

Engine Workshop Manual 13B–MSP (Multi Side Port)

FOREWORD

This manual explains the disassembly, inspection, repair, and reassembly procedures for the above-indicated engine.

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

The information in this manual is current up to October, 2008. Any changes that occur after that time will not be reflected in this particular manual. Therefore, the contents of this manual may not exactly match the mechanism that you are currently servicing.

Mazda Motor Corporation
HIROSHIMA, JAPAN

CONTENTS

Title	Section
GENERAL INFORMATION	00
ENGINE	01

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GENERAL INFORMATION

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SECTION

00-00

GENERAL INFORMATION 00-00

00-00 GENERAL INFORMATION

HOW TO USE THIS MANUAL	00-00-1	Inspection During Removal,	
Range of Topics	00-00-1	Disassembly	00-00-6
Service Procedure	00-00-2	Arrangement of Parts	00-00-7
Symbols	00-00-4	Cleaning of Parts	00-00-7
Advisory Messages	00-00-4	Reassembly	00-00-7
UNITS	00-00-5	Adjustment	00-00-8
Conversion to SI Units		Rubber Parts and Tubing	00-00-8
(Système International d'Unités)	00-00-5	Hose Clamps	00-00-8
Rounding Off	00-00-5	Torque Formulas	00-00-8
Upper and Lower Limits	00-00-5	Vise	00-00-9
FUNDAMENTAL PROCEDURES	00-00-6	ELECTRICAL SYSTEM	00-00-9
Preparation of Tools and Measuring		Connectors	00-00-9
Equipment	00-00-6	SAE STANDARDS	00-00-11
Special Service Tools	00-00-6	ABBREVIATIONS	00-00-11
Disassembly	00-00-6	IDENTIFYING SPECIFICATION	00-00-12

HOW TO USE THIS MANUAL

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Range of Topics

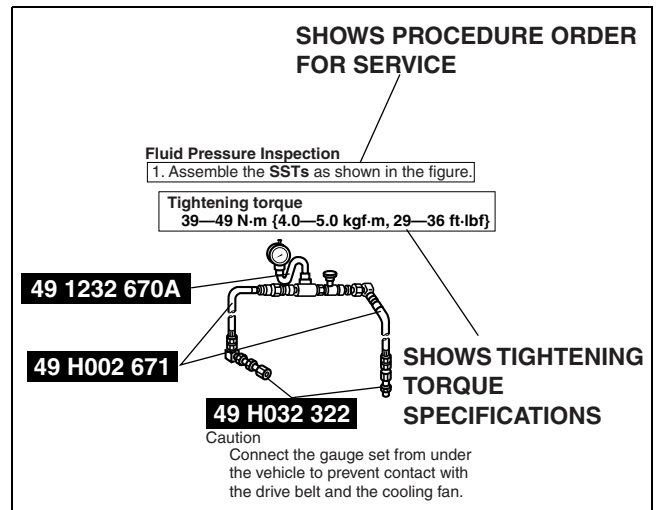
- This manual contains procedures for performing all required service operations. The procedures are divided into the following five basic operations:
 - Removal/Installation
 - Disassembly/Assembly
 - Replacement
 - Inspection
 - Adjustment
- Simple operations which can be performed easily just by looking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

GENERAL INFORMATION

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

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Repair procedure

1. Most repair operations begin with an overview illustration. It identifies the components, shows how the parts fit together, and describes visual part inspection. However, only removal/installation procedures that need to be performed methodically have written instructions.
2. Expendable parts, tightening torques, and symbols for oil, grease, and sealant are shown in the overview illustration. In addition, symbols indicating parts requiring the use of special service tools or equivalent are also shown.
3. Procedure steps are numbered and the part that is the main point of that procedure is shown in the illustration with the corresponding number. Occasionally, there are important points or additional information concerning a procedure. Refer to this information when servicing the related part.

SHOWS SERVICE ITEM(S)

Procedure

“Removal/Installation” Portion

“Inspection After Installation” Portion

FRONT UPPER LINK, FRONT UPPER LEADING LINK REMOVAL/INSTALLATION

1. Jack up the front of the vehicle and support it with safety stands.
2. Remove the splash shield(s). (See 09-11-11 SPLASH SHIELD INSTALLATION.)
3. Remove in the order indicated in the table.
4. Install reverse order of removal.
5. Inspect the front wheel alignment and adjust it if necessary.

INDICATES RELEVANT REFERENCES THAT NEED TO BE FOLLOWED DURING INSTALLATION

SHOWS SPECIAL SERVICE TOOL (SST) FOR SERVICE OPERATION

SHOWS APPLICATION POINTS OF GREASE, ETC.

SHOWS EXPENDABLE PARTS

SHOWS DETAILS

SHOWS TIGHTENING TORQUE SPECIFICATIONS

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

SHOWS PROCEDURE ORDER FOR SERVICE

SHOWS TIGHTENING TORQUE UNITS

SHOWS REFERRAL NOTES FOR SERVICE

1	Split pin	5	Adjust cam bolt
2	Nut	6	Upper lateral link
3	Upper lateral link ball joint	7	Dust boot, clip (upper lateral link)
(See 02-13-6 Upper Lateral Link Ball Joint Removal Note)		8	Split pin
4	Cam nut, cam plate	9	Nut
		10	Upper leading link ball joint
		11	Upper leading link
		12	Dust boot (upper leading link)

Upper Lateral Link Ball Joint Removal Note

- Remove the ball joint using the SSTs.

SHOWS SPECIAL SERVICE TOOL (SST) NO.

49 T028 303

49 T028 304

49 T028 305

KNUCKLE

UPPER LEADING LINK

UPPER LATERAL LINK









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

YLU000WA0

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 ² (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'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/cm² in the following specifications:

210—260 kPa {2.1—2.7 kgf/cm², 30—38 psi}
270—310 kPa {2.7—3.2 kgf/cm², 39—45 psi}

- The actual converted values for 2.7 kgf/cm² 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.

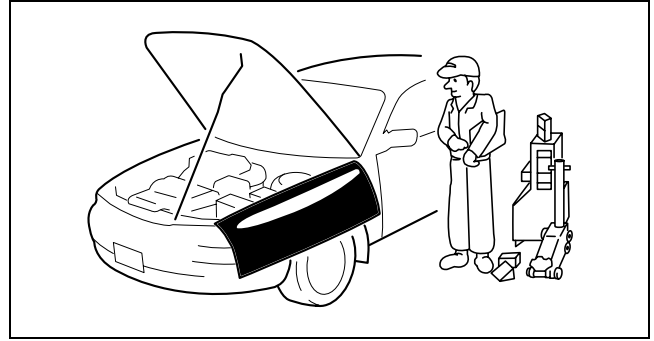
GENERAL INFORMATION

FUNDAMENTAL PROCEDURES

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Preparation of Tools and Measuring Equipment

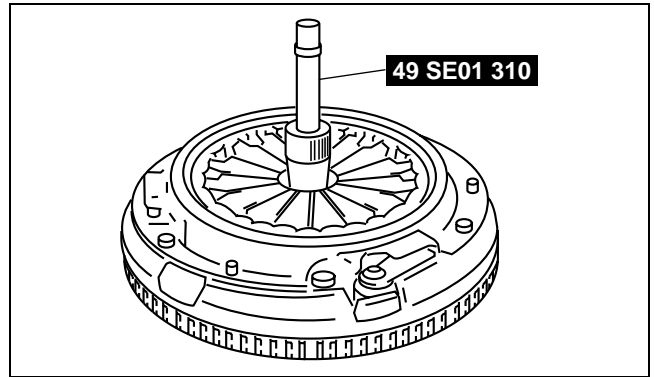
- Be sure that all necessary tools and measuring equipment are available before starting any work.



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Special Service Tools

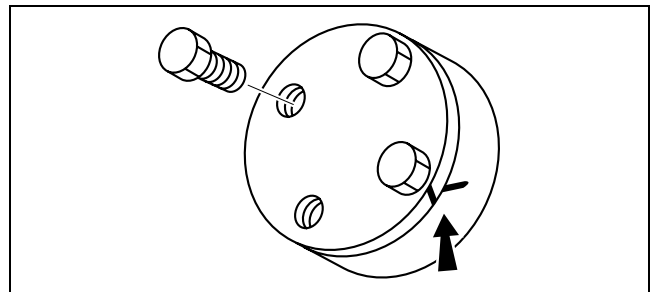
- Use special service tools or equivalent when they are required.



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Disassembly

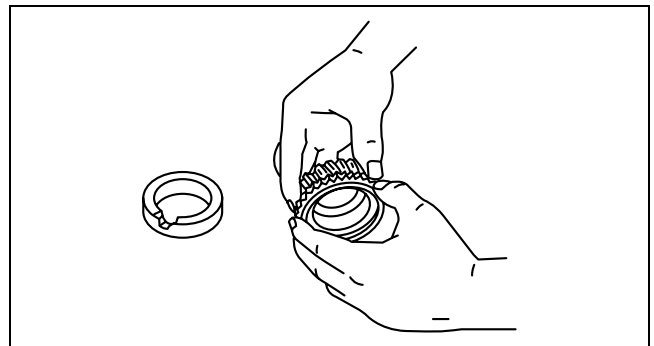
- If the disassembly procedure is complex, requiring many parts to be disassembled, all parts should be marked in a place that will not affect their performance or external appearance and identified so that reassembly can be performed easily and efficiently.



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Inspection During Removal, Disassembly

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

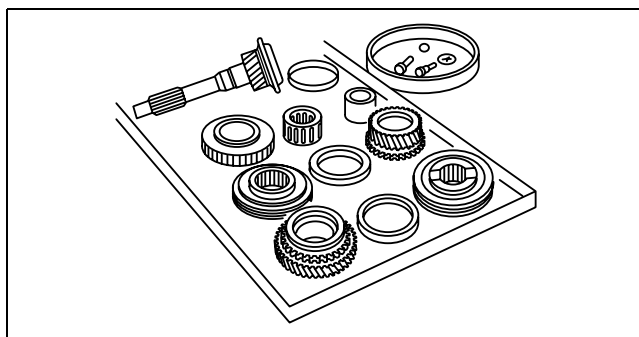


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GENERAL INFORMATION

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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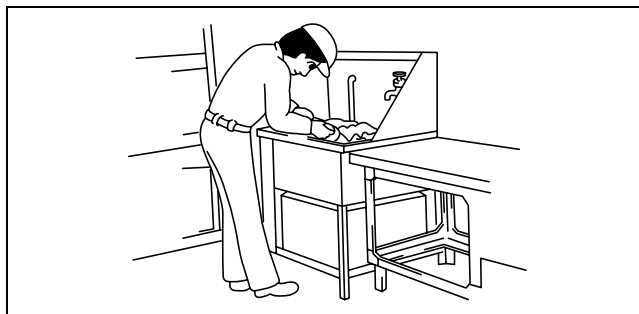
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Cleaning of Parts

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

Warning

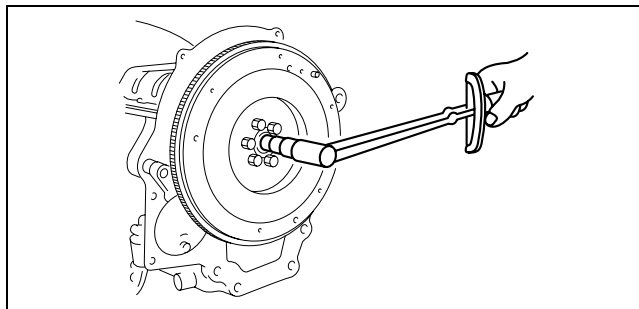
- **Using compressed air can cause dirt and other particles to fly out causing injury to the eyes. Wear protective eye wear whenever using compressed air.**



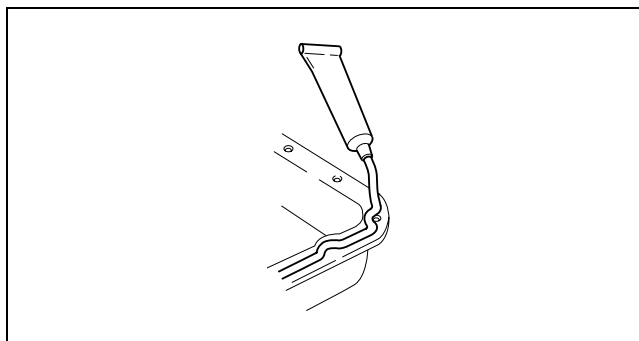
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Reassembly

- 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
 - Lock washers
 - 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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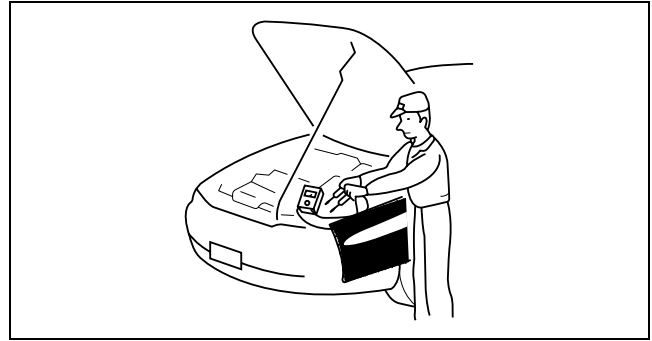


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GENERAL INFORMATION

Adjustment

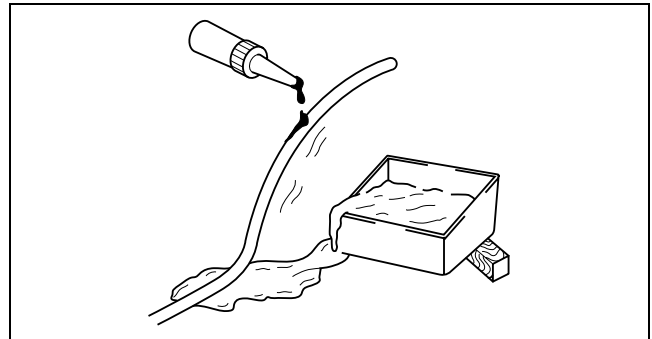
- Use suitable gauges and testers when making adjustments.



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Rubber Parts and Tubing

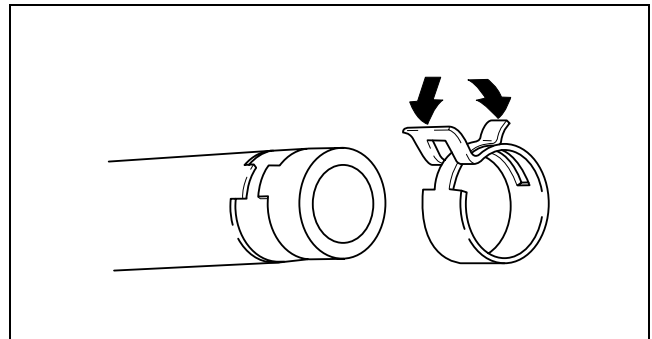
- Prevent gasoline or oil from getting on rubber parts or tubing.



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Hose Clamps

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

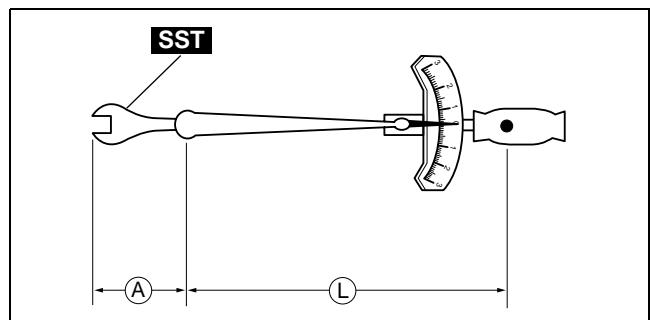


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Torque Formulas

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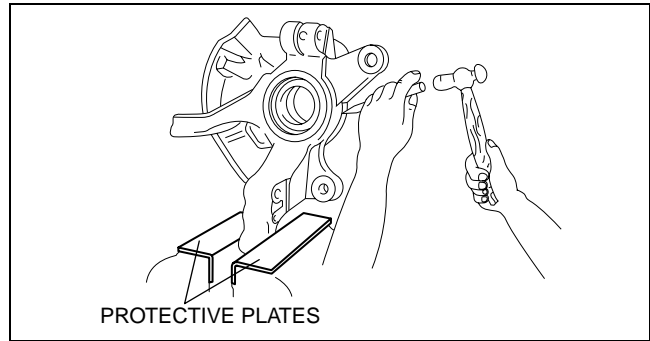
A : The length of the SST past the torque wrench drive.

L : The length of the torque wrench.

GENERAL INFORMATION

Vise

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



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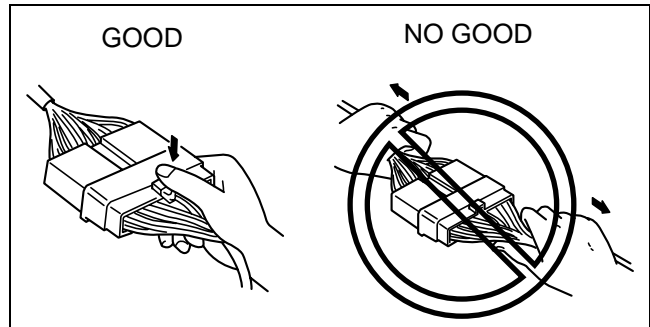
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ELECTRICAL SYSTEM

Connectors

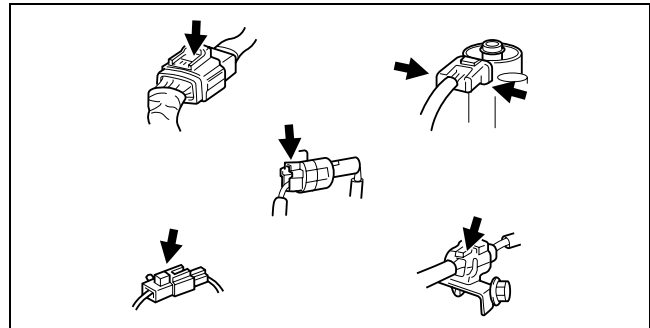
Disconnecting connectors

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



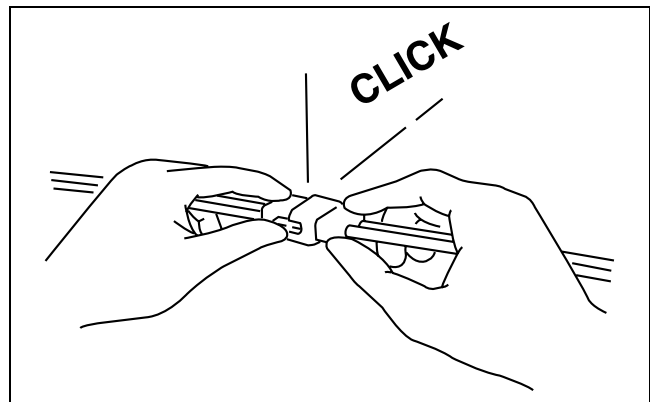
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- Connectors can be disconnected by pressing or pulling the lock lever as shown.



Locking connector

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



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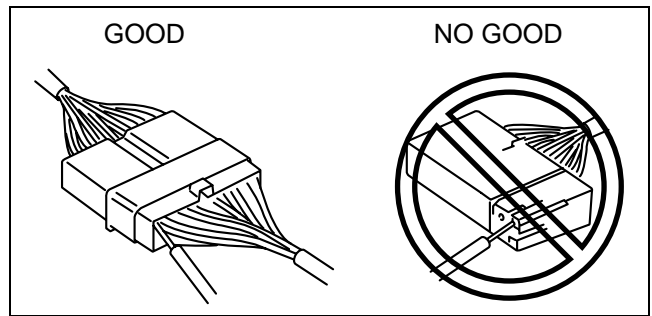
GENERAL INFORMATION

Inspection

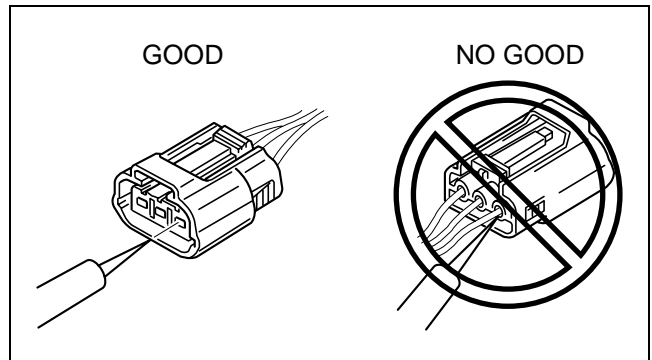
- When a tester is used to inspect for continuity or measuring voltage, insert the tester probe from the wiring harness side.
- Inspect the terminals of waterproof connectors from the connector side since they cannot be accessed from the wiring harness side.

Caution

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



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CHU0000W012

GENERAL INFORMATION

SAE STANDARDS

CHU000000003E02

- In accordance with new regulations, SAE (Society of Automotive Engineers) standard names and abbreviations are now used in this manual. The table below lists the names and abbreviations that have been used in Mazda manuals up to now and their SAE equivalents.

SAE Standard		Remark	SAE Standard		Remark
Abbreviation	Name		Abbreviation	Name	
AP	Accelerator Pedal		MAP	Manifold Absolute Pressure	
APP	Accelerator Pedal Position		MAF	Mass Air Flow	
ACL	Air Cleaner		MAF sensor	Mass Air Flow Sensor	
A/C	Air Conditioning		MFL	Multiport Fuel Injection	
A/F	Air Fuel Ratio		OBD	On-board Diagnostic System	
BARO	Barometric Pressure		OL	Open Loop	
B+	Battery Positive Voltage		OC	Oxidation Catalytic Converter	
CMP sensor	Camshaft Position Sensor		O2S	Oxygen Sensor	
LOAD	Calculated Load Value		PNP	Park/Neutral Position	
CAC	Charge Air Cooler		PID	Parameter Identification	
CLS	Closed Loop System		PSP	Power Steering Pressure	
CTP	Closed Throttle Position		PCM	Powertrain Control Module	#3
CPP	Clutch Pedal Position		PAIR	Pulsed Secondary Air Injection	Pulsed injection
CIS	Continuous Fuel Injection System		AIR	Secondary Air Injection	Injection with air pump
CKP sensor	Crankshaft Position Sensor		SAPV	Secondary Air Pulse Valve	
DLC	Data Link Connector		SFI	Sequential Multiport Fuel Injection	
DTM	Diagnostic Test Mode	#1	3GR	Third Gear	
DTC	Diagnostic Test Code(s)		TWC	Three Way Catalytic Converter	
DI	Distributor Ignition		TB	Throttle Body	
DLI	Distributorless Ignition		TP	Throttle Position	
EI	Electronic Ignition	#2	TP sensor	Throttle Position Sensor	
ECT	Engine Coolant Temperature		TCC	Torque Converter Clutch	
EM	Engine Modification		TCM	Transmission (Transaxle) Control Module	
EVAP	Evaporative Emission		TR	Transmission (Transaxle) Range	
EGR	Exhaust Gas Recirculation		TC	Turbocharger	
FC	Fan Control		VSS	Vehicle Speed Sensor	
FF	Flexible Fuel		VR	Voltage Regulator	
4GR	Fourth Gear		VAF sensor	Volume Air Flow Sensor	
GEN	Generator		WU-TWC	Warm Up Three Way Catalytic Converter	#4
GND	Ground		WOP	Wide Open Throttle	
HO2S	Heated Oxygen Sensor	With heater			
IAC	Idle Air Control				
IAT	Intake Air Temperature				
KS	Knock Sensor				
MIL	Malfunction Indicator Lamp				

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

#2 : Controlled by the PCM

#3 : Device that controls engine and powertrain

#4 : Directly connected to exhaust manifold

ABBREVIATIONS

CHU000000011E01

AT	Automatic Transmission
MT	Manual Transmission
SST	Special Service Tool

GENERAL INFORMATION

IDENTIFYING SPECIFICATION

CHU000000000E01

- Because the engine construction varies depending on the vehicle's period of manufacture, determine the service specification by referring to the following identification.

Identifying Specification

	Applicable VIN
Type A	Except below
Type B	JM1 FE172*9# 400001—
	JM1 FE174*9# 400001—
	JM1 FE17M*9# 400001—
	JM1 FE17P*9# 400001—

MECHANICAL

MECHANICAL 01-10
TECHNICAL DATA 01-50

SERVICE TOOLS 01-60

01-10 MECHANICAL

01-10

ENGINE OVERHAUL SERVICE

WARNING 01-10-2
ENGINE MOUNTING/DISMOUNTING . . 01-10-2
 Mounting 01-10-2
 Dismounting 01-10-3
HOUSING DISASSEMBLY I 01-10-4
 Oil Pan Disassembly Note 01-10-5
 Oil Pan Upper Block
 Disassembly Note 01-10-5
HOUSING DISASSEMBLY II 01-10-6
 Pulley Lockbolt Disassembly Note 01-10-7
 Front Cover Disassembly Note 01-10-7
 Oil Pump Sprocket
 Disassembly Note 01-10-7
HOUSING DISASSEMBLY III 01-10-8
 Flywheel (MT), Counterweight (AT)
 Disassembly Note 01-10-9
 Tension Bolt Disassembly Note 01-10-10
 Rear Housing Disassembly Note 01-10-10
 Stationary Gear Disassembly Note 01-10-10
 Tubular Dowel Disassembly Note 01-10-10
 Rotor Housing Disassembly Note 01-10-11
 Rotor Disassembly Note 01-10-11
 Intermediate Housing
 Disassembly Note 01-10-12
ROTOR DISASSEMBLY 01-10-12
 Oil Seal Disassembly Note 01-10-13
 Oil Seal Spring Disassembly Note 01-10-13
SIDE HOUSING (FRONT, INTERMEDIATE, REAR) INSPECTION 01-10-13
ROTOR HOUSING INSPECTION 01-10-14
ROTOR INSPECTION 01-10-15
APEX SEAL INSPECTION 01-10-16
SIDE SEAL INSPECTION 01-10-17
CUT-OFF SEAL INSPECTION 01-10-18
OIL SEAL INSPECTION 01-10-18
SPRING INSPECTION 01-10-18
 Oil Seal Spring 01-10-18
 Cut-off Seal Spring 01-10-19
 Side Seal Spring 01-10-19
 Corner Seal Spring 01-10-19
 Apex Seal Spring 01-10-19
ROTOR BEARING OIL CLEARANCE INSPECTION 01-10-20
ROTOR BEARING REPLACEMENT . . . 01-10-21
 Removal 01-10-21
 Installation 01-10-21
ECCENTRIC SHAFT INSPECTION 01-10-22
ECCENTRIC SHAFT END PLAY INSPECTION 01-10-22

PILOT BEARING

INSPECTION/REPLACEMENT [MT] . . . 01-10-24
 Inspection 01-10-24
 Replacement 01-10-24
ECCENTRIC SHAFT BYPASS VALVE 01-10-25
ECCENTRIC SHAFT POSITION PLATE INSPECTION 01-10-25
MAIN BEARING OIL CLEARANCE INSPECTION 01-10-25
MAIN BEARING REPLACEMENT 01-10-26
 Removal 01-10-26
 Installation 01-10-27
OIL PUMP INSPECTION 01-10-29
 Type A 01-10-29
 Type B 01-10-29
ROTOR ASSEMBLY 01-10-30
 Oil Seal Spring Assembly Note 01-10-30
 O-Ring Assembly Note 01-10-31
 Oil Seal Assembly Note 01-10-32
 Cut-Off Seal Spring Assembly Note 01-10-32
 Cut-Off Seal Assembly Note 01-10-33
HOUSING ASSEMBLY I 01-10-34
 Thrust Plate Assembly Note 01-10-35
 Rotor Assembly Note 01-10-35
 Oil Jet Plug Assembly Note 01-10-36
 Rotor Housing Assembly Note 01-10-37
 Intermediate Housing
 Assembly Note 01-10-38
 Rear Oil Seal Assembly Note 01-10-39
 Rear Housing Assembly Note 01-10-40
 Tension Bolt Assembly Note 01-10-40
 Flywheel (MT), Counterweight (AT)
 Assembly Note 01-10-41
HOUSING ASSEMBLY II 01-10-42
 Spacer Assembly Note 01-10-43
 Oil Pump Drive Gear
 Assembly Note 01-10-43
 Oil Pump Sprocket Wheel
 Assembly Note 01-10-43
 Front Oil Seal Assembly Note 01-10-43
 Front Cover Assembly Note 01-10-44
 Pulley Lockbolt Assembly Note 01-10-44
HOUSING ASSEMBLY III 01-10-45
 Oil Pan Upper Block
 Assembly Note 01-10-47
 Oil Pan Assembly Note 01-10-47

MECHANICAL

ENGINE OVERHAUL SERVICE WARNING

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Warning

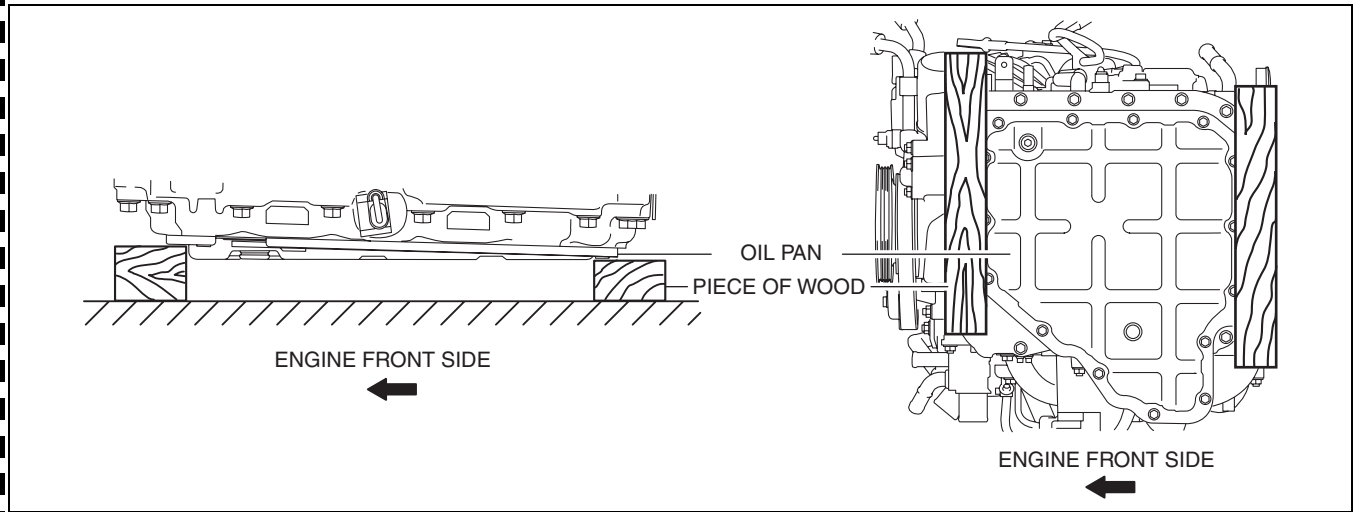
- Continuous exposure to USED engine oil has caused skin cancer in laboratory mice. Protect your skin by washing with soap and water immediately after this work.

ENGINE MOUNTING/DISMOUNTING

CHU011002000E12

Caution

- The oil pan could be damaged or dented if the engine's own weight is subjected to an impact against a level surface. Always set two pieces of wood in the positions shown in the figure to prevent the oil pan from being dented. If the oil pan is dented, the amount of intake oil and the fluid pressure will decrease. (Type B)

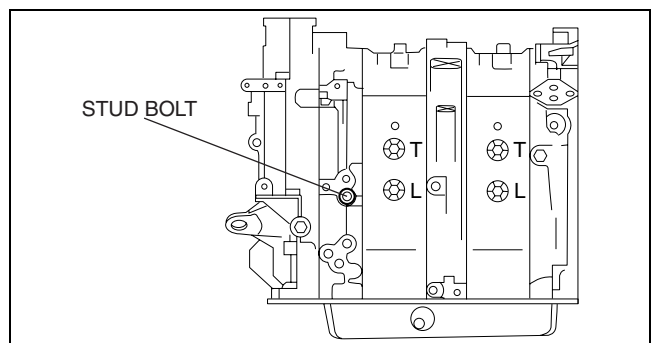


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Mounting

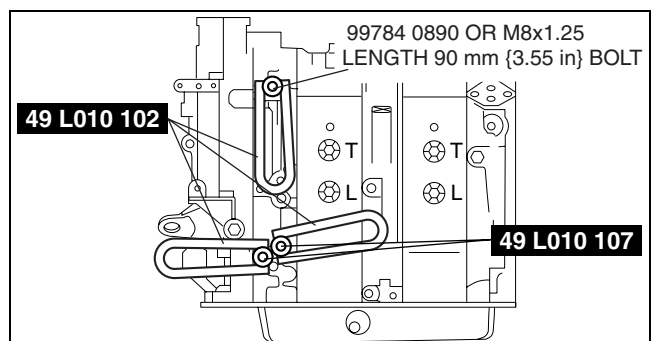
Using 49 L010 1A0

1. Remove the stud bolt.



CHU0110E048

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.

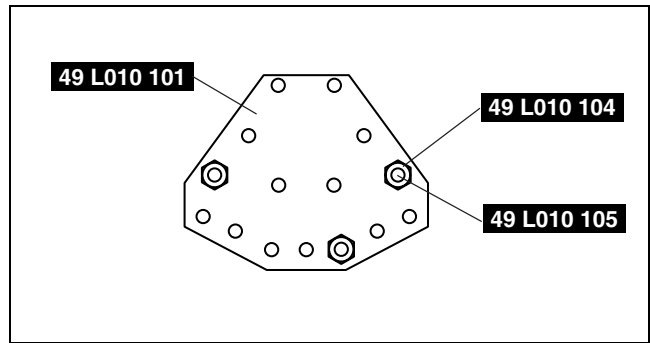


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MECHANICAL

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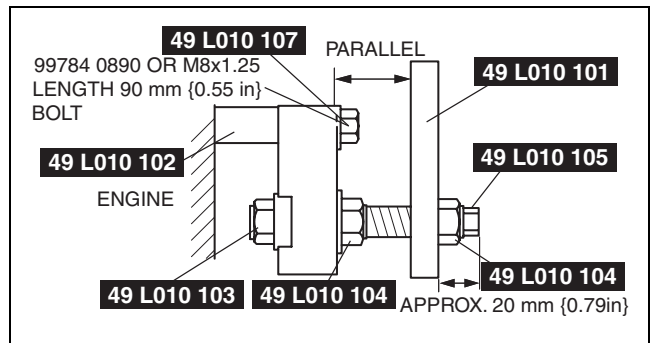
3. Install the **SSTs** (bolt, nut) to the three specified positions as shown in the figure.
4. Install the **SSTs** (bolts, nuts, hook, plate) in Step 3 to the **SST** (arms, bolts) set in Step 2.
5. Adjust the bolt threads by turning them so that they project **approx. 20 mm {0.79 in}** from the plate end.
6. Adjust the bolts and nuts so that the plate and arms are parallel.



BHJ0110E003

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
Type A : 29.4—39.2 N·m {3.00—3.99 kgf·m, 21.7—28.9 ft·lbf}
Type B : 29.4—41.2 N·m {3.00—4.20 kgf·m, 21.7—30.3 ft·lbf}



CHU0110E050

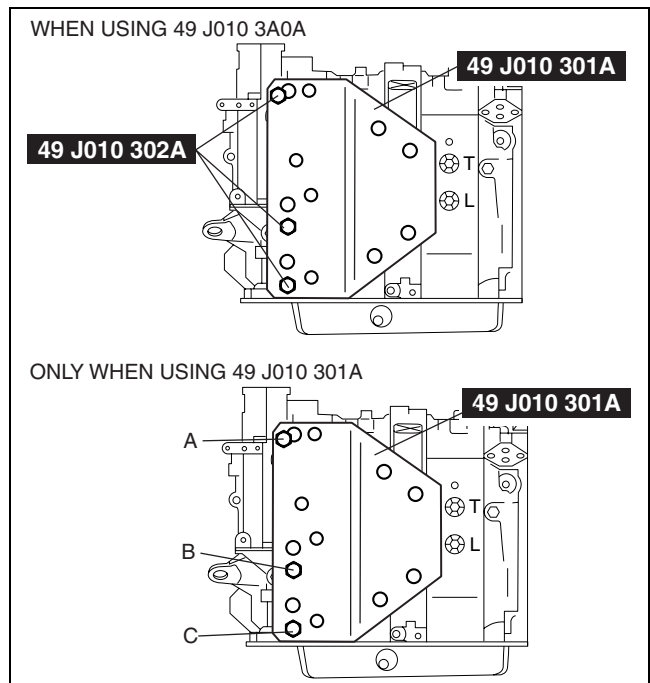
Using 49 J010 3A0A

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
Type A : 29.4—39.2 N·m {3.00—3.99 kgf·m, 21.7—28.9 ft·lbf}
Type B : 29.4—41.2 N·m {3.00—4.20 kgf·m, 21.7—30.3 ft·lbf}



CHU0110E058

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}

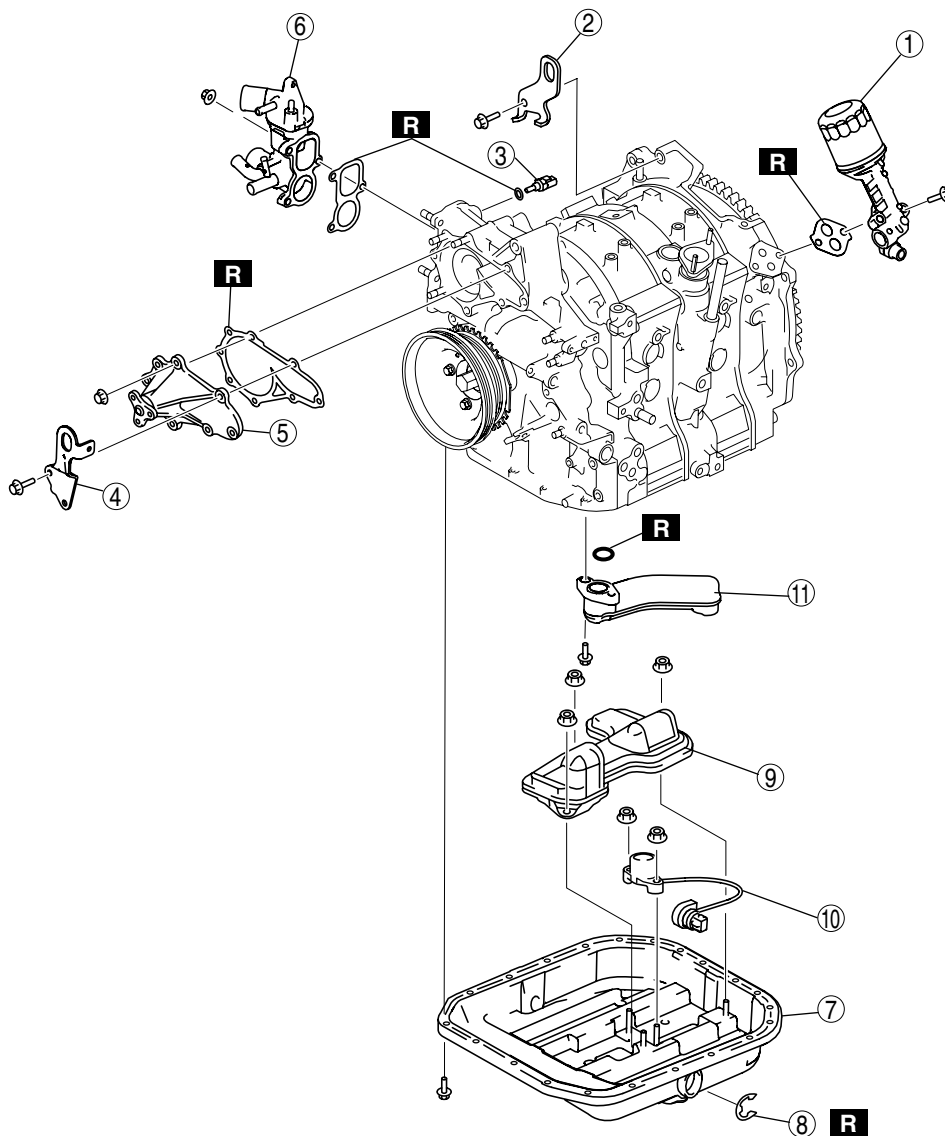
MECHANICAL

HOUSING DISASSEMBLY I

CHU011002000E04

1. Disassemble in the order indicated in the table.

Type A



BHJ0110E006

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

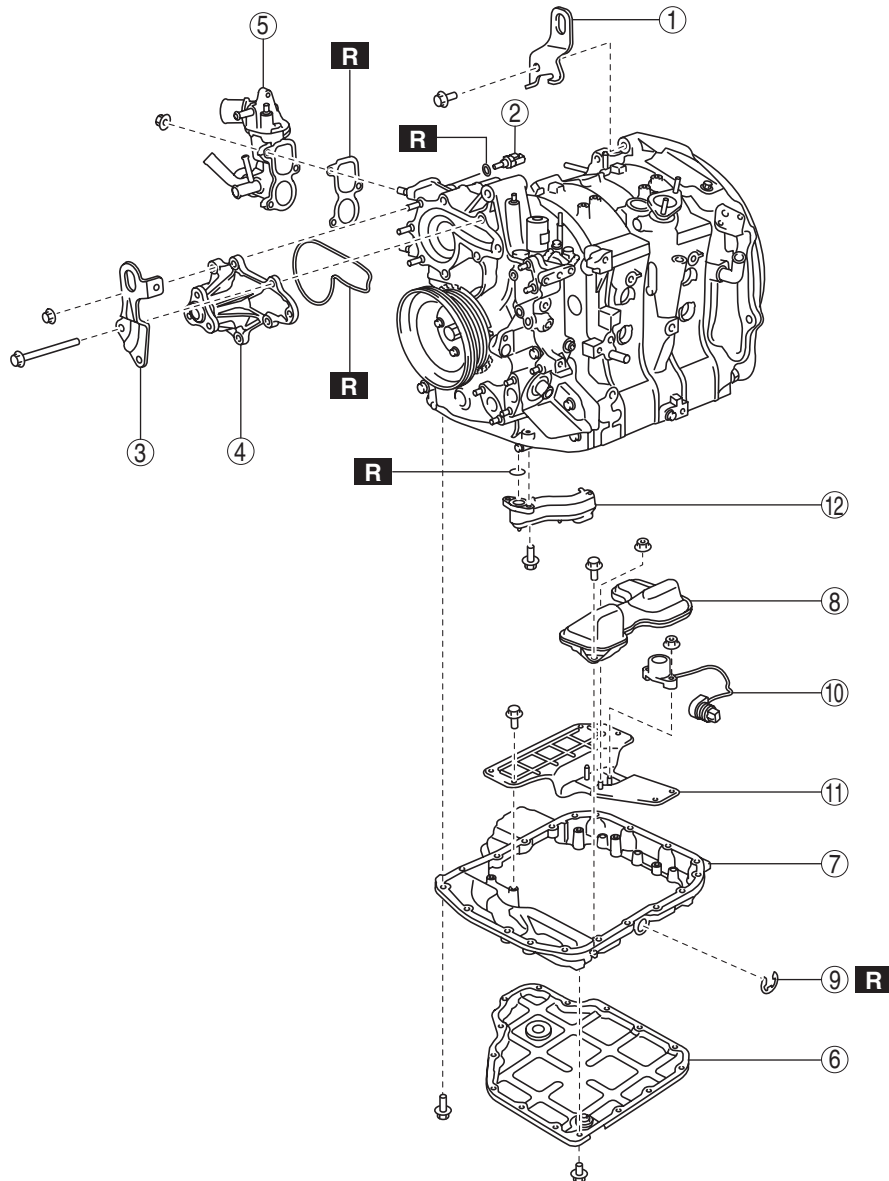
7	Oil pan (See 01-10-5 Oil Pan Disassembly Note.)
8	Clip
9	Oil baffle plate
10	Oil-level sensor
11	Oil strainer

MECHANICAL

CHU011002000E04

Type B

01-10



BHJ0110F002

1	Engine hanger (engine rear side)
2	Engine coolant temperature sensor
3	Engine hanger (engine front side)
4	Water pump body
5	Thermostat component
6	Oil pan (See 01-10-5 Oil Pan Disassembly Note.)

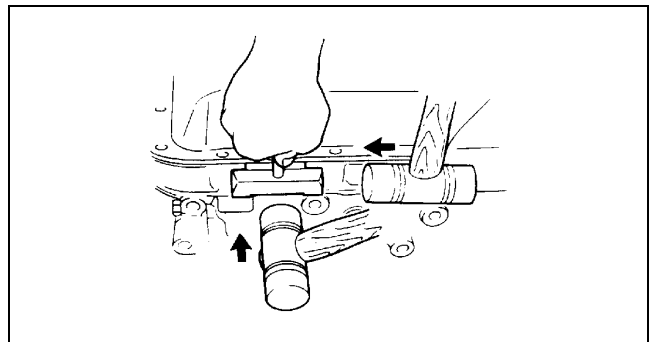
7	Oil pan upper block (See 01-10-5 Oil Pan Upper Block Disassembly Note.)
8	Baffle plate
9	Clip
10	Oil level switch
11	Baffle plate
12	Oil strainer

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MECHANICAL

Oil Pan Disassembly Note

1. Remove the oil pan using the separator tool.

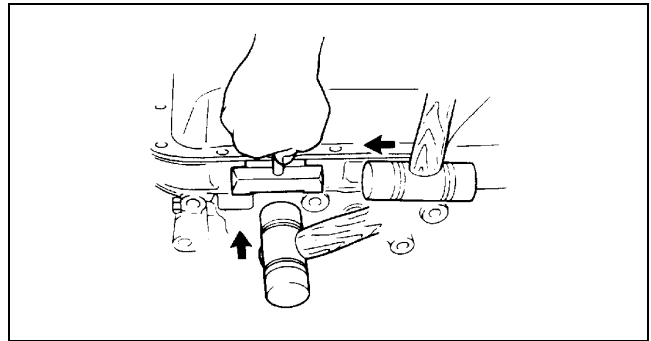


BHJ0111W014

01-10

Oil Pan Upper Block Disassembly Note

1. Remove the oil pan upper block using the separator tool.



BHJ0111E014

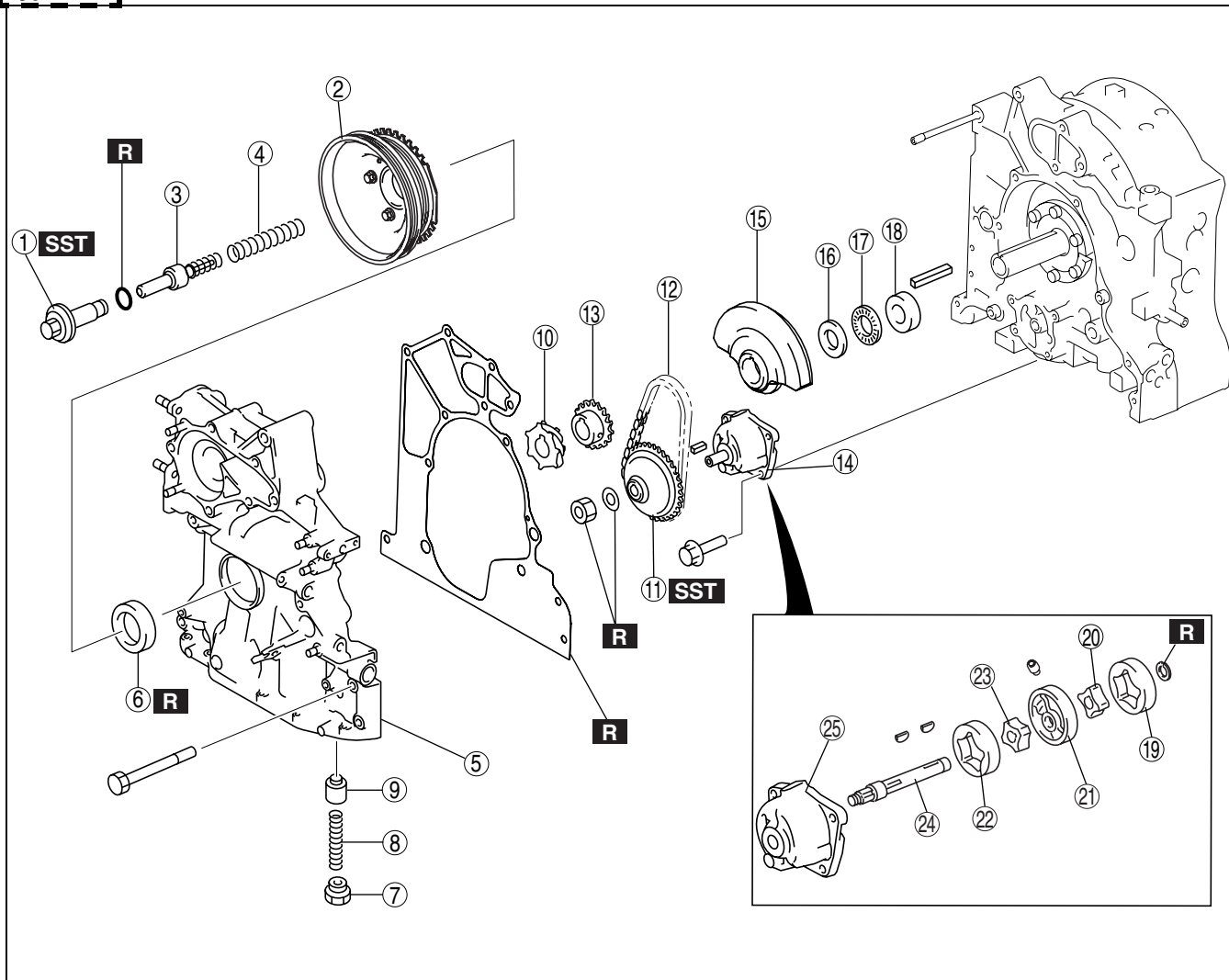
MECHANICAL

HOUSING DISASSEMBLY II

CHU011002000E05

1. Disassemble in the order indicated in the table.

Type A



BHJ0110E008

1	Pulley lockbolt (See 01-10-7 Pulley Lockbolt Disassembly Note.)
2	Pulley component
3	Eccentric shaft bypass valve
4	Spring
5	Front cover (See 01-10-7 Front Cover Disassembly Note.)
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 01-10-7 Oil Pump Sprocket Disassembly Note.)
12	Oil pump chain

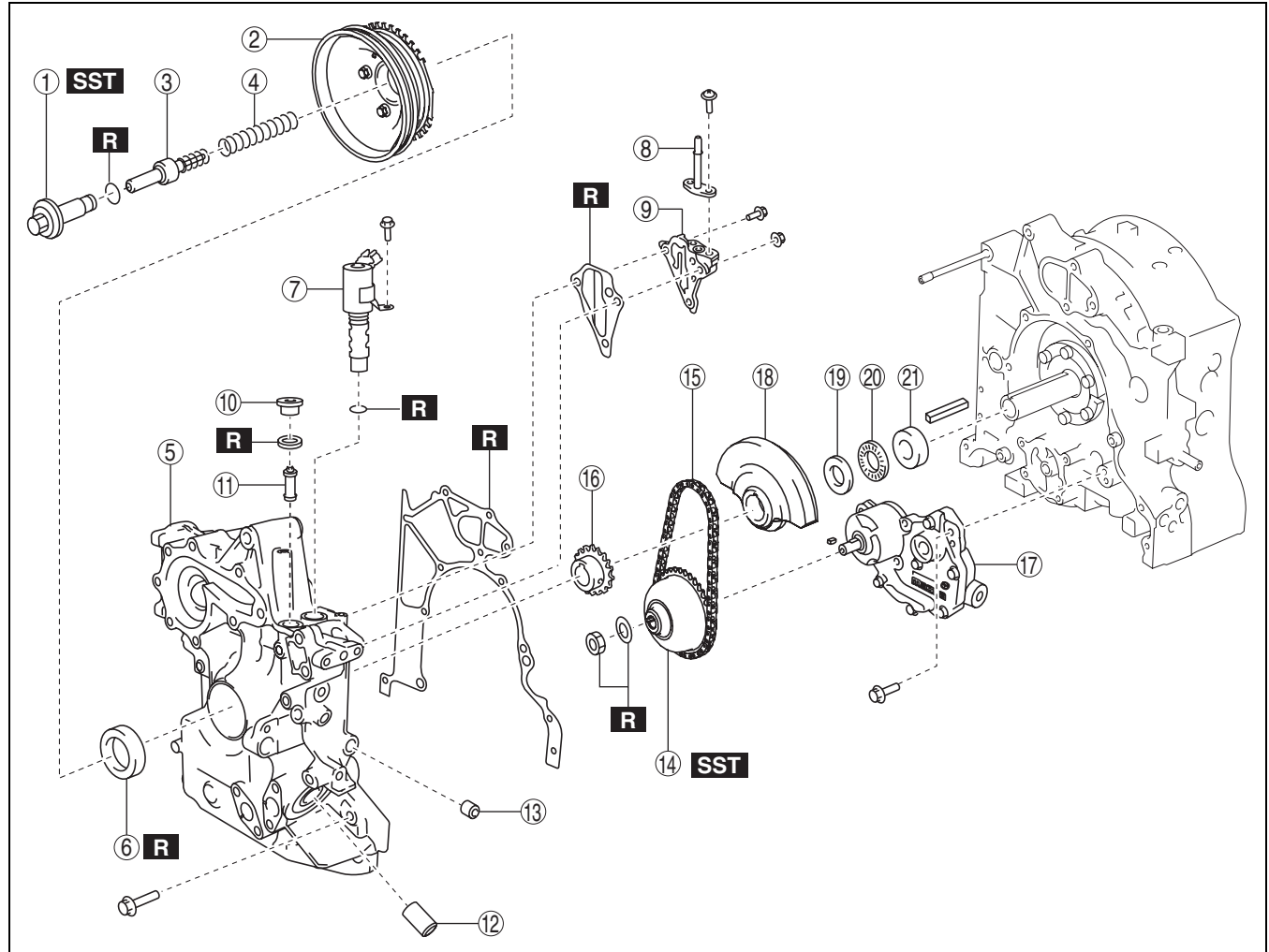
13	Oil pump drive gear
14	Oil pump component
15	Balance weight
16	Thrust plate
17	Needle bearing
18	Spacer
19	Rear outer rotor
20	Rear inner rotor
21	Middle plate
22	Front outer rotor
23	Front inner rotor
24	Shaft
25	Oil pump body

MECHANICAL

CHU011002000E04

Type B

01-10



BHJ0110F003

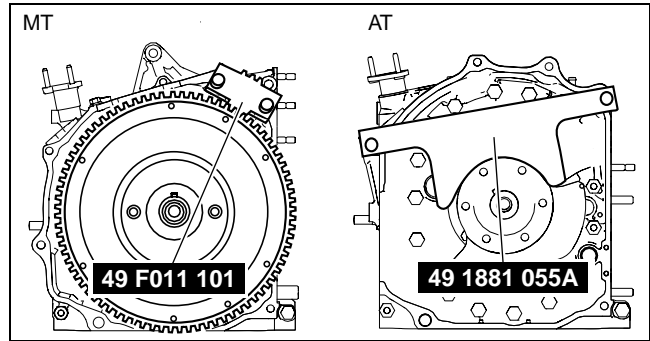
1	Pulley lockbolt (See 01-10-7 Pulley Lockbolt Disassembly Note.)
2	Pulley component
3	Eccentric shaft bypass valve
4	Spring
5	Front cover (See 01-10-7 Front Cover Disassembly Note.)
6	Front oil seal
7	OCV
8	Oil pipe
9	OCV case
10	Plug
11	OCV oil filter

12	Oil filter joint
13	Plug
14	Oil pump sprocket wheel (See 01-10-7 Oil Pump Sprocket Disassembly Note.)
15	Oil pump chain
16	Oil pump drive gear
17	Oil pump component
18	Balance weight
19	Thrust plate
20	Needle bearing
21	Spacer

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Pulley Lockbolt Disassembly Note

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

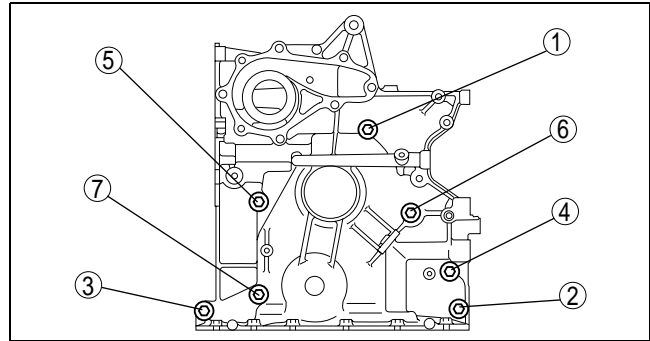


BHJ0110E007

01-10

Front Cover Disassembly Note

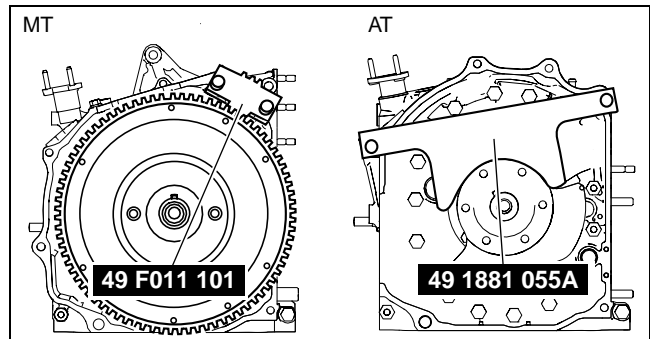
1. Loosen the engine front cover installation bolts in the order shown in the figure.



BHJ0110E009

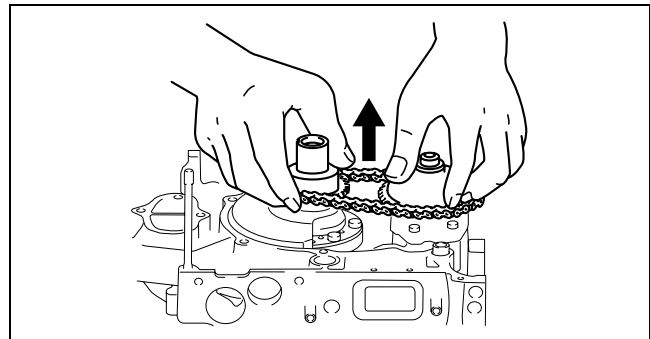
Oil Pump Sprocket Disassembly Note

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.



BHJ0110E007

3. Remove the oil pump drive gear and oil pump sprocket wheel with the oil pump chain engaged.



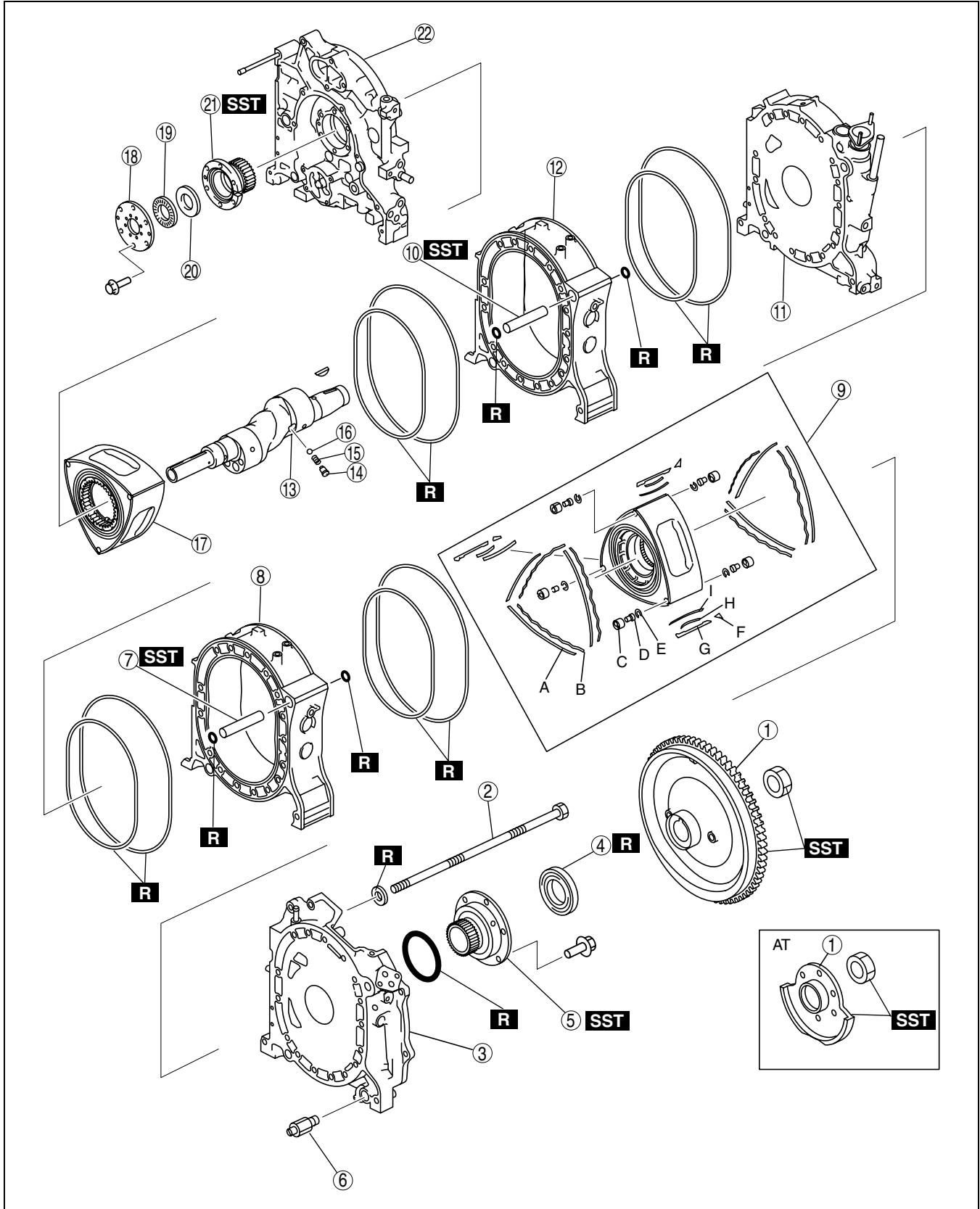
BHJ0110E104

MECHANICAL

HOUSING DISASSEMBLY III

CHU011002000E06

1. Disassemble in the order indicated in the table.



BHJ0110E010

1	Flywheel (MT), counterweight (AT) (See 01-10-9 Flywheel (MT), Counterweight (AT) Disassembly Note.)
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2	Tension bolt (See 01-10-10 Tension Bolt Disassembly Note.)
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01-10-8

MECHANICAL

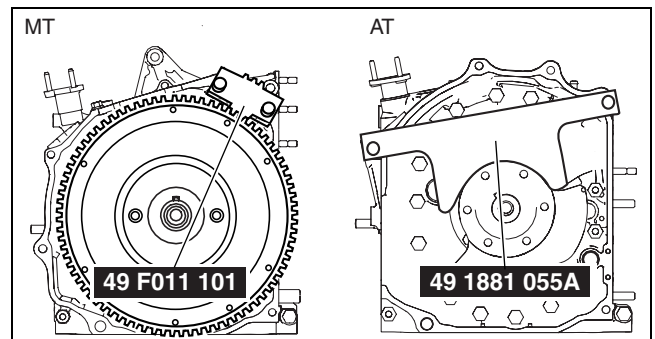
3	Rear housing (See 01-10-10 Rear Housing Disassembly Note.)
4	Rear oil seal
5	Rear stationary gear (See 01-10-10 Stationary Gear Disassembly Note.)
6	Pressure regulator (Type A)
7	Tubular dowel (rear rotor housing side) (See 01-10-10 Tubular Dowel Disassembly Note.)
8	Rear rotor housing (See 01-10-11 Rotor Housing Disassembly Note.)
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 01-10-11 Rotor Disassembly Note.)

10	Tubular dowel (front rotor housing side) (See 01-10-10 Tubular Dowel Disassembly Note.)
11	Intermediate housing (See 01-10-12 Intermediate Housing Disassembly Note.)
12	Front rotor housing (See 01-10-11 Rotor Housing Disassembly Note.)
13	Eccentric shaft
14	Oil jet plug
15	Spring
16	Steel ball
17	Front rotor (See 01-10-11 Rotor Disassembly Note.)
18	Plate
19	Needle bearing
20	Thrust plate
21	Front stationary gear (See 01-10-10 Stationary Gear Disassembly Note.)
22	Front housing

01-10

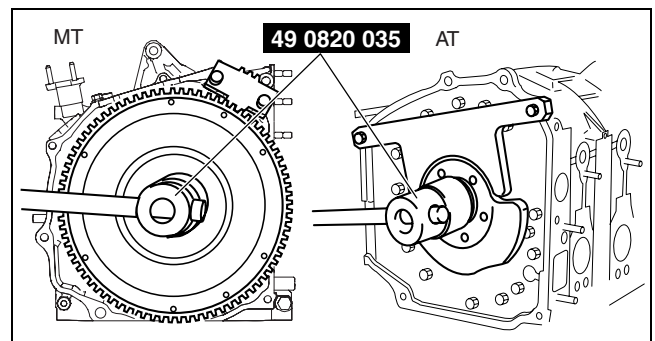
Flywheel (MT), Counterweight (AT) Disassembly Note

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



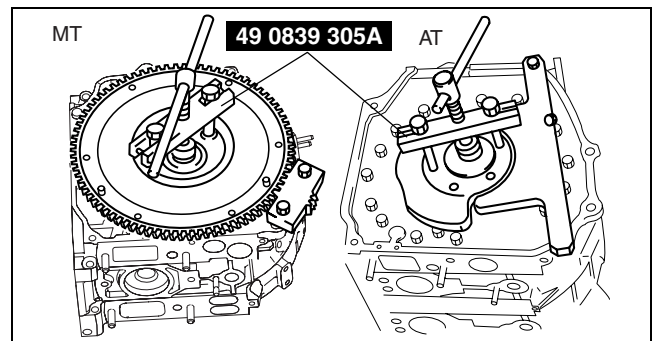
BHJ0110E007

2. Remove the locknut using the **SST**.



BHJ0110E011

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

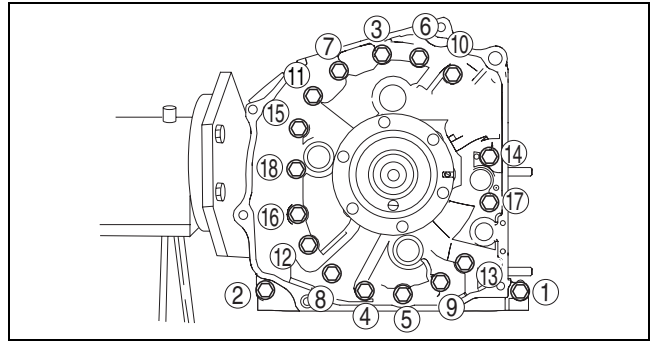


BHJ0110E012

MECHANICAL

Tension Bolt Disassembly Note

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



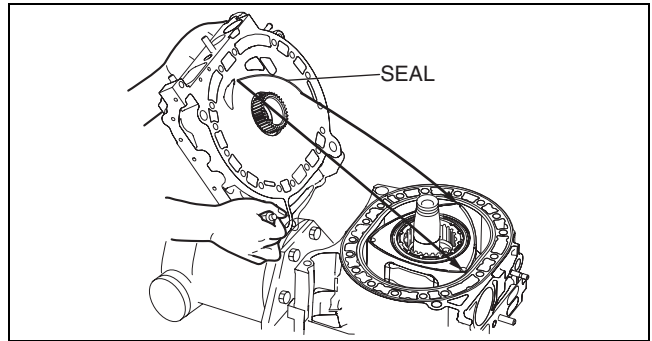
BHJ0110E013

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

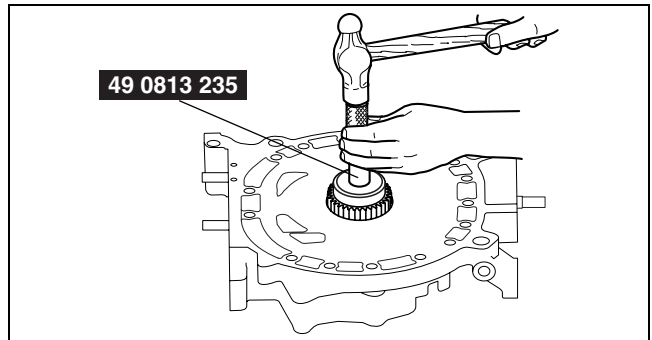
- If a seal adheres to the rear housing, put it back in its original position in the rotor.



CHU0110E039

Stationary Gear Disassembly Note

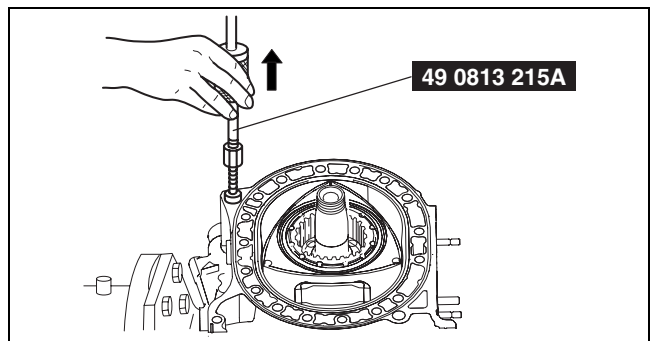
1. Remove the stationary gear using the SST.



BHJ0110E016

Tubular Dowel Disassembly Note

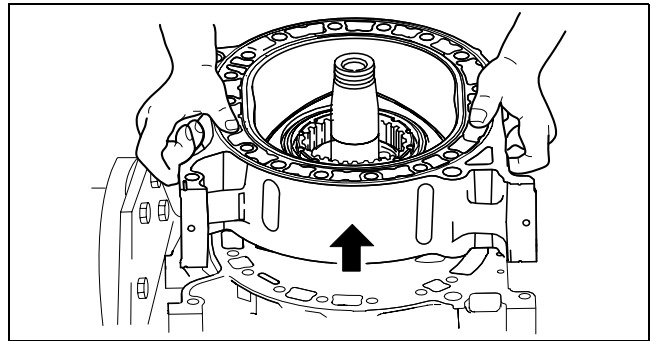
1. Remove the tubular dowel using the SST.



BHJ0110E017

Rotor Housing Disassembly Note

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



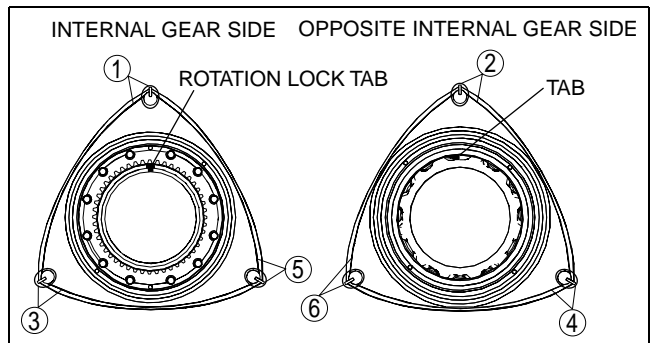
BHJ0110E020

01-10

Rotor Disassembly Note

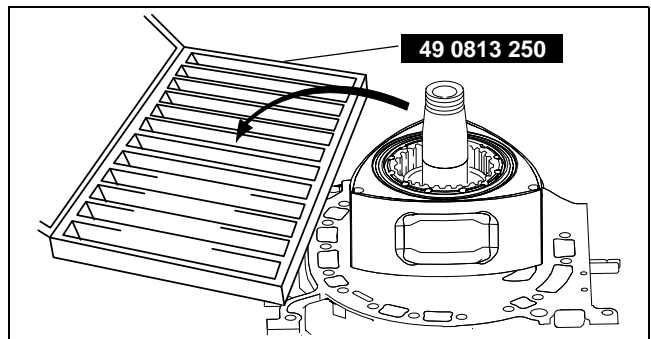
Note

- 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**.



CHU0110E056

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.

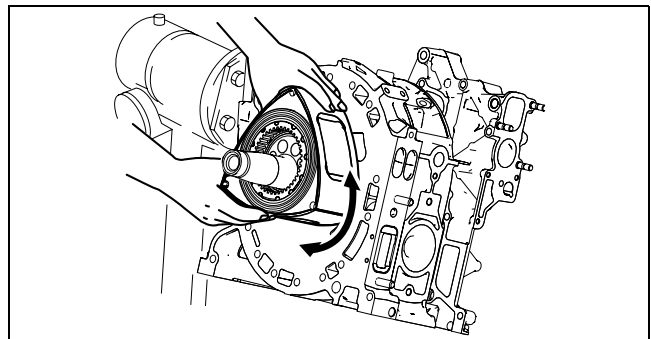


BHJ0110E019

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

Caution

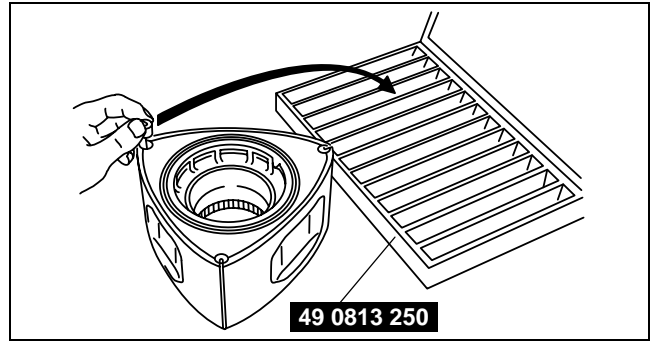
- If a seal adheres to the side housing, put it back in its original position in the rotor.
- Place the removed rotor upright on soft material such as a rubber sheet or cloth. Do not allow the oil seal to directly contact metal or similar hard surface.



BHJ0110E021

MECHANICAL

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.



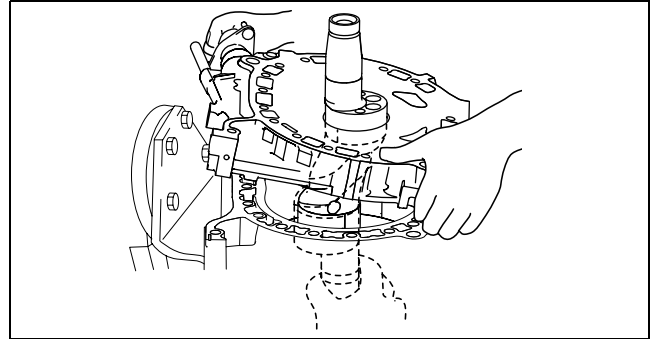
BHJ0110E022

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.

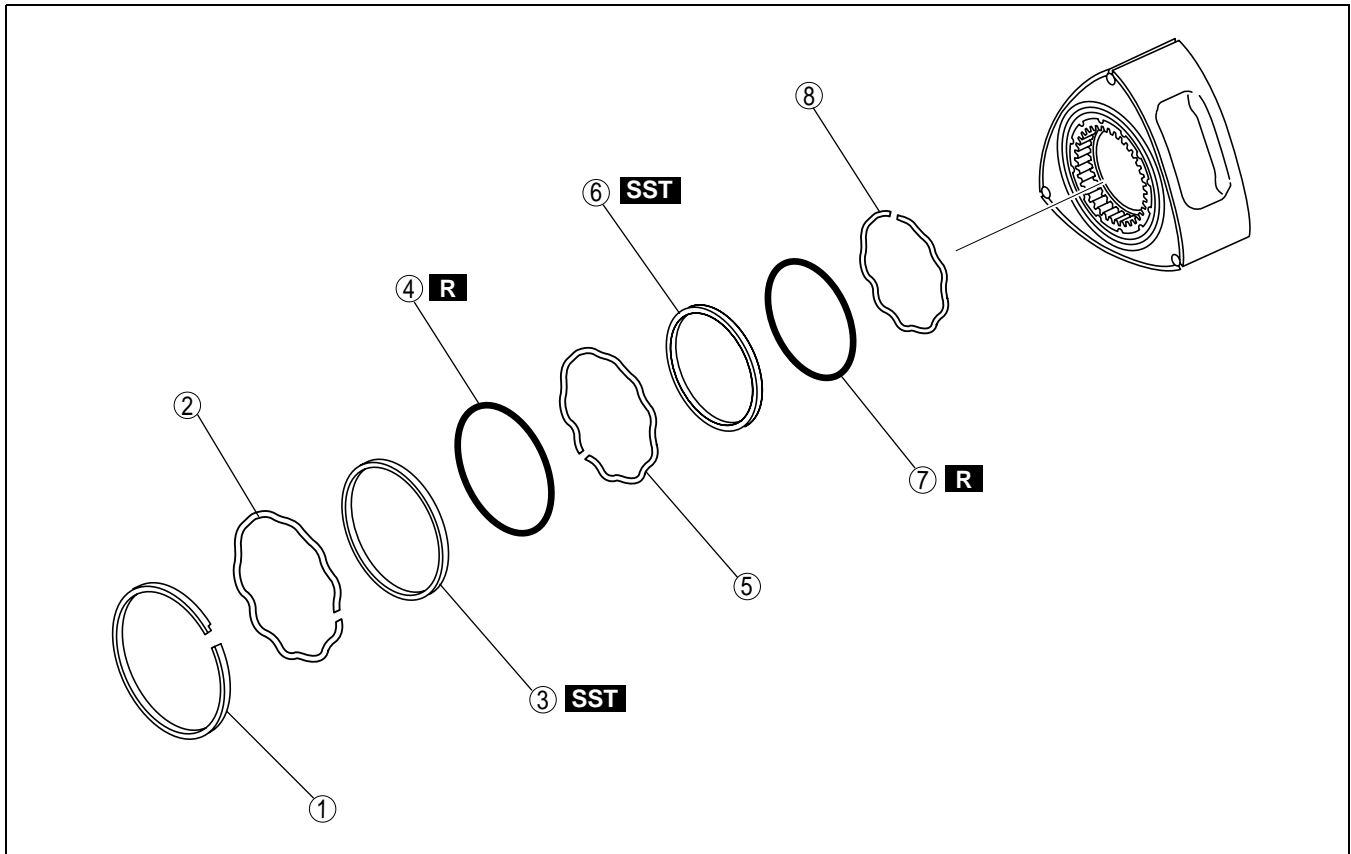


BHJ0110E023

ROTOR DISASSEMBLY

CHU01100200E07

1. Disassemble in the order indicated in the table.



BHJ0110E024

1	Cut-off seal
2	Cut-off seal spring

3	Outer oil seal (See 01-10-13 Oil Seal Disassembly Note.)
4	Outer O-ring (large radius)

01-10-12

MECHANICAL

5	Outer oil seal spring (See 01–10–13 Oil Seal Spring Disassembly Note.)
6	Inner oil seal (See 01–10–13 Oil Seal Disassembly Note.)

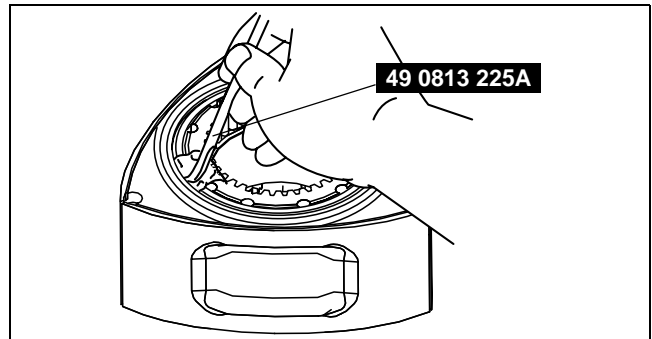
7	Inner O-ring (small radius)
8	Inner oil seal spring (See 01–10–13 Oil Seal Spring Disassembly Note.)

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.



BHJ0110E025

01–10

Oil Seal Spring Disassembly Note

Caution

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

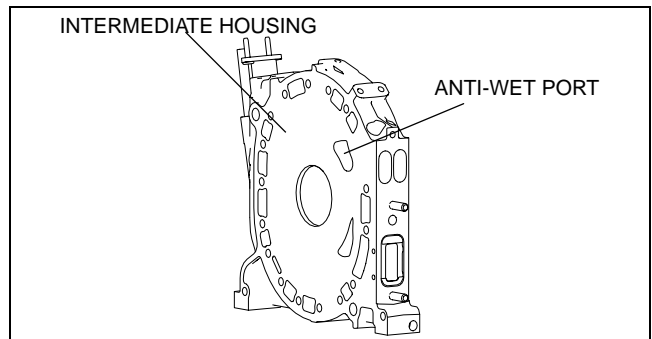
SIDE HOUSING (FRONT, INTERMEDIATE, REAR) INSPECTION

CHU011010D00E01

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.

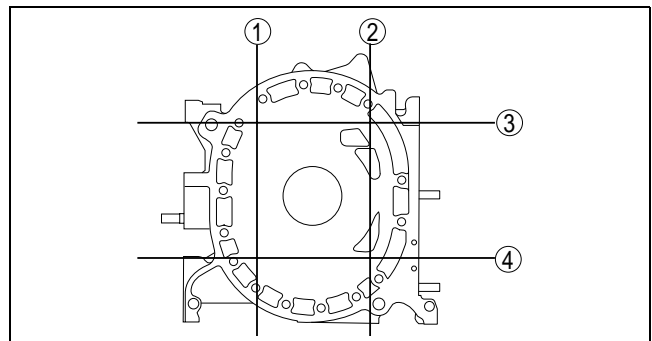


CHU0110E001

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.
 - If any one of the items exceeds the maximum, replace the corresponding side housing.

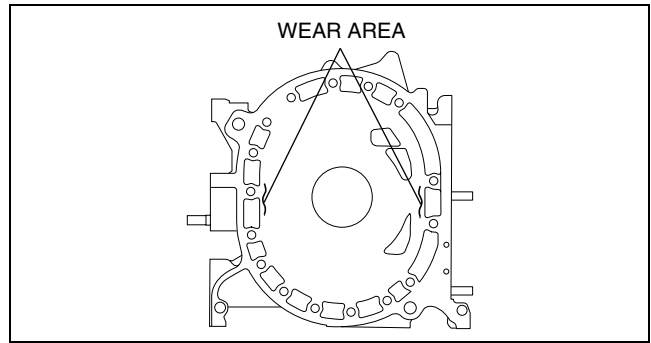


BHJ0110E026

MECHANICAL

(1) Vertical wear

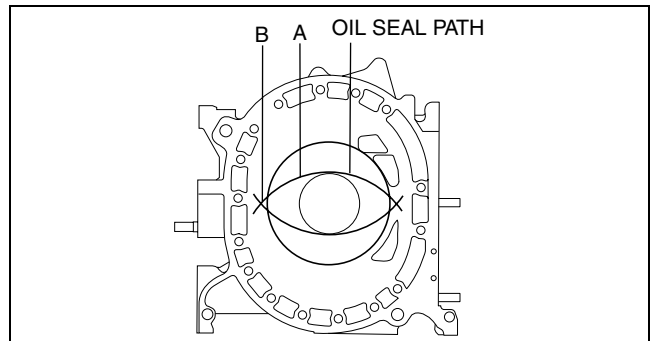
Maximum wear
0.10 mm {0.0039 in}



CHU0110E002

(2) Convex oval

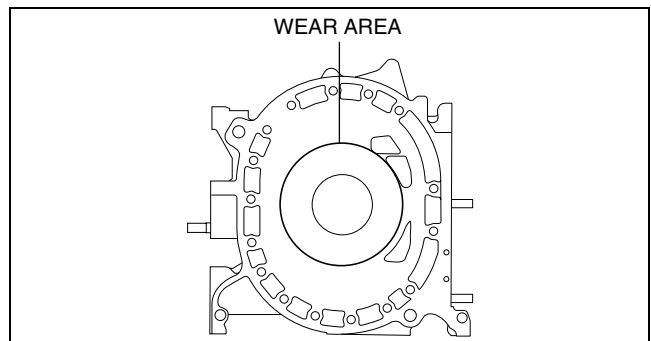
Maximum wear
Oil seal inner path (A): 0.01 mm {0.0004 in}
Oil seal outer path (B): 0.10 mm {0.0039 in}



CHU0110E003

(3) Oil seal stepped path wear

Maximum wear
0.02 mm {0.0008 in}



CHU0110E004

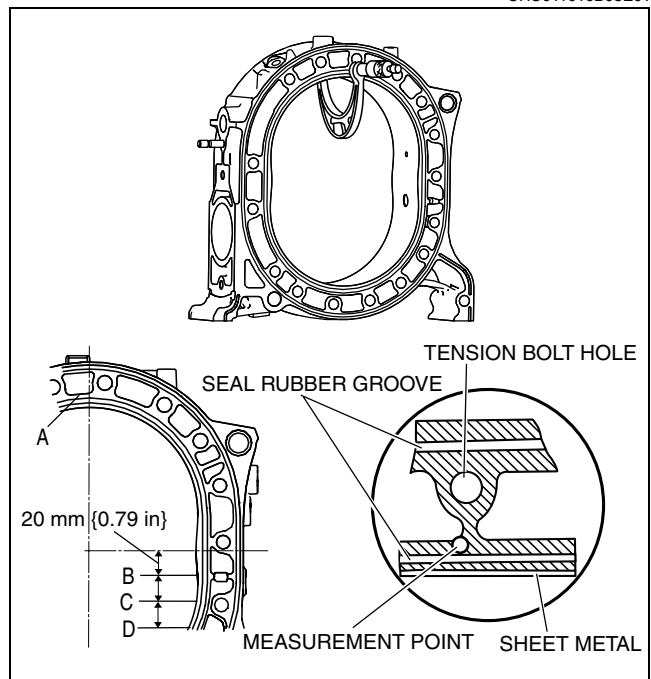
ROTOR HOUSING INSPECTION

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

CHU011010B08E01



CHU0110E005

ROTOR INSPECTION

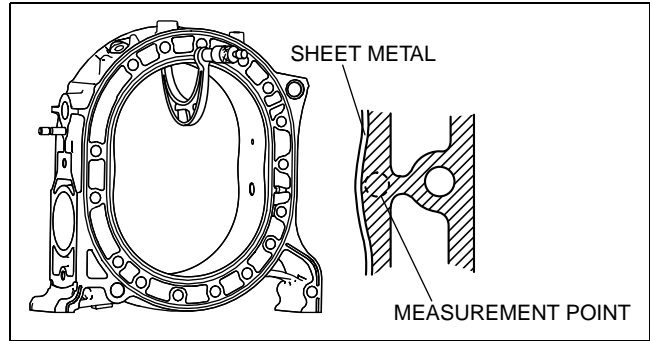
CHU011011B10E01

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.

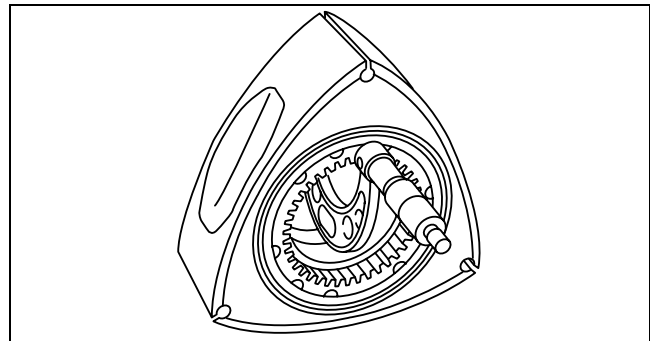
Caution

- **Move the sheet metal piece out of the way when measuring.**



CHU0110E040

- (2) Measure the rotor width at various positions around the rotor round periphery using a micrometer.



BHJ0110E032

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

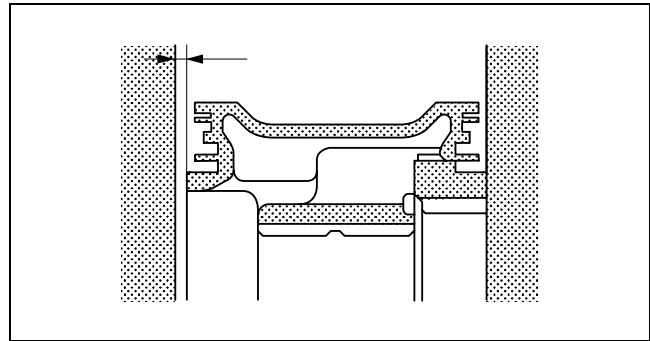
Rotor and side housing clearance = (rotor housing width) – (maximum rotor width)

Standard clearance

0.05—0.19 mm {0.0020—0.0074 in}

Minimum clearance

0.05 mm {0.002 in}



CHU0110E006

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.**

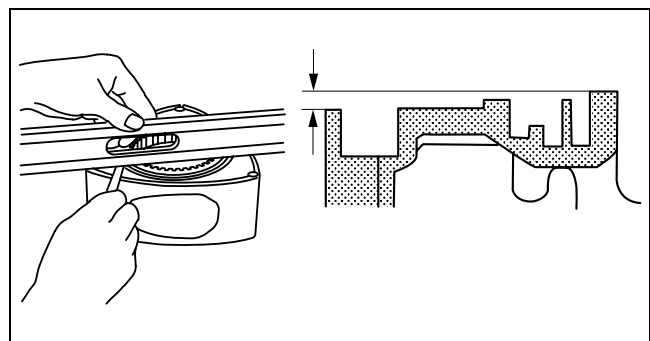
- If it is less than the minimum specification, replace the rotor.

Standard projection

0.12—0.18 mm {0.0048—0.0070 in}

Minimum projection

0.1 mm {0.0039 in}



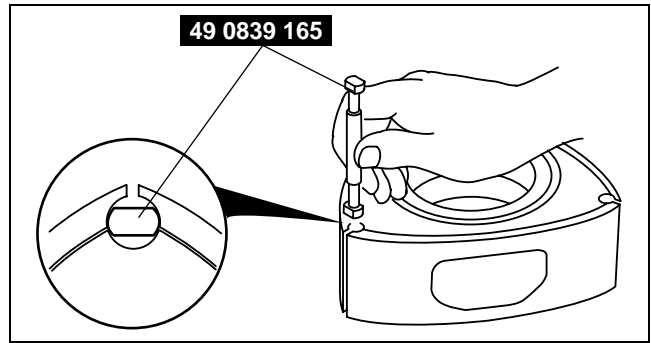
CHU0110E007

MECHANICAL

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



BHJ0110E035

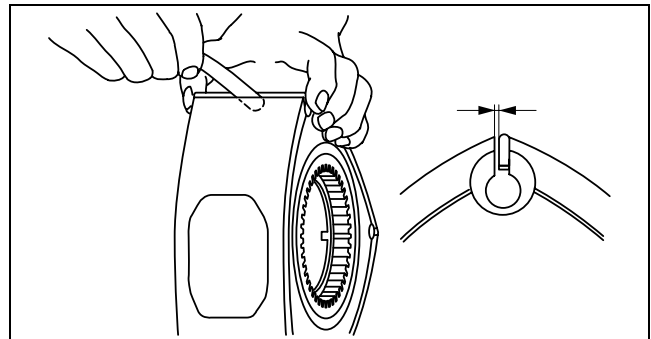
4. Measure the clearance between the apex seal groove and the apex seal using a feeler gauge.
 - If it exceeds the maximum specification, replace the apex seal.
 - If the clearance is still not within the standard after replacing the apex seal, replace the rotor.

Standard clearance

0.042—0.101 mm {0.0017—0.0039 in}

Maximum clearance

0.15 mm {0.0059 in}



CHU0110E008

APEX SEAL INSPECTION

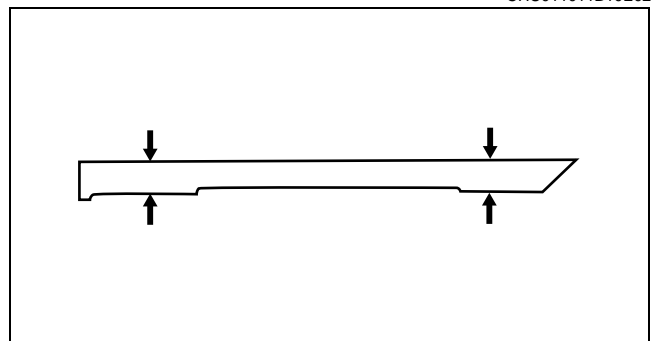
1. Measure the height in the positions shown in the figure.
 - If it is less than the minimum specification, replace the apex seal.
 - Replace the apex seal spring also whenever replacing the apex seal.

Standard Height

5.3 mm {0.20 in}

Minimum height

4.3 mm {0.17 in}



CHU011011B10E02

BHJ0110E037

SIDE SEAL INSPECTION

CHU011011B10E04

Replacing with a new side seal.

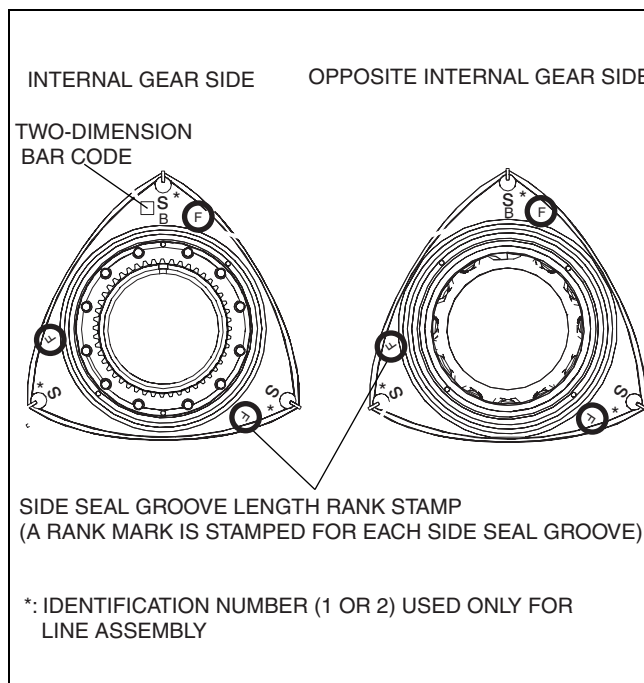
If replacing the side seal, select the appropriate side seal from the side seal groove length rank marked on the rotor.

Note

- If a new side seal is inserted, measuring the clearance is not recommended to maintain an appropriate side seal clearance value.

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	
V	N3Z5 11 C10*
W	
X	
Y	



CHU110ZEC001

* : Revision indication (alphabetical order)

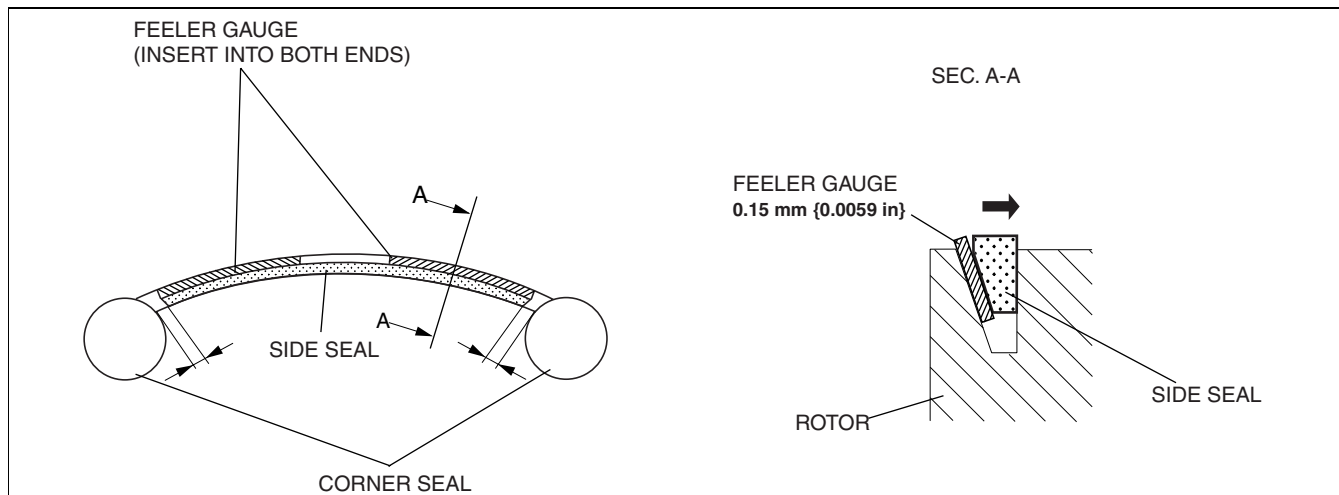
Reusing the side seal

1. Measure the side seal and corner seal clearance and verify that it doesn't exceed the maximum.
 - (1) Assemble the corner seal.
 - (2) Insert a **0.15 mm {0.0059 in}** feeler gauge into the tapered surface side of the side seal as shown in the figure, and fix the side seal by pressing uniformly so that it contacts the inner side of the groove (straight surface).

Caution

- **Press the feeler gauge firmly on both ends of the side seal.**

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



CHU110ZEC002

MECHANICAL

- (4) If the sum of the clearances on both ends exceeds the maximum, replace with a new side seal by selecting one from the side seal selection table.

Maximum clearance

0.4 mm {0.016 in}

CUT-OFF SEAL INSPECTION

1. Measure the cut-off seal height using a vernier caliper.
 - If it is less than the minimum specification, replace the cut-off seal.

Caution

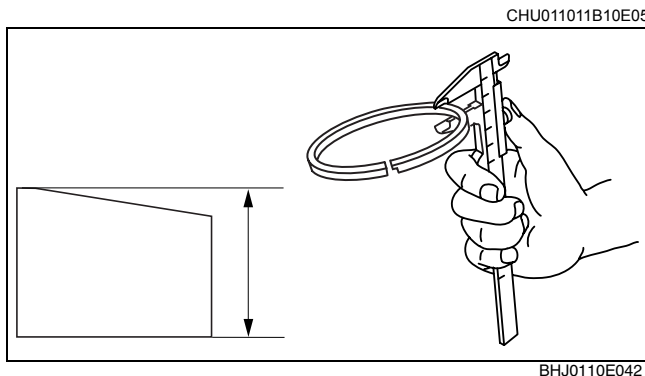
- Measure the cut-off seal height around the complete perimeter.

Standard height

3.95 mm {0.1555 in}

Minimum height

3.8 mm {0.15 in}



OIL SEAL INSPECTION

1. Measure the following two items using a vernier caliper.
 - If either of the items exceeds the maximum specification, replace the oil seal.

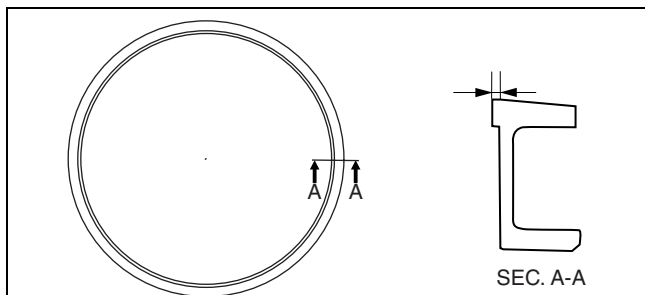
- (1) Width of area that contacts the oil seal lip.

Caution

- Measure the contact width around the complete perimeter.

Maximum contact width

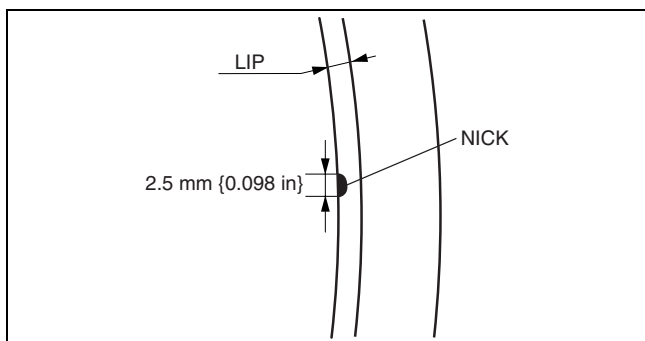
0.5 mm {0.02 in}



- (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



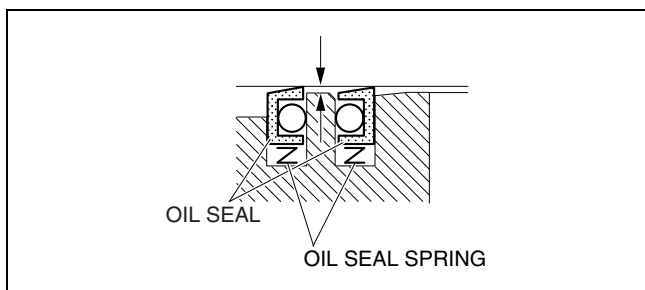
SPRING INSPECTION

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}



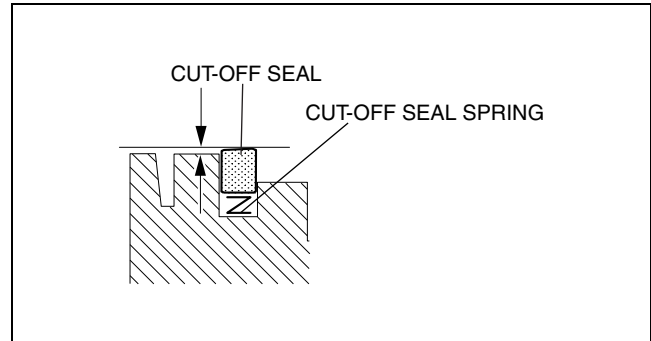
MECHANICAL

Cut-off Seal Spring

1. Assemble the cut-off seal spring into the rotor.
2. Referring to the cut-off seal inspection procedure, verify that the height of the cut-off seal is at the minimum specification or more. (See 01-10-18 CUT-OFF SEAL INSPECTION.)
3. Assemble the cut-off seal into the rotor.

4. 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}



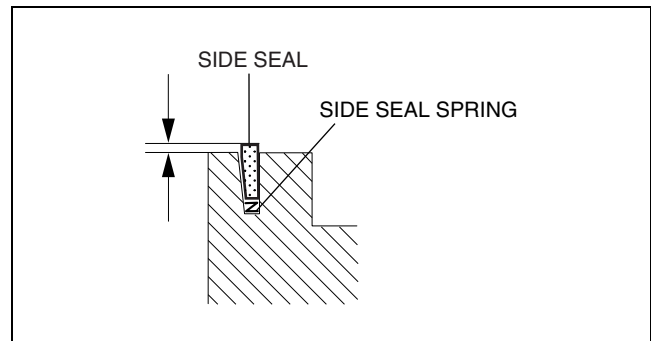
CHU0110E041

01-10

Side Seal Spring

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}

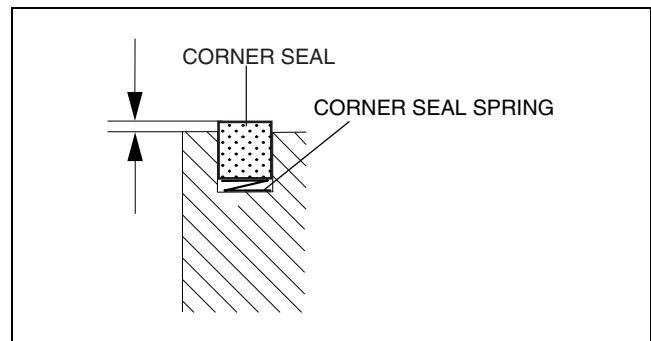


CHU0110E015

Corner Seal Spring

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}



CHU0110E016

Apex Seal Spring

Note

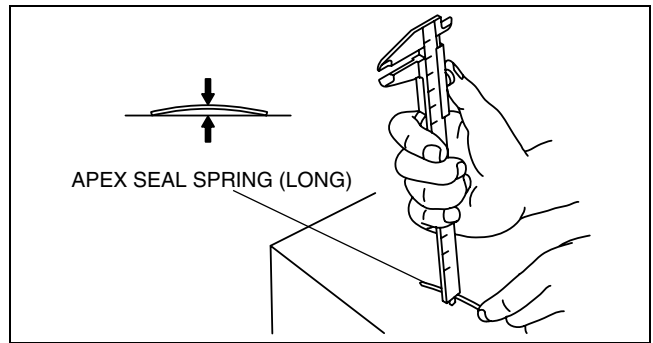
- Inspect the long apex seal spring.

MECHANICAL

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}



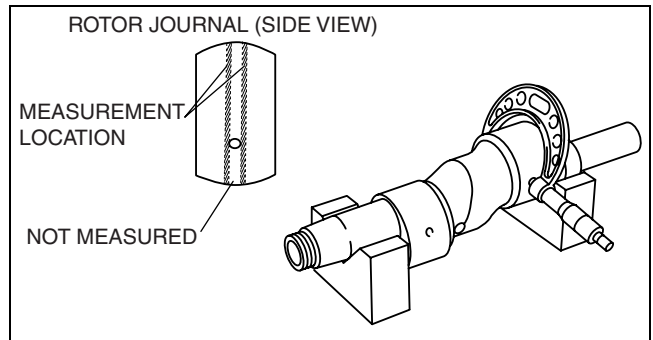
CHU0110E064

ROTOR BEARING OIL CLEARANCE INSPECTION

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

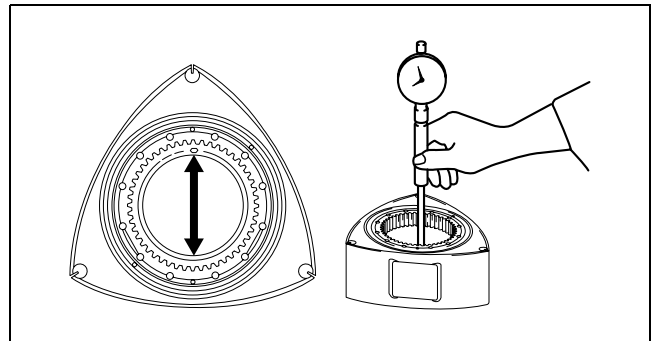
Caution

- 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.



CHU011011B10E08

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



BHJ0110E062

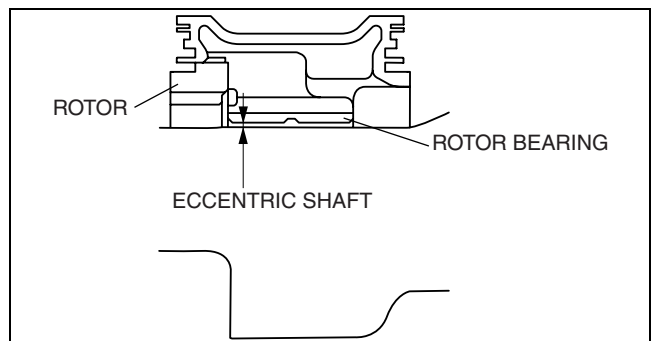
3. Calculate the rotor bearing oil clearance from the rotor journal outer diameter and the rotor bearing inner diameter.

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

- If it exceeds the minimum specification, replace the rotor bearing. (See 01-10-21 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
0.1 mm {0.0039 in}



CHU0110E017

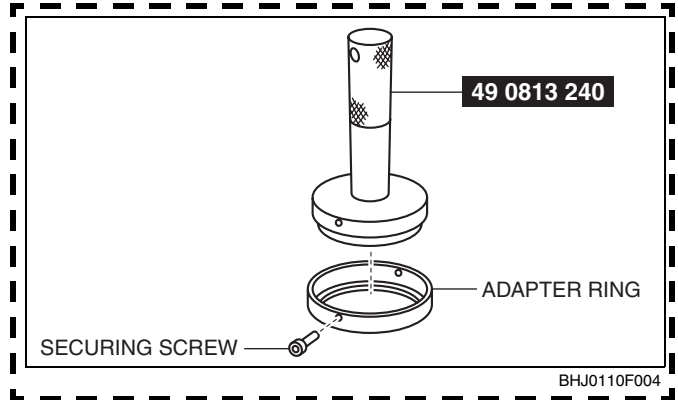
MECHANICAL

ROTOR BEARING REPLACEMENT

CHU011011B10E09

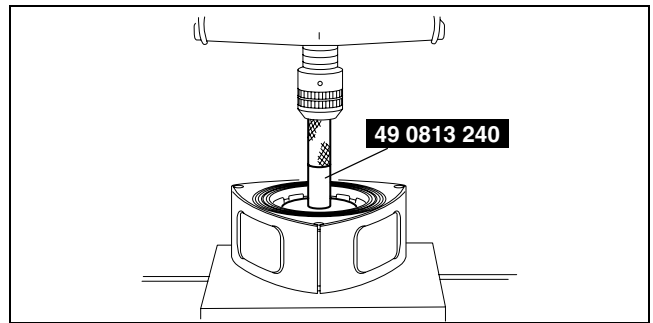
Removal

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



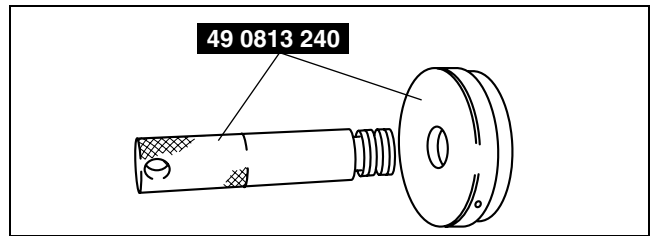
01-10

3. Remove the rotor bearing using the SST.

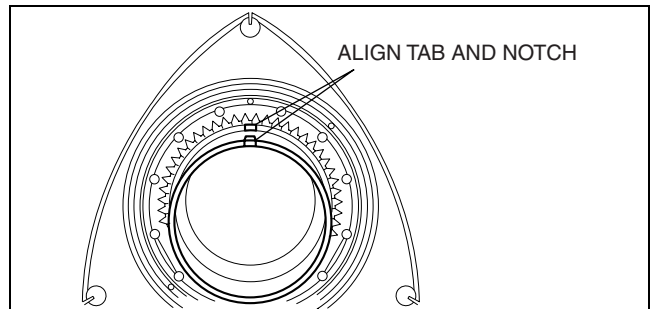


Installation

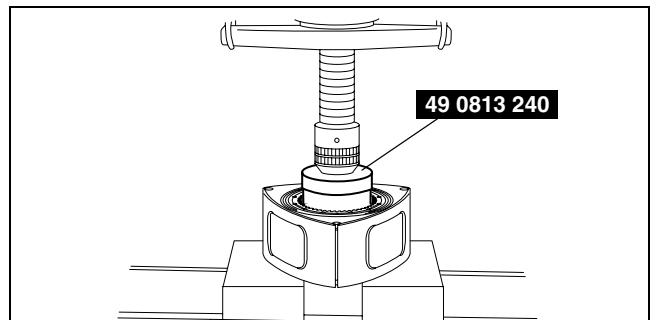
1. Remove the SST handle.



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.

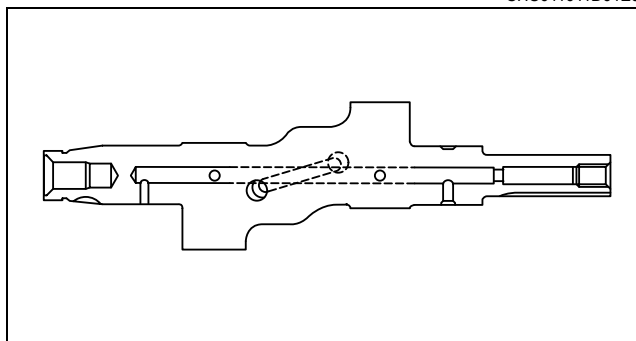


MECHANICAL

ECCENTRIC SHAFT INSPECTION

CHU011011D01E01

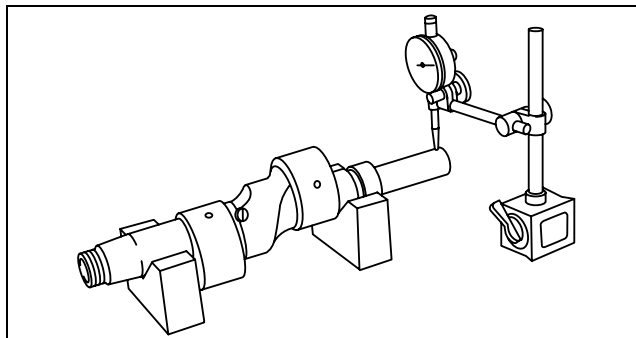
1. Inspect for clogging in the oil passage.
 - If there is any clogging, remove it with a needle or similar device and clean with compressed air.



BHJ0110E050

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.
 - If it exceeds the maximum specification, replace the eccentric shaft.

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

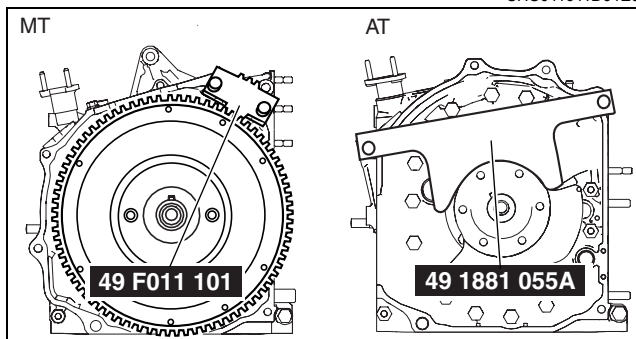
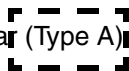


BHJ0110E051

ECCENTRIC SHAFT END PLAY INSPECTION

CHU011011D01E02

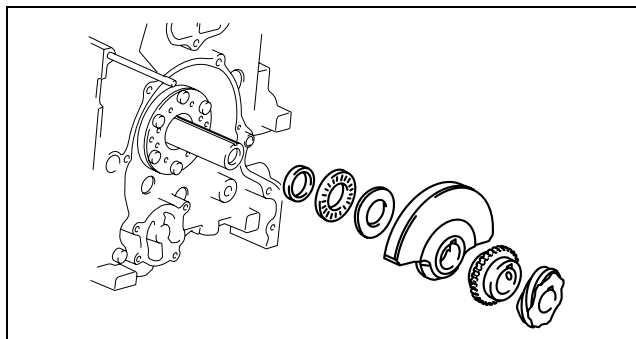
1. Lock the flywheel (MT) or counterweight (AT) against rotation using the **SST**.
2. Assemble the parts in the following order:
 - (1) Spacer
 - (2) Needle bearing
 - (3) Thrust plate
 - (4) Balance weight
 - (5) Oil pump drive gear
 - (6) Metering oil pump drive gear (Type A)



BHJ0110E007

Caution

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



BHJ0110E052

MECHANICAL

- 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}

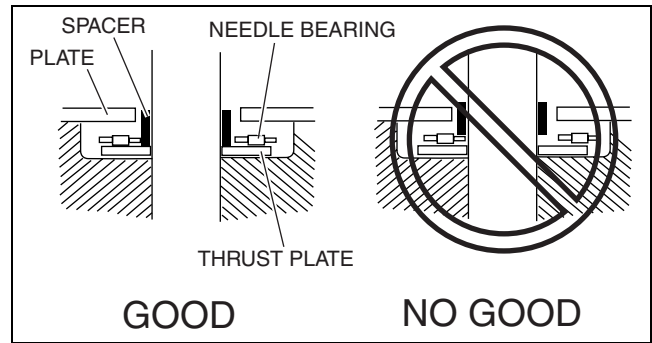
- Remove the SST.

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

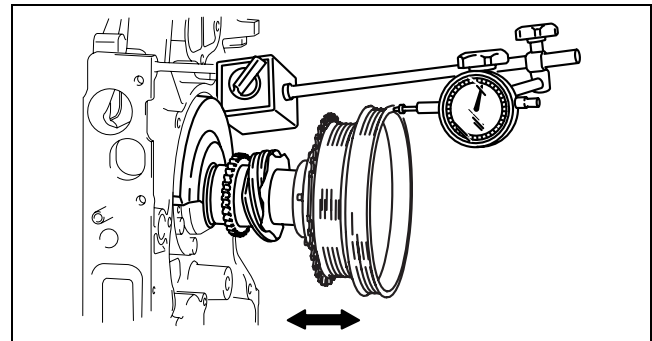
- If not within the specification, replace the spacer with one that is thicker than the currently assembled one. If it exceeds the specification, replace with a thinner spacer.

Standard end play

0.04—0.09 mm {0.0016—0.0035 in}



CHU0110E019



BHU0110E054

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.

MECHANICAL

PILOT BEARING INSPECTION/REPLACEMENT [MT]

CHU011011D01E03

Inspection

Caution

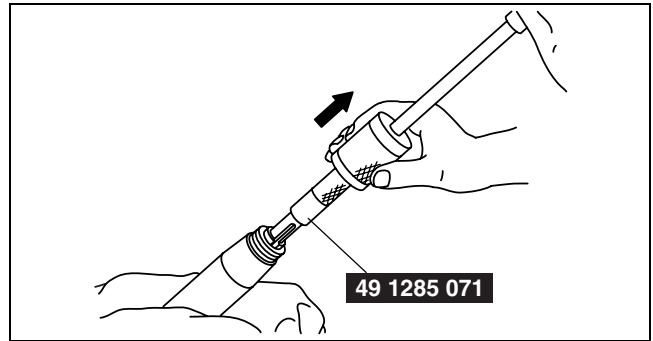
- Inspect the pilot bearing when it is installed to the eccentric shaft.

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

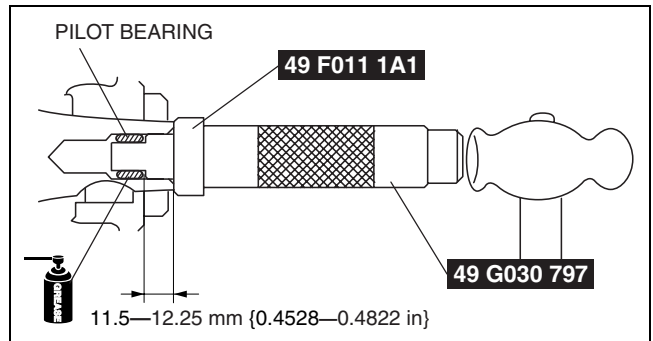
1. Fix the eccentric shaft on a vice.
2. Remove the pilot bearing and the oil seal together using the **SST**.



BHU110E070

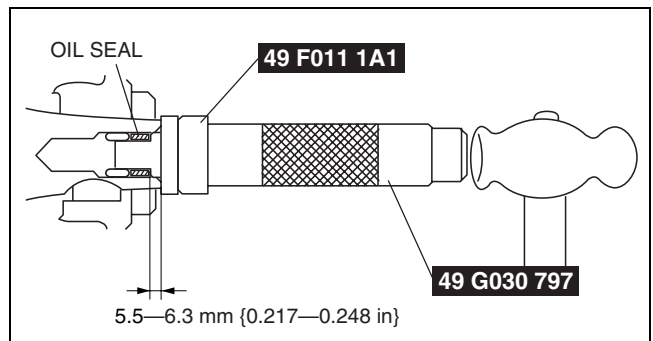
Installation

1. Install a new pilot bearing using the **SSTs**.
2. Apply grease to the pilot bearing.



CHU0110E020

3. Install a new oil seal using the **SSTs**.



CHU0110E021

ECCENTRIC SHAFT BYPASS VALVE

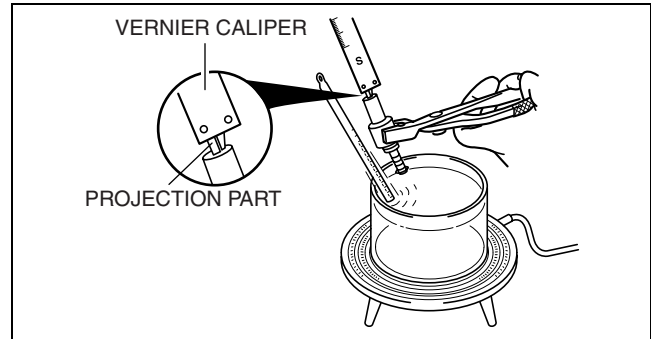
CHU011011D01E04

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}



CHU0110E057

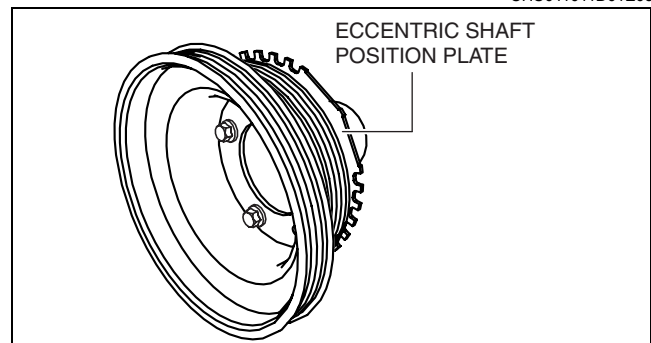
01-10

ECCENTRIC SHAFT POSITION PLATE INSPECTION

CHU011011D01E05

1. Visually inspect the eccentric shaft position plate for damage and erosion.
 - If there is any malfunction, replace the eccentric shaft position plate.

Eccentric shaft pulley tightening torque
14.2—17.2 N·m {1.45—1.75 kgf·m, 10.5—12.6 ft·lbf}

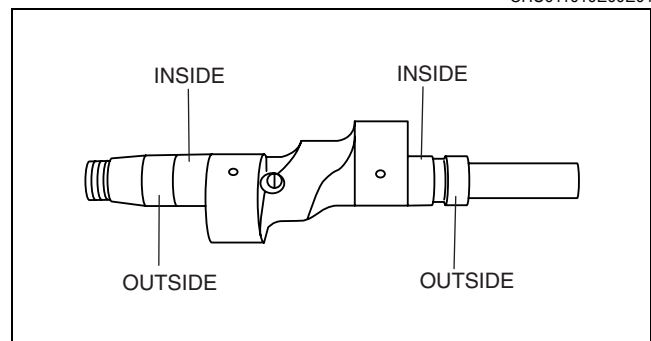


BHJ0110E106

MAIN BEARING OIL CLEARANCE INSPECTION

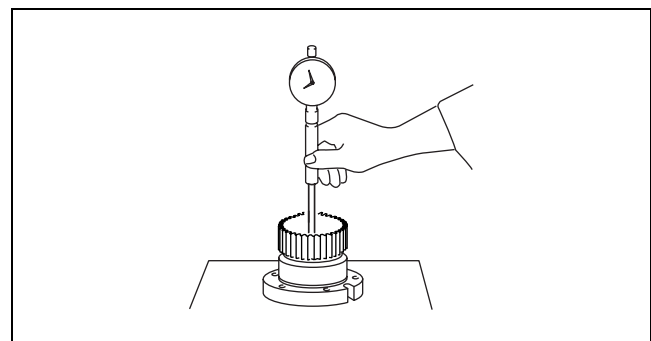
CHU011010E00E01

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



CHU0110E022

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



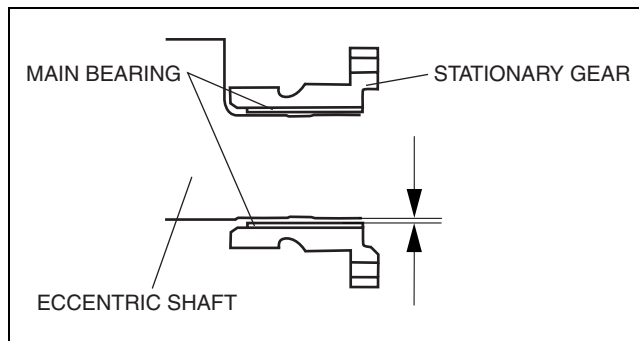
BHJ0110E056

MECHANICAL

- 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 01-10-26 MAIN BEARING REPLACEMENT.)
 - If the clearance is not within the specification after replacing the main bearing, replace the eccentric shaft.



CHU0110E023

Standard main bearing oil clearance

Without stopper screw: 0.045—0.085 mm {0.0018—0.0033 in}

With stopper screw: 0.055—0.075 mm {0.0022—0.0029 in}

Maximum main bearing oil clearance

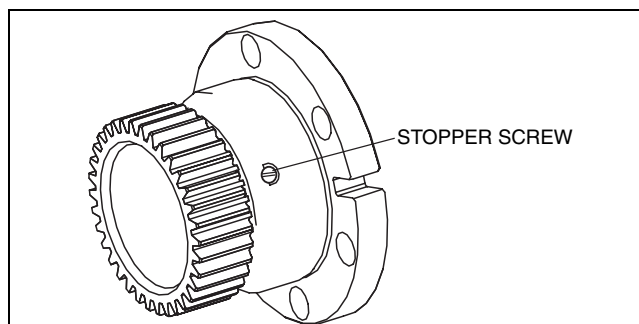
Without stopper screw: 0.1 mm {0.0039 in}

With stopper screw: 0.1 mm {0.0039 in}

MAIN BEARING REPLACEMENT

Removal

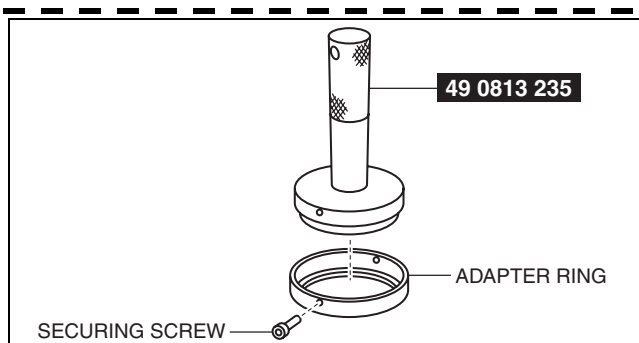
- Remove the stopper screw. (With stopper screw)



CHU011010E00E02

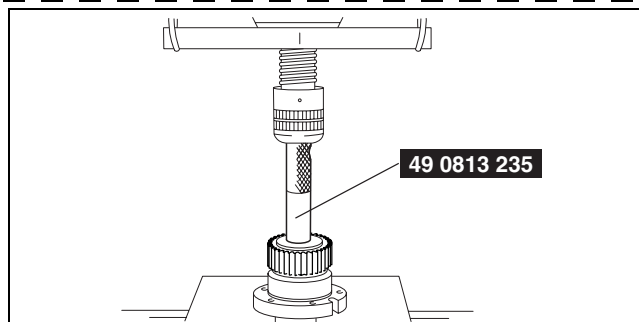
CHU0110E042

- Remove the adapter ring and the securing screw from the SST.
- Set the stationary gear to the hydraulic press so that the gear faces upward.



BHJ0110F005

- Remove the main bearing using the SST.



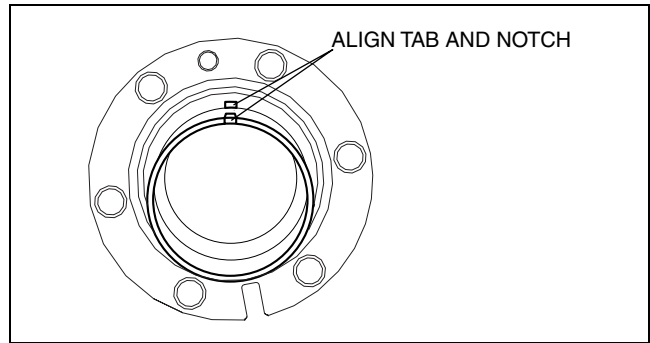
BHJ0110E057

MECHANICAL

Installation

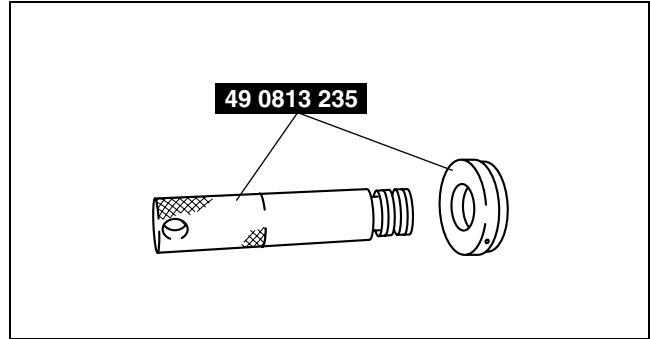
Without stopper screw

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.



CHU0110E043

2. Remove the **SST** handle.

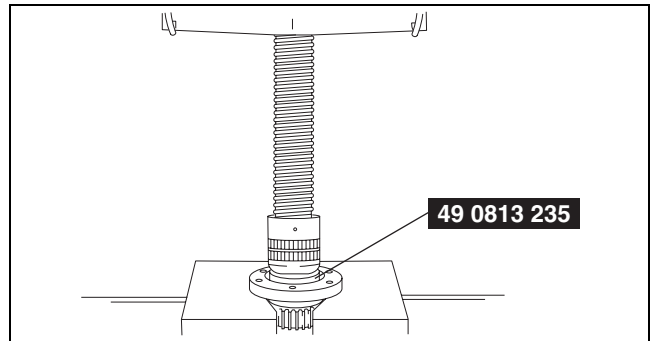


BHJ0110E059

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

Caution

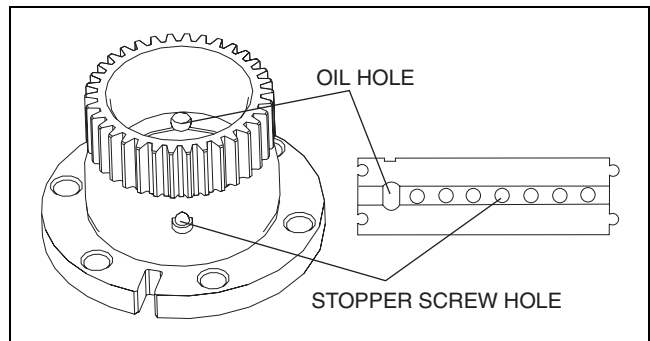
- Press the main bearing in so that the top of the main bearing is flush with the top of the stationary gear flange.



BHJ0110E060

With stopper screw

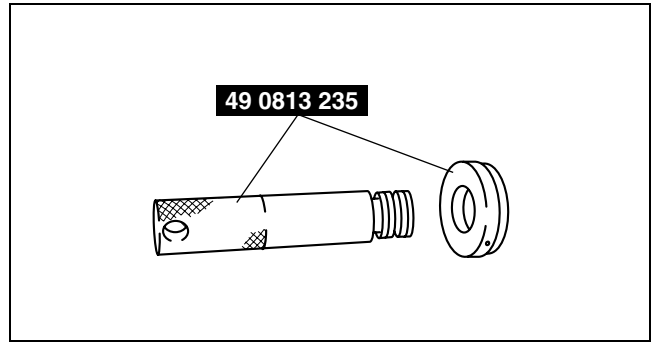
1. Temporarily assemble the stationary gear and the main bearing so that the main bearing screw hole and the stationary gear screw hole are aligned after pressing in the main bearing and rotor.



CHU0110E044

MECHANICAL

- Remove the **SST** handle.

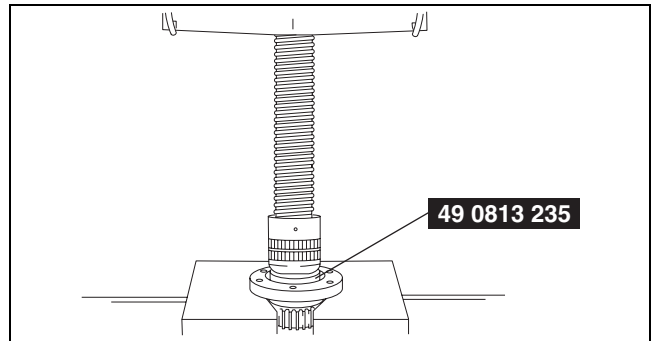


BHJ0110E059

- 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.



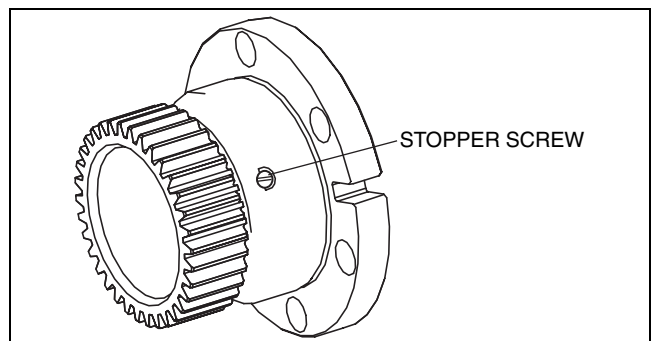
BHJ0110E060

- 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}



CHU0110E042

MECHANICAL

OIL PUMP INSPECTION

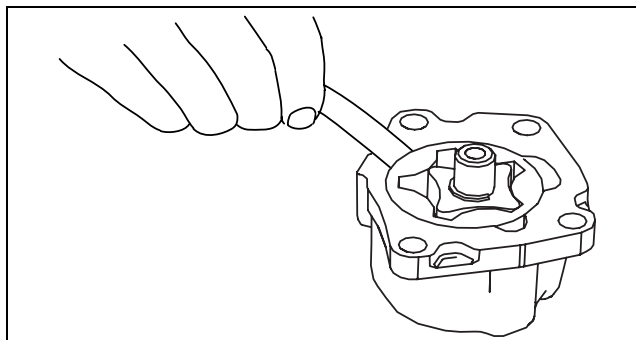
CHU011014100E01

Type A

1. Measure the body clearance between the outer rotor and the body using a feeler gauge.
 - If it exceeds the maximum specification, replace the oil pump.

Standard body clearance
0.20—0.25 mm {0.0079—0.0098 in}

Maximum body clearance
0.3 mm {0.0118 in}

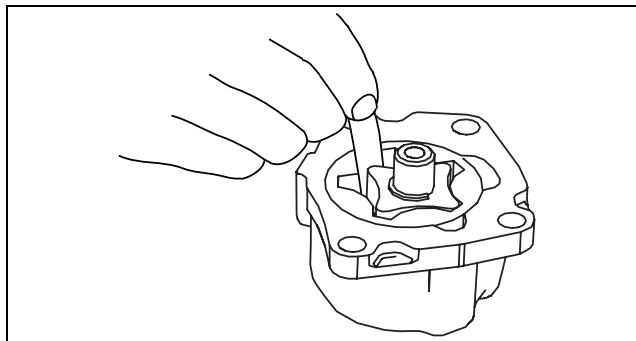


BHJ0110E067

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

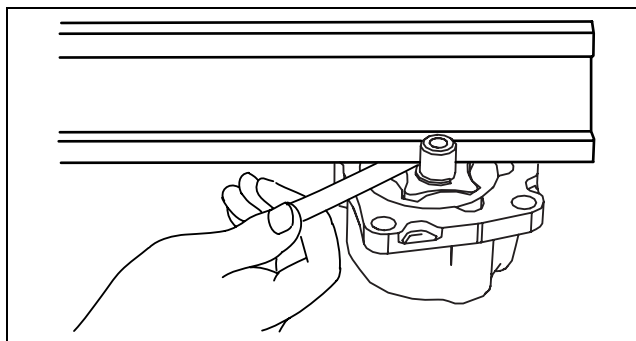


BHJ0110E068

3. Measure the side clearance between the rotor and the side housing using a straight edge and a feeler gauge.
 - If it exceeds the maximum specification, replace the oil pump.

Standard side clearance
0.03—0.125 mm {0.0012—0.0049 in}

Maximum side clearance
0.15 mm {0.0059 in}



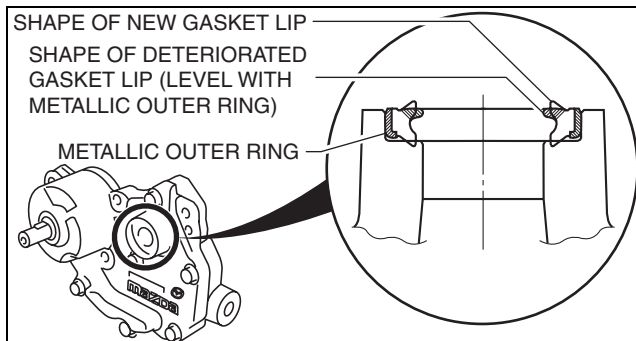
BHJ0110E069

Type B

Note

- The oil pump cannot be disassembled because it is a precision unit. If a malfunction occurs, replace the oil pump component as a single unit.

1. Visually inspect the oil pump gasket.
 - Replace the oil pump component if the condition corresponds to any one of the following:
 - The lip is damaged.
 - The lip and the metallic outer ring are at the same level.



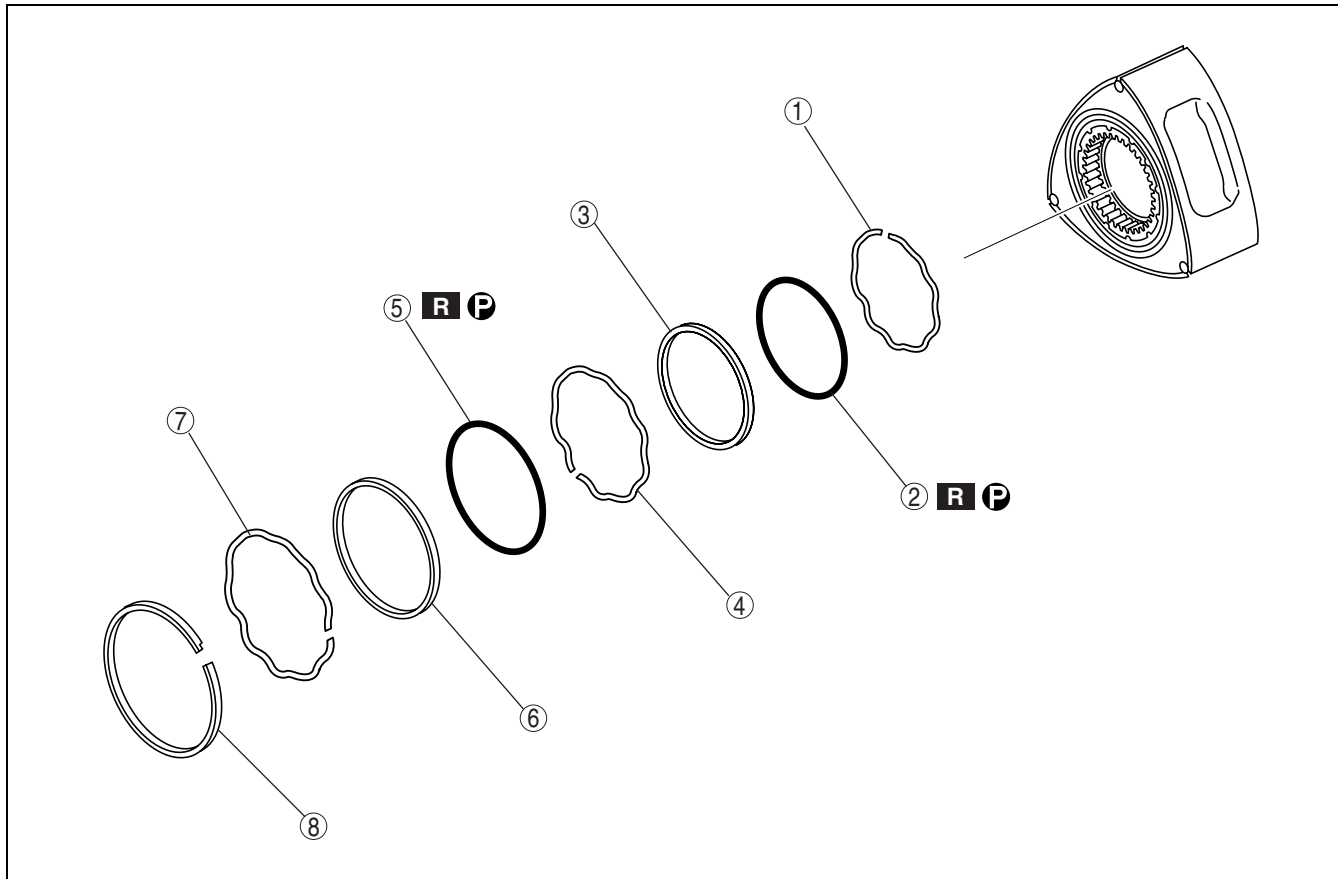
GHE0110E002

MECHANICAL

ROTOR ASSEMBLY

CHU011002000E08

1. Assemble in the order indicated in the table.



BHJ0110E074

1	Inner oil seal spring (See 01-10-30 Oil Seal Spring Assembly Note.)
2	Inner O-ring (small radius) (See 01-10-31 O-Ring Assembly Note.)
3	Inner oil seal (See 01-10-32 Oil Seal Assembly Note.)
4	Outer oil seal spring (See 01-10-30 Oil Seal Spring Assembly Note.)

5	Outer O-ring (large radius) (See 01-10-31 O-Ring Assembly Note.)
6	Outer oil seal (See 01-10-32 Oil Seal Assembly Note.)
7	Cut-off seal spring (See 01-10-32 Cut-Off Seal Spring Assembly Note.)
8	Cut-off seal (See 01-10-33 Cut-Off Seal Assembly Note.)

Oil Seal Spring Assembly Note

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

Spring Identification Color

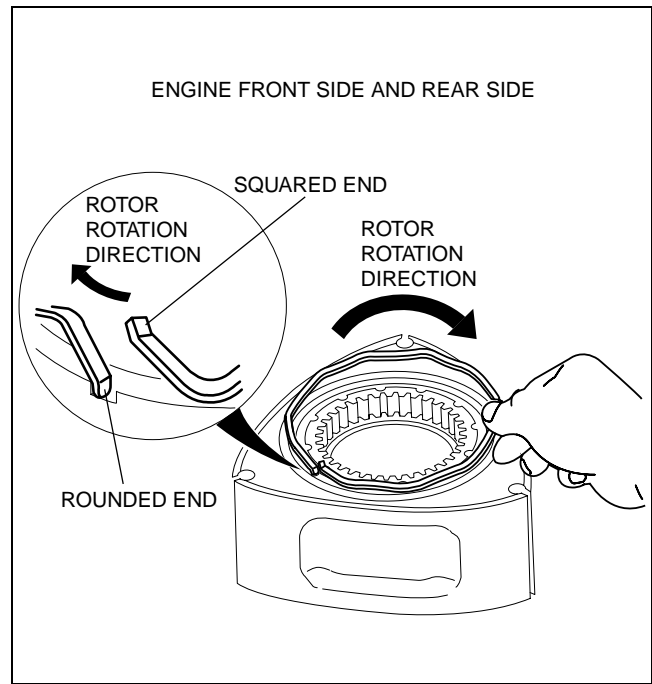
Rotor	Front rotor		Rear rotor	
	Engine front side	Engine rear side	Engine front side	Engine rear side
Inner	White	Blue	White	Blue
Outer	White + pink	Blue + pink	White + pink	Blue + pink

Caution

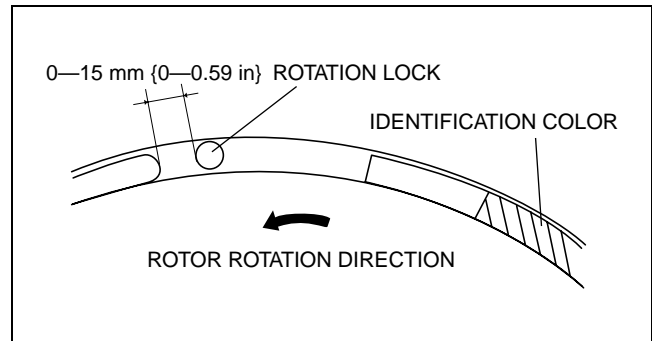
- It is possible that the identification color may not be visible when reusing the oil spring. In that case, assemble the rounded end towards the rotor side and the squared end upward.
- Be careful when assembling the oil seal spring of the front and rear rotor since each spring of the engine front side 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.

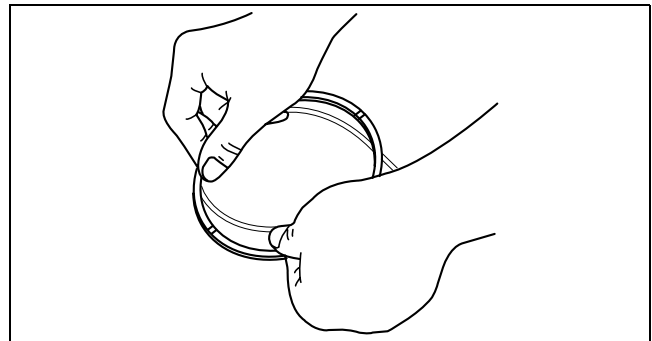


O-Ring Assembly Note

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

Note

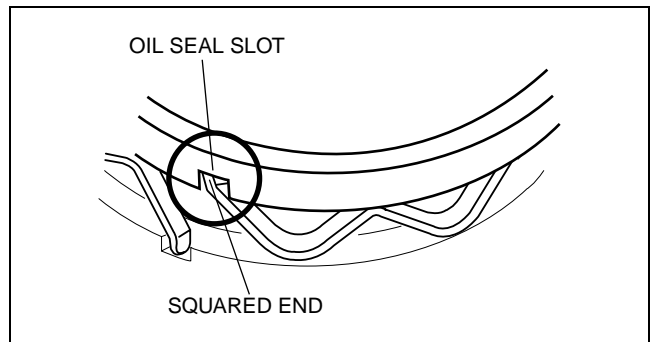
- Assemble the thicker O-ring to the inner oil seal (small radius), and the thinner O-ring to the outer oil seal (large radius).



MECHANICAL

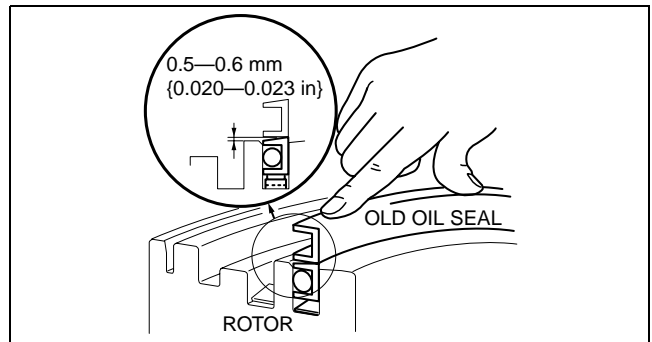
Oil Seal Assembly Note

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



CHU0110E026

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.



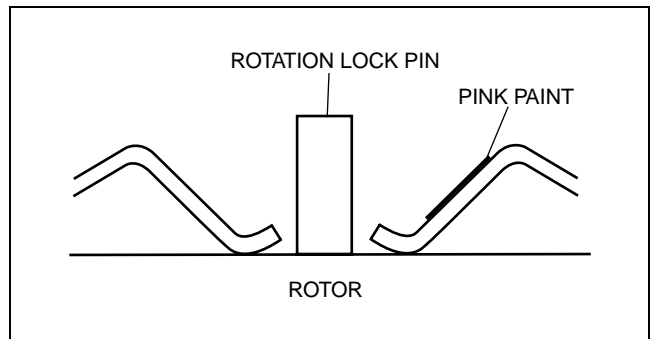
CHU0110E027

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.

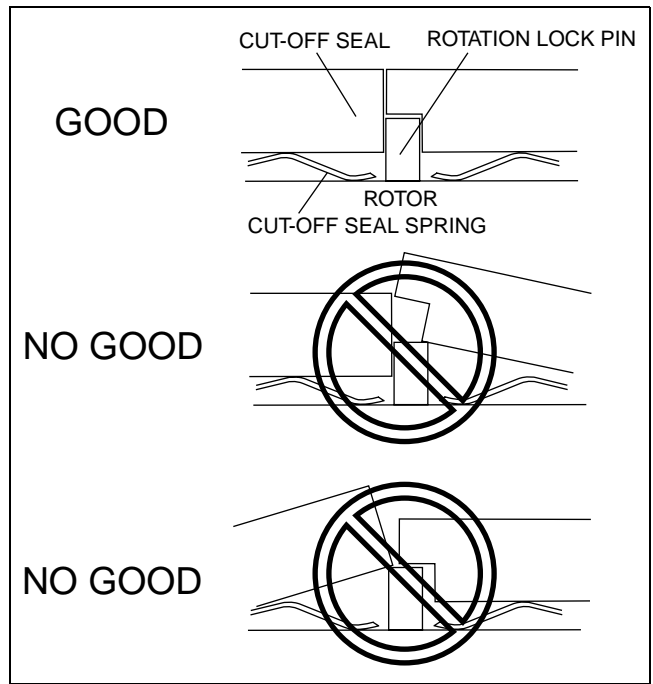


CHU0110E028

MECHANICAL

Cut-Off Seal Assembly Note

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



CHU0110E029

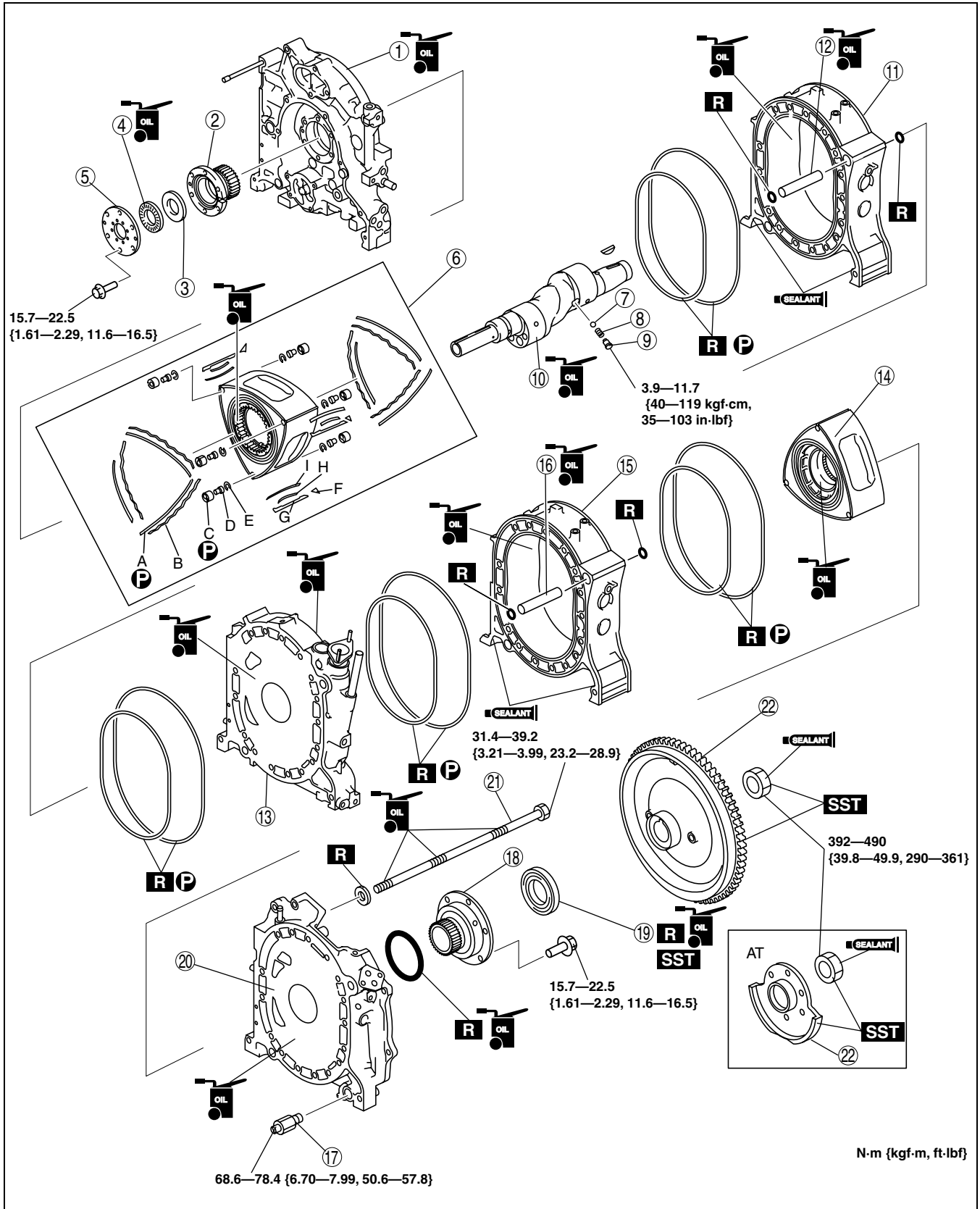
01-10

MECHANICAL

HOUSING ASSEMBLY I

CHU011002000E09

1. Assemble in the order indicated in the table.



CHU0110E052

1	Front housing
2	Front stationary gear

3	Thrust plate (See 01-10-35 Thrust Plate Assembly Note.)
4	Needle bearing

01-10-34

MECHANICAL

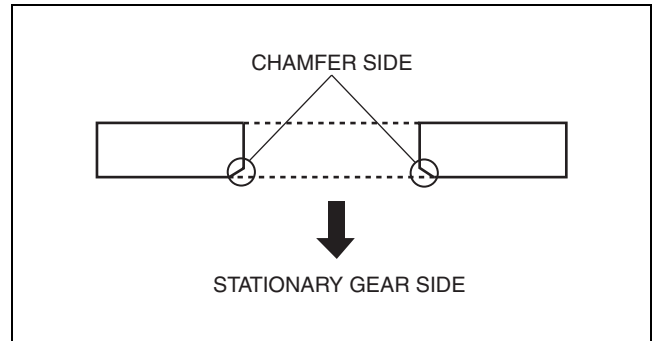
5	Plate
6	Front rotor A: Side seal B: Side seal spring C: Corner seal D: Corner seal plug E: Corner seal spring F: Side piece G: Apex seal H: Apex seal spring (short) I: Apex seal spring (long) (See 01-10-35 Rotor Assembly Note.)
7	Steel ball
8	Spring
9	Oil jet plug (See 01-10-36 Oil Jet Plug Assembly Note.)
10	Eccentric shaft
11	Front rotor housing (See 01-10-37 Rotor Housing Assembly Note.)
12	Tubular dowel (front rotor housing side)

13	Intermediate housing (See 01-10-38 Intermediate Housing Assembly Note.)
14	Rear rotor (See 01-10-35 Rotor Assembly Note.)
15	Rear rotor housing (See 01-10-37 Rotor Housing Assembly Note.)
16	Tubular dowel (rear rotor housing side)
17	Pressure regulator (Type A)
18	Rear stationary gear
19	Rear oil seal (See 01-10-39 Rear Oil Seal Assembly Note.)
20	Rear housing (See 01-10-40 Rear Housing Assembly Note.)
21	Tension bolt (See 01-10-40 Tension Bolt Assembly Note.)
22	Flywheel (MT), counterweight (AT) (See 01-10-41 Flywheel (MT), Counterweight (AT) Assembly Note.)

01-10

Thrust Plate Assembly Note

1. Place the chamfer side facing the stationary gear.



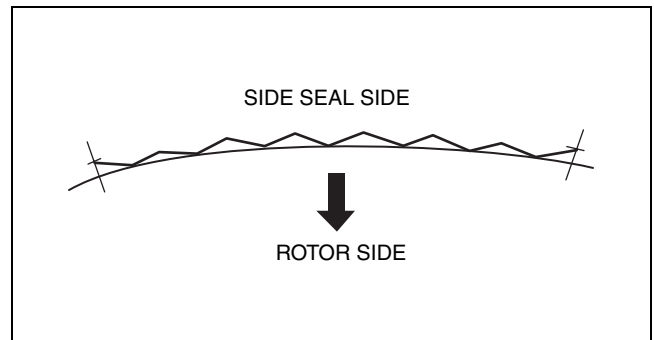
CHU0110E045

Rotor Assembly Note

Caution

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

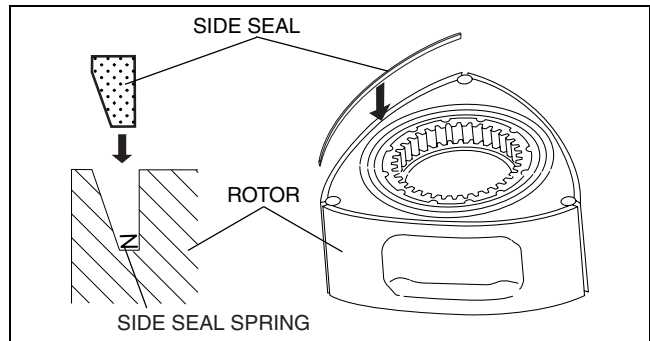
1. Assemble the side seal spring in the direction shown in the figure.



CHU0110E046

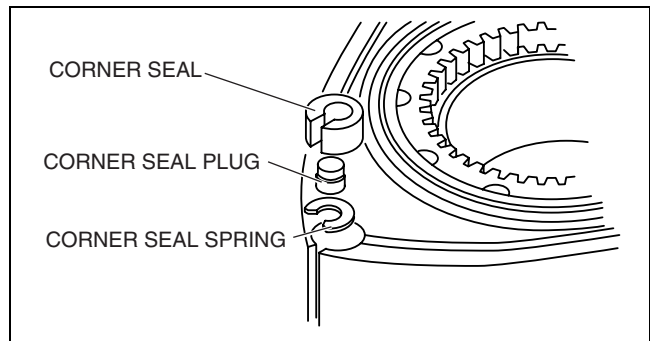
MECHANICAL

2. Assemble the side seal spring in the direction shown in the figure.
3. Apply petroleum jelly between the side seal and side seal groove.



CHU0110E047

4. Assemble the corner seal to the corner seal.



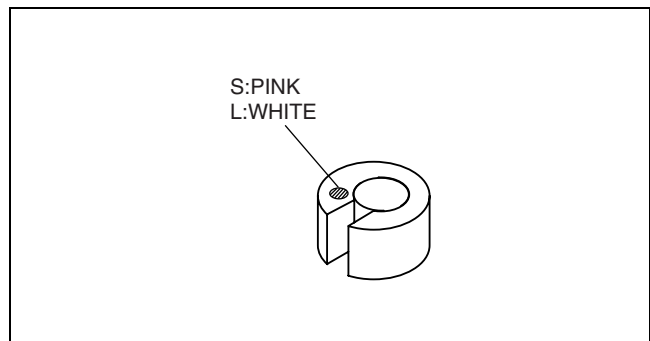
CHU0110E030

Note

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

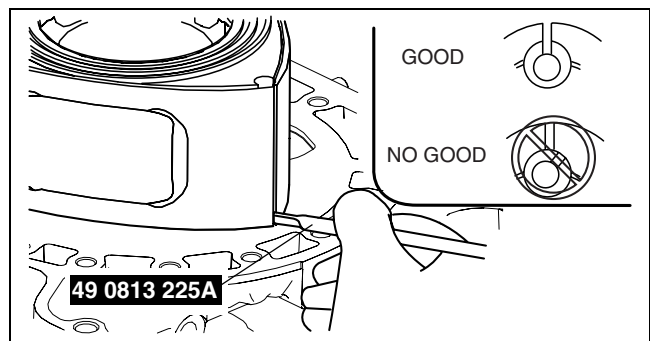
5. Assemble the corner seal and corner seal spring with the notch aligned with the apex seal groove.
6. Apply petroleum jelly between the corner seal and corner seal groove.

7. Place the rotor in the housing.



CHU0110E051

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



CHU0110E070

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

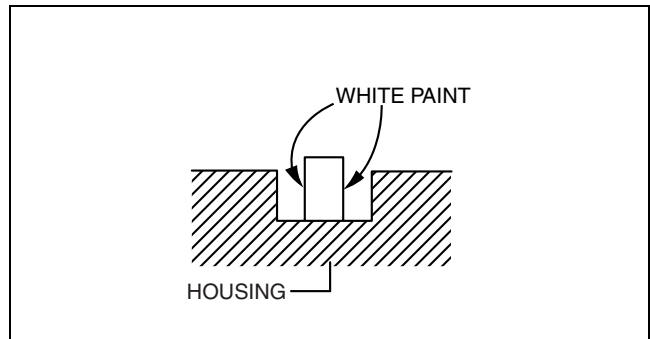
{40—119 kgf·cm, 35—103 in·lbf}

Rotor Housing Assembly Note

Caution

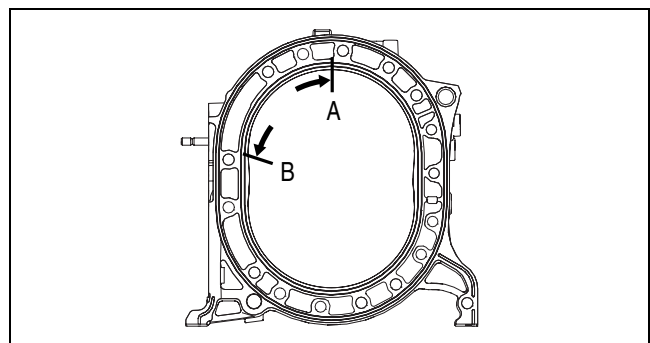
- Assemble the seal rubber without any torsion.
- Do not get oil or grease on the seal rubber.

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.



CHU0110E061

3. Assemble the inner seal rubber to the housing with the seal rubber joint placed between A—B.

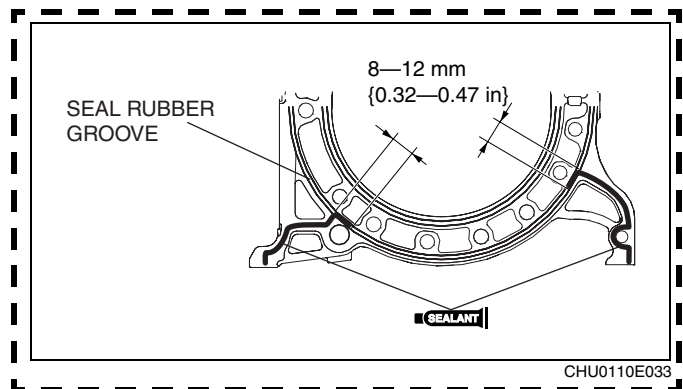


CHU0110E062

4. Apply the silicone sealant to the position indicated in the figure.

Bead thickness

2.5—6.5 mm {0.099—0.255 in}

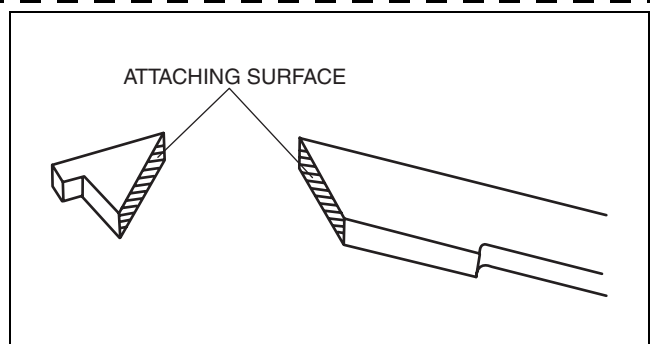


CHU0110E033

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.



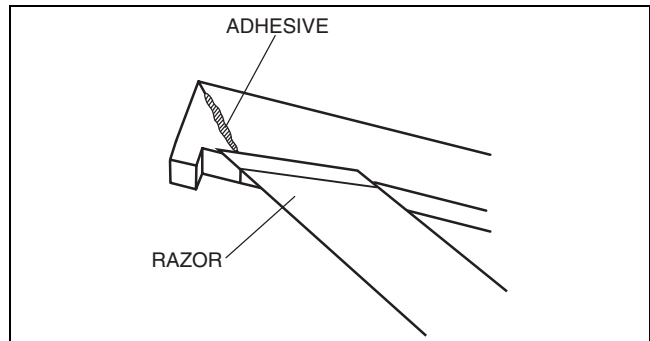
CHU0110E059

MECHANICAL

- If adhesive protrudes, remove with a razor.

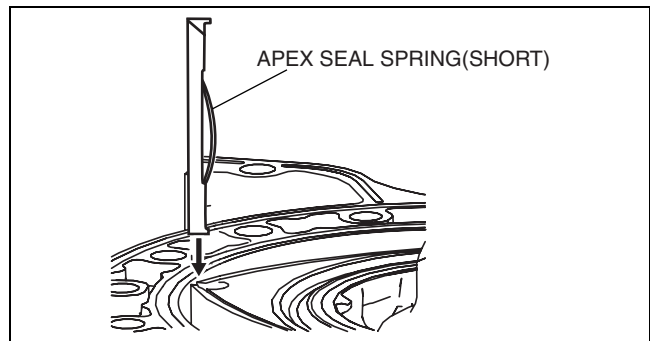
Note

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



CHU0110E069

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

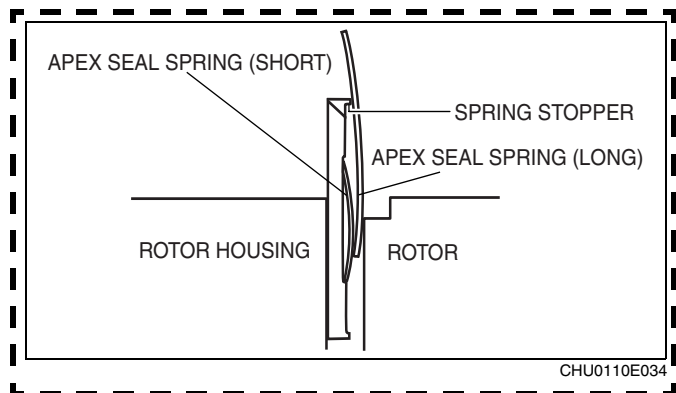


CHU0110E063

7. Assemble the apex seal spring (long) while pressing the apex seal spring (short).

Caution

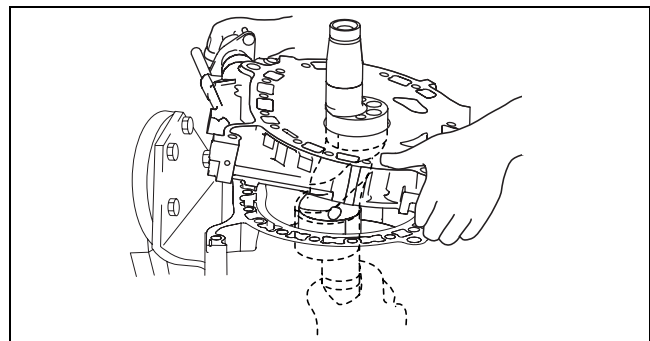
- Assemble the apex seal spring until it catches the spring stopper of the side piece.



CHU0110E034

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}.

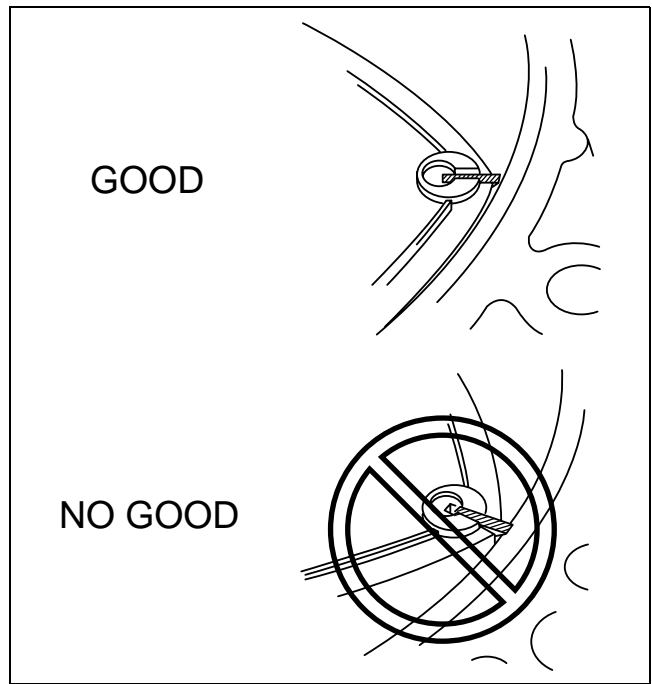


BHJ0110E023

MECHANICAL

Caution

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



CHU0110E060

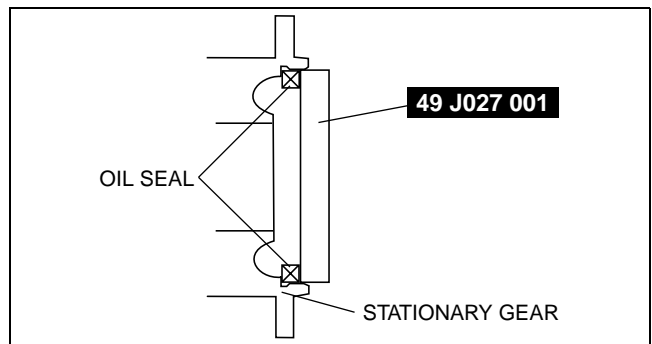
01-10

Rear Oil Seal Assembly Note

1. Assemble the oil seal using the SST.

Caution

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



CHU0110E035

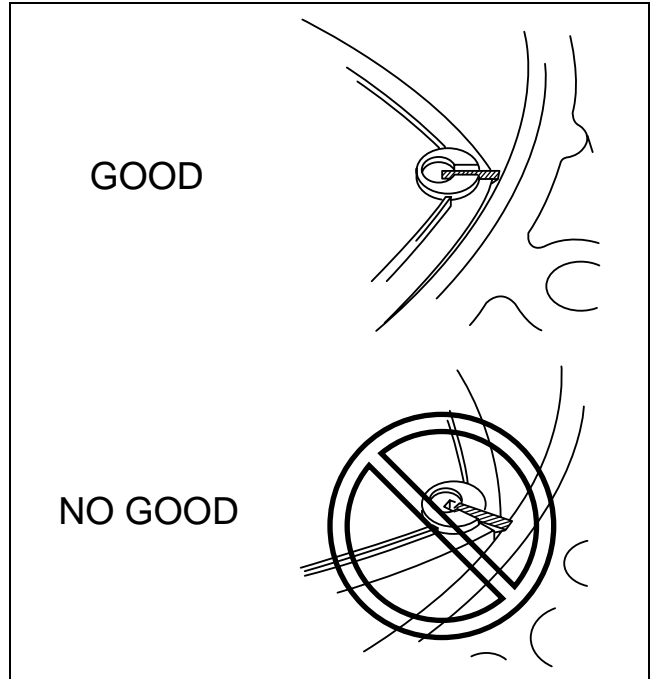
MECHANICAL

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.



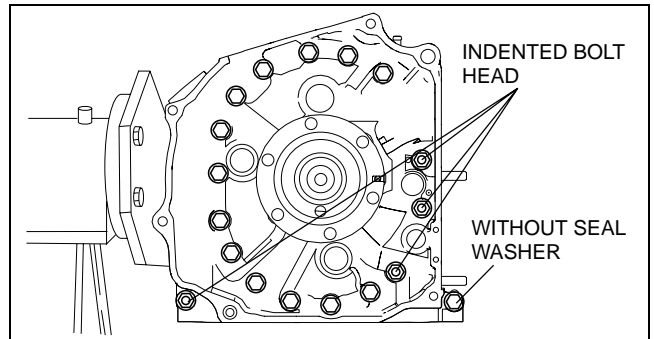
CHU0110E060

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.



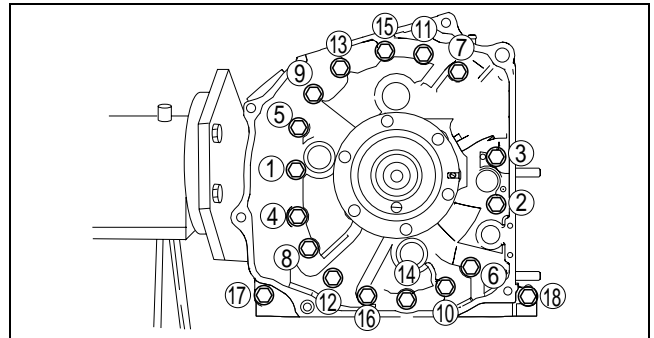
CHU0110E036

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}

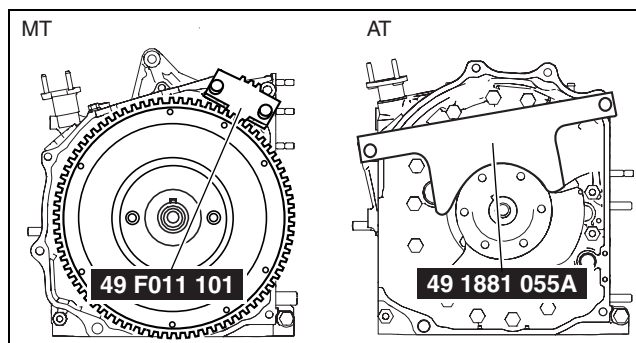


BHJ0110E094

MECHANICAL

Flywheel (MT), Counterweight (AT) Assembly Note

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



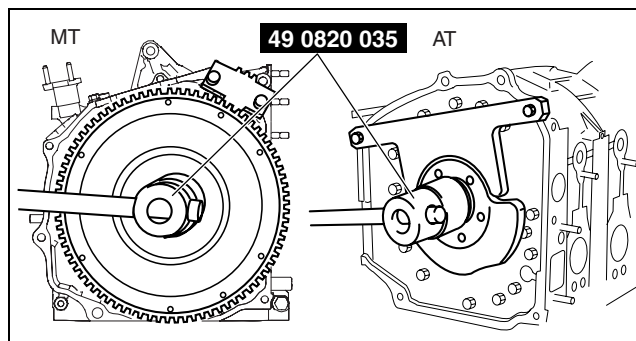
BHJ0110E007

2. Tighten the locknut using the **SST**.

Tightening torque

392—490 N·m

{40.0—49.9 kgf·m, 290—361 ft·lbf}



BHJ0110E011

01-10

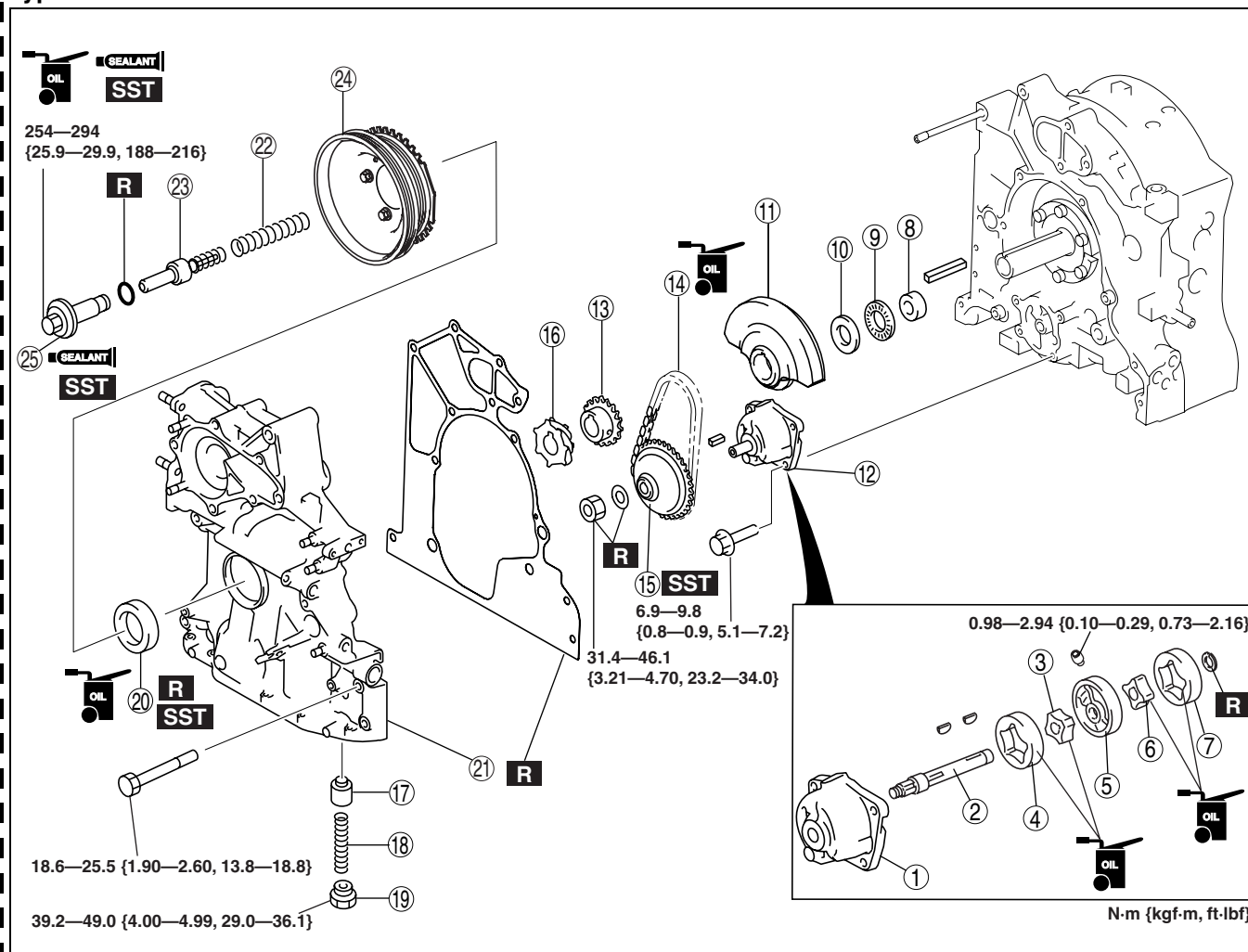
MECHANICAL

CHU011002000E10

HOUSING ASSEMBLY II

1. Assemble in the order indicated in the table.

Type A



BHE0110E001

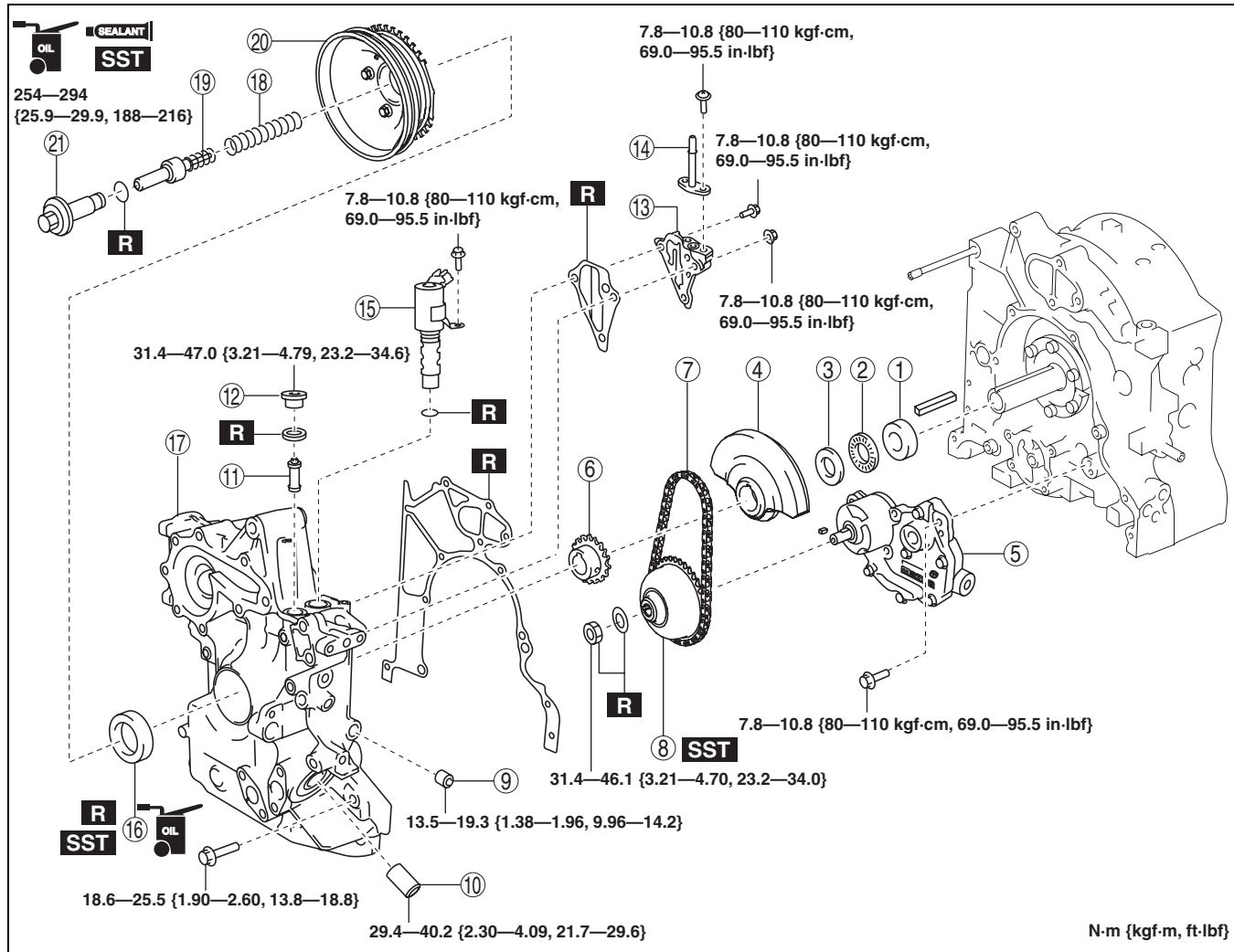
1	Oil pump body
2	Shaft
3	Front inner rotor
4	Front outer rotor
5	Middle plate
6	Rear inner rotor
7	Rear outer rotor
8	Spacer (See 01-10-43 Spacer Assembly Note.)
9	Needle bearing
10	Thrust plate
11	Balance weight
12	Oil pump component
13	Oil pump drive gear (See 01-10-43 Oil Pump Drive Gear Assembly Note.)

14	Oil pump chain
15	Oil pump sprocket wheel (See 01-10-43 Oil Pump Sprocket Wheel Assembly Note.)
16	Metering oil pump drive gear
17	Control valve
18	Control valve spring
19	Plug
20	Front oil seal (See 01-10-43 Front Oil Seal Assembly Note.)
21	Front cover (See 01-10-44 Front Cover Assembly Note.)
22	Spring
23	Eccentric shaft bypass valve
24	Pulley component
25	Pulley lockbolt (See 01-10-44 Pulley Lockbolt Assembly Note.)

MECHANICAL

CHU011002000E04

Type B



01-10

GHE0110E003

1	Spacer (See 01-10-43 Spacer Assembly Note.)
2	Needle bearing
3	Thrust plate
4	Balance weight
5	Oil pump component
6	Oil pump drive gear (See 01-10-43 Oil Pump Drive Gear Assembly Note.)
7	Oil pump chain
8	Oil pump sprocket wheel (See 01-10-43 Oil Pump Sprocket Wheel Assembly Note.)
9	Plug
10	Oil filter joint

11	OCV oil filter
12	Plug
13	OCV case
14	Oil pipe
15	OCV
16	Front oil seal (See 01-10-43 Front Oil Seal Assembly Note.)
17	Front cover (See 01-10-44 Front Cover Assembly Note.)
18	Spring
19	Eccentric shaft bypass valve
20	Pulley component
21	Pulley lockbolt (See 01-10-44 Pulley Lockbolt Assembly Note.)

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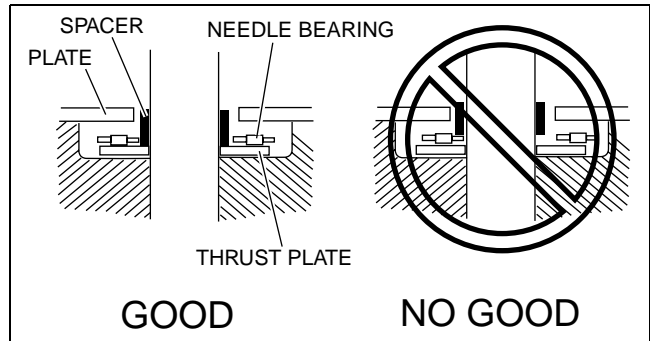
Spacer Assembly Note

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 01-10-22 ECCENTRIC SHAFT END PLAY INSPECTION.)

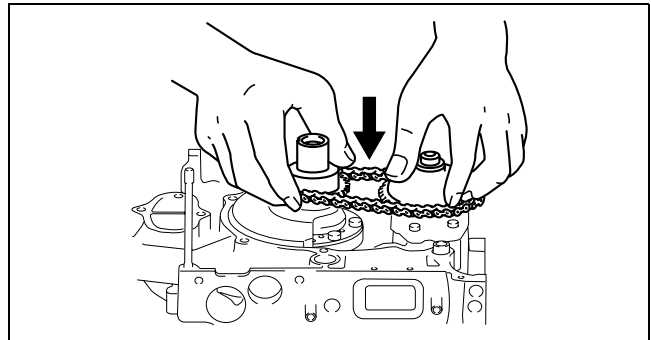


CHU0110E019

01-10

Oil Pump Drive Gear Assembly Note

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



BHJ0110E101

Oil Pump Sprocket Wheel Assembly Note

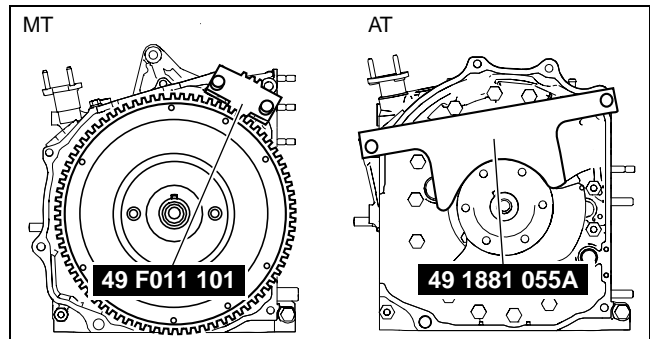
- Lock the flywheel (MT) and counterweight (AT) against rotation using the **SSTs**.
- Assemble the oil pump shaft with a new lock washer and locknut, and tighten.

Tightening torque

31.4—46.1 N·m

{3.21—4.70 kgf·m, 23.2—34.0 ft·lbf}

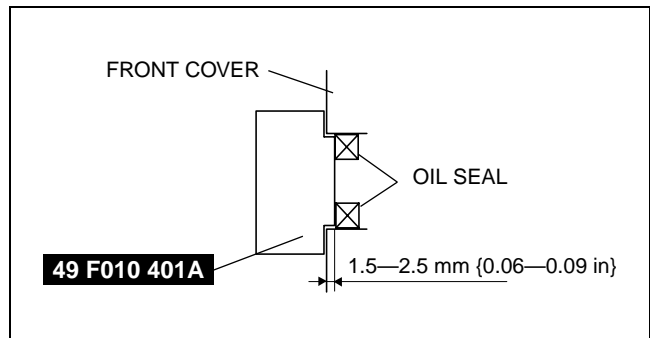
- Bend the lock washer and crimp.



BHJ0110E007

Front Oil Seal Assembly Note

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



CHU0110E037

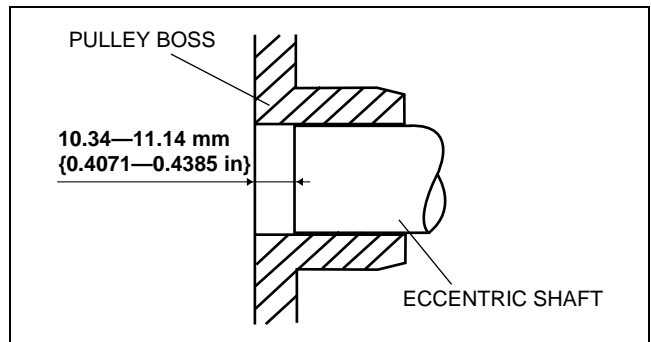
MECHANICAL

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}



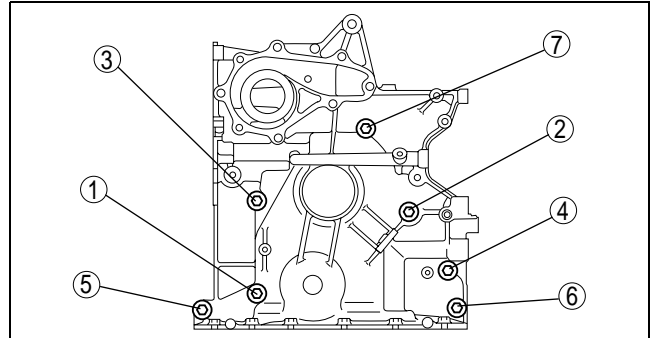
CHU0110E038

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

Tightening torque

18.6—25.5 N·m

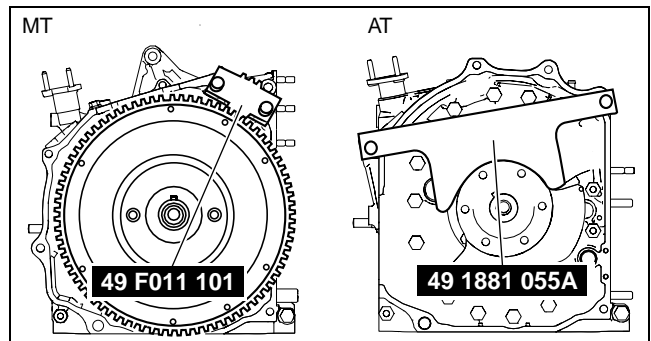
{1.90—2.60 kgf·m, 13.8—18.8 ft·lbf}



BHJ0110E098

Pulley Lockbolt Assembly Note

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



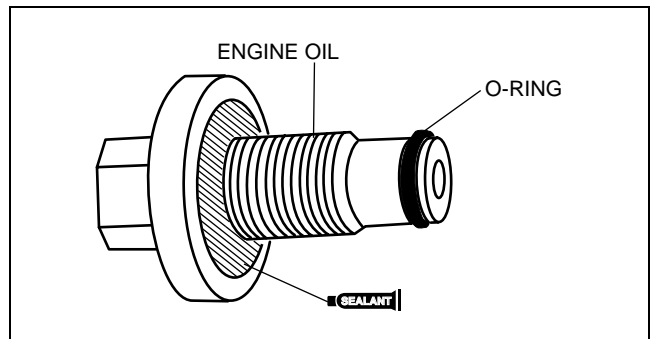
BHJ0110E007

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

300—340 N·m

{30.6—34.6 kgf·m, 222—250 ft·lbf}



CHU0110E066

MECHANICAL

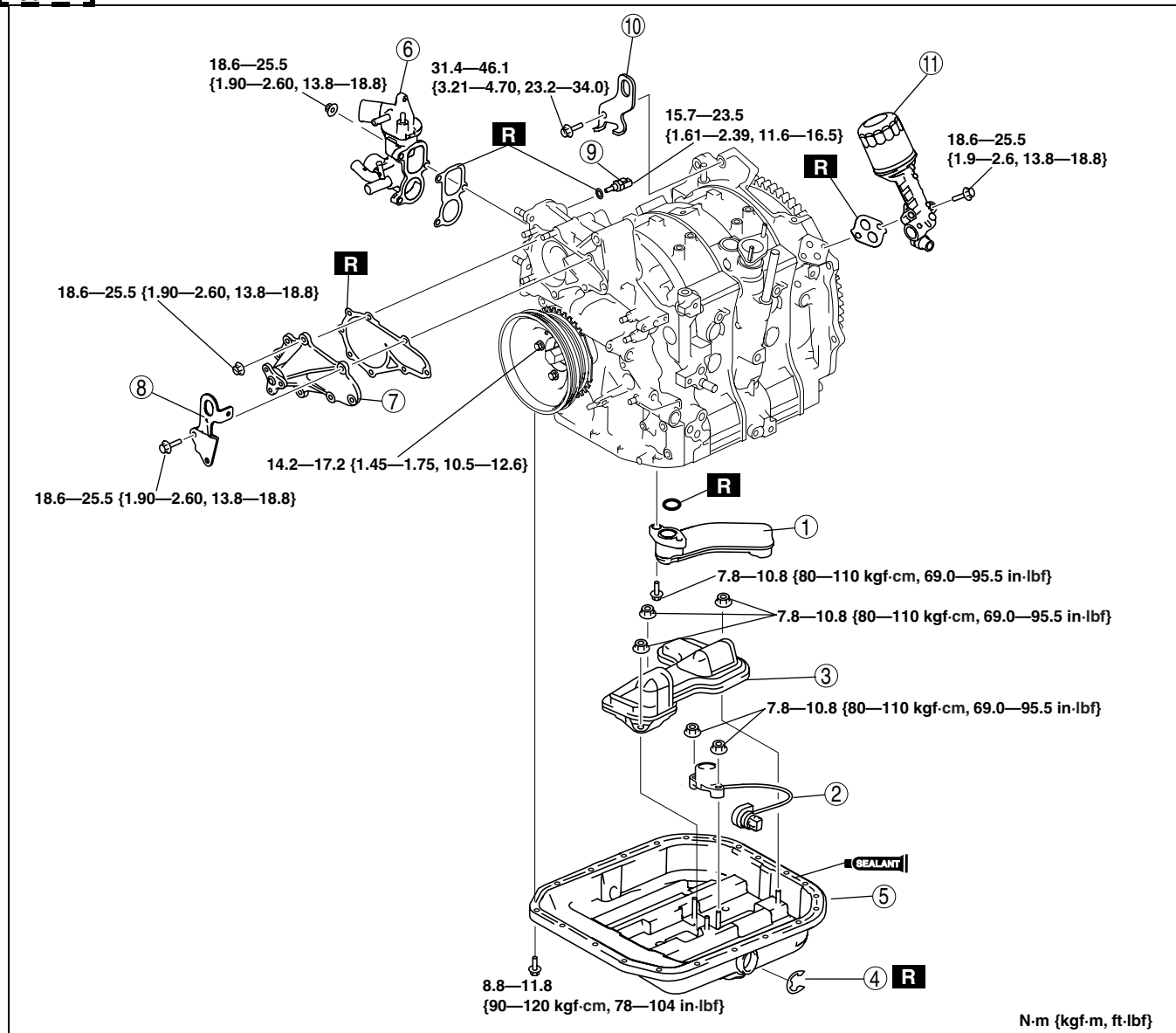
HOUSING ASSEMBLY III

CHU011002000E11

1. Assemble in the order indicated in the table.

Type A

01-10



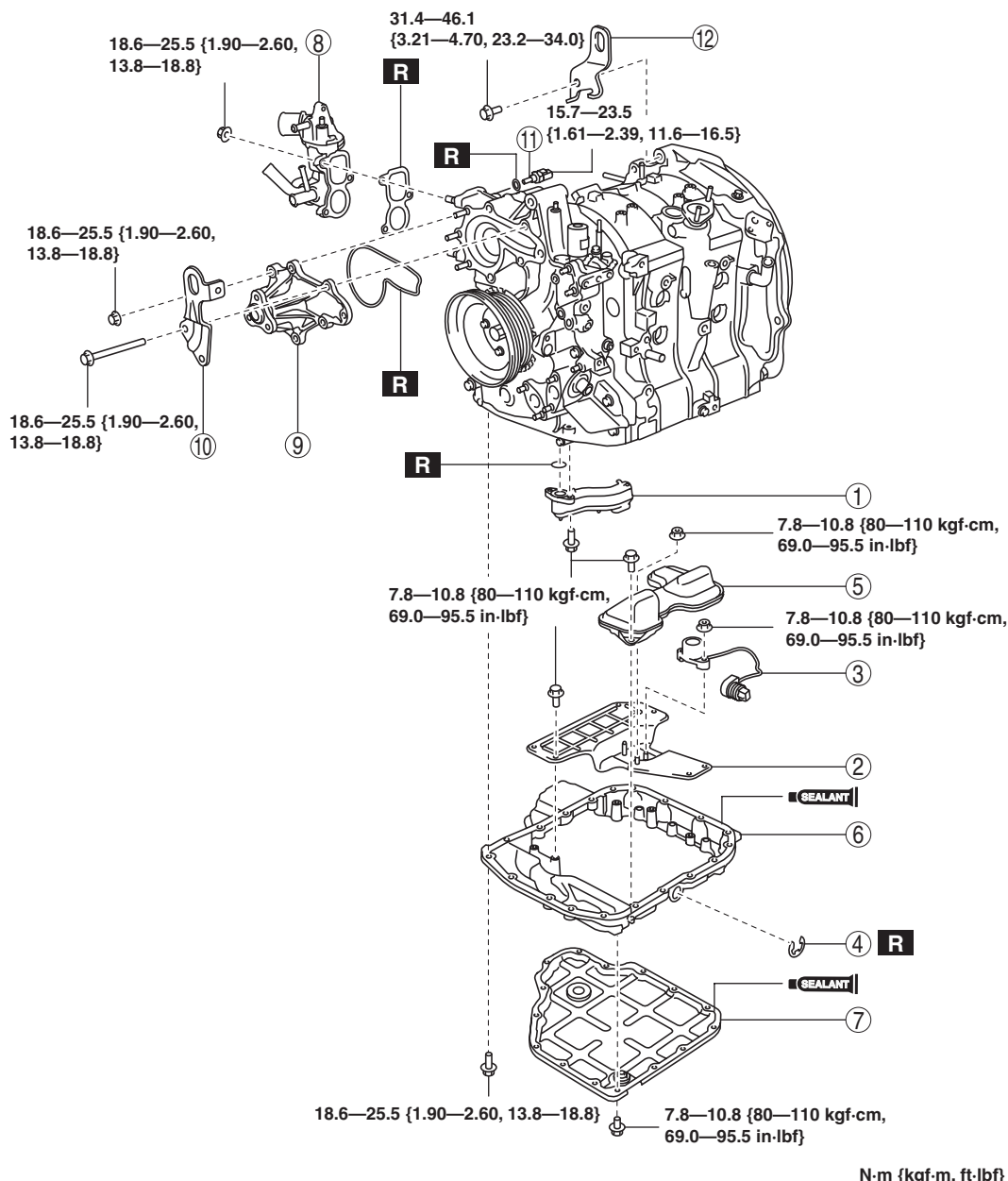
CHU0110E054

1	Oil strainer
2	Oil-level sensor
3	Oil baffle plate
4	Clip
5	Oil pan (See 01-10-47 Oil Pan Assembly Note.)

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

MECHANICAL

Type B



GHE0110E004

1	Oil strainer
2	Baffle plate
3	Oil level switch
4	Clip
5	Baffle plate
6	Oil pan upper block (See 01-10-47 Oil Pan Upper Block Assembly Note.)

7	Oil pan (See 01-10-47 Oil Pan Assembly Note.)
8	Thermostat component
9	Water pump body
10	Engine hanger (engine front side)
11	ECT sensor
12	Engine hanger (engine rear side)

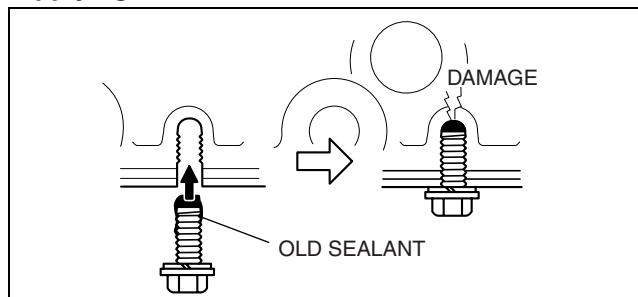
MECHANICAL

Oil Pan Upper Block Assembly Note

Caution

- Apply the silicon sealant in a single, unbroken line around the whole perimeter.
- Install the oil pan upper block within 5 min after applying the silicone sealant.
- Using bolts with the old seal adhering could cause cracks in the housing.

1. Completely clean and remove any oil, dirt, sealant or other foreign material that may be adhering to the oil pan upper block and housing.
2. When reusing the oil pan upper block installation bolts, clean any old sealant from the bolts.



CHU0111W004

3. Apply silicone sealant to the areas as shown in the figure.

Caution

- Apply silicone sealant to the outer circumference of the bolt hole at locations A shown in the figure.

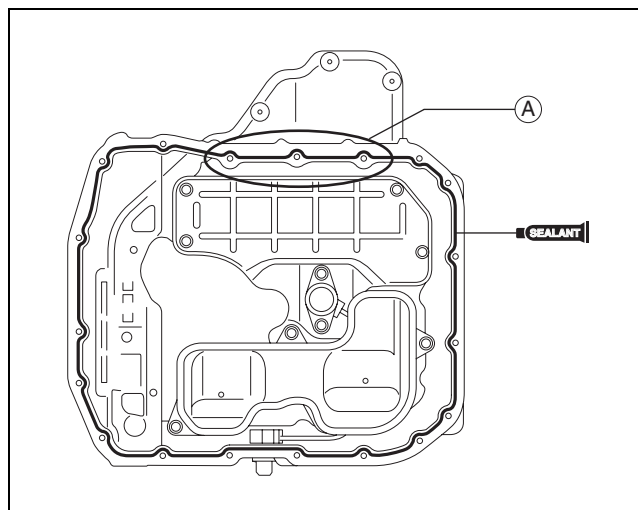
Thickness

2.5—6.5 mm {0.10—0.26 in}

4. Install the oil pan upper block to the housing.
5. Tighten the oil pan upper block installation bolts.

Tightening torque

18.6—25.5 N·m {1.9—2.6 kgf·m, 13.8—18.8 ft·lbf}



BHJ0110F010

01-10

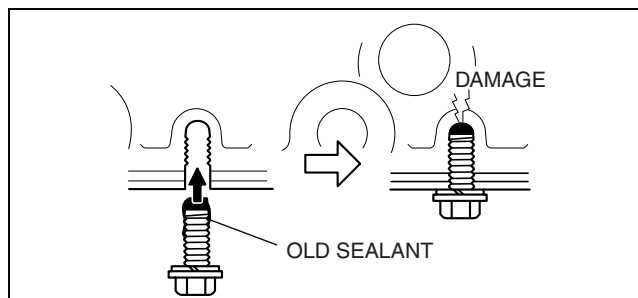
Oil Pan Assembly Note

Type A

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.



CHU0111W004

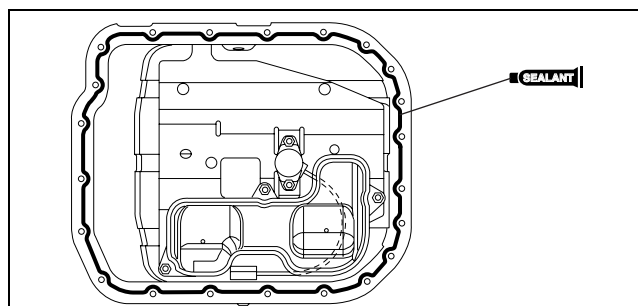
Bead thickness

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}



BHJ0110E100

MECHANICAL**Type B****Caution**

- Apply the silicon sealant in a single, unbroken line around the whole perimeter.
- Install the oil pan within 5 min after applying the silicone sealant.
- Using bolts with the old seal adhering could cause cracks in the housing.

1. Completely clean and remove any oil, dirt, sealant or other foreign material that may be adhering to the oil pan upper block and oil pan.
2. When reusing the oil pan installation bolts, clean any old sealant from the bolts.

3. Apply silicone sealant to the areas as shown in the figure.

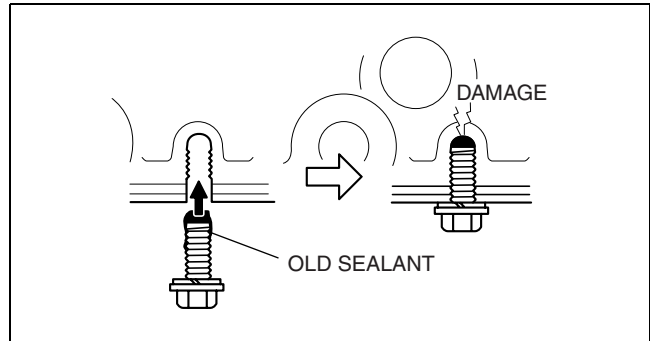
Thickness

2.5—6.5 mm {0.10—0.26 in}

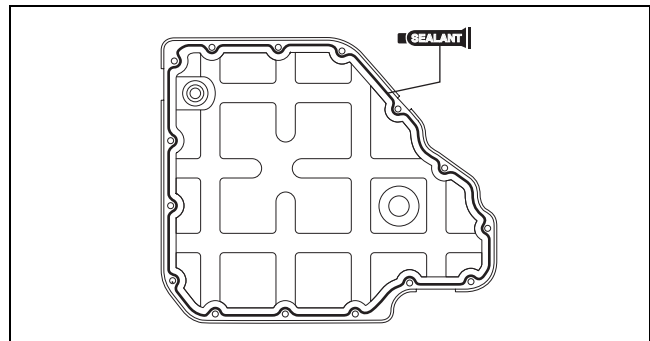
4. Install the oil pan to the oil pan upper block.
5. Tighten the oil pan installation bolts.

Tightening torque

7.8—10.8 N·m {80—110 kgf·cm, 69.0—95.5 in·lbf}



CHU0111W004



AR8WZW000007

TECHNICAL DATA

01-50 TECHNICAL DATA

ENGINE TECHNICAL DATA 01-50-1

ENGINE TECHNICAL DATA

CHU015001001E02




01-50

ITEMS		ENGINE TYPE	
		13B-MSP	
		STANDARD POWER	HIGH POWER
SIDE HOUSING (FRONT, INTERMEDIATE, REAR) INSPECTION			
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}
ROTOR HOUSING			
Maximum width difference	(mm {in})		0.06 {0.0024}
ROTOR			
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—0.077 {0.0017—0.0030}
		Maximum	0.15 {0.0059}
APEX SEAL, APEX SEAL SPRING			
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}
CORNER SEAL, CORNER SEAL SPRING			
Minimum projection of the corner seal	(mm {in})		0.5 {0.02}
SIDE SEAL, SIDE SEAL SPRING			
Corner seal and side seal clearance	(mm {in})	Maximum	0.4 {0.016}
Minimum projection of the side seal	(mm {in})		0.5 {0.02}
CUT-OFF SEAL, CUT OFF SEAL SPRING			
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}
OIL SEAL, OIL SEAL SPRING			
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}
ECCENTRIC SHAFT			
Main bearing oil clearance	(mm {in})	Standard	Without stopper screw: 0.045—0.085 {0.0022—0.0029} With stopper screw: 0.055—0.075 {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}
ECCENTRIC SHAFT BYPASS VALVE			
Minimum projection	(mm {in})		6 {0.24}

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01-50-1

TECHNICAL DATA

ITEMS		ENGINE TYPE	
		13B-MSP	
		STANDARD POWER	HIGH POWER
OIL PUMP			
Body clearance  (Type A)	(mm {in})	Standard	0.20—0.25 {0.0079—0.0098}
		Maximum	0.3 {0.0118}
Tip clearance  (Type A)	(mm {in})	Standard	0.03—0.12 {0.0012—0.0047}
		Maximum	0.15 {0.0059}
Side clearance  (Type A)	(mm {in})	Standard	0.03—0.125 {0.0012—0.0049}
		Maximum	0.15 {0.0059}

END OF PAGE

SERVICE TOOLS

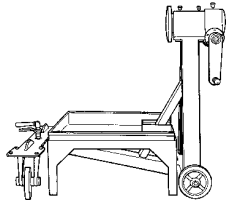
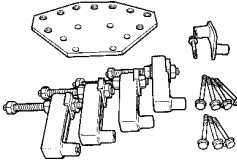
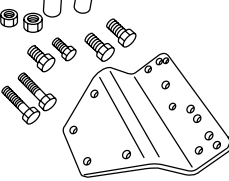

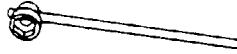
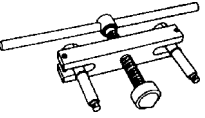
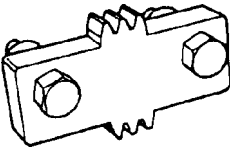

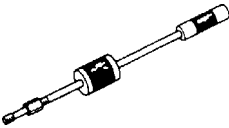
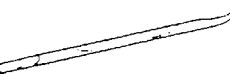
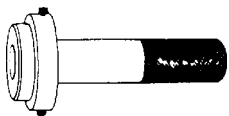
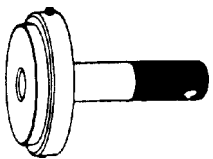

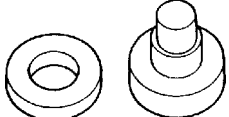
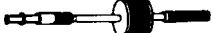
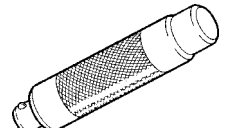
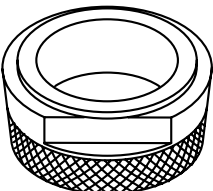
01-60 SERVICE TOOLS

ENGINE SST 01-60-1

ENGINE SST

CHU016001001E02

01-60

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