

# **CHAPTER 3 ENGINE**

**300 cc**

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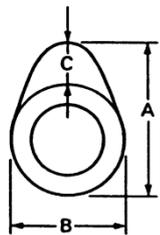
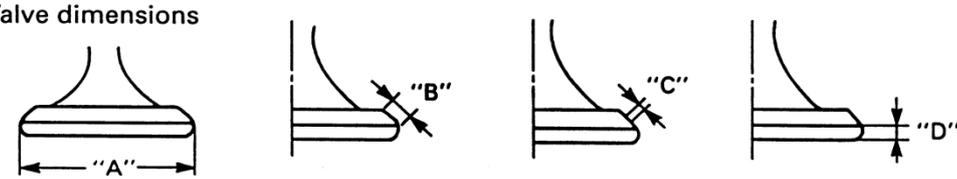
### **3.11.2 WATER PUMP**

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## **3.12 ECU**

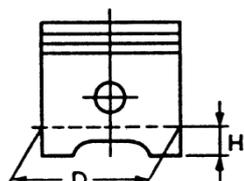
**3.1 MAINTENANCE SPECIFICATIONS**

**3.1.1 SPECIFICATIONS**

Item	Standard	Limit
Cylinder head : Warp limit:		0.03 mm
Cylinder: Bore size	72.500- 72.514 mm	72.525 mm
Out of round limit		0.03 mm
Camshaft: Cam dimensions Intake "A" "B" "C" Exhaust "A" "B" "C" Camshaft runout limit	 36 .545- 36 .645 mm 30.021-30.121 mm 6.524 mm 36 .547- 36 .647 mm 30 .067- 30.167 mm 6.48 mm .....	 36 .45 mm 29.92 mm ... 36 .45 mm 29 .97 mm ... 0.03m m
Cam chain: Cam chain type/No. of links	300: DID SC.A-0404A SDH/104	...
Rocker arm /rocker armshaft: Rocker arm inside diameter Rocker shaft outside diameter Rocker arm - to- rocker arm shaft clearance	12 .000- 12 .018 mm 11.981- 11.991 mm 0.009- 0.012 mm	12 .03 mm 11.95 mm ...
Valve, Valve seat, Valve guide: Valve clearance (cold)	IN 0.08-0.12 mm EX 0.16-0.20 mm	... ...
Valve dimensions Valve dimensions	 Face Width      Seat Width      Margin Thickness	

"A" head diameter	IN	33.9-34.1mm	...
	EX	28.4-28.6mm	...
"B" face width	IN	3.394-3.960mm	...
	EX	3.394-3.960 mm	...
"C " seat width	IN	0.9-1.1mm	...
	EX	0.9-1.1 mm	...
"D" margin thickness	IN	0.8-1.2 mm	...
	EX	0.8-1.2 mm	...
Stem outside diameter	IN	5.975- 5.990 mm	5.94 mm
	EX	5.960-5.975 mm	5.92 mm
Guide inside diameter	IN	6.000- 6.012 mm	6.05 mm
	EX	6.000- 6.012 mm	6.05 mm

Item		Standard	Limit
Stem-to-guide clearance	IN	0.010- 0.037 mm	0.08 mm
	EX	0.025-0.052 mm	0.1 mm
Stem runout limit	IN	...	0.01 mm
	EX	0.9-1.1 mm	1.6 mm
Valve seat width	IN	0.9-1.1 mm	1.6 mm
	EX	0.9-1.1 mm	1.6 mm
Valve spring :			
Free length (Inner)	IN/EX	38.1 mm	361 mm
	(Outer) INEX	36.93 mm	35.0 mm
Set length (valve closed)	(Inner) IN/EX	30.1 mm	...
	(Outer) IN/EX	31.6 mm	...
Com pressed pressure	(Inner) IN/EX	7.8- 9.0 kg	...
	(Outer) IN/EX	37.22-42.83 kg	...
Tilt limit	(Inner) IN/EX	...	2.5° /1.7mm
	(Outer) IN/EX	...	2.5° /1.7mm
Piston:			
Piston to cylinder clearance		300: 0.02 - 0.04 mm	0.15m m
Piston size "D"		300;72.465-72.480 mm	...
Measuring point "H"		5mm	...
Piston pin bore inside diameter		17.004-17.015 mm	17.045 mm
Piston pin outside diameter		16.991-17.000 mm	16.975 mm
Piston rings :			
Top ring :			
Type		Barrel	...
End gap (installed)		0.15- 0.30 mm	0.45 mm
Side clearance (installed )		0.04- 0.08 mm	0.12 mm
2nd ring :			
Type		Taper	...
End gap (installed)		0.30- 0.45 mm	0.7 mm
Side clearance		0.03 - 0.07 mm	0.12 mm



<p>Oil ring : End gap (installed)</p>	<p>0.2- 0.7 mm</p>	<p>...</p>
<p>Crankshaft:</p> <div data-bbox="507 607 699 846" style="text-align: center;"> </div> <p>Crank width "A" Runout limit "C " Big end side clearance "D"</p>	<p>59.95-60.00 mm 0.03 mm 0.35- 0.85 mm</p>	<p>... ... ...</p>

<b>Item</b>	<b>Standard</b>	<b>Limit</b>
Automatic centrifugal clutch: Clutch shoe thickness Clutch hosing inside diameter Clutch shoe spring free length W eight outside diameter Clutch- in revolution	3.0 mm 135 mm 2 8.1 mm 20 mm 2 ,100- 2,700 r/m in	2.0 mm 135 .5 mm ... 19 .5 mm ...
V-belt: V-belt width	22.6 mm	21.0 mm
Oil pump: Type Tip clearance Side clearance Housing and rotor clearance	Trochoid type 0.1- 0 .34 mm 0.013- 0.03 6 mm 0 .04- 0.09 mm	0 .4 mm 0 .15 mm 0 .15 mm

<b>Item</b>	<b>Standard</b>	<b>Limit</b>
Radiator: Type Width/height/thickness	Cooling fin with electric fan 260 /300: 288/238/42 mm	... ... ...
Radiator cap opening pressure	110-140kPa (1.1-1.4kg/cm <sup>2</sup> , 1.1-1.4bar)	...
Radiator capacity	2 L	...
Reservoir tank capacity	0 .35 L	
Thermostatic valve: Valve opening temperature Valve full open temperature Valve full open lift	70 .5- 73 .5°C 85 °C 3 mm	

3.1.2 TIGHTENING TORQUES

Part to be tightened	Part name	Thread size	Q'ty	Tightening Torque		Remarks
				N.m	m.kg	
Oil check bolt	—	M 6	1	10	1.0	
Exhaust pipe stud bolt	—	M 8	2	13	1.3	
Spark plug	—	M12	1	18	1.8	
Cam sprocket cover	Bolt	M 6	2	10	1.0	
Cylinder head and cylinder	Nut	M 8	4	22	2.2	
Cylinder head and cylinder (Cam chain side)	Bolt	M 6	2	10	1.0	
Valve cover	Bolt	M 6	5	10	1.0	
Rotor	Nut	M16	1	80	8.0	
Valve adjuster locknut	Nut	M 6	2	14	1.4	
Cam shaft bearing stopper	Bolt	M 6	2	8	0.8	
Cam sprocket	Bolt	M10	1	60	6.0	
Cam chain tensioner (Body)	Bolt	M 6	2	10	1.0	
(Plug)	Bolt	M8	1	8	0.8	
Guide stopper 2	Bolt	M 6	1	10	1.0	
Water pump housing cover	Bolt	M 6	3	10	1.0	
Hose joint	—	M 6	2	7	0.7	
Thermostatic valve cover	Bolt	M 6	2	10	1.0	
Filer neck supporting	Bolt	M 5	1	5	0.5	
Oil pump	Screw	M 6	2	7	0.7	
Oil pump cover	Bolt	M 3	1	1	0.1	
Drain plug	Bolt	M 35	1	32	3.2	
Throttle body joint	Bolt	M 6	2	10	1.0	
Throttle body joint and Throttle body	Bolt	M 6	2	10	1.0	
Fuel pump	—	M6	2	10	1.0	
Exhaust pipe assembly	Nut	M8	2	20	2.0	
Crankcase (left and right)	Bolt	M 6	9	10	1.0	
Drain bolt	Bolt	M 8	1	22	2.2	
Oil filer	Bolt	M 14	1	3	0.3	
Crankcase cover (left)	Bolt	M 6	10	10	1.0	
Magnet cover	—	M 6	10	10	1.0	

Part to be tightened	Part name	Thread size	Q'ty	Tightening torque		Remarks
				Nm	m.kg	
Cover (oil pump)	Bolt	M 6	2	12	1.2	
Timing check plug	P lug	M 16	1	8	0.8	
One way clutch	—	M 8	3	30	3.0	
Clutch housing	Bolt	M 14	1	60	6.0	
Grease stopper (Primary sheave)	—	M 4	4	3	0.3	
Primary fixed sheave	—	M 14	1	60	6.0	
Clutch carrier assembly	—	M 36	1	90	9.0	
Stator	—	M 5	3	7	0.7	
Pick up coil	—	M 5	2	7	0.7	
Starter motor	Bolt	M 6	2	10	1.0	
Thermo switch	—	M 16	1	23	2.3	
Thermo unit	—	P t1/8	1	8	0.8	

**3.2 PARTS INSPECTION AND SERVICE**

**3.2.1 VALVE CLEARANCE ADJUSTMENT**

**NOTE:**

Valve clearance adjustment should be made with the engine cool, at room temperature.

When the valve clearance is to be measured or adjusted, the piston must be at Top Dead Center (T.D.C.) on the compression.

1. Remove :

- Crankcase cover

2. Remove :

- Spark plug

- Valve cover (intake side)

- Valve cover (exhaust side)

3. Remove:

- Timing check plug

4. Measure:

- Valve clearance

Out of specification → Adjust.

**Valve clearance (cold):**

**300: Intake valve 0.08- 0.12m m**

**Exhaust valve 0.16- 0 .20mm**

**Measurement steps:**

- Rotate the primary fixed sheave counterclockwise to align the slit “a” on the rotor with the stationary pointer “b” on the crankcover 1 when the piston is Top Dead Center (TDC).

- Measure the valve clearance by using a feeler gauge.

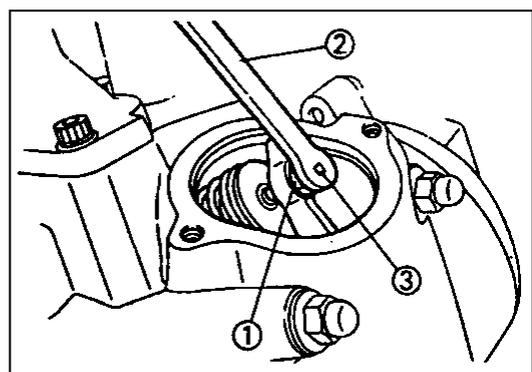
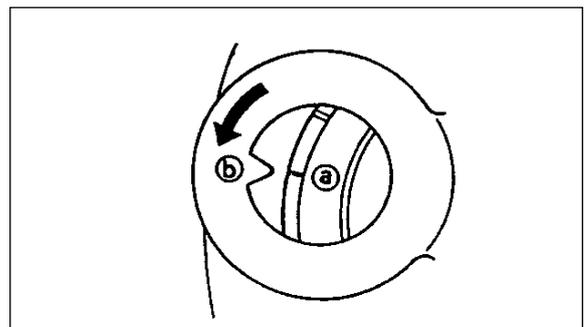
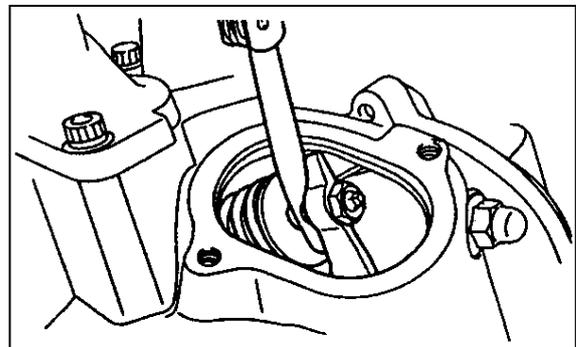
6. Adjust

- Valve clearance

**Adjustment steps:**

- Loosen the locknut ①

- Turn the adjuster ③ in or out with the valve adjusting tool ② until specified clearance is obtained .



Turning in → Valve clearance is decreased  
 Turning out → Valve clearance is increased

- Hold the adjuster to prevent it from moving and tighten the locknut.

 14Nm(1.4m·kg)

- Measure the valve clearance.
- If the clearance is incorrect, repeat above steps until specified clearance is obtained.

7. Install:

- Valve cover (intake side) ①  10Nm(10m·kg)

- O-ring ②

8. Install:

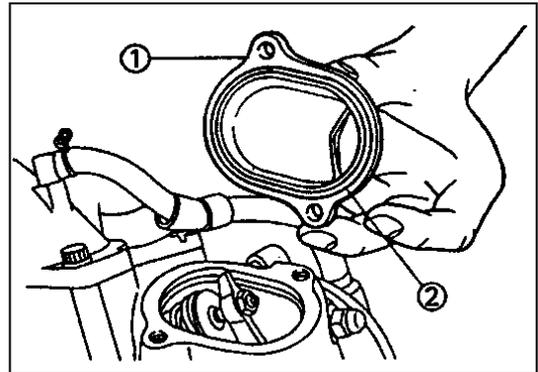
- Valve cover(exhaust side)  10Nm(1.0m·kg)

- O-ring

- Spark plug  18Nm(1.8m·kg)

- Timing check window screw

- Crankcase cover 8N.m( 0.8m.kg)



### 3.2.2 SPARK PLUG INSPECTION

1. Remove :

- Spark plug cap
- Spark plug

#### CAUTION:

Before removing the spark plug, use compressed air to blow away any dirt accumulated in the spark plug wells to prevent it from falling into the cylinder.

1. Check:

- Spark plug type

Incorrect → Replace.

	<b>Standard spark plug: DR8EA (NGK)</b>
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2. Inspect:

● Electrode ①

Wear/ damage → Replace.

● Insulator ②

Abnormal color → Replace.

Normal color is a medium - to- light tan color.

3. Clean:

● Spark plug

(with spark plug cleaner or wire brush)

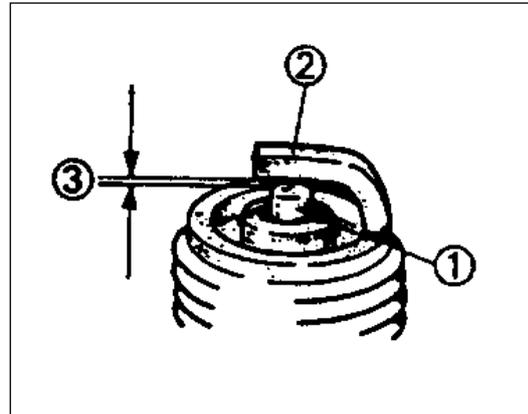
4. Measure:

● Spark plug gap ③

(with a wire gauge)

Out of specification → Adjust gap.

	<b>Spark plug gap : 0.6-0.7 mm</b>
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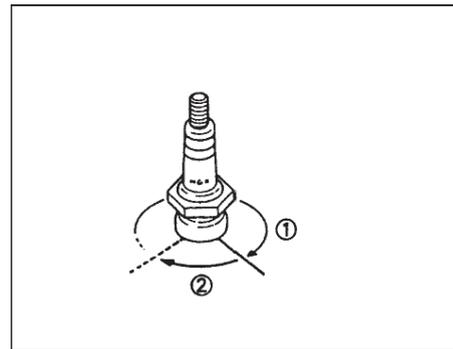


6. Install:

● Spark plug  18Nm(1.8m·kg)

**NOTE:**

**Before installing a spark plug, clean the Gasket surface and plug surface.**



### 3.2.3 COMPRESSION PRESSURE MEASUREMENT

**NOTE :**

Insufficient compression pressure will result in performance loss.

1. Check:

● Valve clearance

Out of specification → Adjust.

Refer to “CALCE CLEARANCE ADJUSTMENT” section.

2. Start the engine and let it warm up for several minutes.

3. Turn off the engine.

4. Remove:

● Spark plug

Before removing the spark plug, use compressed air to blow away any dirt accumulated in the spark plug well to prevent it from falling into the cylinder.

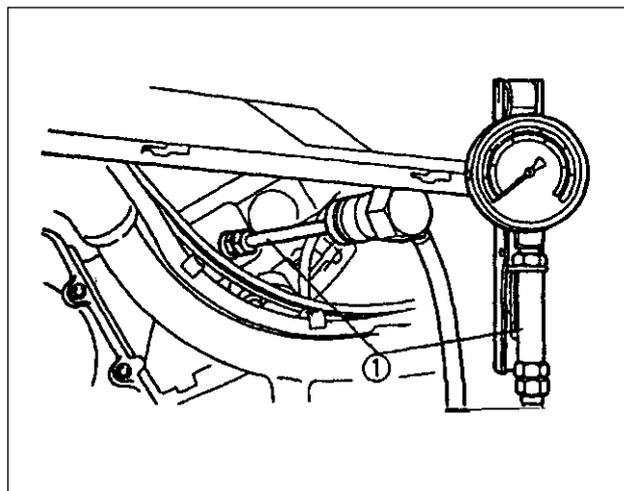
5. Attach:

- Compression gauge ①

6. Measure:

- Compression pressure

If it exceeds the maximum pressure allowed → Inspect the cylinder head, valve surfaces and piston crown for carbon deposits.



If it is below the minimum pressure → Squirt a few drops of oil into the affected cylinder and measure again. Follow the table below.

Compression pressure (With oil applied into cylinder)	
Reading	Diagnosis
Higher than without oil	Worn or damaged pistons
Same as without oil	Possible defective ring (s), valves, cylinder head gasket or Piston → Repair.

	Compression pressure(at sea level):
	Standard: 1,400 kPa (14Kg/cm <sup>2</sup> , 14 bar) Minimum : 1,120 kPa (11.2 kg /cm <sup>2</sup> , 11.2 bar)

Measurement steps :

- Crank the engine with the throttle wide open until reading on the compression gauge stabilizes.

**WARNING :**

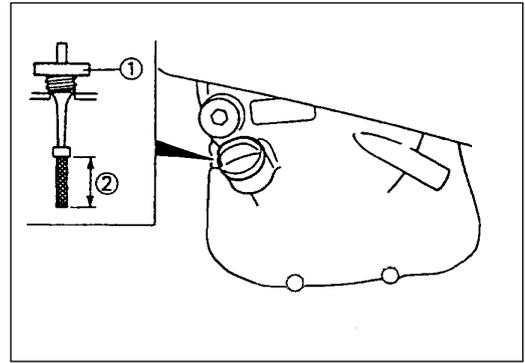
Before cranking the engine, ground all spark plug leads to prevent sparking.

8. Install:

- Spark plug 18Nm(1.8m·kg)

**3.2.4ENGINE OIL LEVEL INSPECTION**

1. Start the engine and let it warm up for a few minutes .
2. Turn off the engine.
3. Inspect: (Do not thread dipstick in)
  - Engine oil level
 Oil level should be between maximum and minimum marks "2" .  
 Oil level is below the minimum mark      Add oil up to the proper lever.



**RECOMMENDED ENGINE OIL**

Refer to the chart for selection of the oils suited to the atmospheric temperature.

	<p><b>API STANDARD:</b> API SG or higher grade</p>
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**CAUTION:**

- Do not put in any chemical additives, use oils with a grade of SG or higher.
- Be sure not to use oils labeled "ENERGY CONSERVING I" or higher. Engine oil also lubricates the clutch and additives could cause clutch slippage.
- Be sure no foreign material enters the crankcase.

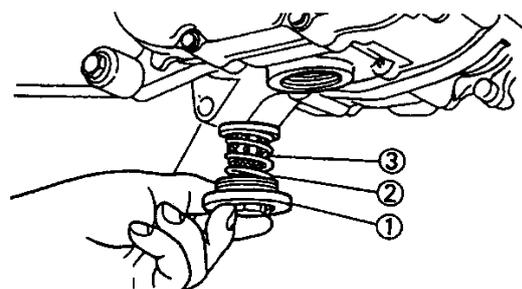
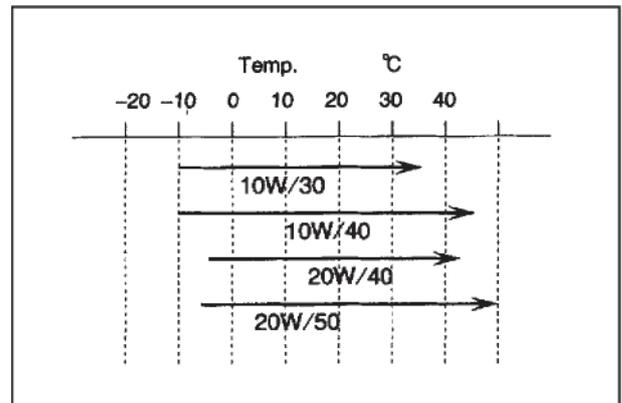
4. Start the engine and let it warm up for a few minutes.
5. Turn off the engine.

**NOTE:**

Wait a few minutes until the oil settles before inspecting the oil level.

**ENGINE OIL REPLACEMENT**

1. Start the engine and let it warm up for several minutes .



2. Turn off the engine and place an oil pan under the engine.

3. Remove :

●Oil filler plug

●Drain plug ①  32Nm(3.2m·kg)

●Compression spring ②

●Oil strainer ③

●O-ring

●Drain the crankcase of its oil.

4. Install:

●O-ring ① **NEW**

●Compression spring ②

●Oil strainer ③

●Drain plug ④

●Oil filler plug

**NOTE :**

Check the drain plug O-ring. If damaged, replace it with a new one.

5. Fill:

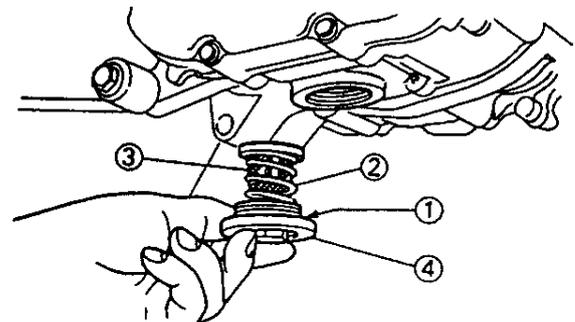
●Crankcase

	Oil quantity: 1.4L
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6. Check:

●Engine oil level

Refer to "ENGINE OIL LEVEL INSPECTION" section



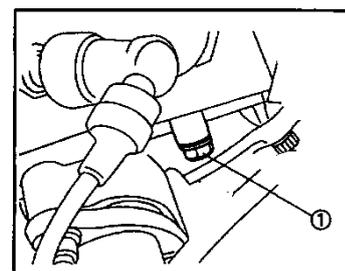
**ENGINE OIL PRESSURE INSPECTION**

Inspection steps:

●Slightly loosen the oil check bolt ①

●Start the engine and keep it idling until the oil begins to seep from the oil check bolt. If no oil comes out after one minute, turn the engine off so it will not seize.

●Check oil passages and oil pump for dam age



or leakage.

- Start the engine after solving the problem (s), and recheck the oil pressure.
- Tighten the oil check bolt to specification.

 10Nm(1.0m·kg)

**CAUTION:**

- Start the engine and check the oil pressure with the oil check bolt loosened.
- Do not apply at high speeds more than specified when checking the pressure.

**NOTE:**

Wipe any spilled oil off the engine.

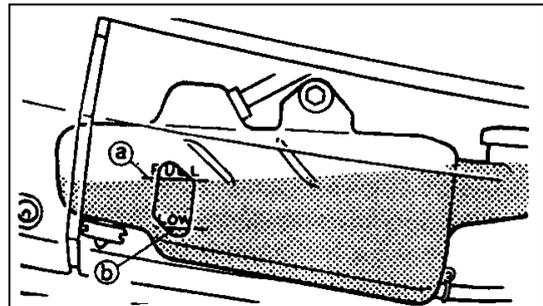
**3.2.5 COOLANT LEVEL INSPECTION**

Inspect:

- Coolant level

Coolant level should be between the maximum  $\bigcirc^a$  and minimum  $\bigcirc^b$  marks.

Coolant level is below the "LOWER " level line  
Add soft water (tap water) up to the proper level.



**CAUTION:**

Hard water or salt water is harmful to engine parts. Use only distilled water if soft water is not available. If you use tap water, make sure it is soft water.

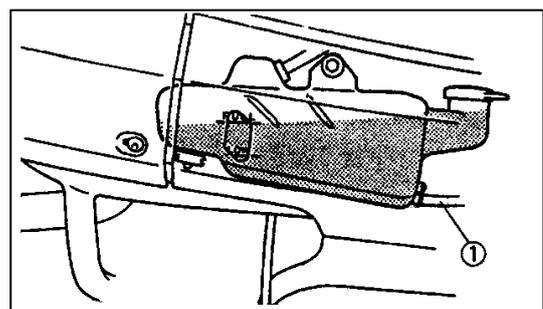
1. Start the engine and let it warm up for several minutes.
2. Turn off the engine and inspect the coolant level again.

**NOTE:**

Wait a few minutes until the coolant settles before inspecting the coolant level.

**COOLANTRE PLACE MENT**

1. Remove:
  - Front cover of ATV plastic body work.
  - Seat.
2. Remove:
  - Hose ① (reservoir tank)
 Drain the reservoir tank of its coolant.



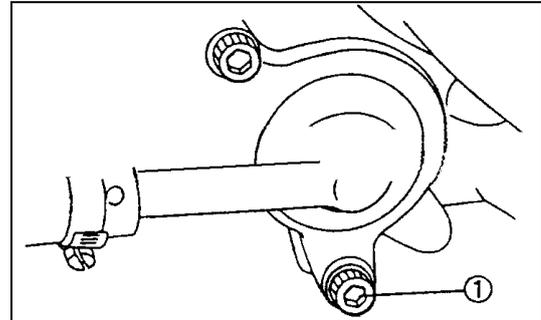
3. Remove:

- Drain bolt ①
- Radiator cap

**WARNING:**

Do not remove the radiator cap when the engine and radiator are hot. Scalding hot fluid and steam may be blown out under pressure, which could cause serious injury. When the engine has cooled, open the radiator cap as follows:

Place a thick rag or a towel over the radiator cap. Slowly rotate the cap counterclockwise toward the detent. This allows any residual pressure to escape. When the hissing sound has stopped, press down on the cap while turning counterclockwise and remove it.



**NOTE:**

- Remove the radiator cap after removing the drain bolt.

4. Clean:

- Radiator

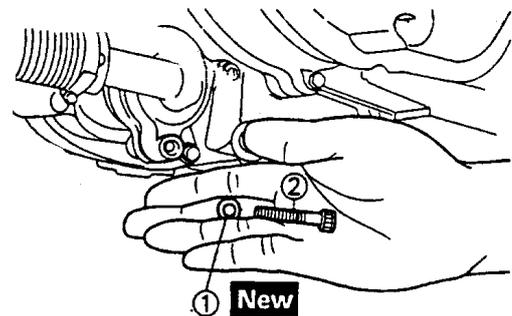
Fill soft water into the filler neck support ① (reservoir tank).

5. Install:

- Gasket ① **NEW**

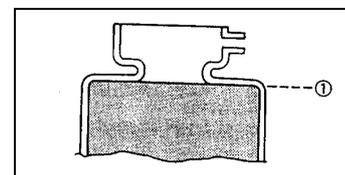
10Nm(1.0m·kg)

- Drain bolt ②



6. Loosen:

- Hose ①



7. Connect:

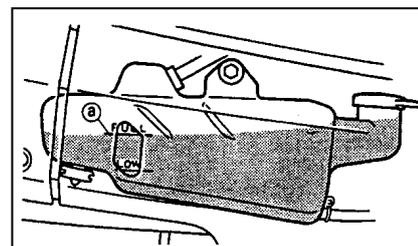
- Hose (reservoir tank)

8. Fill:

- Radiator

( to specified level ① )

Fill the coolant slowly, until the coolant comes out from the head hose.



- Reservoir tank  
( to maximum level ○,a )

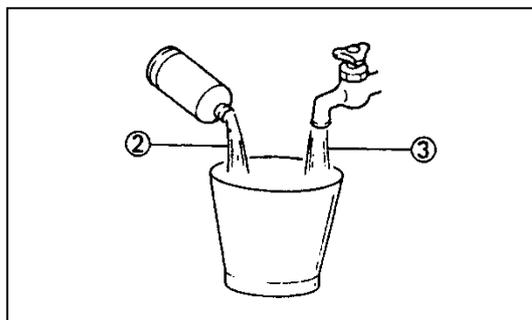
	Recommended coolant: High quality ethylene glycol anti-freeze containing corrosion inhibitors for aluminum engine.
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	Coolant ② and water ③ (soft water) : Mixed ratio: min50% /max50% follow the instruction of the coolant Total amount: 2 L Reservoir tank capacity: 0.35L
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Handling notes for coolant:  
Coolant is potentially harmful and should be handled with special care.

**WARNING:**  
splashes in your eyes:  
Thoroughly wash your eyes with water and consult a doctor.  
If coolant splashes on your clothes:  
●Quickly wash it away with water and then with soap and water.  
If coolant is swallowed:  
Vomit immediately and see a physician.

**CAUTION:**  
●Hard water or salt water is harmful to engine parts. Use only distilled water if soft water is not available.  
●If you use tap water, make sure it is soft water.  
●Do not use water containing impurities or oil.  
●Take care that no coolant splashes onto painted surfaces. If it does, wash them immediately with water.  
●Do not mix different types of ethylene glycol



antifreeze containing corrosion inhibitors for aluminum engines.

9. Tighten:

●Hose

Fill the coolant slowly to the specified level.

10. Install:

●Radiator cap

11. Start the engine and let it warm up for several minutes.

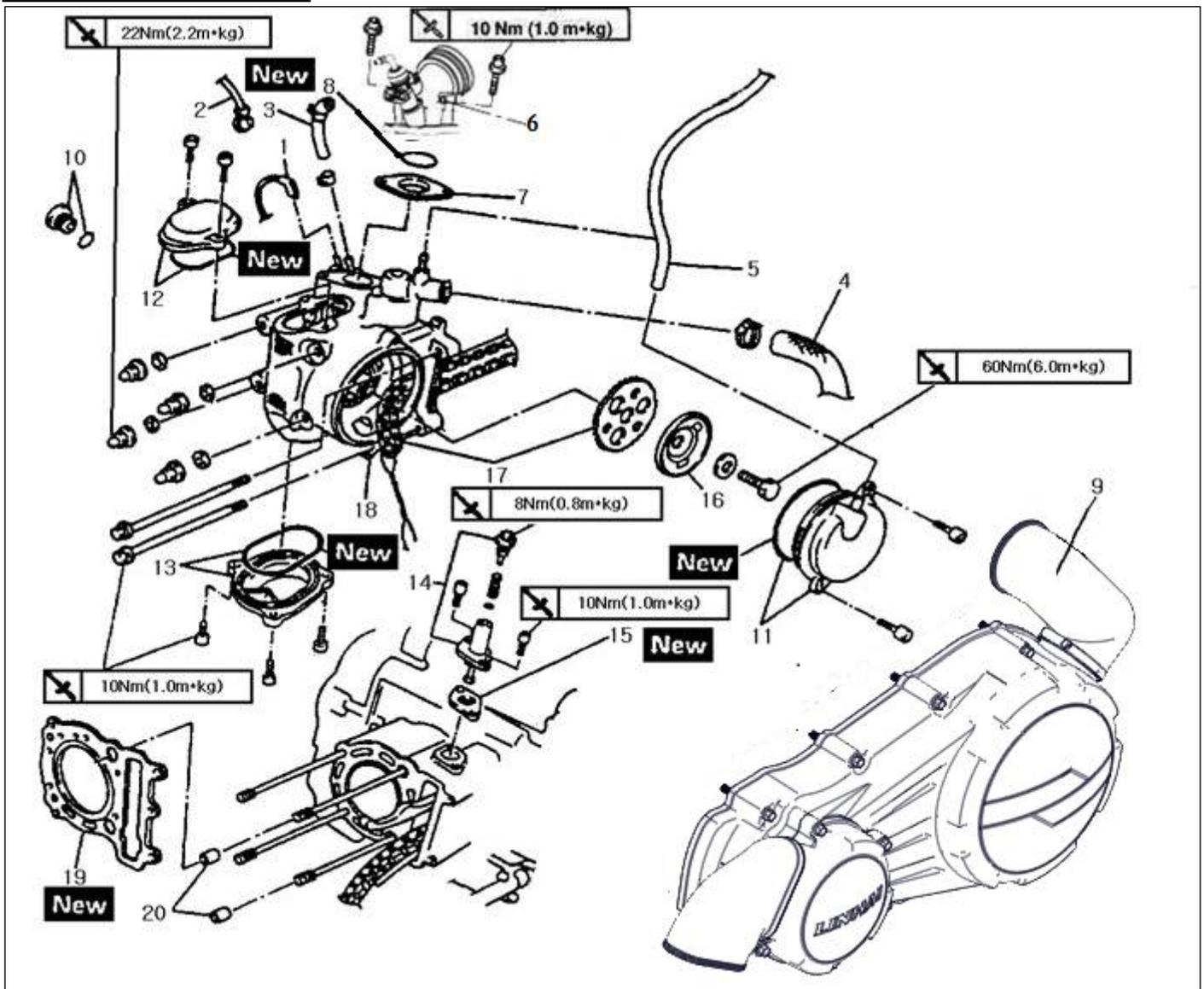
12. Stop the engine and inspect the level.

**NOTE:**

Wait a few minutes until the coolant settles before inspecting the coolant level.

13. Install: Remain parts.

**3.3 CYLINDER HEAD**



Order	Job name / Part name	Q 'ty	Remarks
	Cylinder head removal Drain the coolant. Side panel Footrest board		Remove the parts in order.
1	Thermo unit lead		
2	Plug cap	1	
3	Crankcase breather hose	1	
4	Outlet hose (cylinder head)	2	
5	Breather hose (crankcase)	1	
6	Throttle body joint	1	
7	Joint	1	
8	O-ring	1	
		2	
9	Crankcase cover	1	Refer to "CYLINDER HEAD REMOVAL AND INSTALLATION" section. Reverse the removal procedure for installation.
10	Plug/O-ring	1/1	
11	Cam sprocket cover/O-ring	1/1	
12	Valve cover (intake side)/O-ring	1/1	
13	Valve cover (exhaust	1/1	
14	side)/O-ring	1	
	Timing chain tensioner assembly	1	
15	Timing chain tensioner gasket	1	
16	Breather plate	1/1	
17	Cam sprocket/Timing chain	1	
18	Cylinder head	1	
19	Cylinder head gasket	2	
20	Dowel pin		

**CYLINDER HEAD REMOVAL**

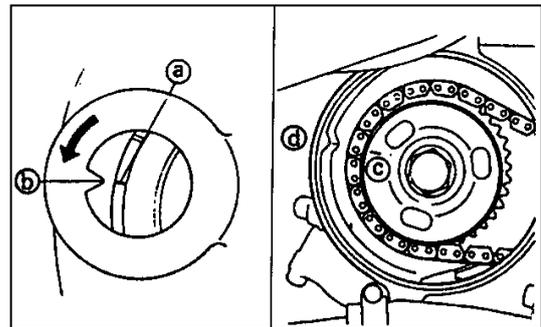
1. Align:

"I" mark ○,a on the rotor  
(with stationary pointer ○,b on the crankcase cover )

**NOTE:** If any special mark found, contact the ATV manufacture via the agent for the parts and special instruction.

**NOTE:**

Turn the primary sheave counterclockwise with a wrench and align the "I" mark ○,c with the cylinder head match mark ○,d when the piston is at TDC on the compression



2. Loosen:

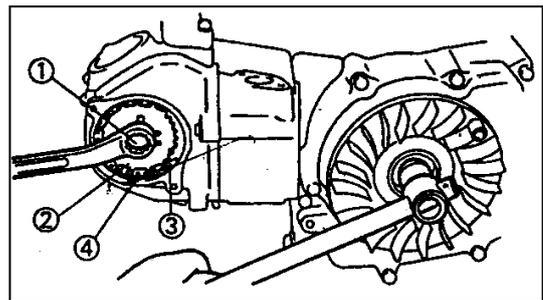
- Bolt ①

3. Remove:

- Timing chain tensioner assembly
- Timing chain tensioner gasket

4. Remove:

- Breather plate ②
- Cam sprocket ③
- Timing chain ④



**NOTE:**

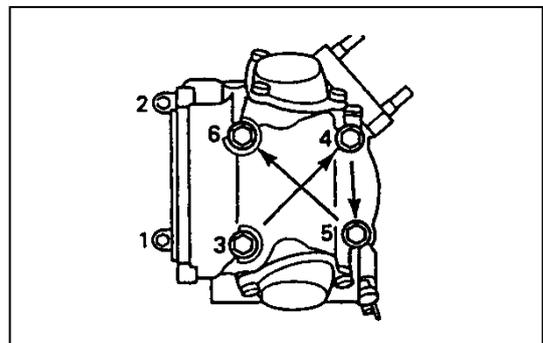
- Fasten a safety wire to the timing chain to prevent it from falling into the crankcase.
- Remove the bolt ① while holding the rotor mounting bolt with a wrench.

5. Remove:

- Cylinder head

**NOTE:**

- Loosen the nuts in their proper loosening sequence.
- Start by loosening each nut 1/2 turn until all are loose.



**CYLINDER HEAD INSPECTION:**

1. Eliminate:

- Carbon deposits (from combustion chambers)

Use a rounded scraper.

**NOTE:**

Do not use a sharp instrument to avoid damaging or scratching:

- Spark plug threads
- Valve seats

2. Inspect:

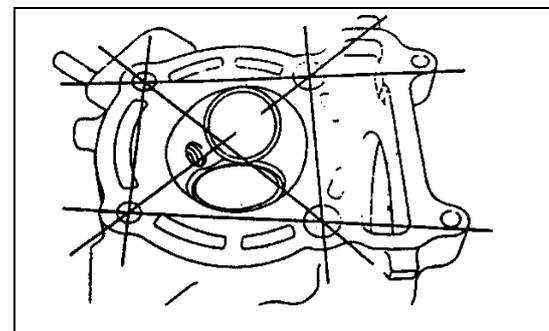
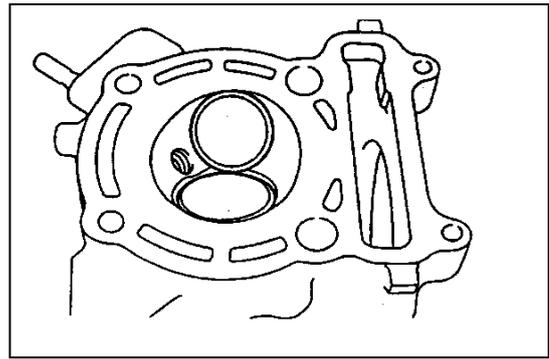
- Cylinder head

Scratches/damage → Replace.

3. Measure:

- Cylinder head warpage

Out of specification → Resurface .



	<p><b>Cylinder head warpage :</b> <b>Less than 0.03 mm</b></p>
---	--

**Warpage measurement and resurfacement steps:**

- Place a straight edge and a feeler gauge across the cylinder head.

- Measure the warpage.

If the warpage is out of specification, resurface the cylinder head.

- Place a 400 ~ 600 grit wet abrasive pape on the surface plate, and resurface the head using a figure eight sanding patten.

**NOTE:**

Rotate the cylinder head several times for an even resurfacement.

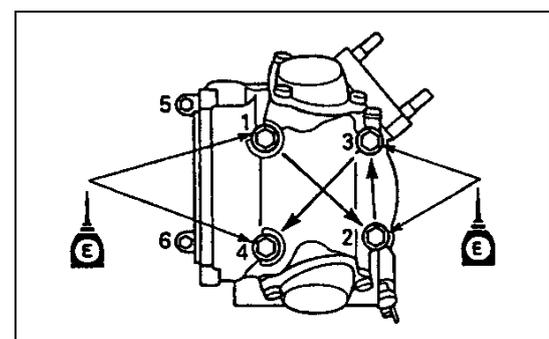
**CYLINDER HEAD INSTALLATION**

1. Install:

- Gasket (cylinder head) **NEW**
- Dowel pins
- Cylinder head

**NOTE:**

- Apply engine oil onto the nut threads.
- Tighten the nuts in a crisscross pattern.



2. Tighten:

- Nuts (cylinder head)  22Nm(2.2m·kg)
- Bolts (cylinder)  10Nm(1.0m·kg)

3. Install:

- Cam sprocket ①
- Timing chain ②

Installing steps :

- Turn the primary sheave counterclockwise until the TDC mark ○,a matches the stationary pointer ○,b.
- Align the "I" mark ○,c on the cam sprocket with the stationary pointer ○,d on the cylinder head.

**NOTE:** If any special mark found, contact the ATV manufacture via the agent for the parts and special instruction.

- Fit the timing chain onto the cam sprocket and install the cam sprocket on the camshaft.

**NOTE:**

- When installing the cam sprocket, keep the timing chain as tense as possible on the exhaust side.
- Align the match mark ○,c on the cam sprocket with the stationary pointer ○,d on the cylinder head.
- Align the pin on the cam shaft with the slot in the cam sprocket.

**CAUTION:**

Do not turn the crankshaft during installation of the cam shaft. Dam age or improper valve timing will result.

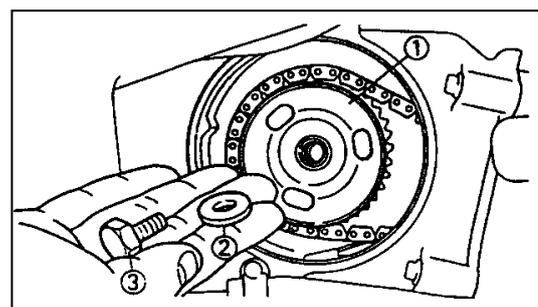
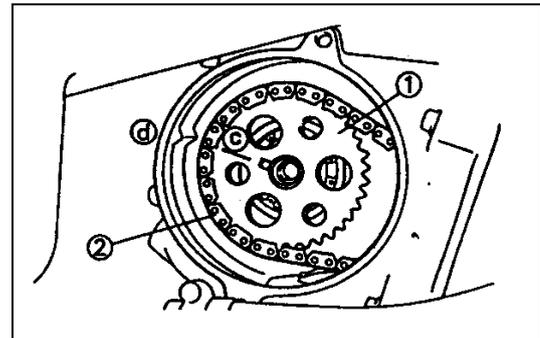
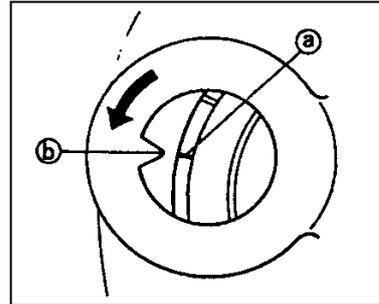
- While holding the camshaft, temporarily tighten the bolts .
- Remove the safety wire from the timing chain.

4. Install:

- Breather plate ①
- Plane washer ②

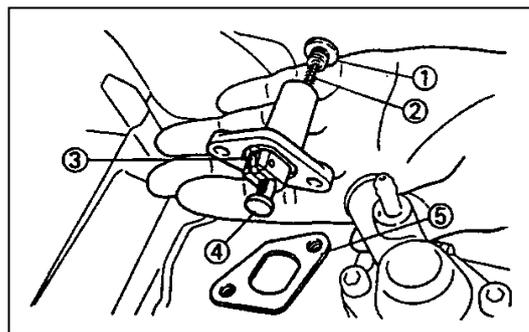
5. Install:

- Timing chain tensioner



### Installing steps:

- Remove the tensioner cap bolt ① and springs ②.
- Release the timing chain tensioner one-way cam ③ and push the tensioner rod ④ all the way in.
- Install the tensioner with a new gasket ⑤ onto the cylinder.
- Install the springs ② and cap bolt ①.
- Tighten the bolt (with gasket) to the specified torque .



Bolt (chain tensioner)  10Nm(1.0m·kg)

Cap bolt (timing chain tensioner)  8Nm(0.8m·kg)

### 6. Tighten:

- Bolt (cam sprocket)

### 7. Check:

- Valve timing

Out of alignment → Adjust.

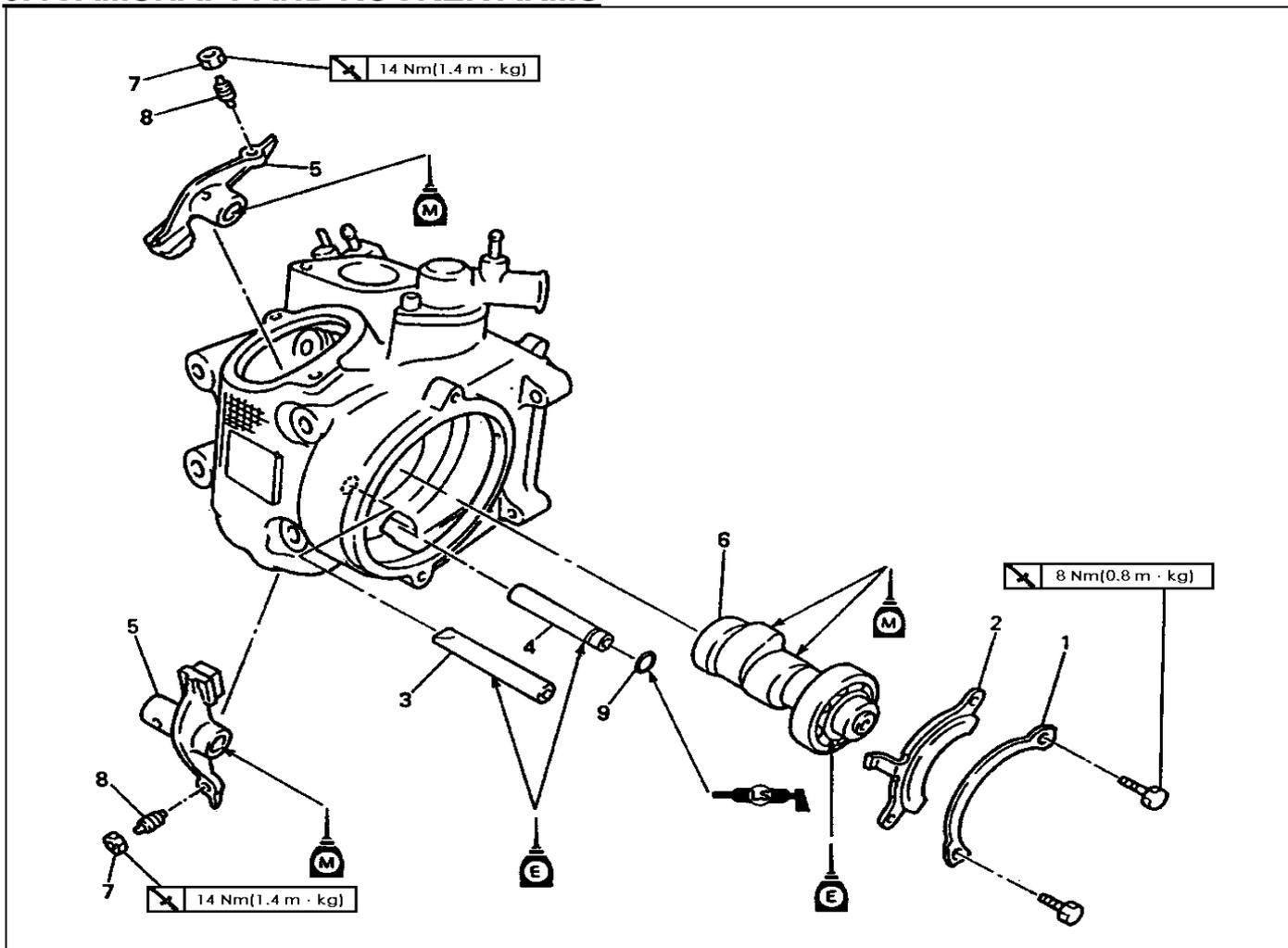
### 8. Check:

- Valve clearance

Out of specification → Adjust.

Refer to the "VALVE CLEARANCE ADJUSTMENT" section.

3.4 CAMSHAFT AND ROCKER ARMS



Order	Job name / Part name	Q 'ty	Remarks
	<b>Cam shaft and rocker arms removal</b>		Remove the parts in order. Refer to "CYLINDER HEAD" section.
	Cylinder head		
1	Lock washer	1	
2	Plate	1	Refer to "ROCKER ARM AND ROCKER SHAFT REMOVAL AND INSTALLATION" section..
3	Rocker arm shaft (intake)	1	
4	Rocker arm shaft (exhaust)	1	
5	Rocker arm	2	
6	Camshaft	1	Refer to "CAMSHAFT INSTALLATION" section .
7	Locknut	2	
8	Adjuster	2	
9	O-ring	1	
			Reverse the removal procedure for installation

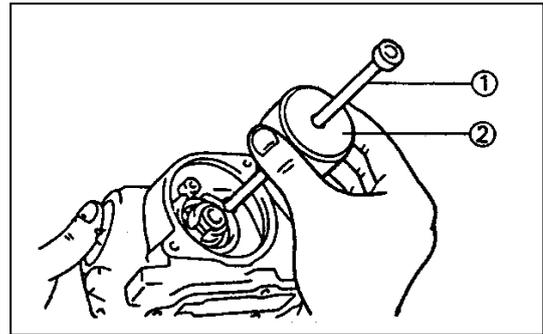
**ROCKER ARM AND ROCKER ARM SHAFTRE MOVAL**

1. Remove:

- Rocker arm shaft (intake)
- Rocker arm shaft (exhaust)

**NOTE:**

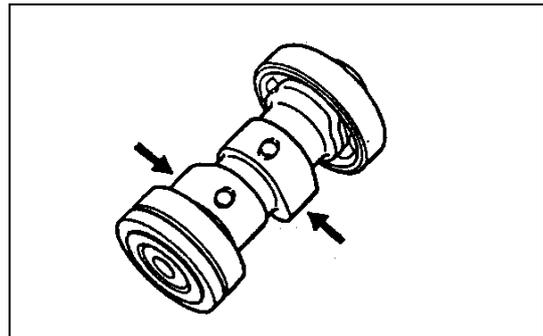
Attach a rocker arm shaft puller bolt ① and weight ② to the rocker arm shaft and slide out the shaft.



**CAM SHAFT INSPECTION**

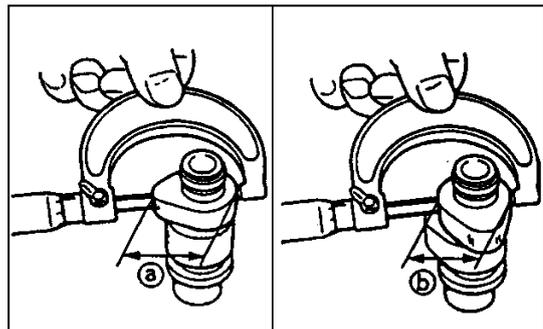
1. Inspect:

- Cam lobes
- Pitting/Scratches/Blue discoloration → Replace .



2. Measure:

- Cam lobes length ○,a and ○,b
- Out of specification → Replace.



**Cam lobes length:**

**Intake:**

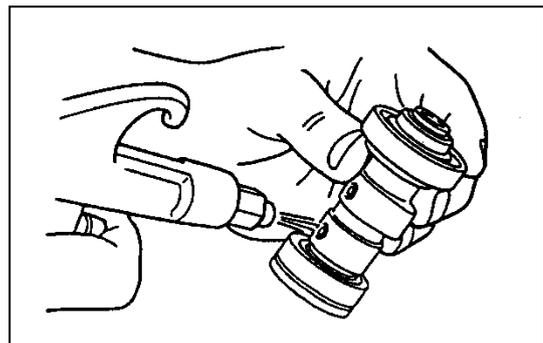
- ,a 36 .545- 36 .645 mm  
<Lim it: 36.45 mm>
- ,b 30.021-30.121 mm  
<Lim it: 29.92 mm>

**Exhaust:**

- ,a 36 .547- 36 .647 mm  
<Lim it: 36.45 mm>
- ,b 30.067- 30.167 mm  
<Lim it: 29.97 mm>

3. Inspect:

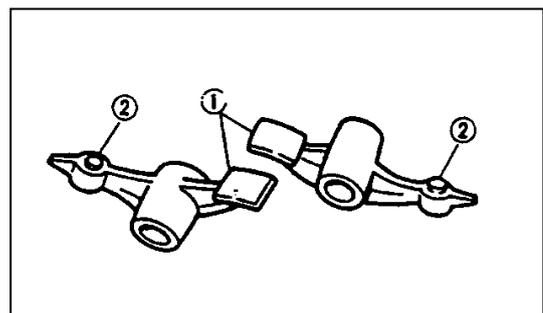
- Cam shaft oil passage
- Stuffed → Blow out oil passage with compressed air.



**ROCKER ARMS AND ROCKER ARM SHAFTS INSPECTION**

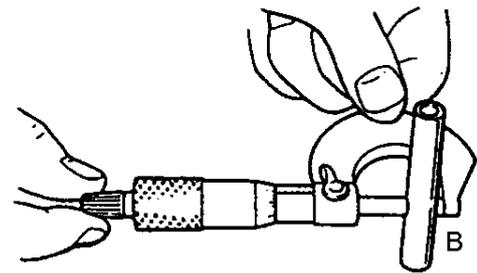
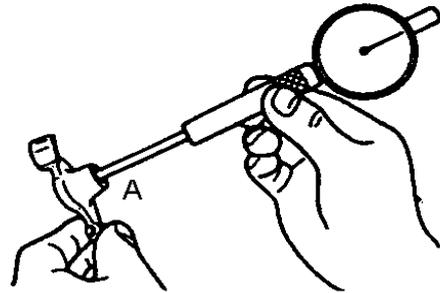
1. Inspect:

- Cam lobe contact surface ①
  - Adjuster surface ②
- Wear/Pitting/Scratches/Blue discoloration→ Replace.



**Inspection steps:**

- Inspect the two contact areas on the rocker arms for signs of unusual wear.
- Rocker arm shaft hole.
- Cam-lobe contact surface.  
Excessive wear → Replace.
- Inspect the surface condition of the rocker arm shafts.  
Pitting/scratches/blue discoloration → Replace or check lubrication.
- Measure the inside diameter A of the rocker arm holes.  
Out of specification → Replace.



	<b>Inside diameter (rocker arm ):</b> <b>12.000- 12.018mm</b> <b>&lt; Lim it: 12.030 mm &gt;</b>
---	--

- Measure the outside diameter B of the rocker arm shafts.  
Out of specification → Replace.

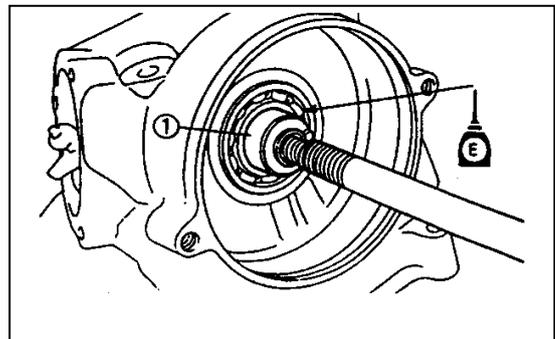
	<b>Outside diameter(rocker arm shaft):</b> <b>11.981-11.991 mm</b> <b>&lt;Limit: 11.95 mm&gt;</b>
--	---

**CAMSHAFT AND ROCKER ARM INSTALLATION**

1. Lubricate:

- Cam shaft ①

	<b>Camshaft:</b> <b>Molybdenum disulfide oil</b>
	<b>Camshaft bearing:</b> <b>Engine oil</b>



2. Install:

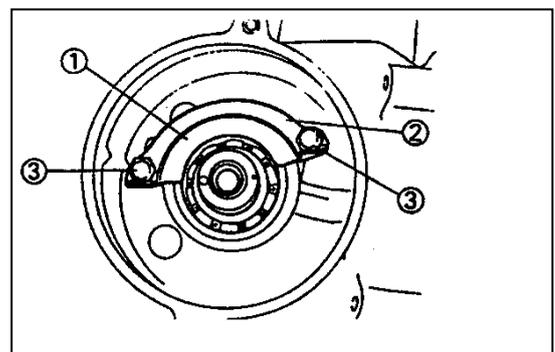
- Plate①
- Lockwasher ② **NEW**
- Bolt ③  8Nm(0.8m·kg)

**NOTE:**

Bend the lockwasher tabs along the bolt ③ faults.

3. Apply:

- Molybdenum disulfide oil onto the rocker arm and rocker arm shaft.



	<b>Molybdenum disulfide oil</b>
---	---------------------------------

4. Install:

- Rocker arm ①
- Rocker arm shaft ② (exhaust)

**NOTE:**

Exhaust:  
Install the rocker arm shaft (exhaust) completely pushed in.

5. Install:

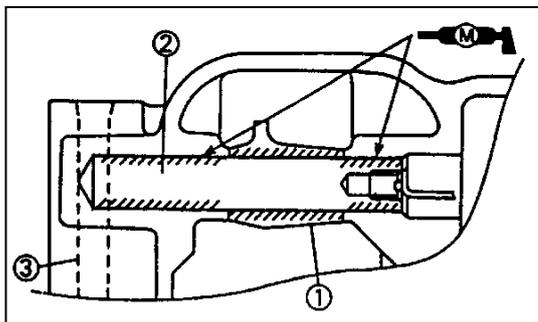
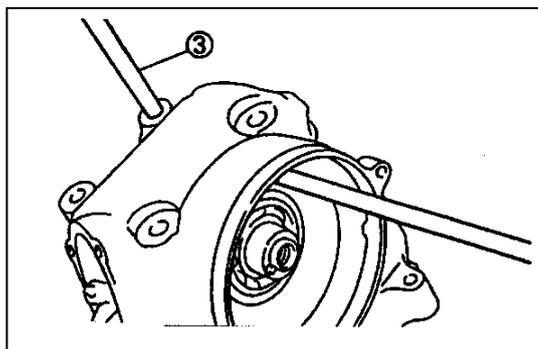
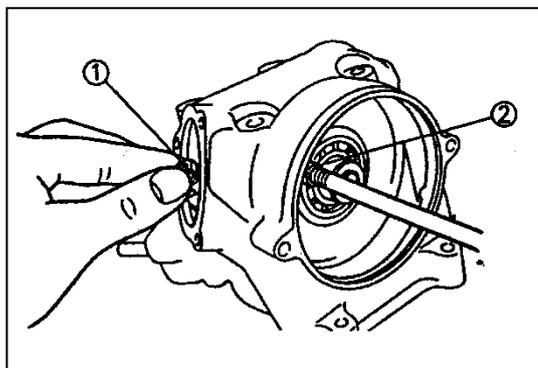
- Rocker arm ①
- Rocker arm shaft ② (intake)

**NOTE:**

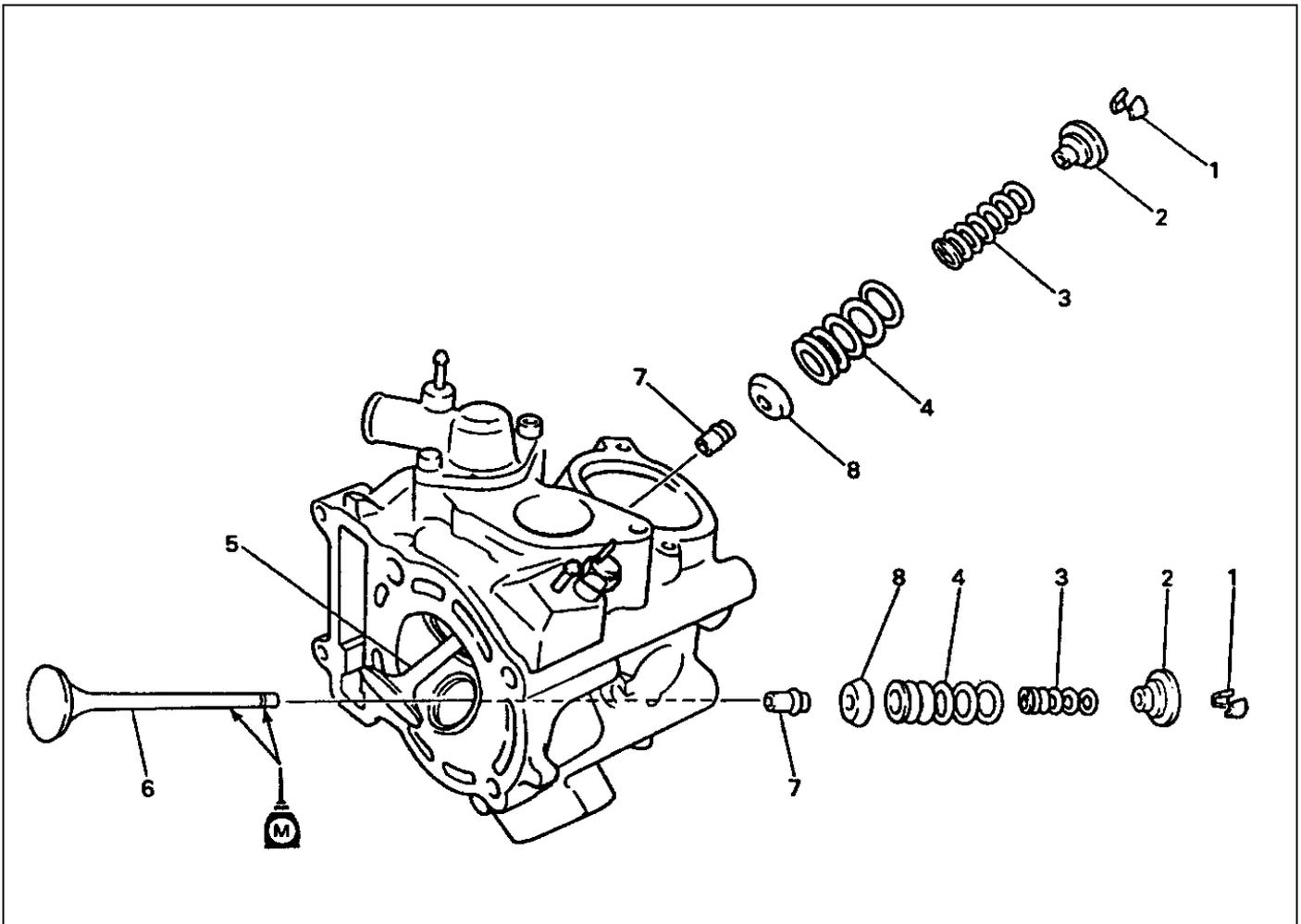
Intake:  
Insert the guide shaft (8 mm) ③ into the stud bolt hole in the cylinder head to the rocker arm shaft (intake).

**CAUTION:**

Do not confuse the installation direction of rocker arm shaft. Be sure to install the threaded part facing outward.



**3.5 VALVES AND VALVE SPRINGS**



Order	Job name / Part name	Q 'ty	Remarks
	Valves and valve springs removal Cylinder head Rocker arm , rocker arm shaft		Remove the parts in order. Refer to "CYLINDER HEAD " section . Refer to "ROCKER ARM SHAFT AND ROCKER ARMS" section.
1	Valve cotters	4	Refer to "VALVES AND VALVE SPRINGS REMOVAL/INSTALLATION" section.
2	Spring retainer	2	Refer to "VALVES AND VALVE SPRINGS INSTALLATION" section
3	Valve spring (inner)	2	
4	Valve spring (Outer)	2	
5	Valve (intake)	1	
6	Valve (exhaust)	1	
7	Valve guide	2	Reverse the removal procedure for installation
8	Spring seat	2	

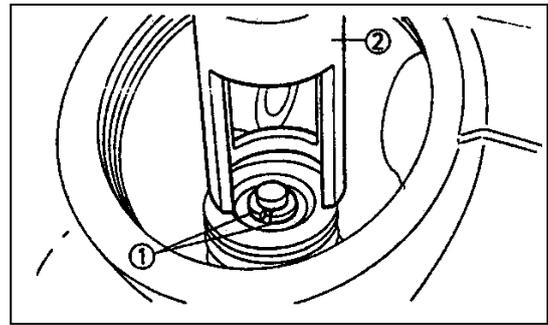
**VALVES AND VALVE SPRINGS REMOVAL**

1. Remove:

- Valve cotters ①

**NOTE:**

Attach a valve spring compressor and attachment ② between the valve spring retainer and cylinder head to remove the valve cotters.



**CAUTION:**

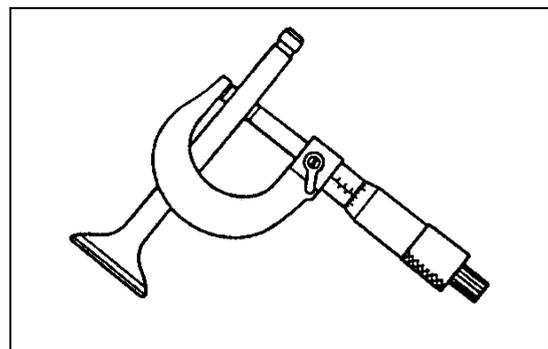
Do not compress so much as to avoid damage to the valve spring.

**VALVE AND VALVE SPRINGS INSPECTION**

1. Measure:

- Valve stem diameter

Out of specification → Replace.

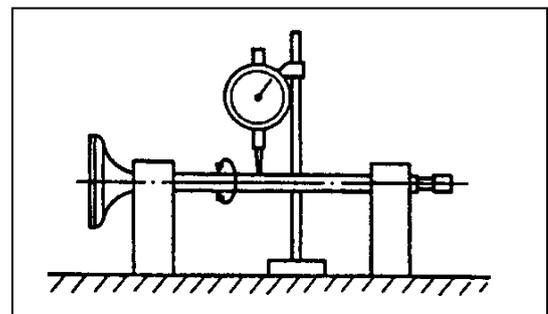


	<p><b>Valve stem diameter:</b></p> <p><b>Intake:</b> 5.975-5.990mm &lt;Limit: 5.94mm&gt;</p> <p><b>Exhaust:</b> 5.960-5.975mm &lt;Limit: 5.92mm&gt;</p>
---	---

2. Measure:

- Runout (valve stem )

Out of specification → Replace.

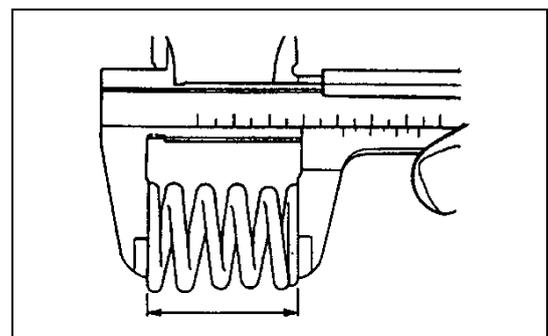


	<p><b>● Runout limit:</b> 0.01 mm</p>
---	---

3. Measure:

- Free length (valve spring)

Out of specification → Replace.



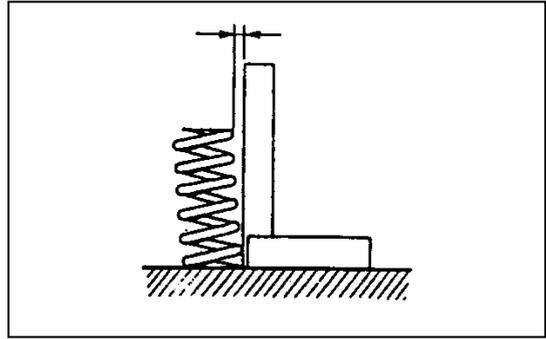
	<p><b>Valve spring free length:</b></p> <p><b>Inner spring:</b> 38.1 mm &lt;Limit: 36.1mm&gt;</p> <p><b>Outer spring:</b> 36.93 mm &lt;Limit: 35.0mm&gt;</p>
---	--

4. Measure:

- Spring tilt

Out of specification → Replace.

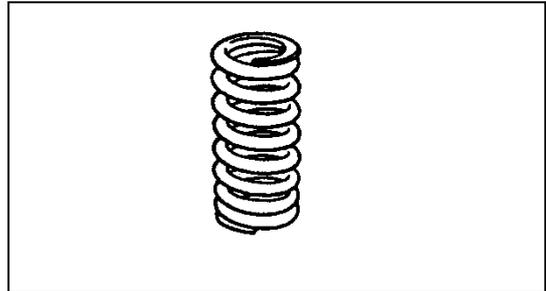
	Spring tilt limit: 1.7mm (2.5°)
---	------------------------------------



5. Inspect:

- Spring contact face

Wear/Pitting/Scratches → Replace.

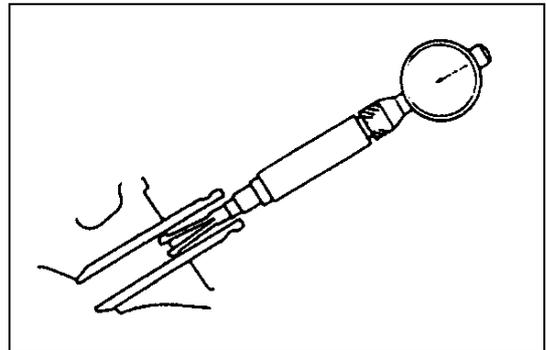


6. Measure:

- Valve guide inside diameter

Out of specification → Replace.

	<b>Valve guide inside diameter:</b> <b>Intake:</b> 6.000-6.012 mm <Limit: 6.05mm> <b>Exhaust:</b> 6.000-6.012 mm <Limit: 6.05 mm>
---	---



7. Measure:

<b>Stem-to guide clearance=</b> <b>Valve guide inside diameter-</b> <b>Valve stem diameter</b>
--

Out of specification → Replace the valve guide.

	<b>Stem-to-guide clearance limit:</b> <b>Intake:</b> 0.08 mm <b>Exhaust:</b> 0.10 mm
---	--

**VALVE SEATS INSPECTION**

1. Eliminate:

- Carbon deposits

(from the valve face and valve seat)

2. Inspect:

- Valve seats

Pitting/wear → Reface the valve seat.

3. Measure:

- Valve seat width ○,a

Out of specification → Reface the valve seat.



**Valve seat width:**

**Intake:**

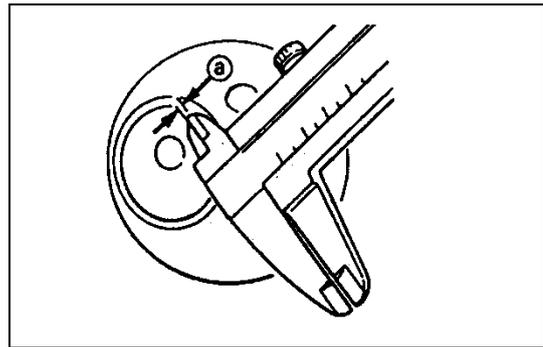
0.9-1.1mm

<Limit:1.6mm>

**Exhaust:**

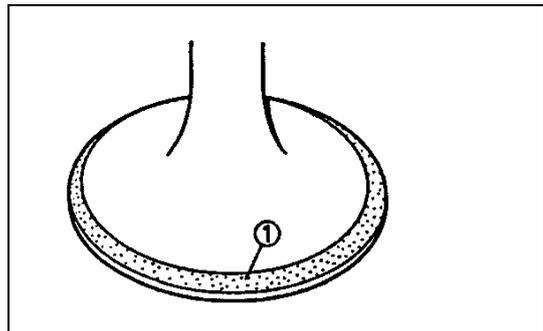
0.9-1.1mm

<Limit:1.6mm>



**Measurement step:**

- Apply Mechanic's blueing dye (Dykem)① to the valve face.
- Install the valve into the cylinder head. Press the valve through the valve guide and onto the valve seat to make a clear pattern.
- Measure the valve seat width. Where the valve seat and valve face made contact, blueing will have been removed.
- If the valve seat is too wide, too narrow, or the seat is not centered, the valve seat must be replaced.

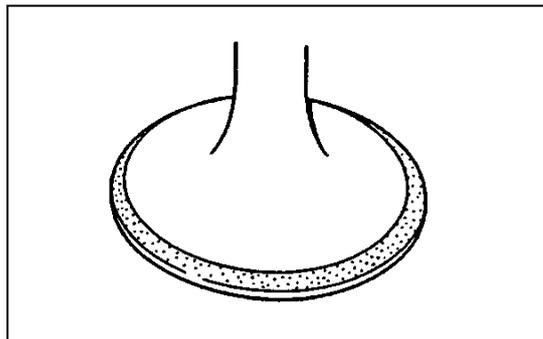


4. Lap:

- Valve face
- Valve seat

**NOTE:**

After replacing the valve seat, valve and valve guide, the valve seat and valve face should be lapped.



**Lapping steps:**

- Apply a coarse lapping compound ○,a to the valve face.

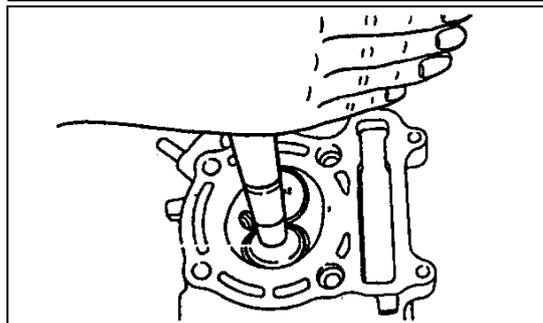
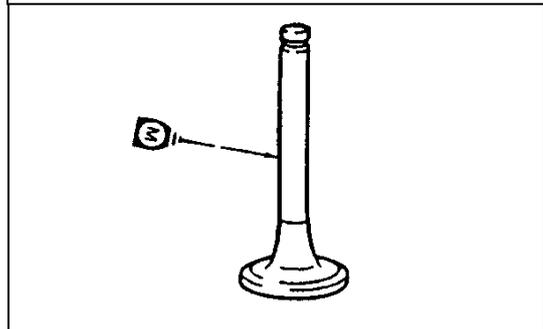
**CAUTION:**

Do not let compound enter the gap between the valve stem and the guide.

- Apply molybdenum disulfide oil to the valve stem.
- Install the valve into the cylinder head.
- Turn the valve until the valve face and valve seat are evenly polished, then clean off all compound.

**NOTE:**

For best lapping results, lightly tap the valve seat while rotating the valve back and forth between your hand.

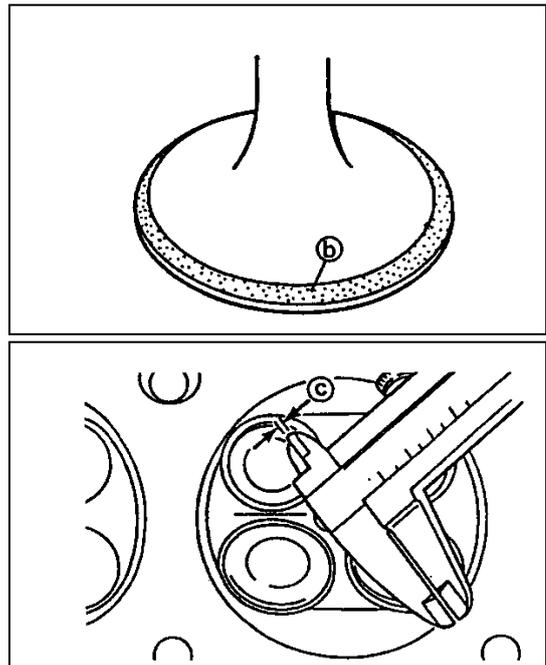


●Apply a fine lapping compound to the valve face and repeat the above steps.

**NOTE:**

Make sure to clean off all compound from the valve face and valve seat after every lapping operation.

- Apply Mechanic's blueing dye (Dykem) ○,b to the valve face.
- Install the valve into the cylinder head.
- Press the valve through the valve guide and onto the valve seat to make a clear pattern.
- Measure the valve seat with ○,c again.



**VALVES AND VALVE SPRINGS INSTALLATION**

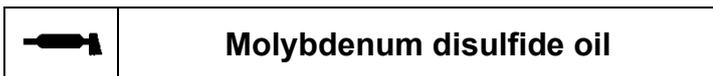
1. Deburr:

- Valve stem end

Use an oilstone to smooth the stem end.

2. Apply:

- Molybdenum disulfide oil (onto the valve stem③ and oil seal ② )



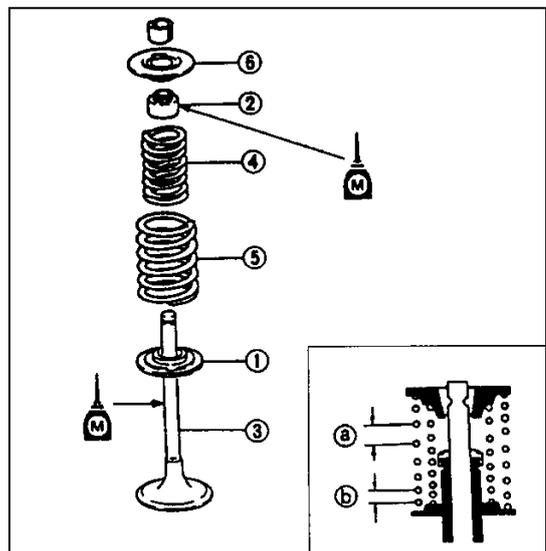
3. Install:

- Valve spring seat ①
- Valve stem seal② **NEW**
- Valve ③ (into the cylinder head)
- Valve spring (under) ④
- Valve spring (outer) ⑤
- Spring retainer ⑥

**NOTE:**

Install the valve spring with the larger pitch ○,a facing upwards.

○,b Smaller pitch

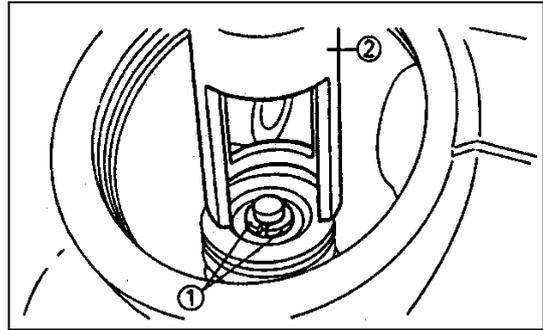


4. Instal:

●Valve cotters ①

**NOTE:**

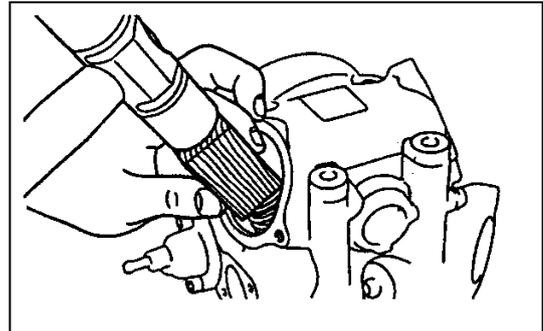
Install the valve cotters while com pressing the valve spring with a valve spring compressor and attachment ②.



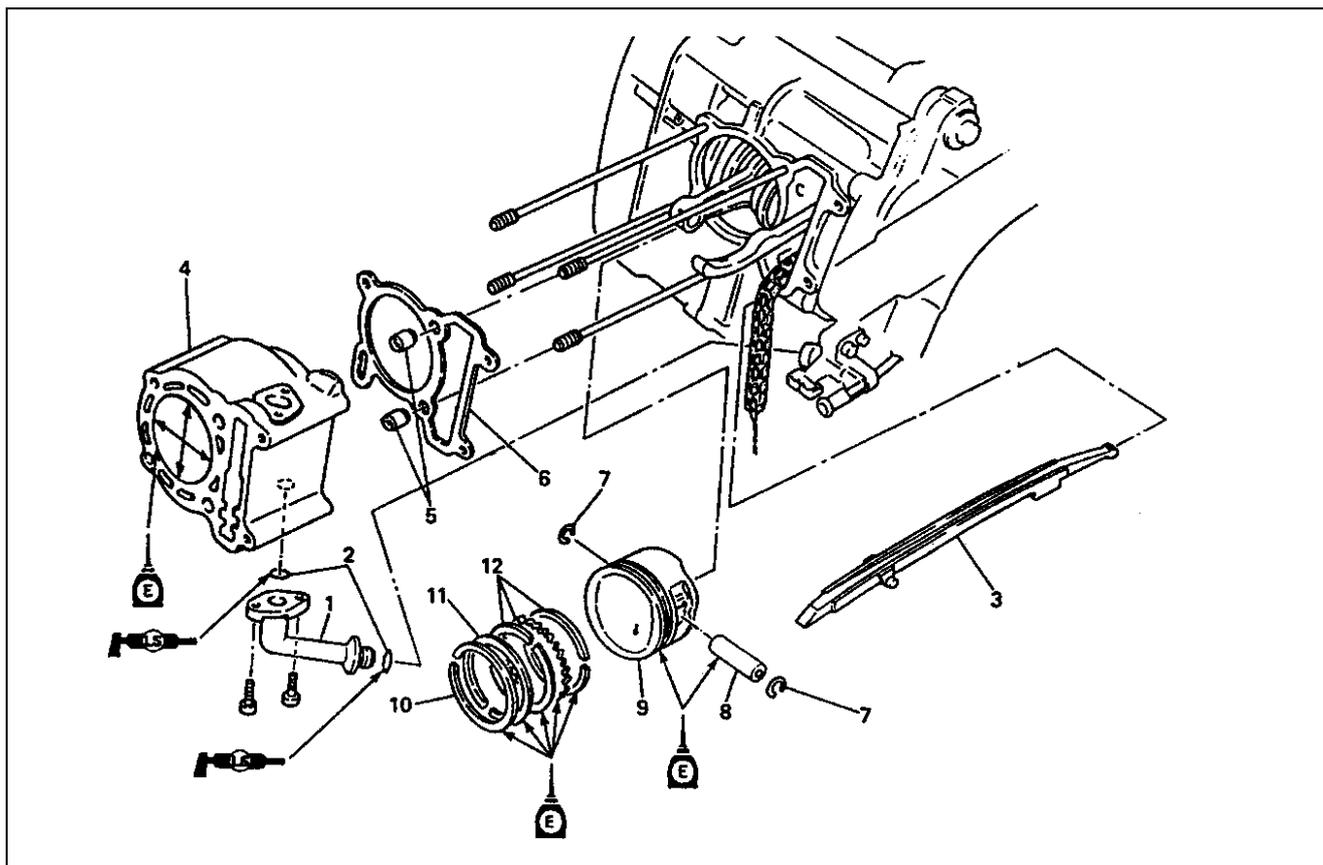
5. Secure the valve cotters onto the valve stem by tapping lightly with a piece of wood.

**CAUTION:**

Do not hit so much as to damage the valve.



**3.6 CYLINDER AND PISTON**



Order	Job name / Part name	Q 'ty	Remarks
	Cylinder and piston removal		Remove the parts in order.
1	Cylinder head	1	Refer to " CYLINDER HEAD "
2	Joint	2	section .
3	O-ring	1	Refer to " PISTON RINGS,
4	Timing chain guide (exhaust side)	1	PISTON AND CYLINDER
	Cylinder	1	INSTALLATION" section.
5	Dowel pin	2	
6	Cylinder gasket	1	
7	Piston pin circlip	2	Refer to "PISTON AND
8	Piston pin	1	PISTON RINGS REMOVAL "
9	Piston	1	section .
10	Piston ring (top)	1	Refer to "PISTON RINGS,
11	Piston ring (2nd)	1	PISTON AND CYLINDER
12	Side rail/Spacer	2/1	INSTALLATION " section .
			Reverse the removal
			procedure for installation .

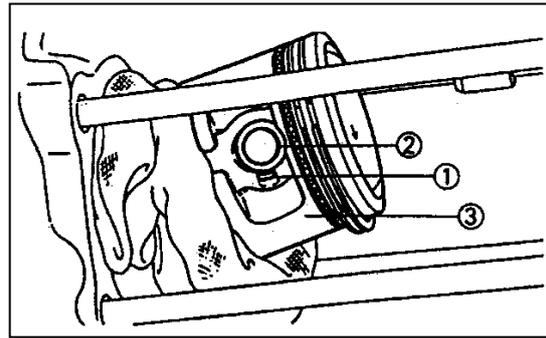
**PISTON AND PISTON RINGS REMOVAL**

1. Remove:

- Piston pin circlip ①
- Piston pin ②
- Piston ③

**NOTE:**

Before removing the piston pin circlip, cover the crankcase opening with a clean towel or rag to prevent the circlip from falling into the crankcase cavity.

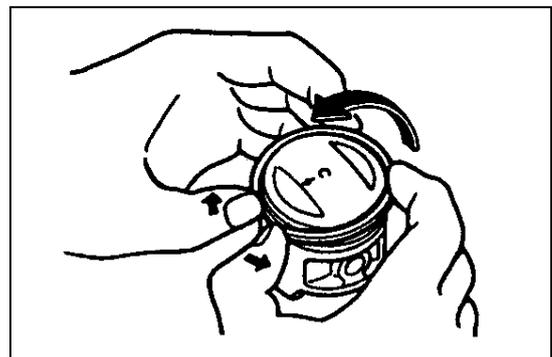


2. Remove:

- Top ring
- 2nd ring
- Oil ring

**NOTE:**

When removing the piston ring, open the end gap of the ring by fingers, and push up the other side of the ring.



**CYLINDER INSPECTION**

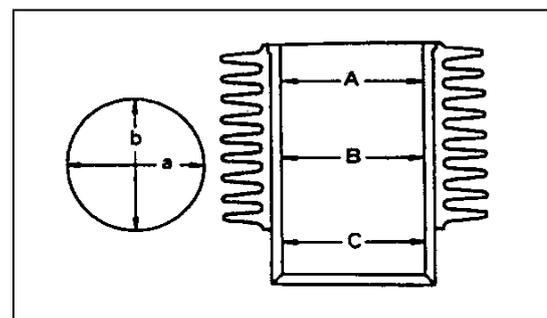
1. Measure:

- Cylinder bore

Out of specification → Rebore or replace.

**NOTE:**

- Measure the cylinder bore with a cylinder bore gauge.
- Measure the cylinder bore in parallel to and a right angle to the crankshaft. Then, find the average of the measurements.

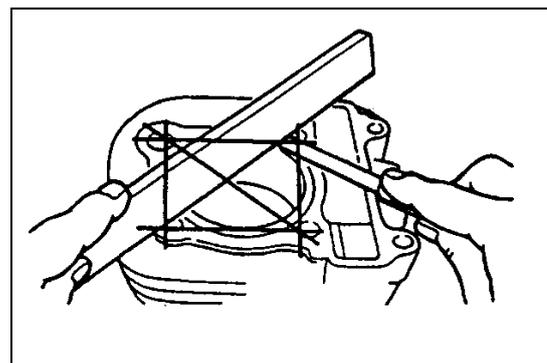


**Cylinder bore:**  
**300;72.500- 72.514mm**  
 < Limit: 300;72.525mm  
 < Difference limit between A,B and C :0.03m m >

2. Measure:

- Warpage

Out of specification → Replace.



Cylinder warpage limit:  
 0.03mm

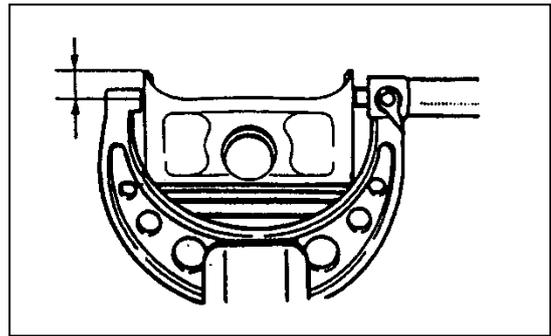
**PISTON AND PISTON PIN INSPECTION**

1. Measure:

- Piston skirt diameter

Out of specification → Replace .

○,a 5.0mm from the piston bottom edge.



	<b>Valve skirt diameter:</b>
	<b>300; 72.465-72.480 mm</b>
	<b>    Oversize (2)</b>
	<b>300; 72.0 mm</b>
	<b>    Oversize (4)</b>
	<b>300;72.5 mm</b>

2. Calculate:

- Piston-to-cylinder clearance

<b>Piston-to-cylinder clearance=</b>
<b>Cylinder bore-Piston skirt diameter</b>

Refer to “CYLINDER” section for cylinder bore measurement.

Out of specification → Replace the piston and piston rings as a set.

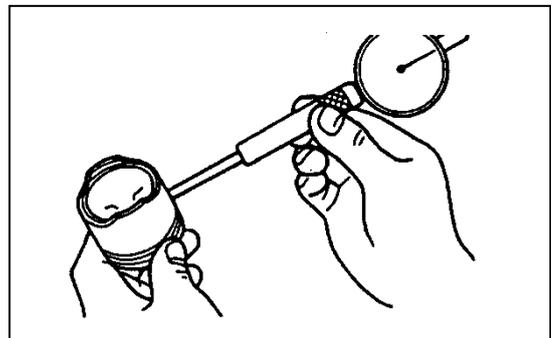
	<b>Piston-to-cylinder clearance:</b>
	<b>0.02-0.04mm</b>

3. Measure:

- Piston pin bore diameter

Out of specification → Replace.

	<b>Piston pin bore diameter:</b>
	<b>17.004-17.015mm</b>
	<b>&lt;Limit:17.045mm&gt;</b>

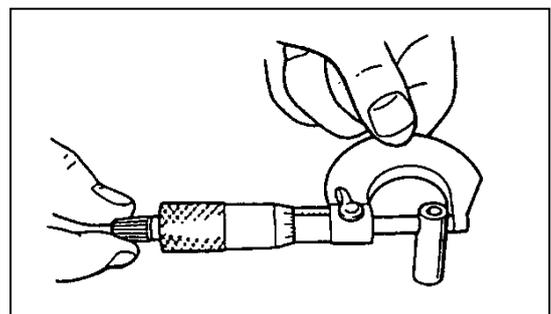


4. Measure:

- Piston pin outside diameter

Out of specification → Replace.

	<b>Piston pin bore diameter:</b>
	<b>16.991-17.000mm</b>
	<b>&lt;Limit:16.975mm&gt;</b>



5. Inspect:

- Piston pin

Blue discoloration/groove → Clean or replace.

**PISTON RINGS INSPECTION**

1. Measure:

- Side clearance ○,1

Out of specification → Replace the piston and the piston rings as a set.

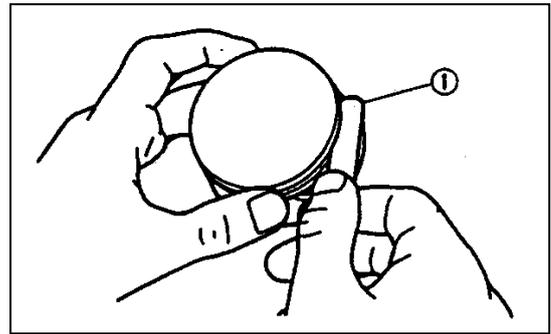
**NOTE:**

Eliminate the carbon deposits from the piston ring grooves and rings before measuring the side clearance.



**Side clearance (piston ring):**

- Top ring:**  
0.04- 0.08m m  
<Limit: 0.12mm>
- 2nd ring:**  
0.03 - 0.07mm  
<Limit: 0.12mm>



2.Position:

- Piston ring into the cylinder

**NOTE :**

Push the ring with the piston crown so that the ring will be at a right angle to the cylinder bore.

○,1 5.0mm

3. Measure:

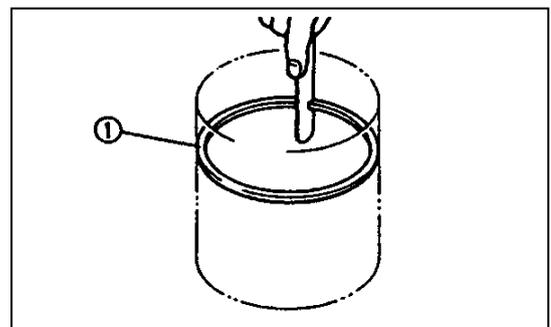
- End gap
- Out of specification → Replace.

**NOTE:**

You cannot measure the end gap on the expander spacer of the oil ring. If the oil ring rails show excessive gap, replace all three rings.



- End gap:**
- Top ring:**  
0.15-0.30mm  
<Limit:0.45mm>
- 2nd ring:**  
0.30-0.45mm  
<Limit:0.70m m>
- Oil ring:**  
0.20-0.70mm



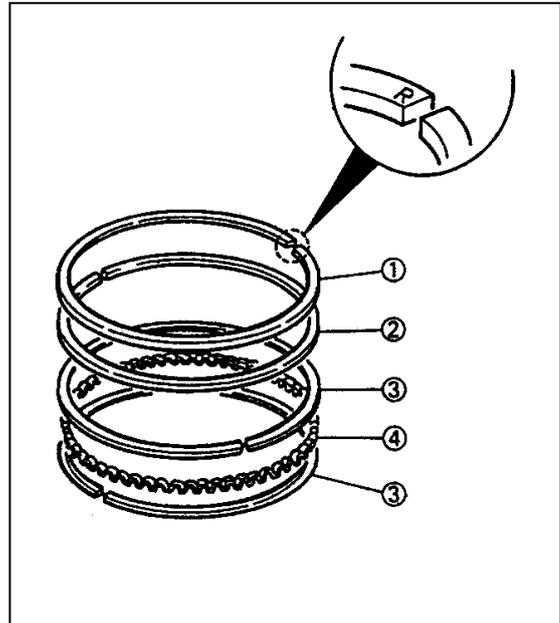
**PISTON RINGS, PISTON AND CYLINDER INSTALLATION**

1. Install:

- Top ring ①
- 2nd ring ②
- Side rails (oil ring) ③
- Expander spacer (oil ring) ④

**NOTE:**

- Make sure to install the piston rings so that the manufacturer's marks or numbers are located on the upper side of the rings.
- Lubricate the pistons and piston rings liberally with engine oil.

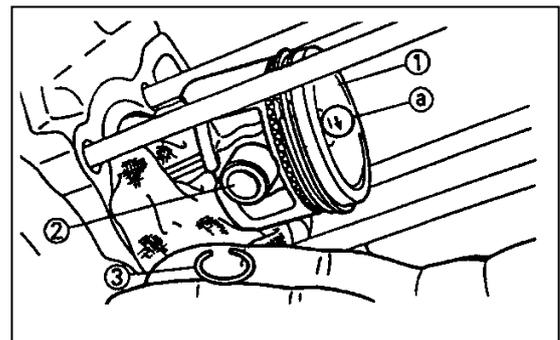


2. Install:

- Piston ①
- Piston pin ②
- Piston pin clip ③ **NEW**

**NOTE:**

- Apply engine oil to the piston pins.
- The " → " mark ○,a on the piston must face the exhaust side of the cylinder.
- Before installing the piston pin clip, cover the crankcase opening with a clean rag to prevent the piston pin clip from falling into the crankcase.
- Make sure to install each piston in its respective cylinder.



3. Install:

- Gasket (cylinder) **NEW**
- Dowel pins

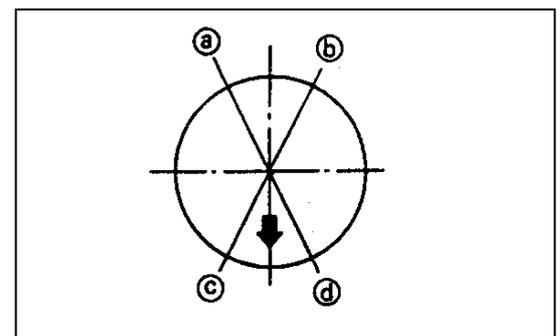
4. Position:

- Piston rings

**NOTE:**

Offset the piston ring end gaps as shown.

- ,a Top ring end
- ,b Oil ring end (lower)
- ,c Oil ring end (upper)
- ,d 2nd ring end



## 5. Lubricate:

- Piston outer surface
- Piston ring
- Cylinder inner surface

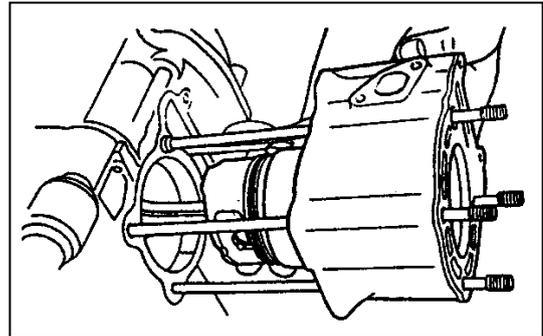
	<b>Engine oil</b>
---	-------------------

## 6. Install:

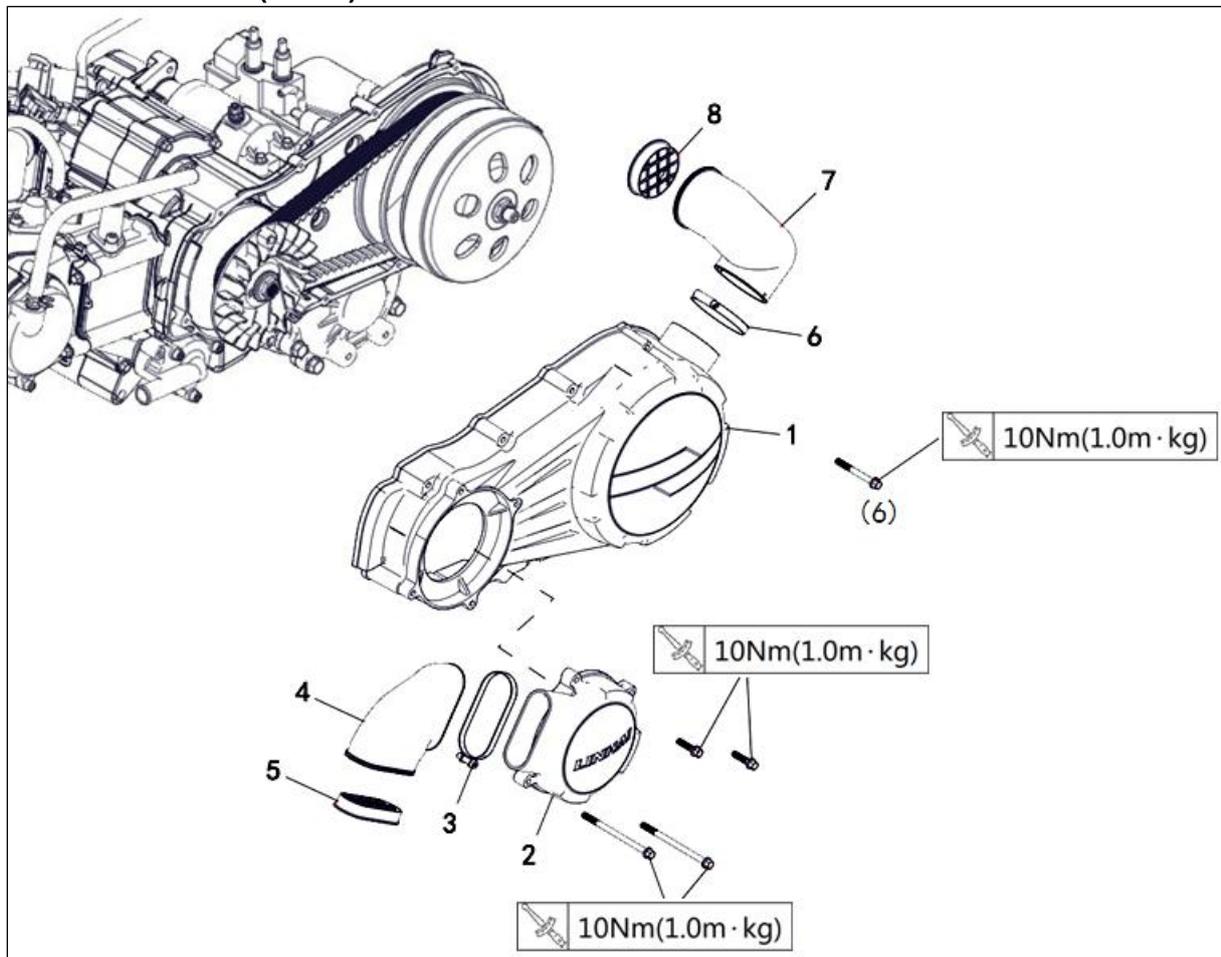
- Cylinder

**NOTE:**

- Install the cylinder with one hand while com pressing the piston rings with the other hand.
- Pass the timing chain and timing chain guide (exhaust side) through the timing chain cavity.



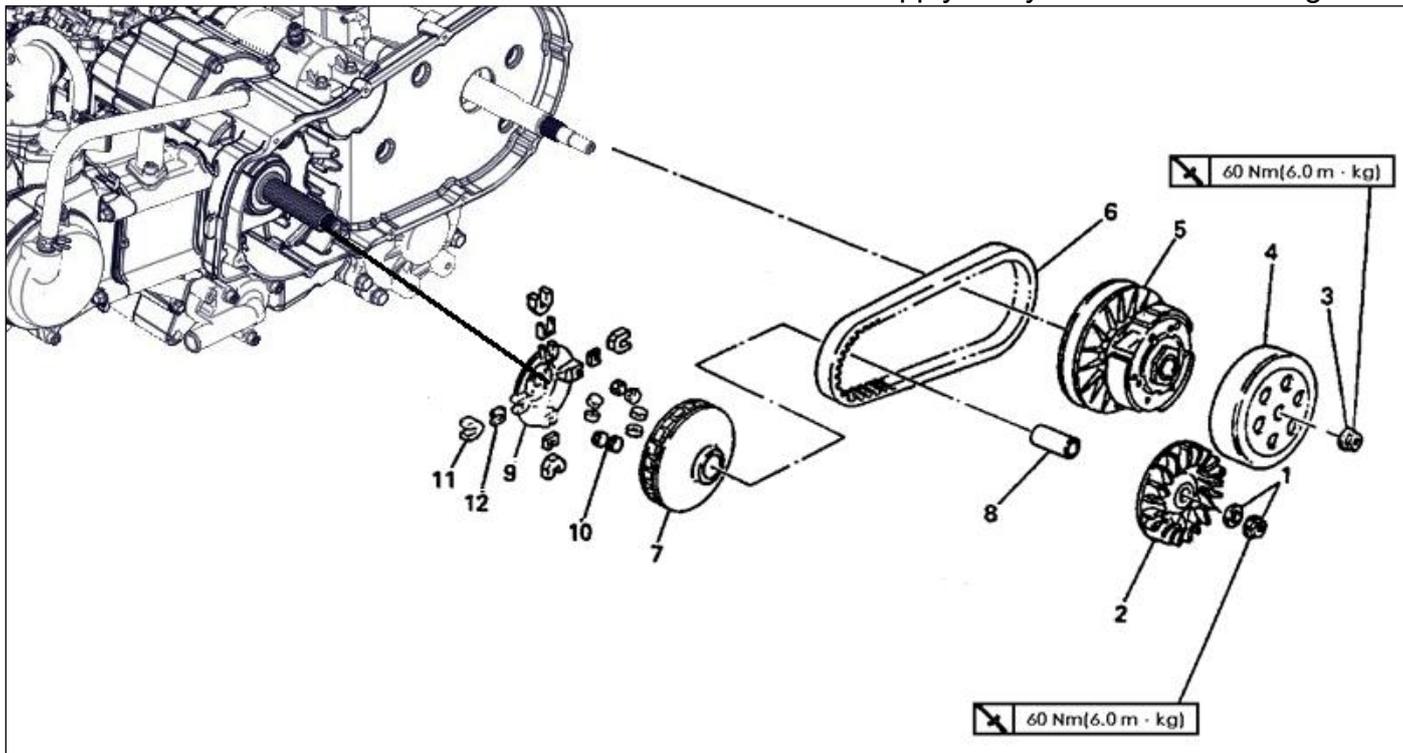
**3.7V-BELT,CLUTCH AND SECONDARY/PRIMARY SHEAVE  
CRANKCASE COVER (LEFT)**



Order	Job name / Part name	Q 'ty	Remarks
	Crankcase cover (left) removal		<b>Remove the parts in order.</b>
1	Crankcase cover (left)	1	
2		1	
3	Hose clamp B	1	
4	Joint B	1	
5	Air strainer B	1	
6	Hose clamp A	1	
7	Joint A	1	
8	Air strainer A	1	Reverse the removal procedure for installation .

**PRIMARY SHEAVE**

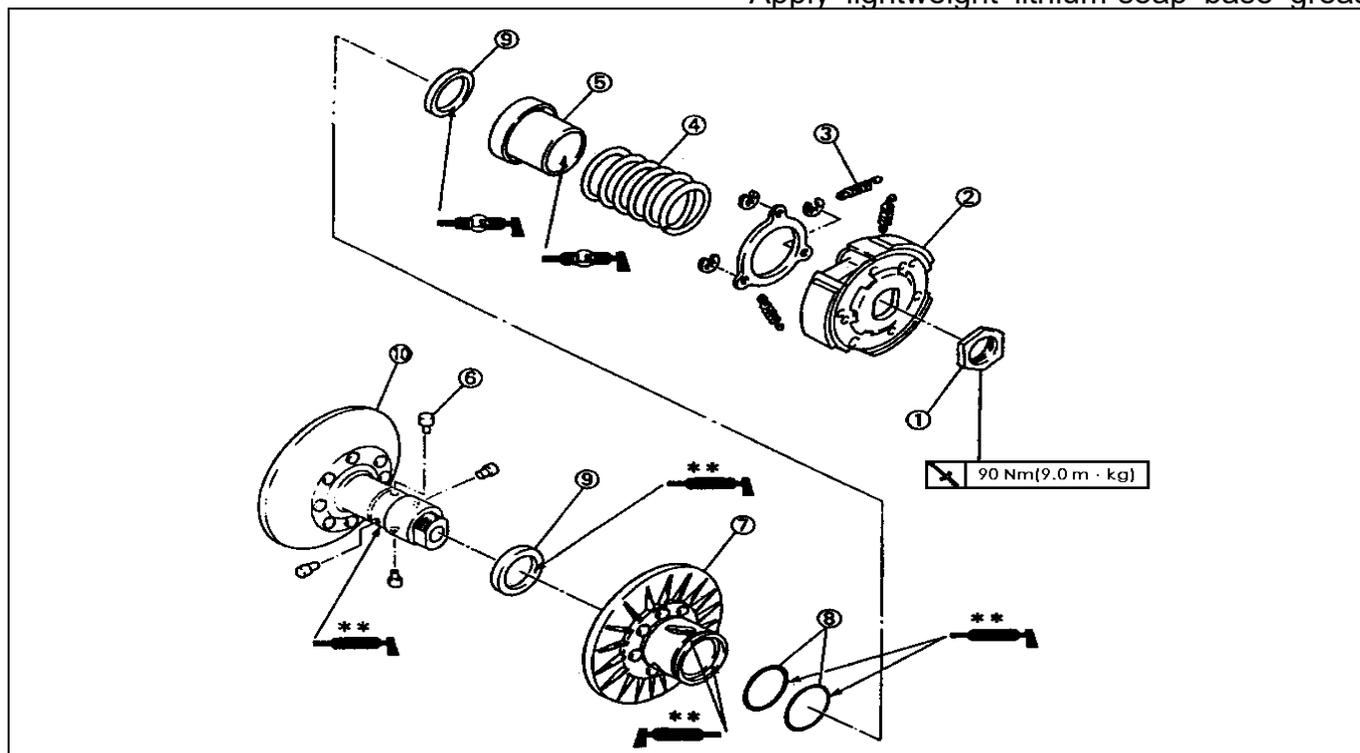
\*Apply molybdenum disulfide grease



Order	Job name / Part name	Q 'ty	Remarks
	V-belt, clutch and secondary/ primary sheave removal		Remove the parts in order
1	Nut/Plain washer	1/1	Refer to "PRIMARY SHEAVE REMOVAL" section.
2	Primary fixed sheave	1	
3	Nut	1	Refer to "SECONDARY SHEAVE AND V-BELT REMOVAL" section.
4	Clutch housing	1	
5	Clutch assembly	1	Refer to "SECONDARY SHEAVE INSTALLATION" section.
6	V-belt	1	
7	Primary sliding sheave	1	Refer to "PRIMARY SHEAVE ASSEMBLY" section.
8	Collar	1	
9	Cam	1	Refer to "PRIMARY SHEAVE ASSEMBLY" section.
10	Weight	8	
11	Slider	4	Refer to "PRIMARY SHEAVE ASSEMBLY" section. Reverse the removal Procedure for installation.
12	Spacer	4	

**SECONDARY SHEAVE**

\*\*Apply lightweight lithium-soap base grease



Order	Job name / Part name	Q 'ty	Remarks
	Secondary sheave disassembly		Disassemble the parts in order.
1	Nut	1	
2	Clutch carrier	1	Refer to "SECONDARY SHEAVE DISASSEMBLY" section.
3	Clutch shoe spring	3	
4	Compression spring	1	
5	Spring seat	1	Refer to "SECONDARY SHEAVE INSTALLATION " section .
6	Guide pin	4	
7	Secondary sliding sheave	1	
8	O-ring	2	Refer to "SECONDARY SHEAVE INSTALLATION" section.
9	Oil seal	2	
10	Secondary fixed sheave	1	
			Reverse the disassembly procedure for assembly.

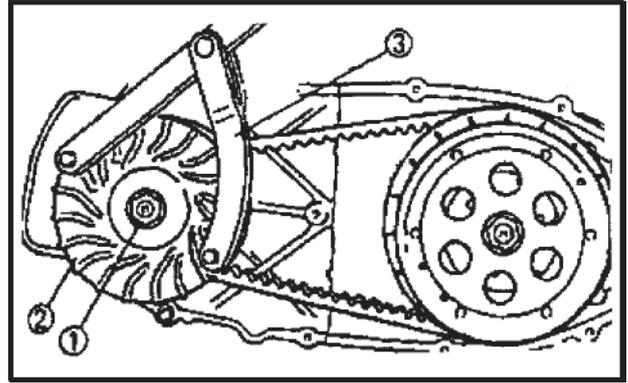
**PRIMARY SHEAVE REMOVAL**

1. Remove:

- Nut ①(primary sheave)
- Plate washer
- Primary fixed sheave②

**NOTE:**

Loosen the nut (primary fixed sheave) while holding the primary fixed sheave with the rotor holder③.



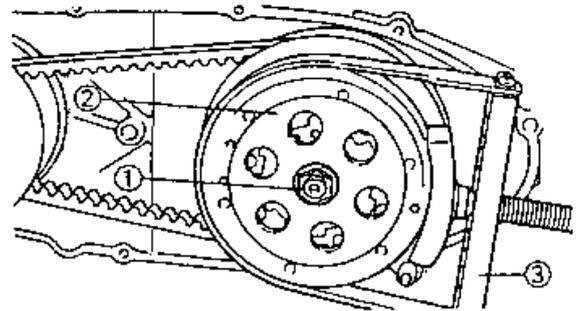
**SECONDARY SHEAVE AND V-BELT REMOVAL**

1. Remove:

- Nut ① (secondary sheave)
- Clutch housing ②

**NOTE:**

Loosen the nut (secondary sheave) while holding the clutch housing with the sheave holder③.



2. Remove:

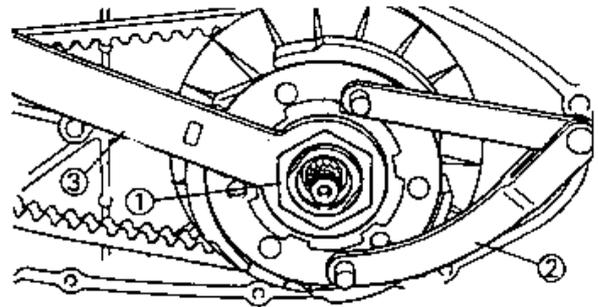
- Nut ① (clutch carrier)

**CAUTION:**

Do not remove the nut (clutch carrier) yet.

**NOTE:**

Loosen the nut (clutch carrier) one turn using the locknut wrench ③ while holding the clutch carrier with the rotor holder②.

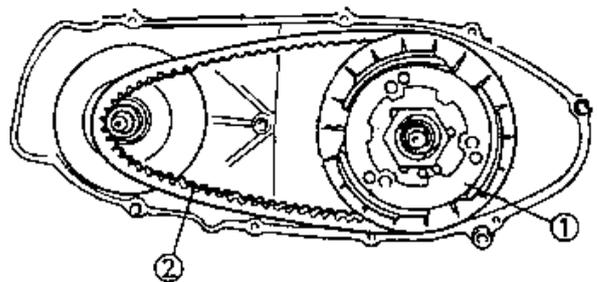


3. Remove:

- Clutch assembly ①
- V-belt ②

**NOTE:**

Remove the V-belt from the primary sheave side with clutch assembly.



**SECONDARY SHEAVE DISASSEMBLY**

1. Remove:

- Nut ① (secondary sheave)

**NOTE:**

Loosen the nut ① while attaching the clutch spring compressor ② and clutch spring holder arm ③ and release the compressed spring after removing the nut.

**CAUTION:**

Use the spacer ④ (diameter:  $\varnothing$  30mm thickness: 2-3mm).

**CLUTCH INSPECTION**

1. Measure:

- Clutch shoe thickness

Scratches → Glaze using coarse sandpaper.

Wear /Damage → Replace



**Clutch shoe thickness:**  
**3.0mm**  
**<Limit:2.0mm>**

**NOTE:**

- After using the sandpaper, clean off the polished particles.
- Inspect the other clutch shoes.
- Replace all three as a set.

**V-BELT INSPECTION**

1. Inspect:

- V-belt ①

Cracks/Wear /Scaling /Chipping → Replace.

Oil/Grease → Check primary sheave and secondary sheave.

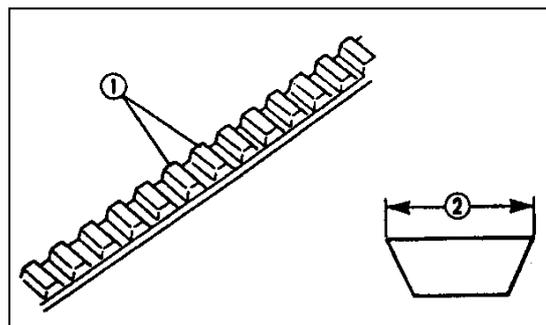
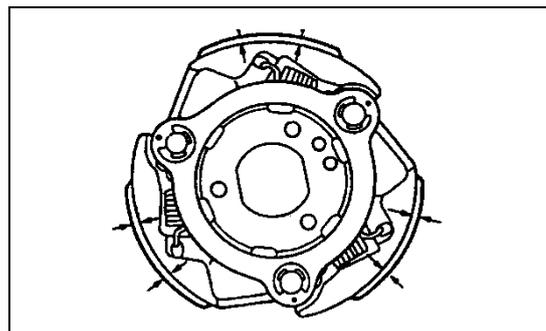
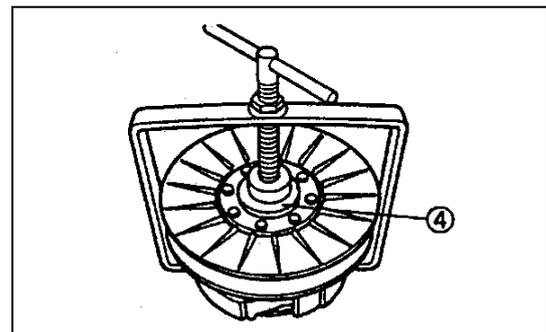
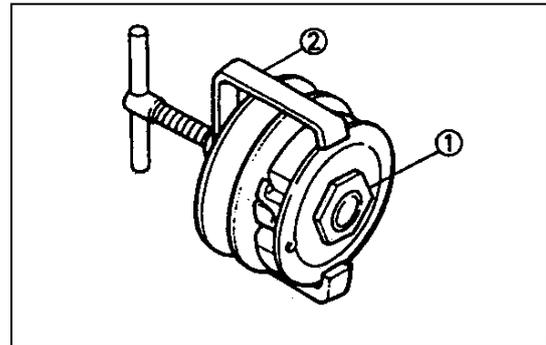
2. Measure:

- V-belt width ②

Out of specification → Replace



**V-belt width:**  
**22.6mm**  
**(Limit:21.0mm)**

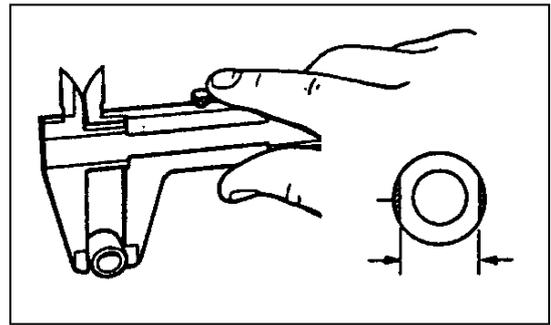


**WEIGHT INSPECTION**

1. Inspect:
- Weight minimum outside diameter
  - Cracks/Wear /Scaling /Chipping → Replace.
  - Out of specification → Replace

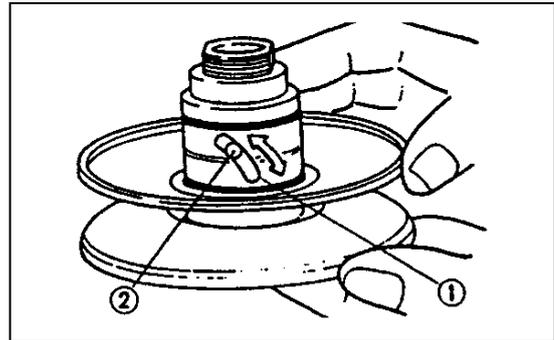


**Weight out side diameter:**  
**20.0 mm**  
 <Limit: 19.5mm>



**SECONDARY SHEAVE INSPECTION**

1. Inspect:
- Secondary fixed sheave smooth operation
  - Secondary sliding sheave smooth operation
2. Inspect:
- Torque cam groove ①
  - Wear /Damage → Replace.
3. Inspect:
- Guide pin ②
  - Wear /Damage → Replace.



**PRIMARY SHEAVE ASSEMBLY**

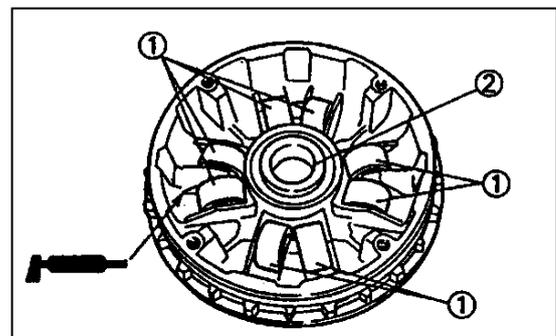
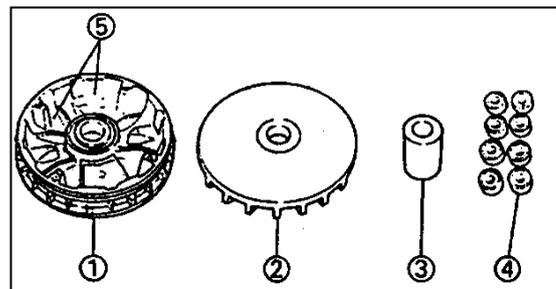
1. Clean:
- Primary sliding sheave face ①
  - Primary fixed sheave face ②
  - Collar ③
  - Weight ④
  - Primary sliding sheave cam face

**NOTE:**  
 Remove any excess grease.

2. Install:
- Weight ①
  - Collar ②

**NOTE:**

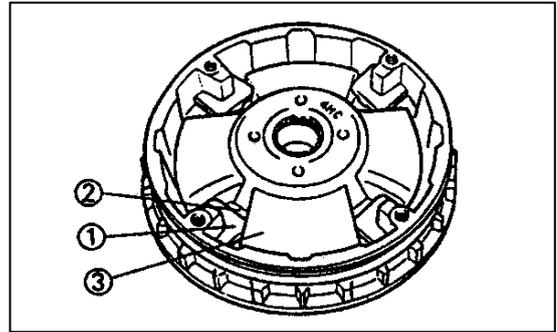
- Apply molybdenum disulfide grease to all of the outside of the weight and install.
- Apply lightweight lithium-soap base grease to the inside of the collar.



3. Install:

- Spacer ①
- Slider ②
- Cam ③
- Primary sliding sheave cap.

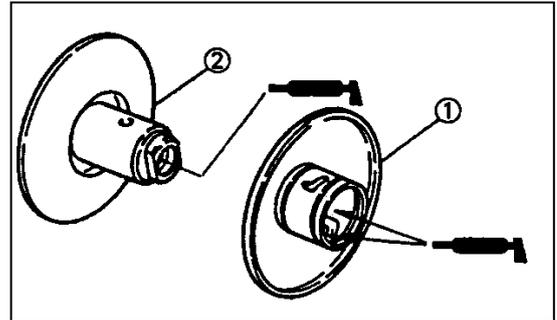
 3Nm(0.3m·kg)



**SECONDARY SHEAVE INSTALLATION**

1. Apply:

- Lightweight lithium-soap base grease (to the secondary sliding sheave ① inner surface, grease nipple groove, and oil seals)
- Lightweight lithium-soap base grease (to the bearings, oil seals and inner surface of the secondary fixed sheave ② )

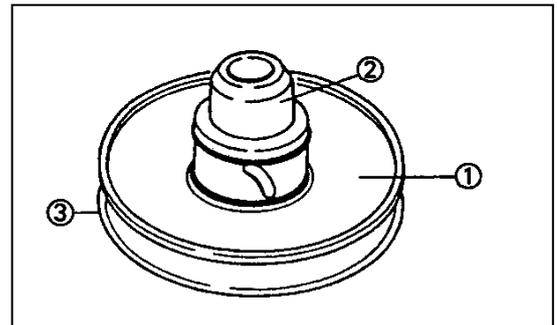


2. Install:

- Secondary sliding sheave ①

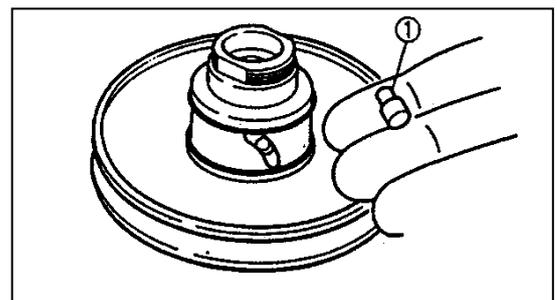
**NOTE:**

Install the secondary sliding sheave ① using the oil seal guide ② to the secondary fixed sheave ③.



3. Install:

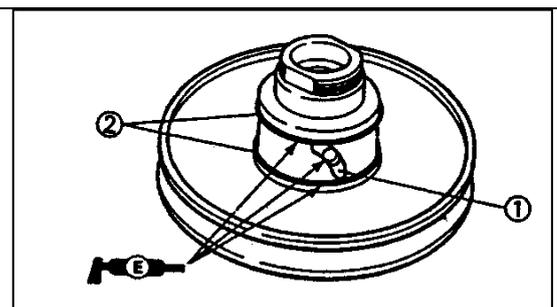
- Guide pin ①



4. Apply:

- Lightweight lithium-soap base grease (to the guide pin sliding groove ①, and oil seal ②)

**NEW**

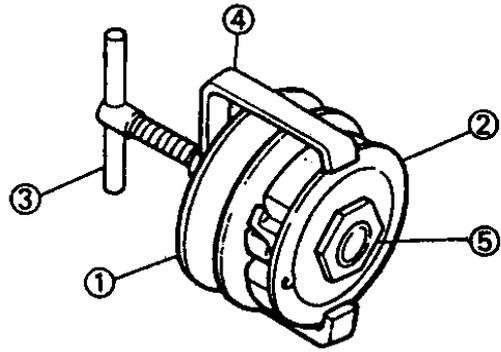


5. Install:

- Secondary sheave complete ①
- Compression spring
- Clutch carrier ②

**NOTE:**

Temporarily tighten the nut ⑤ while attaching the clutch spring holder ③ and clutch spring holder arm ④ and compress the spring.



**CAUTION:**

Use the spacer ⑥ (30mm, thickness: 2-3mm).

6. Install:

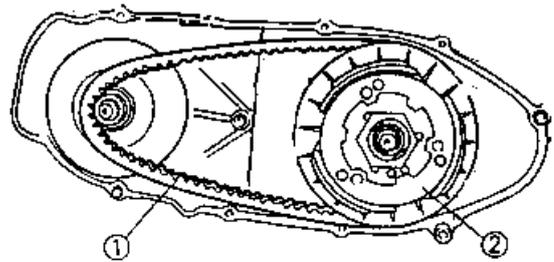
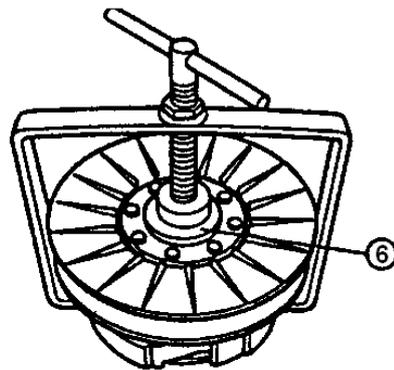
- V-belt ①
- Clutch assembly ②

**NOTE:**

Install the V-bet with clutch assembly to the primary sheave side.

**CAUTION:**

Never smear grease to the V-belt, secondary sheave and clutch.

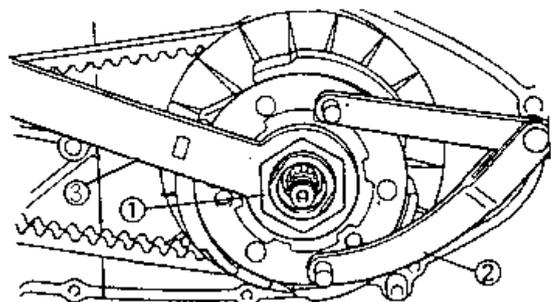


7. Install:

- Nut ① (clutch carrier)

**NOTE:**

Tighten the nut (clutch carrier), using the locknut wrench ③ while holding the clutch carrier with the rotor holder ②

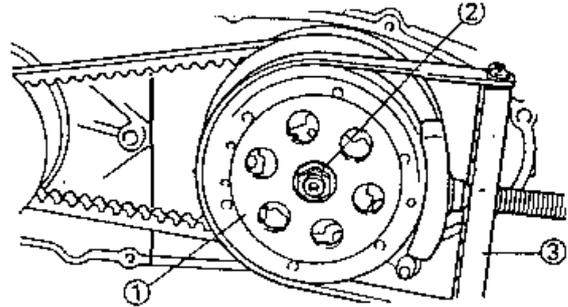


8. Install:

- Clutch housing ①
- Nut (clutch housing) ②

**NOTE:**

Tighten the nut (clutch housing),using the sheave holder ③).

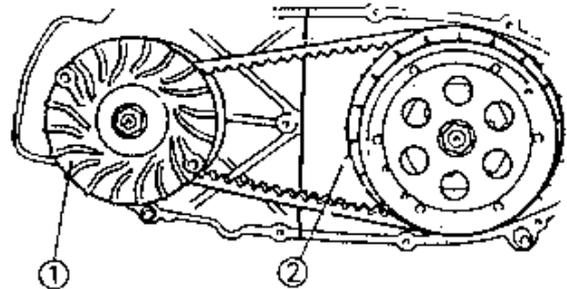


9. Set:

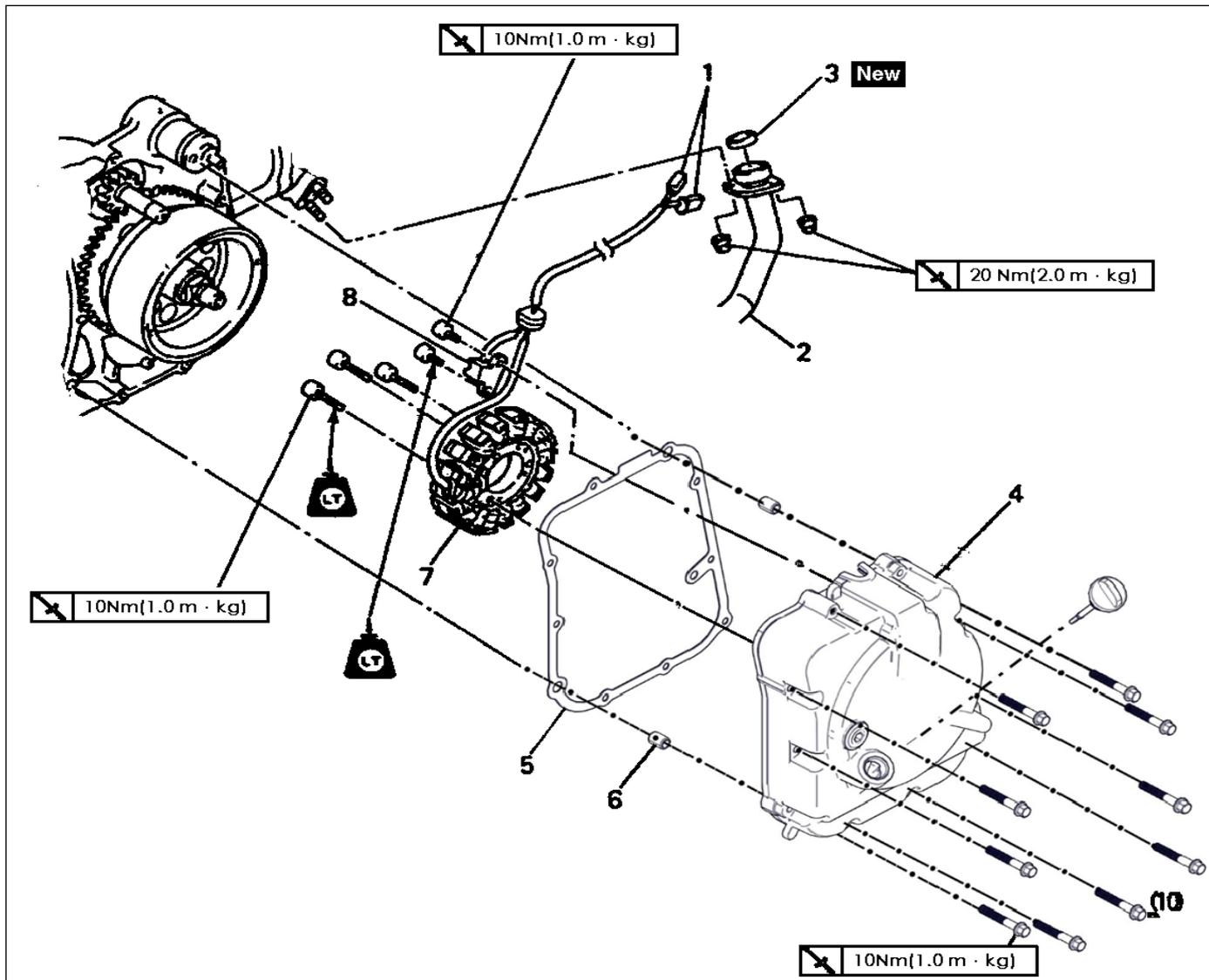
- V- belt ①

**NOTE:**

Move the V-belt to minimum diameter of the primary sheave ①, maximum diameter of the secondary sheave ② and make the V-belt tense.



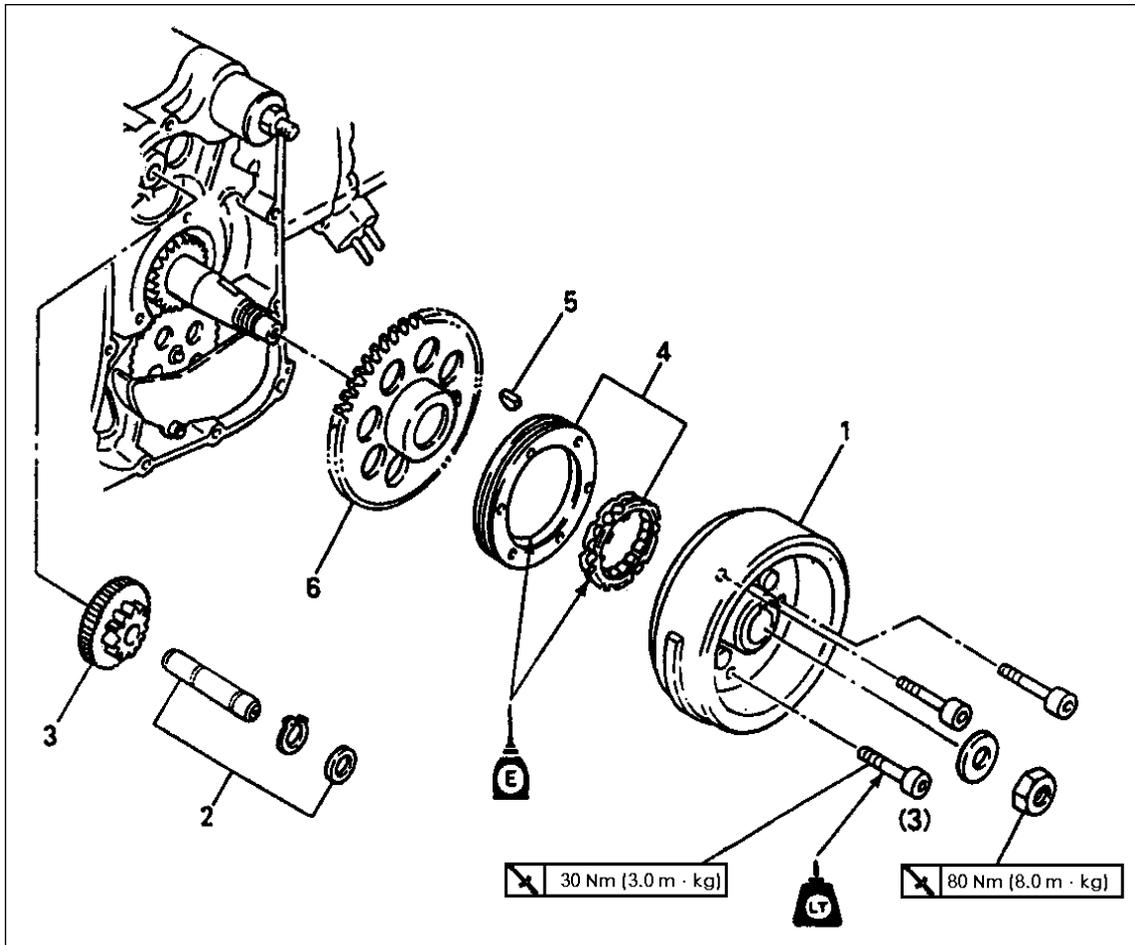
**3.8A.C. MAGNETO AND STARTER CLUTCH**  
**MAGNETO COVER AND STATOR COIL**



Order	Job name/ Part name	Q'ty	Remarks
	<b>Magneto cover and stator coil removal</b>		Remove the parts in order. Refer to "ENGINE OIL REPLACEMENT" section.
	Drain the engine oil.		
1	Couplers (A.C. magneto lead)	2	<b>NOTE:</b> Disconnect the couplers.
2	Exhaust pipe	1	
3	Exhaust pipe gasket	1	
4	Magneto cover	1	
5	Gasket (magneto cover)	1	
6	Dowel pins	2	
7	Stator coil	1	

8	Pick up coil	1	Reverse the removal procedure for
---	--------------	---	-----------------------------------

**A. C. MAGNETO AND STARTER CLUTCH**



Order	Job name/ Part name	Q'ty	Remarks
	<b>A.C. magneto and starter clutch removal</b>		Remove the parts in order.
1	Rotor	1	Refer to "A.C. MAGNETO ROTOR REMOVAL /INSTALLATION" section.
2	Shaft (idle gear)	1	
3	Idler gear	1	
4	Starter one way clutch assembly	1	
5	Woodruff key	1	
6	Starter wheel gear	1	
			Reverse the removal procedure for installation.

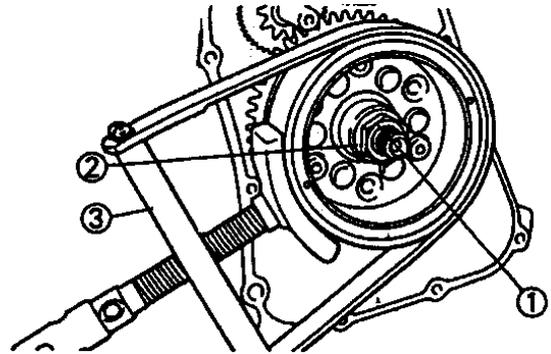
**A.C. MAGNETO ROTOR REMOVAL**

1. Remove:

- Nut ① (rotor)
- Plain washer②

**NOTE:**

- Loosen the nut (rotor) ①while holding the rotor with a sheave holder③ .
- Do not allow sheave the holder touch to the projection on the rotor.

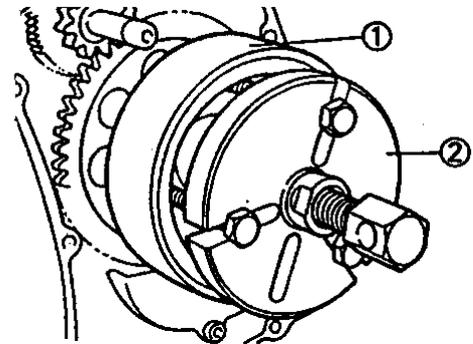


2. Remove:

- Rotor ①
- Woodruff key

**NOTE:**

- Remove the rotor ②using the flywheel puller.
  - Center the flywheel puller over the rotor.
- Make sure after installing the holding bolts that the clearance between the flywheel puller and the rotor is the same everywhere. If necessary, one holding bolt may be turned out slightly to adjust the flywheel puller's position.



**CAUTION:**

Cover the crankshaft end with the box wrench for protection.

**STARTER DRIVE GEAR INSPECTION**

1. Inspect:

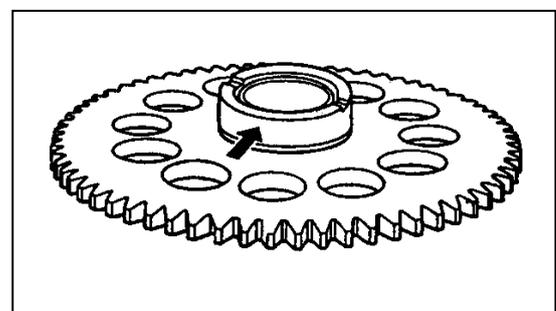
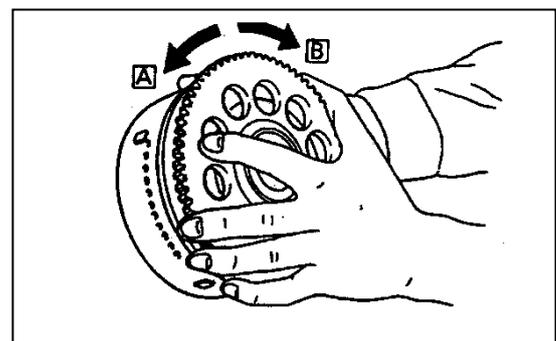
- Starter idle gear teeth
  - Starter drive gear teeth
  - Starter wheel gear teeth
- Burrs /chips /roughness /wear → Replace.

2. Check:

- Starter clutch operation
- Push the dowel pins to the arrow direction.  
Unsmooth operation → Replace.

**Checking steps:**

- Hold the starter clutch.
- When turning the starter wheel gear clockwise, the starter clutch and the starter wheel gear should be engaged.



- If not, the starter clutch is faulty. Replace it.
- When turning the starter wheel gear counter clockwise, it should turn freely.
- If not, the starter clutch is faulty. Replace it.

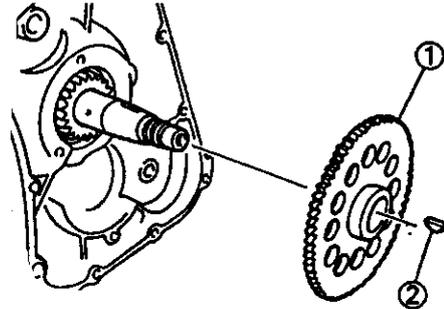
## A.C. MAGNETO ROTOR INSTALLATION

1. Install:

- Starter wheel gear ①.
- Woodruff key ②

### NOTE:

Install the starter wheel gear①, then install the woodruff key②.

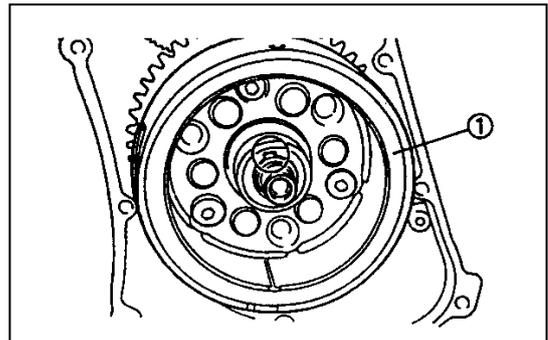


2. Install:

- Rotor ①
- Plain washer

### NOTE:

- Clean the tapered portion of the crankshaft and the rotor hub.
- When installing the magneto rotor, make sure the woodruff key is properly seated in the key way of the crankshaft.

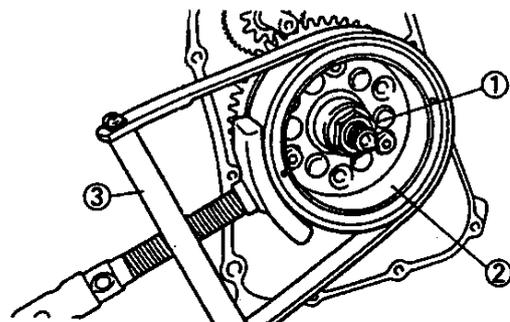


3. Tighten:

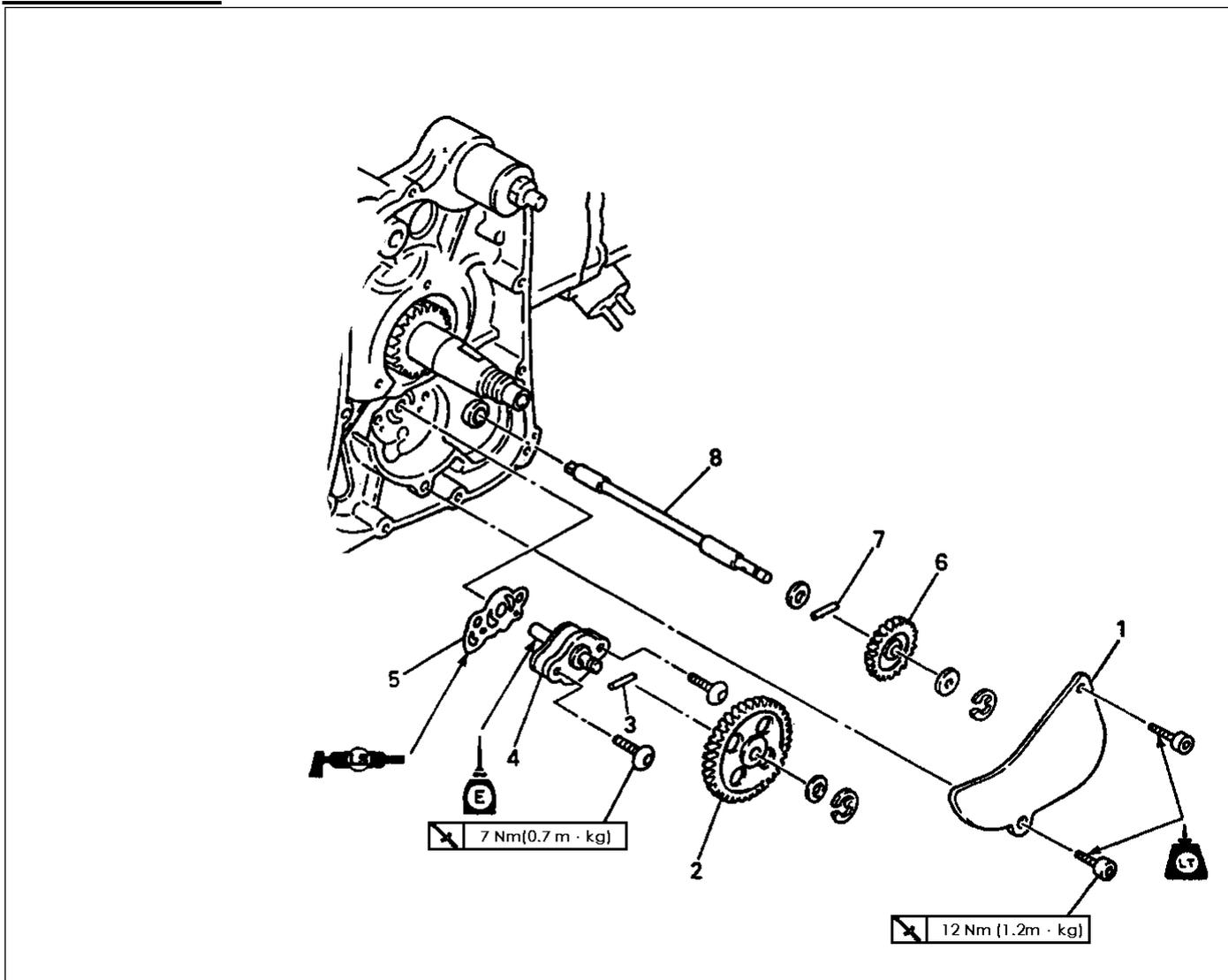
- Nut(rotor)①  80Nm(8.0m·kg)

### NOTE:

Tighten the nut (rotor)① while holding the magneto rotor② with a sheave holder③.



**3.9 OIL PUMP**



Order	Job name/ Part name	Q'ty	Remarks
	<b>Oil pump removal</b>		Remove the parts in order. Refer to "A.C. MAGNETO AND STARTER CLUTCH" section.
	<b>A.C. magneto</b>		
1	Cover	1	
2	Pump driven gear	1	
3	Dowel pin	1	
4	Oil pump assembly	1	
5	Gasket	1	
6	Impeller shaft gear	1	
7	Dowel Pin	1	
8	Shaft	1	

Reverse the removal procedure for installation.

**OIL PUMP INSPECTION**

1. Inspect:

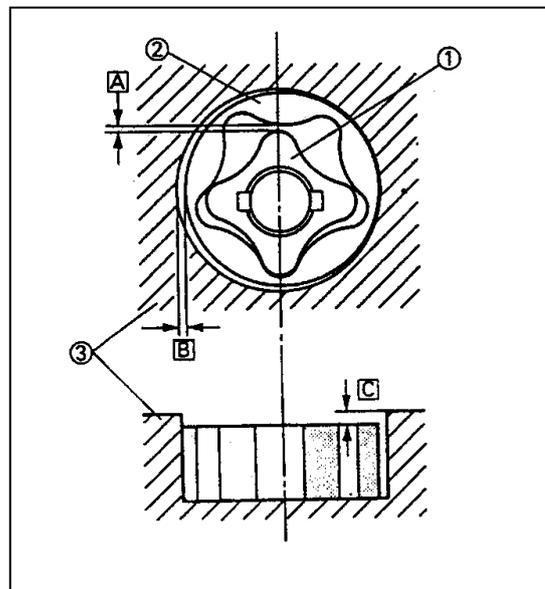
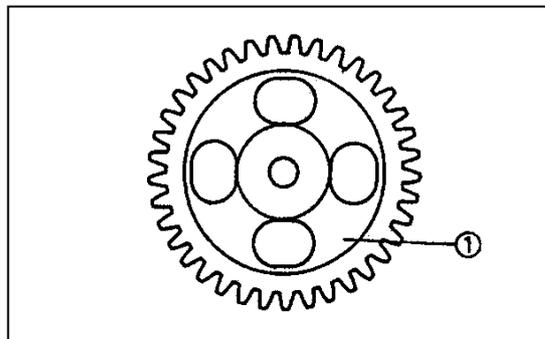
- Drive gear (oil pump) ①
- Pump housing
- Pump housing cover

Wear /cracks/ damage → Replace.

2. Measure:

- Tip clearance (between the inner rotor ① and the outer rotor ②)
- Side clearance (between the outer rotor ② and the pump housing ③)
- Housing and rotor clearance (between the pump housing ③ and the rotors ① ②)

Out of specification → Replace the oil pump assembly.



**Tip clearance** □,A:

**0.10-0.34 mm <Limit: 0.40mm>**

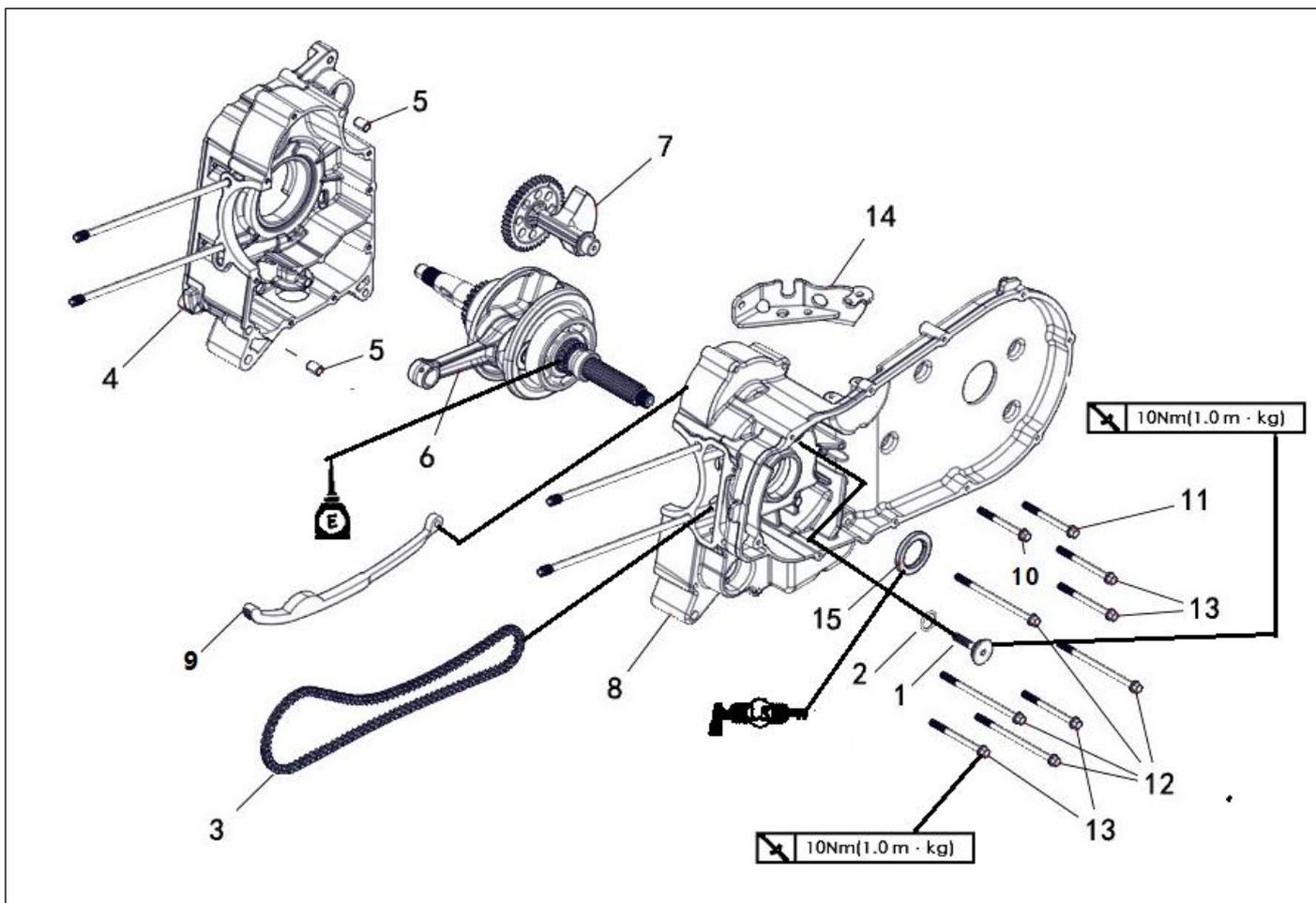
**Side clearance** □,B:

**0.013-0.036mm <Limit:0.15mm>**

**Housing and rotor clearance** □,C:

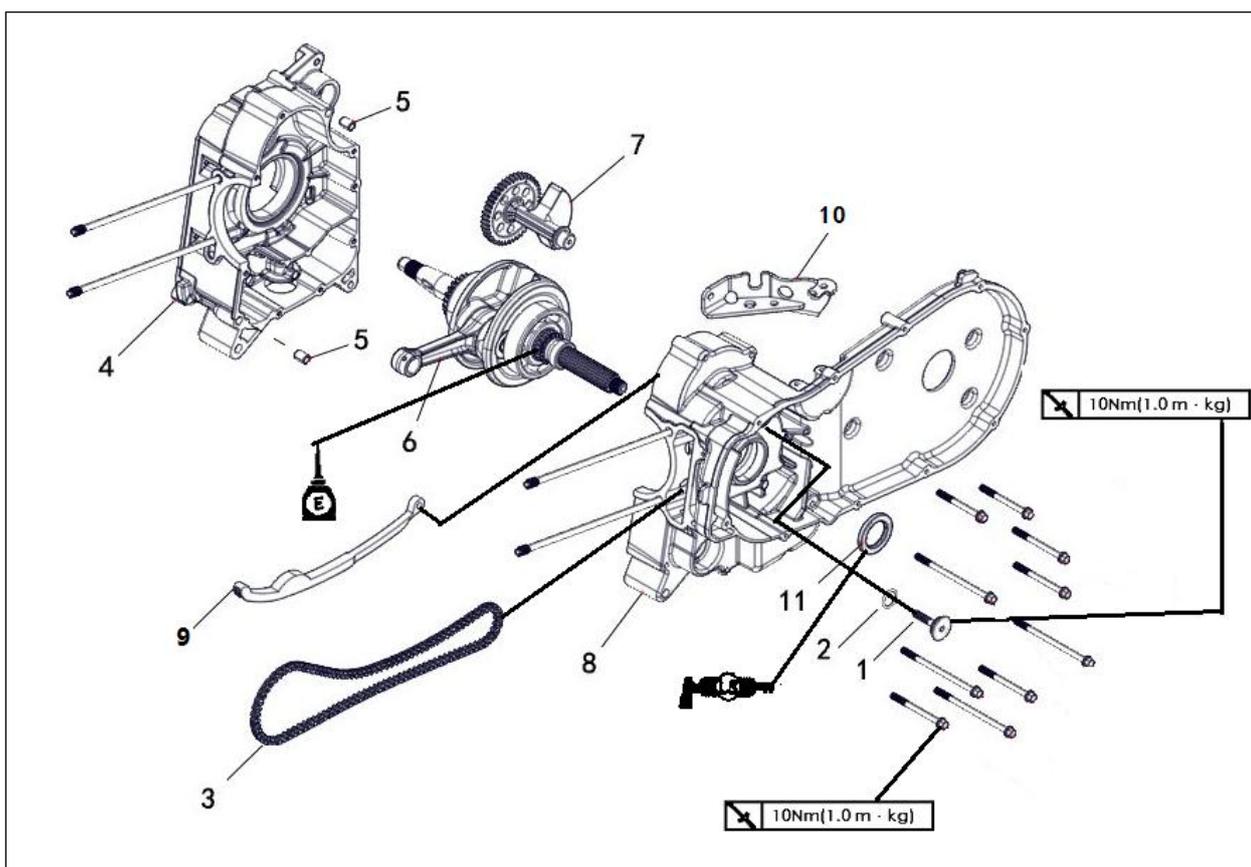
**0.04-0.09 mm <Limit: 0.15mm>**

**3.10 CRANKCASE AND CRANKSHAFT**



Order	Job name/ Part name	Q'ty	Remarks
-------	---------------------	------	---------

<p>1 2</p>	<p><b>Crankcase and crankshaft removal</b>                  Engine removal                  Cylinder head                  Cylinder, and piston                    V-belt, clutch, secondary/ primary sheave                  A.C. magneto and starter clutch                    Oil pump                  Water pump                  Rear wheel                  Bolt                  O- ring</p>	<p>1 1</p>	<p>Remove the parts in the order.</p> <p>Refer to "ENGINE REMOVAL" section.                  Refer to "CYLINDER HEAD" section.                  Refer to "CYLINDER AND PISTON" section.</p> <p>Refer to "V BELT, CLUTCH AND SECONDARY/ PRIMARY SHEAVE" section.                  Refer to "A.C. MAGNETO AND STARTER CLUTCH" section.</p> <p>Refer to "OIL PUMP" section.                  Refer to "WATER PUMP" section.</p> <p>Refer to "REAR WHEEL AND REAR BRAKE" section.</p>
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Order	Job name/ Part name	Q'ty	Remarks
-------	---------------------	------	---------

3	Timing chain	1	
4	Crankcase (right)	1	Refer to "CRANKSHAFT INSTALLATION" section.
5	Dowel pin	2	} Refer to "CRANKSHAFT REMOVAL/INSTALLATION" section.
6	Crankshaft assembly	1	
7	Balancer assembly	1	
8	Crankcase (left)	1	
9	Timing chain guide (intake)	1	
10	Bracket shift	1	
11	Oil seal	1	Reverse the removal procedure for installation.

**CRANKSHAFT REMOVAL**

1. Remove:

- Crankshaft assembly
- Balancer assembly
- Timing chain

**NOTE:**

- Before removing the crankshaft assembly, remove the timing chain from the crankshaft sprocket.
- If the timing chain hooks to the crankshaft sprocket, the crankshaft cannot be removed.

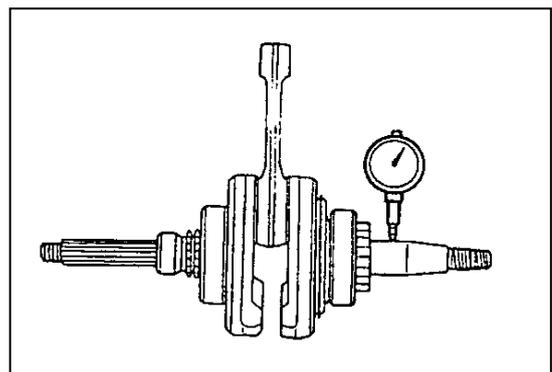
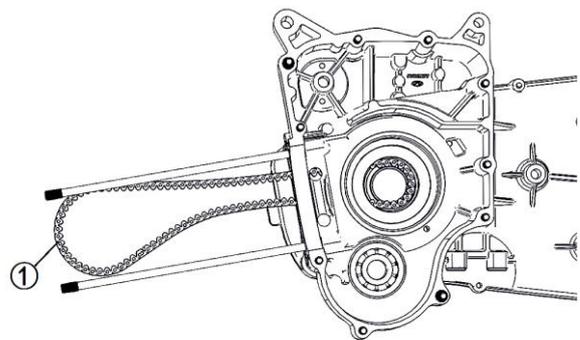
**CRANKSHAFT INSPECTION**

1. Measure:

- Crankshaft runout
- Out of specification → Replace crankshaft and/or bearing.

**NOTE:**

Measure the crankshaft runout with the crankshaft assembly running slowly.



	<b>Runout limit: 0.03 mm</b>
---	----------------------------------

**2. Measure:**

- Big end side clearance

Out of specification → Replace big end bearing, crank pin and/or connecting rod.

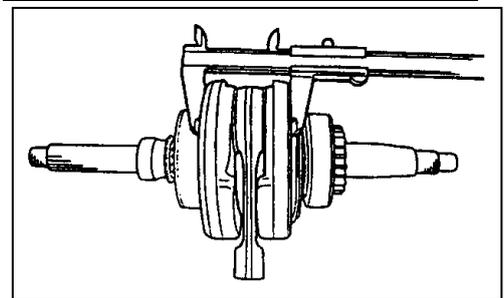
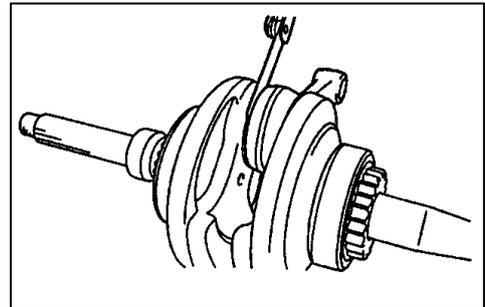
	<b>Big end side clearance: 0.35-0.85 mm</b>
---	---

**3. Measure:**

- Crank width

Out of specification → Replace crankshaft.

	<b>Crank width: 59.95-60.00 mm</b>
--	--



**4. Inspect:**

- Crankshaft sprocket ①

Wear/ Damage → Replace crankshaft.

- Bearing ②

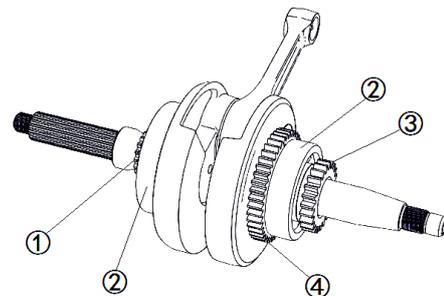
Wear/ Crack /Damage → Replace crankshaft.

- Pump drive gear ③

Wear/ Damage → Replace crankshaft.

- Balancer drive gear ④

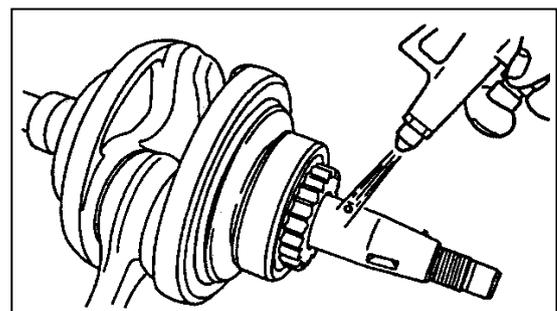
Wear/ Damage → Replace crankshaft.



**5. Inspect:**

- Crankshaft journal

Clogged → Blow out the journal with compressed air.

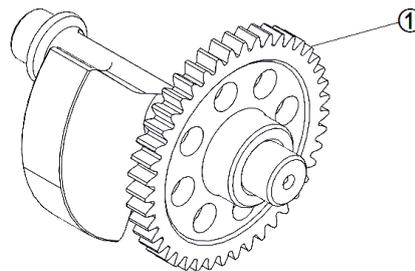


**BALANCER INSPECTION**

Inspect:

- Balancer driven gear ①

Wear/ Damage → Replace balancer.



**CRANKCASE INSTALLATION**

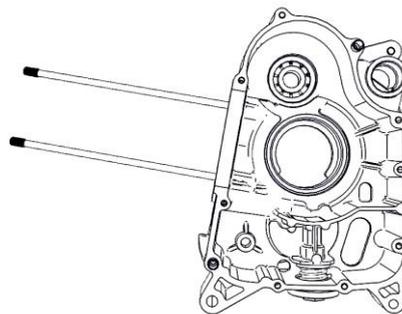
1. Clean all the gasket mating surface and crankcase mating surface thoroughly.

2. Apply:

- Sealant  
(onto the crankcase mating surfaces)

**NOTE:**

DO NOT ALLOW any sealant to come into contact with the oil gallery.

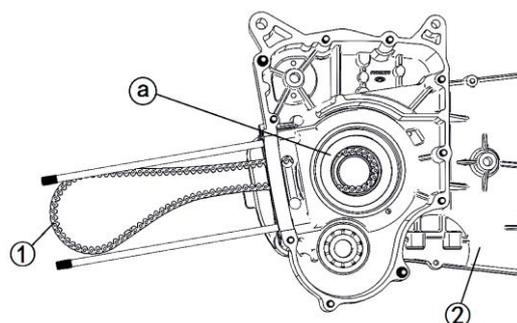


3. Install:

- Dowel pins
- Timing chain ①

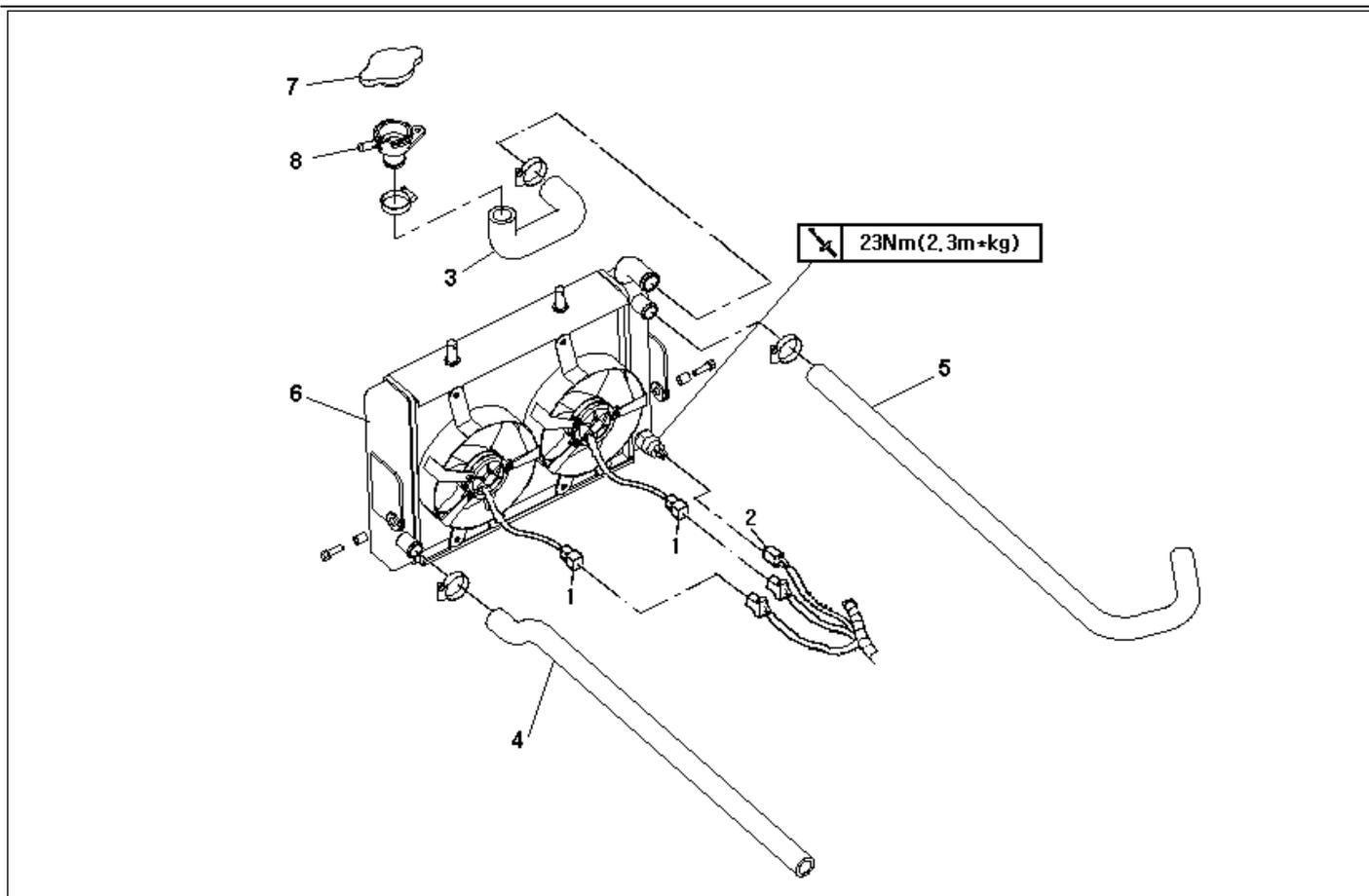
**NOTE:**

Install the timing chain not to be seen through the crankshaft hole ○,a on the crankcase (left)②.



**3.11 COOLING SYSTEM**

**3.11.1 RADIATOR**

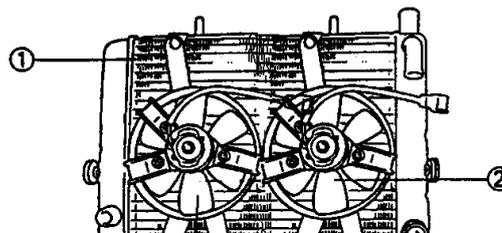


Order	Job name/ Part name	Q'ty	Remarks
	<b>Radiator removal</b> Drain the coolant.		Remove the parts in order. Refer to "COOLANT REPLACEMENT" section.
1	Fan motor leads	2	
2	Thermo switch leads	2	
3	hose (radiator)	1	
4	Outlet hose (radiator)	1	
5	Inlet hose (radiator)	1	
6	Radiator	1	
7	Radiator cap	1	
8	Radiator filler neck	1	
			Reverse the removal procedure for installation.

**INSPECTION**

1. Inspect:

- Radiator ①



Obstruction → Blow out with compressed air through the rear of the radiator.

Flattened fins → Repair or replace.

If flattened over the 20% of radiator fin, repair or replace the radiator.

### CAUTION:

Use only specified adhesive to repair the radiator.

### 2. Inspect:

●Radiator hoses

●Radiator pipes

Cracks/damage → Replace.

### 3. Measure:

●Radiator cap opening pressure

●Radiator cap opens at a pressure below the specified pressure → Replace.



**Radiator cap opening pressure:**

**110-140kPa**

**(1.1-1.4kg/cm<sup>2</sup>, 1.1-1.4 bar)**

### Measurement steps:

●Attach the radiator cap tester ① and adapter ② to the radiator cap ③.

●Apply the specified pressure for 10 seconds, and make sure there is no pressure drop.

### 4. Inspect:

●Fan motor assembly

Damage → Replace.

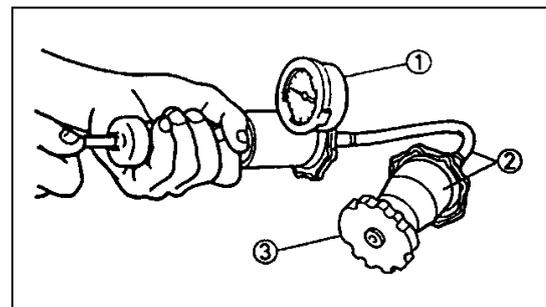
Malfunction → Check and repair.

Refer to "COOLING SYSTEM".

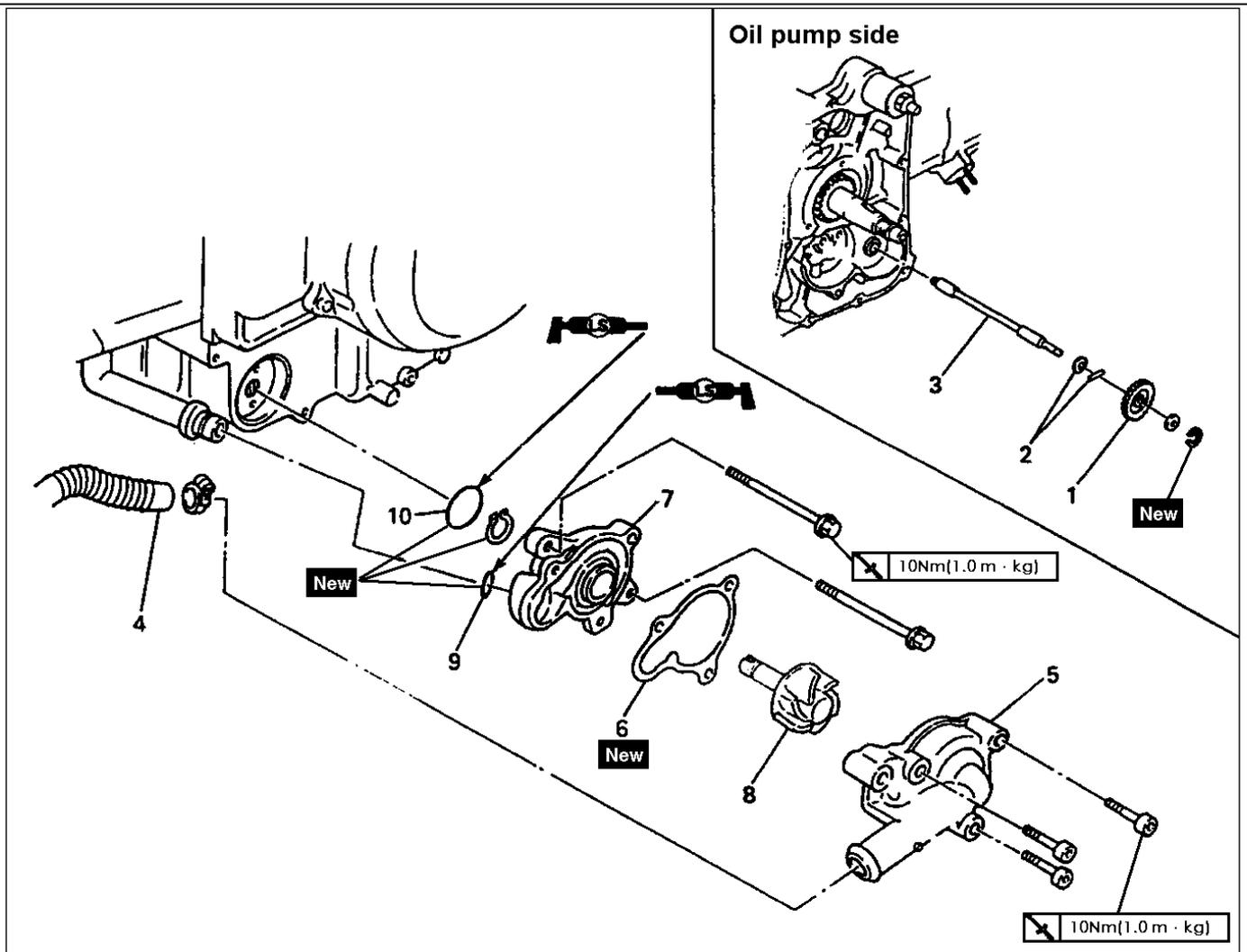
### 5. Inspect:

●Pipes

Cracks/damage → Replace.



## 3.11.2 WATER PUMP



Order	Job name/ Part name	Q'ty	Remarks
	Water pump removal Drain the coolant.		Remove the parts in order. Refer to "COOLANT REPLACEMENT" section.
	A.C. magneto		Refer to "A.C. MAGNETO AND STARTER CLUTCH" section.
1	Impeller shaft gear	1	
2	Dowel pin/plain washer	1/1	
3	Shaft	1	Refer to "WATER PUMP INSTALLATION" section.
4	Outlet hose (radiator)	1	
5	Housing cover	1	
6	Housing cover gasket	1	
7	Water pump housing	1	

Order	Job name/Part name	Q'ty	Remarks
8	Impeller shaft	1	Refer to "WATER PUMPINSTALLATION" section.
9	O-ring	1	
10	O-ring	1	

Reverse the removal procedure for installation.

**NOTE:**

- It is not necessary to disassemble the water pump, unless there is an abnormality such as excessive change in coolant temperature and/or level, discoloration of coolant, or milky transmission oil.
- If necessary, replace water pump as an assembly.

**INSPECTION**

1. Inspect:

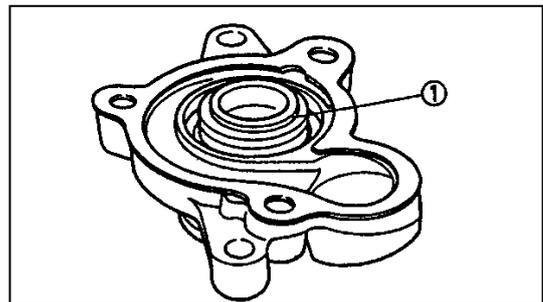
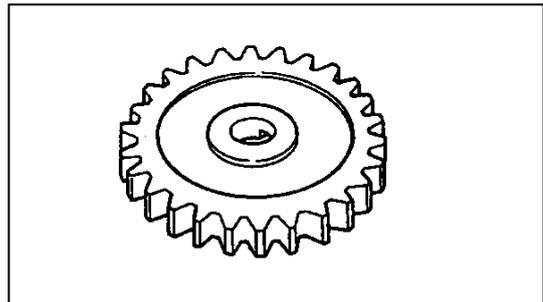
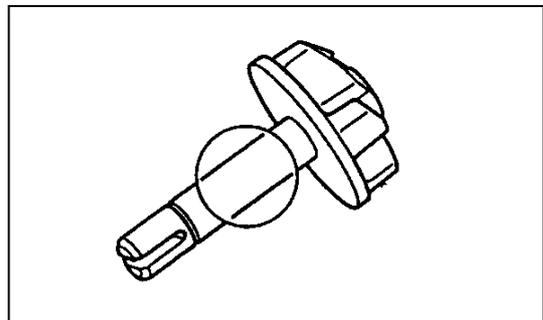
- Impeller shaft
- Wear/damage → Replace.  
Fur deposits → Clean.

2. Inspect:

- Impeller shaft gear
- Wear/damage → Replace.

3. Inspect:

- Mechanical seal ①
- Damage/worn/wear → Replace.



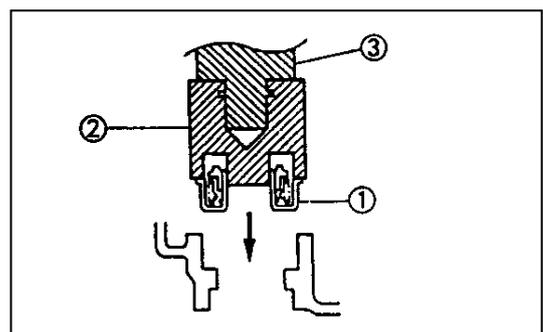
**WATER PUMP INSTALLATION**

1. Install:

- Mechanical seal ① **NEW**

**Installation steps:**

- Apply the bond to the outside of the mechanical seal.
- Install the mechanical seal by using the mechanical seal installer ② and middle shaft bearing driver ③



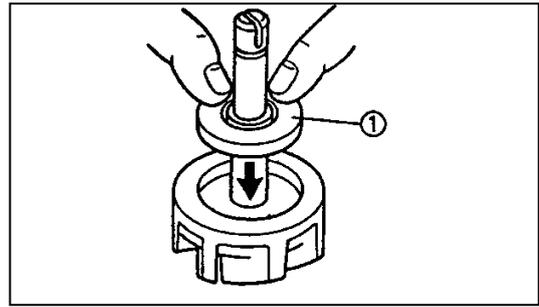
2. Install:

- Mechanical seal ① **NEW**

Apply coolant to the outside of the mechanical seal before installing.

**NOTE:**

Do not smear any oils or grease on the ring side of the mechanical seal.

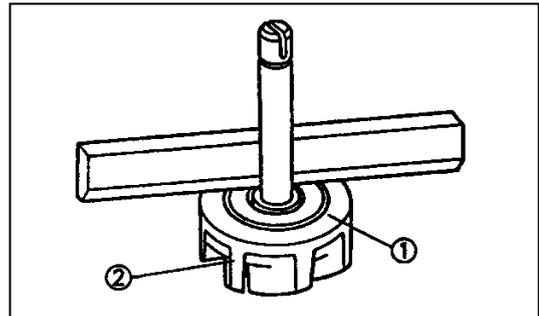


3. Inspect:

- Mechanical sea , slip ring side ①

Inspect the slip ring side of the mechanical seal and the impeller ② for level installation.

Incorrect level → Reinstall.



4. Install:

- Impeller shaft①
- Circ lip ② **NEW**

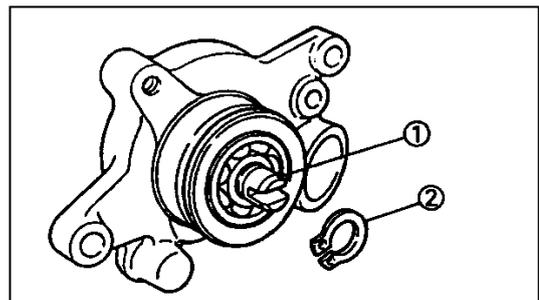
**Installation steps:**

- Apply a small amount of grease to the impeller shaft tip.

- Install the impeller shaft while turning it. Use care so that the oil seal is not damaged or the spring does not slip off its position.

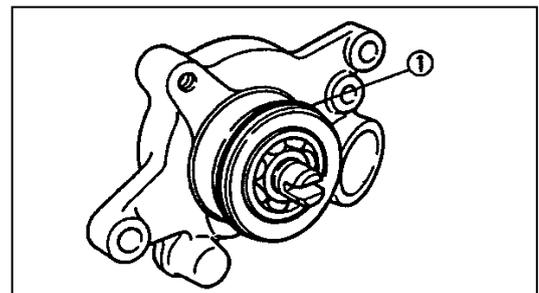
**NOTE:**

After installing the impeller shaft, check it for smooth rotation.



5. Install:

- O-ring①**NEW**



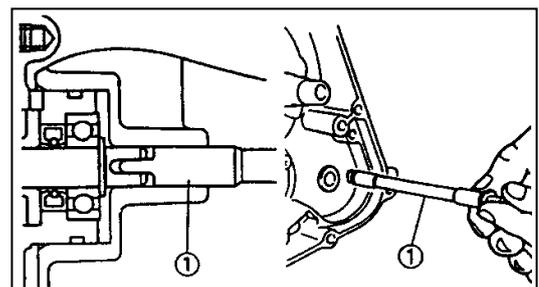
6. Install:

- Water pump housing
- Housing cover  10Nm(1.0m·kg)

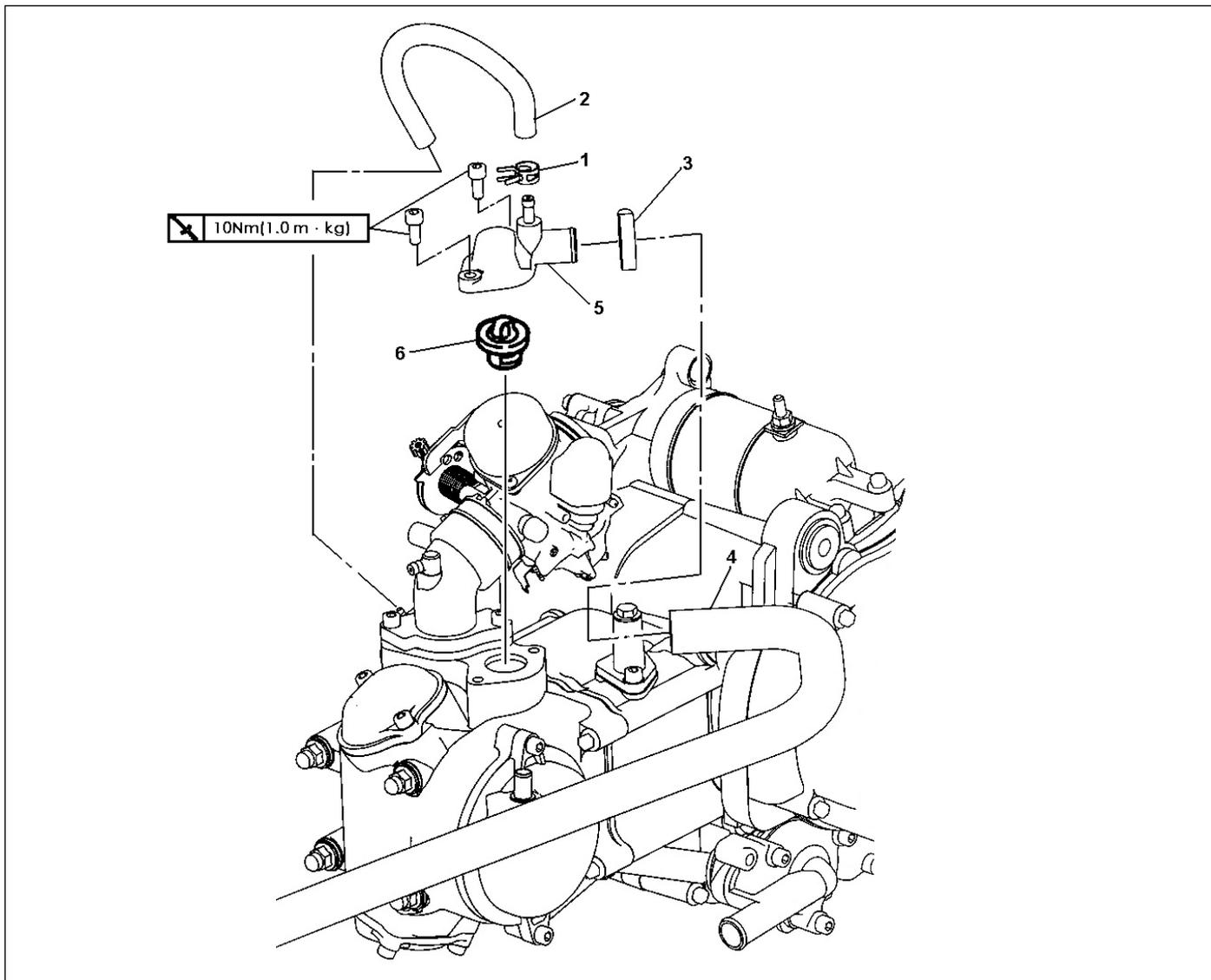
7. Install:

- Shaft①

Align the slot on the impeller shaft with the projection on the shaft when installing.



3.11.3 THERMOSTAT



Order	Job name/ Part name	Q'ty	Remarks
	<b>Thermostat removal</b>		Remove the parts in order.
	Drain the coolant		Refer to "COOLANT REPLACEMENT" section.
1	Clip	1	
2	Hose	1	
3	Hose clamp	1	
4	Inlet hose (radiator)	1	
5	Thermostatic cover	1	Refer to "THERMOSTAT INSTALLATION" section.
6	Thermostatic valve	1	Reverse the removal procedure for installation.

## INSTALLATION

1. Inspect:

- Thermostatic valve

Valve does not open at 70.5-73.5°C → Replace.

### Inspection steps:

- Suspend the thermostatic valve in a vessel.
- Place a reliable thermometer in water.
- Observe the thermometer, while continually stirring the water.

① Thermostatic valve

② Vessel

③ Thermometer

④ Water

**A** CLOSE

**B** OPEN

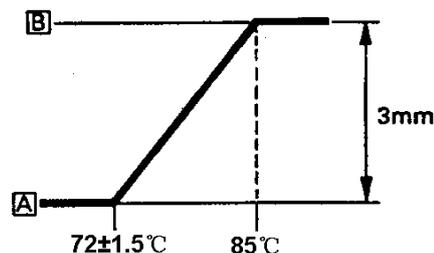
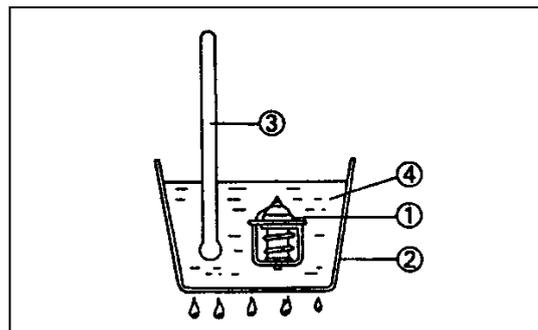
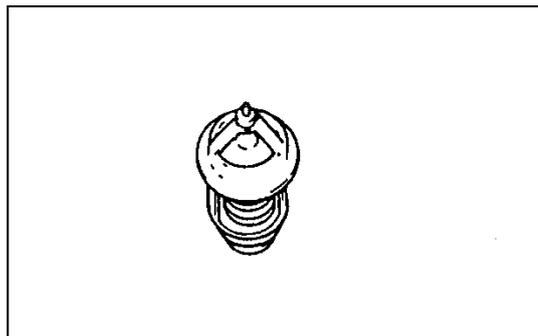
### NOTE:

The thermostatic valve is sealed and its setting requires specialized work. If its accuracy is in doubt, replace. A faulty unit could cause serious over-heating or over cooling.

2. Inspect:

- Thermostatic cover

Cracks /damage → Replace.



## INSTALLATION

1. Install:

- Thermostatic valve

- Thermostatic cover

3.12.1 ECU

3.12.1 .1 Description & Working Principle

The ECU continuously monitors the operating conditions of the engine through the system sensors. It also provides the necessary computation, adaptability, and output control in order to minimize the tailpipe emissions and fuel consumption, while optimizing vehicle drivability for all operating conditions. The ECU also provides diagnosis when system malfunctions occur.

3.12.1 .2 Appearance

The MT05 ECU has a polyester header, with an aluminum base plate. below shows the top and bottom view of the MT05 ECU.



3.12.1 .3 Handling – DOs & DONTs

ACTION	REASON
<b>DO NOT:</b> Place the ECU close to the exhaust pipe or Engine when removed	High temperature might reduce the life of the ECU and also can damage the ECU
<b>DO NOT:</b> Place the ECU close to or pour water, oil or any other liquids.	ECU is susceptible to water and liquids
<b>DO NOT:</b> Allow mud or other debris to accumulate on the surface of the ECU	Having mud or debris accumulated on the ECU casing reduces its heat dissipation efficiency.
<b>DO NOT:</b> Apply any voltage relative to any point to the ECU	Drastically affects the performance of the ECU and may lead to ECU damage
<b>DO NOT:</b> Clean ECU with any solvent or any corrosive liquid	Can damage the housing of the ECU
<b>DO:</b> Take extreme care that water droplets or excess moisture should not fall on ECU connectors	ECU connectors can get short and may lead to ECU damage
<b>DO:</b> Clean the ECU with a moist cloth and keep it dry	Prevents ECU damage

3.12.1 .4 Installation requirements

The ECU shall be mounted using M5 machined screws with a torque of 3.9Nm ±10%. The

mounting surface should also be flat to avoid subjecting the base plate to unnecessary force and warping the PCB.

### 3.12.1 .5 Power Requirements

- Power Supply: The controller's power supply module will power up the microprocessor if the battery voltage is greater than 6.3 Volts. The power on is controlled by the controller hardware only.
- Operating Range: All planned functions are executed in this range. Battery and/or Ignition voltage: 9.0 to 16V DC
- Power Off: The controller will turn its power off when the ignition voltage: < 6.2 V DC. The controller prepares for entry into Power Down mode. The preparation involves storing important information into EEPROM.
- Reset: During reset, all outputs shall be set to a predefined state. The controller shall monitor itself for proper operation and enter reset should any internal errors be detected. The controller shall then restart normal operations after the computer has properly reset
- Over Voltage: the controller will survive no permanent damage if the ignition voltage do not exceed 26V for more than 1 minute
- Reverse Voltage: The controller will survive with no permanent damage: Battery and/or Ignition voltage < -13V DC for 1 minute

### 3.12.1 .6 Temperature Requirements

- Storage: The controller shall suffer no damage as a result of being stored at temperatures of -40 °C or +105 °C continuously for 168 hours. If the storage temperature is not as extremely high as +105 °C or as extremely low as -40 °C, the ECU could be stored for longer time without damage.
- Operating: The controller shall operate in the ambient temperature from -20 °C to +85 °C.

### 3.12.1 .7 Maintenance service and Repair

ECU is a non-serviceable part. Once there are problems, it's important to first determine if the problem is caused by software/calibration. If it is caused by software/calibration, please refer to software/calibration reflashing procedure. In the event of ECU hardware failure or malfunction (during warranty period only) the ECU should be sent back to the vehicle manufacturer giving complete details of the ECU Part No, Serial number, Vehicle Model & Make, manufacturing Date, Total kms run on the vehicle, Location of use, Vehicle No, Date of return.

## 3.12.2 INJECTOR

### 3.12.2.1 Appearance

The figure below shows the standard Multec 3 Fuel Injector appearance



### 3.12.2.2 Sealrings

Seal rings for injectors (refer to Figure 12) are made to withstand temperatures ranging from  $-40^{\circ}\text{C}$  to  $150^{\circ}\text{C}$  ( $-40$  to  $302^{\circ}\text{F}$ ) without leakage or seeping. They must also be resistant to varying amounts of fuel additives to fuel (i.e., ethanol, etc.). The following are currently available seal rings designs. Please contact a Delphi representative if the specific sealing requirements are not met by these designs:

#### Injector to fuel rail seal ring

- Dimensions:
- ID. : 6.35 mm
- OD. : 14.85 mm
- Cross-section: 4.25 mm
- Materials
- Viton  $\square$  GLT (blue color). For low temperature applications
- Viton  $\square$  A (black). All other applications.

#### Injector to manifold

- Dimensions:
- ID: 9.61 mm
- OD: 14.49 mm
- Cross-section: 2.44 mm
- Materials:
- Viton A (black or brown other applications.)

### 3.12.2.3 Sealrings replacement

$\square\square$  Lubricate the seal rings with an approved lubricant or equivalent. The lubricant application process must prevent lubricant from contacting the director plate, which could possibly restrict the injector flow.

$\square\square$  It is preferred to not reuse the seal rings when re-installing an injector. If re-use is necessary, carefully inspect each seal ring for any signs of damage, as even minor defects can lead to fuel / vacuum leakage. Always install injectors and seal rings using the recommended service procedures to avoid the possibility of a safety hazard.

$\square\square$  When installing seal rings to the injector inlet, take extra care not to damage the seal on the injector top flange.

### 3.12.2.4 Lubricant Recommendation

Lubrication should be applied to the O-rings only for ease of injector installation. The table 4 is a list of lubricant oils that were tested and approved for O-ring lubrication. These lubricants have shown to have no effect on injector performance (plugging, sticking).

Lubrication Recommendation		Table: 6
Lubricant Name	Supplier	Viscosity (cSt) @ 40 °C
Spindura 10	Equilon	10
Spindura 22	Equilon	21
DTE-24	Mobil	32
DTE-25	Mobil	46
DTE-26	Mobil	68
Norpar 15	Exxon / Mobil	<1
Drawsol 60	DA Stewart	1-2
NocoLube AW 46	NOCO Energy	46
NocoLube AW 32	NOCO Energy	32
Advantage Spindle Oil	Advantage Lubrication Specialties	10

**3.12.2.5 Over -Voltage**

The Multec 3 injectors and the Multec 3.5 injectors can withstand a voltage of 26v for a maximum of one minute at a duty cycle of 100 ms pulse width and 200 ms period. The injector will be pressurized with calibration test fluid at normal operating pressure during the test. This will not result in any permanent physical damage to the injector or coil assembly, or any degradation in electrical performance.

**3.12.2.6 Temperature Requirements :**

Typical injector temperature environments are defined below. The Multec 3 injectors and the Multec 3.5 injectors will not experience any loss of the ability to comply with the flow tolerance requirements after exposure to the following temperature environments. Also, they will not experience unacceptable external leakage, any type of physical degradation, or loss of service life during or after being exposed to these ambient conditions.

- Normal Operating Temperature Range: - 30 to 125□C
- Extreme Operating Temperature Range (some performance degradation): - 40 to 150□C
- Storage Temperature Range: -60 to 60□C

**3.12.2.7 Fuel Contamination**

The injector fuel inlet filter protects the fuel injector from initial build fuel contamination as well as from fuel system assembly contamination. Filtration is extremely important because particle contaminants can cause an injector to stick open, flow shift or tip leak.

The injector inlet filter is not a serviceable component and is designed only to trap potential built-in contamination between the chassis fuel filter and injector.

**3.12.2.8 Wire Routing**

- Electrical wiring to the injector should be routed so that conductors are protected from excessive heat, damage, and wear.
- Avoid unnecessary handling (disconnecting and connecting) of the electrical

connector.

3.12.2.9 Handling - DOs & DONTs

ACTION	REASON
<b>DO NOT:</b> Re-use injector seal rings if at all possible. If no other choice exists, take extra care in inspecting the seal rings for damage.	Leakage.
<b>DO NOT:</b> Dip injector tips into lubricants.	Can plug injector spray orifices.
<b>DO NOT:</b> Cycle injector repeatedly without fuel pressure.	Damage to internal mechanical components.
<b>DO NOT:</b> Pulse (actuate) a suspected high leak rate injector (leak >50 sccm air)	Can dislodge internal contamination if
<b>DO NOT:</b> Allow water to enter fuel system from air lines, etc. during leak checks.	Can damage injectors.
<b>DO NOT:</b> Contact or apply load to the injector tip for installation.	Apply load to 45 deg angle on nylon over mold see
<b>DO NOT:</b> Pound injectors into manifold during assembly to engine.	Can damage injectors or seal rings.
<b>DO NOT:</b> Apply excessive side loads to electrical connectors.	May cause loss of electrical continuity.
<b>DO NOT:</b> Use any dropped unit.	Internal damage may have occurred.
<b>DO NOT:</b> Store injectors, rails, or subassemblies including engines on which the injectors have been installed in an unprotected environment.	External contamination can damage the injector electrically and/or mechanically.
<b>DO NOT:</b> Use the injector as a handle.	Do not use the injector to lift assemblies
<b>DO NOT:</b> Rack, stage, or handle parts in a manner that allows contact between parts.	Damage will occur.
<b>DO NOT:</b> Remove packing in a way that allows contact between parts.	Damage could occur due ton contact between parts
<b>DO NOT:</b> Tap on fuel injectors to correct any malfunction..	Can damage injector.
<b>DO NOT:</b> Replace the injector with other part number not recommended for this application	Will severely affect the performance of the injector
<b>DO:</b> Take extra care when installing new fuel seal ring over injector inlet flange.	Prevent tearing seal ring during installation
<b>DO:</b> Use proper lubricants on seal ring surfaces to install injector in engine. Minimize time between applying lubricant and inserting injector /rail.	Avoid damage to seal ring during installation. Avoid contamination at seal.
<b>DO:</b> Pulse (actuate) stuck closed or tip-leak suspected injector (Actuate consists of one pulse<5 sec duration at 9 to 15V).	To verify the injector failure
<b>DO:</b> Pulse (actuate) injectors prior to a dry fuel system leak test at engine/vehicle assembly to	Injector valves may not reseat without fuel after shipping and handling resulting in

reseal injector valves.	false leakage.
<b>DO:</b> Avoid any liquid contamination in the injector area.	Coil could short circuit.
<b>DO:</b> Use care during connection of harness to injector.	Avoid terminal damage.
<b>DO:</b> Use recommended terminal lubricant on mating connector.	Minimize potential for terminal fretting corrosion.
<b>DO:</b> Return any dropped, damaged, or suspect material with a tag that describes the problem.	Ensure fast and correct diagnosis of root cause.

**3.12.2.10 Installation guide lines**

Follow these guidelines to prevent damage to the injector and its electrical interface during the replacement or re-installation process.

- Lubrication: Apply a light coating of lubricant to the lower injector seal ring. ISO 10 light mineral oil or equivalent is recommended.
- The preferred technique is to apply the lubricant to the sockets the injectors are being installed into, rather than directly to the seal ring itself. This will help minimize the possibility of injector contamination.
- Avoid applying lubricant over the director plate holes – this may restrict injector flow. Do not dip the injector tip in lubricant.
- All Multec 3 and Multec 3.5 injectors come from the factory with the seal rings attached. The re-use of seal rings is not preferred when replacing an injector. If an injector is to be re-used, and no new seal rings are available, take care to inspect each seal ring for signs of damage. Even minor defects in the seal ring can lead to leakage. Take extra care in installing seal ring over flange of injector inlet.
- Carefully installing the harness connector will prevent terminal damage. Listen for a positive audible click from the connector retention device — this ensures that it is fully engaged.
- Avoid unnecessarily disconnecting/reconnecting the harness connector.
- Wires routed in a manner that can allow them to become pinched between components can result in a short circuit and a stuck open injector.
- For injectors that require orientation for spray pattern, do not rotate the injector in the fuel rail assembly to install the injector electrical connector. This may dislodge the retaining clip, and result in improper spray orientation

**3.12.2.11 Replacement Techniques**

The following procedure outlines standard Multec 3 and Multec 3.5 Fuel Injectors removal and replacement.

**Warning: The injector and all associated hardware may be extremely hot.**

- Shut off ignition.
- Disconnect negative battery cable to avoid possible fuel discharge if an accidental attempt is made to start the engine.
- Disconnect the electrical connector from the injector wiring harness.
- Relieve fuel pressure
- Remove the retaining clip from the fuel injector.
- Remove the fuel line connection from the injector

- Carefully clean debris from the interface surfaces. Do not damage seal mating surfaces.
- Remove the injector from the manifold
- Apply a light coating of a lubricant to both the upper and lower injector seal ring of the replacement injector.
- Install the new injector into the manifold. Check that the injector is installed in the original orientation to maintain proper spray targeting, and that the retaining clip is properly seated on the injector and the fuel line
- Install the retaining clip after connecting the fuel line
- Tighten the injector mounting to the desired torque as mentioned in the manufacturer manual
- Tighten the fuel line
- Re-install the injector electrical connector
- Check for fuel leaks with the key “on” and the engine “off”
- Start engine and verify proper operation

### 3.12.2.12 Interchange ability

The injector should be replaced in service only with an equivalent injector of the same part number. On occasion, a new part number may supersede part numbers. Consult the appropriate vehicle service manual and part number guide for the latest replacement injector part number information.

### 3.12.2.13 Plugging

Fuel deposits cause plugging resulting in flow shifts over the life of the injector. Fuel varnish or gumming, a type of injector deposit, is created when certain types of fuel are heated by high injector tip temperatures at soak (no fuel flow). Deposit build up in the director holes causes the flow shifts

- Plugging can cause flow restrictions, frictional changes and the collection of other particles attracted by the tacky surface. The flow restrictions can degrade emissions and drivability.
- Other fuel and environmental conditions may cause crystal or corrosion growth in the injector and cause a flow shift.
- Oxidation stability of the gasoline affects the potential for deposit formation and must be controlled by the fuel supplier.
- Increased levels of detergent additives reduce the rate of injector plugging.
- In case of plugging of injector follow the injector cleaning procedure mentioned in the section below

### 3.12.2.14 Cleaning Procedure

- Electrically disable the fuel pump by removing the fuel pump connection.
- Relieve the fuel pressure in the system and disconnect the fuel connection at the injector. Plug the fuel feed line.
- Injector cleaner with the specific ratio of the cleaner and gasoline to be mixed in the Injector cleaning tank.
- Connect the injector-cleaning tank to injector in the vehicle.
- Pressurize the injector-cleaning tank to system pressure.
- Start and idle the engine for 15- 20 minutes.
- Disconnect the injector-cleaning tank from the system and install the fuel pump connections. Connect the fuel feed line to injector.

□□ Start and idle the vehicle for an additional 2 minutes to ensure the residual injector cleaner is flushed from system.

### 3.12.3 Throttle Body Assembly (with stepper motor )

#### 3.12.3.1 Description and Working Principle

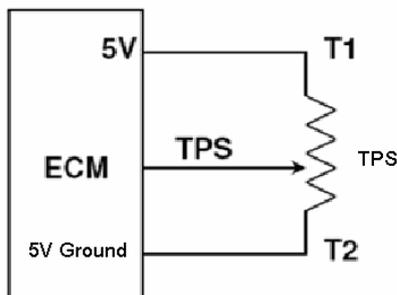
The Throttle Body Assembly is an interactive system comprised of the following subsystems: the main casting body, bearing system, shaft and valve system, return spring system, cable interface system, throttle position sensing system, and the bypass air control system. The subsystems interact and support each other to provide all the functional requirements, which are mentioned below -

- Control intake air flow
- Control idle air flow
- Sense throttle position - Provide position feedback to Engine Controller
- Provide reactionary force to the throttle

#### 3.12.3.2 Technical Parameters

Throttle Position Sensor:

- Reference voltage:  $5 \pm 0.1$  VDC
- Resistance between T1 and T2:  $3k \sim 12k\Omega$



Idle Air Control Valve:

- Operating voltage:  $7.5 \sim 14.2$  VDC
- Solenoid resistance:  $53\Omega \pm 10\%$
- Solenoid inductance:  $33mH \pm 20\%$

#### 3.12.3.3 Operating Conditions

Normal Operating Temperature:  $-30 \sim 120^\circ\text{C}$

#### 3.12.3.4 Throttle Body Removal

- Disconnect negative terminal of the battery
- Disconnect electric lead wire of throttle position sensor coupler, stepper motor coupler and MAP/MAT sensor coupler ( if this sensor is mounted on the throttle body)
- Disconnect accelerator cable from throttle body
- Remove air cleaner outlet hose and throttle body outlet hose

#### 3.12.3.5 Cleaning Procedure

Once the throttle body cover is removed, spray the throttle-body cleaner inside the shipping air passage, and use the brushes to

gently dislodge the dirt, gum and varnish that are present. Do not let the by pass holes be blocked by dirt or foreign particles.

**3.12.3.6 Throttle Body Installation**

Reverse the procedure for installation noting the following:

- Adjust accelerator cable play
- Check to ensure that all removed parts are back in place.
- Reinstall any necessary part which have not been reinstalled

**3.12.3.7 Precautions**

- Do not submerge TPS in any cleaning fluid.
- Always open the throttle valve using the throttle cable or lever.
- Do not hold the valve at opening position by inserting tools or any sticks into the bore. The valve may be warped and the bore may be scratched. This type of damage may keep the throttle from opening easily or fully closing.

**3.12.3.8 Handling - DOs & DONTs**

ACTION	REASON
<b>DO:</b> Use care during assembly of harness to throttle body.	Avoid terminal damage.
<b>DO:</b> Avoid any liquid contamination in the throttle body area.	Ensure proper operation.
<b>DO:</b> Unload and install units one at a time from packing trays.	Damage may be done to critical components.
<b>DO:</b> Return any dropped, damaged, or suspect material with a tag that describes the problem. (Only warranty cases)	Ensure fast and correct diagnosis of root cause.
<b>DO:</b> Remove and discard protective caps just before assembling mating components.	Protects system from contamination, which can prevent proper operation.
<b>DO:</b> clean the by pass passage after removing bottom cover	To ensure good idle stability
<b>DO NOT:</b> Use any dropped or impacted unit.	Internal damage may have occurred or emissions settings may have been upset.
<b>DO NOT:</b> Store units without protective caps in place.	Contamination may impair correct operation.
<b>DO NOT:</b> Ship or store near saltwater without protection.	Corrosion buildup may impact proper operation.
<b>DO NOT:</b> Exposed to environmental conditions (Moisture) prior to complete vehicle installation.	Corrosion buildup may impact proper operation.
<b>DO NOT:</b> Apply any voltage other than system voltage for testing.	Damage could occur
<b>DO NOT:</b> Apply excessive band clamp loading	Damage could occur.
<b>DO NOT:</b> Remove packing in a way that allows contact between parts.	Minimum air leakage could be affected and/or other damage could occur.
<b>DO NOT:</b> Release the throttle cam abruptly from any position without the throttle linkage attached.	Damage could occur.

<b>DO NOT:</b> Let the by pass holes be blocked by dirt or foreign particles.	This could effect idle stability
<b>DO NOT:</b> Rake, stage, or handle parts in a manner that allows contact between parts.	Damage will occur.

### 3.12.4 Engine Cool ant Temper ature Sensor

#### 3.12.4.1 Description and Working Principle

This sensor is used in water cooled engines. It provides a resistance that varies as a function of temperature within prescribed tolerance limits. The sensor has a negative temperature coefficient of resistance. This is a non-serviceable part.

#### 3.12.4.2 Appearance



#### 3.12.4.3 Installation Requirements

□□Dynamic Torque Requirement: The sensor shall be hand into the application and then driven by a driver with a maximum no load speed of 400 rpm or installed to the desired torque by a hand torque wrench (5/8" hex). The recommended installation torque is:

□□Minimum: 20 N·m

□□Maximum: 25 N·m

□□Static Torque Requirement: The torque required to remove the sensor from the mating hole shall be within 200% of the installation torque mentioned above.

#### 3.12.4.4 Operating Environment

□□This device is intended for use in engine coolant and air cooled applications and shall withstand such an under hood environment.

□□Normal Operating Temperature: -40°C ~ 135°C (continuously).

□□Relative Humidity: 0 to 100% RH.

□□Typical Pressure: When installed at the minimum torque the sensor shall be capable of sealing engine coolant with a positive pressure of 206.8 kPa (30 psi) at 135°C applied to the probe tip end of the sensor.

□□Extreme Operating Environment: Maximum temperature excursion to 150°C for 1 hour.

### 3.12.4.5 Storage Environment

- Storage temperature: -40°C to 120°C for an indefinite duration
- Transport at altitudes to: 13,700 m for an indefinite duration

### Electrical Environment

- Typical Voltage: The sensor circuit operates with a DC voltage reference of  $5 \pm 0.1$  VDC.
- Maximum Excitation Current: The sensor calibration shall not be affected by a current source of less than 1 mA at all temperatures.

### 3.12.4.6 Sample Cleaning

- When necessary the samples may be cleaned in isopropyl alcohol for one minute with mating connectors in place and then air-dried

## 3.12.5 Intake Air Pressure and Temperature Sensor(MAP&MAT)

### 3.12.5.1 Description and Working Principle

This sensor has two functions. The first is the intake manifold air temperature, it provides a resistance that varies as a function of temperature within prescribed tolerance limits. The second is the intake manifold air pressure; it provides a voltage varies as the intake air pressure.

### 3.12.5.2 Appearance



The appearance of the MAP&MAT Sensor is shown as above.

### 3.12.5.3 Operating Environment

- This device is intended for use in inlet manifold for sensing air temperature and pressure which shall withstand such an under hood environment.
- Pressure Range: 20~102kPa
- Temperature Range: -40~105°C
- Relative Humidity: 0 to 100% RH.
- Extreme Operating Environment: Maximum temperature excursion to 125°C for 2 hours.

### 3.12.5.4 Storage Environment

□□ Storage temperature: -50°C to 150°C for an indefinite duration

### 3.12.5.5 Electrical Environment

□□ Typical Voltage: The sensor circuit operates with a DC voltage reference of  $5 \pm 0.1$  VDC.

### 3.12.5.6 Sample Cleaning

□□ When necessary the samples may be cleaned in isopropyl alcohol or gasoline for one minute with mating connectors in place and then air-dried

## 3.12.6 Oxygen Sensor

### 3.12.6.1 Description and Working Principle

This sensor is a device for monitoring the residual oxygen in the exhaust of an internal combustion engine. It consists of the wide range sensor and stoichiometric sensor. Usually we use stoichiometric sensor on the small engine. It is the feedback element for engine closed loop control.

### 3.12.6.2 Appearance

The appearance of the Engine Oxygen Sensor is shown as below



### 3.12.6.3 Technical Parameters

□□ A/F ratio rich threshold:  $> 750$  mVDC

□□ A/F ratio lean threshold:  $< 120$  mVDC

□□ Heater power: 7.0W

(These parameters as above are measured basing on 450°C (engine dyno), typically on 70% duty at 10Hz and under 13.5V)

□□ Heater part resistance:  $9.6 \pm 1.5 \Omega$

(This parameter is measured basing on 21°C)

□□ Operating temperature range: 260-850 °C

### 3.12.6.4 Fuel Quality Requirements

□□ Pb  $\leq 0.005$ g/L

□□ P  $\leq 0.0002$ g/L

□□ S  $\leq 0.04\%$  (weight proportion)x

- MMT≤0.0085g/L
- Si≤4ppm

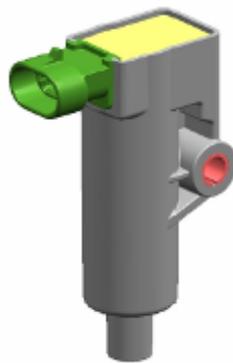
### 3.12.7 Ignition Coil

#### 3.12.7.1 Description and Working Principle

This coil provides energy to the spark plug in the combustion chamber. The coil itself doesn't have a driver. The high voltage tower of the coil is connected to the spark plug using a high voltage cable assembly. This is a non-serviceable component.

#### 3.12.7.2 Appearance

The appearance of the Ignition coil is shown as below.



#### 3.12.7.3 Technical Parameters

- Input voltage: 9~14VDC
- Output voltage: ~25~30KV
- Operating temperature: -30 ~110 °C
- Storage temperature: -40~155°C
- Mounting Torque: 8.8~11.8Nm

#### 3.12.7.4 Installation requirements

- The vehicle frame provides the mounting surface and mounting holes.
- Mount coil close to the spark plug and keep the plug wire length very short (less than 6 “).
- Mount coil away from any pick coil device. Especially, a VR type Crank / Cam sensor. Keep a Min distance of 150 mm (around 6”) between coil and any VR sensor device.
- Never route the coil C- wire with the same bundle as the Crank sensor wires. There is around 200 V peak potential between C- wire and engine ground. This voltage potential could cause a noise on sensor cables.

#### 3.12.7.5 DOs and DONTs

ACTION	REASON
<b>DO NOT:</b> Install the low voltage connectors with the power applied	This might cause an unwanted secondary firing, possibly leading to personal injury

<p><b>DO NOT:</b> Use a screw driver to asset in removing secondary boots from the secondary tower. Use tools designed for secondary removal.</p>	<p>It is possible to damage a secondary lead in such a manner that creates an electrical path to outside the system permitting improper system operation misfire, or even possible personal injury if arcing occurs.</p>
<p><b>DO NOT:</b> Use parts that have been dropped or display physical damage</p>	<p>Damaged components can lead to premature failure.</p>
<p><b>DO NOT:</b> Scratch or apply any non approved material to the surface of the high voltage tower which mates with the high voltage secondary leads.</p>	<p>This can jeopardize the seal integrity of the mating surfaces which in turn can create a secondary high voltage leak path.</p>
<p><b>DO NOT:</b> Strike any part of the ignition system with a tool or other object.</p>	<p>This can lead to physical damage which can cause a system malfunction or failure.</p>
<p><b>DO NOT:</b> Permit paint or other sprayed materials to be sprayed onto the electrical connectors.</p>	<p>Insulating type sprays can create a high resistance or open connection. And, a conductive type spray can create an electrical short condition.</p>
<p><b>DO NOT:</b> Support the ignition system by the wiring harness or plug wire.</p>	<p>These leads are not designed to support the weight of the ignition system. It can create a poor electrical connection Or become disconnected allowing the system to fall and be subjected to physical damage</p>
<p><b>DO NOT:</b> Pierce or probe the secondary leads.</p>	<p>This creates an electrical path to outside the system permitting improper system operation, misfire, or even possible personal injury if arcing occurs.</p>
<p><b>DO NOT:</b> Operate without the spark plug attached</p>	<p>If a technician or mechanic comes in contact with the high voltage generated during operation, personal injury may occur. Or, if the engine is operated under this condition, unburned fuel may fill the converter area creating a potential hazard</p>
<p><b>DO NOT:</b> Share ignition component wiring with other components, Dedicated wiring is required.</p>	<p>This prevents electrical cross talking between components which can lead to component malfunction.</p>
<p><b>DO NOT:</b> Apply voltage to the ignition system other than vehicle system voltage for testing purposes.</p>	<p>This can cause reduced performance or an electrical malfunction of the ignition system</p>
<p><b>DO NOT:</b> Use high impact tools to apply the spark plug boot to the ignition secondary towers. Installation of the high voltage secondary leads by hand is preferred.</p>	<p>Damage to the coil tower, secondary boot, or mating connection surfaces might occur.</p>
<p><b>DO:</b> Install the secondary leads before connecting the primary leads.</p>	<p>In the event the low voltage connection has been made and the power applied, unwanted secondary output might occur possibly resulting in injury, damage</p>

	the ignition component, and test equipment
<b>DO:</b> Take care when working around the ignition system.	The high voltage produced by the coil secondary circuit can cause personal injury and/or damage test equipment
<b>DO:</b> Proper handling and shipping methods need to be in place to reduce the risk of damage due to impact, moisture, or contamination	Damaged components can lead to premature failure.
<b>DO:</b> Avoid unnecessary disconnecting and connecting of the electrical components.	The electrical connections are not designed for repeated connection and disconnection.
<b>DO:</b> Insure the low voltage connectors are entirely seated and the locking mechanism is engaged.	This prevents intermittent electrical connections leading to an improper ignition system operation.
<b>DO:</b> Use approved connector breakouts when testing the ignition system.	Connector and/or component damage may occur.
<b>DO:</b> Insure the appropriate seals are included in the connector system.	Liquid intrusion into the terminal connection area might occur causing an electrical intermittent or short condition. In the event of severe terminal corrosion, an open condition might occur.
<b>DO:</b> Operate with gasoline based internal combustion engines.	Other fuels or combustion designs may require additional design considerations
<b>DO:</b> The power feed line should be fused.	This could protect the system in the event of an electrical short
<b>DO:</b> The module heat sink and back plate must not be used as a connection point when jump starting the engine	The high level of voltage and current which the module could be subjected to, could cause module performance degradation or failure.
<b>DO:</b> Connection of the module back plate to vehicle ground is desirable whenever possible	This greatly reduce potential ground loops and acts as a heat transfer source from the module.
<b>DO:</b> The ignition system ground wire should be kept as short as possible. And, when permissible, should be grounded at the same engine block position as the engine controller	This would greatly reduce the possible of unwanted electrical ground loops.
<b>DO:</b> The electrical wiring to the ignition system should be routed so that the conductors are protected from excessive heat, damage, and wear.	Helps prevent electrical intermittent, open or shorted operating conditions.
<b>DO:</b> Ignition secondary leads should not be routed with the ignition primary harness or any other electrical harness.	Voltage spikes can be transmitted from the secondary cables into other leads which are in close. This could create a component performance degradation or failure condition
<b>DO:</b> Spark plug wires(secondary leads) & primary wiring: - must not contact sharp surface - must not be under tension between fixed points - must be clear of moving parts (belts, fan, etc...) - must be protected from or kept at least 125 mm	- Spark plug wires carry very high voltage (30,000 volt). If the secondary lead loses its dielectric characteristics thru being nicked, cut , chaffed, then an arc thru to a near by ground could take place. This kind of condition could lead to misfire, no start, or premature failure of ignition system.

<p>away from radiant heat source exceeding 400 F.                  - must be protected from environmental damage (dirt, splash, oils, fluids, etc....)                  - must be retained, secured or insulated to prevent pinching, mis-routing, rattles, and squeaks</p>	
<p><b>DO:</b> Not all fasteners are designed for repeat use. Beware of fastener specifications. All harnesses should be supported within 6" of a mating connection.</p>	<p>Adequate retention force might not be achieved if the fastener is not designed to be reused. Mating connections are not designed to support the weight of the harness assembly</p>
<p><b>DO:</b> For removing spark plugs follow the following steps:                  1- Grasp the spark plug boot and gently rotate 90°; and then pull the spark plug boot and cable away from the spark plug                  2- Before removing spark plug, brush or air blast dirt away from the well areas                  3- Use correct size deep socket wrench to loosen each spark plug one or two turns</p>	<p>To remove spark plugs from Aluminum heads, allow the engine to cool. The heat of the engine, in combination with a spark plug that is still hot, may cause the spark plug threads to strip the cylinder head upon removal                  Use goggles to protect eyes from dirt when applying compressed air to spark plug wells</p>
<p><b>DO:</b> Cleaning a spark plug could be done as follow:                  1- wipe all spark plug surfaces clean....remove oil, water, dirt and moist residues.                  2- If the firing end of spark plug has oily or wet deposit, brush the spark plug in an approved, non-flammable and non-toxic solvent. Then dry the spark plug thoroughly with compressed air                  3- Use a propane torch to dry wet-fuel fouled plugs. Allow the torch flame to enter up the center electrode insulator. Allow plug to cool down                  4- If the spark plug threads have carbon &amp; scale deposits, clean with wire brush, taking care not to injure the electrode or the insulator tip</p>	<p>- Cleaning a spark plug will reduce the voltage required for an electrical arc(spark) across the electrodes                  - Cleaning &amp; re-gapping will not restore a used spark plug to a new condition. It may be more economical and efficient to replace used spark plugs with new plugs instead of cleaning.                  - Sooted plugs should be replaced                  - Do not cool by using water or any liquid                  - Clean threads permit easier installation and proper seating which will maximize transfer heat away from the plug</p>
<p><b>DO:</b> Regap spark plugs to the exact measurement specified by the engine manufacturer to keep the best fuel economy and proper engine performance                  - Use round wire-type gauge for an accurate measure of gap on all used spark plugs                  - when gapping a spark plug only the side electrode is moved. The center electrode must not be moved</p>	<p>- Too wide a gap could cause the plug to misfire(higher required ignition voltage).                  - Too narrow of a gap could affect idle stability                  - A flat gauge can't accurately measure the spark plug on used plugs</p>
<p><b>DO:</b> When replacing spark plugs with new ones, always use equivalent plugs with same heat range, thread, size, etc....</p>	<p>- Higher heat range plug(hotter plug) could lead to pre-ignition &amp; possible piston damage                  - Lower heat range (colder plug) could lead to cold fouling &amp; emission problem</p>
<p><b>DO:</b> For installing spark plugs follow the following</p>	<p>- If the thread is damage, it prevents a good heat transform from the shell to the cylinder head</p>

<p>steps:</p> <p>1- make sure the cylinder head threads and spark plug threads are clean. Make sure the spark plug thread is free of dings and burrs. If necessary, use a thread chaser and seat cleaning tool.</p> <p>2- Make sure the spark plug gasket seat is clean, then thread the gasket to fit flush against the gasket seat. Tapered seat plugs do not require gaskets</p> <p>3- Screw the spark plugs finger-tight into the cylinder head. Then, use a torque wrench to tighten spark plugs following manufacturer's recommendation).</p> <p>Torque is different for various plug type &amp; cylinder head material</p>	<p>- Do not use any type of anti-seize compound on spark plug threads. Doing this will decrease the amount of friction between the threads. The result of the lowered friction is that when the spark plug is torqued to the proper specification, the spark plug is turned too far into the cylinder head. This increases the likelihood of pulling or stripping the threads in the cylinder head</p> <p>- Over-tightening of a spark plug can cause stretching of the spark plug shell and could allow blowby to pass thru the gasket seal between the shell and insulator. Over-tightening also results in extremely difficult removal</p>
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### 3.12.8 Fuel Pump Module

#### 3.12.8.1 Description and Working Principle

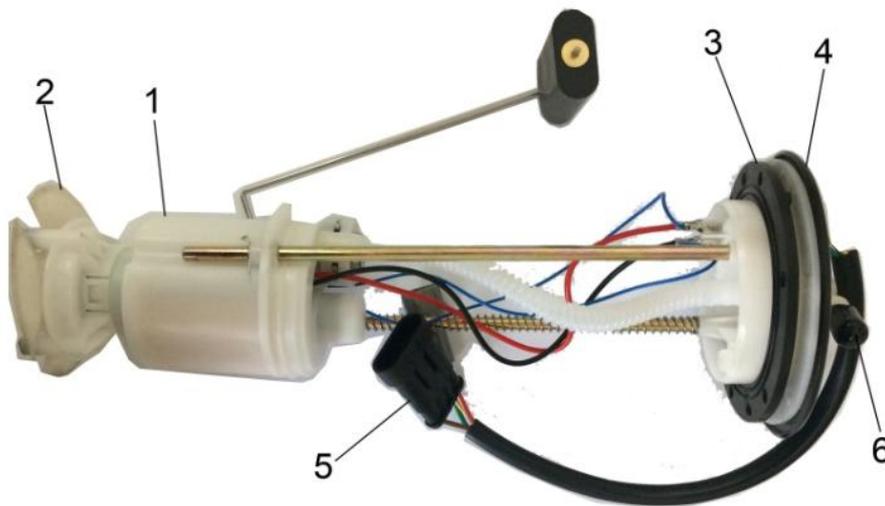
Fuel Pump Module supplies fuel to engine at system pressure. Fuel Pump Module is mounted to fuel tank at bottom and supplies fuel to engine through hoses.

Fuel Pump module consists of Fuel Pump to generate the fuel flow and pressure regulator to regulate the fuel pressure.

#### Fuel Pump

When power is supplied to fuel pump, motor in pump assembly rotates the impeller. Impeller in turn draws the fuel from strainer and pumps the flow to generate the system pressure.

#### 3.12.8.2 Appearance & Components of Fuel Module



- |                   |                   |                         |
|-------------------|-------------------|-------------------------|
| 1. Fuel Pump      | 2. Strainer       | 3. Gasket, Fuel Module  |
| 4. Module Bracket | 5. Module Harness | 6. Fuel Tube (out pump) |

### 3.12.8.3 Dimensions

Fuel Module Cover in elliptical shape with outer edge dimensions as 115mm x 65mm.

### 3.12.8.4 Identification and Markings

Fuel Module, Fuel Pump and Regulator are marked with batch code in Julian Date Code.

On Fuel Module, batch code is mentioned on the label available on fuel module cover.

On Fuel Pump Batch code is engraved on pump body (shell).

On Fuel Pressure Regulator, batch code is engraved on regulator dome area.

### 3.12.8.5 Operating Conditions

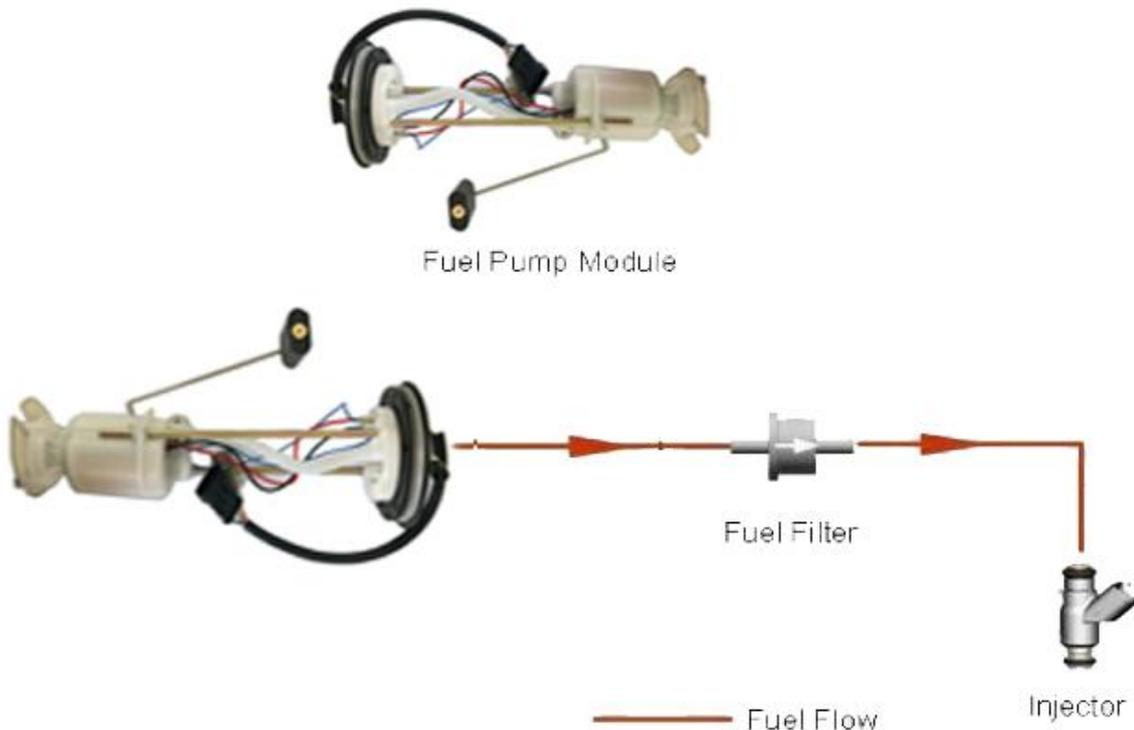
□□ Fuel Pump Module needs to be mounted on Fuel Tank Bottom according to the installation instructions.

□□ Fuel Pump Module is intended to use with gasoline. However if the fuel contains ethanol, please contact vehicle manufacture to check whether the fuel pump module itself can survive or not.

□□ Make sure there is at least 3 liters of gasoline in the fuel tank before priming for first time (do not run the pump dry).

□□ Fuel Hose connections needs to be installed according to the fuel flow diagram shown.

Fuel Flow Description in vehicle fuel system.



### 3.12.8.6 Service Procedure

#### Precautions:

Before attempting any service on fuel system, following cautions should be always followed for personal safety and to avoid system damages.

□□ Disconnect negative cable at battery.

□□ DO NOT smoke, and place 'No SMOKING' sign near work area.

□□ Make sure to have fire extinguisher handy.

□□ Make sure to perform work in well ventilated area and away from any open fire/flames.

□□ Wear Safety glasses.

□□ To relieve fuel vapor pressure in fuel tank, remove fuel filler cap fuel filler neck and then reinstall it.

□□ As fuel lines are at high pressures when the engine is stopped, loosening or disconnecting fuel line

will cause dangerous spout of fuel. Before loosening/disconnecting fuel lines, please follow the “Fuel Pressure Relief Procedure” described in this section.

- Small amount of fuel may drip after the fuel lines are disconnected. In order to reduce the risk of personal injury, cover the pipe/ hose ends with suitable blind with no rust or contamination.
- After servicing, make sure that the fuel hoses and clamps are connected according to the hose fitment instructions given in vehicle instruction manual.
- After servicing, please follow the ‘Fuel Leakage Check Procedure’ described in this section.
- After servicing make sure to fill at least 3 liters gasoline before pump is primed (ignition key should be turned on only after ensuring there is minimum 3 liters of fuel in the fuel tank).

**3.12.8.7 Fuel Module Diagnosis:**

Step	Action	Yes	No
1	Switch on Ignition key. Fuel Pump primes for 3 seconds when the ignition key is ON. Check for fuel pump running noise for 3 seconds after ignition key is ON.	If fuel pump running noise can be heard, go to step 4.	If fuel pump running noise can not be heard, go to step 2.
2	Disconnect fuel module coupler. Check voltage at harness coupler. Is the voltage within 10-14V?	Go to step 3	Check the electrical circuit from Ignition to fuel module.
3	Connect 12V DC power supply (battery) to fuel module. Make sure that enough fuel available in fuel tank to avoid fuel pump running dry. Is the fuel pump running?	1. Check electrical circuit from fuel module to ECU 2. Check ECU	1. Check Fuel Pump Harness integrity 2. Check Fuel Pump
4	Check fuel system pressure at Injector inlet (with a T-joint) while engine is running in idle condition. Is the pressure between 220 ~ 270kPa?	Fuel Module Operation Normal	Go to Step 5
5	Is the Pressure below 220kPa?	1. Check for leakages from hoses, hose joints 2. Check Fuel Pump 3. Check Pressure Regulator	1. Clogged Filter 2. Kink/ Blockage in Fuel Hoses 3. Check Re

**3.12.8.8 Fuel Module Removal:**

- Relieve fuel pressure in fuel lines referring to the ‘Fuel Pressure Relief Procedure’ provided in this section.
- Disconnect negative cable at battery.
- Disconnect fuel module wire coupler.
- Drain the fuel in fuel tank thru fuel filler with help of hand pump (siphon). Collect the fuel in approved container for contamination and safety.
- Disconnect the fuel hoses from fuel module by using standard tools

- Remove the fuel tank from vehicle.
- Place the fuel tank with bottom up condition. Care to be taken not to cause any scratches/ damages on fuel tank.
- Open the fuel module mounting bolts.
- Take out fuel module assembly from fuel tank with care
- Care to be taken not to damage the strainer while removing fuel module from tank.

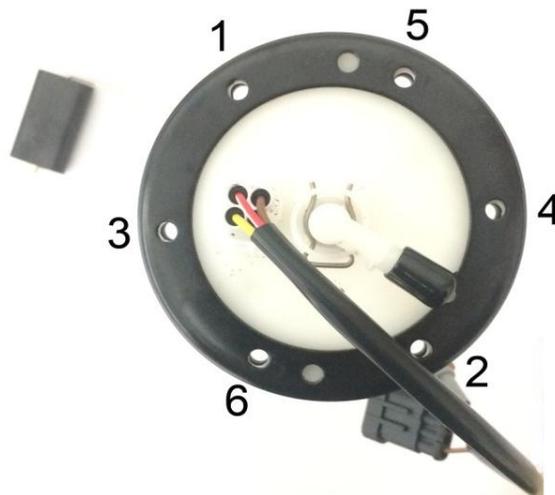
#### 3.12.8.9 Fuel Module Installation:

- Replace the fuel module gasket in fuel module assembly with a new one. Old/ used gaskets can cause leakages.
- Fold strainer towards fuel pump and insert fuel module in tank opening with care. Care should be taken not to cause any damages on strainer.

Fuel Module Orientation: Fuel module bolts not symmetrical and can be mounted only in the intended direction. Regulator side should be facing the Fuel Tank rear side.

Make sure that the fuel tank surface at module mounting area is clean and free of surface defects.

- Place the bolts on module cover and tighten the bolts gradually in star pattern sequence to apply equal compression on gasket. It is shown as below.



Bolt Tightening Torque: 4.4 Nm.

Fuel module is installed with special bolts (step bolts). Use designated bolts only.

Follow the tightening torque and tightening sequence instruction. Over torque and miss-sequence can cause unequal compression of gasket and leakage.

- Install the fuel tank to vehicle.
- Connect for fuel hoses with suitable hose clamps.
- Connect fuel module coupler
- Follow "Fuel Leakage Check Procedure" to check any leakage before the engine is started.

#### 3.12.8.10 Pressure Regulator Assembly Replacement:

- Remove the regulator retainer from module.
- Apply gradual pull force on retainer to avoid any personal injury due to spring action of retainer.
- Take out the pressure regulator assembly from module.
- Do not hit/ damage on the regulator dome and crimping portion.
- Lubricate the O-rings in new pressure regulator assembly with recommended

lubrication oils as mentioned in Table no: 3. Lubrication oil is applied only for ease of regulator assembly.

- Make sure that 2 O-rings (one is bigger diameter the other is smaller diameter) are assembled in pressure regulator.
- Place the pressure regulator on module at regulator pod. Push the regulator gently in the pod.
- Do not hit/ damage on the regulator dome and crimping portion. This will disturb the pressure setting.
- Assemble the retainer on the regulator pod
- Replace the gasket, module with new gasket provided in the kit.

**3.12.8.11 Fuel Pressure Relief Procedure:**

Caution: This work must not be done when engine is hot. If done so, it may cause adverse effect to catalyst (if equipped)

After making sure that engine is cold, relieve fuel pressure as follows.

- Place vehicle gear in 'Neutral'.
- Disconnect fuel module electrical coupler from vehicle harness.
- Start engine and run till it stops due to lack of fuel. Repeat ignition key ON and OFF for 2 ~ 3 times of about 3 seconds each time to relieve fuel pressure in lines. Fuel Connections are now safe for servicing.
- Upon the completion of servicing, Connect Fuel Module Connector to Vehicle Harness

**3.12.8.12 Fuel Leakage Check Procedure:**

After performing any service on fuel system, check to make sure that there are no fuel leakages as below.

- Fill about 3 ~ 5 liters of fuel in tank.
- Turn Ignition key to ON position for 3 seconds (to operate fuel pump) and then turn to OFF position. Repeat this for 3 ~ 4 times to apply fuel pressure in fuel lines.
- In this state, check to see that there are no fuel leakage from any part of fuel system (Fuel Tank, Hoses, Hose Joints, etc)

Handling – DOs and DONTs :

ACTION	REASON
<b>DO NOT:</b> Drop Fuel Module on Floor	Could cause internal damage to Fuel Pump.
<b>DO NOT:</b> Run Fuel Pump Dry (without fuel at pump inlet/ strainer) ensure atleast 3 litres of gasoline is present in the fuel tank	Caused internal damage to Fuel Pump
<b>DO NOT:</b> Damage the strainer during servicing, insertion of fuel module in fuel tank	Contamination enters fuel pump thru damaged strainer damages the Fuel Pump
<b>DO NOT:</b> Disassemble Fuel Pump and regulator internal parts out side Delphi premises. <b>DO NOT:</b> Do any adjustments on pressure regulator and pump except for replacement.	Warranty void.
<b>DO NOT:</b> Use module harness for hold/ carry fuel module.	Wiring Harness Breakage/ Fuel Pump Power disconnection

<b>DO NOT:</b> Pull Wiring Harness in vertical direction to module cover	
<b>DO NOT:</b> Use damaged/ distorted hose clamps	Can cause fuel seepage/ leakage.
<b>DO NOT:</b> Use Fuel Module if the strainer with excessive damage/ cut.	Contamination enters fuel pump thru damaged strainer damages the Fuel Pump
<b>DO NOT:</b> Use Fuel Pump for draining fuel in fuel tank.	Not intended function of fuel module
<b>DO NOT:</b> Use module mounting bolts for mounting other components.	Affects fuel module sealing.
<b>DO NOT:</b> Damage fuel pump harness while servicing fuel module.	Damaged terminals will cause intermittent/ No contact for power supply.
<b>DO NOT:</b> Force hand pump towards fuel module while draining fuel from tank.	To avoid any damages on fuel module
<b>DO :</b> Ensure that there are no damages to fuel pipes while servicing fuel module	Can cause fuel seepage/ leakage.
<b>DO:</b> Use genuine module gasket only.	Spurious gaskets can cause leakages
<b>DO:</b> Use designated hose clamps.	To ensure no leakages/ seepages thru hose joint.
<b>DO:</b> Clamp fuel module harness to vehicle chassis	Clamp provides mechanical support for wiring harness in vibrations.
<b>DO:</b> Use only standard gasoline for operating vehicle/ module	Fuel Module is intended to run in standard gasoline. Adulterated fuel can cause fuel module premature failures which are not covered under warranty.
<b>DO:</b> Change the fuel filter at recommended intervals.	Clogged fuel filter will cause restriction in fuel flow and can cause flow reduction.
<b>DO:</b> Use fuel filters supplied/ recommended fuel filters only.	Spurious fuel filters causes damages to injector, regulator and fuel pump performance.
<b>DO:</b> Ensure that the hoses are routed properly and there are no kinks / rubbing with other components.	Improper routing, kinks and fouling of hoses with other components causes hose damage
<b>DO :</b> Ensure that always sufficient fuel till the strainer height	Avoids Pump running in dry
<b>DO:</b> Replace two O-rings along with replacement/ re-installation of pressure regulator.	For proper functioning of regulator
<b>DO:</b> Use care during connection of harness to module coupler.	Avoid terminal damage.
<b>DO:</b> Return any dropped, damaged, or suspect material with a tag that describes the problem.	Ensure fast and correct diagnosis of root cause.

**3.12.9 Diagnostic Tools**

**3.12.9.1 Mot or Scanner ( for MT05 EMS)**

**3.12.9.1.1 P r e c a u t i o n s**

□□Motor-Scanner is a precision instrument and should be protected from vibration and impact.

- If the unit does not run correctly or the screen is unstable when first turned on, disconnect it from the main lead and try again.
- Make sure the DLC is always firmly inserted into the diagnostic socket.
- Never test electrical signals that exceed the limit of specifications.
- Test cannot be performed by the person who is driving the car.
- This unit should be used and stored in the following conditions:

Ambient temperature: 0~50°C

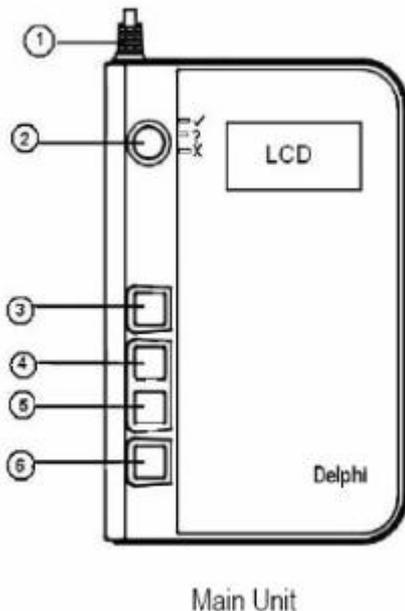
Relative humidity: <90%

### 3.12.9.1.2 .Co n f i g u r a t i o n s

Delphi Motor scanner consists of 2 main part: the main units (with diagnostic main cable) and diagnostic connector link (one end is 6PIN connector; the other is the interface for connecting diagnostic main cable). They are shown in figure 34 as below.



### Out l i n e o f M a i n U n i t



The 6 PIN diagnostic connector link cable and USB type main unit's software update cable are in the delivered package.

1	Diagnostic Cable	To connect the unit and vehicle socket for diagnosis
2	reserved Key	The Key is reserved for future
3	←← Key	To return to the previous interface.
4	[↑] Key	To move the cursor to upper item in the menu
5	[↓] Key	To move the cursor to down item in the menu
6	[↵] Key	To confirm and execute this operation.

Screen:

128×64 array high definition screen with back light for displaying all the information during testing.

Keyboard:

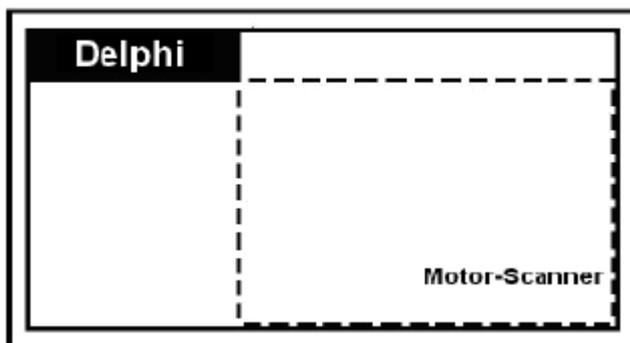
There are 5 keys (one is reserved) on the main unit for selecting and controlling test steps.

3.12.9.1.3 . Preparations Connection

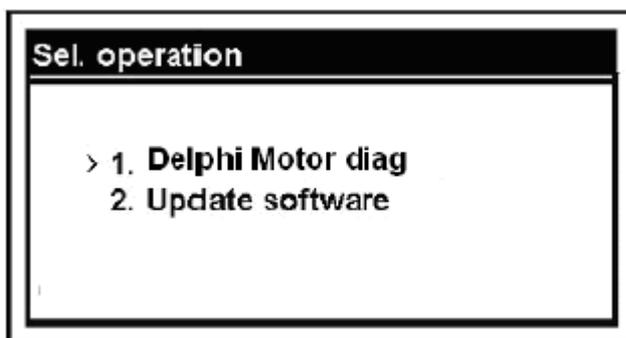
- Find the 6PIN diagnostic socket on the motor.
- Connect one end of the diagnostic main cable to the main unit, and the other end to diagnostic socket on the motor, tighten the screws.

Normal Power – on Display

When power is on normally, the unit will display:



Seconds later, the unit will display:

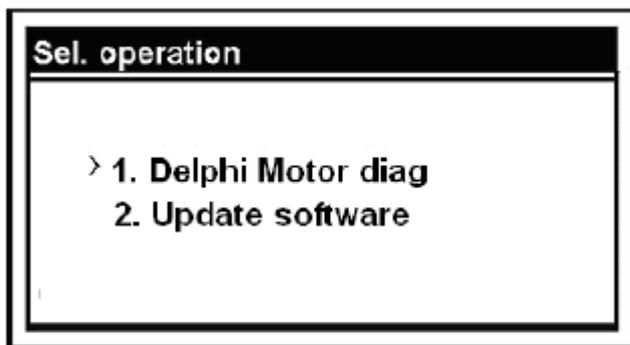


3.12.9.1.4 . F u n c t i o n s

Delphi Motor-Scanner can be used to diagnose Delphi Engine Management System with functions: Read DTC, Clear DTC, Data Stream, Status Stream, and Record Data.

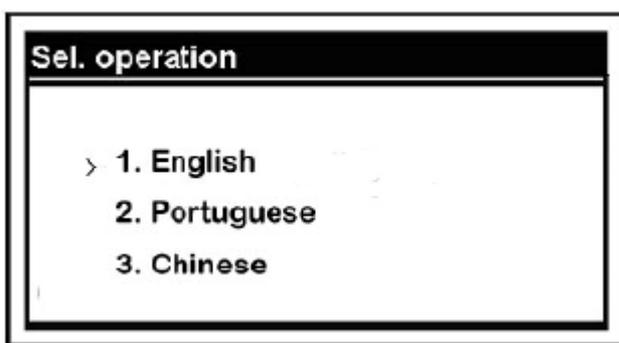
Operations

When the unit is powered up, the screen will display the interface as below.

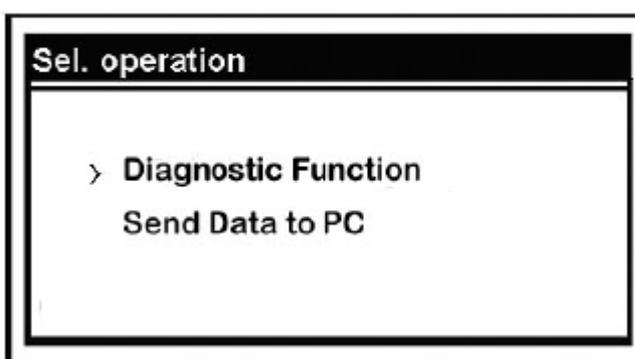


Here, we take diagnostic function for demonstration.

Select 1 and press  key, it will display an interface for language selection, as shown below:



Select 'English' and press  key, it will display information about the diagnostic software version, press  to continue, the interface will display as below:

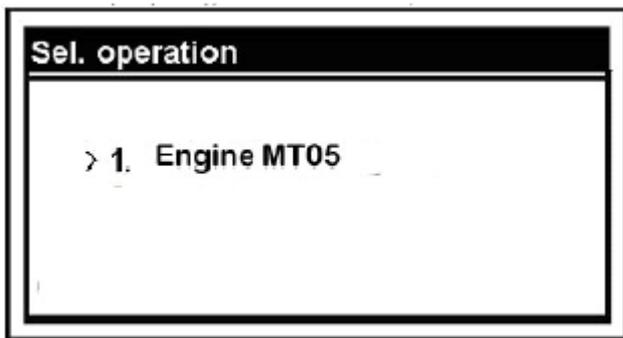


### Diagnostic Function

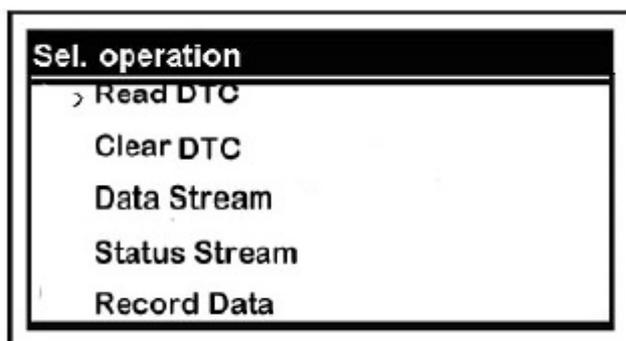
Here, we take 'diagnostic function' for demonstration.

Select 'diagnostic function' and press , the screen will display an interface to indicate 'Delphi-3' diagnostic connector should be used.

Press , the screen will display engine information as below:



Press [↵] , with 'accessing system' fleeting on the screen, then, it will display as below:



Available functions are as follows:

- Read DTC
- Clear DTC
- Data Stream
- Status Stream
- Record Data

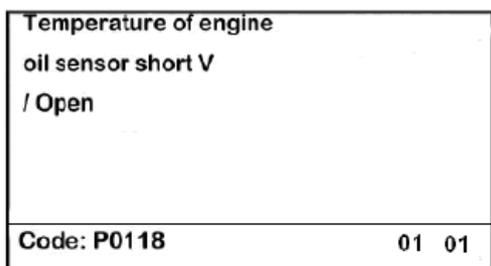
Press [↑] or [↓] key to select function you needed.

1. Read DTC

Select 'Read DTC', and press [↵] , it will display fault code as below:

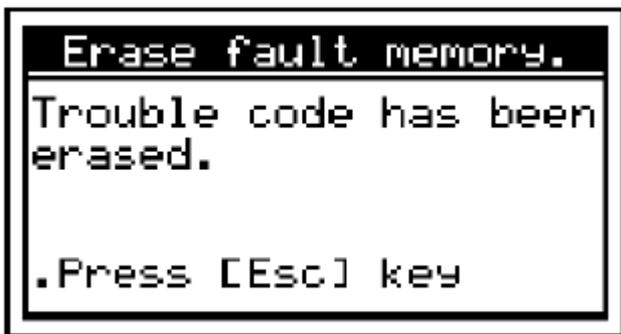
Power Train System		
● P0118	P0113	P0122
P0201	P0650	P0135
P0351		

Press [↑] or [↓] key to move '.' icon, and select fault code, take 'P0118' for example, it's selected when there is '.' in front of it, press [↵] , the screen will display detailed information of the code, as below:



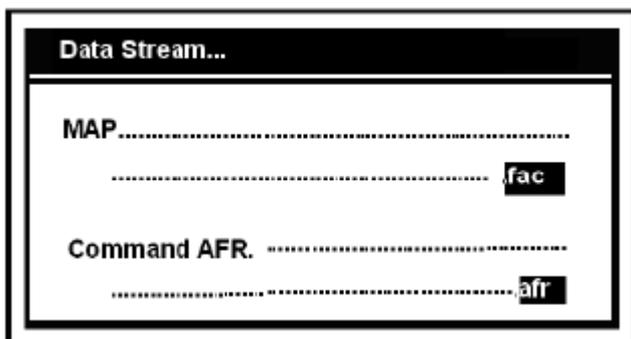
2. Clear DTC

Select 'Clear DTC' and press **[↵]**, it will display as below:



3. Data Stream

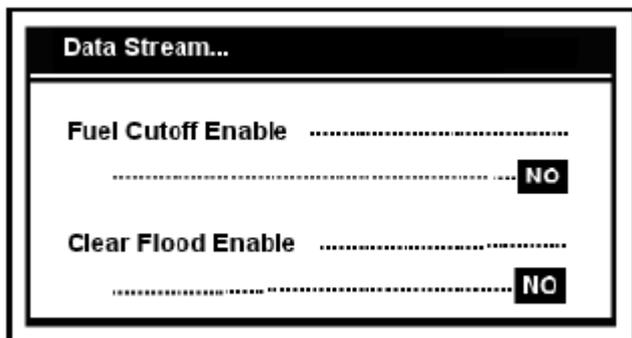
Select 'Data Stream' and press **[↵]**, it will display as below:



Press **[↑]** or **[↓]** key for page up/down to view more. Press **[⏪]** key to exit.

4. Status Stream

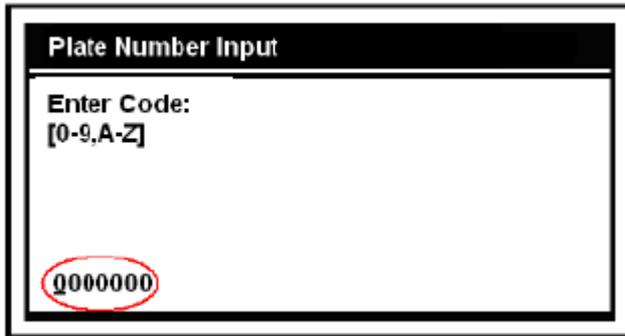
Select 'Status Stream' and press **[↵]**, the interface will display as below:



Press **[↑]** or **[↓]** key for page up/down to view more. Press **[⏪]** key to exit.

5. Record Data

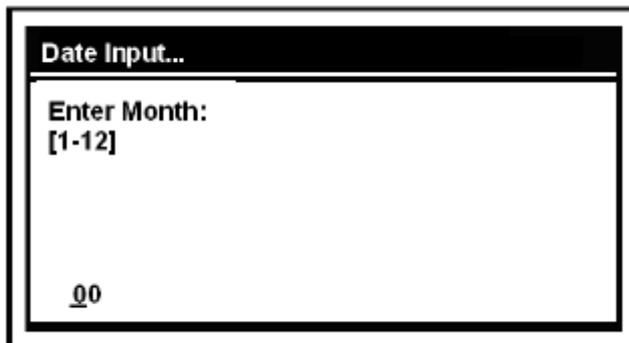
Select 'Record Data' and press [↵], it will display:



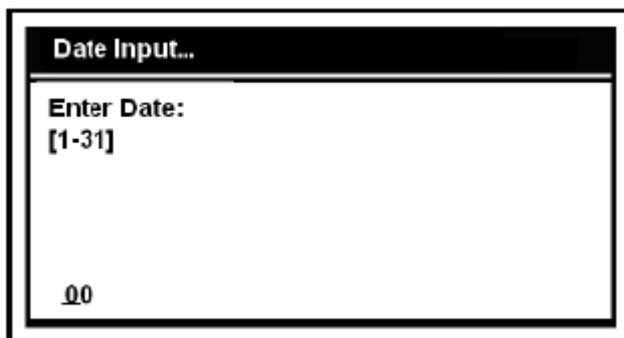
Press [↑] or [↓] key to enter code, when the first number of the code was set, press [↵] to confirm and continue to input the sequent numbers, till all the 7 numbers were input.

When all the 7 numbers were set, press [↵], the screen will display a message for confirmation of the Plate Number input. Press [⏪] to return to the previous interface to input the code again or press [↵] to confirm the code.

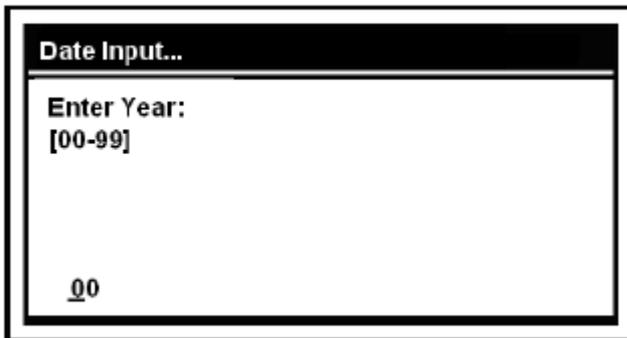
Press [↵], another interface will be displayed for you to input date, as below:



It's the same way to enter month as vehicle code input. Month was input, then enter date, as below:

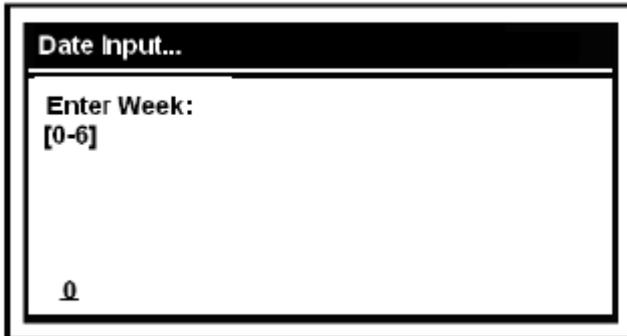


Then, 'Enter Year' continues, as below:



The screenshot shows a rectangular window with a black header bar containing the text "Date Input...". Below the header, the text "Enter Year:" is displayed, followed by "[00-99]" in a smaller font. At the bottom left of the window, the number "00" is shown, indicating the current input.

After that, 'Enter Week' follows, as below:



The screenshot shows a rectangular window with a black header bar containing the text "Date Input...". Below the header, the text "Enter Week:" is displayed, followed by "[0-6]" in a smaller font. At the bottom left of the window, the number "0" is shown, indicating the current input.

Till now, the 'date input' was completed, and it starts to record data, press [⏪] to stop recording.

- Check malf code meaning by reading the below table.

Malf code in MT05	Description
<b>P0107</b>	MAP Circuit Low Voltage or Open
<b>P0108</b>	MAP Circuit High Voltage
<b>P0112</b>	IAT Circuit Low Voltage
<b>P0113</b>	IAT Circuit High Voltage or Open
<b>P0117</b>	Coolant/Oil Temperature Sensor Circuit Low Voltage
<b>P0118</b>	Coolant/Oil Temperature Sensor Circuit High Voltage or Open
<b>P0122</b>	TPS Circuit Low Voltage or Open
<b>P0123</b>	TPS Circuit High Voltage
<b>P0131</b>	O2A Circuit Low Voltage
<b>P0132</b>	O2A Circuit High Voltage
<b>P0031</b>	O2A Heater Circuit High Voltage
<b>P0032</b>	O2A Heater Circuit Low Voltage
<b>P0201</b>	Injector 1 Circuit Malfunction
<b>P0202</b>	Injector 2 Circuit Malfunction
<b>P0230</b>	FPR Coil Circuit Low Voltage or Open
<b>P0232</b>	FPR Coil Circuit High Voltage
<b>P0336</b>	CKP Sensor Noisy Signal
<b>P0337</b>	CKP Sensor No Signal
<b>P0351</b>	Cylinder 1 Ignition Coil Malfunction
<b>P0352</b>	Cylinder 2 Ignition Coil Malfunction
<b>P0505</b>	Idle Speed Control Error
<b>P0562</b>	System Voltage Low
<b>P0563</b>	System Voltage High
<b>P0650</b>	MIL Circuit Malfunction
<b>P1693</b>	Tachometer Circuit Low Voltage
<b>P1694</b>	Tachometer Circuit High Voltage

**NOTES**

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