

# HOW TO USE THIS MANUAL

BHE00000001E01

## Range of Topics

• This manual contains procedures for performing all required service operations. The procedures are divided into the following five basic operations:

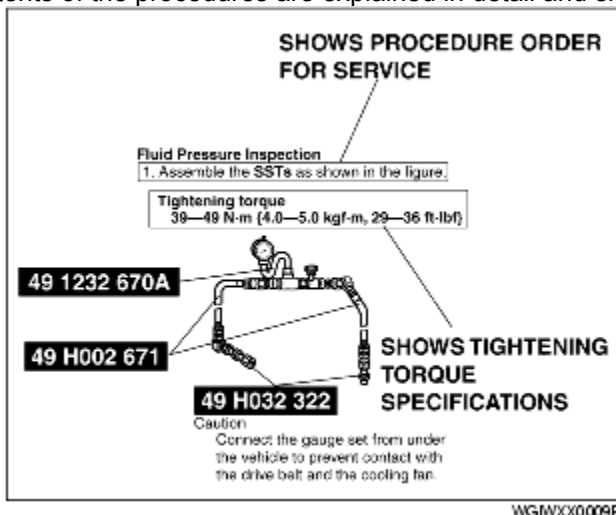
- Removal/Installation
- Disassembly/Assembly
- Replacement
- Inspection
- Adjustment

• 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.

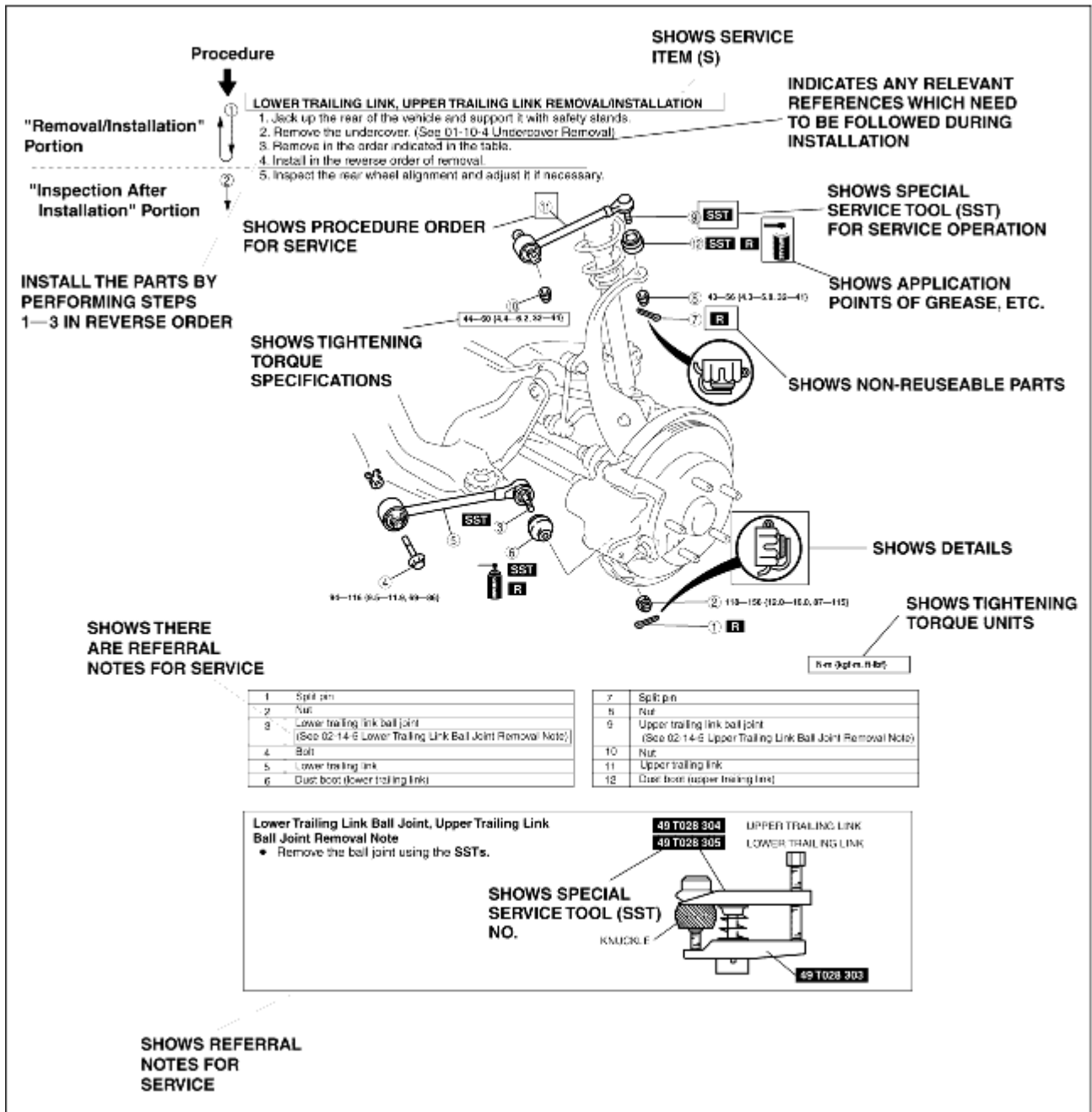


## Repair procedure

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.










BHE0000/W104

## 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.

# UNITS

BHE00000002E01

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)
	fl oz (fluid ounce)
Weight	g (gram)
	oz (ounce)

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

- 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  $2.7 \text{ kgf/cm}^2$  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  $2.7 \text{ kgf/cm}^2$  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.

# NEW STANDARDS

BHE00000003E02

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

New Standard		Previous Standard		Remark
Abbreviation	Name	Abbreviation	Name	
AP	Accelerator Pedal	-	Accelerator Pedal	
ACL	Air Cleaner	-	Air Cleaner	
A/C	Air Conditioning	-	Air Conditioning	
BARO	Barometric Pressure	-	Atmospheric Pressure	
B+	Battery Positive Voltage	Vb	Battery Voltage	
-	Brake Switch	-	Stoplight Switch	
-	Calibration Resistor	-	Corrected Resistance	#6
CMP sensor	Camshaft Position Sensor	-	Crank Angle Sensor	
CAC	Charge Air Cooler	-	Intercooler	
CLS	Closed Loop System	-	Feedback System	
CTP	Closed Throttle Position	-	Fully Closed	
CPP	Clutch Pedal Position	-	Idle Switch	
CIS	Continuous Fuel Injection System	-	Clutch Position	
CS sensor	Control Sleeve Sensor	CSP sensor	Control Sleeve Position Sensor	#6
CKP sensor	Crankshaft Position Sensor	-	Crank Angle Sensor 2	
DLC	Data Link Connector	-	Diagnosis Connector	
DTM	Diagnostic Test Mode	-	Test Mode	#1
DTC	Diagnostic Trouble Code(s)	-	Service Code(s)	
DI	Distributor Ignition	-	Spark Ignition	
DLI	Distributorless Ignition	-	Direct Ignition	
EI	Electronic Ignition	-	Electronic Spark Ignition	#2
ECT	Engine Coolant Temperature	-	Water Thermo	
EM	Engine Modification	-	Engine Modification	
-	Engine Speed Input Signal	-	Engine RPM Signal	
EVAP	Evaporative Emission	-	Evaporative Emission	
EGR	Exhaust Gas Recirculation	-	Exhaust Gas Recirculation	
FC	Fan Control	-	Fan Control	
FF	Flexible Fuel	-	Flexible Fuel	

4GR	Fourth Gear	-	Overdrive	
-	Fuel Pump Relay	-	Circuit Opening Relay	#3
FSO solenoid	Fuel Shut Off Solenoid	FCV	Fuel Cut Valve	#6
GEN	Generator	-	Alternator	
GND	Ground	-	Ground/Earth	
HO2S	Heated Oxygen Sensor	-	Oxygen Sensor	With heater
IAC	Idle Air control	-	Idle Speed Control	
-	IDM Relay	-	Spill Valve Relay	#6
-	Incorrect Gear Ratio	-	-	
-	Injection Pump	FIP	Fuel Injection Pump	#6
-	Input/Turbine Speed Sensor	-	Pulse Generator	
IAT	Intake Air Temperature	-	Intake Air Thermo	
KS	Knock Sensor	-	Knock Sensor	
MIL	Malfunction Indicator Lamp	-	Malfunction Indicator Light	
MAP	Manifold Absolute Pressure	-	Intake Air Pressure	
MAF sensor	Mass Air Flow Sensor	-	Airflow Sensor	
MFL	Multiport Fuel Injection	-	Multiport Fuel Injection	
OBD	On-Board Diagnostic	-	Diagnosis/SelfDiagnosis	
OL	Open Loop	-	Open Loop	
-	Output Speed Sensor	-	Vehicle Speed Sensor 1	
OC	Oxidation Catalytic Converter	-	Catalytic Converter	
O2S	Oxygen Sensor	-	Oxygen Sensor	
PNP	Park/Neutral Position	-	Park/Neutral Range	
-	PCM Control Relay	-	Main Relay	#6
PSP	Power Steering Pressure	-	Power Steering Pressure	
PCM	Powertrain Control Module	ECU	Engine Control Unit	#4
-	Pressure Control Solenoid	-	Line Pressure Solenoid Valve	
PAIR	Pulsed Secondary Air Injection	-	Secondary Air Injection System	Pulsed injection
-	Pump Speed Sensor	-	NE Sensor	#6
AIR	Secondary Air Injection	-	Secondary Air Injection System	Injection with air pump
SAPV	Secondary Air Pulse Valve	-	Reed Valve	
SFI	Sequential Multipoint Fuel Injection	-	Sequential Fuel Injection	
-	Shift Solenoid A	-	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

# FUNDAMENTAL PROCEDURES

---

BHE000000004E01

## Preparation of Tools and Measuring Equipment

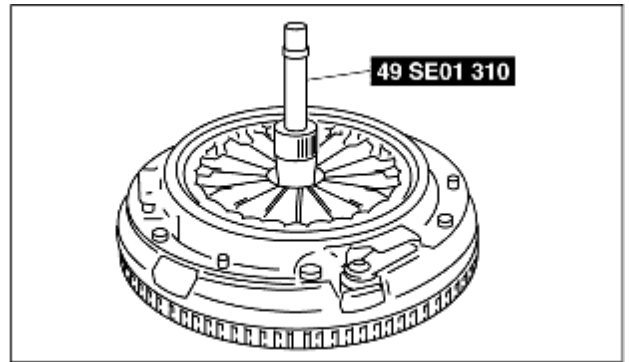
- Be sure that all necessary tools and measuring equipment are available before starting any work.



CHU0014W003

## Special Service Tools

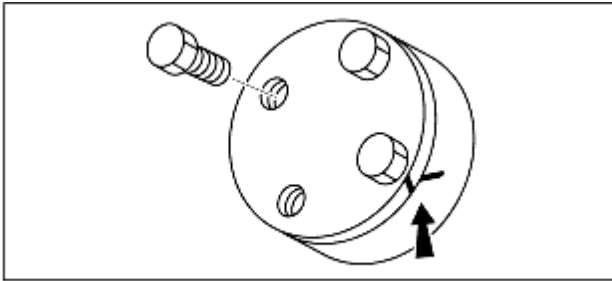
- Use special service tools or equivalent when they are required.



WGMXX0024E

## 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.



WGMXX0027E

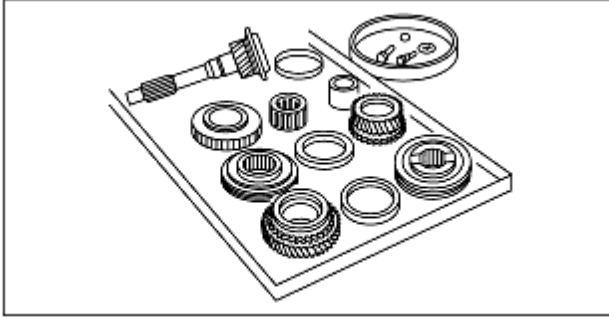
## Inspection During Removal, Disassembly

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



## 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.



## Cleaning of Parts

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

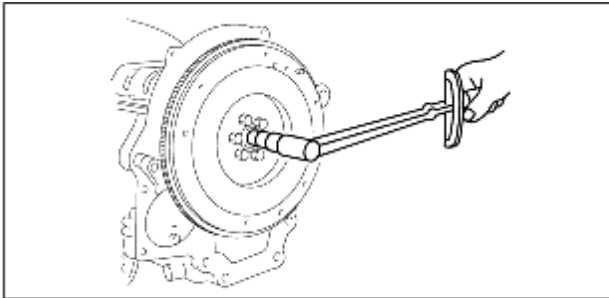


### Warning

- 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.

## Reassembly

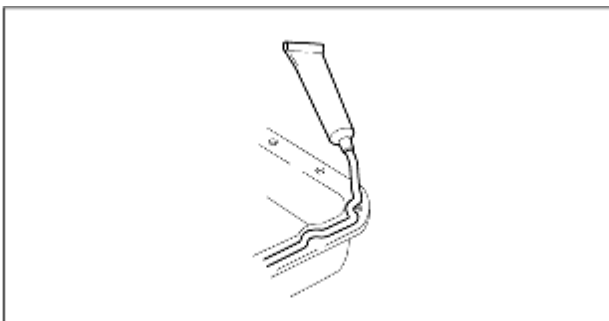
- Standard values, such as torques and certain adjustments, must be strictly observed in the reassembly of all parts.



- If removed, the following parts should be replaced with new ones:

- Oil seals
- Gaskets
- O-rings
- Lockwashers
- Cotter pins
- Nylon nuts

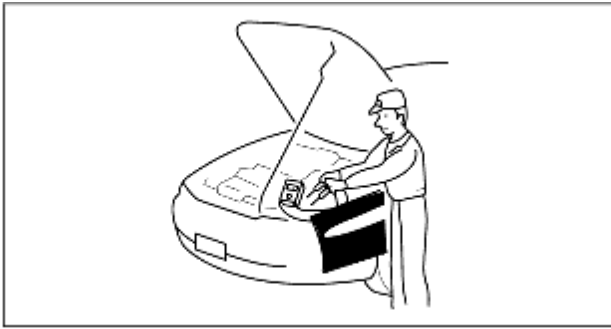
- Depending on location:



- 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.

## Adjustment

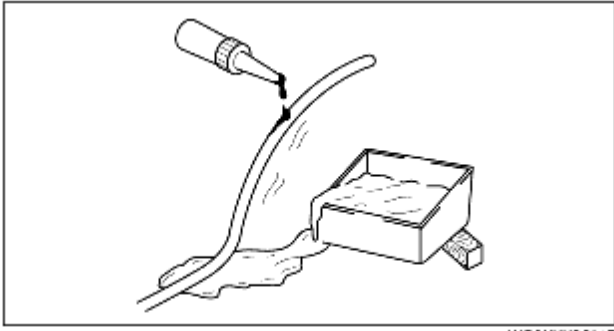
- Use suitable gauges and testers when making adjustments.



CHU0014W005

## Rubber Parts and Tubing

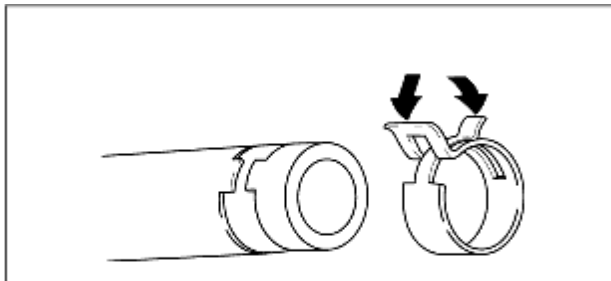
- Prevent gasoline or oil from getting on rubber parts or tubing.



WGMXX0034E

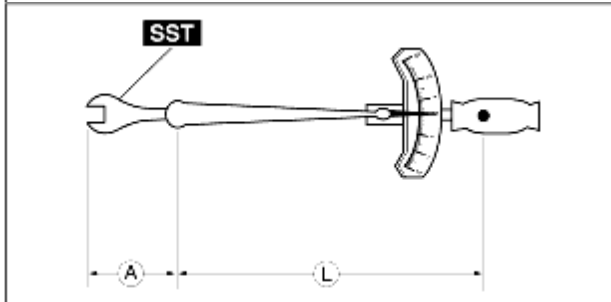
## Hose Clamps

- 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.



## 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.



WGMXX00036E

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

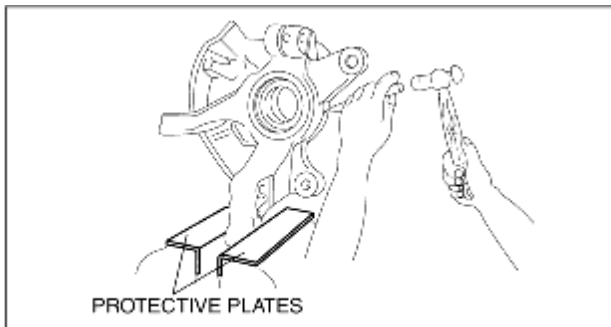
A : The length of the **SST** past the torque wrench

drive.

L : The length of the torque wrench.

## Vise

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



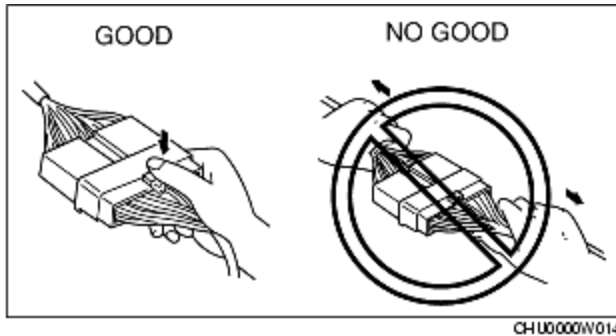
CHU0014W010

# ELECTRICAL SYSTEM

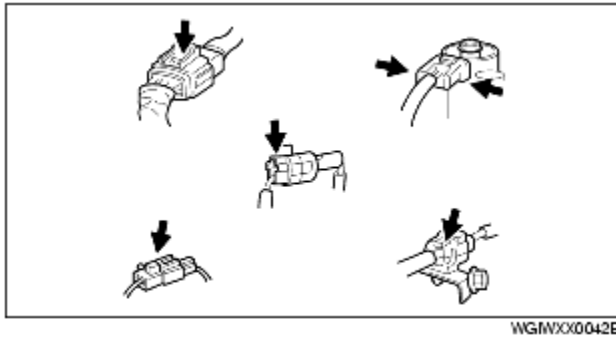
BHE00000006E01

## Connectors

### Disconnecting connectors

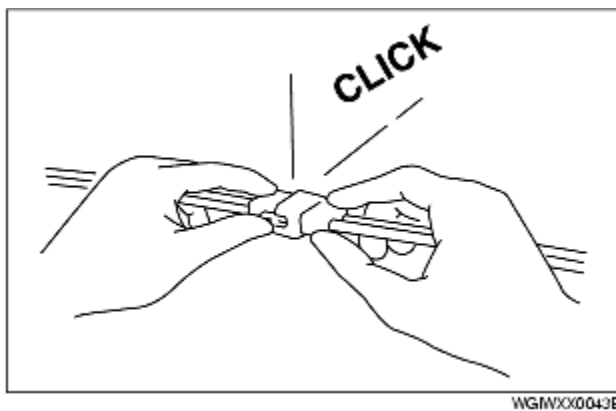


- When disconnecting connector, grasp the connectors, not the wires.



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

### Locking connector

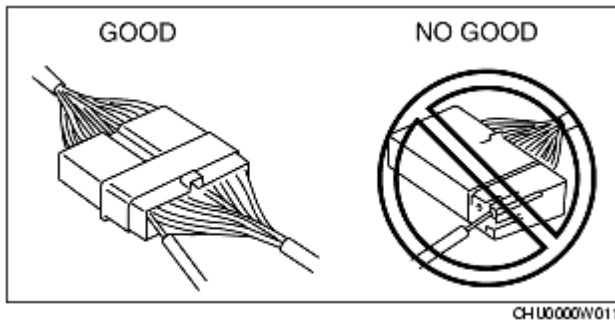


- When locking connectors, listen for a click indicating they are securely locked.

### Inspection

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

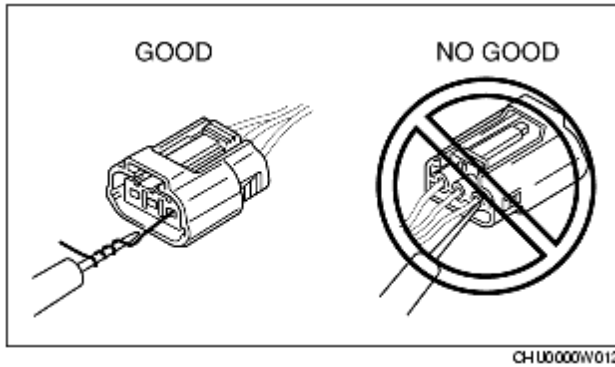




- Inspect the terminals of waterproof connectors from the connector side since they cannot be accessed from the wiring harness side.

**Caution**

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



# ABBREVIATIONS

---

BHE00000011E01

AT	Automatic Transmission
MT	Manual Transmission
SST	Special Service Tool

# ENGINE TECHNICAL DATA

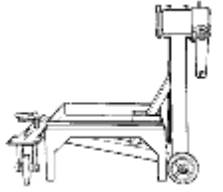

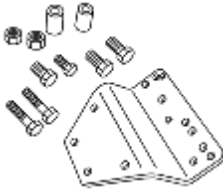

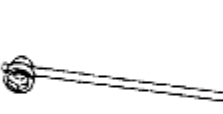
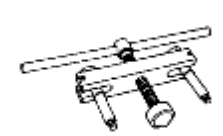
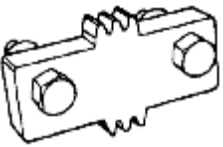

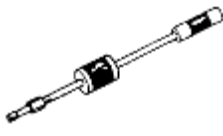

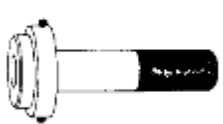
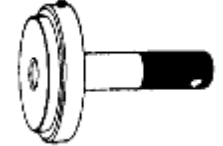

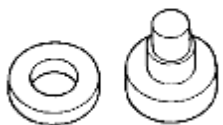

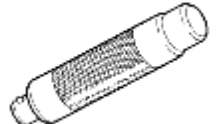


BHE015001001E01

ITEMS	ENGINE TYPE		
	13B-MSP		
	STANDARD POWER	HIGH POWER	
<b>SIDE HOUSING (FRONT, INTERMEDIATE, REAR) INSPECTION</b>			
Maximum distortion	(mm {in})	0.04 {0.0016}	
Maximum wear (Vertical wear)	(mm {in})	0.10 {0.0039}	
Maximum wear (Convex oval)	(mm {in})	Oil seal inner path	0.01 {0.0004}
		Oil seal outer path	0.10 {0.0039}
Maximum wear (Oil seal stepped path wear)	(mm {in})	0.02 {0.0008}	
<b>ROTOR HOUSING</b>			
Maximum width difference	(mm {in})	0.06 {0.0024}	
<b>ROTOR</b>			
Rotor and side housing clearance	(mm {in})	Standard	0.05-0.19 {0.0020-0.0074}
		Maximum	0.05 {0.002}
Protrusion of the rotor round	(mm {in})	Standard	0.12-0.18 {0.0048-0.0070}
		Minimum	0.1 {0.0039}
Apex seal groove and the apex seal clearance	(mm {in})	Standard	0.042-0.101 {0.0017-0.0039}
		Maximum	0.15 {0.0059}
<b>APEX SEAL, APEX SEAL SPRING</b>			
Apex seal height	(mm {in})	Standard	5.3 {0.20}
		Minimum	4.3 {0.17}
Apex seal spring height	(mm {in})	Standard	5.4 {0.213}
		Minimum	3.5 {0.148}
<b>CORNER SEAL, CORNER SEAL SPRING</b>			
Minimum projection of the corner seal	(mm {in})	0.5 {0.02}	
<b>SIDE SEAL, SIDE SEAL SPRING</b>			
Corner seal and side seal clearance	(mm {in})	Standard	0.05-0.15 {0.0020-0.0059}
		Maximum	0.4 {0.016}
Minimum projection of the side seal	(mm {in})	0.5 {0.02}	
<b>CUT-OFF SEAL, CUT OFF SEAL SPRING</b>			

Cut-off seal height	(mm {in})	Standard	3.95 {0.1555}	
		Minimum	3.8 {0.15}	
Minimum projection of the cut off seal	(mm {in})		0.5 {0.02}	
<b>OIL SEAL, OIL SEAL SPRING</b>				
Maximum contact width	(mm {in})		0.5 {0.02}	
Maximum circumferential width	(mm {in})		2.5 {0.098} (or 10 nicks or more)	
Minimum projection of the oil seal	(mm {in})		0.5 {0.02}	
<b>ECCENTRIC SHAFT</b>				
Main bearing oil clearance	(mm {in})	Standard	0.055-0.075 {0.0022-0.0029}	0.045-0.085 {0.0018-0.0033}
		Maximum	0.1 {0.0039 in}	
Rotor bearing oil clearance	(mm {in})	Standard	0.06-0.08 {0.0024-0.0030}	
		Maximum	0.1 {0.0039}	
Runout	(mm {in})	Standard	0.02 {0.0008}	
		Maximum	0.06 {0.0024}	
End play	(mm {in})	Standard	0.04-0.09 {0.0016-0.0035}	
		Maximum	0.1 {0.0039}	
<b>ECCENTRIC SHAFT BYPASS VALVE</b>				
Minimum projection	(mm {in})		6 {0.24}	
<b>OIL PUMP</b>				
Side clearance	(mm {in})	Standard	0.20-0.25 {0.0079-0.0098}	
		Maximum	0.3 {0.0118}	
Tip clearance	(mm {in})	Standard	0.03-0.12 {0.0012-0.0047}	
		Maximum	0.15 {0.0059}	
Body clearance	(mm {in})	Standard	0.03-0.125 {0.0012-0.0049}	
		Maximum	0.15 {0.0059}	

# ENGINE SST

BHE016001001E01

<p>49 0107 680A</p> <p>Engine stand</p>		<p>49 L010 1A0</p> <p>Engine hanger set</p>		<p>49 J010 3A0A</p> <p>Hanger, Engine stand</p>	
<p>49 1881 055A</p> <p>Stopper counter weight (AT)</p>		<p>49 0820 035</p> <p>Flywheel box wrench</p>		<p>49 0839 305A</p> <p>Counterweight puller</p>	
<p>49 F011 101</p> <p>Ring gear brake (MT)</p>		<p>49 0813 250</p> <p>Seal case</p>		<p>49 0813 215A</p> <p>Dowel puller and oil pump puller</p>	
<p>49 0813 225A</p> <p>Oil seal remover</p>		<p>49 0813 235</p> <p>Main bearing puller and installer</p>		<p>49 0813 240</p> <p>Rotor bush puller and installer</p>	
<p>49 0839 165</p> <p>Corner seal gauge</p>		<p>49 F011 1A1</p> <p>Bearing installer set (MT)</p>		<p>49 1285 071</p> <p>Needle bearing puller (MT)</p>	
<p>49 G030 797</p> <p>Handle (MT)</p>		<p>49 F010 401A</p> <p>Installer</p>		<p>49 J027 001</p> <p>Bearing installer</p>	

# ENGINE OVERHAUL SERVICE WARNING

---

BHE011002000E01

## **Warning**

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

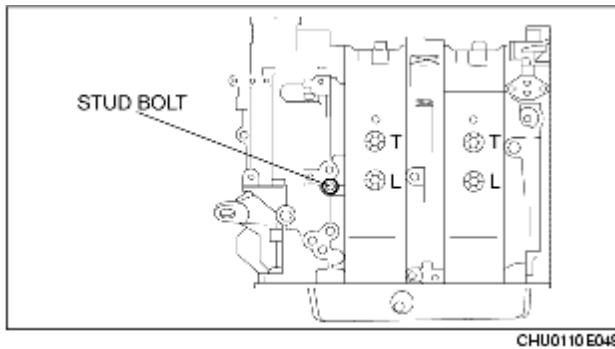
# ENGINE MOUNTING/DISMOUNTING

BHE011002000E02

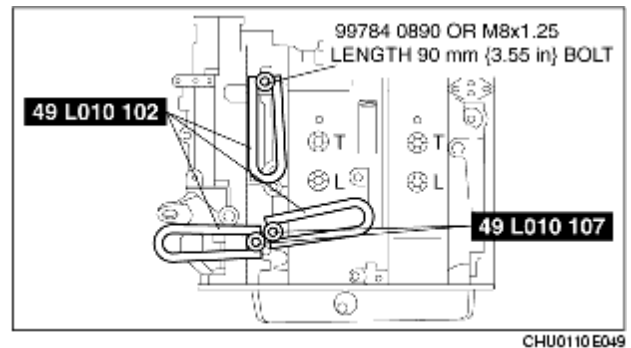
## Mounting

### Using 49 L010 1A0

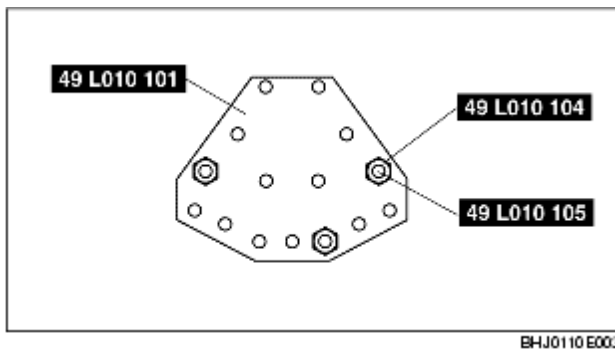
1. Remove the stud bolt.



2. Install the **SSTs** (arms) to the specified three position as shown in the figure, and temporarily tighten with the **SSTs** (bolts) and **99784 0890 or M8x1.25 length 90 mm {3.55 in}** bolt.



3. Install the **SSTs** (bolt, nut) to the three specified positions as shown in the figure.

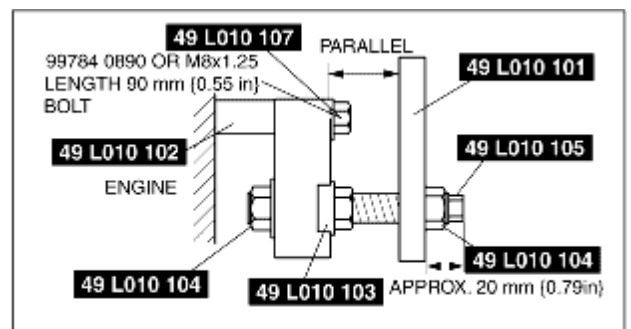


4. Install the **SSTs** (bolts, nuts, hook, plate) in Step 3 to the **SST** (arms, bolts) set in Step 2.

5. Adjust the bolt threads by turning them so that they project **approx. 20 mm {0.79 in}** from the plate end.

6. Adjust the bolts and nuts so that the plate and arms are parallel.

7. Mount the engine to the **SST** (engine stand).



8. Remove the oil pan drain plug and drain the engine oil.

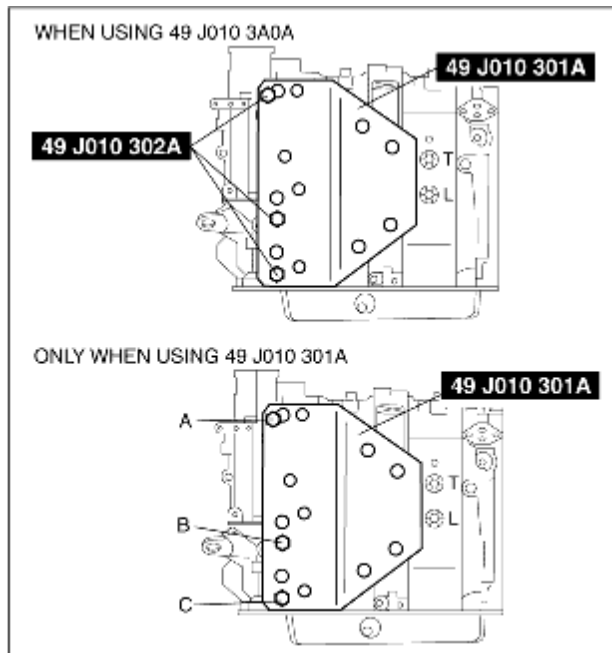
9. Replace with a new washer and install the oil pan drain plug.

### Tightening torque

29.4-39.2 N·m {3.00-3.99 kgf·m, 21.7-28.9 ft·lbf}

## Using 49 J010 3A0A

1. Install the **SSTs** to the position shown in the figure.



A	M8×1.25 length 25 mm {1.28 in} bolt
B	99940 1201 (left side engine mount installation nut) or M12×1.5 nut
C	99756 1230 (left side engine mount installation nut) + washer

2. Mount the engine to the **SST** (engine stand).
3. Remove the oil pan drain plug and drain the engine oil.
4. Install the oil pan drain plug with a new washer.

### Tightening torque

**29.4-39.2 N·m {3.00-3.99 kgf·m, 21.7-28.9 ft·lbf}**

## Dismounting

1. Dismount in the reverse order of mounting.

2. Tighten the stud bolt. (Only when using 49 L010 101.)

### Tightening torque

**14.7-34.3 N·m {1.50-3.49 kgf·m, 10.9-25.2 ft·lbf}**

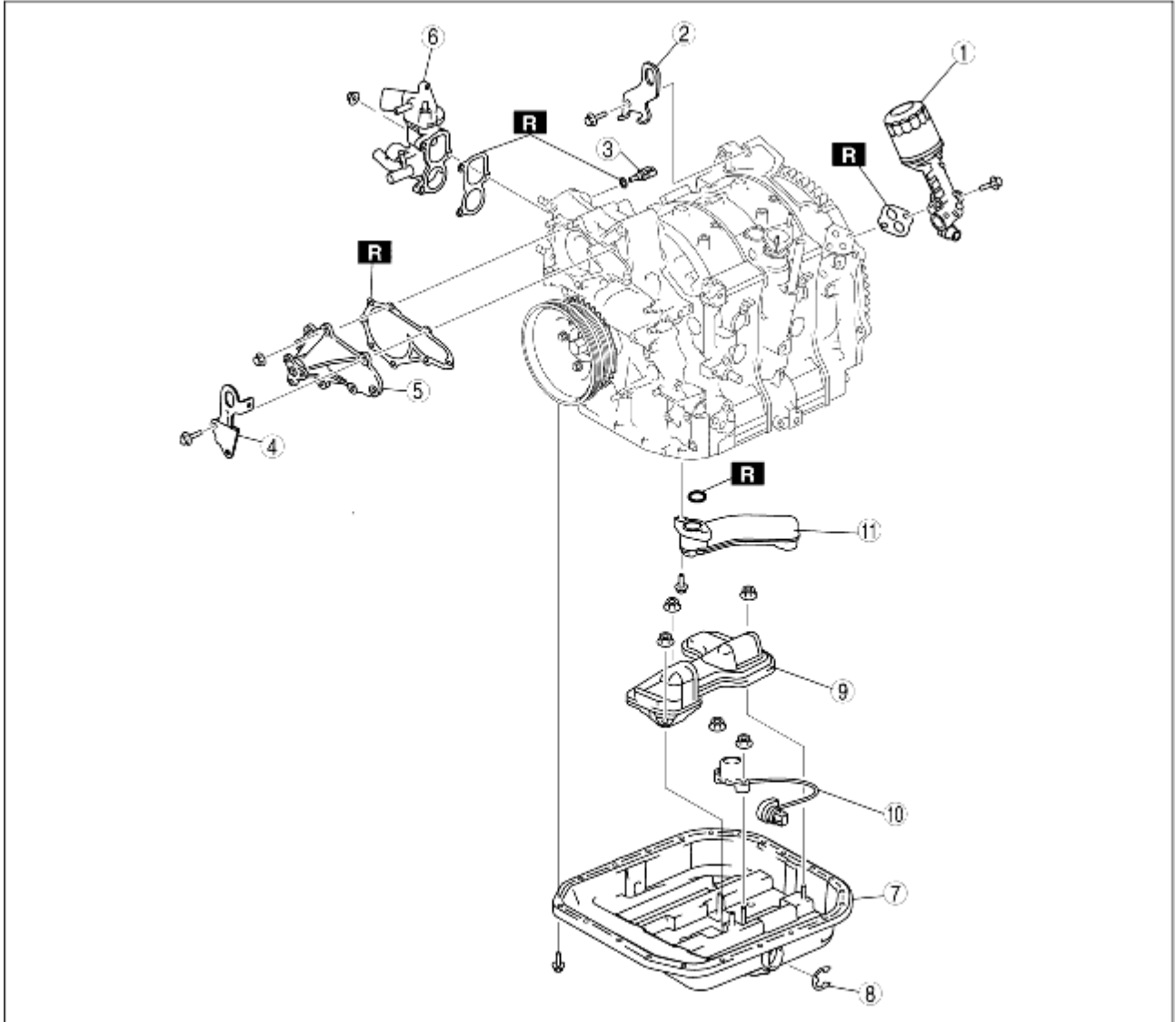
CHU0110 E058



# HOUSING DISASSEMBLY I

BHE011002000E03

1. Disassemble in the order indicated in the table.

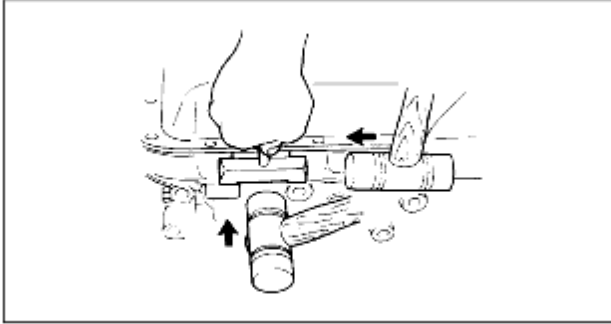


BHJ0110 E006

1	Oil filter component
2	Engine hanger (engine rear side)
3	Engine coolant temperature sensor
4	Engine hanger (engine front side)
5	Water pump body
6	Thermostat component
7	Oil pan (See <a href="#">Oil Pan Disassembly Note.</a> )
8	Clip
9	Oil baffle plate
10	Oil-level sensor
11	Oil strainer

## Oil Pan Disassembly Note

1. Remove the oil pan using the separator tool.

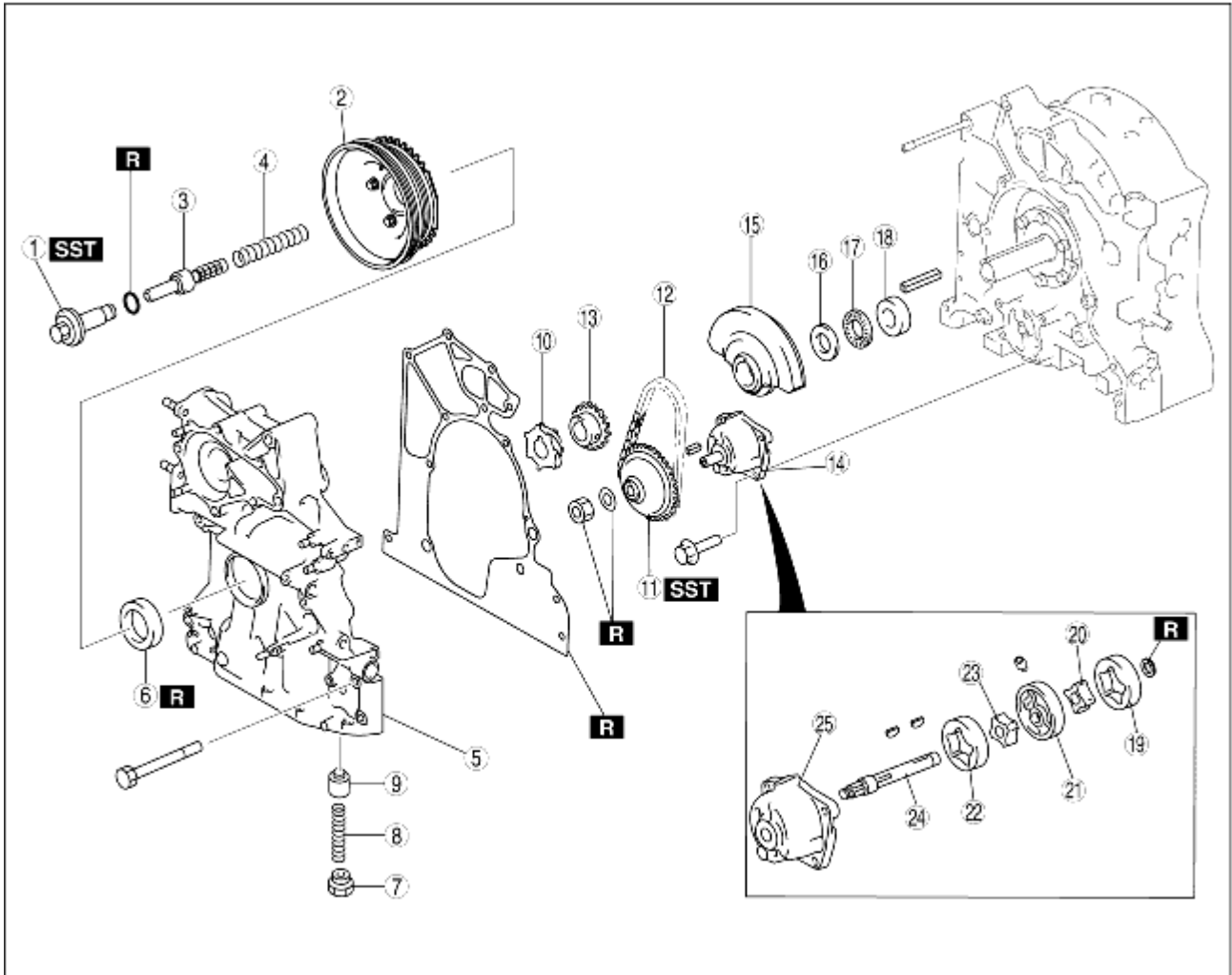


BHJ0111W014

# HOUSING DISASSEMBLY II

BHE011002000E04

1. Disassemble in the order indicated in the table.



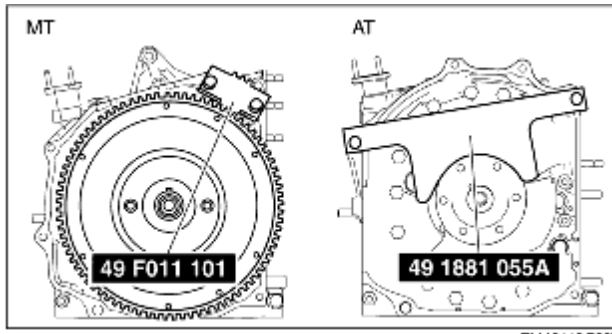
BHJ0110 E008

1	Pulley lockbolt (See <a href="#">Pulley Lockbolt Disassembly Note.</a> )
2	Pulley component
3	Eccentric shaft bypass valve
4	Spring
5	Front cover (See <a href="#">Front Cover Disassembly Note.</a> )
6	Front oil seal
7	Plug
8	Control valve spring
9	Control valve
10	Metering oil pump drive gear
11	Oil pump sprocket wheel (See <a href="#">Oil Pump Sprocket Disassembly Note.</a> )
12	Oil pump chain

13	Oil pump drive gear
14	Oil pump component
15	Balance weight
16	Thrust plate
17	Needle bearing
18	Spacer
19	Rear outer rotor
20	Rear inner rotor
21	Middle plate
22	Front outer rotor
23	Front inner rotor
24	Shaft
25	Oil pump body

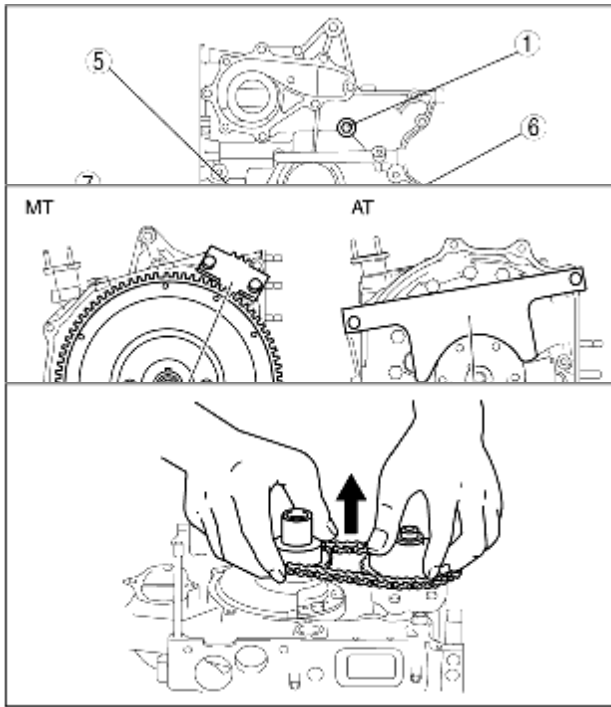
## **Pulley Lockbolt Disassembly Note**

1. Lock the flywheel (MT) or counterweight (AT) against rotation using the **SST**.



## Front Cover Disassembly Note

1. Loosen the engine front cover installation bolts in the order shown in the figure.



## Oil Pump Sprocket Disassembly Note

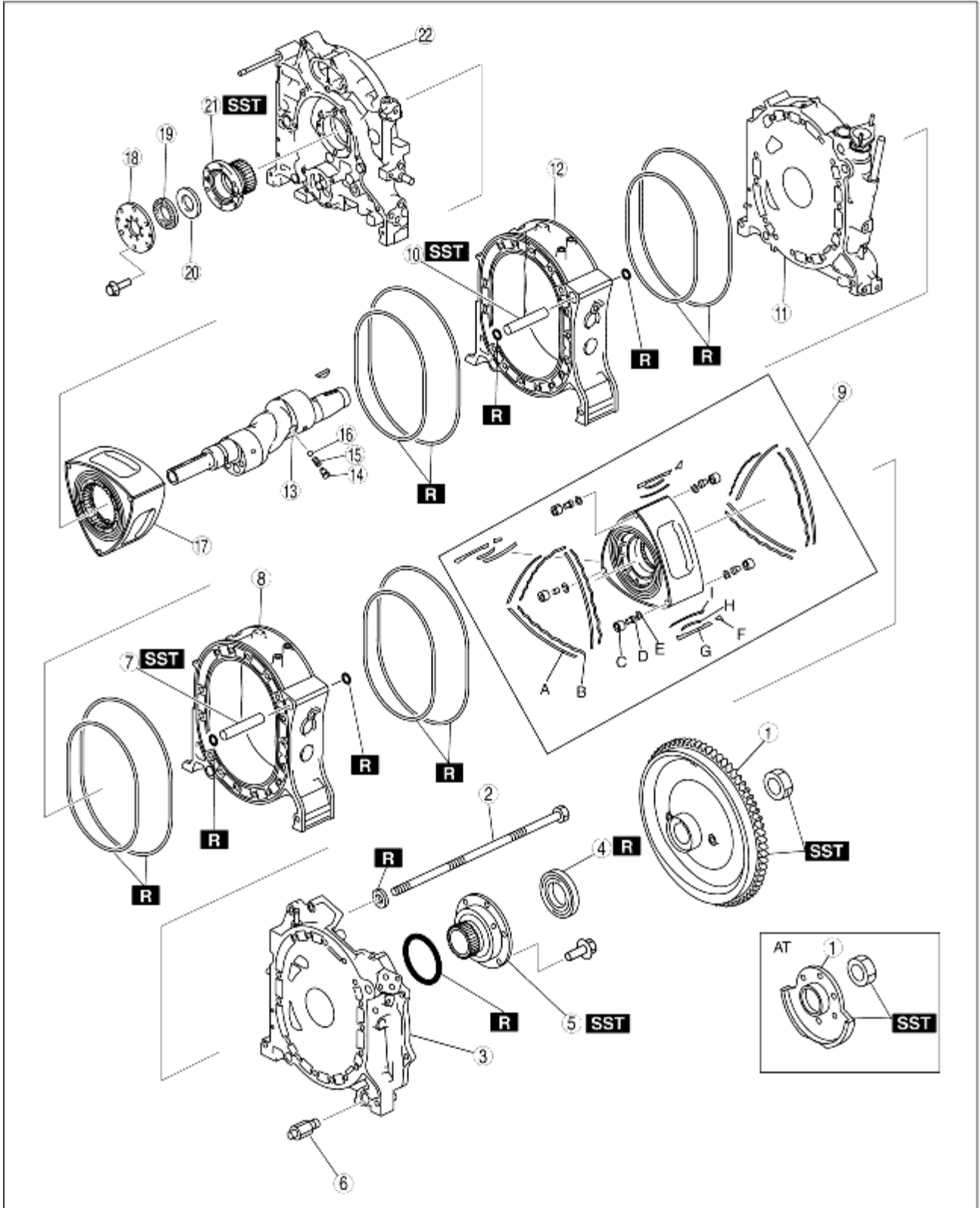
1. Lock the flywheel (MT) or counterweight (AT) against rotation using the **SST**.
2. Unlock the crimped part of the lock washer and remove the locknut and lock washer.
3. Remove the oil pump drive gear and oil pump sprocket wheel with the oil pump chain engaged.

BHJ0110 E104

# HOUSING DISASSEMBLY III

BHE011002000E05

1. Disassemble in the order indicated in the table.



BHJ0110E010

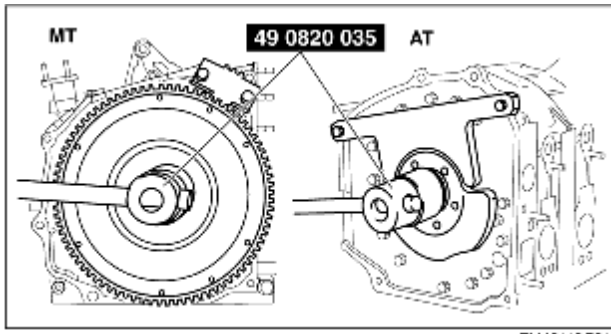
1	Flywheel (MT), counterweight (AT) (See <a href="#">Flywheel (MT), Counterweight (AT) Disassembly Note.</a> )
---	---

2	Tension bolt (See <a href="#">Tension Bolt Disassembly Note.</a> )
3	Rear housing (See <a href="#">Rear Housing Disassembly Note.</a> )
4	Rear oil seal
5	Rear stationary gear (See <a href="#">Stationary Gear Disassembly Note.</a> )
6	Pressure regulator
7	Tubular dowel (rear rotor housing side) (See <a href="#">Tubular Dowel Disassembly Note.</a> )
8	Rear rotor housing (See <a href="#">Rotor Housing Disassembly Note.</a> )
9	Rear rotor A: Side seal B: Side seal spring C: Corner seal D: Corner seal plug E: Corner Seal Spring F: Side piece G: Apex seal H: Apex seal spring (short) I: Apex seal spring (long) (See <a href="#">Rotor Disassembly Note.</a> )
10	Tubular dowel (front rotor housing side) (See <a href="#">Tubular Dowel Disassembly Note.</a> )
11	Intermediate housing (See <a href="#">Intermediate Housing Disassembly Note.</a> )
12	Front rotor housing (See <a href="#">Rotor Housing Disassembly Note.</a> )
13	Eccentric shaft
14	Oil jet plug
15	Spring
16	Steel ball
17	Front rotor (See <a href="#">Rotor Disassembly Note.</a> )
18	Plate
19	Needle bearing
20	Thrust plate
21	Front stationary gear (See <a href="#">Stationary Gear Disassembly Note.</a> )
22	Front housing

## Flywheel (MT), Counterweight (AT) Disassembly Note

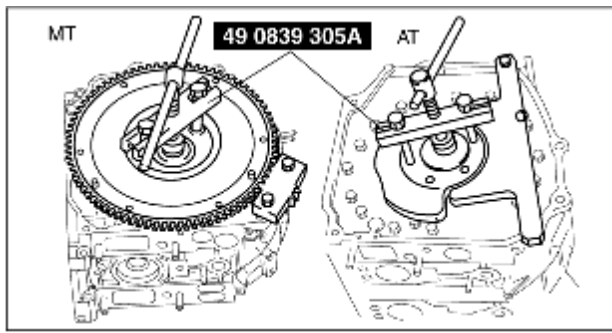
1. Lock the flywheel (MT) or counterweight (AT) against rotation using the **SST**.
2. Remove the locknut using the **SST**.





3. Remove the flywheel (MT) or counterweight (AT), using the **SST**.

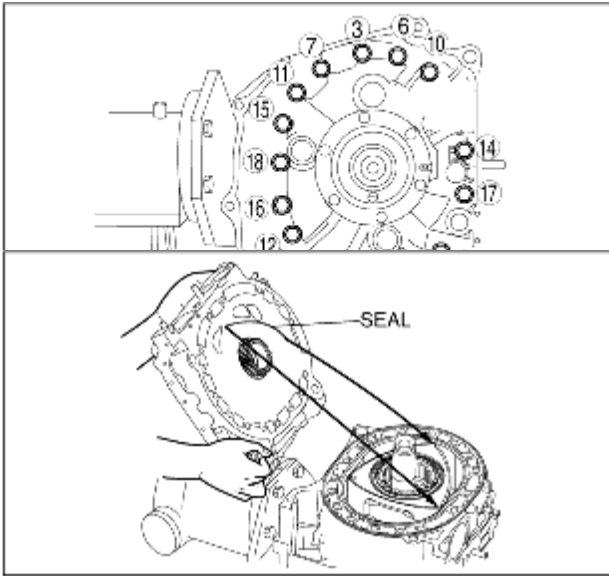
BHJ0110 E011



BHJ0110 E012

## Tension Bolt Disassembly Note

1. Loosen the tension bolts in **2-3** passes in the order shown in the figure and remove them.



## Rear Housing Disassembly Note

1. Move the rear housing to the left and right to cut the oil film.
2. Remove the rear housing.

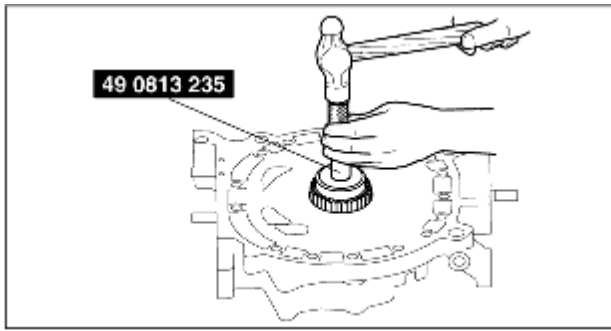
### Caution

- If a seal adheres to the rear housing, put it back in its original position in the rotor.

## Stationary Gear Disassembly Note

1. Remove the stationary gear using the SST.

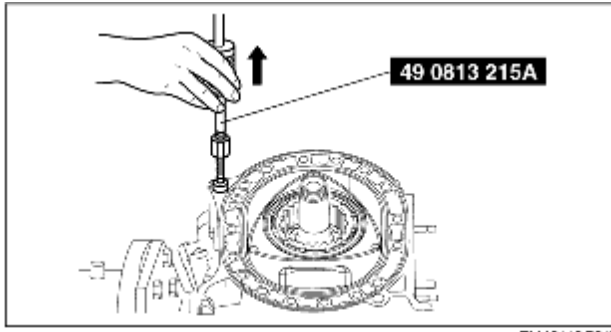
CHU0110 E039



BHJ0110 E016

## Tubular Dowel Disassembly Note

1. Remove the tubular dowel using the **SST**.



## Rotor Housing Disassembly Note

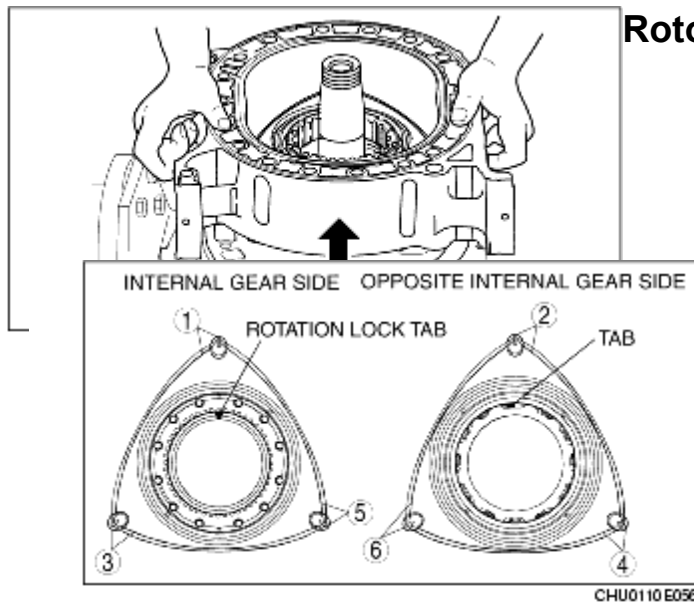
1. Remove the rotor housing being careful not to drop the apex seal.

BHJ0110 E017

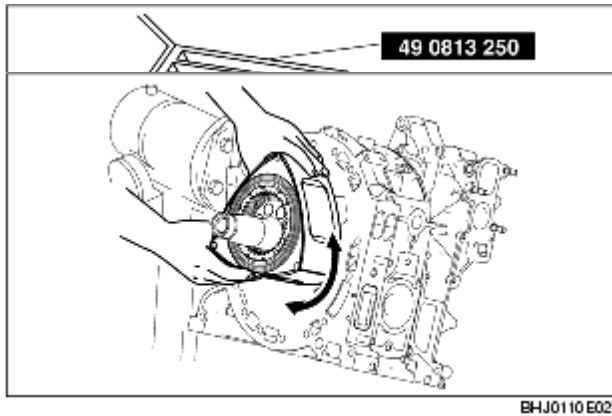
## Rotor Disassembly Note

### Note

- Pair each seal and spring according to the numbers shown in the figure, and place them in the **SST** according to the numbers shown on the **SST**.



1. Remove the side piece, apex seal, corner seal, side seal, and spring on the engine rear side, and place them in the **SST** while keeping them in order.



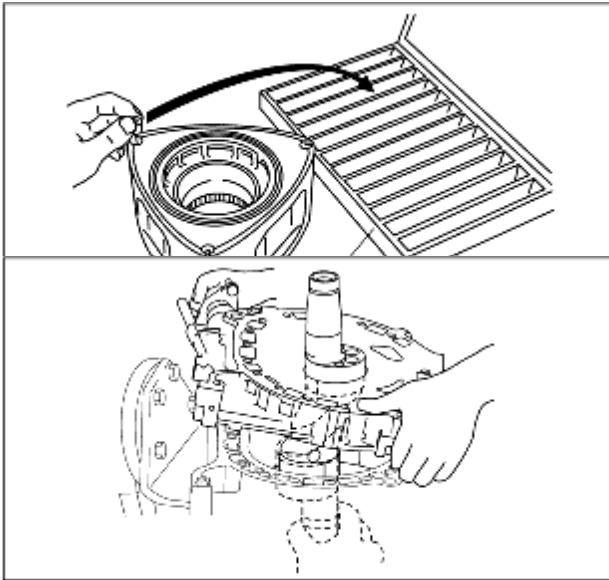
2. Move the rotor to the left and right to cut the oil film.

3. Remove the rotor.

### Caution

- If a seal adheres to the side housing, put it back in its original position in the rotor.
- Place the removed rotor upright on soft material such as a rubber sheet or cloth. Do not allow the oil seal to directly contact metal or similar hard surface.

4. Remove the corner seal, side seal, and spring on the engine front side, and place them in the **SST** while keeping them in order.



## Intermediate Housing Disassembly Note

1. Lift the intermediate housing up while another person pushes the eccentric shaft upward **approx. 3 cm {1.18 in}**.
2. Rotate and remove the intermediate housing at the point where the eccentric shaft does not catch.

### Caution

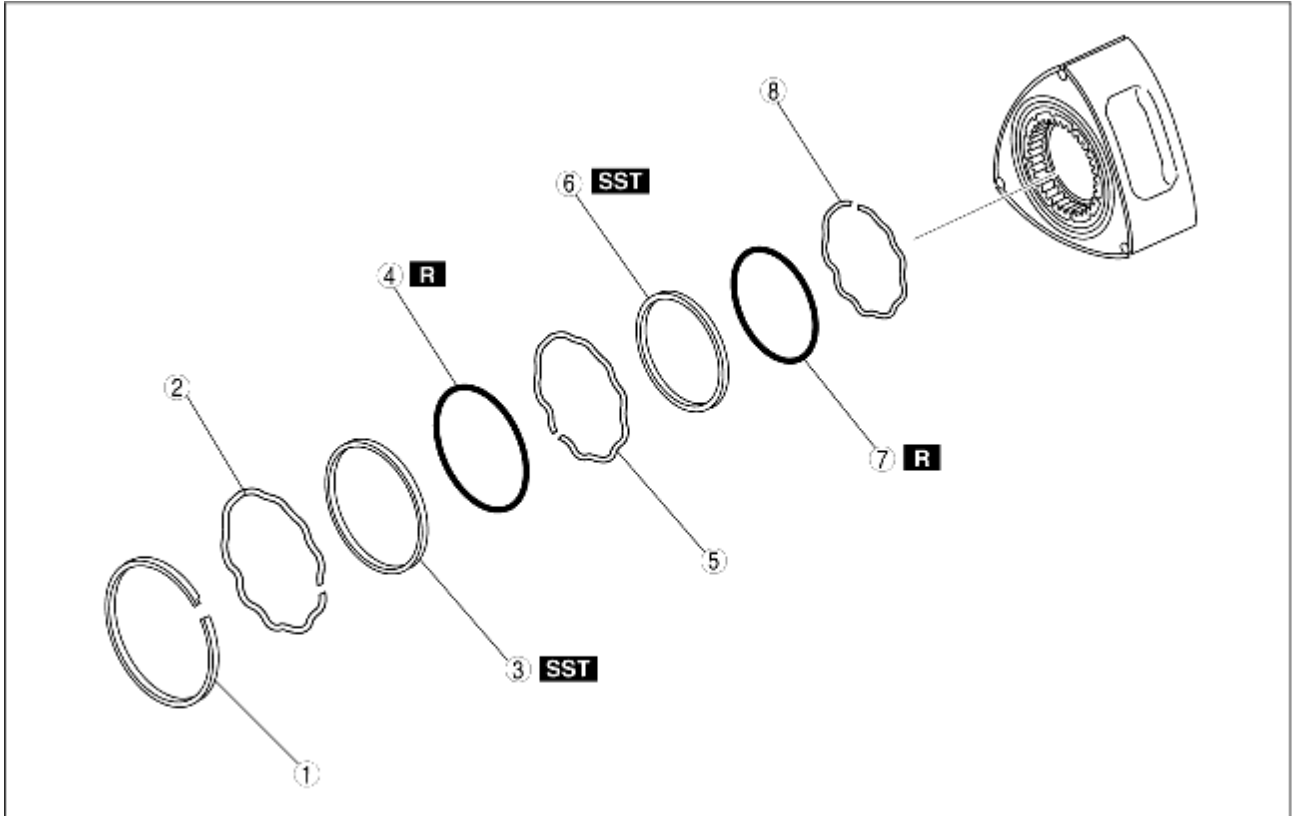
- If a seal adheres to the intermediate housing, put it back in its original position in the rotor.

BHJ0110 E023

# ROTOR DISASSEMBLY

BHE011002000E06

1. Disassemble in the order indicated in the table.



BHJ0110 E024

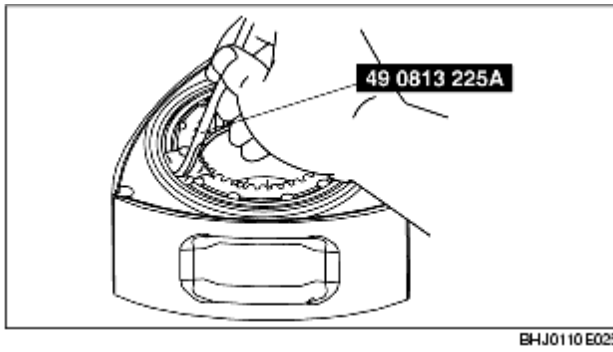
1	Cut-off seal
2	Cut-off seal spring
3	Outer oil seal (See <a href="#">Oil Seal Disassembly Note.</a> )
4	Outer O-ring (large radius)
5	Outer oil seal spring (See <a href="#">Oil Seal Spring Disassembly Note.</a> )
6	Inner oil seal (See <a href="#">Oil Seal Disassembly Note.</a> )
7	Inner O-ring (small radius)
8	Inner oil seal spring (See <a href="#">Oil Seal Spring Disassembly Note.</a> )

## Oil Seal Disassembly Note

1. Remove the oil seal using the **SST**.

**Caution**





- Be sure to keep the removed oil seals separated according to their removal position.

## Oil Seal Spring Disassembly Note

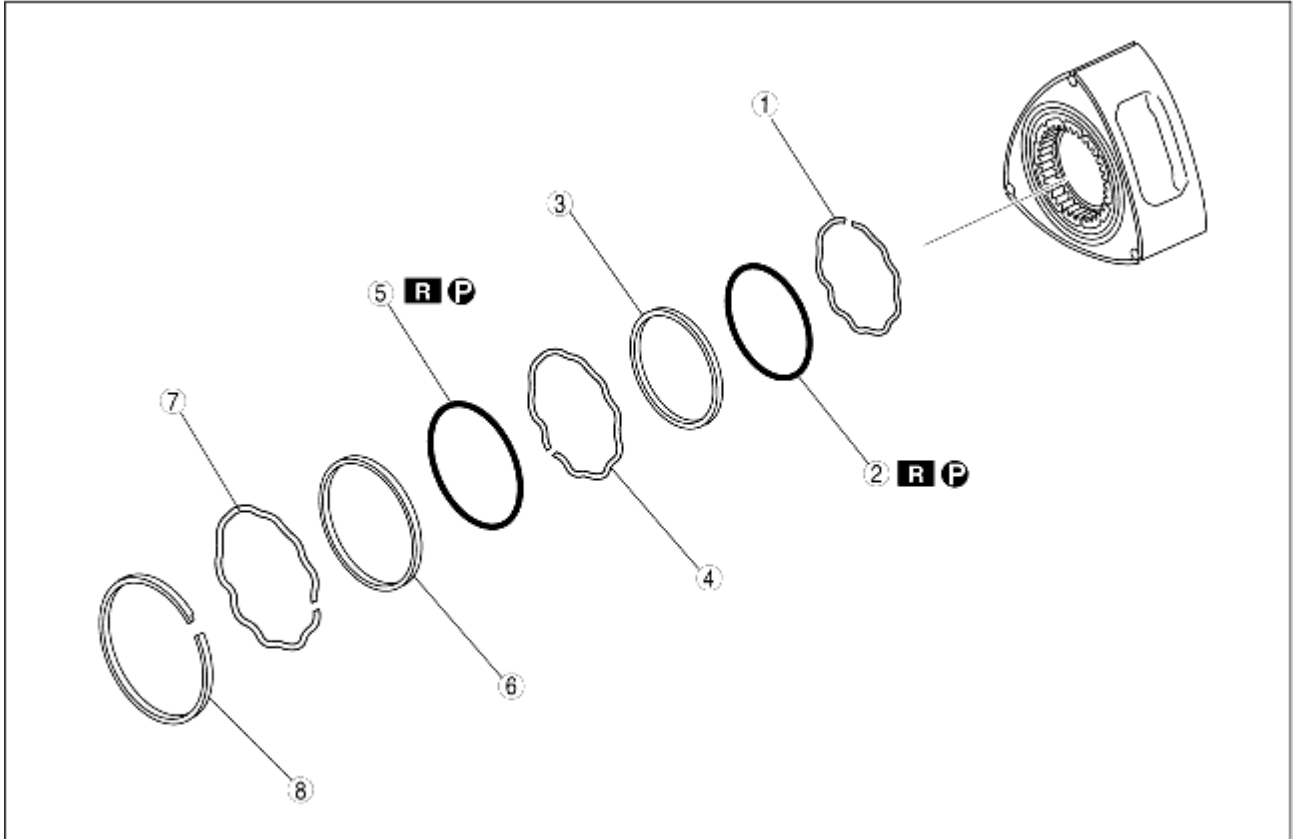
### Caution

- Be sure to keep the removed oil seal springs separated according to their removal positions.

# ROTOR ASSEMBLY

BHE011002000E07

1. Assemble in the order indicated in the table.



BHJ0110 E074

1	Inner oil seal spring (See <a href="#">Oil Seal Spring Assembly Note.</a> )
2	Inner O-ring (small radius) (See <a href="#">O-Ring Assembly Note.</a> )
3	Inner oil seal (See <a href="#">Oil Seal Assembly Note.</a> )
4	Outer oil seal spring (See <a href="#">Oil Seal Spring Assembly Note.</a> )
5	Outer O-ring (large radius) (See <a href="#">O-Ring Assembly Note.</a> )
6	Outer oil seal (See <a href="#">Oil Seal Assembly Note.</a> )
7	Cut-off seal spring (See <a href="#">Cut-Off Seal Spring Assembly Note.</a> )
8	Cut-off seal (See <a href="#">Cut-Off Seal Assembly Note.</a> )

## Oil Seal Spring Assembly Note

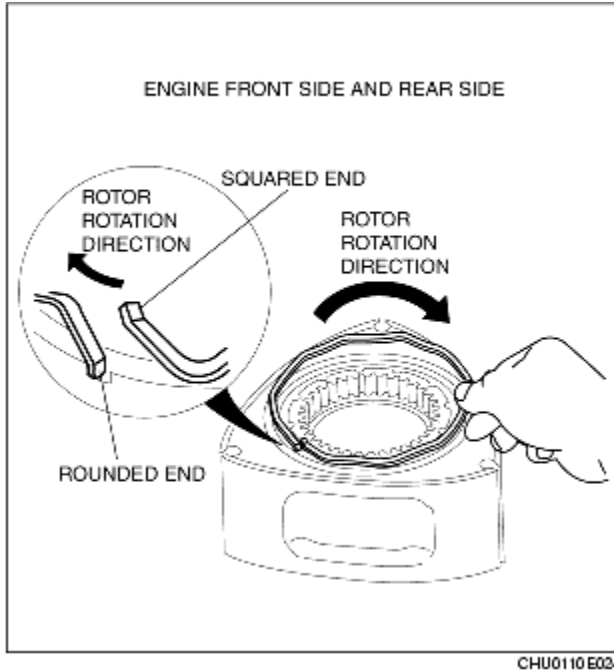
1. Assemble the oil seal spring with the identification color upward.

### Spring Identification Color

Rotor	Front rotor		Rear rotor	
	Engine front side	Engine rear side	Engine front side	Engine rear side
Inner	White	Blue	White	Blue
Outer	White + pink	Blue + pink	White + pink	Blue + pink

### Caution

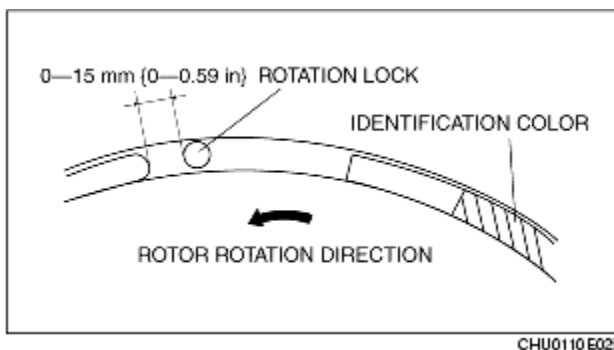
- It is possible that the identification color may not be visible when reusing the oil spring. In that case, assemble the rounded end towards the rotor side and the squared end upward.



- Be careful when assembling the oil seal spring of the front and rear rotor since each spring of the engine front side and engine rear side are the same.

### Note

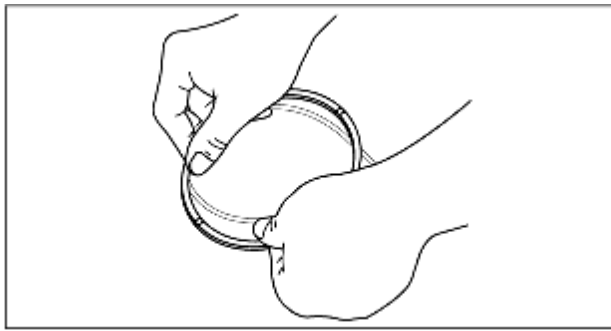
- Either one of the two rotation lock slots on the oil seal can be used as a reference.
  - Assemble the rounded end within **0-15 mm {0-0.59 in}** away from the oil seal spring rotation lock.



## O-Ring Assembly Note

- Apply petroleum jelly to a new O-ring.
- Assemble the O-ring to the oil seal.

### Note



BHJ0110 E077

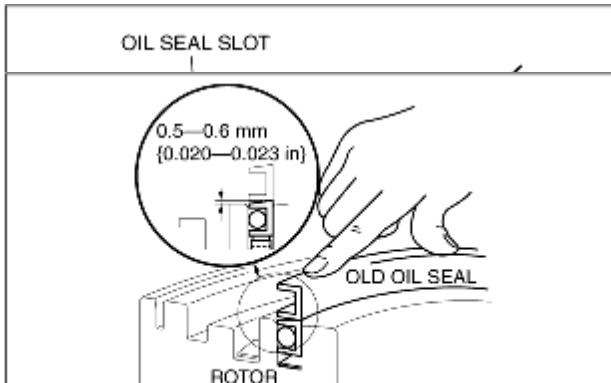
- Assemble the thicker O-ring to the inner oil seal (small radius), and the thinner O-ring to the outer oil seal (large radius).

### Oil Seal Assembly Note

1. Temporarily install the oil seal with the squared end of the oil seal spring fit into the slot of the oil seal.

2. Push in the oil seal using an old oil seal.

3. Verify that the stroke of the oil seal is smooth and there is no catching by pushing the oil seal with your hand.

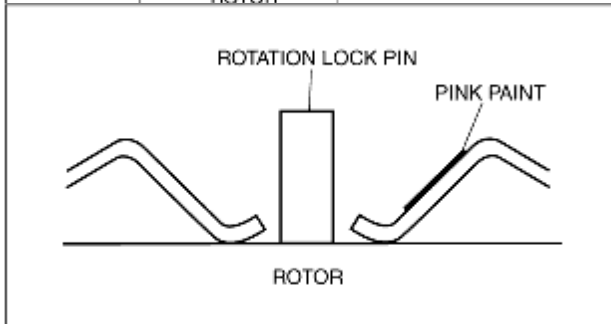


### Cut-Off Seal Spring Assembly Note

1. Assemble the cut-off seal spring with the spring end turned upward.

#### Note

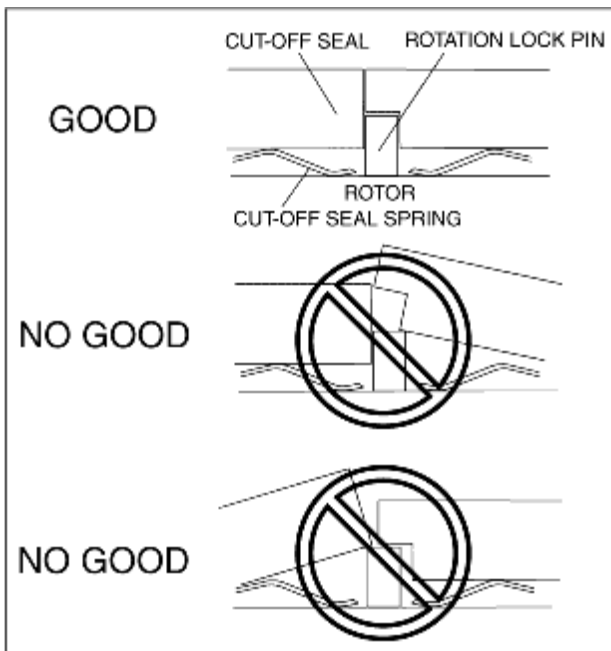
- When replacing a cut-off seal with a new one, assemble the seal with the pink surface facing upward.



CHU0110 E026

### Cut-Off Seal Assembly Note

1. Assemble the cut-off seal so that it does not run over the rotation lock pin.

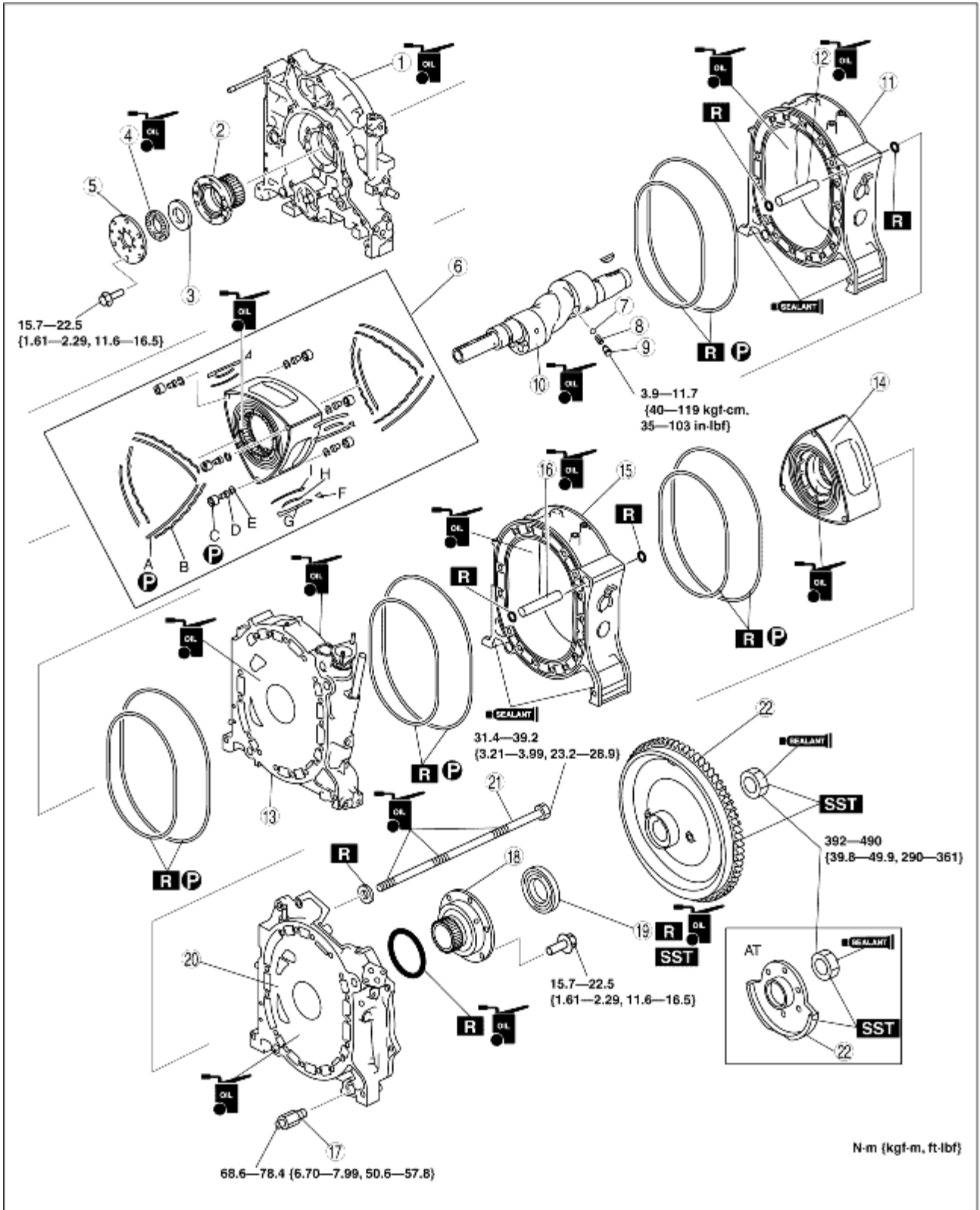


CHU0110 E029

# HOUSING ASSEMBLY I

BHE011002000E08

1. Assemble in the order indicated in the table.



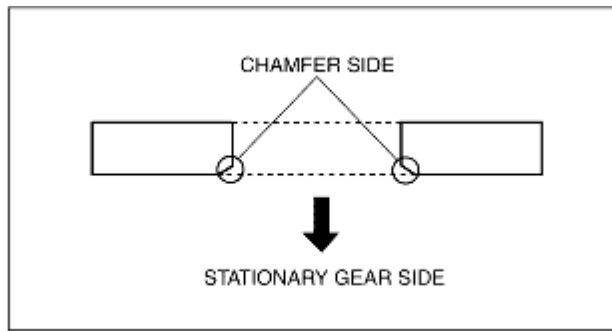
CHU0110 E052

2	Front stationary gear
3	Thrust plate (See <a href="#">Thrust Plate Assembly Note.</a> )
4	Needle bearing
5	Plate
6	Front rotor A: Side seal B: Side seal spring C: Corner seal D: Corner seal plug E: Corner seal spring F: Side piece G: Apex seal H: Apex seal spring (short) I: Apex seal spring (long) (See <a href="#">Rotor Assembly Note.</a> )
7	Steel ball
8	Spring
9	Oil jet plug (See <a href="#">Oil Jet Plug Assembly Note.</a> )
10	Eccentric shaft
11	Front rotor housing (See <a href="#">Rotor Housing Assembly Note.</a> )
12	Tubular dowel (front rotor housing side)
13	Intermediate housing (See <a href="#">Intermediate Housing Assembly Note.</a> )
14	Rear rotor (See <a href="#">Rotor Assembly Note.</a> )
15	Rear rotor housing (See <a href="#">Rotor Housing Assembly Note.</a> )
16	Tubular dowel (rear rotor housing side)
17	Pressure regulator
18	Rear stationary gear
19	Rear oil seal (See <a href="#">Rear Oil Seal Assembly Note.</a> )
20	Rear housing (See <a href="#">Rear Housing Assembly Note.</a> )
21	Tension bolt (See <a href="#">Tension Bolt Assembly Note.</a> )
22	Flywheel (MT), counterweight (AT) (See <a href="#">Flywheel (MT), Counterweight (AT) Assembly Note.</a> )

## Thrust Plate Assembly Note

1. Place the chamfer side facing the stationary gear.

## Rotor Assembly Note

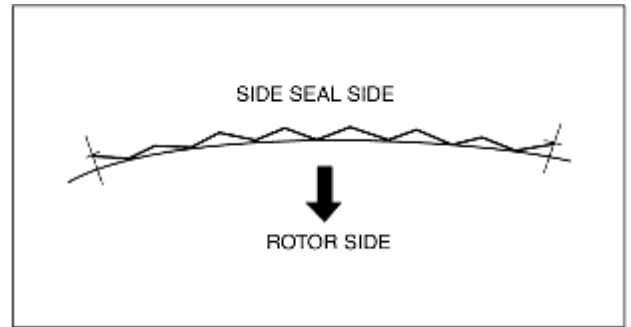


CHU0110 E045

### Caution

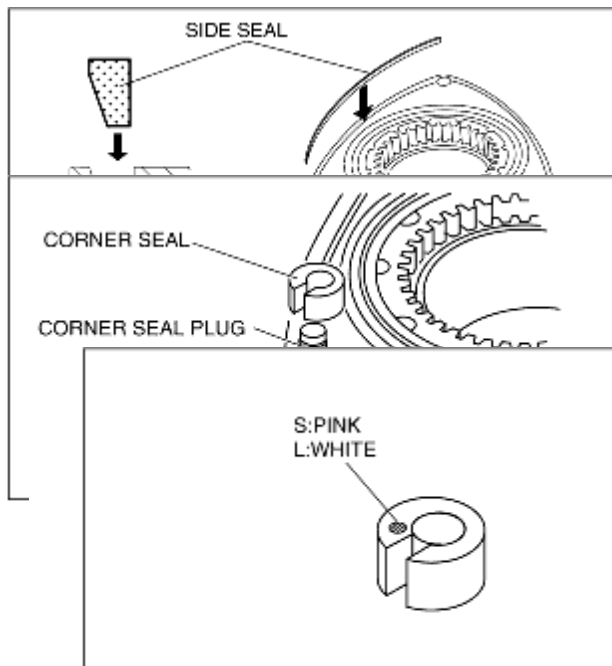
- Assemble only the side seal and corner seal on the engine front side while the rotor is not assembled.

1. Assemble the side seal spring in the direction shown in the figure.



CHU0110 E046

2. Assemble the side seal spring in the direction shown in the figure.



CHU0110 E051

3. Apply petroleum jelly between the side seal and side seal groove.

4. Assemble the corner seal plug to the corner seal.

### Note

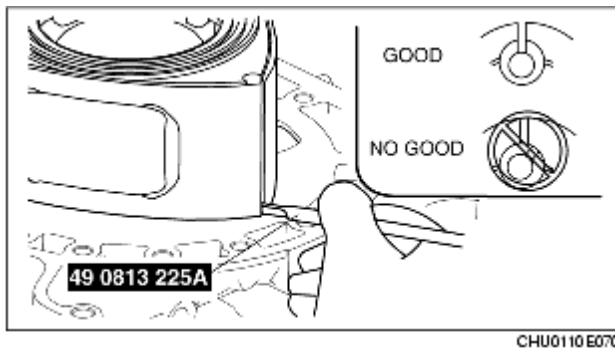
- When replacing a corner seal with new one, assemble the corner seal with the painting surface facing upward.

5. Assemble the corner seal and corner seal spring with the notch aligned with the apex seal groove.

6. Apply petroleum jelly between the corner seal and corner seal groove.

7. Insert the **SST** into the apex seal groove of the rotor and verify that the apex seal groove of the corner seal is aligned with the apex seal groove of the rotor.

8. Assemble the side seal and corner seal for the engine rear side in the same way as the engine front side.



## Oil Jet Plug Assembly Note

1. Apply thread locking compound to the seating face of the oil jet plug.
2. Install the oil jet plug.

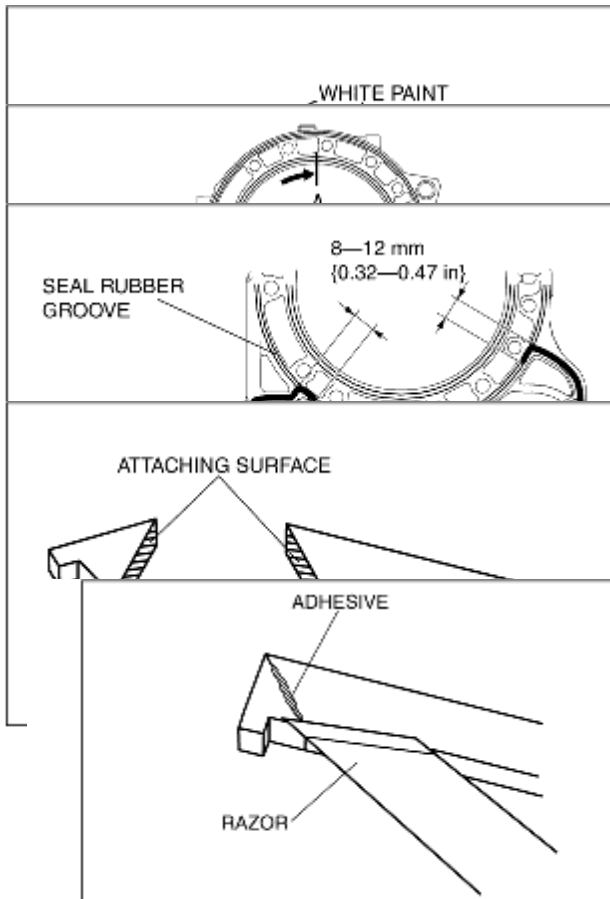
**Tightening torque**  
**3.9-11.7 N·m**  
**{40-119 kgf·cm, 35-103 ft·lbf}**

## Rotor Housing Assembly Note

### Caution

- Assemble the seal rubber without any torsion.
- Do not get oil or grease on the seal rubber.

1. Apply petroleum jelly to a new seal rubber.
2. Assemble the outer seal rubber to the housing with the white paint in the direction shown in the figure.



3. Assemble the inner seal rubber to the housing with the seal rubber joint placed between A-B.
4. Apply the silicone sealant to the position indicated in the figure.

**Bead thickness**  
**2.5-6.5 mm {0.099-0.255 in}**

5. Apply thread locking compound to the attaching surface of the apex seal and the side piece and affix them.

### Caution

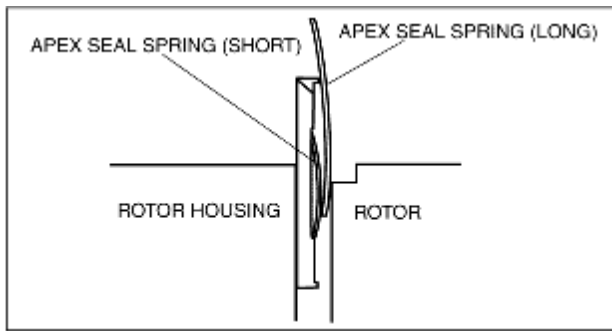
- After adhesion, make sure that there is no gap between the apex seal and side piece.
- If adhesive protrudes, remove with a razor.

### Note

- When using a new apex seal, the procedure above is not needed.

6. Assemble the apex seal and apex seal spring (short) together with the side piece to the engine rear side.
7. Assemble the apex seal spring (long) while pressing the apex seal spring (short).





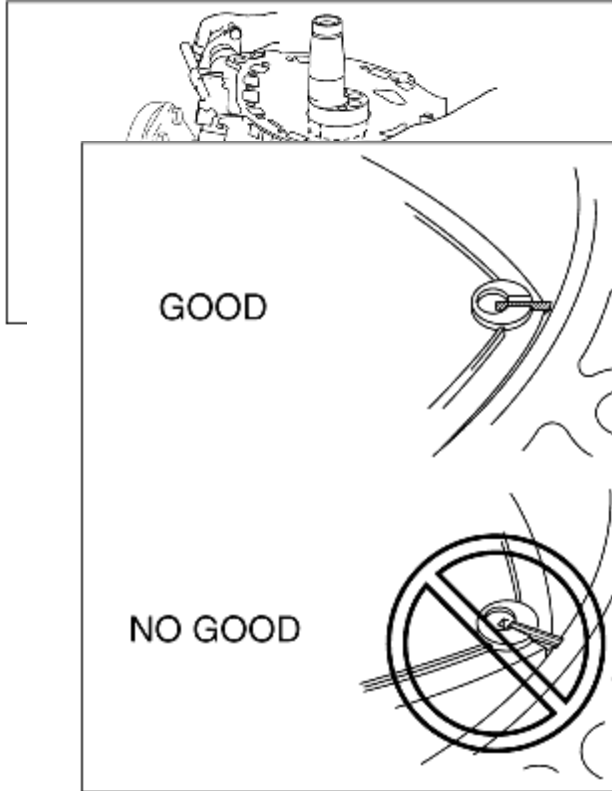
CHU0110 E034

### Caution

- Assemble the apex seal spring until it catches the spring stopper of the side piece.

### Intermediate Housing Assembly Note

1. Assemble the intermediate housing with the support of an assistant pushing the eccentric shaft up **approx. 3 cm {1.18 in}**.



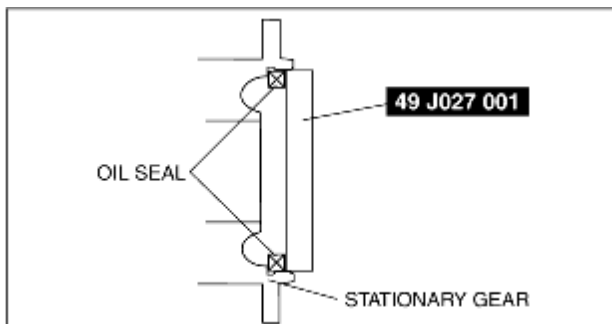
CHU0110 E060

### Caution

- Do not allow the side piece to be caught between the rotor housing and intermediate housing.

### Rear Oil Seal Assembly Note

1. Assemble the oil seal using the **SST**.



CHU0110 E035

### Caution

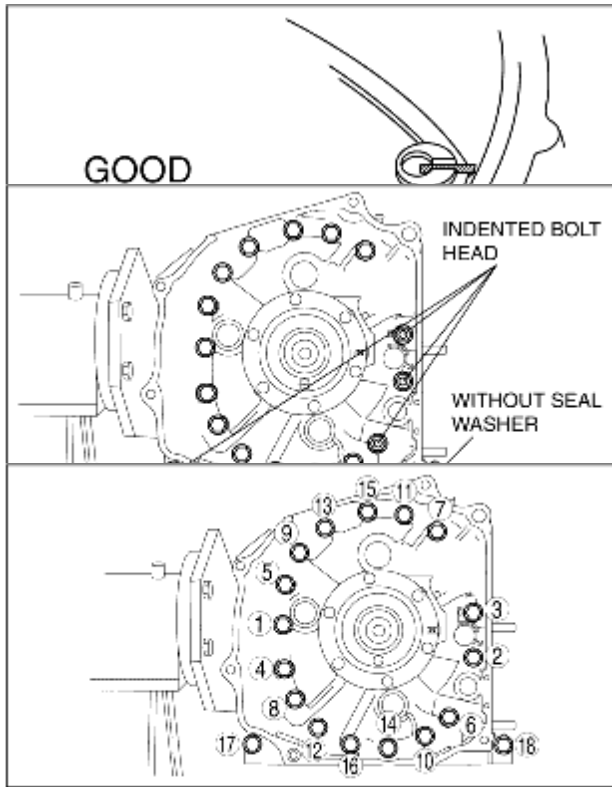
- Insert the rear oil seal until it reaches to the seating face.

### Rear Housing Assembly Note

1. Assemble the rear housing with the rear stationary gear and the internal gear of the rotor engaged.

### Caution

- Do not allow the side piece to be caught between the rotor housing and rear housing.



## Tension Bolt Assembly Note

1. Apply engine oil to the tension bolt threads and assemble to the housing with a new seal washer.

### Caution

- Assemble a tension bolt which has a seal washer with the rubber projection facing the housing side.

2. Tighten the tension bolts in the order indicated in the figure in 2-3 passes.

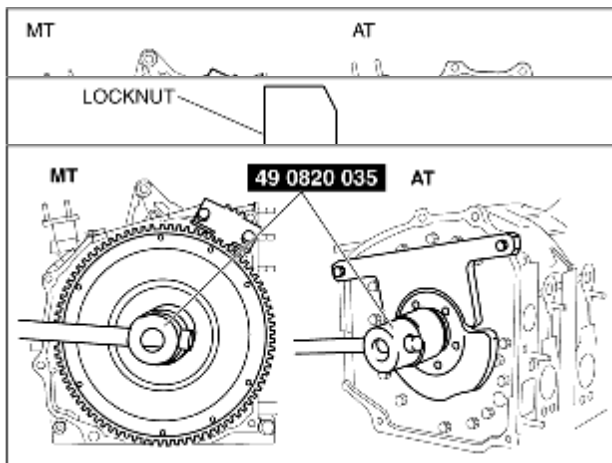
### Tightening torque

31.4-39.2 N·m

{3.21-3.99 kgf·m, 23.2-28.9 ft·lbf}

## Flywheel (MT), Counterweight (AT) Assembly Note

1. Lock the flywheel (MT) or counterweight (AT) against rotation using the SSTs.



2. Apply silicone sealant to the locknut threads.

3. Tighten the locknut using the SST.

### Tightening torque

392-490 N·m

{40.0-49.9 kgf·m, 290-361 ft·lbf}

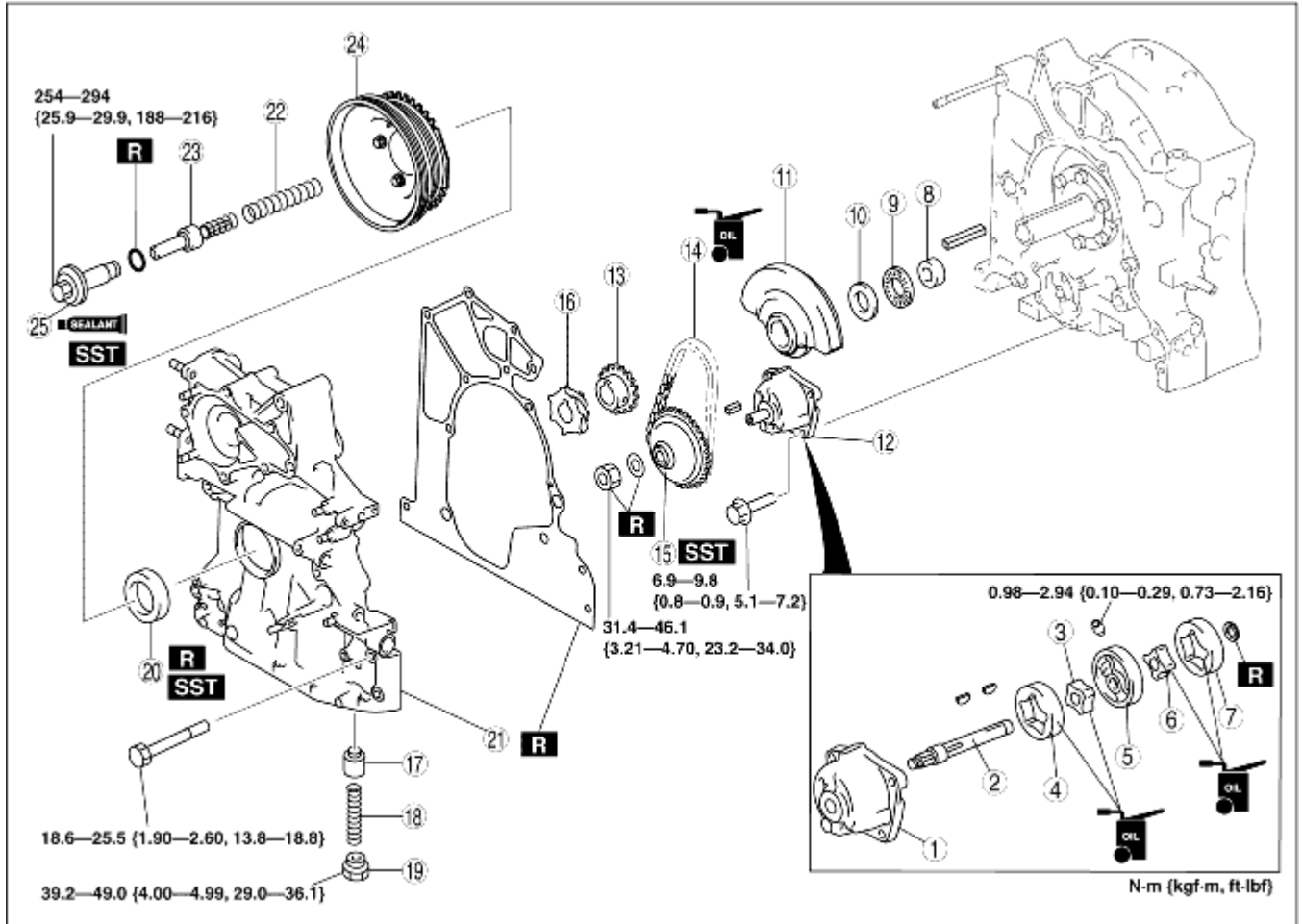
BHJ0110 E094

BHJ0110 E011

# HOUSING ASSEMBLY II

BHE011002000E09

1. Assemble in the order indicated in the table.



BHE0110E01

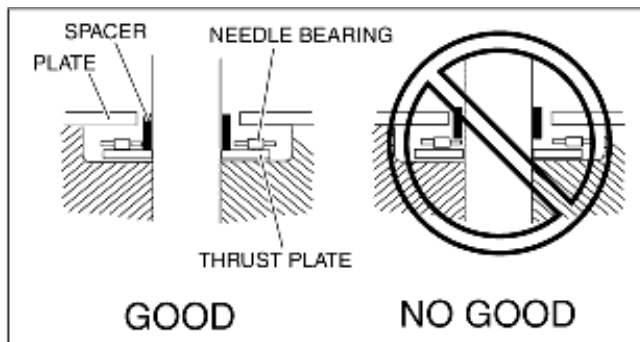
1	Oil pump body
2	Shaft
3	Front inner rotor
4	Front outer rotor
5	Middle plate
6	Rear inner rotor
7	Rear outer rotor
8	Spacer (See <a href="#">Spacer Assembly Note.</a> )
9	Needle bearing
10	Thrust plate
11	Balance weight
12	Oil pump component
13	Oil pump drive gear (See <a href="#">Oil Pump Drive Gear Assembly Note.</a> )

14	Oil pump chain
15	Oil pump sprocket wheel (See <a href="#">Oil Pump Sprocket Wheel Assembly Note.</a> )
16	Metering oil pump drive gear
17	Control valve
18	Control valve spring
19	Plug
20	Front oil seal (See <a href="#">Front Oil Seal Assembly Note.</a> )
21	Front cover (See <a href="#">Front Cover Assembly Note.</a> )
22	Spring
23	Eccentric shaft bypass valve
24	Pulley component
25	Pulley lockbolt (See <a href="#">Pulley Lockbolt Assembly Note.</a> )

## Spacer Assembly Note

### Caution

- When assembling the spacer, do not allow the spacer to be caught in the needle bearing of the plate.



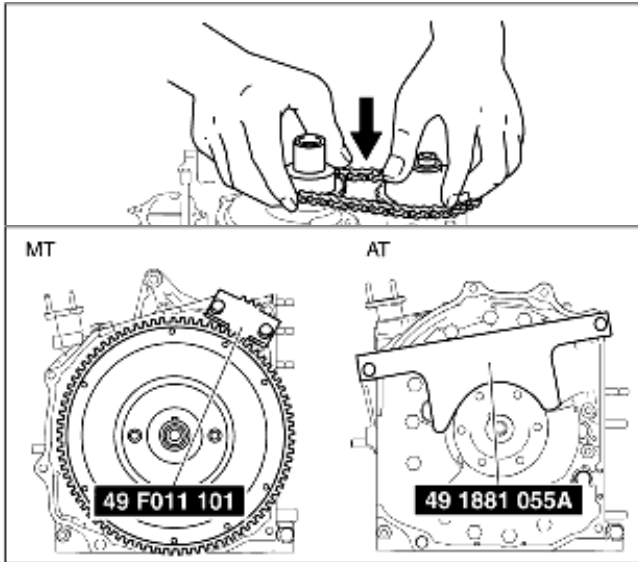
### Note

- Perform eccentric shaft end play inspection.  
(See [ECCENTRIC SHAFT END PLAY INSPECTION.](#))

## Oil Pump Drive Gear Assembly Note

1. Assemble the oil pump drive gear or oil pump sprocket wheel with the oil pump chain engaged.

CHU0110 E019



## Oil Pump Sprocket Wheel Assembly Note

1. Lock the flywheel (MT) and counterweight (AT) against rotation using the **SSTs**.
2. Assemble the oil pump shaft with a new lock washer and locknut, and tighten.

### Tightening torque

**31.4-46.1 N·m**

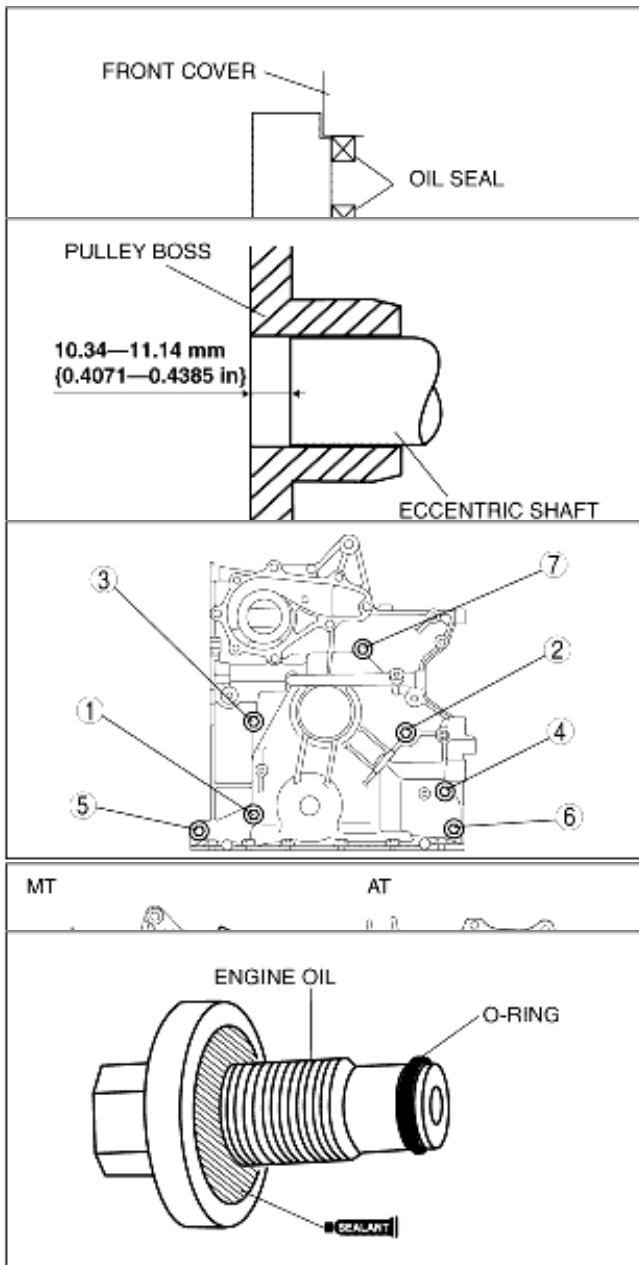
**{3.21-4.70 kgf·m, 23.2-34.0 ft·lbf}**

3. Bend the lock washer and crimp.

BHJ0110 E007

## Front Oil Seal Assembly Note

1. Press the oil seal in using the **SST**.



## Front Cover Assembly Note

1. Before installing the front cover, install the pulley boss to the eccentric shaft and measure the height between the eccentric shaft top and the pulley boss.

- If not within the specification, verify that the spacer is not caught in the needle bearing.

### Standard

**10.34-11.14 mm {0.4071-0.4385 in}**

2. Tighten the engine front cover installation bolts in the order shown in the figure.

### Tightening torque

**18.6-25.5 N·m**

**{1.90-2.60 kgf·m, 13.8-18.8 ft·lb}**

## Pulley Lockbolt Assembly Note

1. Lock the flywheel (MT) or counterweight (AT) against rotation using the **SSTs**.

2. Apply engine oil to the pulley lockbolt threads.

3. Assemble a new O-ring.

4. Apply silicone sealant to the seating face.

5. Tighten the pulley lockbolt.

### Tightening torque

**254-294 N·m**

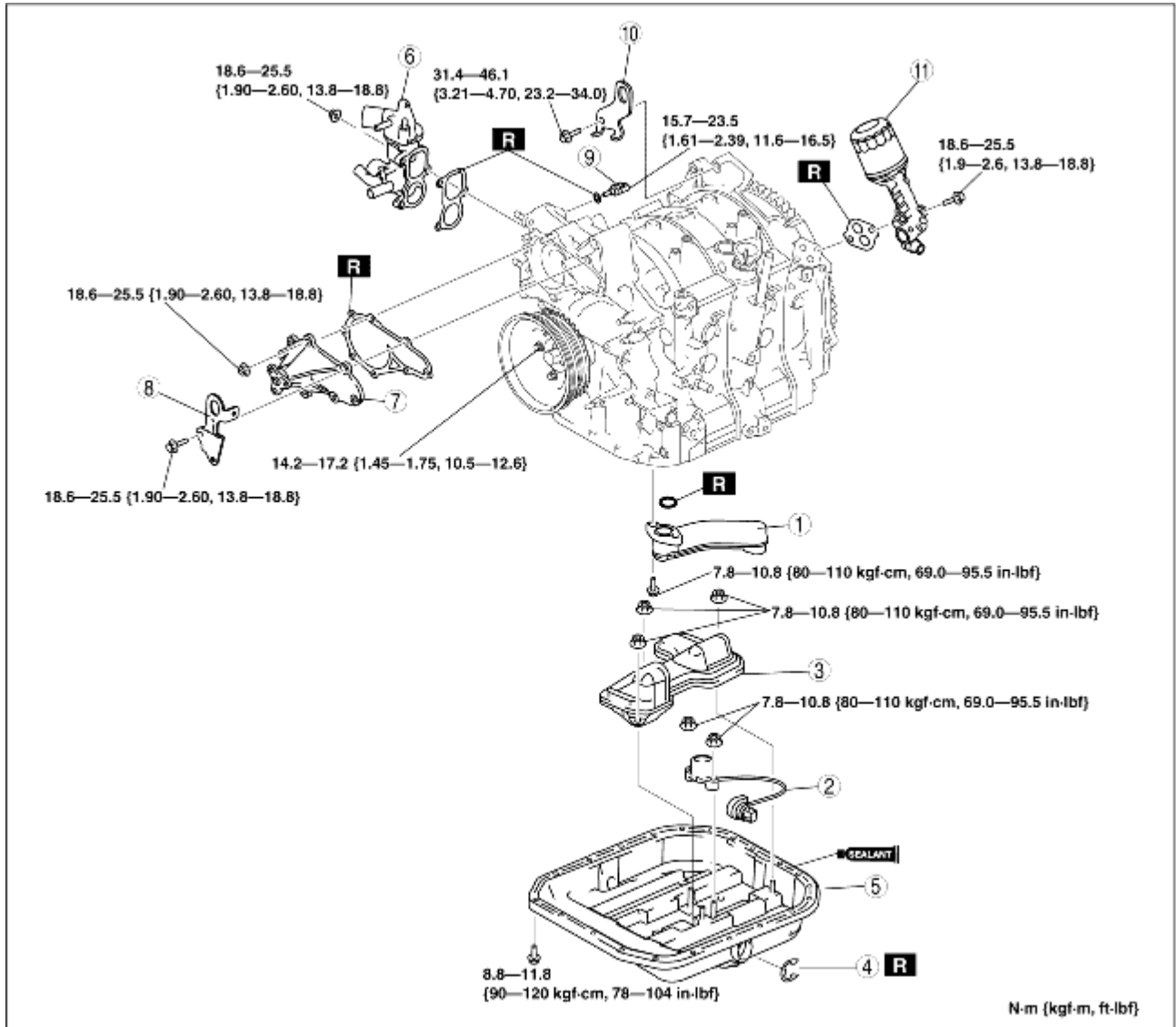
**{25.9-29.9 kgf·m, 188-216 ft·lb}**

CHU0110 E066

# HOUSING ASSEMBLY III

BHE011002000E10

1. Assemble in the order indicated in the table.



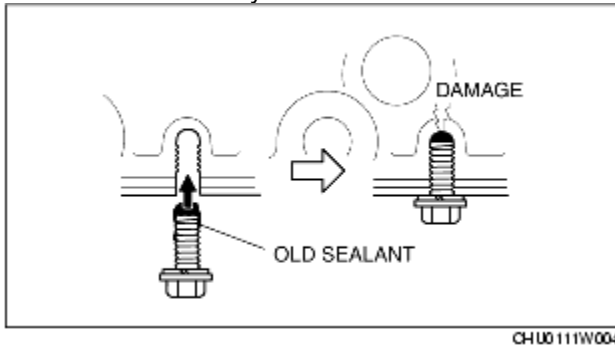
CHU0110 E054

1	Oil strainer
2	Oil-level sensor
3	Oil baffle plate
4	Clip
5	Oil pan (See <a href="#">Oil Pan Assembly Note.</a> )
6	Thermostat component
7	Water pump body
8	Engine hanger (engine front side)
9	Engine coolant temperature sensor
10	Engine hanger (engine rear side)
11	Oil filter component

# Oil Pan Assembly Note

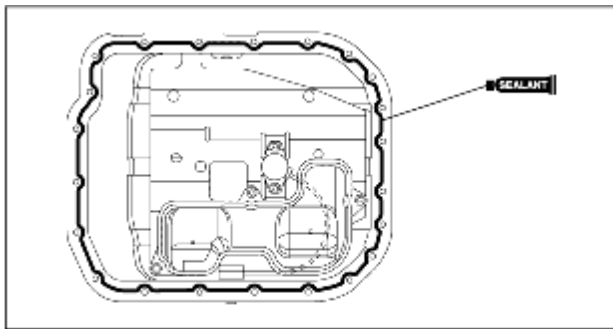
## Caution

- Using bolts with the oil sealant still adhering could cause cracks in the housing. Clean all sealant off all oil pan bolts before assembly.



- Apply the silicon sealant in a single, unbroken line around the whole perimeter.
- Install the engine front cover within 5 min after applying the silicone sealant.

1. Completely clean and remove any oil, dirt, sealant or other foreign material that may be adhering to the housing and oil pan.
2. When reusing oil pan installation bolts, clean any old sealant from the bolts.
3. Apply silicone sealant to the areas shown in the figure.



**Bead thickness**  
**2.5-6.5 mm {0.1-0.2 in}**

4. Tighten the oil pan installation bolts.

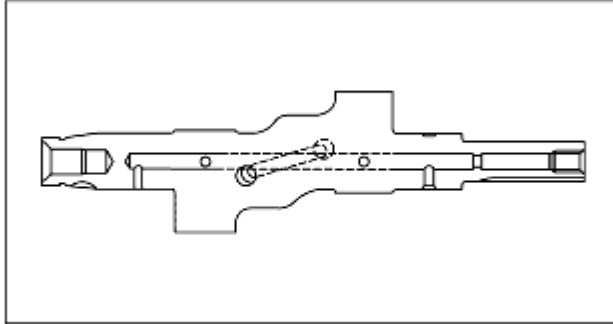
**Tightening torque**  
**8.8-11.8 N·m**  
**{90-120 kgf·cm, 78-104 in·lbf}**



# ECCENTRIC SHAFT INSPECTION

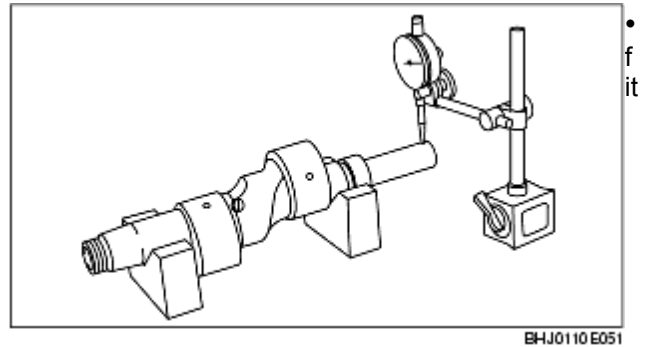
BHE011011D01E01

1. Inspect for clogging in the oil passage.



- If there is any clogging, remove it with a needle or similar device and clean with compressed air.

2. After setting the eccentric shaft main journal on V-blocks and a surface plate, measure the runout at the end of the eccentric shaft using a dial gauge.



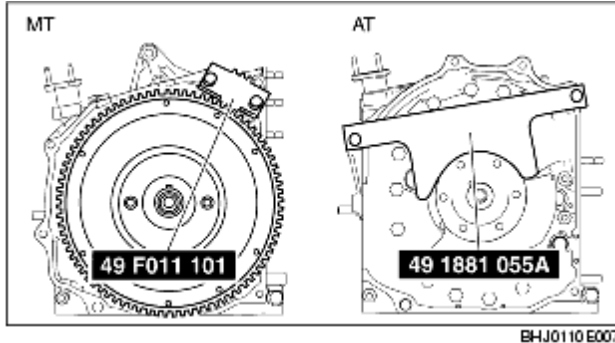
exceeds the maximum specification, replace the eccentric shaft.

**Standard runout**  
**0.02 mm {0.0008 in}**  
**Maximum runout**  
**0.06 mm {0.0024 in}**

# ECCENTRIC SHAFT END PLAY INSPECTION

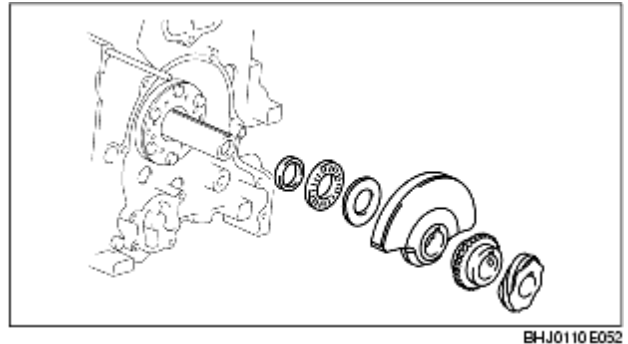
BHE011011D01E02

1. Lock the flywheel (MT) or counterweight (AT) against rotation using the **SST**.



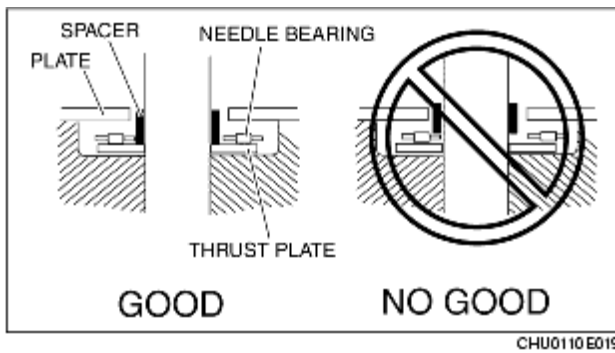
2. Assemble the parts in the following order:

- (1) Spacer
- (2) Needle bearing
- (3) Thrust plate
- (4) Balance weight
- (5) Oil pump drive gear
- (6) Metering oil pump drive gear



## Caution

- When assembling the spacer, do not allow the spacer to be caught in the needle bearing in the plate.

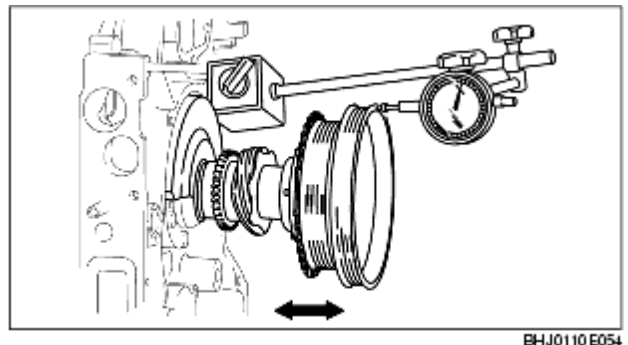


3. Assemble the eccentric shaft pulley, eccentric shaft position plate, pulley boss component apply engine oil to the pulley lockbolt threads, and then tighten.

**Tightening torque**  
**300-340 N·m {30.6-34.6 kgf·m, 222-250 ft·lbf}**

4. Remove the **SST**.

5. Measure the end play of the eccentric shaft using a dial gauge.



- If not within the specification, replace the spacer with one that is thicker than the currently assembled one. If it exceeds the specification, replace with a thinner spacer.

**Standard end play**  
**0.04-0.09 mm {0.0016-0.0035 in}**  
**Maximum end play**

0.1 mm {0.0039 in}

### Spacer types

(mm {in})

Marking	Dimension
A	7.985 {0.3144}
B	8.005 {0.3152}
C	8.025 {0.3159}
D	8.045 {0.3167}
E	8.065 {0.3175}

### Note

- If the end play is not within the specification even after replacing with an A-marked spacer, adjust by grinding it and reuse.

# PILOT BEARING INSPECTION/REPLACEMENT [MT]

BHE011011D01E03

## Inspection

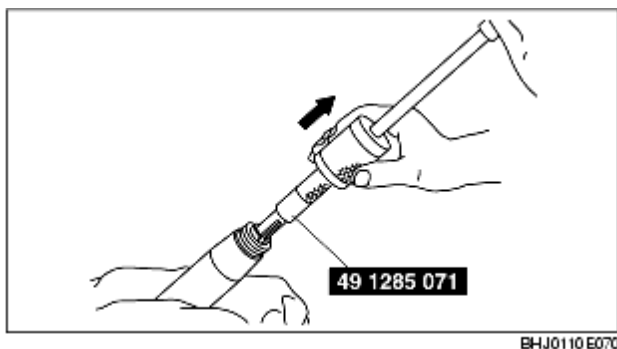
### Caution

- Inspect the pilot bearing when it is installed to the eccentric shaft.
1. Before removing the pilot bearing, inspect it for damage, wear, and proper rotation.
    - If there is any malfunction, replace the pilot bearing.

## Replacement

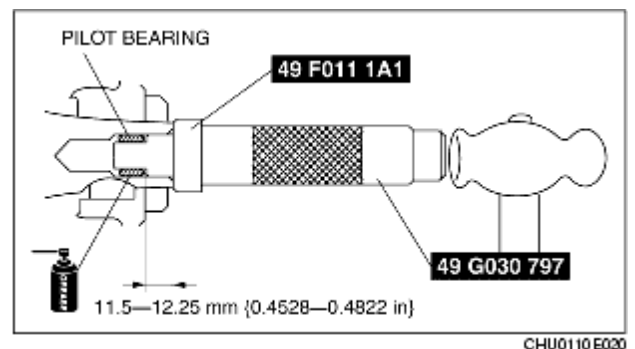
### Removal

1. Fix the eccentric shaft on a vice.
2. Remove the pilot bearing and the oil seal together using the **SST**.

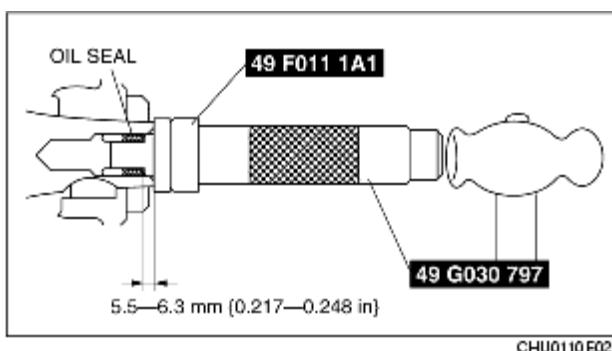


### Installation

1. Install a new pilot bearing using the **SSTs**.



2. Apply grease to the pilot bearing.
3. Install a new oil seal using the **SSTs**.



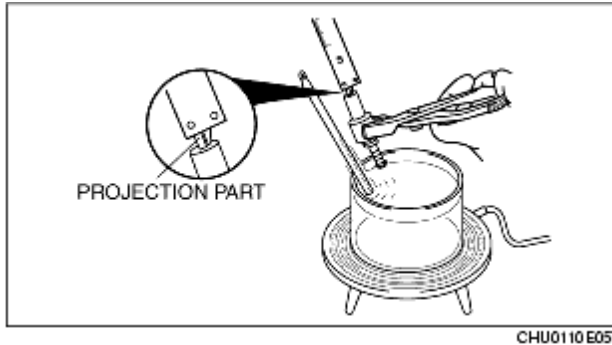
# ECCENTRIC SHAFT BYPASS VALVE

BHE011011D01E04

## Warning

- Engine oil temperature will increase during the inspection and become very dangerous. Be careful not to burn yourself during the inspection.

1. Put the eccentric shaft bypass valve in a container filled with engine oil.



2. Heat the container and verify that the projection protrudes more than the minimum specification when the engine oil temperature is **60 °C {140 °F}**.

- If it is less than the minimum specification, replace the eccentric shaft bypass valve.

**Minimum projection**  
**6 mm {0.24 in}**

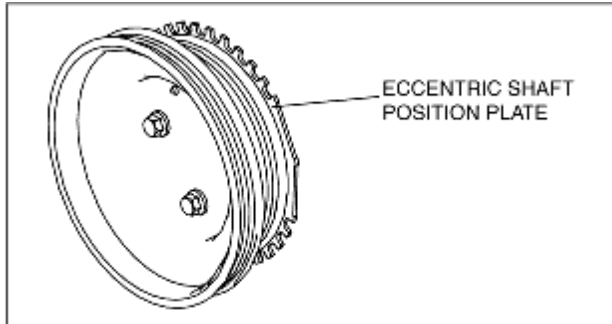
CHU0110 E057

# ECCENTRIC SHAFT POSITION PLATE INSPECTION

---

BHE011011D01E05

1. Visually inspect the eccentric shaft position plate for damage and erosion.



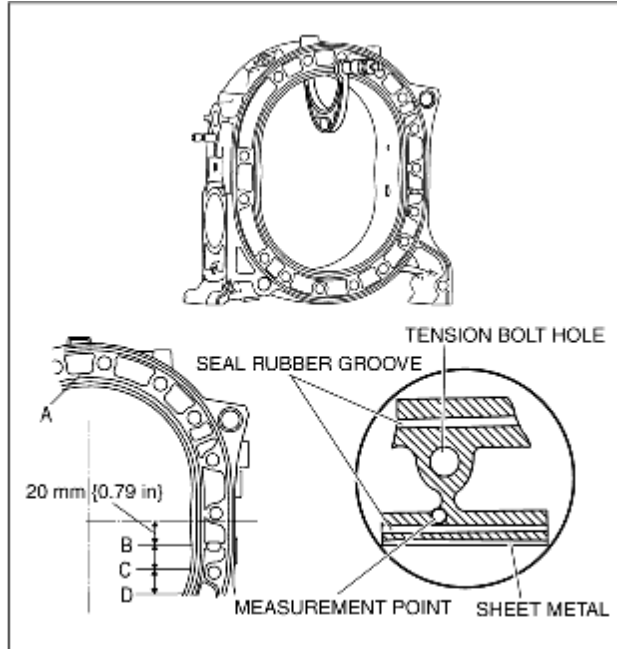
CHU0110 E055

- If there is any malfunction, replace the eccentric shaft position plate.

# ROTOR HOUSING INSPECTION

BHE011010B08E01

1. Measure the width of the rotor housing at four points (A, B, C, and D) as shown in the figure using a micrometer.



CHU0110 E005

2. Compute the width variation.

- If it exceeds the maximum, replace the rotor housing.

**Width difference = (width A) - (the smallest of widths B, C, or D)**

**Maximum width difference**

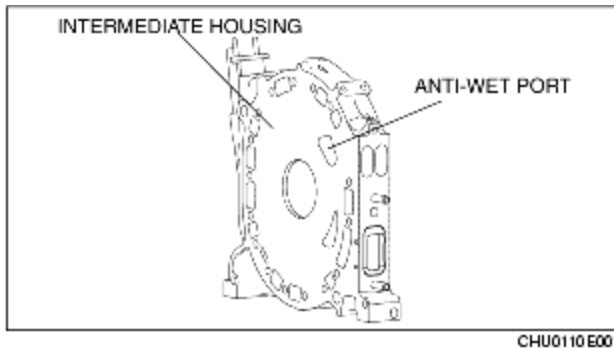
**0.06 mm {0.0024 in}**

# SIDE HOUSING (FRONT, INTERMEDIATE, REAR) INSPECTION

BHE011010D00E01

1. Inspect the intermediate housing for clogging in the intake and exhaust port.

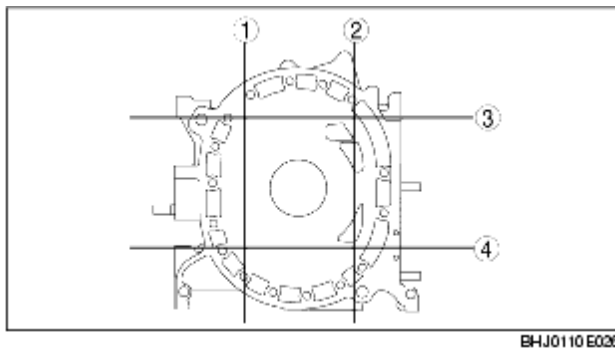
## Caution



- Carefully inspect the anti-wet port of the intermediate housing since it is an essential port.

- If there is any malfunction, replace the corresponding side housing.

2. Inspect the side housing for distortion in four positions as shown in the figure using a straight edge and a feeler gauge.



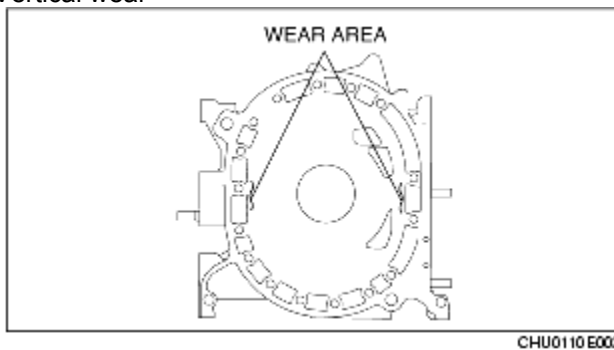
- If the distortion exceeds the maximum, replace the corresponding side housing.

**Maximum distortion**  
**0.04 mm {0.0016 in}**

3. Inspect the following three items related to wear in the areas where the rotor contacts the side housing using a dial gauge.

replace the corresponding side housing.

- (1) Vertical wear

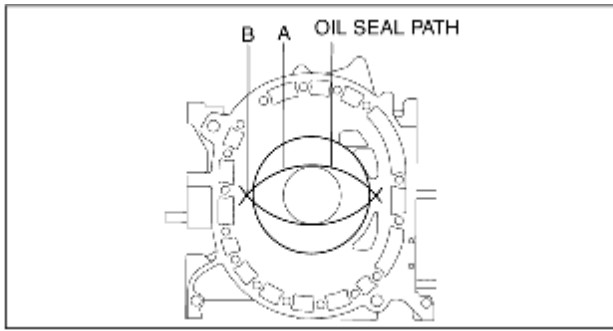


**Maximum wear**  
**0.10 mm {0.0039 in}**

- (2) Convex oval

- If any one of the items exceeds the maximum,





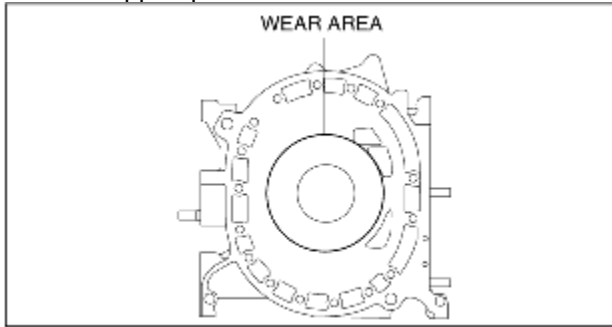
CHU0110 E003

**Maximum wear**

**Oil seal inner path (A): 0.01 mm {0.0004 in}**

**Oil seal outer path (B): 0.10 mm {0.0039 in}**

(3) Oil seal stepped path wear



CHU0110 E004

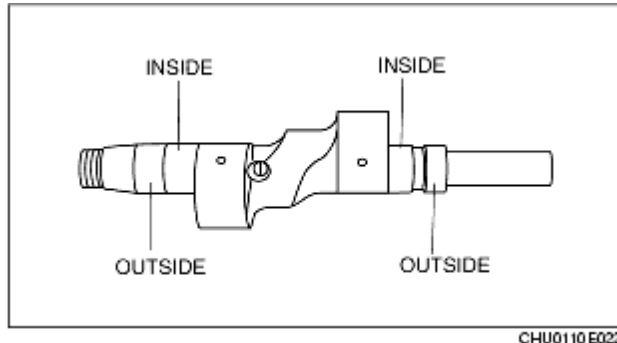
**Maximum wear**

**0.02 mm {0.0008 in}**

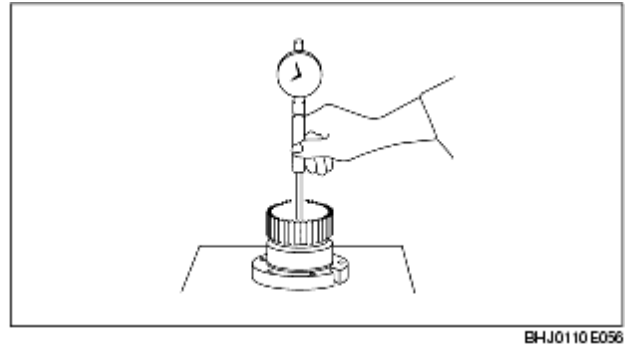
# MAIN BEARING OIL CLEARANCE INSPECTION

BHE011010E00E01

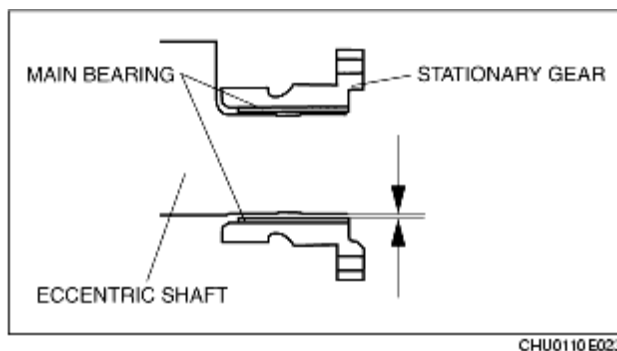
1. Using a micrometer, measure the outer diameters of the inside main journal.



2. Using a cylinder bore gauge, measure the inner diameter of the stationary gear main bearing.



3. Calculate the main bearing oil clearance from the main journal outer diameter and the main bearing inner diameter.



**Main bearing oil clearance = (main bearing inner diameter) - (main journal outer diameter)**

- If it exceeds the maximum specification, replace the main bearing. (See [MAIN BEARING REPLACEMENT](#).)
  - If the clearance is not within the specification after replacing the main bearing, replace the eccentric shaft.

**Standard main bearing oil clearance**

**Standard power: 0.045-0.085 mm**  
**{0.0018-0.0033 in}**

**High power: 0.055-0.075 mm**  
**{0.0022-0.0029 in}**

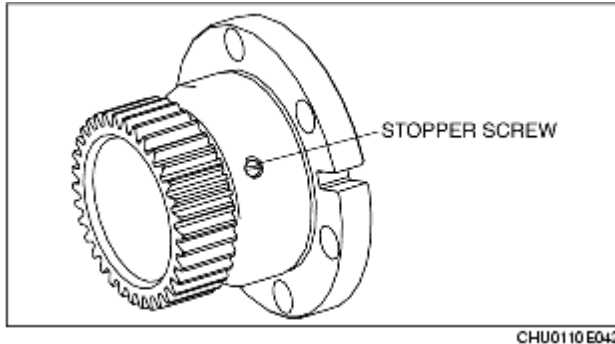
**Maximum main bearing oil clearance**  
**Standard power: 0.1 mm {0.0039 in}**  
**High power: 0.1 mm {0.0039 in}**

# MAIN BEARING REPLACEMENT

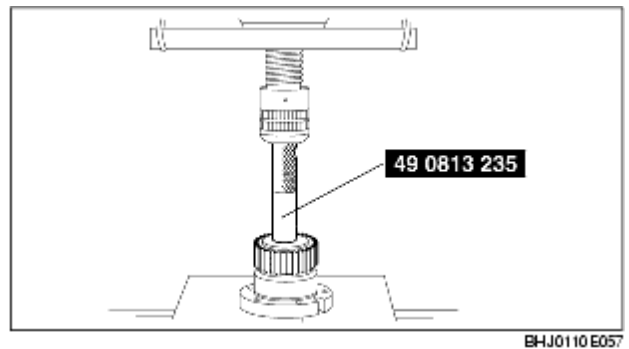
BHE011010E00E02

## Removal

1. Remove the stopper screw. (High power only)



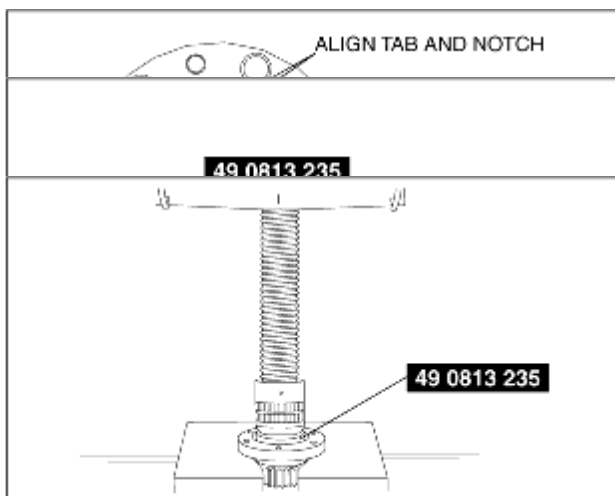
2. Remove the adapter ring and the securing screw from the **SST**.
3. Set the stationary gear to the hydraulic press so that the gear faces upward.
4. Remove the main bearing using the **SST**.



## Installation

### Standard power

1. Temporarily assemble the stationary gear and the main bearing so that the main bearing tab and notch are aligned after pressing in the main bearing and stationary gear.



2. Remove the **SST** handle.
3. Position the gear of the stationary gear downward, and install the main bearing by pressing it with the **SST**.

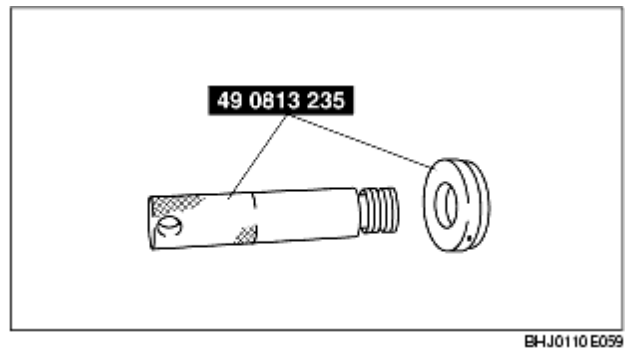
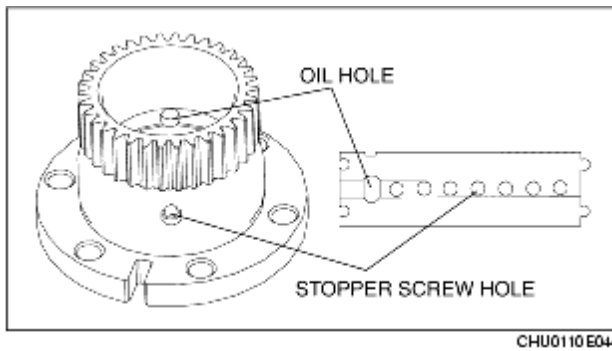
### Caution

- Press the main bearing in so that the top of the main bearing is flush with the top of the stationary gear flange.

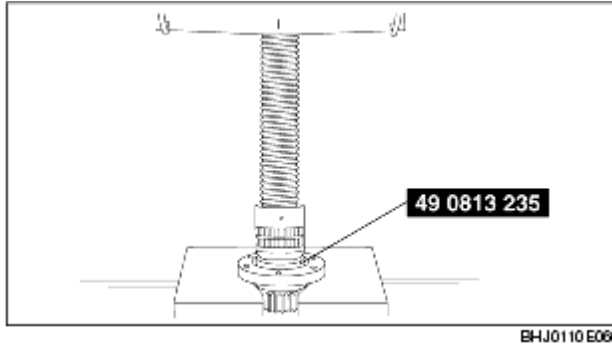
### High power

1. Temporarily assemble the stationary gear and the main bearing so that the main bearing screw hole and the stationary gear screw hole are aligned after pressing in the main bearing and rotor.

2. Remove the **SST** handle.



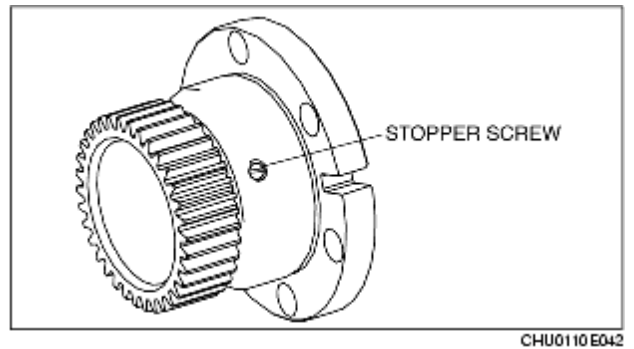
3. Position the gear of the stationary gear downward, and install the main bearing using the **SST**.



### Caution

- Press the main bearing in so that the top of the main bearing is flush with the top of the stationary gear flange.

4. Apply thread-locking compound to the stopper screw and install.



### Tightening torque

3.2-4.7 N·m

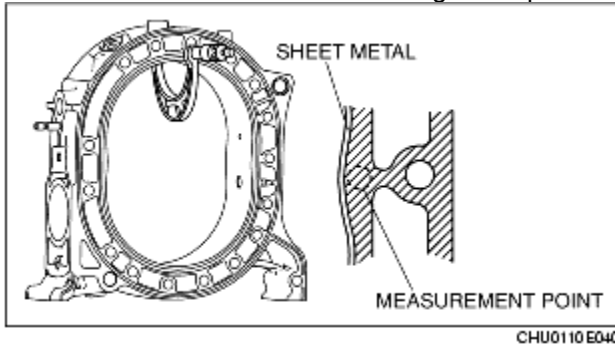
{33-47 kgf·cm, 29-41 in·lbf}

# İROTOR INSPECTION

BHE011011B10E01

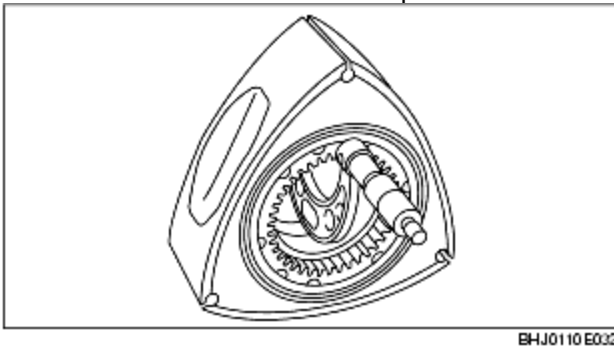
1. Inspect the rotor and side housing clearance according to the following procedure:

- If it is less than the minimum specification, replace the rotor.
- (1) Measure the width of the rotor housing in the position shown in the figure using a micrometer.

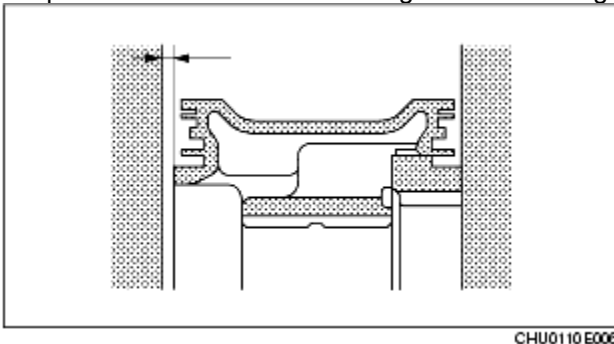


## Caution

- Move the sheet metal piece out of the way when measuring.
- (2) Measure the rotor width at various positions around the rotor round periphery using a micrometer.



- (3) Compute the rotor and side housing clearance using the measurements from (1) and (2).



**Rotor and side housing clearance = (rotor housing width) - (maximum rotor width)**

**Standard clearance**

**0.05-0.19 mm {0.0020-0.0074 in}**

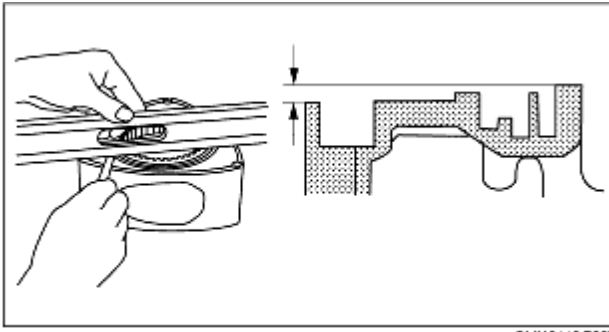
**Minimum clearance**

**0.05 mm {0.002 in}**

2. Measure the protrusion of the rotor round using a straight edge and a feeler gauge.

## Caution

- Measure the the protrusion of the rotor round in the three apexes of the rotor on both the front and rear sides.
- Because the rotor round has two levels, be careful not to measure the level difference of the middle level.

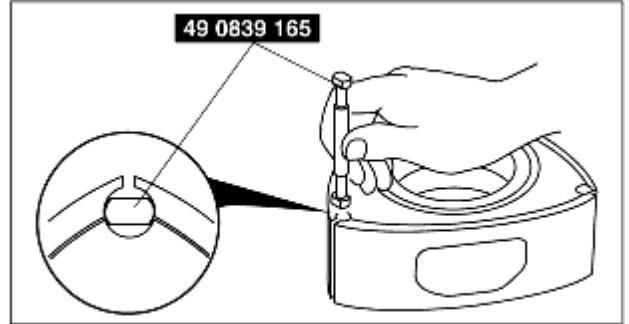


CHU0110 E007

- If it is less than the minimum specification, replace the rotor.

**Standard projection**  
**0.12-0.18 mm {0.0048-0.0070 in}**  
**Minimum projection**  
**0.1 mm {0.0039 in}**

3. Inspect the corner seal groove of the rotor by inserting the SST.



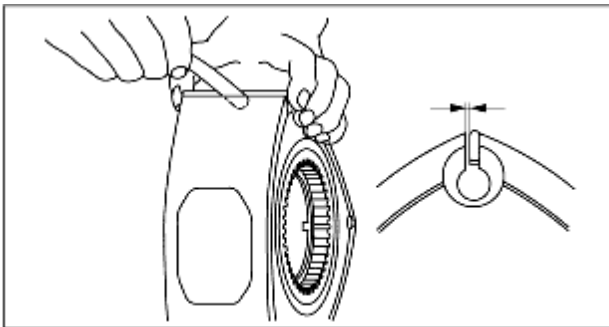
BHJ0110 E035

- If **1/2 or more** of either end of the **SST** can be inserted into the seal groove, replace the corner seal.
- If **1/2 or more** of both ends of the **SST** can be inserted into the corner seal groove, replace the rotor.

### Caution

- Do not push the SST in with force.
- Keep the SST perpendicular to the seal groove.
- When replacing the corner seal, replace with one that matches the S or L inscription on the rotor.

4. Measure the clearance between the apex seal groove and the apex seal using a feeler gauge.



CHU0110 E008

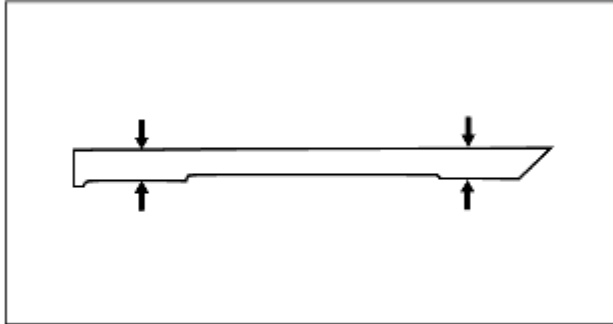
- If it exceeds the maximum specification, replace the apex seal.
- If the clearance is still not within the standard after replacing the apex seal, replace the rotor.

**Standard clearance**  
**0.042-0.101 mm {0.0017-0.0039 in}**  
**Maximum clearance**  
**0.15 mm {0.0059 in}**

# APEX SEAL INSPECTION

BHE011011B10E02

1. Measure the height in the positions shown in the figure.



BHJ0110 E037

- If it is less than the minimum specification, replace the apex seal.
- Replace the apex seal spring also whenever replacing the apex seal.

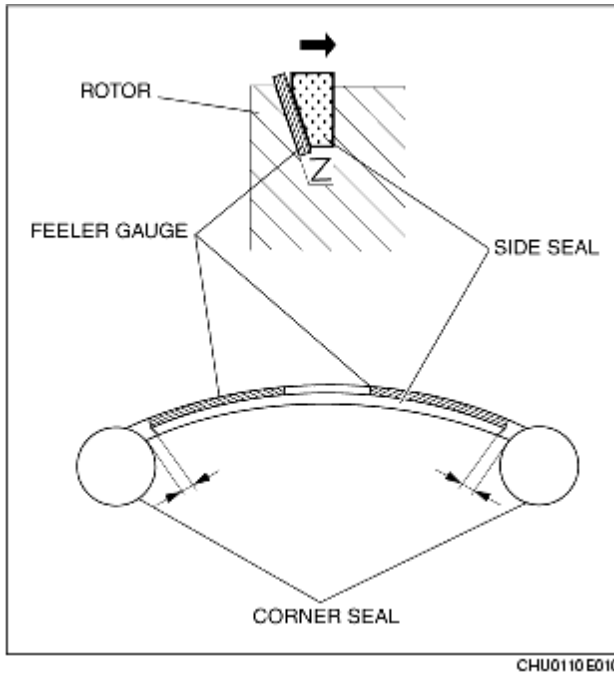
**Standard Height**  
**5.3 mm {0.20 in}**  
**Minimum height**  
**4.3 mm {0.17 in}**

# SIDE SEAL INSPECTION

BHE011011B10E03

1. Assemble the side and corner seals of the rotor.

2. Press the side seal up against the inner side of the side seal groove using **0.05-0.15 mm {0.0020-0.0059}** feeler gauges as shown in the figure.



CHU0110 E010

## Caution

- Press the feeler gauges against the both ends of the side seals correctly.

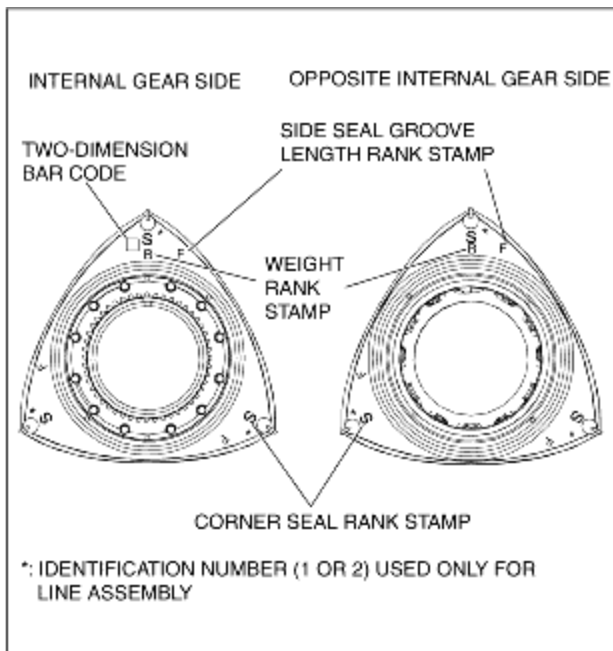
## Note

- Any side seal height is acceptable.

3. Measure the clearance between both ends of the side seal and the corner seal using a feeler gauge.

- If it exceeds the maximum specification, replace the side seal.

**Standard clearance**  
**0.05-0.15 mm {0.0020-0.0059 in}**  
**Maximum clearance**  
**0.4 mm {0.016 in}**



CHU0110 E068

- Select the proper side seal using the side seal selection table when replacing a side seal.

## Side seal selection table

Side seal groove length rank stamp	Part number of side seal
F	N3Z1 11 C10*
G	



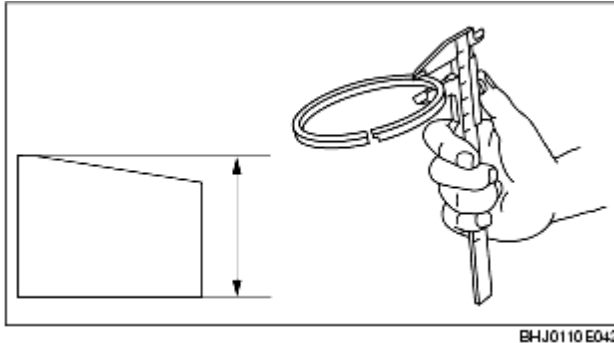
H	
I	
J	N3Z2 11 C10*
K	
L	
M	
N	N3Z3 11 C10*
O	
P	
Q	
R	N3Z4 11 C10*
S	
T	
U	

\* : Revision indication (alphabetical order)

# CUT-OFF SEAL INSPECTION

BHE011011B10E04

1. Measure the cut-off seal height using a vernier caliper.



**3.8 mm {0.15 in}**

- If it is less than the minimum specification, replace the cut-off seal.

## **Caution**

- Measure the cut-off seal height around the complete perimeter.

**Standard height**  
**3.95 mm {0.1555 in}**  
**Minimum height**

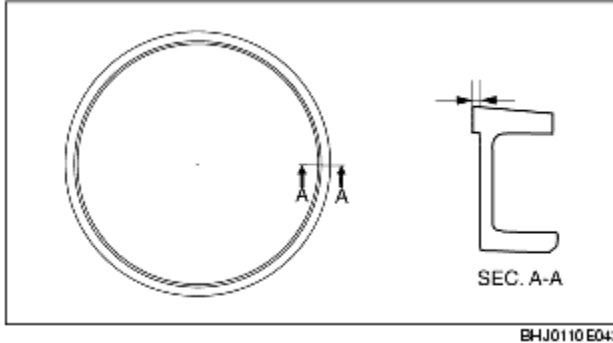
# OIL SEAL INSPECTION

BHE011011B10E05

1. Measure the following two items using a vernier caliper.

- If either of the items exceeds the maximum specification, replace the oil seal.

(1) Width of area that contacts the oil seal lip.



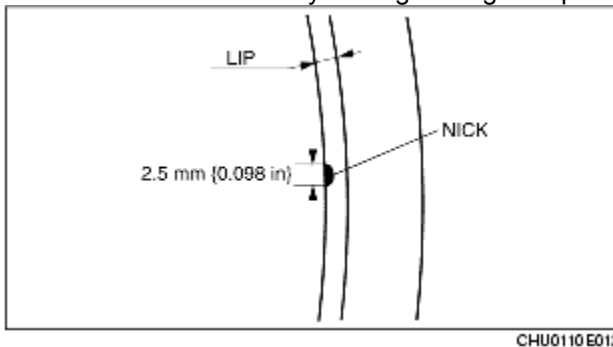
## Caution

- Measure the contact width around the complete perimeter.

**Maximum contact width**

**0.5 mm {0.02 in}**

(2) Circumferential width of any damage along the lip.



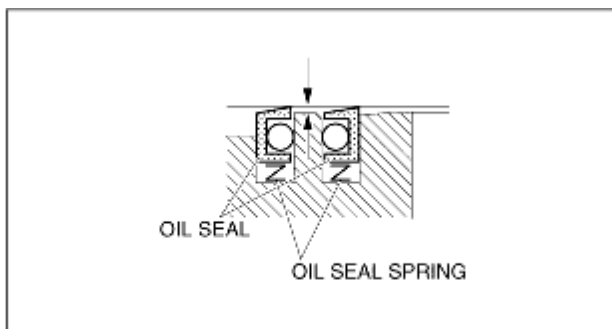
**Maximum circumferential width of the oil seal lip**  
**2.5 mm {0.098 in} or 10 nicks or more**

# SPRING INSPECTION

BHE011011B10E06

## Oil Seal Spring

1. Assemble the oil seal springs into the rotor.
2. Assemble the O-rings into the oil seals.
3. Assemble the oil seals into the rotor.
4. Measure the oil seal projection using a vernier caliper.



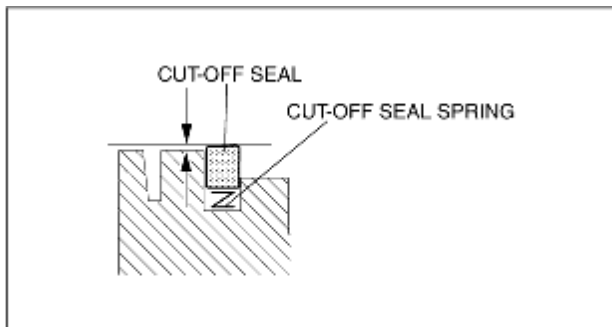
- If it is less than the minimum specification, replace the oil seal spring.

**Minimum projection**  
**0.5 mm {0.02 in}**

## Cut-off seal spring

CHU0110E013 1. Assemble the cut-off seal spring into the rotor.

2. Assemble the cut-off seal into the rotor.
3. Measure the cut-off seal projection using a vernier caliper.



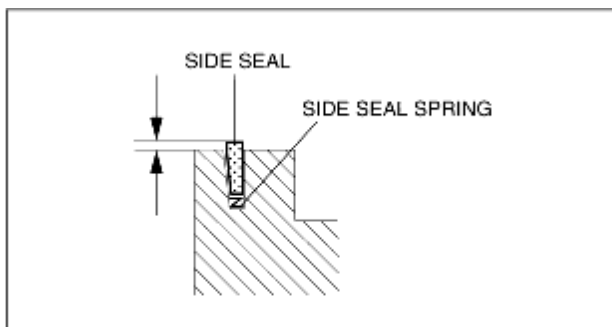
- If it is less than the minimum specification, replace the cut-off seal spring.

**Minimum projection**  
**0.5 mm {0.02 in}**

## Side seal spring

CHU0110E041 1. Assemble the side seal spring into the rotor.

2. Assemble the side seal into the rotor.
3. Measure the side seal projection using a vernier caliper.



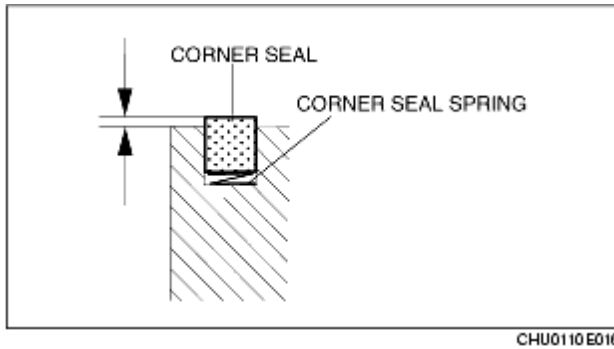
- If it is less than the minimum specification, replace the side seal spring.

**Minimum projection**  
**0.5 mm {0.02 in}**

## Corner Seal Spring

CHU0110E015 1. Assemble the corner seal spring into the rotor.

2. Assemble the corner seal into the rotor.
3. Measure the corner seal projection using a vernier caliper.



- If it is less than the minimum specification, replace the corner seal spring.

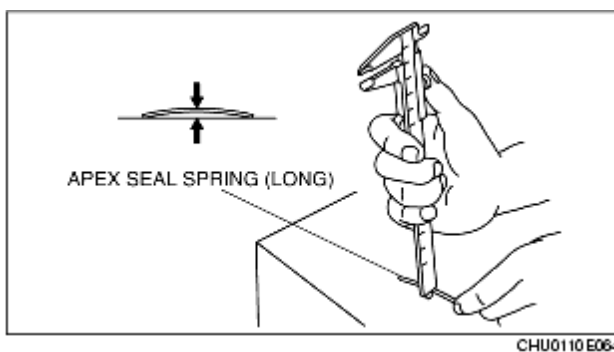
**Minimum projection**  
**0.5 mm {0.02 in}**

## Apex Seal Spring

### Note

- Inspect the long apex seal spring.

1. Measure the height of the apex seal spring using a vernier caliper with the spring placed on a surface plate.



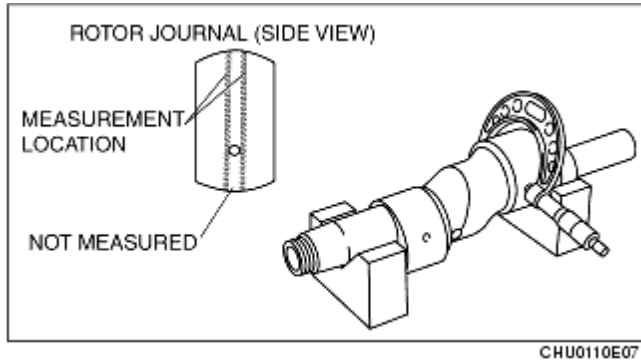
- If it is less than the minimum specification, replace the apex seal spring.

**Standard height**  
**5.4 mm {0.213 in}**  
**Minimum height**  
**3.5 mm {0.148 in}**

# ROTOR BEARING OIL CLEARANCE INSPECTION

BHE011011B10E07

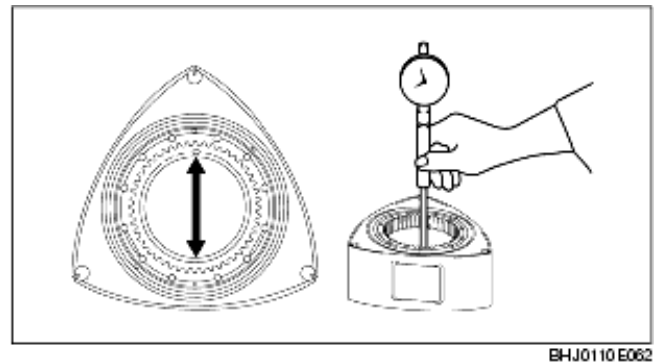
1. Measure the outer diameter of the rotor journal using a micrometer.



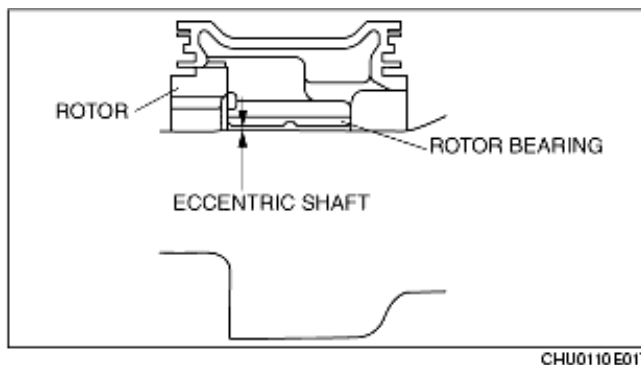
## Caution

- Measure the rotor journal at a point slightly off-center since the center section is raised. Do not measure at the center because it does not contact the rotor bearing.

2. Measure the inner diameter of the rotor bearing using a cylinder gauge.



3. Calculate the rotor bearing oil clearance from the rotor journal outer diameter and the rotor bearing inner diameter.



0.1 mm {0.0039 in}

**Rotor bearing oil clearance = (rotor bearing inner diameter) - (rotor journal outer diameter)**

- If it exceeds the minimum specification, replace the rotor bearing. (See [ROTOR BEARING REPLACEMENT](#).)
- If not within the specification, even with the rotor bearing replaced, replace the eccentric shaft.

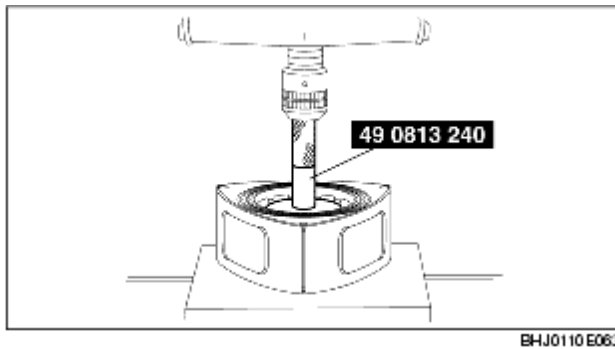
**Standard rotor bearing oil clearance**  
**0.06-0.08 mm {0.0024-0.0030 in}**  
**Maximum rotor bearing oil clearance**

# ROTOR BEARING REPLACEMENT

BHE011011B10E08

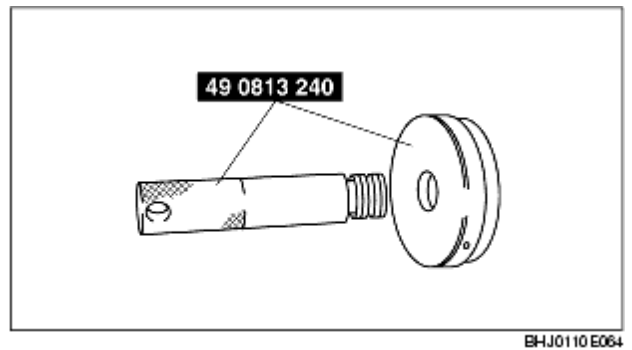
## Removal

1. Set the rotor with the internal gear at the bottom.
2. Remove the adapter ring and the securing screw from the **SST**.
3. Remove the rotor bearing using the **SST**.

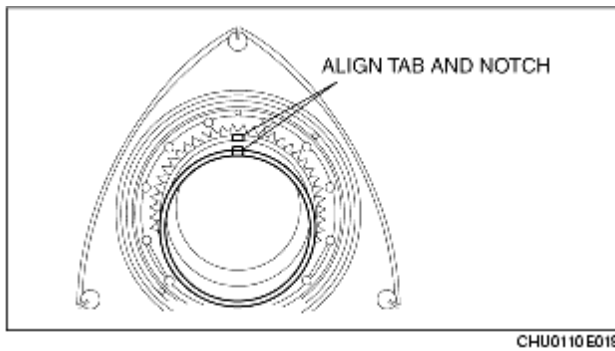


## Installation

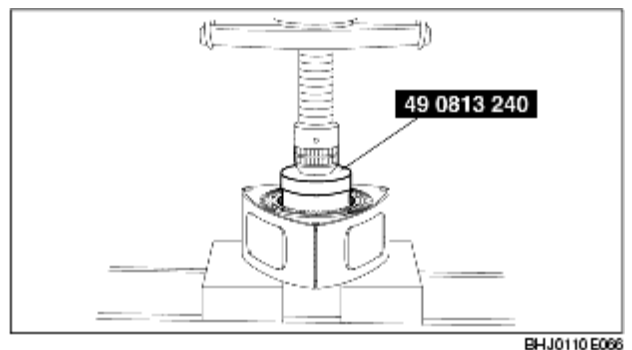
1. Remove the **SST** handle.



2. Temporarily assemble so that the rotor bearing tab and the rotor notch are aligned after pressing in the rotor bearing and rotor.



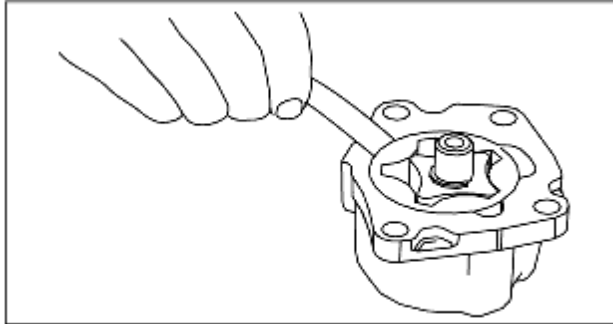
3. Set the temporarily assembled rotor bearing and rotor on a hydraulic press.
4. Press in the rotor bearing using the **SST**.



# OIL PUMP INSPECTION

BHE011014100E01

1. Measure the side clearance between the outer rotor and the body using a feeler gauge.

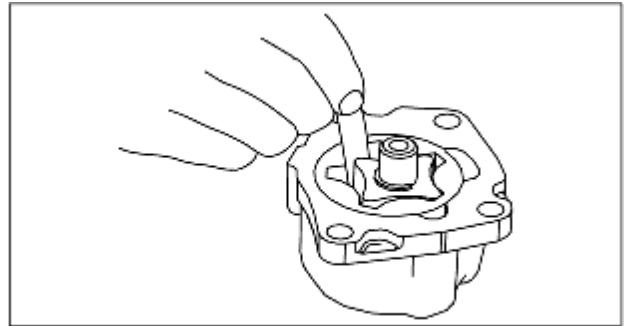


BHJ0110 E067

- If it exceeds the maximum specification, replace the oil pump.

**Standard side clearance**  
**0.20-0.25 mm {0.0079-0.0098 in}**  
**Maximum side clearance**  
**0.3 mm {0.0118 in}**

2. Measure the tip clearance between the inner rotor and the outer rotor using a feeler gauge.

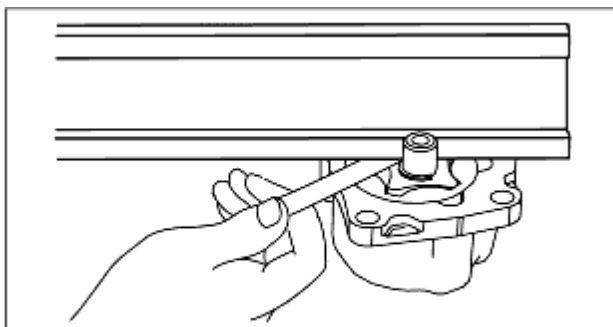


BHJ0110 E068

- If it exceeds the maximum specification, replace the oil pump.

**Standard tip clearance**  
**0.03-0.12 mm {0.0012-0.0047 in}**  
**Maximum tip clearance**  
**0.15 mm {0.0059 in}**

3. Measure the body clearance between the rotor and the side housing using a straight edge and a feeler gauge.



BHJ0110 E069

- If it exceeds the maximum specification, replace the oil pump.

**Standard body clearance**  
**0.03-0.125 mm {0.0012-0.0049 in}**  
**Maximum body clearance**  
**0.15 mm {0.0059 in}**