

# Engine Workshop Manual MZR-CD (RF Turbo)

## FOREWORD

This manual explains the disassembly, inspection, repair, and reassembly procedures for the above-indicated engine. In order to do these procedures safely, quickly, and correctly, you must first read this manual and any other relevant service materials carefully.

The information in this manual is current up to April, 2002. Any changes that occur after that time will not be reflected in this particular manual. Therefore, the contents of this manual may not exactly match the mechanism that you are currently servicing.

**Mazda Motor Corporation  
HIROSHIMA, JAPAN**

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## **WARNING**

Servicing a vehicle can be dangerous. If you have not received service-related training, the risks of injury, property damage, and failure of servicing increase. The recommended servicing procedures for the vehicle in this workshop manual were developed with Mazda-trained technicians in mind. This manual may be useful to non-Mazda trained technicians, but a technician with our service-related training and experience will be at less risk when performing service operations. However, all users of this manual are expected to at least know general safety procedures.

This manual contains "Warnings" and "Cautions" applicable to risks not normally encountered in a general technician's experience. They should be followed to reduce the risk of injury and the risk that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that the "Warnings" and "Cautions" are not exhaustive. It is impossible to warn of all the hazardous consequences that might result from failure to follow the procedures.

The procedures recommended and described in this manual are effective methods of performing service and repair. Some require tools specifically designed for a specific purpose. Persons using procedures and tools which are not recommended by Mazda Motor Corporation must satisfy themselves thoroughly that neither personal safety nor safety of the vehicle will be jeopardized.

The contents of this manual, including drawings and specifications, are the latest available at the time of printing, and Mazda Motor Corporation reserves the right to change the vehicle designs and alter the contents of this manual without notice and without incurring obligation.

Parts should be replaced with genuine Mazda replacement parts or with parts which match the quality of genuine Mazda replacement parts. Persons using replacement parts of lesser quality than that of genuine Mazda replacement parts must satisfy themselves thoroughly that neither personal safety nor safety of the vehicle will be jeopardized.

Mazda Motor Corporation is not responsible for any problems which may arise from the use of this manual. The cause of such problems includes but is not limited to insufficient service-related training, use of improper tools, use of replacement parts of lesser quality than that of genuine Mazda replacement parts, or not being aware of any revision of this manual.

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## HOW TO USE THIS MANUAL

### HOW TO USE THIS MANUAL

#### RANGE OF TOPICS

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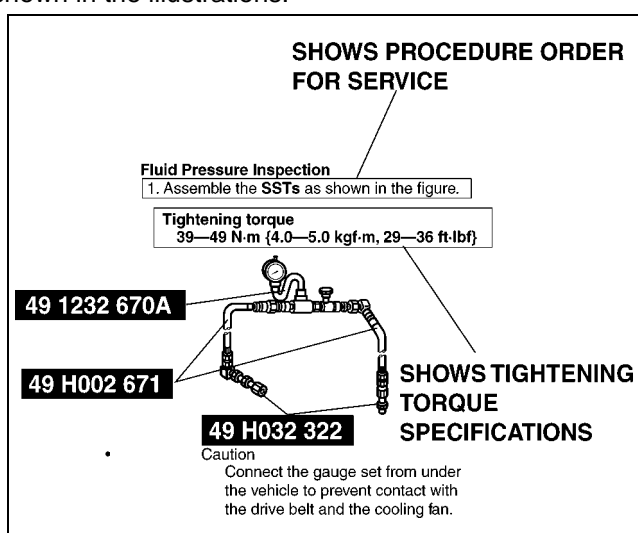
- This manual contains procedures for performing all required service operations. The procedures are divided into the following five basic operations:
  - Removal/Installation
  - Disassembly/Assembly
  - Replacement
  - Inspection
  - Adjustment
- Simple operations which can be performed easily just by looking at the vehicle (i.e., removal/installation of parts, jacking, vehicle lifting, cleaning of parts and visual inspection) have been omitted.

#### SERVICE PROCEDURE

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##### Inspection, adjustment

- Inspection and adjustment procedures are divided into steps. Important points regarding the location and contents of the procedures are explained in detail and shown in the illustrations.



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#### Repair procedure

1. Most repair operations begin with an overview illustration. It identifies the components, shows how the parts fit together and describes visual part inspection. However, only removal/installation procedures that need to be performed methodically have written instructions.
2. Expendable parts, tightening torques and symbols for oil, grease, and sealant are shown in the overview illustration. In addition, symbols indicating parts requiring the use of special service tools or equivalent are also shown.

# HOW TO USE THIS MANUAL

3. Procedure steps are numbered and the part that is the main point of that procedure is shown in the illustration with the corresponding number. Occasionally, there are important points or additional information concerning a procedure. Refer to this information when servicing the related part.

GI

**Procedure**

**SHOWS SERVICE ITEM (S)**

**INDICATES ANY RELEVANT REFERENCES WHICH NEED TO BE FOLLOWED DURING INSTALLATION**

**SHOWS SPECIAL SERVICE TOOL(SST) FOR SERVICE OPERATION**

**SHOWS APPLICATION POINTS OF GREASE, ETC.**

**SHOWS EXPENDABLE PARTS**

**SHOWS DETAILS**

**SHOWS TIGHTENING TORQUE UNITS**

**SHOWS THERE ARE REFERRAL NOTES FOR SERVICE**

**SHOWS REFERRAL NOTES FOR SERVICE**

**"Removal/Installation" Portion**

**"Inspection After Installation" Portion**

**INSTALL THE PARTS BY PERFORMING STEPS 1-3 IN REVERSE ORDER**

**LOWER TRAILING LINK, UPPER TRAILING LINK REMOVAL/INSTALLATION**

1. Jack up the rear of the vehicle and support it with safety stands.
2. Remove the undercover. (See U-5 Undercover Removal)
3. Removes in the order indicated in the table.
4. Install in the reverse order of removal.
5. Inspect the rear wheel alignment and adjust it if necessary.

**SHOWS PROCEDURE ORDER FOR SERVICE**

**SHOWS TIGHTENING TORQUE SPECIFICATIONS**

**SHOWS TIGHTENING TORQUE UNITS**

**SHOWS SPECIAL SERVICE TOOL(SST) FOR SERVICE OPERATION**

**SHOWS APPLICATION POINTS OF GREASE, ETC.**

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**SHOWS DETAILS**

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**SHOWS THERE ARE REFERRAL NOTES FOR SERVICE**

**SHOWS REFERRAL NOTES FOR SERVICE**

1 Split pin	7 Split pin
2 Nut	8 Nut
3 Lower trailing link ball joint (See R-6 Lower Trailing Link Ball Joint Removal Note)	9 Upper trailing link ball joint (See R-6 Upper Trailing Link Ball Joint Removal Note)
4 Bolt	10 Nut
5 Lower trailing link	11 Upper trailing link
6 Dust boot (lower trailing link)	12 Dust boot (upper trailing link)

**Lower Trailing Link Ball Joint, Upper Trailing Link Ball Joint Removal Note**

- Remove the ball joint using the SSTs.

**SHOWS SPECIAL SERVICE TOOL(SST) NO.**

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## SYMBOLS

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• There are eight symbols indicating oil, grease, fluids, sealant, and SST or equivalent use. These symbols show application points or use of these materials during service.

Symbol	Meaning	Kind
	Apply oil	New appropriate engine oil or gear oil
	Apply brake fluid	New appropriate brake fluid

## HOW TO USE THIS MANUAL

Symbol	Meaning	Kind
	Apply automatic transaxle/transmission fluid	New appropriate automatic transaxle/transmission fluid
	Apply grease	Appropriate grease
	Apply sealant	Appropriate sealant
	Apply petroleum jelly	Appropriate petroleum jelly
	Replace part	O-ring, gasket, etc.
	Use SST or equivalent	Appropriate tools

### ADVISORY MESSAGES

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- You'll find several **Warnings**, **Cautions**, **Notes**, **Specifications** and **Upper and Lower Limits** in this manual.

#### Warning

- A Warning indicates a situation in which serious injury or death could result if the warning is ignored.

#### Caution

- A Caution indicates a situation in which damage to the vehicle or parts could result if the caution is ignored.

#### Note

- A Note provides added information that will help you to complete a particular procedure.

#### Specification

- The values indicate the allowable range when performing inspections or adjustments.

#### Upper and lower limits

- The values indicate the upper and lower limits that must not be exceeded when performing inspections or adjustments.

# UNITS

UNITS
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## UNITS

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Electrical current	A (ampere)
Electric power	W (watt)
Electric resistance	ohm
Electric voltage	V (volt)
Length	mm (millimeter)
	in (inch)
Negative pressure	kPa (kilo pascal)
	mmHg (millimeters of mercury)
	inHg (inches of mercury)
Positive pressure	kPa (kilo pascal)
	kgf/cm <sup>2</sup> (kilogram force per square centimeter)
	psi (pounds per square inch)
Torque	N·m (Newton meter)
	kgf·m (kilogram force meter)
	kgf·cm (kilogram force centimeter)
	ft·lbf (foot pound force)
	in·lbf (inch pound force)
Volume	L (liter)
	US qt (U.S. quart)
	Imp qt (Imperial quart)
	ml (milliliter)
	cc (cubic centimeter)
	cu in (cubic inch)
	fl oz (fluid ounce)
Weight	g (gram)
	oz (ounce)

### Conversion to SI Units (Système International d'Unités)

- All numerical values in this manual are based on SI units. Numbers shown in conventional units are converted from these values.

### Rounding Off

- Converted values are rounded off to the same number of places as the SI unit value. For example, if the SI unit value is 17.2 and the value after conversion is 37.84, the converted value will be rounded off to 37.8.

### Upper and Lower Limits

- When the data indicates upper and lower limits, the converted values are rounded down if the SI unit value is an upper limit and rounded up if the SI unit value is a lower limit. Therefore, converted values for the same SI unit value may differ after conversion. For example, consider 2.7 kgf/cm<sup>2</sup> in the following specifications:

**210—260 kPa {2.1—2.7 kgf/cm<sup>2</sup>, 30—38 psi}**  
**270—310 kPa {2.7—3.2 kgf/cm<sup>2</sup>, 39—45 psi}**

- The actual converted values for 2.7 kgf/cm<sup>2</sup> are 264 kPa and 38.4 psi. In the first specification, 2.7 is used as an upper limit, so the converted values are rounded down to 260 and 38. In the second specification, 2.7 is used as a lower limit, so the converted values are rounded up to 270 and 39.

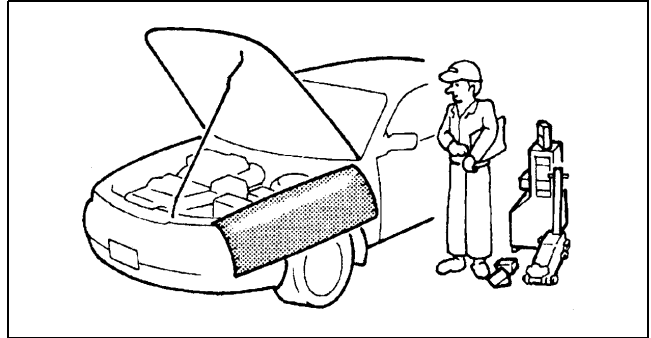
## FUNDAMENTAL PROCEDURES

### FUNDAMENTAL PROCEDURES

#### PREPARATION OF TOOLS AND MEASURING EQUIPMENT

- Be sure that all necessary tools and measuring equipment are available before starting any work.

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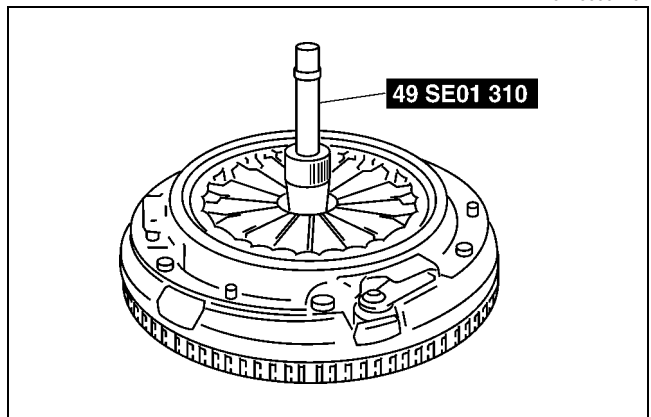


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#### SPECIAL SERVICE TOOLS

- Use special service tools or equivalent when they are required.

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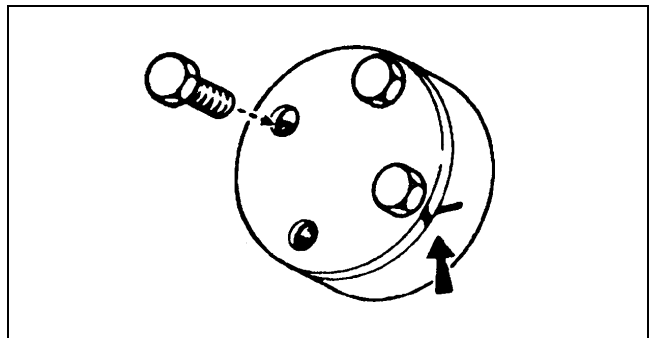


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#### DISASSEMBLY

- If the disassembly procedure is complex, requiring many parts to be disassembled, all parts should be marked in a place that will not affect their performance or external appearance and identified so that reassembly can be performed easily and efficiently.

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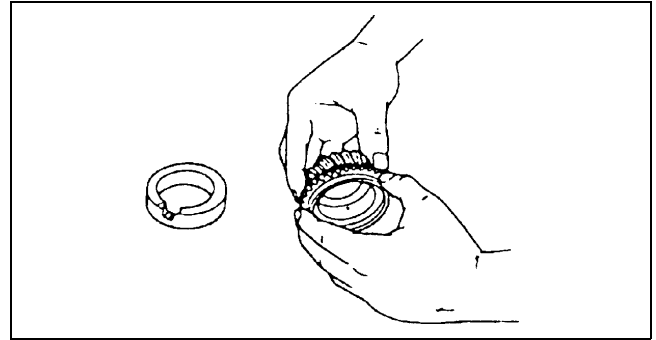


## FUNDAMENTAL PROCEDURES

### INSPECTION DURING REMOVAL, DISASSEMBLY

- When removed, each part should be carefully inspected for malfunction, deformation, damage, and other problems.

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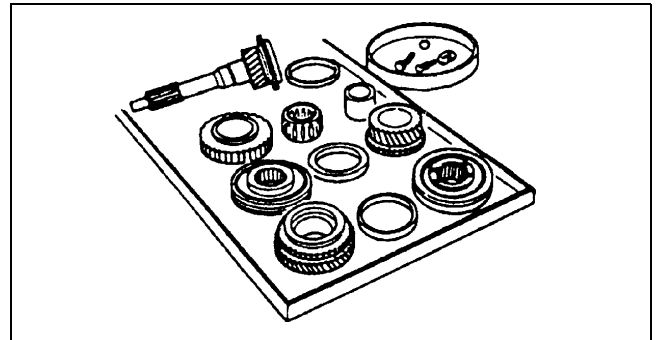


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### ARRANGEMENT OF PARTS

- All disassembled parts should be carefully arranged for reassembly.
- Be sure to separate or otherwise identify the parts to be replaced from those that will be reused.

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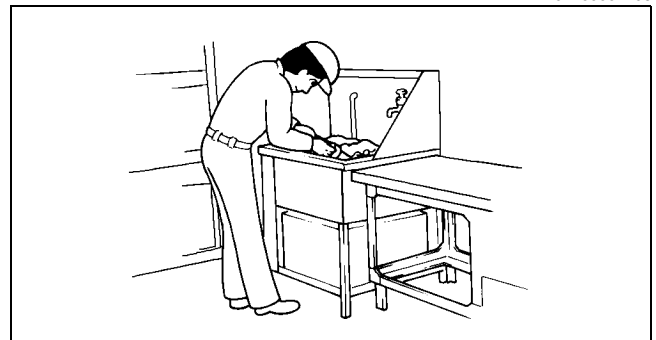
### CLEANING OF PARTS

- All parts to be reused should be carefully and thoroughly cleaned in the appropriate method.

#### Warning

- **Using compressed air can cause dirt and other particles to fly out causing injury to the eyes. Wear protective eye wear whenever using compressed air.**

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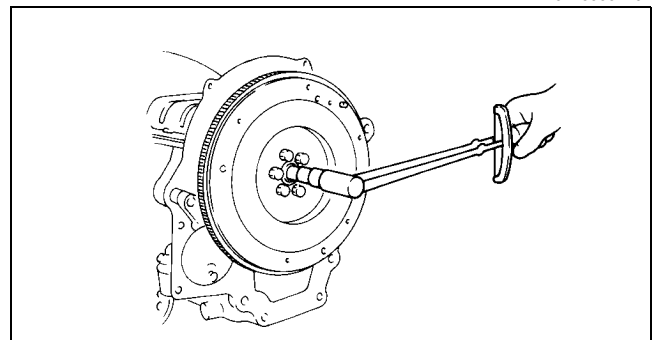


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### REASSEMBLY

- Standard values, such as torques and certain adjustments, must be strictly observed in the reassembly of all parts.
- If removed, these parts should be replaced with new ones:
  - Oil seals
  - Gaskets
  - O-rings
  - Lockwashers
  - Cotter pins
  - Nylon nuts

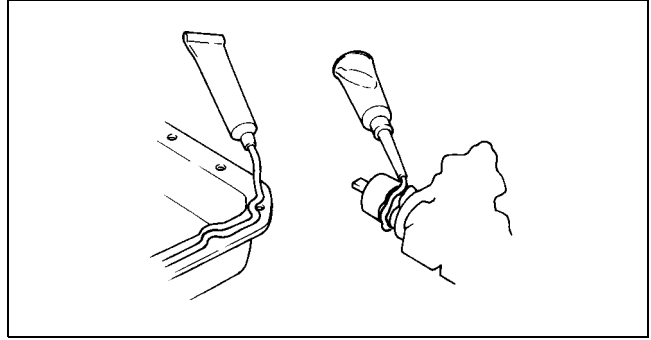
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## FUNDAMENTAL PROCEDURES

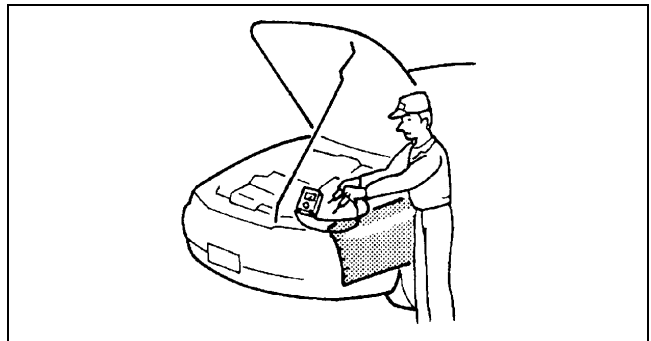
- Depending on location:
  - Sealant and gaskets, or both, should be applied to specified locations. When sealant is applied, parts should be installed before sealant hardens to prevent leakage.
  - Oil should be applied to the moving components of parts.
  - Specified oil or grease should be applied at the prescribed locations (such as oil seals) before reassembly.



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### ADJUSTMENT

- Use suitable gauges and/or testers when making adjustments.

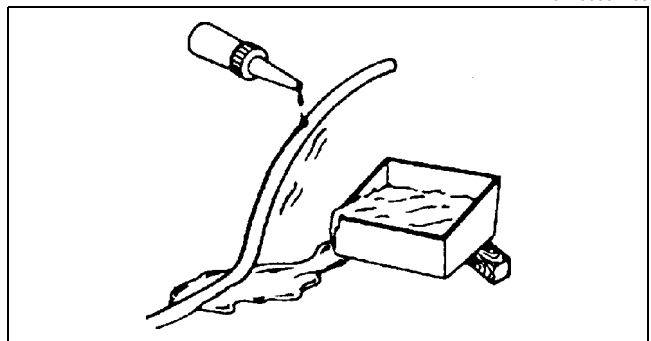


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### RUBBER PARTS AND TUBING

- Prevent gasoline or oil from getting on rubber parts or tubing.

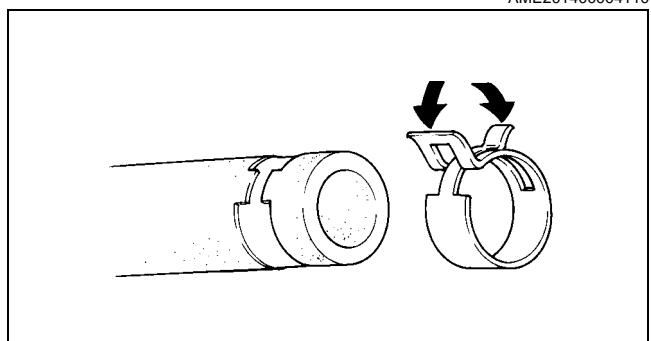


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### HOSE CLAMPS

- When reinstalling, position the hose clamp in the original location on the hose and squeeze the clamp lightly with large pliers to ensure a good fit.



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## FUNDAMENTAL PROCEDURES

### TORQUE FORMULAS

- When using a torque wrench-**SST** or equivalent combination, the written torque must be recalculated due to the extra length that the **SST** or equivalent adds to the torque wrench. Recalculate the torque using the following formulas. Choose the formula that applies to you.

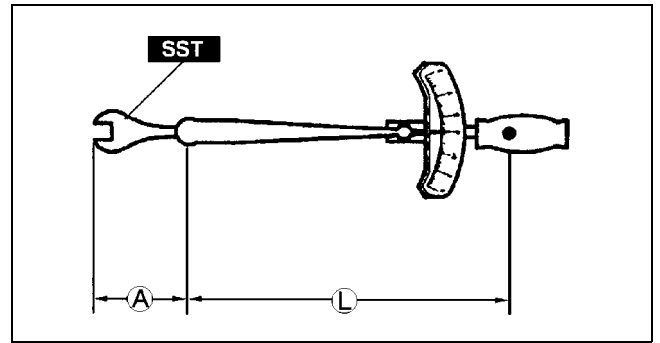
Torque Unit	Formula
N·m	$N\cdot m \times [L/(L+A)]$
kgf·m	$kgf\cdot m \times [L/(L+A)]$
kgf·cm	$kgf\cdot cm \times [L/(L+A)]$
ft·lbf	$ft\cdot lbf \times [L/(L+A)]$
in·lbf	$in\cdot lbf \times [L/(L+A)]$

- A : The length of the **SST** past the torque wrench drive  
 L : The length of the torque wrench

### WISE

- When using a vise, put protective plates in the jaws of the vise to prevent damage to parts.

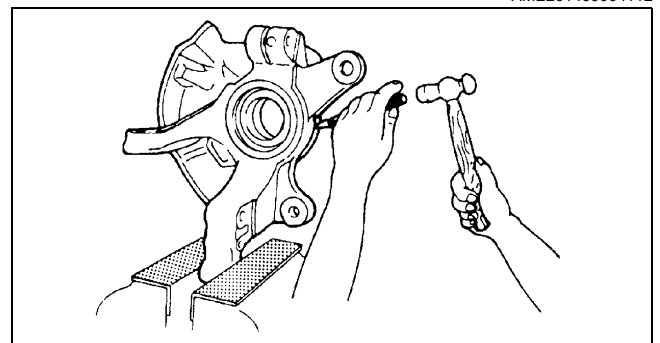
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## ELECTRICAL SYSTEM

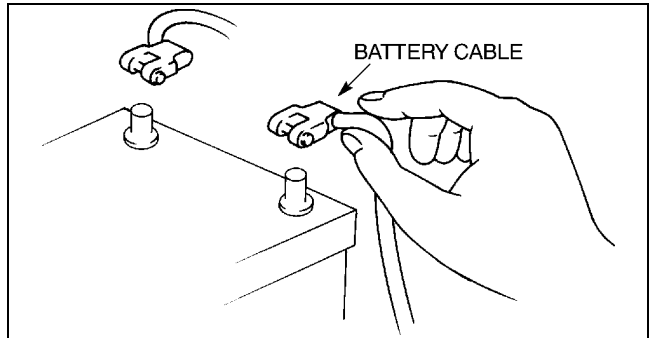
### ELECTRICAL SYSTEM

#### ELECTRICAL PARTS

AME201700006101

##### Battery cable

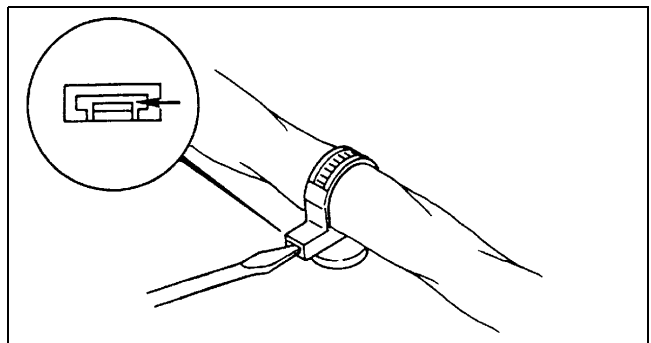
- Before disconnecting connectors or removing electrical parts, disconnect the negative battery cable.



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##### Wiring Harness

- To remove the wiring harness from the clip in the engine room, pry up the hook of the clip using a flathead screwdriver.



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#### CONNECTORS

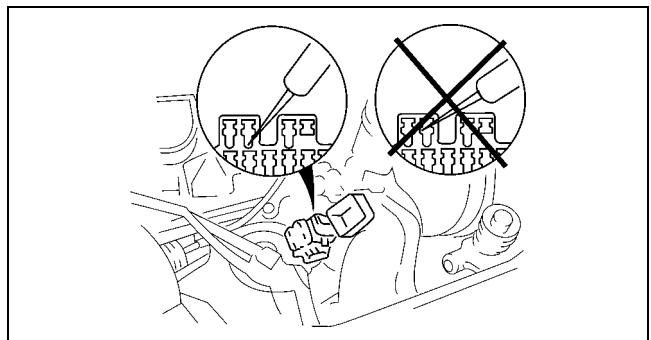
##### Data link connector

AME201700006102

- Insert the probe into the terminal when connecting a jumper wire to the data link connector.

##### Caution

- Inserting a jumper wire probe into the data link connector terminal may damage the terminal.

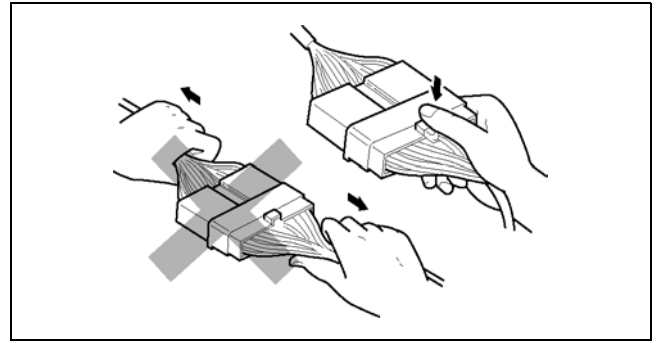


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## ELECTRICAL SYSTEM

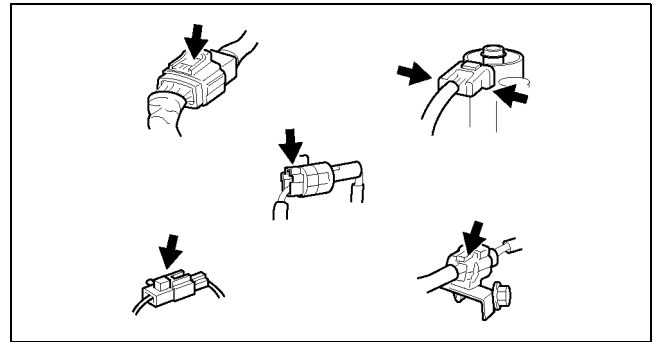
### Disconnecting connectors

- When disconnecting connector, grasp the connectors, not the wires.



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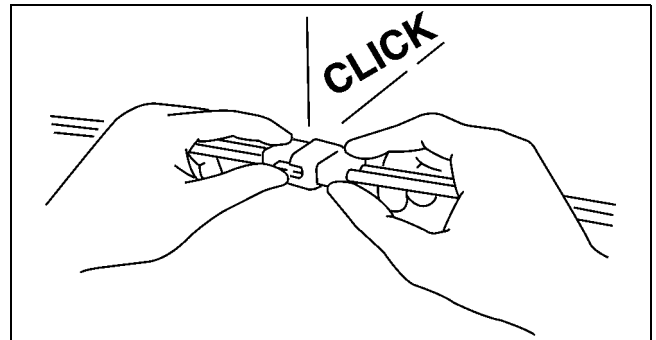
- Connectors can be disconnected by pressing or pulling the lock lever as shown.



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### Locking connector

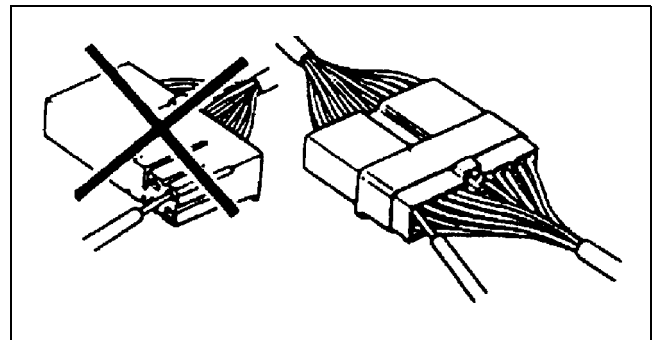
- When locking connectors, listen for a click indicating they are securely locked.



X3U000WB1

### Inspection

- When a tester is used to inspect for continuity or measuring voltage, insert the tester probe from the wiring harness side.



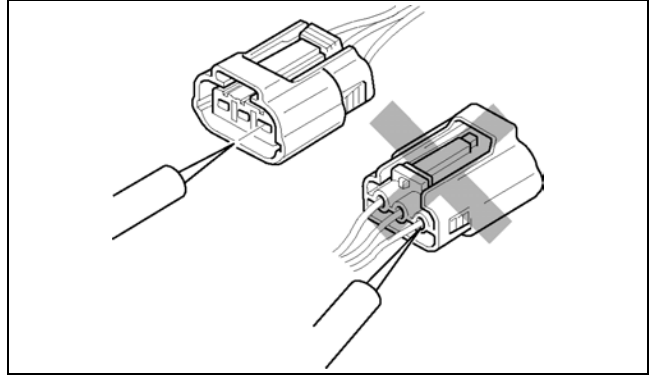
X3U000WB2

## ELECTRICAL SYSTEM

- Inspect the terminals of waterproof connectors from the connector side since they cannot be accessed from the wiring harness side.

### Caution

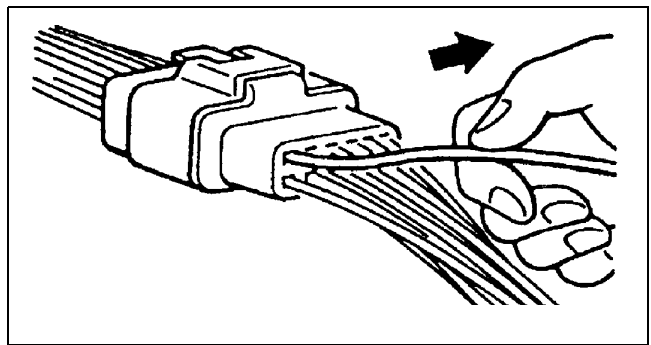
- To prevent damage to the terminal, wrap a thin wire around the tester probe before inserting into terminal.



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### Terminals Inspection

- Pull lightly on individual wires to verify that they are secured in the terminal.



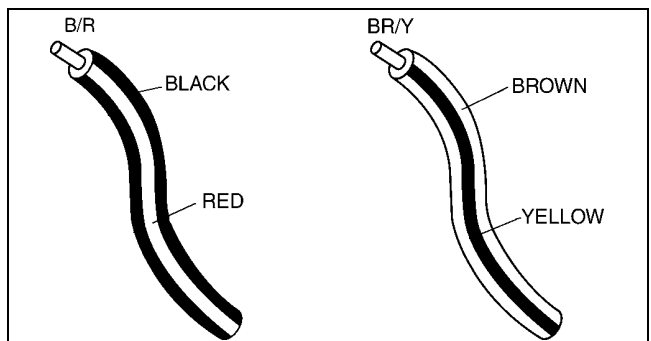
X3U000WB4

### Wiring Harness

#### Wiring color codes

- Two-color wires are indicated by a two-color code symbol.
- The first letter indicates the base color of the wire and the second the color of the stripe.

CODE	COLOR	CODE	COLOR
B	Black	O	Orange
BR	Brown	P	Pink
G	Green	R	Red
GY	Gray	V	Violet
L	Blue	W	White
LB	Light Blue	Y	Yellow
LG	Light Green		



X3U000WB7

## NEW STANDARDS

### NEW STANDARDS

#### NEW STANDARDS

AME202800020101

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- Following is a comparison of the previous standard and the new standard.

New Standard		Previous Standard		Remark
Abbreviation	Name	Abbreviation	Name	
AP	Accelerator Pedal	—	Accelerator Pedal	
ACL	Air Cleaner	—	Air Cleaner	
A/C	Air Conditioning	—	Air Conditioning	
BARO	Barometric Pressure	—	Atmospheric Pressure	
B+	Battery Positive Voltage	Vb	Battery Voltage	
—	Brake Switch	—	Stoplight Switch	
—	Calibration Resistor	—	Corrected Resistance	#6
CMP sensor	Camshaft Position Sensor	—	Crank Angle Sensor	
CAC	Charge Air Cooler	—	Intercooler	
CLS	Closed Loop System	—	Feedback System	
CTP	Closed Throttle Position	—	Fully Closed	
CPP	Clutch Pedal Position	—	Idle Switch	
CIS	Continuous Fuel Injection System	—	Clutch Position	
CS sensor	Control Sleeve Sensor	CSP sensor	Control Sleeve Position Sensor	#6
CKP sensor	Crankshaft Position Sensor	—	Crank Angle Sensor 2	
DLC	Data Link Connector	—	Diagnosis Connector	
DTM	Diagnostic Test Mode	—	Test Mode	#1
DTC	Diagnostic Trouble Code(s)	—	Service Code(s)	
DI	Distributor Ignition	—	Spark Ignition	
DLI	Distributorless Ignition	—	Direct Ignition	
EI	Electronic Ignition	—	Electronic Spark Ignition	#2
ECT	Engine Coolant Temperature	—	Water Thermo	
EM	Engine Modification	—	Engine Modification	
—	Engine Speed Input Signal	—	Engine RPM Signal	
EVAP	Evaporative Emission	—	Evaporative Emission	
EGR	Exhaust Gas Recirculation	—	Exhaust Gas Recirculation	
FC	Fan Control	—	Fan Control	
FF	Flexible Fuel	—	Flexible Fuel	
4GR	Fourth Gear	—	Overdrive	
—	Fuel Pump Relay	—	Circuit Opening Relay	#3
FSO solenoid	Fuel Shut Off Solenoid	FCV	Fuel Cut Valve	#6
GEN	Generator	—	Alternator	
GND	Ground	—	Ground/Earth	
HO2S	Heated Oxygen Sensor	—	Oxygen Sensor	With heater
IAC	Idle Air control	—	Idle Speed Control	
—	IDM Relay	—	Spill Valve Relay	#6
—	Incorrect Gear Ratio	—	—	
—	Injection Pump	FIP	Fuel Injection Pump	#6
—	Input/Turbine Speed Sensor	—	Pulse Generator	
IAT	Intake Air Temperature	—	Intake Air Thermo	
KS	Knock Sensor	—	Knock Sensor	
MIL	Malfunction Indicator Lamp	—	Malfunction Indicator Light	
MAP	Manifold Absolute Pressure	—	Intake Air Pressure	
MAF sensor	Mass Air Flow Sensor	—	Airflow Sensor	
MFL	Multiport Fuel Injection	—	Multiport Fuel Injection	
OBD	On-Board Diagnostic	—	Diagnosis/SelfDiagnosis	
OL	Open Loop	—	Open Loop	

## NEW STANDARDS

New Standard		Previous Standard		Remark
Abbreviation	Name	Abbreviation	Name	
—	Output Speed Sensor	—	Vehicle Speed Sensor 1	
OC	Oxidation Catalytic Converter	—	Catalytic Converter	
O2S	Oxygen Sensor	—	Oxygen Sensor	
PNP	Park/Neutral Position	—	Park/Neutral Range	
—	PCM Control Relay	—	Main Relay	#6
PSP	Power Steering Pressure	—	Power Steering Pressure	
PCM	Powertrain Control Module	ECU	Engine Control Unit	#4
—	Pressure Control Solenoid	—	Line Pressure Solenoid Valve	
PAIR	Pulsed Secondary Air Injection	—	Secondary Air Injection System	Pulsed injection
—	Pump Speed Sensor	—	NE Sensor	#6
AIR	Secondary Air Injection	—	Secondary Air Injection System	Injection with air pump
SAPV	Secondary Air Pulse Valve	—	Reed Valve	
SFI	Sequential Multipoint Fuel Injection	—	Sequential Fuel Injection	
—	Shift Solenoid A	—	1–2 Shift Solenoid Valve	
		—	Shift A Solenoid Valve	
—	Shift Solenoid B	—	2–3 Shift Solenoid Valve	
		—	Shift B Solenoid Valve	
—	Shift Solenoid C	—	3–4 Shift Solenoid Valve	
3GR	Third Gear	—	3rd Gear	
TWC	Three Way Catalytic Converter	—	Catalytic Converter	
TB	Throttle Body	—	Throttle Body	
TP sensor	Throttle Position Sensor	—	Throttle Sensor	
TCV	Timer Control Valve	TCV	Timing Control Valve	#6
TCC	Torque Converter Clutch	—	Lockup Position	
TCM	Transmission (Transaxle) Control Module	—	ECAT Control Unit	
—	Transmission (Transaxle) Fluid Temperature Sensor	—	ATF Thermosensor	
TR	Transmission (Transaxle) Range	—	Inhibitor Position	
TC	Turbocharger	—	Turbocharger	
VSS	Vehicle Speed Sensor	—	Vehicle Speed Sensor	
VR	Voltage Regulator	—	IC Regulator	
VAF sensor	Volume Air Flow Sensor	—	Air flow Sensor	
WUTWC	Warm Up Three Way Catalytic Converter	—	Catalytic Converter	#5
WOT	Wide Open Throttle	—	Fully Open	

#1 : Diagnostic trouble codes depend on the diagnostic test mode

#2 : Controlled by the PCM

#3 : In some models, there is a fuel pump relay that controls pump speed. That relay is now called the fuel pump relay (speed).

#4 : Device that controls engine and powertrain

#5 : Directly connected to exhaust manifold

#6 : Part name of diesel engine



## ABBREVIATIONS

### ABBREVIATIONS

#### ABBREVIATIONS

AME203000011101

BDC	Bottom dead center
EX	Exhaust
IN	Intake
max	Maximum
min	Minimum
SST	Special service tool
TDC	Top dead center

GI

# ENGINE

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# ENGINE

## ENGINE

### ENGINE OVERHAUL SERVICE WARNING

AME222402000101

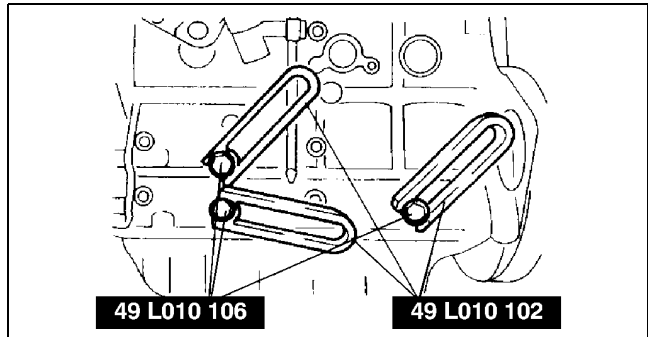
#### Warning

- Continuous exposure with USED engine oil has caused skin cancer in laboratory mice. Protect your skin by washing with soap and water immediately after this work.

### MOUNTING

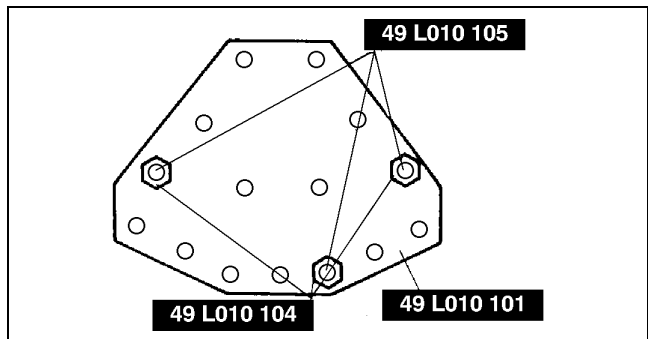
1. Install the **SST** (arms) to the cylinder block holes as shown, and hand-tighten the **SST** (bolts).

AME222402000102



AME2524E001

2. Assemble the **SSTs** (bolts, nuts, and plate) to the specified positions.
3. Install the **SSTs** (bolts, nuts, and plate) assembled in Step 2 to the **SSTs** (arms) installed in Step 1.
4. Adjust the **SSTs** (bolts) so that the thread is exposed less than 20 mm {0.79 in}.
5. Make the **SSTs** (plate and arms) parallel by adjusting the **SSTs** (bolts and nuts).

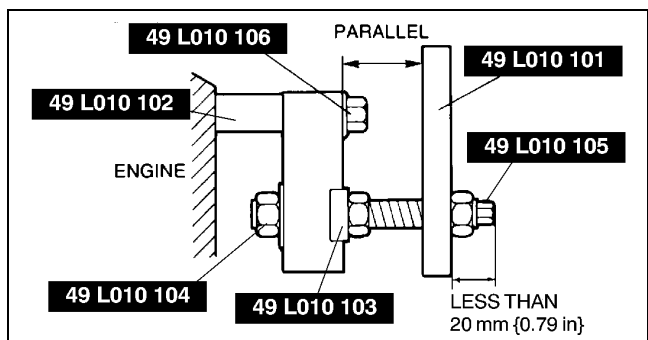


AME2524E002

6. Tighten the **SSTs** (bolts and nuts) to affix the **SST** firmly.

#### Warning

- The self-locking brake system of the engine stand may not be effective when the engine is held in an unbalanced position. This could lead to sudden, rapid movement of the engine and mounting stand handle and cause serious injury. Never keep the engine in an unbalanced position, and always hold the rotating handle firmly when turning the engine.

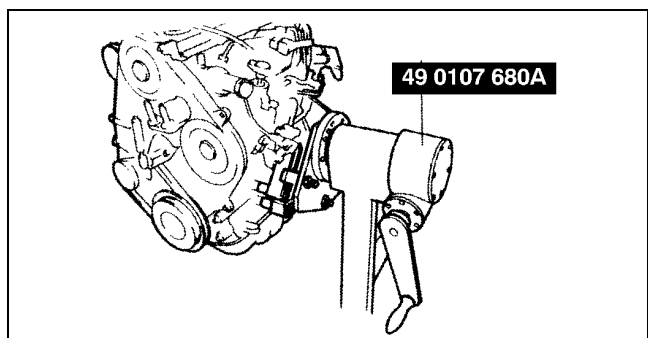


AME2524E003

7. Mount the engine on the **SST** (engine stand).
8. Drain the engine oil into a container.
9. Install the drain plug and a new washer.

#### Tightening torque

30—41 N·m {3.0—42 kgf·m, 22—30 ft·lbn}



AME2524E004

# ENGINE

## ENGINE DISMOUNTING

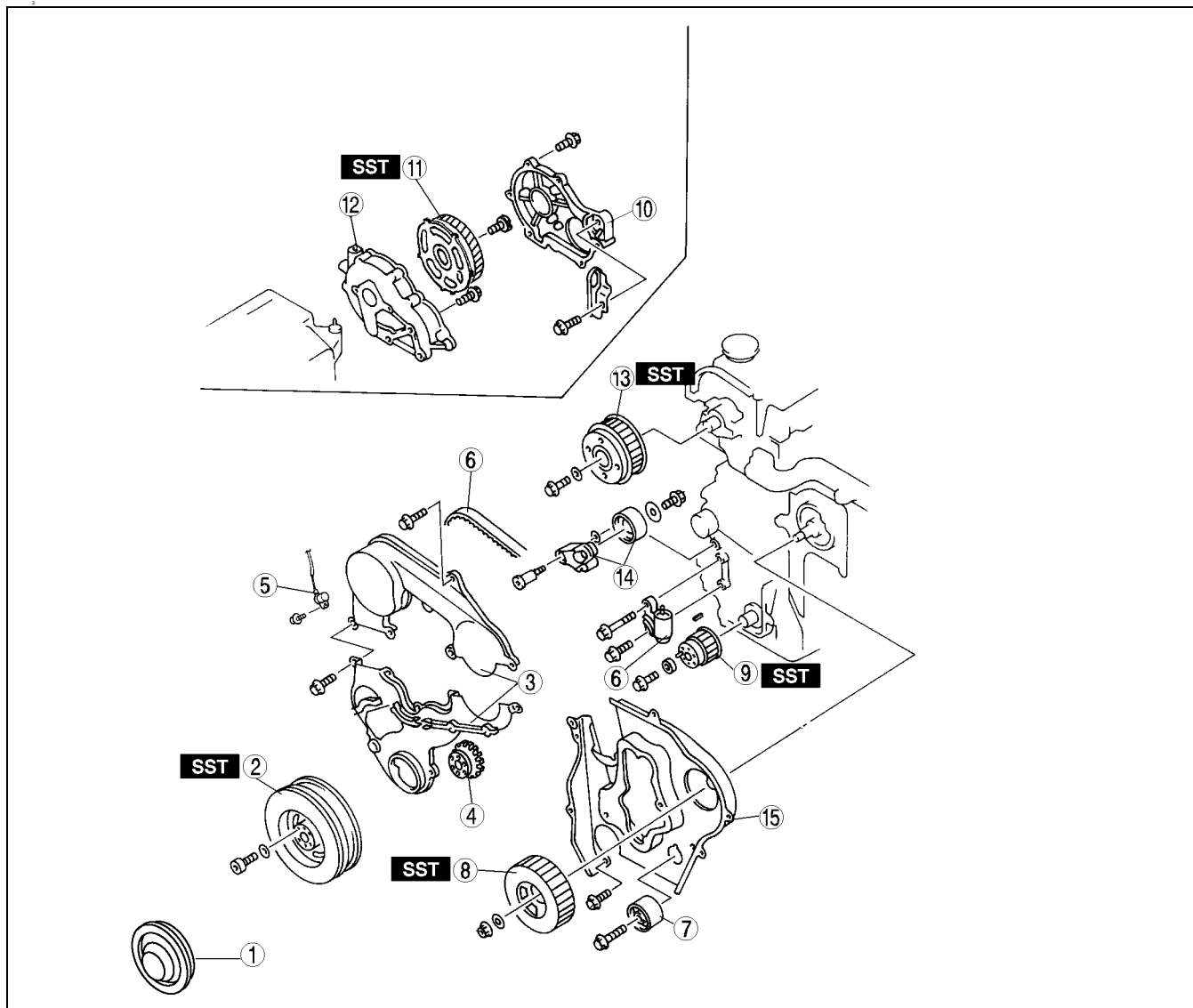
AME222402000103

1. Dismount in the reverse order of mounting.

## TIMING BELT DISASSEMBLY

AME222402000112

1. Disassemble in the order indicated in the table.



AME2516E001

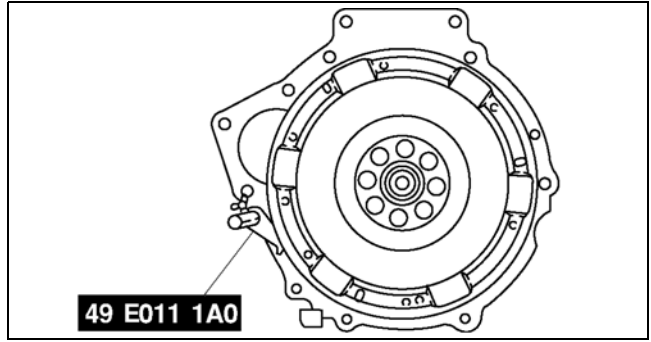
1	Pulley cover
2	Crankshaft pulley (See <a href="#">B-4 Crankshaft Pulley Disassembly Note</a> )
3	Timing belt cover
4	Guide plate
5	Crankshaft position sensor
6	Timing belt, timing belt auto tensioned (See <a href="#">B-4 Timing Belt, Timing Belt Auto Tensioner Disassembly Note</a> )
7	Idler
8	Injection pump pulley (See <a href="#">B-5 Injection Pump Pulley Disassembly Note</a> )

9	Timing belt pulley (See <a href="#">B-5 Timing Belt Pulley Disassembly Note</a> )
10	Gear cover
11	Drive gear (See <a href="#">B-6 Drive Gear Disassembly Note</a> )
12	Gear case
13	Camshaft pulley (See <a href="#">B-6 Camshaft Pulley Disassembly Note</a> )
14	Tensioner
15	Seal plate

## ENGINE

### Crankshaft Pulley Disassembly Note

1. Hold the crankshaft using the **SST**.
2. Remove the crankshaft pulley lock bolt.



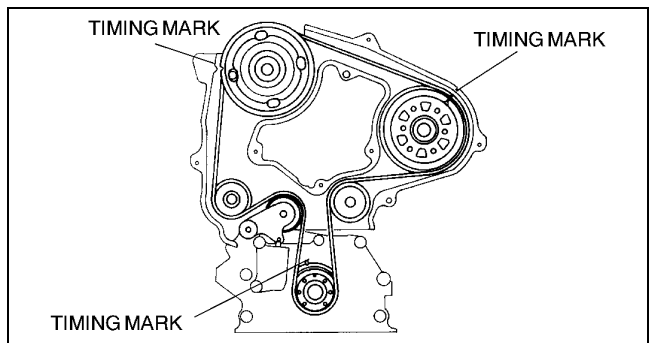
AME2524E066

### Timing Belt, Timing Belt Auto Tensioner Disassembly Note

1. Turn the crankshaft clockwise and align the timing marks as shown.

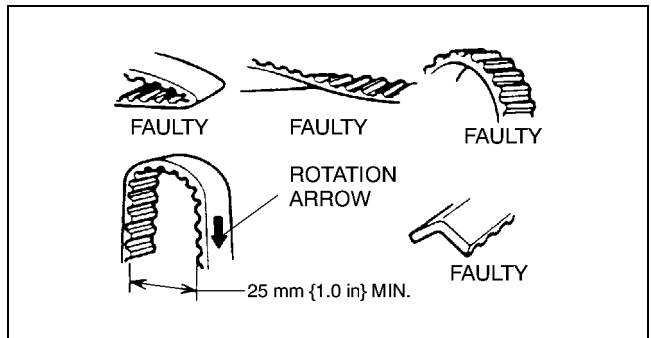
#### Caution

- The following will damage the belt and shorten its life; forcefully twisting it, turning it inside out, or allowing oil or grease on it.
- After removing the timing belt, do not move the crankshaft or the camshaft pulley or both from this position because it can cause the valve and piston to contact.



AME2516E002

2. Remove the timing belt auto tensioner.
3. Mark the timing belt rotation on the belt for proper reinstallation.



AME2516E003

## ENGINE

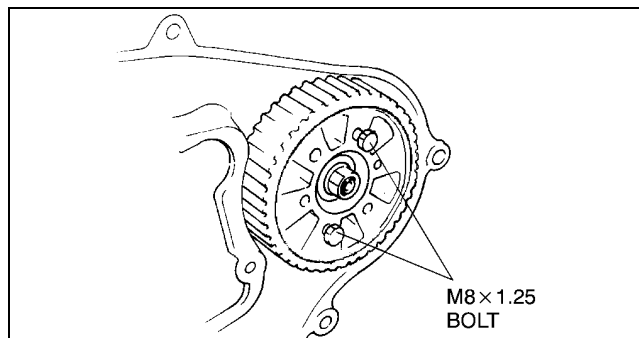
### Injection Pump Pulley Disassembly Note

1. Verify that timing marks are correctly aligned.

#### Caution

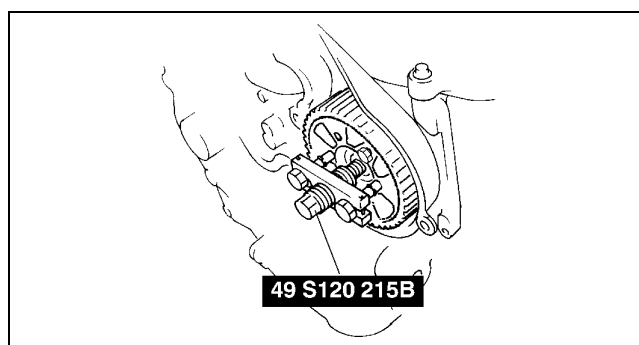
- To prevent the bolts (M8 × 1.25) from damaging the Injection pump and pulley, do not fully tighten the detent bolt. If it contacts the pulley surface, it will damage the pulley.

2. Fix the injection pump pulley to the bracket using two injection pump pulley fixing bolts (M8 × 1.25).
3. Loosen the injection pump pulley lock nut.



AME2524E005

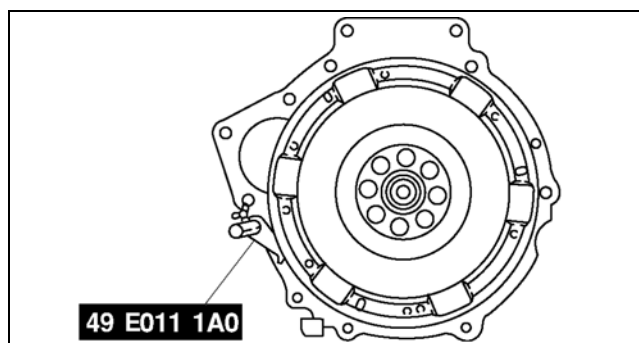
4. Separate the injection pump pulley from the injection pump shaft using the SST.
5. Remove the injection pump pulley fixing bolts (M8 × 1.25).



AME2524E006

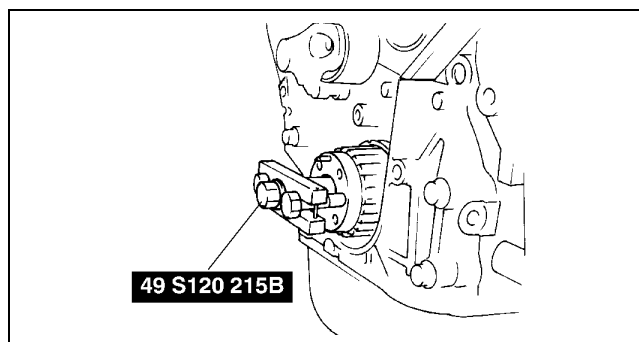
### Timing Belt Pulley Disassembly Note

1. Hold the crankshaft using the SST.
2. Remove the timing belt pulley lock bolt.



AME2524E066

3. Remove the timing belt pulley using the SST.



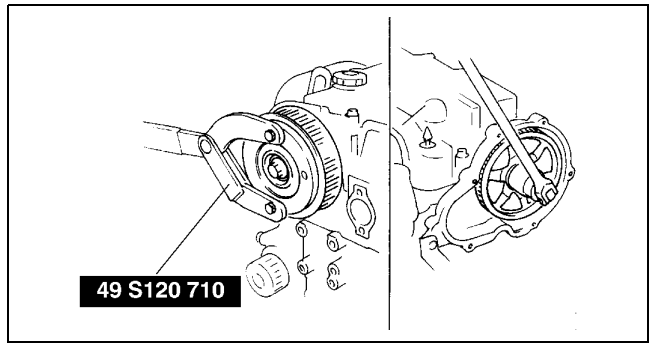
AME2524E007

B

## ENGINE

### Drive Gear Disassembly Note

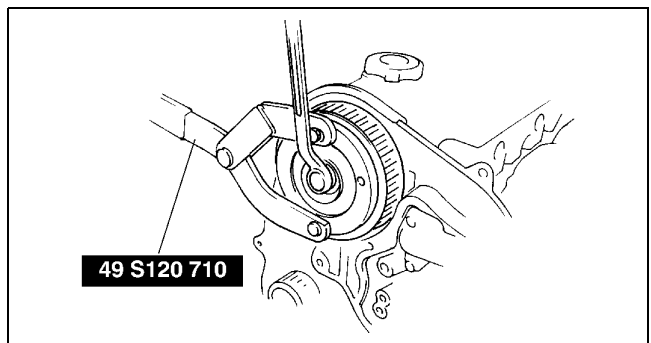
1. Hold the camshaft using the **SST**.
2. Remove the drive gear lock bolt.



AME2524E008

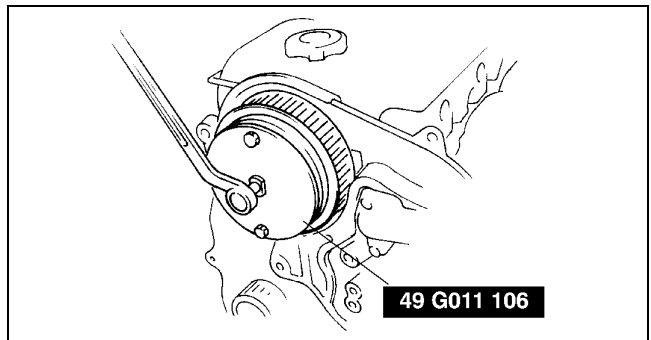
### Camshaft Pulley Disassembly Note

1. Hold the camshaft using the **SST**.
2. Remove the camshaft pulley lock bolt.



AME2524E009

3. Remove the camshaft pulley using the **SST**.



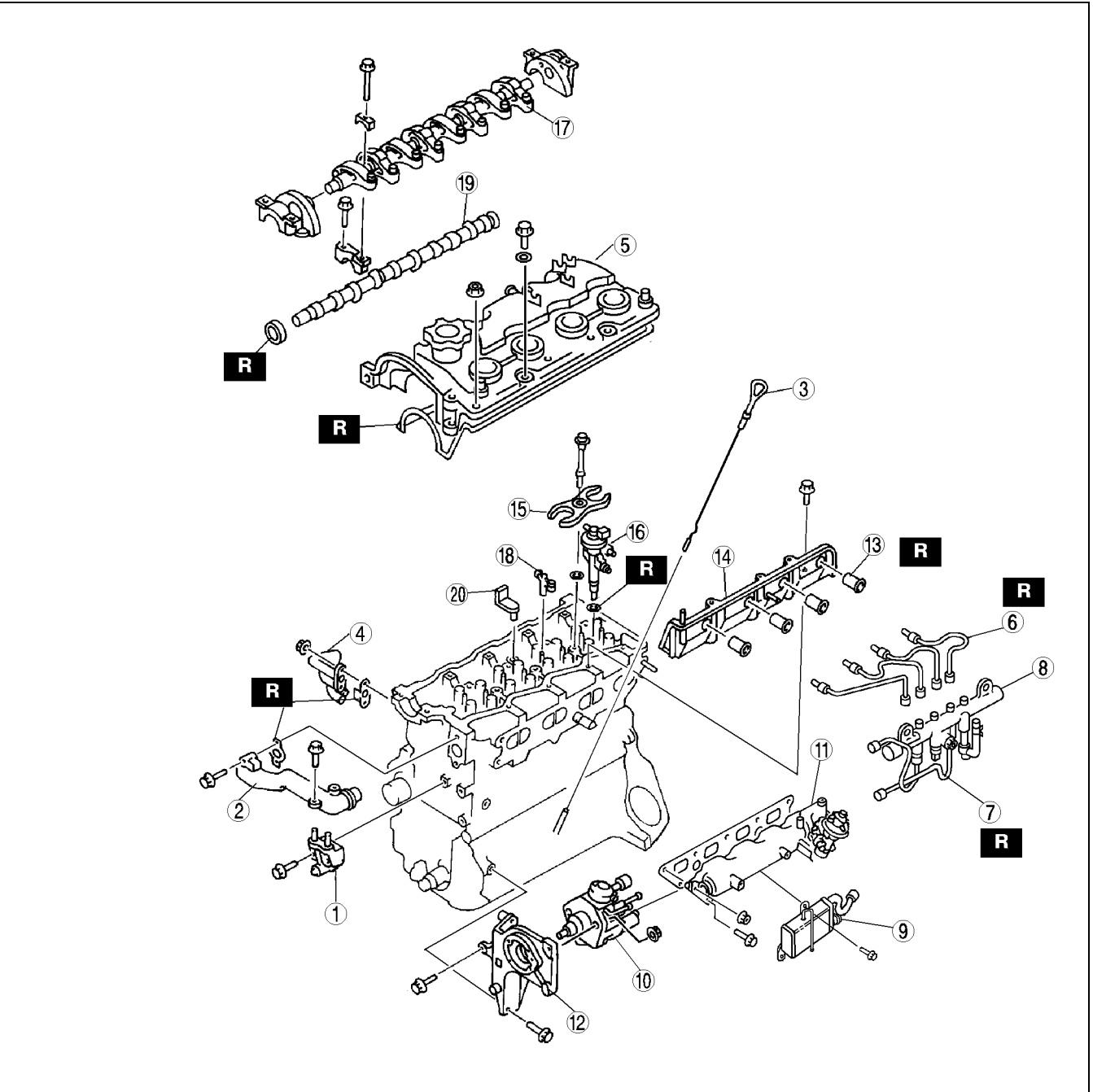
AME2524E010

# ENGINE

## CYLINDER HEAD (I) DISASSEMBLY

AME222402000104

1. Disassemble in the order indicated in the table.



AME2524E014

1	No.3 engine mount bracket
2	Water outlet
3	Dipstick
4	Bypass pipe
5	Cylinder head cover
6	Fuel injection pipe
7	Fuel injection pipe
8	Common rail
9	EGR water cooler
10	Injection pump
11	Intake manifold

12	Injection pump bracket
13	Nozzle seal
14	Side wall
15	Injection nozzle bracket
16	Injection nozzle
17	Rocker arm and rocker arm shaft (See <a href="#">B-8 Rocker Arm and Rocker Arm Shaft Disassembly Note</a> )
18	Rocker bridge
19	Camshaft
20	Breather pipe

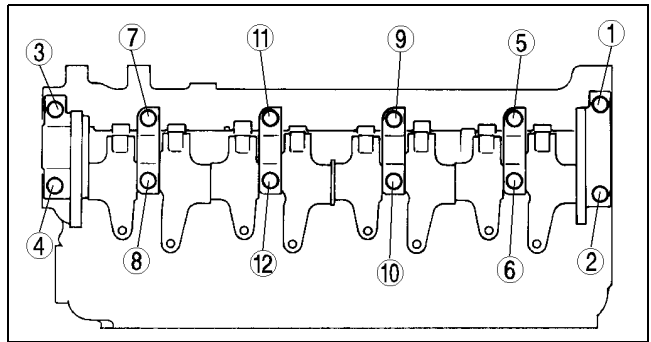
**B**



## ENGINE

### Rocker Arm and Rocker Arm Shaft Disassembly Note

1. Inspect the camshaft end play.  
(See [B-19 CAMSHAFT END PLAY INSPECTION](#))
2. Inspect the camshaft oil clearance.  
(See [B-19 CAMSHAFT OIL CLEARANCE INSPECTION](#))
3. Loosen the bolts in two or three steps in the order shown.



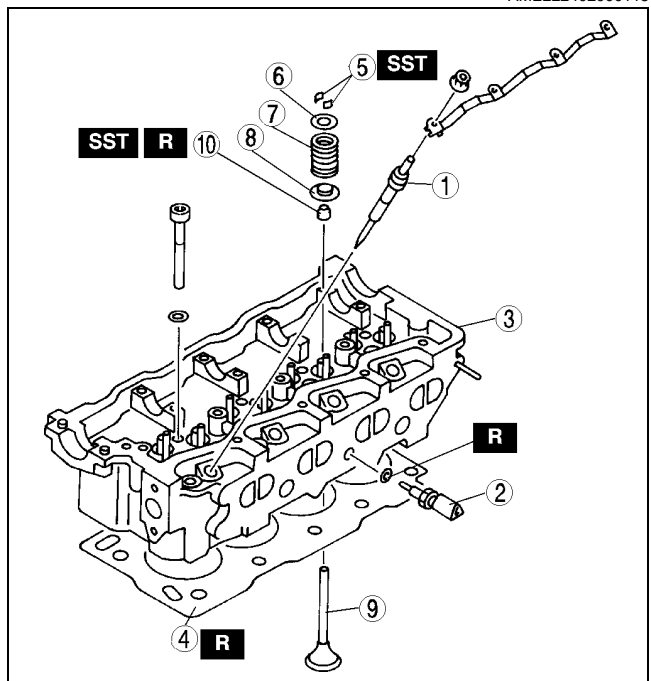
AME2521E001

### CYLINDER HEAD (II) DISASSEMBLY

1. Disassemble in the order indicated in the table.

1	Glow plug, glow plug lead (See <a href="#">B-8 Glow Plug, Glow Plug Lead Disassembly Note</a> )
2	Engine coolant temperature sensor
3	Cylinder head (See <a href="#">B-9 Cylinder Head Disassembly Note</a> )
4	Cylinder head gasket
5	Valve keeper (See <a href="#">B-9 Valve Keeper Disassembly Note</a> )
6	Upper valve spring seat
7	Valve spring
8	Lower valve spring seat
9	Valve
10	Valve seal (See <a href="#">B-9 Valve Seal Disassembly Note</a> )

AME222402000115



AME2524E019

### Glow Plug, Glow Plug Lead Disassembly Note

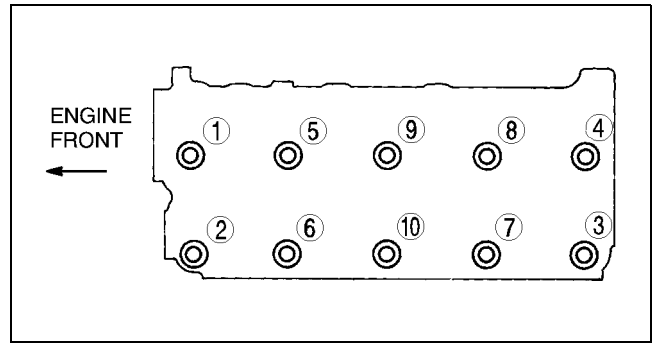
#### Caution

- Damaging heat-generating part of the plug can cause the plug to blow out. Do not use the plug if it is dropped from a height over 10 cm {3.9 in}.
- When removing the glow plug, loosen it one or more threads using tool, then further loosen by hand and remove it.

# ENGINE

## Cylinder Head Disassembly Note

- Loosen the cylinder head bolts in two or three steps in the order shown.

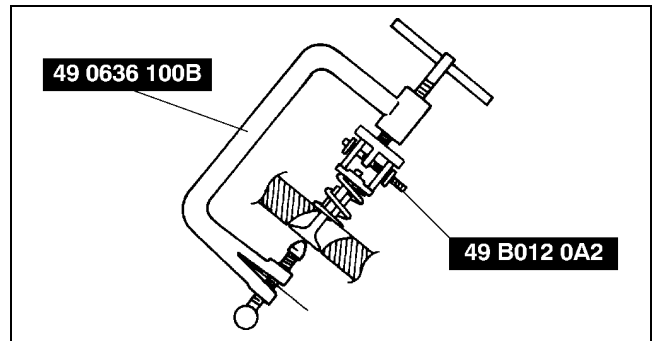


AME2524E020

B

## Valve Keeper Disassembly Note

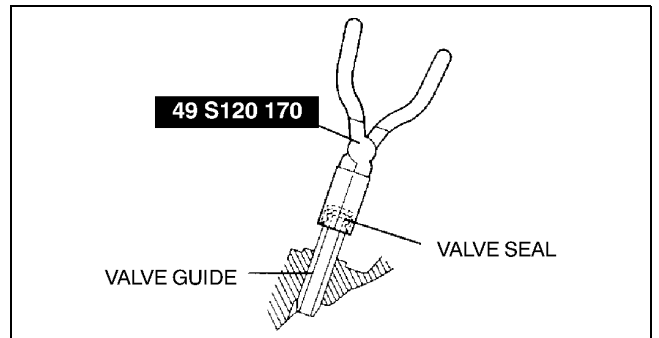
- Remove the valve keeper using the SSTs.



AME2511E001

## Valve Seal Disassembly Note

- Remove the valve seal using the SST.



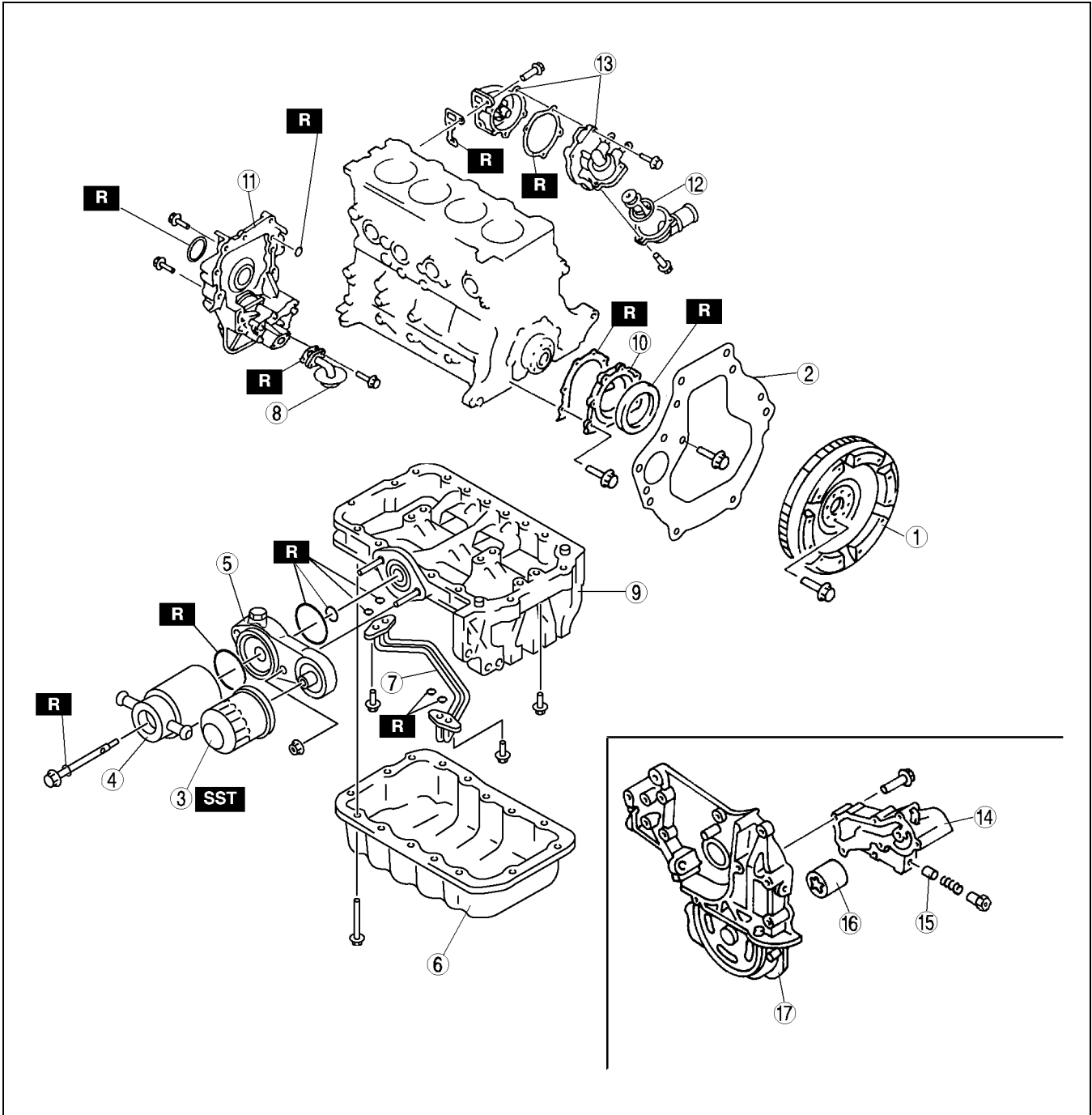
AME2511E002

# ENGINE

## CYLINDER BLOCK (I) DISASSEMBLY

AME222402000105

1. Disassemble in the order indicated in the table.



AME2524E174

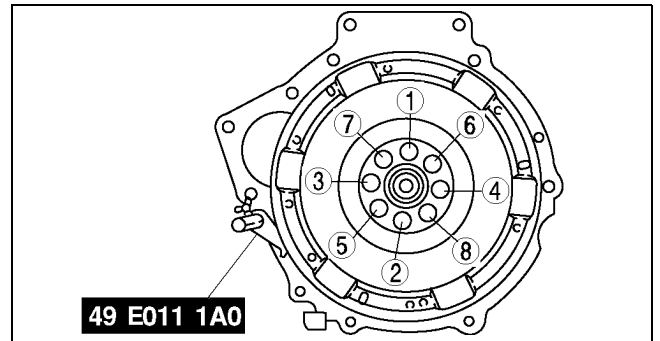
1	Flywheel (See <a href="#">B-11 Flywheel Disassembly Note</a> )
2	End plate
3	Oil filter
4	Oil cooler
5	Oil filter body
6	Oil pan (See <a href="#">B-11 Oil Pan Disassembly Note</a> )
7	Oil pipe
8	Oil strainer
9	Oil pan upper block (See <a href="#">B-12 Oil Pan Upper Block Disassembly Note</a> )

10	Rear cover (See <a href="#">B-12 Rear Cover Disassembly Note</a> )
11	Oil pump (see <a href="#">B-12 Oil Pump Disassembly Note</a> )
12	Thermostat
13	Water pump
14	Oil pump cover
15	Relief valve
16	Outer rotor
17	Oil pump body

## ENGINE

### Flywheel Disassembly Note

1. Hold the flywheel using the **SST**.
2. Loosen the bolts in two or three steps in the order shown.

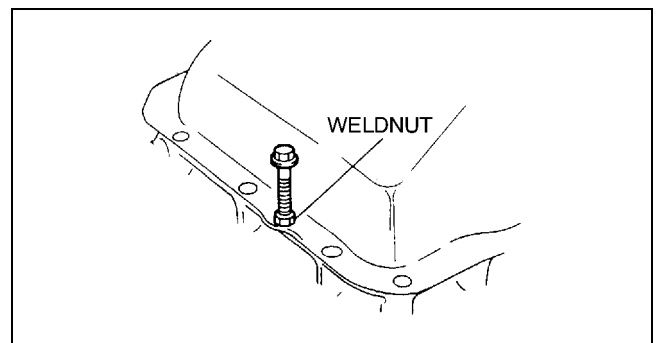


AME2524E072

B

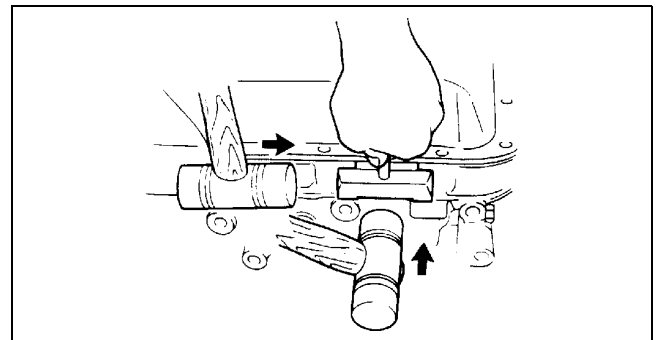
### Oil Pan Disassembly Note

1. Remove the oil pan mounting bolts.
2. Remove the sealant from the bolt threads.
3. Screw an oil pan bolt into the weldnut to make a small gap between the cylinder block and the oil pan.



AME2524E024

4. Remove the oil pan using the separator tool.

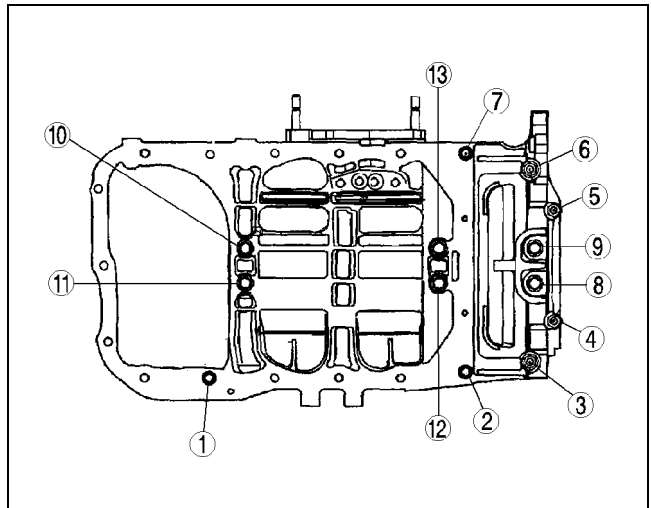


AME2524E025

## ENGINE

### Oil Pan Upper Block Disassembly Note

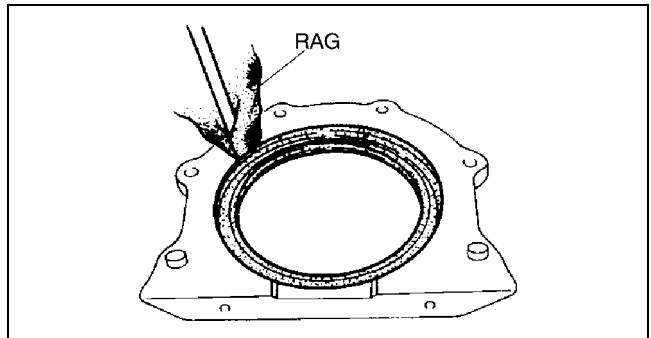
1. Loosen the oil pan upper block bolts in two or three steps in the order shown.
2. Remove the oil pan upper block



AME2524E078

### Rear Cover Disassembly Note

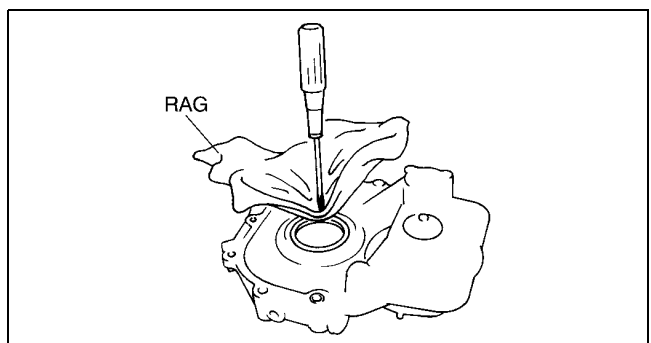
1. Remove the oil seal using a screwdriver protected with a rag.



AME2522E001

### Oil Pump Disassembly Note

1. Remove the oil seal using a screwdriver protected with a rag.



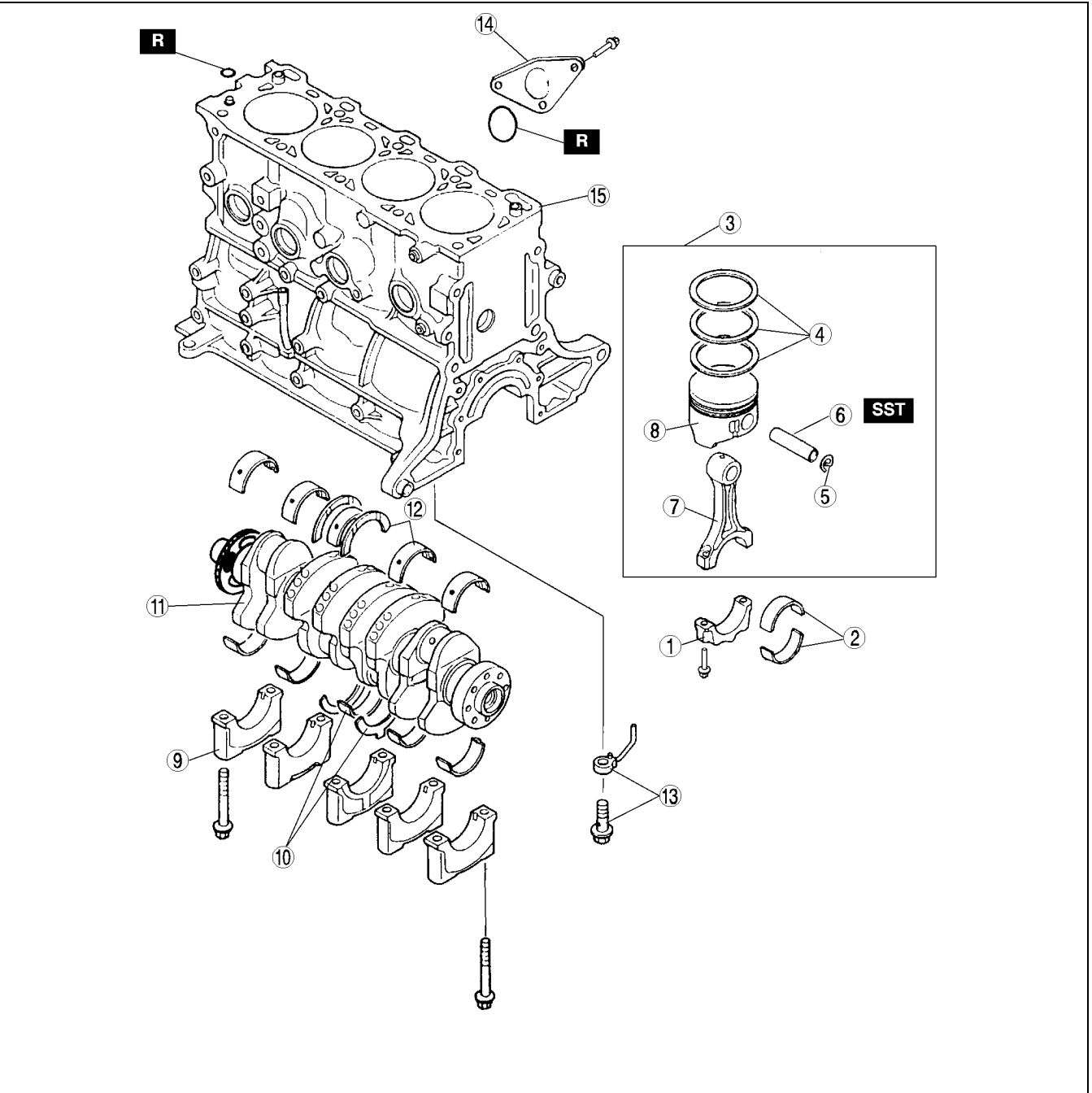
AME2520E001

# ENGINE

## CYLINDER BLOCK (II) DISASSEMBLY

AME222402000106

1. Disassemble in the order indicated in the table.



AME2524E035

1	Connecting rod cap (See <a href="#">B-14 Connecting Rod Cap Disassembly Note</a> )
2	Connecting rod bearing
3	Connecting rod, piston (See <a href="#">B-14 Connecting Rod, Piston Disassembly Note</a> )
4	Piston ring
5	Snap ring
6	Piston pin (See <a href="#">B-14 Piston Pin Disassembly Note</a> )
7	Connecting rod

8	Piston
9	Main bearing cap (See <a href="#">B-14 Main Bearing Cap Disassembly Note</a> )
10	Lower main bearing, thrust bearing
11	Crankshaft (See <a href="#">B-14 Crankshaft Disassembly Note</a> )
12	Upper main bearing, thrust bearing
13	Oil jet
14	Cover
15	Cylinder block

## ENGINE

### Connecting Rod Cap Disassembly Note

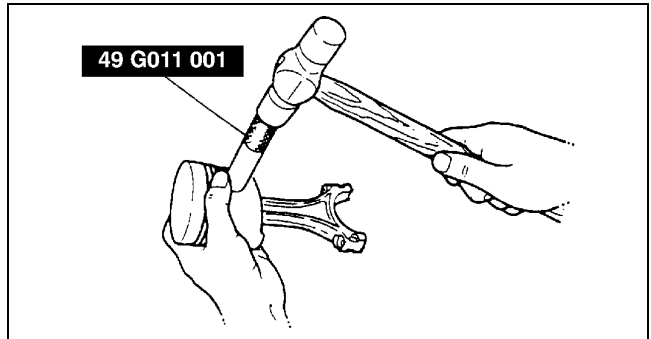
1. Inspect the connecting rod side clearance.  
(See [B-25 CONNECTING ROD SIDE CLEARANCE INSPECTION](#))

### Connecting Rod, Piston Disassembly Note

1. Before disassembling the connecting rod and piston, remove the carbon on the cylinder wall.
2. Inspect the connecting rod oil clearance.  
(See [B-24 CONNECTING ROD OIL CLEARANCE INSPECTION/REPAIR](#))

### Piston Pin Disassembly Note

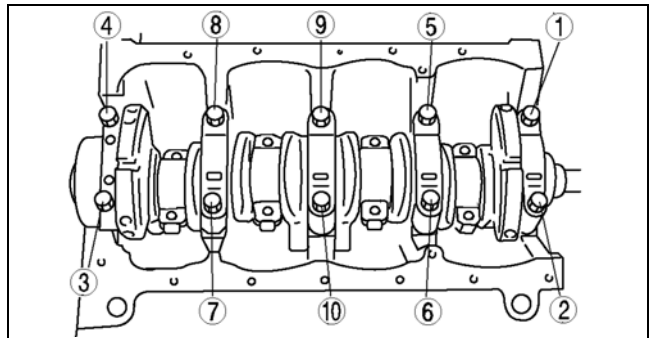
1. Inspect the oscillation torque.  
(See [B-25 PISTON AND CONNECTING ROD INSPECTION](#))
2. Remove the piston pin using the **SST**.



AME2524E034

### Main Bearing Cap Disassembly Note

1. Inspect the crankshaft end play.  
(See [B-24 CRANKSHAFT END PLAY INSPECTION/REPAIR](#))
2. Loosen the main bearing cap bolts in two or three steps in the order shown.



AME2524E068

### Crankshaft Disassembly Note

1. Inspect the crankshaft oil clearance.  
(See [B-23 CRANKSHAFT OIL CLEARANCE INSPECTION/REPAIR](#))

### CYLINDER HEAD INSPECTION

1. Carry out color contrast penetrate examination on the cylinder head surface. Replace the cylinder head if necessary.
2. Inspect for the following and repair or replace if necessary.
  - (1) Sunken valve seats
  - (2) Excessive camshaft oil clearance and end play

AME222410100101

## ENGINE

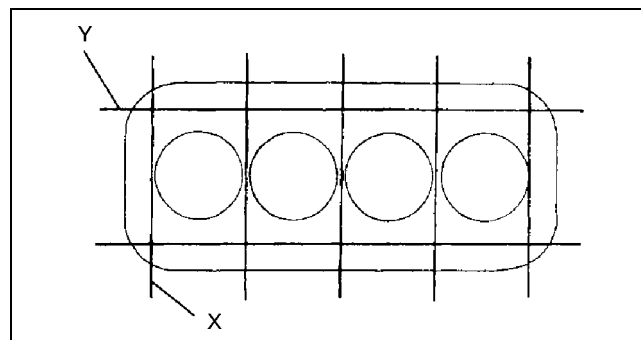
3. Measure the cylinder head for distortion in the seven directions as shown.

### Maximum distortion

**X distortion: 0.01 mm {0.0004 in}**

**Y distortion: 0.04 mm {0.0016 in}**

4. If the cylinder head distortion exceeds the maximum, replace the cylinder head. Do not attempt to repair the cylinder head by milling or grinding.



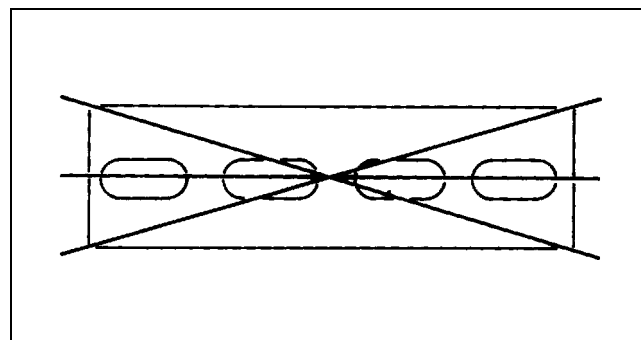
AME2524E038

5. Measure the manifold contact surface distortion as shown.

### Maximum distortion

**0.06 mm {0.0024 in}**

6. If the distortion exceeds the maximum, grind the surface or replace the cylinder head.



AME2524E039

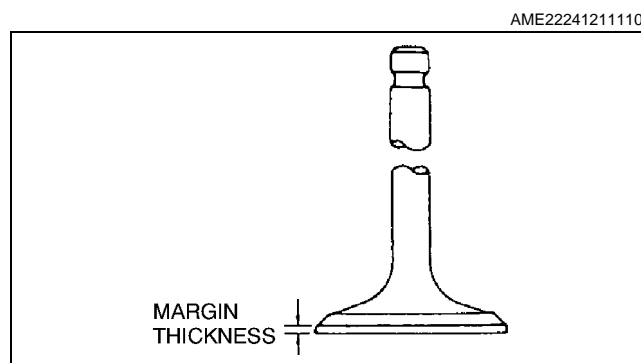
## VALVE, VALVE GUIDE INSPECTION

1. Measure the valve head margin thickness of each valve. Replace the valve if necessary.

### Minimum margin thickness

**IN: 0.8 mm {0.0315 in}**

**EX: 1.0 mm {0.0394 in}**



AME2511E005

2. Measure the length of each valve. Replace the valve if necessary.

### Standard length

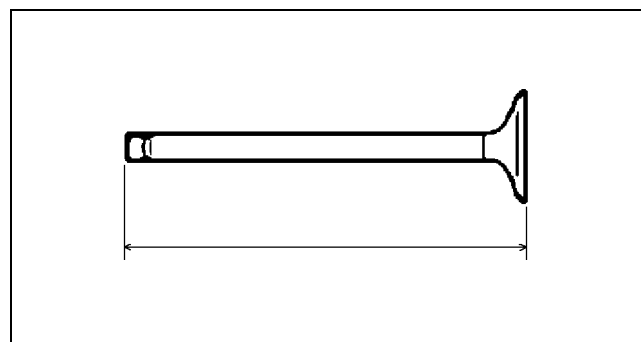
**IN: 115.01—115.51 mm {4.528—4.547 in}**

**EX: 114.35—114.85 mm {4.502—4.521 in}**

### Minimum length

**IN: 114.785 mm {4.519 in}**

**EX: 114.125 mm {4.493 in}**



AMJ2224E071



## ENGINE

3. Measure the stem diameter of each valve in X and Y directions at the three points (A, B, and C) shown. Replace the valve if necessary.

### Standard diameter

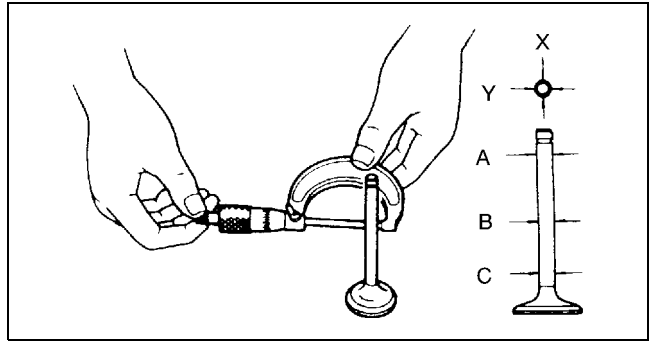
IN: 5.970—5.985 mm {0.2351—0.2356 in}

EX: 5.965—5.980 mm {0.2349—0.2354 in}

### Minimum diameter

IN: 5.920 mm {0.2331 in}

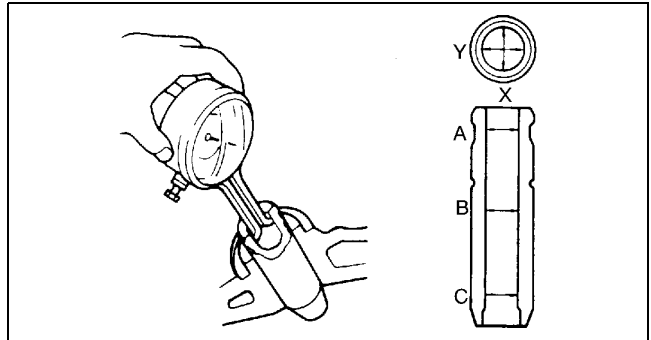
EX: 5.915 mm {0.2329 in}



4. Measure the inner diameter of each valve guide in X and Y directions at the three points (A, B, and C) shown. Replace the valve guide if necessary.

### Standard inner diameter

6.030—6.050 mm {0.2374—0.2381 in}

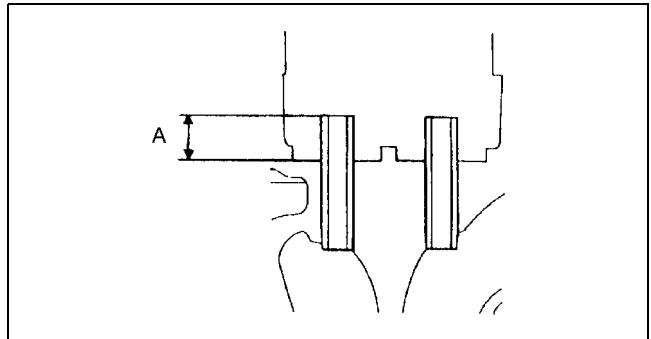


5. Measure the protrusion height (dimension A) of each valve guide without lower valve spring seat. Replace the valve guide if necessary.

### Standard height

IN: 18.7—19.2 mm {0.737—0.755 in}

EX: 17.6—18.1 mm {0.693—0.712 in}

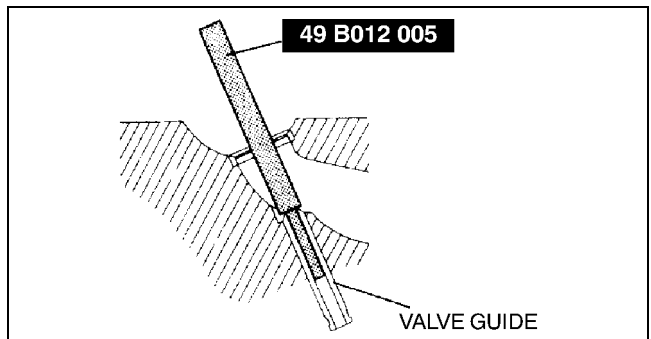


## VALVE GUIDE REPLACEMENT

AME222410280102

### Valve Guide Removal

1. Remove the valve guide from the combustion chamber side using the SST.



## ENGINE

### Valve Guide Installation

1. Assemble the **SSTs** so that depth L is as specified.

#### Depth L

**IN:** 18.7—19.2 mm {0.737—0.755 in}

**EX:** 17.6—18.1 mm {0.693—0.712 in}

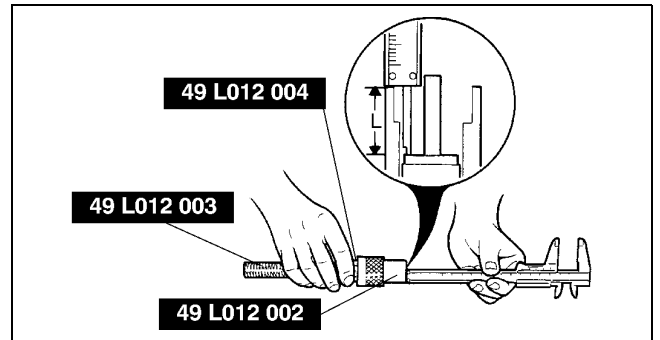
2. Tap the valve guide in from the side opposite the combustion chamber until the **SSTs** contacts the cylinder head.

3. Verify that the valve guide projection height is within the specification.

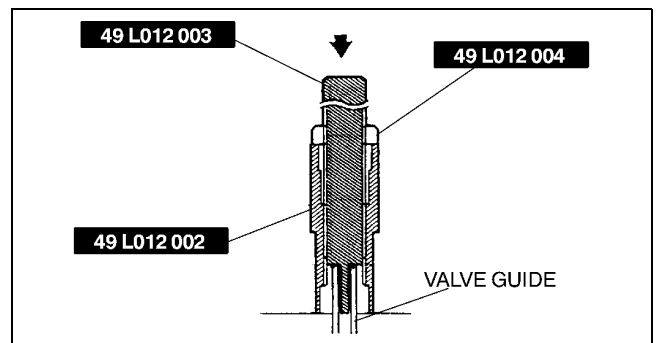
#### Standard height

**IN:** 18.7—19.2 mm {0.737—0.755 in}

**EX:** 17.6—18.1 mm {0.693—0.712 in}



AME2511E010



AME2511E011

### VALVE SEAT INSPECTION/REPAIR

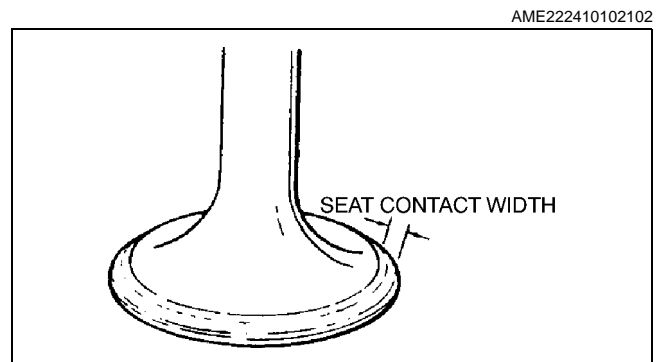
1. Measure the seat contact width. If necessary, resurface the valve seat using a 45° valve seat cutter or resurface the valve face or both.

#### Standard width

**IN:** 1.3—1.9 mm {0.052—0.074 in}

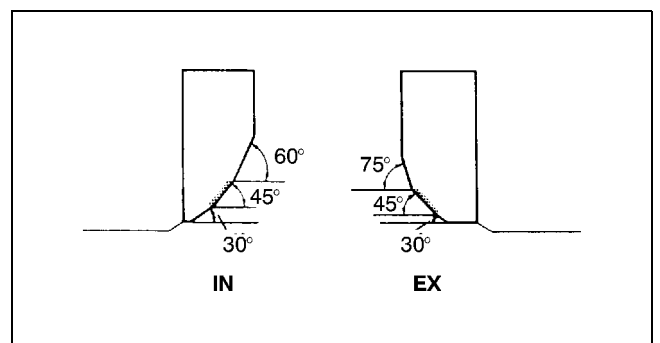
**EX:** 1.3—1.9 mm {0.052—0.074 in}

2. Verify that the valve seating position is at the center of the valve face.
  - (1) If the seating position is too high, correct the valve seat using a 65° (IN) or 75° (EX) cutter, and a 45° cutter.
  - (2) If the seating position is too low, correct the valve seat using a 30° cutter, and a 45° cutter.



AME222410102102

AME2511E012



AME2511E013

## ENGINE

3. Measure the recessed amount from the cylinder head surface. If it exceeds the maximum, replace the cylinder head.

### Standard recession

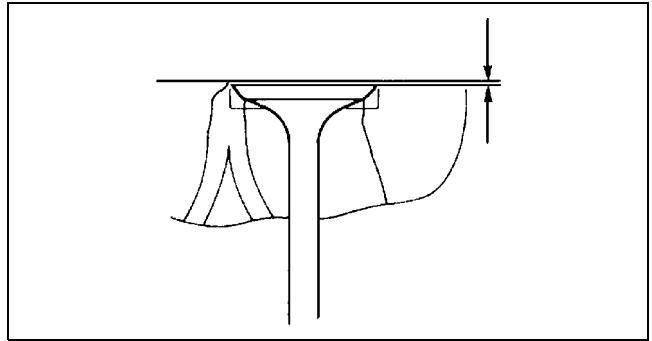
IN: 0.42—0.90 mm {0.017—0.035 in}

EX: 0.46—0.94 mm {0.019—0.037 in}

### Maximum recession

IN: 1.25 mm {0.049 in}

EX: 1.29 mm {0.051 in}



AME2511E014

## VALVE SPRING INSPECTION

1. Apply pressure to the pressure spring and check the spring height. Replace the valve spring if necessary.

### Pressing force

172.1—194.9 N {17.55—19.87 kgf, 38.61—43.79 lbf}

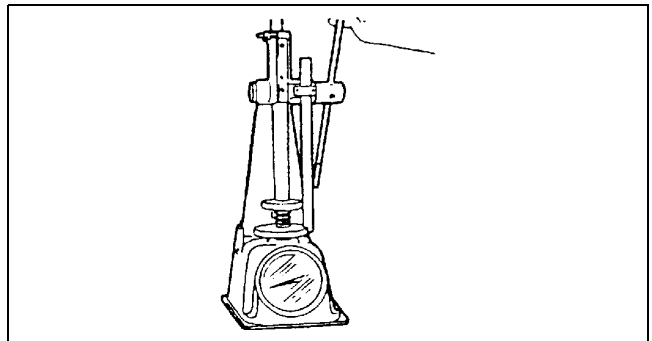
### Standard height

38.0 mm {1.50 in}

2. Measure the out-of-square of the valve spring. Replace the valve spring if necessary.

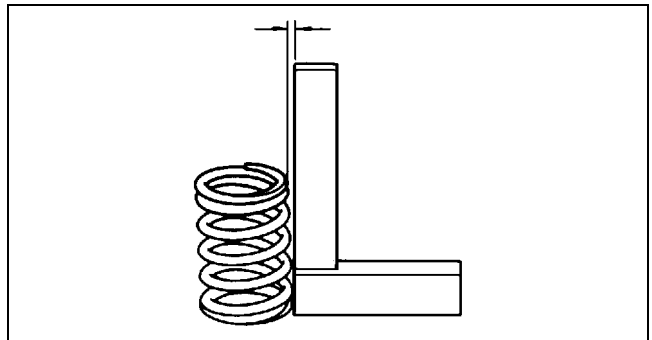
### Maximum valve spring out-of-square

1.55mm {0.061 in}



AME222412125101

AME2511E015



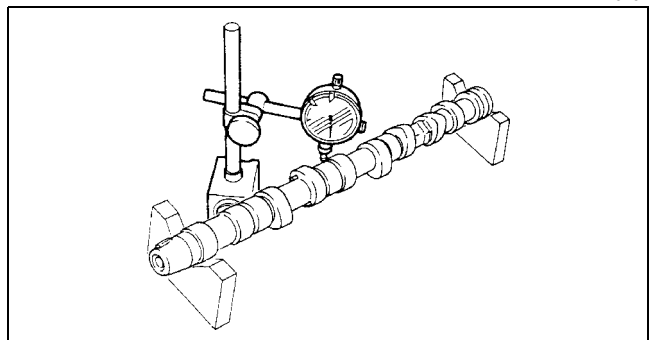
AME2511E016

## CAMSHAFT INSPECTION

1. Set No.1 and No.6 journals on V-blocks. Measure the camshaft runout. Replace the camshaft if necessary.

### Maximum runout

0.03 mm {0.0012 in}



AME222412420102

AME2517E001

## ENGINE

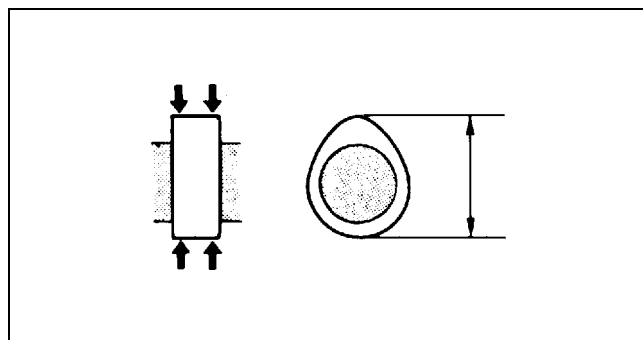
2. Measure the cam lobe height at the two points as shown. Replace the camshaft if necessary.

### Standard height

IN: 40.140 mm {1.5803 in}  
EX: 39.809 mm {1.5673 in}

### Minimum height

IN: 39.940 mm {1.5724 in}  
EX: 39.609 mm {1.5594 in}



AME2517E002

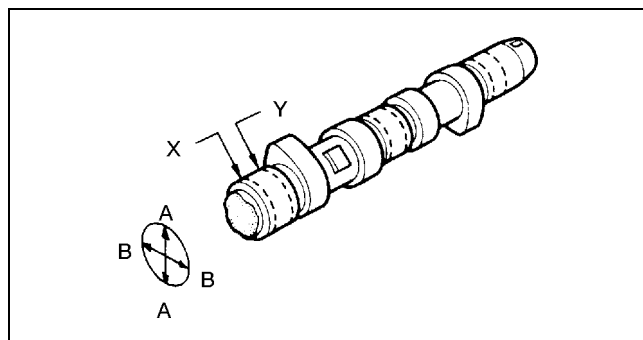
3. Measure the journal diameters in X and Y directions at the two points (A and B) as shown. Replace the camshaft if necessary.

### Standard diameter

31.950—31.975 mm {1.2579—1.2588 in}

### Minimum diameter

31.920 mm {1.2567 in}



AME2517E003

## CAMSHAFT OIL CLEARANCE INSPECTION

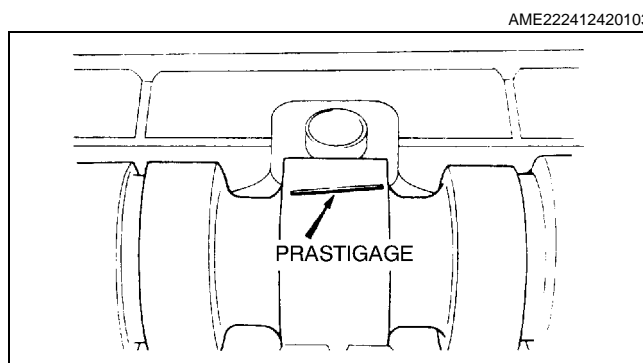
1. Position plastigage atop the journals in the axial direction.
2. Install the camshaft cap and rocker arm shaft. (See [B-40 Rocker Arm and Rocker Arm Shaft Assembly Note](#))
3. Remove the camshaft cap and rocker arm shaft. (See [B-8 Rocker Arm and Rocker Arm Shaft Disassembly Note](#))
4. Measure the oil clearance. Replace the cylinder head if necessary.

### Standard clearance

0.025—0.030 mm {0.0010—0.0011 in}

### Maximum clearance

0.075 mm {0.0030 in}



AME222412420103

AME2517E004

## CAMSHAFT END PLAY INSPECTION

1. Install the camshaft cap and rocker arm shaft. (See [B-40 Rocker Arm and Rocker Arm Shaft Assembly Note](#))

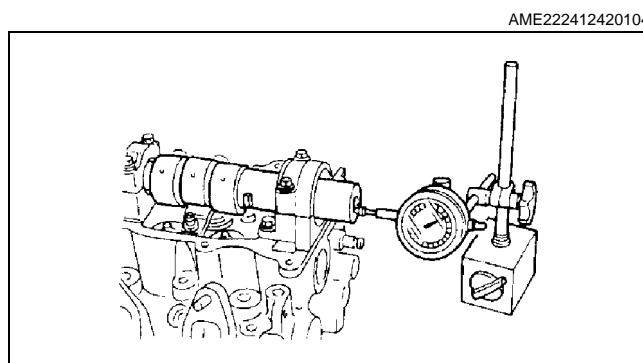
### Standard end play

0.03—0.16 mm {0.0012—0.0062 in}

### Maximum end play

0.20 mm {0.0079 in}

2. Measure the camshaft end play. Replace the cylinder head or camshaft if necessary.
3. Remove the camshaft cap and rocker arm shaft. (See [B-8 Rocker Arm and Rocker Arm Shaft Disassembly Note](#))



AME222412420104

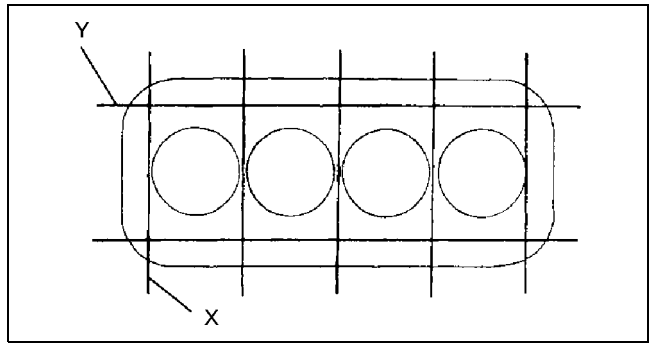
AME2517E005

# ENGINE

## CYLINDER BLOCK INSPECTION/REPAIR

1. Measure the distortion of the cylinder block top surface in the seven directions as shown. Replace in necessary.

**Maximum cylinder block distortion**  
**X direction 0.01 mm {0.0004 in}**  
**Y direction 0.03 mm {0.0012 in}**

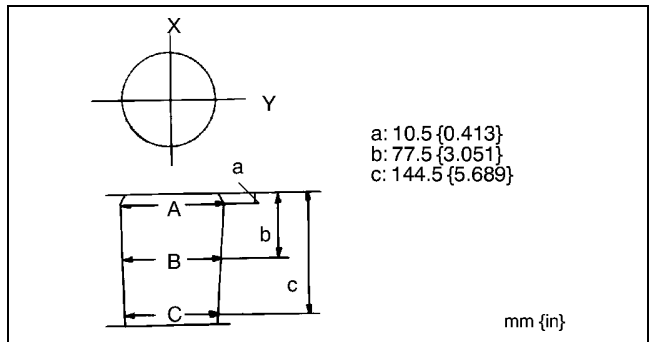


AME222410300102

2. Measure the cylinder bores in X and Y directions at three levels (A,B and C) in each cylinder as shown.
3. If the cylinder bore exceeds the wear limit, replace the cylinder block or rebore the cylinder and install the oversize pistons so that the specified piston-to-cylinder clearance is obtained.

### Note

- Base the boring diameter on the diameter of an oversize piston. All cylinders must have the same diameter.



AME2524E038

## Cylinder bore

(mm {in})

Size	Diameter
Standard	86.000—86.022 {3.3859—3.3866}
0.25 {0.01} oversize	86.250—86.272 {3.3957—3.3965}
0.50 {0.02} oversize	86.500—86.522 {3.4055—3.4063}

### Wear limit

**0.15 mm {0.006 in}**

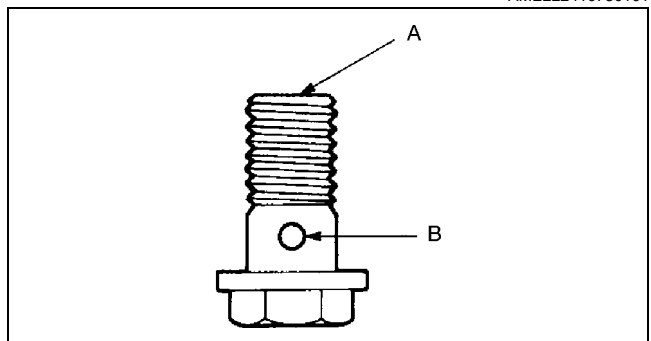
## OIL JET VALVE, NOZZLE INSPECTION

1. Apply compressed air to oil jet valve port A and verify that air passes through oil jet valve port B. If not, replace the oil jet valve.

### Air pressure

**138—196 kpa {1.4—2.0 kgf/cm<sup>2</sup>, 20—28 psi}**

2. Inspect the oil jet nozzle for clogging. Replace the nozzle if necessary.



AME2524E040

# ENGINE

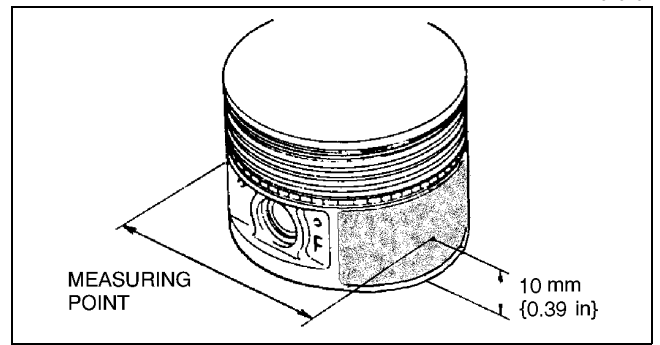
## PISTON INSPECTION

- Measure the outer diameter of each piston at right angle (90°) to the piston pin, **10.0 mm {0.39 in}** above the bottom of piston.

### Piston diameter

mm {in}

Size	Diameter
Standard	85.973—86.015 {3.3848—3.3864}
0.25 {0.01} oversize	86.223—86.265 {3.3946—3.3962}
0.50 {0.02} oversize	86.473—86.515 {3.4045—3.4061}



B

## PISTON CLEARANCE INSPECTION/REPAIR

1. Measure the piston-to-cylinder clearance.  
Replace the piston or rebore the cylinders to fit oversize piston if necessary.

AME222411010103

### Standard clearance

**0—0.034 mm {0—0.0013 in}**

### Maximum clearance

**0.10 mm {0.0039 in}**

2. If the piston is replaced, the piston rings must also be replaced.

## PISTON RING CLEARANCE INSPECTION

1. Measure the piston ring-to-ring groove clearance around the entire circumference. Replace the piston and piston ring if necessary.

AME222411010104

### Standard clearance

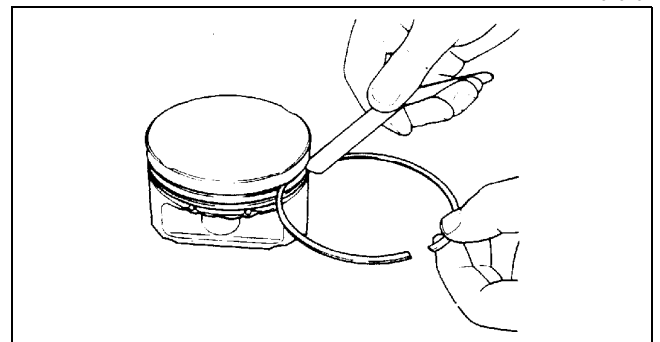
**Top: 0.05—0.09 mm {0.0020—0.0035 in}**

**Second: 0.04—0.08mm {0.0016—0.0031 in}**

**Oil: 0.03—0.07mm {0.0012—0.0027 in}**

### Maximum clearance

**0.15 mm {0.0059 in}**



2. Insert the piston ring into the cylinder by hand and use the piston to push it to the bottom of the ring travel.
3. Measure each piston ring end gap using a feeler gauge. Replace the piston ring if necessary.

### Standard end gap

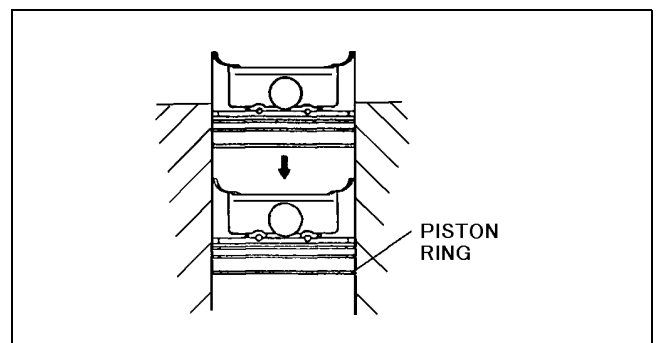
**Top: 0.20—0.30 mm {0.008—0.011 in}**

**Second: 0.20—0.30 mm {0.008—0.011 in}**

**Oil rail: 0.20—0.30 mm {0.008—0.011 in}**

### Maximum end gap

**1.0 mm {0.039 in}**

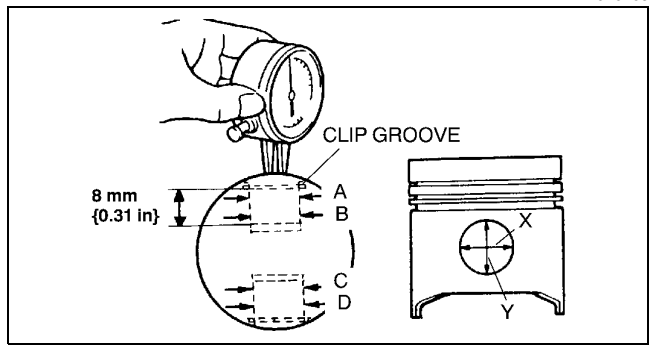


## ENGINE

### PISTON PIN CLEARANCE INSPECTION

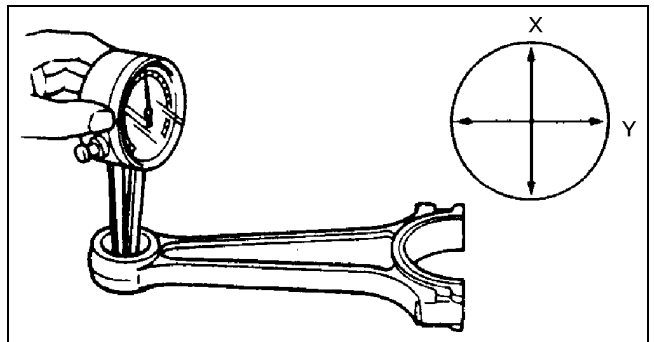
1. Measure each piston pin hole diameter in X and Y directions at the four points (A, B, C, and D) as shown.

**Standard diameter**  
**29.997—30.007 mm {1.1810—1.1813 in}**



2. Measure each connecting rod small end inner diameter in X and Y directions as shown.

**Standard diameter**  
**30.014—30.030 mm {1.1817—1.1822 in}**

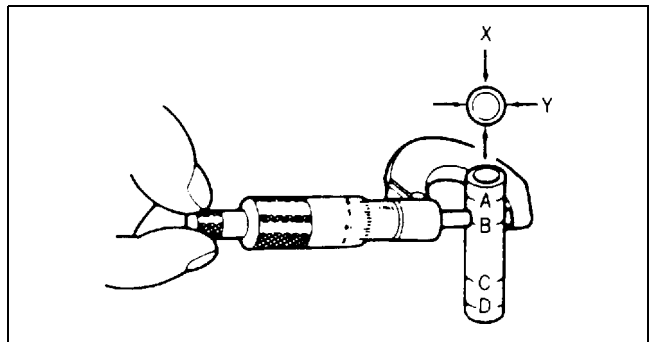


3. Measure each piston pin diameter in X and Y directions at the four points (A, B, C, and D) as shown.

**Standard diameter**  
**29.994—30.000 mm {1.1809—1.1811 in}**

4. Calculate the piston pin-to-piston pin bore clearance. Replace the piston or piston pin or both if necessary.

**Standard clearance**  
**- 0.003—0.013 mm {-0.00011—0.00051 in}**



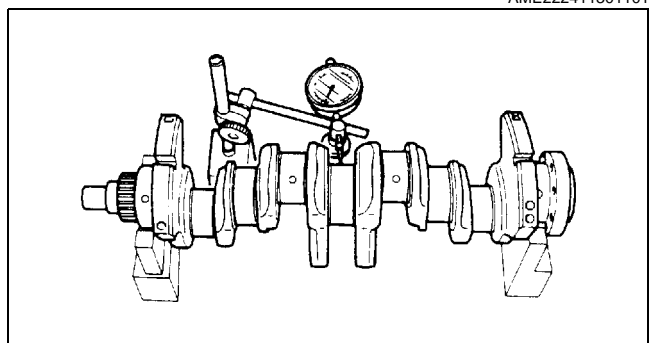
5. Calculate the clearance between connecting rod small end and piston pin. Replace the connecting rod or piston pin if necessary.

**Standard clearance**  
**0.014—0.036 mm {0.00056—0.00141 in}**

### CRANKSHAFT INSPECTION

1. Measure the crankshaft runout. Replace the crankshaft if necessary.

**Maximum runout**  
**0.03 mm {0.001 in}**



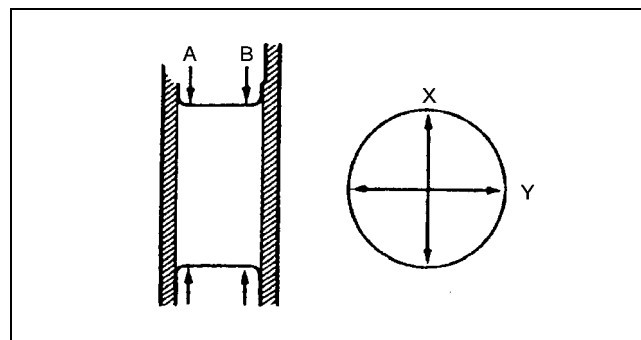
## ENGINE

- Measure the journal diameter in X and Y direction at the two points (A and B) as shown. Replace the crankshaft or grind the journal, and install the undersize bearing if necessary.

### Main Journal

(mm {in})

Bearing size	Diameter
Standard	59.937—59.955 {2.3598—2.3604}
0.25 {0.01} undersize	59.687—59.705 {2.3499—2.3505}
0.50 {0.02} undersize	59.437—59.455 {2.3401—2.3407}
0.75 {0.03} undersize	59.187—59.205 {2.3302—2.3309}



AMJ2224E036

**B**

### Out-of-round

**0.03 mm {0.001 in} max.**

### Crank pin

(mm {in})

Bearing size	Diameter
Standard	50.940—50.955 {2.0056—2.0060}
0.25 {0.01} undersize	50.690—50.705 {1.9957—1.9962}
0.50 {0.02} undersize	50.440—50.455 {1.9859—1.9864}
0.75 {0.03} undersize	50.190—50.205 {1.9760—1.9765}

### Out-of-round

**0.03 mm {0.001 in} max.**

## CRANKSHAFT OIL CLEARANCE INSPECTION/REPAIR

AME222411301102

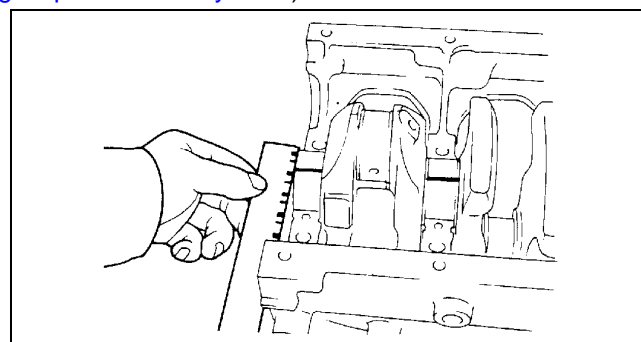
- Position a plastigage above the journals in the axial direction.
- Install the main bearing cap. (See [B-31 Main Bearing Cap Assembly Note](#))
- Remove the main bearing cap. (See [B-14 Main Bearing Cap Disassembly Note](#))
- Measure the main journal oil clearance. If the clearance exceeds the maximum, replace the main bearing or grind the main journal, and install the undersize bearings so that the specified oil clearance is obtained.

### Standard clearance

**0.025—0.044 mm {0.0010—0.0017 in}**

### Maximum clearance

**0.08 mm {0.003 in}**



AME2524E049

(mm {in})

Bearing size	Bearing thickness
Standard	2.007—2.022 {0.0791—0.0796}
0.25 {0.01} oversize	2.129—2.139 {0.0839—0.0842}
0.50 {0.02} oversize	2.254—2.264 {0.0888—0.0891}
0.75 {0.03} oversize	2.379—2.389 {0.0937—0.0940}



# ENGINE

## CRANKSHAFT END PLAY INSPECTION/REPAIR

AME222411301103

1. Install the main bearing cap. (See [B-31 Main Bearing Cap Assembly Note](#))
2. Measure the crankshaft end play. If the end play exceeds the maximum, replace the thrust bearing or grind the crankshaft, and install an undersize bearing so that the specified end play is obtained.

### Standard end play

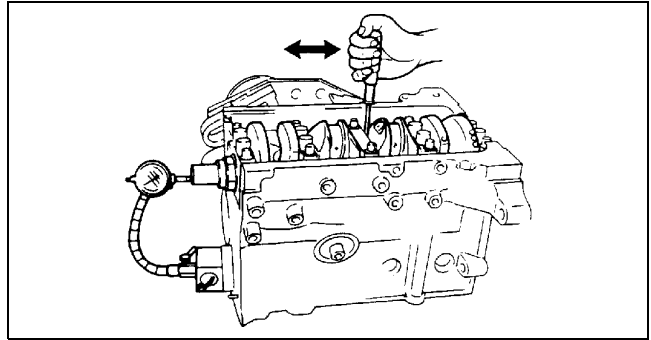
0.040—0.282 mm {0.00158—0.01110 in}

### Maximum end play

0.30 mm {0.012 in}

(mm {in})

Bearing size	Bearing thickness
Standard	2.00—2.05 {0.0788—0.0807}
0.35 {0.01} oversize	2.175—2.225 {0.0857—0.0876}



AME2524E050

3. Remove the main bearing cap. (See [B-14 Main Bearing Cap Disassembly Note](#))

## CONNECTING ROD INSPECTION

AME222411211101

- Measure bending and distortion for each connecting rod. Replace the connecting rod if necessary.

### Bending

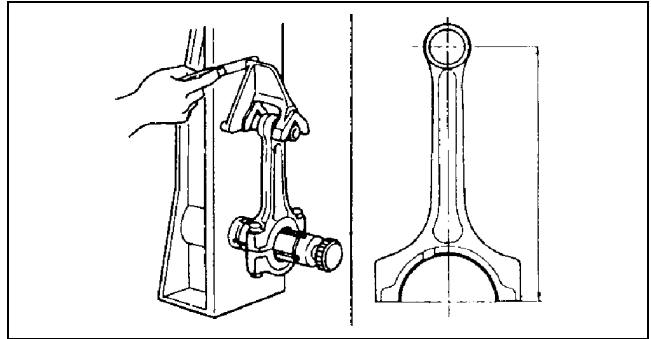
0.080 mm {0.0031 in} max. /50 mm {2.0 in}

### Distortion

0.080 mm {0.0031 in} max. /50 mm {2.0 in}

### Center-to-center distance

151.95—152.05 mm {5.983—5.986 in}



AME2524E051

## CONNECTING ROD OIL CLEARANCE INSPECTION/REPAIR

AME222411211102

1. Position a plastigage above the journals in the axial direction.
2. Install the connecting rod cap. (See [B-32 Connecting Rod Cap Assembly Note](#))
3. Remove the connecting rod cap.
4. Measure the crankpin oil clearance. If the clearance exceeds the maximum, replace the connecting rod bearing or grind the crankpin and use undersize bearings so that the specified clearance is obtained.

### Standard clearance

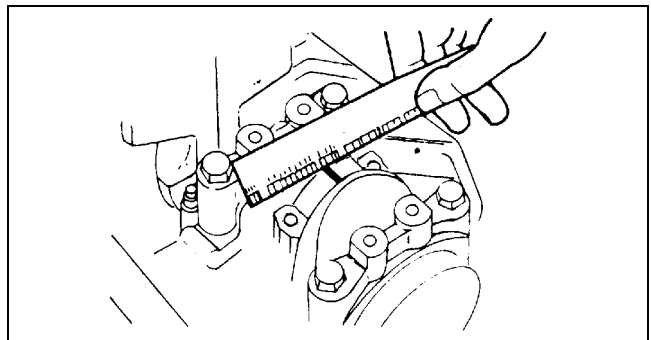
0.027—0.055 mm {0.0011—0.0021in}

### Maximum clearance

0.10 mm {0.0039 in}

(mm {in})

Bearing size	Bearing thickness
Standard	1.506—1.515{0.0593—0.0596}
0.25 {0.01} oversize	1.630—1.640{0.0642—0.0645}
0.50 {0.02} oversize	1.755—1.765{0.0691—0.0694}
0.75 {0.03} oversize	1.880—1.890{0.0741—0.0744}



AME2524E052

## ENGINE

### CONNECTING ROD SIDE CLEARANCE INSPECTION

AME222411211103

1. Install the connecting rod cap. (See [B-32 Connecting Rod Cap Assembly Note](#))
2. Measure the connecting rod large end side clearance. Replace the connecting rod and cap if necessary.

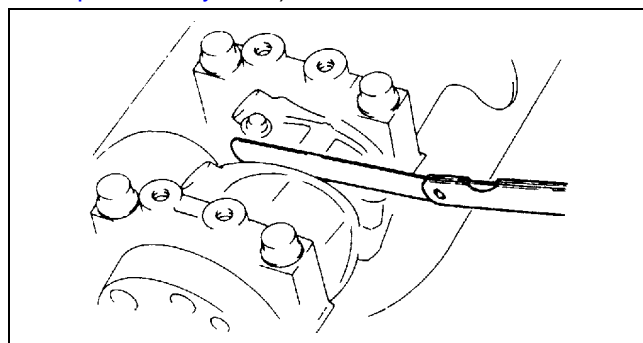
**Standard clearance**

**0.110—0.262 mm {0.0044—0.0103 in}**

**Maximum clearance**

**0.512 mm {0.0202 in}**

3. Remove the connecting rod cap.



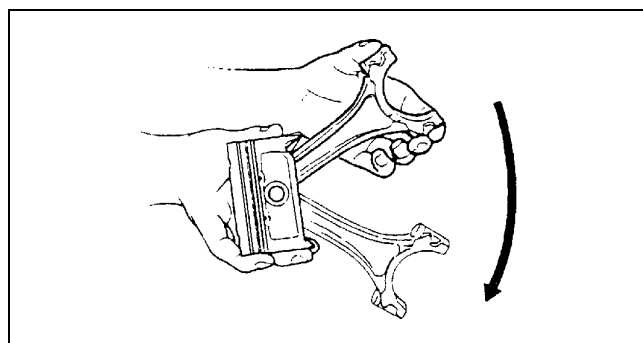
AME2524E053

**B**

### PISTON AND CONNECTING ROD INSPECTION

AME222411010106

- Insert the oscillation torque as shown. If the large end does not drop by its own weight, replace the piston or the piston pin.



AME2524E054

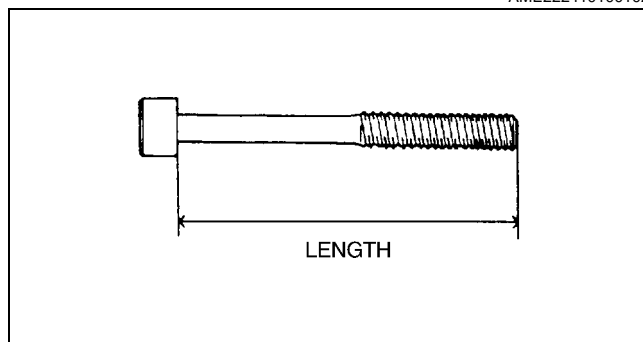
### CYLINDER HEAD BOLT INSPECTION

AME222410100102

- Measure the length of each connecting rod bolt. Replace if necessary.

**Maximum length**

**161.0 mm {6.338 in}**



AME2524E055

# ENGINE

## TIMING BELT AUTO TENSIONER INSPECTION

AME222412711102

1. Measure the tensioner rod projection length.
2. Inspect the auto tensioner for oil leakage.  
Replace the auto tensioner if necessary.

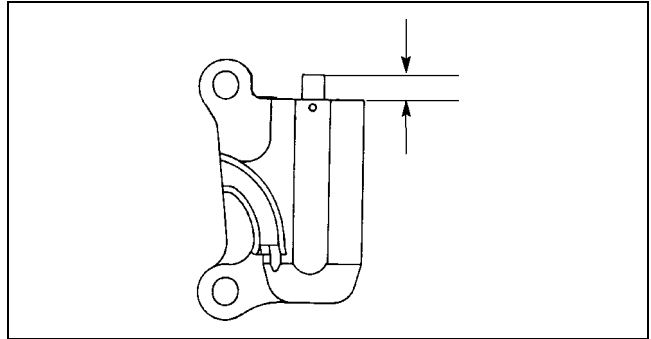
### Projection (Free length)

12.9—14.6 mm {0.508—0.574 in}

3. Inspect for the resistance of the auto tensioner rod, when it is pushed with a force of approximately **235 N {24 kgf, 53 lbf}**.  
If there is no resistance on the tensioner rod is not resistance and it moves slightly, perform the following procedure.

### Caution

- To prevent damage to the inside of the auto tensioner, do not press down the auto tensioner rod with a force greater than the specified **235 N {24 kgf, 53 lbf}**.  
Be careful that the rod does not touch the bottom.



AME2524E056

- (1) Push it down slowly two or three times to the bottom end of the end.
- (2) When the rod protrudes approximately **8.1 mm {0.32 in}**, verify that the resistance is restored on the tensioner rod.  
If the resistance is not restored, replace the auto tensioner.

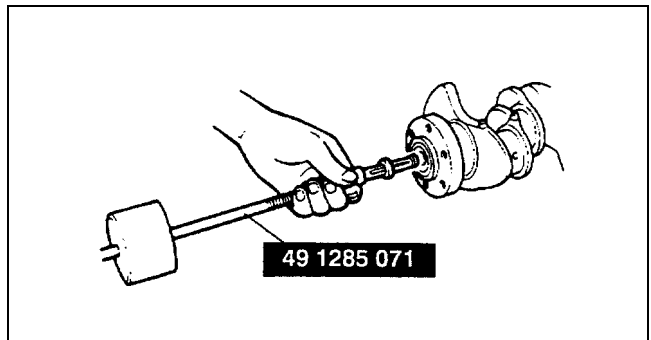
## PILOT BEARING INSPECTION

AME222411501101

- Verify that the pilot bearing rotates smoothly without any abnormal noise. Replace if necessary.

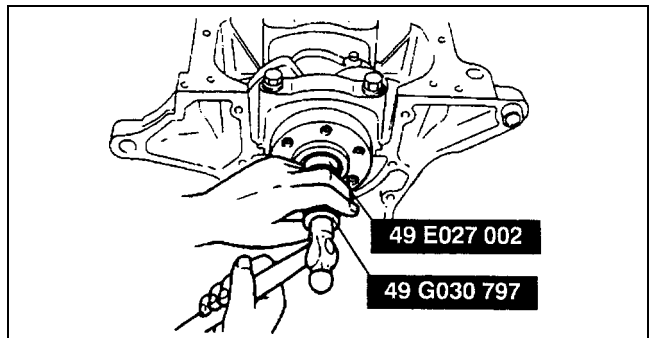
### Replacement

1. Remove the pilot bearing from the crankshaft using the **SST**.



AME2524E080

2. Install the pilot bearing using the **SSTs**.



AME2524E081

# ENGINE

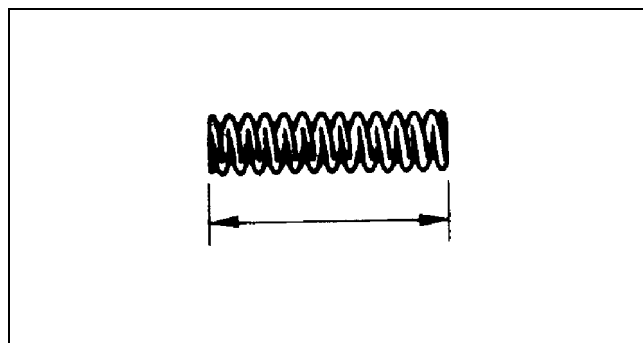
## OIL PUMP INSPECTION

AME222419220101

### Relief Spring

- Measure the free length of the relief spring. Replace the relief spring if necessary.

**Free length**  
43.8 mm {1.724 in}



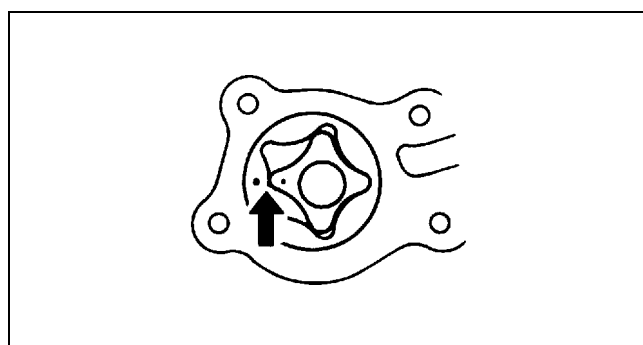
AME2524E057

### Rotor Clearance

- Measure the following clearances. Replace the rotor if necessary.

**Tooth tip clearance**  
0.030—0.120 mm {0.0012—0.0047 in}

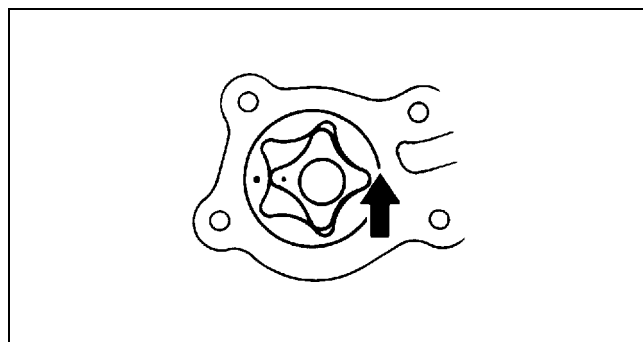
**Maximum tip clearance**  
0.16 mm {0.006 in}



AME2524E058

**Outer rotor-to-pump body clearance**  
0.200—0.294 mm {0.0079—0.0115 in}

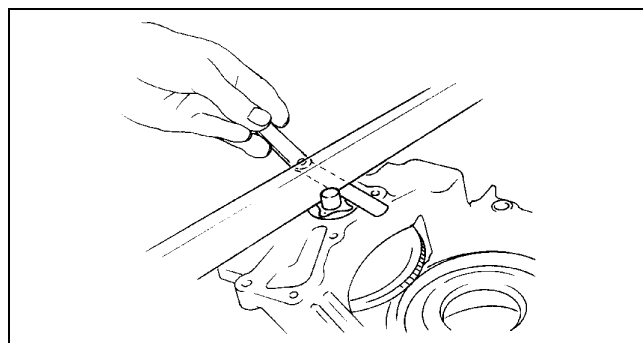
**Maximum clearance**  
0.35 mm {0.013 in}



AME2524E059

**Side clearance**  
0.040—0.100 mm {0.0016—0.0039 in}

**Maximum clearance**  
0.15 mm {0.0059 in}



AME2524E060

**B**

# ENGINE

## VALVE CLEARANCE INSPECTION

AME222412111105

1. Remove the cylinder head cover.
2. Turn the crankshaft and align the timing marks so that the piston of the No.1 or No.4 cylinder is at TDC of compression.
3. Measure the valve clearances A with the No.1 cylinder at TDC of compression, and those of B with the No.4 cylinder at TDC of compression.

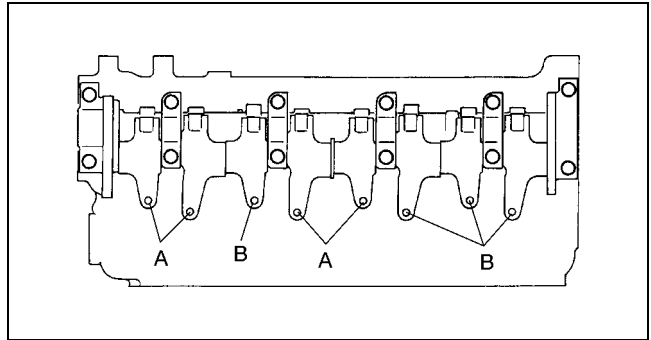
### Standard valve clearance [Engine cold]

IN: 0.12—0.18 mm {0.0048—0.0070 in}

(0.15±0.03 mm {0.0059±0.0012 in})

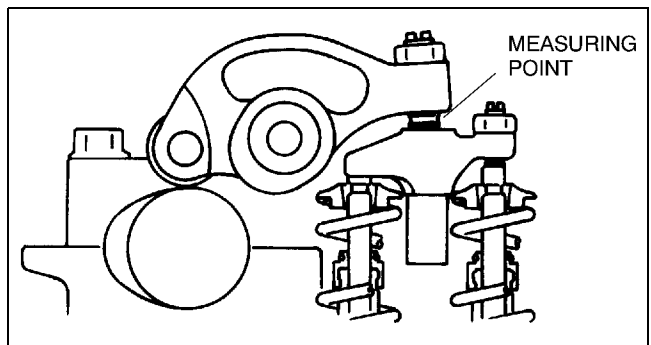
EX: 0.32—0.38 mm {0.0126—0.0149 in}

(0.35±0.03 mm {0.0138±0.0012 in})



AME2512E001

4. If the valve clearance is not within the specification, adjust the valve clearance. (See [B-28 VALVE CLEARANCE ADJUSTMENT](#))
5. Turn the crankshaft one full turn and measure the remaining valve clearances. Adjust the valve clearance if necessary.



AME2512E002

## VALVE CLEARANCE ADJUSTMENT

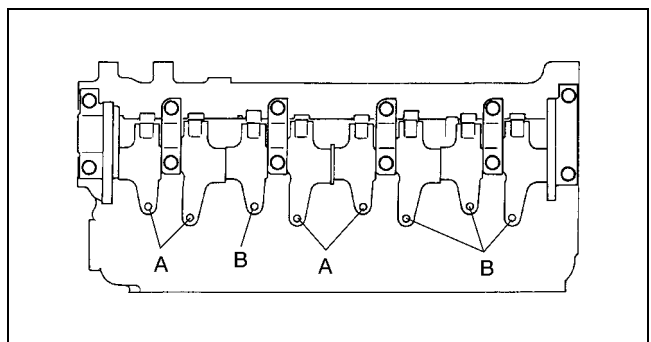
AME222412111106

1. Remove the injection nozzle bracket.
2. Remove the injection nozzle.

### Caution

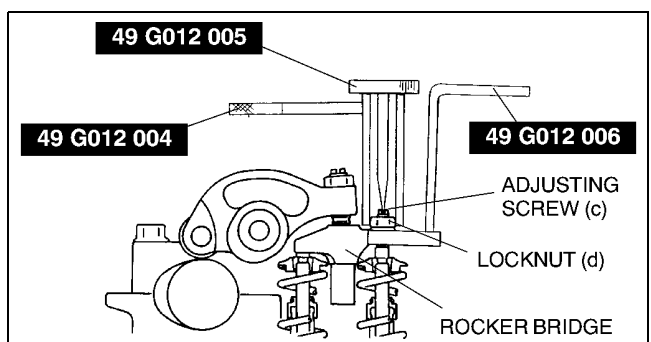
- When removing the injection nozzle bracket, always replace the injection nozzle washer. When replacing the injection nozzle washer, wipe off any carbon adhering to the nozzle installation surface of the cylinder head with a clean cloth before installing.

3. Turn the crankshaft clockwise and set the No.1 cylinder to compression TDC.
4. Adjust the valve clearance A with the No.1 cylinder at TDC of compression, and those of B with the No.4 cylinder at TDC compression.
  - (1) Hold the rocker bridge using the **SST** (49 G012 006).



AME2512E001

- (2) Loosen the locknut (d) using the **SST** (49 G012 004), and then turn the adjusting screw (c) using the **SST** (49 G012 005) until it is separated from the valve stem completely.



AME2512E003

## ENGINE

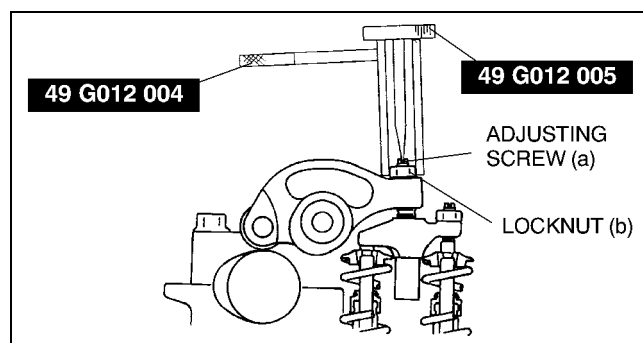
- (3) Loosen the rocker arm locknut (b) using the **SST** (49 G012 004), and then turn the adjusting screw (a) using the **SST** (49 G012 005) until it is separated from the rocker bridge completely.
- (4) Insert a feeler gauge between the rocker arm and rocker bridge (e).

### Standard valve clearance [Engine cold]

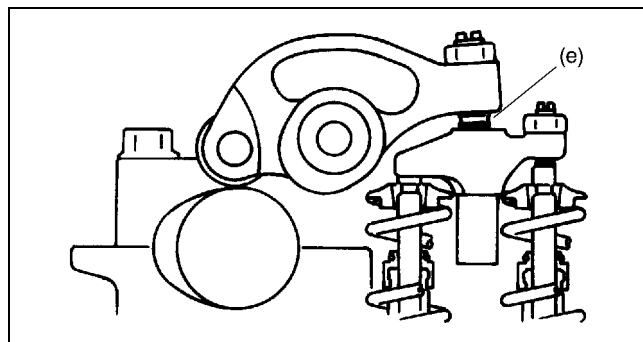
**IN: 0.12—0.18 mm {0.0048—0.0070 in}**  
**(0.15±0.03 mm {0.0059±0.0012 in})**

**EX: 0.32—0.38 mm {0.0126—0.0149 in}**  
**(0.35±0.03 mm {0.0138±0.0012 in})**

- (5) Adjust the valve clearance by turning the adjuster (a) using the **SST** (49 G012 005). Then temporarily tighten locknut (b) using the **SST** (49 G012 004).
- (6) With the feeler gauge inserted between the rocker arm end rocker bridge, verify that the feeler gauge remains firmly in place even when the adjusting screw (c) is loosened. If the feeler gauge does not remain firmly in place, repeat procedures from Step 1.
- (7) Turn the adjusting screw (c) using the **SST** (49 G012 005) until it reaches the valve stem and the feeler gauge fits more firmly. Then tighten the locknut (d) using the **SST** (49 G012 004) to specified torque.



AME2512E004



AME2512E005

### Tightening torque

**16—20 N·m {1.6—2.1 kgf·cm, 12—15 in·lbf}**

- (8) Loosen the locknut (b) using the **SST** (49 G012 004) and readjust the valve clearance (e).

### Standard valve clearance [Engine cold]

**IN: 0.12—0.18 mm {0.0048—0.0070 in} (0.15±0.03 mm {0.0059±0.0012 in})**

**EX: 0.32—0.38 mm {0.0126—0.0149 in} (0.35±0.03 mm {0.0138±0.0012 in})**

- (9) Tighten the locknut (b) using the **SST** (49 G012 004) to specified torque.

### Tightening torque

**16—20 N·m {1.6—2.1 kgf·cm, 12—15 in·lbf}**

- (10) Verify the valve clearance at (e).

### Standard valve clearance [Engine cold]

**IN: 0.12—0.18 mm {0.0048—0.0070 in} (0.15±0.03 mm {0.0059±0.0012 in})**

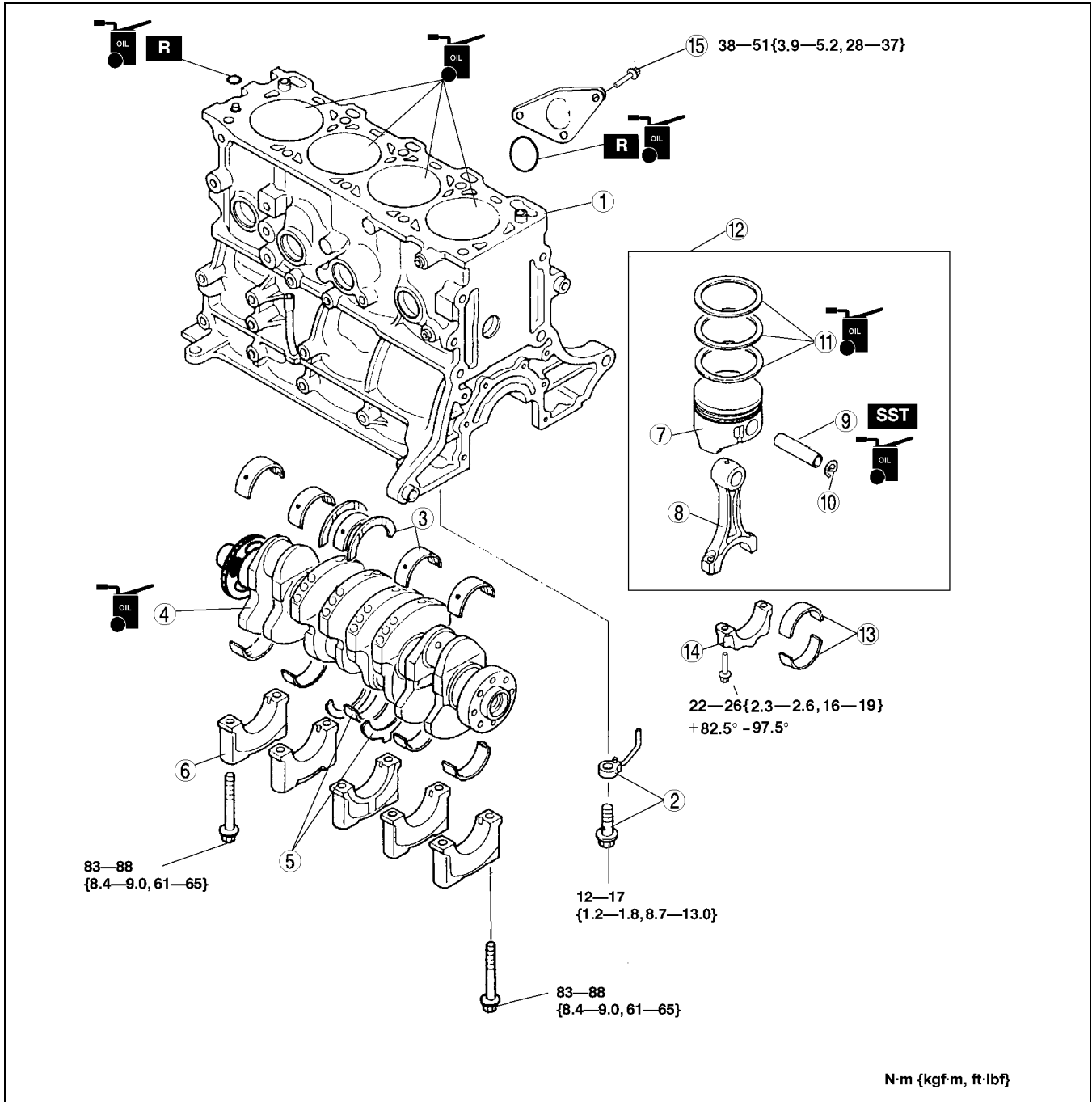
**EX: 0.32—0.38 mm {0.0126—0.0149 in} (0.35±0.03 mm {0.0138±0.0012 in})**

5. Turn the crankshaft one full turn and adjust the remaining valve clearances.
6. Install the injection nozzle.
7. Install the injection nozzle bracket.  
(See [B-41 Injection Nozzle Assembly Note](#))

# ENGINE

## CYLINDER BLOCK (I) ASSEMBLY

1. Assemble in the order indicated in the table.



N·m {kgf·m, ft·lbf}

AME2524E075

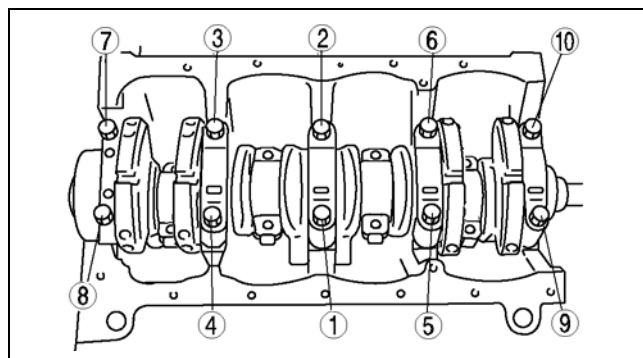
1	Cylinder block
2	Oil jet
3	Upper main bearing, thrust bearing
4	Crankshaft
5	Lower main bearing, thrust bearing
6	Main bearing cap (See B-31 Main Bearing Cap Assembly Note)
7	Piston (See B-31 Piston Assembly Note)
8	Connecting rod

9	Piston Pin
10	Snap ring
11	Piston ring (See B-31 Piston Ring Assembly Note)
12	Connecting rod, piston (See B-31 Piston Ring Assembly Note)
13	Connecting rod bearing
14	Connecting rod cap (See B-32 Connecting Rod Cap Assembly Note)
15	Cover

# ENGINE

## Main Bearing Cap Assembly Note

1. Tighten the bolts in the order shown.

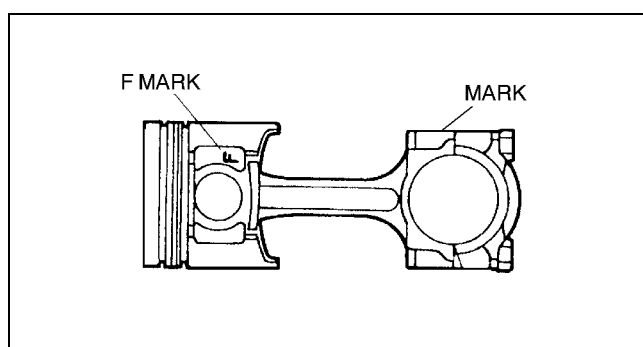


AME2524E067

B

## Piston Assembly Note

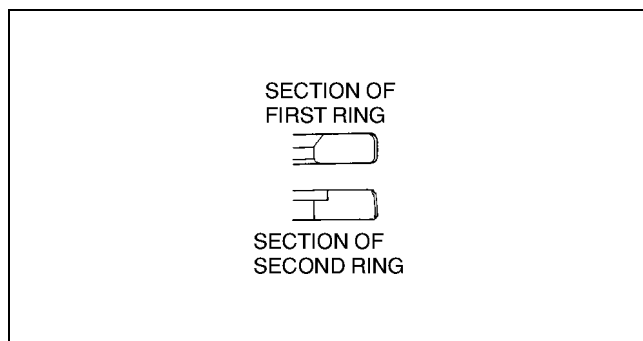
1. Assemble the piston and the connecting rod in the direction from which they were disassembled.
2. Apply clean engine oil to the piston pin.
3. Install the piston pin until the pin contacts the clip. If the pin cannot be installed easily, heat the piston.



AME2524E036

## Piston Ring Assembly Note

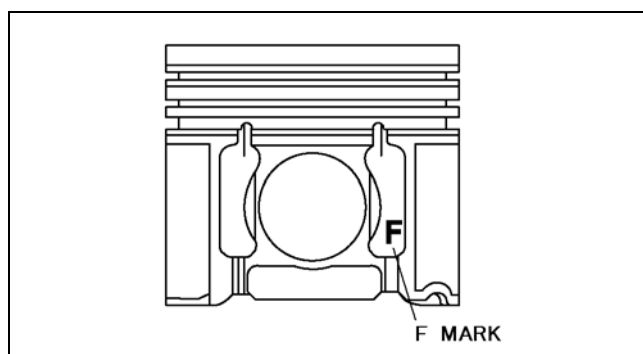
1. Install the first and second rings as shown.



AME2524E037

## Connecting Rod, Piston Assembly Note

1. Insert the piston and connecting rod into the cylinder with the F mark facing the front of the engine.



AME2524E062





## ENGINE

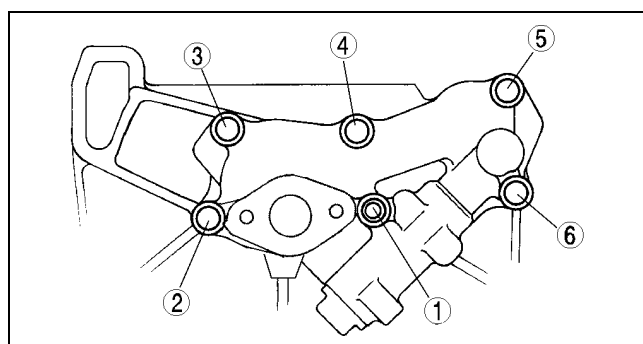
1	Oil pump body
2	Relief valve
3	Outer rotor
4	Oil pump cover (See B-33 Oil Pump Cover Assembly Note)
5	Water Pump
6	Thermostat (See B-33 Thermostat Assembly Note)
7	Oil pump (See B-34 Oil Pump Assembly Note)
8	Rear cover (See B-35 Rear Cover Assembly Note)
9	Oil pan upper block (See B-35 Oil Pan Upper Block Assembly Note)

10	Oil Strainer
11	Oil pipe
12	Oil filter body
13	Oil cooler
14	Oil filter
15	Oil pan (See B-36 Oil Pan Assembly Note)
16	End plate
17	Flywheel (See B-36 Flywheel Assembly Note)

**B**

### Oil Pump Cover Assembly Note

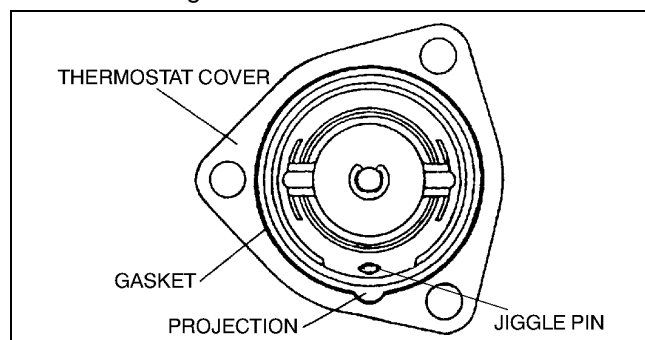
1. Install the oil pump cover in the order shown.
2. Verify that the oil pump rotates smoothly when turned driven gear by hand.



AME2524E026

### Thermostat Assembly Note

1. Verify that the jiggle pin is aligned with the projection of the thermostat gasket as shown.
2. Install the thermostat and gasket into the thermostat cover, aligning the projection with the cover as shown.

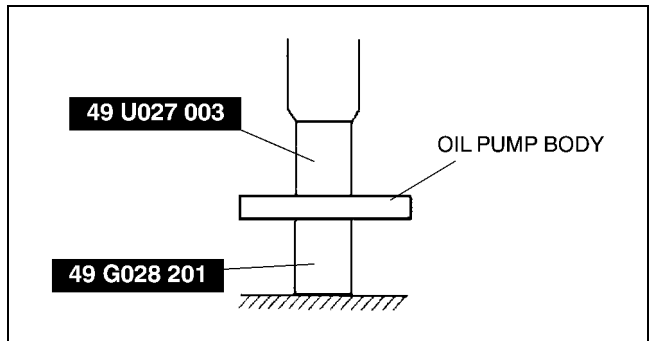


AME2524E027

# ENGINE

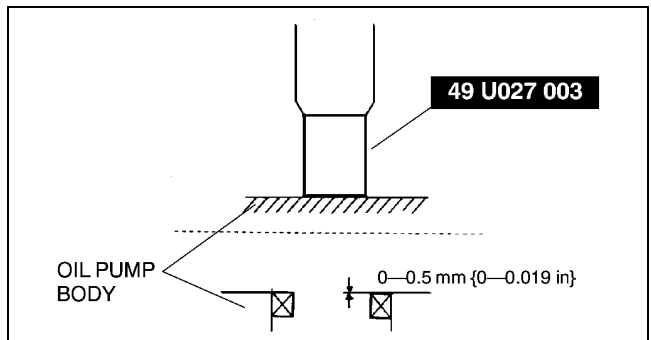
## Oil Pump Assembly Note

1. Apply clean engine oil to the oil seal.
2. Push the oil seal slightly in by hand.
3. Set the oil pump and **SSTs**.



AME2524E028

4. Press the oil seal in evenly using the **SST**.

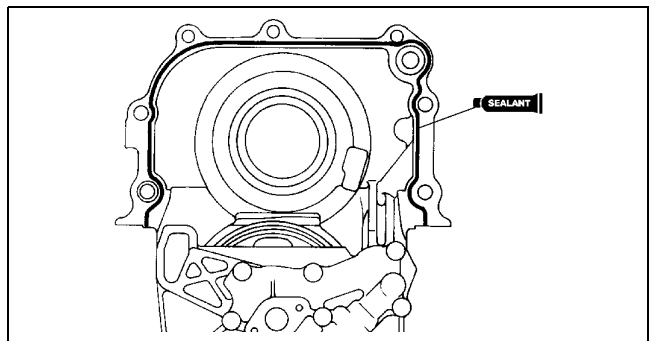


AME2524E029

5. Apply silicone sealant to the oil pump housing continuously as shown.

### Thickness

1.0—2.0 mm {0.040—0.078 in}



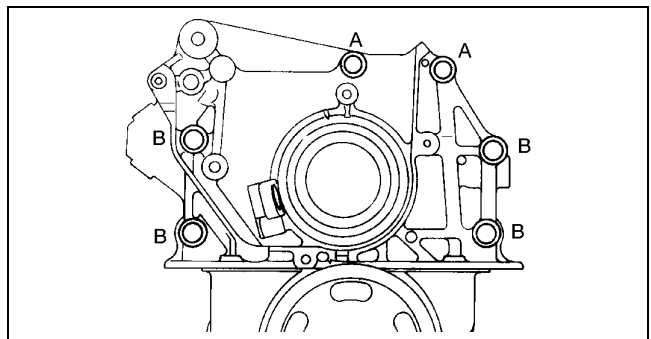
AME2524E030

6. Install the oil pump.

### Tightening torque

A: 19—25 N·m {1.9—2.6 kgf·m, 14—18 ft·lbf}

B: 38—51 N·m {3.8—5.3 kgf·m, 2—38 ft·lbf}



AME2524E031

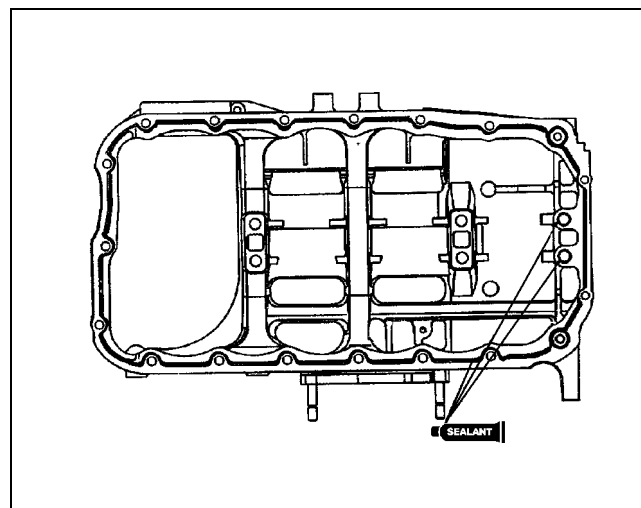
## ENGINE

### Oil Pan Upper Block Assembly Note

1. Apply silicone sealant to the oil pan upper block as shown.

#### Thickness

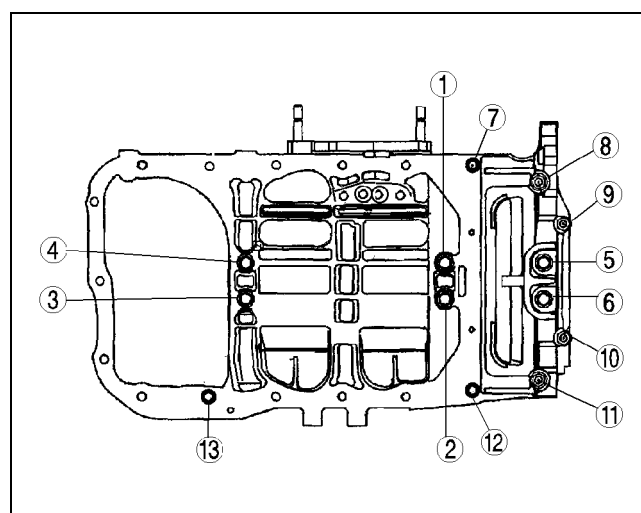
2.0—3.0 mm {0.08—0.11 in}



AME2524E077

2. Tighten the oil pan upper block bolts in two or three steps in the order shown.

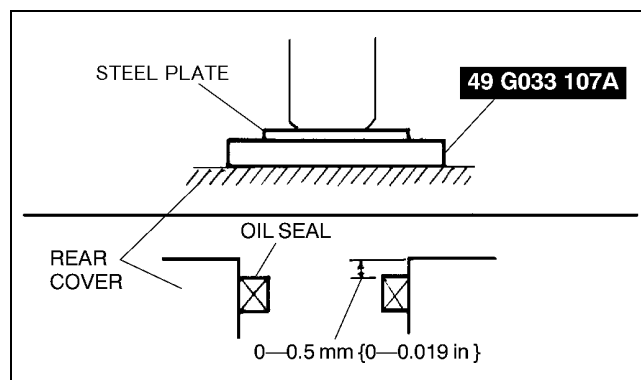
Bolt No.	Tightening Torque
1—6	19—25 N·m {1.9—2.6 kgf·m, 14—18 ft·lbf}
7—13	7.9—10.7 N·m {80—110 kgf·cm, 69.5—95.4 in·lbf}



AME2524E079

### Rear Cover Assembly Note

1. Apply clean engine oil to the oil seal.
2. Push the oil seal slightly in by hand.
3. Press the oil seal in evenly using the **SSTs**.



AME2524E032

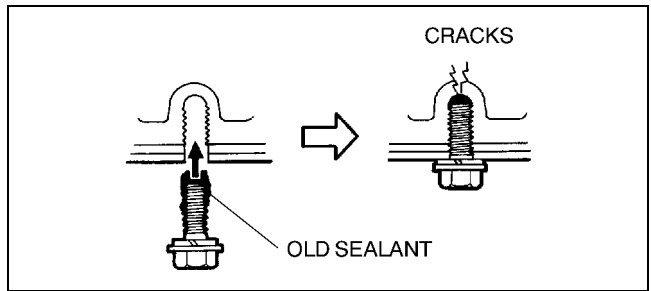
**B**

# ENGINE

## Oil Pan Assembly Note

### Caution

- If the bolts are reused, remove the old sealant from the bolt threads. Tightening a bolt that has old sealant on it can cause bolt hole damage.



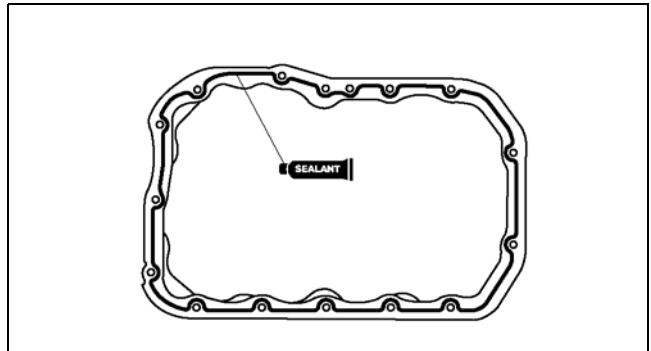
AME2524E033

1. Apply silicone sealant to the oil pan along the inside of the bolt holes and overlap the ends.

### Thickness

2.5—3.5 mm {0.099—0.137 in}

2. Install the oil pan.
3. Hand tighten the flangeless bolts and tighten the flanged bolts.



AME2524E063

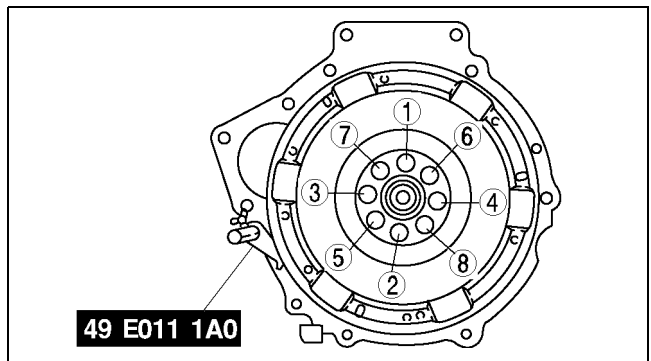
## Flywheel Assembly Note

1. Hold the flywheel using the **SST**.
2. When reusing the bolts, clean and apply sealant to the threads.

### Note

- No sealant is needed when new bolts are use.

3. Tighten the bolts in two or three steps in the order shown.



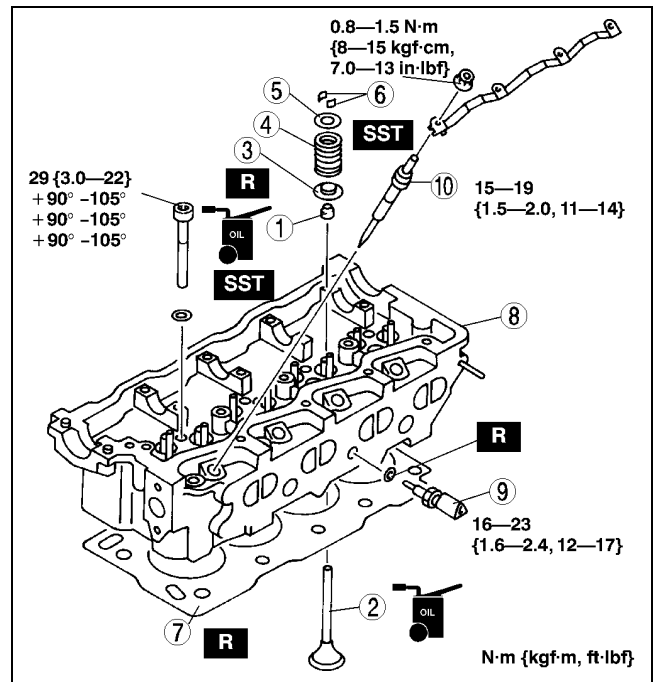
AME2524E072

# ENGINE

## CYLINDER HEAD (I) ASSEMBLY

1. Assemble in the order indicated in the table.

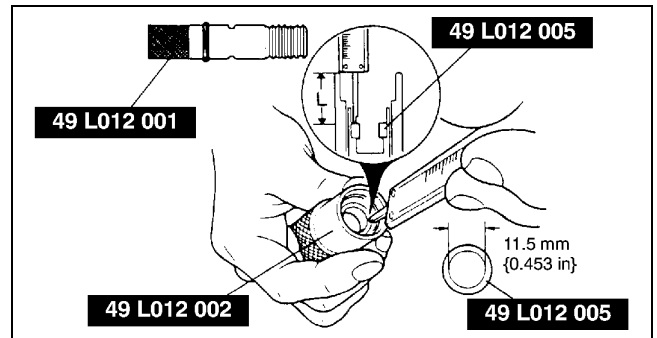
1	Valve Seal (See B-37 Valve Seal Assembly Note)
2	Valve
3	Lower valve spring seat
4	Valve spring
5	Upper valve spring seat
6	Valve keeper (See B-38 Valve Keeper Assembly Note)
7	Cylinder head gasket
8	Cylinder head (See B-38 Cylinder Head Assembly Note)
9	Engine coolant temperature sensor
10	Glow plug, Glow Plug Lead (See B-38 Glow Plug, Glow Plug Lead Assembly Note)



AME2524E073

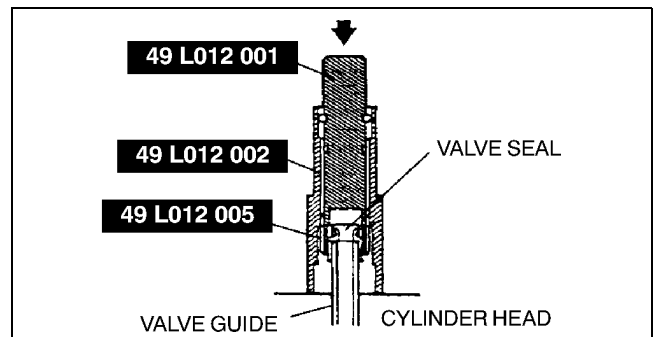
### Valve Seal Assembly Note

1. Assemble the **SSTs** so that depth L is as specified.
2. Press the valve seal onto the valve guide by hand.



AME2511E003

3. Tap the **SSTs** using a plastic hammer until its lower end touches the cylinder head.

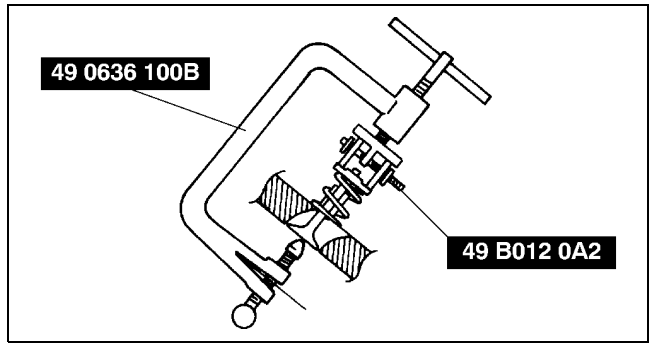


AME2511E004

## ENGINE

### Valve Keeper Assembly Note

1. Install the valve keeper using the SSTs.



AME2511E001

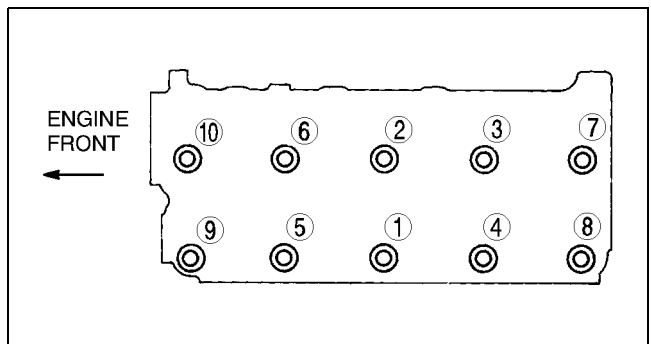
### Cylinder Head Assembly Note

1. Tighten the bolts in two or three steps in the order shown.

#### Tightening torque

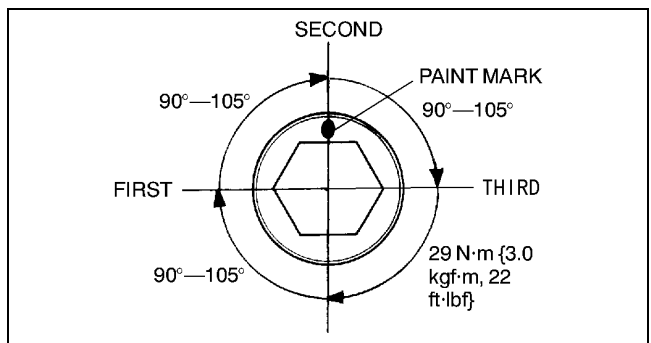
29 N·m {3.0 kgf·m, 22 ft·lbf}

2. Put a paint mark on each bolt head.
3. Using the marks as a reference, tighten the bolts by turning each  $90^{\circ}$ — $105^{\circ}$  in the sequence shown.
4. Further tighten each bolt by turning another  $90^{\circ}$ — $105^{\circ}$ .



AME2524E021

5. Further tighten each bolt by turning another  $90^{\circ}$ — $105^{\circ}$ .



AME2524E022

### Glow Plug, Glow Plug Lead Assembly Note

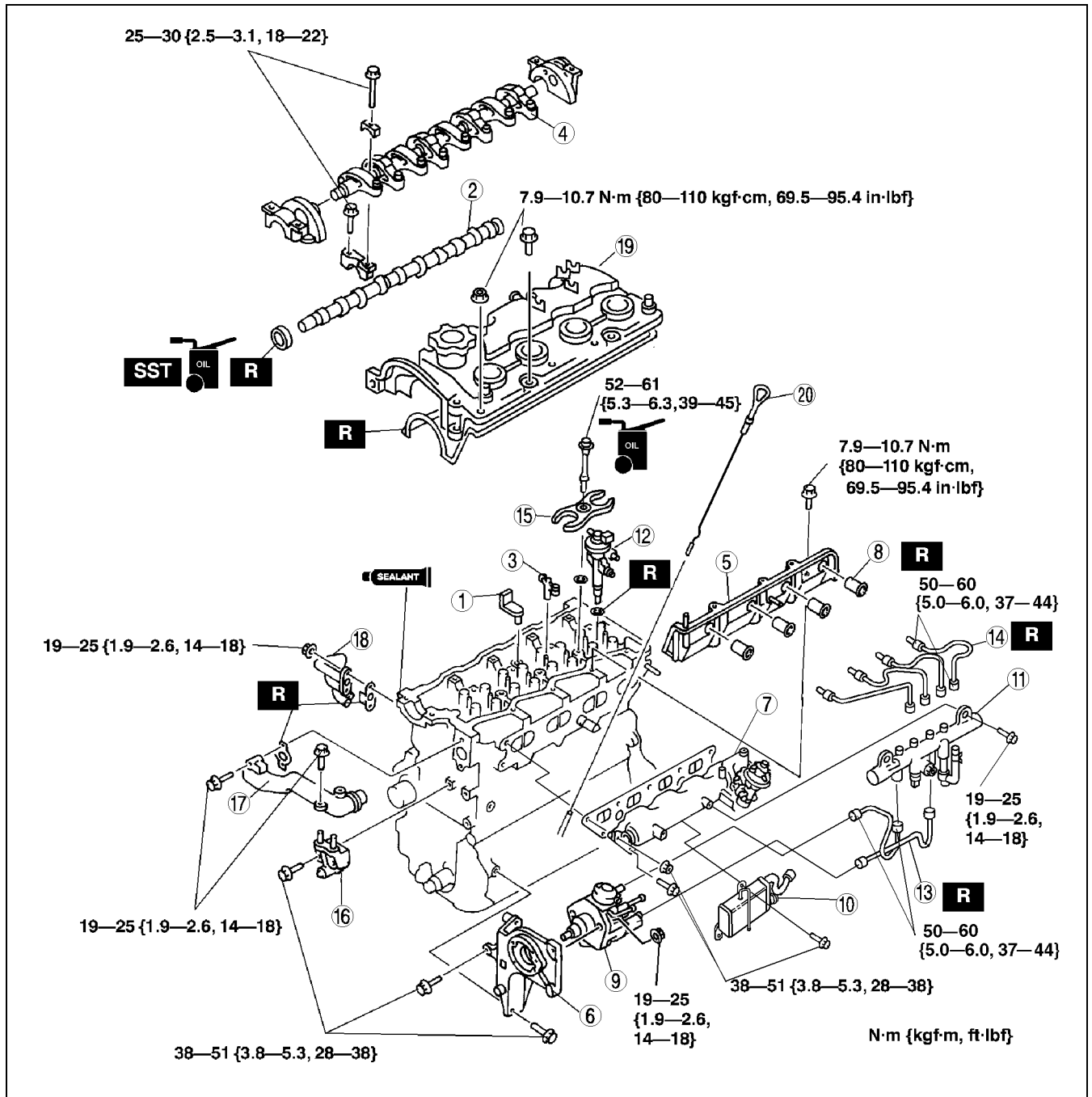
#### Caution

- Damaging heat-generating part of the plug can cause the plug to blow out. Do not use the plug if it is dropped from a height over 10 cm {3.9 in}.
- When installing the glow plug, tighten it one or more threads by hand, then further tighten using tool.

# ENGINE

## CYLINDER HEAD (II) ASSEMBLY

1. Assemble in the order indicated in the table.



AME2524E023

1	Breather pipe
2	Camshaft
3	Rocker bridge
4	Rocker arm and rocker arm shaft (See <a href="#">B-40 Rocker Arm and Rocker Arm Shaft Assembly Note</a> )
5	Side wall
6	Injection pump bracket (See <a href="#">B-41 Injection Pump Bracket Assembly Note</a> )
7	Intake manifold (See <a href="#">B-41 Intake Manifold Assembly Note</a> )
8	Nozzle seal
9	Injection pump
10	EGR water cooler

11	Common rail
12	Injection nozzle (See <a href="#">B-41 Injection Nozzle Assembly Note</a> )
13	Fuel injection pipe
14	Fuel injection pipe
15	Injection nozzle bracket
16	No. 3 engine mount bracket
17	Water outlet (See <a href="#">B-42 Water Outlet Assembly Note</a> )
18	Bypass pipe
19	Cylinder head cover (See <a href="#">B-42 Cylinder Head Cover Assembly Note</a> )
20	Dipstick



# ENGINE

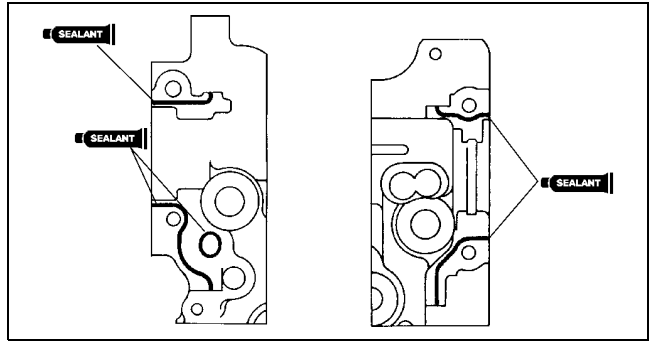
## Rocker Arm and Rocker Arm Shaft Assembly Note

1. Apply sealant as shown in the figure.

### Thickness

2.0 mm {0.079 in} min.

2. Install the camshaft caps according to the cap number.

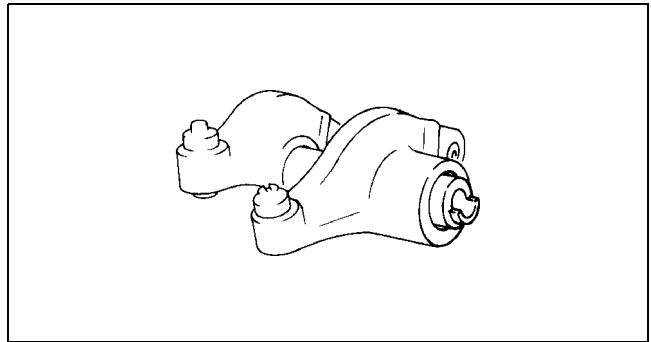


AME2521E002

3. Install the rocker arm shaft plane side upward.

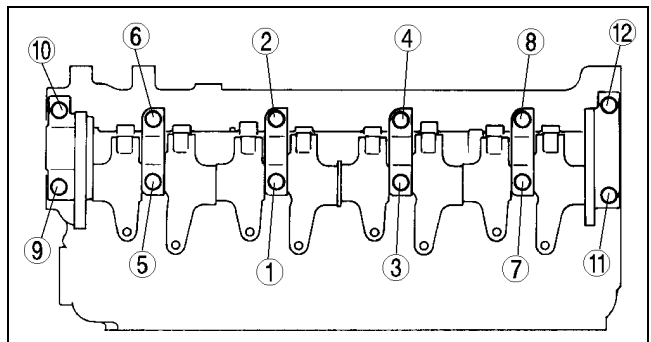
### Caution

- Because there is little camshaft thrust clearance, the camshaft must be held horizontally while it is installed. Otherwise, excessive force will be applied to the thrust area, causing burr on the thrust receiving area of the cylinder head journal. To avoid this, the following procedure must be observed.



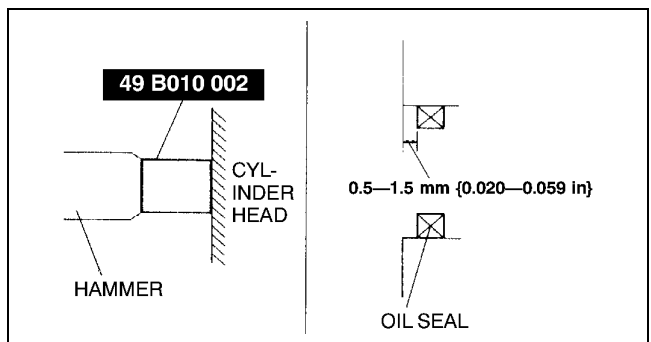
AME2521E003

4. Tighten the bolts in two or three steps in the order shown.
5. Apply clean engine oil to the new oil seal.
6. Push the oil seal slightly in by hand.



AME2521E004

7. Tap the oil seal into the cylinder head using the SST and a hammer.



AME2524E015

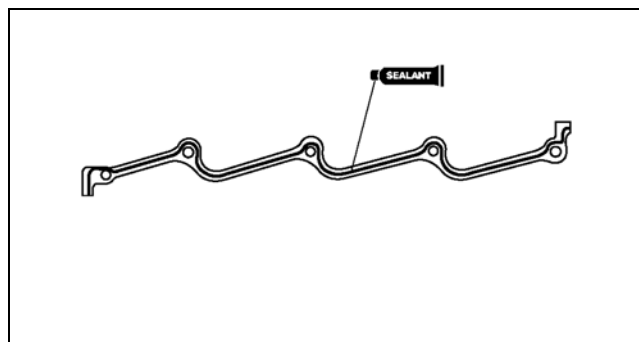
## ENGINE

### Side Wall Assembly Note

1. Apply silicone sealant as shown in the figure.

#### Thickness

2.0 mm {0.079 in} min.

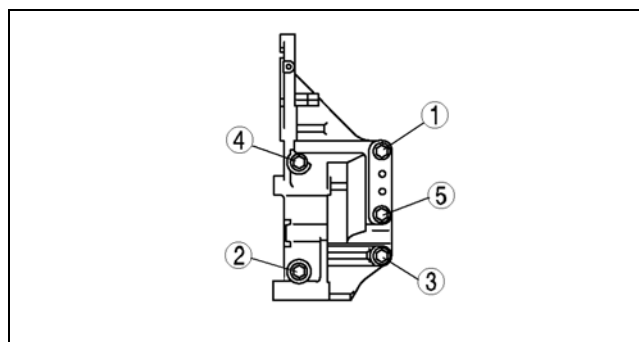


AME2524E069

B

### Injection Pump Bracket Assembly Note

1. Tighten the bolts in the order shown.



AME2524E070

### Intake Manifold Assembly Note

- Tighten from centre to outwards.

### Injection Nozzle Assembly Note

1. Temporarily tighten the injection nozzle bracket.

#### Tightening torque

10—20 N·m {1.0—2.0 kgf·m, 8—14 ft·lbf}

2. Temporarily tighten the common rail.
3. Temporarily tighten the injection pipes.
4. Fully tighten the injector side injection pipes, then tighten the common rail side.

#### Tightening torque

50—60 N·m {5.0—6.0 kgf·m, 37—44 ft·lbf}

5. Fully tighten the injection pump side and common rail side injection pipes.

#### Tightening torque

50—60 N·m {5.0—6.0 kgf·m, 37—44 ft·lbf}

6. Fully tighten the injection nozzle bracket.

#### Tightening torque

52—61 N·m {5.3—6.3 kgf·m, 39—45 ft·lbf}

7. Fully tighten the common rail.

#### Tightening torque

19—25 N·m {1.9—2.6 kgf·m, 14—18 ft·lbf}

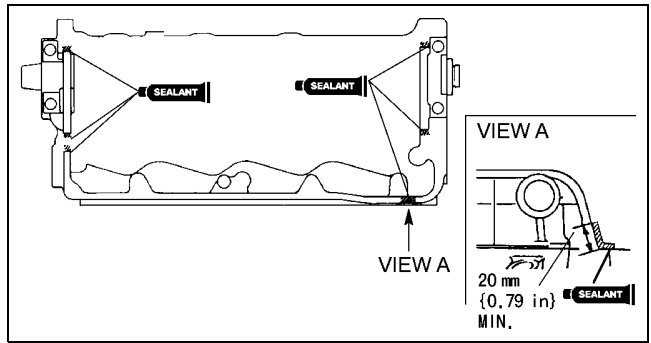
# ENGINE

## Cylinder Head Cover Assembly Note

1. Apply silicone sealant to the shaded areas.

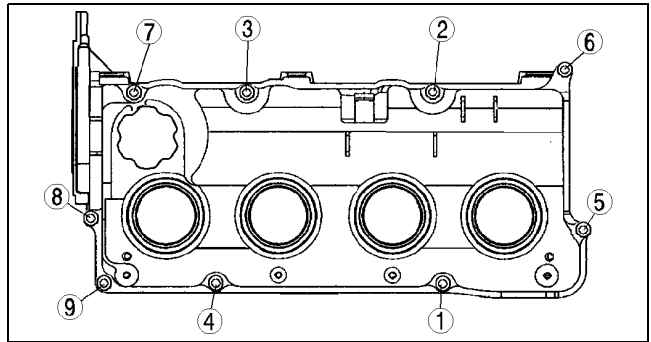
### Thickness

2.0 mm {0.079 in} min.



AME2524E017

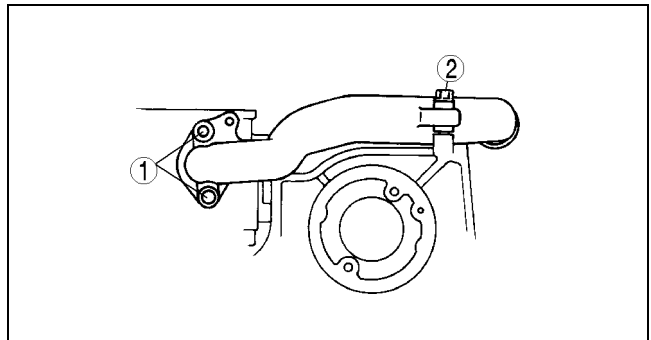
2. Tighten the bolts in the order shown.



AME2524E777

## Water Outlet Assembly Note

1. Tighten the bolts in the order shown.



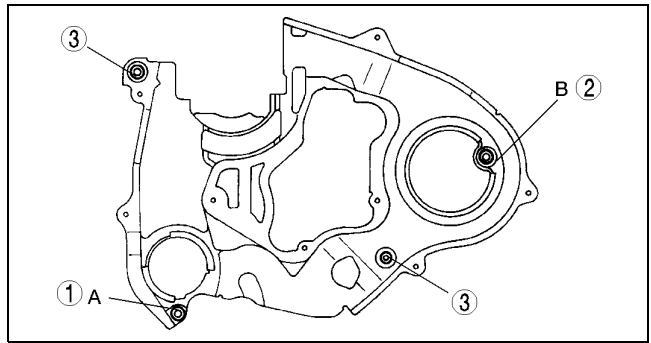
AME2524E018



## ENGINE

### Seal Plate Assembly Note

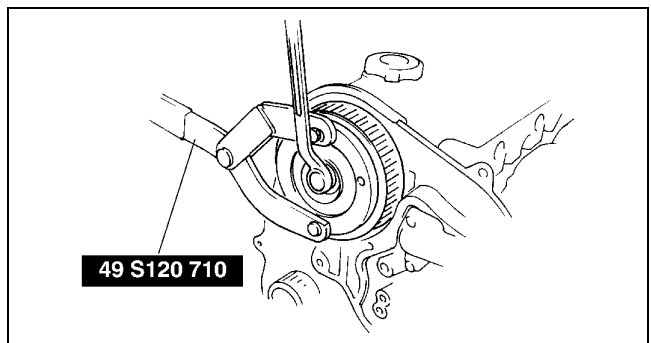
1. Install the seal plate and hand tighten the bolts in the order A to B.
2. Tighten the bolts in the order shown.



AME2516E004

### Camshaft Pulley Assembly Note

1. Hold the camshaft using the SST.



AME2524E009

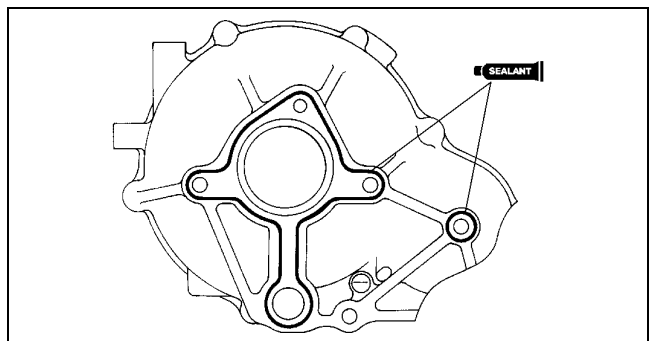
### Gear Case Assembly Note

1. Apply silicone sealant as shown in the figure.

#### Thickness

1.5—2.5 mm {0.059—1.098 in}

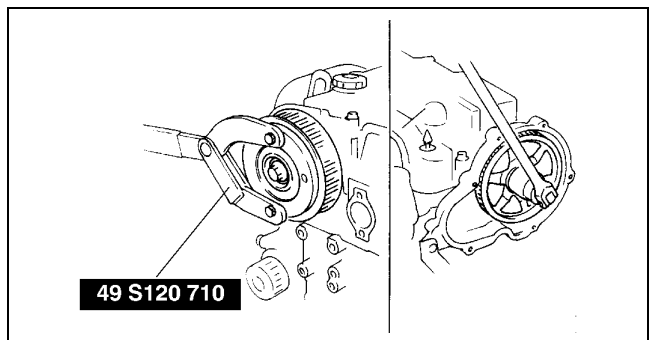
2. Tighten the bolts in clockwise order.



AME2524E011

### Drive Gear Assembly Note

1. Hold the camshaft using the SST.
2. Remove the drive gear lock bolt.



AME2524E008

## ENGINE

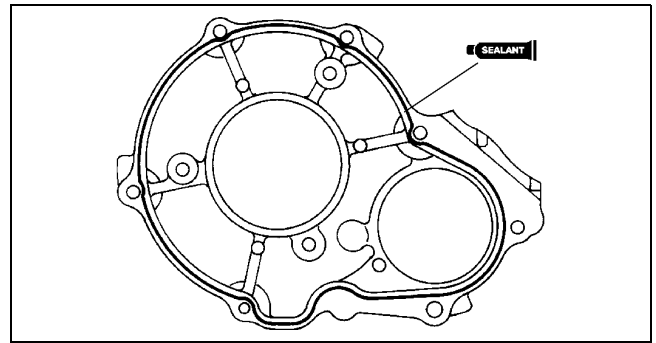
### Gear Cover Assembly Note

1. Apply silicone sealant as shown in the figure.

#### Thickness

1.5—2.5 mm {0.059—1.098 in}

2. Tighten the bolts in clockwise order.

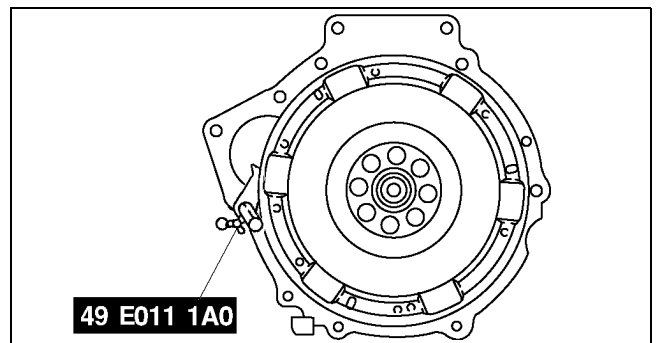


AME2524E012

B

### Timing Belt Pulley Assembly Note

1. Hold the crankshaft using the SST.
2. Tighten the timing belt pulley lock bolt.



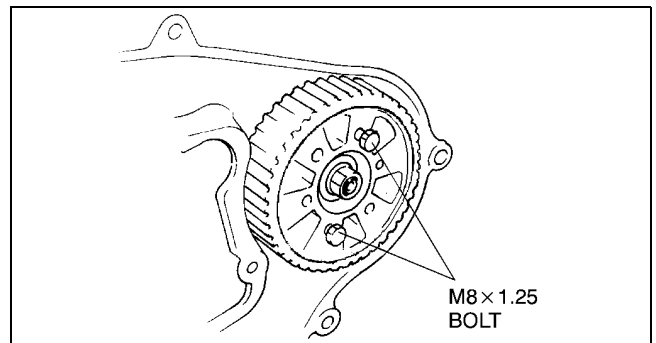
AME2524E065

### Injection Pump Pulley Assembly Note

#### Caution

- To prevent the bolts (M8 x 1.25) from damaging the injection pump and pulley, do not fully tighten the detent bolt. If it contacts the pulley surface, it will damage the pulley.

1. Fix the injection pump pulley to the bracket using two bolts (M8 x 1.25).



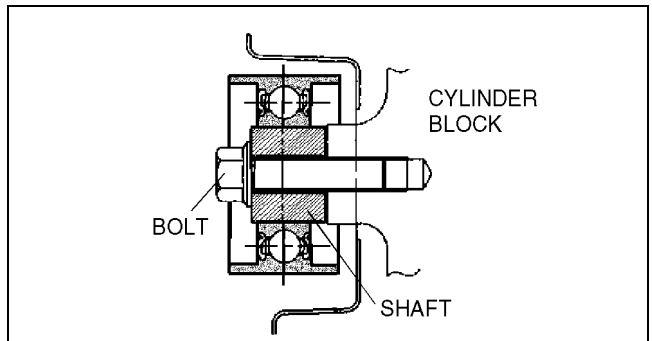
AME2524E005

## ENGINE

### Idler Assembly Note

#### Caution

- The idler has a front and back relative to the engine, therefore when installing make sure that the longer projection of the shaft is on the engine side as indicated in the figure.



AME2524E099

### Timing Belt, Timing Belt Auto Tensioner Assembly Note

#### Caution

- Placing the auto tensioner horizontally can cause oil leakage and damage the auto tensioner. Place the auto tensioner vertically when using a vise.

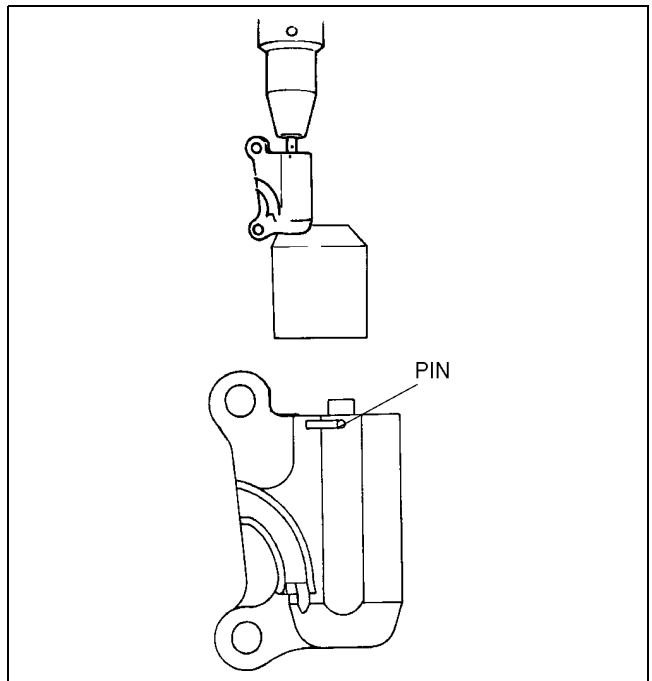
1. Verify the thrust of the auto tensioner rod in the following order:

- (1) If the tensioner rod is rigid when it is pushed with a force of approximately 235 N {24 kgf, 53 lbf}, push it down slowly and fix the pin in the hole.
- (2) If there is no resistance on the tensioner rod and it moves slightly when it is pushed with a force of approximately 235 N {24 kgf, 53 lbf};

#### Caution

- To prevent damage to the inside of the auto tensioner, do not press down the auto tensioner rod with a force greater than the specified 235 N {24 kgf, 53 lbf}. Be careful that the rod does not touch the bottom.

- 1) Push it down slowly two or three times to the bottom end of the rod.
- 2) If the rod protrudes approximately 8.1 mm {0.32 in}, verify that there is resistance on the tensioner rod.
  - If the resistance is restored, push it down slowly and fix the pin in the hole. If the resistance is not restored, replace the auto tensioner.



AME2516E005

#### Caution

- To prevent the bolts (M8 x 1.25) from damaging the injection pump and pulley, do not fully tighten the detent bolt. If it contacts the pulley surface, it will damage the pulley.

2. Verify that all timing marks are correctly aligned.
3. Fix the camshaft pulley to the cylinder head using bolt (M8 x 1.25).

## ENGINE

4. Fix the injection pump pulley to the bracket using two bolts (M8 x 1.25).
5. If not, align all timing marks according to the following procedure.

### Caution

- Turn the crankshaft in the direction which will prevent the TDC and BDC from being passed. Otherwise it can cause the valve and piston to contact.

- (1) Turn the crankshaft and set it an angle of 45° or more away from the TDC and BDC.
- (2) Align the timing marks of the camshaft pulley.
- (3) Align the timing marks of the injection pump pulley.
- (4) Turn the crankshaft and align the timing marks of the timing belt pulley.

6. Install the timing belt on the pulleys in the following order.

- (1) Timing belt pulley
- (2) Idler
- (3) Injection pump pulley
- (4) Camshaft pulley
- (5) Water pump pulley
- (6) Tensioner

7. Remove the injection pump pulley fixing bolts and camshaft pulley fixing bolt (M8 x 1.25).

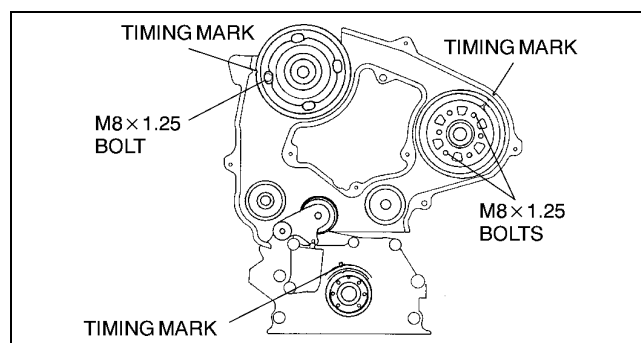
8. Hand-tighten the auto tensioner bolts in the order A to B.

9. Tighten the auto tensioner bolts in the order A to B.

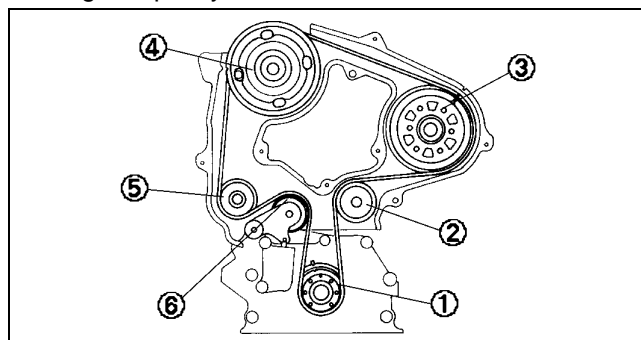
10. Remove the pin from the auto tensioner to apply tension to the belt.

11. Turn the crankshaft clockwise twice, and align the timing marks.

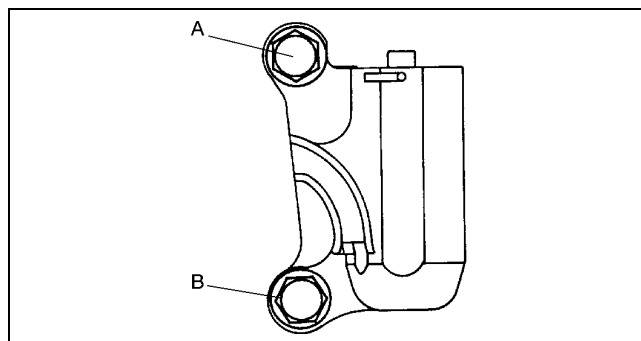
12. Verify that all timing marks are correctly aligned. If not, repeat from **Timing Belt, Timing Belt Auto Tensioner Removal Note**.



AME2516E006



AME2516E007



AME2516E008

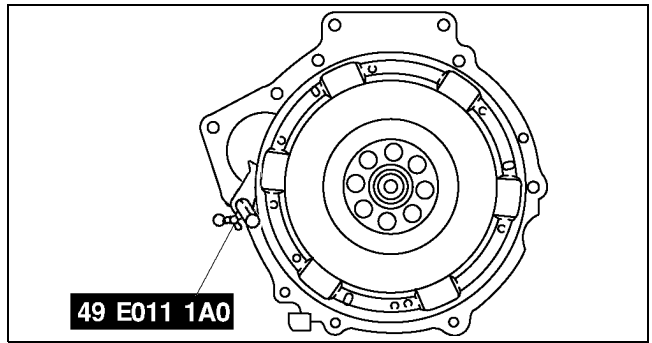
B



## ENGINE

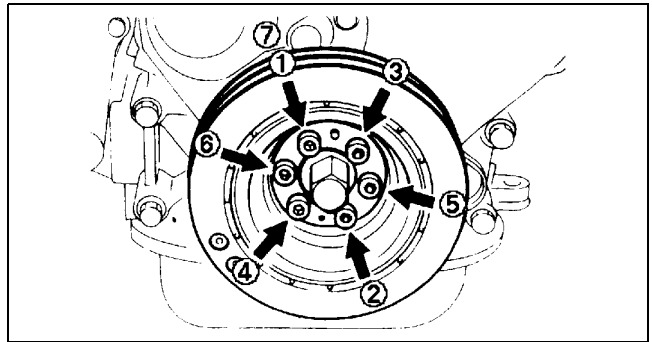
### Crankshaft Pulley Assembly Note

1. Hold the crankshaft using the **SST**.



AME2524E065

2. Tighten the bolts in the order shown.



AME2524E013

# TECHNICAL DATA

TECHNICAL DATA ..... TD-2  
ENGINE ..... TD-2

TD

## TECHNICAL DATA

### TECHNICAL DATA

#### ENGINE

AME931001001101

Item		Specification		
<b>Cylinder head</b>				
Valve clearance [Engine cold]	(mm {in})	IN	0.12—0.18 {0.0048—0.0070} (0.15 ± 0.03 {0.0059 ± 0.0012})	
		EX	0.32—0.38 {0.0126—0.0149} (0.35 ± 0.03 {0.0138 ± 0.0012})	
Cylinder head gasket contact surfaces distortion	(mm {in})	Maximum	X direction:0.01 {0.0004} Y direction:0.04 {0.0016}	
		Maximum	0.06 {0.0024}	
Manifold contact surfaces direction	(mm {in})	Maximum grinding	0.20 {0.008}	
<b>Valve and valve guide</b>				
Margin thickness	(mm {in})	IN	0.8 {0.0315}	
		EX	1.0 {0.0394}	
Valve length	(mm {in})	IN	Standard	115.01—115.51 {4.528—4.547}
			Minimum	114.785 {4.519}
		EX	Standard	114.35—114.85 {4.502—4.521}
			Minimum	114.125 {4.493}
Valve stem diameter	(mm {in})	IN	Standard	5.970—5.985 {0.2351—0.2356}
			Minimum	5.920 {0.2331}
		EX	Standard	5.965—5.980 {0.2349—0.2354}
			Minimum	5.915 {0.2329}
Valve guide inner diameter	(mm {in})		6.030—6.050 {0.2374—0.2381}	
Valve guide protrusion height	(mm {in})	IN	18.7—19.2 {0.737—0.755}	
		EX	17.6—18.1 {0.693—0.712}	
Valve seat contact width	(mm {in})	IN	1.3—1.9 {0.052—0.074}	
		EX	1.3—1.9 {0.052—0.074}	
Valve seat angle		IN	45°	
		EX	45°	
Valve recession	(mm {in})	IN	Standard	0.42—0.90 {0.017—0.035}
			Maximum	1.25 {0.049}
		EX	Standard	0.46—0.94 {0.019—0.037}
			Maximum	1.29 {0.051}
<b>Valve spring</b>				
Standard height	(mm {in})	IN	38.0 {1.50}	
		EX	38.0 {1.50}	
Pressing force/height	(N {kgf, lbf}/mm{in})	IN	172.1—194.9 {17.55—19.87,38.61—43.79}/38.0 {1.50}	
		EX	172.1—194.9 {17.55—19.87,38.61—43.79}/38.0 {1.50}	
Out-of-square	(mm {in})	Maximum	1.55 {0.061}	
<b>Camshaft</b>				
Runout	(mm {in})	Maximum	0.03 {0.0012}	
Cam lobe height	(mm {in})	IN	Standard	40.140 {1.5803}
			Minimum	39.940 {1.5724}
		EX	Standard	39.809 {1.5673}
			Minimum	39.609 {1.5594}
Journal diameter	(mm {in})	Standard	31.950—31.975 {1.2579—1.2588}	
		Minimum	31.920 {1.2567}	
Journal oil clearance	(mm {in})	Standard	0.025—0.030 {0.0010—0.0011}	
		Maximum	0.075 {0.0030}	
End play	(mm {in})	Standard	0.03—0.16 {0.0012—0.0062}	
		Maximum	0.20 {0.0079}	

## TECHNICAL DATA

Item		Specification
<b>Cylinder block</b>		
Cylinder head gasket contact surfaces distortion (mm {in})	Maximum	X direction: 0.01 {0.0004}
		Y direction: 0.03 {0.0012}
Cylinder bore diameter (mm {in})	Standard	86.000—86.022 {3.3859—3.3866}
	0.25 {0.01} oversize	86.250—86.272 {3.3957—3.3965}
	0.50 {0.02} oversize	86.500—86.522 {3.4055—3.4063}
Wear limit (mm {in})		0.15 {0.006}
Oil jet valve, nozzle		
Nozzle opening pressure (kPa{kgf/cm <sup>2</sup> ,psi})		138—196 {1.4—2.0,20—28}
<b>Piston</b>		
Piston diameter [Measured at 90° to pin bore axis and 10mm {0.39 in} above the bottom of piston] (mm {in})	Standard	85.973—86.015 {3.3848—3.3864}
	0.25 {0.01} oversize	86.223—86.265 {3.3946—3.3962}
	0.50 {0.02} oversize	86.473—86.515 {3.4045—3.4061}
Piston-to-cylinder clearance (mm {in})	Standard	0—0.034 {0—0.0013}
	Maximum	0.10 {0.0039}
Piston pin bore diameter (mm {in})		29.997—30.007 {1.1810—1.1813}
<b>Piston ring</b>		
Piston ring-to-ring groove clearance (mm {in})	Top	0.05—0.09 {0.0020—0.0035}
	Second	0.04—0.08 {0.0016—0.0031}
	Oil	0.03—0.07 {0.0012—0.0027}
	Maximum	0.15 {0.0059}
End gap [Measured in cylinder] (mm {in})	Top	0.20—0.30 {0.008—0.011}
	Second	0.20—0.30 {0.008—0.011}
	Oil	0.20—0.30 {0.008—0.011}
	Maximum	1.0 {0.039}
<b>Piston pin</b>		
Diameter (mm {in})		29.994—30.000 {1.1809—1.1811}
Connecting rod-to-piston pin clearance (mm {in})		0.014—0.036 {0.00056—0.00141}
Piston-to-piston pin clearance (mm {in})		-0.003—0.013 {-0.00011—0.00051}
<b>Crankshaft</b>		
Runout (mm {in})		0.03 {0.001}
Main journal diameter (mm {in})	Standard	59.937—59.955 {2.3598—2.3604}
	0.25{0.01} undersize	59.687—59.705 {2.3499—2.3505}
	0.50{0.02} undersize	59.437—59.455 {2.3401—2.3407}
	0.75{0.03} undersize	59.187—59.205 {2.3302—2.3309}
Out-of-round (mm {in})		0.03 {0.001}
Crank pin diameter mm {in})	Standard	50.940—50.955 {2.0056—2.0060}
	0.25{0.01} undersize	50.690—50.705 {1.9957—1.9962}
	0.50{0.02} undersize	50.440—50.455 {1.9859—1.9864}
	0.75{0.03} undersize	50.190—50.205 {1.9760—1.9765}
Out-of-round (mm {in})		0.03 {0.001}
Main journal oil clearance (mm {in})	Standard	0.025—0.044 {0.0010—0.0017}
	Maximum	0.08 {0.003}
Main journal bearing thickness (mm {in})	Standard	2.007—2.022 {0.0791—0.0796}
	0.25{0.01} undersize	2.129—2.139 {0.0839—0.0842}
	0.50{0.02} undersize	2.254—2.264 {0.0888—0.0891}
	0.75{0.03} undersize	2.379—2.389 {0.0937—0.0940}
Crankshaft end play (mm {in})	Standard	0.040—0.282 {0.00158—0.01110}
	Maximum	0.30 {0.012}
Trust bearing thickness (mm {in})	Standard	2.00—2.05 {0.0788—0.0807}
	0.35{0.01}undersize	2.175—2.225 {0.0857—0.0876}

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## TECHNICAL DATA

Item		Specification	
<b>Connecting rod</b>			
Small end inner diameter	(mm {in})	30.014—30.030 {1.1817—1.1822}	
Length (Center to center)	(mm {in})	151.95—152.05 {5.983—5.986}	
Bending	(mm {in})	0.080 {0.0031} max./50 {2.0}	
Distortion	(mm {in})	0.080 {0.0031} max./50 {2.0}	
Connecting rod bearing oil clearance	(mm {in})	Standard	0.027—0.055 {0.0011—0.0021}
		Maximum	0.10 {0.0039}
Connecting rod bearing thickness	(mm {in})	Standard	1.506—1.515 {0.0593—0.0596}
		0.25 {0.01}undersize	1.630—1.640 {0.0642—0.0645}
		0.50 {0.02}undersize	1.755—1.765 {0.0691—0.0694}
		0.75 {0.03}undersize	1.880—1.890 {0.0741—0.0744}
Connecting rod side clearance	(mm {in})	Standard	0.110—0.262 {0.0044—0.0103}
		Maximum	0.512 {0.0202}
<b>Bolt</b>			
Cylinder head bolt length	(mm {in})	Maximum 161.0 {6.338}	
<b>Timing belt auto tensioner</b>			
Rod projection[Free length]	(mm {in})	12.9—14.6 {0.508—0.574}	
<b>Oil pump</b>			
Relief spring free length	(mm {in})	43.8 {1.724}	
Inner rotor tooth tip to outer rotor clearance	(mm {in})	Standard	0.030—0.120 {0.0012—0.0047}
		Maximum	0.16 {0.006}
Outer rotor to body clearance	(mm {in})	Standard	0.200—0.294 {0.0079—0.0115}
		Maximum	0.35 {0.013}
Side clearance	(mm {in})	Standard	0.040—0.100 {0.0016—0.0039}
		Maximum	0.15 {0.0059}
<b>Oil seal</b>			
Camshaft oil seal tapping amount	(mm {in})	0.5—1.5 {0.020—0.059}	
Rear oil seal tapping amount	(mm {in})	0—0.5 {0—0.019}	
Front oil seal tapping amount	(mm {in})	0—0.5 {0—0.019}	

# SPECIAL TOOLS

SPECIAL TOOLS .....	ST-2
ENGINE .....	ST-2

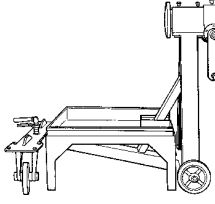
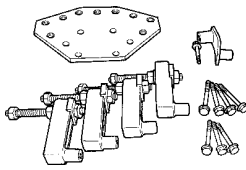
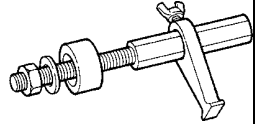
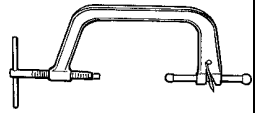
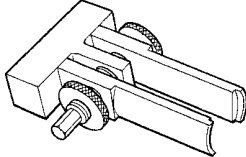
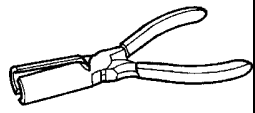

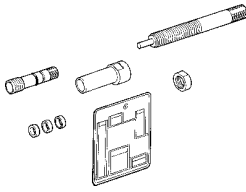
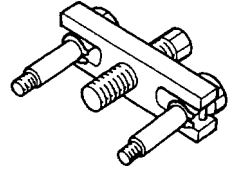
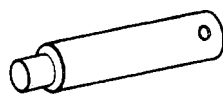
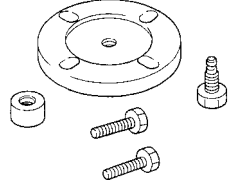
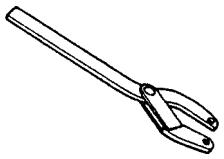
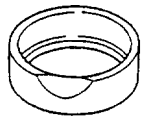
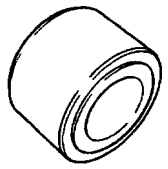
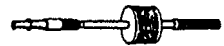
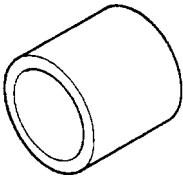
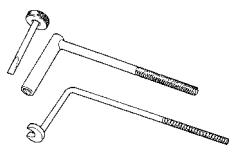
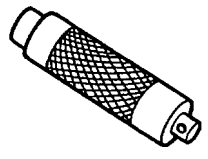
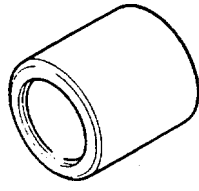
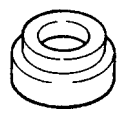
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## SPECIAL TOOLS

### SPECIAL TOOLS

#### ENGINE

AME941001001101

<p>49 0107 680A</p> <p>Engine stand</p> 	<p>49 L010 1A0</p> <p>Engine hanger set</p> 	<p>49 E011 1A0</p> <p>Ring gear brake set</p> 
<p>49 0636 100B</p> <p>Valve spring lifter arm</p> 	<p>49 B012 0A2</p> <p>Pivot</p> 	<p>49 S120 170</p> <p>Valve seal remover</p> 
<p>49 B012 005</p> <p>Valve guide remover &amp; installer</p> 	<p>49 L012 0A0B</p> <p>Valve seal &amp; valve guide installer set</p> 	<p>49 S120 215B</p> <p>Pulley puller</p> 
<p>49 G011 001</p> <p>Piston pin replacer</p> 	<p>49 G011 106</p> <p>Camshaft pulley puller</p> 	<p>49 S120 710</p> <p>Coupling flange holder</p> 
<p>49 G033 107A</p> <p>Dust cover installer</p> 	<p>49 B010 002</p> <p>Oil seal installer</p> 	<p>49 1285 071</p> <p>Bearing puller</p> 
<p>49 U027 003</p> <p>Oil seal installer</p> 	<p>49 G012 0A0</p> <p>Tappet adjust wrench set</p> 	<p>49 G030 797</p> <p>Handle (Part of 49 G030 795)</p> 
<p>49 G028 201</p> <p>Support block</p> 	<p>49 E027 002</p> <p>Attachment</p> 	<p style="text-align: center;">-</p>