

# Engine Workshop Manual LF L3

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PRINTED IN U.S.A., AUGUST 2005  
Form No. 1866-1U-05H  
Part No. 9999-95-LFL3-05

## FOREWORD

This manual explains the service points for the above-indicated automotive system. This manual covers all models with the above-indicated automotive system, not any one specific model.

In order to do these procedures safely, quickly, and correctly, you must first read this manual and any other relevant service materials carefully.

All the contents of this manual, including drawings and specifications, are the latest available at the time of printing. As modifications affecting repair or maintenance occur, relevant information supplementary to this volume will be made available at Mazda dealers. This manual should be kept up-to-date.

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



# GENERAL INFORMATION

**00**  
SECTION

00-00

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**GENERAL INFORMATION . . . . 00-00**

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## **00-00 GENERAL INFORMATION**

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# GENERAL INFORMATION

## HOW TO USE THIS MANUAL

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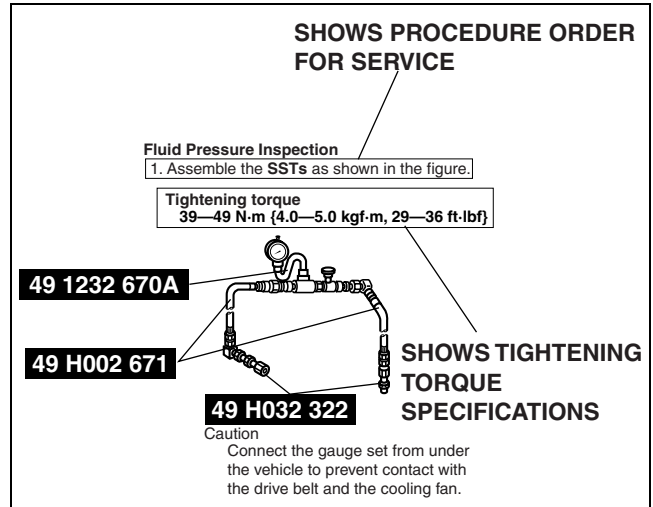
### Range of Topics

- 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

#### 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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# GENERAL INFORMATION

## 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.

**Procedure**

**"Removal/Installation" Portion**

**"Inspection After Installation" Portion**

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

SHOWS THERE ARE REFERRAL NOTES FOR SERVICE

**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 NON-REUSEABLE PARTS**

**SHOWS DETAILS**

**SHOWS TIGHTENING TORQUE UNITS**

**SHOWS TIGHTENING TORQUE SPECIFICATIONS**

**SHOWS PROCEDURE ORDER FOR SERVICE**

**SHOWS TIGHTENING TORQUE SPECIFICATIONS**

**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 01-10-4 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.

1	Split pin
2	Nut
3	Lower trailing link ball joint (See 02-14-5 Lower Trailing Link Ball Joint Removal Note)
4	Bolt
5	Lower trailing link
6	Dust boot (lower trailing link)

7	Split pin
8	Nut
9	Upper trailing link ball joint (See 02-14-5 Upper Trailing Link Ball Joint Removal Note)
10	Nut
11	Upper 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









N-m (kgf-m, ft-lbf)

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## GENERAL INFORMATION

### Symbols

- There are eight symbols indicating oil, grease, fluids, sealant, and the use of **SST** or equivalent. 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
	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

- You will 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.

# GENERAL INFORMATION

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## UNITS

Electric 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)
Number of revolutions	rpm (revolutions per minute)
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)
Weight	fl oz (fluid ounce)
	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.

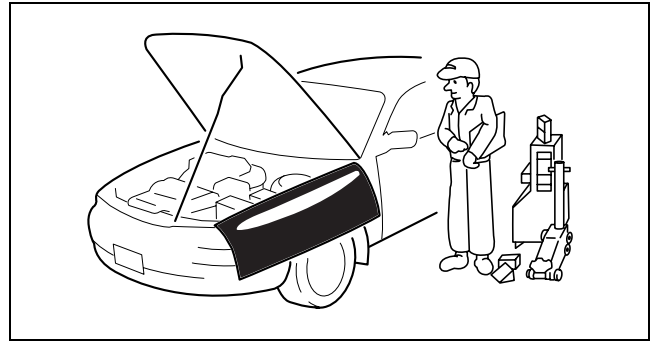
# GENERAL INFORMATION

## FUNDAMENTAL PROCEDURES

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### Preparation of Tools and Measuring Equipment

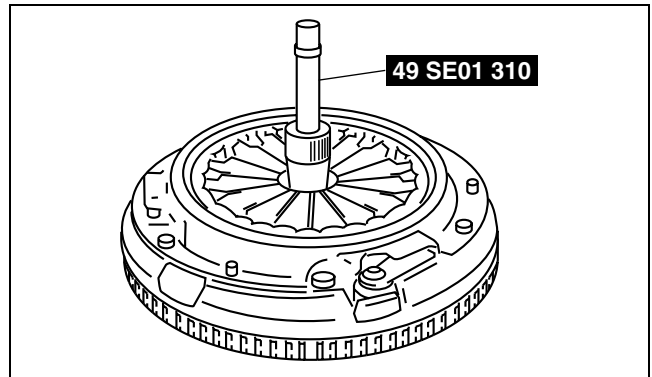
- Be sure that all necessary tools and measuring equipment are available before starting any work.



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### Special Service Tools

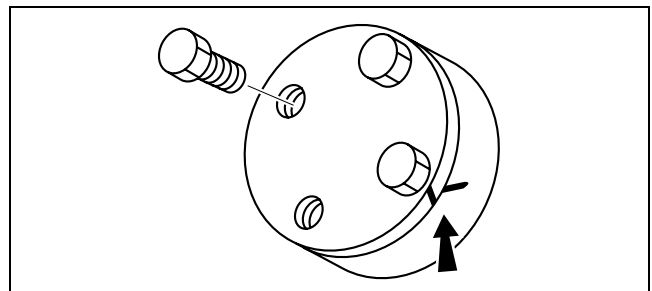
- Use special service tools or equivalent when they are required.



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### Disassembly

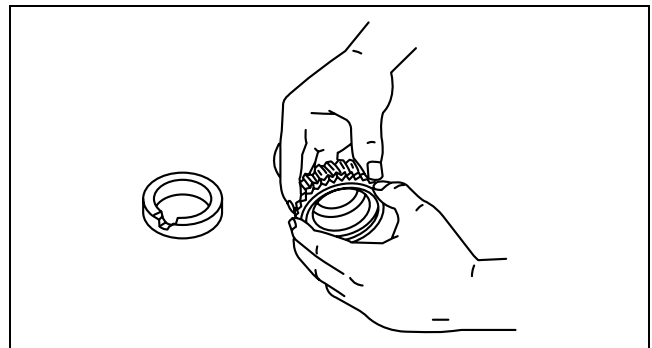
- If the disassembly procedure is complex, requiring many parts to be disassembled, all parts should be marked in a place that will not affect their performance or external appearance and identified so that reassembly can be performed easily and efficiently.



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### Inspection During Removal, Disassembly

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



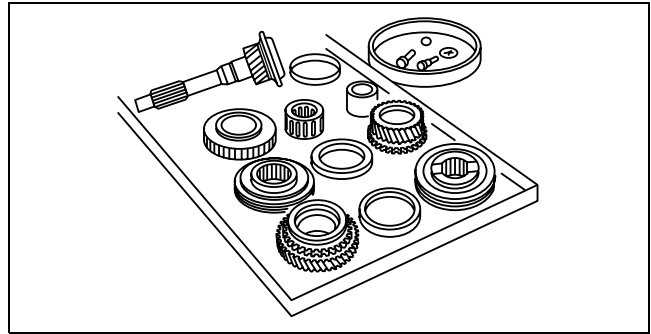
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# GENERAL INFORMATION

## 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.



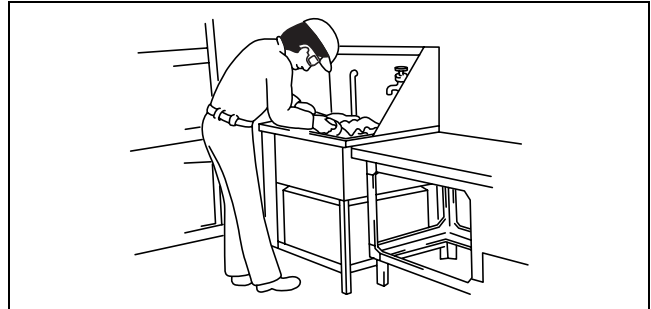
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## Cleaning of Parts

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

### Warning

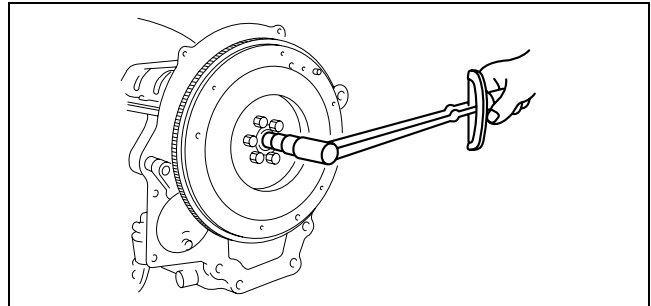
- **Using compressed air can cause dirt and other particles to fly out causing injury to the eyes. Wear protective eye wear whenever using compressed air.**



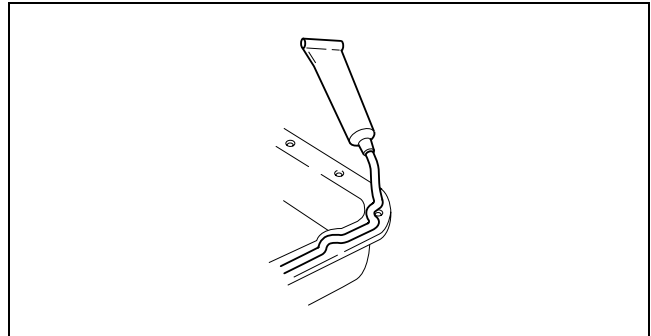
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## Reassembly

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



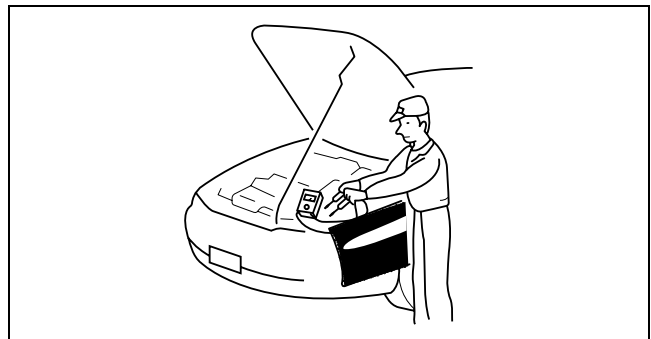
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## Adjustment

- Use suitable gauges and testers when making adjustments.



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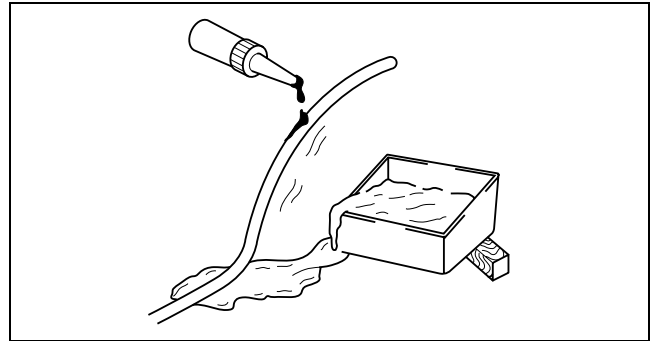
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## GENERAL INFORMATION

### Rubber Parts and Tubing

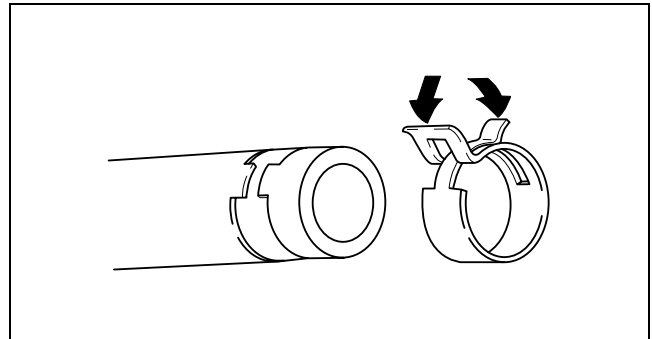
- Prevent gasoline or oil from getting on rubber parts or tubing.



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### Hose Clamps

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

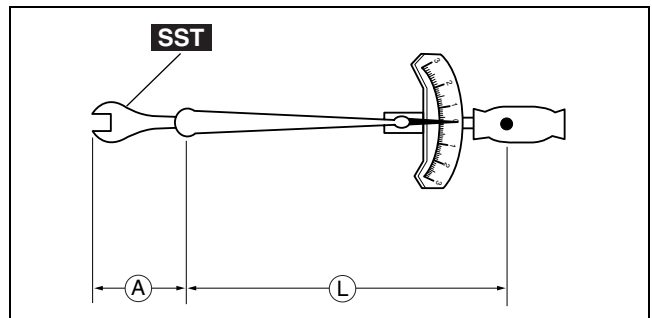


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### Torque Formulas

- 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 by 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	$in \cdot lbf \times [L / (L + A)]$



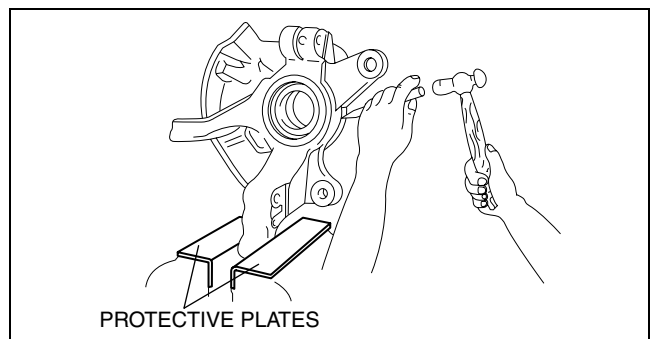
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A : The length of the **SST** past the torque wrench drive.

L : The length of the torque wrench.

### Vise

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



PROTECTIVE PLATES

CHU0014W010

# GENERAL INFORMATION

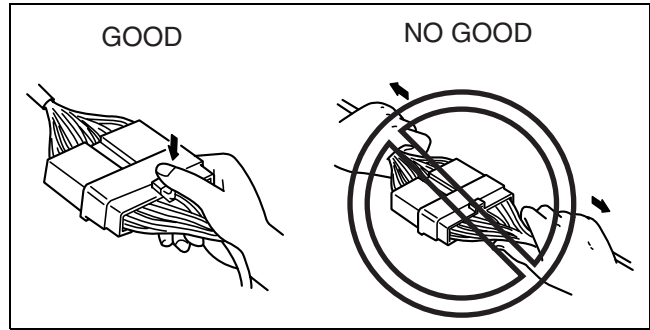
## ELECTRICAL SYSTEM

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### Connectors

#### Disconnecting connectors

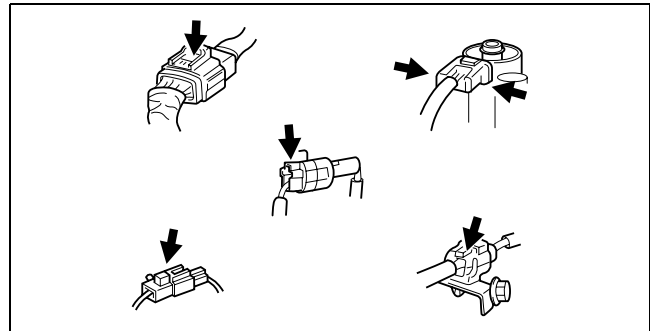
- When disconnecting connector, grasp the connectors, not the wires.



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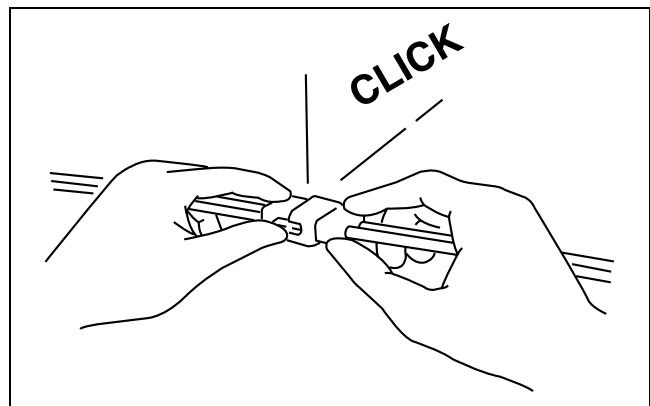
- Connectors can be disconnected by pressing or pulling the lock lever as shown.



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#### Locking connector

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

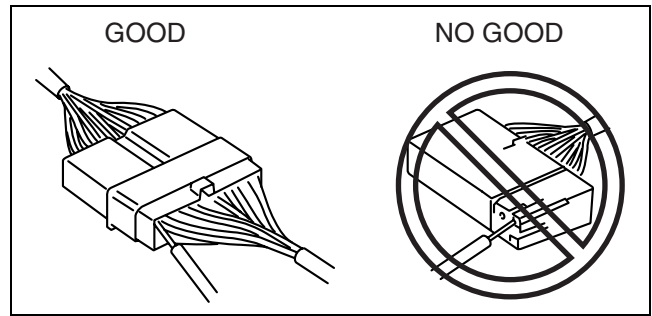


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## GENERAL INFORMATION

### Inspection

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

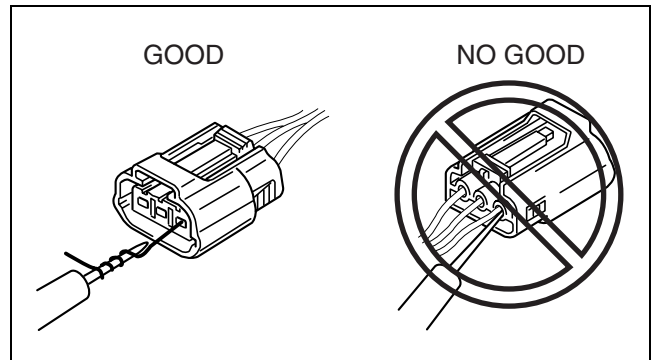


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- Inspect the terminals of waterproof connectors from the connector side since they cannot be accessed from the wiring harness side.

### Caution

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



CHU0000W012

## GENERAL INFORMATION

### NEW STANDARDS

E5U000000000E05

- 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/Self-Diagnosis	
OL	Open Loop	—	Open Loop	
—	Output Speed Sensor	—	Vehicle Speed Sensor 1	
OC	Oxidation Catalytic Converter	—	Catalytic Converter	
O2S	Oxygen Sensor	—	Oxygen Sensor	

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## GENERAL INFORMATION

New Standard		Previous Standard		Remark
Abbreviation	Name	Abbreviation	Name	
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	—	12 Shift Solenoid Valve	
—		—	Shift A Solenoid Valve	
—	Shift Solenoid B	—	23 Shift Solenoid Valve	
—		—	Shift B Solenoid Valve	
—	Shift Solenoid C	—	34 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	—	EC-AT 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

E5U000000000E06

ATDC	After Top Dead Center
ATX	Automatic Transaxle
EGR	Exhaust Gas Recirculation
EX	Exhaust
IN	Intake
MTX	Manual Transaxle
OCV	Oil Control Valve
TDC	Top Dead Center
SST	Special Service Tool

# ENGINE

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01-10

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### CYLINDER BLOCK

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**OIL JET VALVE INSPECTION** . . . . . 01-10-18

**PISTON INSPECTION** . . . . . 01-10-18

**CRANKSHAFT INSPECTION** . . . . . 01-10-19

**CONNECTING ROD INSPECTION** . . . . . 01-10-20

**BOLT INSPECTION** . . . . . 01-10-21

### VARIABLE VALVE TIMING ACTUATOR

**INSPECTION [With variable valve**

**timing mechanism]** . . . . . 01-10-21

### OIL CONTROL VALVE (OCV)

**INSPECTION [With variable valve**

**timing mechanism]** . . . . . 01-10-21

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Spool Valve Operation Inspection . . . . . 01-10-22

### VALVE CLEARANCE

**INSPECTION** . . . . . 01-10-22

### VALVE CLEARANCE

**ADJUSTMENT** . . . . . 01-10-23

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Piston Ring Assembly Note . . . . . 01-10-28

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## MECHANICAL

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Crankshaft Pulley Lock Bolt  
Assembly Note . . . . . **01-10-41**  
Cylinder Head Cover  
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### ENGINE OVERHAUL SERVICE WARNING

E5U011002000E01

#### Warning

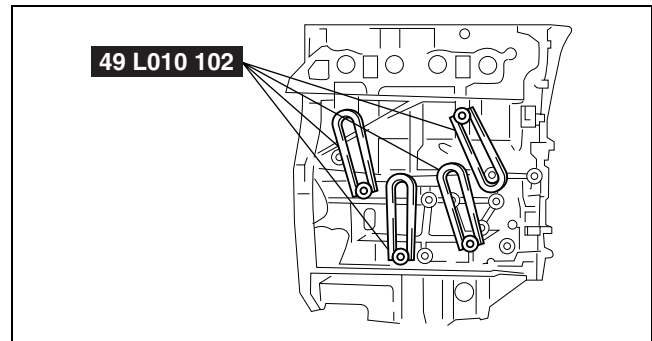
- **Continuous exposure with USED engine oil has caused skin cancer in laboratory mice. Protect your skin by washing with soap and water immediately after this work.**



## ENGINE MOUNTING/DISMOUNTING

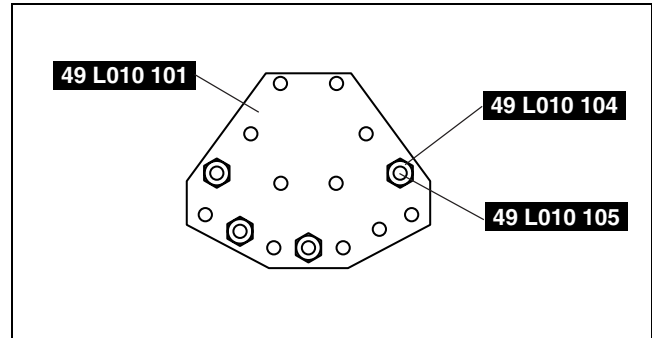
1. Install the **SSTs** (arms) to the cylinder block holes as shown, and hand-tighten the bolts (**part No.: 9YA20-1003**) or **M10 × 1.5T length 90 mm {3.55 in}**.

E5U011002000E02



B3E0110W127

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).

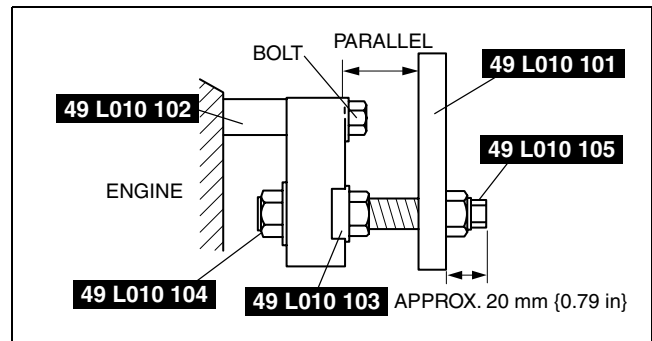


C3U0110E001

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.**



E5U1102W8S01

6. Mount the engine on the **SST** (engine stand).
7. Drain the engine oil into a container.
8. Install the oil pan drain plug.
  - With washer
    1. Install the oil pan drain plug with a new washer.

### Tightening torque

**30—41 N·m {3.1—4.1 kgf·m, 23—30 ft·lbf}**

- Without washer
  1. Inspect the seal rubber of the oil pan drain plug and make sure there are no cracks or damage.
    - If necessary, replace the oil pan drain plug.
  2. Clean the flange surface (seal rubber) on the oil pan drain plug, then install the oil pan drain plug.

### Tightening torque

**22—30 N·m {2.2—3.1 kgf·m, 16—22 ft·lbf}**

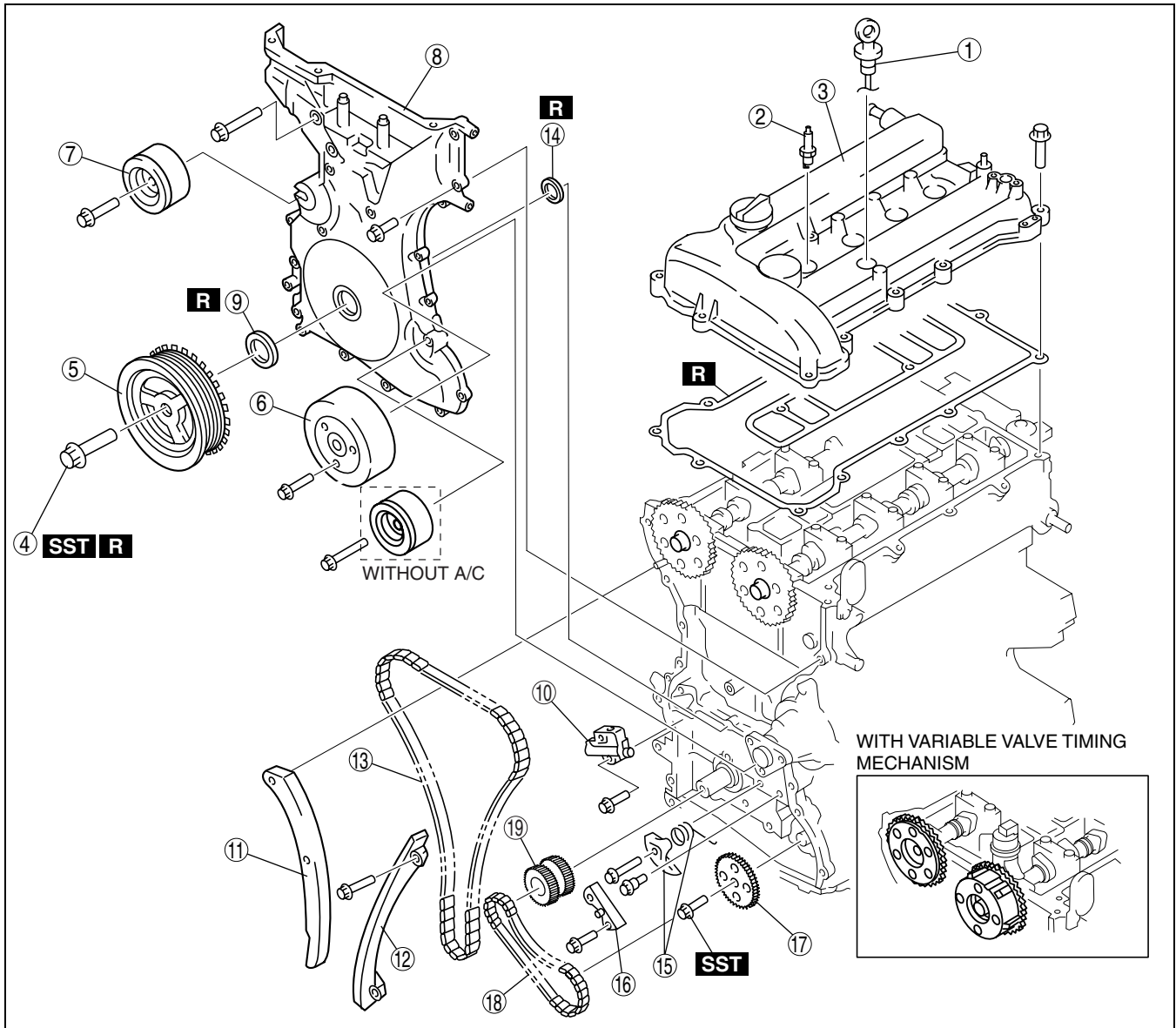
## DISMOUNTING

- Dismount in the reverse order of mounting.

## TIMING CHAIN DISASSEMBLY

E5U011002000E03

1. Disassemble in the order indicated in the table.



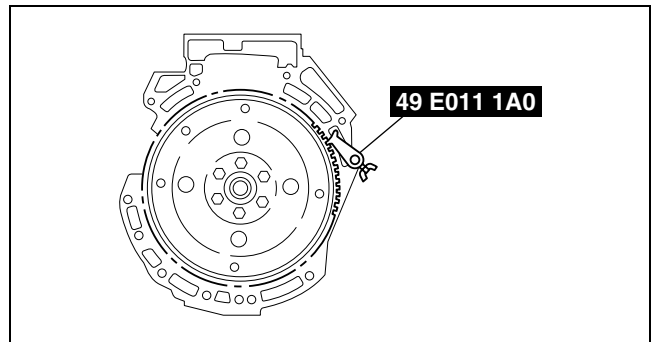
E5U110ZE7S01

1	Oil level gauge (if equipped)
2	Spark plug
3	Cylinder head cover
4	Crankshaft pulley lock bolt (See 01-10-5 Crankshaft Pulley Lock Bolt Disassembly Note.)
5	Crankshaft pulley
6	Water pump pulley
7	Drive belt idler pulley (Without stretch-type A/C drive belt)
8	Engine front cover
9	Front oil seal (See 01-10-5 Front Oil Seal Disassembly Note.)

10	Chain tensioner (See 01-10-5 Chain Tensioner Disassembly Note.)
11	Tensioner arm
12	Chain guide
13	Timing chain
14	Seal (With variable valve timing mechanism)
15	Oil pump chain tensioner
16	Oil pump chain guide
17	Oil pump sprocket (See 01-10-5 Oil Pump Sprocket Disassembly Note.)
18	Oil pump chain
19	Crankshaft sprocket

### Crankshaft Pulley Lock Bolt Disassembly Note

1. Install the **SST** to the ring gear to lock the crankshaft against rotation.

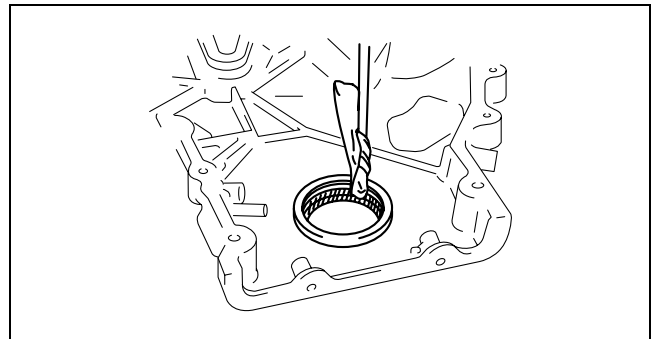


D3U110ZE4003

01-10

### Front Oil Seal Disassembly Note

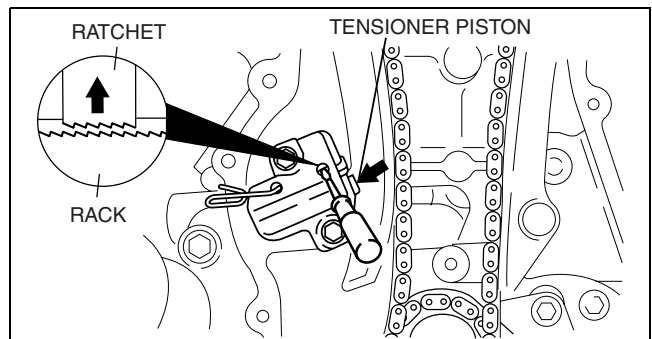
1. Remove the oil seal using a screwdriver.



E6U110ZWB044

### Chain Tensioner Disassembly Note

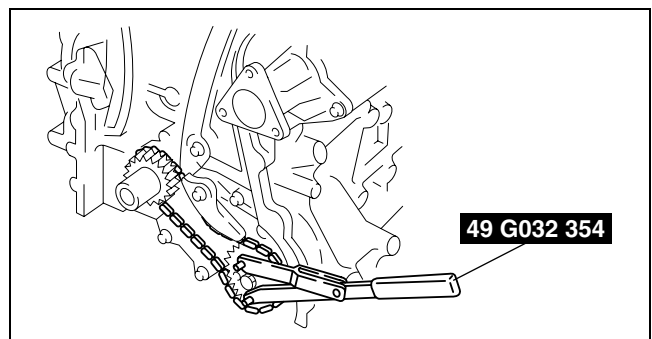
1. Unlock the chain tensioner ratchet using a suitable screw driver or equivalent tool.
2. Slowly press the tensioner piston.
3. Hold the chain tensioner piston with a **1.5 mm {0.06 in}** wire or paper clip.



C3U0110W098

### Oil Pump Sprocket Disassembly Note

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

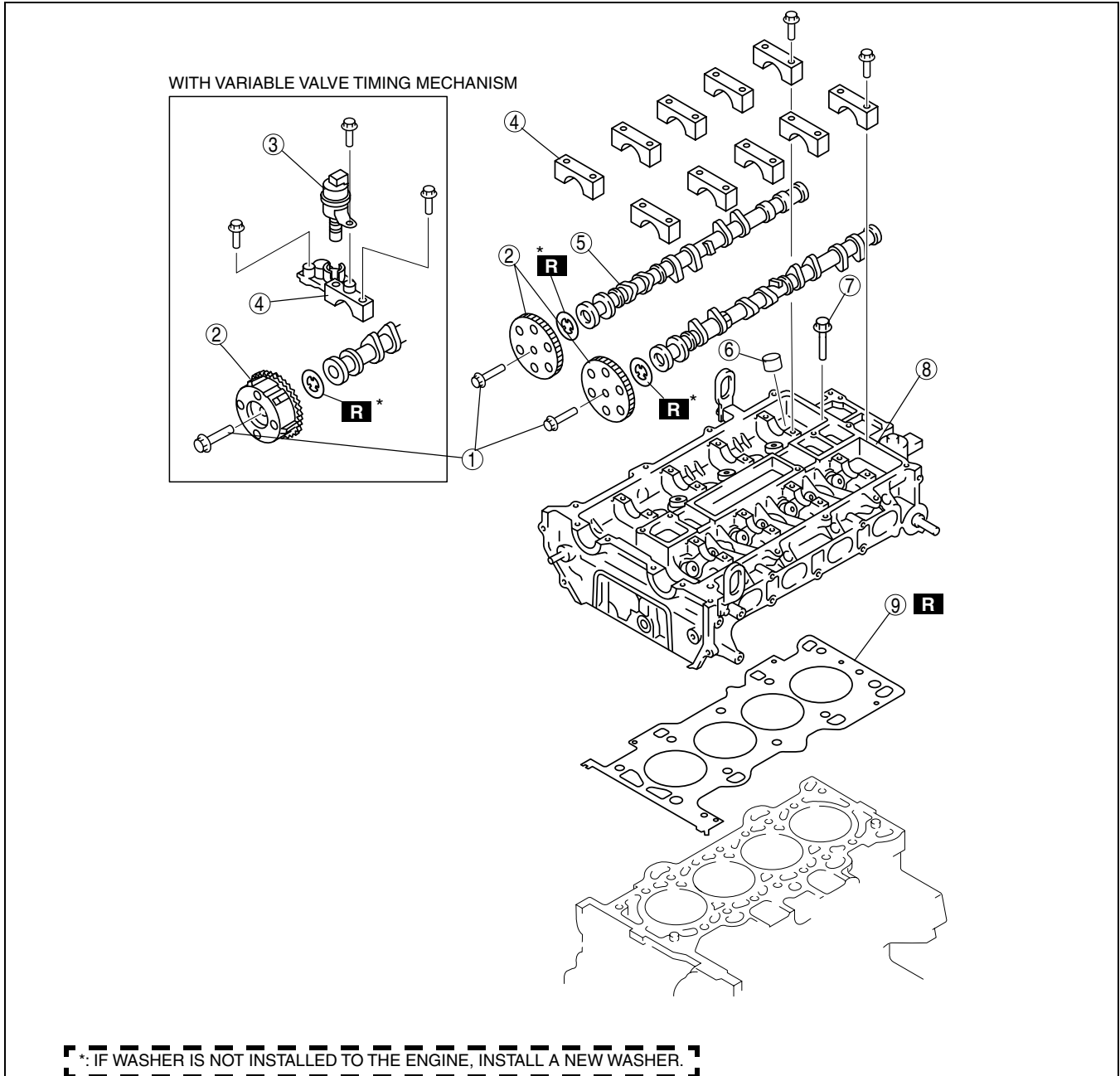


B3E0110E054

**CYLINDER HEAD (I) DISASSEMBLY**

E5U011002000E04

1. Disassemble in the order indicated in the table.



E5U110ZECL01

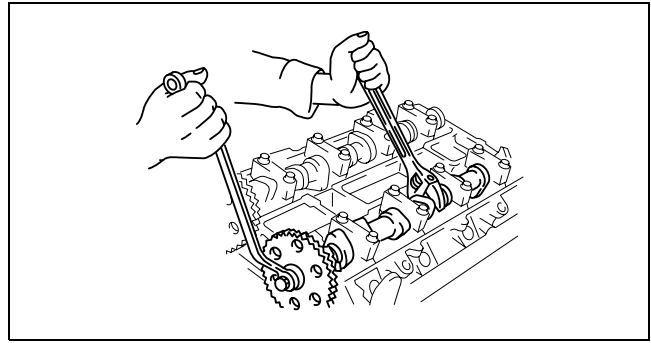
1	Camshaft sprocket lock bolt, variable valve timing actuator lock bolt (With variable valve timing mechanism) (See 01-10-7 Camshaft Sprocket Lock Bolt, Variable Valve Timing Actuator Lock Bolt Disassembly Note .)
2	Camshaft sprocket, variable valve timing actuator (With variable valve timing mechanism)
3	Oil control valve (OCV) (with variable valve timing mechanism)

4	Camshaft cap (See 01-10-7 Camshaft Cap Disassembly Note.)
5	Camshaft
6	Tappet (See 01-10-7 Tappet Disassembly Note.)
7	Cylinder head bolt (See 01-10-8 Cylinder Head Bolt Disassembly Note.)
8	Cylinder head
9	Cylinder head gasket

# MECHANICAL

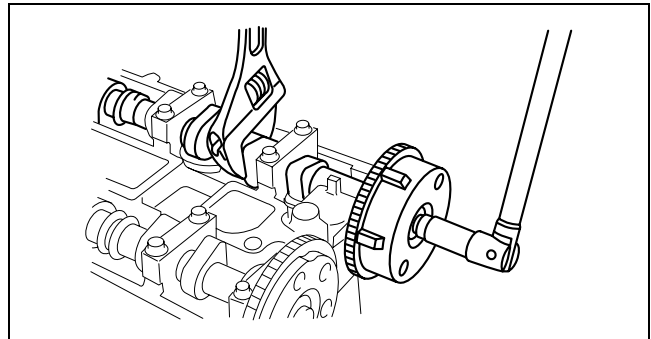
## Camshaft Sprocket Lock Bolt, Variable Valve Timing Actuator Lock Bolt Disassembly Note

1. Hold the camshaft by using a wrench on the cast hexagon as shown, and loosen the camshaft sprocket installation bolt or variable valve timing actuator installation bolt (With variable valve timing mechanism).  
**Without variable valve timing mechanism**



B3E0110E056

## With variable valve timing mechanism



B3E0110E058

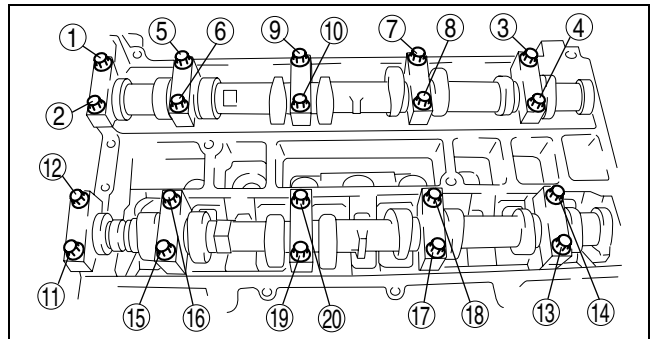
## Camshaft Cap Disassembly Note

1. Before removing the camshaft caps, inspect the following:
  - Camshaft end play and camshaft journal oil clearance (See 01-10-15 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 2—3 steps in the order shown in the figure.



B3E0110E057

## Tappet Disassembly Note

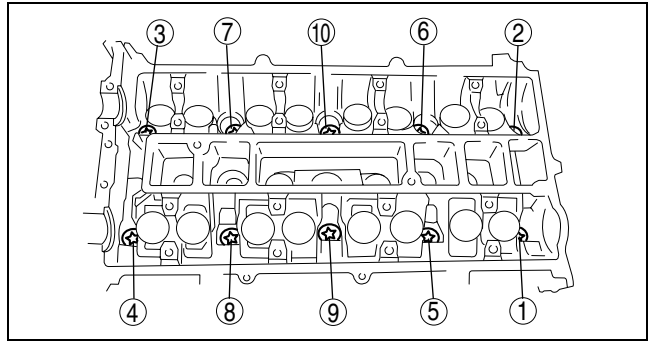
### Note

- 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.

# MECHANICAL

## Cylinder Head Bolt Disassembly Note

- Loosen the cylinder head bolts in 2—3 steps in the order shown in the figure.

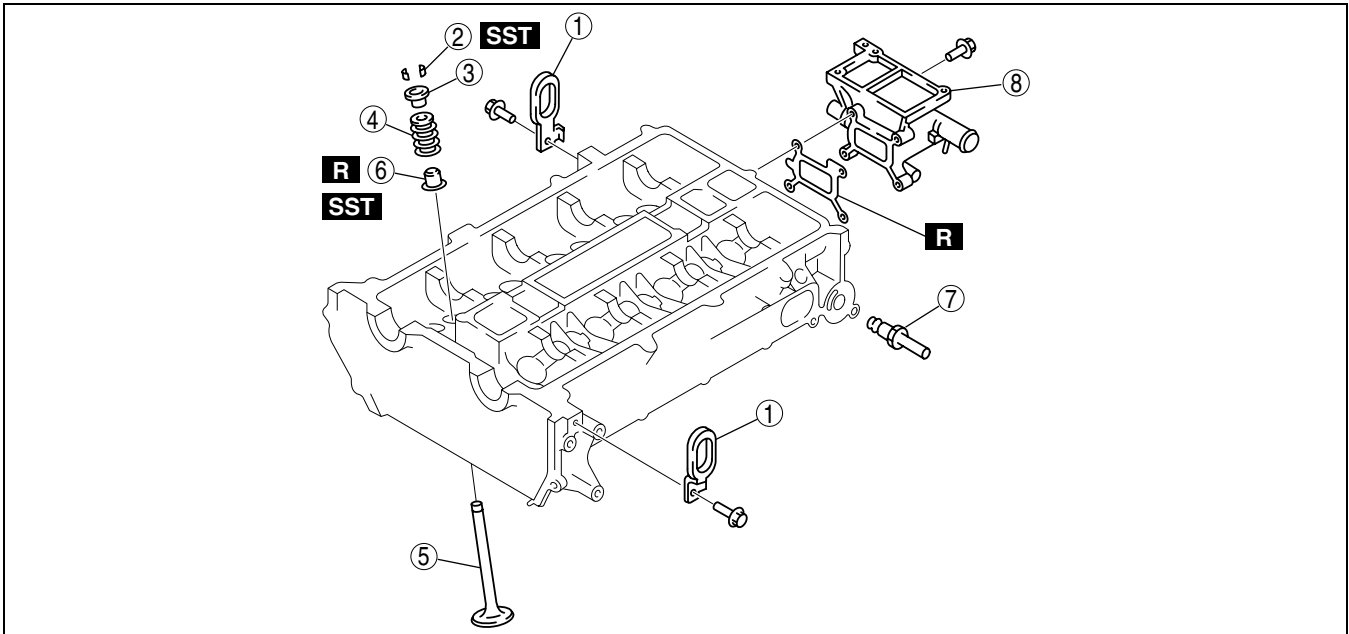


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## CYLINDER HEAD (II) DISASSEMBLY

- Disassemble in the order indicated in the table.

E5U011002000E05



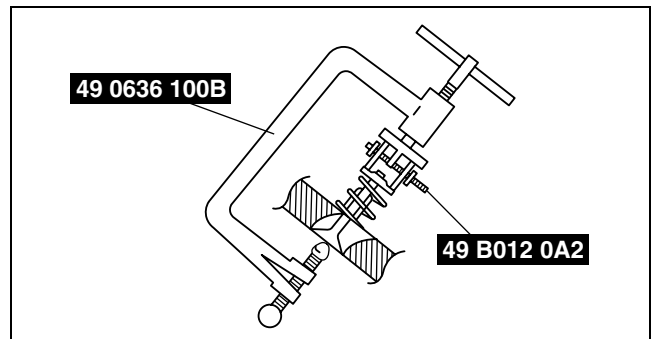
B3E0110E060

1	Engine hanger
2	Valve keeper (See 01-10-8 Valve Keeper Disassembly Note.)
3	Upper valve spring seat
4	Valve spring

5	Valve
6	Valve seal (See 01-10-9 Valve Seal Disassembly Note.)
7	EGR pipe
8	Water outlet

## Valve Keeper Disassembly Note

- Remove the valve keeper using the SSTs.

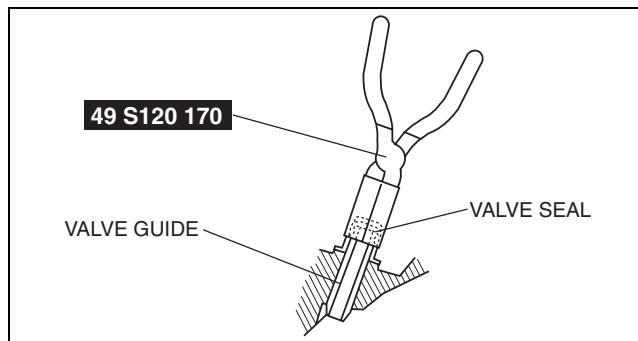


B3E0110E124

# MECHANICAL

## Valve Seal Disassembly Note

1. Remove the valve seal using the SST.



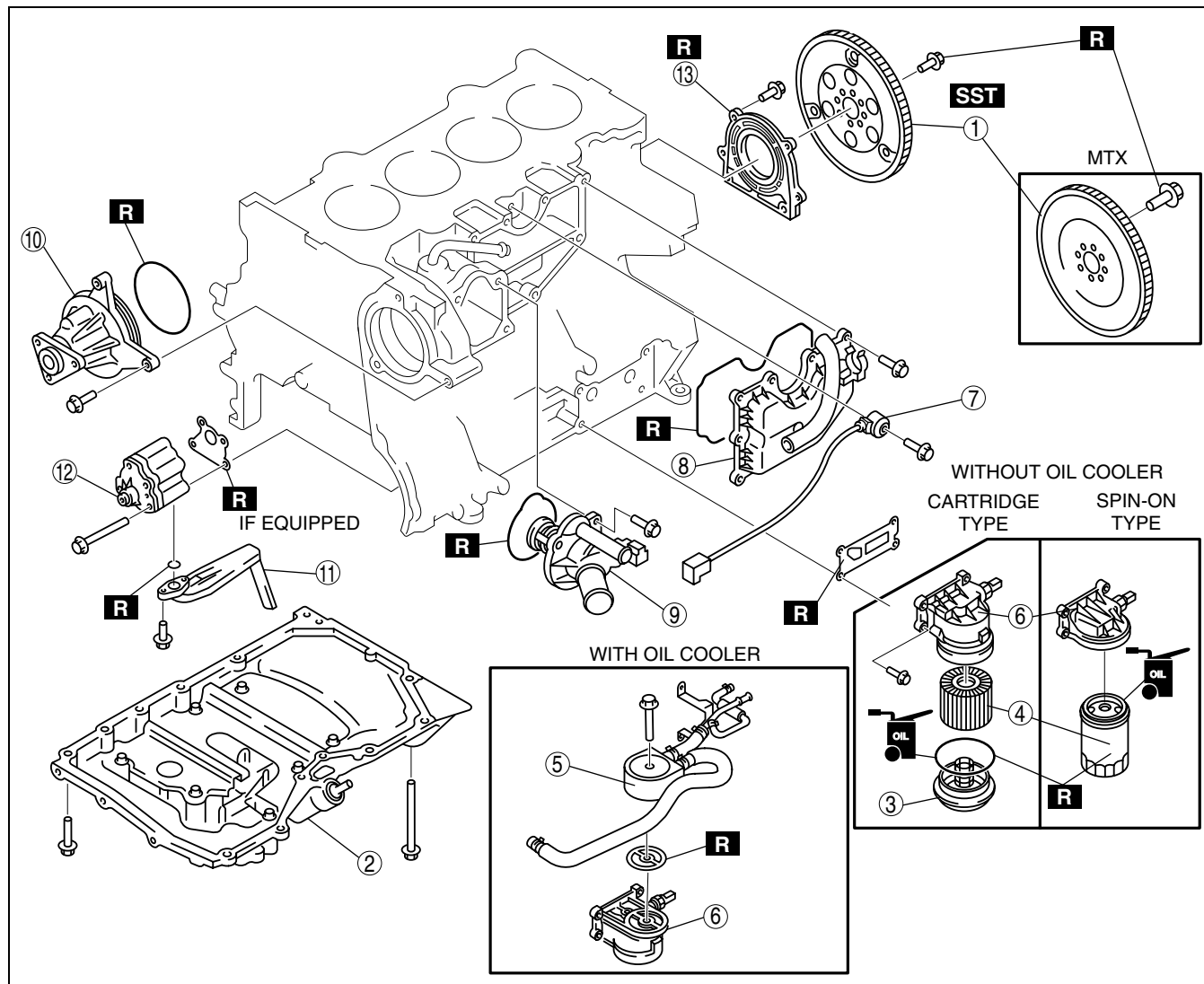
B3E0110E061

01-10

## CYLINDER BLOCK (I) DISASSEMBLY

E5U011002000E06

1. Disassemble in the order indicated in the table.



E5U110ZE7S10

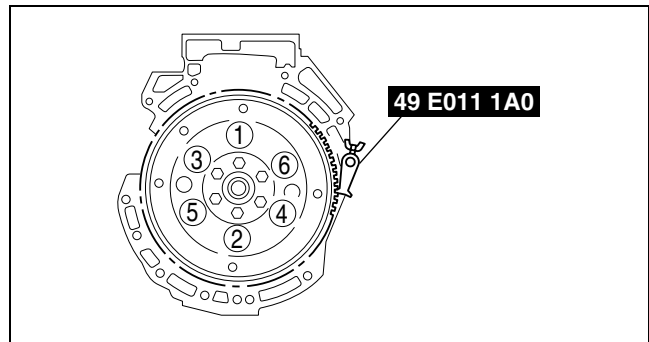
1	Flywheel (MTX), Drive plate (ATX) (See 01-10-10 Drive Plate (ATX), Flywheel (MTX) Disassembly Note)
2	Oil pan
3	Oil filter cover (cartridge type)
4	Oil filter
5	Oil cooler
6	Oil filter adapter

7	Knock sensor
8	Oil separator
9	Thermostat
10	Water pump
11	Oil strainer
12	Oil pump
13	Rear oil seal

# MECHANICAL

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

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

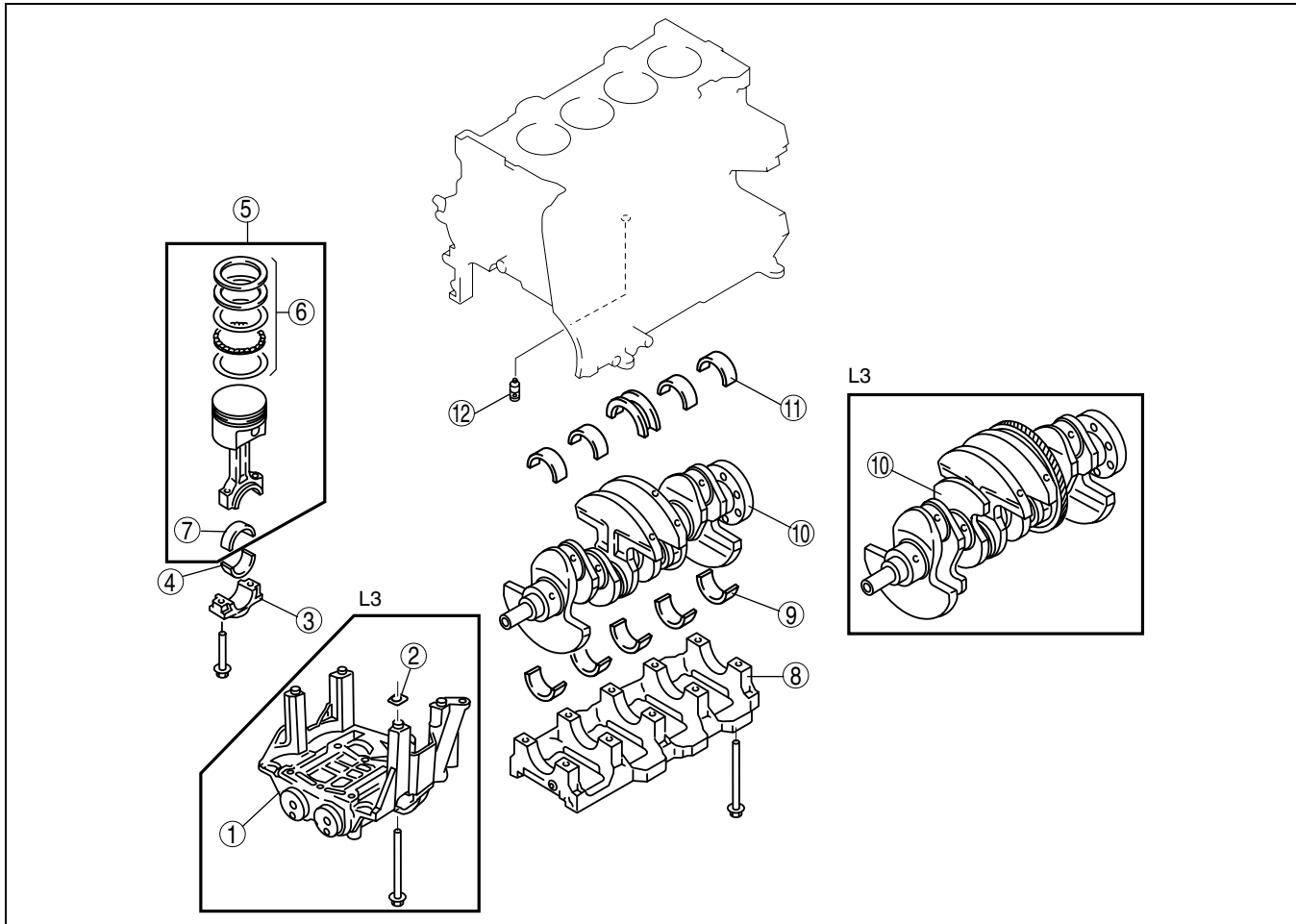


B3E0110E051

## CYLINDER BLOCK (II) DISASSEMBLY

E5U011002000E07

1. Disassemble in the order indicated in the table.



E5U110ZE7S07

1	Balancer unit
2	Adjustment shim
3	Connecting rod cap (See 01-10-11 Connecting Rod Cap Disassembly Note.)
4	Lower connecting rod bearing
5	Connecting rod, Piston component
6	Piston ring

7	Upper connecting rod bearing
8	Main bearing cap (See 01-10-11 Main Bearing Cap Disassembly Note.)
9	Lower main bearing, thrust bearing
10	Crankshaft
11	Upper main bearing, thrust bearing
12	Oil jet valve



## Connecting Rod Cap Disassembly Note

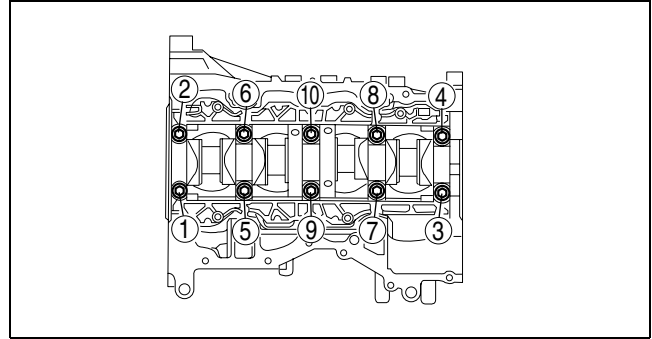
1. Before removing connecting rod inspect the connecting rod side clearance. (See 01-10-20 CONNECTING ROD INSPECTION.)
2. Remove the connecting rod bolt from the connecting rod cap by tapping the bolt with a plastic hammer.

### 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. Before removing main bearing cap inspect the crankshaft end play. (See 01-10-19 CRANKSHAFT INSPECTION.)
2. Loosen the main bearing cap bolts in two or three steps in the order shown in the figure.



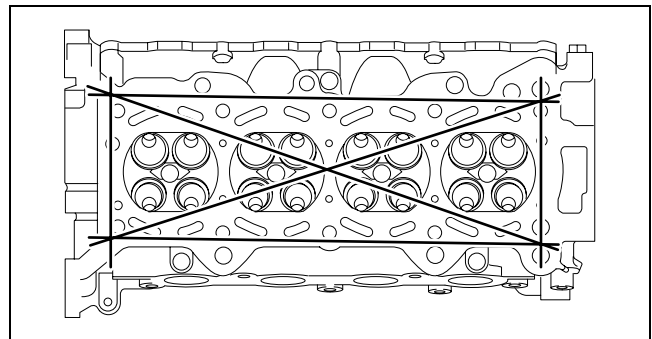
B3E0110E067

## CYLINDER HEAD INSPECTION

1. Perform 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 six directions as shown in the figure.
  - If it exceeds the maximum specification, replace the cylinder head.

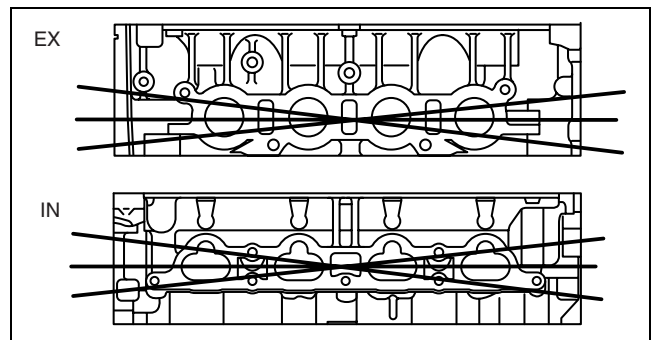
E5U011010100E01

**Cylinder head gasket contact surface distortion (Maximum)**  
**0.10 mm {0.004 in}**



B3E0110E008

4. Measure the manifold contact surface distortion as shown in the figure.



C3U0110E003

- If it exceeds the maximum specification, grind the surface or replace the cylinder head.

**Manifold contact surfaces distortion (Maximum)**  
**0.10 mm {0.004 in}**

**Manifold contact surfaces distortion (Maximum grinding)**  
**0.15 mm {0.006 in}**

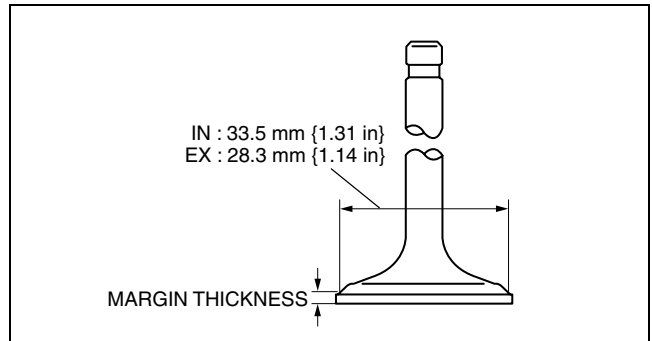
## VALVE, VALVE GUIDE INSPECTION

E5U011012111E01

1. Measure the valve head margin thickness of each valve.
  - If it is less than the specification, replace the valve.

**Valve head margin thickness (Minimum)**

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



C3U0110E051

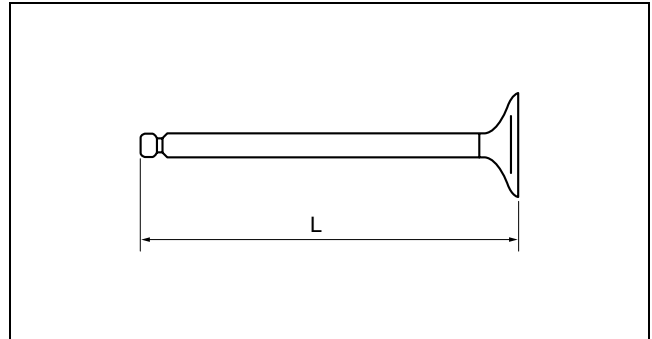
2. Measure the length of each valve. Replace the valve if necessary.
  - If it is less than the specification, replace the valve.

**Valve length (Standard)**

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

**Valve length (Minimum)**

**IN: 102.99 mm {4.055 in}**  
**EX: 104.25 mm {4.104 in}**



B3E0110E068

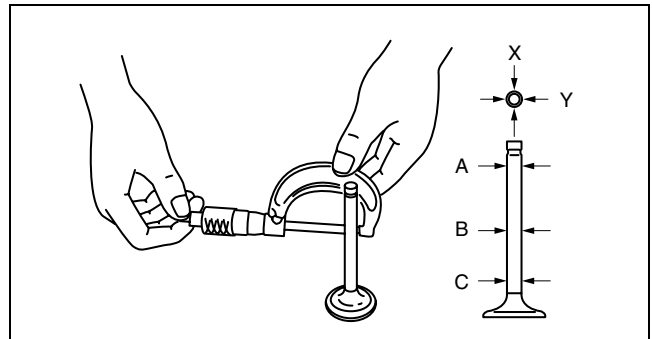
3. Measure the stem diameter of each valve in X and Y directions at the three points (A, B, and C) as indicated in the figure.
  - If it exceeds the specification, replace the valve.

**Valve stem diameter (Standard)**

**IN: 5.470—5.485 mm {0.2154—0.2159 in}**  
**EX: 5.465—5.480 mm {0.2152—0.2157 in}**

**Valve stem diameter (Minimum)**

**IN: 5.440 mm {0.2142 in}**  
**EX: 5.435 mm {0.2140 in}**

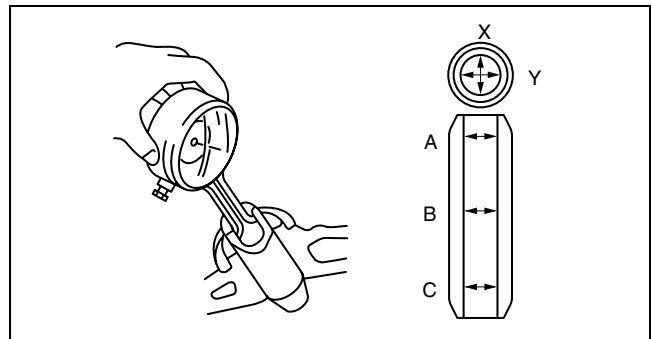


ADJ2224E024

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.

**Valve guide inner diameter (Standard)**

**5.509—5.539 mm {0.2169—0.2180 in}**



ADJ2224E026

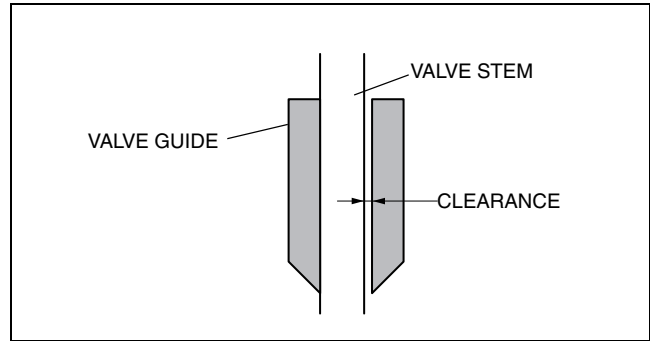
- Calculate the valve stem to guide clearance by subtracting the outer diameter of the valve stem from the inner diameter of the corresponding valve guide.
  - If it exceeds the specification, replace the valve and/or the valve guide.

**Valve stem to guide clearance (Standard)**  
 IN: 0.024—0.069 mm {0.0009—0.0027 in}  
 EX: 0.029—0.074 mm {0.0012—0.0029 in}

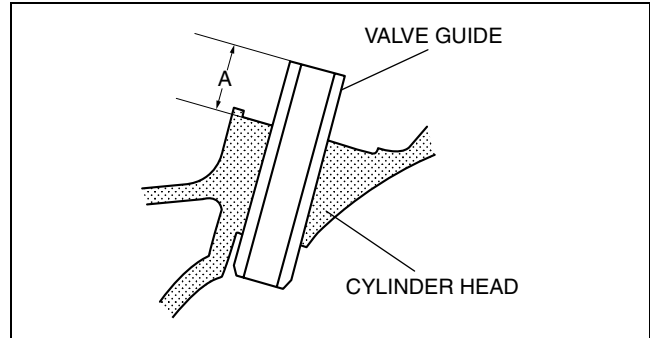
**Valve stem to guide clearance (Maximum)**  
 0.10 mm {0.004 in}

- Measure the protrusion height (dimension A) of each valve guide without lower valve spring seat.
  - If not within the specified, replace the valve guide.

**Valve guide protrusion height (standard)**  
 12.2—12.8 mm {0.481—0.503 in}



ADA2224E027



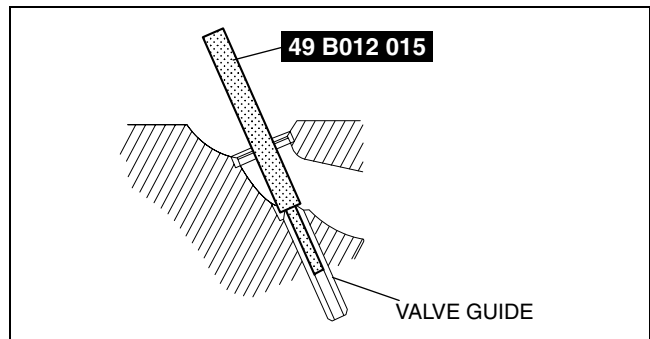
C3U0110E004

## VALVE GUIDE REPLACEMENT

### Valve Guide Removal

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

E5U011012111E02

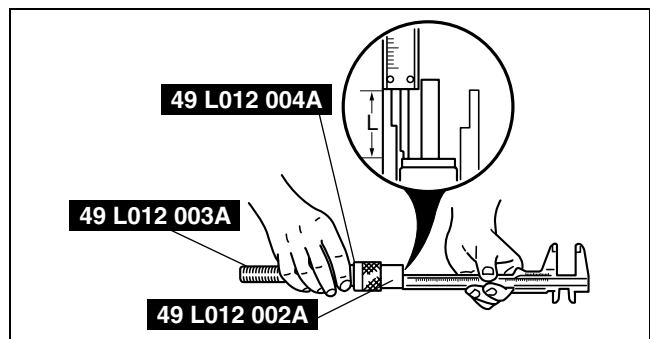


C3U0110E005

### Valve Guide Installation

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

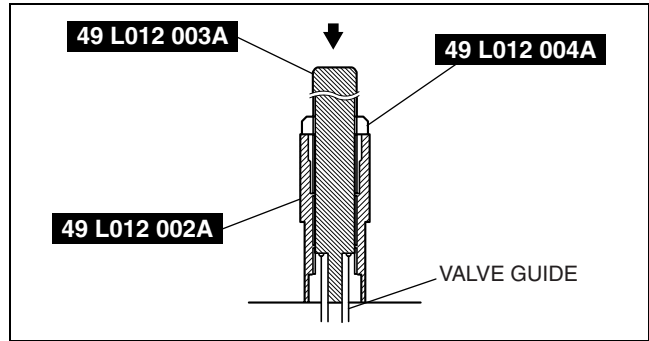
**Valve guide protrusion height (standard)**  
 12.2—12.8 mm {0.481—0.503 in}



B3E0110E071

## MECHANICAL

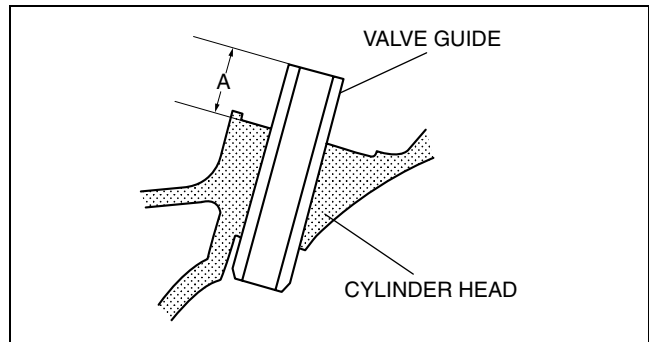
2. Tap the valve guide in from the top of the cylinder head until the **SSTs** contacts the cylinder head.



B3E0110E072

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

**Valve guide protrusion height (standard)**  
12.2—12.8 mm {0.481—0.503 in}



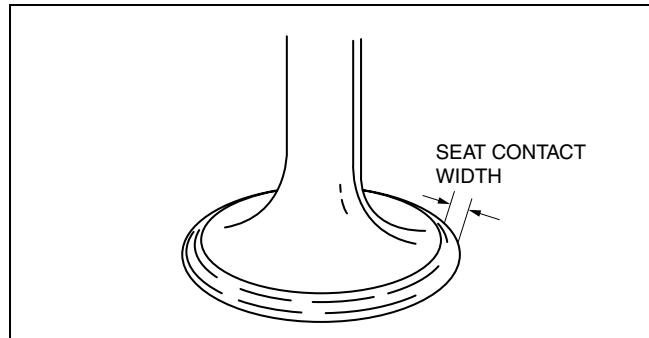
C3U0110E004

E5U011010102E01

### VALVE SEAT INSPECTION/REPAIR

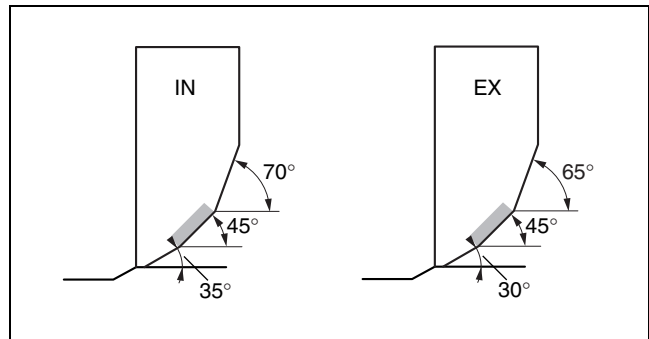
1. Measure the seat contact width.
  - If not within the specification, resurface the valve seat using a **45°** valve seat cutter and/or resurface the valve face.

**Valve seat contact width (Standard)**  
1.2—1.6 mm {0.048—0.062 in}



ADA2224E019

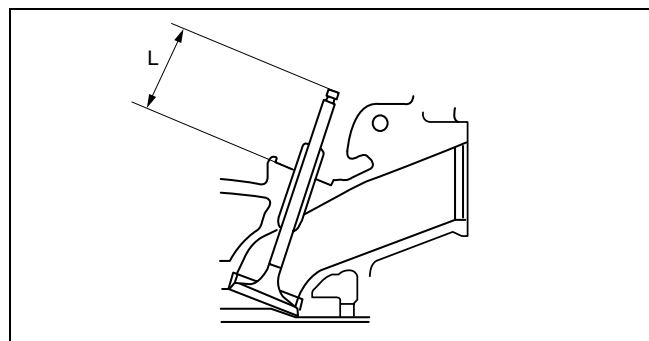
2. Verify that the valve seating position is at the center of the valve face.
  - (1) If the seating position is too out side, correct the valve seat using a **70°** (IN) or **65°** (EX) cutter, and a **45°** cutter.
  - (2) If the seating position is too inner side, correct the valve seat using a **35°** (IN) cutter, and a **30°** (EX) cutter, and a **45°** cutter.



B3E0110E133

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.

**Valve protrusion height (Standard)**  
IN: 40.64—42.24 mm {1.600—1.662 in}  
EX: 40.50—42.10 mm {1.595—1.657 in}



C3U0110E006

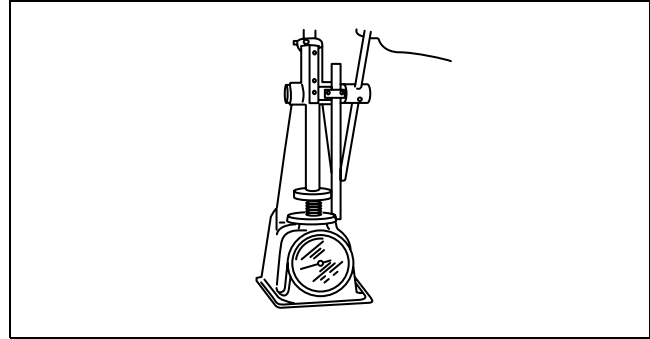
## VALVE SPRING INSPECTION

E5U011012125E01

1. Apply pressing force to the pressure spring and inspect the spring height.
  - If it is less than the specification, replace the valve spring.

**Valve spring pressing force**  
 390 N {39.76 kgf, 87.67 lbf}

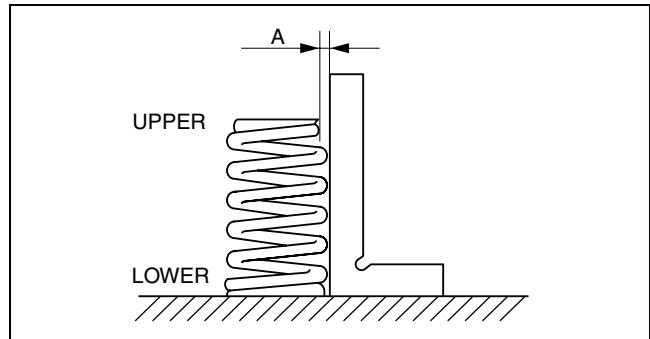
**Valve spring standard height H**  
 28.68 mm {1.129 in}



ADJ2224E028

2. Measure the out-of-square of the valve spring, using a square, as shown in the figure.
  - (1) Rotate the valve spring one full turn and measure "A" at the point where the gap is the largest.
    - If it exceeds the specification, replace the valve spring.

**Valve spring out-of-square (Maximum)**  
 1.95 mm {0.0767 in}



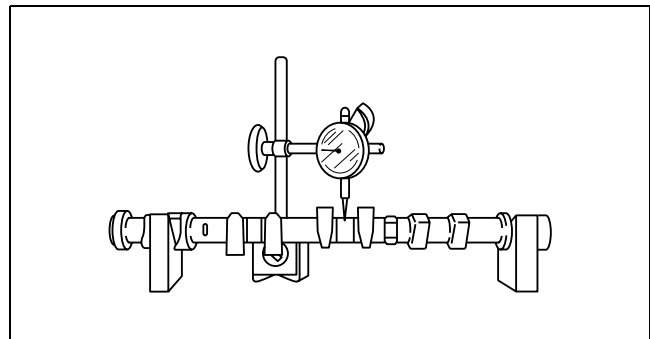
B3E0110E073

## CAMSHAFT INSPECTION

E5U011012420E01

1. Set the No.1 and No.5 journals on V-blocks.
2. Measure the camshaft runout.
  - If it exceeds the specification, replace the camshaft.

**Maximum runout (Maximum)**  
 0.03 mm {0.0012 in}

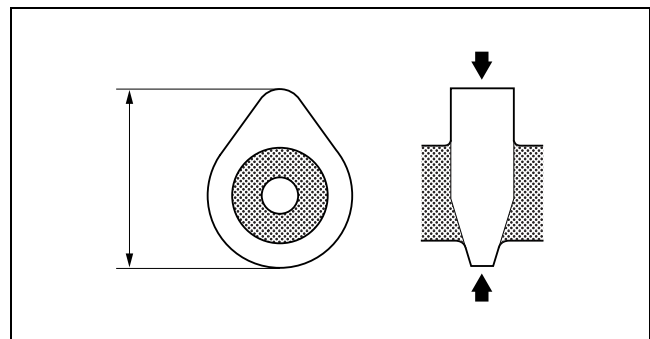


B3E0110E074

3. Measure the cam lobe height at the two points as shown in the figure.
  - If it is less than the specification, replace the camshaft.

**Camshaft standard height (mm {in})**  
**With variable valve timing mechanism**  
 IN: 42.44 {1.671}  
 EX: 41.18 {1.621}  
**Without variable valve timing mechanism**  
 IN: 42.12 {1.659}  
 EX: 41.08 {1.618}

**Camshaft minimum height (mm {in})**  
**With variable valve timing mechanism**  
 IN: 42.33 {1.666}  
 EX: 41.06 {1.616}  
**Without variable valve timing mechanism**  
 IN: 42.01 {1.653}  
 EX: 40.96 {1.612}



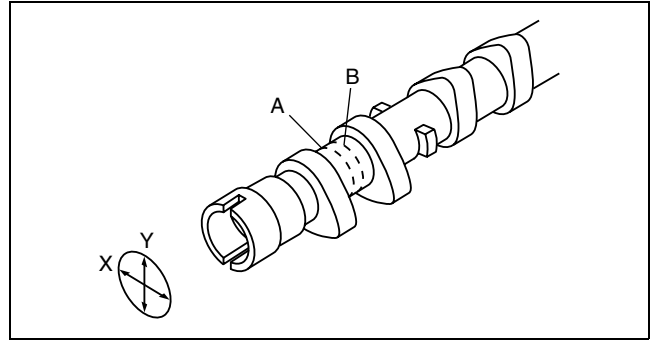
B3E0110E076

## MECHANICAL

4. Measure the journal diameters in X and Y directions at the two points (A and B) as indicated in the figure.
  - If it is less than the specification, replace the camshaft.

**Camshaft journal diameter (Standard)**  
24.96—24.98 mm {0.9827—0.9834 in}

**Camshaft journal diameter (Minimum)**  
24.95 mm {0.982 in}

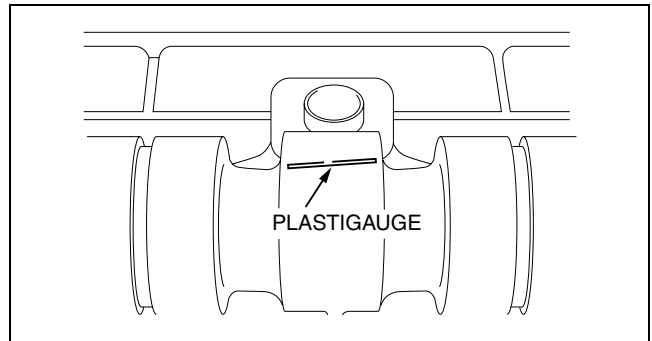


B3E0110E075

5. Remove the tappet.
6. Position a plastigage atop the journals in the axial direction.
7. Install the camshaft cap. (See 01–10–37 Camshaft Assembly Note.)
8. Remove the camshaft cap. (See 01–10–7 Camshaft Cap Disassembly Note.)
9. Measure the oil clearance.
  - If it exceeds the specification, replace the cylinder head.

**Camshaft journal oil clearance (Standard)**  
0.035—0.080 mm {0.0014—0.0031 in}

**Camshaft journal oil clearance (Maximum)**  
0.09 mm {0.0035 in}



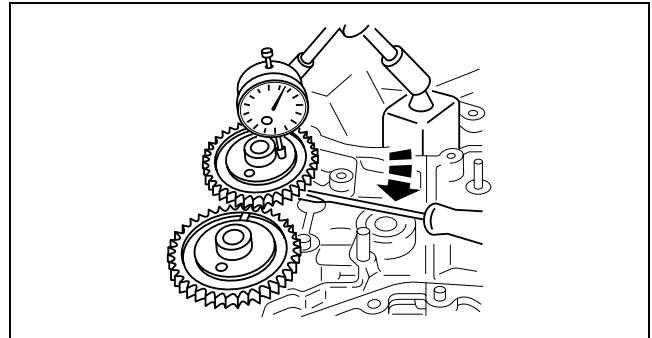
B3E0110E077

10. Install the camshaft cap. (See 01–10–37 Camshaft Assembly Note.)
11. Measure the camshaft end play.
  - If it exceeds the specification, replace the cylinder head or camshaft.

**Camshaft end play (Standard)**  
0.09—0.24 mm {0.0035—0.0094 in}

**Camshaft end play (Maximum)**  
0.25 mm {0.0098 in}

12. Remove the camshaft cap. (See 01–10–7 Camshaft Cap Disassembly Note.)

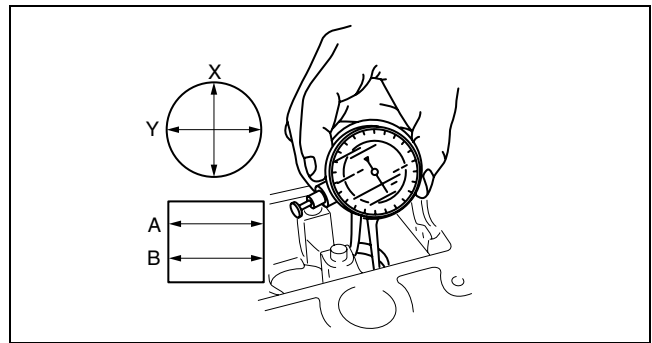


B3E0110E078

## TAPPET INSPECTION

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

**Tappet bore diameter (Standard)**  
**31.000—31.030 mm {1.2205—1.2216 in}**



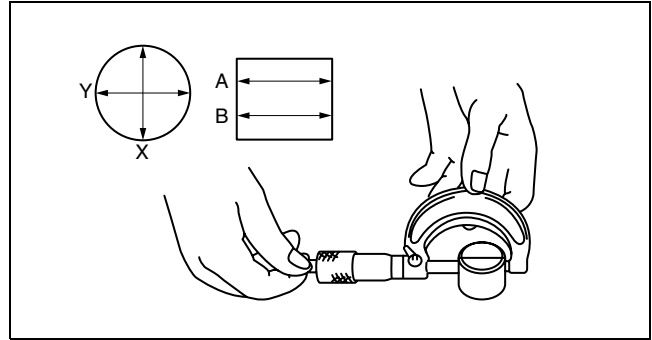
2. Measure the tappet body outer diameter in X and Y directions at the two points (A and B) shown in the figure.

**Tappet diameter (Standard)**  
**30.970—30.980 mm {1.2193—1.2196 in}**

3. Subtract the tappet body outer diameter from the tappet hole inner diameter.
  - If it exceeds the specification, replace the tappet or cylinder head.

**Tappet-to-Tappet bore oil clearance (Standard)**  
**0.02—0.06 mm {0.0008—0.0023 in}**

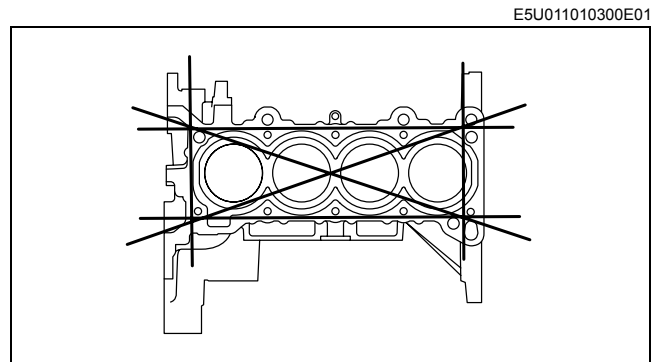
**Tappet-to-Tappet bore oil clearance (Maximum)**  
**0.15 mm {0.006 in}**



## CYLINDER BLOCK INSPECTION

1. Measure the distortion of the cylinder block top surface in six directions as indicated in the figure.
  - If it exceeds the maximum, replace the cylinder block.

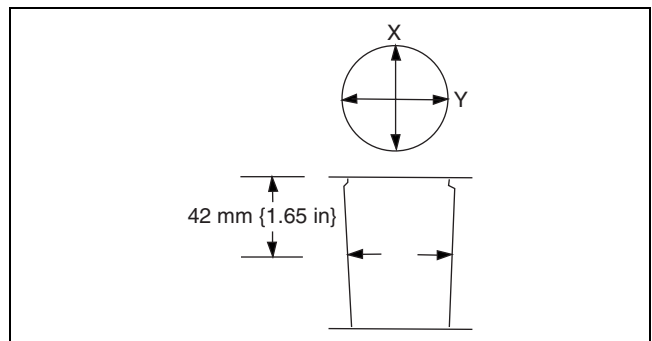
**Cylinder head gasket contact surfaces distortion (Maximum)**  
**0.10 mm {0.004 in}**



2. Measure the cylinder bores in X and Y directions at 42 mm {1.65 in} below the top surface.
  - If not within the specification, replace the cylinder block.

**Cylinder bore diameter (Standard)**  
**87.500—87.530 mm {3.4449—3.4460 in}**

**Minimum / maximum bore diameter limit**  
**87.440—87.590 mm {3.4425—3.4484 in}**



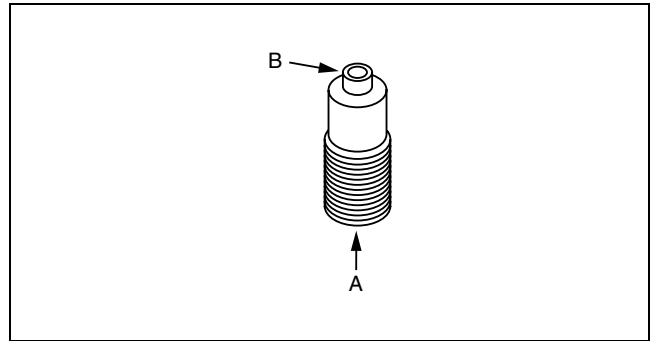
## OIL JET VALVE INSPECTION

E5U011010730E01

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

### Oil jet valve air pressure

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



B3E0110E079

## PISTON INSPECTION

E5U011011010E01

### Caution

- The piston 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 not within the specification, replace the piston, piston pin, piston ring and connecting rod as a single unit.

### Piston diameter (Standard)

87.465—87.495 mm {3.4435—3.4446 in}

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

### Piston-to-cylinder clearance (Standard)

0.025—0.045 mm {0.0010—0.0017 in}

### Piston-to-cylinder clearance (Maximum)

0.11 mm {0.0043 in}

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

### Piston ring-to-ring groove clearance (Standard)

Top: 0.03—0.08 mm {0.0012—0.0031 in}

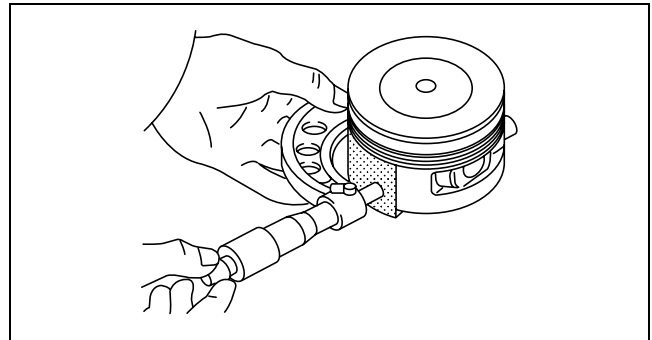
Second: 0.03—0.07 mm {0.0012—0.0027 in}

Oil: 0.03—0.07 mm {0.0012—0.0027 in}

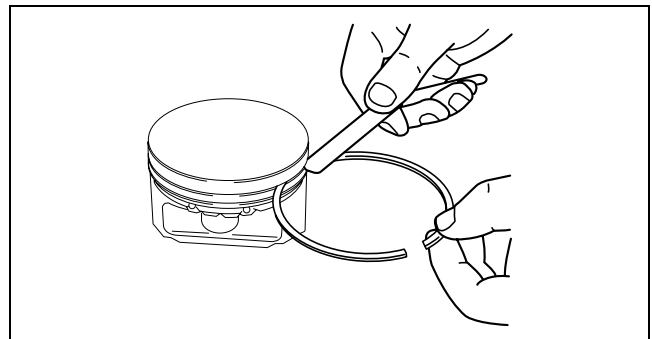
### Piston ring-to-ring groove clearance (Maximum)

Top: 0.17 mm {0.0067 in}

Second, Oil: 0.15 mm {0.0059 in}



B3E0110E080



B3E0110E081



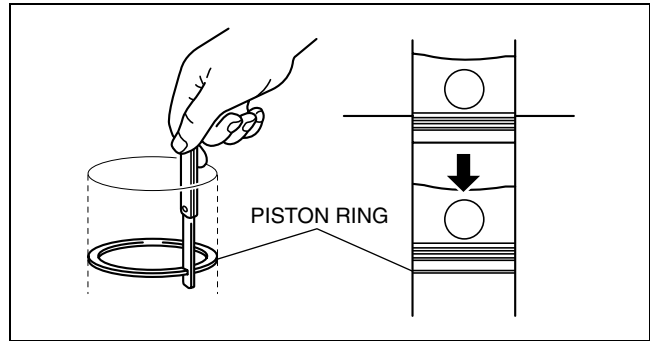
4. Insert the piston ring into the cylinder by hand and use the piston to push it to the bottom of the ring travel.
5. Measure each piston ring end gap with a feeler gauge.
  - If it exceeds the specification, replace the piston, piston pin, piston ring and connecting rod as a single unit.

**Piston end gap (Standard)**

**Top:** 0.16—0.31 mm {0.0063—0.0122 in}  
**Second:** 0.33—0.48 mm {0.0130—0.0189 in}  
**Oil (rail):** 0.20—0.70 mm {0.0079—0.0275 in}

**Piston end gap (Maximum)**

**1.0 mm {0.0393 in}**



B3E0110E082

## CRANKSHAFT INSPECTION

E5U011011301E01

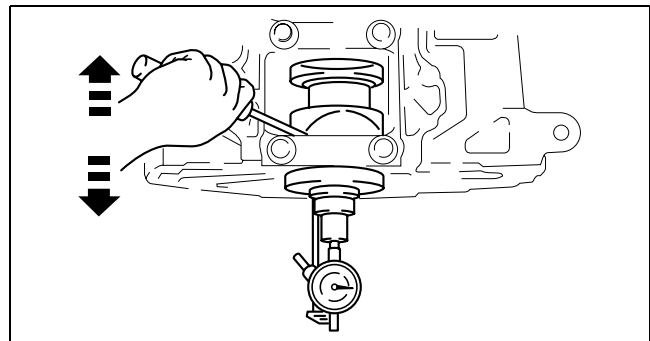
1. Install the main bearing cap. (See 01-10-28 Main Bearing Cap Assembly Note.)
2. Measure the crankshaft end play.
  - If it exceeds the specification, replace the thrust bearing or crankshaft so that the specified end play is obtained.

**Crankshaft end play (Standard)**

**0.22—0.45 mm {0.0087—0.0177 in}**

**Crankshaft end play (Maximum)**

**0.55 mm {0.0216 in}**

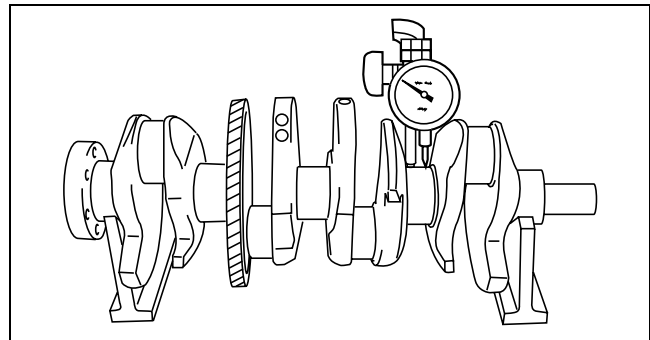


B3E0110E083

3. Remove the main bearing cap. (See 01-10-11 Main Bearing Cap Disassembly Note.)
4. Measure the crankshaft runout.
  - If it exceeds the specification, replace the crankshaft.

**Crankshaft runout (Maximum)**

**0.05 mm {0.0019 in}**



AME2224E311

5. Measure the journal diameter in X and Y directions at the two points (A and B) as indicated in the figure.
  - If it exceeds the specification, replace the crankshaft or grind the journal and install the undersize bearing.

**Main journal bearing size**

**STD:** 51.980—52.000 mm {2.0464—2.0472 in}  
**US0.25:** 51.730—51.750 mm {2.0366—2.0373 in}

**Main journal out of round (Maximum)**

**0.05 mm {0.0019 in}**

**Crank pin journal diameter [LF]**

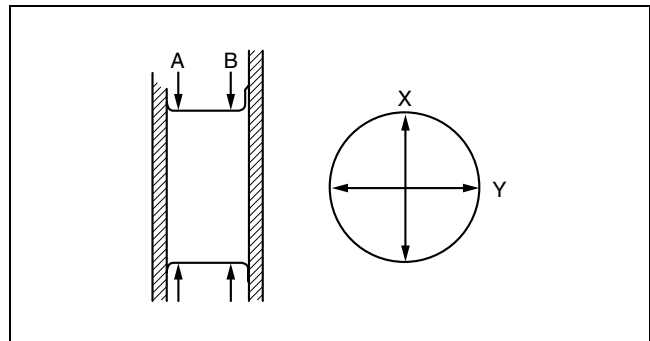
**STD:** 46.980—47.000 mm {1.8497—1.8503 in}  
**US0.25:** 46.730—46.750 mm {1.8398—1.8405 in}

**Crank pin journal diameter [L3]**

**STD:** 49.980—50.000 mm {1.9677—1.9685 in}  
**US0.25:** 49.730—49.750 mm {1.9579—1.9586 in}

**Crank pin out of round (Maximum)**

**0.05 mm {0.0019 in}**



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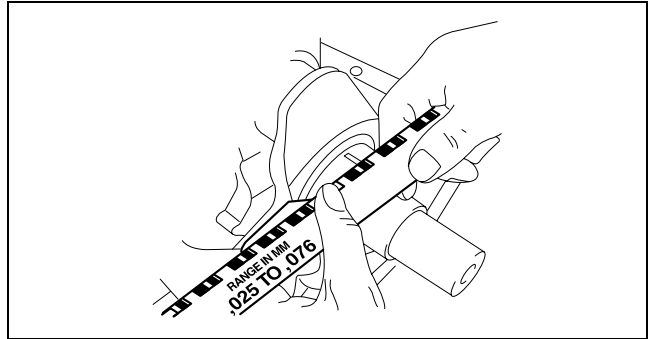
## MECHANICAL

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 01–10–28 Main Bearing Cap Assembly Note.)
9. Remove the main bearing caps. (See 01–10–11 Main Bearing Cap Disassembly Note.)
10. Measure the main journal oil clearance.
  - If it exceeds the specification, 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.

**Main journal oil clearance (Standard)**  
0.019—0.035 mm {0.0007—0.0013 in}

**Main journal oil clearance (Maximum)**  
0.10 mm {0.0039 in}

**Main bearing size**  
STD: 2.506—2.509 mm {0.0987—0.0988 in}  
OS0.25: 2.628—2.634 mm {0.1034—0.1037 in}



B3E0110E086

### CONNECTING ROD INSPECTION

E5U011011211E01

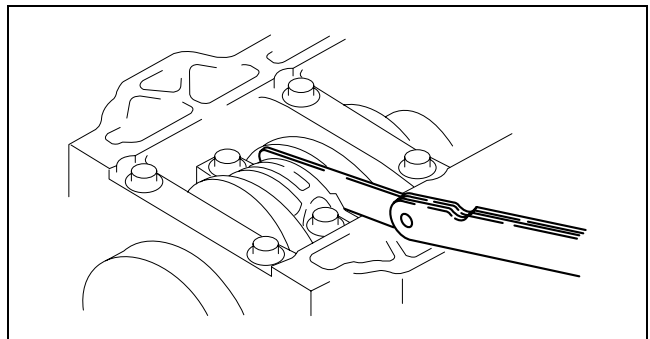
#### Caution

- The piston 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 01–10–29 Connecting Rod Cap Assembly Note.)
2. Measure the connecting rod large end side clearance.
  - If it exceeds the specification, replace the piston, piston pin, piston ring and connecting rod as a single unit.

**Connecting rod side clearance (Standard)**  
0.14—0.36 mm {0.0056—0.0141 in}

**Connecting rod side clearance (Maximum)**  
0.435 mm {0.0172 in}



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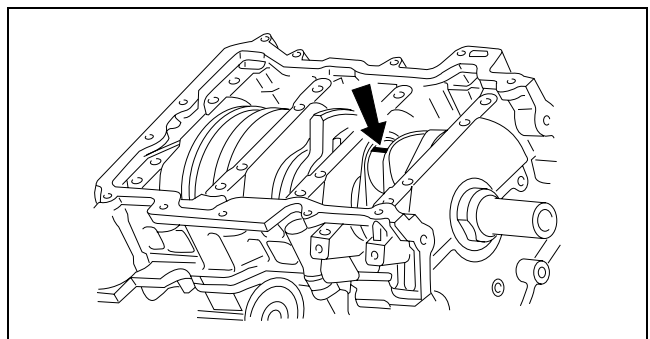
3. Remove the connecting rod cap.
4. Position plastigage atop the journals in the axial direction.
5. Install the connecting rod bearing and connecting rod cap. (See 01–10–29 Connecting Rod Cap Assembly Note.)
6. Remove the connecting rod cap.
7. Measure the connecting rod oil clearance.
  - If it exceeds the specification, replace the connecting rod bearing or grind the crank pin and use oversize bearings so that the specified clearance is obtained.

**Connecting rod bearing oil clearance (Standard)**  
0.026—0.052 mm {0.0011—0.0020 in}

**Connecting rod bearing oil clearance (Maximum)**  
0.1 mm {0.0039 in}

**Connecting rod bearing size [LF]**  
STD: 1.498—1.504 mm {0.0589—0.0592 in}  
OS0.25: 1.623—1.629 mm {0.0639—0.0641 in}

**Connecting rod bearing size [L3]**  
STD: 1.496—1.502 mm {0.0589—0.0591 in}  
OS0.25: 1.621—1.627 mm {0.0639—0.0641 in}



B3E0110W128

## 01–10–20

## BOLT INSPECTION

1. Measure the length of each bolt.
  - If it exceeds the specification, replace the bolt.

### Bolt length (mm {in})

#### Cylinder head bolt (With washer)

Standard: 149.2—149.8 {5.87—5.90}

Maximum: 150.5 {5.91}

#### Cylinder head bolt (Without washer)

Standard: 145.2—145.8 {5.72—5.74}

Maximum: 146.5 {5.77}

#### Connecting rod bolt

Standard: 44.7—45.3 {1.75—1.78}

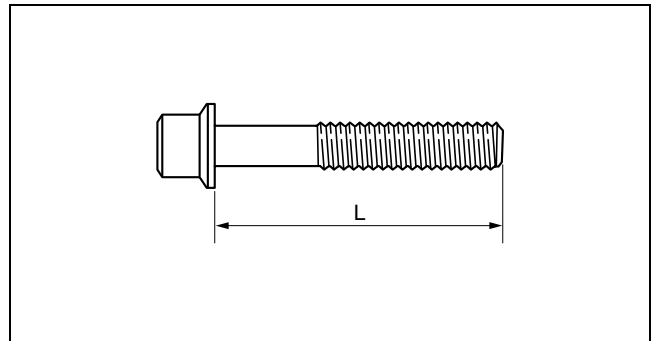
Maximum: 46.0 {1.81}

#### Main bearing cap bolt (Plastic region tightening bolt only)

Standard: 110.0—110.6 {4.33—4.35}

Maximum: 111.3 {4.38}

E5U011010135E01



B3E0110E088

01-10

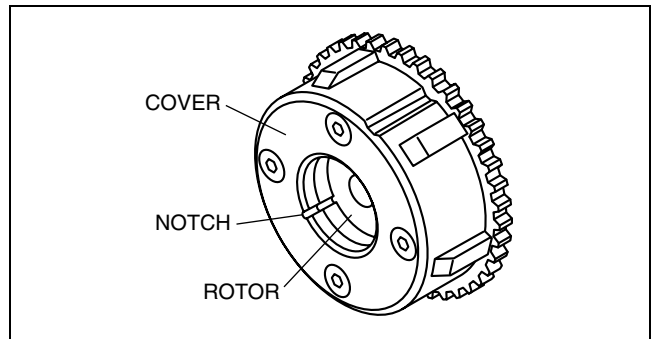
## VARIABLE VALVE TIMING ACTUATOR INSPECTION [WITH VARIABLE VALVE TIMING MECHANISM]

E5U011012490E01

### Caution

- Variable valve timing actuator cannot be disassembled because it is a precision unit.

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



B3E0110E089

## OIL CONTROL VALVE (OCV) INSPECTION [WITH VARIABLE VALVE TIMING MECHANISM]

E5U011014420E01

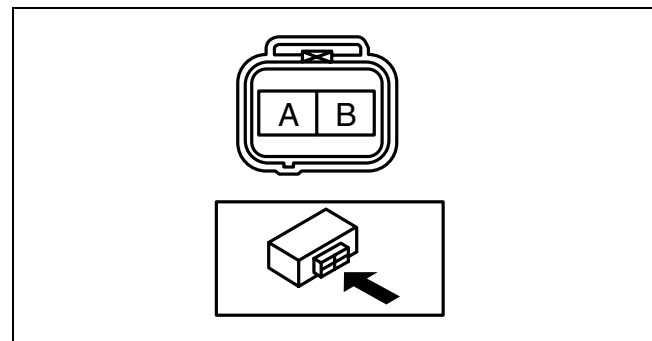
### Coil Resistance Inspection

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 [20 °C {68 °F}]

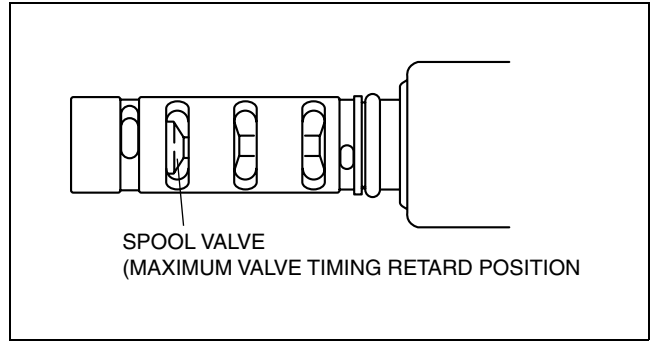
4. Connect the oil control valve (OCV) connector.



B3E0110W151

## 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 it exceeds the specification, replace the oil control valve (OCV).
4. Verify that the battery is fully charged.
  - If it is less than specification, recharge the battery.

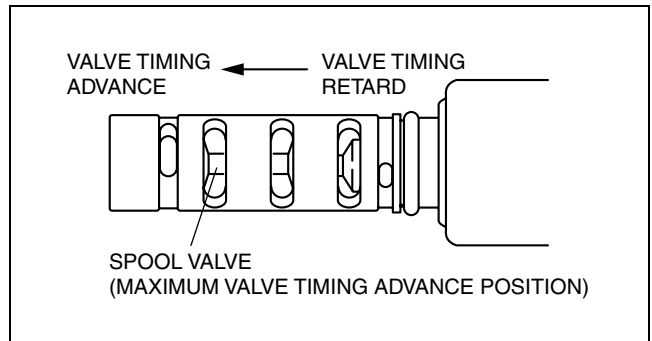


B3E0110E090

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 it exceeds the specification, 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



B3E0110E091

6. Stop applying battery positive voltage and verify that the spool valve returns to the maximum valve timing retard position.
  - If it exceed the specification, replace the oil control valve (OCV).

## VALVE CLEARANCE INSPECTION

E5U011012111E03

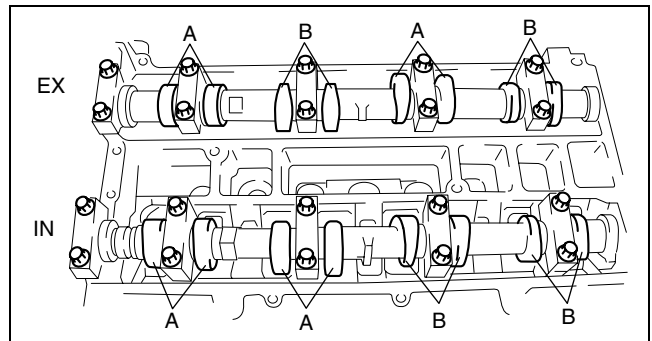
1. Measure the valve clearance as follows.
  - (1) Turn the crankshaft clockwise so that the No.1 piston is at TDC of the compression stroke.
  - (2) Measure the valve clearance at A in the figure.
    - If the valve clearance exceeds the standard, replace the tappet. (See 01-10-23 VALVE CLEARANCE ADJUSTMENT.)

### Note

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

### Valve clearance [Engine cold]

**IN: 0.22—0.28 mm {0.0087—0.0110 in}**  
**EX: 0.27—0.33 mm {0.0106—0.0130 in}**



B3E0110E092

- (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 01-10-23 VALVE CLEARANCE ADJUSTMENT.)

### Note

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

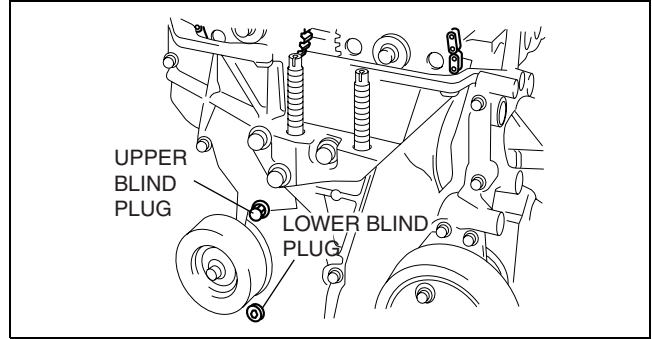
### Valve clearance [Engine cold]

**IN: 0.22—0.28 mm {0.0087—0.0110 in}**  
**EX: 0.27—0.33 mm {0.0106—0.0130 in}**

## VALVE CLEARANCE ADJUSTMENT

E5U011012111E04

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.



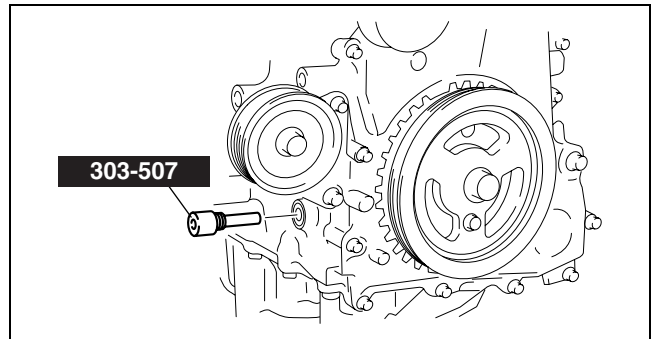
B3E0110E093

4. Install the SST as shown in the figure.

### Caution

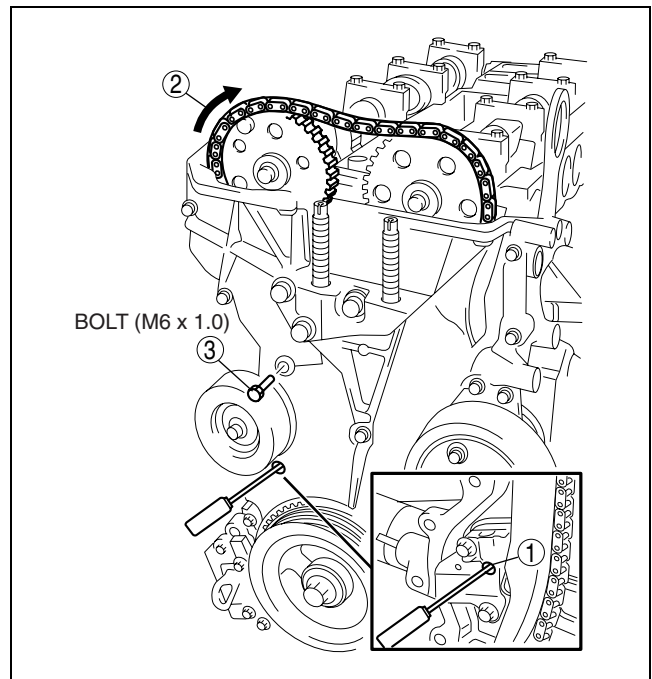
- Removal of this SST is extremely important. If you crank the engine with this SST installed, the cylinder block will be damaged.

5. Turn the crankshaft clockwise so that the crankshaft is in the No.1 cylinder TDC position.



D3U110ZE4006

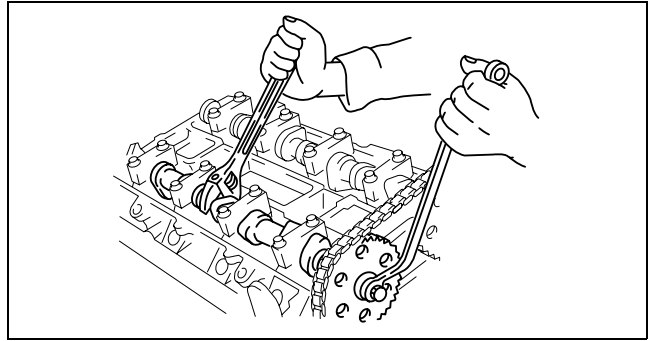
6. Loosen the timing chain.
  - (1) Using a suitable screwdriver or equivalent tool, unlock the chain tensioner ratchet.
  - (2) Turn the exhaust camshaft clockwise using a suitable wrench on the cast hexagon and loosen the timing chain.
  - (3) Placing the suitable bolt (M6 × 1.0 Length 25—35 mm {0.9—1.3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



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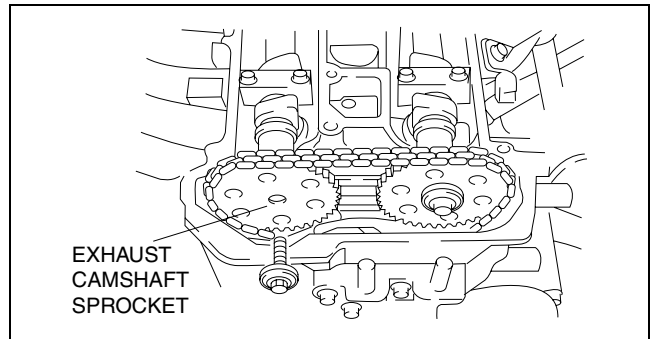
## MECHANICAL

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



B3E0110E095

8. Remove the exhaust camshaft sprocket.

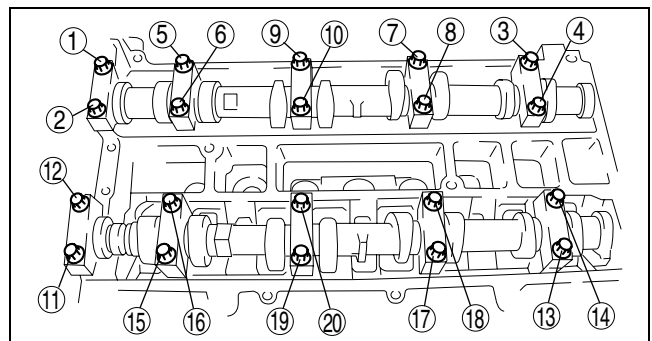


B3E0110E097

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

### 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.



B3E0110E057

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

### New adjustment shim

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

### Valve clearance [Engine cold]

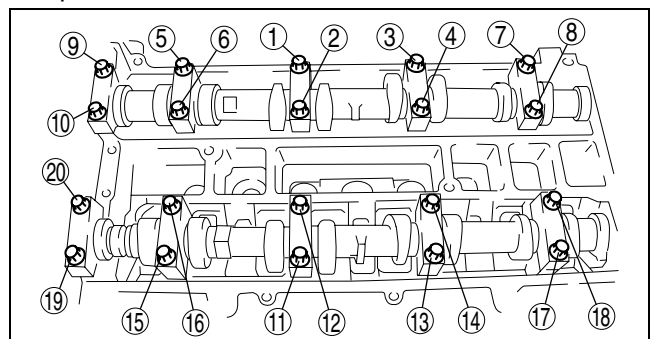
$$\text{IN: } 0.22\text{—}0.28 \text{ mm } \{0.0087\text{—}0.0110 \text{ in}\}$$

$$\text{EX: } 0.27\text{—}0.33 \text{ mm } \{0.0106\text{—}0.0130 \text{ in}\}$$

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

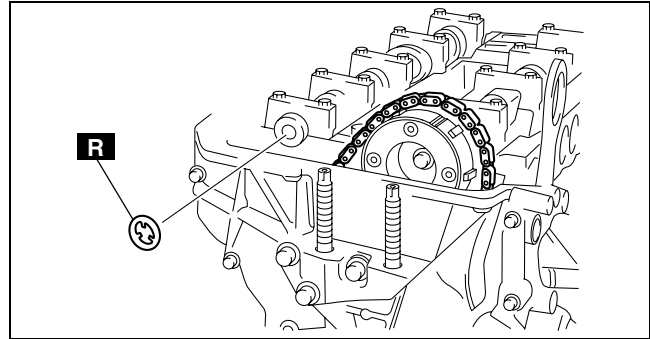
### Tightening torque

- (1) 5.0—9.0 N·m  
{51.0—91.7 kgf·cm, 44.3—79.5 in·lbf}  
(2) 14.0—17.0 N·m  
{1.43—1.73 kgf·m, 10.4—12.5 ft·lbf}



B3E0110E098

15. [Install a new washer.]

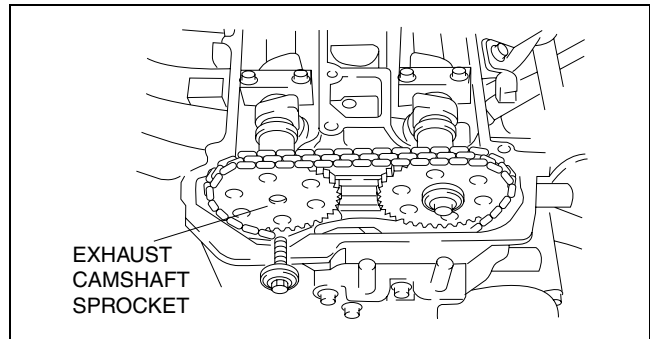


01-10

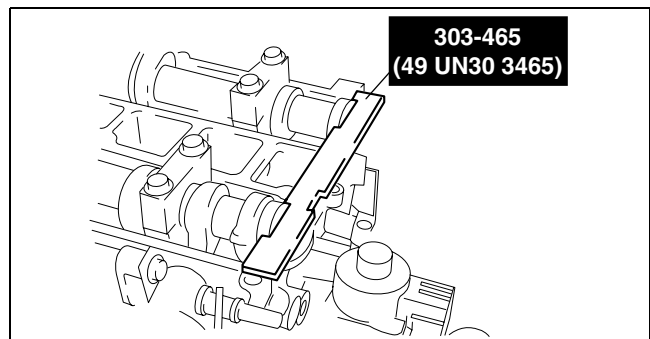
16. Install the exhaust camshaft sprocket.

**Note**

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



17. Install the **SST** to the camshaft as shown in the figure.
18. Remove the M6 × 1.0 bolt from the engine front cover to apply tension to the timing chain.
19. Turn the crankshaft clockwise so that the crankshaft is in the No.1 cylinder TDC position.

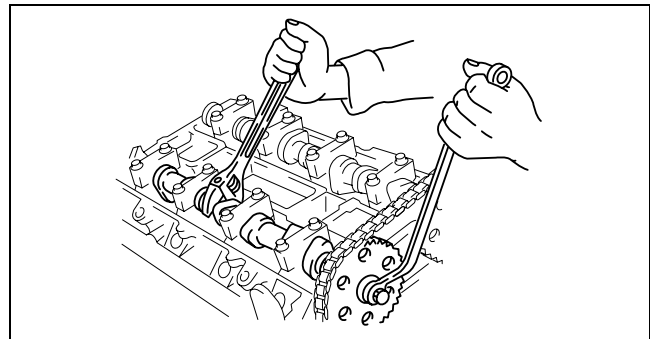


20. Hold the exhaust camshaft using a suitable wrench on the cast hexagon as shown in the figure.
21. Tighten the exhaust camshaft sprocket lock bolt.

**Tightening torque**

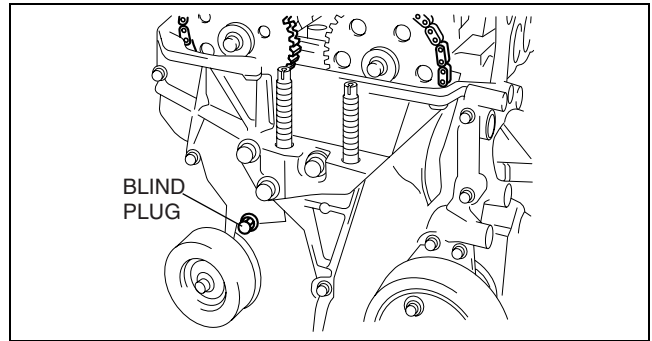
**69—75 N·m {7.1—7.6 kgf·m, 50.9—55.3 ft·lbf}**

22. Remove the **SST** from the camshaft.
23. Remove the **SST** from the block lower blind plug.
24. Rotate the crankshaft clockwise two turns until the TDC position.
- If not aligned, loosen the camshaft sprocket lock bolt and repeat from Step 17.



25. Install the new engine front cover upper blind plug.

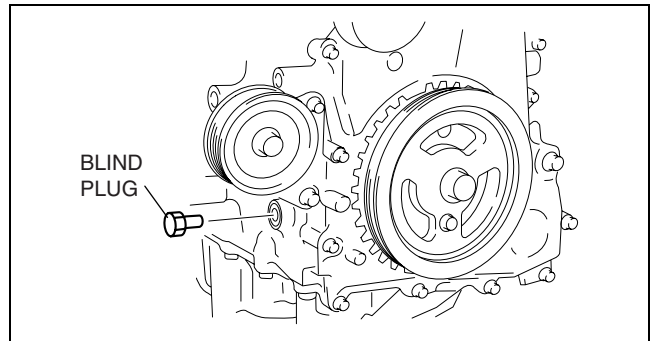
**Tightening torque**  
8.0—11.5 N·m {82—117 kgf·cm, 71—101 in·lbf}



B3E0110E101

26. Install the cylinder block lower blind plug.

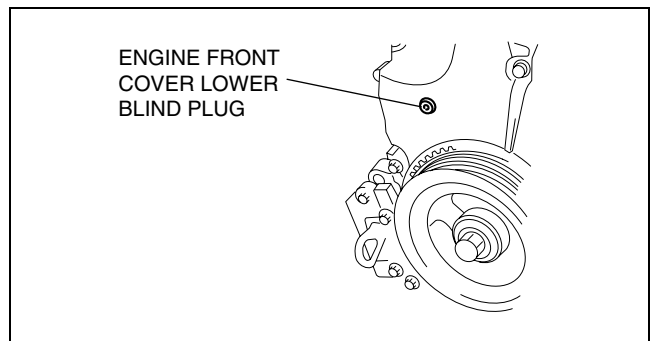
**Tightening torque**  
18—22 N·m {1.9—2.2 kgf·m, 13.3—16.2 ft·lbf}



B3E0110E102

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

**Tightening torque**  
10—14 N·m {102—142 kgf·cm, 89—123 in·lbf}



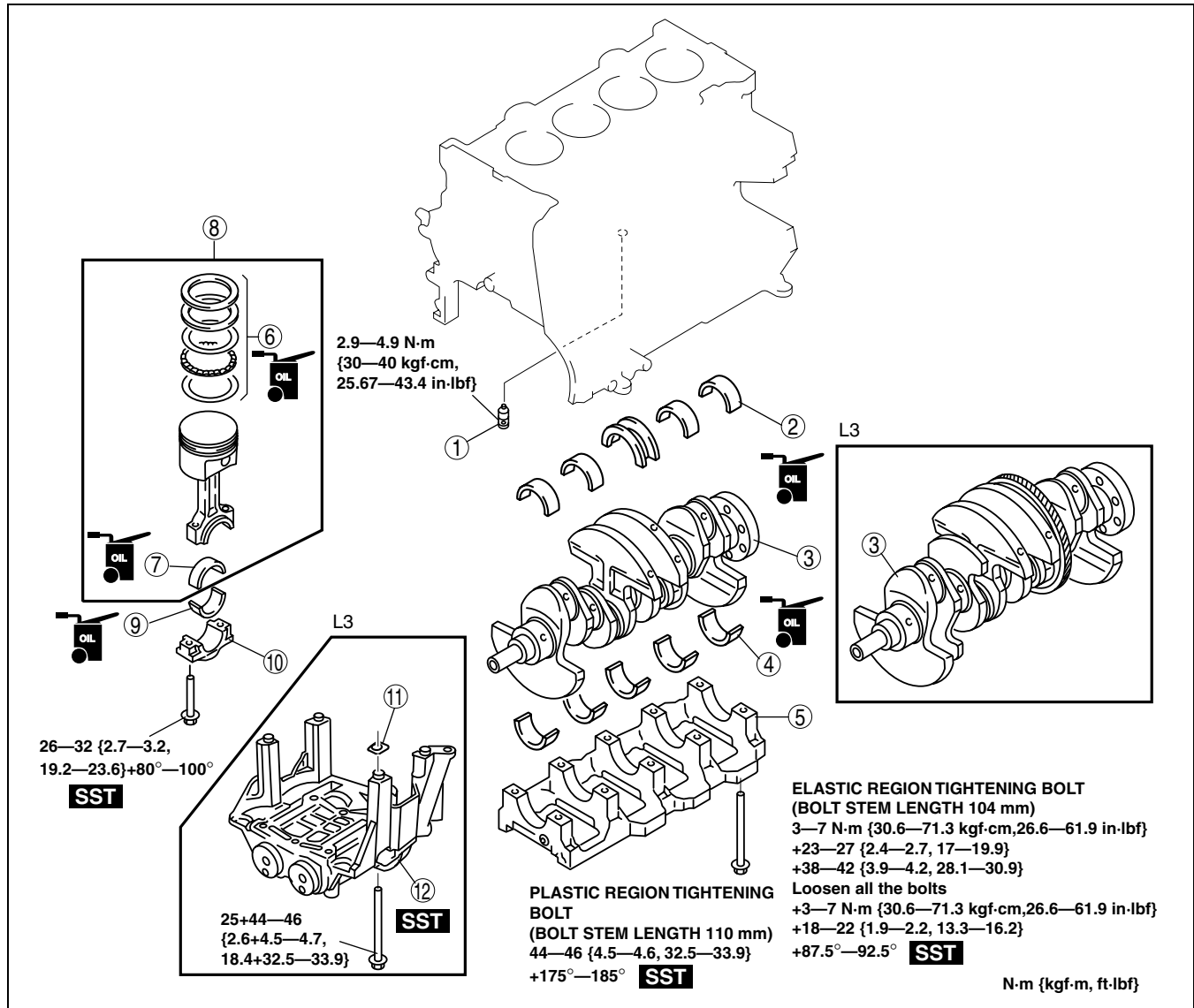
B3E0110W063



## CYLINDER BLOCK (I) ASSEMBLY

E5U011002000E08

1. Assemble in the order indicated in the table.



E5U110ZE7S03

1	Oil jet valve
2	Upper main bearing, thrust bearing
3	Crankshaft
4	Lower main bearing, thrust bearing
5	Main bearing cap (See 01-10-28 Main Bearing Cap Assembly Note)
6	Piston ring (See 01-10-28 Piston Ring Assembly Note)
7	Upper connecting rod bearing (See 01-10-29 Connecting Rod Bearing Assembly Note)

8	Connecting rod, piston assembly (See 01-10-28 Piston Assembly Note)
9	Lower connecting rod bearing (See 01-10-29 Connecting Rod Bearing Assembly Note)
10	Connecting rod cap (See 01-10-29 Connecting Rod Cap Assembly Note)
11	Adjustment shim
12	Balancer unit (See 01-10-29 Balancer Unit Assembly Note)

## MECHANICAL

### Main Bearing Cap Assembly Note

1. Install the main bearing caps in the order indicated in the figure.
2. Tighten the main bearing cap bolts using the **SST (49 D032 316)**.

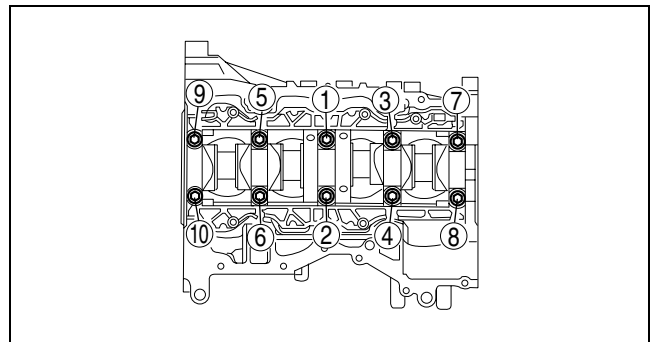
#### Tightening torque

**Plastic region tightening bolt (Bolt stem length 110 mm)**

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

**Elastic region tightening bolt (Bolt stem length 104 mm)**

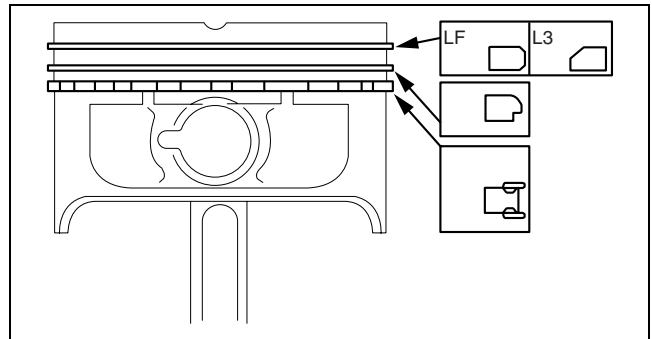
- (1) Apply engine oil to all bolts.
- (2) 3—7 N·m {30.6—71.3 kgf·cm, 26.6—61.9 in·lbf}
- (3) 23—27 N·m {2.4—2.7 kgf·m, 17—19.9 ft·lbf}
- (4) 38—42 N·m {3.9—4.2 kgf·m, 28.1—30.9 ft·lbf}
- (5) Loosen all the bolts. (no remaining torque.)
- (6) 3—7 N·m {30.6—71.3 kgf·cm, 26.6—61.9 in·lbf}
- (7) 18—22 N·m {1.9—2.2 kgf·m, 13.3—16.2 ft·lbf}
- (8) 87.5°—92.5°



B3E0110E105

### Piston Ring Assembly Note

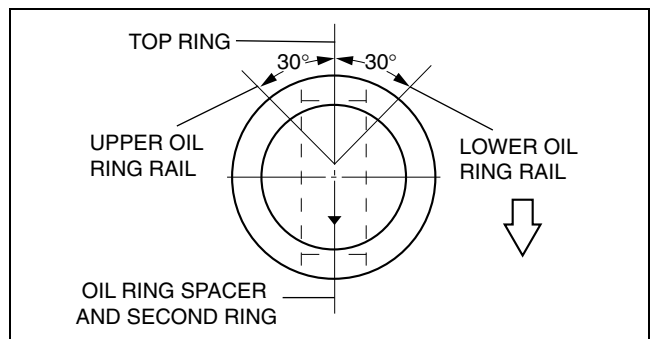
1. Install the two oil control ring segments and spacer.
2. Verify that the second ring is installed with scraper face side downward.
3. Verify that the top ring is installed with scraper face side inner of upper.



C3U0110E056

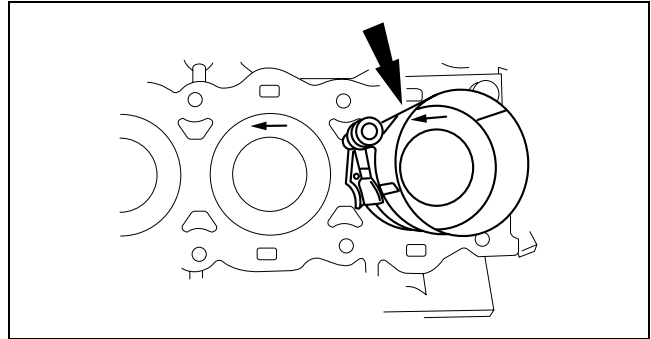
### Piston Assembly Note

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



B3E0110E107

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

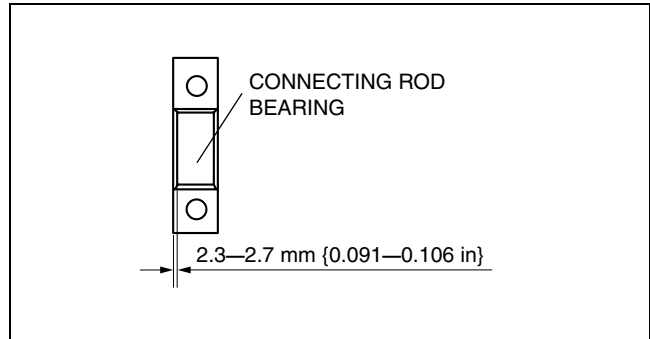


B3E0110E108

01-10

### Connecting Rod Bearing Assembly Note

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



B3E0110E109

### 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 using the **SST (49 D032 316)**.

#### Tightening torque

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

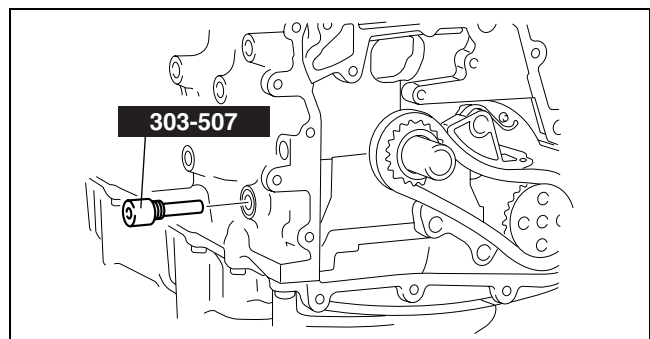
### Balancer Unit Assembly Note

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.

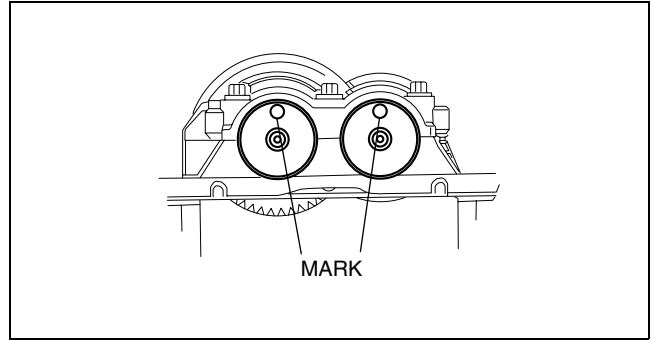
2. Install the **SST** as shown in the figure.
3. Turn the crankshaft clockwise the crankshaft is in the No.1 cylinder TDC position (until the balance weight is attached to the **SST**).
4. Install the adjustment shim to the seat face of the balancer unit.



D3U110ZE4007

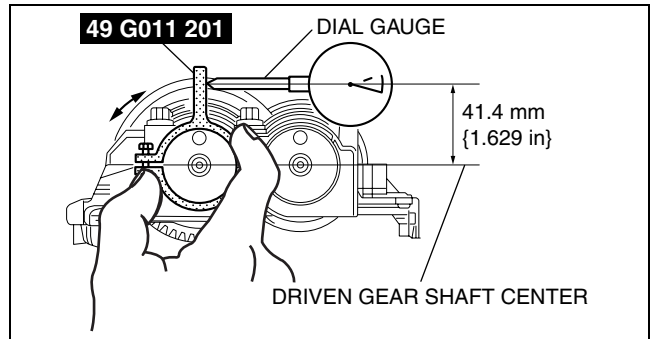
## MECHANICAL

5. With the balancer unit marks at the exact top center, assemble the unit to the cylinder block.



B3E0110E111

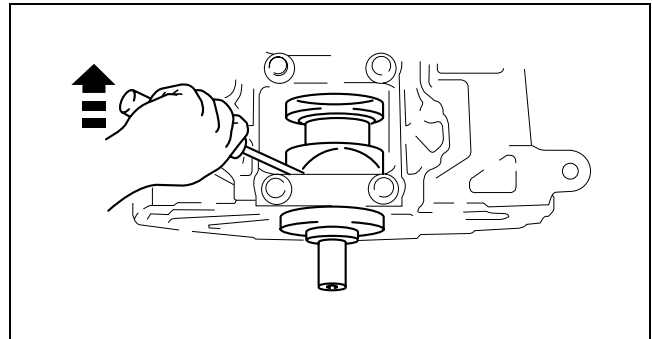
6. Set the **SST** as shown, then measure the gear backlash using a dial gauge.



B3E0110E112

### Note

- For an accurate measurement of gear backlash, insert a screwdriver into the crankshaft No. 1 balance weight area and set both the rotation and the thrust direction with the screwdriver, using a prying action, as shown in the figure.



B3E0110E113

- 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.

### Value range

0.005—0.101 mm {0.00019—0.0039 in}

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

# MECHANICAL

**Adjustment shim selection table**

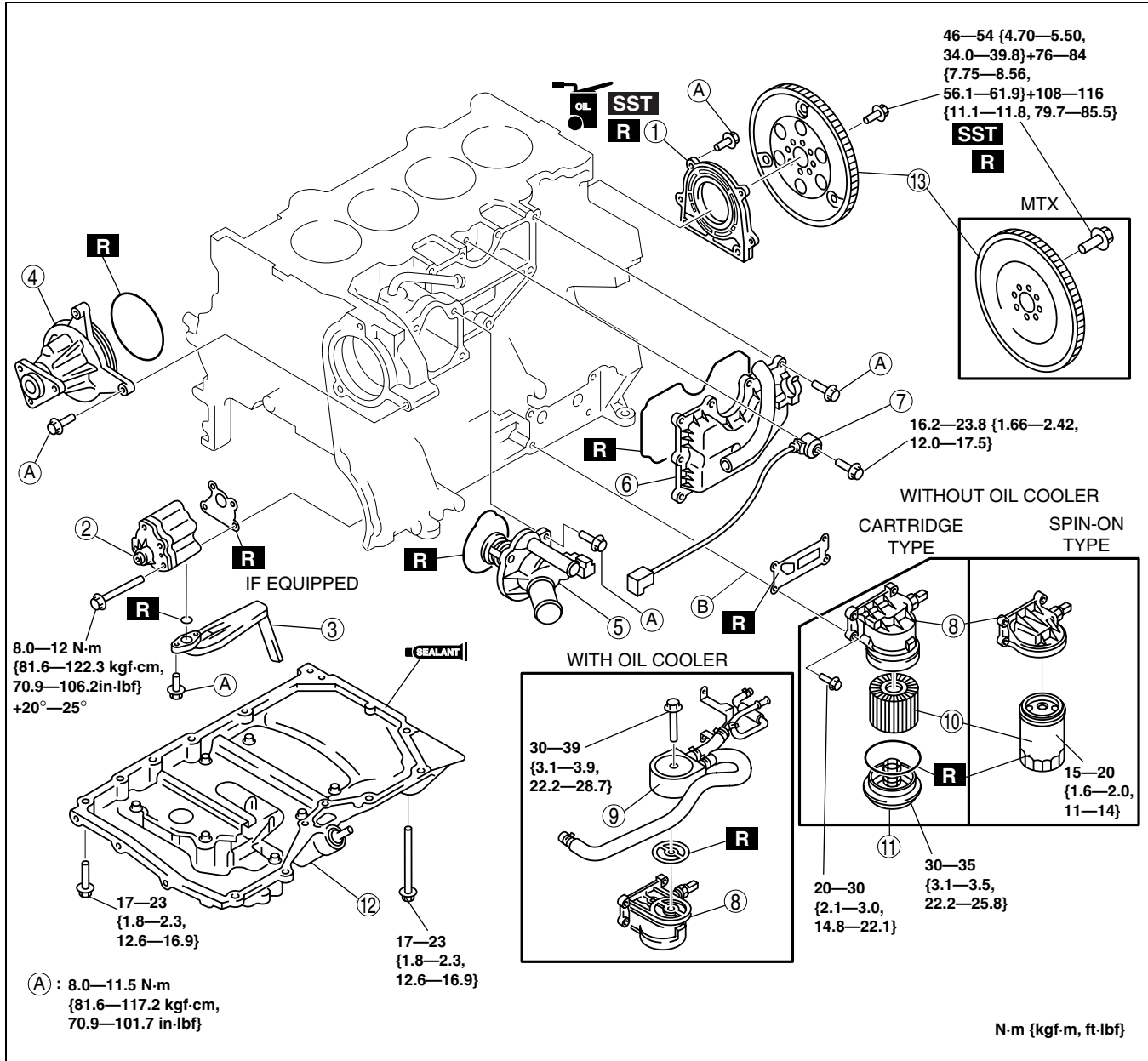
Backlash mm {in}	Selection shim (No.)	Shim thickness mm {in}	Backlash mm {in}	Selection shim (No.)	Shim thickness mm {in}
0.267—0.273 {0.01051— 0.01074}	15	1.15 {0.0452}	0.127—0.133 {0.00500— 0.00523}	35	1.35 {0.0531}
0.260—0.266 {0.01023— 0.01047}	16	1.16 {0.0456}	0.120—0.126 {0.00472— 0.00496}	36	1.36 {0.0535}
0.253—0.259 {0.00996— 0.01019}	17	1.17 {0.0460}	0.113—0.119 {0.00444— 0.00468}	37	1.37 {0.0539}
0.246—0.252 {0.00968— 0.00992}	18	1.18 {0.0464}	0.106—0.112 {0.00417— 0.00440}	38	1.38 {0.0543}
0.239—0.245 {0.00940— 0.00964}	19	1.19 {0.0468}	0.099—0.105 {0.00389— 0.00413}	39	1.39 {0.0547}
0.232—0.238 {0.00913— 0.00937}	20	1.20 {0.0472}	0.092—0.098 .087 {0.00362— 0.00385}	40	1.40 {0.0551}
0.225—0.231 {0.00885— 0.00909}	21	1.21 {0.0476}	0.085—0.091 {0.00334— 0.00358}	41	1.41 {0.0555}
0.218—0.224 {0.00858— 0.00881}	22	1.22 {0.0480}	0.078—0.084 {0.00307— 0.00330}	42	1.42 {0.0559}
0.211—0.217 {0.00830— 0.00854}	23	1.23 {0.0484}	0.071—0.077 {0.00279— 0.00303}	43	1.43 {0.0562}
0.204—0.210 {0.00803— 0.00826}	24	1.24 {0.0488}	0.064—0.070 {0.00251— 0.00275}	44	1.44 {0.0566}
0.197—0.203 {0.00775— 0.00799}	25	1.25 {0.492}	0.057—0.063 {0.00224— 0.00248}	45	1.45 {0.0570}
0.190—0.196 {0.00748— 0.00771}	26	1.26 {0.496}	0.050—0.056 {0.00196— 0.00220}	46	1.46 {0.0574}
0.183—0.189 {0.00720— 0.00744}	27	1.27 {0.499}	0.043—0.049 {0.00169— 0.00192}	47	1.47 {0.0578}
0.176—0.182 {0.00692— 0.00716}	28	1.28 {0.503}	0.036—0.042 {0.00141— 0.00165}	48	1.48 {0.0582}
0.169—0.175 {0.00665— 0.00688}	29	1.29 {0.507}	0.029—0.035 {0.00114— 0.00137}	49	1.49 {0.0586}
0.162—0.168 {0.00637— 0.00661}	30	1.30 {0.511}	0.022—0.028 {0.000866— 0.00110}	50 (master)	1.50 {0.0590}
0.155—0.161 {0.00610— 0.00633}	31	1.31 {0.515}	0.015—0.021 {0.00059— 0.000826}	51	1.51 {0.0594}
0.148—0.154 {0.00582— 0.00606}	32	1.32 {0.519}	0.008—0.014 {0.000314— 0.000551}	52	1.52 {0.0598}
0.141—0.147 {0.00555— 0.00578}	33	1.33 {0.523}	0.001—0.007 {0.00003— 0.000275}	53	1.53 {0.0602}
0.134—0.140 {0.00527— 0.00551}	34	1.34 {0.527}	0.000—0.000 {0.000—0.000}	54	1.54 {0.0606}

# MECHANICAL

## CYLINDER BLOCK (II) ASSEMBLY

E5U011002000E09

1. Assemble in the order indicated in the table.



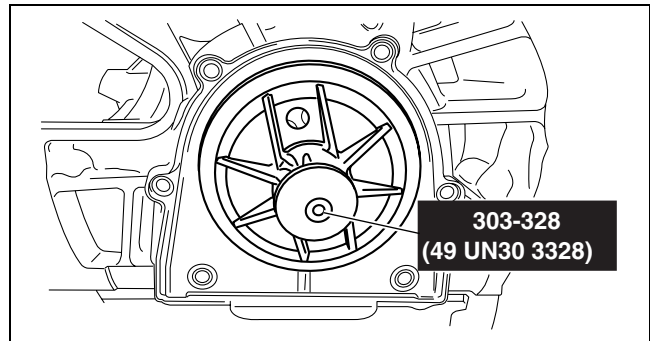
E5U110ZE7S08

1	Rear oil seal (See 01-10-33 Rear Oil Seal Assembly Note)
2	Oil pump
3	Oil strainer
4	Water pump
5	Thermostat
6	Oil separator
7	Knock sensor

8	Oil filter adapter
9	Oil cooler
10	Oil filter
11	Oil filter cover (cartridge type)
12	Oil pan (See 01-10-34 Oil pan Assembly Note)
13	Flywheel (MTX), Drive plate (ATX) (See 01-10-33 Drive Plate (ATX), Flywheel (MTX) Assembly Note)

## Rear Oil Seal Assembly Note

1. Apply clean engine oil to the new oil seal lip.
2. Install the rear oil seal using the **SST** as shown in the figure.



CUE110BW2005

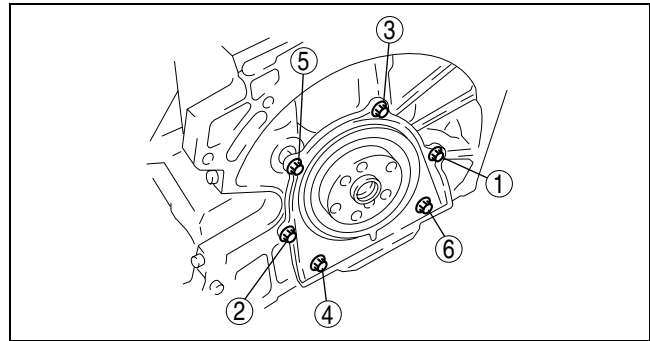
01-10

3. Tighten the rear oil seal bolts in the order as shown in the figure.

### Tightening torque

8.0—11.5 N·m

{81.6—117.2 kgf·cm, 70.9—101.7 in·lbf}



B3E0110E116

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

1. Hold the crankshaft using the **SST**.
2. Tighten the bolts in the 3 steps in the figure.

### Tightening torque

(1) 46—54 N·m

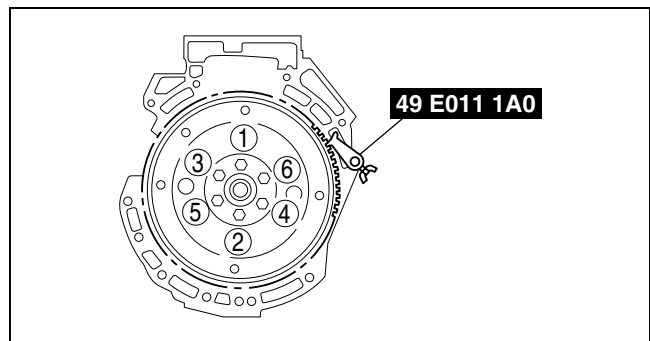
{4.70—5.50 kgf·m, 34.0—39.8 ft·lbf}

(2) 76—84 N·m

{7.75—8.56 kgf·m, 56.1—61.9 ft·lbf}

(3) 108—116 N·m

{11.1—11.8 kgf·m, 79.7—85.5 ft·lbf}



B3E0110E119

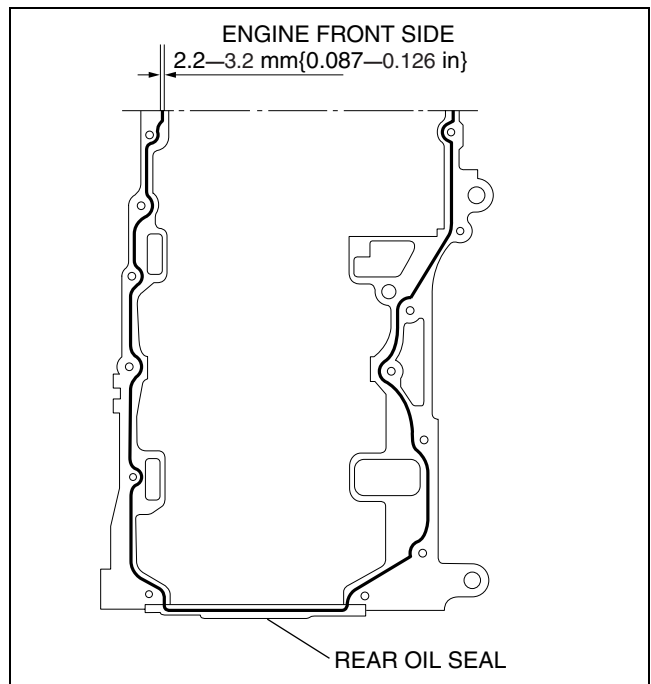
## MECHANICAL

### Oil pan Assembly Note

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

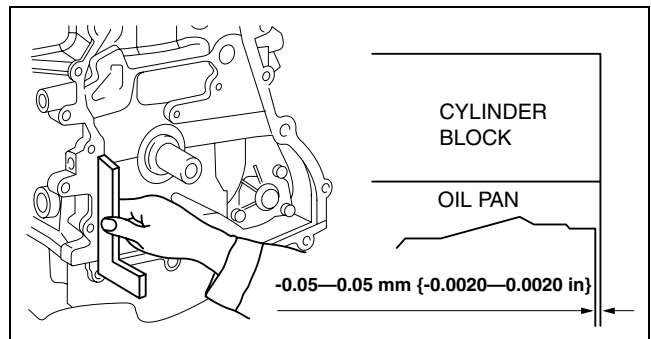
#### Caution

- Install the oil pan within 10min of applying the silicone sealant
- Make sure that there is no oil or dust on the seal side of oil pan.



C3U0110E061

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



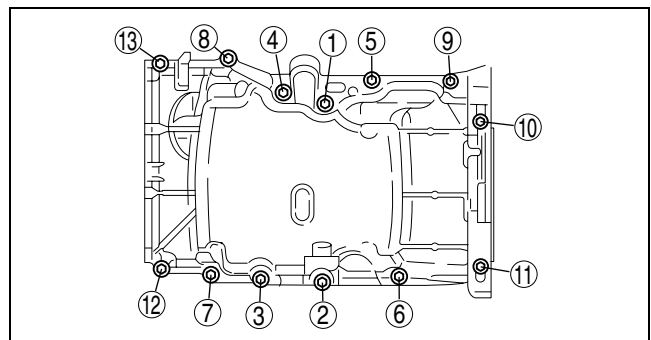
B3E0110E120

3. Tighten the rear oil pan bolts in the order as shown in the figure.

#### Tightening torque

17—23 N·m

{1.8—2.3 kgf·m, 12.6—16.9 ft·lbf}



B3E0110E122

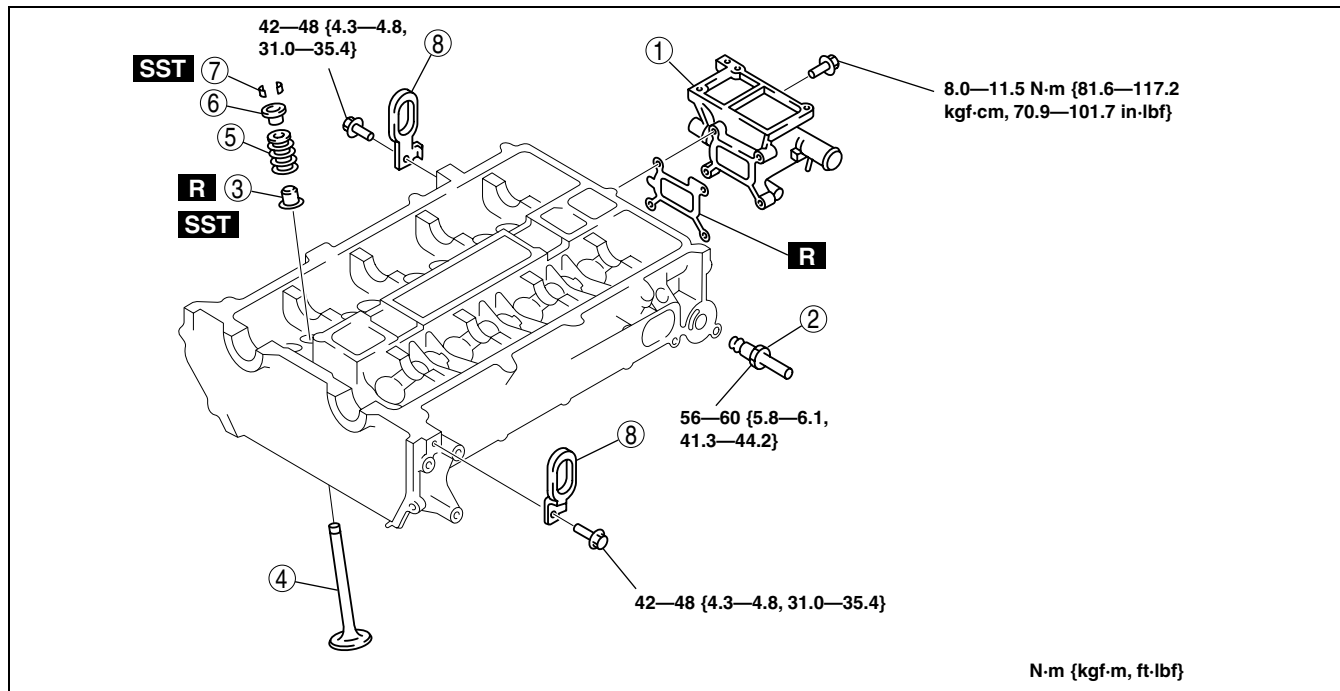


CYLINDER HEAD (I) ASSEMBLY

E5U011002000E10

01-10

1. Assemble in the order indicated in the table.



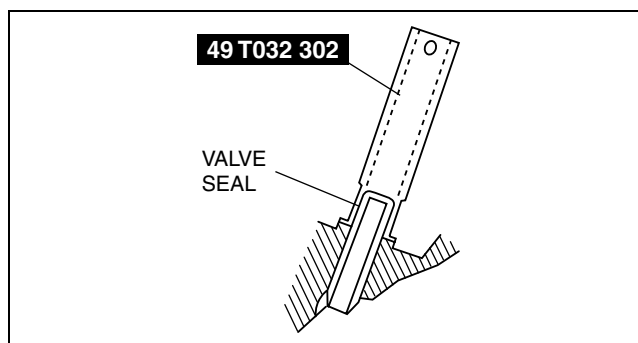
B3E0110E130

1	Water outlet
2	EGR pipe
3	Valve seal (See 01-10-35 Valve Seal Assembly Note)
4	Valve

5	Valve spring
6	Upper valve spring seat
7	Valve keeper (See 01-10-35 Valve Keeper Assembly Note)
8	Engine hanger

Valve Seal Assembly Note

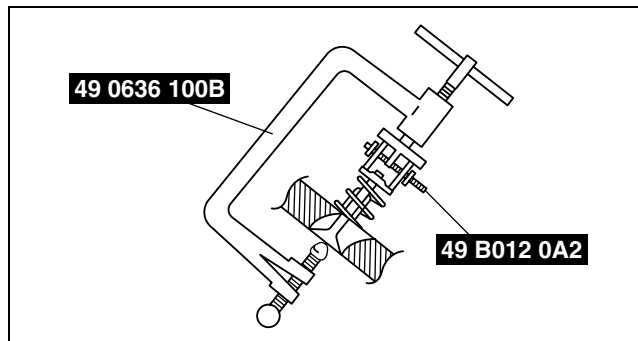
1. Press the valve seal onto the valve guide by hand.
2. Lightly tap the **SST** using a plastic hammer.



B3E0110E123

Valve Keeper Assembly Note

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



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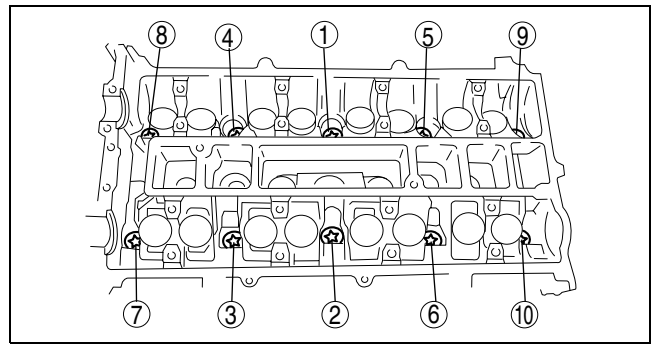


## Cylinder Head Bolt Assembly Note

1. Tighten the cylinder head bolts in the order indicated in the figure in 5 steps using the SST (49 D032 316).

### Tightening torque

- (1) 3—11 N·m  
{30.6—112 kgf·cm, 26.6—97.3 in·lbf}
- (2) 13—17 N·m  
{1.4—1.7 kgf·m, 9.6—12.5 ft·lbf}
- (3) 43—47 N·m  
{4.4—4.7 kgf·m, 31.8—34.6 ft·lbf}
- (4) 88°—92°
- (5) 88°—92°



C3U0110E054

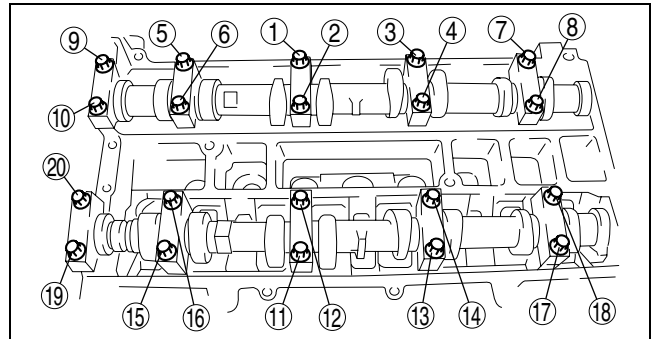
01-10

## Camshaft Assembly Note

1. Set the cam position of No.1 cylinder at the top dead center (TDC) and install the camshaft.
2. Temporarily tighten the camshaft bearing caps evenly in 2—3 steps.
3. Tighten the camshaft cap bolt in the order shown two steps.

### Tightening torque

- (1) 5.0—9.0 N·m  
{51.0—91.7 kgf·cm, 44.3—79.5 in·lbf}
- (2) 14—17 N·m  
{1.43—1.73 kgf·m, 10.4—12.5 ft·lbf}



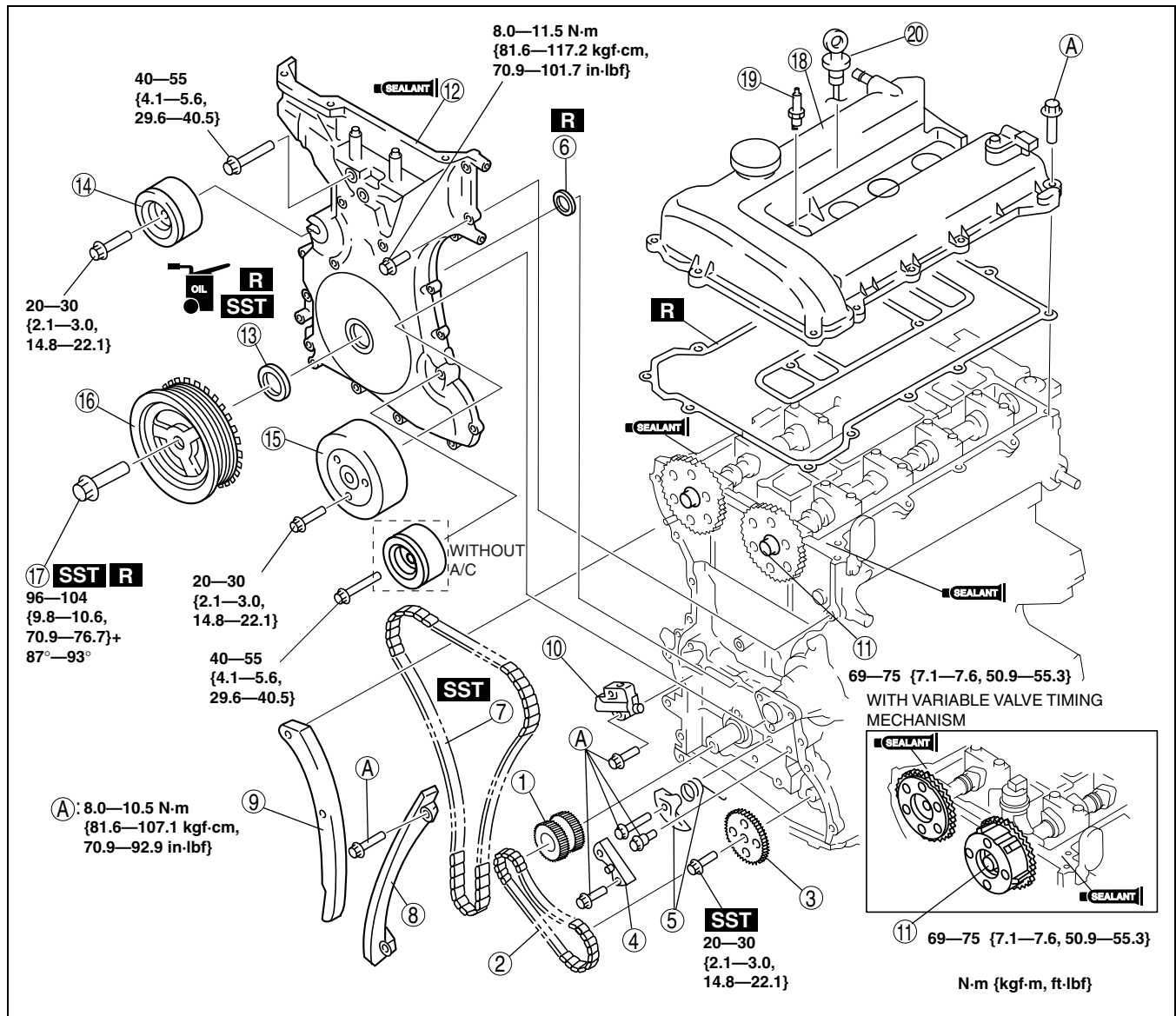
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## Camshaft Sprocket, Variable Valve Timing Actuator Assembly Note

1. Temporarily tighten the camshaft sprocket or variable valve timing actuator installation bolts by hand until the timing chain is installed.
2. Fully tighten the camshaft sprocket or variable valve timing actuator installation bolts after timing chain installation.

## TIMING CHAIN ASSEMBLY

1. Assemble in the order indicated in the table.



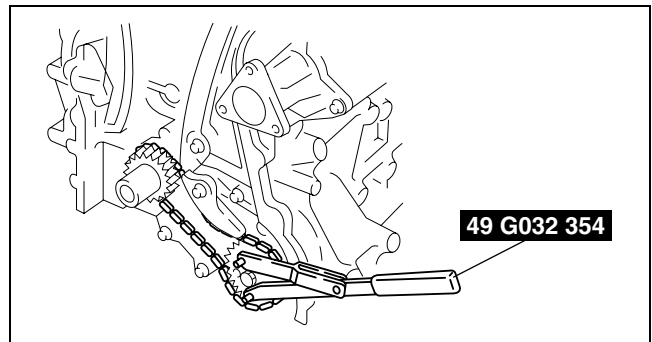
E5U110ZE7S05

1	Crankshaft sprocket
2	Oil pump chain
3	Oil pump sprocket (See 01-10-39 Oil Pump Sprocket Assembly Note.)
4	Oil pump chain guide
5	Oil pump chain tensioner
6	Seal (With variable valve timing mechanism)
7	Timing chain (See 01-10-39 Timing Chain Assembly Note.)
8	Chain guide
9	Tensioner arm
10	Chain tensioner
11	Camshaft sprocket, variable valve timing actuator (See 01-10-40 Camshaft Sprocket, Variable Valve Timing Actuator Assembly Note.)

12	Engine front cover (See 01-10-41 Engine Front Cover Assembly Note.)
13	Front oil seal (See 01-10-40 Front Oil Seal Assembly Note.)
14	Drive belt idler pulley (Without stretch-type A/C drive belt)
15	Water pump pulley
16	Crankshaft pulley
17	Crankshaft pulley lock bolt (See 01-10-41 Crankshaft Pulley Lock Bolt Assembly Note.)
18	Cylinder head cover (See 01-10-42 Cylinder Head Cover Assembly Note)
19	Spark plug
20	Dipstick (if equipped)

## Oil Pump Sprocket Assembly Note

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

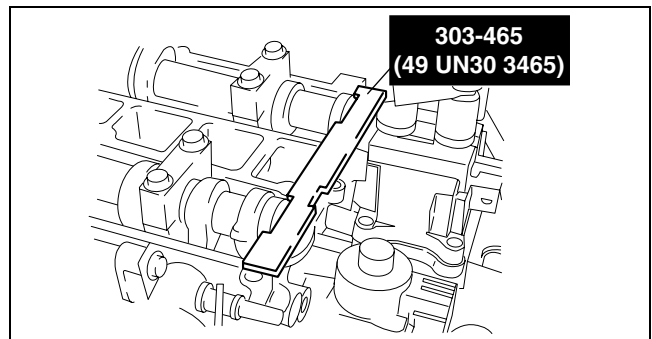


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01-10

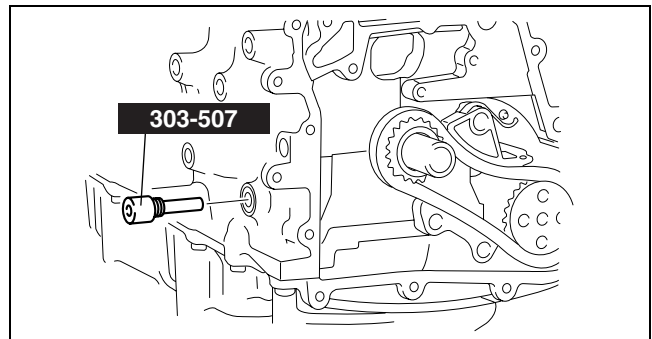
## Timing Chain Assembly Note

1. Install the **SST** to the camshaft, then align the No. 1 camshaft position with the TDC.
2. Remove the cylinder block lower blind plug.



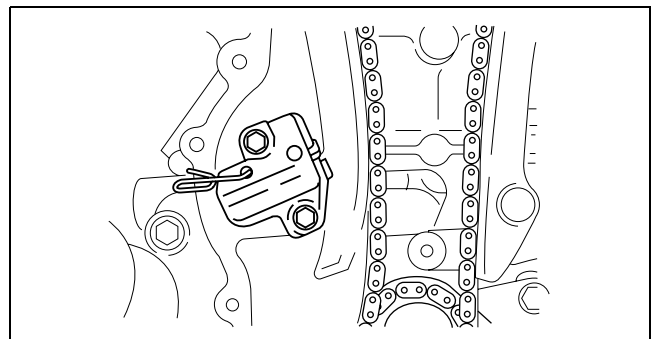
C3U0110E052

3. Install the **SST** as shown in the figure.
4. Turn the crankshaft clockwise so that the crankshaft is in the No.1 cylinder TDC position.
5. Install the timing chain.



D3U110ZE4007

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



B3E0110E126

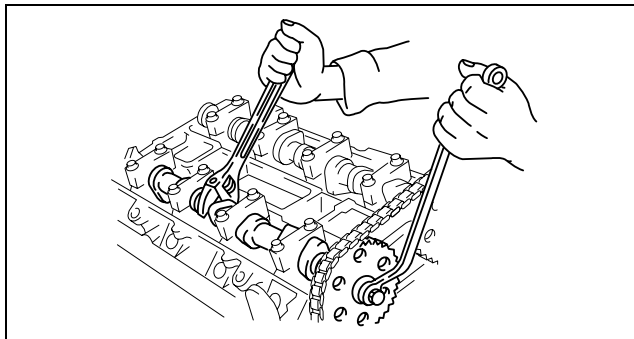
## MECHANICAL

### Camshaft Sprocket, Variable Valve Timing Actuator Assembly Note

1. Hold the camshaft using a suitable wrench on the cast hexagon as shown in the figure.
2. Tighten the camshaft sprocket lock bolt.

#### Tightening torque

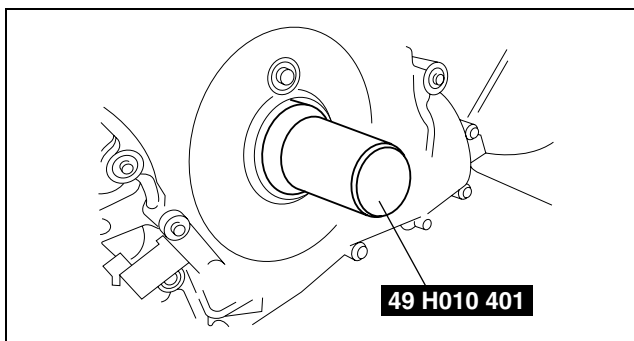
69—75 N·m {7.1—7.6 kgf·m, 50.9—55.3 ft·lbf}



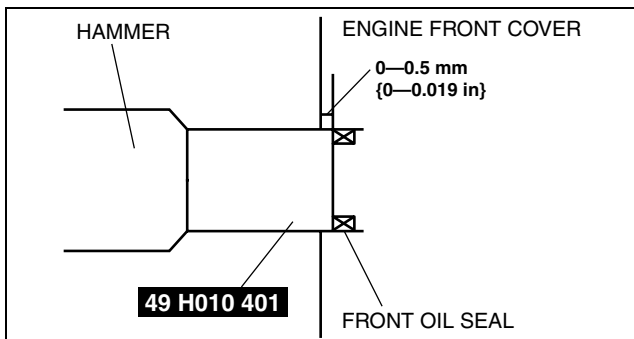
B3E0110E095

### 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.



B3E0110E127



E5U110ZE7S09

## Engine Front Cover Assembly Note

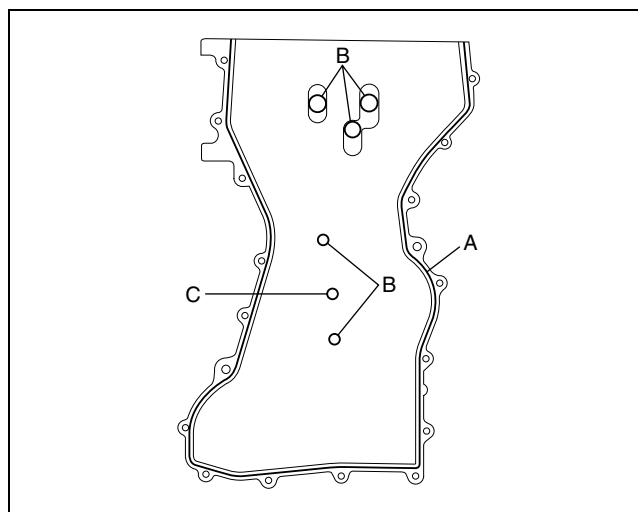
1. Apply silicone sealant to the engine front cover as shown in the figure.

### Caution

- Install the cylinder head cover within 10 min of applying the silicone sealant.
- Silicone sealant is not need in area C as indicated below due to an existing. (With variable valve timing mechanism)
- Make sure that there is no oil or dust on the seal side of oil pan.

### Thickness

- A:** 2.2—3.2 mm {0.087—0.125 in}  
**B:** 1.5—2.5 mm {0.059—0.098 in}

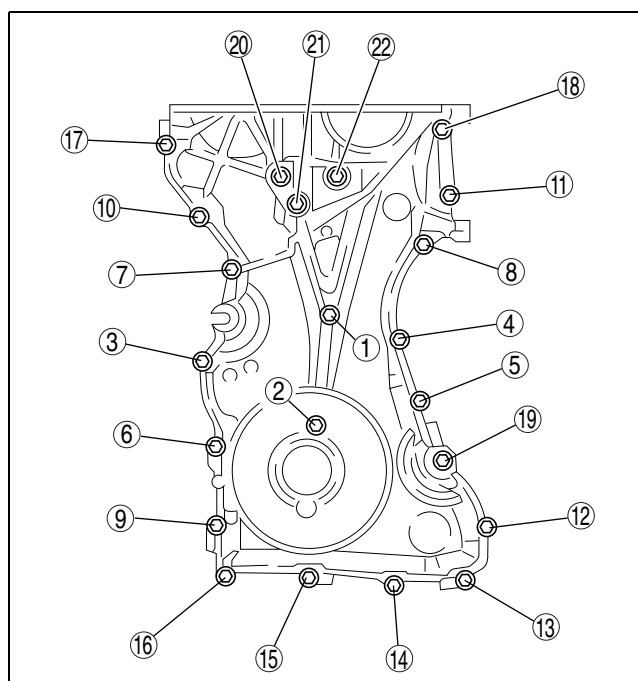


B3E0110E129

01-10

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

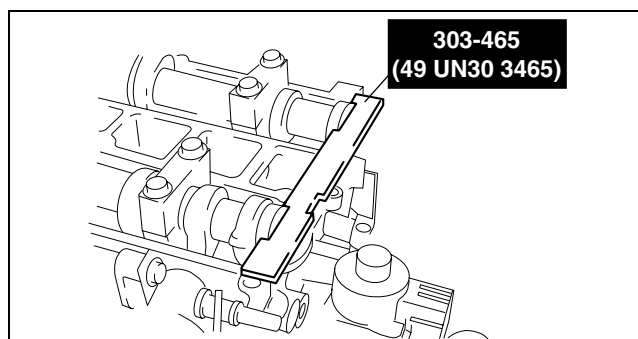
Bolt No.	Tightening torque N·m {kgf·m, ft·lbf}
1—18	8.0—11.5 N·m {81.6—117.2 kgf·cm, 70.9—101.7 in·lbf}
19—22	40—55 {4.1—5.6, 29.6—40.5}



B3E0110E062

## Crankshaft Pulley Lock Bolt Assembly Note

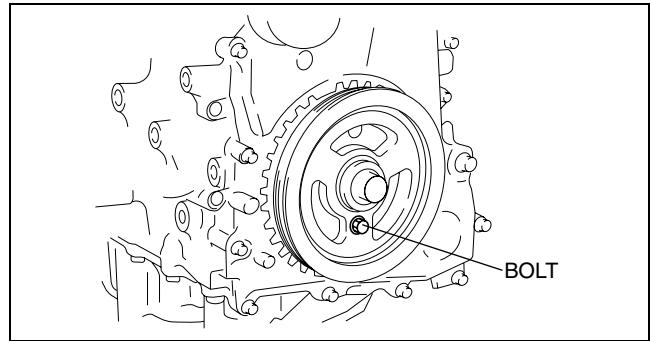
1. Install the SST to the camshaft as shown in the figure.



C3U0110E066

## MECHANICAL

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

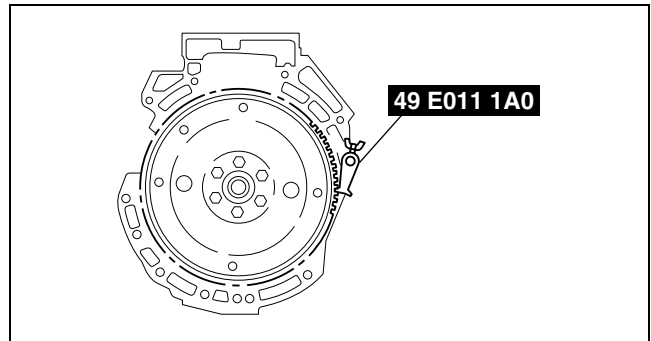


B3E0110E063

4. Hold the crankshaft pulley using the **SST**.
5. Tighten the crankshaft pulley lock bolt in the order shown following two steps using the **SST (49 D032 316)**.

### Tightening torque

- (1) 96—104 N·m  
{9.8—10.6 kgf·m, 70.9—76.7 ft·lbf}
- (2) 87°—93°



E5U110ZE7S11

6. Remove the M6 × 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

18—22 N·m {1.9—2.2 kgf·m, 13.3—16.2 ft·lbf}

### Cylinder Head Cover Assembly Note

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

#### Caution

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

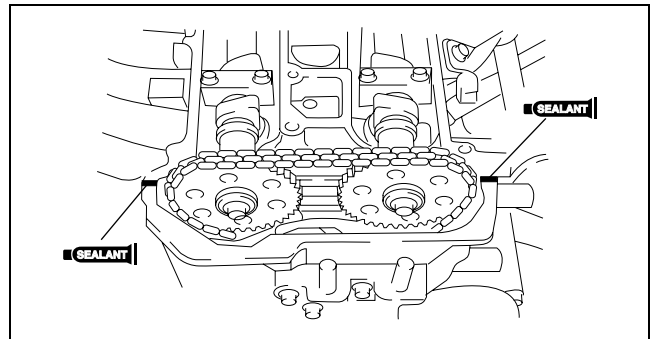
#### Dot diameter

4.0—6.0 mm {0.16—0.23 in}

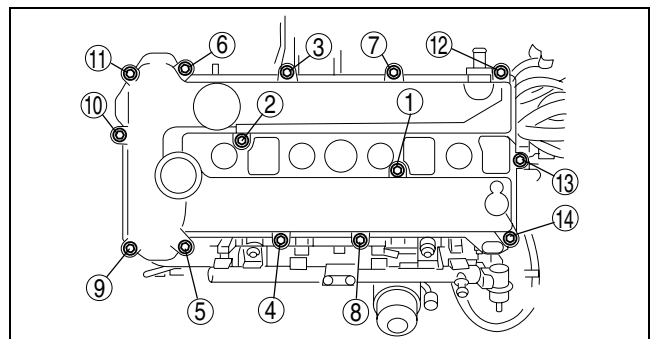
2. Install the cylinder head cover with a new gasket.
3. Tighten the bolts in the order shown in the figure.

### Tightening torque

8.0 —10.5 N·m  
{81.6—107.1 kgf·cm, 70.9—92.9 in·lbf}



B3E0110E064



B3E0110W050



# 01-50 TECHNICAL DATA

ENGINE TECHNICAL DATA . . . . . 01-50-1

## ENGINE TECHNICAL DATA

E5U01500000E01

01-50

Item	Specification
Cylinder head gasket contact surface distortion (Maximum)	0.10 mm {0.004 in}
Manifold contact surfaces distortion (Maximum)	0.10 mm {0.004 in}
Manifold contact surfaces distortion (Maximum grinding)	0.15 mm {0.006 in}
Valve head margin thickness (Minimum)	IN: 1.62 mm {0.0637 in} EX: 1.82 mm {0.0716 in}
Valve length (Standard)	IN: 102.99—103.79 mm {4.055—4.086 in} EX: 104.25—105.05 mm {4.105—4.135 in}
Valve length (Minimum)	IN: 102.99 mm {4.055 in} EX: 104.25 mm {4.104 in}
Valve stem diameter (Standard)	IN: 5.470—5.485 mm {0.2154—0.2159 in} EX: 5.465—5.480 mm {0.2152—0.2157 in}
Valve stem diameter (Minimum)	IN: 5.440 mm {0.2142 in} EX: 5.435 mm {0.2140 in}
Valve guide inner diameter (Standard)	5.509—5.539 mm {0.2169—0.2180 in}
Valve stem to guide clearance (Standard)	IN: 0.024—0.069 mm {0.0009—0.0027 in} EX: 0.029—0.074 mm {0.0012—0.0029 in}
Valve stem to guide clearance (Maximum)	0.10 mm {0.004 in}
Valve guide protrusion height (standard)	12.2—12.8 mm {0.481—0.503 in}
Valve seat contact width (Standard)	1.2—1.6 mm {0.048—0.062 in}
Valve protrusion height (Standard)	IN: 40.64—42.24 mm {1.600—1.662 in} EX: 40.50—42.10 mm {1.595—1.657 in}
Valve spring pressing force	390 N {39.76 kgf, 87.67 lbf}
Valve spring standard height H	28.68 mm {1.129 in}
Valve spring out-of-square (Maximum)	1.95 mm {0.0767 in}
Maximum runout (Maximum)	0.03 mm {0.0012 in}
Camshaft standard height (mm {in})	With variable valve timing mechanism IN: 42.44 {1.671} EX: 41.18 {1.621} Without variable valve timing mechanism IN: 42.12 {1.659} EX: 41.08 {1.618}
Camshaft minimum height (mm {in})	With variable valve timing mechanism IN: 42.33 {1.666} EX: 41.06 {1.616} Without variable valve timing mechanism IN: 42.01 {1.653} EX: 40.96 {1.612}
Camshaft journal diameter (Standard)	24.96—24.98 mm {0.9827—0.9834 in}
Camshaft journal diameter (Minimum)	24.95 mm {0.982 in}
Camshaft journal oil clearance (Standard)	0.035—0.080 mm {0.0014—0.0031 in}
Camshaft journal oil clearance (Maximum)	0.09 mm {0.0035 in}
Camshaft end play (Standard)	0.09—0.24 mm {0.0035—0.0094 in}
Camshaft end play (Maximum)	0.25 mm {0.0098 in}
Tappet bore diameter (Standard)	31.000—31.030 mm {1.2205—1.2216 in}
Tappet diameter (Standard)	30.970—30.980 mm {1.2193—1.2196 in}
Tappet-to-Tappet bore oil clearance (Standard)	0.02—0.06 mm {0.0008—0.0023 in}
Tappet-to-Tappet bore oil clearance (Maximum)	0.15 mm {0.006 in}
Cylinder head gasket contact surfaces distortion (Maximum)	0.10 mm {0.004 in}
Cylinder bore diameter (Standard)	87.500—87.530 mm {3.4449—3.4460 in}

## TECHNICAL DATA

Item	Specification
Minimum / maximum bore diameter limit	87.440—87.590 mm {3.4425—3.4484 in}
Oil jet valve air pressure	216—274 kPa {2.2—2.7 kgf·cm <sup>2</sup> 31.4—39.7 psi}
Piston diameter (Standard)	87.465—87.495 mm {3.4435—3.4446 in}
Piston-to-cylinder clearance (Standard)	0.025—0.045 mm {0.0010—0.0017 in}
Piston-to-cylinder clearance (Maximum)	0.11 mm {0.0043 in}
Piston ring-to-ring groove clearance (Standard)	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}
Piston ring-to-ring groove clearance (Maximum)	Top: 0.17 mm {0.0067 in} Second, Oil: 0.15 mm {0.0059 in}
Piston end gap (Standard)	Top: 0.16—0.31 mm {0.0063—0.0122 in} Second: 0.33—0.48 mm {0.0130—0.0189 in} Oil (rail): 0.20—0.70 mm {0.0079—0.0275 in}
Piston end gap (Maximum)	1.0 mm {0.0393 in}
Crankshaft end play (Standard)	0.22—0.45 mm {0.0087—0.0177 in}
Crankshaft end play (Maximum)	0.55 mm {0.0216 in}
Crankshaft runout (Maximum)	0.05 mm {0.0019 in}
Main journal bearing size	STD: 51.980—52.000 mm {2.0464—2.0472 in} US0.25: 51.730—51.750 mm {2.0366—2.0373 in}
Main journal out of round (Maximum)	0.05 mm {0.0019 in}
Crank pin journal diameter [LF]	STD: 46.980—47.000 mm {1.8497—1.8503 in} US0.25: 46.730—46.750 mm {1.8398—1.8405 in}
Crank pin journal diameter [L3]	STD: 49.980—50.000 mm {1.9677—1.9685 in} US0.25: 49.730—49.750 mm {1.9579—1.9586 in}
Crank pin out of round (Maximum)	0.05 mm {0.0019 in}
Main journal oil clearance (Standard)	0.019—0.035 mm {0.0007—0.0013 in}
Main journal oil clearance (Maximum)	0.10 mm {0.0039 in}
Main bearing size	STD: 2.506—2.509 mm {0.0987—0.0988 in} OS0.25: 2.628—2.634 mm {0.1034—0.1037 in}
Connecting rod side clearance (Standard)	0.14—0.36 mm {0.0056—0.0141 in}
Connecting rod side clearance (Maximum)	0.435 mm {0.0172 in}
Connecting rod bearing oil clearance (Standard)	0.026—0.052 mm {0.0011—0.0020 in}
Connecting rod bearing oil clearance (Maximum)	0.1 mm {0.0039 in}
Connecting rod bearing size [LF]	STD: 1.498—1.504 mm {0.0589—0.0592 in} OS0.25: 1.623—1.629 mm {0.0639—0.0641 in}
Connecting rod bearing size [L3]	STD: 1.496—1.502 mm {0.0589—0.0591 in} OS0.25: 1.621—1.627 mm {0.0639—0.0641 in}
Bolt length (mm {in})	Cylinder head bolt (With washer) Standard: 149.2—149.8 {5.87—5.90} Maximum: 150.5 {5.91} Cylinder head bolt (Without washer) Standard: 145.2—145.8 {5.72—5.74} Maximum: 146.5 {5.77} Connecting rod bolt Standard: 44.7—45.3 {1.75—1.78} Maximum: 46.0 {1.81} Main bearing cap bolt (Plastic region tightening bolt only) Standard: 110.0—110.6 {4.33—4.35} Maximum: 111.3 {4.38}
Valve clearance [Engine cold]	IN: 0.22—0.28 mm {0.0087—0.0110 in} EX: 0.27—0.33 mm {0.0106—0.0130 in}
Value range	0.005—0.101 mm {0.00019—0.0039 in}

# 01-60 SERVICE TOOLS

ENGINE SST ..... 01-60-1

## ENGINE SST

E5U016002000E01

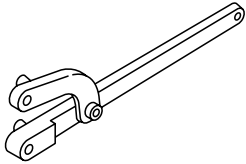
01-60

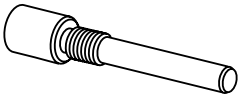
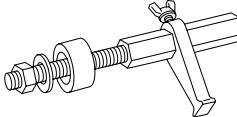
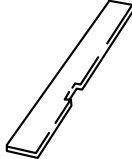
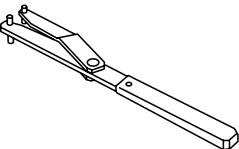
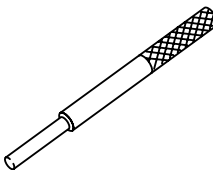
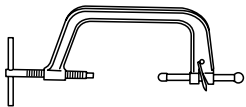
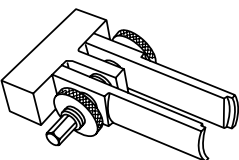
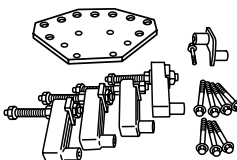
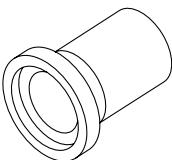
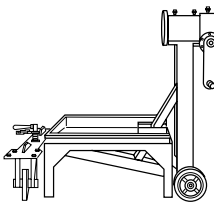

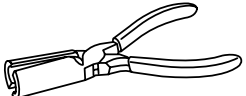
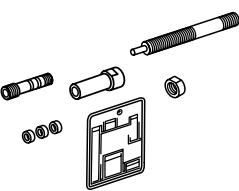
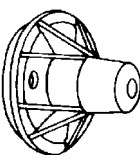
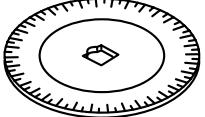
1: Mazda **SST** number  
2: Global **SST** number

### Example

1:49 UN20 5072  
2:205-072

Holder



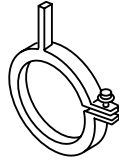
<p>1: - 2:303-507</p> <p>Crankshaft TDC setting peg</p> 	<p>1:49 E011 1A0 2: -</p> <p>Ring gear brake set</p> 	<p>1:49 UN30 3465 2: 303-465</p> <p>Camshaft Alignment timing Tool</p> 
<p>1:49 G032 354 2: -</p> <p>Adjusting wrench</p> 	<p>1:49 B012 015 2: -</p> <p>Valve guide installer</p> 	<p>1:49 0636 100B 2: -</p> <p>Valve spring lifter arm</p> 
<p>1:49 B012 0A2 2: -</p> <p>Pivot</p> 	<p>1:49 L010 1A0 2: -</p> <p>Engine hanger set</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 T032 302 2: -</p> <p>Bearing installer</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 UN30 3328 2: 303-328</p> <p>Rear oil seal replacer</p> 	<p>1:49 D032 316 2: -</p> <p>Protractor</p> 

## SERVICE TOOLS

1:49 G011 201

2: -

Attachment



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