

# Engine Workshop Manual L8 LF L3

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PRINTED IN The Netherlands, MARCH 2002  
1731-1E-02C

## 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 March, 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 serving.

**Mazda Motor Corporation**  
**HIROSHIMA, JAPAN**

## **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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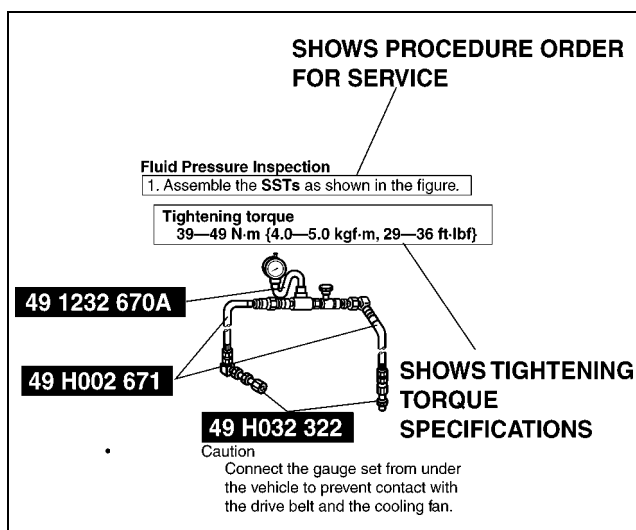
- This manual contains procedures for performing all required service operations. The procedures are divided into the following five basic operations:
  - Removal/Installation
  - Disassembly/Assembly
  - Replacement
  - Inspection
  - Adjustment
- Simple operations which can be performed easily just 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.
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.

# HOW TO USE THIS MANUAL

**Procedure**

**"Removal/Installation" Portion**

**"Inspection After Installation" Portion**

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

**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 TIGHTENING TORQUE SPECIFICATIONS**

**SHOWS PROCEDURE ORDER FOR SERVICE**

**SHOWS THERE ARE REFERRAL NOTES FOR SERVICE**

**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 N-5 Undercover Removal)
3. Remove 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.

44-60 (4.8-9.2, 32-44)

54-116 (9.5-11.0, 69-86)

43-66 (4.3-5.8, 32-41)

119-156 (12.0-16.0, 87-115)

N.m. (kgf.cm, ft.lbf)

1	Split pin	7	Split pin
2	Nut	8	Nut
3	Lower trailing link ball joint (See P-6 Lower Trailing Link Ball Joint Removal Note)	9	Upper trailing link ball joint (See P-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.**

49 T028 304 UPPER TRAILING LINK  
49 T028 305 LOWER TRAILING LINK  
49 T028 303



KNUCKLE

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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

A6E20100001E04

- 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.

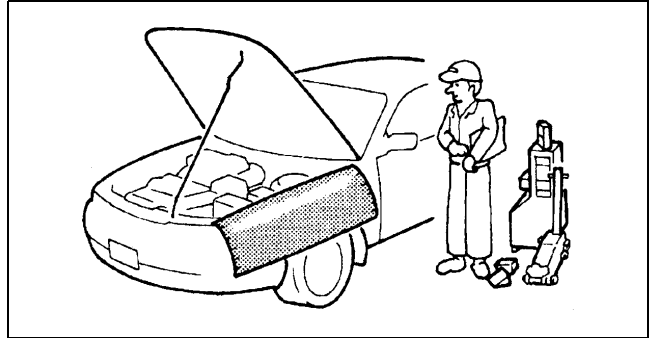
## FUNDAMENTAL PROCEDURES

### 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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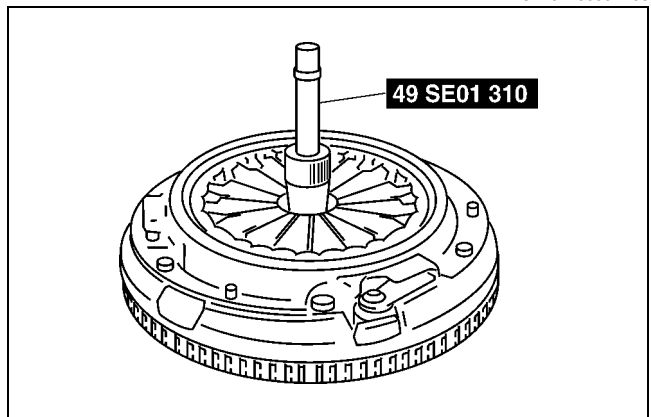


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#### SPECIAL SERVICE TOOLS

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

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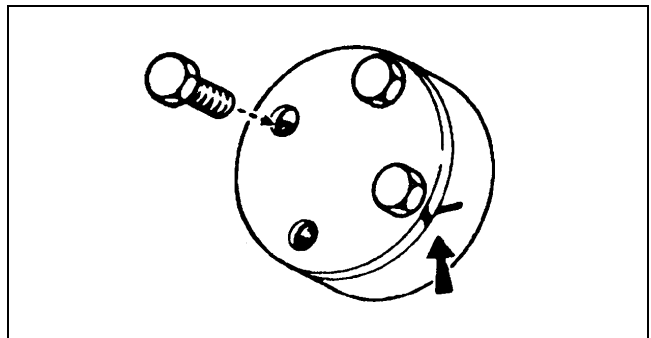


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#### DISASSEMBLY

- 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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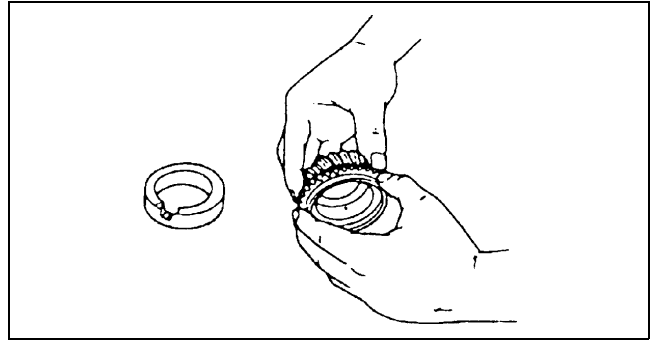


## FUNDAMENTAL PROCEDURES

### INSPECTION DURING REMOVAL, DISASSEMBLY

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

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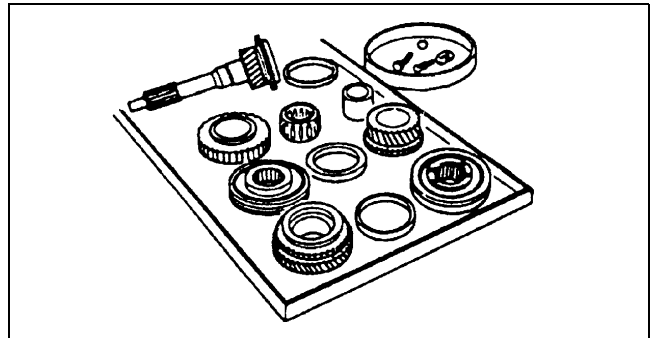


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### ARRANGEMENT OF PARTS

- 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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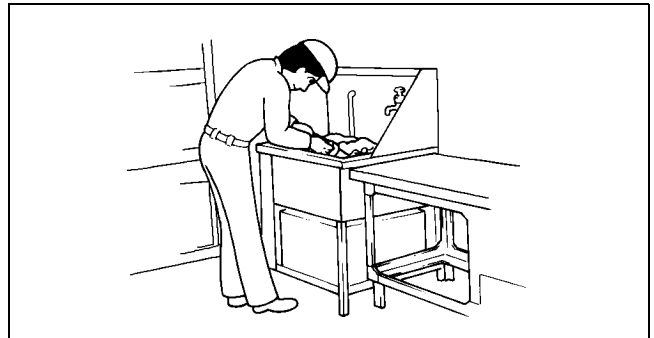
### CLEANING OF PARTS

- 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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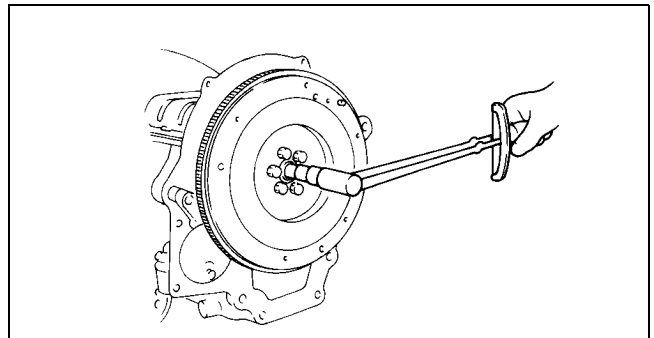


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### REASSEMBLY

- 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

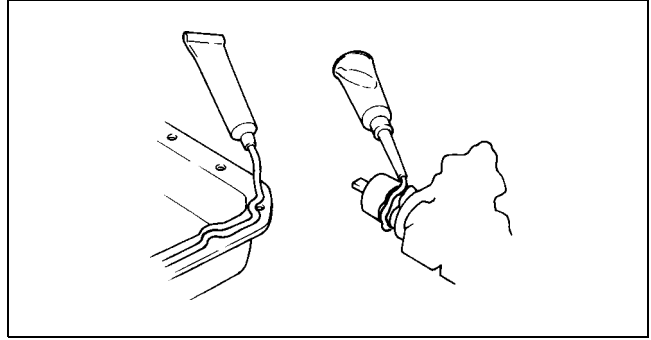
A6E20140004E11



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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.

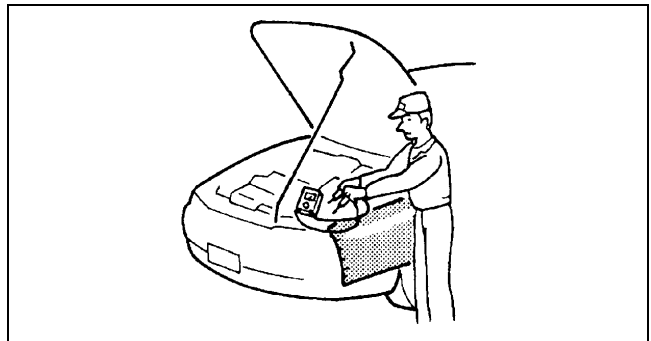


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### ADJUSTMENT

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

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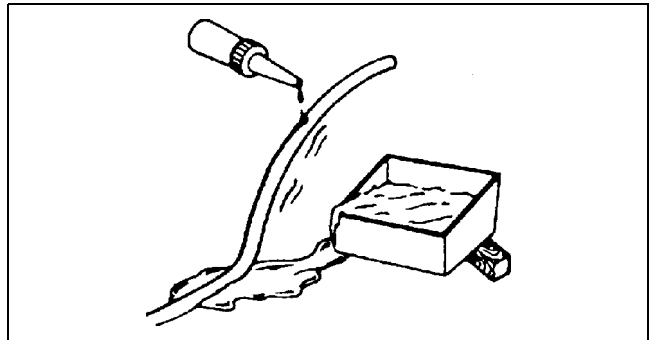


X3U000WAS

### RUBBER PARTS AND TUBING

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

A6E201400004E13

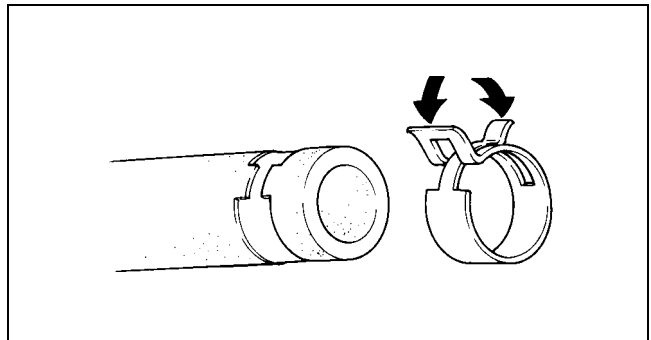


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### HOSE CLAMPS

- 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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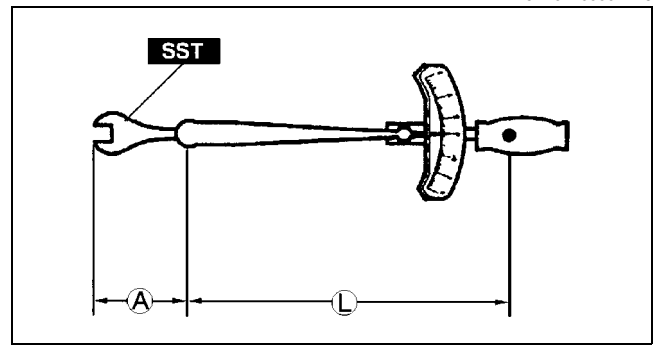
# FUNDAMENTAL PROCEDURES

## 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



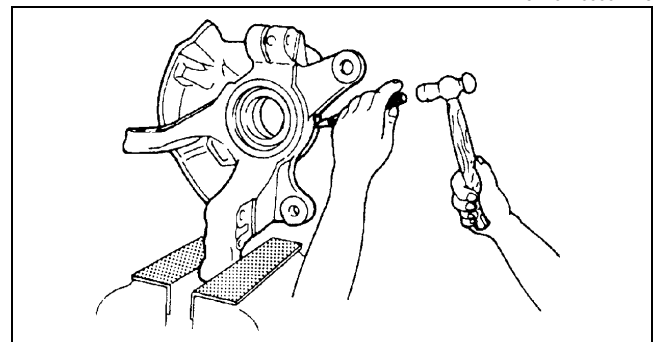
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GI

## WISE

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



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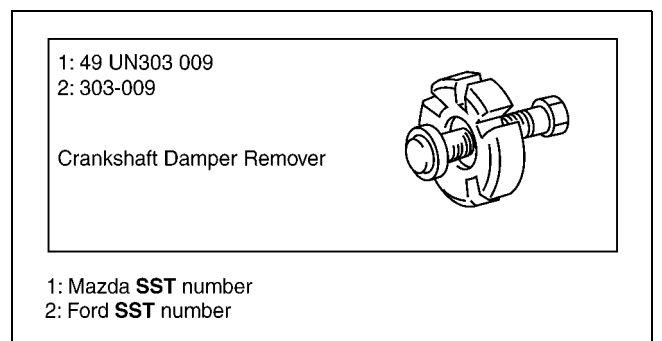
X3U000WAW

## SST

- Some Ford **SST** or equivalent are used as **SSTs** necessary for engine repair. Note that these **SSTs** are marked with Ford **SST** numbers.
- Note that a Ford **SST** number is written together with a corresponding Mazda **SST** number as shown below.

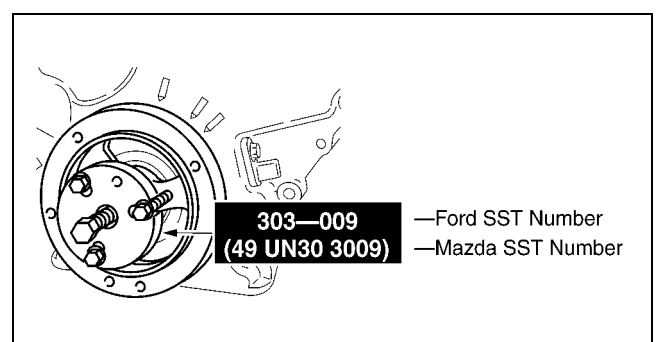
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### Example (section ST)



XME2014002

### Example (except section ST)



XME2014001

# ELECTRICAL SYSTEM

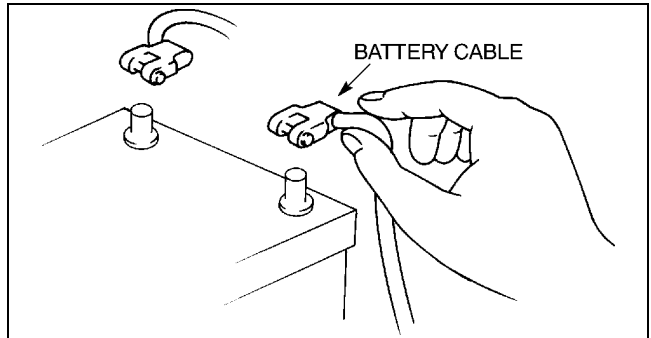
## ELECTRICAL SYSTEM

### ELECTRICAL PARTS

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#### Battery cable

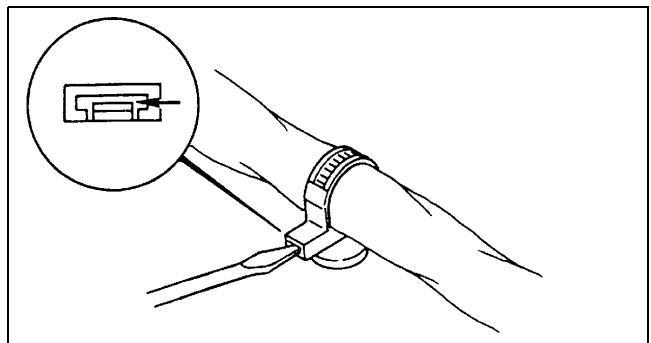
- Before disconnecting connectors or removing electrical parts, disconnect the negative battery cable.



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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

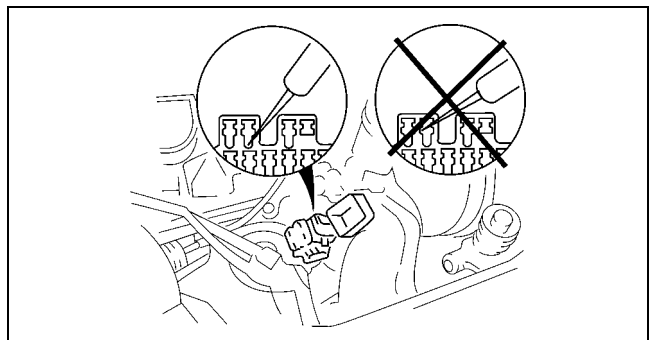
#### Data link connector

A6E201700006E02

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

#### Caution

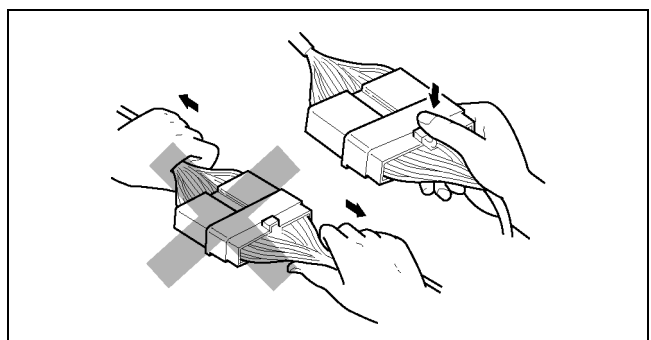
- Inserting a jumper wire probe into the data link connector terminal may damage the terminal.



X3U000WAY

#### Disconnecting connectors

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

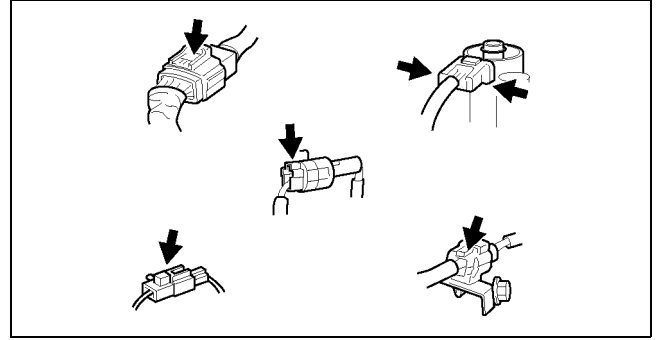


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## ELECTRICAL SYSTEM

GI

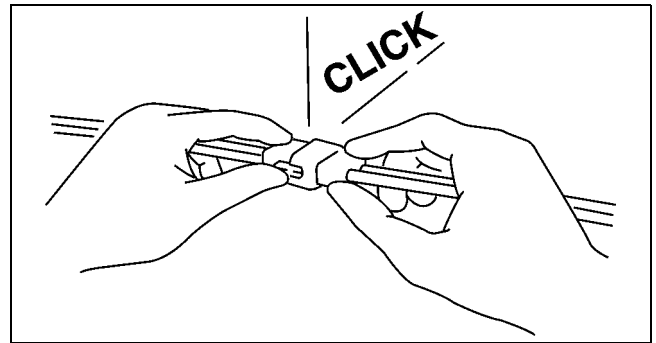
- Connectors can be disconnected by pressing or pulling the lock lever as shown.



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### Locking connector

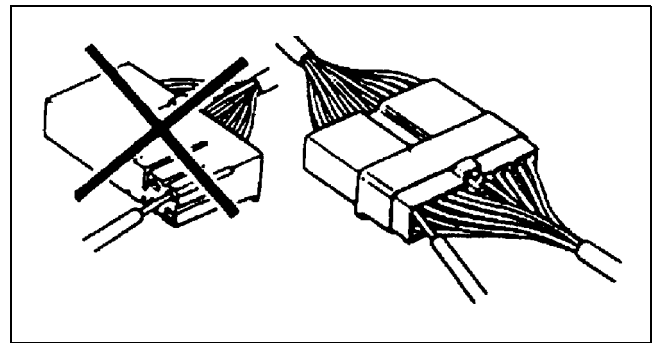
- When locking connectors, listen for a click indicating they are securely locked.



X3U000WB1

### Inspection

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

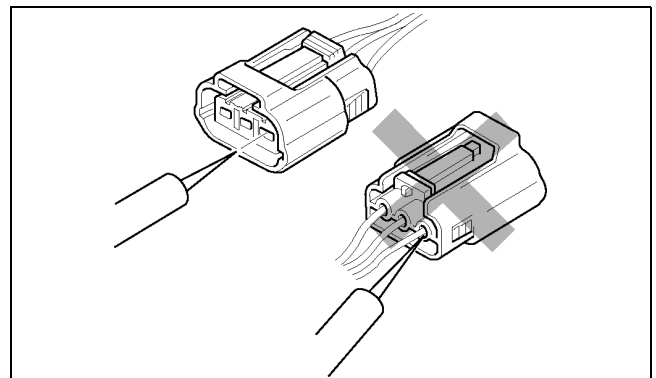


X3U000WB2

- 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.



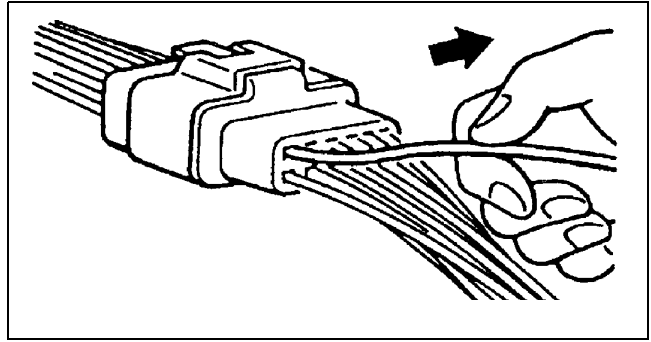
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# ELECTRICAL SYSTEM

## Terminals

### Inspection

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



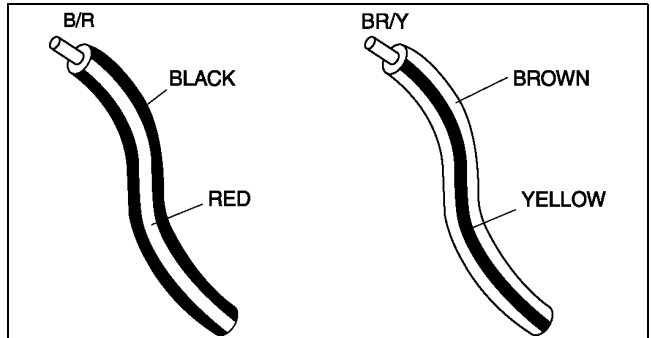
X3U000WB4

## 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

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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

A6E203000011E01

MTX	Manual transaxle
ATX	Automatic transaxle
ATDC	After top dead center
TDC	Top dead center
IN	Intake
EX	Exhaust
EGR	Exhaust gas recirculation
OCV	Oil control valve
SST	Special service tool

GI

# ENGINE

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# ENGINE

## ENGINE

### ENGINE OVERHAUL SERVICE WARNING

A6E242402000E01

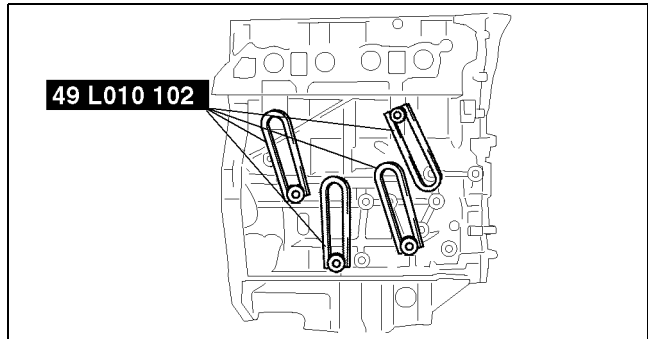
#### Warning

- 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.

### ENGINE MOUNTING/DISMOUNTING

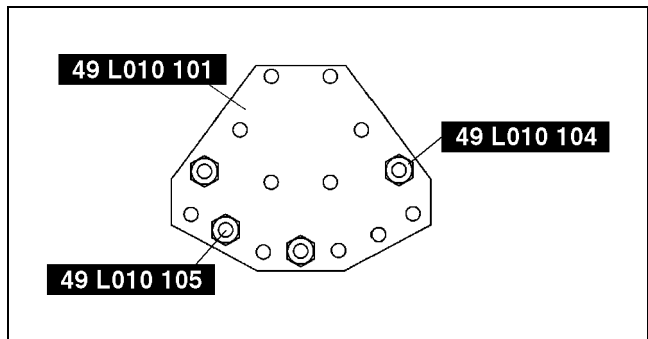
A6E242402000E02

1. Install the **SSTs** (arms) to the cylinder block holes as shown, and hand-tighten the bolts (**part No.: 9YA20-1003**) or **M10×1.5T** length 90 mm {3.55 in}).



AME2224E065

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

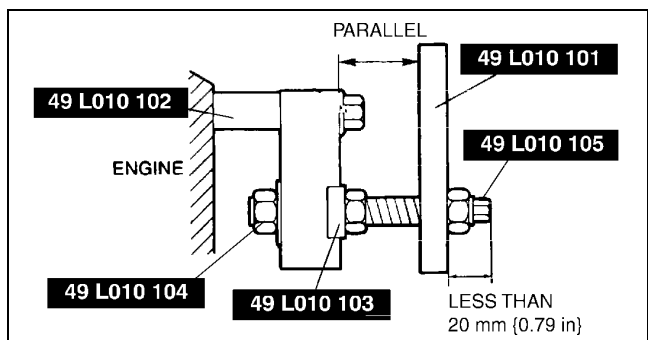


AME2224E300

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

#### Warning

- 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.



AME2224E301

6. Mount the engine on the **SST** (engine stand).
7. Drain the engine oil into a container.
8. Clean the flange surface (seal rubber) of the oil pan drain plug, then install the oil pan drain plug.

#### Tightening torque

20—30 N·m {2.1—3.0 kgf·m, 15—22 ft·lbf}

### DISMOUNTING

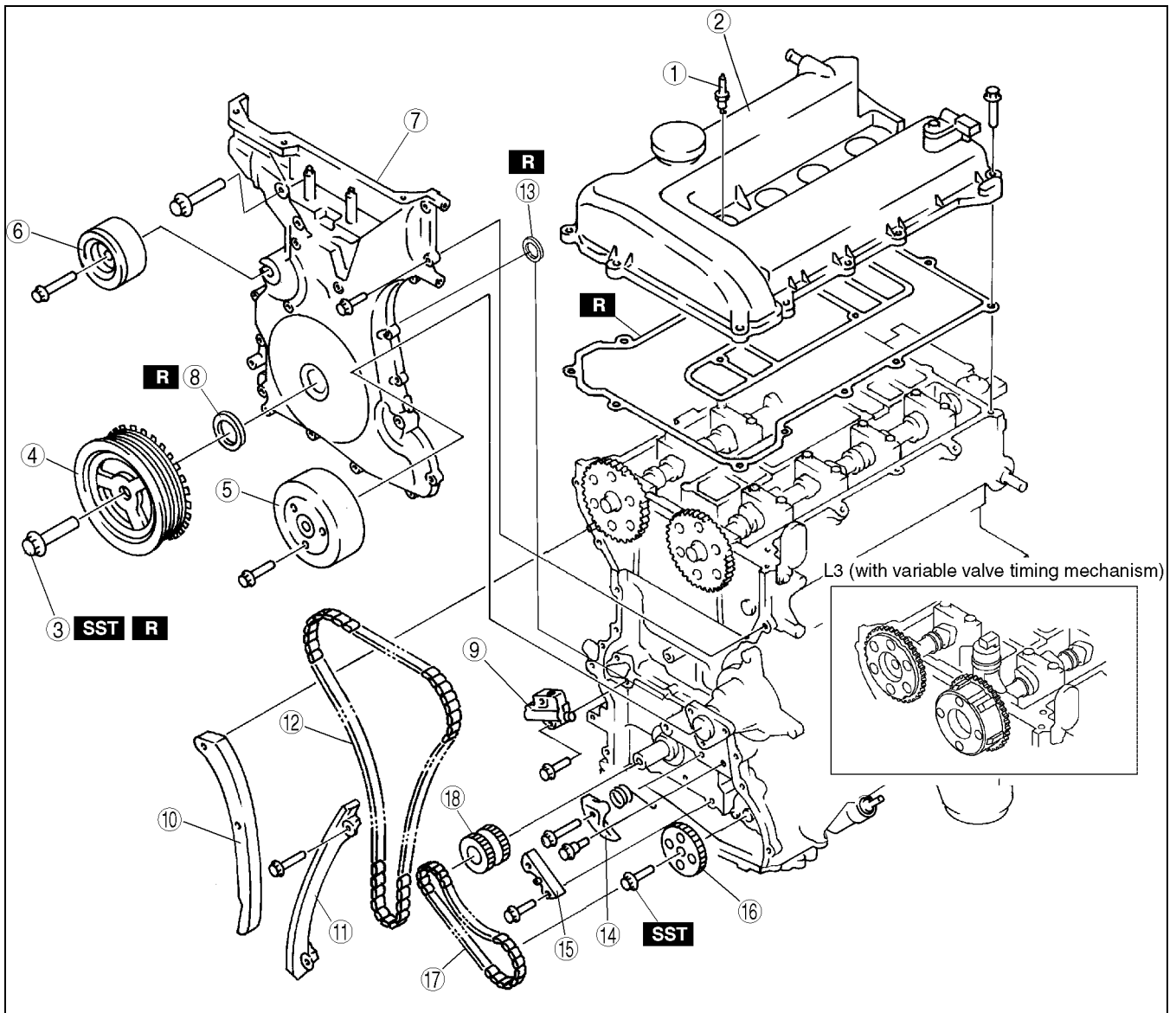
- Dismount in the reverse order of mounting.

# ENGINE

## TIMING CHAIN DISASSEMBLY

A6E242402000E04

1. Disassemble in the order indicated in the table.



AME2224E337

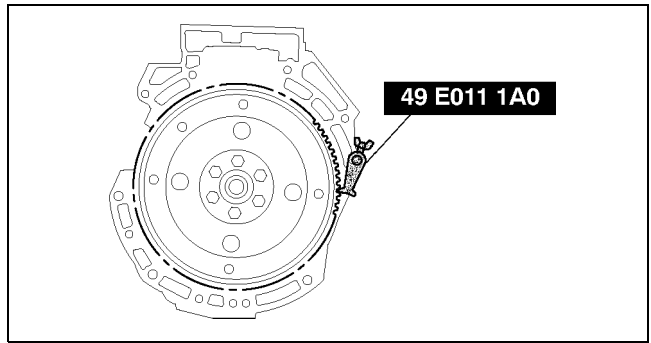
1	Spark plug
2	Cylinder head cover
3	Crankshaft pulley lock bolt (See <a href="#">B-4 Crankshaft Pulley Lock Bolt Disassembly Note</a> )
4	Crankshaft pulley
5	Water pump pulley
6	Drive belt idler pulley
7	Engine front cover
8	Front oil seal (See <a href="#">B-4 Front Oil Seal Disassembly Note</a> )

9	Chain tensioner (See <a href="#">B-4 Chain Tensioner Disassembly Note</a> )
10	Tensioner arm
11	Chain guide
12	Timing chain
13	Seal (L3 (with variable valve timing mechanism))
14	Oil pump chain tensioner
15	Oil pump chain guide
16	Oil pump sprocket (See <a href="#">B-4 Oil Pump Sprocket Disassembly Note</a> )
17	Oil pump chain
18	Crankshaft sprocket

## ENGINE

### Crankshaft Pulley Lock Bolt Disassembly Note

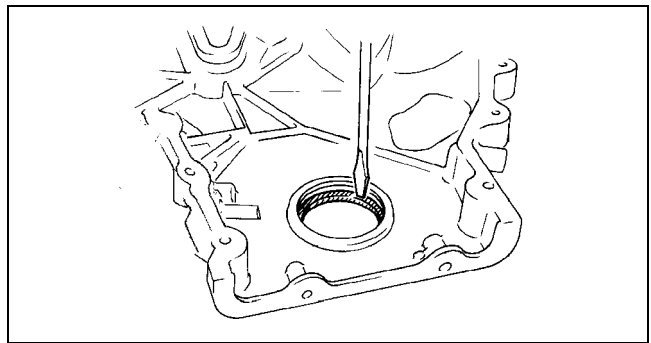
1. Hold the crankshaft using the SST.
2. Remove the crankshaft pulley lock bolt.



AME2224E106

### Front Oil Seal Disassembly Note

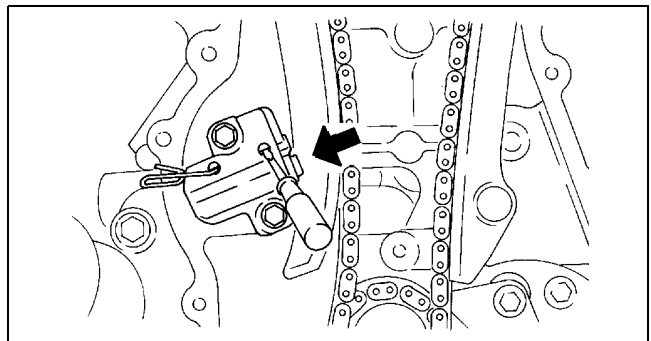
1. Remove the oil seal using a screwdriver.



AME2224E338

### Chain Tensioner Disassembly Note

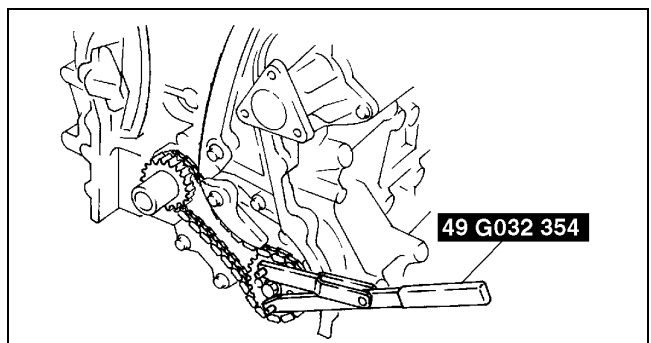
1. Hold the chain tensioner ratchet lock mechanism away from the ratchet stem with a thin screwdriver.
2. Slowly press the tensioner piston.
3. Hold the chain tensioner piston with a 1.5 mm {0.06 in} wire or paper clip.



AME2224E339

### Oil Pump Sprocket Disassembly Note

1. Hold the oil pump sprocket using the SST.



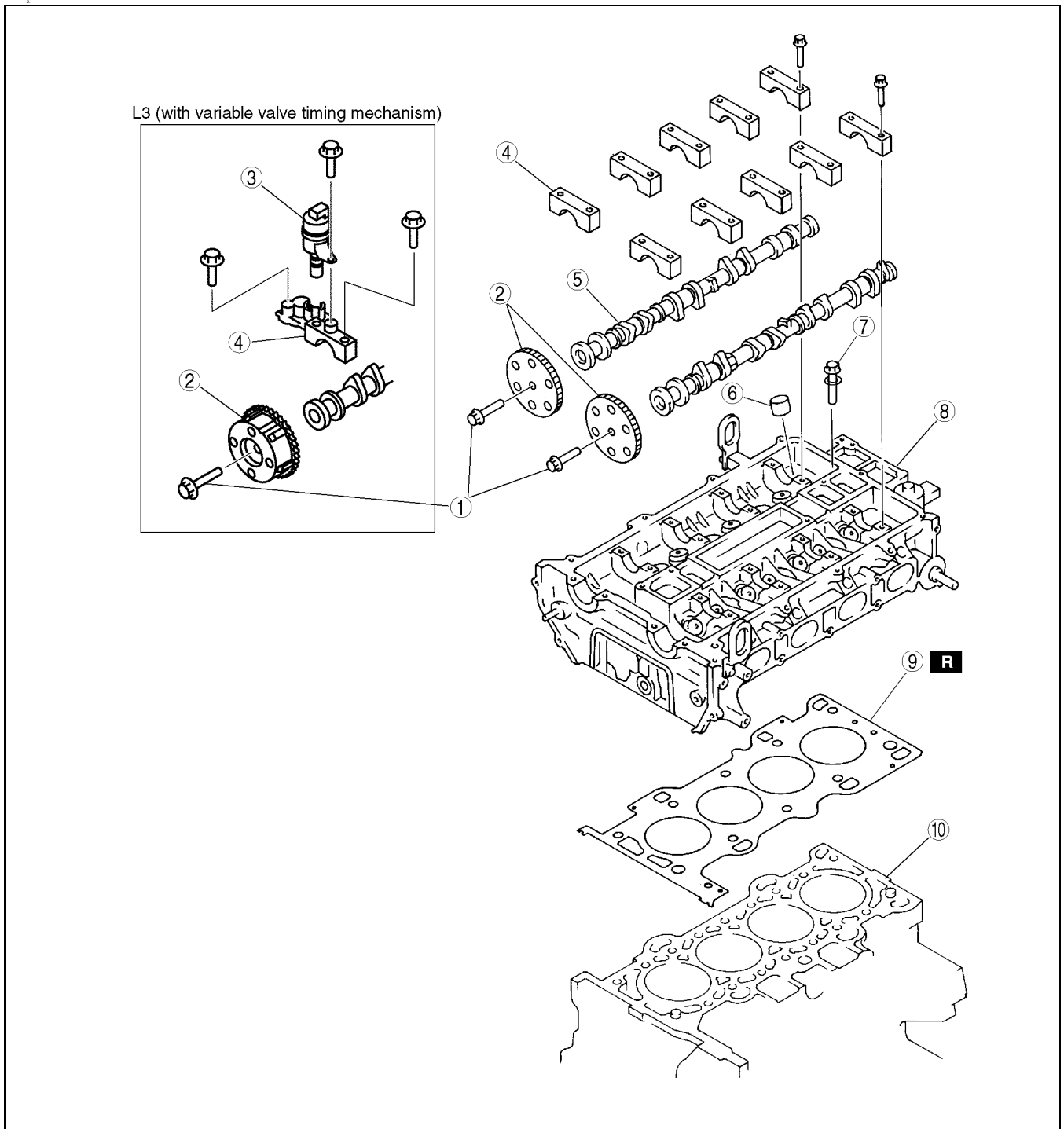
AME2224E340

# ENGINE

## CYLINDER HEAD (I) DISASSEMBLY

A6E242402000E05

1. Disassemble in the order indicated in the table.



AME2224E001

1	Camshaft sprocket lock bolt, Variable valve timing actuator lock bolt (L3 (with variable valve timing mechanism)) (See <a href="#">B-6 Camshaft Sprocket Lock Bolt, Variable Valve Timing Actuator Lock Bolt (L3 (with variable valve timing mechanism)) Disassembly Note</a> )
2	Camshaft sprocket, Variable valve timing actuator (L3 (with variable valve timing mechanism))
3	Oil control valve (OCV) (L3 (with variable valve timing mechanism))

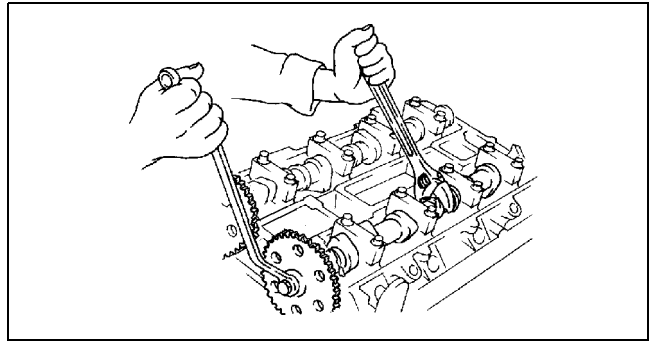
4	Camshaft cap (See <a href="#">B-6 Camshaft Cap Disassembly Note</a> )
5	Camshaft
6	Tappet (See <a href="#">B-7 Tappet Disassembly Note</a> )
7	Cylinder head bolt (See <a href="#">B-7 Cylinder Head Bolt Disassembly Note</a> )
8	Cylinder head
9	Cylinder head gasket
10	Cylinder block

## ENGINE

### Camshaft Sprocket Lock Bolt, Variable Valve Timing Actuator Lock Bolt (L3 (with variable valve timing mechanism)) Disassembly Note

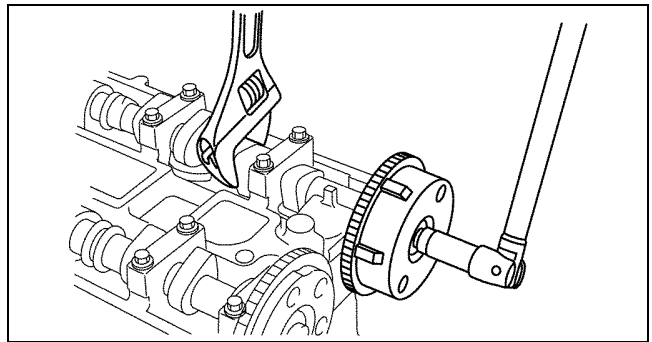
1. Hold the camshaft by using a wrench on the cast hexagon as shown, and loosen the camshaft sprocket lock bolt or variable valve timing actuator lock bolt (L3 (with variable valve timing mechanism)).

L8, LF, L3



AME2224E077

L3 (with variable valve timing mechanism)



AME2224E078

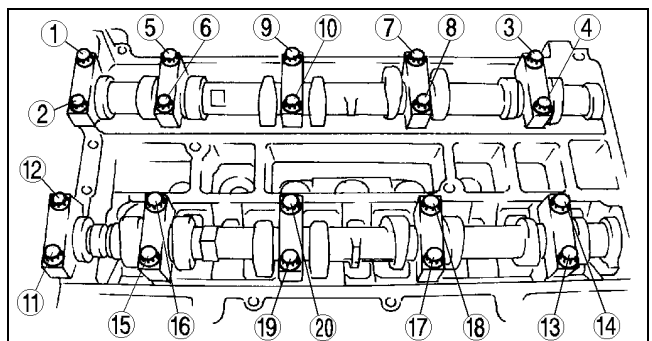
### Camshaft Cap Disassembly Note

1. Before removing the camshaft caps, inspect the following.
  - Camshaft end play and camshaft journal oil clearance (See [B-16 CAMSHAFT INSPECTION.](#))

#### Note

- The camshaft caps are numbered to make sure they are assembled in their original positions. When removed, keep the caps with the cylinder head they were removed from. Do not mix the caps.

2. Loosen the camshaft caps bolts in two or three steps in the order shown.



AME2224E006

# ENGINE

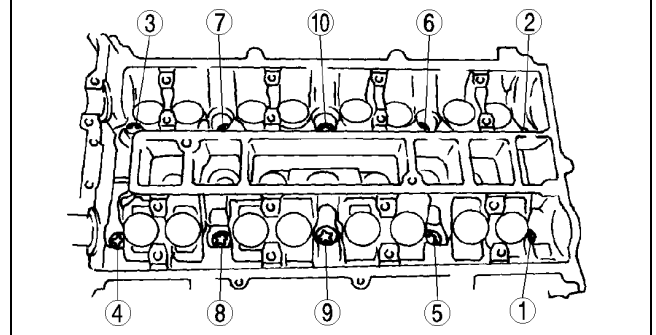
## Tappet Disassembly Note

### Note

- The tappets are numbered to make sure they are assembled in their original positions. When removed, keep the tappets with the cylinder head they were removed from. Do not mix the tappets.

## Cylinder Head Bolt Disassembly Note

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

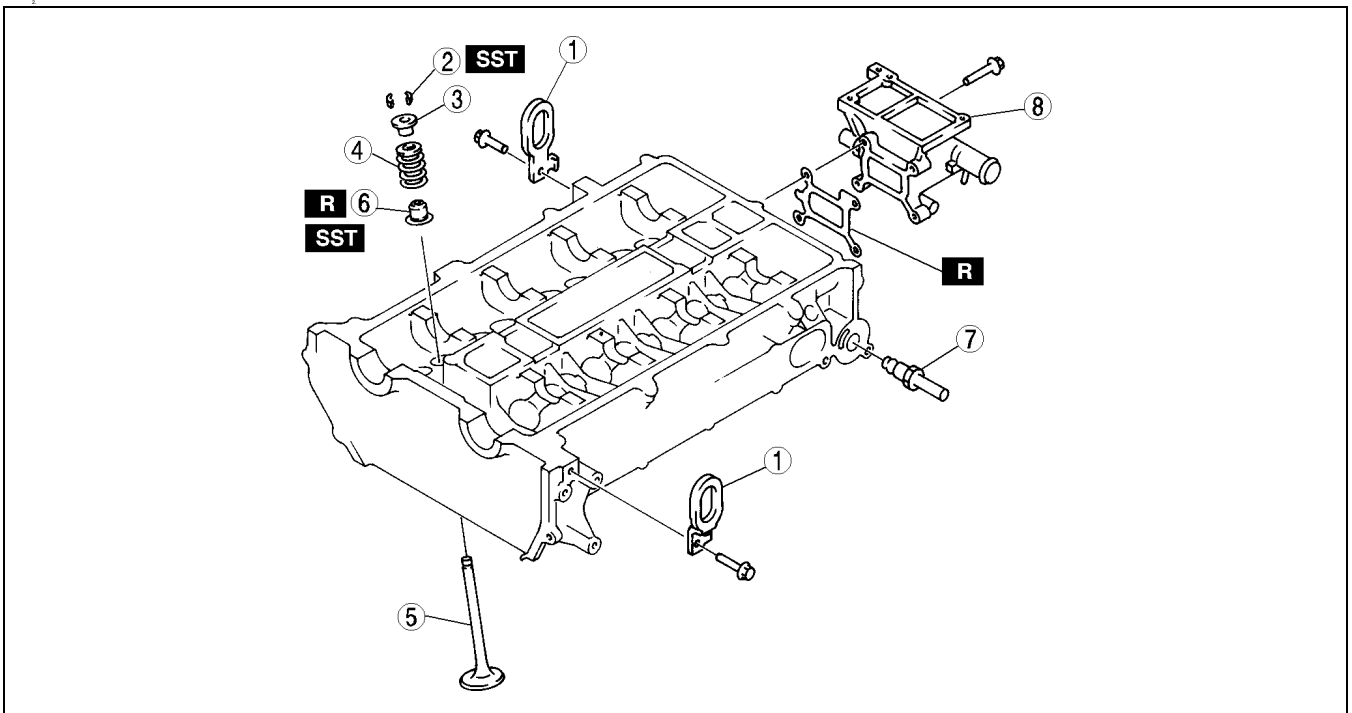


AME2224E005

## CYLINDER HEAD (II) DISASSEMBLY

A6E242402000E06

- Disassemble in the order indicated in the table.



AME2224E008

1	Engine hanger
2	Valve keeper (See <a href="#">B-8 Valve Keeper Disassembly Note</a> )
3	Upper valve spring seat
4	Valve spring

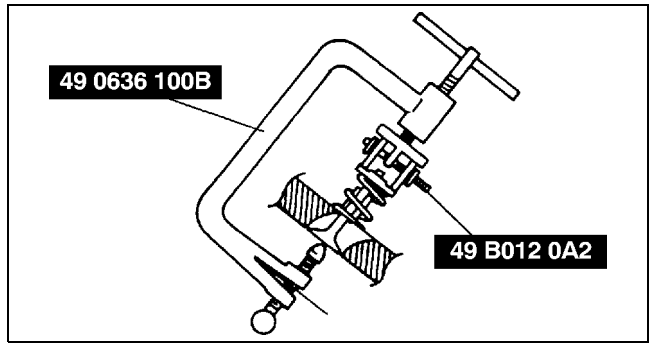
5	Valve
6	Valve seal (See <a href="#">B-8 Valve Seal Disassembly Note</a> )
7	EGR pipe
8	Water outlet case



## ENGINE

### Valve Keeper Disassembly Note

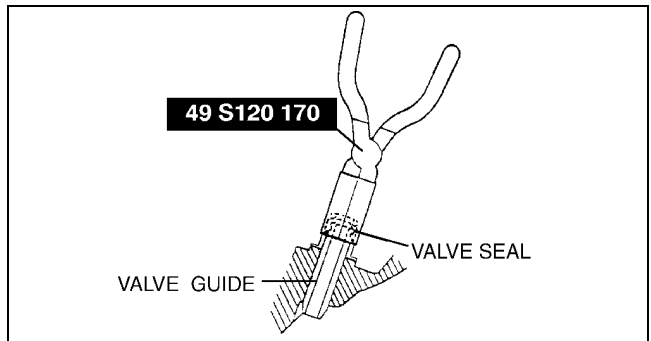
1. Remove the valve keeper using the SSTs.



AME2224E302

### Valve Seal Disassembly Note

1. Remove the valve seal using the SST.



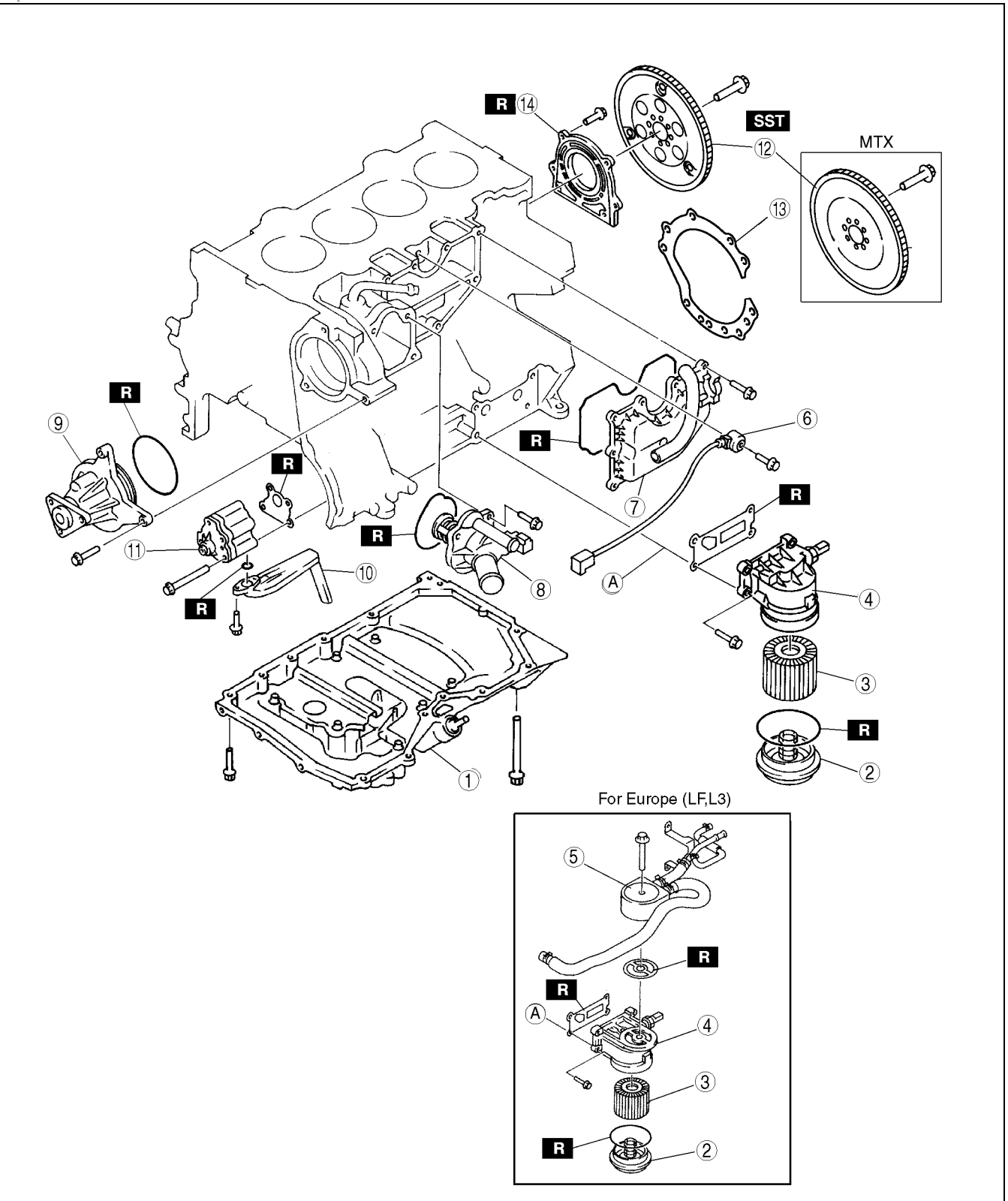
AME2224E303

# ENGINE

## CYLINDER BLOCK (I) DISASSEMBLY

A6E242402000E07

1. Disassemble in the order indicated in the table.



1	Oil pan
2	Oil filter cover
3	Oil filter
4	Oil filter adapter
5	Oil cooler

6	Knock sensor
7	Oil separator
8	Thermostat
9	Water pump
10	Oil strainer

AME2224E011

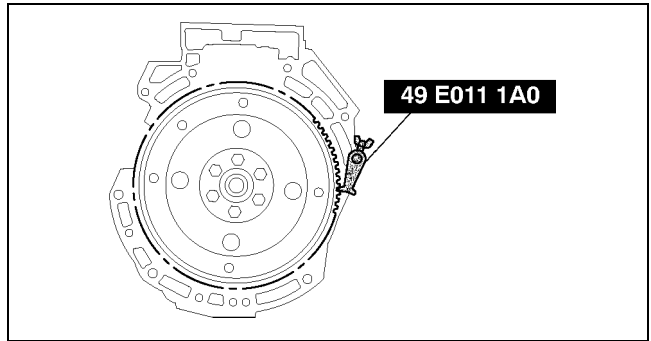
**B**

# ENGINE

11	Oil pump
12	Flywheel (MTX ), Drive plate (ATX) (See <a href="#">B-10 Drive Plate (ATX), Flywheel (MTX) Disassembly Note</a> )
13	End plate (MTX)
14	Rear oil seal

## Drive Plate (ATX), Flywheel (MTX) Disassembly Note

1. Hold the crankshaft using the SST.
2. Remove the bolts in several passes.

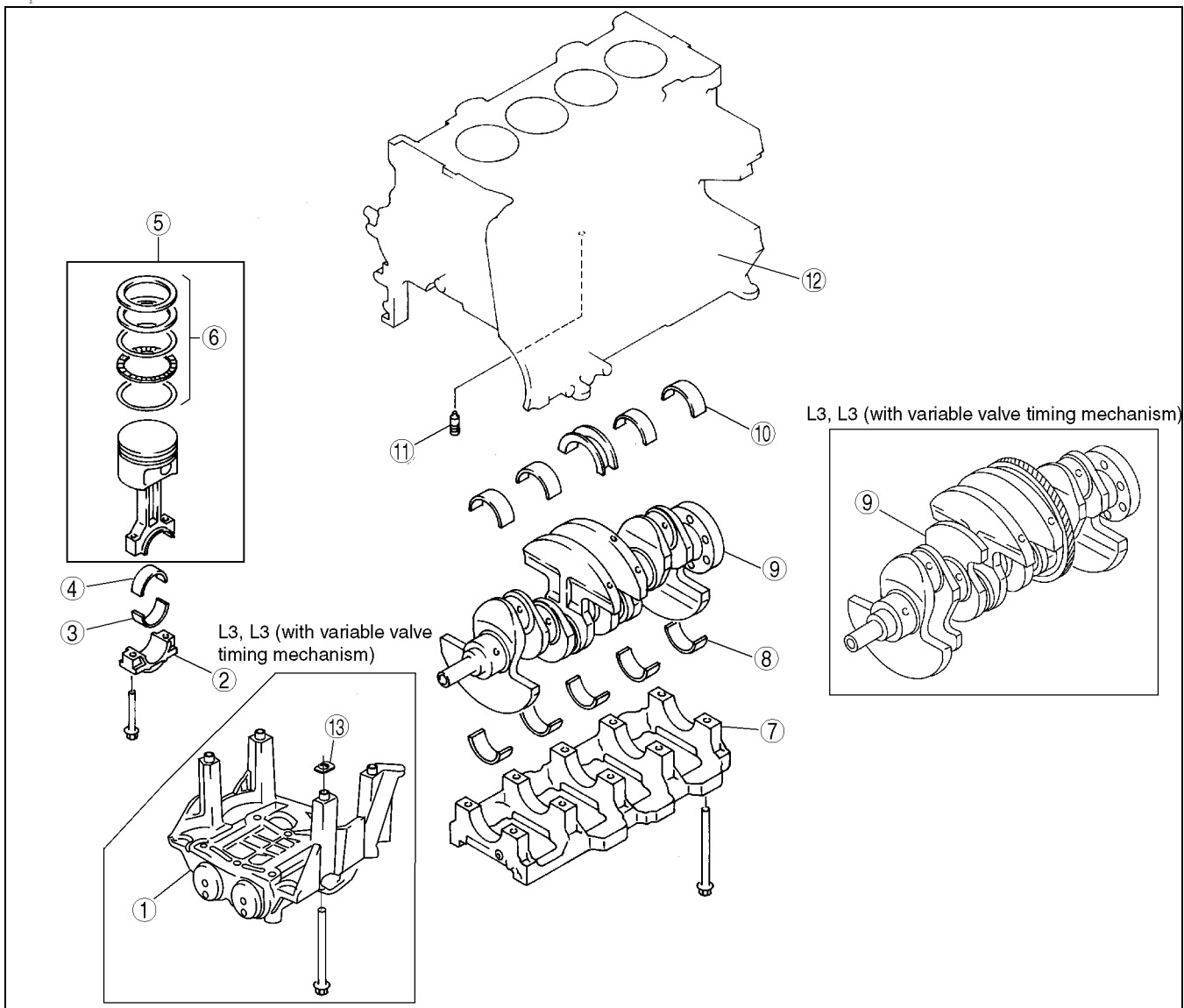


AME2224E106

## CYLINDER BLOCK (II) DISASSEMBLY

1. Disassemble in the order indicated in the table.

A6E242402000E08



AME2224E012

## ENGINE

1	Balancer unit (L3, L3 (with variable valve timing mechanism))
2	Connecting rod cap (See <a href="#">B-11 Connecting Rod Cap Disassembly Note</a> )
3	Lower connecting rod bearing
4	Upper connecting rod bearing
5	Connecting rod, Piston assembly
6	Piston ring

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

**B**

### Connecting Rod Cap Disassembly Note

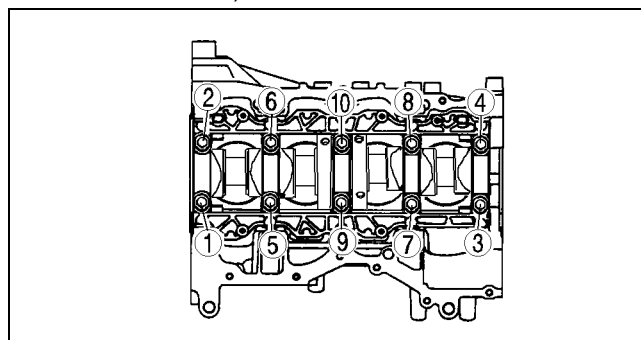
1. Inspect the connecting rod side clearance. (See [B-22 CONNECTING ROD INSPECTION](#) .)
2. Remove the connecting rod bolt from the connecting rod cap by tapping the bolt with a plastic hammer.

#### Note

- The tappets are numbered to make sure they are assembled in their original positions. When removed, keep the tappets with the cylinder head they were removed from. Do not mix the tappets.

### Main Bearing Cap Disassembly Note

1. Inspect the crankshaft end play. (See [B-20 CRANKSHAFT INSPECTION](#) .)
2. Loosen the main bearing cap bolts in two or three steps in the order shown.



AME2224E341

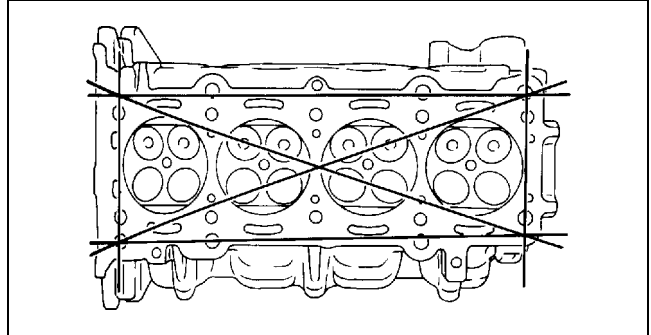
# ENGINE

## CYLINDER HEAD INSPECTION

A6E242410100E01

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
3. Measure the cylinder head for distortion in the six directions as shown.
  - If the distortion exceeds the maximum, replace the cylinder head.

**Maximum distortion:**  
**0.10 mm {0.004 in}**

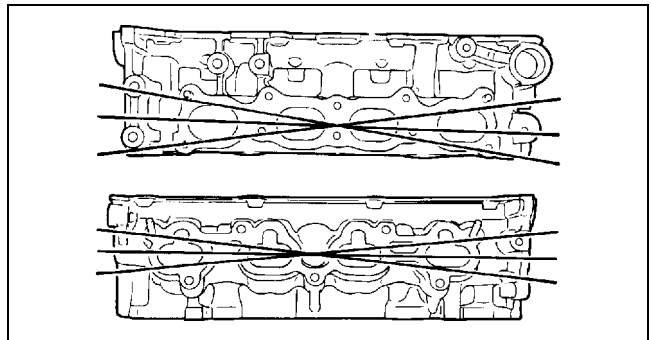


AME2224E317

4. Measure the manifold contact surface distortion as shown.
  - If the distortion exceeds the maximum, grind the surface or replace the cylinder head.

**Maximum distortion:**  
**0.10 mm {0.004 in}**

**Maximum grinding:**  
**0.15 mm {0.006 in}**



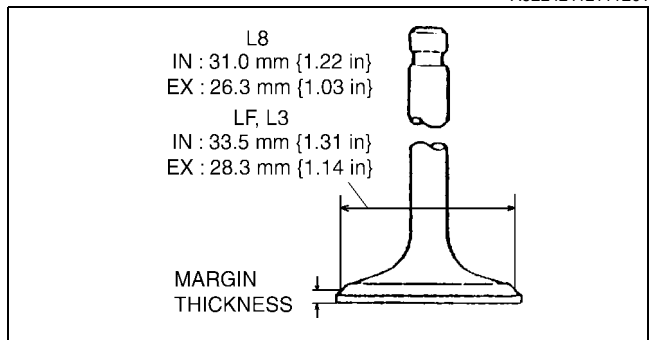
AME2224E318

## VALVE, VALVE GUIDE INSPECTION

A6E242412111E01

1. Measure the valve head margin thickness of each valve.
  - If not specified, replace the valve.

**Margin thickness:**  
**IN: 1.62 mm {0.0637 in}**  
**EX: 1.82 mm {0.0716 in}**

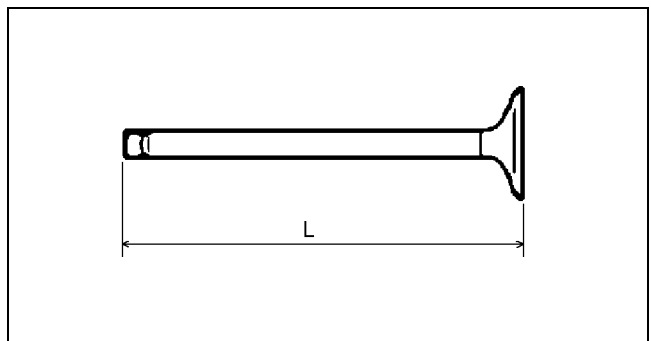


AME2224E070

2. Measure the length of each valve. Replace the valve if necessary.
  - If not specified, replace the valve.

**Standard length L:**  
**IN: 102.99—103.79 mm {4.055—4.086 in}**  
**EX: 104.25—105.05 mm {4.105—4.135 in}**

**Minimum length L:**  
**IN: 102.99 mm {4.055 in}**  
**EX: 103.79 mm {4.086 in}**



AME2224E071

## ENGINE

3. Measure the stem diameter of each valve in X and Y directions at the three points (A, B, and C) as indicated in the figure.

- If not as specified, replace the valve.

**Standard diameter:**

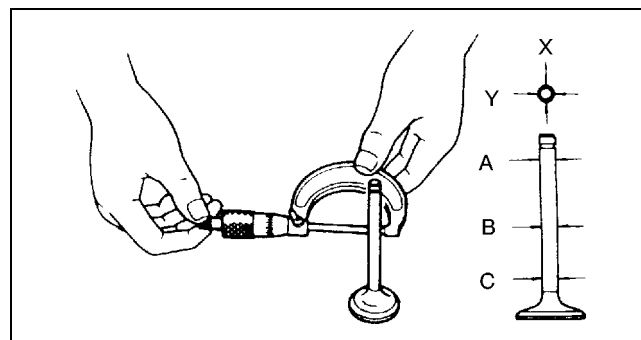
**IN:** 5.470—5.485 mm {0.2154—0.2159 in}

**EX:** 5.465—5.480 mm {0.2152—0.2157 in}

**Maximum diameter:**

**IN:** 5.440 mm {0.2142 in}

**EX:** 5.435 mm {0.2140 in}



AME2224E313

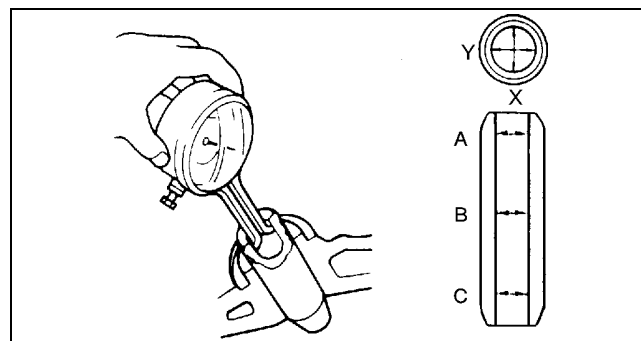
4. Measure the inner diameter of each valve guide in X and Y directions at the three points (A, B, and C) as indicated in the figure.

- If not as specified, replace the valve guide.

**Standard Inner diameter:**

**IN:** 5.509—5.539 mm {0.2169—0.2180 in}

**EX:** 5.509—5.539 mm {0.2169—0.2180 in}



AME2224E314

5. Calculate the valve stem to guide clearance by subtracting the outer diameter of the valve stem from the inner diameter of the corresponding valve guide.

- If not as specified, replace the valve and/or the valve guide.

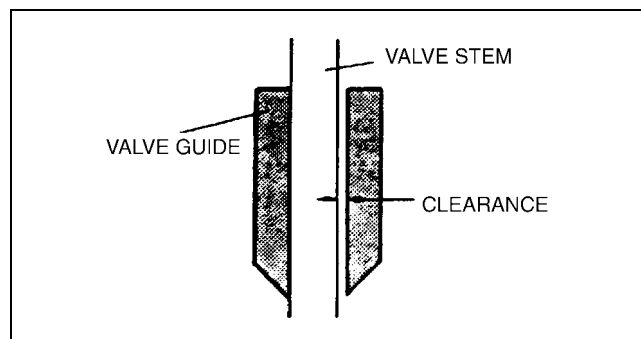
**Standard clearance:**

**IN:** 0.024—0.069 mm {0.0009—0.0027 in}

**EX:** 0.029—0.074 mm {0.0012—0.0029 in}

**Maximum clearance:**

**0.10 mm {0.004 in}**



AME2224E315

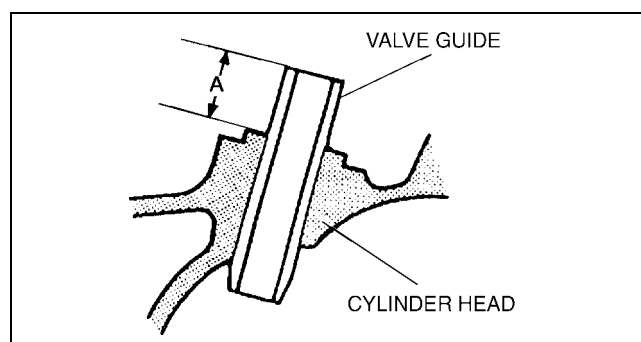
6. Measure the protrusion height (dimension A) of each valve guide without lower valve spring seat.

- If not as specified, replace the valve guide.

**Standard diameter:**

**IN:** 12.2—12.8 mm {0.481—0.503 in}

**EX:** 12.2—12.8 mm {0.481—0.503 in}



AME2224E073

**B**

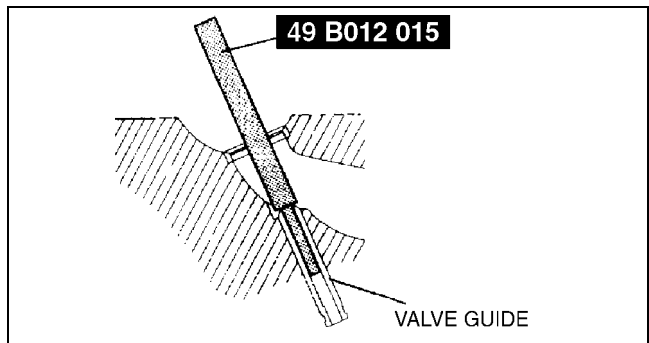
# ENGINE

## VALVE GUIDE REPLACEMENT

A6E242412111E04

### Valve Guide Removal

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



AME2224E312

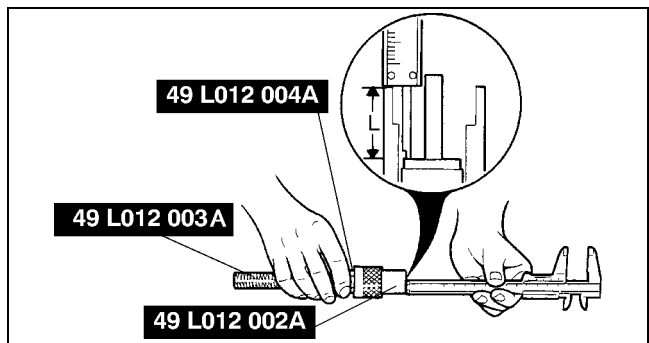
### Valve Guide Installation

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

#### Depth L:

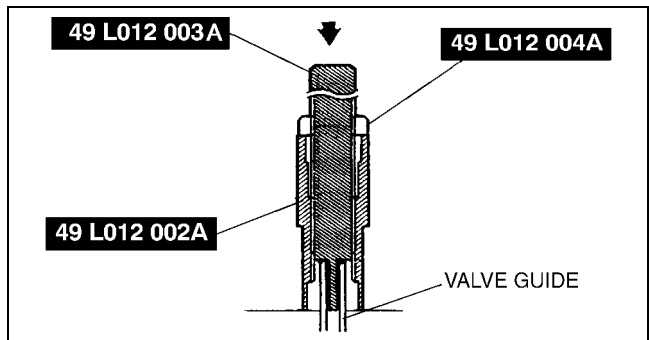
**IN:** 12.2—12.8 mm {0.481—0.501 in}

**EX:** 12.2—12.8 mm {0.481—0.501 in}



AME2224E107

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



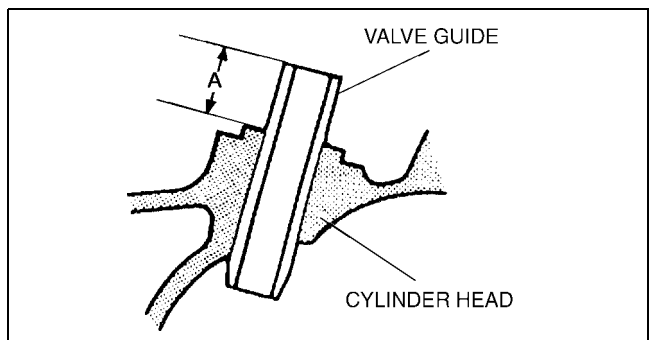
AME2224E018

3. Verify that the valve guide projection height (dimension A) is within the specification.

#### Standard height:

**IN:** 12.2—12.8 mm {0.481—0.501 in}

**EX:** 12.2—12.8 mm {0.481—0.501 in}



AME2224E073

## ENGINE

### VALVE SEAT INSPECTION/REPAIR

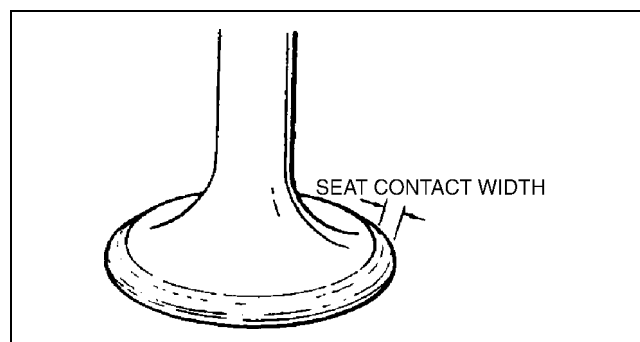
A6E242410102E01

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

**Standard width:**

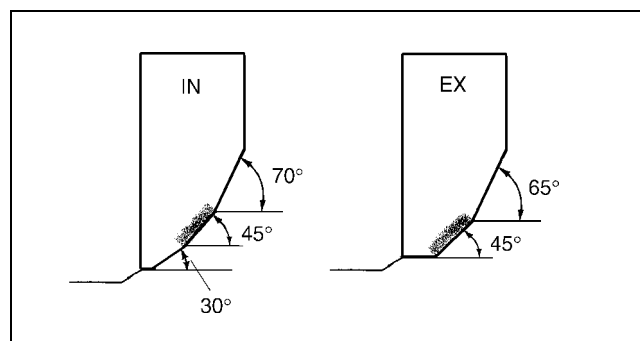
**1.2—1.6 mm {0.048—0.062 in}**

2. Verify that the valve seating position is at the center of the valve face.



AME2224E316

- (1) If the seating position is too out side, correct the valve seat using a 70° (IN) or 65° (EX) cutter, and a 45° cutter.
- (2) If the seating position is too inner side, correct the valve seat using a 30° (IN) cutter, and a 0° (EX) cutter, and a 45° cutter.



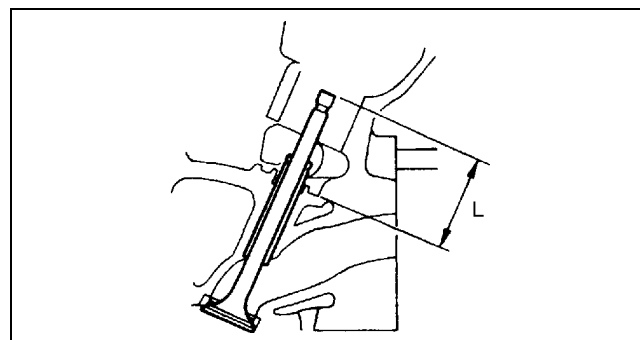
AME2224E020

3. Inspect the sinking of the valve seat. Measure the protruding length (dimension L) of the valve stem.
  - If not specified, replace the cylinder head.

**Standard dimension L:**

**IN: 40.64—42.24 mm {1.600—1.662 in}**

**EX: 40.50—42.10 mm {1.595—1.657 in}**



AME2224E079

### VALVE SPRING INSPECTION

A6E242412125E01

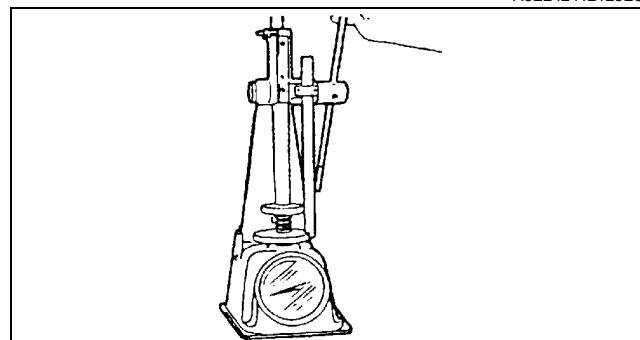
1. Apply pressing force to the pressure spring and inspect the spring height.
  - If not as specified, replace the valve spring.

**Pressing force:**

**494.9 N {50.47 kgf, 111.2 lbf}**

**Standard height:**

**27.80 mm {1.094 in}**



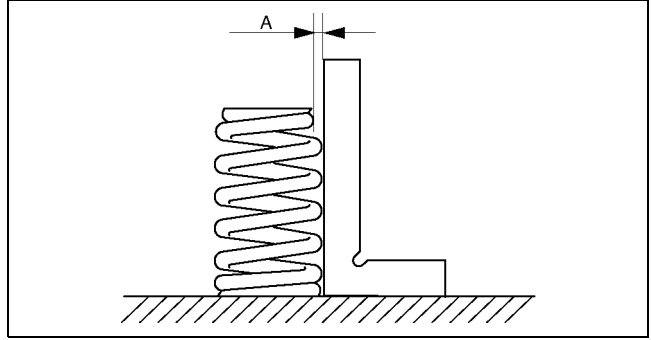
AME2224E308



## ENGINE

2. Measure the out-of-square of the valve spring, using a square, as shown.
- (1) Rotate the valve spring one full turn and measure "A" at the point where the gap is the largest.
- If not as specified, replace the valve spring.

**Valve spring maximum out-of-square:**  
**1% (2.10 mm {0.0826 in})**

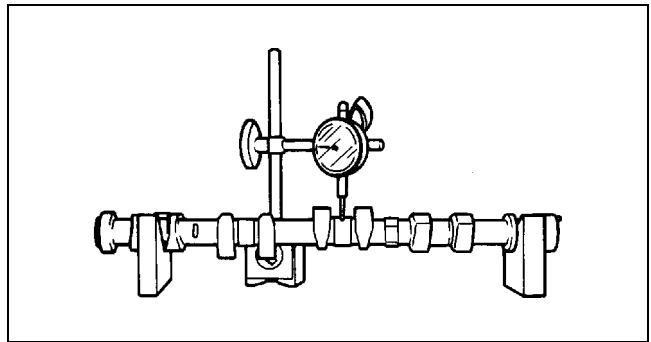


AME2224E309

### CAMSHAFT INSPECTION

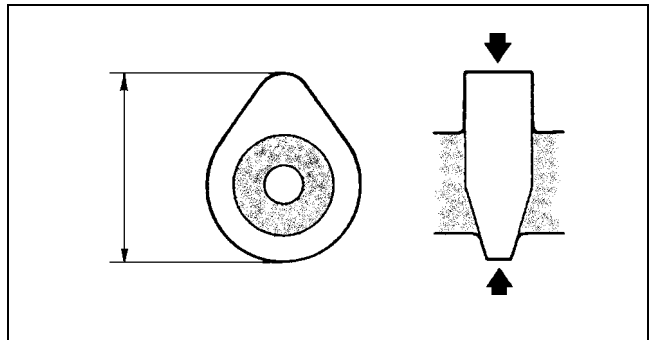
1. Set the No.1 and No.5 journals on V-blocks.
2. Measure the camshaft runout.
  - If not as specified, replace the camshaft.

**Maximum runout:**  
**0.03 mm {0.0012 in}**



AME2224E082

3. Measure the cam lobe height at the two points as shown.
  - If not as specified, replace the camshaft.



AME2224E343

### Standard height (mm) {in}

Camshaft	L8	LF, L3	L3 (with variable valve timing mechanism)
INT	40.79 {1.606}	42.12 {1.659}	42.44 {1.671}
EXH	41.08 {1.618}	41.08 {1.618}	41.18 {1.622}

### Minimum height (mm) {in}

Camshaft	L8	LF, L3	L3 (with variable valve timing mechanism)
INT	40.692 {1.603}	42.022 {1.655}	42.342 {1.667}
EXH	40.982 {1.614}	40.982 {1.614}	41.082 {1.618}

## ENGINE

4. Measure the journal diameters in X and Y directions at the two points (A and B) as indicated in the figure.

- If not as specified, replace the camshaft.

**Standard diameter:**

**24.96—24.98 mm {0.9827—0.9834 in}**

**Minimum diameter:**

**24.95 mm {0.982 in}**

5. Remove the tappet.
6. Position plasticgage atop the journals in the axial direction.
7. Install the camshaft cap. (See [B-40 Camshaft Assembly Note](#).)
8. Remove the camshaft cap. (See [B-6 Camshaft Cap Disassembly Note](#).)
9. Measure the oil clearance.
  - If not as specified, replace the cylinder head.

**Standard clearance:**

**0.04—0.08 mm {0.002—0.003 in}**

**Maximum clearance:**

**0.09 mm {0.0035 in}**

10. Install the camshaft cap. (See [B-40 Camshaft Assembly Note](#))

11. Measure the camshaft end play.

- If not as specified, replace the cylinder head or camshaft.

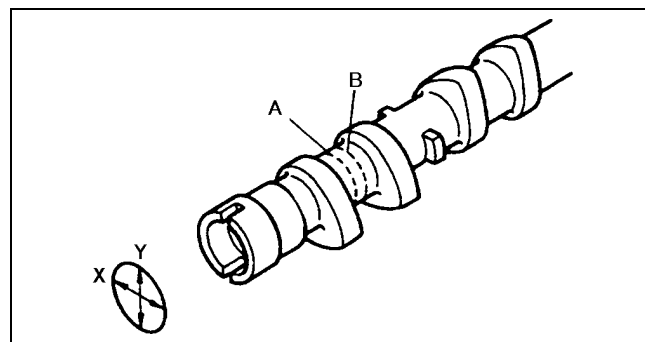
**Standard end play:**

**0.09—0.24 mm {0.0035—0.0094 in}**

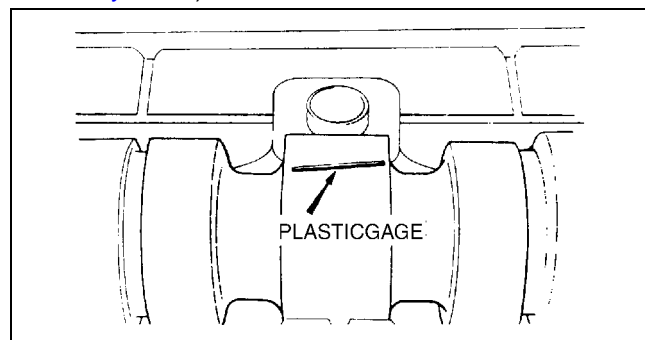
**Maximum end play:**

**0.25 mm {0.0099 in}**

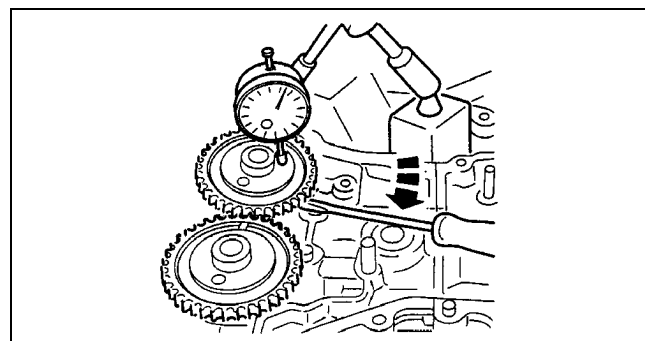
12. Remove the camshaft cap. (See [B-6 Camshaft Cap Disassembly Note](#).)



AME2224E344



AME2224E307



AME2224E025

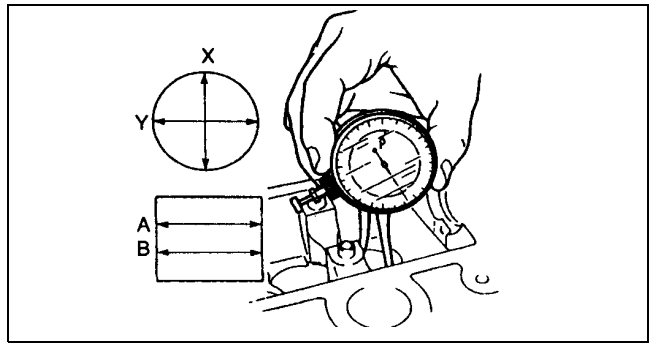
# ENGINE

## TAPPET INSPECTION

1. Measure the tappet hole inner diameter in X and Y directions at the two points (A and B) shown.

**Inner diameter:**

**31.000—31.030 mm {1.2205—1.2216 in}**



AME2224E319

2. Measure the tappet body outer diameter in X and Y directions at the two points (A and B) shown.

**Outer diameter:**

**30.970—30.980 mm {1.2193—1.2196 in}**

3. Subtract the tappet body outer diameter from the tappet hole inner diameter.

- If not as specified, replace the tappet or cylinder head.

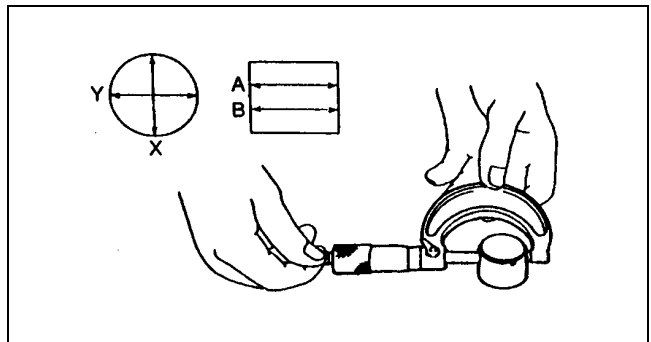
**Clearance**

**Standard:**

**0.02—0.06 mm {0.0008—0.0023 in}**

**Maximum:**

**0.15 mm {0.006 in}**



AME2224E320

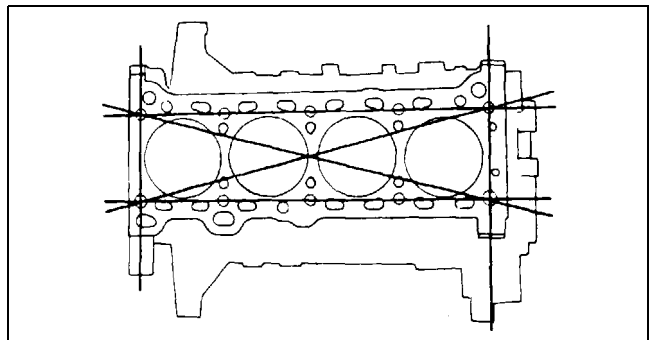
## CYLINDER BLOCK INSPECTION

1. Measure the distortion of the cylinder block top surface in the six directions as indicated in the figure.

- If the distortion exceeds the maximum, replace the cylinder block.

**Maximum cylinder block distortion:**

**0.10 mm {0.004 in}**



AME2224E089

2. Measure the cylinder bores in X and Y directions at 42 mm {1.65 in} below the top surface.

- If the cylinder bore exceeds the wear limit, replace the cylinder block.

**Standard diameter limit**

**L8:**

**83.000—83.030 mm {3.2677—3.2689 in}**

**LF, L3, L3 (with variable valve timing mechanism):**

**87.500—87.530 mm {3.4449—3.4460 in}**

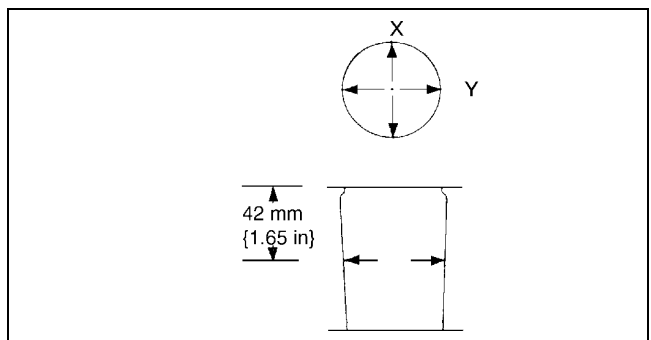
**Minimum / maximum bore diameter limit**

**L8:**

**82.940—83.090 mm {3.2653—3.2712 in}**

**LF, L3, L3 (with variable valve timing mechanism):**

**87.440—87.590 mm {3.4425—3.4484 in}**



AME2224E090

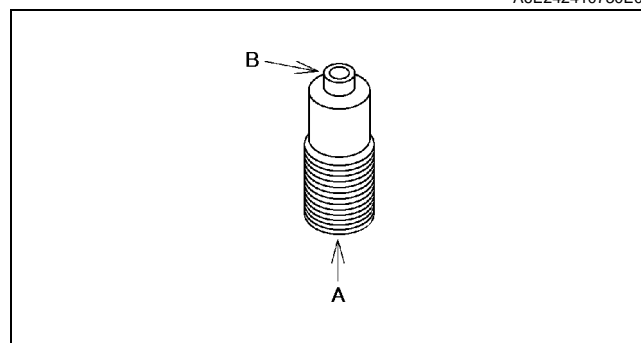
## ENGINE

### OIL JET VALVE INSPECTION

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

#### Air pressure:

216—274 kPa {2.2—2.7kgf•cm<sup>2</sup> 31.4—39.7 psi}



AME2224E105

### PISTON INSPECTION

A6E242411010E01

#### Caution

- The piston, piston ring and connecting rod cannot be disassembled.
- When replacing the piston, piston pin, piston ring and connecting rod, replace them together as a single unit.

1. Measure the outer diameter of each piston at right angle 90° to the piston pin, 10.0 mm {0.40 in} above the under of the piston.
  - If the piston diameter is below the standard diameter, replace the piston, piston pin, piston ring and connecting rod as a single unit.

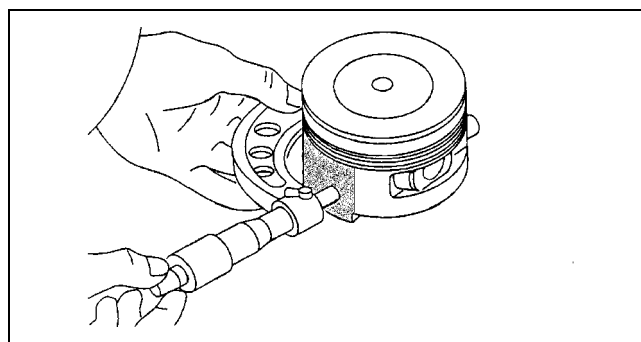
#### Piston diameter

##### L8:

82.965—82.995 mm {3.2664—3.2675 in}

##### LF, L3, L3 (with variable valve timing mechanism):

87.465—87.495 mm {3.4435—3.4446 in}



AME2224E030

2. Measure the piston-to-cylinder clearance.
  - If not as specified, replace the piston, piston pin, piston ring and connecting rod as a single unit.

#### Standard clearance:

0.025—0.045 mm {0.0010—0.0017 in}

#### Maximum clearance:

0.11 mm {0.0043 in}

3. Measure the piston ring-to-ring groove clearance around the entire circumference.
  - If the piston ring-to-ring groove clearance exceeds the maximum clearance, replace the piston, piston pin, piston ring and connecting rod as a single unit.

#### Standard clearance:

Top: 0.03—0.08 mm {0.0012—0.0031 in}

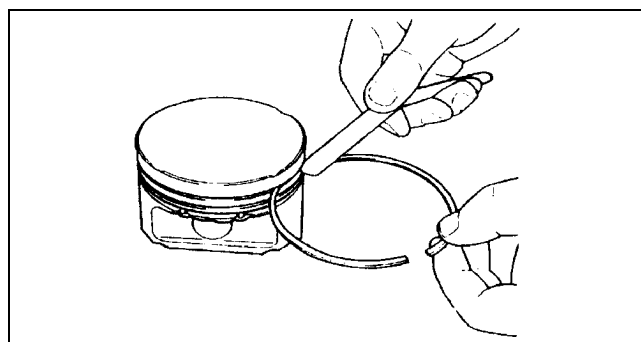
Second: 0.03—0.07 mm {0.0012—0.0027 in}

Oil: 0.03—0.07 mm {0.0012—0.0027 in}

#### Maximum clearance:

Top: 0.17 mm {0.0067 in}

Second, Oil: 0.15 mm {0.0059 in}



AME2224E029

## ENGINE

4. Insert the piston ring into the cylinder by hand and use the piston to push it to the bottom of the ring travel.
5. Measure each piston ring end gap with a feeler gauge.
  - If the piston ring end gap exceeds the maximum end gap, replace the piston, piston pin, piston ring and connecting rod as a single unit.

### Standard end gap:

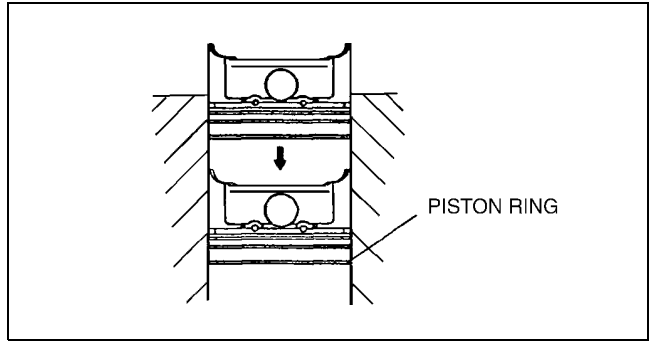
**Top:** 0.16—0.31 mm {0.0063—0.012 in}

**Second:** 0.33—0.48 mm {0.0130—0.0189 in}

**Oil (rail):** 0.20—0.70 mm {0.0079—0.0275 in}

### Maximum end gap:

1.0 mm {0.0393 in}



AME2224E104

## CRANKSHAFT INSPECTION

1. Install the main bearing cap. (See [B-30 Main Bearing Caps Assembly Note.](#))
2. Measure the crankshaft end play.
  - If not as specified, replace the thrust bearing or crankshaft so that the specified end play is obtained.

A6E242411301E01

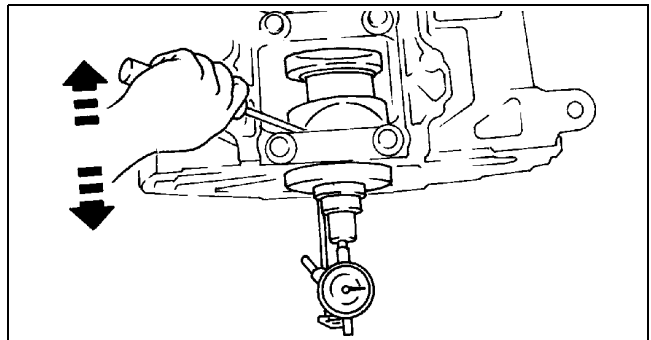
### Standard end play:

0.22—0.45 mm {0.0087—0.0177 in}

### Maximum end play:

0.55 mm {0.022 in}

3. Remove the main bearing cap. (See [B-11 Main Bearing Cap Disassembly Note.](#))
4. Measure the crankshaft runout.
  - If the crankshaft runout exceeds the maximum runout, replace the crankshaft.

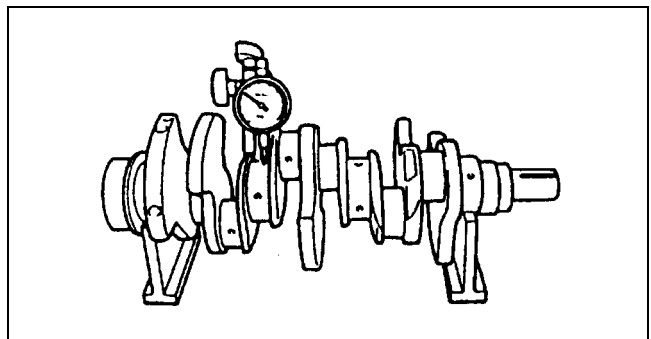


AME2224E034

### Maximum runout:

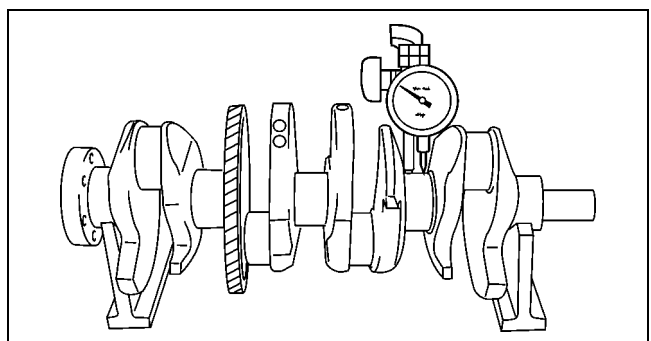
0.05 mm {0.0019 in}

L8, LF



AME2224E035

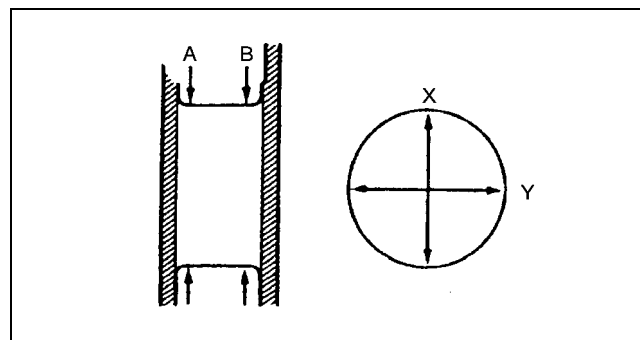
L3, L3 (with variable valve timing mechanism)



AME2224E311

## ENGINE

5. Measure the journal diameter in X and Y directions at the two points (A and B) as indicated in the figure.
  - If not as specified, replace the crankshaft or grind the journal and install the undersize bearing.



AME2224E036

### Main journal

mm {in}

Bearing size	Standard diameter
Standard	51.980—52.000 {2.0464—2.0472}
0.25 {0.01} undersize	51.730—51.750 {2.0366—2.0373}

**Maximum out-of-round:  
0.05 mm {0.0019 in}**

### Crank pin

mm {in}

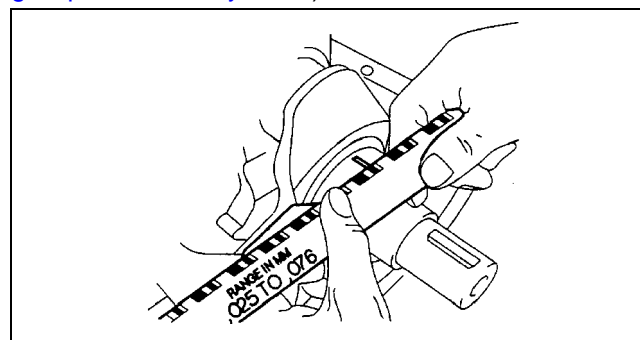
Bearing size	Standard diameter
Standard	49.980—50.000 {1.9677—1.9685}
0.25 {0.01} undersize	49.730—49.750 {1.9579—1.9586}

**Maximum out-of-round:  
0.05 mm {0.0019 in}**

6. Install the main bearing caps and crankshaft.
7. Position a plastigage atop the journals in the axial direction.
8. Install the main bearing caps and cylinder block. (See [B-30 Main Bearing Caps Assembly Note.](#))
9. Remove the main bearing caps. (See [B-11 Main Bearing Cap Disassembly Note.](#))
10. Measure the main journal oil clearance.
  - If the clearance exceeds the maximum, replace the main bearing using the main bearing selection table or grind the main journal and install the oversize bearings so that the specified oil clearance is obtained.

**Standard clearance:  
0.019—0.035 mm {0.0007—0.0013 in}**

**Maximum clearance:  
0.10 mm {0.0039 in}**



AME2224E038

mm {in}

Bearing size	Color	Bearing thickness
Standard	Green	2.506—2.509 {0.0987—0.0988}
0.25 {0.01} oversize		2.628—2.634 {0.1034—0.1037}
0.50 {0.02} oversize		2.753—2.759 {0.1084—0.1086}

# ENGINE

## CONNECTING ROD INSPECTION

A6E242411211E01

### Caution

- The piston, piston ring and connecting rod cannot be disassembled.
- When replacing the piston, piston pin, piston ring and connecting rod, replace them together as a single unit.

1. Install the connecting rod cap. (See [B-31 Connecting Rod Cap Assembly Note](#).)
2. Measure the connecting rod large end side clearance.

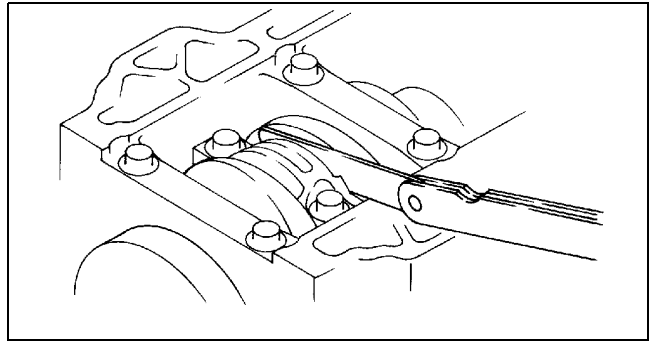
- If the connecting rod large end side clearance exceeds the maximum clearance, replace the piston, piston pin, piston ring and connecting rod as a single unit.

### Standard clearance:

0.14—0.36 mm {0.0056—0.0141 in}

### Maximum clearance:

0.435 mm {0.0172 in}



AME2224E059

3. Remove the connecting rod cap.
4. Position plastigage atop the journals in the axial direction.
5. Install the connecting rod bearing and connecting rod cap. (See [B-31 Connecting Rod Cap Assembly Note](#).)
6. Remove the connecting rod cap.
7. Measure the connecting rod oil clearance.

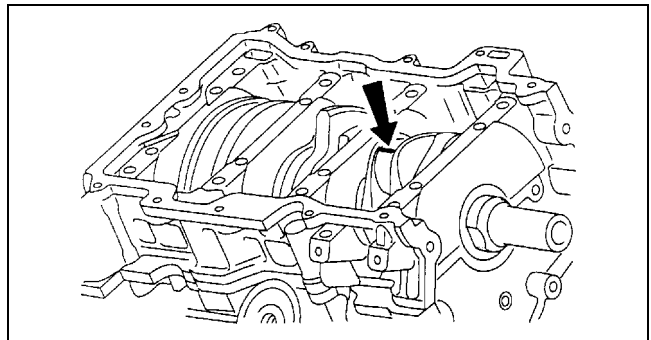
- If not as specified, replace the connecting rod bearing or grind the crank pin and use oversize bearings so that the specified clearance is obtained.

### Standard clearance:

0.026—0.052 mm {0.0011—0.0020 in}

### Maximum clearance:

0.1 mm {0.0039 in}



AME2224E310

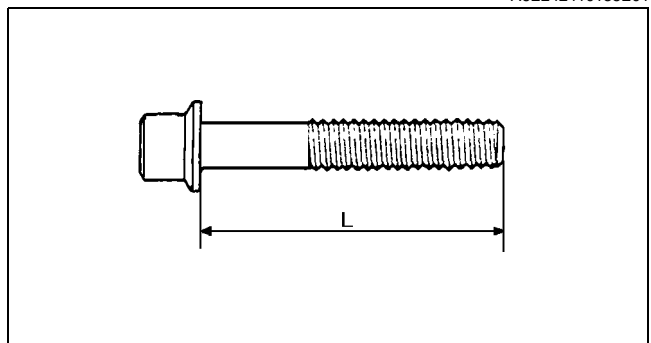
mm {in}

Bearing size	Color	Bearing thickness
Standard	Green	1.496—1.502 {0.0589—0.0591}
0.50 {0.02} oversize		1.748—1.754 {0.0688—0.0690}
0.25 {0.01} oversize		1.623—1.629 {0.0639—0.0641}

## BOLT INSPECTION

A6E242410135E01

1. Measure the length of each bolt.
  - Replace any that exceeds maximum length.



AME2224E050

# ENGINE

## Length L

bolt	Standard (mm) {in}	Maximum (mm) {in}
Cylinder head bolt	149.0—150 {5.86—5.90}	150.5 {5.92}
Connecting rod bolt	44.7—45.3 {1.75—1.78}	46.0 {1.81}
Main bearing cap bolt	110.0—110.6 {4.33—4.35}	111.3 {4.38}

B

## VARIABLE VALVE TIMING ACTUATOR INSPECTION

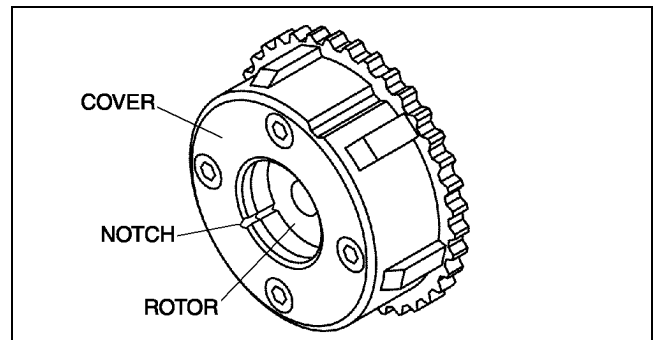
A6E242400142E02

### L3 (with variable valve timing mechanism)

#### Caution

- Variable valve timing actuator can not be disassembled it is a precision unit /

1. Confirm that notch of the rotor and bump of the cover at the variable valve timing actuator are aligned and fitted.
  - If the notch and the bump are not aligned, rotate the rotor toward the bulb timing retard position by hand until they are in place.
  - If the rotor and cover are not secured even though their notch and groove are aligned, replace the variable valve timing actuator.



AME2224E342

## OIL CONTROL VALVE (OCV) INSPECTION

A6E242414420E02

### L3 (with variable valve timing mechanism)

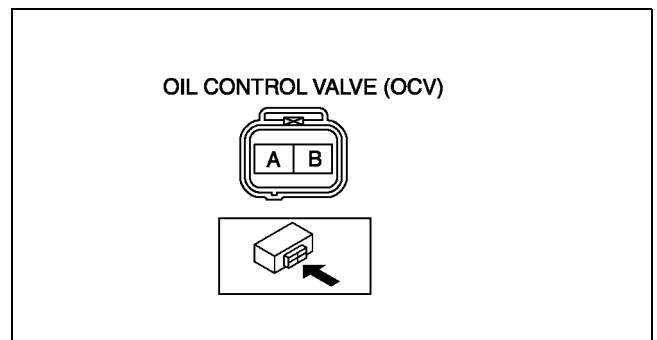
#### Coil resistance inspection

1. Disconnect the negative battery cable.
2. Disconnect the oil control valve (OCV) connector.
3. Measure the resistance between terminals A and B using an ohmmeter.
  - If not as specified, replace the oil control valve (OCV).

#### Specification

6.9—7.9 ohms

4. Connect the oil control valve (OCV) connector.



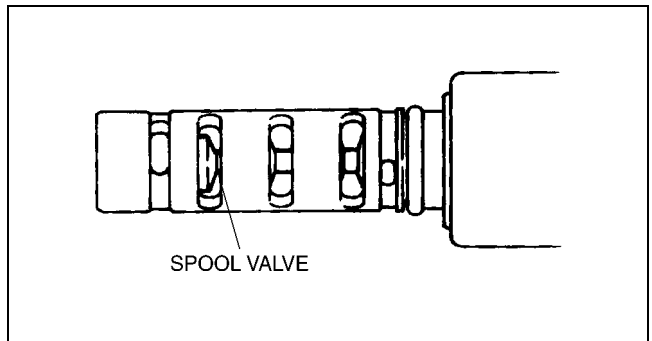
A6E2226W002



## ENGINE

### Spool valve operation inspection

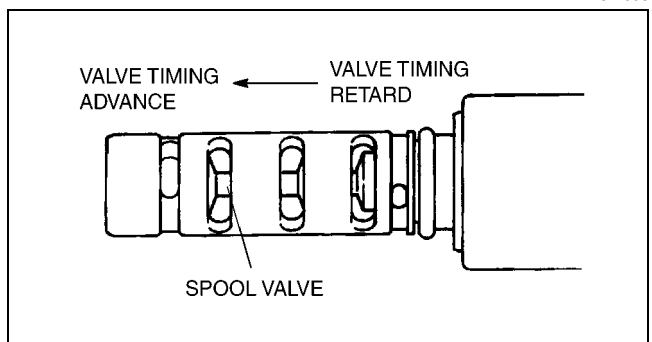
1. Disconnect the negative battery cable.
2. Remove the oil control valve (OCV).
3. Verify that the spool valve in the oil control valve (OCV) is in the maximum valve timing retard position as indicated in the figure.
  - If not as specified, replace the oil control valve (OCV).
4. Verify that the battery is fully charged.
  - If not as specified, recharge the battery.



5. Apply battery positive voltage between the oil control valve (OCV) terminals and verify that the spool valve operates and moves to the maximum valve timing advance position.
  - If not as specified, replace the oil control valve (OCV).

#### Note

- When applying battery positive voltage between the oil control valve (OCV) terminals, the connection can be either of the following:
  - Positive battery cable to terminal A, negative battery cable to terminal B
  - Positive battery cable to terminal B, negative battery cable to terminal A



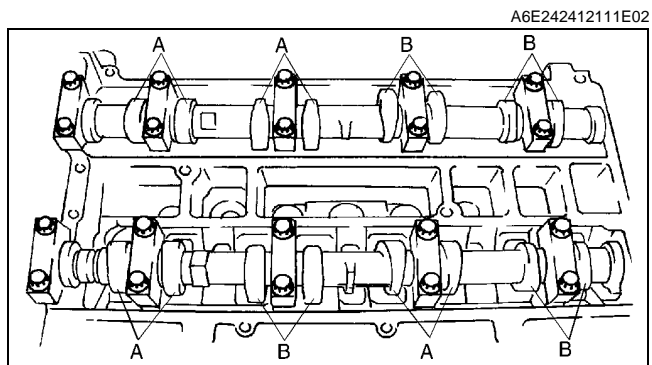
6. Stop applying battery positive voltage and verify that the spool valve returns to the maximum valve timing retard position.
  - If not as specified, replace the oil control valve (OCV).

### VALVE CLEARANCE INSPECTION

1. Measure the valve clearance as follows.
  - (1) Turn the crankshaft clockwise so that the No.1 piston is at TDC of the compression stroke.
  - (2) Measure the valve clearance at A in the figure.
    - If the valve clearance exceeds the space the tappet. (See [B-25 VALVE CLEARANCE ADJUSTMENT](#).)

#### Note

- Make sure to note the measured values for choosing the suitable replacement tappets.



#### Standard [Engine cold]

IN: 0.22—0.28 mm {0.0087—0.0110 in} (0.25±0.03 mm {0.0098±0.0011 in})

EX: 0.27—0.33 mm {0.0106—0.0130 in} (0.30±0.03 mm {0.0118±0.0011 in})

- (3) Turn the crankshaft 360° clockwise so that the No.4 piston is at TDC of the compression stroke.
- (4) Measure the valve clearance at B in the figure.

- If the valve clearance exceeds the standard, replace the tappet. (See [B-25 VALVE CLEARANCE ADJUSTMENT](#).)

#### Note

- Make sure to note the measured values for choosing the suitable replacement tappets.

#### Standard [Engine cold]

IN: 0.22—0.28 mm {0.0087—0.0110 in} (0.25±0.03 mm {0.0098±0.0011 in})

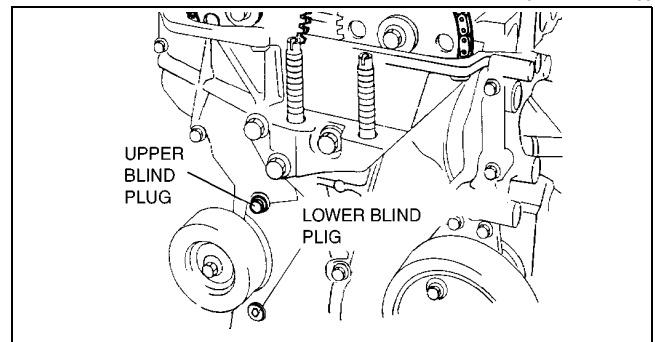
EX: 0.27—0.33 mm {0.0106—0.0130 in} (0.30±0.03 mm {0.0118±0.0011 in})

## ENGINE

### VALVE CLEARANCE ADJUSTMENT

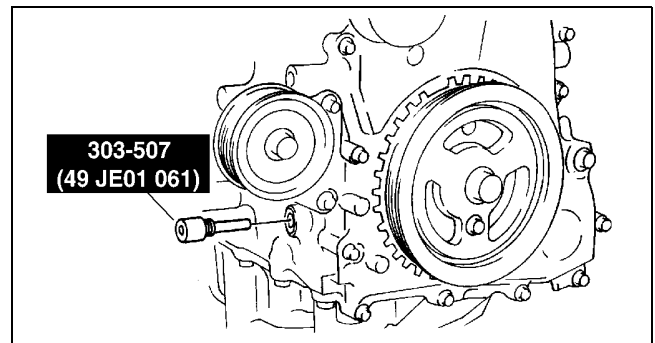
1. Remove the engine front cover lower blind plug.
2. Remove the engine front cover upper blind plug.
3. Remove the cylinder block lower blind plug.

A6E242412111E03



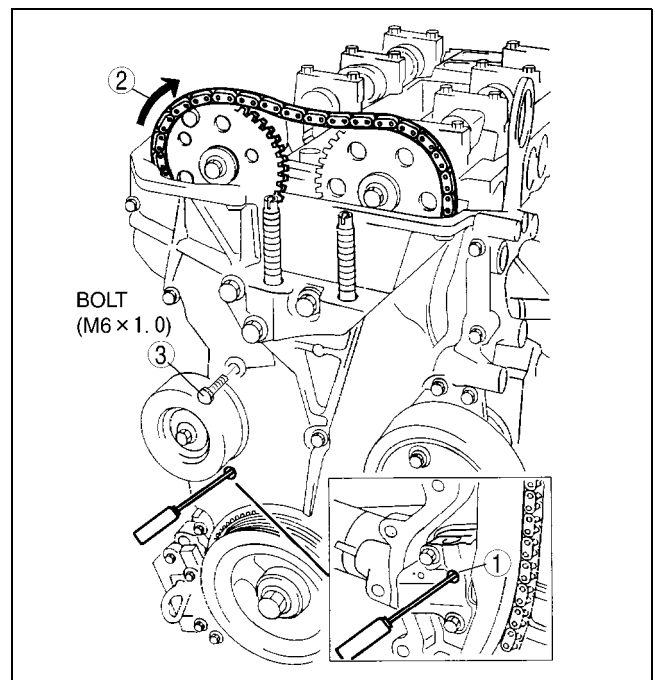
AMJ2212E004

4. Install the SST as shown.
5. Turn the crankshaft clockwise the crankshaft is in the No.1 cylinder TDC position.



AME2212W004

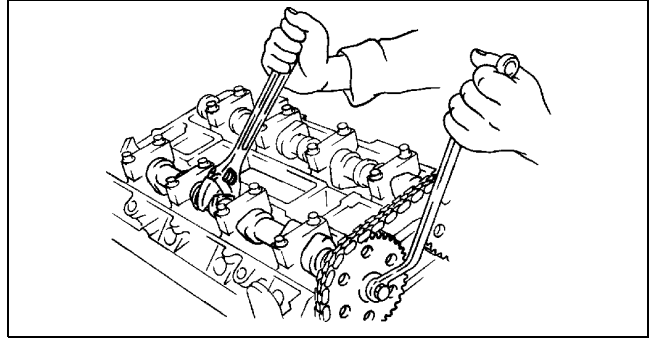
6. Loosen the timing chain.
  - (1) Using a suitable screwdriver or equivalent tool, unlock the chain tensioner ratchet.
  - (2) Turn the exhaust camshaft clockwise using a suitable wrench on the cast hexagon and loosened the timing chain.
  - (3) Placing the suitable bolt (**M6 X 1.0 Length 25—35 mm {0.9—1.3 in}**) at the engine front cover upper blind plug, secure the chain guide at the position where the tension is released.



AME2212W005

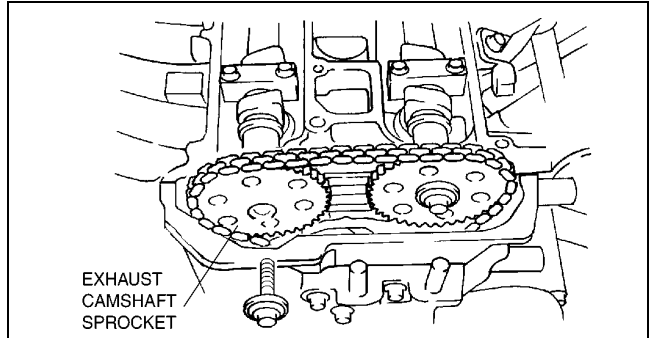
## ENGINE

7. Hold the exhaust camshaft using a suitable wrench on the cast hexagon as shown.



AME2212W006

8. Remove the exhaust camshaft sprocket.

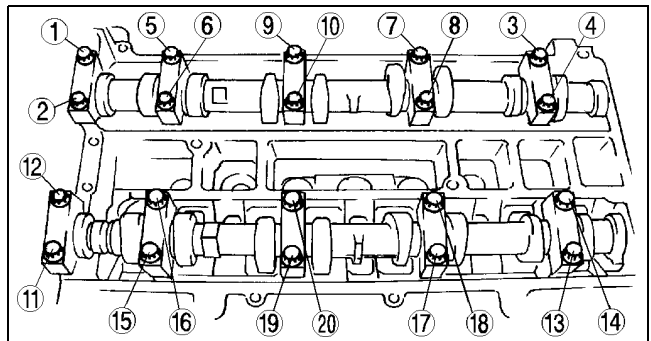


AME2212W007

9. Loosen the camshaft cap bolts in several passes in the order shown.

### Note

- The cylinder head and the camshaft caps are numbered to make sure they are reassembled in their original position. When removed, keep the caps with the cylinder head they were removed from. Do not mix the caps.



AME2212W008

10. Remove the camshaft.  
11. Remove the tappet.  
12. Select proper adjustment shim.

### New adjustment shim

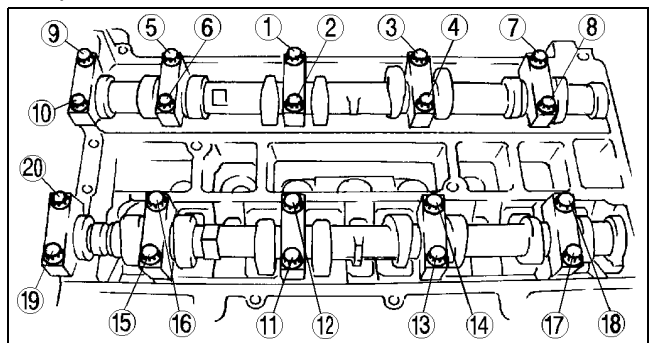
= Removed shim thickness + Measured valve clearance - Standard valve clearance (IN: 0.25 mm {0.0098 in}, EX: 0.30 mm {0.0118 in})

### Standard [Engine cold]

IN: 0.22—0.28 mm {0.0087—0.0110 in} (0.25±0.03 mm {0.0098±0.0011 in})  
EX: 0.27—0.33 mm {0.0106—0.0130 in} (0.30±0.03 mm {0.0118±0.0011 in})

13. Install the camshaft with No.1 cylinder aligned with the TDC position.  
14. Tighten the camshaft cap bolt using the following two steps.

- Tighten to 5.0—9.0 N·m {51.0—91.7 kgf·cm, 44.3—79.5 in·lbf}.
- Tighten to 14.0—17.0 N·m {1.5—1.7 kgf·m, 10.4—12.5 ft·lbf}.



AME2212W009

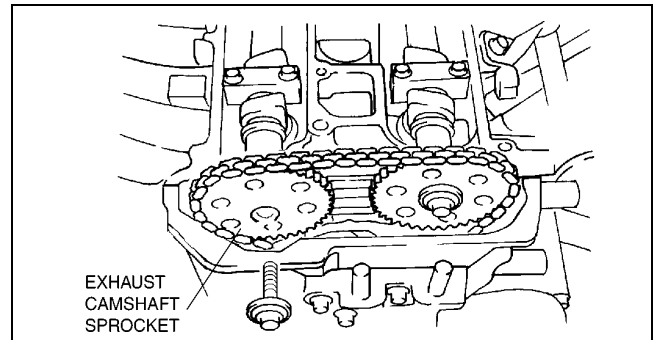
## ENGINE

15. Install the exhaust camshaft sprocket.

### Note

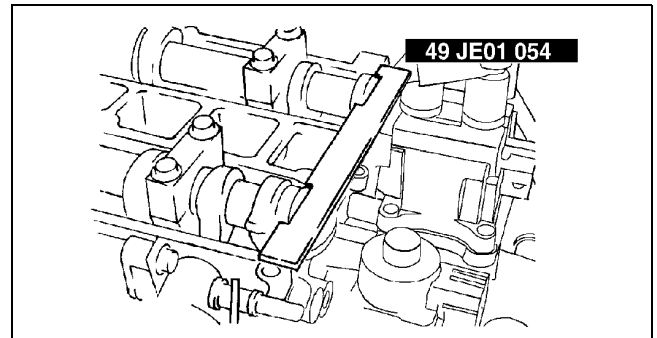
- Do not tighten the bolt for the camshaft sprocket during this step. First confirm the valve timing, then tighten the bolt.

16. Install the **SST** to the camshaft as shown.



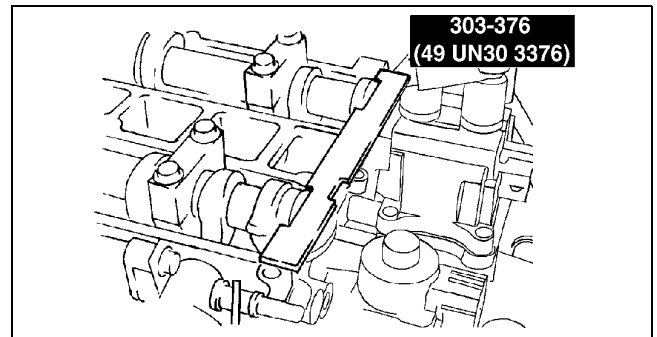
AME2212W007

### Europe



AME2212W010

### Except Europe



AME2212W011

17. Remove the M6 x 1.0 bolt from the engine front cover to apply tension to the timing chain.

18. Turn the crankshaft clockwise the crankshaft is in the No.1 cylinder TDC position.

19. Hold the exhaust camshaft using a suitable wrench on the cast hexagon as shown.

20. Tighten the exhaust camshaft sprocket lock bolt

### Tightening torque

69—75 N·m {7.10—7.6 kgf·m,  
50.9—55.3 ft·lbf}

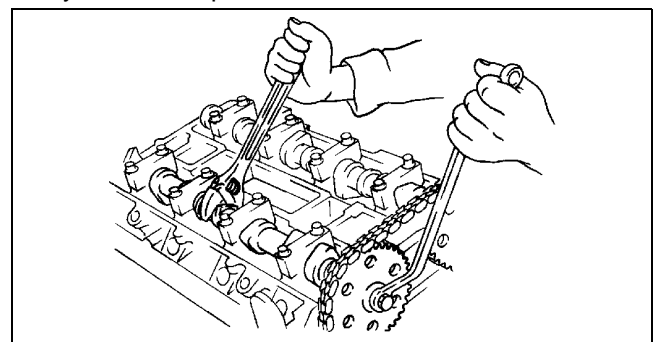
21. Remove the **SST** from the camshaft.

22. Remove the **SST** from the block lower blind plug.

23. Rotate the crankshaft clockwise two turns until the TDC position.

- If not aligned, loosen the crankshaft pulley lock bolt and repeat from Step 14.

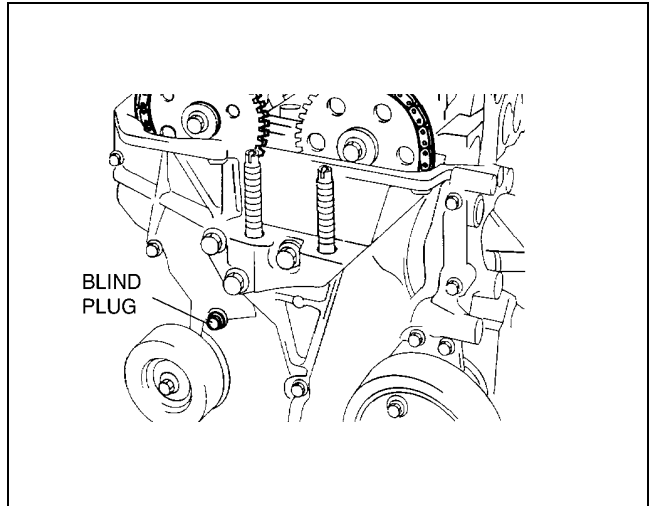
24. Apply silicone sealant to the engine front cover upper blind plug.



## ENGINE

25. Install the engine front cover upper blind plug.

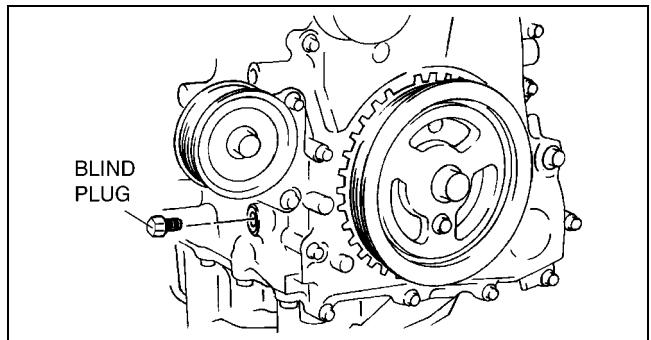
**Tightening torque:**  
**10 N·m {1.0 kgf·m, 7.4 ft·lbf}**



AME2212W003

26. Install the cylinder block lower blind plug.

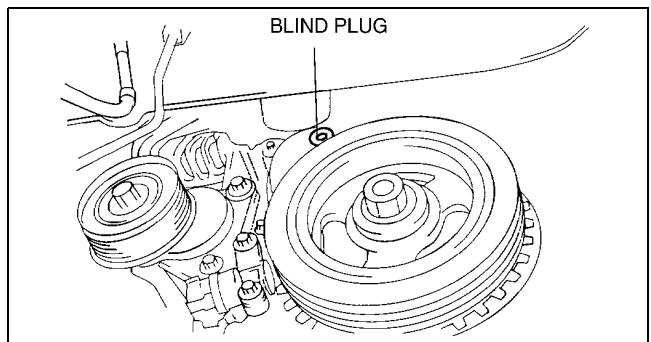
**Tightening torque:**  
**20 N·m {2.0 kgf·m, 14.8 ft·lbf}**



AME2212W012

27. Install the new engine front cover lower blind plug.

**Tightening torque:**  
**12 N·m {1.2 kgf·m, 8.9 ft·lbf}**



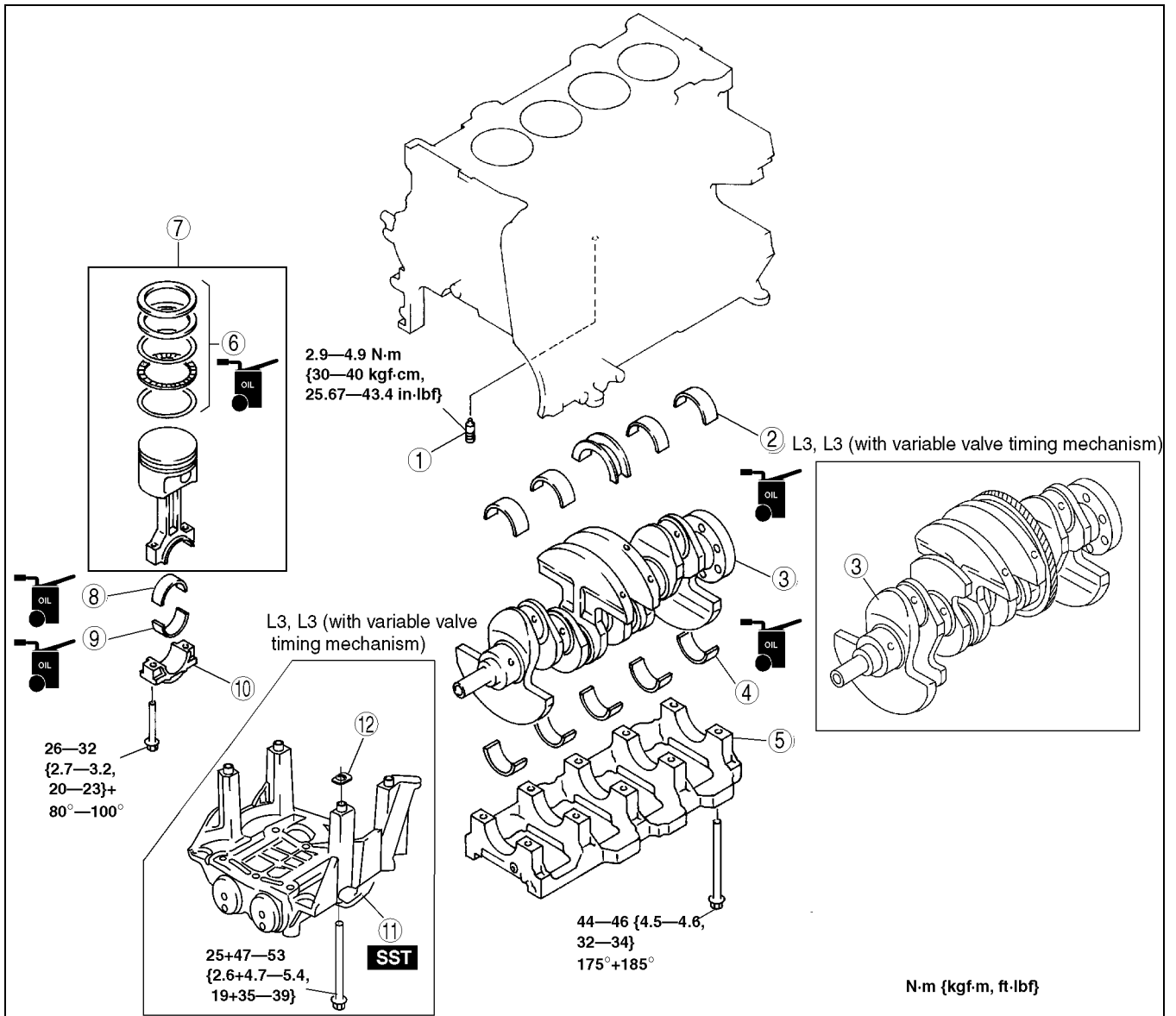
AME2212W002

# ENGINE

## CYLINDER BLOCK (I) ASSEMBLY

A6E242402000E09

1. Assemble in the order indicated in the table.



AME2224E039

1	Oil jet valve
2	Upper main bearing, thrust bearing
3	Crankshaft
4	Lower main bearing, thrust bearing
5	Main bearing cap (See B-30 Main Bearing Caps Assembly Note)
6	Piston ring (See B-30 Piston Ring Assembly Note)
7	Connecting rod, Piston assembly (See B-30 Piston Assembly Note)

8	Upper connecting rod bearing (See B-31 Connecting Rod Bearing Assembly Note)
9	Lower connecting rod bearing (See B-31 Connecting Rod Bearing Assembly Note)
10	Connecting rod cap (See B-31 Connecting Rod Cap Assembly Note)
11	Engine balancer (L3 (with variable valve timing mechanism)) (See B-31 Balancer Unit Assembly Note)
12	Adjustment shim

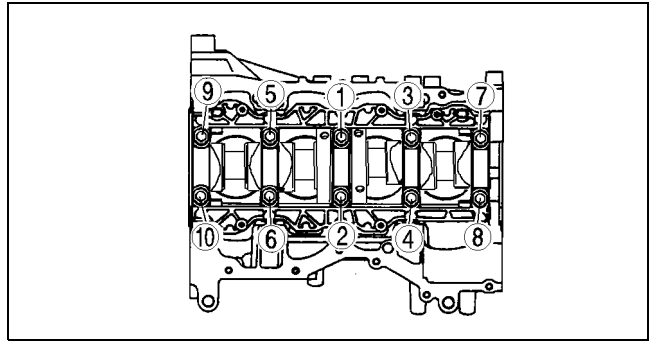
## ENGINE

### Main Bearing Caps Assembly Note

1. Install the main bearing caps in the order indicated in the figure.

#### Tightening torque:

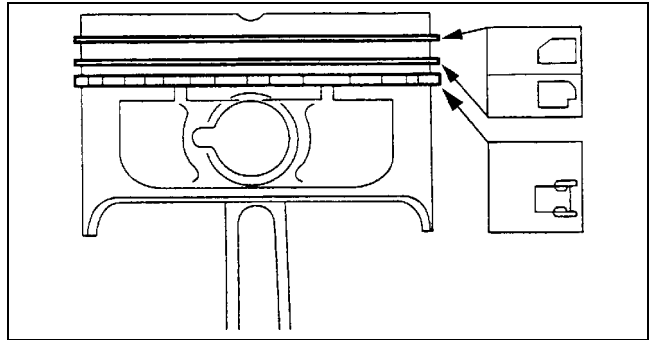
- (1) 44—46 N·m  
{4.5—4.6 kgf·m, 32.5—33.9 ft·lbf}
- (2) 175°—185°



AME2224E052

### Piston Ring Assembly Note

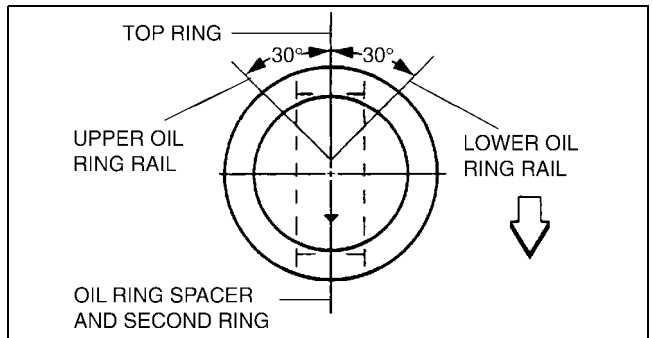
1. Install the two oil control ring segments and spacer.
2. Verify that the second ring is installed with scraper face side downward.
3. Verify that the top ring is installed with scraper face side inner of upper.



AME2224E322

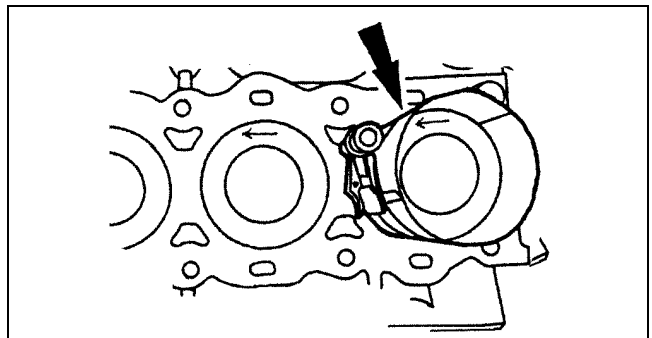
### Piston Assembly Note

1. Position the end gap of each ring as indicated in the figure.



AME2224E323

2. Insert the piston and connecting rod into the cylinder with the arrow mark to front of the engine.

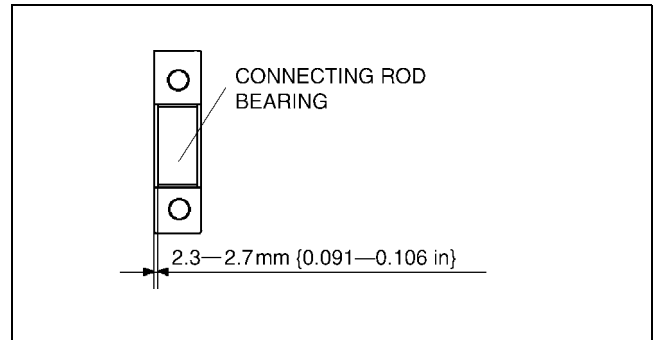


AME2224E042

## ENGINE

### Connecting Rod Bearing Assembly Note

1. Install the connecting rod bearing to the connecting rod and connecting rod caps, as shown in the figure.



AME2224E053

### Connecting Rod Cap Assembly Note

#### Caution

- When assembling the connecting rod caps, align the broken, rough faces of the connecting rods and connecting rod caps.

1. Tighten the connecting rod bolts in two steps.

#### Tightening torque:

- (1) 26—32 N·m  
{2.7—3.2 kgf·m, 19.2—23.6 ft·lbf}
- (2) 80°—100°

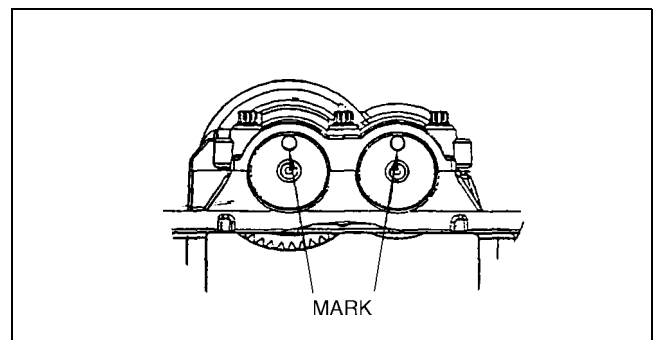
### Balancer Unit Assembly Note

1. Confirm by visual inspection that there is no damage to the balancer unit gear and verify that the shaft turns smoothly.
  - If there is any damage or malfunction, replace the balancer unit.

#### Caution

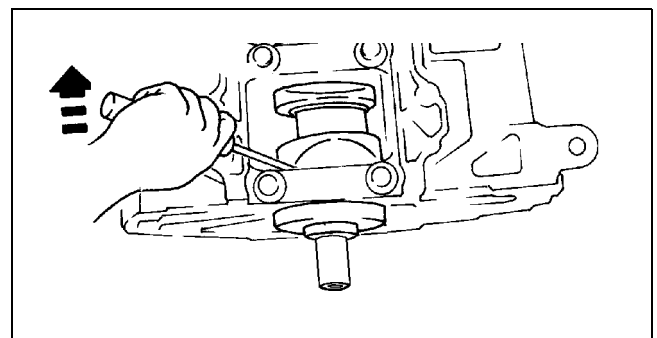
- Due to the precision interior construction of the balancer unit, it cannot be disassembled.

2. Rotate the crankshaft clockwise and align the No. 1 cylinder to the TDC.
3. Install the adjustment shim to the seat face of the balancer unit.
4. With the balancer unit marks at the exact top center, assemble the unit to the cylinder block.



AME2224E061

5. Insert a screwdriver into the crankshaft No. 1 crankweight area and set both the rotation and the thrust direction with the screwdriver, using a prying action, as shown.



AME2224E080



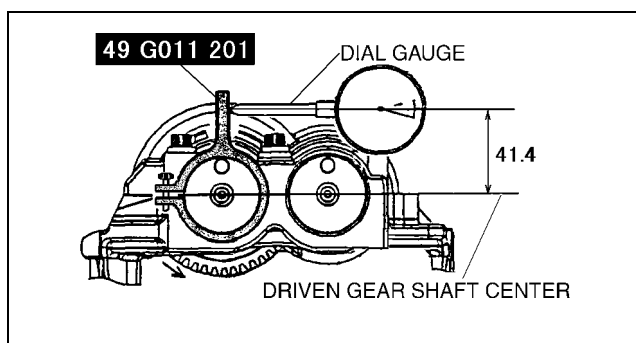
## ENGINE

6. Set the SST as shown, then measure the gear backlash using a dial gauge.

- If the backlash exceeds the specified range, remeasure the backlash and, using the adjustment shim selection table, select the proper shim, according to the following procedure.

### Caution

- **When measuring the backlash, rotate the crankshaft one full rotation and verify that it is within the specified range at all of the following six positions: 10°, 30°, 100°, 190°, 210°, 280° ATDC.**



AME2224E060

### Value range:

**0.005—0.101 mm {0.00019—0.0039 in}**

- (1) Using master adjustment shim (No.50), assemble the balancer unit to the cylinder block, then measure the backlash.
- (2) Select the proper adjustment shim according to the measured value.
- (3) Install the selected adjustment shim to the balancer unit, then assemble the balancer unit to the cylinder block.

### Adjustment shim selection table

Backlash mm {in}	Selection shim (No.)	Shim thickness mm {in}	Backlash mm {in}	Selection shim (No.)	Shim thickness mm {in}
0.256—0.262 {0.0100—0.01031}	15	1.15 {0.0452}	0.116—0.122 {0.00456— 0.00480}	35	1.35 {0.0531}
0.249—0.255 {0.0098— 0.010039}	16	1.16 {0.0456}	0.109—0.115 {0.00429— 0.00452}	36	1.36 {0.0535}
0.242—0.248 {0.0096—0.00976}	17	1.17 {0.0460}	0.102—0.108 {0.00401— 0.00425}	37	1.37 {0.0539}
0.235—0.241 {0.0093—0.0948}	18	1.18 {0.0464}	0.095—0.101 {0.00374— 0.00397}	38	1.38 {0.0543}
0.228—0.234 {0.00897— 0.00921}	19	1.19 {0.0468}	0.088—0.094 {0.00346— 0.00370}	39	1.39 {0.0547}
0.221—0.227 {0.00870— 0.00893}	20	1.20 {0.0472}	0.081—0.087 {0.00318— 0.00342}	40	1.40 {0.0551}
0.214—0.220 {0.00842— 0.00874}	21	1.21 {0.0476}	0.074—0.080 {0.00291— 0.00314}	41	1.41 {0.0555}
0.207—0.213 {0.00814— 0.00838}	22	1.22 {0.0480}	0.067—0.073 {0.00263— 0.00287}	42	1.42 {0.0559}
0.200—0.206 {0.00787— 0.00811}	23	1.23 {0.0484}	0.060—0.066 {0.00236— 0.00259}	43	1.43 {0.0562}
0.193—0.199 {0.00759— 0.00783}	24	1.24 {0.0488}	0.053—0.059 {0.00208— 0.00232}	44	1.44 {0.0566}
0.186—0.192 {0.00732— 0.00755}	25	1.25 {0.492}	0.046—0.052 {0.00181— 0.00204}	45	1.45 {0.0570}
0.179—0.185 {0.00704— 0.00728}	26	1.26 {0.496}	0.039—0.045 {0.00153— 0.00177}	46	1.46 {0.0574}

## ENGINE

Backlash mm {in}	Selection shim (No.)	Shim thickness mm {in}	Backlash mm {in}	Selection shim (No.)	Shim thickness mm {in}
0.172—0.178 {0.00677— 0.00700}	27	1.27 {0.499}	0.032—0.038 {0.00125— 0.00149}	47	1.47 {0.0578}
0.165—0.171 {0.00649— 0.00673}	28	1.28 {0.503}	0.025—0.031 {0.000984— 0.00122}	48	1.48 {0.0582}
0.158—0.164 {0.00622—0.00645}	29	1.29 {0.507}	0.018—0.024 {0.000708— 0.000944}	49	1.49 {0.0586}
0.151—0.157 {0.00594— 0.00618}	30	1.30 {0.511}	0.011—0.017 {0.000433— 0.000669}	50 (master)	1.50 {0.0590}
0.144—0.150 {0.0566—0.0590}	31	1.31 {0.515}	0.004—0.010 {0.00015— 0.000393}	51	1.51 {0.0594}
0.137—0.143 {0.00539— 0.00562}	32	1.32 {0.519}	0.000—0.004 {0.000—0.000157}	52	1.52 {0.0598}
0.130—0.136 {0.00511— 0.00535}	33	1.33 {0.523}	0.000—0.000 {0.000—0.000}	53	1.53 {0.0602}
0.123—0.129 {0.00484— 0.00507}	34	1.34 {0.527}	0.000—0.000 {0.000—0.000}	54	1.54 {0.0606}

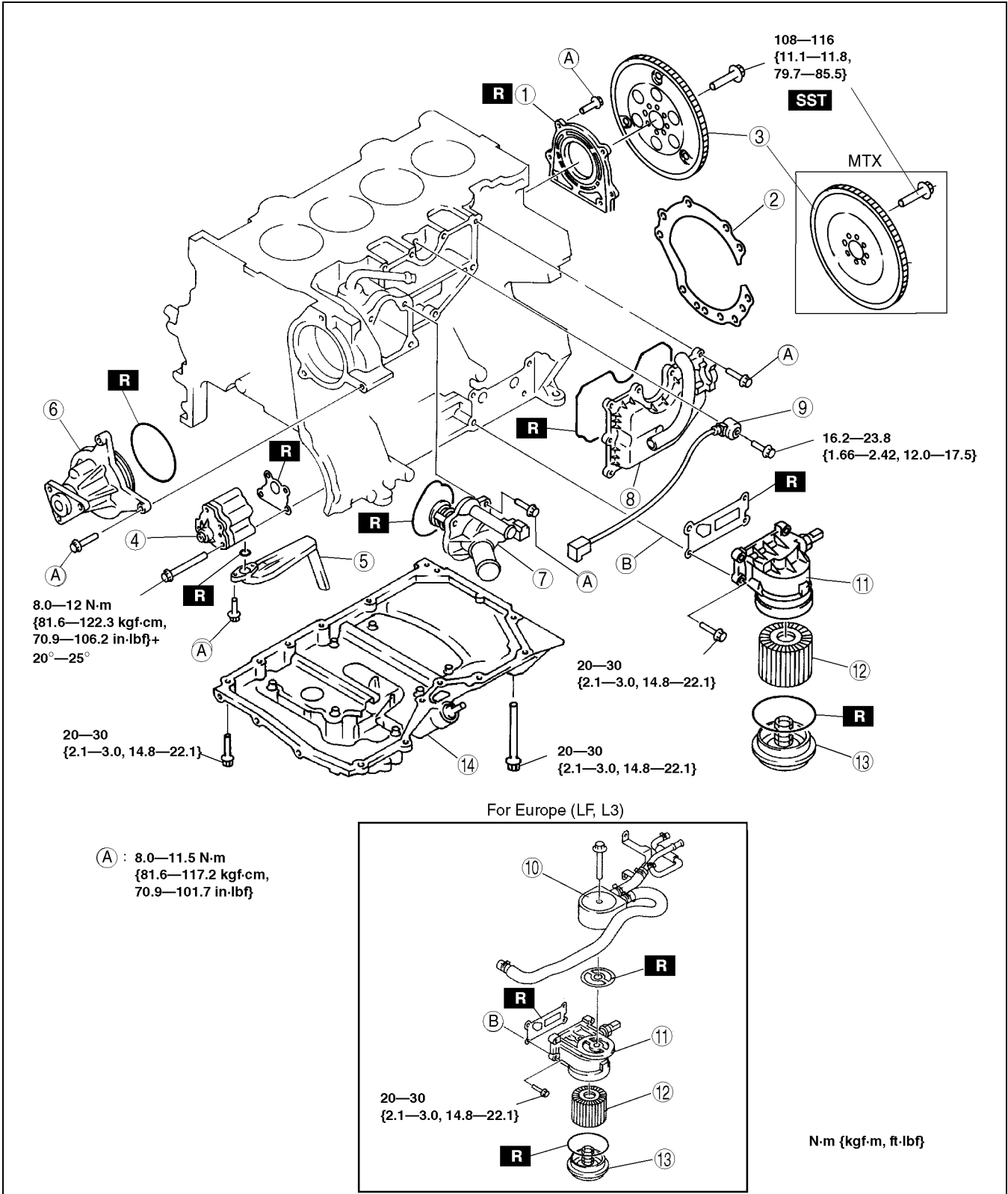
**B**

# ENGINE

## CYLINDER BLOCK (II) ASSEMBLY

A6E242402000E10

1. Assemble in the order indicated in the table.



AME2224E043

## ENGINE

1	Rear oil seal (See <a href="#">B-35 Rear Oil Seal Assembly Note</a> )
2	End plate (MPV)
3	Flywheel (MTX), Drive plate (ATX) (See <a href="#">B-36 Drive Plate (ATX)</a> , <a href="#">Flywheel (MTX) Assembly Note</a> )
4	Oil pump
5	Oil strainer
6	Water pump
7	Thermostat

8	Oil separator
9	Knock sensor
10	Oil cooler
11	Oil filter adapter
12	Oil filter
13	Oil filter cover
14	Oil pan (See <a href="#">B-36 Oil pan Assembly Note</a> )
15	MTX

B

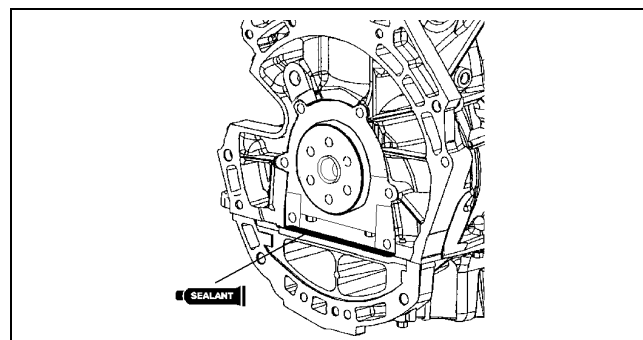
### Rear Oil Seal Assembly Note

1. Apply silicone sealant to the mating faces as shown.

**Dot diameter:**

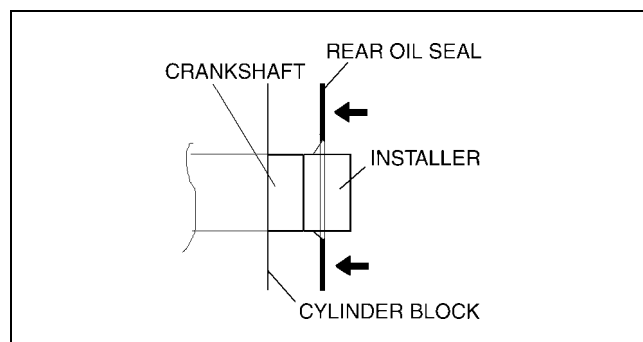
**4.0—6.0 mm {0.16—0.23 in}**

2. Apply clean engine oil to the new oil seal lip.



AME2224E325

3. Install the rear oil seal using the installer as shown.

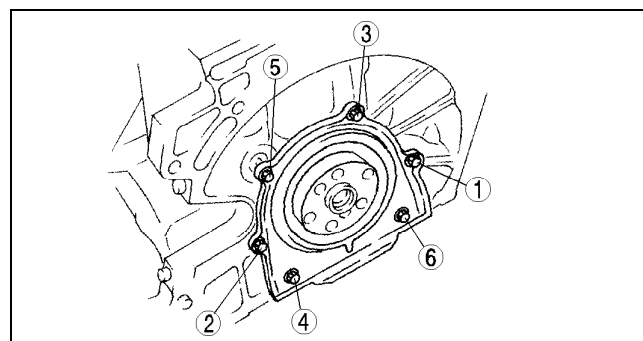


AME2224E326

4. Tighten the rear oil seal bolts in the order as shown.

**Tightening torque:**

**8.0—11.5 N·m {81.6—117.2 kgf·m, 70.9—101.7 in·lbf}**

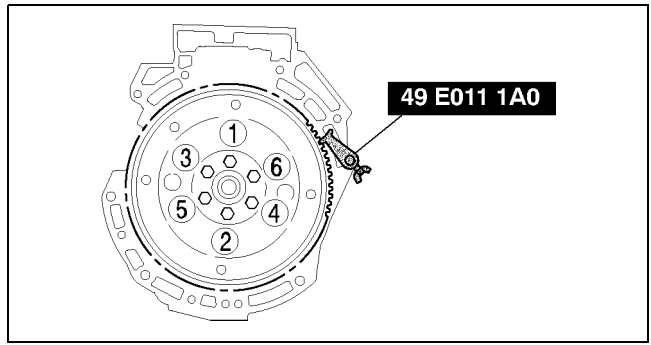


AME2224E002

## ENGINE

### Drive Plate (ATX), Flywheel (MTX) Assembly Note

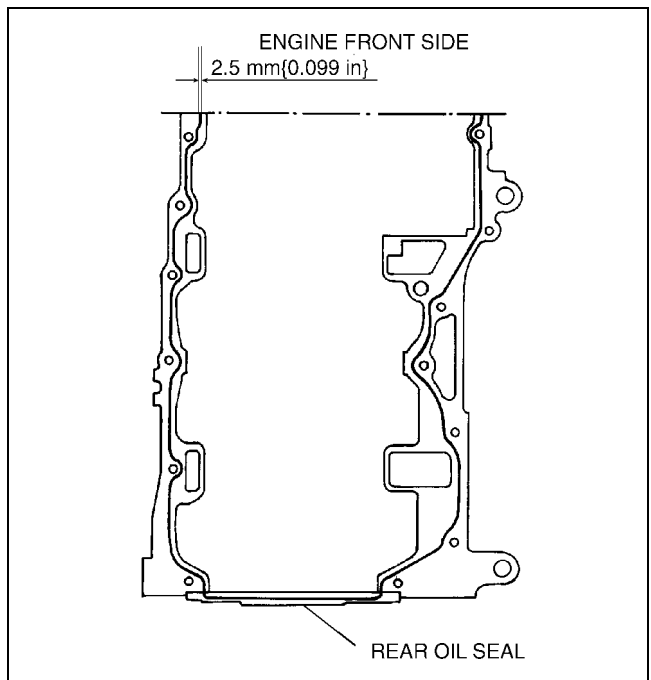
1. Hold the crankshaft using the **SST**.
2. Tighten the bolts in the order indicated in the figure in several passes.



AME2224E102

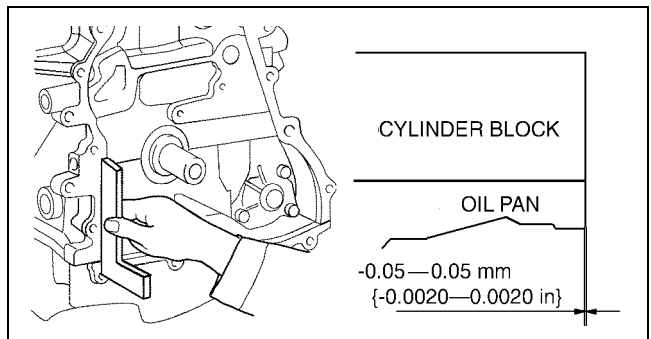
### Oil pan Assembly Note

1. Apply a continuous bead of silicone sealant to the oil pan as indicated in the figure.



AME2224E555

2. Use a square ruler to unite the oil pan and the cylinder block junction side on the engine front cover side.



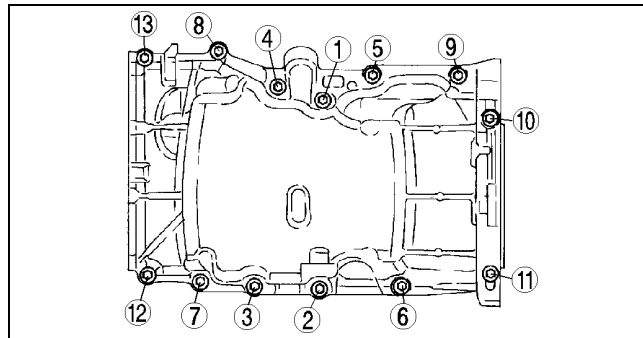
AME2224E054

# ENGINE

- Tighten the rear oil pan bolts in the order as shown.

**Tightening torque:**

**20—30 N·m {2.1—3.0 kgf·m, 15.2—21.6 in·lbf}**



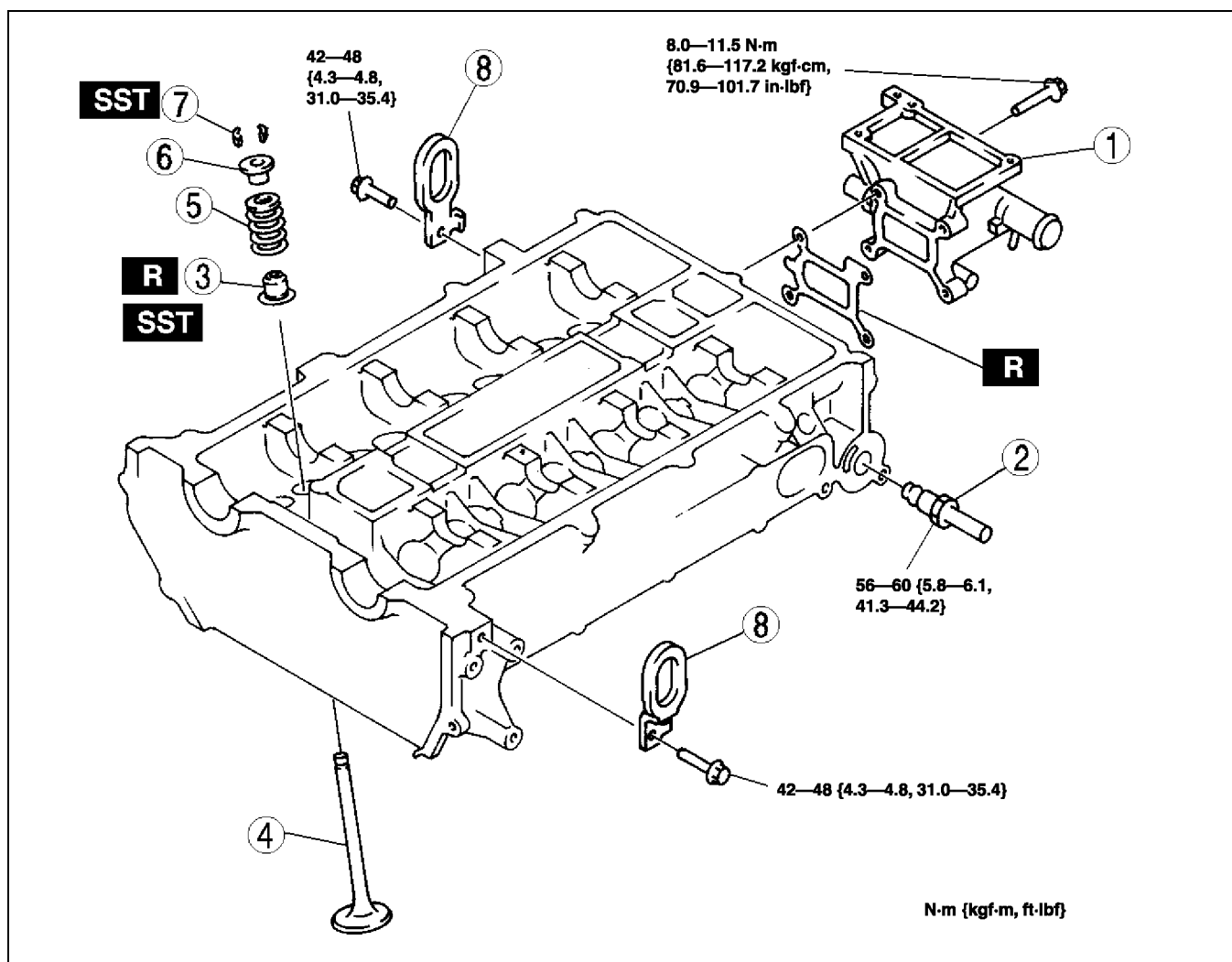
AME2224E056

**B**

## CYLINDER HEAD (I) ASSEMBLY

A6E242402000E11

- Assemble in the order indicated in the table.



AME2224E044

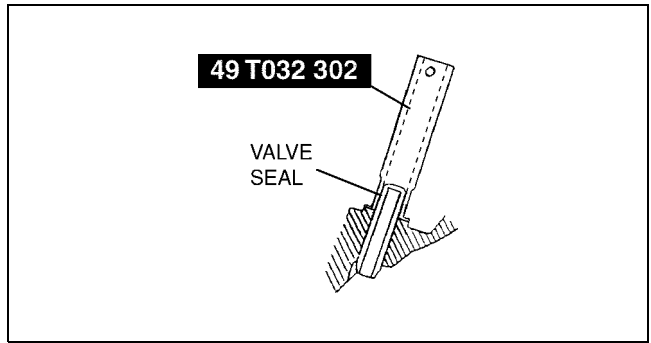
1	Water outlet case
2	EGR pipe
3	Valve seal (See <a href="#">B-38 Valve Seal Assembly Note</a> )
4	Valve

5	Valve spring
6	Upper valve spring seat
7	Valve keeper (See <a href="#">B-38 Valve Keeper Assembly Note</a> )
8	Engine hanger

## ENGINE

### Valve Seal Assembly Note

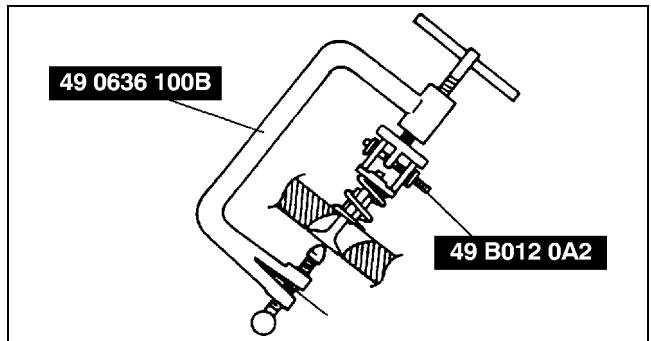
1. Press the valve seal onto the valve guide by hand.
2. Lightly tap the **SST** using a plastic hammer.



AME2224E321

### Valve Keeper Assembly Note

1. Install the valve keeper using the **SSTs**.



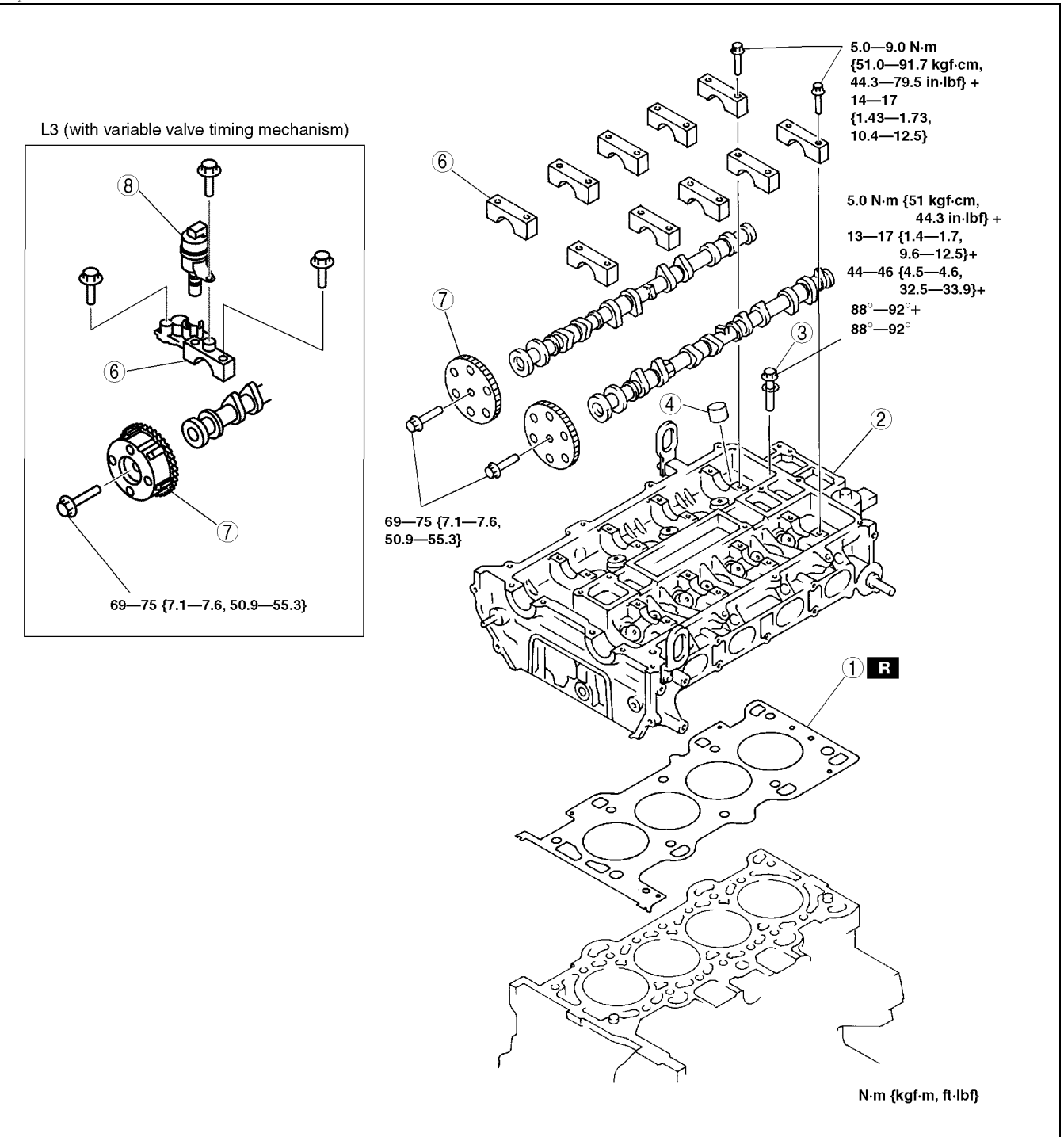
AME2224E302

# ENGINE

## CYLINDER HEAD (II) ASSEMBLY

A6E242402000E12

1. Assemble in the order indicated in the table.



AME2224E046

1	Cylinder head gasket
2	Cylinder head
3	Cylinder head bolt (See <a href="#">B-40 Cylinder Head Bolt Assembly Note</a> )
4	Tappet
5	Camshaft (See <a href="#">B-40 Camshaft Assembly Note</a> )

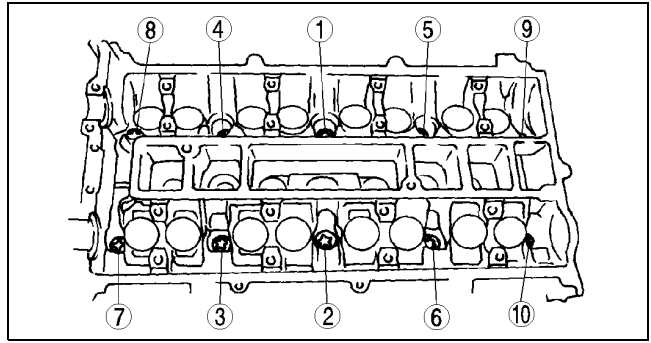
6	Camshaft cap
7	Camshaft sprocket, Variable valve timing actuator (L3 (with variable valve timing mechanism)) (See <a href="#">B-40 Camshaft Sprocket, Variable Valve Timing Actuator (L3 (with variable valve timing mechanism)) Assembly Note</a> )
8	Oil control valve (OCV) (L3 (with variable valve timing mechanism))



## ENGINE

### Cylinder Head Bolt Assembly Note

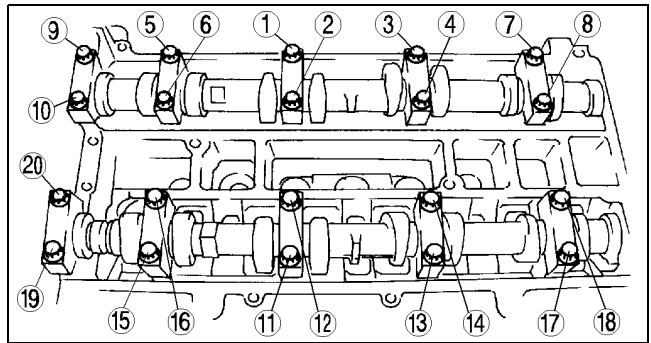
1. Tighten the cylinder head bolts in the order indicated in the figure in six steps.
  - (1) Tighten to **5.0 N·m {51 kgf·cm, 44.3 in·lbf}**.
  - (2) Tighten to **13—17 N·m {1.4—1.7 kgf·m, 9.6—12.5 ft·lbf}**.
  - (3) Tighten to **44—46 N·m {4.5—4.6 kgf·m, 32.5—33.9 ft·lbf}**.
  - (4) Tighten **88°—92°**.
  - (5) Tighten **88°—92°**.



AME2224E047

### Camshaft Assembly Note

1. Install the camshaft with No.1 cylinder aligned with TDC position.
2. Tighten the camshaft cap bolt using the following two steps.
  - (1) Tighten to **5.0—9.0 N·m {51.0—91.7 kgf·cm, 44.3—79.5 in·lbf}**.
  - (2) Tighten to **14.0—17.0 N·m {1.5—1.7 kgf·m, 10.4—12.5 ft·lbf}**.



AME2224E048

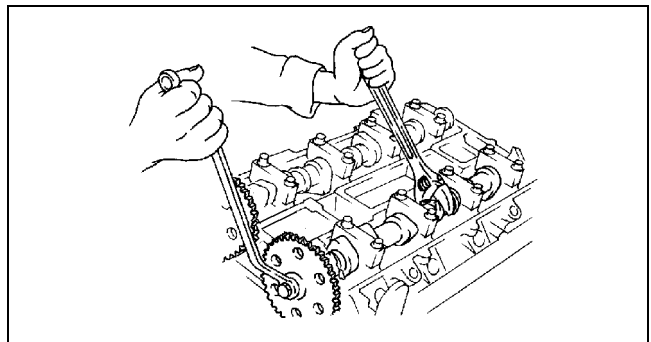
### Camshaft Sprocket, Variable Valve Timing Actuator (L3 (with variable valve timing mechanism)) Assembly Note

1. Camshaft sprocket or variable valve timing actuator (L3 (with variable valve timing mechanism)) attachment bolt is changed into the state of a temporary bundle by hand until it attaches timing chain.
2. The attachment bolt of camshaft sprocket or variable valve timing actuator (L3 (with variable valve timing mechanism)) is bound tight for timing chain after attachment.

#### Tightening torque

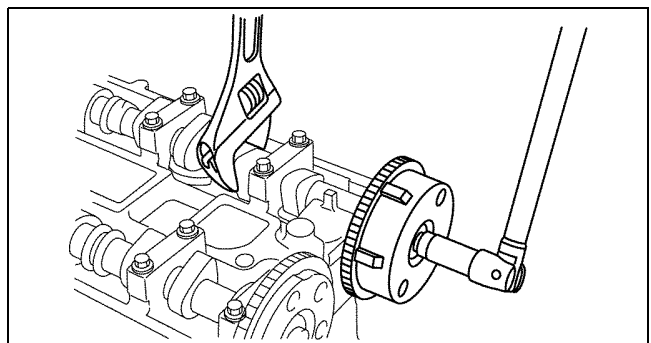
**69—75 N·m {7.10—7.60 kgf·m, 50.9—55.3 ft·lbf}**

L8, LF, L3



AME2224E077

L3 (with variable valve timing mechanism)



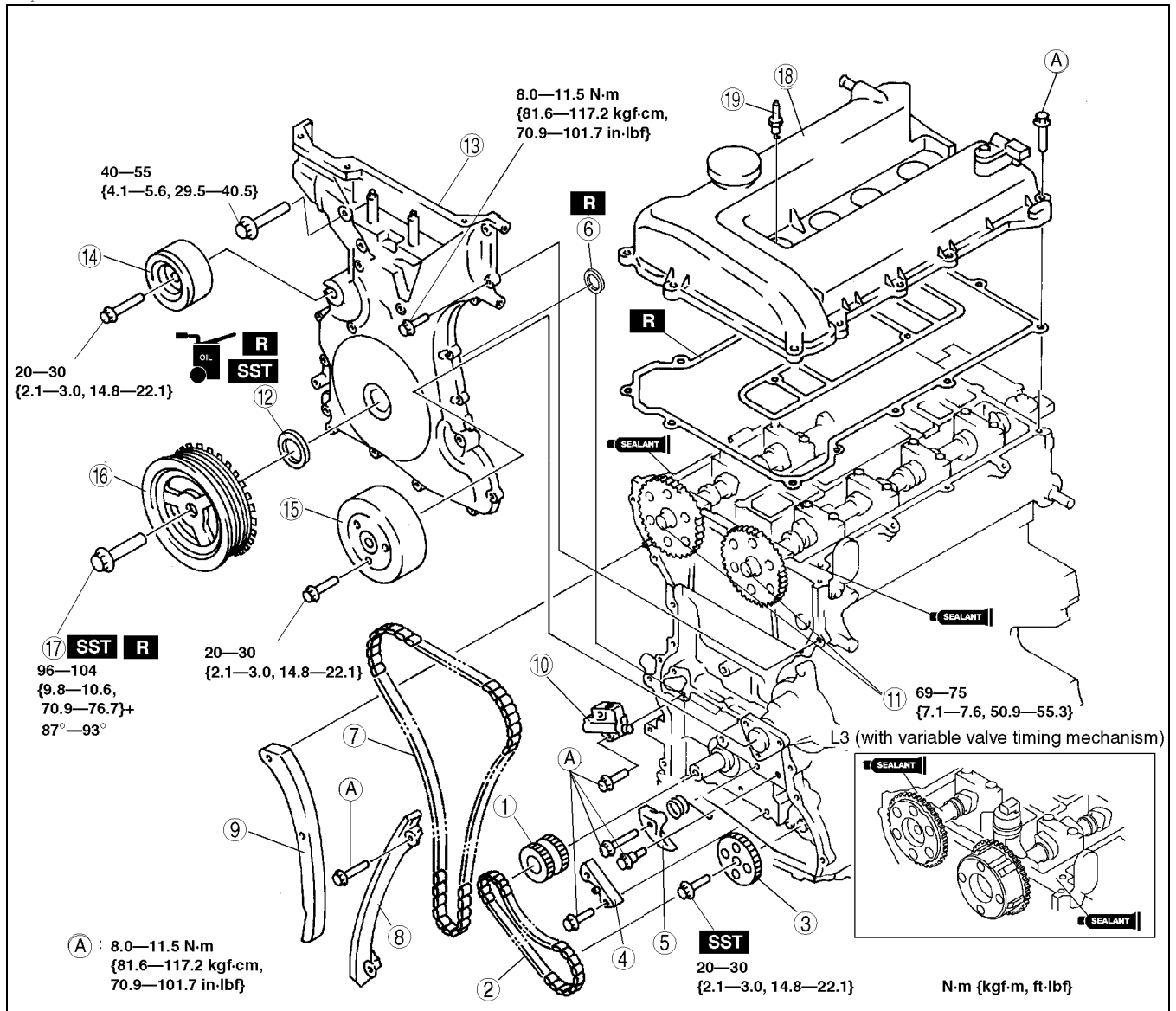
AME2224E078

# ENGINE

## TIMING CHAIN ASSEMBLY

A6E242402000E13

1. Assemble in the order indicated in the table.



AME2224E327

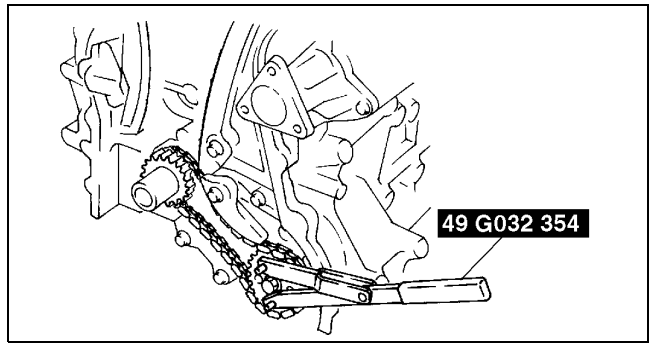
1	Crankshaft sprocket
2	Oil pump chain
3	Oil pump sprocket (See <a href="#">B-42 Oil Pump Sprocket Assembly Note</a> )
4	Oil pump chain guide
5	Oil pump chain tensioner
6	Seal (L3 (with variable valve timing mechanism))
7	Timing chain (See <a href="#">B-42 Timing Chain Assembly Note</a> )
8	Chain guide
9	Tensioner arm
10	Chain tensioner
11	Camshaft sprocket, Variable Valve Timing Actuator (L3 (with variable valve timing mechanism)) (See <a href="#">B-43 Camshaft Sprocket, Variable Valve Timing Actuator (L3 (with variable valve timing mechanism)) Assembly Note</a> )

12	Front oil seal (See <a href="#">B-44 Front Oil Seal Assembly Note</a> )
13	Engine front cover (See <a href="#">B-44 Engine Front Cover Assembly Note</a> )
14	Drive belt idler pulley
15	Water pump pulley
16	Crankshaft pulley
17	Crankshaft pulley lock bolt (See <a href="#">B-45 Crankshaft Pulley Lock Bolt Assembly Note</a> )
18	Cylinder head cover (See <a href="#">B-46 Cylinder Head Cover Assembly Note</a> )
19	Spark plug

## ENGINE

### Oil Pump Sprocket Assembly Note

1. Hold the oil pump sprocket using the **SST**.

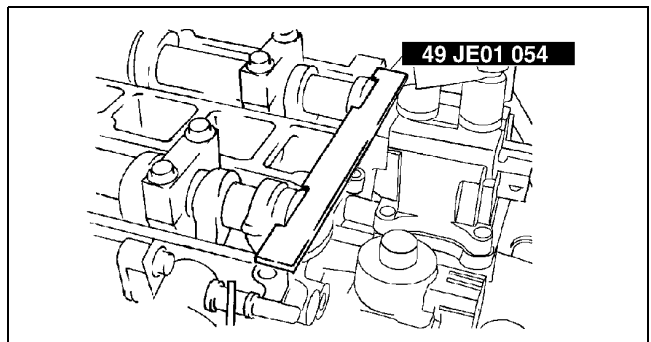


AME2224E340

### Timing Chain Assembly Note

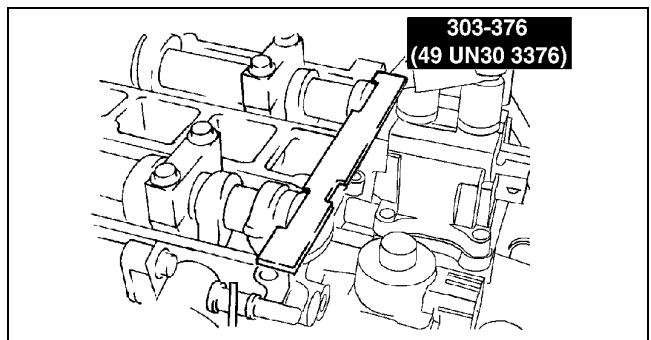
1. Install the **SST** to the camshaft, then align the No. 1 camshaft position with the TDC.

#### Europe



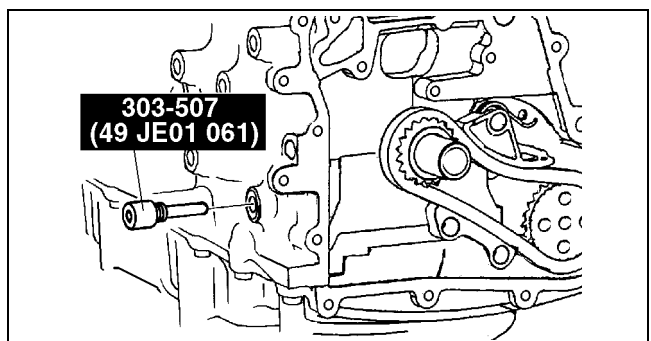
AME2224E329

#### Except Europe



AME2224E328

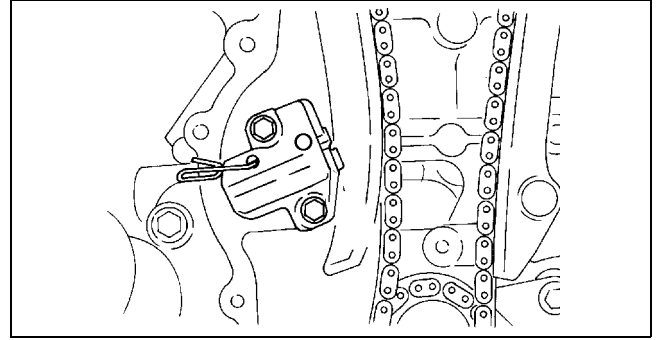
2. Remove the cylinder block lower blind plug.
3. Install the **SST** as shown.
4. Turn the crankshaft clockwise so that the crankshaft is in the No.1 cylinder TDC position.
5. Install the timing chain.



AMJ2224E666

## ENGINE

6. Install the chain tensioner and remove the retaining wire.

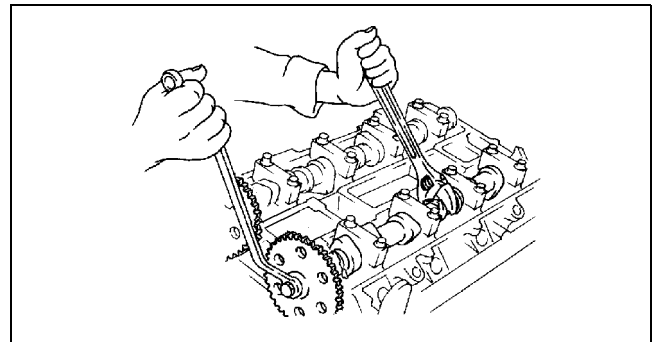


AME2224E330

B

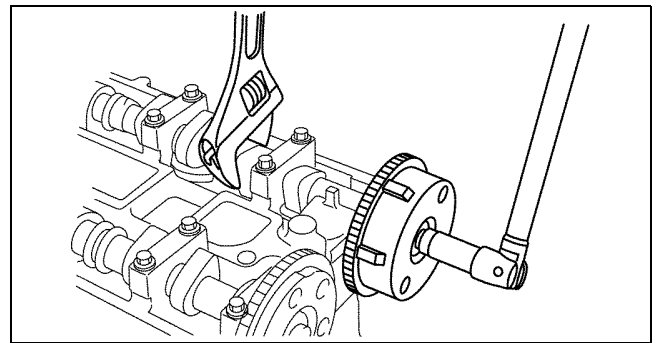
### Camshaft Sprocket, Variable Valve Timing Actuator (L3 (with variable valve timing mechanism)) Assembly Note

1. Hold the camshaft using a suitable wrench on the cast hexagon as shown.  
L8, LF, L3



AME2224E077

### L3 (with variable valve timing mechanism)



AME2224E078

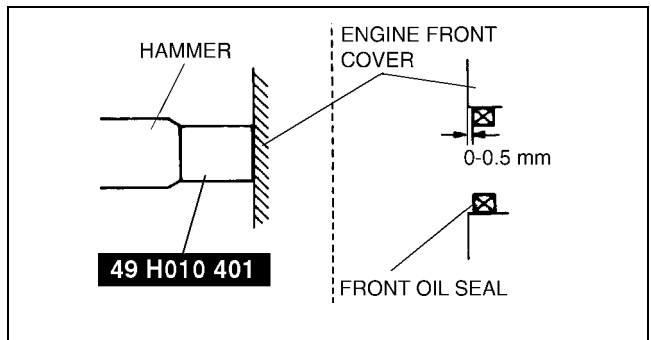
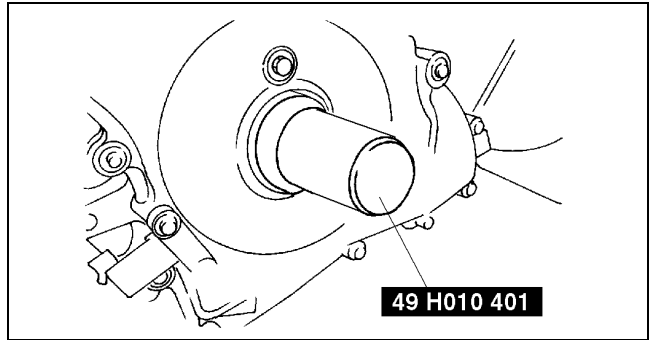
2. Tighten the camshaft sprocket lock bolt.

**Tightening torque: 69—75 N·m {7.10—7.6 kgf·m, 50.9—55.3 ft·lbf}**

# ENGINE

## Front Oil Seal Assembly Note

1. Apply clean engine oil to the oil seal.
2. Push the oil seal slightly in by hand.
3. Compress the oil seal using the SST and a hammer.



## Engine Front Cover Assembly Note

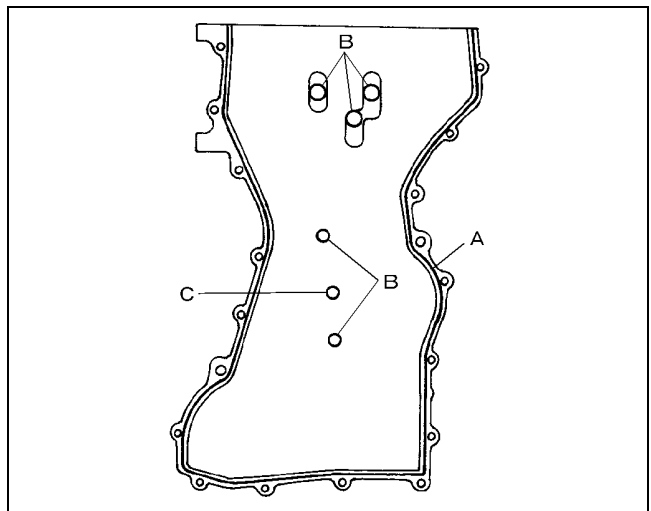
1. Apply silicone sealant to the engine front cover as shown.

### Caution

- Install the cylinder head cover within 10 minutes of applying the silicone sealant.
- Silicone sealant is not need in area C as indicated below due to an existing. (L3 (with variable valve timing mechanism))

### Thickness

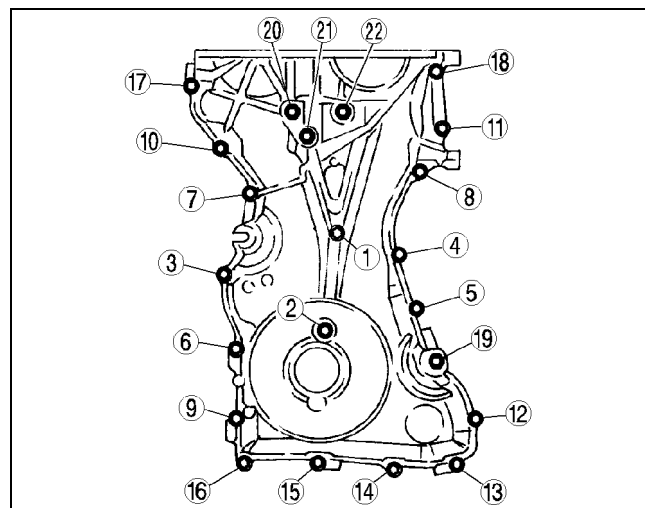
- A: 2.0—3.0 mm {0.079—0.118 in}
- B: 1.5—2.5 mm {0.059—0.098 in}



## ENGINE

2. Install the cylinder head cover bolts in the order as shown.

Bolt No.	Tightening torque N·m {kgf·m, ft·lbf}
1—18	8.0—11.5 N·m {81.6—117.2 kgf·cm, 70.9—101.7 in·lbf}
19—22	40—55 {4.1—5.6, 29.7—40.5}

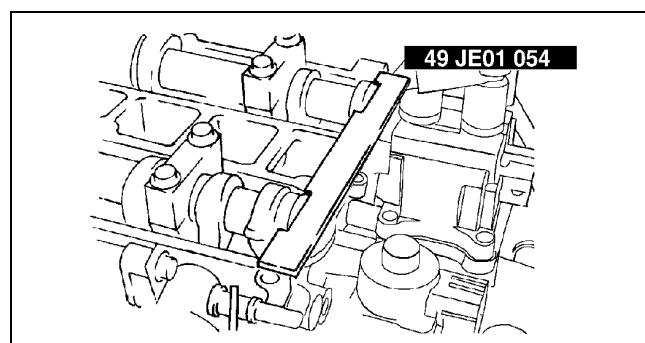


AME2224E334

### Crankshaft Pulley Lock Bolt Assembly Note

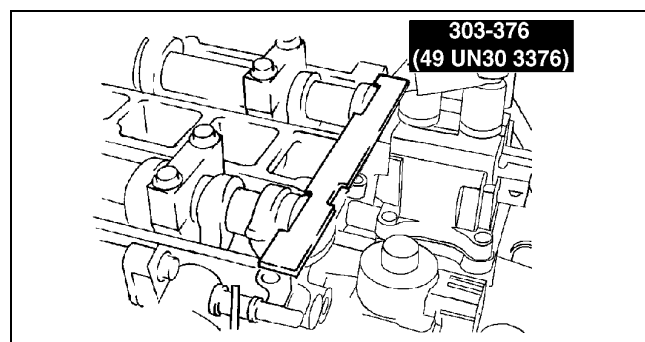
1. Install the **SST** to the camshaft as shown.

#### Europe



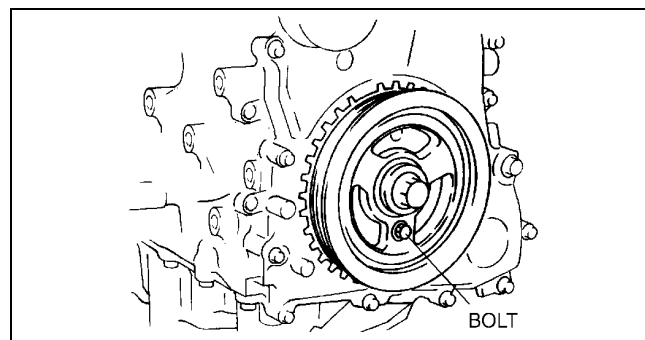
AME2224E329

#### Except Europe



AME2224E328

2. Install the M6 x 1.0 bolt in by hand.
3. Turn the crankshaft clockwise so that the crankshaft is in the No.1 cylinder TDC position.



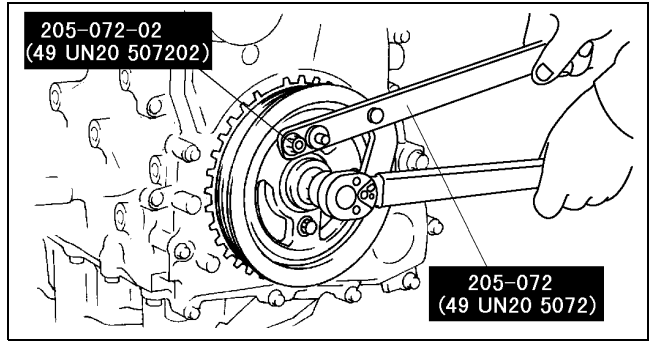
AME2224E009

B

## ENGINE

4. Hold the crankshaft pulley using the **SST**.
5. Tighten the crankshaft pulley lock bolt in the following two steps.
  - (1) Tighten to **96—104 N·m {9.8—10.6 kgf·m, 70.9—76.7 ft·lbf}**
  - (2) Tighten **87°—93°**.
6. Remove the M6 x 1.0 bolt.
7. Remove the **SST** from the camshaft.
8. Remove the **SST** from the block lower blind plug.
9. Rotate the crankshaft clockwise two turns until the TDC position.
  - If not aligned, loosen the crankshaft pulley lock bolt and repeat from Step 1.
10. Install the cylinder block lower blind plug.

**Tightening torque: 20 N·m {2.0 kgf·m, 14.8 ft·lbf}**



AME2224E015

### Cylinder Head Cover Assembly Note

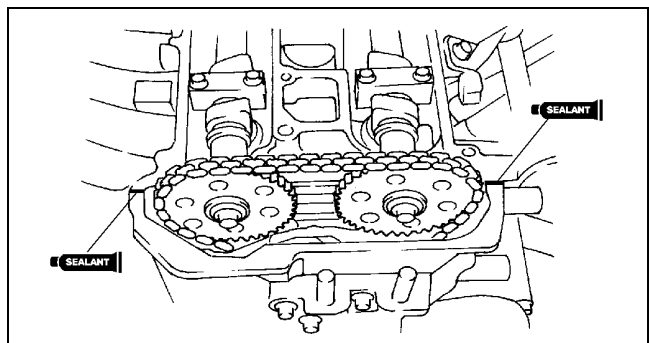
1. Apply silicone sealant to the mating faces as shown.

#### Caution

- Install the cylinder head cover within **10 minutes** of applying the silicone sealant.

**Dot diameter: 4.0—6.0 mm {0.16—0.23 in}**

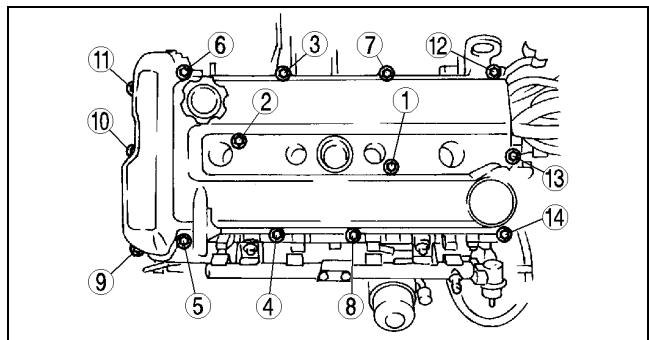
2. Install the cylinder head cover with a new gasket.



AME2224E335

3. Tighten the bolts in the order shown.

**Tightening torque: 8.0 —12 N·m {81.6—122.3 kgf·cm, 70.9—106.2 in·lbf}**



AME2224E336

# TECHNICAL DATA

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

TD



## TECHNICAL DATA

### TECHNICAL DATA

#### ENGINE TECHNICAL DATA

A6E931001001E01

Item		Engine		
		L8	LF	L3, L3 (with variable valve timing mechanism)
<b>Cylinder head</b>				
Cylinder head gasket contact surfaces distortion	(mm {in})	Maximum		0.10 {0.004}
Manifold contact surfaces distortion	(mm {in})	Maximum		0.10 {0.004}
		Maximum grinding		0.15 {0.006}
Valve clearance [Engine cold]	(mm {in})	IN		0.22—0.28 {0.0087—0.0110}
		EX		0.27—0.33 {0.0106—0.0130}
<b>Valve and valve guide</b>				
Valve stem diameter	(mm {in})	Standard	IN	5.470—5.485 {0.2154—0.2159}
			EX	5.465—5.480 {0.2152—0.2157}
		Minimum	IN	5.440 {0.2142}
			EX	5.435 {0.2140}
Valve stem to guide clearance	(mm {in})	Standard	IN	0.024—0.069 {0.0009—0.0027}
			EX	0.029—0.074 {0.0012—0.0029}
		Maximum	IN	0.10 {0.004}
			EX	0.10 {0.004}
Valve length	(mm {in})	Standard	IN	102.99—103.79 {4.055—4.086}
			EX	104.25—105.05 {4.105—4.135}
		Minimum	IN	102.99 {4.055}
			EX	103.79 {4.086}
Valve guide inner diameter	(mm {in})	Standard	IN	5.509—5.539 {0.2169—0.2180}
			EX	5.509—5.539 {0.2169—0.2180}
Valve guide protrusion height	(mm {in})	IN		12.2—12.8 {0.481—0.503}
		EX		12.2—12.8 {0.481—0.503}
Valve head margin thickness	(mm {in})	Minimum	IN	1.62 {0.0637}
			EX	1.82 {0.0716}
<b>Valve seat</b>				
Valve seat contact width	(mm {in})	Standard	IN	1.2—1.6 {0.048—0.062}
			EX	1.2—1.6 {0.048—0.062}
Valve seat angle		(°)	IN	45
			EX	45
Valve seat sinking (Valve protrusion height)	(mm {in})	Standard	IN	40.64—42.24 {1.600—1.662}
			EX	40.50—42.10 {1.595—1.657}
<b>Valve spring</b>				
Out-of-square	(mm {in})	Maximum		1% (2.10 {0.082})
Pressing force at valve spring height H	(N {kgf, lbf})	H: 27.8 mm {1.094 in}		494.9 {50.47,111.2}
<b>OCV (Oil control valve)</b>				
Coil resistance [20° C {68°F}]	(ohm)	Standard	—	6.9—7.9 *

## TECHNICAL DATA

Item	Engine				
	L8	LF	L3, L3 (with variable valve timing mechanism)		
<b>Camshaft</b>					
Camshaft runout (mm {in})	Maximum	0.03 {0.0012}			
Cam lobe height (mm {in})	Standard	IN	40.79 {1.606}	42.12 {1.659}	42.12 {1.659}
		EX	41.08 {1.618}	41.08 {1.618}	42.44 {1.671} <sup>*</sup>
	Minimum	IN			41.08 {1.618}
					41.18 {1.622} <sup>*</sup>
		EX			42.022 {1.655}
					42.342 {1.667} <sup>*</sup>
			40.982 {1.614}	40.982 {1.614}	41.082 {1.618} <sup>*</sup>
Journal diameter (mm {in})	Standard	24.96—24.98 {0.9827—0.9834}			
	Minimum	24.95 {0.982}			
Journal oil clearance (mm {in})	Standard	0.04—0.08 {0.002—0.003}			
	Maximum	0.09 {0.0035}			
End play (mm {in})	Standard	0.09—0.24 {0.0035—0.0094}			
	Maximum	0.25 {0.009}			
<b>Tappet</b>					
Tappet bore diameter (mm {in})	Standard	31.000—31.030 {1.2205—1.2216}			
Tappet diameter (mm {in})	Standard	30.970—30.980 {1.2193—1.2196}			
Tappet-to-Tappet bore oil clearance (mm {in})	Standard	0.02—0.06 {0.0008—0.0023}			
	Maximum	0.15 {0.006}			
<b>Cylinder block</b>					
Cylinder head gasket contact surfaces distortion (mm {in})	Maximum	0.10 {0.004}			
Cylinder bore diameter [Measure the cylinder bore at 42 mm {1.65 in} below the top surface] (mm {in})	Standard	83.000—83.030 {3.2677—3.2689}	87.500—87.530 {3.4449—3.4460}		
Minimum / maximum bore diameter Limit (mm {in})		82.940—83.090 {3.2653—3.2712}	87.440—87.590 {3.4425—3.4484}		
<b>Piston</b>					
Piston diameter (mm {in})	Standard	82.965—82.995 {3.2664—3.2675}	87.465—87.495 {3.4435—3.4446}		
Piston-to-cylinder clearance (mm {in})	Standard	0.025—0.045 {0.0010—0.0017}			
	Maximum	0.11 {0.0043}			
<b>Piston ring</b>					
Piston ring-to-ring groove clearance (mm {in})	Standard	Top	0.03—0.08 {0.0012—0.0031}		
		Second	0.03—0.07 {0.0012—0.0027}		
		Oil (rail)	0.03—0.07 {0.0012—0.0027}		
	Maximum	Top	0.17 {0.0067}		
		Second	0.15 {0.0059}		
		Oil (rail)	0.15 {0.0059}		
End gap (measured in cylinder) (mm {in})	Standard	Top	0.16—0.31 {0.0063—0.0122}		
		Second	0.33—0.48 {0.0130—0.0189}		
		Oil (rail)	0.20—0.70 {0.0079—0.0275}		
	Maximum	Top	1.0 {0.0393}		
		Second	1.0 {0.0393}		
		Oil (rail)	1.0 {0.0393}		

TD

## TECHNICAL DATA

Item	Engine		
	L8	LF	L3, L3 (with variable valve timing mechanism)
<b>Connecting rod and connecting rod bearing</b>			
Connecting rod side clearance (mm {in})	Standard	0.14—0.36 {0.0056—0.0141}	
	Maximum	0.435 {0.0172}	
Connecting rod bearing size (mm {in})	Standard	1.496—1.502 {0.0589—0.0591}	
	0.25 {0.01} Oversize	1.623—1.629 {0.0639—0.0641}	
	0.50 {0.02} Oversize	1.748—1.754 {0.0688—0.0690}	
Connecting rod bearing oil clearance (mm {in})	Standard	0.026—0.052{0.0011—0.0020}	
	Maximum	0.10{0.0039}	
<b>Crankshaft</b>			
Crankshaft runout (mm {in})	Maximum	0.05 {0.0019}	
Main journal diameter (mm {in})	Standard	51.980—52.000 {2.0464—2.0472}	
	0.25 {0.01} undersize	51.730—51.750 {2.0366—2.0373}	
Main journal oil clearance (mm {in})	Standard	0.019—0.035{0.0007—0.0013}	
	Maximum	0.10 {0.0039}	
Main journal out of round (mm {in})	Maximum	0.05 {0.0019}	
Main bearing size (mm {in})	Standard	2.506—2.509 {0.0987—0.0988}	
	0.25 {0.01} Oversize	2.628—2.634 {0.1034—0.1037}	
	0.50 {0.02} Oversize	2.753—2.759 {0.1084—0.1086}	
Crank pin journal diameter (mm {in})	Standard	49.980—50.000 {1.9677—1.9685}	
	0.25 {0.01} undersize	49.730—49.750 {1.9579—1.9586}	
Crank pin out of round (mm {in})	Maximum	0.05 {0.022}	
Crankshaft end play (mm {in})	Standard	0.22—0.45{0.0087—0.0177}	
	Maximum	0.55 {0.0216}	
<b>Front oil seal</b>			
Pushing distance of the front oil seal [from the edge of the engine front cover] (mm {in})		0—0.5 {0—0.019}	
<b>Bolt</b>			
Cylinder head bolt length	Standard	149.0—150.0 {5.86—5.90}	
	Maximum	150.5 {5.92}	
Connecting rod bolt length	Standard	44.7—45.3 {1.75—1.78}	
	Maximum	46.0 {1.81}	
Main bearing cap bolt length	Standard	110.0—110.6 {4.33—4.35}	
	Maximum	111.3 {4.38}	
<b>Balance shaft</b>			
Gear backlash (mm {in})	Maximum	—	0.005-0.101 {0.00019—0.0039}

\*: With variable valve timing mechanism

# SPECIAL TOOLS

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

ST

# SPECIAL TOOLS

## SPECIAL TOOLS

### ENGINE SST

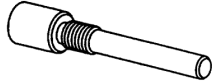
A6E941001001E01

Ford SST numbers are collated with Mazda SST numbers in the example below.  
Ford SSTs are marked with Ford SST number.

#### Example

1:49 JE01 061  
2:303-507

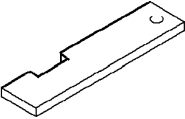
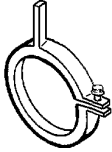
Peg



1: Mazda SST number  
2: Ford SST number

<p>1:49 JE01 061 2:303-507</p> <p>Peg</p>	<p>1:49 UN20 5072 2:205-072</p> <p>Holder</p>	<p>1:49 UN20 507202 2:205-072-02</p> <p>Adapter</p>
<p>1:49 G032 354 2: -</p> <p>Adjusting wrench</p>	<p>1:49 E011 1A0 2: -</p> <p>Ring gear brake set</p>	<p>1:49 0636 100B 2: -</p> <p>Valve spring lifter arm</p>
<p>1:49 B012 0A2 2: -</p> <p>Pivot</p>	<p>1:49 B012 015 2: -</p> <p>Valve guide installer</p>	<p>1:49 H010 401 2: -</p> <p>Oil seal installer</p>
<p>1:49 0107 680A 2: -</p> <p>Engine stand</p>	<p>1:49 L010 1A0 2: -</p> <p>Engine hanger set</p>	<p>1:49 S120 170 2: -</p> <p>Valve seal remover</p>
<p>1:49 L012 0A0B 2: -</p> <p>Valve seal and valve guide installer set</p>	<p>1:49 T032 302 2: -</p> <p>Bearing installer</p>	<p>1:49 D032 316 2: -</p> <p>Protractor</p>

## SPECIAL TOOLS

<p>1:49 JE01 054 (Europe) 49 UN30 3376 (Except Europe) 2: 303-376</p> <p>Plate</p> 	<p>1:49 G011 201 2: -</p> <p>Attachment</p> 	<p>-</p>
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ST