ENGINE

01 SECTION

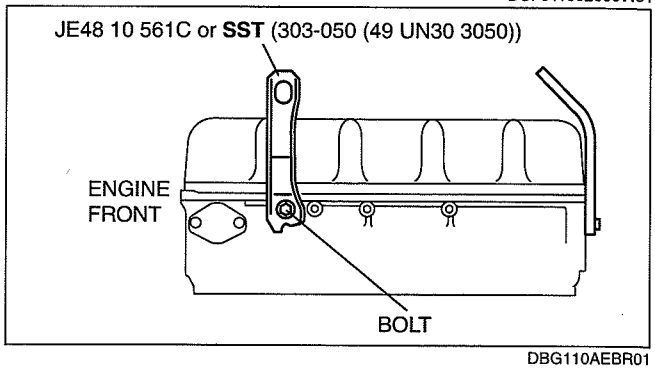
01–10A MECHANICAL [WL-3]

ENGINE MOUNTING [WL-3]

1. Install the engine hanger (JE48 10 561C) or **SST** (303-050 (49 UN30 3050)) to the cylinder head using the bolt (99794 0820 or **M8X1.25, 6T**, length **20mm {0.79 in}**) as shown in the figure.

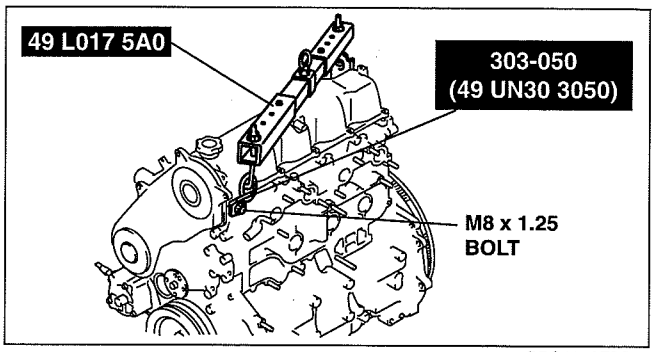
   Tightening torque
   18.6—25.5 N·m {1.90—2.60 kgf·m, 13.8—18.8 ft·lbf}

DCF011002000W01



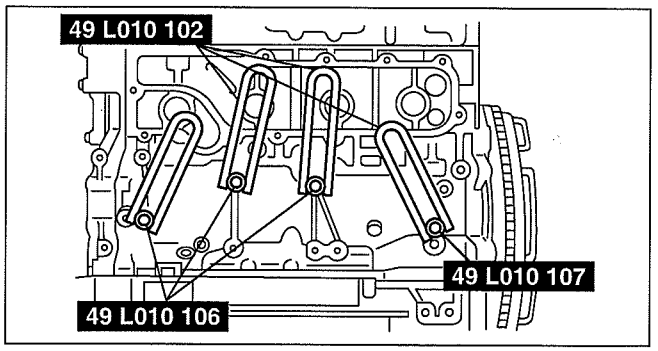
DBG110AEBR01

2. If the **SST** (303-050 (49 UN30 3050)) is used, use the **SST** (49 L017 5A0) when suspending the engine.



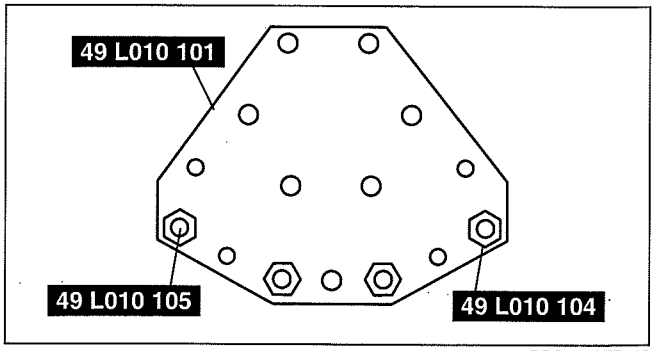
DBG110AEBR84

3. Install the **SST** (arms) to the holes as shown in the figure, and hand tighten the **SST** (bolts).



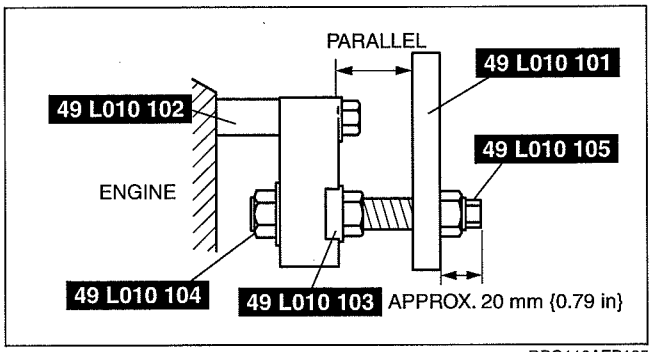
DBG110AEB002

4. Assemble the **SSTs** (bolts, nuts and plate) to the specified positions.



DBG110AEB003

5. Adjust the **SST** (bolts) so that **20 mm {0.79 in}** or more of thread is exposed.
6. Align the **SSTs** (plate and arms) so that they are parallel by adjusting the **SSTs** (bolts and nuts).
7. Tighten the **SSTs** (bolts and nuts) to affix the **SST** firmly.
8. Mount the engine on the **SST** (engine stand).

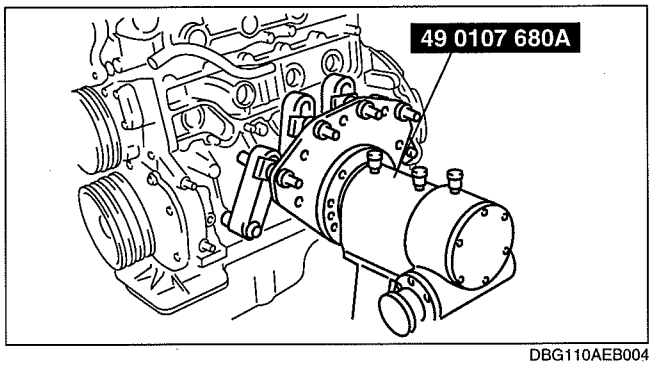


DBG110AEB105

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

9. Remove the engine hanger (JE48 10 561C) or **SST** (303-050 (49 UN30 3050)).
10. Drain the engine oil into a container.
11. Install the drain plug using new washer.

Tightening torque
29.4—41.2 N·m {3.00—4.20 kgf·m, 21.7—30.3 ft·lbf}



DBG110AEB004

ENGINE DISMOUNTING [WL-3]

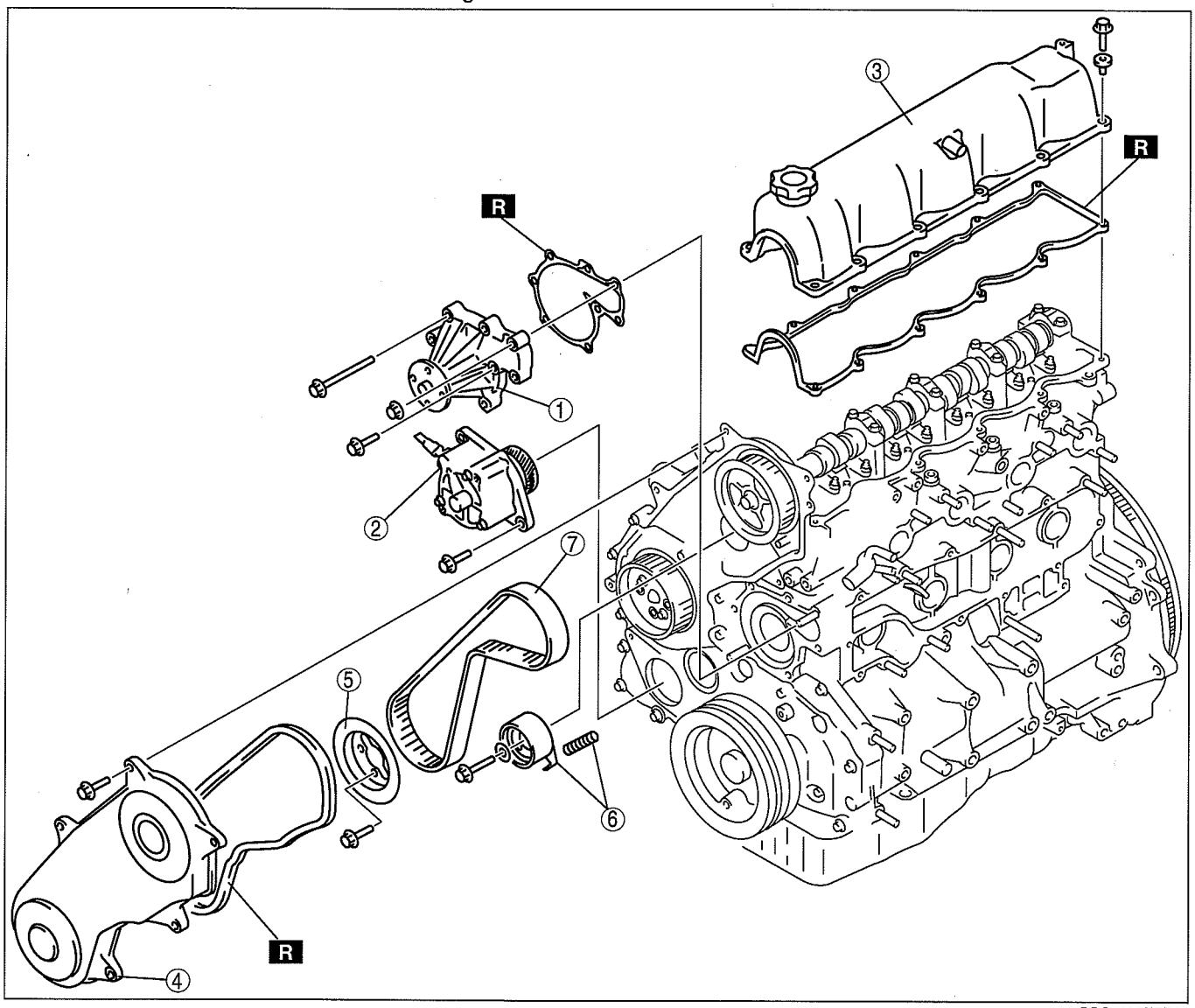
DCF011002000W02

1. Dismount in the reverse order of mounting.

TIMING BELT DISASSEMBLY [WL-3]

DCF011002000W03

1. Disassemble in the order shown in the figure.



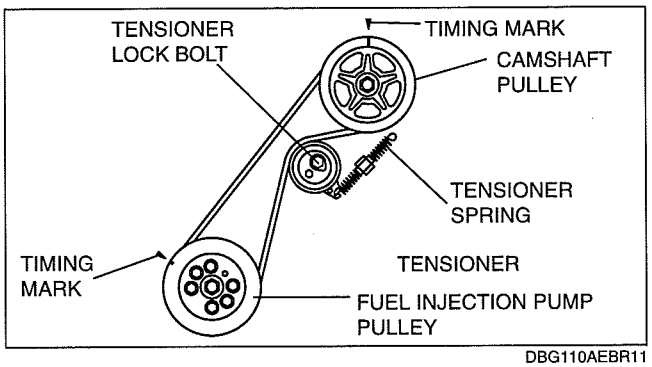
DBG110AEBR05

1	Water pump
2	Vacuum pump
3	Cylinder head cover
4	Timing belt cover
5	Pulley plate

6	Tensioner, tensioner spring (See 01–10A–5 Tensioner, Tensioner Spring Disassembly Note.)
7	Timing belt (See 01–10A–5 Timing Belt Disassembly Note.)

Tensioner, Tensioner Spring Disassembly Note

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



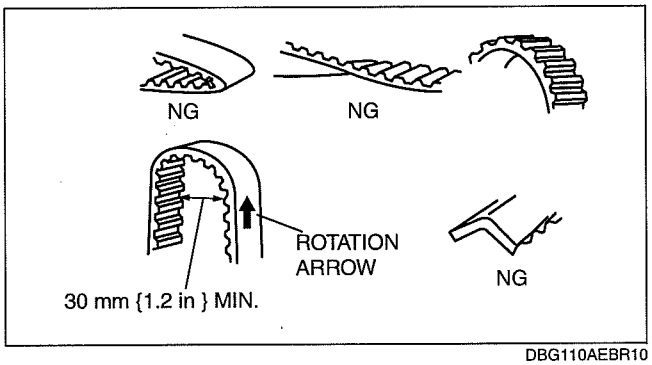
DBG110AEBR11

Timing Belt Disassembly Note

1. Mark the timing belt rotation on the belt for proper reinstallation.

Caution

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

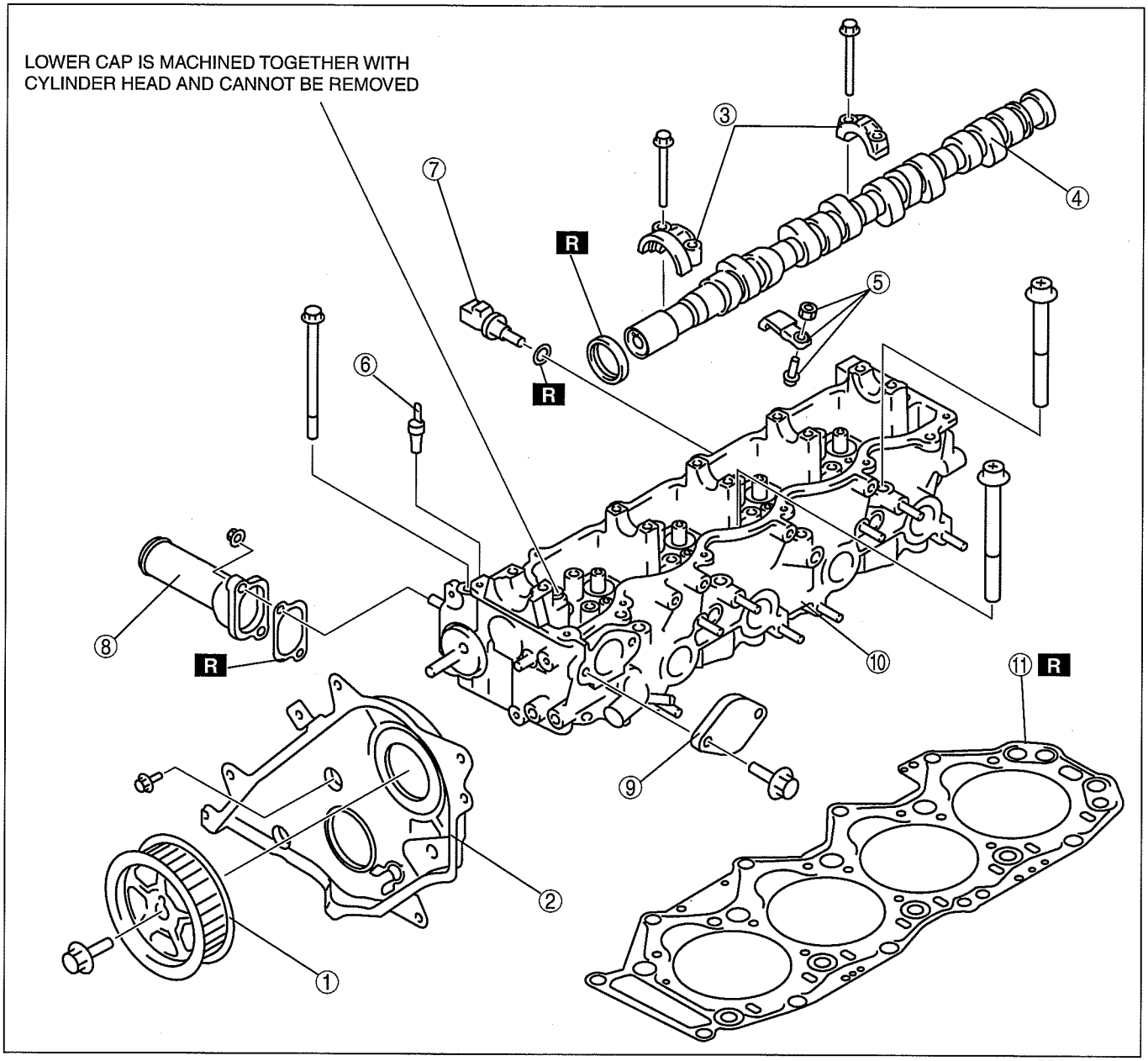


DBG110AEBR10

CYLINDER HEAD DISASSEMBLY(I) [WL-3]

DCF011002000W04

1. Disassemble in the order shown in the figure.



DBG110AEBR08

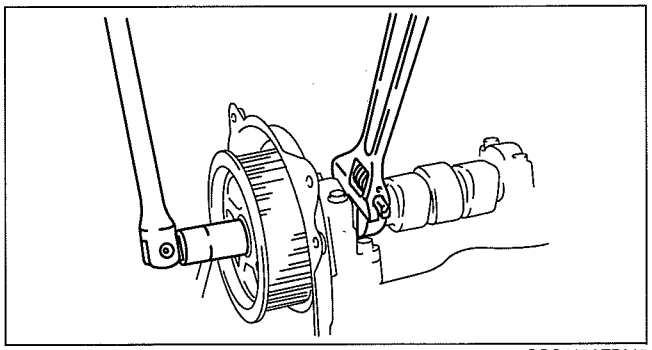
1	Camshaft pulley (See 01–10A–7 Camshaft Pulley Disassembly Note.)
2	Seal plate
3	Camshaft cap (See 01–10A–7 Camshaft Cap Disassembly Note.)
4	Camshaft (See 01–10A–7 Camshaft Disassembly Note.)

5	Rocker arm
6	Water temperature sender unit
7	ECT sensor
8	Water outlet pipe
9	Blind cover
10	Cylinder head (See 01–10A–7 Cylinder Head Disassembly Note.)
11	Cylinder head gasket

Camshaft Pulley Disassembly Note

Caution
- **Do not move the camshaft from this position because it can cause the valve and piston to contact each other and damage them.**

1. Hold the camshaft by using a wrench on the cast hexagon.



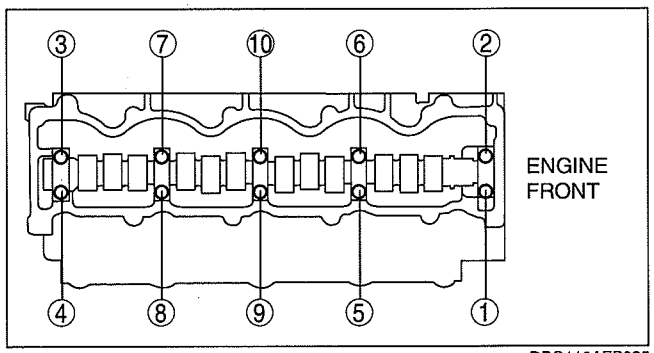
DBG110AEB015

Camshaft Cap Disassembly Note

Caution
- **Removing the camshaft cap under load can break the camshaft. When removing the camshaft cap, loosen the locknut and the adjust screw to prevent the camshaft from pressing down the rocker arm.**

Note
- Mark the camshaft cap so that they can be reinstalled in the position from which they were removed.

1. Loosen the camshaft cap bolts in three or four steps in the order shown in the figure.



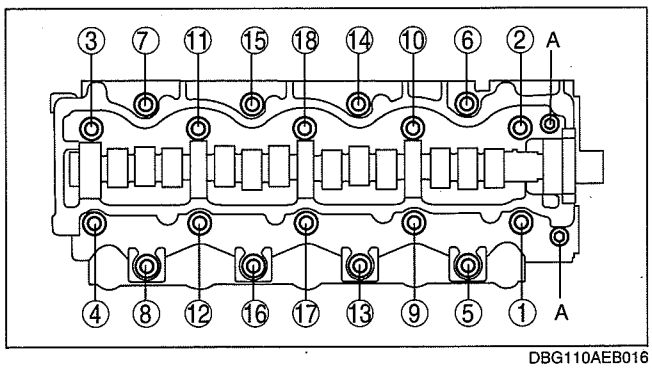
DBG110AEB025

Camshaft Disassembly Note

1. Before removing the camshaft, inspect the camshaft oil clearance. (See 01–10A–21 CAMSHAFT OIL CLEARANCE INSPECTION [WL-3].)

Cylinder Head Disassembly Note

1. Remove bolts A.
2. Loosen the cylinder head bolts in two or three steps in the order shown in the figure.

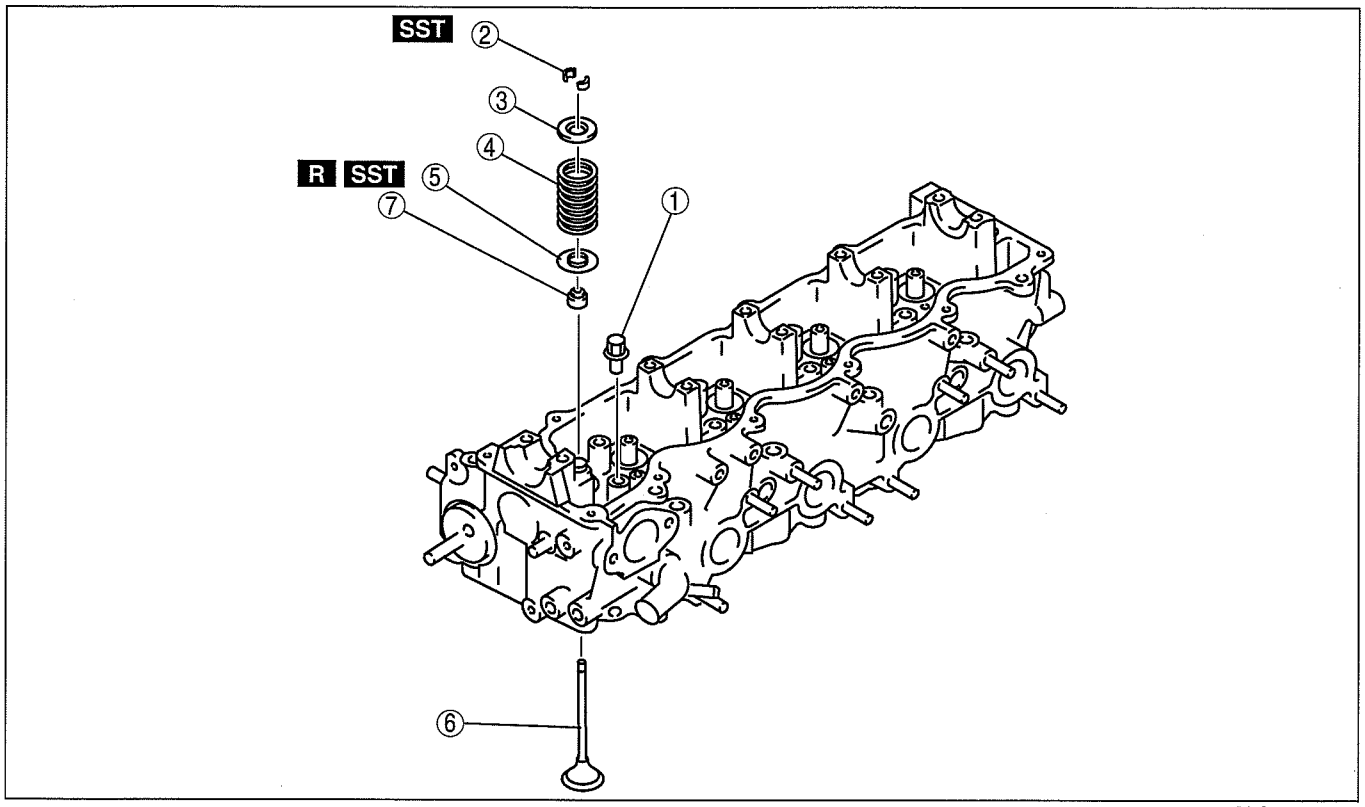


DBG110AEB016

CYLINDER HEAD DISASSEMBLY (II) [WL-3]

DCF011002000W05

1. Disassemble in the order shown in the figure.



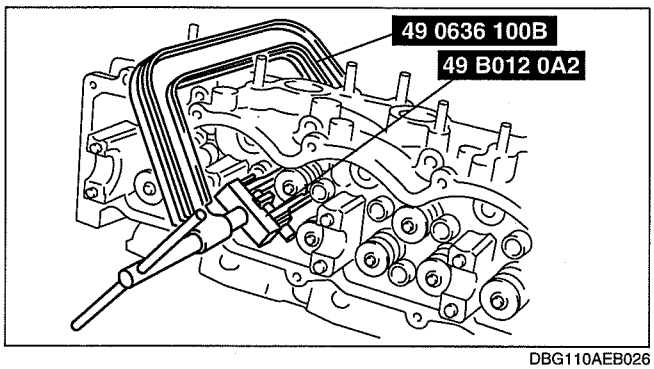
DBG110AEBR24

1	Pivot
2	Valve keeper (See 01–10A–8 Valve Keeper Disassembly Note.)
3	Upper valve spring seat
4	Valve spring

5	Lower valve spring seat
6	Valve
7	Valve seal (See 01–10A–9 Valve Seal Disassembly Note.)

Valve Keeper Disassembly Note

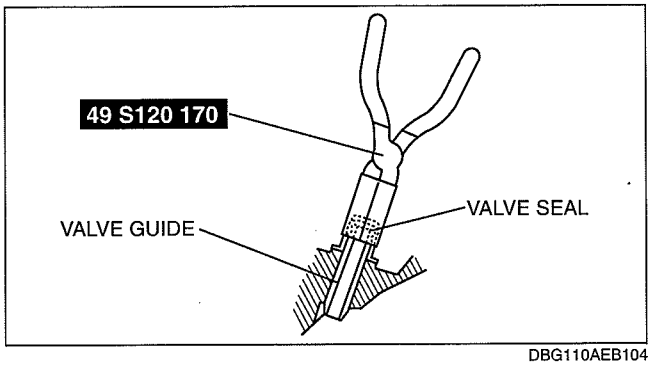
1. Remove the valve keeper using the **SST**.



DBG110AEB026

Valve Seal Disassembly Note

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

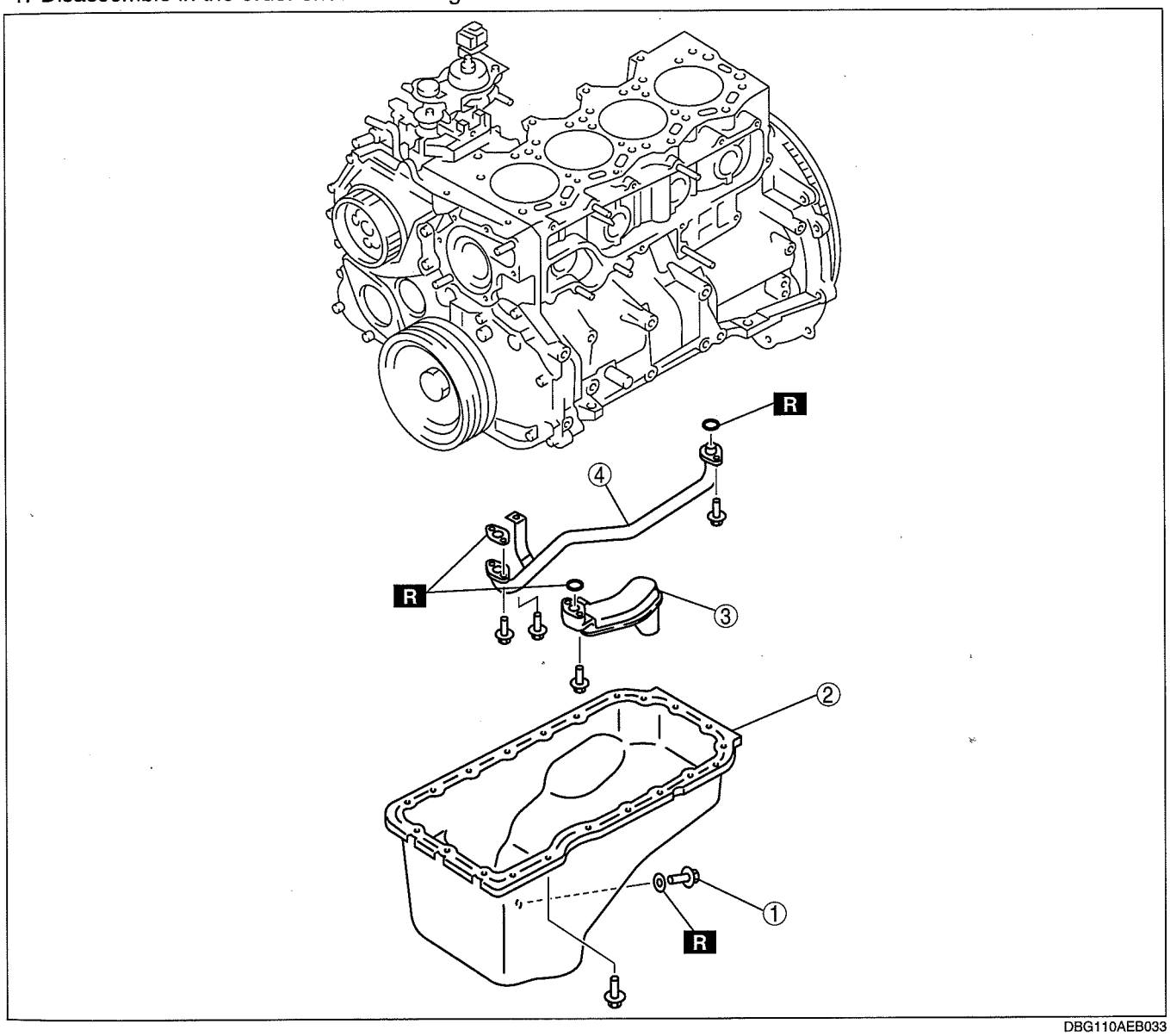


DBG110AEB104

CYLINDER BLOCK DISASSEMBLY (I) [WL-3]

DCF011002000W06

1. Disassemble in the order shown in the figure.



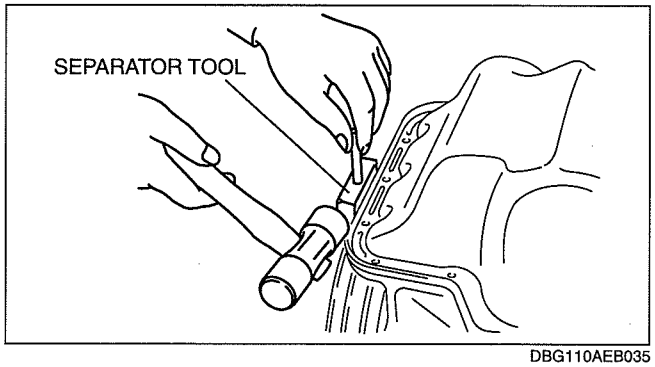
DBG110AEB033

1	Oil drain plug
2	Oil pan (See 01–10A–10 Oil Pan Disassembly Note.)

3	Oil strainer
4	Oil pipe

Oil Pan Disassembly Note

1. Remove the oil pan using a separator tool.

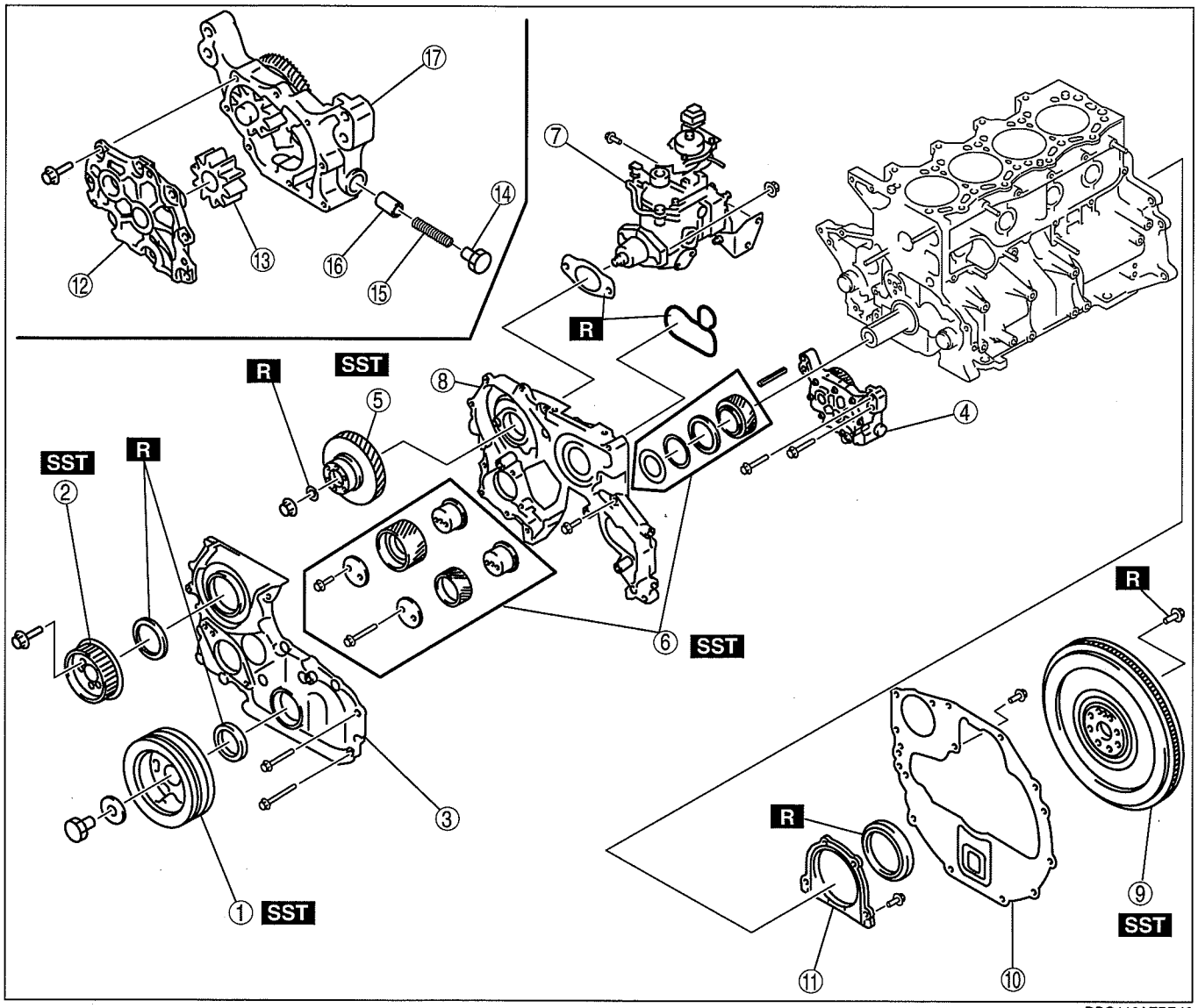


DBG110AEB035

CYLINDER BLOCK DISASSEMBLY (II) [WL-3]

DCF011002000W07

1. Disassemble in the order shown in the figure.



DBG110AEBR40

1	Crankshaft pulley (See 01–10A–11 Crankshaft Pulley Disassembly Note.)
2	Fuel injection pump pulley (See 01–10A–11 Fuel Injection Pump Pulley Disassembly Note.)
3	Timing gear cover (See 01–10A–12 Timing Gear Cover Disassembly Note.)

4	Oil pump
5	Fuel injection pump gear (See 01–10A–12 Fuel Injection Pump Gear Disassembly Note.)
6	Timing gear
7	Fuel injection pump

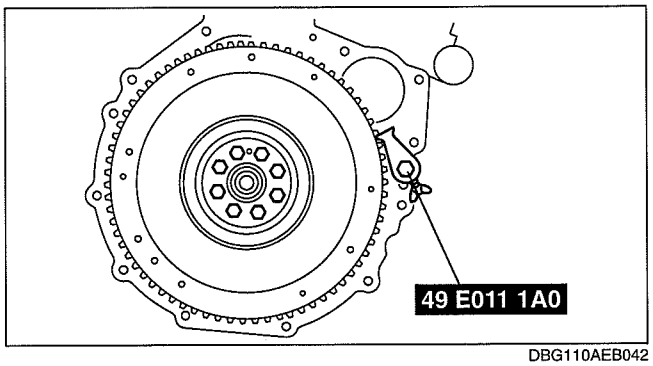
8	Timing gear case (See 01–10A–14 Timing Gear Case Disassembly Note.)
9	Flywheel (See 01–10A–14 Flywheel Disassembly Note.)
10	End plate
11	Rear cover (See 01–10A–14 Rear Cover Disassembly Note.)
12	Oil pump cover
13	Driven gear
14	Plug
15	Plunger spring
16	Control plunger
17	Oil pump body

Crankshaft Pulley Disassembly Note

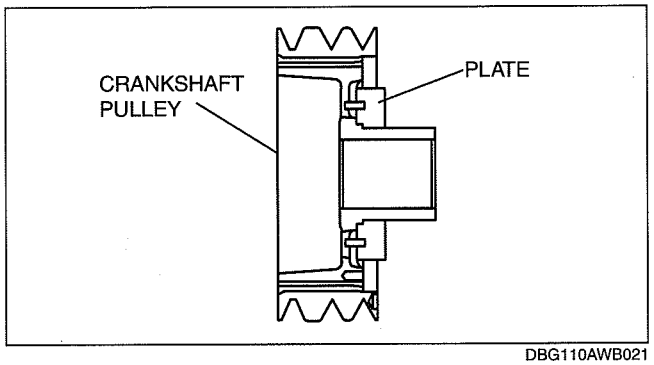
1. Remove the crankshaft pulley using the **SST**.

Caution

- **The CKP sensor plate is a very important part for engine operation control; any deformation of the plate may disable the operation control.**
  When disassembling/assembling the crankshaft pulley, be very careful not to deform the plate by interference with other parts or improper handling.



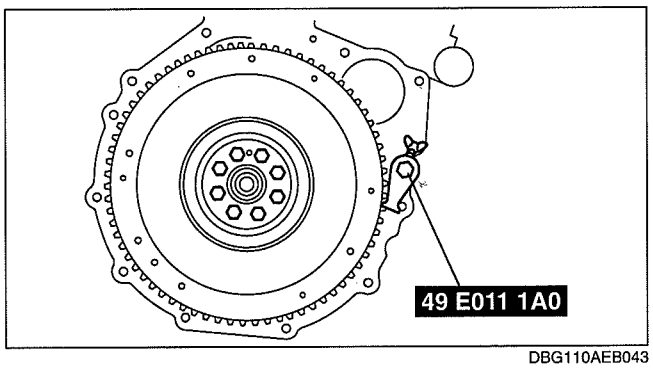
DBG110AEB042



DBG110AWB021

Fuel Injection Pump Pulley Disassembly Note

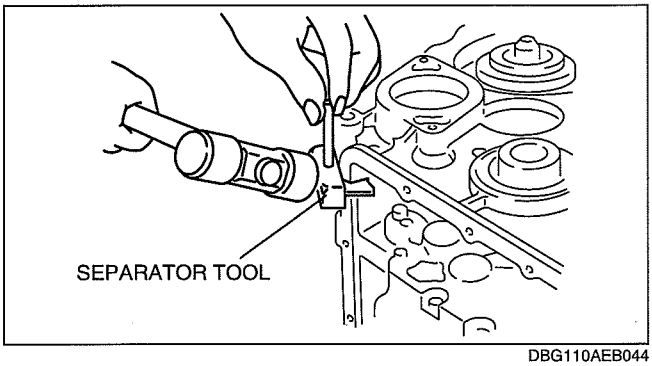
1. Remove the fuel injection pump pulley using the **SST**.



DBG110AEB043

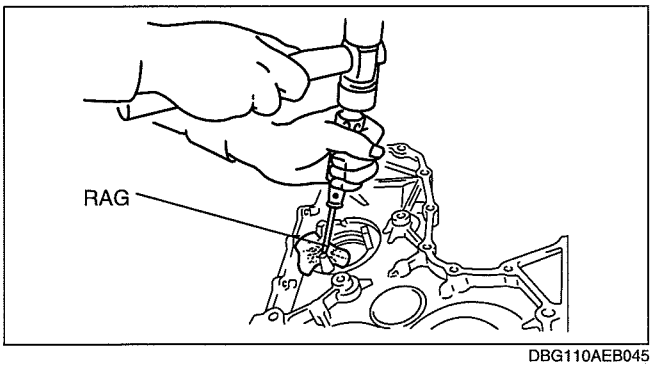
Timing Gear Cover Disassembly Note

1. Remove the timing gear cover using a separator tool.



DBG110AEB044

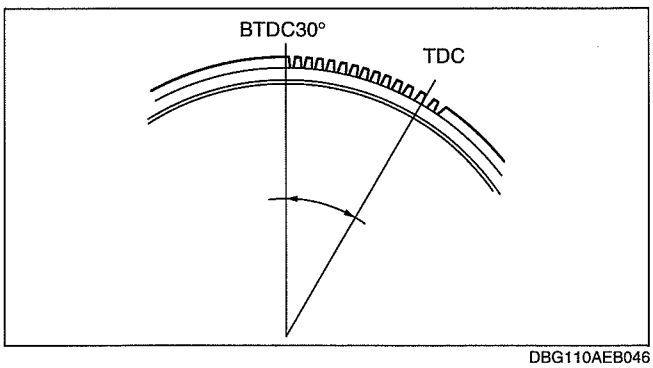
2. Remove the oil seal using a screwdriver protected with a rag.



DBG110AEB045

Fuel Injection Pump Gear Disassembly Note

1. Set the No.1 cylinder to TDC of compression.
2. Rotate the flywheel ring gear from TDC to approximately **30°** BTDC (about 13 teeth on the gear).

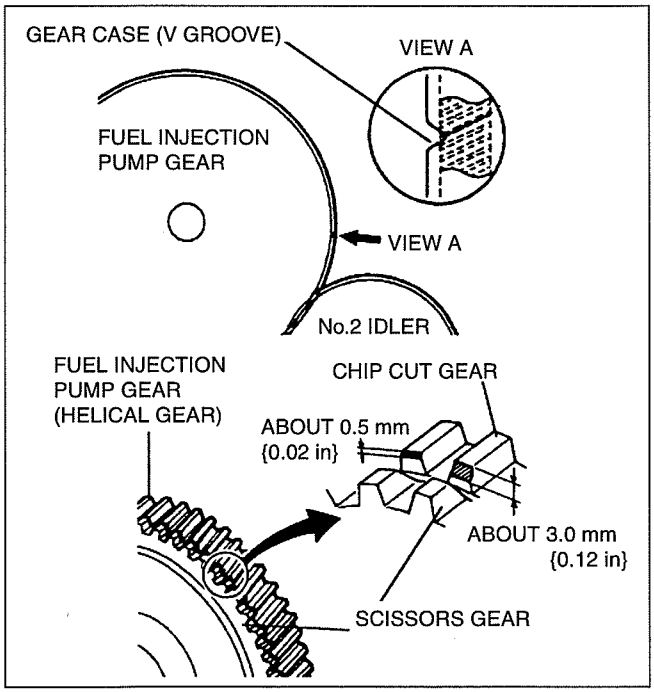


DBG110AEB046

3. Verify that the end-gap (V groove) of the timing gear case and the chip cut gear of the fuel injection pump gear are aligned.

Note

- If the chip cut gear is hard to find, move the fuel injection pump gear on notch back and forth, then check the chip cut gear.



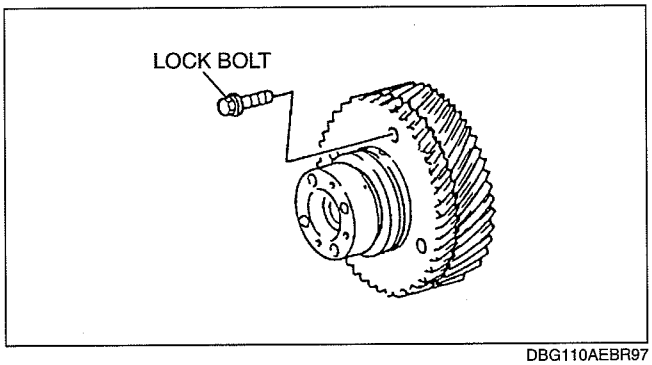
DBG110AEBRR8

4. Fix the scissors gear to the fuel injection pump gear using a lock bolt (**M8×1.25**; length under the bolt head is approximately **14 mm {0.55 in}**).

Warning
- **When removing the fuel injection pump gear, be sure to secure the scissors gear to the fuel injection pump gear using a lock bolt (M8×1.25; length under the bolt head is approximately 14 mm {0.55 in}). Otherwise, the scissors gear will rotate with the spring force, causing personal injury.**

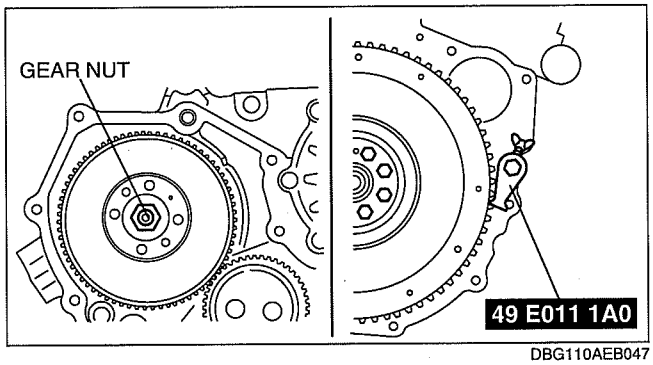
Caution
- **When removing the fuel injection pump gear, be sure to secure the scissors gear to the fuel injection pump gear using a look bolt (M8×1.25; length under the bolt head is approximately 14 mm {0.55 in}) to prevent the scissors gear form rotating with the spring force. Otherwise, the scissors gear will not align with the fuel injection pump gear, and the fuel injection pump gear with the scissors gear will not engage with the idler gear.**

Note
- The fuel injection pump gear with a scissors gear has a lock bolt hole.



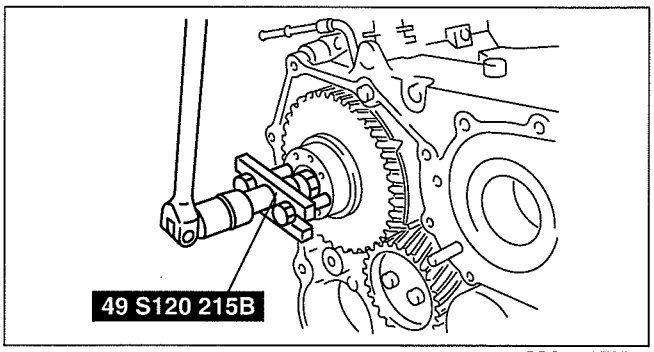
DBG110AEBR97

5. Hold the crankshaft using the **SST** and loosen the gear nut.



DBG110AEB047

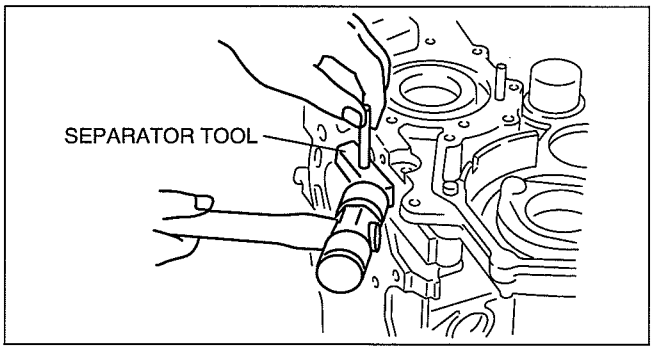
6. Remove the fuel injection pump gear using the **SST**.



DBG110AEBR48

Timing Gear Case Disassembly Note

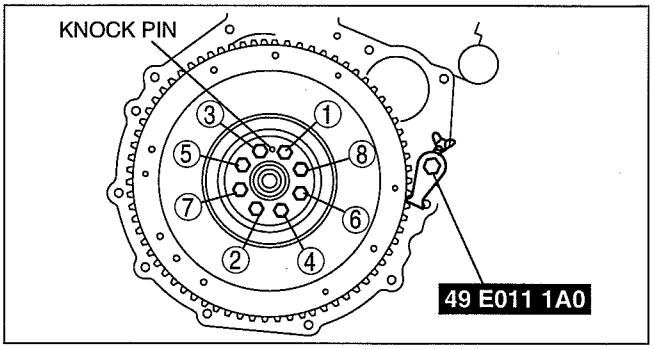
1. Remove the timing gear case using the separator tool.



DBG110AEB050

Flywheel Disassembly Note

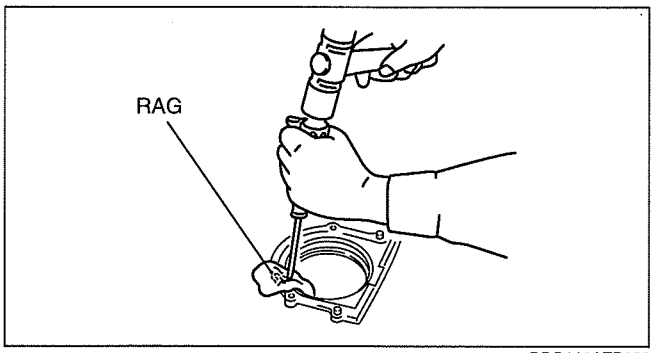
1. Remove the flywheel using the **SST**.



DBG110AEBR56

Rear Cover Disassembly Note

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

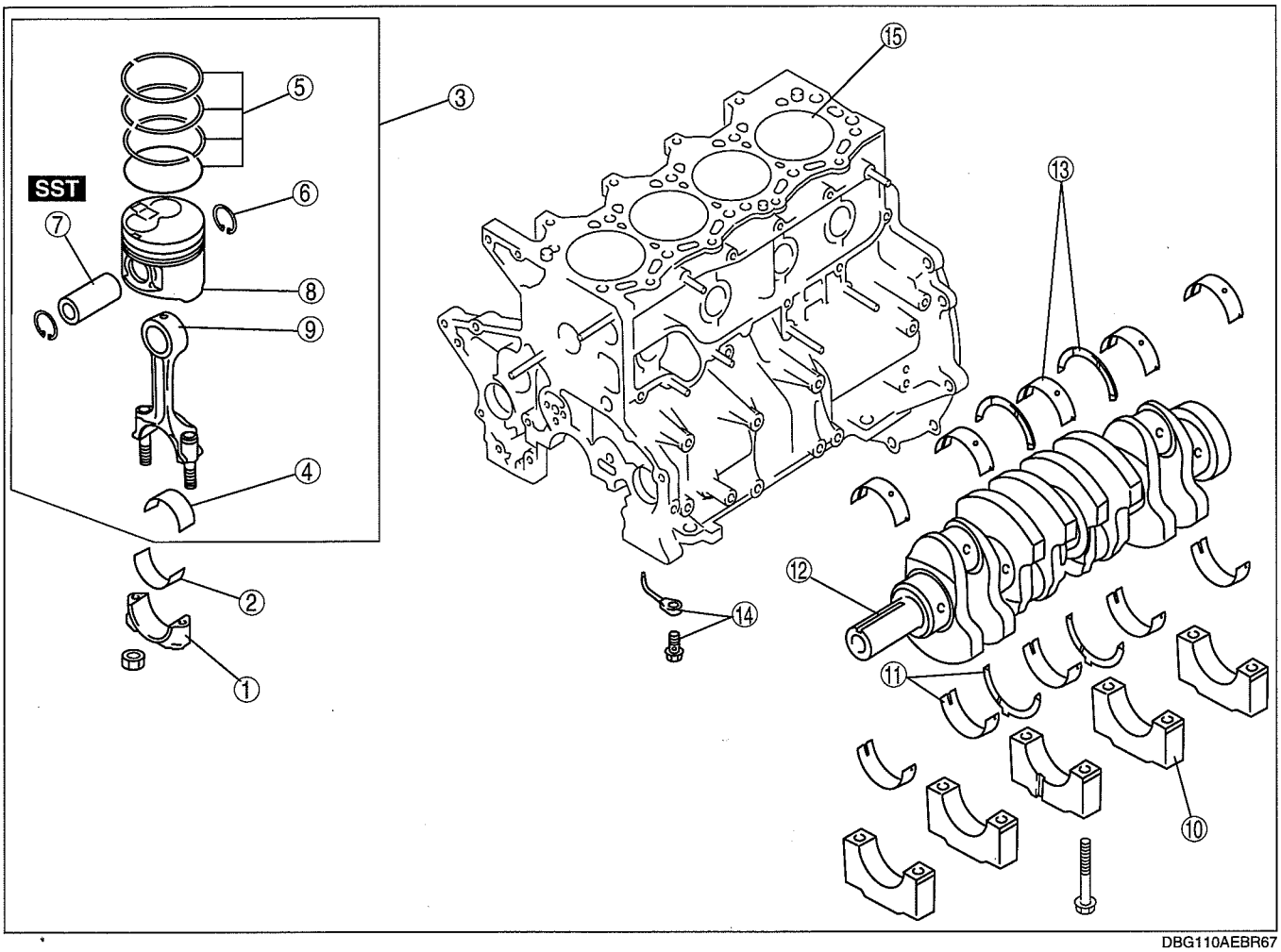


DBG110AEB052

CYLINDER BLOCK DISASSEMBLY (III) [WL-3]

DCF011002000W08

1. Disassemble in the order shown in the figure.



DBG110AEBR67

1	Connecting rod cap (See 01–10A–15 Connecting Rod Cap Disassembly Note.)
2	Lower connecting rod bearing
3	Piston, connecting rod (See 01–10A–15 Piston, Connecting Rod Disassembly Note.)
4	Upper connecting rod bearing
5	Piston ring
6	Piston pin clip
7	Piston pin (See 01–10A–16 Piston Pin Disassembly Note.)

8	Piston
9	Connecting rod
10	Main bearing cap (See 01–10A–16 Main Bearing Cap Disassembly Note.)
11	Lower main bearing, lower thrust bearing
12	Crankshaft (See 01–10A–16 Crankshaft Disassembly Note.)
13	Upper main bearing, upper thrust bearing
14	Oil jet valve, nozzle
15	cylinder block

Connecting Rod Cap Disassembly Note

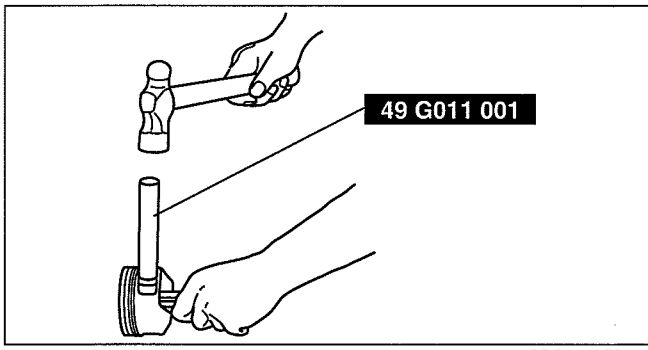
1. Before removing the connecting rod cap, inspect the connecting rod side clearance. (See 01–10A–27 CONNECTING ROD SIDE CLEARANCE INSPECTION [WL-3].)

Piston, Connecting Rod Disassembly Note

1. Before removing the piston and connecting rod, inspect the connecting rod oil clearance. (See 01–10A–27 CONNECTING ROD OIL CLEARANCE INSPECTION/REPAIR [WL-3].)
2. Inspect the oscillation torque. (See 01–10A–28 PISTON AND CONNECTING ROD INSPECTION [WL-3].)

Piston Pin Disassembly Note

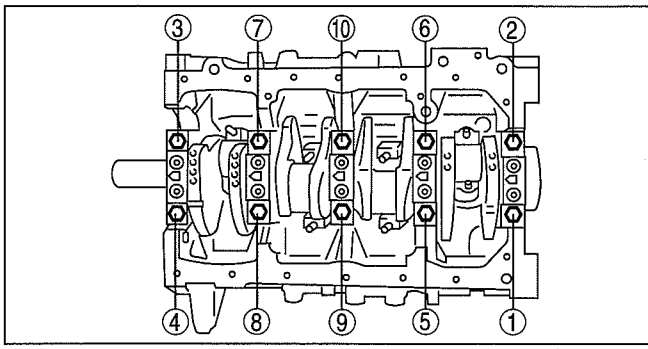
1. Remove the piston pin using the **SST**.



DBG110AEB069

Main Bearing Cap Disassembly Note

1. Before removing the main bearing cap, inspect the crankshaft end play. (See 01–10A–26 CRANKSHAFT END PLAY INSPECTION/REPAIR [WL-3].)
2. Loosen the main bearing cap bolts in two or three steps in the order shown in the figure.



DBG110AEB070

Crankshaft Disassembly Note

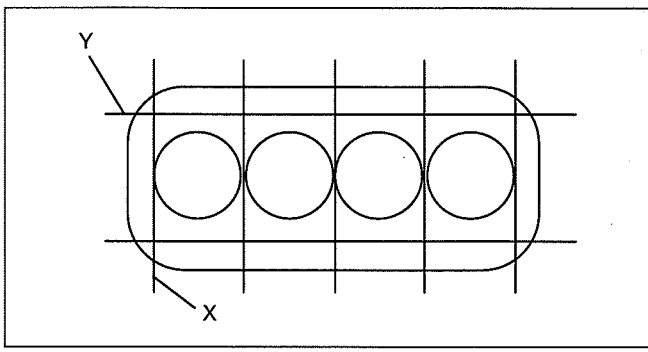
1. Before removing the crankshaft, inspect the main journal oil clearance. (See 01–10A–26 CRANKSHAFT OIL CLEARANCE INSPECTION/REPAIR [WL-3].)

CYLINDER HEAD INSPECTION/REPAIR [WL-3]

DCF011010100W01

1. Inspect the cylinder head surface for cracks. Replace the cylinder head if necessary.
2. Inspect for the following and repair or replace.
   (1) Sunken valve seats
   (2) Excessive camshaft oil clearance and end play
3. Measure the cylinder head for distortion in the seven directions as shown in the figure.

   Maximum cylinder head distortion
   X distortion: 0.02 mm {0.0008 in}
   Y distortion: 0.05 mm {0.0020 in}

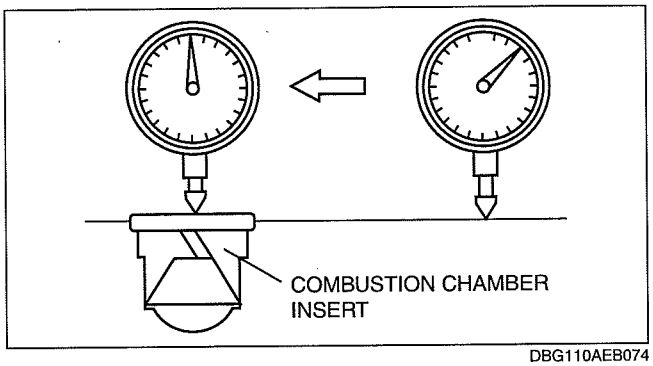


DBG110AEB115

4. Measure the receded or projected amount of combustion chamber insert from the cylinder head surface.
   - If it exceeds the maximum specification, replace the cylinder head.

   Maximum combustion chamber recession
   0.02 mm {0.0008 in}

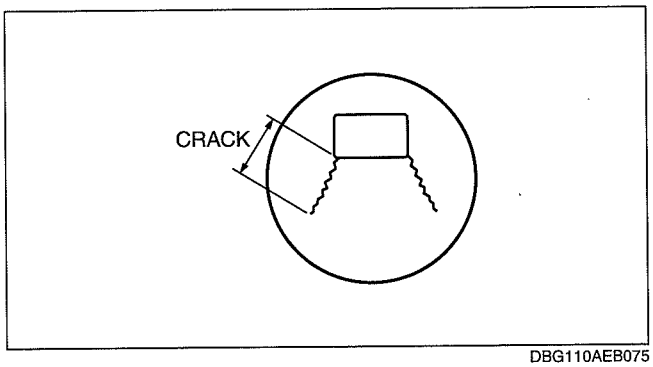
   Maximum combustion chamber projection
   0.005 mm {0.0002 in}



DBG110AEB074

5. Inspect the combustion chamber insert crack.
   - If it exceeds the limit specification, replace the cylinder head.

   Combustion chamber crack
   Limit: 10mm {0.39 in}

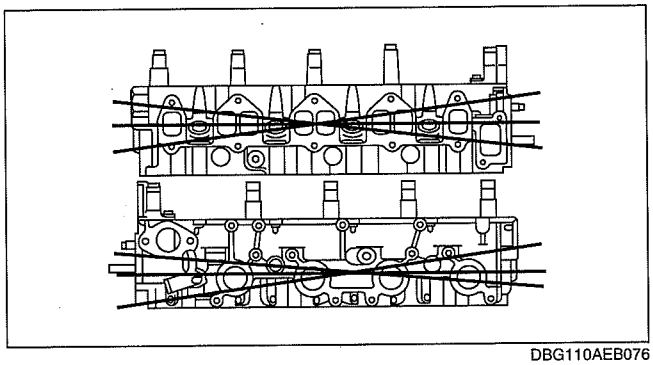


DBG110AEB075

6. Measure the manifold contact surface distortion as shown in the figure.
   - If the distortion exceeds the maximum specification, grind the surface or replace the cylinder head.

   Maximum manifold contact surface distortion
   0.05 mm {0.0020 in}

   Maximum manifold contact surface grinding
   0.15 mm {0.0059 in}



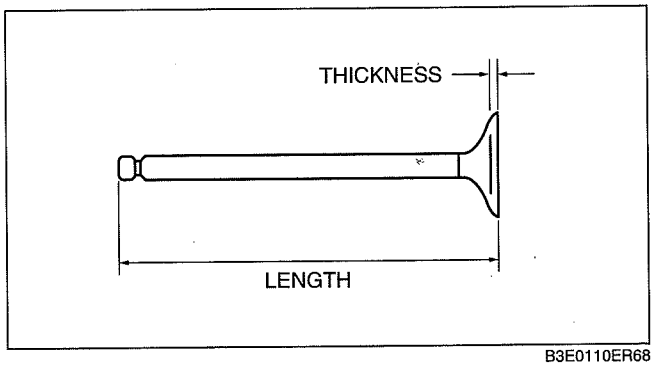
DBG110AEB076

VALVE INSPECTION [WL-3]

DCF011012111W01

1. Measure the valve head margin thickness of each valve.
   - If it exceeds the standard specification, replace the valve.

   Standard valve margin thickness
   IN: 1.5 mm {0.059 in}
   EX: 0.75 mm {0.030 in}



B3E0110ER68

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

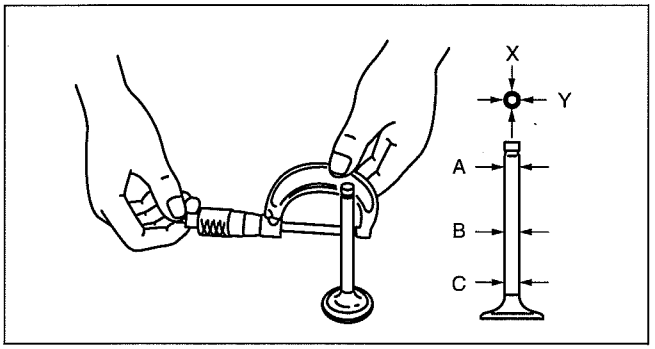
   Standard valve length
   IN: 111.6—112.1 mm {4.394—4.413 in}
   EX: 111.5—112.0 mm {4.390—4.409 in}

   Minimum valve length
   IN: 111.35 mm {4.384 in}
   EX: 111.25 mm {4.380 in}

3. Measure the stem diameter of each valve in the X and Y directions at the three points (A, B, and C) shown in the figure.
   - If it is less than the minimum specification, replace the valve.

   Standard valve stem diameter
   IN: 6.970—6.985 mm {0.2745—0.2749 in}
   EX: 6.965—6.980 mm {0.2743—0.2748 in}

   Minimum valve stem diameter
   IN: 6.920 mm {0.2724 in}
   EX: 6.915 mm {0.2722 in}



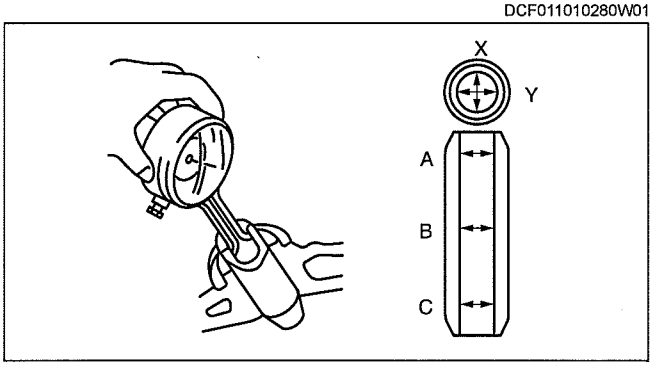
DBG110AEB106

VALVE GUIDE INSPECTION [WL-3]

DCF011010280W01

1. Measure the inner diameter of each valve guide in the X and Y directions at the three points (A, B, and C) shown in the figure.
   - If it is not within the specification, replace the valve guide.

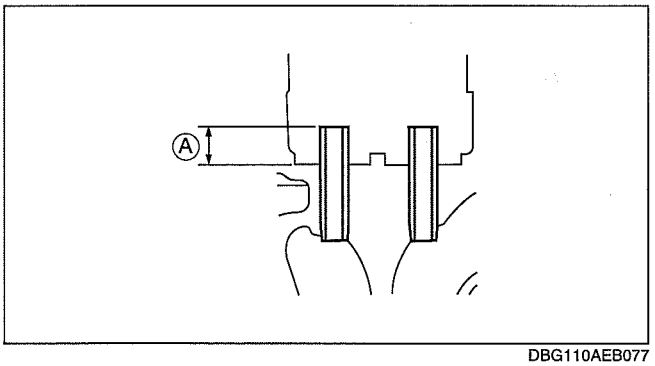
   Standard valve guide inner diameter
   7.025—7.045 mm {0.2766—0.2773 in}



DBG110AEB108

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

   Standard valve guide height
   14.0—14.5 mm {0.552—0.570 in}



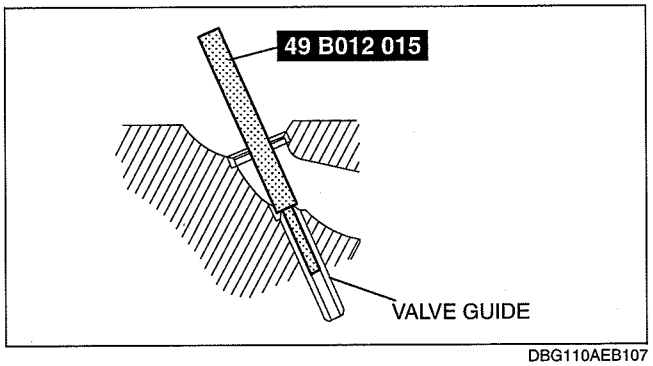
DBG110AEB077

VALVE GUIDE REPLACEMENT [WL-3]

DCF011010280W02

Valve Guide Removal

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

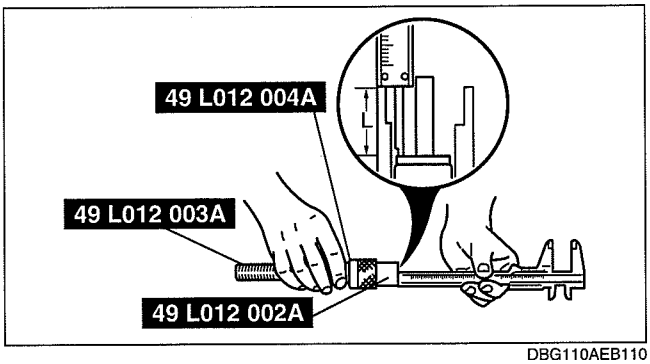


DBG110AEB107

Valve Guide Installation

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

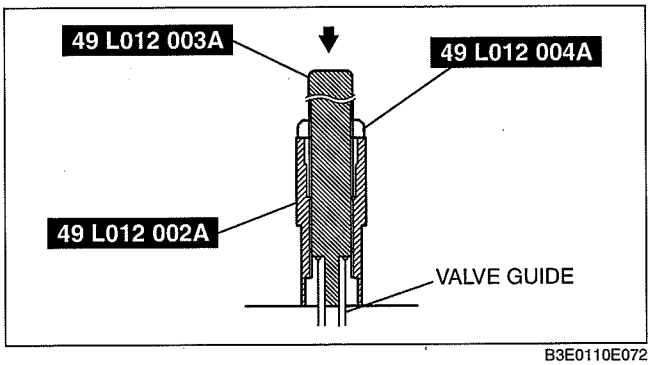
   Depth L
   14.0—14.5 mm {0.552—0.570 in}



DBG110AEB110

2. Tap the valve guide in from the side opposite the combustion chamber until the **SST** contacts the cylinder head.
3. Verify that the valve guide projection height is within the specification.

   Standard valve guide height
   14.0—14.5 mm {0.552—0.570 in}



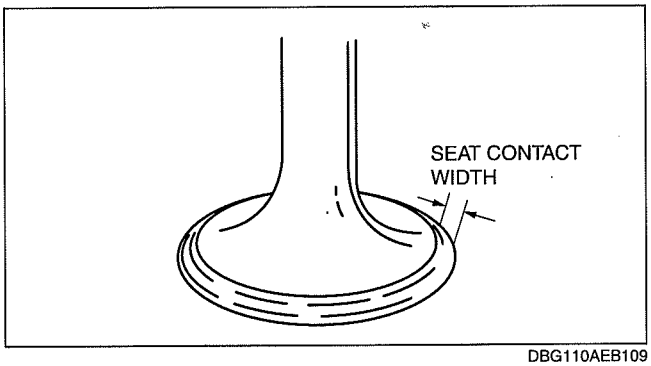
B3E0110E072

VALVE SEAT INSPECTION/REPAIR [WL-3]

DCF011010102W01

1. Measure the seat contact width.
   - If it is not within the specification, resurface the valve seat using the **45°** valve seat cutter.

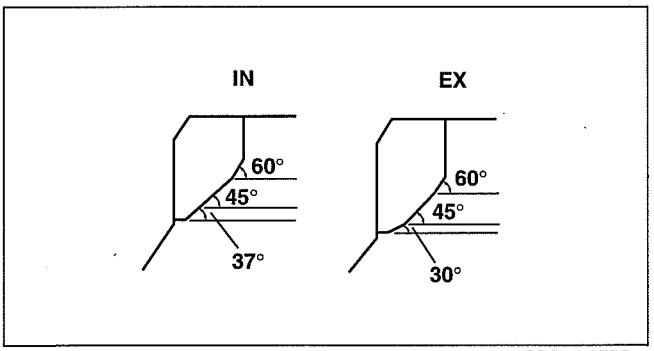
   Standard valve seat contact width
   IN: 1.6—2.2 mm {0.063—0.086 in}
   EX: 1.7—2.3 mm {0.067—0.090 in}



DBG110AEB109

2. Verify that the valve seating position is at the center of the valve face.
   - If the seating position is too high, correct the valve seat using a **60°** cutter, and then a **45°** cutter.
   - If the seating position is too low, correct the valve seat using a **37°** (IN) or **30°** (EX) cutter, and a **45°** cutter.

   Valve seat angle
   IN: 45°
   EX: 45°

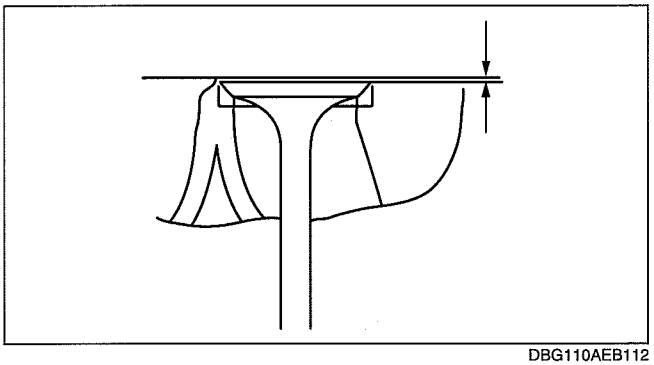


DBG110AEBR75

3. Measure the receded amount from the cylinder head surface.
   - If it exceeds the maximum specification, replace the cylinder head.

   Standard valve recession
   IN: 0.61—1.09 mm {0.025—0.042 in}
   EX: 0.71—1.19 mm {0.028—0.046 in}

   Maximum valve recession
   IN: 1.50 mm {0.059 in}
   EX: 1.60 mm {0.063 in}


DBG110AEB112

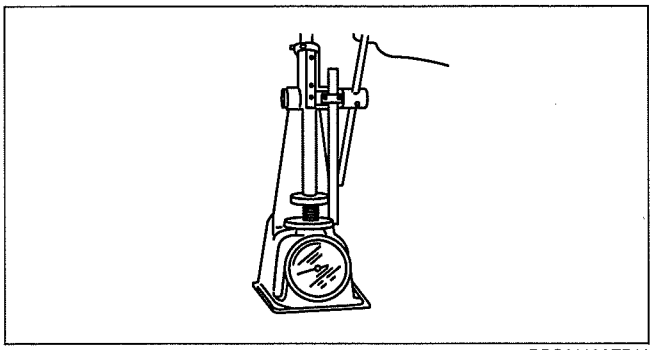
VALVE SPRING INSPECTION [WL-3]

DCF011012125W01

1. Apply a pressing force to the pressure spring and check the spring height.
   - If it is not within the specification, replace the valve spring.

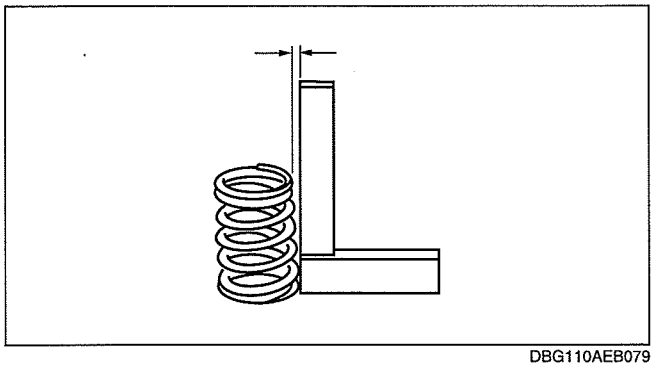
   Valve spring installation pressing force
   238—269 N {25—27 kgf, 54—60 lbf}

   Valve spring installation height
   35.5 mm {1.40 in}


DBG0110AEB11

2. Measure the amount the valve spring is out-of-square.
   - If it exceeds the maximum specification, replace the valve spring.

   Maximum valve spring out-of-square
   2.0° (1.70mm {0.067 in})

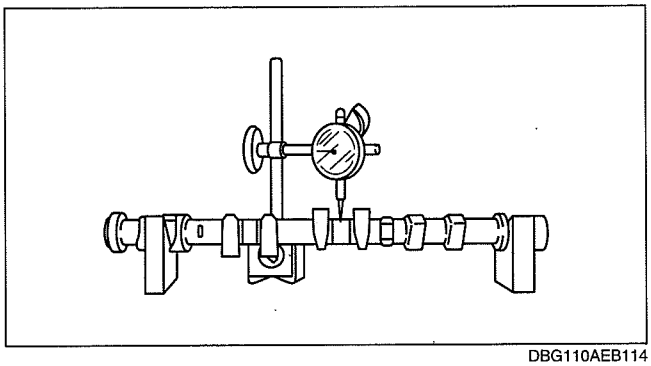

DBG110AEB079

CAMSHAFT INSPECTION [WL-3]

DCF011012420W01

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

Maximum camshaft runout
0.03 mm {0.0012 in}

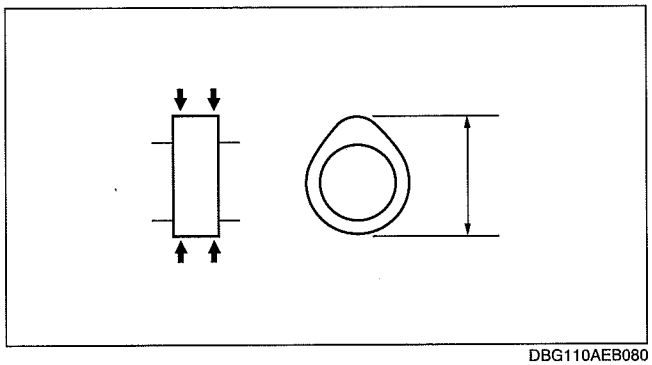


DBG110AEB114

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

Standard cam lobe height
IN: 42.400—42.500 mm {1.6692—1.6732 in}
EX: 42.395—42.495 mm {1.6691—1.6730 in}

Minimum cam lobe height
IN: 42.050 mm {1.6555 in}
EX: 42.045 mm {1.6711 in}

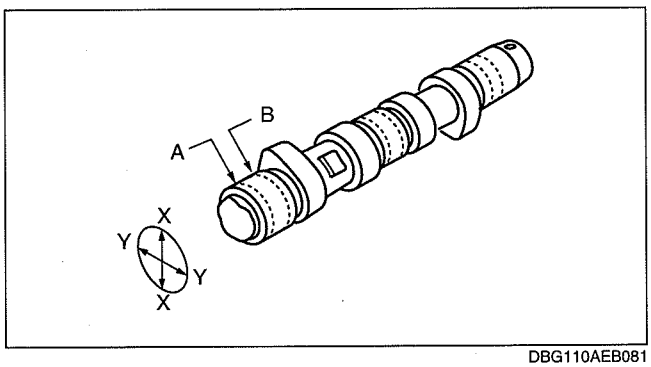


DBG110AEB080

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

Standard cam journal diameter
No.1, No.5: 25.940—25.965 mm {1.0213—1.0222 in}
No.2—No.4: 25.910—25.935 mm {1.0201—1.0210 in}

Minimum cam journal diameter
No.1, No.5: 25.890 mm {1.0193 in}
No.2—No.4: 25.860 mm {1.0181 in}



DBG110AEB081

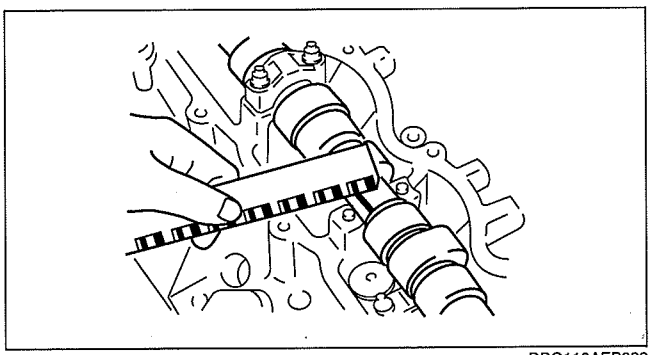
CAMSHAFT OIL CLEARANCE INSPECTION [WL-3]

DCF011012420W02

1. Position a plastigage on top of the journals in the axial direction.
2. Install the camshaft cap. (See 01–10A–49 Camshaft Cap Assembly Note.)
3. Remove the camshaft cap. (See 01–10A–7 Camshaft Cap Disassembly Note.)
4. Measure the oil clearance.
   - If it exceeds the maximum specification, replace the camshaft.

Standard camshaft clearance
No.1, 5: 0.035—0.081 mm {0.0014—0.0031 in}
No.2—4: 0.065—0.111 mm {0.0026—0.0043 in}

Maximum camshaft clearance
No.1, 5: 0.12 mm {0.0047 in}
No.2—4: 0.15 mm {0.0059 in}



DBG110AEB082

CAMSHAFT END PLAY INSPECTION [WL-3]

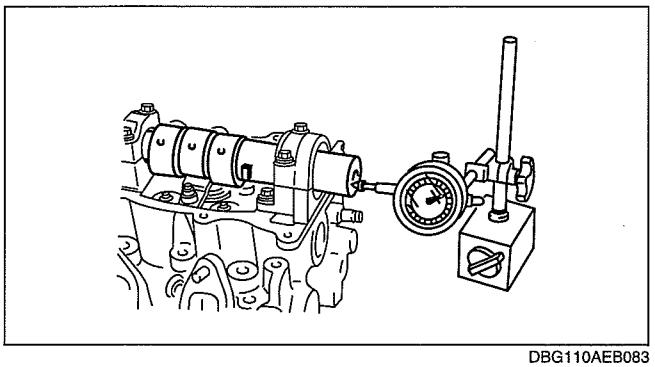
DCF011012420W03

1. Install the camshaft cap. (See 01–10A–49 Camshaft Cap Assembly Note.)
2. Measure the camshaft end play.
   - If it exceeds the maximum specification, replace the cylinder head or camshaft.

Standard camshaft end play
0.030—0.160 mm {0.0012—0.0062 in}

Maximum camshaft end play
0.20 mm {0.0079 in}

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



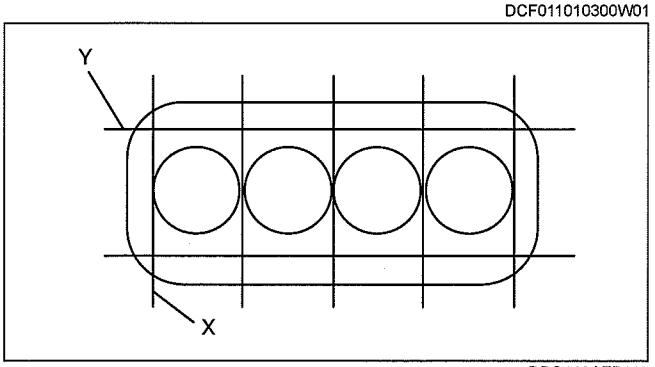
DBG110AEB083

CYLINDER BLOCK INSPECTION/REPAIR [WL-3]

DCF011010300W01

1. Measure the distortion of the cylinder block top surface in the seven directions as shown in the figure.
   - If the distortion exceeds the maximum specification, replace the cylinder head.

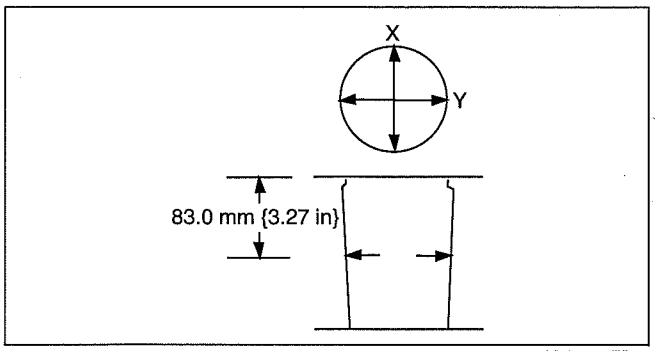
Maximum cylinder block distortion
X direction: 0.02 mm {0.0008 in}
Y direction: 0.05 mm {0.0020 in}



DBG110AEB115

2. Measure the cylinder bore using the cylinder gauge. Measurement positions are in the X and Y directions at **83 mm {3.27 in}** below the top surface of the cylinder.
   - If the cylinder bore exceeds the wear limit, replace the cylinder block or rebore the cylinder and install the oversized pistons so that the specified piston-to-cylinder clearance is obtained.

Note
- Base the boring diameter on the diameter of an oversized piston. All cylinders must be the same diameter.



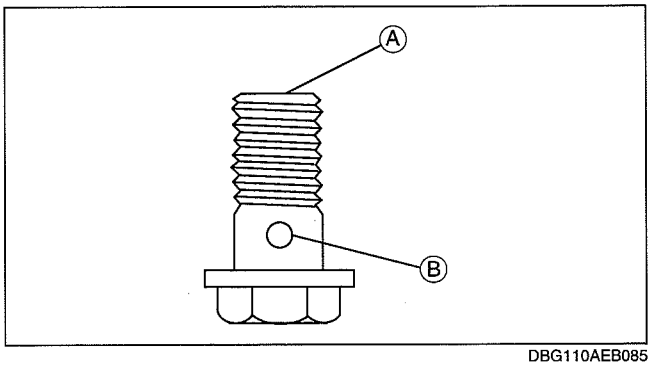
ADA2224ER91

Cylinder bore size
Standard: 93.000—93.022 mm {3.6615—3.6622 in}
0.25 {0.01} oversize: 93.250—93.272 mm {3.6713—3.6721 in}
0.50 {0.02} oversize: 93.500—93.522 mm {3.6811—3.6819 in}

Cylinder bore wear limit
0.15 mm {0.0059 in}

OIL JET VALVE, NOZZLE INSPECTION [WL-3]

DCF011010730W01



DBG110AEB085

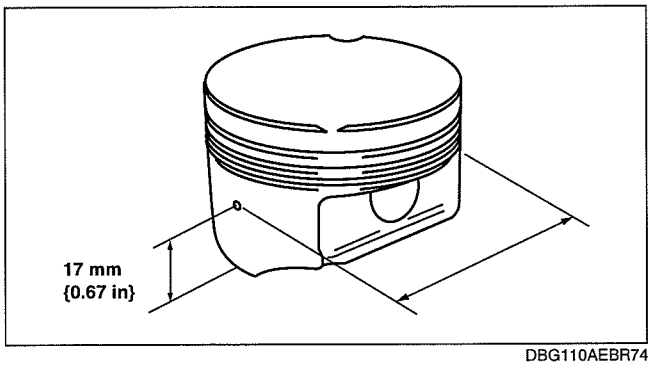
1. Apply compressed air to oil jet valve A and verify that air passes through oil jet valve B.
   - If it is not within the specification, replace the oil jet.

   Oil jet air pressure
   137.6—196.4 kPa {1.5—2.0 kgf/cm^2, 20—28 psi}

2. Check the oil jet nozzle for clogs. Replace the nozzle if necessary.

PISTON INSPECTION [WL-3]

DCF011011010W01



DBG110AEBR74

1. Measure the outer diameter of each piston at right angle (**90°**) to the piston pin, **17 mm {0.67 in}** from the lower end of the piston.
   - If it is not within the specification, replace the piston.

   Piston diameter
   Standard: 92.951—92.977 mm {3.6595—3.6605 in}
   0.25 {0.0098} oversize: 93.186—93.212 mm {3.6688—3.6697 in}
   0.50 {0.02} oversize: 93.436—93.462 mm {3.6786—3.6795 in}

PISTON CLEARANCE INSPECTION/REPAIR [WL-3]

DCF011011010W02

1. Measure the piston-to-cylinder clearance.
   - If it exceeds the maximum specification, replace the piston or rebore the cylinders to fit the oversized piston.

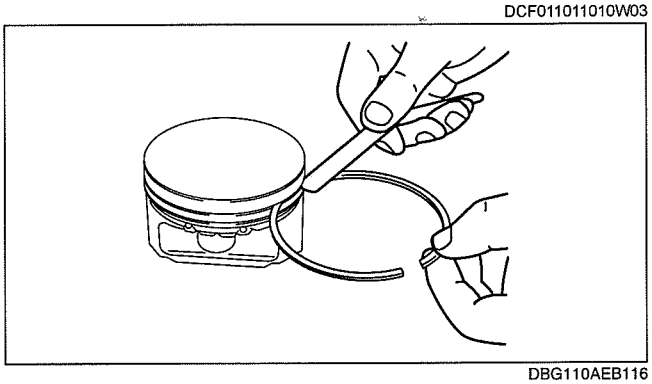
   Standard piston clearance
   0.055—0.073 mm {0.0022—0.0028 in}

   Maximum piston clearance
   0.15 mm {0.0059 in}

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

PISTON RING CLEARANCE INSPECTION [WL-3]

DCF011011010W03



DBG110AEB116

1. Measure the piston ring-to-ring land clearance around the entire circumference.
   - If it exceeds the maximum specification, replace the piston and piston ring.

   Standard piston ring clearance
   Top: 0.06—0.10 mm {0.0024—0.0039 in}
   Second: 0.04—0.08 mm {0.0016—0.0031 in}
   Oil: 0.03—0.07 mm {0.0012—0.0027 in}

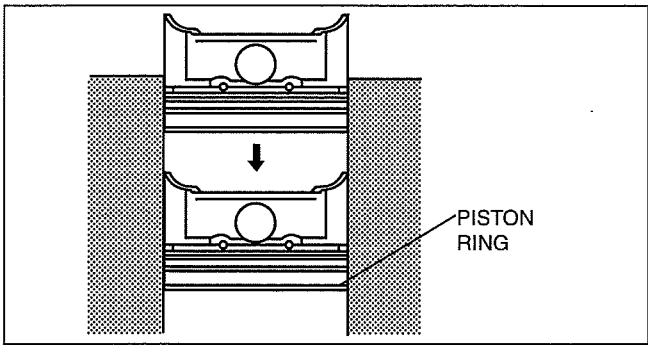
   Maximum piston ring clearance
   0.15 mm {0.0059 in}

2. Insert the piston ring into the cylinder by hand and use the piston to push it to the bottom of the ring travel.

3. Measure each piston ring end gap with a feeler gauge.
   - If it exceeds the maximum specification, replace the piston ring.

   Standard piston ring end gap
   Top: 0.22—0.32 mm {0.0087—0.0125 in}
   Second: 0.32—0.47 mm {0.0126—0.0185 in}
   Oil: 0.22—0.37 mm {0.0087—0.0145 in}

   Maximum piston ring end gap
   1.0 mm {0.039 in}



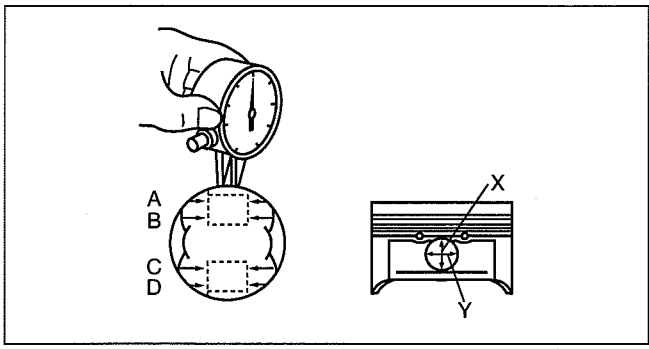
DBG110AEB087

PISTON PIN CLEARANCE INSPECTION [WL-3]

DCF011011010W04

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

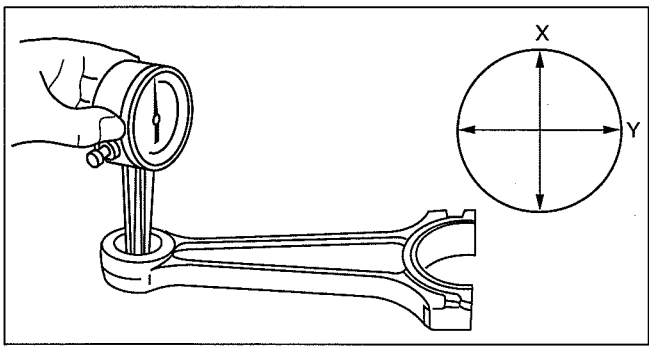
   Standard piston pin bore diameter
   31.997—32.007 mm {1.2598—1.2601 in}



DBG110AEB088

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

   Standard connecting rod small end inner diameter
   32.012—32.033 mm {1.2604—1.2611 in}



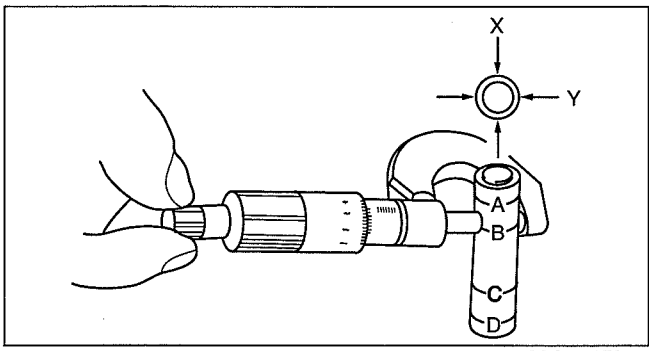
DBG110AEB117

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

   Standard piston pin diameter
   31.994—32.000 mm {1.25961—1.25984 in}

4. Calculate the piston pin-to-piston pin bore clearance.
   - If it is not within the specification, replace the piston or the piston pin.

   Standard piston pin-to-piston pin bore clearance
   –0.003—0.013 mm {–0.00011—0.00051 in}



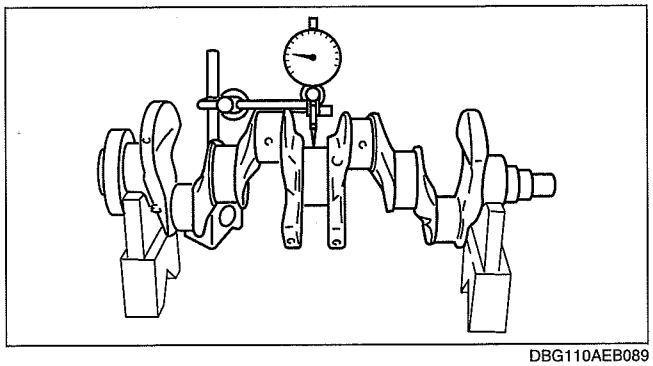
DBG110AEB118

5. Calculate the connecting rod small end-to-piston pin clearance.
   - If it is not within the specification, replace the connecting rod or the piston pin.

   Standard connecting rod small end-to-piston pin clearance
   0.012—0.039 mm {0.00048—0.00153 in}

CRANKSHAFT INSPECTION [WL-3]

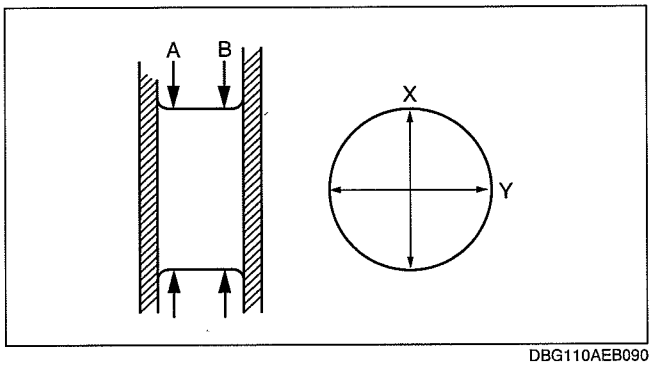
DCF011011301W01



DBG110AEB089

1. Measure the crankshaft runout.
   - If it exceeds the maximum specification, replace the crankshaft.

Maximum crankshaft runout
0.05 mm {0.0020 in}



DBG110AEB090

2. Measure the main journal or crank pin diameter in the X and Y directions at the two points (A and B) as shown in the figure.
   - If it is not within the specification or if it exceeds the maximum off-round, grind the main journal or crank pin with an undersized bearing.

Main journal diameter
Standard
No.1, 2, 4, 5: 66.937—66.955 mm {2.6354—2.6360 in}
No.3: 66.920—66.938 mm {2.6347—2.6353 in}
0.25 {0.01} undersize
No.1, 2, 4, 5: 66.687—66.705 mm {2.6255—2.6261 in}
No.3: 66.670—66.688 mm {2.6248—2.6255 in}
0.50 {0.02} undersize
No.1, 2, 4, 5: 66.437—66.455 mm {2.6157—2.6163 in}
No.3: 66.420—66.438 mm {2.6150—2.6156 in}
0.75 {0.03} undersize
No.1, 2, 4, 5: 66.187—66.205 mm {2.6058—2.6064 in}
No.3: 66.170—66.188 mm {2.6052—2.6058 in}

Main journal wear limit
0.05 mm {0.0020 in}

Main journal out-of-round
0.03 mm {0.0012 in}

Crank pin diameter
Standard: 54.940—54.955 mm {2.1630—2.1635 in}
0.25 {0.01} undersize: 54.690—54.705 mm {2.1532—2.1537 in}
0.50 {0.02} undersize: 54.440—54.455 mm {2.1434—2.1438 in}
0.75 {0.03} undersize: 54.190—54.205 mm {2.1335—2.134 in}

Crank pin wear limit
0.05 mm {0.0020 in}

Crank pin out-of-round
0.03 mm {0.0012 in}

CRANKSHAFT OIL CLEARANCE INSPECTION/REPAIR [WL-3]

DCF011011301W02

1. Position a plastigage on top of the journals in the axial direction.
2. Install the main bearing cap. (See 01–10A–34 Main Bearing Cap Assembly Note.)
3. Remove the main bearing cap. (See 01–10A–16 Main Bearing Cap Disassembly Note.)
4. Measure the main journal oil clearance.
   - If the clearance exceeds the maximum specification, replace the main bearing or grind the main journal and install the undersize bearings so that the specified oil clearance is obtained.

Standard main journal clearance
No.1, 2, 4, 5: 0.027—0.046 mm {0.0011—0.0018 in}
No.3: 0.044—0.063 mm {0.0018—0.0025 in}

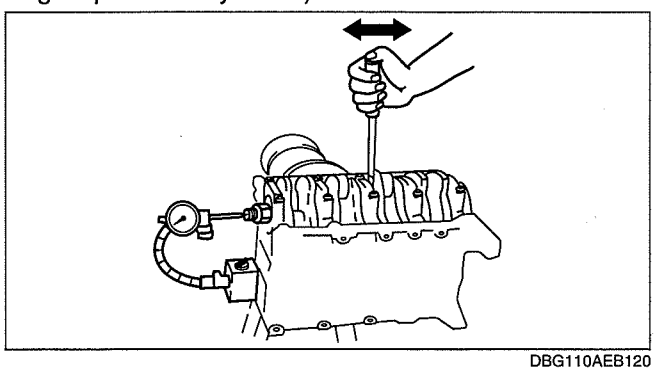
Maximum main journal clearance
0.08 mm {0.0031 in}

Main bearing thickness
Standard: 2.006—2.021 mm {0.0790—0.0795 in}
0.25 {0.01} undersize: 2.124—2.134 mm {0.0837—0.0840 in}
0.50 {0.02} undersize: 2.249—2.259 mm {0.0886—0.0889 in}
0.75 {0.03} undersize: 2.374—2.384 mm {0.0935—0.0938 in}

CRANKSHAFT END PLAY INSPECTION/REPAIR [WL-3]

DCF011011301W03

1. Install the main bearing cap. (See 01–10A–34 Main Bearing Cap Assembly Note.)
2. Measure the crankshaft end play.
   - If the end play exceeds the maximum specification, replace the thrust bearing or grind the crankshaft and install an oversized bearing so that the specified end play is obtained.



DBG110AEB120

Standard crankshaft end play
0.040—0.282 mm {0.0016—0.0111 in}

Maximum crankshaft end play
0.3 mm {0.012 in}

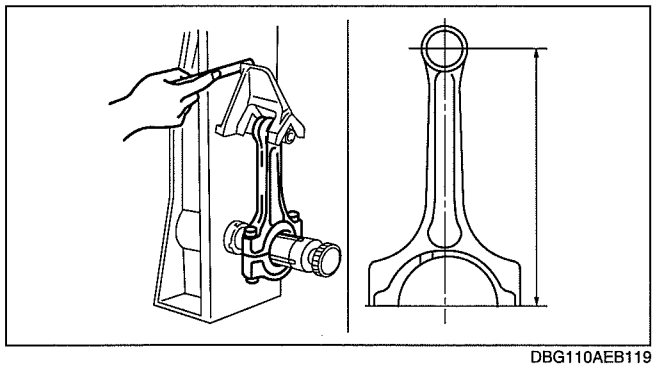
Thrust bearing thickness
Standard: 2.454—2.506 mm {0.0967—0.0986 in}
0.35 {0.014} oversize: 2.629—2.681 mm {0.1036—0.1055 in}

3. Remove the main bearing cap. (See 01–10A–16 Main Bearing Cap Disassembly Note.)

CONNECTING ROD INSPECTION [WL-3]

DCF011011211W01

1. Measure each connecting rod for bending and distortion.
   - If it exceeds the maximum specification, replace the connecting rod.



DBG110AEB119

Maximum connecting rod bending
0.075 mm {0.0030 in} /50 mm {2.0 in}

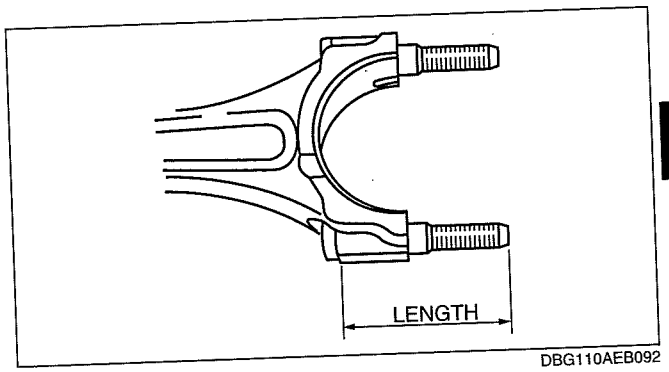
Maximum connecting rod distortion
0.18 mm {0.0071 in} /50 mm {2.0 in}

Connecting rod center-to-center distance
151.96—152.04 mm {5.9827—5.9858 in}

2. Measure the length of the connecting rod bolt.
   - If it exceeds the maximum specification, replace the connecting rod and connecting rod cap.

Standard connecting rod bolt length
67.5—68.5 mm {2.66—2.69 in}

Maximum connecting rod bolt length
69 mm {2.7 in}



DBG110AEB092

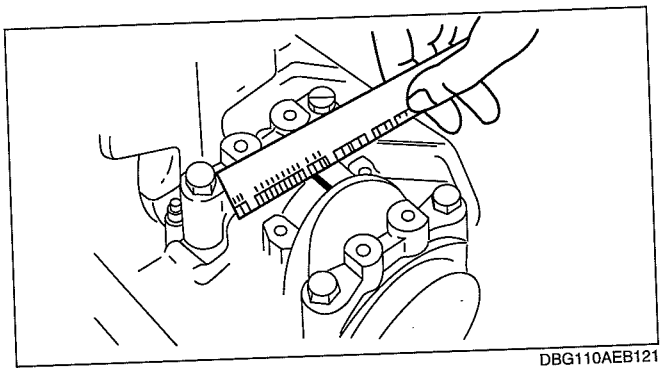
CONNECTING ROD OIL CLEARANCE INSPECTION/REPAIR [WL-3]

DCF011011211W02

1. Position a plastigage on top of the journals in the axial direction.
2. Install the connecting rod cap. (See 01–10A–35 Piston, Connecting Rod Assembly Note.)
3. Remove the connecting rod cap.
4. Measure the crankpin oil clearance.
   - If the clearance exceeds the maximum, replace the connecting rod bearing or grind the crankpin and use undersized bearings so that the specified clearance is obtained.

Standard connecting rod oil clearance
0.025—0.052 mm {0.0010—0.0020 in}

Maximum connecting rod oil clearance
0.08 mm {0.0031 in}


DBG110AEB121

Connecting rod bearing thickness
Standard: 1.507—1.516 mm {0.0594—0.0596 in}
0.25 {0.01} undersize: 1.624—1.634 mm {0.0640—0.0643 in}
0.50 {0.02} undersize: 1.749—1.759 mm {0.0689—0.0692 in}
0.75 {0.03} undersize: 1.874—1.884 mm {0.0738—0.0741 in}

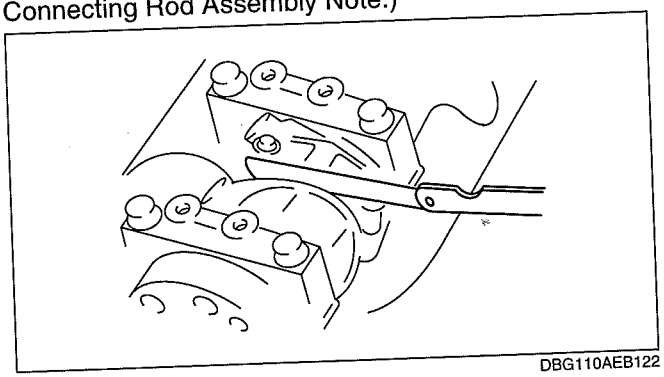
CONNECTING ROD SIDE CLEARANCE INSPECTION [WL-3]

DCF011011211W03

1. Install the connecting rod cap. (See 01–10A–35 Piston, Connecting Rod Assembly Note.)
2. Measure the connecting rod large end side clearance.
   - If it exceeds the maximum specification, replace the connecting rod and connecting rod cap.

Standard connecting rod side clearance
0.110—0.262 mm {0.0044—0.0103 in}

Maximum connecting rod side clearance
0.35 mm {0.014 in}

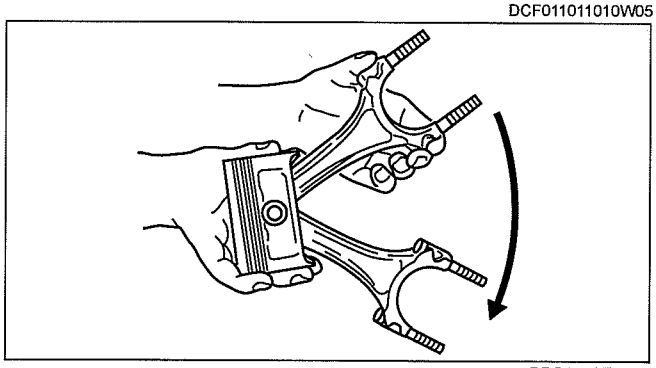

DBG110AEB122

3. Remove the connecting rod cap.

PISTON AND CONNECTING ROD INSPECTION [WL-3]

1. Check the oscillation torque as shown in the figure. If the large end does not drop by its own weight, replace the piston or the piston pin.

DCF011011010W05



DBG110AEB093

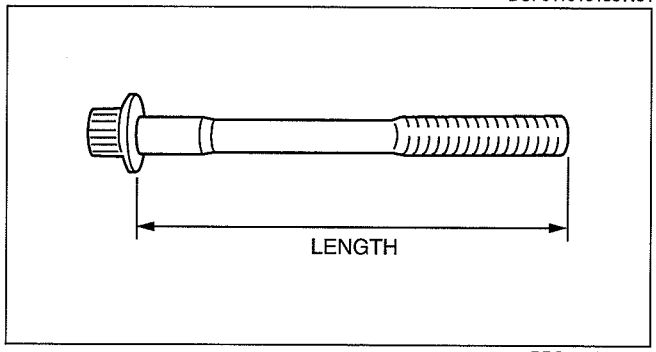
BOLT INSPECTION [WL-3]

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

Cylinder head bolt length
Bolt head mark W
Standard length: 101.2—101.8 mm {3.985—4.007 in}
Maximum length: 102.5 mm {4.035 in}
Bolt head mark N
Standard length: 113.2—113.8 mm {4.457—4.480 in}
Maximum length: 114.5 mm {4.508 in}

Main bearing cap bolt length
Standard length: 84.7—85.3 mm {3.34—3.35 in}
Maximum length: 86.0 mm {3.39 in}

DCF011010135W01



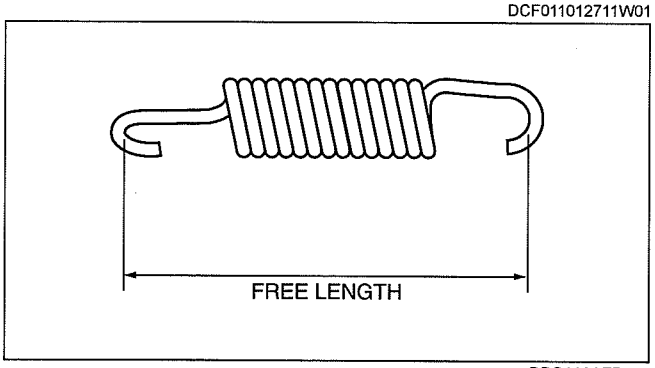
DBG110AEB097

TENSIONER SPRING INSPECTION [WL-3]

1. Measure the free length of the tensioner spring.
   - If it exceeds the standard specification, replace the tensioner spring.

Standard tensioner spring length
63.0 mm {2.48 in}

DCF011012711W01

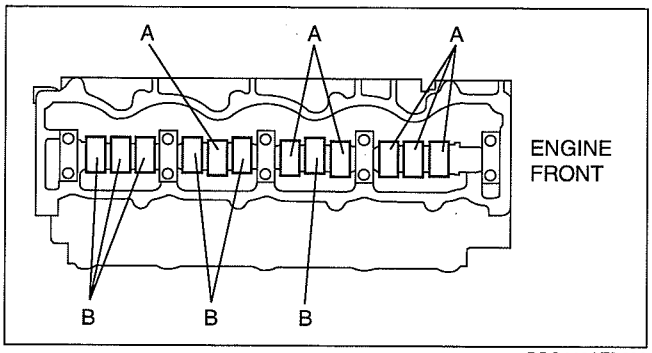


DBG110AEB098

VALVE CLEARANCE INSPECTION [WL-3]

DCF011012111W02

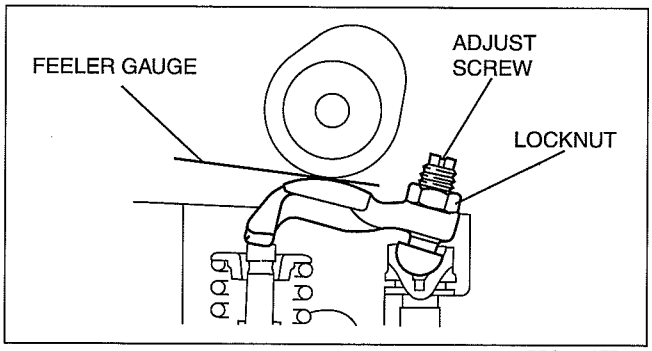
1. Turn the crankshaft and align the timing mark so that the piston of the No.1 or No.4 cylinder is at TDC of compression.
2. Measure valve clearances A with the No.1 cylinder at TDC of compression, and those of B with the No.4 cylinder at TDC of compression.
   - If it is not within the specification, adjust and recheck the valve clearance.



DBG110AEB099

Valve clearance (engine cold)
IN: 0.05—0.15 mm {0.0020—0.0059 in}
EX: 0.15—0.25 mm {0.0060—0.0098 in}

3. Turn the crankshaft one full turn and measure the remaining valve clearances. Adjust if necessary.



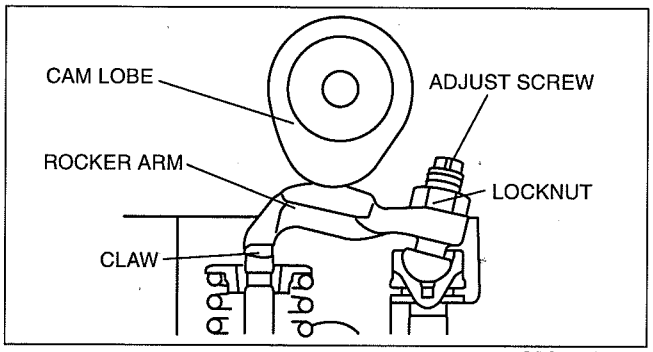
DBG110AEB100

VALVE CLEARANCE ADJUSTMENT [WL-3]

DCF011012111W03

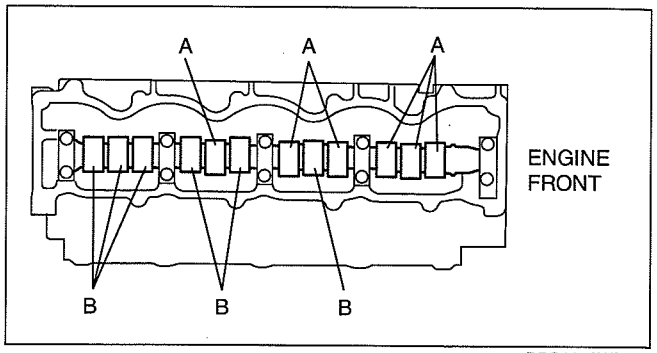
Caution
- **Loosening the locknut and the adjust screw while the cam lobe is not pressing down the rocker arm will damage the claw of the rocker arm. When loosening the locknut and the adjust screw, rotate the crankshaft clockwise and be sure that the cam lobe presses down the rocker arm firmly as shown in the figure.**

1. Remove the cylinder head cover.
2. Turn the crankshaft and align the timing mark so that the piston of the No. 1 or No. 4 cylinders is at TDC of the compression.



DBG110AWB002

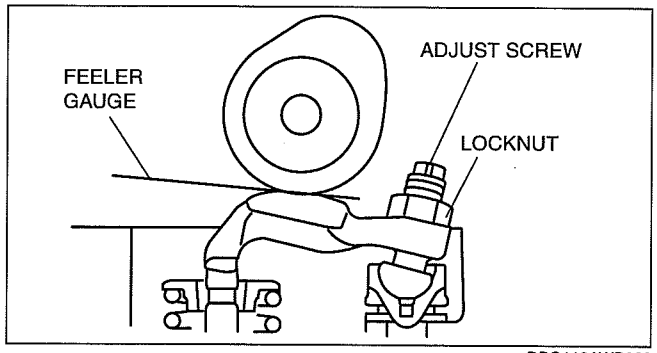
3. Adjust the valve clearances A with the No.1 cylinder at TDC of compression, and those of B with the No.4 cylinder at TDC of compression.



DBG110AWB001

Valve clearance
IN: 0.05 — 0.15 mm {0.0020 — 0.0059 in}
[Engine cold]
0.15 mm {0.0059 in}
[Engine hot (reference)]
EX: 0.15 —0.25 mm {0.0060 — 0.0098 in}
[Engine cold]
0.25 mm {0.0098 in}
[Engine hot (reference)]

Tightening torque (locknut)
16—20 N·m {1.7—2.0 kgf·m, 12—14 ft·lbf}



DBG110AWB003

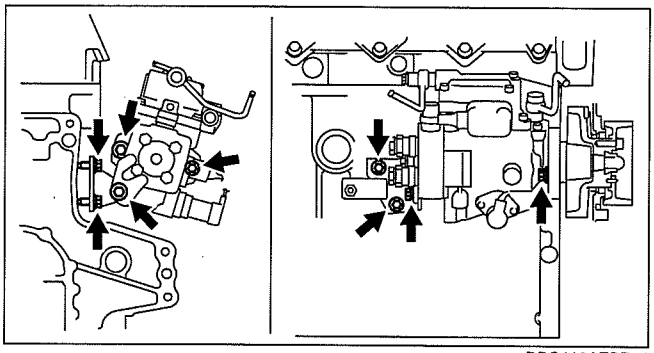
4. Turn the crankshaft one full turn and adjust the remaining valve clearances.

INJECTION TIMING ADJUSTMENT [WL-3]

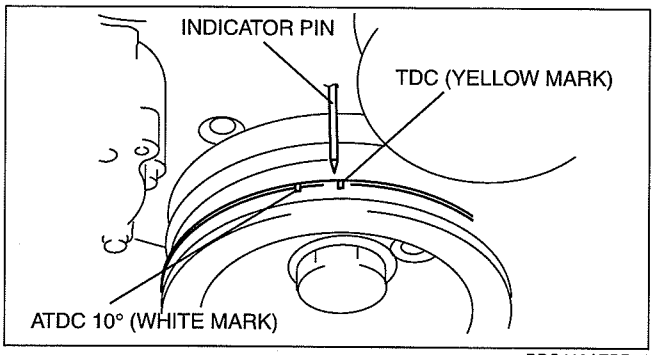
DCF011002000W09

Caution
- **Excessive tension on the timing belt may cause damage to the timing belt and camshaft. If the bolt and nuts of the fuel injection pump are temporarily loosened, re-tension the timing belt.**

1. Loosen the bolts and nuts of the fuel injection pump and bracket.

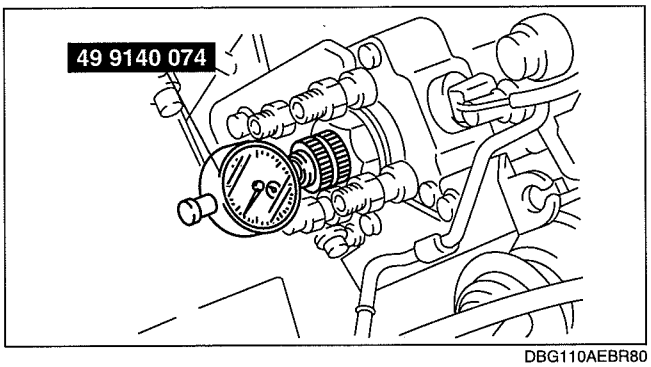

DBG110AEBR76

2. Rotate the crankshaft clockwise and align the crankshaft pulley TDC mark (yellow mark) with the indicator pin.
3. Remove the hydraulic head plug of the fuel injection pump.



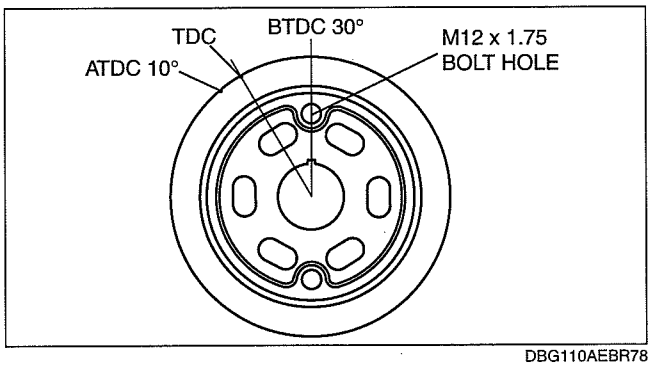
DBG110AEBR81

4. Insert the **SST** into the hydraulic head plug hole and install it so that the dial gauge indicates approx. **2 mm {0.08 in}**.



DBG110AEBR80

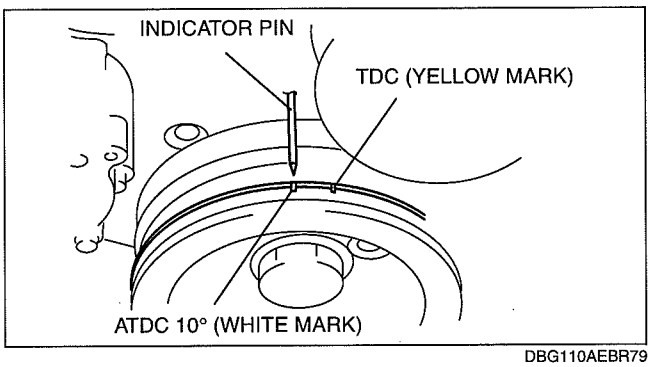
5. Rotate the crankshaft counterclockwise and find the place where the dial gauge needle does not move near approx. **30° BTDC**. (**SST** installation bolt hole of crankshaft pulley and indicator pin align at approx. **30° BTDC**)
6. Set the dial gauge to **0 mm {0 in}**.



DBG110AEBR78

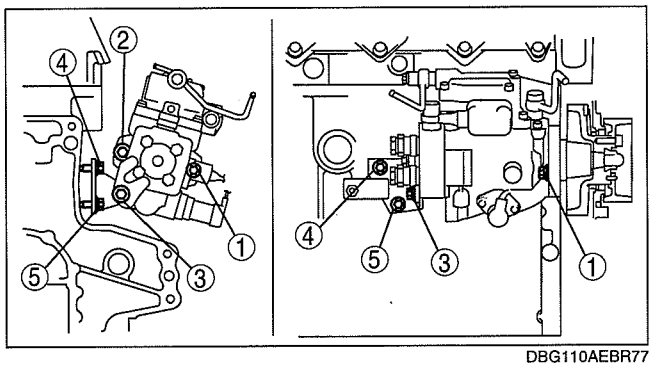
7. Rotate the crankshaft clockwise and read the dial gauge when the **10° ATDC** mark (white mark) of the crankshaft pulley and the indicator pin align.
8. Adjust the dial gauge within the specification.

Fuel injection pump plunger adjustment value
0.95—1.05 mm {0.038—0.041 in}



DBG110AEBR79

9. Tighten the fuel injection pump in the order shown in the figure.
10. Remove the **SST** and install the hydraulic head plug through a new gasket.
11. Re-tension the timing belt.



DBG110AEBR77

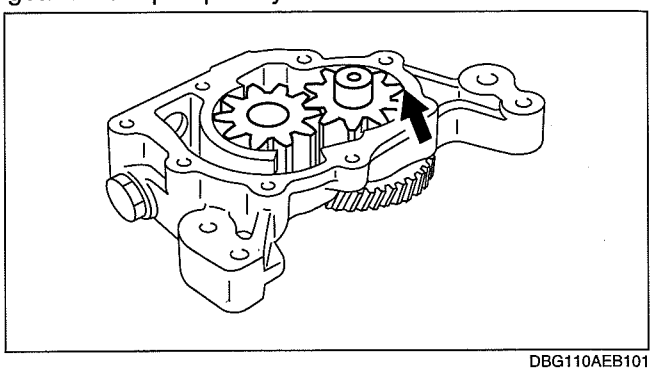
GEAR CLEARANCE INSPECTION [WL-3]

DCF011019220W01

1. Measure the following clearance.
   - If it exceeds the maximum specification, replace the gear and/or pump body.

Standard oil pump tip clearance
0.10—0.19 mm {0.0040—0.0074 in}

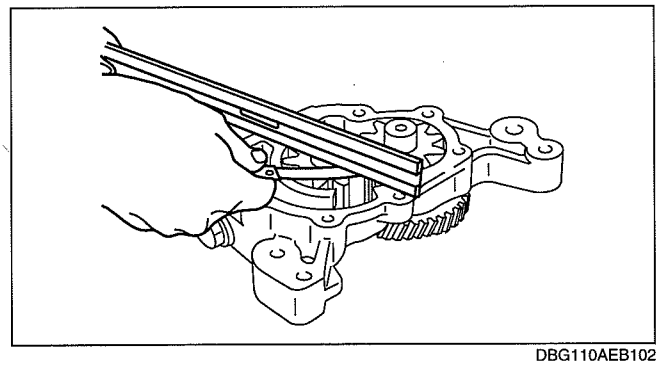
Maximum oil pump tip clearance
0.20 mm {0.0079 in}



DBG110AEB101

Standard oil pump side clearance
0.04—0.09 mm {0.0016—0.0035 in}

Maximum oil pump side clearance
0.15 mm {0.0059 in}



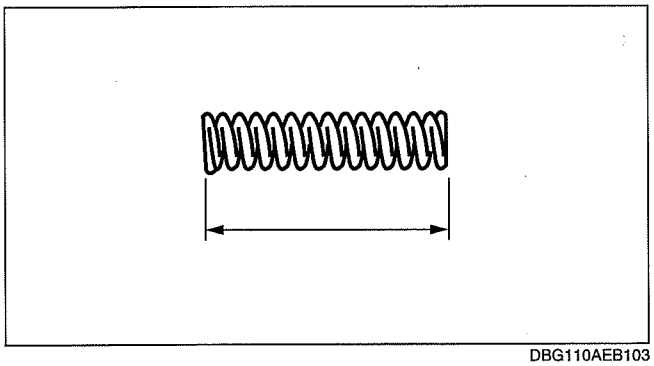
DBG110AEB102

PLUNGER SPRING INSPECTION [WL-3]

DCF011014116W01

1. Measure the free length of plunger spring.
   - If it exceeds the standard specification, replace the plunger spring.

Standard plunger spring length
43.8 mm {1.72 in}

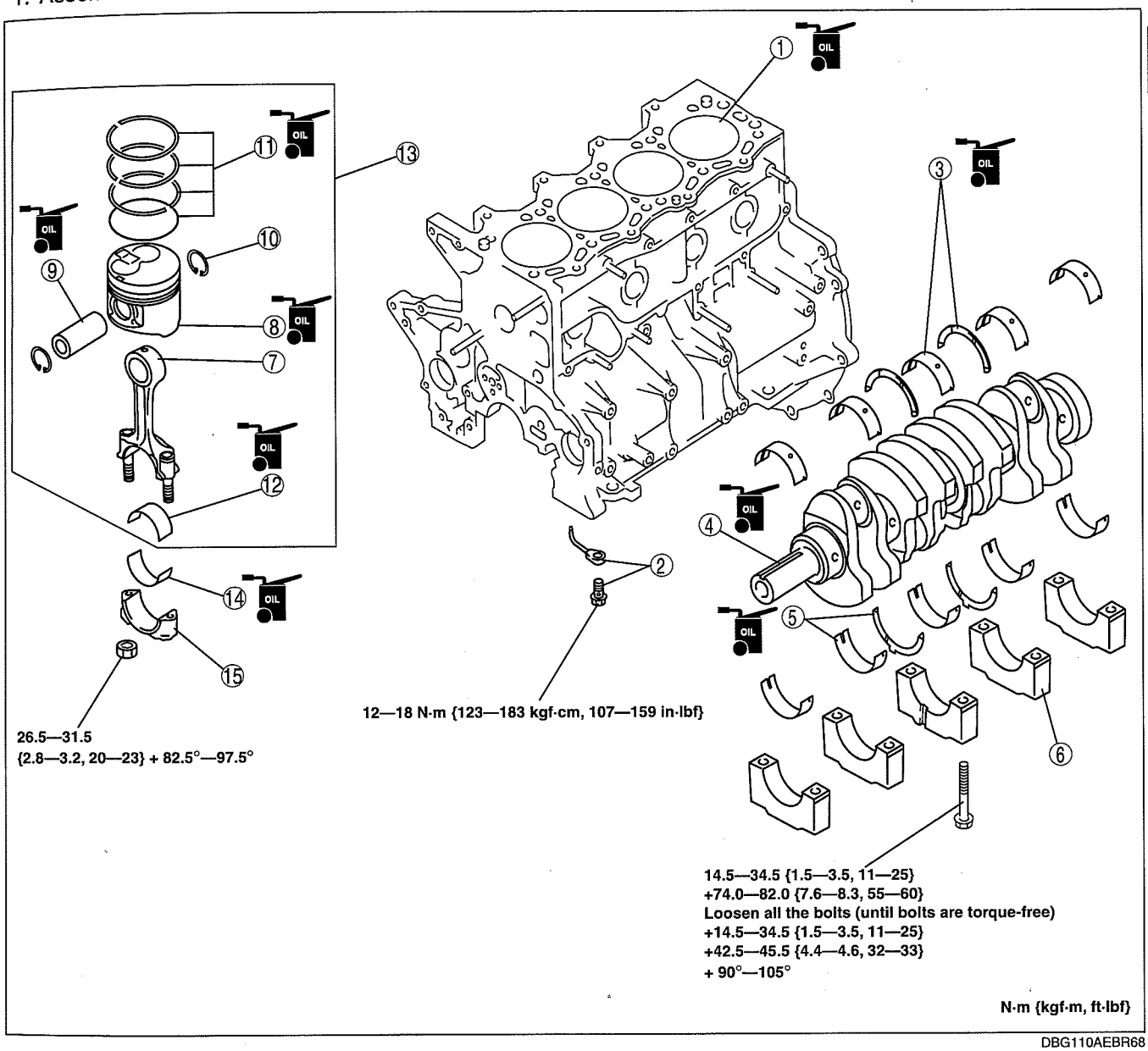


DBG110AEB103

CYLINDER BLOCK ASSEMBLY (I) [WL-3]

DCF011002000W10

1. Assemble in the order indicated in the table.



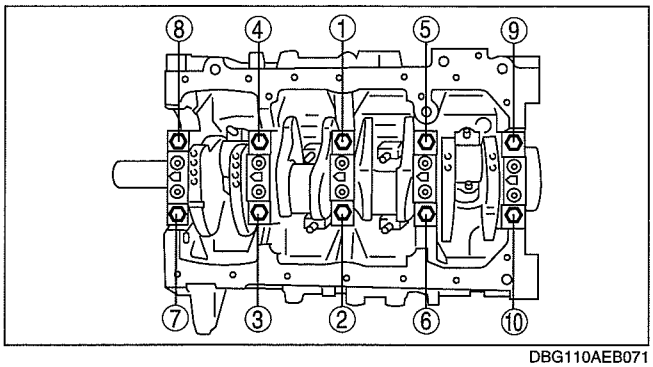
DBG110AEBR68

1	Cylinder block
2	Oil jet valve, nozzle
3	Upper main bearing, upper thrust bearing
4	Crankshaft
5	Lower main bearing, lower thrust bearing
6	Main bearing cap (See 01–10A–34 Main Bearing Cap Assembly Note.)
7	Connecting rod (See 01–10A–34 Piston, Connecting Rod, Piston Pin Assembly Note.)
8	Piston (See 01–10A–34 Piston, Connecting Rod, Piston Pin Assembly Note.)

9	Piston pin (See 01–10A–34 Piston, Connecting Rod, Piston Pin Assembly Note.)
10	Piston pin clip
11	Piston ring (See 01–10A–35 Piston Ring Assembly Note.)
12	Upper connecting rod bearing
13	Piston, connecting rod (See 01–10A–35 Piston, Connecting Rod Assembly Note.)
14	Lower connecting rod bearing
15	Connecting rod cap

Main Bearing Cap Assembly Note

1. Apply clean engine oil to the bolt threads and seat faces of the lower cylinder block bolts.
2. Tighten the bolts in two or three steps in the order shown in the figure.

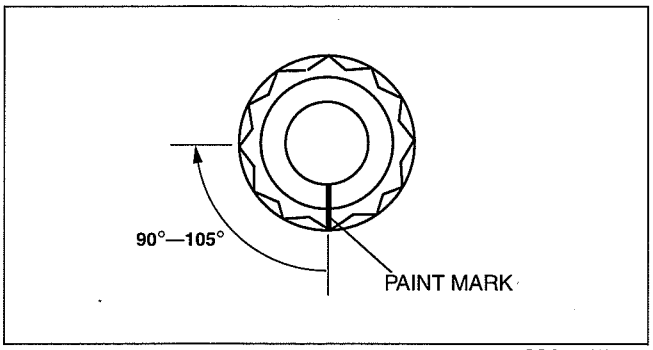


DBG110AEB071

Tightening procedure

(1) 14.5—34.5 N·m {1.5—3.5 kgf·m, 11—25 ft·lbf}
(2) 74.0—82.0 N·m {7.6—8.3 kgf·m, 55—60 ft·lbf}
(3) Loosen all the bolts (until bolts are torque-free).
(4) 14.5—34.5 N·m {1.5—3.5 kgf·m, 11—25 ft·lbf}
(5) 42.5—45.5 N·m {4.4—4.6 kgf·m, 32—33 ft·lbf}

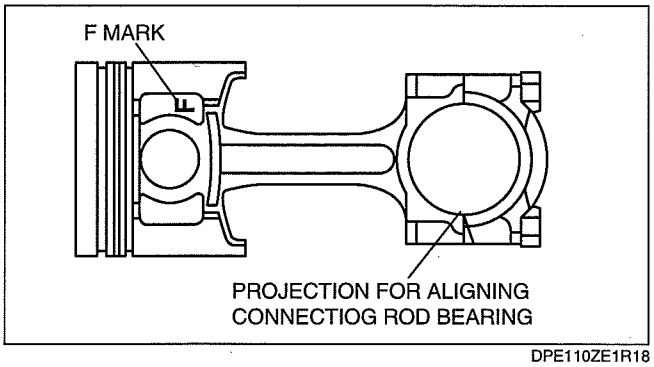
3. Put a paint mark on each bolt head.
4. Using the marks as a reference, tighten the bolts by turning each **90°—105°** as in Step 2.



DBG110AEBR72

Piston, Connecting Rod, Piston Pin Assembly Note

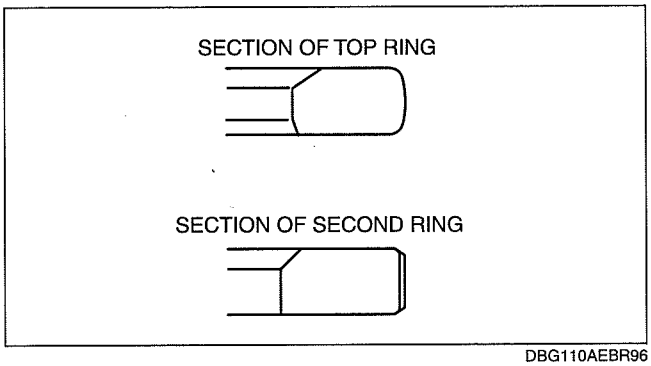
1. Install one piston pin clip.
2. Assemble the piston and connecting rod in the direction indicated in the figure.
3. Apply clean engine oil to the piston pin.
4. Install the piston pin until the pin contacts the clip as shown. If the pin cannot be installed easily, heat the piston.



DPE110ZE1R18

Piston Ring Assembly Note

1. Install the oil ring.
2. Install the second ring with tapered face side upward.
3. Install the top ring with tapered face side upward.



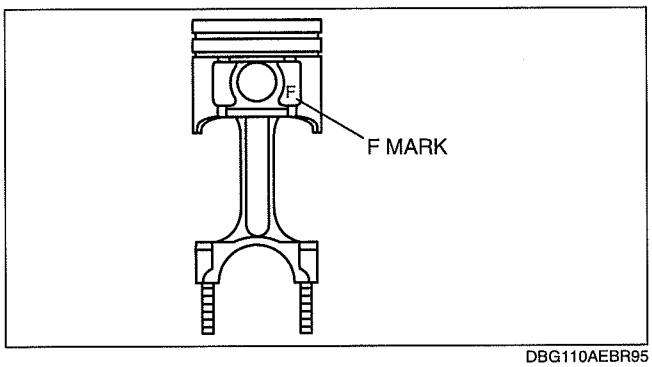
DBG110AEBR96

Piston, Connecting Rod Assembly Note

1. Insert the piston and connecting rod assembly into the cylinder with the F mark facing the front of the engine.
2. Tighten the connecting rod cap nuts in two or three steps.

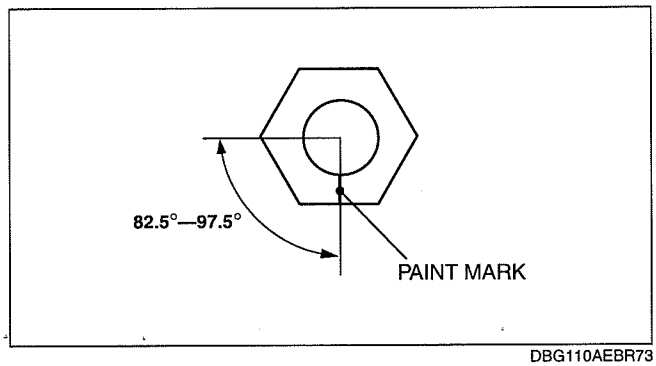
   Tightening torque
   26.5—31.5 N·m {2.8—3.2 kgf·m, 20—23 ft·lbf}

3. Put a paint mark on each nut.



DBG110AEBR95

4. Using the marks as a reference, tighten the nuts by turning each **82.5°—97.5°**

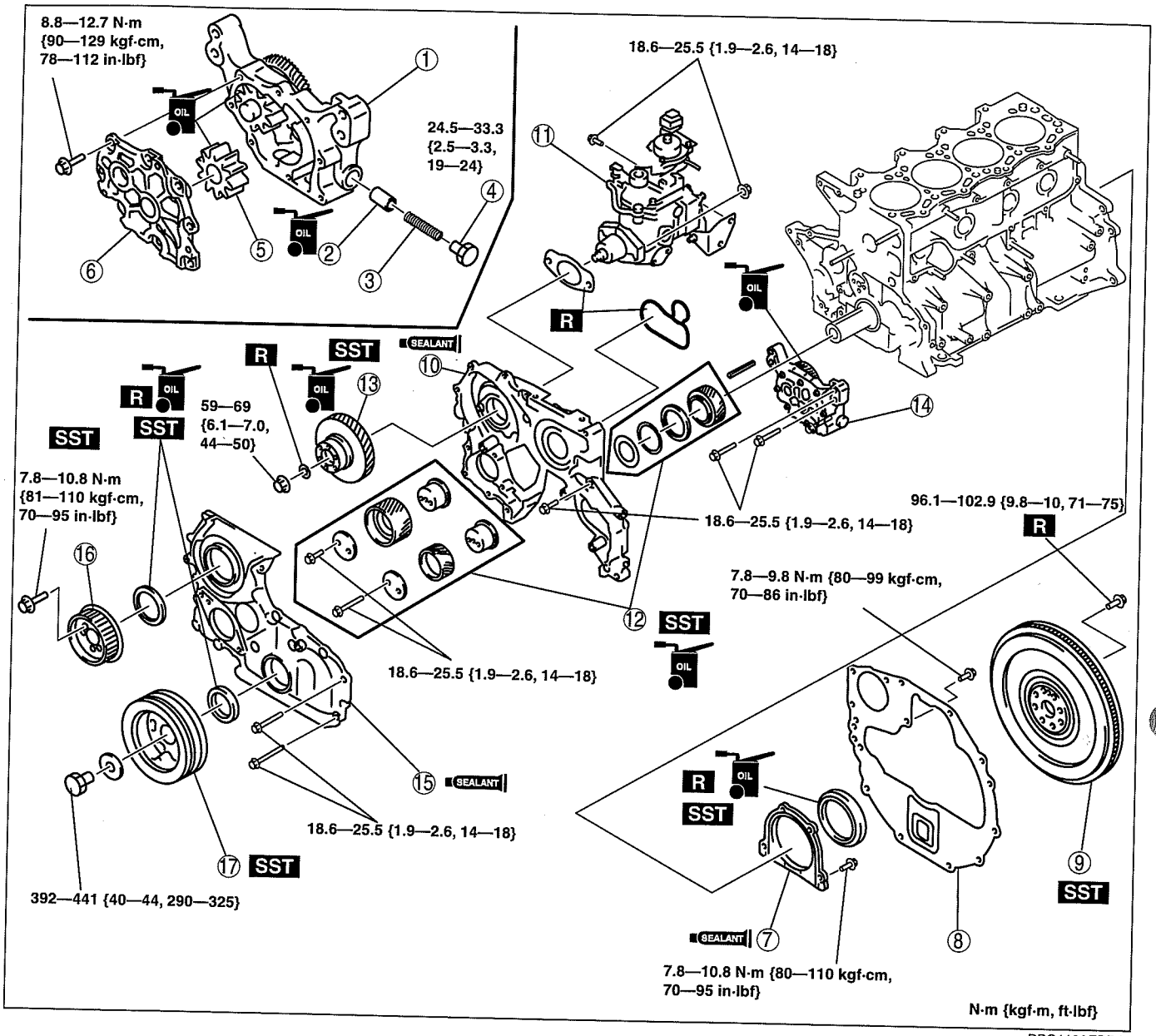


DBG110AEBR73

CYLINDER BLOCK ASSEMBLY (II) [WL-3]

1. Assemble in the order indicated in the table.

DCF011002000W11



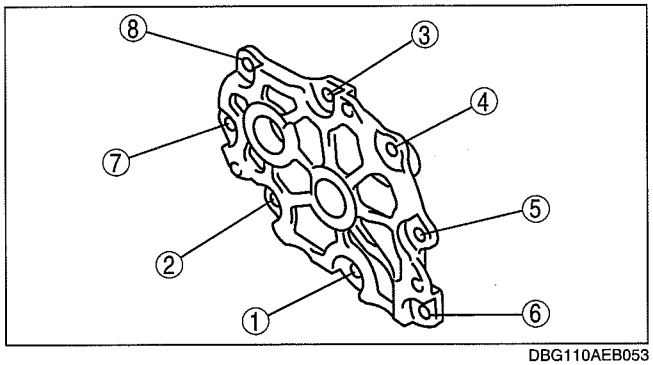
DBG110AEBR41

1	Oil pump body
2	Control plunger
3	Plunger spring
4	Plug
5	Driven gear
6	Oil pump cover (See 01–10A–37 Oil Pump Cover Assembly Note.)
7	Rear cover, end plate (See 01–10A–37 Rear Cover, End Plate Assembly Note.)
8	End plate (See 01–10A–37 Rear Cover, End Plate Assembly Note.)
9	Flywheel (See 01–10A–38 Flywheel Assembly Note.)
10	Timing gear case (See 01–10A–38 Timing Gear Case Assembly Note.)

11	Fuel injection pump
12	Timing gear (See 01–10A–38 Timing Gear, Fuel Injection Pump Gear Assembly Note.)
13	Fuel injection pump gear (See 01–10A–38 Timing Gear, Fuel Injection Pump Gear Assembly Note.)
14	Oil pump
15	Timing gear cover (See 01–10A–40 Timing Gear Cover Assembly Note.)
16	Fuel injection pump pulley (See 01–10A–41 Fuel Injection Pump Pulley Assembly Note.)
17	Crankshaft pulley (See 01–10A–41 Crankshaft Pulley Assembly Note.)

Oil Pump Cover Assembly Note

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

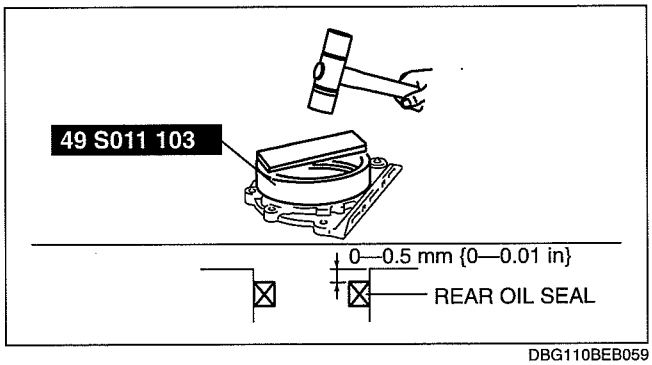


DBG110AEB053

Rear Cover, End Plate Assembly Note

1. Apply soapy water along the perimeter of the new oil seal.
2. Push the oil seal slightly in by hand.
3. Tap the oil seal in evenly by using the **SST** and a hammer.
4. To ensure that the oil seal is installed correctly, measure the distance between the end of the rear cover and the face of the oil seal.

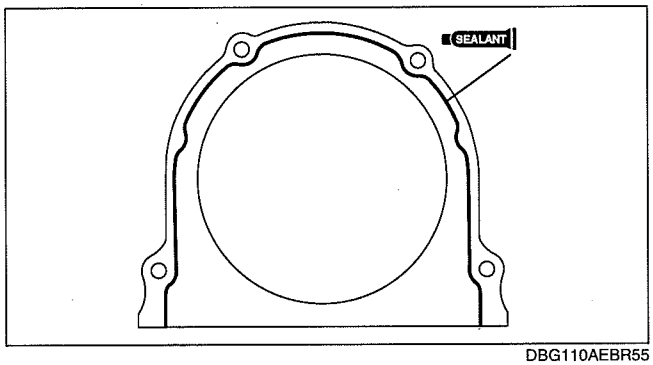
   Rear oil seal press-in amount
   0—0.5 mm {0—0.01 in}



DBG110BEB059

5. Apply silicone sealant to the rear cover as shown in the figure.

   Thickness
   ϕ2.0—3.0 mm {0.079—0.118 in}

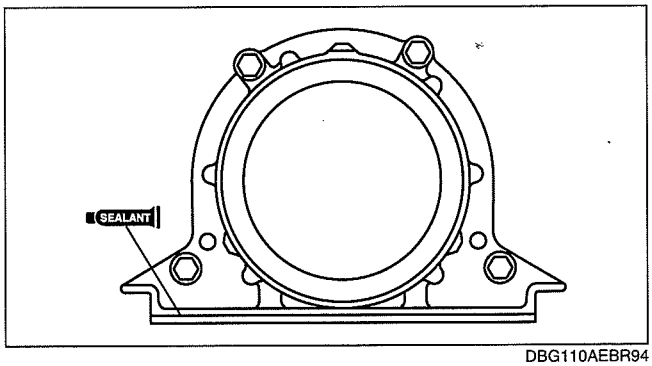


DBG110AEBR55

6. Apply silicone sealant to the rear cover as shown in the figure.

   Thickness
   ϕ2.0—3.0 mm {0.079—0.118 in}

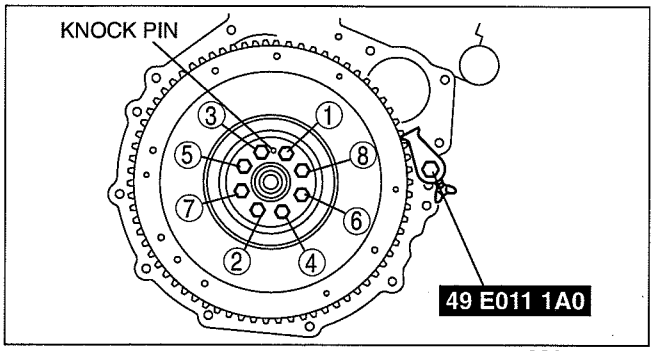
7. Install the end plate.



DBG110AEBR94

Flywheel Assembly Note

1. Hold the crankshaft using the **SST**.
2. Tighten the bolts in the order shown in the figure.

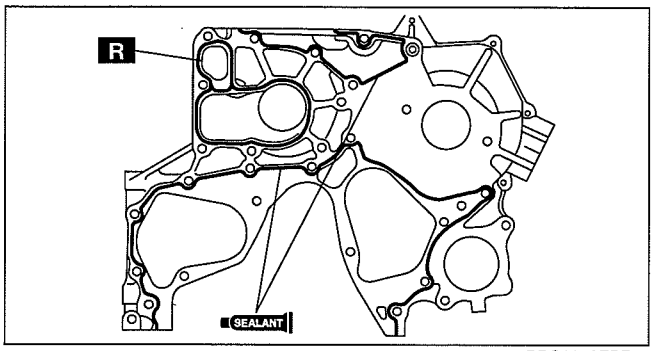


DBG110AEB056

Timing Gear Case Assembly Note

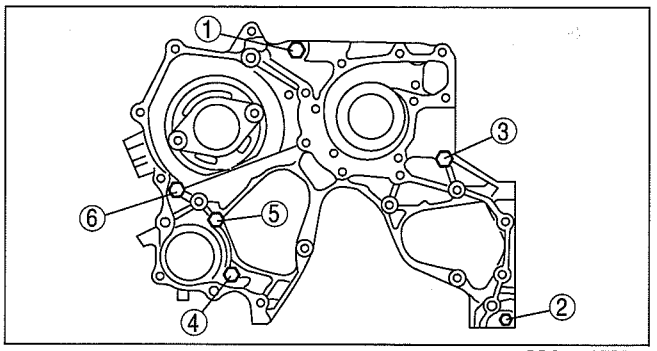
1. Install the new O-ring.
2. Apply silicone sealant to the timing gear case as shown in the figure. Do not apply sealant to the O-ring.

   Thickness
   ϕ2.0—3.0 mm {0.079—0.118 in}



DBG110AEBR57

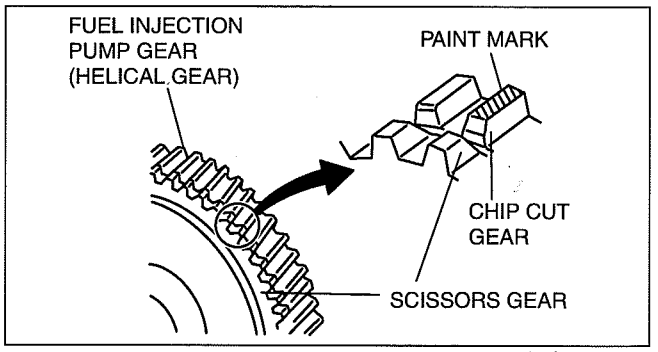
3. Tighten the bolts in two or three steps in the order shown in the figure.



DBG110AEBR58

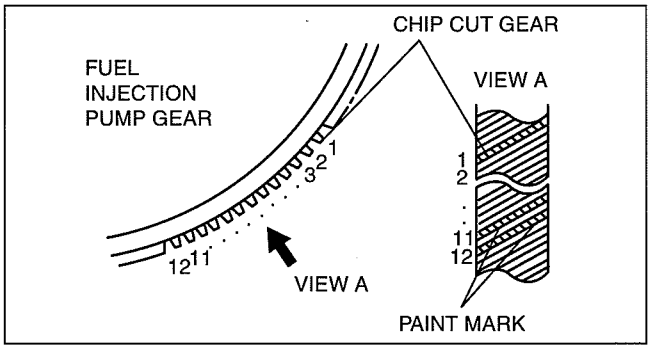
Timing Gear, Fuel Injection Pump Gear Assembly Note

1. Put a paint mark on the chip cut gear of the fuel injection pump gear.



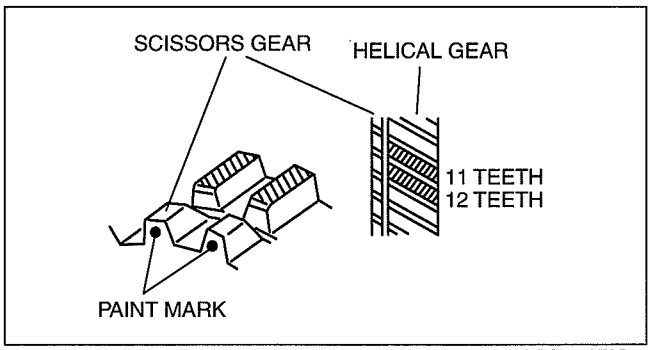
DBG110AEB9R3

2. Put a paint mark on the 11th and 12th teeth of the helical gear counting clockwise from the chip cut gear.



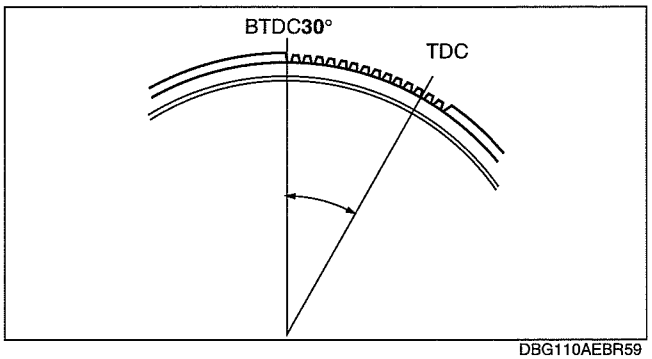
DBG110AEBR83

3. Verify that the 11th and 12th teeth of fuel injection pump gear (helical gear) and the teeth of the scissors gear are aligned, then put a paint mark on the scissors gear.
4. Set the No.1 cylinder to TDC of compression.



DBG110AEBR82

5. Rotate the flywheel ring gear from TDC to approximately **30°** BTDC (13 teeth on the gear).

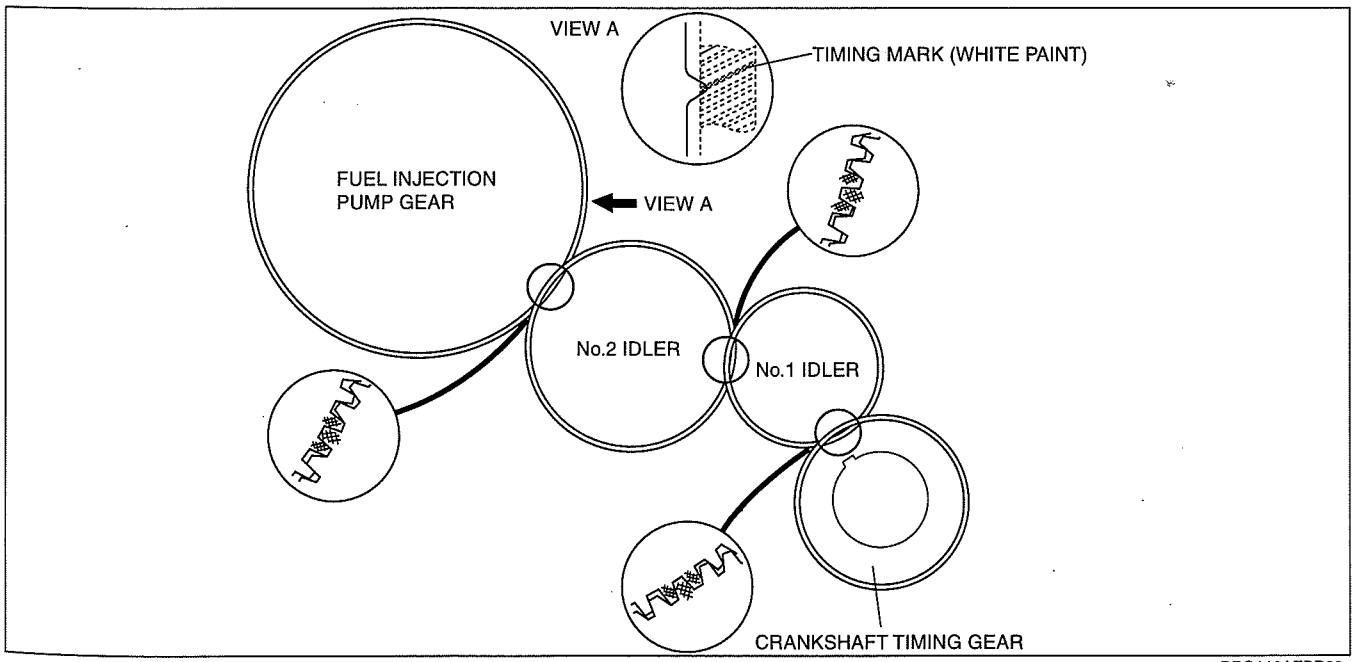


DBG110AEBR59

6. Align the timing marks. For the fuel injection pump gear, align the timing mark as shown in the figure (View A).

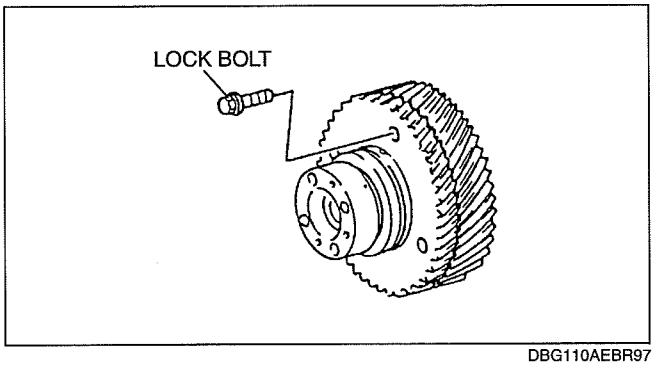
Note

- The helical gears except for the fuel injection pump gear have a punch mark as the timing mark. The timing mark of each gear can be aligned easily if the paint mark is made on the punch mark.



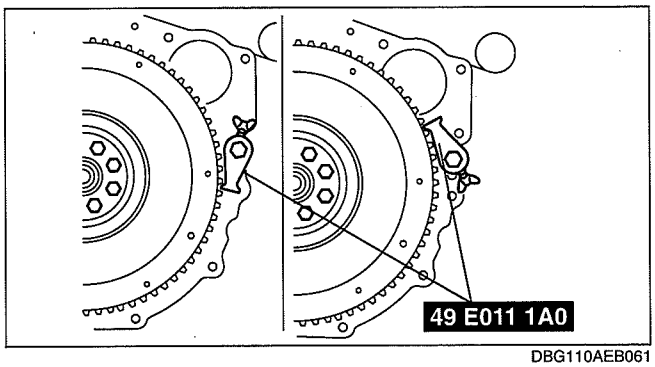
DBG110AEBR60

7. Remove the lock bolt.



DBG110AEBR97

8. Tighten the bolts using the **SST**.



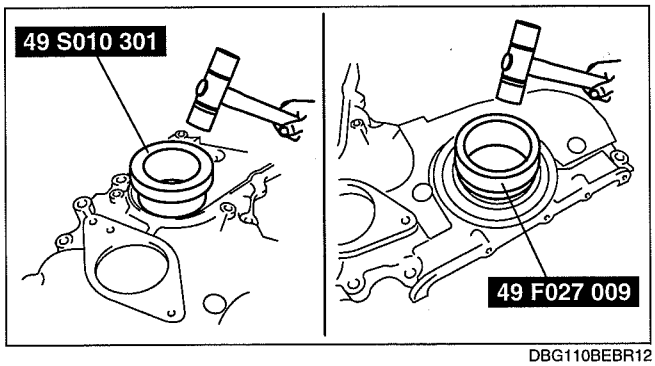
DBG110AEB061

Timing Gear Cover Assembly Note

1. Apply soapy water along the perimeter of the new oil seal.
2. Push the oil seal slightly in by hand.
3. Tap the oil seal in evenly using the **SST** and a hammer.
4. To ensure that the oil seal is installed correctly, measure the distance between the end of the timing gear cover and the face of the oil seal.

   Front oil seal press-in amount
   0—0.4 mm {0—0.01 in}

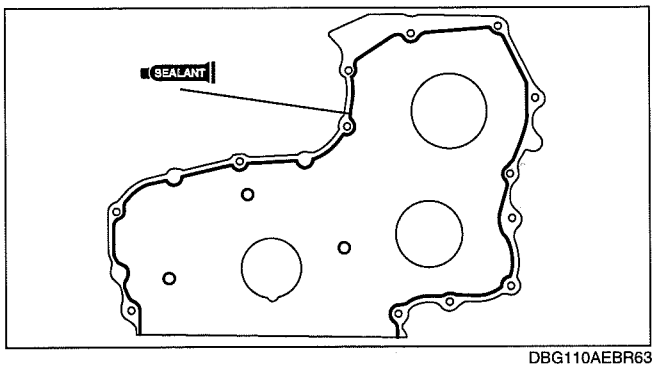
   Fuel injection pump oil seal press-in amount
   0—0.4 mm {0—0.01 in}



DBG110BEBR12

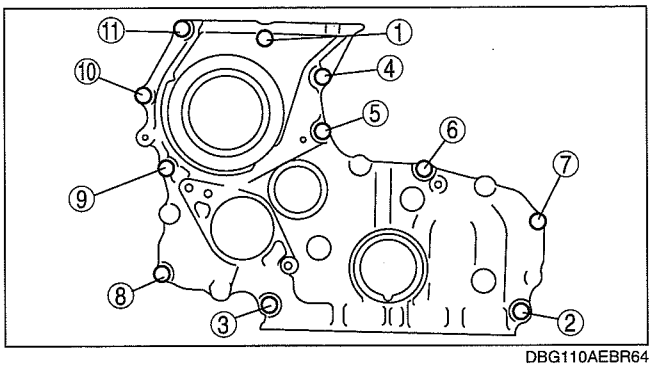
5. Apply silicone sealant to the timing gear cover as shown in the figure.

   Thickness
   ϕ2.0—3.0 mm {0.079—0.118 in}



DBG110AEBR63

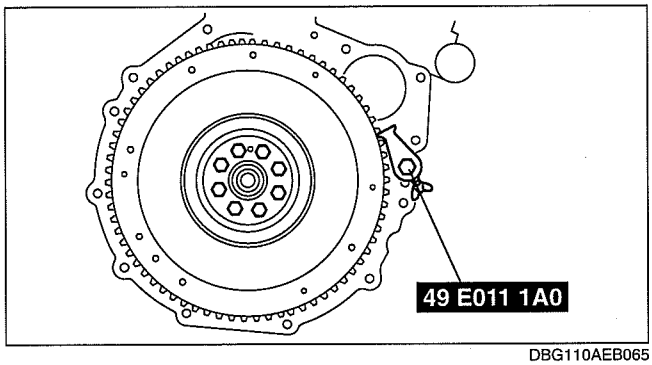
6. Tighten the bolts in two or three steps in the order shown in the figure.



DBG110AEBR64

Fuel Injection Pump Pulley Assembly Note

1. Install the fuel injection pump pulley using the **SST**.

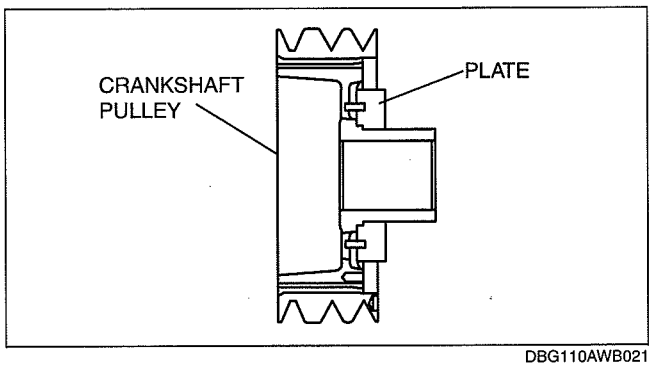


DBG110AEB065

Crankshaft Pulley Assembly Note

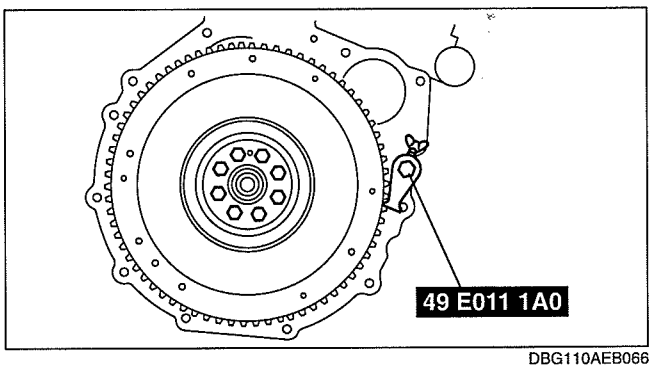
Caution

- **The CKP sensor plate is a very important part for engine operation control; any deformation of the plate may disable the operation control.**
  When disassembling/assembling the crankshaft pulley, be very careful not to deform the plate by interference with other parts or improper handling.



DBG110AWB021

1. Install the crankshaft pulley using the **SST**.

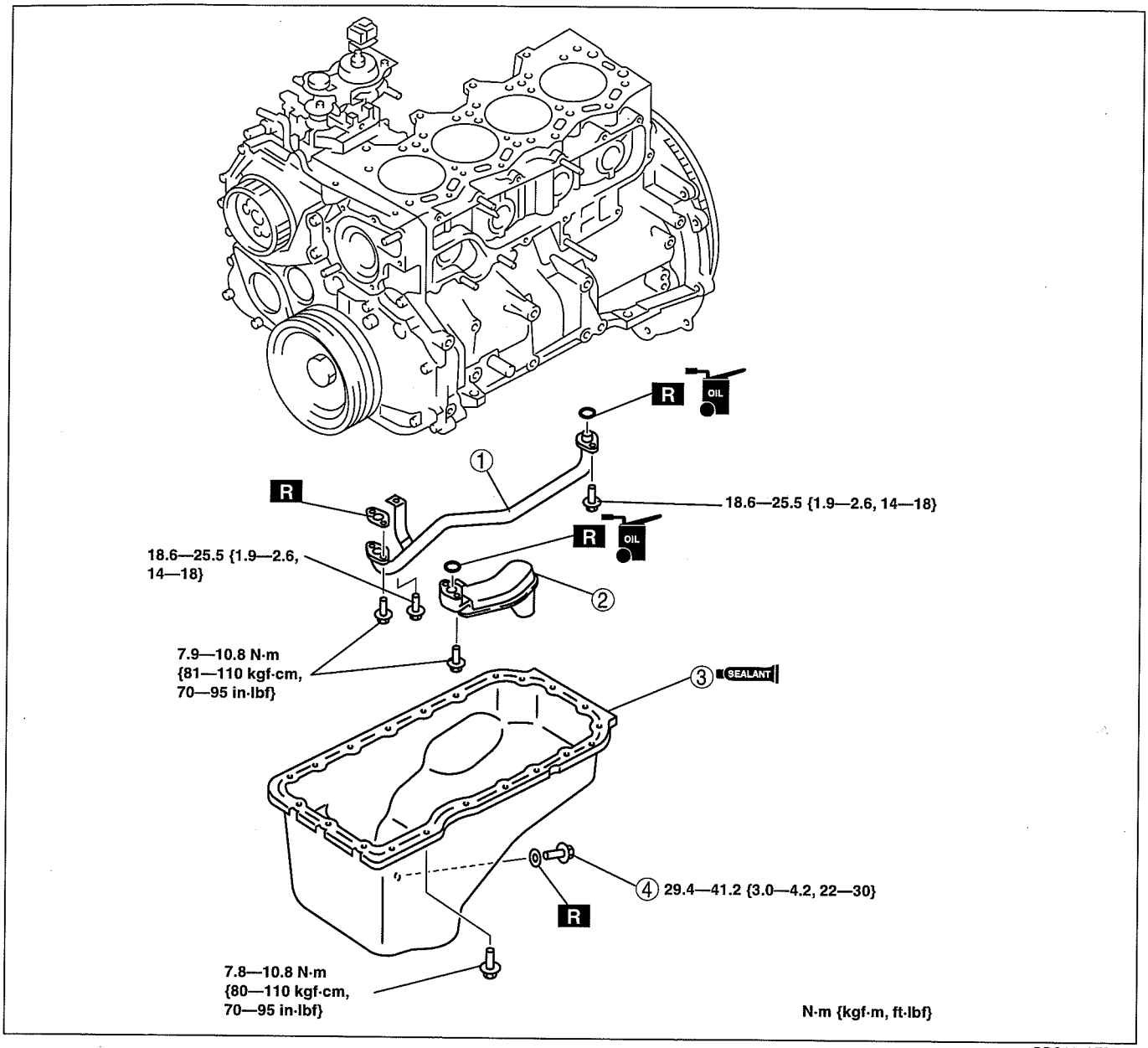


DBG110AEB066

CYLINDER BLOCK ASSEMBLY (III) [WL-3]

DCF011002000W12

1. Assemble in the order indicated in the table.



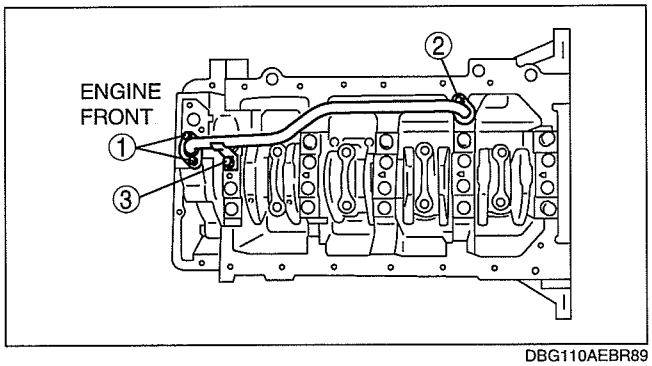
DBG110AEBR90

1	Oil pipe (See 01–10A–43 Oil Pipe Assembly Note.)
2	Oil strainer

3	Oil pan (See 01–10A–43 Oil Pan Assembly Note.)
4	Oil drain plug

Oil Pipe Assembly Note

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

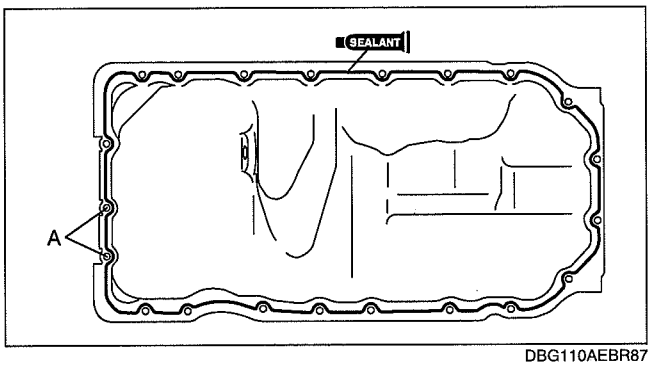


DBG110AEBR89

Oil Pan Assembly Note

1. Apply silicone sealant to the oil pan as shown in the figure.

   Thickness
   ϕ2.0—3.0 mm {0.08—0.118 in}

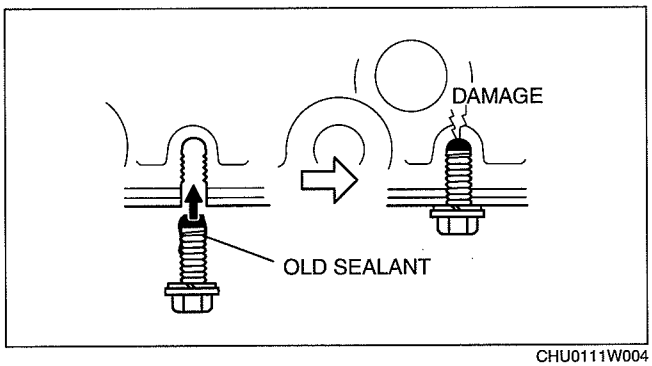


DBG110AEBR87

2. Tighten the oil pan bolts A as shown in the figure.

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

3. Tighten the remaining oil pan bolts in several passes.

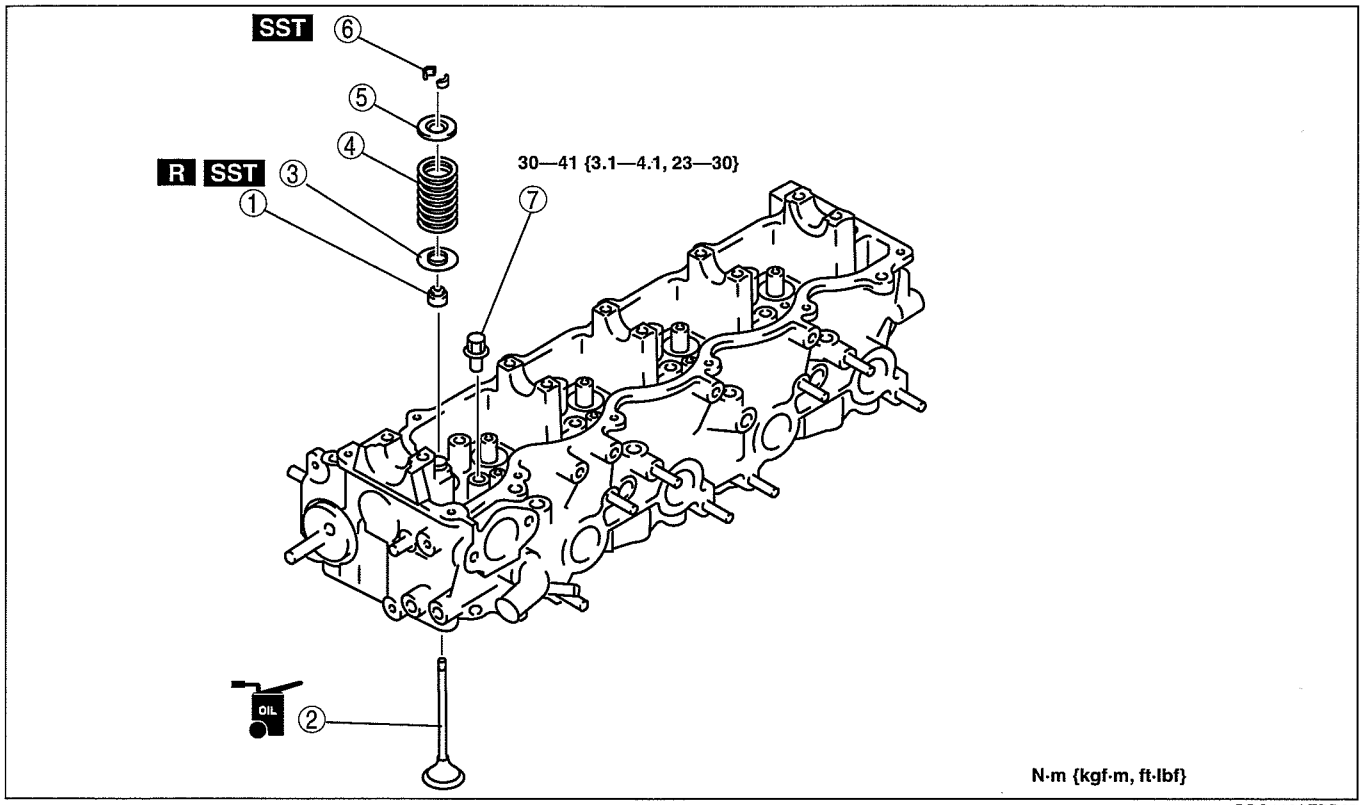


CHU0111W004

CYLINDER HEAD ASSEMBLY (I) [WL-3]

DCF011002000W13

1. Assemble in the order indicated in the table.



DBG110AEBR27

1	Valve seal (See 01–10A–44 Valve Seal Assembly Note.)
2	Valve
3	Lower valve spring seat
4	Valve spring

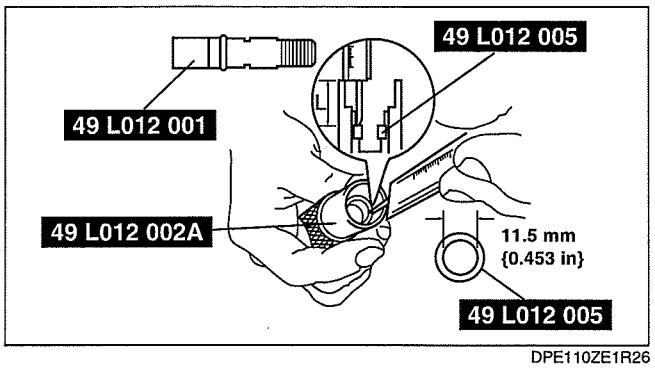
5	Upper valve spring seat
6	Valve keeper (See 01–10A–45 Valve Keeper Assembly Note.)
7	Pivot

Valve Seal Assembly Note

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

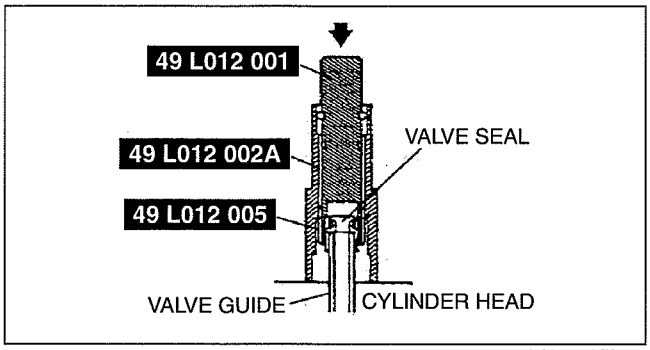
   Depth L
   15.6 mm {0.614 in}

2. Press the valve seal onto the valve guide by hand.



DPE110ZE1R26

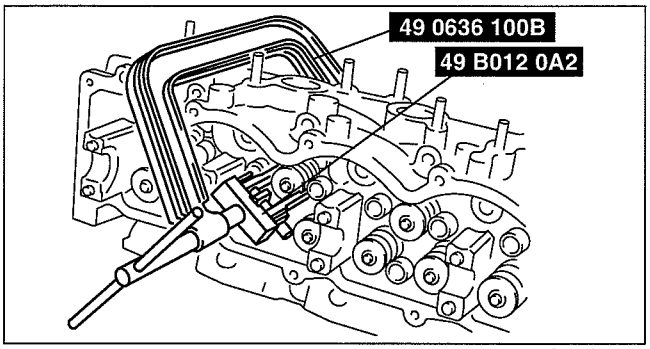
3. Tap the **SST** using a plastic hammer until its lower end touches the cylinder head.



DGB110AEB111

Valve Keeper Assembly Note

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

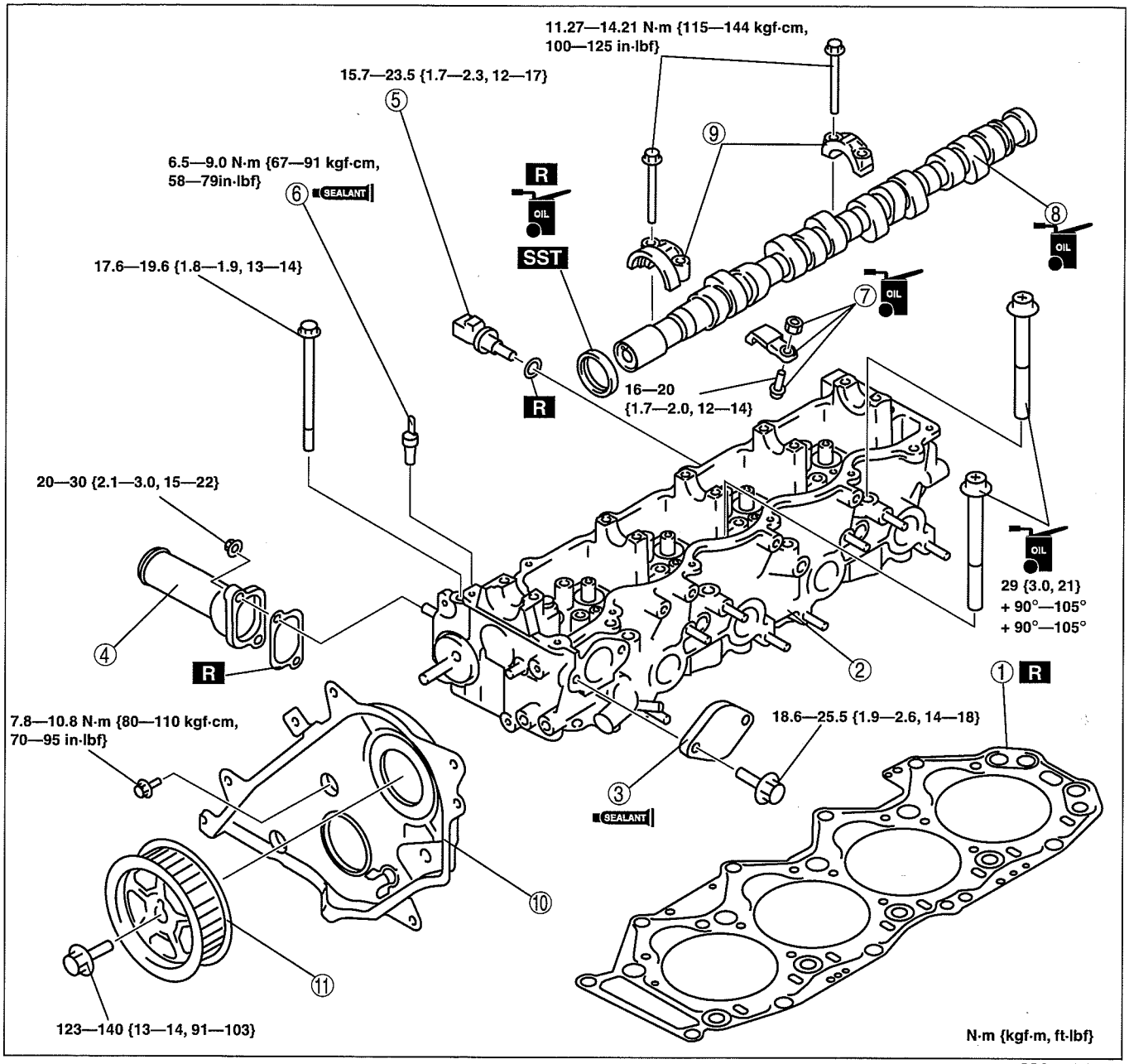


DBG110AEB029

CYLINDER HEAD ASSEMBLY (II) [WL-3]

DCF011002000W14

1. Assemble in the order indicated in the table.



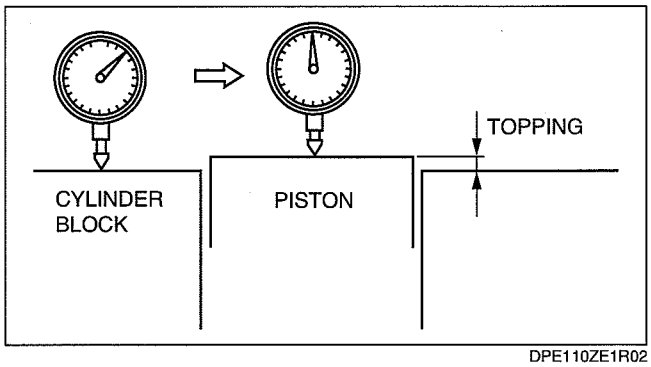
DBG110AEBR09

1	Cylinder head gasket (See 01–10A–47 Cylinder Head Gasket Assembly Note.)
2	Cylinder head (See 01–10A–48 Cylinder Head Assembly Note.)
3	Blind cover (See 01–10A–48 Blind Cover Assembly Note.)
4	Water outlet pipe
5	ECT sensor
6	Water temperature sender unit (See 01–10A–48 Water Temperature Sender Unit Assembly Note.)

7	Rocker arm (See 01–10A–49 Rocker Arm Assembly Note.)
8	Camshaft
9	Camshaft cap (See 01–10A–49 Camshaft Cap Assembly Note.)
10	Seal plate (See 01–10A–50 Seal Plate Assembly Note.)
11	Camshaft pulley (See 01–10A–50 Camshaft Pulley Assembly Note.)

Cylinder Head Gasket Assembly Note

1. Measure the piston topping of all the cylinders.

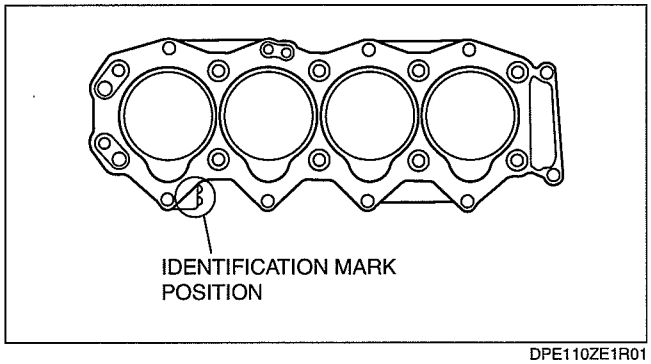


DPE110ZE1R02

2. Choose the gasket according to each measured piston topping.

Cylinder head gasket select table

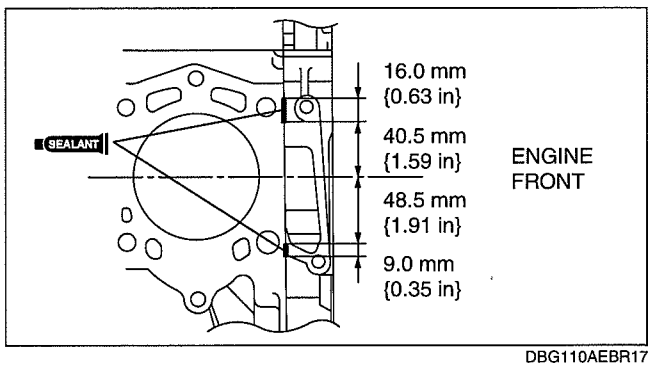
Piston topping (mm {in})	Cylinder head gasket identification mark
0.205—0.325 {0.081—0.127}	
0.265—0.385 {0.105—0.151}	
0.325—0.445 {0.128—0.175}	



DPE110ZE1R01

3. Apply silicone sealant to the cylinder block as shown in the figure.

Thickness
ϕ2.0—3.0 mm {0.079—0.118 in}



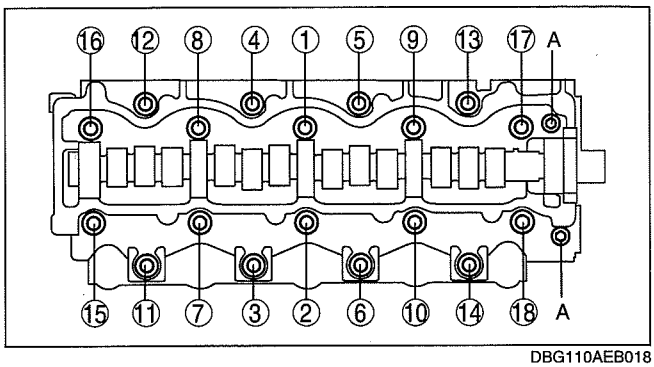
DBG110AEBR17

Cylinder Head Assembly Note

1. Before installing the cylinder head bolts, inspect their length. (See 01–10A–28 BOLT INSPECTION [WL-3].)
2. Apply clean engine oil to the threads and the seat face of each bolt and install them.
3. Tighten the cylinder head bolts in the order indicated in the figure in several passes.

   Tightening torque
   29 N·m {3.0 kgf·m, 2.1 ft·lbf}

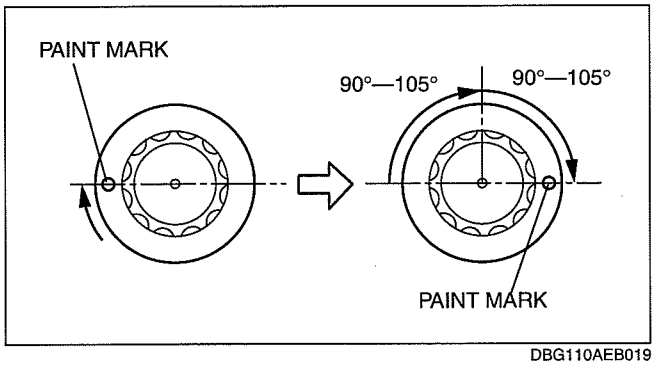
4. Retighten the bolts in the order shown in the figure until all the bolts are tightened to **29 N·m {3.0 kgf·m, 2.1 ft·lbf}**.



DBG110AEB018

5. Put a paint mark on each bolt head.
6. Using the marks as a reference, tighten the cylinder head bolts by turning each **90°—105°** in the order indicated in Step 3.
7. Further tighten each bolt by turning another **90°—105°** in the order indicated in Step 3.
8. Tighten the bolts A.

   Tightening torque
   17.6—19.6 N·m {1.8—1.9 kgf·m, 13—14 ft·lbf}

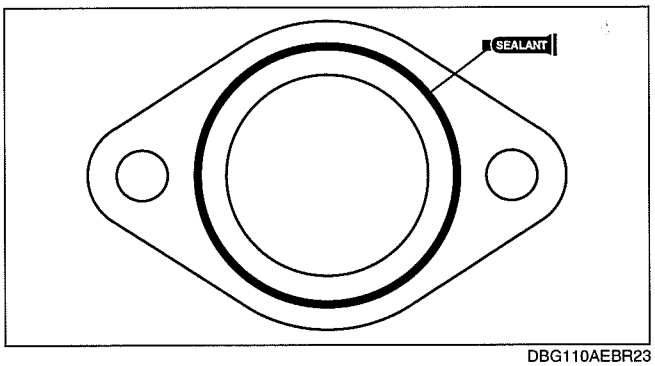


DBG110AEB019

Blind Cover Assembly Note

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

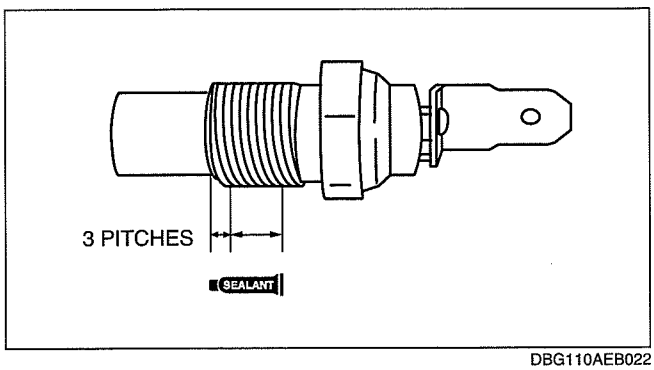
   Thickness
   ϕ1.5—2.5 mm {0.059—0.098 in}



DBG110AEBR23

Water Temperature Sender Unit Assembly Note

1. Apply silicone sealant to the thread of the water temperature sender unit as shown in the figure.

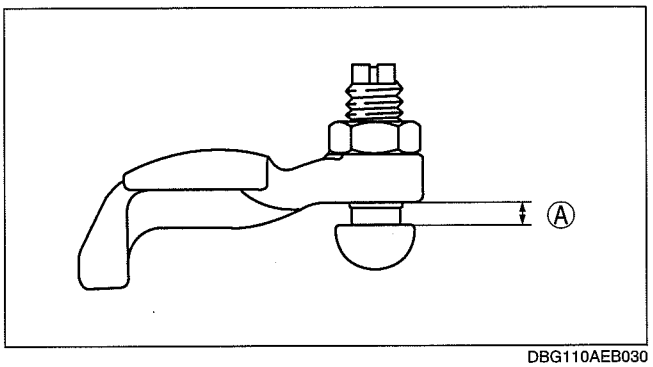


DBG110AEB022

Rocker Arm Assembly Note

1. If new rocker arm is used, set dimension A as follows.

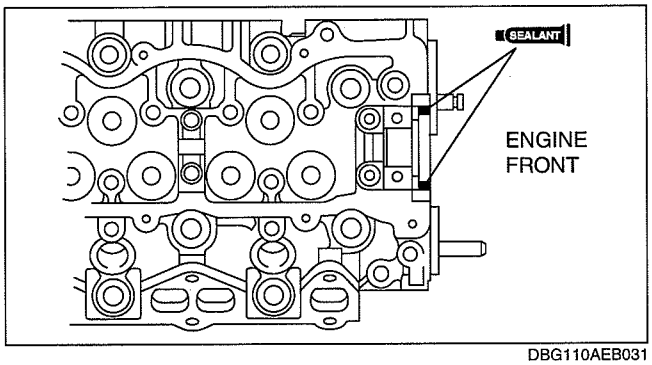
   Dimension A
   0.0—4.0 mm {0.0—0.15 in}



DBG110AEB030

Camshaft Cap Assembly Note

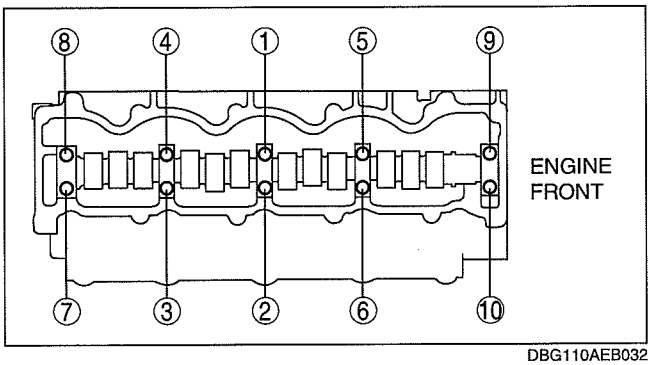
1. Apply silicone sealant to the front camshaft cap mounting surfaces as indicated in the figure. Avoid getting sealant onto the camshaft journal, camshaft oil seal surface, and camshaft thrust surface.



DBG110AEB031

2. Tighten the camshaft cap bolts gradually in three or four steps in the order shown in the figure.

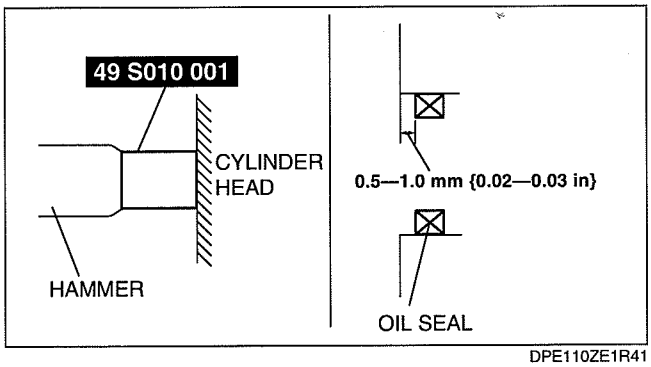
   Caution
   - **Because there is little camshaft thrust clearance, the camshaft must be held horizontally while it is installed. Otherwise, excessive force will be applied to the thrust area, causing burrs on the thrust receiving area of the cylinder head journal. To avoid this, the following procedure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



DBG110AEB032

3. Apply soapy water along the perimeter of the new oil seal.
4. Push the oil seal slightly in by hand.
5. Tap the oil seal lightly into the cylinder head using the **SST** and a hammer.
6. To ensure that the oil seal is installed correctly, measure the distance between the end of the cylinder head and the face of the oil seal.

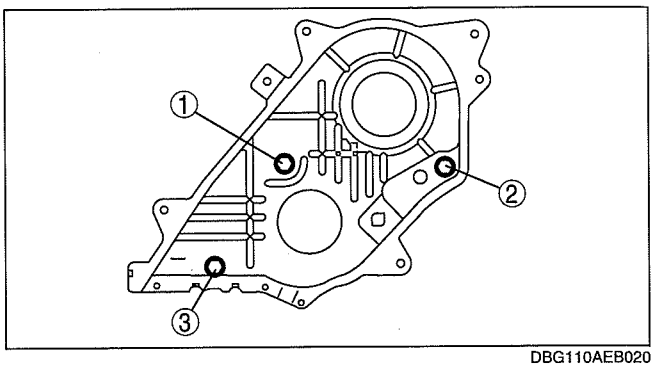
   Camshaft oil seal press-in amount
   0.5—1.0 mm {0.02—0.03 in}



DPE110ZE1R41

Seal Plate Assembly Note

1. Tighten the seal plate bolts in the order indicated in the figure.

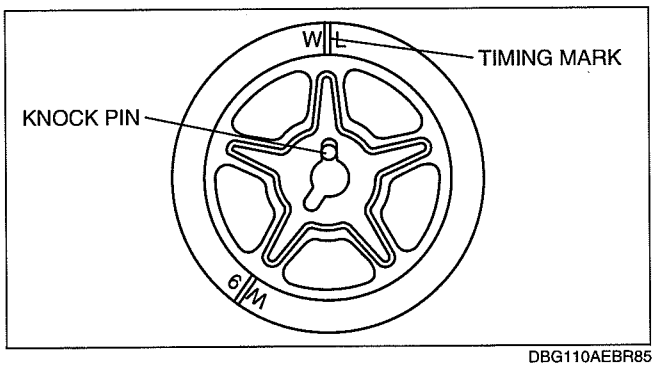


DBG110AEB020

Camshaft Pulley Assembly Note

1. Install the camshaft pulley on the camshaft with the knock pin fitted into the hole at the timing mark.

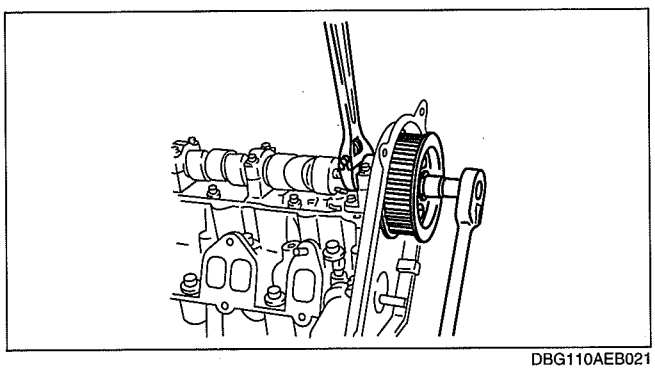
   Timing mark
   WL



DBG110AEBR85

2. Hold the camshaft using a wrench on the cast hexagon and tighten the pully lock bolt.

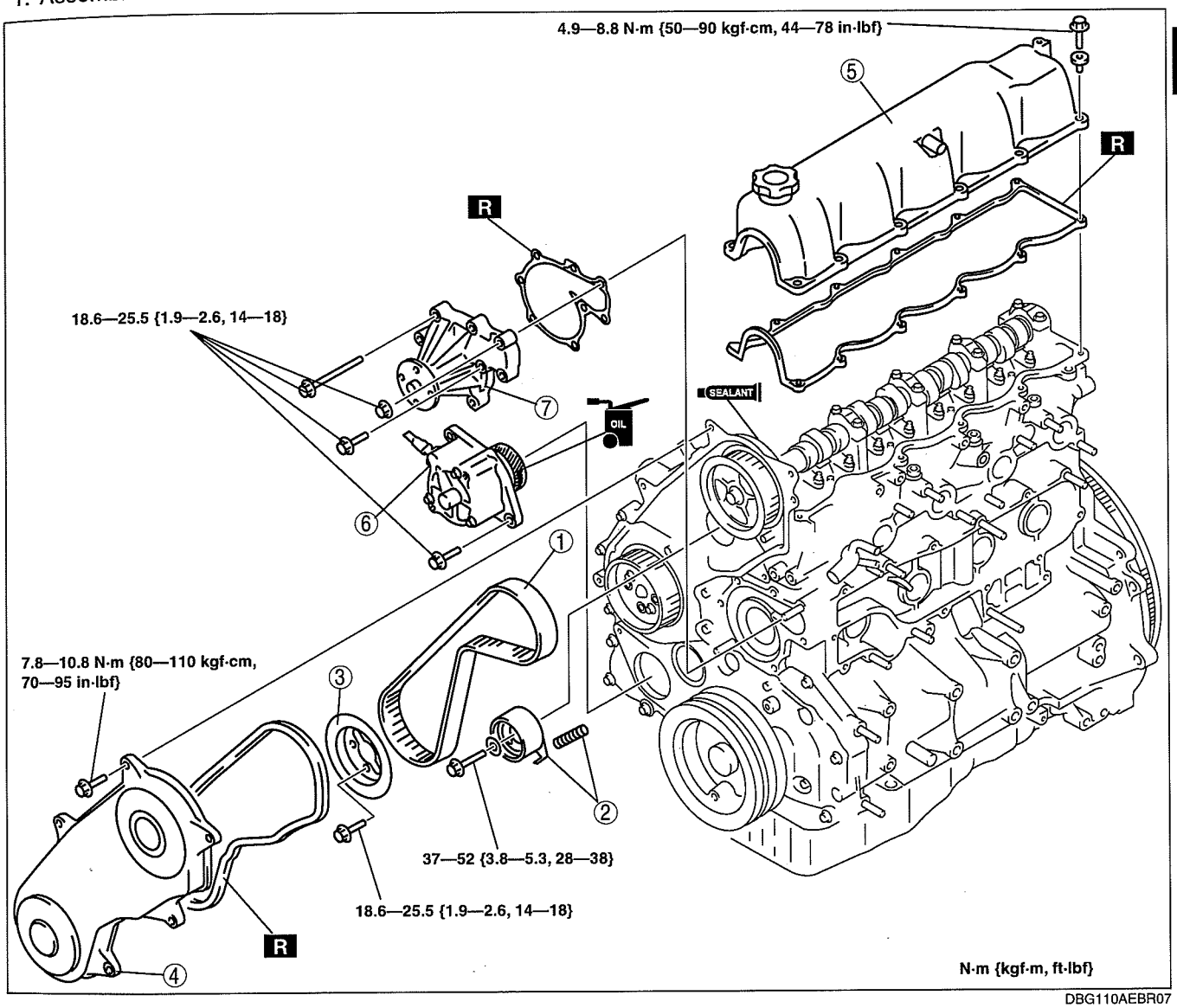
   Caution
   - **Do not move the camshaft from this position because it can cause the valve and piston to contact each other and damage them.**


DBG110AEB021

TIMING BELT ASSEMBLY [WL-3]

DCF011002000W15

1. Assemble in the order indicated in the table.



DBG110AEBR07

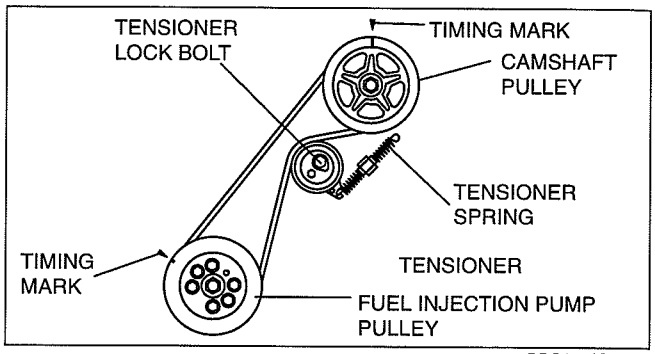
1	Timing belt (See 01–10A–52 Timing Belt, Tensioner, Tensioner Spring Assembly Note.)
2	Tensioner, tensioner spring (See 01–10A–52 Timing Belt, Tensioner, Tensioner Spring Assembly Note.)
3	Pulley plate

4	Timing belt cover (See 01–10A–52 Timing Belt Cover Assembly Note.)
5	Cylinder head cover (See 01–10A–52 Cylinder Head Cover Assembly Note.)
6	Vacuum pump
7	Water pump

Timing Belt, Tensioner, Tensioner Spring Assembly Note

Caution
- **Overtensioning of the timing belt can cause breakage of the belt and the camshaft.**

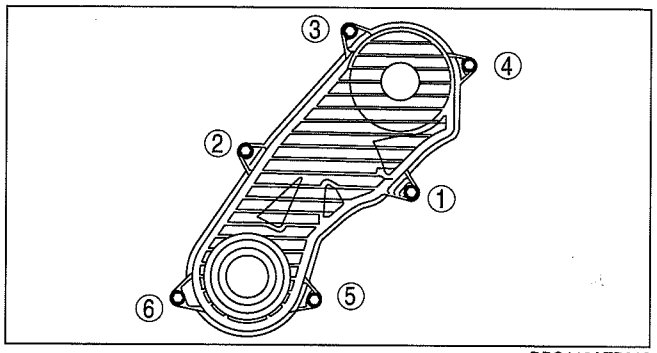
1. Align the timing marks as shown in the figure.
2. Verify that the fuel injection pump attaching bolts and nuts are tightened to the specified torque. This must be done to prevent overtensioning of the timing belt after it has been installed.
3. Install the timing belt.
4. Install the tensioner, tensioner spring, and the lock bolt.
5. Tighten the tensioner lock bolt.
6. Turn the crankshaft clockwise twice, and align the timing marks. If they are not aligned, remove the timing belt and repeat from Step 1.
7. Loosen the tensioner lock bolt to apply tension to the belt. Do not apply tension other than that of the tensioner spring.
8. Tighten the tensioner lock bolt. Be sure the tensioner does not move together with the bolt rotation.



DBG110AEBR11

Timing Belt Cover Assembly Note

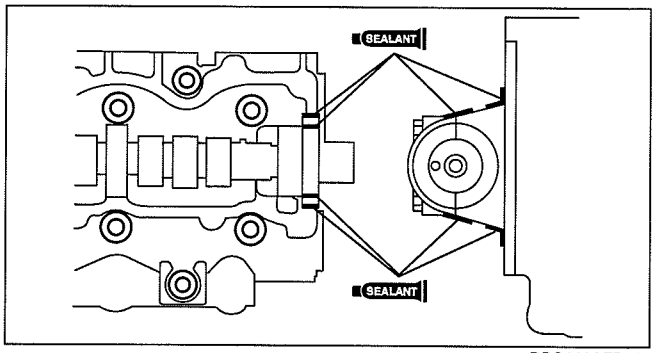
1. Tighten the timing belt cover bolts in the order shown in the figure.



DBG110AEB012

Cylinder Head Cover Assembly Note

1. Before installing the cylinder head cover, inspect the valve clearance. (See 01–10A–29 VALVE CLEARANCE INSPECTION [WL-3].)
2. Apply silicone sealant to the cylinder head as shown.



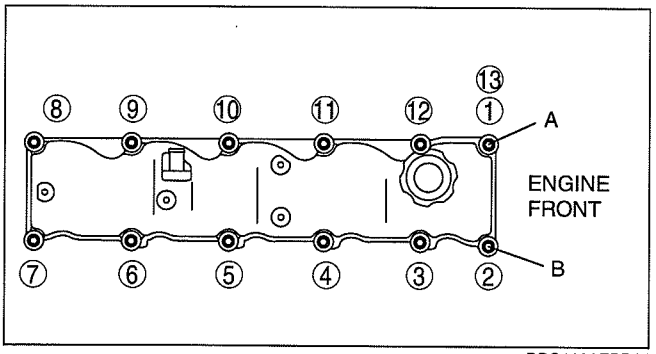
DBG110AEB013

3. Tighten cylinder head cover bolts A and B.

   Tightening torque
   1.5—2.9 N·m {16—29 kgf·cm, 14—25 in·lbf}

4. Tighten the cylinder head cover bolts in the order shown in the figure.

   Tightening torque
   4.9—8.8 N·m {50—89 kgf·cm, 44—77 in·lbf}



DBG110AEBR14

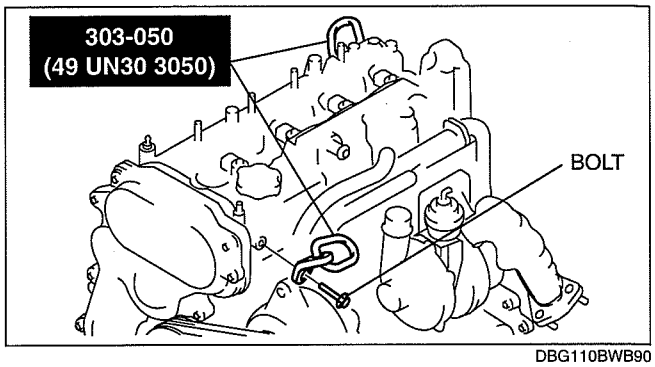
01–10B MECHANICAL [WL-C, WE-C]

ENGINE MOUNTING [WL-C, WE-C]

DCF011002000W16

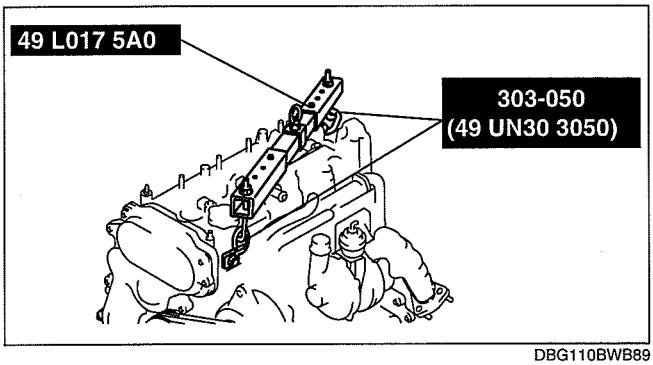
1. Install the **SST** to the cylinder head using the bolt (99784 1020 or **M10X1.25**, **8T**, length **20mm {0.79 in}**) as shown in the figure.

   Tightening torque
   43.1—60.8 N·m {4.40—6.10 kgf·m, 31.8—44.8 ft·lbf}



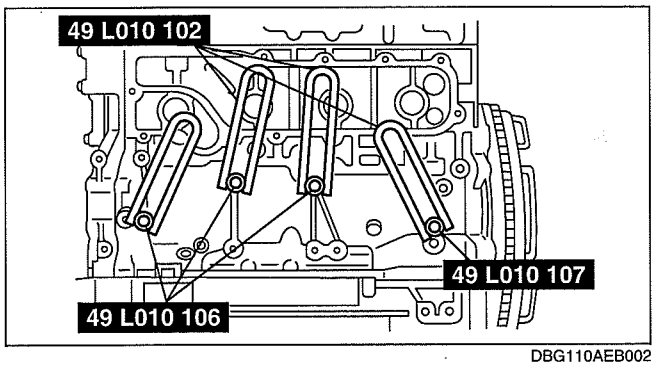
DBG110BWB90

2. Suspend the engine using the **SST**.



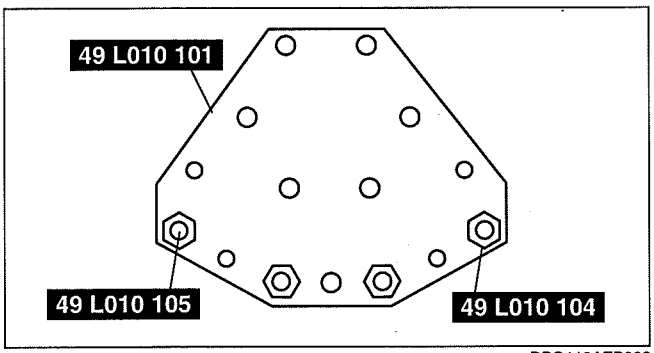
DBG110BWB89

3. Install the **SST** (arms) to the holes as shown in the figure, and hand tighten the **SST** (bolts).



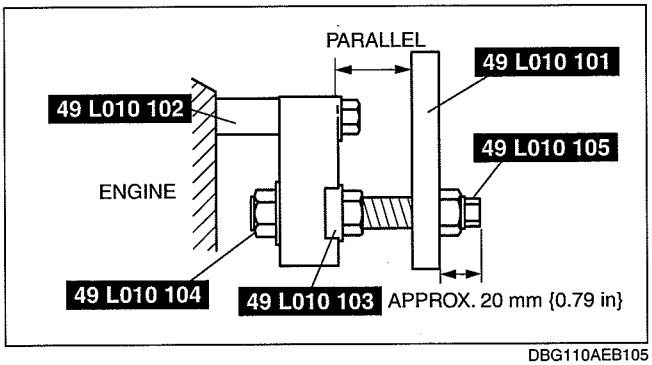
DBG110AEB002

4. Assemble the **SSTs** (bolts, nuts and plate) to the specified positions.



DBG110AEB003

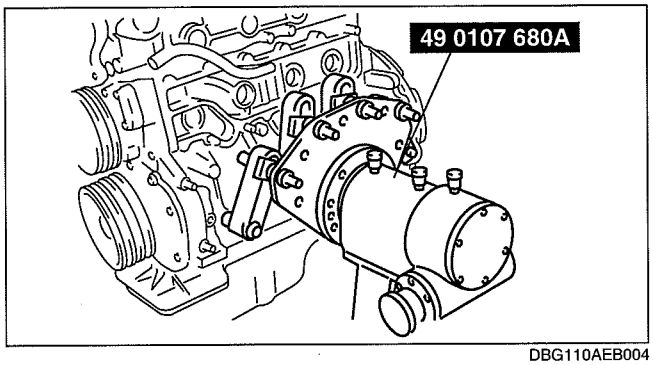
5. Adjust the **SST** (bolts) so that **20 mm {0.79 in}** or more of thread is exposed.
6. Align the **SSTs** (plate and arms) so that they are parallel by adjusting the **SSTs** (bolts and nuts).
7. Tighten the **SSTs** (bolts and nuts) to affix the **SST** firmly.



DBG110AEB105

8. Mount the engine on the **SST** (engine stand).

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



DBG110AEB004

9. Remove the **SST** (303-050 (49 UN30 3050)).
10. Drain the engine oil into a container.
11. Install the drain plug using new washer.

Tightening torque
29.4—41.2 N·m {3.0—4.2 kgf·m, 22—30 ft·lbf}

ENGINE DISMOUNTING [WL-C, WE-C]

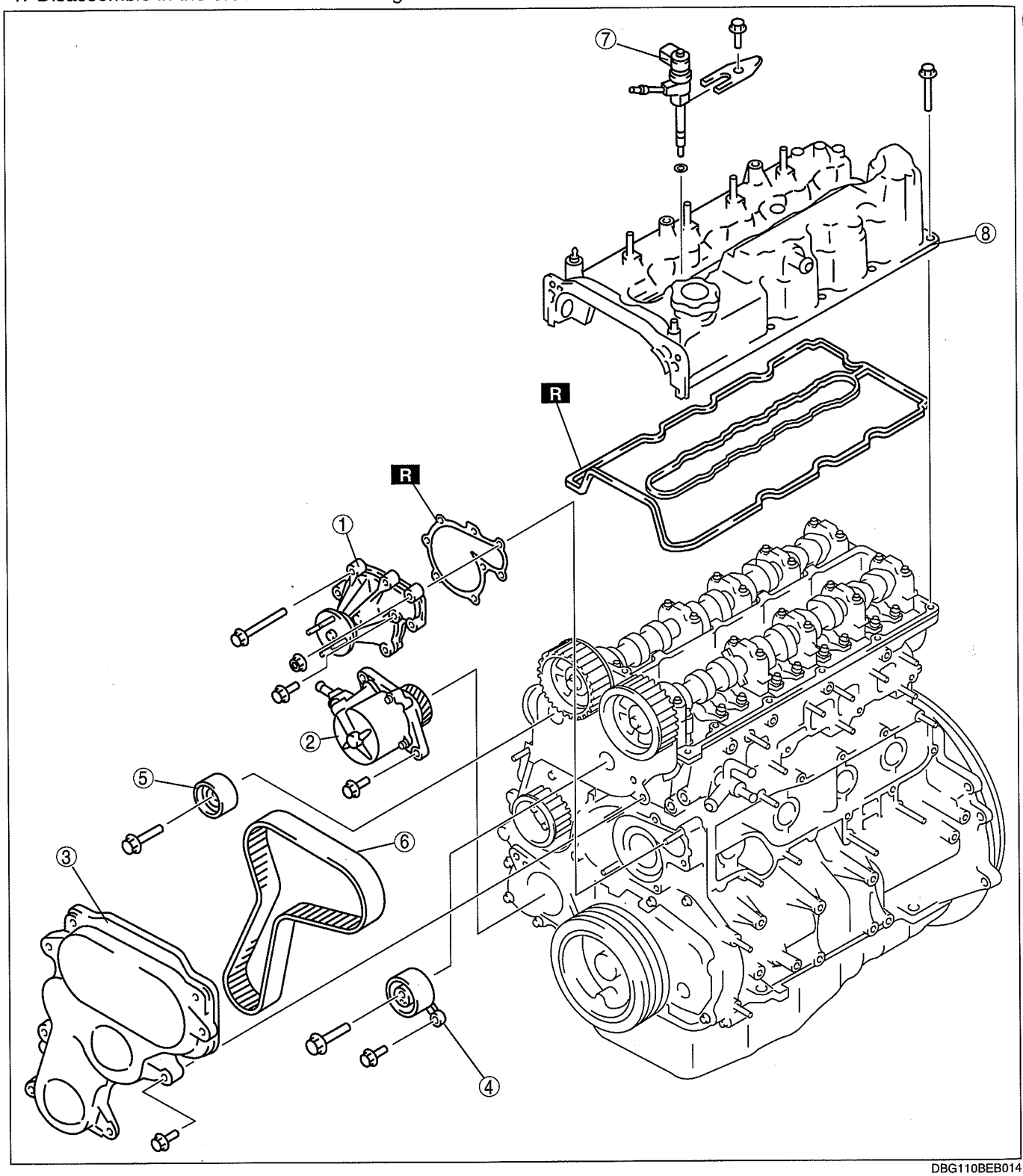
DCF011002000W17

1. Dismount in the reverse order of mounting.

TIMING BELT DISASSEMBLY [WL-C, WE-C]

DCF011002000W18

1. Disassemble in the order shown in the figure.



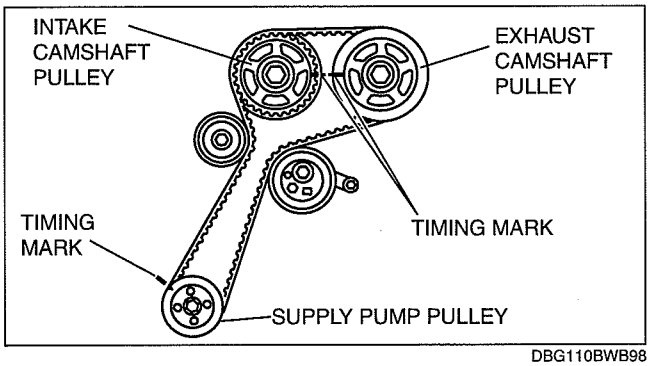
DBG110BEB014

1	Water pump
2	Vacuum pump
3	Timing belt cover
4	Tensioner (See 01–10B–5 Tensioner Disassembly Note.)

5	Idler
6	Timing belt (See 01–10B–5 Timing Belt Disassembly Note.)
7	Injector
8	Cylinder head cover

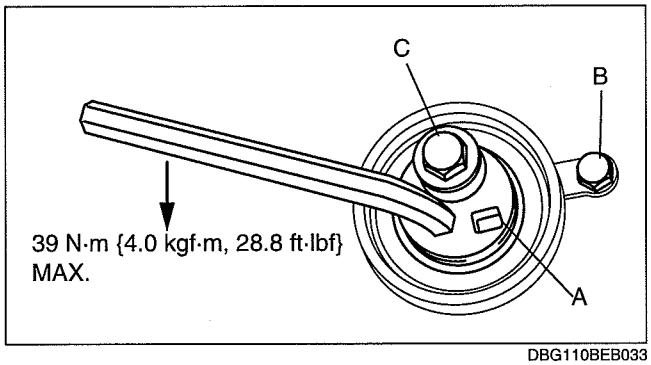
Tensioner Disassembly Note

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



DBG110BWB98

2. Turn the auto tensioner counterclockwise using an Allen wrench. (Rotate the auto tensioner with a force of **39 N·m {4.0 kgf·m, 28.8 ft·lbf}** or less.)
3. Insert a fixing pin of approx. **6 mm {0.24 in}** diameter into hole A to secure the auto tensioner.
4. Remove the bolts in the order of B and C, then remove the auto tensioner.

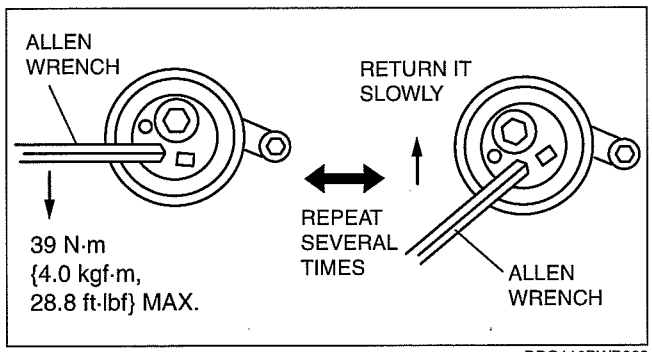


DBG110BEB033

Note

- If the rod projects suddenly while removing the auto tensioner, the air flows into the pressure chamber and the rod could move slightly. If this occurs, bleed the air from the pressure chamber using the following procedure.

5. Assemble the auto tensioner to the engine.
6. Turn the auto tensioner with a force of **39 N·m {4.0 kgf·m, 28.8 ft·lbf}** or less using an Allen wrench, then turn it back slowly. Repeat this procedure several times.
7. Verify that the rod has resistance when it is in the most projected position. If there is no resistance, repeat the above procedure.



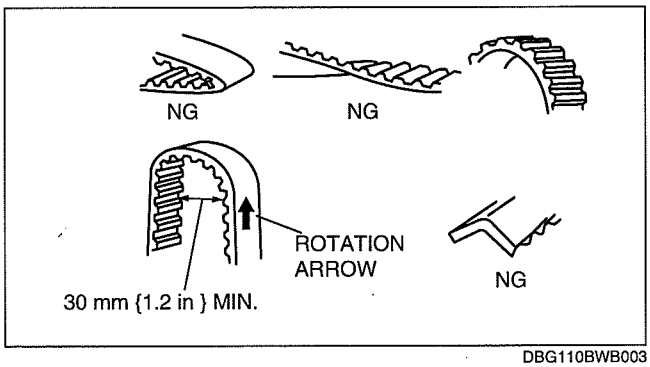
DBG110BWB999

Timing Belt Disassembly Note

Caution

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

1. Mark the timing belt rotation on the belt for proper reinstallation.

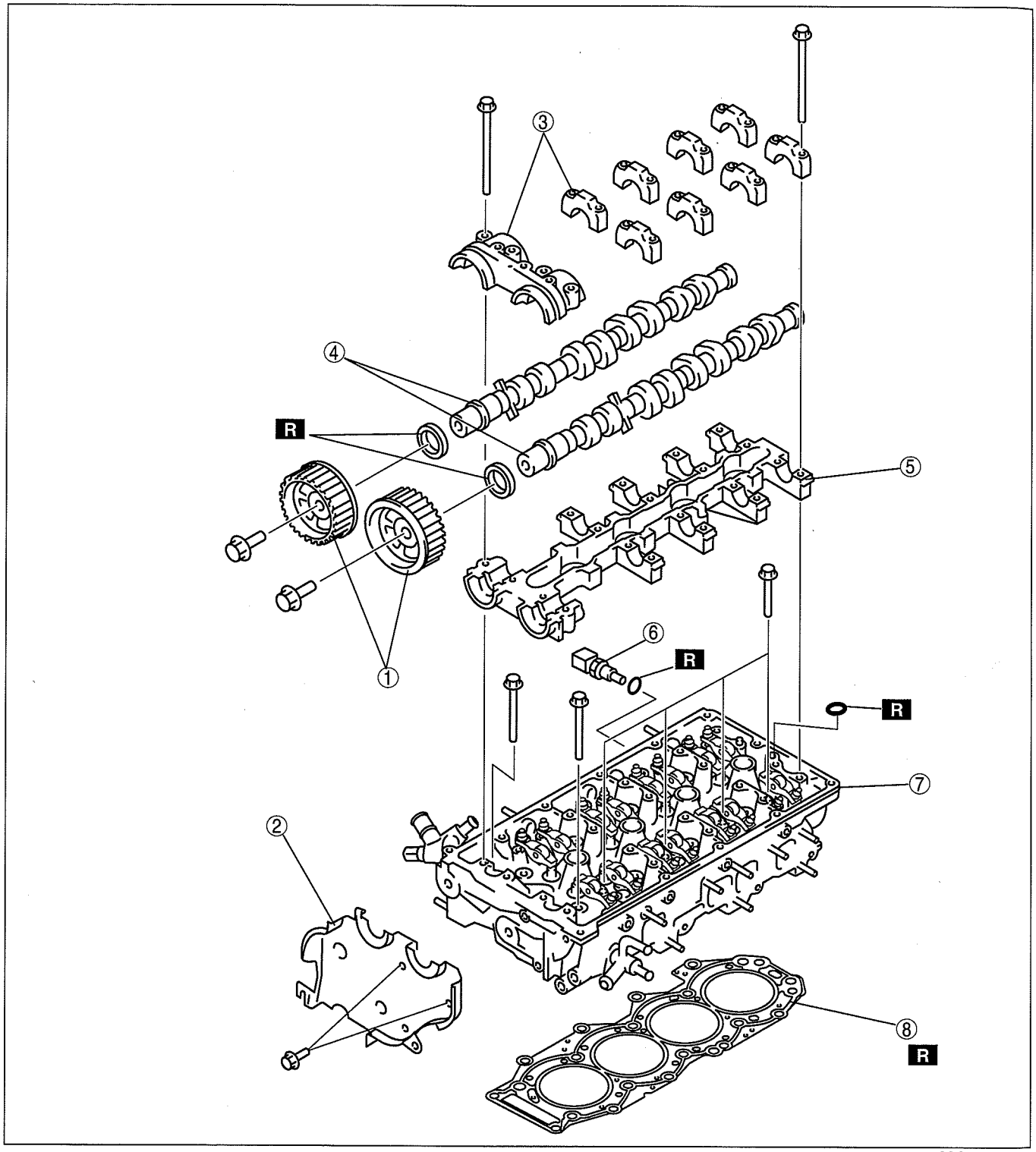


DBG110BWB003

CYLINDER HEAD DISASSEMBLY(I) [WL-C, WE-C]

DCF011002000W19

1. Disassemble in the order shown in the figure.



DBG110BEB062

1	Camshaft pulley (See 01–10B–7 Camshaft Pulley Disassembly Note.)
2	Seal plate
3	Camshaft cap upper (See 01–10B–7 Camshaft Cap Upper Disassembly Note.)
4	Camshaft

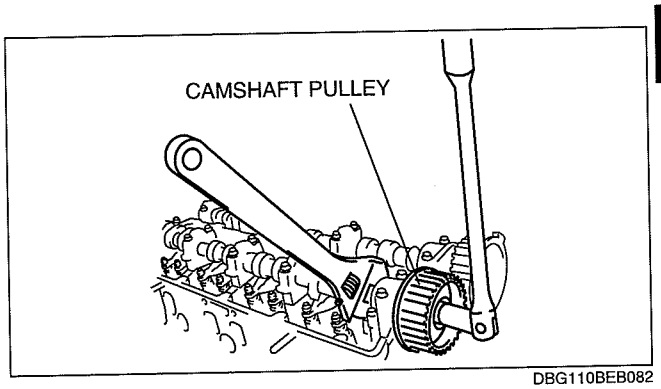
5	Camshaft cap Lower
6	ECT sensor
7	Cylinder head (See 01–10B–7 Cylinder Head Disassembly Note.)
8	Cylinder head gasket

Camshaft Pulley Disassembly Note

1. Hold the camshaft using a wrench on the cast hexagon.

Caution

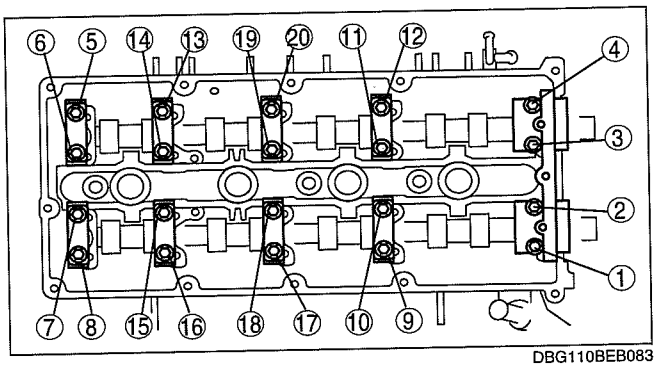
- **Do not move the camshaft from this position because it can cause the valve and piston to contact each other and damage them.**



DBG110BEB082

Camshaft Cap Upper Disassembly Note

1. Loosen the camshaft cap bolts in three or four steps in the order shown in the figure.



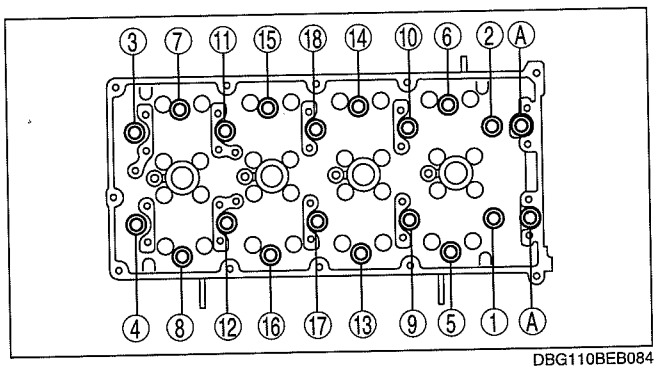
DBG110BEB083

Camshaft Disassembly Note

1. Before removing the camshaft, inspect the camshaft oil clearance. (See 01–10B–21 CAMSHAFT OIL CLEARANCE INSPECTION [WL-C, WE-C].)

Cylinder Head Disassembly Note

1. Remove bolts A.
2. Loosen the cylinder head bolts in two or three steps in the order shown in the figure.

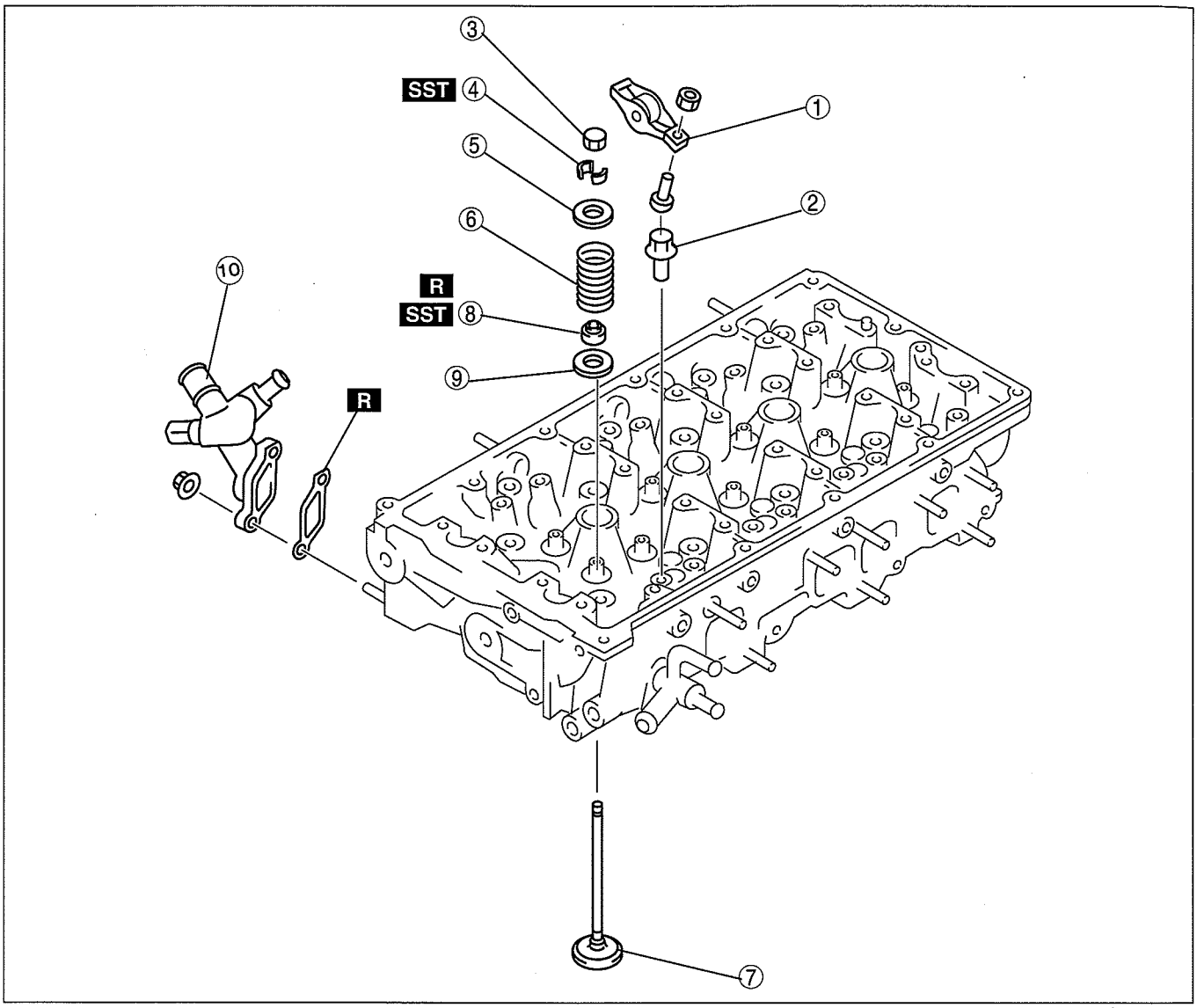


DBG110BEB084

CYLINDER HEAD DISASSEMBLY (II) [WL-C, WE-C]

DCF011002000W20

1. Disassemble in the order shown in the figure.



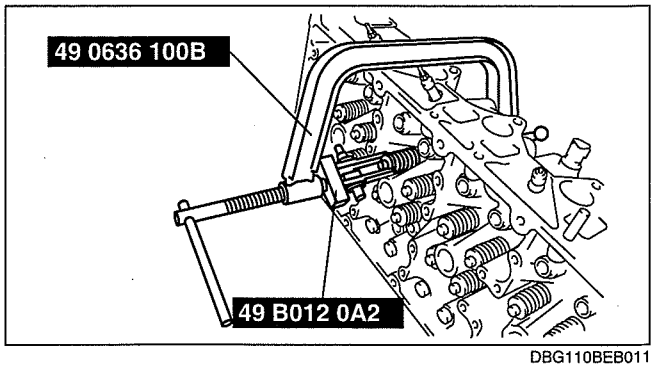
DBG110BEB016

1	Rocker arm
2	Pivot
3	Valve cap
4	Valve keeper (See 01–10B–8 Valve Keeper Disassembly Note.)
5	Upper valve spring seat

6	Valve spring
7	Valve
8	Valve seal (See 01–10B–9 Valve Seal Disassembly Note.)
9	Lower valve spring seat
10	Water outlet pipe

Valve Keeper Disassembly Note

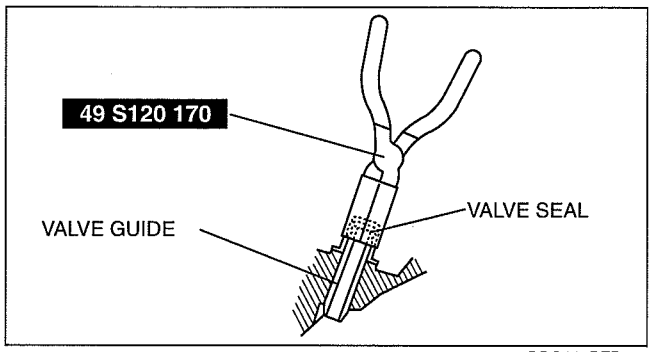
1. Remove the valve keeper using the **SST**.



DBG110BEB011

Valve Seal Disassembly Note

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

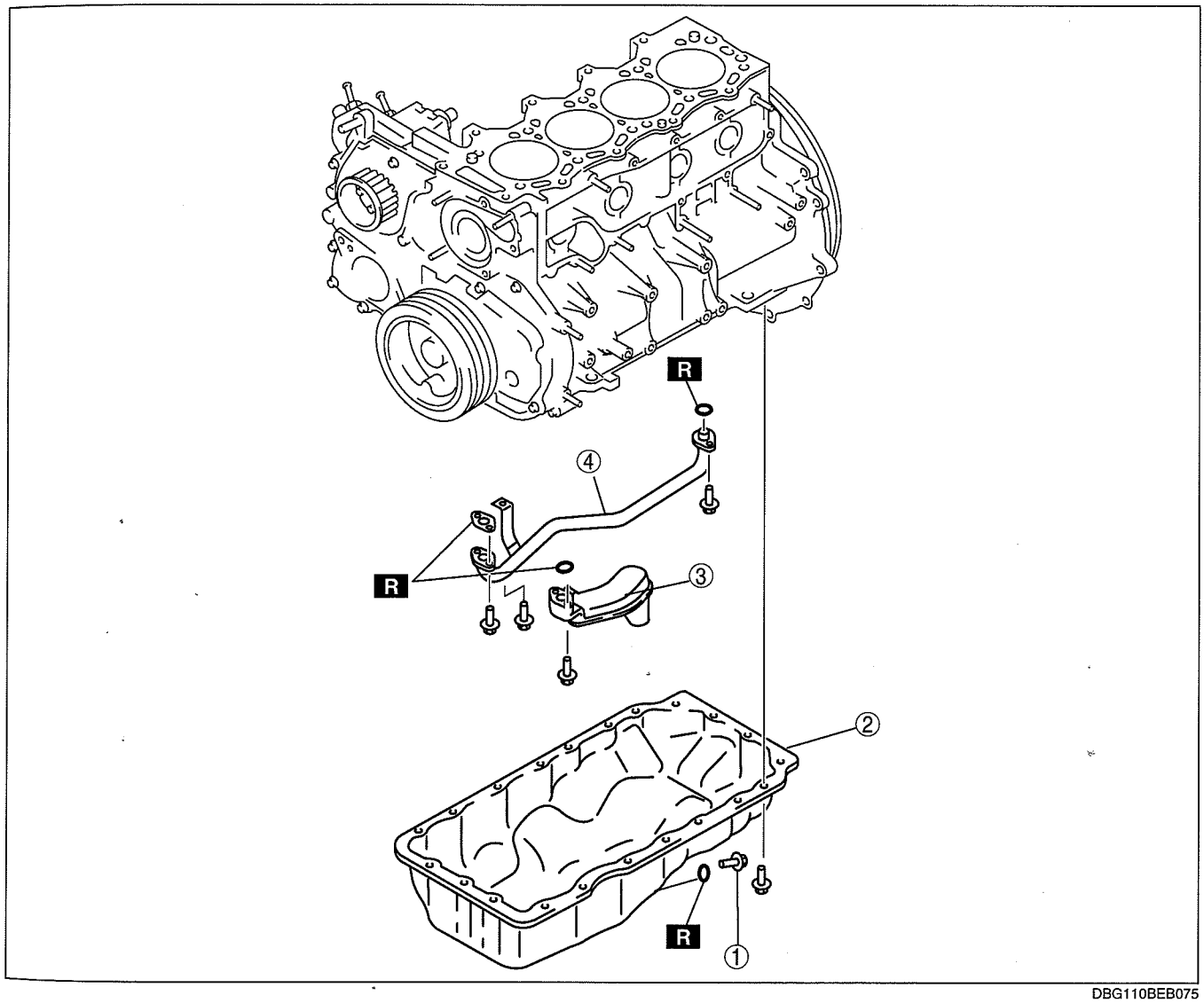


DBG110BEB085

CYLINDER BLOCK DISASSEMBLY (I) [WL-C, WE-C]

DCF011002000W21

1. Disassemble in the order shown in the figure.



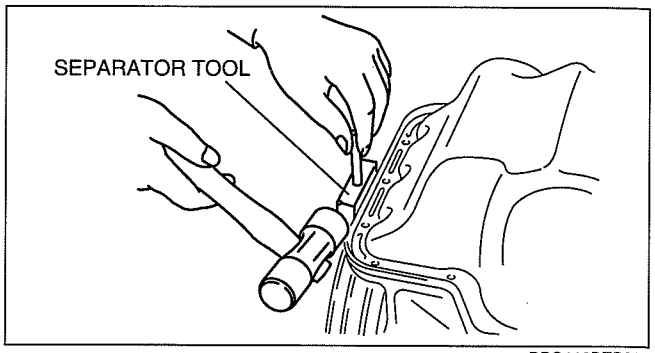
DBG110BEB075

1	Oil drain plug
2	Oil pan (See 01–10B–10 Oil Pan Disassembly Note.)

3	Oil strainer
4	Oil pipe

Oil Pan Disassembly Note

1. Remove the oil pan using a separator tool.

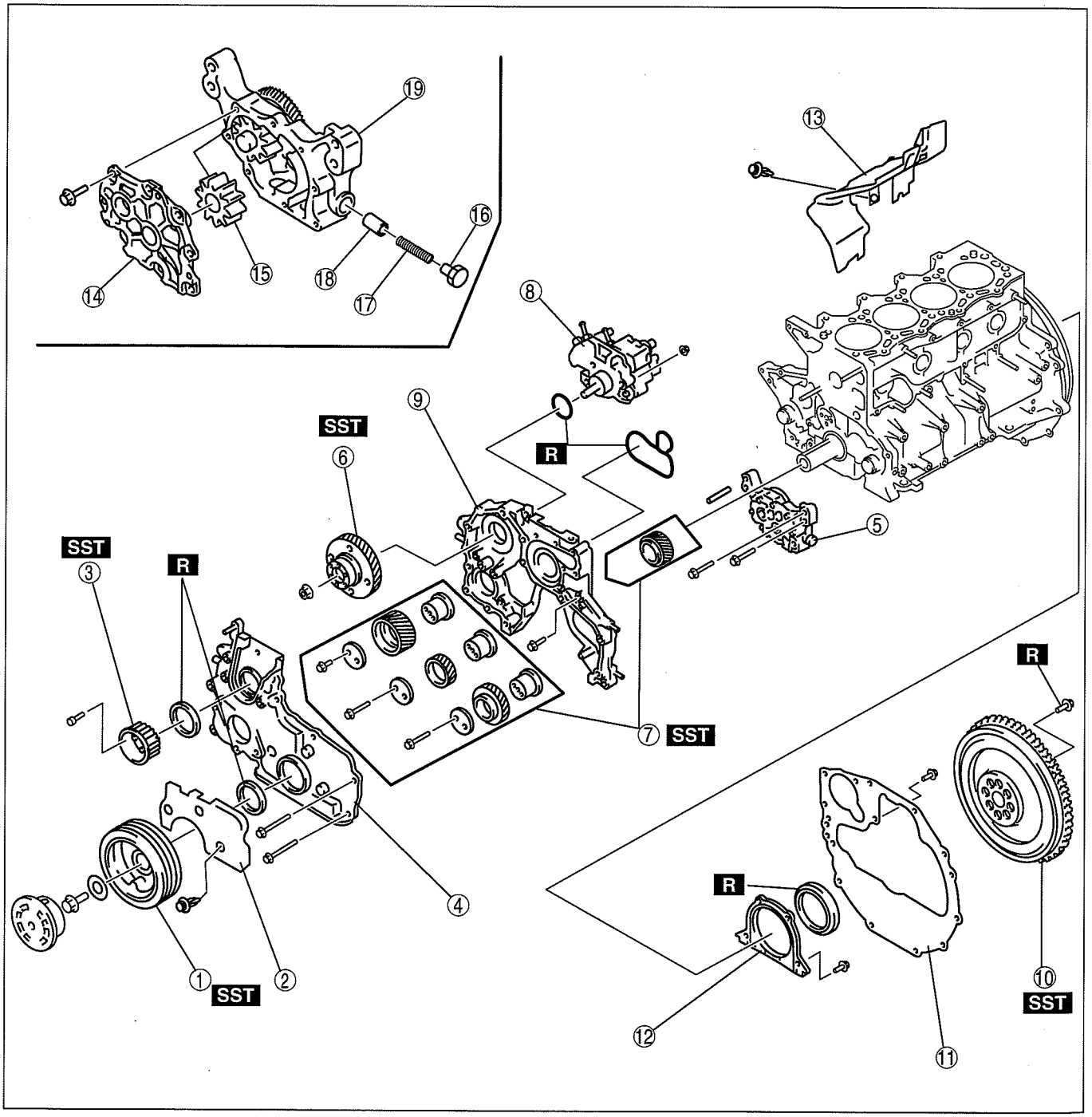


DBG110BEB086

CYLINDER BLOCK DISASSEMBLY (II) [WL-C, WE-C]

DCF011002000W22

1. Disassemble in the order shown in the figure.



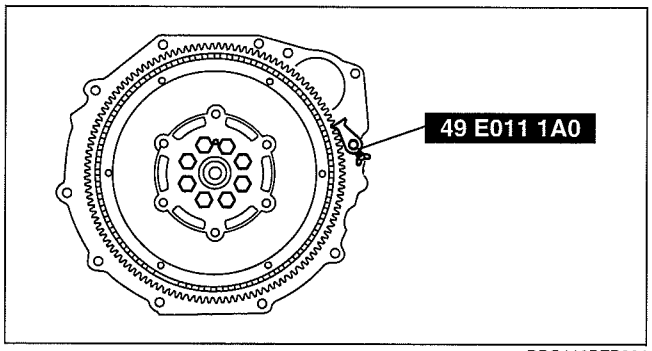
DBG110BEB019

1	Crankshaft pulley (See 01–10B–11 Crankshaft Pulley Disassembly Note.)
2	Seal plate
3	Supply pump pulley (See 01–10B–11 Supply Pump Pulley Disassembly Note.)
4	Timing gear cover (See 01–10B–11 Timing Gear Cover Disassembly Note.)
5	Oil pump
6	Supply pump gear (See 01–10B–12 Supply Pump Gear Disassembly Note.)
7	Timing gear
8	Supply pump

9	Timing gear case (See 01–10B–14 Timing Gear Case Disassembly Note.)
10	Dual-mass flywheel (See 01–10B–14 Dual-mass flywheel Disassembly Note.)
11	End plate
12	Rear cover (See 01–10B–14 Rear Cover Disassembly Note.)
13	Seal plate
14	Oil pump cover
15	Driven gear
16	Plug
17	Plunger spring
18	Control plunger
19	Oil pump body

Crankshaft Pulley Disassembly Note

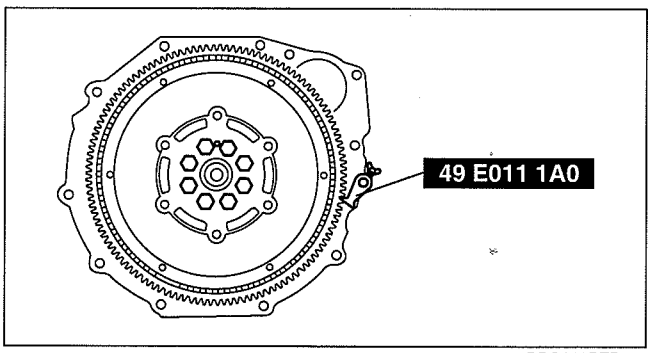
1. Remove the crankshaft pulley using the **SST**.



DBG110BEB064

Supply Pump Pulley Disassembly Note

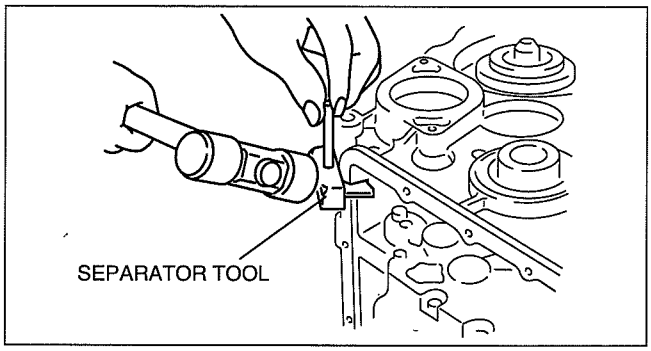
1. Remove the supply pump pulley using the **SST**.



DBG110BEB055

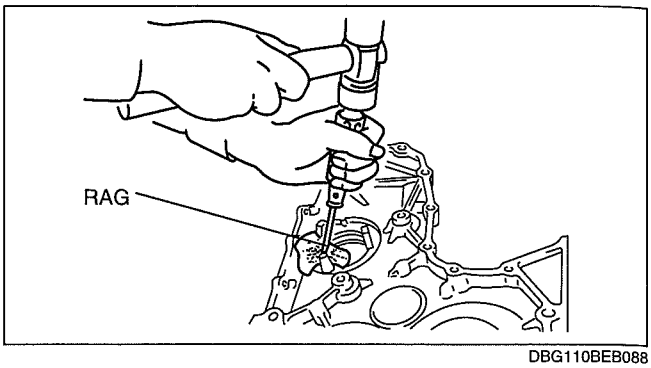
Timing Gear Cover Disassembly Note

1. Remove the timing gear cover using a separator tool.



DBG110BEB087

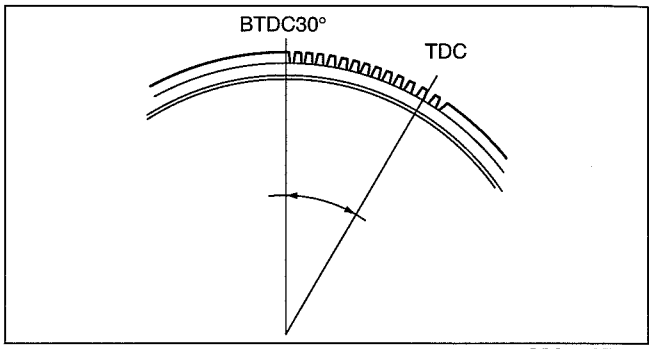
2. Remove the oil seal using a screwdriver protected with a rag,



DBG110BEB088

Supply Pump Gear Disassembly Note

1. Set the No.1 cylinder to TDC of compression.
2. Rotate the flywheel ring gear from TDC to approximately **30°** BTDC (about 13 teeth on the gear).

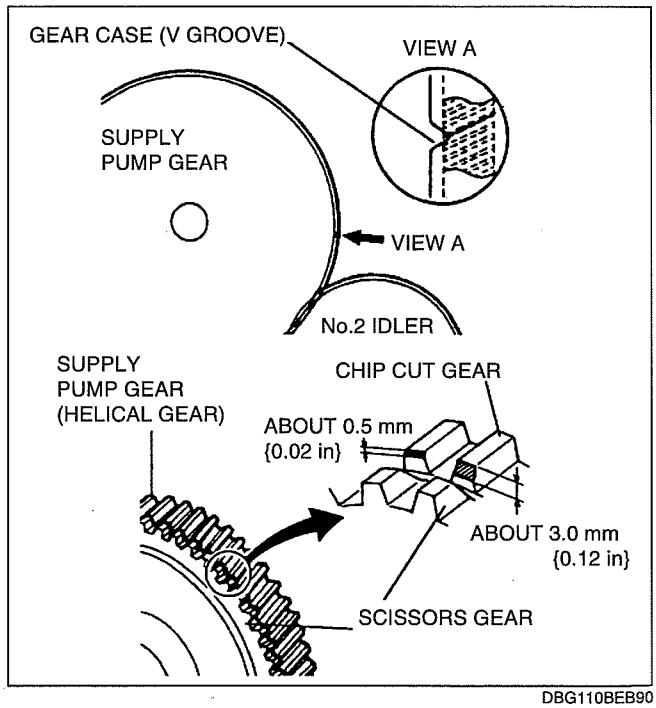


DBG110BEB089

3. Verify that the end-gap (V groove) of the timing gear case and the chip cut gear of the fuel injection pump gear are aligned.

Note

- If the chip cut gear is hard to find, move the supply pump gear on notch back and forth, then check the chip cut gear.



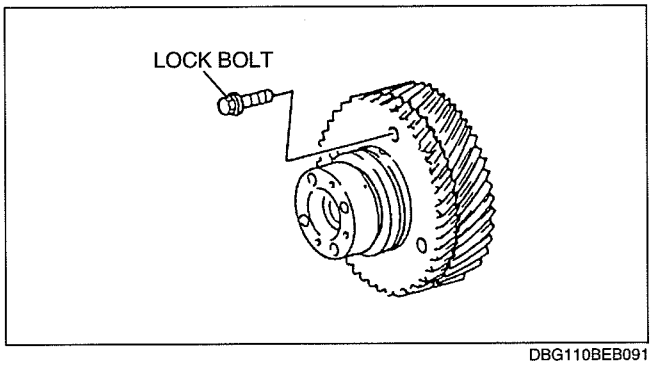
DBG110BEB90

4. Fix the scissors gear to the supply pump gear using a lock bolt (**M6×1.0**; length under the bolt head is approximately **16 mm {0.63 in}**).

Warning
- **When removing the supply pump gear, be sure to secure the scissors gear to the supply pump gear using a lock bolt (M6×1.0; length under the bolt head is approximately 16 mm {0.63 in}). Otherwise, the scissors gear will rotate with the spring force, causing personal injury.**

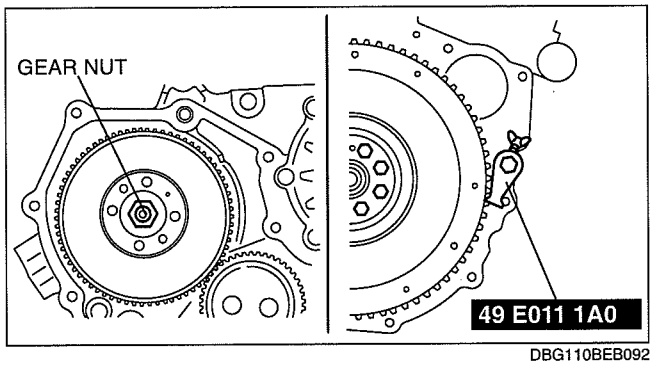
Caution
- **When removing the supply pump gear, be sure to secure the scissors gear to the supply pump gear using a look bolt (M6×1.0; length under the bolt head is approximately 16 mm {0.63 in}) to prevent the scissors gear form rotating with the spring force. Otherwise, the scissors gear will not align with the supply pump gear, and the supply pump gear with the scissors gear will not engage with the idler gear.**

Note
- **The supply pump gear with a scissors gear has a lock bolt hole.**



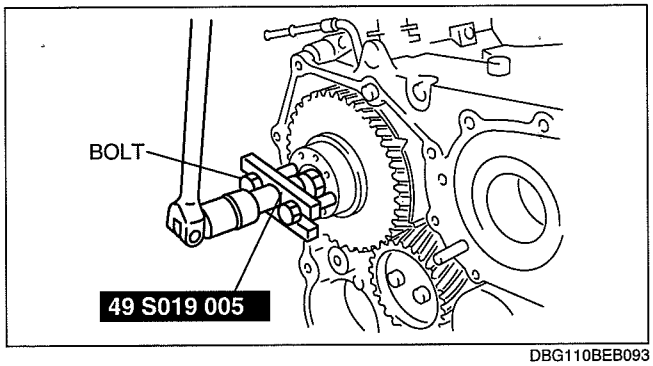
DBG110BEB091

5. Hold the crankshaft using the **SST** and loosen the gear nut.



DBG110BEB092

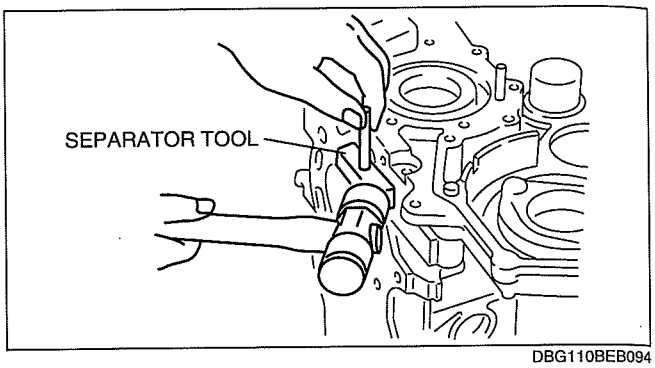
6. Remove the supply pump gear using the **SST** and bolt (**M6X1.0**, Length **30mm {1.18 in}**).



DBG110BEB093

Timing Gear Case Disassembly Note

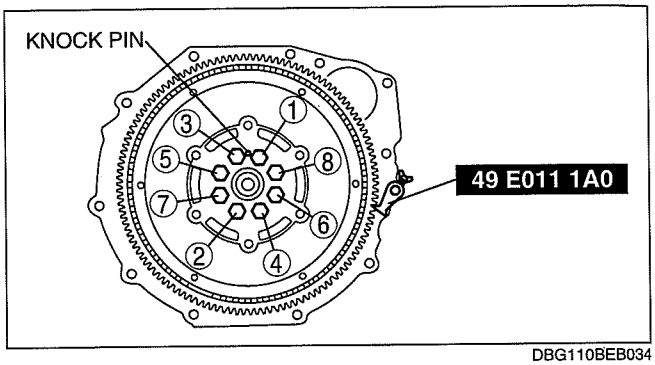
1. Remove the timing gear case using the separator tool.



DBG110BEB094

Dual-mass flywheel Disassembly Note

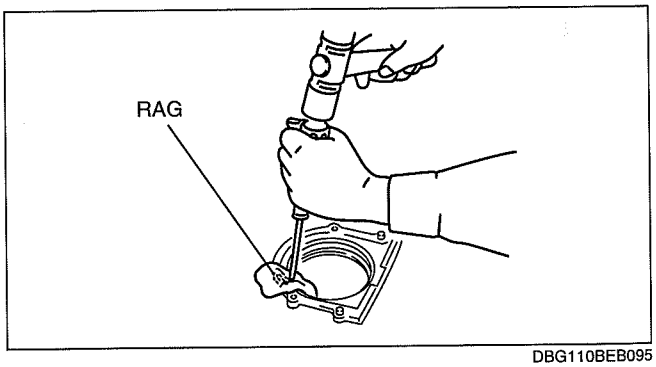
1. Remove the Dual-mass flywheel using the **SST**.



DBG110BEB034

Rear Cover Disassembly Note

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

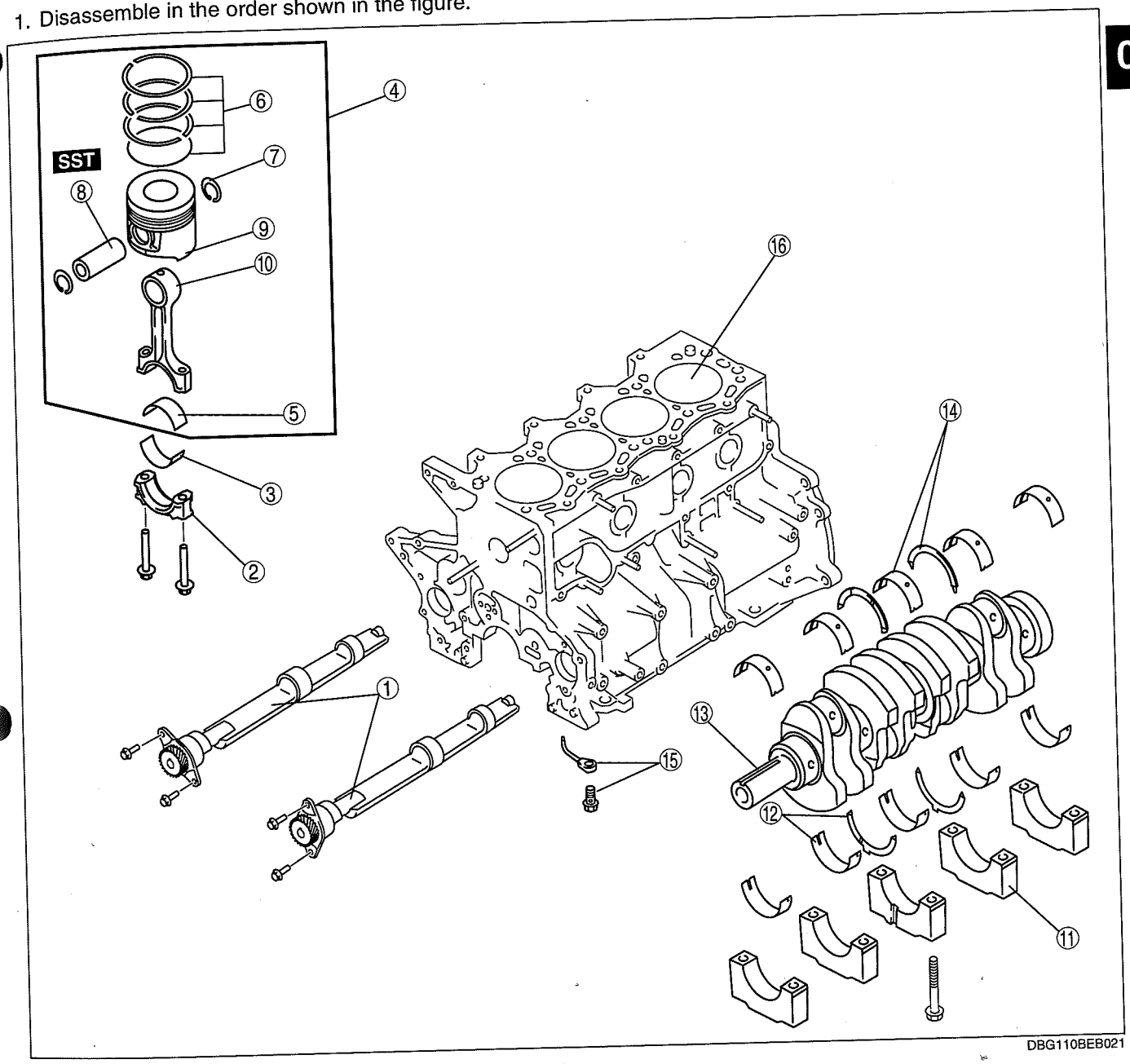


DBG110BEB095

CYLINDER BLOCK DISASSEMBLY (III) [WL-C, WE-C]

DCF011002000W23

1. Disassemble in the order shown in the figure.



DBG110BEB021

1	Balance shaft
2	Connecting rod cap (See 01–10B–16 Connecting Rod Cap Disassembly Note)
3	Lower connecting rod bearing
4	Piston, connecting rod (See 01–10B–16 Piston, Connecting Rod Disassembly Note)
5	Upper connecting rod bearing
6	Piston ring
7	Piston pin clip
8	Piston pin (See 01–10B–16 Piston Pin Disassembly Note)

9	Piston
10	Connecting rod
11	Main bearing cap (See 01–10B–16 Main Bearing Cap Disassembly Note)
12	Lower main bearing, lower thrust bearing
13	Crankshaft (See 01–10A–16 Crankshaft Disassembly Note)
14	Upper main bearing, upper thrust bearing
15	Oil jet valve, nozzle
16	Cylinder block

Connecting Rod Cap Disassembly Note

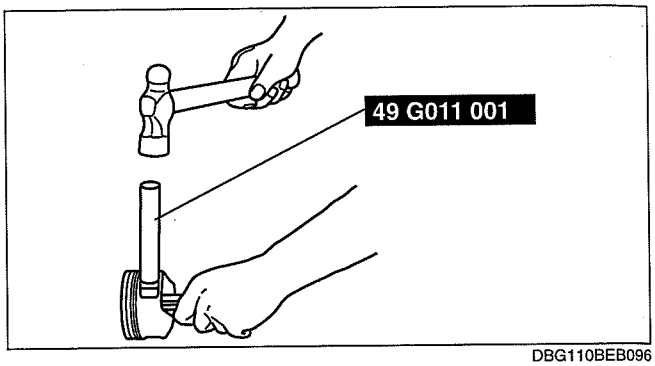
1. Before removing the connecting rod cap, inspect the connecting rod side clearance. (See 01–10B–29 CONNECTING ROD SIDE CLEARANCE INSPECTION [WL-C, WE-C].)

Piston, Connecting Rod Disassembly Note

1. Before removing the piston and connecting rod, inspect the connecting rod oil clearance. (See 01–10B–29 CONNECTING ROD OIL CLEARANCE INSPECTION/REPAIR [WL-C, WE-C].)
2. Inspect the oscillation torque. (See 01–10B–30 PISTON AND CONNECTING ROD INSPECTION [WL-C, WE-C].)

Piston Pin Disassembly Note

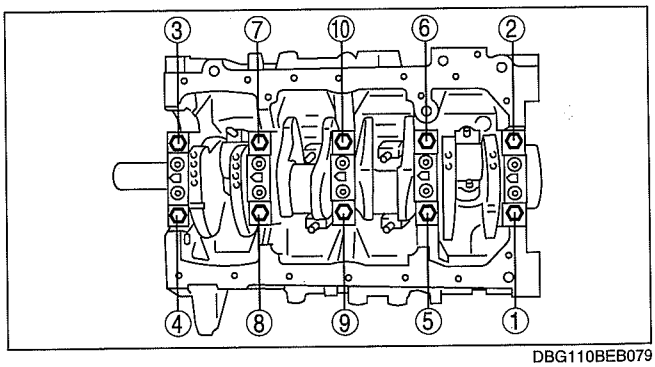
1. Remove the piston pin using the **SST**.



DBG110BEB096

Main Bearing Cap Disassembly Note

1. Before removing the main bearing cap, inspect the crankshaft end play. (See 01–10B–28 CRANKSHAFT END PLAY INSPECTION/REPAIR [WL-C, WE-C].)
2. Loosen the main bearing cap bolts in two or three steps in the order shown in the figure.



DBG110BEB079

Crankshaft Disassembly Note

1. Before removing the crankshaft, inspect the main journal oil clearance. (See 01–10B–28 CRANKSHAFT OIL CLEARANCE INSPECTION/REPAIR [WL-C, WE-C].)

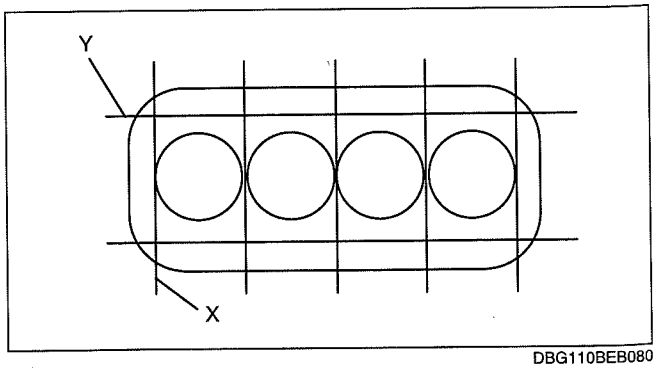
CYLINDER HEAD INSPECTION/REPAIR [WL-C, WE-C]

DCF011010100W02

1. Inspect the cylinder head surface for cracks. Replace the cylinder head if necessary.
2. Inspect for the following and repair or replace.
   (1) Sunken valve seats
   (2) Excessive camshaft oil clearance and end play
3. Measure the cylinder head for distortion in the seven directions as shown in the figure.

   Maximum cylinder head distortion
   X distortion: 0.02 mm {0.0008 in} max.
   Y distortion: 0.05 mm {0.0020 in} max.

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



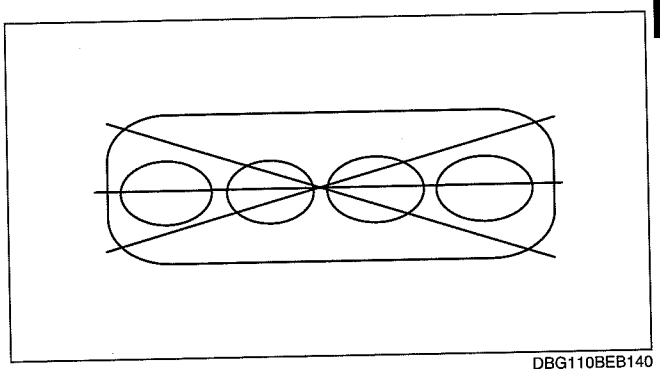
DBG110BEB080

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

Maximum manifold contact surface distortion
0.05 mm {0.002 in} max.

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

Maximum manifold contact surface grinding
0.15 mm {0.0059 in} max.



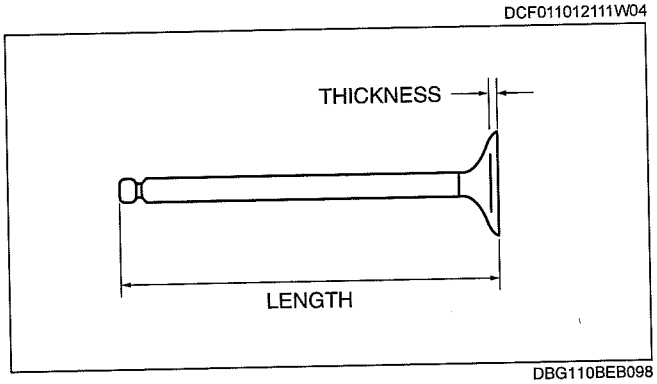
DBG110BEB140

VALVE INSPECTION [WL-C, WE-C]

DCF011012111W04

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

Standard valve margin thickness
IN: 1.55—1.85 mm {0.061—0.072 in}
EX: 1.80—2.10 mm {0.070—0.082 in}



DBG110BEB098

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

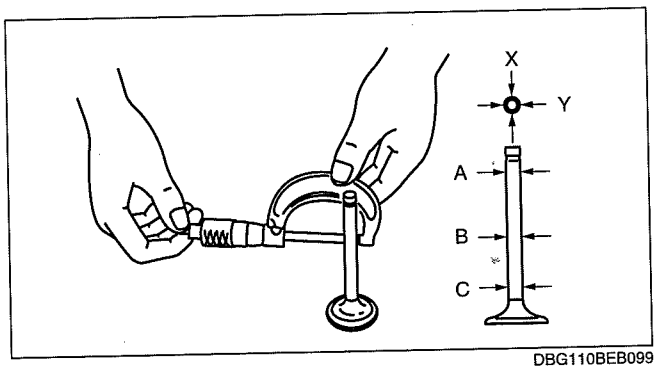
Standard valve length
IN: 111.65—112.25 mm {4.394—4.413 in}
EX: 111.6—112.2 mm {4.390—4.409 in}

Minimum valve length
IN: 111.50 mm {4.390 in}
EX: 111.45 mm {4.388 in}

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

Standard valve stem diameter
IN: 5.970—5.985 mm {0.2350—0.2356 in}
EX: 5.965—5.980 mm {0.2348—0.2354 in}

Minimum valve stem diameter
IN: 5.920 mm {0.2330 in}
EX: 5.915 mm {0.2328 in}



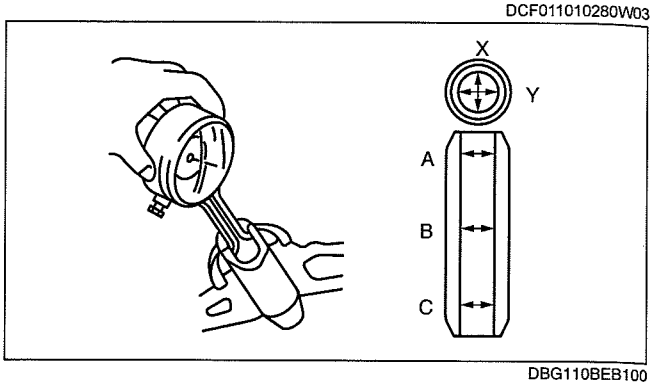
DBG110BEB099

VALVE GUIDE INSPECTION [WL-C, WE-C]

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

   Standard valve guide inner diameter
   6.025—6.045 mm {0.2372—0.2379 in}

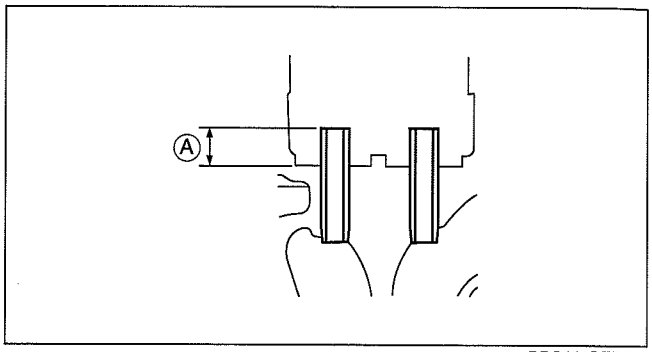
DCF011010280W03



DBG110BEB100

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

   Standard valve guide height
   IN: 15.0—15.5 mm {0.59—0.61 in}
   EX: 17.0—17.5 mm {0.67—0.69 in}



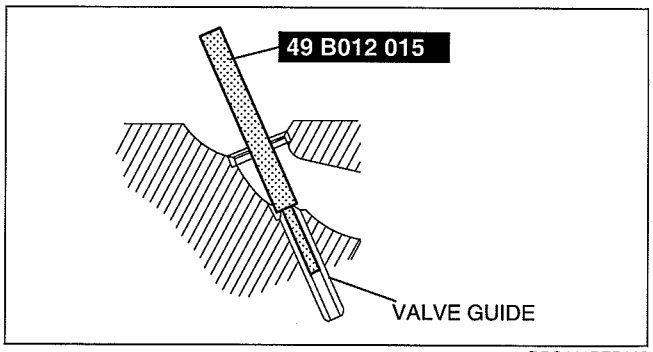
DBG110BEB101

VALVE GUIDE REPLACEMENT [WL-C, WE-C]

Valve Guide Removal

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

DCF011010280W04

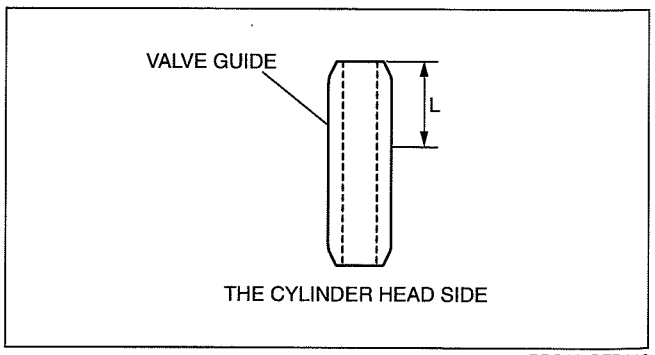


DBG110BEB102

Valve Guide Installation

1. Mark the dimension L position on the valve guide.

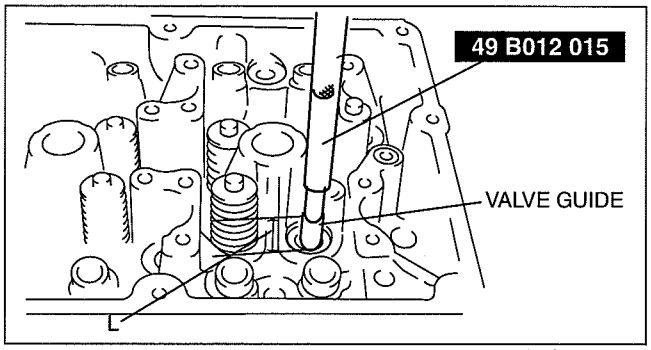
   Depth L
   IN: 15.0—15.5 mm {0.59—0.61 in}
   EX: 17.0—17.5 mm {0.67—0.68 in}



DBG110BEB110

2. When the valve guide nears the dimension L position while it is being tapped in, verify the dimension L position again with vernier calipers to prevent deviation in insertion.
3. Verify that the valve guide projection height is within the specification.

Standard valve guide height
IN: 15.0—15.5 mm {0.59—0.61 in}
EX: 17.0—17.5 mm {0.67—0.68 in}



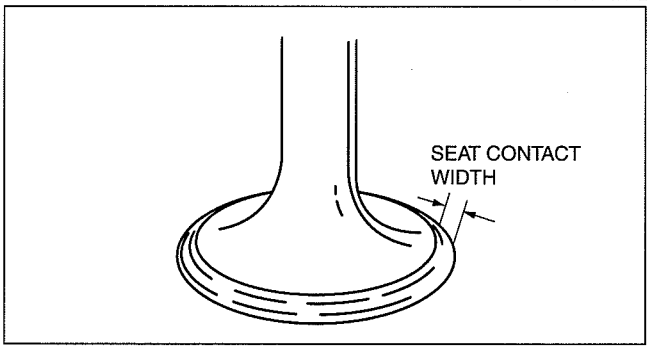
DBG110BEB045

VALVE SEAT INSPECTION/REPAIR [WL-C, WE-C]

DCF011010102W02

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

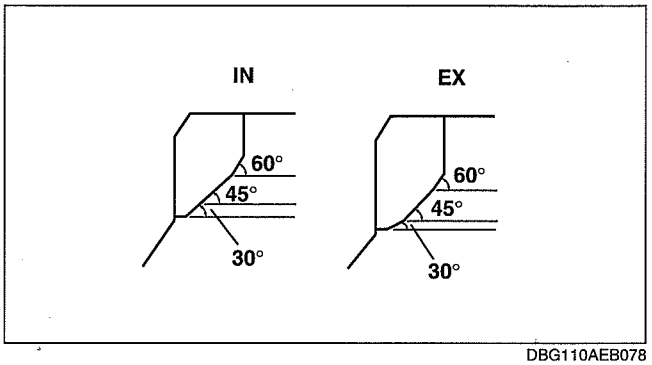
Standard valve seat contact width
1.3—1.9 mm {0.052—0.074 in}



DBG110AEB109

2. Verify that the valve seating position is at the center of the valve face.
   1. If the seating position is too high, correct the valve seat using a **60°** cutter, and then a **45°** cutter.
   2. If the seating position is too low, correct the valve seat using a **30°** cutter, and a **45°** cutter.

Valve seat angle
IN: 45°
EX: 45°

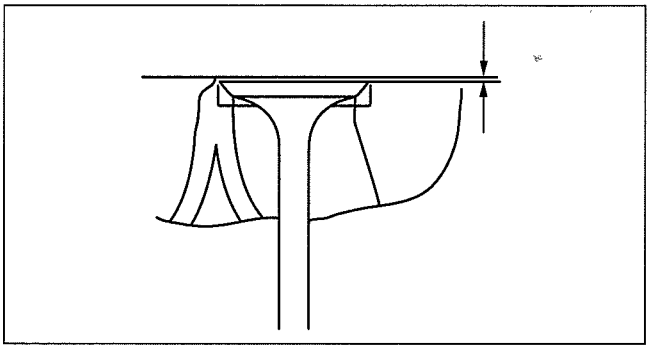


DBG110AEB078

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

Standard valve recession
IN: 0.79—1.27 mm {0.039—0.050 in}
EX: 0.84—1.32 mm {0.033—0.051 in}

Maximum valve recession
IN: 1.68 mm {0.066 in}
EX: 1.73 mm {0.062 in}



DBG110AEB112

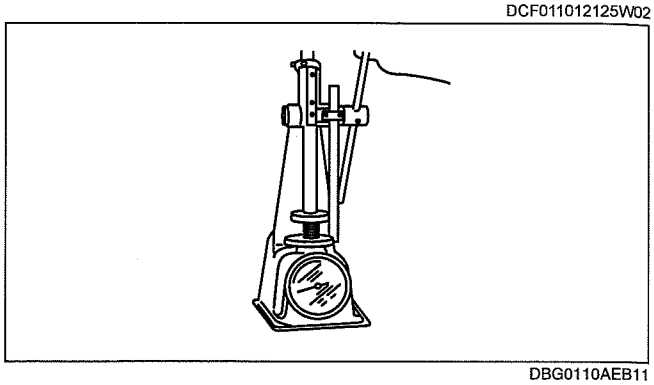
VALVE SPRING INSPECTION [WL-C, WE-C]

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

   Valve spring installation pressing force
   172.9—195.6 N {15.67—17.74 kgf, 34.48—39.02 lbf}

   Valve spring installation height
   39.0 mm {1.53 in}

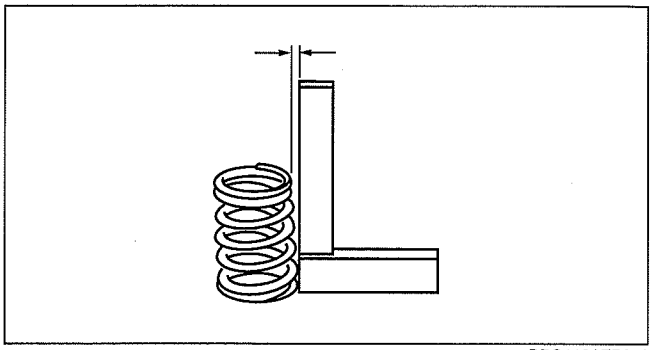
DCF011012125W02



DBG0110AEB11

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

   Maximum valve spring out-of-square
   2.0° (1.60mm {0.062 in})



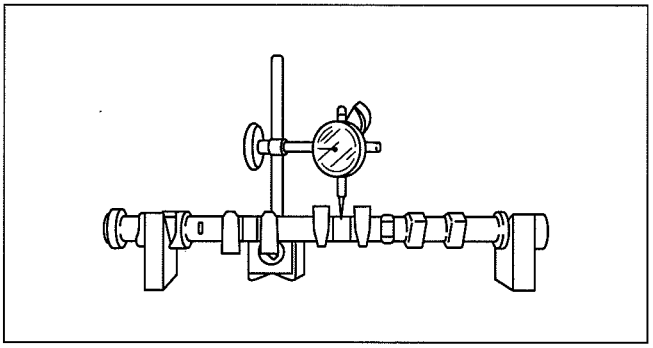
DBG110AEB079

CAMSHAFT INSPECTION [WL-C, WE-C]

1. Set the No.1 and No.5 journals on V-blocks. Measure the camshaft runout. Replace the camshaft if necessary.

   Maximum camshaft runout
   0.03 mm {0.001 in} max.

DCF011012420W04

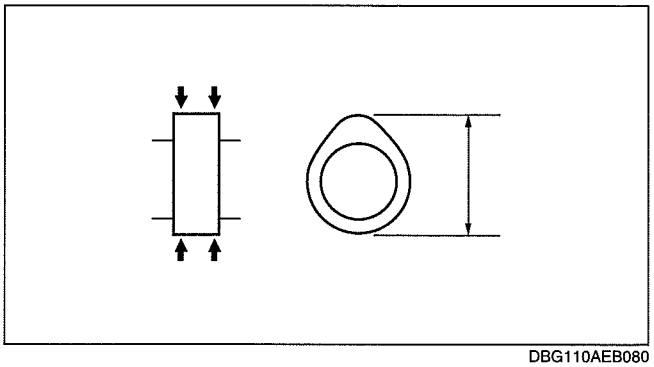


DBG110AEB114

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

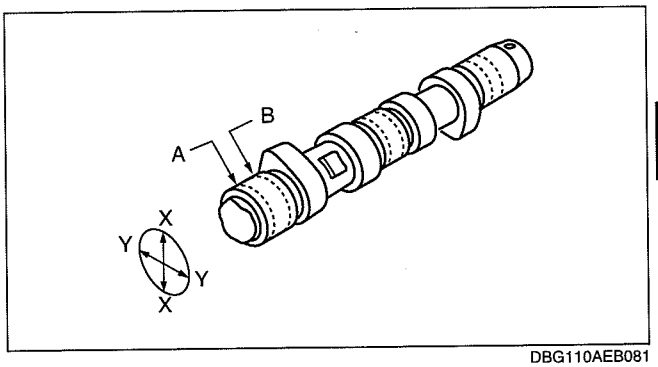
   Standard cam lobe height
   IN: 42.067—42.167 mm {1.6561—1.6601 in}
   EX: 41.949—42.049 mm {1.6515—1.6554 in}

   Minimum cam lobe height
   IN: 41.717 mm {1.6424 in}
   EX: 41.599 mm {1.6377 in}



DBG110AEB080

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



DBG110AEB081

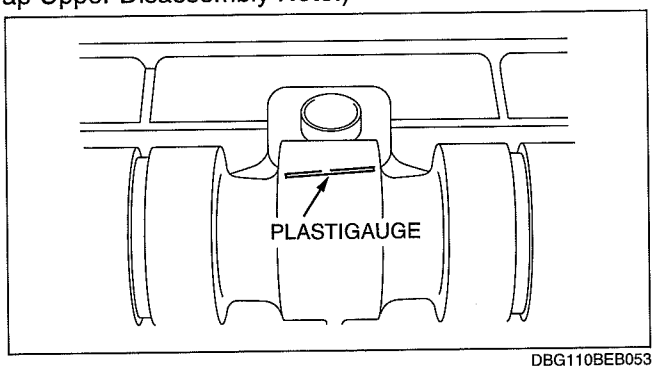
Standard cam journal diameter
No.1: 31.940—31.965 mm {1.2575—1.2582 in}
No.2—No.4: 25.910—25.935 mm {1.0201—1.0210 in}
No.5: 25.940—25.965 mm {1.0212—1.0222 in}

Minimum cam journal diameter
No.1: 31.890 mm {1.2555 in}
No.2—No.4: 25.860 mm {1.0181 in}
No.5: 25.890 mm {1.0193 in}

CAMSHAFT OIL CLEARANCE INSPECTION [WL-C, WE-C]

DCF011012420W05

1. Position a plastigage on top of the journals in the axial direction.
2. Install the camshaft cap. (See 01–10B–49 Camshaft Cap Upper Assembly Note.)
3. Remove the camshaft cap. (See 01–10B–7 Camshaft Cap Upper Disassembly Note.)
4. Measure the oil clearance. Replace the cylinder head if necessary.



DBG110BEB053

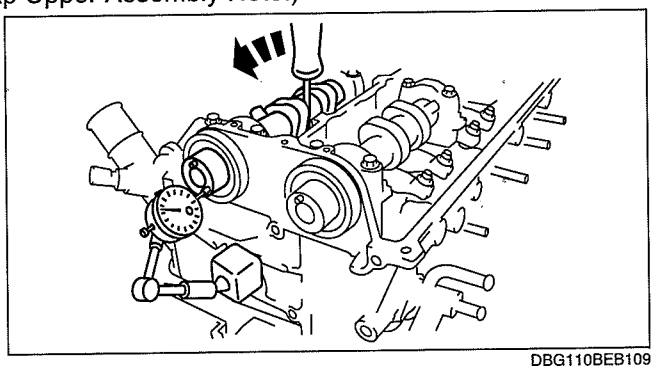
Standard camshaft clearance
No.1: 0.035—0.081 mm {0.0014—0.0031 in}
No.2—4: 0.065—0.111 mm {0.0026—0.0043 in}
No.5: 0.056—0.081 mm {0.0014—0.0031 in}

Maximum camshaft clearance
No.1: 0.12 mm {0.0047 in}
No.2—4: 0.15 mm {0.0059 in}
No.5: 0.16 mm {0.0063 in}

CAMSHAFT END PLAY INSPECTION [WL-C, WE-C]

DCF011012420W06

1. Install the camshaft cap. (See 01–10B–49 Camshaft Cap Upper Assembly Note.)
2. Measure the camshaft end play. Replace the cylinder head or camshaft if necessary.


DBG110BEB109

Standard camshaft end play
0.030—0.160 mm {0.0012—0.0062 in}

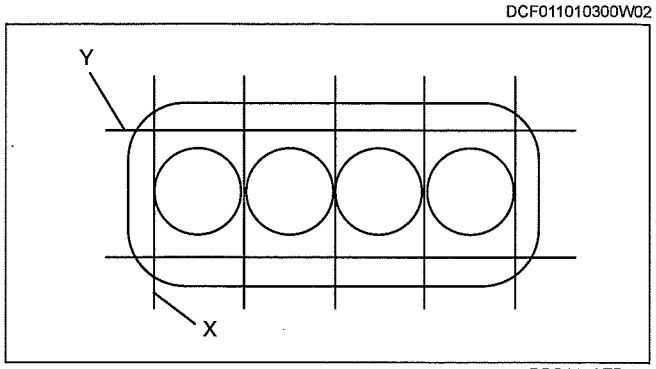
Maximum camshaft end play
0.20 mm {0.0078 in}

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

CYLINDER BLOCK INSPECTION/REPAIR [WL-C, WE-C]

DCF011010300W02

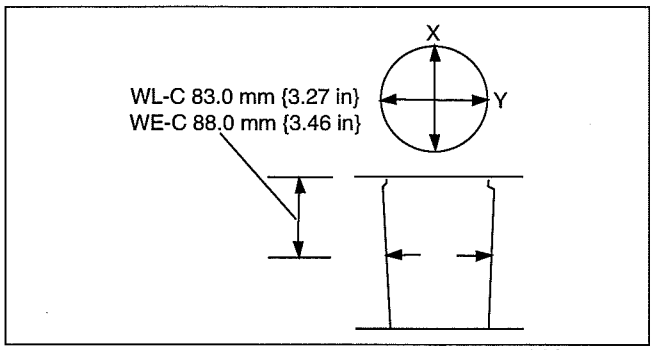
1. Measure the distortion of the cylinder block top surface in the seven directions as shown in the figure. Replace if necessary.



DBG110AEB115

Maximum cylinder block distortion
X direction: 0.02 mm {0.0008 in}
Y direction: 0.05 mm {0.002 in}

2. Measure the cylinder bore using the cylinder gauge. Measurement positions are in the X and Y directions at **83 mm {3.27 in}** (WL-C) or **88 mm {3.46 in}** (WE-C) below the top surface of the cylinder.
   - If the cylinder bore exceeds the wear limit, replace the cylinder block or rebore the cylinder and install the oversized pistons so that the specified piston-to-cylinder clearance is obtained.



DBG110BEB047

Note
- Base the boring diameter on the diameter of an oversized piston. All cylinders must be the same diameter.

Cylinder bore size [WL-C]
Standard: 93.000—93.022 mm {3.6615—3.6622 in}
0.25 {0.01} oversize: 93.250—93.272 mm {3.6713—3.6721 in}
0.50 {0.02} oversize: 93.500—93.522 mm {3.6811—3.6819 in}

Cylinder bore size [WE-C]
Standard: 96.000—96.022 mm {3.6615—3.6622 in}
0.25 {0.01} oversize: 96.250—96.272 mm {3.7893—3.7902 in}
0.50 {0.02} oversize: 96.500—96.522 mm {3.7992—3.8000 in}

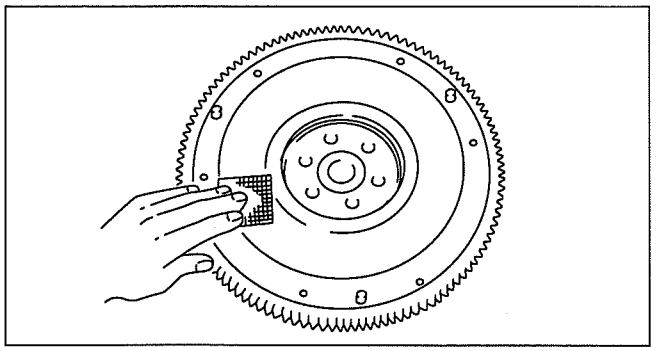
Cylinder bore wear limit
0.15 mm {0.0059 in}

DUAL-MASS FLYWHEEL INSPECTION [WL-C, WE-C]

DCF011011500W01

Caution
- **Do not rework the flywheel if it is distorted.**
- **Do not clean the dual mass flywheel with any kind of fluid. Clean the flywheel with a dry cloth only.**
- **Do not clean the gap between the primary and secondary mass. Only clean the bolt connection surface and the clutch surface.**

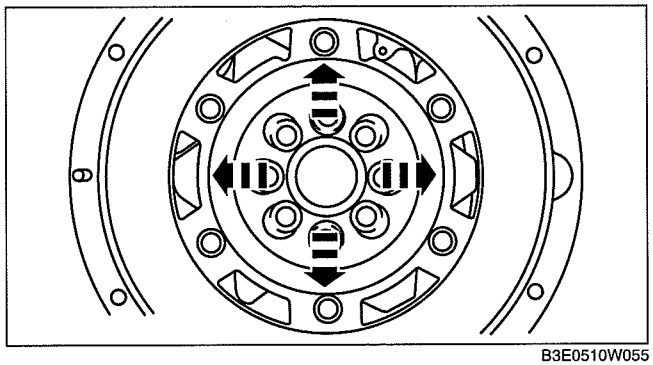
Note
- Correct slight scratches and discoloration using sandpaper.
- Inspect the runout of the surface that contacts the clutch disc with the flywheel installed to the crankshaft.



C3U0510W004

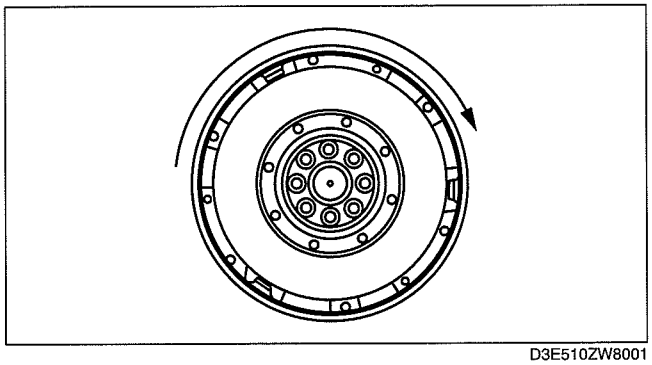
1. Inspect the flywheel.
   — Cracks
   — Worn ring gear teeth
   — Chipped or cracked ring gear teeth
   — Surface that contacts the clutch disc for scratches, nicks, and discoloration.
   - If there is any malfunction, replace the flywheel.

2. Verify that the center of the flywheel does not move.
   (1) Rotate the flywheel or attempt to move it up and down, and left and right to verify that the center of the flywheel does not move.
      - If there is any movement as indicated by the arrows in the figure, replace the flywheel with a new one.



B3E0510W055

3. Verify that the secondary mass rotates by 15 teeth or more.
   - If it rotates by 15 teeth or more, replace the dual-mass flywheel.

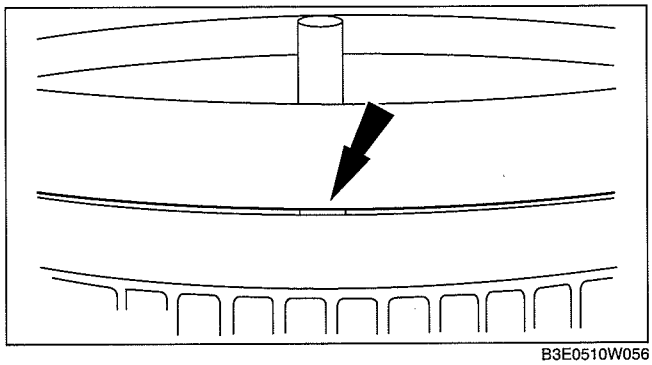


D3E510ZW8001

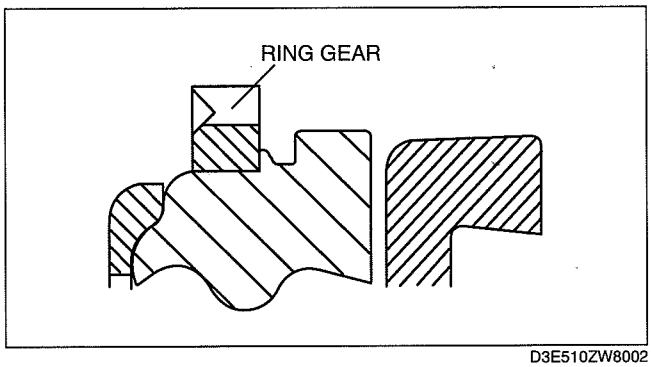
4. Inspect for locating dowels touching the primary mass of the flywheel.

   Caution
   - **Make sure that the three locating dowels are installed.**

   - If the locating dowels are touching the primary mass of the flywheel, replace the flywheel with a new one.
5. Visually inspect the secondary mass.
   - If there is any damage, replace the dual-mass flywheel.
6. Visually inspect the ring gear on the dual-mass flywheel.
   - If there is any damage, replace the dual-mass flywheel.

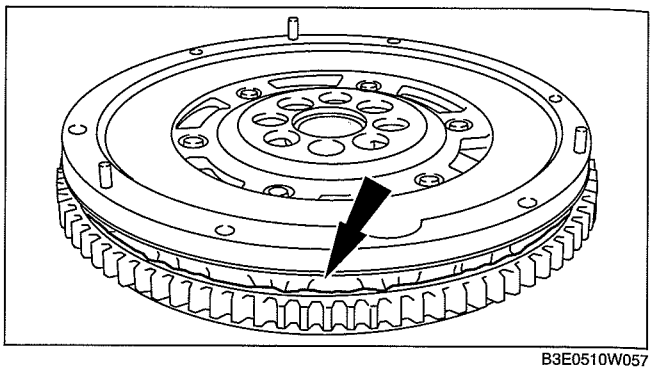


B3E0510W056



D3E510ZW8002

7. Inspect the welded area of the dual-mass flywheel for grease leakage.
   - If there is grease leakage, replace the dual-mass flywheel.

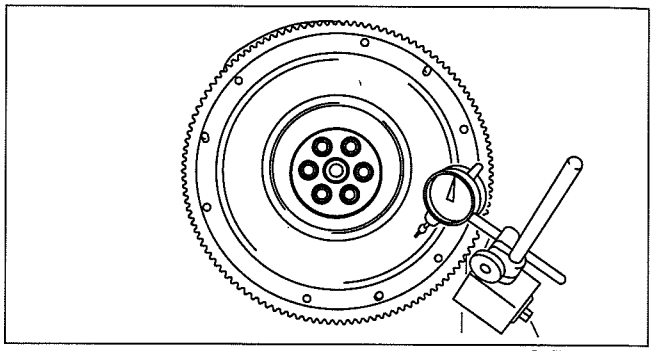


B3E0510W057

8. Inspect the dual-mass flywheel runout.

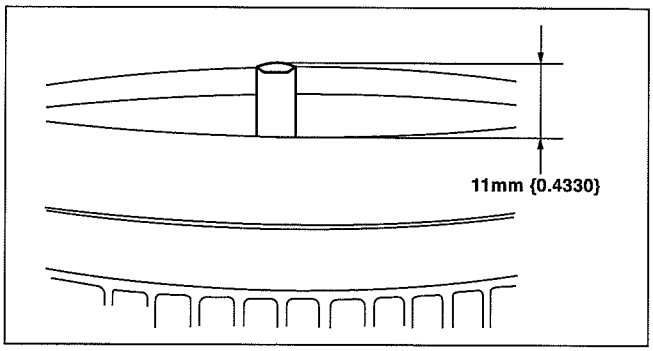
   Flywheel maximum runout
   1.5 mm {0.059 in}

   - If it is more than the maximum specification, replace the dual-mass flywheel.



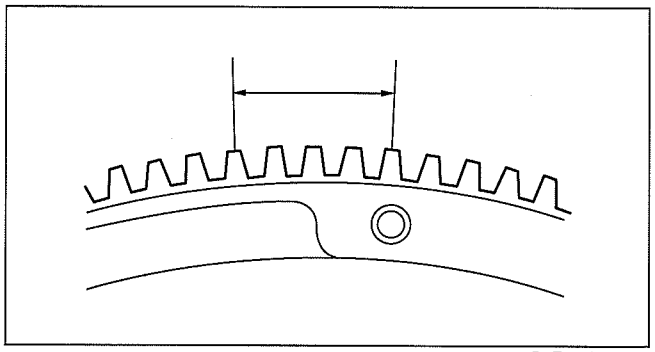
D3E510ZW8007

9. Inspect the dual-mass flywheel for the amount of guide pin projection.
   - If not within the specification, replace the dual-mass flywheel.



D3E510ZW8005

10. Rotate the secondary mass left and right and verify that it rotates within a range of five teeth without resistance.
    - If there is any malfunction, replace the dual-mass flywheel.
11. Inspect the dual-mass flywheel for cracks.
    - If there are cracks, replace the dual-mass flywheel.



D3E510ZW8006

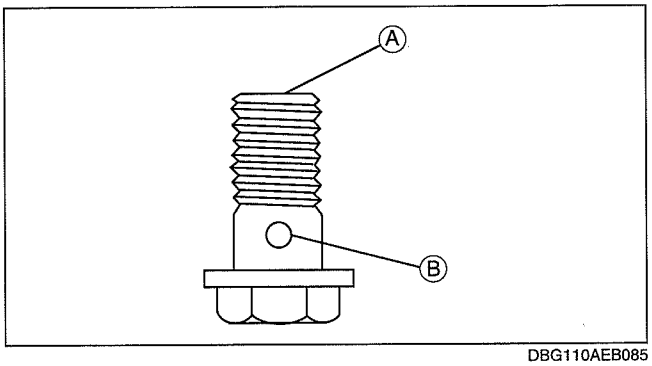
OIL JET VALVE, NOZZLE INSPECTION [WL-C, WE-C]

DCF011010730W02

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

Oil jet air pressure
137.6—196.4 kPa {1.4—2.0 kgf/cm^2, 20—28 psi}

2. Check the oil jet nozzle for clogs. Replace the nozzle if necessary.



DBG110AEB085

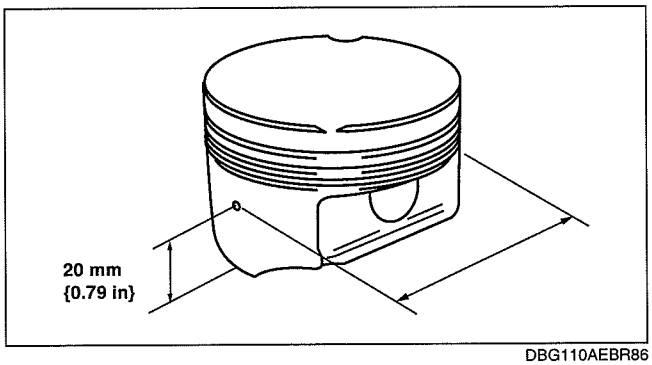
PISTON INSPECTION [WL-C, WE-C]

DCF011011010W06

1. Measure the outer diameter of each piston at right angle (**90°**) to the piston pin, **20 mm {0.79 in}** below the oil ring land lower edge.

Piston diameter [WL-C]
Standard: 92.918—92.944 mm {3.6582—3.6592 in}
0.25 {0.010} oversize: 93.153—93.179 mm {3.6675—3.6684 in}
0.50 {0.020} oversize: 93.403—93.429 mm {3.6773—3.6782 in}

Piston diameter [WE-C]
Standard: 95.918—95.944 mm {3.7763—3.7773 in}
0.25 {0.010} oversize: 96.153—96.179 mm {3.7856—3.7865 in}
0.50 {0.020} oversize: 96.403—96.429 mm {3.7954—3.7964 in}



DBG110AEBR86

PISTON CLEARANCE INSPECTION/REPAIR [WL-C, WE-C]

DCF011011010W07

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

Standard piston clearance
0.071—0.089 mm {0.0015—0.0022 in}

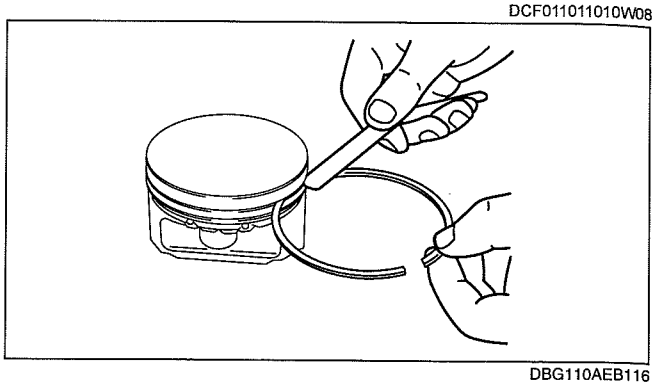
Maximum piston clearance
0.15 mm {0.0059 in}

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

PISTON RING CLEARANCE INSPECTION [WL-C, WE-C]

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

DCF011011010W08



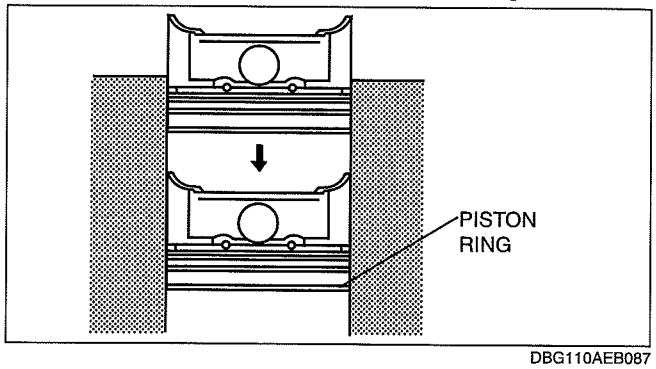
DBG110AEB116

Standard piston ring clearance [WL-C]
Top: 0.06—0.10 mm {0.0024—0.0039 in}
Second: 0.04—0.08 mm {0.0016—0.0031 in}
Oil: 0.02—0.06 mm {0.0012—0.0023 in}

Standard piston ring clearance [WE-C]
Top: 0.06—0.10 mm {0.0024—0.0039 in}
Second: 0.04—0.08 mm {0.0016—0.0031 in}
Oil: 0.02—0.06 mm {0.0008—0.0023 in}

Maximum piston ring clearance
0.15 mm {0.0059 in}

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



DBG110AEB087

Standard piston ring end gap [WL-C]
Top: 0.22—0.32 mm {0.0087—0.0125 in}
Second: 0.49—0.64 mm {0.0193—0.0251 in}
Oil: 0.22—0.52 mm {0.0087—0.0204 in}

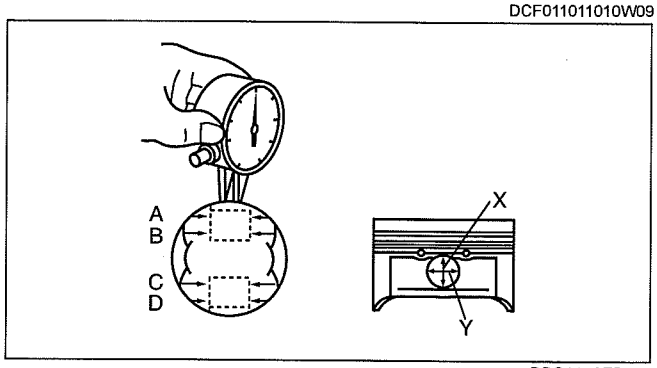
Standard piston ring end gap [WE-C]
Top: 0.23—0.33 mm {0.0091—0.0129 in}
Second: 0.50—0.65 mm {0.0197—0.0255 in}
Oil: 0.22—0.52 mm {0.0087—0.0204 in}

Maximum piston ring end gap
1.0 mm {0.039 in}

PISTON PIN CLEARANCE INSPECTION [WL-C, WE-C]

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

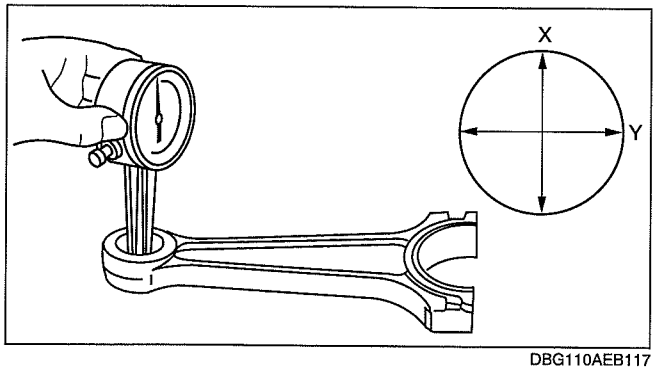
DCF011011010W09



DBG110AEB088

Standard piston pin bore diameter
33.997—34.007 mm {1.3384—1.3388 in}

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

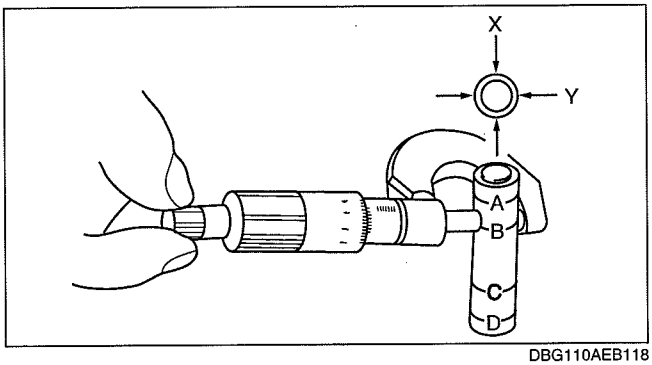


DBG110AEB117

Standard connecting rod small end inner diameter
34.012—34.033 mm {1.3391—1.3398 in}

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

   Standard piston pin diameter
   33.994—34.000 mm {1.3384—1.3385 in}



DBG110AEB118

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

   Standard piston pin-to-piston pin bore clearance
   –0.003—0.013 mm {–0.0001—0.0005 in}

5. Calculate the connecting rod small end-to-piston pin clearance. Replace the connecting rod or piston pin.

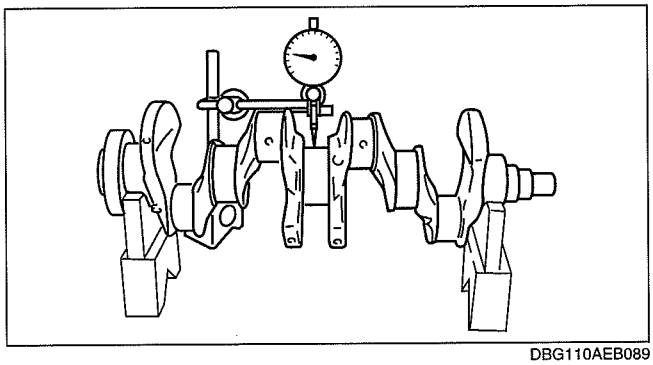
   Standard connecting rod small end-to-piston pin clearance
   0.012—0.039 mm {0.00048—0.0015 in}

CRANKSHAFT INSPECTION [WL-C, WE-C]

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

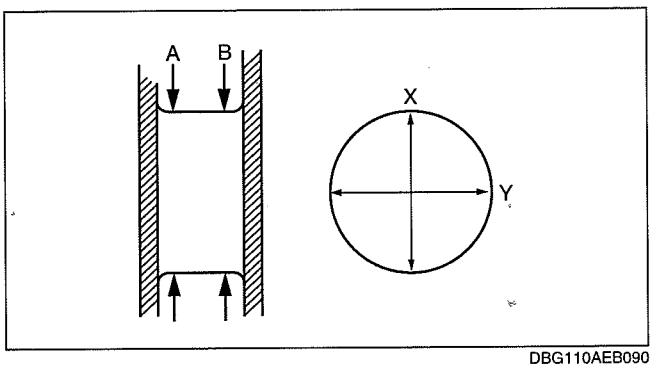
   Maximum crankshaft runout
   0.05 mm {0.002 in}

DCF011011301W04


DBG110AEB089

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

   Main journal diameter [No.1,2,4,5]
   Standard: 66.937—66.955 mm {2.6354—2.6360 in}
   0.25 {0.010} undersize: 66.687—66.705 mm {2.6255—2.6261 in}
   0.50 {0.020} undersize: 66.437—66.455 mm {2.6157—2.6163 in}
   0.75 {0.030} undersize: 66.187—66.205 mm {2.6058—2.6064 in}



DBG110AEB090

   Main journal diameter [No.3]
   Standard: 66.920—66.938 mm {2.6347—2.6353 in}
   0.25 {0.010} undersize: 66.670—66.688 mm {2.6367—2.6373 in}
   0.50 {0.020} undersize: 66.420—66.438 mm {2.6150—2.6156 in}
   0.75 {0.030} undersize: 66.170—66.188 mm {2.6052—2.6058 in}

   Main journal wear limit
   0.05 mm {0.002 in}

   Main journal out-of-round
   0.03 mm {0.001 in}

Crank pin diameter [WL-C]
Standard: 54.940—54.955 mm {2.1630—2.1635 in}
0.25 {0.010} undersize: 54.690—54.705 mm {2.1532—2.1537 in}
0.50 {0.020} undersize: 54.440—54.455 mm {2.1434—2.1438 in}
0.75 {0.030} undersize: 54.190—54.205 mm {2.1335—2.1340 in}

Crank pin diameter [WE-C]
Standard: 56.940—56.955 mm {2.2417—2.2423 in}
0.25 {0.010} undersize: 56.690—56.705 mm {2.2318—2.2324 in}
0.50 {0.020} undersize: 56.440—56.455 mm {2.2220—2.2226 in}
0.75 {0.030} undersize: 56.190—56.205 mm {2.2122—2.2128 in}

Crank pin wear limit
0.05 mm {0.0020 in}

Crank pin out-of-round
0.03 mm {0.0012 in}

CRANKSHAFT OIL CLEARANCE INSPECTION/REPAIR [WL-C, WE-C]

DCF011011301W05

1. Position a plastigage on top of the journals in the axial direction.
2. Install the main bearing cap. (See 01–10B–35 Main Bearing Cap Assembly Note.)
3. Remove the main bearing cap. (See 01–10B–16 Main Bearing Cap Disassembly Note.)
4. Measure the main journal oil clearance. If the clearance exceeds the maximum, replace the main bearing or grind the main journal and install the undersize bearings so that the specified oil clearance is obtained.

Standard main journal clearance
No.1, 2, 4, 5: 0.027—0.045 mm {0.0010—0.0017 in}
No.3: 0.044—0.062 mm {0.0017—0.0024 in}

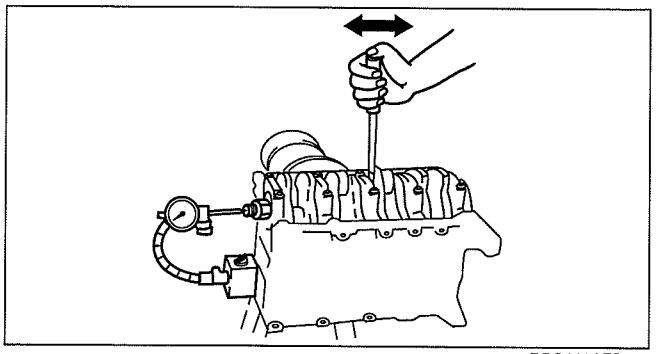
Maximum main journal clearance
0.08 mm {0.003 in}

Main bearing thickness
Standard: 2.006—2.021 mm {0.0789—0.0794 in}
0.25 {0.010} undersize: 2.124—2.134 mm {0.0836—0.0838 in}
0.50 {0.020} undersize: 2.249—2.259 mm {0.0885—0.0888 in}
0.75 {0.030} undersize: 2.374—2.384 mm {0.0934—0.0937 in}

CRANKSHAFT END PLAY INSPECTION/REPAIR [WL-C, WE-C]

DCF011011301W06

1. Install the main bearing cap. (See 01–10B–35 Main Bearing Cap Assembly Note.)
2. Measure the crankshaft end play. If the end play exceeds the maximum, replace the thrust bearing or grind the crankshaft and install an oversized bearing so that the specified end play is obtained.



DBG110AEB120

Standard crankshaft end play
0.040—0.282 mm {0.0016—0.0111 in}

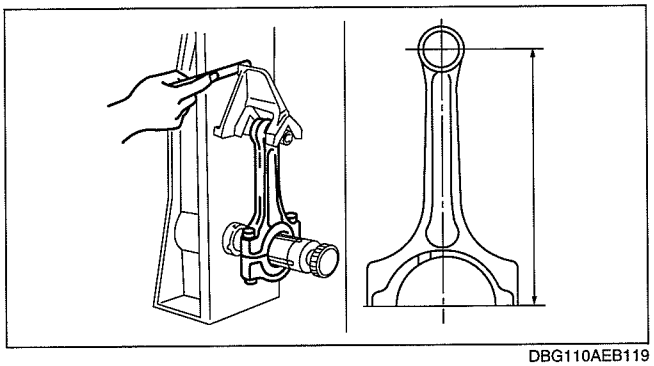
Maximum crankshaft end play
0.3 mm {0.01 in}

Thrust bearing thickness
Standard: 2.455—2.505 mm {0.0967—0.986 in}
0.35 {0.010} oversize: 2.630—2.680 mm {0.1036—0.1055 in}

3. Remove the main bearing cap. (See 01–10B–16 Main Bearing Cap Disassembly Note.)

CONNECTING ROD INSPECTION [WL-C, WE-C]

DCF011011211W04



DBG110AEB119

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

Connecting rod bending
0.075 mm {0.0030 in} max./50 mm {1.968 in}

Connecting rod distortion
0.18 mm {0.0070 in} max./50 mm {1.968 in}

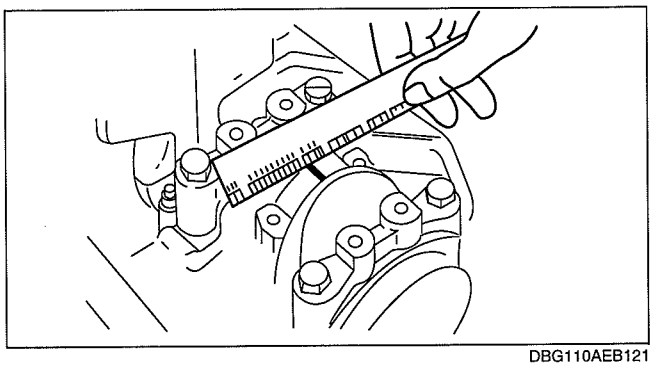
Connecting rod center-to-center distance [WL-C]
162.96—163.04 mm {6.416—6.418 in}

Connecting rod center-to-center distance [WE-C]
157.96—158.04 mm {6.219—6.222 in}

CONNECTING ROD OIL CLEARANCE INSPECTION/REPAIR [WL-C, WE-C]

DCF011011211W05

1. Position a plastigage on top of the journals in the axial direction.
2. Install the connecting rod cap. (See 01–10B–36 Piston, Connecting Rod Assembly Note.)
3. Remove the connecting rod cap.
4. Measure the crankpin oil clearance. If the clearance exceeds the maximum, replace the connecting rod bearing or grind the crankpin and use undersized bearings so that the specified clearance is obtained.



DBG110AEB121

Standard connecting rod oil clearance
0.025—0.052 mm {0.0009—0.0020 in}

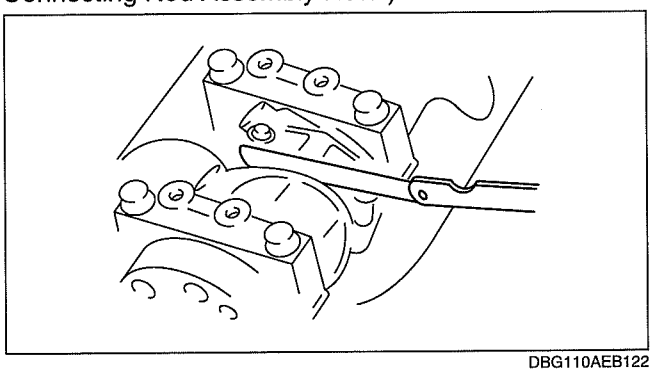
Maximum connecting rod oil clearance
0.08 mm {0.003 in}

Connecting rod bearing thickness
Standard: 1.507—1.516 mm {0.0592—0.0595 in}
0.25 {0.010} undersize: 1.624—1.634 mm {0.0638—0.0642 in}
0.50 {0.020} undersize: 1.749—1.759 mm {0.0687—0.0691 in}
0.75 {0.030} undersize: 1.874—1.884 mm {0.0737—0.0740 in}

CONNECTING ROD SIDE CLEARANCE INSPECTION [WL-C, WE-C]

DCF011011211W06

1. Install the connecting rod cap. (See 01–10B–36 Piston, Connecting Rod Assembly Note.)
2. Measure the connecting rod large end side clearance. Replace the connecting rod and cap if necessary.



DBG110AEB122

Standard connecting rod side clearance
0.110—0.262 mm {0.0043—0.0103 in}

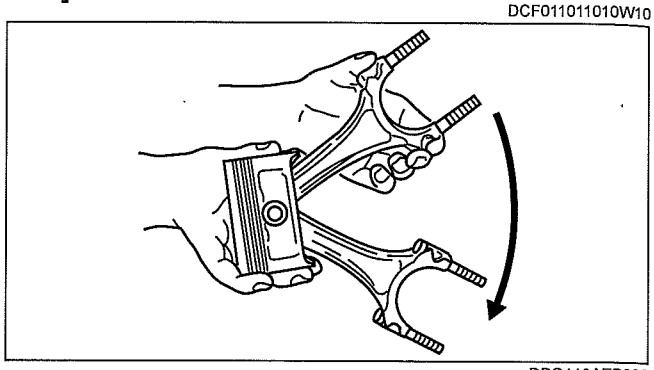
Maximum connecting rod side clearance
0.35 mm {0.014 in}

3. Remove the connecting rod cap.

PISTON AND CONNECTING ROD INSPECTION [WL-C, WE-C]

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

DCF011011010W10



DBG110AEB093

BALANCE SHAFT INSPECTION [WL-C, WE-C]

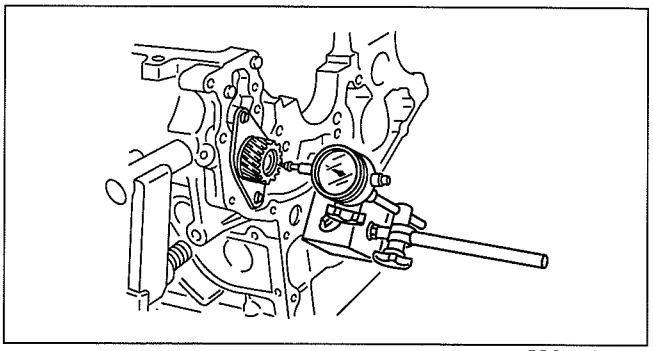
DCF011010300W03

1. Install the balance shaft and tighten the thrust plate fitting bolt.

   Tightening torque
   7.85—10.8 N·m {80—110 kgf·m, 70—95 in·lbf}

2. Measure the balance shaft end play. Replace the balance shaft and/or cylinder block if necessary.

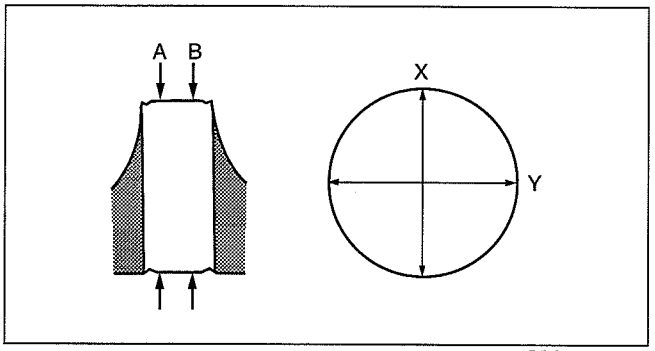
   Balance shaft Standard end play
   0.04—0.16 mm {0.002—0.006 in}



DBG110AEB094

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

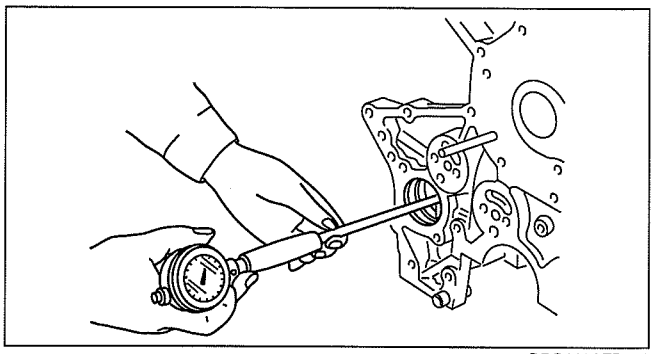
   Standard diameter
   Front: 41.945—41.960 mm {1.6514—1.6519 in}
   Center: 39.945—39.960 mm {1.5727—1.5732 in}
   Rear: 37.975—37.990 mm {1.4951—1.4956 in}



DBG110AEB095

4. Measure the balance shaft bore in the cylinder block. Calculate the balance shaft-to-balance shaft bore clearance. Replace the balance shaft and/or cylinder block if necessary.

   Standard clearance
   Front, rear: 0.050—0.115 mm {0.0020—0.0045 in}
   Center: 0.080—0.145 mm {0.0032—0.0057 in}

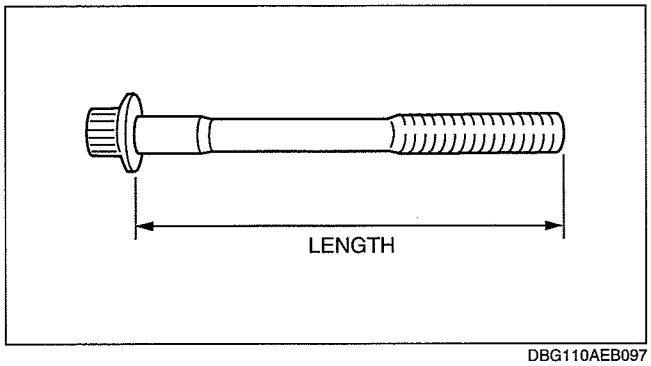


DBG110AEB096

BOLT INSPECTION [WL-C, WE-C]

DCF011010135W02

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



DBG110AEB097

Cylinder head bolt length
Bolt head mark W
Standard length: 101.2—101.8 mm {3.985—4.007 in}
Maximum length: 102.5 mm {4.035 in}
Bolt head mark N
Standard length: 113.2—113.8 mm {4.457—4.480 in}
Maximum length: 114.5 mm {4.508 in}
Bolt head mark I
Standard length: 149.0—150.0 mm {5.866—5.905 in}
Maximum length: 150.5 mm {5.925 in}

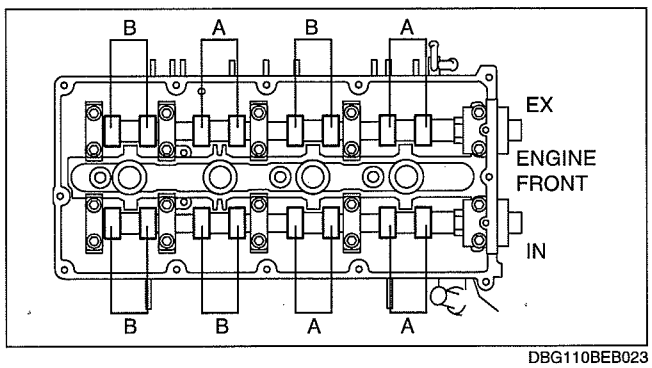
Main bearing cap bolt length
Standard length: 84.7—85.3 mm {3.34—3.35 in}
Maximum length: 86.0 mm {3.39 in}

Connecting rod cap bolt length
Standard length: 55.45—56.05 mm {2.19—2.20 in}
Maximum length: 56.75 mm {2.23 in}

VALVE CLEARANCE INSPECTION [WL-C, WE-C]

DCF011012111W05

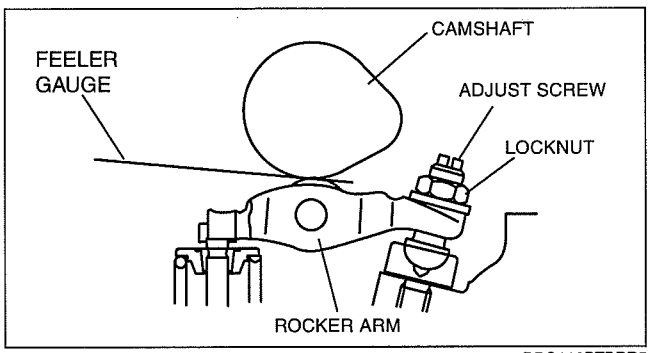
1. Remove the cylinder head cover.
2. Turn the crankshaft and align the timing mark so that the piston of the No. 1 or No. 4 cylinders is at TDC of compression.
3. Measure valve clearances A with the No.1 cylinder at TDC of compression, and those of B with the No.4 cylinder at TDC of compression.
   - If it is not within the specification, adjust and recheck the valve clearance. (See 01–10B–32 VALVE CLEARANCE ADJUSTMENT [WL-C, WE-C].)



DBG110BEB023

Valve clearance [Engine cold]
IN: 0.10—0.16 mm {0.0040—0.0062 in}
EX: 0.17—0.23 mm {0.0067—0.0090 in}

4. Turn the crankshaft one full turn and measure the remaining valve clearances. Adjust if necessary.
5. Install the cylinder head cover.



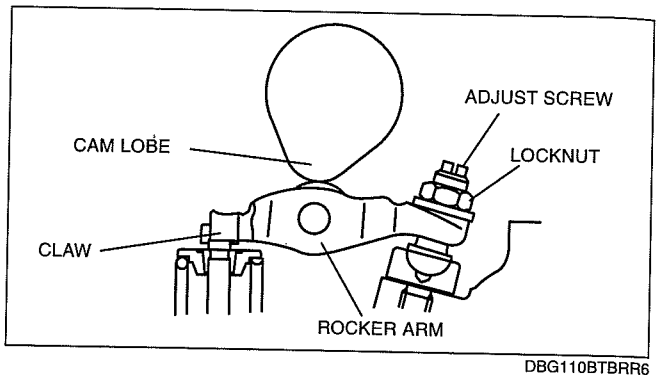
DBG110BTBRR5

VALVE CLEARANCE ADJUSTMENT [WL-C, WE-C]

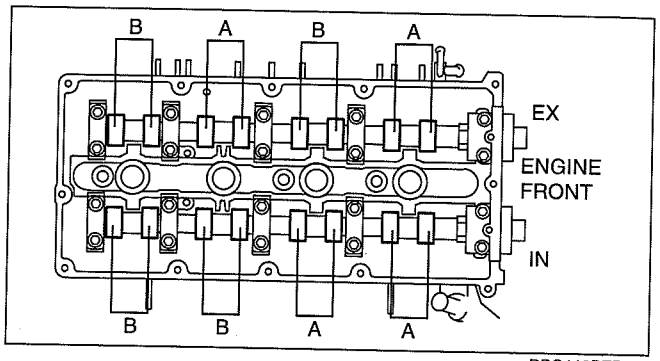
DCF011012111W06

Caution
- **Loosening the locknut and the adjust screw while the cam lobe is not pressing down the rocker arm will damage the claw of the rocker arm. When loosening the locknut and the adjust screw, rotate the crankshaft clockwise and be sure that the cam lobe presses down the rocker arm firmly as shown in the figure.**

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



DBG110BTBRR6

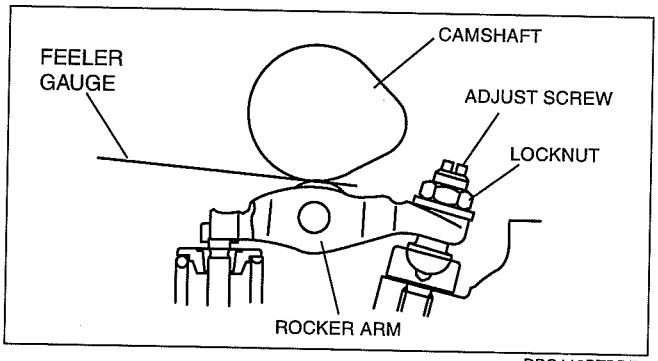


DBG110BEB023

Valve clearance [Engine cold]
IN: 0.10—0.16 mm {0.0040—0.0062 in}
EX: 0.17—0.23 mm {0.0067—0.0090 in}

Tightening torque (lock nut)
20—24 N·m {2.1—2.4 kgf·m, 15—17 ft·lbf}

4. Turn the crankshaft one full turn and measure the remaining valve clearances. Adjust if necessary.
5. Install the cylinder head cover.



DBG110BTBRR5

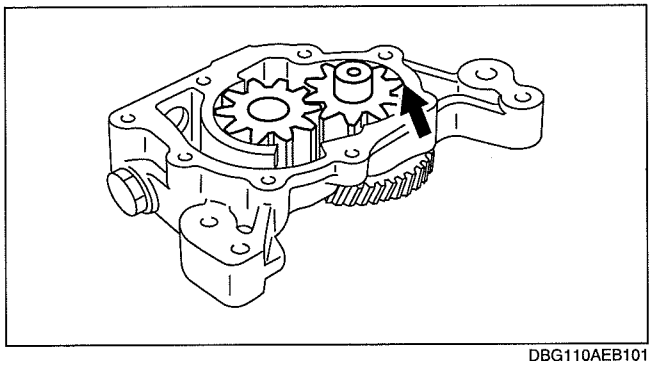
GEAR CLEARANCE INSPECTION [WL-C, WE-C]

DCF011019220W02

1. Measure the following clearance.
   - If it exceeds the maximum specification, replace the gear and/or pump body.

Standard oil pump tip clearance
0.10—0.19 mm {0.0040—0.0074 in}

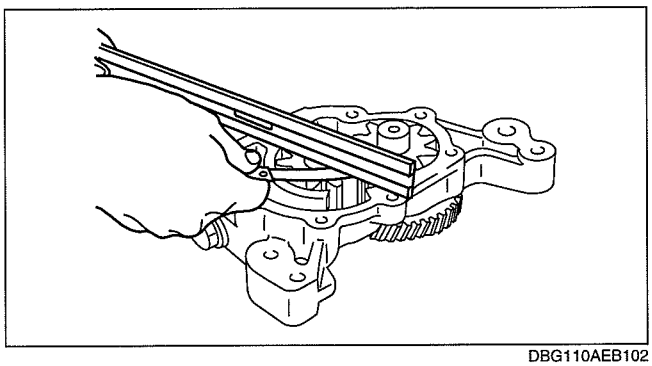
Maximum oil pump tip clearance
0.20 mm {0.008 in}



DBG110AEB101

Standard oil pump side clearance
0.04—0.09 mm {0.0016—0.0035 in}

Maximum oil pump side clearance
0.15 mm {0.0059 in}



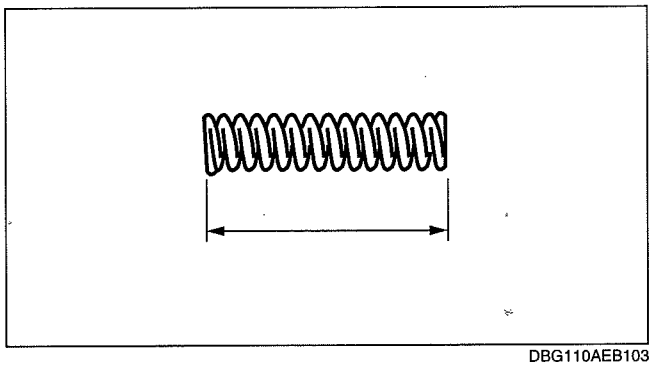
DBG110AEB102

PLUNGER SPRING INSPECTION [WL-C, WE-C]

DCF011014116W02

1. Apply pressing force to the pressure spring and check the spring height. Replace the plunger spring if necessary.

Standard plunger spring length
43.8 mm {1.72 in}

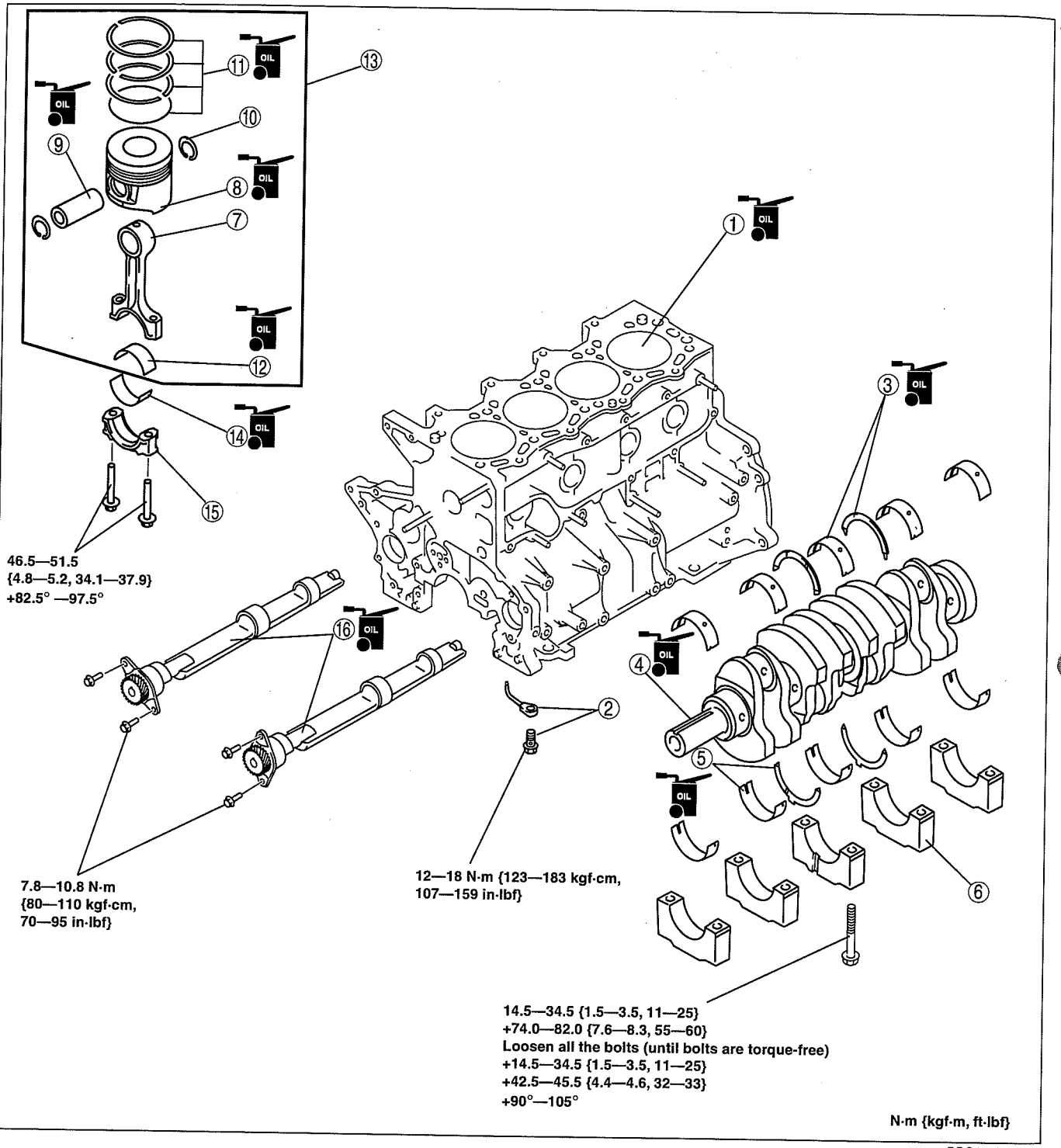


DBG110AEB103

CYLINDER BLOCK ASSEMBLY (I) [WL-C, WE-C]

1. Assemble in the order indicated in the table.

DCF011002000W24



DBG110BEB052

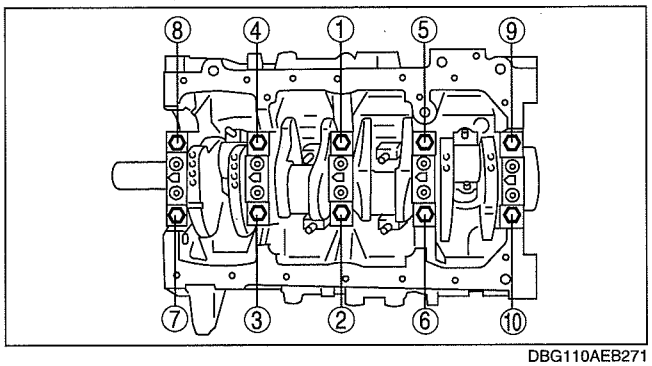
1	Cylinder block
2	Oil jet valve, nozzle
3	Upper main bearing, upper thrust bearing
4	Crankshaft
5	Lower main bearing, lower thrust bearing
6	Main bearing cap (See01–10B–35 Main Bearing Cap Assembly Note.)
7	Connecting rod (See01–10B–35 Piston, Connecting Rod, Piston Pin Assembly Note.)

8	Piston (See01–10B–35 Piston, Connecting Rod, Piston Pin Assembly Note.)
9	Piston pin (See01–10B–35 Piston, Connecting Rod, Piston Pin Assembly Note.)
10	Piston pin clip
11	Piston ring (See01–10B–36 Piston Ring Assembly Note.)
12	Upper connecting rod bearing

13	Piston, connecting rod (See01–10B–36 Piston, Connecting Rod Assembly Note.)
14	Lower connecting rod bearing
15	Connecting rod cap
16	Balance shaft

Main Bearing Cap Assembly Note

1. Apply clean engine oil to the bolt threads and seat faces of the lower cylinder block bolts.
2. Tighten the bolts in two or three steps in the order shown in the figure.

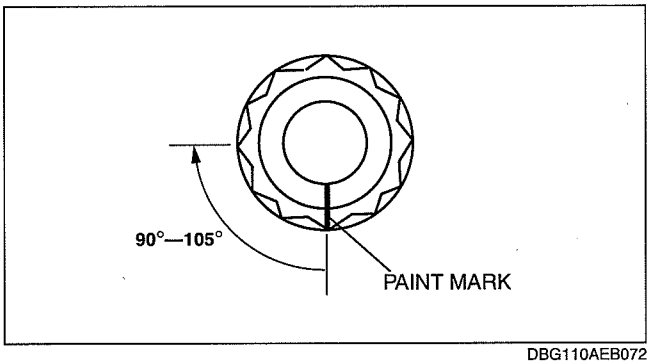


DBG110AEB271

Tightening procedure

(1) 14.5—34.5 N·m {1.5—3.5 kgf·m, 11—25 ft·lbf}
(2) 74.0—82.0 N·m {7.6—8.3 kgf·m, 55—60 ft·lbf}
(3) Loosen all the bolts (until bolts are torque-free).
(4) 14.5—34.5 N·m {1.5—3.5 kgf·m, 11—25 ft·lbf}
(5) 42.5—45.5 N·m {4.4—4.6 kgf·m, 32—33 ft·lbf}

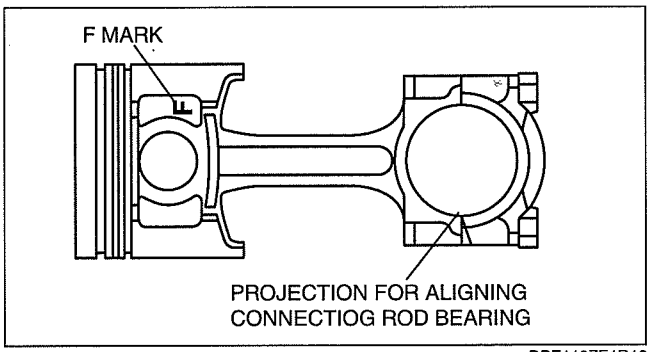
3. Put a paint mark on each bolt head.
4. Using the marks as a reference, tighten the bolts by turning each **90°—105°** as in Step 2.



DBG110AEB072

Piston, Connecting Rod, Piston Pin Assembly Note

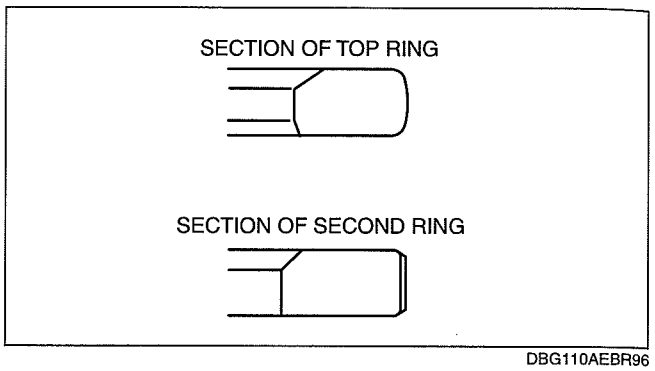
1. Install one piston pin clip.
2. Assemble the piston and connecting rod in the direction indicated in the figure.
3. Apply clean engine oil to the piston pin.
4. Install the piston pin until the pin contacts the clip as shown. If the pin cannot be installed easily, heat the piston.



DPE110ZE1R18

Piston Ring Assembly Note

1. Install the oil ring.
2. Install the second ring with R mark side upward.
3. Install the top ring with tapered face side upward.



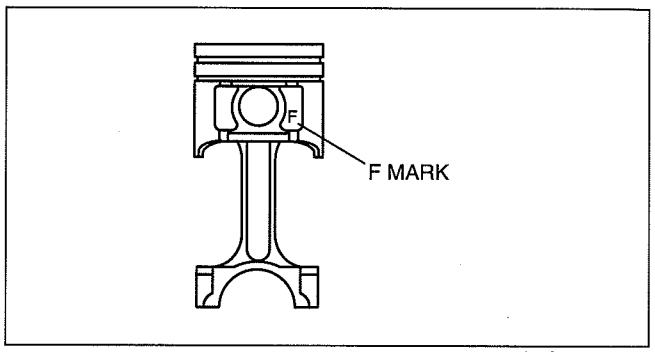
DBG110AEBR96

Piston, Connecting Rod Assembly Note

1. Insert the piston and connecting rod assembly into the cylinder with the F mark facing the front of the engine.
2. Tighten the connecting rod cap bolts in two or three steps.

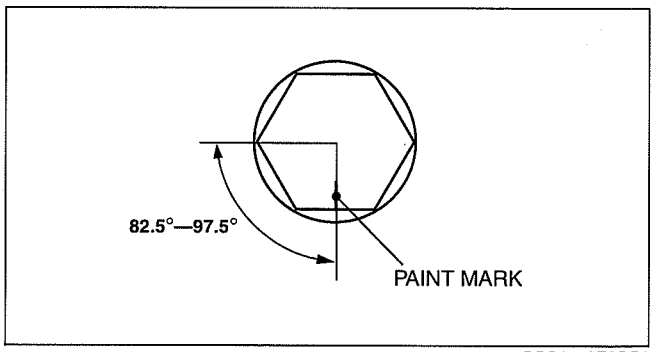
   Tightening torque
   46.5—51.5 N·m {4.8—5.2 kgf·m, 34.3—37.9 ft·lbf}

3. Put a paint mark on each bolt.



DBG110AEBRR5

4. Using the marks as a reference, tighten the bolts by turning each **82.5°—97.5°**

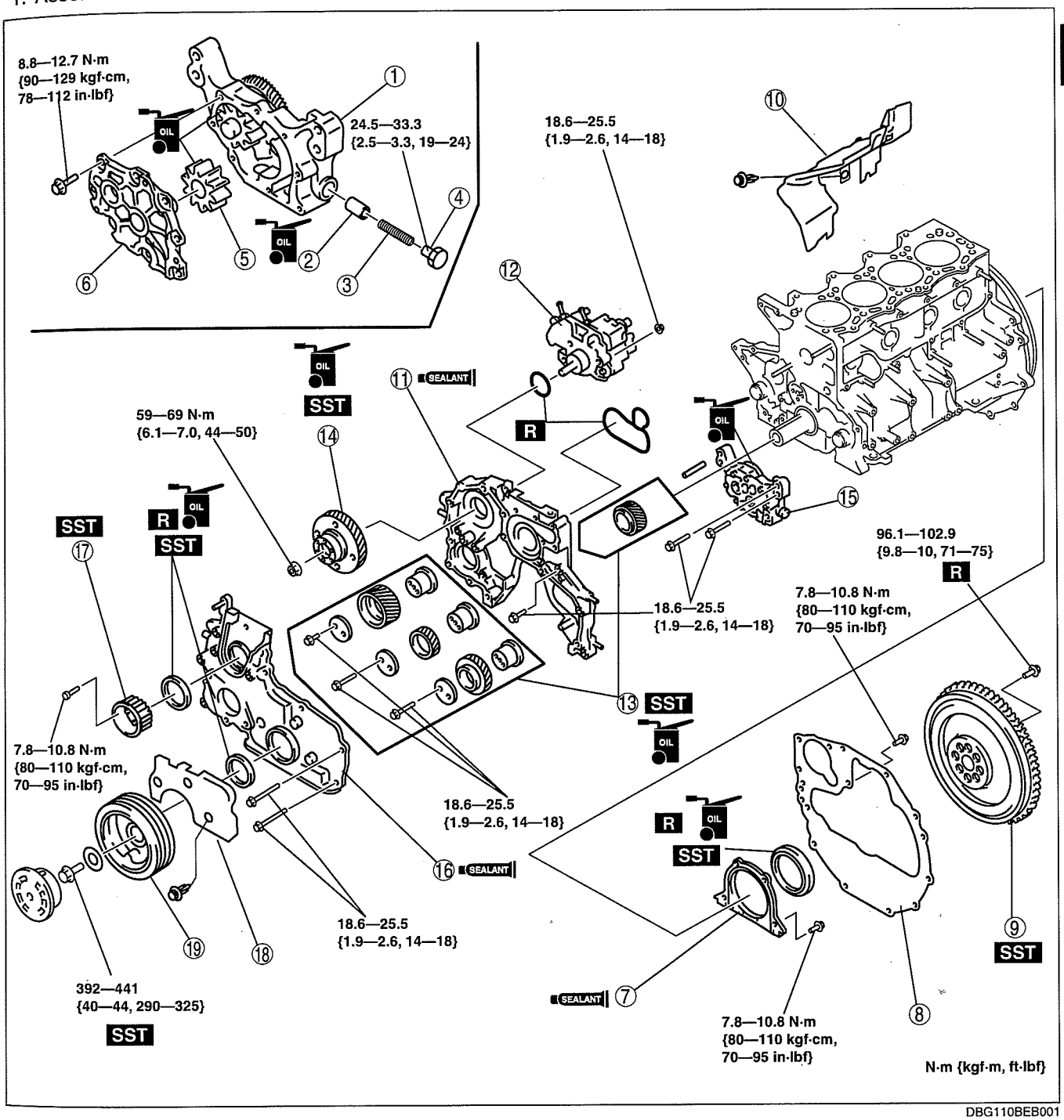


DBG110AEBRR3

CYLINDER BLOCK ASSEMBLY (II) [WL-C, WE-C]

DCF011002000W25

1. Assemble in the order indicated in the table.



DBG110BEB001

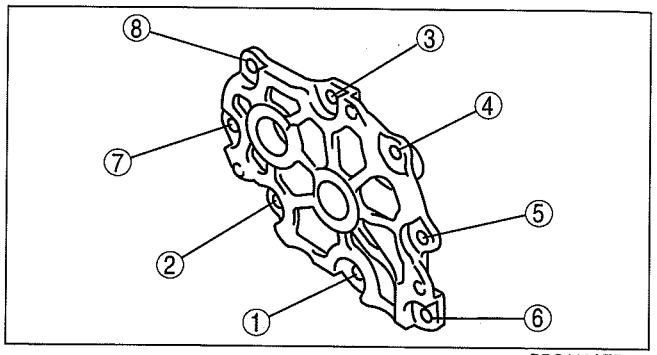
1	Oil pump body
2	Control plunger
3	Plunger spring
4	Plug
5	Driven gear
6	Oil pump cover (See01–10B–38 Oil Pump Cover Assembly Note.)
7	Rear cover (See01–10B–38 Rear Cover, End Plate Assembly Note.)

8	End plate (See01–10B–38 Rear Cover, End Plate Assembly Note.)
9	Dual-mass flywheel (See01–10B–39 Dual-mass Flywheel Assembly Note.)
10	Seal plate
11	Timing gear case (See01–10B–39 Timing Gear Case Assembly Note.)
12	Supply pump

13	Timing gear (See01–10B–40 Timing Gear, Supply Pump Gear Assembly Note.)
14	Supply pump gear (See01–10B–40 Timing Gear, Supply Pump Gear Assembly Note.)
15	Oil pump
16	Timing gear cover (See01–10B–42 Timing Gear Cover Assembly Note.)
17	Supply pump pulley (See01–10B–42 Supply Pump Pulley Assembly Note.)
18	Seal plate
19	Crankshaft pulley (See01–10B–43 Crankshaft Pulley Assembly Note.)

Oil Pump Cover Assembly Note

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

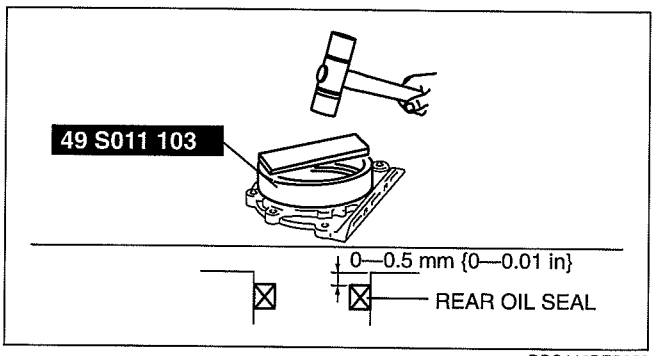


DBG110AEB053

Rear Cover, End Plate Assembly Note

1. Apply soapy water along the perimeter of the new oil seal.
2. Push the oil seal slightly in by hand.
3. Tap the oil seal in evenly using the **SST** and a hammer
4. To ensure that the oil seal is installed correctly, measure the distance between the end of the rear cover and the face of the oil seal.

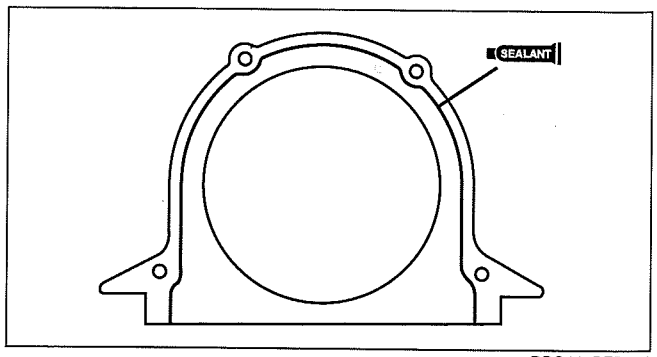
   Rear oil seal press-in amount
   0—0.5 mm {0—0.01 in}



DBG110BEB059

5. Apply silicone sealant to the rear cover as shown.

   Thickness
   ϕ2.0—3.0 mm {0.07—0.12 in}

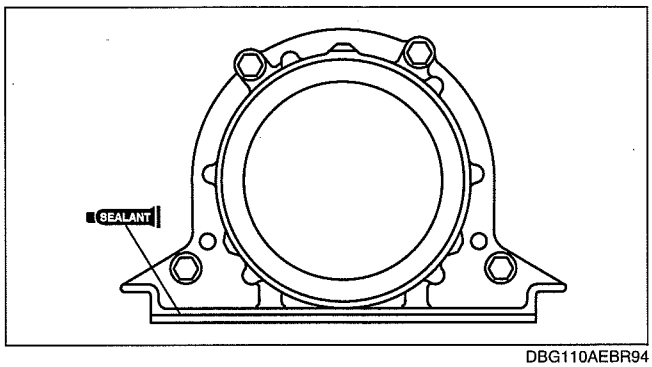


DBG110BEB003

6. Apply silicone sealant to the rear cover as shown in the figure.

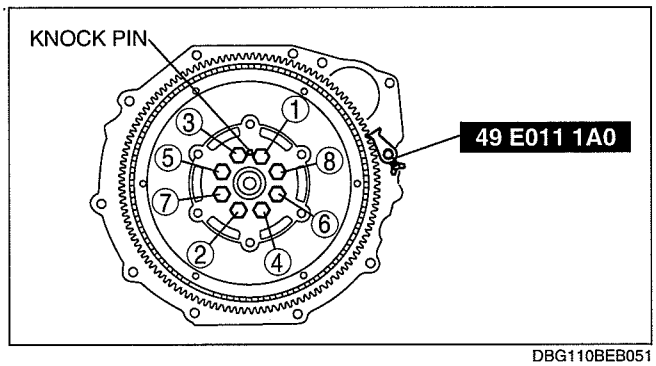
Thickness
ϕ2.0—3.0 mm {0.07—0.12 in}

7. Install the end plate.



DBG110AEBR94

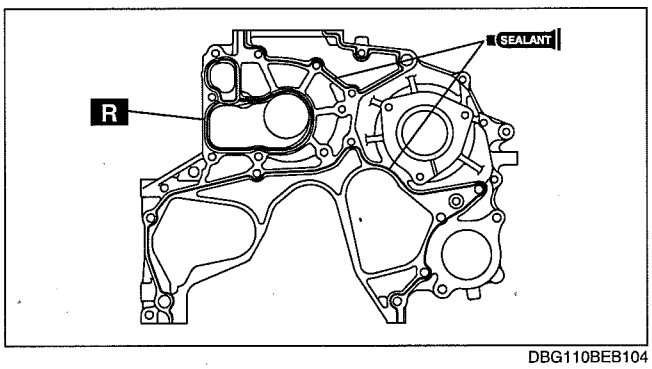
Dual-mass Flywheel Assembly Note
1. Hold the crankshaft using the **SST**.
2. Tighten the bolts in the order shown in the figure.



DBG110BEB051

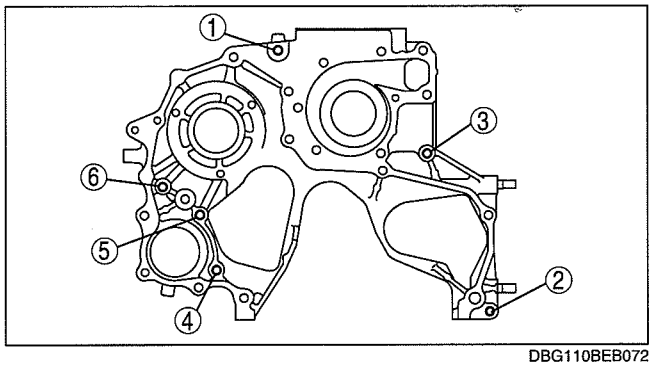
Timing Gear Case Assembly Note
1. Install the new O-ring.
2. Apply silicone sealant to the timing gear case as shown in the figure. Do not apply sealant to the O-ring.

Thickness
ϕ2.0—3.0 mm {0.07—0.12 in}



DBG110BEB104

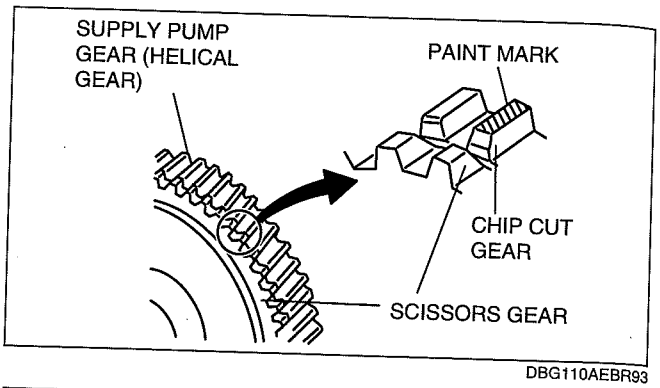
3. Tighten the bolts in two or three steps in the order shown in the figure.



DBG110BEB072

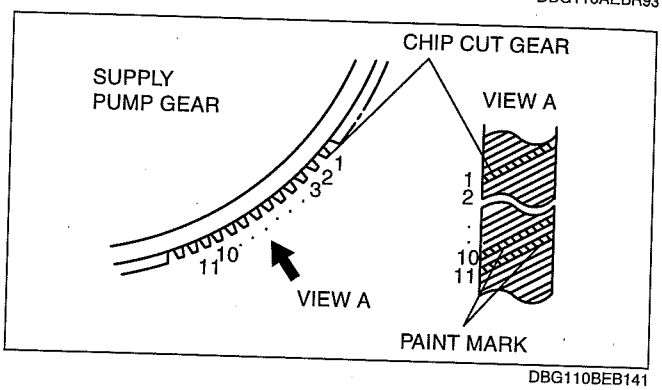
Timing Gear, Supply Pump Gear Assembly Note

1. Put a paint mark on the chip cut gear of the supply pump gear.



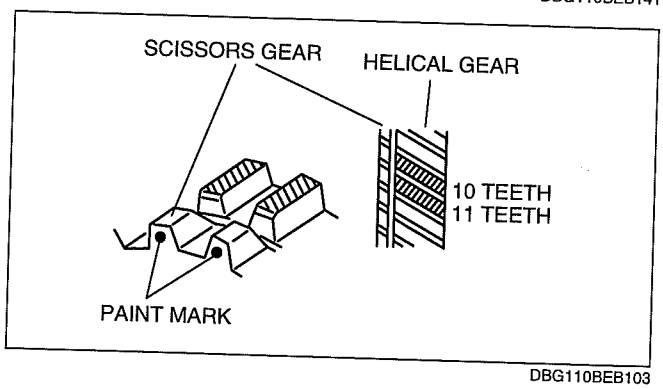
DBG110AEBR93

2. Put a paint mark on the 10th and 11th teeth of the helical gear counting clockwise from the chip cut gear.



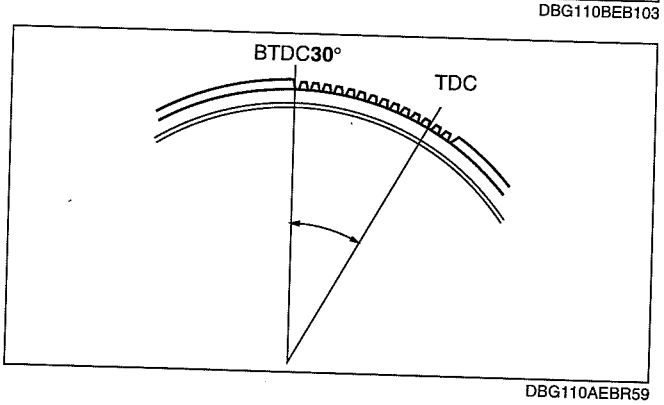
DBG110BEB141

3. Verify that the 10th and 11th teeth of supply pump gear (helical gear) and the teeth of the scissors gear are aligned, then put a paint mark on the scissors gear.
4. Set the No.1 cylinder to TDC of compression.



DBG110BEB103

5. Rotate the flywheel ring gear from TDC to approximately **30°** BTDC (13 teeth on the gear).

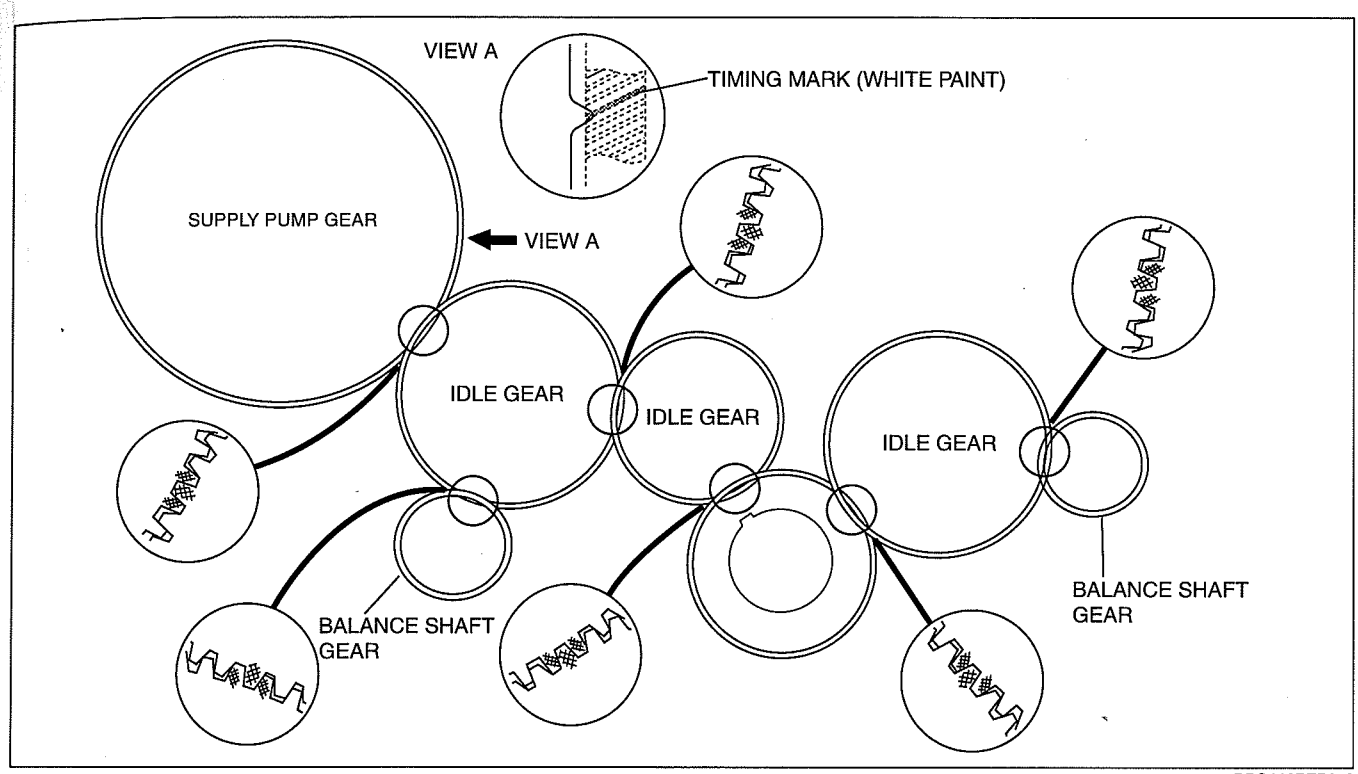


DBG110AEBR59

6. Align the timing marks. For the supply pump gear, align the timing mark as shown in the figure (View A).

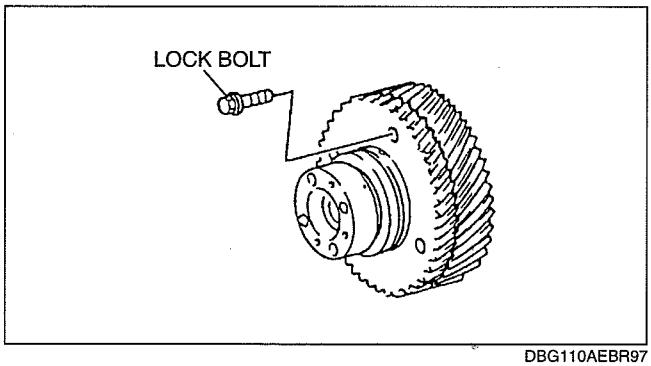
Note

- The helical gears except for the supply pump gear have a punch mark as the timing mark. The timing mark of each gear can be aligned easily if the paint mark is made on the punch mark.



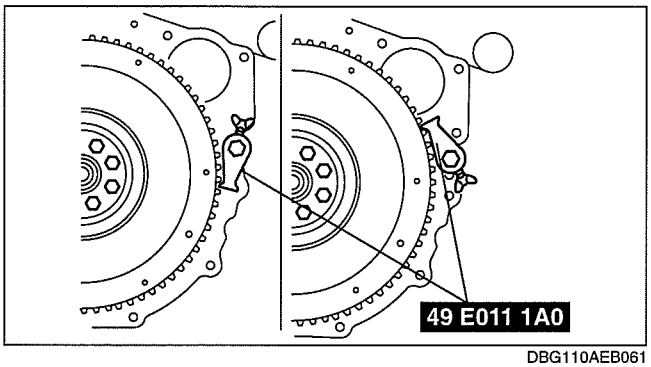
DBG110BEB078

7. Remove the lock bolt.



DBG110AEBR97

8. Tighten the bolts using the **SST**.



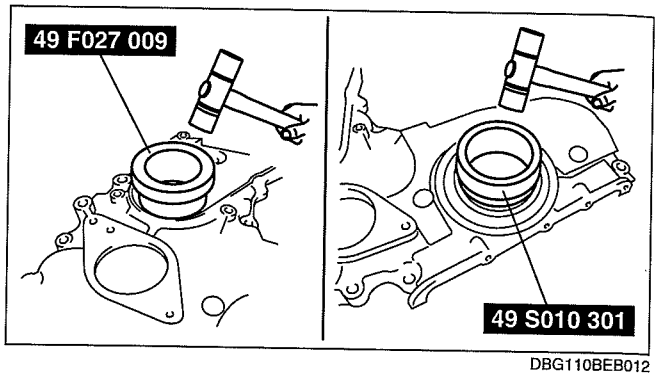
DBG110AEB061

Timing Gear Cover Assembly Note

1. Apply soapy water along the perimeter of the new oil seal.
2. Push the oil seal slightly in by hand.
3. Tap the oil seal in evenly using the **SST** and a hammer.
4. To ensure that the oil seal is installed correctly, measure the distance between the end of the timing gear cover and the face of the oil seal.

   Front oil seal press-in amount
   0.0—0.40 mm {0.0—0.015 in}

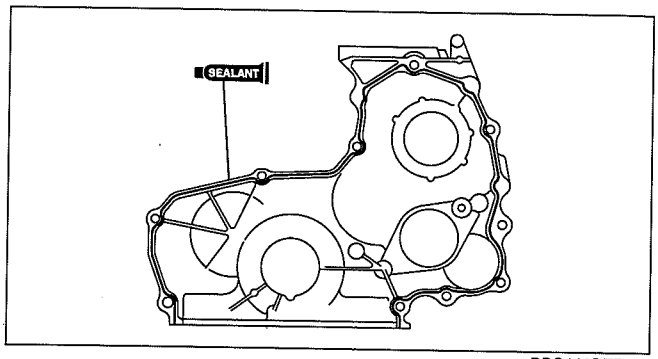
   Fuel injection pump oil seal press-in amount
   0.0—0.40 mm {0.0—0.015 in}



DBG110BEB012

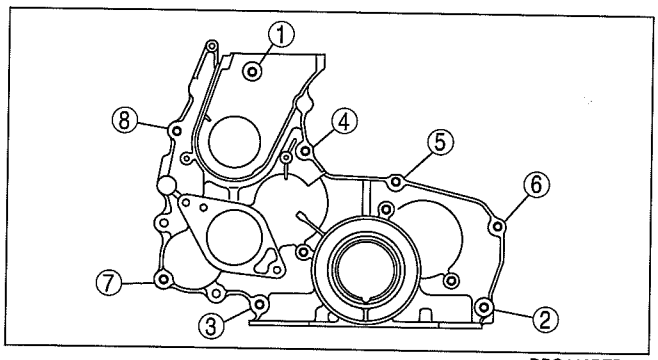
5. Apply silicone sealant to the timing gear cover as shown.

   Thickness
   ϕ2.0—3.0 mm {0.079—0.118 in}



DBG110BEB071

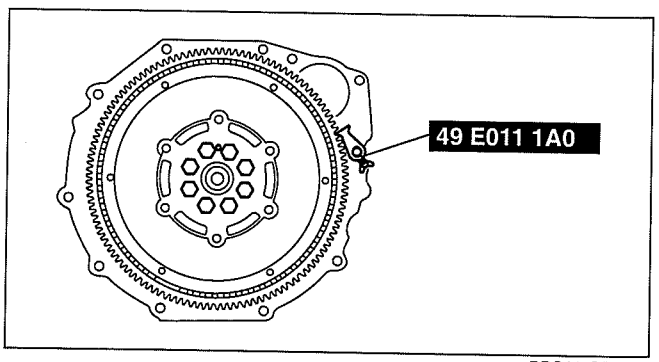
6. Tighten the bolts in two or three steps in the order shown in the figure.



DBG110BEB073

Supply Pump Pulley Assembly Note

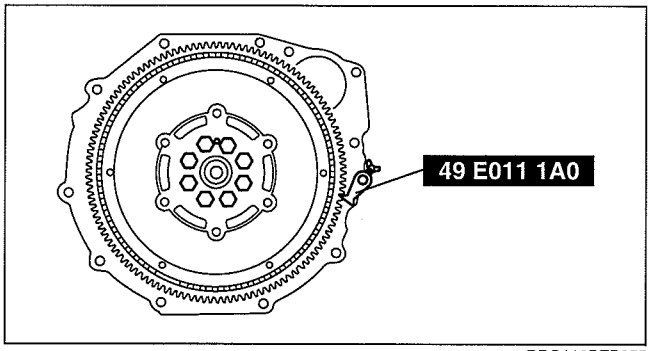
1. Install the supply pump pulley using the **SST**.



DBG110BEB054

Crankshaft Pulley Assembly Note

1. Install the crankshaft pulley using the **SST**.

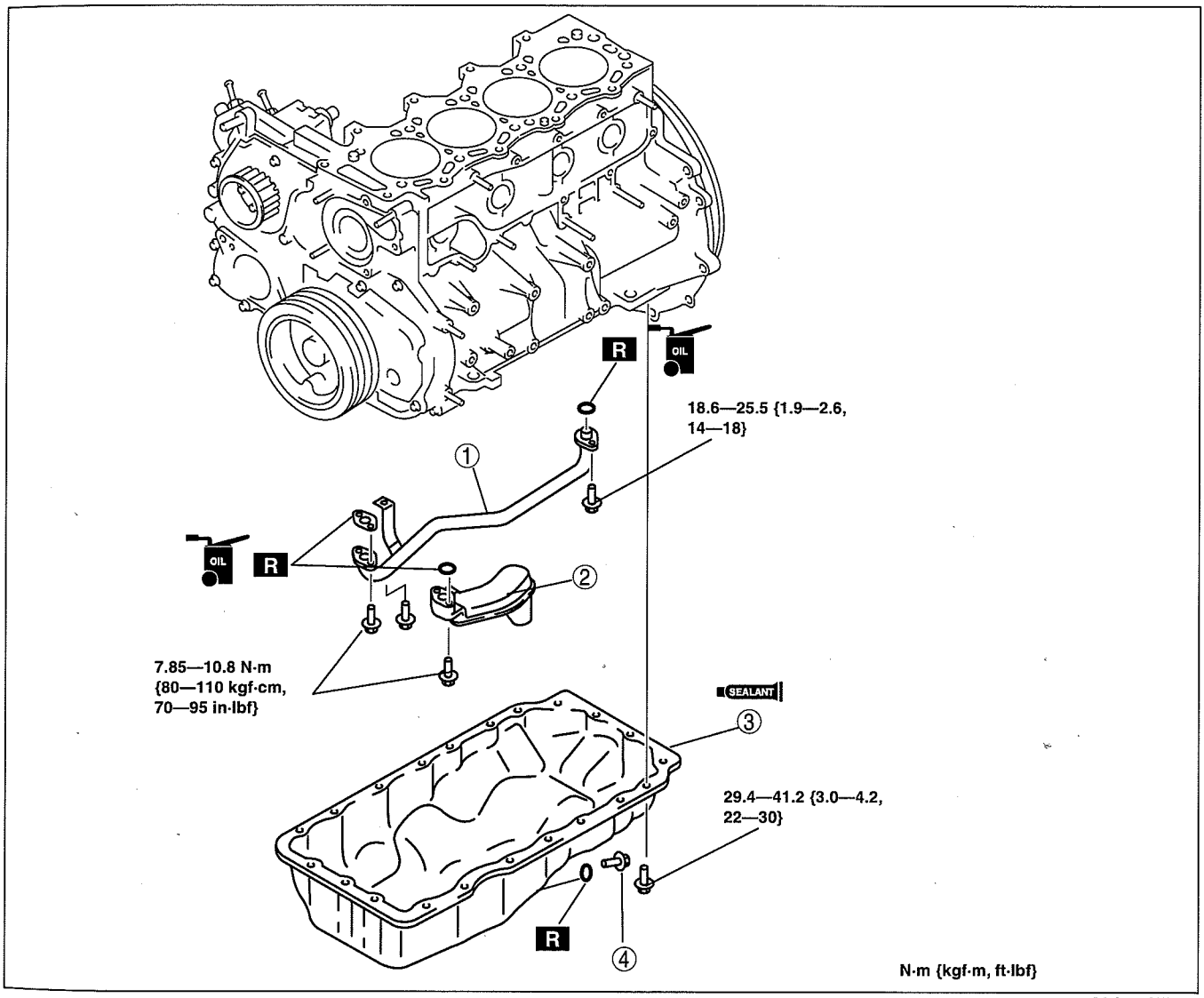


DBG110BEB055

CYLINDER BLOCK ASSEMBLY (III) [WL-C, WE-C]

DCF011002000W26

1. Assemble in the order indicated in the table.



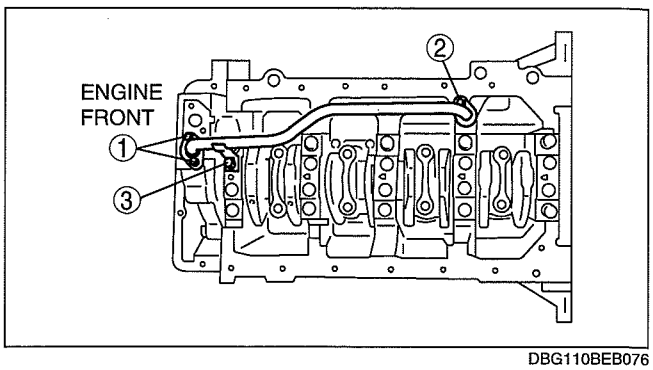
DBG110BEB074

1	Oil pipe (See01–10B–44 Oil Pipe Assembly Note.)
2	Oil strainer

3	Oil pan (See01–10B–44 Oil Pan Assembly Note.)
4	Oil drain plug

Oil Pipe Assembly Note

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



DBG110BEB076

Oil Pan Assembly Note

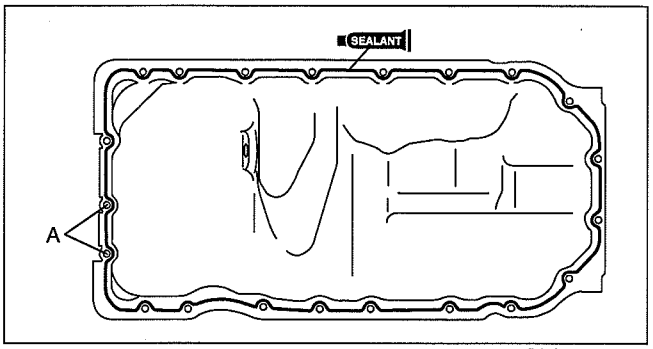
1. Apply silicone sealant to the oil pan as shown in the figure.

   Thickness
   ϕ2.0—3.0 mm {0.07—0.12 in}

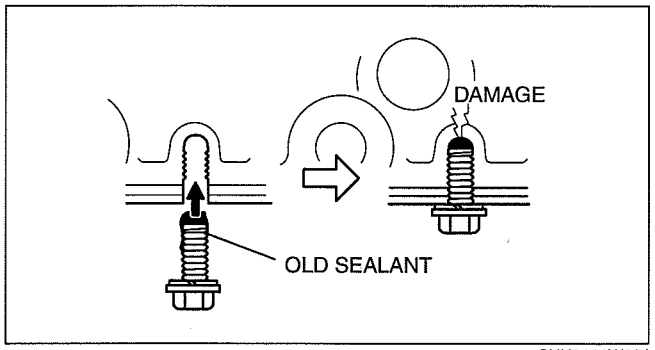
2. Tighten the oil pan bolts A as shown in the figure.

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

3. Tighten the remaining oil pan bolts in several passes.



DBG110BEB056

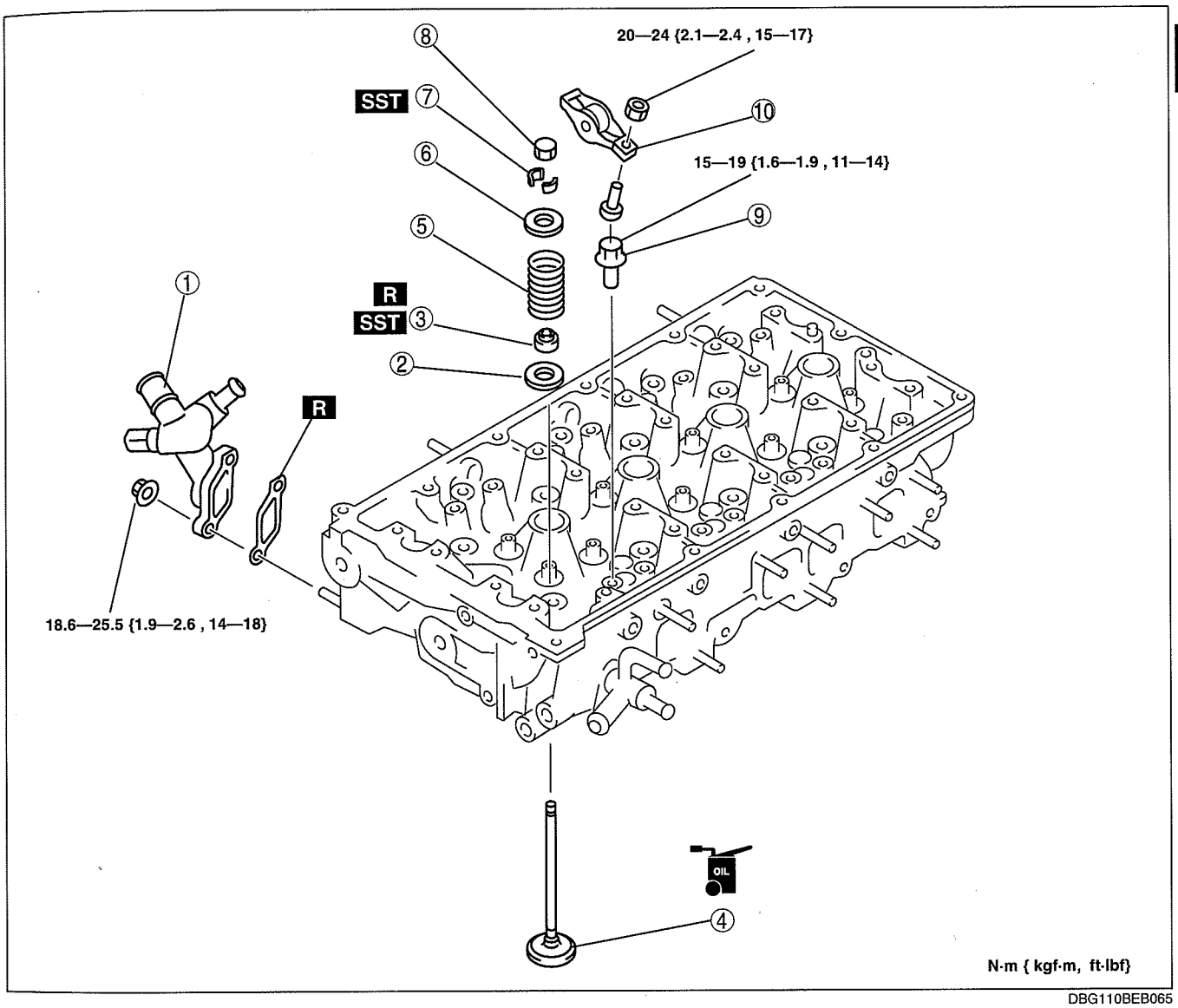


CHU0111W004

CYLINDER HEAD ASSEMBLY (I) [WL-C, WE-C]

DCF011002000W27

1. Assemble in the order indicated in the table.



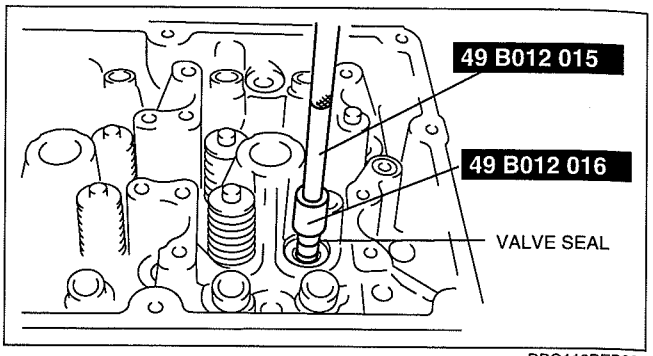
DBG110BEB065

1	Water outlet pipe
2	Lower valve spring seat
3	Valve seal (See01–10B–46 Valve Seal Assembly Note.)
4	Valve
5	Valve spring
6	Upper valve spring seat

7	Valve keeper (See01–10B–46 Valve Keeper Assembly Note.)
8	Valve cap
9	Pivot (See01–10B–46 Pivot Assembly Note.)
10	Rocker arm (See 01–10B–46 Rocker Arm Assembly Note.)

Valve Seal Assembly Note

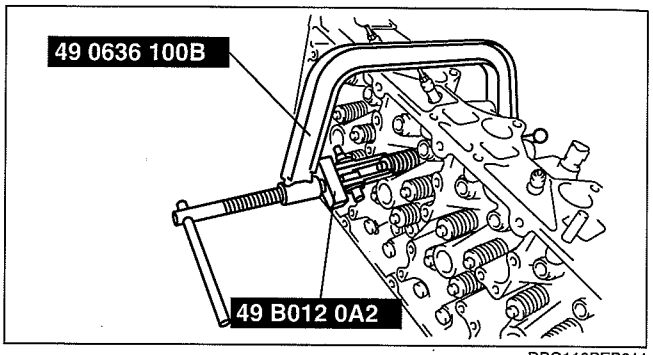
1. Tap the **SST** using a plastic hammer.



DBG110BEB008

Valve Keeper Assembly Note

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



DBG110BEB011

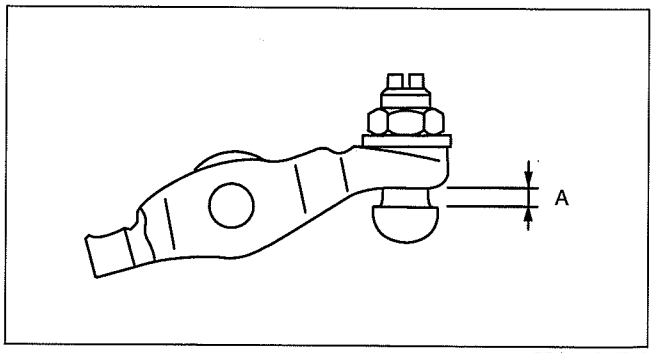
Pivot Assembly Note

1. Apply adhesive to the thread of the pivot.

Rocker Arm Assembly Note

1. If a new rocker arm is used, set dimension A as follows.

   Dimension A
   0.0—4.0 mm {0.0—0.115 in}

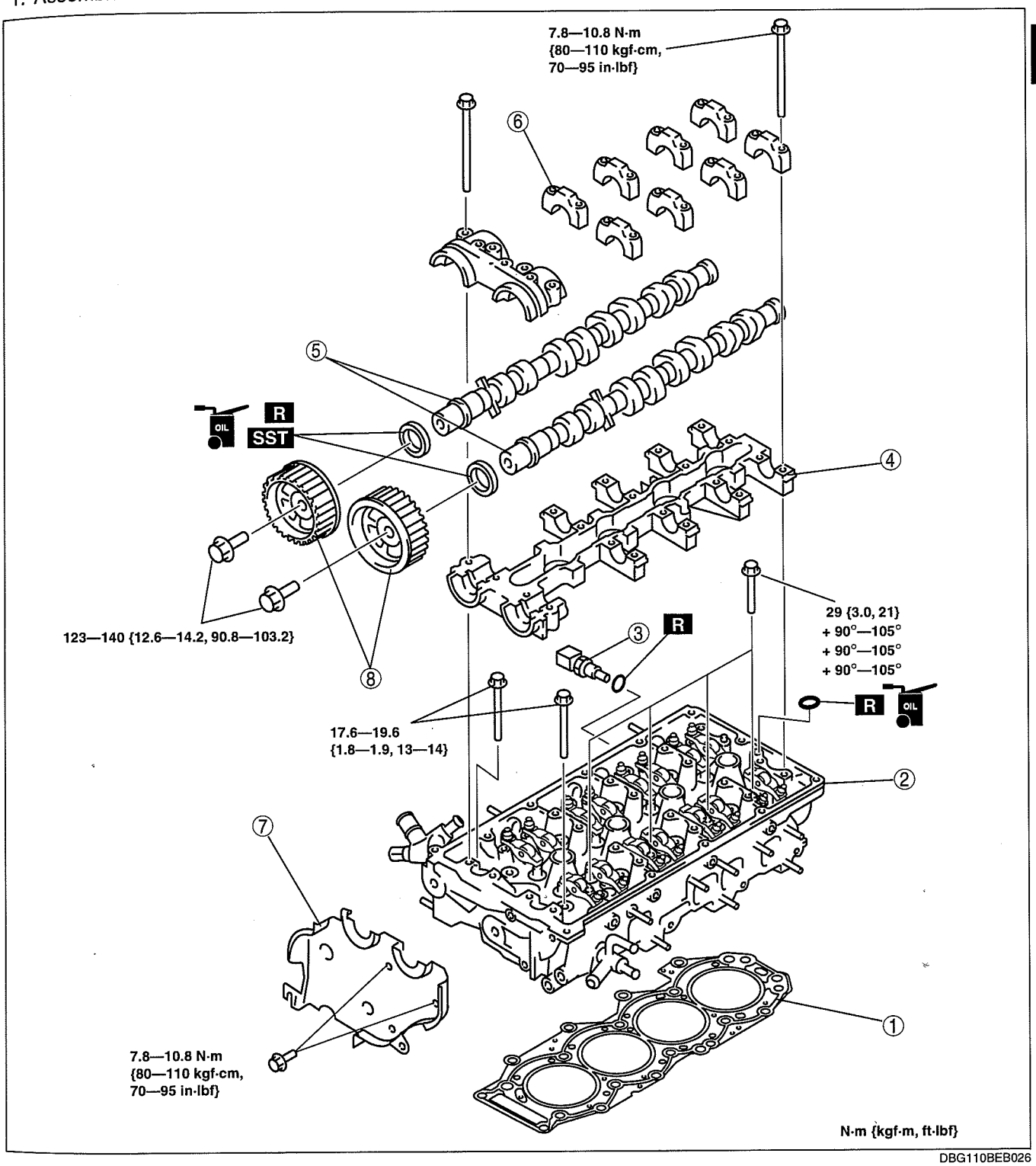


DBG110BWB92

CYLINDER HEAD ASSEMBLY (II) [WL-C, WE-C]

DCF011002000W28

1. Assemble in the order indicated in the table.



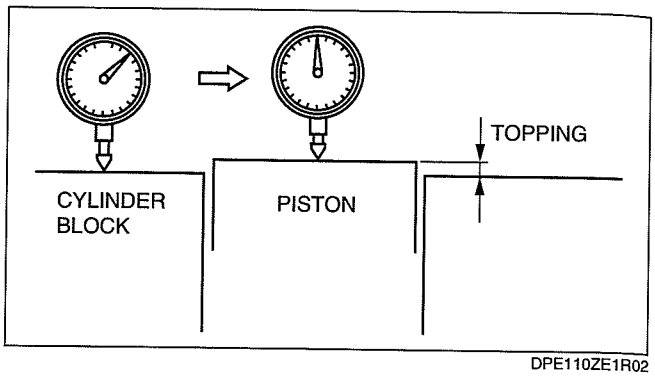
DBG110BEB026

1	Cylinder head gasket (See 01–10B–48 Cylinder Head Gasket Assembly Note.)
2	Cylinder head (See 01–10B–48 Cylinder Head Assembly Note.)
3	ECT sensor
4	Camshaft cap lower (See 01–10B–49 Camshaft Cap Lower Assembly Note.)

5	Camshaft
6	Camshaft cap upper (See 01–10B–49 Camshaft Cap Upper Assembly Note.)
7	Seal plate (See 01–10B–50 Seal Plate Assembly Note.)
8	Camshaft pulley (See 01–10B–50 Camshaft Pulley Assembly Note.)

Cylinder Head Gasket Assembly Note

1. Measure the piston topping of all the cylinders.

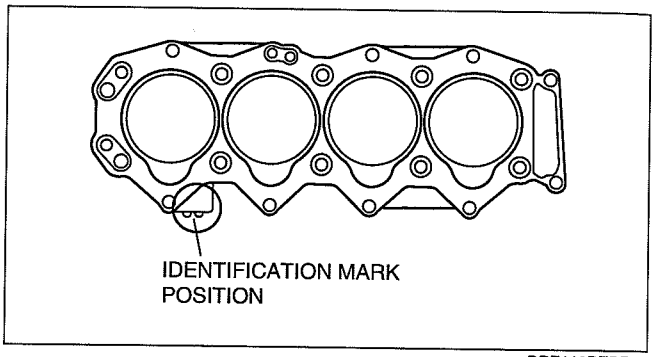


DPE110ZE1R02

2. Choose the gasket according to each measured piston topping.

Cylinder head gasket select table

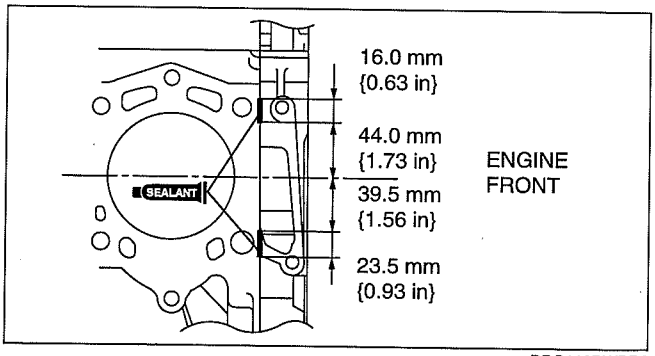
Piston topping (mm {in})	Cylinder head gasket identification mark
0.080—0.190 {0.004—0.007}	
0.135—0.255 {0.006—0.010}	
0.200—0.310 {0.008—0.012}	



DPE110BEBR94

3. Apply silicone sealant to the cylinder block as shown in the figure.

Thickness
ø2.0—3.0 mm {0.08—0.11 in}



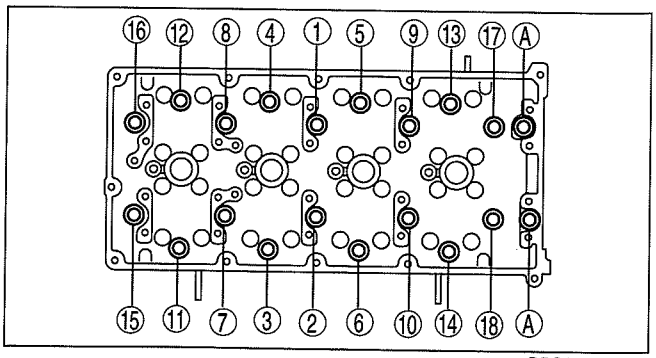
DBG110BWBR9

Cylinder Head Assembly Note

1. Before installing the cylinder head bolts, inspect their length. (See01–10B–31 BOLT INSPECTION [WL-C, WE-C].)
2. Apply clean engine oil to the threads and the seat face of each bolt and install them.
3. Tighten the bolts in two or three steps in the order shown in the figure.

Tighten torque
29 N·m {3.0 kgf·m, 21 ft·lbf}

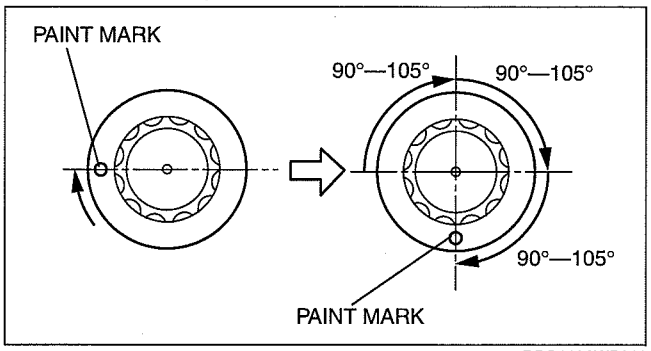
4. Retighten the bolts in the order shown in the figure until all the bolts are tightened to **29 N·m {3.0 kgf·m, 2.1 ft·lbf}**.



DBG110BEB027

5. Put a paint mark on each bolt head.
6. Using the marks as a reference, tighten the bolts by turning each **90°—105°** in the sequence shown.
7. Further tighten each bolt by turning another **90°—105°**.
8. Further tighten each bolt by turning another **90°—105°**.
9. Apply adhesive to the thread of bolt A.
10. Tighten bolts A.

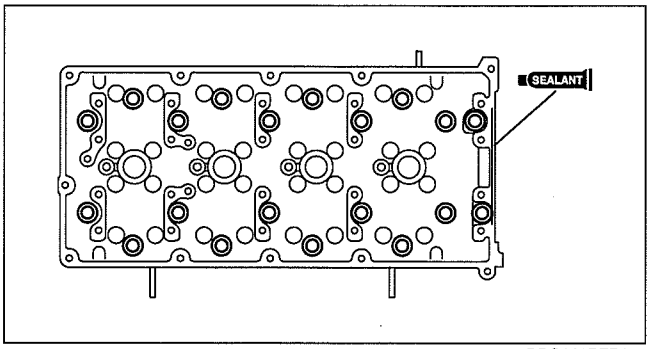
Tighten torque
17.6—19.6 N·m {1.8—1.9 kgf·m, 13—14 ft·lbf}



DBG110AWB311

Camshaft Cap Lower Assembly Note

1. Apply silicone sealant to the cylinder head as shown in the figure.

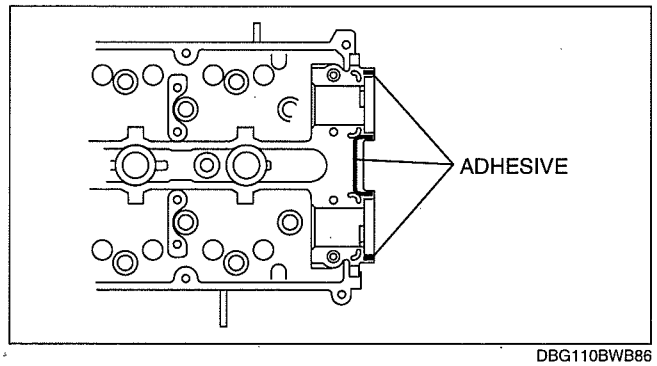


DBG110BEB105

Camshaft Cap Upper Assembly Note

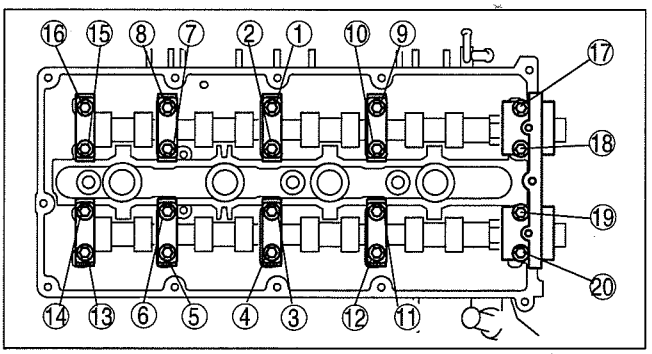
1. Apply adhesive to the front camshaft cap mounting surfaces as shown in the figure.
2. Tighten the camshaft cap bolts gradually in three or four steps in the order shown in the figure.

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



DBG110BWB86

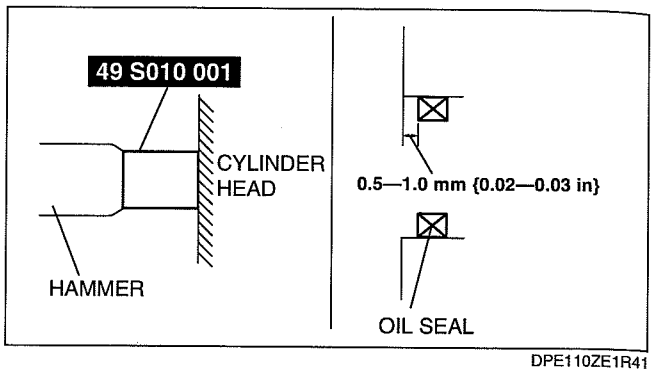
3. Apply soapy water along the perimeter of the new oil seal.
4. Push the oil seal slightly in by hand.



DBG110BEBR25

5. Tap the oil seal lightly into the cylinder head using the **SST** and a hammer.
6. To ensure that the oil seal is installed correctly, measure the distance between the end of the cylinder head and the face of the oil seal.

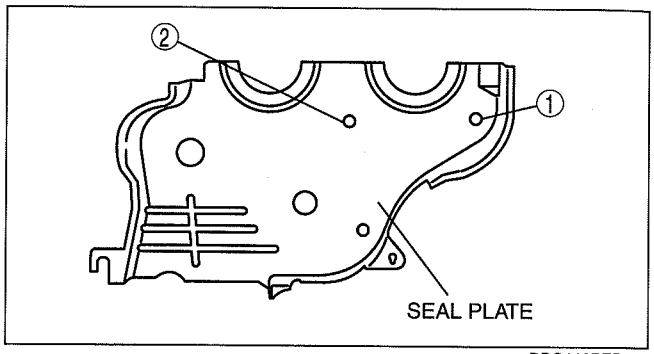
Camshaft oil seal press-in amount
0.5—1.0 mm {0.020—0.039 in}



DPE110ZE1R41

Seal Plate Assembly Note

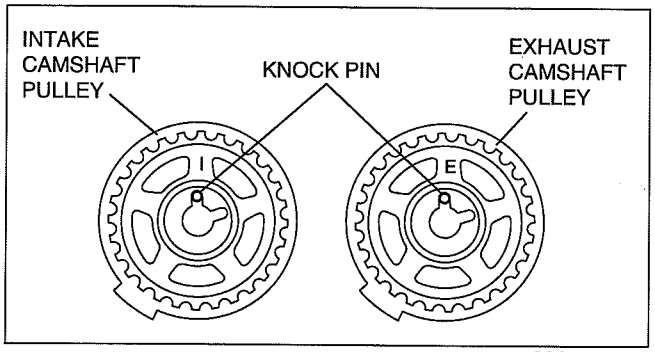
1. Tighten the seal plate bolts in the order indicated in the figure.



DBG110BEB041

Camshaft Pulley Assembly Note

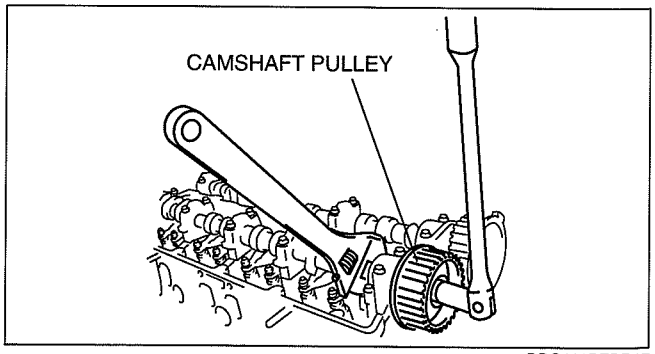
1. Install the camshaft pulleys, positioning the knock pins as shown in the figure.



DBG110BWB85

2. Hold the camshaft using a wrench on the cast hexagon.

Caution
- **Do not move the camshaft from this position because it can cause the valve and piston to contact each other and damage them.**

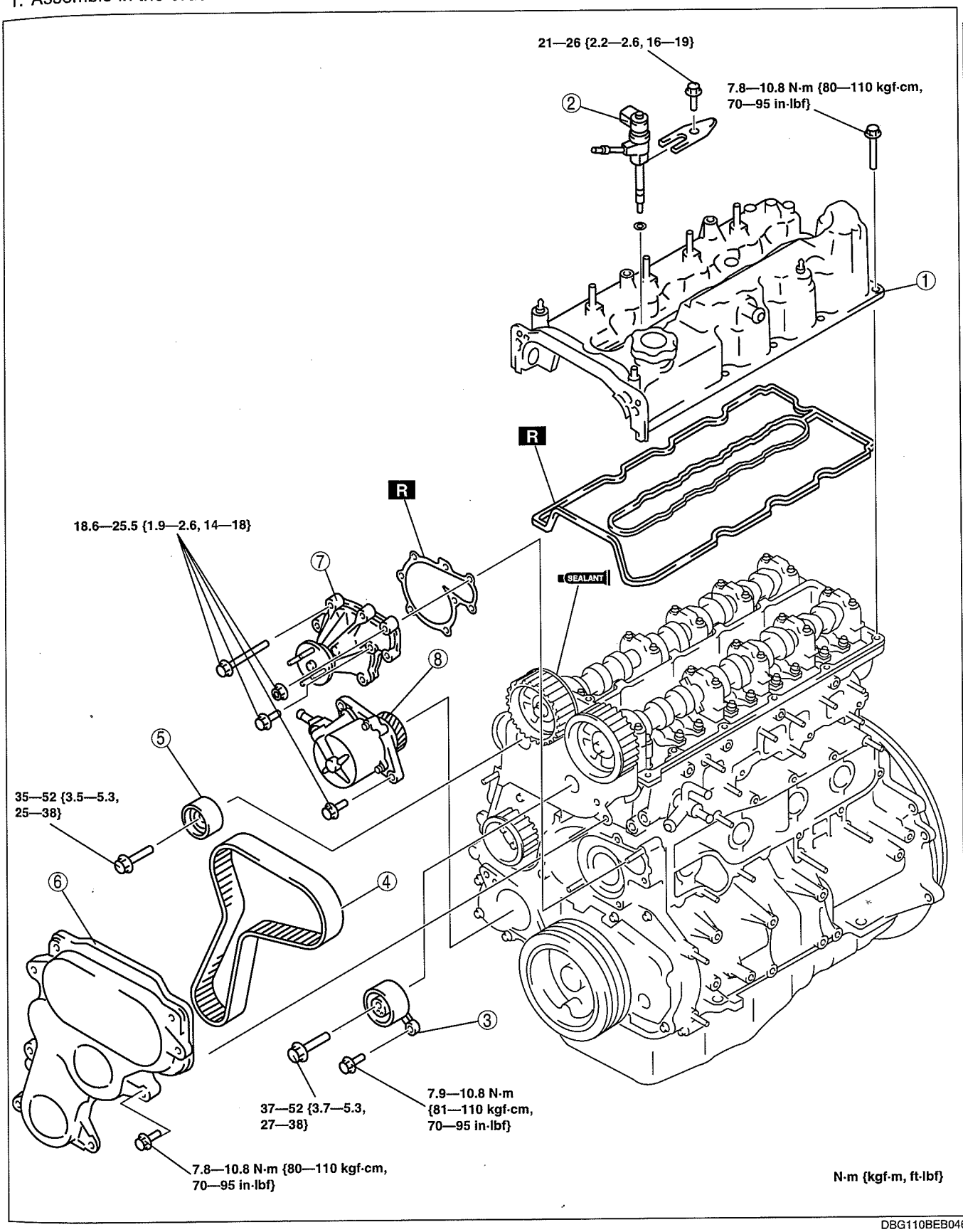


DBG110BEBR17

TIMING BELT ASSEMBLY [WL-C, WE-C]

DCF011002000W29

1. Assemble in the order indicated in the table.



DBG110BEB046

1	Cylinder head cover
2	Injector

3	Auto tensioner (See01–10B–52 Timing Belt Assembly Note.)

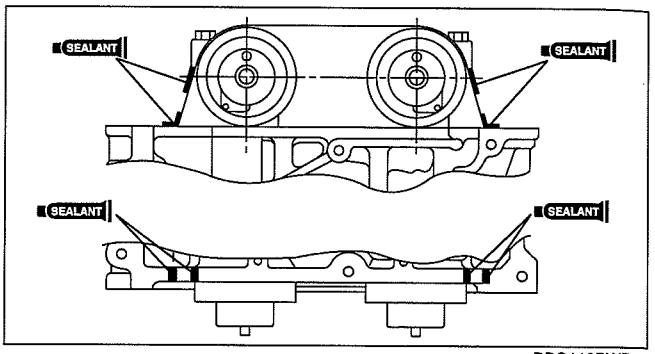
4	Timing belt (See01–10B–52 Timing Belt Assembly Note.)
5	Idler (See01–10B–52 Timing Belt Assembly Note.)

6	Timing belt cover (See 01–10B–53 Timing Belt Cover Assembly Note.)
7	Water pump
8	Vacuum pump

Cylinder Head Cover Assembly Note

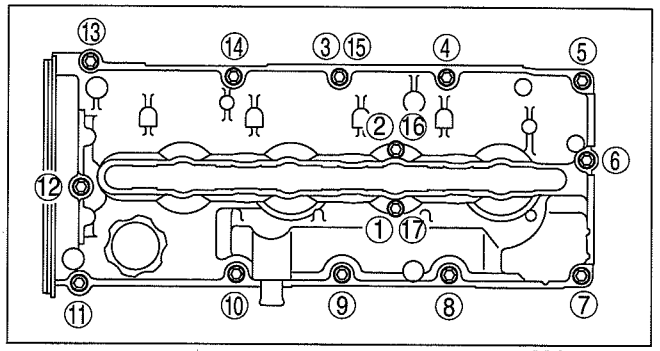
1. Apply silicone sealant to the cylinder head as shown in the figure.

   Thickness
   ø2.0—3.0 mm {0.08—0.11 in}



DBG110BWB84

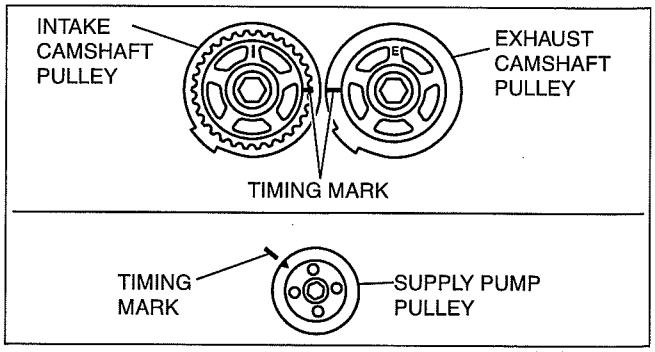
2. Tighten the cylinder head cover bolts in the order shown in the figure.



DBG110BEB005

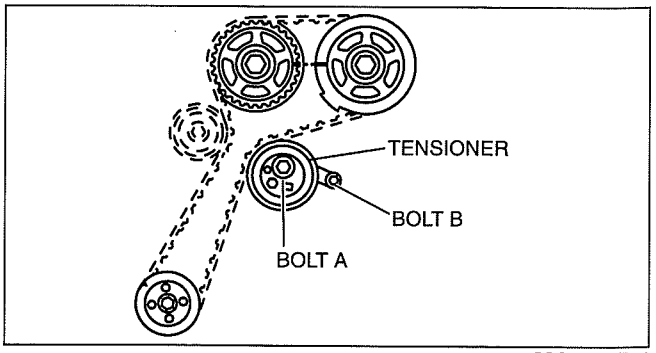
Timing Belt Assembly Note

1. Align the timing marks as shown in the figure.
2. Verify that the supply pump attaching bolts and nuts are tightened to the specified torque. This must be done to prevent over-tensioning of the timing belt after it has been installed.



DBG110BWB97

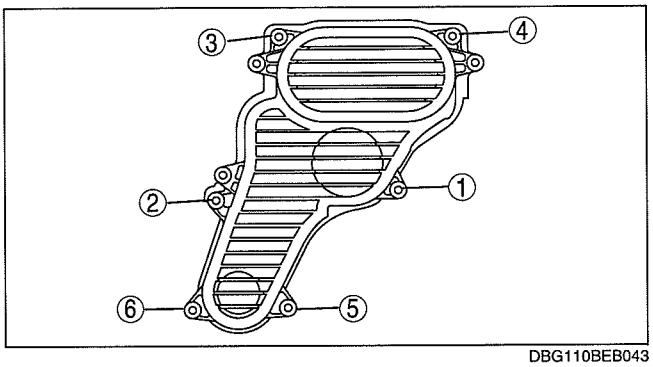
3. Install the tensioner and hand-tighten lock bolts A and B.
4. Install the timing belt.
5. Install the idler.
6. Tighten the lock bolt A.
7. Tighten the lock bolt B.
8. Remove the set pin from the tensioner.
9. Turn the crankshaft clockwise twice, and align the camshaft pully timing marks. If they are not aligned, remove the timing belt and repeat from Step 1.



DBG110BWB96

Timing Belt Cover Assembly Note

1. Tighten the timing belt cover bolts in the order shown in the figure.



DBG110BEB043

01–50A TECHNICAL DATA [WL-3]

ENGINE TECHNICAL DATA [WL-3]

DCF015000000W01

Item	Specification
Maximum cylinder head distortion	X distortion: 0.02 mm {0.0008 in} Y distortion: 0.05 mm {0.0020 in}
Maximum combustion chamber recession	0.02 mm {0.0008 in}
Maximum combustion chamber projection	0.005 mm {0.0002 in}
Combustion chamber crack	Limit: 10mm {0.39 in}
Maximum manifold contact surface distortion	0.05 mm {0.0020 in}
Maximum manifold contact surface grinding	0.15 mm {0.0059 in}
Standard valve margin thickness	IN: 1.5 mm {0.059 in} EX: 0.75 mm {0.030 in}
Standard valve length	IN: 111.6—112.1 mm {4.394—4.413 in} EX: 111.5—112.0 mm {4.390—4.409 in}
Minimum valve length	IN: 111.35 mm {4.384 in} EX: 111.25 mm {4.380 in}
Standard valve stem diameter	IN: 6.970—6.985 mm {0.2745—0.2749 in} EX: 6.965—6.980 mm {0.2743—0.2748 in}
Minimum valve stem diameter	IN: 6.920 mm {0.2724 in} EX: 6.915 mm {0.2722 in}
Standard valve guide inner diameter	7.025—7.045 mm {0.2766—0.2773 in}
Standard valve guide height	14.0—14.5 mm {0.552—0.570 in}
Standard valve seat contact width	IN: 1.6—2.2 mm {0.063—0.086 in} EX: 1.7—2.3 mm {0.067—0.090 in}
Valve seat angle	IN: 45° EX: 45°
Standard valve recession	IN: 0.61—1.09 mm {0.025—0.042 in} EX: 0.71—1.19 mm {0.028—0.046 in}
Maximum valve recession	IN: 1.50 mm {0.059 in} EX: 1.60 mm {0.063 in}
Valve spring installation pressing force	238—269 N {25—27 kgf, 54—60 lbf}
Valve spring installation height	35.5 mm {1.40 in}
Maximum valve spring out-of-square	2.0° (1.70mm {0.067 in})
Maximum camshaft runout	0.03 mm {0.0012 in}
Standard cam lobe height	IN: 42.400—42.500 mm {1.6692—1.6732 in} EX: 42.395—42.495 mm {1.6691—1.6730 in}
Minimum cam lobe height	IN: 42.050 mm {1.6555 in} EX: 42.045 mm {1.6711 in}
Standard cam journal diameter	No.1, No.5: 25.940—25.965 mm {1.0213—1.0222 in} No.2—No.4: 25.910—25.935 mm {1.0201—1.0210 in}
Minimum cam journal diameter	No.1, No.5: 25.890 mm {1.0193 in} No.2—No.4: 25.860 mm {1.0181 in}
Standard camshaft clearance	No.1, 5: 0.035—0.081 mm {0.0014—0.0031 in} No.2—4: 0.065—0.111 mm {0.0026—0.0043 in}
Maximum camshaft clearance	No.1, 5: 0.12 mm {0.0047 in} No.2—4: 0.15 mm {0.0059 in}
Standard camshaft end play	0.030—0.160 mm {0.0012—0.0062 in}
Maximum camshaft end play	0.20 mm {0.0079 in}
Maximum cylinder block distortion	X direction: 0.02 mm {0.0008 in} Y direction: 0.05 mm {0.0020 in}
Cylinder bore size	Standard: 93.000—93.022 mm {3.6615—3.6622 in} 0.25 {0.01} oversize: 93.250—93.272 mm {3.6713—3.6721 in} 0.50 {0.02} oversize: 93.500—93.522 mm {3.6811—3.6819 in}
Cylinder bore wear limit	0.15 mm {0.0059 in}
Oil jet air pressure	137.6—196.4 kPa {1.5—2.0 kgf/cm^2, 20—28 psi}

Item	Specification
Piston diameter	Standard: 92.951—92.977 mm {3.6595—3.6605 in} 0.25 {0.0098} oversize: 93.186—93.212 mm {3.6688—3.6697 in} 0.50 {0.02} oversize: 93.436—93.462 mm {3.6786—3.6795 in}
Standard piston clearance	0.055—0.073 mm {0.0022—0.0028 in}
Maximum piston clearance	0.15 mm {0.0059 in}
Standard piston ring clearance	Top: 0.06—0.10 mm {0.0024—0.0039 in} Second: 0.04—0.08 mm {0.0016—0.0031 in} Oil: 0.03—0.07 mm {0.0012—0.0027 in}
Maximum piston ring clearance	0.15 mm {0.0059 in}
Standard piston ring end gap	Top: 0.22—0.32 mm {0.0087—0.0125 in} Second: 0.32—0.47 mm {0.0126—0.0185 in} Oil: 0.22—0.37 mm {0.0087—0.0145 in}
Maximum piston ring end gap	1.0 mm {0.039 in}
Standard piston pin bore diameter	31.997—32.007 mm {1.2598—1.2601 in}
Standard connecting rod small end inner diameter	32.012—32.033 mm {1.2604—1.2611 in}
Standard piston pin diameter	31.994—32.000 mm {1.25961—1.25984 in}
Standard piston pin-to-piston pin bore clearance	–0.003—0.013 mm {–0.00011—0.00051 in}
Standard connecting rod small end-to-piston pin clearance	0.012—0.039 mm {0.00048—0.00153 in}
Maximum crankshaft runout	0.05 mm {0.0020 in}
Main journal diameter	Standard No.1, 2, 4, 5: 66.937—66.955 mm {2.6354—2.6360 in} No.3: 66.920—66.938 mm {2.6347—2.6353 in} 0.25 {0.01} undersize No.1, 2, 4, 5: 66.687—66.705 mm {2.6255—2.6261 in} No.3: 66.670—66.688 mm {2.6248—2.6255 in} 0.50 {0.02} undersize No.1, 2, 4, 5: 66.437—66.455 mm {2.6157—2.6163 in} No.3: 66.420—66.438 mm {2.6150—2.6156 in} 0.75 {0.03} undersize No.1, 2, 4, 5: 66.187—66.205 mm {2.6058—2.6064 in} No.3: 66.170—66.188 mm {2.6052—2.6058 in}
Main journal wear limit	0.05 mm {0.0020 in}
Main journal out-of-round	0.03 mm {0.0012 in}
Crank pin diameter	Standard: 54.940—54.955 mm {2.1630—2.1635 in} 0.25 {0.01} undersize: 54.690—54.705 mm {2.1532—2.1537 in} 0.50 {0.02} undersize: 54.440—54.455 mm {2.1434—2.1438 in} 0.75 {0.03} undersize: 54.190—54.205 mm {2.1335—2.134 in}
Crank pin wear limit	0.05 mm {0.0020 in}
Crank pin out-of-round	0.03 mm {0.0012 in}
Standard main journal clearance	No.1, 2, 4, 5: 0.027—0.046 mm {0.0011—0.0018 in} No.3: 0.044—0.063 mm {0.0018—0.0025 in}
Maximum main journal clearance	0.08 mm {0.0031 in}
Main bearing thickness	Standard: 2.006—2.021 mm {0.0790—0.0795 in} 0.25 {0.01} undersize: 2.124—2.134 mm {0.0837—0.0840 in} 0.50 {0.02} undersize: 2.249—2.259 mm {0.0886—0.0889 in} 0.75 {0.03} undersize: 2.374—2.384 mm {0.0935—0.0938 in}
Standard crankshaft end play	0.040—0.282 mm {0.0016—0.0111 in}
Maximum crankshaft end play	0.3 mm {0.012 in}
Thrust bearing thickness	Standard: 2.454—2.506 mm {0.0967—0.0986 in} 0.35 {0.014} oversize: 2.629—2.681 mm {0.1036—0.1055 in}
Maximum connecting rod bending	0.075 mm {0.0030 in} /50 mm {2.0 in}
Maximum connecting rod distortion	0.18 mm {0.0071 in} /50 mm {2.0 in}
Connecting rod center-to-center distance	151.96—152.04 mm {5.9827—5.9858 in}
Standard connecting rod bolt length	67.5—68.5 mm {2.66—2.69 in}
Maximum connecting rod bolt length	69 mm {2.7 in}
Standard connecting rod oil clearance	0.025—0.052 mm {0.0010—0.0020 in}
Maximum connecting rod oil clearance	0.08 mm {0.0031 in}

Item	Specification
Connecting rod bearing thickness	Standard: 1.507—1.516 mm {0.0594—0.0596 in} 0.25 {0.01} undersize: 1.624—1.634 mm {0.0640—0.0643 in} 0.50 {0.02} undersize: 1.749—1.759 mm {0.0689—0.0692 in} 0.75 {0.03} undersize: 1.874—1.884 mm {0.0738—0.0741 in}
Standard connecting rod side clearance	0.110—0.262 mm {0.0044—0.0103 in}
Maximum connecting rod side clearance	0.35 mm {0.014 in}
Cylinder head bolt length	Bolt head mark W Standard length: 101.2—101.8 mm {3.985—4.007 in} Maximum length: 102.5 mm {4.035 in} Bolt head mark N Standard length: 113.2—113.8 mm {4.457—4.480 in} Maximum length: 114.5 mm {4.508 in}
Main bearing cap bolt length	Standard length: 84.7—85.3 mm {3.34—3.35 in} Maximum length: 86.0 mm {3.39 in}
Standard tensioner spring length	63.0 mm {2.48 in}
Valve clearance (engine cold)	IN: 0.05—0.15 mm {0.0020—0.0059 in} EX: 0.15—0.25 mm {0.0060—0.0098 in}
Fuel injection pump plunger adjustment value	0.95—1.05 mm {0.038—0.041 in}
Standard oil pump tip clearance	0.10—0.19 mm {0.0040—0.0074 in}
Maximum oil pump tip clearance	0.20 mm {0.0079 in}
Standard oil pump side clearance	0.04—0.09 mm {0.0016—0.0035 in}
Maximum oil pump side clearance	0.15 mm {0.0059 in}
Standard plunger spring length	43.8 mm {1.72 in}
Front oil seal press-in amount	0—0.4 mm {0—0.01 in}
Fuel injection pump oil seal press-in amount	0—0.4 mm {0—0.01 in}
Camshaft oil seal press-in amount	0.5—1.0 mm {0.02—0.03 in}

01–50B TECHNICAL DATA [WL-C, WE-C]

ENGINE TECHNICAL DATA [WL-C, WE-C]

DCF015000000W02

Item	Specification
Maximum cylinder head distortion	X distortion: 0.02 mm {0.0008 in} max. Y distortion: 0.05 mm {0.0020 in} max.
Maximum manifold contact surface distortion	0.05 mm {0.002 in} max.
Maximum manifold contact surface grinding	0.15 mm {0.0059 in} max.
Standard valve margin thickness	IN: 1.55—1.85 mm {0.061—0.072 in} EX: 1.80—2.10 mm {0.070—0.082 in}
Standard valve length	IN: 111.65—112.25 mm {4.394—4.413 in} EX: 111.6—112.2 mm {4.390—4.409 in}
Minimum valve length	IN: 111.50 mm {4.390 in} EX: 111.45 mm {4.388 in}
Standard valve stem diameter	IN: 5.970—5.985 mm {0.2350—0.2356 in} EX: 5.965—5.980 mm {0.2348—0.2354 in}
Minimum valve stem diameter	IN: 5.920 mm {0.2330 in} EX: 5.915 mm {0.2328 in}
Standard valve guide inner diameter	6.025—6.045 mm {0.2372—0.2379 in}
Standard valve guide height	IN: 15.0—15.5 mm {0.59—0.61 in} EX: 17.0—17.5 mm {0.67—0.69 in}
Standard valve guide height	IN: 15.0—15.5 mm {0.59—0.61 in} EX: 17.0—17.5 mm {0.67—0.68 in}
Standard valve seat contact width	1.3—1.9 mm {0.052—0.074 in}
Valve seat angle	IN: 45° EX: 45°
Standard valve recession	IN: 0.79—1.27 mm {0.039—0.050 in} EX: 0.84—1.32 mm {0.033—0.051 in}
Maximum valve recession	IN: 1.68 mm {0.066 in} EX: 1.73 mm {0.062 in}
Valve spring installation pressing force	172.9—195.6 N {15.67—17.74 kgf, 34.48—39.02 lbf}
Valve spring installation height	39.0 mm {1.53 in}
Maximum valve spring out-of-square	2.0° (1.60mm {0.062 in})
Maximum camshaft runout	0.03 mm {0.001 in} max.
Standard cam lobe height	IN: 42.067—42.167 mm {1.6561—1.6601 in} EX: 41.949—42.049 mm {1.6515—1.6554 in}
Minimum cam lobe height	IN: 41.717 mm {1.6424 in} EX: 41.599 mm {1.6377 in}
Standard cam journal diameter	No.1: 31.940—31.965 mm {1.2575—1.2582 in} No.2—No.4: 25.910—25.935 mm {1.0201—1.0210 in} No.5: 25.940—25.965 mm {1.0212—1.0222 in}
Minimum cam journal diameter	No.1: 31.890 mm {1.2555 in} No.2—No.4: 25.860 mm {1.0181 in} No.5: 25.890 mm {1.0193 in}
Standard camshaft clearance	No.1: 0.035—0.081 mm {0.0014—0.0031 in} No.2—4: 0.065—0.111 mm {0.0026—0.0043 in} No.5: 0.056—0.081 mm {0.0014—0.0031 in}
Maximum camshaft clearance	No.1: 0.12 mm {0.0047 in} No.2—4: 0.15 mm {0.0059 in} No.5: 0.16 mm {0.0063 in}
Standard camshaft end play	0.030—0.160 mm {0.0012—0.0062 in}
Maximum camshaft end play	0.20 mm {0.0078 in}
Maximum cylinder block distortion	X direction: 0.02 mm {0.0008 in} Y direction: 0.05 mm {0.002 in}
Cylinder bore size [WL-C]	Standard: 93.000—93.022 mm {3.6615—3.6622 in} 0.25 {0.01} oversize: 93.250—93.272 mm {3.6713—3.6721 in} 0.50 {0.02} oversize: 93.500—93.522 mm {3.6811—3.6819 in}

Item	Specification
Cylinder bore size [WE-C]	Standard: 96.000—96.022 mm {3.6615—3.6622 in} 0.25 {0.01} oversize: 96.250—96.272 mm {3.7893—3.7902 in} 0.50 {0.02} oversize: 96.500—96.522 mm {3.7992—3.8000 in}
Cylinder bore wear limit	0.15 mm {0.0059 in}
Flywheel maximum runout	1.5 mm {0.059 in}
Oil jet air pressure	137.6—196.4 kPa {1.4—2.0 kgf/cm^2, 20—28 psi}
Piston diameter [WL-C]	Standard: 92.918—92.944 mm {3.6582—3.6592 in} 0.25 {0.010} oversize: 93.153—93.179 mm {3.6675—3.6684 in} 0.50 {0.020} oversize: 93.403—93.429 mm {3.6773—3.6782 in}
Piston diameter [WE-C]	Standard: 95.918—95.944 mm {3.7763—3.7773 in} 0.25 {0.010} oversize: 96.153—96.179 mm {3.7856—3.7865 in} 0.50 {0.020} oversize: 96.403—96.429 mm {3.7954—3.7964 in}
Standard piston clearance	0.071—0.089 mm {0.0015—0.0022 in}
Maximum piston clearance	0.15 mm {0.0059 in}
Standard piston ring clearance [WL-C]	Top: 0.06—0.10 mm {0.0024—0.0039 in} Second: 0.06—0.08 mm {0.0024—0.0031 in} Oil: 0.02—0.06 mm {0.0012—0.0023 in}
Standard piston ring clearance [WE-C]	Top: 0.06—0.10 mm {0.0024—0.0039 in} Second: 0.04—0.08 mm {0.0016—0.0031 in} Oil: 0.02—0.06 mm {0.0008—0.0023 in}
Maximum piston ring clearance	0.15 mm {0.0059 in}
Standard piston ring end gap [WL-C]	Top: 0.22—0.32 mm {0.0087—0.0125 in} Second: 0.49—0.64 mm {0.0193—0.0251 in} Oil: 0.22—0.52 mm {0.0087—0.0204 in}
Standard piston ring end gap [WE-C]	Top: 0.23—0.33 mm {0.0091—0.0129 in} Second: 0.50—0.65 mm {0.0197—0.0255 in} Oil: 0.22—0.52 mm {0.0087—0.0204 in}
Maximum piston ring end gap	1.0 mm {0.039 in}
Standard piston pin bore diameter	33.997—34.007 mm {1.3384—1.3388 in}
Standard connecting rod small end inner diameter	34.012—34.033 mm {1.3391—1.3398 in}
Standard piston pin diameter	33.994—34.000 mm {1.3384—1.3385 in}
Standard piston pin-to-piston pin bore clearance	−0.003—0.013 mm {−0.0001—0.0005 in}
Standard connecting rod small end-to-piston pin clearance	0.012—0.039 mm {0.00048—0.0015 in}
Maximum crankshaft runout	0.05 mm {0.002 in}
Main journal diameter [No.1,2,4,5]	Standard: 66.937—66.955 mm {2.6354—2.6360 in} 0.25 {0.010} undersize: 66.687—66.705 mm {2.6255—2.6261 in} 0.50 {0.020} undersize: 66.437—66.455 mm {2.6157—2.6163 in} 0.75 {0.030} undersize: 66.187—66.205 mm {2.6058—2.6064 in}
Main journal diameter [No.3]	Standard: 66.920—66.938 mm {2.6347—2.6353 in} 0.25 {0.010} undersize: 66.670—66.688 mm {2.6367—2.6373 in} 0.50 {0.020} undersize: 66.420—66.438 mm {2.6150—2.6156 in} 0.75 {0.030} undersize: 66.170—66.188 mm {2.6052—2.6058 in}
Main journal wear limit	0.05 mm {0.002 in}
Main journal out-of-round	0.03 mm {0.001 in}
Crank pin diameter [WL-C]	Standard: 54.940—54.955 mm {2.1630—2.1635 in} 0.25 {0.010} undersize: 54.690—54.705 mm {2.1532—2.1537 in} 0.50 {0.020} undersize: 54.440—54.455 mm {2.1434—2.1438 in} 0.75 {0.030} undersize: 54.190—54.205 mm {2.1335—2.1340 in}
Crank pin diameter [WE-C]	Standard: 56.940—56.955 mm {2.2417—2.2423 in} 0.25 {0.010} undersize: 56.690—56.705 mm {2.2318—2.2324 in} 0.50 {0.020} undersize: 56.440—56.455 mm {2.2220—2.2226 in} 0.75 {0.030} undersize: 56.190—56.205 mm {2.2122—2.2128 in}
Crank pin wear limit	0.05 mm {0.0020 in}
Crank pin out-of-round	0.03 mm {0.0012 in}
Standard main journal clearance	No.1, 2, 4, 5: 0.027—0.045 mm {0.0010—0.0017 in} No.3: 0.044—0.062 mm {0.0017—0.0024 in}
Maximum main journal clearance	0.08 mm {0.003 in}

Item	Specification
Main bearing thickness	Standard: 2.006—2.021 mm {0.0789—0.0794 in} 0.25 {0.010} undersize: 2.124—2.134 mm {0.0836—0.0838 in} 0.50 {0.020} undersize: 2.249—2.259 mm {0.0885—0.0888 in} 0.75 {0.030} undersize: 2.374—2.384 mm {0.0934—0.0937 in}
Standard crankshaft end play	0.040—0.282 mm {0.0016—0.0111 in}
Maximum crankshaft end play	0.3 mm {0.01 in}
Thrust bearing thickness	Standard: 2.455—2.505 mm {0.0967—0.986 in} 0.35 {0.010} oversize: 2.630—2.680 mm {0.1036—0.1055 in}
Connecting rod bending	0.075 mm {0.0030 in} max./50 mm {2.0 in}
Connecting rod distortion	0.18 mm {0.0070 in} max./50 mm {1.968 in}
Connecting rod center-to-center distance [WL-C]	162.96—163.04 mm {5.983—5.986 in}
Connecting rod center-to-center distance [WE-C]	157.96—158.04 mm {5.983—5.986 in}
Standard connecting rod oil clearance	0.025—0.052 mm {0.0009—0.0020 in}
Maximum connecting rod oil clearance	0.08 mm {0.003 in}
Connecting rod bearing thickness	Standard: 1.507—1.516 mm {0.0592—0.0595 in} 0.25 {0.010} undersize: 1.624—1.634 mm {0.0638—0.0642 in} 0.50 {0.020} undersize: 1.749—1.759 mm {0.0687—0.0691 in} 0.75 {0.030} undersize: 1.874—1.884 mm {0.0737—0.0740 in}
Standard connecting rod side clearance	0.110—0.262 mm {0.0043—0.0103 in}
Maximum connecting rod side clearance	0.35 mm {0.014 in}
Balance shaft Standard end play	0.04—0.16 mm {0.002—0.006 in}
Standard diameter	Front: 41.945—41.960 mm {1.6514—1.6519 in} Center: 39.945—39.960 mm {1.5727—1.5732 in} Rear: 37.975—37.990 mm {1.4951—1.4956 in}
Standard clearance	Front, rear: 0.050—0.115 mm {0.0020—0.0045 in} Center: 0.080—0.145 mm {0.0032—0.0057 in}
Cylinder head bolt length	Bolt head mark W Standard length: 101.2—101.8 mm {3.985—4.007 in} Maximum length: 102.5 mm {4.035 in} Bolt head mark N Standard length: 113.2—113.8 mm {4.457—4.480 in} Maximum length: 114.5 mm {4.508 in} Bolt head mark I Standard length: 149.0—150.0 mm {5.866—5.905 in} Maximum length: 150.5 mm {5.925 in}
Main bearing cap bolt length	Standard length: 84.7—85.3 mm {3.34—3.35 in} Maximum length: 86.0 mm {3.39 in}
Connecting rod cap bolt length	Standard length: 55.45—56.05 mm {2.19—2.20 in} Maximum length: 56.75 mm {2.23 in}
Valve clearance [Engine cold]	IN: 0.10—0.16 mm {0.0040—0.0062 in} EX: 0.17—0.23 mm {0.0067—0.0090 in}
Valve clearance [Engine cold]	IN: 0.10—0.16 mm {0.0040—0.0062 in} EX: 0.17—0.23 mm {0.0067—0.0090 in}
Standard oil pump tip clearance	0.10—0.19 mm {0.0040—0.0074 in}
Maximum oil pump tip clearance	0.20 mm {0.008 in}
Standard oil pump side clearance	0.04—0.09 mm {0.0016—0.0035 in}
Maximum oil pump side clearance	0.15 mm {0.0059 in}
Standard plunger spring length	43.8 mm {1.72 in}
Front oil seal press-in amount	0.0—0.40 mm {0.0—0.015 in}
Fuel injection pump oil seal press-in amount	0.0—0.40 mm {0.0—0.015 in}
Camshaft oil seal press-in amount	0.5—1.0 mm {0.020—0.039 in}

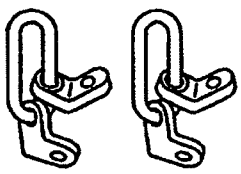
01–60A SERVICE TOOLS [WL-3]

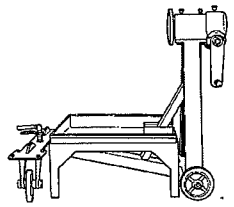
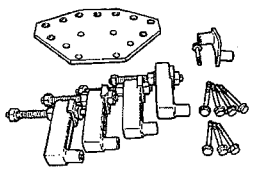
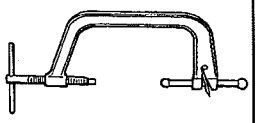
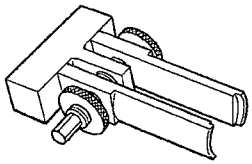
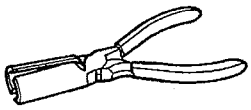
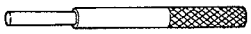
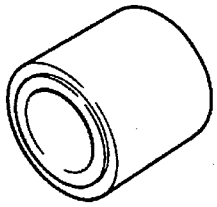
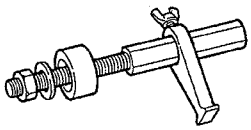
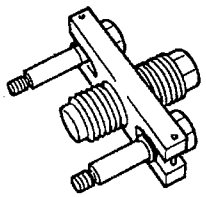
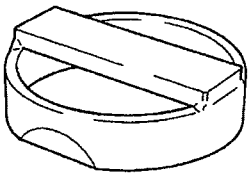
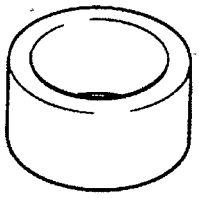
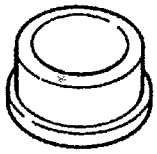
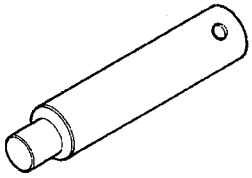
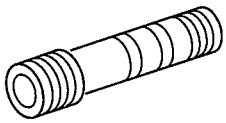
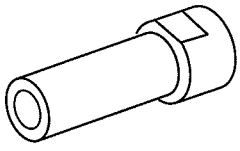
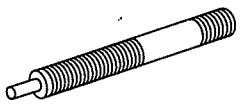
ENGINE [WL-3]

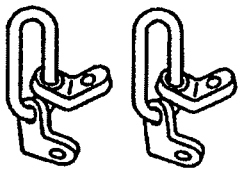
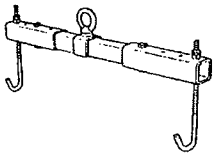
DCF016000000W01

1: Mazda SST number
2: Global SST number

Example

1:49 UN30 3050 2:303-050 Engine lifting brackets	

1:49 0107 680A 2:– Engine stand 	1:49 L010 1A0 2:– Engine hanger set 	1:49 0636 100B 2:– Valve spring lifter arm 
1:49 B012 0A2 2:– Pivot 	1:49 S120 170 2:– Valve seal remover 	1:49 B012 015 2:– Installer (Part of 49 B012 0A3) 
1:49 S010 001 2:– Oil seal installer 	1:49 E011 1A0 2:– Ring gear brake set 	1:49 S120 215B 2:– Pulley puller 
1:49 S011 103 2:– Oil seal installer 	1:49 S010 301 2:– Oil seal installer 	1:49 F027 009 2:– Oil seal installer 
1:49 G011 001 2:– Piston pin replacer 	1:49 L012 001 2:– Installer (Part of 49 L012 0A0B) 	1:49 L012 002A 2:– Body (Part of 49 L012 0A0B) 
1:49 L012 005 2:– Spacer (Part of 49 L012 0A0B) 	1:49 L012 003A 2:– Installer (Part of 49 L012 0A0B) 	1:49 L012 004A 2:– Nut (Part of 49 L012 0A0B) 

1:49 UN30 3050 2:303-050 Engine lifting brackets 	1:49 L017 5A0 2:– Support hanger 	1:49 9140 074 2:– Cam lift measuring device 

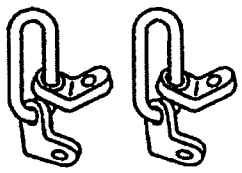
01–60B SERVICE TOOLS [WL-C, WE-C]

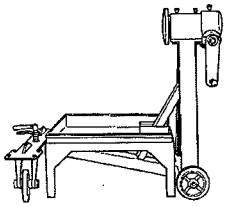
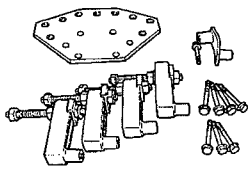
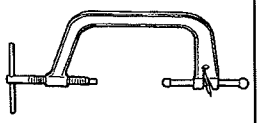
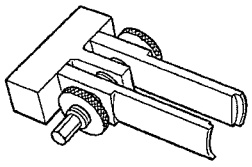
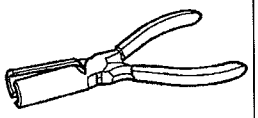
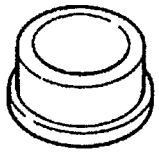
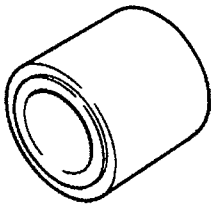
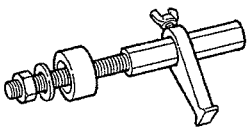
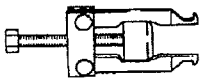
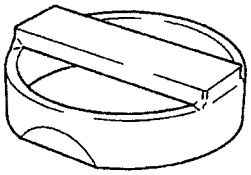
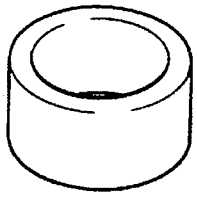
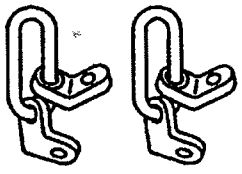
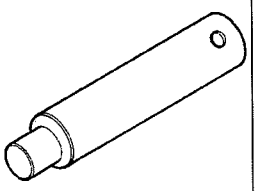
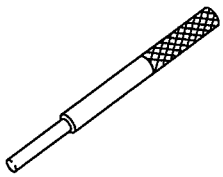
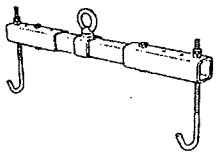
ENGINE SERVICE TOOLS [WL-C, WE-C]

DCF016000000W02

1: Mazda SST number
2: Global SST number

Example

1:49 UN30 3050 2:303-050 Engine lifting brackets	

1:49 0107 680A 2:– Engine stand 	1:49 L010 1A0 2:– Engine stand hanger set 	1:49 0636 100B 2:– Valve spring lifter arm 
1:49 B012 0A2 2:– Pivot 	1:49 S120 170 2:– Valve seal remover 	1:49 F027 009 2:– Oil seal installdr 
1:49 S010 001 2:– Oil seal installer 	1:49 E011 1A0 2:– Ring gear brake set 	1:49 S120 215B 2:– Pulley puller 
1:49 S011 103 2:– Oil seal installer 	1:49 S010 301 2:– Oil seal installer 	1:49 UN30 3050 2:– Engine lifting brackets 
1:49 G011 001 2:– Piston pin replacer 	1:49 B012 015 2:– Valve guide remover and installer 	1:49 L017 5A0 2:– Support hanger 

1:49 B012 016 2:– Valve seal installer