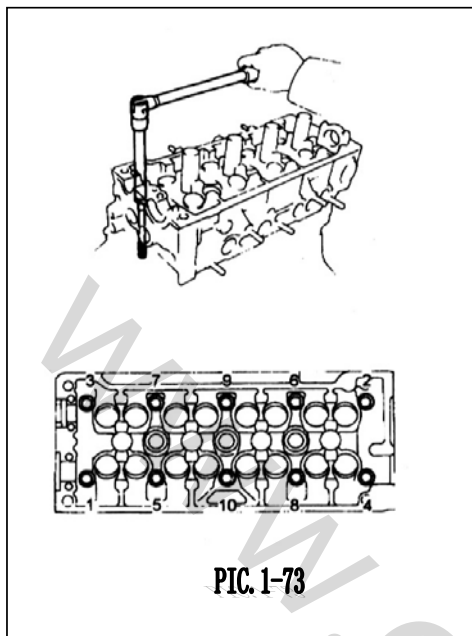
- (c) Remove snap ring with snap ring clamp (pic. 1-72)

- (d) Remove following components:

- (1) Wave washer
- (2) Camshaft pinion
- (3) Camshaft anti-backlash spring



28. Dismantle Semi-circle plug



29. Dismantle cylinder head

(a) Use special service tool, evenly unscrew and remove 10 cylinder head bolts in several times as illustrated sequence. (pic. 1-73)

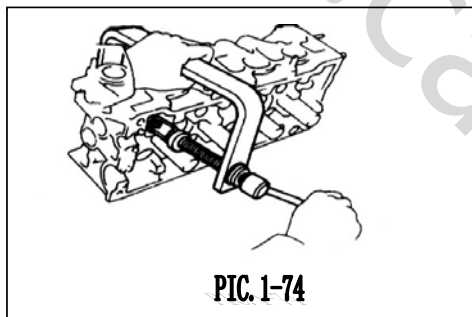
Note: Incorrect sequence of removing bolts may cause cylinder head warp or break.

(b) Dismantle 10 plate washers.

(c) Lift cylinder head up from locating dowel of the cylinder body, place cylinder head onto a wooden plate above work bench.

Hint: If the cylinder head is hard to be lifted, pry between cylinder head and cylinder flange a little bit with screwdriver.

Note: Pay special attention not to damage the contact surface between cylinder head and cylinder body.



II. Dismantle

1. Dismantle valve tappet

Hint:

Place valve tappet as per correct sequence.

2. Dismantle valve

(a) Use special service tool to compress valve spring and remove 2 positioning locate plate.

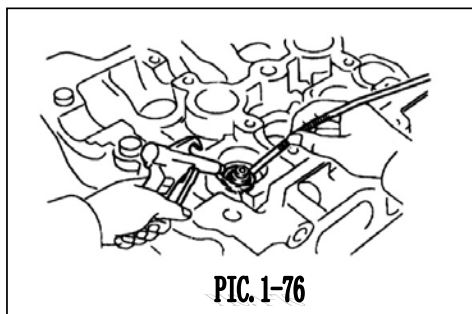
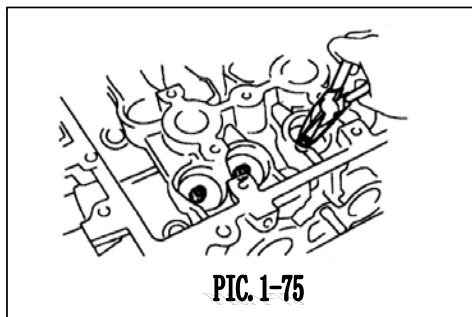
(pic. 1-74)

(b) Dismantle following components:

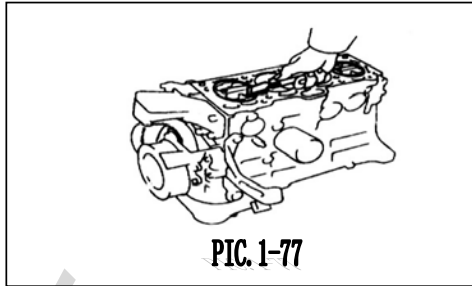
- pring seat
- Valve spring
- Valve

(c) Remove Valve oil seal with a sharp nose pliers.

(pic. 1-75)



(d) Purge dismantled spring seat with compressed air and magnetic rod. (pic. 1-76)

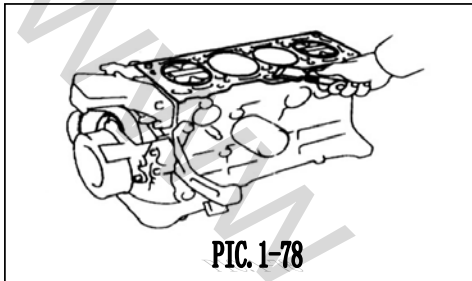


Hint: Place valve per correct order, valve spring, spring seat and spring bed plate.

III. Inspection

1. Clean piston top face and cylinder body

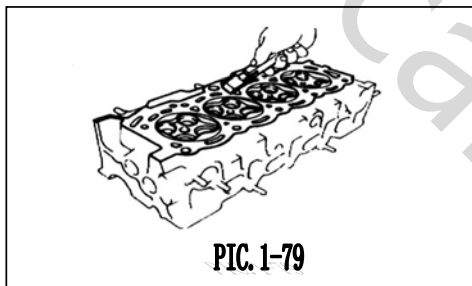
(a) Rotate crankshaft, rise each piston to top dead center (TDC). remove all wobble from top of piston with a liner scraper. (pic. 1-77)



(b) Clear all liner on surface of cylinder body with a liner scraper. (pic. 1-78)

(c) Purge wobble and engine oil from bolt hole with compressed air.

Caution: When using high pressure compressed air, take care to protect your eyes.

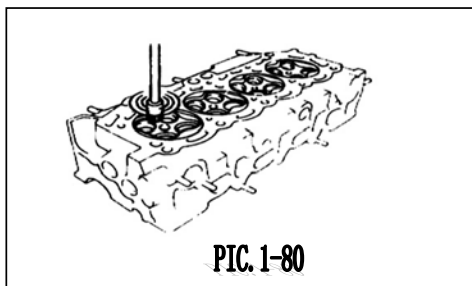


2. Clean cylinder head

A. Remove liner material

Clear all liner material from contact surface of cylinder body with a liner scraper. (pic. 1-79)

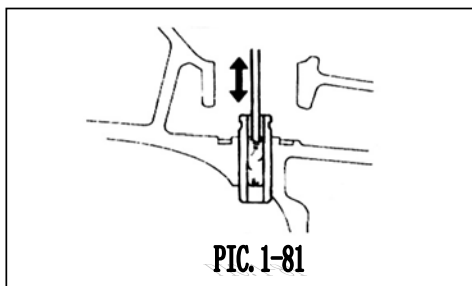
Note: Pay special attention not to scratch the contact face of cylinder body.



B. Clean combustion chamber

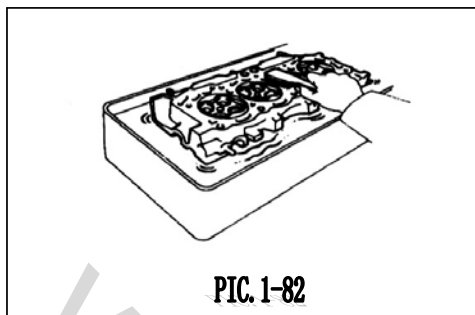
Clear all wobble from combustion chamber with steel wire brush. (pic. 1-80)

Note: Pay special attention not to scratch contact surface of cylinder body.



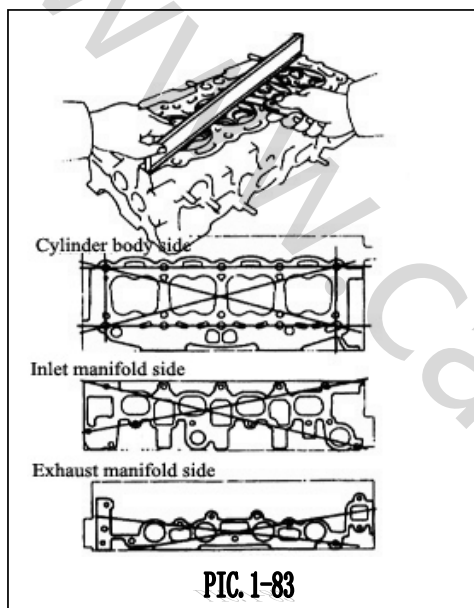
C. Clean valve conduit bushing

Clean all conduit bushing with valve conduit bushing brush and solvent. (pic. 1-81)



D. Clean cylinder head

Clean cylinder head thoroughly with soft brush and solvent. (pic. 1-82)



3. Inspect cylinder head

A. Check flatness

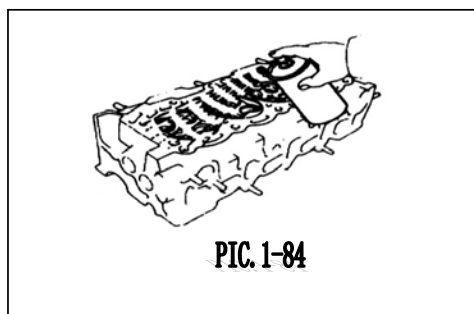
Measure if there is warp between cylinder body and manifold contact surface with precise ruler and feeler gage. (pic. 1-83)

Max. warp:

Cylinder body side: 0.05mm

Manifold side : 0.10mm

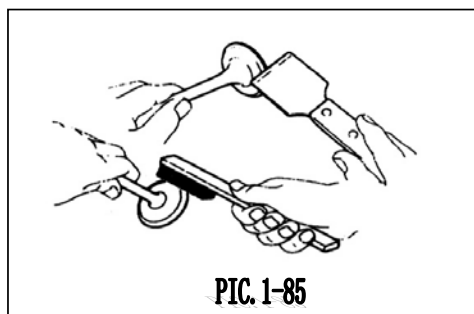
If the warp had exceeded max. value, change cylinder head.



B. Check for crack

Inspect combustion chamber, air inlet, air outlet and cylinder body surface with dye penetrant for cracks. (pic. 1-84)

Change cylinder head if there is any cracks.

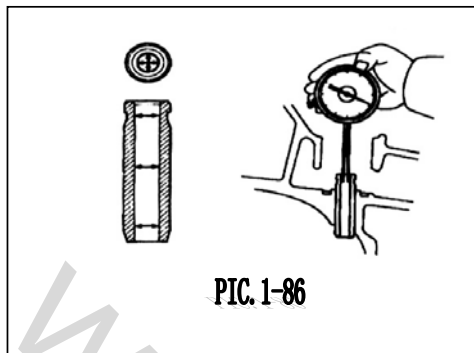


4. Clean valve

(a) Clean wobble from valve end with liner scraper.

(b) Clean valve thoroughly with steel wire brush.

(pic. 1-85)



5. Inspect valve stem and conduit bushing

(a) Measure I.D. of conduit bushing with caliper gauge. (pic. 1-86)

Bushing I.D.: 6.010-6.030 mm

(b) Measure valve stem dia. with screw micrometer.

Valve stem dia.:

Air inlet: 5.970-5.985mm

Air outlet: 5.965-5.980mm

(c) Deduct valve stem dia. value from conduit bushing I.D. value.

Standard oil clearance:

Air inlet: 0.025-0.060mm

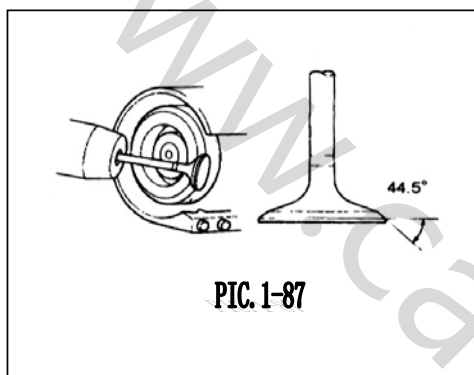
Air outlet: 0.030-0.065mm

Max. oil clearance:

Air inlet: 0.08mm

Air outlet: 0.10mm

If the clearance exceeds max. value, change valve and conduit bushing.

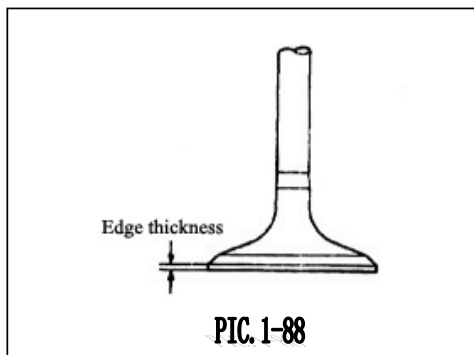


6. Check and grind valve

(a) Grind valve till dent or wobble removed.

(b) Check valve for ground to correct valve taper. (pic. 1-87)

Valve taper: 45.5°.



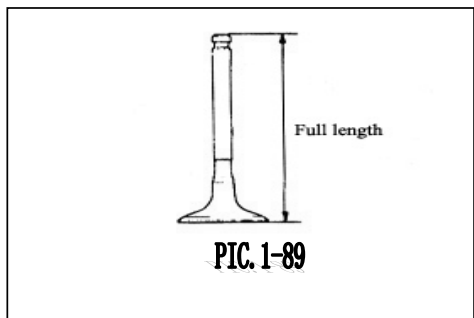
(c) Check valve head's edge thickness. (pic. 1-88)

Standard edge thickness: 0.8-1.2mm

Min. edge thickness: 0.5mm

If the edge thickness is smaller than min. value, change Valve.

(d) Check full length of valve (pic. 1-89).



Standard full length:

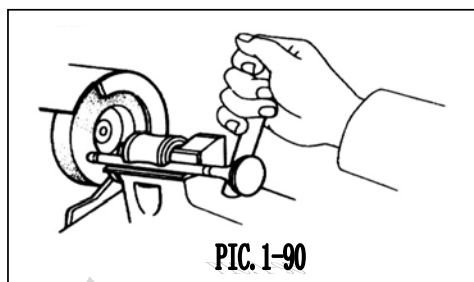
Air inlet: 87.45 mm

Air outlet: 87.84 mm

Min. full length:

Air inlet: 86.95 mm

Air outlet: 87.35 mm

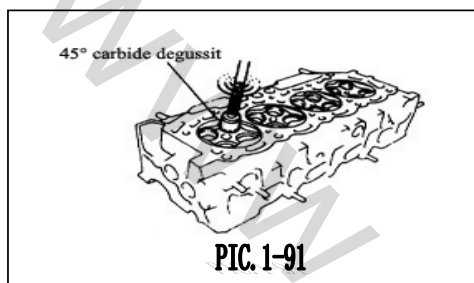


If the valve's full length is smaller than min. value, change valve.

(e) Check abrasion on end surface of valve stem.

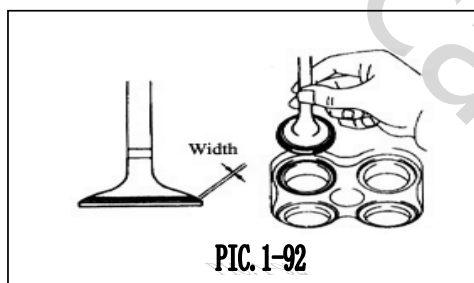
If the valve stem end is abraded, grind end with grinding wheel or change valve (pic. 1-90)

Note: Do not grind over beyond value.



7. Check and clean valve seat

(a) Use 45° carbide degussit to plane the valve seat. Remove suitable amount of metal to clear valve seat. (pic. 1-91)



(b) Check valve seat position.

Apply a thin layer of Prussian blue (or white lead) on surface of valve, slightly press valve to valve seat, do not rotate valve. (pic. 1-92)

(c) Check following items on valve surface and valve seat:

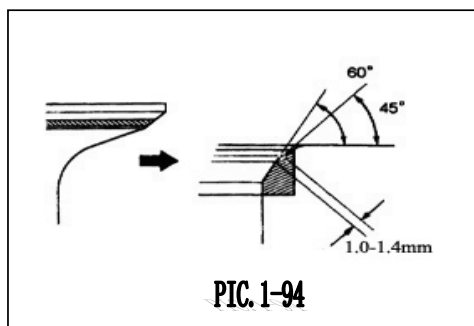
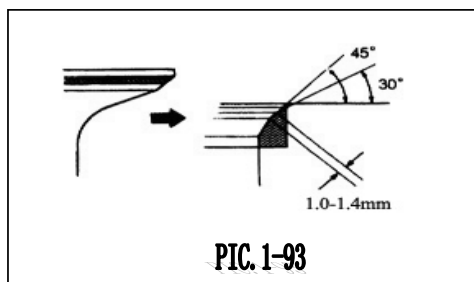
. If the blue dye on valve surface is 360° centered at the valve center, then the valve is co-axial, or the valve must be changed.

. If the blue dye on valve seat is 360° centered at the valve center, then the conduit is co-axial with the surface, or the valve must be changed.

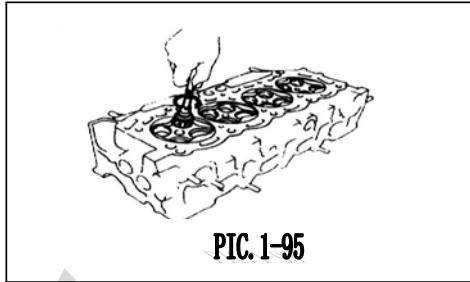
. Check if contract face of bed seat is in the center of valve surface, its width shall be: 1.0-1.4mm (pic. 1-93)

Or change valve seat ring per following method:

(1) If the seat is too high from the valve surface, rectify seat ring with 30° & 45° tool (pic. 1-93)

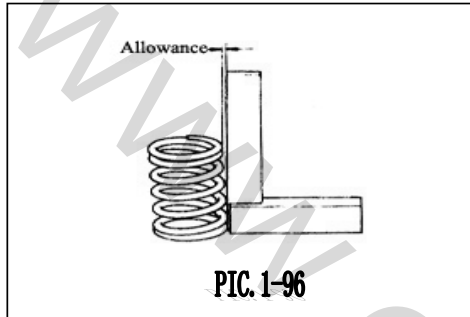


(2) If the seat is too low from the valve surface, rectify seat with 60° and 45°. (pic. 1-94)



(d) Manual grind valve and valve seat with grinding material. (pic. 1-95)

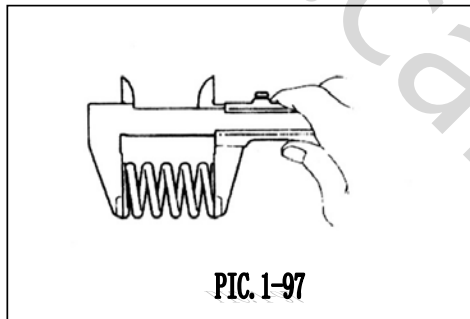
(e) After manual grind, clear valve and valve seat.



8. Check valve spring

(a) Measure perpendicularity of valve spring with steel angle gauge. (pic. 1-96)

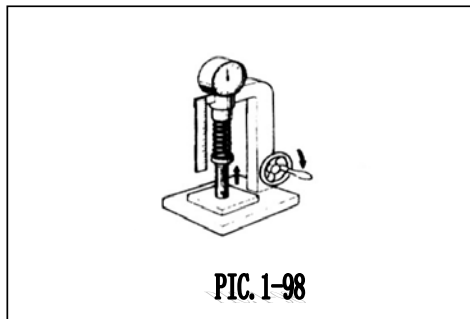
If the tolerance exceeds max. value, change valve spring.



(b) Measure free length of valve spring with vernier caliper. (pic. 1-97)

Free length: 39 ± 0.13 mm

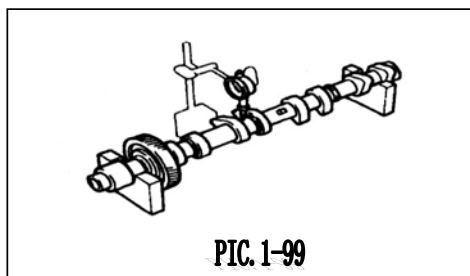
If the free length disaccords with specification, change valve spring.



(c) Use spring tester to measure tensile force of valve spring at specified install length. (pic. 1-98)

**Install tensile (Length at 31.7mm):
157~174N)**

If the installation tensile force disaccords with specification, change valve spring.



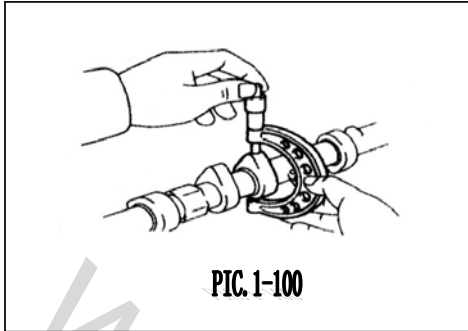
9. Check camshaft and bearing

A. Check radial runout of camshaft

(a) Put camshaft on V-block. (pic. 1-99)

(b) Use micrometer to measure circumferential radial runout at middle journal.

Max. circumferential radial runout: 0.03mm



If the circumferential radial runout is bigger than max. value, change camshaft.

B. Check cam nose

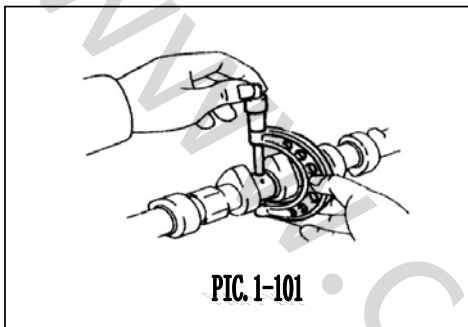
Measure cam nose height with screw micrometer. (pic. 1-100)

Standard **cam nose height:**

air inlet: 41.71~41.81mm

air outlet: 41.96-42.06mm

If the height of cam nose disaccords with specification, change camshaft.



C. Check camshaft journal

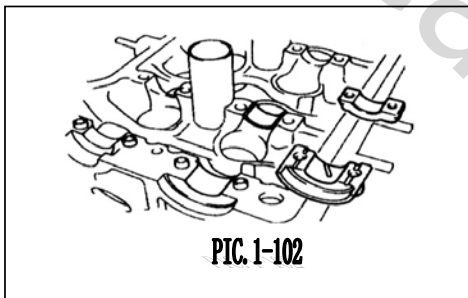
Use screw micrometer to measure the dia. of journal(pic.1-101).

Journal dia.:

#1 air outlet: 24.949-24.965mm

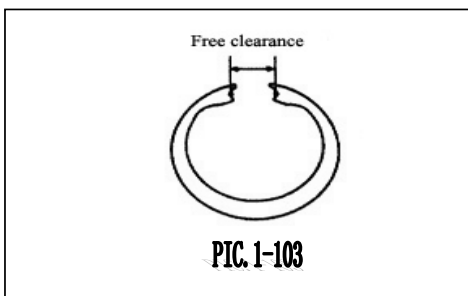
Others: 22.949~22.965mm

If the journal dia. disaccords with specification, check oil clearance.



D. Check cam bearing.

Check bearing for peeling or burn, if the bearing is damaged, change the whole bearing cap and cylinder head(pic.1-102).

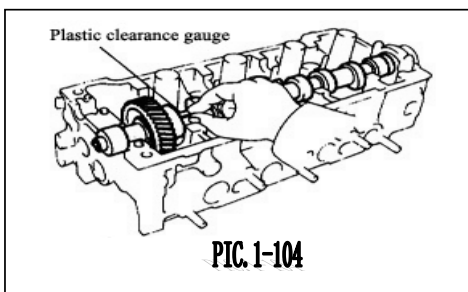


E. Check camshaft anti-backlash spring

Use vernier caliper to measure free distance (pic.1-103) on both ends of spring.

Free distance: 17.0-17.6mm

If the free distance disaccords with specification, change anti-backlash spring.

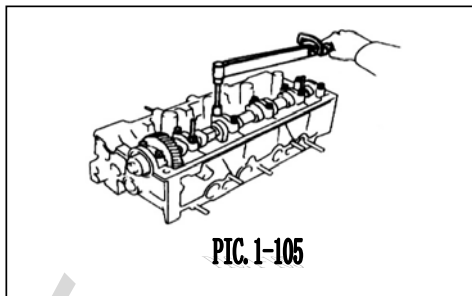


F. Check oil clearance on camshaft journal

(a)Clear bearing cap and camshaft journal.

(b)Put camshaft on cylinder head.

(c)Put a plastic clearance gauge on each camshaft journa(pic.1-104).

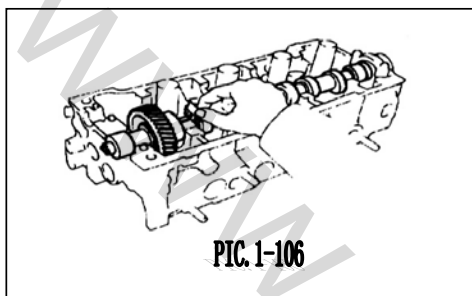


(d) Install bearing cap (pic. 1-105)

Torque: 11N.m

Note: don't rotate camshaft.

(e) Dismantle bearing cap.



(f) Measure clearance with a plastic clearance gauge at the widest position (pic. 1-106).

Standard oil clearance: 0.035-0.072mm

Max. oil clearance: 0.10mm

If the oil clearance is bigger than max. value, change camshaft. If necessary, change the whole set of bearing cap and cylinder head.

(g) Remove all plastic clearance gauge.

G. Check camshaft axial clearance

(a) Install camshaft

(b) Use micrometer to measure axial clearance while move camshaft forward and backward (pic. 1-107).

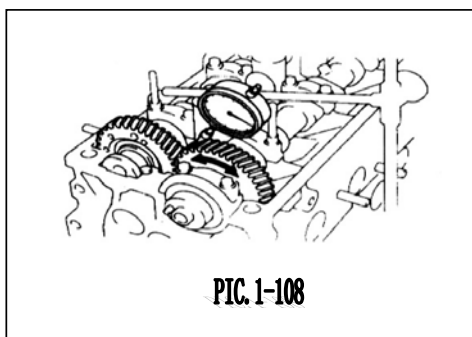
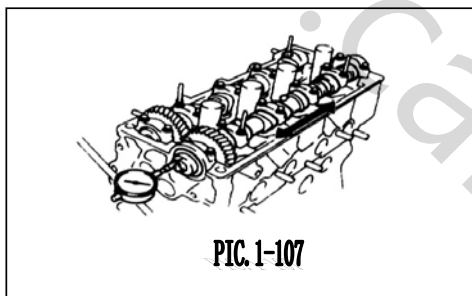
Standard axial clearance:

Air inlet: 0.030-0.085mm.

Air outlet: 0.035-0.090mm

Max. axial clearance: 0.11mm

If the axial clearance exceeds max. value, change camshaft. If necessary, change bearing cap and cylinder head.



H. Check camshaft gear backlash

(a) Install camshaft, but not air outlet cam pinion

(b) Measure backlash with micrometer (pic. 1-108).

Standard backlash: 0.020-0.200mm

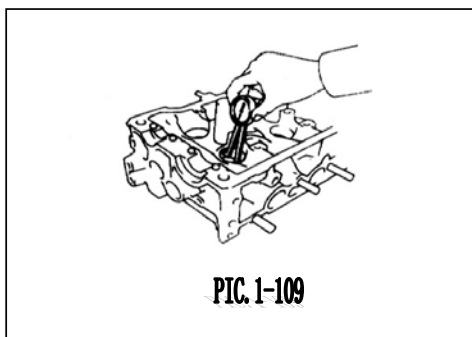
Max. backlash: 0.30mm

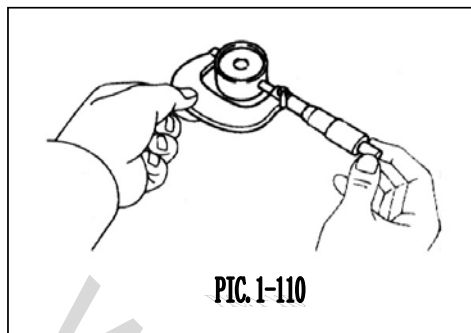
If the backlash is bigger than max. value, change camshaft.

10. Check valve tappet and tappet aperture

(a) Use caliper gauge to measure cylinder head tappet aperture (pic. 1-109).

Tappet aperture: 31.000-31.025mm





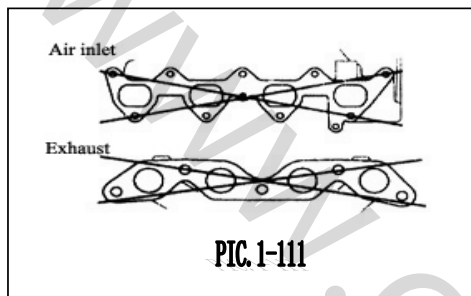
(b) Measure tappet dia. with screw micrometer(pic.1-110).

Tappet dia.: 30.966-30.976mm

(c) Deduct tappet dia. value from tappet aperture value.

Standard oil clearance: 0.024-0.059mm
Max. oil clearance: 0.07mm

If the oil clearance is bigger than max. value, change tappet. Change cylinder head if necessary.



11. Check air inlet and exhaust manifold

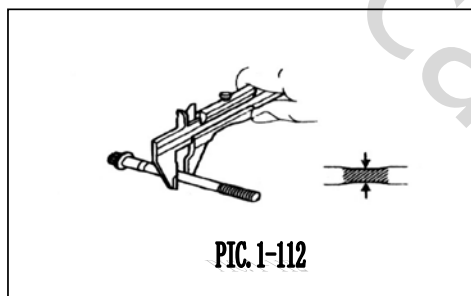
Use precise ruler and thickness gauge to measure if the contact face of cylinder head warp(pic.1-111).

Max. warp:

Air inlet manifold: 0.20mm

Exhaust manifold: 0.30mm

If the warp is bigger than max. value, change manifold.

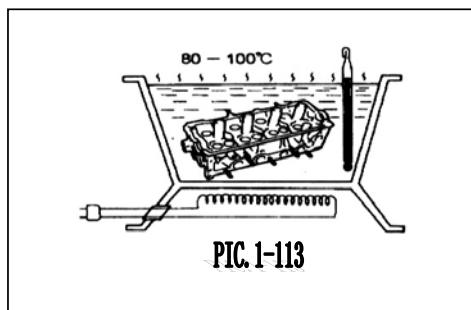


12. Check cylinder head bolt(pic.1-112)

Standard O.D.: 8.5mm

Min. O.D.: 8.3mm

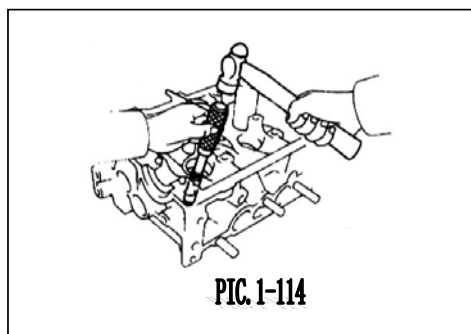
If the O.D. is less than min. value, change bolt.



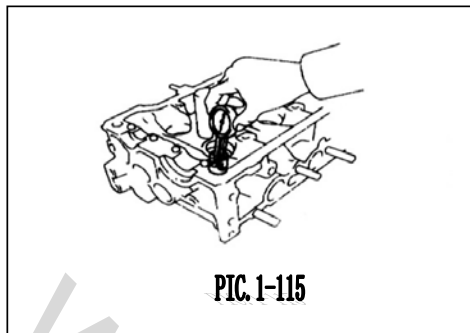
IV. Change

1. Check valve conduit bushing

(a) Gradually warm up cylinder head to 80~100°C (pic.1-113) .



(b) Slightly punch out conduit bushing with a special service tool and hammer(pic.1-114).



(c) Measure liner I.D. of cylinder head with caliper gauge (pic.1-115).

Standard valve conduit aperture (cold state):

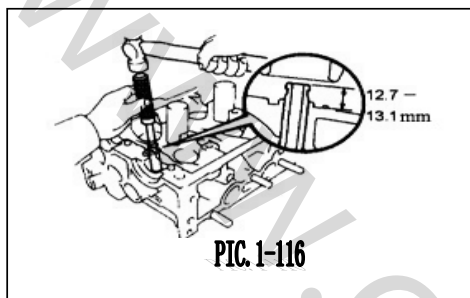
11.000-11.027mm

(d) Select new conduit bushing (Standard value or 0.05 larger size).

If the I.D. of cylinder head liner is bigger than 11.027mm, machine liner I.D. to dimension:

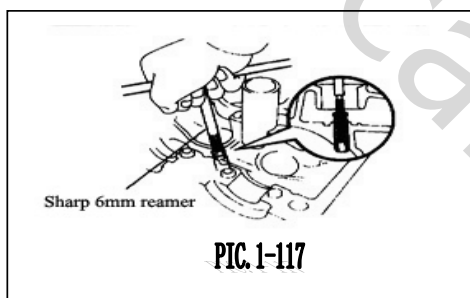
11.050-11.077mm

If the I.D. of cylinder head liner is bigger than 11.077mm, change cylinder head.

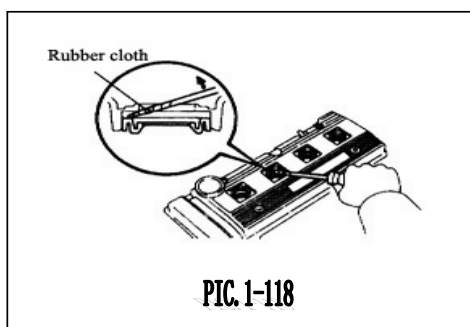


(e) Gradually warm up cylinder head to 80~100°C.

(f) Strike in new conduit bushing with special service tool and hammer, till its extension from cylinder head is 12.7-13.1mm (pic.1-116).



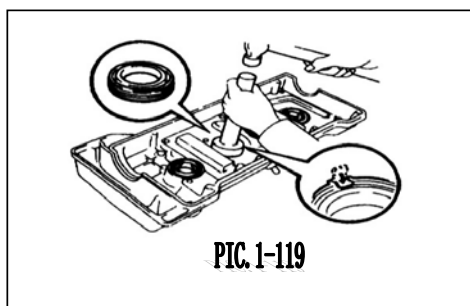
(g) Use sharp 6mm reamer to ream conduit bushing, so that the clearance between conduit bushing and valve stem reaches standard ((pic.1-117) refer to above step c).



2. Change oil seal of cylinder cover

(a) Bend up small tongue on ventilation flap preventing oil seal from slip out (pic.1-118).

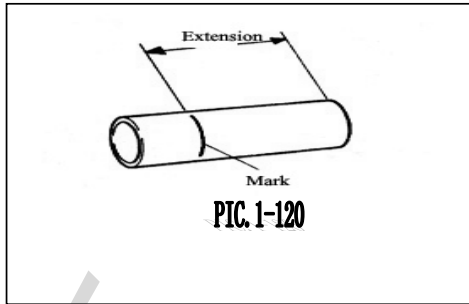
(b) Pry out oil seal with screwdriver.



(c) Slightly strike in new oil seal with special service tool and hammer as illustrated (pic.1-119).

(d) Apply a thin layer of all purpose grease on edge of gasket.

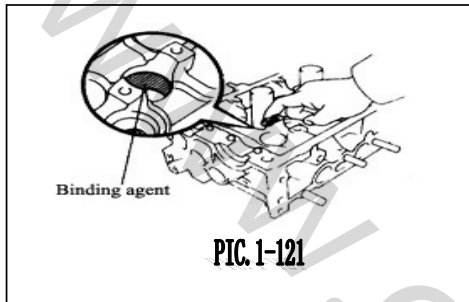
(e) Resume small tongue on ventilation flap to home position.



V. Re-assemble

Hint:

- . Thoroughly clean all parts to be assembled
- . Before assemble parts, apply new engine oil on all sliding and rotating surfaces
- . Change all gaskets and oil seal with new ones

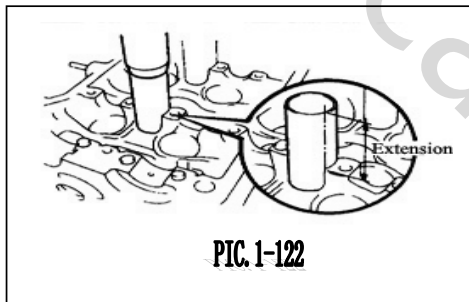


1. Install spark plug pipe

Hint: When using new cylinder head, install spark plug pipe

- (a) Standard distance between mark on spark plug and edge.

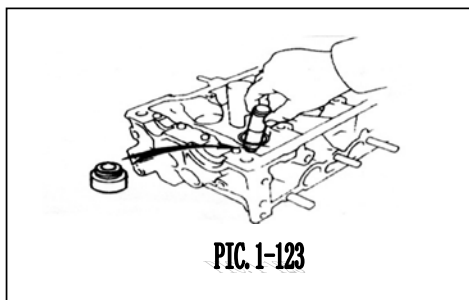
Standard extension: 46.8-47.6mm(pic.1-120)



- (b) Apply binding agent inside spark plug bore on cylinder head(pic.1-121).

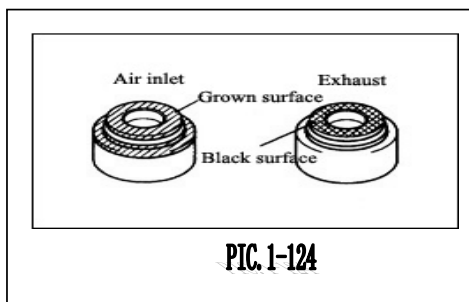
- (c) Use presser to press in new spark plug pipe, till the extension out from camshaft bearing cap level on cylinder head is 46.8-47.6mm(pic.1-122).

Note: Measure extension during pressing, to prevent from excessive press in of new spark plug.

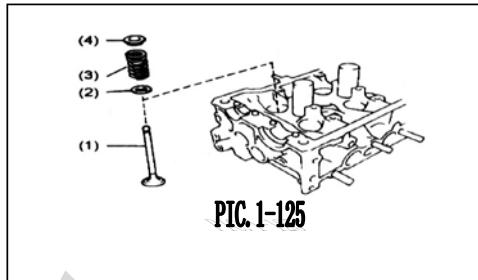


2. Install valve

- (a) Use special service tool to press in new valve oil seal(pic.1-123).

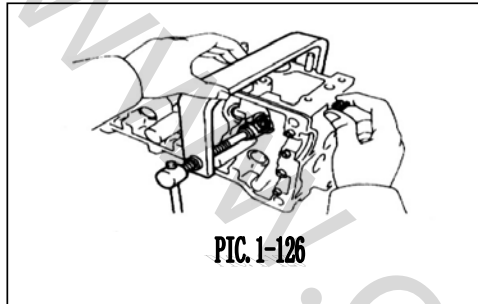


Hint: Valve oil seal at air inlet is gray, valve oil seal at air outlet is black(pic.1-124).

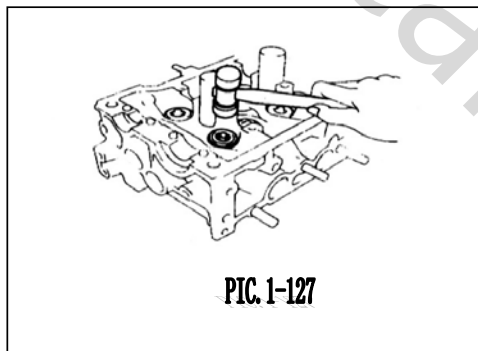


(b) Install following parts(pic.1-125).

- (1) Valve
- (2) Spring seat
- (3) Valve spring
- (4) Spring seat



(c) Use special service tool to compress valve spring, place 2 lock pieces around valve stem(pic.1-126).



(d) Strike top of valve stem with plastic overlay hammer, to ensure good matching(pic.1-127).

3. Install valve tappet and shims

- (a) Install valve tappet and shims.
- (b) Check valve tappet with hand, the valve tappet shall rotate flexibly.

VI. Installation

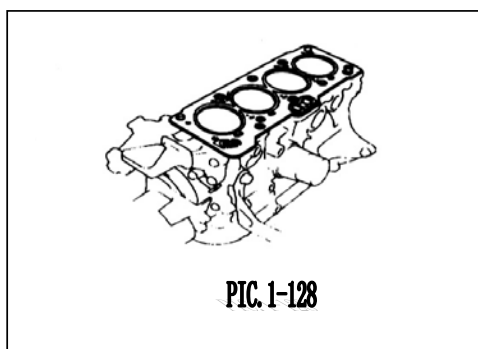
1. Install cylinder head

A. Place cylinder head upon cylinder body

- (a) Place new cylinder head liner on cylinder body in position(pic.1-128).

Note: Pay attention to install direction. Keep the marked (character) side upward

- (b) Place cylinder head on cylinder head liner in position.

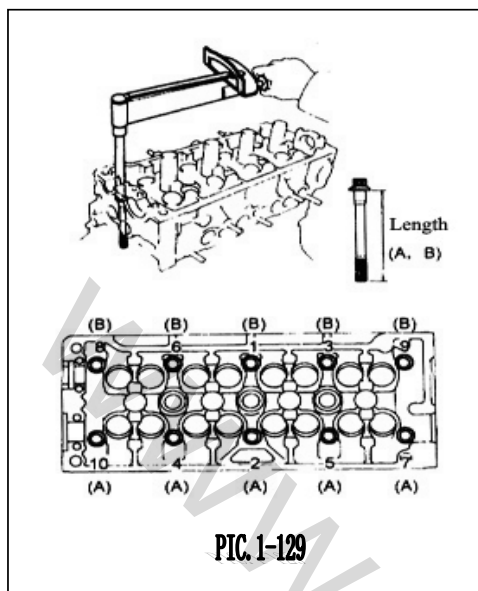


B. Install cylinder head bolt

Hint:

- . Do not use bolts with crack or distortion.

- (a) Apply a thin layer of engine oil on end and thread of cylinder head bolt.



(b) Use special service tool to tighten the 10 cylinder head bolts in different time as illustrated sequence(pic.1-129).

Torque: 90N.m

If the bolt disaccords with torque specification, change.

Hint: The length of cylinder head bolts shall be 90mm and 108mm, 90 mm bolt (B) used on air inlet manifold side. 108 mm bolt (A) used on air outlet manifold side.

2. Assemble air inlet camshaft

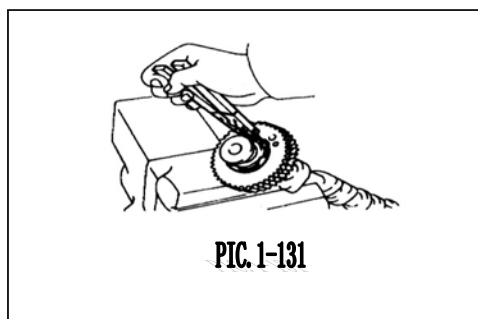
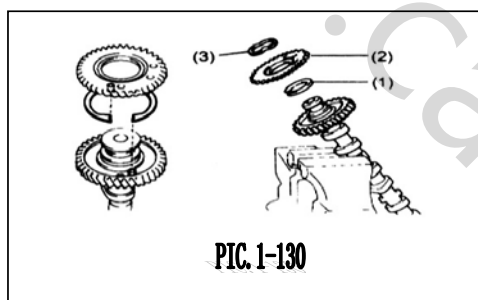
(a) Clamp hexagon head of camshaft on bench vice(pic.1-130).

Note: Pay attention not to damage camshaft.

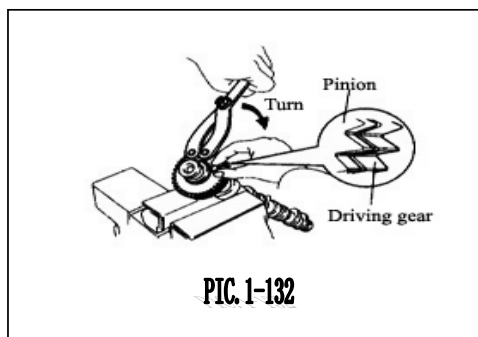
(b) Install following parts:

- (1) Camshaft gear circlip
- (2) Camshaft pinion
- (3) Wave washer

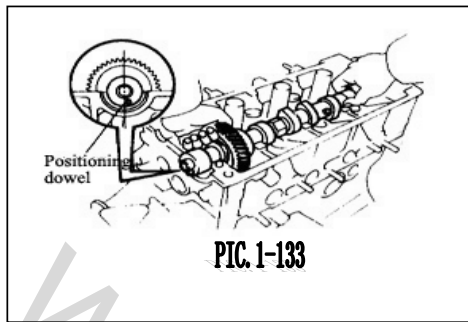
Hint: Align pin on gear with end of gear circlip.



(c) Install snap ring with snap ring pliers(pic.1-131).

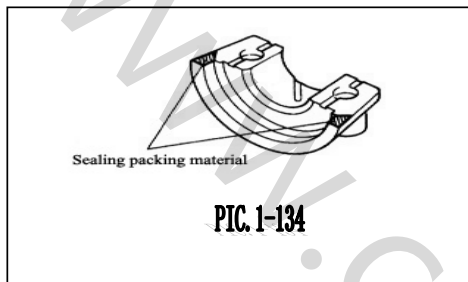


(d) Use special service tool to rotate camshaft pinion CW, align driving gear of camshaft with pinion hole, install service bolt(pic.1-132).



3. Install air inlet and air outlet camshaft

Note: Due to small axial clearance on camshaft, keep camshaft in horizontal when dismantle. If failed, the part of cylinder head that bears axial thrust may crack or damage, and cause consequently camshaft jammed or break. Following steps shall be carried out to prevent this situations.



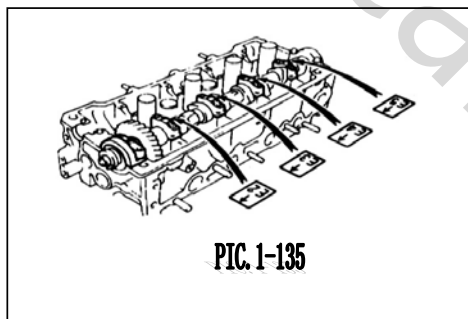
A. Install air outlet camshaft

(a) Apply all purpose grease on anti-thrust part of camshaft.

(b) Position air outlet camshaft, make its locating dowel the position slightly CCW to the vertical axis of camshaft (pic.1-133).

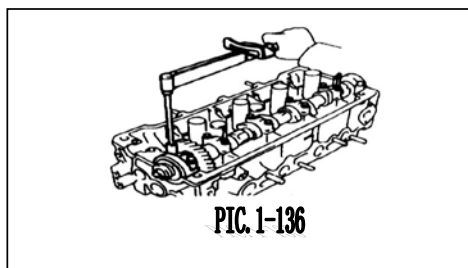
Hint: Above angle allows the #1 and #3 cylinder cam noses of air outlet camshaft evenly push their valve tappets.

(c) Clear all old packing material.



(d) Apply sealing packing material onto bearing cap as illustrated (pic.1-134).

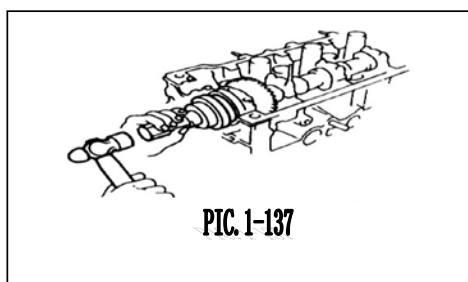
(e) Install 5 bearing caps onto suitable position (pic.1-135).



(f) Apply a thin layer of engine oil under bearing cap bolt head and thread.

(g) Tighten 10 bearing cap bolts in different times as illustrated (pic.1-136).

Torque: 11N.m

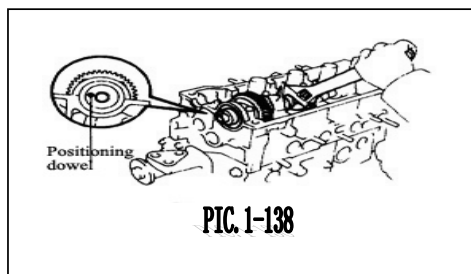


(h) Apply all purpose grease on new oil seal edge.

(i) Strike in oil seal with special service tool (pic.1-137).

Note:

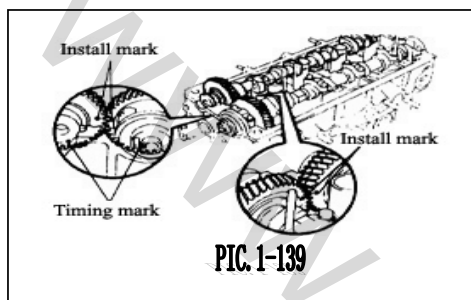
. When install oil seal, make sure the edge direction is correct.



. Insert oil seal in to deepest place of cylinder head.

B. Install air inlet camshaft

- (a) Place air inlet camshaft, make the locating dowel slightly higher than top of cylinder head (pic.1-138).
- (b) Apply grease on anti-thrust part of camshaft.

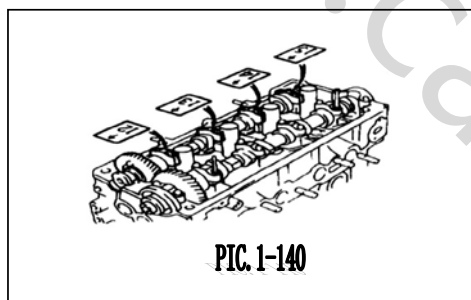


- (c) Match install mark on each gear, make air inlet camshaft gear gears with air outlet camshaft gear (pic.1-139).

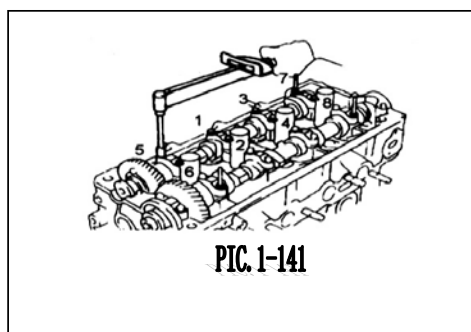
Note: As shown in figure, each gear has timing marks (for TDC), do not use these marks.

- (d) When gears are geared, fall air inlet camshaft onto bearing journal.

Hint: Above angle allows #1 and #3 cylinder cam nose of air inlet camshaft evenly push their valve tappets.



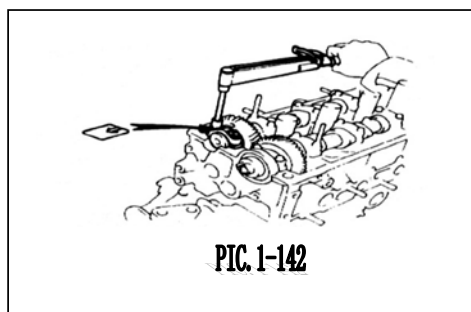
- (e) Install 4 bearing caps on suitable position (pic.1-140).



- (f) Apply a thin layer of engine oil under bearing cap bolt head and on thread.
- (g) Install and tighten 8 bearing cap bolts in several times as illustrated (pic.1-141).

Torque: 11N.m

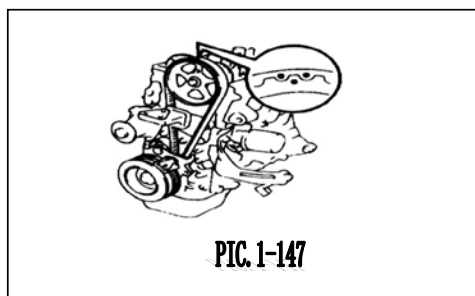
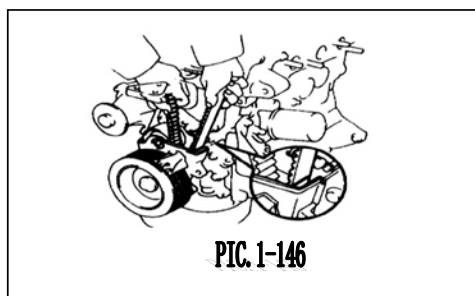
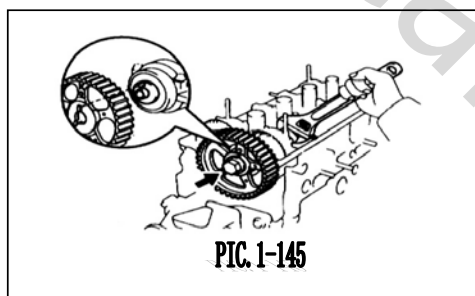
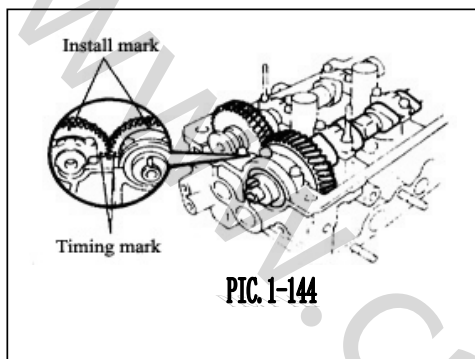
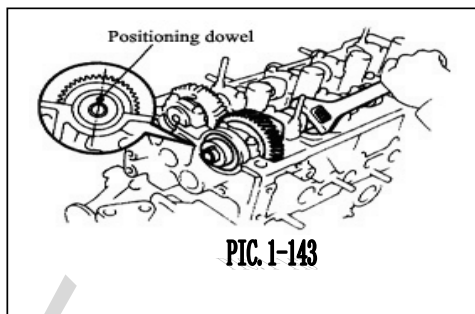
- (h) Remove service bolt.



- (i) Install #1 bearing cap with arrow mark forward (pic.1-142).

Note: If #1 bearing cap was not well matched, pry apart cylinder head and camshaft gear with screwdriver, and push camshaft gear backward.

- (j) Apply a thin layer of engine oil under bearing cap bolt head and on thread.
- (k) Install and tighten 2 bolts alternatively.

**Torque: 11N.m**

- (l) Rotate air outlet camshaft CW. Make locating dowel upward(pic.1-143).

- (m) Check if the timing mark on camshaft gear is aligned.

Hint: The install mark is located on top(pic.1-144).

4. Check and adjust valve clearance

Rotate camshaft, make cam nose upward, Check and adjust valve clearance.

valve clearance(cold state):

air inlet: 0.20~0.25mm

air outlet: 0.20-0.25mm

5. Install camshaft timing belt pulley

- (a) Align camshaft locating dowel with locating dowel notch on "K" mark site of belt pulley (with 2 locating dowels), and slide into timing belt pulley(pic.1-145).

- (b) Temporarily install timing belt pulley bolt.

- (c) Fix on hexagon head of camshaft with spanner, tighten timing belt pulley bolt.

Torque: 59N.m**6. Install AC generator bracket**

Install AC generator bracket with 3 bolts(pic.1-146).

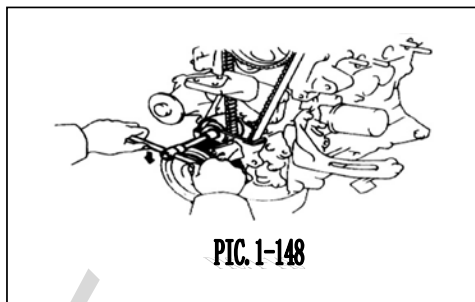
Torque: 26N.m**7. Install timing belt**

Hint:

. Check if the align mark on timing belt match with end of #1 timing belt hood mark. If not, move gearing part of timing belt pulley till match.

. Align timing belt with align mark on camshaft timing belt pulley(pic.1-147).

- (a) Wipe clean oil or water from camshaft timing belt pulley.



- (b) Install timing belt, check tension between crankshaft timing belt pulley and camshaft timing belt pulley.

8. Check Valve timing

- (a) Unscrew belt tensioner bolts (pic.1-148).

- (b) Slowly rotate crankshaft 2 turns, from TDC to TDC.

Note: Rotate crankshaft clockwise.

- (c) Check if every belt pulley is aligned with timing mark as illustrated. If the timing mark was not matched, dismantle timing belt and re-install (pic.1-149).

- (d) Tighten belt tensioner bolts.

Torque: 35N.M

- (e) Install rubber O-ring for #1 timing belt hood

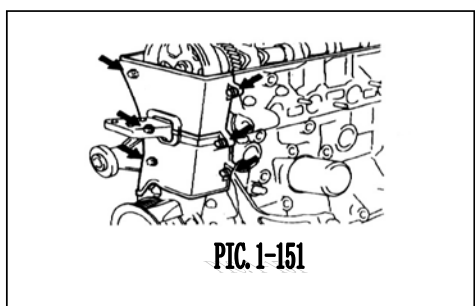
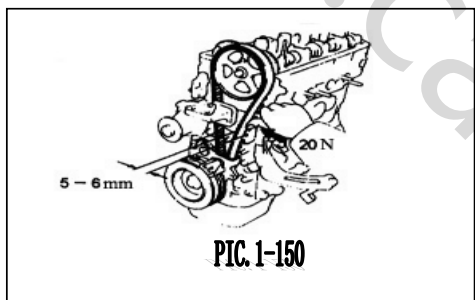
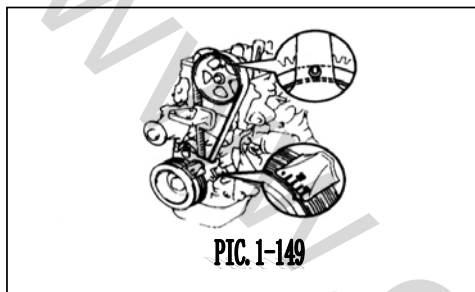
9. Reference:

Check flexibility of timing belt

Check flexibility of belt at illustrated position (pic.1-150).

Flexibility: **5-6mm at 20N**

If the flexibility disaccords with specification, re-adjust belt tensioner.



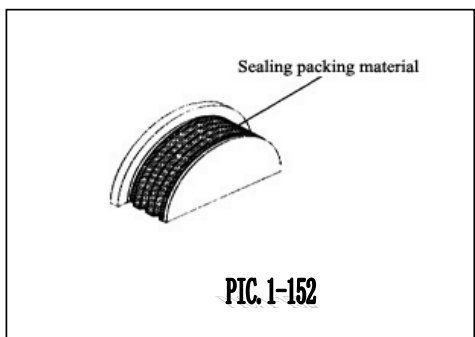
10. Install #2 & #3 timing belt hood

Install #2 & #3 timing belt hood with 6 bolts (pic.1-151).

Torque: 8N.m

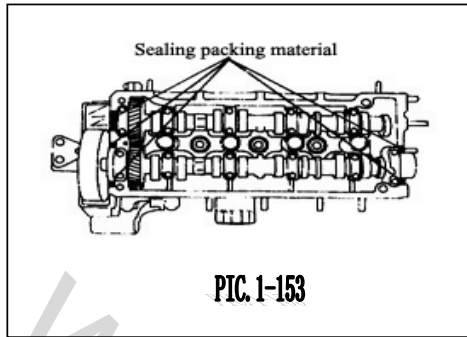
11. Install semi-circle plug

- (a) Clear all old packing material.
- (b) Apply sealing packing material for semi-circle plug (pic.1-152).
- (c) Install semi-circle plug on cylinder head.



12. Install cylinder head cover

- (a) Clear old packing material.

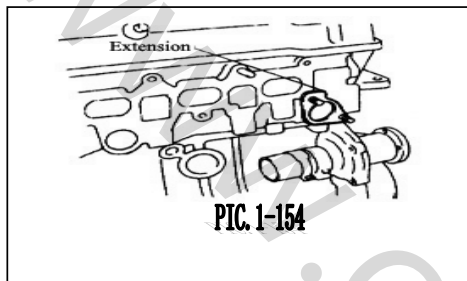


- (b) Apply sealing packing material onto cylinder head as illustrated (pic.1-153).
- (c) Install cylinder head cover gasket onto cylinder head cover.
- (d) Use 4 bellows seal and lock nuts to install on cylinder head cover.

Torque: 12N.m

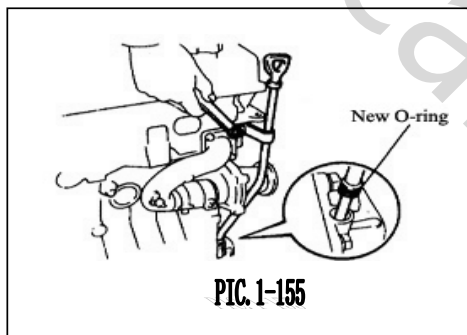
13. Install spark plug

14. Install water supply pipe for water pump



- (a) Place a new gasket on cylinder head, keep the extended part upward.
- (b) Connect water pump supply hose to water pump.
- (c) Install water pump supply pipe with 2 nuts (pic.1-154).

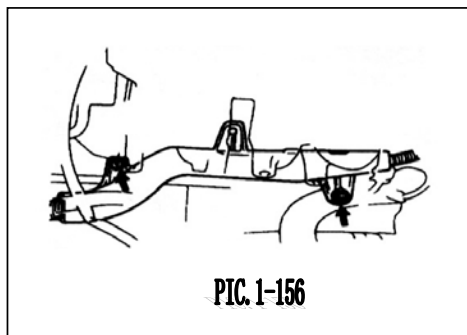
Torque: 15N.m



15. Install oil level meter and its conduit

- (a) Install new O-ring on oil level meter conduit.
- (b) Apply soap water on O-ring.
- (c) Push in oil level meter and its conduit, and fix with bolt (pic.1-155).

Torque: 9.3N.m



16. Install air inlet manifold

Assembly nut2-M8、bolt7-M8X25 (pic.1-156).

Torque: 23±1N.m

17. Install fuel injection nozzle and fuel distribution pipe

18. Connect fuel hose to supply pipe

Torque: 29N.m

19. Connect engine harness

Fix engine harness with two nuts.

20. Install cooling water bypass hose

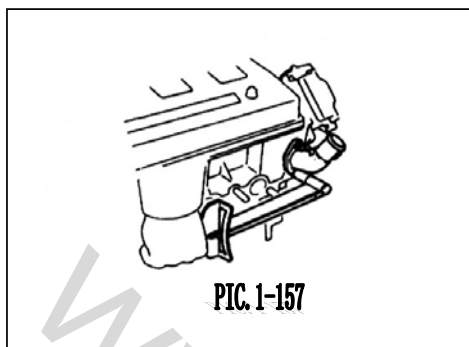
Install water bypass hose and fuel return hose onto air inlet manifold with two nuts.

Torque: 10.2N.m

21. Install air inlet manifold brace

Install air inlet manifold brace with 2 bolts.

Torque:



12mm bolt: 21N.m

14mm bolt: 44N.m

22. Install choke valve body

23. Install water pipe and thermostat seat

(a) Install water pipe, thermostat seat and gasket with bolts and 2 nuts

Torque: 22N.m

(b) Connect two water bypass hose.

24. Install engine right suspension

Install engine suspension with bolts.

Torque: 30N.m

25. Install bobbin bracket

Install bobbin bracket with bolts

26. Install water outlet pipe

Install water outlet with 2 bolts(pic.1-157).

Torque: 22N.m

27. Install exhaust manifold(pic.1-158)

(a) Install lower thermal shield onto exhaust manifold with 2 bolts.

Torque: 9.3N.m

(b) Install new gasket and exhaust manifold with 5 nuts. Tighten nuts in several times.

Torque: 34N.m

(c) Install manifold brace with 2 bolts, tighten bolts alternatively.

Torque: 59N.m

(d) Install upper thermal shield with 4 bolts

Torque: 17N.m

28. Install AC generator

29. Connect engine harness

(a) Install engine harness seat with bolts.

(b) Connect following conductors and grommets:

(1) AC generator connector

(2) AC generator conductor

(3) Oil pressure switch connector

(c) Conductor grommet

30. Install water pump belt pulley and AC generator driving belt

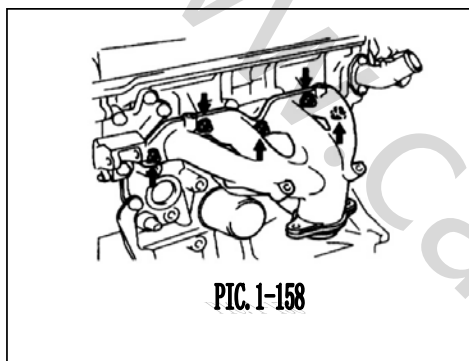
(a) Temporarily install water pump belt pulley with 4 bolts.

(b) Install driving belt with adjustable bolts and pivot bolts.

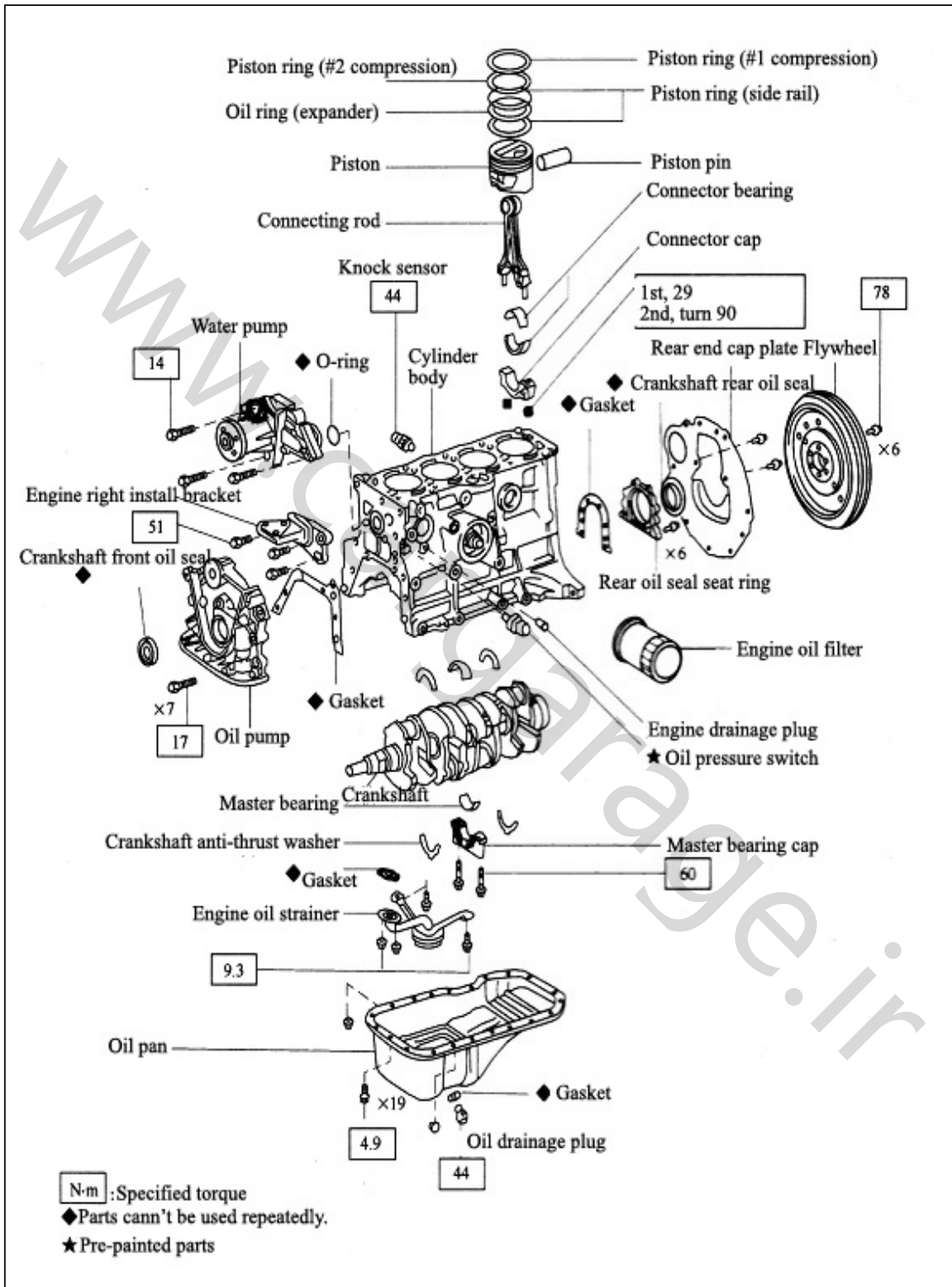
(c) Tighten 4 water pump belt pulley bolts.

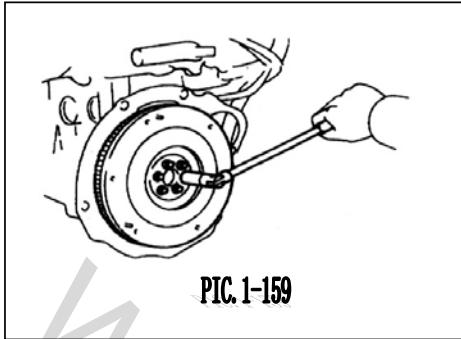
31. Adjust driving belt

32. Fill in engine coolant



Section 7 cylinder body
Cylinder body exploded view

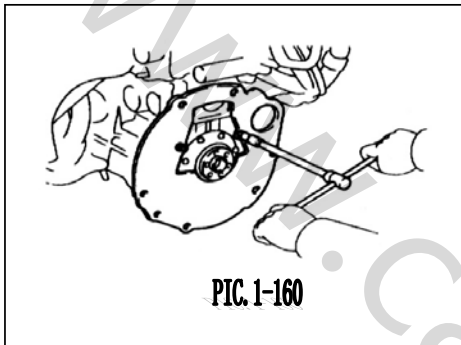




I. Dismantle

1. Dismantle flywheel

Dismantle 6 bolts and flywheel(pic.1-159).



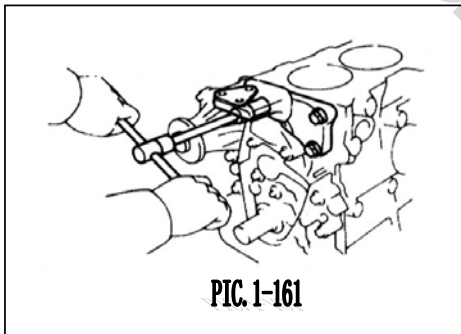
2. Dismantle transmission gear partition plate

dismantle 2 bolts and end cap(pic.1-160).

3. Install engine on engine bracket for dismantle

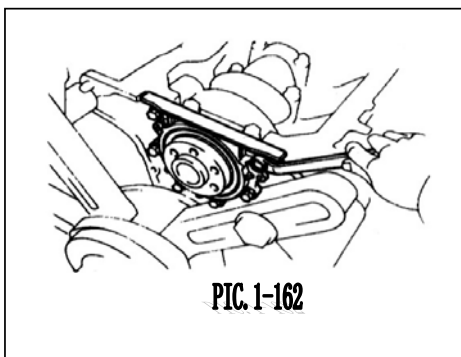
4. Dismantle timing belt and belt pulley

5. Dismantle cylinder head



6. Dismantle adjust block of generator

Dismantle 2 bolts and AC generator adjust block(pic.1-161).



7. Dismantle engine right bracket(pic.1-162)

Remove 3 bolts and engine right bracket.

8. Dismantle water pump

(a) Dismantle 3 bolts with water pump .

(b) Remove O-ring.

9. Dismantle engine oil strainer

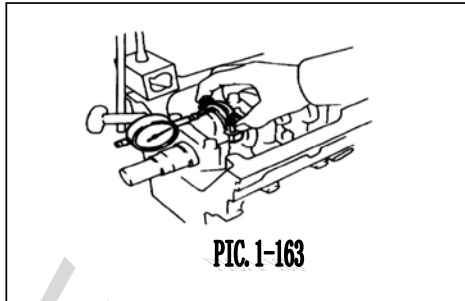
10. Dismantle oil pressure switch

11. Dismantle knockmeter

12. Dismantle engine oil pan and engine oil pump

13. Dismantle rear oil seal seat ring

Dismantle 6 bolts, rear end cap and gasket.



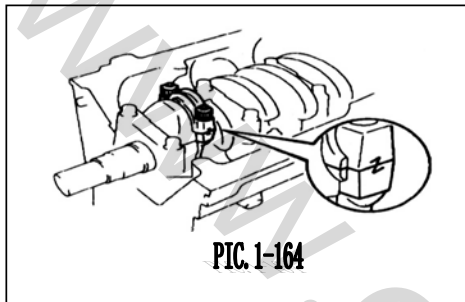
14. Check axial clearance of connecting rod

Move connecting rod forward and backward, measure its axial clearance with micrometer(pic.1-163).

Standard axial clearance: **0.15-0.25mm**

Max. axial clearance: 0.30mm

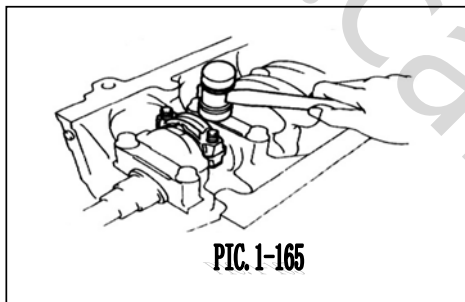
If the axial clearance exceeds max. value, change connecting rod assembly. Change crankshaft if necessary.



15. Dismantle connecting rod cap and check oil clearance

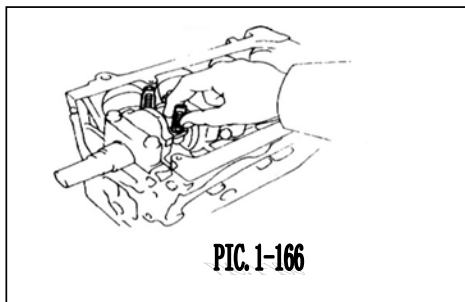
(a) Check match mark on connecting rod and cap, make sure correct re-assemble(pic.1-164).

(b) Remove connecting rod cap nuts.

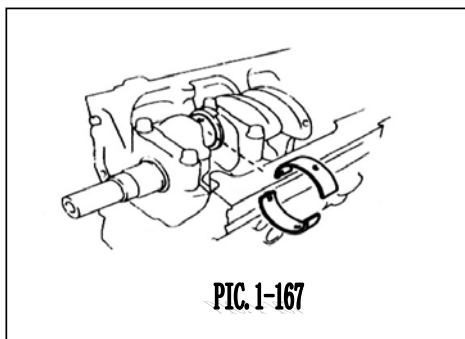


(c) Slightly strike connecting rod bolt with plastic overlay hammer and lift up connecting rod cap(pic.1-165).

Hint: Keep lower bearing bush inlaid in connecting rod cap.



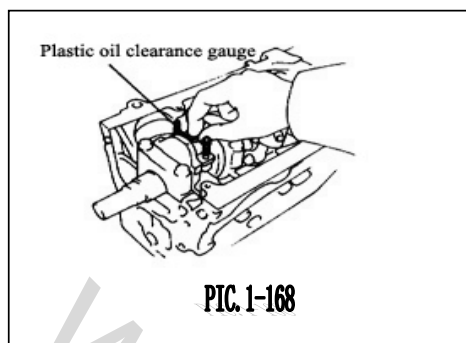
(d) Envelop connecting rod bolt with short hose socket, to protect crankshaft from damaging(pic.1-166).



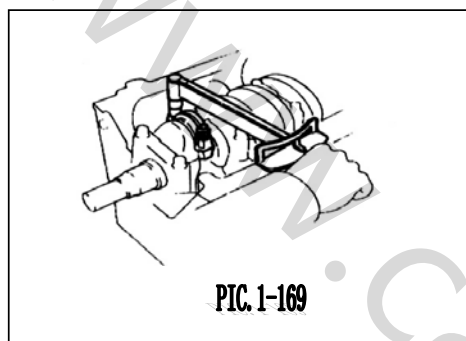
(e) Clean crankshaft pin and bearing bush.

(f) Check crankshaft pin and bearing bush for any dent or scratch(pic.1-167).

If the crankshaft pin or bearing bush is damaged, change bearing bush. Grind or change crankshaft if necessary.



(g) Thread a segment of plastic clearance gauge through crankshaft pin (pic.1-168).



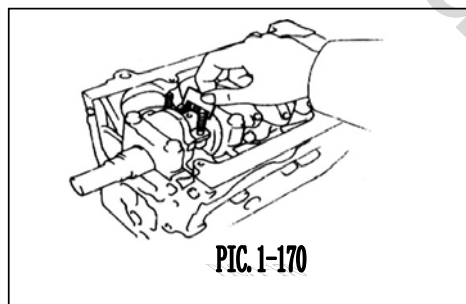
(h) Install connecting rod cap.

Tighten connecting rod cap bolts in several times (pic.1-169).

Torque: 55N.m

Note: Do not rotate crankshaft .

(i) Dismantle connecting rod cap.



(j) Measure with plastic oil clearance gauge at the widest position (pic.1-170).

Standard oil clearance:

Standard type: 0.020-0.051mm

0.25 larger size: 0.019-0.065mm

Max. oil clearance: 0.08mm

If the oil clearance exceeds max. value, change bearing bush. Grind or change crankshaft if necessary.

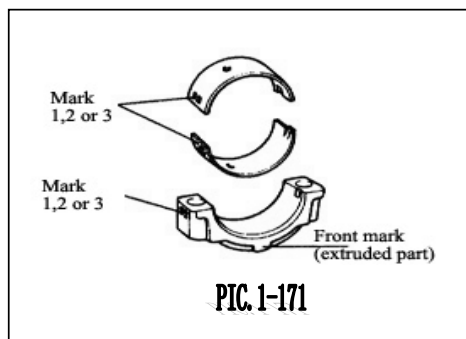
Hint: If the standard bearing bush is used, change with bearing bush that has the same mark number on connecting rod cap. There are 3 different sizes of standard bearing bush, they are number "1", "2" and "3" (pic.1-171).

Center wall thickness of standard size bearing bush:

Mark "1": 1.486-1.490mm

Mark "2": 1.490-1.494mm

Mark "3": 1.494-1.498mm



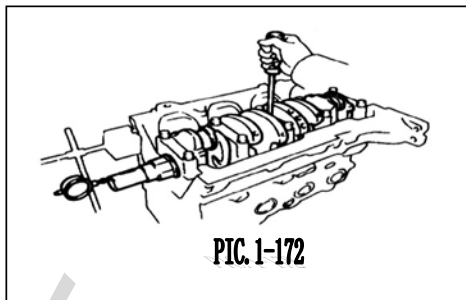
(k) Remove all plastic oil clearance gauges.

16. dismantle piston and connecting rod

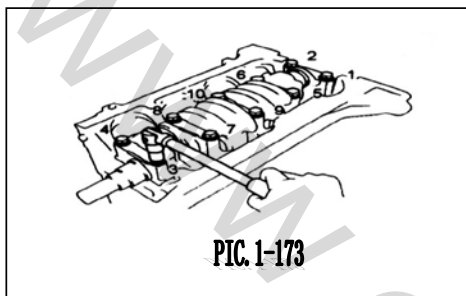
(a) Use cylinder port reamer to remove all wobble from top of cylinder.

(b) Envelop connecting rod bolt with short hose, protect crankshaft from damaging.

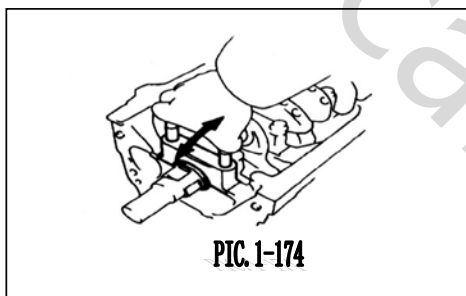
(c) Push piston, connecting rod assembly and top bearing bush over top of cylinder body.



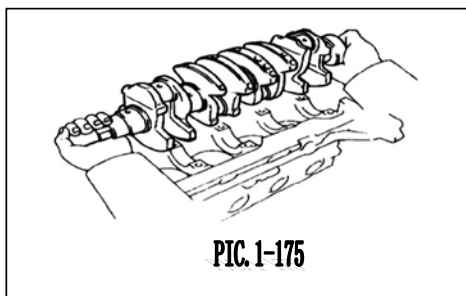
PIC. 1-172



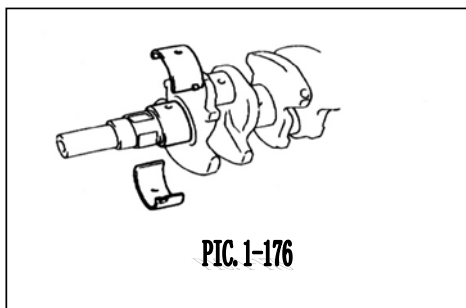
PIC. 1-173



PIC. 1-174



PIC. 1-175



PIC. 1-176

Hint:

.Put bearing bush, connecting rod and connecting rod cap together.

. Place piston and connecting rod assembly as per correct sequence.

17. Check crankshaft axial clearance

Pry crankshaft with screwdriver and measure axial clearance with micrometer(pic.1-172).

Standard axial clearance: 0.10-0.25mm

Max. axial clearance: 0.30mm

If the axial clearance exceeds max. value, change the whole set of thrust plate.

Thrust plate thickness: 2.450-2.480mm

18. Dismantle main shaft cap and check oil clearance

(a)Unscrew and remove main shaft cap bolts in several times as illustrated(pic.1-173).

(b)Use removed main shaft cap bolts to pry main shaft cap, and remove main shaft cap, lower master bearing bush and lower thrust plate (#3 main shaft cap only)(pic.1-174).

Hint:

. Place lower master bearing bush and main shaft cap together.

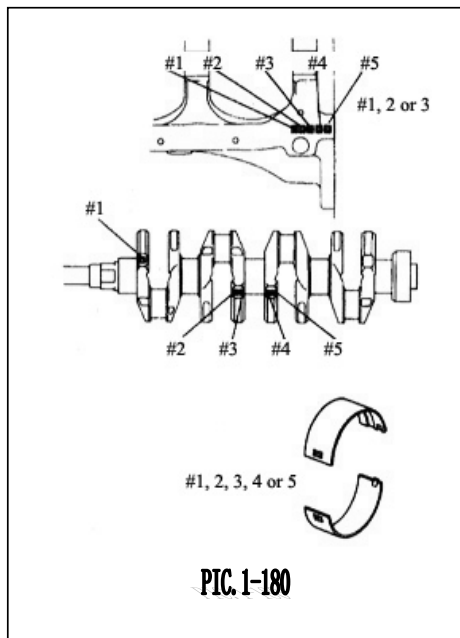
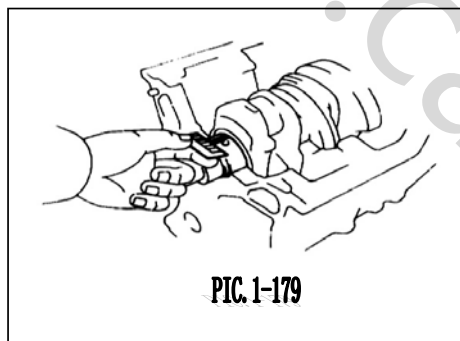
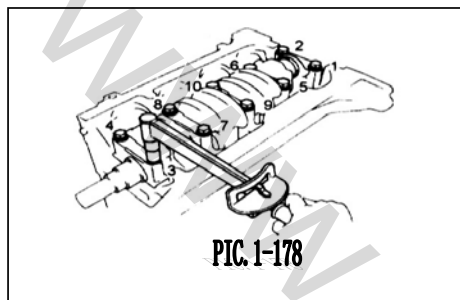
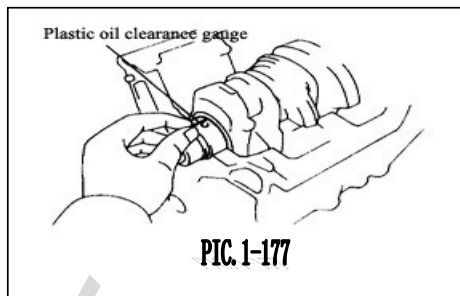
. Place main shaft cap and lower thrust plate per correct sequence.

(c)Remove crankshaft upwards.

Hint: Put upper main shaft bush, upper thrust plate and cylinder body together(pic.1-175).

(d)Clean all main journal and main shaft bush(pic.1-176).

(e)Check all main journal and main shaft bush for dents or scratch. If the main journal or main



shaft bush is defected, change bearing bush. Grind or change crankshaft if necessary.

- (f) Install crankshaft onto cylinder body.
- (g) Thread a segment of plastic oil clearance gauge through every journal (pic.1-177).

(h) Install main shaft cap (pic.1-178).

Torque: 78N.m

Note: Do not rotate crankshaft .

(i) Dismantle main shaft cap.

(j) Measure with plastic oil clearance gauge at the widest position (pic.1-179).

Standard oil clearance:

Standard type: 0.015-0.033mm

0.25 size larger: 0.016-0.056mm

Max. oil clearance: 0.10mm

Hint: If the cylinder body parts is changed. the standard clearance of bearing bush is: 0.015-0.045mm.

If the oil clearance exceeds max. value, change bearing bush. Grind or change crankshaft if necessary (pic.1-180).

Hint: If standard bearing bush is used, change with same number bearing bush.

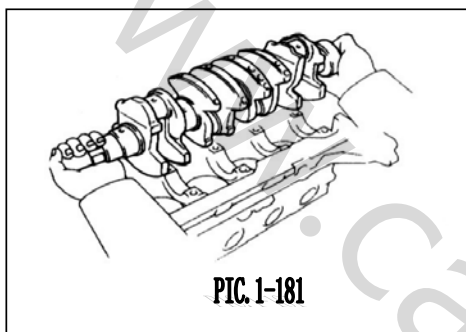
If the number of bearing bush can not be determined, add numbers printed on cylinder body and crankshaft, then choose bearing bush with same number with the sum of the numbers, to ensure correct selection of bearing bush. There are total 5 standard bearing bush sizes, respectively marked with "1", "2", "3", "4" and "5".

	Number								
	1			2			3		
cylinder body	0	1	2	0	1	2	0	1	2
crankshaft	0	1	2	0	1	2	0	1	2
Matched bearing bush	1	2	3	1	2	3	1	2	3

e.g.: Cylinder body #3 number "2"+crankshaft number "1"= total number "3" (i.e., adopt #"3" bearing bush)

Standard bearing bush reference table

-	Number	mm
I.D. of cylinder body main journal	"1"	52.025-52.031
	"2"	52.032-52.037
	"3"	52.038-52.043
Dia. of crankshaft journal	"0"	47.993-48.000
	"1"	47.987-47.994
	"2"	47.982-47.988
Standard type bearing bush center arm thickness	"1"	2.002-2.005
	"2"	2.006-2.008
	"3"	2.009-2.011
	"4"	2.012-2.014
	"5"	2.015-2.017



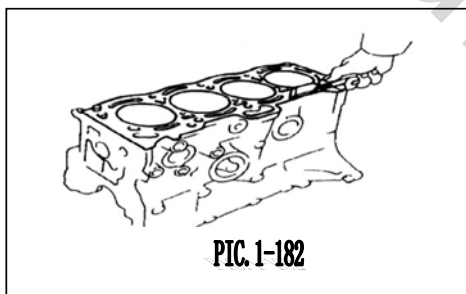
(k) Remove all plastic oil clearance gauge.

19. dismantle crankshaft

(a) Remove crankshaft upward (pic.1-181).

(b) Remove upper main shaft bush and upper thrust plate from cylinder body.

Hint: Place main shaft cap main shaft bush and thrust plate per correct sequence.



II. Inspection

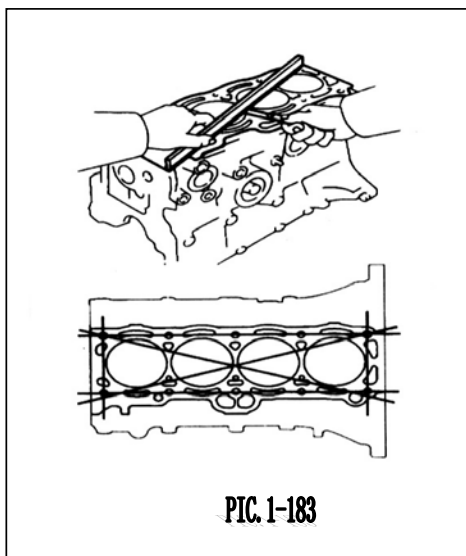
1. Clear cylinder body

(A) Clear liner material

Clear all liner material from top of cylinder body with liner scraper (pic.1-182).

(B) Clean cylinder body

Clean cylinder body thoroughly with soft brush and solvent.



2. Check levelness of surface on top of cylinder body

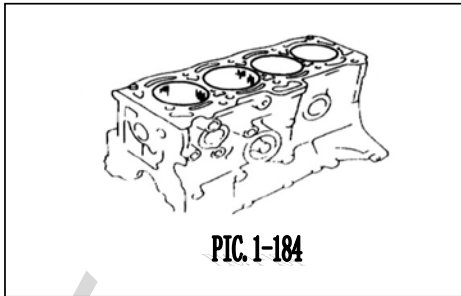
Use precise ruler and feeler gage to measure the warp on contact face with cylinder head gasket (pic.1-183).

Max. warp: 0.05mm

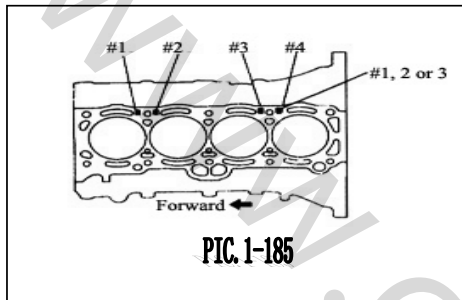
If warp exceeds max. value, change cylinder body.

3. Check cylinder for vertical abrasion

Visual check vertical abrasion. If the abrasion is

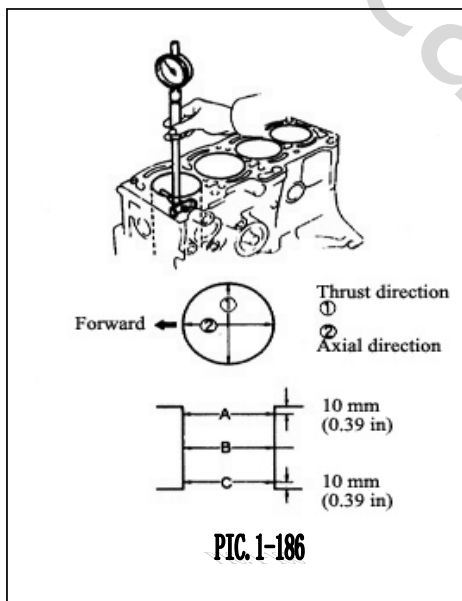


deep, re-bore 4 cylinders. Change cylinder body if necessary(pic.1-184).



4. Check cylinder I.D.

Hint: There are total 3 sizes of standard cylinder I.D., marked respectively as "1", "2" and "3". This mark is printed on top of cylinder body(pic.1-185).



Use cylinder bore gauge to measure dia. of cylinder bore in thrust and axial direction at 3 points respectively of A, B, C(pic.1-186).

Standard dia.:

Standard type:

"1": 81.02-81.03mm

"2": 81.03-81.04mm

"3": 81.04-81.05mm

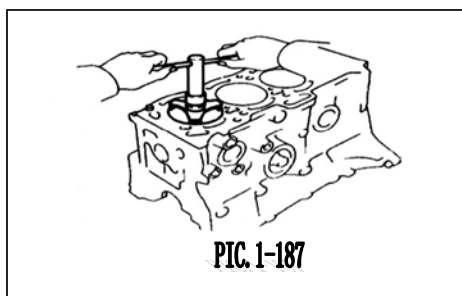
Max. dia.:

Standard type: 81.02mm

If the dia. exceeds max. value, all 4 cylinders must be re-bored. Change cylinder body if necessary.

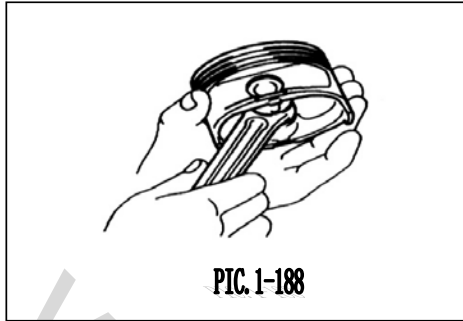
5. Remove convex on cylinder port

If the abrasion is less than 0.2mm, grind cylinder top face with cylinder port reamer(pic.1-187).

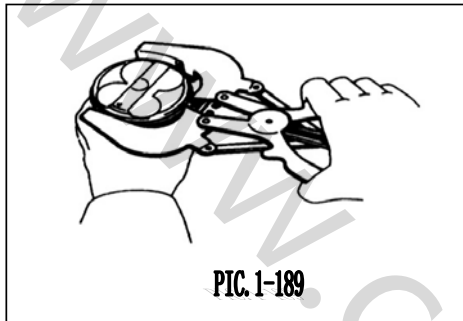


6. Check matching between connecting rod and piston pin

Try if the piston may move forward and backward on piston pin. If any displacement is



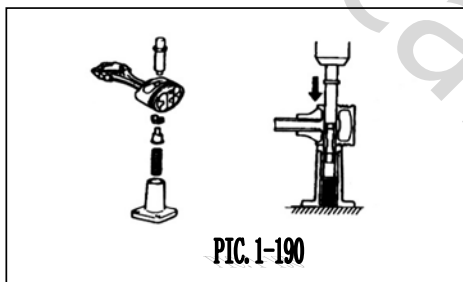
felt, change the whole set of connecting rod and piston pin(pic.1-188).



7. Dismantle piston ring

- (a) Use piston ring expander to dismantle 2 gas ring(pic.1-189).
- (b) Use hand to dismantle 2 film ring and bushing ring.

Hint: Place piston ring at correct sequence.

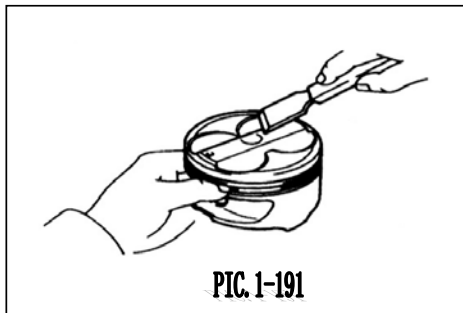


8. Dismantle connecting rod from piston

Use special service tool to press out piston pin from connecting rod. Remove connecting rod(pic.1-190).

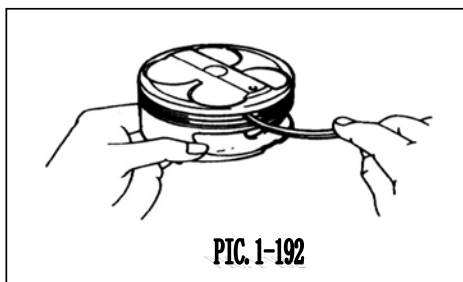
Hint:

- . Connecting rod, pin and piston are matching components.
- . Place piston, pin, ring, connecting rod and bearing per correct sequence.

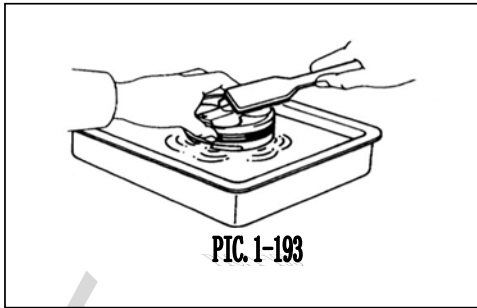


9. Clean piston

- (a) Clear wobble from top of piston with liner scraper(pic.1-191).

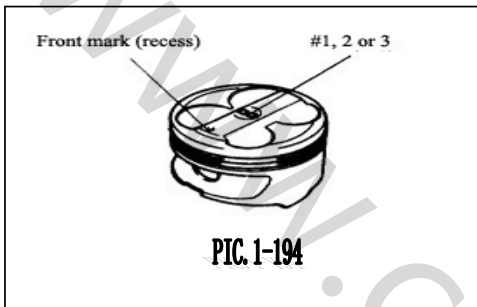


- (b) Use groove clean tool or break ring clean tool to clear the piston ring groove(pic.1-192).



(c) Clean piston thoroughly with solvent and brush (pic.1-193).

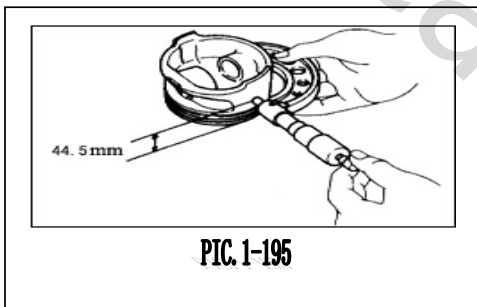
Note: Do not use steel wire brush.



10. Check piston and piston ring

A. Check piston oil clearance

Hint: Total 3 sizes standard piston dia. is marked respectively as "I", "II", "III". This mark is printed on top of piston (pic.1-194).



(a) Measure dia. of piston which is in right angle with piston pin center line with micrometer at the position 44.5mm from piston top (pic.1-195).

Piston dia.:

Standard type:

Mark "1": 80.955-80.965 mm

Mark "2": 80.965-80.975 mm

Mark "3": 80.975-80.985 mm

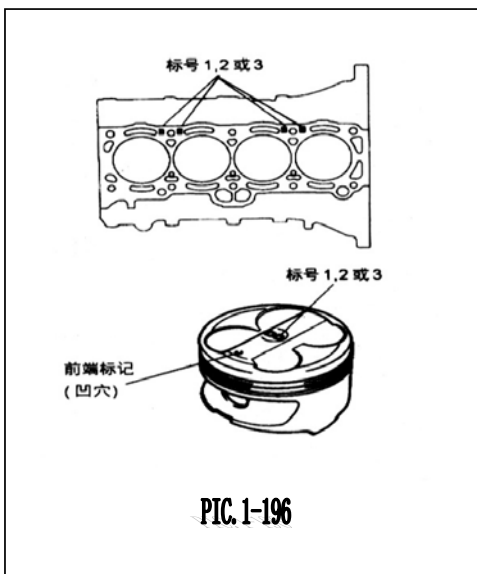
Larger size 0.50 type: 81.035-81.465 mm

(b) Measure cylinder bore I.D. at thrust direction.

(c) Deduct piston dia. from cylinder bore I.D.

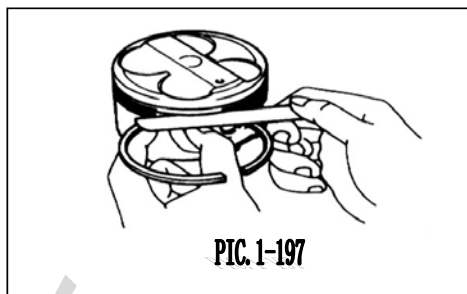
Standard oil clearance: 0.055-0.075mm

Max. oil clearance: 0.075mm



If oil clearance exceeds max. value, change all 4 pistons, re-bore 4 cylinders. Change cylinder body if necessary.

Prompt (when using new cylinder body): use same piston with number mark same as that on cylinder aperture of cylinder body (pic.1-196).



B. Check piston ring groove clearance

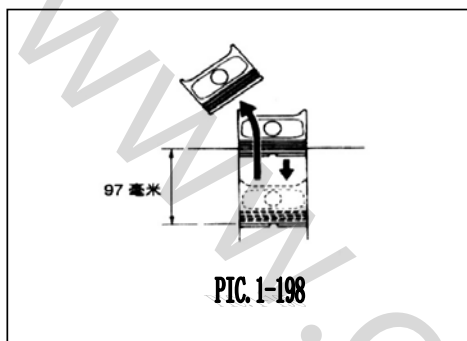
Measure clearance between new piston ring and ring groove wall with thickness gauge(pic.1-197).

Ring groove clearance:

First ring groove: 0.040-0.080mm

Second ring groove: 0.030-0.070mm

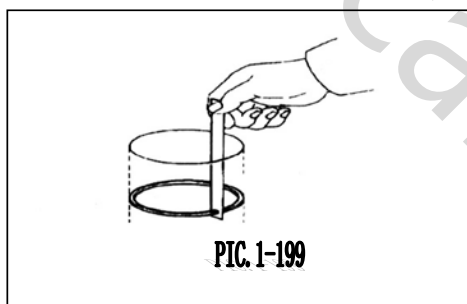
If the clearance exceeds max. value, change piston.



C. Check piston ring split gap

(a) Inlay piston ring into cylinder bore.

(b) Use piston to push piston ring slightly beyond bottom of ring travel, approximate 97mm from top of cylinder body(pic.1-198).



(c) Measure split gap with thickness gauge(pic.1-199).

Standard split gap:

First ring: 0.20-0.40mm

Second ring: 0.30-0.50mm

Film ring: 0.150-0.500mm

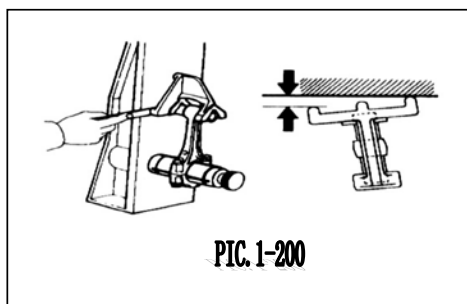
Max. split gap:

First ring: 1.05mm

Second ring: 1.20mm

Film ring: 1.10mm

If the split gap exceeds max. value, change piston ring. If after using new piston ring, the split gap is still bigger than max. value, re-bore these 4 cylinders or change cylinder body.



11. Check connecting rod

A. Check connecting rod straightness (linearity)

Use connecting rod collimator and thickness gauge to check the connecting rod straightness.

- Check decollimation(pic.1-200)

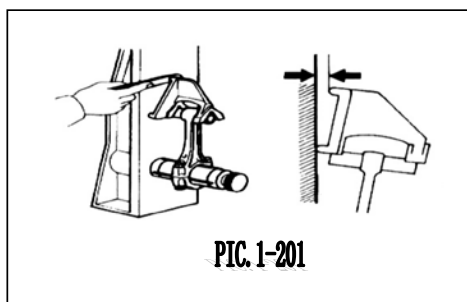
Max. decollimation: 0.05mm/100mm

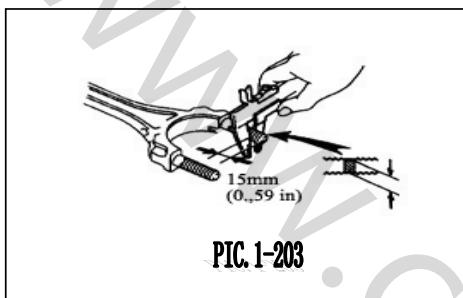
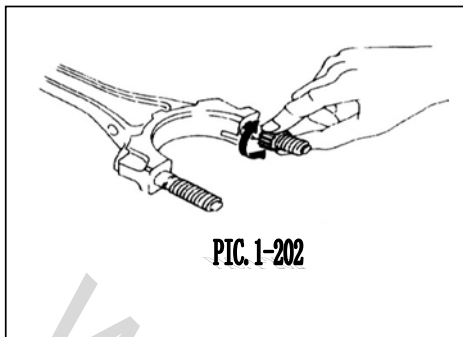
If the decollimation exceeds max. value, change connecting rod assembly.

- Check distortion(pic.1-201)

Max. distortion: 0.05mm/100mm

If distortion exceeds max. value, change connecting rod assembly.





B. Check connecting rod bolt

(a) Install lock nut of connecting rod bolt. Check if the lock nuts can be turned to the end of thread by hand (pic.1-202).

(b) If the lock nut can not be rotated freely, measure O.D. of connecting rod bolt with vernier caliper (pic.1-203).

Standard O.D.: 8.860-9.000mm

Min. O.D.: 8.60mm.

Hint: If this part can not be checked or determined by visual inspection, measure O.D. at the illustrated position.

If the O.D. is less than min. value, change the whole set of connecting rod bolts and nuts

12. Boring

Hint:

- . Bore aperture of 4 cylinders to enlarge the piston O.D..
- . Change all piston ring to match with larger size piston.

A. Save larger size piston

80.955~80.985 Larger size piston dia.:

Larger size 0.50 type: 81.455mm

B. Calculate boring quantity

(a) Use screw micrometer to measure piston dia. at a distance of 44.5mm from cylinder head which is in right of piston pin center line.

(b) Calculate re-boring quantity of each cylinder per following equation: **Re-bore size = P+C-H**

P=piston dia.

C=piston oil clearance: 0.035-0.055mm

H=Honing tolerance: 0.02mm or less

C. Bore and hone cylinder to calculated size

Max. bore value: 0.02mm

Note: Excessive honing will damage roundness of finished products.

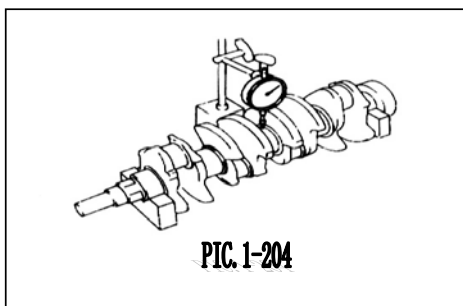
13. Check radial runout of crankshaft

(a) Put crankshaft on V-block (pic.1-204).

(b) Use micrometer to measure radial runout of center journal.

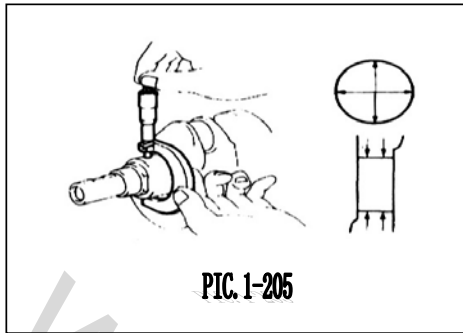
Max. radial runout: 0.03mm

If the radial runout exceeds max. value, change crankshaft .

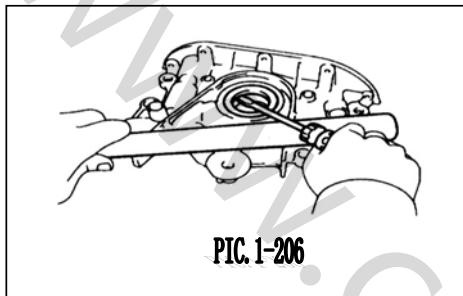


14. Check main journal and connecting rod neck

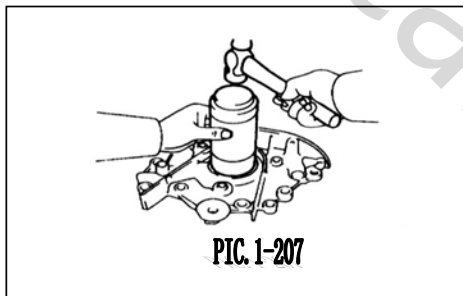
(a) Use micrometer to measure dia. of each main



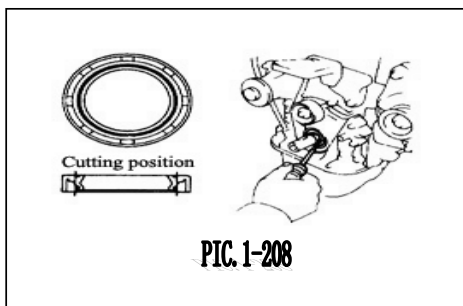
PIC. 1-205



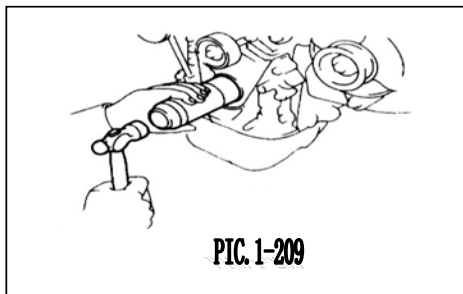
PIC. 1-206



PIC. 1-207



PIC. 1-208



PIC. 1-209

journal and connecting rod neck(pic.1-205).

Main journal dia.:

Standard type: 47.982-48.000mm

Larger size 0.25 type: 47.745-47.755mm.

connecting rod neck dia.:

Standard type: 39.985-40.000mm

Larger size 0.25 type: 39.745-39.755mm.

If the dia. disaccords with specification, check oil clearance. Grind or change crankshaft if necessary.

(b) Check taper and out of roundness of each main journal and connecting rod neck as illustrated.

Max. tap and out of roundness: 0.02mm

If the taper and out of roundness is no bigger than max. value, change crankshaft .

15. Grind and hone main journal and/or connecting rod neck if necessary

Grind and hone main journal and/or connecting rod neck to smaller dia. than finished size (refer to Step 14). Install new size bearing bush match with main journal and/or connecting rod neck.

III. Change

Hint: There are two ways of changing oil seal (A & B) as follows:

1. Change oil seal in front of crankshaft

A. If the oil pump is already dismantled from cylinder body

(a) Pry out oil seal with screwdriver(pic.1-206).

(b) Use special service tool and hammer to strike new oil seal in, till its surface flush with oil pump casing edge(pic.1-207).

(c) Apply grease on oil seal edge.

B. If the oil pump is installed on cylinder body

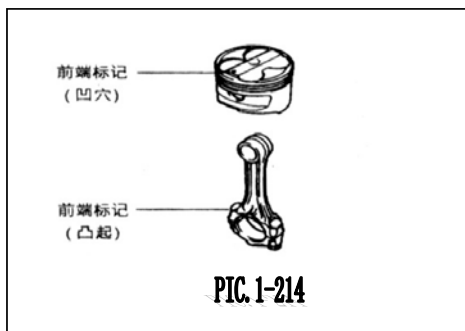
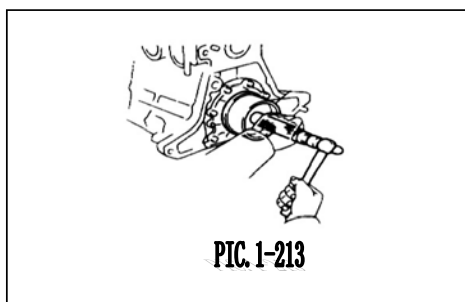
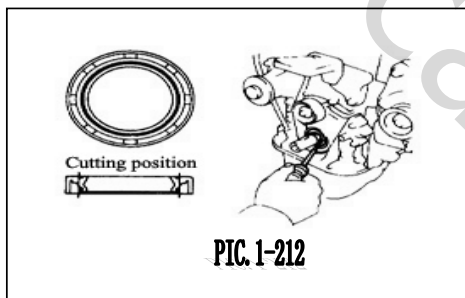
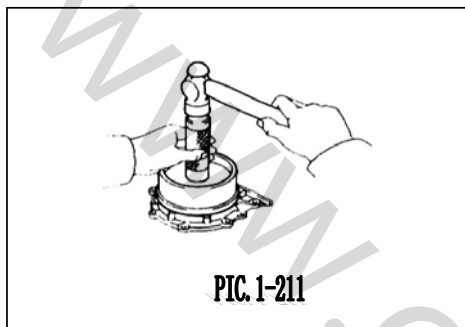
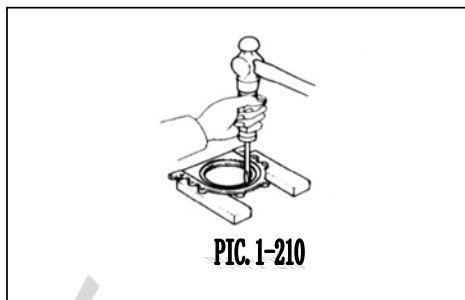
(a) Cut off oil seal edge with a small knife(pic.1-208).

(b) Pry out oil seal with screwdriver.

Note: Pay attention not to damage crankshaft. Wrap screwdriver tip with coated fabric.

(c) Apply grease on edge of new oil seal.

(d) Use special service tool and hammer to strike in oil seal, till its surface flush with pump casing edge(pic.1-209).



2. Change crankshaft rear end cap

A. If the rear end cap of crankshaft has been dismantled from cylinder body

(a) Strike out oil seal with screwdriver and hammer (pic.1-210).

(b) Use special service tool and hammer to strike in new oil seal, till its surface flush with rear oil seal edge (pic.1-211).

(c) Apply MP grease on edge of oil seal.

B. If the crankshaft rear end cap has been installed on cylinder body

(a) Cut oil seal edge with knife (pic.1-212).

(b) Use screwdriver to pry out oil seal.

Note: Take care not to damage crankshaft. Wrap screwdriver tip with rubber cloth.

(c) Apply grease on new oil seal edge.

(d) Use special service tool and hammer to strike in new oil seal, till its surface is flush with edge of crankshaft rear end cap (pic.1-213).

IV. Re-assemble

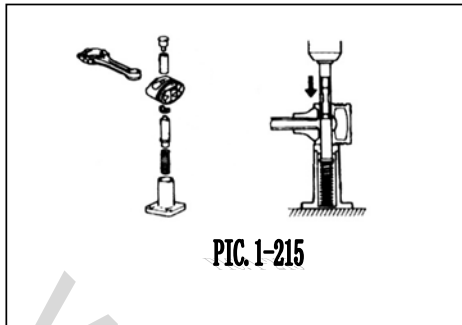
Hint:

- . Thoroughly clean all parts to be assembled.
- . Prior to parts assembling, apply new engine oil on all sliding and rotating face
- . Change all gaskets, O-ring and oil seal with new ones.

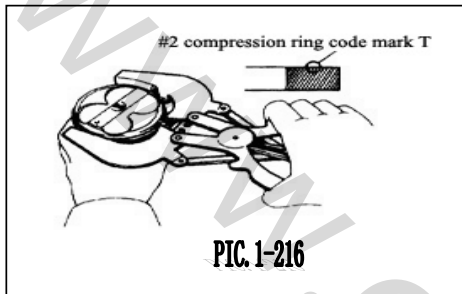
1. Assemble piston and connecting rod

(a) Apply engine oil on piston pin and piston pin hole:

(b) Make front end mark on both piston and connecting rod on same side, push in piston pin with thumb (pic.1-214).



(c) Use special service tool to press in piston pin (pic.1-215).

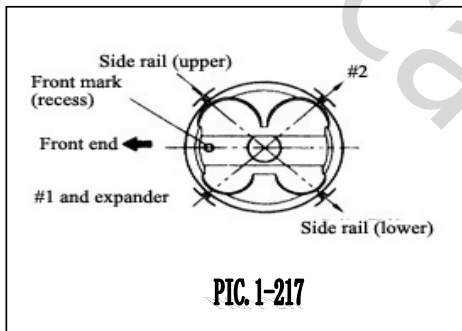


2. Install piston ring

(a) Install film ring and liner ring with hand.

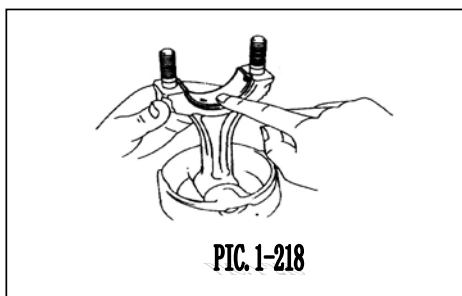
(b) Install two gas ring with piston ring expander, make its code mark upwards (pic.1-216).

Code mark (2 compress ring only).



(c) The position of placing piston ring shall be as illustrated (pic.1-217).

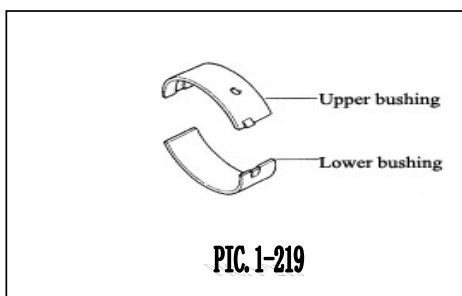
Note: Keep split of ring from same line.



3. Install bearing bush

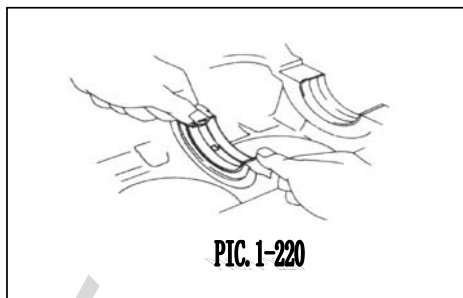
(a) Align convex of bearing bush with recess on connecting rod or connecting rod cap (pic.1-218).

(b) Install bearing bush into connecting rod and connecting rod cap.

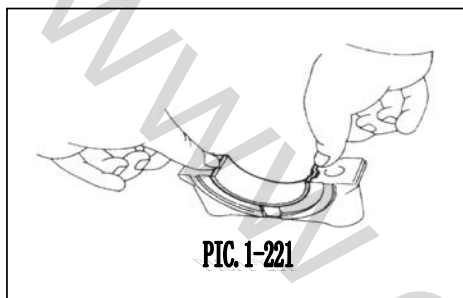


4. Install main shaft bush

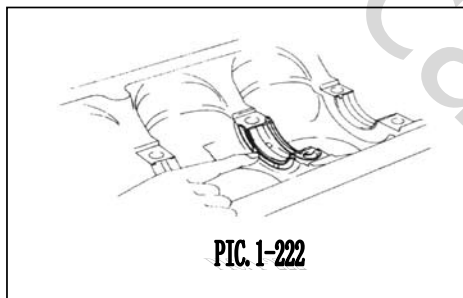
Hint: There are oil groove and oil hole on upper main shaft bush, there is none on lower main shaft bush (pic.1-219).



(a) Align convex of main shaft bush with recess on cylinder body, push in 5 upper main shaft bush(pic.1-220).



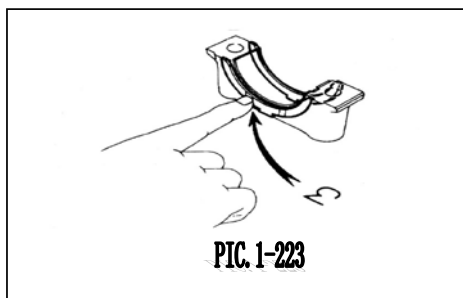
(b) Align convex of main shaft bush with recess on main shaft cap, push in 5 lower main shaft bush(pic.1-221).



5. Install upper thrust plate

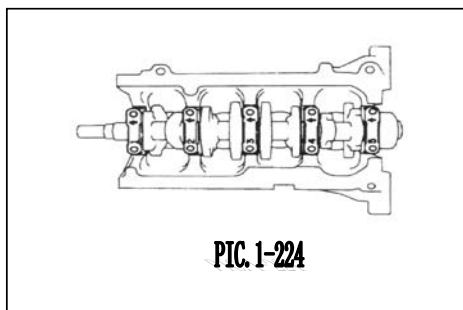
Install 2 thrust plates under #3 journal, make oil groove facing outward(pic.1-222).

6. Put crankshaft on cylinder body



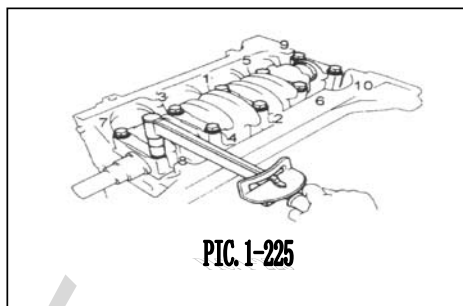
7. Install main shaft cap and lower thrust plate

(a) Install 2 thrust plates upon #3 main shaft cap, make oil groove outward(pic.1-223).



(b) Install 5 main shaft caps to suitable position(pic.1-224).

Hint: Each bearing cap has a number and front end number.



- (c) Apply a thin layer of engine oil under bolt head and on thread of main shaft cap bolt.
- (d) Install and tighten 10 main bearing bolts in several times as illustrated (pic.1-225).

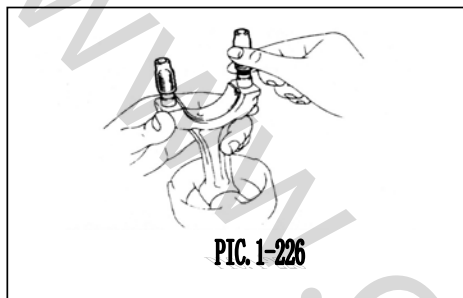
Torque: 78N.m

- (e) Check crankshaft for flexible rotation.

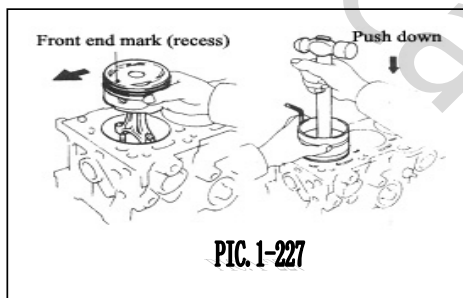
8. Check crankshaft axial clearance

9. Install piston and connecting rod

- (a) Envelop short hose on connecting rod bolt to protect crankshaft from damaging (pic.1-226).



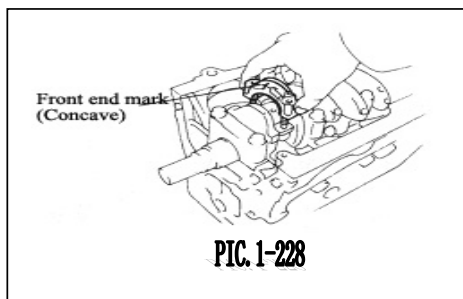
- (b) Use piston ring compressor to push piston and connecting rod with matching number with each cylinder respectively into each cylinder, make front end mark of piston forwards (pic.1-227).



10. Install connecting rod cap

A. Install connecting rod cap onto connecting rod

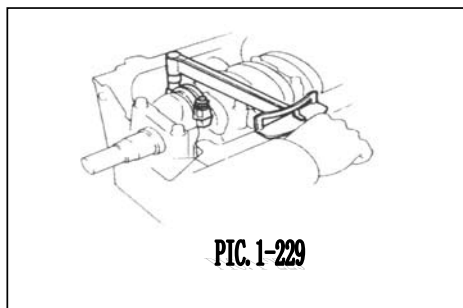
- (a) Match connecting rod cap with corresponding connecting rod by numbers.
- (b) Install connecting rod cap, make front end mark forward (pic.1-228).



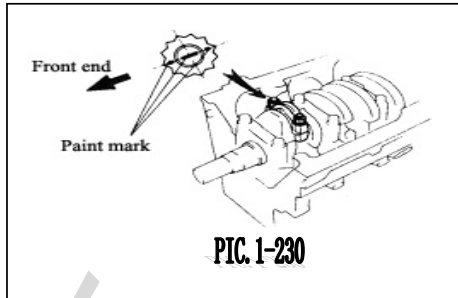
B. Install connecting rod cap nuts

Hint:

- Connecting rod cap nuts shall be gradually tightened in 2 steps (pic.1-229).
- If there is fracture or distortion on connecting rod cap bolt, change.



- (a) Apply a thin layer of engine oil under connecting rod cap nut.

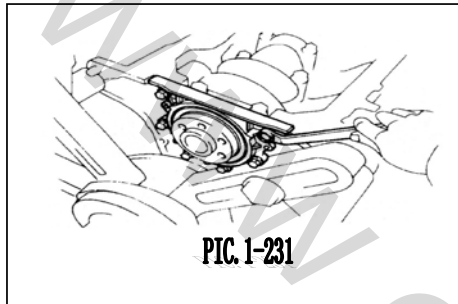


(b) Install and tighten lock nut alternatively in several times.

Torque: 60N.m

If the lock nut can not reach specified torque, change the whole set of connecting rod bolt and lock nut.

(c) Mark on connecting rod bolt and lock nut with paint(pic.1-230).



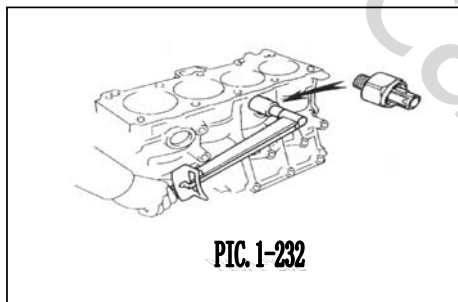
(d) Check crankshaft for flexible rotation.

11. Check connecting rod axial clearance

12. Install rear oil seal seat ring

Use 6 bolts to install new gaskets and oil seal seat ring(pic.1-231).

Torque: 11N.m



13. Install oil pump and oil pan

14. Install knockmeter

Use special service tool to install knockmeter(pic.1-232).

Torque: 30N.m

15. Install oil pressure switch

(a) Apply binding agent on 2nd or 3rd thread of oil pressure switch.

(b) Use special service tool to install oil pressure switch.

16. Install oil filter

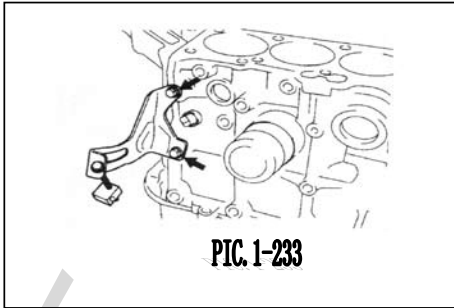
17. Install water pump

(a) Place a new O-ring on cylinder body.

(b) Install water pump with 3 bolts.

Torque: 20N.m

18. Install engine right bracket



Install engine right bracket with 3 bolts.

Torque: 50N.m

19. Install AC generator adjust block(pic.1-233)

Install AC generator adjust block with 2 bolts.

Torque: 30N.m

20. Install cylinder head

21. Install timing belt and belt pulley

22. Remove engine from engine seat

23. Install rear end cap

Install rear end cap with 2 bolts.

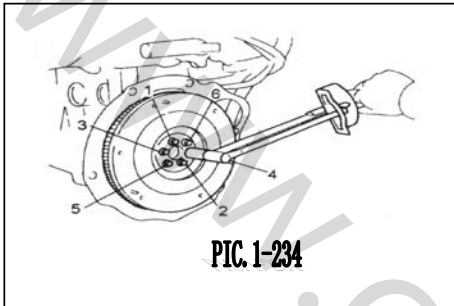
Torque: 10N.m

24. Install flywheel

(a)Install flywheel on crankshaft.

(b)Install and tighten erection bolt in several times as illustrated(pic.1-234).

Torque: 80N.m



Chapter 2 Cooling system

Section 1 coolant

I. Inspection

1. Check engine coolant level in water tank of heat radiator

When engine in cold state, the level of engine coolant shall be between "LOW" and "FULL" lines.

If the coolant level is relatively low, check for leakage, fill up engine coolant to "FULL" line.

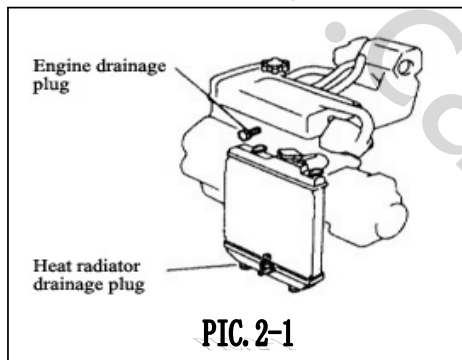
2. Check engine coolant quality

(a) Remove heat radiator cap

Note: To avoid scolding, when engine and heat radiator is still hot, do not remove heat radiator cap, the coolant and vapor may eject out under pressure.

(b) There shall be no excessive rust or scale on heat radiator cap or around heat radiator water filling port, no organic oil is allowed in coolant, if the coolant is dirty, change coolant.

(c) Re-install heat radiator cap



II. Change

1. Drain engine coolant

(a) Remove heat radiator cap

Note:

Note: To avoid scolding, when engine and heat radiator is still hot, do not remove heat radiator cap, the coolant and vapor may eject out under pressure.

(b) Unscrew drainage screws respectively on heat radiator (right bottom of water tank under heat radiator) and engine coolant drainage tube connector (rear left of cylinder body) and drain out coolant(pic.2-1).

(c) Tighten drainage plug screw

Torque: (engine side) 12.7N.m

2. Refill engine coolant

(a) Slowly refill coolant into cooling system.

- Use quality brand ethylene glycol coolant, mix as instructed by the manufacturer.

- We recommend coolant with ethylene glycol content over 50% (less than 70%).

Note:

- **Do not use ethanol coolant.**

- **Coolant shall be mixed with demineralized water or distilled water.**

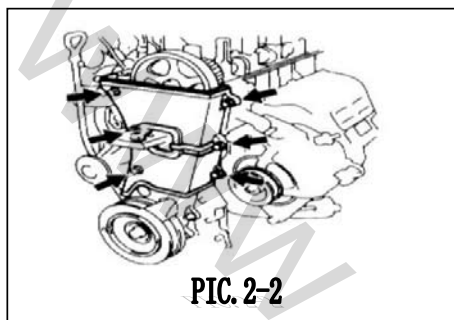
Capacity: 5.3L

(b) Reinstall heat radiator cap.

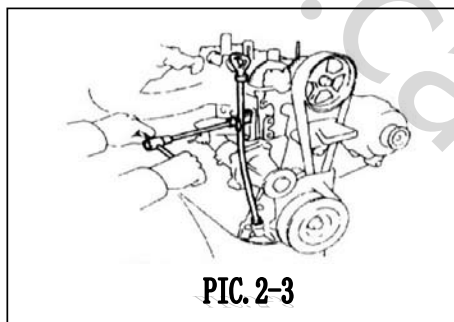
- (c) Start up engine, exhaust air from cooling system
- (d) Refill coolant into coolant tank till "FULL" line.

3. Check engine coolant for leakage

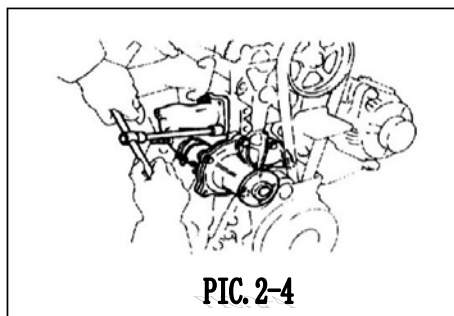
Section 2 Water pump



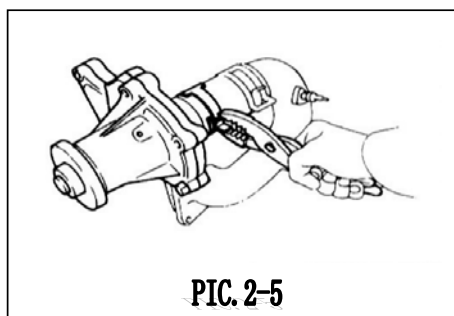
PIC. 2-2



PIC. 2-3



PIC. 2-4



PIC. 2-5

I. Dismantle

1. Drain out engine coolant
2. Dismantle AC generator driving belt and water pump belt pulley
3. Dismantle cylinder head cover
4. Dismantle #2 & #3 timing belt hood
Dismantle 6 bolts, #2 & #3 timing belt hood(pic.2-2).
5. Dismantle harness protective hood

6. Remove oil level meter and its conduit(pic.2-3)

- (a) Dismantle erection bolts.
- (b) Pull out oil level meter and its conduit.
- (c) Remove O-ring from oil level meter conduit.

7. Dismantle water pump and water pump inlet pipe(pic.2-4)

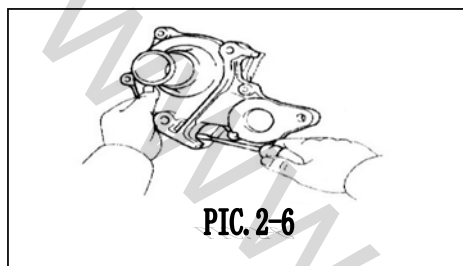
- (a) Loose water temperature sensor connector.
- (b) Dismantle 2 nuts that connect water pump with cylinder head.
- (c) Dismantle 3 bolts, water pump and water pump inlet pipe.
- (d) Remove O-ring from cylinder body.

8. Separate water pump and water pump inlet pipe(pic.2-5).

II. Inspection

Check water pump

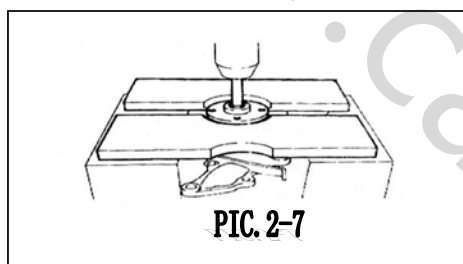
- (a) Visual check if there is coolant leakage from exhaust port or drainage port, change water pump, if any.
- (b) Rotate belt pulley, check water pump bearing rotation, it should be smooth and silent, change water pump if necessary.



III. Dismantle

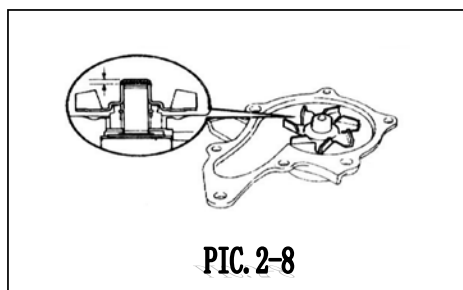
1. Dismantle water pump suction cap(pic.2-6)

- (a) Dismantle 4 bolts.
- (b) Pry off water pump suction cap with screwdriver.



2. Dismantle belt pulley seat

Use special service tool and presser to press down bearing shaft. Dismantle belt pulley seat(pic.2-7).

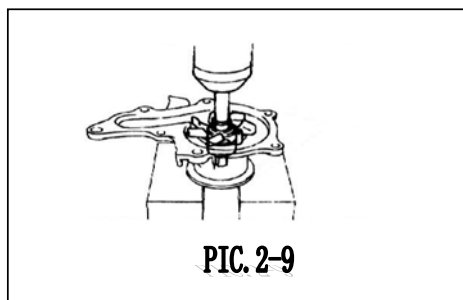


3. Remove water pump bearing

- (a) Grind water pump rotor with grinding wheel as illustrated(pic.2-8).

Note: Do not grind bearing shaft of water pump.

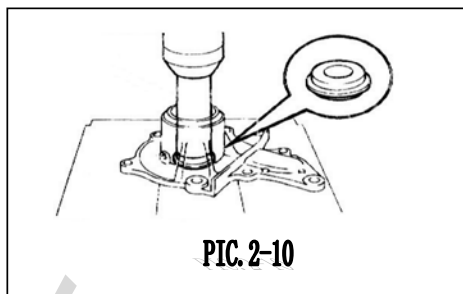
- (b) Gradually warm up water pump body to around 85°C.



- (c) Use special service tool and presser to press down bearing shaft, remove rotor and bearing(pic.2-9).

- (d) Remove sealing seat from water pump.

Note: Do not damage water pump body.

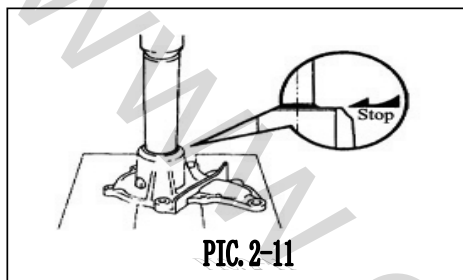


4. Remove sealant

Use special service tool and presser, to press off sealant(pic.2-10).

IV. Re-assemble

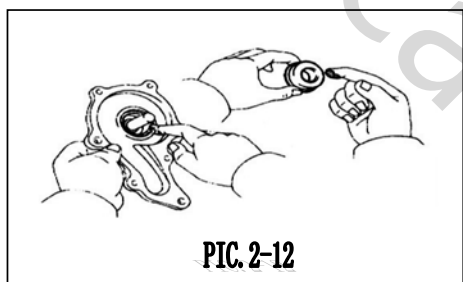
Hint: Use new sealing member, new rotor and new bearing when re-assemble water pump.



1. Install water pump bearing

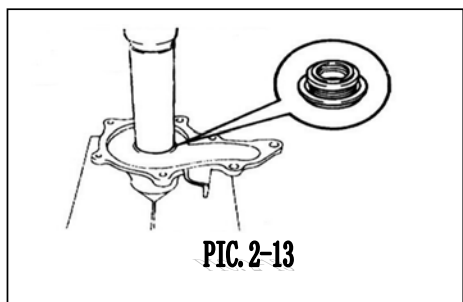
(a) Gradually warm up water pump body to about 85°C.

(b) Use special service tool and presser, to press down bearing outer ring, make its surface flush with water pump body surface(pic.2-11).

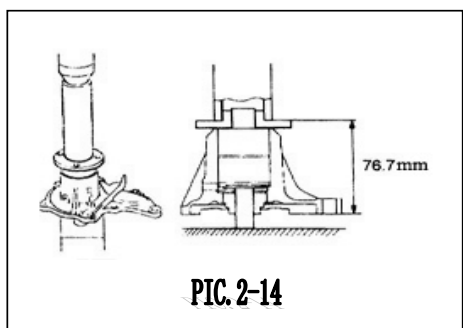


2. Install sealing member

(a) Apply sealing packing material on new sealing member and pump body(pic.2-12).

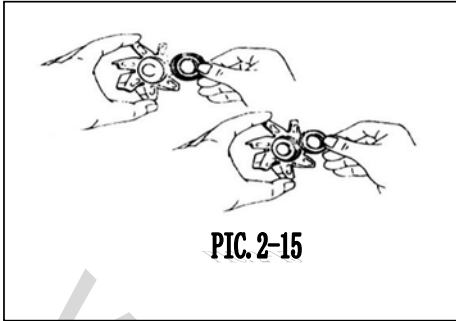


(b) User special service tool and presser to press in sealing member(pic.2-13).



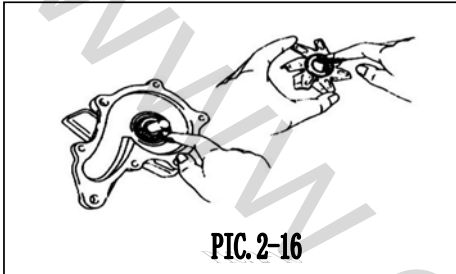
3. Install belt pulley seat

Use special service tool and presser to press belt pulley seat onto shaft of water pump bearing, so to make it departure from pump body installation surface approximate 76.7mm(pic.2-14).

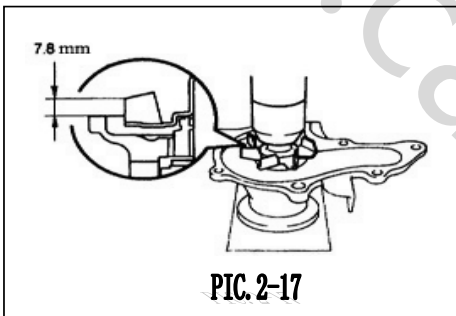


4. Install rotor

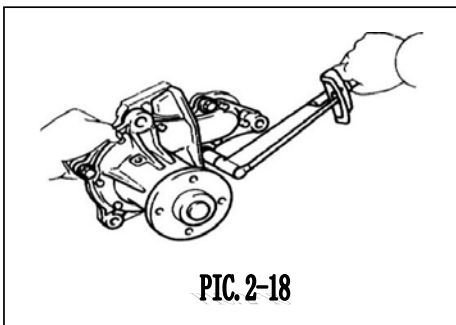
(a) Install new packing material and seat into rotor (pic.2-15).



(b) Apply small amount of organo silicic oil on wheel seat and contact face of rotor (pic.2-16).



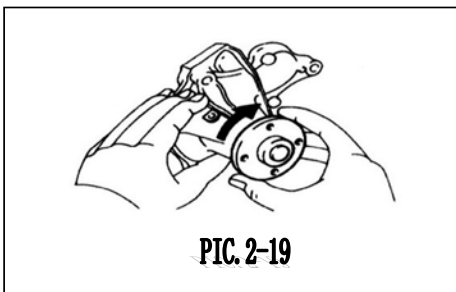
(c) Use presser to press new rotor on shaft of water pump bearing till it departure from pump body installation surface approximate 7.8mm (pic.2-17).



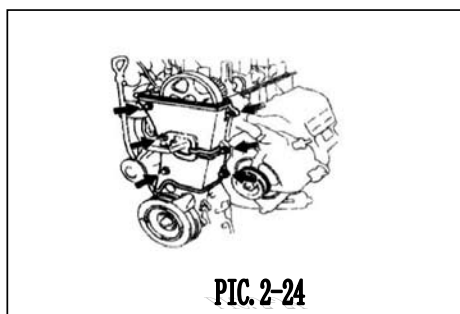
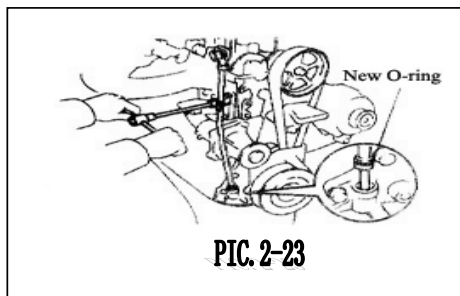
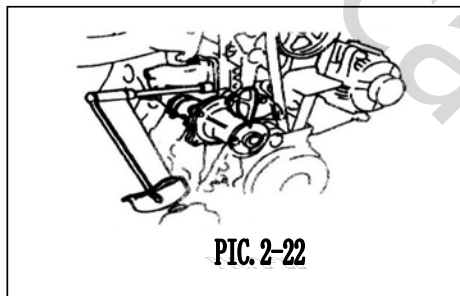
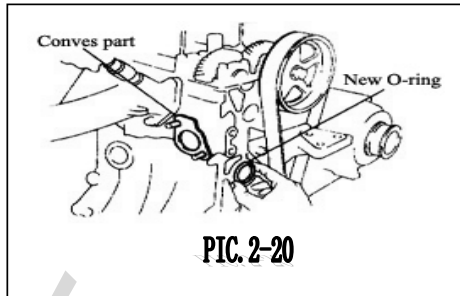
5. Install water pump suction cap

Use new gasket and 3 bolts to install water pump suction cap (pic.2-18).

Torque: 9.1N.m



6. Check if water pump is rotating smoothly (pic.2-19)



V. Install

1. Assemble water pump and water pump inlet pipe

2. Install water pump and water pump inlet pipe

- (a) Put a new O-ring on cylinder body(pic.2-20).
- (b) Place a new gasket on cylinder head, keep upper mark face upward.
- (c) Temporarily install water pump and water pump inlet pipe with 3 bolts and 2 nuts(pic.2-21).

- (d) Tighten bolts and nuts(pic.2-22).

Torque: bolt: 14N.m

Nuts: 15N.m

3. Install oil level meter and its conduit

- (a) Install a new O-ring for ruler conduit(pic.2-23).
- (b) Apply soap water on O-ring.
- (c) Push oil level meter and its conduit inward, install with bolts.

Torque: 9.3N.m

4. Connect harness protective sleeve

5. Install #2 & #3 timing belt hood

Install #2 & #3 timing belt hood with 6 bolts(pic.2-24).

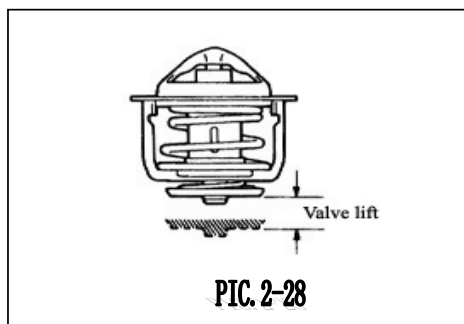
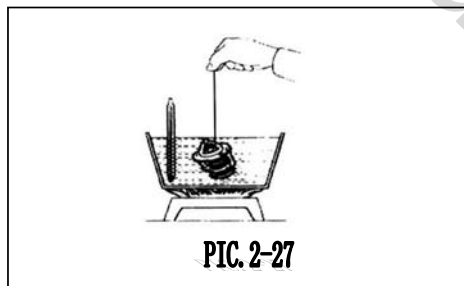
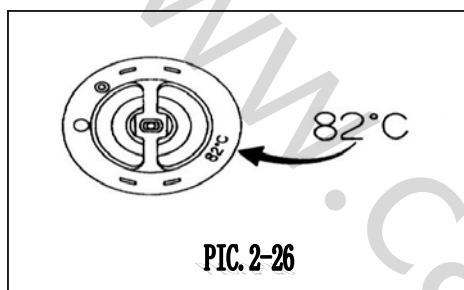
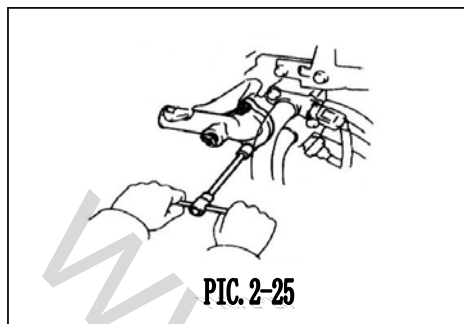
6. Install cylinder head cover

7. Install water pump belt pulley and AC generator driving belt

8. Fill up engine coolant

9. Start up engine and check for leakage

Section 3 Thermostat



I. Dismantle

Hint: Dismantle thermostat has negative influence, it may deteriorate cooling effect, do not dismantle thermostat even the engine is going to be overheat.

1. Drain engine coolant

2. Disconnect water temperature sensor connector

3. Dismantle water inlet and thermostat

- Remove 2 bolts and water inlet (pic.2-25).
- Dismantle thermostat.
- Remove gasket from thermostat.

II. Inspection

Check thermostat

Hint: Valve opening temperature is marked on thermostat (pic.2-26).

- Dip thermostat in water, gradually warm up water (pic.2-27).
- Check valve opening temperature.

Valve opening temperature: 80-84°C

If the valve opening temperature disaccord with specification, change thermostat.

- Check valve lift (pic.2-28).

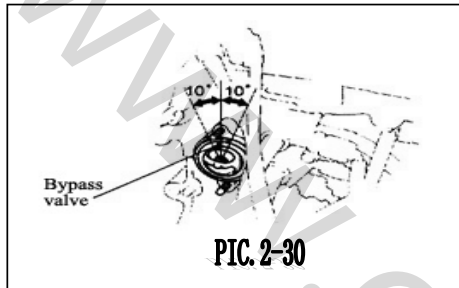
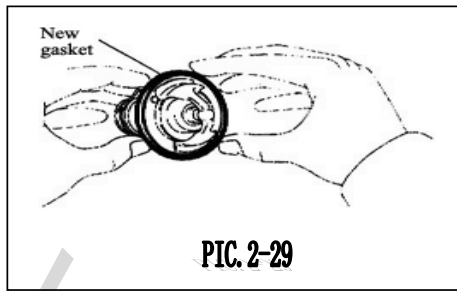
Valve lift:

The lift shall be at least 8mm or more at 95°C.

If the valve lift disaccords with specification, change thermostat.

- When thermostat is in relatively low temperature (less than 40°C), check if valve is completely closed.

If not, change thermostat.



III. Install

1. Put thermostat in water inlet casing

(a) Install new gasket on thermostat(pic.2-29).

(b) Align thermostat bypass valve with upper end of stud, insert thermostat into water inlet port Hint: Bypass valve can be placed in 10° range of specified position(pic.2-30)

2. Install water inlet

Use 2 nuts to install water inlet

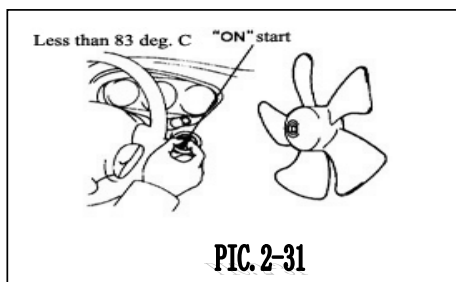
Torque: 9.3N.m

3. Connect water temperature sensor connector

4. Fill in engine coolant

5. Start up engine and check coolant for leakage.

Section 4 Electric cooling fan



I. On-vehicle inspection

1. Check operation of cooling fan under low temperature (less than 83°C)

(a) Turn on ignition switch (ON)(pic.2-31).

(b) Check if cooling fan is stopped.

If it is not stopped, check cooling fan relay and water temperature switch.

Check for disconnected connector or break conductor between cooling fan relay and water temperature switch.

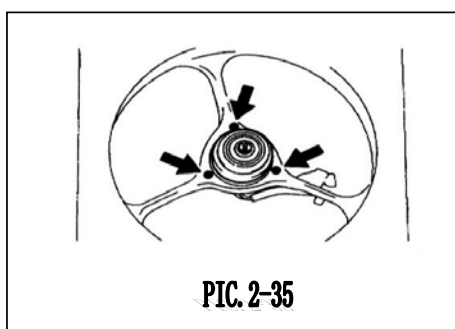
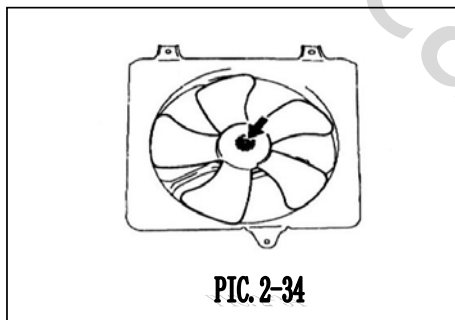
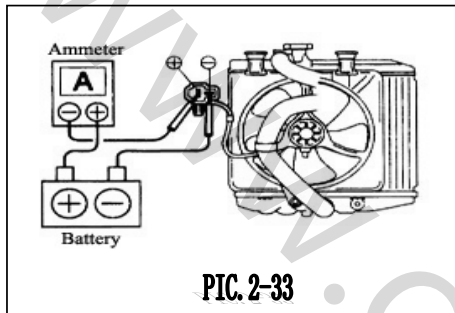
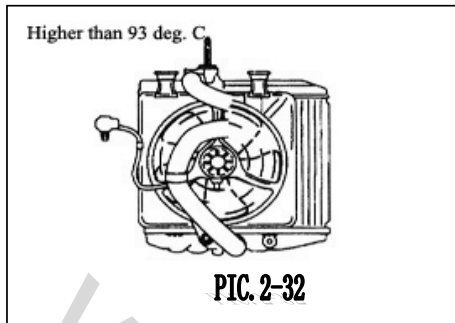
2. Dismantle water temperature switch connector.

(a) Dismantle water temperature switch connector.

(b) Use a segment of conductor to connect water temperature switch connector with earthing line.

(c) Check if cooling fan is rotating.

If not, check cooling fan relay, cooling fan, fuse, engine master relay and check if there is short circuit between cooling fan relay and water temperature switch.



3. Re-connect water temperature switch connector

4. Check cooling fan's operation under high temperature

- (a) Start up engine, warm up coolant to over 93°C(pic.2-32).
- (b) Check if cooling fan is rotating.

If not, change water temperature sensor.

5. Check cooling fan

- (a) Disconnect cooling fan connector.
- (b) Connect battery, ammeter with cooling fan connector(pic.2-33).
- (c) Check if cooling fan is rotating smoothly, check reading on ammeter.

Standard current intensity: 5.7-7.7 amp

- (d) Reconnect cooling fan connector.

II. Dismantle

1. Dismantle fan hood

Remove nuts and fan(pic.2-34).

2. Dismantle fan motor

Disconnect conductor from fan hood.

Remove 3 screws and fan motor(pic.2-35).

III. Re-assemble

1. Install fan motor

- (a) Install fan motor with 3 screws(pic.2-34)

Torque: 26N.m

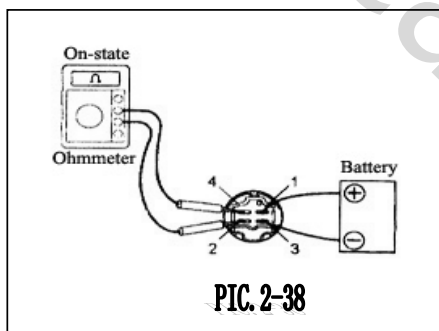
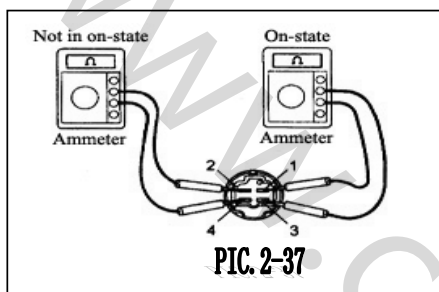
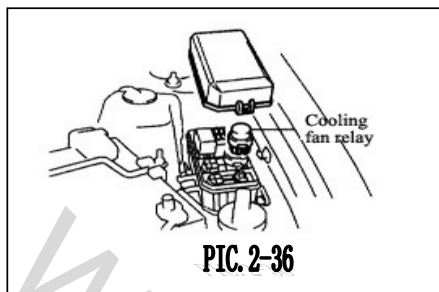
- (b) Connect conductor on fan hood

2. Install fan

Install fan with nuts.

Torque: 6.2N.m

Section 5 Cooling fan relay



1. Check cooling fan relay

- (a) Remove relay box cover.
- (b) Remove cooling fan relay (pic.2-36).

(c) Check cooling fan relay on-state (pic.2-37):

- (1) Check with ohmmeter. Terminal 1 and 3 shall be in on-state.

If not, change relay.

- (2) Check between terminal 2 and 4, it must not be in on-state.

If in on-state, change relay.

(d) Check cooling fan relay functioning (pic.2-38):

- (1) Apply positive voltage from battery on terminal 1 & 3.

- (2) Check between terminal 2 & 4 with ohmmeter, it shall be in on-state.

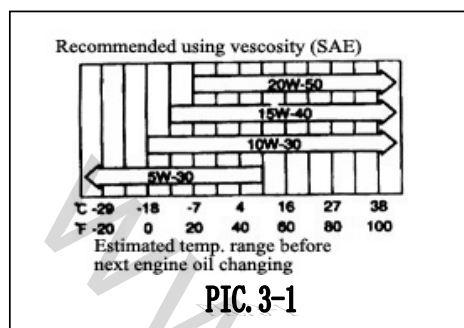
If not, change relay.

- (e) Replace cooling fan relay.

- (f) Replace relay box cover.

Chapter 3 Lubrication system

Section 1 Engine oil and filter

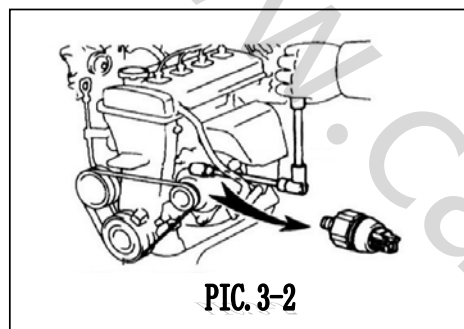


I. Inspection

1. Check engine oil quality

Check engine oil for deterioration, water inlet, fade or dilution.

If the oil quality is deteriorated by visual inspection, change Engine oil.



The suggest viscosity is as illustrated(pic.3-1).

2. Check engine oil level

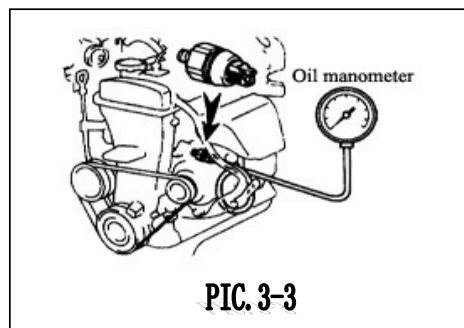
Preheat engine and stop for 5 min., the engine oil level shall be between L & F mark of engine oil ruler. If its lower, check for leakage and fill in engine oil to F mark.

Note: Do not fill in engine oil over F mark.

3. Dismantle oil pressure switch. Install oil pressure meter.

(a)Use special service tool to remove oil pressure switch(pic.3-2).

(b) Install oil pressure meter(pic.3-3).



4. Preheat engine

Preheat engine to normal working temperature.

5. Check oil pressure

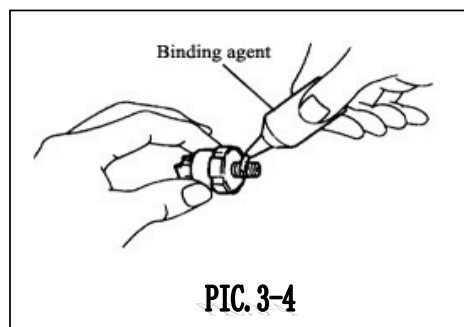
Oil pressure: 49kPa at idle speed: 3000 rpm, 294-539kPa

6. Dismantle oil pressure meter and replace oil pressure switch

(a)Dismantle oil pressure meter

(b)Apply binding agent on 2 or 3 threads on oil pressure switch(pic.3-4).

(c)Use special service tool to install oil pressure switch.



Torque: 15N.m

7. Start up engine and check for leakage

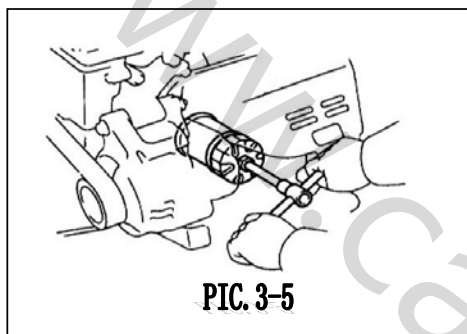
II. Change

Notes:

- Long time contact with mineral oil may remove natural fat from skin and cause dry, irritation and dermatitis. Besides, used engine oil contains harmful pollutant that may cause skin cancer.

- Take care to reduce duration and frequency of your skin contact with used engine oil, wear blue protective clothes and gloves. Clean skin thoroughly with soap and water or use anhydrous cleanser to clear any used engine oil. No not use gasoline, dilutant or solvent.

- In order to protect environment, dispose used engine oil and oil filter at specified place.

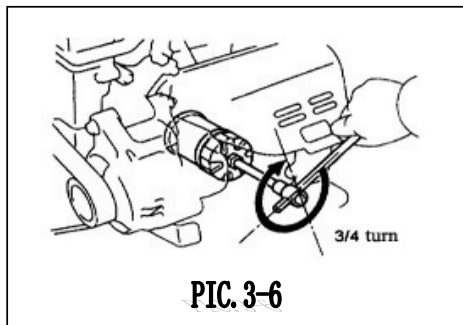


1. Drain engine oil

- Remove engine oil filler cap.
- Remove engine oil drainage plug screw, drain engine oil into containers.

2. Change oil filter

- Use special service tool to dismantle oil filter(pic.3-5).
- Check and clear install surface of filter.
- Check if parts number of new oil filter is identical with original number.
- Apply new engine oil on gasket of new oil filter.
- Slightly tighten oil filter, tighten when gasket touches seat.
- Use special service tool and tighten another 3/4(pic.3-6).



3. Refill engine oil

- Clean oil drainage plug screw. Replace oil drainage plug screw after changing gasket.

Torque: 54N.m

- Fill in new engine oil.

Capacity

Drain and refill:

Change oil filter: 3.0L

Without change oil filter: 2.8L

Fill in dry oil tank : 3.5L

- Install engine oil filler cap.

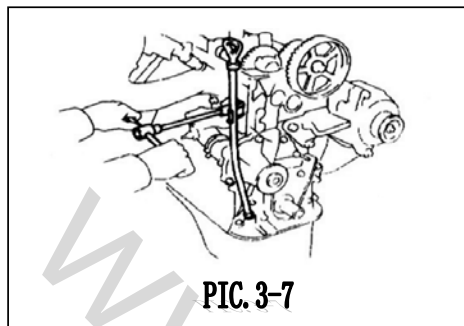
4. Start up engine and check for leakage

5. Recheck engine oil level

Section 2 Engine oil pump

I. Dismantle

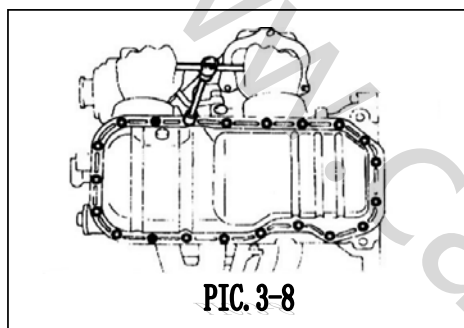
Hint: When repair oil pump, dismantle and clean oil pan and engine oil strainer.



PIC. 3-7

1. Drain out engine oil.
2. Dismantle timing belt .
3. Dismantle tensioner and its tension spring.
4. Dismantle crankshaft timing belt pulley.
5. Dismantle oil level meter and its conduit(pic.3-7).

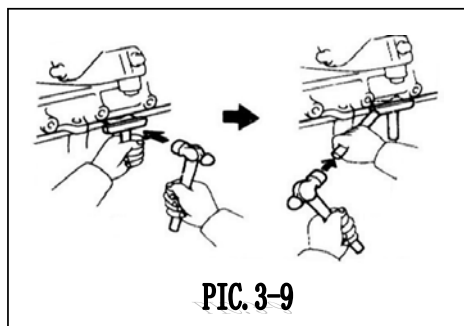
- (a) Dismantle erection bolt.
- (b) Pull out oil level meter and its conduit.
- (c) Remove O-ring from oil level meter conduit.



PIC. 3-8

6. Dismantle oil pan

- (a) Dismantle 19 bolts and 2 nuts(pic.3-8).

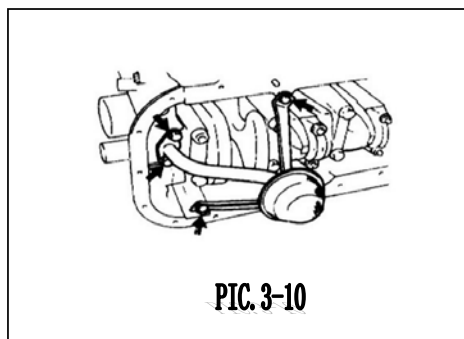


PIC. 3-9

- (b) Insert blade of special service tool in between cylinder body and oil pan, cut open applied sealant. Remove oil pan(pic.3-9).

Note:

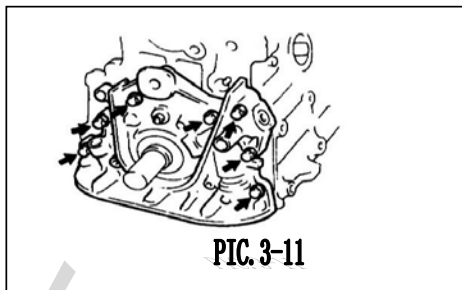
- . Do not use special service tool on oil pump main body side and engine oil rear sealing seat.
- . Take care not to damage oil pan flange.



PIC. 3-10

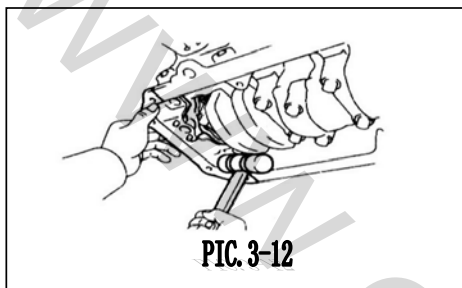
7. Dismantle Engine oil strainer

Dismantle 2 bolts, 2 nuts, strainer and gasket(pic.3-10).

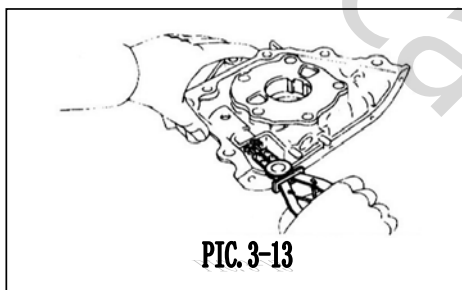


8. Dismantle oil pump

- (a) Dismantle 7 bolts (pic.3-11).
- (b) Slightly strike oil pump body using plastic overlaid hammer and dismantle oil pump.

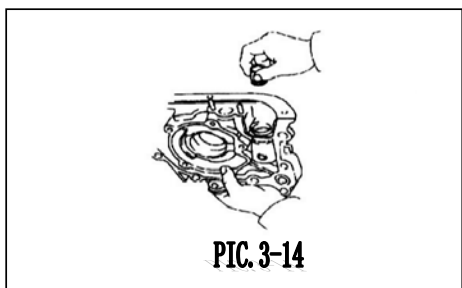


- (c) Remove gasket (pic.3-12).



II. Disassemble

1. Dismantle relief valve
 - (a) Remove snap ring with snap ring pliers (pic.3-13).
 - (b) Dismantle limit and driven rotor
2. Dismantle driving and driven rotor
 - Dismantle 5 screws, pump body outer cap, O-ring, driving and driven rotor

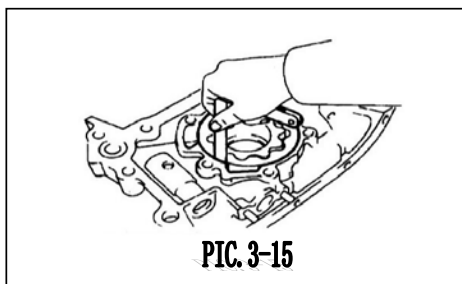


III. Inspection

1. Check relief valve

Apply relief valve with engine oil, check if it can fall into valve orifice at its own gravity (pic.3-14).

If not, change relief valve. change oil pump assembly if necessary.



2. Check driving and driven rotor

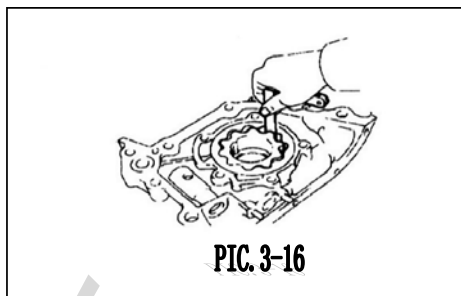
A. Check rotor clearance.

Measure clearance between driven rotor and main body with thickness meter (pic.3-15).

Standard main body clearance: 0.10-0.18mm

Max. main body clearance: 0.20mm

If the clearance exceeds max. value, change



whole sets of rotor. change oil pump assembly if necessary.

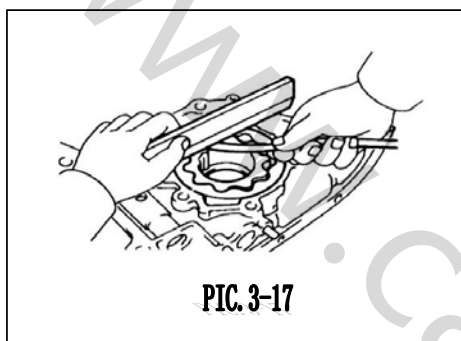
B. Check rotor tip clearance.

Standard tip clearance: 0.060-0.180mm

Max. tip clearance: 0.35mm

Measure clearance between tips of driving and driven rotors with a thickness meter(pic.3-16).

If the tip clearance is larger than max. value, change the whole set of rotor.



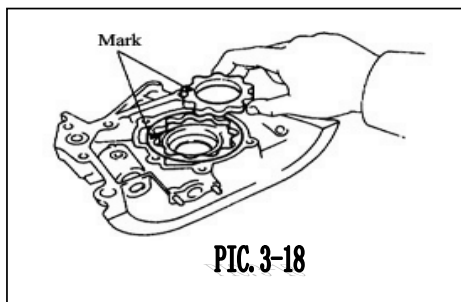
C. Check rotor side clearance.

Measure clearance between rotor and precise ruler with thickness meter and precise ruler(pic.3-17).

Standard side clearance: 0.025-0.075mm

Max. side clearance: 0.10mm

If the side clearance exceeds max. value, change the whole set of rotor. Change oil pump assembly if necessary.



IV. Change

Change oil seal in front of crankshaft

V. Re-install

1. Install driving and driven rotor

(a) Turn driving and driven rotor into pump body, keep the mark facing pump body cap side(pic.3-18).

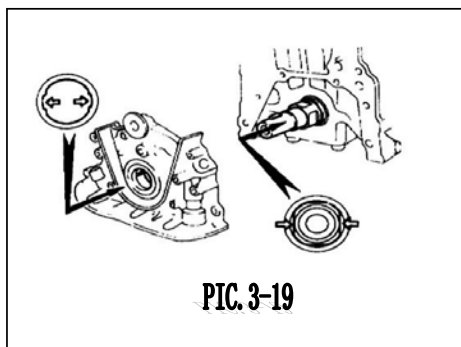
(b) Install oil pump body cap with 5 screws

Torque: 10N.m

2. Install relief valve

(a) Insert relief valve, spring and limiter into oil pump body orifice.

(b) Install snap ring with snap ring pliers.

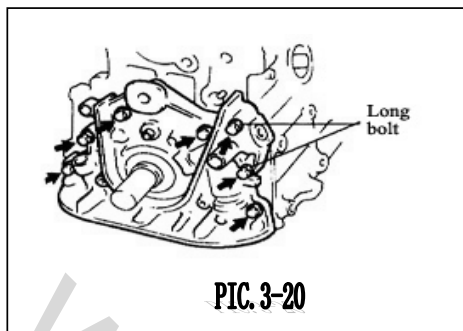


VI. Install

1. Install oil pump

(a) Place a new gasket onto specified end face on cylinder body.

(b) Engage key way of oil pump driving rotor with big teeth on crankshaft, slide in oil pump(pic.3-19).



(c) Install oil pump with 7 bolts.

Torque: 22N.m

Long bolts: 35mm(pic.3-20)

Other bolts: 25mm

2. Install engine oil strainer

Install new gasket and engine oil strainer with 2 bolts and 2 nuts.

Torque: 9.3N.m

3. Install oil pan

(a) Remove all old packing material, take care not to drip engine oil on contact face between oil pan and cylinder body.

- Use blade and gasket cleaner to clear all used packing material from gasket surface and sealing groove.

- Thoroughly clean all parts. Clear all loose matters.

- Clean both sides of sealing surface with residueless solvent.

Note: Do not use solvent that might influence varnish surface.

(b) Apply sealing packing material on oil pan as illustrated(pic.3-21).

- . Install filling nozzle with cut dia. of 3-5mm.

- . Assemble parts within 5 min. after applying packing material, or the packing material shall be cleared and reapplied.

- . Dismantle filler from pipe immediately and replace cap.

(c) Install oil pan with 19 bolts and 2 nuts.

Torque: 4.9N.m

4. Install oil level meter and its conduit

(a) Install new O-ring on oil level meter conduit(pic.3-22).

(b) Apply soap water on O-ring.

(c) Push in oil level meter conduit and oil level meter together and installed with bolts.

Torque: 9.3N.m

5. Install crankshaft timing wheel

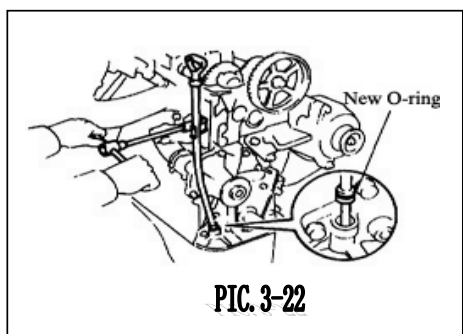
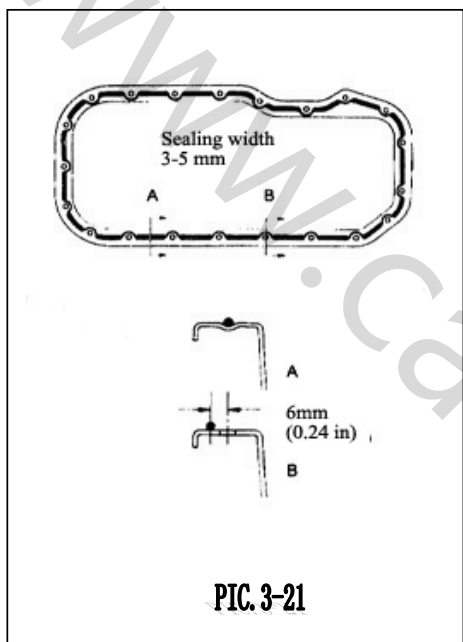
6. Temporarily install tensioner and tension spring

7. Install timing belt

8. Fill in engine oil

9. Start up engine and check for oil leakage

10. Recheck engine oil level



Chapter 4 Tail gas exhaust control

Section 1 General

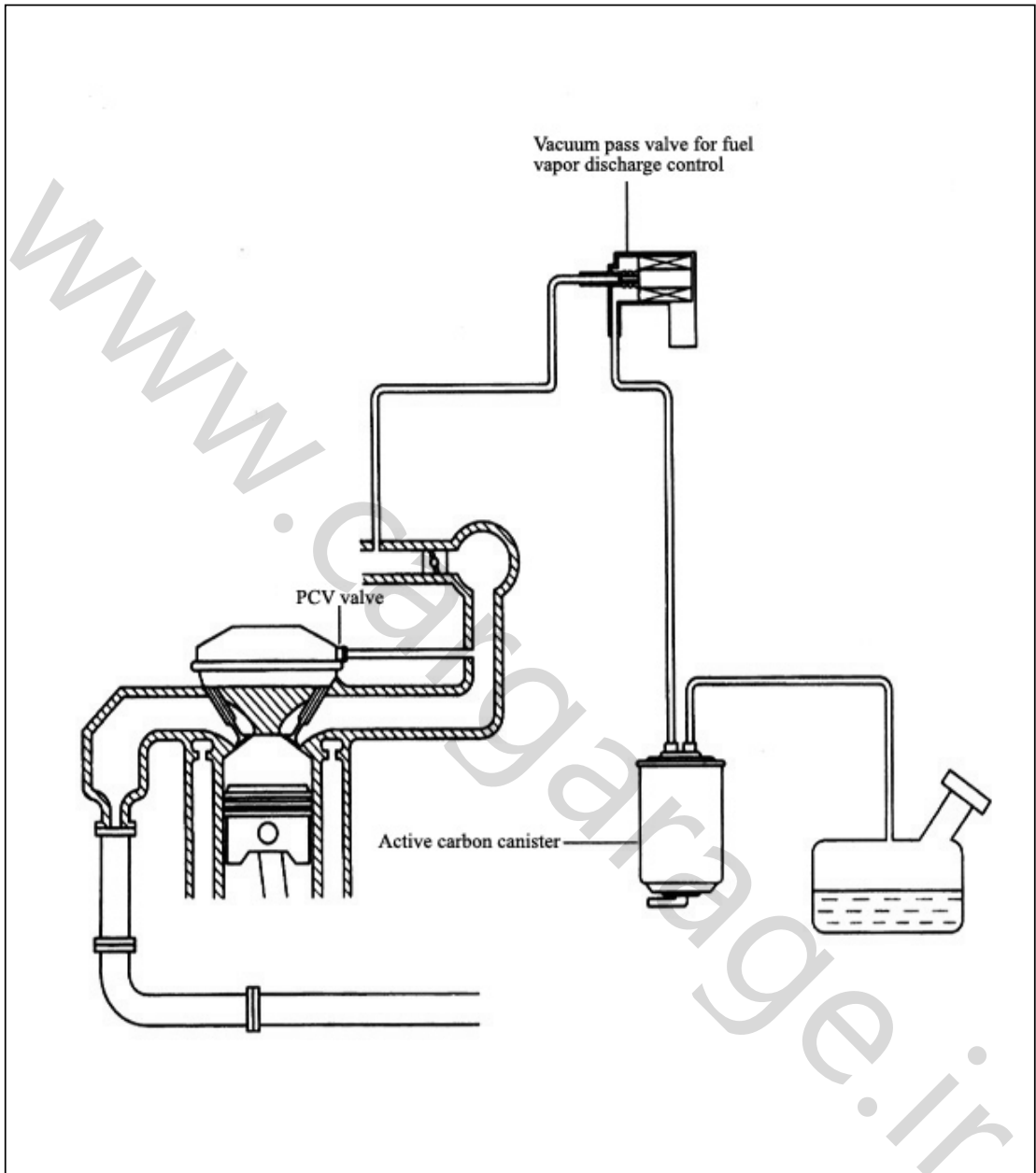
Purpose

Install tail gas exhaust control system for reducing CO emission and hydrocarbon quantity from engine, so to prevent hydrocarbon contained gas from exhausted to atmosphere, and thus effectively prevent hydrocarbon contained fuel vapor discharged from fuel tank from entering atmosphere.

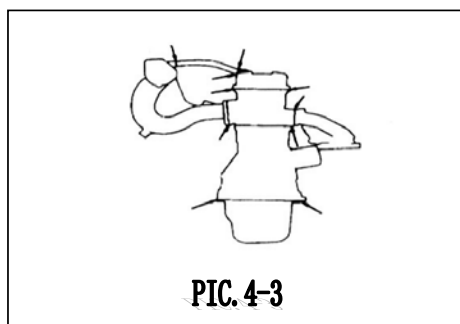
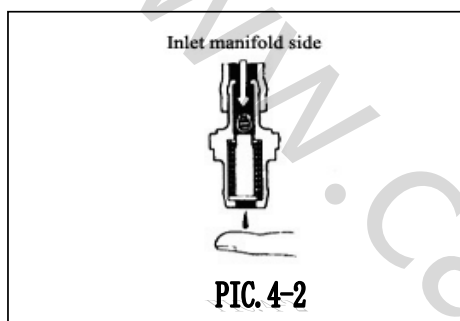
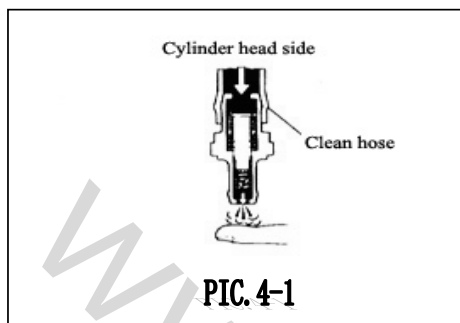
Function table of system refers to following:

System	Abbr.	Purpose
(1) Positive crankcase ventilation system	PCV	Reduce gas leakage (hydrocarbon)
(2) Evaporative system	EVAP	Reduce hydrocarbon evaporation
(3) Electronic fuel injection	EFI	Adjust work condition of all parts of engine to reduce tail gas emission

Schematic diagram



Section 2 Positive crankcase ventilation (PCV) system



Inspection

1. Dismantle PCV valve

- (a) Dismantle PCV hose from PCV valve.
- (b) Dismantle PCV valve.

2. Install clean hose on PCV valve

3. Check PCV valve operation

- (a) Purge air in PCV valve from cylinder head side, check if the air path is smooth (PIC.4-1).

Note:

- Do not purge in air via PCV valve.
- Petroleum substances in PCV valve are harmful.

- (b) Purge air in PCV valve from air inlet side, check if the air path is smooth (pic.4-2).

In operation disaccords with requirement, change PCV valve.

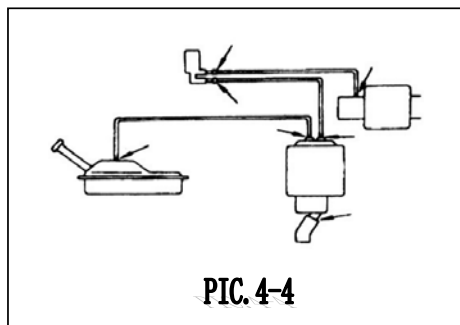
4. Dismantle & clean hose from PCV valve.

5. Re-install PCV valve

6. Visual check hose, connector and gasket

Check for crack, leakage or damage (pic.4-3).

Section 3 Fuel evaporative discharge (EVAP) control system



Inspection (pic.4-4)

1. Visual inspect pipe and connector

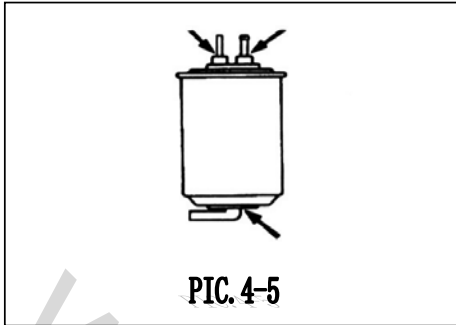
Check for loose connector, sharp bend or damage.

2. Visual check fuel tank

Check for distortion, crack or fuel leakage.

3. Visual check fuel tank cap

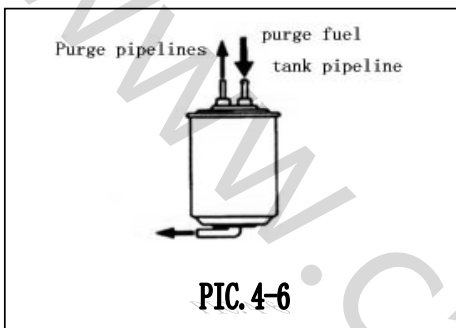
Check tank cap and/or liner for deformation or damage. Repair or change tank cap if necessary.



4. Check active carbon canister(pic.4-5)

A. Dismantle active carbon canister

B. Visual check active carbon canister casing

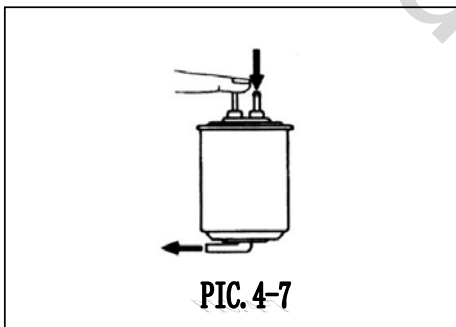


C. Check if filter is clogged, if the check valve is jammed(pic.4-6)

(a) Use low pressure compressed air to purge fuel tank pipeline, check if the air is flowing out smoothly from other pipelines.

(b) Purge pipelines, check if the air flows out from other pipelines.

If anything wrong, change this active carbon canister



D. Clean filter inside active carbon canister

Close other pipelines from top of active carbon canister, purge air into fuel tank pipe to clean filter

Hint: Do not attempt to clean active carbon canister, do not let active carbon leaked.

E. Install active carbon canister

5. Check vacuum pass valve for fuel vapor discharge control(pic.4-7)

Chapter 5 Electrics

Section 1 Electronic fuel injection (EFI) system

1. Notice:

Disconnect cable from negative pole of battery before fuel system service.

Note: Every fault diagnosis code saved by computer is to be deleted when disconnect battery negative (-) wire. Therefore, read fault diagnosis code prior to disconnect battery negative (-) wire.

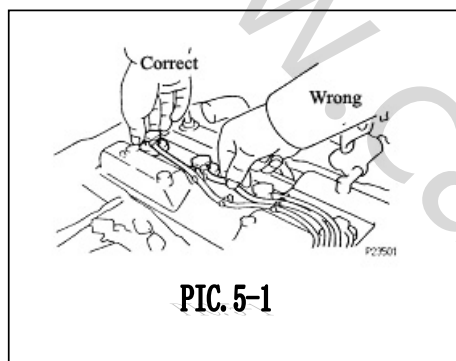
- (a) During fuel system servicing, do not smoke or operate near open flame
- (b) Keep rubber or leather parts from gasoline
- (c) Repair one group of component at a time in case make confuse of similar components;
- (d) Keep service site clean in case polluting other parts;
- (e) Take care not to mix or miss clamps or springs.

2. Notice prior to service:

- (a) Use battery as power source for timing lights and Tachometer, etc.
- (b) If the engine can not be ignited, check following items
 - (1) Check if battery terminals are correctly connected.
 - (2) Carefully pull out high voltage winding(pic.5-1).
 - (3) After service, check if bobbin wiring terminal and other conductors of ignition system are securely connected.
 - (4) When cleaning engine chamber, pay special attention to water seepage into electronic system.
- (c) Notice when pulling out oxygen sensor
 - (1) Do not allow oxygen sensor to fall or collision with other objects.
 - (2) Do not contact oxygen sensor with water.
- (d) Connect harness to socket
 - (1) Insert harness terminals into socket till it is safely locked in socket clip.
 - (2) Pull harness and check if the lock is secure.

3. Air inlet system

- (a) Disengage of engine oil ruler, engine oil filler cap, PCV (Positive crankcase ventilation) hose, etc. will cause engine malfunction.
- (b) If the air inlet system components between choke valve and cylinder head is disconnected, loosed or cracked, air may be absorbed and cause engine malfunction.



PIC. 5-1

Section 2 Electric control system

1. Notice before service:

- (a) Before removing ECM harness plug, turn off power or disconnect battery negative (-) terminal even the ignition key is in Off position.

Note: Check fault diagnosis code before disconnect battery negative (-) terminal.

- (b) Special care shall be taken when install battery, do not opposite the positive & negative pole of battery.

- (c) When dismantle and install electronic elements, prevent from interactivity among elements in case negative influence. Carefully treat all electric element, especially ECM.

- (d) Since there are large number of transistor circuit in ECM, special attention shall be taken during fault locating process, even slight contact may cause failure.

- (e) Do not open ECM hood.

- (f) Special attention shall be taken when conduct inspection in rainy days in case water enters in ECM, when clean engine chamber, prevent water from entering ECM and harness plug.

- (g) ECM component shall be changed as assembly.

- (h) Take caution when insert and pull out harness terminals.

(1) After release lock, the outer pull force shall be applied on plug (pic.5-2).

(2) During assembling, the plug shall be fully inserted and locked (pic.5-3).

- (i) When checking connector with voltmeter/ohmmeter:

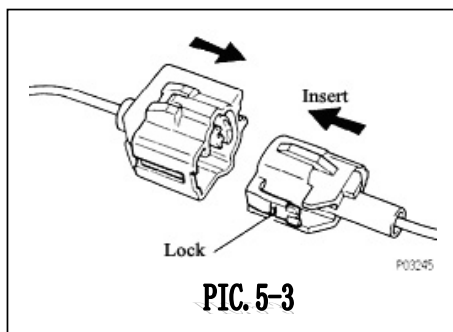
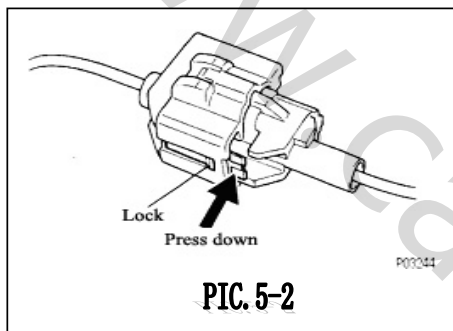
(1) If its water proof plug, slightly pull out water proof plug.

(2) Insert test probe from one side of harness into plug to check on-state, current and voltage.

(3) Do not apply unnecessary over strength on terminal.

(4) After inspection, install water proof plug on harness plug and fix.

- (j) Use special service tool to check and test fuel injection nozzle or conductor connectors



2. Measure engine alarm lamp

- (a) When ignition switch is ON without start up engine, the engine alarm lamp will light up.
 (b) After engine, the engine alarm lamp shall OFF. If not, it indicates fault or abnormal situation exists in engine electric system.

3. Use hand held diagnosis instrument (diagnosis instrument model OBD II) to detect fault code.

- (a) Connect hand held diagnosis instrument to diagnosis plug.
 (b) Read diagnosis failure code as per prompt on screen, please refer to hand held diagnosis instrument guide for more details.

4. Clear fault diagnosis code

- (a) After fault area recovered, the fault code remains in ECM RAM. To clear these codes, disconnect electronic fuel ejection fuse (15A) or disconnect battery negative pole at least 10 sec. when ignition switch in OFF position, so to clear fault code by cutting off system power. This time is determined by ambient temperature (the lower the temperature is, the longer the power off duration is).

Note:

. Clearing fault code may also be realized by disconnect battery negative (-) cable, however, under this situation, other RAM (such as clock, etc.) shall also be cleared.

. If these fault code were remained uncleared, then these fault code will be save by ECM and will occur as history fault code together with new fault code in future fault inspection.

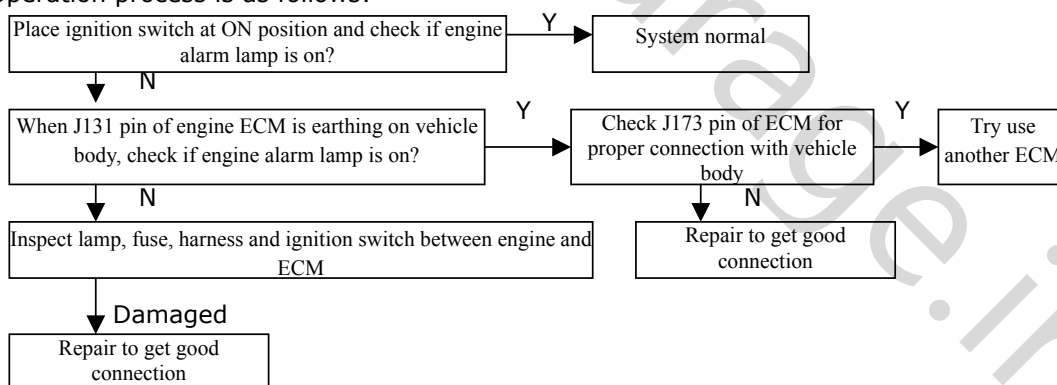
. If service at terminals disconnected from power on engine assembly is required, first check if the fault code is recorded.

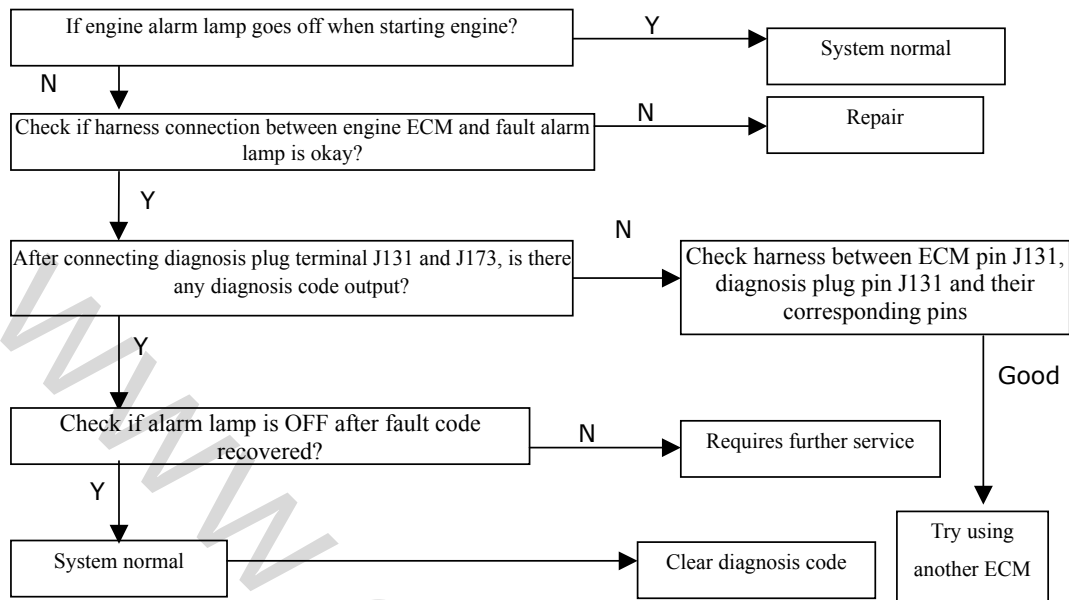
- (b) After fault code cleared, conduct road test to vehicles to check if alarm lamp for engine fault is regularly displaced. If same fault code occurs, it indicates the fault area is not completed repaired.

5. Monitor ECM data with hand held diagnosis instrument

- (a) Connect hand held diagnosis instrument with diagnosis plug.
 (b) Monitor ECM data as per prompt on instrument screen.

Operation process is as follows:





6. Use high impedance multimeter to check fault

Note:

- . Following fault diagnosis procedure is designed for diagnose each independent system, therefore the actual inspection procedure might have difference with following procedure. However, fault inspection shall be conducted as per inspection mode mentioned in this manual.
- . Before inspection, briefly check fuse, heavy current fuse and connection of plugs.
- . Following procedure of fault detection is based upon following assumptions: i.e. fault is caused by short-circuit or break circuit in computer.
- . If the fault still exists when normal working voltage at diagnosis instrument interface is detected, consider the ECM has fault and change it.

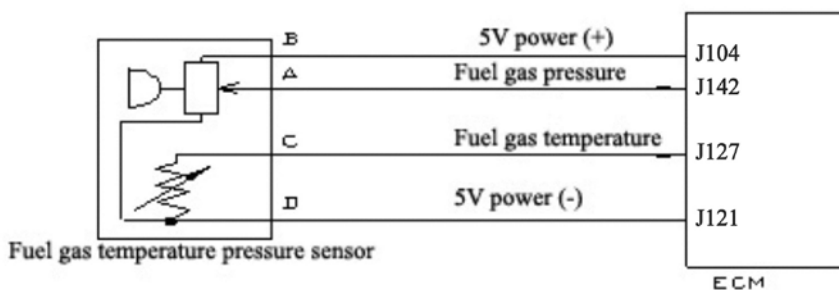
7. EFI system inspection procedure

Preparation before inspection:

- . Conduct overall voltage measuring when all plugs are well connected.
- . Make sure the battery voltage is no less than 11V when ignition switch is at ON position.

(a) Detect air inlet temperature & pressure sensor fault

Schematic diagram as follows:



(b) Check fault with hand held tester and read value from it.

(1) Turn ignition switch to ON position.

(2) Turn on hand held tester and operate per instruction, read out value displayed on tester (pressure value, temperature value shall be identical with atmospheric pressure and air inlet temperature), check if there is corresponding fault code, if OK, check for intermittent fault; If not OK, proceed to next step.

(3) Measure voltage on ECM terminal J104

a. Turn ignition switch to ON position.

b. Measure voltage between ECM connector terminal J104 and terminal J121, the normal value shall be 4.5~5.5V.

If not OK, check and change ECM; If OK, proceed to next step.

(4) Measure voltage on ECM connector terminal J142

a. Turn ignition switch to ON position.

b. Measure voltage between ECM connector terminal J142 and terminal J121, the normal value is 3.4~3.8V;

If not OK, check and change ECM; If OK, proceed to next step.

(5) Measure voltage on ECM connector terminal J127

Measure voltage between ECM connector terminal J127 and terminal J121, when air inlet temperature is 20°C, the voltage is 0.5~3.4V; When air inlet temperature is 60°C, the voltage is 0.2~1.0V. If OK, check and change ECM; If not, proceed to next step.

(6) Check harness and connector (ECM-air inlet temperature pressure sensor):

a. Disconnect ECM connector and air inlet temperature pressure sensor connector.

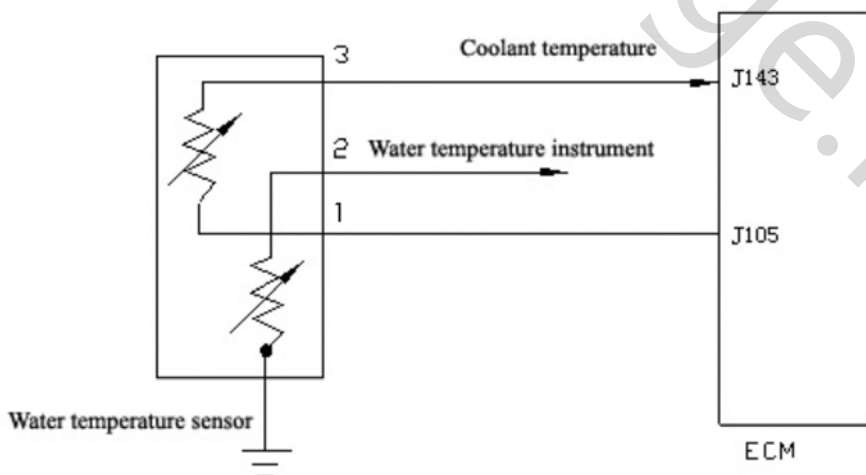
b. Measure resistance respectively on ECM connector terminal J104, J121, J142, J127 and resistance on sensor connector terminal B, D, A, C, its value shall be no bigger than 1Ω.

c. Measure resistance respectively between ECM connector terminal J104, J121, J127, J142 and chassis tapping, the value of which shall be no less than 1MΩ.

If not OK, repair or change harness or connector; If OK, change air inlet temperature pressure sensor.

8. Water temperature sensor fault detection

Schematic diagram as follows:



Detect fault with hand held tester

(a) Read value from hand held tester (engine coolant temperature).

(1) Turn ignition switch to ON position.

(2) Turn on hand held tester, operate as per instruction, read value displayed on tester (engine coolant temperature), check for corresponding fault code. If OK, check for intermittent fault; If there is intermittent fault, proceed to next step.

(b) Check harness on-state.

(1) Turn ignition switch to ON position.

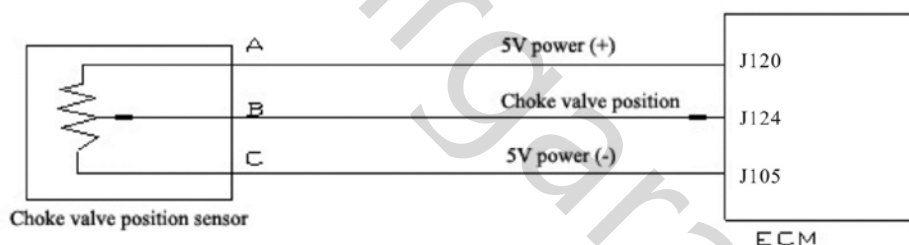
(2) Disconnect water temperature sensor connector. Measure voltage between water temperature sensor connector terminal 3 & terminal 1, its value shall be 4.5~5.5V. If OK, change sensor; If not, proceed to next step inspection.

(3) Turn ignition switch to OFF position, disconnect water temperature sensor and ECM connector, check resistance between ECM terminal J143 and sensor terminal 3, ECM terminal J105 and sensor terminal 1, the value of which shall be no higher than 1Ω. Check resistance between sensor terminal and chassis tapping, the value of which shall be no less than 1 MΩ. If not OK, change harness; If OK, change sensor.

If the fault code still exist or the display value is not normal after changing sensor, change ECM.

9. Choke valve position sensor circuit fault

Schematic diagram for testing circuit is as follows:



Detect fault with hand held tester

(a) Read value from hand held tester (choke valve opening percentage).

(1) Turn ignition switch to ON position.

(2) Turn on hand held tester, read displayed value or see if there is fault code. If there is not, check for intermittent fault. Step down accelerator pedal, choke valve opening shall enlarge accordingly. If fault exists or display abnormal, proceed with following steps.

(b) Check choke valve position sensor:

(1) Disconnect choke valve position sensor connector.

(2) Check voltage between choke valve position sensor connector terminal A and terminal B, the voltage shall be $5 \pm 0.5V$, If not OK, check, ECM and harness, If OK, proceed with following steps.

(3) Measure resistance on sensor terminal A, B and C, resistance between terminal A & B shall be 12kΩ, the resistance change between terminal A and C shall be 3~12 kΩ. If the resistance is not normal, change sensor, the changed sensor shall be matched with choke valve body before use. If OK, proceed with following steps.

(c) Check harness and connector (ECM-choke valve position sensor):

- (1) Disconnect ECM connector and sensor connector.
- (2) Measure resistance between ECM connector terminal J120 and sensor terminal A; resistance between ECM connector terminal J124 and sensor terminal C as well as resistance between ECM connector terminal J105 and sensor terminal B, the value of which shall be no bigger than 1Ω . If OK, proceed with following steps; If not OK, change sensor.
- (3) Measure resistance between ECM connector terminal J120, J124, J105 and chassis tapping, the value of which shall be no less than $1M\Omega$. Measure resistance, If not OK, change harness. If OK, change sensor. If the changed sensor is still not working properly, change ECM.

10. Oxygen sensor circuit fault inspection

(a) Method:

- (1) Check voltage on ECM connector terminals J162 and J106
- (2) Start up engine, warm up to normal working temperature.
- (3) Keep engine at rotate speed of 2000 rpm for 1 min. and then measure voltage on both terminals, measure if the voltage is fluctuating near 0.45V. If yes, the oxygen sensor and its loop is intact, then check for intermittent fault. If the voltage is not normal, proceed with next step inspection;

(b) Measure if the voltage remain unchanged at above 0.45V.

(1) If yes, check if J162 is short connected to power circuit or if the air-fuel mixture too condensed. If the circuit is OK, check air inlet temperature-pressure sensor, engine water temperature sensor, fuel pressure, fuel injector and its loop, if they are normal, check ECM and its circuit.

(2) If the voltage is not normal, proceed to next step inspection.

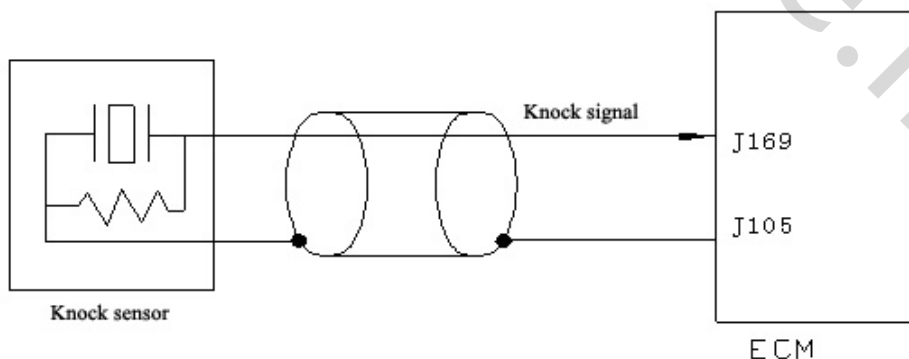
(3) Keep engine rotate speed at 2000 rpm for 1 min., quick accelerate engine repeatedly, check its voltage

a. If the voltage displays 0.45 or even one times higher, then the J162 and J106 electric circuit is badly connected or the air-fuel mixture is too thin, if the circuit is OK, check air inlet temperature-pressure sensor, engine water temperature sensor, fuel pressure, fuel injector and its loop, If OK, check ECM and its circuit.

b. If the displayed voltage is less than 0.45V, then there is J162 and J106 short circuit, open circuit or oxygen sensor functional defect. If the circuit and connection are OK, change oxygen sensor. If defect still exist after changing oxygen sensor, change ECM.

11. Knockmeter circuit fault

Schematic diagram of testing circuit is as follows:



Use hand held tester to read hold frame data. Told frame data, when detecting fault, records engine status, when locating fault, it can be used to determine whether the car is running or

stop during fault occurs, is the engine preheated, is the air fuel ratio high or low, etc..

(a) Check harness and connector:

Check on-state of harness between ECM and knockmeter. Disconnect ECM and sensor connector and measure resistance between ECM connector terminal and chassis tapping, the value of which shall be no less than $1M\Omega$. If not OK, change harness.

(b) Check knockmeter: If the oscillation frequency at normal status is not 8.1kHz, the sensor is defected, check if terminal and chassis is in on-state. If not OK, change knockmeter; If OK, proceed to next step.

(c) Check harness and connector (ECM-knockmeter)

(1) Disconnect ECM connector.

(2) Disconnect knockmeter connector.

(3) Measure resistance between ECM connector terminal J169 and knockmeter connector terminal, the value of which shall be no bigger than $1M\Omega$.

(4) Measure resistance between ECM connector terminal J169 and chassis tapping, the value of which shall be no less than $1M\Omega$. If the resistance is not normal, fix or change harness or connector; If OK, proceed to next step.

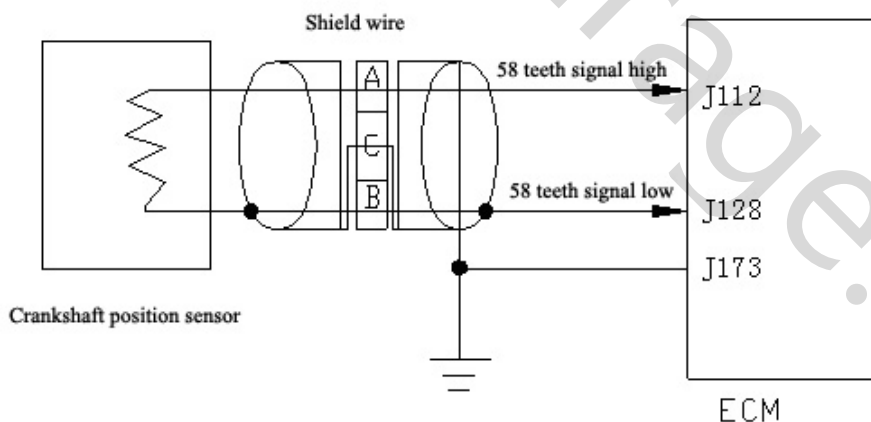
(d) After confirm installing new knockmeter, the circuit fault shall disappear

(1) Change with new knockmeter.

(2) Run road test after fault cleared.

(3) Read fault code. If fault code is no longer output, change knockmeter; If the fault code output again, check/change ECM.

12. Schematic diagram of crankshaft position sensor circuit defect testing circuit if as follows:



Use hand held tester to read hold frame data. Told frame data, when detecting fault, records engine status, when locating fault, it can be used to determine whether the car is running or stop during fault occurs, is the engine preheated, is the air fuel ratio high or low, etc.. First locate fault with identical fault code, if no fault is found, proceed with mechanical system fault diagnosis and exclusion.

(a) Check crankshaft position sensor (including resistance)

Measure resistance between crankshaft position sensor connector terminal A & B, its value shall be $560\Omega \pm 10\%$ (25Ω)

(b) Check harness and connector (ECM—crankshaft position sensor):

(1) Disconnect ECM connector.

(2) Disconnect crankshaft position sensor connector.

(3) Measure resistance between ECM connector terminal J112 and crankshaft position sensor connector terminal A, the value of which shall be no bigger than 1Ω .

(4) Measure resistance between ECM connector terminal J128 and crankshaft position sensor terminal B, the value of which shall be no bigger than 1Ω .

(5) Measure resistance between ECM connector terminal J112 and terminal J128, the value of which shall be no less than $1M\Omega$.

(6) Measure resistance between ECM connector terminal J128 and chassis tapping, the value of which shall be no less than $1M\Omega$.

(7) Measure resistance between ECM connector terminal J112 and chassis tapping, the value of which shall be no less than $1M\Omega$.

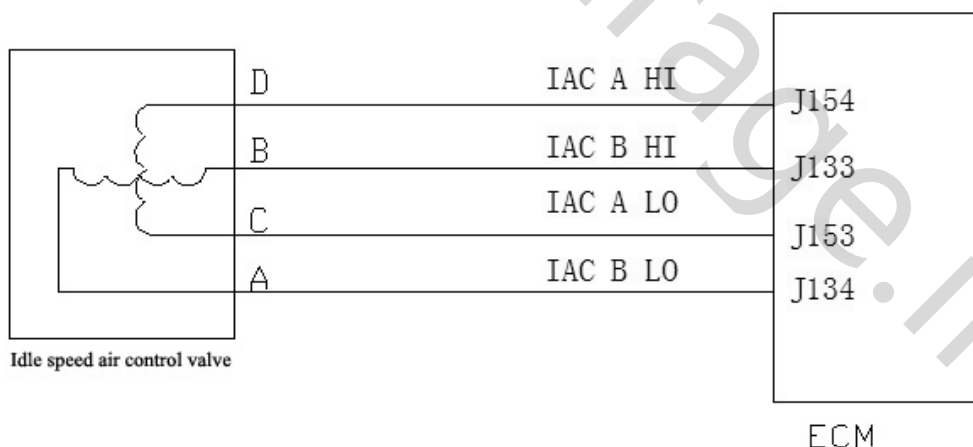
If the resistance is not OK, repair or change harness or connector; If OK, proceed to next step.

(c) Check crankshaft position sensor installation: If not OK, tighten sensor; If OK, proceed with next step.

(d) Check crankshaft timing belt pulley (Signal panel):

(1) Dismantle crankshaft timing belt pulley.

(2) Check signal panel teeth. If not OK, repair or change crankshaft timing belt pulley; If OK, check or change ECM.

13. Schematic diagram of idle speed control system electric circuit defect testing circuit is as follows:

(a) Use hand held tester

(1) Start engine, keep idle speed till engine temperature normal.

(2) Connect tester, read engine rotate speed from tester, check if the rotate speed is within the range of 800 ± 50 rpm, if the rotate speed is OK, then the idle speed air control valve system is normal. If the rotate speed is not within this range, proceed with next step inspection.

- (3) Read and check if choke valve position sensor opening figure, water temperature sensor readings, system voltage are OK, if not, check above sensors and their circuit. If the readings are OK, check idle speed air control valve and its electric circuit.
- (b) Turn ignition switch to OFF position, disconnect connector from ECM and sensor, check harness on-state.
- (1) Measure resistance between ECM connector terminal J133 and sensor terminal B, the value of which shall be no bigger than 1Ω .
 - (2) Measure resistance between ECM connector terminal J134 and sensor terminal A, the value of which shall be no bigger than 1Ω .
 - (3) Measure resistance between ECM connector terminal J153 and sensor terminal C, the value of which shall be no bigger than 1Ω .
 - (4) Measure resistance between ECM connector terminal J154 and sensor terminal D, the value of which shall be no bigger than 1Ω .
 - (5) Respectively measure resistance between connector terminal J133, J134, J153, J154 and chassis tapping, the value of which shall be no less than $1M\Omega$.
- If the above measured resistance value is not OK, repair or change harness or connector; If OK, proceed with next step.
- (c) Change idle speed air control valve, restart engine, check if idle speed is OK, If not OK, change ECM.

14. Fuel injector circuit fault inspection

(a) Check fuel injector working conditions

(1) Check working noise of each fuel injector
When engine is running or starting, use audio detector to measure if the engine gives out normal working noise under constant rotate speed.

(2) If there is no noise detector available, check fuel injector working condition with fingers. If there is no working noise or abnormal working noise, check harness terminals, fuel injector or fuel injection signal from ECM.

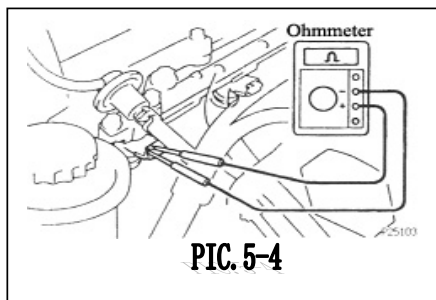
(b) Check impedance of fuel injector

- (1) Dismantle fuel injector connector.
- (2) Use ohmmeter to measure impedance between two terminals of fuel injector (pic.5-4).

Impedance: at 20°C (68°F): 12-16 Ω

If the impedance exceeds allowance, change this fuel injector.

- (3) Re-connect fuel injector connector



Section 3 Ignition system

Notes:

1. Connect a tachometer on ignition system, connect test conductor of tachometer to terminal IG (1) of connector for test.
2. Because some tachometer is not compatible with ignition system, we suggest confirming whether the used tachometer is compatible with tested ignition system prior to application.
3. Do not contact tachometer earthing terminal with earthing line, or it may cause igniter and (or) bobbin failure.

- 4. Do not disconnect battery when engine is running.**
5. Check igniter, make it correctly earthing with chassis.

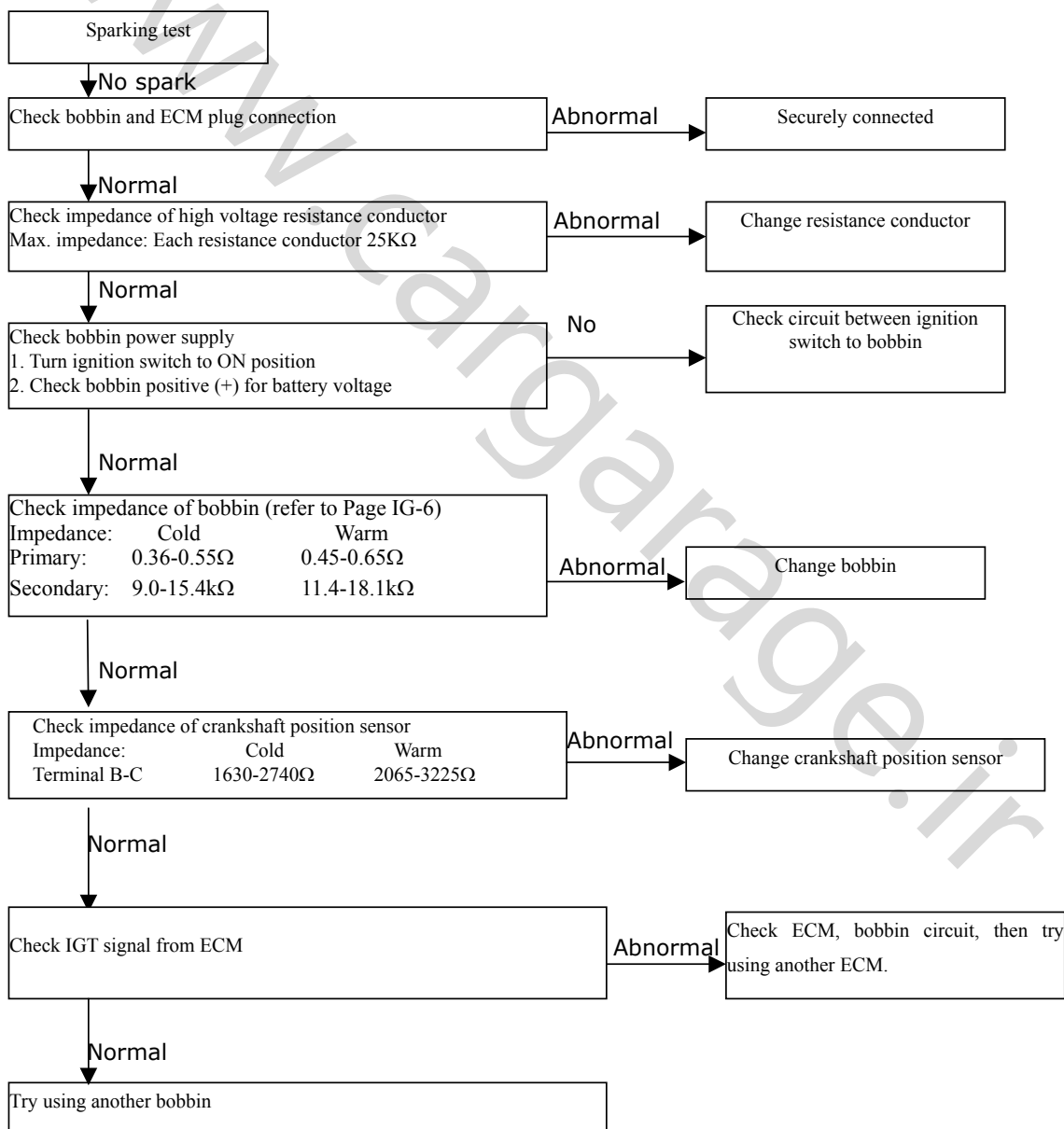
On vehicle inspection

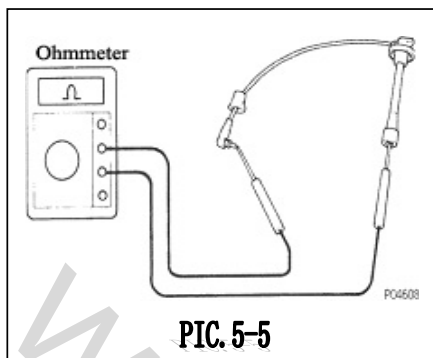
1. Sparking test

A. Check spark generation

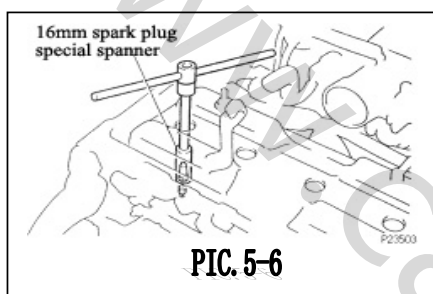
- (a) Disconnect high voltage resistance conductor from spark plug.
 (b) Remove spark plug.
 (c) Install spark plug for each high voltage resistance conductor.
 (d) Earthing spark plug.
 (e) Check if spark occurs during engine start.

Note: During test, in order to prevent gasoline from bursting out from fuel injector, each engine starting up time shall be no longer than 1-2 sec. If there is no spark, proceed with following test:

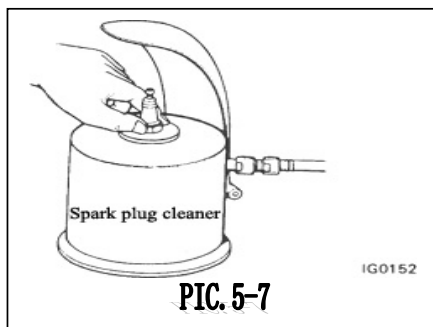




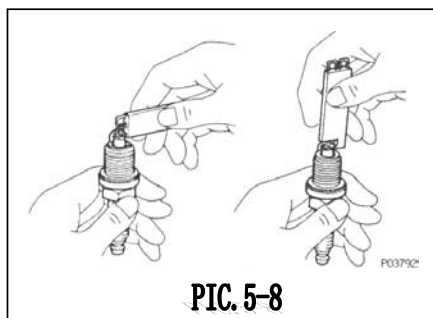
PIC. 5-5



PIC. 5-6



PIC. 5-7



PIC. 5-8

2. Check high voltage resistance conductor

(a) Disconnect high voltage resistance conductor from rubber shield.

(b) Do not pull on resistance conductor.

Notice:

- Pull or bend resistance conductor might damage inner conductor.
- After dismantle high voltage resistance conductor, Do not wipe oil smear on grommet.

(c) Check impedance of high voltage resistance conductor

Use ohmmeter to measure impedance of high voltage resistance conductor (pic.5-5) .

Max. impedance: each resistance conductor is 25K Ω

If the impedance of resistance conductor is higher than max. value, check terminals. If necessary, change high voltage resistance conductor.

(d) Reconnect high voltage resistance conductor onto spark plug.

Make sure the high voltage resistance conductor and clamp is well installed.

3. Check spark plug

(a) Disconnect high voltage resistance conductor from spark plug

(Refer to step 1 for high voltage resistance conductor inspection)

(b) Dismantle spark plug

Use a 16mm spark plug special spanner to dismantle spark plug (pic.5-6) .

(c) Clean spark plug

Use spark plug cleaner or steel wire brush to clean spark plug (pic.5-7) .

(d) Visual check spark plug

Check electrode wear, thread damage and insulation damage of spark plug.

If abnormality found, change spark plug.

Recommended spark plug: CHAMPION:

(e) Adjust electrode clearance (pic.5-8)

Carefully bend outer electrode to obtain correct electrode clearance.

Correct electrode clearance: 0.8mm

(f) Install spark plug

Use a 16mm spark plug special spanner to install spark plug.

Torque: 18N.m

(g) Reconnect high voltage resistance conductor onto spark plug

(Refer to (b) step of high voltage resistance conductor inspection)

4. Bobbin inspection

(a) Check impedance of primary coil

Measure impedance between terminal A & C with ohmmeter

Impedance of primary coil:

Cold state: 0.36-0.55Ω

Warm state: 0.45-0.65Ω

If the impedance of measured value exceeds allowance, change bobbin.

(b) Check impedance of secondary coil

Measure impedance at positive pole (+) and high voltage resistance conductor terminal with ohmmeter.

Impedance of secondary coil: cold state: 9.0-15.4KΩ; Warm state: 11.4-18.1 KΩ

If the measured value of impedance exceeds allowance, change bobbin.

5. Check crankshaft position sensor

Note: "cold state", "Warm state" in context indicates temperature of the sensor itself. "cold state" indicates temperature from -10°C to 50°C, and "Warm state" indicates temperature from 50°C to 100°C.

(a) Dismantle crankshaft position sensor

(Refer to removing crankshaft position sensor in "crankshaft position sensor")

(b) Check impedance of crankshaft position sensor.

Check impedance of terminal B & C with ohmmeter.

Impedance: cold state: 1630-2740Ω; warm state: 2065-3225Ω

If the impedance exceeds allowance, change crankshaft position sensor.

(c) Re-install crankshaft position sensor. Install crankshaft position sensor (Installation procedure is reverse with procedure of dismantle)

Service criterion Service data

Ignition sequence	---		1-3-2--4
High voltage resistance conductor	Max. value of impedance		25KΩ for each resistance conductor
spark plug	Recommended spark plug ND		K16R-U
	Correct electrode clearance		0.8mm
bobbin	Impedance of primary coil	coil cold state	0.36-0.55Ω
		warm state	0.45-0.65Ω
	impedance of secondary	coil cold state	9.0-15.4KΩ
		warm state	11.4-18.1KΩ
crankshaft position sensor	Impedance	Cold state	B-C 1630-2740Ω
		warm state	B-C 2065-3225Ω

Section 4 Starting system

On vehicle inspection

Note: Check following items again prior to operating starter:

- (1) Connection of connector
- (2) Install attachment, for instance: anti-theft system

A. Dismantle starter

- (1) Dismantle nut, remove conductor from magnetic switch terminals.
- (2) Unscrew 2 nuts that fix magnetic switch on starter casing.
- (3) Pull up magnetic switch, release plunger hood on driving rod when lifting magnetic switch front part, then release magnetic switch.
- (4) Dismantle plunger cap.

B. Dismantle magnetic pole frame and armature

- (1) Dismantle wiring between magnetic switch and motor, remove nuts, and disconnect conductor from terminal.

Torque: 5.9N.m

- (2) Remove 2 thru-bolt. **Torque: 1.2kW type: 5.9N.m**
- (3) Remove magnetic pole frame and armature from magnetic switch assembly.
- (4) Remove O-RING.

Notation to assembling:

- . Use new O-RING.
- . Align cam on magnetic pole frame with notch on magnetic switch.

C. Remove starter casing, clutch assembly and gear

- (1) Remove 2 screws. **Torque:**
1.2kW type: 5.9N.m
1.4kW type: 5.9N.m
2.0kW type: 9.3N.m

- (2) Remove following parts from magnetic switch assembly:
 Starter casing, return spring, bearing, idler, clutch assembly

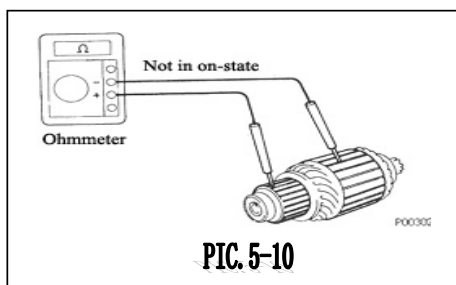
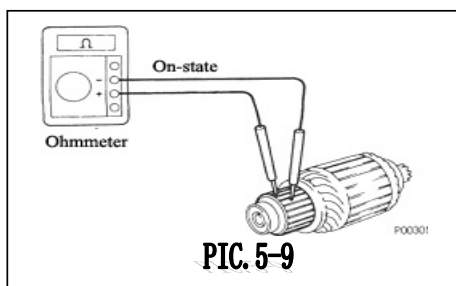
- (3) Remove steel, suck out ball from clutch shaft hole with magnetic pin.

D. Remove brush holder

- (1) Remove 2 screws and end cap in magnetic pole frame.

Torque: 1.2kW type: 1.5N.m
1.4kW type: 1.5N.m
2.0kW type: 3.8N.m

- (2) Remove O-ring from magnetic pole frame. Notation to assembling: Use new O-ring.



- (3) Press spring with screwdriver, remove electric brush from brush holder. Disconnect 4 electric brushes and remove brush holder.

E. Remove armature from magnetic pole frame

F. Armature coil

(1) Check on-state of commutator

Use ohmmeter to check if two commutator segments of commutator in on-state (pic.5-9). If any commutator segment failed, change armature winding.

(2) Check commutator earthing

Use ohmmeter to check if commutator and armature coil spindle is in on-state (pic.5-10). If it's in on-state, change armature.

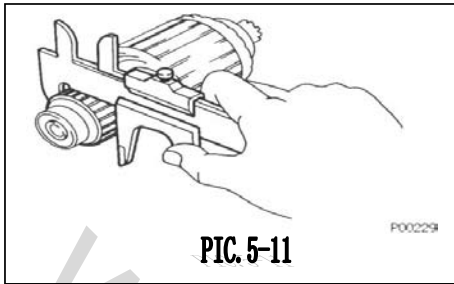
G. Commutator

(a) Check commutator pollution and surface burn

If surface is polluted or burnt, process with sand paper or turning mill.

(b) Check commutator gear ring run-out

- (1) Place commutator on a V-shape wedge.



(2) Use a micrometer to measure gear ring run-out.

Max. gear ring run-out: 0.05mm

If gear ring run-out exceeds max. value, correct it on turning mill.

(c) Check commutator dia.

Use vernier caliper to measure dia. of commutator (pic.5-11).

Standard dia.:

1.2kW type: 30mm

1.4kW type: 30mm

2.0kW type: 35mm

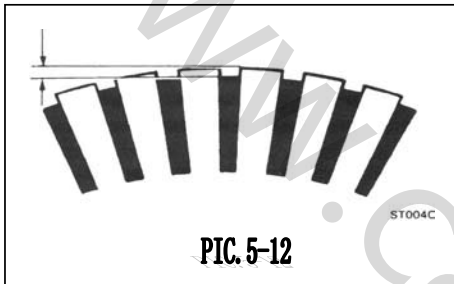
Min. dia.:

1.2kW type: 29mm

1.4kW type: 29mm

2.0kW type: 34mm

If the dia. is less than Min. value, change armature.



(d) Check undercut depth (pic.5-12)

Make sure the undercut position is clean without foreign matters, smooth edge.

Standard undercut depth:

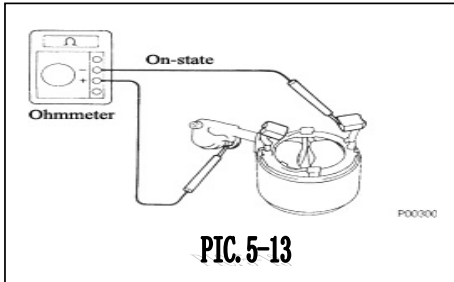
1.2kW type: 0.6mm

1.4kW type: 0.6mm

2.0kW type: 0.7mm

Min. undercut depth: 0.2mm

If the undercut depth is less than Min. value, correct with hacksaw blade.



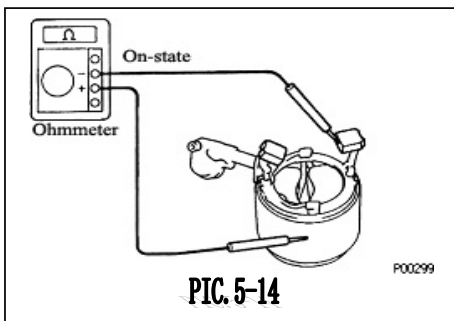
H. Magnetic pole frame (exciting coil)

(a) Check circuit break situation of exciting coil

Check with ohmmeter if the conductor and exciting coil carbon brush in on-state (pic.5-13).

If not, change magnetic pole frame.

(b) Check exciting coil earthing



Use ohmmeter to check if the end of exciting coil and magnetic pole frame not in on-state (pic.5-14).

If they are in on-state, repair or change magnetic pole frame.

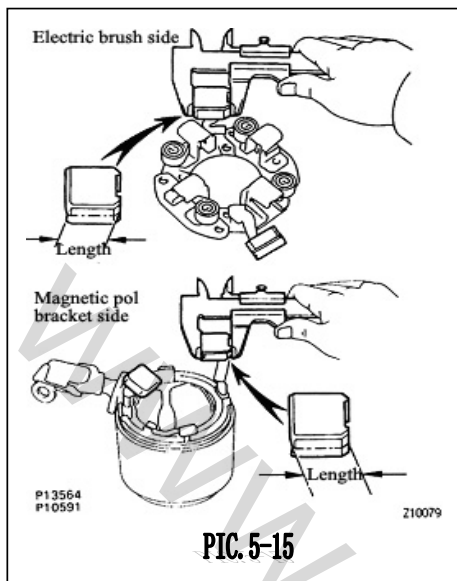
2.0 kW type: Check impedance of commutating coil

Use ohmmeter to check impedance between commutator terminal (A) and commutator terminal (B).

Standard impedance: at 20°C: 1.5-1.9Ω

I. Electric brush

Check length of electric brush length



Measure length of electric brush with vernier caliper(pic.5-15).

Standard length:

1.2kW type: 15.5mm

1.4kW type: 15.5mm

2.0kW type: 15.0mm

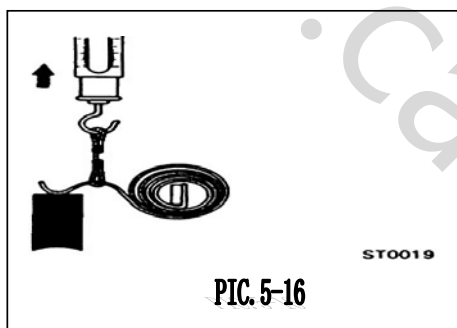
Min. length:

1.2kW type: 10.0mm

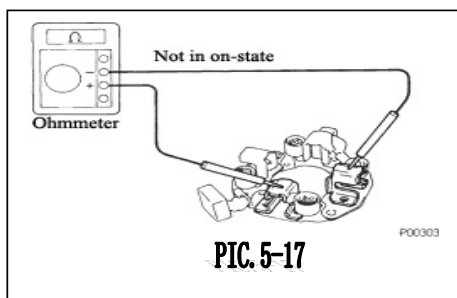
1.4kW type: 10.0mm

2.0kW type: 9.0mm

If the length is less than min. value, change brush holder and magnetic pole frame.



J. Electric brush spring(pic.5-16)



K. Brush holder

Check brush holder insulation

Use ohmmeter to check positive (+) and negative (-) pole of brush holder, it must not be in on-state(pic.5-17)

If they are in on-state, repair or change brush holder.

L. Clutch and gear

(a) Check gear teeth

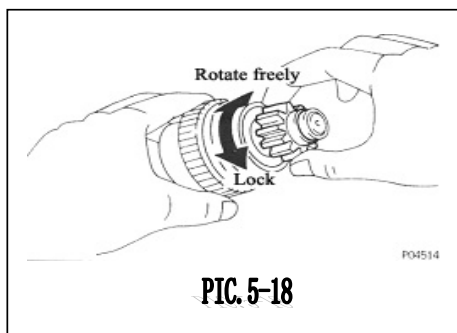
Check planet pinion, idler and gear teeth on clutch assembly for wear through or damage.

If there is damage, change gear or clutch assembly.

If there is damage, conduct wear through or damage inspection to circular gear on flywheel.

(b) Check clutch planet pinion

Hold starter clutch and turn planet pinion CW, check if the pinion can rotate freely, then try turn planet pinion CCW, it must not be rotated(pic.5-18).



Change clutch assembly if necessary.

(c)Check gear teeth

Check planet pinion, idler and gear teeth on clutch assembly for wear through or damage.

If there is damage, change gear or clutch assembly.

If there is damage, conduct wear through or damage inspection to circular gear on flywheel.

(d)Check clutch planet pinion

Hold starter clutch and turn planet pinion CW, check if the pinion can rotate freely, then try turn planet pinion CCW, it must not be rotated.

Change clutch assembly if necessary.

Section 5 charge system

Pre-alarm items -----CH-2

Preparation -----CH-2

On-vehicle inspection---CH-3


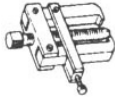
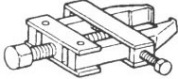
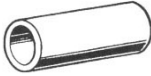
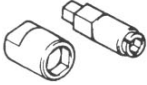
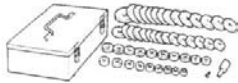
AC generator-----CH-7




Service criterion-----CH-1

Pre-alarm items

1. Check if battery cable is connected to correct terminal.
2. Disconnect battery cable, rapid discharge battery.
3. Do not use high voltage insulation impedance tester during test.
4. Do not disconnect battery when engine is running.

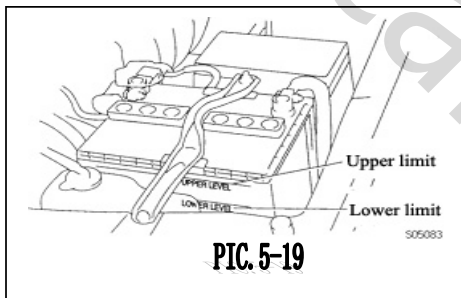
Special tools (special service tool)

Sketch map	Name	Remarks
	Injection pump camshaft cone bearing inner ring changing tool	Rotor rear bearing cap
	Injection pump spline puller	Rectifier end frame
	AC generator rear bearing puller	
	AC generator bearing changing tool	Rotor rear bearing
	AC generator belt nut spanner suite	
	Changing tool suite	Rotor front bearing

	Changing tool 26	
	Changing tool 50	
	Adaptor	

Equipment:

Equipment name	Remarks
Ammeter (A)	
Battery specific gravity gauge	
Belt tension gauge	
Torsion spanner	
Vernier caliper gauge	Rotor (slip ring), electric brush



I. On-vehicle inspection

Check battery electrolyte level(pic.5-19)

1. Maintenance free battery:

If level lower than lower limit, change battery (or fill in distilled water if possible), check discharge system.

2. Non-maintenance free battery:

(a) Check electrolyte density:

Check density of electrolyte in each battery, if lower than lower limit, fill in distilled water

Standard density:

20°C: 1.25-1.29

If density is less than specification, discharge battery.

(b) Check battery voltage

(1)After vehicle operation, within 20 min. after engine stopped, place ignition switch in ON position and keep electric system (head ights, blower rotor and rear defroster, etc.) operate 60 seconds to eliminate their surface electric load.

(2)Turn ignition switch to OFF position and switch off electric system.

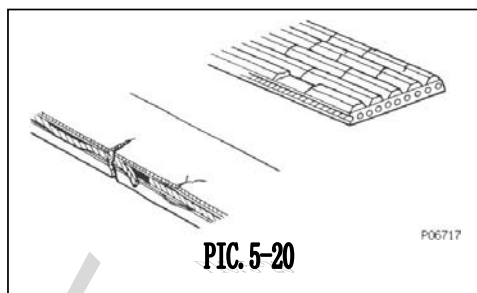
(3)Measure voltage on positive (+) and negative (-) poles of battery.

Standard voltage:

20°C (68°F): 12.5-12.9V

If the voltage is less than specified, discharge the battery.

Note: check indicator as illustrated.

**(c) Check battery electrode, fusible wire or fuse**

- (1) Check battery electrode for loose or corrosion. If the electrode is corroded, clean electrode.
- (2) Check on-state of fusible wire and fuse.

3. Check driving belt**(a) Visual check belt for excessive wear, grommet fracture, etc.(pic.5-20).**

If any flaw occurs, change driving belt.

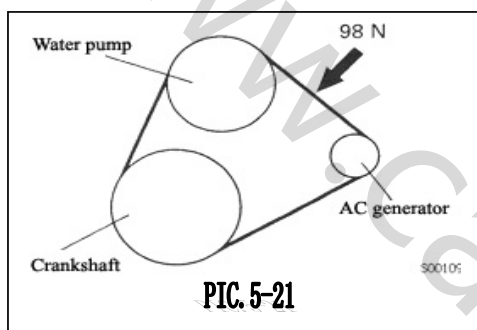
Note: Crack is allowed on toothed side of driving belt. If the teeth rib has no group blocks, change driving belt.

(b) Press illustrated position with 98N force, check tolerance of driving belt(pic.5-21).**Tolerance of driving belt:**

New driving belt: 7-9mm (0.28-0.35 in)

Old driving belt: 11.5-13.5mm (0.45-0.53 in)

Adjust tolerance of driving belt if necessary.

**Reference**

Check tension of driving belt with tensometer.

Tension of driving belt:

New driving belt: 685-785N

Old driving belt: 295-440N

If the tension of driving belt exceeds allowance, adjust.

Note:

."New belt" indicates driving belt that has worked less than 5 min. on running engine.

."Old driving belt" indicates driving belt that has worked 5 min. or above on running engine.

.After installing driving belt, check if it's properly matched with pulley groove(pic.5-22).

.Check with hand to confirm that the belt has not slid off slot beneath belt pulley.

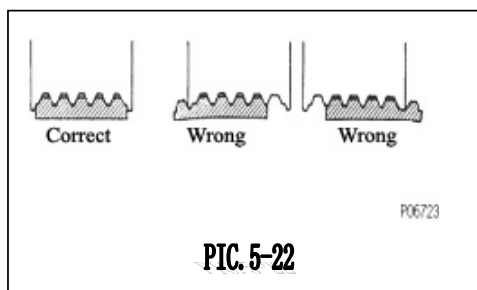
.After install new belt, run engine 5 min., and recheck tension of belt.

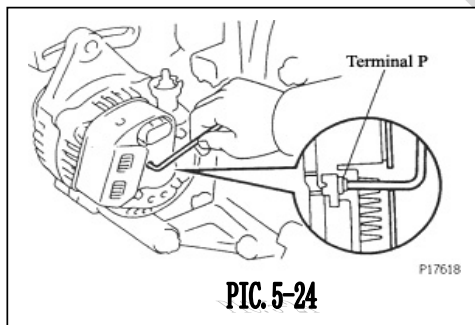
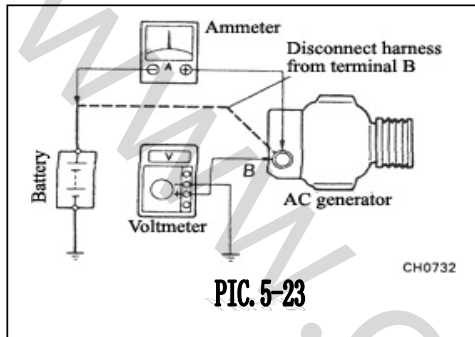
(c) Visual check AC generator connection and listen if there is abnormal noise

- (1) Check if wiring in good condition.
- (2) Check if AC generator gives abnormal noise during engine running.

(d) Check discharge alarm light circuit

- (1) When ignition switch is in ON position, check if





the discharge alarm indicator is correctly light up.
(2) Start engine. Check if the discharge alarm indicator is correctly extinguished.

If the discharge alarm indicator is not as described above, check and repair discharge alarm indicator circuit defect.

(e) Check no-load charge circuit

Note: If battery/AC generator tester is used, connect tester and indicator as manufacturer instruction.

If there is no tester, connect voltmeter and current/charger circuit as follows (pic.5-23):

- . Disconnect circuit from terminal B of AC generator, connect it with negative (-) pole terminal of ammeter.
- . Connect ammeter positive (+) with terminal B of AC generator.
- . Connect positive (+) conductor of voltmeter to terminal B of AC generator.
- . Earthing the negative (-) conductor of voltmeter.

(f) Check charge circuit per following rules:

Keep engine idle running at 2000 rpm, check and read readings from ammeter and voltmeter.

Standard current: 10A or smaller

**Standard voltage: 14.0-14.8V (25°C)
13.5-14.3V (115°C)**

If reading from voltmeter is bigger than standard voltage, change IC adjuster.

If reading from voltmeter is less than standard voltage, check IC adjuster and AC generator as following steps: Terminal F earthing, start up engine and check reading from voltmeter on terminal B (pic.5-24).

If reading from voltmeter is bigger than standard voltage, change IC adjuster.

If reading from voltmeter is less than standard voltage, check AC generator.

(g) Check loaded discharge circuit

(1) When engine is running at 2000 rpm, turn on head lights upper beam, set warm air switch to "HI".

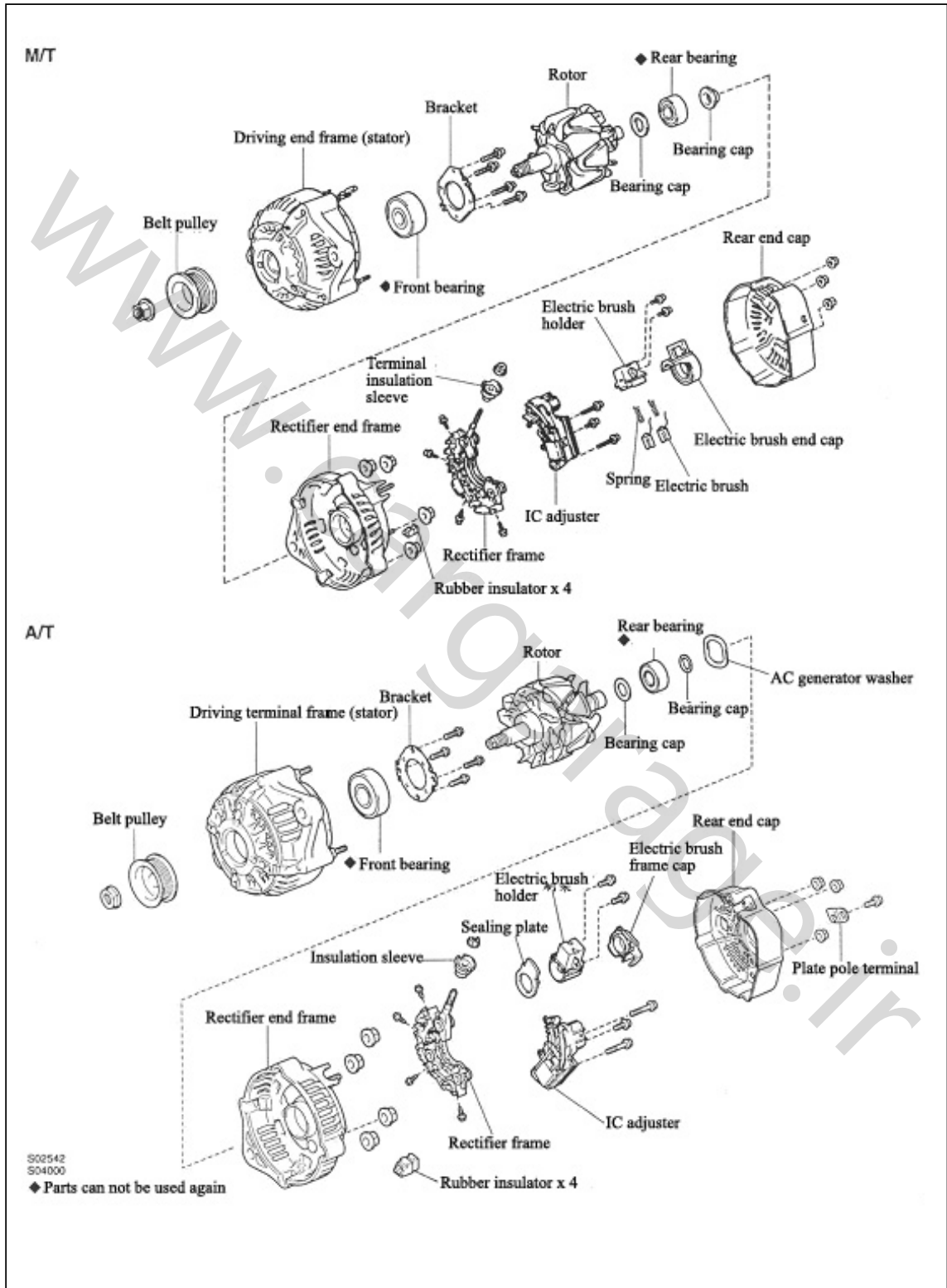
(2) Check reading from ammeter.

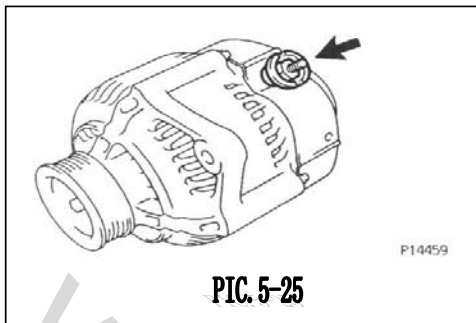
Standard current: 30A or larger

If reading from ammeter is less than standard current, change AC generator.

Note: If battery has been discharged thoroughly, reading of ammeter might be less than standard current.

AC generator exploded view

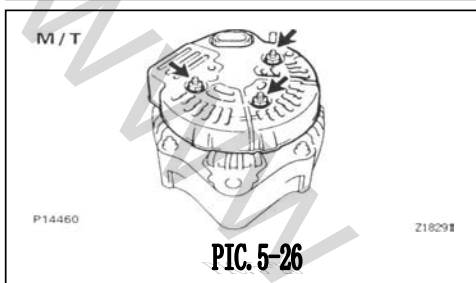




II. Dismantle AC generator

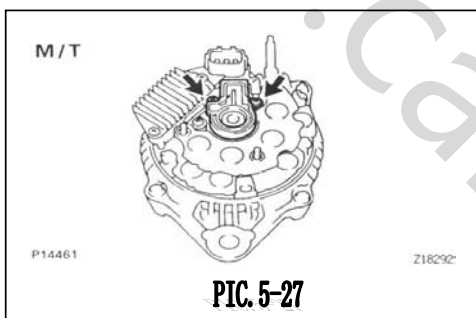
1. Dismantle rear end cap

(a) Remove nuts and terminal insulation bushing(pic.5-25).



(b) M/T:

Remove 3 nuts and end cap(pic.5-26).

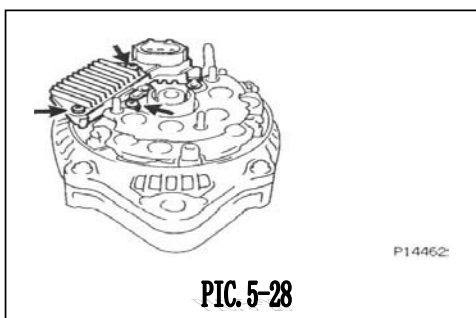


2. Remove brush holder

(a) M/T:

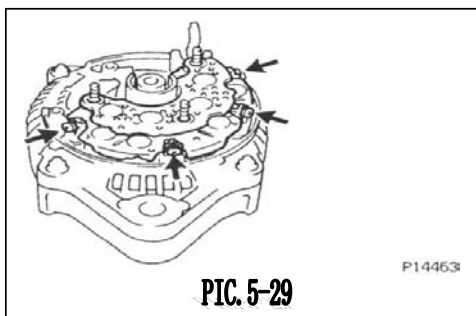
(1) Remove 2 screws and brush holder(pic.5-27).

(2) Remove brush holder cap from brush holder.



3. Remove IC adjuster

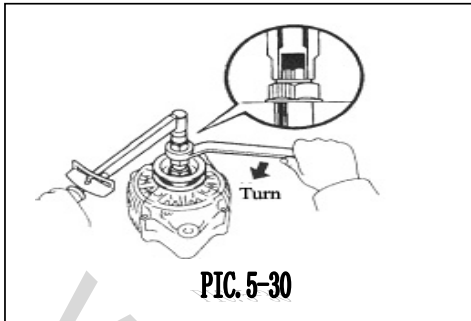
Remove 3 screws and IC adjuster(pic.5-28).



4. Remove rectifier frame

(a) Remove 4 screws and rectifier frame(pic.5-29).

(b) Remove 4 rubber insulation.

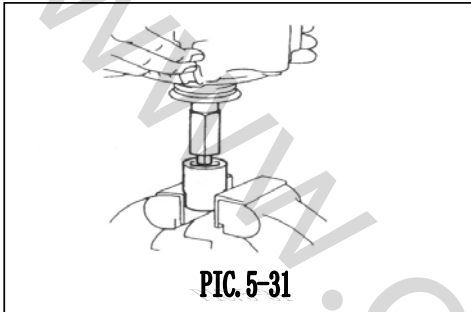


5. Dismantle pulley

(a) Hold special tool (A) with torque wrench, tighten special tool (B) CW to specified torque(pic.5-30).

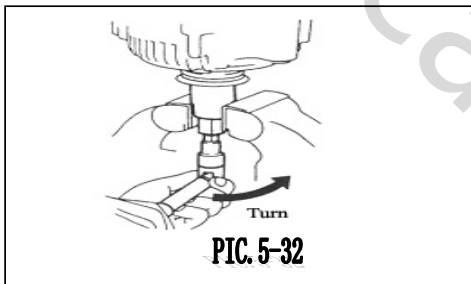
Torque: 39N.m

Check if the special tool (A) is securely fixed onto rotor shaft.



(b) Place special tool (C) on a vice(pic.5-31).

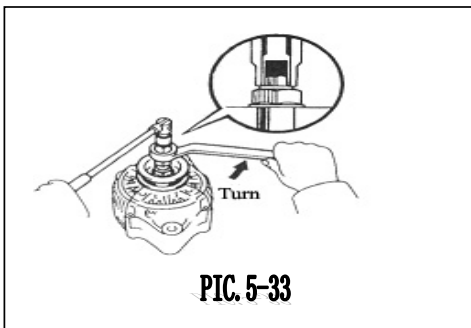
(c) Install generator on special tool (C).



(d) Unscrew belt pulley nuts, turn special tool (A) as illustrated direction(pic.5-32).

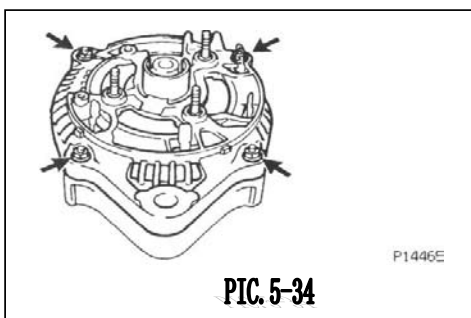
Notice: To avoid damaging rotor shaft, when unscrew pulley nut, do not exceed half turn.

(e) Remove generator from special tool (C).



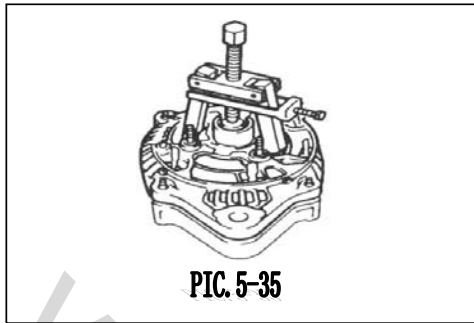
(f) Turn special tool (B) and remove special tool (A & B)(pic.5-33).

(g) Remove belt pulley nuts and belt pulley.



6. Dismantle whole rectifier end frame

(a) Remove 4 nuts(pic.5-34).



(b) Remove rectifier end frame with special tool(pic.5-35).

7. Dismantle rotor from driving end frame.

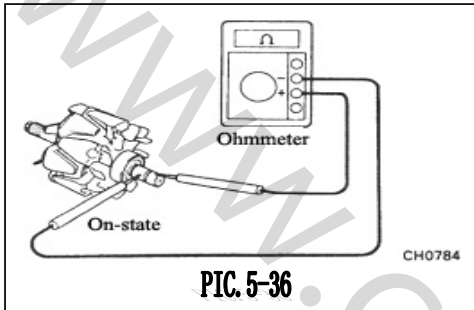
(a) Check and repair rotor

(1) Check rotor's on-state

Use ohmmeter to check the on-state between slip ring(pic.5-36).

**Standard impedance (cold state): M/T:
2.1-2.5Ω**

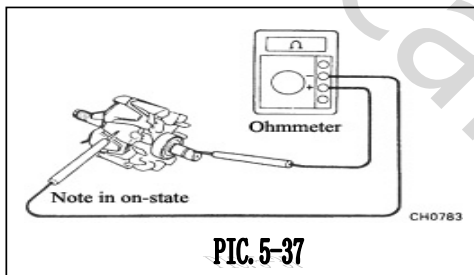
If not in on-state, change rotor.



(2) Check rotor earthing

Use ohmmeter to check, on-state is not allowed between slip ring and rotor(pic.5-37).

If in on-state, change rotor.



(3) Check slip ring

a. Check slip ring roughness or scratching.

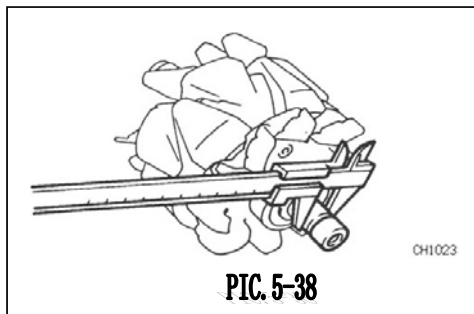
If the slip ring is rough and has scratching, change rotor.

b. Use vernier caliper to measure slip ring dia(pic.5-38).

Standard dia. : 14.2-14.4mm

Min. dia.: 12.8mm

If the measured dia. is less than min., change rotor.



(b) Stator (driving end frame) check and service

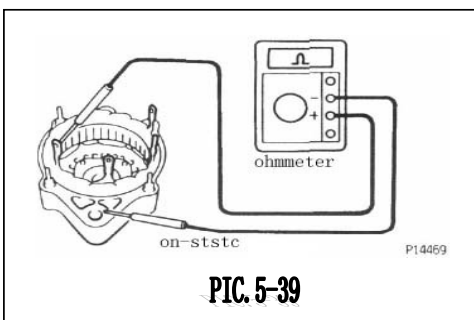
(1) Check open circuit of stator

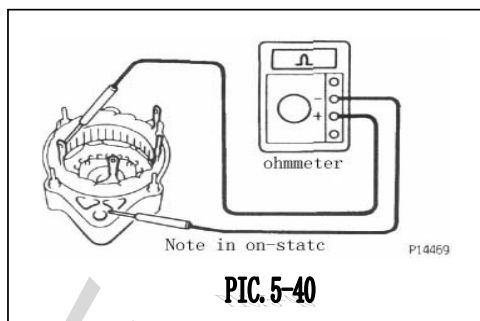
Check on-state of coils with ohmmeter(pic.5-39).

If not, change driving end frame assembly.

(2) Check stator earthing

Use ohmmeter to check coil conductor and





driving end frame, they shall not in on-state(pic.5-40).

If they are in on-state, change driving end frame assembly.

(c) Check and repair electric brush

(1) Check the exposed length of electric brush

Measure exposed length of electric brush with vernier caliper(pic.5-41).

Standard exposed length: 10.5mm

Min. exposed length: 1.5mm

If the exposed length is less than Min. value, change electric brush (M/T).

M/T: Change electric brush if necessary

(2) Melt and remove electric brush and spring(pic.5-42).

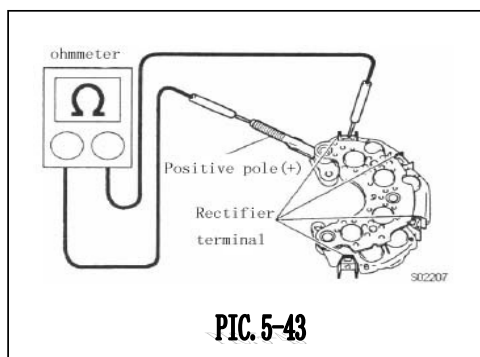
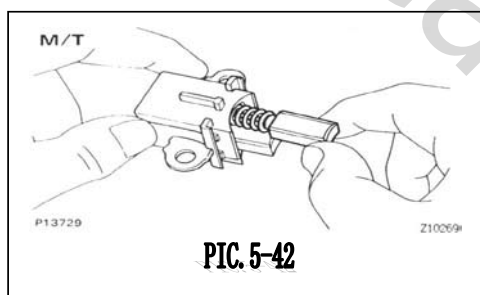
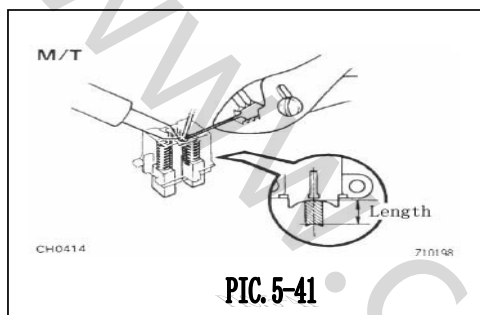
(3) Thread a new electric brush harness through brush holder hole, insert spring and electric brush.

(4) Solder electric brush harness on brush holder per specified exposed length.

exposed length: 10.5mm

(5) Check if the electric brush can slide smoothly on brush holder.

(6) Cut off residual harness. Paint insulation paint on soldering area.



(d) Check and repair rectifier (Rectifier from)

(1) Check rectifier's positive direction rectifying

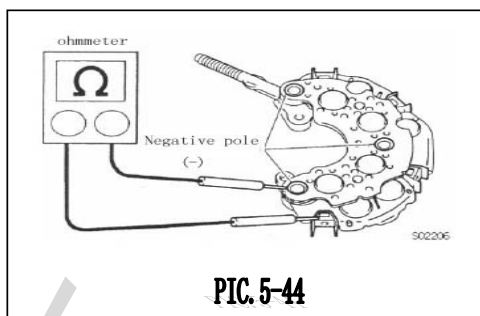
.Connect one tester probe of ohmmeter to positive (+) pole, and the other probe to each rectifier terminal(pic.5-43).

.Exchange the polarity of tester probe and repeat step (a).

.Check ohmmeter, one should display on-state and the other not. If the on-state is not in conformity with above description, change rectifier frame.

(2) Check negative pole of rectifier

. Connect one tester probe of ohmmeter to



negative (-) pole, and the other probe to each rectifier terminal(pic.5-44).

. Exchange the polarity of tester probe and repeat step (a).

. Check ohmmeter, one should display on-state and the other not. If the on-state is not in conformity with above description, change rectifier frame.

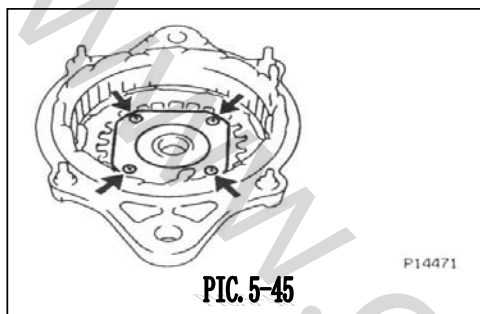
(e)Check and repair bearing

(1) Check front bearing

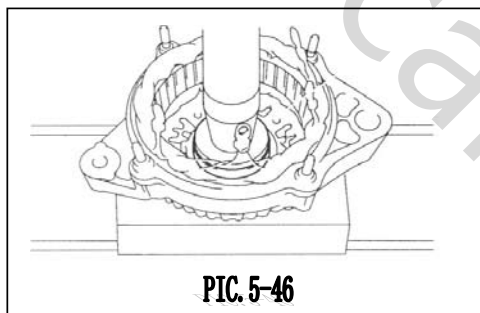
Check bearing roughness or abrasion.

(2) Change front bearing if necessary

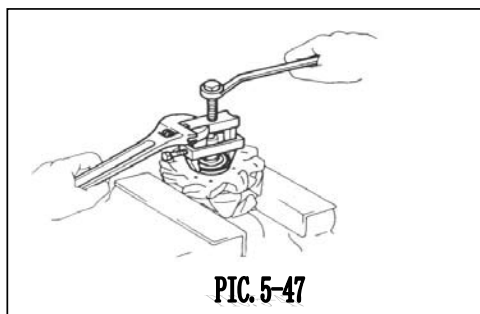
.Remove 4 screws, bearing bracket and bearing(pic.5-45).



. Press out bearing with special tool and pressing tool(pic.5-46).

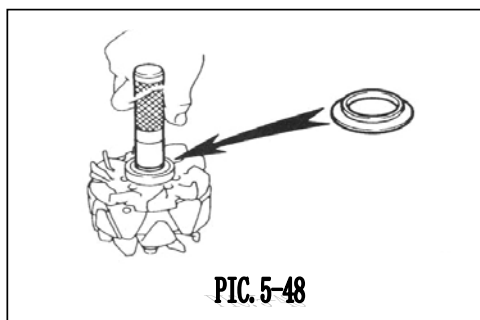


. Press in a new bearing with special tool and pressing tools.



. Install bearing bracket and 4 screws(pic.5-47)

Torque: M/T: 2.6N.m

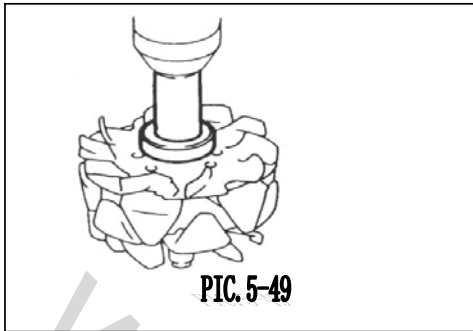


(3)Install rear bearing

Check bearing roughness and abrasion.

Change rear bearing if necessary.

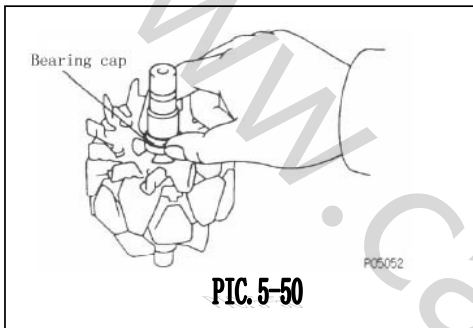
.Remove bearing cap and bearing with special tool(pic.5-48)



Note: Take care not to damage fan.

. Place bearing cap on rotor.

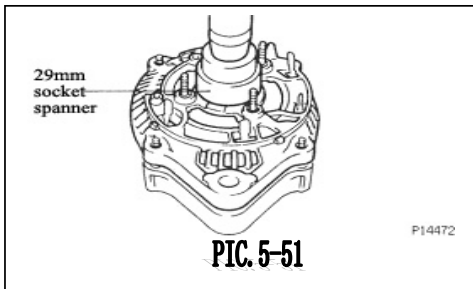
. Use special tool and pressing tool to press in new bearing(pic.5-49).



. Push in bearing cap with special tool(pic.5-50).

(f)AC generator assembly

- (1)Place driving end frame on belt pulley
- (2)Install rotor on driving end frame

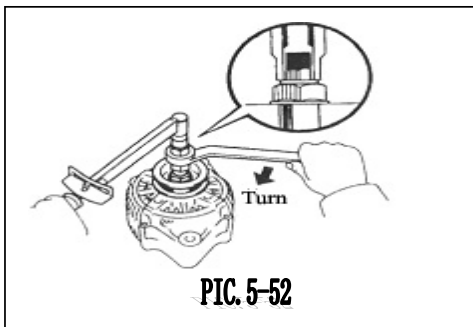


- (3)Install rectifier end frame

. Use a 29mm socket spanner and pressing tool to press in rectifier end frame slowly(pic.5-51).

. Install 4 nuts.

Torque: 4.5N.m



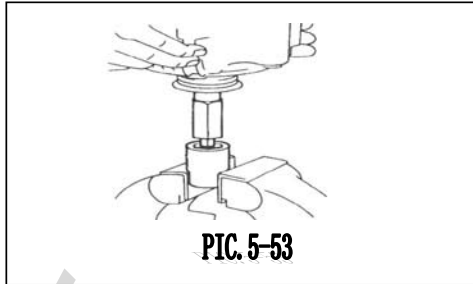
- (4)Install belt pulley

. Tighten belt pulley nut with hand, install belt pulley on stator shaft.

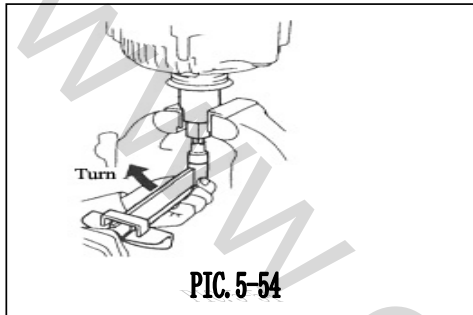
. Use torque wrench to hold special tool (A), tighten special tool (B) CW to with torque(pic.5-52).

Torque: 39N.m

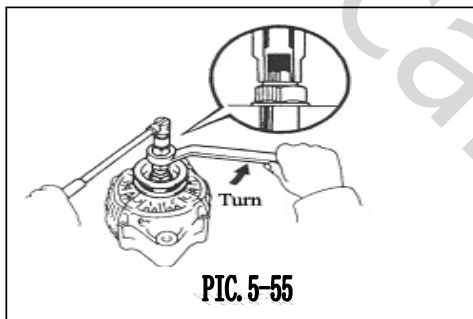
. Check special tool (A), it shall be fixed on belt pulley shaft.



. Install special tool (C) on a vice(pic.5-53).



.Install AC generator on special tool (C)(pic.5-54).

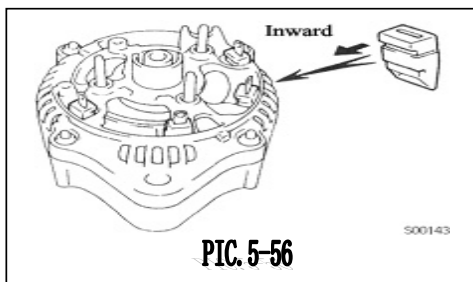


. Turn special tool (A) per illustrated direction to allow belt pulley nuts rotate(pic.5-55).

Torque: 110.5N.m

. Remove AC generator from special tool (C).

Use special tool (B) and remove special tool (A & B).



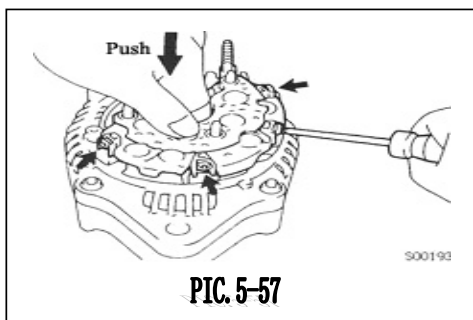
(5) Install Rectifier frame

. Install 4 rubber insulator on conductor(pic.5-56、 pic.5-57).

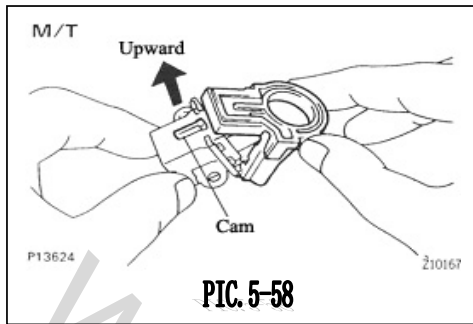
Note: Pay attention to the install direction of rubber insulator.

. Install rectifier frame and 4 screws.

Torque: M/T: 2.0N.m



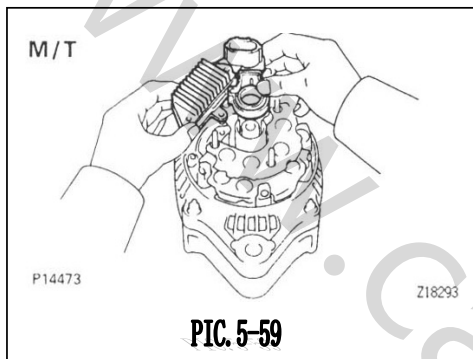
(6) Install IC adjuster 和 brush holder

**M/T:**

. Install brush holder cover to brush holder(pic.5-58).

Note: Pay attention to install direction of brush holder.

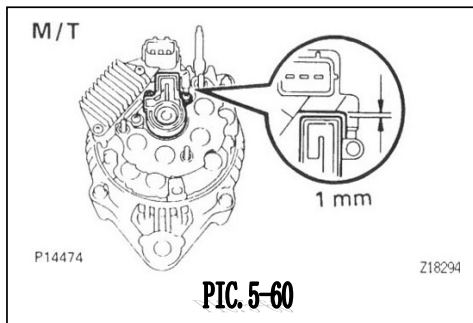
. Place IC adjuster and brush holder together horizontally.



. Install 5 screws, keep clearance between brush holder and plugs 1mm (0.04 in)(pic.5-59 , pic.5-60).

Torque: 2.0N.m

. Install brush holder cover.



(7)Install rear end cap

A. M/T:

Install end cap and 3 nuts

Torque: 4.4N.m

B. Install terminal insulation bushing and nuts.

Torque: 4.1N.m

7. Check if rotor is rotating smoothly**8. Service Standard And Service data****Service Standard 、 Service data**

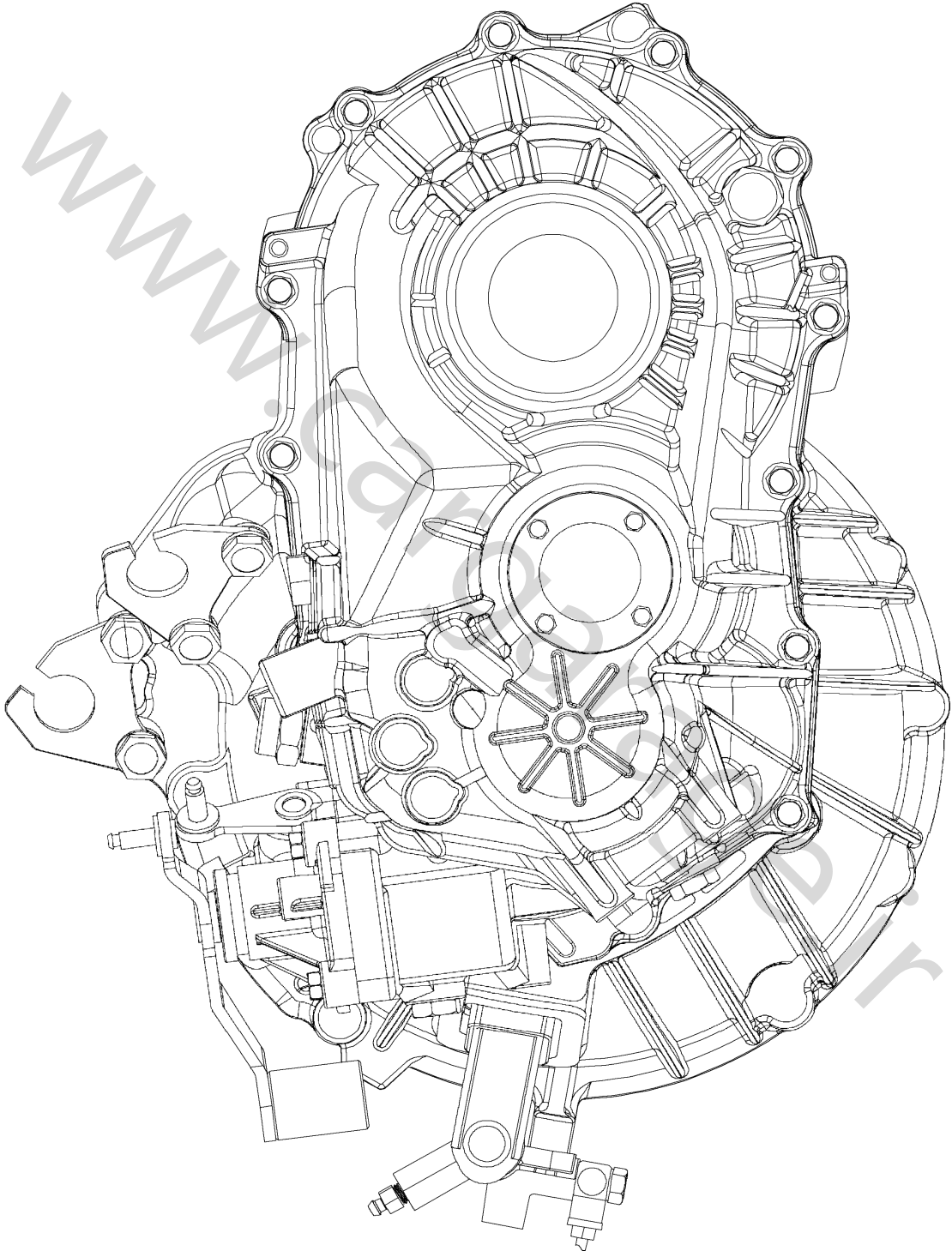
Name	Index	Condition	Parameter
Battery	Specific gravity	at 20°C (68°F)	1.25-1.29
Driving belt	Skewness	New	5-7m
		Old	7-8m
	Tension	New	685-785N
		Old	295-440N
AC generator	Rated output	M/T	12V 7A
	Rotor coil impedance	M/T	2.1-2.5Ω
	Slip ring dia	STD	14.2-14.4mm
		Min value	12.8mm
	Exposed length of electric brush	STD	10.5mm
		Min value	1.5mm
IC adjuster	Adjust voltage		13.2-14.8V

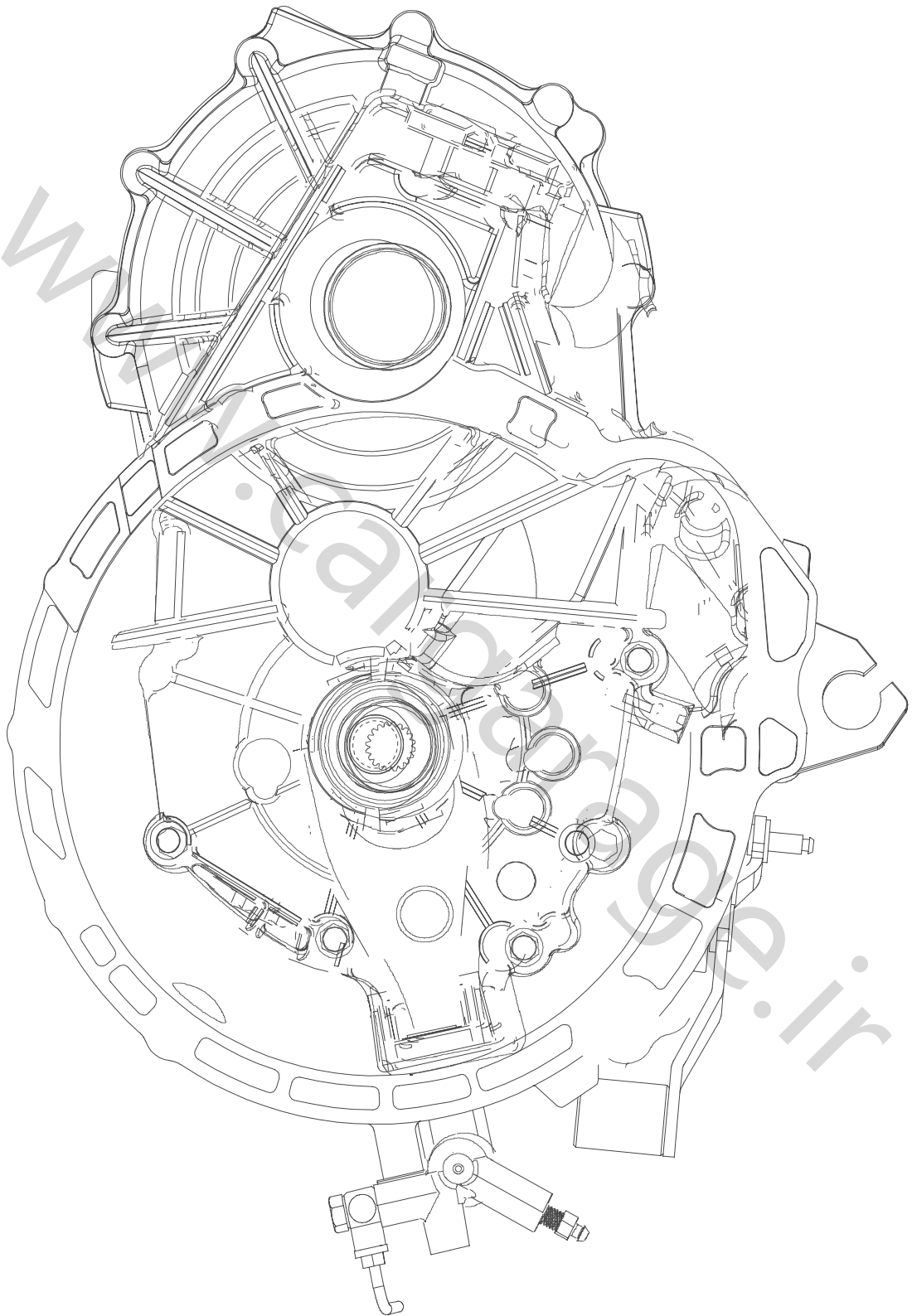
Torque criterion

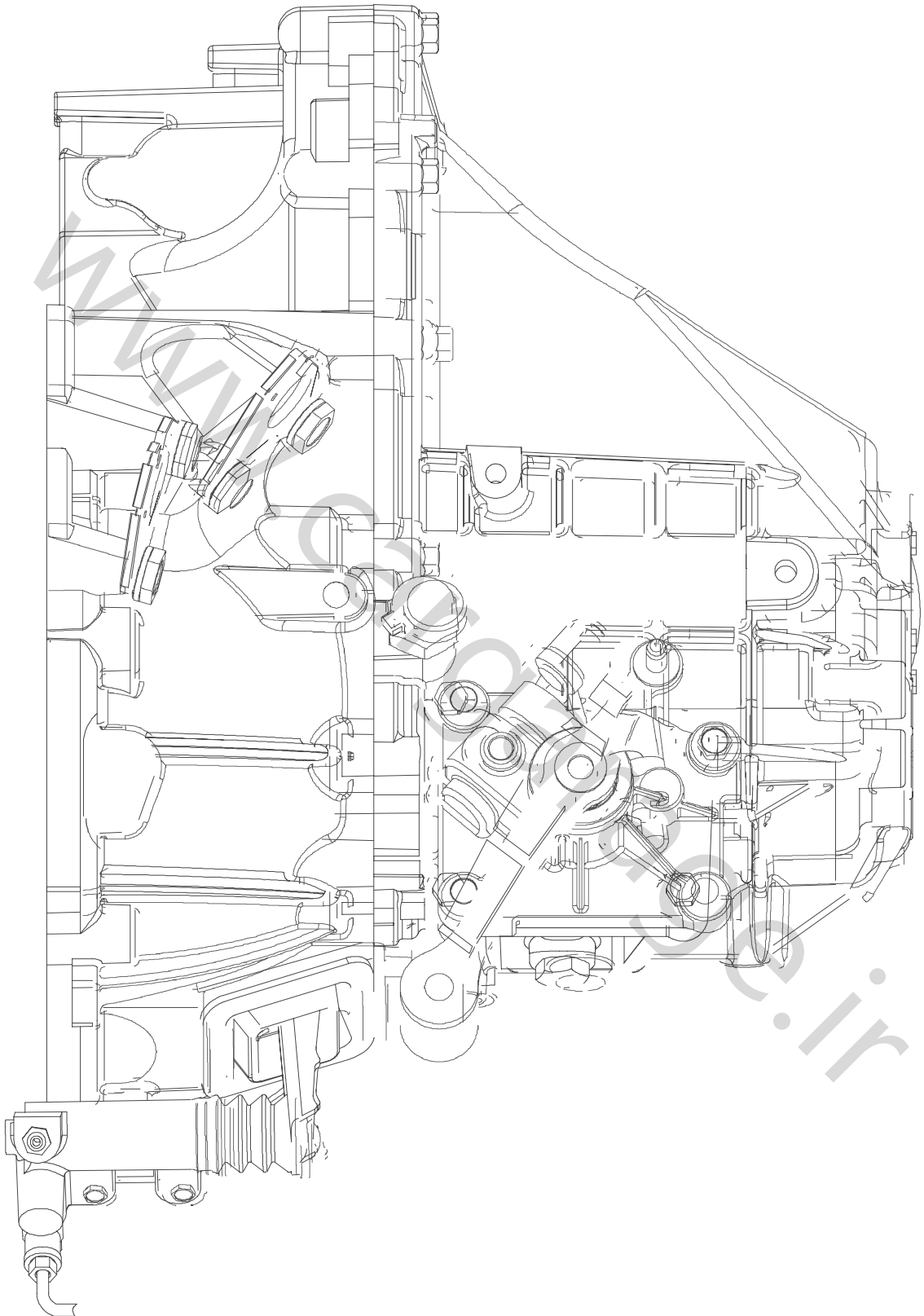
Tightened parts	N.m
bearing bracket ×driving end frame M/T	2.6
Rectifier end frame×driving end frame	4.5
AC generator belt ×rotor	110.5
Rectifier end frame×brush holder, IC adjuster	2.0
Rectifier frame×Coil conductor on rectifier end frame M/T	2.0
Rear end cap× Rectifier frame	4.4
Panel polar terminal× Rectifier frame bolt	3.8
Terminal insulator × Rectifier frame	4.1

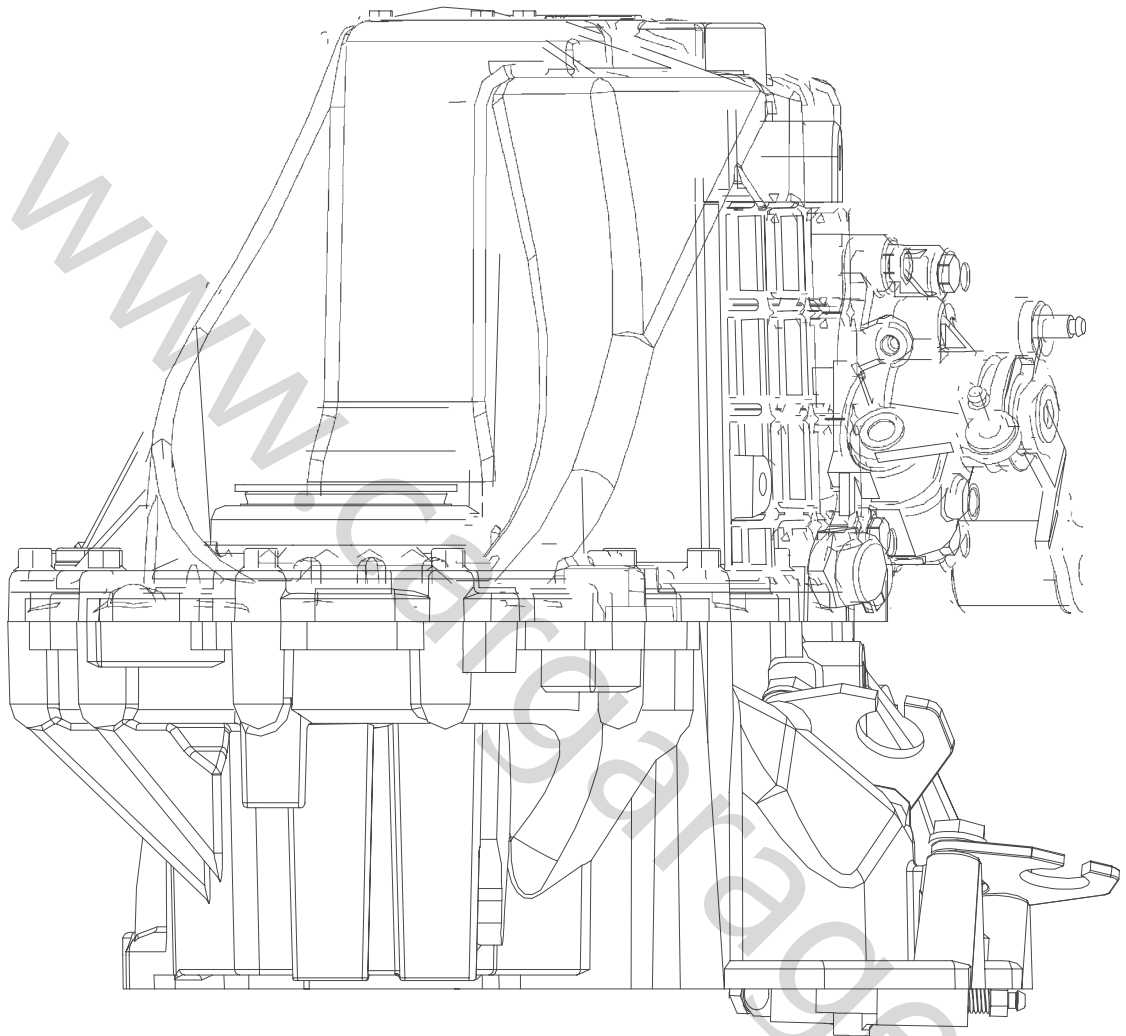
Chapter Six transmission

Section 1 LF481Q3 Transmission Outline Figure









Section 2 Technical Parameter

Model	LF481Q3
Transmission ratio: /Z1 main drive	56:13=4.308
I gear	35:11=3.182
II gear	36:19=1.895
III gear	35:28=1.250
IV gear	30:33=0.909
V gear	26:37=0.703
Reverse gear	37:12=3.083
Rated power	80KW
Rated torque	137N · m
Rated speed	6000r/min
Amount of lubrication oil	2.0L
Lubricants model	API 80(75)W-90 GL-3 gear oil
Input shaft spline	20 gear involute spline, modulus 1, pressure angle 3°, big dia. Φ21 -0.3, small dia. Φ18.5
Outline size	455 × 343.5 × 392

Section 3 Structure Model and Application Scope

LF481Q3 transmission brought in, developed and manufactured by our company is a horizontal mechanical transmission applicable to fuel cars. The transmission with differential equipment has 5 drive gears and 1 reverse gear. Synchronizer shift is adopted for the drive gear and sliding gear engagement shift is adopted for the reverse gear. Aluminium casting is adopted for such components as shell and cover, and specially manufactured sealant (no need of seal paper pad) is applied between the shell and cover. Quality low carbon alloy steel with good hardenability and little deformation is applied for such components as gear and axle. This transmission enjoys a lot of advantages such as reliable gear shift, compacted structure, light weight, excellent seal performance, smooth transmission, low noise and long service life, etc.

Mainly match to the 481 series engine (single-point injection and multi-point injection).

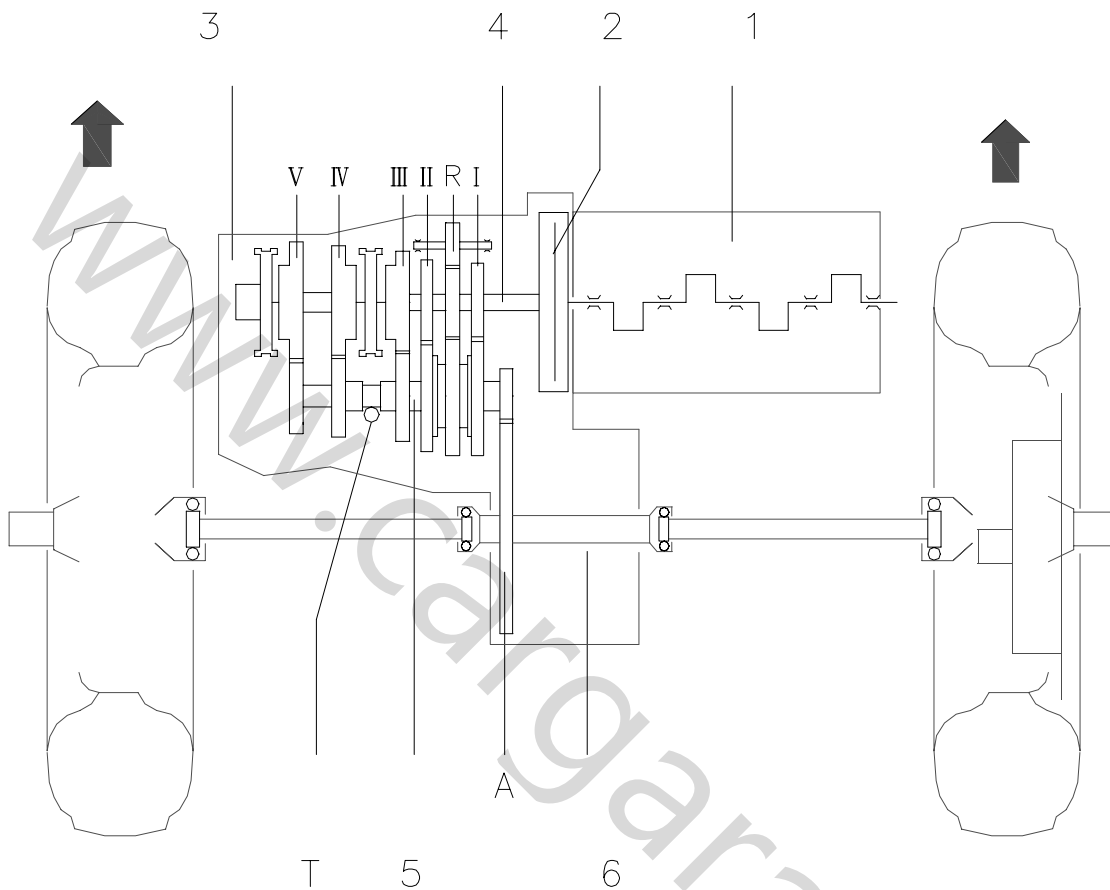
Section 4 Transportation and Safekeeping

1. Rust proof measures shall be provided to make sure the transmission avoid rustiness during the normal transportation and storage.
2. Transmission shall be encased or placed on the transportation rack before transportation to avoid any damage under the normal transportation.
3. Transmission shall be stored in a dry warehouse with good ventilation.

Section 5 Use and Operation

1. The clutch pedal should be completely stepped while gear shifting, to make the transmission quickly operate the shifting lever after disengaged in the engine torque.
2. Low speed gear should be selected while uprising, downgrading and turning. Sliding of the disengaging clutch is not allowed.
3. Stop the car to check for the causes while difficult occurs for operating the shifting lever. Strong pushing force on the selector lever is not allowed.

Section 6 Transmission System Illustration



Name:

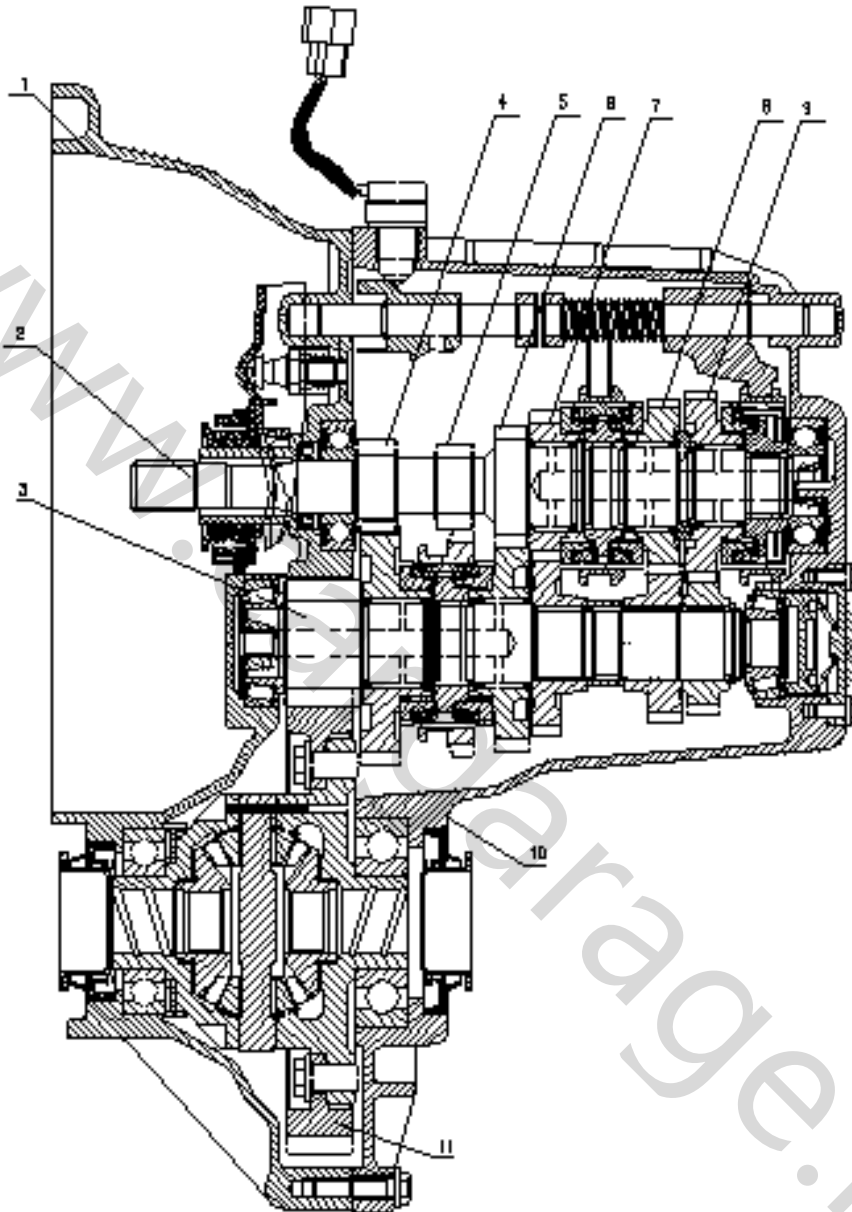
- | | | |
|----------------|-----------------|--------------------|
| 1. Engine | 2. Clutch | 3. Transmission |
| 4. Input shaft | 5. Output shaft | 6. Output assembly |

Transmission ratio:

- | | | |
|---------------|-----------------------------|----------------|
| I-1 gear | II-2 gear | III-3 gear |
| IV-4 gear | V-5 gear | R-reverse gear |
| A. Main drive | T. Speedometer transmission | |

●Arrowhead shows the driving direction.

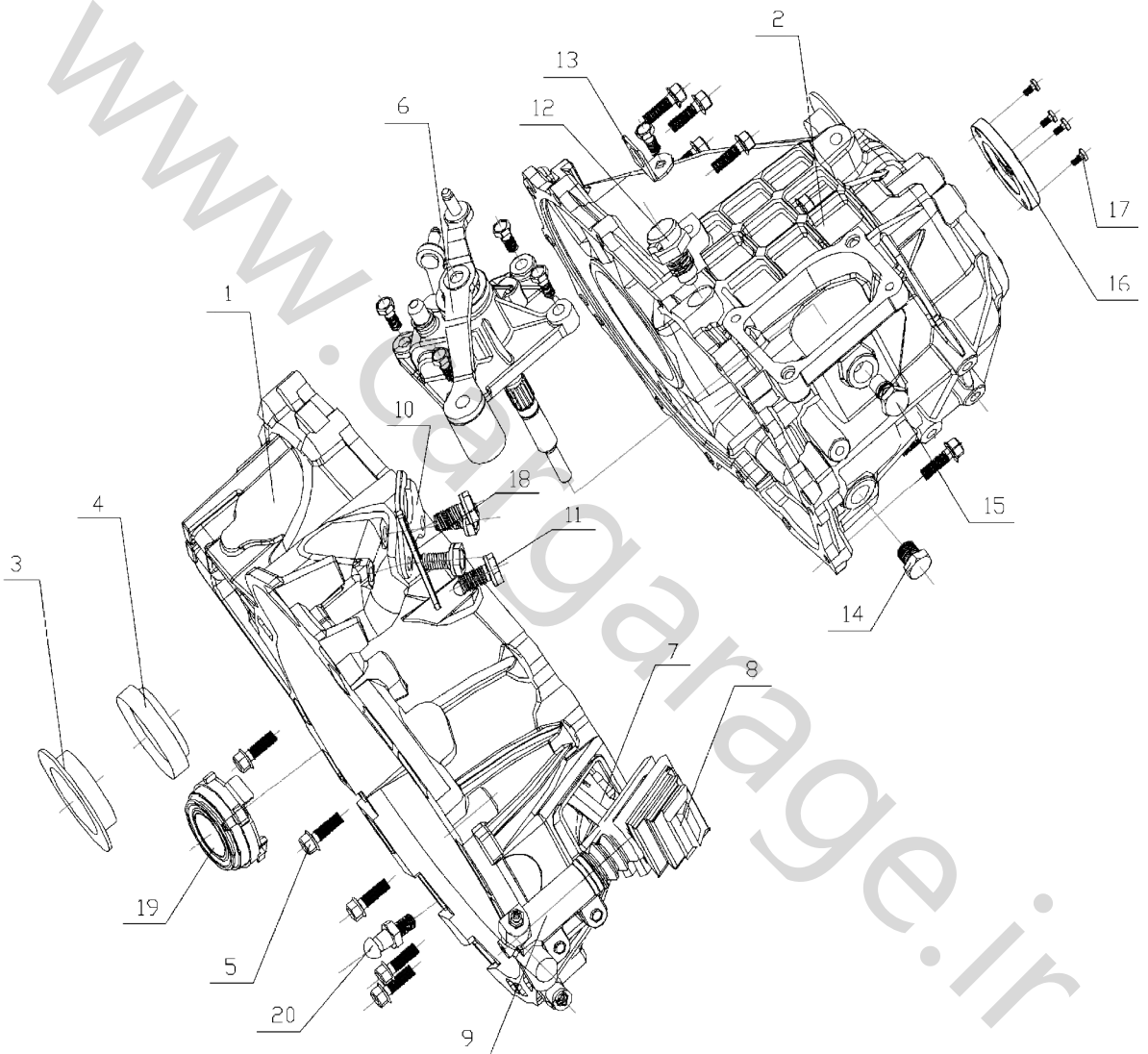
Section 7 Gear Shift System Illustration



1. Clutch housing	2. Input shaft	3. Output shaft
4. I gear	5. Reverse gear	6. II gear
7. III gear	8. IV gear	9. V gear
10. Transmissio housing	11. Main reducing part	

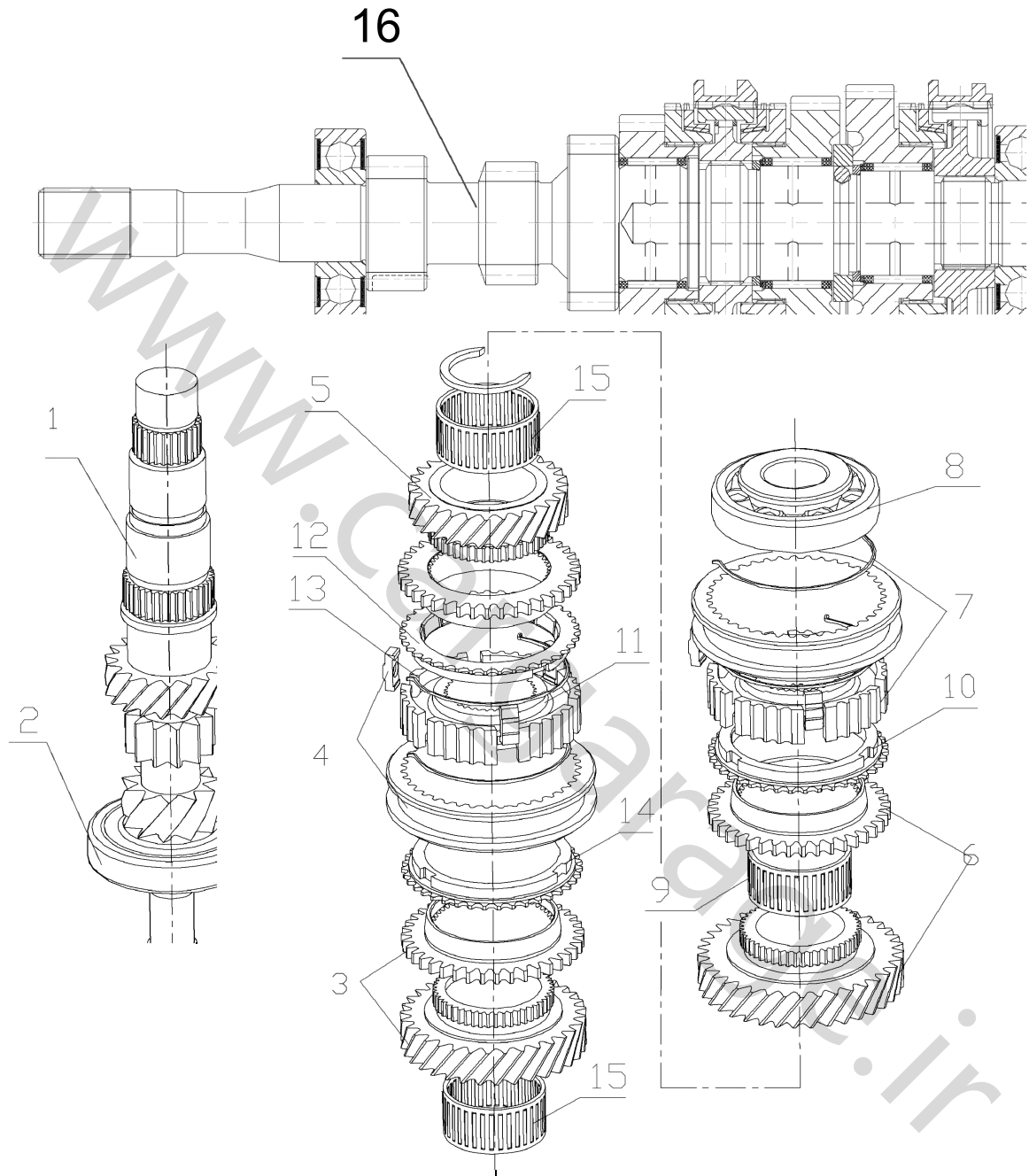
Section8 Assembling Illustration of Transmission

1. Structure analysis of the clutch and transmission housing assembly



S/N	Illustration No.	Name	Qty.
1.	LF481Q3-1601341A	Clutch housing	1
2.	LF481Q3-1701011A	Transmission housing	1
3.	LF481Q3-1701337A	Differential protection sleeve	2
4.	LF481Q3-2303312A	Differential rear oil seal	1
5.	LF481Q3-1701023A	Hexagon flange bolt	14
6.	LF481Q3-1702110A	Shifting guide shaft assembly	1
7.	LF481Q3-1701330A	Disengaging yoke	1
8.	LF481Q3-1701331A	Disengaging yoke dustproof cap	1
9.	LF481Q3-1701041A	hydraulic cylinder	1
10.	LF481Q3-1701032A	Shifting rocker arm cable support	1
11.	LF481Q3-1702047A	Hexagon flange bolt	4
12.	LF481Q3-1701027A	Reverse lamp switch	1
13.	LF481Q3-1701024A	Square support	1
14.	LF481Q3-1701025A	Magnetic screw plug	1
15.	LF481Q3-1701033AA	Shift locator assembly	1
16.	LF481Q3-1701154A	Output shaft rear end cap	1
17.	LF481Q3-1701155A	Rear end cap connecting bolt	4
18.	LF481Q3-1701031A	Shifting rocker arm cable support	1
18.	LF481Q3-1701031A	Shifting rocker arm cable support	1
19.	LF481Q3-1701334A	Disengaging bearing	1
20.	LF481Q3-1701333A	Disengaging yoke supporting nail	1

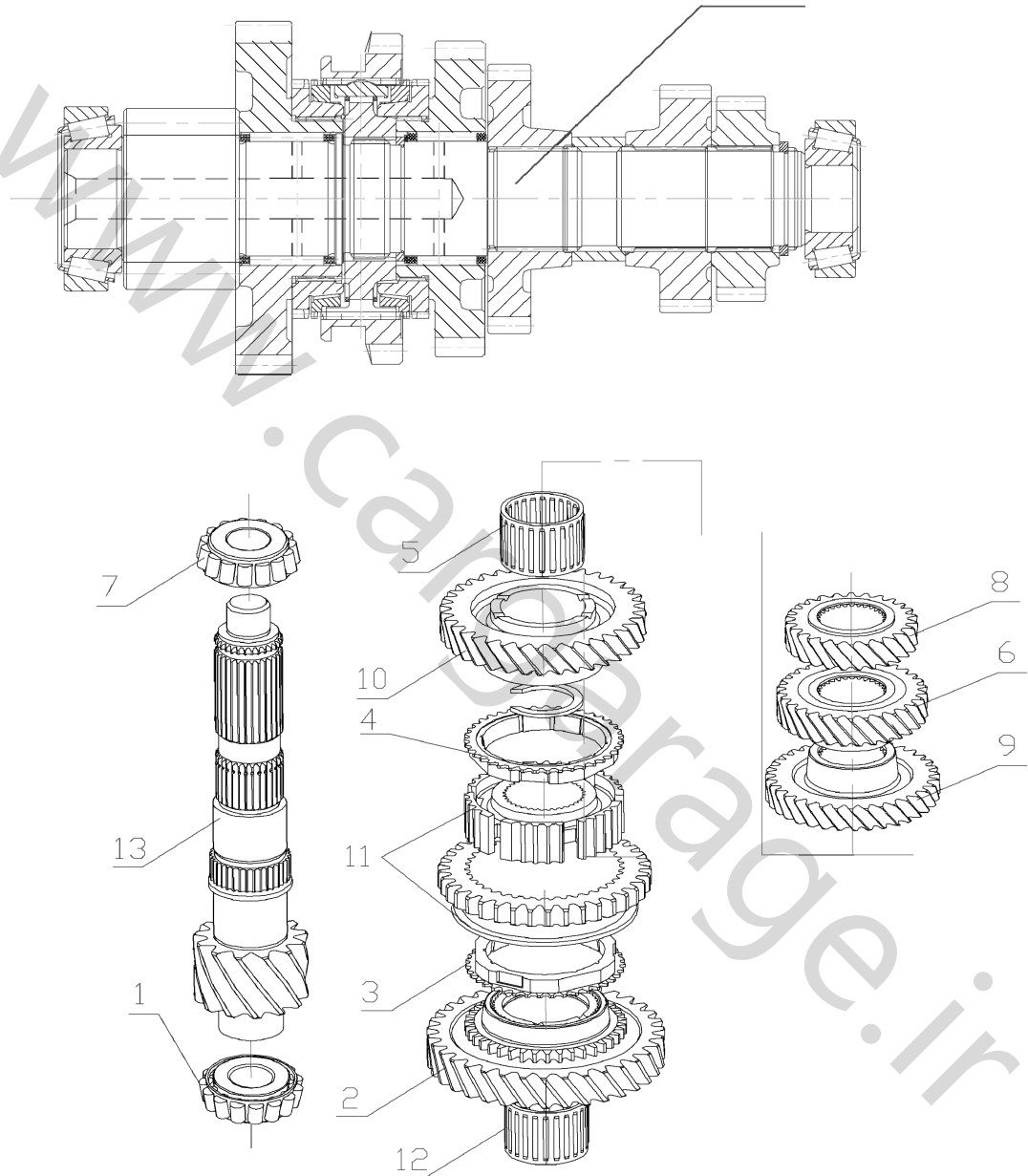
2. Structure analysis of input shaft assembly



S/N	Illustration No.	Name	Qty.
1.	LF481Q3-1701041A	Input shaft	1
2.	LF481Q3-1701075A	Input shaft front bearing	1
3.	LF481Q3-1701050A	3rd gear drive gear assembly	1
4.	LF481Q3-1701060A	3rd & 4th gear synchronizer assembly	1
5.	LF481Q3-1701053A	4th gear drive gear assembly	1
6.	LF481Q3-1701057A	5th gear drive gear assembly	1
7.	LF481Q3-1701070A	5th gear synchronizer assembly	1
8.	LF481Q3-1701079A	Input shaft rear bearing	1
9.	LF481Q3-1701078A	5th gear needle bearing	1
10.	LF481Q3-1701069A	5th gear synchronizing ring	1
11.	LF481Q3-1701044A	4th gear thrust washer	1
12.	LF481Q3-1701065A	4th gear synchronizing ring	1
13.	LF481Q3-1701042A	Synchronizer hub retaining ring	1
14.	LF481Q3-1701059A	3rd gear synchronizing ring	1
15.	LF481Q3-1701076A	3rd & 4th gear needle bearing	2
16.	LF481Q3-1701040A	Input shaft assembly	1

3. Structure analysis of output shaft assembly

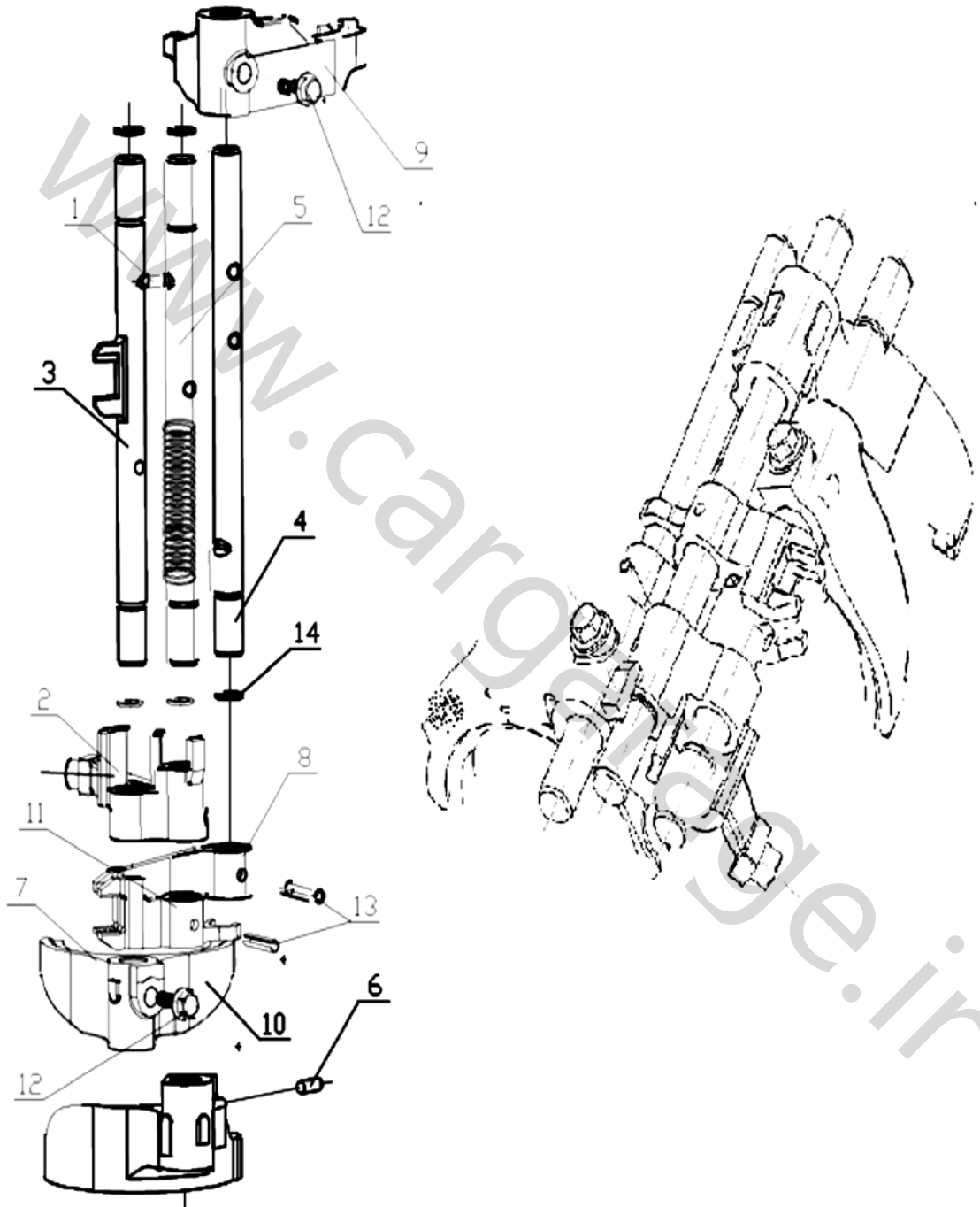
14



S/N	Illustration No.	Name	Qty.
1.	LF481Q3-1701141A	Front bearing, output shaft	1
2.	LF481Q3-1701110A	1st driven gear assembly	1
3.	LF481Q3-1701113A	1st synchronizing ring	1
4.	LF481Q3-1701124A	2nd synchronizing ring	1
5.	LF481Q3-1701127A	2nd needle bearing	1
6.	LF481Q3-1701138A	4th driven gear	1
7.	LF481Q3-1701150A	Rear bearing, output shaft	1
8.	LF481Q3-1701140A	5th driven gear	1
9.	LF481Q3-1701136A	3rd driven gear	1
10.	LF481Q3-1701130A	2nd driven gear assembly	1
11.	LF481Q3-1701120A	1st and 2nd synchronizer assembly	1
12.	LF481Q3-1701103A	1st needle bearing	1
13.	LF481Q3-1701106A	Output shaft	1
14.	LF481Q3-1701100A	Output shaft assembly	1

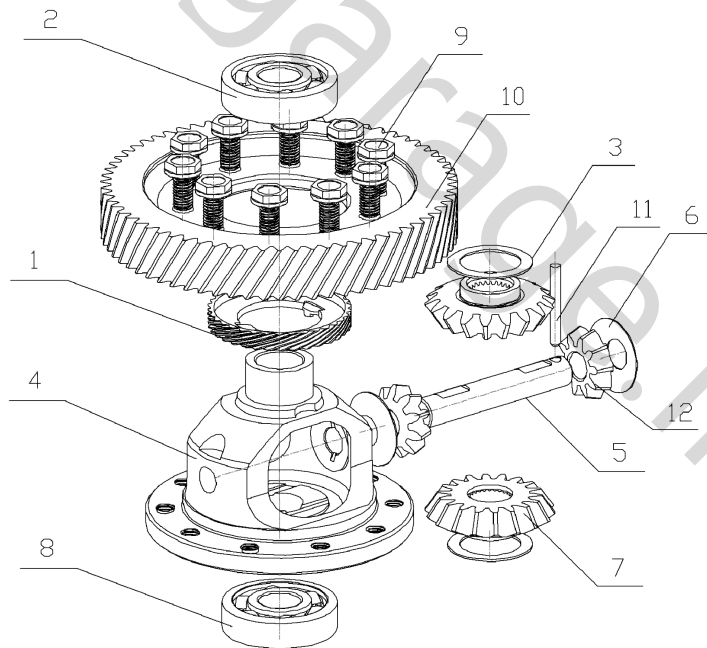
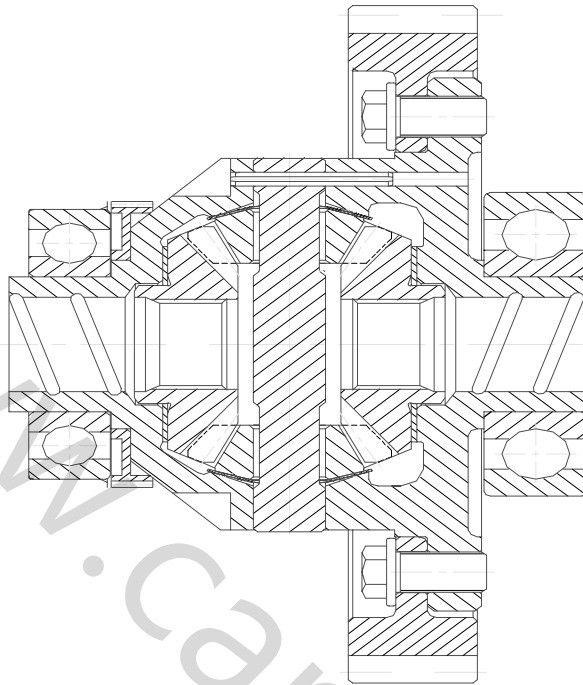
4. Structure analysis of fork shaft assembly

Structure analysis of fork shaft assembly



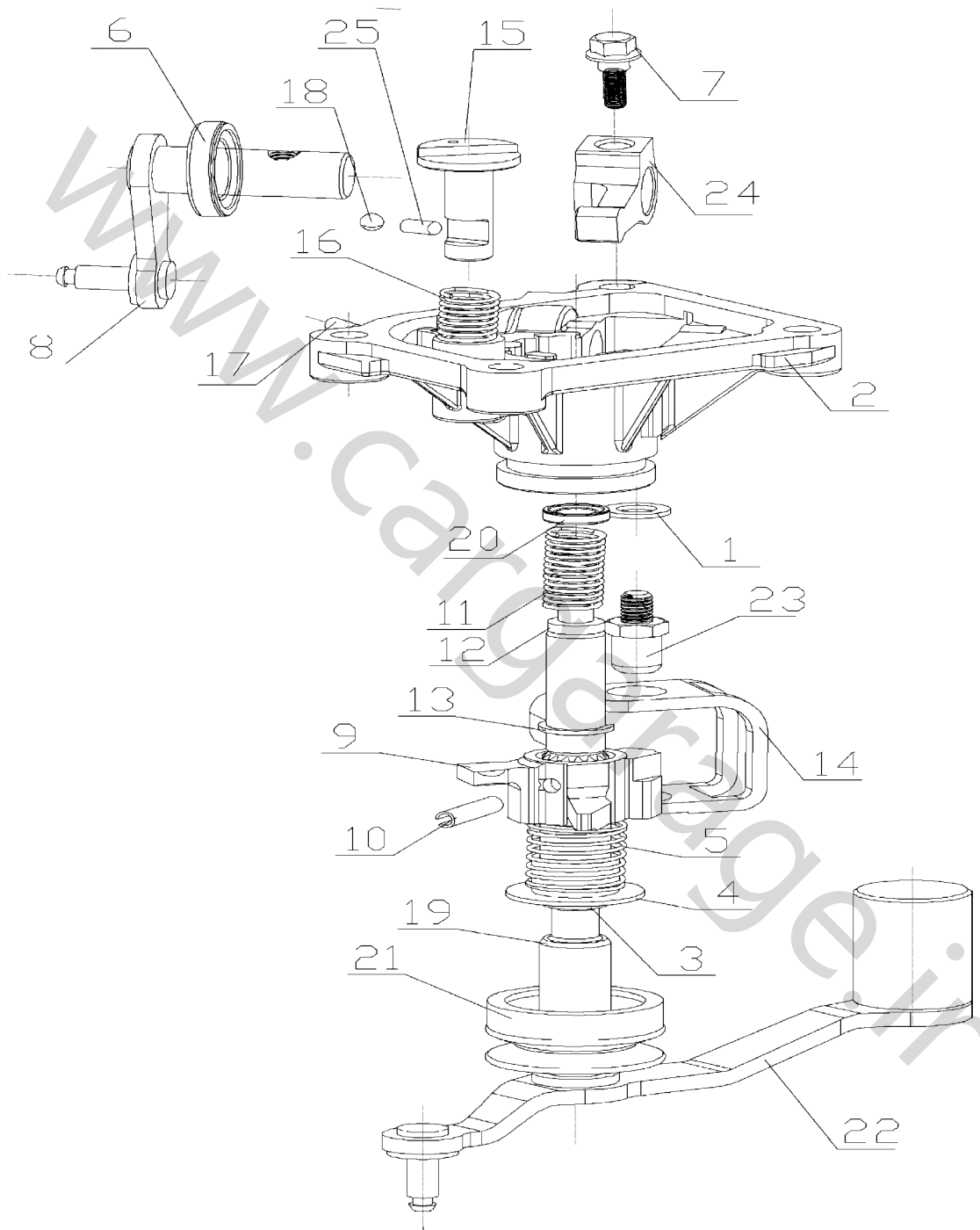
S/N	Illustration No.	Name	Qty.
1.	LF481Q3-1702081A	Interlock pin	1
2.	LF481Q3-1702075A	Guide block of reverse gear and shift gear	1
3.	LF481Q3-1702061A	3rd and 4th fork shafts	1
4.	LF481Q3-1702051A	1st and 2nd shafts	1
5.	LF481Q3-1702071A	5th reverse gear fork shafts	1
6.	LF481Q3-1702081A	Interlock pin	1
7.	LF481Q3-1702062A	3rd and 4th selector forks	1
8.	LF481Q3-1702052A	1st and 2nd gear shift guide blocks	1
9.	LF481Q3-1702053A	1st and 2nd selector forks	1
10.	LF481Q3-1702073A	5th gear selector forks	1
11.	LF481Q3-1702072A	Guide blocks of 5th reverse gear and shift gear	1
12.	LF481Q3-1702054A	Fork fastening bolt	2
13.	LF481Q3-1702056A	Spring-type cylindrical pin	2
14.	LF481Q3-1702057A	Fork shaft retaining ring	5

5. Structure analysis of differential assembly



S/N	Illustration No.	Name	Qty.
1.	LF481Q3-2303309A	Milometer drive gear	1
2.	LF481Q3-2303310A	Differential front bearing	1
3.	LF479Q3-2303307A	Half shaft gear washer	2
4.	LF481Q3-2303301A	Differential housing	1
5.	LF481Q3-2303310A	Planetary gear shaft	1
6.	LF479Q3-1601000A	Planetary gear washer	2
7.	LF481Q3-2303302A	Half shaft gear	2
8.	LF481Q3-2303312A	Differential rear bearing	1
9.	LF481Q3-2303311A	Fastening bolt of differential gear ring	10
10.	LF481Q3-2303308A	Main reducing driven gear	1
11.	LF481Q3-2303307A	Spring-type cylindrical pin	2
12.	LF481Q3-2303303A	Planetary gear	2

6. Structure analysis of shift mechanism assembly



S/N	Illustration No.	Name	Qty.
1.	LF481Q3-1702141A	Breather valve washer	1
2.	LF481Q3-1702151A	Shifting handle housing	1
3.	LF481Q3-1702138A	Retaining ring of shift guide shaft	1
4.	LF481Q3-1702128A	Spring seat	1
5.	LF481Q3-1702156A	Pull-back spring	1
6.	LF481Q3-1702035A	Oil seal, select lever	1
7.	LF481Q3-1702115A	Fastening bolt of switchover swing link	1
8.	LF481Q3-1702030A	Select lever shaft assembly	1
9.	LF481Q3-1702142A	Shift swing link	1
10.	LF481Q3-1702116A	Spring-type cylindrical pin	1
11.	LF481Q3-1702155A	Pull-back spring	1
12.	LF481Q3-1702154A	Nylon pad	1
13.	LF481Q3-1702137A	Retaining ring of shift guide shaft	1
14.	LF481Q3-1702108A	Interlock plate	1
15.	LF481Q3-1702120A	5th reverse gear interlock cam	1
16.	LF481Q3-1702122A	Pull-back spring of 5th reverse gear interlock cam	1
17.	LF481Q3-1702016A	Alignment pin of shift housing	2
18.	LF481Q3-1702121A	Steel ball	1
19.	LF481Q3-1702152A	Alignment spacer ring of shift guide shaft	1
20.	LF481Q3-1702036A	Shifting shaft seal	1
21.	LF481Q3-1702105A	Dust cap	1
22.	LF481Q3-1702110A	Shift guide shaft assembly	1
23.	LF479Q3-1702215A	Air plug assembly	1
24.	LF481Q3-1702114A	Switchover swing link	1
25.	LF481Q3-1702123A	Interlock cam pin of 5th reverse gear	1

Section 9 Disassembly and Assembly of Transmission

1. Disassembly

1. Support the transmission, unscrew the drain screw plug and drain the oil.
2. Take out the clutch release bearing and pull out the release yoke.
3. Take off the black dust cap of shifting shaft, screw off the shift locator assembly and the reverse lamp switch, screw off the screw plug of shifting shaft with the special tool, remove the set screw of the reverse gear and take out the compressed spring and the shifting shaft assembly.
4. Screw off the fastening bolt of rear end cap of output shaft with the special tool, and take off the output shaft's end cap and disc spring. Screw off the rear plug of output shaft, the transmission housing as well as the fastening bolt of clutch housing, and take off the transmission housing.
5. Screw off the two fastening bolts of the reverse locking mechanism and take off the reverse locking mechanism assembly.
6. Take off the differential assembly, the fork shaft assembly, the output shaft assembly and the input shaft assembly step by step. Disassemble each assembly with the special tool.

2. Assembly

Transmission assembly steps are basically reverse against the disassembly procedure, but the following precautions shall be regarded:

1. Install the stopper ring of the bearing and the needle bearing, direction of the bearing stopper ring shall be regarded; the inside dia. of the bearing stopper ring shall contact with the bearing seat.
2. While installing the 1st and 2nd synchronizers, the side with teeth shall face to the 1st driven gear.
3. Install the idler and the idler shaft on the clutch housing. Note that the screw hole of the idler shaft is outward.
4. Installing the 2nd needle bearing bushing, the needle bearing, the synchronizing ring and the 2nd driven gear; while installing the 3rd driven gear, the boss side shall face the 2nd driven gear.
5. Put the balance spring of fork shaft into the fork shaft hole of clutch housing during installing the fork shaft. Install the shift fork assembly in a proper position.
6. Before installing the shifting shaft, insert it and bigger pressure spring as well while the transmission is in the neutral position, and then tighten the plug cover with a torque of $50\text{N} \cdot \text{m}$.
7. Screw the shift locator assembly, and tighten it with a torque of $40\text{N} \cdot \text{m}$.

Section 10 Transmission Maintenance

For the maintenance quality, keep the driver clean with carefulness while operating. Use proper tools.

General basic safety rules also apply to the maintenance of driver LF481Q3.

To avoid repetition, the same instructions in a series of maintenance process are as below.

Driver

Fully fill the lubrication oil while a new driver is installed. Refer to the Technical Parameter Table for the quantity and specification of lubrication oil. Locating pin must be completely matched with its hole when install the driver assembly on the engine.

Sealant

The sealant must be changed; before changing, the contact surface should be clean.

Completely wash interface. Apply sealant if necessary.

Oil seal

Before installing, apply lubrication oil to the outer circumference, and fill up the space between the seal lips with lubrication grease. After installing, check the quantity of driver lubrication oil, and add it if necessary.

Snap ring

To prevent deformation, do not overextend it. It should be changed if it has deformed. Make sure it is perfectly fit the ring slot.

Bolts & Nuts

Loosen and tighten the bolts and nuts on the end cap and housing of driver according to the diagonal. Tightening torque is applicable to the oil-free bolts and nuts.

Bearing

The side with a thicker wall faces to the installing tools when install the needle bearing. During installing, all the bearings shall be lubricated with driver lubrication oil. Heat the inner ring of tapered needle bearing to 100°C before installing. Outer ring and inner ring of bearings with the same size can not be exchanged. Tapered roller bearings on the same shaft should be changed simultaneously with the same bearing model.

Adjusting washer

Use calipers to check the thickness of adjusting shim unit at several different positions repeatedly, to see whether there is any burr or damage, and change it if damaged.

Synchronizing ring

Synchronizing ring should match the original gear when it is reused.

Lubricate it with driver lubrication oil while installing.

Gear

Wash and heat it up to about 100°C on heating plate before pressing in.

Transmission lubrication oil level

Tilt 19 ° to left side during installing the driver assembly, and at that time, when check the oil level, lubrication oil will overflow from the sight hole even though the quantity is normal, probably resulting in the lubricating effect of the rest oil not so good.

To keep the LF481Q3 drive lubrication oil in good condition, the following points are worthy of your attention:

1. Check the sealing performance rather than the lubrication oil level (keep filler bolt closed) because the driver is sealed.
2. Before reinstall the driver on the car, which has been disassembled and repaired, add 2.0L of lubrication oil.
3. When check the oil level of the dismantled driver, place the driver in a horizontal position, screw off the drain plug, and flush oil level with the drain plug hole.
4. The drain plug must be screwed up soon and carefully after screwed out for checking oil level or changing sealing ring.

Adjustment table

During maintaining the driver assembly, taking the readjustment of the installing dimensions of output shaft or differential assembly into consideration is necessary after any component in the following table is changed.

Changing Parts	Regulating Item	
	Output Shaft	Differential Assembly
Transmission Housing	Do not	Do
Clutch Housing	Do	Do
Cone Bearing	Do not	Do
Output Shaft	Do	Do not
Differential Housing	Do not	Do
Front Bearing of Output Shaft	Do	Do not

Transmission Maintenance

Maintenance of the release shaft assembly, release shaft oil seal and the release bearing: Transmission assembly can stay at where they were on the vehicle while these parts are removed.

Removal procedure: Set the vehicle on the table, remove the clutch cable assembly, raise the vehicle and get the lubrication oil in the transmission drained.

Punch off the rear cover by the formed punch (Note: Do not make the contact surface damaged.), remove the fixed clamp of the release finger and drag the release shaft assembly out. Then take out the release finger and the return spring.

Take out the release bearing of the clutch and punch off the release shaft oil seal assembly by the formed punch (Note: Do not make the contact surface damaged.)

The installation procedure:

Removal steps are reverse against the installation procedure. Please note the following:

Apply lubrication grease on the oil seal surface and press the oil seal in with the special tool.

Install the clutch release finger, the release shaft, spring and clamp step by step. When spring is installed, make the new rear cover pressed fully into the target position with the special tool.

Following steps must be carried out on condition that installation is processed on the entire vehicle: Fill the transmission with 2.0L lubrication oil. Lower the entire vehicle from the bench and connect the clutch cable.

Maintenance of the shifting shaft oil seal: The removal and installation of the shifting shaft oil seal can be carried out without the disassembly of the transmission assembly. Removal: Remove the shifting shaft oil seal with square trowel and formed punch.

Installation: Apply lubrication grease on the oil seal lip and press the oil seal onto the transmission housing completely with the special tool.

Maintenance of the shifting shaft bearing: It requires to take shifting shaft assembly out and to remove the shifting shaft oil seal when the shifting shaft bearing is replaced. Removal: Knock with deeply stretched special tool in the transmission housing until the bearing hops out.

Installation: Press the shifting shaft bearing to the very target position with deeply stretched special tool in the transmission housing. Then, press the shifting shaft oil seal in and install the shifting shaft assembly.

Maintenance of the shifting shaft assembly: Repair the shifting shaft assembly, and it is no need to disassemble the transmission assembly.

Removal: Set the assembly on the stand or work bench with gear at the neutral position

(shifting shaft operating smoothly) and screw down the positioning base assembly. Loosen the screw plug cover with the special tool and take the shifting shaft out.

Disassembly: Press the smaller pressure spring base inwards to get the inner spring compressed. Hold the position without change to remove the ring snap.

Installation: Installation steps are basically reverse against the above mentioned procedure.

Note: Make sure that the fork system is in neutral. Tightening torque of the screw plug cover : 50N.m; tightening torque of the positioning base: 40N.m.

Removal and installation of the input shaft front bearing

Removal: Punch the front bearing off and install the input shaft front bearing with special tools. The completely press needs to be assured.

Removal and installation of the input shaft oil seal

Removal: Remove the input shaft oil seal with the special tool.

Installation: Apply lubrication grease fully on the oil seal lip and press the oil seal to the target position with the special tool.

Removal and installation of the cone bearing:

The front and rear bearing on the output shaft are all cone bearings. Hence, please pay attention to avoid the mixture of bearings, especially the same two power output bearings, during the cone bearing installation. The inner and outer ring shall be applied in set without exchange. And the corresponding shaft installation position shall be reset after the cone bearing has been changed.

Section 11 Common Malfunction and Elimination

Malfunction	Possible Reason	Elimination
The noise is too load and abnormal	The input and output bearing, and power output bearing are damaged.	Replace the bearing.
	The gear tooth surface is damaged so that there is flash or there is point corrosion on the tooth surface, or the contact is not good.	Repair or replace the gear.
	The axial position of gear and clearance are not equality.	Inspect\adjust
	The oil level is too low so that the lubrication is not enough.	Fill oil to the required level.
	There is other material in the assembly.	Inspection and elimination
Leak oil	The oil seal is worn too much or damaged.	Replace it.
	The seal glue is not sprayed evenly or the seal gasket is damaged.	Replace the seal gasket, and spray glue again.
	The connection face is hurt and not trimmed smoothly in time.	Inspect, repair
	The oil seal of difference is damaged.	Replace
Difficult to shit	The transmission is not adjusted correctly so that it can't disengage completely.	Adjust the transmission.
	The shift driving system is not adjusted correctly or the moving is block.	Inspect and adjust
	The synchronizer ring fails	Replace
Loss of shift	The synchronizer gear bushing or the connection tooth conical surface of gear is worn.	Replace relevant parts.
	The shift driving system is not adjusted well.	Inspect and replace
No shift	The shift driving system is loosed.	Inspect and replace
	The shifting arm of shift driving axle is loosed.	Repair
Bearing is abnormally damaged.	There is metal in the lubrication oil.	Replace
	It is not lubricated well or the lubrication oil does not meet the requirement.	Replace
	Use unqualified bearing.	Replace

Section 12 Easily Worn Parts List

S/N	Illustration (Code) No.	Name	Qty.
1	LF481Q3-1701103A	1 st gear needle bearing	1
2	LF481Q3-1701127A	2 nd gear needle bearing	1
3	LF481Q3-1701076A	3 rd and 4 th gear needle bearing	2
4	LF481Q3-1701075A	Front bearing, input shaft	1
5	LF481Q3-1701079A	Rear bearing, input shaft	1
6	LF481Q3-1701078A	Bearing, input shaft	2
7	LF481Q3-1701141A	Front bearing, output shaft	1
8	LF481Q3-1701150A	Rear bearing, output shaft	1
9	LF481Q3-1701077A	5 th gear needle bearing	1
10	LF481Q3-1701334A	Release bearing	1
11	LF481Q3-2303310A	Front bearing, differential	1
12	LF481Q3-1701113A	1 st gear synchronizing ring	1
13	LF481Q3-1701124A	2 nd gear synchronizing ring	1
14	LF481Q3-1701059A	3 rd gear synchronizing ring	1
15	LF481Q3-1701065A	4 th gear synchronizing ring	1
16	LF481Q3-1701069A	5 th gear synchronizing ring	1
17	LF481Q3-1701030A	Oil seal, input shaft	1
18	LF481Q3-2303321A	Front oil seal, differential	1
19	LF481Q3-2303314A	Front oil seal, differential	1
20	LF481Q3-1702035A	Oil seal, select lever	1
21	LF481Q3-1702036A	Oil seal, shift shaft	1
22	LF481Q3-1701214A	O-ring seal, odometer shaft sleeve	1
23	LF481Q3-1701074A	Rear bearing washer, input shaft	3
24	LF481Q3-1701151A	Rear bearing washer, output shaft	1
25	LF481Q3-1701101A	5th gear driven gear retaining ring	1
26	LF481Q3-1701042A	Synchronizer hub retaining ring	2
27	LF481Q3-1701046A	Synchronizer hub retaining ring	1

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