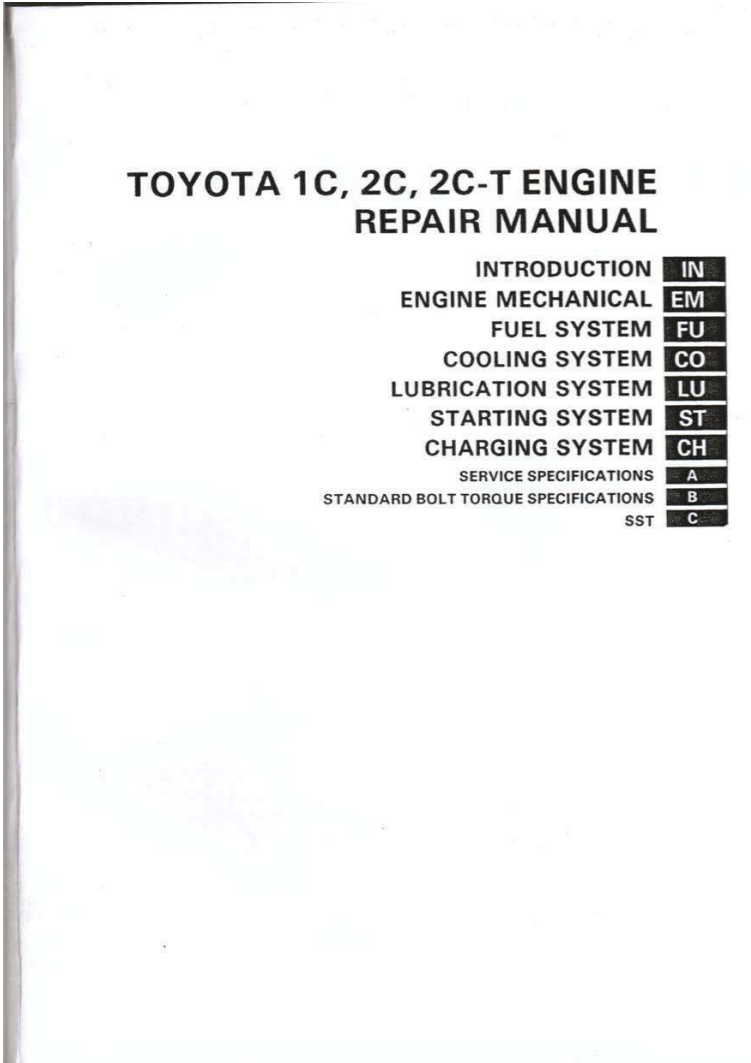
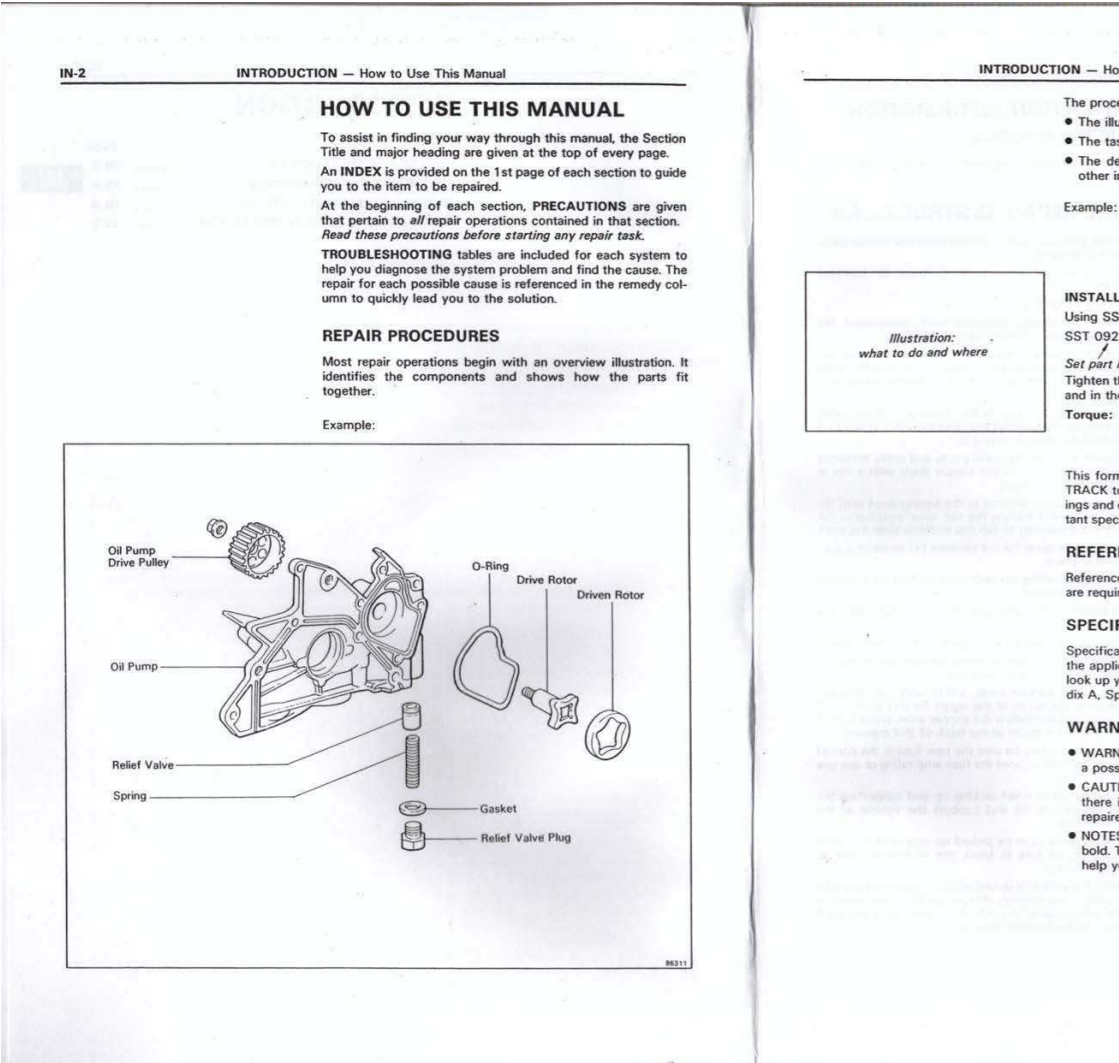
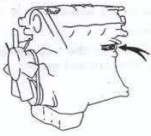






IN-4INTRODUCTION — Identification Information, General Repair Instructions	INTRODUCTION — General Information
 IDENTIFICATION INFORMATION ENGINE SERIAL NUMBER The engine serial number is stamped on the left side of the cylinder block. GENERAL REPAIR INSTRUCTIONS 1. Use fender, seat and floor covers to keep the vehicle clean and prevent damage. 2. During disassembly, keep parts in order to facilitate reassembly. 3. Observe the following: (a) Before performing electrical work, disconnect the negative cable from the battery terminal. (b) If it is necessary to disconnect the battery for inspection or repair, always disconnect the cable from the negative (–) terminal which is grounded to the vehicle body. (c) To prevent damage to the battery terminal post, loosen the terminal nut and raise the cable straight up without twisting or prying it. (d) Clean the battery terminal posts and cable terminals with a shop rag. Do not scrape them with a file or other abrasive object. (e) Install the cable terminal to the battery post with the nut loose, and tighten the nut after installation. Do not use a hammer to tap the terminal onto the post. (f) Be sure the cover for the positive (+) terminal is properly in place. 4. Check hose and wiring connectors to make sure that they are secure and correct. 5. Always replace cotter pins gaskets and O-rings with new ones. 6. When necessary, use sealer on gaskets to prevent leaks. 7. Carefully observe all specifications for bolt tightening torques. Always use a torque wrench. 8. Use of special service tools (SST) may be required, depending on the nature of the repair. Be sure to use SST where specified and follow the proper work procedure. A list of SST can be found at the back of this manual. 9. When replacing fuses, be sure the new fuse is the correct amperage. DO NOT exceed the fuse amp rating or use one of a lower rating. 10. Care must be taken when jacking up and supporting the vehicle. Be sure to lift and support the vehicle at the proper locations. (a) If the vehicle is to be jacked up only at the front or rear end, be sure to block the wheels in order to ensure safety. (b) After the vehicle is jacked up, be sure to support it on stands. It is extremely dangerous to do any work on the vehicle raised on jack alone, even for a small job that can be finished quickly.	11. Observe the following: (a) (b) (c) (d) (e) (f) (g) 12. After the repair is completed, check the following: (a) (b) (c)

IN-6

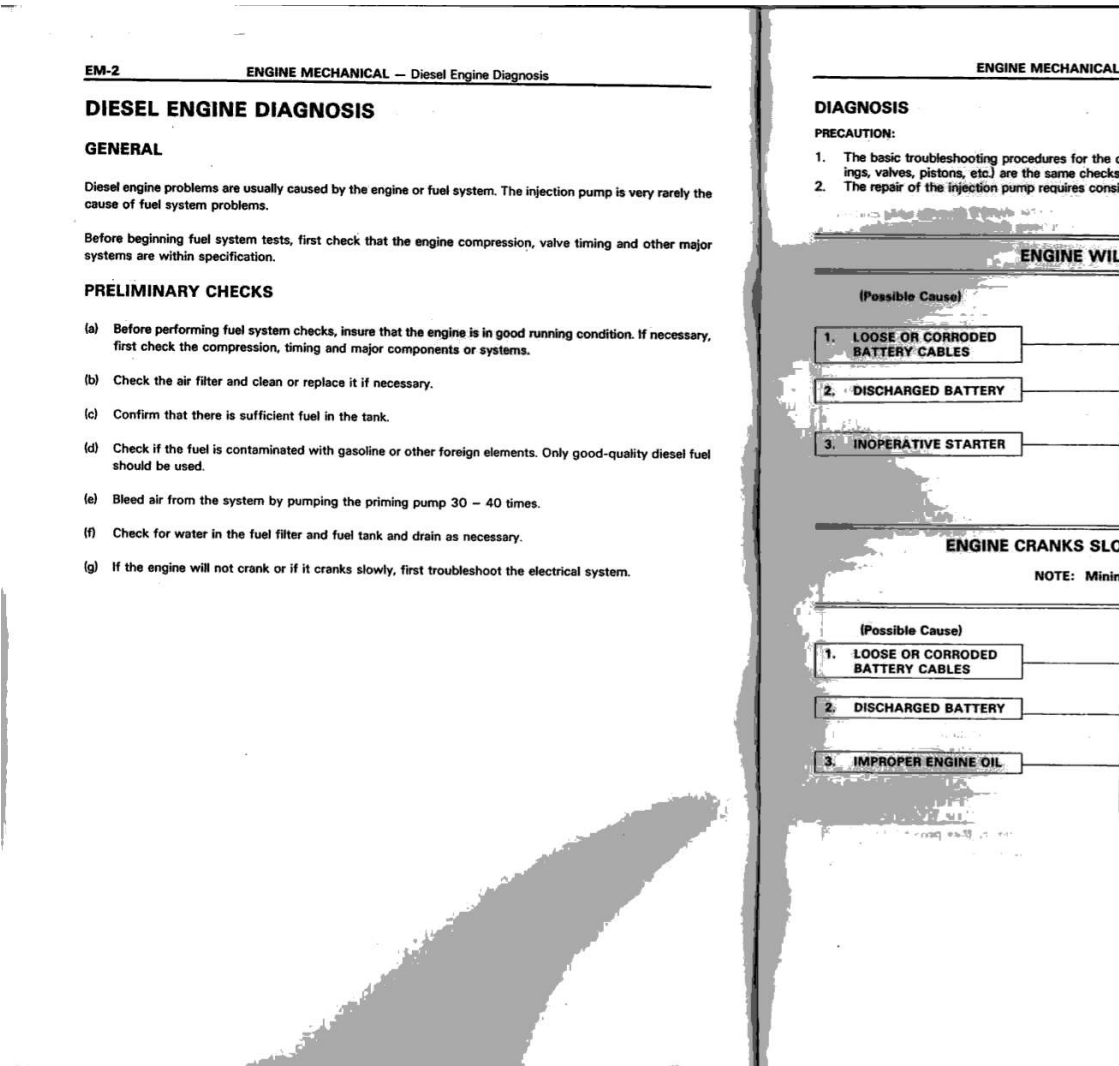
INTRODUCTION — Abbreviations Used in This Manual

ABBREVIATIONS USED IN THIS MANUAL

A/C	Air Conditioner
A/T	Automatic Transmission
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
EX	Exhaust
FF	Front Engine Front Drive
FR	Front Engine Rear Drive
HAC	High Altitude Compensator
IN	Intake
LH	Left-hand
LHD	Left-hand Drive
MP	Multipurpose
OPT	Option
O/S	Oversize
PCV	Positive Crankcase Ventilation
PS	Power Steering
RH	Right-hand
RHD	Right-hand Drive
SST	Special Service Tool
STD	Standard
TDC	Top Dead Center
U/S	Undersize
w/	With
w/o	Without

ENGINE

DIESEL ENG
DIESEL ELE
TURBOCHAI
TURBOCHAI
DIAGNOS
ENGINE TUR
COMPRESSI
TIMING BEL
TURBOCHAI
CYLINDER H
CYLINDER E



EM-4

ENGINE MECHANICAL — Diesel Engine Diagnosis

ENGINE CRANKS NORMALLY BUT WILL NOT START

(Possible Cause)

(Check Procedure and Correction Method)

1. NO FUEL TO NOZZLE HOLDER

Loosen any one injection pipe union nut from its nozzle holder.
Crank the engine for about 5 seconds while confirming that fuel is being discharged from the pipe.
If fuel is coming out, begin diagnosis from item 4.
If not, begin from item 2.

2. NO FUEL CUT SOLENOID OPERATION

With starter switch turned ON, check for fuel cut solenoid operation noise (clicking sound) while repeatedly connecting and disconnecting fuel cut solenoid.
If no noise, check if there is battery voltage to the solenoid when the starter switch is ON.
If battery voltage is confirmed, fuel cut solenoid is faulty and should be replaced. If no voltage, refer to ELECTRICAL DIAGNOSIS and make necessary repairs.

3. NO FUEL INTO INJECTION PUMP

Disconnect inlet hoses to fuel filter and feed clean fuel from separate container directly into pump.
If engine starts, either the fuel filter or line between fuel tank and filter is clogged and should be repaired accordingly.
If engine still does not start (no fuel intake), check fuel line between filter and pump.
If normal, pump is faulty and should be replaced.
NOTE: When feeding fuel directly into pump, keep container at same level as vehicle fuel tank.

4. INOPERATIVE PRE-HEATING OPERATION

With starter switch ON and the glow plug indicator lamp illuminated, check that there is voltage applied to the glow plugs.
If not, refer to ELECTRICAL DIAGNOSIS and repair as necessary.

5. FAULTY GLOW PLUG OPERATION

Check glow plug continuity (See page ST-6).
If no continuity, a broken wire is indicated and glow plug should be replaced.

6. FUEL LEAKAGE FROM INJECTION PIPE

Check for loose unions or cracks.
If leaking, tighten to specified torque or, if necessary, replace pipe(s).

ENGINE MECHANICAL

7. IMPROPER INJECTION TIMING

8. IMPROPER COLD START ADVANCE AND FAST IDLE

9. FAULTY NOZZLE OR NOZZLE HOLDER

ROUGH IDLE WITH

(Possible Cause)

1. IMPROPER ADJUSTMENT OF ACCELERATOR CABLE

2. IDLE SPEED TOO LOW

3. FUEL LEAKAGE

EM-6ENGINE MECHANICAL — Diesel Engine Diagnosis

4. IMPROPER INJECTION TIMING

Refer to item 7 of ENGINE CRANKS NORMALLY BUT WILL NOT START, above.

5. IMPROPER OPERATION OF NOZZLE OR DELIVERY VALVE

With engine idling, loosen the injection pipe to each cylinder in order, and check if the idle speed changes.

If no change, a faulty cylinder is indicated. Check according to following procedure.

- Faulty Nozzle or Nozzle Holder

Check nozzle with nozzle tester. (See page FU-6)

Opening pressure: 135 — 155 kg/cm²
(1,920 — 2,205 psi)
(13,239 — 15,200 kPa)

If pressure is not within specification, nozzle is faulty and injection pressure should be readjusted. (See page FU-8)

- Faulty Delivery Valve

If injection pressure is within specification, delivery valve is defective and should be replaced.

ENGINE SUDDENLY STOPS

(Possible Cause)

(Check Procedure and Correction Method)

1. ENGINE WILL NOT RE-START

Check to see if engine re-starts according to prescribed procedure.

If not, refer to ENGINE CRANKS NORMALLY BUT WILL NOT START, above, and repair as necessary.

2. ROUGH IDLE

If idle is not stable, refer to ROUGH IDLE WITH WARM ENGINE and repair accordingly.

3. MALFUNCTION OF FUEL-CUT SOLENOID

Refer to ENGINE CRANKS NORMALLY BUT WILL NOT START, above, and check accordingly.

NOTE: No operation noise from the fuel cut solenoid may be due to loose electrical connections, so check connectors before proceeding with further repairs.

4. NO FUEL INTO INJECTION PUMP

Refer to item 3 of ENGINE CRANKS NORMALLY BUT WILL NOT START, above.

ENGINE MECHANICAL

LACK OF

NOTE:

1. First confirm that the air cleaner is not clogged.

2. Not applicable if the customer desires an engine with a higher idle speed.

For accuracy, adjust with a chassis dynamometer.

(Possible Cause)

1. IMPROPER ACCELERATOR CABLE ADJUSTMENT

2. INSUFFICIENT MAXIMUM SPEED

3. INTERCHANGED OVERFLOW SCREW (OUT) AND INLET (NO MARK) FITTING

4. FUEL LEAKAGE

5. CLOGGED FUEL FILTER

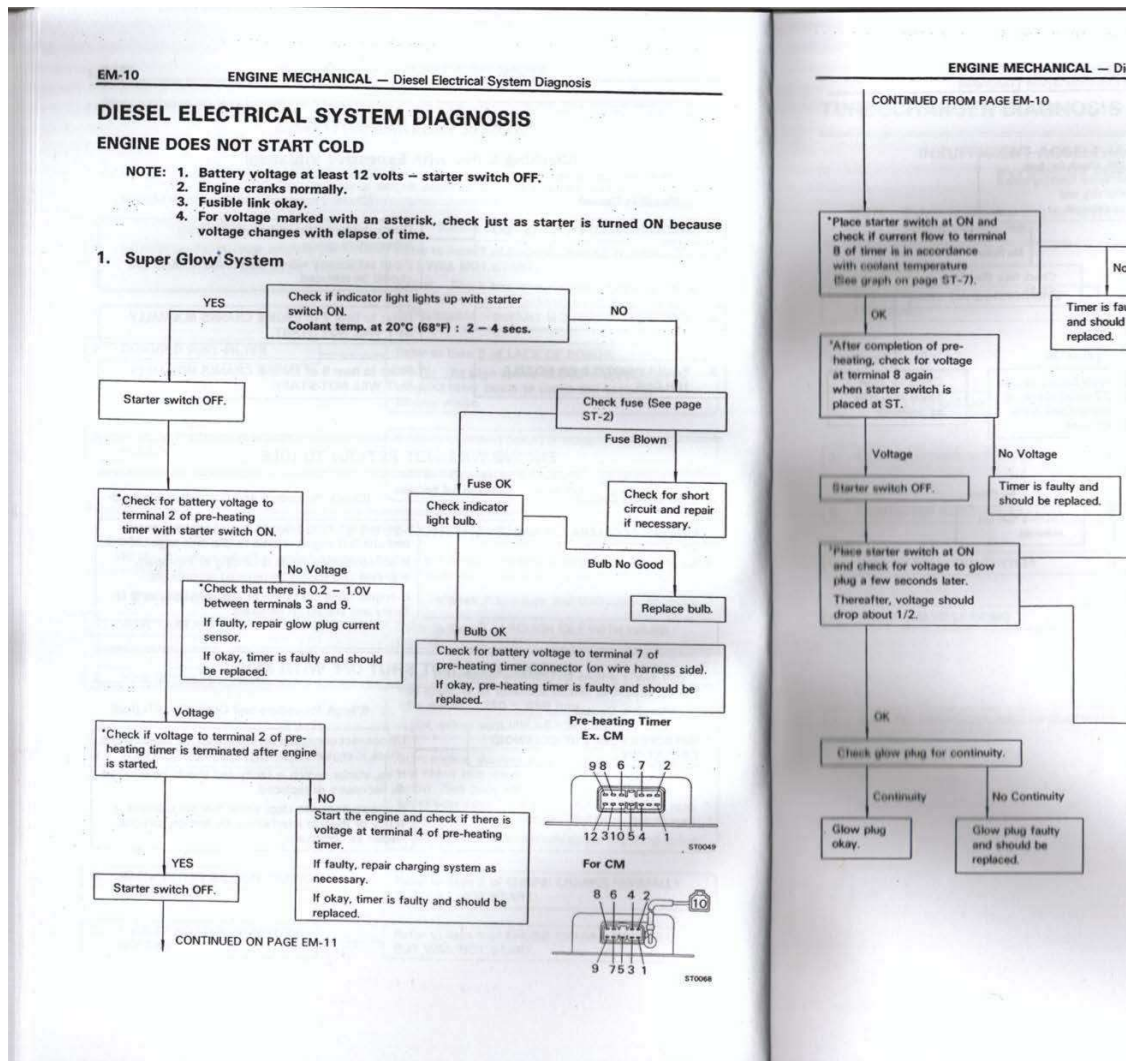
6. IMPROPER INJECTION TIMING

7. FAULTY NOZZLE OR NOZZLE HOLDER

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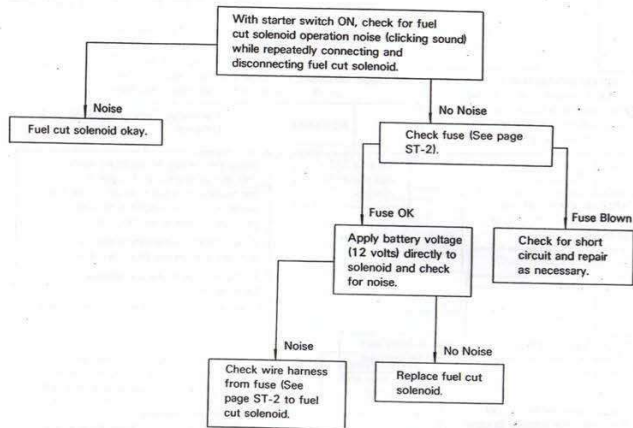
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EM-8	ENGINE MECHANICAL — Diesel Engine Diagnosis	ENGINE MECHANIC
EXCESSIVE EXHAUST SMOKE		ENGINE NOISE
NOTE:		(Clanking Noise with
1. Confirm that the air cleaner is not clogged. 2. Confirm with the customer whether or not oil consumption has been excessive.		)
(Possible Cause)	(Check Procedure and Correction Method)	(Possible Cause)
1. IMPROPER INJECTION TIMING	Refer to item 7 of ENGINE CRANKS NORMALLY BUT WILL NOT START. NOTE: Black smoke indicates advanced timing while white smoke indicates retarded timing. Adjustments should be made accordingly.	1. COOLANT TEMPERATURE TOO LOW
2. CLOGGED FUEL FILTER	Refer to item 5 of LACK OF POWER. NOTE: At high speed (2,000 – 3,000 rpm), a clogged filter tends to make the exhaust smoke white.	2. IMPROPER INJECTION TIMING
3. FAULTY NOZZLE OR NOZZLE HOLDER	Refer to item 9 of ENGINE CRANKS NORMALLY BUT WILL NOT START. NOTE: Excessive exhaust smoke is often caused by nozzle pressure being too low.	3. FAULTY NOZZLE OR NOZZLE HOLDER
EXCESSIVE FUEL CONSUMPTION		ENGINE WILL NOT
NOTE: Confirm whether clutch slipping, brakes grabbing, tires wrong size or air filter clogged.		(Possible Cause)
(Possible Cause)	(Check Procedure and Correction Method)	BINDING ACCELERATOR CABLE
1. FUEL LEAKAGE	Refer to item 3 of ROUGH IDLE WITH WARM ENGINE.	ENGINE WILL NOT
2. IDLE SPEED TOO HIGH	After sufficiently warming up engine, check that idle speed is as specified below. (See page EM-23) Idle speed: CV 750 – 850 rpm If not, adjust with idle adjusting screw.	(Possible Cause)
3. MAXIMUM SPEED TOO HIGH	Start engine, depress accelerator pedal to floor and check that maximum speed is as specified below. (See page EM-23) Maximum speed: CV 5,100 – 5,200 rpm Others 5,300 – 5,400 rpm If not, adjust with maximum speed adjusting screw.	IMPROPER FUEL CUT-SOLENOID OPERATION
4. IMPROPER INJECTION TIMING	Refer to item 7 of ENGINE CRANKS NORMALLY BUT WILL NOT START.	
5. FAULTY NOZZLE OR NOZZLE HOLDER	Refer to item 9 of ENGINE CRANKS NORMALLY BUT WILL NOT START.	



EM-12 ENGINE MECHANICAL — Diesel Electrical System Diagnosis

2. Fuel Cut Solenoid



ENGINE MECHANICAL

TURBOCHARGER DIAGNOSIS

**INSUFFICIENT ACCELERATION
EXCESSIVE FUEL**

NOTE: Before troubleshooting the turbocharger, check injector timing, etc.

(Possible Causes)

1. INSUFFICIENT TURBOCHARGING PRESSURE
2. RESTRICTED INTAKE AIR SYSTEM
3. LEAK IN INTAKE AIR SYSTEM
4. RESTRICTED EXHAUST SYSTEM
5. LEAK IN EXHAUST SYSTEM
6. RELIEF VALVE LEAKING
7. ERRATIC TURBOCHARGER OPERATION

EM-14ENGINE MECHANICAL — Turbocharger Diagnosis

ABNORMAL NOISE

(Possible Cause)

(Check Procedure and Correction Method)

1. TURBO INSULATOR RESONNANCE

Check for loose, improperly installed or deformed insulator mount bolts, and repair or replace as necessary.

2. EXHAUST PIPE LEAKING OR VIBRATING

Check for deformed exhaust pipe, loose mount bolts or damaged gasket, and repair or replace as necessary.

3. ERRATIC TURBOCHARGER OPERATION

Refer to item 7 of INSUFFICIENT ACCELERATION, LACK OF POWER OR EXCESSIVE FUEL CONSUMPTION.

EXCESSIVE OIL CONSUMPTION OR WHITE EXHAUST

(Possible Cause)

(Check Procedure and Correction Method)

FAULTY TURBOCHARGER SEAL

Check for oil leakage in exhaust system.

Remove the turbine elbow from the turbocharger and check for excessive carbon deposits on the turbine wheel. Excessive carbon deposits would indicate a faulty turbocharger.

Check for oil leakage in intake air system.

Check for axial play in impeller wheel, and replace the turbocharger if necessary. (See page EM-43).

CAUTION: There is some oil mist from the PCV in the blowby gas so care must be taken not to diagnosis this as an oil leakage from the turbocharger.

ENGINE MECHANICAL — Turbo

TURBOCHARGER ELECTRICAL

Troubleshooting of Turbocharger Indica

Do both green indicator light and amber warning light light when ignition switch is turned ON?

NO

Are indicator and warning lights out during engine idle?

YES

Both lights stay on

Is discharge warning light out?

Green light stays on

Check for open circuit in wire l low pressure switch and combi

Amber light comes on

Check for open circuit in wire harness betw and combination meter and check for grou

YES

Does green indicator light come on when 0.14 kg/cm² (2.0 psi, 14 kPa) pressure is applied to both pressure switches?

NO

Check for short circuit in wire pressure switch and combina

Amber light comes on

Does green indicator light come on when (10.4 psi, 72 kPa) pressure applied to b

YES

Does amber indicator light come on when 0.73 kg (10.4 psi, 72 kPa) pressure applied to both switc

NO

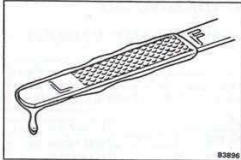
Check for short circuit in wire pressure switch and combina

YES

Turbocharger indicator and warning light operation okay.

EM-16

ENGINE MECHANICAL — Engine Tune-up

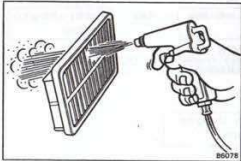


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ENGINE TUNE-UP

CHECK OIL LEVEL

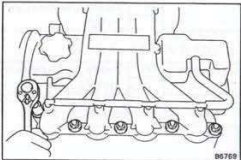
The oil level should be between the "L" and "F" marks on the level gauge.
If low, check for leakage and add oil up to the "F" mark.



95075

CHECK AIR FILTER

(a) Visually check that the air filter element is not excessively dirty, damaged or oily.
If necessary, replace the air filter element.
(b) Clean the element with compressed air.
First blow from the inside thoroughly. Then blow off the outside of the element.

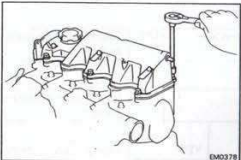


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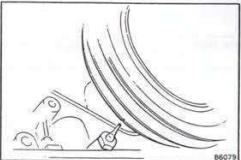
INSPECTION AND ADJUSTMENT OF VALVE CLEARANCE

NOTE: Check and adjust the valve clearance while the engine is cold.

1. REMOVE NO. 2 AIR INTAKE MANIFOLD (CE 70)
(See step 1 on page EM-48)
2. REMOVE TWO BOLTS FROM NO. 2 TIMING COVER
3. REMOVE CYLINDER HEAD COVER
Remove the six nuts and seal washers, and pull out the head cover with the gasket.



EM0378



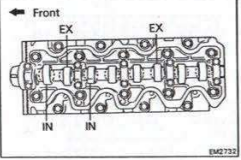
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4. MEASURE VALVE CLEARANCE

(a) Set the No. 1 cylinder to TDC/compression.

- Turn the crankshaft pulley and align its groove with the timing pointer on the oil pump.
- Check that the valve lifters on the No. 1 cylinder are loose and valve lifters on the No. 4 are tight.
If not, turn the crankshaft one complete revolution.

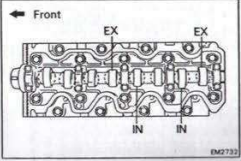
ENGINE MECHANICAL



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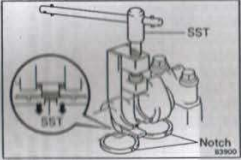
(b)

Val



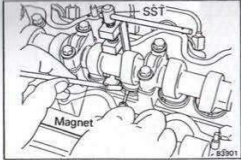
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(c)



SST
Notch
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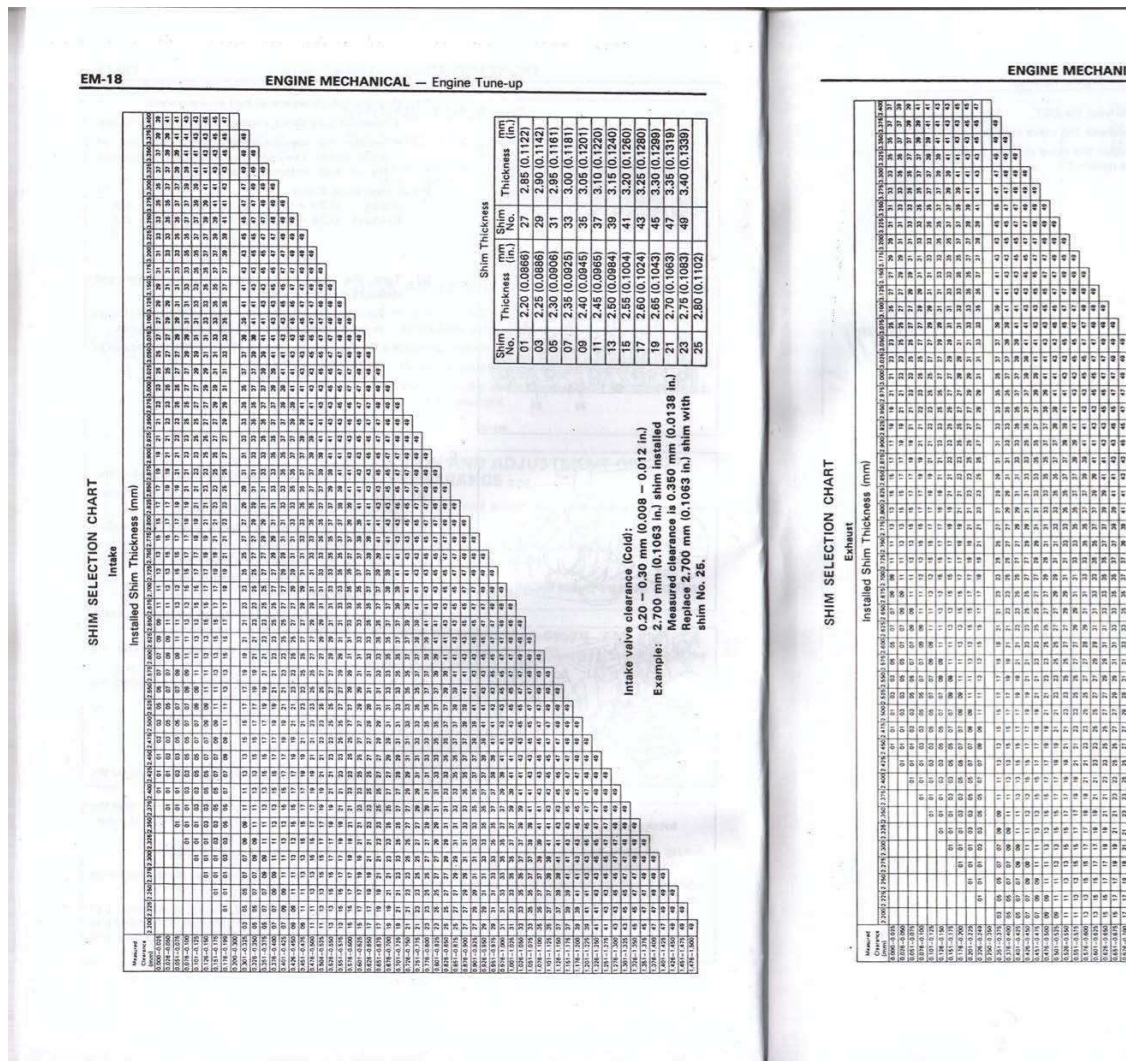
5. AD
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(a)
(b)
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SS
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ev
(d)
(e)



SST
Magnet
93901

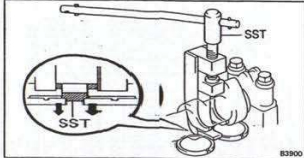
Intake side:
New shim thickness
= T + [A - 0.25 mm
(0.0098 in.)]
Exhaust side:
New shim thickness
= T + [A - 0.30 mm
(0.0118 in.)]

NC
O/
3.
sh



EM-20

ENGINE MECHANICAL — Engine Tune-up



(f) Remove the SST.
(g) Recheck the valve clearance.
(h) Adjust the valve clearance of the remaining cylinders as required.

6. INSTALL CLINDER HEAD COVER
(See step 3 on page EM-67)

7. INSTALL TWO BOLTS TO NO. 2 TIMING COVER

8. INSTALL NO. 2 AIR INTAKE MANIFOLD (CE70)

INSPECTION AND ADJUSTEMENT OF INJECTION TIMING

1. INSTALL PLUNGER STROKE MEASURING TOOL (SST) AND DIAL INDICATOR

(a) Remove the distributive head plug bolt from the injection pump.
(b) Install SST and the dial indicator to the distributive head plug hole.
SST 09275-54010

2. SET NO. 1 OR NO. 4 CYLINDER TO ABOUT 25 – 30° BTDC/ COMPRESSION

Turn the crankshaft pulley clockwise so the pulley groove is 25 – 30° from the oil pump pointer.

3. RELEASE COLD STARTING SYSTEM

(a) Using a screwdriver, turn the cold starting lever counterclockwise about 20° as shown.
(b) Put a metal plate 8.5 – 10 mm (0.33 – 0.39 in.) thick between the cold starting lever and thermo wax plunger.

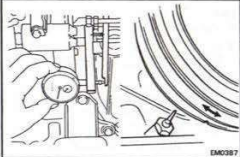
Diagram showing the installation of the SST and dial indicator to the distributive head plug hole. The SST is labeled and shown being installed. Part number B63600 is indicated.

Diagram showing the crankshaft pulley being turned clockwise to set the cylinder to about 25 – 30° BTDC/ COMPRESSION. The pulley groove is shown being aligned with the oil pump pointer. Part number B63600 is indicated.

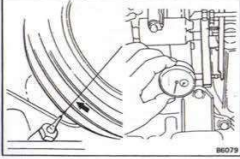
Diagram showing the cold starting lever being turned counterclockwise about 20° using a screwdriver. A metal plate 8.5 – 10 mm thick is shown being placed between the cold starting lever and thermo wax plunger. Part number B63600 is indicated.

ENGINE MECHANICA

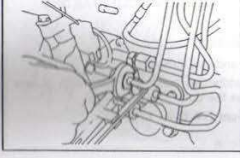
4. CHEI
(a)
(b)



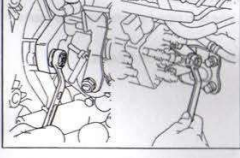
(c)
(d)
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5. ADJ
(a)

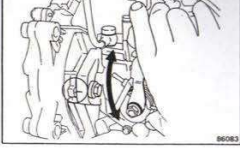


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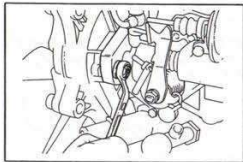
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EM-22

ENGINE MECHANICAL — Engine Tune-up

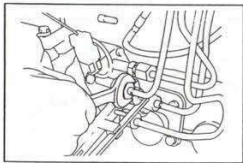


(d) Tighten the injection pump mounting bolt and nuts. Torque the bolt and nuts.

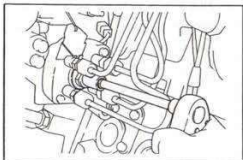
Torque: Bolt 475 kg-cm (34 ft-lb, 47 N-m)
Nut 180 kg-cm (13 ft-lb, 18 N-m)

(e) Recheck the plunger stroke.

Plunger stroke: CV 0.67 – 0.73 mm
(0.0264 – 0.0287 in.)
Others 0.77 – 0.83 mm
(0.0303 – 0.0327 in.)



(f) Tighten all union nuts on the injection pipes. Torque: 300 kg-cm (22 ft-lb, 29 N-m)

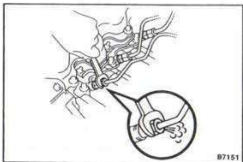


6. REMOVE METAL PLATE FROM COLD STARTING LEVER

7. REMOVE SST AND DIAL INDICATOR

(a) Remove SST and dial indicator.
(b) Install the distributive head plug bolt with a new gasket. Torque the bolt.

Torque: 170 kg-cm (12 ft-lb, 17 N-m)



8. BLEED AIR FROM FUEL LINE

Bleed air from the injection pipe by activating the starter motor.

9. START ENGINE AND CHECK FOR LEAKS

ENGINE MECHANICAL

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AND M

1. INI

(a)

(b)

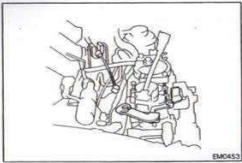
(c)

(d)

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3. DI

Dis



EM0453

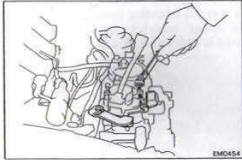
4. IN:

(a)

(b)

(c)

(d)



EM0454

(c)

(d)

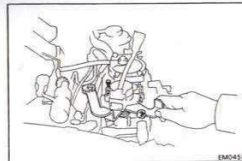
5. IN

(a)

(b)

(c)

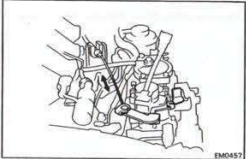
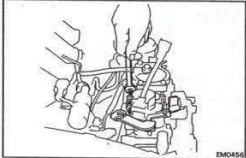
(d)



EM0455

EM-24

ENGINE MECHANICAL — Engine Tune-up



(b) Cut the maximum adjusting screw wire.

(c) Loosen the lock nut and adjust by turning the maximum speed adjusting screw.

CAUTION: Perform adjustment at low rpm, and then recheck at maximum speed.

(d) Securely tighten the lock nut and recheck the maximum speed.

(e) Lock the maximum speed adjusting screw with the wire.

6. CONNECT ACCELERATOR CABLE

(a) Connect the accelerator cable and adjust so there is no slack in it.

(b) Inspect to see that the adjusting lever is stopped by the maximum speed adjusting screw when the accelerator pedal is depressed all the way.

7. DISCONNECT TACHOMETER

ENGINE MECHANICAL

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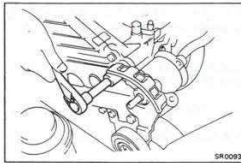
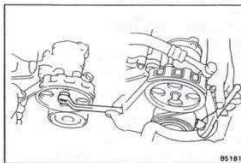
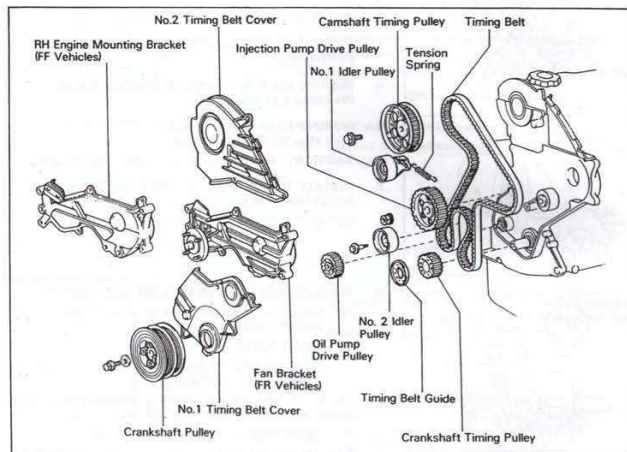
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TIMING BELT COMPONENTS



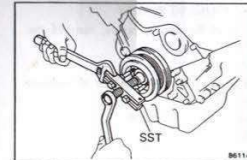
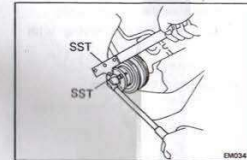
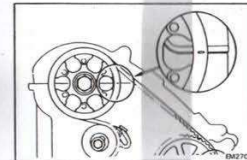
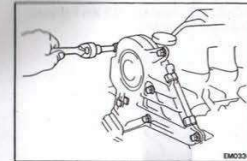
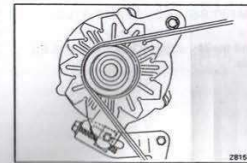
REMOVAL OF TIMING BELT

1. REMOVE PS PUMP PULLEY AND DRIVE BELT (FF Vehicles)

- Push on the drive belt to hold the pulley in place and remove the pulley nut.
- Loosen the drive belt adjusting bolt.
- Remove the drive belt.
- Remove the pulley and woodruff key.

2. REMOVE PS PUMP (FF Vehicles)

Remove the three bolts and PS pump.

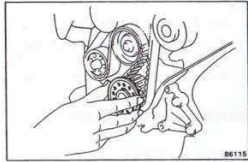


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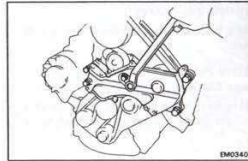
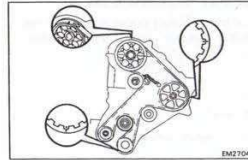
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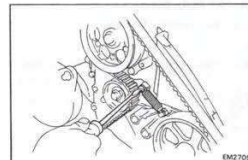
ENGINE MECHANICAL — Timing Belt

**10. REMOVE NO. 1 TIMING BELT COVER AND BELT GUIDE**

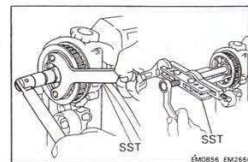
Remove five bolts and the No. 1 timing belt cover with the gasket and belt guide.

**11. REMOVE FAN BRACKET (FR Vehicles) OR RH ENGINE MOUNTING BRACKET (FF Vehicles)****12. REMOVE TIMING BELT**

NOTE: If reusing the timing belt, draw a direction arrow on the belt (in direction of engine revolution), and place matchmarks on the pulleys and timing belt.



- (a) Using a screwdriver, remove the tension spring.
- CAUTION:** Do not pinch the tension spring with pliers or such.
- (b) Loosen the No. 1 idler pulley bolt.
- (c) Remove the timing belt from each pulley.

**13. REMOVE CAMSHAFT TIMING PULLEY**

- (a) Using SST to hold the timing pulley, remove the pulley mount bolt.

SST 09278-54012

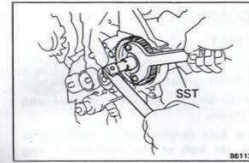
CAUTION: Avoid turning the camshaft or the valves will hit against the pistons.

- (b) Using SST, remove the timing pulley.

SST 09950-20014

14. REMOVE NO. 1 IDLER PULLEY

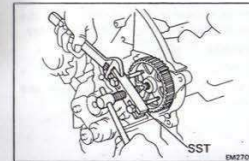
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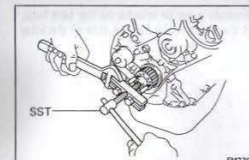
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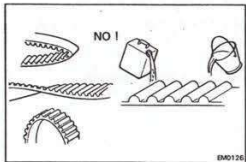
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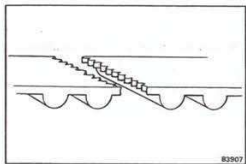
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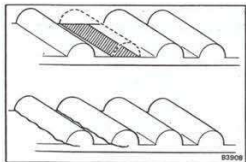
ENGINE MECHANICAL — Timing Belt



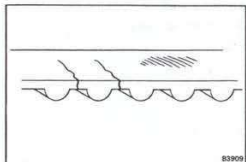
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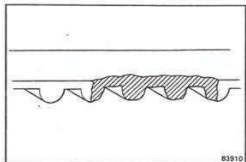
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INSPECTION OF COMPONENTS

1. INSPECT TIMING BELT

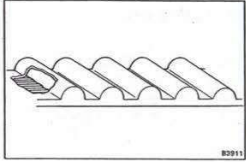
CAUTION:

1. Do not bend, twist or turn the belt inside out.
2. Do not allow the belt to come into contact with oil, water or steam.
3. Do not utilize belt tension when installing or removing the set bolt of the camshaft timing pulley.

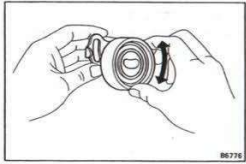
If there are defects as shown in the figures, check the following points and replace the timing belt if necessary.

- (a) Premature severance
- Check for proper installation.
 - Check the timing cover gasket for damage and proper installation.
- (b) If the belt teeth are cracked or damaged, check to see if the camshaft, water pump or oil pump is locked.
- (c) If there is noticeable wear or cracks on the belt face, check to see if there are nicks on one side of the idler pulley lock.
- (d) If there is wear or damage on only one side of the belt, check the belt guide and the alignment of each pulley.

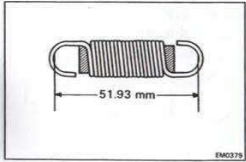
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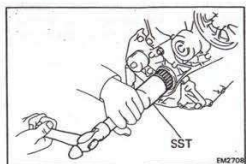


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ENGINE MECHANICAL — Timing Belt

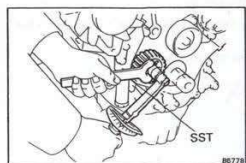


INSTALLATION OF TIMING BELT

(See page EM-26)

1. INSTALL CRANKSHAFT TIMING PULLEY

- Align the woodruff key groove of the timing pulley with the woodruff key on the crankshaft.
- Using SST and a hammer, drive in the timing pulley. SST 09214-60010

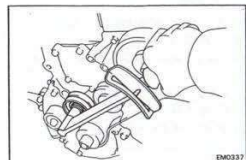


2. INSTALL OIL PUMP DRIVE PULLEY

Using SST to hold the pulley, install and torque the pulley nut.

SST 09612-24013

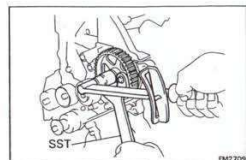
Torque: 475 kg-cm (34 ft-lb, 47 N-m)



3. INSTALL NO. 2 IDLER PULLEY

Torque: 375 kg-cm (27 ft-lb, 37 N-m)

NOTE: Check that the pulley moves smoothly.



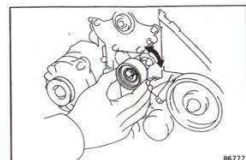
4. INSTALL INJECTION PUMP DRIVE PULLEY

- Match the woodruff key groove of the drive pulley with the woodruff key on the drive shaft.
- Using SST to hold the drive pulley, install and torque the pulley nut.

SST 09278-54012

Torque: 650 kg-cm (47 ft-lb, 64 N-m)

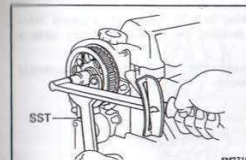
CAUTION: Do not use an impact wrench.



5. PROVISIONALLY INSTALL NO. 1 IDLER PULLEY

- Place the idler pulley on the cylinder head and finger tighten the pulley bolt to the extent that the idler pulley is free.
- Install and torque the pulley guide bolt. Torque: 75 kg-cm (65 in.-lb, 7.4 N-m)
- Check that the idler pulley bracket can be moved to the left and right by hand.

ENGINE MECHANICAL



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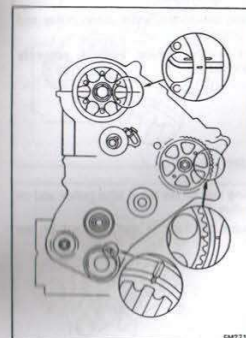
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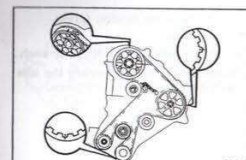
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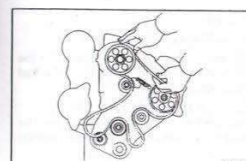
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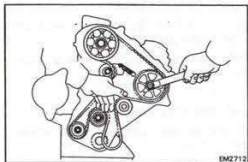
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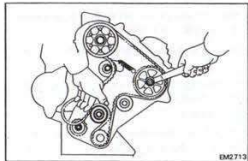
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EM-34

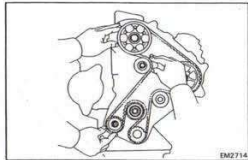
ENGINE MECHANICAL — Timing Belt



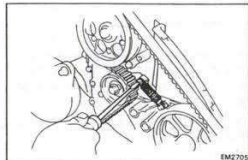
(b) Place the timing belt to the injection pump drive pulley while holding the pulley stationary with a wrench.
CAUTION: Be sure the timing belt is securely meshed and not loose.



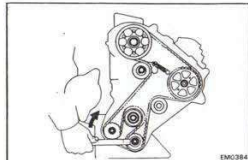
(c) Place the timing belt to the water pump pulley and crankshaft timing pulley.
CAUTION: Be sure the timing belt is securely meshed and not loose.



(d) Place the timing belt to the No. 2 idler pulley and oil pump drive pulley.
CAUTION: Be sure the belt is not twisted or too tight.



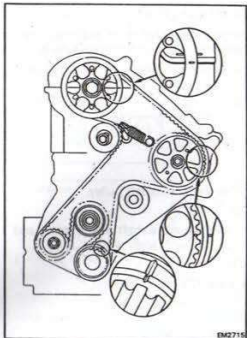
(e) Using a screwdriver, install the tension spring.
CAUTION:
• Do not pinch the tension spring with pliers or such.
• Loosen the No. 1 idler pulley bolt to where the idle pulley lightly moves with tension spring force.



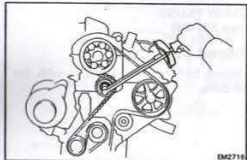
9. CHECK VALVE TIMING

(a) Temporarily install the crankshaft pulley bolt.
(b) Turn the crankshaft two revolutions to where the line mark of the camshaft pulley and the upper surface of the cylinder head are again aligned.
CAUTION: Always turn the crankshaft clockwise. If turned counterclockwise, there is possibility of the belt teeth becoming unmeshed and the belt tension changing.

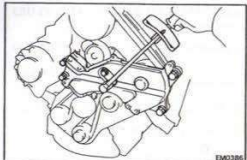
ENGINE MECHANICAL



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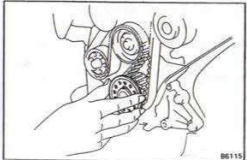


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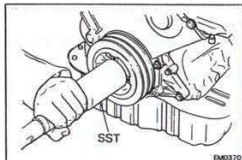
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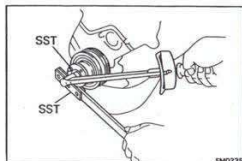
ENGINE MECHANICAL — Timing Belt



13. INSTALL CRANKSHAFT PULLEY

- Align the woodruff key groove of the crankshaft pulley with the woodruff key on the crankshaft.
- Using SST and hammer, drive in the crankshaft pulley.

SST 09214-60010



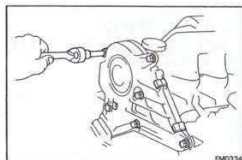
- Install the SST to the crankshaft pulley.

SST 09213-14010

- Using SST to hold the crankshaft pulley, install and torque the pulley bolt with plate washer.

SST 09330-00021

Torque: 1,000 kg-cm (72 ft-lb, 98 N-m)

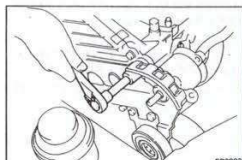


14. INSTALL FOUR GLOW PLUGS

(See step 8 on page EM-68)

15. INSTALL NO. 2 TIMING BELT COVER

Install the No. 2 timing belt cover and gasket with the three clips and five bolts.



16. PROVISIONALLY INSTALL FAN PULLEY AND FLUID COUPLING (FR Vehicles)

- Place the fan pulley and fluid coupling on the fan bracket.
- Finger tighten the four fan pulley nuts.

17. INSTALL PS PUMP (FF Vehicles)

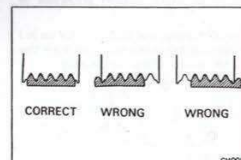
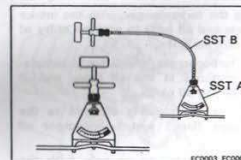
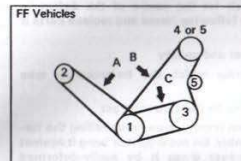
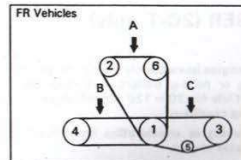
Install the PS pump with three bolts. Torque the bolts.

Torque: 400 kg-cm (29 ft-lb, 39 N-m)

18. PROVISIONALLY INSTALL PS PUMP PULLEY (FF Vehicles)

- Place the pump pulley and woodruff key on the pump drive shaft.
- Finger tighten the pump pulley nut.

ENGINE MECHANICAL



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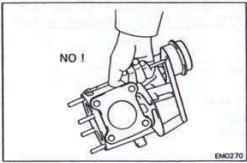
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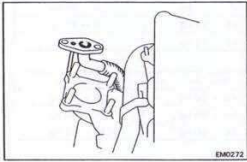
EM-38

ENGINE MECHANICAL — Turbocharger

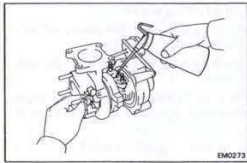
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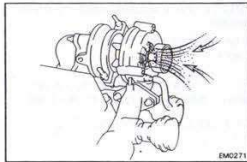
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CAUTION:

- Do not stop the engine immediately after high-speed or uphill driving or pulling trailers, but keep the engine running at idle for 20 – 120 seconds depending on the driving condition.
- Avoid sudden racing or acceleration immediately after starting a cold engine.
- If the turbocharger is defective and must be replaced, first check for the cause of the defect in reference to the following items and replace parts if necessary:

Engine oil level and quality

Conditions under which the turbocharger was used

Oil lines leading to the turbocharger
- Use caution when removing and reinstalling the turbocharger assembly. Do not drop it or bang it against anything, and never grasp it by easily-deformed parts such as the actuator or rod when moving it.
- Before removing the turbocharger, plug the intake and exhaust ports and oil inlet to prevent entry of dirt or other foreign particles.
- If replacing the turbocharger, check for accumulation of sludge particles in the oil pipes and, if necessary, replace the oil pipes.
- Completely remove the gaskets adhered to the lubrication oil pipe flange and turbocharger oil flange.
- If replacing bolts or nuts, do so only with the specified new ones to guard against breakage or deformation.
- If replacing the turbocharger, put in 20 cc (1.2 cu in.) of oil in the oil inlet of the new one and turn the impeller by hand to spread oil to the bearing.

- If the engine is run with the air cleaner, case cover and hose removed, foreign particles entering will damage the wheels which run at extremely high speed.
- If the engine was replaced or overhauled, shut off fuel and glow function after reassembly and crank the engine for 30 seconds to spread oil throughout. Then, allow the engine to idle for 60 seconds.

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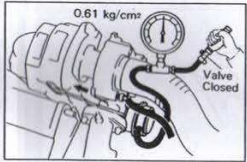
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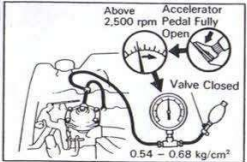
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Valve Closed

Above 2,500 rpm
Accelerator Pedal Fully Open



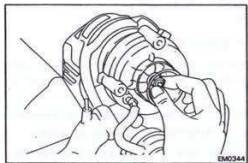
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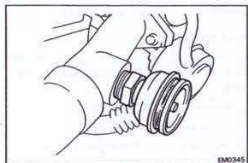
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EM-40

ENGINE MECHANICAL — Turbocharger



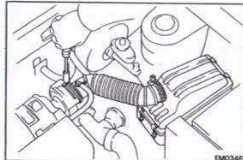
5. **INSPECT IMPELLER WHEEL ROTATION**
- (a) Disconnect the air cleaner hose.
 - (b) Grasp the edge of the impeller wheel and turn it. Check that it turns smoothly.
- If it does not turn or if it turns with drag, replace the turbocharger assembly.



6. **INSPECT RELIEF VALVE**
- Check the outside of the relief valve for excessive oil oozing.
- If no oil oozing is found, the relief valve is okay.
- If oil oozing is found, replace the relief valve and check the performance. If there is no change in performance, the relief valve is okay.

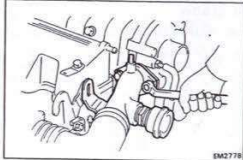
ENGINE MECHANICAL

COMP



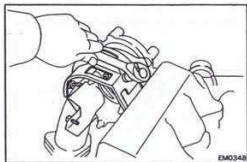
REMO

1. **REMOVAL**
- (a)
 - (b)
 - (c)
2. **DISASSEMBLY**
3. **REASSEMBLY**
- (a)
 - (b)
 - (c)
 - (d)

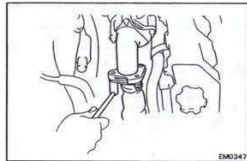


EM-42

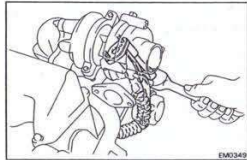
ENGINE MECHANICAL — Turbocharger



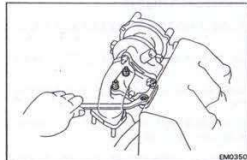
4. REMOVE TURBOCHARGER HEAT INSULATORS



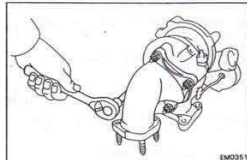
5. DISCONNECT EXHAUST PIPE FROM TURBINE ELBOW
- (a) Remove the three nuts from the flange.
 - (b) Disconnect the exhaust pipe from the manifold and remove the gasket.



6. REMOVE TURBOCHARGER OIL PIPE FLANGE NUTS



7. REMOVE TURBOCHARGER FROM EXHAUST MANIFOLD
- Remove the four nuts and remove the turbocharger, turbocharger gasket and flange gasket.

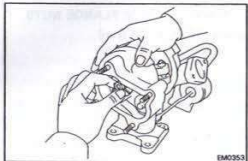


8. REMOVE TURBINE ELBOW
- Remove the four nuts, washers, turbine elbow and gasket.

ENGINE MECHANICAL

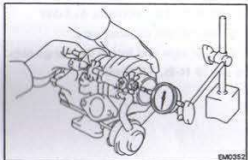


9. REMOVE TURBINE ELBOW

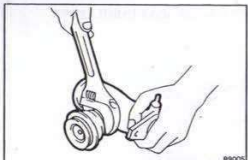


INSPIRATION

1. INSPIRATION
- Grasp the elbow and pull it away from the turbocharger.



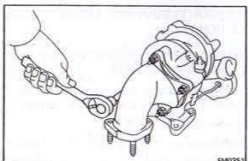
2. INSPIRATION
- Insert the elbow into the turbocharger and secure it.



INSTALLATION

- (See page 42 for component location)

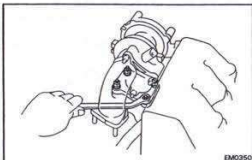
1. INSTALLATION
- To install the elbow, insert it into the turbocharger and secure it.



2. INSTALLATION
- Insert the elbow into the turbocharger and secure it.

EM-44

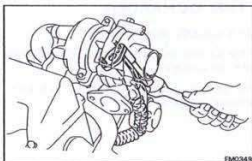
ENGINE MECHANICAL — Turbocharger



3. INSTALL TURBOCHARGER

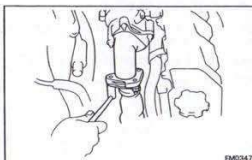
- (a) Place a new gasket with the protrusion on the opposite side of the cylinder head.
- (b) Install the turbocharger, with a new oil pipe gasket, to the exhaust manifold and oil pipe.
- (c) Install and torque the nuts.

Torque: 530 kg-cm (38 ft-lb, 52 N-m)



4. INSTALL TURBOCHARGER OIL PIPE FLANGE NUTS

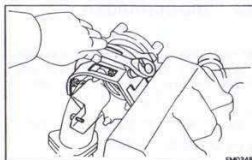
Torque: 185 kg-cm (13 ft-lb, 18 N-m)



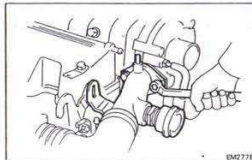
5. CONNECT EXHAUST PIPE TO TURBINE ELBOW

- (a) Place a new gasket on the exhaust pipe.
- (b) Connect the exhaust pipe and install the flange nuts.

Torque: 130 kg-cm (9 ft-lb, 13 N-m)



6. INSTALL TURBOCHARGER HEAT INSULATORS



7. INSTALL COMPRESSOR ELBOW WITH RELIEF VALVE AND AIR INTAKE HOSE

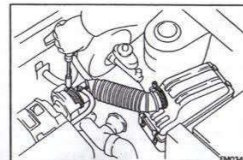
8. CONNECT TURBOCHARGER PRESSURE HOSE FOR INDICATOR AND WARNING LIGHTS

- (a) Install the compressor elbow with relief valve and air intake hose with the two bolts and a new gasket.

Torque: 130 kg-cm (9 ft-lb, 13 N-m)

- (b) Connect the elbow stay to the engine No. 2 hanger.
- (c) Connect the air intake hose to the intake manifold with the clamp.

ENGINE MECHANICAL

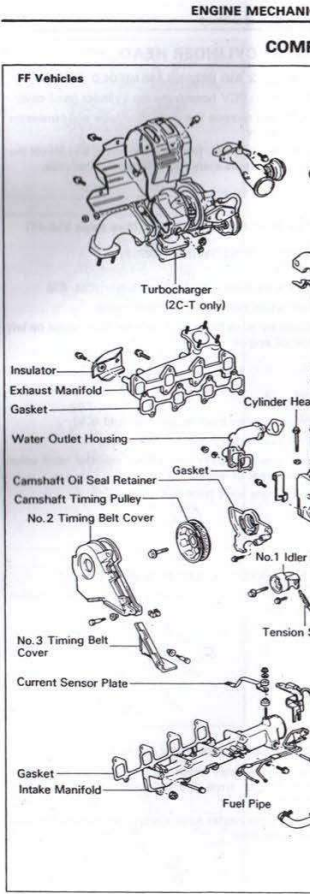
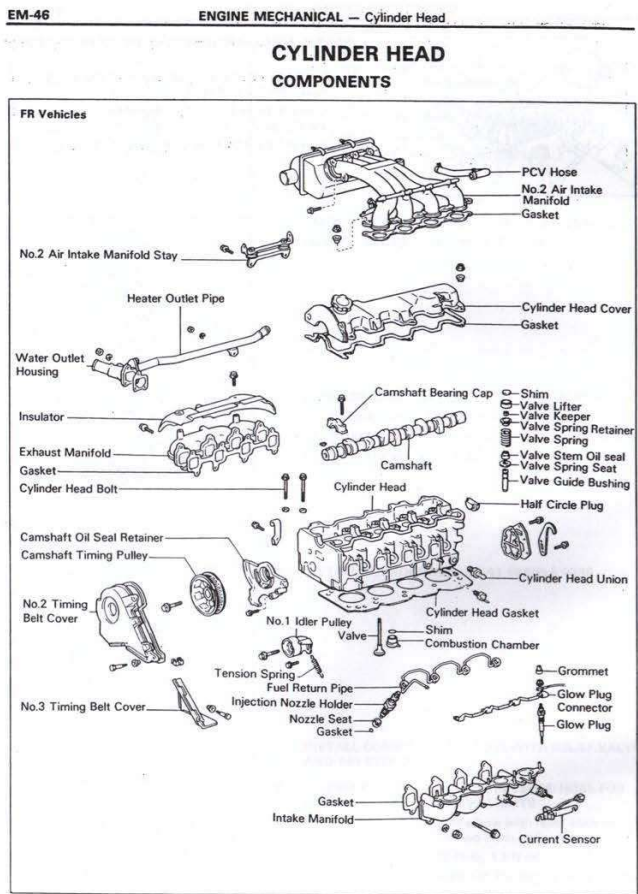


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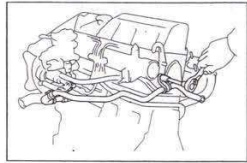
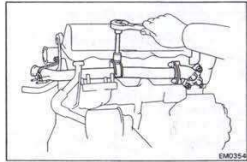
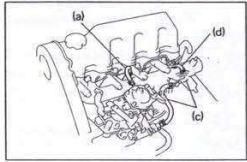
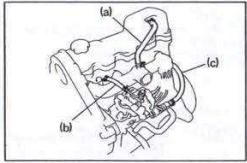
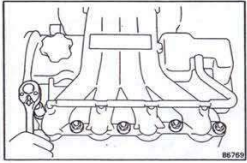
(b)

(c)



EM-48ENGINE MECHANICAL — Cylinder Head

REMOVAL OF CYLINDER HEAD



1. REMOVE NO. 2 AIR INTAKE MANIFOLD (CE70)
(a) Disconnect PCV hose from the cylinder head cover.
NOTE: Do not remove the ventilation tube and connector unless necessary.
(b) Remove two bolts, five nuts and seals, and lift off the No. 2 air intake manifold with air cleaner case.

2. REMOVE TURBOCHARGER (CV) (See page EM-41)

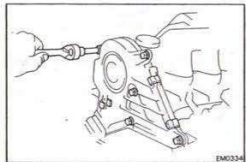
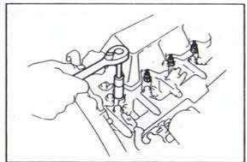
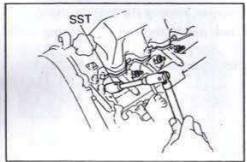
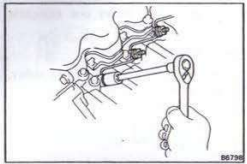
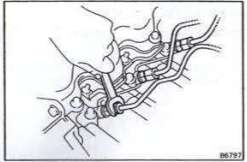
3. DISCONNECT FOLLOWING HOSES: (FF Vehicles)
(a) PCV hose from cylinder head cover (CM, CR)
(b) Fuel return hose from injection pump
(c) Water by-pass hose from cylinder head union on left rear of engine

(FF Vehicles)
(a) Pressure hose from intake manifold (CV)
(b) Two fuel hoses from injection pump
(c) Two water by-pass hoses from cylinder head union on left rear of engine
(d) Fuel return hose from fuel pipe

4. REMOVE WATER OUTLET PIPE (FF Vehicles)
Remove two bolts, three nuts and water pipe with gasket.

5. REMOVE HEATER PIPE (FF Vehicles)
(a) Remove the pipe mounting bolt and nut with engine rear hanger from the cylinder head and injection pump.
(b) Loosen the heater hose clamp and pull out the hose with the pipe.

ENGINE MECHANICAL



6. REMOVE NO. 2 AIR INTAKE MANIFOLD (CE70)
(a) Disconnect PCV hose from the cylinder head cover.
NOTE: Do not remove the ventilation tube and connector unless necessary.
(b) Remove two bolts, five nuts and seals, and lift off the No. 2 air intake manifold with air cleaner case.

7. REMOVE TURBOCHARGER (CV) (See page EM-41)

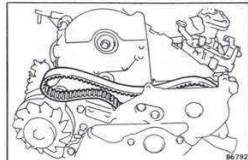
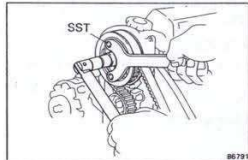
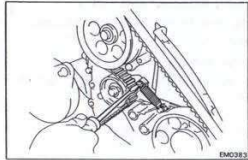
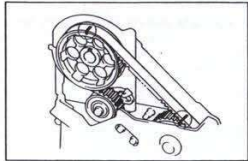
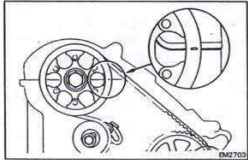
8. DISCONNECT FOLLOWING HOSES: (FF Vehicles)
(a) PCV hose from cylinder head cover (CM, CR)
(b) Fuel return hose from injection pump
(c) Water by-pass hose from cylinder head union on left rear of engine

(FF Vehicles)
(a) Pressure hose from intake manifold (CV)
(b) Two fuel hoses from injection pump
(c) Two water by-pass hoses from cylinder head union on left rear of engine
(d) Fuel return hose from fuel pipe

9. REMOVE WATER OUTLET PIPE (FF Vehicles)
Remove two bolts, three nuts and water pipe with gasket.

10. REMOVE HEATER PIPE (FF Vehicles)
(a) Remove the pipe mounting bolt and nut with engine rear hanger from the cylinder head and injection pump.
(b) Loosen the heater hose clamp and pull out the hose with the pipe.

EM-50ENGINE MECHANICAL — Cylinder Head



13. SET NO. 1 CYLINDER AT TDC/COMPRESSION

(a) Turn the crankshaft pulley and align its groove with the pointer on the oil pump.

(b) Check that the line mark of the camshaft timing pulley aligns with the top end of the cylinder head.

If necessary, turn the crankshaft pulley one complete revolution.

14. REMOVE CAMSHAFT TIMING PULLEY

(a) Place matchmarks on the camshaft timing pulley, injection pump pulley and timing belt.

(b) Using a screwdriver, remove the tension spring.

CAUTION: Do not pinch the tension spring with pliers or such.

(c) Loosen the No. 1 idler pulley bolt.

(d) Using SST, to hold the camshaft timing pulley, remove the pulley bolt with the plate washer.

SST 09278-54012

CAUTION: Avoid turning the camshaft because the valves will hit against the piston.

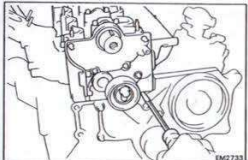
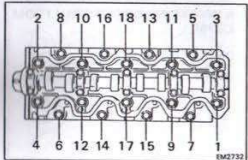
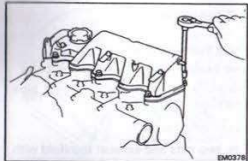
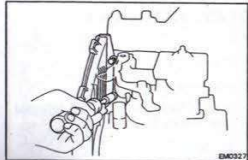
(e) Remove the camshaft timing pulley with the timing belt.

(f) Support the belt so the meshing of the injection pump timing pulley and timing belt does not shift.

CAUTION:

- Be careful not to drop anything inside the timing belt cover.
- Do not allow the belt to come into contact with oil, water or dust.

ENGINE MECHANICAL



15. RE

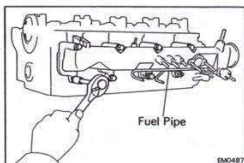
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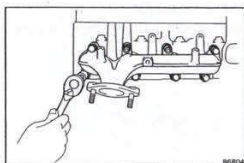
ENGINE MECHANICAL — Cylinder Head

**DISASSEMBLY OF CYLINDER HEAD**

(See page EM-46 or 47)

1. REMOVE NO. 1 IDLER PULLEY**2. REMOVE INTAKE MANIFOLD**

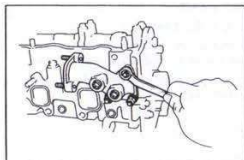
Remove the six bolts, two nuts, fuel pipes (FF vehicles) and intake manifold with the gasket.

**3. REMOVE EXHAUST MANIFOLD (FR Vehicles)**

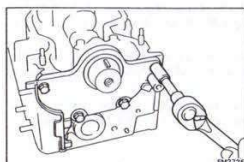
- (a) Remove the three bolts and insulator.
- (b) Remove the two heater outlet pipe mounting bolts.
- (c) Remove the six bolts, two nuts, heater outlet pipe and exhaust manifold with gasket.

(FF Vehicles)

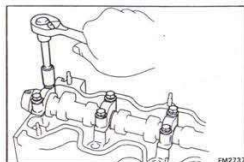
Remove the six bolts, two nuts and exhaust manifold with the gasket.

**4. REMOVE NO. 2 AIR INTAKE MANIFOLD STAY FROM CYLINDER HEAD (CE70)****5. REMOVE WATER OUTLET HOUSING**

Remove the three nuts and outlet housing with the gasket.

**6. REMOVE CAMSHAFT OIL SEAL RETAINER**

Remove five bolts and remove oil seal retainer.

**7. REMOVE CAMSHAFT**

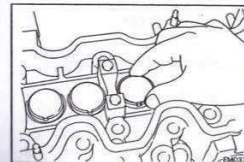
- (a) Gradually loosen and remove the bearing cap bolts from outside in three passes.

CAUTION: Loosen each cam bearing cap bolt a little time.

- (b) Remove the bearing caps and camshaft.

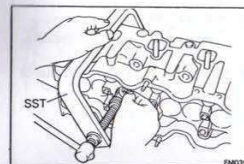
8. REMOVE HALF CIRCLE PLUG FROM CYLINDER HEAD REAR SIDE

ENGINE MECHANICAL

**9. RE**

(a)

(b)

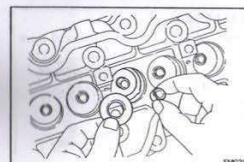
**10. RE**

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(b)

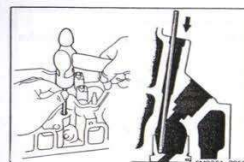
(c)



(d)

(e)

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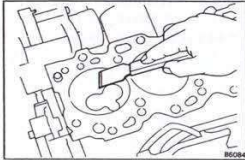
**11. RE**

(a)

(b)

EM-54

ENGINE MECHANICAL — Cylinder Head

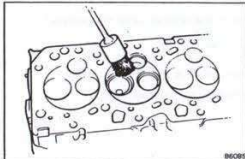


INSPECTION AND CLEANING OF COMPONENTS

1. CLEAN TOP OF PISTONS AND TOP OF CYLINDER BLOCK

- (a) Scrape the carbon from the piston top.
- (b) Remove all gasket material from the top of the block. Blow carbon and oil from the bolt holes.

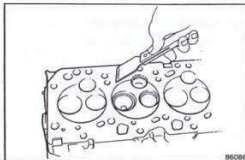
WARNING: Protect your eyes when using high pressure air.



2. CLEAN COMBUSTION CHAMBER

Using a wire brush, remove all the carbon from the combustion chambers.

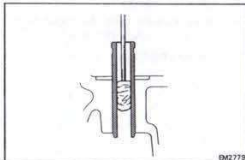
CAUTION: Be careful not to scratch the head gasket contact surface.



3. REMOVE GASKET MATERIAL

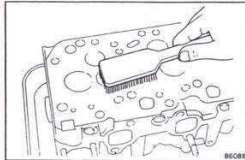
Using a gasket scraper, remove all gasket material from the head and manifold surfaces.

CAUTION: Be careful not to scratch the surfaces.



4. CLEAN VALVE GUIDE BUSHINGS

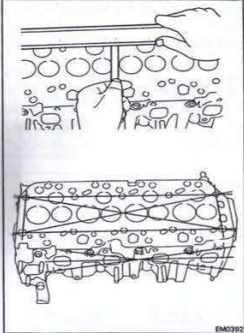
Using a valve guide brush and solvent, clean all the valve guide bushings.



5. CLEAN CYLINDER HEAD

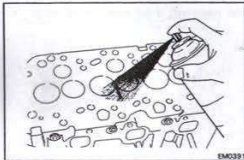
Using a soft brush and solvent, clean the head.

ENGINE MECHANICAL

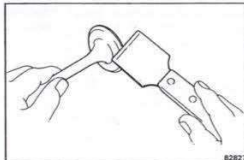


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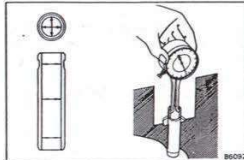
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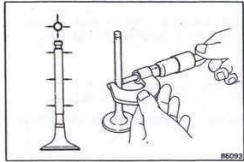
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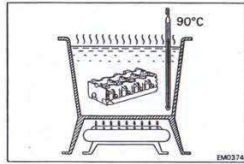
9. IN
(a)

EM-56

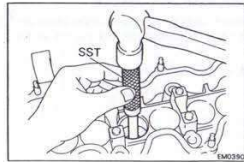
ENGINE MECHANICAL — Cylinder Head



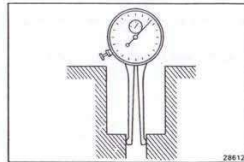
- (b) Using a micrometer, measure the diameter of the valve stem.
- (c) Subtract the valve stem measurement from the valve guide bushing measurement.
- Maximum oil clearance:
Intake 0.08 mm (0.0031 in.)
Exhaust 0.10 mm (0.0039 in.)
- If the clearance is greater than the maximum, replace the valve and valve guide bushing.



10. IF NECESSARY, REPLACE VALVE GUIDE BUSHING
- (a) Gradually heat the cylinder head to about 90°C (194°F).



- (b) Using SST and hammer, drive out the valve guide bushing.
- SST 09201-60011

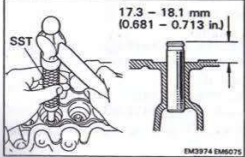


- (c) Using a dial indicator or telescoping gauge, measure the valve guide bushing bore of the cylinder head.

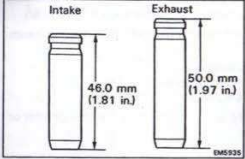
Both intake and exhaust	
Bushing bore mm (in.)	Bushing size
13.000 – 13.027 (0.5118 – 0.5129)	Use STD
Over 13.027 (0.5129)	Use O/S 0.05

- (d) Select a new valve guide bushing.
- If the valve guide bushing bore of the cylinder head is more than 13.027 mm (0.5129 in.), machine the bore to the following dimension.
- Rebored valve guide bushing bore dimension:
13.050 – 13.077 mm (0.5138 – 0.5148 in.)

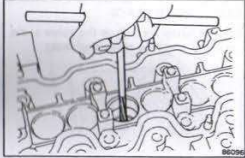
ENGINE MECHANICAL



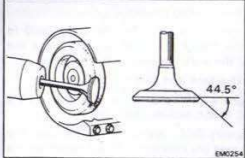
- (e)
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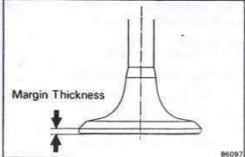
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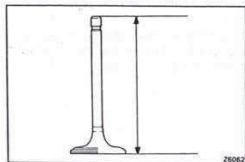
11. IN
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EM-58

ENGINE MECHANICAL — Cylinder Head



(d) Check the valve overall length.

Minimum overall length:

Intake 105.20 mm (4.1417 in.)

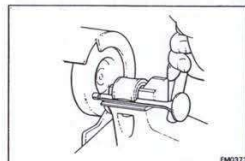
Exhaust 104.85 mm (4.1279 in.)

Standard overall length:

Intake 105.70 mm (4.1614 in.)

Exhaust 105.35 mm (4.1476 in.)

If the valve overall length is less than minimum, replace the valve.



(e) Check the surface of the valve stem tip for wear.

CAUTION: Do not grind off more than the minimum amount.

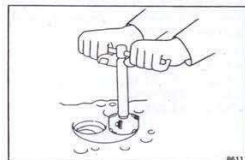
Minimum overall length:

Intake 105.20 mm (4.1417 in.)

Exhaust 104.85 mm (4.1279 in.)

If the valve stem tip is worn, resurface it with a grinder or replace the valve.

12. INSPECT AND CLEAN VALVE SEATS



(a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.



(b) Check the valve seating position.

Apply a thin coat of prussian blue (or white lead) to the valve face. Install the valve. Lightly press the valve against the seat. Do not rotate the valve.

(c) Check the valve face and seat for the following:

- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.

- If blue appears 360° around the valve seat, the guide and seat are concentric. If not, resurface the seat.

- Check that the seat contact is on the middle of the valve face with the following width:

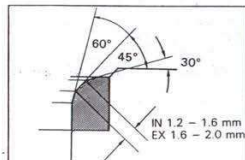
IN: 1.2 – 1.6 mm (0.047 – 0.063 in.)

EX: 1.6 – 2.0 mm (0.063 – 0.079 in.)

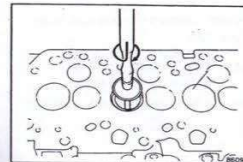
If not, correct the valve seat as follows:

- If seating is too high on the valve face, use 30° and 45° cutters to correct the seat.

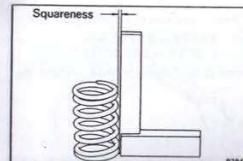
- If seating is too low on the valve face, use 60° and 45° cutters to correct the seat.



ENGINE MECHANICAL



(d)



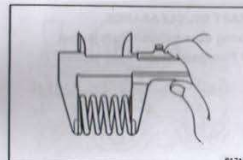
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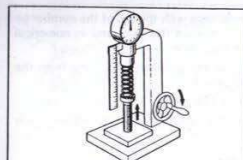
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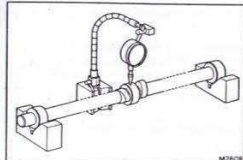
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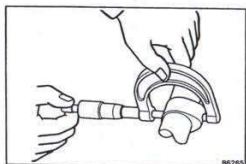
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EM-60

ENGINE MECHANICAL — Cylinder Head



(b) Using a micrometer, measure the cam lobe height.

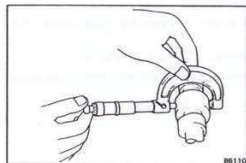
Minimum cam lobe height:

Intake CV 45.925 mm (1.8081 in.)

Others 46.325 mm (1.8238 in.)

Exhaust 46.835 mm (1.8439 in.)

If the cam lobe height is less than minimum, replace the camshaft.

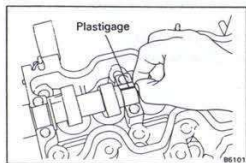


(c) Using a micrometer, measure the journal diameter.

Standard diameter: 27.979 – 27.995 mm

(1.1015 – 1.1022 in.)

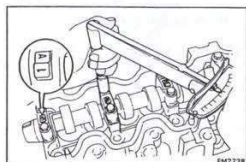
If the journal diameter is less than specified, replace the camshaft.



15. INSPECT CAMSHAFT OIL CLEARANCE

(a) Clean the bearing caps and camshaft journal.

(b) Lay a strip of Plastigage across each journal.

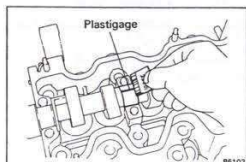


(c) Place the bearing caps with the top of the number on the cap pointing toward the front and in numerical order from the front side.

(d) Install and torque the cap bolts gradually from the inside in three passes.

Torque: 185 kg-cm (13 ft-lb, 18 N-m)

NOTE: Do not turn the camshaft while the Plastigage is in place.



(e) Remove the caps and measure the Plastigage at its widest point.

Maximum oil clearance: 0.1 mm (0.004 in.)

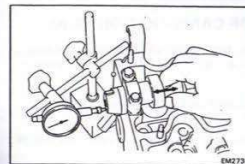
Standard oil clearance: 0.037 – 0.073 mm

(0.0015 – 0.0029 in.)

If clearance is greater than the maximum, replace the head and/or camshaft.

(f) Clean out the pieces of Plastigage from the bearing caps and journals.

ENGINE MECHANICAL



16. INS

(a)

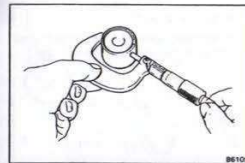
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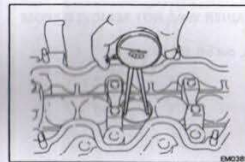
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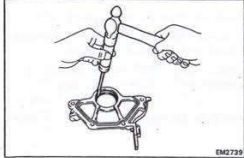
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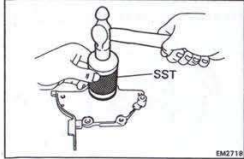
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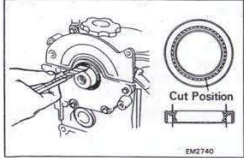
EM-62ENGINE MECHANICAL — Cylinder Head



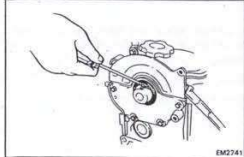
EM62739



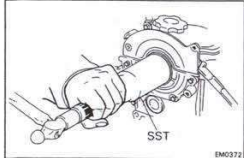
EM62718



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EM62722

REPLACEMENT OF CAMSHAFT OIL SEAL

NOTE: There are two ways of oil seal replacement depending on whether the oil seal retainer was removed or not.

1. IF OIL SEAL RETAINER WAS REMOVED FROM CYLINDER HEAD

(a) Using a screwdriver and hammer, drive out the oil seal.

(b) Apply MP grease to the oil seal.

(c) Using SST and a hammer, drive in a new oil seal until its surface is flush with the oil seal retainer edge.
SST 09214-60010

2. IF OIL SEAL RETAINER WAS NOT REMOVED FROM CYLINDER HEAD

(a) Using a knife, cut off the oil seal lip.

(b) Using a screwdriver, pry out the oil seal.
CAUTION: Tape the screwdriver tip and be careful not to damage the camshaft.

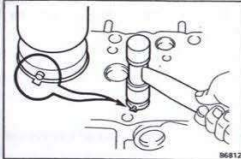
(c) Apply MP grease to a new oil seal.

(d) Using SST and a hammer, drive in the oil seal until its surface is flush with oil seal retainer edge.
SST 09214-60010

ENGINE MECHANICAL

ASSEMBLY
(See page 35/49)

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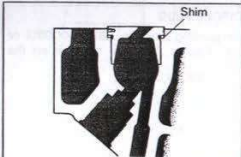
1. INSTALLATION

(a)

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COIL SPRING



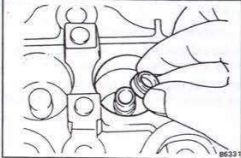
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2. INSTALLATION

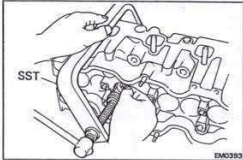
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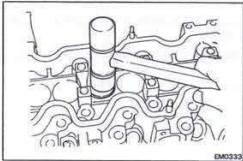


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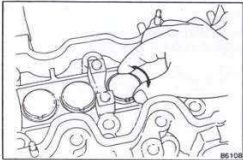
EM-64ENGINE MECHANICAL — Cylinder Head



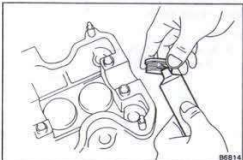
(c) Place the spring and retainer on the spring seat.
(d) Using SST, press the retainer and place the two keepers around the valve stem.
SST 09202-43013
(e) Unscrew the SST and confirm proper fit of the keepers.



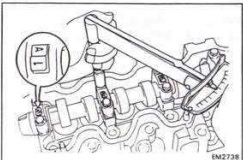
(f) Using a plastic hammer, lightly tap the valve stem tip to assure proper fit.



3. INSTALL VALVE LIFTERS WITH SHIMS
(a) Install the valve lifters with shims on the valve stem tips.
(b) Check the valve lifters and shims are installed in the correct order.
(c) Check the valve lifters rotate smoothly by hand.

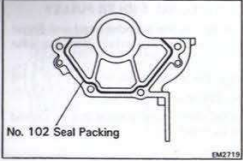


4. INSTALL HALF CIRCLE PLUG
Apply No. 102 seal packing (Part No. 08826-00080) or equivalent to the half circle plug and install it on the cylinder head.

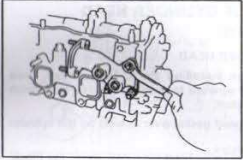


5. INSTALL CAMSHAFT
(a) Place the camshaft in the cylinder head.
(b) Place the bearing caps with the top of the number on the cap pointing toward the front as shown.
(c) Gradually install and tighten the cap bolts from the inside in three passes. Torque the bolts on the final pass.
Torque: 185 kg-cm (13 ft-lb, 18 N-m)

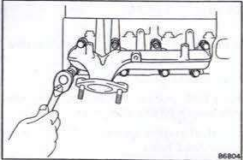
ENGINE MECHANICAL



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No. 102 Seal Packing



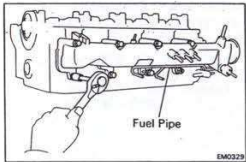
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EM-66

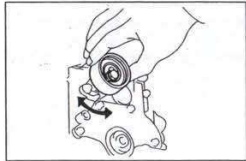
ENGINE MECHANICAL -- Cylinder Head



11. INSTALL INTAKE MANIFOLD

- (a) Install a new manifold gasket, fuel pipes (FF vehicles) and intake manifold with six bolts and two nuts.
- (b) Torque the bolts and nuts.

Torque: 185 kg-cm (13 ft-lb, 18 N-m)

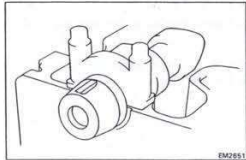


12. PROVISIONALLY INSTALL NO. 1 IDLER PULLEY

- (a) Place the idler pulley on the cylinder head and finger tighten the pulley bolt to the extent that the idler pulley is free.
- (b) Install and torque the pulley guide bolt.

Torque: 75 kg-cm (65 in.-lb, 7.4 N-m)

NOTE: Check that the idler pulley bracket can be moved to the left and right by hand.



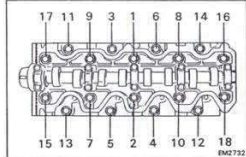
INSTALLATION OF CYLINDER HEAD

(See page EM-46 or 47)

1. INSTALL CYLINDER HEAD

CAUTION: When installing the cylinder head, face the camshaft key upward to prevent interference with the valve and piston.

- (a) Place a new head gasket over dowels on the cylinder block.
- (b) Position the cylinder head over dowels on the block.



2. TIGHTEN CYLINDER HEAD BOLTS

NOTE:

- The cylinder head bolts are tighten in three progressive steps.

- If any of the bolts break or deform, replace them.

- If the cylinder head bolts are to be replaced, use only cylinder head bolts with a cavity in the head.

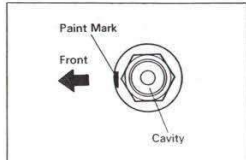
- (a) Apply a light coat of engine oil on the threads and under the cylinder head bolts.

- (b) First, uniformly tighten the eighteen cylinder head bolts in several passes and in the sequence shown.

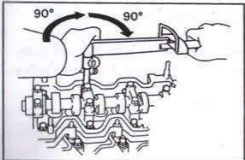
Torque: 450 kg-cm (33 ft-lb, 44 N-m)

If any one of the bolts does not meet the torque specification, replace the bolt.

- (c) Mark the front side of the top of head bolt with paint.



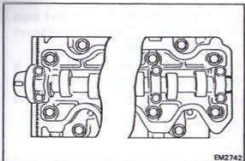
ENGINE MECHANICAL



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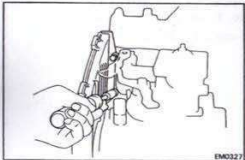
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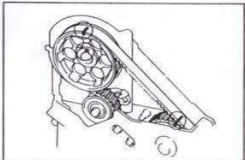
(b)

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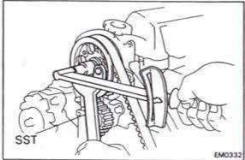
4. IN



5. IN

(a)

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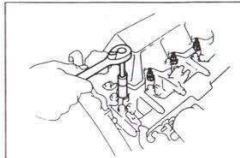
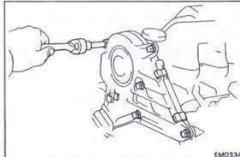
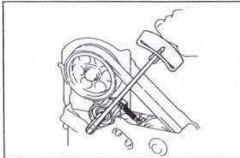
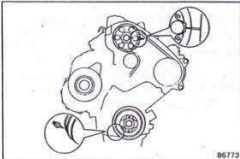
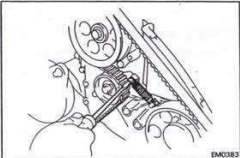
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EM-68ENGINE MECHANICAL — Cylinder Head



(d) Using a screwdriver, install the tension spring.

CAUTION:

- Do not pinch the tension spring with pliers or such.
- Loosen the idler pulley bolt to where the idler pulley lightly moves with tension spring force.

(e) Turn the crankshaft pulley two revolutions and align its groove with the pointer on the oil pump. Always turn the crankshaft pulley clockwise.

(f) Check that the line mark of the timing pulley is aligned with the top end of the cylinder head. If the mark are not aligned, repeat the procedure above from (a).

(g) Torque the No. 1 idler pulley bolt.
Torque: 375 kg-cm (27 ft-lb, 37 N·m)

6. INSTALL NO. 2 TIMING BELT COVER WITH GASKET

7. INSTALL OIL LEVEL GAUGE GUIDE CLAMP WITH BOLT TO INTAKE MANIFOLD

8. INSTALL GLOW PLUGS

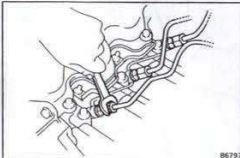
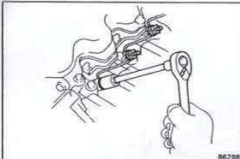
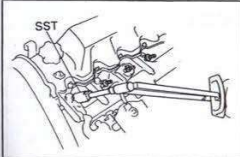
(a) Install and torque the four glow plugs.
Torque: 130 kg-cm (9 ft-lb, 13 N·m)

(b) Install the glow plug connector and current sensor plate with four nuts.

(c) Install four grommets on the glow plugs.

9. INSTALL GLOW PLUG CURRENT SENSOR TO INTAKE MANIFOLD

ENGINE MECHANICAL



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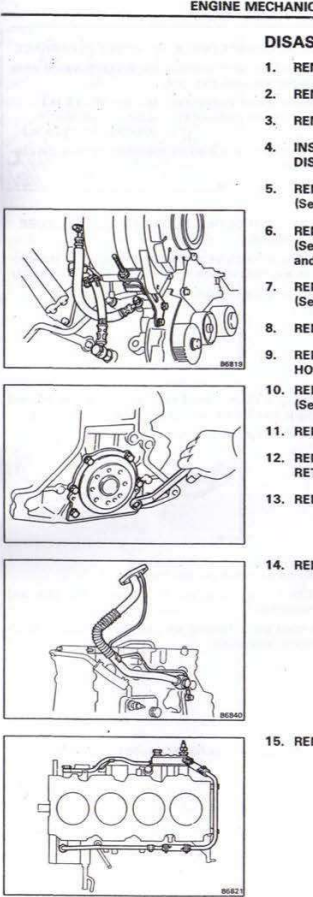
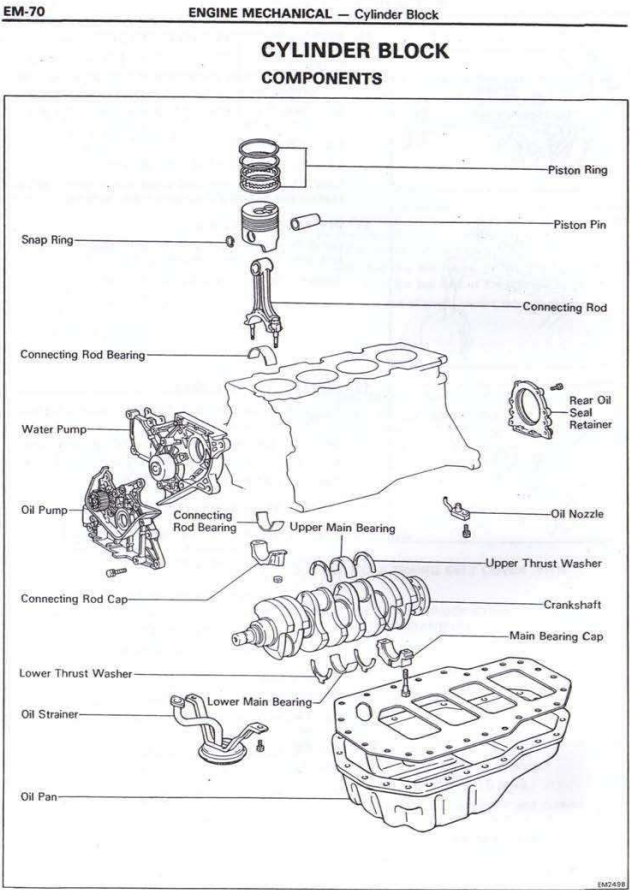
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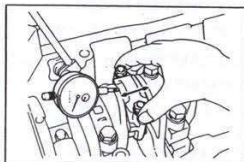
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EM-72

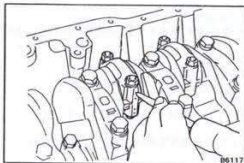
ENGINE MECHANICAL — Cylinder Block

**16. MEASURE CONNECTING ROD THRUST CLEARANCE**

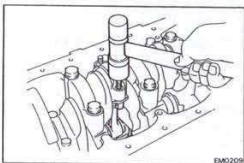
Using a dial indicator, measure the thrust clearance while moving the rod back and forth.

Maximum thrust clearance: 0.4 mm (0.016 in.)
Standard thrust clearance: 0.08 – 0.30 mm (0.0031 – 0.0118 in.)

If clearance is greater than the maximum, replace the connecting rod.

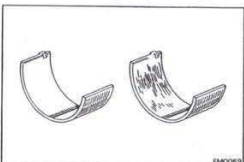
**17. REMOVE CONNECTING ROD CAPS AND MEASURE OIL CLEARANCE**

- Using a punch or numbering stamp, mark the connecting rods and caps to ensure correct reassembly.
- Remove the cap nuts.



- Using a plastic-faced hammer, lightly tap the rod bolts and lift off the cap with the lower bearing.

NOTE: Arrange the bearings in order.



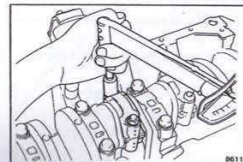
- Clean the crank pin and bearing.
- Check the crank pin and bearing for pits and scratches.

If the crank pin or bearing are damaged replace the bearing and/or crankshaft.



- Lay a strip of Plastigage across the crank pin.

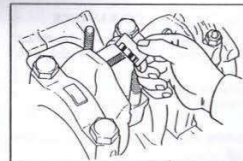
ENGINE MECHANICAL —



- Align and torque.

Torque:

- Do not
- Apply and un

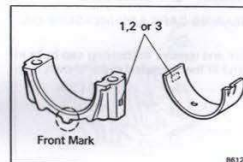


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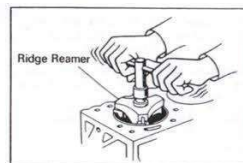
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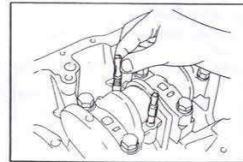
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**18. REMOVE**

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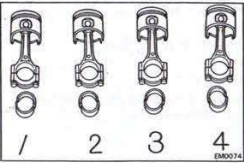
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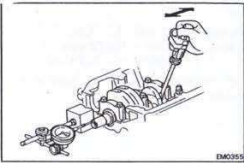
EM-74

ENGINE MECHANICAL — Cylinder Block

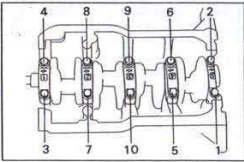


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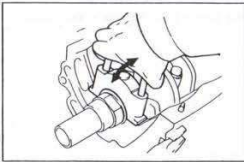
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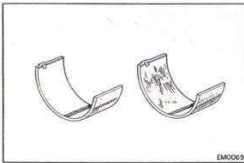
EM0355



4 8 9 6 2
3 7 10 5 1



EM0356



EM0069

(d) Arrange the piston and connecting rod with the rod cap in order.

NOTE: Keep the bearing insert with the rod and rod cap.

19. MEASURE CRANKSHAFT THRUST CLEARANCE

Set a dial indicator as shown and measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Maximum thrust clearance: 0.3 mm (0.012 in.)
Standard thrust clearance: 0.04 – 0.24 mm (0.0016 – 0.0094 in.)

If the clearance is greater than the maximum, replace the thrust washers as set.

Over size thrust washer: O/S 0.125, 0.250

20. REMOVE MAIN BEARING CAPS AND MEASURE OIL CLEARANCE

(a) Gradually loosen and remove the bearing cap bolts in three passes and in the numerical order shown.

(b) Using the removed bearing cap bolts, pry the bearing cap fore-and- aft, and remove it with the lower bearing and thrust washers No. 3 journal only.

(c) Lift out the crankshaft and remove the upper bearings and upper thrust washers (for the No. 3 journal only) from the cylinder block.

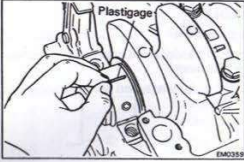
NOTE: Arrange the caps, bearings and thrust washers in order.

(d) Clean each journal and bearing.

(e) Check each journal and bearing for pits and scratches.

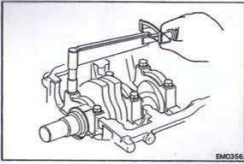
If the journal or bearing are damaged, replace the bearing and/or crankshaft.

ENGINE MECHANICAL

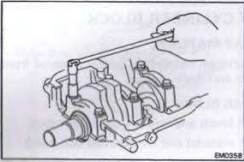


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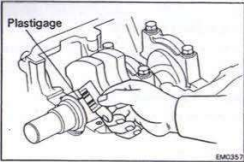
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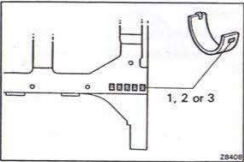


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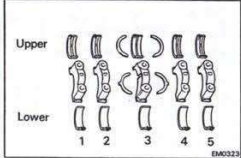
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EM-76ENGINE MECHANICAL — Cylinder Block



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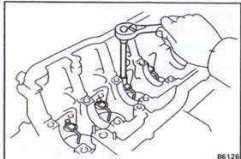
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21. REMOVE CRANKSHAFT

(a) Remove the crankshaft.

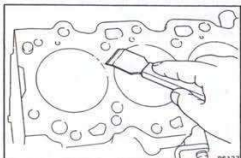
(b) Remove the upper bearings and upper thrust washers from the cylinder block.

(c) Arrange the caps, bearings and thrust washers in order.



86120

22. REMOVE OIL NOZZLES



86121

INSPECTION OF CYLINDER BLOCK

1. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all gasket material from the cylinder block surface.

2. CLEAN CYLINDER BLOCK

(a) Using a soft brush and solvent, clean the block.

(b) Blow gasket material and oil from the bolt holes.

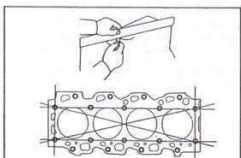
WARNING: Protect your eyes when using high pressure air.

3. INSPECT TOP OF CYLINDER BLOCK

Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

Maximum warpage: 0.20 mm (0.0079 in.)

If warpage is greater than maximum, replace the cylinder block.

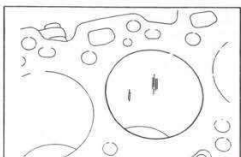


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4. INSPECT CYLINDERS

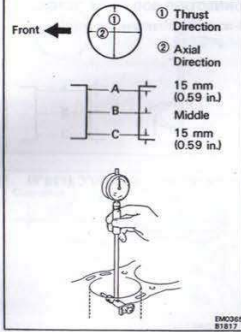
Visually inspect the cylinders for vertical scratches.

If deep scratches are present, rebore all four cylinders. (See page EM-82)



86123

ENGINE MECHANIC



Front

① Thrust Direction

② Axial Direction

A 15 mm (0.59 in.)

B Middle

C 15 mm (0.59 in.)

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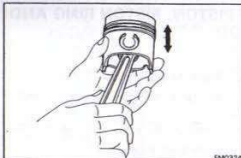
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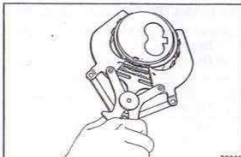
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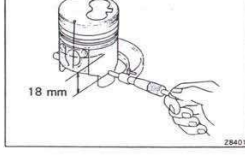
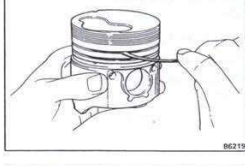
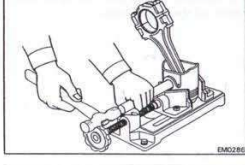
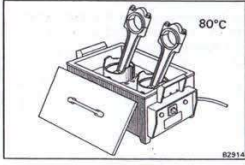
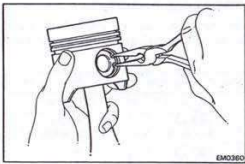
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EM-78

ENGINE MECHANICAL — Cylinder Block



3. DISCONNECT CONNECTING ROD FROM PISTON

(a) Using needle-nose pliers, remove the snap rings.

(b) Gradually heat the piston to about 80°C (176°F).

(c) Using a brass bar and hammer, lightly tap out the piston pin and remove the connecting rod.

(d) Arrange the piston, piston pin, piston ring and connecting rod together for each cylinder.

1. CLEAN PISTON

(a) Scrape carbon from the piston top.

(b) Using a groove cleaning tool or broken ring, clean the ring grooves.

(c) Using solvent and brush, clean the piston thoroughly.

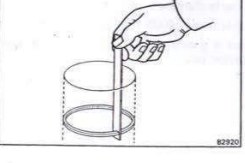
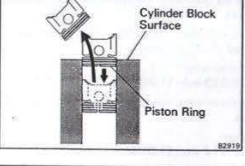
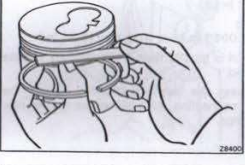
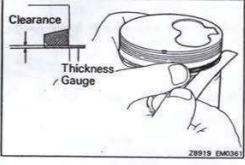
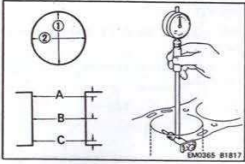
CAUTION: Do not use a wire brush.

2. MEASURE PISTON DIAMETER AND OIL CLEARANCE

(a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 18 mm (0.71 in.) below the piston pin center line.

Piston size	Piston diameter mm (in.)	
	1C series	2C series
STD	82.95 – 82.98 (3.2657 – 3.2669)	85.95 – 85.98 (3.3839 – 3.3850)
O/S 0.50	83.45 – 83.48 (3.2854 – 3.2866)	86.45 – 86.48 (3.4035 – 3.4047)

ENGINE MECHANICAL



3. N/A

(a) N/A

(b) N/A

(c) N/A

(d) N/A

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(a) M

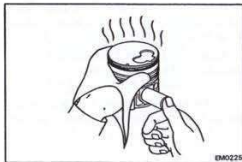
(b) M

(c) M

(d) M

EM-80

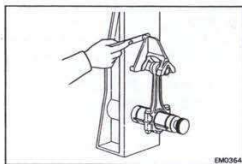
ENGINE MECHANICAL — Cylinder Block



5. CHECK PISTON PIN FIT

At 80°C (176°F), the pin should be able to be pushed into the piston with your thumb.

If the pin can be installed at a normal room temperature, replace the piston and pin.



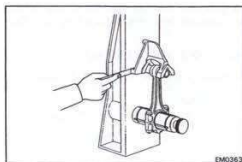
6. INSPECT CONNECTING RODS

(a) Using a connecting rod aligner and feeler gauge, check the rod alignment.

- Check for bend.

Maximum bend:

0.05 mm (0.0020 in.) per 100 mm (3.94 in.)



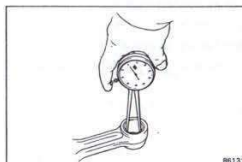
- Check for twist.

Maximum twist:

0.15 mm (0.0059 in.) per 100 mm (3.94 in.)

If the bend or twist is greater than the maximum, replace the connecting rod.

NOTE: If replacing the connecting rods, replace the same number of connecting rod bearings as that of new connecting rod caps.



(b) Measure the oil clearance between the rod bushing and piston pin.

- Using an inside dial indicator, measure the inside diameter of the rod bushing.

Standard inside diameter:

27.011 – 27.023 mm (1.0634 – 1.0639 in.)

- Using a micrometer, measure the diameter of the piston pin.

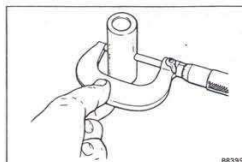
Standard diameter:

27.000 – 27.012 mm (1.0630 – 1.0635 in.)

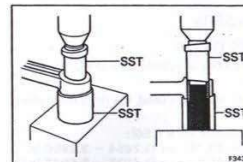
- Subtract the piston pin diameter from the rod bushing inside diameter.

Maximum oil clearance: 0.05 mm (0.0020 in.)

If the oil clearance is greater than maximum, replace the rod bushing or piston pin.



ENGINE MECHANICAL



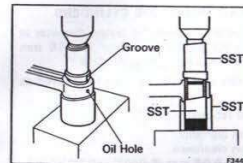
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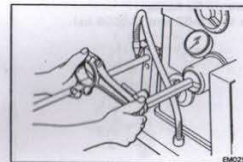
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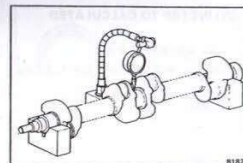
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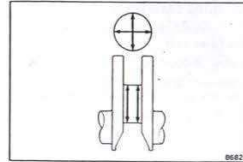
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BORING OF CYLINDERS

1. SELECT OVERSIZED PISTON

If using a O/S piston, bore all cylinders for the O/S piston outside diameter.

NOTE: If oversized pistons are used, the rings must also be oversized.

Oversize piston diameter (O/S 0.50):

1C series 83.45 – 83.48 mm (3.2854 – 3.2866 in.)

2C series 86.45 – 86.48 mm (3.4035 – 3.4047 in.)

2. CALCULATE DIMENSION TO BORE CYLINDERS

(a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 18 mm (0.71 in.) below the piston pin center line.

(b) Calculate the size each cylinder is to be rebored as follows:

Size to be rebored = P + C – H

P = Piston diameter

C = Piston clearance

0.04 – 0.06 mm (0.0016 – 0.0024 in.)

H = Allowance for honing

Less than 0.02 mm (0.0008 in.)

3. BORE AND HONE CYLINDERS TO CALCULATED DIMENSIONS

Maximum honing: 0.02 mm (0.0008 in.)

CAUTION: Excess honing will destroy the finished roundness.

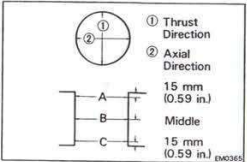
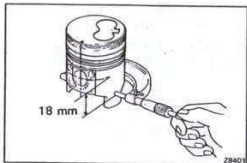
4. INSPECT CYLINDER BORE DIAMETER

(a) The difference between A, B and C measurements is greater than the taper limit.

Taper limit: 0.01 mm (0.0004 in.)

(b) The difference between the thrust and axial measurements is greater than the out-of-round limit.

Out-of-round limit: 0.006 mm (0.0002 in.)



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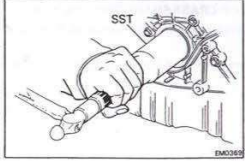
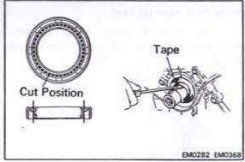
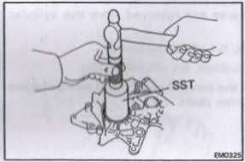
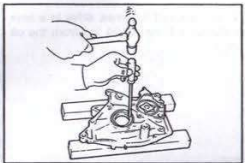
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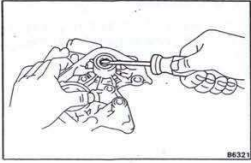
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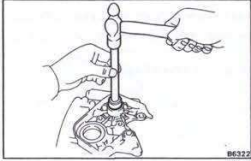
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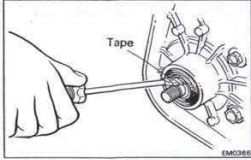


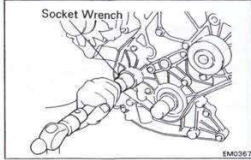
EM-84

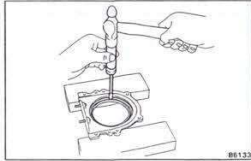
ENGINE MECHANICAL — Cylinder Block


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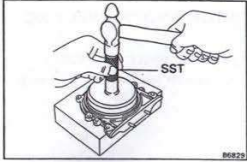

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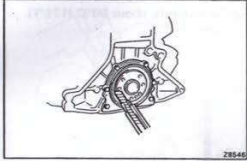
2. REPLACEMENT OF OIL PUMP SEAL
If the oil pump was removed from the cylinder block:
(a) Using a screwdriver, pry off the oil seal.
(b) Apply MP grease to a new oil seal.
(c) Using a socket wrench and hammer, drive in a new oil seal to the depth of 1 mm (0.04 in.) from the oil pump body edge.

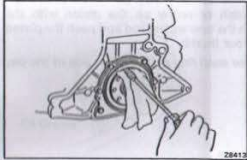
If the oil pump was not removed from the cylinder block:
(a) Using a knife, cut off the oil seal tip.
(b) Using a screwdriver, pry off the oil seal.
CAUTION: Tap the screwdriver tip and be careful not to damage the drive shaft.
(c) Apply MP grease to a new oil seal.
(d) Using a socket wrench and hammer, drive in a new oil seal to the depth of 1 mm (0.04 in.) from the oil pump body edge.

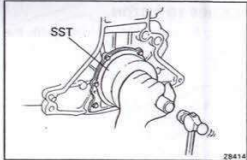
3. REPLACEMENT OF CRANKSHAFT REAR OIL SEAL
If the rear oil seal retainer was removed from the cylinder block:
(a) Using a screwdriver and hammer, drive out the oil seal.

ENGINE MECHANIC


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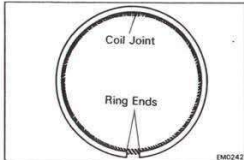
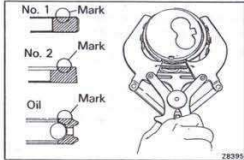
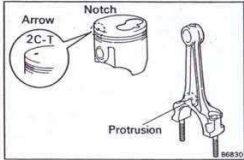
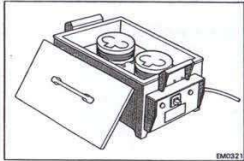
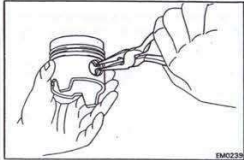
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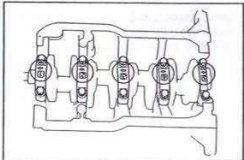
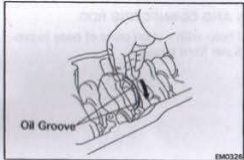
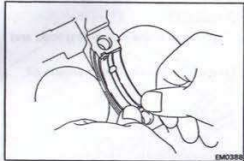
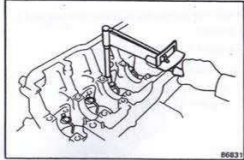
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EM-86ENGINE MECHANICAL — Cylinder Block



ASSEMBLY OF PISTON AND CONNECTING ROD
1. ASSEMBLE PISTON AND CONNECTING ROD
(a) Install a new snap ring on one side of the piston pin hole.
(b) Gradually heat the piston to about 80°C (176°F).
(c) Align the notch or arrow on the piston with the protrusion on the connecting rod and push the piston pin in with your thumb.
(d) Install the new snap ring on the other side of the pin.
2. INSTALL PISTON RINGS TO PISTON
Using a ring expander, install the piston rings with the code marks facing up.
CAUTION: Face the end gap of the oil ring in opposite direction of the coil joint.

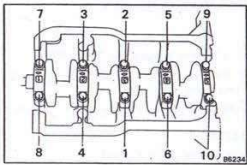
ENGINE MECHANIC



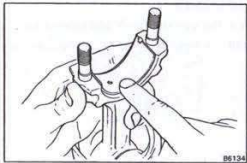
ASSEMBLY
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EM-88

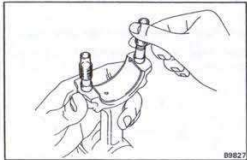
ENGINE MECHANICAL — Cylinder Block



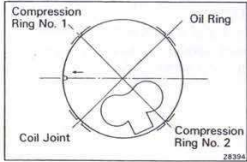
- (d) Install and tighten the cap bolts in three passes and in the sequence shown.
- Torque: 1,050 kg-cm (76 ft-lb, 103 N-m)
- (e) Check that the crankshaft turns.
- (f) Check the crankshaft thrust clearance. (See step 19 on page EM-74)



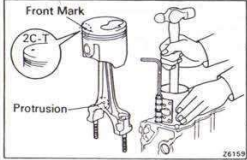
- 5. INSTALL BEARING INSERTS
- (a) Install the bearing inserts in the connecting rods and rod caps.
- (b) Lubricate the face of the bearings with engine oil.



- 6. INSTALL PISTON AND CONNECTING ROD
- (a) Cover the rod bolts with a short piece of hose to protect the crank pin from damage.

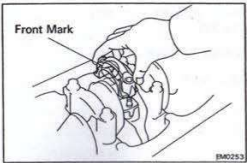


- (b) Position the piston rings so that the ring end gaps are as shown.
- CAUTION: Do not align the end gaps.

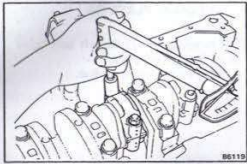


- (c) Using a ring compressor, push the correctly numbered piston and connecting rod into each cylinder with the front mark of the piston facing forward.

ENGINE MECHANICAL



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- (b)



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EM-90

ENGINE MECHANICAL — Cylinder Block

18. INSTALL EACH TIMING PULLEY AND BELT
(See pages EM-32 to 37)

19. REMOVE ENGINE FROM ENGINE STAND

20. INSTALL REAR END PLATE

21. INSTALL FLYWHEEL OR DRIVE PLATE ON
CRANKSHAFT

(a) Clean the set bolt threads and crankshaft bolt holes
of any sealer, oil or foreign particles.
Remove any oil with kerosene or gasoline.

Anaerobic Adhesive
and Sealant

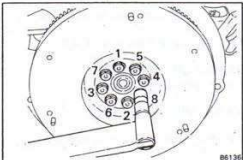


(b) Apply anaerobic adhesive and sealant* [THREE BOND
1324 (Part No. 08833-00070) or equivalent] to 2 or
3 threads of the bolt end.

* This adhesive will not harden while exposed to air.
It will act as a sealer or binding agent only when
applied to threads, etc. and air is cut off.

(c) Install the flywheel or drive plate on the crankshaft.
Tighten the bolts to the specified torque in two or
three passes in the sequence shown.

Torque: Flywheel 900 kg-cm (65 ft-lb, 88 N-m)
Drive plate 750 kg-cm (54 ft-lb, 74 N-m)



22. INSTALL CLUTCH DISC AND COVER (M/T only)

<https://cardiagn.com/engine-mechanical-c-engine/>

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