

HOW TO USE THIS ENGINE REPAIR MANUAL (2ZZ-GE)

010C6-01

GENERAL INFORMATION

1. GENERAL DESCRIPTION

- (a) This manual is made in accordance with SAE J2008.
- (b) Generally repair operations can be separated in the following 3 main processes:
 1. Diagnosis
 2. Removing and Installing, Replacing, Disassembling, Installing and Checking, Adjusting
 3. Final Inspection
- (c) This manual explains "Removing and Installing, Replacing, Disassembling, Installing and Checking, Adjusting", but "Final Inspection" is omitted.
- (d) The following essential operations are not written in this manual, however these operations must be done in the practical situation.
 - (1) Operation with a jack or lift
 - (2) Cleaning of a removed part when necessary
 - (3) Visual check

2. INDEX

- (a) An alphabetical INDEX is provided as a section on the end of the book to guide you to the item to be repaired.

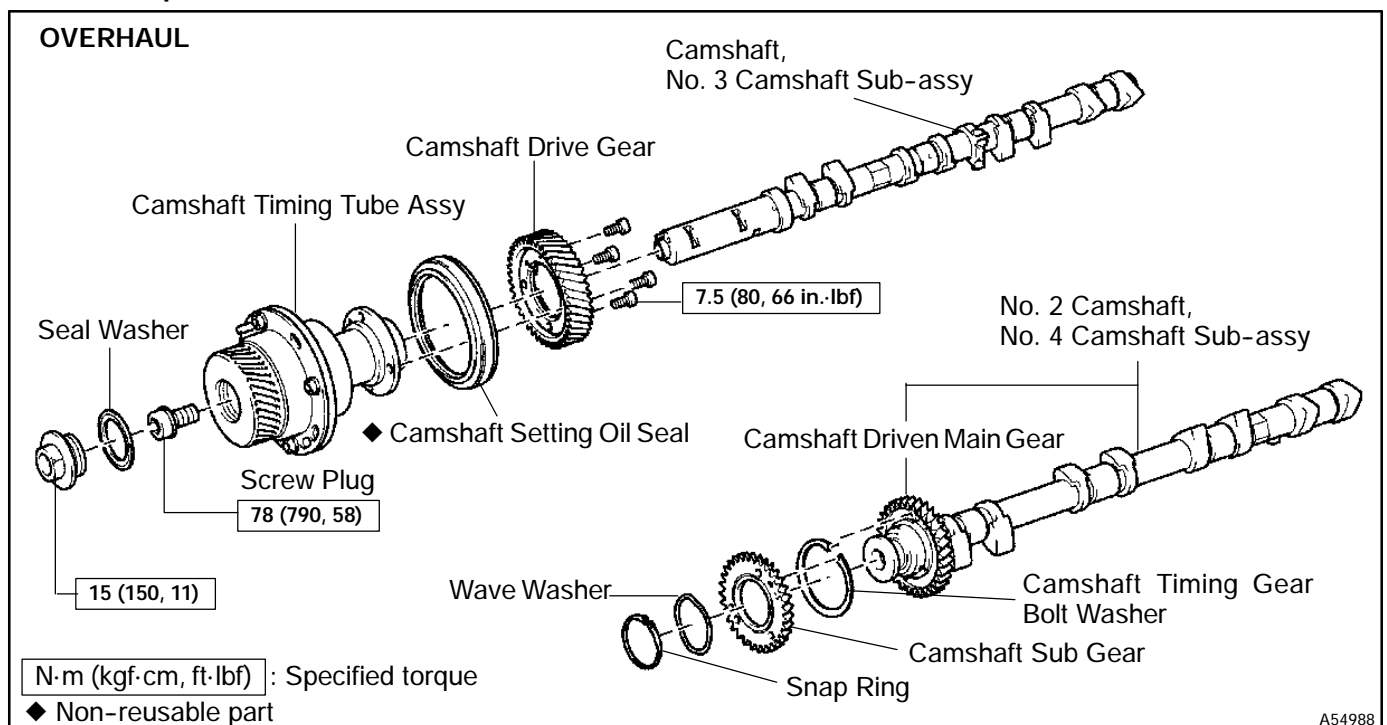
3. PREPARATION

- (a) Use of special service tools (SST) and special service materials (SSM) may be required, depending on the repairing condition. Be sure to use SST and SSM when they are required and follow the working procedure properly. A list of SST and SSM is in the Preparation section of this manual.

4. REPAIR PROCEDURES

- (a) Component drawing is placed as the section or title when necessary.
- (b) Illustrations of the parts catalog are placed as the "disassembled parts drawing" so that it enables you to understand the fitting condition of the components.
- (c) Non-reusable parts, grease applied parts, precoated parts and tightening torque are specified in the components drawing.

Example:

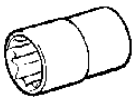

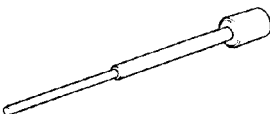
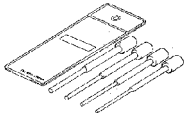
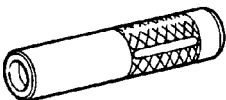
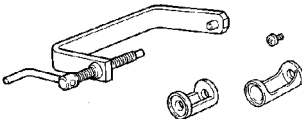
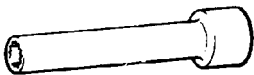


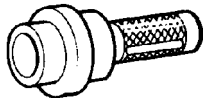
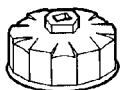
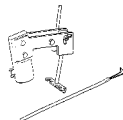


ENGINE MECHANICAL

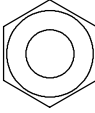
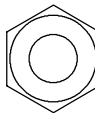
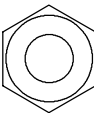
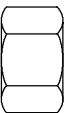

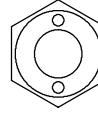
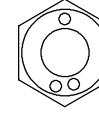
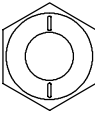
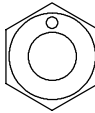
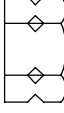
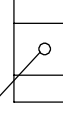
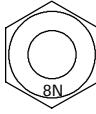
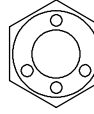
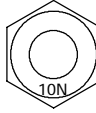
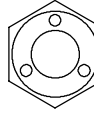
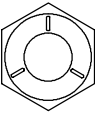
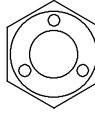

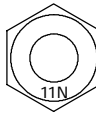
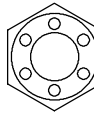

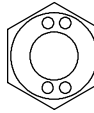
PREPARATION

0216V-01

SST

	09011-38121	12 mm Socket Wrench for 12 Pointed Head	CYLINDER BLOCK(2ZZ-GE)
	09032-00100	Oil Pan Seal Cutter	PARTIAL ENGINE ASSY(2ZZ-GE)
	09201-01055	Valve Guide Bushing Remover & Replacer 5.5	CYLINDER HEAD ASSY(2ZZ-GE)
	09201-10000	Valve Guide Bushing Remover & Replacer Set	CYLINDER HEAD ASSY(2ZZ-GE)
	09201-41020	Valve Stem Oil Seal Replacer	CYLINDER HEAD ASSY(2ZZ-GE)
	09202-70020	Valve Spring Compressor	CYLINDER HEAD ASSY(2ZZ-GE)
	09205-16010	Cylinder Head Bolt Wrench	CYLINDER BLOCK(2ZZ-GE)
	09213-70011	Crankshaft Pulley Holding Tool	PARTIAL ENGINE ASSY(2ZZ-GE)
	09223-15030	Oil Seal & Bearing Replacer	PARTIAL ENGINE ASSY(2ZZ-GE)
	09223-22010	Crankshaft Front Oil Seal Replacer	PARTIAL ENGINE ASSY(2ZZ-GE)
	09228-06501	Oil Filter Wrench	PARTIAL ENGINE ASSY(2ZZ-GE)
	09248-77010	Valve Clearance Adjusting Compressor Set	PARTIAL ENGINE ASSY(2ZZ-GE)

HOW TO DETERMINE NUT STRENGTH

Nut Type			Class
Present Standard Hexagon Nut	Old Standard Hexagon Nut		
	Cold Forging Nut	Cutting Processed Nut	
 No Mark			4N
 No Mark (w/ Washer)	 No Mark (w/ Washer)	 No Mark	5N (4T)
  			6N
	 	 	7N (5T)
 			8N
 	 	 No Mark	10N (7T)
 			11N
 			12N

*: Nut with 1 or more marks on one side surface of the nut.

HINT:

Use the nut with the same number of the nut strength classification or the greater than the bolt strength classification number when tightening parts with a bolt and nut.

Example: Bolt = 4T

Nut = 4N or more

ENGINE MECHANICAL

SERVICE DATA

03000-07

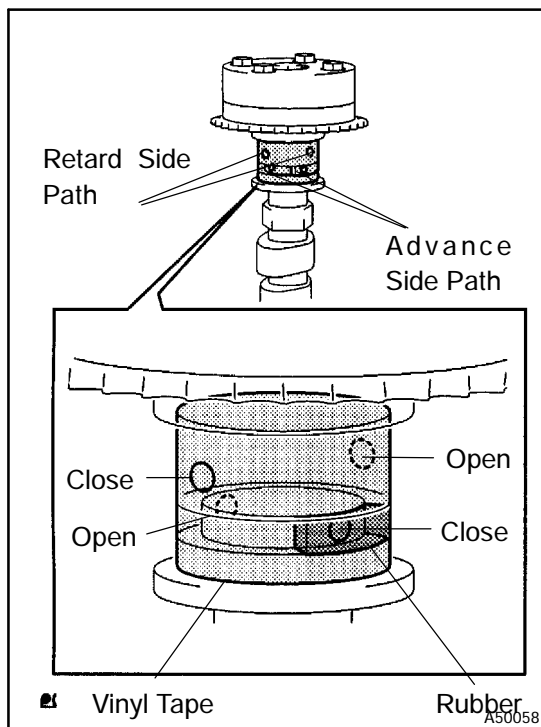
Chain length at 16 links	Maximum	122.6 mm (4.827 in.)
Camshaft timing sprocket diameter (w / chain)	Minimum	97.3mm (3.831 in.)
Crankshaft timing sprocket diameter (w / chain)	Minimum	51.6mm (2.031in.)
Chain tensioner slipper wear	Maximum	1.0 mm (0.039 in.)
Chain tensioner vibration damper wear	Maximum	1.0 mm (0.039 in.)
Cylinder head bolt length	Standard Maximum	146.8 - 148.2 mm (5.780-5.835 in.) 148.5 mm(5.846 in.)
Camshaft circle runout	Maximum	0.03 mm (0.0012 in.)
Camshaft lobe height	Standard Intake No. 1 Intake No. 2 Exhaust No. 1 Exhaust No. 2 Minimum Intake No. 1 Intake No. 2 Exhaust No. 1 Exhaust No. 2	 40.607 - 40.707 mm (1.59586 - 1.59979 in.) 38.769 - 38.869 mm (1.52362 - 1.52755 in.) 40.019 - 40.119 mm (1.57275 - 1.57668 in.) 38.863 - 38.963 mm (1.52732 - 1.53125 in.) 40.45 mm (1.5925 in.) 38.61 mm (1.520 in.) 39.86 mm (1.5693 in.) 38.71 mm (1.5240 in.)
Camshaft journal diameter	No. 1 Others	34.449 - 34.465 mm (1.3563 - 1.3569 in.) 22.949 - 22.965 mm (0.9035 - 0.9041 in.)
Valve clearance (Cold)	Intake Exhaust	0.08 - 0.18 mm (0.003 - 0.007 in.) 0.22 - 0.32 mm (0.009 - 0.013in.)
Cylinder head warpage	Maximum Cylinder block side Intake manifold side Exhaust manifold side	0.2 mm (0.0080 in.) 0.2 mm (0.0080 in.) 0.3 mm (0.0120 in.)
Busing oil clearance inside diameter		5.500 - 5.518 mm (0.2165 - 0.2172 in.)
Valve stem diameter	Intake Exhaust	5.460 - 5.475 mm (0.2145 - 0.2156 in.) 5.445 - 5.470 mm (0.2144 - 0.2154 in.)
Valve stem oil clearance	Standard Intake Exhaust Maximum Intake Exhaust	0.025 - 0.058 mm (0.0010 - 0.0023 in.) 0.030 - 0.063 mm (0.0012 - 0.0025 in.) 0.10 mm (0.0039 in.) 0.10 mm (0.0039 in.)
Valve guide bush diameteruse	Use STD Use O/S	10.448 - 10.506 mm (0.4129 - 0.4136 in.) 10.538 - 10.556 mm (0.4149 - 0.4156 in.)
Valve spring free length	Intake Exhaust	46.4 mm (1.830 in.) 46.5 mm (1.831 in.)
Valve spring deviation	Maximum	1.6 mm (0.063 in.)
Valve spring angle (reference)	Maximum	2°
Valve overall length	Standard Intake Exhaust Minimum Intake Exhaust	111.3 mm (4.382 in.) 111.7 mm (4.392 in.) 110.9 mm (4.366 in.) 111.3 mm (4.382 in.)
Valve head margin thickness	Standard Minimum	1.0 mm (0.039 in.) 0.7 mm (0.028 in.)
Valve rocker shaft diameter		15.965 - 15.985 mm (0.6285 -0.6293 in.)
Camshaft thrust clearance	Standard Maximum	0.040 - 0.140 mm (0.0016 - 0.0055 in.) 0.15 mm (0.0059 in.)
Camshaft oil clearance	Standard Maximum	0.035 - 0.076 mm (0.0014 - 0.0030 in.) 0.010 mm (0.0039 in.)
Water hose union protrusion	Standard A B C	29 mm (1.14 in.) 69.8 mm (2.748 in.) 24 mm (0.95 in.)
Valve guide bush protrusion height		15.3 - 15.7 mm (0.602 - 0.618 in.)

- (c) Check smooth revolution
 - (1) Revolve the camshaft timing gear assembly within the movable range except for the most retarded position several times, and check the smooth revolution.

CAUTION:

Be sure to perform this check by hand, instead of air pressure.

- (d) Check the lock in the most retarded position.
 - (1) Confirm that the camshaft timing gear assembly is locked at the most retarded position.

**25. REMOVE CAMSHAFT TIMING GEAR ASSY**

- (a) Grip the camshaft with a vice, and confirm that the gear is locked.

CAUTION:

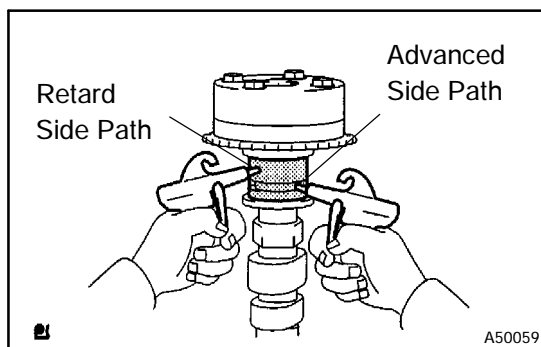
Be careful not to damage the camshaft.

- (b) Cover 4 oil paths of cam journal with vinyl tape as shown in the illustration.

HINT:

Two advance side paths are provided in the groove of the camshaft. Plug one of the path with a rubber piece.

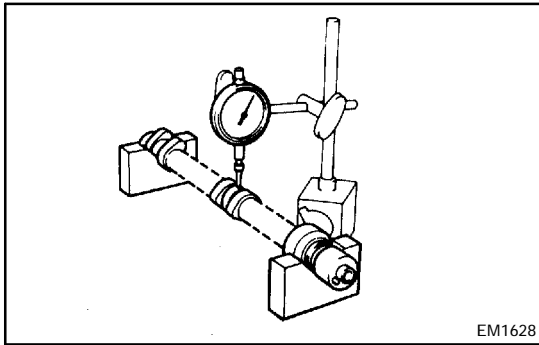
- (c) Break through the tapes of the advance side path and the retard side path on the opposite side of the groove.



- (d) Put air pressure into two broken paths (the advance side path and the retard side path) with about 150 kPa {1.5 kgf/cm²}.

CAUTION:

Cover the paths with shop rag to avoid oil splashing.

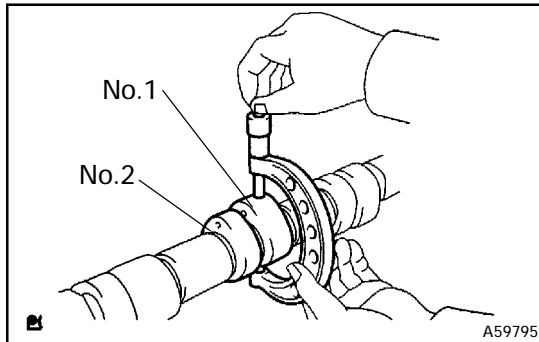


45. INSPECT CAMSHAFT

- (a) Inspect camshaft for runout.
 - (1) Place the camshaft on V-blocks.
 - (2) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.06 mm (0.0012 in.)

- (b) If the circle runout is greater than maximum, replace the camshaft.



- (c) Inspect cam lobes.
 - (1) Using a micrometer, measure the cam lobe height.

Standard cam lobe height:

No.1 40.607 - 40.707 mm (1.59586 - 1.59979 in.)

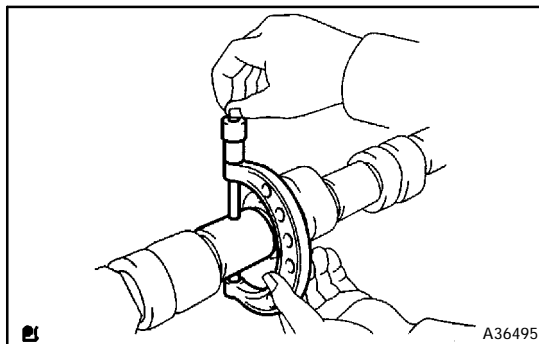
No.2 38.769 - 38.869 mm (1.52362 - 1.52755 in.)

Minimum cam lobe height:

No.1 40.45 mm (1.5925 in.)

No.2 38.61 mm (1.5201 in.)

- (2) If the cam lobe height is less than minimum, replace the camshaft.



- (d) Inspect camshaft journals.

- (1) Using a micrometer, measure the journal diameter.

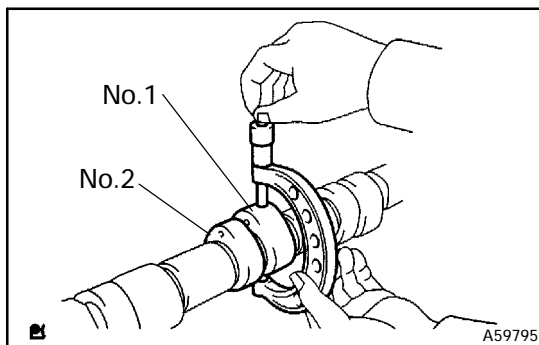
No. 1 journal diameter:

34.449 - 34.465 mm (1.3563 - 1.3569 in.)

Others journal diameter:

22.949 - 22.965 mm (0.9035 - 0.9041 in.)

- (2) If the journal diameter is not as specified, check the oil clearance.



46. INSPECT NO.2 CAMSHAFT

- (a) Inspect cam lobes.
 - (1) Using a micrometer, measure the cam lobe height.

Standard cam lobe height:

No.1 40.019 - 40.119 mm (1.57275 - 1.57668 in.)

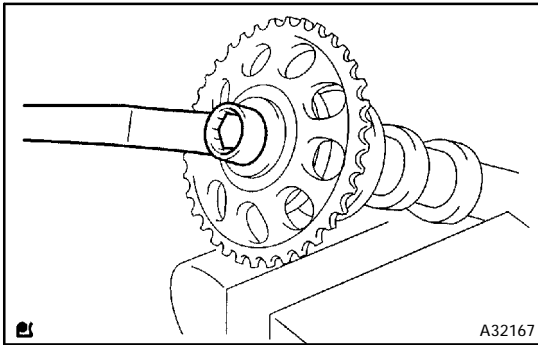
No.2 38.863 - 38.963 mm (1.52732 - 1.53125 in.)

Minimum cam lobe height:

No.1 39.86 mm (1.5693 in.)

No.2 38.71 mm (1.5240 in.)

- (2) If the cam lobe height is less than minimum, replace the camshaft.



58. INSTALL CAMSHAFT TIMING GEAR OR SPROCKET

- (a) Grip the camshaft with a vice, and install the camshaft timing gear.

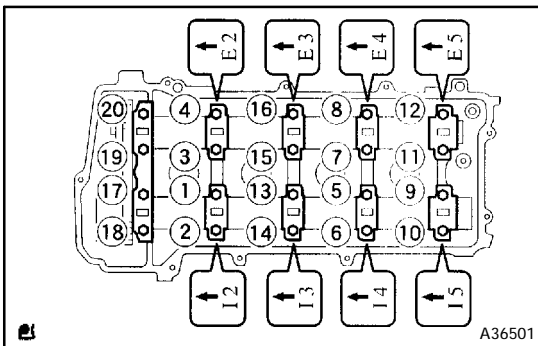
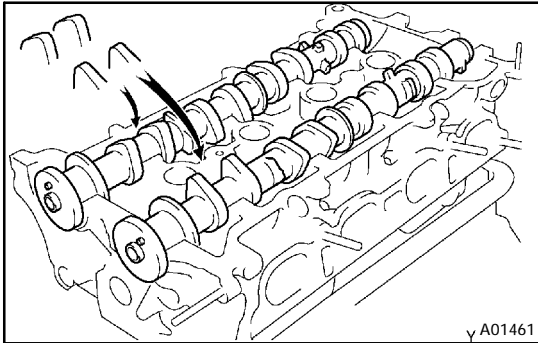
Torque: 54 N·m (551 kgf·cm 40 ft·lbf)

NOTICE:

Be careful not to damage the camshaft.

59. INSTALL CAMSHAFT

- (a) Apply light coat of engine oil on the camshaft journals.
- (b) Place the 2 camshafts on the cylinder head with the No. 1 cam lobes facing as shown the illustration.

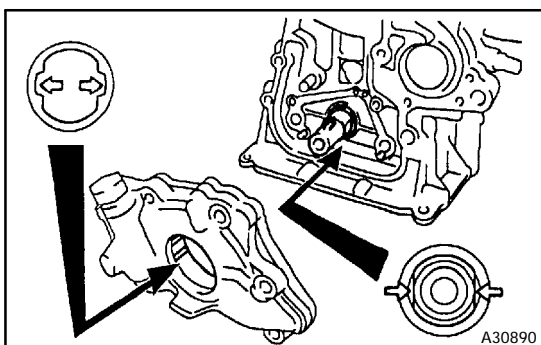


- (c) Examine the front marks and numbers and tighten the bolts in the order shown in the illustration.

Torque: 19 N·m (194 kgf·cm, 7 ft·lbf)

60. INSTALL OIL PUMP GASKET

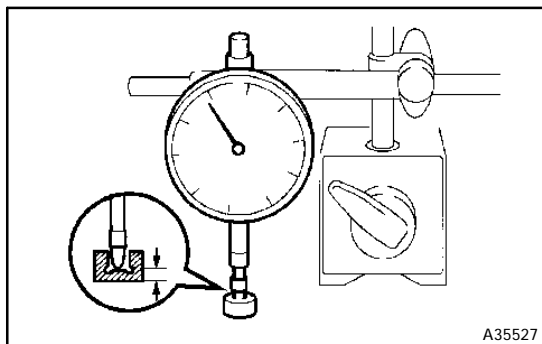
- (a) Place a new gasket on the cylinder block.



61. INSTALL OIL PUMP ASSY

- (a) Engage the spline teeth of the oil pump drive rotor with the large teeth of the crankshaft, and side the oil pump.
- (b) Install the oil pump with the 5 bolts.

Torque: 9.0 N·m (92 kgf·cm, 80 in·lbf)



- (2) Determine the size of the replaced shim according to there Formula or Charts:

- Using a dial indicator, measure the thickness of the removed shim.
- Calculate the thickness of a new shim so that the valve clearance comes within the specified value.

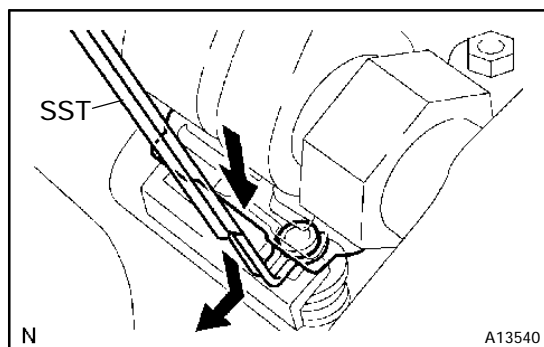
A	Thickness of new shim
B	Thickness of used shim
C	Measured valve clearance

$$\text{Intake: } A = B + (C - 0.13 \text{ mm (0.005 in.)}) \times 1.5$$

$$\text{Exhaust: } A = B + (C - 0.27 \text{ mm (0.011 in.)}) \times 1.5$$

HINT:

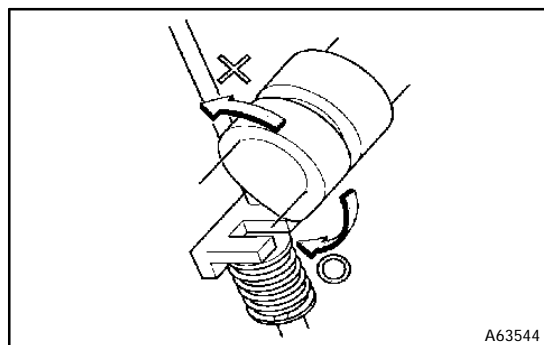
Shim are available in 41 sizes in increments of 0.020 mm (0.0008 in.), from 2.000 mm (0.0787 in.) to 2.800 mm (0.1102 in.).



- (c) Lift the rocker arm to make a room and use SST, install the adjusting shim.

HINT:

- ☐ Setting SST from the right above makes the removal easy.
- To remove SST from the adjusting shim, it is advisable to push down the rocker arm.



- (d) Turn the crankshaft so that the related rocker arm, where the valve clearance is adjusted, is fully pushed down.

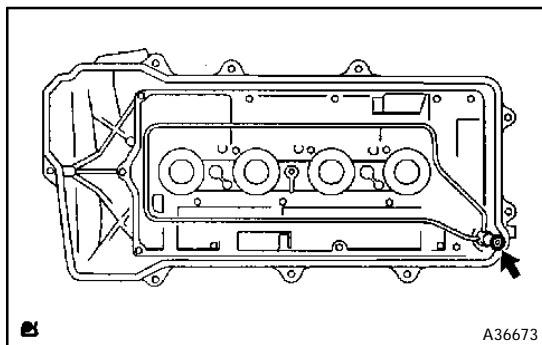
NOTICE:

- Pay attention to the direction of the rotation to prevent the nose of the camshaft from interfering with the SST's shaft.
 - Do not rotate the crankshaft excessively.
- (e) After loosening the 2 set screws of SST, remove SST itself.

SST 09248-77010 (09248-07010)

75. INSTALL CYLINDER HEAD COVER SUB-ASSY

- (a) Install the gasket to the cylinder head cover.
(b) Remove any old packing (FIPG) material.



31. INSTALL STUD BOLT

- (a) Install the stud bolts as shown in the illustration.

Torque:

A: 9.5 N·m (97kgf·cm, 84in·lbf)

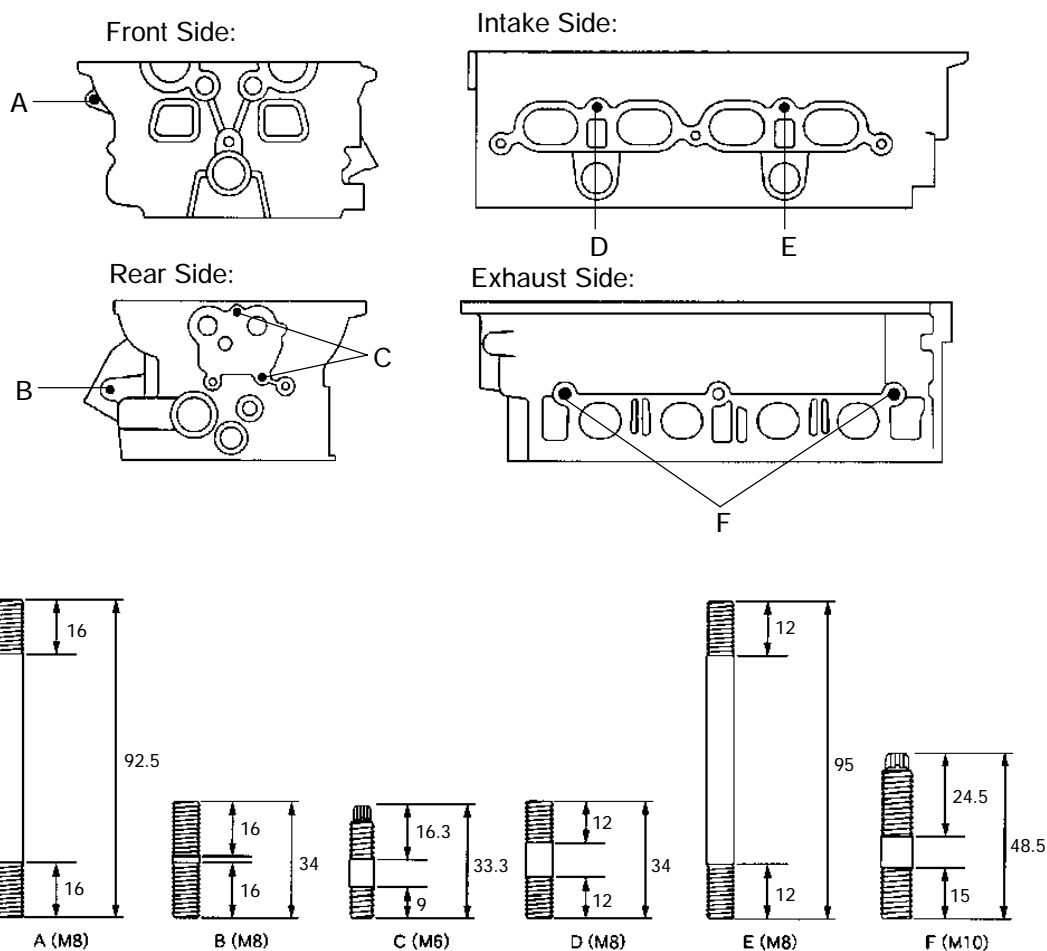
B: 9.5 N·m (97kgf·cm, 84in·lbf)

C: 5.0 N·m (51kgf·cm, 44in·lbf)

D: 9.5 N·m (97kgf·cm, 84in·lbf)

E: 9.5 N·m (97kgf·cm, 84in·lbf)

F: 19.0 N·m (194kgf·cm, 14ft·lbf)



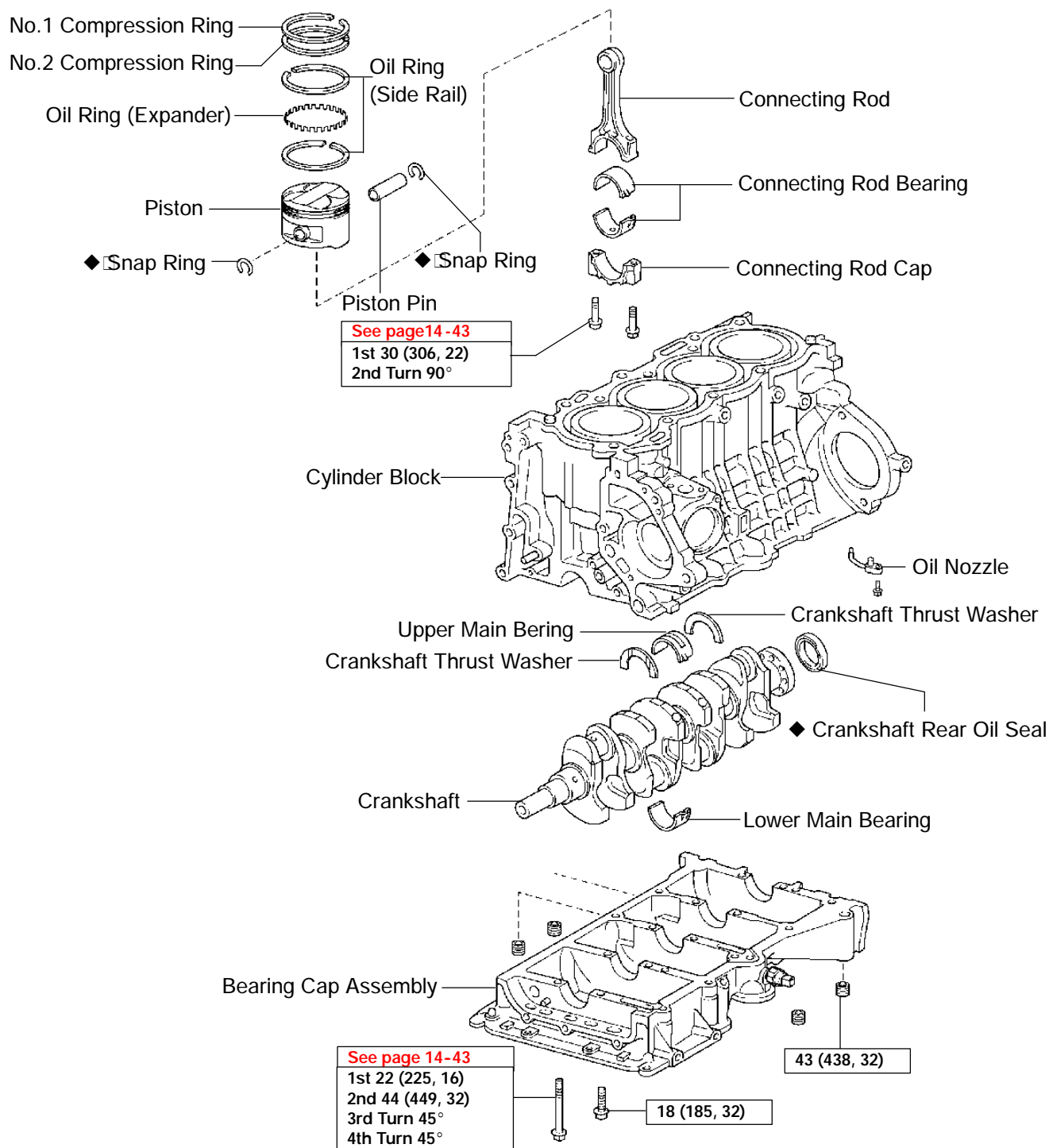
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CYLINDER BLOCK (2ZZ-GE)

COMPONENTS

140N7-01



N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

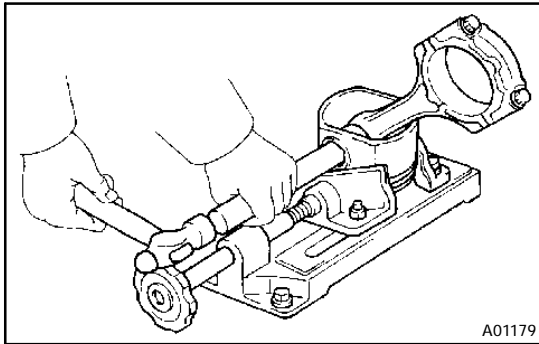
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8. REMOVE W/PIN PISTON SUB-ASSY

- (a) Gradually heat the piston to 80 - 90 °C (176 - 194 °F).
- (b) Using a plastic-faced hammer and brass bar, lightly tap out the piston pin and remove the connecting rod.

HINT:

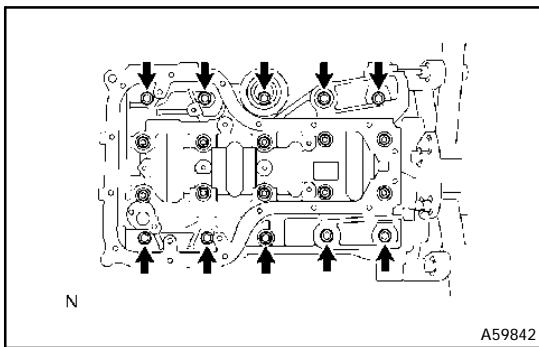
- The piston and pin are a matched set.
- □ Arrange the piston, pins, ring, connecting rod and bearings in the correct order.



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9. REMOVE CRANKSHAFT BEARING CAP SUB ASSY

- (a) Remove the 4 screw plugs from the bearing cap sub-assembly.
- (b) Remove the 10 hexagon head bearing cap sub-assembly bolts.
- (c) Uniformly loosen the 10 bearing cap sub-assembly bolts, in several passes, in the sequence shown in the illustration.

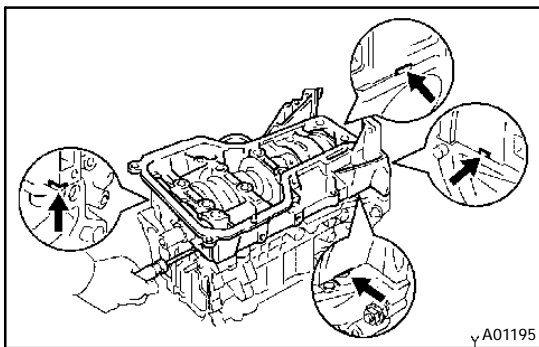


A59842

- (d) Using a screwdriver, remove the bearing cap sub-assembly by prying the indicated portions between the cylinder block and bearing cap sub-assembly. Remove the 5 lower main bearings.

NOTICE:

Be careful not to damage the contact surfaces of the cylinder block and bearing cap sub-assembly.



A01195

10. INSPECT CRANKSHAFT THRUST CLEARANCE

- (a) Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard thrust clearance:

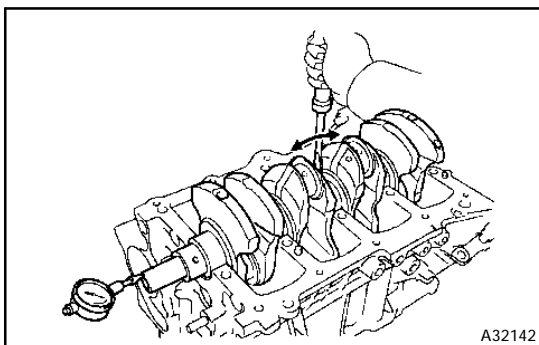
0.04 - 0.24 mm (0.0015 - 0.0095 in.)

Maximum thrust clearance: 0.30 mm (0.0118 in.)

- (b) If the thrust clearance is greater than maximum, measure the thrust washer thickness. If the thickness is not specified, replace the thrust washer.

Thrust washer thickness:

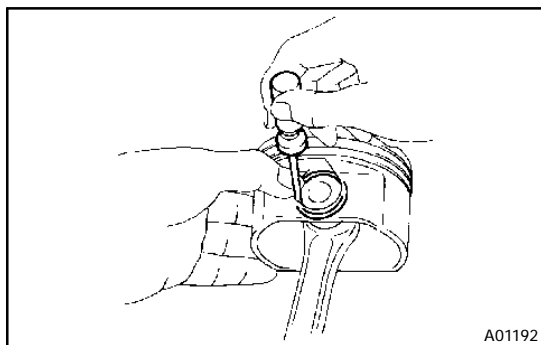
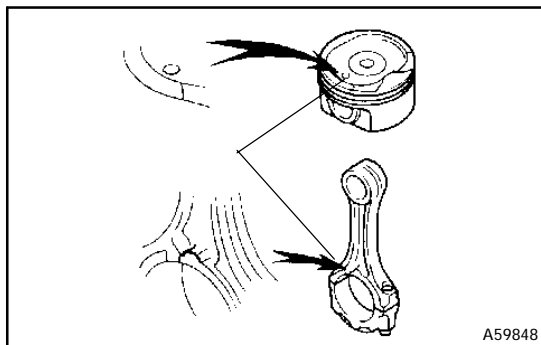
2.430 - 2.480 mm (0.0957 - 0.0976 in.)



A32142

34. INSTALL W/PIN PISTON SUB-ASSY

- (a) Gradually heat the piston to 80 - 90 °C (176-194 °F).
- (b) Align the front marks on the piston with connecting rod, and push in the piston with your thumb.

**35. INSTALL PISTON PIN HOLE SNAP RING**

- (a) Using a small screwdriver, install a new snap ring on the other end of the piston pin hole.

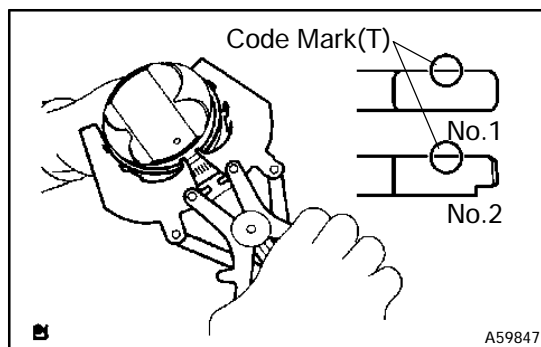
HINT:

Be sure that end gap of the snap ring is aligned with the pin hole cutout portion of the piston.

36. INSTALL PISTON RING SET**HINT:**

In case of reusing the piston rings, install them to the matched pistons with the surfaces faced correctly.

- (a) Install the oil ring expander and 2 side rails by hand.
- (b) Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
Code mark : T



OVERHAUL

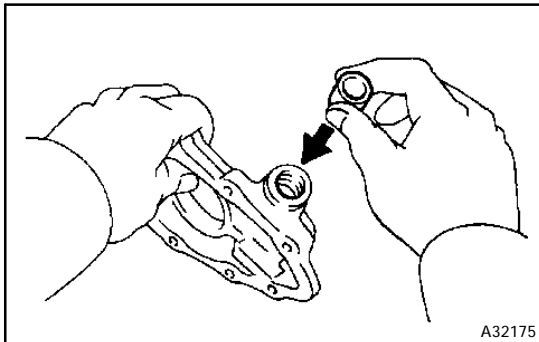
1. INSPECT PUMP ASSY, OIL

- (a) Remove oil pump cover.
 - (1) Remove the 5 screws and the oil pump cover.
- (b) Remove oil pump rotor sub-assembly.

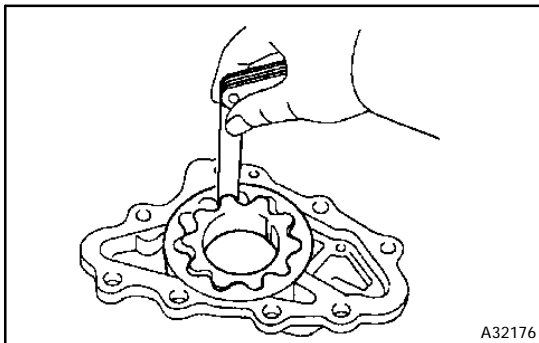
CAUTION:

Reserve the face, back and the install direction of the two rotors.

- (c) Remove oil pump relief valve plug.
- (d) Remove oil pump relief valve spring.
- (e) Remove oil pump relief valve.
- (f) Inspect oil pump relief valve.
 - (1) Coat the valve with engine oil and check that it falls smoothly into the valve hole by its own weight.
- (g) Inspect oil pump rotor sub-assembly.
 - (1) Coat the oil pump gear set with engine oil and place them into the oil pump body. Check that the rotors revolves smoothly.



A32175



A32176

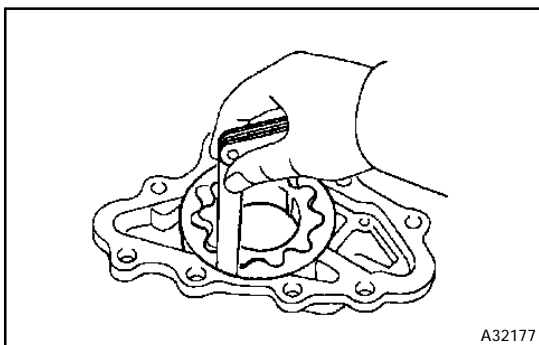
- (h) Inspect rotor tip clearance.
 - (1) Using a feeler gauge, measure the clearance between the drive and driven rotor tips.

Standard tip clearance:

0.060 - 0.180 mm (0.0024 - 0.0071 in.)

Maximum tip clearance:

0.35 mm (0.0138 in.)



A32177

- (i) Inspect body clearance.
 - (1) Using a feeler gauge, measure the clearance between the driven rotor and body.

Standard body clearance:

0.125 - 0.180 mm (0.0049 - 0.0071 in.)

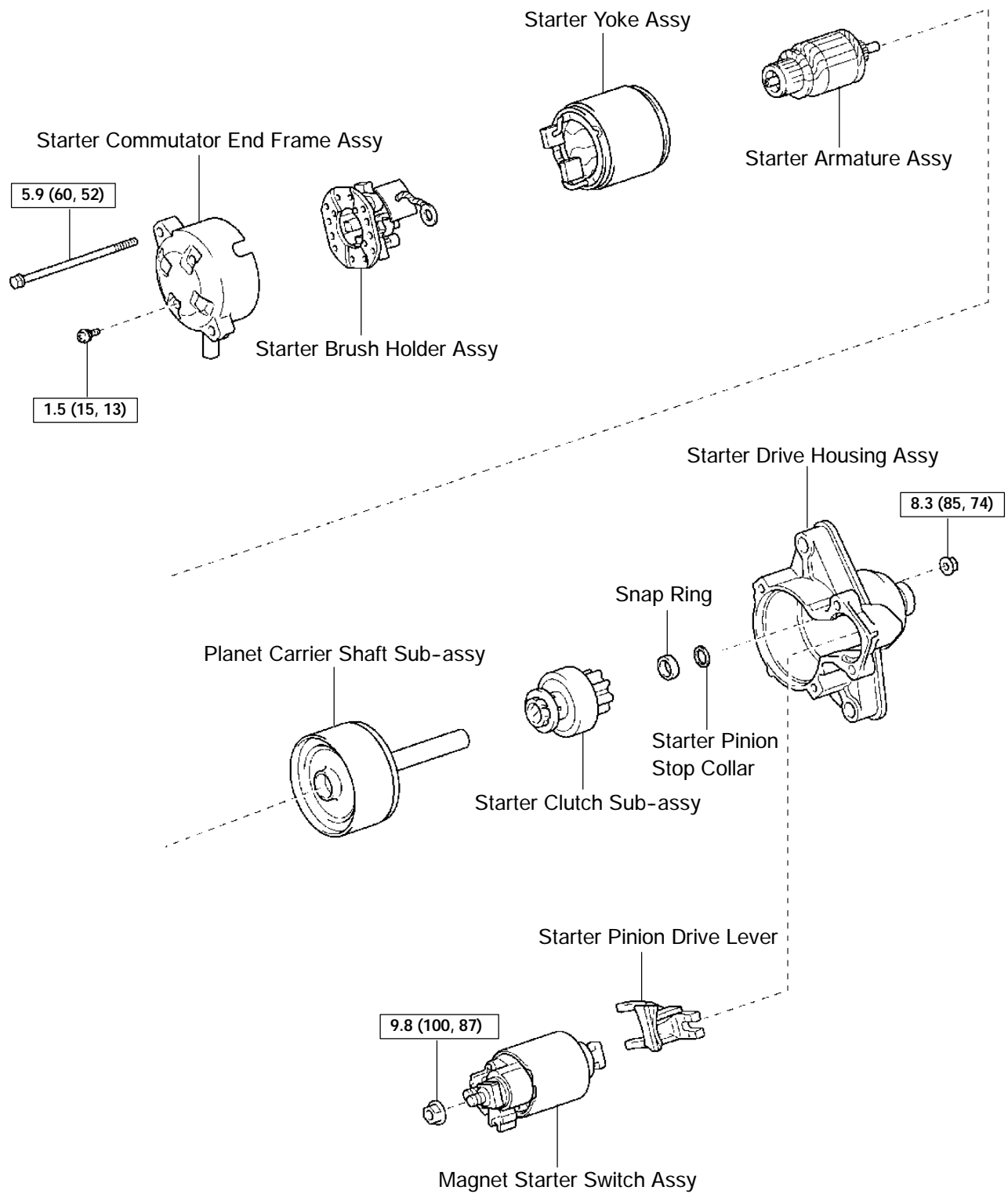
Maximum body clearance:

0.325 mm (0.0128 in.)

STARTER ASSY (2ZZ-GE)

COMPONENTS

190BG-01



Y N·m (kgf·cm, in.·lbf) : Specified torque

A62216

GENERATOR ASSY (2ZZ-GE)

COMPONENTS

190BH-01

